

# CLYMER<sup>®</sup>



# BMW

**R50/5 through R100GS PD • 1970-1996**  
*(See back cover for models)*

**SERVICE • REPAIR • MAINTENANCE**



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# CLYMER®

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# QUICK REFERENCE DATA

## MOTORCYCLE INFORMATION

MODEL: \_\_\_\_\_ YEAR: 1970  
 VIN NUMBER: \_\_\_\_\_  
 ENGINE SERIAL NUMBER: \_\_\_\_\_  
 CARBURETOR SERIAL NUMBER OR I.D. MARK: \_\_\_\_\_

## TIRE INFLATION PRESSURE (COLD)\*

Model/speed	Rider only		Rider and passenger	
	psi	kPa	psi	kpa
<b>1970-1973</b>				
Up to speed limit				
Front	27	186	30	206
Rear	30	206	35	241
Up to 100 mph (160 kmh)				
Front	30	206	33	227
Rear	33	227	38	262
<b>1974-1976</b>				
Up to speed limit				
Front	27	186	28	193
Rear	28	193	32	220
Up to 100 mph (160 kmh)				
Front	30	206	31	213
Rear	31	213	35	241
<b>1977-1987</b>				
Up to speed limit				
Front	27	186	30	206
Rear	26	179	32	220
Up to 100 mph (160 kph)				
Front	27	186	30	206
Rear	29	199	32	220
<b>1988-on**</b>				
Up to speed limit				
Front	31	213	34	234
Rear	36	248	41	283

\* Tire inflation pressure for factory equipped tires. Aftermarket tires may require different inflation pressure.

\*\* BMW does not provide inflation pressures for speeds over the speed limit on these models.



### MAINTENANCE AND TUNE-UP TORQUE SPECIFICATIONS

Item	N•m	in.-lb.	ft.-lb.
Oil drain plug	30	—	22
Oil strainer holder bolts	9	80	—
Oil pan Allen bolts	9-12	80-106	—
Transmission filler plug	28-21	—	21-23
Transmission drain plug	23-26	—	17-19
Final drive unit level/filler plug	28-31	—	21-23
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Final drive separate filler plug	20	—	15
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\*Except R100GS models as this model's drive shaft does not require lubrication.

### GENERAL TORQUE SPECIFICATIONS

Thread diameter	N•m	ft.-lb.
5 mm	3.4-4.9	30-43 in.-lb.
6 mm	5.9-7.8	52-69 in.-lb.
8 mm	14-19	10-14
10 mm	25-39	18-29
12 mm	44-61	32-45
14 mm	73-98	54-72
16 mm	115-155	84-114
18 mm	165-225	121-166
20 mm	225-325	166-240

### OIL QUANTITY AND RECOMMENDED TYPE

Item	Quantity	Recommended Type
Engine oil (without oil cooler)		API SE or SF
Oil change	2.0 liter (2.1 qt.)	
Oil change and filter	2.25 liter (2.4 qt.)	
Engine oil (with oil cooler)		API SE or SF
Oil change	2.5 liter (2.7 liter)	
Oil change and filter	(2.75 liter (3.0 qt.)	
Transmission oil (4 and 5 speed)	800 cc (1.7 pt.)	Hypoid gear oil GL5 SAE 80W/90

(continued)

### OIL QUANTITY AND RECOMMENDED TYPE (continued)

Item	Quantity	Recommended Type
Drive shaft oil <sup>1</sup> /5 models with short wheel base (1970-to-mid 1973)	100 cc (0.21 pt.)	Hypoid gear oil GL5 SAE 80W/90
All other models	150 cc (0.32 pt.)	
Final drive unit oil 1970-1980	250 cc (8.45 oz.)	Hypoid gear oil GL5 SAE 80W/90
R100GS	260 cc (8.89 oz.)	
All other models	350 cc (11.8 oz.)	
Fork oil <sup>2</sup> 1970-1976	280 cc (9.5 oz.)/ 265 cc (8.96 oz.)	Bel Ray SAE 5 wt Golden Spectro Very Light Aero Shell 4
1977-1979 and R100RT	250 cc (8.4 oz.)/ 235 cc (7.9 oz.)	BMW 7.5 wt <sup>3</sup> Esso Comfort Shell EB/B/33 (R100GS)
R65 (1979-1985), R65LS, and R80ST	190-200 cc (6.5-6.8 oz.)/ 190 cc (6.5 oz.)	
R80RT (1983-1984), R80G/S (1981-1984), R100, R100CS, R100RS, R100RT (1976-1984)	220-230 cc (7.4-7.8 oz.)/ 220 cc (7.4 oz.)	
R80 (1985-on), R65 (1986-on) R80RT (1985-on), R100RS and R100RT (1987-on)	290-310 cc (9.6-10.2 oz.)/same 310-330 cc (10.5-11.2 oz.)/same	
R100 GS		
Right fork leg	430-450 cc (14.2-14.8 oz.)/same	
Left fork leg	400-420 cc (13.2-13.8 oz.)/same	
<p>1. Except R100GS models as this model's drive shaft does not require lubrication.                  2. First quantity is at rebuild; second is quantity at oil change.                  3. Many BMW dealerships recommend this fork oil for all R-series applications.</p>		

### TUNE-UP SPECIFICATIONS

#### Valve clearance\*

Intake (rear valves): 0.10 mm (0.004 in.)  
 Exhaust (front valves): 0.20 mm (0.008 in.)

#### Spark plug type (Bosch)

W5D1: R50/5, 1974-1976 R60

W5D: 1977-1979 R60, R65LS, all 1977-1980 R100 models (R100,  
 R100S, R100T, R100RS, R100RT)

W6D: R75/5, R75/6, R75/7, R90/6, R90S, R100/7, 1981-1987 R100  
 models (R100, R100CS, R100RS, R100RT)

W7D: R80, R80/7, R80ST, R80G/S, R80RT

W7DC: 1988-on R100RS, R100RT, R100GS

(continued)

### TUNE-UP SPECIFICATIONS (continued)

**Spark plug gap**  
 Recommended 0.6-0.7 mm (0.024-0.028 in.)  
**Contact breaker-point gap**  
 1979-1980 R65: 0.40-0.45 mm (0.016-0.018 in.)  
 All other models: 0.35-0.40 mm (0.014-0.016 in.)  
**Compression pressure**  
 Good: more than 1012 kPa (145 psi)  
 Normal: 848-1012 kPa (123-145 psi)  
 Poor: less than 848 kPa (123 psi)  
**Idle speed**  
 1970-1976: 600-800 rpm  
 1977-on: 800-1100 rpm

\*Cylinder head maximum temperature: 35° C (95° F).

### MODEL, YEAR AND ENGINE SERIAL NUMBERS

Model	Year	Engine Serial No.
R50/5	1970-1973	2903624-2910000
R60/5	1970	2930001-2938704
	1971-1973	2938706-2950000
R60/6	1973-1974	4900001-4910000
	1975	4920001-4925000
	1976	4925001-4925914
R60/7	1976-1977	6100001-5104007
	1978	6101001-6102000
R65	1978-1980	6380001-6381580
	1981	6385001-6386143
	1982	6386144-6386702
	1983	6386703-6387631
	1984	6387635-6388192
	1985	6388193-6388255
R65/85 (monolever)	1985-1986	6128001-6128365
	1987	6128366-6128516
R65/LS	1982	6370003-6371099
	1983	6371100-6371377
	1984	6371378-6371704
	1985	NA
R75/5	1970	2970001-2983737
	1971	2982738-3000000*
R75/6	1973-1974	4910001-4920000
	1975	4940001-4945000
	1976	4945001-4947578
R75/7	1976-1977	6120001-6121474
R80/7	1978	6122501-6124909
	1979-1980	6126001-6128000*
R80	1985	6480001-6480468
	1986	6480569-6480831
	1987	6480832-6481120
R80ST	1982-1983	6207011-6207701
	1984	6207702-6210000

(continued)



**MODEL, YEAR AND ENGINE SERIAL NUMBERS (continued)**

<b>Model</b>	<b>Year</b>	<b>Engine Serial No.</b>
R80G/S	1980-1982	6362001-6362748
	1983	6362766-6362883
	1984	6362884-6363059
	1985	6363060-6363157
	1986	6363158-6363350
R80RT	1982-1983	6172001-6175000
	1984	6176000-6179231
	1985	649001-6490565
	1986	6490566-6491236
	1987	6491237-6491452
R90/6	1973-1974	4930001-4940000
	1975	4960001-4970000
	1976	4970001-4973316
R90S	1973-1974	4950001-4960000
	1975	4980001-1990000
	1976	4990001-4991260
R100/7	1976-1977	6140001-6142451
	1978	6145001-6148196
	1979	6170001-6172000*
R100	1981	6175001-6175593
	1982	6175594-6176221
	1983	6176222-6176785
	1984	6176789-6178001
R100S	1977	6160001-6161385
	1978	6162501-6163870
	1979-1980	6165001-6167000
R100CS	1981	6188001-6188163
	1982-1983	6188164-6190000*
	1984	6188171-6190000
R100T	1979-1980	6103001-6104000
R100RS	1977	6180001-6181263
	1978	6182001-6183592
	1979-1980	6185001-6186000
	1981	6225001-6225511
	1983	6226175-6226786
	1984	6226787-6229000*
	1987-1988	6247001-6247548
	1989	6247549-on
R100RT	1976-1978	619001-6193000
	1979-1980	6195001-6199000
	1981	6240001-6241130
	1982	6241131-6242300
	1983	6242301-6243356
	1987-1988	6292601-6293171
	1989	6293172-6293397
R100GS	1988	6152765-6153373
	1989	6153841-on

\*Indicates a break in the sequence on model years. Not all models were produced in consecutive years.  
 NA = Not available

### CONVERSION TABLES

Multiply	By:	To get the equivalent of:
<b>Length</b>		
Inches	25.4	Millimeter
Inches	2.54	Centimeter
Miles	1.609	Kilometer
Feet	0.3048	Meter
Millimeter	0.03937	Inches
Centimeter	0.3937	Inches
Kilometer	0.6214	Mile
Meter	3.281	Mile
<b>Fluid volume</b>		
U.S. quarts	0.9463	Liters
U.S. gallons	3.785	Liters
U.S. ounces	29.573529	Milliliters
Imperial gallons	4.54609	Liters
Imperial quarts	1.1365	Liters
Liters	0.2641721	U.S. gallons
Liters	1.0566882	U.S. quarts
Liters	33.814023	U.S. ounces
Liters	0.22	Imperial gallons
Liters	0.8799	Imperial quarts
Milliliters	0.033814	U.S. ounces
Milliliters	1.0	Cubic centimeters
Milliliters	0.001	Liters
<b>Torque</b>		
Foot-pounds	1.3558	Newton-meters
Foot-pounds	0.138255	Meters-kilograms
Inch-pounds	0.11299	Newton-meters
Newton-meters	0.7375622	Foot-pounds
Newton-meters	8.8507	Inch-pounds
Meters-kilograms	7.2330139	Foot-pounds
<b>Volume</b>		
Cubic inches	16.387064	Cubic centimeters
Cubic centimeters	0.0610237	Cubic inches
<b>Temperature</b>		
Fahrenheit	$(F - 32) \times 0.556$	Centigrade
Centigrade	$(C \times 1.8) + 32$	Fahrenheit
<b>Weight</b>		
Ounces	28.3495	Grams
Pounds	0.4535924	Kilograms
Grams	0.035274	Ounces
Kilograms	2.2046224	Pounds
<b>Pressure</b>		
Pounds per square inch	0.070307	Kilograms per square centimeter
Kilograms per square centimeter	14.223343	Pounds per square inch
Kilopascals	0.1450	Pounds per square inch
Pounds per square inch	6.895	Kilopascals
<b>Speed</b>		
Miles per hour	1.609344	Kilometers per hour
Kilometers per hour	0.6213712	Miles per hour

# INTRODUCTION

The 1960's was an era of dramatic change and no less for the motorcycle industry. Europe and Japan began to exert their fast recovering post-war economies. The German industrial resurgence, particularly automobile manufacturing, would allow BMW to prosper and fight off the onslaught of motorcycles from Japan. Spearheaded by Honda, Japanese motorcycles were originally viewed as poorly constructed and little more than toys. However, through remarkable refinement, creative marketing and a steady increase in capacity, the "toys" were tapping into a hitherto unknown motorcycle market of American baby boomers. In contrast, the proud British motorcycle industry would be virtually dead by the 70's and play an insignificant role in what many consider to be the golden era of motorcycle development, an era that began with wheezing vertical and V-twins, ring ding two-strokes and one big four, and would be punctuated by the machines from BMW.

Expanding European auto sales required an increase in BMW's production capacity. To meet this demand, the last of the Earles-fork BMW's rolled off the Munich assembly line in 1969. Bavarian production would be devoted to automobiles. Henceforth, motorcycle production would take place in the



Berlin suburb of Spandau. The pre-1970 BMW's (**Figure 1**, 1960 R50) were known for their reliability, comfort and quiet operation. They got the rider to the destination with confidence. However, these attributes were no longer the exclusive province of BMW because many of the new Japanese offerings did it at a significant price reduction along with impressive performance. The old BMW's were great machines, but the next generation had to be even better.



The all-new motorcycles known as the 'Slash 5' (**Figure 2**, 1970 R75/5) were available in three capacities (500 cc, 600 cc and 750 cc). While relying on the well-known boxer twin/shaft drive layout, they were radical departures in many ways from long established BMW traditions. Gone were the Earles-fork, replaced by a modern long travel telescopic unit. 6-volt electrics were eschewed in favor of 12-volt power for the electric starter (600 and 750 cc machines) and turn signal indicators. Plus, to the horror of many a BMW loyalist, the new models were available in colors other than *schwartz mit weiss*.

However the centerpiece was what lay between the two-section frame. While relying on the previ-

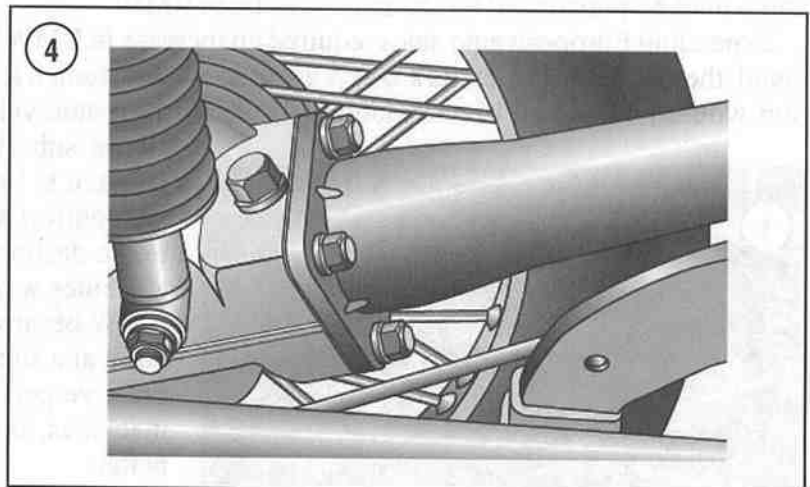
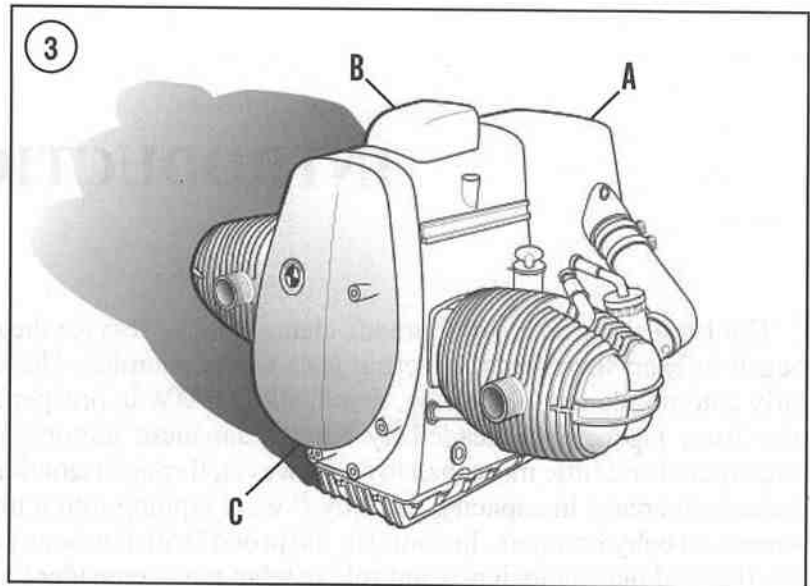


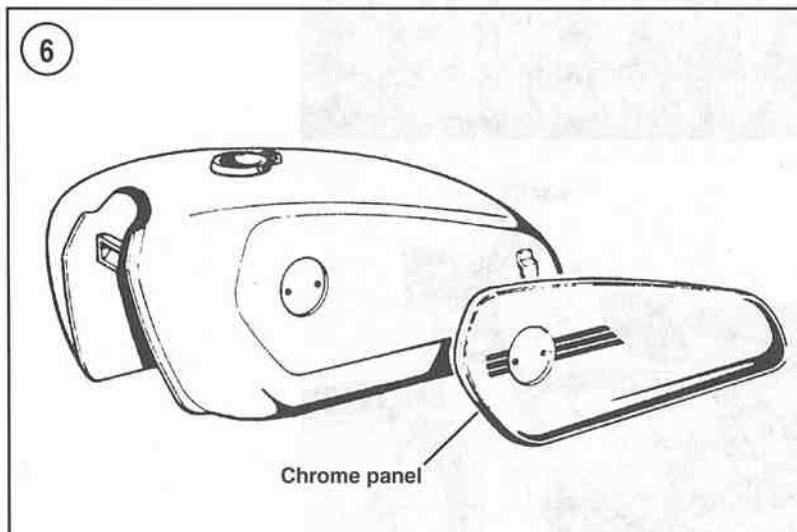
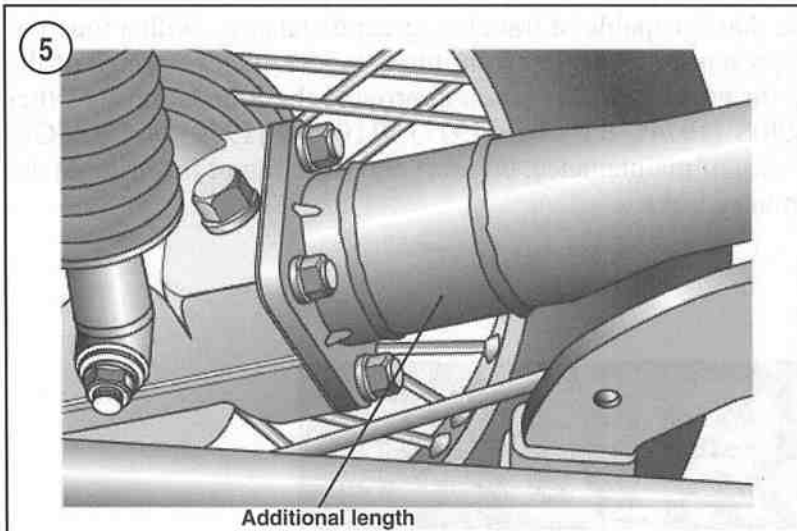
ous models, horizontally opposed air-cooled design with overhead valves, the engine was all new. Outwardly, the first noticeable change from previous BMW designs was the pushrod tubes mounted under the alloy barrels and cylinder heads. The tubes also provided drainage for the rocker oil. The pushrod position revealed a fundamental change in the /5 engine, as the camshaft was now positioned underneath the one-piece forged alloy crankshaft.

The crankshaft operates in split type bearings enclosed within the one-piece alloy crankcase. The automobile-type bearings, which were well tested by BMW's automotive section, require a higher pressure lubrication system than ball or roller bearings. A camshaft driven Eaton oil pump at the rear of the crankcase provides the required pressure. The camshaft is driven by chain off of the crankshaft timing sprocket immediately forward of the front main bearing. A non-pressure fed ball bearing operating in the timing chain cover supports the front of the crankshaft and timing sprocket.

At first impression, the engine provides a sense of immense size as the aluminum covers enclose the air filter (A, **Figure 3**), the starter (B) and the alternator/ignition components (C). The four-speed gearbox, with a dry single clutch plate, is attached to the rear of the crankcase and this, combined with everything encased in one solid mass from the lower frame rail and disappearing under the tank, provides the illusion of one large and heavy mass. However, the appearance is misleading. With the extensive use of alloys, and the heavy components such as the forged crankshaft and the camshaft positioned low, the center of gravity is low. The enclosed design also has the advantage of keeping sensitive electrics protected from exposure to the elements, and reducing engine noises usually associated with air-cooled machines. A crossover pipe connecting the individual exhaust head pipes further enhances the noise reduction.

To feed the hemispherical cylinder heads, conventional slide valve carburetors are used on R50 and R60 models, whereas R75 models are equipped with Bing constant velocity (CV) carburetors. The carburetors being easily accessed, along with the valves, breaker points, air cleaner and battery, coupled with the low maintenance shaft drive, make all air head beemers straightforward affairs when it comes to service.





The brakes consist of an 8 in. twin-leading shoe (2LS) unit upfront and an 8 in. single-leading shoe unit in the rear. The front drum was changed with the 1974 introduction of the R90S (dual front disc) and /6 models (single front disc).

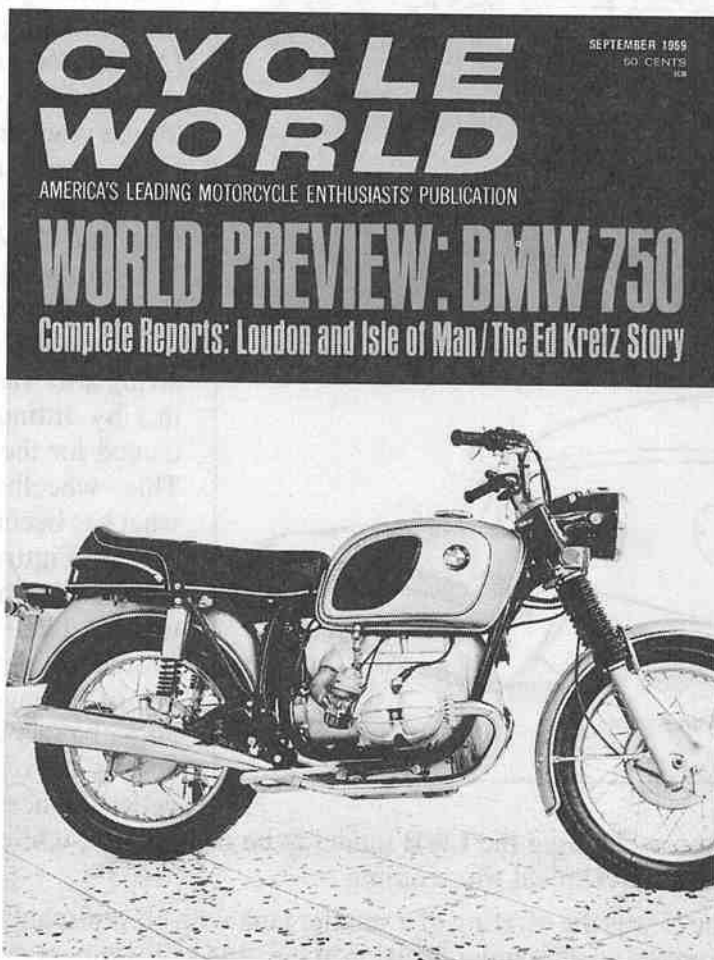
The first three years of production included a number of changes. Foremost among these is the subject of short and long wheelbase (SWB and LWB) models. Early road testers complained of a disconcerting torque reaction when the power was suddenly reduced while cornering. Other tests described a tendency for front end wobble on some machines at high speeds. This prompted the first major technical modification for mid-1973 models of the /5. The swing arm was lengthened 50 mm (2 in.) by fitting the swing arms intended for the upcoming /6 models. This wheelbase increase created what has become known as the LWB model. **Figure 4** shows the swing arm detail of a SWB model and **Figure 5** a LWB type. The increase in overall machine length allowed the use of a longer rear frame section, larger battery and larger seat (noticeable by the one piece grab rail). The debate concerning wheelbase con-

tinues to this day, with those claiming the LWB model to be far superior, while others covet the early machines despite the dubious technical shortcoming.

Another change for the /5 was the offering of a smaller tank with chrome panels, known as the toaster model (**Figure 6**). This proved an unpopular decision at the time as customers reacted strongly in disapproval to the reduced fuel capacity and garish look. One wonders why BMW chose to make this change, considering the heyday of the chrome-tanked motorcycle had definitely come to an end by 1972. Ironically, the chrome tank models are now considered more desirable; the product of low production and changing tastes.

Despite teething troubles and the new bikes not being universally loved due to the radical departures from the past, including the non recommendation for side car use, increased use of plastics (the front and rear fenders are fiberglass) and overall simplification, the concept was a technical masterpiece and with the introduction of the /5 in September 1969 (courtesy of *Cycle World*), BMW set a new standard. While relying on their traditional flat twin/shaft drive design, a design that many believed outdated, they created a machine that could be ridden faster and farther. The July 1973 issue of *Cycle World*

agreed; the latest R75 is "...a motorcycle that is capable of traveling great distances...with a touch of 'superbike' thrown in." The /5 model represents a transition from the dated Munich offerings of the 60's. The basic concept would continue for more than 20 years and provide the foundation for other landmark motorcycles, including the R90S (1974), R100RS (1977), R100RT (1979) and R80G/S (1981). As a testament to the reliability, ease of maintenance, comfort and handling of the original design, many /5's are still used on cross-country treks.



**NOTE:** If you own a 1990 or later model, first check the Supplement at the back of this book for any new service information.

## CHAPTER ONE

# GENERAL INFORMATION

This detailed and comprehensive manual covers the 1970-1996 BMW Boxer Twins from 500-1000 cc. The text provides complete information on maintenance, tune-up, repair and overhaul. Hundreds of photos and drawings guide the reader through every job.

A shop manual is a reference tool and as in all Clymer manuals, the chapters are thumb tabbed for easy reference. Important items are indexed at the end of the book. All procedures, tables and figures are designed for the reader who may be working on the vehicle for the first time. Frequently used specifications and capacities from individual chapters are summarized in the *Quick Reference Data* at the front of the book.

### MANUAL ORGANIZATION

All dimensions and capacities are expressed in metric and U.S. standard units of measurement.

This chapter provides general information on shop safety, tool use, service fundamentals and shop supplies.

Chapter Two provides methods for quick and accurate diagnosis of problems. Troubleshooting procedures pres-

ent typical symptoms and logical methods to pinpoint and repair the problem.

Chapter Three explains all routine maintenance necessary to keep the vehicle running well. Chapter Three also includes recommended tune-up procedures, eliminating the need to constantly consult the chapters on the various assemblies.

Subsequent chapters describe specific systems such as engine, transmission, clutch, drive system, fuel and exhaust systems, suspension and brakes. Each disassembly, repair and assembly procedure is discussed in step-by-step form.

Some of the procedures in this manual specify special tools. In most cases, the tool is illustrated in use. Well-equipped mechanics may be able to substitute similar tools or fabricate a suitable replacement. However, in some cases, the specialized equipment or expertise needed may make it impractical for the home mechanic to attempt the procedure. When necessary, such operations are identified in the text with the recommendation to have a dealership or specialist perform the task. It may be less expensive to have a professional perform these jobs, especially when considering the cost of the equipment.



## WARNINGS, CAUTIONS AND NOTES

The terms, WARNING, CAUTION and NOTE have specific meanings in this manual.

A WARNING emphasizes areas where injury or even death could result from negligence. Mechanical damage may also occur. WARNINGS *are to be taken seriously*.

A CAUTION emphasizes areas where equipment damage could result. Disregarding a CAUTION could cause permanent mechanical damage, though injury is unlikely.

A NOTE provides additional information to make a step or procedure easier or clearer. Disregarding a NOTE could cause inconvenience, but would not cause equipment damage or personal injury.

## SAFETY

Professional mechanics can work for years and never sustain a serious injury or mishap. Follow these guidelines and practice common sense to safely service the vehicle.

1. Do not operate the vehicle in an enclosed area. The exhaust gasses contain carbon monoxide, an odorless, colorless, and tasteless poisonous gas. Carbon monoxide levels build quickly in small enclosed areas and can cause unconsciousness and death in a short time. Make sure the work area is properly ventilated or operate the vehicle outside.
2. *Never* use gasoline or any extremely flammable liquid to clean parts. Refer to *Cleaning Parts* and *Handling Gasoline Safely* in this chapter.
3. *Never* smoke or use a torch in the vicinity of flammable liquids, such as gasoline or cleaning solvent.
4. If welding or brazing on the vehicle, remove the fuel tank, carburetor and shocks to a safe distance at least 50 ft. (15 m) away.
5. Use the correct type and size of tools to avoid damaging fasteners.
6. Keep tools clean and in good condition. Replace or repair worn or damaged equipment.
7. When loosening a tight fastener, be guided by what would happen if the tool slips.
8. When replacing fasteners, make sure the new fasteners are of the same size and strength as the original ones.
9. Keep the work area clean and organized.
10. Wear eye protection *anytime* the safety of the eyes is in question. This includes procedures involving drilling, grinding, hammering, compressed air and chemicals.
11. Wear the correct clothing for the job. Tie up or cover long hair so it can not get caught in moving equipment.
12. Do not carry sharp tools in clothing pockets.
13. Always have an approved fire extinguisher available. Make sure it is rated for gasoline (Class B) and electrical (Class C) fires.
14. Do not use compressed air to clean clothes, the vehicle or the work area. Debris may be blown into the eyes or

skin. *Never* direct compressed air at anyone. Do not allow children to use or play with any compressed air equipment.

15. When using compressed air to dry rotating parts, hold the part so it can not rotate. Do not allow the force of the air to spin the part. The air jet is capable of rotating parts at extreme speed. The part may be damaged or disintegrate, causing serious injury.

16. Do not inhale the dust created by brake pad and clutch wear. These particles may contain asbestos. In addition, some types of insulating materials and gaskets may contain asbestos. Inhaling asbestos particles is hazardous to health.

17. *Never* work on the vehicle while someone is working under it.

18. When placing the vehicle on a stand, make sure it is secure before walking away.

## Handling Gasoline Safely

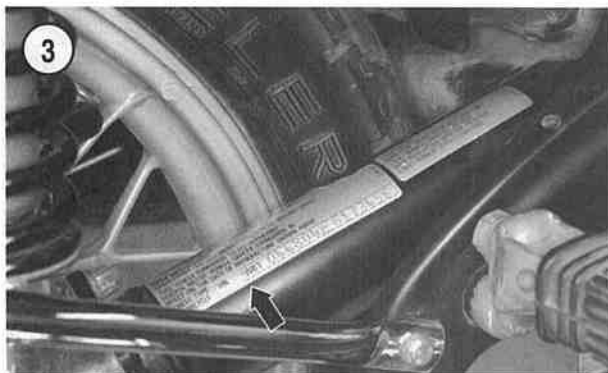
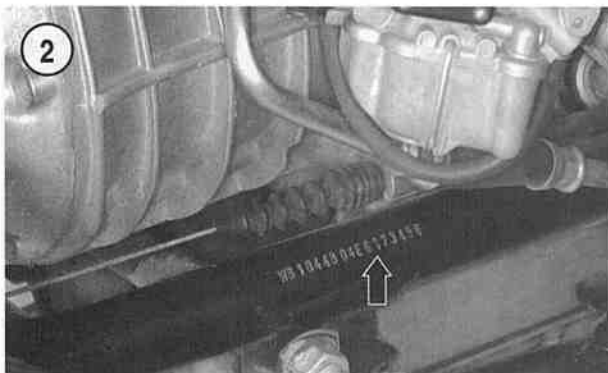
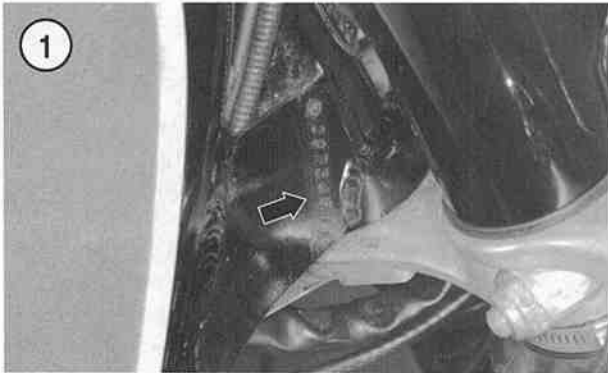
Gasoline is a volatile flammable liquid and is one of the most dangerous items in the shop. Because gasoline is used so often, many people forget that it is hazardous. Only use gasoline as fuel for gasoline internal combustion engines. Keep in mind, when working on a vehicle, gasoline is always present in the fuel tank, fuel line and carburetor. To avoid a disastrous accident when working around the fuel system, carefully observe the following precautions:

1. *Never* use gasoline to clean parts. See *Cleaning Parts* in this chapter.
2. When working on the fuel system, work outside or in a well-ventilated area.
3. Do not add fuel to the fuel tank or service the fuel system while the vehicle is near open flames, sparks or where someone is smoking. Gasoline vapor is heavier than air, it collects in low areas and is more easily ignited than liquid gasoline.
4. Allow the engine to cool completely before working on any fuel system component.
5. When draining the carburetor, catch the fuel in a plastic container and then pour it into an approved gasoline storage device.
6. Do not store gasoline in glass containers. If the glass breaks, a serious explosion or fire may occur.
7. Immediately wipe up spilled gasoline with rags. Store the rags in a metal container with a lid until they can be properly disposed of, or place them outside in a safe place for the fuel to evaporate.
8. Do not pour water onto a gasoline fire. Water spreads the fire and makes it more difficult to put out. Use a class B, BC or ABC fire extinguisher to extinguish the fire.
9. Always turn off the engine before refueling. Do not spill fuel onto the engine or exhaust system. Do not overfill the fuel tank. Leave an air space at the top of the tank

to allow room for the fuel to expand due to temperature fluctuations.

### Cleaning Parts

Cleaning parts is one of the more tedious and difficult service jobs performed in the home garage. There are many types of chemical cleaners and solvents available for shop use. Most are poisonous and extremely flammable. To prevent chemical exposure, vapor buildup, fire and serious injury, observe each product warning label and note the following:



1. Read and observe the entire product label before using any chemical. Always know what type of chemical is being used and whether it is poisonous and/or flammable.
2. Do not use more than one type of cleaning solvent at a time. If mixing chemicals is called for, measure the proper amounts according to the manufacturer.
3. Work in a well-ventilated area.
4. Wear chemical-resistant gloves.
5. Wear safety glasses.
6. Wear a vapor respirator if the instructions call for it.
7. Wash hands and arms thoroughly after cleaning parts.
8. Keep chemical products away from children and pets.
9. Thoroughly clean all oil, grease and cleaner residue from any part that must be heated.
10. Use a nylon brush when cleaning parts. Metal brushes may cause a spark.
11. When using a parts washer, only use the solvent recommended by the manufacturer. Make sure the parts washer is equipped with a metal lid that will lower in case of fire.

### Warning Labels

Most manufacturers attach information and warning labels to the vehicle. These labels contain instructions that are important to personal safety when operating, servicing, transporting and storing the vehicle. Refer to the owner's manual for the description and location of labels. Order replacement labels from the manufacturer if they are missing or damaged.

### SERIAL NUMBERS

Serial numbers are stamped on various locations on the frame, engine, transmission and carburetor. Record these numbers in the *Quick Reference Data* section in the front of the book. Have these numbers available when ordering parts.

The frame number for 1970-1982 models is stamped on the right side of the steering head (**Figure 1**). For later models it is on the lower frame tube (**Figure 2**). On some models the VIN number is also stamped on the right side of the swing arm (**Figure 3**).

The engine number for 1970-1983 model is stamped on the left side of the crankcase (**Figure 4**). On all other models it is located on a pad on the left side of the crankcase (**Figure 5**).

Models equipped with emission controls have a label attached to the top of the rear fender (**Figure 6**).

The carburetor number is located on the side of the carburetor body.

Year and engine serial numbers are in the *Quick Reference Data* section at the front of the manual.

## FASTENERS

Proper fastener selection and installation is important to ensure that the vehicle operates as designed and can be serviced efficiently. The choice of original equipment fasteners is not arrived at by chance. Make sure that replacement fasteners meet all the same requirements as the originals.

### Threaded Fasteners

Threaded fasteners secure most of the components on the vehicle. Most are tightened by turning them clockwise (right-hand threads). If the normal rotation of the component being tightened would loosen the fastener, it may have left-hand threads. If a left-hand threaded fastener is used, it is noted in the text.

Two dimensions are required to match the thread size of the fastener: the number of threads in a given distance and the outside diameter of the threads.

Two systems are currently used to specify threaded fastener dimensions: the U.S. Standard system and the metric system (**Figure 7**). Pay particular attention when working with unidentified fasteners; mismatching thread types can damage threads.

#### NOTE

*To ensure that the fastener threads are not mismatched or cross-threaded, start all fasteners by hand. If a fastener is hard to start or turn, determine the cause before tightening with a wrench.*

The length (L, **Figure 8**), diameter (D) and distance between thread crests (pitch) (T) classify metric screws and bolts. A typical bolt may be identified by the numbers, 8—1.25 × 130. This indicates the bolt has diameter of 8 mm, the distance between thread crests is 1.25 mm and the length is 130 mm. Always measure bolt length as shown in **Figure 8** to avoid purchasing replacements of the wrong length.

The numbers located on the top of the fastener (**Figure 8**) indicate the strength of metric screws and bolts. The higher the number, the stronger the fastener is. Unnumbered fasteners are the weakest.

Many screws, bolts and studs are combined with nuts to secure particular components. To indicate the size of a nut, manufacturers specify the internal diameter and the thread pitch.

The measurement across two flats on a nut or bolt indicates the wrench size.

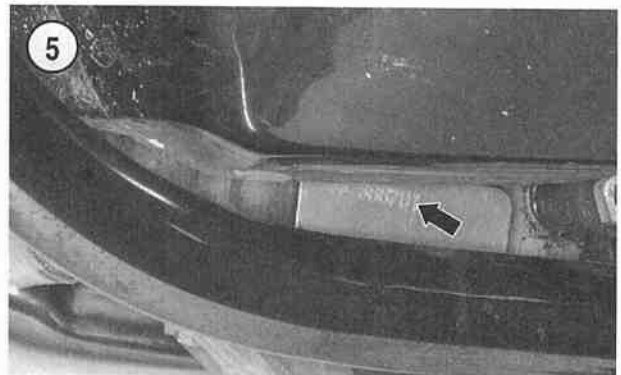
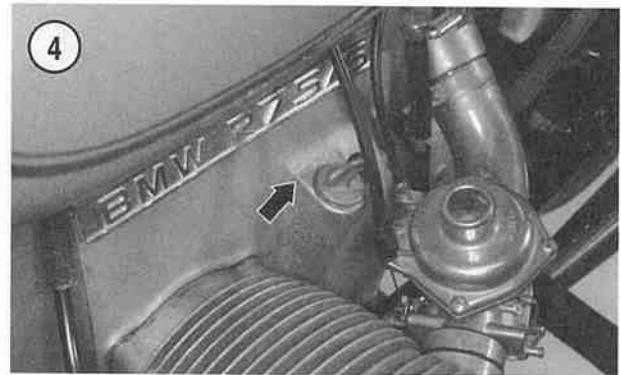
#### WARNING

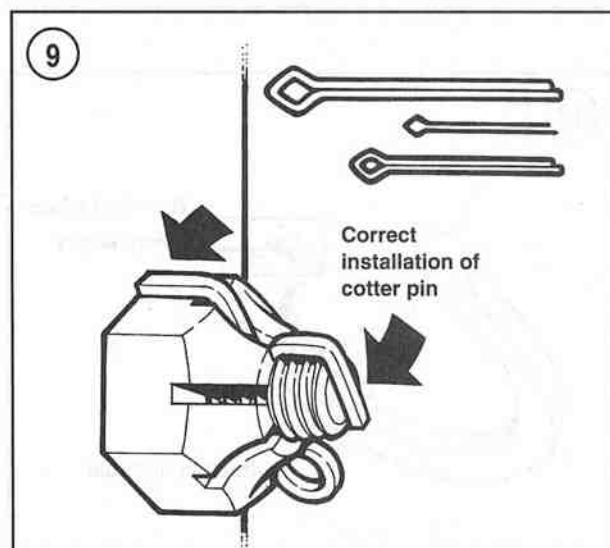
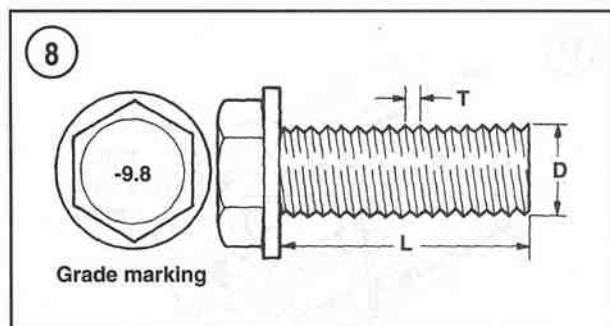
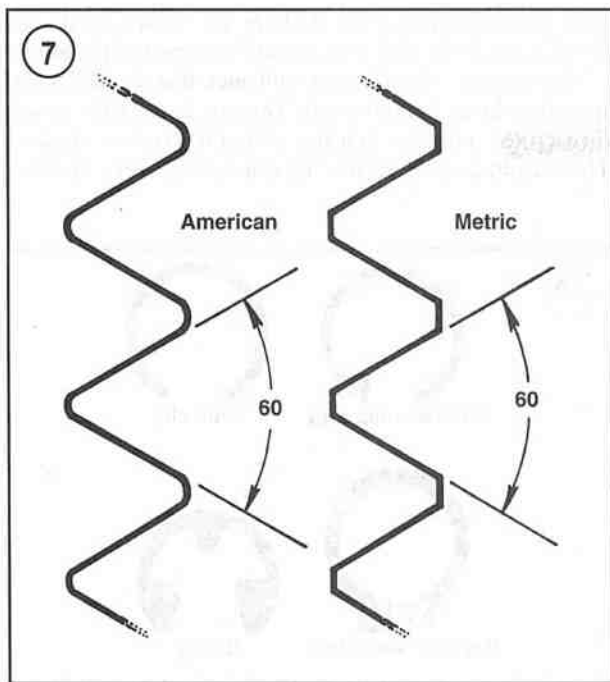
*Do not install fasteners with a strength classification lower than what was originally installed by the manufacturer. Doing so may cause equipment failure and/or damage.*

### Torque Specifications

The materials used in the manufacture of the vehicle may be subjected to uneven stresses if the fasteners of the various subassemblies are not installed and tightened correctly. Fasteners that are improperly installed or work loose can cause extensive damage. It is essential to use an accurate torque wrench, described in this chapter, with the torque specifications in this manual.

Specifications for torque are provided in Newton-meters (N•m), foot-pounds (ft.-lb.) and inch-pounds (in.-lb.). Refer to the *QRD* section for general torque specifications. To use the table, first determine the size of the





fastener as described in *Fasteners* in this chapter. Torque specifications for specific components are at the end of the appropriate chapters. Torque wrenches are covered in the *Basic Tools* section.

### Self-Locking Fasteners

Several types of bolts, screws and nuts incorporate a system that creates interference between the two fasteners. Interference is achieved in various ways. The most common type is the nylon insert nut and a dry adhesive coating on the threads of a bolt.

Self-locking fasteners offer greater holding strength than standard fasteners, which improves their resistance to vibration. Most self-locking fasteners cannot be reused. The materials used to form the lock become distorted after the initial installation and removal. It is a good practice to discard and replace self-locking fasteners after their removal. Do not replace self-locking fasteners with standard fasteners.

### Washers

There are two basic types of washers: flat washers and lockwashers. Flat washers are simple discs with a hole to fit a screw or bolt. Lockwashers are used to prevent a fastener from working loose. Washers can be used as spacers and seals, or to help distribute fastener load and to prevent the fastener from damaging the component.

As with fasteners, when replacing washers make sure the replacement washers are of the same design and quality.

### Cotter Pins

A cotter pin is a split metal pin inserted into a hole or slot to prevent a fastener from loosening. In certain applications, such as the rear axle on an ATV or motorcycle, the fastener must be secured in this way. For these applications, a cotter pin and castellated (slotted) nut is used.

To use a cotter pin, first make sure the diameter is correct for the hole in the fastener. After correctly tightening the fastener and aligning the holes, insert the cotter pin through the hole and bend the ends over the fastener (**Figure 9**). Unless instructed to do so, never loosen a torqued fastener to align the holes. If the holes do not align, tighten the fastener just enough to achieve alignment.

Cotter pins are available in various diameters and lengths. Measure length from the bottom of the head to the tip of the shortest pin.



## Snap Rings and E-clips

Snap rings (**Figure 10**) are circular-shaped metal retaining clips. They are required to secure parts and gears in place on parts such as shafts, pins or rods. External type snap rings are used to retain items on shafts. Internal type snap rings secure parts within housing bores. In some applications, in addition to securing the component(s), snap rings of varying thickness also determine endplay. These are usually called selective snap rings.

Two basic types of snap rings are used: machined and stamped snap rings. Machined snap rings (**Figure 11**) can be installed in either direction, since both faces have sharp edges. Stamped snap rings (**Figure 12**) are manufactured with a sharp edge and a round edge. When installing a stamped snap ring in a thrust application, install the sharp edge facing away from the part producing the thrust.

E-clips and circlips are used when it is not practical to use a snap ring. Remove E-clips with a flat blade screwdriver by prying between the shaft and E-clip. To install an E-clip, center it over the shaft groove and push or tap it into place.

Observe the following when installing snap rings:

1. Remove and install snap rings with snap ring pliers. See *Snap Ring Pliers* in this chapter.
2. In some applications, it may be necessary to replace snap rings after removing them.
3. Compress or expand snap rings only enough to install them. If overly expanded, they lose their retaining ability.
4. After installing a snap ring, make sure it seats completely.
5. Wear eye protection when removing and installing snap rings.

## SHOP SUPPLIES

### Lubricants and Fluids

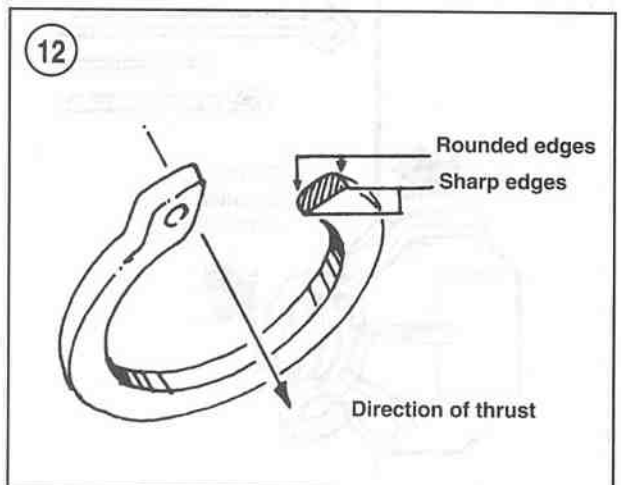
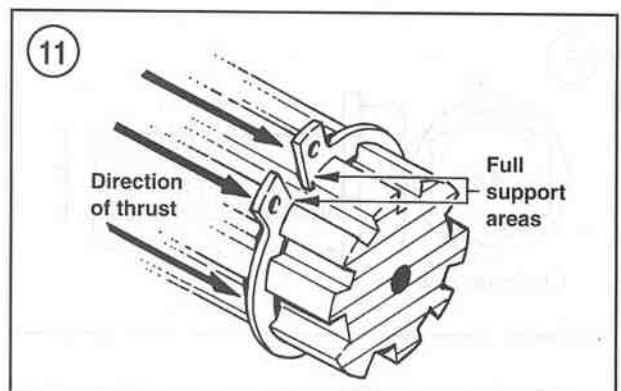
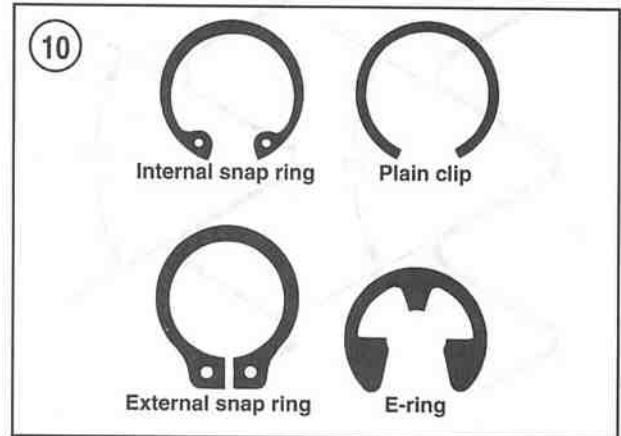
Periodic lubrication helps ensure a long service life for any type of equipment. Using the correct type of lubricant is as important as performing the lubrication service, although in an emergency the wrong type is better than none. The following section describes the types of lubricants most often required. Make sure to follow the manufacturer's recommendations for lubricant types.

### Engine oils

Engine oil is classified by two standards: the American Petroleum Institute (API) service classification and the Society of Automotive Engineers (SAE) viscosity rating. This information is on the oil container label. Two letters indicate the API service classification. The number or sequence of numbers and letter (10W-40 for example) is the

oil's viscosity rating. The API service classification and the SAE viscosity index are not indications of oil quality.

The service classification indicates that the oil meets specific lubrication standards. The first letter in the classification (S) indicates that the oil is for gasoline engines. The second letter indicates the standard the oil satisfies.



Always use an oil with a classification recommended by the manufacturer. Using an oil with a different classification can cause engine damage.

Viscosity is an indication of the oil's thickness. Thin oils have a lower number while thick oils have a higher number. Engine oils fall into the 5- to 50-weight range for single-grade oils.

Most manufacturers recommend multigrade oil. These oils perform efficiently across a wide range of operating conditions. Multigrade oils are identified by a *W* after the first number, which indicates the low-temperature viscosity.

Engine oils are most commonly mineral (petroleum) based; however, synthetic and semi-synthetic types are used more frequently. When selecting engine oil, follow the manufacturer's recommendation for type, classification and viscosity when selecting engine oil.

### **Greases**

Grease is lubricating oil with thickening agents added to it. The National Lubricating Grease Institute (NLGI) grades grease. Grades range from No. 000 to No. 6, with No. 6 being the thickest. Typical multipurpose grease is NLGI No. 2. For specific applications, manufacturers may recommend water-resistant type grease or one with an additive such as molybdenum disulfide ( $\text{MoS}_2$ ).

### **Brake fluid**

Brake fluid is the hydraulic fluid used to transmit hydraulic pressure (force) to the wheel brakes. Brake fluid is classified by the Department of Transportation (DOT). Current designations for brake fluid are DOT 3, DOT 4 and DOT 5. This classification appears on the fluid container.

Each type of brake fluid has its own definite characteristics. Do not intermix DOT 5 (silicone) type brake fluid as this may cause brake system failure since the DOT 5 brake fluid is not compatible with other brake fluids. When adding brake fluid, *only* use the fluid recommended by the manufacturer (DOT 4).

Brake fluid will damage any plastic, painted or plated surface it contacts. Use extreme care when working with brake fluid and remove any spills immediately with soap and water.

Hydraulic brake systems require clean and moisture free brake fluid. Never reuse brake fluid. Keep containers and reservoirs properly sealed.

#### **WARNING**

*Never put a mineral-based (petroleum) oil into the brake system. Mineral oil will cause rubber parts in the system to swell and break apart, resulting in complete brake failure.*

### **Cleaners, Degreasers and Solvents**

Many chemicals are available to remove oil, grease and other residue from the vehicle. Before using cleaning solvents, consider how they will be used and disposed of, particularly if they are not water-soluble. Local ordinances may require special procedures for the disposal of many types of cleaning chemicals. Refer to *Safety* and *Cleaning Parts* in this chapter for more information on their use.

Use brake parts cleaner to clean brake system components when contact with petroleum-based products will damage seals. Brake parts cleaner leaves no residue. Use electrical contact cleaner to clean electrical connections and components without leaving any residue. Carburetor cleaner is a powerful solvent used to remove fuel deposits and varnish from fuel system components. Use this cleaner carefully, as it may damage finishes.

Generally, degreasers are strong cleaners used to remove heavy accumulations of grease from engine and frame components.

Most solvents are designed to be used in a parts washing cabinet for individual component cleaning. For safety, use only nonflammable or high flash point solvents.

### **Gasket Sealant**

Sealants are used in combination with a gasket or seal and are occasionally alone. Follow the manufacturer's recommendation when using sealants. Use extreme care when choosing a sealant different from the type originally recommended. Choose sealants based on their resistance to heat, various fluids and their sealing capabilities.

One of the most common sealants is RTV, or room temperature vulcanizing sealant. This sealant cures at room temperature over a specific time period. This allows the repositioning of components without damaging gaskets.

Moisture in the air causes the RTV sealant to cure. Always install the tube cap as soon as possible after applying RTV sealant. RTV sealant has a limited shelf life and will not cure properly if the shelf life has expired. Keep partial tubes sealed and discard them if they have surpassed the expiration date.

### **Applying RTV sealant**

Clean all old gasket residue from the mating surfaces. Remove all gasket material from blind threaded holes; it can cause inaccurate bolt torque. Spray the mating surfaces with aerosol parts cleaner and then wipe with a lint-free cloth. The area must be clean for the sealant to adhere.

Apply RTV sealant in a continuous bead 2-3 mm (0.08-0.12 in.) thick. Circle all the fastener holes unless otherwise specified. Do not allow any sealant to enter

these holes. Assemble and tighten the fasteners to the specified torque within the time frame recommended by the RTV sealant manufacturer.

### Gasket Remover

Aerosol gasket remover can help remove stubborn gaskets. This product can speed up the removal process and prevent damage to the mating surface that may be caused by using a scraping tool. Most of these types of products are very caustic. Follow the gasket remover manufacturer's instructions for use.

### Threadlocking Compound

A threadlocking compound is a fluid applied to the threads of fasteners. After tightening the fastener, the fluid dries and becomes a solid filler between the threads. This makes it difficult for the fastener to work loose from vibration, or heat expansion and contraction. Some threadlocking compounds also provide a seal against fluid leakage.

Before applying threadlocking compound, remove any old compound from both thread areas and clean them with aerosol parts cleaner. Use the compound sparingly. Excess fluid can run into adjoining parts.

Threadlocking compounds are available in different strengths. Follow the particular manufacturer's recommendations regarding compound selection. Two manufacturers of threadlocking compound are ThreeBond and Loctite. They both offer a wide range of compounds for various strength, temperature and repair applications.

## BASIC TOOLS

Most of the procedures in this manual can be carried out with simple hand tools and test equipment familiar to the home mechanic. Always use the correct tools for the job at hand. Keep tools organized and clean. Store them in a tool chest with related tools organized together.

Quality tools are essential. The best are constructed of high-strength alloy steel. These tools are light, easy to use and resistant to wear. Their working surface is devoid of sharp edges and the tool is carefully polished. They have an easy-to-clean finish and are comfortable to use. Quality tools are a good investment.

When purchasing tools to perform the procedures covered in this manual, consider the tools' potential frequency of use. If a tool kit is just now being started, consider purchasing a basic tool set (**Figure 13**) from a large tool supplier. These sets are available in many tool combinations and offer substantial savings when compared to individually purchased tools. As work experience grows and tasks become more complicated, specialized tools can be added.

### Screwdrivers

Screwdrivers of various lengths and types are mandatory for the simplest tool kit. The two basic types are the slotted tip (flat blade) and the Phillips tip. These are available in sets that often include an assortment of tip sizes and shaft lengths.

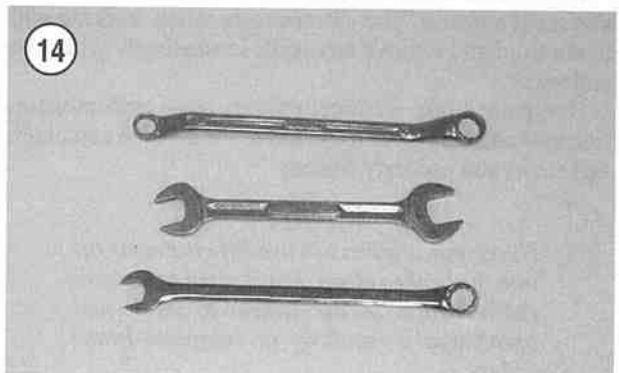
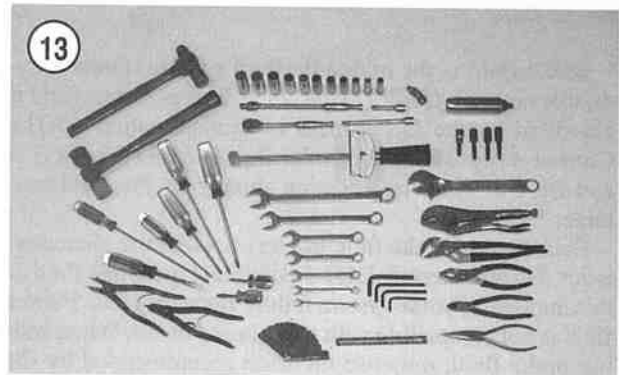
As with all tools, use a screwdriver designed for the job. Make sure the size of the tip conforms to the size and shape of the fastener. Use them only for driving screws. Never use a screwdriver for prying or chiseling metal. Repair or replace worn or damaged screwdrivers. A worn tip may damage the fastener, making it difficult to remove.

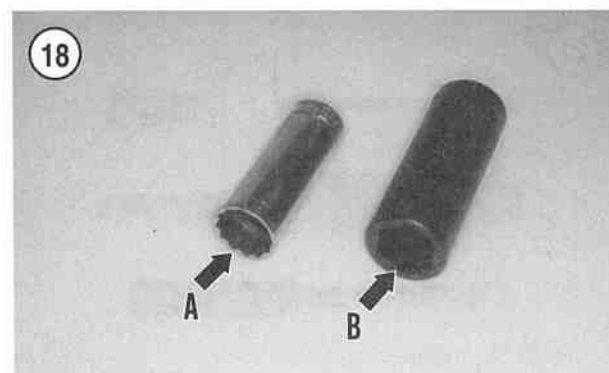
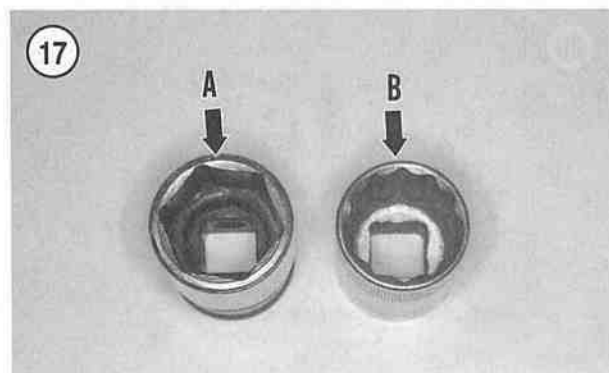
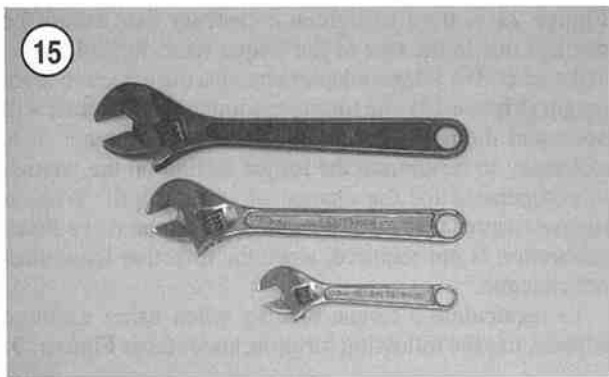
### Wrenches

Open-end, box-end and combination wrenches (**Figure 14**) are available in various types and sizes.

The number stamped on the wrench refers to the distance between the work areas. This size must match the size of the fastener head.

The box-end wrench is an excellent tool because it grips the fastener on all sides. This reduces the chance of the tool slipping. The box-end wrench is designed with either a 6- or 12-point opening. For stubborn or damaged fasteners, the 6-point provides superior holding ability by contacting the fastener across a wider area at all six edges. For general use, the 12-point works well. It allows the wrench





to be removed and reinstalled without moving the handle over such a wide arc.

An open-end wrench is fast and works best in areas with limited overhead access. It contacts the fastener at only two points, and is subject to slipping under heavy force, or if the tool or fastener is worn. A box-end wrench is preferred in most instances, especially when breaking loose and applying the final tightness to a fastener.

The combination wrench has a box end on one end and an open end on the other. This combination makes it a very convenient tool.

### Adjustable Wrenches

An adjustable wrench or Crescent wrench (**Figure 15**) can fit nearly any nut or bolt head that has clear access around its entire perimeter. Adjustable wrenches are best used as a backup wrench to keep a large nut or bolt from turning while the other end is being loosened or tightened with a box-end or socket wrench.

Adjustable wrenches contact the fastener at only two points, making them more likely to slip off the fastener. The fact that one jaw is adjustable and may loosen only aggravates this shortcoming. Make certain that the solid jaw is the one transmitting the force.

### Socket Wrenches, Ratchets and Handles

Sockets that attach to a ratchet handle (**Figure 16**) are available with 6-point (A, **Figure 17**) or 12-point (B) openings and different drive sizes. The drive size indicates the size of the square hole that accepts the ratchet handle. The number stamped on the socket is the size of the work area and must match the fastener head.

As with wrenches, a 6-point socket provides superior holding ability, while a 12-point socket needs to be moved only half as far to reposition it on the fastener.

Sockets are designated for either hand or impact use. Impact sockets are made of thicker material for more durability. Compare the size and wall thickness of a 19-mm hand socket (A, **Figure 18**) and the 19-mm impact socket (B). Use impact sockets when using an impact driver or air tools. Use hand sockets with hand-driven attachments.

#### WARNING

*Do not use hand sockets with air or impact tools, as they may shatter and cause injury. Always wear eye protection when using impact or air tools.*

Various handles are available for sockets. The speed handle is used for fast operation. Flexible ratchet heads in varying lengths allow the socket to be turned with varying force, and at odd angles. Extension bars allow the socket setup to reach difficult areas. The ratchet is the most ver-



satile. It allows the user to install or remove the nut without removing the socket.

Sockets combined with any number of drivers make them undoubtedly the fastest, safest and most convenient tool for fastener removal and installation.

### Impact Driver

An impact driver provides extra force for removing fasteners, by converting the impact of a hammer into a turning motion. This makes it possible to remove stubborn fasteners without damaging them. Impact drivers and interchangeable bits (**Figure 19**) are available from most tool suppliers. When using a socket with an impact driver make sure the socket is designed for impact use. Refer to *Socket Wrenches, Ratchets and Handles* in this section.

#### WARNING

*Do not use hand sockets with air or impact tools as they may shatter and cause injury. Always wear eye protection when using impact or air tools.*

### Allen Wrenches

Allen or setscrew wrenches (**Figure 20**) are used on fasteners with hexagonal recesses in the fastener head. These wrenches are available in L-shaped bar, socket and T-handle types. A metric set is required when working on most vehicles. Allen bolts are sometimes called socket bolts.

### Torque Wrenches

A torque wrench is used with a socket, torque adapter or similar extension to tighten a fastener to a measured torque. Torque wrenches come in several drive sizes (1/4, 3/8, 1/2 and 3/4) and have various methods of reading the torque value. The drive size indicates the size of the square drive that accepts the socket, adapter or extension. Common methods of reading the torque value are the deflecting beam, the dial indicator and the audible click (**Figure 21**).

When choosing a torque wrench, consider the torque range, drive size and accuracy. The torque specifications in this manual provide an indication of the range required.

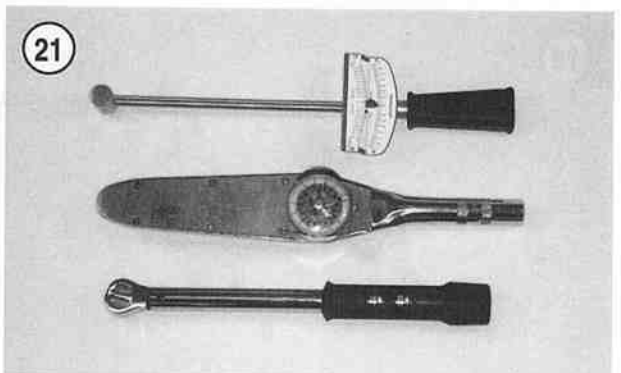
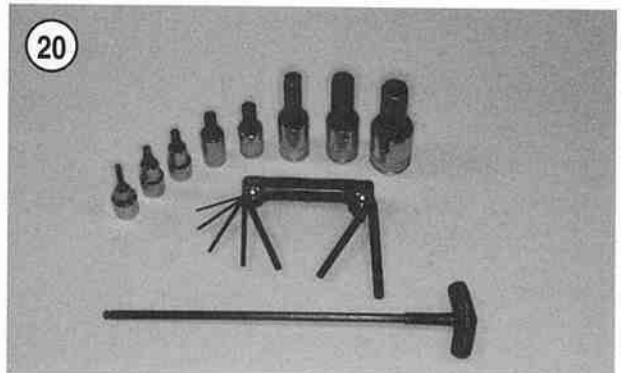
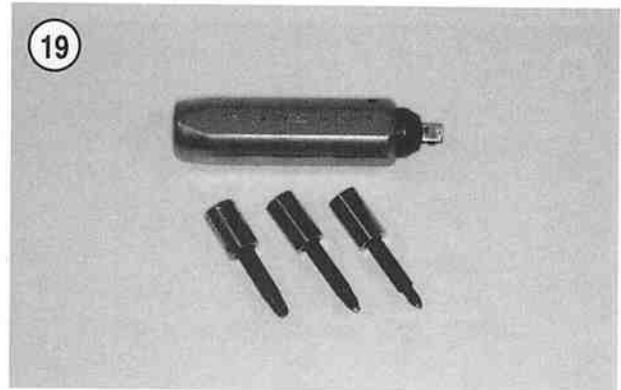
A torque wrench is a precision tool that must be properly cared for to remain accurate. Store torque wrenches in cases or separate padded drawers within a toolbox. Follow the manufacturer's instructions for their care and calibration.

### Torque Adapters

Torque adapters or extensions extend or reduce the reach of a torque wrench. The torque adapter shown in

**Figure 22** is used to tighten a fastener that cannot be reached due to the size of the torque wrench head, drive, and socket. If a torque adapter changes the effective lever length (**Figure 23**), the torque reading on the wrench will not equal the actual torque applied to the fastener. It is necessary to recalibrate the torque setting on the wrench to compensate for the change of lever length. When a torque adapter is used at a right angle to the drive head, calibration is not required, since the effective length has not changed.

To recalculate a torque reading when using a torque adapter, use the following formula, and refer to **Figure 23**.



$$TW = TA \times L$$

$$L + A = E$$

TW is the torque setting or dial reading on the wrench.  
 TA is the torque specification and the actual amount of torque that will be applied to the fastener.

A is the amount that the adapter increases (or in some cases reduces) the effective lever length as measured along the centerline of the torque wrench (**Figure 23**).

L is the lever length of the wrench as measured from the center of the drive to the center of the grip.

The effective length is the sum of L and A (**Figure 23**).

Example:

$$TA = 20 \text{ ft.-lb.}$$

$$A = 3 \text{ in.}$$

$$L = 14 \text{ in.}$$

$$E = 17 \text{ in.}$$

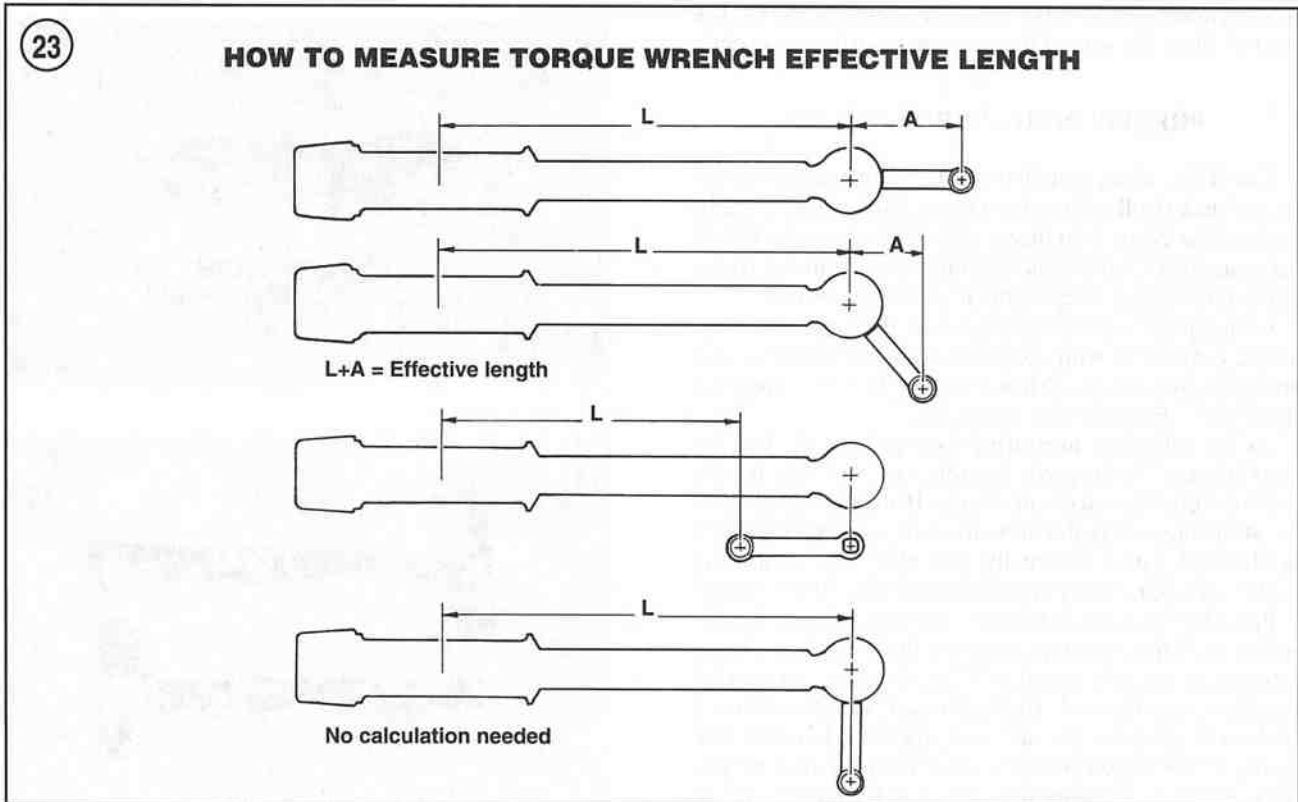
$$TW = \frac{20 \times 14}{17} = \frac{280}{17} = 16.5 \text{ ft.-lb.}$$

$$14 + 3 = 17$$

In this example, the torque wrench would be set to the recalculated torque value (TW = 16.5 ft.-lb.). When using a beam-type wrench, tighten the fastener until the pointer aligns with 16.5 ft.-lb. In this example, although the torque wrench is preset to 16.5 ft.-lb., the actual torque is 20 ft.-lb.

**Pliers**

Pliers come in a wide range of types and sizes. Pliers are useful for holding, cutting, bending, and crimping. Do not use them to turn fasteners. **Figure 24** and **Figure 25** show several types of useful pliers. Each design has a specialized function. Slip-joint pliers are general-purpose pliers used for gripping and bending. Diagonal cutting pliers are needed to cut wire and can be used to remove cotter pins. Needlenose pliers are used to hold or bend small objects. Locking pliers (**Figure 25**), sometimes called Vise-grips, are used to hold objects very tightly. They have many uses, ranging from holding two parts together to gripping the end of a broken stud. Use caution when using locking pliers, as the sharp jaws will damage the objects they hold.



### Snap Ring Pliers

Snap ring pliers are specialized pliers with tips that fit into the ends of snap rings to remove and install them.

Snap ring pliers are available with a fixed action (either internal or external) or convertible (one tool works on both internal and external snap rings). They may have fixed tips or interchangeable ones of various sizes and angles. For general use, select a convertible type pliers with interchangeable tips.

#### WARNING

*Snap rings can slip and fly off when removing and installing them. Also, the snap ring pliers tips may break. Always wear eye protection when using snap ring pliers.*

### Hammers

Various types of hammers (Figure 26) are available to fit a number of applications. A ball-peen hammer is used to strike another tool, such as a punch or chisel. Soft-faced hammers are required when a metal object must be struck without damaging it. *Never* use a metal-faced hammer on engine and suspension components, as damage will occur in most cases.

Always wear eye protection when using hammers. Make sure the hammer face is in good condition and the handle is not cracked. Select the correct hammer for the job and make sure to strike the object squarely. Do not use the handle or the side of the hammer to strike an object.

## PRECISION MEASURING TOOLS

The ability to accurately measure components is essential to successfully rebuild an engine. Equipment is manufactured to close tolerances, and obtaining consistently accurate measurements is essential to determining which components require replacement or further service.

Each type of measuring instrument is designed to measure a dimension with a certain degree of accuracy and within a certain range. When selecting the measuring tool, make sure it is applicable to the task.

As with all tools, measuring tools provide the best results if cared for properly. Improper use can damage the tool and result in inaccurate results. If any measurement is questionable, verify the measurement using another tool. A standard gauge is usually provided with measuring tools to check accuracy and calibrate the tool if necessary.

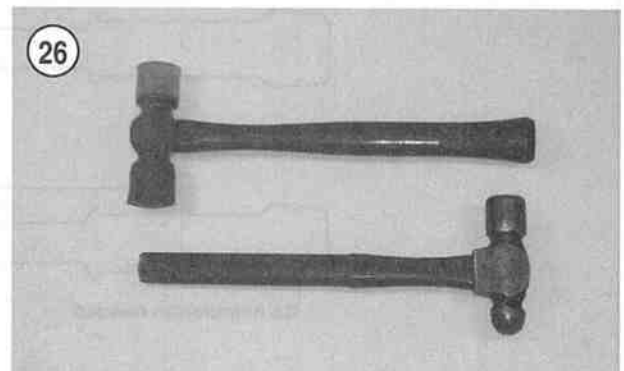
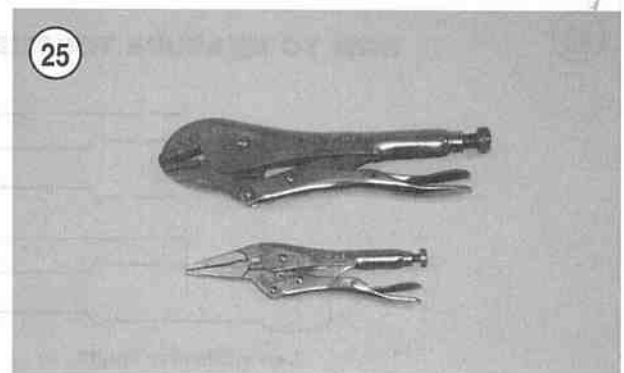
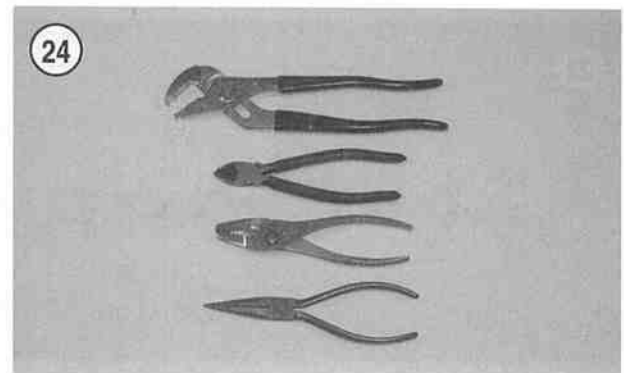
Precision measurements can vary according to the experience of the person performing the procedure. Accurate results are only possible if the mechanic possesses a feel for using the tool. Heavy-handed use of measuring tools will produce less accurate results. Hold the tool gently by the fingertips so the point at which the tool contacts the object is easily felt. This feel for the equipment

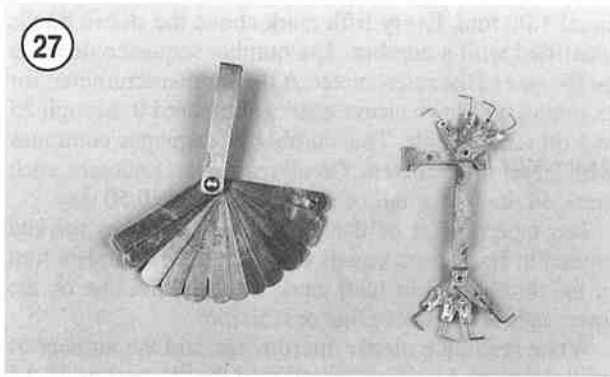
will produce more accurate measurements and reduce the risk of damaging the tool or component. Refer to the following sections for specific measuring tools.

### Feeler Gauge

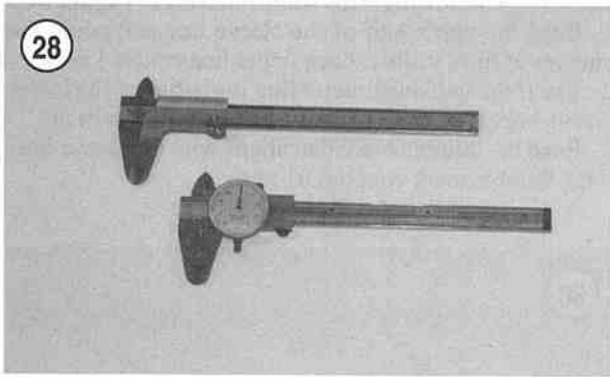
The feeler or thickness gauge (Figure 27) is used for measuring the distance between two surfaces.

A feeler gauge set consists of an assortment of steel strips of graduated thickness. Each blade is marked with its thickness. Blades can be of various lengths and angles for different procedures.





A common use for a feeler gauge is to measure valve clearance. Wire (round) type gauges are used to measure spark plug gap.



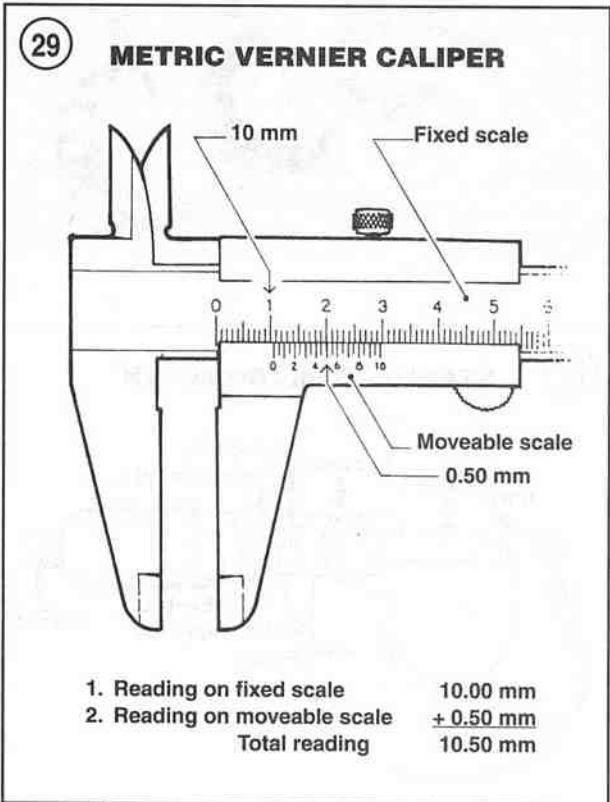
**Calipers**

Calipers (Figure 28) are excellent tools for obtaining inside, outside and depth measurements. Although not as precise as a micrometer, they allow reasonable precision, typically to within 0.05 mm (0.001 in.). Most calipers have a range up to 150 mm (6 in.).

Calipers are available in dial, vernier or digital versions. Dial calipers have a dial readout that provides convenient reading. Vernier calipers have marked scales that must be compared to determine the measurement. The digital caliper uses an LCD to show the measurement.

Properly maintain the measuring surfaces of the caliper. There must not be any dirt or burrs between the tool and the object being measured. Never force the caliper closed around an object; close the caliper around the highest point so it can be removed with a slight drag. Some calipers require calibration. Always refer to the manufacturer's instructions when using a new or unfamiliar caliper.

To read a vernier caliper refer to Figure 29. The fixed scale is marked in 1 mm increments. Ten individual lines on the fixed scale equal 1 cm. The moveable scale is marked in 0.05 mm (hundredth) increments. To obtain a reading, establish the first number by the location of the 0 line on the movable scale in relation to the first line to the left on the fixed scale. In this example, the number is 10 mm. To determine the next number, note which of the lines on the movable scale align with a mark on the fixed scale. A number of lines will seem close, but only one will align exactly. In this case, 0.50 mm is the reading to add to the first number. The result of adding 10 mm and 0.50 mm is a measurement of 10.50 mm.



**Micrometers**

A micrometer is an instrument designed for linear measurement using the decimal divisions of the inch or meter. While there are many types and styles of micrometers, most of the procedures in this manual call for an outside micrometer. The outside micrometer is used to measure the outside diameter of cylindrical forms and the thickness of materials.

A micrometer's size indicates the minimum and maximum size of a part that it can measure. The usual sizes (Figure 30) are 0-1 in. (0-25 mm), 1-2 in. (25-50 mm), 2-3 in. (50-75 mm) and 3-4 in. (75-100 mm).

Micrometers that cover a wider range of measurements are available. These use a large frame with interchangeable anvils of various lengths. This type of micrometer of-



fers a cost savings; however, its overall size may make it less convenient.

### Reading a Micrometer

When reading a micrometer, numbers are taken from different scales and added together. The following sections describe how to read the measurements of various types of outside micrometers.

For accurate results, properly maintain the measuring surfaces of the micrometer. There can not be any dirt or burrs between the tool and the measured object. Never force the micrometer closed around an object. Close the micrometer around the highest point so it can be removed with a slight drag. **Figure 31** shows the markings and parts of a standard inch micrometer. Be familiar with these terms before using a micrometer in the following sections.

#### Standard inch micrometer

The standard inch micrometer is accurate to one-thousandth of an inch or 0.001. The sleeve is marked in 0.025 in. increments. Every fourth sleeve mark is numbered 1, 2, 3, 4, 5, 6, 7, 8, 9. These numbers indicate 0.100, 0.200, 0.300, and so on.

The tapered end of the thimble has twenty-five lines marked around it. Each mark equals 0.001 in. One complete turn of the thimble will align its zero mark with the first mark on the sleeve or 0.025 in.

When reading a standard inch micrometer, perform the following steps while referring to **Figure 32**.

1. Read the sleeve and find the largest number visible. Each sleeve number equals 0.100 in.
2. Count the number of lines between the numbered sleeve mark and the edge of the thimble. Each sleeve mark equals 0.025 in.
3. Read the thimble mark that aligns with the sleeve line. Each thimble mark equals 0.001 in.

#### NOTE

*If a thimble mark does not align exactly with the sleeve line, estimate the amount between the lines. For accurate readings in ten-thousandths of an inch (0.0001 in.), use a vernier inch micrometer.*

4. Add the readings from Steps 1-3.

#### Metric micrometer

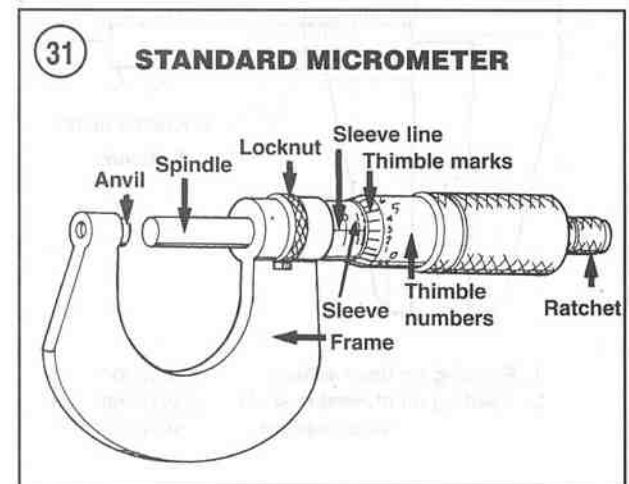
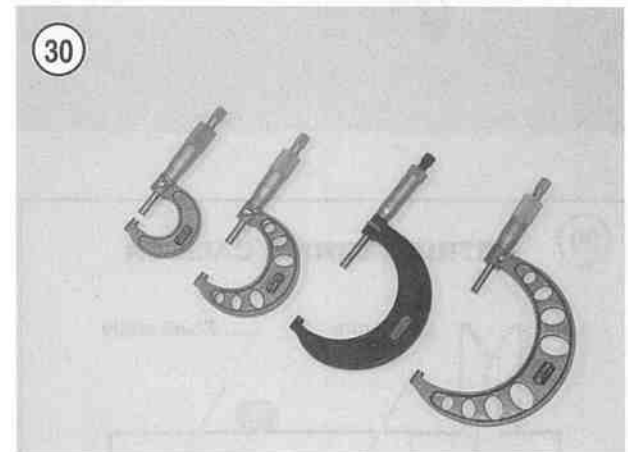
The standard metric micrometer (**Figure 33**) is accurate to one one-hundredth of a millimeter (0.01-mm). The sleeve line is graduated in millimeter and half millimeter increments. The marks on the upper half of the sleeve line

equal 1.00 mm. Every fifth mark above the sleeve line is identified with a number. The number sequence depends on the size of the micrometer. A 0-25 mm micrometer, for example, will have sleeve marks numbered 0 through 25 in 5 mm increments. This numbering sequence continues with larger micrometers. On all metric micrometers, each mark on the lower half of the sleeve equals 0.50 mm.

The tapered end of the thimble has 50 lines marked around it. Each mark equals 0.01 mm. One complete turn of the thimble aligns its 0 mark with the first line on the lower half of the sleeve line or 0.50 mm.

When reading a metric micrometer, add the number of millimeters and half-millimeters on the sleeve line to the number of one one-hundredth millimeters on the thimble. Perform the following steps while referring to **Figure 34**.

1. Read the upper half of the sleeve line and count the number of lines visible. Each upper line equals 1 mm.
2. See if the half-millimeter line is visible on the lower sleeve line. If so, add 0.50 mm to the reading in Step 1.
3. Read the thimble mark that aligns with the sleeve line. Each thimble mark equals 0.01 mm.



**NOTE**

If a thimble mark does not align exactly with the sleeve line, estimate the amount between the lines. For accurate readings in two-thousandths of a millimeter (0.002 mm), use a metric vernier micrometer.

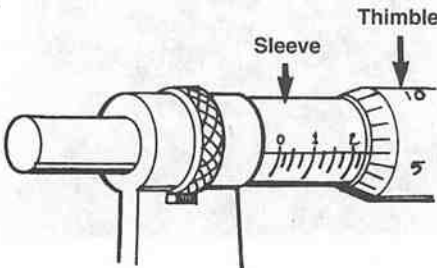
4. Add the readings from Steps 1-3.

**Micrometer Adjustment**

Before using a micrometer, check its adjustment as follows.

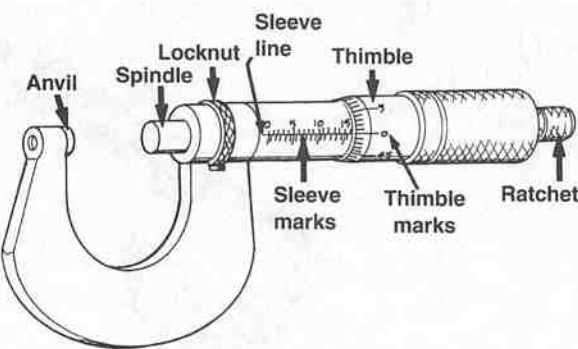
1. Clean the anvil and spindle faces.
- 2A. To check a 0-1 in. or 0-25 mm micrometer:

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1. Largest number of visible sleeve line	0.200 in.
2. Number on sleeve marks visible between the numbered sleeve mark and the thimble edge	0.025 in.
3. Thimble mark that aligns with sleeve line	0.006 in.
<b>Total reading</b>	<b>0.231 in.</b>

**33 STANDARD METRIC MICROMETER**



- a. Turn the thimble until the spindle contacts the anvil. If the micrometer has a ratchet stop, use it to ensure that the proper amount of pressure is applied.
- b. If the adjustment is correct, the 0 mark on the thimble will align exactly with the 0 mark on the sleeve line. If the marks do not align, the micrometer is out of adjustment.
- c. Follow the manufacturer's instructions to adjust the micrometer.

2B. To check a micrometer larger than 1 in. or 25 mm use the standard gauge supplied by the manufacturer. A standard gauge is a steel block, disc or rod that is machined to an exact size.

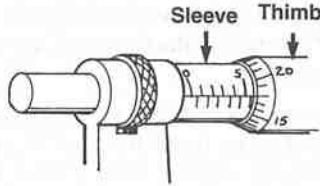
- a. Place the standard gauge between the spindle and anvil, and measure its outside diameter or length. If the micrometer has a ratchet stop, use it to ensure that the proper amount of pressure is applied.
- b. If the adjustment is correct, the 0 mark on the thimble will align exactly with the 0 mark on the sleeve line. If the marks do not align, the micrometer is out of adjustment.
- c. Follow the manufacturer's instructions to adjust the micrometer.

**Micrometer Care**

Micrometers are precision instruments. They must be used and maintained with great care. Note the following:

1. Store micrometers in protective cases or separate padded drawers in a toolbox.
2. When in storage, make sure the spindle and anvil faces do not contact each other or another object. If they do, temperature changes and corrosion may damage the contact faces.

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1. Reading on upper sleeve line	5.00 mm
2. Reading on lower sleeve line	0.50 mm
3. Thimble line coinciding with sleeve line	0.18 mm
<b>Total Reading</b>	<b>5.68 mm</b>

3. Do not clean a micrometer with compressed air. Dirt forced into the tool will cause wear.
4. Lubricate micrometers with WD-40 to prevent corrosion.

### Telescoping and Small Bore Gauges

Use telescoping gauges (**Figure 35**) and small hole gauges (**Figure 36**) to measure bores. Neither gauge has a scale for direct readings. An outside micrometer must be used to determine the reading.

To use a telescoping gauge, select the correct size gauge for the bore. Compress the movable post and carefully insert the gauge into the bore. Carefully move the gauge in the bore to make sure it is centered. Tighten the knurled end of the gauge to hold the movable post in position. Remove the gauge and measure the length of the posts. Telescoping gauges are typically used to measure cylinder bores.

To use a small-bore gauge, select the correct size gauge for the bore. Carefully insert the gauge into the bore. Tighten the knurled end of the gauge to carefully expand the gauge fingers to the limit within the bore. Do not overtighten the gauge, as there is no built-in release. Excessive tightening can damage the bore surface and damage the tool. Remove the gauge and measure the outside dimension (**Figure 37**). Small hole gauges are typically used to measure valve guides.

### Dial Indicator

A dial indicator (**Figure 38**) is a gauge with a dial face and needle used to measure variations in dimensions and movements. Measuring brake rotor runout is a typical use for a dial indicator.

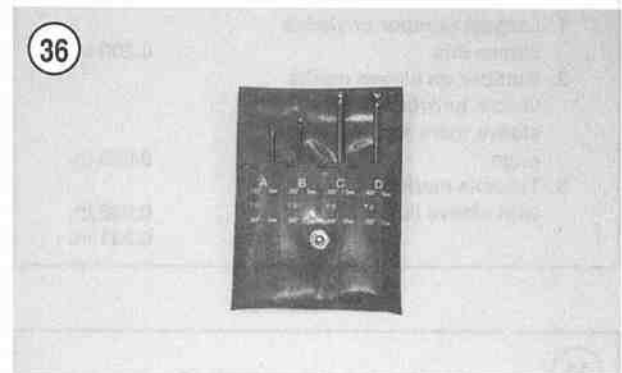
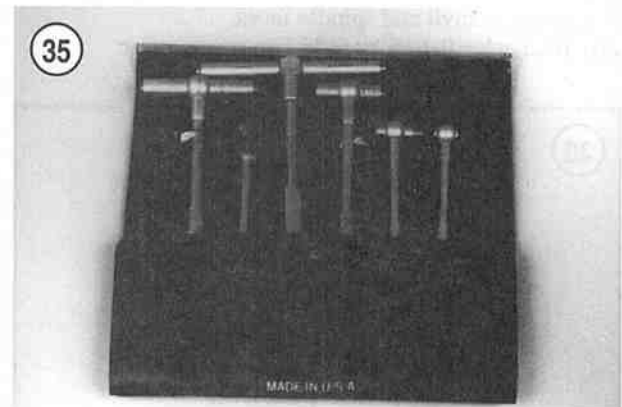
Dial indicators are available in various ranges and graduations and with three basic types of mounting bases: magnetic, clamp, or screw-in stud. When purchasing a dial indicator, select the magnetic stand type with a continuous dial.

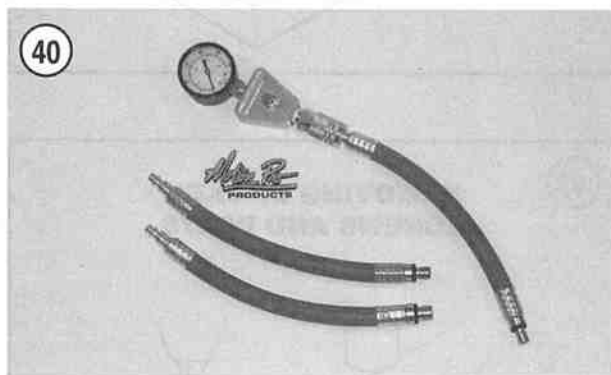
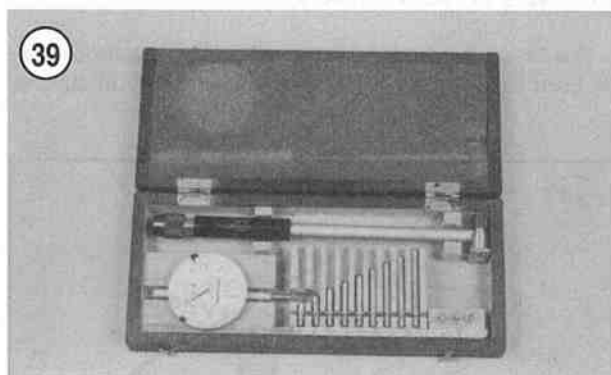
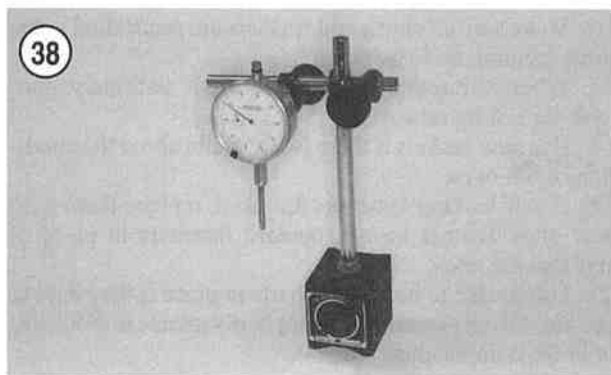
### Cylinder Bore Gauge

A cylinder bore gauge is similar to a dial indicator. The gauge set shown in **Figure 39** consists of a dial indicator, handle, and different length adapters (anvils) to fit the gauge to various bore sizes. The bore gauge is used to measure bore size, taper and out-of-round. When using a bore gauge, follow the manufacturer's instructions.

### Compression Gauge

A compression gauge (**Figure 40**) measures combustion chamber (cylinder) pressure, usually in psi or kg/cm<sup>2</sup>. The gauge adapter is either inserted or screwed into the spark plug hole to obtain the reading. Disable the engine so it will not start and hold the throttle in the wide-open position when performing a compression test. An engine that does not have adequate compression cannot be properly tuned. See Chapter Three.





### Multimeter

A multimeter (**Figure 41**) is an essential tool for electrical system diagnosis. The voltage function indicates the voltage applied or available to various electrical components. The ohmmeter function tests circuits for continuity, or lack of continuity, and measures the resistance of a circuit.

Some manufacturers' specifications for electrical components are based on results using a specific test meter. Results may vary if a meter not recommend by the manufacturer is used. Such requirements are noted when applicable.

### Ohmmeter (analog) calibration

Each time an analog ohmmeter is used or if the scale is changed, the ohmmeter must be calibrated.

Digital ohmmeters do not require calibration.

1. Make sure the meter battery is in good condition.
2. Make sure the meter probes are in good condition.
3. Touch the two probes together and observe the needle location on the ohms scale. The needle must align with the 0 mark to obtain accurate measurements.
4. If necessary, rotate the meter ohms adjust knob until the needle and 0 mark align.

### SPECIAL TOOLS

Some of the procedures in this manual require special tools. These are described in the appropriate chapter and are available from either the manufacturer or a tool supplier.

In many cases, an acceptable substitute may be found in an existing tool kit. Another alternative is to make the tool. Many schools with a machine shop curriculum welcome outside work that can be used as practical shop applications for students.

### BASIC SERVICE METHODS

Most of the procedures in this manual are straightforward and can be performed by anyone reasonably competent with tools. However, consider personal capabilities carefully before attempting any operation involving major disassembly of the engine.

1. Front, in this manual, refers to the front of the vehicle. The front of any component is the end closest to the front of the vehicle. The left and right sides refer to the position of the parts as viewed by the rider sitting on the seat facing forward.
2. Whenever servicing an engine or suspension component, secure the vehicle in a safe manner.
3. Tag all similar parts for location and mark all mating parts for position. Record the number and thickness of any



shims as they are removed. Identify parts by placing them in sealed and labeled plastic sandwich bags.

4. Tag disconnected wires and connectors with masking tape and a marking pen. Do not rely on memory alone.

5. Protect finished surfaces from physical damage or corrosion. Keep gasoline and other chemicals off painted surfaces.

6. Use penetrating oil on frozen or tight bolts. Avoid using heat where possible. Heat can warp, melt or affect the temper of parts. Heat also damages the finish of paint and plastics.

7. When a part is a press fit or requires a special tool for removal, the information or type of tool is identified in the text. Otherwise, if a part is difficult to remove or install, determine the cause before proceeding.

8. To prevent objects or debris from falling into the engine, cover all openings.

9. Read each procedure thoroughly and compare the illustrations to the actual components before starting the procedure. Perform the procedure in sequence.

10. Recommendations are occasionally made to refer service to a dealership or specialist. In these cases, the work can be performed more economically by the specialist than by the home mechanic.

11. The term *replace* means to discard a defective part and replace it with a new part. *Overhaul* means to remove, disassemble, inspect, measure, repair and/or replace parts as required to recondition an assembly.

12. Some operations require the use of a hydraulic press. If a press is not available, have these operations performed by a shop equipped with the necessary equipment. Do not use makeshift equipment that may damage the vehicle.

13. Repairs are much faster and easier if the vehicle is clean before starting work. Degrease the vehicle with a commercial degreaser; follow the directions on the container for the best results. Clean all parts with cleaning solvent as they are removed.

#### CAUTION

*Do not direct high-pressure water at steering bearings, carburetor hoses, wheel bearings, suspension and electrical components, or drive belt. The water will force the grease out of the bearings and possibly damage the seals.*

14. If special tools are required, have them available before starting the procedure. When special tools are required, they will be described at the beginning of the procedure.

15. Make diagrams of similar-appearing parts. For instance, crankcase bolts are often not the same lengths. Do not rely on memory alone. It is possible that carefully laid out parts will become disturbed, making it difficult to reassemble the components correctly without a diagram.

16. Make sure all shims and washers are reinstalled in the same location and position.

17. Whenever rotating parts contact a stationary part, look for a shim or washer.

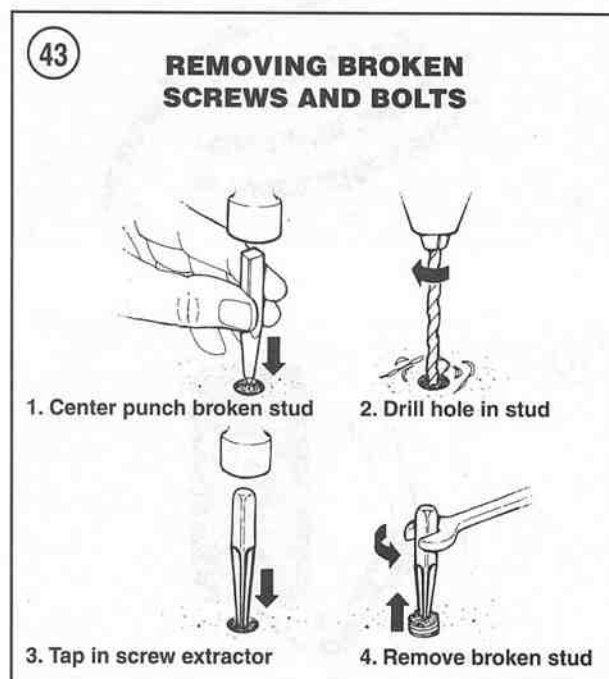
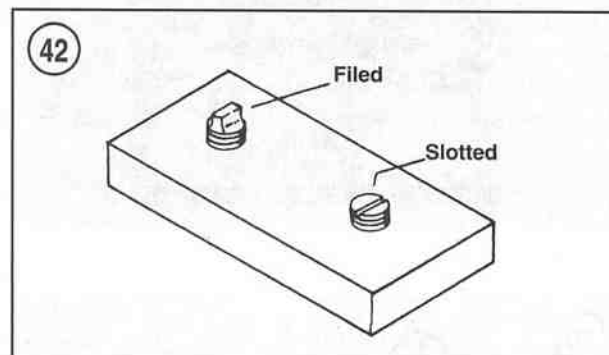
18. Use new gaskets if there is any doubt about the condition of old ones.

19. If self-locking fasteners are used, replace them with new ones. Do not install standard fasteners in place of self-locking ones.

20. Use grease to hold small parts in place if they tend to fall out during assembly. Do not apply grease to electrical or brake components.

#### Removing Frozen Fasteners

If a fastener cannot be removed, several methods may be used to loosen it. First, apply penetrating oil such as



Liquid Wrench or WD-40. Apply it liberally and let it penetrate for 10-15 minutes. Rap the fastener several times with a small hammer. Do not hit it hard enough to cause damage. Reapply the penetrating oil if necessary.

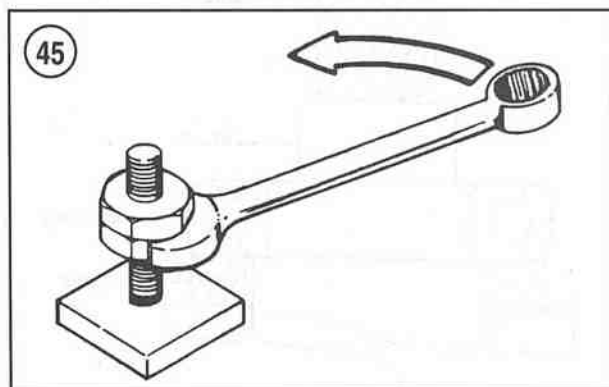
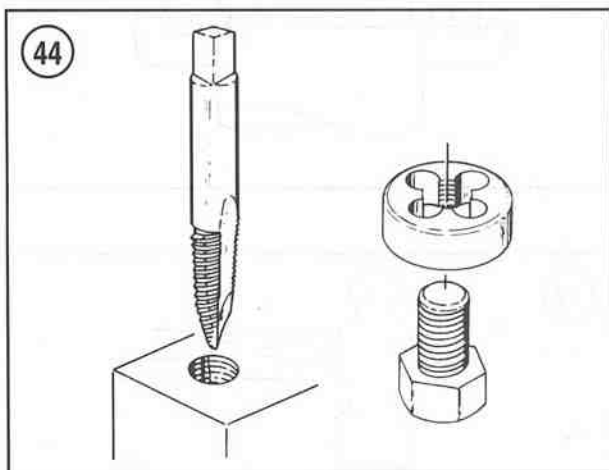
For frozen screws, apply penetrating oil as described, then insert a screwdriver in the slot and rap the top of the screwdriver with a hammer. This loosens the rust so the screw can be removed in the normal way. If the screw head is too damaged to use this method, grip the head with locking pliers and twist the screw out.

Avoid applying heat unless specifically instructed, as it may melt, warp or remove the temper from parts.

### Removing Broken Fasteners

If the head breaks off a screw or bolt, several methods are available for removing the remaining portion. If a large portion of the remainder projects out, try gripping it with locking pliers. If the projecting portion is too small, file it to fit a wrench or cut a slot in it to fit a screwdriver (Figure 42).

If the head breaks off flush, use a screw extractor. To do this, centerpunch the exact center of the remaining portion



of the screw or bolt. Drill a small hole in the screw and tap the extractor into the hole. Back the screw out with a wrench on the extractor (Figure 43).

### Repairing Damaged Threads

Occasionally, threads are stripped through carelessness or impact damage. Often the threads can be repaired by running a tap (for internal threads on nuts) or die (for external threads on bolts) through the threads (Figure 44). To clean or repair spark plug threads, use a spark plug tap.

If an internal thread is damaged, it may be necessary to install a Helicoil or some other type of thread insert. Follow the manufacturer's instructions when installing their insert.

### Stud Removal/Installation

A stud removal tool is available from most tool suppliers. This tool makes the removal and installation of studs easier. If one is not available, thread two nuts onto the stud and tighten them against each other. Remove the stud by turning the lower nut (Figure 45).

1. Measure the height of the stud above the surface.
2. Thread the stud removal tool onto the stud and tighten it, or thread two nuts onto the stud.
3. Remove the stud by turning the stud remover or the lower nut.
4. Remove any threadlocking compound from the threaded hole. Clean the threads with an aerosol parts cleaner.
5. Install the stud removal tool onto the new stud or thread two nuts onto the stud.
6. Apply threadlocking compound to the threads of the stud.
7. Install the stud and tighten with the stud removal tool or the top nut.
8. Install the stud to the height noted in Step 1 or its torque specification.
9. Remove the stud removal tool or the two nuts.

### Removing Hoses

When removing stubborn hoses, do not exert excessive force on the hose or fitting. Remove the hose clamp and carefully insert a small screwdriver or pick tool between the fitting and hose. Apply a spray lubricant under the hose and carefully twist the hose off the fitting. Clean the fitting of any corrosion or rubber hose material with a wire brush. Clean the inside of the hose thoroughly. Do not use any lubricant when installing the hose (new or old). The lubricant may allow the hose to come off the fitting, even with the clamp secure.

## Bearings

Bearings are used in the engine and transmission assembly to reduce power loss, heat and noise resulting from friction. Because bearings are precision parts, they must be maintained by proper lubrication and maintenance. If a bearing is damaged, replace it immediately. When installing a new bearing, take care to prevent damaging it. Bearing replacement procedures are included in the individual chapters where applicable; however, use the following sections as a guideline.

### NOTE

*Unless otherwise specified, install bearings with the manufacturer's mark or number facing outward.*

## Removal

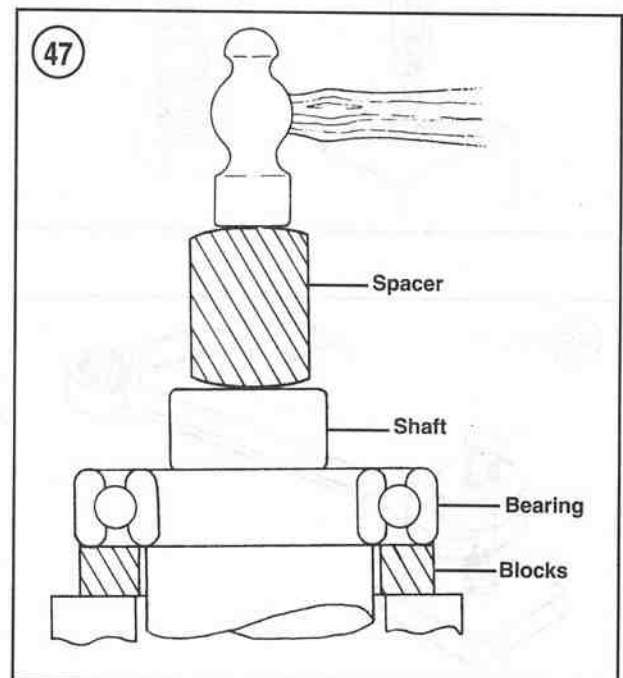
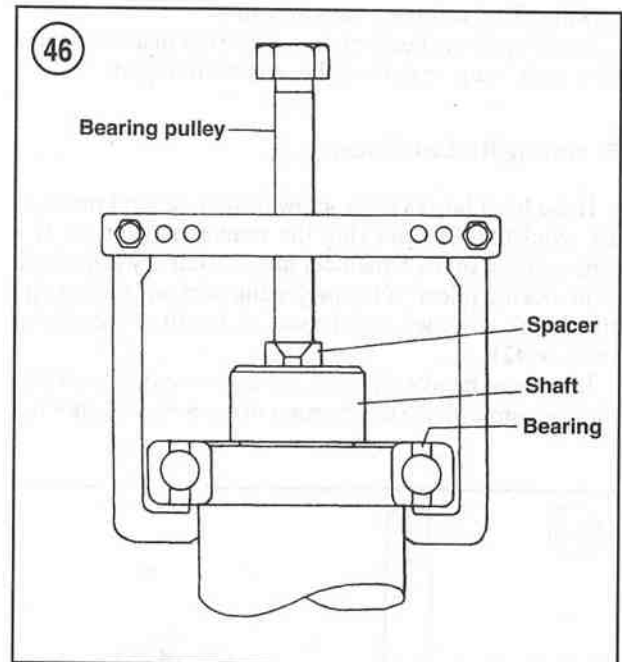
While bearings are normally removed only when damaged, there may be times when it is necessary to remove a bearing that is in good condition. However, improper bearing removal will damage the bearing and maybe the shaft or case half. Note the following when removing bearings.

1. When using a puller to remove a bearing from a shaft, take care that the shaft is not damaged. Always place a piece of metal between the end of the shaft and the puller screw. In addition, place the puller arms next to the inner bearing race. See **Figure 46**.
2. When using a hammer to remove a bearing from a shaft, do not strike the hammer directly against the shaft. Instead, use a brass or aluminum rod between the hammer and shaft (**Figure 47**) and make sure to support both bearing races with wooden blocks as shown.
3. A hydraulic press is the ideal method of bearing removal. Note the following when using a press:
  - a. Always support the inner and outer bearing races with a suitable size wooden or aluminum spacer (**Figure 48**). If only the outer race is supported, pressure applied against the balls and/or the inner race will damage them.
  - b. Always make sure the press arm (**Figure 48**) aligns with the center of the shaft. If the arm is not centered, it may damage the bearing and/or shaft.
  - c. The moment the shaft is free of the bearing, it will drop to the floor. Secure or hold the shaft to prevent it from falling.

## Installation

1. When installing a bearing in a housing, apply pressure to the *outer* bearing race (**Figure 49**). When installing a bearing on a shaft, apply pressure to the *inner* bearing race (**Figure 50**).

2. When installing a bearing as described in Step 1, some type of driver is required. Never strike the bearing directly with a hammer or the bearing will be damaged. When installing a bearing, use a piece of pipe or a driver with a diameter that matches the bearing race. **Figure 51** shows the correct way to use a driver and hammer to install a bearing.

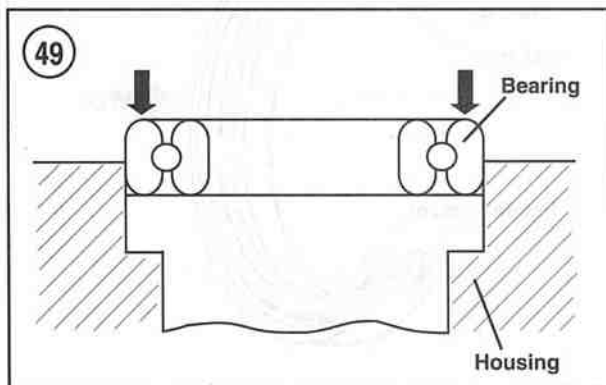
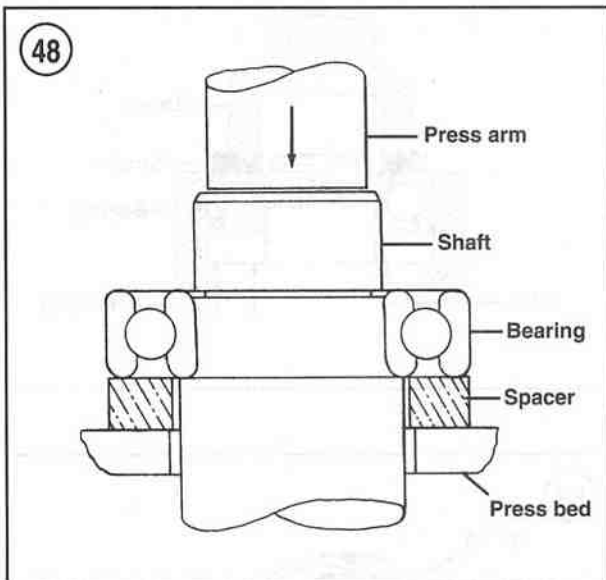


3. Step 1 describes how to install a bearing in a case half or over a shaft. However, when installing a bearing over a shaft and into a housing at the same time, a tight fit will be required for both outer and inner bearing races. In this situation, install a spacer underneath the driver tool so that pressure is applied evenly across both races (**Figure 52**). If the outer race is not supported as shown, the balls will push against the outer bearing race and damage it.

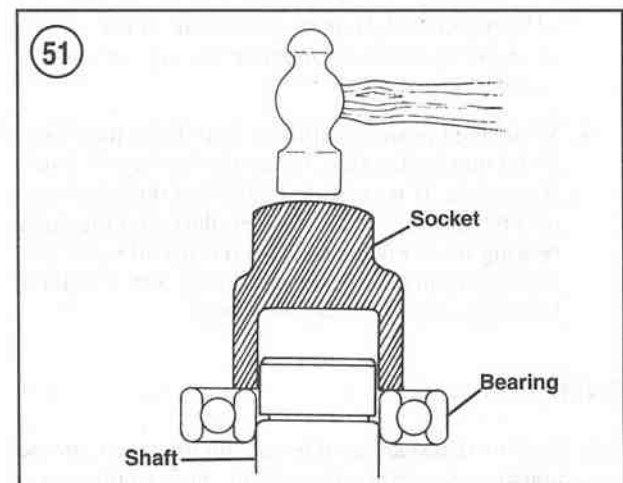
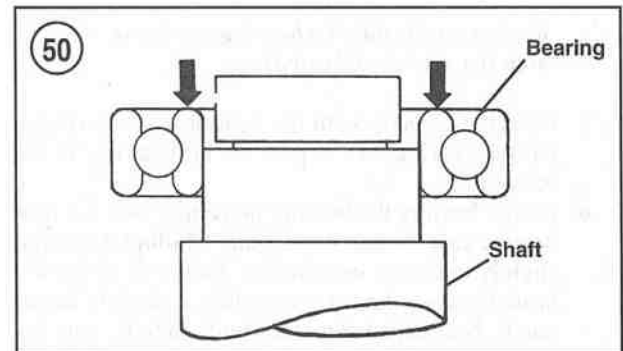
### Interference Fit

1. Follow this procedure when installing a bearing over a shaft. When a tight fit is required, the bearing inside diameter will be smaller than the shaft. In this case, driving the bearing on the shaft using normal methods may cause bearing damage. Instead, heat the bearing before installation. Note the following:

- a. Secure the shaft so it is ready for bearing installation.



- b. Clean all residues from the bearing surface of the shaft. Remove burrs with a file or sandpaper.
  - c. Fill a suitable pot or beaker with clean mineral oil. Place a thermometer rated above 120° C (248° F) in the oil. Support the thermometer so that it does not rest on the bottom or side of the pot.
  - d. Remove the bearing from its wrapper and secure it with a piece of heavy wire bent to hold it in the pot. Hang the bearing in the pot so it does not touch the bottom or sides of the pot.
  - e. Turn the heat on and monitor the thermometer. When the oil temperature rises to approximately 120° C (248° F), remove the bearing from the pot and quickly install it. If necessary, place a socket on the inner bearing race and tap the bearing into place. As the bearing chills, it will tighten on the shaft, so installation must be done quickly. Make sure the bearing is installed completely.
2. Follow this step when installing a bearing in a housing. Bearings are generally installed in a housing with a slight interference fit. Driving the bearing into the housing using normal methods may damage the housing or cause bearing damage. Instead, heat the housing before the bearing is installed. Note the following:





**CAUTION**

Before heating the housing in this procedure, wash the housing thoroughly with detergent and water. Rinse and rewash the cases as required to remove all traces of oil and other chemical deposits.

- a. Heat the housing to approximately 212° F (100° C) in an oven or on a hot plate. An easy way to check that it is the proper temperature is to place tiny drops of water on the housing; if they sizzle and evaporate immediately, the temperature is correct. Heat only one housing at a time.

**CAUTION**

Do not heat the housing with a propane or acetylene torch. Never bring a flame into contact with the bearing or housing. The direct heat will destroy the case hardening of the bearing and will likely warp the housing.

- b. Remove the housing from the oven or hot plate, and hold onto the housing with a kitchen potholder, heavy gloves or heavy shop cloth. It is hot!

**NOTE**

Remove and install the bearings with a suitable size socket and extension.

- c. Hold the housing with the bearing side down and tap the bearing out. Repeat for all bearings in the housing.
- d. Before heating the bearing housing, place the new bearing in a freezer if possible. Chilling a bearing slightly reduces its outside diameter while the heated bearing housing assembly is slightly larger due to heat expansion. This will make bearing installation easier.

**NOTE**

Always install bearings with the manufacturer's mark or number facing outward.

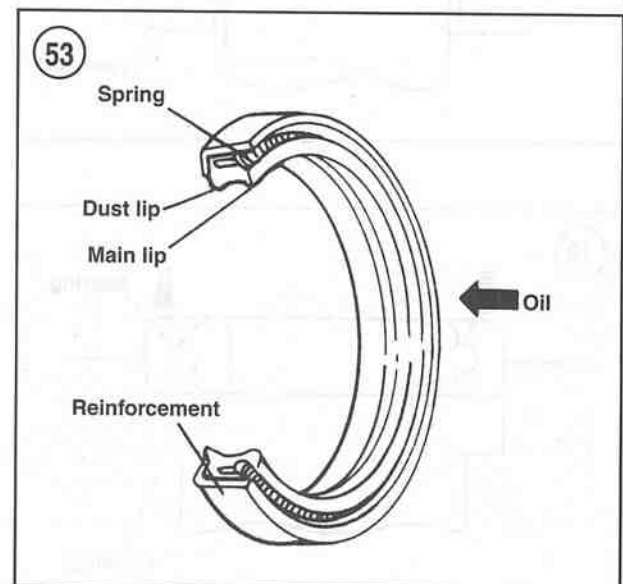
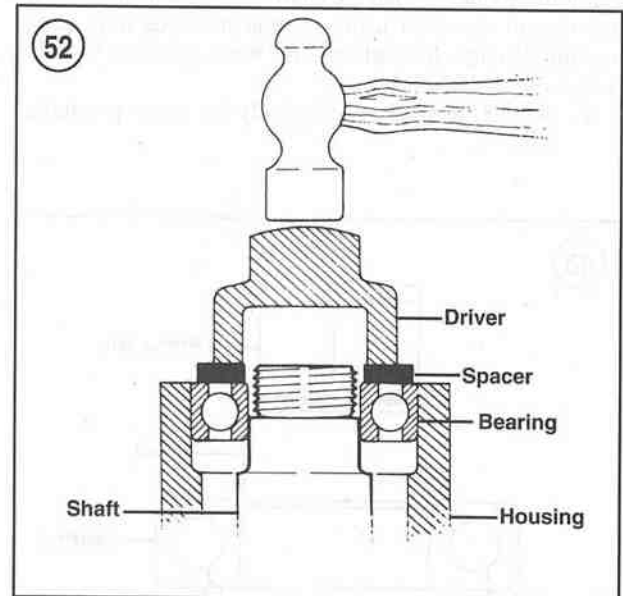
- e. While the housing is still hot, install the new bearing(s) into the housing. Install the bearings by hand, if possible. If necessary, lightly tap the bearing(s) into the housing with a socket placed on the outer bearing race (Figure 49). Do not install new bearings by driving on the inner-bearing race. Install the bearing(s) until it seats completely.

**Seal Replacement**

Seals (Figure 53) are used to contain oil, water, grease or combustion gasses in a housing or shaft. Improper re-

moval of a seal can damage the housing or shaft. Improper installation of the seal can damage the seal. Note the following:

1. Prying is generally the easiest and most effective method of removing a seal from a housing. However, always place a rag underneath the pry tool (Figure 54) to prevent damage to the housing.
2. Pack waterproof grease in the seal lips before the seal is installed.
3. In most cases, install seals with the manufacturer's numbers or marks face out.
4. Install seals with a socket placed on the outside of the seal as shown in Figure 55. Drive the seal squarely into



the housing. Never install a seal by hitting against the top of the seal with a hammer.

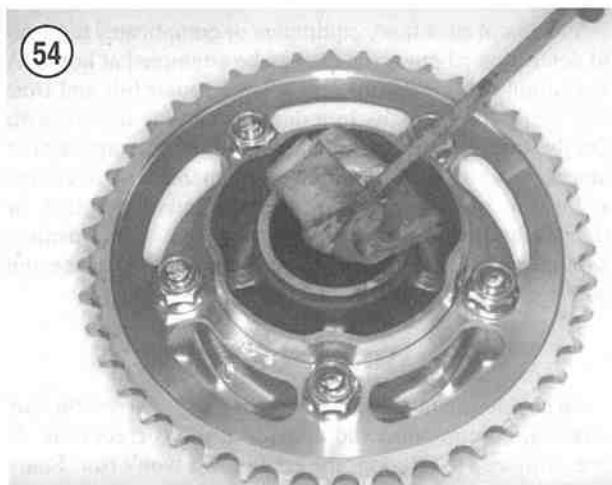
## STORAGE

Several months of non-use can cause a general deterioration of the vehicle. This is especially true in areas of extreme temperature variations. This deterioration can be minimized with careful preparation for storage. A properly stored vehicle will be much easier to return to service.

### Storage Area Selection

When selecting a storage area, consider the following:

1. The storage area must be dry. A heated area is best, but not necessary. It should be insulated to minimize extreme temperature variations.
2. If the building has large window areas, mask them to keep sunlight off the vehicle.
3. Avoid buildings in industrial areas where corrosive emissions may be present. Avoid areas close to saltwater.
4. Consider the area's risk of fire, theft or vandalism. Check with an insurer regarding vehicle coverage while in storage.



### Preparing the Vehicle for Storage

The amount of preparation a vehicle should undergo before storage depends on the expected length of non-use, storage area conditions and personal preference. Consider the following list the minimum requirement:

1. Wash the vehicle thoroughly. Make sure all dirt, mud and road debris are removed.
2. Start the engine and allow it to reach operating temperature. Drain the engine oil, regardless of the riding time since the last service. Fill the engine with the recommended type of oil. If the motorcycle will be in storage for an extended period of time consider changing the gearbox, final drive and drive shaft oils.
3. Drain all fuel from the fuel tank, run the engine until all the fuel is consumed from the lines and carburetor. In some cases BMW recommends filling the fuel tank to protect the tank coating. If this method is chosen, add a fuel stabilizer to the fuel.
4. Remove the spark plugs and pour a teaspoon of engine oil into the cylinders. Place a rag over the openings and slowly turn the engine over to distribute the oil. Reinstall the spark plugs.
5. Remove the battery. Store the battery in a cool and dry location.
6. Cover the exhaust and intake openings.
7. Reduce the normal tire pressure by 20%.
8. Lubricate the clutch and brake lever pivots. Spray the motorcycle; especially chrome components, with protective oil.
9. Apply a protective substance to the plastic and rubber components, including the tires. Make sure to follow the manufacturer's instructions for each type of product being used.
10. Place the bike on a stand or wooden blocks, so the wheels are off the ground. If this is not possible, place a piece of plywood between the tires and the ground. Inflate the tires to the recommended pressure if the bike can not be elevated.
11. Cover the vehicle with old bed sheets or something similar. Do not cover it with any plastic material that will trap moisture.

### Returning the Vehicle to Service

The amount of service required when returning a vehicle to service after storage depends on the length of non-use and storage conditions. In addition to performing the reverse of the above procedures, make sure the brakes, clutch, throttle and engine stop switch work properly before operating the vehicle. Refer to Chapter Three and evaluate the service intervals to determine which areas require service.

## CHAPTER TWO

# TROUBLESHOOTING

Diagnosing mechanical problems is relatively simple if you use orderly procedures and keep a few basic principles in mind.

The troubleshooting procedures in this chapter analyze typical symptoms and show logical methods of isolating causes. These are not necessarily the only methods; there may be several ways to solve a problem, but only a systematic, methodical approach can guarantee success.

Never assume anything. Do not overlook the obvious. If you are riding along and the engine suddenly quits, check the easiest, most accessible problems first. Is there gasoline in the tank? Has a spark plug wire cap come loose? Check the ignition switch and key. Sometimes the weight of the key ring may turn the ignition off suddenly.

If nothing obvious turns up in a quick check, look a little further. Learning to recognize and describe symptoms will make repairs easier for you or a mechanic at the shop. Describe problems accurately and fully. Saying that "it won't run" isn't the same as saying "it quit at high speed and won't start" or that "it sat in my garage for 3 months and then wouldn't start."

Gather as many symptoms together as possible to aid in diagnosis. Note whether the engine lost power gradually or all at once. Remember that the more complicated a machine is, the easier it is to troubleshoot because symptoms point to specific problems.

After the symptoms are defined, areas which could cause the problems are tested and analyzed. Guessing at the cause of a problem may provide the solution, but it can easily lead to frustration, wasted time and a series of expensive, unnecessary parts replacements.

You do not need fancy equipment or complicated test gear to determine whether repairs can be attempted at home. A few simple checks could save a large repair bill and time lost while the bike sits in a dealer's service department. On the other hand, be realistic and don't attempt repairs beyond your abilities. Service departments tend to charge a lot for putting together a disassembled engine or transmission that may have been abused. Some dealers won't even take on such a job—so use common sense and don't get in over your head.

### OPERATING REQUIREMENT

An engine needs 3 basics to run properly: correct fuel/air mixture, compression and a spark at the correct time. If one or more are missing, the engine just won't run. Four-stroke engine operating principles are described under *Engine Principles* in Chapter Four. The electrical system is the weakest link of the 3 basics. More problems result from electrical breakdowns than from any other source. Keep that in mind before you begin tampering with carburetor adjustments and the like.

If the bike has been sitting for any length of time and refuses to start, check and clean the spark plugs and then look to the gasoline delivery system. This includes the fuel tank, fuel filter and the fuel lines to the carburetors. Gasoline deposits may have formed and gummed up the carburetor jets or filter. Gasoline tends to lose its potency after standing for long periods. Condensation may contaminate the fuel with water. Drain the old fuel and try starting with a fresh tankful.



## EMERGENCY TROUBLESHOOTING

When the bike is difficult to start or won't start at all, it does not help to wear out your leg on the kickstarter or wear down the battery with the starter. Check for obvious problems even before getting out your tools. Go down the following list step-by-step. Do each one; you may be embarrassed to find the engine stop switch is stuck in the OFF position, but that is better than wearing out your leg or the battery. If it still will not start, refer to the appropriate troubleshooting procedure which follows in this chapter.

### WARNING

*Do not use an open flame to check inside the tank. A serious explosion is certain to result.*

1. Make sure there is fuel in the tank.
2. On models so equipped, make sure the ignition switch (**Figure 1**) or engine stop switch (**Figure 2**) is in the ON position and not in the OFF position (**Figure 3**). Make sure that the wire is not broken and shorted out.
3. Make sure the spark plug wire caps (**Figure 4**) are on tight. Push each one on and slightly rotate each spark plug cap to clean the electrical connection between each plug and its connector.

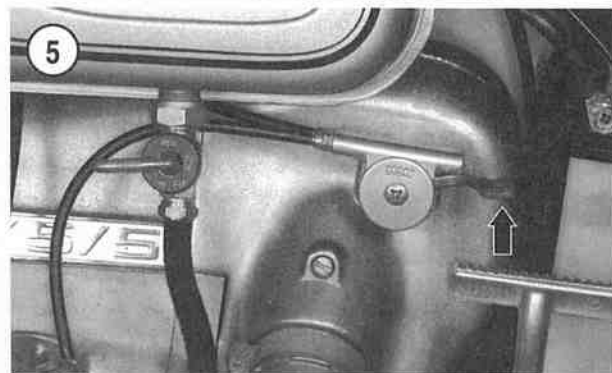
### NOTE

*In ambient temperatures below 0°C (32°F), disengage the clutch to make engine starting easier. By doing this the transmission input shaft will not turn during the cranking procedure.*

4. Make sure the choke is in the correct position. The choke lever should be in one of the following positions:

#### Engine mounted choke lever

- a. Pull the lever all the way to the UP position (**Figure 5**) when ambient temperature is above 0°C (32°F) or the engine is warm.





- b. Push the lever all the way to the DOWN position when the engine is cold or the ambient temperature is below 0° C (32° F).
- c. As the engine reaches normal operating temperature, push the lever all the way to the UP position.

#### Handlebar mounted choke lever

- a. Use position 1 (at right angles to the handlebar hand grip), as shown in **Figure 6**, when ambient temperature is below 10° C (50° F).
- b. Use position 2 (mid-way point of lever), as shown in **Figure 7**, when ambient temperature is above 10° C (50° F).
- c. Use position 0 (in line with the handlebar hand grip), as shown in **Figure 8**, when the engine is at normal operating temperature.

### ENGINE STARTING

An engine that refuses to start or is difficult to start is very frustrating. More often than not, the problem is very minor and can be found with a simple and logical troubleshooting approach.

The following items show a beginning point from which to isolate engine starting problems.

#### Engine Cranks, but Fails to Start

Perform the following spark test to determine if the ignition system is operating properly.

1. Remove the spark plug from one of the cylinder heads as described under *Spark Plug Removal/Inspection* in Chapter Three.
2. Connect the spark plug wire and cap to the spark plug and touch the spark plug's base to a good ground such as the engine cylinder head (**Figure 9**). Make sure the spark plug is against bare metal, not a painted surface. Position the spark plug so you can see the electrodes.

#### WARNING

*On models equipped with electronic ignition, if it is necessary to hold the high voltage lead, do so with an insulated pair of pliers. The high voltage generated by the ignition trigger unit could produce serious or fatal shocks.*

3. Crank the engine over with the kickstarter or starter. A fat blue spark should be evident across the plug's electrodes.

#### NOTE

*If the starter does not crank or if the starter motor rotates but the engine does not turn over, refer to appropriate starter related check list in this section.*

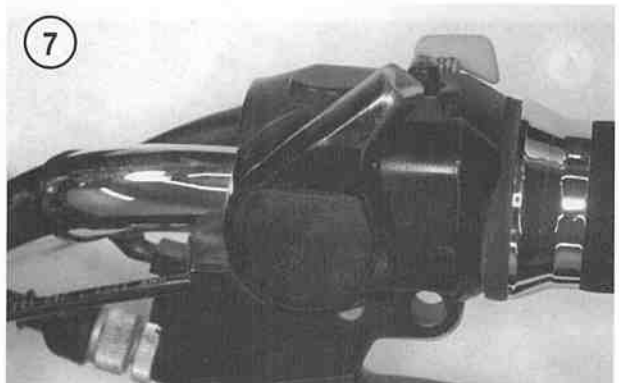
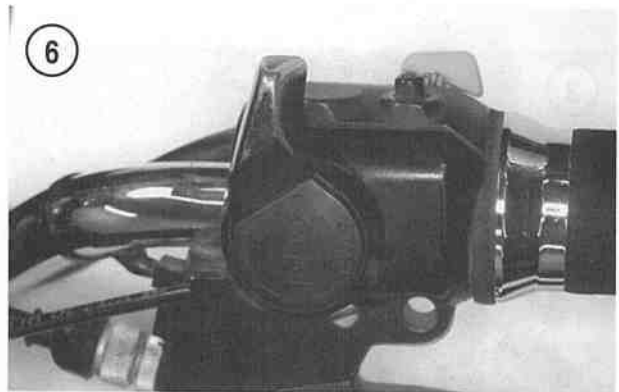
4. If the spark is good, check for one or more of the following possible malfunctions:
  - a. Obstructed fuel line(s).
  - b. Low compression.
  - c. Leaking head gasket(s).
  - d. Choke not operating properly.
  - e. Throttle not operating properly.

5. If spark is not good, check for one or more of the following:
  - a. Weak ignition coil(s).
  - b. Faulty contact breaker points (1970-1980 models).
  - c. Weak or faulty ignition control unit (1981-on models).
  - d. Ignition or engine stop switch malfunction.
  - e. Broken or shorted high tension lead(s) to the spark plug(s).
  - f. Loose or corroded electrical connectors within the ignition system.
  - g. Loose or broken ignition coil ground wire(s).

#### Engine Is Difficult to Start

Check for one or more of the following possible malfunctions:

- a. Fouled spark plug(s).
- b. Improperly adjusted choke.
- c. Contaminated fuel system.
- d. Weak ignition coil(s).



- e. Faulty contact breaker points (1970-1980 models)
- f. Weak or faulty ignition control unit (1981-on models).
- g. Incorrect type ignition coil(s).
- h. Poor compression.
- i. Loose or corroded electrical connectors in the fuel injection system.

### Starter Will Not Operate

Check for one or more of the following possible malfunctions:

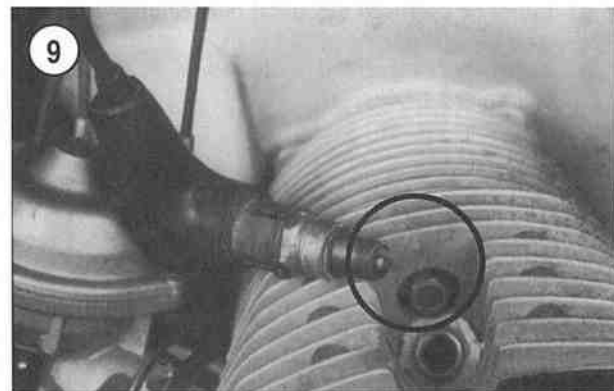
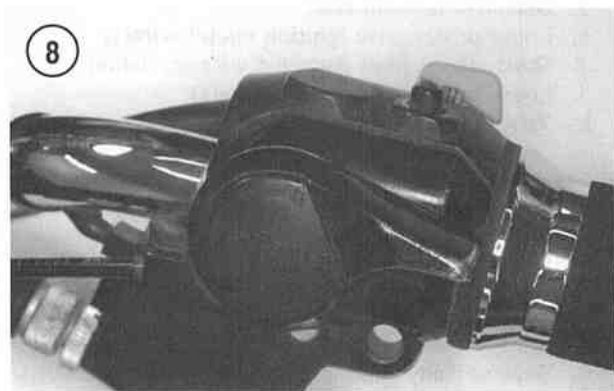
- a. Discharged battery.
- b. Defective starter motor, starter solenoid or start switch.
- c. Ignition or engine stop switch malfunction.

### Starter Operates, but Engine Will Not Crank

- a. Broken starter gears.
- b. Broken kickstarter assembly.

### Starter Will Not Turn Engine

- a. Seized piston(s).
- b. Seized crankshaft bearings.
- c. Broken connecting rod(s).
- d. Locked-up transmission or clutch assembly.



## ENGINE PERFORMANCE

In the following check list, it is assumed that the engine runs, but is not operating at peak performance. This will serve as a starting point from which to isolate a performance malfunction.

### Engine Will Not Start or is Hard to Start

- a. Fuel tank empty.
- b. Obstructed fuel line(s) or fuel filter.
- c. Low compression.
- d. Leaking head gasket(s)
- e. Choke not operating properly or improperly adjusted.
- f. Throttle not operating properly.
- g. Faulty contact breaker points (1970-1980 models)
- h. Weak or faulty ignition control unit (1981-on models).
- i. Improper choke operation.
- j. Fouled or improperly gapped spark plug(s).
- k. Ignition timing incorrect (faulty component in system).
- l. Ignition or engine stop switch malfunction.
- m. Broken or shorted ignition coil(s).
- n. Improper valve timing.
- o. Improperly adjusted carburetors.
- p. Damaged carburetor diaphragm(s).
- q. Clogged air filter element.
- r. Contaminated fuel.

### Engine Will Not Idle or Idles Erratically

- a. Improperly adjusted carburetors (too lean or too rich). Damaged carburetor diaphragm(s).
- b. Obstructed fuel line.
- c. Fouled or improperly gapped spark plug(s).
- d. Faulty contact breaker points (1970-1980 models)
- e. Weak or faulty ignition control unit (1981-on models).
- f. Incorrect type ignition coil(s).
- g. Ignition timing incorrect (faulty component in system).
- h. Leaking head gasket(s) or vacuum leak.
- i. Improper valve timing.
- j. Low engine compression.
- k. Improper valve clearance.
- l. Valve(s) and valve seat(s) require service.
- m. Clogged air filter element.

### Engine Misses at High Speed

- a. Fouled or improperly gapped spark plug(s).
- b. Improper ignition timing (faulty component in system).
- c. Faulty contact breaker points (1970-1980 models).
- d. Weak or faulty ignition control unit (1981-on models).
- e. Broken or shorted high tension lead(s) to the spark plug(s).

- f. Loose or corroded electrical connectors within the ignition system.
- g. Loose or broken ignition coil ground wire(s).
- h. Weak ignition coil(s).
- i. Improper valve timing.
- j. Obstructed fuel line.
- k. Improper carburetor main jet selection.
- l. Clogged carburetor jets.
- m. Clogged or dirty air filter element.

#### Engine Continues to Run with Ignition Off

- a. Excessive carbon build-up in engine.
- b. Vacuum leak in intake system.
- c. Contaminated fuel or incorrect octane rating.

#### Engine Overheating

- a. Obstructed cooling fins on the cylinders and cylinder heads.
- b. Ignition timing retarded.
- c. Improper ignition timing (faulty component in system).
- d. Improper spark plug heat range.
- e. Improper carburetor(s) adjustment or jet selection.
- f. Engine oil level low.
- g. Engine oil not circulating properly.
- h. Valve(s) leaking.
- i. Heavy engine carbon deposits.
- j. Dragging brakes.
- k. Clutch slipping.

#### Engine Misses at Idle

- a. Fouled or improperly gapped spark plug(s).
- b. Spark plug cap(s) faulty.
- c. Ignition cable(s) insulation deteriorated (shorting out).
- d. Dirty or clogged air filter element.
- e. Loose or corroded electrical connectors within the ignition system.
- f. Faulty contact breaker points (1970-1980 models)
- g. Weak or faulty ignition control unit (1981-on models).
- h. Improperly adjusted carburetors.
- i. Obstructed fuel line.
- j. Fouled or improperly gapped spark plug(s).
- k. Leaking head gasket(s) or vacuum leak.
- l. Incorrect type ignition coil(s).
- m. Ignition timing incorrect (faulty component in system).
- n. Improper valve timing.
- o. Poor compression.

#### Engine Backfires—Explosions in Muffler

- a. Fouled or improperly gapped spark plug(s).
- b. Spark plug cap(s) faulty.
- c. Ignition cable(s) insulation deteriorated (shorting out).
- d. Ignition timing incorrect (faulty component in system).
- e. Improper valve timing.
- f. Contaminated fuel.
- g. Burned or damaged intake and/or exhaust valves.
- h. Weak or broken intake and/or exhaust valve springs.

#### Pre-ignition (Fuel Mixture Ignites Before Spark Plug Fires)

- a. Hot spot in combustion chamber (piece of carbon).
- b. Valve(s) stuck in guide.
- c. Overheating engine, coolant level low.

#### Smoky Exhaust and Engine Runs Roughly

- a. Improperly adjusted carburetors—mixture too rich.
- b. Choke not operating correctly.
- c. Water or other contaminants in fuel.
- d. Clogged fuel line.
- e. Clogged air filter element.
- f. Spark plugs fouled.
- g. Defective ignition coil.
- h. Loose or defective ignition circuit wire(s).
- i. Short circuit from damaged wire insulation.
- j. Loose battery cable connection(s).
- k. Valve timing incorrect.

#### Engine Loses Power at Normal Riding Speed and Lacks Power

- a. Engine overheating.
- b. Improper ignition timing (faulty component in system).
- c. Faulty contact breaker points (1970-1980 models)
- d. Weak or faulty ignition control unit (1981-on models).
- e. Incorrectly gapped spark plug(s).
- f. Spark plug wires and/or caps defective.
- g. Loose or corroded electrical connectors within the ignition system.
- h. Carburetors incorrectly adjusted.
- i. Obstructed muffler(s).
- j. Dragging brakes.
- k. Improper valve clearance.

#### Engine Lacks Acceleration

- a. Carburetor(s) mixture too lean.
- b. Clogged fuel line.
- c. Improper ignition timing.
- d. Dragging brake(s).
- e. Slipping clutch.

## ENGINE NOISES

Often the first evidence of an internal engine problem is a strange noise. That knocking, clicking or tapping sound which you never heard before may be warning you of impending trouble.

While engine noises can indicate problems, they are difficult to interpret correctly; inexperienced mechanics can be seriously misled by them.

Professional mechanics often use a special stethoscope (which looks like a doctor's stethoscope) for isolating engine noises. You can do nearly as well with a "sounding stick" which can be an ordinary piece of wood doweling, or a section of small hose. By placing one end in contact with the area to which you want to listen and the other end to the front of your ear (not directly on your ear), you can hear sounds emanating from that area. The first time you do this, you may be confused at the strange sounds coming from even a normal engine. If you can, have an experienced friend or mechanic help you sort out the noises.

### NOTE

*If you have removed the front fairing for a service procedure, left it off and then taken the bike on a test ride, the engine will sound different. Don't panic, as the front fairing panels tend to absorb engine and road sounds, thus making everything sound a little different.*

Consider the following when troubleshooting engine noises:

1. *Knocking or pinging during acceleration*—Caused by using a lower octane fuel than recommended. May also be caused by poor fuel. Pinging can also be caused by spark plugs of the wrong heat range or carbon buildup in the combustion chambers. Refer to *Spark Plug Selection* in Chapter Three.

### NOTE

*Piston slap is easier to detect when the engine is cold and before the pistons have expanded. Once the engine has warmed up, piston expansion reduces piston-to-cylinder clearance.*

2. *Slapping or rattling noises at low speed or during acceleration*—May be caused by piston slap (excessive piston-to-cylinder wall clearance).

3. *Knocking or rapping while decelerating*—Usually caused by excessive rod bearing clearance.

4. *Persistent knocking and vibration occurring every crankshaft rotation*—Usually caused by excessive main bearing clearance.

5. *Rapid on-off squeal*—Compression leak around cylinder head gasket(s) or spark plug(s).

6. *Valve train noise*—Check the following:
- Valves adjusted incorrectly.
  - Loose valve adjuster(s).
  - Valve(s) sticking in guides.
  - Low oil pressure.
  - Damaged rocker arm or shaft. Rocker arm may be binding on shaft.

## ENGINE LUBRICATION

An improperly operating engine lubrication system will quickly lead to engine seizure. The engine oil level should be checked weekly and topped up as necessary as described in Chapter Three. Oil pump service is described under *Oil Pump* in Chapter Four.

### Oil Consumption High or Engine Smokes Excessively

- Worn or leaking valve guides.
- Worn or damaged piston rings.

### Excessive Engine Oil Leaks

- Loose engine parts.
- Damaged gasket sealing surfaces.

### White Smoke

- Worn valve guide(s).
- Worn piston ring oil ring(s)
- Excessive piston-to-cylinder clearance.

### Oil Pressure Too High

- Clogged oil filter.
- Clogged oil gallery or metering orifice.
- Pressure relief valve stuck in the closed position.

### Low Oil Pressure

- Low oil level.
- Clogged oil filter.
- Clogged oil screen.
- Damaged oil pump.
- Pressure relief valve stuck in the open position.
- Internal oil leakage

### No Oil Pressure

- No oil.
- Excessively low oil level.
- Damaged oil pump.
- Internal oil leakage



### Oil Pressure Warning Light Stays On

- a. Low oil pressure.
- b. No oil pressure.
- c. Damaged oil pressure switch.
- d. Short circuit in warning light circuit.

### Oil Contamination

- a. Water contamination due to leaking gaskets.
- b. Oil and filter not changed at specified intervals or when abnormal operating conditions demand more frequent changes.

### CLUTCH

The four basic clutch problems are as follows:

- a. Clutch slippage.
- b. Clutch dragging.
- c. Excessive clutch noise.
- d. Rough clutch operation.

All clutch troubles, except for adjustment, require transmission removal and clutch disassembly to identify and cure the problem. Refer to Chapter Five.

### GEARSHIFT LINKAGE

The gearshift linkage assembly connects the gearshift pedal with the internal shift mechanism located within the transmission housing. The four basic gearshift mechanism problems are as follows:

- a. Difficult shifting.
- b. Gearshift pedal does not return.
- c. Transmission gears pop out of mesh.
- d. Rough clutch operation.

All gearshift troubles require transmission removal and gearshift linkage disassembly to identify and cure the problem. Refer to Chapter Six.

### TRANSMISSION

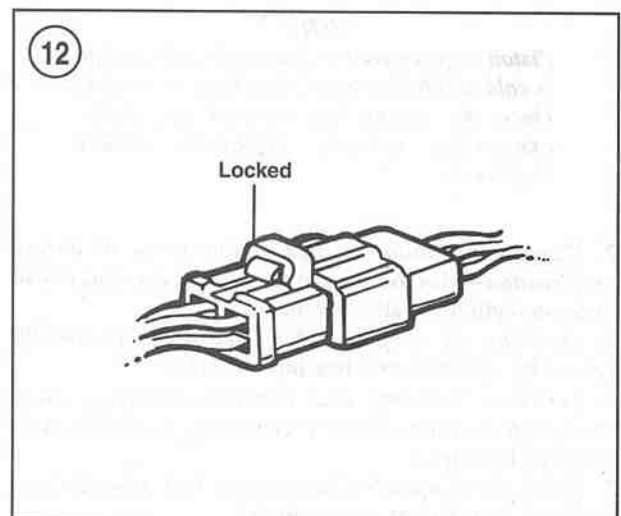
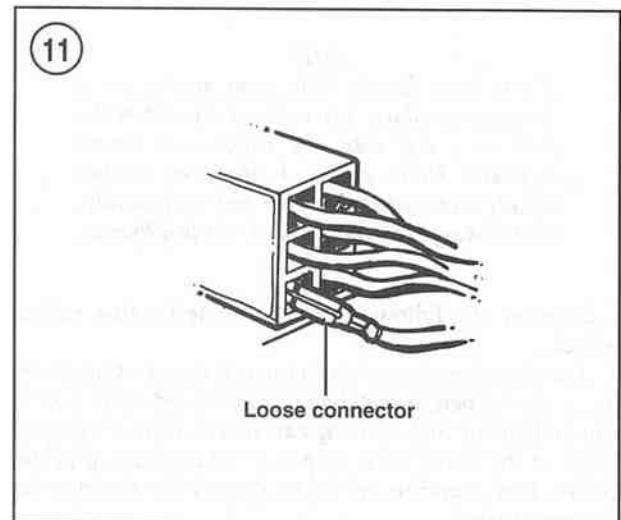
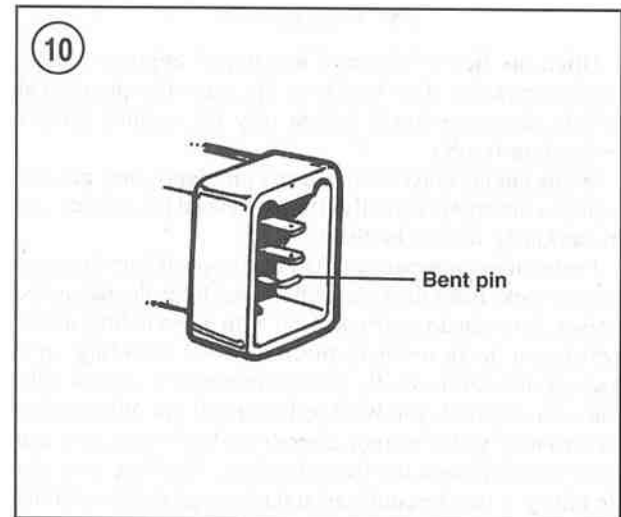
The basic transmission problems are as follows:

- a. Excessive gear noise.
- b. Difficult shifting.
- c. Gears pop out of mesh.
- d. Incorrect gear shift lever operation.

Transmission symptoms are sometimes hard to distinguish from clutch symptoms. All transmission troubles require transmission removal and disassembly to identify and cure the problem. Refer to Chapter Six.

### EXCESSIVE VIBRATION

Usually this is caused by loose engine mounting hardware. If not, it can be difficult to find without disassembling the engine.



## ELECTRICAL TROUBLESHOOTING

This section describes the basics of electrical troubleshooting, how to use test equipment and the basic test procedures with the various pieces of test equipment.

Electrical troubleshooting can be very time-consuming and frustrating without proper knowledge and a suitable plan. Refer to the wiring diagrams at the end of this book and to the individual system diagrams included with the charging system, ignition system and starting system in Chapter Eight. Wiring diagrams will help you determine how the circuit should work by tracing the circuit paths from the power source through the circuit components to ground. Also check any circuits that share the same fuse, ground or switch, etc. If the other circuits work properly, then the shared wiring is okay and the cause must be in the wiring used only by the suspected circuit. If all related circuits are faulty at the same time, the probable cause is a poor ground connection or a blown fuse(s).

As with all troubleshooting procedures, analyze typical symptoms in a systematic procedure. Never assume anything and don't overlook the obvious like a blown fuse or an electrical connector that has separated. Test the simplest and most obvious cause first and try to make tests at easily accessible points on the bike.

## Preliminary Checks and Precautions

Before starting any electrical troubleshooting procedure perform the following:

- a. Check the individual fuse(s) for each circuit; make sure they are not blown. Replace if necessary.
- b. Inspect the battery. Make sure it is fully charged, the electrolyte level is correct and make sure that the battery cables are clean and securely attached to the battery terminals. Refer to *Battery* in Chapter Three.
- c. Disconnect each electrical connector in the suspect circuit and check that there are no bent metal pins on the male side of the electrical connector (**Figure 10**). A bent pin will not connect to its mating receptacle in the female end of the connector, causing an open circuit.
- d. Check each female end of the connector. Make sure that the metal connector on the end of each wire (**Figure 11**) is pushed all the way into the plastic connector. If not, carefully push them in with a narrow-bladed screwdriver.
- e. Check all electrical wires where they enter the individual metal connector in both the female and male plastic connector.
- f. Make sure all terminals within the connector are clean and free of corrosion. Clean, if necessary, and pack the connector with a dielectric grease.
- g. After all is checked out, push the connectors together and make sure they are fully engaged and locked together (**Figure 12**).

- h. Never pull on the electrical wires when disconnecting an electrical connector—pull only on the connector plastic housings.
- i. Never use a self-powered test light on circuits that contain solid-state devices. The solid-state devices may be damaged.

## TEST EQUIPMENT

## Test Light or Voltmeter

A test light can be constructed of a 12-volt light bulb with a pair of test leads carefully soldered to the bulb. To check for battery voltage (12 volts) in a circuit, attach one test lead to ground and the other test lead to various points along the circuit. Where battery voltage is present, the light bulb will light.

A voltmeter is used in the same manner as the test light to find out if battery voltage is present in any given circuit. The voltmeter, unlike the test light, will also indicate how much voltage is present at each test point. When using a voltmeter, attach the red positive lead (+) to the component or wire to be checked and the black negative (-) lead to a good ground.

## Self-powered Test Light and Ohmmeter

A self-powered test light can be constructed of a 12-volt battery, a pair of test leads and a 12-volt light bulb. When the test leads are touched together the light bulb will go on (providing the 12-volt battery is in good condition).

Use the self-powered test light as follows:

- a. Touch the test leads together to make sure the light bulb goes on. If not, correct the problem before using it in a test procedure.
- b. Disconnect the bike's battery or remove the fuse(s) that protect the circuit to be tested.
- c. Select 2 points within the circuit where there should be continuity.
- d. Attach one lead of the self-powered test light to each point.
- e. If there is continuity, the self-powered test light bulb will come on.
- f. If there is no continuity, the self-powered test light bulb will *not* come on indicating an open circuit.

An ohmmeter can be used in place of the self-powered test light. The ohmmeter, unlike the test light, will also indicate how much resistance is present between each test point. Low resistance means good continuity in a complete circuit. Before using an ohmmeter, it must first be calibrated. This is done by touching the leads together and turning the ohms calibration knob until the meter reads "zero."

## CAUTION

*An ohmmeter must never be connected to any circuit which has power applied to it. Always disconnect the battery negative lead before using the ohmmeter.*

### Jumper Wire

When using a jumper wire always install an inline fuse/fuse holder (available at most auto supply stores or electronic supply stores) to the jumper wire. Never use a jumper wire across any load (a component that is connected and turned on). This would result in a direct short and will blow the fuse(s).

## BASIC TEST PROCEDURES

### Voltage Testing

Unless otherwise specified, all voltage tests are made with the electrical connector still *connected*. Insert the test leads into the backside of the connector and make sure the test lead touches the electrical wire or metal connector within the connector. If the test lead only touches the wire insulation you will get a false reading.

Always check both sides of the connector as one side may be loose or corroded, thus preventing electrical flow through the connector. This type of test can be performed with a test light or voltmeter. A voltmeter will give the best results.

#### NOTE

*If using a test light, it doesn't make any difference which test lead is attached to ground.*

1. Attach the negative (-) test lead (if using a voltmeter) to a good ground (bare metal). If necessary, scrape away paint from the frame or engine (retouch later with paint). Make sure the part is used for ground and is not insulated with a rubber gasket or rubber grommet.
2. Attach the positive (+) test lead (if using a voltmeter) to the point (electrical connector, etc.) you want to check.
3. Turn the ignition switch on. If using a test light, the test light will come on if voltage is present. If using a voltmeter, note the voltage reading. The reading should be within 1 volt of battery voltage (12 volts). If the voltage is less than 11 volts there is a problem in the circuit.

### Voltage Drop Test

A voltage drop of 1 volt means there is a problem in the circuit. All components within the circuit are designed for low resistance in order to conduct electricity within a minimum loss of voltage.

1. Connect the voltmeter positive (+) test lead to the end of the wire or switch closest to the battery.
2. Connect the voltmeter negative (-) test lead to the other end of the wire or switch.
3. Turn the components on in the circuit.
4. The voltmeter should indicate zero volts. If there is a drop of 1 volt or more, there is a problem in the circuit.
5. Check the circuit for loose or dirty connections within the electrical connector(s).

### Continuity Test

A continuity test is made to determine if the circuit is complete with no open in either the electrical wires or (breaks or bad connections) components within the circuit.

Unless otherwise specified, all continuity tests are made with the electrical connectors still *connected*. Insert the test leads into the backside of the connector and make sure the test lead touches the electrical wire or metal connector within the connector. If the test lead only touches the wire insulation you will get a false reading.

Always check both sides of the connector(s) as one side may be loose or corroded, thus preventing electrical flow through the connector(s). This type of test can be performed with a self-powered test light or an ohmmeter. An ohmmeter will give the most specific results.

If using an ohmmeter, calibrate the meter by touching the test leads together and turning the ohms calibration knob until the meter reads "zero." This is necessary in order to get accurate results.

1. Disconnect the battery negative lead.
2. Attach one test lead (test light or ohmmeter) to one end of the part of the circuit to be tested.
3. Attach the other test lead to the other end of the part of the circuit to be tested.
4. The self-powered test light will come on if there is continuity. The ohmmeter will indicate either low or no resistance (means good continuity in a complete circuit).
5. The self-powered test light will *not* come on if there is no continuity. The ohmmeter will indicate infinite resistance (means an open circuit).

### Testing For a Short With a Self-powered Test Light or Ohmmeter

This test can be performed with either a self-powered test light or an ohmmeter.

1. Disconnect the battery negative lead.
2. Remove the blown fuse from the fuse panel.
3. Attach one test lead (test light or ohmmeter) to the load side (battery side) of the fuse terminal in the fuse panel.
4. Attach the other test lead to a good ground (bare metal). If necessary, scrape away paint from the frame or engine (retouch later with paint). Make sure the part used for a ground is not insulated with a rubber gasket or rubber grommet.
5. With the self-powered test light or ohmmeter attached to the fuse terminal and ground, wiggle the wiring harness relating to the suspect circuit at 6-inch intervals. Start next to the fuse panel and work your way away from the fuse panel. Watch the self-powered test light or ohmmeter as you progress along the harness.
6. If the self-powered test light blinks or the needle on the ohmmeter moves, there is a short-to-ground at that point in the harness.

### Testing For a Short With a Test Light or Voltmeter

This test can be performed with either a test light or a voltmeter.

1. Remove the blown fuse from the fuse panel.
2. Connect the test light or voltmeter across the fuse terminals in the fuse panel. Turn the ignition switch on and check for battery voltage (12 volts).
3. With the test light or voltmeter attached to the fuse terminals, wiggle the wiring harness relating to the suspect circuit at 6-inch intervals. Start next to the fuse panel and work your way away from the fuse panel. Watch the test light or voltmeter as you progress along the harness.
4. If the test light blinks or the needle on the voltmeter moves, there is a short-to-ground at that point in the harness.

## ELECTRICAL PROBLEMS

If light bulbs burn out frequently, the cause may be excessive vibration, loose connections that permit sudden current surges, or the installation of the wrong type or size of bulb.

Most light and ignition problems are caused by loose or corroded ground connections. Check these before replacing a bulb or electrical component.

## ELECTRICAL SYSTEMS TROUBLESHOOTING

Troubleshooting for the various electrical systems on the bike are covered in Chapter Eight. These systems are as follows:

- a. Charging system.
- b. Ignition system.
- c. Starting system.
- d. Switches.

## FRONT SUSPENSION AND STEERING

Poor handling may be caused by improper tire pressure, a damaged or bent frame or steering components, a worn front fork assembly, worn wheel bearings or dragging brakes. Possible causes of suspension and steering malfunctions are as follows.

### Irregular or Wobbly Steering

- a. Loose wheel axle nut(s).
- b. Loose or worn steering head bearings.
- c. Excessive wheel hub bearing play.
- d. Damaged wheel.

- e. Unbalanced wheel assembly.
- f. Worn hub bearings.
- g. Incorrect wheel alignment.
- h. Bent or damaged steering stem or frame (at steering stem).
- i. Tire incorrectly seated on the rim.
- j. Excessive front end load from non-standard equipment.
- k. Damaged fairing assembly (models so equipped).
- l. Loose fairing mounts and brackets (models so equipped).

### Stiff Steering

- a. Low front tire air pressure.
- b. Bent or damaged steering stem or frame head tube.
- c. Loose or worn steering head bearings.

### Stiff or Heavy Fork Operation

- a. Incorrect fork springs (too long).
- b. Incorrect fork oil viscosity.
- c. Excessive amount of fork oil.
- d. Bent fork tubes.
- e. Fluid passages clogged.

### Poor Fork Operation

- a. Worn or damaged fork tubes.
- b. Fork oil level low due to leaking fork seals.
- c. Bent or damaged fork tubes.
- d. Contaminated fork oil.
- e. Heavy front end loading from non-standard equipment.

### Poor Rear Shock Absorber Operation

- a. Damper unit leaking.
- b. Incorrect rear shock adjustment.
- c. Heavy rear end loading from non-standard equipment.
- d. Incorrect loading.
- e. Weak spring(s).
- f. Worn swing arm bearings.
- g. Bent swing arm.

## BRAKE PROBLEMS

A sticking drum brake may be caused by worn or weak return springs, dry pivot and cam bushings or improper adjustment. Grabbing drum brakes may be caused by greasy or oily linings which must be replaced. Brake grab may also be due to an out-of-round drum. Glazed linings will cause loss of stopping power.

Sticking brake pads may be caused by a stuck piston(s) in a caliper assembly or warped pad shim or disc.



## CHAPTER THREE

# LUBRICATION, MAINTENANCE AND TUNE-UP

A motorcycle, even in normal use, is subjected to tremendous heat, stress and vibration. When neglected, any bike becomes unreliable and dangerous to ride.

To gain the utmost in safety, performance and useful life from the BMW Boxer Twins it is necessary to make periodic inspections and adjustments. Minor problems are often found during these inspections that are simple and inexpensive to correct at the time. If they are not found and corrected at this time they could lead to major and more expensive problems later on.

Regular cleaning of the bike is also very important. It makes routine maintenance a lot easier by not having to work your way through built-up road dirt to get to a component for adjustment or replacement. Routine cleaning also allows you to see a damaged component that can be repaired or replaced as soon as the damage occurs. If a damaged part is allowed to deteriorate, it may create a dangerous riding condition that could lead to an accident.

Start out by doing simple tune-up, lubrication and maintenance. Tackle more involved jobs as you become more acquainted with the bike.

Refer to Tables 1-7 at the end of this chapter.

### ROUTINE SAFETY CHECK

The following safety checks should be performed before the first ride of the day.

### General Inspection

1. Quickly inspect the engine for signs of oil or fuel leakage.
2. Check the tires for embedded stones. Pry them out with a suitable tool from your tool kit.
3. Make sure all lights work.

#### NOTE

*At least check the brake light. It can burn out at any time. Motorists cannot stop as quickly as you and need all the warning you can give.*

4. Inspect all fuel lines and fittings for wetness. If the bike is equipped with a front fairing, this is difficult, but it is still a good idea to check for fuel leakage.
5. Make sure the fuel tank is full of fresh gasoline.
6. Check the operation of the front and rear brakes. Add hydraulic fluid to the master cylinder(s) on models so equipped.
7. Check the operation of the clutch. If necessary, adjust the clutch free-play as described in this chapter.
8. Check the throttle and the rear brake pedal. Make sure they operate properly with no binding.
9. Inspect the front and rear suspension; make sure they have a good solid feel with no looseness.
10. Check tire pressure. Refer to **Table 2**.
11. Check the exhaust system for damage.
12. Check the tightness of all fasteners, especially engine mounting hardware.

### Engine Oil Level

Refer to *Periodic Lubrication* in this chapter.

### Tire Pressure

Tire pressure must be checked with the tires cold. Correct tire pressure, listed in **Table 2**, varies with the load you are carrying. Refer to *Tires and Wheels* in this chapter.

### Battery

Check the battery electrolyte level as described under *Battery Removal, Electrolyte Level Check and Installation* in this chapter.

Check the level more frequently in hot weather; electrolyte will evaporate rapidly as engine and ambient temperatures increase.

### Evaporative Emission Control System (California Models)

The evaporative emission control system consists of a series of hoses and a relief valve between the fuel tank and the crankcase. Inspect the hoses to make sure they are not kinked or bent and that it is securely connected to the fuel tank and the engine crankcase.

Refer to *Evaporative Emission Control System* in Chapter Seven for complete service on the system.

### Lights and Horn

With the engine running, check the following:

1. Pull the front brake lever on and check that the brake light comes on.
2. Push the rear brake pedal down and check that the brake light comes on soon after you have begun depressing the pedal.
3. Turn the ignition switch on. Press the headlight dimmer switch to the high, the low and flashing positions and check to see that both headlight elements are working in the headlight.
4. Turn the turn signal switch to the left and right positions and check that all 4 turn signals are working.
5. Push the horn button and make sure that the horn blows loudly.
6. If the horn or any of the lights failed to operate properly, refer to Chapter Eight.

## MAINTENANCE INTERVALS

The services and intervals shown in **Table 1** are recommended by the BMW factory. Strict adherence to these recommendations will ensure long service from the BMW. If the bike is run in an area of high humidity, the lubrication services must be done more frequently to prevent possible rust damage.

For convenience when maintaining your motorcycle, most of the services shown in these tables are described in this chapter. However, some procedures which require more than minor disassembly or adjustment are covered elsewhere in the appropriate chapter. The Table of Contents and Index can help you locate a particular service procedure.

## BIKE CLEANING

Regular cleaning of the bike is very important. It makes routine maintenance a lot easier by not having to work your way through built-up road dirt to get to a component for adjustment or replacement. It also makes the bike look like new even though it may have many thousands of miles on it.

If you ride in an area where there is a lot of rain or road salt residue in the winter, clean the bike more often in order to maintain the painted, plated and polished surfaces in good condition. Keep a good coat of wax on the bike during the winter to prevent premature weathering of all finishes.

Washing the bike should be done in a gentle way to avoid damage to the painted and plated finishes and to components that are not designed to withstand high-pressure water. Try to avoid using the coin-operated car wash systems as the cleaning agents may be harmful to the plastic parts on the bike. Also the rinse cycle is usually fairly high pressure and will force water into areas that should be kept dry.

Use a mild detergent (mild liquid dish washing detergent) or a commercial car washing detergent available at most auto parts outlets. Be warned, these detergents will remove some of the wax that you have applied to the finish. Follow the manufacturer's instructions for the correct detergent-to-water mixture.

### CAUTION

*BMW has determined that the use of S100 Total Cycle Cleaner may damage, or even remove, the electrolyte-dip matte black finish from components on the bike. This includes both engine and frame components. If your bike is still under warranty, BMW will not cover any damage caused by using this cleaner.*

If the lower end of the engine and frame are covered with oil, grease or road dirt, first remove this dirt with a commercial cleaner like Gunk Cycle Cleaner, or equivalent. Keep this cleaner off of the plastic components (fairing panels, windshield, frame side covers, luggage cases, etc.) as it may damage the finish. Follow the manufacturer's instructions and rinse with *plenty of cold water*. Do not allow any of this cleaner residue to settle in any pockets as it will stain or destroy the finish of most painted parts.

Use a commercial tar stain remover to remove any severe road dirt and tar stains. Be sure to rinse all areas thoroughly with plenty of clean water to make sure all of the tar stain remover is rinsed off of all surfaces.

Before washing the plastic and painted surfaces of the bike, make sure the surfaces are cool. Do not wash a hot bike as you will probably end up with streaks from the soap suds starting to dry before being rinsed off.

#### CAUTION

*Do not allow water (especially under pressure) to enter the air intake, brake assemblies, electrical switches and connectors, instrument cluster, wheel bearing areas, swing arm bearings, the breather tube on the final drive unit or any other moisture sensitive areas of the bike.*

After all of the heavy soiled areas are cleaned off, use the previously described detergent, warm water and a soft natural sponge and carefully wash down the entire bike – starting at the top and work down to the lower sections, including the wheels and tires. Don't use too much detergent as it will be difficult to thoroughly rinse off all of the soap suds. After all areas are washed, rinse off the soap suds with low-pressure cold water. Make sure all of the detergent residue is thoroughly rinsed off.

Take the bike off the centerstand and lean it to both sides to allow water to drain off of all horizontal surfaces. If you have access to compressed air, gently blow excess water from areas where the water may have collected. Do not force the water into any of the sensitive areas mentioned in the previous CAUTION. Gently dry off the bike with a chamois, a clean soft turkish towel or an old plain T-shirt (no transfers or hand-painted designs).

Be careful cleaning the windshield as it can easily be scratched or damaged. Do not use a cleaner with an abrasive or a combination cleaner and wax. Never use gasoline or cleaning solvent. These products will either scratch or totally destroy the surface finish of the windshield.

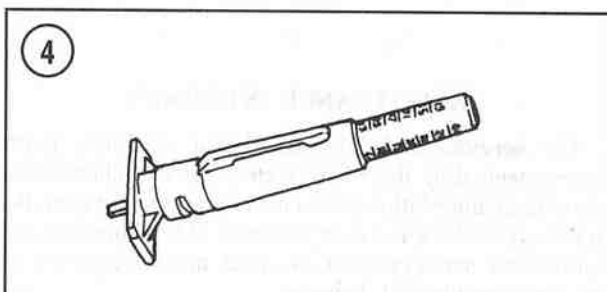
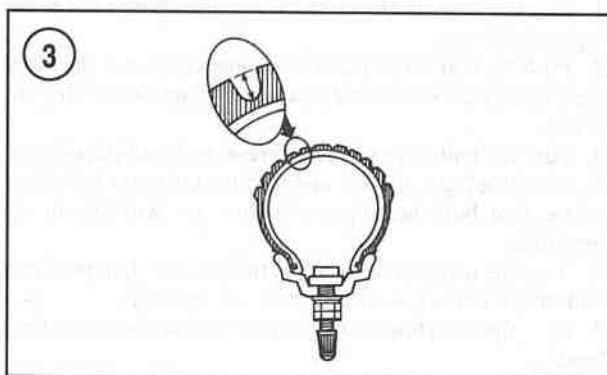
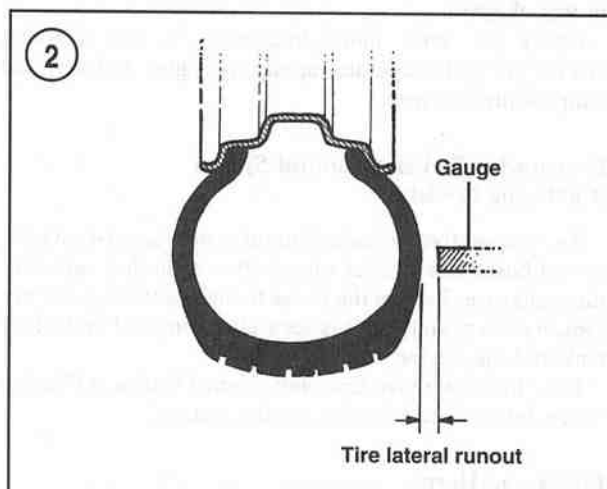
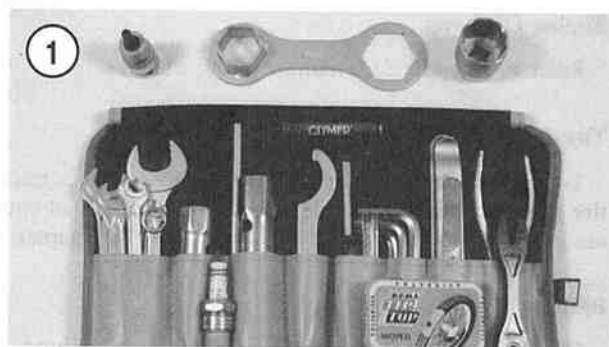
Clean the windshield with a soft cloth or natural sponge and plenty of water. Dry thoroughly with a soft cloth or chamois – do not press hard.

#### WARNING

*The brake components may have gotten wet. If they are damp or wet they will not be operating at their optimum effectiveness. Be prepared to take a longer distance to stop the bike just after washing the bike. Ride slowly and lightly apply the brakes to dry off the pads.*

Start the bike and let it reach normal operating temperature. Take the bike out for a slow and careful ride around the block to blow off any residual water. Bring the bike back to the wash area and dry off any residual water and streaks from the painted and plated surfaces.

Once the bike is thoroughly dry, get out the polish, wax and Armor All and give the bike a good polish and wax job to protect the painted, plated and polished finishes.



## TIRES AND WHEELS

### Tire Pressure

Check and adjust tire pressure to maintain the smoothness of the tire, good traction and handling and to get the maximum life out of the tire. Incorrect tire inflation will cause rapid and uneven tire wear and create a severe safety hazard during all riding conditions. Underinflation results in excessive tire heat that causes tire wear and failure. Severe underinflation may cause a tubeless tire to slip on the rim and break its sealing bead. Overinflation makes the tire more susceptible to damage from holes or objects in the road.



A simple, accurate gauge can be purchased for a few dollars and should be carried in your motorcycle tool kit (**Figure 1**). Check tire pressure when the tires are cold because pressure builds up in the tires when they are in motion. The appropriate tire pressures are shown in **Table 2**.

#### NOTE

*After checking and adjusting the air pressure, make sure to install the air valve cap. The cap prevents small pebbles and dirt from collecting in the valve stem, allowing for possible air leakage or result in incorrect tire pressure readings.*

### Tire Inspection

The likelihood of tire failure increases with tread wear. It is estimated that most tire failures occur during the last 10 percent of usable tread wear. Check tire tread for excessive wear, deep cuts, abrasions, and embedded objects such as stones, nails, etc. Check also for high spots or lateral runout (**Figure 2**) that indicates internal tire damage. Replace tires that show high spots or swelling. If you find a nail or other object in the tire, mark its location with a light crayon before removing it. This will help locate the hole for repair. Refer to Chapter Nine for tire changing and repair information.

Check local traffic regulations concerning minimum tread depth. Measure the tread depth at the center of the tire tread (**Figure 3**) using a tread depth gauge (**Figure 4**) or small ruler. BMW recommends that original equipment tires be replaced when the tread depth has worn to 2.0 mm (0.08 in.) or less.

### Rim Inspection

Frequently inspect the wheel rims (**Figure 5**). If a rim has been damaged, it might have been knocked out of balance. Improper wheel balance can cause severe vibration and result in an unsafe riding condition. If the rim portion of an alloy wheel is damaged, the wheel must be replaced as it cannot be repaired.

## BATTERY

### Removal, Electrolyte Level Check and Installation

The battery is the heart of the electrical system. Check and service the battery at the interval indicated in **Table 1**. Most electrical system troubles can be attributed to neglect of this vital component.

1. Remove the seat as described in Chapter Twelve.
2. If necessary, remove both frame side covers (**Figure 6**).
- 3A. On 1970-1973 models, remove the air filter element as described in this chapter.
- 3B. On 1974-1976 models, remove the air filter case as described in Chapter Seven.
4. On models so equipped, remove the tool box (**Figure 7**) from the frame.



5. On models so equipped, flip up the protective cover: on the terminals.
6. Disconnect the battery leads. First disconnect the battery negative (-) lead (A, **Figure 8**) then the positive (+) lead (B).
- 7A. On models so equipped, remove the rubber hold-down strap(s) (C, **Figure 8**) and cover from the battery.
- 7B. On all other models, remove the knurled nuts (A, **Figure 9**) securing the battery hold-down strap (B) and remove the strap.
8. Disconnect the breather tube and vent elbow from the battery. Leave the breather tube routed through the frame.
9. Lay several thick layers of old newspapers on top of your workbench where you intend to place the battery. This will protect the work bench surface if there is electrolyte residue on the sides and bottom of the battery.
10. Carefully lift the battery upward and maneuver the battery until it clears the frame, then remove the battery from the frame.
11. Set the battery on the newspapers.
12. Maintain the electrolyte level so it is between the upper and lower lines (**Figure 10**).

**WARNING**

*Protect your eyes, skin and clothing. If electrolyte gets into your eyes, flush your eyes thoroughly with clean water and get prompt medical attention.*

**CAUTION**

*Be careful not to spill battery electrolyte on plastic, painted or plated surfaces. This liquid is highly corrosive and will damage the finish. If it is spilled, wash it off immediately with soapy water and thoroughly rinse with clean water.*

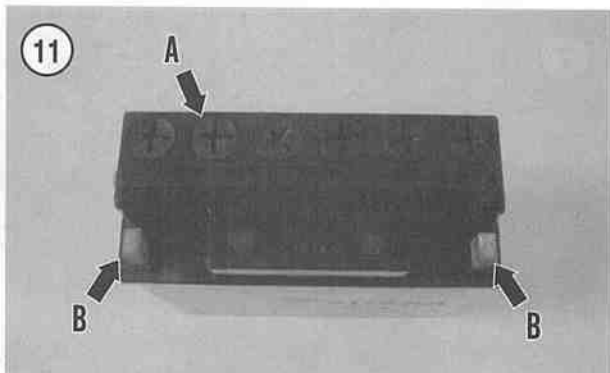
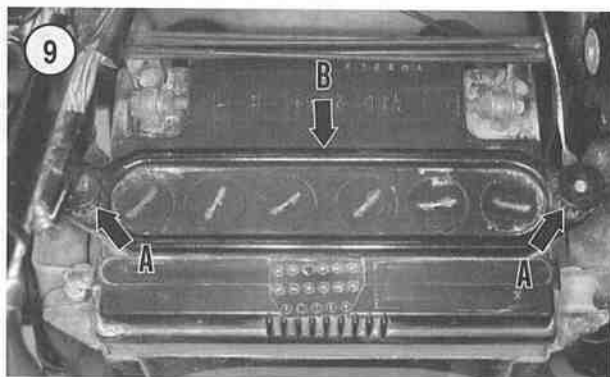
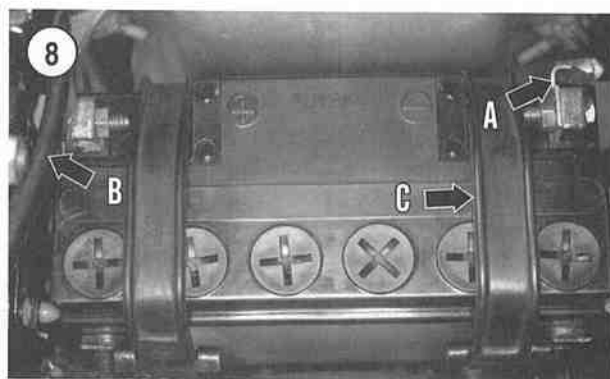
13. Remove the battery filler caps (A, **Figure 11**) from each cell and check the electrolyte level in each cell.
14. Add distilled water to correct the level. *Never* add electrolyte (acid) to correct the level.
15. Install the battery filler caps (A, **Figure 11**) and tighten securely.

**NOTE**

*If distilled water has been added, reinstall the battery caps and gently shake the battery for several minutes to mix the existing electrolyte with the new water.*

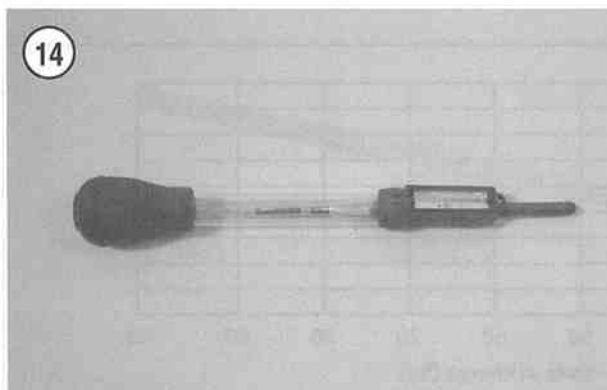
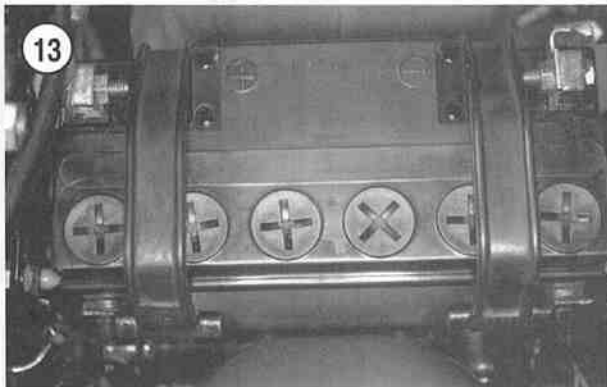
**CAUTION**

*If distilled water is going to be added to a battery (while the battery is installed in the bike) in freezing or near freezing weather, add it to the battery, dress warmly and then ride the bike for a **minimum of 30 minutes**. This*



will help mix the water into the electrolyte in the battery. Distilled water is lighter than electrolyte and will float on top of the electrolyte if it is not mixed in properly. If the water stays on the top, it may freeze and fracture the battery case, ruining the battery.

16. After the fluid level has been corrected and the battery allowed to stand for a few minutes, remove the battery caps and check the specific gravity of the electrolyte with a hydrometer. See *Testing* in this section.



17. After the battery has been refilled, recharged or replaced, install it by reversing these removal steps. Note the following during installation.

18. Clean the battery terminals (B, **Figure 11**), electrical cable connectors and surrounding case and reinstall the battery in the frame.

19. Coat the battery terminals with dielectric grease or protective spray (**Figure 12**) to retard corrosion and decomposition of the terminals.

#### CAUTION

*If the breather tube was removed from the frame, be sure to route it so that residue will not drain onto any part of the bike's frame. The tube must be free of bends or twists as any restrictions may pressurize the battery and damage it.*

#### CAUTION

*The battery must be installed in the frame correctly so that the battery cables will be attached to the correct terminals (positive to positive and negative to negative). The original equipment battery cables will be difficult to attach if the battery is installed backwards with the terminals located at the rear.*

20. Position the battery so the battery cable terminals are toward the front (**Figure 13**).

21. On models equipped with a hold-down strap, do not overtighten the battery hold-down strap knurled nuts as the strap may damage the battery case. Tighten the bolts so that the battery is held securely in place.

### Testing

Hydrometer testing is the best way to check battery condition. Use a hydrometer (**Figure 14**) with numbered graduations from 1.100 to 1.300 rather than one with just color-coded bands. To use the hydrometer, perform the following.

1. Remove the battery filler caps (A, **Figure 11**) from each cell.
2. Squeeze the rubber ball, insert the tip into the cell and release the pressure on the ball.
3. Draw enough electrolyte to float the weighted float inside the hydrometer. Note the number in line with the surface of the electrolyte (**Figure 15**), this is the specific gravity for this cell.
  - a. The specific gravity of the electrolyte in each battery cell is an excellent indicator of that cell's condition. A fully charged cell will read from 1.260-1.280, while a cell in good condition reads from 1.230-1.250 and anything below 1.120 is discharged. Refer to **Figure 16**.

- b. If the cells test in the poor range, the battery requires recharging. The hydrometer is useful for checking the progress of the charging operation. **Table 3** shows approximate charge rates/times.
4. Squeeze the rubber ball again and return the electrolyte to the cell from which it came.
5. Install the caps onto each battery cell and tighten securely.

### Charging

Use only a battery charger with a 3-amp maximum output. The charger should also taper the charge rate as the battery accepts the charge.

#### WARNING

*During the charging process, highly explosive hydrogen gas is released from the battery. The battery should be charged only in a well-ventilated area away from any open flames (including pilot lights on home gas appliances). Do not allow any smoking in the area. Never check the charge by arcing (connecting pliers or other metal objects) across the terminals; the resulting spark can ignite the hydrogen gas.*

#### CAUTION

*Always remove the battery from the bike's frame before connecting the battery charger. Never recharge a battery in the bike's frame; the corrosive mist that is emitted during the charging process will corrode all surrounding surfaces.*

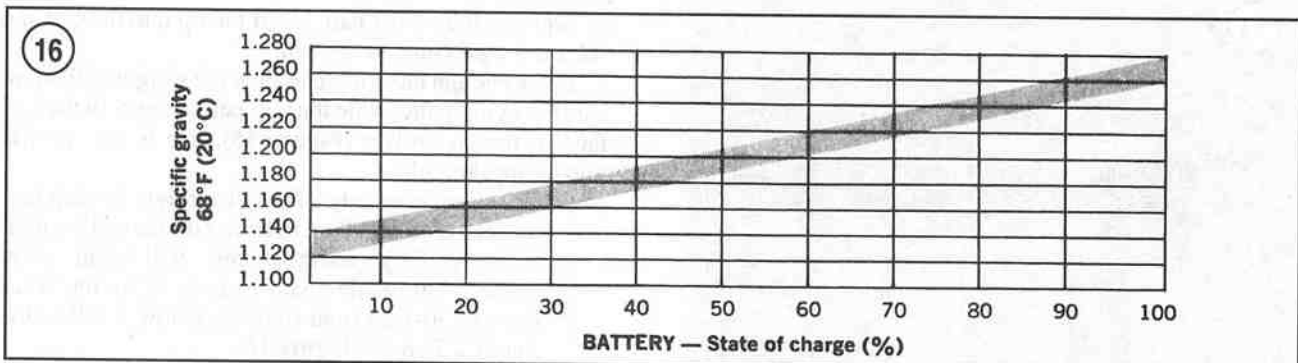
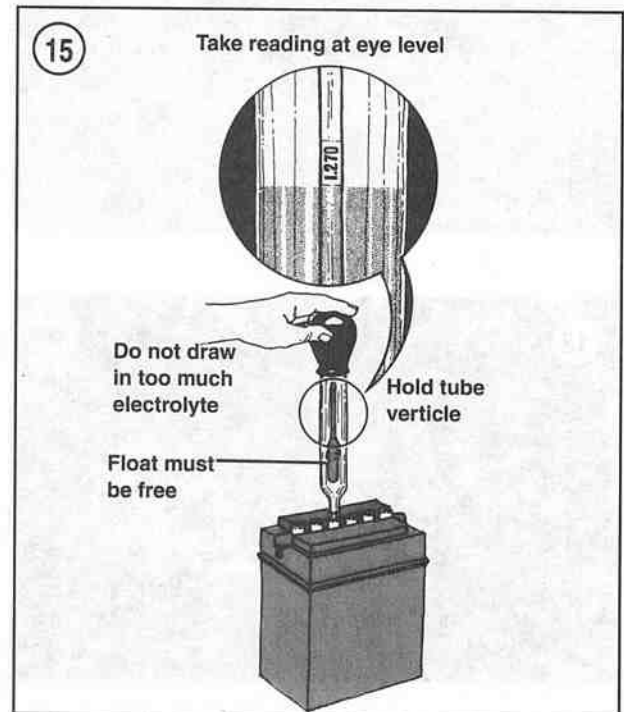
1. Connect the positive (+) charger lead to the positive (+) battery terminal and the negative (-) charger lead to the negative (-) battery terminal.
2. Remove the battery filler caps (A, **Figure 11**) from each battery cell.

3. Set the charger to 12 volts and switch the charger on. If the output of the charger is variable, it is best to select a low setting – 1 1/2 to 2 amps.

#### CAUTION

*The electrolyte level must be maintained at a level 6 mm (1/4 in.) above the top of the battery plates during the charging cycle; check and refill as necessary.*

4. Refer to **Table 3** for approximate charge rates/times. After the battery has been charged, turn the charger off, and disconnect the leads and check the specific gravity of each cell. If the charge remains stable for 1 hour, the battery is considered charged.
5. Install the caps onto each battery cell and tighten securely.



6. Clean the battery terminals (B, **Figure 11**), electrical cable connectors and surrounding case. Reinstall the battery in the frame by reversing the removal steps. Coat the battery terminals with dielectric grease or protective spray (**Figure 12**).

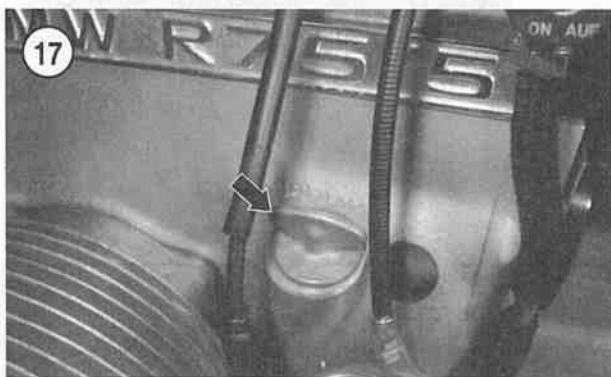
#### CAUTION

*Route the breather tube so that it does not drain onto any part of the frame. The tube must be free of bends or twists as any restriction may pressurize the battery and damage it.*

### New Battery Installation

When purchasing a new battery for your BMW, be sure to choose one that matches the cranking power required by your specific engine size. The larger the engine displacement, the greater amp/hour size battery required. The following are the original factory equipped battery amp/hour ratings for each engine displacement:

1. 30-amp/hour battery: 1000 cc (R100 models).
2. 25-amp/hour battery: 700, 800 and 900cc (R75, R80, R90 models).
3. 20-amp/hour battery: 500, 600 and 650cc (R50, R60, R65 models).



#### NOTE

*BMW recommends the 25-amp/hour battery as "the best all around" size battery for all displacement models, except for cold climate 1000 cc models. For reliable cold starting performance, the 1000 cc model needs the 30- amp/hour battery. The 25-amp/hour battery has more room between the plates and a larger electrolyte capacity. Therefore it can be recharged quicker and is less sensitive to sulfation.*

When replacing the old battery with a new one, be sure to charge it completely (specific gravity 1.260-1.280), as described in this chapter, before installing it in the bike. Failure to do so, or using the battery with a low electrolyte level, will permanently damage the new battery.

### PERIODIC LUBRICATION

#### Oil

Oil is classified according to its viscosity, which is an indication of how thick it is. The Society of Automotive Engineers (SAE) system distinguishes oil viscosity by numbers. Thick oils have higher viscosity numbers than thin oils. For example, an SAE 5 oil is a thin oil while an SAE 90 oil is relatively thick.

#### Grease

A good-quality grease (preferably waterproof) should be used. Water does not wash grease off parts as easily as it washes oil off. In addition, grease maintains its lubricating qualities better than oil on long and strenuous rides.

In many cases in this manual, a special grease called molybdenum disulfide grease is specified. It is used on some parts during engine assembly and on some suspension components. Whenever this type of grease is specified, it should be used as it has special lubricating qualities. Be sure to use this special type of grease, even though it may be more expensive than ordinary multipurpose grease.

#### Engine Oil Level Check

Engine oil level is checked with the dipstick (**Figure 17**), located on left-hand side of the crankcase in front of the carburetor.

1. Place the bike on the centerstand and on level ground. A false reading will be given if the bike is tipped to either side.
2. Start the engine and let it idle for 2-3 minutes.
3. Shut off the engine and let the oil settle for 1-2 minutes.
4. Unscrew the dipstick and wipe it clean with a lint-free cloth. Reinsert it onto the threads in the hole; do not screw it in (**Figure 18**).
5. Remove the dipstick and check the oil level. The bike must be level for a correct reading.



6. The oil level should be between the upper (MAX) and lower (MIN) lines. The oil level should never be above the upper line (**Figure 19**).
7. If additional oil is necessary, perform the following:
  - a. Insert a small funnel into the filler hole.
  - b. Add the recommended engine oil weight as indicated in **Figure 20** to correct the level.

### Engine Oil and Oil Filter Change

Change the engine oil and the oil filter at the same time as the recommended oil change interval indicated in **Table 1**. This assumes that the motorcycle is operated in moderate climates. In extreme climates, oil should be changed more frequently. The time interval is more important than the mileage interval because acids formed by combustion blowby will contaminate the oil even if the motorcycle is not run for several months. If the motorcycle is operated under dusty conditions, the oil will get dirty more quickly and should be changed more frequently than recommended.

Oil for motorcycle and automotive engines is classified by the American Petroleum Institute (API) and the Society of Automotive Engineers (SAE) in several categories. Oil containers display these classifications on the label (**Figure 21**). It is suggested that the oil (**Figure 22**) manufactured for and sold by BMW dealers be used in this engine. A substitute brand of oil may be used, but first confer with a BMW dealer regarding which type is compatible.

Use only a high-quality detergent motor oil with an API classification of SF or SG. Try to use the same brand of oil at each change. Refer to **Figure 20** for correct oil viscosity to use under anticipated ambient temperatures (not engine oil temperature).

To change the engine oil and filter you will need the following:

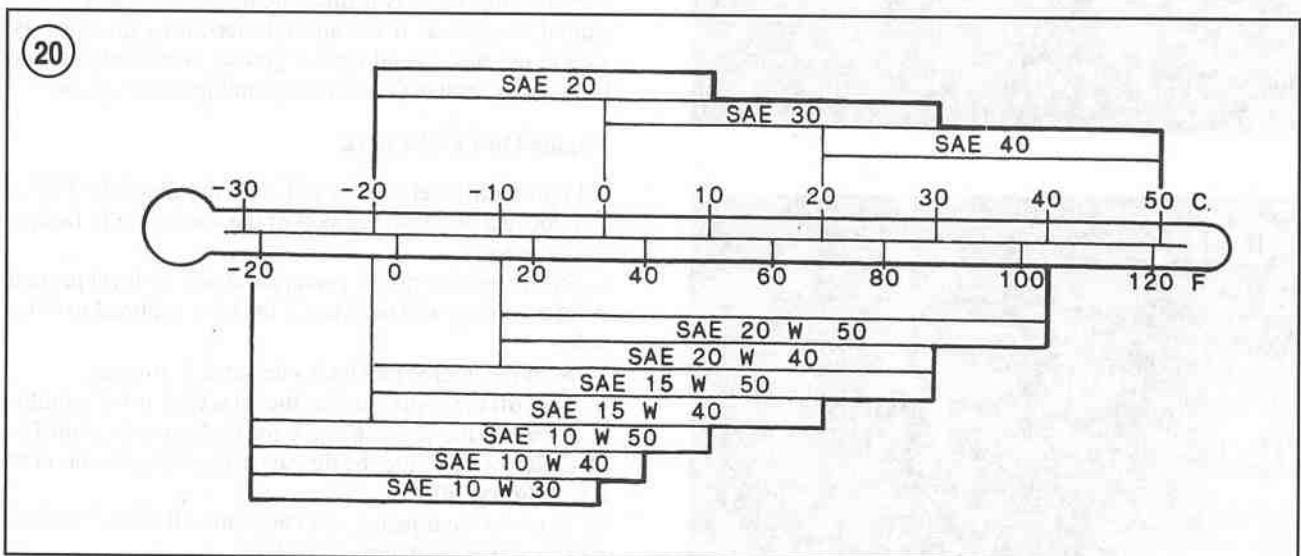
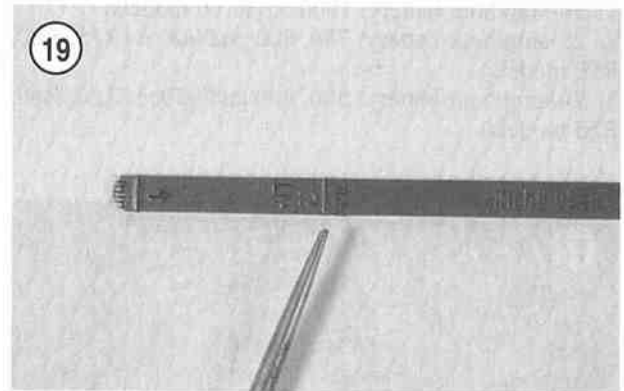
- a. Drain pan.
- b. Funnel.
- c. Can opener or pour spout (oil in cans).
- d. Allen wrench (drain plug).
- e. 3 quarts of oil.
- f. New BMW oil filter element.

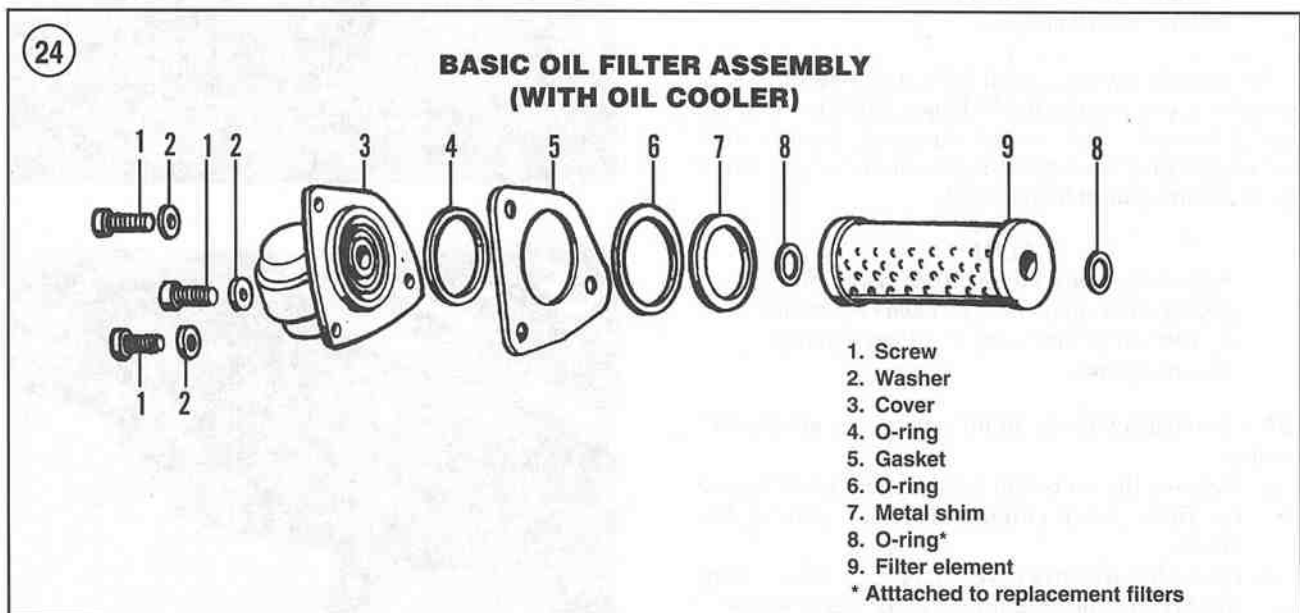
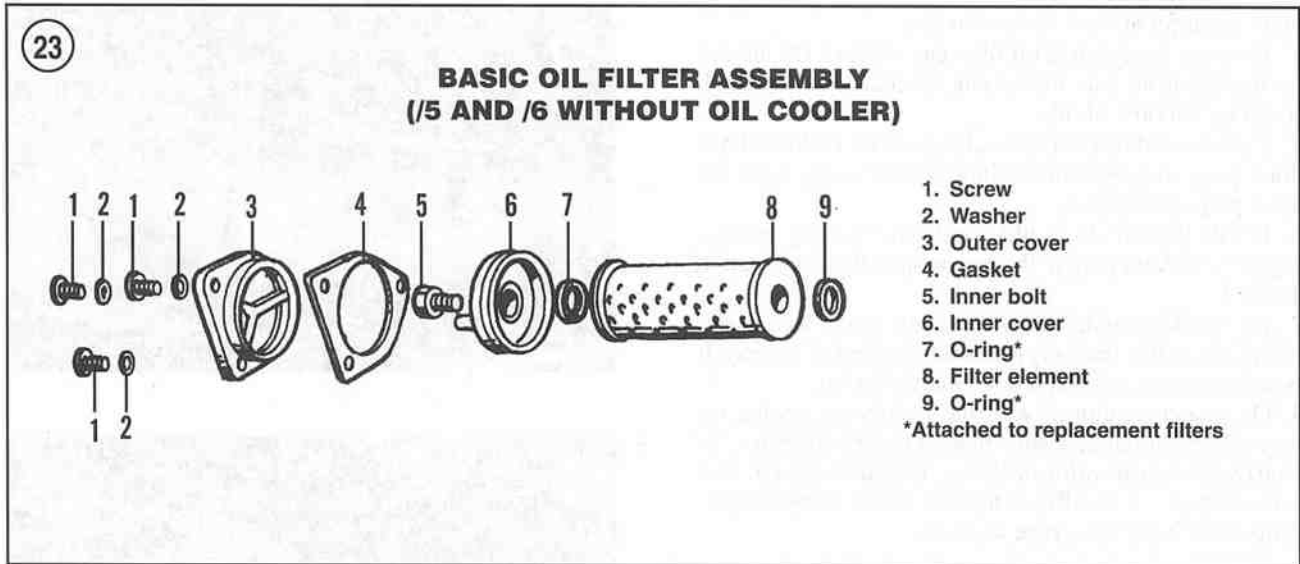
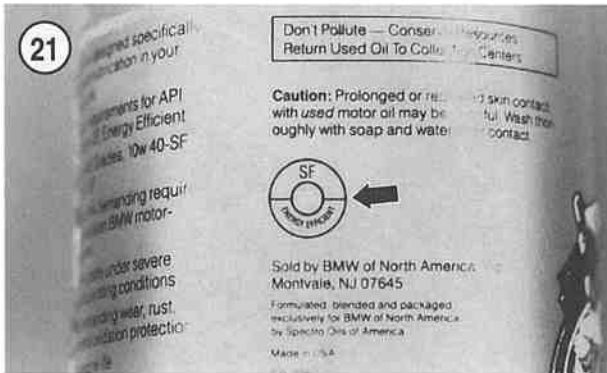
There are a number of ways to discard the old oil safely. Some service stations and oil retailers will accept your used oil for recycling; some may even give you money for it. Never drain the oil onto the ground or place it in your household trash.

Refer to **Figure 23** and **Figure 24** for this procedure.

#### NOTE

*Warming the engine allows the oil to heat up; thus it flows freely and carries contamination and any sludge buildup out with it.*





1. Start the engine and let it reach operating temperature; 15-20 minutes of stop-and-go riding is usually sufficient.
2. Turn the engine off and place the bike on level ground on the centerstand.

**WARNING**

*During the next step, hot oil will spurt from the drain plug hole. Be ready to move your hand away quickly once the drain plug is removed so hot oil will not run on your hand and down your arm.*

3. Place a drain pan under the oil pan and remove the drain plug (**Figure 25**) with an Allen wrench. Allow the oil to drain for at least 15-20 minutes.
4. Unscrew the dipstick/oil filler cap (**Figure 18**) located on the left-hand side of the engine crankcase; this will speed up the flow of oil.
5. Remove and discard the sealing washer on the oil pan drain plug. Replace the sealing washer every time the drain plug is removed.
6. Install the oil drain plug and new sealing washer. Tighten the drain plug to the torque specification listed in **Table 4**.
7. On models equipped with safety bars, loosen the right-hand safety bar and pivot it forward out of the way. It is not necessary to completely remove the bar.
8. On models equipped with the factory oil cooler, remove the right-hand exhaust pipe as described under *Exhaust System Removal/Installation* in Chapter Seven. This is necessary as it is difficult to gain access to the components with the exhaust pipe in place.

**NOTE**

*If a hinge filter is used, it is not necessary to remove the exhaust pipe.*

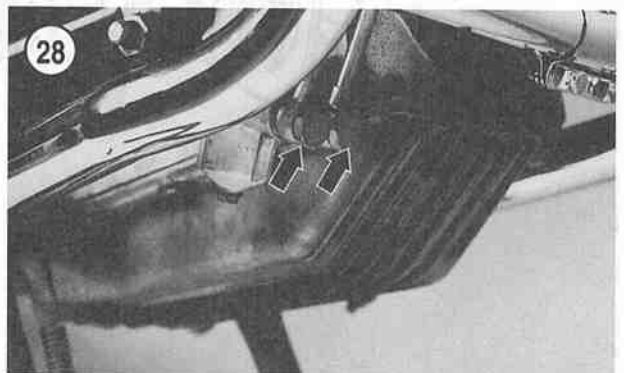
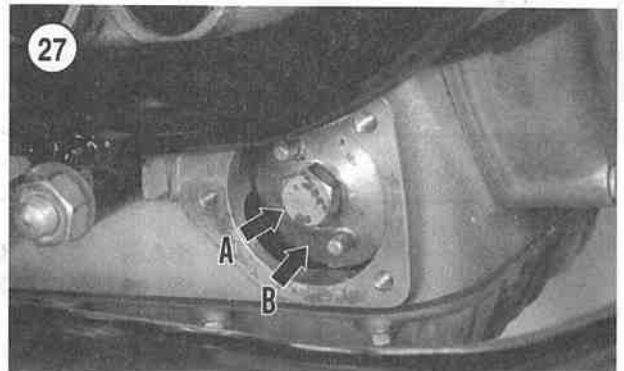
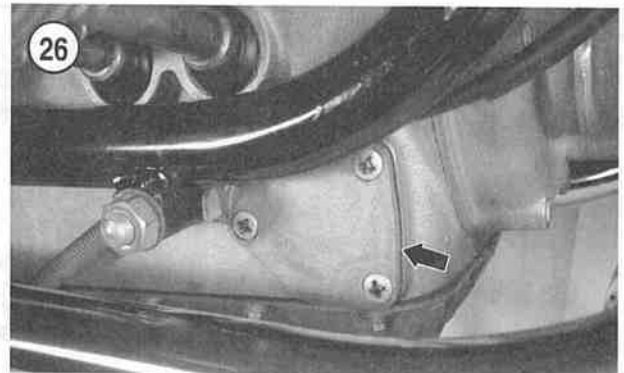
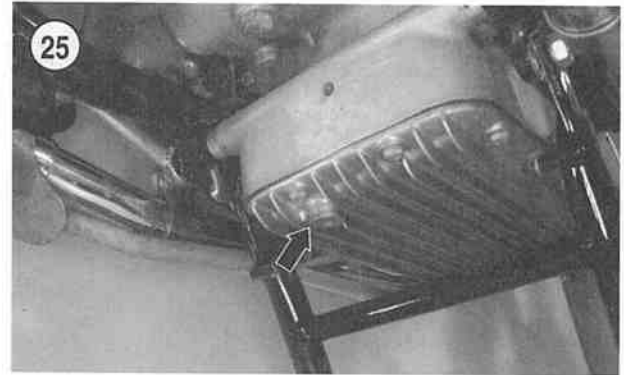
9. On models equipped with a front fairing, it is suggested that you use the BMW hinged oil filter. It is designed to work with fairing equipped models. If a non-hinged filter is used, the right-hand lower portion of the front fairing must be removed.

**NOTE**

*Before removing the oil filter cover, thoroughly clean off all road dirt and oil around it. This will prevent any dirt from entering the crankcase.*

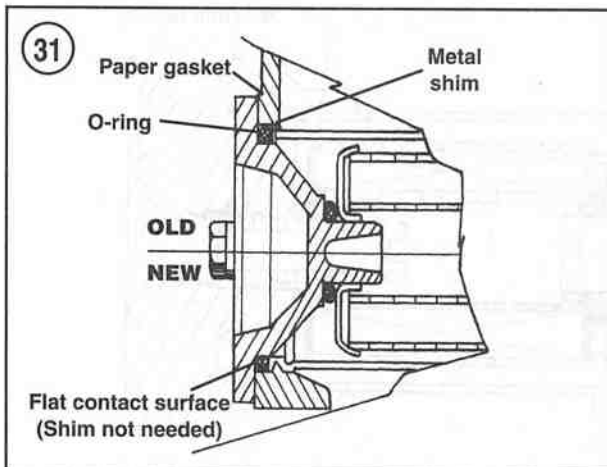
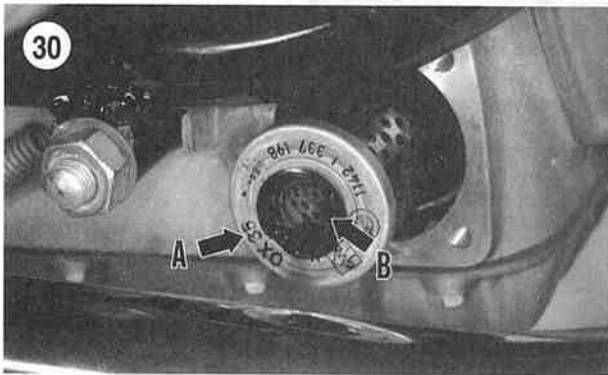
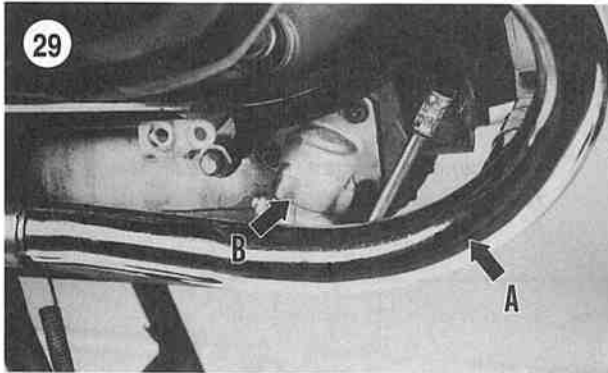
- 10A. On models without an oil cooler, perform the following:

- a. Remove the bolts and lockwashers securing the oil filter cover (**Figure 26**) and remove the cover.
- b. On models with two covers, loosen the bolt (A, **Figure 27**) securing the inner cover (B) and remove it.



10B. On models equipped with an oil cooler, perform the following:

- Remove the bolts (Figure 28) securing the oil lines to the oil filter cover.
- Remove the right-hand exhaust pipe (A, Figure 29) as described under *Exhaust System* in Chapter Seven.
- Remove the bolts securing the oil filter cover (B, Figure 29).



- Carefully remove the cover and interconnecting hoses from the crankcase. Move the cover out of the way only enough to gain access to the oil filter.
11. Withdraw the oil filter (A, Figure 30) from the crankcase.

#### NOTE

The design of the filters has been changed by BMW. The original equipment filter kit for non-oil cooler equipped engines came with sealing rings that were slipped over the pipe that passes through the filter (OLD, Figure 31). These seals are now attached to the filter (NEW and B, Figure 30). Make sure there is not an O-ring remaining on the pipe. Do not continue to use the separate O-rings with filters that have seals attached to them. Oil cooler equipped engines use a filter with a seal attached to the end of the filter that goes into the engine first. The larger square section ring seals the cover.

- Remove any O-ring seal and/or gasket from the oil filter cover and inner cover. Clean off the inner surface of the oil filter cover(s) with a shop rag and cleaning solvent. Remove any oil sludge if necessary. Wipe it (or them) dry with a clean, lint-free cloth.

#### CAUTION

Refer to Figures 31-34 for O-rings, shim and gasket locations for various models. The placement of these seals is critical to preventing oil leaks and maintaining oil pressure. On models prior to 1982 (except /5 and /6) without an oil cooler, the metal shim must be between the single outer cover O-ring and the filter canister (OLD, Figure 31). The shim prevents the canister edge from damaging the O-ring. 1982 and later models have a canister edge that is crimped to provide a flat sealing surface (NEW, Figure 31). It is recommended on these models that the shim be used to provide additional compression of the seal and improve its sealing ability.

- Install the new oil filter into the crankcase. Make sure it bottoms out.

14A. On models with two covers (/5, /6 and R90S), install the paper gasket on the outer cover (A, Figure 35). No O-ring is used on the inner cover (B, Figure 35). Install the inner cover and bolt (Figure 27). Tighten the bolt to 41 N·m (30 ft.-lb.). Then install the outer cover and gasket. Tighten the screws or bolts to 10 N·m (88 in. lbs.).

14B. On single cover models, install the paper gasket (A, Figure 36), O-ring (B) and metal shim (C) onto the cover. Use a small dab of grease to hold the pieces in place. Install the cover and make sure the metal shim is between the O-ring and the filter housing. Tighten the bolt to 10



N-m (88 in-lbs.).

15. On models with an oil cooler, perform the following:
  - a. Move the oil lines into position and install the bolts (**Figure 28**) securing the oil lines to the oil filter cover. Tighten the bolts securely. Refer to *Oil Cooler* in Chapter Four for additional illustrations.
  - b. Install the right-hand exhaust pipe (A, **Figure 29**) as described under *Exhaust System* in Chapter Seven.
16. Insert a funnel into the oil fill hole and fill the engine with the correct viscosity and quantity of oil. Refer to **Table 5**.
17. Install the dipstick and tighten securely.
18. Remove the oil drain pan from under the engine and discard the oil properly.
19. Start the engine, let it run at idle speed and check for leaks.

20. Turn the engine off and check for correct oil level; adjust as necessary.

21. On models equipped with safety bars, move the safety bars back into position and tighten the bolts and nuts.

22. On models equipped with a front fairing, if a non-hinged filter was installed, install the right-hand lower portion of the front fairing.

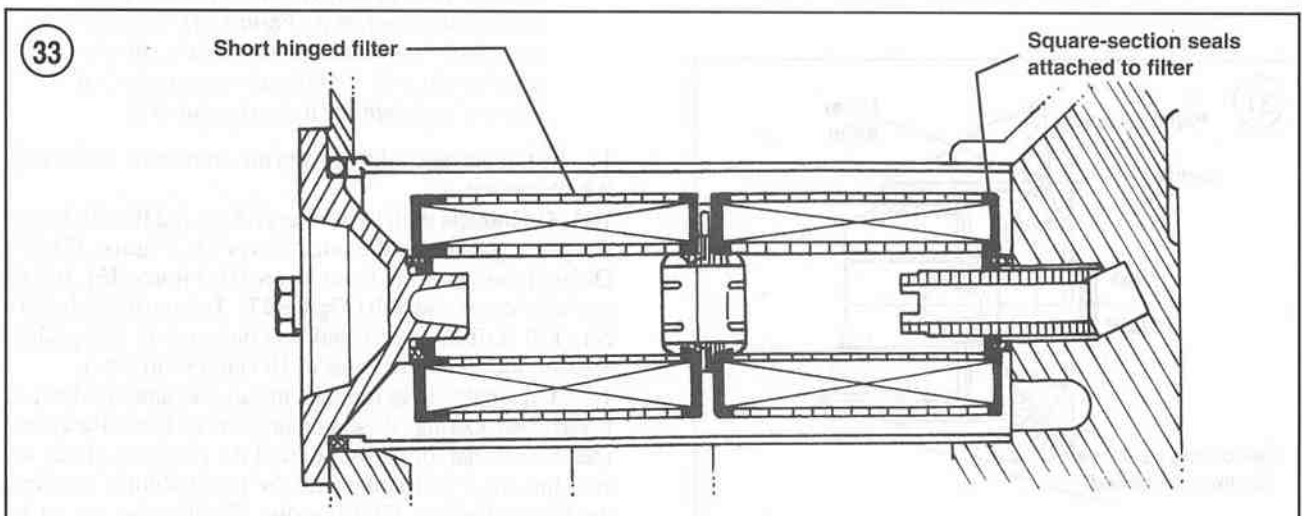
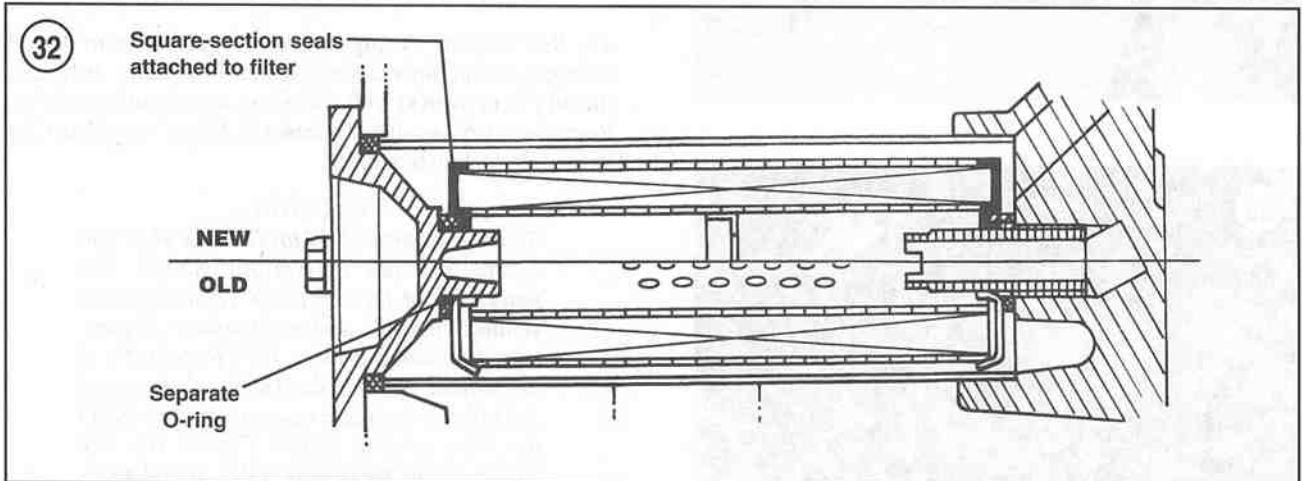
### Oil Pump Filter Screen and Oil Pan Cleaning

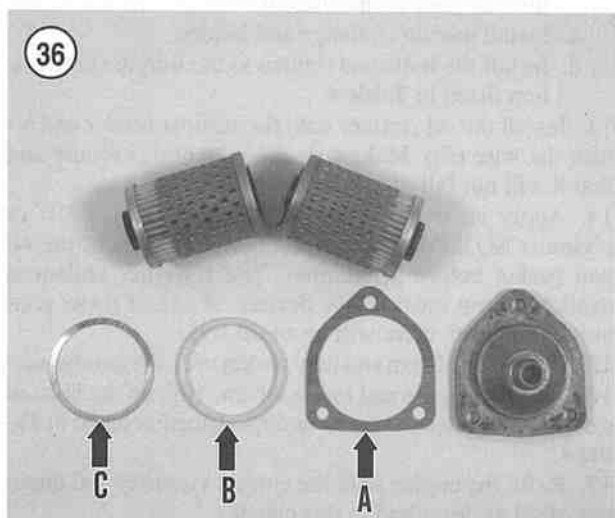
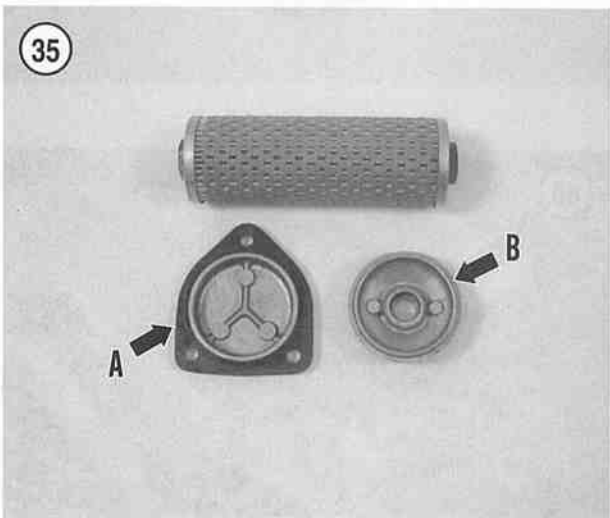
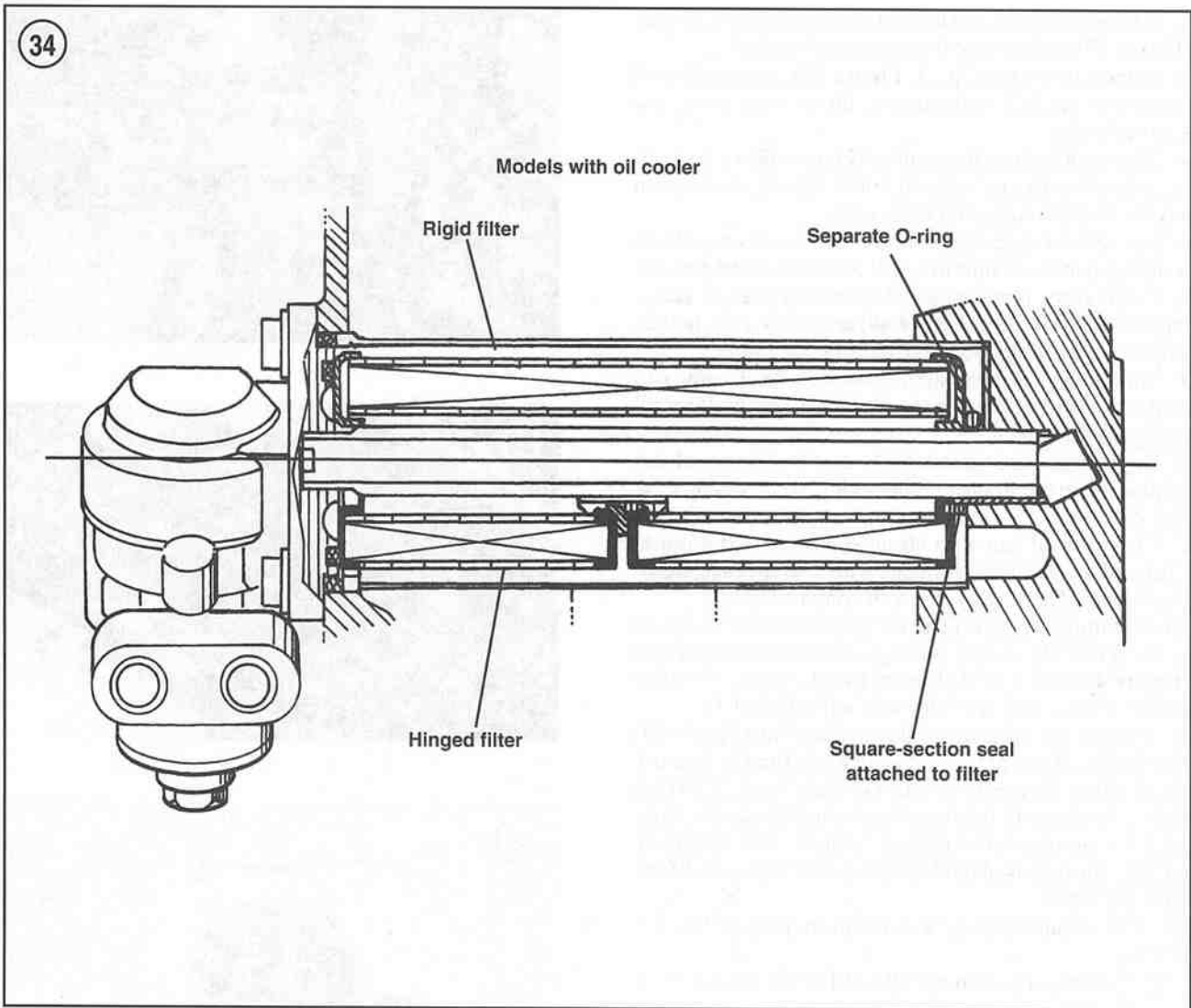
The oil filter screen and oil pan should be cleaned every time the oil pan is removed from the engine.

1. Drain the engine oil as described in this chapter.

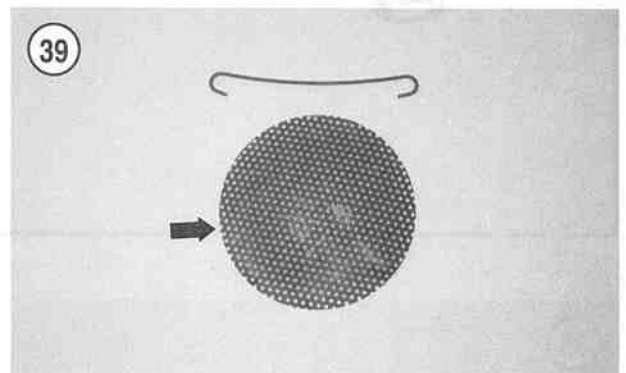
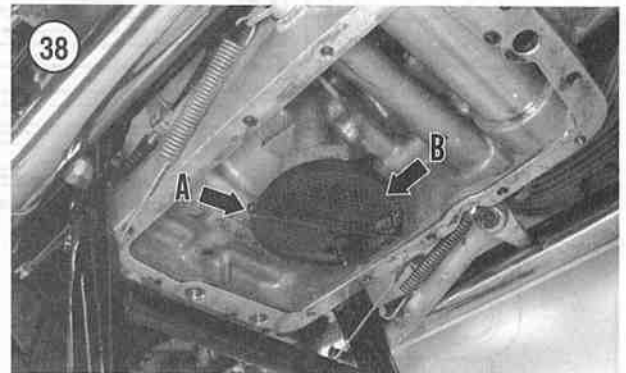
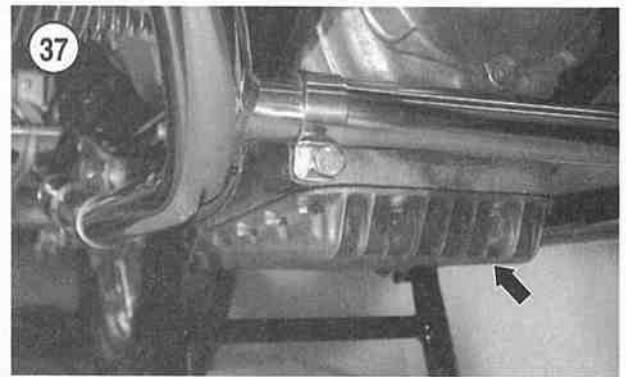
#### NOTE

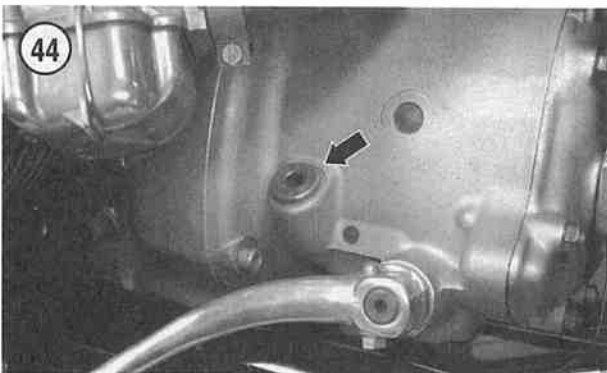
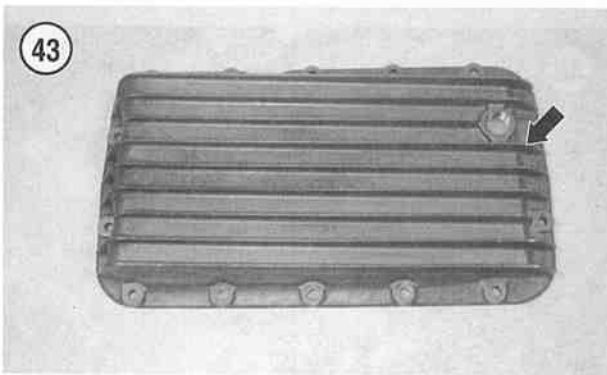
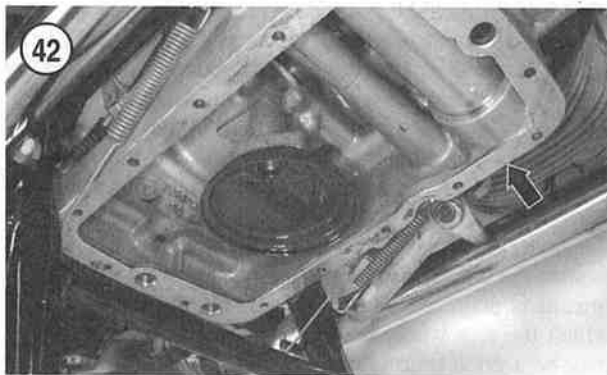
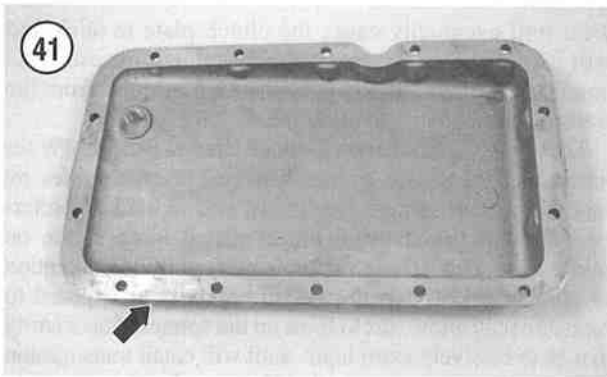
*The following steps are shown with the engine removed and turned upside down for clarity.*





2. Remove the bolts and lockwashers securing the oil pan (Figure 37) and remove the oil pan and gasket.
3. Remove the wire clip (A, Figure 38) securing the oil pump strainer (B) and remove the strainer from the strainer holder.
4. Thoroughly clean the strainer (Figure 39) with cleaning solvent and a medium soft brush. Be sure to clean out any built-up oil sludge on the screen.
5. Dry with compressed air. Make sure there is no solvent residue left in the strainer as it will contaminate the new oil.
6. If necessary, remove the bolts and lockwashers securing the strainer holder (Figure 40) and remove the holder, gasket(s) and flange. Remove the strainer holder.
7. Thoroughly clean the strainer holder with cleaning solvent and a brush. Be sure to clean out any built-up oil sludge on the screen.
8. Dry with compressed air. Make sure there is no solvent residue left in the strainer holder as it will contaminate the new oil.
9. Clean the oil pan with cleaning solvent and a brush. Clean off any buildup oil sludge with a scraper and cleaning solvent. Thoroughly dry with compressed air.
10. Carefully scrape off any old gasket residue on the oil pan (Figure 41) and the mating surface of the crankcase (Figure 42). For a final cleanup, use an aerosol electrical contact cleaner and wipe dry with a lint-free cloth.
11. Inspect the oil pan and the cooling fins (Figure 43) for damage. If any of the fins are damaged and broken off, check where they were attached to the oil pan. If just the fin(s) is broken off, but the oil pan is not cracked or damaged, the oil pan can be reused. Fractures may lead to an oil leak; the oil pan should be repaired or replaced if fractures are visible.
12. If the strainer holder was removed, perform the following:
  - a. Thoroughly clean off all old Loctite residue from the bolt threads.
  - b. Apply blue Loctite Threadlocker No. 242 to the bolt threads prior to installation.
  - c. Install gasket(s), flange and holder.
  - d. Install the bolts and tighten to the torque specification listed in Table 4.
13. Install the oil strainer onto the strainer holder and attach the wire clip. Make sure the wire clip is secure and that it will not fall off of the holder.
14. Apply an even coat of Three Bond No. 1216 or Hylomer SQ32/M gasket sealant to both sides of the oil pan gasket before installation. The Hylomer sealant is available from most BMW dealers. If one of these sealants is not used, there will be an oil leak.
15. Install the oil pan and new gasket onto the crankcase.
16. Install the bolts and lockwashers. Tighten the bolts in a crisscross pattern to the torque specification listed in Table 4.
17. Refill the engine with the correct viscosity and quantity of oil as described in this chapter.





### Transmission Oil Level Check

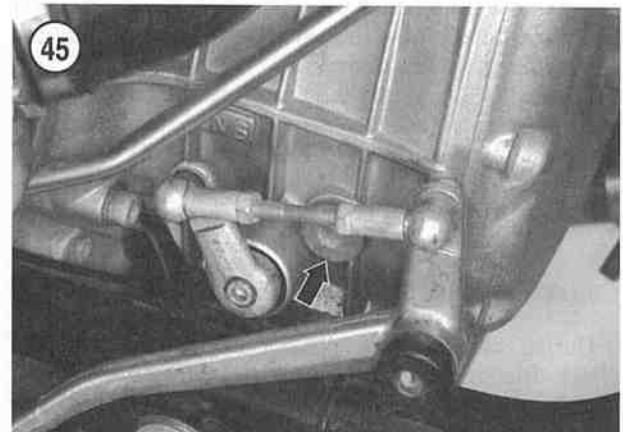
Inspect the transmission oil level at the interval listed in **Table 1**. If the bike has been run, allow it to cool down (at least 10 minutes), then check the transmission oil level. When checking the transmission oil level, do not allow any dirt or foreign matter to enter the case opening.

1. Place the bike on the centerstand on level ground.
2. Wipe the area around the oil filler cap clean.
- 3A. On 4-speed transmission models, perform the following:
  - a. Use an Allen wrench and unscrew the oil filler cap and sealing washer (**Figure 44**).
  - b. The oil level should be up to the bottom of the filler cap threads in the transmission housing.
- 3B. On 5-speed transmission models, perform the following:
  - a. Use an 8 mm Allen wrench and unscrew the oil filler cap and sealing washer (**Figure 45**).
  - b. The oil level should be up to the bottom of the filler cap threaded hole in the transmission housing.

#### NOTE

*Add only enough oil to bring the oil level up to the specified level. Do not overfill the case by adding too much oil.*

4. If necessary, add the recommended oil to bring the oil up to the correct level.
5. If the oil level is low, add the type of oil recommended in **Table 5**.
6. Inspect the sealing washer on the oil filler cap; replace if necessary.
7. Install the sealing washer and the oil filler cap and tighten securely.
8. Wipe off any spilled oil from the transmission case.





### Transmission Oil Change

Replace the transmission oil at the interval listed in **Table 1**.

To change the transmission oil you will need the following:

- a. Drain pan.
  - b. Funnel.
  - c. 8 mm Allen wrench (oil filler cap plug).
  - d. 19 mm box wrench (drain plug).
  - e. 1 liter (1 quart) of hypoid gear oil.
1. Ride the bike until the transmission oil reaches normal operating temperature. Usually 10-15 minutes of stop and go riding is sufficient. Shut the engine off.
  2. Place the bike on the centerstand on level ground.

#### NOTE

*Before removing the drain plug, loosen the oil filler cap. If you are unable to loosen the oil filler cap, do not remove the oil drain plug as you will end up with an empty transmission and no way to replace it. Take the bike to a dealer and have them loosen the oil filler cap for you.*

3. Wipe the area around the oil filler cap clean and unscrew the oil filler cap and sealing washer. This will speed up the flow of oil. Refer to **Figure 44** for 4-speed transmissions or **Figure 45** for 5-speed transmissions.
4. Place a drain pan under the drain plug.
5. Remove the drain plug (**Figure 46**) with a 19 mm box wrench. Allow the oil to drain for at least 15-20 minutes.
6. Remove and discard the sealing washer on the transmission oil drain plug. Replace the sealing washer every time the drain plug is removed.
7. Install the drain plug and new sealing washer. Tighten the drain plug to the torque specification listed in **Table 4**.
8. Insert a funnel into the oil fill hole and fill the transmission with the correct viscosity and quantity of hypoid gear oil. Refer to **Table 5**.
9. Install the oil filler cap and tighten to the torque specification listed in **Table 4**.
10. Remove the oil drain pan from under the transmission and discard the oil as outlined under *Engine Oil and Oil Filter Change* in this chapter.
11. Ride the bike until the transmission oil reaches normal operating temperature. Usually 10-15 minutes of stop and go riding is sufficient. Shut the engine off.
12. Check the transmission oil level as described in this chapter and readjust if necessary.

### Clutch and Input Shaft Spline Lubrication

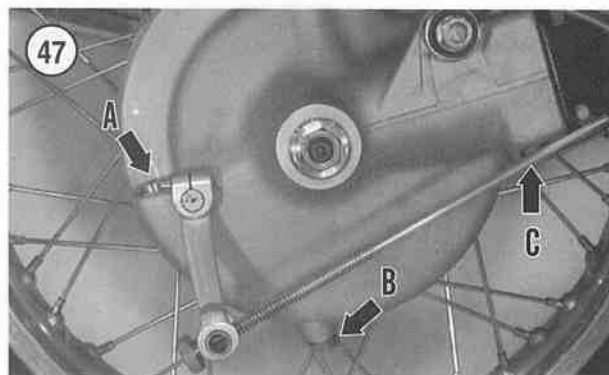
During clutch disengagement and engagement the clutch friction plate moves on the transmission input shaft's splines. On some models, this movement has been known to cause the input shaft splines to wear. Excessive

wear will eventually cause the clutch plate to stick and will be noticed as erratic (grabbing) clutch release. This condition is often initially accompanied by noise from the transmission when operating the clutch lever.

There is no recommended service interval from BMW for lubricating the clutch splines. General practice varies by model, use and storage conditions, and individual preference. BMW began using nickel plated input shafts on mid-80's models. These require significantly less attention to lubrication. Models not ridden regularly or exposed to moisture may allow rust to form on the splines. Considering that an excessively worn input shaft will entail transmission disassembly, somewhere in the 20,000-mile range for early models and 30,000 mile range for later models with nickel plated shafts should be considered as a guide.

Lubricate the splines with Optimal T white paste, or an equivalent with a percentage of molybdenumdisulfid, by removing the transmission to access the splines.

On some models it is possible to access the splines for lubrication without completely removing the transmission. This is achieved by leaving the rear wheel in place and disconnecting the driveshaft at the transmission and removing the swing arm pivots. By moving the swing arm back, room to slide the unbolted transmission back enough to apply lubricant is achieved. However, considering the ease with which the rear wheel and differential can be removed, it may be a good time to consider removing the swing arm and servicing the swing arm bearings and rear hub splines.



### Swing Arm Pivot Bearing Lubrication

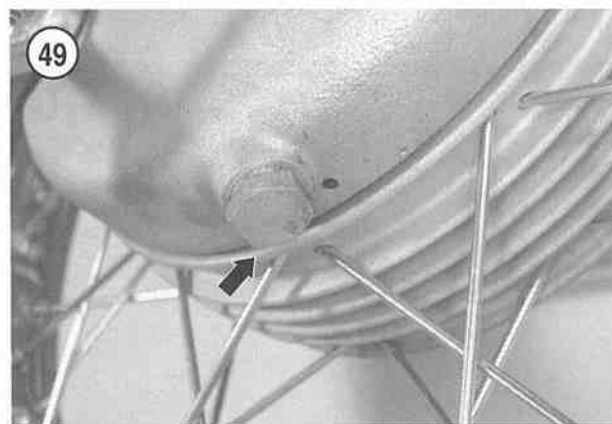
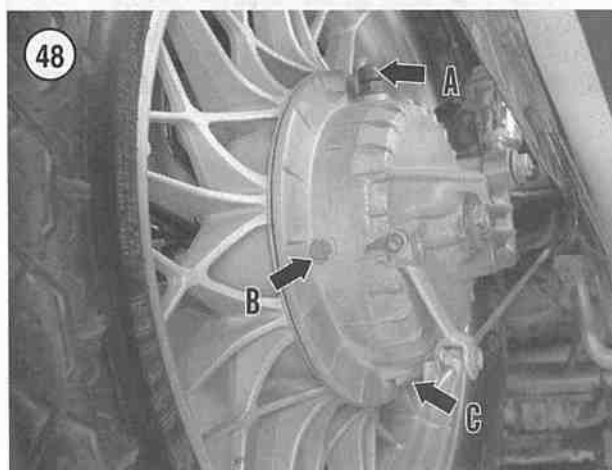
Lubricate the swing arm pivot bearings at the intervals in **Table 1**. A tapered grease gun fitting is required. This can be purchased at most automotive or hardware stores to replace the standard zirc adapter.

1. Pry the swing arm pivot trim caps from both sides of the frame. See *Rear Suspension* in this chapter.
2. Wipe the pivot pin and insert the grease gun into the pivot pin hole.
3. Force grease into the pivot pin.
4. Wipe up excess grease and install the trim caps.

### Final Drive Oil Level Check

Inspect the final drive oil level at the interval listed in **Table 1**. If the bike has been run, allow it to cool down (at least 10 minutes), then check the final drive oil level. When checking the final drive oil level, do not allow any dirt or foreign matter to enter the case opening.

1. Place the bike on the centerstand on level ground.
2. Wipe the area around the oil filler cap clean.



3. Unscrew the oil level/filler plug (A, **Figure 47**). Or on models with a separate fill plug in the top of final drive (A, **Figure 48**), remove the oil level plug (B).
4. Look into the oil filler cap threaded hole in the final drive unit.
5. The oil level is correct if the oil is up to the lower edge of the filler cap hole (approximately 12 mm/0.48 in. from the top surface of the oil filler hole).
6. If the oil level is low, add the recommended type of oil listed in **Table 5**.
7. Inspect the sealing washer on the oil level/filler plug; replace if necessary.
8. Install the sealing washer and the oil level/filler plug and tighten securely.
9. Wipe off any spilled oil from the final drive case.

### Final Drive Oil Change

Replace the final drive oil at the interval listed in **Table 1**.

1. Ride the bike until the final drive oil reaches normal operating temperature. Usually 10-15 minutes of stop and go riding is sufficient. Shut the engine off.
2. Place the bike on the centerstand on level ground.
3. Wipe the area around the oil level/filler plug clean and unscrew it and sealing washer. This will speed up the flow of oil. Refer to A, **Figure 47** or **Figure 48** for models with a separate filler plug.
4. Place a drain pan under the drain plug.
5. Remove the drain plug. Refer to C, **Figure 48** or **Figure 49**. Allow the oil to drain for at least 15-20 minutes.
6. Remove and discard the sealing washer on the final drive unit oil drain plug. Replace the sealing washer every time the drain plug is removed.
7. Install the drain plug and new sealing washer. Tighten the drain plug to the torque specification listed in **Table 4**.
8. Insert a funnel into the oil fill hole and fill the transmission with the correct viscosity and quantity of oil. Refer to **Table 5**.
9. Install the oil level/filler plug and sealing washer and tighten securely.
10. Remove the oil drain pan from under the final drive unit and discard the oil as outlined under *Engine Oil and Oil Filter Change* in this chapter.
11. Ride the bike until the final drive oil reaches normal operating temperature. Usually 10-15 minutes of stop and go riding is sufficient. Shut the engine off.
12. Check the final drive unit oil level as described in this chapter and readjust if necessary.

### Drive Shaft Oil Level Check (All Models Except R100GS)

#### NOTE

The drive shaft and final drive unit on the R100GS are different from all other models covered in this book. The drive shaft on the R100GS model does not require any type of lubrication.

Inspect the drive shaft oil level at the interval listed in **Table 1**. If the bike has been run, allow it to cool down (at least 10 minutes), then check the final drive oil level. When checking the final drive oil level, do not allow any dirt or foreign matter to enter the case opening.

1. Place the bike on the centerstand on level ground. The rear wheel must be on the ground.
2. Wipe the area around the oil filler plug clean.
3. Unscrew the oil filler plug and sealing washer (**Figure 50**) at the front end of the final drive unit.
4. Insert a screwdriver or metal rod *straight* down into the center of the drive shaft filler cap hole until it touches the top surface of the drive shaft.
5. Withdraw the screwdriver or metal rod. The oil level should be 2 mm (0.08 in.) above the end of the rod.
6. If the oil level is low, add the recommended type of oil listed in **Table 5**.
7. Inspect the sealing washer on the oil filler cap; replace if necessary.
8. Install the sealing washer and the oil filler plug and tighten to the torque specification in **Table 4**.
9. Wipe off any spilled oil from the final drive case.

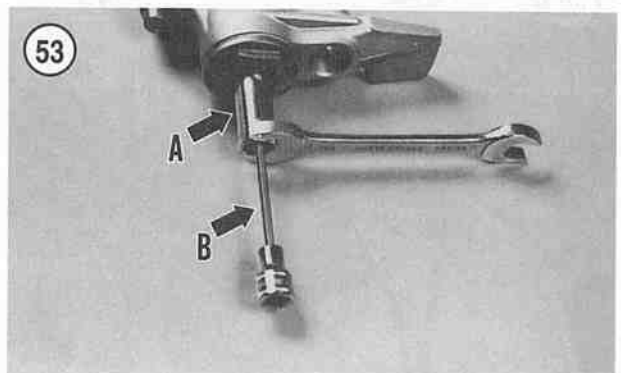
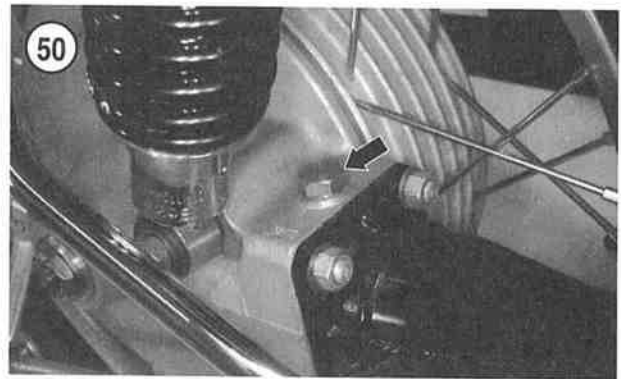
### Drive Shaft Oil Change (All Models Except R100GS)

Replace the drive shaft oil at the interval listed in **Table 1**. To change the drive shaft oil you will need the following:

- a. Drain pan.
  - b. Funnel.
  - c. 17 mm box wrench (drain plug and filler cap).
  - d. 100-150 cc (3.4-5.1 ounces) of hypoid gear oil.
1. Ride the bike until the drive shaft oil reaches normal operating temperature. Usually 10-15 minutes of stop and go riding is sufficient. Shut the engine off.
  2. Place the bike on the centerstand on level ground.

#### NOTE

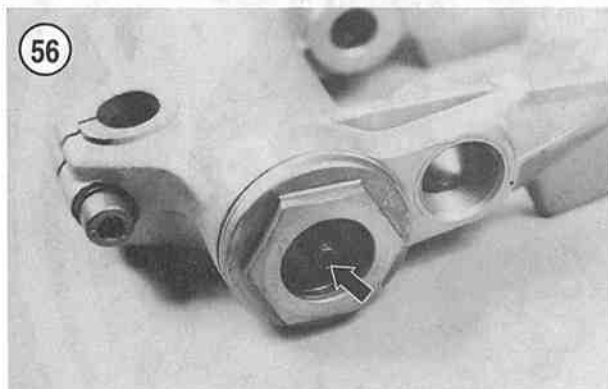
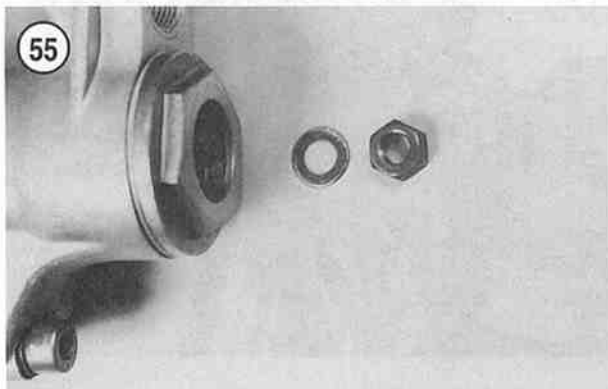
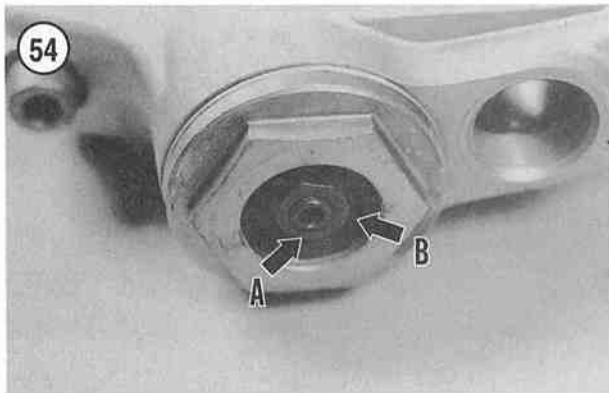
Before removing the drain plug, loosen the oil filler plug. If you are unable to loosen the oil filler plug, do not remove the oil drain plug as you will end up with an empty drive shaft cavity and no way to refill it. Take the bike to a dealer and have them loosen the oil filler plug for you.



3. Wipe the area around the oil filler plug clean and unscrew the oil filler plug and sealing washer (Figure 50). This will speed up the flow of oil.
4. Place a drain pan under the drain plug.

**WARNING**

During the next step, hot oil will spurt from the drain plug hole. Be ready to move your hand away quickly once the drain plug is removed so hot oil will not run onto your hand and down your arm.



5. Remove the drain plug (C, Figure 47). Allow the oil to drain for at least 15-20 minutes.
6. Remove and discard the sealing washer on the drive shaft oil drain plug. Replace the sealing washer every time the drain plug is removed.
7. Install the drain plug and new sealing washer. Tighten the drain plug to the torque specification listed in Table 4.
8. Insert a funnel into the oil fill hole and fill the drive shaft cavity of the final drive unit with the correct viscosity and quantity of oil. Refer to Table 5.
9. Install the oil filler plug and sealing washer and tighten to the torque specification in Table 4.
10. Remove the oil drain pan from under the final drive unit and discard the oil as outlined under *Engine Oil and Oil Filter Change* in this chapter.
11. Ride the bike until the drive shaft oil reaches normal operating temperature. Usually 10-15 minutes of stop and go riding is sufficient. Shut the engine off.
12. Check the drive shaft oil level as described in this chapter and readjust if necessary.

### Front Fork Oil Change (1970-1979 Models)

To simplify fork service and to prevent the mixing of parts, the legs should be disassembled and assembled individually.

It is a good practice to change the fork oil at the interval listed in Table 1 or once a year. If it becomes contaminated with dirt or water, change it immediately.

1. Place the bike on the centerstand with the front wheel off of the ground.
2. Unscrew the top trim cap (Figure 51) from the top of each fork tube.
3. Place a drain pan under the right-hand and left-hand fork sliders.
4. Unscrew the cap from the lower cap on the base of the fork slider.

**NOTE**

Components in Figures for Steps 5-9 and Steps 12-15 are shown with fork tube assembly removed for clarity. It is not necessary to remove the fork tube assembly for this procedure.

5. Grind 2 flats on the top of a socket so that it will accept a 15 mm open end wrench as shown in Figure 52.
6. Install the socket (A, Figure 53) and wrench onto the lower nut and insert an Allen wrench (B, Figure 53) through the socket and into the threaded plug (A, Figure 54) on the lower end of the damper rod.
7. Hold onto the Allen wrench and loosen, then remove the nut (B, Figure 54) and the washer (Figure 55).
8. Unscrew the oil fill plug and washer from the fork top cap bolt.
9. With the Allen wrench, push up on the threaded plug (Figure 56). This will allow the fork oil to drain out.



10. Repeat Steps 6-9 for the other fork leg.
11. Allow the fork oil to drain for 10-15 minutes to allow the fork oil to drain out.
12. Install the washer and nut (**Figure 55**) onto the lower end of the damper rod.
13. Install the socket (A, **Figure 53**) and wrench onto the lower nut. Insert an Allen wrench (B, **Figure 53**) through the socket and into the threaded plug (A, **Figure 54**) on the lower end of the damper rod.
14. Hold onto the Allen wrench and tighten the nut (B, **Figure 54**) securely.
15. Install the cap onto the lower cap on the base of the fork slider.
16. Repeat Steps 12-15 for the other fork leg.
17. Insert a small funnel into the opening in the fork top cap bolt.

**NOTE**

*Use the recommended weight fork oil or the fork damping will be very stiff.*

**NOTE**

*To measure the correct amount of fluid, use a plastic baby bottle. These bottles have measurements in fluid ounces (oz.) and cubic centimeters (cc) on the side.*

18. Fill the fork leg with the correct viscosity and quantity of fork oil. Refer to **Table 5**. Remove the small funnel.
19. Repeat Step 17 and Step 18 for the other fork leg.
20. Leave the bike on the centerstand and sit on the seat. Apply the front brake and lean on the handlebars and compress the front forks several times to expel any trapped air in the fork assemblies and to distribute the fork oil. Get off of the seat.
21. Inspect the sealing washer on the oil filler plug. Replace if damaged in any way.
22. Install the sealing washer and oil filler plug in each fork spring retainer and tighten securely.
23. Install the top trim cap and gasket (**Figure 57**).
24. Road test the bike and check for leaks.

### Front Fork Oil Change (1980-on Models)

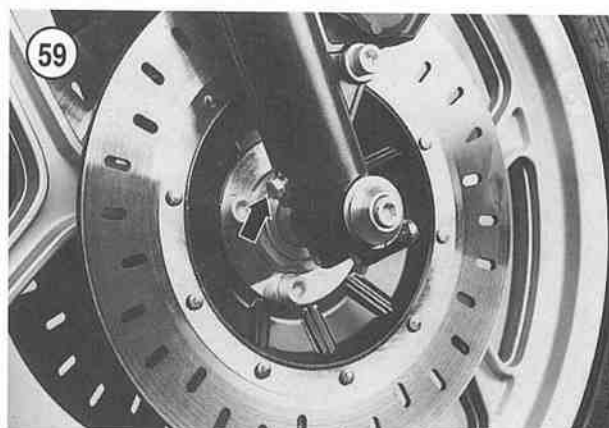
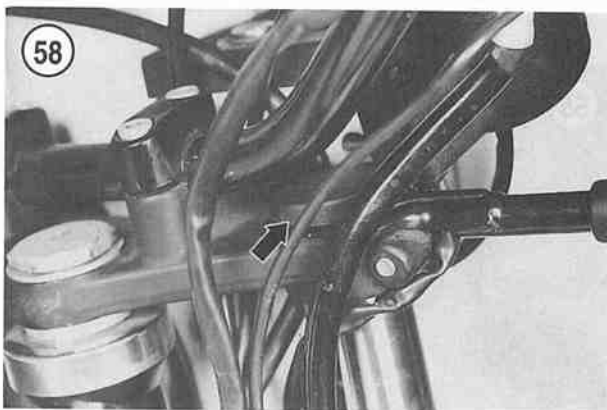
It is a good practice to change the fork oil at the interval listed in **Table 1** or once a year. If it becomes contaminated with dirt or water, change it immediately.

1. Place the bike on the centerstand.
2. Remove the plastic trim cap (**Figure 58**) from the top of each fork tube.
3. Place a drain pan under the right-hand and left-hand fork sliders.

**NOTE**

*Due to the number of models and years covered, this is a typical fork oil drain plug location. The drain plug location may vary slightly, but all drain plugs are located at the base of the fork slider.*

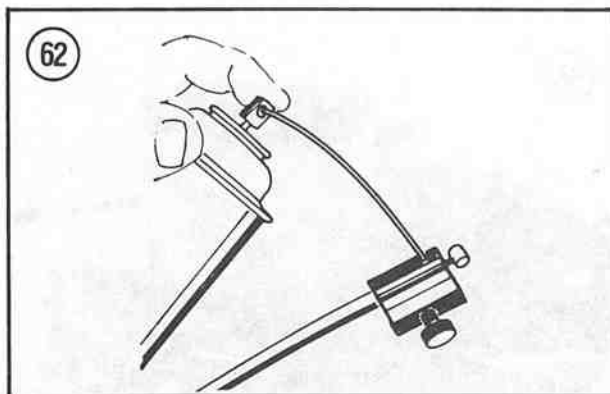
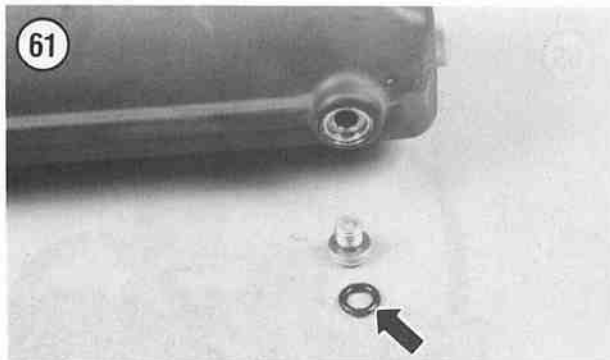
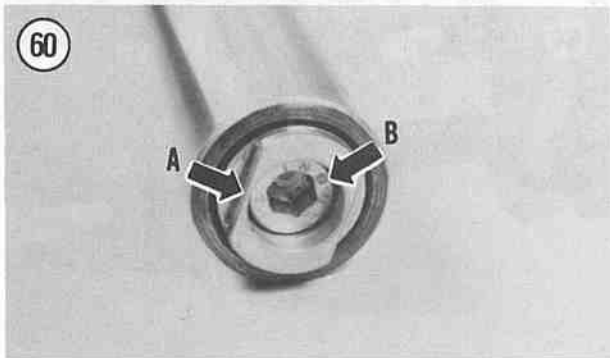
4. Remove the oil drain plug (**Figure 59**) from each fork slider.



**NOTE**

*Figure 60 is shown with the fork assembly removed for clarity. It is not necessary to remove the fork assembly to change the fork oil.*

5. Hold onto the fork top cap bolt (A, **Figure 60**) to prevent it from turning.
6. Unscrew the oil filler plug (B, **Figure 60**) from the fork top cap bolt.
7. Repeat Step 5 and Step 6 for the other fork leg.
8. Allow the fork oil to drain for 10-15 minutes to allow the fork oil to drain out.
9. Leave the bike on the centerstand. Sit on the seat, apply the front brake and lean on the handlebars and compress



the front forks several times to expel any additional fork oil. Get off of the seat.

10. Inspect the sealing washer (**Figure 61**) on the drain plug. Replace it if damaged in any way.
11. Install the sealing washer and drain plug in each fork leg and tighten securely.
12. Repeat Step 10 and Step 11 for the other fork leg.
13. Insert a small funnel into the opening in the fork spring retainer.

**NOTE**

*Use the recommended weight fork oil or the fork damping will be very stiff.*

**NOTE**

*To measure the correct amount of fluid, use a plastic baby bottle. These bottles have measurements in fluid ounces (oz.) and cubic centimeters (cc) on the side.*

14. Fill the fork leg with the correct viscosity and quantity of fork oil. Refer to **Table 5**. Remove the small funnel.
15. Repeat Step 13 and Step 14 for the other fork leg.
16. Leave the bike on the centerstand, sit on the seat and apply the front brake. Lean on the handlebars and compress the front forks several times to expel any trapped air in the fork assemblies and to distribute the fork oil. Get off of the seat.
17. Inspect the sealing washer on the oil filler plug. Replace if damaged in any way.
18. Install the sealing washer and oil filler plug in each fork spring retainer and tighten securely.
19. Install the plastic trim cap.
20. Repeat Steps 17-19 for the other fork assembly.
21. Road test the bike and check for leaks.

**Control Cables**

The control cables should be lubricated at the interval listed in **Table 1**. They should also be inspected at this time for fraying and the cable sheath checked for chafing. The cables are relatively inexpensive and should be replaced when found to be faulty.

The control cables can be lubricated either with a cable lubricant and a cable lubricator available at most motorcycle dealers.

**NOTE**

*The main cause of cable breakage or cable stiffness is improper lubrication. Maintaining the cables as described in this section will assure long cable service life.*

1. Disconnect the cable from the clutch, the choke (models so equipped) and the throttle grip assemblies. Refer to Chapter Five and Seven for cable removal procedures.
2. Attach a lubricator following the manufacturer's instructions (**Figure 62**).

**NOTE**

Place a shop cloth at the end of the cable(s) to catch all excess lubricant that will flow out.

3. Insert the nozzle of the lubricant can in the lubricator, press the button on the can and hold down until the lubricant begins to flow out of the other end of the cable.

**NOTE**

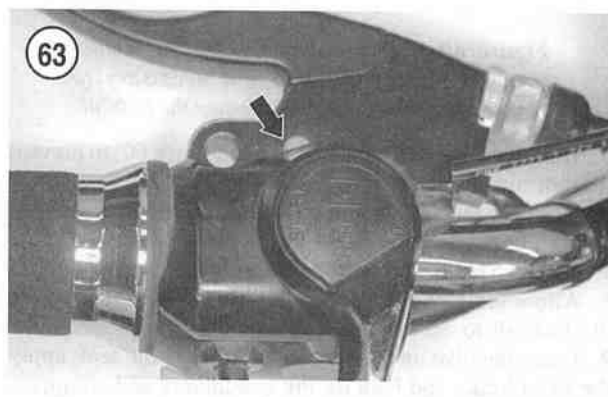
If the lubricant does not flow out of the other end of the cable, check the entire length of the cable for fraying, bending or other damage.

4. Remove the lubricator, reconnect the cable(s) and adjust the cables as described in this chapter.

**Miscellaneous Lubrication Points**

Lubricate the clutch lever (**Figure 63**), front brake lever (**Figure 64**), sidestand pivot point, centerstand pivot point on each side and the footpeg pivot points. Use SAE 10W-40 engine oil.

If the sidestand and centerstand pivot points will not respond to lubrication by the engine oil, remove the assemblies, clean and lubricate them as described in Chapter Twelve.

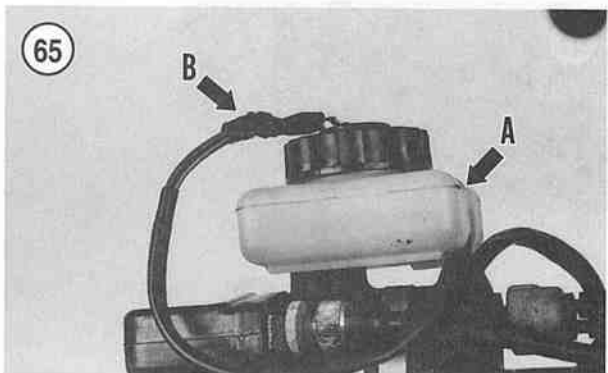
**PERIODIC MAINTENANCE****Disc Brake Fluid Level**

The fluid level should be up between the MAX and MIN marks within the reservoir. Refer to A, **Figure 65** or **Figure 66**.

If the brake fluid level reaches the lower level mark, visible through the master cylinder's transparent reservoir, the fluid level must be corrected by adding fresh brake fluid.

**Front master cylinder (frame mounted models)**

1. Remove the fuel tank as described in Chapter Seven.
2. Place the bike on level ground so the front master cylinder reservoir is level.
3. Clean any dirt from the area around the top cover before removing the cover.
4. Disconnect the electrical connector (B, **Figure 65**) from the top cover.
5. Unscrew the top cover (**Figure 67**).
6. Add brake fluid until the level is to the upper line on the master cylinder reservoir.

**WARNING**

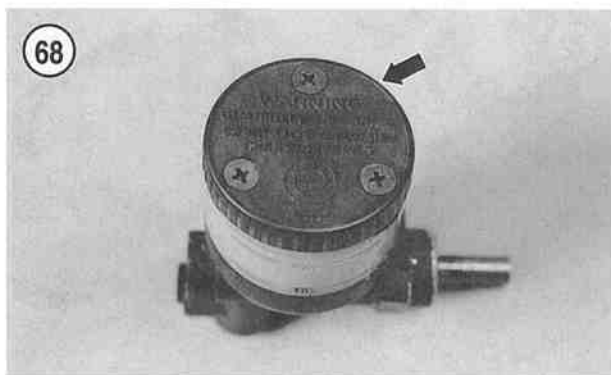
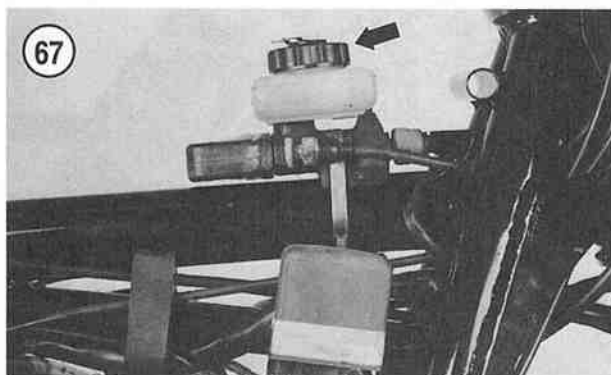
Use brake fluid from a sealed container and clearly marked DOT 4 only and specified for disc brakes. Others may vaporize and cause brake failure. Do not intermix different brands or types of brake fluid as they may not be compatible. Do not intermix a silicone based

(DOT 5) brake fluid as it can cause brake component damage leading to brake system failure.

#### CAUTION

Be careful when handling brake fluid. Do not spill it on painted or plated surfaces or plastic parts as it will destroy the surface. Wash the area immediately with soapy water and thoroughly rinse it off.

7. Reinstall the top cover (Figure 67) and tighten securely.



8. Connect the electrical connector (B, Figure 65) onto the top cover.  
9. Install the fuel tank as described in Chapter Seven.

#### Front master cylinder (handlebar mounted models)

1. Place the bike on level ground and position the handlebars so the front master cylinder reservoir is level.  
2. Clean any dirt from the area around the top cover before removing the cover.

#### NOTE

Figure 68 is shown with the master cylinder removed for clarity. It is not necessary to remove it for this procedure.

3A. On 1978-1980 models, remove the screws securing the top cover (Figure 68). Remove the top cover, washer and the rubber diaphragm.

3B. On 1981-on models, remove the screws securing the top cover. Remove the top cover (Figure 69), gasket and the rubber diaphragm.

4. Add brake fluid until the level is to the MAX line on the master cylinder reservoir (Figure 66).

#### WARNING

Use brake fluid from a sealed container and clearly marked DOT 4 only and specified for disc brakes. Others may vaporize and cause brake failure. Do not intermix different brands or types of brake fluid as they may not be compatible. Do not intermix a silicone based (DOT 5) brake fluid as it can cause brake component damage leading to brake system failure.

#### CAUTION

Be careful when handling brake fluid. Do not spill it on painted or plated surfaces or plastic parts as it will destroy the surface. Wash the area immediately with soapy water and thoroughly rinse it off.

5A. On 1978-1980 models, reinstall the rubber diaphragm, washer and the top cover.

5B. On 1981-on models, reinstall the rubber diaphragm, gasket and the top cover.

6. Tighten the top cover screws securely.

#### Rear master cylinder

1. Place the bike on level ground so the rear master cylinder reservoir is level.

2. Remove the frame right-hand side panel.

3. Disconnect the electrical connector from the top cover.

4. Clean any dirt from the area around the top cover before removing the cover.



5. Unscrew and remove the top cover.
6. Add brake fluid until the level is to the MAX level line within the master cylinder reservoir.

**WARNING**

Use brake fluid from a sealed container and clearly marked DOT 4 only and specified for disc brakes. Others may vaporize and cause brake failure. Do not intermix different brands or types of brake fluid as they may not be compatible. Do not intermix a silicone based (DOT 5) brake fluid as it can cause brake component damage leading to brake system failure.

**CAUTION**

Be careful when handling brake fluid. Do not spill it on painted or plated surfaces or plastic parts as it will destroy the surface. Wash the area immediately with soapy water and thoroughly rinse it off.

7. Reinstall the top cover and tighten the top cover securely.
8. Connect the electrical connector onto the top cover.
9. Install the frame right-hand side panel.

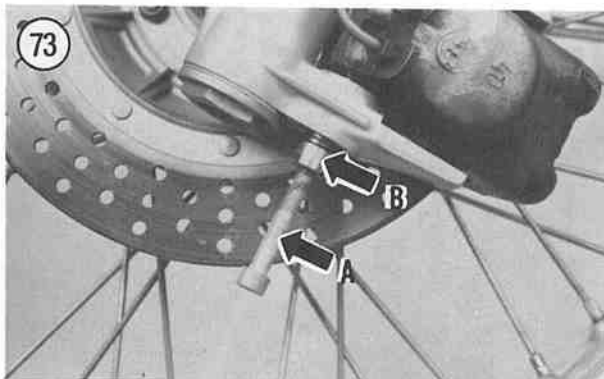
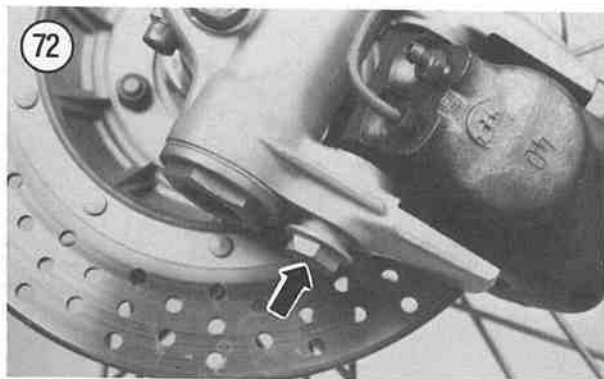
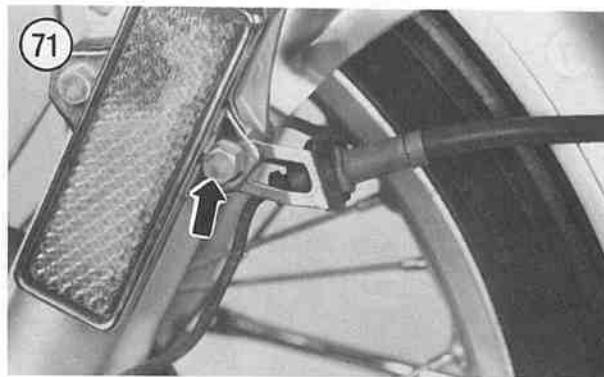
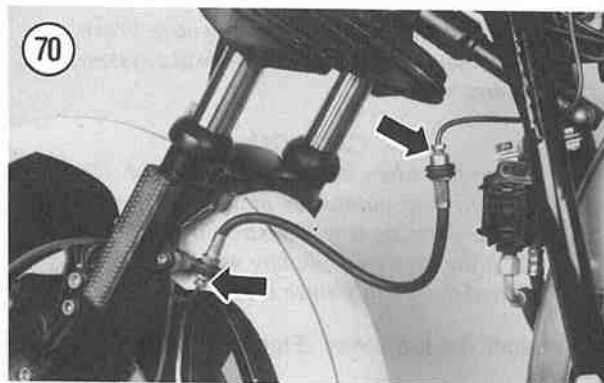
### Disc Brake Lines

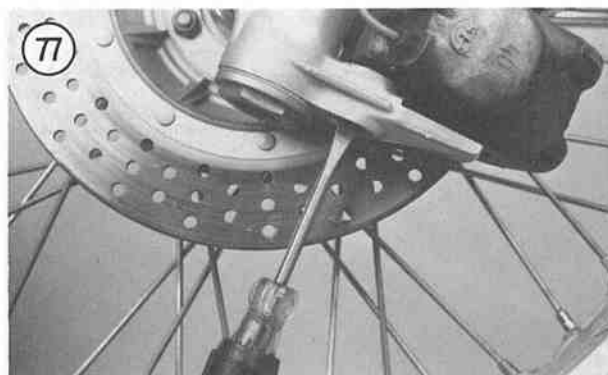
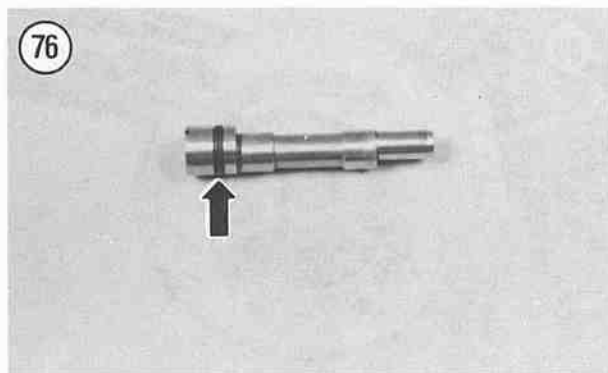
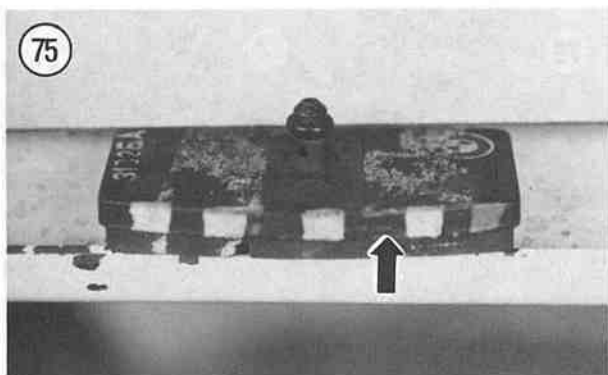
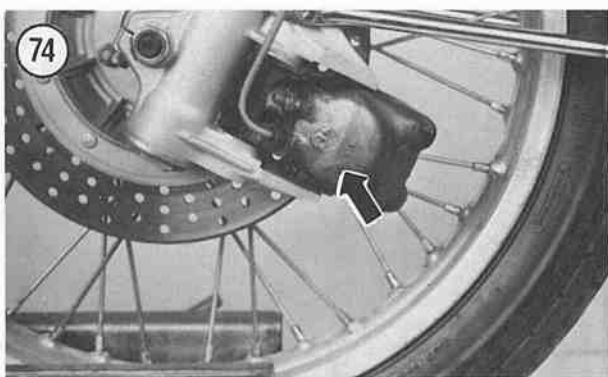
Check the brake lines and hoses between the master cylinder(s) and the brake caliper(s). If there is any leakage, tighten the connections (Figure 70) and bleed the brakes as described under *Bleeding the System* in Chapter Eleven. If this does not stop the leak or if a brake line is obviously damaged, cracked or chafed, replace the brake line and bleed the system as described in Chapter Eleven.

### Front Disc Brake Pad Wear (1974-1977 Models)

Inspect the brake pads for excessive or uneven wear.

1. Place the bike on the centerstand.
2. To prevent accidental application of the front brake lever, place a spacer between the front brake lever and the hand grip. Hold the spacer in place with a large rubber band, a tie wrap or a piece of tape.
3. To allow slack in the hydraulic brake lines, remove the bolt (Figure 71) securing the brake lines and bracket to the front fork.
4. Unscrew the cap screw (Figure 72) from the base of the fork boss. Remove the cap screw and spring.
5. Screw an 8 mm  $\times$  1.25  $\times$  50 mm bolt (A, Figure 73) into the bearing pin (B, Figure 73). Withdraw the bearing pin from the brake caliper and fork slider.
6. Slide the caliper assembly off of the brake disc (Figure 74).
7. Look into the caliper assembly and check the pad thickness (Figure 75).





8. Replace both pads if they are worn to the wear limit line on the pad. Refer to *Brake Pad Replacement* in Chapter Eleven.

9. If the brake pads are okay, perform the following:

- Carefully reinstall the caliper assembly onto the brake disc, taking care not to damage the leading edges of the pads.
- Install the bearing pin bolt and tighten securely.

10. Thoroughly lubricate the bearing pin bolt and the bolt receptacle in the front fork and the pivot portion of the brake caliper with a good grade of silicone brake grease (Molykote BR2 or equivalent).

11. Install the front caliper onto the mounting boss on the fork slider.

12. Make sure the O-ring seal (**Figure 76**) is in place, then install the bearing pin. Push it all the way in.

13. Align the caliper assembly to the disc as follows:

- Insert a flat-bladed screwdriver (**Figure 77**) up into the receptacle in the fork.
- Rotate the eccentric adjuster (bearing pin) until the caliper assembly is positioned the farthest distance away from the brake disc.
- Slowly turn the eccentric in the opposite direction until the fixed brake pad (inboard pad) is parallel to the brake disc.
- Apply radial marks to the inboard surface of the brake disc with a wide-tip felt marking pen.
- Remove the spacer between the front brake lever and the hand grip.
- Spin the front wheel and apply the front brake several times.
- Observe how the felt marker radial lines have been wiped off. If the marks are removed evenly and completely, the inner pad is making full contact, indicating that the caliper is aligned correctly. If the marks are only wiped off a portion of the disc, readjust the caliper.

14. Install the spring and cap screw (**Figure 72**). Tighten the cap screw to the torque specification listed in **Table 4**.

15. Move the hydraulic brake lines and bracket into position on the front fork and install the bolt (**Figure 71**). Tighten the bolt securely.

### Front and Rear Disc Brake Pad Wear (1978-on Models)

Inspect the brake pads for excessive or uneven wear.

1. Using a flat-bladed screwdriver, carefully pry off the plastic cover (**Figure 78**) from each caliper assembly.

2. Look down into the caliper assembly and check the pad thickness (**Figure 79**).

3. Replace both pads if they are worn to the service limit dimension of 1.5 mm (1/16 in.). Refer to *Brake Pad Replacement* in Chapter Eleven.

4. If the brake pads are okay, reinstall the plastic cover on each caliper assembly.

## Disc Brake Fluid Change

Every time the reservoir cap is removed, a small amount of dirt and moisture enters the brake fluid. The same thing happens if a leak occurs or if any part of the hydraulic system is loosened or disconnected. Dirt can clog the system and cause unnecessary wear. Water in the brake fluid vaporizes at high temperature, impairing the hydraulic action and reducing the brake's stopping ability.

To maintain peak performance, change the brake fluid at the interval indicated in **Table 1**. To change brake fluid, follow the *Bleeding the System* procedure in Chapter Eleven. Continue adding new fluid to the master cylinders and bleeding out at the calipers until the fluid leaving the caliper is clean and free of contaminants.

### WARNING

*Use brake fluid from a sealed container and clearly marked DOT 4 only and specified for disc brakes. Others may vaporize and cause brake failure. Do not intermix different brands or types of brake fluid as they may not be compatible. Do not intermix a silicone based (DOT 5) brake fluid as it can cause brake component damage leading to brake system failure.*

## Drum Brake Lining Inspection

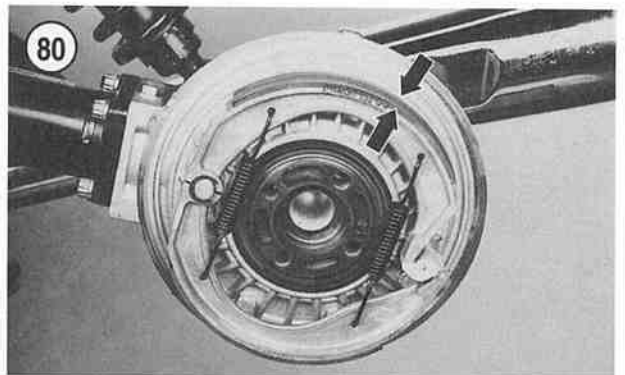
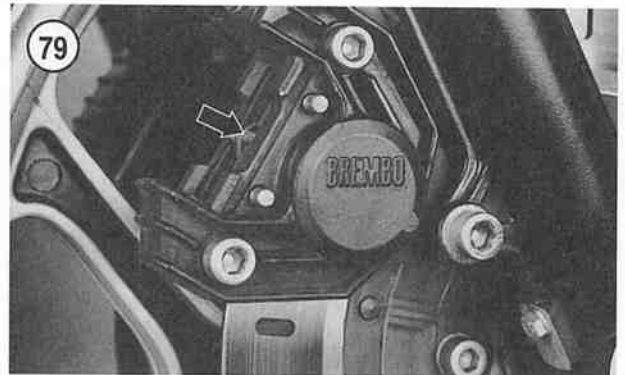
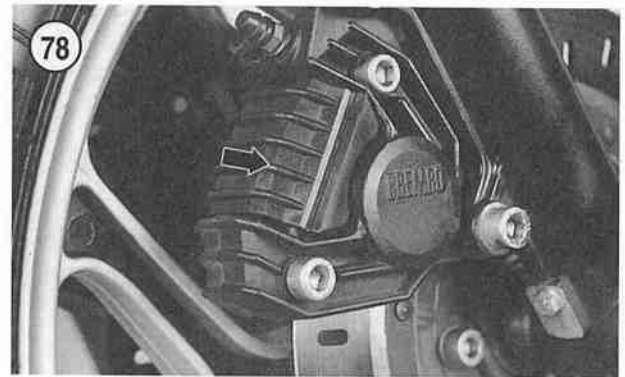
Inspect the brake lining thickness at the interval listed in **Table 1**. Neither the front or rear drum brake assemblies are equipped with a brake lining wear indicator.

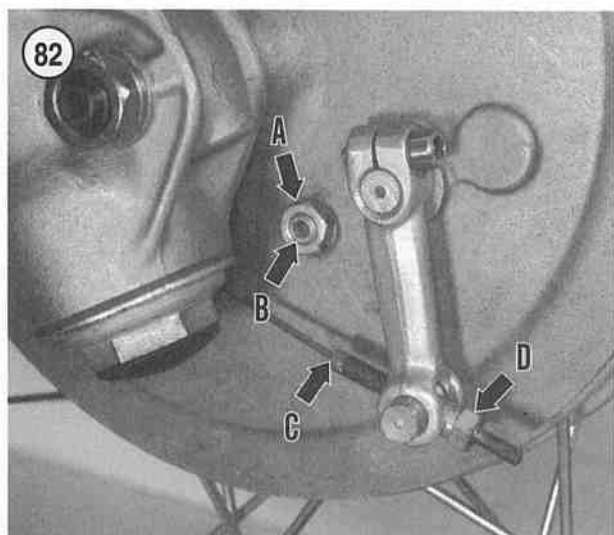
1. Remove the brake panel assembly as described under *Front Drum Brake* or *Rear Drum Brake* in Chapter Eleven.
2. Using a vernier caliper, measure the thickness of the brake lining (**Figure 80**).
3. Replace the brake linings if they are worn to the service limit dimension of 1.5 mm (1/16 in.). Refer to *Brake Lining Replacement* in Chapter Eleven.

## Front Drum Brake Adjustment

Adjust the front brake lever freeplay at the interval in **Table 1**. The lever freeplay will change with brake shoe wear. The brake lever must have 8-15 mm (0.31-0.59 in.) of free play as measured at the lever (**Figure 81**).

1. Place the bike on the centerstand.
2. Make sure the brake lever is in the at-rest position.
3. Loosen the locknut (A, **Figure 82**) on the adjustment cam.
4. Turn the adjusting cam (B, **Figure 82**) *counterclockwise* until it is tight, then stop.
5. From the position achieved in Step 4, turn the adjusting cam (B, **Figure 82**) *clockwise* until there is 4 mm (0.157 in.) free movement in the lower brake arm at the cable anchor before the brake shoe contacts the drum. Tighten the locknut (A, **Figure 82**).





6. Hold the threaded cable sleeve (C, **Figure 82**) with a wrench.

7. Turn the adjuster nut (D, **Figure 82**) until there is 4 mm (0.157 mm) free movement in the upper brake arm before the brake shoe contacts the drum.

8. Turn the front wheel slowly. The brake shoes should not be contacting the brake drum at this time. If you can hear brake shoe contact, and there is brake pedal free play, the brake shoe return spring(s) may be stretched or broken. Refer to *Front Brake Drum* in Chapter Eleven and correct the problem.

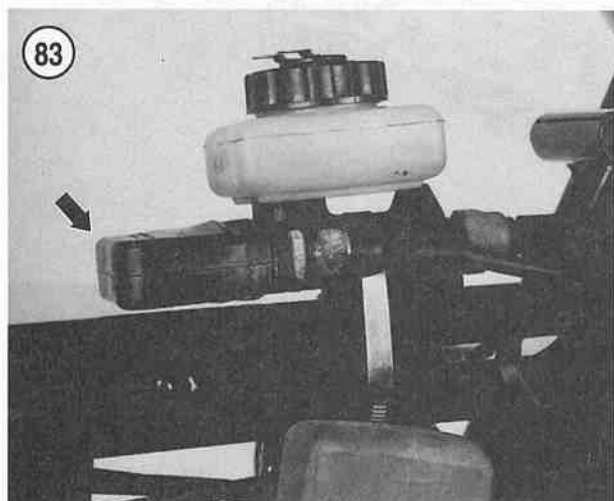
### Front Master Cylinder (Cable Operated) Cable Adjustment

The front master cylinder cable should be adjusted at the interval listed in **Table 1**. The correct clearance is 0.25 mm (0.010 in.). The cable will stretch with use and must be adjusted.

The end of the master cylinder piston must protrude the specified amount from the master cylinder body. This is necessary so that the fluid ports within the master cylinder will be uncovered, allowing the fluid to move from one chamber to the other.

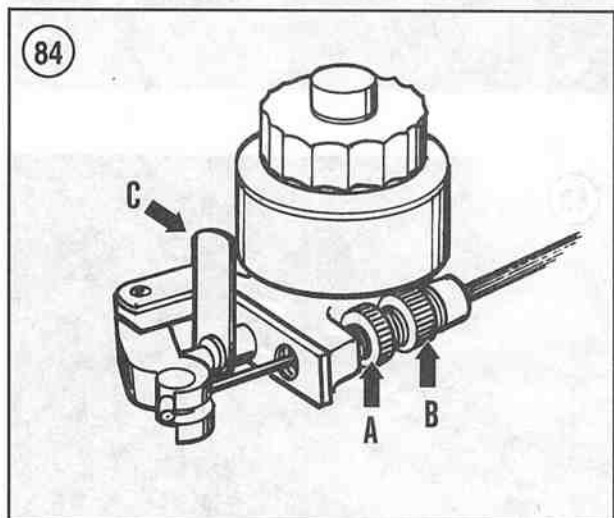
If there is no clearance and the cable actuation arm is in contact with the end of the master cylinder piston, it will not allow the piston to return to the at-rest position. If the end of the master cylinder piston does not protrude from the master cylinder body, disassemble and inspect the master cylinder as there is an internal problem that must be corrected. Refer to Chapter Eleven.

1. Remove the fuel tank as described in Chapter Seven.
2. Slide the rubber boot (**Figure 83**) off the end of the master cylinder.



#### NOTE

*If the original special feeler gauge is not available, use a 0.25 mm (0.010 in.) flat feeler gauge.*



3. Use the special feeler gauge provided in the factory tool kit and check the clearance between the end of the master cylinder piston and the cable actuation lever as shown in **Figure 84**.

4. The clearance is correct if there is a slight drag on the feeler gauge as it is moved back and forth (C, **Figure 84**).

5. If the clearance is not correct, perform the following.
  - a. Loosen the locknut (A, **Figure 84**) on the cable.
  - b. Turn the adjuster nut (B, **Figure 84**) in either direction until the correct amount of clearance is achieved.
  - c. Hold onto the adjuster nut and tighten the locknut securely.
  - d. Recheck the clearance and readjust if necessary.

6. While the fuel tank is removed, inspect the fluid level in the master cylinder as described in this chapter.



7. Slide the rubber boot (**Figure 83**) onto the end of the master cylinder. Make sure it's on all the way.
8. Install the fuel tank as described in Chapter Seven.

### Rear Brake Pedal Height Adjustment

Adjust the rear brake pedal height at the interval listed in **Table 1**. The pedal height will change with brake shoe wear. The pedal height above the footpeg should be adjusted for individual rider preference. The top of the brake pedal (**Figure 85**) should be positioned so it is close to the rider's boot sole in the normal riding position.

#### NOTE

*Figure 86 is a typical location for the adjust bolt and locknut. The bolt location on the brake pedal differs among the various models.*

- To adjust the brake pedal height, perform the following:
- a. Loosen the locknut and turn the adjust bolt (**Figure 86**) in either direction until the desired height is achieved.
  - b. Hold onto the adjust bolt and tighten the locknut securely.

### Rear Drum Brake Pedal Freeplay Adjustment

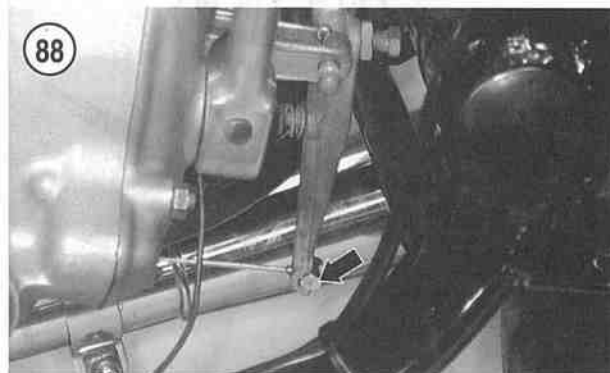
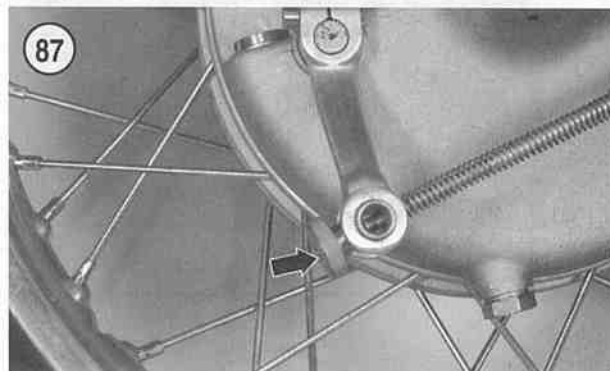
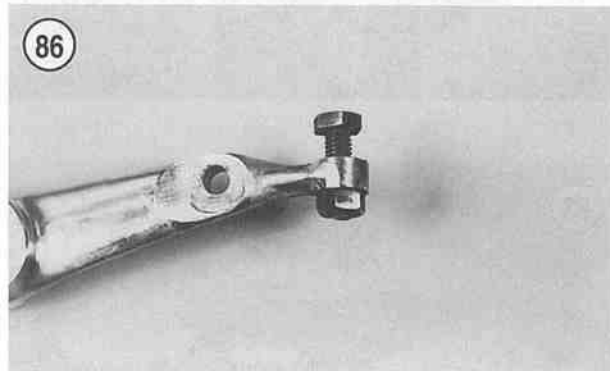
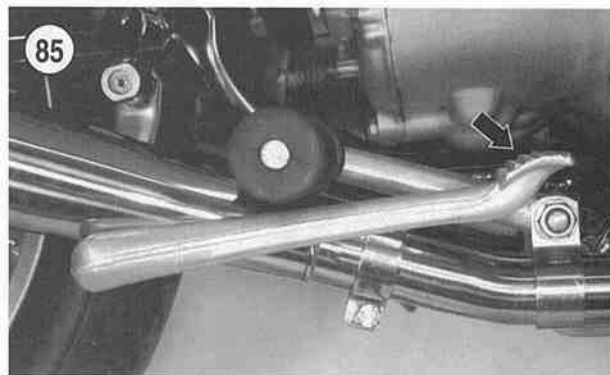
The rear brake pedal freeplay should be adjusted at the interval listed in **Table 1**. The pedal freeplay will change with brake shoe wear.

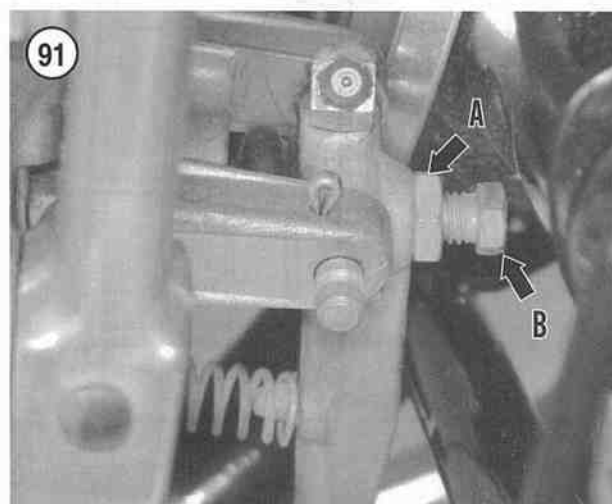
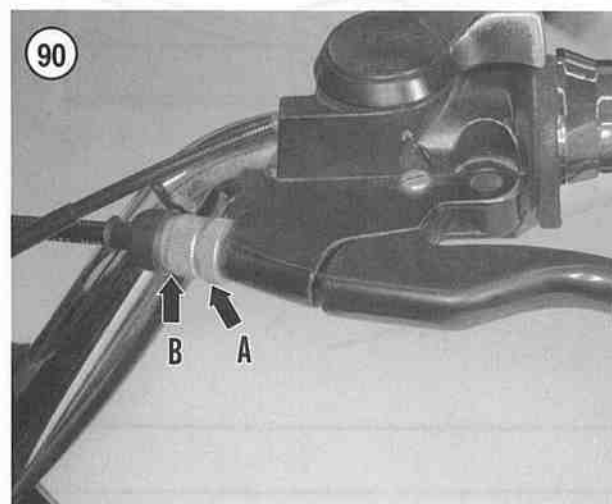
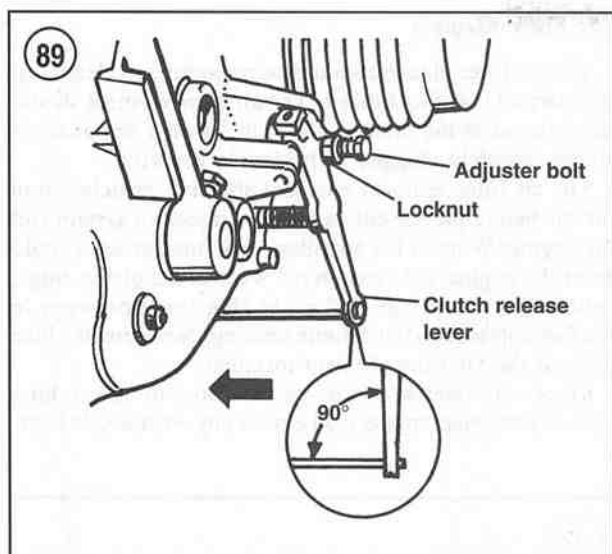
1. Place the bike on the centerstand.
2. Make sure the brake pedal is in the at-rest position.
3. Turn the rear wheel slowly and tighten the wing nut (**Figure 87**) on the end of the brake rod until the brake shoes just make contact with the brake drum. When you hear a slight grinding sound, contact is made – stop.
4. At this point, loosen the wing nut 3-5 complete turns.
5. Turn the rear wheel slowly. The brake shoes should not be contacting the brake drum at this time. If you can hear brake shoe contact, and there is brake pedal free play, the brake shoe return spring(s) may be stretched or broken. Refer to *Rear Brake Drum* in Chapter Eleven and correct the problem.

### Clutch Free Play Adjustment (1970-1980 Models)

Check and adjust the clutch at the interval indicated in **Table 1**. If the clutch slips when engaged or if the bike creeps forward when in gear, even with the clutch disengaged, the free play on the clutch release mechanism is out of adjustment.

1. At the clutch lever on the transmission case, perform the following:





- a. Push on the clutch lever at the clutch cable end (**Figure 88**) by hand until resistance is felt. This is the free play.
- b. The clutch cable end of the clutch lever should move 2 mm (0.08 in.).
- c. If the free play is incorrect, adjust the clutch.

**NOTE**

*The clutch release lever should be 90° to the clutch cable when the clutch is fully engaged (**Figure 89**).*

2. To adjust, at the clutch hand lever, loosen the locknut (**A, Figure 90**) and turn the cable adjuster (**B, Figure 90**) in either direction until the correct amount of clutch free play is obtained. If the correct amount of freeplay cannot be achieved by adjusting the cable at the hand lever, proceed to Step 4.
3. Tighten the cable adjuster locknut (**A, Figure 90**) securely.
4. At the clutch hand lever, loosen the locknut (**A, Figure 90**) and turn the cable adjuster (**B, Figure 90**) in all the way in toward the locknut.
5. Tighten the cable adjuster locknut (**A, Figure 90**) securely.
6. At the clutch release lever on the transmission case, perform the following:
  - a. Loosen the locknut (**A, Figure 91**) and turn the adjust bolt (**B, Figure 91**) in either direction until the correct amount of clutch free play is obtained.
  - b. Tighten the adjust locknut (**A, Figure 91**) to the torque specification listed in **Table 4**.
7. If necessary, for fine adjustment, adjust at cable adjuster (**B, Figure 90**) at the hand level.
8. After adjustment is complete, check that the locknuts are tight at the clutch hand lever and at the clutch release lever on the transmission case.
9. Apply the clutch hand lever several times to make sure the cable has seated correctly. Recheck the free play.
10. Road test the bike to make sure the clutch fully disengages when the lever is pulled in; if it does not, the bike will creep in gear when stopped. Also make sure the clutch fully engages; if it does not, the clutch will slip, particularly when accelerating in high gear.
11. If the proper amount of adjustment cannot be achieved using this procedure, the cable has stretched to the point where it needs replacing. Refer to *Clutch Cable Replacement* in Chapter Five for complete procedure.

### Clutch Free Play Adjustment (1981-on Models)

Check and adjust the clutch at the interval indicated in **Table 1**. If the clutch slips when engaged or if the bike creeps forward when in gear, even with the clutch disengaged, the free play on the clutch release mechanism is out of adjustment.

1. At the clutch lever on the handlebar, perform the following:
  - a. Pull the clutch hand lever until resistance is felt. This is the free play.
  - b. The clutch hand lever should move so there is a gap between the clutch lever stop and the clamp (**Figure 92**) of 1.5-2.5 mm (0.06-0.10 in.).
  - c. If the free play is incorrect, adjust the clutch.
2. To adjust, at the clutch hand lever, loosen the locknut (**A**, **Figure 90**) and turn the cable adjuster (**B**, **Figure 90**) in either direction until the exposed length of clutch cable at the transmission case is 201-203 mm (7.91-7.99 in.). Refer to dimension "A" in **Figure 93**.

#### NOTE

*At this point the clutch release lever should be angled rearward by about 4°.*

3. Tighten the cable adjuster locknut (**A**, **Figure 90**) securely.
4. At the clutch release lever on the transmission case, perform the following:
  - a. Loosen the locknut (**A**, **Figure 93**) and turn the adjust bolt (**B**, **Figure 93**) in either direction until the correct amount of clutch free play is obtained at the clutch hand lever as described in sub-step 1b.
  - b. Tighten the adjust locknut (**A**, **Figure 93**) securely.
5. After adjustment is complete, check that the locknuts are tight at the clutch hand lever and at the clutch release lever on the transmission case.
6. Apply the clutch hand lever several times to make sure the cable has seated correctly. Recheck the free play.
7. Road test the bike to make sure the clutch fully disengages when the lever is pulled in; if it does not, the bike will creep in gear when stopped. Also make sure the clutch fully engages; if it does not, the clutch will slip, particularly when accelerating in high gear.
8. If the proper amount of adjustment cannot be achieved using this procedure, the cable has stretched to the point where it needs replacing. Refer to *Clutch Cable Replacement* in Chapter Five for complete procedure.

### Camshaft Chain Tensioner Adjustment

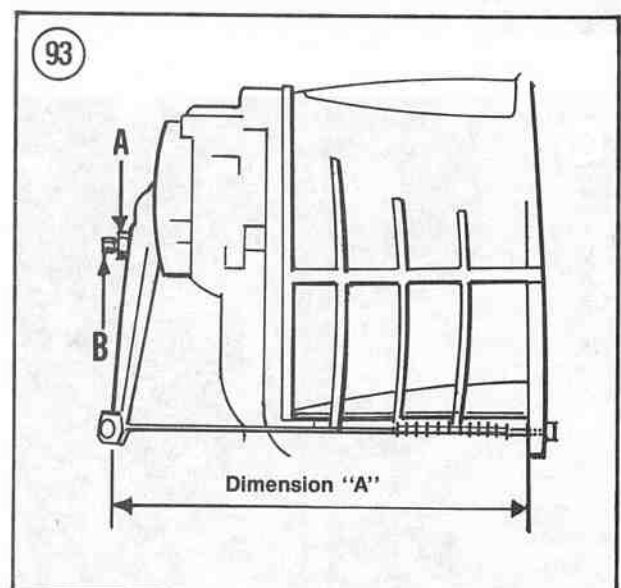
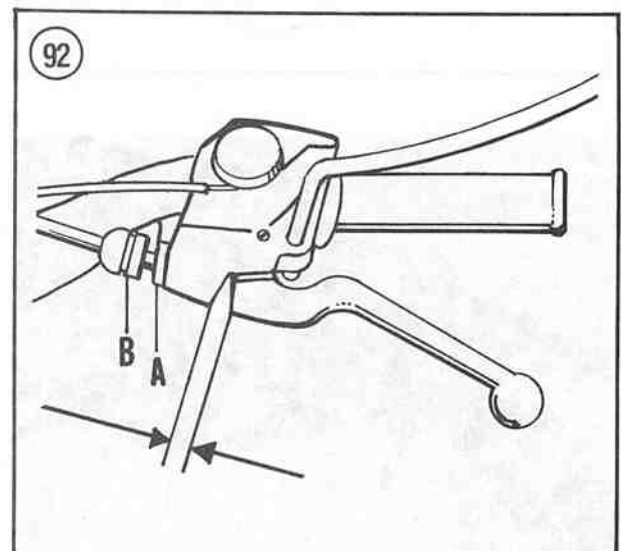
There is *no* provision for cam chain tensioner adjustment on this engine. Camshaft chain tension is maintained automatically.

### Air Filter Element

The air filter element should be removed and cleaned at the interval listed in **Table 1**. The air filter element should be replaced at the interval listed in **Table 1** or sooner if soiled, severely clogged or broken in any area.

The air filter removes dust and abrasive particles from the air before the air enters the fuel injection system and the engine. Without the air filter, very fine particles could enter the engine and cause rapid wear of the piston rings, cylinders and bearings and might clog small passages in the fuel injectors and/or throttle housing. Never run the bike without the air filter element installed.

Proper air filter servicing can do more to ensure long service from your engine than almost any other single item.



### Air Filter Element Removal/Cleaning/Installation (1970-1979 Models)

Refer to **Figure 94** for this procedure.

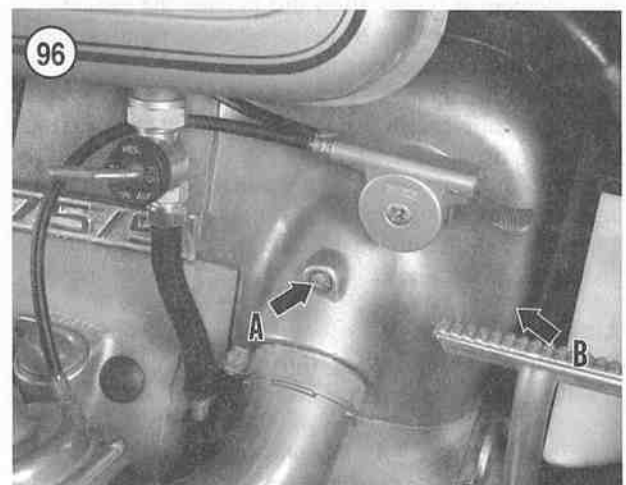
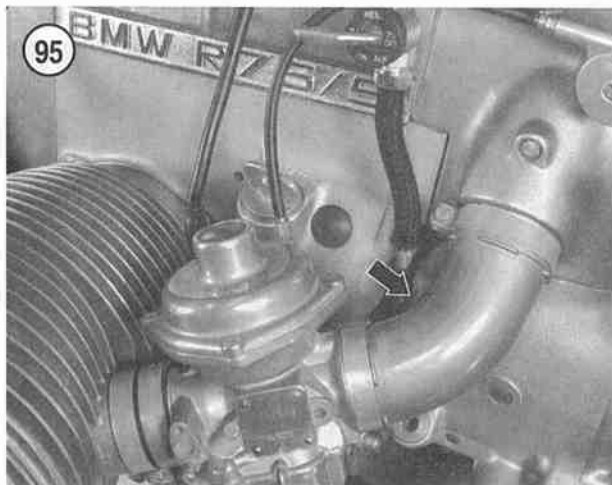
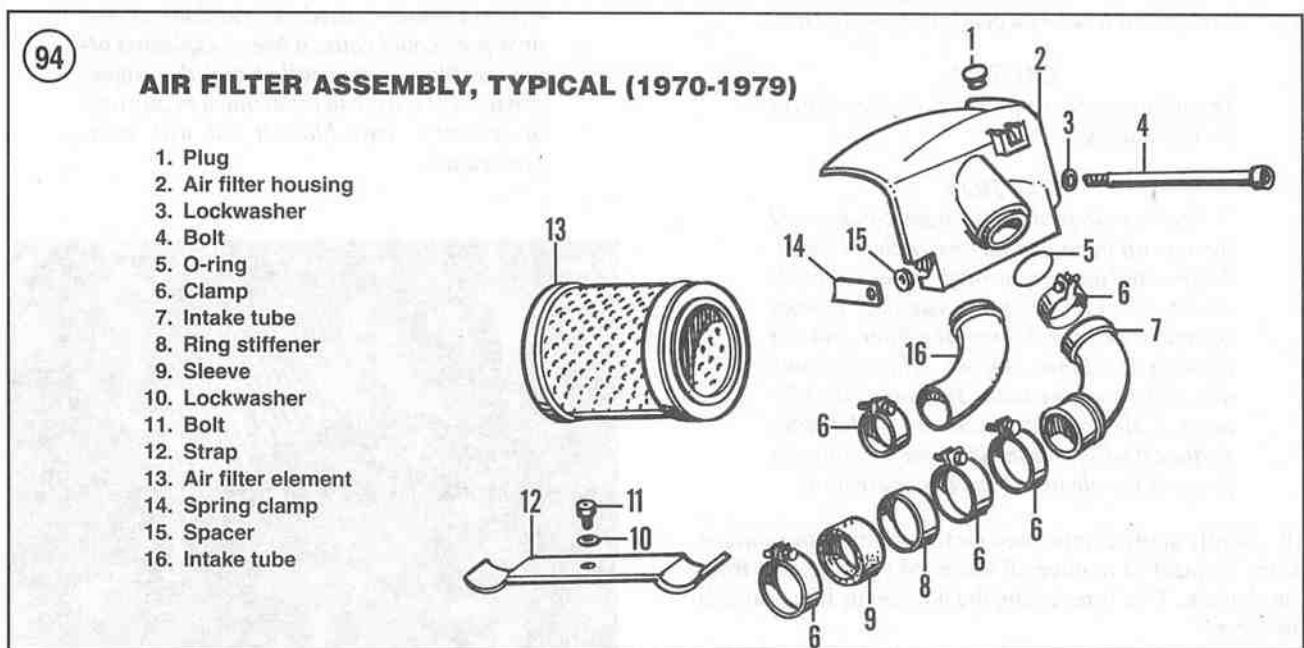
1. Place the bike on the centerstand.
2. On models so equipped, move the kickstarter down until it bottoms out. Tie it in this position to get it out of the way.
3. On 1979 models, perform the following:
  - a. Remove the fuel tank as described in Chapter Seven.
  - b. Remove the screws securing the starter cover and remove the cover.

c. Disconnect the engine breather hose from the air filter housing.

4. Loosen the hose clamps on the left-hand intake tube (**Figure 95**).

5. Carefully remove the left-hand intake tube from the engine air filter housing and the carburetor. Cover the carburetor inlet with tape or a plastic bag to keep out foreign matter.

6. Remove the screw (A, **Figure 96**) securing the left-hand air filter housing (B) and remove the housing from the crankcase. Move the housing out of the way, being careful not to kink or damage the choke cables.





7. Withdraw the air filter element (**Figure 97**) from the crankcase air filter housing air box. If the element is in good condition, place it in a resealable plastic bag and keep it clean so that it can be reused.
8. Wipe out the interior of the air box with a shop rag dampened with cleaning solvent. Remove any foreign matter that may have passed through a broken element.
9. Gently tap the air filter element to loosen the dust.

**WARNING**

*Never clean the air filter element in gasoline or low flash point cleaning solvent. If this type of cleaner is used, the residual solvent or vapors could cause a pre or explosion after the filter is reinstalled and the engine started. Do not clean the element in any type of solvent – blow it out with gentle compressed air.*

**CAUTION**

*Do not use high air pressure or the element will be damaged.*

**CAUTION**

*In the next step, do not direct compressed air toward the outer surface of the element. The normal air flow through the air filter element, when the engine is running, is from the outer surface through the filter and out through the inner surface. Therefore any dirt will be on the outer surface of the element. If air pressure is directed to the outer surface it will force the dirt and dust into the pores of the element, restricting air flow.*

10. Gently apply compressed air toward the inner surface of the element to remove all loosened dirt and dust from the element. This is reversing the normal air flow through the filter.

11. Inspect the element; if it is torn or damaged in any area, it must be replaced. Do not run the bike with a damaged element as it may allow dirt to enter the engine.

12. Install the air filter by reversing these removal steps. Note the following during installation.

13. Install the air filter element into the crankcase and press it in until it seats correctly onto the three studs (**Figure 98**) in the air box. Make sure the element is correctly seated into the air box so the sealing surface is tight up against the air box surface.

14. Make sure the intake tube clamp screws are secure to prevent a vacuum leak.

### **Air Filter Element Removal/Cleaning/Installation (1980-on Models)**

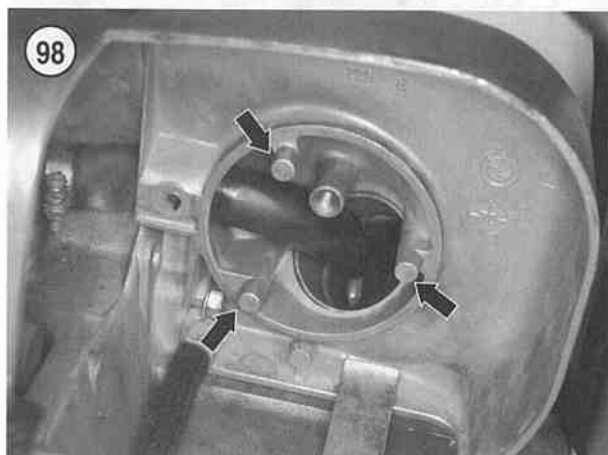
Refer to **Figure 99** for this procedure.

1. Place the bike on the centerstand.

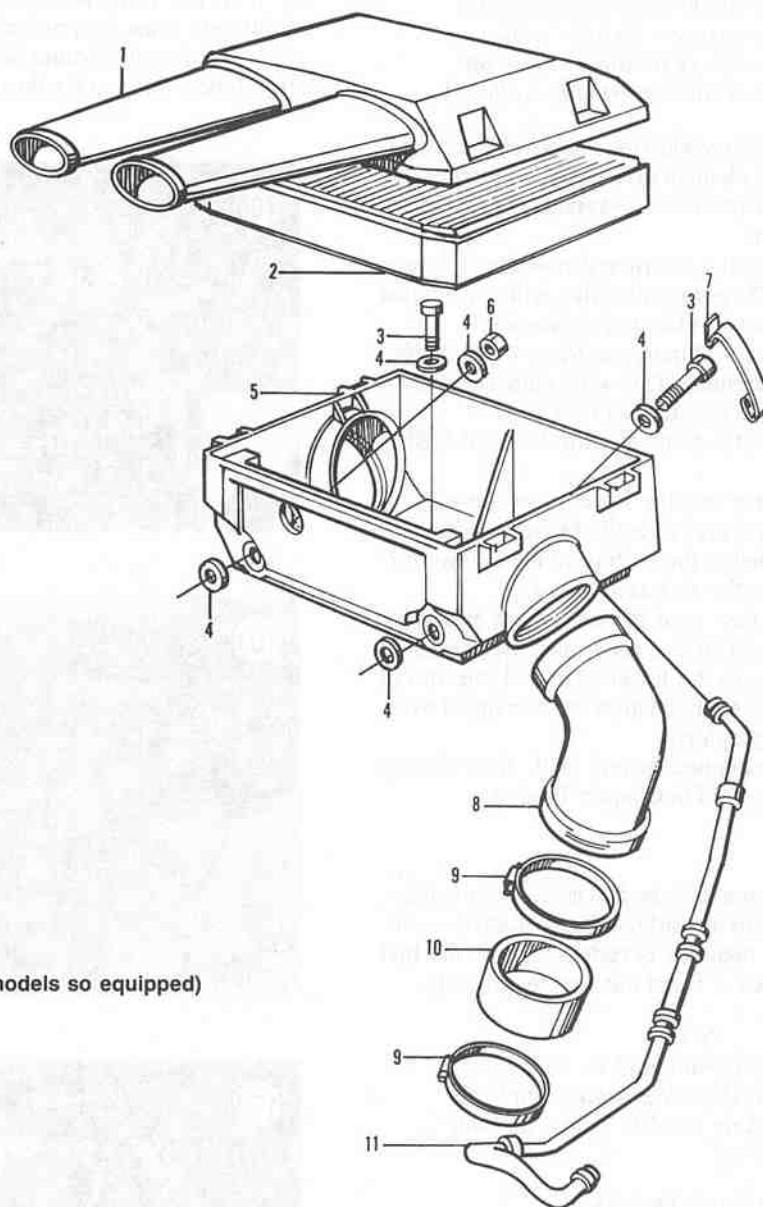
2. On models so equipped, remove both front fairing lower sections as described in Chapter Twelve.
3. Unhook the spring clamps (**Figure 100**) on each side securing the upper case to the lower case.
4. Raise the upper case away from the lower case and withdraw the air filter element (**Figure 101**) out through the left-hand side.
5. Wipe out the interior of the lower case with a shop rag dampened with cleaning solvent. Remove any foreign matter that may have passed through a broken element.
6. Gently tap the air filter element to loosen the dust.

**WARNING**

*Never clean the air filter element in gasoline or low flash point cleaning solvent. If this type of cleaner is used, the residual solvent or vapors could cause a fire or explosion after the filter is reinstalled and the engine started. Do not clean the element in any type of solvent – only blow it out with compressed air.*



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**AIR FILTER ASSEMBLY (1980-ON)**

1. Upper case
2. Air filter element
3. Bolt
4. Washer
5. Lower case
6. Nut
7. Spring clamp
8. Intake tube
9. Clamp
10. Rubber sleeve
11. Intake manifold (models so equipped)

**CAUTION**

*In the next step, do not direct compressed air toward the upper surface of the element. The normal air flow through the air filter element, when the engine is running, is from the upper side down through the element and out through the lower side. Therefore any dirt will be on the upper surface of the element. If air pressure is directed to the upper surface it will force the dirt and dust into the pores of the element, restricting air flow.*

7. Apply compressed air toward the bottom side, or throttle housing side, of the element to remove all loosened dirt and dust from the element. This is reversing the normal air flow through the filter.
8. Inspect the element; if it is torn or damaged in any area it must be replaced. Do *not* run the bike with a damaged element as it may allow dirt to enter the engine.
9. Apply a light coat of multipurpose grease to the sealing edges of the air filter element. This will assure an air-tight fitting of the element to the air filter case.
10. Position the air filter element with the TOP-OBEN arrow facing UP.
11. Install the air filter into the lower case and press it down to make sure it seats correctly. Make sure the element is correctly seated in the air box so the sealing surface is tight up against the air box surfaces.
12. Install the upper case onto the lower case and make sure it is correctly seated all the way around the perimeter. Secure the upper case to the lower case with the spring clamps. Make sure the spring clamps have snapped over-center and are holding tightly.
13. On models so equipped, install both front fairing lower sections as described in Chapter Twelve.

**Fuel Flow Test**

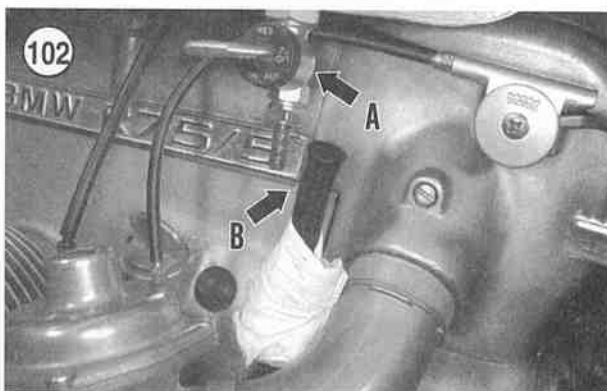
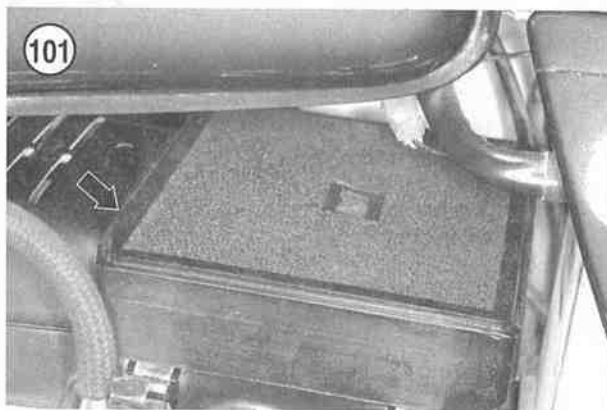
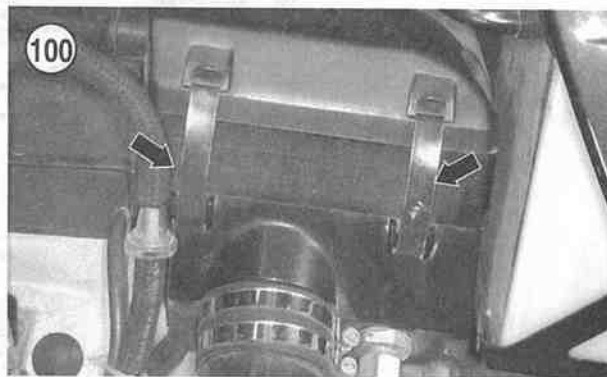
If there is any indication that the fuel is not flowing properly from the fuel tank to the carburetors, perform this simple test to see if the fuel line is restricted or if the fuel shutoff valve is clogged or is not functioning properly.

**NOTE**

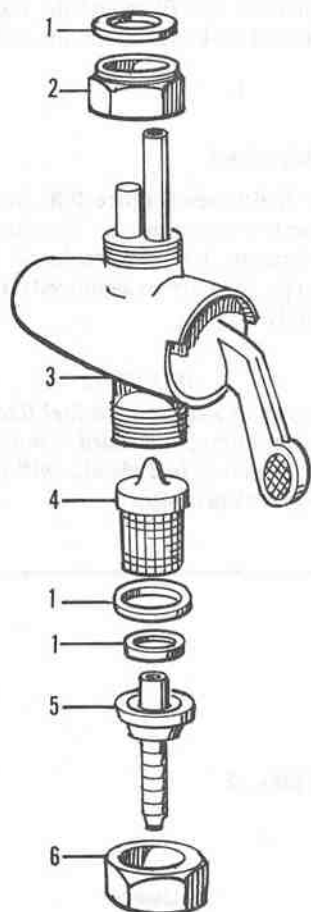
*On 1985-on California models, turn the ignition switch to the ON position. Fuel will **not** flow on these models if the ignition switch is turned off*

1. Make sure there is fuel in the tank.
2. Turn the fuel shutoff valve to the OFF position (A, Figure 102).
3. Disconnect the fuel line (B, Figure 102) from the carburetor.
4. Place the loose end in a container to catch the expelled fuel.
5. Turn the fuel shutoff valve to the ON position – fuel should flow from the fuel line.

6. Turn the fuel shutoff valve to the RES position – fuel should flow from the fuel line.
7. Turn the fuel shutoff valve to the OFF position – fuel should not flow from the fuel line.
8. If the fuel does not flow when it should, inspect the fuel lines for blockage or any kinks. If the fuel line is okay, remove and clean the fuel filter as described in this chapter.
9. If the fuel flows when it should not, the shutoff valve is faulty and must be repaired or replaced. Refer to *Fuel Shutoff Valves* in Chapter Seven.
10. Repeat this test for the other shutoff valve.



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**FUEL SHUTOFF VALVE NO. 1**

1. Gasket
2. Nut
3. Valve body
4. Filter
5. Hose connection
6. Coupling nut

**Fuel Shutoff Valve Filter(s)**

The integral fuel filter in the fuel shutoff valves removes particles in the fuel which might otherwise enter into the carburetors. Such particles could cause the float needle to stay in the open position or clog one of the jets. There is a shutoff valve and fuel hose on each side of the fuel tank.

There are 4 different models of fuel shutoff valves used among the various models and years. All shutoff valves are interchangeable. If your shutoff valve(s) is found to be faulty while performing this procedure, it is suggested that you replace it with the latest version. In this procedure, the fuel shutoff valves are referred to as Model No. 1, No. 2, etc. This refers to the sequence in which they were placed into production and is not a model number.

If any replacement parts are required, be sure to identify which shutoff valve(s) your bike is equipped with. There are no specific shutoff valve models equipped on any specific model or year. If you are not the original owner, a prior owner may have installed a newer valve(s). You may even have 2 different shutoff valves.

Clean the fuel filter at the interval listed in **Table 1**. Refer to **Figures 103-106** for this procedure.

**WARNING**

*Gasoline is very volatile and presents an extreme fire hazard. Be sure to work in a well-ventilated area away from any open flames (including pilot lights on household appliances). Do not allow anyone to smoke in the area and have a fire extinguisher rated for gasoline fires handy.*

1. Disconnect the battery negative lead as described under **Battery** in this chapter.
2. Turn the fuel shutoff valve to the OFF position (A, **Figure 102**) and disconnect the fuel line (B, **Figure 102**) from the valve.

**NOTE**

*The fuel tank can either be removed or left in place on the frame; drain all fuel from the fuel tank in either case.*

3. Install a longer piece of clean fuel line to the valve and place the loose end into a clean, sealable metal container. If the fuel is kept clean it can be reused.
4. Turn the fuel shutoff valve to the RES position and open the fuel filler cap. This will speed up the flow of fuel. Drain the fuel tank completely. Close the fuel filler cap.
- 5A. On Model No. 1 and No. 3, perform the following:
  - a. Unscrew the coupling nut securing the hose connector to the shutoff valve.
  - b. Remove the hose connector, gasket(s) and the fuel filter from the shutoff valve assembly.
  - c. Remove the fuel filter from the valve body.



- 5B. On Model No. 2, perform the following:
- Unscrew the hose connector from the shutoff valve assembly.
  - Remove the lower fuel filter from the valve body.

**NOTE**

*Shutoff valve No. 2 is equipped with an upper and lower filter.*

**CAUTION**

*The nut securing the fuel shutoff valve to the fuel tank has left-hand threads. Unscrew the nut clockwise.*

- 5C. On Models No. 2 and No. 4, perform the following:
- Unscrew the nut (A, **Figure 107**) securing the shutoff valve to the fuel tank.
  - Remove the shutoff valve (B, **Figure 107**) from the fuel tank.
  - Remove the fuel filter from the valve body.
6. After removing either the filter or the valve assembly, insert a corner of a clean shop cloth into the opening in the tank or valve to stop the dribbling of fuel onto the engine and frame.

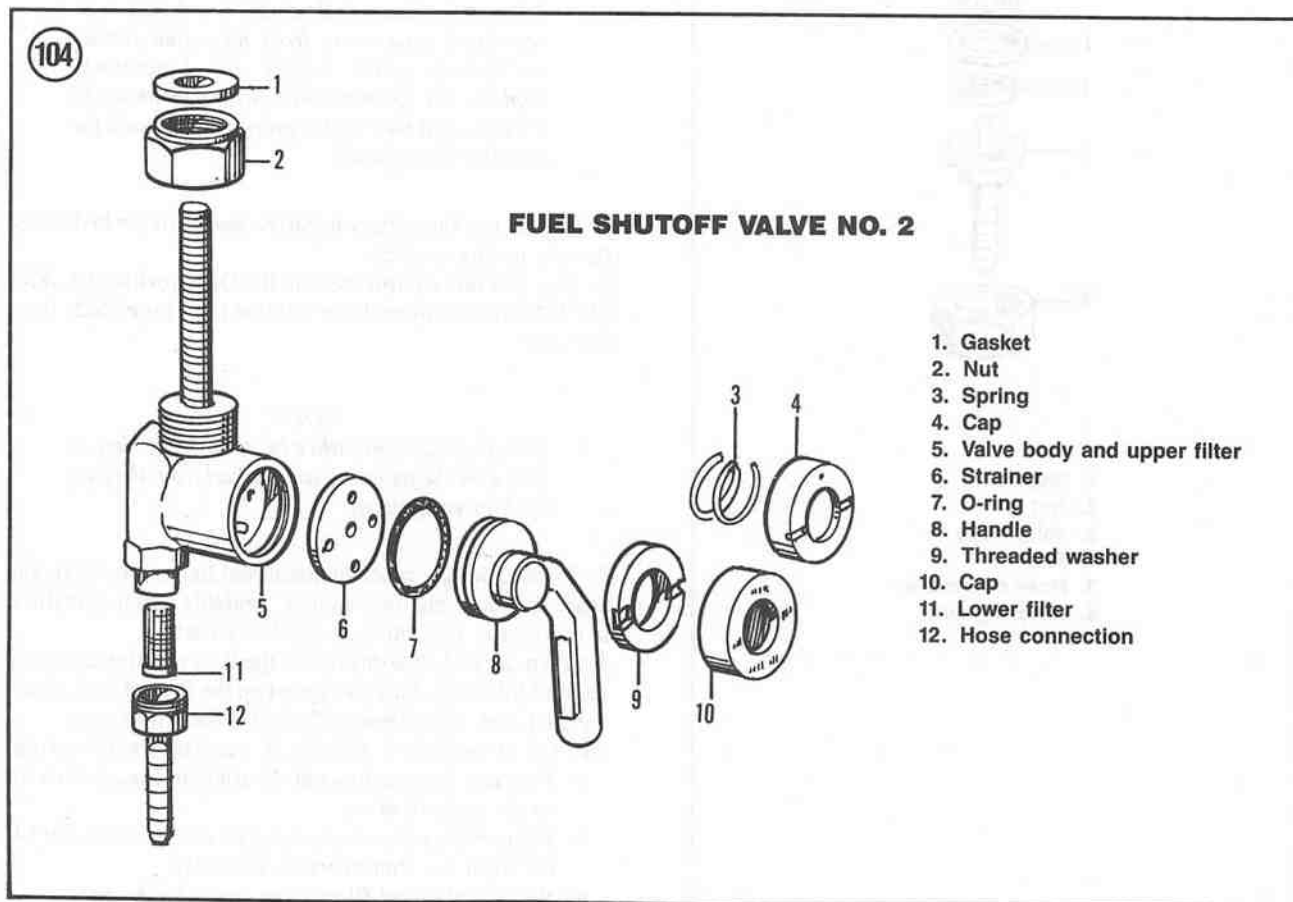
- Clean the fuel filter(s) with a medium soft toothbrush and blow out with compressed air.
- Inspect the fuel filter(s) for damage and replace if defective.
- Install by reversing these removal steps. Note the following during installation.
- On Models No. 2 and No. 4, be sure to install a new gasket between the fuel filter and the fuel tank.
- Refill the fuel tank and check for fuel leaks.

**Fuel Hose Inspection**

Inspect the fuel hoses (**Figure 108**) from the fuel tank to their respective components. If either is cracked or starting to deteriorate, it must be replaced. Also, make sure the hose clamps (models so equipped) are in place and holding securely.

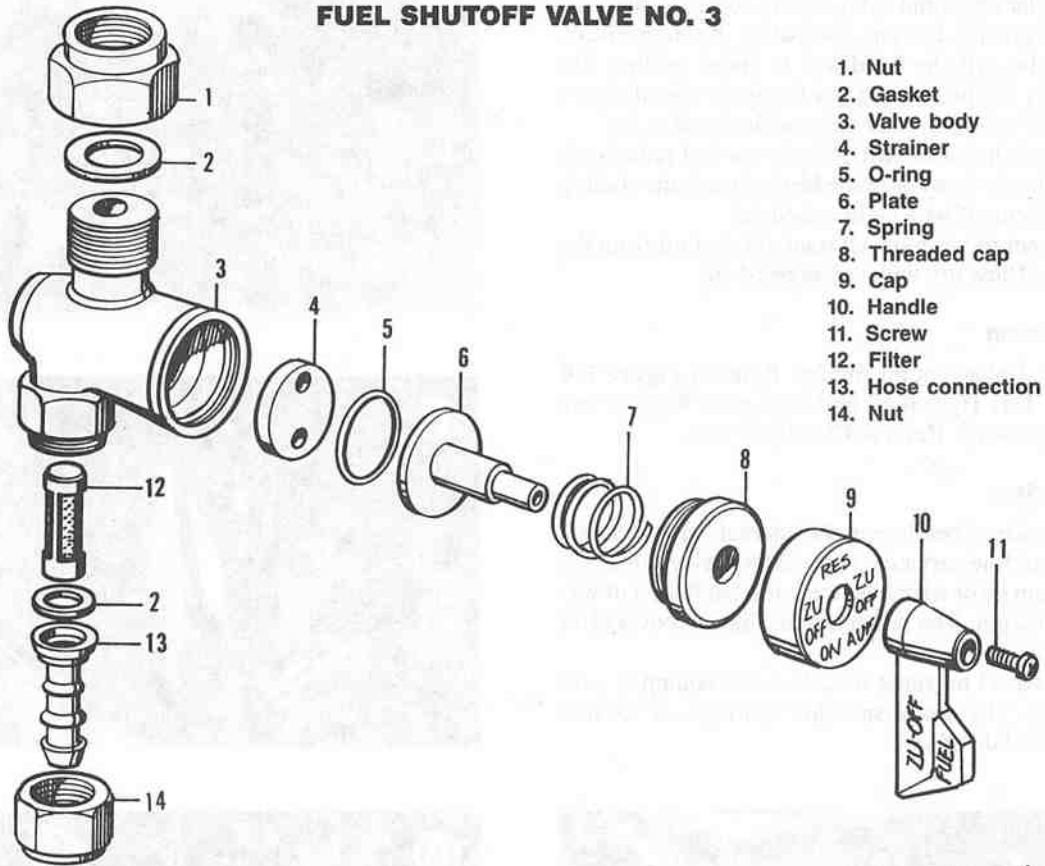
**WARNING**

*A damaged or deteriorated fuel line presents a very dangerous fire hazard to both the rider and the vehicle if fuel should spill onto a hot engine or exhaust pipe.*



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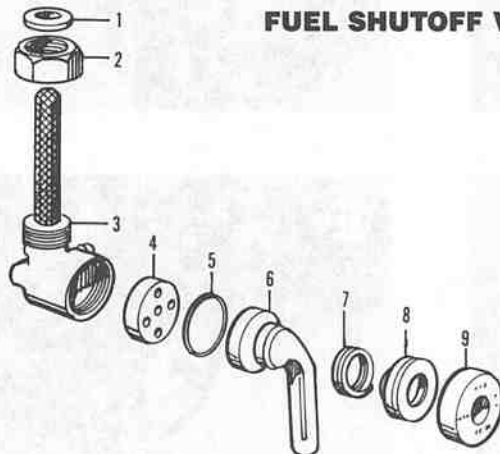
**FUEL SHUTOFF VALVE NO. 3**



- 1. Nut
- 2. Gasket
- 3. Valve body
- 4. Strainer
- 5. O-ring
- 6. Plate
- 7. Spring
- 8. Threaded cap
- 9. Cap
- 10. Handle
- 11. Screw
- 12. Filter
- 13. Hose connection
- 14. Nut

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**FUEL SHUTOFF VALVE NO. 4**



- 1. Gasket
- 2. Nut
- 3. Valve body and filter
- 4. Strainer
- 5. O-ring
- 6. Handle
- 7. Spring
- 8. Threaded cap
- 9. Cap

### Cooling Fins Inspection

The cylinder heads and cylinders are cooled by air passing over the cooling fins and dissipating the engine heat.

1. Inspect the cylinder head and cylinder cooling fins (**Figure 109**) for dirt, oil and any foreign matter that prevents them from doing what they are designed to do.
2. Use a wick brush or stiff paint brush and remove all foreign matter that may be embedded between the cooling fins. Blow them off with compressed air.
3. Use solvent to wash off all road dirt and oil from the cooling fins. Blow dry with compressed air.

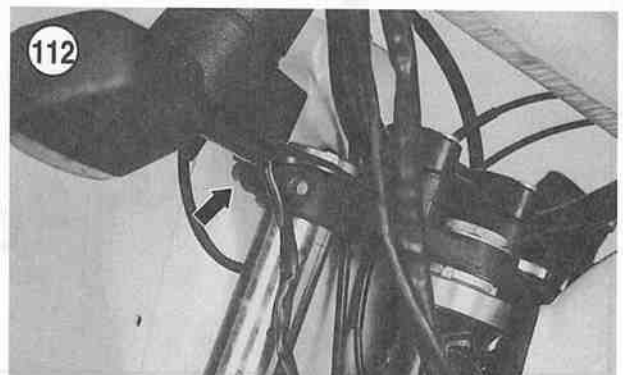
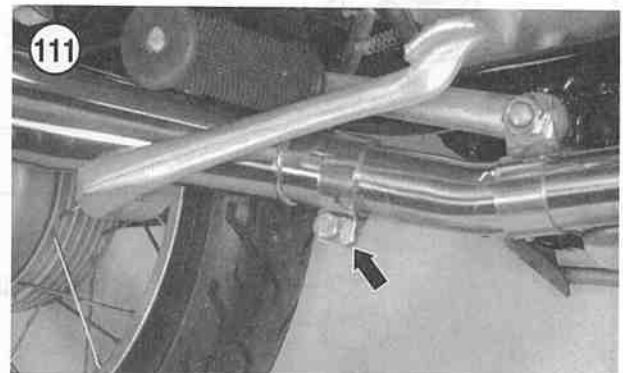
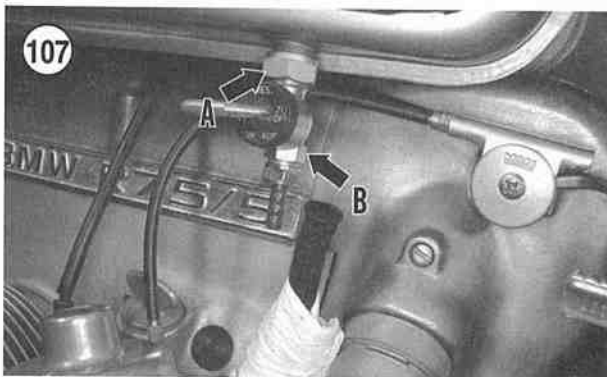
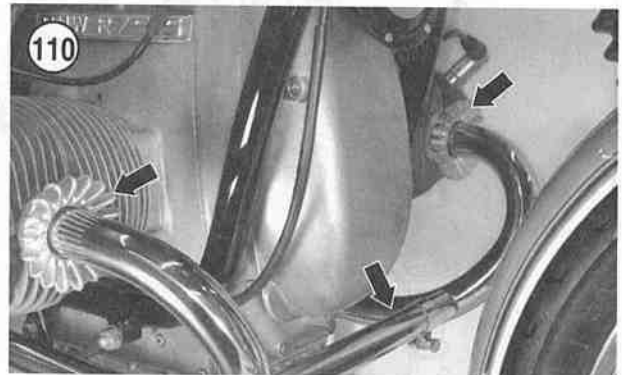
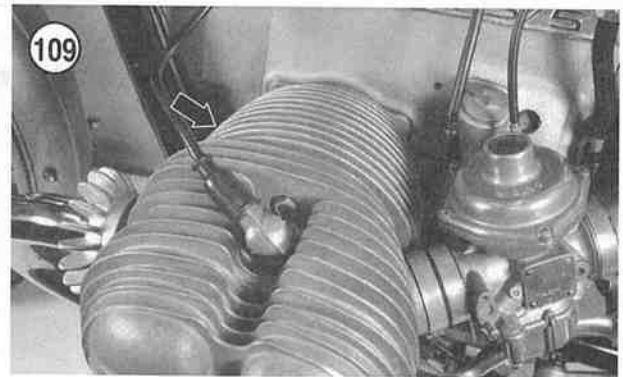
### Exhaust System

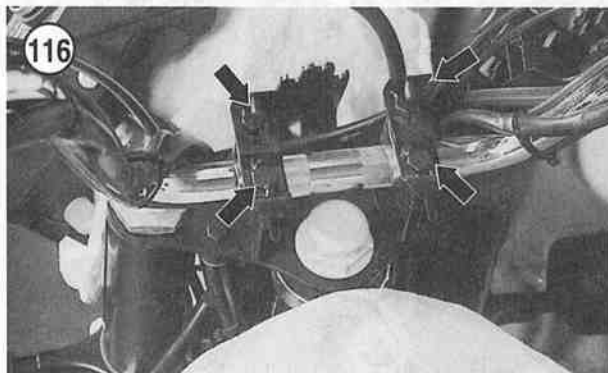
Check for leakage at all fittings. Refer to **Figure 110** and **Figure 111**. Tighten all bolts and nuts. Replace any gaskets if necessary. Refer to Chapter Seven.

### Wheel Bearings

Check the wheel bearings at the interval listed in **Table 1**. They should be serviced, if necessary, every time the wheel is removed or whenever there is a likelihood of water contamination. The service procedure is covered in Chapter Nine.

The rear wheel on some models is not equipped with any bearings. The rear suspension bearings are located within the final drive unit.





### Front Suspension Check

1. Apply the front brake and pump the forks up and down as vigorously as possible. Check for smooth operation and check for any oil leaks.
2. Make sure the upper fork bridge bolts (models so equipped) (Figure 112) and lower fork bridge bolts or nuts (Figure 113) are tight on each side.

#### NOTE

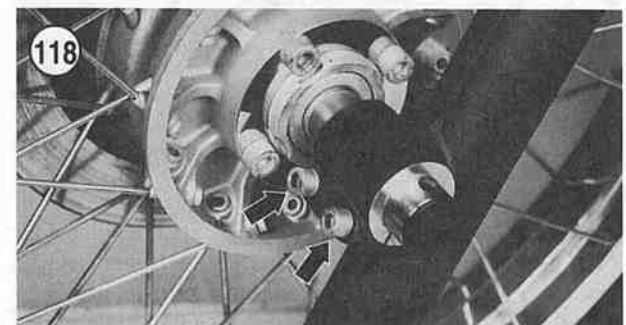
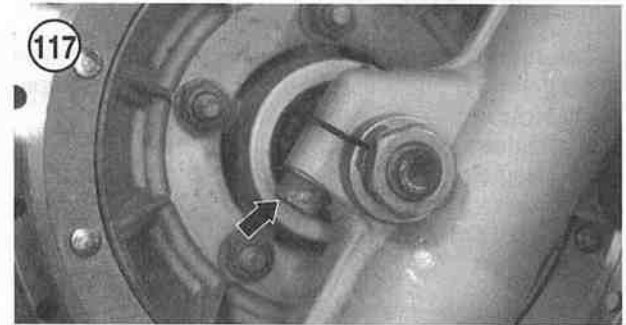
*On models that the fork cap is held in place with a snap ring, there is no way to check the tightness of the snap ring.*

3. On models equipped with a fork top cap bolt, perform the following:
  - a. Remove the trim cap (Figure 114) from the top of the fork leg.
  - b. Make sure the fork top cap bolt (Figure 115) is tight.
4. On models equipped with an impact pad, remove the pad as described under *Handlebar Removal* in Chapter Nine.
5. Make sure all Allen bolts securing the handlebar upper holders (Figure 116) are tight.

#### NOTE

*In Step 6 and Step 7 the locations of the bolts vary among the different models. These steps show several locations.*

6. Make sure the front axle clamp bolt(s) is tight. Refer to Figure 117 and Figure 118.





7. Check the tightness of the front axle bolt (**Figure 119**).
8. Service the steering head bearings at the interval listed in **Table 1**. The correct service procedure is covered in Chapter Nine.

**CAUTION**

*If any of the previously mentioned bolts and nuts are loose, refer to Chapter Nine for correct procedures and torque specifications.*

### Rear Suspension Check

1. Place a wood block(s) under each side of the frame to support it securely with the rear wheel off the ground.
2. Push hard on the rear wheel (sideways) to check for side play in the rear swing arm bearings. Remove the wood block(s).
3. Check the tightness of the shock absorber upper and lower mounting bolt(s) and nut(s). Refer to **Figure 120** and **Figure 121**.
4. Remove the plastic trim cap (**Figure 122**). Make sure the swing arm pivot bolt locknuts are tight (**Figure 123**).
- 5A. On dual shock models, make sure the rear axle nut (**Figure 124**) and axle pinch bolt (**Figure 125**) are tight.
- 5B. On single shock models, make sure the rear wheel bolts or nuts are tight (**Figure 126**).

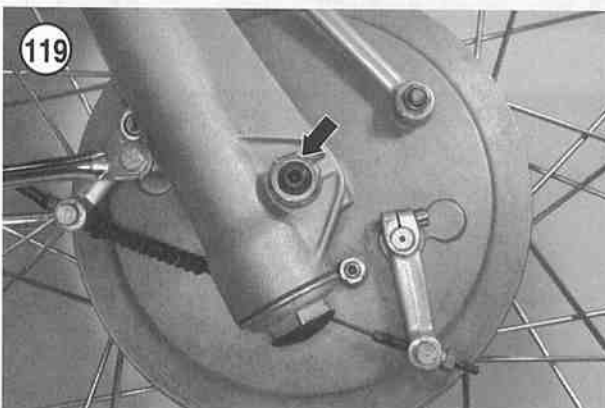
**CAUTION**

*If any of the previously mentioned bolts and nuts are loose, refer to Chapter Ten for correct procedures and torque specifications.*

### Nuts, Bolts and Other Fasteners

Constant vibration can loosen many of the fasteners on the motorcycle. Check the tightness of all fasteners, especially those on:

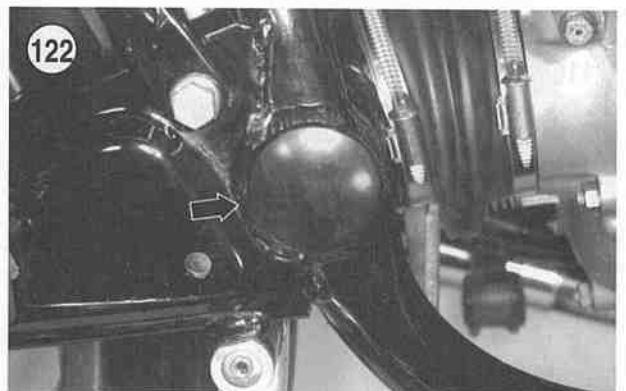
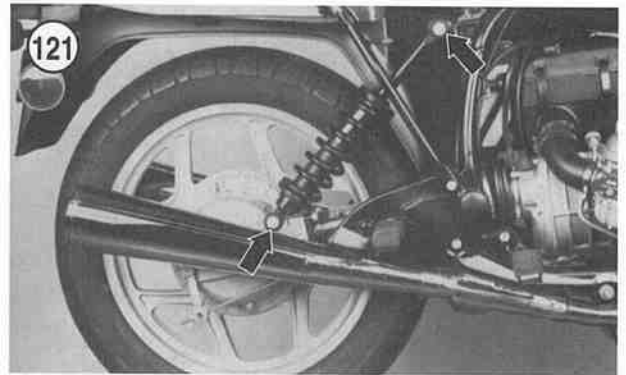
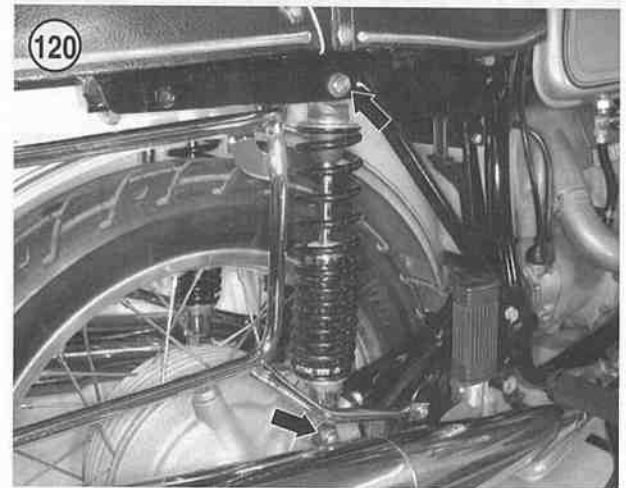
- a. Engine mounting hardware.
- b. Handlebar and front forks.
- c. Gearshift lever.
- d. Brake pedal and lever.

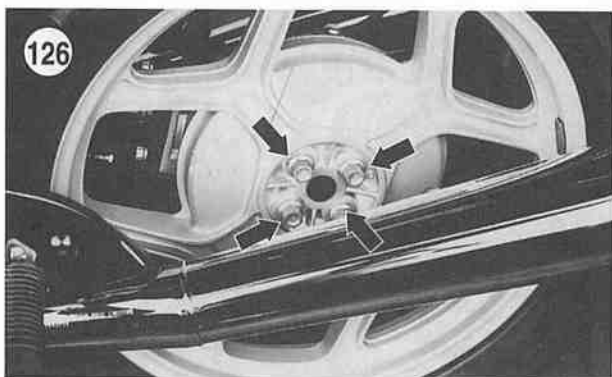
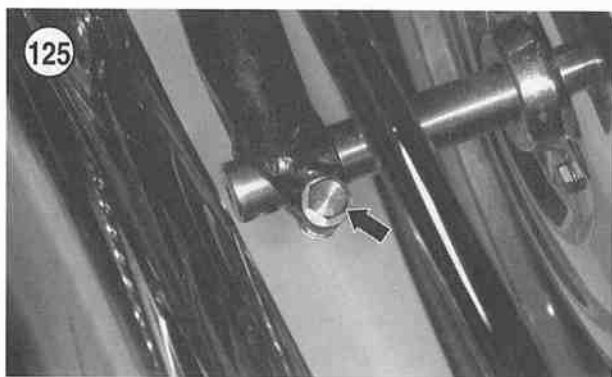


- e. Exhaust system.
- f. Lighting equipment.
- g. Body panels and luggage.

### Steering Head Adjustment Check

Check the steering head bearings for looseness at the interval listed in **Table 1**.





Place a wood block(s) under each side of the frame to support it securely with the front wheel off the ground.

Hold onto the front fork tube and gently rock the fork assembly back and forth. If you feel looseness, refer to Chapter Nine.

### Crankcase Breather

Inspect the breather hoses from the crankcase to the air filter air box. If it is cracked or starting to deteriorate, it must be replaced. Make sure the hose clamps are in place and holding securely.

### Evaporative Emission Control System (Models So Equipped)

When the bike is stopped after a ride, the fuel and fuel vapor in the fuel tank expands due to engine heat (or ambient temperature). The fuel vapor is routed into the engine crankcase via vent hoses. It is stored in the crankcase until the engine is started.

When the engine is restarted, the vacuum in the air intake system pulls the fuel vapor from the crankcase and mixes it with the incoming fresh air, thus burning it in the engine.

There is no routine maintenance on the evaporative emission control system other than to inspect the hoses and the pressure relief valve whenever the fuel tank is removed. Make sure the hoses are not kinked or damaged.

Make sure all vapor hoses are correctly routed and attached. Inspect the hoses and replace any if necessary.

### TUNE-UP

Perform a complete tune-up at the interval listed in **Table 1** for normal riding. More frequent tune-ups may be required if the bike is ridden in stop-and-go traffic. The purpose of the tune-up is to restore the performance lost due to normal wear and deterioration of parts.

The spark plugs should be routinely replaced at every other tune-up or if the electrodes show signs of erosion. In addition, this is a good time to clean the air filter element. Have the new parts on hand before you begin.

Because the different systems in an engine interact, the procedures should be done in the following order:

- a. Cylinder head nut torque.
- b. Adjust valve clearances.
- c. Contact breaker point service (models so equipped).
- d. Check ignition timing.
- e. Run a compression test.
- f. Replace the spark plugs.
- g. Clean carburetor float bowls.
- h. Carburetor adjustment and idle speed.
- i. Synchronize the carburetors.

Refer to **Table 6** for tune-up specifications.

**NOTE**

*It is a good idea to start the engine after each one of the tune-up procedures is completed and make sure it runs okay. If for some reason, the procedure was not done correctly or a faulty new part(s) was installed, you can then concentrate on that specific procedure and part(s) and correct the problem. If you wait until all of the tune-up procedures are completed and then the bike runs worse or does not start at all, then you have to narrow it down to which one of the procedures or parts is causing the problem.*

To perform a tune-up on your BMW, you will need the following tools and equipment:

- a. 5 mm Allen wrench.
- b. BMW spark plug wrench (in factory tool kit) or 13/16 in. spark plug wrench.
- c. Socket wrench and assorted sockets.
- d. Flat feeler gauge.
- e. Compression gauge.
- f. Spark plug wire feeler gauge and gapper tool.
- g. Manometer for synchronizing the carburetors.

### Cylinder Head Nut Torque and Valve Clearance Measurement and Adjustment

Measure the valve clearance at the interval listed in **Table 1**.

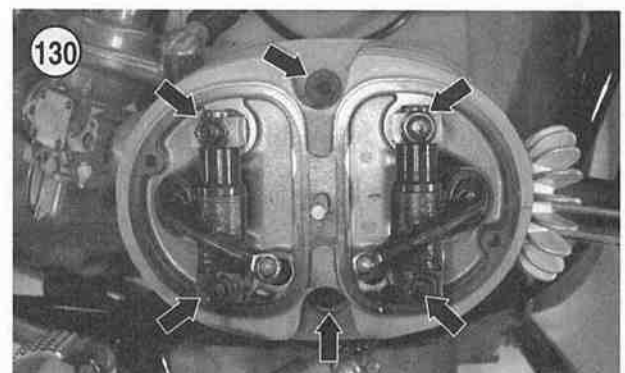
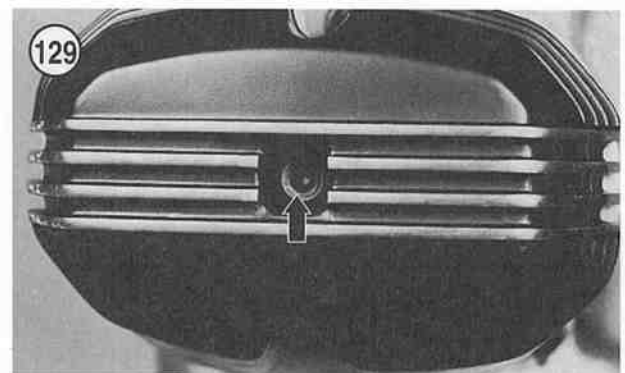
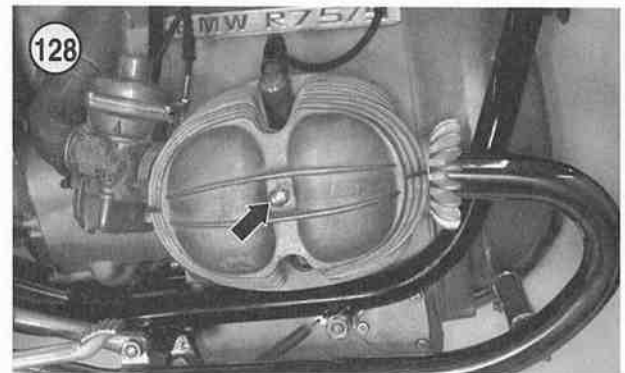
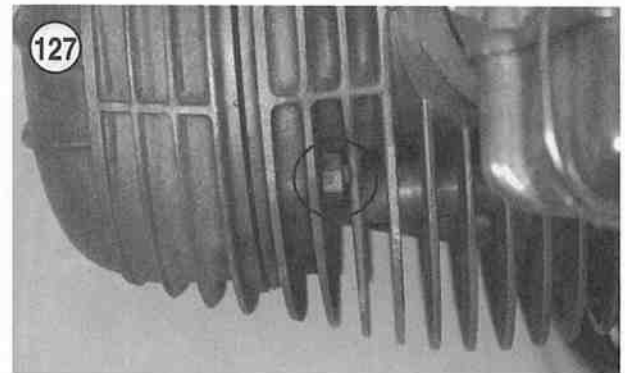
Cylinder head nut torque procedure must be performed with the engine cool, at room temperature. The maximum temperature the cylinder head can be is 35° C/95° F. If the temperature is greater than that specified, the torque specification will be incorrect. Preferably, let the bike sit overnight and check the cylinder head nut torque and valve clearance the first thing in the morning.

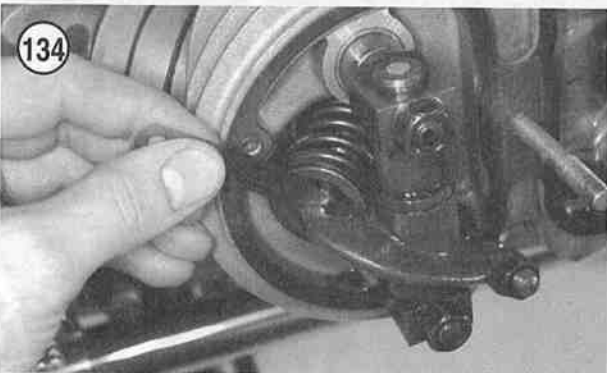
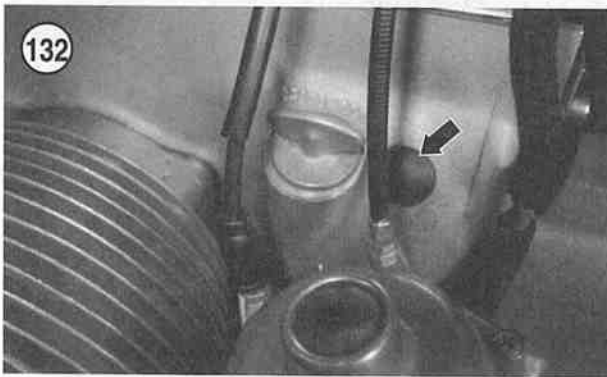
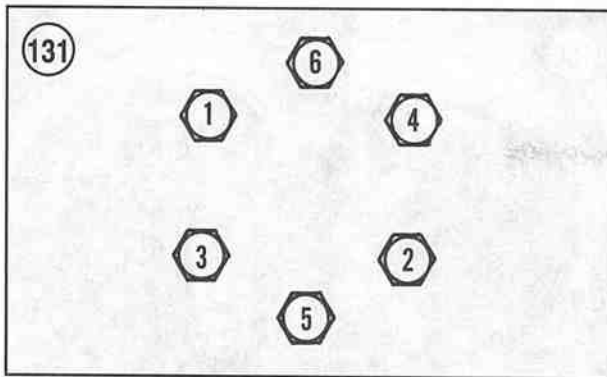
The intake valve is located at the rear of the cylinder head and the exhaust valves are located at the front. Intake valve clearance is 0.10 mm (0.004 in.). Exhaust valve clearance is 0.20 mm (0.008 in.).

**CAUTION**

*Tighten the cylinder head nuts first before adjusting the valves or the valve clearance will not be correct.*

1. Place the bike on the centerstand.
2. Place a drip pan under the cylinder head cover as some residual oil will probably drip out after the cover is removed.





3. Remove the nut and lockwasher at the front and rear (**Figure 127**) of the cylinder head securing the cylinder head cover.
4. Remove the center special nut (**Figure 128**) and washer (**Figure 129**) securing the cylinder head cover.
5. If necessary, carefully tap around the perimeter of the cylinder head cover with a soft-faced mallet to break it loose. Remove the cylinder head cover and gasket.
6. Loosen each cylinder head nut (**Figure 130**) by 1/4 turn only – do not loosen the nuts any more than specified as it will place undue stress on the valve train.
7. Using the torque pattern shown in **Figure 131**, tighten the cylinder head nuts to the torque specification listed in **Table 4**.
8. Repeat Steps 2-7 for the other cylinder head.
9. Shift the transmission into either 4th or 5th gear.

#### CAUTION

Follow the spark plug removal procedure in this chapter carefully to prevent engine damage.

10. Remove the spark plug from both cylinder heads as described in this chapter. This will make it easier to rotate the engine by hand during this procedure.
11. Remove the rubber plug (**Figure 132**) from the timing inspection hole in the crankcase on the left-hand side.

#### NOTE

A cylinder at top dead center (TDC) on its compression stroke will have free play in both of its rocker arms, indicating that both the intake and exhaust valves are closed.

12. Rotate the engine using the rear wheel until the cylinder to be adjusted is at top dead center (TDC) on its compression stroke. To determine TDC for that cylinder, perform the following:
  - a. Rotate the rear wheel, in normal forward rotation, until the intake valve has opened completely and then been allowed to close.
  - b. Using a small flashlight, direct the light into the timing hole (**Figure 133**) in the crankcase to observe the timing mark.
  - c. Continue to slowly rotate the rear wheel until the TDC timing mark "OT" (**Figure 133**) aligns with the fixed mark on the crankcase. At this point the cylinder's piston has reached the top of its stroke. This will be TDC on the compression stroke.
13. With the engine in this position, check the clearance of the cylinder's intake and exhaust valves.
14. Check the clearance by inserting a flat feeler gauge between the rocker arm and the valve stem (**Figure 134**). When the clearance is correct, there will be a slight drag on the feeler gauge when it is inserted and withdrawn. Measure the valve clearance for both the intake and exhaust valves.



15. To adjust the valve clearance, perform the following:
- Loosen the valve adjuster locknut (A, **Figure 135**) and turn the adjuster (B, **Figure 135**) either in or out until there is a slight drag on the feeler gauge.
  - Hold the adjuster with the wrench and tighten the locknut to the torque specification listed in **Table 4**.
  - Recheck the clearance to make sure the adjuster did not turn while tightening the locknut. Readjust if necessary.
16. Rotate the engine 360° until the other cylinder is at TDC on the compression stroke.
17. Repeat Steps 13-16 for the other cylinder.
18. After all valve clearances have been adjusted, use the rear wheel, to rotate the engine several complete revolutions. This will seat all components.
19. Reinspect all valve clearances as described in this procedure. If any of the clearances are still not within specification, repeat this procedure until all clearances are correct.

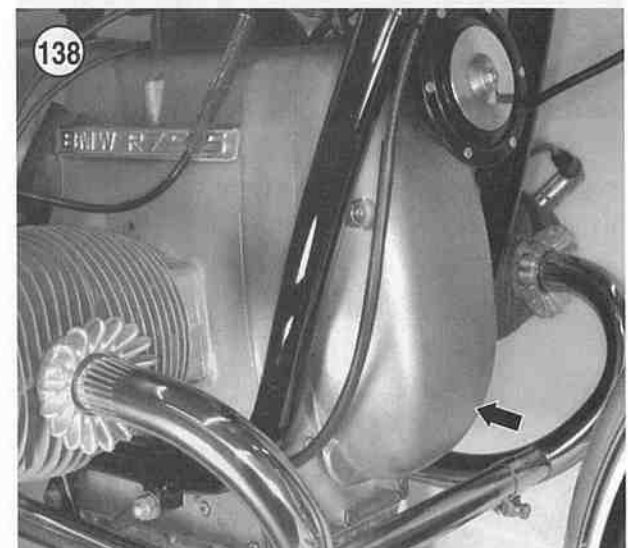
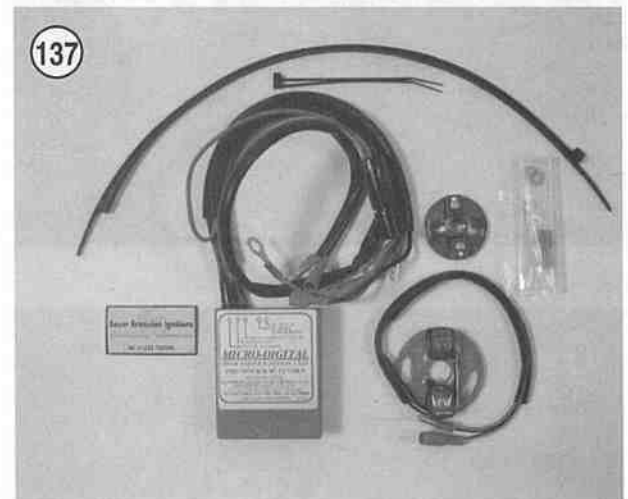
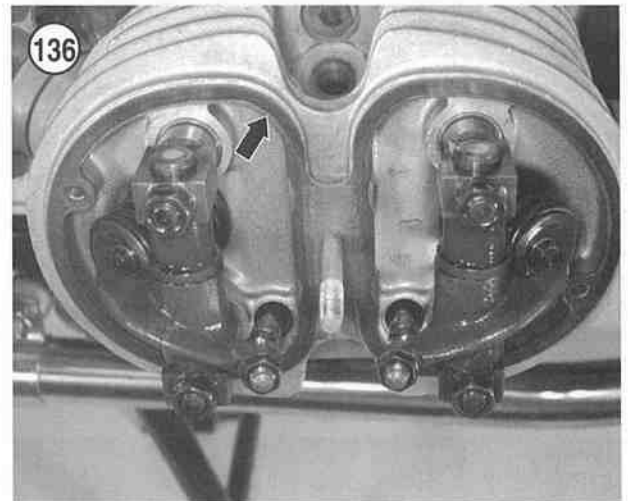
**NOTE**

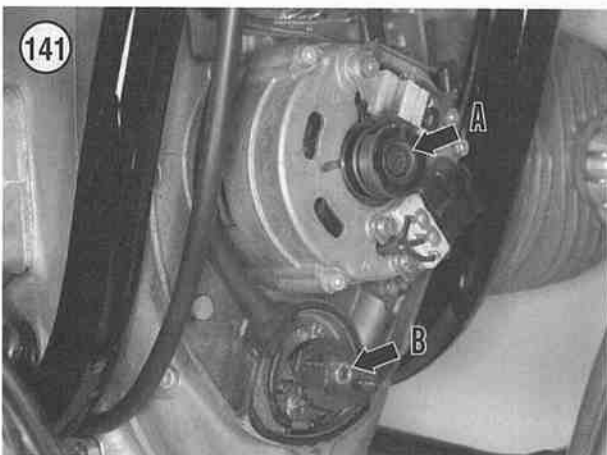
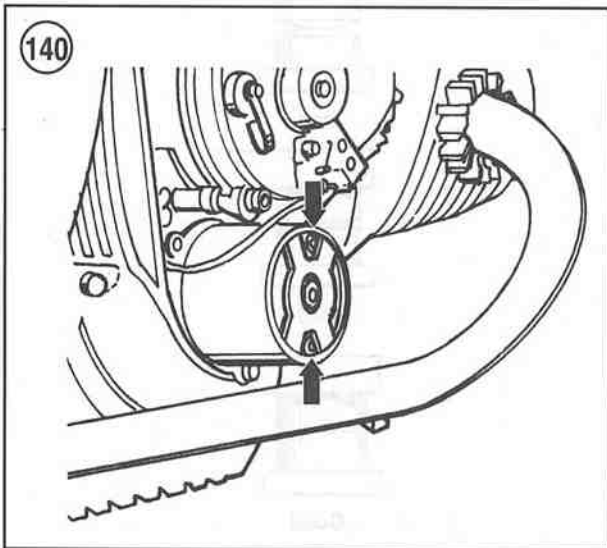
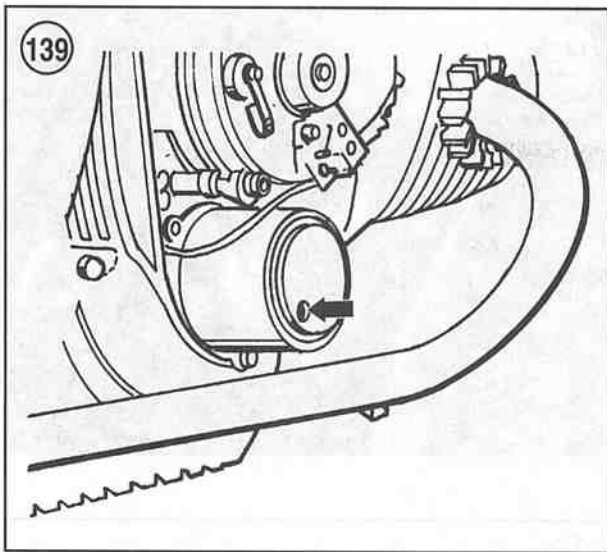
*On 1970-1980 models, if the contact breaker points are going to be serviced, do not install the spark plugs at this time.*

20. Install the spark plug into each cylinder head as described in this chapter.
21. Inspect the gasket and gasket surfaces (**Figure 136**) on each cylinder head; replace the gasket(s) if necessary.
22. Install the cylinder head cover and install the center washer (**Figure 129**) and special nut (**Figure 128**). Tighten the nut securely.
23. Install the nut and lockwasher (**Figure 127**) at the front and rear of the cylinder head to secure the cylinder head cover. Tighten the nuts securely.
24. Start the bike and make sure it runs correctly.

**NOTE**

*If the engine is still noisy after the valves have been adjusted, inspect the rocker arm end float as described in Chapter Four.*





### Contact Breaker Point Inspection (1970-1980 Models)

There are two types of contact breaker systems. On 1970-1978 models the points are accessed by removing the engine front cover. On 1979-1980 models, after removing the engine front cover, the distributor is enclosed in a separate distributor cover. 1981-on models are equipped with an electronic system that uses no breaker points.

Contact breaker systems suffer from performance reduction due to wear of the cam follower-to breaker lever area. The reduction in dwell angle results in a corresponding timing retardation. Contact erosion (pitting) of the points also reduces ignition performance. For these reasons the point gap (dwell angle) must be checked regularly and if necessary the points replaced.

A number of electronic ignition kits are available for retrofit on older models. They provide improved performance and reliability, along with reduced maintenance by eliminating the points and in most cases, depending on the system, the mechanical advance mechanism. The type shown in **Figure 137** is a Boyer Brandson system available from Moto-Bin Ltd. at [www.Motbins.co.uk](http://www.Motbins.co.uk).

#### CAUTION

*To prevent an accidental short to ground, disconnect the negative battery cable before removing the engine front cover. If a short occurs, the rectifier diodes may be damaged and require replacement.*

1. Disconnect the battery negative lead as described in this chapter.
2. Remove the engine front cover (**Figure 138**) as described in Chapter Four.
3. On 1979-1980 models, perform the following:
  - a. Remove the screw (**Figure 139**) securing the distributor cover and remove the cover.
  - b. Remove the screws (**Figure 140**) securing the support and remove the support.
4. Insert an Allen wrench into the alternator rotor mounting bolt (A, **Figure 141**).

#### CAUTION

*On 1970-1978 models, do not rotate the engine with the ignition advance mechanism nut. (B, **Figure 141**).*

5. Rotate the engine *clockwise* until the contact points are fully open. Refer to **Figure 142** for 1970-1978 models. The 1979-1980 models are similar, but are not shown.
6. Inspect the surface of the contact points and compare to **Figure 143**. A gray discoloration is normal, but the surface condition is critical for maximum performance.

7. If the contact surface is slightly pitted, it can be cleaned as follows:

- a. Dress both contact surfaces with a point file. Never use sandpaper or emery cloth as they can leave a residue. Using something other than a point file will also round off the contact surfaces, which tends to create a condition that is similar to extreme wear.
- b. After the points have been dressed, clean them with an aerosol electrical contact cleaner. Also run a clean white business card or paper through the points to make sure they are completely clean. Make sure the contact surfaces are absolutely clean, as even the oil from a fingerprint can affect performance.

8. Replace the contact point assembly, as described in this chapter, if they cannot be cleaned up or if they are severely pitted or worn.

9A. If the contact points are in good condition, install all components removed.

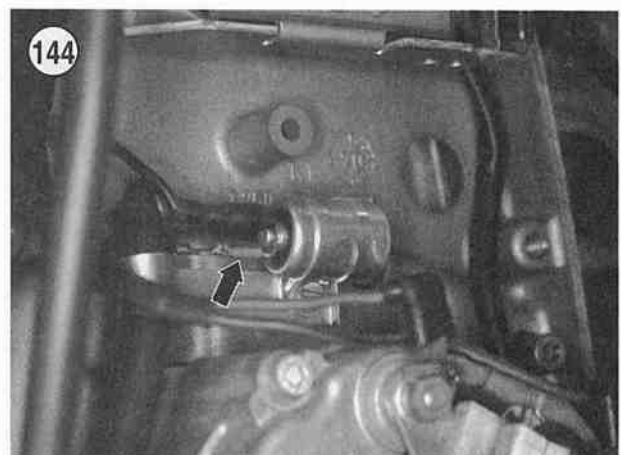
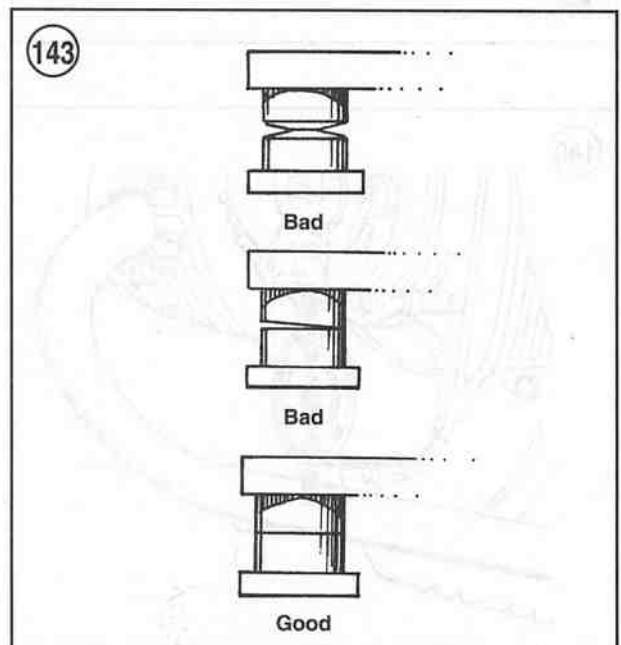
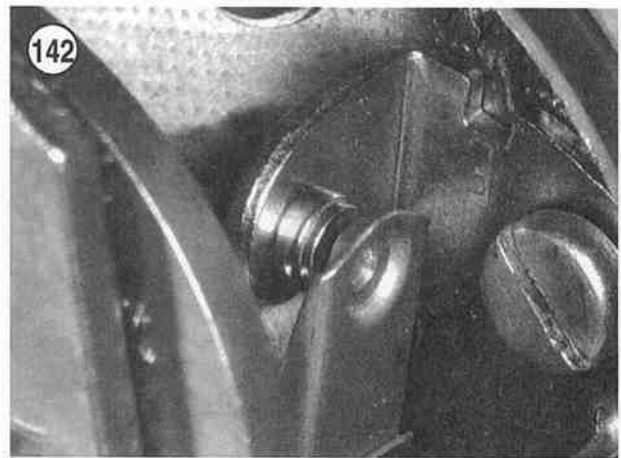
9B. If the contact points are defective, replace them as described in this chapter.

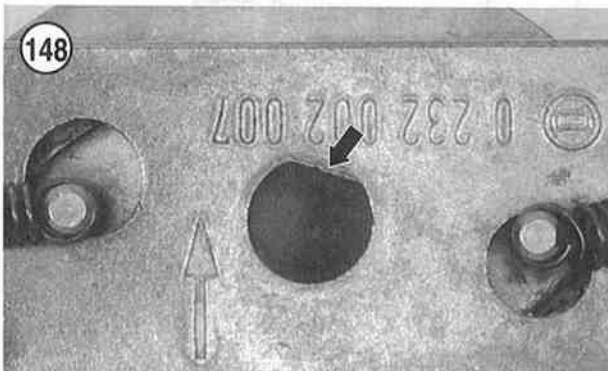
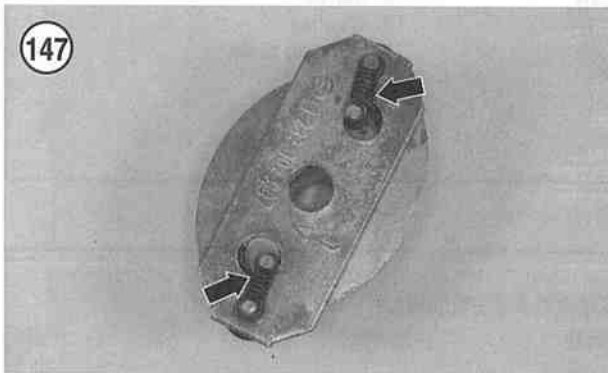
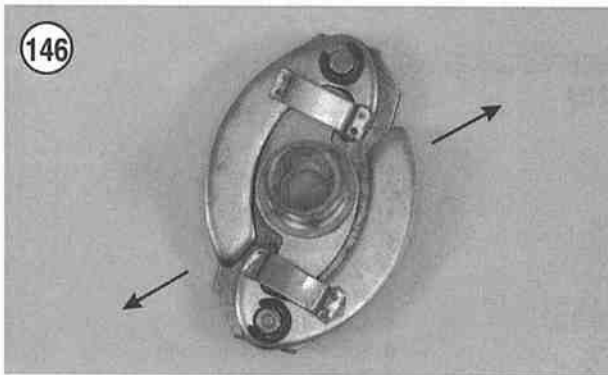
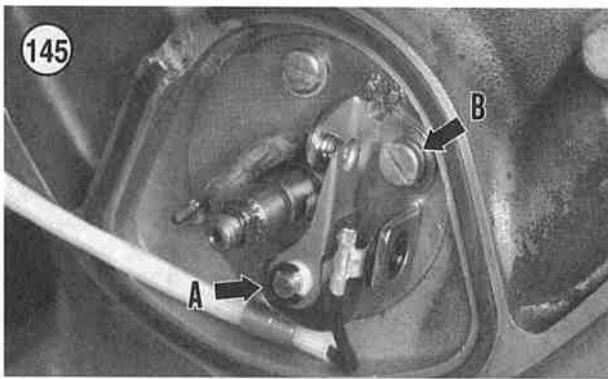
### Contact Breaker Point Replacement (1970-1978 Models)

#### CAUTION

*The battery negative lead must be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged. This will necessitate replacement of the entire diode board.*

1. Disconnect the battery negative lead as described in this chapter.
2. Remove the engine front cover (Figure 138) as described in Chapter Four.
3. Disconnect the contact breaker point electrical connector (Figure 144) from the condenser.
4. Unscrew the nut (Figure 141) securing the advance nut and remove the unit.
5. Remove the screw (A, Figure 145) and wire clamp securing the condenser wire.
6. Remove the screw (B, Figure 145) securing the contact breaker point assembly.
7. Remove the rubber grommet from the crankcase.
8. Remove the contact breaker point assembly.
9. Apply a light coat of distributor cam grease (Bosch Ft1v4) to the felt pad where it rubs against the distributor cam. Also apply a small amount to the ignition advance shaft.
10. Install by reversing these removal steps. Note the following during installation.
11. Correctly index the brass pin on the backside of the contact breaker point assembly into the receptacle in the mounting plate. Install a new contact breaker point assembly.
12. Make sure the mounting screws are tight.





13. Before installing the ignition advance unit, move it to its limits and make sure it moves freely (**Figure 146**). Lubricate (Bosch Ft1v26) the sliding areas or replace the unit if necessary.

14. Make sure the return springs (**Figure 147**) are in good condition and that they return the weights completely.

15. Position the ignition advance mechanism so the flat in the mounting hole (**Figure 148**) aligns with the flat on the camshaft. Install the mechanism and tighten the mounting nut to 6 N·m (53-in.-lb.).

16. Make sure all electrical connectors are free of corrosion and are tight.

17. Adjust the contact breaker point gap as described in this chapter.

### Contact Breaker Point Gap Adjustment (1970-1978 Models)

Refer to **Figure 149** for this procedure.

1. Insert an Allen wrench into the alternator rotor mounting bolt (A, **Figure 141**).

#### CAUTION

*Do not attempt to rotate the engine with the nut (**Figure 141**) securing the ignition advance mechanism to the camshaft. If the nut is used, the camshaft may be damaged.*

2. Rotate the engine *clockwise* until the contact points are fully open. Refer to **Figure 142**.

3. Loosen the mounting screw (A, **Figure 150**) securing the contact breaker point assembly.

4. Place the blade of a screwdriver between the 2 pins (B, **Figure 150**) on the backing plate and into the notch in the contact breaker point assembly.

5. Insert a flat feeler gauge into the point gap.

#### NOTE

*If new points were installed, set the gap to the largest setting, as this will allow the rub pad on the points to wear in while taking a "set." As the rub pad wears, the gap will decrease.*

6. Apply pressure to the contact breaker point assembly and move it in either direction until the point gap is between 0.35-0.40 mm (0.014-0.016 in.).

7. Tighten the mounting screw (A, **Figure 150**) securely and recheck the point gap. Readjust if necessary.

### Contact Breaker Point Replacement (1979-1980 Models)

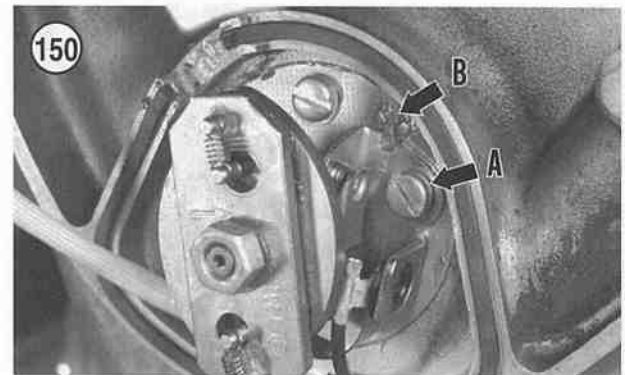
Refer to **Figure 151** for this procedure.



**CAUTION**

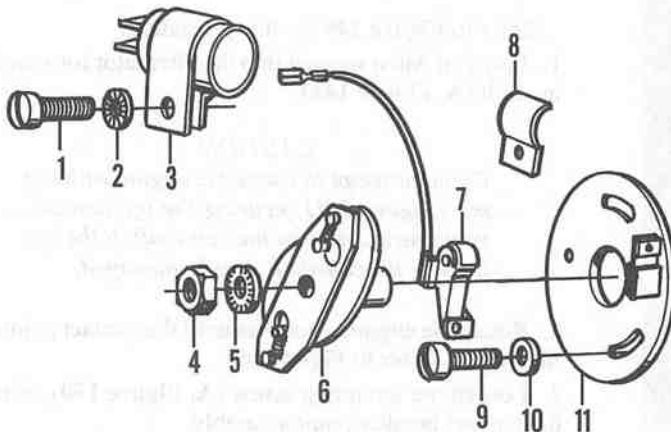
To prevent an accidental short to ground, disconnect the negative battery cable before removing the engine front cover. If a short occurs, the rectifier diodes may be damaged and require replacement.

1. Disconnect the battery negative lead as described in this chapter.
2. Remove the engine front cover as described in Chapter Four.



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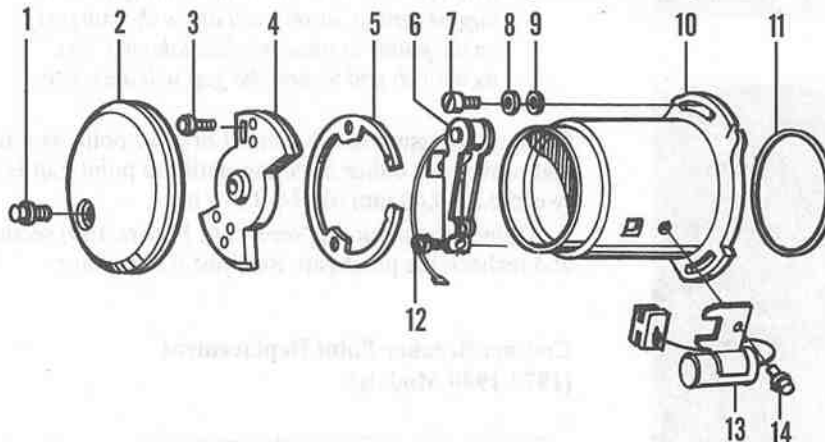
### CONTACT BREAKER POINT ASSEMBLY (1970-1978)



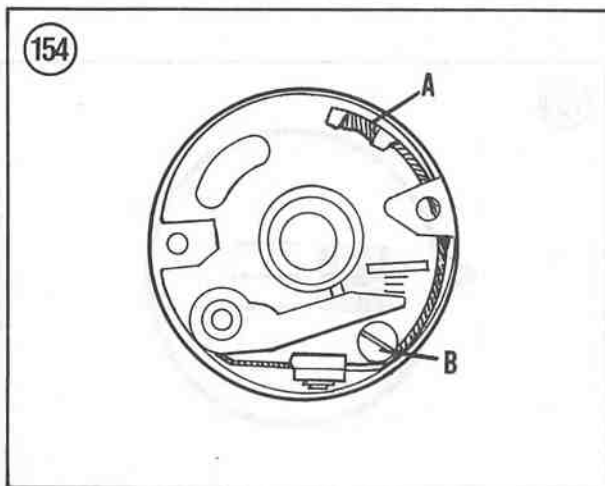
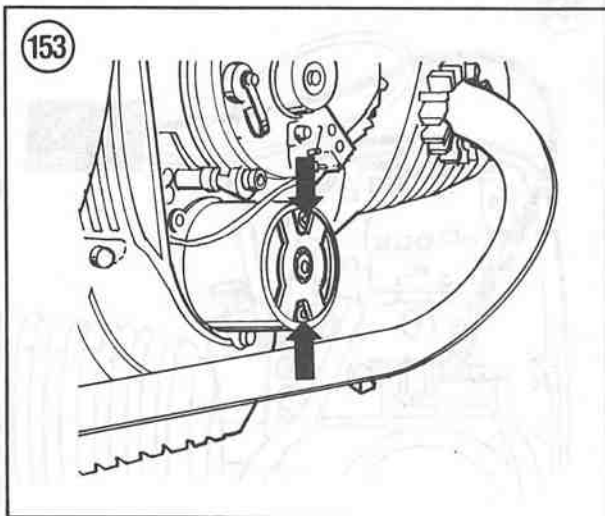
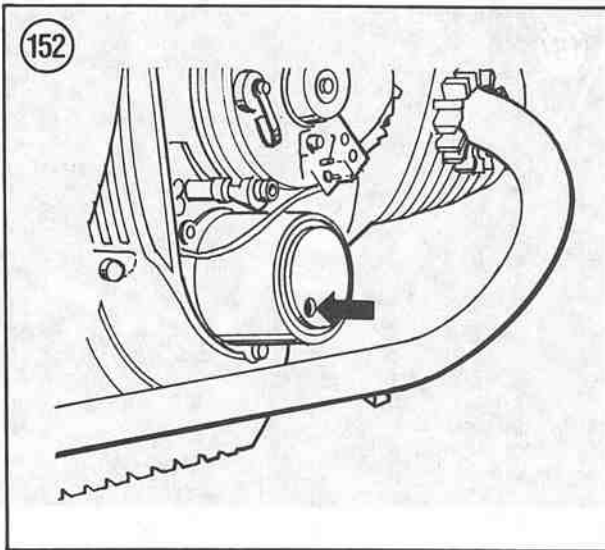
1. Screw
2. Lockwasher
3. Condenser
4. Nut
5. Lockwasher
6. Ignition advance unit
7. Breaker point
8. Clip
9. Screw
10. Washer
11. Backing plate

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### CONTACT BREAKER POINT ASSEMBLY (1979-1980)



1. Screw
2. Cover
3. Screw
4. Support
5. Ring
6. Breaker points
7. Screw
8. Washer
9. Washer
10. Distributor housing
11. O-ring
12. Screw
13. Condenser
14. Screw



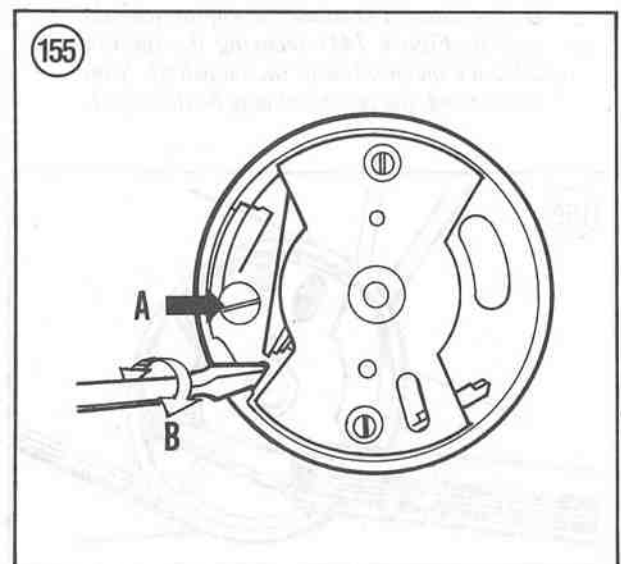
3. Remove the screw (Figure 152) securing the distributor cover and remove the cover.
4. Remove the screws (Figure 153) securing the support and remove the support.
5. Disconnect the electrical connector (A, Figure 154).
6. Remove the screw (B, Figure 154) securing the contact breaker point assembly.
7. Remove the contact breaker point assembly from the distributor.
8. Install a new contact breaker point assembly by reversing these removal steps. Note the following during installation.
9. Make sure the mounting screws are tight.
10. Make sure all electrical connectors are free of corrosion and are tight.
11. Adjust the contact breaker point gap as described in this chapter.

#### Contact Breaker Point Gap Adjustment (1979-1980 Models)

1. Insert an Allen wrench into the alternator rotor mounting bolt (Figure 140).
2. Rotate the engine *clockwise* until the contact points are fully open.
3. Loosen the mounting screw (A, Figure 155) securing the contact breaker point assembly.
4. Place the blade of a screwdriver between the 2 pins on the backing plate and into the notch in the contact breaker point assembly (B, Figure 155).
5. Insert a flat feeler gauge into the point gap (Figure 156).

#### NOTE

*If new points were installed, set the gap to the largest setting as this will allow the rub pad on the points to wear in while taking a "set." As the rub pad wears, the gap will decrease.*



6. Apply pressure to the contact breaker point assembly and move it in either direction until the point gap is 0.40 mm (0.016 in.).
7. Tighten the mounting screw (A, **Figure 155**) securely and recheck the point gap. Readjust if necessary as described in this chapter.

### Ignition Timing (1970-1980 Models)

Check the ignition timing at the interval indicated in **Table 1**.

There are two ways to check the ignition timing: the static method, and the more precise way using a stroboscope timing light.

The static method requires the use of a "buzz box," an ohmmeter or a continuity light. The continuity light is the easiest to use.

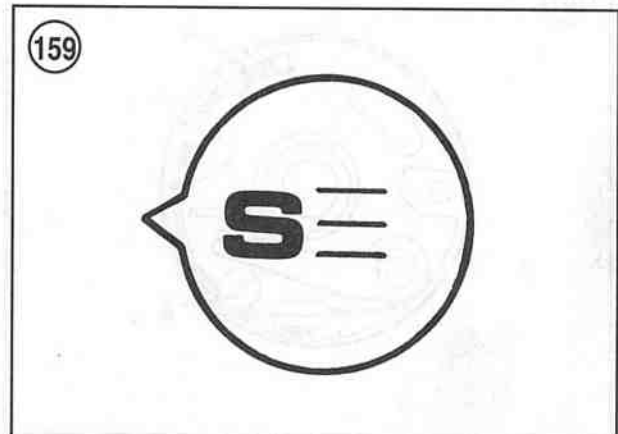
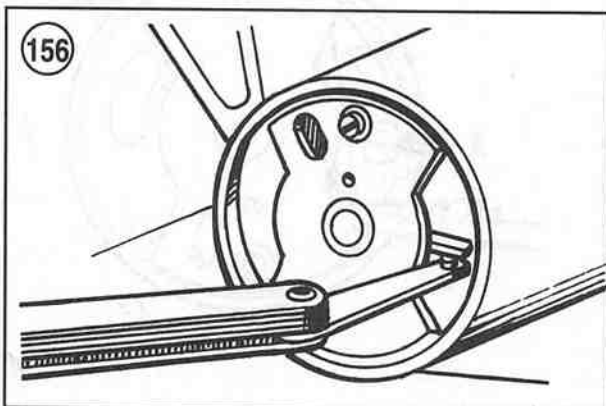
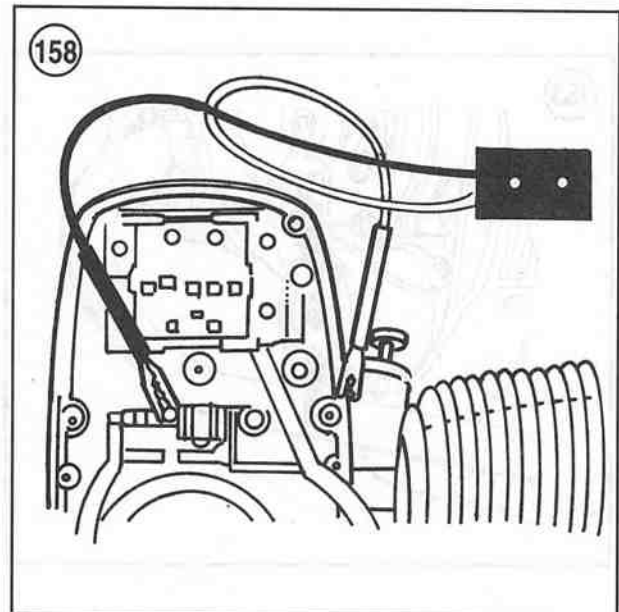
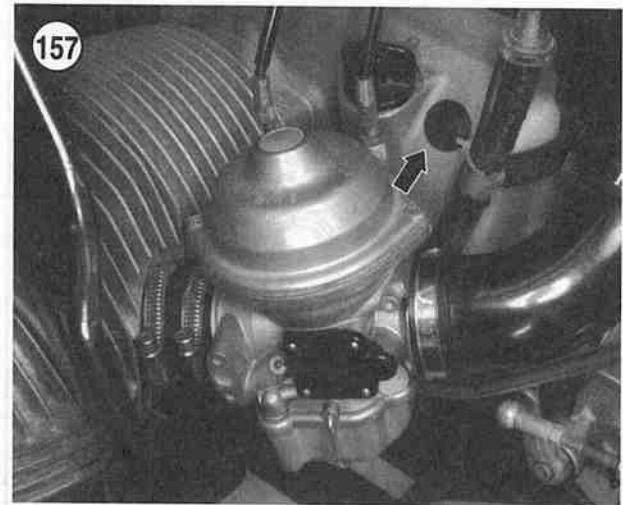
The continuity light can be a homemade unit from a 12-volt bulb, a bulb socket with wires attached to it, and an alligator clip at the loose end of each wire.

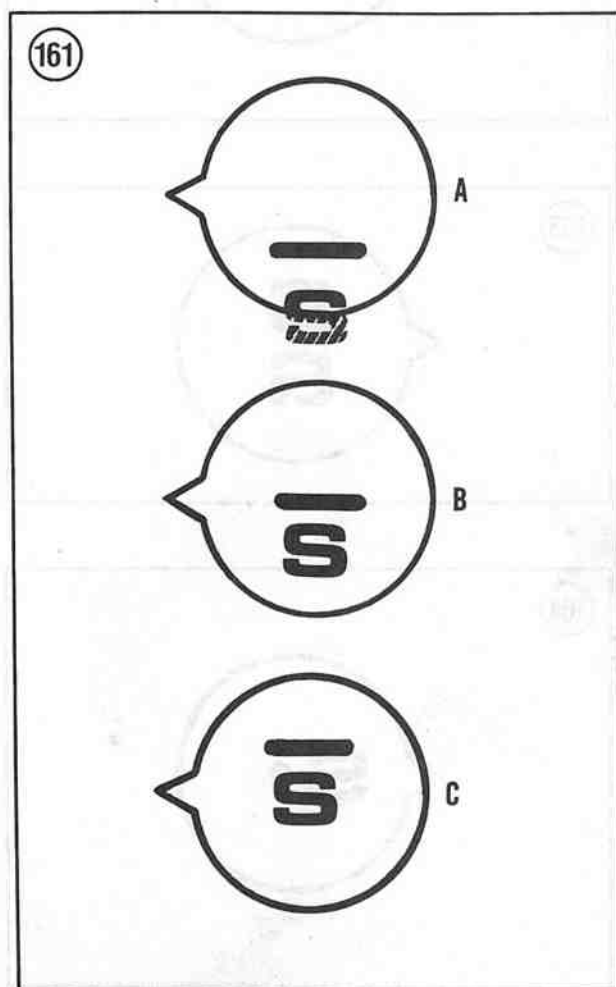
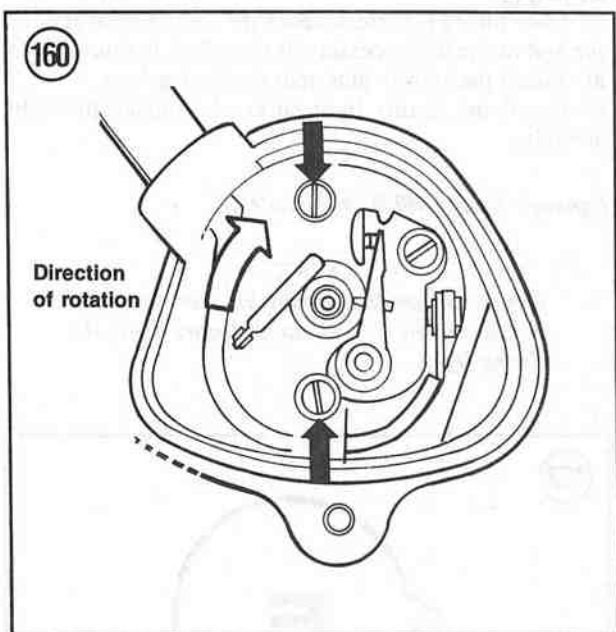
#### Static timing (1970-1980 models)

1. If not already removed, remove the spark plugs as described in this chapter.
2. Remove the rubber plug (**Figure 157**) from the timing hole on the left-hand side of the crankcase.
3. Connect a "buzz box" according to the manufacturer's instructions or connect a continuity light as shown in **Figure 158**. Connect with one lead to the condenser electrical terminal and the other to a good engine ground. Make sure it is a good ground — one that is not corroded or contaminated with oil or grease.
4. Insert an Allen wrench into the alternator rotor mounting bolt (A, **Figure 141**).

#### CAUTION

*Do not attempt to rotate the engine with the nut (B, **Figure 141**) securing the ignition advance mechanism to the camshaft. If the nut is used, the camshaft may be damaged.*





5. Rotate the engine *clockwise* until the "S" timing mark aligns with the fixed pointer on the crankcase timing hole (Figure 159). This is the basic timing.

**NOTE**

The three marks adjacent to the "S" mark indicate optimum timing for different models. The top mark should be used for R60 models, the middle mark for R65 to R100 models and the bottom mark for all other models.

6. If the basic timing is correct, the continuity light will come on or the "buzz box" will sound. Slightly move the crankshaft past the "S" mark in both directions. The light should light or the buzzer should sound.

7. If the light does not come on or the buzzer sound each time the "S" passes the timing mark, loosen the base plate screws (Figure 160) and gradually rotate the base plate assembly *clockwise* to retard or *counterclockwise* for advance. Tighten the base plate screws securely.

8. Once again, gradually rotate the base plate assembly, approximately the amount as was necessary in Step 7, until the light comes on or the buzzer sounds. If not, readjust until timing is correct.

9. Once timing is correct, check the contact breaker point gap and readjust if necessary.

10. Install the rubber plug (Figure 157) into the timing hole.

11. Install the spark plugs as described in this chapter.

12. Install the engine front cover and tighten the bolts securely.

**Dynamic timing (1970-1978 models)**

Use a Xenon powered timing light, as it produces a strong bright light required for this procedure. If you use an inexpensive one, the results may not be accurate.

**CAUTION**

Do not allow the engine to idle for extended periods of time during the adjustment. The lack of air flowing over the engine may lead to engine overheating. If a high-velocity portable electric fan is available, turn it on HIGH and aim it at the front of the engine.

1. If removed, install the spark plugs as described in this chapter.

2. Remove the rubber plug (Figure 157) from the timing hole on the left-hand side of the crankcase.

3. Connect the timing light according to the manufacturer's instructions.

4. Start the engine and let it idle between 600 and 800 rpm.

5. Aim the timing light perpendicular to the rotational axis of the crankshaft and pull the trigger.

6. The timing is correct if the white mark above the "S" timing mark aligns with the fixed pointer on the crankcase timing hole (B, Figure 161).



7. If the "S" mark appears below the fixed pointer (A, **Figure 161**), the timing is too retarded and must be adjusted as follows:

- a. Shut the engine off.
- b. Loosen the base plate screws (**Figure 160**) and gradually rotate the base plate assembly *counterclockwise* to advance the timing.
- c. Tighten the base plate screws securely.

8. If the "S" mark appears above the fixed pointer (C, **Figure 161**), the timing is too advanced and must be adjusted as follows:

- a. Shut the engine off.
- b. Loosen the base plate screws (**Figure 160**) and gradually rotate the base plate assembly *clockwise* to retard the timing.
- c. Tighten the base plate screws securely.

9. Restart the engine.

10. Increase engine speed. At 800 rpm the "S" mark starts to disappear and then will completely disappear as engine speed increases further.

11. Increase engine speed to 2,600-3,000 rpm. At this speed the "F" mark (**Figure 162**) should appear and align with the fixed pointer on the crankcase. This indicates that the ignition is at full advance.

12. When ignition timing is correct, with the strobe flashing, the timing marks will move up and down as engine speed is increased and decreased. If this does not happen, the automatic ignition advance mechanism is not working correctly or not working at all. Proceed to Step 13 and Step 14. If the automatic ignition advance mechanism is working correctly, proceed to Step 15.

13. Shut the engine off.

14. Inspect the ignition advance mechanism as follows:

- a. Move the mechanism to its limits and check for free movement of the weights and springs. If they do not move freely, check for contamination or corrosion.
- b. Check that the springs return the mechanism completely from the outermost position.
- c. Check the mechanism for excessive side play on the shaft.
- d. Clean the mechanism and/or apply contact breaker lubricant to all pivot points.
- e. If the mechanism still does not operate correctly, replace it.
- f. If the "S" mark lines up correctly at idle but the "F" mark will not align when the ignition is supposed to be fully advanced, the mechanism is probably worn and should be replaced.

#### NOTE

If a split image appears (**Figure 163**), the cam lobes on the mechanism are not 180° apart as they should be, on the advancer unit, or the cam is bent. If this happens, replace the advancer mechanism.

15. Once timing is correct, check the contact breaker point gap and readjust if necessary as described in this chapter.

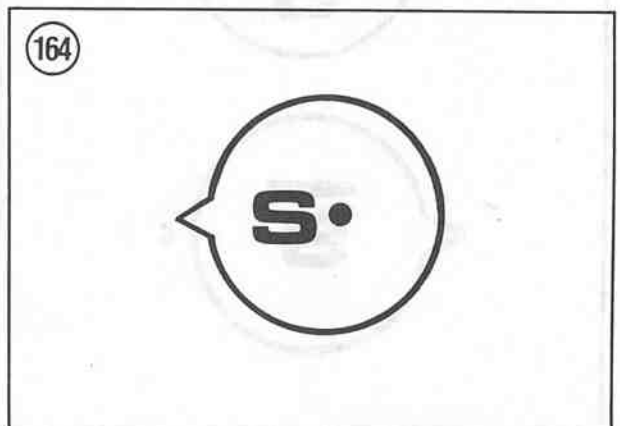
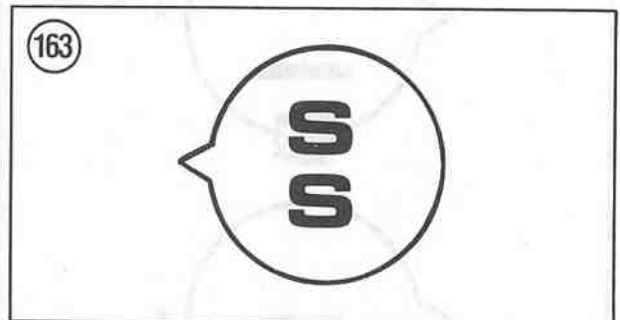
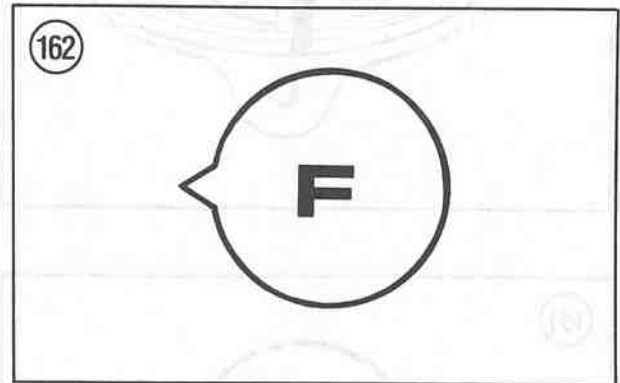
16. Install the rubber plug into the timing hole.

17. Install the engine front cover and tighten the bolts securely.

#### Dynamic timing (1979-1980 models)

#### NOTE

It is recommended that the breaker-point gap be checked by a dwell meter before using the timing light.

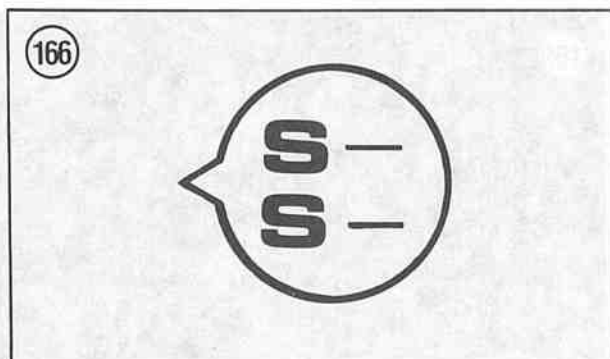
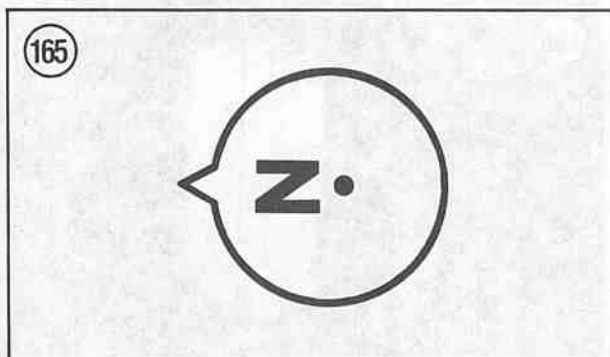


Use a Xenon powered timing light as it produces a strong bright light required for this procedure. If you use an inexpensive light the results may not be accurate.

#### CAUTION

*Do not allow the engine to idle for extended periods of time during the adjustment. The lack of air flowing over the engine may lead to engine overheating. If a high-velocity portable electric fan is available, turn it on HIGH and aim it at the front of the engine.*

1. If removed, install the spark plugs as described in this chapter.
2. Connect a dwell meter following the manufacturer's instructions.
3. Start the engine and let it idle.
4. Increase idle speed to 1,000 rpm. At this point the dwell angle should be 120°.
5. If the dwell angle is not as specified, perform the following:
  - a. Shut the engine off.
  - b. If the dwell angle is less than 120°, reduce the contact breaker point gap.
  - c. If the dwell angle is greater than 120°, increase the contact breaker point gap.
6. Disconnect the dwell meter.
7. Remove the rubber plug (Figure 157) from the timing hole on the left-hand side of the crankcase.



8. Connect the timing light according to the manufacturer's instructions.
9. Start the engine and let it idle between 800 and 1,000 rpm.
10. Aim the timing light perpendicular to the rotational axis of the crankshaft and pull the trigger.
11. The timing is correct if the "S" timing mark aligns with the fixed pointer on the crankcase timing hole (Figure 164).
12. If the "S" mark appears below the fixed pointer, the timing is too retarded and must be adjusted as follows:

- a. Shut the engine off.
- b. Loosen the base plate screws (Figure 160) and gradually rotate the base plate assembly *counterclockwise* to advance the timing.
- c. Tighten the base plate screws securely.

13. If the "S" mark appears above the fixed pointer the timing is too advanced and must be adjusted as follows:

- a. Shut the engine off.
- b. Loosen the base plate screws (Figure 160) and gradually rotate the base plate assembly *clockwise* to retard the timing.
- c. Tighten the base plate screws securely.

14. Restart the engine.
15. Increase engine speed. At 800 rpm the "S" mark starts to disappear and then will completely disappear as engine speed increases further.
16. Increase engine speed to 3,500 rpm. At this speed, the "Z" mark (Figure 165) should appear and align with the fixed pointer on the crankcase. This indicates that the ignition is at full advance.

17. When ignition timing is correct, with the strobe flashing, the timing marks will move up and down as engine speed is increased and decreased. If this does not happen, the automatic ignition advance mechanism is not working correctly or is not working at all. Proceed to Step 18 and Step 19. If the automatic ignition advance mechanism is working correctly, proceed to Step 20.

18. Shut the engine off.
19. Inspect the ignition advance mechanism as follows:
  - a. Move the mechanism to its limits and check for free movement of the weights and springs. If they do not move freely, check for contamination or corrosion.
  - b. Check that the springs return the mechanism completely from the outermost position.
  - c. Check the mechanism for excessive side play on the shaft.
  - d. Clean the mechanism and/or apply contact breaker lubricant to all pivot points.
  - e. If the mechanism still does not operate correctly, replace it.
  - f. If the "S" mark lines up correctly at idle but the "F" mark will not align when the ignition is supposed to be fully advanced, the mechanism is probably worn and should be replaced.

**NOTE**

If a split image appears (Figure 166), the cam lobes on the mechanism are not 180° apart as they should be, on the advancer unit, or the cam is bent. If this happens, replace the advancer mechanism.

20. Once timing is correct, check the contact breaker point gap and readjust if necessary as described in this chapter.
21. Install the rubber plug into the timing hole.
22. Install the spark plugs as described in this chapter.
23. Install the engine front cover and tighten the bolts securely.

### Electronic Ignition (1981-on Models)

All 1981 and later models are equipped with an electronic ignition system. The distributor and contact breaker point assembly is replaced with an ignition trigger unit that controls the ignition distribution.

There are two ways to inspect the ignition timing – static method (engine stopped) and dynamic method (engine running).

#### Static timing

Due to the high voltage generated by the electronic ignition system, checking the static timing with a test light or “buzz box” is not possible. BMW has a special tool called the “timing box” and it must be used for static timing. The special timing box tool is BMW part No. 12 3 650 (Figure 167). The timing box has a light-emitting diode (LED) and a 9-volt battery.

**CAUTION**

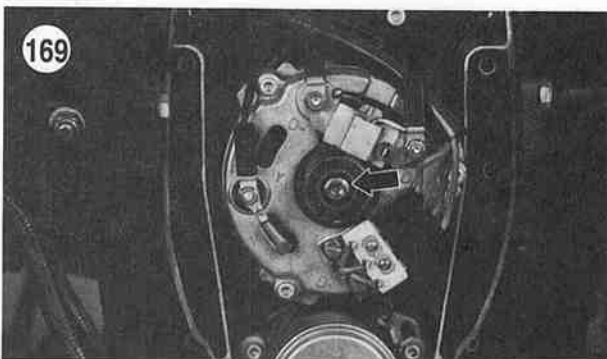
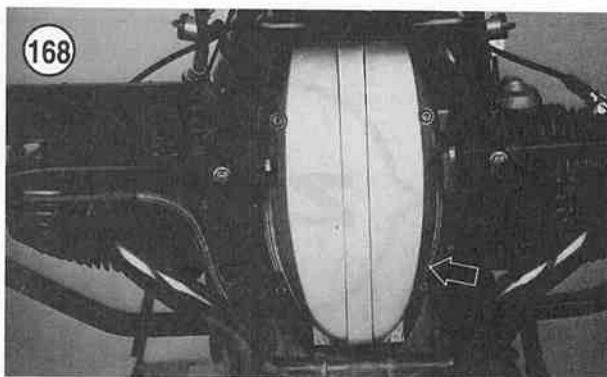
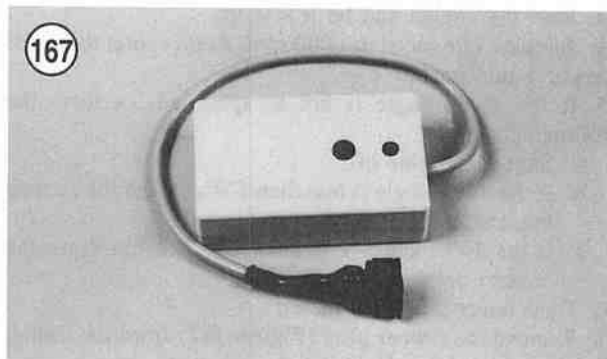
The ignition switch must be OFF during this procedure.

**CAUTION**

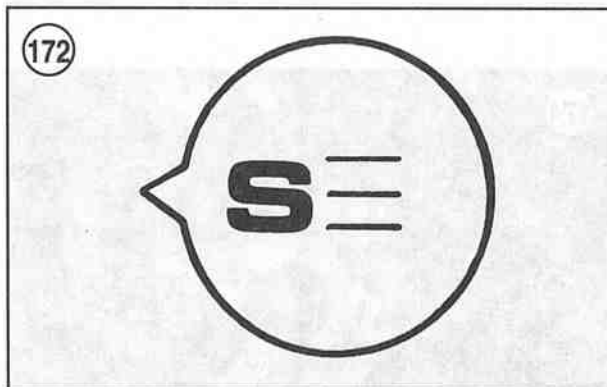
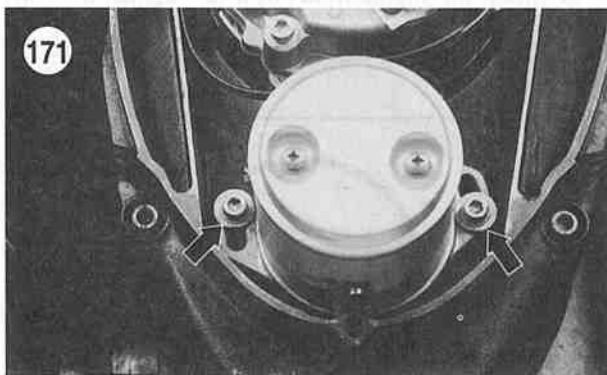
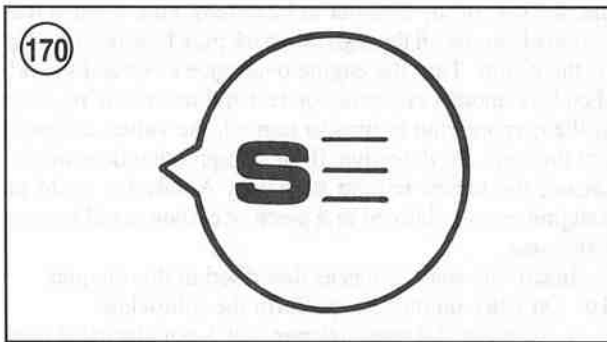
The battery negative lead must be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged. This will necessitate replacement of the entire diode board.

1. Disconnect the battery negative lead as described in this chapter.
2. Remove the engine front cover (Figure 168) as described in Chapter Four.
3. Remove the spark plugs as described in this chapter.
4. Remove the rubber plug (Figure 157) from the timing hole on the left-hand side of the crankcase.
5. Disconnect the 3-pin electrical connector at the ignition trigger unit and connect the BMW special timing box tool to the connector following the manufacturer’s instructions.

6. Insert an Allen wrench into the alternator rotor mounting bolt (Figure 169).
7. Rotate the engine clockwise and observe the timing hole.
8. The timing is correct if the LED on the BMW timing box lights up when the centerline “S” timing mark aligns with the fixed pointer on the crankcase timing hole (Figure 170).
9. If the timing is incorrect, loosen the screws (Figure 171) securing the ignition trigger unit and perform the following:
  - a. Gradually rotate the ignition trigger unit counter-clockwise to advance the timing.
  - b. Gradually rotate the ignition trigger unit clockwise to retard the timing.
  - c. Tighten the screws securely.



10. Repeat Step 7 and Step 8 and recheck timing. Readjust if necessary.
11. Remove the Allen wrench from the alternator rotor mounting bolt.
12. Disconnect the BMW special timing box tool and reconnect the 3-pin electrical connector to the spark trigger unit.
13. Install the rubber plug into the timing hole.
14. Install the spark plugs as described in this chapter.
15. Install the engine front cover and tighten the bolts securely.
16. Connect the battery negative lead as described in this chapter.



### Dynamic timing

Use a Xenon powered timing light as it produces a strong bright light required for this procedure. If you use an inexpensive light, the results may not be accurate.

#### CAUTION

*Do not allow the engine to idle for extended periods of time during the adjustment. The lack of air flowing over the engine may lead to engine overheating. If a high-velocity portable electric fan is available, turn it on HIGH and aim it at the front of the engine.*

1. If removed, install the spark plugs as described in this chapter.
2. Remove the rubber plug (**Figure 157**) from the timing hole on the left-hand side of the crankcase.
3. Connect the timing light according to the manufacturer's instructions.
4. Start the engine and let it idle between 800 and 1,100 rpm.
5. Aim the timing light perpendicular to the rotational axis of the crankshaft and pull the trigger.
6. The timing is correct if the center line "S" timing mark aligns with the fixed pointer on the crankcase timing hole (**Figure 172**). Proceed to Step 13.
7. If the lower "S" mark aligns with the fixed pointer (**Figure 172**), the timing is too retarded and must be adjusted as follows:
  - a. Shut the engine off.

#### CAUTION

*The battery negative lead must be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged. This will necessitate replacement of the entire diode board.*

- b. Remove the engine front cover (**Figure 168**) as described in Chapter Four.
  - c. Loosen the screws (**Figure 171**) securing the ignition trigger unit and gradually rotate the ignition trigger unit assembly counterclockwise to advance the timing.
  - d. Tighten the screws securely.
8. If the upper "S" mark aligns with the fixed pointer (**Figure 172**), the timing is too advanced and must be adjusted as follows:
  - a. Shut the engine off.
  - b. Remove the engine front cover (**Figure 168**) as described under *Engine Front Cover Removal/Installation* Chapter Four.
  - c. Loosen the screws (**Figure 171**) securing the ignition trigger unit and gradually rotate the ignition trigger unit assembly clockwise to retard the timing.
  - d. Tighten the screws securely.
9. Restart the engine.



10. Increase engine speed. Above 1,100 rpm the "S" mark starts to disappear and then will completely disappear as engine speed increases further.
11. Increase engine speed to about 3,500 rpm. At this speed, the "F" mark (**Figure 173**) should appear and align with the fixed pointer on the crankcase. This indicates that the ignition is at full advance.
12. When ignition timing is correct, with the strobe flashing, the timing marks will move up and down as engine speed is increased and decreased. If this does not happen, the automatic ignition advance mechanism within the ignition trigger unit is not working correctly or is not working at all. Proceed to Step 13 and Step 14. If the automatic ignition advance mechanism is working correctly, proceed to Step 16.
13. Shut the engine off.
14. If the ignition advance mechanism is not operating correctly, have a BMW dealer inspect the ignition advance mechanism within the ignition trigger unit. If the unit checks out okay, adjust the spark trigger unit so that the "F" timing mark is aligned as noted in Step 11. Use the "F" timing mark setting rather than the "S" timing mark setting.
15. Disconnect the timing light.
16. Install the rubber plug into the timing hole.
17. Install the engine front cover and tighten the bolts securely.

### Compression Test

Check the cylinder compression at the interval indicated in **Table 1**. Record the results and compare them to the results at the next interval. A running record will show trends in deterioration so that corrective action can be taken before complete failure.

The results, when properly interpreted, can indicate general cylinder, piston ring and valve condition.

1. Warm the engine to normal operating temperature, then shut it off.
2. Place the bike on the centerstand.
3. Shift the transmission into NEUTRAL.
4. Remove both spark plugs from the cylinder head as described in this chapter. This will make it easier to rotate the engine during this procedure.

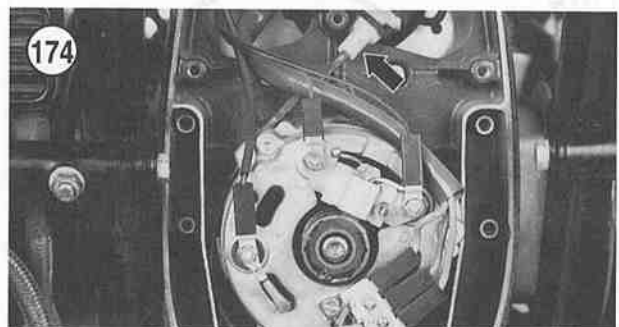
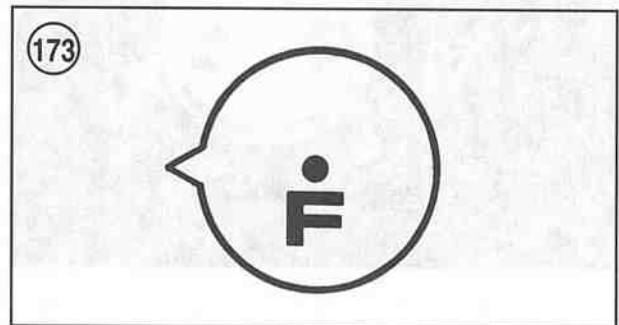
#### CAUTION

*On 1981-on models, the spark trigger unit electrical connector must be disconnected during this procedure in order prevent damage to the ignition system.*

5. On 1981-on models, perform the following:
  - a. Remove the engine front cover (**Figure 168**) as described in Chapter Four.
  - b. Disconnect the spark trigger unit 3-pin electrical connector (**Figure 174**) from the main wire harness.

6. Connect the compression tester to one of the cylinders following the manufacturer's instructions.
7. Using the kickstarter or starter, crank the engine over 2-3 revolutions until there is no further rise in pressure.
8. Remove the tester and record the reading. When interpreting the results, actual readings are not as important as the difference between the readings. The recommended "Good," "Normal" and "Poor" cylinder compression pressures are listed in **Table 6**. If the reading(s) is less than that listed in **Table 6** under "poor", this would indicate broken rings, leaky or sticking valves, a blown head gasket or a combination of all.
 

If a low reading (10% or more) is obtained in a cylinder(s), it indicates valve or ring trouble. To determine which, carefully lay the bike over as far as possible (opposite the side of the cylinder to be tested). Pour about a teaspoon of engine oil through the spark plug hole onto the top of the piston. Turn the engine over once to spread the oil, then take another compression test and record the reading. If the compression returns to normal, the valves are good but the rings are defective. If the compression does not increase, the valves require servicing. A valve(s) could be hanging open or burned or a piece of carbon could be on a valve seat.
9. Install the spark plugs as described in this chapter.
10. On 1981-on models, perform the following:
  - a. Connect the spark trigger unit 3-pin electrical connector (**Figure 174**).
  - b. Install the engine front cover and tighten the bolts securely.
11. Start the bike and make sure it runs correctly.



## Spark Plug Selection

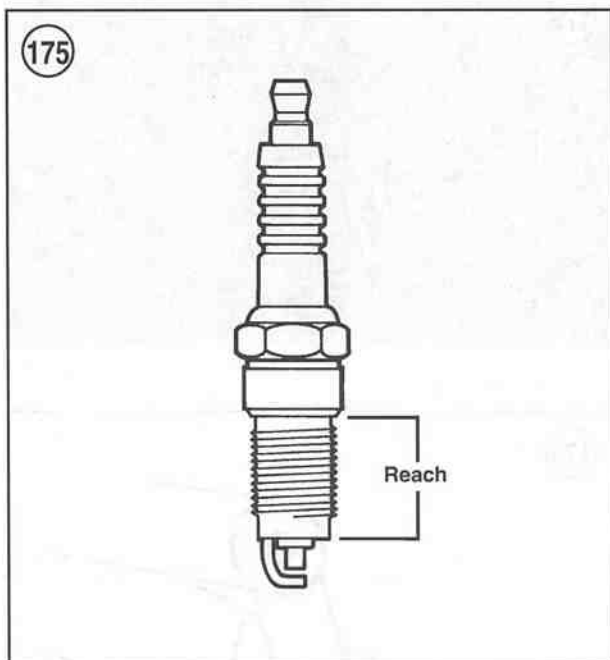
Spark plugs are available in various heat ranges, hotter or colder plugs than originally installed at the factory.

Select a plug of the heat range designed for the loads and temperature conditions under which the bike will be run. The use of incorrect heat ranges can cause a seized piston, scored cylinder wall or damaged piston crown.

In general, use a hot plug for low speeds, low engine loads and low temperatures. Use a cold plug for high speeds, high engine loads and high temperatures. The plug should operate hot enough to burn off unwanted deposits, but not so hot that it is damaged or causes preignition. A spark plug of the correct heat range will

show a light tan color on the portion of the insulator within the cylinder after the plug has been in service.

The reach (length) of a spark plug (**Figure 175**) is also important. A longer than normal plug could interfere with the valves and pistons, causing permanent and severe damage. The BMW factory recommends a single heat range for all conditions and it is listed in **Table 6**.



## Spark Plug Removal/Inspection

### CAUTION

*On 1981-on models, do not turn the engine over with the starter or try to run the engine with any of the spark plug leads disconnected. This will damage ignition system components.*

### WARNING

*On 1981-on models, do not touch any of the spark plug leads or suppressors while the engine is running. The high voltage generated by this ignition system could lead to serious or fatal electrical shocks.*

1. Place the bike on the centerstand.

### CAUTION

*Do not jerk or pull hard on the spark plug wire or the connector as they will be damaged. The spark plug may even work loose within the connector, leading to a hard-to-detect electrical problem.*

2. Carefully pull the spark plug wire and connector (**Figure 176**) from the spark plug. Slightly rotate the connector to break it loose from the spark plug insulator.

### CAUTION

*If any dirt falls into the cylinder when the plugs are removed, it could cause serious engine damage.*

3. Use compressed air and blow away any dirt that may have accumulated in the cylinder head cavity around the spark plug.

### NOTE

*Keep the spark plugs in order according to the side from which they were removed (e.g. right-hand and left-hand cylinder). If one of the spark plugs shows signs of abnormal engine operation, it is a good idea to know from what cylinder it was removed.*

- Remove the spark plug with the spark plug wrench furnished in the factory tool kit or a 13/16 in. spark plug wrench.

**NOTE**

*If plug is difficult to remove, apply penetrating oil around base of plug and let it soak in about 10-20 minutes.*

- Inspect the spark plug carefully. Look for a broken center porcelain, excessively eroded electrodes and excessive carbon or oil fouling. Replace such a plug. If deposits are light, the plug may be cleaned in solvent with a wire brush or in a special spark plug sandblast cleaner.
- Insert a wire feeler gauge between the center and the side electrode of the plug (**Figure 177**) and check the gap. The correct gap is listed in **Table 6**.
- If the gap is correct, you will feel a slight drag as you pull the wire through. If there is no drag or the gauge won't pass through, regap the spark plug as described in this chapter.

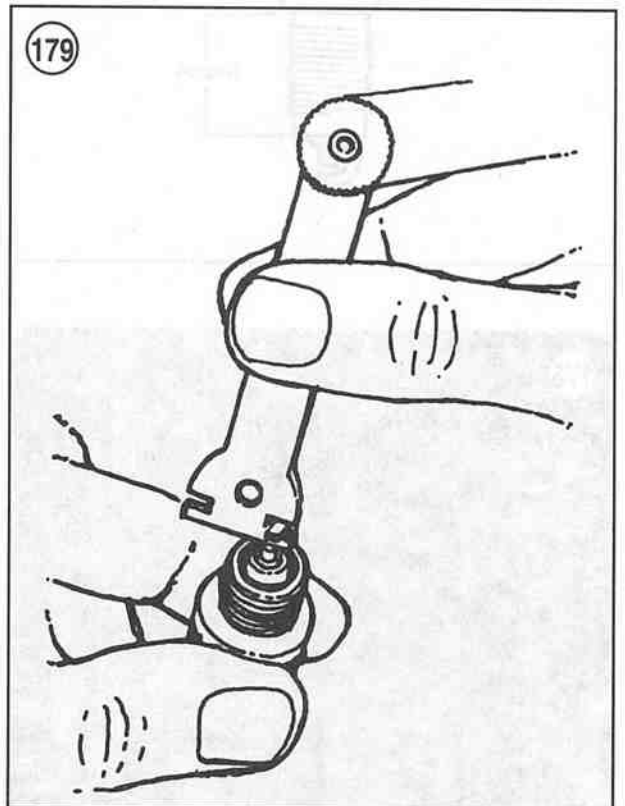
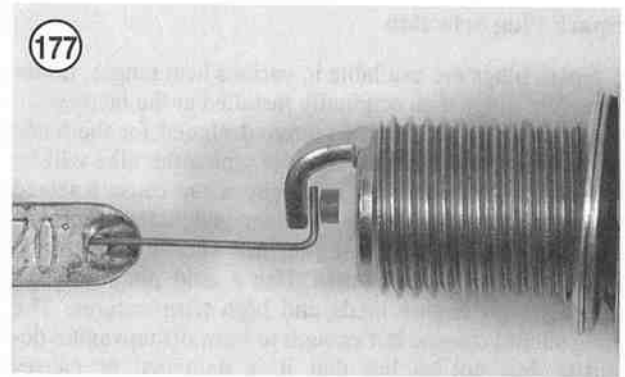
### Spark Plug Gapping and Installation

A spark plug must be carefully gapped to ensure a reliable, consistent spark. You must use a special spark plug gapping tool with a wire feeler gauge.

- Install the terminal nut (**Figure 178**) onto the spark plug.
- Insert a wire feeler gauge between the center and the side electrode of the plug (**Figure 177**). The correct gap is listed in **Table 6**.
- If the gap is correct, you will feel a slight drag as you pull the wire through. If there is no drag or the gauge won't pass through, bend the side electrode *with the gapping tool* (**Figure 179**) to set the proper gap.
- Put a *small* amount of aluminum anti-seize compound (**Figure 180**) on the threads of the spark plug.
- Screw the spark plug in by hand until it seats. Very little effort is required. If force is necessary, you have the plug cross-threaded; unscrew it and try again.
- 6A. If you are installing new spark plugs, tighten the spark plug an additional 1/2 turn after the gasket has made contact with the cylinder head. Then tighten to the torque specification listed in **Table 4**.
- 6B. If you are reinstalling old spark plugs and are reusing the old gaskets, tighten only an additional 1/4 turn after the gasket has made contact with the cylinder head.

**CAUTION**

*Do not overtighten. This will only squash the gasket and destroy its sealing ability. Overtightening may also lead to thread damage in the cylinder head, which will require inserting a Helicoil thread repair kit (**Figure 181**). If damage is severe, a new cylinder head may be required.*



7. Wipe the electrical connector on the end of the spark plug clean. Make sure there is no oil film on it.

8. If there was any oil contamination on the spark plug, it may have worked its way up into the spark plug wire electrical connector. If contaminated, perform the following:

- a. Wrap the end of a No. 2 wood pencil or wood dowel of the same diameter with a thin clean cloth.
- b. Insert the pencil and cloth up into the electrical connector and carefully rotate it to clean out the connector. Change positions of the cloth and do this several times until the cloth is clean after it is withdrawn.



- c. Spray some aerosol electrical contact cleaner up into the electrical connector. Flood it thoroughly and then blow it out with compressed air.
9. Install the spark plug wire and electrical connector; make sure the connector is on tight.
  10. Repeat for the other cylinder.
  11. Start the bike and make sure it runs correctly.

### Reading Spark Plugs

Much information about engine and spark plug performance can be determined by careful examination of the spark plugs. This information is more valid after performing the following steps.

1. Ride the bike about 6 miles (10 km) at moderate speeds to thoroughly warm up the engine.
2. Ride back to your work area where you can remove the spark plugs and examine them.
3. While the bike is still rolling, turn the engine kill switch to the OFF position (**Figure 182**), close the throttle and simultaneously pull in the clutch or shift to NEUTRAL; coast and brake to a stop.
4. Remove one spark plug at a time, as described in this chapter, and examine it. Compare it to the following and to **Figure 183**:
  - a. If the plug has a light tan or gray colored deposit and no abnormal gap wear or electrode erosion is evident, the plug and the engine are running properly.
  - b. If the plug is covered with soft, dry soot deposits, the carburetor(s) is malfunctioning, probably with a too-rich mixture or a dirty or blocked air filter element. Also the spark plug heat range may be too cold.
  - c. If the plug is brightly colored from overheating, the carburetor(s) is malfunctioning, probably with a too-lean mixture. Also the ignition timing may be too far advanced or the spark plug heat range may be too hot. There may also be deposits in the combustion chamber.
  - d. If the plug exhibits a black insulator tip, a damp and oily film over the firing end and a carbon layer over the entire nose, it is oil fouled. Engine oil is passing by the valve guides or piston rings and fouling the plug. An oil fouled plug can be cleaned, but it is better to replace it.
5. If the existing spark plug is okay, reinstall it. If not, replace with a new one.
6. Repeat Step 4 and Step 5 for the other spark plug. If either of the spark plugs are questionable, replace both as a set for maximum performance.

### Carburetor Float Bowl Cleaning

Remove and clean the carburetor float bowls at the interval listed in Table 1.

1. Place the bike on the centerstand.
2. Turn the fuel shutoff valves to the OFF position.



(183)

**SPARK PLUG CONDITION****Normal**

- Identified by light tan or gray deposits on the firing tip.
- Can be cleaned

**Carbon-fouled**

- Identified by black, dry fluffy carbon deposits on insulator tips, exposed shell surfaces and electrodes.
- Caused by too cold a plug, weak ignition, dirty air cleaner, too rich a fuel mixture, or excessive idling. Can be cleaned.

**Oil-fouled**

- Identified by wet black deposits on the insulator shell bore and electrodes.
- Caused by excessive oil entering combustion chamber through worn rings and pistons, excessive clearance between valve guides and stems, or worn or loose bearings. Can be cleaned. If engine is not repaired, use a hotter plug.

**Gap-bridged**

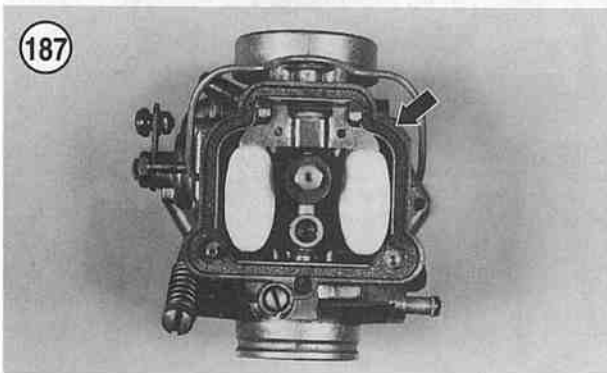
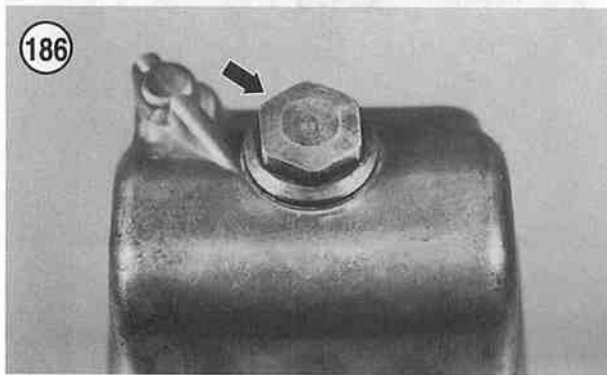
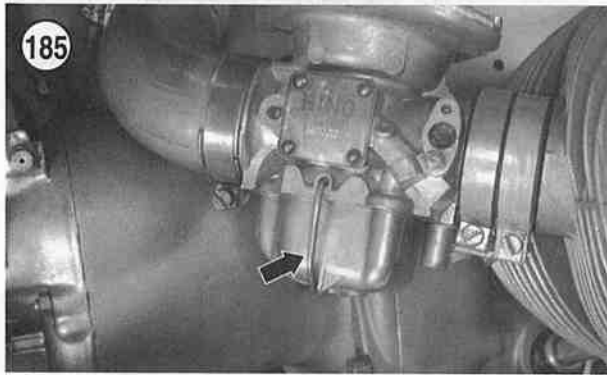
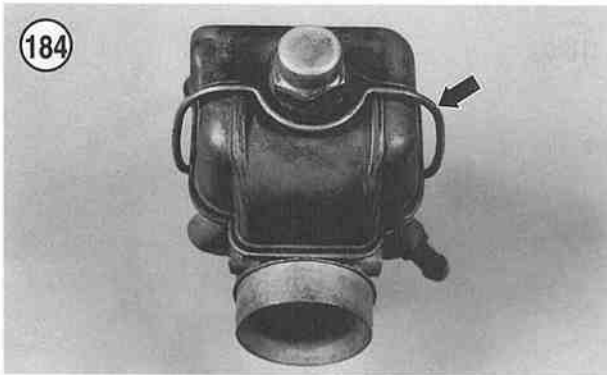
- Identified by deposit buildup closing gap between electrodes.
- Caused by oil or carbon fouling. If deposits are not excessive, the plug can be cleaned.

**Overheated**

- Identified by a white or light gray insulator with small black or gray brown spots and with bluish-burnt appearance of electrodes.
- Caused by engine overheating, wrong type of fuel, loose spark plugs, too hot a plug, or incorrect ignition timing. Replace the plug.

**Sustained preignition**

- Identified by melted electrodes and possibly blistered insulator. Metallic deposits on insulator indicates engine damage.
- Caused by wrong type of fuel, incorrect ignition timing or advance, too hot a plug, burned valves, or engine overheating. Replace the plug.

**CAUTION**

Have a fire extinguisher rated for gasoline fires handy during this procedure.

- Place a container under the carburetor to catch the fuel in the float bowl.

**NOTE**

In Step 4, the carburetors are shown removed for clarity. It is not necessary to remove them from the engine for this procedure.

- On Bing slide and constant velocity type carburetors, slide the float bowl retaining clip off of the float bowl. Refer to **Figure 184** for the Bing slide or **Figure 185** for the Bing constant velocity type.

- On Dell'Orto carburetors, unscrew the float bowl drain bolt and gasket (**Figure 186**).

- Remove the float bowl and drain the fuel from the float bowl. Dispose of the fuel properly.

- Thoroughly clean the float bowl in solvent and dry with compressed air.

- Inspect the float bowl gasket (**Figure 187**) and replace if necessary.

- Install the float bowl and secure it.

- Turn the fuel shutoff valves to the ON position to fill the float bowls. Turn the fuel shutoff valves back to the OFF position.

### Carburetor Idle Mixture and Speed Adjustment

Adjust the carburetors at the interval listed in **Table I**.

#### Slide valve carburetors (Bing and Dell'Orto)

**CAUTION**

Do not allow the engine to idle for extended periods of time during the adjustment. The lack of air flowing over the engine may lead to engine overheating. If a high-velocity portable electric fan is available, turn it on HIGH and aim it at the front of the engine.

Before making this adjustment, the air filter element must be clean and the engine must have adequate compression. See *Compression Test* in this chapter. Otherwise this procedure cannot be done properly.

- Start the engine and let it reach normal operating temperature. Usually 10-15 minutes of stop-and-go riding is sufficient.

- Make sure the choke lever is moved all the way back toward the open (or warm engine) position.

- Turn the engine off and place the bike on the centerstand.

4. Rotate the throttle grip to the idle position and check for throttle cable free play as follows:
  - a. Pull on each throttle cable. There should be 1 mm (0.039 in.) of free play at the top of the carburetor.
  - b. If the free play is insufficient, loosen the jam nut (A, **Figure 188**) and turn the adjuster screw (B, **Figure 188**) in either direction until the correct amount of free play is achieved. Tighten the locknut securely.
  - c. Both throttle cables must have the same amount of free play.

**CAUTION**

*The idle mixture screw seat can be damaged if the idle mixture screw is tightened too hard against the seat.*

5. Turn the idle mixture screw in until it seats lightly, then back it out 1 1/2 turns as the preliminary adjustment. Refer to A, **Figure 189** for Bing carburetors or A, **Figure 190** for Dell'Orto carburetors. Repeat for the other carburetor.
6. Start the engine and adjust each throttle stop screw an equal amount until the engine idle speed is 1,000-1,200 rpm. Refer to (B, **Figure 189**) for Bing carburetors or (B, **Figure 190**) for Dell'Orto carburetors.
7. Shut the engine off.

**NOTE**

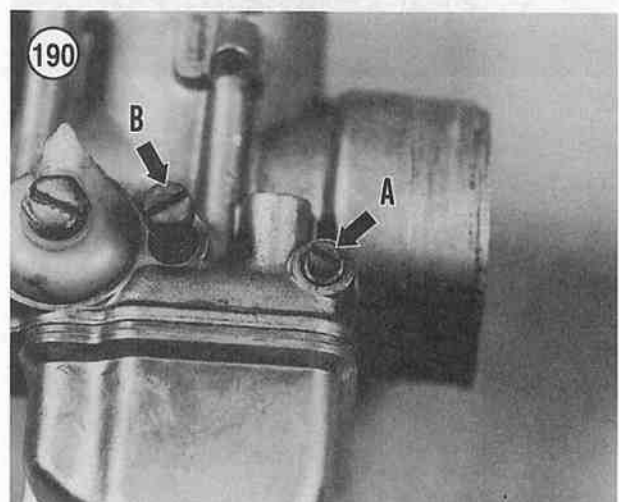
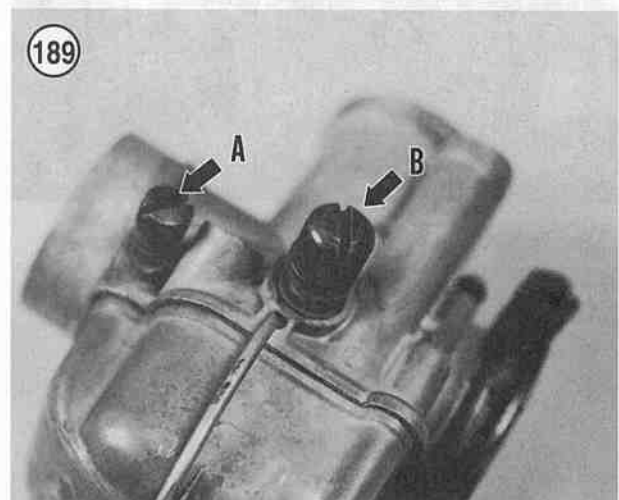
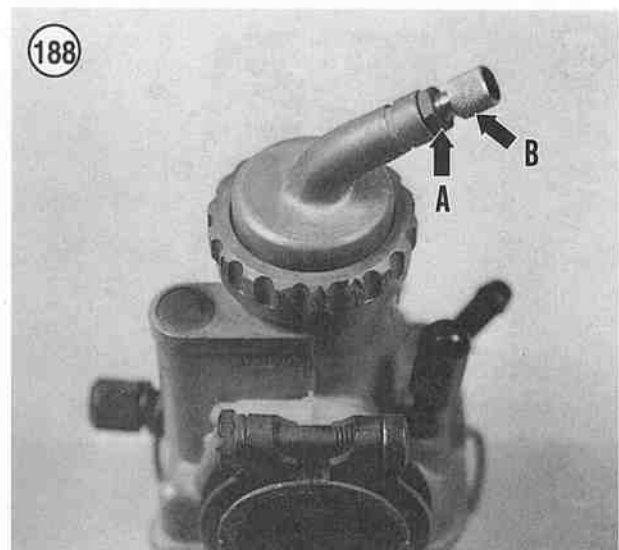
*Each idle mixture screw must be adjusted individually with the engine running on one cylinder only. To determine the response to the adjustment, remove the spark plug lead from the spark plug on the cylinder opposite the carburetor being adjusted.*

8. To adjust the right-hand carburetor, perform the following:
  - a. Remove the left-hand spark plug lead. Attach the spark plug cable so it is grounded to an engine or frame component. Start the engine.

**NOTE**

*In sub-step b and sub-step c the idle mixture screw will be turned from the lean to rich settings where the engine runs roughly. The final setting will be midway between these two positions so it is necessary to note how many turns there are between the two settings.*

- b. Rotate the idle mixture screw on the right-hand carburetor *clockwise* until the engine begins to run roughly. Refer to A, **Figure 189** for Bing carburetors or A, **Figure 190** for Dell'Orto carburetors. Note the screw position.
- c. Slowly back out the idle mixture screw *counter-clockwise*. The engine will run more smoothly. Continue to back out the screw until the engine runs roughly again. Note the position.



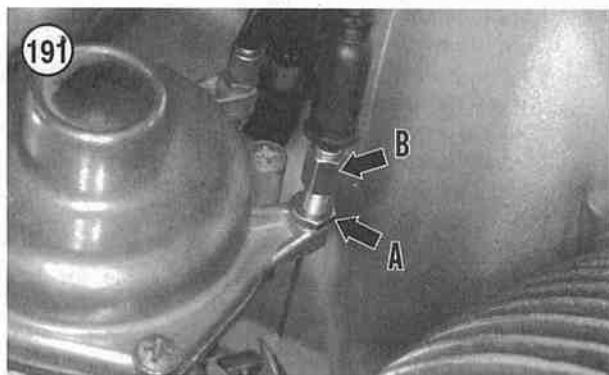
**NOTE**

The optimum adjustment setting is midway between the lean and rich running conditions. For example, if the extremes occur two turns apart, turn the idle mixture screw one turn from either extreme position. This procedure requires a lot of patience and close attention to the sound of the engine. Always allow a few seconds after each turn of the idle mixture adjustment screw for the engine to respond properly.

- d. Turn the idle mixture screw to the midpoint achieved in sub-step b and sub-step c.
  - e. Shut the engine off and attach the left-hand spark plug lead.
9. To adjust the left-hand carburetor, disconnect the right-hand spark plug lead and repeat Step 8.
  10. Shut the engine off and attach the right-hand spark plug lead.
  11. Start the engine and adjust each throttle stop screw an equal amount until the engine idle speed is 500-750 rpm. Refer to B, **Figure 189** for Bing carburetors or B, **Figure 190** for Dell'Orto carburetors.

**WARNING**

With the engine running at idle speed, move the handlebar from side-to-side. If the idle



speed increases during this movement, the throttle cables may need adjusting or may be incorrectly routed through the frame. Correct this problem immediately. Do not ride the bike in this unsafe condition.

12. Shut the engine off and make sure both spark plug leads are on tight.

**Constant velocity carburetors  
(1970-1978 models)**

This procedure can be used only on 1970-1978 models. Do *not* use this procedure on models that are equipped with the electronic ignition system. The electronic ignition system will be damaged if one of the spark plug leads is disconnected and the engine is started and run as is required in this procedure.

**CAUTION**

Do not allow the engine to idle for extended periods of time during the adjustment. The lack of air flowing over the engine may lead to engine overheating. If a high-velocity portable electric fan is available, turn it on HIGH and aim it at the front of the engine.

Before making this adjustment, the air filter element must be clean and the engine must have adequate compression. See *Compression Test* in this chapter. Otherwise this procedure cannot be done properly.

1. Make sure the choke lever is moved all the way back toward the open (or warm engine) position.
2. Turn the engine off and place the bike on the centerstand.
3. Rotate the throttle grip to the idle position and check for throttle cable free play as follows:
  - a. Pull on each throttle cable. There should be 4 mm (0.16 in.) of free play at the cable sheath at the carburetor.
  - b. If the free play is insufficient, loosen the locknut (A, **Figure 191**) and turn the adjuster (B, **Figure 191**) in either direction until the correct amount of free play is achieved. Tighten the locknut securely.
  - c. Both throttle cables must have the same amount of free play.
4. Move the choke lever (**Figure 192**) to the open position (warm engine) and check for choke cable free play as follows:
  - a. Pull on each choke cable. There should be 4 mm (0.16 in.) of free play at the cable sheath at the carburetor.
  - b. If the free play is insufficient, loosen the locknut (A, **Figure 193**) and turn the adjuster (B, **Figure 193**) in either direction until the correct amount of free play is achieved. Tighten the locknut securely.



- c. Both choke cables must have the same amount of free play.

**NOTE**

*The throttle stop screw is located on the bottom surface of the carburetor on early models or on the top surface on later models.*

5. Turn the throttle stop screw (A, **Figure 194**) until it contacts the butterfly linkage. Then turn it one additional turn. Repeat for the other carburetor.

**CAUTION**

*The idle mixture screw seat can be damaged if the idle mixture screw is tightened too hard against the seat.*

6. Turn the idle mixture screw (B, **Figure 194**) in until it seats *lightly* then back it out 1 full turn as the preliminary adjustment. Repeat for the other carburetor.

7. Start the engine and let it reach normal operating temperature. Usually 10-15 minutes of stop-and-go riding is sufficient.

**NOTE**

*Each idle mixture screw must be adjusted individually with the engine running on one cylinder only. To determine the response to the adjustment, remove the spark plug lead from the spark plug on the cylinder opposite the carburetor being adjusted.*

8. To adjust the right-hand carburetor, perform the following:

- Remove the left-hand spark plug lead. Position the spark plug cable so that it will not ground out on an engine or frame component. Start the engine.
- Rotate the idle mixture screw on the right-hand carburetor until the engine speed is 1,000 rpm.
- Shut the engine off and attach the left-hand spark plug lead.

9. To adjust the left-hand carburetor, perform the following:

- Remove the right-hand spark plug lead. Position the spark plug cable so that it will not ground out on an engine or frame component. Start the engine.
- Rotate the idle mixture screw on the left-hand carburetor until the engine speed is 1,000 rpm.
- Shut the engine off and attach the right-hand spark plug lead.

10. Start the engine and adjust each throttle stop screw (A, **Figure 194**) an equal amount until the engine idle speed is 600-800 rpm. Shut the engine off.

11. Move the choke lever all the way until it stops and check for choke cable free play as follows:

- Pull on each choke cable. There should be 0.5-1.0 mm (0.02-0.04 in.) of free play at the cable sheath at the carburetor.
- If the free play is insufficient, loosen the locknut (A, **Figure 193**) and turn the adjuster (B, **Figure 193**) in either direction until the correct amount of free play is achieved. Tighten the locknut securely.
- Both choke cables must have the same amount of free play.

12. Rotate the throttle grip to the idle position and check for throttle cable free play as follows:

- Pull on each throttle cable. There should be 0.5-1.0 mm (0.02-0.04 in.) of free play at the cable sheath at the carburetor.
- If the free play is insufficient, loosen the locknut (A, **Figure 191**) and turn the adjuster (B, **Figure 191**) in either direction until the correct amount of free play is achieved. Tighten the locknut securely.
- Both throttle cables must have the same amount of free play.

13. When the idle has been adjusted correctly and all control cables adjusted, start the engine and check the transition from idle to load by turning the throttle. Engine speed should increase proportionately.

14. Check the individual cylinder operation as follows:

- Turn the engine off and disconnect one of the spark plug cables. Position the spark plug cable so that it will not ground out on an engine or frame component.
- Start the engine and observe the idle speed.
- Shut off the engine and reconnect the spark plug lead.
- Repeat sub-steps 14a-c for the other cylinder and note the engine speed.
- If one of the cylinders idles at a lower speed, adjust that cylinder's carburetor throttle cable for less freeplay.



- f. Repeat sub-step 14e until both cylinders idle at the same speed.

**WARNING**

*With the engine running at idle speed, move the handlebar from side-to-side. If the idle speed increases during this movement, the throttle cables may need adjusting or may be incorrectly routed through the frame. Correct this problem immediately. Do not ride the bike in this unsafe condition.*

15. Shut the engine off and make sure both spark plug leads are on tight.

**Constant vacuum carburetors  
(1979-on models)**

This procedure is to be used on 1979-1980 models and 1981-on models that are equipped with the electronic ignition system.

Achieving a balanced carburetor adjustment on these models, especially the later models, is very difficult. If you don't feel qualified to perform this procedure correctly yourself, take the bike to a BMW dealer and have them adjust the carburetors. If the carburetors are not balanced correctly, the engine will run very rough and the performance will be less than desirable.

This test requires the use of a mercury manometer, or dial gauge set. It is suggested that this procedure be performed with the special BMW tool designed for this purpose (part No. 13 0 700). Aftermarket mercury manometers are available and are less expensive but are not as accurate as the BMW unit. This procedure is shown with an aftermarket dial gauge set to show how it is to be connected and used.

The mercury manometer is an expensive piece of equipment, and this adjustment is required so infrequently, you should compare the purchase price of the test equipment to the cost of having the carburetors synchronized by a BMW dealer.

Also, after synchronizing the carburetors, the CO level must be checked and adjusted. This test requires the use of a special tool called an exhaust gas analyzer. The exhaust gas analyzer determines the composition of the exhaust gases—mainly the carbon monoxide level. This level must be maintained to the correct percentage to conform with today's environmental laws.

The exhaust gas analyzer is also an expensive piece of equipment, and this adjustment is also required so infrequently, you should compare the purchase price of the test equipment to the cost of having the CO level tested and adjusted by a BMW dealer.

The following procedure is provided if you choose to perform this procedure yourself. Follow the manufacturer's instruction provided with the special tool.

Before synchronizing the carburetors the following items must be correct:

- Ignition timing must be correct.
- New or fairly new spark plugs installed.
- Valve clearances are correctly adjusted.
- A clean air filter element installed.
- The choke lever must be in the OFF position, (the position for a normal operating temperature engine).
- The intake and exhaust systems must be free of all leaks.
- Engine must be at normal operating temperature (approximately 10-15 minutes of stop-and-go riding is usually sufficient).

**CAUTION**

*Do not allow the engine to idle for extended periods of time during the adjustment. The lack of air flowing over the engine may lead to engine overheating. If a high-velocity portable electric fan is available, turn it on HIGH and aim it at the front of the engine.*

- Make sure the choke lever is moved all the way back toward the open (or warm engine) position (**Figure 192**).
- Turn the engine off and place the bike on the center stand.
- Rotate the throttle grip to the idle position and check for throttle cable free play as follows:
  - Pull on each throttle cable. There should be 4 mm (0.16 in.) of free play at the cable sheath at the carburetor.
  - If the free play is insufficient, loosen the locknut (A, **Figure 191**) and turn the adjuster (B, **Figure 191**) in either direction until the correct amount of free play is achieved. Tighten the locknut securely.
  - Both throttle cables must have the same amount of free play.
- Move the choke lever to the OFF position (warm engine) and make sure that the choke levers, on the backside of the carburetors, are in their at-rest position against the stop on the carburetor. Adjust the choke cable(s) if necessary as follows:
  - Loosen the locknut (A, **Figure 193**) and turn the adjuster (B, **Figure 193**) in either direction until the choke lever bottoms out.
  - Tighten the locknut securely.
- Turn the throttle stop screw (A, **Figure 194**) until it contacts the butterfly linkage. Then turn it one additional turn. Repeat for the other carburetor.

**CAUTION**

*The idle mixture screw seat can be damaged if the idle mixture screw is tightened too hard against the seat.*

6. Turn the idle mixture screw (B, **Figure 194**) in until it seats lightly, then back it out the number of turns listed in **Table 7**. Repeat for the other carburetor.
7. Start the engine and let it reach normal operating temperature. Usually 10-15 minutes of stop-and-go riding is sufficient.
8. Unscrew the plug (**Figure 195**) from the side of the carburetor. On some models the plug is next to the idle mixture screw.
9. Attach the mercury manometer following the manufacturer's instructions.
10. Start the engine and let it idle.

**NOTE**

*If the manometer is equipped with damping adjusters, adjust them so that the fluctuations are just removed. If adjusted too far, the instrument will not be able to read small changes in vacuum.*

11. Note the level of the mercury in both columns (or gauge dials). The level should be exactly the same for both cylinders.
- 12A. If both levels are correct, turn the engine off, disconnect the special tool. Install the plugs onto the vacuum ports.
- 12B. If the levels are not correct, proceed to Step 13.
13. Alternately adjust each idle mixture screw (B, **Figure 194**), in small increments, until the highest engine idle speed is obtained.

**NOTE**

*In Step 14, the vacuum gauge reading is not important. The important thing is that both readings are **exactly** the same.*

14. Alternately adjust each idle mixture screw (B, **Figure 194**), in small increments, until the vacuum level in both carburetors is the same. If after this adjustment the idle speed is not correct, turn both throttle adjust screws in equal amounts to achieve the correct idle speed of 800-1,000 rpm.
15. Turn the engine off and disconnect the special tool. Install the plugs onto the vacuum ports.
16. Move the choke lever all the way until it stops and check for choke cable free play as follows:
  - a. Pull on each choke cable. There should be 0.5-1.0 mm (0.02-0.04 in.) of free play at the cable sheath at the carburetor.
  - b. If the free play is insufficient, loosen the locknut (A, **Figure 193**) and turn the adjuster (B, **Figure 193**) in either direction until the correct amount of free play is achieved. Tighten the locknut securely.
  - c. Both choke cables must have the same amount of free play.
17. Rotate the throttle grip to the idle position and check for throttle cable free play as follows:
  - a. Pull on each throttle cable. There should be 0.5-1.0 mm (0.02-0.04 in.) of free play at the cable sheath at the carburetor.

- b. If the free play is insufficient, loosen the locknut (A, **Figure 191**) and turn the adjuster (B, **Figure 191**) in either direction until the correct amount of free play is achieved. Tighten the locknut securely.
  - c. Both throttle cables must have the same amount of free play.
18. When the idle has been adjusted correctly and all control cables adjusted, start the engine and check the transmission from idle to load by turning the throttle. Engine speed should increase proportionately.

**WARNING**

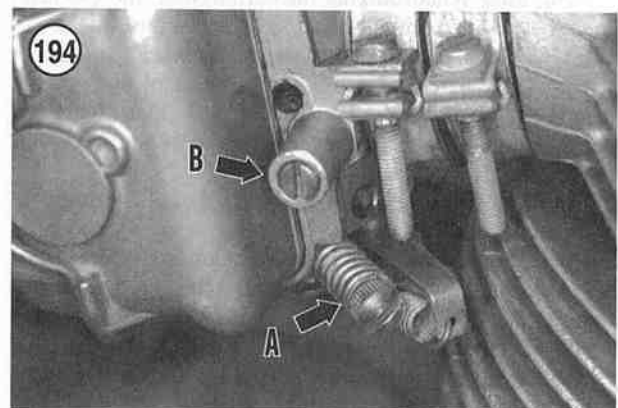
*With the engine running at idle speed, move the handlebar from side-to-side. If the idle speed increases during this movement, the throttle cables may need adjusting or it may be incorrectly routed through the frame. Correct this problem immediately. Do not ride the bike in this unsafe condition.*

19. Adjust the CO (carbon monoxide) level as follows:

**NOTE**

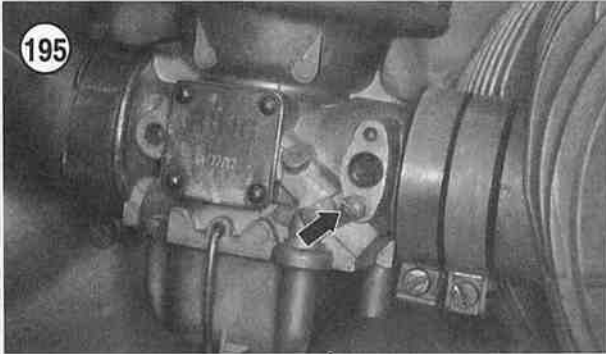
*If adjustment is necessary, carry it out in small increments. A minimal amount of adjustment can make quite a difference in the end result. Also, wait a few minutes for the system to stabilize after the adjustment has been made. On models equipped with the evaporative emission control system, make sure the engine is thoroughly warmed up to normal operating temperature. The fuel vapors stored in the crankcase on these models must be thoroughly burned after the engine is started and run. If a reading is made too soon, the exhaust composition will not be normal.*

- a. Insert the exhaust gas analyzer probe or sensor into one of the mufflers opening a minimum of 5 mm (20 in.). This is necessary to prevent outside air (oxygen



rich) from coming in contact with the analyzer probe and giving a false meter reading.

- b. Start the engine and let it reach normal operating temperature. Approximately 10-15 minutes of stop-and-go riding is usually sufficient.
- c. Start the engine and let idle for a few minutes to allow the analyzer to stabilize.



- d. Follow the manufacturer's instructions and observe the needle movement. When it stabilizes, note the reading. The specified maximum amount of CO (carbon monoxide) is  $2 \pm 0.5\%$ .
- e. If the reading is within specification, shut off the engine and disconnect the analyzer.

**NOTE**

*After an adjustment has been made, wait a few minutes for the system to stabilize. Don't be in a hurry. This procedure requires patience and time. Different types of analyzers respond differently and some take a little longer to settle down and give an accurate reading.*

- f. If the CO is outside of the specification, let the engine continue to idle and slowly turn the idle mixture screw until the CO percentage is within specification.
- g. Repeat sub-steps 19a-f for the other cylinder.
- h. After the CO level percentage is correct, shut off the engine and disconnect the analyzer.

Tables 1-7 are on the following pages.



**Table 1 MAINTENANCE SCHEDULE<sup>1</sup>**

Perform these procedures at specific monthly intervals. This is especially true if the bike is not routinely ridden.	
Every 3 months	Check the battery electrolyte level. Refill if necessary.
Every 3 months or at least every 2,000 miles (3218 km).	Change engine oil and filter if the bike is operated when the outside temperature is below 0° C (32° F).
Every 6 months	Change engine oil and filter if the bike is used for short trips only. Lubricate the clutch plate and input shaft splines if bike
Every 12 months	Change engine oil and filter. Change transmission oil. Change final drive oil. Change front fork oil. Change drive shaft oil (except R100GS). Clean fuel shutoff valve filters. Change brake fluid and bleed the brake system. Lubricate the clutch plate and input shaft splines if bike is used in high humidity areas. Perform this procedure if clutch operation is erratic. <sup>2</sup>
Before each ride	Inspect tire, spoke and rim condition. Check tire inflation pressure. Check fuel supply, Make sure there is enough fuel for the intended ride. Check brake operation and for fluid leakage (disc brake). Check for fuel leakage. Check the oil level in the engine, transmission, drive shaft (except R100GS) and final drive unit. Check for smooth clutch and throttle operation. Check for smooth gearshift operation. Check steering for smooth operation with no excessive play or restrictions. Check headlight, taillight/brakelight and turn signal operation. Check horn operation.
Every 4,500 miles (7240 km)	Change engine oil and filter. Check battery electrolyte level. Make sure battery cables are clean and properly secured. Check spark plug condition and gap. Clean or replace air filter element if bike is ridden in dirty or dusty conditions. Check all fuel line connections for wetness or damage. Tighten hose clamps if necessary. Check the fuel tank vent and drain lines. Check front disc brake master cylinder cable free play (Type A cable operated models). Check brake fluid level in master cylinder(s). Check all brake lines and hoses for leakage or damage. Check brake pads for wear. Check brake discs for wear or damage. Check brake drum(s) and linings for wear. Check and adjust clutch if necessary.

(continued)

**Table 1 MAINTENANCE SCHEDULE<sup>1</sup> (continued)**

	<p>Lubricate control cables.</p> <p>Lubricate centerstand and sidestand pivot points.</p> <p>Lubricate swing arm pivot bearings.</p> <p>Check tightness of sidestand pivot bolt.</p> <p>Inspect tire tread depth and inflation pressure.</p> <p>Check tightness of rear wheel mounting bolts (single shock models).</p> <p>Check tightness of muffler heat shield bolts.</p> <p>Check tightness of sidestand pivot bolt.</p> <p>Check for smooth clutch and throttle operation.</p> <p>Check for smooth gearshift operation.</p> <p>Check steering for smooth operation with no excessive play or restrictions.</p> <p>Check and adjust engine idle speed.</p> <p>Check all running and illumination lights.</p> <p>Check horn operation.</p>
Every 8,500 miles (13,680 km)	<p>Replace both spark plugs.</p> <p>Replace contact breaker points and adjust (models so equipped).</p> <p>Lubricate felt on contact breaker points and advance mechanism (models so equipped).</p> <p>Re-torque cylinder head nuts.</p> <p>Check valve clearance.</p> <p>Check ignition timing.</p> <p>Run a compression test.</p> <p>Replace air filter element.</p> <p>Clean fuel filter.</p> <p>Replace transmission oil.</p> <p>Replace final drive oil.</p> <p>Replace drive shaft oil (except R100GS)</p> <p>Replace front fork oil.</p> <p>Check and adjust throttle free play.</p> <p>Check and adjust brake pedal height.</p> <p>Check and adjust steering head bearings.</p> <p>Check and adjust swing arm bearing play.</p> <p>Check wheel bearings.</p> <p>Check tightness of front axle bolt and clamping bolts.</p> <p>Check tightness of sidestand and centerstand pivot bolts.</p> <p>Check tightness of shock absorber mounting bolts and/or nuts.</p> <p>Check tightness of engine mounting bolts and nuts.</p> <p>Check tightness of exhaust system fasteners.</p>
Every 16,000 miles (25,750 km)	<p>Clean the fuel filter(s).</p> <p>Service the steering stem and wheel bearings (/5 models).</p>
Every 20,000 miles (32,190 km)	<p>Service the steering and wheel bearings (all models except /5).</p> <p>Lubricate the clutch plate and input shaft splines.</p>
<p>1. This maintenance schedule should be considered as a guide to general maintenance and lubrication intervals. Harder than normal use and exposure to mud, water, sand, high humidity, ect. will naturally dictate more frequent attention to most maintenance items.</p> <p>2. See text.</p>	

**TIRE INFLATION PRESSURE (COLD)\***

Model/speed	Rider only		Rider and passenger	
	psi	kPa	psi	kpa
<b>1970-1973</b>				
Up to speed limit				
Front	27	186	30	206
Rear	30	206	35	241
Up to 100 mph (160 kmh)				
Front	30	206	33	227
Rear	33	227	38	262
<b>1974-1976</b>				
Up to speed limit				
Front	27	186	28	193
Rear	28	193	32	220
Up to 100 mph (160 kmh)				
Front	30	206	31	213
Rear	31	213	35	241
<b>1977-1987</b>				
Up to speed limit				
Front	27	186	30	206
Rear	26	179	32	220
Up to 100 mph (160 kph)				
Front	27	186	30	206
Rear	29	199	32	220
<b>1988-on**</b>				
Up to speed limit				
Front	31	213	34	234
Rear	36	248	41	283

\* Tire inflation pressure for factory equipped tires. Aftermarket tires may require different inflation pressure.  
 \*\* BMW does not provide inflation pressures for speeds over the speed limit on these models.

**Table 3 BATTERY CHARGING RATES/TIMES (APPROXIMATE)**

Voltage	% of charge	3 amp charger	6 amp charger	10 amp charger	20 amp charger
12.8	100	—	—	—	—
12.6	75	1.75 hours	50 minutes	30 minutes	15 minutes
12.3	50	3.5 hours	1.75 hours	1 hour	30 minutes
12.0	25	5 hours	2.5 hours	1.5 hours	45 minutes
11.8	0	6 hours and 40 minutes	3 hours and 20 minutes	2 hours	1 hour

**Table 4 MAINTENANCE AND TUNE-UP TORQUE SPECIFICATIONS**

Item	N·m	in.-lb.	ft.-lb.
Oil drain plug	30	—	22
Oil filter inner cover bolt (/5 and /6 models)	41	—	30
Oil filter cover bolts	10	88	—
Oil strainer holder bolts	9	80	—
Oil pan Allen bolts	9	80	—
Transmission filler plug	28-31	—	21-23
Transmission drain plug	23-26	—	17-19
Final drive unit level/filler plug	28-31	—	21-23
Final drive separate level plug	8-10	71-88	—
Final drive separate filler plug	20	—	15
Final drive unit drain plug	23	—	17
Swing arm/drive shaft filler plug*	14	—	10
Swing arm/drive shaft drain plug*	14-16	—	10-12
Clutch adjust bolt locknut	20-23	—	15-17
Cylinder head nuts	35	—	26
Valve adjuster locknut	18-23	—	13-17
Spark plugs	20-30	—	15-33
Front brake caliper screw	60-65	—	44-48

\*Except R100GS models as this model's drive shaft does not require lubrication.

**Table 5 OIL QUANTITY AND RECOMMENDED TYPE**

Item	Quantity	Recommended type
Engine oil (without oil cooler)		API SF or SG
Oil change	2.0 liter (2.1 qt.)	
Oil change and filter	2.25 liter (2.4 qt.)	
Engine oil (with oil cooler)		API SF or SG
Oil change	2.5 liter (2.7 qt.)	
Oil change and filter	2.75 liter (3.0 qt.)	
Transmission oil (4 and 5 speed)	800 cc (1.7 pt.)	Hypoid gear oil GL5 SAE 80W/90
Drive shaft oil <sup>1</sup>		Hypoid gear oil GL5 SAE 80W/90
/5 model with short wheel base	100 cc (0.21 pt.)	
All other models	150 cc (0.32 pt.)	
Final drive oil		Hypoid gear oil GL5 SAE 80W/90
1970-1980	250 cc (8.45 oz.)	
R100GS	260 cc (8.89 oz.)	
All other models	350 cc (11.8 oz.)	

(continued)



**Table 5 OIL QUANTITY AND RECOMMENDED TYPE (continued)**

Item	Quantity	Recommended type
Fork oil <sup>2</sup>		
1970-1976	280cc (9.5 oz.)/ 265 cc (8.96 oz.)	Bel Ray SAE 5 wt, Golden Spectro Very Light, Aero Shell 4, BMW 7.5 wt <sup>3</sup> , Esso Comfort and Shell EB/B/33 (R100GS)
1977-1979 and R100RT	250 cc (8.4 oz.)/ 235 cc (7.9 oz.)	
R65 (1979-1985), R65LS, and R80ST	190-200 cc (6.5-6.8 oz.)/ 190 cc (6.5 oz.)	
R80RT (1983-1984), R80G/S (1981-1984), R100, R100CS, R100RS, R100RT (1976-1984)	220-230 cc (7.4-7.8 oz.)/ 220 cc (7.4 oz.)	
R80 (1985-on), R65 (1986-on) R80RT (1985-on), R100RS and RT100RT (1987-on)	290-310 cc (9.6-10.2 oz.)/same 310-330 cc (10.5-11.2 oz.)/same	
R100GS		
Right fork leg	430-450 cc (14.2-14.8 oz.)/same	
Left fork leg	400-420 cc (13.2-13.8 oz.)/same	
<ol style="list-style-type: none"> <li>1. Except R100GS models as this model's drive shaft does not require lubrication. 100 cc (.21 pt.) on /5 models with short wheel base (1970-1973)/</li> <li>2. First quantity is at rebuild; second is quantity at oil change.</li> <li>3. Many BMW dealerships recommend this fork oil for all R-series applications.</li> </ol>		

**Table 6 TUNE-UP SPECIFICATIONS**

Valve clearance*
Intake (rear valves): 0.10 mm (0.004 in.)
Exhaust (front valves): 0.20 mm (0.008 in.)
Spark plug type (Bosch)
W5D1: R50/5, 1974-1976 R60
W5D: 1977-1979 R60, R65LS, all 1977-1980 R100 models (R100, R100S, R100T, R100RS, R100RT)
W6D: R75/5, R75/6, R75/7R90/6, R90S, R100/7, 1981-1987 R100 models (R100, R100CS, R100RS, R100RT)
W7D: R80, R80/7, R80ST, R80G/S, R80RT
W7DC: 1988-on R100RS, R100RT, R100GS
Spark plug gap
Recommended 0.6-0.7 mm (0.024-0.028 in.)
Contact breaker-point gap
1979-1980: 0.40-0.45 mm (0.016-0.018 in.)
All other models: 0.35-0.40 mm (0.014-0.016 in.)
Compression pressure
Good: more than 1000 kPa (130 psi)
Normal: 758-1000 kPa (110-130 psi)
Pool: less than 758 kPa (110 psi)
Idle speed
1970-1976: 800 rpm
1977-on: 800-1100 rpm
*Cylinder head maximum temperature: 35° C (95° F)

**Table 7 CARBURETOR IDLE MIXTURE SCREW INITIAL OPENING**

<b>Model/year</b>	<b>Number of turns</b>
R50/5	1/2-1 1/2
R60/5	1/2-1 1/2
R60/6	1/4-1 1/4
R60/7	1/4-1 1/4
R65 (1979-1980)	3/4
R65 (1981-1982) and R65LS (1982)	3/4
R65 (1983-1985) and R65LS (1983-1984)	3/4
R65 (1986-1987)	3/4
R75/5, R75/6, R75/7	1/2-1
R80 (1985-1987)	1/2-1
R80/7 (1978)	1/2-1
R80/7 (1979)	1/2-1
R80ST (1983)	3/4-1
R80ST (1984)	3/4-1
R80G/S (1981)	3/4-1
R80G/S (1983-1986)	3/4-1
R80RT (1983)	3/4-1
R80RT (1984)	3/4-1
R80RT (1985-1987)	3/4-1
R90/6 and R90/S	1/2-1
R100CS, R100RS and R100RT (1981-1984)	1-1/4
R100/7	1/2
R100S (1977)	1-1/4
R100S (1979)	1/2
R100T (1979)	1-1/4
R100RS (1977)	1-1/4
R100RS (1978)	1/2
R100S, R100RS and R100RT (1979)	1-1/4
R100S, R100T, R100RS, and R100RT (1980)	1/2
R100RS, R100RT and R100GS (1988-1989)	1/2

## CHAPTER FOUR

# ENGINE

The air-cooled engine in the BMW is a horizontally opposed twin with pushrod-operated overhead valves. The twin is very smooth with minimal vibration due to the fact that both pistons reach top dead center at the same time.

There are 2 valves per cylinder and the camshaft is chain-driven from the drive sprocket on the front end of the crankshaft.

This chapter provides procedures for complete service and overhaul including information for removal, disassembly, inspection, service and reassembly of the engine. Although the clutch is located within the rear portion of the engine, it is covered in Chapter Five to simplify this material.

Upper end service, including connecting rod removal, can be carried out with the engine in the frame. Camshaft and crankshaft service require removing the engine from the frame.

Service procedures for all models are virtually the same. Where differences occur, they are identified.

Before starting any work, re-read Chapter One of this book. You will do a better job with this information fresh in your mind.

Throughout the text, there is frequent mention of the right-hand and left-hand sides of the engine. This refers to the engine as it sits in the bike's frame, *not* as it sits on your workbench. "Right-" and "left-hand" refers to a rider sitting on the seat facing forward.

Refer to **Table 1** for complete engine torque specifications. **Table 1** and **Table 2** are located at the end of this chapter.

### ENGINE PRINCIPLES

**Figure 1** explains how the engine works. This will be helpful when troubleshooting or repairing the engine.

### SERVICING ENGINE IN FRAME

The following components can be serviced while the engine is mounted in the frame (the bike's frame is a great holding fixture for breaking loose stubborn bolts and nuts):

- Carburetors.
- Exhaust system.
- Alternator and starter.
- Cylinder heads and cylinders.
- Pistons and connecting rods.

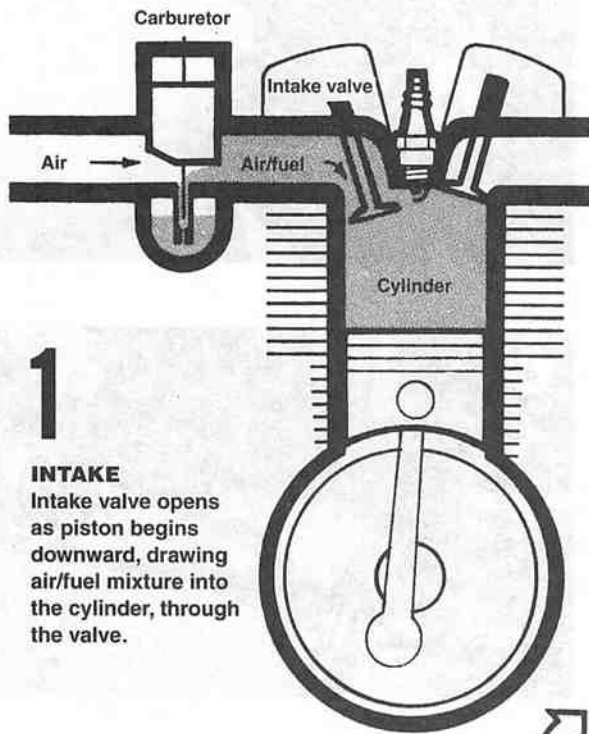
### ENGINE

#### Removal/Installation

The engine, clutch and transmission housing should remain as a complete unit, then be disassembled after the engine is removed from the frame. The transmission housing can be removed from the frame as an assembly—leaving the engine in the frame. The engine *cannot* be removed leaving the transmission housing in the frame. This is due to the various frame mounting points and where they attach to these components.

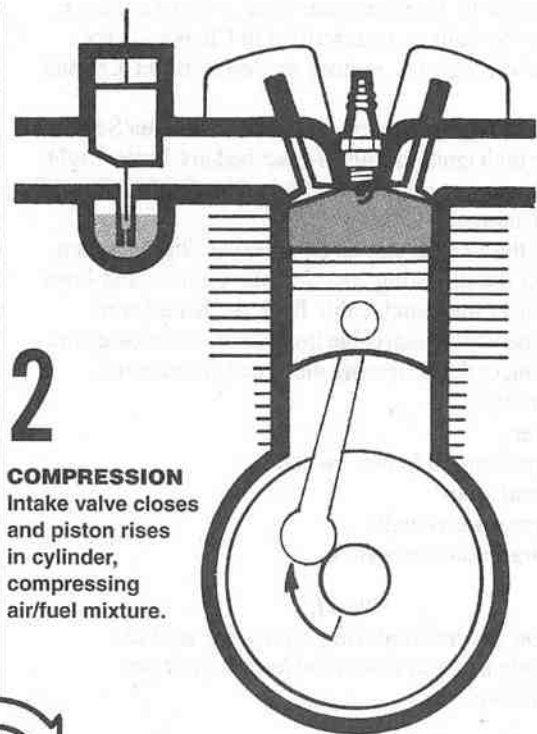
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**4-STROKE OPERATING PRINCIPLES**



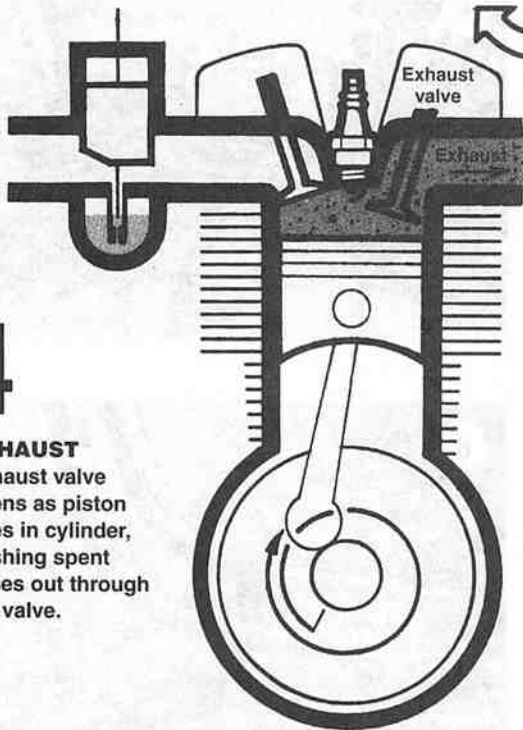
**1**

**INTAKE**  
Intake valve opens as piston begins downward, drawing air/fuel mixture into the cylinder, through the valve.



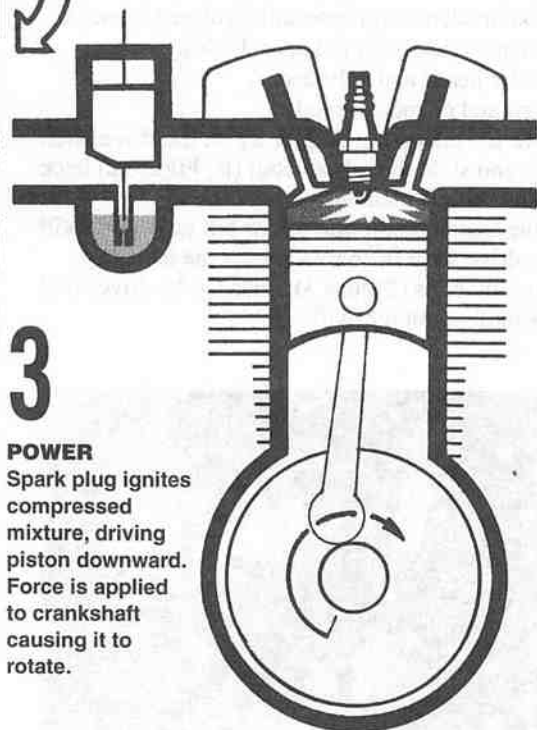
**2**

**COMPRESSION**  
Intake valve closes and piston rises in cylinder, compressing air/fuel mixture.



**4**

**EXHAUST**  
Exhaust valve opens as piston rises in cylinder, pushing spent gases out through the valve.



**3**

**POWER**  
Spark plug ignites compressed mixture, driving piston downward. Force is applied to crankshaft causing it to rotate.

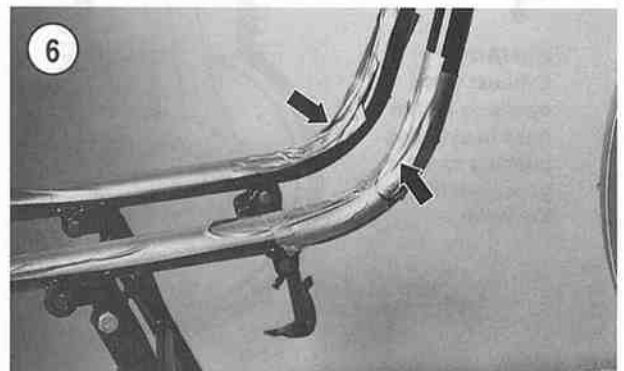
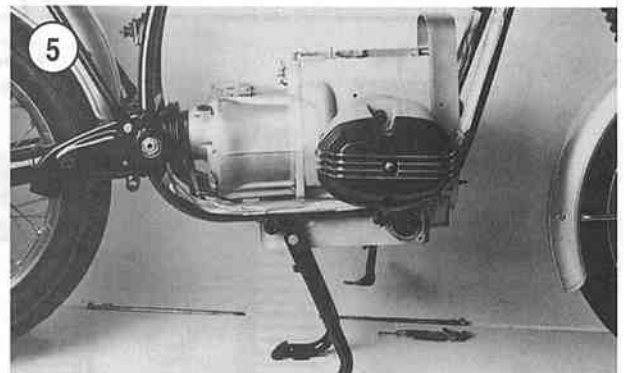
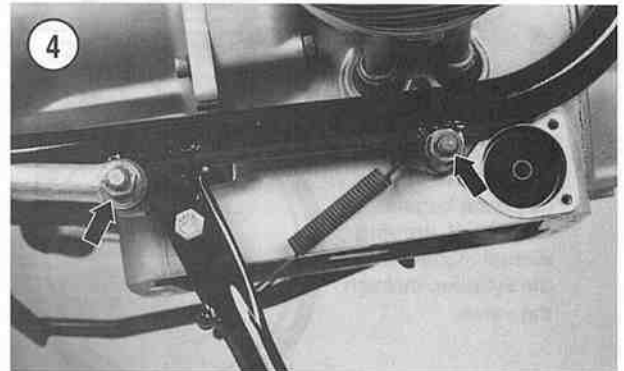
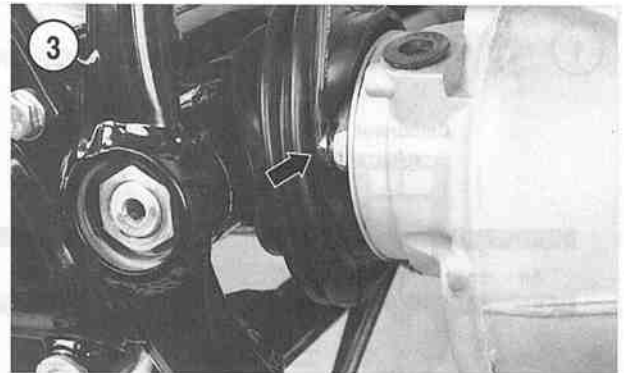
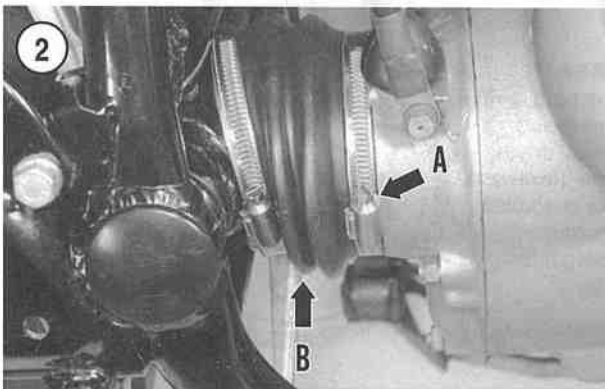


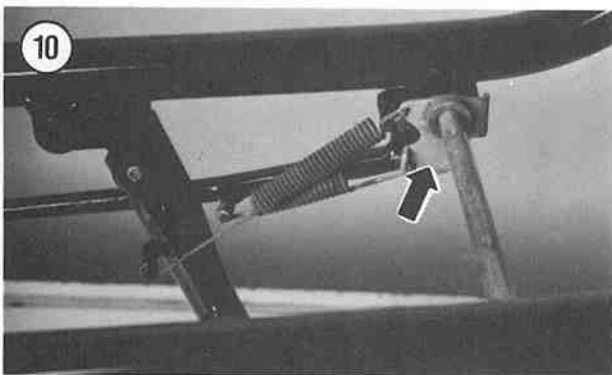
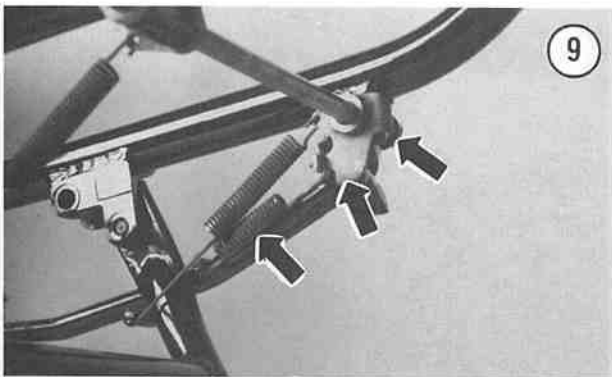
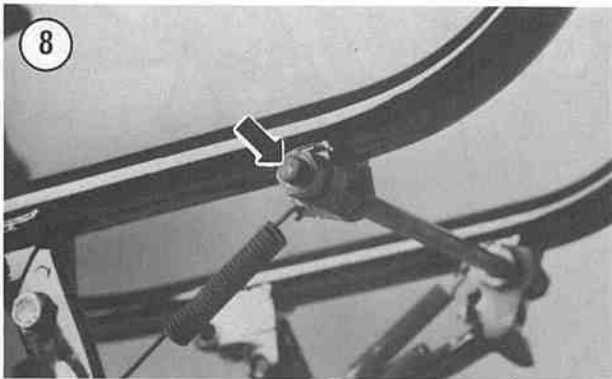
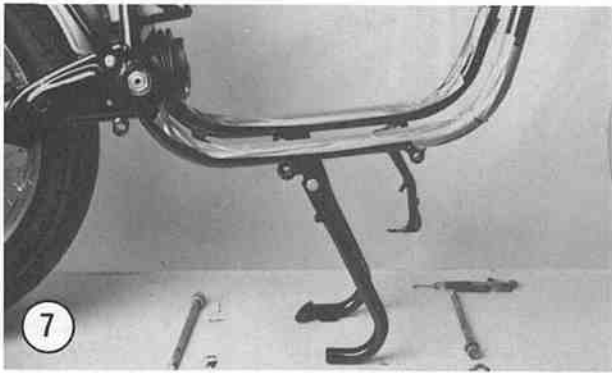
1. Remove the seat as described in Chapter Twelve.
2. On models so equipped, remove the front fairing as described in Chapter Twelve.
3. Remove the fuel tank as described in Chapter Seven.
4. Remove the battery as described in Chapter Three.
5. Remove the exhaust system as described in Chapter Seven.
6. Remove the carburetors as described in Chapter Seven.
7. Remove both ignition coils as described in Chapter Eight.
8. Drain the engine oil as described under *Engine Oil and Oil Filter Change* in Chapter Three.
9. Remove the air filter case as described in Chapter Seven.
10. Loosen the adjusting barrel at the clutch hand lever and disconnect the clutch cable from the hand lever.
11. Disconnect the clutch cable from the clutch release arm.
12. Disconnect the following electrical connectors:
  - a. Alternator.
  - b. Starter.
  - c. Oil pressure indicator switch.
  - d. Ground strap.
  - e. Oil pressure switch.
  - f. Neutral indicator switch.

**NOTE**

*If you are just removing the engine and are not planning to disassemble it, do not perform Step 13.*

13. If the engine is going to be disassembled, remove the following parts while the engine is still in the frame. Removal is described in this chapter unless otherwise noted:
  - a. Alternator and starter (Chapter Eight).
  - b. Cylinder heads and cylinders.
  - c. Pistons and connecting rods.
14. Remove the clamp (A, **Figure 2**) on the drive shaft rubber boot and slide the rubber boot (B, **Figure 2**) back and off of the transmission housing.
15. Shift the transmission into 4th or 5th gear. This will prevent the drive shaft from rotating for the next step.
16. Remove the bolts (**Figure 3**) securing the drive shaft to the transmission output shaft.





17. Take a final look all over the engine to make sure everything has been disconnected.

18. Apply several layers of duct tape to the frame lower rails to protect the paint finish.

19. Place a suitable size jack, with a piece of wood to protect the oil pan, under the engine. Apply a small amount of jack pressure up on the engine and transmission housing assembly.

#### CAUTION

*Continually adjust jack pressure during engine removal and installation to prevent damage to the mounting bolt threads and hardware.*

20. Remove the nut and washer (Figure 4) from the front and rear through-bolts on one side of the engine.

#### WARNING

*The following steps require the aid of at least 2 helpers to safely remove the engine and transmission housing assembly.*

21. Apply a small amount of jack pressure up on the engine and carefully withdraw the engine mounting bolts. On the left-hand side, the sidestand mounting plates will come off when the front through-bolt is removed. Don't lose any of these parts.

22. With the aid of a helper, carefully pull the engine and transmission housing forward (Figure 5).

23. Disengage the drive shaft from the transmission output shaft. Push the drive shaft back into the swing arm if it has moved forward.

24. Move the engine toward the rear and then remove it from the frame and take it to the workbench for further disassembly and service.

25. If necessary, remove the transmission housing from the engine as described in Chapter Six.

26. If necessary, remove the clutch assembly from the engine as described in Chapter Five.

27. Install by reversing these removal steps. Note the following during installation.

28. If necessary, apply additional layers of duct tape to the frame lower rails to protect the paint finish (Figure 6).

29. Prior to moving the engine into the frame, position all of the engine mounting hardware (Figure 7) below the frame in its correct locations. This will make installation easier.

30. Refer to the following figures to show the correct location of all engine mounting hardware:

a. Figure 8: front right-hand side.

b. Figure 9: front left-hand side.

c. Figure 10 and Figure 11: rear right-hand side.

31. Make sure the drive shaft rubber boot (Figure 12) is in place on the swing arm before installing the engine.

32. Tighten the engine-to-frame mounting bolts and nuts to the torque specifications in **Table 1**.
33. Fill the engine with the recommended type and quantity of oil; refer to Chapter Three.
34. Adjust the clutch as described in Chapter Three.
35. Start the engine and check for leaks.

### ENGINE FRONT COVER

#### Removal/Installation

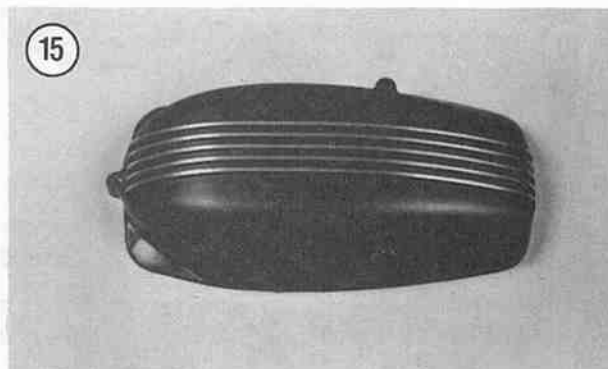
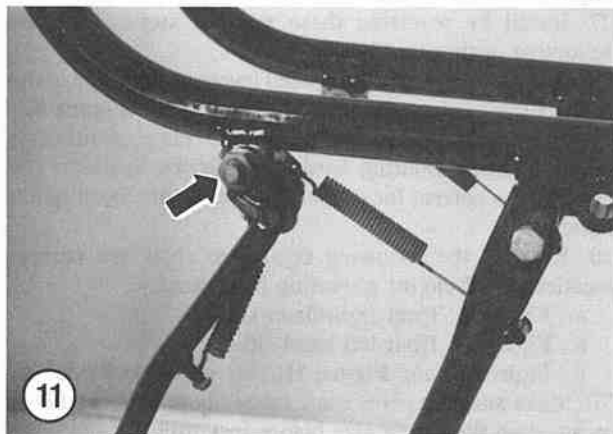
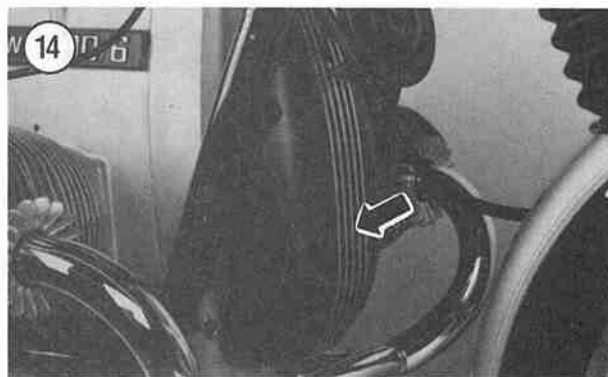
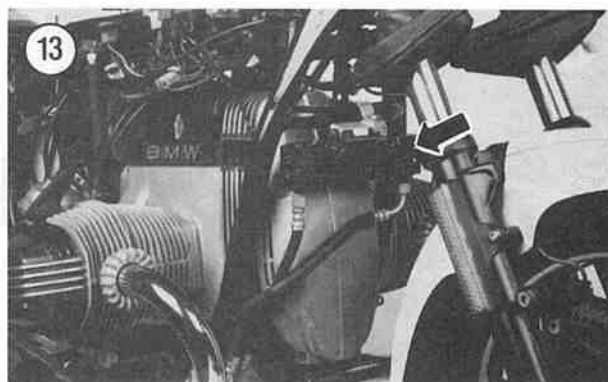
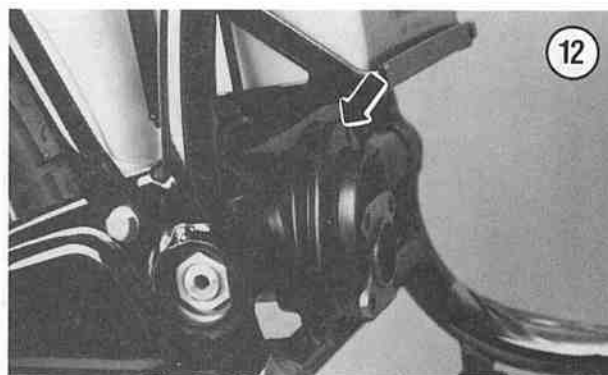
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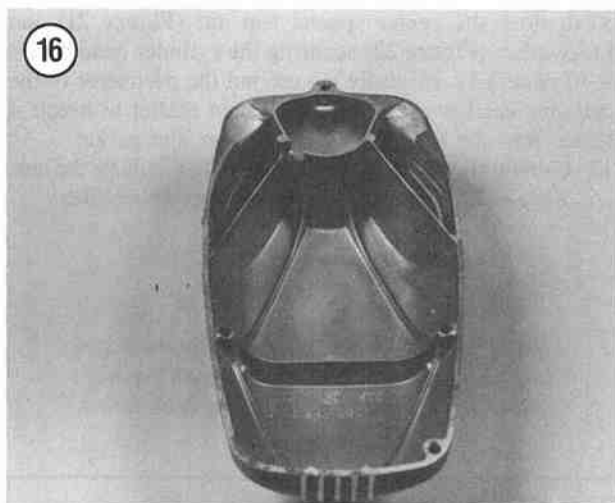
*The engine front cover can be removed with the engine in the frame.*

##### CAUTION

*The battery negative lead **must** be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating the replacement of the entire diode board.*

1. Disconnect the battery negative lead as described under **Battery** in Chapter Three.
2. On models so equipped, remove the oil cooler (**Figure 13**) from the engine as described in this chapter.
3. Remove the bolts securing the engine front cover (**Figure 14**).
4. Pull the front cover straight off of the engine and remove it.
5. Inspect the outer surface (**Figure 15**) and inner surface and ribs (**Figure 16**) of the front cover for damage or fractures. Make sure the sealing surface is in good condition. Replace if necessary.
6. Install by reversing these removal steps, noting the following.
7. Make sure the mating surface of the engine front cover and crankcase are clean before installing the cover.
8. Install the front cover and tighten the bolts securely.





### CYLINDER HEAD AND COVER

#### Removal

The cylinder head can be removed with the engine in the frame. This procedure is shown with the engine removed for clarity.

Refer to the following illustrations for this procedure:

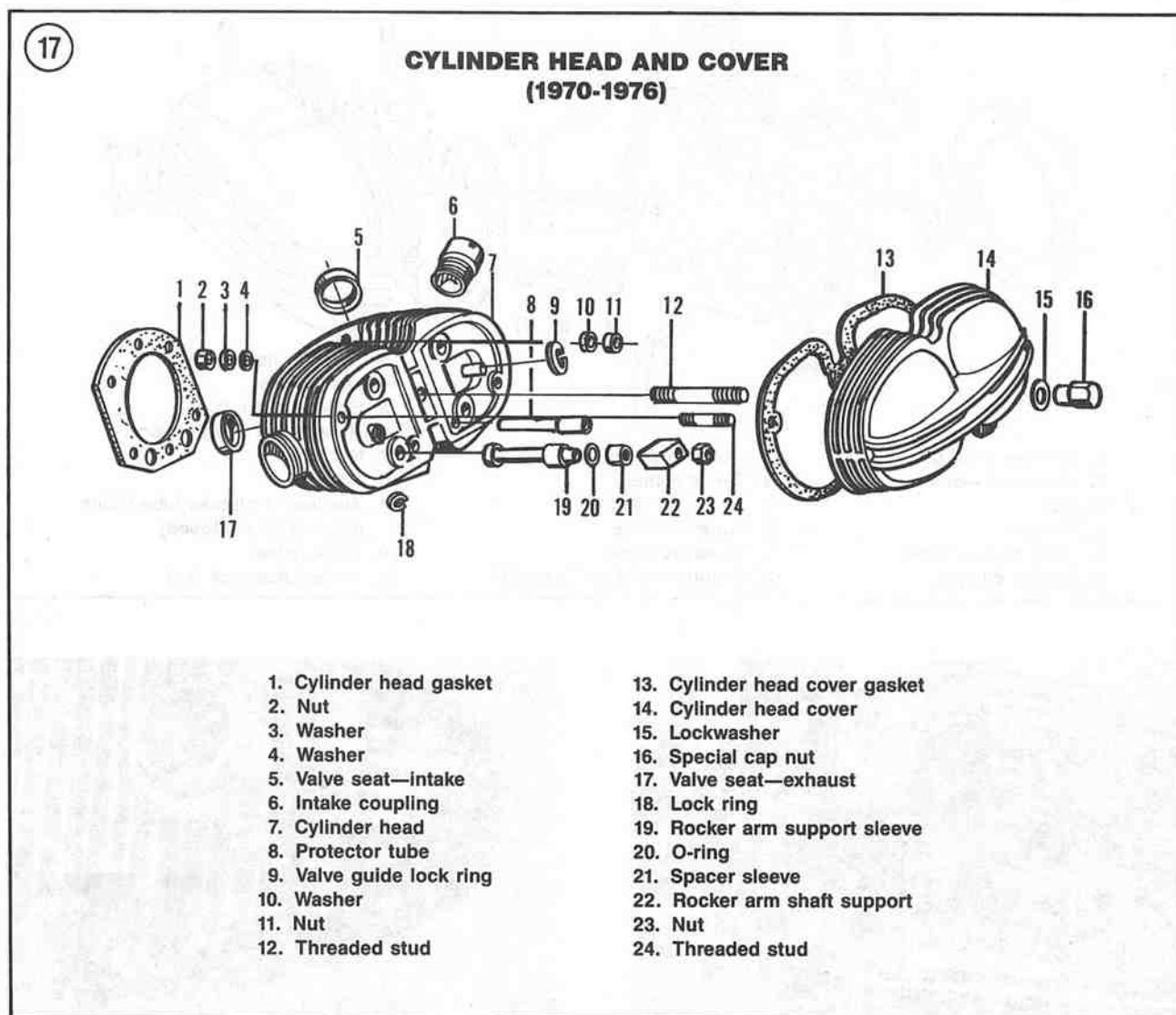
- a. **Figure 17:** 1970-1976 models.
- b. **Figure 18:** 1977-on models.

#### CAUTION

*To prevent any warpage and damage, remove the cylinder head only after the engine has been at room temperature for at least 12 hours.*

1. Place the bike on the centerstand.

4

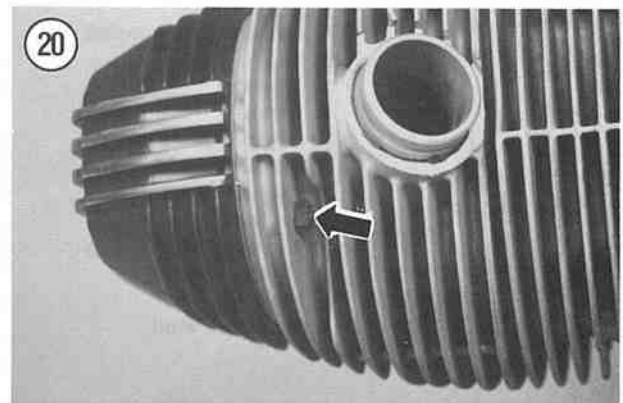
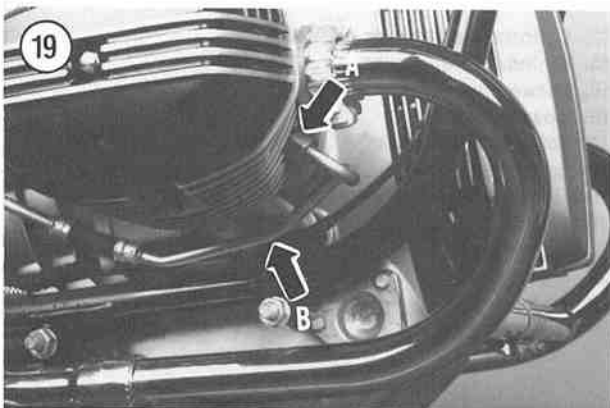
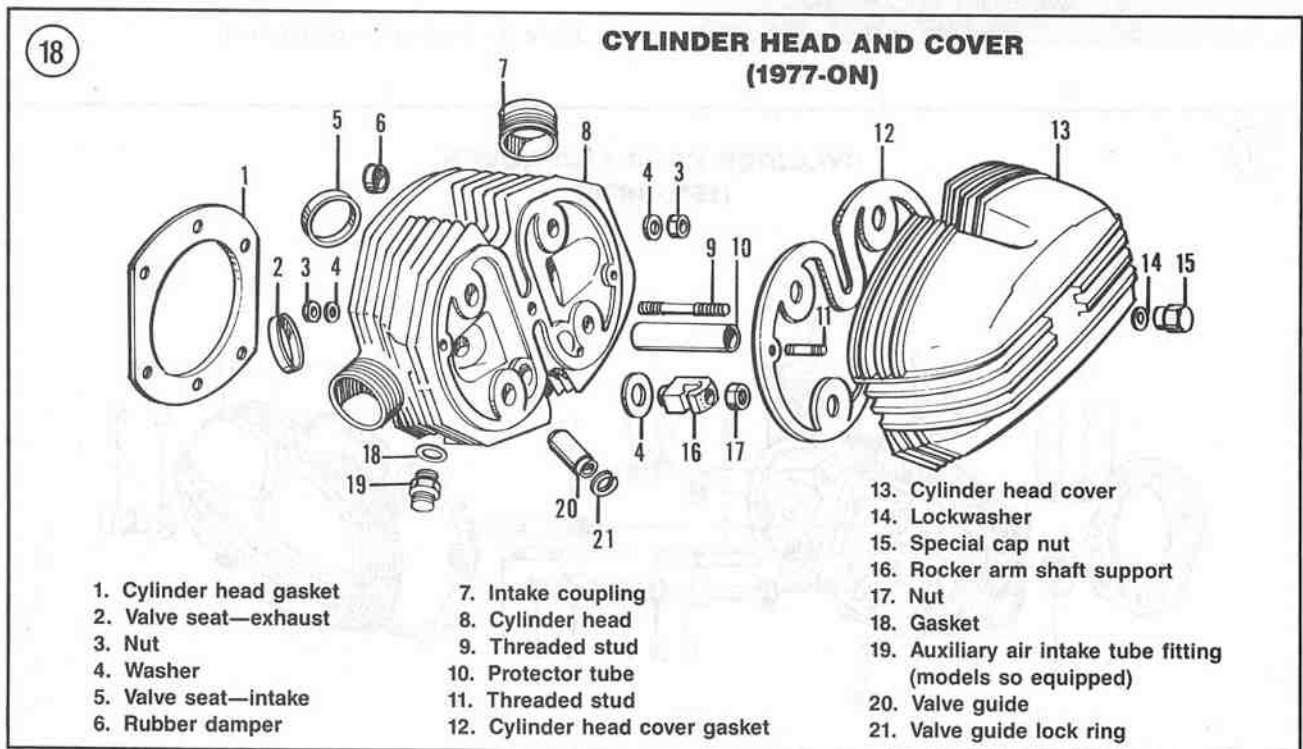


2. Remove the carburetor as described in Chapter Seven.
3. Remove the exhaust system as described in Chapter Seven.
4. On models so equipped, unscrew the nut (A, **Figure 19**) securing the intake air line to the cylinder head. Move the air line (B, **Figure 19**) out of the way—it is not necessary to remove the air line.
5. Remove the spark plug as described in Chapter Three.
6. Place a drip pan under the cylinder head cover as some residual oil will probably drip out after the cover is removed.
7. Remove the nut and lockwasher (**Figure 20**) at the front and rear of the cylinder head securing the cylinder head cover.

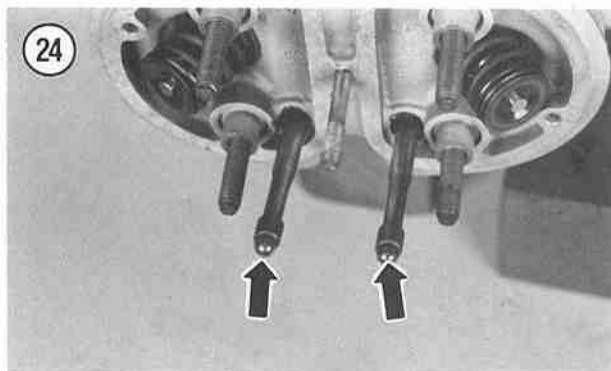
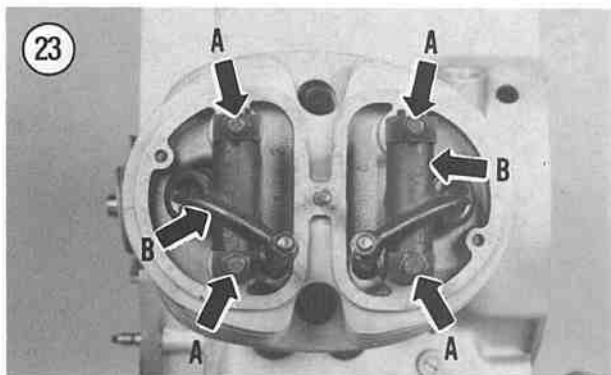
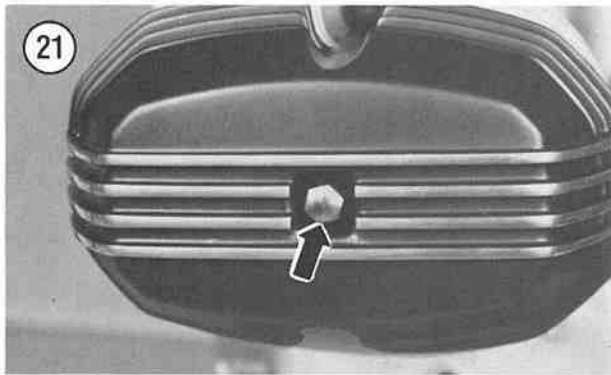
8. Remove the center special cap nut (**Figure 21**) and lockwasher (**Figure 22**) securing the cylinder head cover.
9. If necessary, carefully tap around the perimeter of the cylinder head cover with a soft-faced mallet to break it loose. Remove the cylinder head cover and gasket.
10. Using a crisscross pattern, loosen, then remove the nuts (A, **Figure 23**) securing the rocker arm assemblies.

**NOTE**

*Place the rocker arm assemblies in their own box after removal. This will keep all parts together and avoid any mixup during installation.*







11. Remove each rocker arm assembly (B, Figure 23) and place it in a separate box.

12. Withdraw the pushrods (Figure 24) from the cylinder head. Mark the pushrod with the cylinder "R" or "L," and "I" (intake valve) or "E" (exhaust valve). Also mark the inner or outer end of the pushrod so it will be reinstalled in the same position during installation.

13. Remove the upper and lower nuts and washers (Figure 25) securing the cylinder head to the cylinder.

14. Loosen the cylinder head by tapping around the perimeter with a rubber or soft-faced mallet. If necessary, *gently* pry the head loose with a broad-tipped screwdriver.

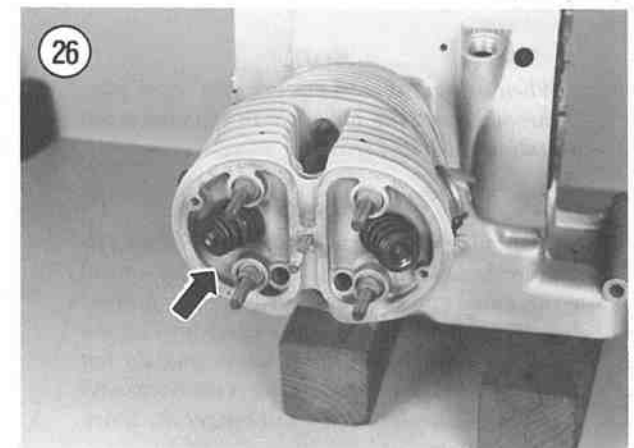
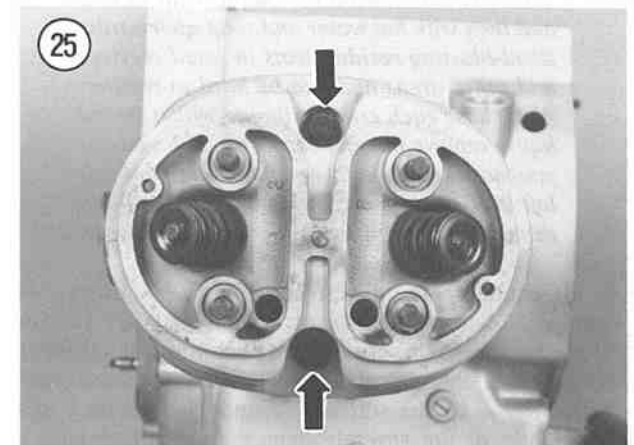
15. Lift the cylinder head (Figure 26) straight off the cylinder.

16. Remove the cylinder head gasket and discard it. Don't lose the locating dowels on models so equipped.

17. Repeat for the other cylinder if necessary.

### Inspection

1. Remove all traces of gasket material from the cylinder head mating surfaces on the cylinder head (Figure 27) and the cylinder (Figure 28).



**NOTE**

**Figure 27** is shown with the valves removed for clarity. Do not remove them for inspection purposes.

**CAUTION**

If the combustion chamber is cleaned while the valves are removed, there is a good chance of damaging the valve seat surfaces. A damaged or even slightly scratched valve seat will cause poor valve seating.

2. Without removing the valves, remove all carbon deposits from the combustion chamber and valve ports with a wire brush. A blunt screwdriver or chisel may be used if care is taken not to damage the head, valves and spark plug threads.
3. After the carbon is removed from the combustion chamber and the valve intake and exhaust ports (**Figure 29**), clean the entire head in cleaning solvent. Blow dry with compressed air.

**CAUTION**

If the cylinder head was bead-blasted, make sure to clean the head thoroughly with solvent and then with hot water and soap afterwards. Bead-blasting residue seats in small crevices and other areas and can be hard to remove. Also chase each exposed thread with a thread tap to remove the grit between the threads or you may damage a thread later. Residual grit left in the engine will wind up in the oil and cause premature piston, ring and bearing wear.

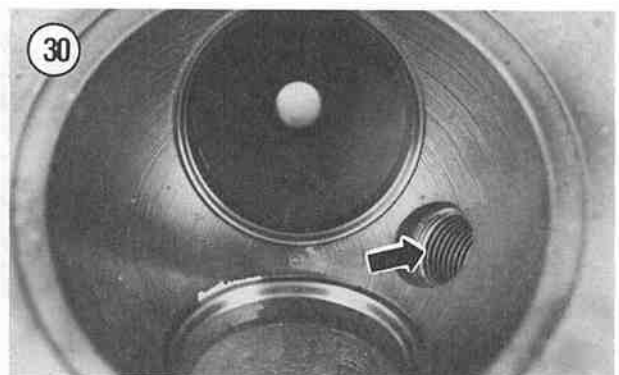
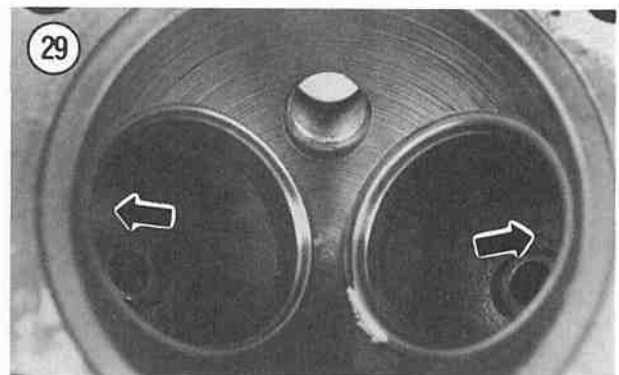
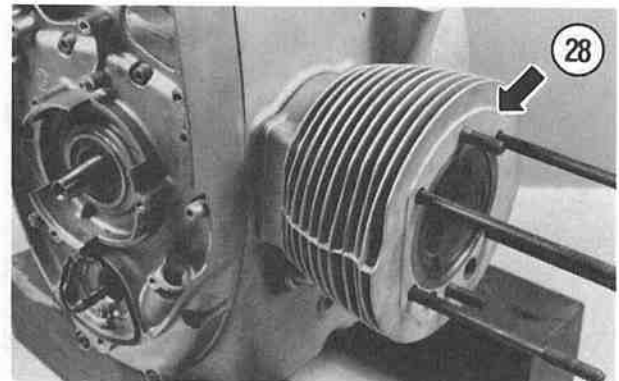
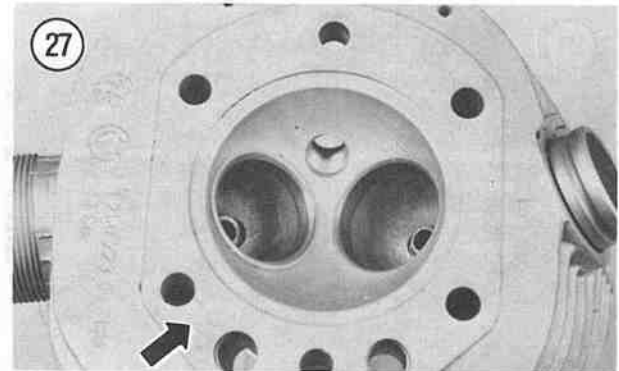
4. Inspect the spark plug threads (**Figure 30**) for wear or damage. If damage is minor or if the threads are dirty or clogged with carbon, use a spark plug thread tap (**Figure 31**) to clean the threads following the manufacturer's instructions. If the threads cannot be cleaned out sufficiently or are severely damaged, install or have a Helicoil thread repair kit installed by a BMW dealer or machine shop.

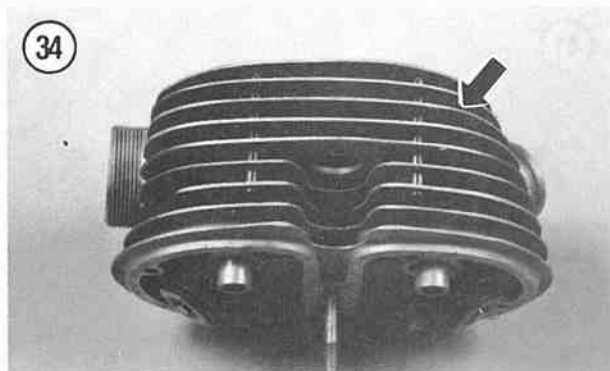
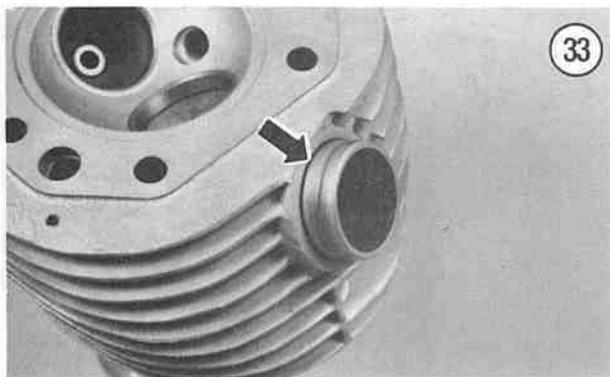
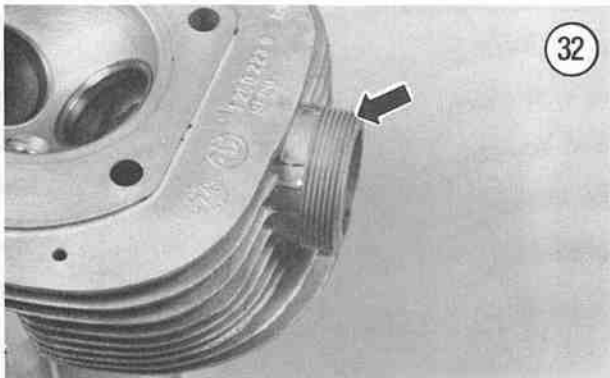
**NOTE**

When using a thread tap to clean spark plug threads, coat the tap with an aluminum tap cutting fluid or kerosene.

**NOTE**

Spark plug thread damage in an aluminum cylinder head is commonly due to galling, cross-threading and overtightening. To prevent galling, apply an anti-seize compound on the plug threads before installation and do not overtighten. Be careful not to get the compound on the electrodes as this will render the spark plug useless.





5. Clean away all carbon from the piston crown. Do not remove the carbon ridge at the top of the cylinder bore.

6. Check for cracks in the combustion chamber and exhaust port. A cracked head must be replaced.

7. After the head has been thoroughly cleaned, place a straightedge across the cylinder head/cylinder gasket surface at several points. Measure the warp by inserting a flat feeler gauge between the straightedge and the cylinder head at each location. There should be no warp; if a small amount is present, it can be resurfaced by a dealer or qualified machine shop. BMW does not provide service limit specifications for the maximum allowable amount of cylinder head distortion.

8. Check the valves and valve guides as described in this chapter.

9. Inspect the threads (Figure 32) on the exhaust port for cracks or other damage. If necessary, clean the threads with a suitable size thread die or fine-cut file. If damage is severe, have it repaired by a shop specializing in the repair of precision aluminum castings or replace the cylinder head.

10. Inspect the intake port (Figure 33) for cracks or damage. If damaged, unscrew the intake port and replace it with a new one. Tighten the intake port securely.

11. Check for cracked or missing cooling fins (Figure 34). If damage is found, have it repaired by a shop specializing in the repair of precision aluminum castings or replace the cylinder head.

12. Make sure the cooling fins are clean and free of any road dirt buildup. Clean out with a stiff brush and wash with solvent. Blow off with compressed air.

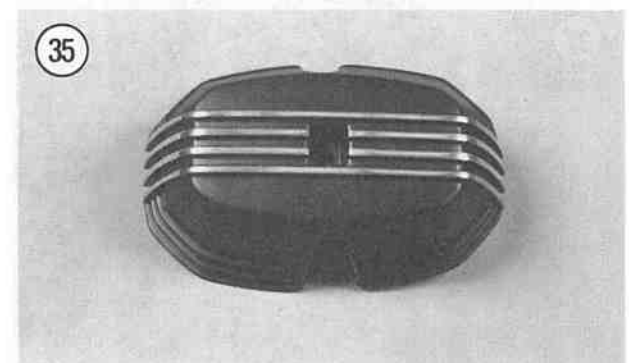
13. Inspect the cylinder head cover (Figure 35) for cracks or damage that could lead to an oil leak. If damage is found, replace the cylinder head cover.

### Installation

1. On models so equipped, make sure the locating dowels are in place.

### CAUTION

*The holes in the cylinder head and cylinder are offset in relation to the crankcase studs that pass through the cylinder. If the cylinder head*



*gasket is installed backwards, the gasket holes will slightly overlap the holes in the cylinder head and cylinder. This will cause the gasket material to interfere with the pushrods.*

2. Install a new cylinder head gasket (**Figure 36**) onto the cylinder. Make sure that the gasket holes (**Figure 37**) for the pushrods align with the holes in the cylinder and that no holes are blocked.
3. Carefully slide the cylinder head onto the cylinder. Push it down until it bottoms out on the piston holding fixture.

**CAUTION**

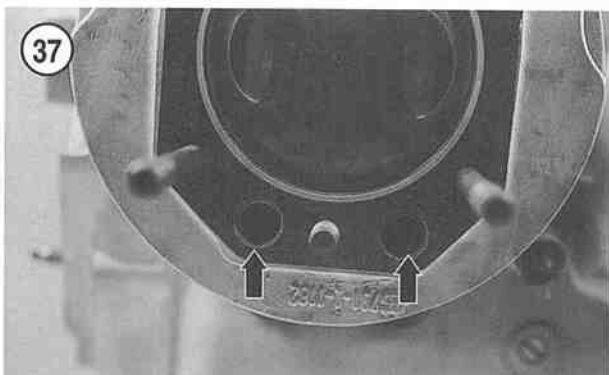
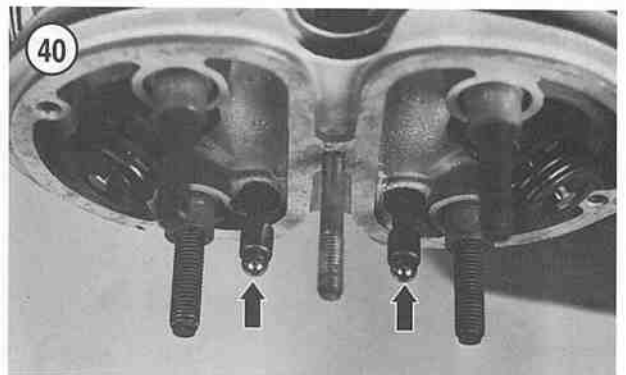
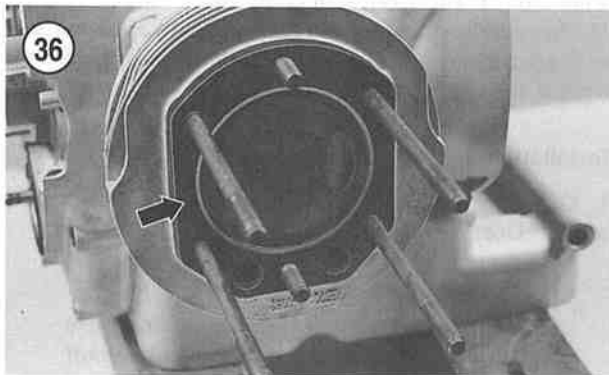
*Correctly position the washers with the chamfer side (**Figure 38**) going on last.*

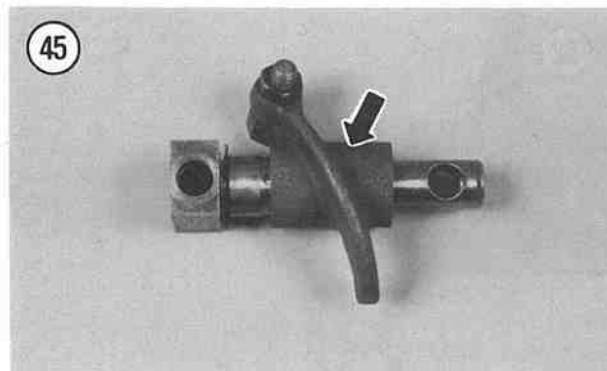
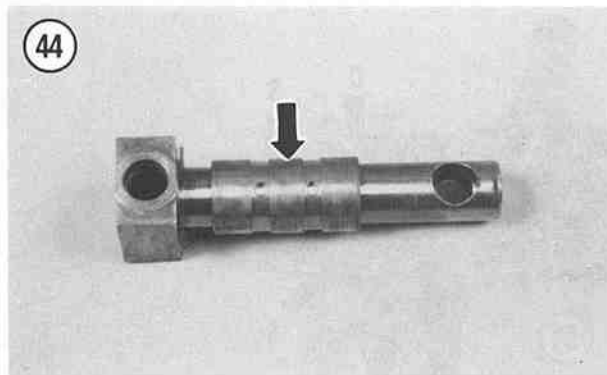
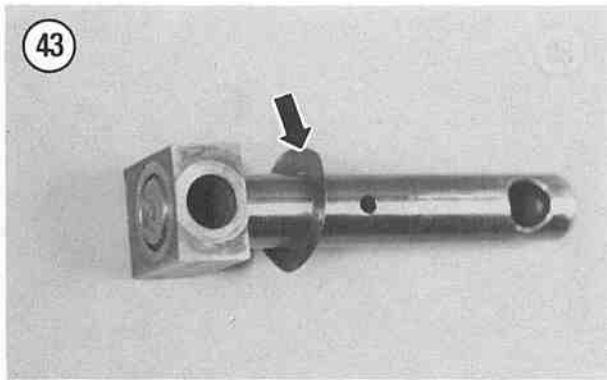
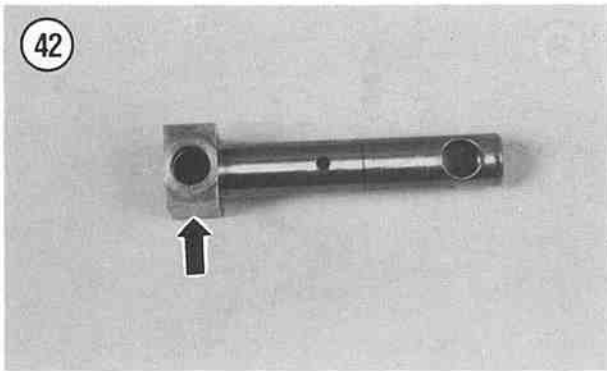
4. Install the upper and lower washers and nuts (**Figure 39**) securing the cylinder head to the cylinder. Tighten the nuts only finger-tight at this time.

**CAUTION**

*Be sure to install the pushrods into their correct location and direction as noted in **Step 12, Removal**.*

5. Apply assembly oil or clean engine oil to the inner ends of the pushrods prior to installation.
6. Install each pushrod (**Figure 24**) into the correct position in the cylinder head. Make sure the correct end of the



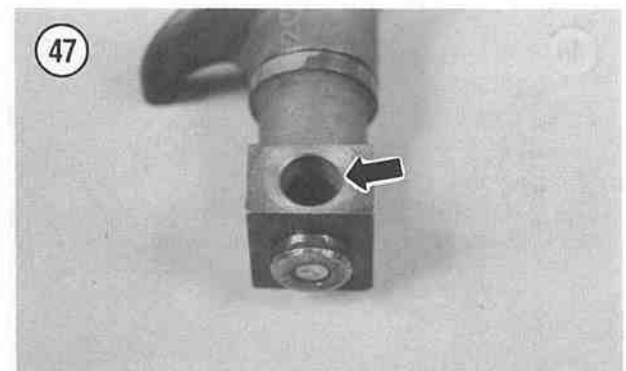
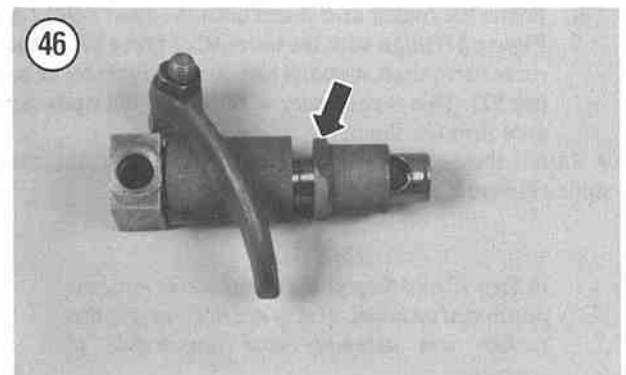


pushrod goes in first. Push the pushrod in until the pushrods are correctly seated (Figure 40) in the valve lifter in the crankcase.

7. On models so equipped, make sure the O-ring seal is in place on each rocker arm support sleeve.

8A. On 1970-1973 models, assemble the rocker arm shaft assemblies as follows:

- a. Apply clean engine oil to all mating parts prior to assembly (Figure 41).
- b. Position the rocker arm shaft support with the raised boss facing out and with the slot facing away from the center of the cylinder head.
- c. Install the lower rocker arm shaft support (Figure 42) onto the rocker arm shaft, then slide on the spring washer (Figure 43).
- d. Install the rocker arm bushing onto the rocker arm shaft (Figure 44).
- e. Install the rocker arm (Figure 45) onto the rocker arm bushing.
- f. Position the thrust bushing with the shoulder end going on first and install it onto the *upper end* of the rocker arm shaft (Figure 46).
- g. Position the rocker arm shaft support with the raised boss facing out and with the slot facing away from the center of the cylinder head.
- h. Install the lower rocker arm shaft support (Figure 47) onto the rocker arm shaft.
- i. Repeat for the other rocker arm assembly.





- j. Rotate the rocker arm shafts until the shaft holes align with the holes (Figure 48) in the rocker arm shaft supports and check alignment. This is necessary so the crankcase studs can pass through them.
- 8B. On 1974-on models, assemble the rocker arm shaft assemblies as follows:
- Apply clean engine oil to all mating parts prior to assembly.

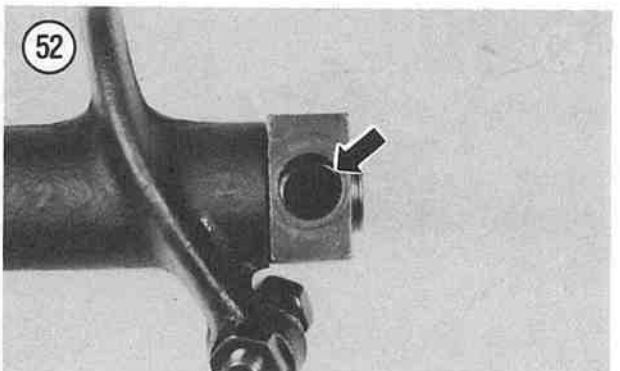
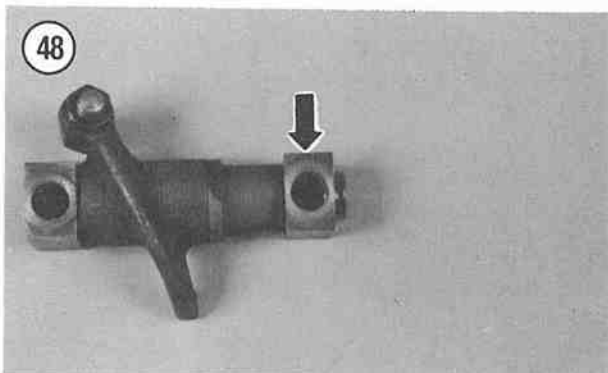
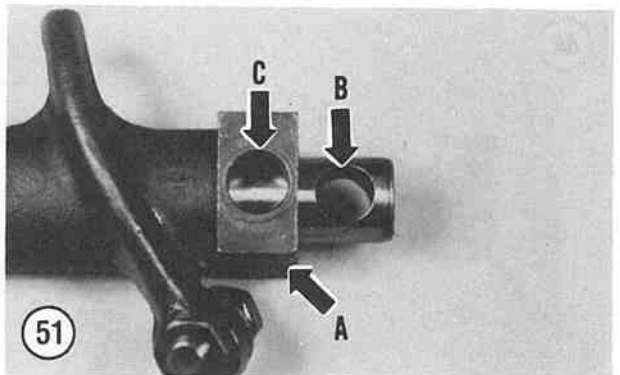
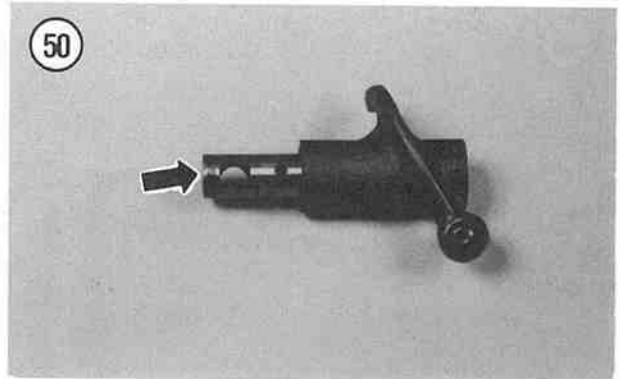
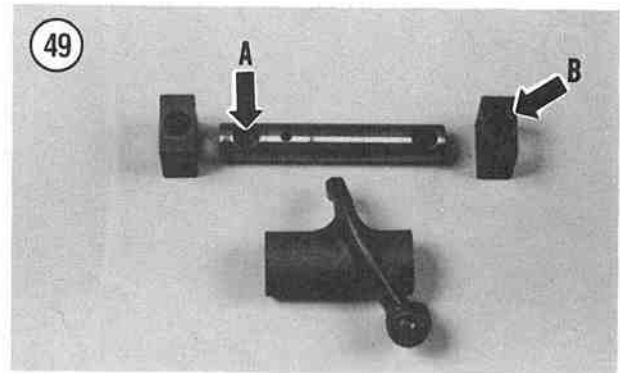
**NOTE**

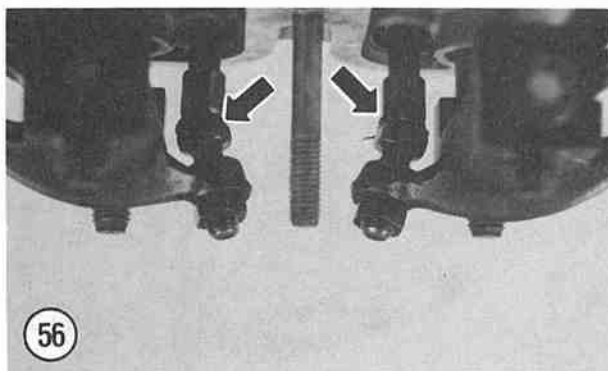
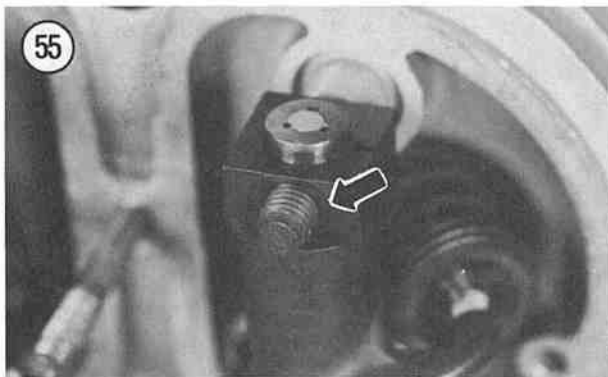
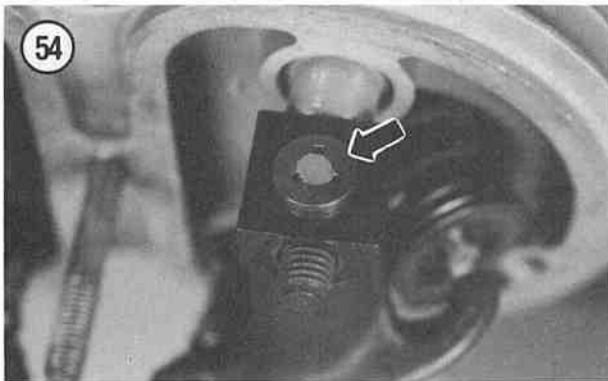
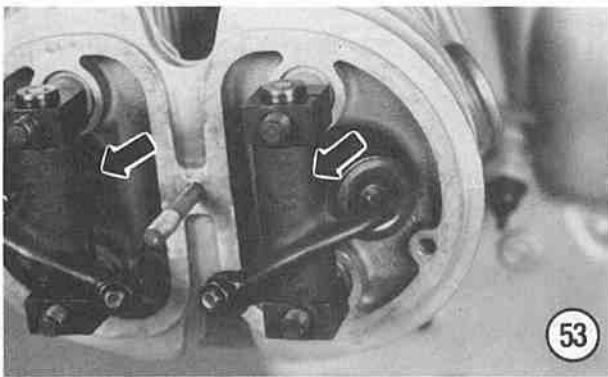
*On 1980-on models, position the rocker arm shaft so that the punch mark is facing away from the engine.*

- Position the rocker arm shaft so the end with the hole farther down on the shaft (A, Figure 49) is located at the top of the assembly. On early models, this will also position the end with the insert at the top.
  - Position the rocker arm shaft support (B, Figure 49) with the raised boss, that the mounting nut rides against, facing out.
  - Install the rocker arm shaft into the rocker arm (Figure 50).
  - Onto the *upper end* of the rocker arm shaft, install the plastic insert (models so equipped) and the shim.
  - Position each rocker arm shaft support with the slot (A, Figure 51) facing away from the center of the cylinder head.
  - Repeat for the other rocker arm assembly.
  - Rotate the rocker arm shafts until the shaft holes (B, Figure 51) align with the holes (C, Figure 51) in the rocker arm shaft supports and check alignment (Figure 52). This is necessary so the crankcase studs can pass through them.
9. Install the rocker arm assemblies onto the crankcase studs (Figure 53).

**CAUTION**

*In Step 10 and Step 11 the components must be positioned as noted. If they are not, remove the rocker arm assembly and reassemble it correctly.*



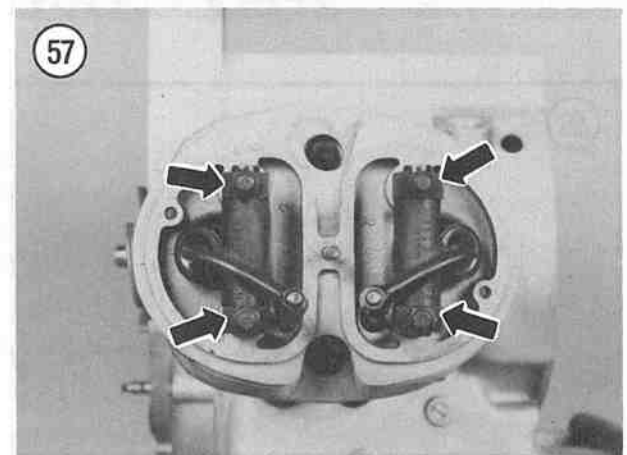


10. On early models, recheck that the rocker arm shaft end with the insert at the top is facing up (Figure 54).
11. Recheck that the raised boss (Figure 55) on the rocker arm shaft support is facing out where the mounting nut will ride against.
12. Make sure the rocker arm adjust bolts are positioned correctly onto each pushrod as shown in Figure 56.
13. Install the nuts (Figure 57) securing the rocker arm assemblies. Tighten the nuts finger-tight at this time.

#### CAUTION

*The BMW special tool is necessary on 1970-1973 models to ensure that the rocker arm assembly is installed square to the cylinder head. If any part of the rocker arm assembly is not installed square, there will be a considerable amount of valve noise. This could also lead to expensive valve train damage.*

- 14A. On 1970-1973 models, perform the following:
  - a. Install BMW special tool (part No. 200) to the cylinder head.
  - b. Using a crisscross pattern, tighten the nuts in 2-3 stages to the torque specification listed in Table 1.
  - c. After the nuts have been tightened, check that the rocker arms have a minimal amount of end float so that they can move freely, but not excessively.
  - d. Remove the special tool from the cylinder head.
- 14B. On 1974-on models, perform the following:
  - a. Using a crisscross pattern, tighten the nuts in 2-3 stages to the torque specification listed in Table 1.
  - b. After the nuts have tightened, insert a flat feeler gauge (Figure 58) between the rocker arm and the rocker arm shaft support. Check that the rocker arms have a minimal amount of end float so that they can move freely, but not excessively. On models so equipped, shims can be replaced with a thicker or thinner one. These shims are available from BMW dealers in the following thickness: 0.20, 0.25, 0.30, 0.35 and 0.50 mm.



15. After all of the nuts have been installed, recheck the torque of all 6 cylinder head nuts using the torque sequence shown in **Figure 59**.

16. Adjust the valves as described under *Cylinder Head Nut Torque and Valve Clearance Measurement and Adjustment* in Chapter Three.

17. Install a new cylinder head cover gasket (**Figure 60**) and the cylinder head cover.

18. Install the washer (**Figure 61**) and the center special nut (**Figure 62**) securing the cylinder head cover. Tighten the nut securely.

19. Install the lockwasher and nut (**Figure 63**) at the front and rear of the cylinder head securing the cylinder head cover. Tighten the nuts securely.

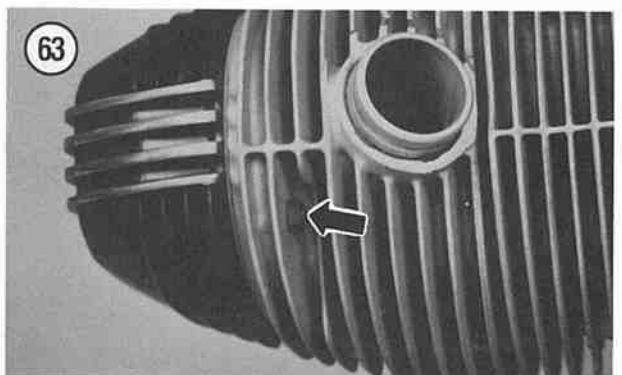
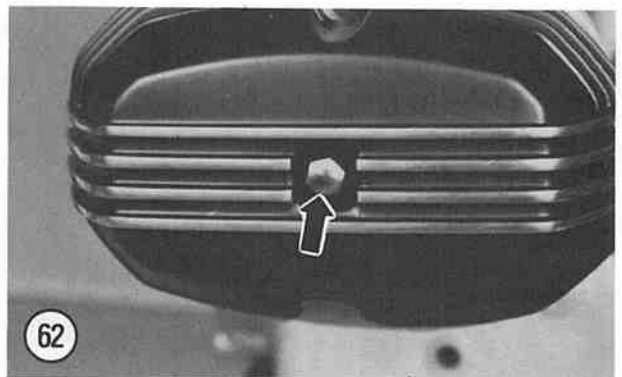
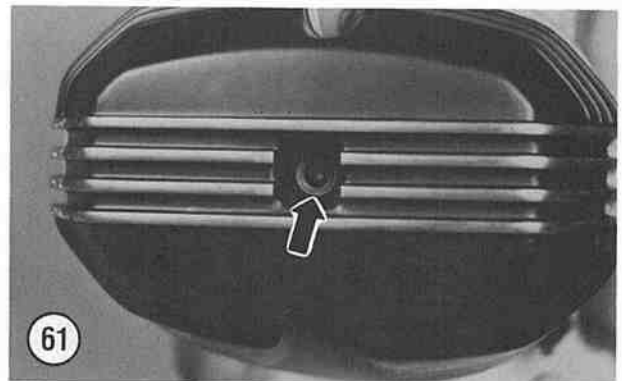
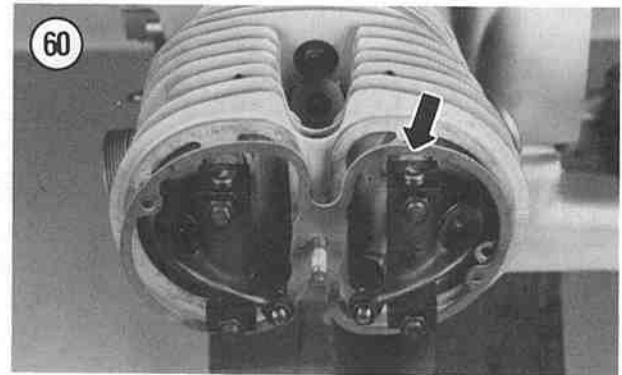
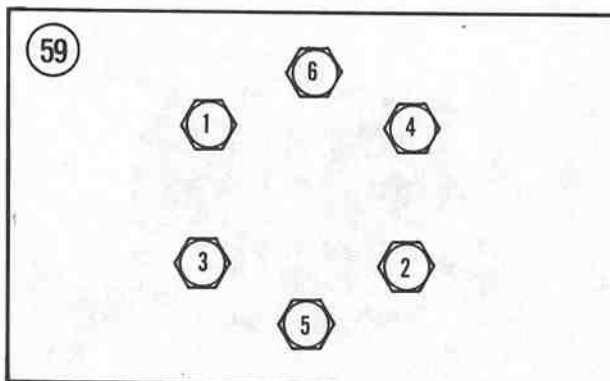
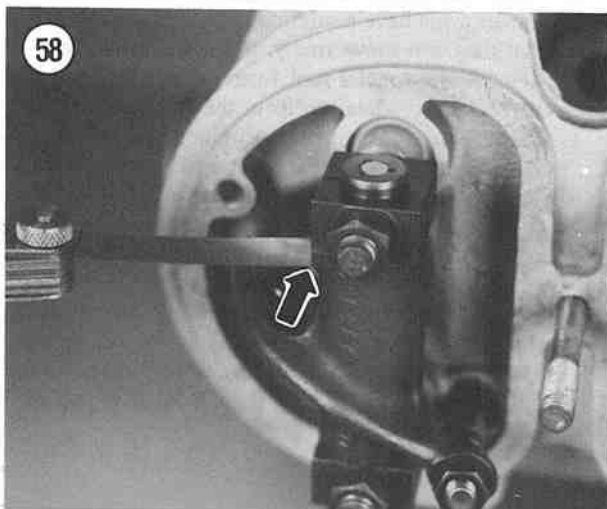
20. Install the spark plug as described under *Spark Plug Removal/Inspection* in Chapter Three.

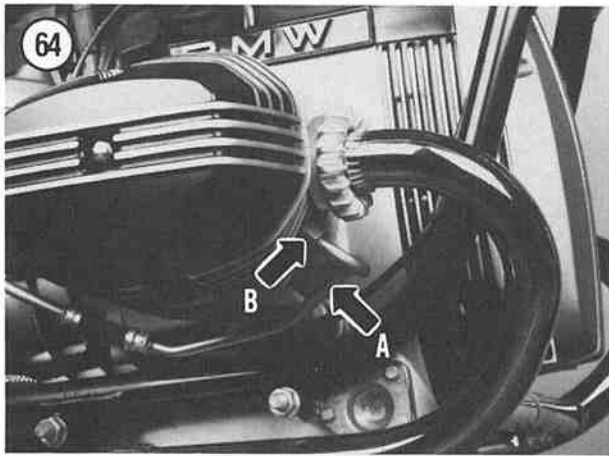
21. On models so equipped, move the intake air line (A, **Figure 64**) into place on the cylinder head and tighten the nut securely (B, **Figure 64**).

22. Install the exhaust system as described in Chapter Seven.

23. Install the carburetor as described in Chapter Seven.

24. Repeat for the other cylinder if necessary.





**ROCKER ARM ASSEMBLIES**

**Removal/Installation**

Rocker arm removal and installation is covered under *Cylinder Head* in this chapter.

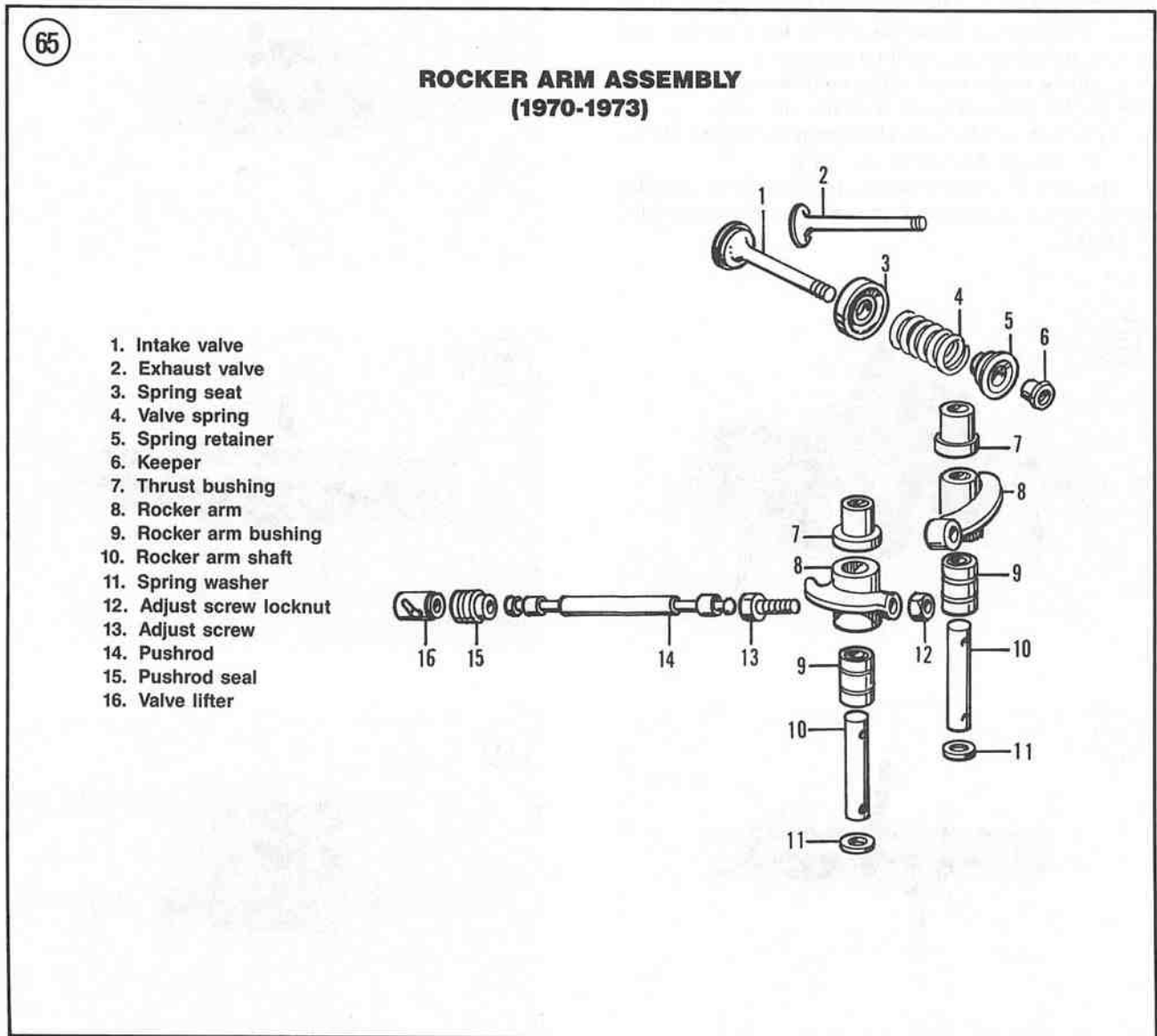
**Inspection**

(1970-1973 Models)

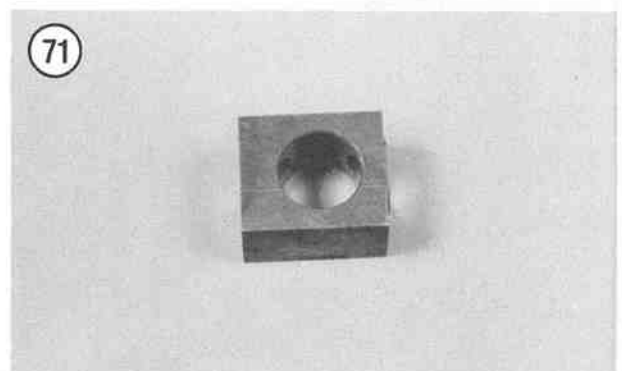
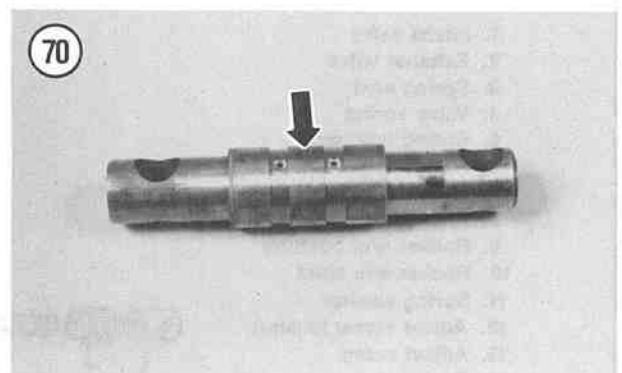
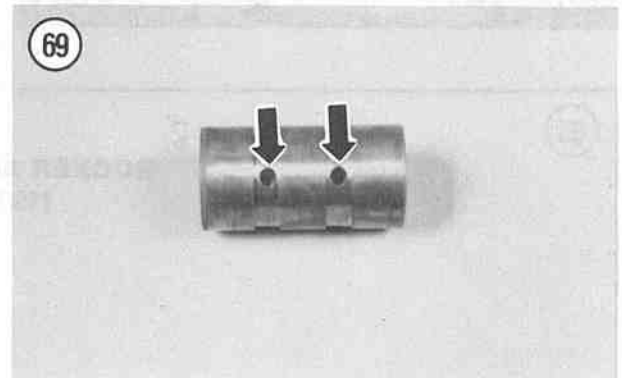
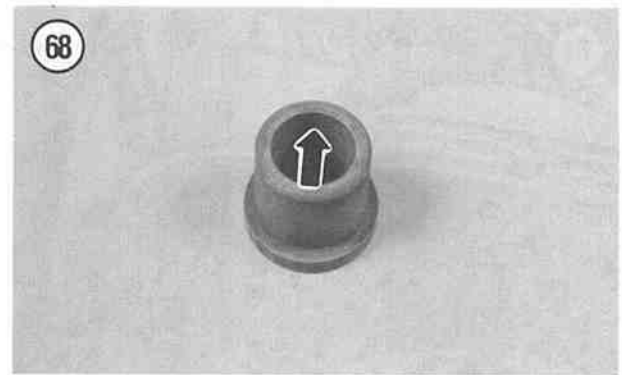
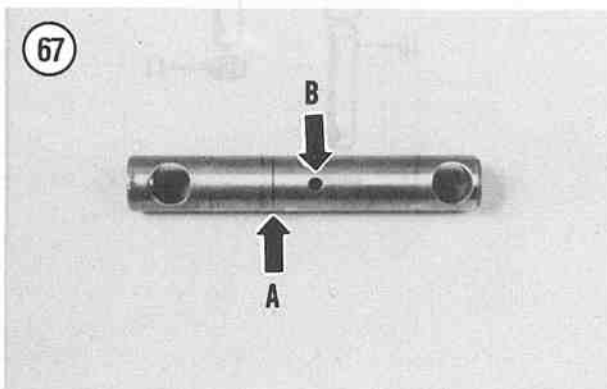
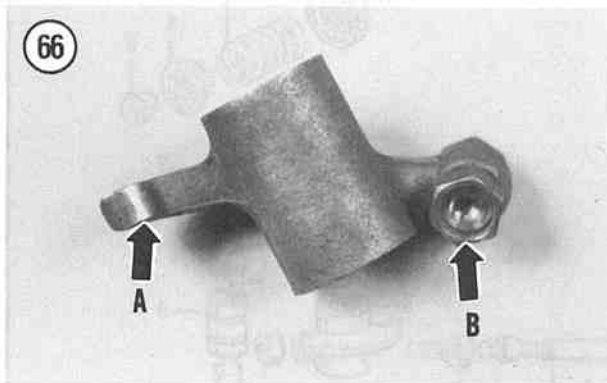
Refer to **Figure 65** for this procedure.

Keep the rocker arm assemblies separated in their respective sets. Do not intermix the parts as they have taken on their own unique wear pattern.

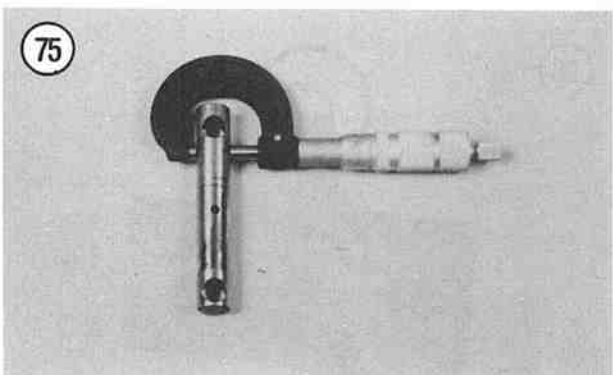
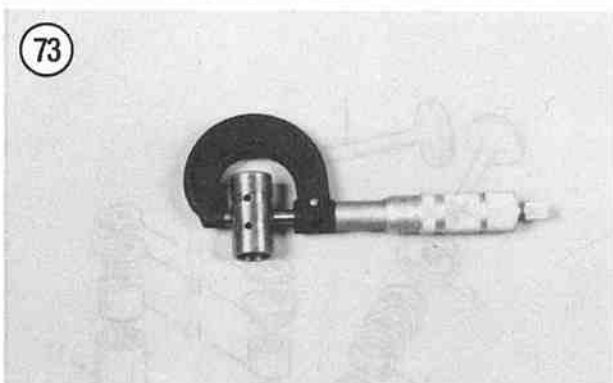
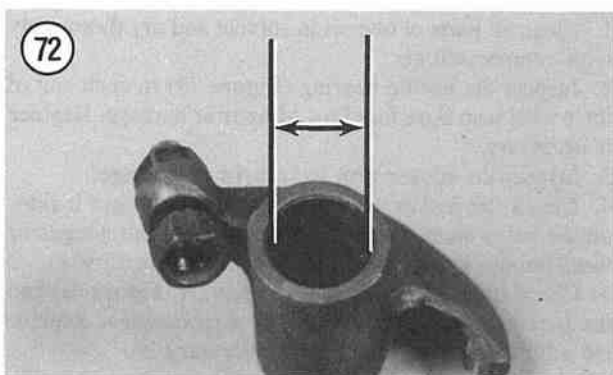
1. Clean all parts of one set in solvent and thoroughly dry with compressed air.



2. Inspect the rocker arm bore and rocker arm bushing bearing surfaces for signs of wear or scoring.
3. Inspect the rocker arm for cracks or damage.
4. Check the rocker arm pad (A, **Figure 66**) where it rides on the valve stem. It must be smooth with no gouges or wear points. Replace the rocker arm if necessary.
5. Check the rocker arm adjust screw and locknut (B, **Figure 66**) for wear or damage. Replace the adjust screw and locknut if necessary.
6. Inspect the rocker arm shaft (A, **Figure 67**) bearing surface for signs of wear or scoring. Make sure the oil control hole (B, **Figure 67**) is open. If necessary, clean out with a piece of wire and solvent and blow clear with compressed air.
7. Inspect the thrust bushing inner bearing surface (**Figure 68**) for signs of wear or scoring.
8. Inspect the rocker arm bushing surface for signs of wear or scoring. Make sure the oil control holes (**Figure 69**) are open. If necessary, clean out with a piece of wire and solvent and blow clear with compressed air.
9. Install the rocker arm bushing onto the rocker arm shaft (**Figure 70**) and make sure it rotates smoothly.
10. Inspect the rocker arm shaft support (**Figure 71**) for wear or damage. Replace if necessary.
11. Measure the inside diameter of the rocker arm (**Figure 72**) with a micrometer. Compare to the dimension listed in **Table 2**.







12. Measure the outside diameter of the rocker arm bushing (**Figure 73**) with a micrometer. Compare to the dimension listed in **Table 2**.

13. Subtract the rocker arm bushing outer diameter from the rocker arm inner diameter. This will give the oil clearance between the 2 parts. Compare to the dimension listed in **Table 2**. If the clearance is greater than specified, replace the rocker arm and the rocker arm bushing as a set.

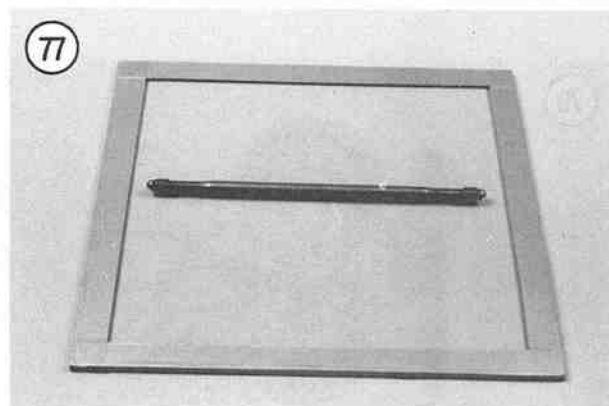
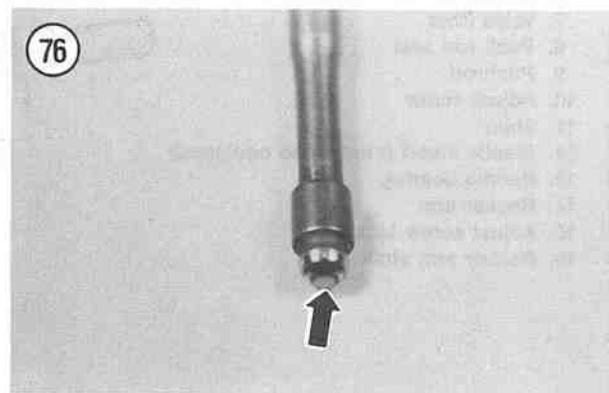
14. Measure the inside diameter of the rocker arm bushing (**Figure 74**) with a micrometer. Compare to the dimension listed in **Table 2**.

15. Measure the outside diameter of the rocker arm shaft (**Figure 75**) with a micrometer. Compare to the dimension listed in **Table 2**.

16. Subtract the rocker arm shaft outer diameter from the rocker arm bushing inner diameter. This will give the oil clearance between the 2 parts. Compare to the dimension listed in **Table 2**. If the clearance is greater than specified, replace the rocker arm and the rocker arm bushing as a set.

17. Inspect each end of the pushrods (**Figure 76**) where it rides either in the valve lifter or against the adjust bolt in the rocker arm. The end must be smooth with no signs of damage or wear. Replace if necessary.

18. Roll the pushrod on a flat surface like a piece of plate glass (**Figure 77**). Check for signs of bending or damage. Replace the pushrod if any bending is evident.

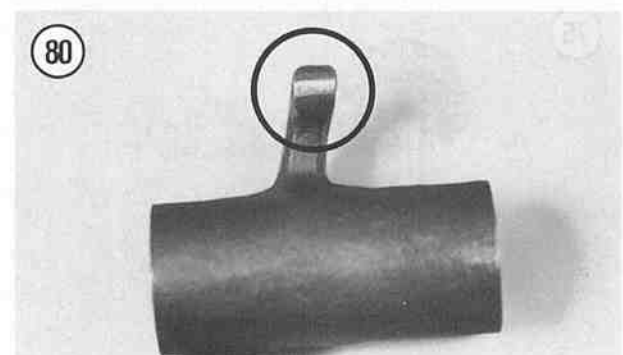
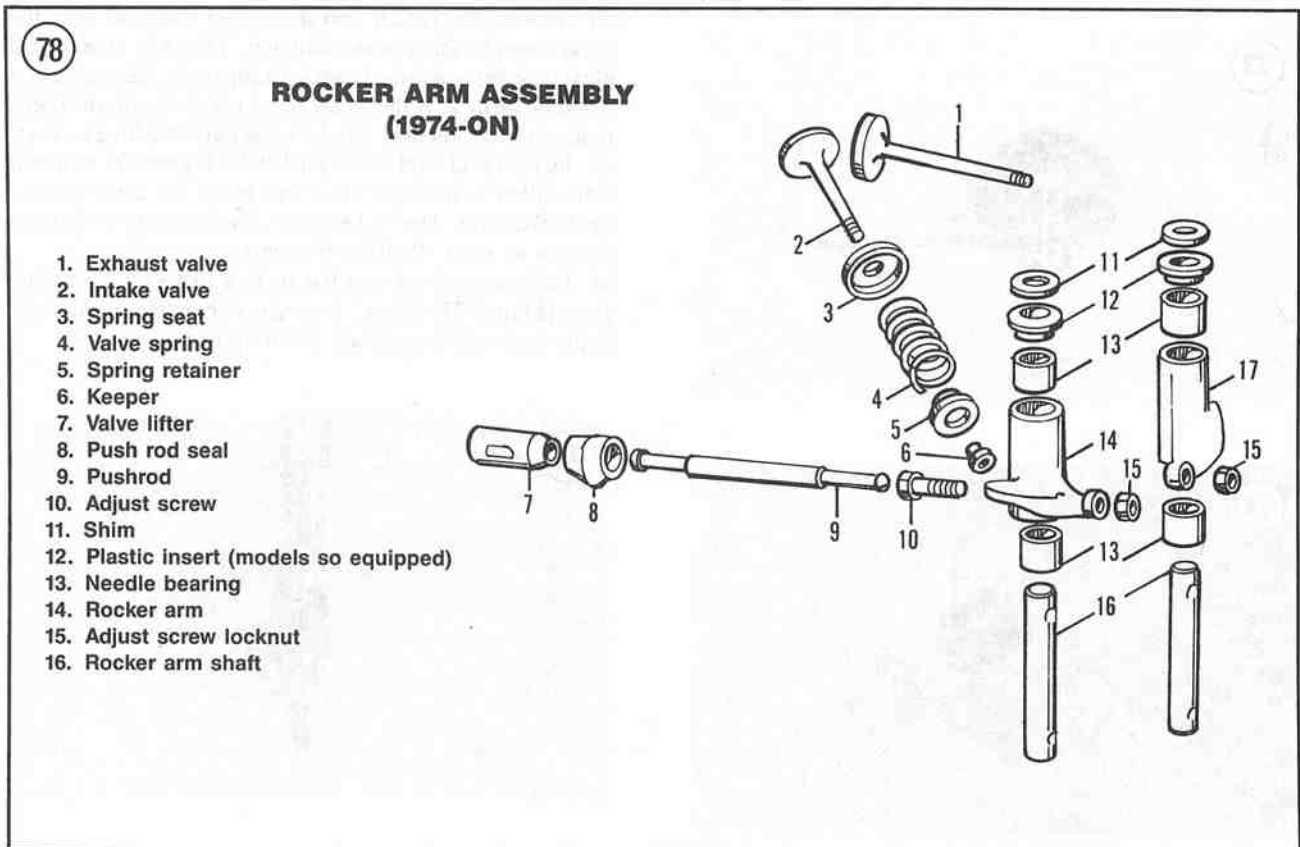


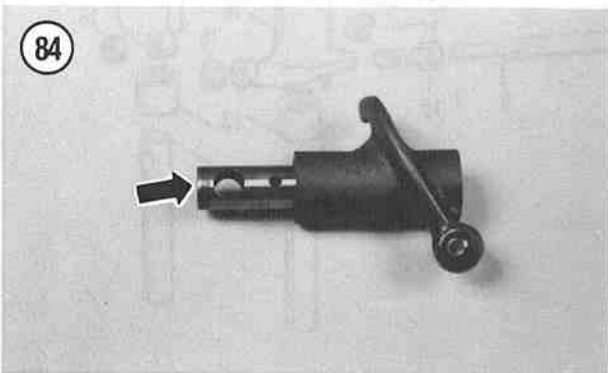
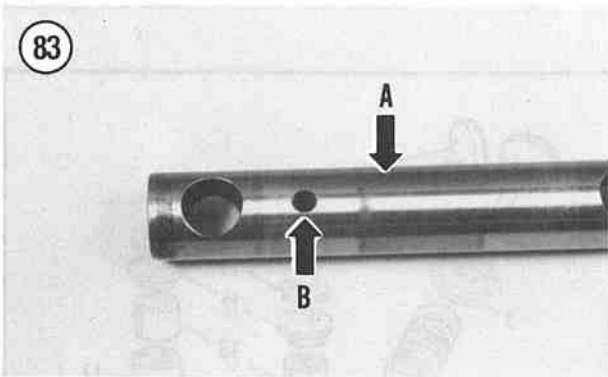
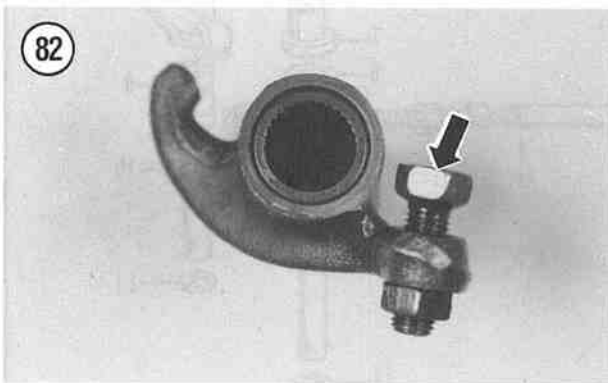
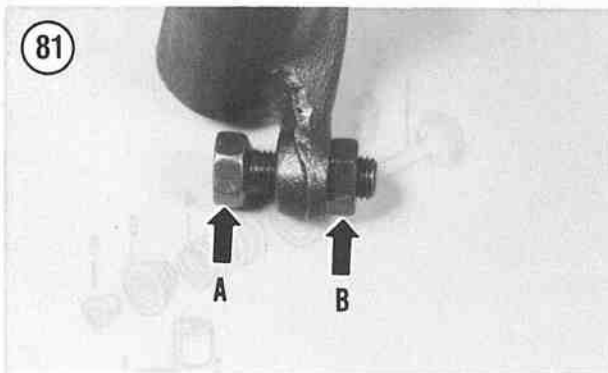
### Inspection (1974-on Models)

Refer to **Figure 78** for this procedure.

Keep the rocker arm assemblies separated in their respective sets. Do not intermix the parts as they have taken on their own unique wear pattern. The intake and exhaust rocker arms within the same cylinder cannot be intermixed as they would not align properly with the valve stem during installation. But the intake or exhaust rocker arm assembly parts could be intermixed between sets of rocker arms and this should be avoided.

1. Clean all parts of one set in solvent and dry thoroughly with compressed air.
2. Inspect the needle bearing (**Figure 79**) in each end of the rocker arm bore for signs of wear or damage. Replace if necessary.
3. Inspect the rocker arm for cracks or damage.
4. Check the rocker arm pad (**Figure 80**) where it rides on the valve stem. It must be smooth with no gouges or wear points. Replace the rocker arm if necessary.
5. Check the rocker arm adjust screw (A, **Figure 81**) and the locknut (B, **Figure 81**) for wear or damage. Replace the adjust screw and locknut if necessary.





6. Check the head of the rocker arm adjust screw (Figure 82) where the push rod rides for wear or damage. Replace the adjust screw if necessary.

7. Inspect the rocker arm shaft (A, Figure 83) bearing surface for signs of wear or scoring. Make sure all oil holes (B, Figure 83) are clear. Clean out with a piece of wire and rinse thoroughly with solvent. Blow dry with compressed air.

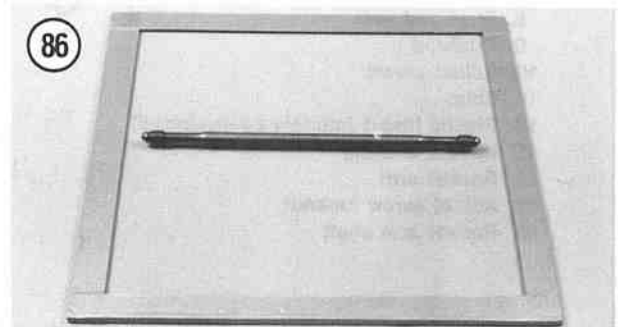
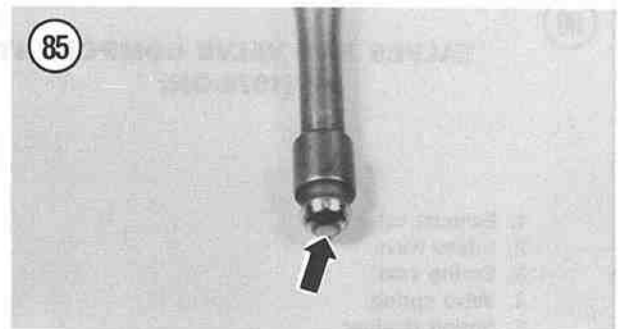
**NOTE**

*BMW does not provide any service dimensions for the outer diameter of the rocker arm shaft or the inner bore diameter of the needle bearings. The clearance between the 2 parts is by feel only. If you feel unqualified to make this judgement, take the parts to a BMW dealer and have them check the clearance for you.*

8. Insert the rocker arm shaft (Figure 84) into the rocker arm and move the shaft back and forth. Also rotate the shaft within the rocker arm. The shaft must move easily but without any noticeable play. Replace the rocker arm shaft if necessary. If the clearance is not acceptable, replace both parts as a set.

9. Inspect both ends of each pushrod (Figure 85) where it rides either in the valve lifter or against the adjust bolt in the rocker arm. The ends must be smooth with no signs of damage or wear. Replace if necessary.

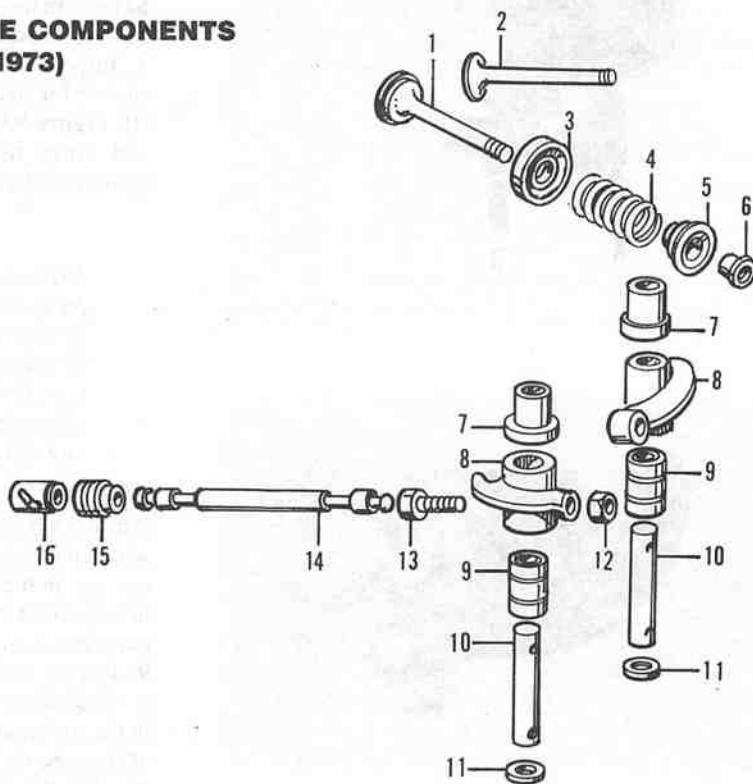
10. Roll the pushrod on a flat surface such as a piece of plate glass (Figure 86). Check for signs of bending or damage. Replace the pushrod if any bending is evident.



87

### VALVES AND VALVE COMPONENTS (1970-1973)

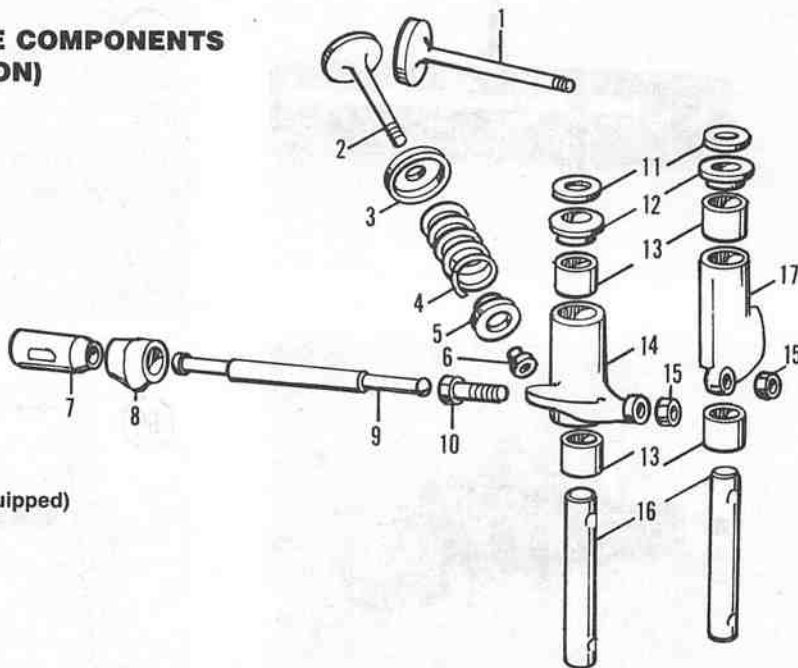
1. Intake valve
2. Exhaust valve
3. Spring seat
4. Valve spring
5. Spring retainer
6. Keeper
7. Thrust bushing
8. Rocker arm
9. Rocker arm bushing
10. Rocker arm shaft
11. Spring washer
12. Adjuster screw locknut
13. Adjust screw
14. Pushrod
15. Push rod seal
16. Valve lifter

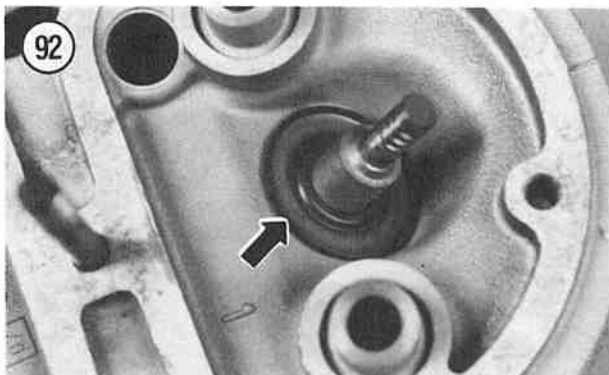
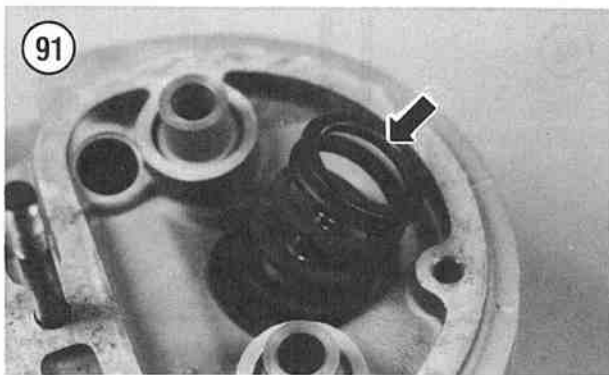
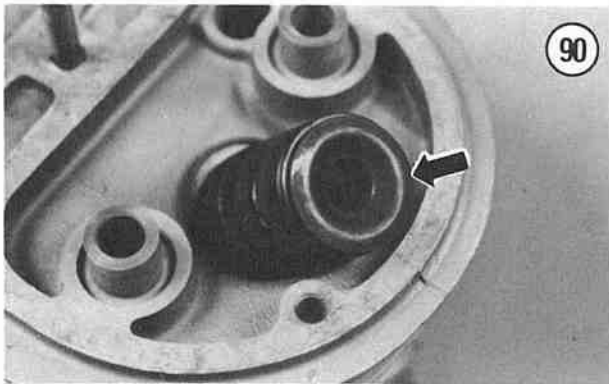
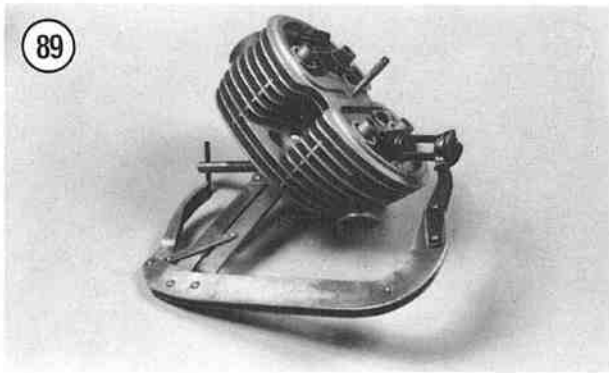


88

### VALVES AND VALVE COMPONENTS (1974-ON)

1. Exhaust valve
2. Intake valve
3. Spring seat
4. Valve spring
5. Spring retainer
6. Keeper
7. Valve lifter
8. Push rod seal
9. Pushrod
10. Adjust screw
11. Shim
12. Plastic insert (models so equipped)
13. Needle bearing
14. Rocker arm
15. Adjust screw locknut
16. Rocker arm shaft





## VALVES AND VALVE COMPONENTS

A general practice among those who do their own service is to remove the cylinder head(s) and take it to a machine shop or dealer for inspection and service. Since the cost is low relative to the required effort and equipment, this is the best approach, even for the experienced mechanics.

This procedure is included for those who chose to do their own valve service.

Refer to the following illustrations for this procedure:

- a. **Figure 87:** 1970-1973 models.
- b. **Figure 88:** 1974-on models.

### Valve Removal

1. Remove the cylinder head(s) as described in this chapter.

#### CAUTION

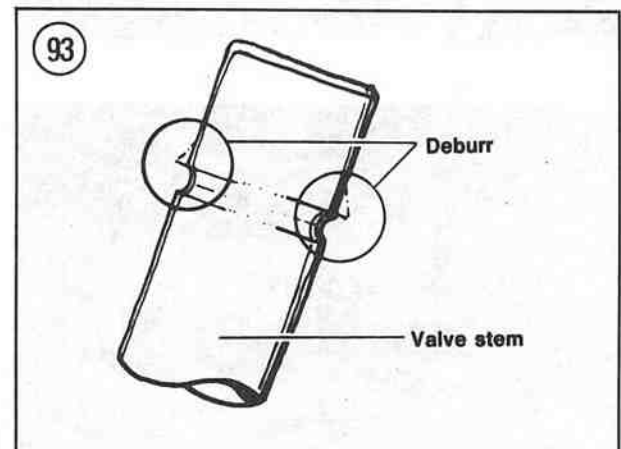
*To avoid loss of spring tension, do not compress the valve spring any more than necessary to remove the keepers.*

2. Compress the valve spring with a valve compressor tool (**Figure 89**). Remove the valve keepers and release the compression. Remove the valve compressor tool.
3. Remove the valve spring retainer (**Figure 90**) and the valve spring (**Figure 91**).
4. Remove the spring seat (**Figure 92**).
5. Before removing the valve, remove any burrs from the valve stem (**Figure 93**). Otherwise the valve guide will be damaged.
6. Remove the valve (**Figure 94**).

#### NOTE

*This engine is not equipped with an oil seal on the valve guide.*

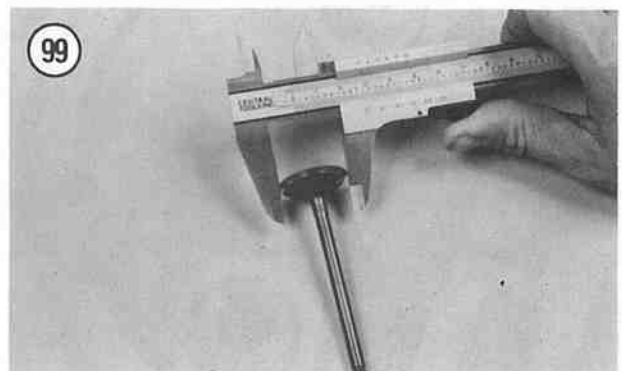
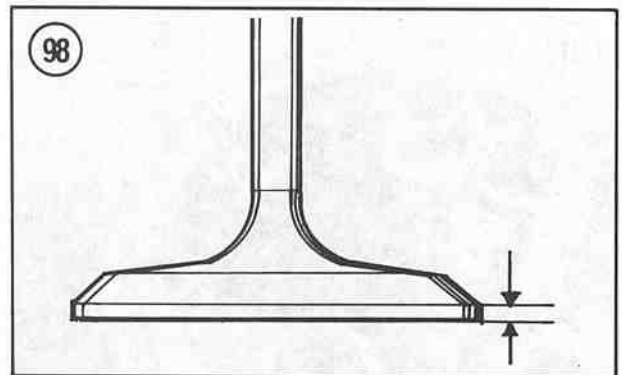
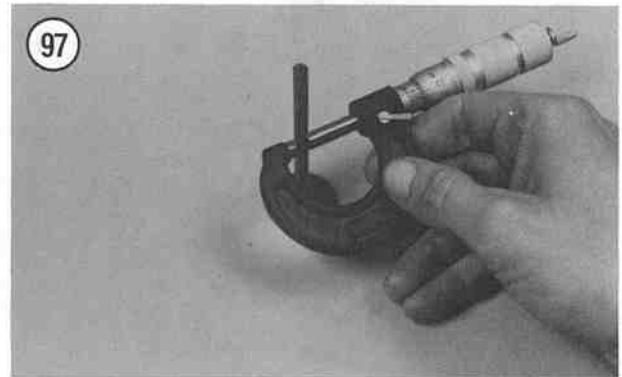
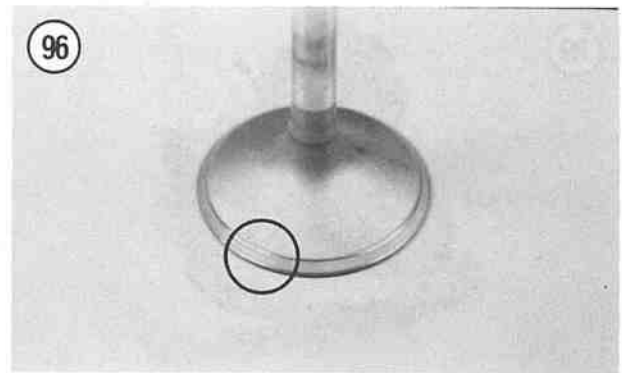
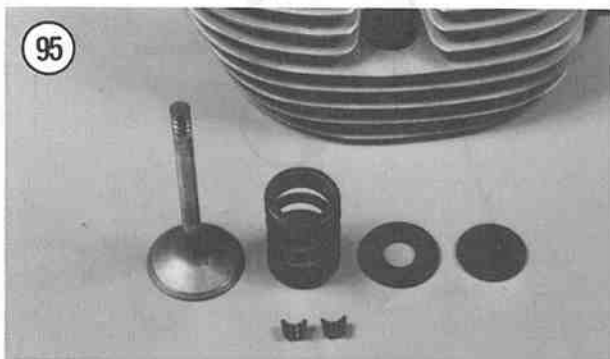
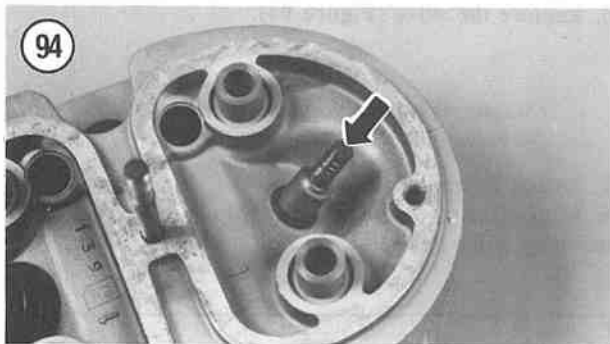
7. Repeat for the other valve.
8. Mark all parts (**Figure 95**) as they are disassembled so that they will be installed in their same locations.

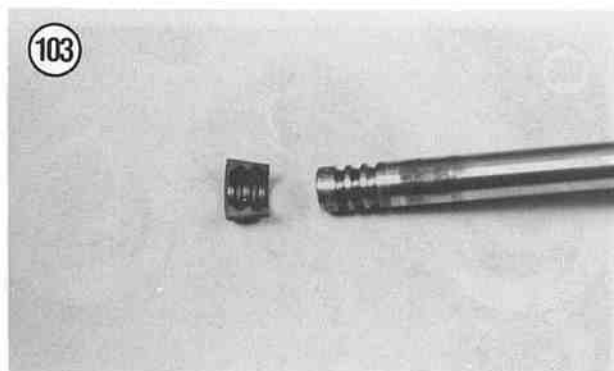
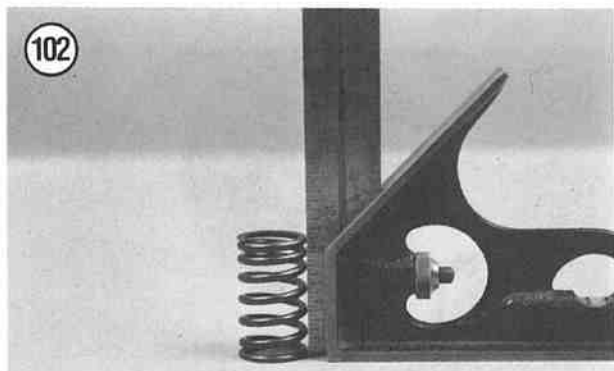
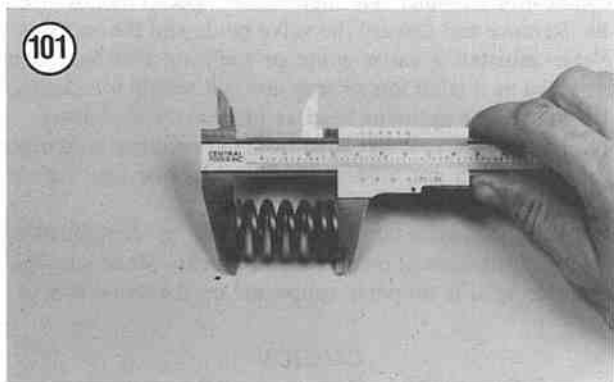
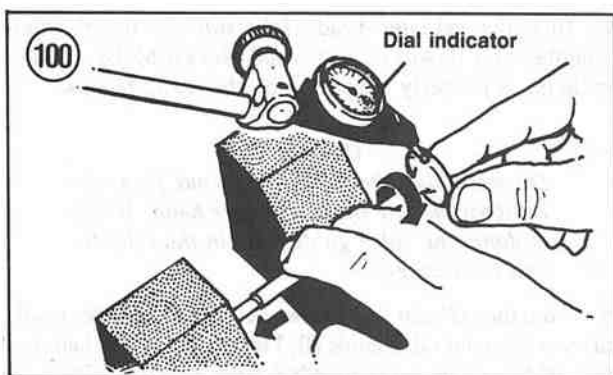




### Valve Inspection

1. Clean the valves with a wire brush and solvent.
2. Inspect the contact surface of each valve for burning or pitting (**Figure 96**). Unevenness of the contact surface is an indication that the valve is not serviceable. The valve contact surface can *not* be ground and must be replaced if defective.
3. Inspect each valve stem for wear and roughness. BMW does not provide service specification for valve stem runout.
4. Measure the outside diameter of each valve stem (**Figure 97**). If worn to the wear limit listed in **Table 2**, the valve must be replaced.
5. Measure each valve head edge thickness (**Figure 98**). If worn to the wear limit listed in **Table 2** or less, the valve must be replaced.
6. Measure the outside diameter of each valve head (**Figure 99**). If worn to the wear limit listed in **Table 2** or less, the valve must be replaced.
7. Place a valve in V-blocks. Using a dial indicator, measure the valve head runout as shown in **Figure 100**. If it exceeds the wear limit listed in **Table 2**, the valve must be replaced.
8. Remove all carbon and varnish from each valve guide with a stiff spiral wire brush.
9. Using a small bore gauge, measure the inside diameter of the valve guide. If worn to the wear limit listed in **Table 2** or more, the valve guide must be replaced.
10. Subtract the valve stem outer diameter dimension, taken in Step 2, from the valve guide inner diameter. This will give the valve stem-to-valve guide clearance.





11. Measure the free length of each valve spring with a vernier caliper (Figure 101). All should be within the length specified in Table 2 with no signs of bends or distortion (Figure 102). Replace defective springs.

12. Check the valve stem grooves and the valve keepers (Figure 103). If they are in good condition they may be reused; replace as necessary.

13. Inspect the valve seats. If worn or burned, they must be reconditioned as described in this chapter.

### Valve Installation

1. Coat the valve stems with molybdenum disulfide grease. To avoid damage to the valve stem seal, turn the valve slowly while inserting the valve into the cylinder head (Figure 94).
2. Position the spring seat with the flange side facing up and install the spring seat (Figure 92).
3. Install the valve spring (Figure 91). The spring is *not* progressively wound so either end can go on first.
4. Install the valve spring retainer (Figure 90) on top of the valve spring.

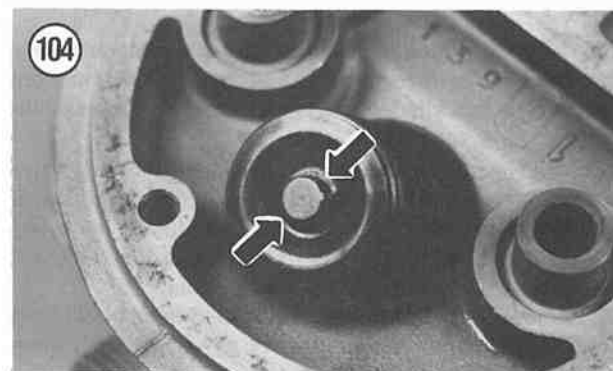
### CAUTION

*To avoid loss of spring tension, do not compress the spring any more than necessary to install the keepers.*

5. Compress the valve spring with a compressor tool (Figure 89) and install the valve keepers. Make sure the keepers fit snugly into the grooves in the valve stem.
6. Remove the compression tool.
7. After the spring has been installed, gently tap the end of the valve stem with a soft-aluminum or brass drift and hammer. This will ensure that the keepers are properly seated (Figure 104).
8. Repeat for the other valve assembly.
9. Install the cylinder head as described in this chapter.
10. Repeat for the other cylinder head if necessary.

### Valve Guide Replacement

When valve guides are worn so that there is excessive valve stem-to-guide clearance or valve tipping, the guides



must be replaced. This job should be done only by a dealer as special tools are required as well as considerable expertise. If a valve guide is replaced, also replace the valve.

The following procedure is provided in case you choose to perform this task yourself.

#### NOTE

*There may be a residual oil or solvent odor left in the oven after heating the cylinder head. If you use a household oven, first check with the person who uses the oven for food preparation to avoid getting into trouble.*

1. Remove the valves as described in this chapter.
2. Place the cylinder head on a soft-wood block.

#### NOTE

*If you are unable to tap the valve guide up in Step 3, the upper portion of the valve guide must be milled off down to the lockring, so the lockring can be removed. Have this step performed by a competent machine shop or BMW dealer.*

3. Working on the combustion chamber side of the cylinder head, carefully tap the valve guide (Figure 105) up sufficiently to remove the lockring from the valve guide.
4. Turn the cylinder head over and remove the lockring (A, Figure 106).

#### CAUTION

*Do not heat the cylinder head with a torch (propane or acetylene); never bring a flame into contact with the cylinder head or valve guides. The direct heat will destroy the case hardening of the valve guides and will likely warp the cylinder head. The entire cylinder head assembly must be heated as a unit.*

5. The valve guides are installed with a slight interference fit. Place the cylinder head in a heated oven (or on a hot plate). Heat the cylinder head to a temperature between 240-260° C (465-500° F).
6. While heating up the cylinder head, place the new valve guides in a freezer for 30 minutes. Chilling them will slightly reduce their overall diameter while the hot cylinder head is slightly larger due to heat expansion. This will make valve guide installation much easier.
7. Remove the cylinder head from the oven and hold onto it with kitchen pot holders, heavy gloves or heavy shop cloths—it is very hot.

8. Turn the cylinder head *right side up* (combustion chamber side down) on soft-wood blocks. Make sure the cylinder is properly supported on the wood blocks.

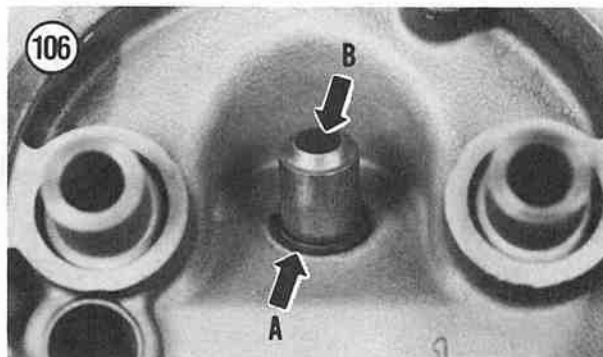
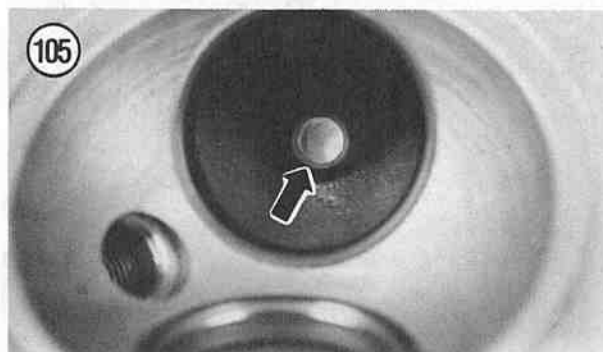
#### CAUTION

*Do not drive the valve guide out from the combustion side of the cylinder head. If this is done, the valve guide bore in the cylinder will be damaged.*

9. From the *cylinder head cover side* of the cylinder head, drive out the old valve guide (B, Figure 106) with a hammer and BMW valve guide mandrel (part No. 11 1 780), or suitable size drift. Drive the valve guide out through the combustion chamber side. Remove the special tool or drift.
10. Remove and discard the valve guide and the lockring. *Never* reinstall a valve guide or lockring that has been removed as it is no longer true nor is it within tolerances.
11. Reheat the cylinder head as previously described.
12. Remove the cylinder head from the oven and hold onto it with kitchen pot holders, heavy gloves or heavy shop cloths—it is very hot.
13. Turn the cylinder head *right side up* (combustion chamber side down) on soft-wood blocks. Make sure the cylinder head is properly supported on the wood blocks.

#### CAUTION

*Failure to apply fresh engine oil to both the valve guide and the valve guide hole in the cyl-*

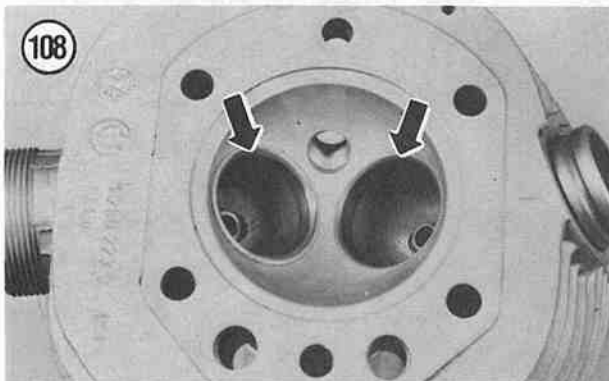
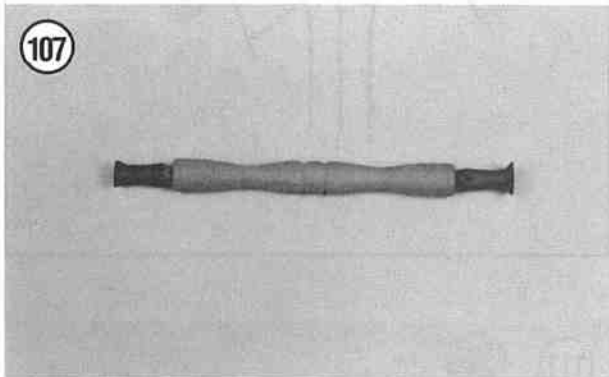


inder head will result in damage to the cylinder head and/or the new valve guide.

14. Install a new lockring onto the new valve guide. The lockring must be in place as it acts as the stop for the valve guide during installation.
15. Apply fresh engine oil to the new valve guide and the valve guide hole in the cylinder head.
16. From the *cylinder head cover side* of the cylinder, drive in the new valve guide with a hammer and BMW valve guide mandrel (part No. 11 1 790). Drive the valve guide in until the lockring bottoms out in the cylinder head. Make sure the guide is completely seated in the cylinder head. Remove the special tool.
17. After installation and when the cylinder head and new valve guide reach room temperature, ream the new valve guide with the BMW special tool (part No. 8 H 7 reamer).
18. If necessary, repeat Steps 1-17 for the other valve guide.
19. Thoroughly clean the cylinder head and valve guides with solvent to wash out all metal particles. Dry with compressed air.
20. Reface the valve seats as described in this chapter.

### Valve Seat Inspection

1. Remove the valves as described in this chapter.
2. The most accurate method for checking the valve seal is to use Prussian blue or machinist's dye, available from



auto parts stores or machine shops. To check the valve seal with Prussian blue or machinist's dye, perform the following:

- a. Thoroughly clean off all carbon deposits from the valve face with solvent or detergent, then dry thoroughly.
  - b. Spread a thin layer of Prussian blue or machinist's dye evenly on the valve face.
  - c. Moisten the end of a suction cup valve tool (Figure 107) and attach it to the valve. Insert the valve into the guide.
  - d. Using the suction cup tool, tap the valve up and down in the cylinder head. Do *not* rotate the valve or a false indication will result.
  - e. Remove the valve and examine the impression left by the Prussian blue or machinist's dye. If the impression left in the dye (on the valve or in the cylinder head) is not even and continuous and the valve seat width is not within specified tolerance listed in Table 2, the cylinder head valve seat must be reconditioned.
3. Closely examine the valve seat (Figure 108) in the cylinder head. It should be smooth and even with a polished seating surface.
  4. If the valve seat is okay, install the valves as described in this chapter.
  5. If the valve seat is not correct, recondition the valve seat as described in this chapter.

### Valve Seat Reconditioning

Special valve cutter tools and considerable expertise are required to properly recondition the valve seats in the cylinder head. You can save considerable money by removing the cylinder head and taking just the cylinder head to a dealer or machine shop and having the valve seats ground.

The following procedure is provided in case you choose to perform this task yourself.

BMW dealers use the Hunger valve seat machine tool. Follow the manufacturer's instructions for operating the tool.

The intake and exhaust valves are machined to the same 45° angle but the width differs between the intake and exhaust valve seats as listed in Table 2.

Refer to Figure 109 for valve seat diameter and valve seat width. The valve seat diameter and seat width are listed in Table 2.

1. Use a 45° angle cutter tool for the main valve seat surface.
2. Use the special tool and descale and clean the valve seat with one or two turns.

#### CAUTION

*Measure the valve seat contact area in the cylinder head after each cut to make sure the contact area is correct and to prevent removing too much material. If too much material is removed, the valve seat inserts will have to be replaced.*



3. If the seat is still pitted or burned, turn the cutter additional turns until the surface is clean. Refer to the previous CAUTION to avoid removing too much material from the cylinder head.
4. Inspect the valve seat-to-valve face impression as follows:
  - a. Spread a thin layer of Prussian blue or machinist's dye evenly on the valve face.
  - b. Moisten the end of a suction cup valve tool (Figure 107) and attach it to the valve. Insert the valve into the guide.
  - c. Using the suction cup tool, tap the valve up and down in the cylinder head. Do not rotate the valve or a false indication will result.
  - d. Remove the valve and examine the impression left by the Prussian blue or machinist's dye.
  - e. Measure the valve seat width. Refer to Table 2 for the seat width.

#### CAUTION

*There must not be any tool chatter marks on the valve seat face as this will cause leaking.*

5. Check that the finish has a smooth and velvety surface; it should not be shiny or highly polished. The final seating will take place when the engine is first run.
6. After the main face is cut to the 45° angle, there are 2 additional cuts necessary. They are as follows (Figure 110).
  - a. A 15° angle on the combustion chamber side of the valve seat.
  - b. A 75° angle on the intake or exhaust port side of the valve seat.
  - c. The valve seat should look like the one shown in Figure 111 with 2 separate rings after the 2 additional angle cuts are made on the original 45° face.
7. Repeat Steps 1-6 for the remaining valve seat.
8. Thoroughly clean the cylinder head and all valve components in solvent or detergent and hot water.
9. Install the valve assemblies as described in this chapter and fill the ports with solvent to check for leaks. If any leaks are present, the valve seats must be inspected for foreign matter or burrs that may be preventing a proper seal.
10. If the cylinder head and valve components were cleaned in detergent and hot water, apply a light coat of engine oil to all bare metal surfaces to prevent any rust formations.

## CYLINDER

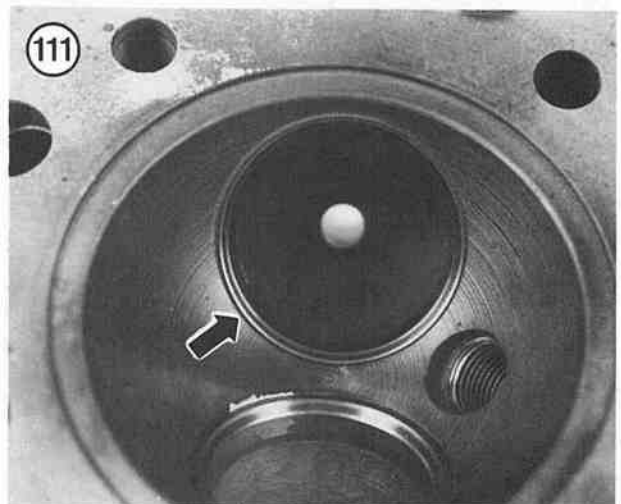
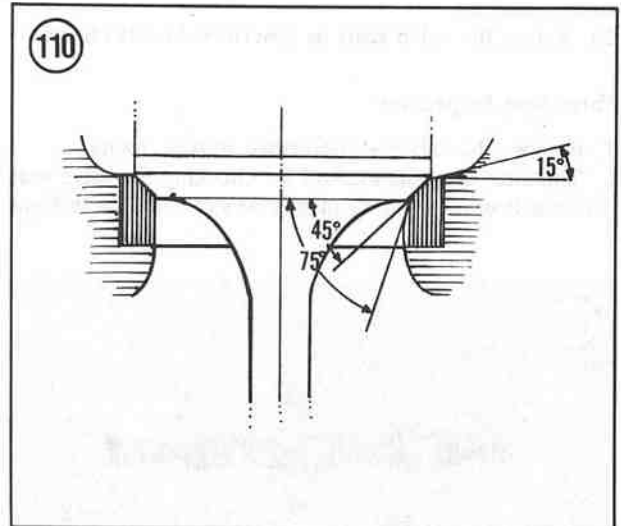
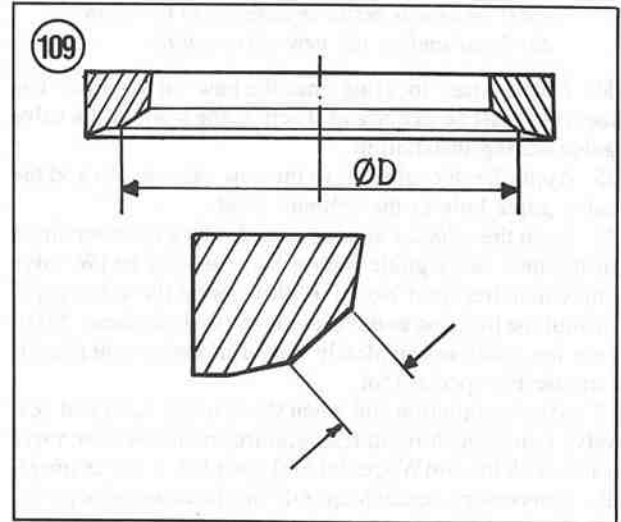
### Removal

Refer to Figure 112 for this procedure.

1. Remove the cylinder head, pushrods and cylinder head gasket as described in this chapter.

#### CAUTION

*When the cylinder is removed, the piston will fall down and make contact with the crankcase*





*studs. Be sure to catch the piston after it is clear of the cylinder bore.*

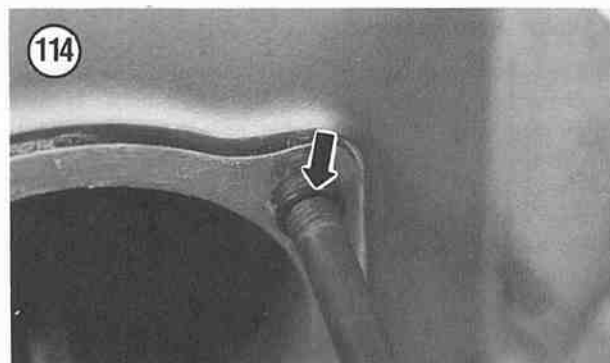
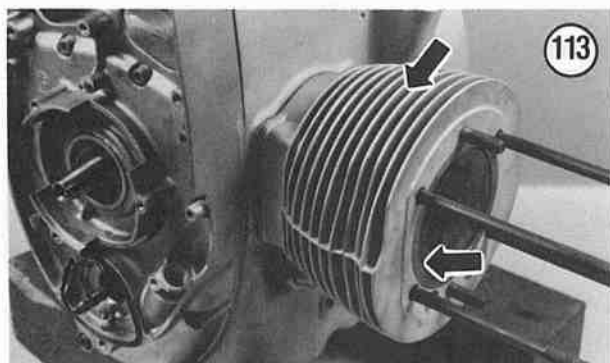
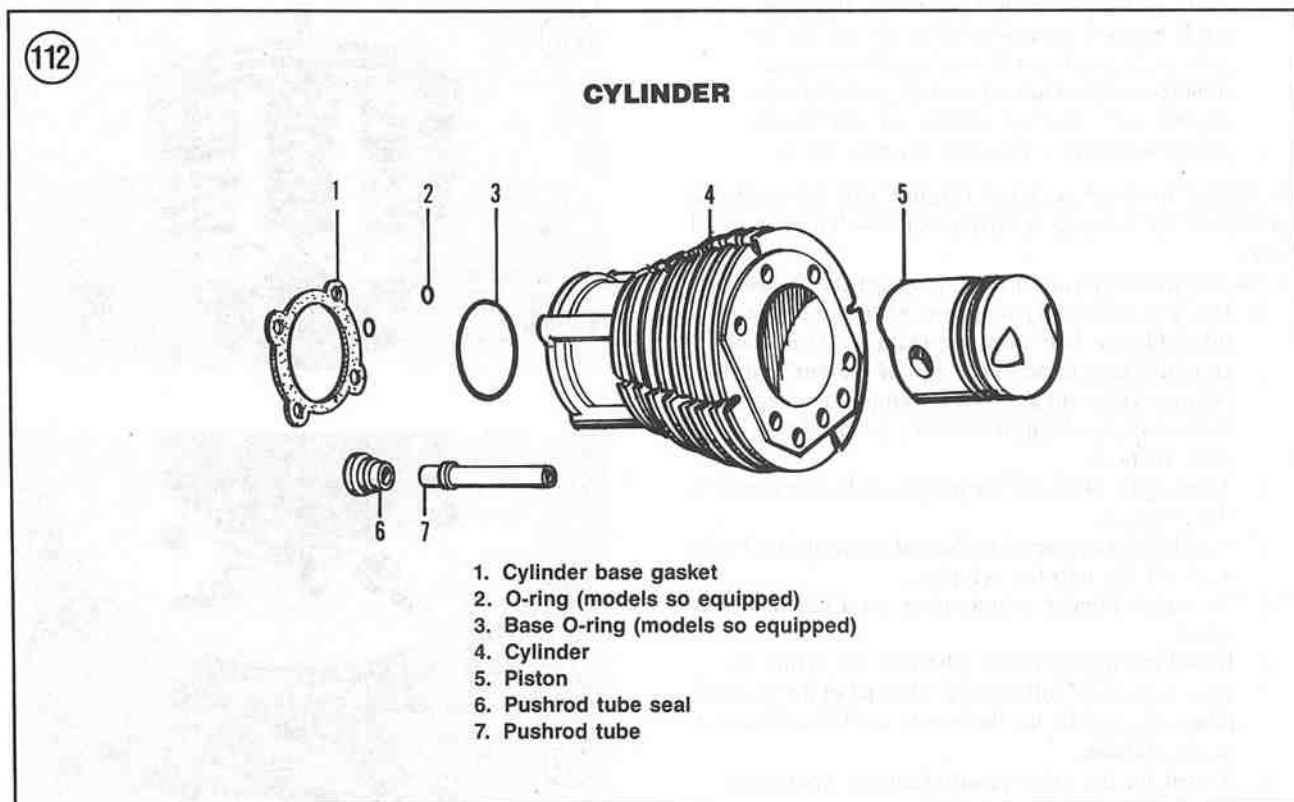
2. Carefully pull the cylinder (**Figure 113**) off of the crankcase studs. The pushrod tubes will come off with the cylinder.
3. On models so equipped, remove the O-ring seals (**Figure 114**) from the upper 2 crankcase studs or the base of the cylinder. The O-rings may stick to either surface. Discard the O-rings as they must be replaced whenever the cylinder is removed.
4. Slide the cylinder base gasket off of the crankcase studs. Discard the gasket as it must be replaced whenever the cylinder is removed.

5. Place a shop rag over the 2 lower crankcase studs underneath the piston. Let the piston rest on the shop rag and crankcase studs.
6. On models so equipped, remove the large O-ring seal from the base of the cylinder.
7. Remove the rubber seal from the lower end of each pushrod tube.
8. Inspect the cylinder as described in this chapter.

#### Cylinder External Inspection

1. Carefully inspect the cylinder for cracks and fractures.

4

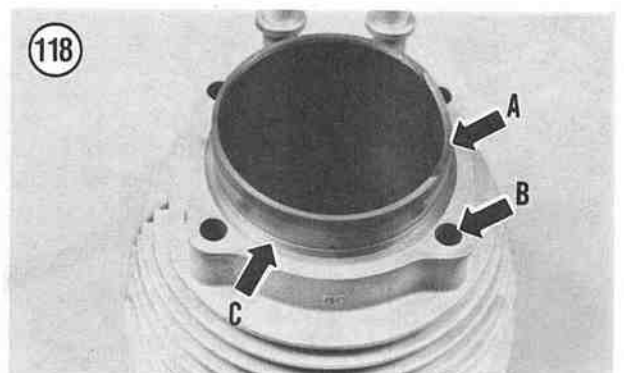
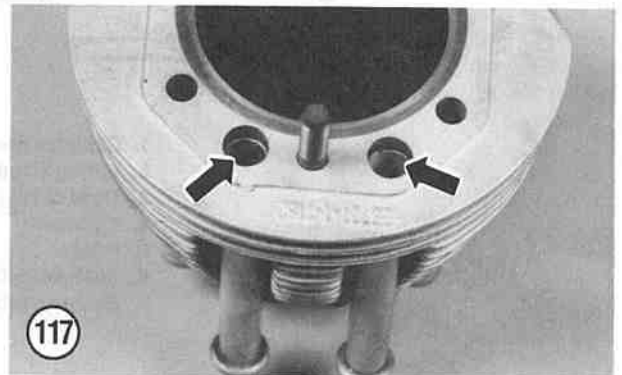
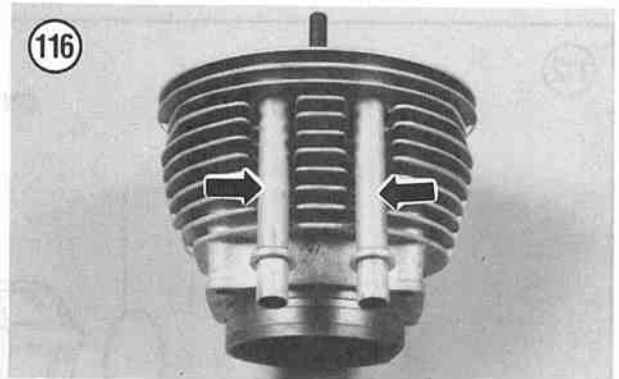
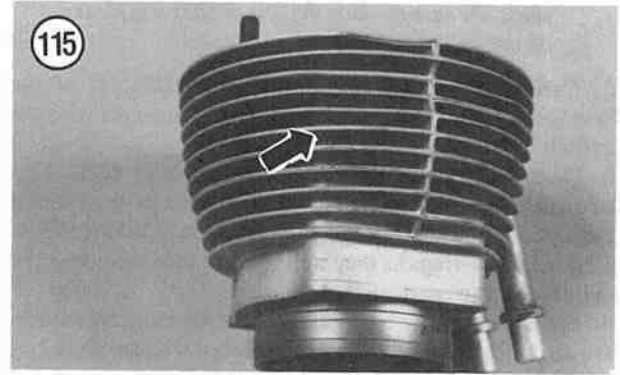


2. Inspect the cooling fins (**Figure 115**) for cracks or missing fins. If damage is found, have it repaired by a shop specializing in the repair of precision aluminum castings or replace the cylinder.
3. Make sure the cooling fins are clean and free of any road dirt buildup. Clean out with a stiff brush and wash with solvent. Blow off with compressed air.

**CAUTION**

*If the cylinder was bead-blasted, make sure to clean the cylinder thoroughly with solvent and then with hot water and soap afterwards. Make sure the pushrod tubes are thoroughly cleaned out as this is a major oil flow path. Bead-blasting residue seats in small crevices and other areas and can be hard to remove. Also chase each exposed thread with a thread tap to remove the grit between the threads or you may damage a thread later. Residual grit left in the engine will wind up in the oil and cause premature piston, ring and bearing wear.*

4. Inspect the pushrod tubes (**Figure 116**) for cracks or damage. If there is even a small crack it will lead to an oil leak.
5. To replace the pushrod tube, perform the following:
  - a. Using a pair of slip joint pliers, withdraw the pushrod tube (**Figure 116**) from the cylinder. If necessary, carefully tap on the upper end of the pushrod tube (**Figure 117**) with a drift and hammer and tap it out of the cylinder. Remove the other pushrod tube in the same manner.
  - b. Thoroughly clean out the pushrod tube receptacle in the cylinder.
  - c. Apply clean engine oil to the end of the pushrod tube where it fits into the cylinder.
  - d. Turn the cylinder upside down on a block of soft wood.
  - e. Install the new pushrod tube into the cylinder.
  - f. Place a block of soft wood on the end of the pushrod tube and carefully tap the tube in until it bottoms out in the cylinder.
  - g. Repeat for the other pushrod tube if necessary.

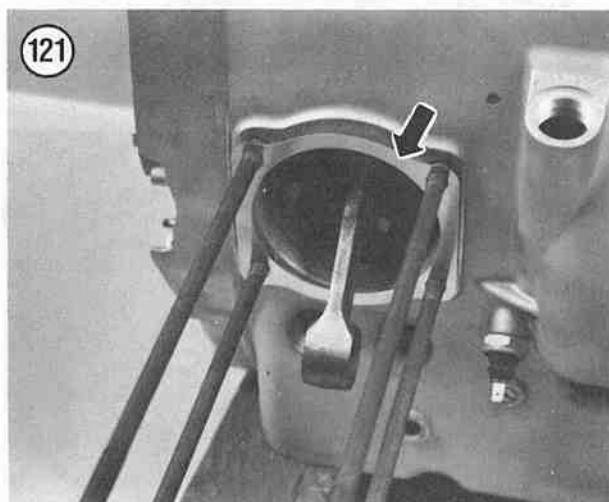
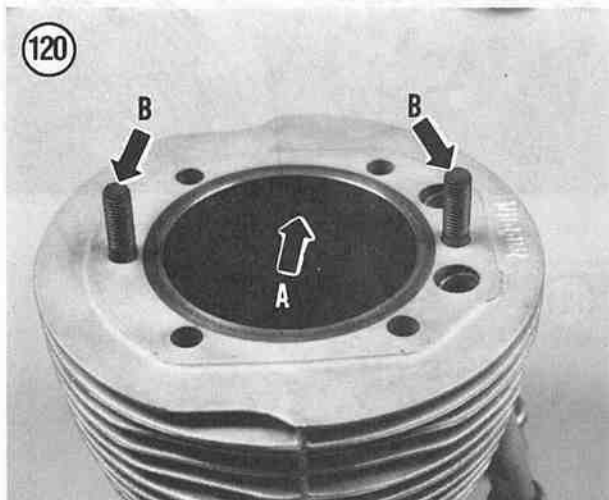
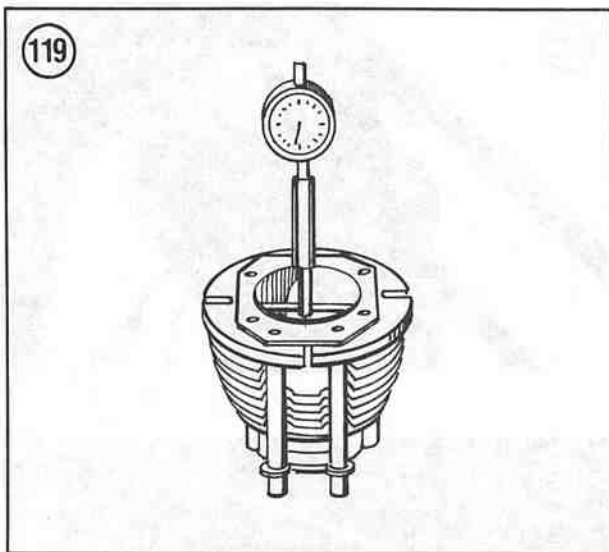


### Cylinder Bore Inspection

The following procedure requires the use of highly specialized and expensive measuring instruments. If such equipment is not readily available, have the measurements performed by a dealer or qualified machine shop.

The cylinder bore on 1970-1980 models can be rebored and an oversize piston installed.

On 1981-on models, the cylinder *cannot* be rebored. The cylinder bore is *not* equipped with steel liners. The cylinders instead are electrically plated with a very hard nickel/silicone carbide layer that is machined to the correct bore size. This surface is so hard that it will wear out a



diamond hone if used. There are many well maintained BMW Twins with close to 200,000 miles on them that rarely require any major engine service (e.g. cylinder bore out of specification). This type of extended service depends greatly on how well the bike is maintained. Don't forget to maintain the correct oil level and change the oil at the recommended intervals.

1. Soak with solvent any old cylinder head gasket material on the cylinder. If necessary, use a broad-tipped *dull* chisel and gently scrape off all cylinder base gasket residue (A, **Figure 118**) or cylinder head gasket residue. Do not gouge the sealing surface on either side as an oil leak will result.
2. Measure the cylinder bore with a cylinder gauge or inside micrometer (**Figure 119**) at 3 locations within the cylinder. Measure in 2 axes—in line with the piston-pin and at 90° to the pin.

3A. On 1970-1980 models, if the taper or out-of-round is 0.010 mm (0.004 in.) or greater, the cylinder can be rebored to the next oversize and a new oversize piston installed.

3B. On 1981-on models, if the taper or out-of-round is 0.010 mm (0.004 in.) or greater, the cylinder must be replaced as it *cannot* be rebored. The piston must be replaced at the same time.

4. Check the cylinder wall (A, **Figure 120**) for scratches; if evident, the cylinder may have to be rebored (1970-1980 models) or replaced (1981-on models).

**NOTE**

*The maximum wear limit on the cylinders is listed in Table 2. If any cylinder is worn to this limit, the cylinder must be replaced.*

**NOTE**

*Table 2 lists cylinder bore dimensions in 3 categories ("A," "B" or "C"). Either an "A," "B" or "C" is stamped on the cylinder. These letters relate to the grade or finished inner dimension of the cylinder bore. It is virtually impossible to manufacture all cylinder bores to the same exact dimension.*

5. Inspect the cylinder head mounting threaded studs (B, **Figure 120**) for wear or damage. If the threads are damaged, clean them up with a thread die of the correct thread size and pitch. If the threads are beyond cleanup, replace the threaded stud(s).

**Installation**

1. Make sure both valve lifters are installed in their receptacles in the crankcase.

**NOTE**

*Figure 121 is shown with the piston removed for clarity. The piston must be installed before installing the cylinder.*

2. Apply a light coat of Three Bond No. 1216 to both sides of the new cylinder base gasket and slide the gasket (**Figure 121**) down the crankcase studs until it touches the crankcase.

**NOTE**

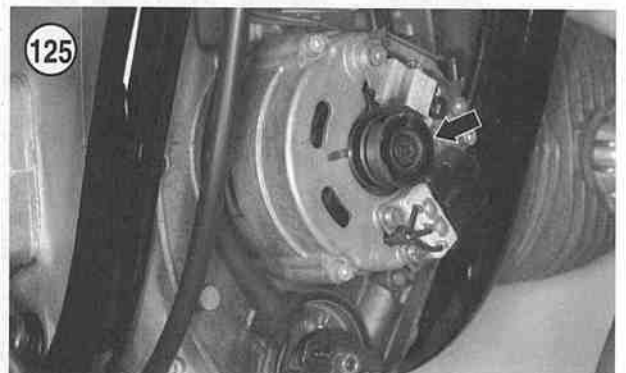
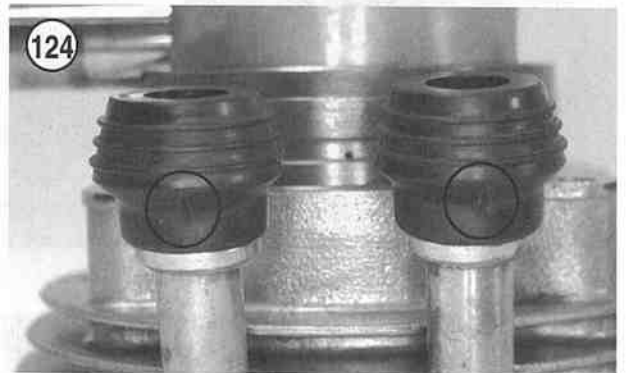
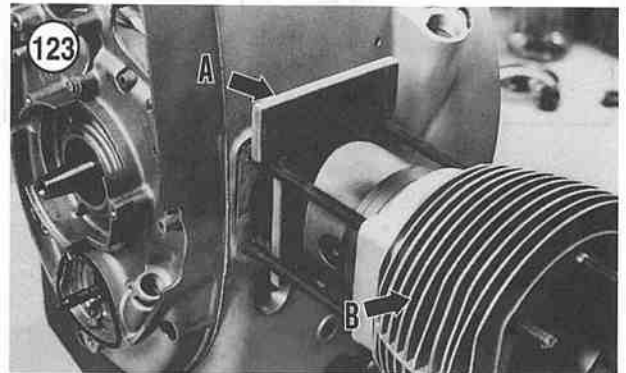
*Not all models are equipped with the O-ring seals at the 2 upper crankcase studs. If you are installing a rebuilt cylinder and are not sure if you should install the O-rings, check the crankcase upper stud holes (B, **Figure 118**) in the base of the cylinder. A cylinder designed to be used with O-rings will have a recessed machined groove surrounding the upper 2 holes. These recessed grooves are necessary to accept the O-ring seals. Do **not** install the O-rings on the crankcase studs if the cylinder does not have these machined grooves.*

3. On models so equipped, be sure to install new O-ring seals (**Figure 114**) on the upper 2 crankcase studs.
4. Install a piston ring compressor (**Figure 122**) over the piston rings.
5. Place a wooden piston holding fixture (A, **Figure 123**) between the piston skirt and the crankcase.
6. Make sure the rubber seal (**Figure 124**) is in place on the lower end of each pushrod tube. Position them with the index line facing down.

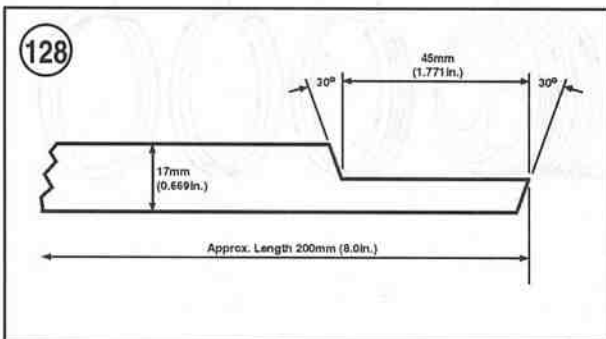
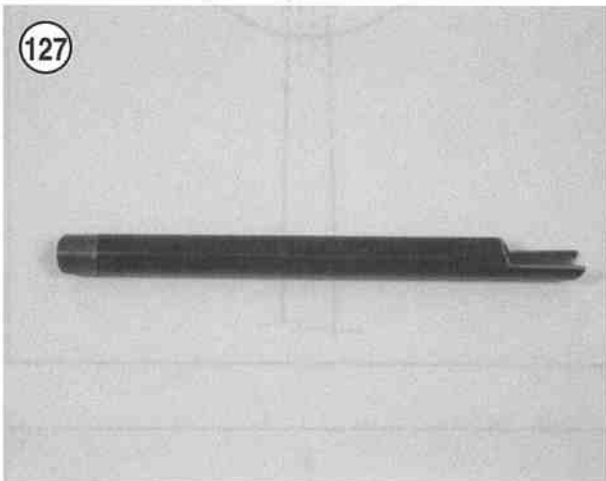
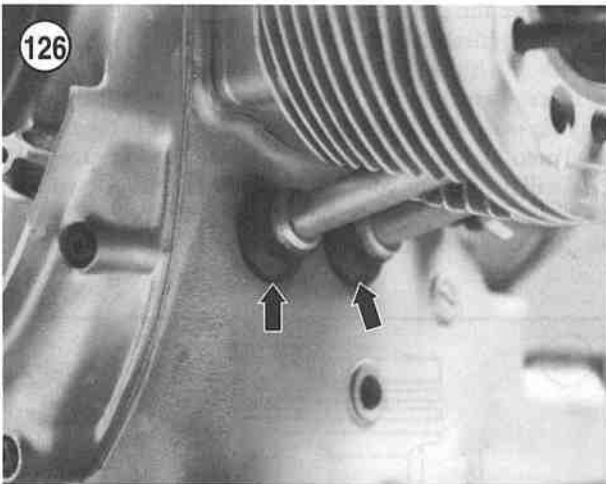
**NOTE**

*Not all models are equipped with a large O-ring seal at the base of the cylinder. If you are installing a rebuilt cylinder and are not sure if you should install a new large O-ring, check the area around the base of the cylinder adjacent to the skirt. A cylinder designed to be used with this large O-ring will have a recessed machined groove in the cylinder base surrounding the cylinder skirt (C, **Figure 118**). This recessed groove is necessary to accept the O-ring seal. Do **not** install an O-ring on a cylinder that does not have this machined groove.*

7. On models so equipped, be sure to install a new large O-ring seal onto the cylinder. Push it all the way down into the machined groove.



8. Apply clean engine oil to the cylinder wall and to the piston and piston rings.
9. If not already removed, remove the engine front cover as described in this chapter.
10. Insert an Allen wrench into the alternator rotor mounting bolt (Figure 125).



11. Rotate the engine *clockwise* until the piston skirt comes to rest on the holding fixture. Remove the Allen wrench from the alternator rotor.
12. Carefully install the cylinder (B, Figure 123) over the piston. Guide the piston into the cylinder as the cylinder is pushed on. Take care not to damage the piston rings as they enter the cylinder. The piston rings are large and very stiff and are difficult to guide into the cylinder without damage to both the piston rings and to the cylinder bore.
13. After the piston rings have entered the cylinder, remove the ring compressor.
14. Push the cylinder down until it bottoms out on the piston holding fixture.
15. Withdraw the piston holding fixture, then push the cylinder all the way down until it bottoms out on the crankcase (Figure 113). While pushing the cylinder down, also guide the pushrod rubber seals into the receptacles in the crankcase.
16. Make sure both pushrod tube rubber seals are seated correctly in their receptacles in the crankcase and that the index lines are facing down (Figure 126).
17. Install the cylinder head as described in this chapter.
18. Install the engine front cover as described in this chapter.

#### NOTE

On models prior to 1981, seat the pushrod rubber sleeves with the BMW tubular punch or fabricate a suitable substitute with an end as show in Figure 128. The tool used in Figure 127 was made out of a length of 1/2 in. x 12 in. standard plumbing pipe available at any hardware store. 1981 and later models have pushrod tubes with seal support rings that cannot be moved.

## PISTONS

The pistons are made of an aluminum alloy. The piston pins are made of steel and are a precision fit in the piston pin bore in the piston. The piston pin is held in place by either a clip or circlip at each end.

The pistons can be removed with the engine in the frame. This procedure is shown with the engine removed for clarity.

### Removal

Refer to Figure 129 for this procedure.

1. Remove the cylinder head and the cylinder as described in this chapter,
2. Mark the piston crowns with their respective location, left-hand cylinder ("L") or right-hand cylinder ("R"). Remember that the left-hand and right-hand side designations



refer to a rider sitting on the seat facing forward. Also add an arrow indicating the front of the piston.

**WARNING**

*The edges of all piston rings are very sharp. Be careful when handling the piston to avoid cutting fingers.*

3. Before removing the piston, rock the piston as shown in **Figure 130**. Any rocking motion (do not confuse with the normal sliding motion) indicates wear on the piston pin, piston pin bore or connecting rod small-end bore (more likely a combination of these).

**NOTE**

*Have a small parts box for each piston assembly. As the piston is disassembled, place the parts for that piston assembly into one box. If the parts all check out okay, they must be re-assembled in the same set since the parts have taken a unique wear pattern as a set.*

4A. On models equipped with a clip, perform the following:

- a. Remove the clip (**Figure 131**) from each side of the piston pin bore with a small screwdriver or scribe.
- b. Hold your thumb over one edge of the clip when removing it to prevent the clip from springing out.

4B. On models equipped with a circlip, use circlip pliers and remove the circlip from each end of the piston pin.

5. Use a proper size wooden dowel or socket extension and push out the piston pin (**Figure 132**). Mark the piston pin in relation to the piston so that they will be reassembled into the same set.

**CAUTION**

*Be careful when removing the pin to avoid damaging the connecting rod. If it is necessary to gently tap the pin to remove it, be sure that the piston is properly supported so that lateral shock is not transmitted to the lower connecting rod bearing.*

6. If the piston pin is difficult to remove, perform the following:

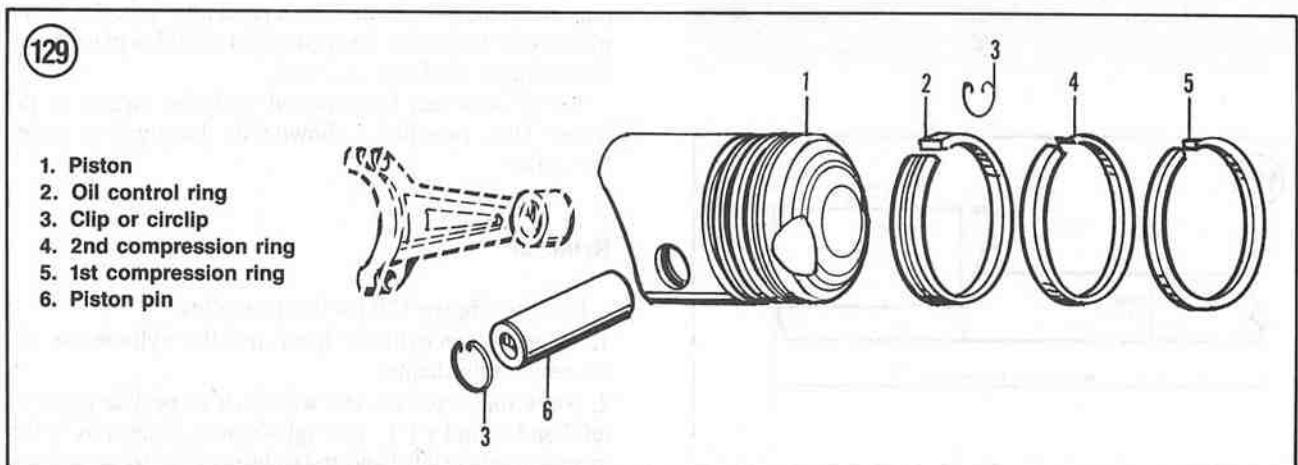
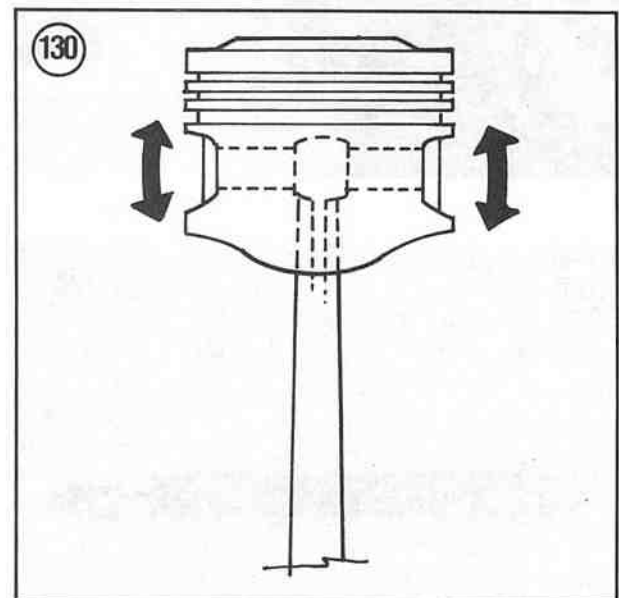
- a. Heat the piston and pin with a hair drier. The pin will probably push right out. Heat the piston to only about 140° F (60° C), i.e., until it is too warm to touch, but not excessively hot.
- b. If the pin is still difficult to push out, use a homemade tool as shown in **Figure 133**.

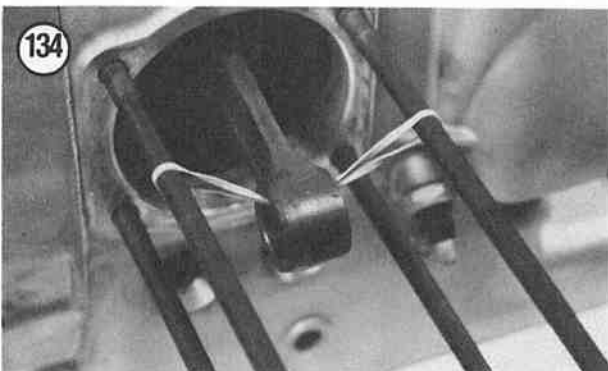
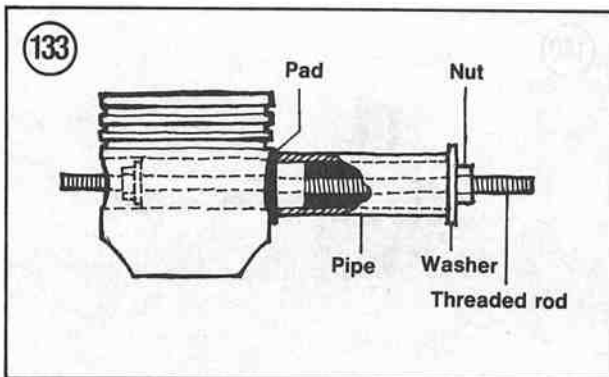
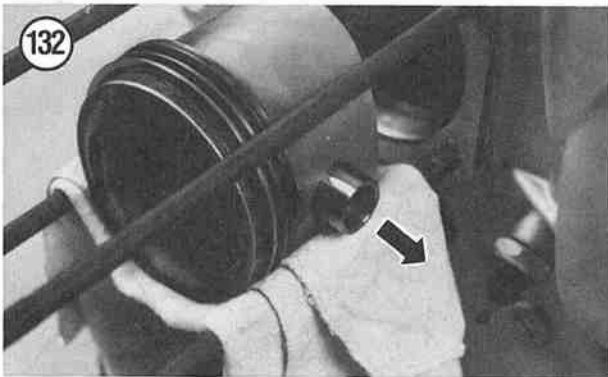
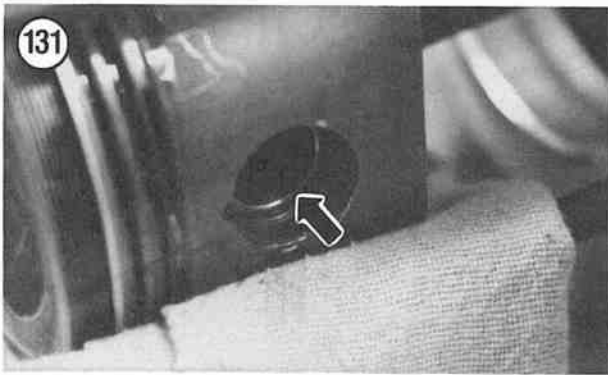
7. Remove the piston pin.

8. Lift the piston off the connecting rod and place in the same box with the piston pin and piston pin clips.

9. Insert a medium thick rubber band through the piston pin hole in the connecting rod and place ends of the rubber band onto 2 of the crankcase studs as shown in **Figure 134**. This will prevent the connecting rod from falling down and damaging the edge of the hole in the crankcase.

10. Repeat for the other piston if necessary.





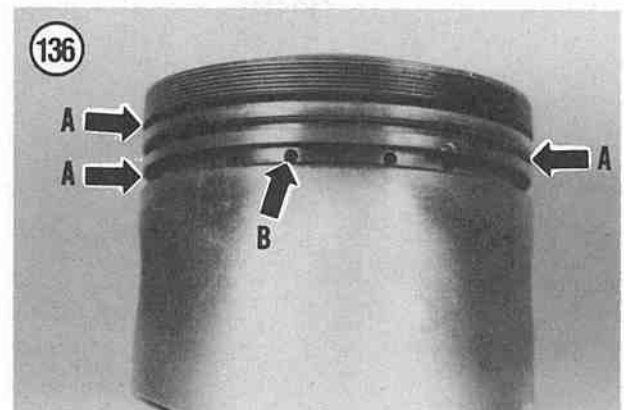
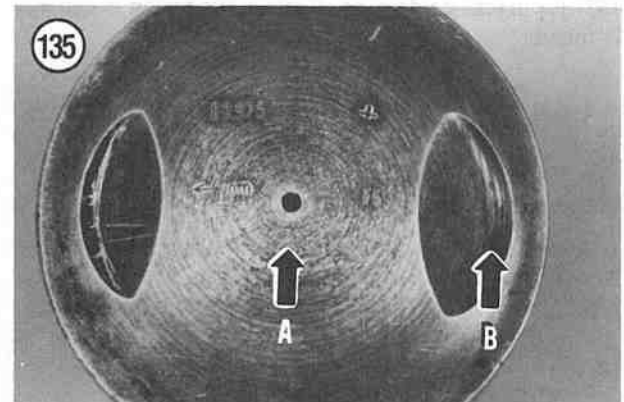
### Inspection

1. Remove the piston rings as described in this chapter.
2. Carefully clean the piston as follows:
  - a. Clean the carbon from the piston crown (A, **Figure 135**) with a chemical remover or with a soft scraper.
  - b. Be sure to remove all deposits from the valve reliefs (B, **Figure 135**) in the piston crown.
  - c. Do not remove or damage the carbon ridge around the circumference of the piston above the top ring.
  - d. If the pistons, rings and cylinders are found to be dimensionally correct and can be reused, removal of the carbon ring from the top of the piston or the carbon ridge from the top of the cylinder wall will promote excessive oil consumption in this cylinder.

### CAUTION

*Do not wire brush the piston skirts.*

3. Examine each ring groove (A, **Figure 136**) for burrs, dented edges and wide wear. Pay particular attention to the top compression ring groove as it usually wears more than the other grooves.
4. Check each oil hole (B, **Figure 136**) for carbon or oil sludge buildup. Clean the holes with a piece of wire or small diameter drill bit and blow out with compressed air.



5. If damage or wear indicates piston replacement, select a new piston as described under *Piston Clearance* in this chapter.

6. Oil the piston pin and install it in the connecting rod (Figure 137). Slowly rotate the piston pin and check for play (Figure 138). If any play exists, the piston pin should be replaced, providing the connecting rod bore is in good condition.

7. Measure the inside diameter of the piston pin bore with a snap gauge (Figure 139) and measure the outside diameter of the piston pin with a micrometer (Figure 140). Compare with dimensions given in Table 2. Replace the piston and piston pin as a set if either or both are worn. The piston and pin are a matched set—never replace only one of the parts.

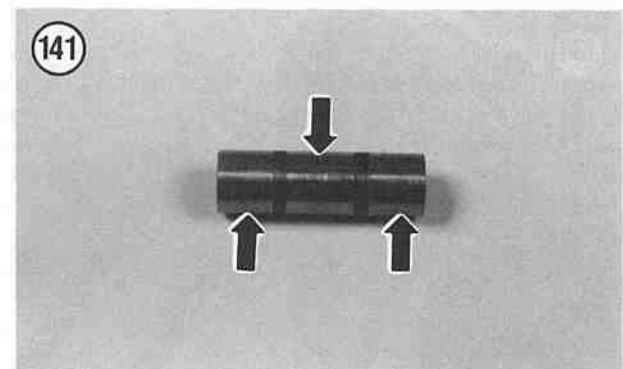
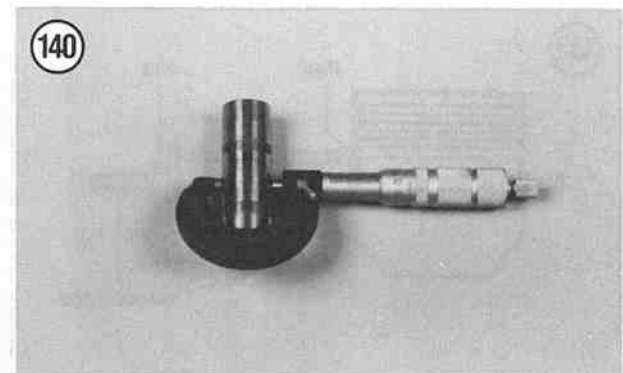
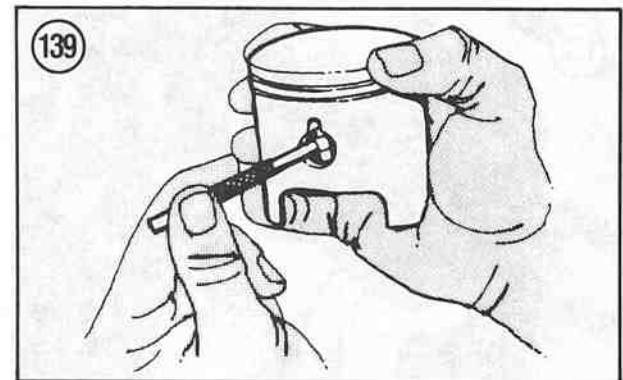
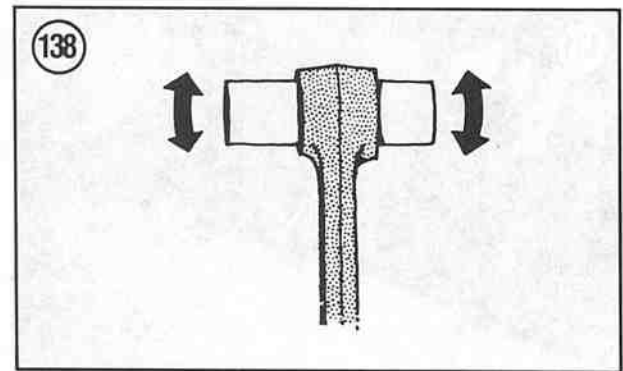
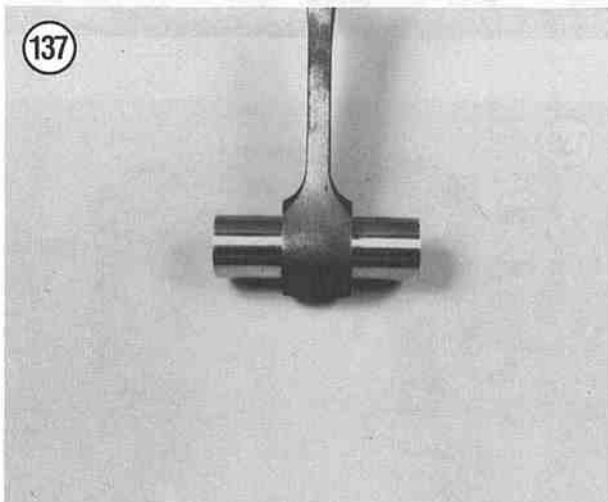
8. Inspect the piston pin (Figure 141) in the areas where it rotates within the connecting rod and piston. Check for wear or damage and replace (along with the piston) if necessary.

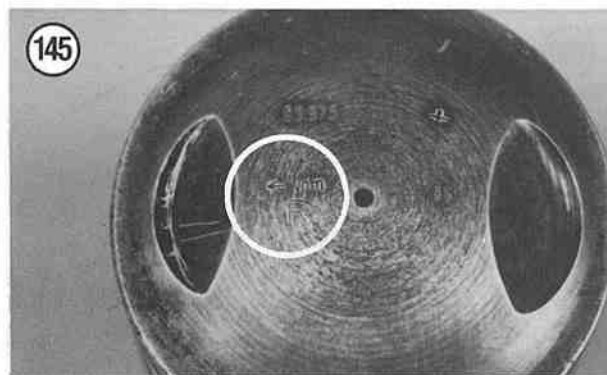
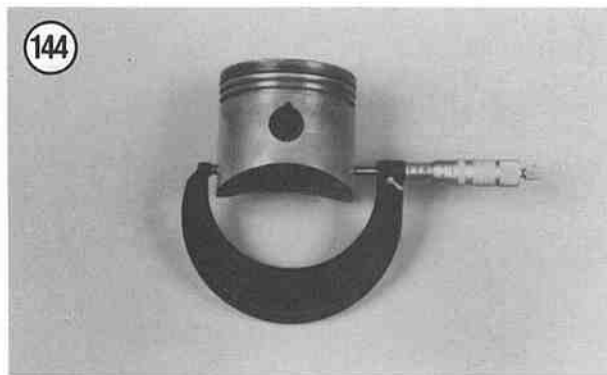
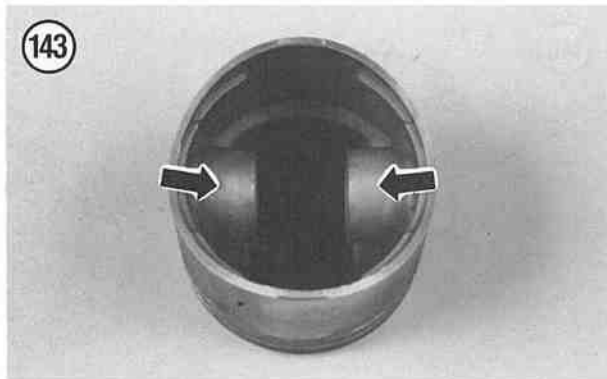
9. Check the piston skirt (Figure 142) for galling and abrasion which may have been caused by piston seizure. If a piston(s) shows signs of partial seizure (bits of aluminum build-up on the piston skirt), the pistons should be replaced and the cylinder bores inspected by a BMW dealer. The cylinder bores on 1981-on models *cannot* be rebored.

10. Check the inner bosses in the piston pin area (Figure 143) for cracks or damage. Replace the piston if damage is found.

### Piston Clearance

1. Make sure the piston and cylinder wall are clean and dry.
2. Measure the inside diameter of the cylinder bore at a point 13 mm (1/2 in.) from the upper edge with a bore gauge.





3. Measure the outside diameter of each piston across the skirt (Figure 144) at right angles to the piston pin and 18-27 mm (0.71-1.06 in.) up from the bottom of the skirt.

#### NOTE

Table 2 lists piston outer dimensions in 3 categories ('A,' 'B' or 'C'). Either an 'A,' 'B' or 'C' is stamped on the piston crown. These letters relate to the grade or finished outer dimension of the piston. It is virtually impossible to manufacture all pistons to the same exact dimension.

4. Piston clearance is the difference between the maximum piston diameter and the minimum cylinder diameter. Subtract the dimension of the piston from the cylinder dimension and compare to the dimension listed in Table 2. If the clearance exceeds that specified, and the piston is within specifications, the cylinder must be bored on 1970-1980 models and the cylinder must be replaced on 1981-on models as it *cannot* be rebored.

#### Installation

1. Apply molybdenum disulfide grease to the inside surface of the connecting rod.

#### CAUTION

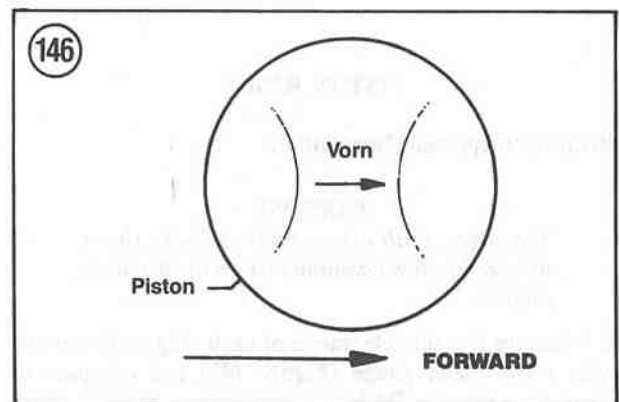
*New piston pin clips or circlips must be installed during assembly in order to maintain good piston pin retention.*

2A. On models equipped with clips, install one piston pin clip in the piston on one side.

2B. On models equipped with circlips, install one circlip onto the groove in one end of the piston pin.

3. Oil the piston pin with assembly oil or fresh engine oil and install the piston pin in the piston until its end extends slightly beyond the inside of the boss.

4. Position the piston so the arrow and/or "VORN" ("front" in German) (Figure 145) on top of the piston points toward the front of the engine (Figure 146).



**CAUTION**

When installing the piston pin in Step 5 on models equipped with clips, do not push the pin in too far, or the piston pin clip installed in Step 2 will be forced into the piston material, destroying the clip groove and loosening the clip.

5. Line up the piston pin with the hole in the connecting rod. Push the piston pin into the connecting rod. It may be necessary to move the piston around until the piston pin enters the connecting rod. Do not use force during installation or damage may occur.

6A. On models equipped with clips, push the piston pin in until it touches the pin clip on the other side of the piston.

6B. On models equipped with circlips, push the piston pin in until the already installed circlip bottoms out on the piston surface.

7. If the piston pin does not slide easily, use the homemade tool used during removal but eliminate the piece of pipe. Pull the piston pin in until it stops.

8. After the piston is installed, recheck and make sure that the arrow, or "VORN," on top of the piston is pointing toward the front of the engine.

**NOTE**

On models equipped with clips, install the clips with the gap away from the cutout in the piston (Figure 147).

9A. On models equipped with clips, install the second piston pin clip in the groove in the piston. Make sure both piston pin clips are seated in the grooves in the piston.

9B. On models equipped with circlips, install the second piston pin circlip in the groove in the piston pin. Make sure both piston pin circlips are correctly seated in the grooves in the piston pin.

10. Check the installation by rocking the piston back and forth around the pin axis and from side-to-side along the axis. It should rotate freely back and forth but not from side-to-side.

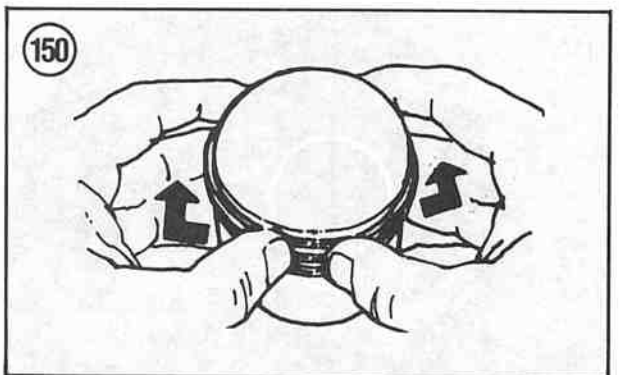
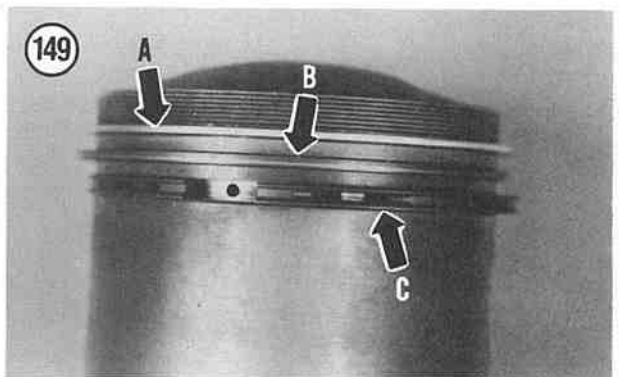
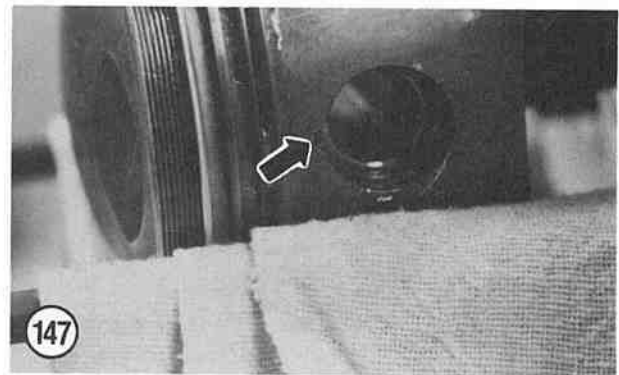
11. Repeat Steps 1-10 for the other piston.

12. Install the piston rings as described in this chapter.

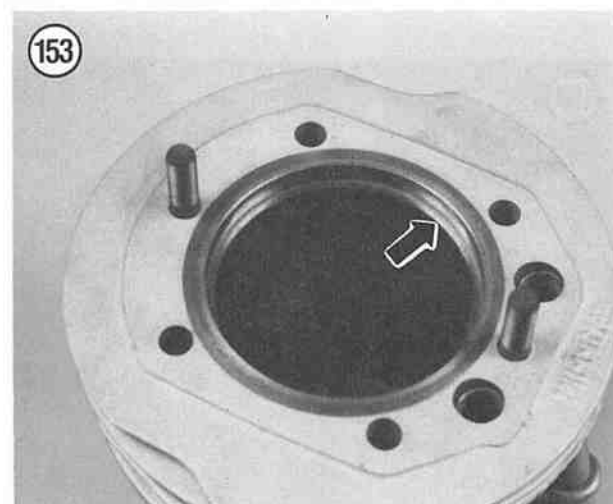
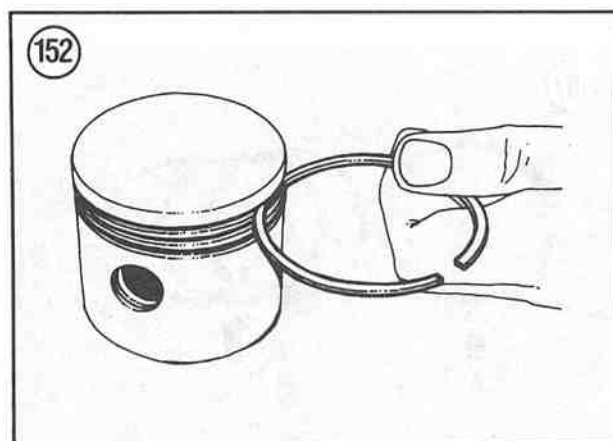
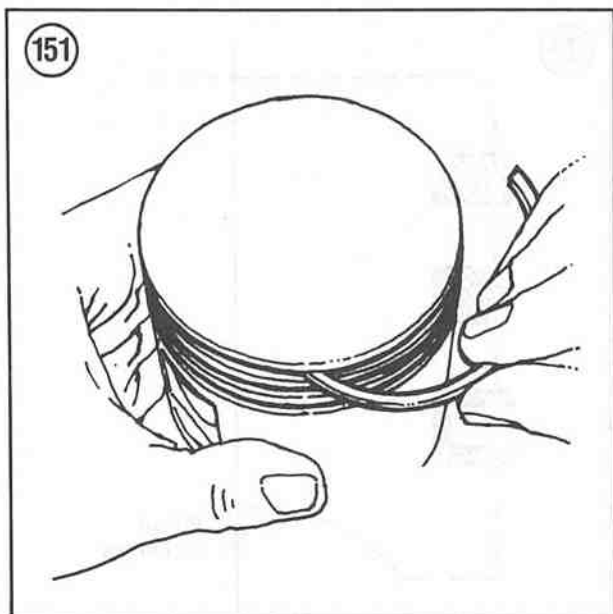
**PISTON RINGS****Removal/Inspection/Installation****WARNING**

The edges of all piston rings are very sharp. Be careful when handling them to avoid cutting fingers.

1. Measure the side clearance of each ring in its groove with a flat feeler gauge (Figure 148) and compare to dimensions given in Table 2. If the clearance is greater than







specified, the rings must be replaced. If the clearance is still excessive with the new rings, the piston(s) must also be replaced.

2. Remove the old top compression ring (A, **Figure 149**) by spreading the ends with your thumbs just enough to slide the ring up over the piston (**Figure 150**). Repeat for the 2nd compression ring (B, **Figure 149**) and for the oil ring (C, **Figure 149**).

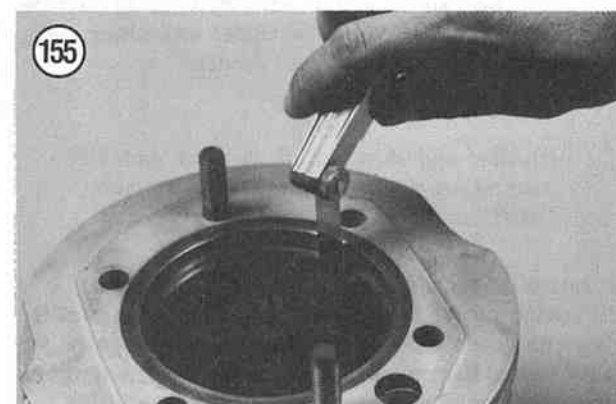
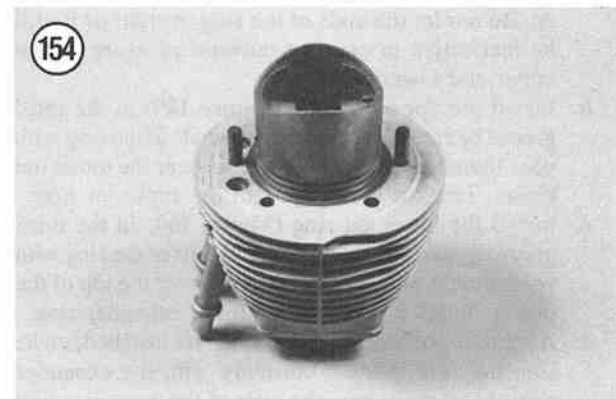
3. Carefully remove all carbon buildup from the ring grooves with a broken piston ring (**Figure 151**). Inspect the grooves carefully for burrs, nicks or broken and cracked lands. Recondition or replace the piston if necessary.

4. Roll each ring around its piston groove as shown in **Figure 152** to check for binding. Minor binding may be cleaned up with a fine-cut file.

5. Place each ring, one at a time, into the cylinder (**Figure 153**) and push it in about 13 mm (1/2 in.) with the crown of the piston (**Figure 154**) to ensure that the ring is square in the cylinder bore.

6. Measure the gap with a flat feeler gauge (**Figure 155**) and compare to dimensions in **Table 2**. If the gap is greater than specified, the rings should be replaced.

7. When installing new rings, measure their end gap as described in Step 5 and Step 6 and compare to dimensions given in **Table 2**. If the end gap is greater than specified, return the rings to the dealer for another set(s).



**NOTE**

Install the piston rings in the order shown in Figure 156. The 1st and 2nd rings have a completely different cross section and must be installed in the correct piston groove.

8A. Install the one-piece oil ring (A, Figure 157) in the third groove (C, Figure 149) by carefully spreading the ends of the ring with your thumbs and slipping the ring over the top of the piston.

**NOTE**

Aftermarket 3-piece oil rings are available. If you are going to install the 3-piece oil ring, make sure it is the correct size for the piston in the bike. The 3-piece oil ring is difficult to install and if the ring is the wrong size it will make installation even more difficult. The center, or expander ring will try to overlap or there will be a space between the ring ends where they are supposed to butt up against each other. If this happens, that cylinder will burn oil.

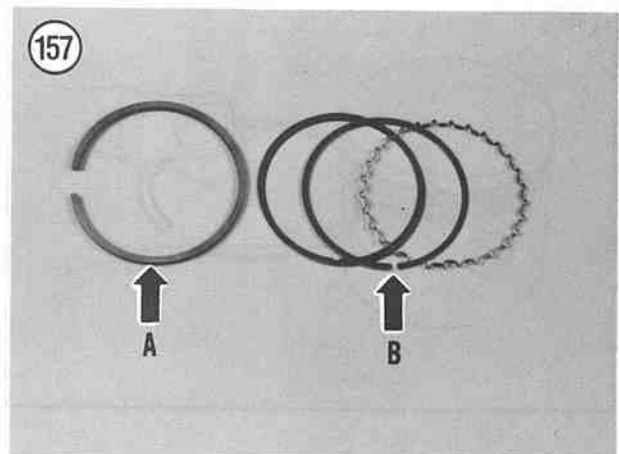
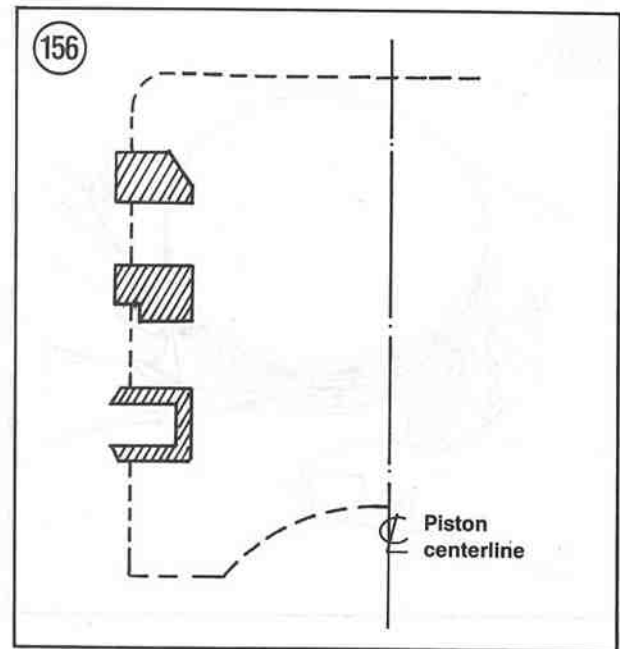
8B. Install the 3-piece oil rings (B, Figure 157) in the third groove (C, Figure 149) as follows:

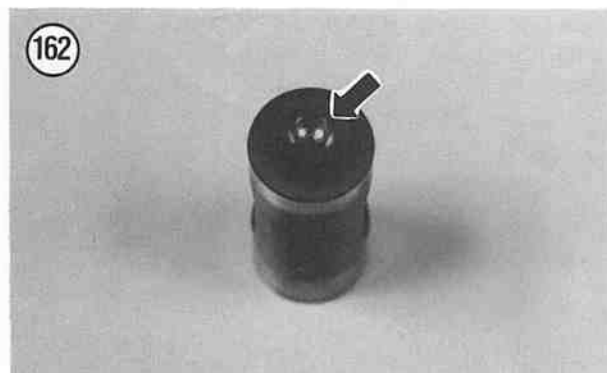
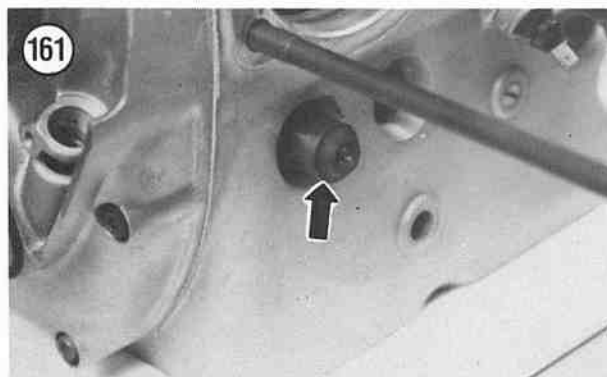
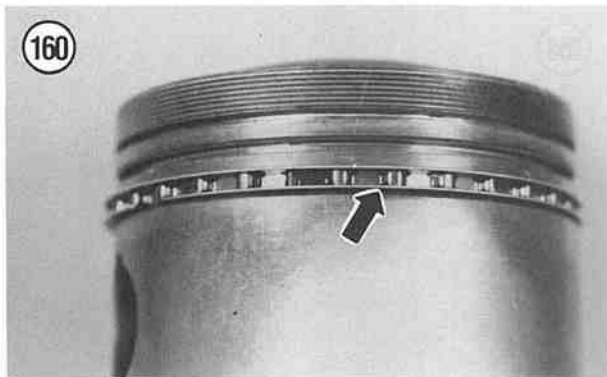
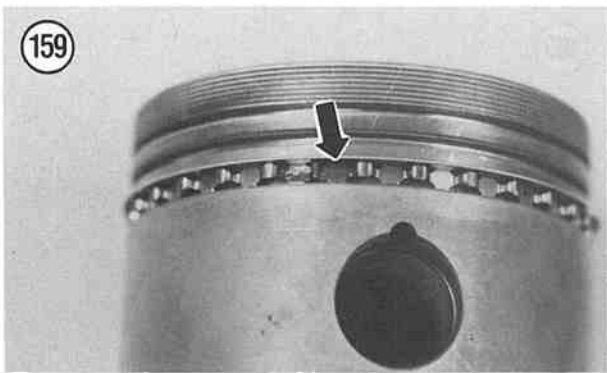
- a. Install the center, or expander ring first (Figure 158). The ends of the ring are to butt up against each other. Do *not* let the ends of the ring overlap or it will be ineffective in exerting outward pressure on the upper and lower oil rings.
- b. Install the upper oil ring (Figure 159) in the third groove by carefully spreading the ends of the ring with your thumbs and slipping the ring over the top of the piston. Index it correctly with the expander ring.
- c. Install the lower oil ring (Figure 160) in the third groove by carefully spreading the ends of the ring with your thumbs and slipping the ring over the top of the piston. Index it correctly with the expander ring.
- d. After the upper and lower oil rings are installed, make sure they are indexed correctly with the expander ring. Also, make sure the ends of the expander ring butt up against each other. Do *not* let the ends of the ring overlap or it will be ineffective in exerting outward pressure on the upper and lower rings, leading to an oil burning cylinder.

**NOTE**

Position and then install the 2nd and 1st compression rings with the manufacturer marks "TOP" or "OBEN" facing up.

9. Install the second compression ring (B, Figure 149) in the second groove by carefully spreading the ends of the ring with your thumbs and slipping the ring over the top of the piston. Remember that the manufacturer's marks on the piston ring must be toward the top of the piston.





10. Install the top compression ring (A, **Figure 149**) in the first groove by carefully spreading the ends of the ring with your thumbs and slipping the ring over the top of the piston. Remember that the manufacturer's marks on the piston ring must be toward the top of the piston.

11. Make sure the rings are seated completely in their grooves all the way around the piston.

12. Apply clean engine oil to the piston rings and grooves.

#### WARNING

*The edges of all piston rings are very sharp. Wear cotton gloves or use a shop rag in the next step. Be careful when handling the rings to avoid cutting fingers.*

13. Carefully and slowly rotate each piston ring around in its groove in the piston. Make sure the ring rotates freely with no binding or dragging. The ring must be free and move easily so that when the engine is running each ring can rotate in its groove freely.

14. Distribute the ring ends at 120° apart from each other around the piston. The important thing is that the ring gaps are not aligned with each other when installed to prevent compression pressure from escaping past them.

15. Follow the *Break-in* procedure in this chapter if new pistons or new piston rings have been installed.

## VALVE LIFTERS

### Removal/Inspection/Installation

1. Remove the cylinder head and cylinder as described in this chapter.

#### CAUTION

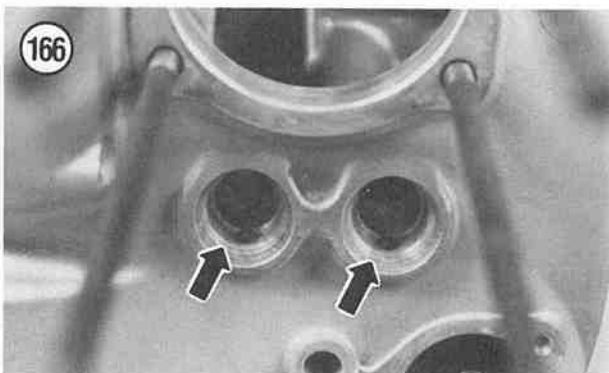
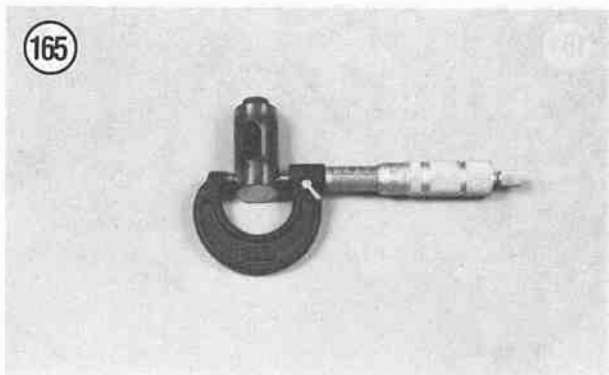
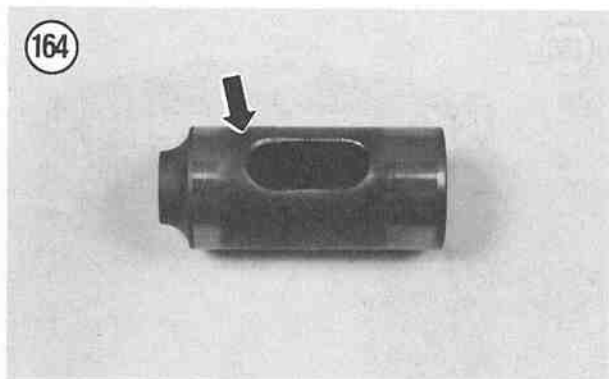
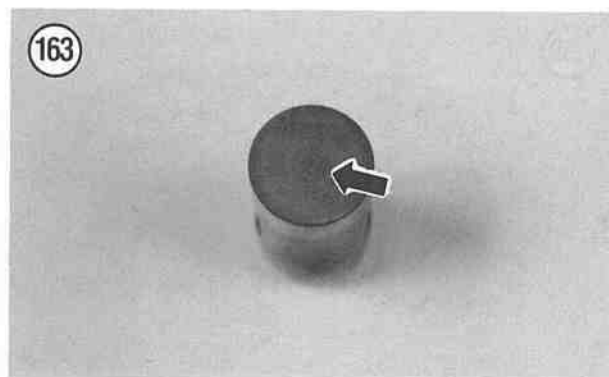
*The valve lifters must be reinstalled in the same location. Do not intermix the lifters as they have taken on their own unique wear pattern.*

2. Use a piece of wire with the end bent over slightly. Insert the piece of wire into the oil hole in the valve lifter and pull the valve lifter (**Figure 161**) out of the receptacle in the crankcase. Mark the valve lifter location (left or right cylinder and intake or exhaust). Remove all 4 valve lifters.

3. Clean all parts in solvent and dry thoroughly with compressed air.

4. Inspect the outer end (**Figure 162**) of the valve lifter where the pushrod fits. The receptacle should be smooth with no burrs or damage. If damaged, replace the valve lifter and also check the end of the pushrod that goes with that specific valve lifter. It may also be damaged and require replacement.

5. Inspect the inner end (**Figure 163**) of the valve lifter where it rides on the camshaft lobe. The surface should be smooth with no burrs or damage. There will probably be many small concentric circles on the lifter face. The valve lifter sits off to one side of the camshaft lobe and therefore rotates while the engine is running. These circles are okay unless there are some deep scratches. If damaged, replace the valve lifter and also check that specific camshaft lobe for damage. The camshaft may also require replacement.
6. Inspect the outside surface of the valve lifter (**Figure 164**) where it rides in the crankcase for wear or scratches. Replace as necessary.
7. Using a micrometer, measure the outside diameter of the valve lifter (**Figure 165**). Compare to the dimension listed in **Table 2**. If worn to the wear limit or less, replace the valve lifter.
8. Using a bore gauge, measure the inside diameter of each valve lifter receptacle (**Figure 166**) in the crankcase. Compare to the dimension listed in **Table 2**. If worn to the wear limit or more, the crankcase must be replaced.
9. There is a specified oil or radial clearance between the valve lifter and the valve lifter receptacle in the crankcase. To determine the clearance, perform the following:
  - a. Subtract the valve lifter outside diameter dimension from the valve lifter receptacle bore dimension.
  - b. This dimension will give the oil clearance.
  - c. Refer to the valve lifter oil clearance wear limit dimensions listed in **Table 2**.
  - d. If either the valve lifter or the crankcase is worn to the wear limit, replace the worn part.
10. Apply a coat of clean engine oil to the valve lifter and the receptacle in the crankcase.
11. Install the valve lifter into the correct receptacle in the crankcase as noted in Step 2.
12. After the valve lifter is installed, rotate it to make sure there is no binding. The valve lifter must rotate freely.
13. Install the cylinder and cylinder head as described in this chapter.



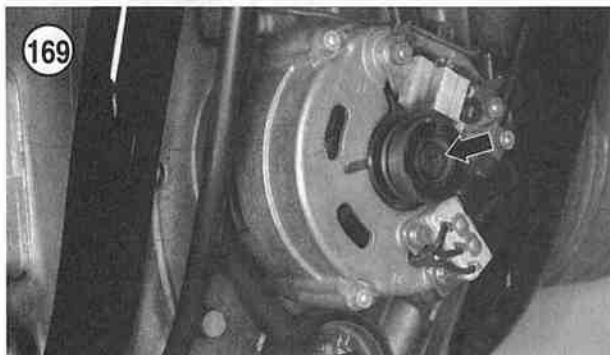
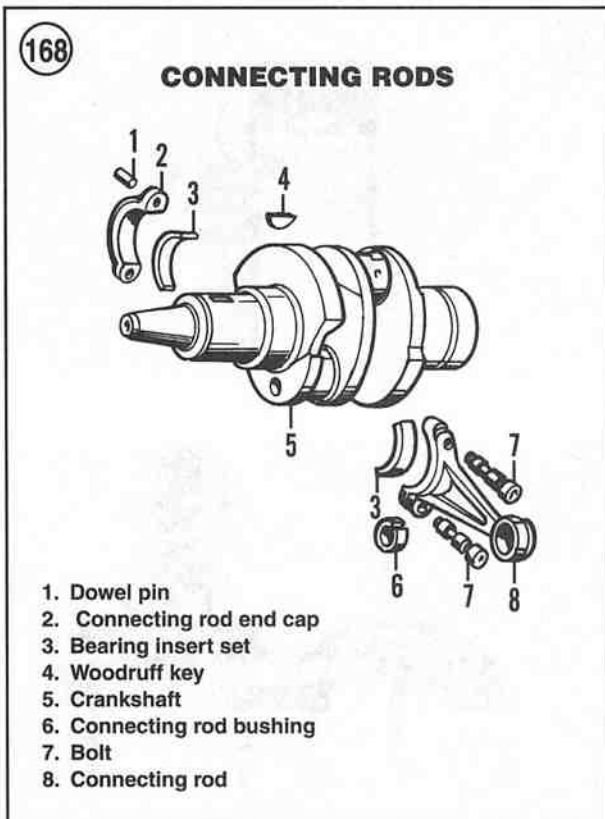
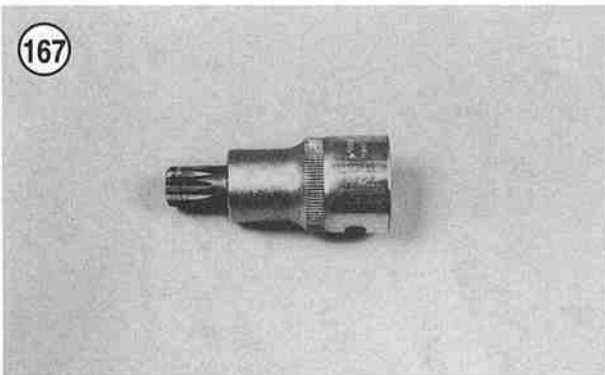
## CONNECTING RODS

### CAUTION

*Do not try to remove the connecting rod bolts without the BMW special 12-point socket. Do not try to use an Allen wrench as it will only damage the internal points within the special bolt head.*

A BMW special tool is required for this procedure to remove and install the connecting rod bolts. The BMW special tool is a 12-point special male socket (part No. 11 2 860) (**Figure 167**) that fits into the 12-point recess in the connecting rod bolts.

The connecting rod bolts *must be replaced* every time the bearing cap is removed. The bolts stretch when tightened



and must be replaced as described in this chapter. Do not try to reuse the bolts as they may fracture and break leading to expensive engine damage.

### Removal

Refer to **Figure 168** for this procedure.

1. Remove both cylinder heads and cylinders as described in this chapter. Both sets of cylinder heads and cylinders must be removed for this procedure in order to gain access to the connecting rod caps.
2. If not already removed, remove the engine front cover as described in this chapter.
3. Insert an Allen wrench into the alternator rotor mounting bolt (**Figure 169**).

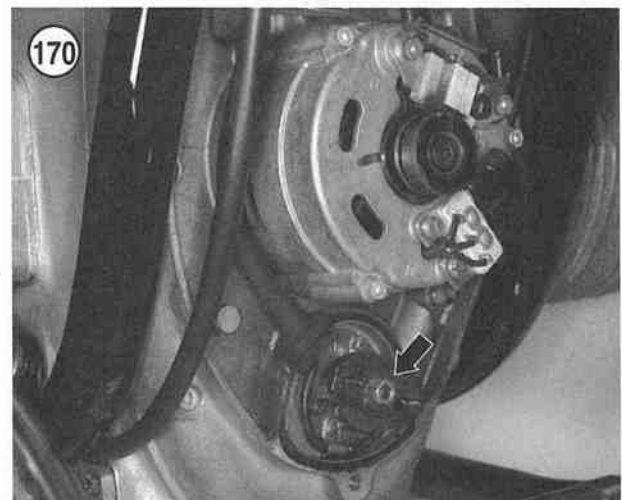
### CAUTION

*On 1970-1978 models, do not attempt to rotate the engine with the nut (**Figure 170**) securing the ignition advance mechanism to the camshaft. If the nut is used, the camshaft may be damaged.*

4. Rotate the engine *clockwise* until the connecting rod to be removed is at top dead center. This will position the connecting rod for easy access to the bolts.

### NOTE

*Before disassembling the connecting rods, mark the rods and caps with a "L" (left-hand cylinder) or "R" (right-hand cylinder). Use a permanent marker pen or scribe and carefully mark both the connecting rod and cap with the correct letter for each cylinder. Left-hand side refers to a rider sitting on the seat facing forward.*





5. Using the BMW special tool, remove the connecting rod bolts (Figure 171).
6. Separate the rod (Figure 172) and cap from the crankshaft and remove them from the crankcase. Keep each cap with its original rod.

**NOTE**

Keep each bearing insert in its original place on the rod or rod cap. If you are going to assemble the engine with the original inserts, they must be installed exactly as removed in order to prevent rapid wear.

7. Repeat Steps 3-6 for the other connecting rod assembly.
8. Inspect the connecting rods as described in this chapter.

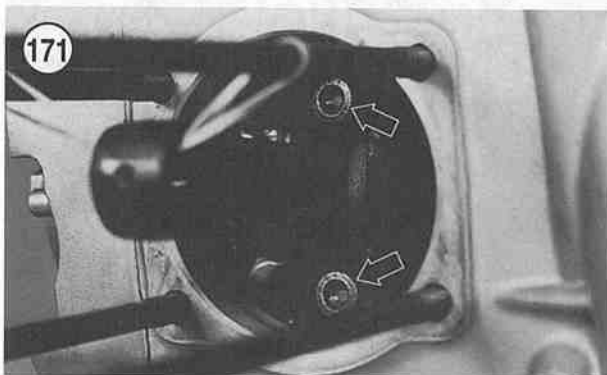
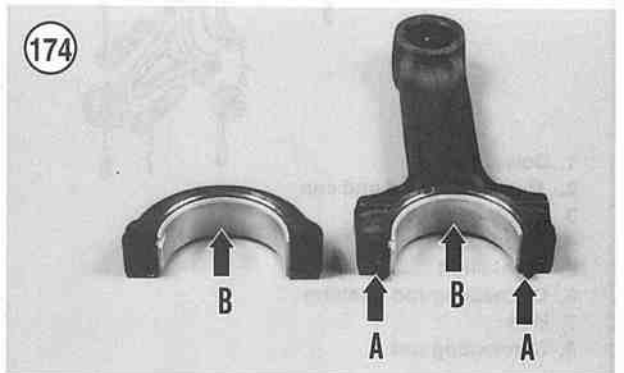
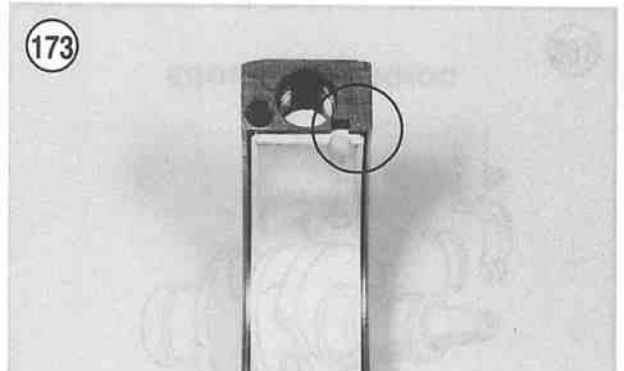
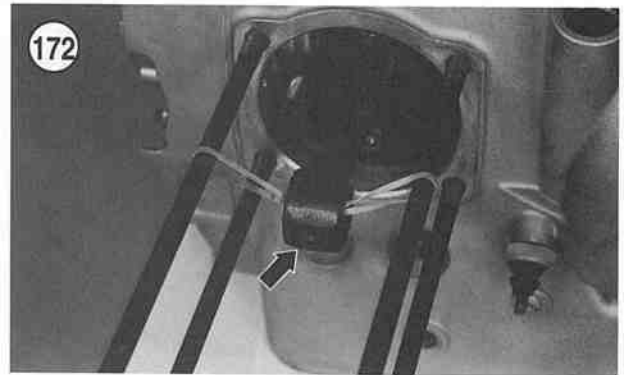
**Installation**

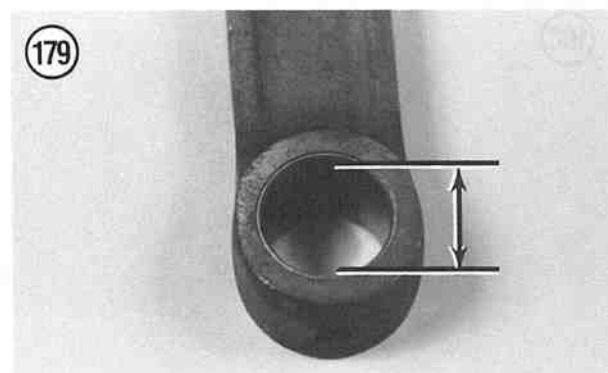
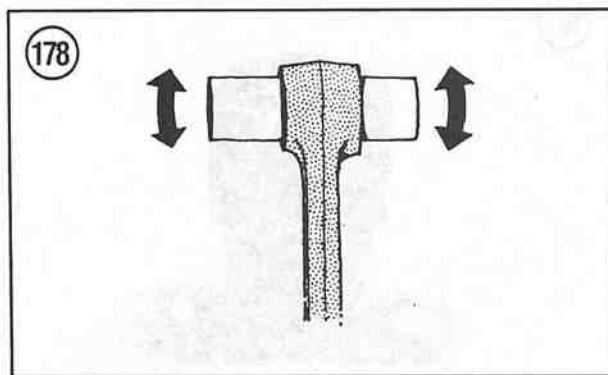
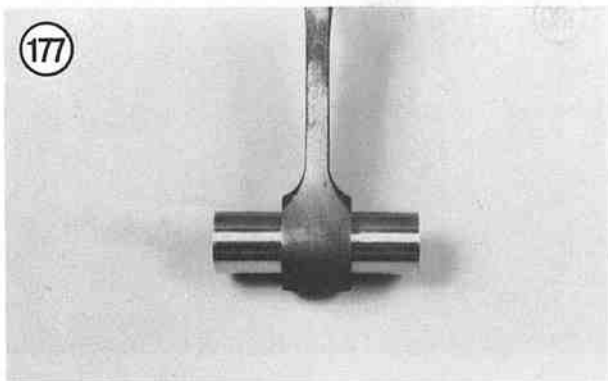
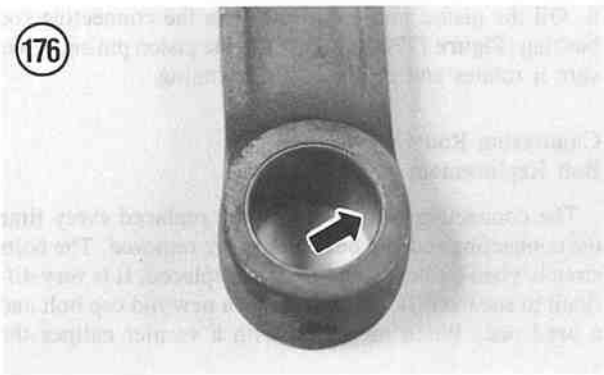
1. Make sure that the bearing inserts are locked into place in the connecting rod and the rod cap. Make sure the locking tab (Figure 173) fits correctly into the groove in the rod or cap.

**NOTE**

If new bearing inserts are going to be installed, check the bearing clearance as described in this chapter.

2. Apply a light, even coat of molybdenum disulfide grease to the crankshaft connecting rod bearing journals and to the connecting rod bearing inserts.
3. Position the connecting rod and rod cap with the locating dowels (A, Figure 174) facing toward the front of the engine.
4. Install the connecting rod and end cap onto the crankshaft.
5. Install new connecting rod bolts.
6. Use the same tool setup used during removal. Tighten the connecting rod bolts in a staggered pattern in 2-3 stages until the bolts are snug.
7. Using a torque wrench, tighten the bolts to the torque specification listed in Table 1.
8. After the bolts have been tightened to the correct torque specification, raise the connecting rod and allow it to fall





down of its own weight. Do this several times to make sure the molybdenum disulfide grease is not interfering with the free movement of the connecting rod.

9. If the connecting rod will not move freely, perform the following:
  - a. Remove the connecting rod and end cap and check for any burrs on the bearing inserts or any other possible problem.
  - b. Reinstall the connecting rod and end cap again using *new* connecting rod bolts. The bolts must be replaced *every time* they have been tightened to the recommended torque specification, and then loosened.
10. Insert a medium thick rubber band through the piston pin hole in the connecting rod and place ends of the rubber band onto 2 of the crankcase studs as shown in **Figure 172**. This will prevent the connecting rod from falling down and damaging the edge of the hole in the crankcase.
11. Repeat for the other connecting rod.
12. After both connecting rods are installed and the bolts tightened to the correct torque, rotate the crankshaft several times and check that the bearings are not too tight. Make sure there is no binding.

### Connecting Rod Inspection

#### NOTE

*If either of the connecting rods require replacement, they must be replaced with ones of the same weight tolerance. Each of the three weight tolerance groups is color coded and marked. If the marking has worn off, the old connecting rods must be weighed in order to correctly match the new connecting rods. The allowable weight deviation between any one of the connecting rods in the set is  $\pm 4$  grams.*

1. Remove the piston and connecting rod assembly as described in this chapter.
2. Check each connecting rod and end cap (**Figure 175**) for obvious damage such as cracks and burrs.
3. Check the piston pin bushing (**Figure 176**) for wear or scoring.
4. Take the connecting rods to a machine shop and check the alignment for twisting and bending.
5. Examine the bearing inserts (B, **Figure 174**) for wear, scoring, or burring. They are reusable if in good condition. Examine the bearings as described under *Connecting Rod Big End Bearing Clearance Measurement* in this chapter.
6. Oil the piston pin and install it in the connecting rod bushing (**Figure 177**). Slowly rotate the piston pin and check for play (**Figure 178**). If any play exists, measure the piston pin as described in this chapter. If the piston pin is okay, measure the connecting rod small end.
7. Measure the inside diameter of the piston pin bushing (**Figure 179**) with an inside micrometer or snap gauge.

Compare with dimensions given in **Table 2**. Replace the bushing if worn to the service limit or more as described in this chapter.

8. Measure the connecting rod big end width with a micrometer (**Figure 180**). Compare with dimensions given in **Table 2**. Replace the connecting rod assembly if worn to the service limit or less.

### Connecting Rod Piston Pin Bushing Replacement

The bushing is pressed into place and must be removed and installed with a press and suitable size tool. After the new bushing is pressed into place, the bushing inner hole must be turned in a lathe to an exact dimension. The connecting rod must be mounted in a lathe with a special face plate large enough to accept the entire connecting rod. The bushing inner diameter must then be machined to the size listed in **Table 2**.

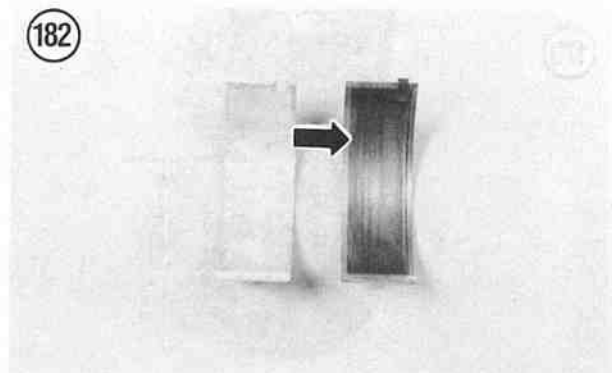
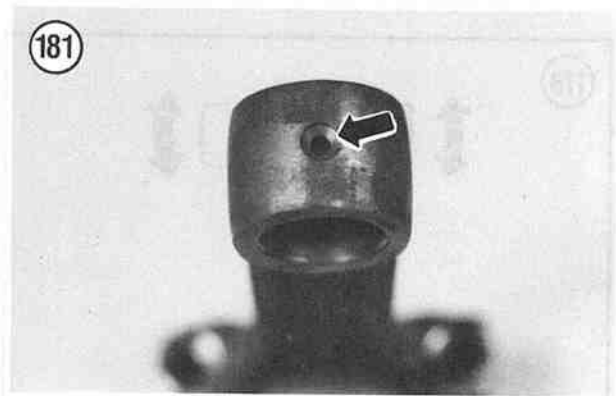
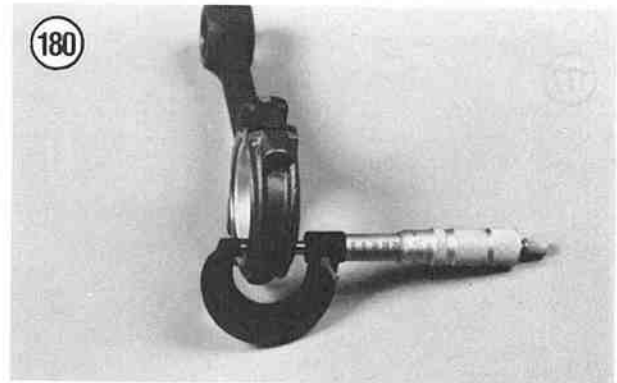
The machining portion of this procedure must be performed by a BMW dealer or a competent machine shop. Removal and installation of the bushing can be performed by a home mechanic and the procedure is included in case you choose to perform this portion yourself.

1. Using a suitable size socket or piece of pipe and a hydraulic press, press the bushing (**Figure 176**) out of the connecting rod. Protect the connecting rod so it is not damaged while removing the bushing.
2. Thoroughly clean out the inner surface of the connecting rod where the bushing was located.
3. Position the gap of the new bushing so it is 60° on either side of the centerline of the connecting rod.
4. Using a suitable size socket or piece of pipe and a hydraulic press, press the new bushing into the connecting rod. The bushing must be flush with each side of the connecting rod so it will not interfere with the inside bosses of the piston.
5. Drill an oil hole through the new bushing using the hole in the connecting rod (**Figure 181**) as a guide. Drill the hole using a drill bit that matches the existing hole in the connecting rod. After the hole is drilled, clean off all burrs on the inner surface of the bushing.
6. Take the connecting rod to a BMW dealer or competent machine shop and have them machine the inner diameter of the bushing. Refer to **Table 2** for the inside diameter of the piston pin bushing.
7. After the bushing has been machined, inspect the oil hole drilled in Step 5. Clean off all burrs in the hole and any on the inner surface of the bushing.
8. Thoroughly clean the connecting rod in solvent and dry with compressed air. Make sure there are no metal particles left in the bushing from the drilling and machining operation. If any are left in, they will destroy the bushing or other component in the engine if they get into the oil and circulate in the engine.

9. Oil the piston pin and install it in the connecting rod bushing (**Figure 177**). Slowly rotate the piston pin and make sure it rotates and slides with no binding.

### Connecting Rod Cap Bolt Replacement

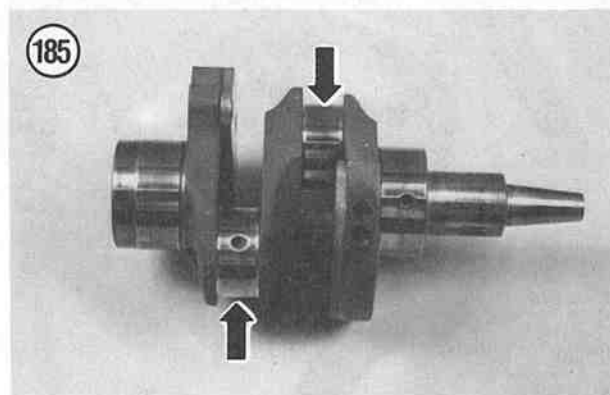
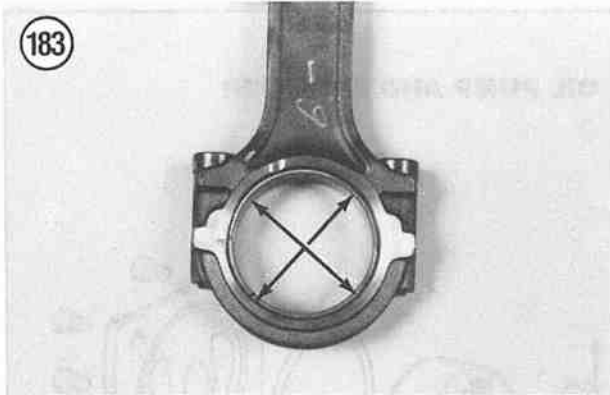
The connecting rod bolts must be replaced every time the connecting rod and bearing cap are removed. The bolts stretch when tightened and must be replaced. It is very difficult to see the difference between a new rod cap bolt and a used one. When measured with a vernier caliper the



difference is difficult to calculate. Do not try to reuse the bolts as they may fracture and break which could lead to expensive engine damage.

### Connecting Rod Big End Bearing Clearance Measurement

1. Check each existing rod bearing insert (**Figure 182**) for evidence of wear, abrasion and scoring. If the bearings are good, they may be reused. If any insert is questionable, replace as a set.



2. Clean the bearing surfaces of the crankshaft; also the connecting rod bearing inserts.
3. Install the rod bearing inserts in the connecting rod and bearing cap. Make sure they are locked in place correctly.
4. Install the bearing cap onto the connecting rod.

#### NOTE

*For this measurement procedure, it is okay to use the old connecting rod bolts. Do not use new ones as they will stretch and have to be discarded—they cannot be reused.*

5. Install the *old* connecting rod bolts and tighten to the torque specification listed in **Table 1**.

#### NOTE

*Do not measure the inside diameter of the connecting rod bearing where the connecting rod and bearing cap join. Measure at the locations shown in **Figure 183**.*

6. Using an inside micrometer or bore gauge, measure the inside diameter of the connecting rod bearing. Measure in 2 axes, 90° apart as shown in **Figure 184**.
7. Using a micrometer, measure the outside diameter of the connecting rod bearing journals (**Figure 185**) on the crankshaft. Measure in 2 axes, 90° apart.
8. To determine the oil clearance, subtract the rod bearing journal outer diameter of the crankshaft from the inside diameter of the connecting rod bearing. Compare to the dimension listed in **Table 2**.
9. If the oil clearance is not within specification and the rod bearing journal on the crankshaft is within specification, replace the bearing insert with an appropriately sized new one.
10. If the oil clearance is not within specification and the rod bearing journal on the crankshaft is worn less than specification, the crankshaft must be reground to the next undersize and new bearing inserts installed.

### Connecting Rod-to-Crankshaft Bearing Selection

There are three undersize bearing inserts available from BMW dealers. The crankshaft crankpin bearing journal outer diameters are listed in **Table 2**.

After new bearing inserts have been installed, recheck the clearance by repeating the *Connecting Rod Big End Bearing Clearance Measurement* procedure in this chapter. If the clearance is still out of specifications, either the connecting rod or the crankshaft is worn beyond the service limit and requires replacement.

**OIL PUMP**

Refer to **Figure 186** for this procedure.

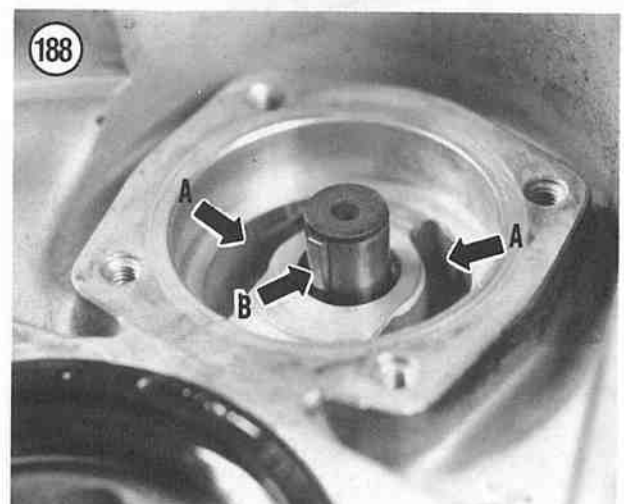
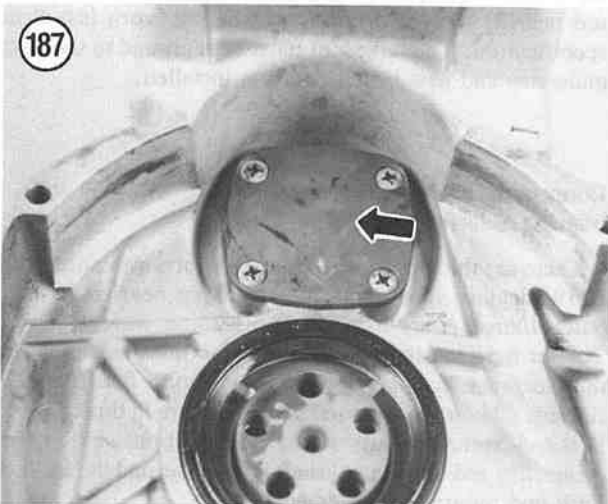
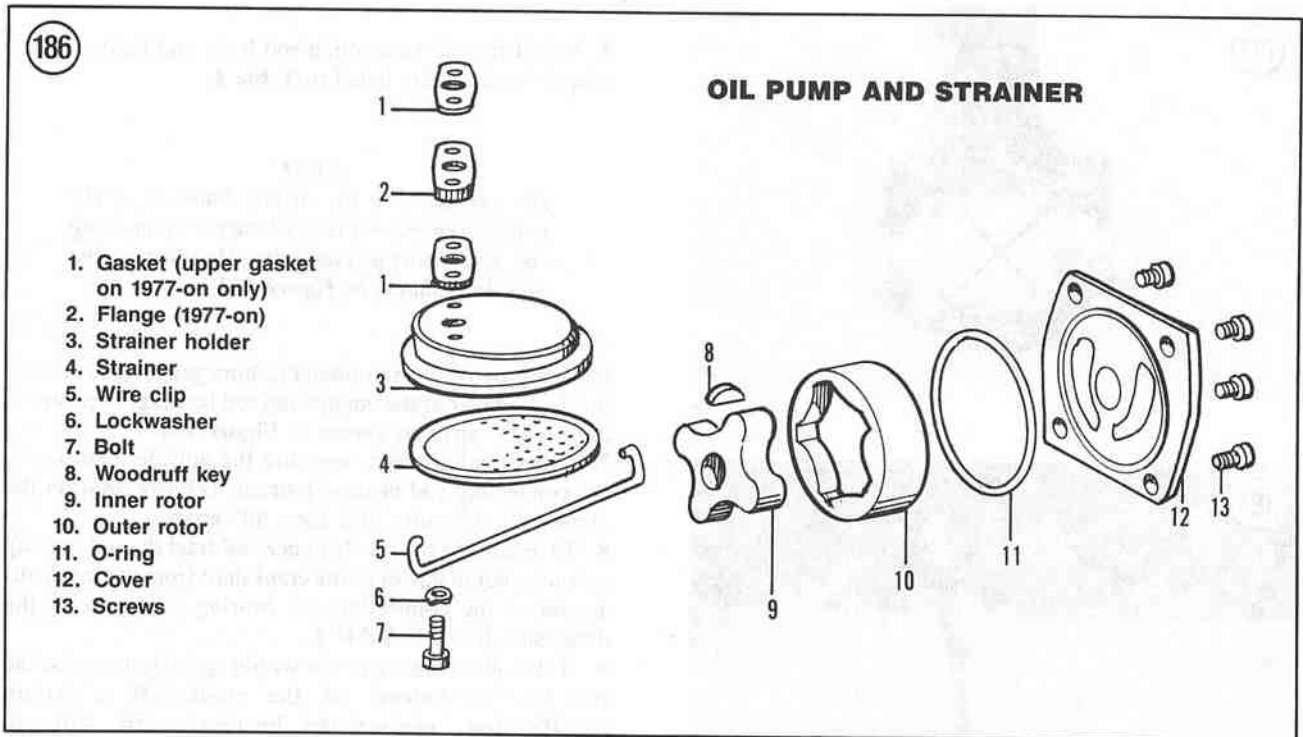
**Removal/Disassembly**

1. Remove the engine as described in this chapter.
2. Remove the clutch and flywheel as described in Chapter Five.
3. Remove the screws securing the cover (**Figure 187**) and remove the cover and the O-ring seal.
4. Remove the inner and outer rotors.

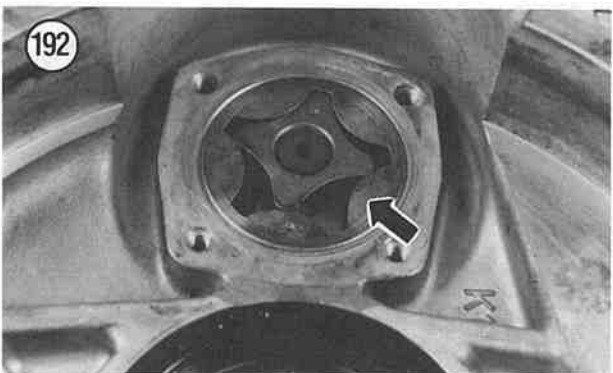
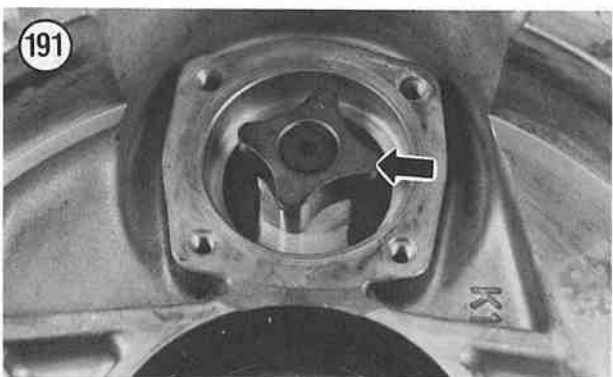
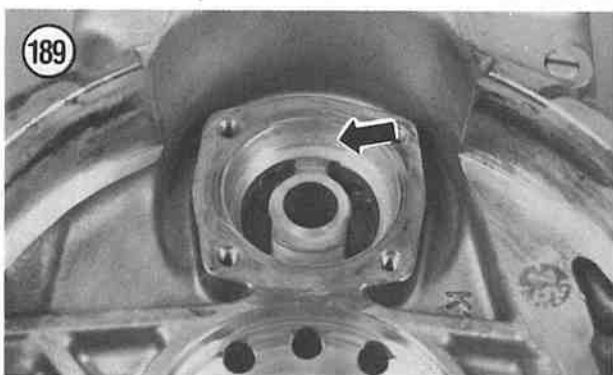
5. Close off the small crankcase openings (**A, Figure 188**) in the oil pump housing area with a lint-free cloth. This will prevent the accidental loss of the Woodruff key in the next step.
6. Remove the Woodruff key (**B, Figure 188**) from the crankshaft.
7. Inspect the pump assembly as described in this chapter.

**Inspection**

1. Clean all parts in solvent and dry with compressed air.







2. Thoroughly clean out the oil pump cavity (Figure 189) in the crankcase with solvent and dry with compressed air or a lint-free cloth.

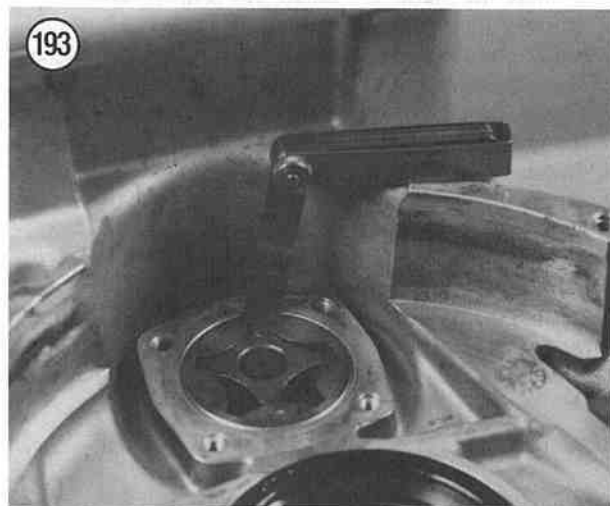
3. Inspect the oil pump area (Figure 189) in the crankcase for cracks or any visible damage.

4. Inspect both rotors (Figure 190) for wear or abrasion. Replace if necessary.

5. Position the rotors with their marks facing out. Install the inner rotor (Figure 191) and outer rotor (Figure 192).

6. Measure the clearance between the outer rotor and the housing (Figure 193) with a flat feeler gauge. Compare to the specified clearance dimension listed in Table 2. Replace the worn part if worn beyond the clearance.

7. Measure the clearance between the inner rotor tip and the outer rotor (Figure 194) with a flat feeler gauge. Compare to the specified clearance dimension listed in Table 2. Replace the worn part if worn beyond the clearance.



8. Place a straightedge across the rotors and the oil pump housing and check the rotor end clearance (**Figure 195**) with a flat feeler gauge. Compare to the specified clearance dimension listed in **Table 2**. Replace the worn part if worn beyond the clearance.
9. Remove the rotors from the housing.

#### Assembly/Installation

1. Close off the small crankcase openings in the oil pump housing area with a lint-free cloth. This will prevent the accidental loss of the Woodruff key in the next step.
2. Install the Woodruff key (B, **Figure 188**) in the slot in the crankshaft. Make sure it is installed straight and not cocked in the slot.
3. Remove the cloth used in Step 1.
4. Apply clean engine oil to the pump area to prime it. Also apply clean engine oil to the rotors prior to installation.
5. Position the rotors with their marks facing out. Install the inner rotor (**Figure 191**) and outer rotor (**Figure 192**). Make sure the marks are facing out (**Figure 196**).
6. Apply a light coat of grease to the O-ring seat to hold it in place on the cover. Install a new O-ring seal (**Figure 197**) to the cover.
7. Apply a thin even coat of Three Bond 1216 gasket sealer to the mating surfaces of the pump cover.
8. Install the cover (**Figure 187**).
9. Apply blue Loctite Threadlocker (No. 242) to the cover screws prior to installation.
10. Install the screws and tighten the screws in a crisscross pattern. Tighten the screws securely.
11. Install the flywheel and clutch as described in Chapter Five.
12. Install the engine as described in Chapter Four.

#### OIL PAN AND STRAINER

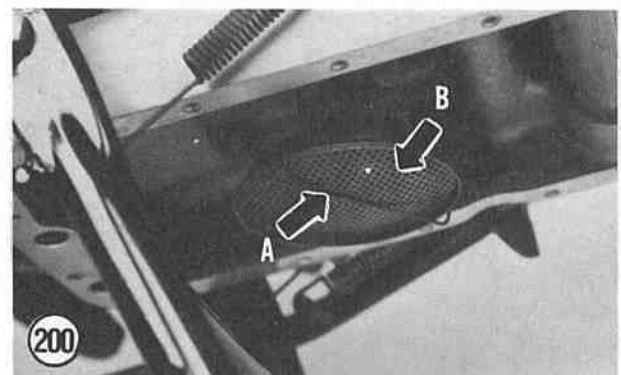
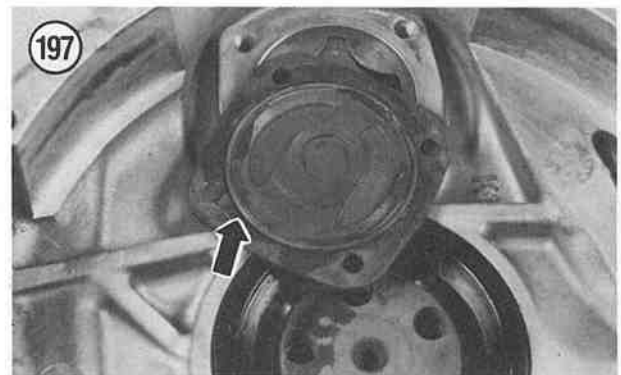
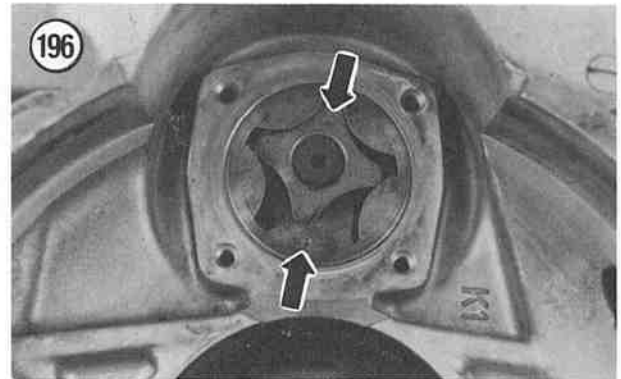
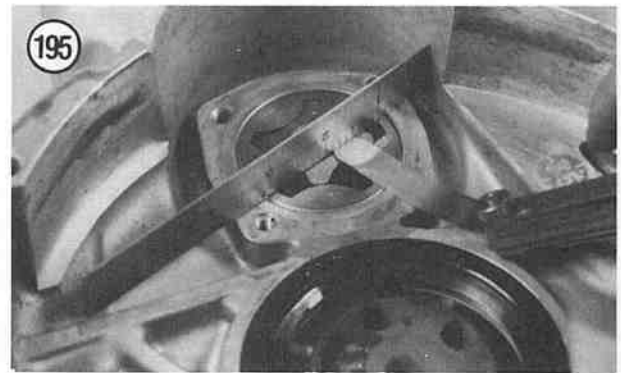
Refer to the following illustrations for this procedure:

- a. **Figure 198**: for the oil pan.
- b. **Figure 186**: for the oil strainer.

The oil pan and strainer can be removed with the engine in the frame. This procedure is shown with the engine removed for clarity.

#### Removal

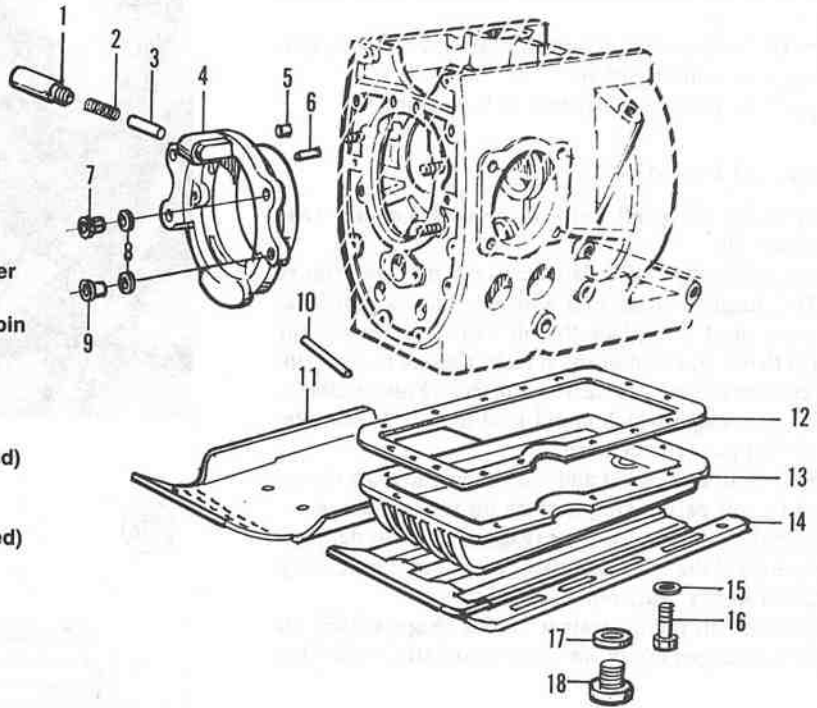
1. Drain the engine oil as described under *Engine Oil and Oil Filter Change* in Chapter Three.
2. Using the pattern shown in **Figure 199**, loosen the bolts securing the oil pan.
3. Remove the bolts and lockwashers securing the oil pan and remove the oil pan and gasket from the crankcase. Discard the gasket even if it comes off in one piece. The gasket cannot be reused or an oil leak will occur.
4. Remove the wire clip (A, **Figure 200**) securing the strainer and remove the strainer (B, **Figure 200**).



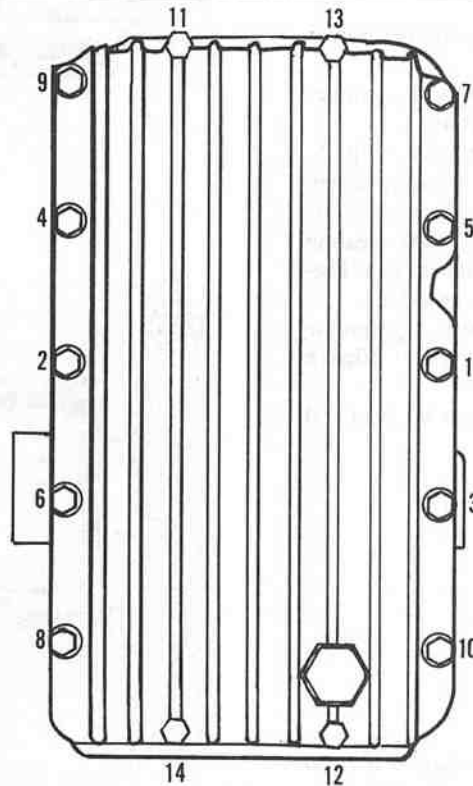
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**OIL PRESSURE RELIEF VALVE  
AND OIL PAN**

- 1. Pressure relief valve housing
- 2. Spring
- 3. Plunger
- 4. Crankshaft front bearing carrier
- 5. Plug
- 6. Timing chain tensioner pivot pin
- 7. Nut
- 8. Lockwasher
- 9. Nut
- 10. Bearing carrier locating pin
- 11. Skid plate (models so equipped)
- 12. Oil pan gasket
- 13. Oil pan
- 14. Skid plate (models so equipped)
- 15. Washer
- 16. Bolt
- 17. Sealing washer
- 18. Drain plug



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5. Remove the bolts and lockwashers securing the strainer holder (Figure 201).
- 6A. On 1970-1976 models, remove the strainer holder and gasket.
- 6B. On 1977-on models, remove the strainer holder, gasket, flange and other gasket.
7. Inspect the parts as described in this chapter.

### Cleaning and Inspection

1. Thoroughly clean all parts in solvent and dry with compressed air.
2. Inspect the oil pan for damaged cooling fins (Figure 202). If damage is slight and will not cause an oil leak, there is no need to replace the oil pan. If there are any fractures that could lead to an oil leak, replace the oil pan.
3. Make sure the oil pan sealing surface (Figure 203) is free of any damage which could lead to an oil leak. Replace the oil pan if necessary.
4. Clean off all old gasket and sealer residue from the oil pan and the oil pan mating surface on the crankcase.
5. Inspect the oil pump strainer (Figure 204) for damage. Make sure all of the holes are open; clean out if necessary. If damaged in any way, replace the strainer.
6. Inspect the oil pump strainer holder (Figure 205) for damage. If damaged in any way, replace the strainer holder.

### Installation

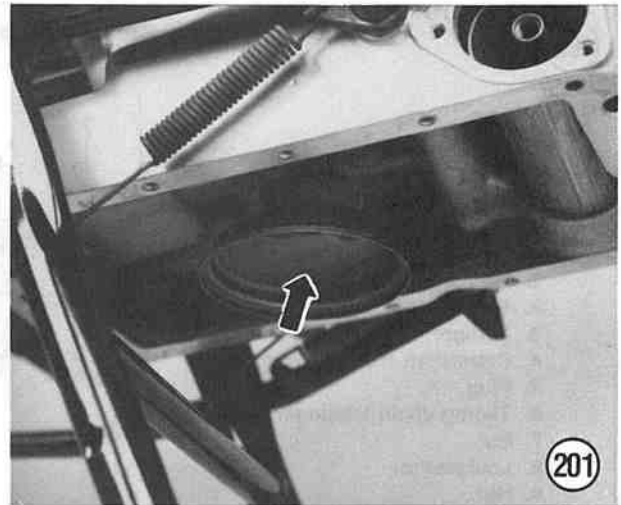
- 1A. On 1970-1976 models, install the gasket and the strainer holder.
- 1B. On 1977-on models, install the gasket, strainer holder and other gasket.
2. Install the bolts and lockwashers securing the strainer holder (Figure 201). Tighten the bolts securely.
3. Install the strainer (B, Figure 200) and the wire clip (A, Figure 200). Make sure the wire clip is properly seated so that it will not work loose, causing the strainer to fall off.
4. Apply Three Bond No. 1216 gasket sealer to the sealing surface of the crankcase (Figure 206) and the oil pan (Figure 203) following the manufacturer's instructions.
5. Install the oil pan, bolts and lockwashers. Tighten the bolts in the same torque pattern used for removal (Figure 199). Tighten the bolts securely.
6. Refill the engine oil with the recommended type and quantity as described in Chapter Three.

## OIL COOLER

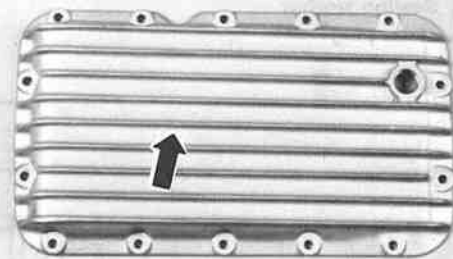
### Removal/Installation (1977-on R100RS and R100RT Models)

Refer to Figure 207 for this procedure.

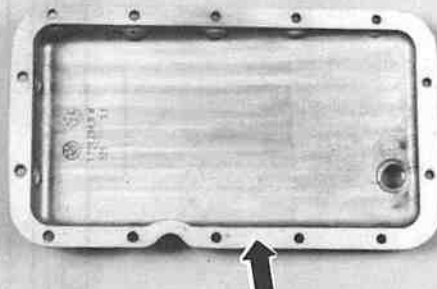
1. Drain the engine oil as described under *Engine Oil and Oil Filter Change* in Chapter Three.



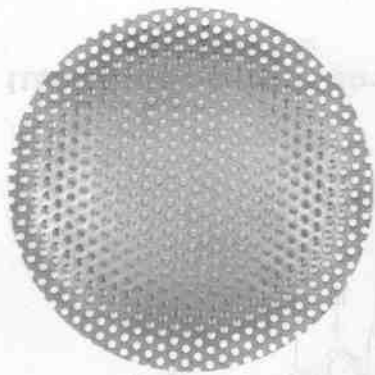
202



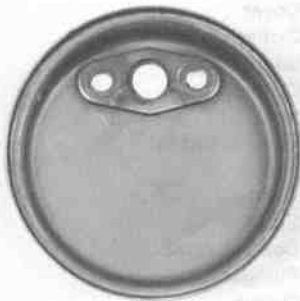
203



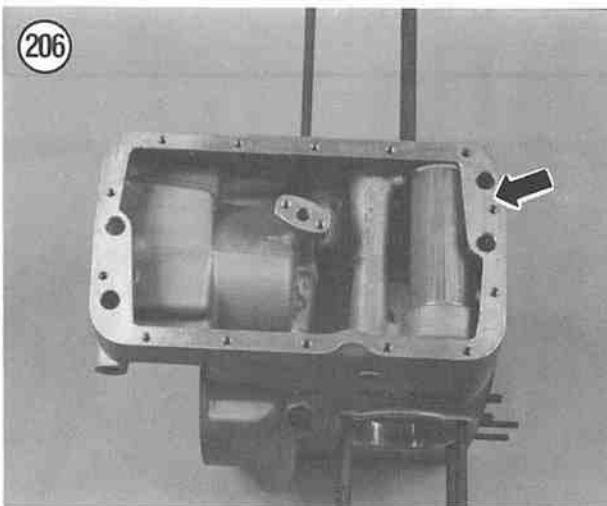
204



205



206



2. Remove the lower center section of the front fairing as described under *Front Fairing Removal/Installation* in Chapter Twelve.
3. Place the oil drain pan under the oil cooler hoses where they attach to the housing. Some residual oil will drain out when the union bolts are removed.
4. Remove the union bolts (**Figure 208**) and sealing washers securing the oil cooler hoses to the oil filter housing. Let the residual oil drain out.
5. On models so equipped, remove the screws securing the trim panel and remove the trim panel from the oil cooler.
6. To remove the oil hoses only, unscrew the fittings (A, **Figure 209**) from the oil cooler and remove the hoses.
7. To remove the oil cooler, remove the bolts and lockwashers (B, **Figure 209**) securing the oil cooler to the mounting bracket on the frame.
8. Carefully remove the oil cooler and the hoses from the frame.
9. Install by reversing these removal steps. Note the following during installation.
10. Make sure the oil hole in each union bolt is clear. Clean out with a piece of wire and solvent if necessary.
11. Install new sealing washers and tighten the union bolts securely.
12. Refill the engine oil with the recommended type and quantity as described in Chapter Three.
13. Start the engine and check for an oil leak. Retighten the union bolts if necessary.

#### Removal/Installation (R100GS Models)

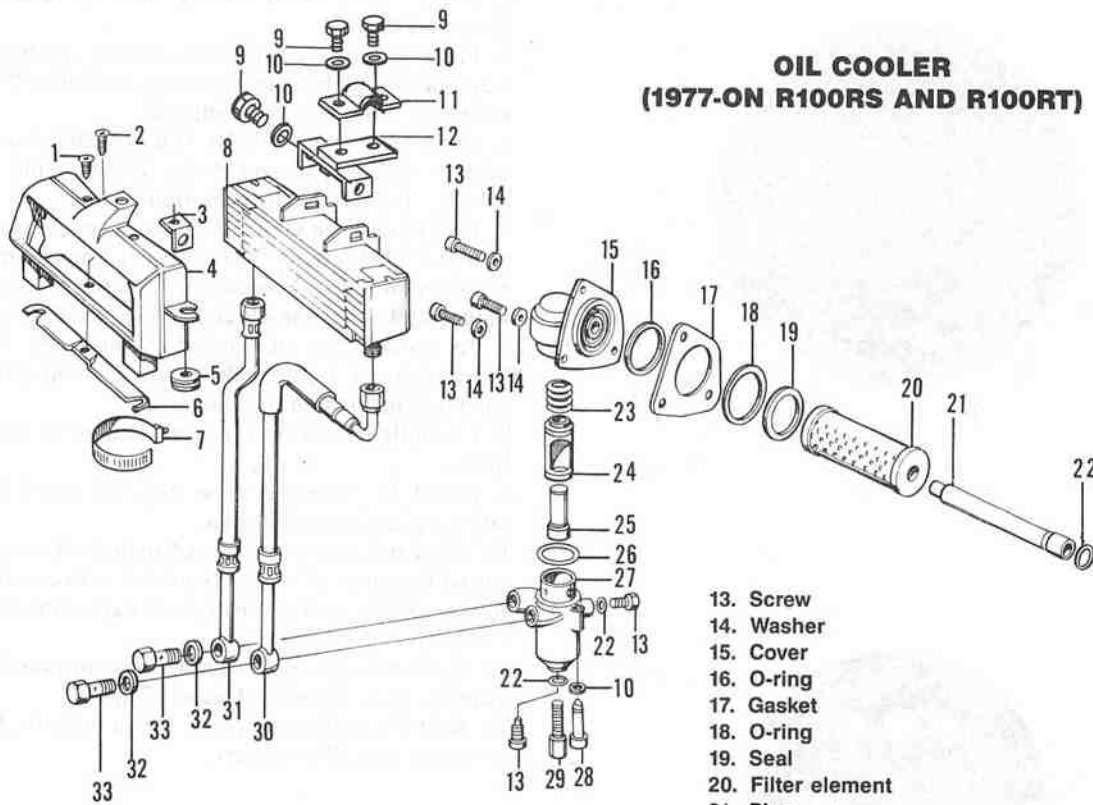
Refer to **Figure 210** for this procedure.

1. Drain the engine oil as described under *Engine Oil and Oil Filter Change* in Chapter Three.
2. Place the oil drain pan under the oil cooler hoses where they attach to the housing. Some residual oil will drain out when the union bolts are removed.
3. Remove the union bolts (**Figure 211**) and sealing washers securing the oil cooler hoses to the oil filter cover. Let the residual oil drain out.
4. Remove the bolts and lockwashers securing the oil cooler (**Figure 212**) to the safety bar.
5. Carefully remove the oil cooler and the hoses.
6. Install by reversing these removal steps. Note the following during installation.
7. Make sure the oil hole in each union bolt is clear. Clean out with a piece of wire and solvent if necessary.
8. Install new sealing washers and tighten the union bolts securely.
9. Refill the engine oil with the recommended type and quantity as described in Chapter Three.
10. Start the engine and check for an oil leak. Retighten the union bolts if necessary.



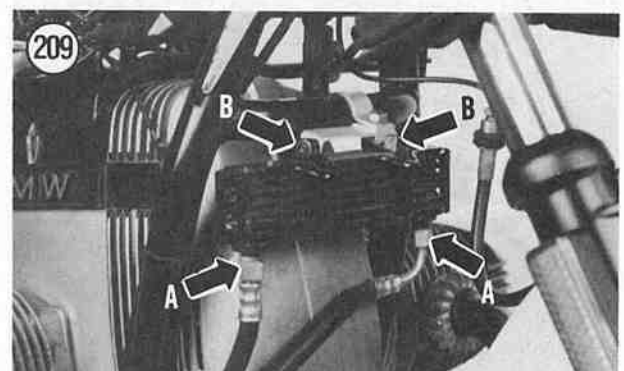
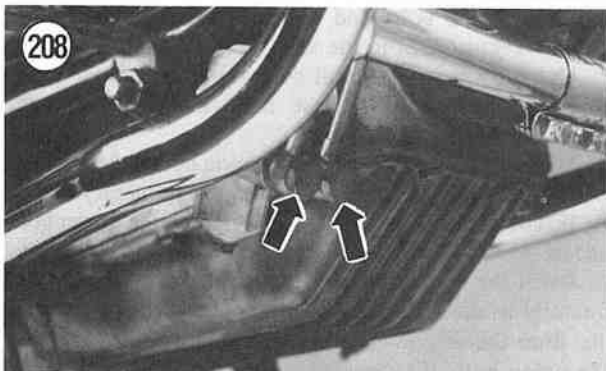
207

### OIL COOLER (1977-ON R100RS AND R100RT)



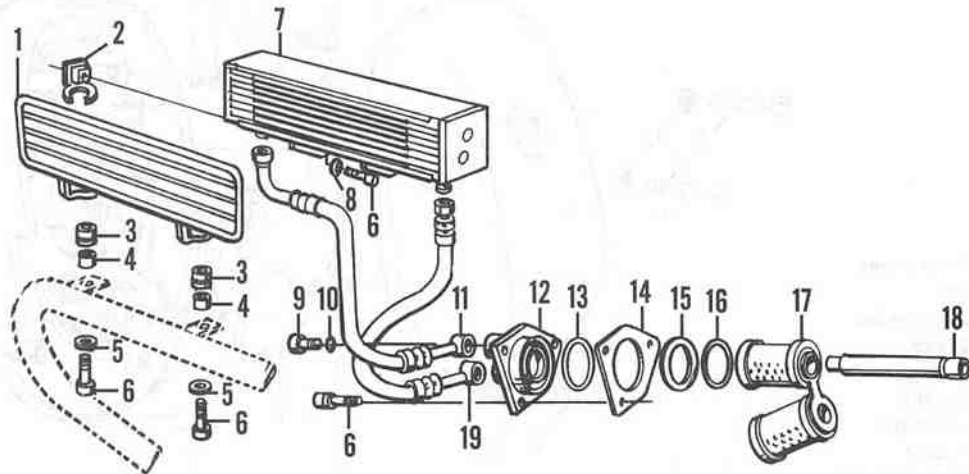
1. Screw
2. Screw
3. Bracket
4. Trim panel
5. Rubber grommet
6. Holder
7. Clamp
8. Oil cooler
9. Bolt
10. Washer
11. Clamp
12. Mounting bracket

13. Screw
14. Washer
15. Cover
16. O-ring
17. Gasket
18. O-ring
19. Seal
20. Filter element
21. Pipe
22. O-ring
23. Spring
24. Control valve
25. Plunger
26. O-ring
27. Housing
28. Bolt
29. Bolt
30. Oil hose
31. Oil hose
32. Sealing washer
33. Union bolt

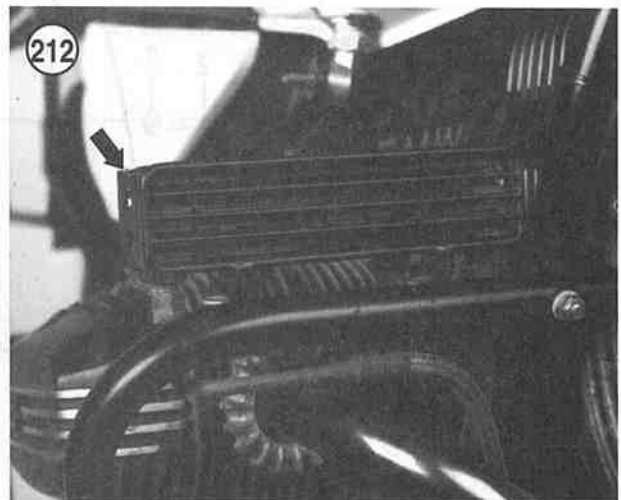
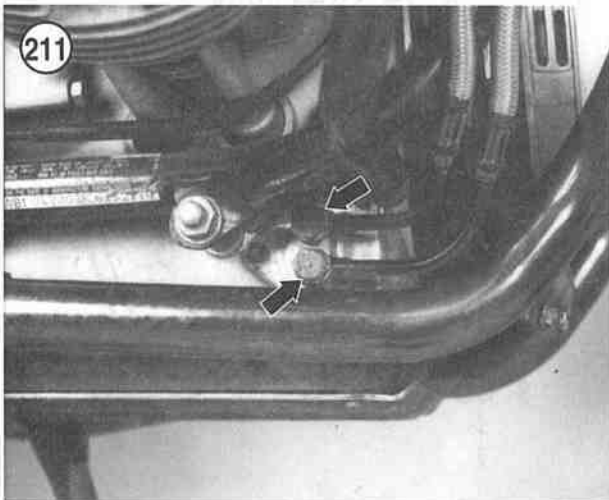


210

**OIL COOLER  
(R100GS)**



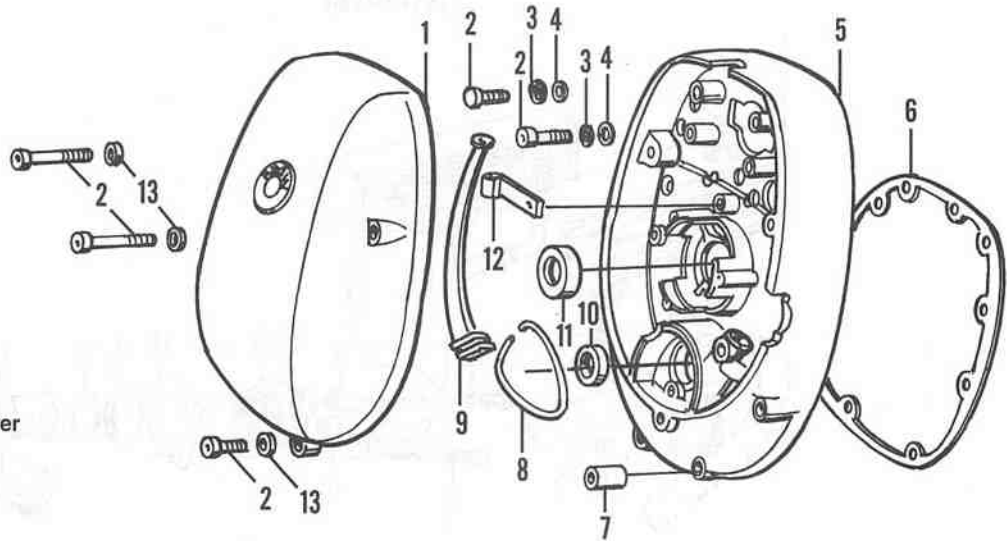
- |                    |                    |
|--------------------|--------------------|
| 1. Rock guard      | 11. Oil hose       |
| 2. Bracket         | 12. Cover          |
| 3. Rubber grommet  | 13. O-ring         |
| 4. Bushing         | 14. Gasket         |
| 5. Washer          | 15. O-ring         |
| 6. Bolt            | 16. Seal           |
| 7. Oil cooler      | 17. Filter element |
| 8. Lockwasher      | 18. Pipe           |
| 9. Union bolt      | 19. Oil hose       |
| 10. Sealing washer |                    |



213

**TIMING CHAIN COVER  
(1970-1978)**

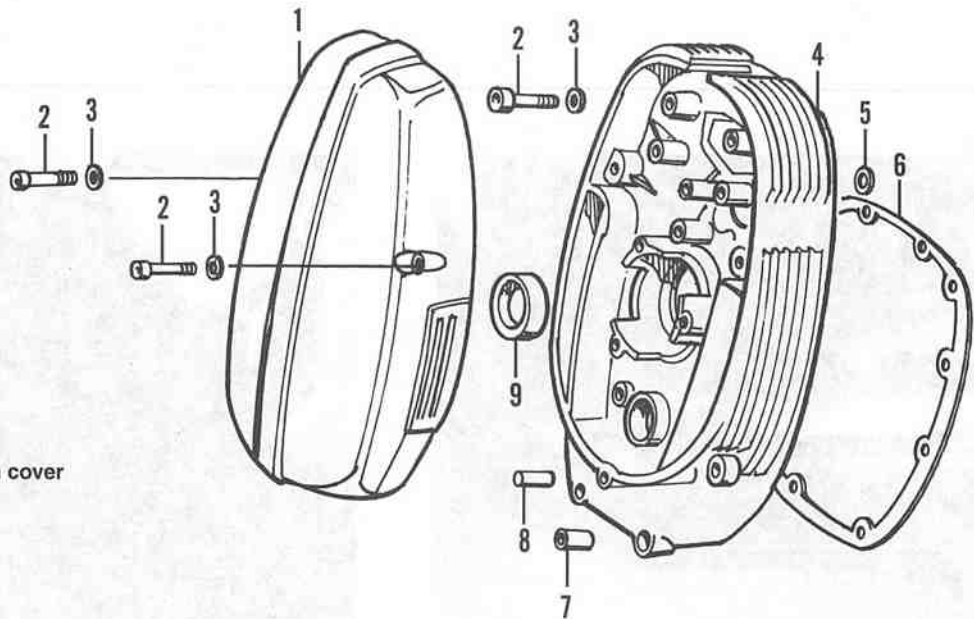
- 1. Front cover
- 2. Bolt
- 3. Lockwasher
- 4. Gasket
- 5. Timing chain cover
- 6. Gasket
- 7. Dowel pin
- 8. Gasket
- 9. Wire protector
- 10. Oil seal
- 11. Oil seal
- 12. Strap
- 13. Lockwasher



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**TIMING CHAIN COVER  
(1979-ON)**

- 1. Front cover
- 2. Bolt
- 3. Lockwasher
- 4. Timing chain cover
- 5. Washer
- 6. Gasket
- 7. Dowel pin
- 8. Pin
- 9. Oil seal



## TIMING CHAIN COVER

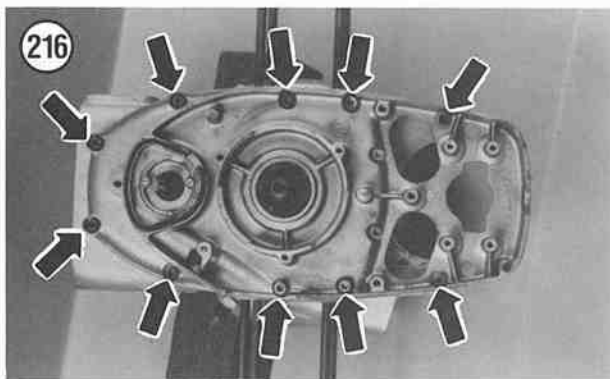
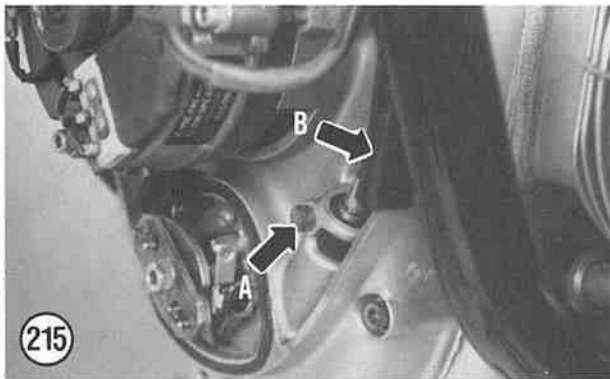
## Removal/Installation

Refer to the following illustrations for this procedure:

- a. **Figure 213:** 1970-1978 models.
- b. **Figure 214:** 1979-on models.

## NOTE

The timing chain cover can be removed with the engine in the frame. This procedure is shown with the engine removed for clarity.



## CAUTION

The battery negative lead **must** be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating replacement of the entire diode board.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the engine front cover as described in this chapter.
3. Remove the alternator as described in Chapter Eight.
- 4A. On 1970-1980 models, remove the contact breaker point assembly as described under *Contact Breaker Point Replacement* in Chapter Three.
- 4B. On 1981-on models, remove the ignition trigger unit assembly as described under *Ignition Trigger Unit Replacement* in Chapter Eight.
5. If the engine is still installed in the frame, perform the following:
  - a. Drain the engine oil as described under *Engine Oil and Oil Filter Change* in Chapter Three.

## NOTE

Prior to disconnecting the electrical connectors, identify and mark each one so that it will be reconnected to the correct terminal on the diode board.

- b. Disconnect the electrical connectors going to the diode board.
6. On 1970-1978 models, perform the following:
  - a. Remove the bolt (A, **Figure 215**) securing the tachometer drive cable.
  - b. Withdraw the tachometer drive cable (B, **Figure 215**) from the timing chain cover. Reinstall the bolt to avoid misplacing it.
7. Using a crisscross pattern, loosen, then remove the bolts and washers (**Figure 216**) securing the timing chain cover to the crankcase.

## CAUTION

It may be difficult to pull the timing chain cover off of the crankshaft front ball bearing. Do not try to pry or force the cover off of the crankshaft front bearing as the cover will be damaged.

8. Remove the timing chain cover and gasket from the crankcase. Discard the gasket as it must be replaced.
9. If the timing chain cover is difficult to remove, perform one of the following:
  - a. First try heating the area surrounding the crankshaft front bearing with a hair dryer. Heat the area until it is too hot to touch and then try to remove the timing chain cover.
  - b. If the hair dryer does not work, a BMW special tool (**Figure 217**) must be used.

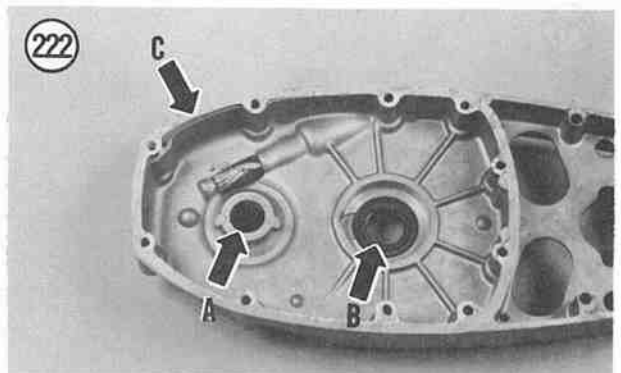
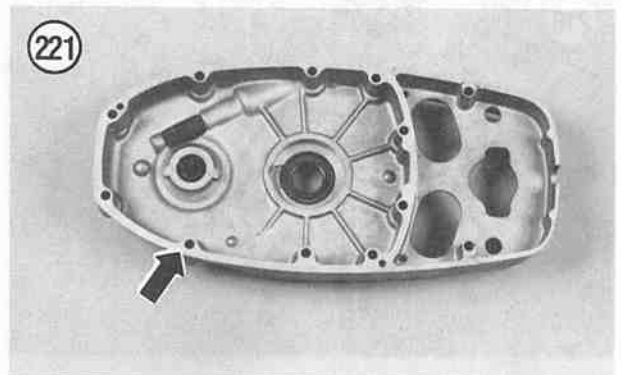
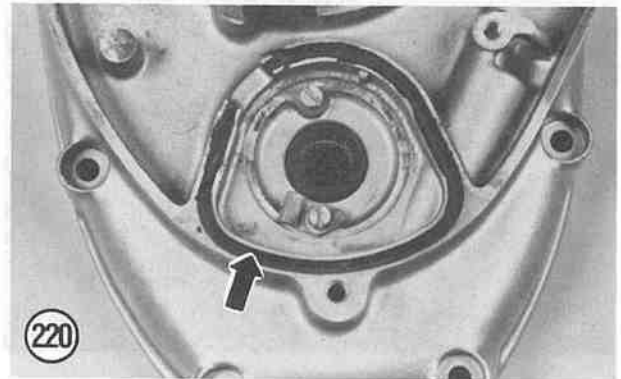
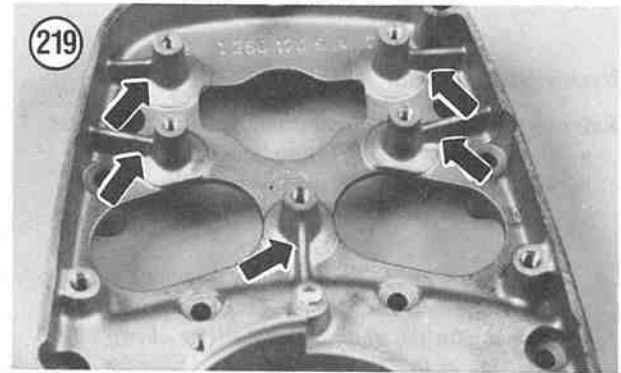
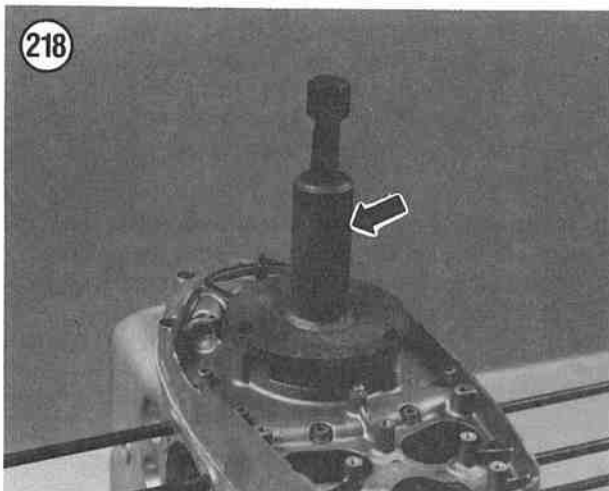
- c. Install the BMW puller (part No. 11 1 800) to the timing chain cover with three M5 bolts (Figure 218). Tighten the bolts securely.
  - d. Slowly tighten the center bolt and pull the timing chain cover off of the crankshaft front bearing. Remove the cover.
  - e. Remove the special tool from the cover.
10. Inspect the timing chain cover as described in this chapter.

### Cleaning and Inspection

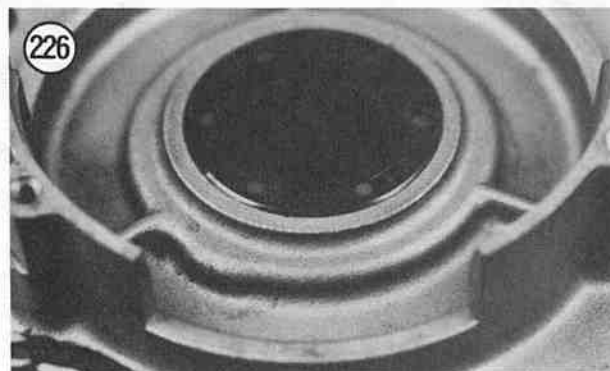
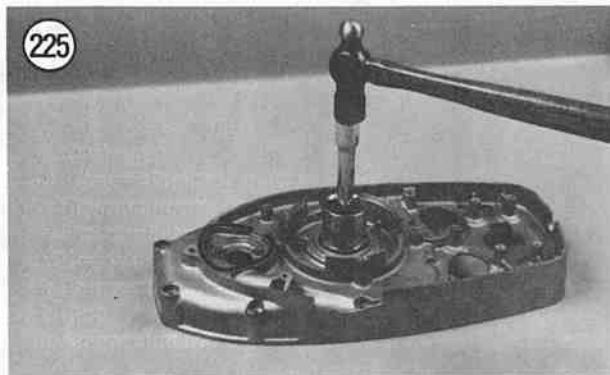
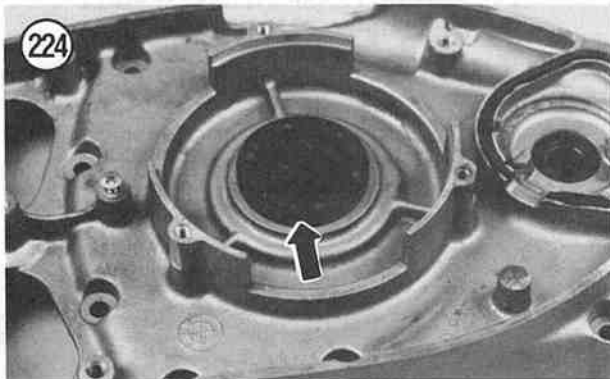
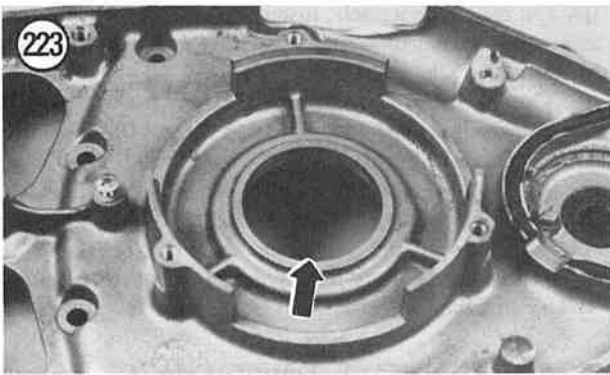
1. Thoroughly clean the cover in solvent and dry with compressed air.
2. Inspect the cover for damage. Inspect any strengthening ribs (Figure 219) or any area that retains a gasket (Figure 220) for cracks or fractures. Replace the cover if necessary.
3. Clean off all old gasket and sealer residue from the cover and from the cover's mating surface on the crankcase.
4. Make sure the cover's inner sealing surface (Figure 221) is free of any damage which could lead to an oil leak. Replace the cover if necessary.
5. Inspect the oil seals in the cover for wear or damage. Replace if necessary as described in this chapter.

### Oil Seal Replacement

1. Using a screwdriver and hammer, carefully tap the camshaft oil seal (A, Figure 222) and crankshaft oil seal (B, Figure 222) out from the backside of the cover.
2. Thoroughly clean out the oil seal receptacles (Figure 223) in the cover with solvent and dry with compressed air.
3. Apply a light coat of clean engine oil to the oil seal receptacles in the cover and to the outer surface of the new oil seals.
4. To install the crankshaft oil seal, perform the following:
  - a. Lay the cover, with the front side facing up, on a piece of soft wood so the gasket sealing surface will not be damaged.





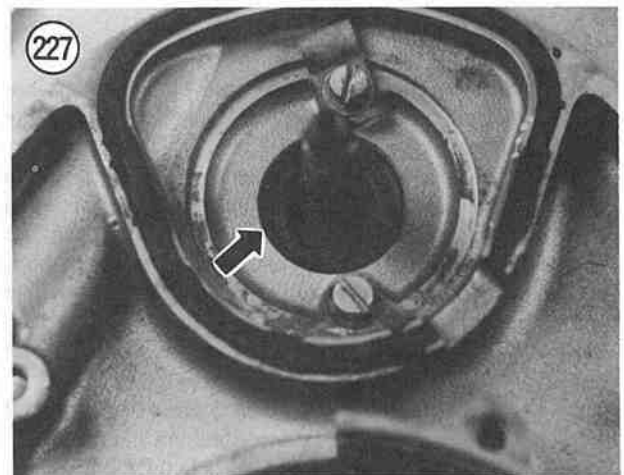


- b. Position the oil seal (**Figure 224**) with the open side facing down toward the crankshaft.
- c. Use a socket (**Figure 225**) or piece of pipe that matches the outer diameter of the oil seal.
- d. Carefully tap the new seal in squarely. Do not allow the oil seal to get cocked as it will be damaged and not seal properly.
- e. Tap the oil seal in until it is flush with the surrounding cover surface (**Figure 226**).

**NOTE**

*The timing chain cover must be reinstalled onto the crankcase before installing the camshaft oil seal. If the oil seal is installed prior to installing the cover, the seal will not seat properly.*

5. To install the camshaft oil seal, perform the following:
  - a. Install the timing chain cover onto the crankcase as described in this chapter.
  - b. Position the oil seal with the open side facing down toward the camshaft.
  - c. Use a socket or piece of pipe that matches the outer diameter of the oil seal.
  - d. Carefully tap the new seal in squarely. Do not allow the oil seal to get cocked as it will be damaged and not seal properly.
  - e. Tap the oil seal in until it is flush with the surrounding cover surface (**Figure 227**).
6. On 1970-1978 models, to replace the tachometer drive gear oil seal, perform the following:
  - a. Unscrew the drive gear retaining bolt.
  - b. Using a metal hook, carefully pull out the drive gear bushing (**Figure 228**).
  - c. Turn the cover over and place it on a soft piece of wood.



- d. Using a piece of soft aluminum or brass rod, carefully tap the drive gear (Figure 229), washer and oil seal out of the cover.
- e. Thoroughly clean out the drive gear receptacle in the cover with solvent and dry with compressed air.
- f. Apply a light coat of clean engine oil to the receptacle in the cover and to the outer surface of the new oil seal.
- g. Install the drive gear, washer, new oil seal and the bushing into the front side of the cover.
- h. Use a socket that matches the outer diameter of the bushing. Carefully tap this assembly into the receptacle in the cover.
- i. Rotate the drive gear and make sure there is no binding.

### Installation

1. Make sure the mating surface of the timing chain cover and crankcase are clean before installing the cover.
2. Apply a thin even coat of Three Bond 1216 gasket sealer to each side of the new gasket.
3. Install a new gasket (C, Figure 222) on the crankcase. Also install new washers at the top.
4. Using a portable hair dryer, heat the area surrounding the crankshaft front ball bearing receptacle on the backside of the cover.
5. Install the timing chain cover, being careful not to damage the crankshaft oil seal. It may be necessary to gently tap on the area surrounding the crankshaft front ball bearing with a soft-faced mallet to help seat the cover.

### CAUTION

*The cover should fit onto the crankcase without force. Do not attempt to pull the cover down onto the crankcase with the mounting bolts as the cover will be distorted and damaged.*

6. Make sure the cover completely seats onto the crankcase around its entire perimeter before installing any of the mounting bolts.
7. Install the bolts and washers securing the timing chain cover. Starting from the center of the cover, using a crisscross pattern, tighten the bolts (Figure 216) securely.
8. Install the camshaft oil seal as described in this chapter.
9. On 1970-1978 models, install the tachometer drive cable and bolt. Tighten the bolt securely.
10. If the engine is still installed in the frame, perform the following:
  - a. Refill the engine with the recommended type and quantity of engine oil as described in Chapter Three.
  - b. Connect the electrical connectors to the diode board.

11A. On 1970-1980 models, install the contact breaker point assembly as described under *Contact Breaker Point Replacement* in Chapter Three.

11B. On 1981-on models, install the ignition trigger unit assembly as described under *Ignition Trigger Unit Replacement* in Chapter Eight.

12. Install the alternator as described in Chapter Eight.

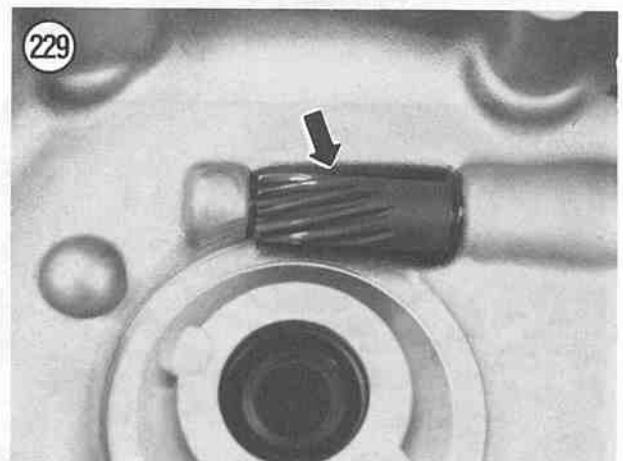
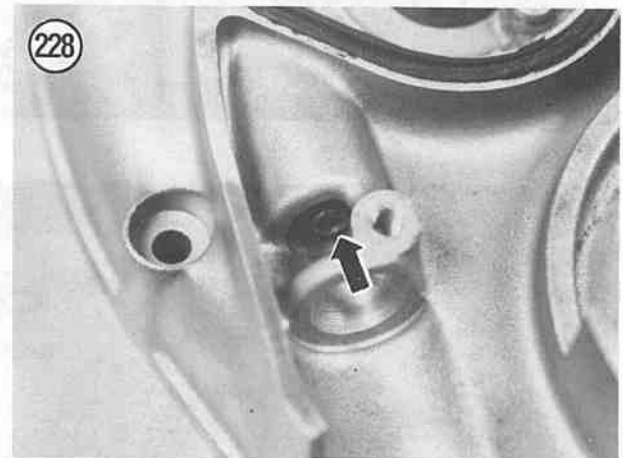
13. Install the engine front cover and the bolts. Tighten the bolts securely.

14. Connect the battery negative lead as described under *Battery* in Chapter Three.

### CAMSHAFT, TIMING CHAIN, TIMING SPROCKETS AND CHAIN TENSIONER ASSEMBLY (1970-1978 MODELS)

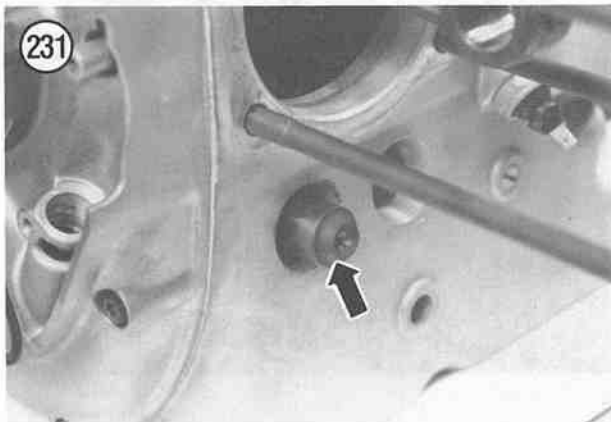
The original factory timing chain is manufactured as a closed loop with no master link. Therefore the timing chain, the camshaft and the crankshaft timing chain sprocket must all come off as an assembly.

Refer to Figure 230 for this procedure.



**Removal**

1. Remove the engine from the frame as described in this chapter.
2. Remove the following components as described in this chapter or other related chapters:
  - a. Cylinder heads and cylinders (this chapter).
  - b. Pistons (this chapter).
  - c. Connecting rods (this chapter).



- d. Engine front cover and timing chain cover (this chapter).
- e. Oil pump (this chapter).
- f. Clutch and flywheel (Chapter Five).

**CAUTION**

*All 4 valve lifters must be removed from the crankcase prior to removing the camshaft. If they are left in place, the camshaft lobes will hangup on them during removal and either the camshaft or the valve lifters will be damaged during camshaft removal.*

3. If not already removed, use a wire hook and remove all 4 valve lifters (Figure 231). Label them so they will be reinstalled in their correct locations.
4. Place the crankcase assembly on end so that the front of the engine is facing up.

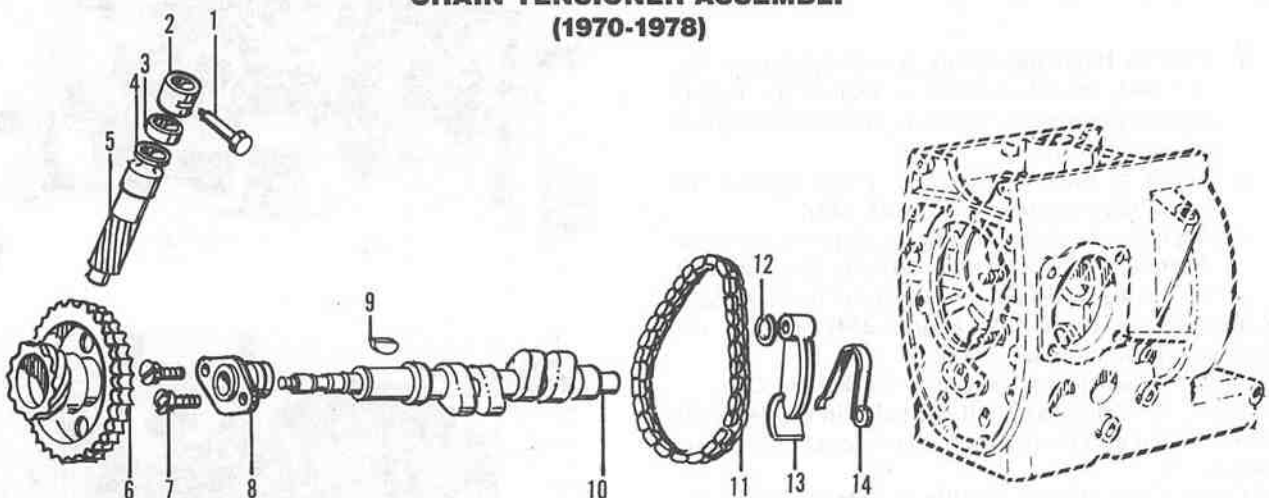
**NOTE**

*The crankshaft front bearing can be pulled off either with the BMW factory special tools or with a gear puller. There is less chance of damage to the bearing if the BMW special tools are used.*

4

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**CAMSHAFT, TIMING CHAIN,  
TIMING SPROCKETS AND  
CHAIN TENSIONER ASSEMBLY  
(1970-1978)**



1. Bolt
2. Bushing
3. Seal
4. Washer
5. Tachometer driven gear
6. Timing sprocket and tachometer drive gear
7. Screw

8. Bearing flange
9. Woodruff key
10. Camshaft
11. Timing chain
12. Circlip
13. Chain tensioner
14. Tensioner spring

5A. If using the BMW special bearing extractor (part No. 00 7 500) and an insert to remove the outer bearing, perform the following;

- a. Place the BMW special pressure pad tool, part No. 11 1 690 (A, **Figure 232**), onto the end of the crankshaft. This is necessary to avoid damage to the end of the crankshaft during this step.
  - b. Place the insert (B, **Figure 232**) under the outer race of the outer bearing.
  - c. Attach the BMW special bearing extractor tool, part No. 00 7 500 (C, **Figure 232**), onto the insert and onto the end of the crankshaft.
  - d. Screw the center threaded stud (D, **Figure 232**) down until it makes contact with the pressure pad.
  - e. Hold onto the sides (C, **Figure 232**) of the special tool and slowly tighten the center threaded stud (D, **Figure 232**) with a wrench.
  - f. Continue to tighten the center threaded stud and slowly withdraw the outer bearing off of the crankshaft. Continue until the outer bearing is released from the end of the crankshaft.
- 5B. If using a gear puller to remove the outer bearing, perform the following:

**NOTE**

*If you don't want to purchase and use the BMW pressure pad, protect the end of the crankshaft with a couple of copper pennies or a piece of copper or brass. Place the protective pieces between the end of the crankshaft and the center portion of the gear puller.*

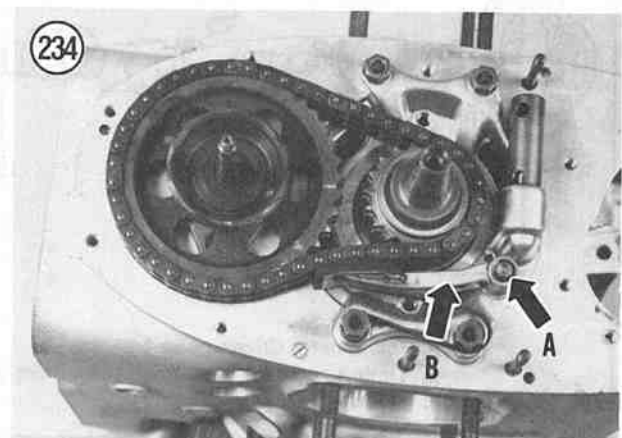
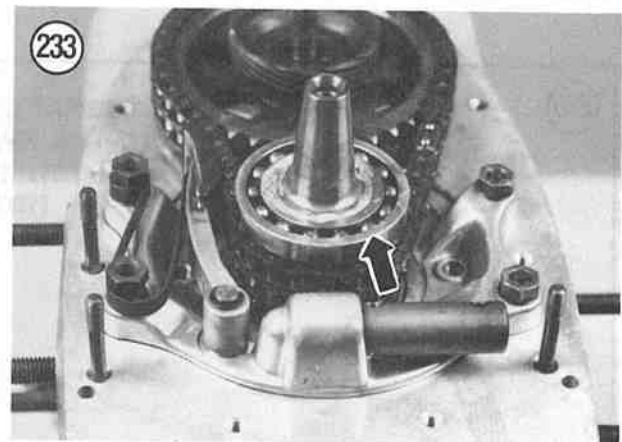
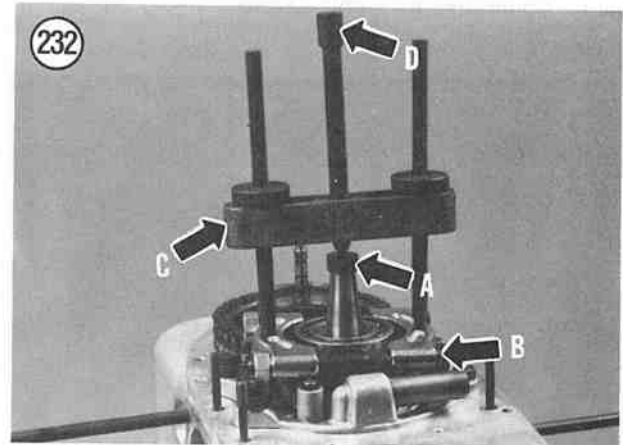
- a. Place the BMW special tool, pressure pad, (part No. 11 1 690) onto the end of the crankshaft. This is necessary to avoid damage to the end of the crankshaft during this step.
  - b. Attach a suitable size gear puller behind the crankshaft front bearing (**Figure 233**).
  - c. Apply pressure on the puller and slowly withdraw the front bearing from the crankshaft. Continue until the bearing is released from the end of the crankshaft.
6. Remove the circlip (A, **Figure 234**) securing the camshaft chain tensioner assembly.
7. Slide off the tensioner assembly (B, **Figure 234**).
8. Rotate the crankshaft until the holes in the camshaft sprocket align with the bolts securing the camshaft bearing flange.
9. Remove the Allen bolts (**Figure 235**) securing the camshaft bearing flange.

**NOTE**

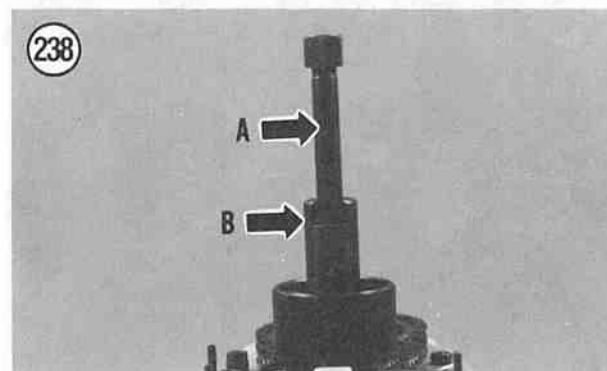
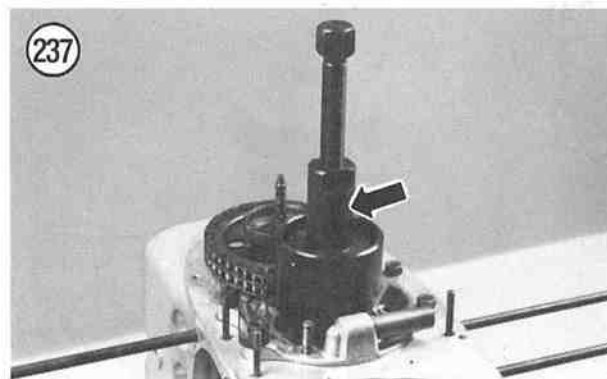
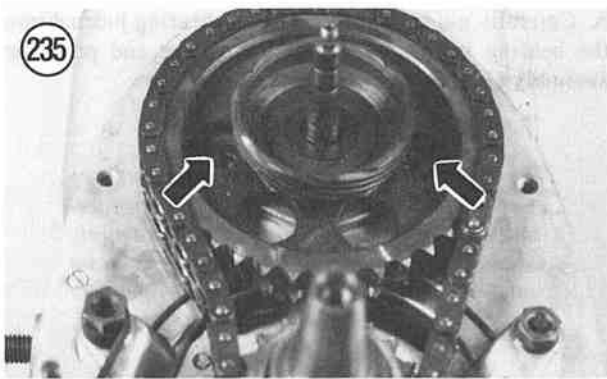
*The crankshaft timing gear can be pulled off either with the BMW factory special tool or with a gear puller. There is less chance of damage to the components if the BMW special tool is used.*

10A. If using the BMW special puller tool (**Figure 236**) (part No. 11 2 600), perform the following;

- a. Place the BMW special tool, pressure pad, (part No. 11 1 690) onto the end of the crankshaft. This is necessary to avoid damage to the end of the crankshaft during this step.







- b. Place the lower ledge of the 2 outer pieces under the timing gear and timing chain.
- c. Install the center portion onto the 2 outer pieces and then slide the outer ring onto and over all 3 parts of the special tool (Figure 237).
- d. Screw the center threaded stud (A, Figure 238) down until it makes contact with the pressure pad.

#### CAUTION

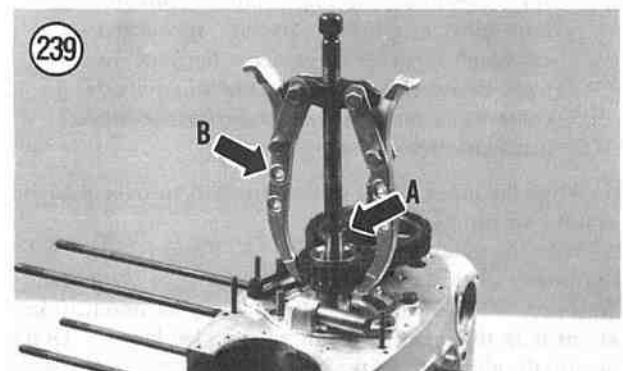
*During the next step, have an assistant tap on the rear end of the camshaft. The camshaft must be withdrawn from the crankcase along with the crankshaft timing sprocket. If this does not happen, the camshaft or the timing sprocket will get cocked and become damaged. Damage will also occur to the crankcase.*

- e. Hold onto the flats (B, Figure 238) on the center portion with a wrench and slowly tighten the center threaded stud (A, Figure 238) with another wrench.
  - f. Continue to tighten the center threaded stud and slowly withdraw the crankshaft timing sprocket from the crankshaft. While applying pressure on the pulley, continue to tap on the rear end of the camshaft. This will ensure that the camshaft travels out of the crankcase at the same rate that the timing sprocket is being withdrawn from the crankshaft. Continue until the timing sprocket is released from the end of the crankshaft.
- 10B. If using a gear puller, perform the following:

#### NOTE

*If you don't want to purchase and use the BMW pressure pad, protect the end of the crankshaft with a couple of copper pennies or a piece of copper or brass. Place the protective pieces between the end of the crankshaft and the center portion of the gear puller.*

- a. Place the BMW special tool, pressure pad, (part No. 11 1 690) onto the end of the crankshaft (A, Figure 239). This is necessary to avoid damage to the end of the crankshaft during this step.





- b. Attach a suitable size gear puller behind the crankshaft timing chain sprocket and onto the end of the crankshaft (B, **Figure 239**).

**CAUTION**

*During the next step, have an assistant tap on the rear end of the camshaft. The camshaft must be withdrawn from the crankcase along with the crankshaft timing sprocket. If this does not happen, the camshaft or the timing sprocket will get cocked and become damaged. Damage to the crankcase will also occur.*

- c. Apply pressure on the puller and slowly withdraw the crankshaft timing sprocket from the crankshaft. While applying pressure on the pulley, continue to tap on the rear end of the camshaft. This will ensure that the camshaft travels out of the crankcase at the same rate that the timing sprocket is being withdrawn from the crankshaft. Continue until the timing sprocket is released from the end of the crankshaft.
11. Remove the timing chain and the crankshaft timing sprocket. Remove the special tools.
12. Withdraw the camshaft from the crankcase.
13. Don't lose the Woodruff key (**Figure 240**) on the crankshaft. If it is not loose, there is no need to remove it unless the crankshaft is going to be serviced.
14. Inspect all components as described in this chapter.

### Installation

1. Apply a light, but complete, coat of molybdenum disulfide grease to each camshaft bearing journal. Also coat the bearing surface in the crankcase with the same grease.
2. Coat the inner surface of the crankshaft timing sprocket with an anti-seize lubricant (**Figure 241**). This will make installation of the sprocket easier and also make it easier if the sprocket is removed again.
3. Make sure the Woodruff key (**Figure 240**) is in place on the crankshaft.
4. Carefully set the camshaft part way into the crankcase.

**CAUTION**

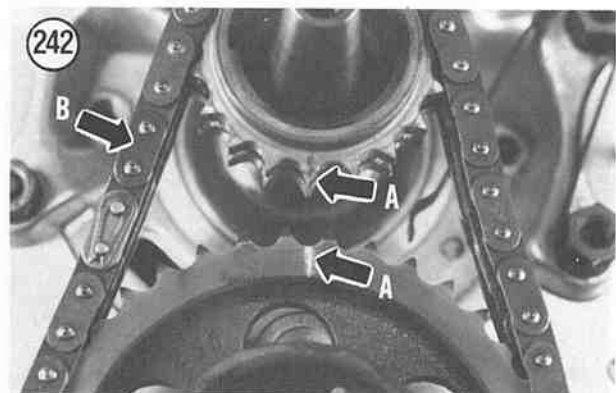
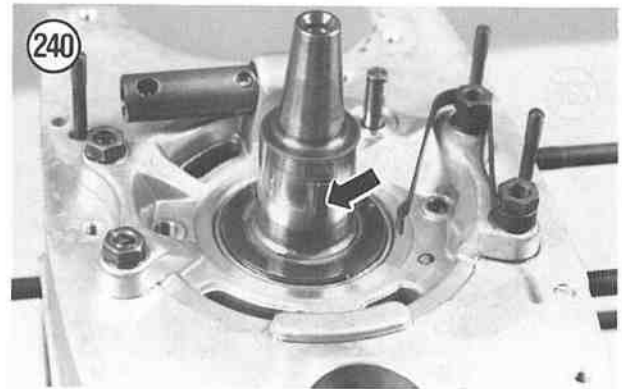
*Very expensive damage could result from improper crankshaft timing sprocket-to-camshaft sprocket alignment. Recheck your work several times to be sure alignment is correct and remains correct during the entire installation producer.*

5. Align the index marks of the camshaft sprocket and the crankshaft timing sprocket.
6. With the index marks aligned (A, **Figure 242**), install the timing chain (B, **Figure 242**) onto both sprockets.
7. If necessary, rotate the crankshaft until the Woodruff key aligns with the crankshaft timing sprocket keyway. Don't disturb the alignment of the index marks on both sprockets.

8. Carefully guide the camshaft rear bearing journal into the bearing in the rear of the crankcase and push the assembly (**Figure 243**) down until it stops.

**CAUTION**

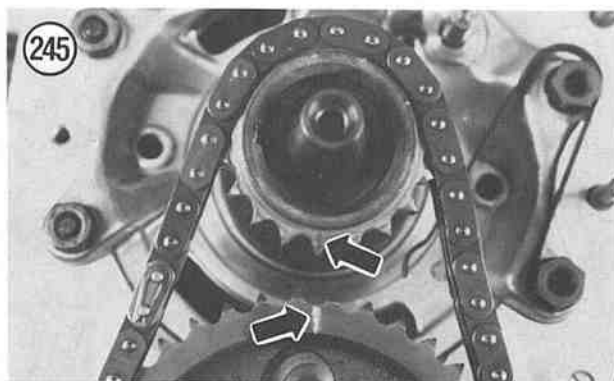
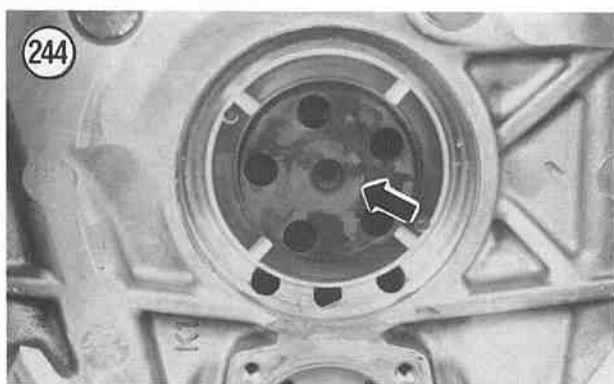
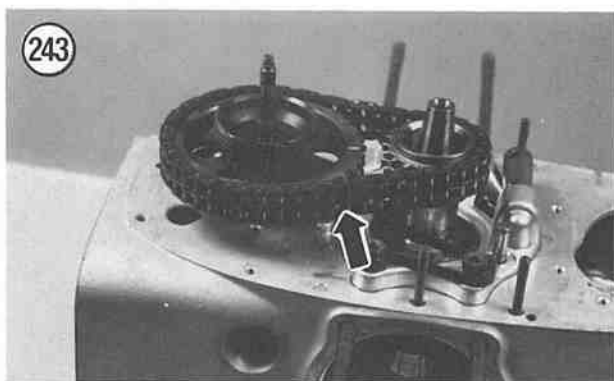
*The rear end of the crankshaft must be supported while installing the timing sprocket onto the front of the crankshaft. Do not apply force to the front of the crankshaft without supporting the rear of the crankshaft as the rear portion of the crankcase will be damaged.*



9. Place a piece of steel, a section of pipe or socket on the rear of the crankshaft (Figure 244). It must be long enough so that it extends beyond the rear surface of the crankcase. Set this assembly into a press, making sure the part that is against the rear of the crankshaft is resting on the press plate.

**CAUTION**

*To avoid damage to the crankshaft and crankcase, press the timing gear onto the crankshaft instead of tapping it into place with a hammer.*



10. With the rear of the crankshaft supported, place a socket or piece of pipe that matches the outer surface of the crankshaft timing sprocket onto the timing sprocket. Make sure the Woodruff key and keyway are properly aligned. Carefully press the crankshaft timing sprocket onto the crankshaft.

**CAUTION**

*While pressing on the crankshaft timing sprocket, make sure that the rear end of the camshaft is also correctly entering the crankcase receptacle at the rear. Don't allow the camshaft to become cocked during installation.*

**CAUTION**

*Make sure the camshaft bearing flange (at the front) is aligned with the mounting holes in the crankcase. If the flange is not aligned, it will bottom out on the raised surface of the crankcase. This will keep the camshaft (and timing chain) from traveling all the way into the crankcase.*

11. Press the crankshaft timing sprocket on until it bottoms out on the crankshaft shoulder.
12. Release hydraulic pressure and remove the assembly from the press.
13. After the crankshaft timing sprocket, timing chain and camshaft assembly are completely installed, recheck that the sprocket timing marks are still aligned (Figure 245). If alignment is incorrect, remove this assembly and reinstall it correctly with the index marks properly aligned.
14. Rotate the crankshaft until the holes in the camshaft sprocket align with the bolt holes in the camshaft bearing flange.
15. Apply blue Loctite Threadlocker (No. 242) to the camshaft bearing flange bolts prior to installation.
16. Install the Allen bolts (Figure 235) securing the camshaft bearing flange. Tighten the bolts securely.

**CAUTION**

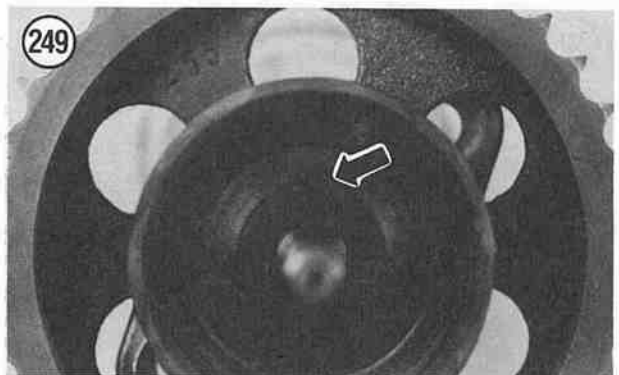
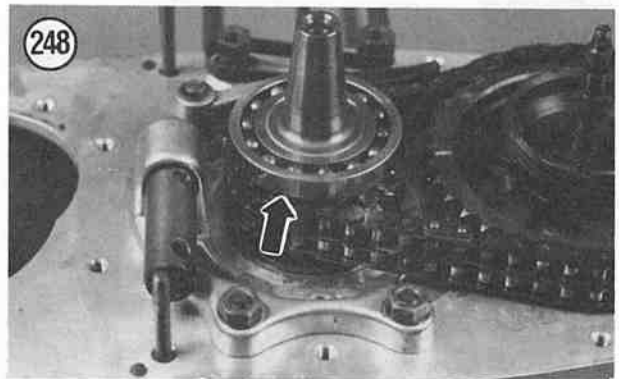
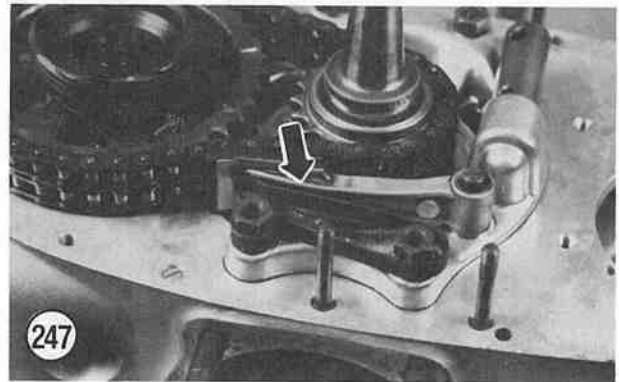
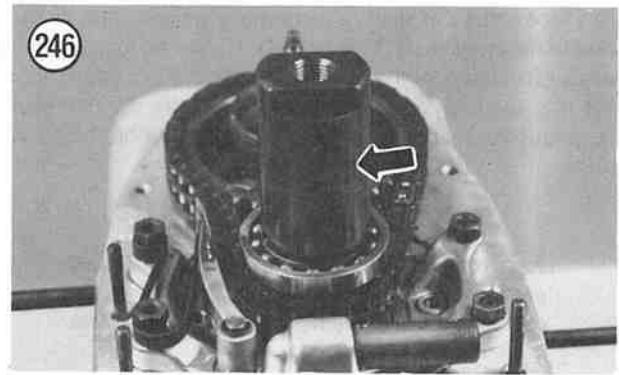
*In the next step, if there is any binding while rotating the crankshaft, stop. Determine the cause before proceeding.*

17. After installation is complete, slowly rotate the crankshaft several times. Make sure the engine rotates smoothly with no binding.
18. Place the crankshaft front bearing in an oven or on a hot plate for about 15 minutes, or until it is too hot to touch.

19. Use a pair of pliers and remove the bearing from the oven. Install it onto the crankshaft and slide it down until it bottoms out on the crankshaft shoulder. If necessary, tap it in place with a suitable size socket or piece of pipe (**Figure 246**) that matches the inner race.
20. Install the timing chain tensioner assembly (B, **Figure 234**) onto the post on the crankcase. Install the circlip (A, **Figure 234**) securing the tensioner. Make sure the circlip is installed correctly in the post groove.
21. Make sure the spring is properly indexed and is pushing against the tensioner (**Figure 247**).
22. Apply assembly lube or molybdenum disulfide grease to the valve lifters. Install all 4 valve lifters (**Figure 231**) into the locations noted in Step 3, *Removal*.
23. The crankshaft front bearing (**Figure 248**) has cooled down by now. Apply clean engine oil to the bearing and rotate it several times to make sure the balls are covered with oil. Apply oil several times.
24. Install the following components as described in this chapter or other related chapters:
  - a. Clutch and flywheel (Chapter Five).
  - b. Oil pump (this chapter).
  - c. Engine front cover and timing chain cover (this chapter).
  - d. Connecting rods (this chapter).
  - e. Pistons (this chapter).
  - f. Cylinder heads and cylinders (this chapter).
25. Install the engine into the frame as described in this chapter.
26. Adjust the valves as described under *Cylinder Head Nut Torque and Valve Clearance Measurement and Adjustment* in Chapter Three.

#### Camshaft Timing Sprocket Removal/Installation

1. Remove the camshaft and timing sprocket assembly as described in this chapter.
2. Install the camshaft and timing sprocket onto a suitable size pipe that matches the outer surface of the timing gear. The sprocket must lie flat on the piece of pipe.
3. Use a suitable size piece of pipe that matches the end of the camshaft. The pipe must be long enough so that the thin end (contact breaker spindle) of the camshaft is not damaged.
4. Carefully press the camshaft out of the timing gear and the mounting flange with a hydraulic press.
5. Install by reversing these removal steps. Note the following during installation.
6. Make sure the Woodruff key is in place on the camshaft.
7. Be sure to align the Woodruff key with the keyway (**Figure 249**) on the timing sprocket during installation.
8. After installation, check the clearance between the camshaft timing gear and the mounting flange with a flat feeler gauge (**Figure 250**). Compare with the dimension listed in **Table 2**. Readjust if necessary by moving the timing sprocket either way until the clearance is correct.



### CAMSHAFT, TIMING CHAIN AND TIMING SPROCKETS (1979-ON MODELS)

Refer to Figure 251 for this procedure.

#### Removal

The original factory timing chain is manufactured with a master link. Therefore the timing chain can be removed without removing the camshaft and the crankshaft timing chain sprockets as on previous models.

1. Remove the engine from the frame as described in this chapter.
2. Remove the engine front cover and timing chain cover as described in this chapter.
3. Remove the bolt and washer and the nut and washer securing the chain guide rail to the crankcase. Remove the chain guide rail.

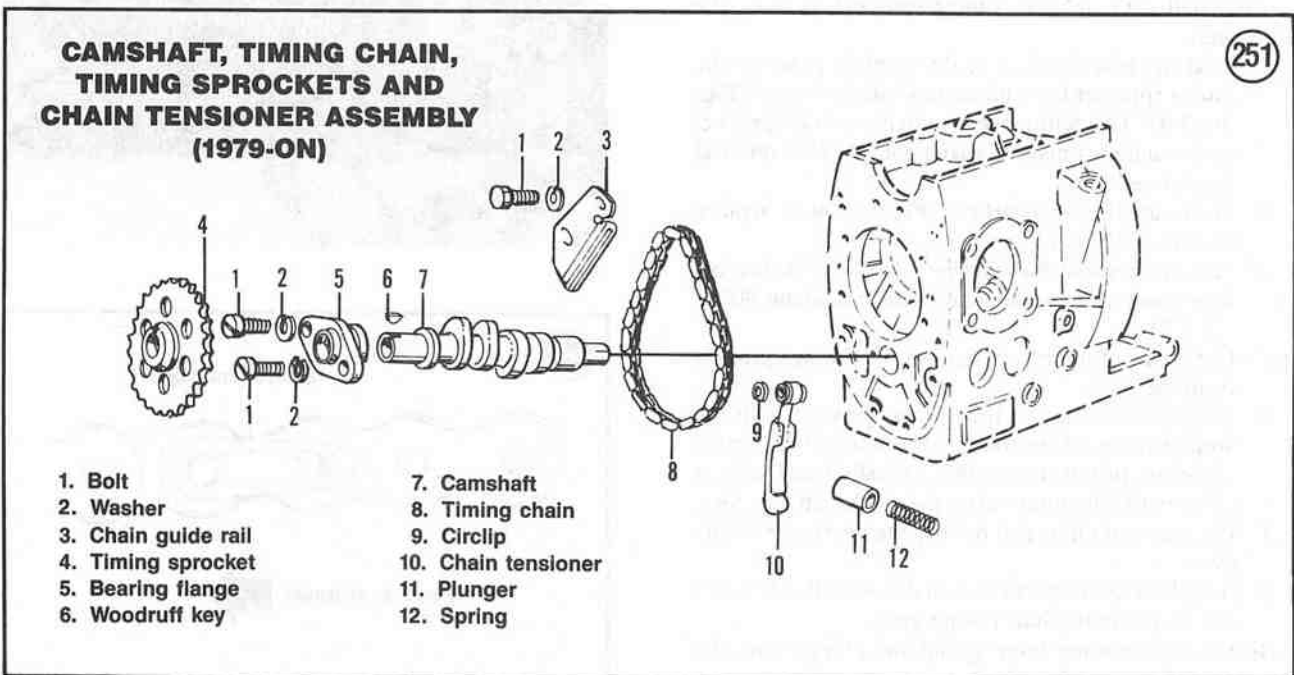


4. Remove the circlip securing the tensioner lever and remove the tensioner lever.
5. Remove the master link from the timing chain and remove the timing chain from both timing sprockets.
6. Remove the tensioner lever plunger and spring from the receptacle in the crankcase.
7. To remove the crankshaft timing sprocket and front bearing, perform the following:
  - a. Attach a suitable size puller behind the crankshaft timing chain sprocket.
  - b. Apply pressure on the puller and slowly withdraw the crankshaft timing sprocket and front bearing from the crankshaft. Continue until the timing sprocket and bearing are released from the end of the crankshaft. Remove the timing sprocket and bearing.
  - c. Don't lose the Woodruff key on the crankshaft. If it is not loose, there is no need to remove it.

#### CAUTION

*The camshaft timing sprocket can be removed with the aid of a bearing puller—but care must be taken to not damage the crankcase surface surrounding the timing sprocket. If the surface is gouged or damaged, there will be an oil leak.*

8. To remove the camshaft timing sprocket, perform the following:
  - a. Cover the crankcase surface on each side of the camshaft timing sprocket with pieces of leather and/or duct tape to protect the surface.
  - b. Use two large flat-bladed screwdrivers, or pry bars, located 180° apart and carefully pry the timing sprocket up and off of the camshaft.





- c. Remove the timing sprocket from the camshaft.
  - d. Don't lose the Woodruff key on the camshaft. If it is not loose, there is no need to remove it.
9. Inspect all components as described in this chapter.

### Installation

1. To install the camshaft timing sprocket, perform the following:
  - a. Make sure the Woodruff key is in place on the camshaft.
  - b. Coat the inner surface of the camshaft timing sprocket and the end of the camshaft with clean engine oil. This will make installation of the sprocket easier.

#### CAUTION

*In the following steps, the rear of the camshaft must be supported while installing the timing sprocket onto the front of the camshaft. The rear surface of the crankcase will be damaged, where the rear end of the camshaft rides, if the camshaft is not supported.*

- c. Have an assistant hold a *heavy* metal-faced hammer against the rear end of the camshaft to absorb the shock during timing sprocket installation.
  - d. Align the keyway on the timing sprocket with the Woodruff key on the camshaft and install the timing sprocket.
  - e. Use a soft-faced mallet and carefully tap the camshaft timing sprocket onto the camshaft.
2. To install the crankshaft timing sprocket, perform the following:
    - a. Coat the outer surface of the crankshaft where the timing sprocket fits with an anti-seize lubricant (**Figure 241**). This will make installation of the sprocket easier and also make it easier for sprocket removal later if necessary.
    - b. Make sure the Woodruff key (**Figure 240**) is in place on the crankshaft.
    - c. Place the crankshaft timing sprocket and front bearing in an oven or on a hot plate. Heat it to about 80° C (175° F).
    - d. Use a pair of pliers and remove the timing sprocket from the oven.
    - e. Align the keyway on the timing sprocket with the Woodruff key on the crankshaft and install the timing sprocket. Install it onto the crankshaft and slide it down until it bottoms out on the crankshaft shoulder.
    - f. Use a pair of pliers and remove the bearing from the oven.
    - g. Install the bearing and slide it down until it bottoms out on the crankshaft timing gear.
  3. Install the tensioner lever spring and plunger into the receptacle in the crankcase.

#### CAUTION

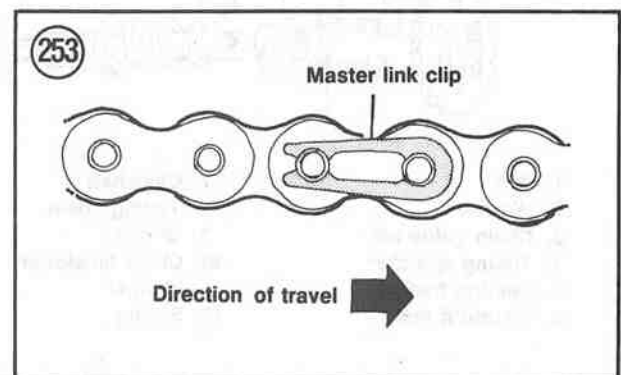
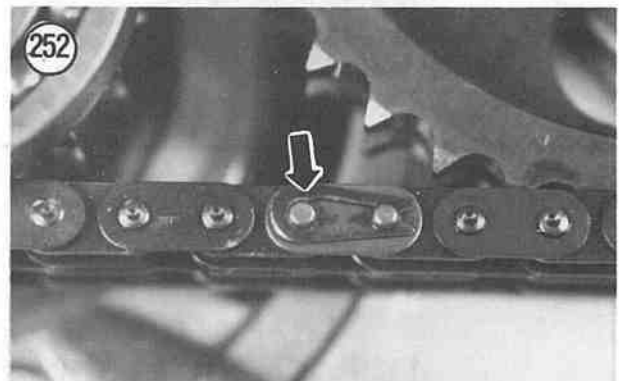
*Very expensive damage could result from improper crankshaft timing sprocket-to-camshaft sprocket alignment. Recheck your work several times to be sure alignment is correct and remains correct during the entire installation procedure.*

4. Align the index marks of the camshaft sprocket and the crankshaft timing sprocket.
5. With the timing sprocket index marks aligned, install the timing chain onto both sprockets.

#### CAUTION

*Incorrect installation of the timing chain master link clip could cause the timing chain to disconnect during engine operation and result in expensive engine damage.*

6. Install the master link, then install the master link clip (**Figure 252**) so that the closed end of the clip is facing the direction of chain travel (**Figure 253**).
7. The crankshaft front bearing has cooled down by now. Apply clean engine oil to the bearing and rotate it several times to make sure the balls are covered with oil. Apply oil several times.
8. After the crankshaft timing sprocket, timing chain and camshaft sprocket are completely installed, recheck that





the timing marks are still aligned. If alignment is incorrect, remove the timing chain and reinstall it correctly with the sprocket index marks properly aligned.

**CAUTION**

*In the next step, if there is any binding while rotating the crankshaft, stop. Determine the cause before proceeding.*

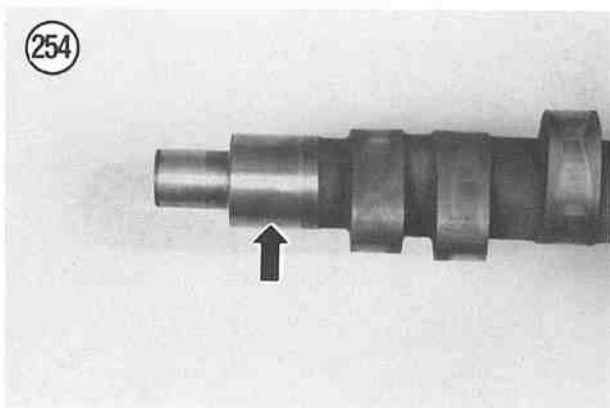
9. After installation is complete, *slowly* rotate the crankshaft several times. Make sure the engine rotates smoothly with no binding.
10. Install the tensioner lever onto the post on the crankcase. Install the circlip securing the tensioner lever. Make sure the circlip is installed correctly in the post groove.
11. Install the chain guide rail, the bolt and washer and the nut and washer securing the chain guide rail to the crankcase.
12. Push the guide rail up against the timing chain so that the guide rail is parallel to the timing chain. Tighten the bolt and the nut securely. After tightening the bolt and nut, recheck and make sure the guide rail is still parallel to the timing chain. Readjust if necessary.
13. Install the engine front cover and timing chain cover as described in this chapter.
14. Install the engine into the frame as described in this chapter.

**CAMSHAFT  
(1979-ON MODELS)**

**Removal/Installation**

Refer to **Figure 251** for this procedure.

1. Remove the engine from the frame as described in this chapter.
2. Remove the following components as described in this chapter or other related chapters:
  - a. Cylinder heads and cylinders (this chapter).
  - b. Pistons (this chapter).
  - c. Connecting rods (this chapter).



- d. Engine front cover and timing chain cover (this chapter).
  - e. Oil pump (this chapter).
  - f. Clutch and flywheel (Chapter Five).
3. Remove the timing chain as described under *Timing Chain and Timing Sprockets (1979-On Models)* in this chapter.

**CAUTION**

*All 4 valve lifters must be removed from the crankcase before removing the camshaft. If they are left in place, the camshaft lobes will hangup on them during removal and the camshaft or the valve lifters will be damaged during camshaft removal.*

4. If not already removed, use a wire hook and remove all 4 valve lifters (**Figure 231**). Label them so they will be reinstalled in their original locations.
5. Remove the bolts and lockwashers securing the camshaft mounting flange.
6. Withdraw the camshaft from the crankcase.
7. Inspect the camshaft as described in this chapter.
8. Install by reversing these removal steps. Note the following during installation.
9. Apply assembly lube or molybdenum disulfide grease to the camshaft lobes and to the rear bearing surfaces.
10. Apply blue Loctite Threadlocker (No. 242) to the camshaft bearing flange bolts prior to installation.
11. Install the Allen bolts and lockwashers securing the camshaft bearing flange. Tighten the bolts securely.

**CAMSHAFT, TIMING CHAIN,  
TIMING SPROCKETS  
AND CHAIN TENSIONER  
ASSEMBLY INSPECTION**

**Camshaft Inspection  
(All Models)**

**NOTE**

*BMW does not provide any service limit dimensions for the camshaft. They provide only a maximum and minimum new dimension for a specific area. If any portion of the camshaft is worn to less than the specified minimum new dimension, the camshaft should be replaced.*

1. Clean all parts in solvent and dry with compressed air.
2. Inspect the rear bearing journal and the lobes for wear or damage.
3. Inspect the camshaft rear bearing journal (**Figure 254**) for wear and scoring. Measure with a micrometer (**Figure**

255). Compare to the dimensions given in **Table 2**. If worn to less than the specified minimum dimension, the camshaft must be replaced.

4. Check the camshaft lobes (**Figure 256**) for wear. The lobes should show no signs of scoring and the edges should be square. Slight damage may be removed with a silicon carbide oilstone. Use No. 100-120 grit initially, then polish with a No. 280-320 grit.

5. Even though the camshaft lobe surface appears to be satisfactory, with no visible signs of wear, the camshaft lobes should be measured with a micrometer (**Figure 257**) and compared to the other similar camshaft lobe (intake-to-intake lobes and exhaust-to-exhaust lobes). BMW does not provide a lobe height dimension but the similar lobes should be the same height.

6. Inspect the camshaft rear bearing insert surfaces in the crankcase. Measure with a snap gauge or inside micrometer. Compare to the dimensions given in **Table 2**. If worn to more than the specified maximum dimension, the crankcase must be replaced.

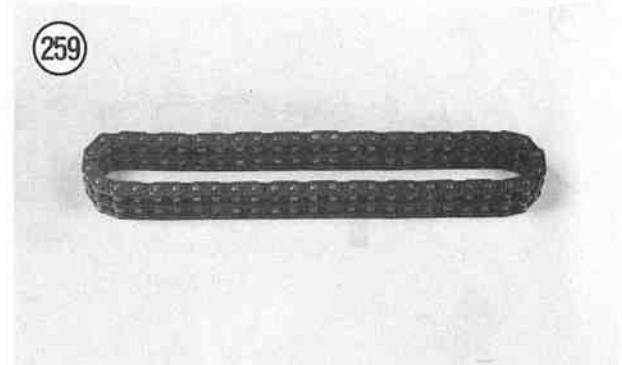
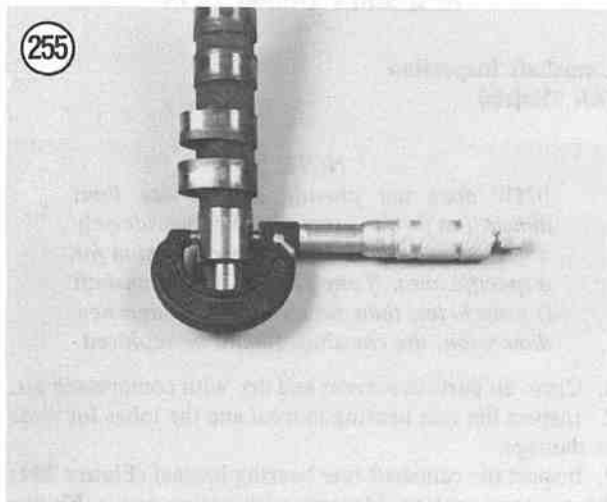
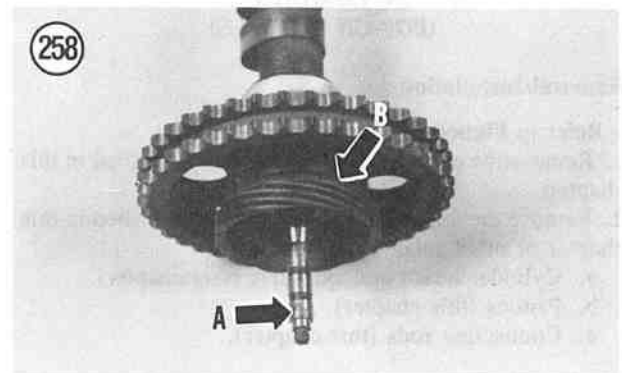
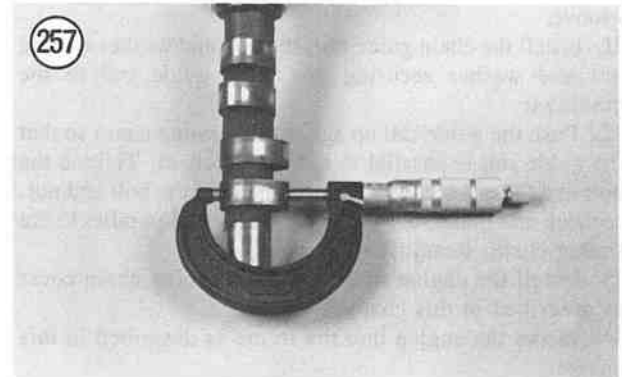
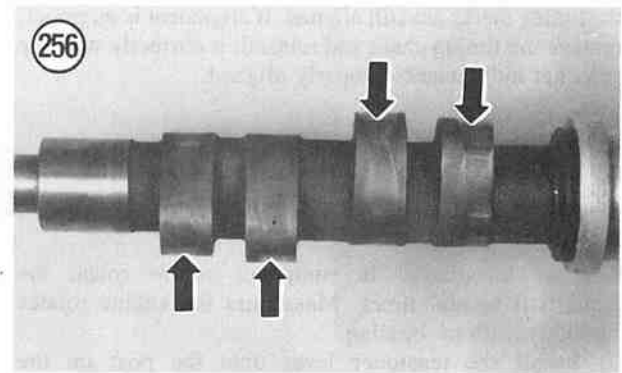
7. Inspect the front section of the camshaft (A, **Figure 258**) for wear or damage. Replace if necessary.

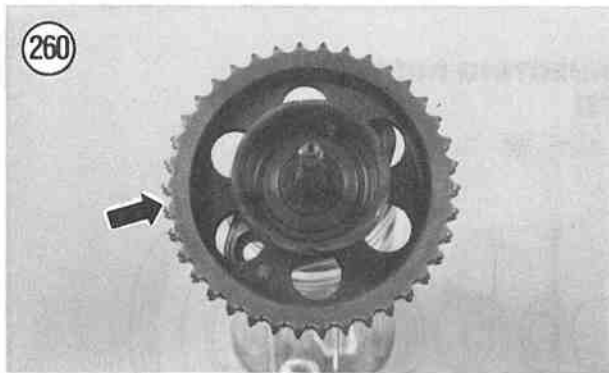
8. On models so equipped, inspect the tachometer drive gear (B, **Figure 258**) for wear or damage. Replace if necessary.

#### Timing Chain Inspection (All Models)

1. Inspect the timing chain (**Figure 259**) for wear or damage. BMW does not provide any service limit specifications for length of chain between any given number of pins. If the chain shows signs of wear or damage, replace it. If the pins and plates look scuffed or worn or if the chain is noisy during normal engine operation, the chain should be replaced.

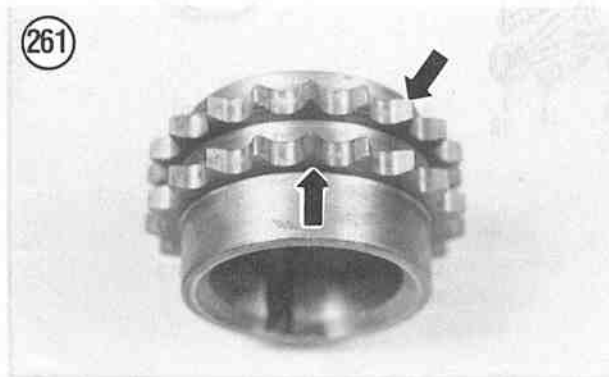
2. On models so equipped, inspect the master link clip. It must be tight on the master link pins. If the clip is not tight, replace the master link assembly.





### Timing Sprocket Inspection (All Models)

1. Inspect the camshaft sprocket teeth (Figure 260) for wear; replace if necessary.
2. Inspect the crankshaft sprocket teeth (Figure 261) for wear; replace if necessary.
3. Inspect the Woodruff keyway (Figure 262) for wear or damage; replace if necessary.

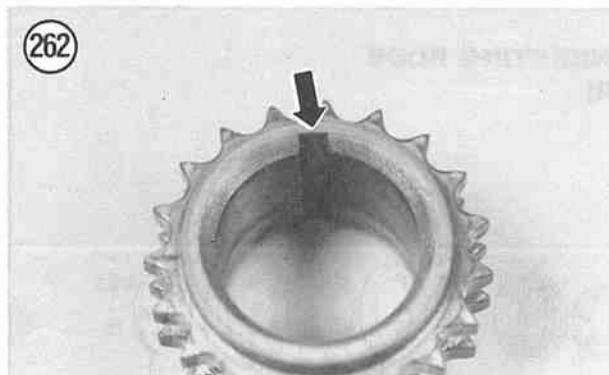


### Tensioner Assembly Inspection (All Models)

Inspect the rubbing surface of the tensioner for wear or damage. Replace if necessary.

### Crankshaft Bearing Inspection

1. Inspect the crankshaft bearing (Figure 263) for wear or damage. Turn the bearing by hand. It must rotate freely with no signs of wear.
2. Check the balls for evidence of wear, pitting or excessive heat (bluish tint).
3. Replace the bearing if necessary.

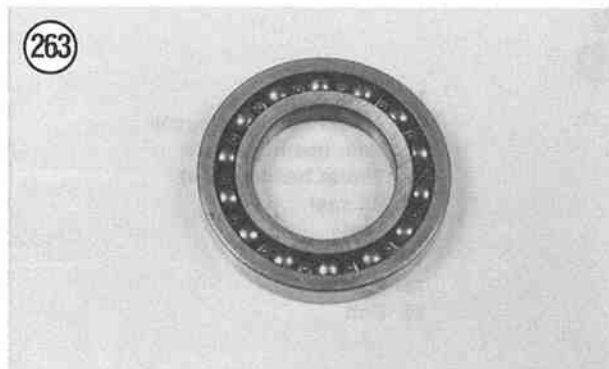


## CRANKSHAFT

### Removal/Installation

Refer to the following illustrations for this procedure:

- a. Figure 264: 1970-1978 models.
  - b. Figure 265: 1979-on models.
  - c. Figure 266: all models.
1. Remove the engine from the frame as described in this chapter.
  2. Remove the following components as described in this chapter or other related chapters:
    - a. Cylinder heads and cylinders (this chapter).
    - b. Pistons (this chapter).
    - c. Connecting rods (this chapter).
    - d. Engine front cover and timing chain cover (this chapter).
    - e. Timing chain and camshaft (this chapter).
    - f. Oil pump (this chapter).
    - g. Clutch and flywheel (Chapter Five).
  3. Remove the nuts and lockwashers securing the crankshaft front bearing carrier. Refer to Figure 267 for the right-hand side and A, Figure 268 for the left-hand side.
  4. On the left-hand side also remove the timing chain tensioner spring (B, Figure 268).

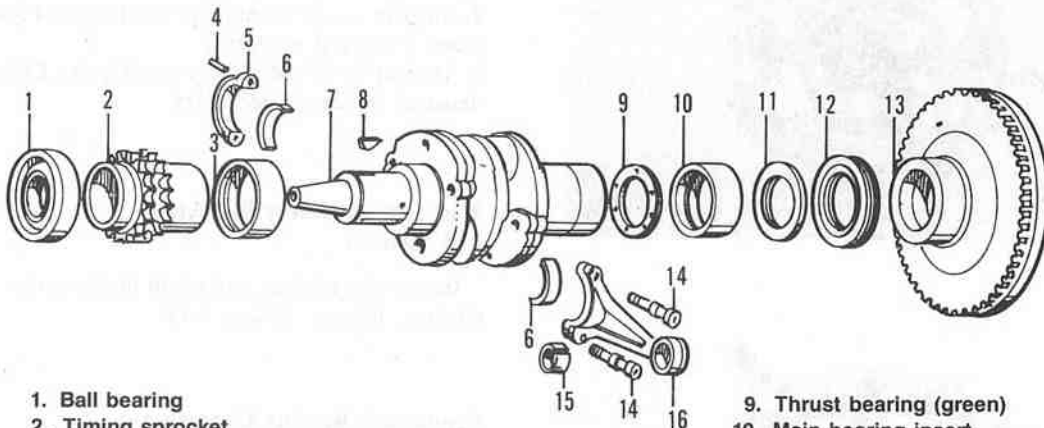


### CAUTION

*Be sure to use the pressure pad to avoid damage to the front of the crankshaft.*

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### CRANKSHAFT AND CONNECTING RODS (1970-1978)

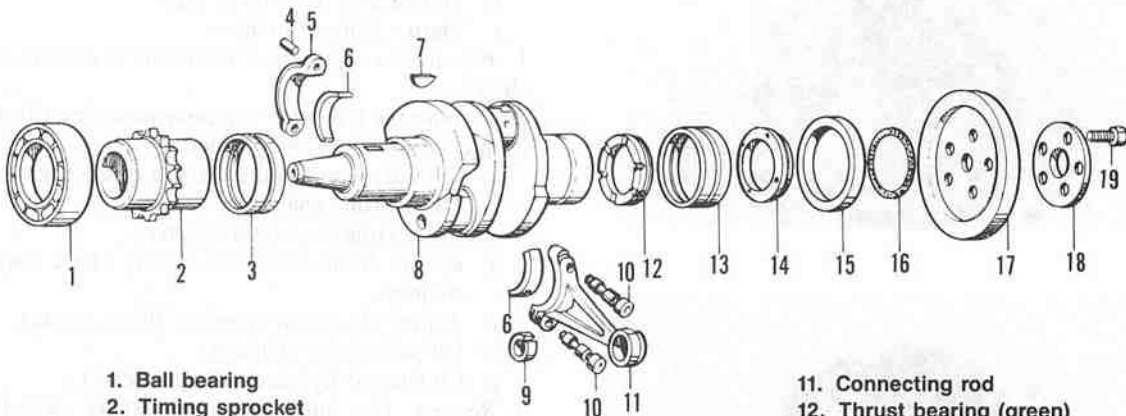


1. Ball bearing
2. Timing sprocket
3. Main bearing insert
4. Dowel pin
5. Connecting rod end cap
6. Bearing insert set
7. Crankshaft
8. Woodruff key

9. Thrust bearing (green)
10. Main bearing insert
11. Thrust bearing (red)
12. Oil seal
13. Flywheel
14. Bolt
15. Connecting rod bushing
16. Connecting rod

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### CRANKSHAFT AND CONNECTING RODS (1979-ON)

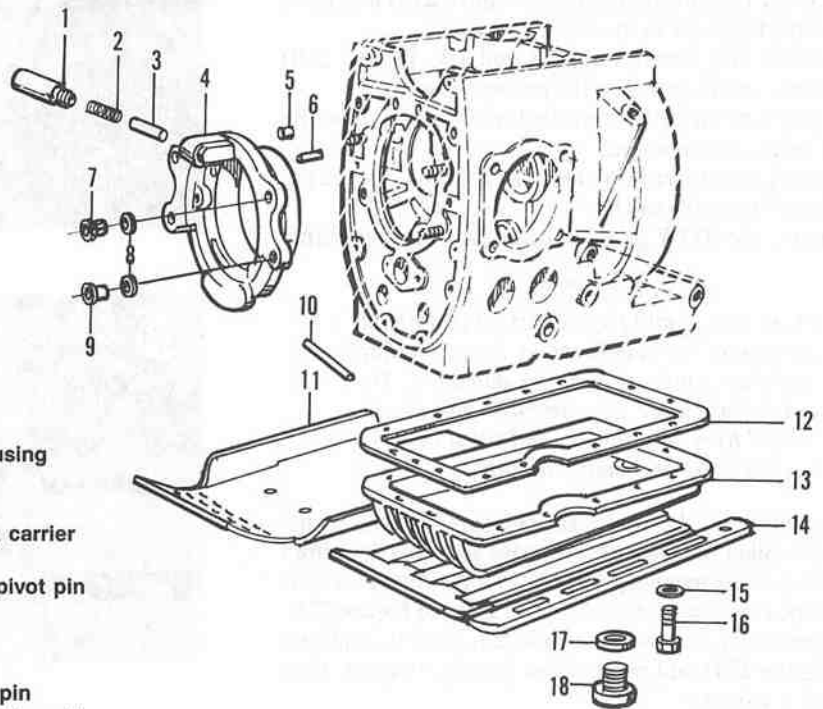


1. Ball bearing
2. Timing sprocket
3. Main bearing insert
4. Dowel pin
5. Connecting rod end cap
6. Bearing insert set
7. Woodruff key
8. Crankshaft
9. Connecting rod bushing
10. Bolt

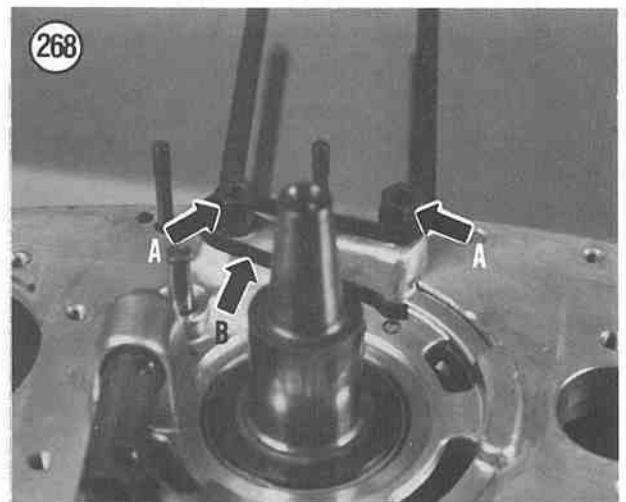
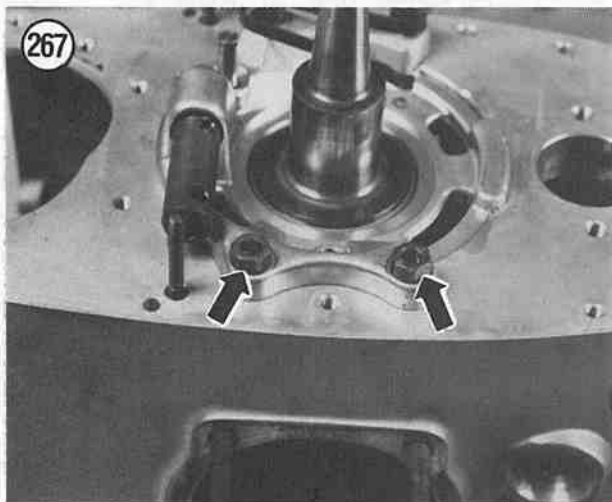
11. Connecting rod
12. Thrust bearing (green)
13. Main bearing insert
14. Thrust bearing (red)
15. Oil seal
16. Seal
17. Flywheel
18. Washer
19. Bolt

266

**CRANKSHAFT FRONT BEARING CARRIER AND OIL PAN**



- 1. Pressure relief valve housing
- 2. Spring
- 3. Plunger
- 4. Crankshaft front bearing carrier
- 5. Plug
- 6. Timing chain tensioner pivot pin
- 7. Nut
- 8. Lockwasher
- 9. Nut
- 10. Bearing carrier locating pin
- 11. Skid plate (models so equipped)
- 12. Oil pan gasket
- 13. Oil pan
- 14. Skid plate (models so equipped)
- 15. Washer
- 16. Bolt
- 17. Sealing washer
- 18. Drain plug





5. Install the BMW special pressure pad tool, part No. 11 1 690 (**Figure 269**), into the hole in the crankshaft end.
6. Install the BMW special puller tool (part No. 00 7 500) onto the crankshaft front bearing carrier as follows:
  - a. Screw the threaded rods (**A**, **Figure 270**) into the 2 threaded holes in the carrier.
  - b. Screw the center threaded rod (**B**, **Figure 270**) down until it contacts the pressure pad.
7. Slowly turn the center threaded rod and withdraw the carrier from the crankcase.
8. Remove the carrier from the crankcase and remove the special tool from the carrier.
9. Remove the BMW pressure pad from the crankshaft.

#### CAUTION

*Do not try to pull the crankshaft straight up and out of the crankcase as the crankshaft and the crankcase may be damaged. The crankshaft must be carefully pulled out, moved from side-to-side and tilted in order to obtain the necessary clearance.*

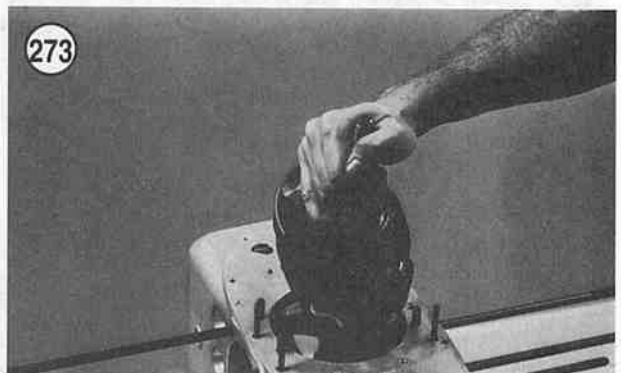
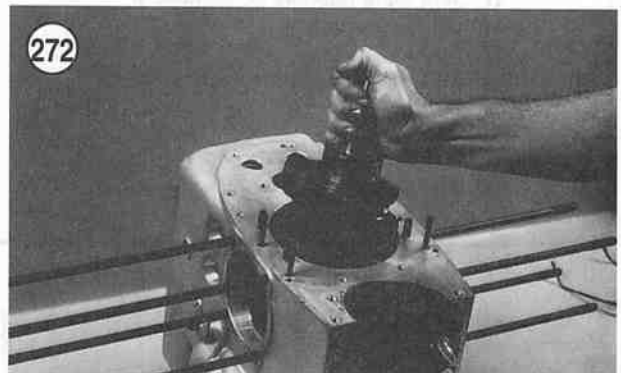
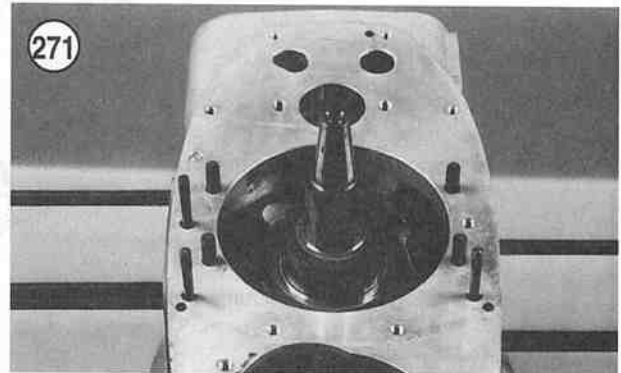
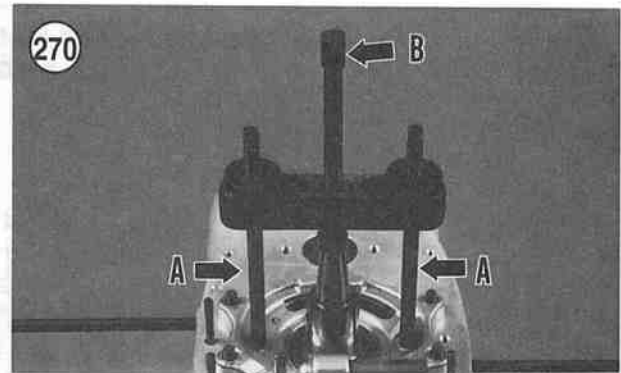
10. Carefully pull the crankshaft (**Figure 271**) out of the crankcase. Slightly rotate, tilt and move the crankshaft from side-to-side while removing it in order for the counterweights to clear the crankcase. Refer to **Figure 272** and **Figure 273**.
11. If necessary, remove the crankshaft inner thrust bearing (**Figure 274**) and outer thrust bearing (**Figure 275**) from the crankcase.
12. Inspect the crankshaft and front bearing carrier as described in this chapter.

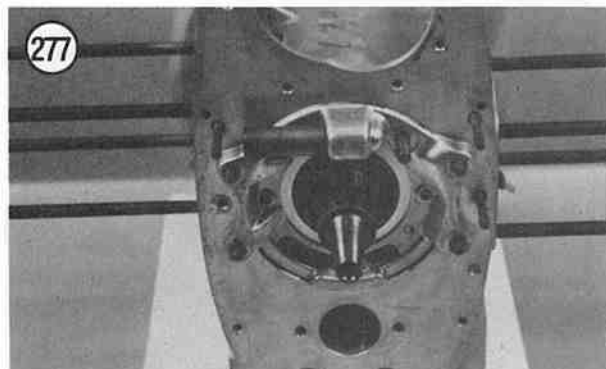
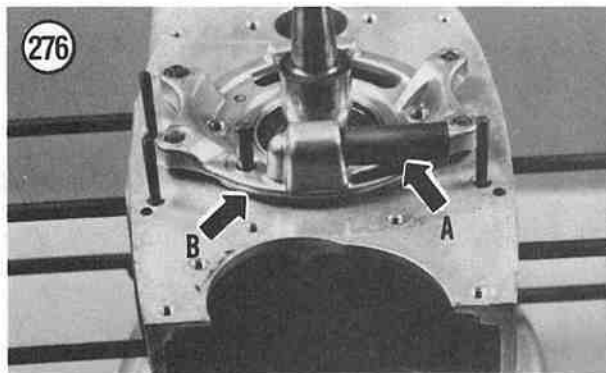
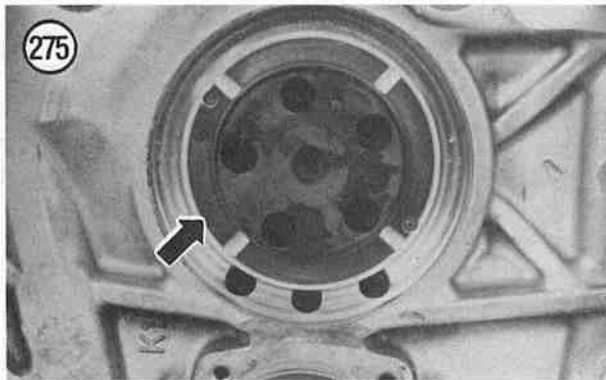
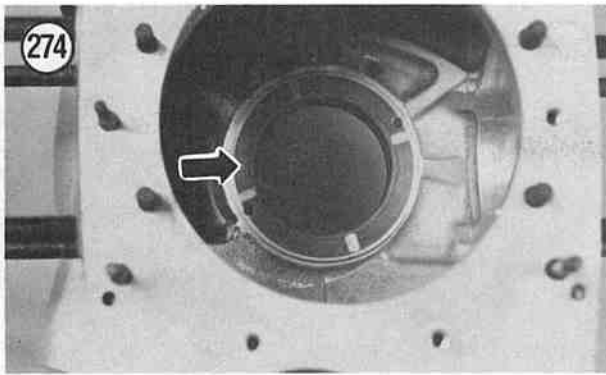
#### Installation

1. If removed, install the crankshaft inner (green colored) thrust bearing (**Figure 274**) and outer (red colored) thrust bearing (**Figure 275**) into the crankcase. Make sure the inserts are seated correctly on the crankcase locating pins.

#### CAUTION

*Do not try to install the crankshaft straight down and into the crankcase as the crankshaft and the crankcase may be damaged. The*





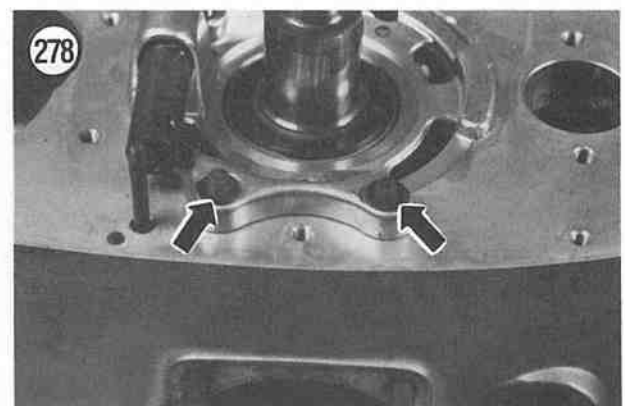
*crankshaft must be carefully moved in and out, from side-to-side and tilted in order to obtain the necessary clearance.*

2. Carefully install the crankshaft into the crankcase. Slightly rotate, tilt and move the crankshaft from side-to-side while installing it in order to clear the counterweights. Refer to **Figure 273** and **Figure 272**.
3. Make sure the crankshaft is completely seated in the crankcase and on the crankshaft inner thrust washer (**Figure 271**).
4. Correctly position the front bearing carrier with the oil pressure relief valve assembly (A, **Figure 276**) located toward the top of the crankcase.
5. Install the front bearing carrier (B, **Figure 276**) onto the crankcase.
6. Using a soft-faced mallet or plastic hammer, lightly tap around the perimeter of the front bearing carrier. Tap it down until it seats completely onto the crankcase surface (**Figure 277**).

#### CAUTION

*The bearing carrier should fit down onto the crankcase without force. If it does not fit down flush, do not attempt to pull the bearing carrier down onto the crankcase surface with the mounting nuts. Remove the carrier and correct the problem. Check that the inner thrust bearing is correctly seated on the back surface of the crankcase. Do not risk damaging either part by trying to force the 2 parts together.*

7. Install the lockwashers (**Figure 278**) onto the threaded studs.
8. On the left-hand side, install the timing chain tensioner spring (B, **Figure 268**) onto the threaded studs.
9. Position the nuts with the round turned end going on first. Install the nuts securing the crankshaft front bearing carrier. Refer to **Figure 267** for the right-hand side and A, **Figure 268** for the left-hand side.
10. Tighten the nuts in 2-3 stages in a crisscross pattern. Tighten the nuts securely.



11. Install the following components as described in this chapter or other related chapters:
  - a. Clutch and flywheel (Chapter Five).
  - b. Oil pump (this chapter).
  - c. Timing chain and camshaft (this chapter).
  - d. Engine front cover and timing chain cover (this chapter).
  - e. Connecting rods (this chapter).
  - f. Pistons (this chapter).
  - g. Cylinder heads and cylinders (this chapter).
12. Install the engine in the frame as described in this chapter.

### Crankshaft Front Bearing Carrier Inspection

1. Inspect the front bearing carrier (**Figure 279**) for cracks or any other visible damage.
2. Make sure all mounting holes are in good condition.
3. Make sure the circlip groove (**Figure 280**) on the timing chain tensioner stud is in good condition.
4. Replace the front bearing carrier if damaged in any way.

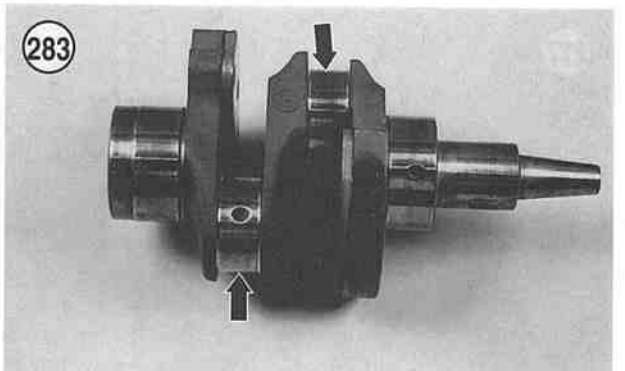
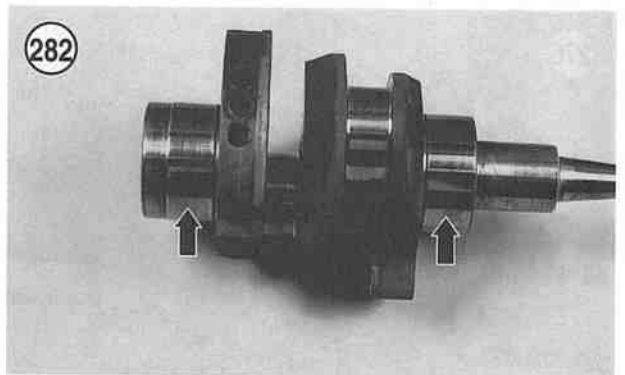
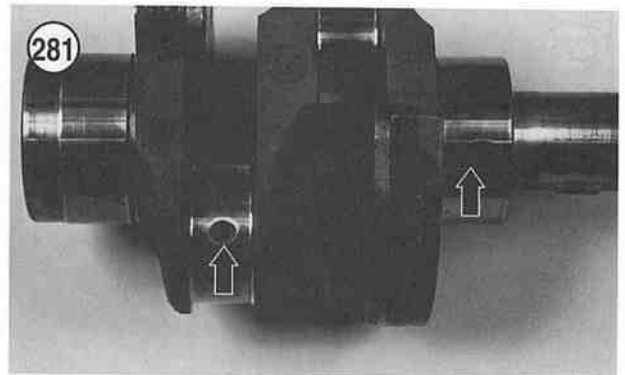
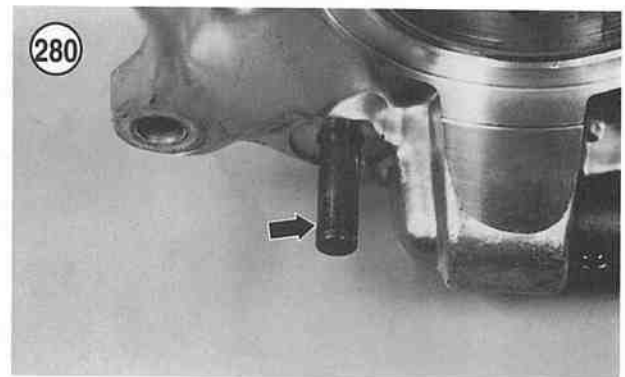
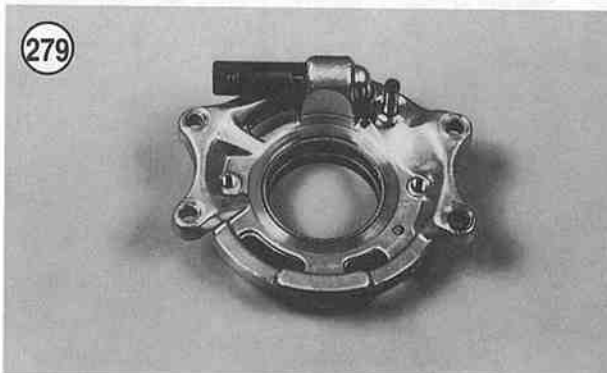
### Crankshaft Inspection and Bearing Journal Measurement

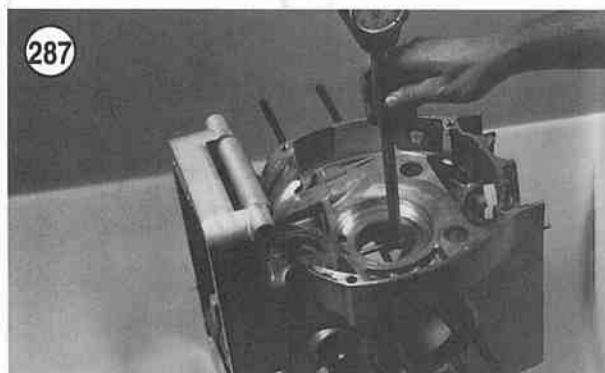
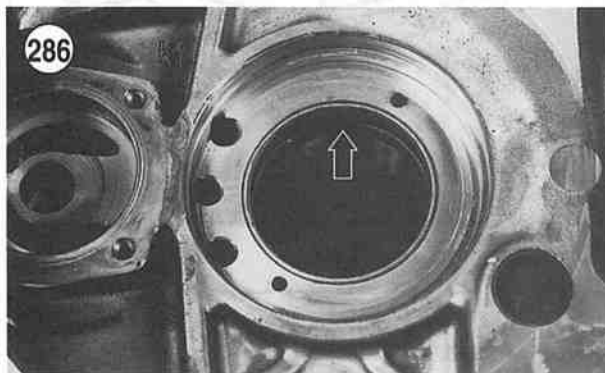
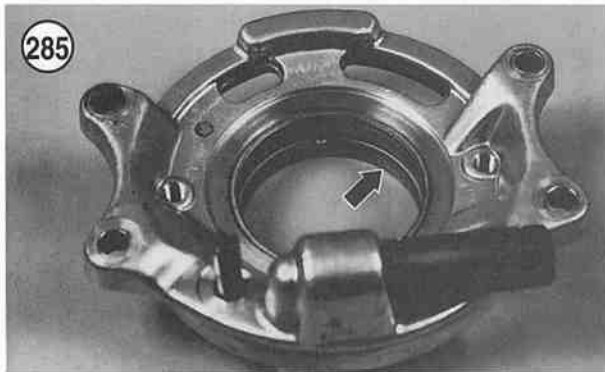
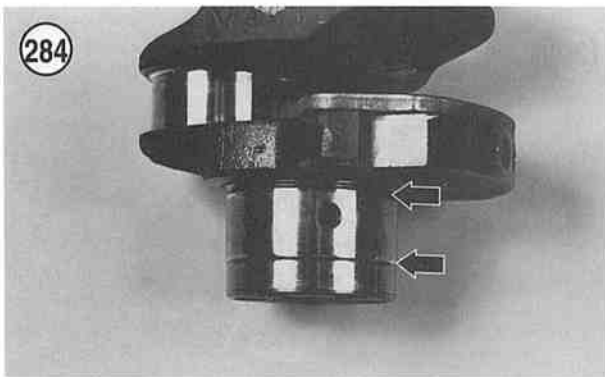
If the main bearing journals are worn, the crankshaft can be reground to the next undersize and new bearings installed.

1. Clean crankshaft thoroughly with solvent. Clean oil holes (**Figure 281**) with rifle cleaning brushes; flush thoroughly and dry with compressed air. Lightly oil all bearing journal surfaces immediately to prevent rust.
2. Carefully inspect each main bearing journal (**Figure 282**) for scratches, ridges, scoring, nicks, etc. Very small nicks and scratches may be removed with crocus cloth. If the damage is more serious, regrind or replace the crankshaft.

#### NOTE

*Inspection and measurement of the connecting rod journals are covered under **Connecting Rods** in this chapter.*





3. While the crankshaft is removed, also inspect the connecting rod journals (**Figure 283**) for scratches, ridges, scoring, nicks, etc. Very small nicks and scratches may be removed with crocus cloth. If the damage is more serious, regrind or replace the crankshaft.

**NOTE**

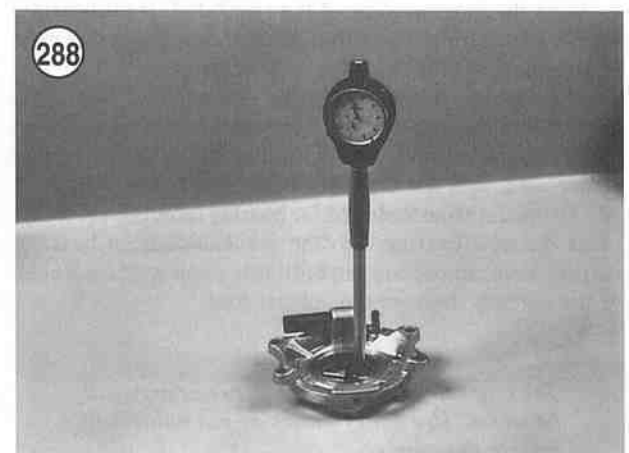
*Because the main bearing journals are so wide, measure the front and rear planes of the bearing as shown in **Figure 284**. Also measure in 2 axes, 90° apart.*

4. If the surface finish on all journals is satisfactory, measure the journals with a micrometer and check out-of-roundness, taper, and wear on the journals. Crankshaft journals are identified by color coding as listed in **Table 2**.  
5. If the crankshaft main journals are out of specification, regrind the crankshaft to the next undersize and install the appropriate new bearing inserts.

#### Crankshaft Main Bearing Inspection and Measurement

The crankshaft front main bearing is located in the front bearing carrier and the rear main bearing is located in the rear wall of the crankcase.

1. Check each main bearing insert for evidence of wear, abrasion, and scoring. Refer to **Figure 285** for the front bearing or **Figure 286** for the rear bearing. If the bearings are good, they may be reused. If either bearing insert is questionable, replace both as a set.
2. Clean the main bearing inserts with solvent and dry with compressed air or a lint-free cloth.
3. Use a bore gauge and measure the rear bearing (**Figure 287**) on 2 axes, 90° apart. Write this dimension down and use for main bearing selection in the following procedure.
4. Use a bore gauge and measure the front bearing (**Figure 288**) on 2 axes, 90° apart. Write this dimension down and use for main bearing selection in the following procedure.





### Crankshaft-to-Crankcase Main Bearing Selection

1. Subtract the crankshaft main journal outer diameter dimension from the main bearing inner diameter. This will give the clearance between the 2 parts.
2. Check against measurements given in **Table 2** and select new bearings.
3. If the clearance is not within specifications, replace the bearing insert(s) with an appropriate sized new bearing insert as described in this chapter.
4. If the crankshaft is worn to a dimension that oversize bearings will not bring the clearance within specification, the crankshaft must be replaced.

### Main Bearing Replacement

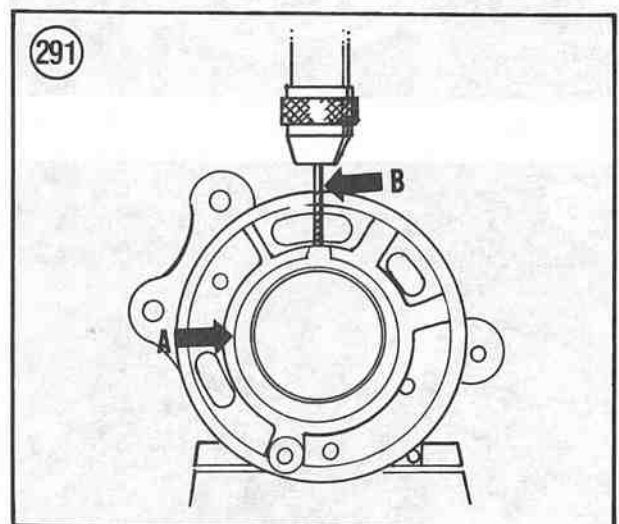
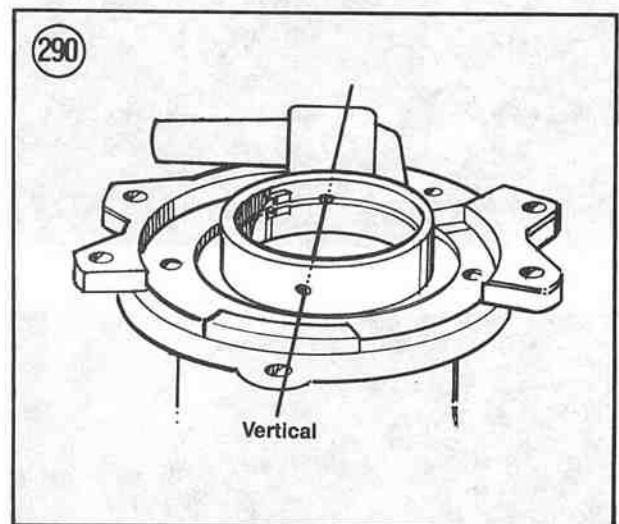
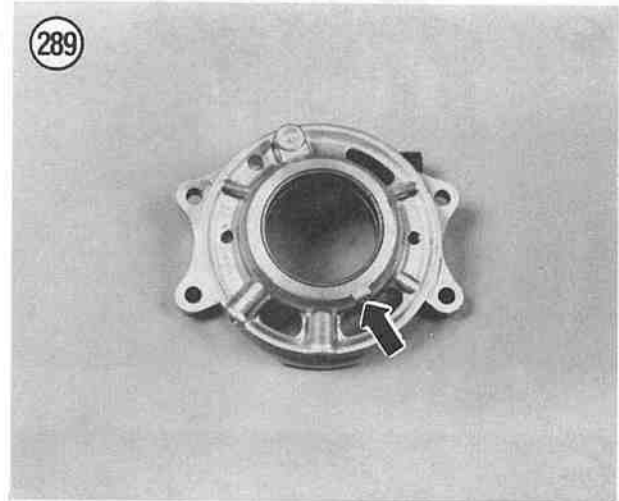
#### Front bearing

This procedure requires the use of several BMW special tools and a hydraulic press. Do not try to substitute the special tools as the crankshaft front bearing carrier may be damaged.

1. Place the new bearing in a freezer for 30 minutes. This will reduce the overall size of the bearing.
2. Place the crankshaft front bearing carrier in a vise with soft jaws.
3. Using a suitable size drift, carefully tap the bearing locating pin (**Figure 289**) out from the *inner surface*. Remove the locating pin.
4. Remove the crankshaft front bearing carrier from the vise.
5. Heat the crankshaft front bearing carrier in an oven or hot plate to 100-120° C (180-200° F).
6. Place the crankshaft front bearing carrier, front side up, on a BMW special assembly tool (part No. 11 2 710).
7. Install the BMW special pressing mandrel tool (part No. 11 2 700) onto the bearing and press the bearing out of the crankshaft front bearing carrier. Remove the special tool and the bearing.
8. Leave the crankshaft front bearing carrier in the special tool.
9. Wipe the inner surface of the crankshaft front bearing carrier with a lint-free cloth. Check for any burrs that may hinder the installation of the new bearing.
10. Remove the bearing from the freezer.
11. Position the new bearing in the crankshaft front bearing carrier so the bearing joint is located 26° to the left of top center, and with the oil holes vertical (**Figure 290**).
12. Using the same tool used for bearing removal, carefully press the new bearing into the crankshaft front bearing carrier. Press the bearing in until it is flush with each side of the carrier. Remove the special tool.

#### WARNING

*The crankshaft front bearing carrier may still be warm. Use heavy gloves or pot holders to handle the carrier.*



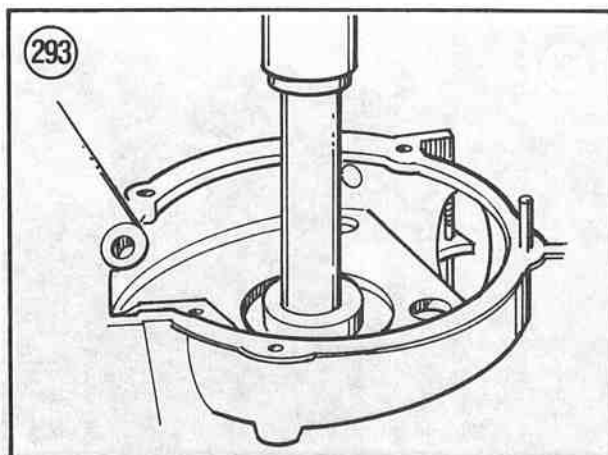
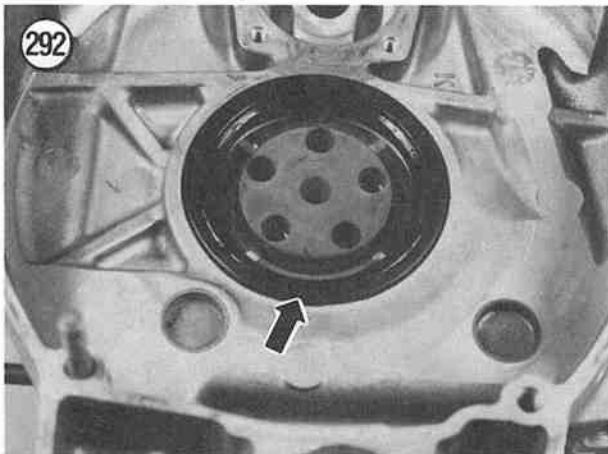


13. Remove the crankshaft front bearing carrier from the special tool.
14. Inspect the crankshaft front bearing carrier and make sure the bearing is installed correctly.
15. Place the crankshaft front bearing carrier in a vise with soft jaws with the bearing locating pin hole facing up.
16. Drill 2 holes all the way through the new bearing with a 3.15 mm (0.124 in.) drill bit. Drill through the existing holes in the crankshaft front bearing carrier (A, **Figure 291**). Deburr the new holes in the bearing. Make sure the inner surface is free of any burrs.
17. Drill a locating pin hole through the new bearing as follows:

**CAUTION**

*Do not drill all the way through the bearing with the first size drill bit as you are creating a tapered hole.*

- a. Partially drill into the new bearing (B, **Figure 291**) with a 3.825 mm (0.156 in.) drill bit. Do not drill all the way through the insert.



- b. Drill all the way through the new bearing with a 3.750 mm (0.148 in.) drill bit.

**CAUTION**

*In the following step, do not ream the hole all the way through. This step is to provide a tapered hole to accept the locating pin. The locating pin must only travel partway and must not come in contact with the crankshaft bearing journal.*

- c. Use a No. 4H8 reamer and partially ream the drilled hole.
- d. Deburr the hole in the bearing. Make sure the inner surface is free of any burrs.
18. Install the BMW special pressing mandrel tool (part No. 11 2 700) into a vise in a horizontal position.
19. Install the crankshaft front bearing carrier onto the mandrel tool with the locating pin hole facing up.
20. Install, then tap the locating pin into the hole in the crankshaft front bearing carrier. Tap the locating pin into the hole until it is 0.5-1.0 mm (0.0197-0.0394 in.) below the surface of the pin boss. Check to make sure the pin did not pass all the way through the hole.
21. Use a centerpunch and hammer, and stake the edge of the pin boss hole several times to prevent the pin from backing out.
22. Remove the crankshaft front bearing carrier from the special tool.

**Rear bearing**

This procedure requires the use of several BMW special tools and a hydraulic press. Do not try to substitute the special tools as the crankcase may be damaged.

1. Remove the crankshaft rear main oil seal (**Figure 292**) as described in this chapter.
2. Place the new bearing in a freezer for 30 minutes. This will reduce the overall size of the bearing.
3. Heat the rear surface of the crankcase on a hot plate to 100-120° C (180-200° F).
4. Place a BMW special assembly tool (part No. 11 2 710) on the base plate of the hydraulic press in a vertical position.

**WARNING**

*The crankcase is hot. Use heavy gloves or pot holders to handle the crankcase.*

5. Remove the crankcase from the hot plate and set it on the special tool in the hydraulic press. Position the crankcase so the inner thrust washer locating pins are aligned with the matching holes in the special tool. Have an assistant hold the crankcase in place.
6. Install the BMW special pressing mandrel tool (part No. 11 2 700) onto the bearing (**Figure 293**) and press the bearing out of the crankcase. Remove the special tool and the bearing.

7. Keep the crankcase and the special tool on the hydraulic press base plate.
8. Wipe the inner surface of the crankcase with a lint-free cloth. Check for any burrs that may hinder the installation of the new bearing.
9. Remove the bearing from the freezer.
10. Position the new bearing on the crankcase so the bearing joint is located  $26^\circ$  to left of bottom center, and with the oil holes aligned with the oil holes in the crankcase.
11. Install the BMW special pressing mandrel tool (part No. 11 2 720) with the plastic insert in place onto the bearing (A, **Figure 294**).
12. Align the 2 reliefs (B, **Figure 294**) in the special tool with the 2 locating pins (C, **Figure 294**).
13. Recheck that the inner thrust washer locating pins are still aligned with the matching holes in the special tool. Readjust if necessary and have an assistant hold the crankcase in place.
14. Press the bearing into the crankcase until the special tool bottoms out. Remove the special tool and the bearing.
15. When the bearing is installed correctly, the bearing edge will be set back an equal amount on each side of the crankcase bearing bore. Make sure the bearing is installed correctly and that the oil holes are correctly aligned. If necessary, remove the bearing and install another bearing correctly.
16. Install a new crankshaft rear main oil seal as described in this chapter.

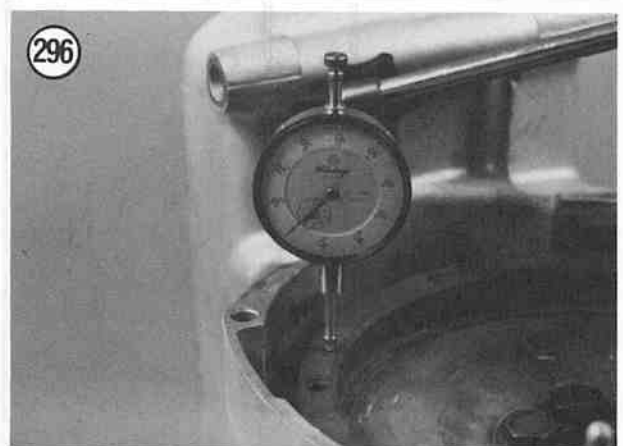
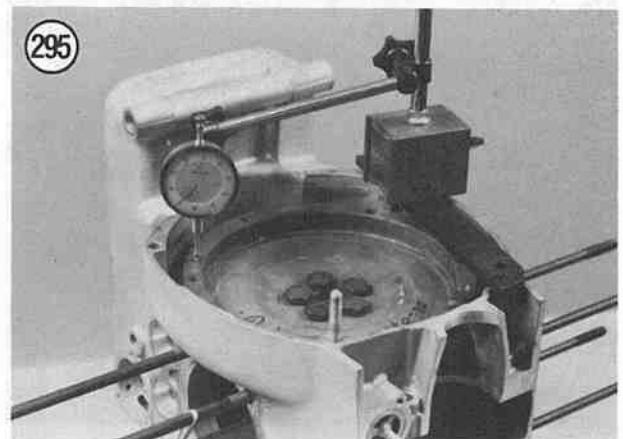
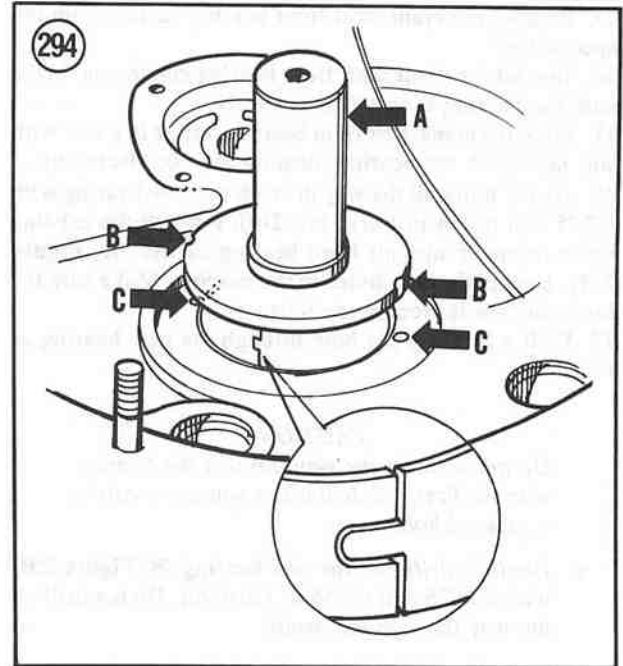
### Crankshaft End Float Measurement

1. Make sure the crankshaft inner (green colored) thrust bearing (**Figure 274**) and outer (red colored) thrust bearing (**Figure 275**) are in place in the crankcase.
2. Install the crankshaft into the crankcase as described in this chapter.
3. Install the crankshaft front bearing carrier as described in this chapter.

#### CAUTION

*For this measurement procedure, use the old flywheel mounting bolts. Do not use new bolts as they will stretch and cannot be reused.*

4. Install the flywheel as described in Chapter Five.
5. Place the crankcase horizontally in its normal position.
6. Attach a dial indicator to the rear surface of the crankcase as shown in **Figure 295**.
7. Place the dial indicator probe on the rear surface of the flywheel.
8. Move the crankshaft all the way toward the *front* of the crankcase until it bottoms out.
9. Zero the dial indicator (**Figure 296**).
10. Move the crankshaft all the way toward the *rear* of the crankcase until it bottoms out.



11. Note the distance the crankshaft traveled on the dial indicator. This is the total end float. The end float should be between 0.08-0.15 mm (0.0031-0.0059 in.).
12. Double check by repeating Steps 6-9 and note the distance traveled this time. It should be the same each time.
13. Refer to specifications listed in **Table 2**. If the end float has worn to the specification or greater, the rear outer red thrust washer (**Figure 275**) must be replaced with one of a different thickness. There are 3 additional thrust bearing sets available from a BMW dealer.
14. Remove the dial indicator.
15. Remove the flywheel as described in Chapter Five.
16. Remove the rear outer thrust washer (red colored) (**Figure 275**) and measure with a micrometer (**Figure 297**).
17. To calculate the correct thrust washer thickness proceed as follows:

**NOTE**

For calculations use the midpoint of the specified clearance. For example, if the clearance is 0.08-0.15 mm, the midpoint is 0.12 mm.

**NOTE**

The following numbers are for example only. Use the measurement taken in Step 17 for your calculations.

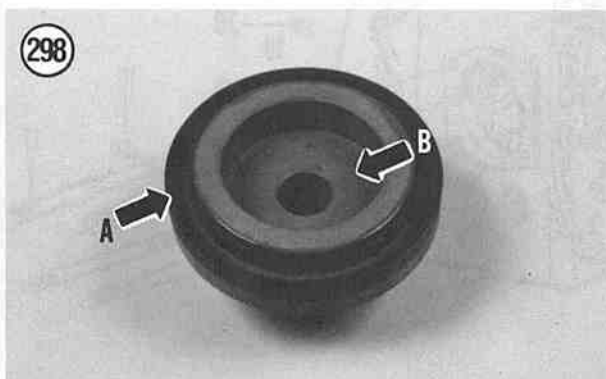
Actual measured end play	0.18 mm
Subtract the specified end play	-0.12 mm
Equals excess end play	0.06 mm
Add thickness of thrust washer removed and measured	+2.48 mm
New thrust washer should be	2.54 mm

18. Select a new thrust washer that is as close to the specified thickness as possible. It shouldn't be more than 0.03 mm (0.0012 in.) or less than 0.04 mm (0.0016 in.) of the desired thickness.

**CAUTION**

Again, use the old flywheel mounting bolts. Do not use new bolts as they will stretch and cannot be reused.

19. Install the new thrust washer and install the flywheel as described in Chapter Five.
20. Repeat Steps 5-15 and recheck the end float measurement. Repeat this procedure if the end float is still not within specification.
21. After the correct end float is achieved, remove the old flywheel bolts and install the new flywheel bolts. Refer to the *Flywheel* procedure in Chapter Five.

**Rear Main Oil Seal Replacement**

BMW has made constant running changes to the design of the rear main oil seal. When purchasing a new one from a dealer ask for the "latest version" as it will have the best sealing qualities.

The new oil seal should be soaked in clean engine oil for 2-3 hours prior to installation. This will soften the lips of the seal and make installation easier and also lessen the chance of damaging the seal during installation.

1. Remove the flywheel as described in Chapter Five.
2. Carefully pry the oil seal (**Figure 292**) out of its receptacle in the crankcase. Be careful to not damage the surrounding area of the oil seal receptacle.
3. Soak the new rear main seal in clean engine oil for 2-3 hours prior to installation. This will soften the lips.

**CAUTION**

Do not try to install the rear main oil seal without the BMW special tool. The seal is so large in diameter that it may get "tweaked" and misaligned if installed by other means. The special tool also positions the oil seal into the crankcase the correct distance so that it will ride on the correct area of the crankshaft.

4. Install the oil seal (A, **Figure 298**) onto the BMW special impact mandrel tool, part No.11 1 890 (B, **Figure 298**).

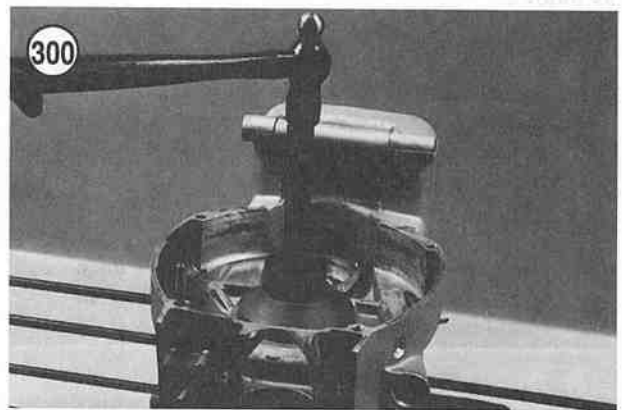
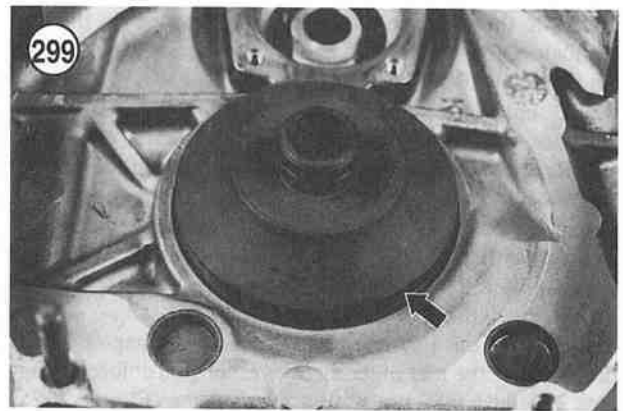
5. Apply clean engine oil to the rear main seal receptacle in the crankcase.
6. Position the BMW special tool, with the oil seal installed, onto the rear of the crankcase (**Figure 299**).
7. Carefully tap the rear main oil seal into place (**Figure 300**).
8. Remove the special tool.
9. Install the flywheel as described in Chapter Five.

## CRANKCASE

### Disassembly/Assembly

Refer to **Figure 301** for this procedure.

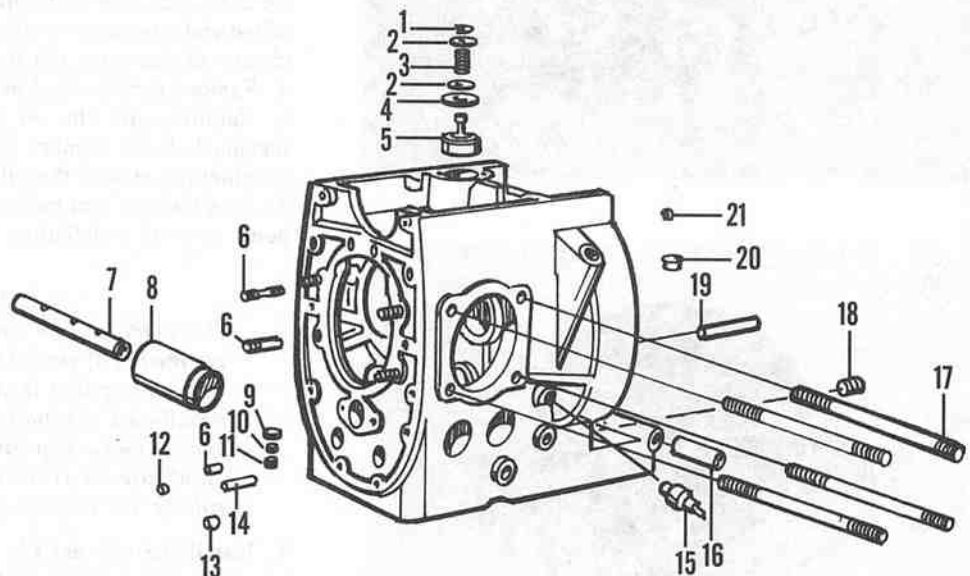
1. Remove the engine from the frame as described in this chapter.
2. Remove the following components as described in this chapter or other related chapters:
  - a. Cylinder heads and cylinders: this chapter.
  - b. Pistons: this chapter.
  - c. Connecting rods: this chapter.
  - d. Engine front cover and timing chain cover: this chapter.
  - e. Timing chain and camshaft: this chapter.
  - f. Oil pump: this chapter.
  - g. Oil pan and strainer: this chapter.
  - h. Clutch and flywheel: Chapter Five.
  - i. Crankshaft: this chapter.
3. Inspect the crankcase as described in this chapter.
4. Assemble by reversing these disassembly steps.



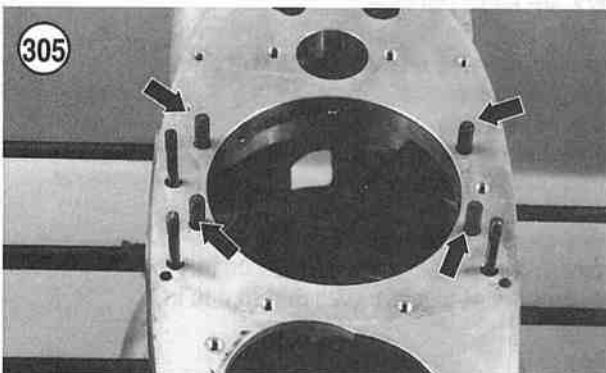
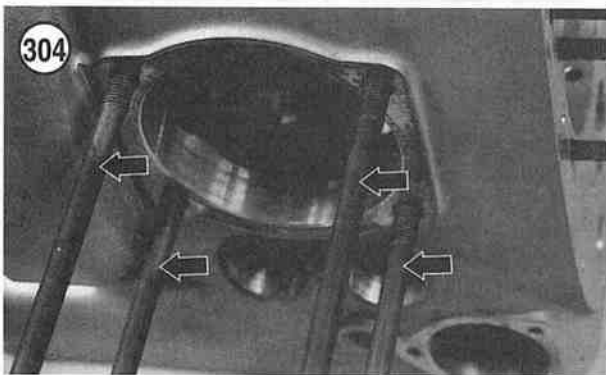
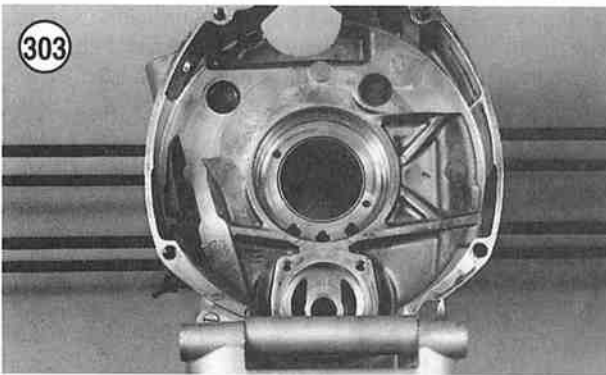
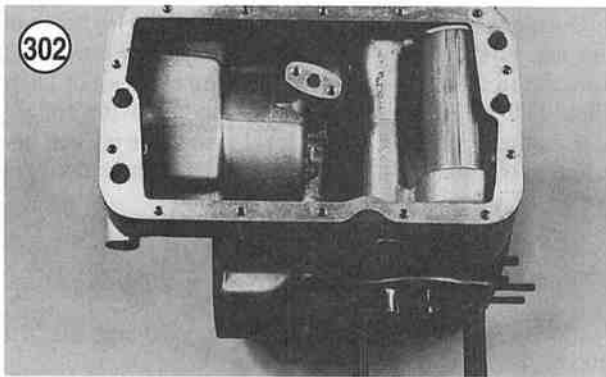
301

## CRANKCASE

1. Spring
2. Retaining clip
3. Spring
4. Valve disc
5. Valve
6. Threaded stud
7. Tube
8. Oil filter housing
9. Retainer
10. Steel ball
11. Spring
12. Set screw
13. Plug
14. Stud
15. Oil pressure switch
16. Spacer tube
17. Crankcase stud
18. Plug
19. Locating pin
20. Timing hole cover
21. Cover







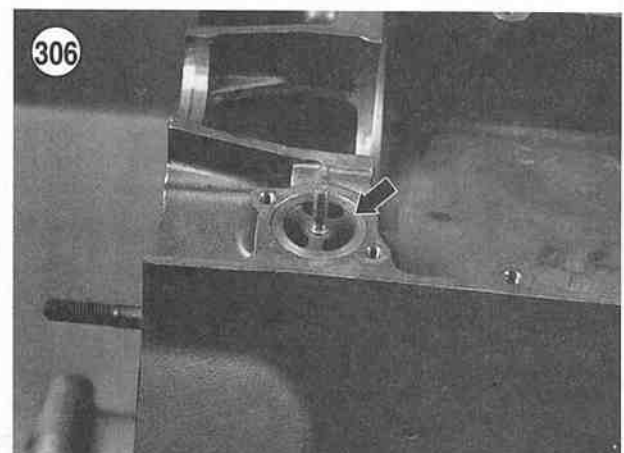
### Inspection

1. Thoroughly clean the entire crankcase in solvent. Remove all traces of old gasket material and sealant. Make sure to clean the lower end of the crankcase (Figure 302) if the oil was contaminated prior to engine disassembly. Remove all sludge residue.
2. Dry thoroughly with compressed air.

#### CAUTION

*If the crankcase was bead-blasted, make sure to clean it thoroughly with solvent and then with hot water and soap afterwards. Thoroughly rinse out with a high pressure garden hose and plenty of water. Bead-blasting residue settles in the many small crevices and other areas and can be hard to remove. Also chase each exposed thread with a thread tap to remove the grit between the threads or you may damage a thread later. Residual grit left in the engine will wind up in the oil and cause premature piston, ring and bearing wear.*

3. Inspect all surfaces of the crankcase (Figure 303) for signs of damage. Check all stiffening ribs for fractures or breaks.
4. Make sure the crankcase studs (Figure 304) for the cylinders and cylinder heads are tight. Tighten securely if necessary.
5. Make sure the crankshaft front bearing carrier threaded studs (Figure 305) are tight. Tighten securely if necessary.
6. Inspect the threads on all studs for wear or damage. If necessary, clean them up with a correct size thread die. If the threads cannot be cleaned, replace the stud(s).
7. Inspect the threads of all threaded holes for wear or damage. If necessary, clean them up with a correct size thread tap. If the threads cannot be cleaned, have the threads repaired with a Heli-coil thread repair kit.
8. Make sure the crankcase breather aperture (Figure 306) is clean.





### BREAK-IN

Following cylinder servicing (new pistons, new rings, etc.) and major lower end work, the engine should be broken in just as though it were new. The performance and service life of the engine depend greatly on a careful and sensible break-in.

For the first 800 km (500 miles), no more than one-third throttle should be used and speed should be varied as much as possible within the one-third throttle limit. Prolonged, steady running at one speed, no matter how moderate, is to be avoided, as is hard acceleration.

Following the 800 km (500 mile) service, increasingly more throttle can be used but full throttle should not be used until the motorcycle has covered at least 1,600 km (1,000 miles) and then it should be limited to short bursts until 2,410 km (1,500 miles) have been logged.

During this period, oil consumption will be higher than normal. It is therefore important to frequently check and correct the oil level. At no time, during break-in or later, should the oil level be allowed to drop below the bottom line on the dipstick; if the oil level is low, the oil will become overheated resulting in insufficient lubrication and increased wear.

### 800 km (500 Miles) Service

It is essential that oil and filter be changed after the first 800 km (500 miles). In addition, it is a good idea to change the oil and filter at the completion of break-in (about 2,410 km/1,500 miles) to ensure that all of the particles produced during break-in are removed from the lubrication system. The small added expense may be considered a smart investment that will pay off in increased engine life.

**Table 1 ENGINE TORQUE SPECIFICATIONS**

Item	N•m	ft.-lb.
Engine-to-frame bolts and nuts		
All 800 cc models	55	41
All other models	75	55
Cylinder head/rocker arm nuts	35	26
Connecting rod cap bolts	48-52	35-38
Exhaust pipe finned nuts	140-180	103-134

**Table 2 ENGINE SPECIFICATIONS**

General engine type	Air-cooled, opposed twin with pushrod operated overhead valves. Two valves per cylinder.
Engine rotation	Clockwise as viewed from front of engine.
Compression pressure	Good: more than 1012 kPa (145 psi) Normal: 848-1012 kPa (123-145 psi) Poor: less than 848 kPa (123 psi)
Idle speed	1970-1976: 800 rpm 1977-on: 800-1100 rpm
Engine lubrication	Crankshaft drive oil pump with wet sump. Full flow oil filter. Oil bypass valve. Oil pressure warning light comes on when oil pressure is below 3-7 psi.
Valves	Valve clearance (cold) Intake (rear valves): 0.10 mm (0.004 in.) Exhaust (front valves): 0.20 mm (0.008 in.)

(continued)

Table 2 ENGINE SPECIFICATIONS (continued)

Item	Specification	
Valve total length R50 (1971-1972)  R65, R65LS  R60 (1970-1976)  R60 (1977-1978)  All other models	Intake	Exhaust
	102.6-103.0 mm (4.0394-4.0551 in.)	102.1-102.5 mm (4.0197-4.0354 in.)
	98.8-100.2 mm (3.8898-3.9449 in.)	99.1-99.5 mm (3.9016-3.9174 in.)
	98.2-98.5 mm (3.8661-3.8780 in.)	97.2-97.5 mm (3.8268-3.8386 in.)
	99.2-99.5 mm (3.9055-3.9173 in.)	98.2-98.5 mm (3.8661-3.8780 in.)
	98.4-98.8 mm (3.8740-3.8898 in.)	98.4-98.8 mm (3.8740-3.8898 in.)
Head diameter R50 R60 and R65 (1974-1980) R65 (1981-1987), R65LS All R75, all 800 cc models (1978-1985) R90/6, R90S, R100 (1981-1985) R100/7, R100S, R100CS, R100T, R100RS, R100RT, R100GS All 800 cc models (1986-on), all 1000 cc models (1986-on)	Intake	Exhaust
	34 mm (1.34 in.)	32 mm (1.26 in.)
	38 mm (1.50 in.)	34 mm (1.34 in.)
	40 mm (1.58 in.)	36 mm (1.42 in.)
	42 mm (1.65 in.)	38 mm (1.50 in.)
	42 mm (1.65 in.)	40 mm (1.58 in.)
	44 mm (1.73 in.)	40 mm (1.58 in.)
42 mm (1.65 in.)	40 mm (1.58 in.)	
Stem diameter R60 (1970-1976)  R65, R65LS  All other models	Intake	Exhaust
	7.935-7.950 mm (0.3124-0.3130 in.)	7.920-7.935 mm (0.3118-0.3124 in.)
	6.945-6.960 mm (0.2734-0.2740 in.)	6.945-6.960 mm (0.2734-0.2740 in.)
	7.935-7.950 mm (0.3124-0.3130 in.)	7.935-7.950 mm (0.3124-0.3130 in.)
Valve head edge thickness R65, R65LS  R80, R80ST, R80G/S, R80RT All other models	Intake	Exhaust
	1.0-1.5 mm (0.0394-0.0591 in.)	1.0-1.2 mm (0.0394-0.0472 in.)
	0.8 mm (0.0315 in.)	0.8 mm (0.0315 in.)
Valve head runout 1970-1976 models  1000 cc models All other models	Intake	Exhaust
	0.025 mm (0.0010 in.)	0.025 mm (0.0010 in.)
	NA	NA
	0.020 mm (0.0008 in.)	0.020 mm (0.0008 in.)
Valve seat angle Main seat face Combustion chamber face Intake and exhaust port face	Intake and exhaust	
	45°	
	15°	
Valve seat width Intake Exhaust	75°	
	1.5 mm (0.0591 in.)	2.0 mm (0.0787 in.)

(continued)

Table 2 ENGINE SPECIFICATION (continued)

Item	Specification	
<b>Valve guide</b>		
<b>Total length—intake and exhaust</b>		
1970-1976 models (except (R90S)	54 mm (2.1260 in.)	
R65, R65LS	42 mm (1.6535 in.)	
1977-1979 models, R90S, all 1000 cc models	48 mm (1.8898 in.)	
R80, R80ST, R80G/S, R80RT	44 mm (1.7323 in.)	
<b>Outside diameter—intake and exhaust</b>		
R65, R65LS	14.0 mm (0.5512 in.)	
All other models	14.050-14.061 mm (0.5532-0.5536 in.)	
<b>Inside diameter—intake and exhaust</b>		
1970-1979 1000 cc models	8 mm (0.3150 in.)	
R65, R65LS	7 mm (0.2756 in.)	
All other models	8.000-8.015 mm (0.3150-0.3156 in.)	
<b>Bore in cylinder head</b>		
1981-on 800 cc, all 1000 cc	14.000-14.018 mm (0.5512-0.5519 in.)	
All other models	14 mm (0.5512 in.)	
<b>Valve stem/guide clearance (standard)</b>		
1971-1972 R50	<b>Intake</b> 0.040-0.070 mm (0.0016-0.0028 in.)	<b>Exhaust</b> 0.050-0.080 mm (0.0020-0.0032 in.)
R65, R65LS	0.025-0.055 mm (0.0010-0.0022 in.)	0.040-0.070 mm (0.0016-0.0028 in.)
R60/5, R60/6, R60/7	0.050-0.080 mm (0.0020-0.0032 in.)	0.065-0.095 mm (0.0026-0.0037 in.)
All other models	0.050-0.080 mm (0.0020-0.0032 in.)	0.050-0.080 mm (0.0020-0.0032 in.)
<b>Valve seats</b>		
<b>Outer diameter</b>		
R50/5	<b>Intake</b> 36.175-36.200 mm (1.4242-1.4252 in.)	<b>Exhaust</b> 36.140-36.150 mm (1.4228-1.4232 in.)
R60/5, R60/6, R60/7	39.175-39.200 mm (1.5423-1.5422 in.)	39.175-39.200 mm (1.5423-1.5433 in.)
R65, R65LS	39.2 mm (1.5433 in.)	39.2 mm (1.5433 in.)
R75/5	43.175-43.200 mm (1.6998-1.7008 in.)	43.140-43.150 mm (1.6984-1.6988 in.)
R75/6, R90/6, R90S	43.175-43.200 mm (1.6998-1.7008 in.)	43.175-43.200 mm (1.6998-1.7008 in.)
R75/7, R80/7, R100/7, R100S	43.175-43.200 mm (1.6998-1.7008 in.)	43.134-43.200 mm (1.6982-1.7008 in.)
1985-1987 R80, R80ST, R80RT, R80G/S	43.175-43.200 mm (1.6998-1.7008 in.)	43.134-43.150 mm (1.6982-1.6988 in.)
All other 1000 cc	45.175-45.200 mm (1.7785-1.7795 in.)	45.175-45.200 mm (1.7785-1.7795 in.)
<b>Bore in cylinder head (intake and exhaust)</b>		
R50/5	36.000-36.025 mm (1.4173-1.4183 in.)	
R60/5, R60/6, R60/7	39.000-39.025 mm (1.5354-1.5364 in.)	

(continued)

Table 2 ENGINE SPECIFICATION (continued)

Item	Specification	
Bore in cylinder head (intake and exhaust) (continued)		
R65, R65LS	39 mm (1.5354 in.)	
All 800 cc and 900 cc, 1977-1979 1000 cc	43.000-43.025 mm (1.6929-1.6939 in.)	
All other 1000 cc	45.000-45.025 mm (1.7717-1.7727 in.)	
Interference fit in cylinder head		
R50/75, R75/5, R75/6	Intake 0.150-0.200 mm (0.0059-0.0079 in.)	Exhaust 0.115-0.150 mm (0.0045-0.0059 in.)
R65, R65LS	NA	NA
R75/7, R80, R100, R80G/S, R80ST	0.150-0.200 mm (0.0059-0.0079 in.)	0.109-0.150 mm (0.0043-0.0059 in.)
All other models	0.150-0.200 mm (0.0059-0.0079 in.)	0.150-0.200 mm (0.0059-0.0079 in.)
Valve springs		
Wire gauge	4.25 mm (0.167 in.)	
Coil winding direction	Clockwise	
Spring free length		
Green and blue	43.5 mm (1.713 in.)	
Brown	46.0 mm (1.811 in.)	
Rocker arms (1970-1973)		
Rocker arm bore I.D.	18.032-18.059 mm (0.7099-0.7110 in.)	
Rocker arm bushing O.D.	18.012-18.030 mm (0.7091-0.7098 in.)	
Rocker arm bushing I.D.	14.532-14.559 mm (0.5721-0.5732 in.)	
Rocker arm-to-bushing oil clearance	0.002-0.047 mm (0.00008-0.00185 in.)	
Rocker arm shaft O.D.	14.512-14.530 mm (0.5713-0.5720 in.)	
Rocker arm bushing-to-shaft clearance	0.002-0.047 mm (0.00008-0.00185 in.)	
Rocker arms (1974-on)		
Axial play	Without play—but must move easily	
Camshaft (all models)		
Flange bearing		
Bearing bore I.D. In crankcase	40.000-40.039 mm (1.5745-1.5763 in.)	
Bearing O.D.	39.984-40.000 mm (1.5742-1.5748 in.)	
Bearing I.D.	25.000-25.013 mm (0.9843-0.9848 in.)	
Camshaft bearing bore in crankcase (flywheel end)	24.000-24.021 mm (0.9449-0.9457 in.)	
Camshaft bearing journal—Alternator end (front)	24.967-24.980 mm (0.9830-0.9835 in.)	
Flywheel end (rear)	23.967-23.980 mm (0.9436-0.9441 in.)	
Camshaft radial play	0.02-0.046 mm (0.0008-0.0018 in.)	
(Front and rear)	0.02-0.054 mm (0.0008-0.0018 in.)	
Camshaft end float	0.08-0.120 mm (0.0032-0.0047 in.)	
Camshaft timing gear to mounting flange clearance (1970-1978 models)	0.08-0.12 mm (0.0031-0.0047 in.)	
Camshaft base circle	28 mm (1.1024 in.)	
Camshaft lift		
1970-1974 R50 and R60	6.198 mm (0.24440 in.)	
All other models	6.756 mm (0.2260 in.)	
Valve lifters		
Valve lifter O.D.	21.955-21.975 mm (0.8644-0.8652 in.)	
Valve lifter receptacle in crankcase I.D.	21.985-22.006 mm (0.8656-0.8664 in.)	

(continued)

Table 2 ENGINE SPECIFICATIONS (continued)

Item	Specification	
Valve lifters (continued)		
Valve lifter-to-crankcase clearance		
Standard clearance	0.010-0.051 mm (0.0004-0.0020 in.)	
Service limit clearance	0.75 mm (0.0030 in.)	
Pushrod length		
R66, R65LS	NA	
All other models	274.7-275.3 mm (10.8149-10.8386 in.)	
Crankshaft		
Main journal O.D.		
Standard		
Red/red	59.980-59.990 mm (2.3614-2.3618 in.)	59.980-59.990 mm (2.3614-2.3618 in.)
Red/blue	59.980-59.990 mm (2.3614-2.3618 in.)	59.971-59.980 mm (2.3610-2.3614 in.)
Blue/red	59.971-59.980 mm (2.3610-2.3614 in.)	59.980-59.990 mm (2.3614-2.3618 in.)
Blue/blue	59.971-59.980 mm (2.3610-2.3614 in.)	59.971-59.980 mm (2.3610-2.3614 in.)
1st undersize 0.25 mm (0.010 in.)		
Red/red	59.730-59.740 mm (2.3516-2.3520 in.)	59.730-59.740 mm (2.3516-2.3520 in.)
Red/blue	59.730-59.740 mm (2.3516-2.3520 in.)	59.721-59.730 mm (2.3512-2.3516 in.)
Blue/red	59.721-59.730 mm (2.3512-2.3516 in.)	59.730-59.740 mm (2.3516-2.3520 in.)
Blue/blue	59.721-59.730 mm (2.3512-2.3516 in.)	59.721-59.730 mm (2.3512-2.3516 in.)
2nd undersize 0.50 mm (0.020 in.)		
Red/red	59.480-59.490 mm (2.3417-2.3421 in.)	59.480-59.490 mm (2.3417-2.3421 in.)
Red/blue	59.480-59.490 mm (2.3417-2.3421 in.)	59.471-59.480 mm (2.3414-2.3417 in.)
Blue/red	59.471-59.480 mm (2.3414-2.3417 in.)	59.480-59.490 mm (2.3417-2.3421 in.)
Blue/blue	59.471-59.480 mm (2.3414-2.3417 in.)	59.471-59.480 mm (2.3414-2.3417 in.)
3rd undersize 0.75 mm (0.030 in.)		
Red/red	59.230-59.240 mm (2.3319-2.3323 in.)	59.230-59.240 mm (2.3319-2.3323 in.)
Red/blue	59.230-59.240 mm (2.3319-2.3323 in.)	59.221-59.230 mm (2.3315-2.3319 in.)
Blue/red	59.221-59.230 mm (2.3315-2.3319 in.)	59.230-59.240 mm (2.3319-2.3323 in.)
Blue/blue	59.221-59.230 mm (2.3315-2.3319 in.)	59.221-59.230 mm (2.3315-2.3319 in.)
Connecting rod journal O.D.		
Standard		
1st undersize 0.25 mm (0.010 in.)	47.975-47.991 mm (1.8888-1.8894 in.)	
2nd undersize 0.50 mm (0.020 in.)	47.725-47.741 mm (1.8789-1.8795 in.)	
3rd undersize 0.75 mm (0.030 in.)	47.475-47.491 mm (1.8691-1.8697 in.)	
	47.225-47.241 mm (1.8592-1.8598 in.)	

(continued)



Table 2 ENGINE SPECIFICATIONS (continued)

Item	Specification
<b>Main bearing journal oil clearance</b>	
All 1970-1976 models, R80/7, all 1978-1980 1000 cc models	0.035-0.065 mm (0.00138-0.00256 in.)
All other models	
Red	0.017-0.066 mm (0.0007-0.00259 in.)
Blue	0.019-0.067 mm (0.0007-0.00263 in.)
<b>Connecting rod journal oil clearance</b>	0.023-0.069 mm (0.0009-0.0027 in.)
<b>Crankshaft end float</b>	0.080-0.150 mm (0.0032-0.0059 in.)
<b>Maximum runout at alternator end</b>	0.02 mm (0.0008 in.)
<b>Thrust washer thickness</b>	
Red	2.483-2.530 mm (0.0978-0.0996 in.)
Blue	2.530-2.578 mm (0.0996-0.1015 in.)
Green	2.578-2.626 mm (0.1015-0.1034 in.)
Yellow	2.626-2.673 mm (0.1034-0.1052 in.)
Wear limit	Subtract 0.20 mm (0.0079 in.) from the listed minimum thickness dimension.
<b>Connecting rods</b>	
<b>Big end bore I.D. with bearing insert</b>	
Standard	47.975-47.991 mm (1.8888-1.8894 in.)
<b>Crankpin journal regrind</b>	
1st undersize	0.25 mm (0.010 in.)
2nd undersize	0.50 mm (0.020 in.)
3rd undersize	0.75 mm (0.030 in.)
<b>Big end bore I.D. without bearing insert</b>	
1970-1976 models	52.000-52.010 mm (2.04272-2.0476 in.)
1977-on models	52.000-52.015 mm (2.0472-2.0478 in.)
<b>Big end width</b>	21.883-21.935 mm (0.8615-0.8636 in.)
<b>Crankpin journal width</b>	22.065-22.149 mm (0.8687-0.8720 in.)
<b>Axial clearance</b>	
Standard	0.130-0.266 mm (0.0051-0.0105 in.)
Maximum allowable	0.320 mm (0.0126 in.)
<b>Small end bore I.D. without bushing</b>	24.000-24.021 mm (0.9449-0.9457 in.)
<b>Small end bore bushing</b>	
Outer diameter	24.060-24.100 mm (0.9472-0.9488 in.)
Inner diameter	
Standard	22.015-22.020 mm (0.8667-0.8669 in.)
Wear limit	22.040 mm (0.8677 in.)
<b>Maximum weight deviation between rods</b>	
1970-1976 models	6 grams (0.2116 oz.)
All 800 cc models	± 2 grams (0.0705 oz.)
All other models	± 3 grams (0.1058 oz.)
<b>Cylinder bore I.D.</b>	
<b>R50/5</b>	
Grade A	67.000 mm (2.6378 in.)
Grade B	67.010 mm (2.6382 in.)
Grade C	67.020 mm (2.6386 in.)
<b>R60/5</b>	
Grade A	73.500 mm (2.8937 in.)
Grade B	73.510 mm (2.8941 in.)
Grade C	73.520 mm (2.8945 in.)

(continued)

Table 2 ENGINE SPECIFICATIONS (continued)

Item	Specifications
<b>Cylinder bore I.D. (continued)</b>	
R60/6, R60/7	
Grade A	73.500-73.510 mm (2.8937-2.8941 in.)
Grade B	73.510-73.520 mm (2.8941-2.8945 in.)
Grade C	73.520-73.530 mm (2.8945-2.8949 in.)
R65, R65LS	
Grade A	81.995-82.005 mm (3.2281-3.2285 in.)
Grade B	82.005-82.015 mm (3.2285-3.2289 in.)
Grade C	82.015-82.025 mm (3.2289-3.2293 in.)
R75/5, R75/6	
Grade A	82.000 mm (3.2283 in.)
Grade B	82.010 mm (3.2287 in.)
Grade C	82.020 mm (3.2291 in.)
R75/7	
Grade A	82.005-82.015 mm (3.2285-3.2289 in.)
Grade B	82.015-82.025 mm (3.2289-3.2293 in.)
Grade C	82.025-82.035 mm (3.2293-3.2297 in.)
<b>All 800 cc models</b>	
Grade A	84.795-84.805 mm (3.3384-3.3388 in.)
Grade B	84.805-84.815 mm (3.3388-3.3392 in.)
Grade C	84.815-84.825 mm (3.3392-3.3396 in.)
<b>All 900 cc models</b>	
Grade A	90.000 mm (3.5433 in.)
Grade B	90.010 mm (3.5437 in.)
Grade C	90.020 mm (3.5441 in.)
<b>All 1000 cc models</b>	
Grade A	94.005-94.015 mm (3.7010-3.7014 in.)
Grade B	94.015-94.025 mm (3.7014-3.7018 in.)
Grade C	94.025-94.035 mm (3.7018-3.7022 in.)
<b>Cylinder rebore size (up to 1980)</b>	
<b>All 1970-1976 models, 1979 R60, 1978-1979 R100</b>	
1st oversize	0.50 mm (0.020 in.)
2nd oversize	1.00 mm (0.040 in.)
<b>1979 R65, 1978-1979 R80</b>	
1st oversize	0.25 mm (0.010 in.)
2nd oversize	0.50 mm (0.020 in.)
<b>All 1977-1980 1000 cc models</b>	
	0.25 mm (0.010 in.)
<b>Pistons</b>	
<b>Outer diameter</b>	
<b>R50/5</b>	
Grade A	66.960 mm (2.6362 in.)
Grade B	66.970 mm (2.6366 in.)
Grade C	66.980 mm (2.6370 in.)
<b>R60/5, R60/6</b>	
Grade A	73.460 mm (2.8921 in.)
Grade B	73.470 mm (2.8925 in.)
Grade C	73.480 mm (2.8929 in.)
<b>R60/7</b>	
Grade A	73.470 mm (2.8925 in.)
Grade B	73.480 mm (2.8929 in.)
Grade C	73.490 mm (2.8933 in.)

(continued)

Table 2 ENGINE SPECIFICATIONS

Item	Specification
<b>Pistons</b>	
<b>Outer diameter (continued)</b>	
<b>R65, R65LS</b>	
Grade A	81.955-81.965 mm (3.2266-3.2270 in.)
Grade B	81.965-81.975 mm (3.2270-3.2274 in.)
Grade C	81.975-81.985 mm (3.2274-3.2278 in.)
<b>R75/7, R75/6</b>	
Grade A	81.960 mm (3.2268 in.)
Grade B	81.970 mm (3.2272 in.)
Grade C	81.980 mm (3.2276 in.)
<b>R75/7</b>	
Grade A	81.965 mm (3.2270 in.)
Grade B	81.975 mm (3.2274 in.)
Grade C	81.985 mm (3.2278 in.)
<b>All 800 cc models</b>	
Grade A	84.765 mm (3.3372 in.)
Grade B	84.775 mm (3.3376 in.)
Grade C	84.785 mm (3.3380 in.)
<b>All 900 cc models</b>	
Grade A	89.960 mm (3.5417 in.)
Grade B	89.970 mm (3.5417 in.)
Grade C	89.980 mm (3.5425 in.)
<b>All 1000 cc models</b>	
Grade A	93.960 mm (3.6992 in.)
Grade B	93.970 mm (3.6996 in.)
Grade C	93.980 mm (3.7000 in.)
<b>Piston-to-cylinder clearance</b>	
<b>1970-1976 models</b>	0.035-0.045 mm (0.0014-0.0018 in.)
1977 R60	0.020-0.040 mm (0.0008-0.0016 in.)
1979-1980 R65	0.030-0.050 mm (0.0012-0.0020 in.)
1977 R75	0.019-0.040 mm (0.0007-0.0016 in.)
1978-1979 R80	0.023-0.047 mm (0.0009-0.0019 in.)
1981-on 1000 cc	0.030-0.040 mm (0.0012-0.0016 in.)
<b>Maximum allowable piston-to-cylinder clearance</b>	
1970-1976	0.120 mm (0.0047 in.)
All other models	0.080 mm (0.0032 in.)
<b>Piston pin bore I.D.</b>	
1970-1980 with white code ("W" mark on piston crown)	22.000-22.003 mm (0.8661-0.8662 in.)
1970-1980 with black code ("S" mark on piston crown)	21.997-22.000 mm (0.8660-0.8661 in.)
R65, R65LS	22.005-22.010 mm (0.8663-0.8665 in.)
All 800 and 1000 cc models	22.000-22.004 mm (0.8661-0.8663 in.)
<b>Piston pin</b>	
<b>Outer diameter</b>	
1970-1980 with white code ("W" mark on piston crown)	21.997-22.000 mm (0.8660-0.8661 in.)
1970-1980 with black code ("S" mark on piston crown)	21.994-21.997 mm (0.8659-0.8660 in.)
R65, R65LS	21.995-22.000 mm (0.8659-0.8661 in.)
All 800 and 1000 cc models	21.996-22.000 mm (0.8660-0.8661 in.)

(continued)

Table 2 ENGINE SPECIFICATIONS (continued)

Item	Specification
<b>Piston pin (continued)</b>	
<b>Pin-to-piston clearance</b>	
1970-1980	0.000-0.006 mm (0.000-0.0002 in.)
R65, R65LS	0.005-0.015 mm (0.0002-0.0006 in.)
All other models	0.000-0.008 mm (0.000-0.0003 in.)
<b>Pin-to-connecting rod bushing clearance</b>	
1970-1980 with white code ("W" mark on piston crown)	0.015-0.023 mm (0.0006-0.0009 in.)
1970-1980 with black code ("S" mark on piston crown)	0.018-0.026 mm (0.0007-0.0010 in.)
R65, R65LS, all 800 cc, all 1000 cc models	0.015-0.025 mm (0.0006-0.0009 in.)
<b>Piston rings</b>	
<b>1st compression ring</b>	
<b>Thickness</b>	
1970-1976 models	1.790-1.810 mm (0.0705-0.0713 in.)
All other models	1.728-1.740 mm (0.0680-0.0685 in.)
<b>End gap clearance (installed)</b>	
R50/5, R60/5, R60/6	0.25-0.40 mm (0.0098-0.0158 in.)
R60/7, R75/5, R75/6, 900 cc	0.30-0.45 mm (0.0118-0.0177 in.)
1981-on 1000 cc	0.40-0.65 mm (0.0158-0.0256 in.)
All other models	0.30-0.50 mm (0.0118-0.0197 in.)
<b>Side clearance</b>	
1970-1976 models	0.060-0.070 mm (0.0024-0.0028 in.)
1977-1979 models	0.060-0.090 mm (0.0024-0.0035 in.)
All other models	0.050-0.082 mm (0.0020-0.0032 in.)
<b>2nd compression ring</b>	
<b>Thickness</b>	
1970-1976 models	2.030-2.050 mm (0.0799-0.0807 in.)
1977-1979 models	2.010-2.022 mm (0.0791-0.0796 in.)
All other models	1.978-1.990 mm (0.0779-0.0784 in.)
<b>End gap clearance (installed)</b>	
R50/5, R60/5, R60/6, R60/7	0.25-0.40 mm (0.0098-0.0158 in.)
All 800 cc models	0.30-0.50 mm (0.0118-0.0197 in.)
1981-on 1000 cc	0.40-0.65 mm (0.0158-0.0256 in.)
All other models	0.30-0.45 mm (0.0118-0.0177 in.)
<b>Side clearance</b>	
1970-1976 models	0.050-0.060 mm (0.0020-0.0024 in.)
All other models	0.040-0.072 mm (0.0016-0.0028 in.)
<b>Oil ring (one piece)</b>	
<b>Thickness</b>	
1970-1976 models	4.010-4.030 mm (0.1579-0.1587 in.)
1977-1979 and 1000 cc models	4.010-4.022 mm (0.1579-0.1584 in.)
R65, R65LS	3.978-3.990 mm (0.1566-0.1571 in.)
All 800 cc models	3.478-3.490 mm (0.1369-0.1374 in.)
<b>End gap clearance (installed)</b>	
1970-1973 models	0.20-0.35 mm (0.0079-0.0138 in.)
R60/6	0.25-0.35 mm (0.0098-0.0138 in.)
All other models	0.25-0.40 mm (0.0098-0.0158 in.)

(continued)

Table 2 ENGINE SPECIFICATION (continued)

Item	Specification
<b>Piston rings (continued)</b>	
<b>Side clearance</b>	
1970-1976 models	0.030-0.040 mm (0.0012-0.0016 in.)
R60/7	0.020-0.050 mm (0.0008-0.0020 in.)
All other models	0.030-0.062 mm (0.0012-0.0024 in.)
<b>Oil pump</b>	
<b>Outer rotor-to-housing clearance</b>	
R65, R65LS, R80G/S, R80ST	0.15-0.29 mm (0.006-0.011 in.)
All other models	0.10-0.17 mm (0.004-0.007 in.)
<b>Inner rotor tip-to-outer rotor clearance</b>	0.12-0.20 mm (0.005-0.008 in.)
<b>Oil pump housing-to-rotor end clearance</b>	0.025-0.070 mm (0.001-0.003 in.)



## CHAPTER FIVE

# CLUTCH

This chapter provides complete service procedures for the clutch and clutch release mechanism.

The clutch is a dry single-plate type that is mounted at the rear portion of the engine. The clutch design is basically an automotive type, instead of the wet multiplate type found on most Japanese motorcycles. The clutch friction plate is splined to the transmission input shaft and is sandwiched between the clutch pressure plate and the pressure ring on 1970-1980 models, or between the clutch pressure plate and the clutch housing cover on 1981-on models. The forged alloy clutch housing is splined and bolted to the end of the engine output shaft. The housing cover is equipped with locating pins that go through mounting holes in the pressure plate and this assembly is then bolted to the clutch housing. The clutch assembly, except for the friction plate, rotates with the engine. When the clutch is engaged, the friction plate also turns with this assembly, thus turning the transmission input shaft.

The clutch was redesigned in 1981 using a clutch design similar to that used on the 3- and 4-cylinder K-series BMWs. The new clutch configuration is lighter and requires less pressure to operate.

The clutch release pushrod, which is a light alloy, rides within the hollow channel in the transmission's input shaft. It is controlled by the cable-operated clutch release lever that is mounted on the rear of the transmission housing. When the clutch lever on the handlebar is pulled in, the clutch cable actuates the clutch release lever on the transmission housing and pushes the release pushrod forward. A

pressure piston, ball bearing and bearing race accommodate the rotation of the release push rod as it touches the rotating diaphragm spring. The forward end of the release push rod has a conical steel tip that rides against the center of the diaphragm spring. As the release pushrod moves forward, it releases the spring pressure, allowing the clutch housing assembly to rotate freely without touching or rotating the friction plate and transmission input shaft.

In order for smooth clutch operation, the clutch friction disc must slide freely on the transmission input shaft splines. Refer to *Clutch and Input Shaft Spline Lubrication* in Chapter Three.

This type of clutch does require routine adjustment as the control cable will stretch with use. Refer to Chapter Three for clutch adjustment procedures.

Specifications for the clutch are listed in **Table 1**. **Table 1** and **Table 2** are located at the end of this chapter.

### CLUTCH AND FLYWHEEL (1970-1980 MODELS)

#### Removal

Refer to **Figure 1** for this procedure.

The clutch assembly can be removed with the engine in the frame but the transmission housing must be removed. This procedure is shown with the engine removed for clarity.

1. Remove the transmission housing as described in Chapter Six.

**NOTE**

The 1970-1980 clutch assembly is *not* equipped with balance marks that the 1981-on models have. If there is no appreciable vibration coming from the engine, it is then presumed that the 3 parts were previously installed correctly and are balanced correctly. Using a permanent marking pen, make a straight line across the pressure ring, the pressure plate and the flywheel. These marks can then be used during the reassembly alignment procedure.

**WARNING**

The clutch diaphragm spring exerts a lot of pressure. Only loosen, then remove the clutch assembly mounting bolts as described in Steps 2-7. Failure to do so will lead to personal injury and component damage.

2. Using an impact driver, *loosen* all of the clutch assembly mounting bolts (Figure 2).

**NOTE**

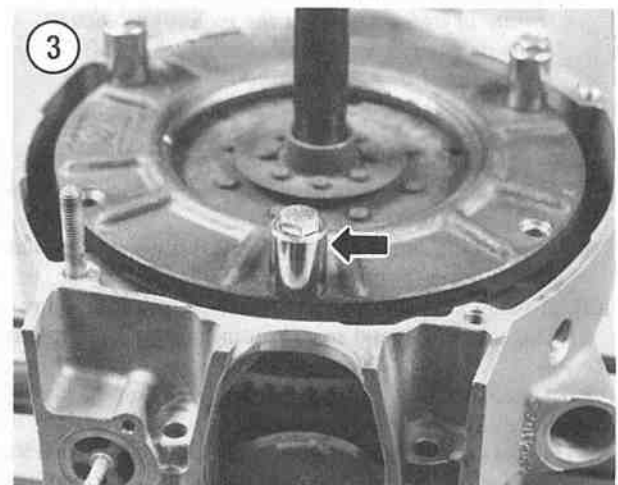
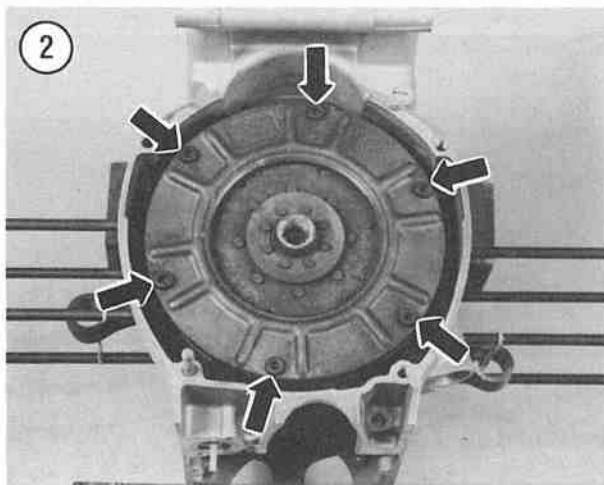
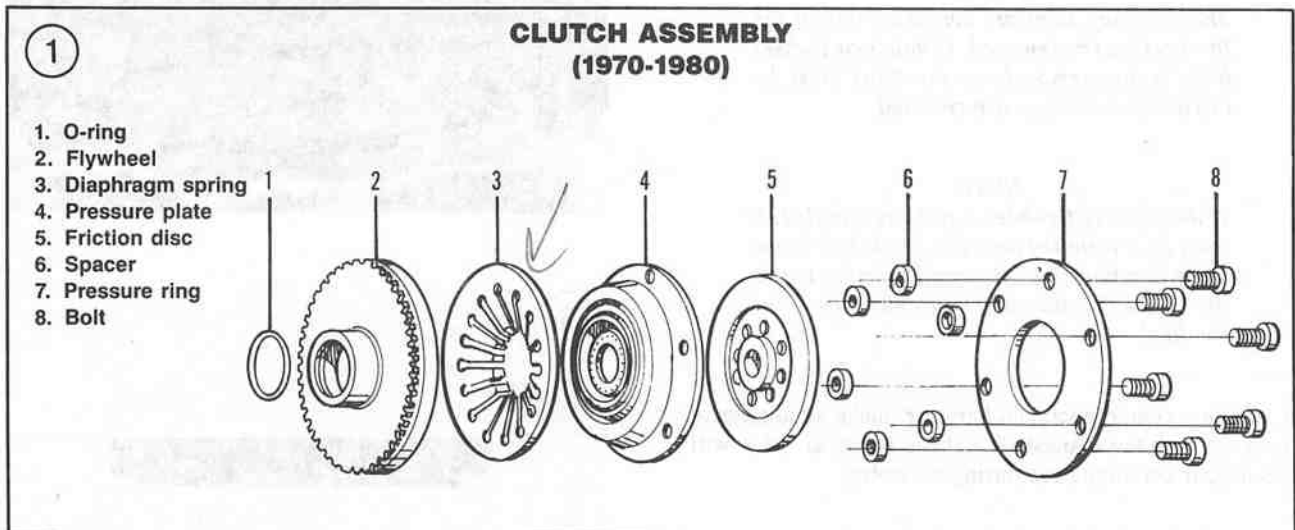
Some models are equipped with a spacer between the pressure plate and pressure ring at each mounting bolt location. Don't lose the spacers when the bolts are removed.

3. Remove *every other* bolt from the assembly.

4. Install an 8 mm bolt about 50 mm (2 in.) long, with a spacer (piece of pipe or socket), into the threaded holes where the 3 bolts were removed (Figure 3). Screw the bolts in until they bottom out.

5. Remove the remaining bolts from the assembly.

5



6. Gradually loosen the 3 long bolts (**Figure 4**) in a staggered pattern. This will allow the clutch assembly to move away from the flywheel evenly and allow the diaphragm spring to relax until it is no longer under pressure.

7. After the diaphragm spring is no longer under pressure, remove the 3 long bolts and spacers.

**NOTE**

*Note that the long side (**Figure 5**) of the friction plate splined section is facing out toward the transmission. It must be reinstalled the same way.*

8. Remove the pressure ring, friction plate, pressure plate and diaphragm spring as an assembly.

**NOTE**

*The following steps are necessary only if the flywheel is to be removed. Obtain new flywheel bolts before removal, as the bolts must be discarded once they are removed.*

**NOTE**

*If the existing flywheel is to be reinstalled, it must be reinstalled onto the crankshaft in the same location since the engine timing marks are located on the outer circumference of the flywheel.*

9. Using a centerpunch and hammer, make an alignment mark on both the crankshaft and the flywheel. This will ensure correct alignment during assembly.

**NOTE**

*The flywheel must be secured so it will not rotate in order to loosen the mounting bolts. This can be accomplished either with a BMW special tool or a homemade tool.*

10A. If using the BMW special tool, perform the following:

- Install the BMW special holder tool (part No. 11 2 800) (**Figure 6**) onto the flywheel.

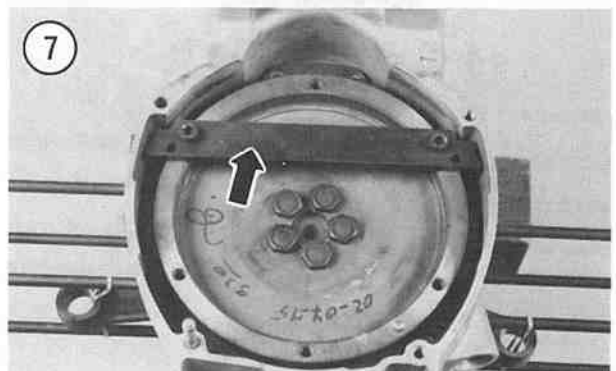
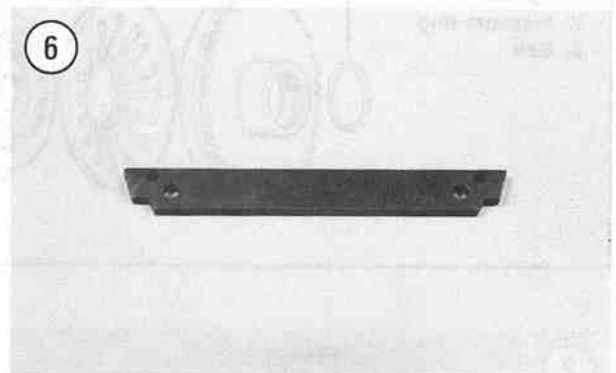
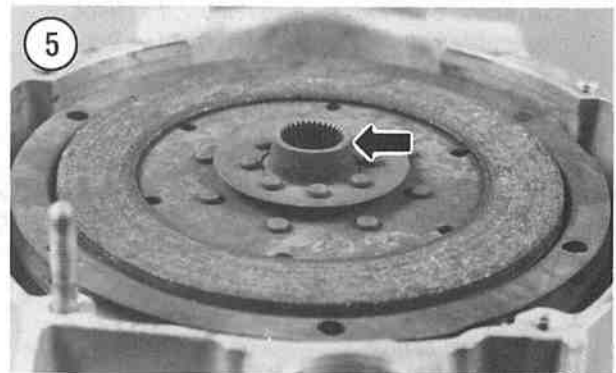
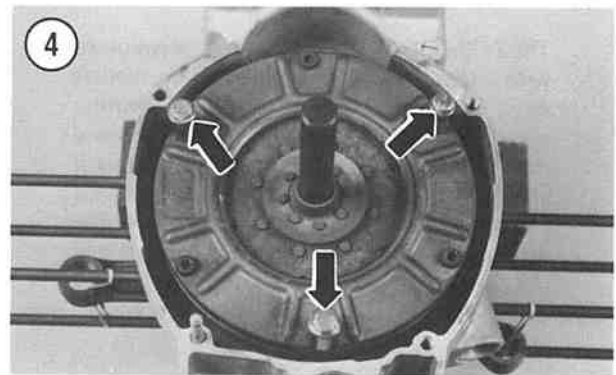
- Use 2 of the clutch assembly bolts to attach the special tool (**Figure 7**) to the flywheel.

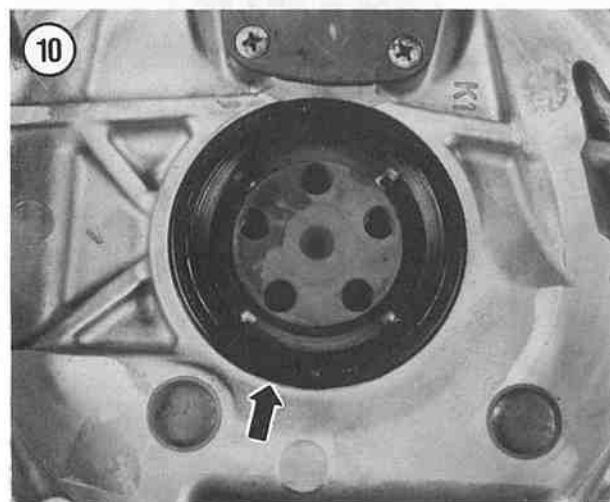
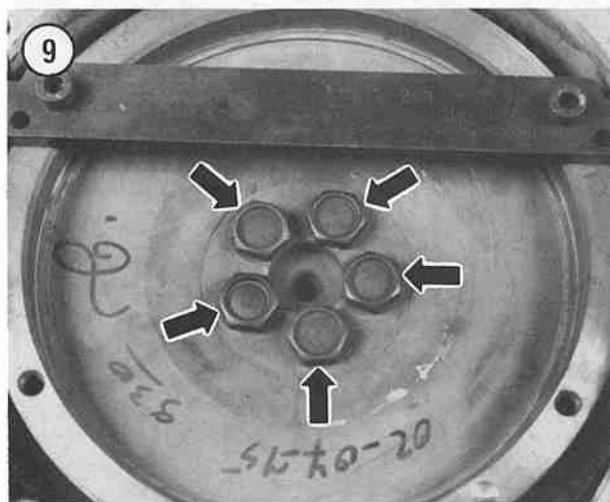
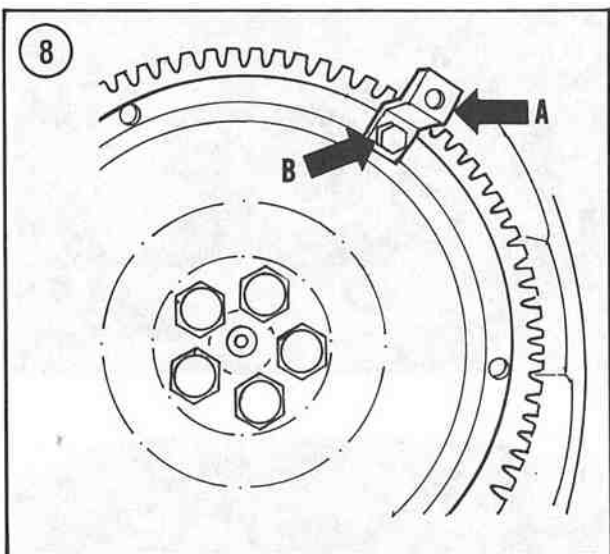
10B. If using a homemade tool, perform the following:

- Make a small metal strap holding fixture (A, **Figure 8**).

- Attach the fixture to the flywheel with 1 of the clutch assembly bolts (B, **Figure 8**).

11. Using a crisscross pattern, loosen the bolts (**Figure 9**) securing the flywheel to the crankshaft.





12. Remove the bolts and the flywheel from the engine. Discard the flywheel bolts, as they are of the stretch type and must be replaced whenever the flywheel is removed. *Never* reuse these bolts as it can lead to expensive engine damage.

13. If the BMW special tool was used, remove the bolts and remove the tool from the flywheel.

14. Inspect all clutch components as described in this chapter.

### Clutch Inspection

Refer to **Table 1** for clutch specifications.

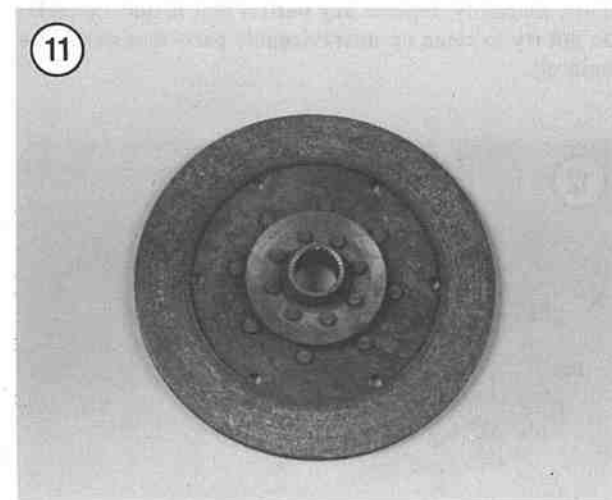
1. Check all parts for oil or grease contamination. If the friction plate is fouled with oil or grease it must be replaced. It is impossible to remove *all* oil or grease residue from the friction material.

2. If the pressure ring, diaphragm spring or pressure plate are contaminated with oil and/or grease, perform the following:

- Thoroughly clean in solvent and dry with compressed air.
- After cleaning in solvent, clean the surfaces of the pressure ring and pressure plate that contact the friction disc with lacquer thinner and/or aerosol electrical contact cleaner to remove any petroleum-based solvent residue.
- Dry with a lint-free cloth.

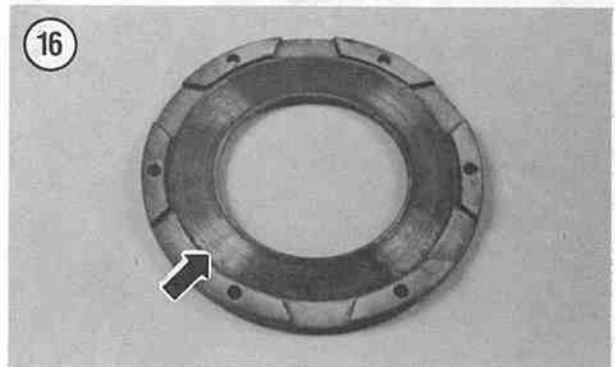
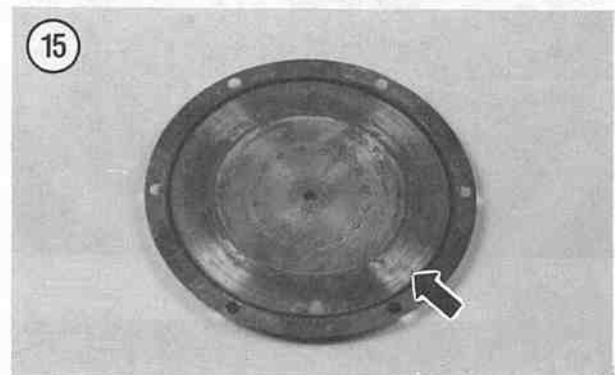
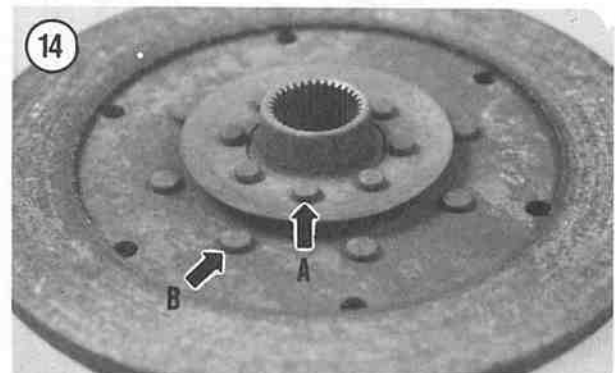
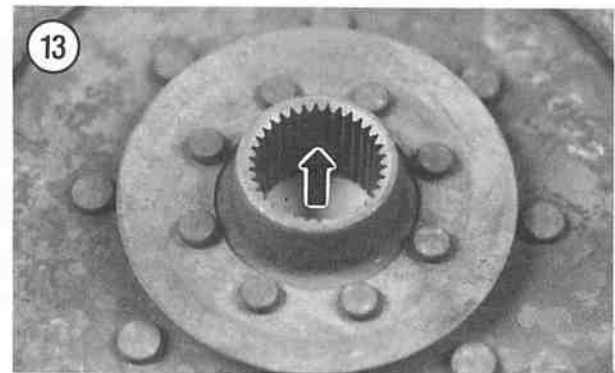
3. If there is oil and/or grease contamination on the clutch parts, inspect the oil seals in the transmission housing and the crankshaft rear main oil seal (**Figure 10**) on the engine. Replace the oil seals if necessary as described in Chapter Four (engine) or Chapter Six (transmission).

4. Inspect the friction plate (**Figure 11**) for damage or wear. If the friction material has worn close to any rivet head, replace the friction plate.

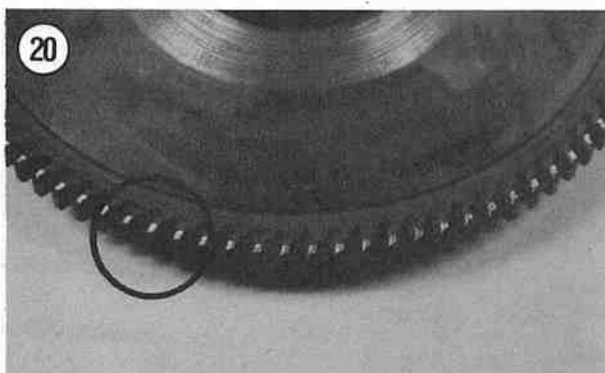
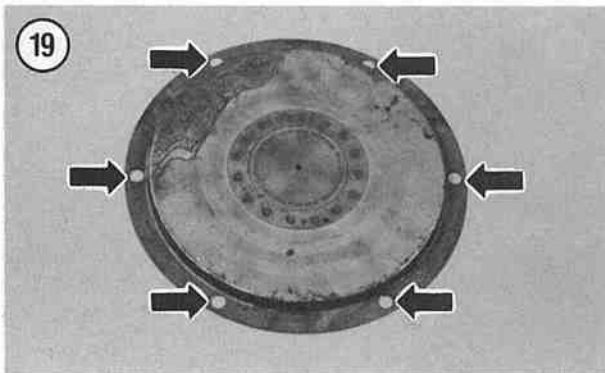
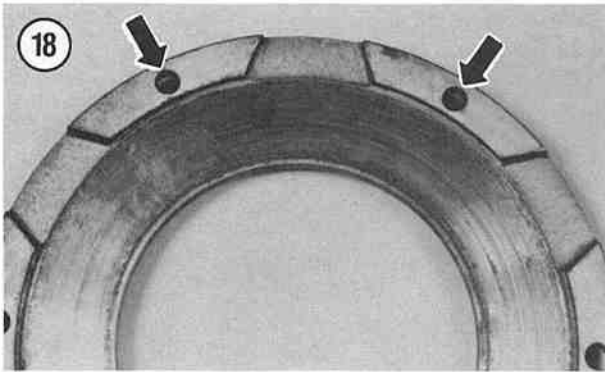
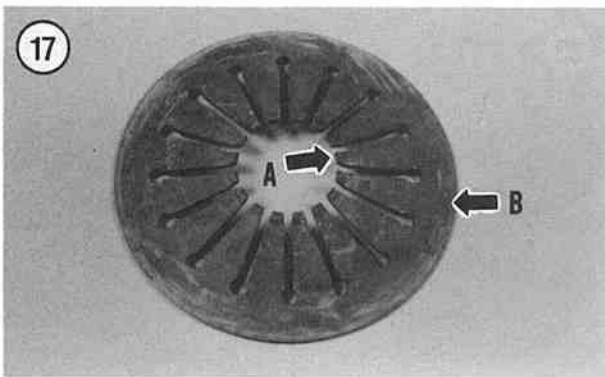


5. Measure the friction plate at several places around the plate with a micrometer (**Figure 12**) or vernier caliper. Compare to the specifications listed in **Table 1**. Replace the friction plate if it is worn to the service limit or less.
6. Inspect the inner splines (**Figure 13**) in the friction plate for cracks, nicks or galling where they come in contact with the transmission shaft. If any severe damage is evident, the friction plate must be replaced. If the splines are damaged, the clutch action may be erratic. Replace the friction plate.
7. Also inspect the transmission input shaft splines for wear or damage that may have been caused by the friction plate or vice versa. If the transmission input shaft is damaged, refer to Chapter Six for transmission shaft replacement procedures.
8. Inspect the rivets securing the inner spline portion (A, **Figure 14**) to the friction disc and the rivets securing the friction material (B, **Figure 14**) to each side of the disc. If any of the rivets are loose or appear to be damaged, replace the friction disc.
9. Inspect the friction plate contact surface of both the pressure plate (**Figure 15**) and the pressure ring (**Figure 16**). Check for wear, cracks or scoring (friction disc rivet contact). If any of these conditions are found, replace either or both parts.
10. Inspect the diaphragm spring as follows:
  - a. Check the center portion (A, **Figure 17**) where the pressure plate makes contact for wear or damage.
  - b. Check the outer portion (B, **Figure 17**) where the spring makes contact with the pressure plate for wear or damage.
  - c. Check the spring for any cracked or broken spring fingers.
  - d. Check the spring for weakness. Lay the diaphragm spring on a piece of plate glass with the spring fingers facing up. Measure the height of the spring fingers with a surface gauge. Compare to specification listed in **Table 1**.
  - e. Replace the diaphragm spring if any of these faults are found.

In order to maintain maximum performance from the clutch assembly, replace any part(s) that is questionable. Do not try to clean up unserviceable parts that should be replaced.







11. Inspect the mounting holes in the pressure ring (**Figure 18**) and pressure plate (**Figure 19**) for wear, damage or elongation.

12. Inspect the gear on the flywheel for chipped or missing teeth. Replace the flywheel if damaged or rounded off.

#### Flywheel Inspection

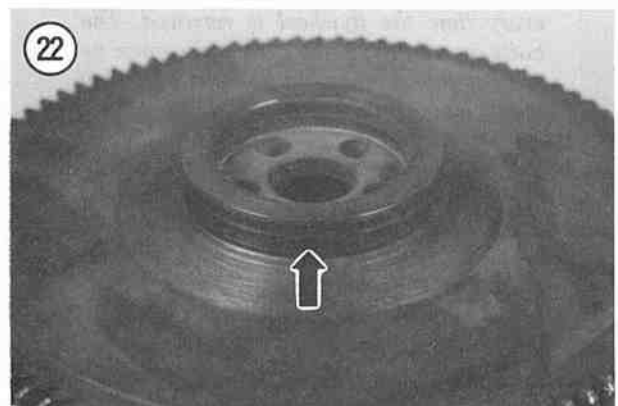
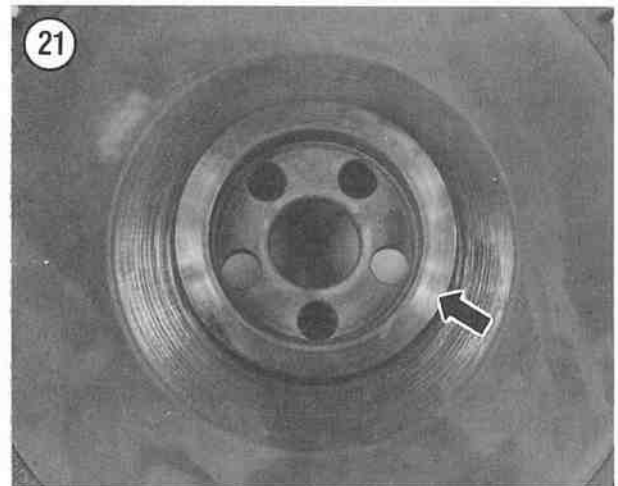
1. Inspect the mounting holes in the flywheel for wear, damage or elongation. If damaged, replace the flywheel.

2. Inspect the clutch assembly threaded mounting holes in the flywheel for wear, damage or elongation. If damaged, clean out the threads with a proper size thread tap.

3. Inspect the gear (**Figure 20**) on the flywheel for chipped or missing teeth. Replace the flywheel if damaged or rounded off.

4. Inspect the surface (**Figure 21**) that rides up against the crankcase outer thrust bearing for wear or damage. It should be smooth with no gouges. If damaged, replace the flywheel.

5. Inspect the surface (**Figure 22**) that rides against the rear main oil seal for wear or damage. It should be smooth with no gouges. If damaged, replace the flywheel.



6. While the flywheel is removed, fill in the timing marks (Figure 23) with typewriter white correction fluid or white crayon. This will make ignition timing easier as the timing marks will be easier to see.

### Installation

Refer to Figure 1 for this procedure.

#### CAUTION

The correct type of lubricant must be applied to the clutch/input shaft splines. Optimol T white paste (Figure 24) is recommended by BMW. This replaces BMW's previous recommendation of Staburags NBU 30 PTM. Make sure the lubricant used is compatible with this application. The incorrect lubricant could contaminate the clutch friction disc and make replacement necessary.

#### CAUTION

When applying the special lubricant, **apply only a thin coat** and-only to the designated areas. If too much lubricant is used or is applied in the wrong place, it will be thrown off and may contaminate the clutch friction plate.

#### NOTE

Step 1 and Step 2 are necessary only if the flywheel was removed.

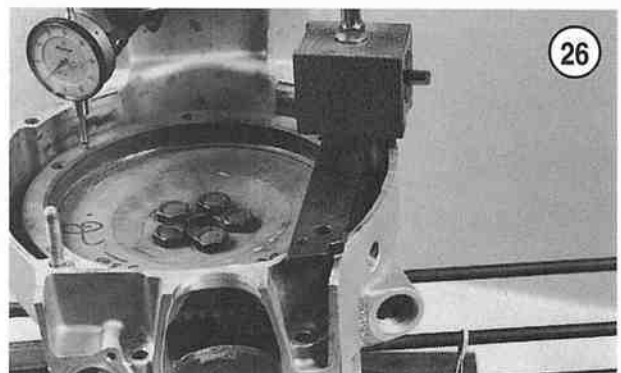
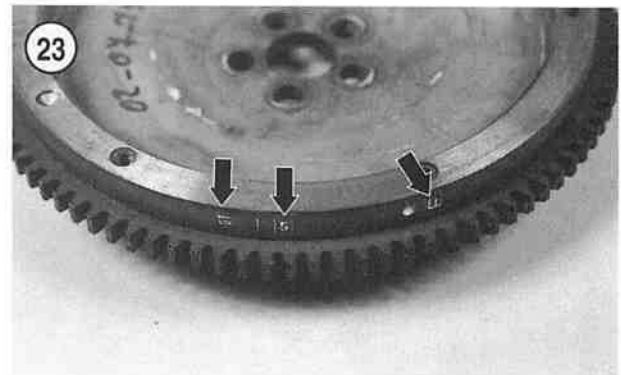
1. Make sure the mating surfaces of the end of the crankshaft and the flywheel are clean and free of any dirt or burrs. If there is anything that will not allow these parts to fit correctly up against each other, the flywheel runout will be affected.
2. Apply clean engine oil to the rear main oil seal (Figure 10) and to the mating surface of the flywheel (Figure 22).

#### CAUTION

New flywheel mounting bolts must be used every time the flywheel is removed. The bolts are of the stretch type and cannot be reused. Never reuse old bolts as they may break, leading to expensive engine damage.

3A. If installing the existing flywheel, perform the following:

- a. Using the alignment marks made in Step 9 of Removal, align the flywheel with the crankshaft and install the flywheel.
- b. Apply a light coat of engine oil to the new flywheel mounting bolts and install the bolts.
- c. Install the same holding fixture used during removal to keep the flywheel from turning.

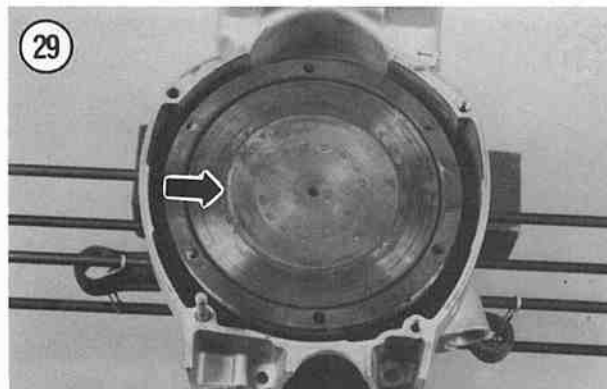
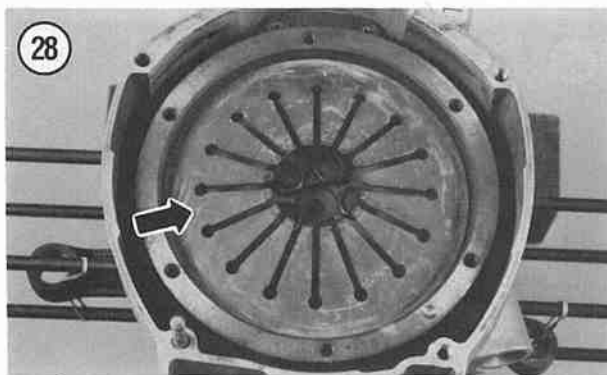
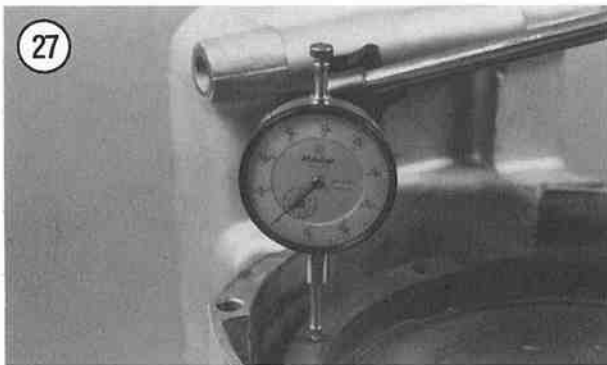


- d. Using a crisscross pattern, tighten the bolts (**Figure 9**) to the torque specification listed in **Table 2**.
- e. Remove the holding fixture from the flywheel.

**NOTE**

*If a new flywheel is being installed, it must be located correctly on the crankshaft so that the engine timing marks will be correct.*

- 3B. If installing a new flywheel, perform the following:
  - a. Use the alternator rotor mounting bolt and rotate the engine until the cylinders are at top dead center (TDC).



- b. Position the flywheel so that the "OT" timing mark is aligned with the fixed mark (**Figure 25**) in the timing hole in the crankcase.
- c. Apply a light coat of engine oil to the *new* flywheel mounting bolts and install the bolts.
- d. Install the same fixture used during removal to keep the flywheel from turning.
- e. Using a crisscross pattern, tighten the bolts (**Figure 9**) to the torque specification listed in **Table 2**.
- f. Remove the holding fixture from the flywheel.

**CAUTION**

*After the flywheel is installed, the runout must be inspected. The flywheel and clutch assembly is a large rotating mass and if the runout is out of specification, there will be severe engine vibration that can lead to costly engine damage.*

4. Inspect flywheel runout as follows:
  - a. Attach a dial indicator to the rear surface of the crankcase as shown in **Figure 26**.
  - b. Place the dial indicator probe on the rear surface of the flywheel.
  - c. Zero the dial indicator (**Figure 27**).

**NOTE**

*If the engine is mounted in the frame, press in on the flywheel to take up any crankshaft end float. If the engine is removed, position it vertically so the flywheel is pressing on the crankshaft and will take up all end float.*

- d. Slowly rotate the engine and flywheel and note the dial gauge readings. Compare to specifications listed in **Table 1**. If the runout is out of specification, the flywheel must be turned and straightened by a machine shop or replaced.
- e. Remove the dial gauge assembly from the crankcase.

**NOTE**

*Note that the long side of the friction plate splined section is facing out toward the transmission. It must be installed the same way.*

**NOTE**

*Refer to alignment marks made during removal and in the following steps align these marks.*

5. Apply a light coat of Staburags NBU 30 PTM grease to the perimeter (B, **Figure 17**) and to the raised portions (A, **Figure 17**) on the diaphragm spring where they make contact with the pressure plate.
6. Position the diaphragm spring (**Figure 28**) with the raised fingers facing out toward the transmission.
7. Install the pressure plate (**Figure 29**) and align the mounting holes with those in the flywheel.

8. Install the friction plate (Figure 30) and position it so that the long side (Figure 31) of the friction plate splined section is facing out toward the transmission.

**NOTE**

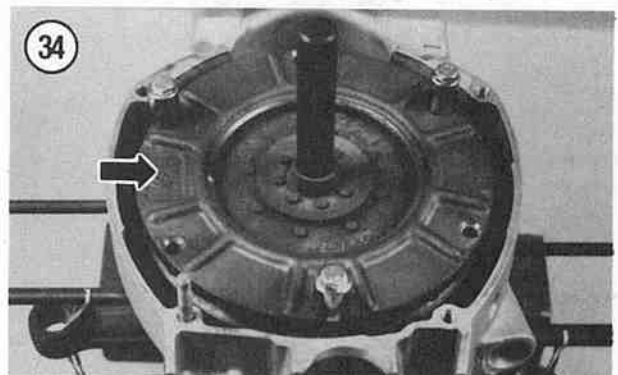
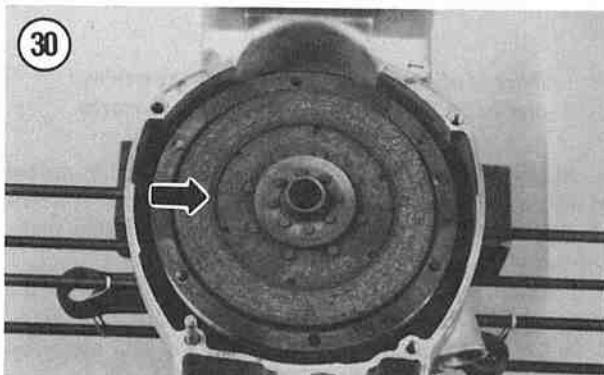
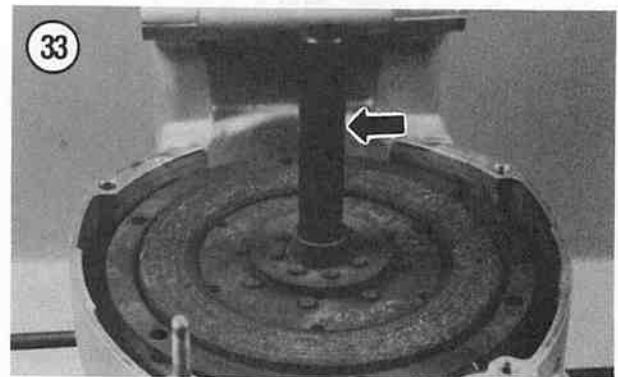
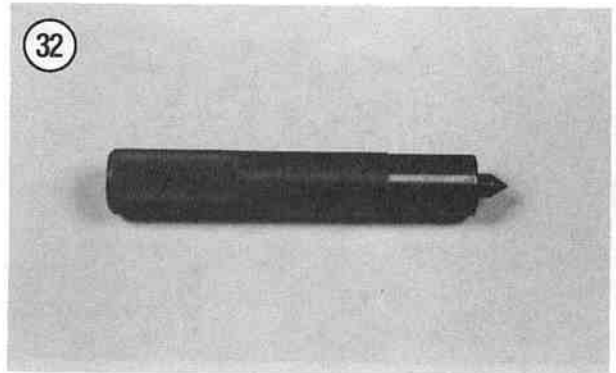
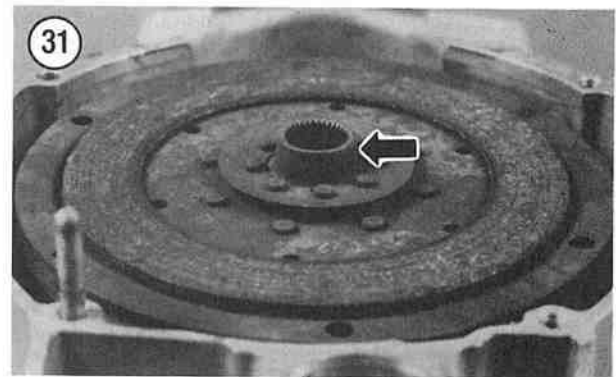
*Do not try to reassemble and install the clutch assembly without the clutch plate centering tool (BMW special tool part No. 21 6 650) (Figure 32). The alignment of the friction plate to the transmission shaft is very critical. During transmission assembly installation, the transmission's input shaft slides through the friction plate's center splines. If this alignment is not correct, you will not be able to install the transmission assembly.*

9. Install the clutch centering tool (Figure 33) into the clutch assembly.

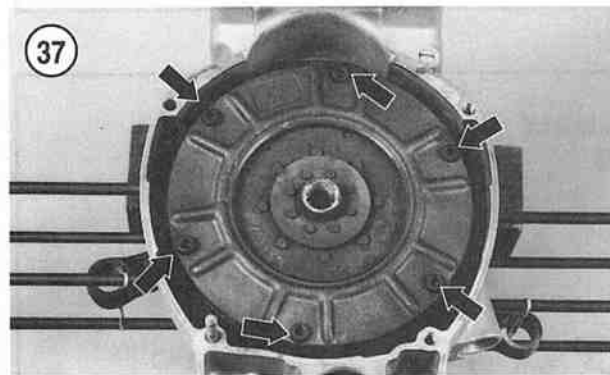
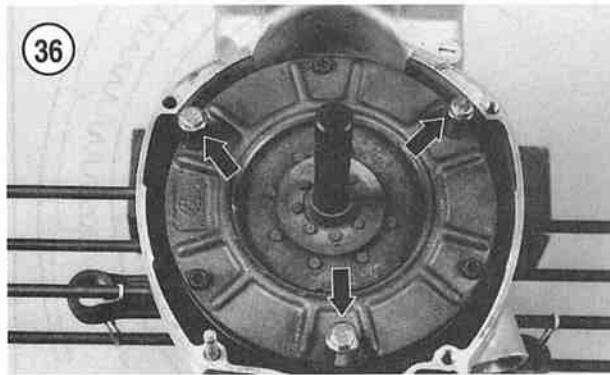
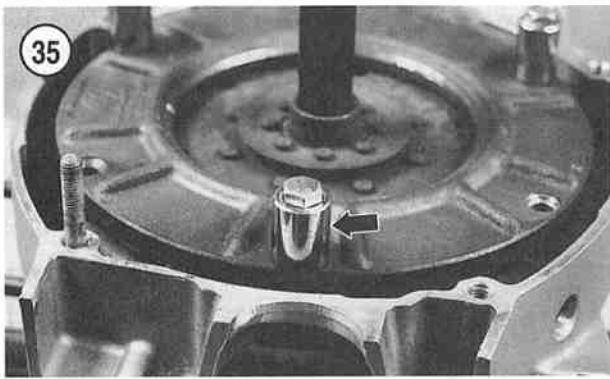
**NOTE**

*If so equipped, be sure to install the spacer between the pressure plate and pressure ring at each mounting bolt location.*

10. Align the mounting bolt holes of the clutch pressure ring (Figure 34) and install it.
11. Check the alignment of the mounting bolt holes of the clutch pressure ring and the pressure plate with the threaded holes in the flywheel. Realign if necessary.
12. Install an 8 mm bolt about 50 mm (2 in.) long, with a spacer (piece of pipe or socket) (Figure 35), into every other threaded hole.
13. Gradually tighten the 3 long bolts (Figure 36) in a staggered pattern. This will compress the clutch assembly. Continue to tighten until the clutch is completely compressed and the pressure ring has bottomed out.
14. Install the 3 regular clutch bolts and tighten securely, but to less than the torque specified in Table 2.
15. Remove the 3 long bolts and spacers.
16. Install the 3 remaining regular clutch bolts and tighten securely, but to less than the torque specified in Table 2.
17. Using a crisscross pattern, tighten the clutch bolts (Figure 37) to the torque specification listed in Table 2.







18. Remove the clutch centering tool.
19. Before installing the transmission, apply a light coat of Optimol T White Paste (**Figure 24**) to the following areas:
  - a. The release pushrod end.
  - b. Inner splines of the friction plate (**Figure 38**).
  - c. Outer splines of the transmission input shaft where it rides in the friction plate.
20. Install the transmission as described in Chapter Six.

### CLUTCH AND FLYWHEEL (1981-ON MODELS)

#### Removal

Refer to **Figure 39** for this procedure.

The clutch assembly can be removed with the engine in the frame but the transmission housing must be removed. This procedure is shown with the engine removed for clarity.

1. Remove the transmission housing as described in Chapter Six.

#### CAUTION

*The housing cover, pressure plate and flywheel are installed as a balanced assembly. The relationship of these 3 parts must remain the same or severe vibration may result. Before performing Step 2, check to see if there is a yellow or white factory paint balance mark on each of these 3 parts. These parts are symmetrical but are not equal in weight. The marks are placed at the heaviest portion of each part. The parts are installed with the balance marks spaced 120° apart from each other. This spreads out the weight imbalance in order to equalize the assembly into a balanced assembly.*

#### NOTE

*If these balance marks are not visible, and there was no appreciable vibration coming from the engine, it is then presumed that the 3 parts were previously installed correctly. Using a permanent marking pen, make a straight line across the housing cover, the pressure plate and the flywheel. These marks can then be used during the reassembly alignment procedure.*

2. Using a crisscross pattern, loosen, then remove the clutch assembly mounting bolts.



- Remove the housing cover, friction plate and pressure plate and diaphragm spring as an assembly.

**NOTE**

The following steps are necessary only if the flywheel is to be removed. Obtain new flywheel bolts before removal, as the bolts must be discarded once they are removed.

**NOTE**

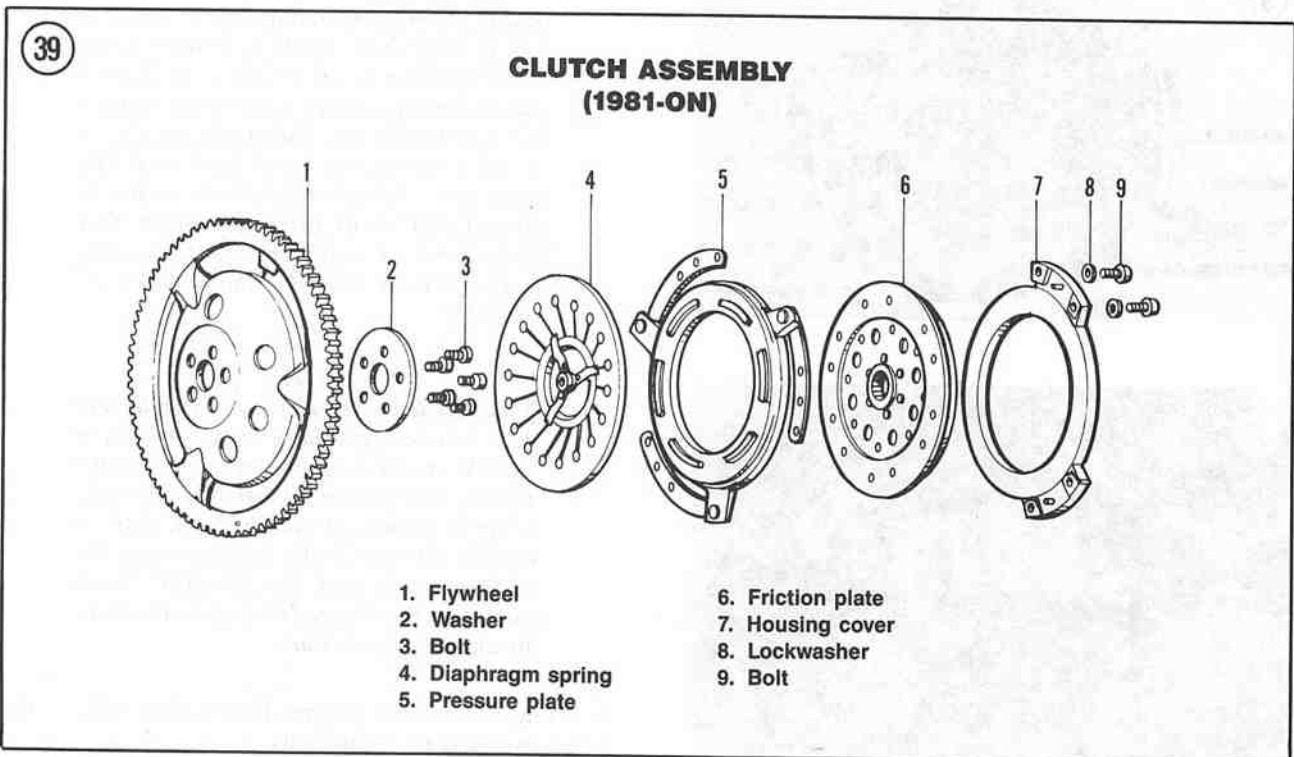
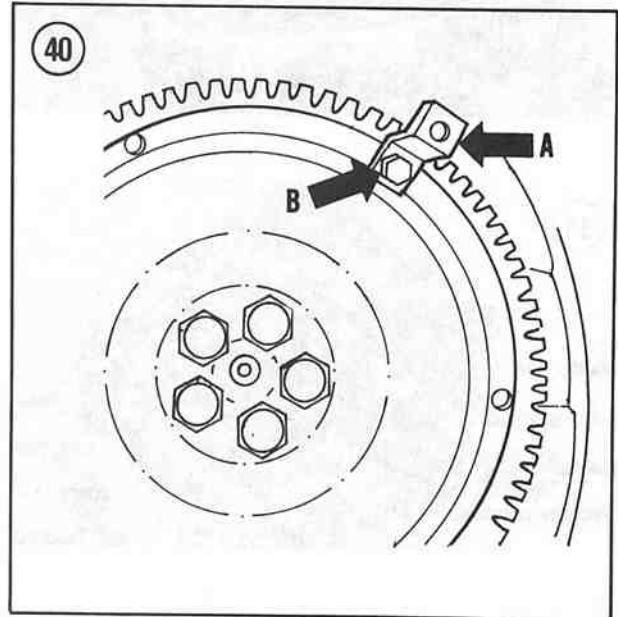
If the existing flywheel is to be reinstalled, it must be reinstalled onto the crankshaft in the same location since the engine timing marks are located on the outer circumference of the flywheel.

- Using a centerpunch and hammer, make an alignment mark on both the crankshaft and the flywheel. This will ensure correct alignment during assembly.

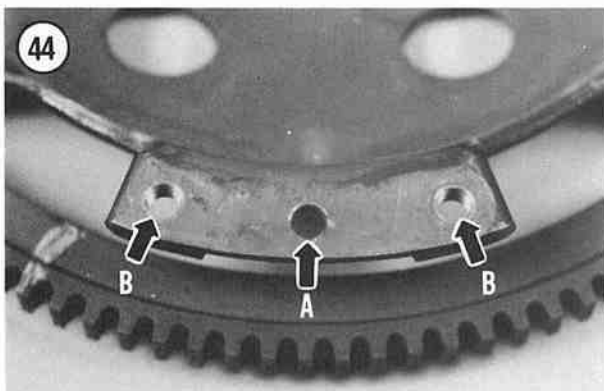
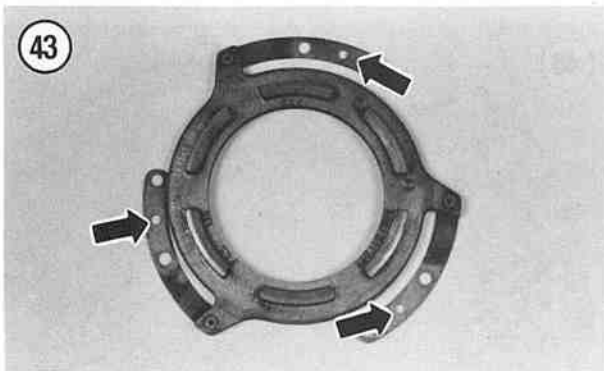
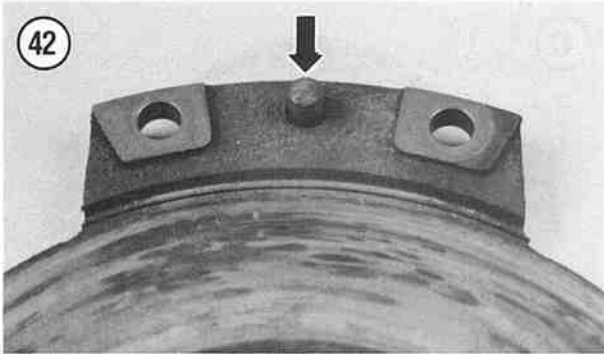
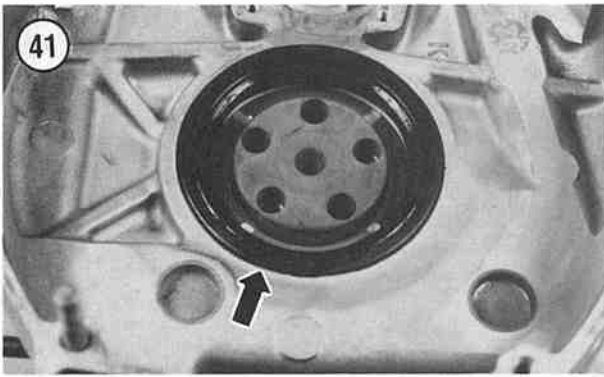
**NOTE**

The flywheel must be secured in order to loosen the bolts securing the flywheel to the engine crankshaft.

- Make a small metal strap holding fixture and attach it to the flywheel (A, Figure 40) with an 8 mm bolt (B, Figure 40).
- Using a crisscross pattern, loosen the bolts securing the flywheel to the crankshaft.



- Remove the bolts, washer and the flywheel from the engine. Discard the flywheel bolts, as they are of the stretch type and must be replaced whenever the flywheel is removed. Never reuse these bolts as it can lead to expensive engine damage.
- Inspect all clutch components as described in this chapter.



### Clutch Inspection

Refer to **Table 1** for clutch specifications.

1. Check all parts for oil or grease contamination. If the friction plate is fouled with oil or grease it must be replaced. It is impossible to remove *all* oil or grease residue from the friction material.
2. If the housing cover, pressure plate, or diaphragm spring are contaminated with oil and/or grease, perform the following:
  - a. Thoroughly clean in solvent and dry with compressed air.
  - b. After cleaning in solvent, clean the surfaces of the housing cover and pressure plate that contact the friction disc with lacquer thinner and/or aerosol electrical contact cleaner to remove any petroleum-based solvent residue.
  - c. Dry with a lint-free cloth.
3. If there is oil and/or grease contamination on the clutch parts, inspect the oil seals in the transmission housing and the crankshaft oil seal (**Figure 41**) on the engine. Replace the oil seals if necessary.
4. Inspect each of the 3 locating pins (**Figure 42**) on the housing cover and the locating pin holes in the pressure plate (**Figure 43**) and flywheel (A, **Figure 44**) for wear or damage. Replace any defective part.
5. Inspect the friction plate for damage or wear. If the friction material has worn close to the rivet head, replace the friction plate.
6. Measure the friction plate at several places around the plate with a micrometer (**Figure 45**) or vernier caliper. Compare to the specifications listed in **Table 1**. Replace the friction plate if it is worn to the service limit or less.
7. Inspect the inner splines (**Figure 46**) in the friction plate for cracks, nicks or galling where they come in contact with the transmission shaft. If any severe damage is evident, the friction plate must be replaced. If the splines are damaged, the clutch action may be erratic. Replace the friction plate. Also, inspect the transmission input shaft splines for wear



or damage that may have been caused by the friction plate or vice versa. If the transmission input shaft is damaged, refer to Chapter Six for transmission shaft replacement procedures.

8. Inspect the rivets securing the inner spline portion to the friction disc and the rivets securing the friction material to each side of the disc (**Figure 47**). If any of the rivets are loose or appear to be damaged, replace the friction disc.

9. Inspect the friction plate contact surface of both the pressure plate (**Figure 48**) and the housing cover (**Figure 49**). Check for wear, cracks or scoring (friction disc rivet contact). If any of these conditions are found, replace either or both parts.

10. Inspect the diaphragm spring as follows:

- Check the center portion (A, **Figure 50**), where the release pushrod makes contact, for wear or damage.
- Check the outer portion (B, **Figure 50**), where the spring makes contact with the pressure plate, for wear or damage.
- Check the spring for any cracked or broken spring fingers (**Figure 51**).
- Check the spring for weakness. BMW does not provide any specifications for the spring height in order to determine spring sag. If the clutch has been slipping and the clutch release mechanism is properly adjusted, the spring may have sagged to the point where it is no longer exerting sufficient pressure on the friction plate.
- Replace the diaphragm spring if any of these faults are found.

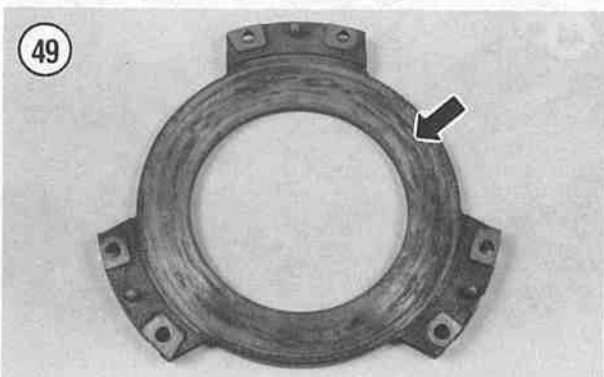
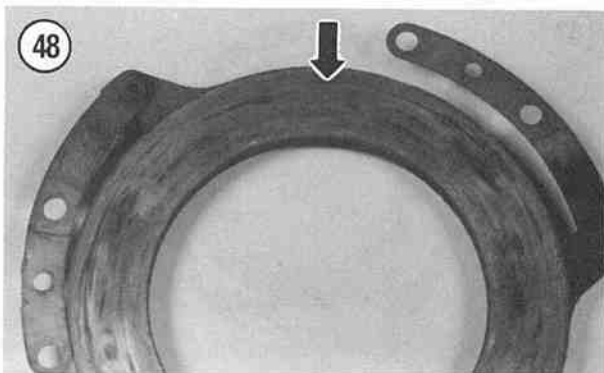
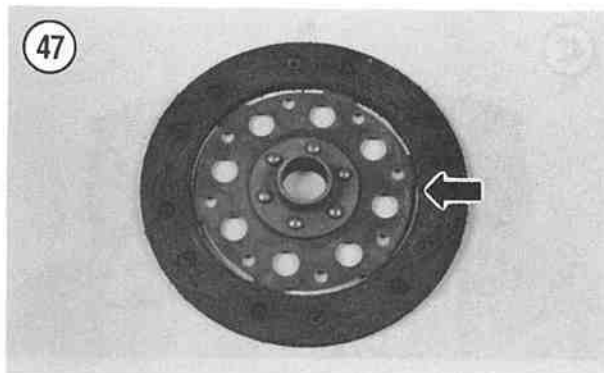
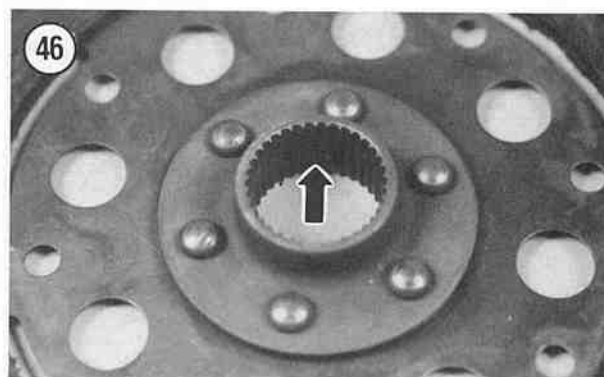
In order to maintain maximum performance from the clutch assembly, replace any part(s) that is questionable. Do not try to clean-up unserviceable parts that should be replaced.

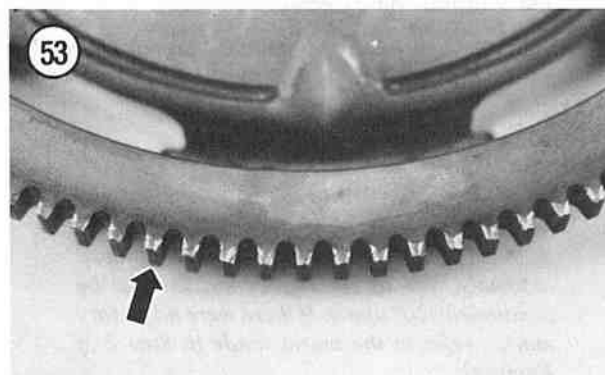
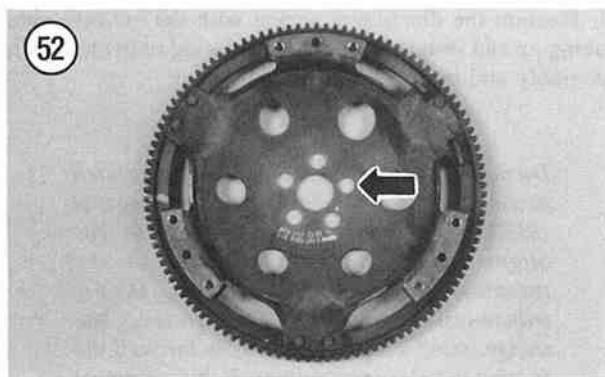
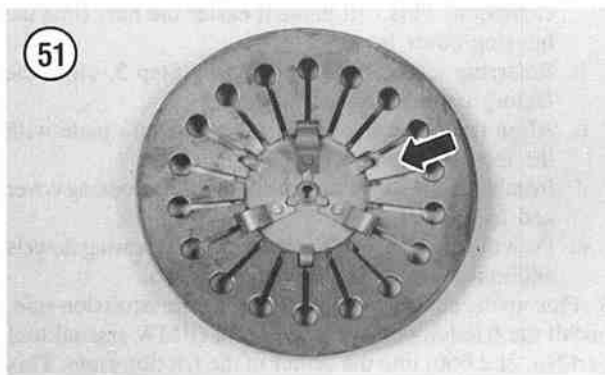
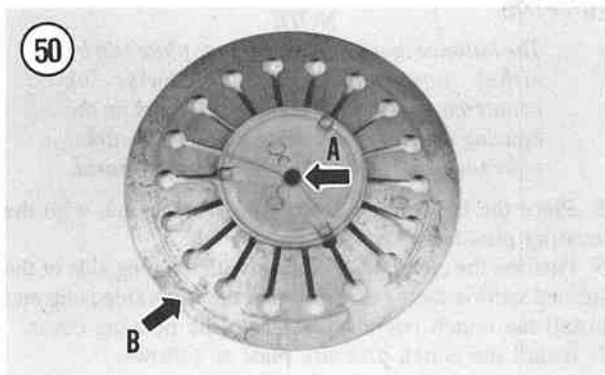
### Flywheel Inspection

- Inspect the flywheel mounting holes (**Figure 52**) for wear, damage or elongation. If damaged, replace the flywheel.
- Inspect the clutch assembly threaded mounting holes (B, **Figure 44**) in the flywheel for wear, damage or elongation. If damaged, clean out the threads with a proper size thread tap.
- Inspect the gear (**Figure 53**) on the flywheel for chipped or missing teeth. Replace if damaged or rounded off.
- While the flywheel is removed, fill in the timing marks with typewriter correction fluid or white crayon. This will make ignition timing easier as the timing marks will be easy to see.

### Installation

Refer to **Figure 39** for this procedure.



**CAUTION**

Use only the BMW recommended lubricant (Staburags NBU 30 PTM) (Figure 24) in this assembly procedure. This lubricant is available from BMW dealers. In order for the clutch to operate as effectively and smoothly as it is designed to, this type of lubricant must be used and used sparingly. Do not substitute another type of lubricant as it will only lead to future clutch problems.

**CAUTION**

When applying the special lubricant, apply only a thin coat and only to the designated areas. If too much lubricant is used or is applied in the wrong place it will be thrown off and may contaminate the clutch friction plate.

1. Make sure the mating surfaces on the end of the crankshaft and the flywheel are clean and free of any dirt or burrs. If there is anything that will not allow these parts to fit correctly up against each other, the flywheel runout will be affected.

**CAUTION**

New flywheel mounting bolts must be used every time the flywheel is removed. The bolts are of the stretch type and cannot be reused. Never reuse old bolts as they may fracture and break leading to expensive engine damage.

- 2A. If installing the existing flywheel, perform the following:
  - a. Using the alignment marks made in Step 4 of *Removal*, align the flywheel with the crankshaft and install the flywheel.
  - b. Apply a light coat of engine oil to the new flywheel mounting bolts and install the bolts.
  - c. Install the same metal strap holding fixture used during removal to keep the flywheel from turning.
  - d. Using a crisscross pattern, tighten the bolts to the torque specification listed in **Table 2**.
  - e. Remove the holding fixture from the flywheel.

**NOTE**

If a new flywheel is being installed, it must be located correctly on the crankshaft so that the engine timing marks will be correct.

- 2B. If installing a new flywheel, perform the following:
  - a. Use the alternator rotor mounting bolt and rotate the engine until the cylinders are at top dead center (TDC).



- b. Position the flywheel so that the "OT" timing mark is aligned with the fixed mark in the timing hole in the crankcase.
- c. Apply a light coat of engine oil to the new flywheel mounting bolts and install the bolts.
- d. Install the same metal strap holding fixture used during removal to keep the flywheel from turning.
- e. Using a crisscross pattern, tighten the bolts to the torque specification listed in **Table 2**.
- f. Remove the holding fixture from the flywheel.

#### CAUTION

*After the flywheel is installed, the runout must be inspected. The flywheel and clutch assembly is a large rotating mass and if the runout is out of specification, there will be severe engine vibration that can lead to costly engine damage.*

3. Inspect flywheel runout as follows:
  - a. Attach a dial gauge to the transmission mounting surface of the crankcase.
  - b. Zero the dial gauge.

#### NOTE

*If the engine is mounted in the frame, press in on the flywheel to take up any crankshaft end float. If the engine is removed, position it vertically so the flywheel is pressing on the crankshaft and will take up all end float.*

- c. Slowly rotate the engine and flywheel and note the dial gauge readings. Compare to specifications listed in **Table 1**. If the runout is out of specification, the flywheel must be turned and straightened by a machine shop.

#### CAUTION

*As noted during removal, the pressure plate and clutch housing cover must be installed onto the flywheel in a specific arrangement in order to form a balanced assembly. The relationship of these three parts must be correct or severe vibration will result, leading to costly clutch and/or engine damage.*

4. Apply a light coat of Staburags NBU 30 PTM grease to the perimeter and the raised portions on the diaphragm spring where they make contact with the pressure plate.

#### NOTE

*Refer to the factory balance paint marks noted prior to Step 2 of Removal, or the marks that you made.*

#### NOTE

*The balance mark on the pressure plate can be either positioned 120° clockwise or counterclockwise from the balance mark on the housing cover. If there were no factory marks, refer to the marks made in Step 2 of Removal.*

5. Place the housing cover on your work bench with the locating pins facing up.
6. Position the clutch friction disc with the long side of the splined section facing down so that the flush side is up and install the clutch friction plate onto the housing cover.
7. Install the clutch pressure plate as follows:
  - a. Apply a light coat of multipurpose grease to the locating pins on the housing cover to prevent corrosion. This will make it easier the next time the housing cover is removed.
  - b. Referring to the NOTE preceding Step 5, align the factory paint marks 120° apart.
  - c. Align the mounting holes in the pressure plate with the locating pins on the housing cover.
  - d. Install the clutch pressure plate onto the housing cover and friction disc.
  - e. Push the clutch pressure plate onto the locating dowels and make sure it is completely seated.
8. Pick up the clutch assembly. From the transmission side, install the friction plate centering tool (BMW special tool part No. 21 2 660) into the center of the friction plate. This will correctly center the friction disc within the clutch assembly.
9. Position the diaphragm spring with the concave side facing up and install the diaphragm spring onto the clutch assembly and onto the special tool.

#### NOTE

*Do not try to reassemble and install the clutch assembly without the clutch plate centering tool (BMW special tool part No. 21 6 660). The alignment of the friction plate to the transmission shaft is very critical. During transmission assembly installation, the transmission's input shaft slides through the friction plate's center splines. If this alignment is not correct, you will not be able to install the transmission assembly.*

10. Install the clutch assembly onto the engine. Carefully insert the end of the BMW special tool into the end of the crankshaft.

#### NOTE

*The balance mark on the pressure plate and housing cover must be positioned 120° from the flywheel balance mark to maintain a balanced assembly. The three balance marks must be positioned 120° apart. If there were no factory marks, refer to the marks made in Step 2 of Removal.*

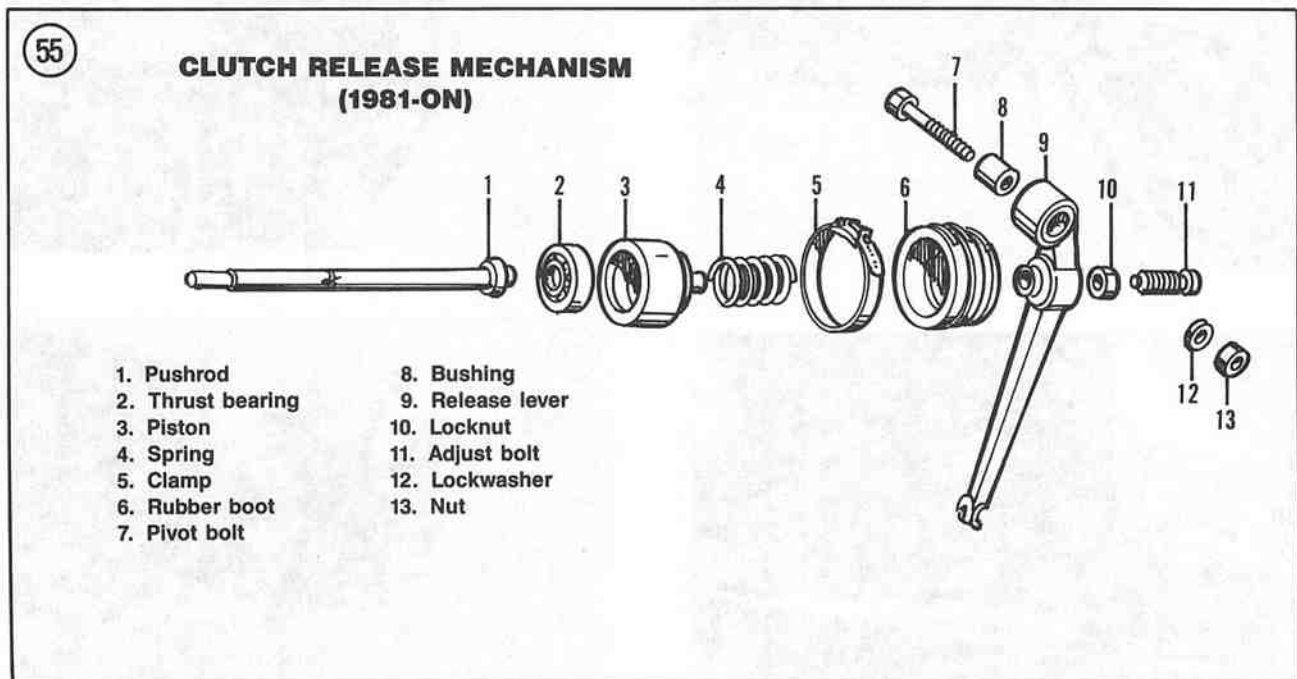
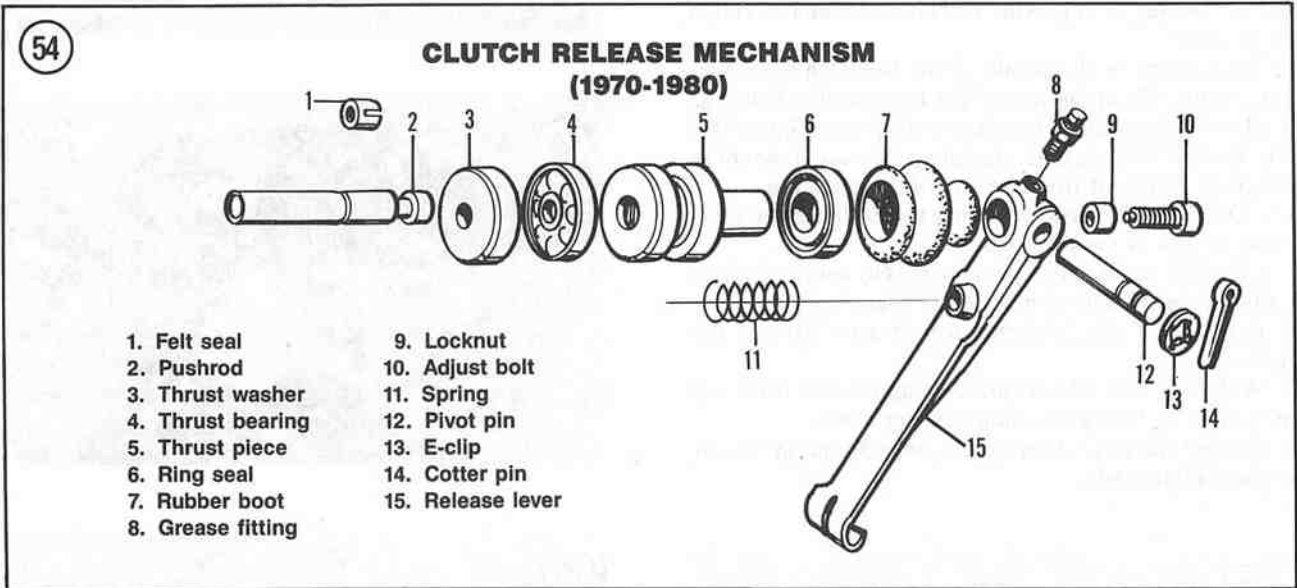


11. Align the mounting bolt holes of the clutch assembly with the holes in the flywheel.
12. Install the clutch assembly mounting bolts only to a loose finger-tight at this time.
13. Using a crisscross pattern, tighten the clutch assembly mounting bolts in 2-3 stages to the torque specification listed in **Table 2**.
14. Remove the special tool from the friction plate.
15. Before installing the transmission, apply a light coat of Staburags NBU 30 PTM grease to the following areas:

- a. The release push rod end.
  - b. Inner splines of the friction plate.
  - c. Outer splines of the transmission input shaft where it rides in the friction plate.
16. Install the transmission as described in Chapter Six.

**CLUTCH RELEASE MECHANISM**

Refer to **Figure 54** for 1970-1980 models or **Figure 55** for 1981-on models for this procedure.

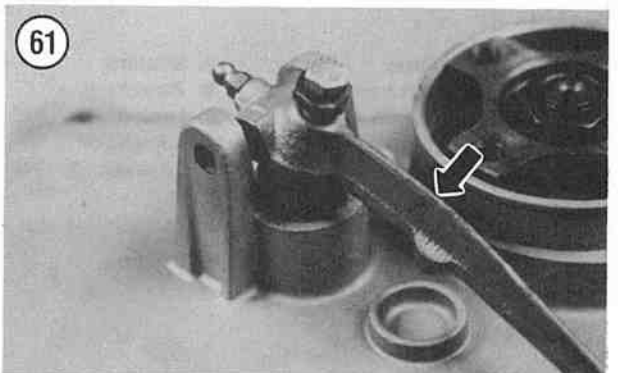
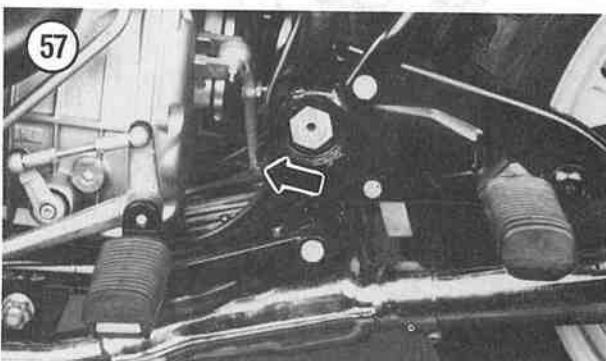
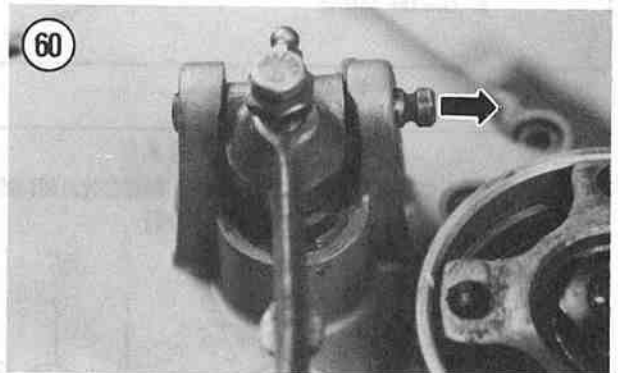
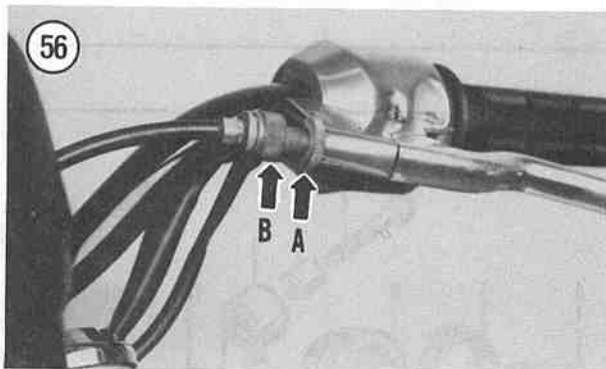
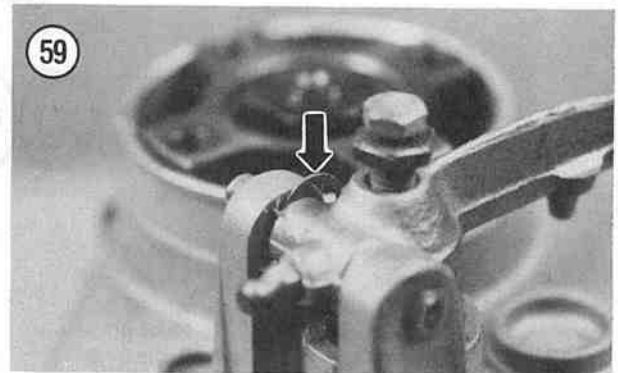
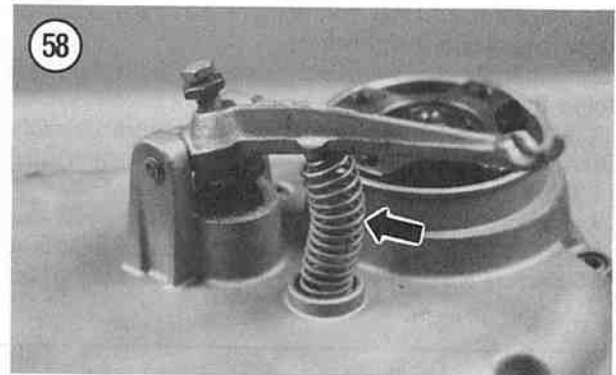


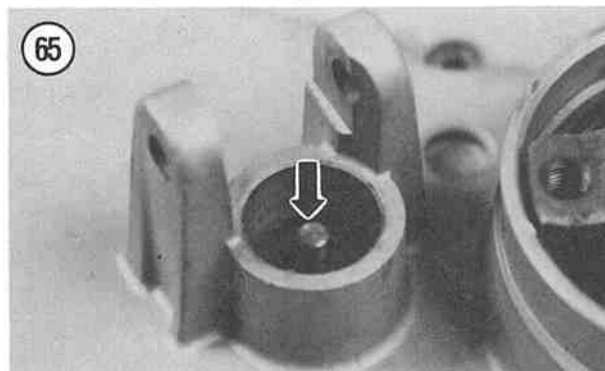
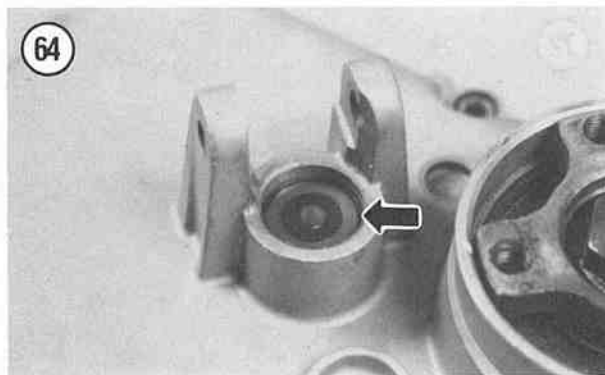
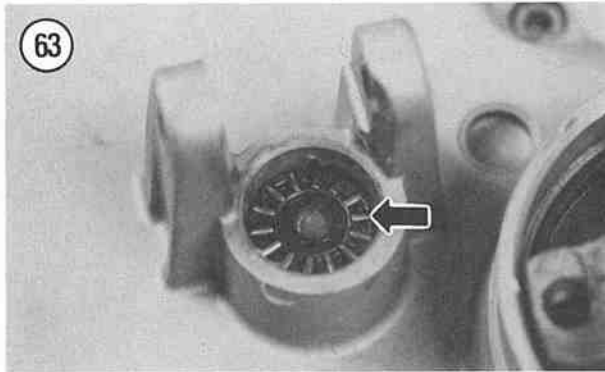
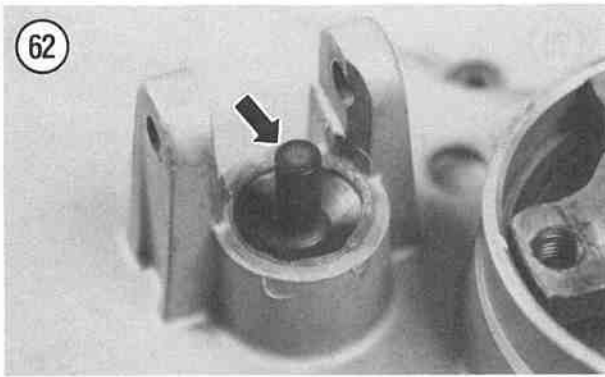
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### Removal (1970-1980 Models)

The clutch release arm and related components can be removed with the engine and transmission housing in the frame. The transmission must be removed from the frame for the removal of the clutch pushrod. From Step 4 on, this procedure is shown with the transmission housing removed from the frame for clarity.

1. Place the bike on the centerstand.
2. At the clutch hand lever on the handlebar, loosen the locknut (A, **Figure 56**) and turn the adjuster (B, **Figure 56**) all the way in to provide maximum amount of clutch cable slack.
3. Disconnect the clutch cable from the clutch release lever (**Figure 57**) at the rear of the transmission housing.
4. Remove the clutch release arm coil spring (**Figure 58**).
  - 5A. On 1970-1973 models, straighten the ends of the cotter pin, then remove it from the end of the pivot pin.
  - 5B. On 1974-1980 models, remove the E-clip (**Figure 59**) from the end of the pivot pin.
6. Carefully tap the pivot pin (**Figure 60**) out of the pivot posts on the transmission housing cover.
7. Remove the clutch release arm (**Figure 61**) and the rubber boot.
8. Withdraw the release piece (**Figure 62**) from the receptacle in the transmission housing cover.
9. Remove the thrust bearing (**Figure 63**) and the thrust washer (**Figure 64**).





10. If the clutch pushrod requires removal, remove the transmission as described in Chapter Six.

11. Withdraw the pushrod from the transmission shaft assembly (Figure 65).

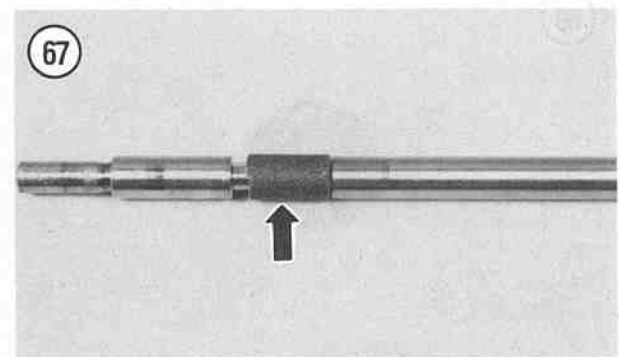
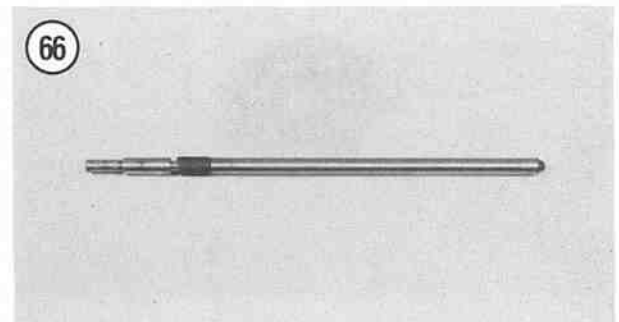
12. Inspect all components as described in this chapter.

#### Inspection (1970-1980 Models)

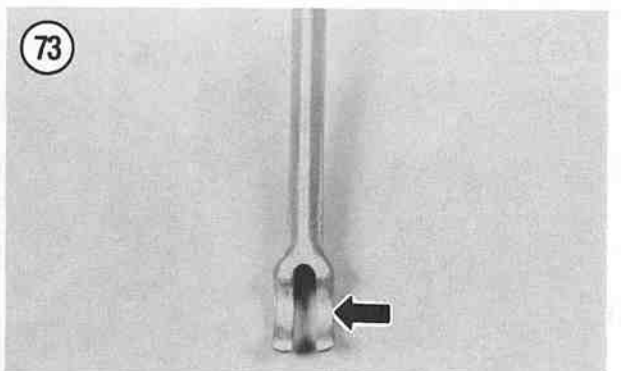
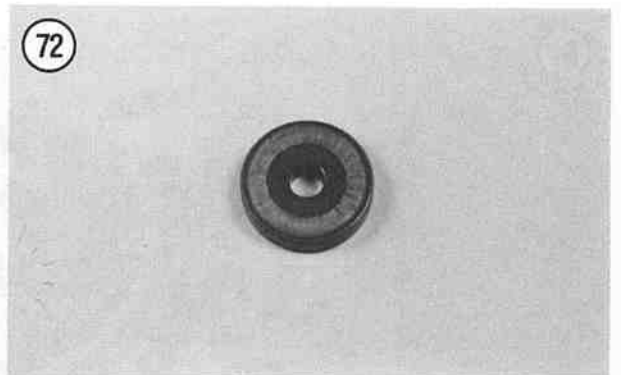
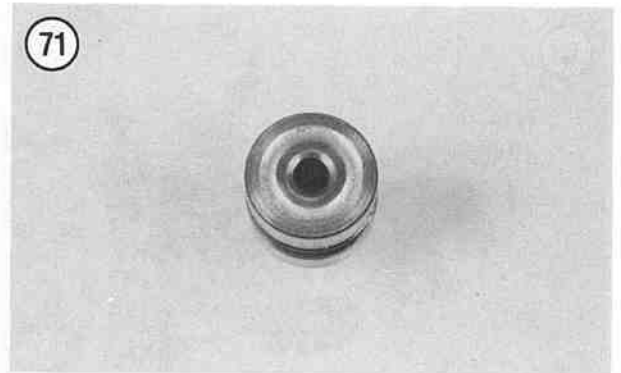
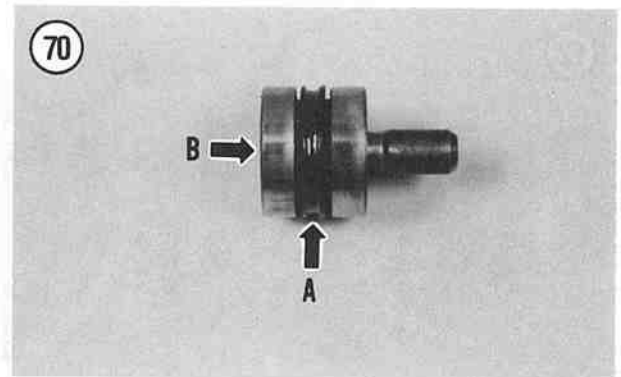
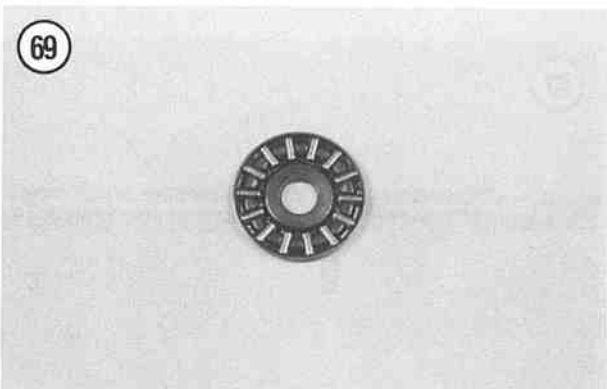
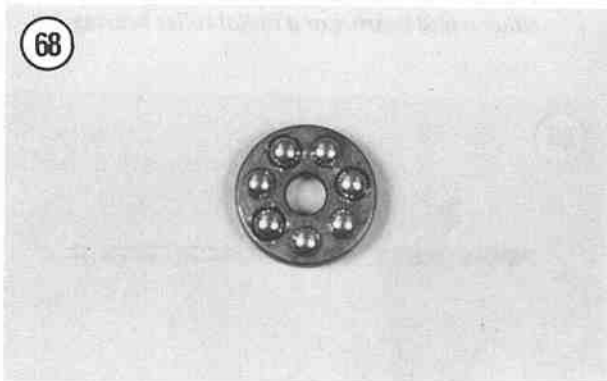
1. Inspect the rubber boot for damage or deterioration; replace if necessary.
2. Inspect the spring for sagging or damage. BMW does not provide a service limit dimension for the spring free length. Replace the spring if it is questionable.
3. Lay the release pushrod (Figure 66) on a piece of plate glass and check for straightness with a flat feeler gauge. Replace if the rod is warped the slightest amount as it may hang up in the hollow portion of the transmission input shaft.
4. Inspect the release pushrod end where it makes contact with the diaphragm spring. Make sure it is not damaged or rough. Replace if necessary.
5. Remove the felt ring (Figure 67) from the pushrod. Inspect the felt ring for wear or damage. Thoroughly saturate the felt ring (old or new ring) in multipurpose grease and reinstall it on the pushrod.

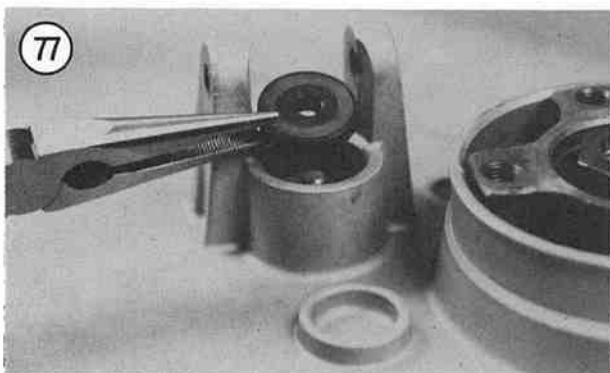
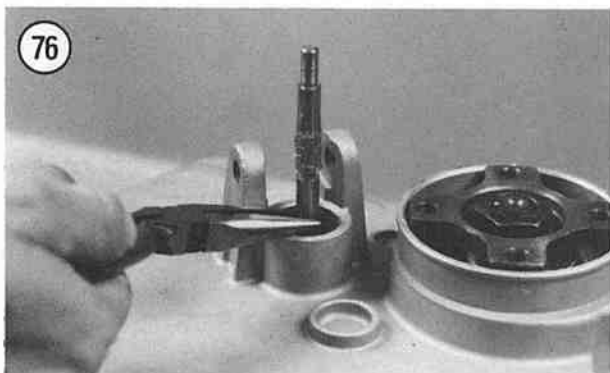
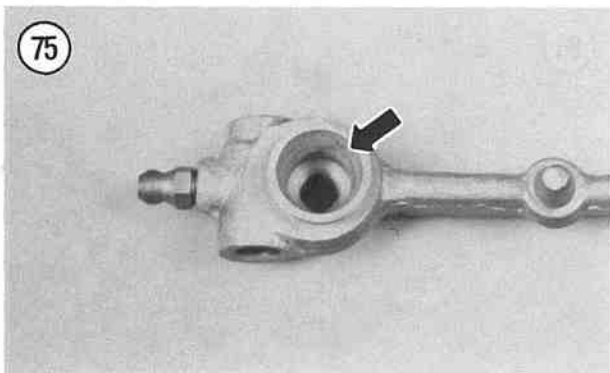
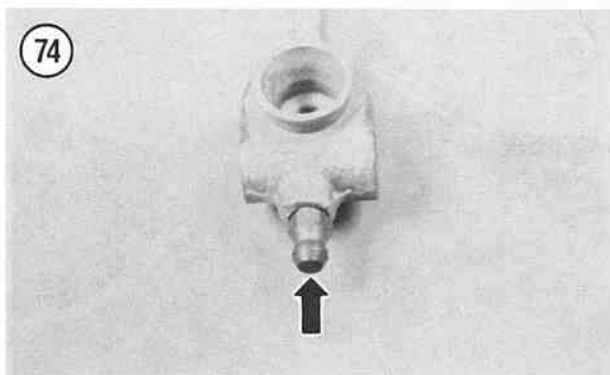
#### NOTE

*The release mechanism may be equipped with either a ball bearing or a radial roller bearing.*



6. Inspect the bearing. Refer to **Figure 68** or **Figure 69**. Turn it by hand; it must rotate smoothly with no signs of wear or damage. Replace if necessary.
7. Carefully remove the sealing ring (A, **Figure 70**) from the thrust piece. Thoroughly clean both pieces in solvent and dry with compressed air.
8. Inspect the thrust washer for wear or damage. Refer to **Figure 71** or **Figure 72**. Replace if necessary.
9. Inspect both the sealing ring and thrust piece (B, **Figure 70**) for wear or damage. Replace if necessary.
10. Carefully install the sealing ring onto the thrust piece. Apply multipurpose grease to both pieces. Make sure they are completely coated.
11. Inspect the clutch release lever where the clutch cable attaches (**Figure 73**) for wear or damage. Replace if necessary.
12. Inspect the clutch release lever adjustment bolt and locknut for wear or damage. Replace if necessary.
13. Inspect the grease fitting (**Figure 74**). Make sure it is clear and that grease flows freely through it. If the fitting is clogged, unscrew it and clean it out with a piece of wire and solvent. Reinstall and tighten securely.
14. Inspect the spring receptacle (**Figure 75**) in the clutch release lever for wear or damage. Replace the lever if necessary.
15. Inspect the pivot pin receptacle in the clutch release lever for wear or damage. Replace the lever if necessary.





### Installation (1970-1980 Models)

#### NOTE

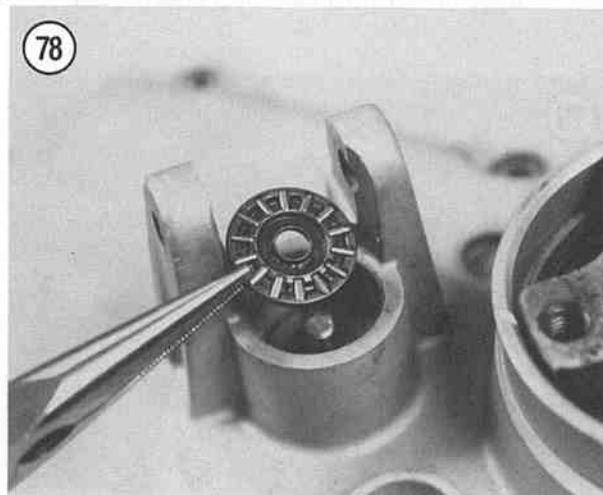
Installing the pushrod into the transmission housing cover is very difficult, especially with a new felt seal. Smooth the grease on the exterior of the felt seal. Place the pushrod in a freezer for 30 minutes. This will solidify the grease and will make installation easier.

1. If removed, install the pushrod into the transmission shaft assembly as follows:
  - a. Partially install the pushrod into the receptacle in the transmission housing cover (Figure 76).
  - b. When the felt seal reaches the sealing surface of the transmission housing cover, slow down.

#### NOTE

When the felt seal starts to enter the leading edge of the cover it tends to bunch up.

- c. Slowly push the pushrod and felt seal into the cover. It may be necessary to guide the felt seal in by pushing around its perimeter with a small flat-bladed screwdriver.
  - d. Continue to push and guide the felt seal in until it is completely inserted into the cover.
  - e. Push the pushrod in until it bottoms out.
2. Install the following into the receptacle in the transmission housing.
  - a. Using Staburags NBU 30 PTM grease, thoroughly coat the thrust washer, thrust bearing and thrust piece. Make sure the recess in the sealing ring is thoroughly packed with grease.
  - b. Install the thrust washer (Figure 77) and thrust bearing. Refer to Figure 78 or Figure 79.



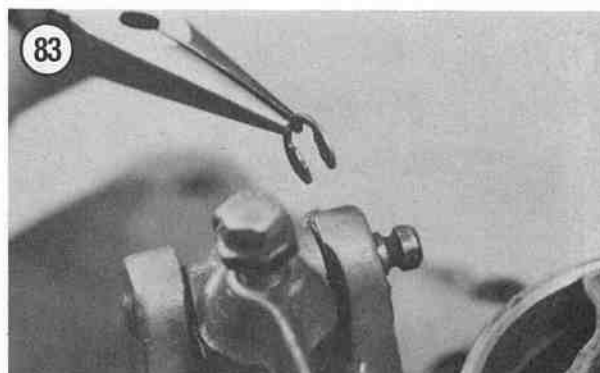
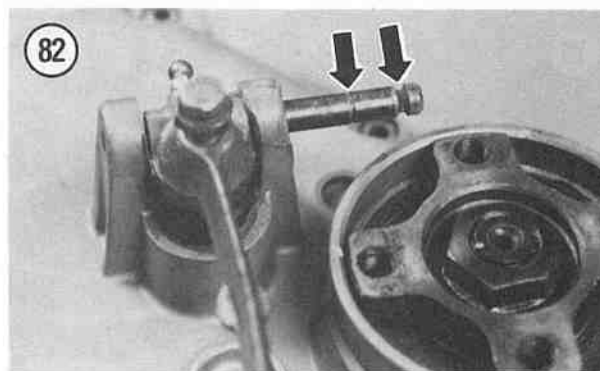
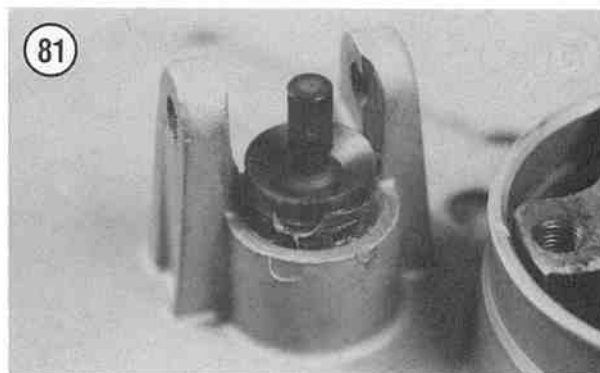
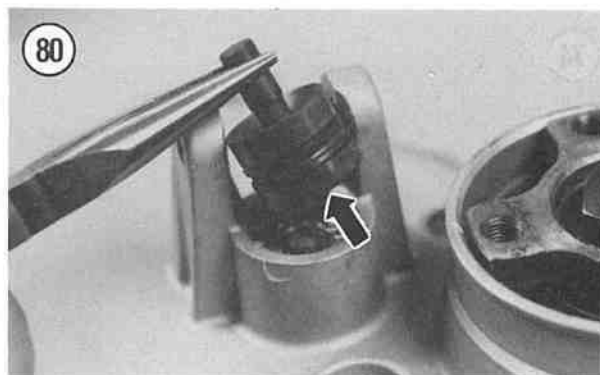
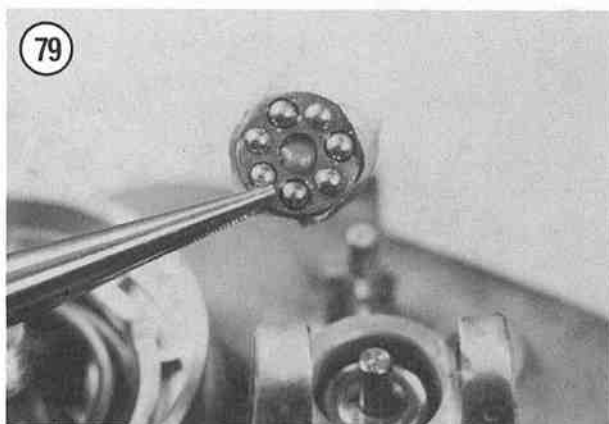


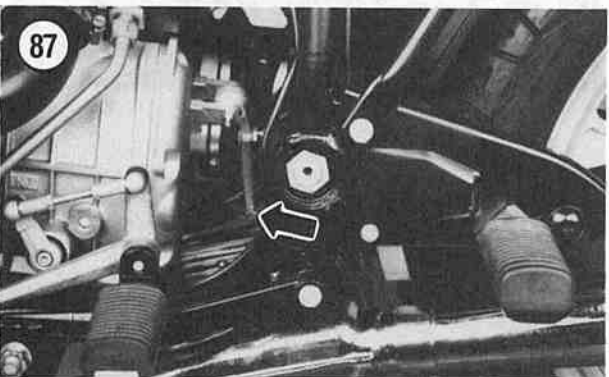
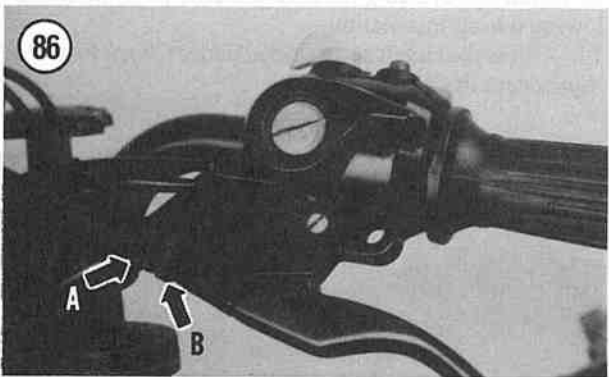
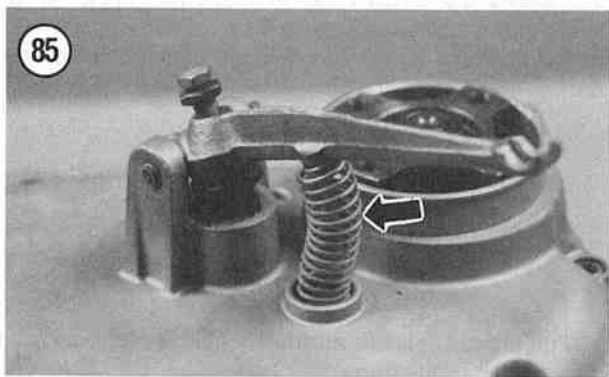
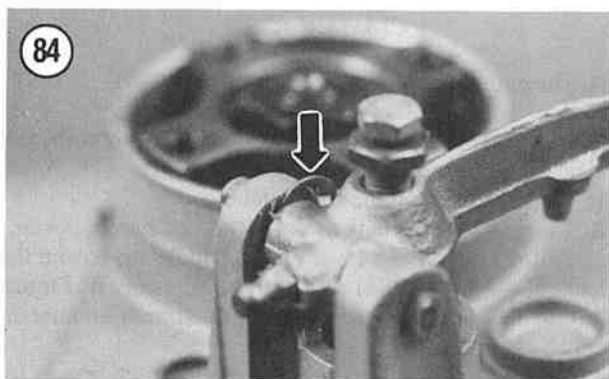
- c. Position the thrust piece with the flush side going in first (**Figure 80**).
  - d. Carefully install the thrust piece into the receptacle (**Figure 81**). Be careful not to damage the sealing ring during installation.
3. Install the transmission as described in Chapter Six.
  4. Install the rubber boot onto the clutch release arm.
  5. Install the clutch release arm into position in the transmission housing cover.
  6. Align the clutch release arm with the pivot post holes.
  7. Position the pivot pin with the grooves going in last (**Figure 82**). Install the pivot pin and tap it in until it bottoms out.
  - 8A. On 1970-1973 models, install a *new* cotter pin and bend the ends over completely.
  - 8B. On 1974-1980 models, install the E-clip (**Figure 83**) onto the end of the pivot pin (**Figure 84**). Make sure it is completely seated.
  9. Install the spring (**Figure 85**) into the receptacle in the release lever. Make sure it is correctly seated on the raised post on the transmission housing.
  10. Attach the clutch cable onto the clutch release lever.
  11. Adjust the clutch hand lever free play as described under *Clutch Free Play Adjustment* in Chapter Three.

#### Removal (1981-on Models)

The clutch release arm and related components can be removed with the engine and transmission housing in the frame. The transmission must be removed from the frame for the removal of the clutch pushrod.

1. Place the bike on the centerstand.
2. At the clutch hand lever on the handlebar, loosen the locknut (A, **Figure 86**) and turn the adjuster (B, **Figure 86**) all the way in to provide maximum amount of clutch cable slack.
3. Disconnect the clutch cable from the clutch release lever (**Figure 87**) at the rear of the transmission housing.
4. Unscrew the nut and lockwasher from the pivot bolt and remove the pivot bolt from the clutch release lever.

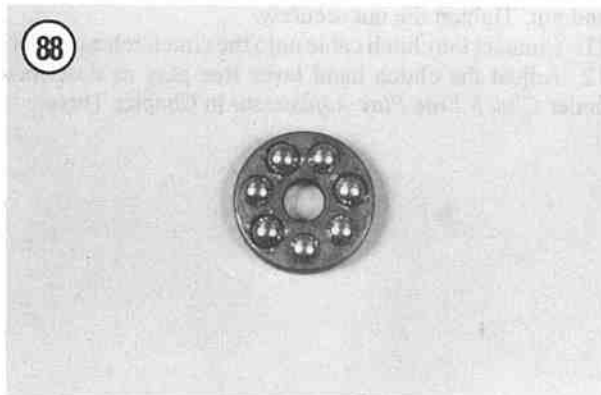




5. Remove the clutch release lever from the pivot posts on the backside of the transmission housing. Don't lose the bushing in the release lever needle bearing.
6. Loosen the clamp screw securing the rubber boot to the transmission housing boss. Remove the rubber boot.
7. Remove the spring, the pressure piston and the bearing.
8. If the clutch pushrod requires removal, remove the transmission as described in Chapter Six.
9. Withdraw the pushrod from the transmission shaft assembly.
10. Inspect all components as described in this chapter.

#### Inspection (1981-on Models)

1. Inspect the rubber boot for damage or deterioration; replace if necessary.
2. Inspect the spring for sagging or damage. BMW does not provide a service limit dimension for the spring free length. Replace the spring if it is questionable.
3. Lay the release pushrod on a piece of plate glass and check for straightness. Replace if the rod is warped the slightest amount as it may hang up in the hollow portion of the transmission input shaft.
4. Inspect the release pushrod end where it makes contact with the diaphragm spring. Make sure it is not damaged or rough. Replace if necessary.
5. Inspect the bearing (Figure 88). Turn it by hand; it must rotate smoothly with no signs of wear or damage.
6. Insert the pivot rod into the clutch release lever. Slowly rotate the rod and check for bushing or needle bearing wear or damage. If the needle bearing is damaged and requires replacement, remove the pivot rod and perform the following:
  - a. Remove the bushing from the needle bearing.
  - b. Heat the clutch release lever in the area of the needle bearing with a hair dryer or hot water.
  - c. Carefully tap the needle bearing out of the lever from the inside surface.
  - d. Use solvent and thoroughly clean out the pivot area of the lever prior to installing a new needle bearing. Dry with compressed air.



- e. Apply a light coat of Staburags NBU 30 PTM grease to the pivot bore of the lever and to the outer surface of the new needle bearing.
  - f. Carefully tap the new needle bearing into the lever until it is flush with the outer surface.
  - g. Apply a light coat of Staburags NBU 30 PTM grease to the inner surface of the needle bearing.
7. Inspect the clutch release lever where the clutch cable attaches for wear or damage. Replace if necessary.
  8. Inspect the clutch release lever adjustment bolt and locknut for wear or damage. Replace if necessary.

### Installation (1981-on Models)

1. If removed, install the clutch release pushrod into the transmission input shaft.

#### NOTE

*If the transmission was removed for pushrod removal, it will be easier to install the remaining components into the backside of the transmission before installing the transmission. Do not install the clutch release lever at this time.*

2. Apply a light coat of Staburags NBU 30 PTM grease to the bearing and pressure piston prior to installation.
3. Install the bearing and the pressure piston.
4. Install the spring.
5. Apply a light coat of Staburags NBU 30 PTM grease to the pivot rod prior to installation.
6. Install the rubber boot onto the transmission housing boss. Tighten the clamp screw securely.
7. If removed, install the transmission as described under *Removal/Installation in the Transmission Housing (All Models)* section of Chapter Six.
8. If removed, install the bushing into the release lever needle bearing.
9. Install the clutch release lever into the pivot posts on the backside of the transmission housing.
10. Align the pivot bolt holes and install the pivot bolt from the inside surface of the lever. Install the lockwasher and nut. Tighten the nut securely.
11. Connect the clutch cable onto the clutch release lever.
12. Adjust the clutch hand lever free play as described under *Clutch Free Play Adjustment* in Chapter Three.

## CLUTCH CABLE

### Replacement

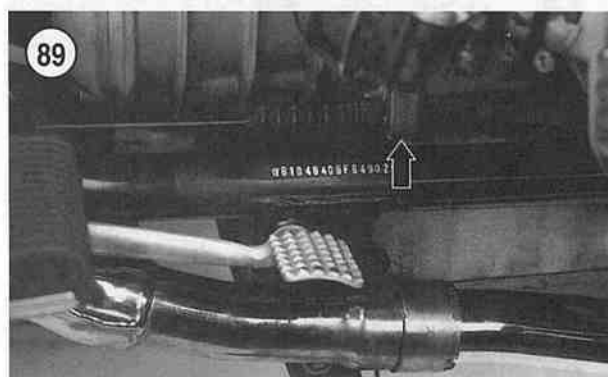
In time, the clutch cable will stretch to the point where it is no longer useful and must be replaced.

1. Place the bike on the centerstand.
2. Remove the fuel tank as described in Chapter Seven.
3. At the clutch hand lever on the handlebar, loosen the locknut (A, **Figure 86**) and turn the adjuster (B, **Figure 86**) all the way in to provide the maximum amount of clutch cable slack.
4. Disconnect the clutch cable from the clutch release lever (**Figure 87**) on the rear of the transmission housing.
5. Unhook the clutch cable from the receptacle on the transmission housing (**Figure 89**).
6. Remove any straps securing the clutch cable to the frame.

#### NOTE

*Before removing the cable, make a drawing of the cable routing through the frame. It is very easy to forget how it was, once it has been removed. Replace the cable exactly as it was, avoiding any sharp turns.*

7. Pull the clutch cable out from behind the steering head area and out of the frame.
8. Remove the cable and replace it with a new cable.
9. Install by reversing these removal steps. Note the following during installation.
10. Adjust the clutch as described under *Clutch Free Play Adjustment* in Chapter Three.



**Table 1 CLUTCH SPECIFICATIONS**

Item	Specifications
<b>Friction plate thickness</b>	
R50/5, R60/5, R60/6, R60/7, 1979-1980 R65 models	2.4 mm (0.0945 in.)
R75/5, R75/6, R75/7/R80/7	2.6 mm (0.1024 in.)
All 900 cc, 1977-1980 1000 cc	2.8 mm (0.1102 in.)
1981-on minimum thickness	4.5 mm (0.1722 in.)
<b>Diaphragm spring finger height (relaxed)</b>	
R50/5, R60/5 models	17.0-18.0 mm (0.6693-0.7087 in.)
1979-1980 R65 models	14.7-15.7 mm (0.5787-0.6181 in.)
1977-1980 1000 cc models	17.1-17.7 mm (0.6732-0.6969 in.)
1981-on 1000 cc models	NA
All other models	18.5-19.5 mm (0.7283-0.7677 in.)
<b>Clutch plate</b>	
<b>Diameter</b>	
1979-1980 R65 models	160 mm (6.30 in.)
All other 1970 197-1980 models	180 mm (7.09 in.)
1981-on models	164-166 mm (6.46-6.54 in.)
<b>Thickness</b>	
1970-1980 models	5.75-6.25 mm (0.2264-0.2461 in.)
1981-on models	5.25-5.75 mm (0.2067-0.2264 in.)
Service limit	4.50 mm (0.1772 in.)
Maximum runout	0.15 mm (0.0059 in.)
Maximum vertical play	0.30 mm (0.0118 in.)
Flywheel radial runout (maximum)	0.10 mm (0.0039 in.)
NA = Information not available from BMW.	

Table 2 is on the following page.

**Table 2 CLUTCH TORQUE SPECIFICATIONS**

Item	N•m	ft.-lbs.
<b>Clutch housing cover mounting bolt</b>		
1970-1980	23	17
1981-on	20-22	15-16
<b>Flywheel bolts</b>		
1970-1973 models	58-62	43-46
R60/6, R75/R	60-65	44-48
R90/6, R90S	70-75	52-55
All other models	100-105	74-77
<b>Clutch lever adjust screw locknut</b>	20-23	15-17



## CHAPTER SIX

# TRANSMISSION, GEARSHIFT MECHANISMS AND KICKSTARTER

6

This chapter provides complete service procedures for the transmission shaft assemblies, gearshift mechanism and kickstarter.

A 4-speed transmission is used on 1970-1973 models. 1974-on models are equipped with a 5-speed transmission. The gearshift mechanism is unique to each transmission. The different components are covered in separate procedures to avoid confusion.

The transmission shafts, the gearshift mechanism and the kickstarter mechanism are all located within a transmission housing that is bolted directly to the back of the engine. All transmission shafts are equipped with a ball bearing at each end.

The input shaft (engine-driven shaft) is splined to the clutch friction plate and is equipped with a shock damper to damp out engine-to-transmission shock loads. The rear end of the input shaft has a helical-cut gear that mates to a similar gear on the intermediate shaft. The intermediate shaft transmits engine power from the input shaft to the output shaft. With the exception of the one helical-cut gear on the input and intermediate shafts, all other gears are straight-cut.

Refer to **Table 1** for transmission and gearshift mechanism specifications. **Table 1** and **Table 2** are located at the end of this chapter.

### TRANSMISSION HOUSING (ALL MODELS)

The transmission can be removed from the engine in the frame by unbolting the swing arm and moving it back.

### Removal/Installation (1970-1980 Models)

1. Place the bike on the centerstand.
2. If the transmission is going to be disassembled, drain the transmission oil as described under *Transmission Oil Change* in Chapter Three.
3. Place wood blocks under the frame to support the bike securely.
4. Remove the battery and carrier.
5. Remove the air filter as described in Chapter Three.
6. On models so equipped, remove the front fairing side panels as described in Chapter Twelve.
7. Remove the mufflers as described under *Exhaust System Removal/Installation* in Chapter Seven.
8. Remove the rear wheel as described in Chapter Ten.
9. Disconnect the choke cable from each carburetor.
10. Remove the bolt securing the right-hand crankcase upper cover. Disconnect the breather hose and remove the cover.
11. Remove the right-hand carburetor as described in Chapter Seven.
12. Slide the rubber boot up and off of the speedometer drive cable.
13. Remove the bolt securing the speedometer drive and the ground cable. Disconnect the speedometer drive cable.
14. On 1978 models, disconnect the gearshift pedal linkage from the transmission.
15. Place a drip pan under the swing arm rubber boot.
16. Loosen the front clamping band screw (A, **Figure 1**) on the rubber boot and pull the rubber boot (B, **Figure 1**) off of the transmission housing. Let any oil drain out of the boot.

17. Loosen, then remove the 4 bolts securing the drive shaft to the transmission output flange. Refer to A, **Figure 2** and **Figure 3**.
18. Remove the swing arm pivot bolt dust cap on each side.
19. Place wood blocks or a wooden box under the swing arm to maintain its position.

**NOTE**

Use a 27 mm socket to loosen the pivot bolts in Step 20. In order for the socket to fit in the pivot bolt area of the frame, some of the material from the outer surface of the socket (**Figure 4**) must be removed. The socket can be turned in a lathe or ground off. Remove a minimum amount of material or the socket wall will be weak and may break.

20. Loosen the swing arm pivot bolt locknut (B, **Figure 2**) and unscrew the pivot bolt (C, **Figure 2**) on each side.
21. Pull the swing arm and drive shaft back. Make sure the drive shaft is completely disengaged from the transmission.
22. Remove the bolt securing the rear brake pedal and pull the pedal off of the shaft.
23. Perform Steps 1-6 of *Clutch Release Mechanism Removal (1970-1980 Models)* in Chapter Five and remove the clutch release arm from the transmission.
24. Disconnect the electrical wire connection from the neutral indicator switch.

**NOTE**

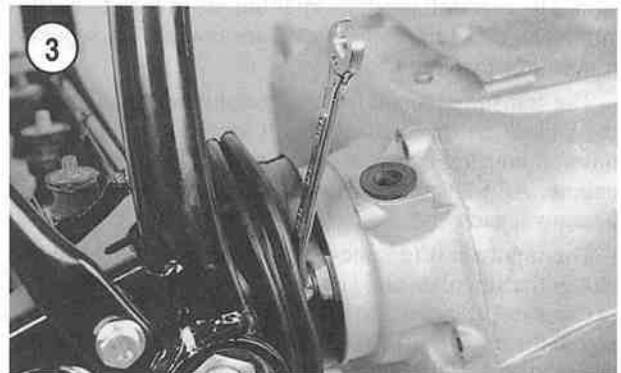
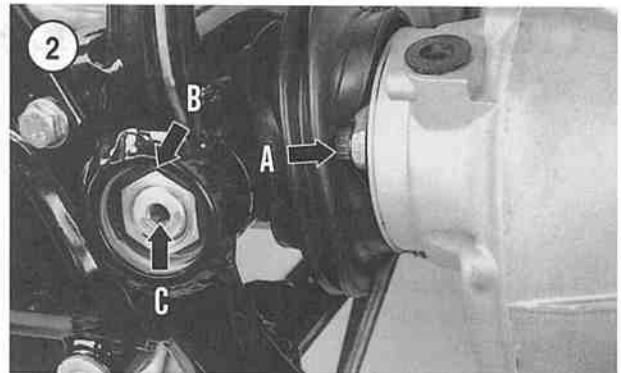
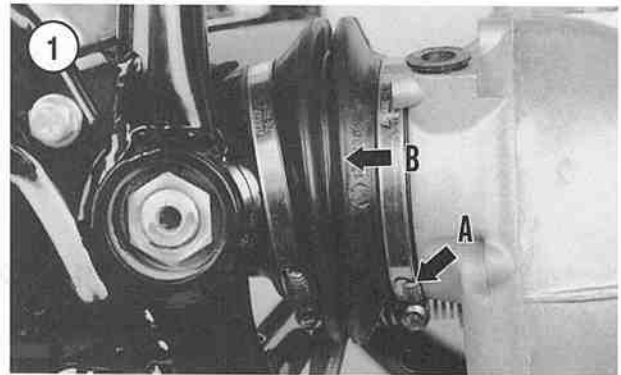
The following steps are shown with the engine and transmission removed from the frame for clarity.

25. Loosen the upper right-hand nut and washer (A, **Figure 5**) and the lower right-hand bolt (B, **Figure 5**) securing the transmission housing to the engine.
26. Loosen the upper (A, **Figure 6**) and lower left-hand bolts securing the transmission housing to the engine.
27. Place a jack under the transmission and apply a small amount of jack pressure and lift the transmission up sufficiently to remove the mounting bolts.

**NOTE**

Do not lose the metal plate (B, **Figure 6**) under the upper left-hand bolt. It must be reinstalled in the same location as it helps secure the air filter housing to the engine.

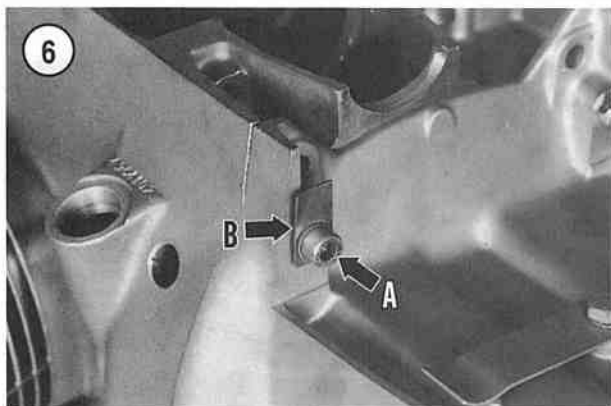
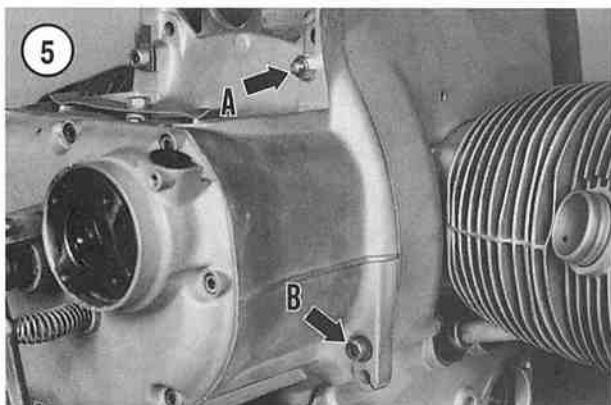
28. Remove the bolts and the nut and washer securing the transmission housing to the engine. Do not lose the tab on the upper left-hand bolt. It must be reinstalled under this bolt during installation.



**CAUTION**

In the following step, to prevent damage to the transmission input shaft and clutch release pushrod, pull the transmission housing straight back until it is disengaged from the clutch assembly.

29. Using a soft-faced mallet, tap around the perimeter of the transmission housing to break it loose from the rear of the engine.

**NOTE**

The transmission housing should separate easily from the engine. If it will not, first check that all external components have been removed that would hinder separation. If the bike has a lot of miles on it, and it has been subjected to salt solutions (either salt-water or road salt), the 2 locating pins may be corroded at the engine-to-transmission mounting bolts. Apply Liquid Wrench, or equivalent penetrating oil, to the locating pins and let it sit for 15 minutes.

30. Pull the transmission housing straight back until it is free of the engine and clutch assembly.

31. Remove the transmission housing from the left-hand side of the frame and take to a workbench for further disassembly (if necessary).

32. Install by reversing these removal steps. Note the following during installation.

33. If the transmission shaft assemblies were disassembled, rotate the input shaft and shift the transmission through all 4 or 5 gears. Make sure all shafts rotate smoothly.

34. Before installing the transmission, apply a light coat of Optimol T White Paste (Figure 7) to the following areas:

- The release pushrod end.
- Inner splines of the clutch friction plate.
- Outer splines of the transmission input shaft where it rides in the clutch friction plate.

35. Clean the mating surface of both the engine and the transmission housing of any corrosion. Make sure the locating pins are in place and are clean. Apply a light coat of multipurpose grease to both the locating pins and their receptacles to prevent any further corrosion.

36. Raise the transmission housing and align it with the back surface of the engine.

**CAUTION**

To prevent damage to the transmission input shaft and clutch release pushrod, push the transmission housing straight forward until it is properly engaged into the clutch assembly.

37. Push the transmission housing forward and align the input shaft splines with the inner splines of the clutch friction plate. If necessary, shift the transmission into high gear and slightly wiggle or rotate the output shaft at the rear of the transmission housing until alignment is achieved. Also align the locating pins on the engine-to-transmission housing.

**NOTE**

Do not forget to install the metal plate (B, Figure 6) under the upper left-hand bolt. It must be reinstalled in the same location as it helps secure the air filter housing to the engine.

38. Push the transmission housing forward until it has bottomed out. Install the mounting bolts and tighten to the torque specification listed in **Table 2**.
39. Install and tighten the transmission housing mounting nut and washer. Tighten to the torque specification listed in **Table 2**.
40. Install and tighten the bolts (**Figure 3**) securing the drive shaft to the transmission output flange. Tighten the nuts to the torque specification listed in **Table 2**.
41. Refill the drive shaft with oil as described under *Drive Shaft Oil Change* in Chapter Three.
42. If the transmission was drained or disassembled, refill the transmission oil as described under *Transmission Oil Change* in Chapter Three.

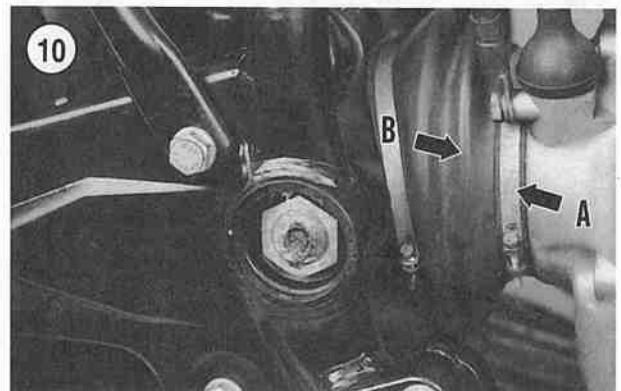
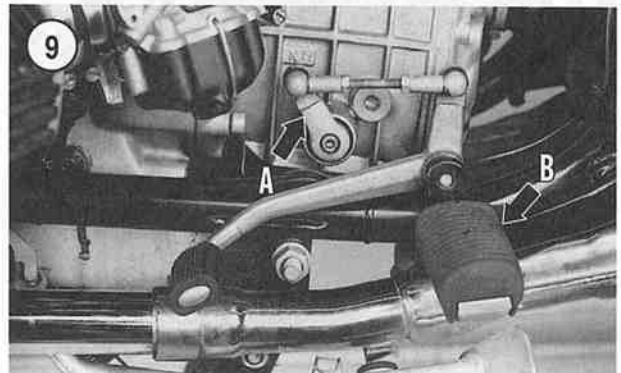
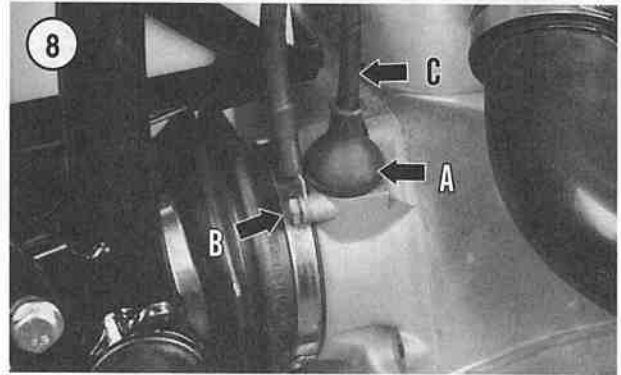
### Removal/Installation (1981-on Models)

1. Place the bike on the centerstand.
2. If the transmission is going to be disassembled, drain the transmission oil as described under *Transmission Oil Change* in Chapter Three.
3. Place wood blocks under the frame to support the bike securely.
4. Remove the battery as described under *Battery Removal, Electrolyte Level Check and Installation* in Chapter Three.
5. Remove the air filter as described in Chapter Three.
6. On models so equipped, remove the front fairing side panels as described in Chapter Twelve.
- 7A. On models equipped with a primary muffler, remove the secondary mufflers and primary muffler as described under *Exhaust System Removal/Installation* in Chapter Seven.
- 7B. On all other models, remove mufflers as described under *Exhaust System Removal/Installation* in Chapter Seven.
8. Remove the rear wheel as described in Chapter Ten.
9. Disconnect the choke cables from both carburetors.
10. Remove the bolt securing the right-hand crankcase upper cover. Disconnect the breather hose and remove the cover.
11. Pull the T-fitting on the crankcase vent line out of the air filter housing.
12. Remove the left-hand carburetor as described in Chapter Seven.
13. Disconnect the air lines from the air filter case.
14. Slide the rubber boot (A, **Figure 8**) up and off of the speedometer drive cable.
15. Remove the bolt (B, **Figure 8**) securing the speedometer drive and the ground cable (C, **Figure 8**). Disconnect the speedometer drive cable.
16. Perform Steps 1-6 of *Clutch Release Mechanism Removal (1981-on Models)* in Chapter Five and remove the clutch release arm from the transmission.
17. Disconnect the gearshift pedal linkage (A, **Figure 9**) from the transmission.
18. Remove the left-hand footpeg (B, **Figure 9**) as described in Chapter Twelve.

#### NOTE

*On all models except the R100GS, the drive shaft has its own oil supply. When the rubber boot is removed, some of that oil will drain out.*

19. On all models except the R100GS, place a drip pan under the drive shaft rubber boot.
20. Loosen the clamping band (A, **Figure 10**) on the rubber boot (B, **Figure 10**) and pull the rubber boot off of the transmission housing. Let any oil drain out of the boot (except the R100GS).
21. Have an assistant apply the rear brake.



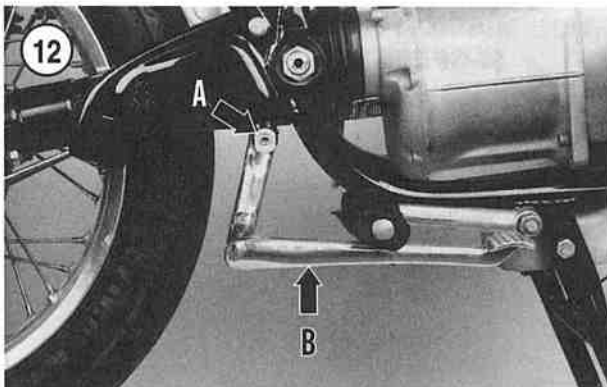
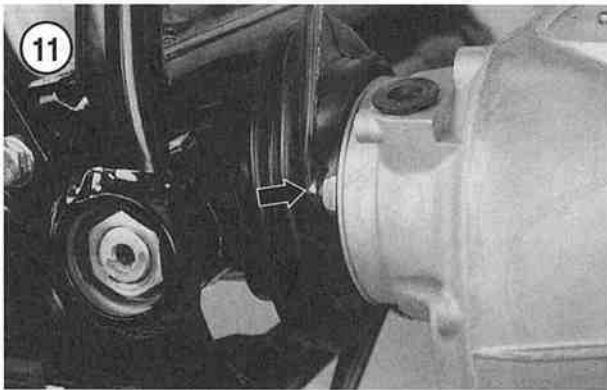


22. Loosen, then remove the bolts (**Figure 11**) securing the drive shaft to the transmission output flange.
23. Remove the bolt (A, **Figure 12**) securing the rear brake pedal (B, **Figure 12**) and pull the pedal off of the shaft.
24. Remove the bolts securing the engine front cover and remove the cover. This is necessary to allow the engine to move forward in the following steps.
25. Place a jack under the engine, with a piece of wood to protect the crankcase, and apply a small amount of jack pressure to lift the engine sufficiently to remove the mounting bolts.
26. Remove the nuts and lockwashers on each side of the engine mounting bolts.
27. Remove both mounting bolts. Note the location of any spacers between the engine and the frame. Mark each spacer and its exact location for ease of installation.

**NOTE**

*Apply several layers of duct tape, or equivalent, to the lower frame section to prevent accidental paint damage during engine movement.*

28. Move the engine and transmission housing forward in the frame as far as it will go.
29. Remove the nut and washer and both bolts securing the air filter lower case half and remove the lower case half.



**NOTE**  
*Steps 30-33 show the engine and transmission assembly removed from the frame for clarity.*

30. Loosen the upper right-hand nut and washer (A, **Figure 5**) and the lower right-hand bolt (B, **Figure 5**) securing the transmission housing to the engine.
31. Loosen the upper (A, **Figure 6**) and lower left-hand bolts securing the transmission housing to the engine.
32. Place a jack under the transmission. Apply a small amount of jack pressure and lift the transmission up sufficiently to remove the mounting bolts.
33. Remove the bolts and the nut and washer securing the transmission housing to the engine. Don't lose the tab (B, **Figure 6**) under the upper left-hand bolt. It must be reinstalled on this bolt during installation.

**CAUTION**

*In the following step, to prevent damage to the transmission input shaft and clutch release pushrod, pull the transmission housing straight back until it is disengaged from the clutch assembly.*

34. Using a soft-faced mallet, tap around the perimeter of the transmission housing to break it loose from the rear of the engine.

**NOTE**

*The transmission housing should separate easily from the engine. If it won't, first check that all external components have been removed that would hinder separation. If the bike has a lot of miles on it or it has been subjected to salt solutions (either salt water or road salt), the 2 locating pins may be corroded at the engine-to-transmission mounting bolts. Apply Liquid Wrench, or equivalent penetrating oil, to the locating pins and let it sit for 15 minutes.*

35. Pull the transmission housing straight back until it is free of the engine and clutch assembly. If necessary, reach in with a pair of pliers and move the clutch release rod back into the transmission.
36. Rotate the transmission onto its side and disconnect the electrical wire connection from the neutral indicator switch.
37. Remove the transmission housing from the left-hand side of the frame and take to a workbench for further disassembly (if necessary).
38. Install by reversing these removal steps. Note the following during installation.
39. If the transmission shaft assemblies were disassembled, rotate the input shaft and shift the transmission through all 5 gears. Make sure all shafts rotate smoothly.



40. Before installing the transmission, apply a light coat of Staburags NBU 30 PTM grease (Figure 7) to the following areas:

- a. The release pushrod end.
- b. Inner splines of the clutch friction plate.
- c. Outer splines of the transmission input shaft where it rides in the clutch friction plate.

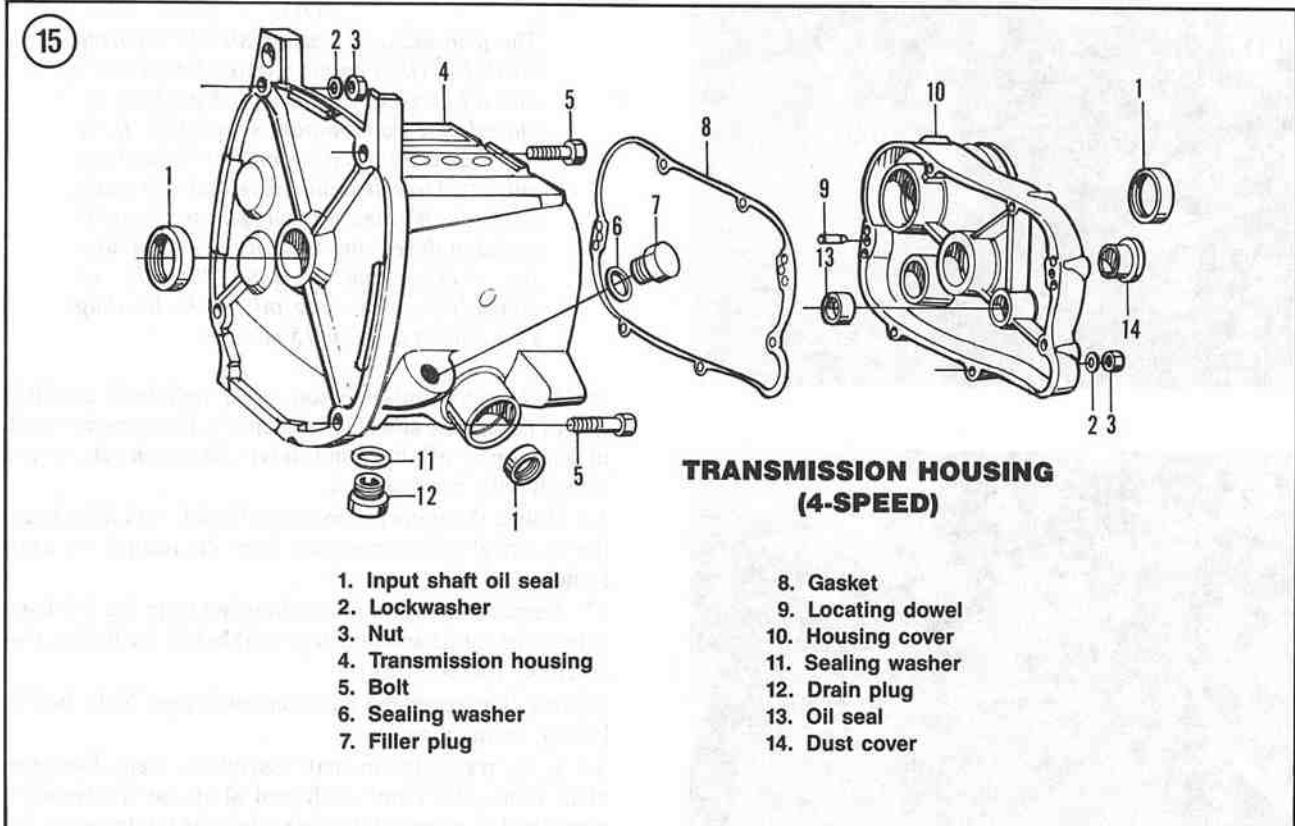
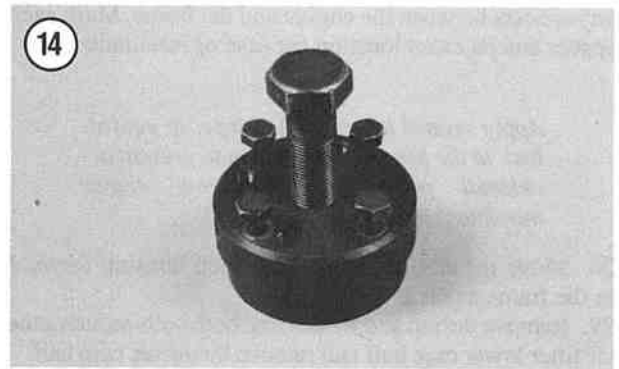
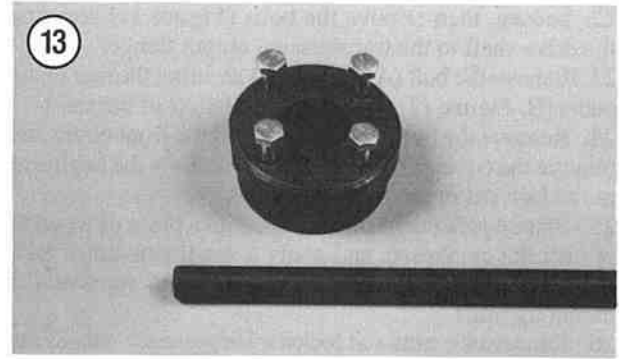
41. Clean the mating surfaces of both the engine and the transmission housing of any corrosion. Make sure the locating pins are in place and are clean. Apply a light coat of multipurpose grease to both the locating pins and their receptacles to prevent any further corrosion.

42. Raise the transmission housing and align it with the back surface of the engine.

**CAUTION**

*To prevent damage to the transmission input shaft and clutch release pushrod, push the transmission housing straight forward until it is properly engaged into the clutch assembly.*

43. Push the transmission housing forward and align the input shaft splines with the inner splines of the clutch friction plate. If necessary, shift the transmission into 5th gear and slightly wiggle or rotate the output shaft at the rear of the transmission housing until alignment is achieved. Also align the locating pins on the engine-to-transmission housing.

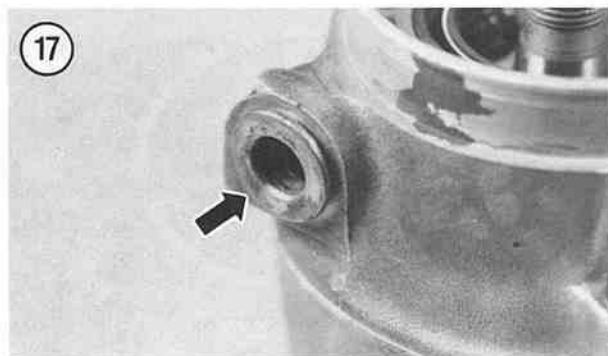
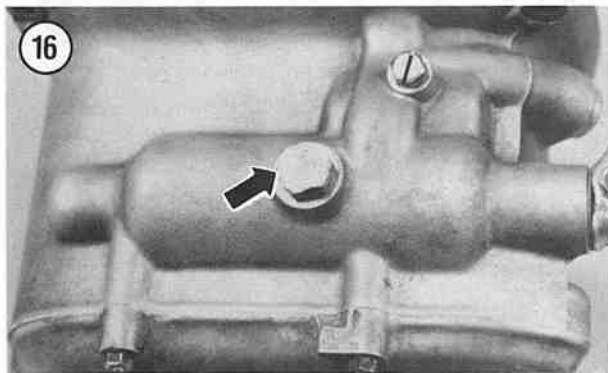


44. Push the transmission housing forward until it has bottomed out. Install the mounting bolts and tighten to the torque specification listed in **Table 2**. Be sure to install the tab onto the left-hand upper bolt.

45. Install and tighten the transmission housing mounting nut and washer. Tighten to the torque specification listed in **Table 2**.

46. Install and tighten the engine mounting bolts, any applicable spacer, lockwashers and nuts. Tighten the nuts securely.

47. Install and tighten the bolts securing the drive shaft to the transmission output flange. Tighten the bolts to the torque specification listed in **Table 2**.



48. On all except R100GS models, refill the drive shaft with oil as described under *Drive Shaft Oil Change* in Chapter Three.

49. If the transmission was drained or disassembled, refill the transmission oil as described under *Transmission Oil Change* in Chapter Three.

### HOUSING COVER (4-SPEED TRANSMISSION)

#### Housing Cover Removal/Installation

Two BMW special tools are required to remove the output shaft flange from the transmission output shaft. If you try to remove the flange without these special tools, the flange will probably be damaged and have to be replaced.

The special tools are as follows:

- BMW special tool output flange holder (part No. 234) as shown in **Figure 13**.
- BMW special tool extractor (part No. 232) as shown in **Figure 14**.

Refer to **Figure 15** for this procedure.

1. If you haven't already done so, drain the transmission oil as follows:

- Place a drain pan under the transmission.
- Remove the drain bolt and washer (**Figure 16**) and drain the transmission oil. Allow the oil to drain for at least 15 minutes.
- Install the drain bolt and washer and tighten securely.

2. Remove the clutch release mechanism from the transmission housing cover as described under *Clutch Release Mechanism Removal (1970-1980 Models)* in Chapter Five.

#### CAUTION

*Do not set the transmission housing so that the input shaft touches the workbench top. If the shaft touches the workbench top, the shaft components will be damaged.*

#### CAUTION

*Do not clamp the input shaft in a vise in order to secure the transmission housing.*

- Place the transmission on 2 blocks of wood on the workbench with the housing cover facing up.
- Remove the speedometer drive gear retaining bolt and washer.
- Using 2 flat-bladed screwdrivers, carefully pry the speedometer drive gear bushing (**Figure 17**) out of the transmission housing.
- Remove the speedometer drive gear bushing and withdraw the speedometer drive gear (**Figure 18**).

**CAUTION**

The following steps are very difficult and require the aid of a helper. The special tools listed are required to avoid damage to the expensive output flange. Do not try to remove the output flange without these special tools. The output flange is attached to the output shaft with a locking taper and is not equipped with a Woodruff key. The flange is long and the 24 mm nut is tightened to a high torque. The combination of these two factors securely locks the flange onto the transmission shaft.

7. Install BMW special tool output flange holder (part No. 234) to the output flange (A, **Figure 19**) and secure with 4 bolts. Tighten the 4 bolts in a crisscross pattern in 2-3 stages until they are tight. Make sure the bolts are tight and that the special tool is completely up against the flange holder.

8. Insert the bar into the flange holder (B, **Figure 19**).

**CAUTION**

Do not allow the bar to rest against the clutch release arm pivot posts as they will be damaged.

**CAUTION**

The 24 mm nut (**Figure 20**) was tightened to 220-240 N·m (159-173 ft.-lb.) and is very difficult to loosen. If you are unable to loosen the nut, take the transmission to a BMW dealer and have it loosened.

9. Have the helper hold onto the holder. Then, using a 24 mm socket, loosen the 24 mm nut securing the flange.

10. Remove the nut (**Figure 20**) and lockwasher (**Figure 21**).

11. Remove the special tools used in Step 7 and Step 8.

**NOTE**

If you have the extra time, apply Liquid Wrench, or equivalent, to the area of the flange where the 24 mm nut was removed. Fill up the flange inner area and let this sit overnight if possible. This will allow some of the penetrating oil to work its way between the output shaft flange and the transmission shaft.

**CAUTION**

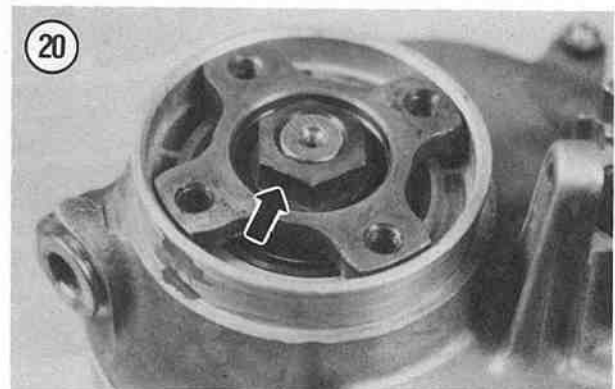
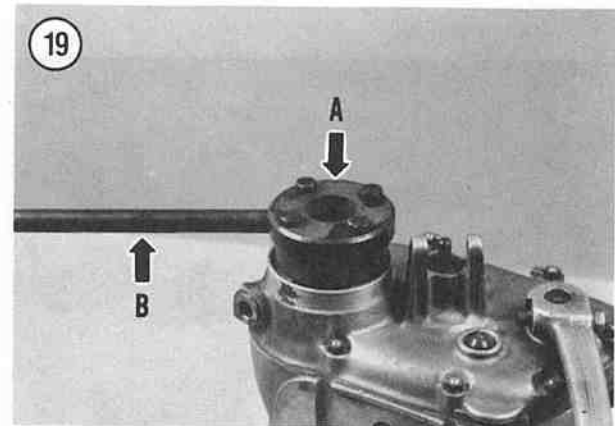
In Step 12, make sure that all bolts are tightened securely and that the extractor is snug up against the output flange. If the bolts are not tight, the output flange will be distorted due to the amount of pressure exerted in Step 13.

12. Install the BMW special tool extractor (part No. 232) onto the output flange and secure with 4 bolts. Tighten the 4 bolts in a crisscross pattern in 2-3 stages until they are tight (A, **Figure 22**). Make sure the bolts are tight and that the special tool is completely up against the flange holder.

13. Insert the bar (B, **Figure 22**) into the extractor.

**CAUTION**

Do not allow the bar to rest against the clutch release arm pivot posts as they will be damaged.



14. Have an assistant hold onto the bar.

**NOTE**

Tap on the end of the threaded stud with a hammer while tightening it. This may help break the flange loose.

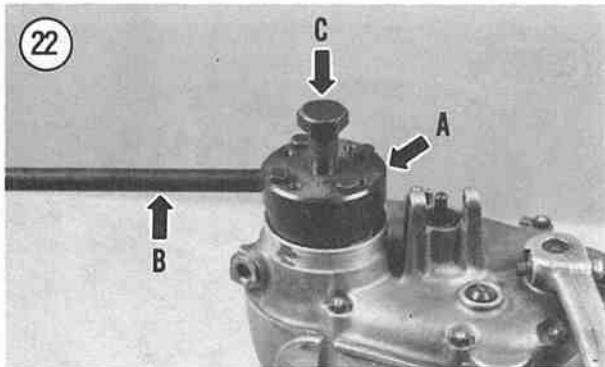
**CAUTION**

The output shaft flange is very difficult to remove. If you are unable to break it loose, take the transmission to a BMW dealer and have

removed. Do not try other means of loosening the flange as this will lead to expensive damage.

**NOTE**

When the output shaft flange works loose from the transmission shaft it will usually make a loud "crack" or "pop" sound similar to something metallic that has just broken. In this case, it has not broken, but simply broken loose from the locking taper of the transmission output shaft.



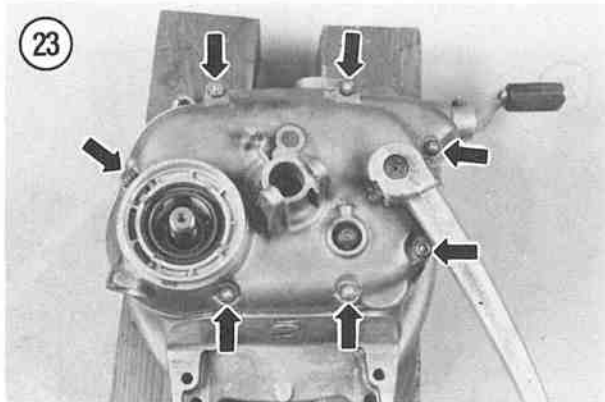
15. Tighten the center threaded stud (C, **Figure 22**), in the extractor, slowly until the output shaft flange works loose from the output shaft.

16. Remove the special tools and output shaft flange.

17. Remove the special tool from the flange.

18. Using a crisscross pattern, loosen, then remove the nuts and lockwashers (**Figure 23**) securing the housing cover.

19. Using a soft-faced mallet, carefully tap around the perimeter of the housing cover to loosen it from the housing.

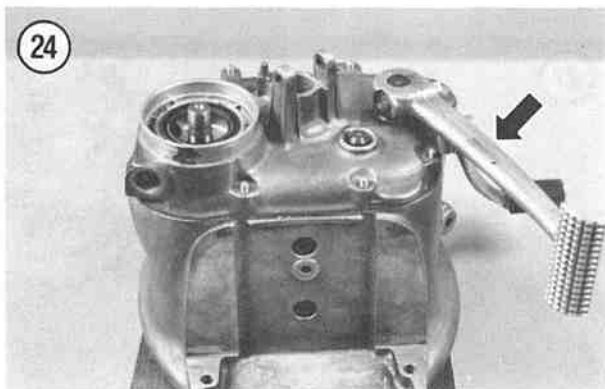


**NOTE**  
BMW recommends that the cover be heated to 100° C (212° F) to aid in the removal of the cover. If you are unable to remove the cover in Step 19, heat the cover with rags and hot water. We found that this was not necessary as the cover slipped off easily.

**CAUTION**

Do not heat the cover with a torch (propane or acetylene); never bring a flame into contact with the cover. The direct heat will warp the cover.

20. If necessary, use a broad-tipped screwdriver and carefully pry off the cover. It may be necessary to gently tap on the output shaft with a soft-faced mallet to aid in removal.



**NOTE**  
Don't lose any of the end float shims that will either stay on the end of the transmission shafts or in the bearing recesses in the cover. They must be reinstalled on the appropriate transmission shaft during assembly.

21. If equipped with a kickstarter, slightly depress the kickstarter pedal (**Figure 24**) while removing the cover.  
22. Slowly remove the cover from the housing. While removing the cover, look inside to see if any of the end float shims are working loose and may fall out of the end cover. If they are coming off, immediately place them on the end of the correct transmission shaft assembly.



23. Remove the cover and gasket.
24. Thoroughly clean and inspect the cover as described in this chapter.
25. Clean off all old gasket material from the mating surface of the cover and the transmission housing with solvent. Thoroughly dry with compressed air.
26. After the surfaces have been cleaned, clean once again with aerosol electrical contact cleaner and a lint-free cloth to remove any traces of solvent.
27. Install a new gasket (Figure 25) to the transmission housing.
28. Apply a light coat of grease to the end float shims (Figure 26) and place them on the proper transmission shaft bearing. They must be reinstalled on the original transmission housing.
29. Apply a light coat of transmission gear oil or engine oil to the outer surfaces of the transmission shaft ball bearings where they ride in the transmission cover. This will make cover installation easier.

**NOTE**

*BMW recommends that the cover be heated to 100° C (212° F) to aid in the installation of the cover. If you are unable to install the cover in Step 30, heat the cover in an oven or with rags and hot water.*

30. Position the cover onto the transmission housing and start it down into place. If necessary, move the ends of the transmission shaft assemblies so that the bearings are aligned with their respective receptacles in the cover.
31. If equipped with a kickstarter, slightly depress the kickstarter pedal (Figure 24) while installing the cover.
32. Push the cover down until the bearings have started to enter the cover. After you are sure the bearings are properly started, *carefully* tap the cover into place with a soft-faced mallet. Tap on the cover directly over the bearing locations and around the perimeter until the cover is completely seated against the transmission housing.

**CAUTION**

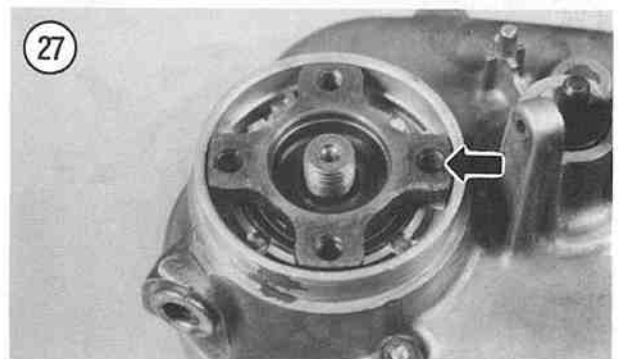
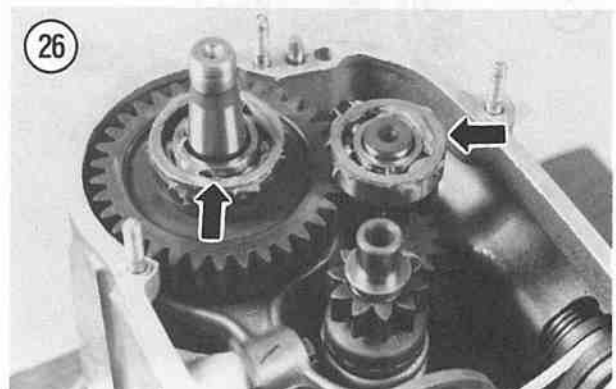
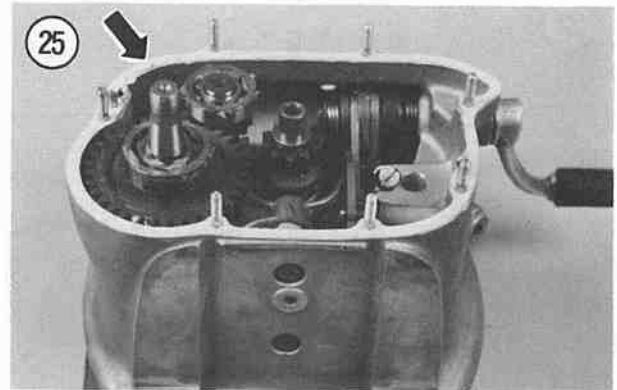
*The cover should fit down completely on the transmission housing. If the cover does not fit completely, do not try to pull the cover down with the cover nuts. Remove the cover, investigate and correct the interference.*

33. Install the lockwashers and nuts (Figure 23). Tighten them in a crisscross pattern and to the torque specification listed in Table 2.
34. To install the output shaft flange, perform the following:
  - a. Thoroughly clean off all oil residue from the outer taper on the output shaft and inner taper on the flange. Use an aerosol electrical contact cleaner and wipe clean with a lint-free cloth.

- b. Install the output shaft flange (Figure 27) onto the transmission output shaft.
- c. Carefully tap the flange down until it is completely seated on the transmission shaft.
- d. Apply engine oil to the nut threads on the output shaft.
- e. Install the lockwasher (Figure 21) and the 24 mm nut (Figure 20).

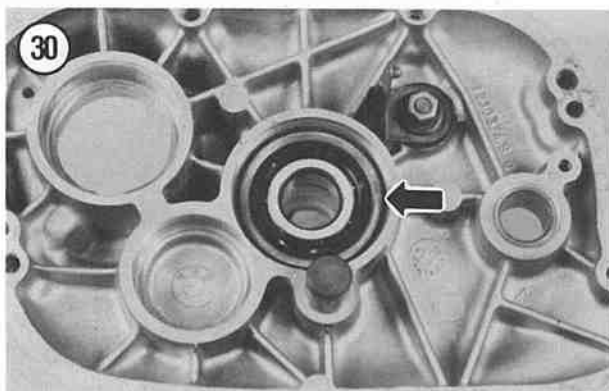
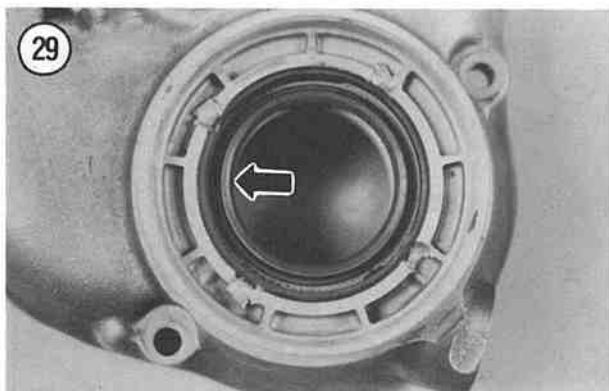
**CAUTION**

*Do not allow the holder to rest against the clutch release arm pivot posts as they will be damaged.*





- f. Use the same tool setup used during removal and hold the flange while tightening the nut.
  - g. Tighten the 24 mm nut to the torque specification listed in **Table 2**.
  - h. Remove the special tool.
35. Install the speedometer drive gear (**Figure 18**).
  36. Position the speedometer drive gear bushing (**Figure 28**) in the receptacle in the transmission housing. Carefully tap the bushing into place with a soft-faced mallet.
  37. Install the speedometer drive gear retaining bolt and washer. Tighten the bolt securely.



### Cover Inspection

1. Thoroughly clean the cover in solvent and dry with compressed air.
2. Inspect the cover for any cracks or damage. Check around the ribs and the transmission sealing surface. If damaged, replace the cover.
3. Inspect the output shaft oil seal (**Figure 29**) in the cover. If it is worn or if the sealing lips are damaged in any way, replace the seal as described in this chapter.
4. Inspect the input shaft bearing in the cover (**Figure 30**). It must rotate freely with no signs of wear or damage. If necessary, replace the bearing as described in this chapter.
5. Inspect the kickstarter shaft oil seal (A, **Figure 31**) in the cover. If it is worn or if the sealing lips are damaged in any way, replace the seal as described in this chapter.

### Cover Output Shaft Oil Seal Replacement

1. Use a large flat-bladed screwdriver and carefully pry the oil seal (**Figure 29**) out of the cover. Be careful not to damage the seal receptacle in the cover.
2. Thoroughly clean out the seal receptacle in the cover with solvent and dry with compressed air.
3. Apply a light coat of multipurpose grease to the outer surface of the new seal and the seal receptacle in the cover.
4. Position the new seal with the open side facing *out* toward the output shaft flange.

#### NOTE

*In the following step, BMW special tools can be used to install the oil seal, but a carefully used socket will perform the same job for a lot less money. If you choose to use the special tools, use BMW part No. 231 for oil seal installation.*

5. Using a hammer and a suitable size socket that matches the outer diameter of the seal, carefully tap the new seal into the cover from the *outside* surface of the cover. Tap the seal in squarely and evenly until it bottoms out in the cover.
6. Apply a light coat of multipurpose grease to the sealing lips of the new seal.

### Cover Input Shaft Bearing Replacement

Inspect the input shaft bearing in the cover. It must rotate freely with no signs of wear or damage. If the bearing requires replacement, perform the following.

1. Remove the neutral switch (B, **Figure 31**).
2. Remove the circlip (A, **Figure 32**) securing the kickstarter intermediate gear (B, **Figure 32**) and remove the gear.
3. Remove the flanged sleeve (A, **Figure 33**) and oil baffle/shim (B, **Figure 33**) from the bearing.
4. Place the new bearing in a freezer for 30 minutes. This will reduce the overall size of the bearing and will make bearing installation much easier.
5. Place the cover in an oven or place it on a hot plate and heat the cover to 100° C (212° F) to aid in bearing removal.
6. Use a pot holder or heavy rags and place the housing cover on wood blocks with the inner surface facing down.
7. Use a drift and hammer and carefully drive out the bearing from the *outer* surface of the cover.

#### WARNING

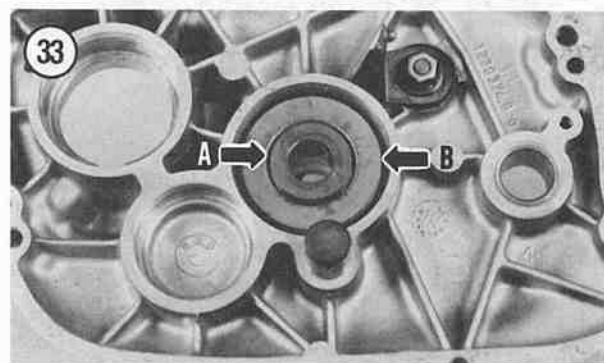
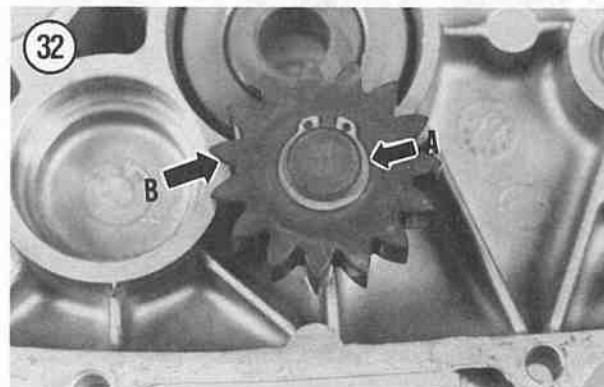
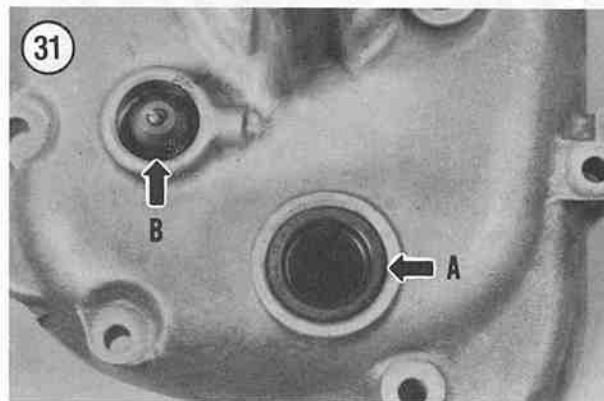
*Remember that the cover is still hot. Protect yourself accordingly.*

8. Turn the cover over and thoroughly clean out the seal receptacle in the cover with solvent and dry with compressed air.
9. Remove the bearing from the freezer and apply a light coat of multipurpose grease to the outer surface of the new bearing. Also apply a light coat to the bearing receptacle in the cover.
10. Using a hammer and a suitable size socket that matches the outer diameter of the bearing, carefully tap the new bearing into the cover from the *inner* surface of the cover. Tap the bearing in squarely and evenly until it bottoms out in the cover.
11. Apply a light coat of multipurpose grease to the bearing cavity.
12. Position the oil baffle/shim (B, **Figure 33**) with the raised perimeter section facing toward the bearing.
13. Carefully tap the flanged sleeve (A, **Figure 33**) into the bearing. Tap the flanged sleeve in until it is completely seated in the bearing.
14. Position the kickstarter gear with the shoulder facing toward the cover.
15. Install the kickstarter intermediate gear (B, **Figure 32**) and the circlip (A, **Figure 32**). Make sure the circlip is properly seated in the stud groove.
16. Install the neutral switch (B, **Figure 31**).

#### Cover Kickstarter Shaft Oil Seal Replacement

1. Use a large flat-bladed screwdriver and carefully pry the oil seal (A, **Figure 31**) out of the cover. Be careful to not damage the seal receptacle in the cover.

2. Thoroughly clean out the seal receptacle in the cover with solvent and dry with compressed air.
3. Apply a light coat of multipurpose grease to the outer surface of the new seal and the seal receptacle in the cover.
4. Position the new seal with the closed side facing *out*.
5. Using a hammer and a suitable size socket that matches the outer diameter of the seal, carefully tap the new seal into the cover from the *outside* surface of the cover. Tap the seal in squarely and evenly until it bottoms out in the cover.
6. Apply a light coat of multipurpose grease to the sealing lips of the new seal.



**GEARSHIFT MECHANISM  
(4-SPEED MODELS)**

**Removal**

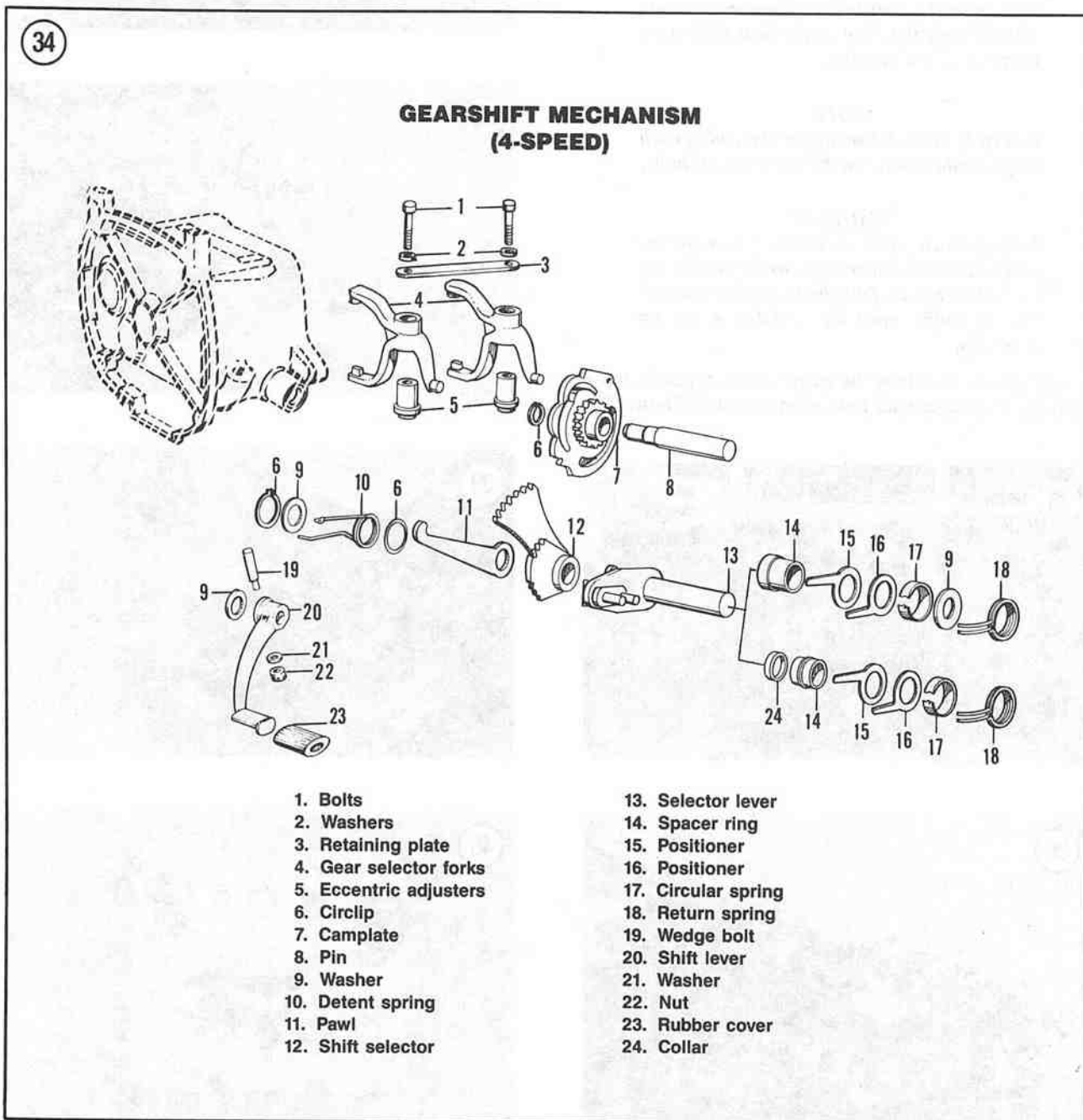
Refer to **Figure 34** for the gearshift mechanism for this procedure.

1. Remove the transmission housing as described in this chapter.
2. Remove the transmission housing cover as described in this chapter.

3. Using a cold chisel or centerpunch and hammer, mark the gear selector forks and their respective eccentric adjusters. This is necessary so that the parts will be reinstalled in their correct location and in the correct relationship to each other.

4. On the exterior of the transmission housing, remove the bolts and washers (**Figure 35**) securing the upper and lower gear selector forks.

5. Remove the retaining plate (**Figure 36**) located between the forks and the transmission housing.



**NOTE**

BMW recommends that the clutch side of the transmission housing be heated to 100° C (212° F) to aid in the removal of the transmission shaft assemblies. If you are unable to remove the shaft assemblies in Step 7, heat the lower end of the housing on a hot plate or with rags and hot water.

**CAUTION**

Do not heat the housing with a torch (propane or acetylene); never bring a flame into contact with the housing. The direct heat will cause warpage of the housing.

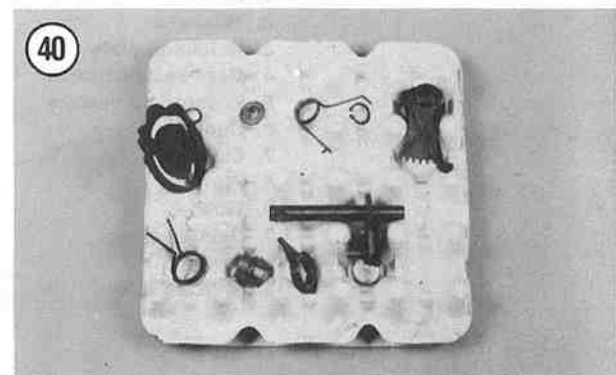
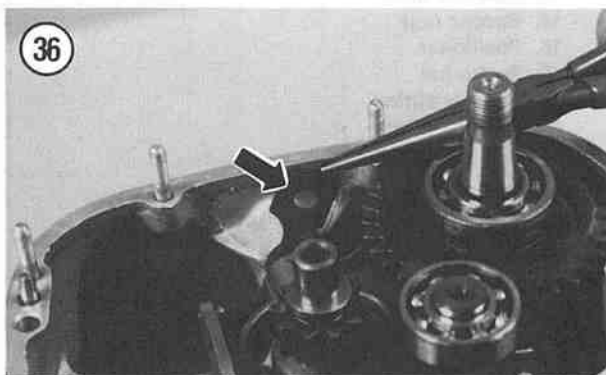
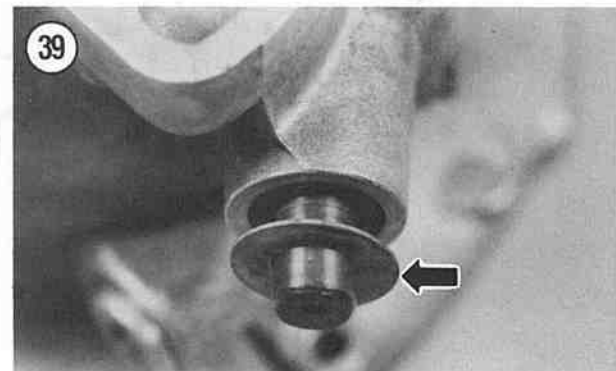
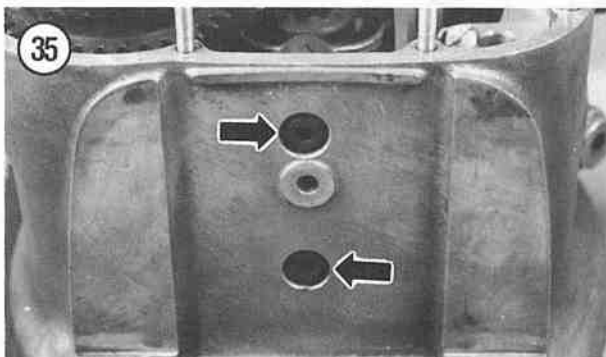
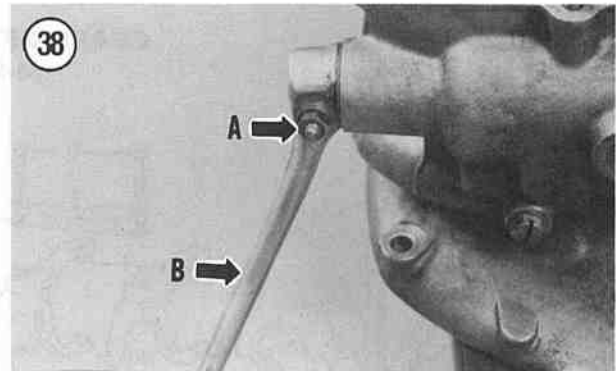
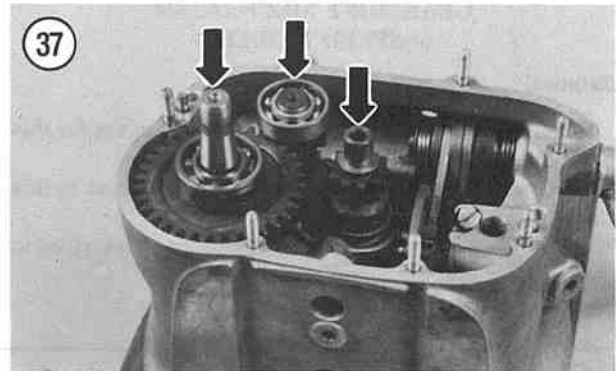
**NOTE**

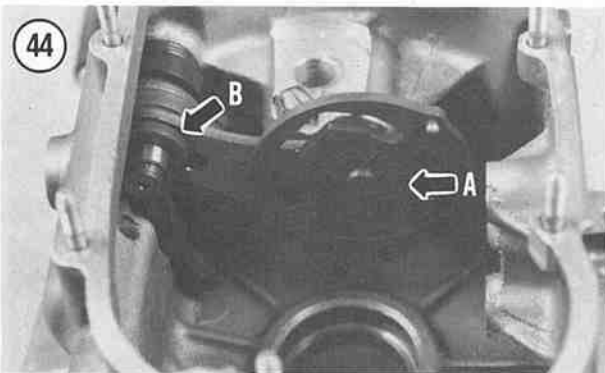
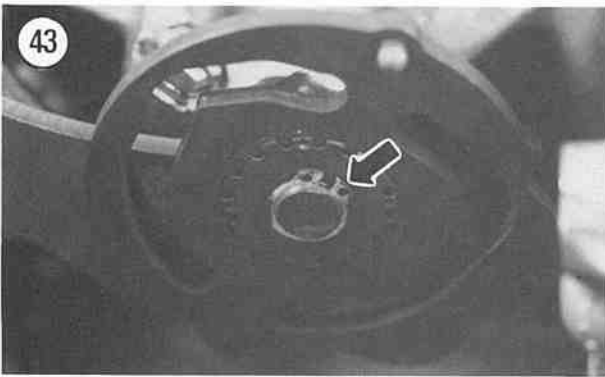
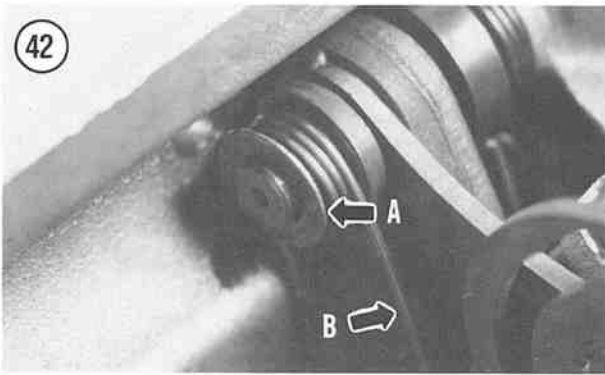
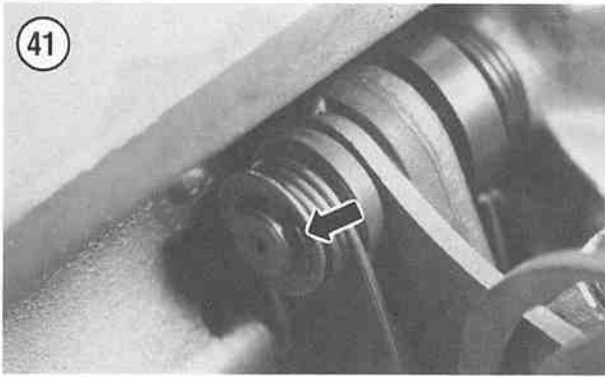
In Step 6, the ball bearing on the end of each shaft should remain on their respective shafts.

**CAUTION**

In the following step, do not try to remove one shaft without the other shafts as the bevel gears on the lower ends of the shafts will be damaged. The 3 shafts must be withdrawn as an assembly.

6. Lift up and withdraw the output shaft, layshaft, input shaft and the gear selector forks as an assembly (Figure 37).





7. Remove the gear selector forks and their eccentric adjusters from the transmission output shaft.
8. Inspect the transmission shaft assemblies as described under *Transmission Shaft Preliminary Inspection (4-Speed Models)* in this chapter.
9. Remove the nut and washer (A, **Figure 38**) securing the gearshift lever.
10. Carefully tap out the bolt securing the gearshift lever to the shaft.
11. Remove the gearshift lever (B, **Figure 38**).
12. Slide the washer (**Figure 39**) from the shaft.

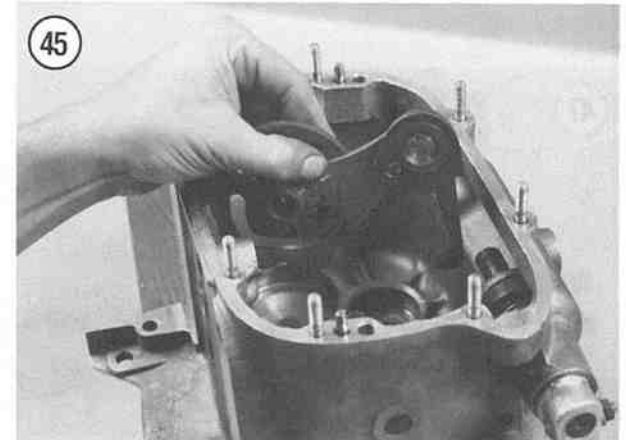
**NOTE**

*The following steps are for removal of the remainder of the gearshift mechanism. Continue to Step 13 only if this remaining mechanism is to be removed and serviced. Place the parts in a large egg flat (the type that restaurants get their eggs in). As you remove the parts from the housing, set it in one of the depressions in the same position from which it was removed as shown in **Figure 40**.*

13. Remove the circlip (**Figure 41**) and washer (A, **Figure 42**) from the end of the selector shaft.
14. Remove the detent spring (B, **Figure 42**).
15. Remove the circlip (**Figure 43**) securing the cam plate to the stud.
16. Slide off the cam plate (A, **Figure 44**) and pawl/shift selector assembly (B, **Figure 44**) from their respective stud and selector lever shaft.
17. Withdraw the selector lever assembly (**Figure 45**) from the transmission housing.

**NOTE**

*There are some slight differences among the various years. BMW does not specify in which years the differences occur so pay attention when disassembling the selector lever assembly. Refer to **Figure 34**.*





18. To separate the selector lever assembly, perform the following:

- a. Remove the return spring (Figure 46).
  - b. On early models, slide off the washer and the positioners and circular spring assembly.
  - c. On later models, slide off the spacer ring (Figure 47) and the positioners and circular spring assembly (Figure 48).
  - d. On early models, slide off the spacer ring.
  - e. On later models, slide off the collar (Figure 49).
19. Inspect the gearshift mechanism as described in this chapter.

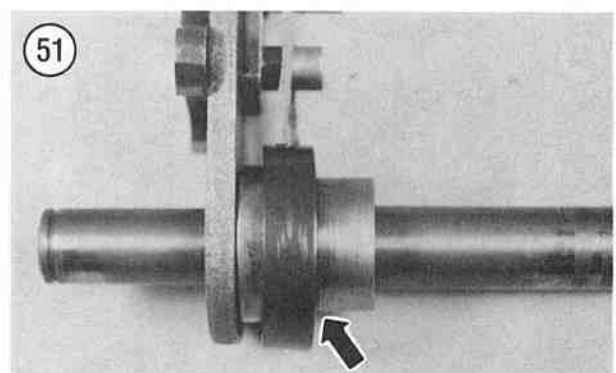
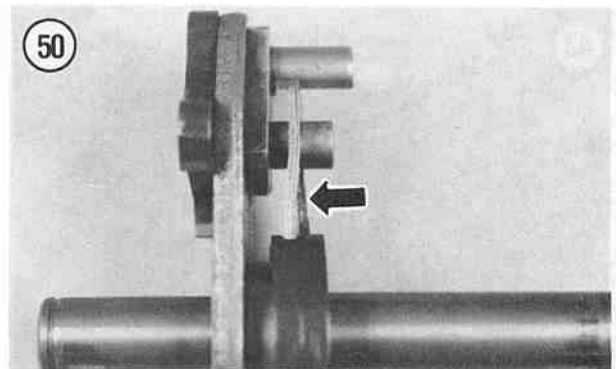
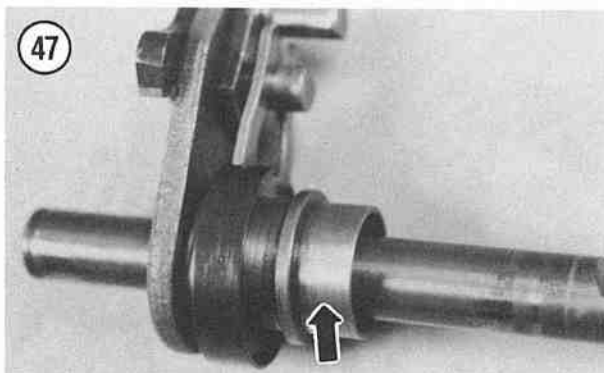
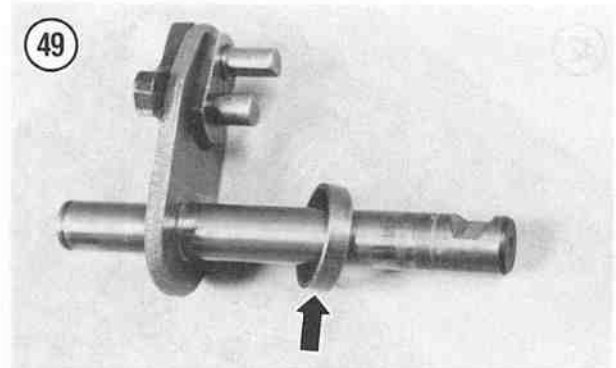
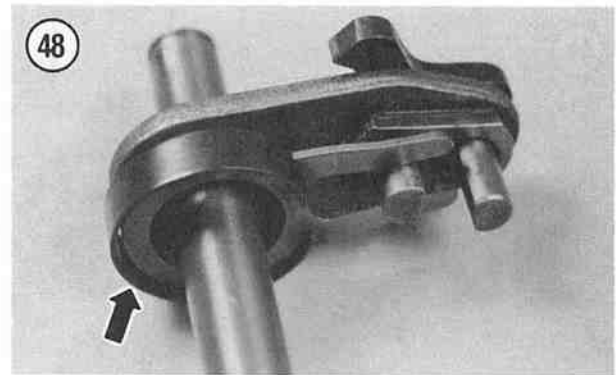
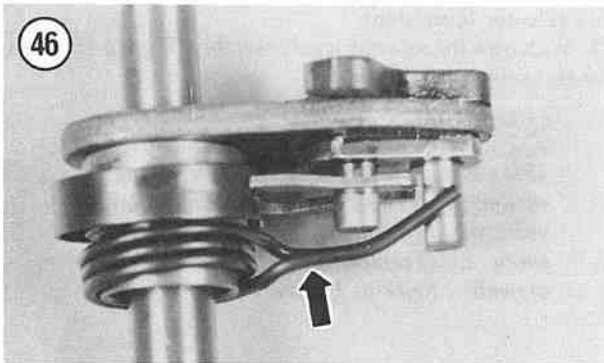
### Installation

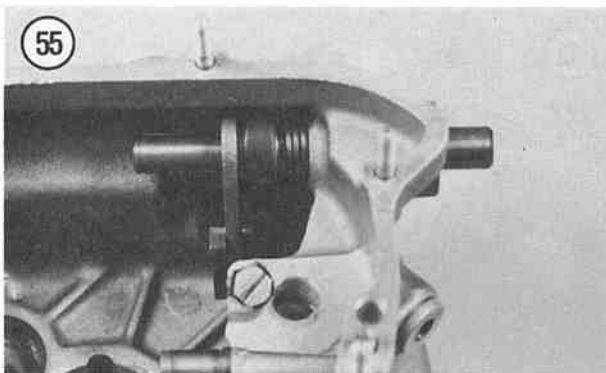
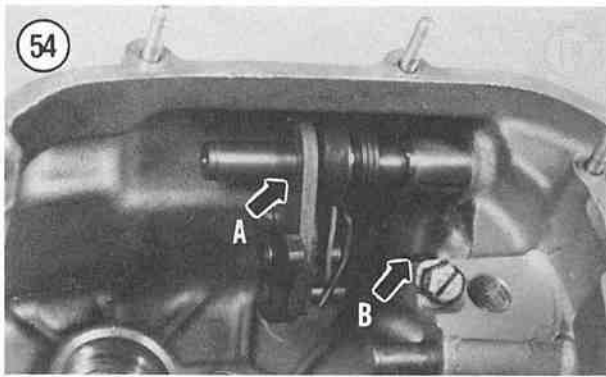
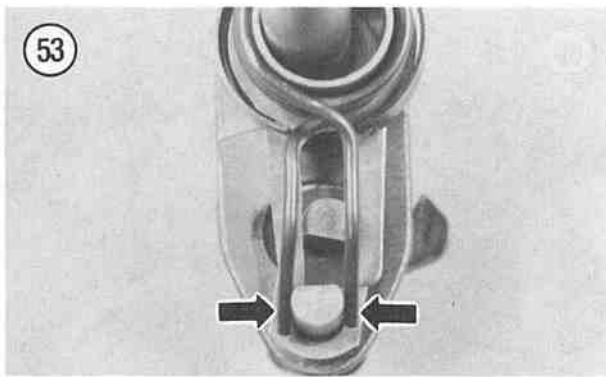
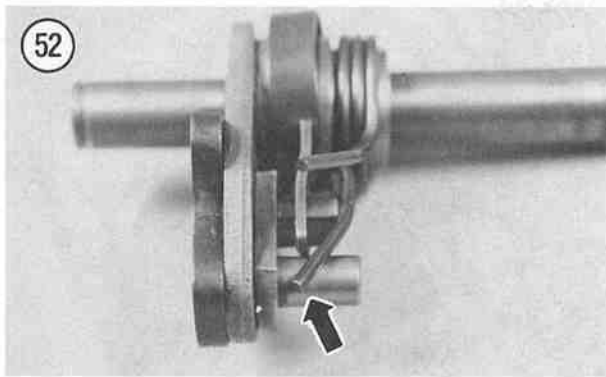
#### NOTE

*If the gearshift mechanism was removed, perform Steps 1-8 and refer to Figure 34. If the mechanism was not removed, proceed to Step 9.*

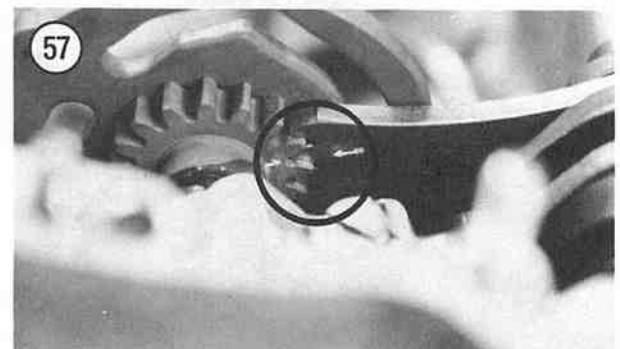
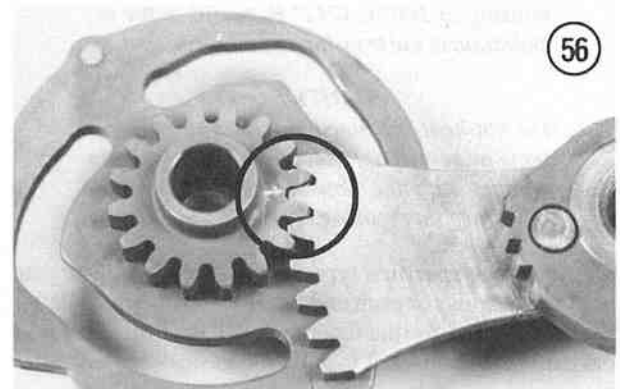
1. To assemble the selector lever assembly, perform the following:

- a. On later models, slide on the collar (Figure 49).
- b. On early models, slide on the spacer ring.
- c. On early models, slide on the positioners and circular spring assembly onto the spacer ring. Pry open the positioners and place them on the selector lever post.





- d. On later models, slide on the positioners and circular spring assembly (Figure 48). Pry open the positioners and place them on the selector lever post (Figure 50).
  - e. On later models, slide on the spacer ring (Figure 47) and push it into the positioners and circular spring assembly (Figure 51).
  - f. On early models, slide on the washer.
  - g. Install the return spring (Figure 46). Pry open the spring ends and place them on the selector lever post. Refer to Figure 52 and Figure 53.
2. Slide the selector lever assembly (A, Figure 54) onto the transmission housing. Push it on and index it onto the post (B, Figure 54) on the transmission housing. Push the assembly on until it bottoms out (Figure 55).
  3. Mesh the cam plate and pawl/shift selector assembly as shown in Figure 56. The two arrows must align.
  4. Hold the cam plate and pawl/shift selector assembly together (Figure 45) and install them onto their respective stud and selector lever shaft.
  5. After the cam plate and pawl/shift selector have been installed, recheck the alignment of the 2 parts (Figure 57). Readjust if necessary.
  6. Install the circlip (Figure 43) securing the cam plate to the stud. Make sure it is correctly seated in the circlip groove.
  7. Install the detent spring (B, Figure 42). Hook one end of the spring onto the pawl and place the other end onto the surface of the transmission housing.



8. Install the washer (A, **Figure 42**) and the circlip (**Figure 41**) onto the end of the selector shaft.
9. Slide the washer (**Figure 39**) onto the selector shaft.
10. Install the shift lever (B, **Figure 38**) onto the shaft and align the retaining bolt hole with the recessed flat on the selector shaft. This alignment is necessary so the retaining bolt can be installed.
11. Install the bolt and, if necessary, carefully tap the bolt into place.
12. Install the washer and nut (A, **Figure 38**) and tighten securely.
13. With the transmission in either 2nd, 3rd or 4th gear, check the clearance between the pawl and the detent in the cam plate (**Figure 58**). There should be a minimum approximate clearance of 2 mm (0.008 in.) between the 2 parts. If the clearance is less than specified, place a shim under the stop bolt to increase the clearance.
14. Adjust the gear selector forks as described in this chapter.
15. Position the oil baffle/shim with the concave side going in first (**Figure 59**) and install the oil baffle/shim (**Figure 60**) into the receptacle in the transmission housing.
16. Place all 3 transmission shaft assemblies in a freezer for 30 minutes. This will reduce the overall size of the ball bearings and will make installation of the transmission shaft assemblies much easier.

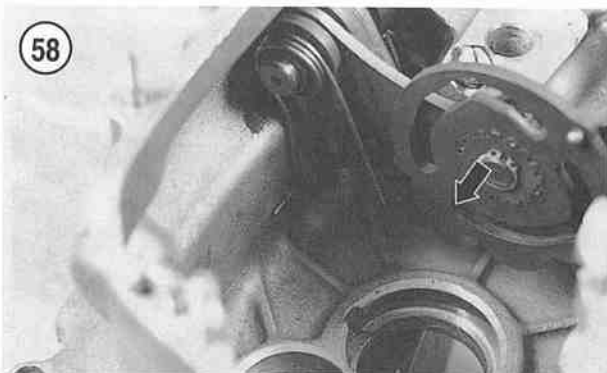
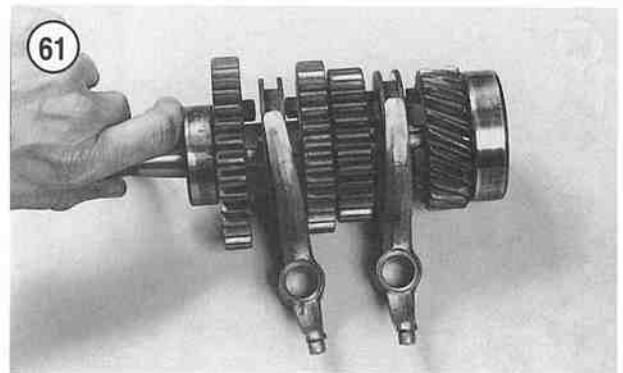
**NOTE**

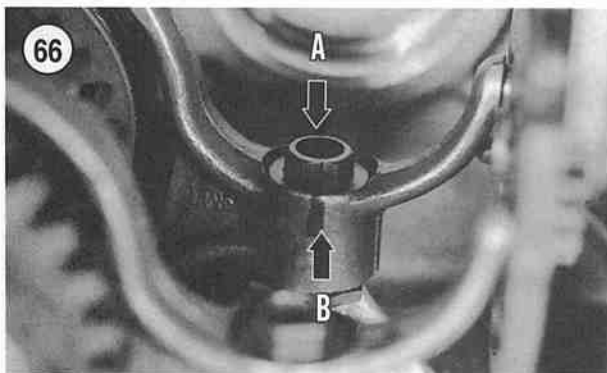
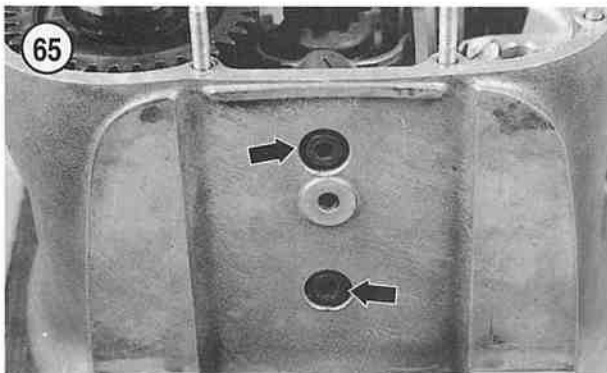
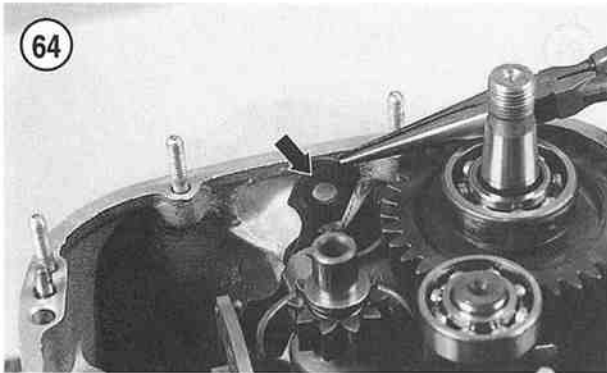
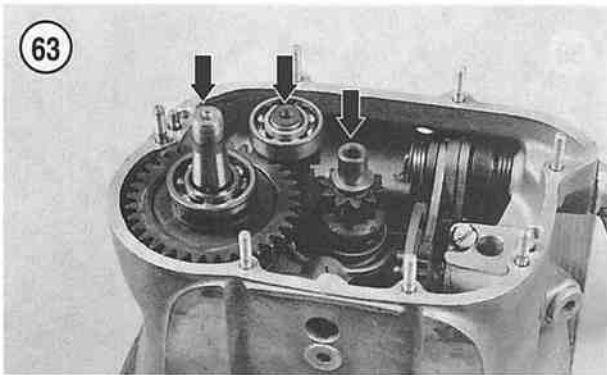
*Heat the clutch side of the transmission housing to 100° C (212° F) to aid in the installation of the transmission shaft assembly.*

**CAUTION**

*Do not heat the housing with a torch (propane or acetylene); never bring a flame into contact with the housing. The direct heat will warp the housing.*

17. Apply the specified type and viscosity of clean gear oil to the bearings at each end of all 3 transmission shafts. Refer to **Table 1** for the recommended gear oil. This will make transmission shaft installation easier.





18. Install the gear selector forks into their correct position in the output shaft (**Figure 61**).

19. Install the eccentric adjuster into each fork. The eccentric adjusters cannot be installed once the shaft assemblies are installed since there is insufficient room.

#### CAUTION

*In the following step, do not try to install one shaft without the other shafts as the bevel gears (4th gear) will be damaged. All shafts must be installed as an assembly.*

20. Properly mesh the intermediate shaft, the output shaft and the input shaft together as an assembly.

21. Make sure the gear selector forks are still properly engaged in the output shaft.

22. Install this assembly into the transmission housing (**Figure 62**) as an assembly.

23. Make sure the bearings are properly aligned with their respective bearing receptacles in the transmission housing. Carefully tap on the ends of the transmission shaft assemblies (**Figure 63**) with a plastic or soft-faced mallet. Tap on the shaft assemblies until they are completely seated.

24. Spin each transmission shaft and make sure it rotates freely. If it binds or does not spin at all, correct the problem at this time.

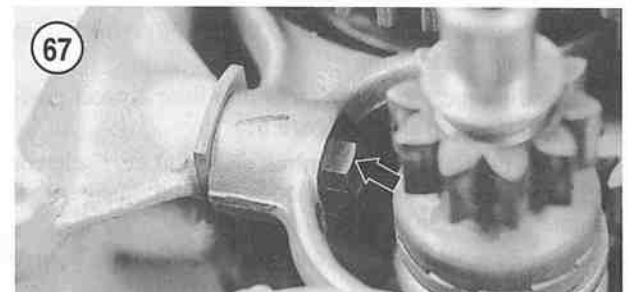
25. If either transmission shaft assembly was disassembled (even for bearing replacement), perform *Transmission Shaft End Float Measurement and Adjustment* as described in this chapter. This procedure is necessary if any component has been removed, since the overall length of the transmission shaft(s) has changed.

26. Index the gear selector forks into the grooves in the cam plate.

27. Install the gear selector retaining plate (**Figure 64**) and install the bolts and washers (**Figure 65**). Tighten the bolts finger-tight at this time.

28. Refer to *Gear Selector Fork Alignment Adjustment* in this chapter. Align the mark on the lower eccentric adjuster (A, **Figure 66**) with the mark made on the gear selector fork (B, **Figure 66**) during the alignment procedure. Tighten the lower bolt securing the eccentric adjuster securely.

29. Refer to *Gear Selector Fork Alignment Adjustment* in this chapter. Align the mark on the upper eccentric adjuster (**Figure 67**) with the mark made on the gear selector fork





(Figure 68) during the alignment procedure. Tighten the upper bolt securing the eccentric adjuster securely.

30. Apply a liberal coat of transmission gear oil onto the gear selector forks and transmission gears.

31. Install the housing cover as described in this chapter but do not install the nuts until Step 32.

32. Spin the transmission shafts and shift through all 4 gears using the shift lever. Make sure you can shift into all gears. This is the time to find that something may be installed incorrectly – not after the transmission is completely assembled and installed onto the engine.

33. If the transmission shifts through all gears correctly, install the housing cover nuts and tighten to the torque specification listed in Table 2.

34. Install the transmission housing as described in this chapter.

### Gear Selector Fork Alignment Adjustment

#### NOTE

*Whenever the transmission shafts and gear selector forks have been removed, the forks must be realigned. This procedure requires the use of a BMW special tool (Figure 69) to hold the transmission output shaft in correct alignment with the transmission housing.*

1. Place the transmission output shaft assembly in a freezer for 30 minutes. This will reduce the overall size of the ball bearing and will make transmission shaft assembly installation much easier.

#### NOTE

*Heat the clutch side of the transmission housing to 100° C (212° F) to aid in the installation of the transmission shaft assembly.*

#### CAUTION

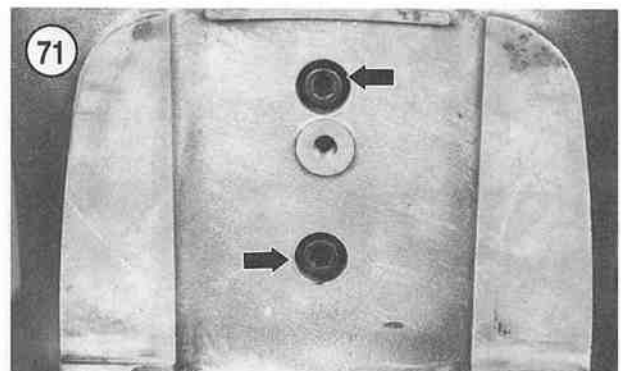
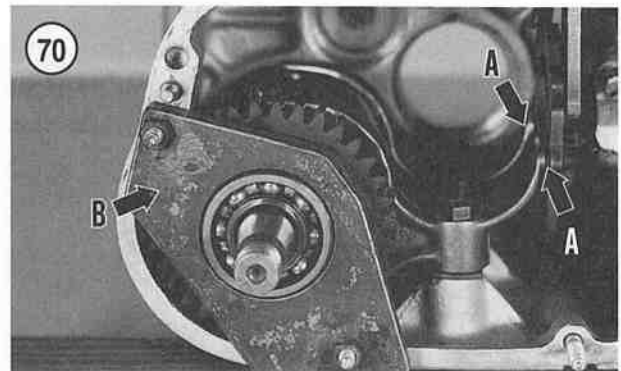
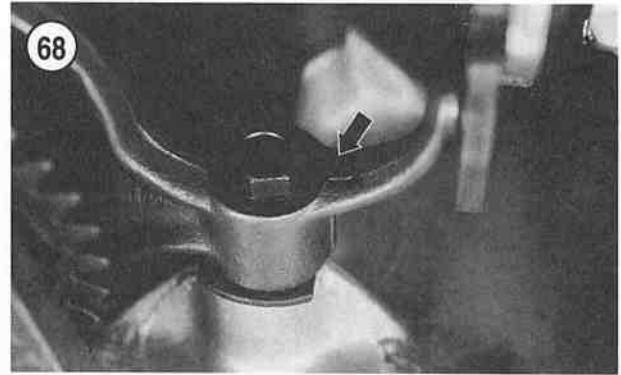
*Do not heat the housing with a torch (propane or acetylene); never bring a flame into contact with the housing. The direct heat will warp the housing.*

2. Make sure the oil baffle/shim (Figure 60) is in place in the transmission housing.

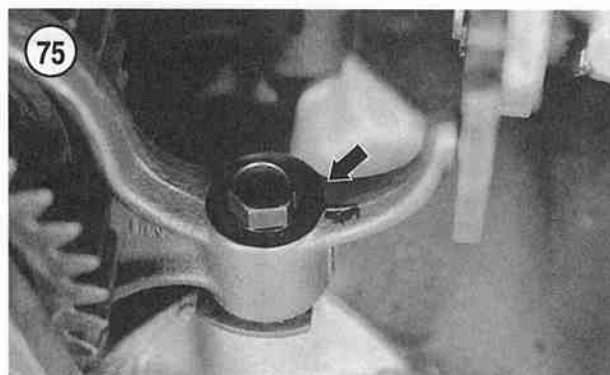
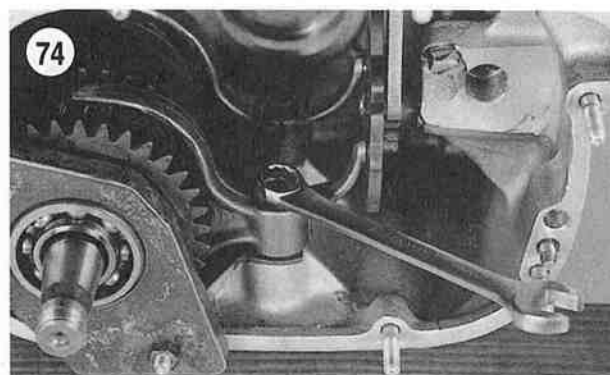
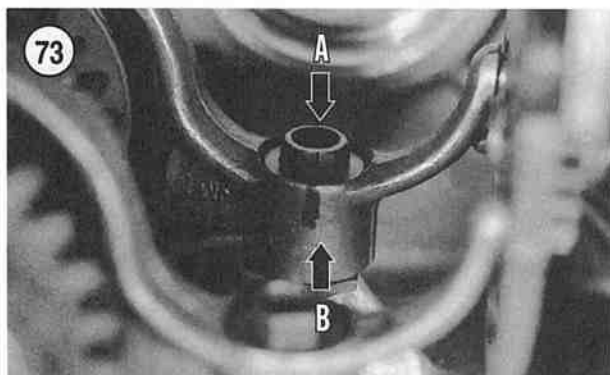
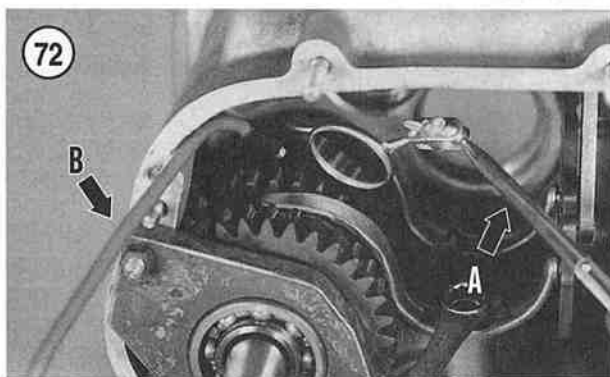
3. Install the gear selector forks into their correct positions in the output shaft (Figure 61).

4. Install the transmission output shaft and gear selector fork assembly into the transmission housing. Make sure it completely seats in the housing.

5. Properly mesh the forks with the cam plate (A, Figure 70).







6. Install the BMW special tool (part No. 23 2 750) (B, **Figure 70**) onto the transmission shaft and housing. Secure the special tool with the nuts used to secure the transmission cover.
7. Install the retaining plate under both forks.
8. Install the eccentric adjuster into each gear selector fork.
9. Install the bolts and washers (**Figure 71**) securing the eccentric adjusters.
10. Tighten the eccentric adjuster bolts until they hold the eccentrics securely – but not too tightly, as they must be slightly rotated in the following steps.
11. Lay the transmission housing down into its normal in-frame installed position.

#### NOTE

*The following steps require a small adjustable mirror (A, **Figure 72**) and flexible neck light (B, **Figure 72**). These are necessary as you must be able to see the backside of the transmission gears.*

12. Move the cam plate to the neutral position.
13. With the aid of the mirror, inspect the lower fork first.
14. Move the gear selector fork back and forth and make sure the sliding coupling is centered between the 3rd and 4th gears.
15. To adjust, turn the eccentric adjuster (A, **Figure 73**) with a box wrench until the sliding coupling is centered between the 3rd and 4th gears.
16. Tighten the bolt securing the eccentric adjuster and recheck the adjustment.
17. Make an alignment mark (B, **Figure 73**) on the gear selector fork adjacent to the index line on the eccentric adjuster.
18. With the aid of the mirror, inspect the upper fork.
19. Move the gear selector fork back and forth and make sure the sliding coupling is centered between the 1st and 2nd gears.
20. To adjust, turn the eccentric adjuster with a box wrench (**Figure 74**) until the sliding coupling is centered between the 1st and 2nd gears.
21. Tighten the bolt securing the eccentric adjuster and recheck the adjustment.
22. Make an alignment mark (**Figure 75**) on the gear selector fork adjacent to the index line on the eccentric adjuster.
23. Remove the bolts and washers (**Figure 71**) securing the eccentric adjusters.
24. Remove the eccentric adjuster from each gear selector fork.
25. Remove the retaining plate under both forks.
26. Remove the nuts securing the BMW special tool (part No. 23 2 750) (B, **Figure 70**) and remove the tool from the transmission shaft and housing.

**NOTE**

Heat the clutch side of the transmission housing to 100° C (212° F) to aid in the removal of the transmission shaft assembly.

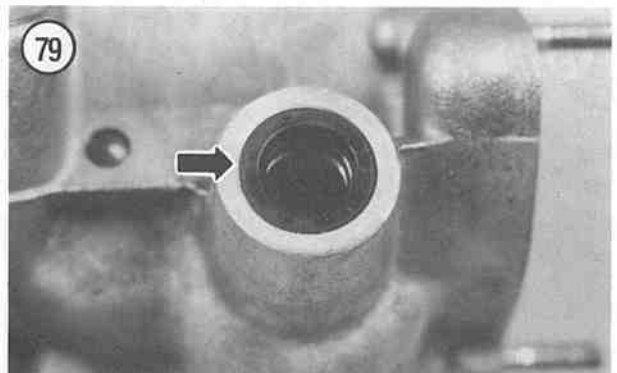
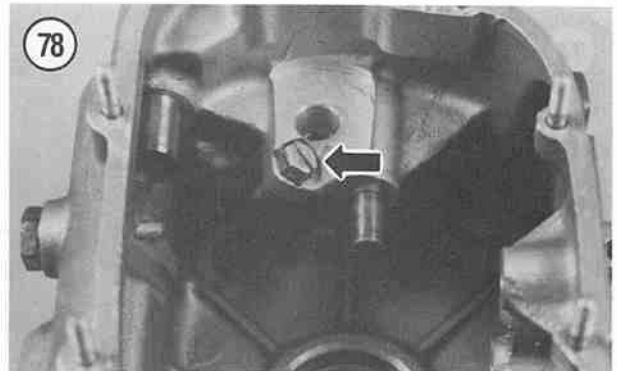
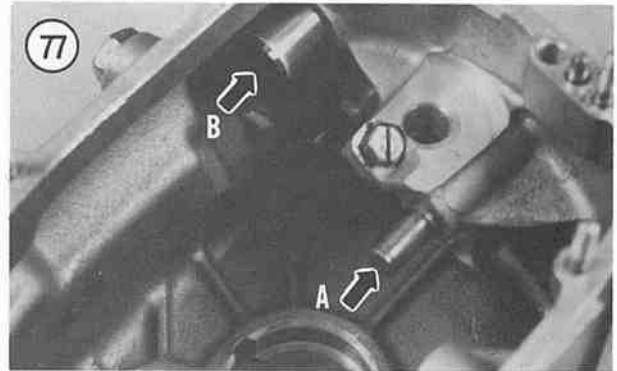
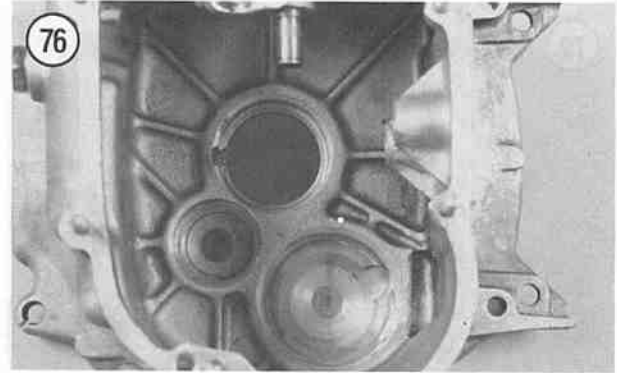
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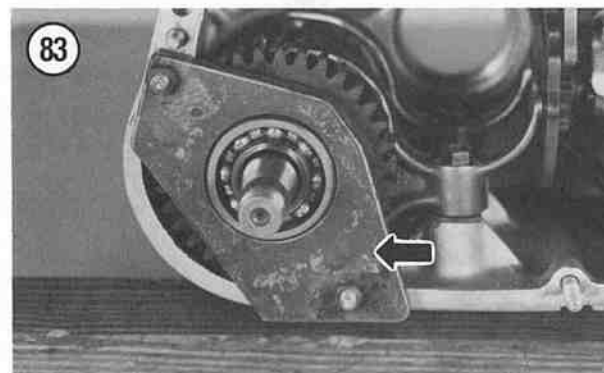
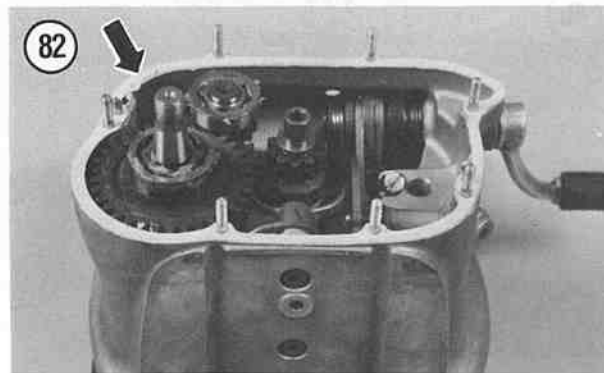
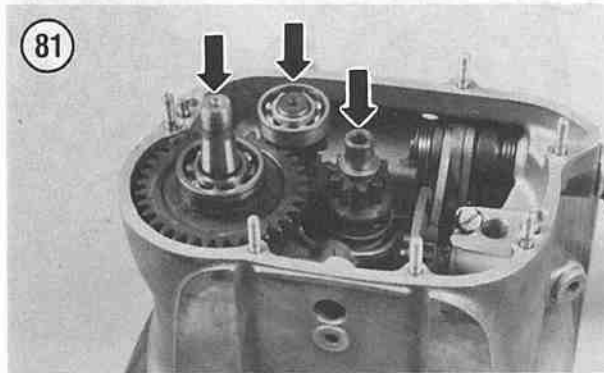
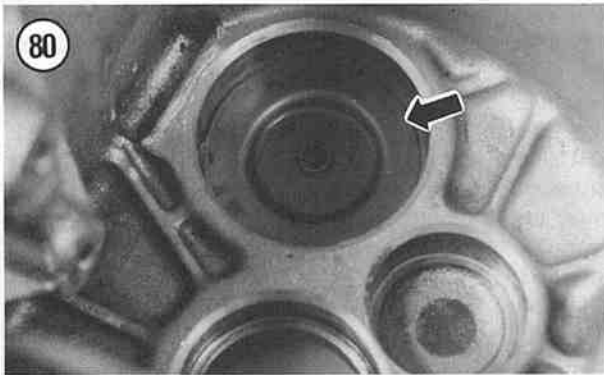
Do not heat the housing with a torch (propane or acetylene); never bring a flame into contact with the housing. The direct heat will warp the housing.

27. Remove the transmission shaft assembly and the oil baffle/shim from the transmission housing.

### Housing Inspection, Input Shaft Oil Seal Replacement and Gearshift Lever Shaft Oil Seal Replacement

1. Thoroughly clean the housing in solvent and dry with compressed air.
2. Inspect the housing for any cracks or damage. Check around the ribs (Figure 76) and the transmission housing-to-cover sealing surface. If damaged, replace the housing.
3. Inspect the gearshift mechanism mounting stud (A, Figure 77) and sleeve (B, Figure 77) for wear or damage. Replace if necessary.
4. Inspect the selector lever stopper bolt (Figure 78) for tightness; tighten it securely if necessary. Also make sure the lockwasher tab is bent up against one of the flats on the bolt head.
5. Inspect the input shaft bearing oil seal for wear or damage. If necessary, replace as follows:
  - a. Place the housing on wood blocks to protect the sealing surface from damage.
  - b. Use a large flat-bladed screwdriver and carefully pry the oil seal out of the receptacle in the housing.
  - c. Thoroughly clean out the seal receptacle in the housing with solvent and dry with compressed air.
  - d. Apply a light coat of multipurpose grease to the outer surface of the new seal and the seal receptacle in the case.
  - e. Working from the outer surface of the transmission housing, carefully tap the new input shaft seal into the transmission housing. Tap the seal in until it bottoms out.
6. Inspect the gearshift lever shaft oil seal for wear or damage. If necessary, replace as follows:
  - a. Place the housing on wood blocks to protect the sealing surface from damage.
  - b. Use a large flat-bladed screwdriver and carefully pry the oil seal (Figure 79) out of the receptacle in the housing.
  - c. Thoroughly clean out the seal receptacle in the housing with solvent and dry with compressed air.
  - d. Apply a light coat of multipurpose grease to the outer surface of the new seal and the seal receptacle in the case.





- e. Working from the outer surface of the transmission housing, carefully tap the new input shaft seal into the transmission housing. Tap the seal in until it bottoms out.

#### Transmission Shaft End Float Measurement and Adjustment

The transmission shaft end float must be checked whenever the transmission shafts have been serviced or removed from the transmission housing.

The end float is the play or free space between the ends of the transmission shafts and the transmission housing cover. The ball bearings must have a certain amount of freedom or end float. If the end float is not correct, the bearings will wear prematurely.

The transmission shaft rear bearings must be completely seated in the transmission housing in order for this adjustment to be correct. If they are not completely seated, the transmission shaft will sit up too high and throw off the measurements taken in this procedure.

Use a *metric* vernier caliper or depth gauge as it will be easier to calculate shim selection in this procedure.

#### NOTE

*The oil baffle/shim (Figure 80) must be installed under the output shaft or the dimension taken will be incorrect.*

1. Make sure the transmission shaft assemblies (Figure 81) are properly seated in the transmission housing and are sitting perfectly upright—they cannot be tilted to one side.
2. Install a new transmission housing cover gasket (Figure 82) on the transmission housing.

#### Output shaft

#### NOTE

*The BMW special tool is designed to be used only on the output shaft.*

- 1A. If using the BMW special tool, perform the following:
  - a. Install the BMW special tool (part No. 504) (Figure 83) over the output shaft and attach it to the transmission housing with 2 nuts. Tighten the nuts securely.
  - b. Place a machined straightedge across the output shaft bearing surface and hold it level.
  - c. Using a metric vernier caliper or depth gauge, measure the distance from the top surface of the transmission housing to the top surface of the output shaft bearing (Figure 84). Write down this dimension (dimension A).
- 1B. If *not* using the BMW special tool, perform the following:
  - a. Hold the output shaft perfectly upright.

- b. Place a machined straightedge (A, **Figure 85**) across the transmission housing gasket surface.
  - c. Using a metric vernier caliper or depth gauge, measure the distance from the top surface of the machined straightedge to the top surface of the output shaft bearing. Subtract the thickness of the machined straightedge. Write down this dimension (dimension A).
2. Using a vernier caliper or depth gauge, measure the distance from the top surface of the transmission housing cover to the shoulder (**Figure 86**) where the shaft's rear bearing bottoms out in the cover. Write down this dimension (dimension B).
  3. Remove the machined straightedge.
  4. For correct output shaft shim(s) selection proceed as follows:

**NOTE**

The specified amount of free play load is 0.10 mm.

**NOTE**

The following numbers are examples only. Use the numbers written down during this procedure.

**Example:**

Actual measured distance	
Measurement B	36.90 mm
Subtract measurement A	<u>-36.05 mm</u>
Equals excess clearance (without any shims)	0.85 mm
Specified free play	<u>-0.10 mm</u>
Equals required shim thickness (round off to the nearest shim thickness)	0.75 mm

**NOTE**

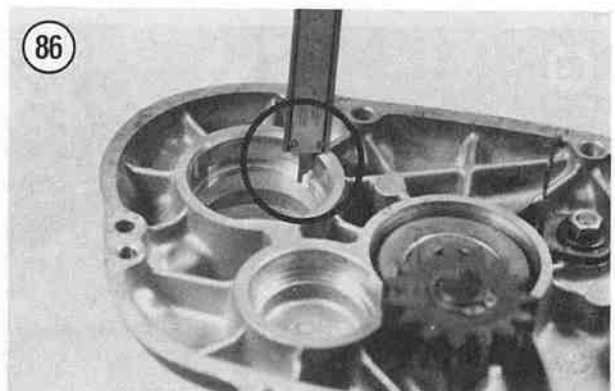
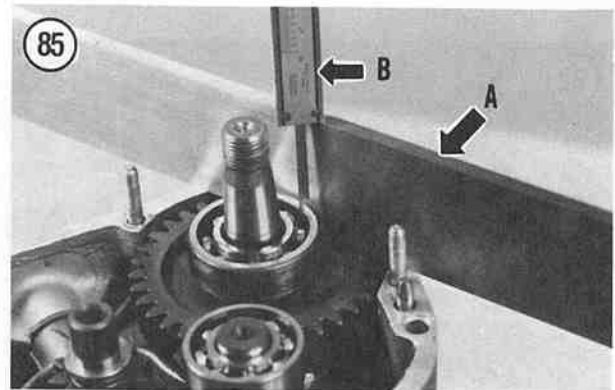
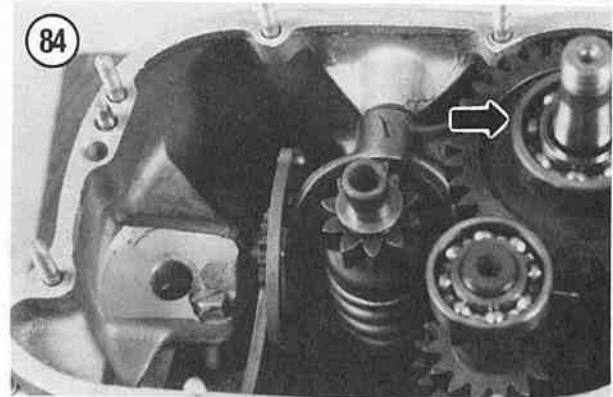
Output shaft shims are available from BMW dealers in the following thicknesses: 0.20, 0.28, 0.38, 0.50, 0.63, 0.75, 0.88 and 1.0 mm. Use the correct thickness of one shim or a combination of shims to achieve the specified preload.

5. The shim(s) (A, **Figure 87**) is placed on top of the output shaft front bearing outer race and is sandwiched between the bearing outer race and the transmission housing cover.
6. If installed, remove the special tool installed in Step 1.

**Intermediate shaft**

1. Place a machined straightedge across the transmission housing gasket surface.

2. Using a metric vernier caliper or depth gauge, measure the distance from the top surface of the machined straightedge to the top surface of the intermediate shaft bearing. Subtract the thickness of the machined straightedge. Write down this dimension (dimension A).
3. Using a vernier caliper or depth gauge, measure the distance from the top surface of the transmission housing cover to the shoulder (**Figure 88**) where the shaft's rear bearing bottoms out in the cover. Write down this dimension (dimension B).
4. Remove the machined straightedge.





5. For correct output shaft shim(s) selection proceed as follows:

**NOTE**

The specified amount of free play is 0.10 mm.

**NOTE**

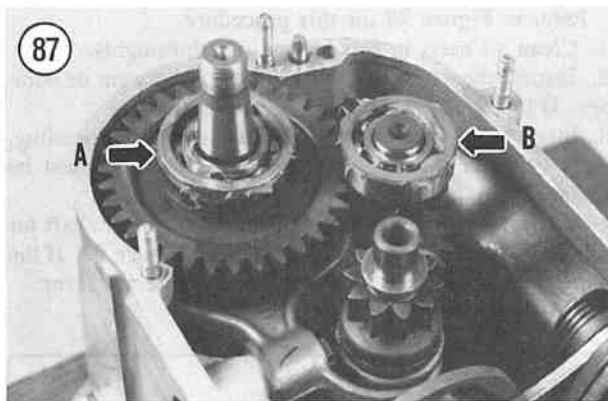
The following numbers are examples only. Use the numbers written down during this procedure.

**Example:**

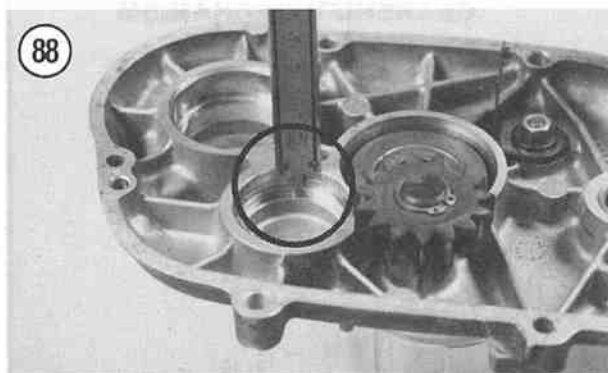
Actual measured distance	
Measurement B	36.90 mm
Subtract measurement A	<u>-36.05 mm</u>
Equals excess clearance (without any shims)	0.85 mm
Specified free play	<u>-0.10 mm</u>
Equals required shim thickness (round off to the nearest shim thickness)	0.75 mm

**NOTE**

Intermediate shaft shims are available from BMW dealers in the following thicknesses: 0.18, 0.28, 0.38 and 0.50 mm. Use the correct thickness of one shim or a combination of shims to achieve the specified preload.



6. The shim(s) (B, **Figure 87**) is placed on top of the intermediate shaft front bearing outer race and is sandwiched between the bearing outer race and the transmission housing cover.



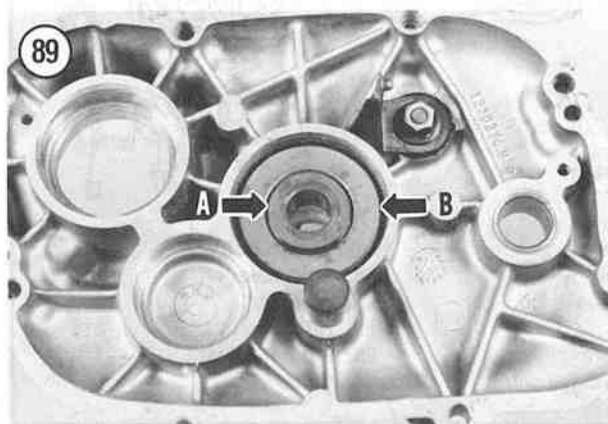
**Input shaft**

**NOTE**

This BMW special tool is required on the input shaft since the rear ball bearing is installed in the housing cover.

**NOTE**

Make sure the washer is in place on the input shaft, otherwise the measured dimension will be incorrect.



1. Install the BMW special tool measuring sleeve (part No. 5061) onto the input shaft. This tool is exactly 20 mm thick.
2. Place a machined straightedge across the transmission housing gasket surface.
3. Using a metric vernier caliper or depth gauge, measure the distance from the top surface of the machined straightedge to the top surface of the special tool. Subtract 20 mm from this dimension (deleting the special tool dimension). Also subtract the thickness of the machined straightedge. Write down this dimension (dimension A).
4. Place a machined straightedge across the housing cover.
5. Using a vernier caliper or depth gauge, measure the distance from the top surface of the transmission housing cover to the shoulder of the flanged sleeve (A, **Figure 89**). Write down this dimension (dimension B).



6. For the correct shim selection proceed as follows:

**NOTE**

The specified amount of free play is 0.10 mm.

**NOTE**

The following numbers are examples only. Use the numbers written down during this procedure.

**Example:**

Actual measured distance	
Measurement B	36.90 mm
Subtract measurement A	-36.05 mm
Equals excess clearance (without any shims)	0.85 mm
Specified free play	-0.10 mm
Equals required shim thickness (round off to the nearest shim thickness)	0.75 mm

**NOTE**

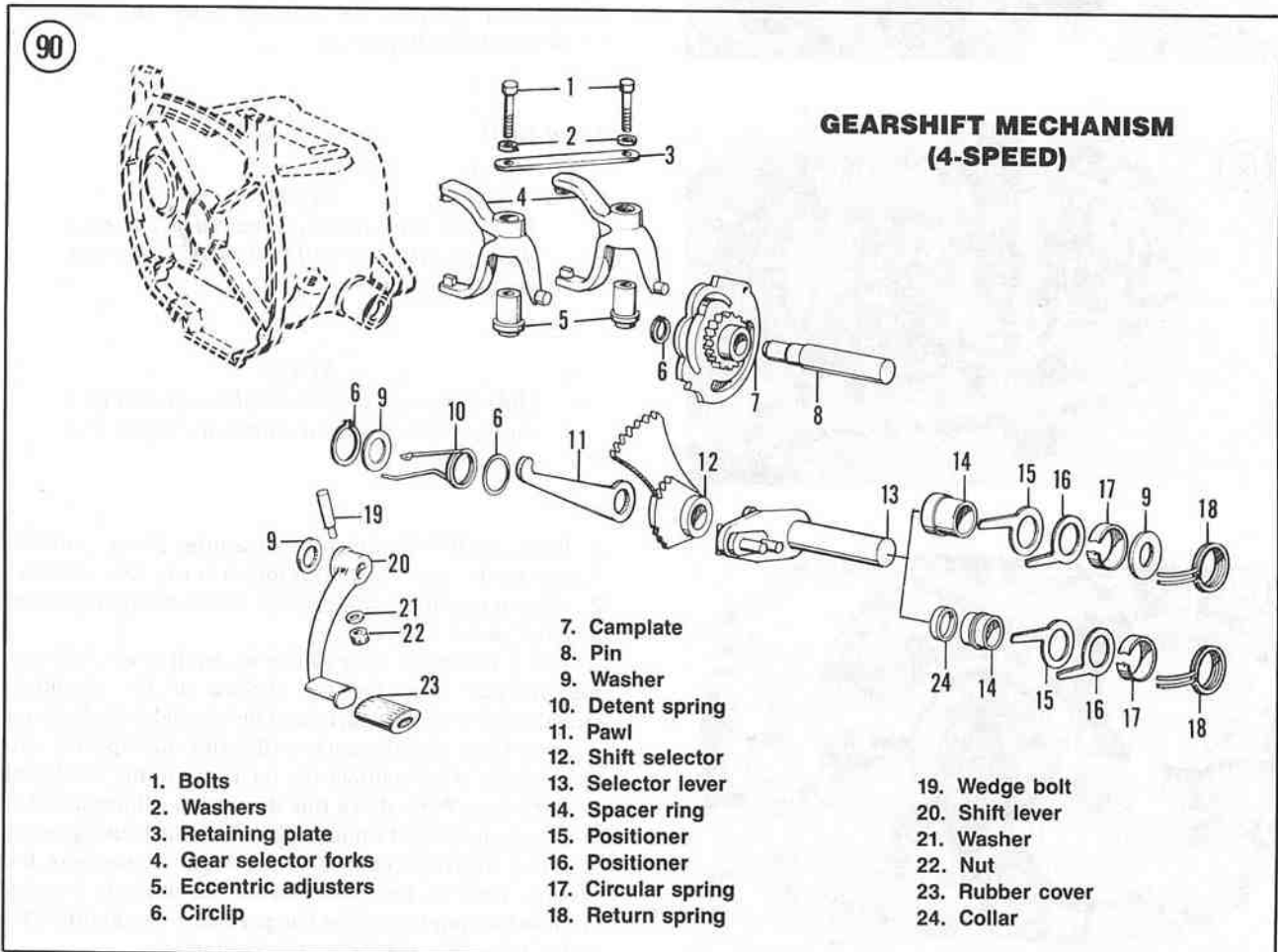
The combination oil baffle/shims are available from BMW dealers in the following thicknesses: 0.38, 0.50, 0.63, 0.75, 0.88 and 1.00 mm. Use the correct thickness of one oil baffle/shim to achieve the specified preload.

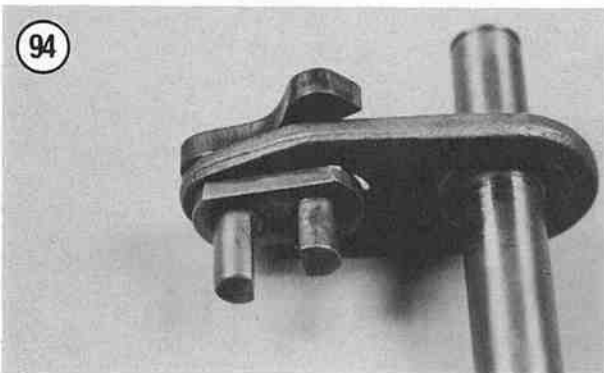
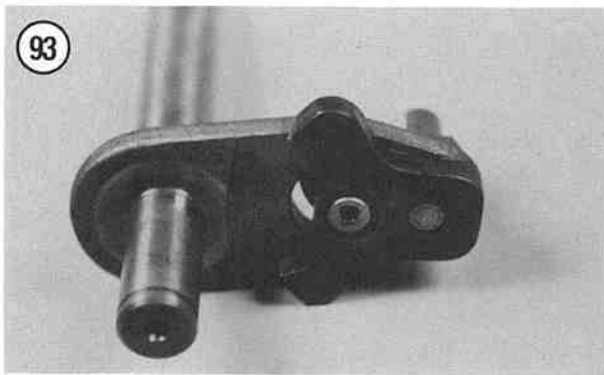
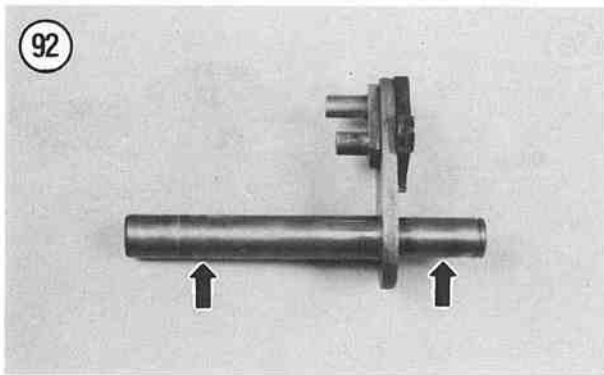
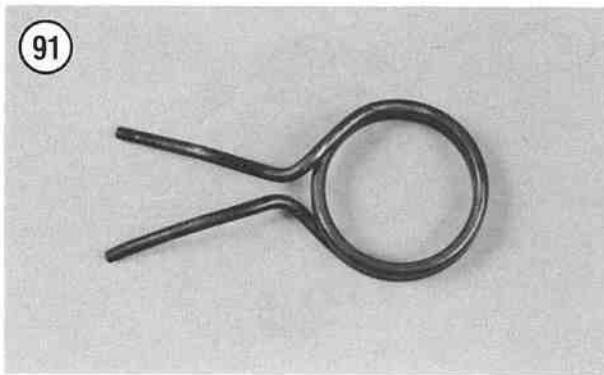
7. The oil baffle/shim (B, **Figure 89**) is placed between the flanged sleeve and the bearing in the transmission housing cover.

**Gearshift Mechanism Inspection**

Refer to **Figure 90** for this procedure.

1. Clean all parts in solvent and dry thoroughly.
2. Inspect the detent spring (**Figure 91**) for wear or damage. If broken or weak, replace the spring.
3. Inspect the selector lever shaft (**Figure 92**) for bending, wear or other damage. If the shaft is bent, it must be replaced.
4. Inspect the pivot portion of the selector lever shaft for free movement. Refer to **Figure 93** and **Figure 94**. If the movement is loose or stiff, replace the selector lever.





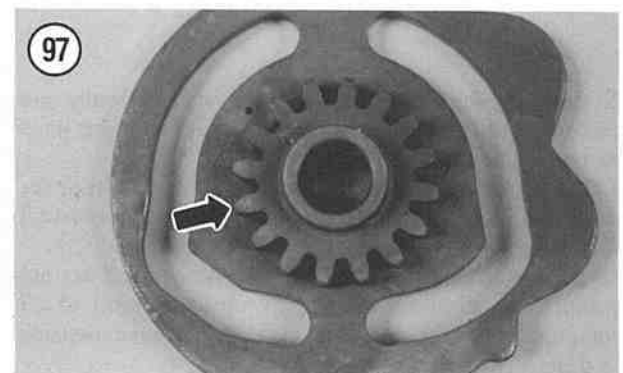
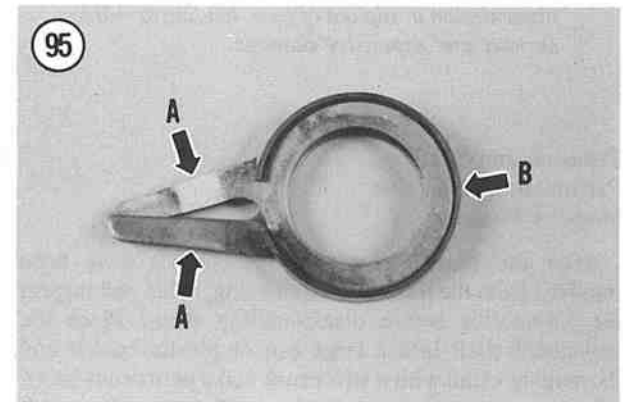
5. Inspect the positioners (A, **Figure 95**) and the circular spring (B, **Figure 95**) for wear or damage. Replace any faulty part.

6. Check the inner and outer surfaces of the spacer ring (**Figure 96**) for wear or damage. Replace if necessary.

7. Inspect the gear teeth (**Figure 97**) and the ramps (**Figure 98**) of the cam plate for wear or roughness. Replace if necessary.

8. Inspect the gear teeth (**Figure 99**) of the pawl and the shift selector for wear or roughness. Replace if necessary.

9. Inspect each gear selector fork (**Figure 100**) for signs of wear or cracking. Check for bending. Make sure the tabs



(Figure 101) that ride in the output shaft sliding coupling are free of burrs and are not worn. Make sure the tab (Figure 102) that rides in the cam plate is free of burrs and is not worn. Replace the fork(s) if necessary.

10. Inspect the outer pivoting surface of the eccentric adjuster (A, Figure 103) and the inner surface of the gear selector fork (B, Figure 103) for wear or roughness. Replace any worn part.

#### CAUTION

*Marginally worn gear selector forks should be replaced. Worn forks can cause the transmission to slip out of gear, leading to more serious and expensive damage.*

#### Transmission Shaft Preliminary Inspection (4-speed Models)

After the transmission shaft assemblies have been removed from the transmission housing, clean and inspect the assemblies before disassembling them. Place the assembled shaft into a large can or plastic bucket and thoroughly clean with a stiff brush and a petroleum-based solvent such as kerosene and a stiff brush. Dry with compressed air or let it sit on rags to drip dry. Repeat for the other shaft assemblies.

1. After they have been cleaned, visually inspect the components of the assemblies for excessive wear. Any burrs, pitting or roughness on the teeth of a gear will cause wear on the mating gear. Minor roughness can be cleaned up with an oilstone but there's little point in attempting to remove deep scars.

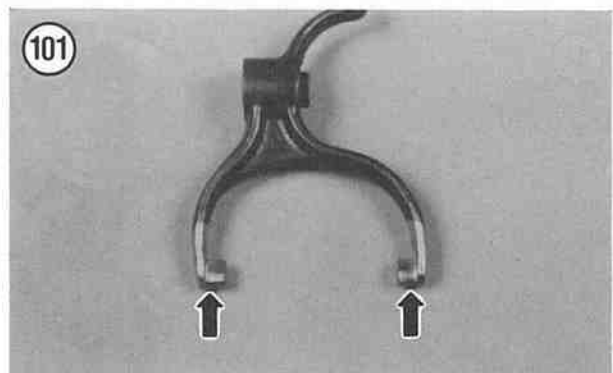
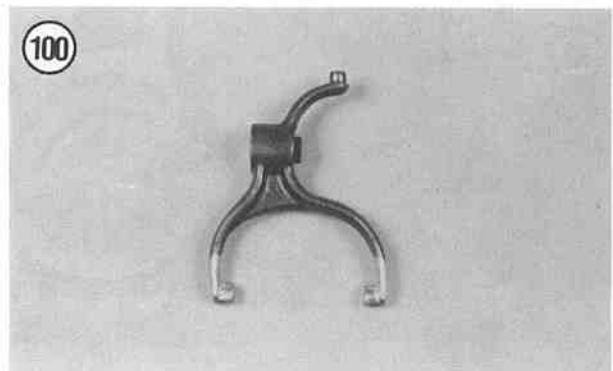
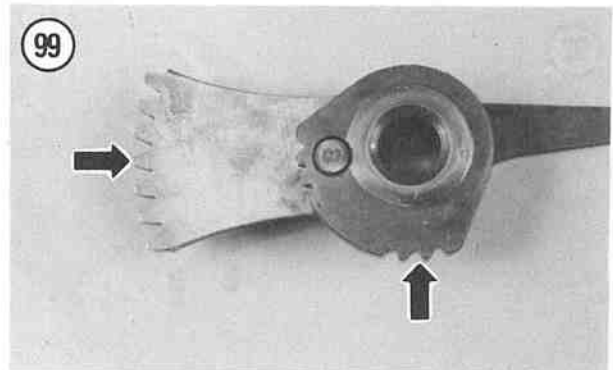
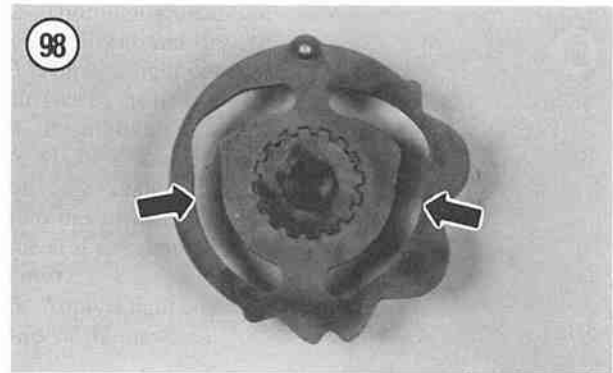
#### NOTE

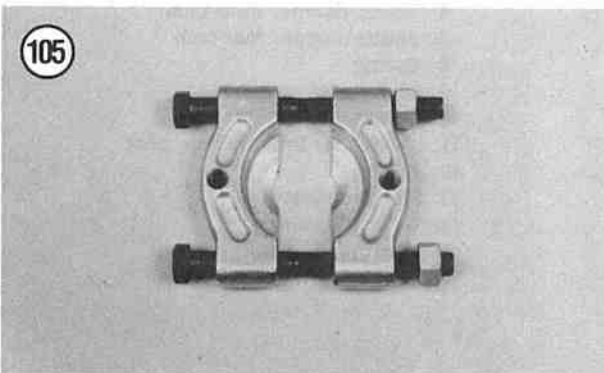
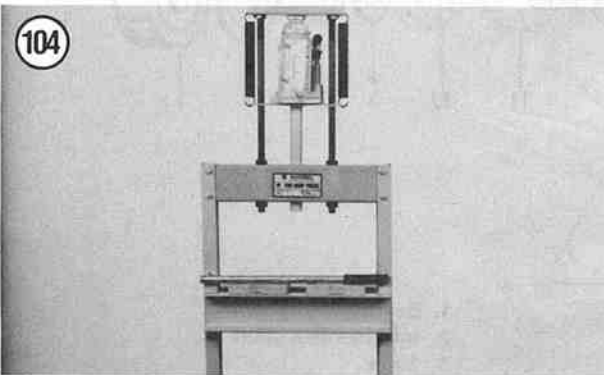
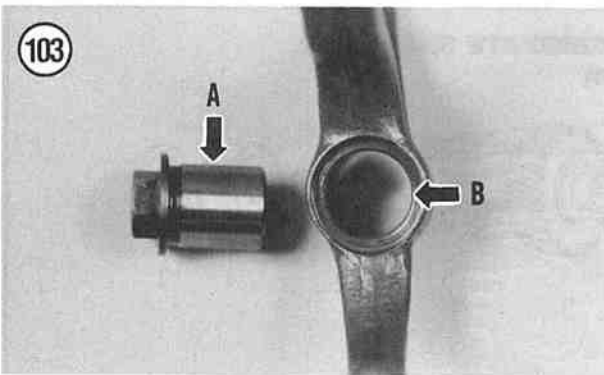
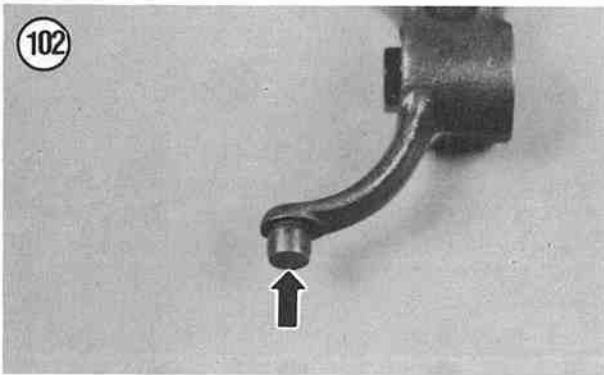
*Defective gears should be replaced. It's a good idea to replace the mating gear on the other shaft even though it may not show as much wear or damage.*

2. Carefully check the engagement dogs. If any are chipped, worn, rounded or missing, the affected gear must be replaced.

3. Rotate the transmission bearings by hand. Check for roughness, noise and radial play. Any bearing that is suspect should be replaced as described in this chapter.

4. If the transmission shafts are satisfactory and are not going to be disassembled, apply clean gear oil to all components and reinstall them in the transmission housing as described in this chapter.



**NOTE**

If disassembling a used, well run-in (high mileage) transmission for the first time by yourself, pay particular attention to any additional shims that may have been added by a previous owner. These may have been added to take up the tolerance of worn components or thrust washers and must be reinstalled in the same position since the shims have developed a wear pattern. If new parts are going to be installed these shims may be eliminated. This is something you will have to determine upon reassembly.

Do not confuse this statement with the end float and preload adjustment that must be done before installing the shaft assemblies as noted in this chapter.

**Input Shaft Disassembly**

Disassembly of the input shaft requires the use of a hydraulic press (Figure 104), an insert (Figure 105) and a bearing puller.

Refer to Figure 106 for this procedure.

**NOTE**

A helpful "tool" that should be used for transmission disassembly is a large egg flat (the type that restaurants get their eggs in) as shown in Figure 107. As you remove a part from the shaft, set it in one of the depressions in the same position from which it was removed. This is an easy way to remember the correct relationship of all parts.

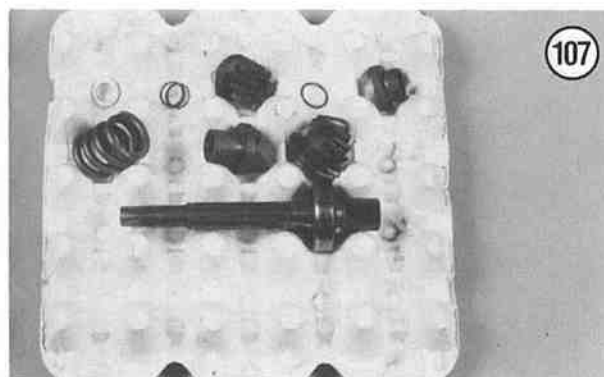
1. If not cleaned in the *Transmission Shaft Preliminary Inspection* sequence, place the assembled shaft into a large can or plastic bucket and thoroughly clean with solvent and a stiff brush. Dry with compressed air or let it sit on rags to dry.
2. Measure the overall length of the assembled shaft before disassembly. Write this dimension down as it will be used for reference after the shaft is reassembled.
3. Install the insert under the kickstarter intermediate gear as shown in Figure 108.
4. Install the input shaft assembly in the hydraulic press.
5. Place a 1/2 inch socket drive extension (Figure 109) between the end of the shaft and the press.
6. While holding onto the input shaft, slowly press the thrust washer, spring and kickstarter intermediate gear off of the shaft.
7. Release the hydraulic pressure and remove the input shaft assembly from the hydraulic press.

**NOTE**

A special tool is required for Step 9, but a homemade tool can easily be fabricated from a piece of 3/4 inch galvanized pipe as described in Step 8.

8. Refer to **Figure 110** and fabricate the special tool as follows:

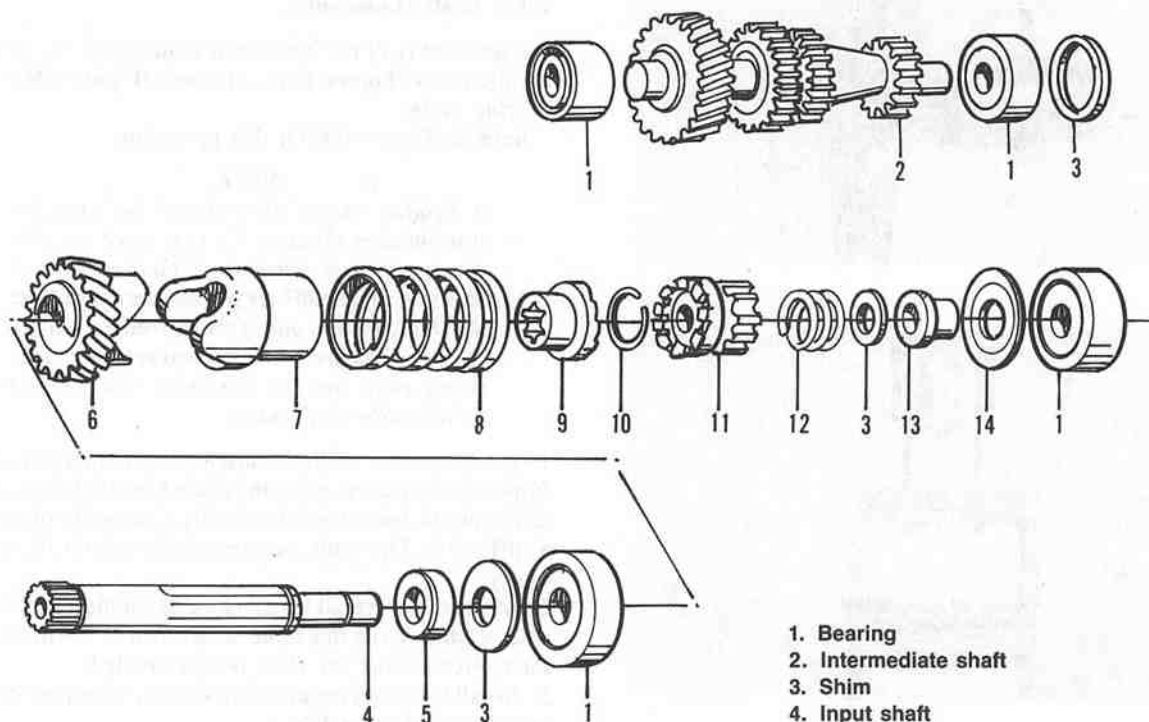
- Use a piece of 3/4 in. galvanized pipe approximately 4-6 in. long. The end of the piece of pipe that is going to be modified must be cut off at 90°. It cannot be cut off at a slight angle.
- Use a hacksaw and make 2 cuts on each side of the piece of pipe about 1/2 in. apart and about 1/2 in. deep.
- Use a pair of Vise Grips and bend the pieces of pipe between the cuts back and forth until they break off.
- Use a rattail file and file the end of the slots until they are round and the end is approximately 3/4 in. from the end of the pipe.



107

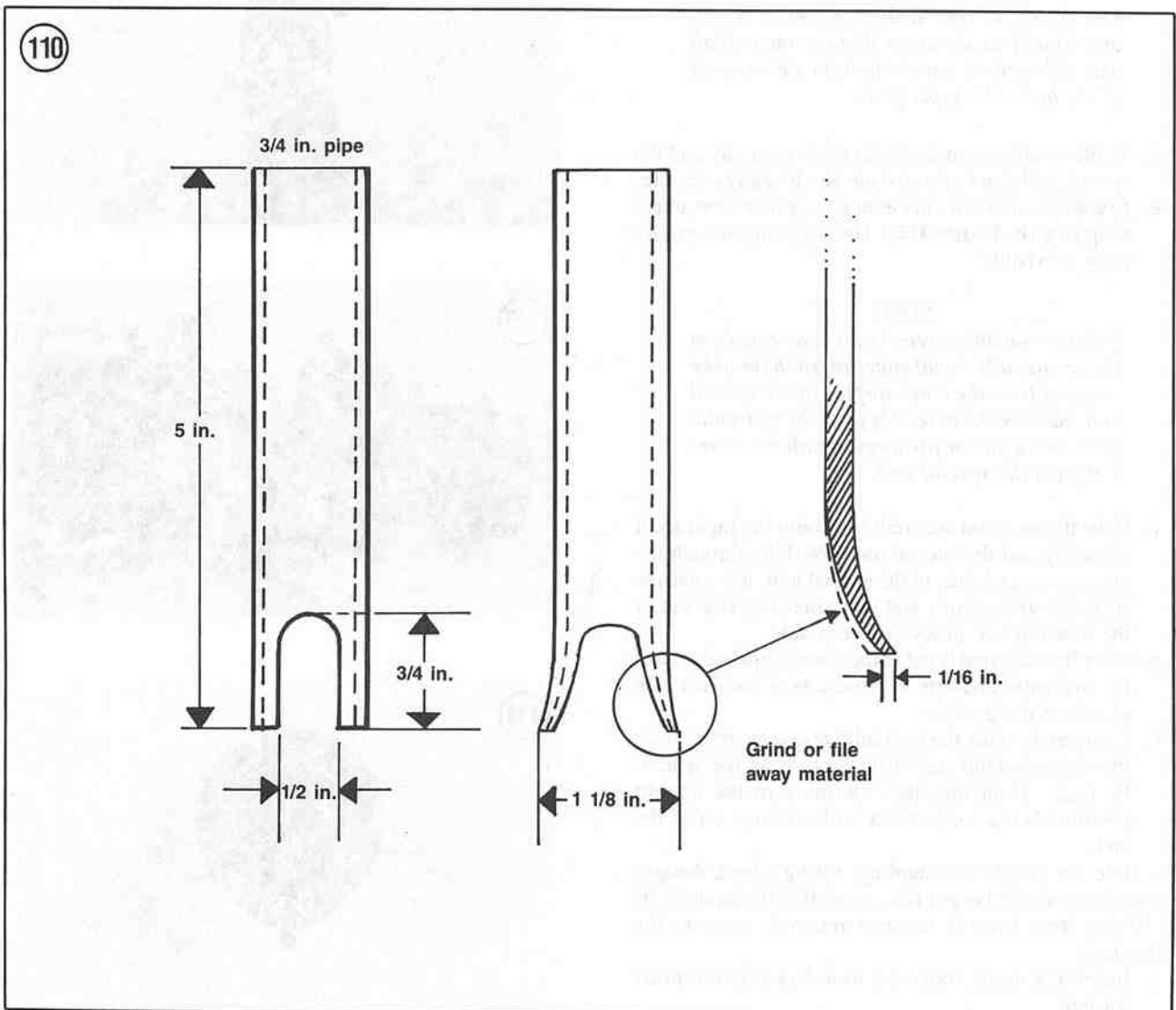
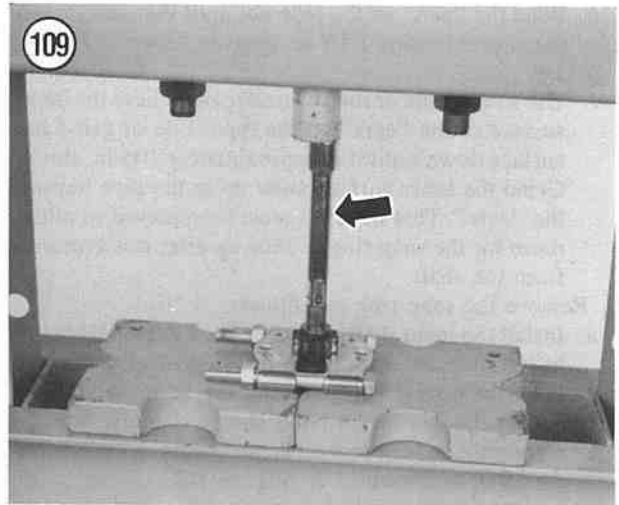
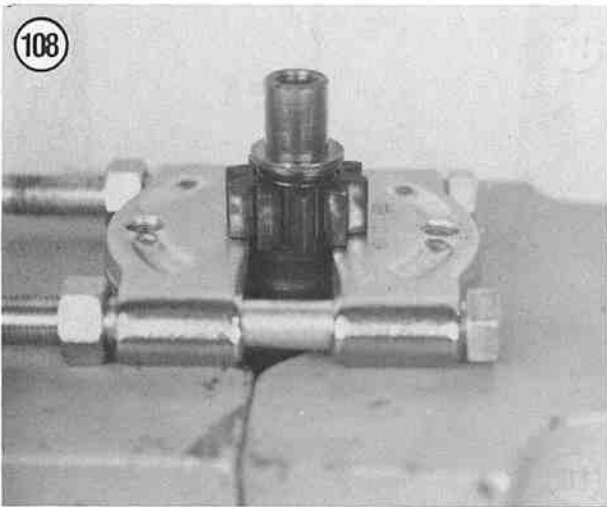
106

### INPUT SHAFT AND INTERMEDIATE SHAFT (4-SPEED)



- Bearing
- Intermediate shaft
- Shim
- Input shaft
- Bushing
- Shock damper front cam
- Shock damper rear cam
- Spring
- Kickstarter coupling
- Circlip
- Kickstarter intermediate gear
- Spring
- Flanged sleeve
- Oil baffle/shim





- e. Bend the “ears” of the pipe out until they are spread out approximately 1 1/8 in. apart as shown in **Figure 110**.
  - f. Use a rattail file or rotary grinder and relieve the inner surface of the “ears” on the pipe. File or grind the surface down until it is approximately 1/16 in. thick. Grind the inner surface away up in the pipe beyond the “ears.” This material must be removed to allow room for the snap ring to slide up after it is removed from the shaft.
9. Remove the snap ring as follows:
- a. Install the input shaft assembly (A, **Figure 111**) in the hydraulic press with the splined end facing down.
  - b. Place the special tool (B, **Figure 111**) fabricated in Step 8 onto the end of the input shaft assembly.
  - c. Center the special tool on the ledge of the kickstarter coupling as shown in A, **Figure 112**.

**WARNING**

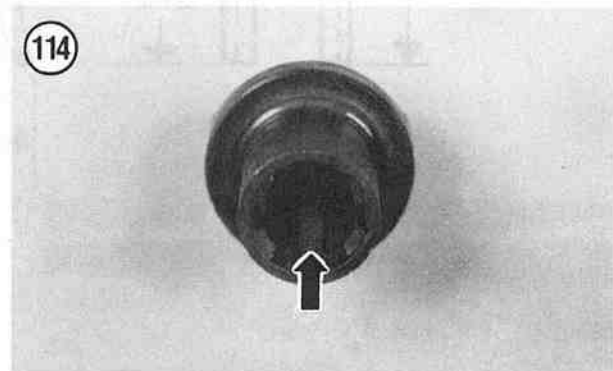
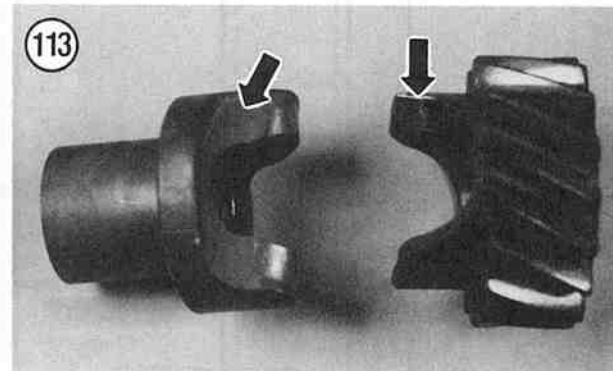
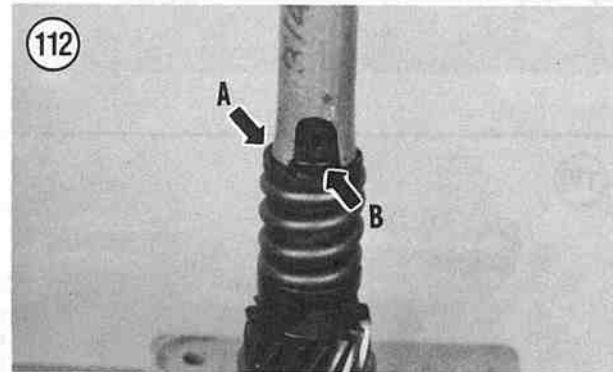
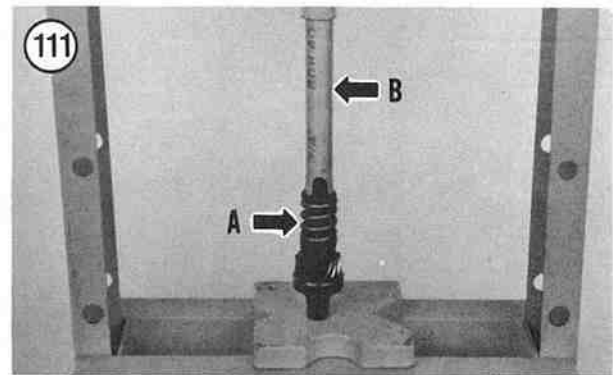
*The spring is very strong. Protect yourself accordingly in the event that the input shaft assembly and the special tool should move off of the hydraulic press plate.*

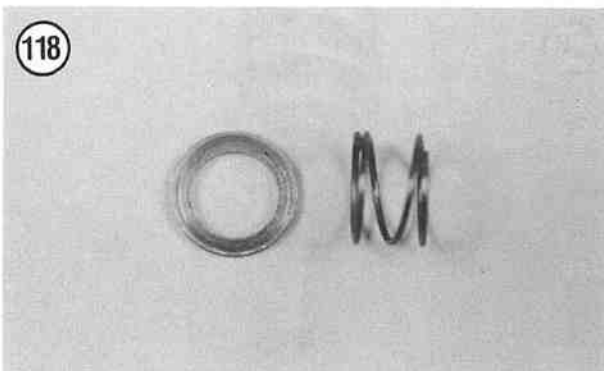
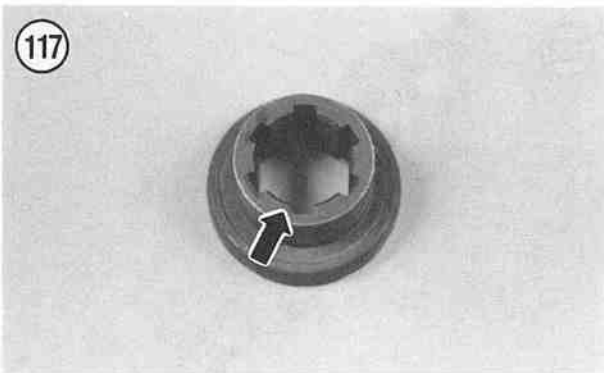
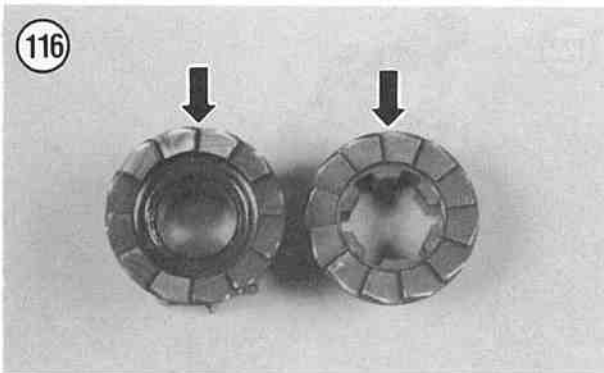
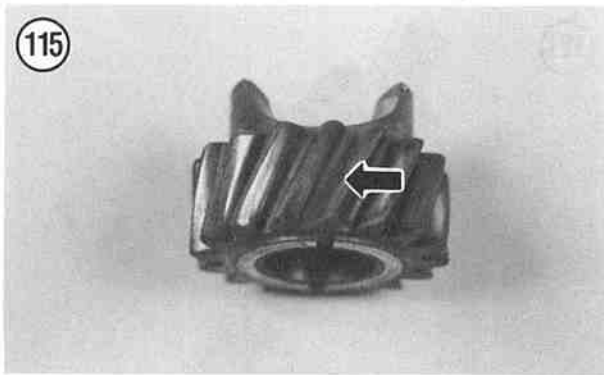
- d. While holding onto the input shaft assembly and the special tool, have an assistant slowly apply pressure.
- e. Compress the shaft only enough to gain access to the snap ring (B, **Figure 112**). The snap ring and groove must be visible.

**NOTE**

*If you are unable to remove the snap ring from the groove, additional material will have to be removed from the inner surface of the special tool. Remove the assembly from the hydraulic press and grind or file away additional material from the special tool.*

- f. Have the assistant securely hold onto the input shaft assembly and the special tool. Working through the opening on each side of the special tool, use a narrow screwdriver or scribe and work the snap ring out of the transmission groove on each side.
  - g. After the snap ring is out of the groove, gradually relax the hydraulic pressure and make sure the snap ring is free of the groove.
  - h. Completely relax the hydraulic pressure and remove the shaft assembly and special tool from the hydraulic press. Hold the shaft assembly in the upright position so the components will not slide off of the end.
10. Slide the kickstarter coupling, spring, shock damper rear cam and shock damper front cam off of the input shaft.
11. If the front bearing requires removal, perform the following:
- a. Install the insert under the front bearing and thrust washer.

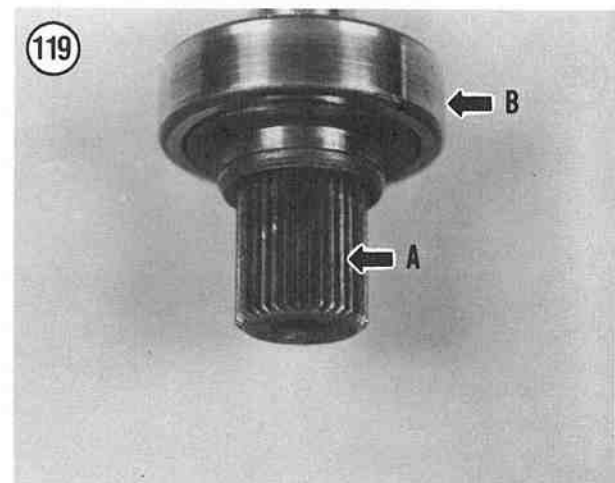




- b. Install the input shaft assembly in the hydraulic press.
  - c. While holding onto the input shaft assembly, slowly press the shaft off of the bearing. Remove the shaft assembly from the hydraulic press.
  - d. Slide the thrust washer off of the shaft.
12. If the bushing requires removal, perform the following:
    - a. Install the insert under the bushing.
    - b. Install the input shaft assembly in the hydraulic press.
    - c. While holding onto the input shaft assembly, slowly press the shaft off of the bushing. Remove the shaft assembly from the hydraulic press.
  13. Inspect all components as described in this chapter.

### Input Shaft Inspection

1. Inspect the ramps (Figure 113) of both the front and rear shock dampers. Check for excessive wear, burrs, pitting or chipped areas. Replace if necessary.
2. Inspect the inner splines (Figure 114) of the rear shock damper for wear or damage. Replace if necessary.
3. Check for chipped or missing teeth on the shock damper front cam (Figure 115). Replace if necessary.
4. Check for chipped or missing teeth on the kickstarter intermediate gear and coupling ratchet surfaces (Figure 116). Replace if necessary.
5. Check for chipped or missing teeth on the kickstarter intermediate gear. Replace if necessary.
6. Inspect the inner splines (Figure 117) of the kickstarter coupling for wear or damage. Replace if necessary.
7. Inspect the kickstarter intermediate spring and thrust washer (Figure 118). If broken or weak, replace the spring. BMW does not provide specifications for the overall length of the spring in the relaxed position. If the thrust washer is damaged in any way, replace it.
8. Inspect the front end splines (A, Figure 119) on the input shaft for wear or damage. If worn or damaged, replace the shaft.
9. Make sure that the shock dampers slide smoothly on the input shaft splines and sliding surfaces.



10. Inspect the shock damper spring (Figure 120). If broken or weak, replace the spring. BMW does not provide specifications for the overall length of the spring in the relaxed position.
11. Rotate the input shaft bearing (B, Figure 119) by hand. Check for roughness, noise and radial play. Any bearing that is suspect should be replaced.

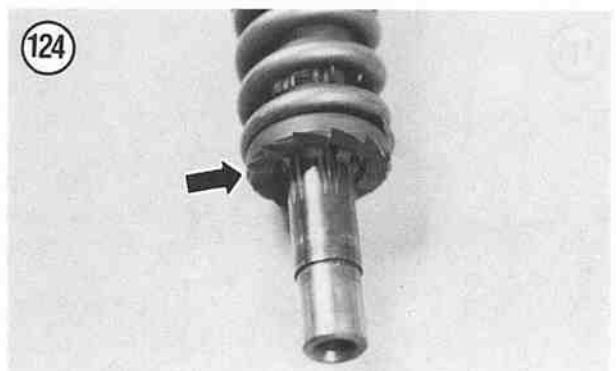
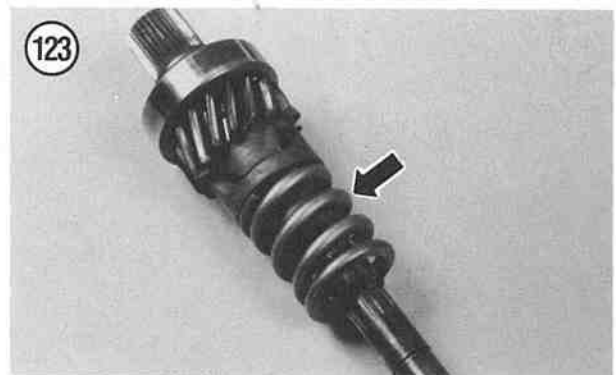
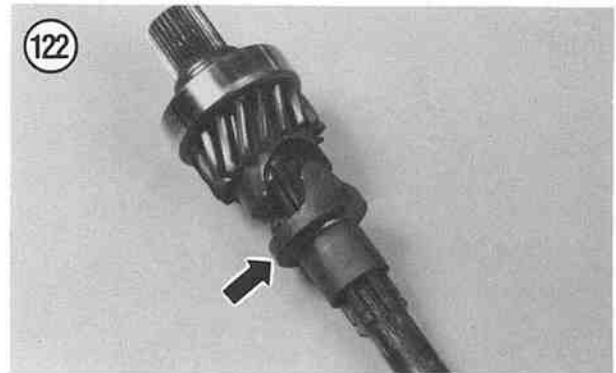
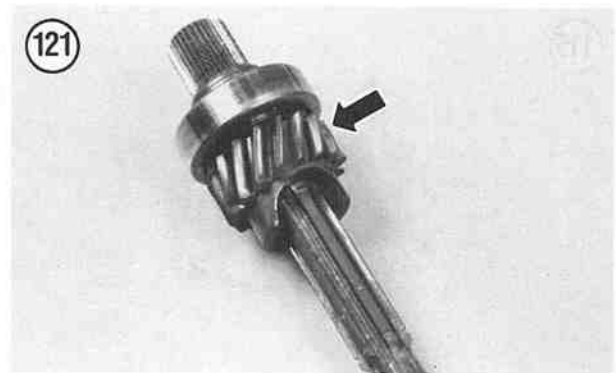
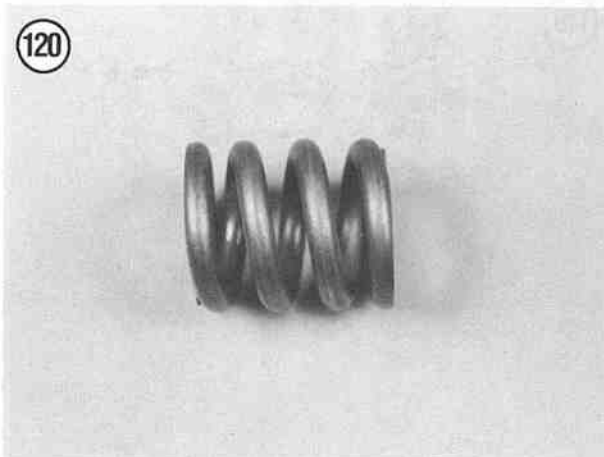
### Input Shaft Assembly

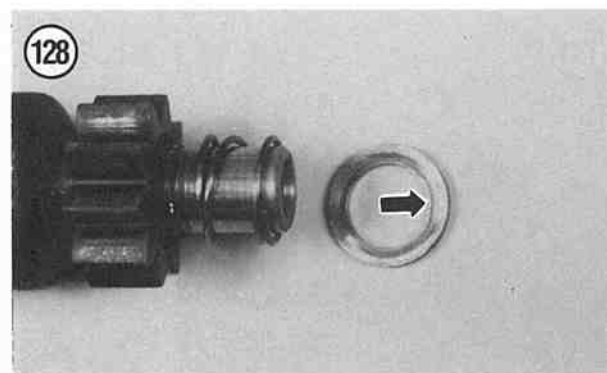
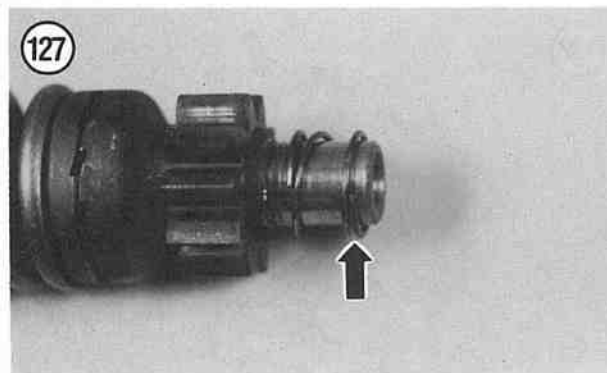
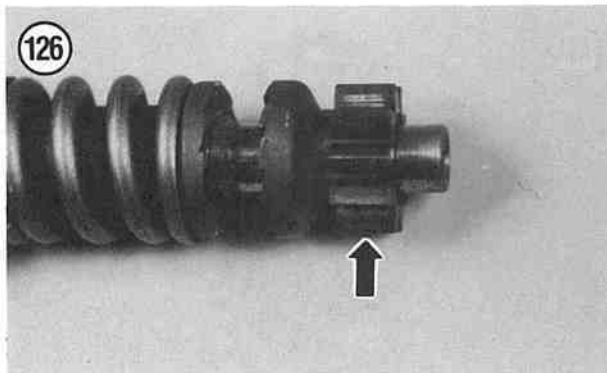
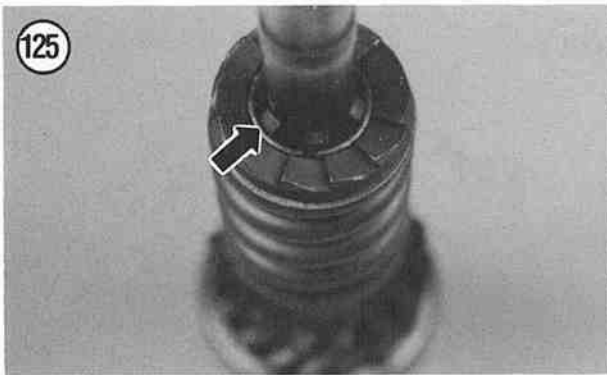
1. Apply a light coat of clean transmission gear oil to all sliding surfaces before installing any parts.
2. If the bushing was removed, perform the following:
  - a. Slide the bushing onto the shaft until it will travel no farther.
  - b. Install the input shaft assembly in the hydraulic press and install the inserts under the bushing.
  - c. While holding onto the input shaft assembly, slowly press the bushing onto the shaft until it bottoms out. Relax the hydraulic pressure and remove the shaft assembly from the hydraulic press.
  - d. Slide on the thrust washer.
3. Slide on the shock damper front cam (Figure 121) and the shock damper rear cam (Figure 122) onto the input shaft.
4. Slide on the spring (Figure 123) and the kickstarter coupling (Figure 124).

#### NOTE

*The snap ring should be replaced every time the transmission is disassembled to ensure proper retention.*

5. Slide the *new* snap ring onto the end of the input shaft.
6. Install the snap ring as follows:
  - a. Install the input shaft assembly (A, Figure 111) in the hydraulic press with the snap ring end facing up.
  - b. Place the special tool (B, Figure 111) fabricated in Step 8 of *Input Shaft Disassembly*, onto the end of the input shaft assembly.



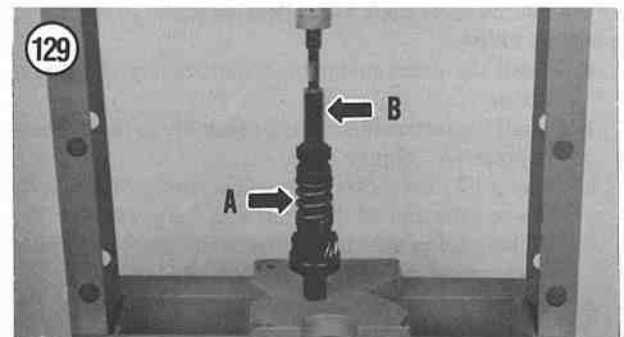


- c. Center the special tool on the ledge of the kickstarter coupling or spring seat.

**WARNING**

*The spring is very strong. Protect yourself accordingly in the event that the input shaft assembly and the special tool should move off of the hydraulic press plate.*

- d. While holding onto the input shaft assembly and the special tool, have an assistant slowly apply pressure.
  - e. Compress the shaft only enough to gain access to the snap ring groove. The snap ring and groove must be visible.
  - f. Have the assistant securely hold onto the input shaft assembly and the special tool. Working through the opening on each side of the special tool, use a screwdriver and work the snap ring into the transmission groove on each side.
  - g. After the snap ring is completely installed into the groove, gradually relax the hydraulic pressure and make sure the snap ring is indexed properly in the groove.
  - h. Completely relax the hydraulic pressure and remove the shaft assembly and special tool from the hydraulic press.
7. Make sure the kickstarter coupling seats correctly on the circlip (Figure 125). It must completely seat and not hang up on it.
  8. Install the kickstarter intermediate gear (Figure 126) and spring (Figure 127).
  9. Position the thrust washer with the inner recess (Figure 128) facing toward the spring.
  10. Install the thrust washer onto the end of the shaft. In order for the thrust washer to be effective, it must be pressed into place and hold the spring in position. If you can slide the thrust washer onto the shaft by hand, it must be replaced.
  11. Position the input shaft (A, Figure 129) on the press plates.
  12. Place a suitable size socket (B, Figure 129) on the thrust washer. The socket must fit onto the thrust washer close to the shaft and must also be large on the inside to clear the input shaft. If the inner surface of the socket touches





the shaft, the shaft will be damaged and the socket may get pressed onto the shaft by mistake.

13. While holding onto the input shaft, slowly press the thrust washer onto the shaft until it bottoms out on the shaft shoulder.

14. Release the hydraulic pressure and remove the socket from the input shaft.

15. Measure the overall length of the assembled shaft (**Figure 130**) after assembly is complete. Compare to the dimension written down in Step 2 of *Input Shaft Disassembly*. The dimension should be the same. If not, determine and correct the problem.

### Intermediate Shaft Inspection and Bearing Replacement

Refer to **Figure 106** for this procedure.

The intermediate shaft is one assembly with no removable parts except for the ball bearing at each end of the shaft. If any portion of the shaft is defective, except for the ball bearings, the entire shaft assembly must be replaced.

#### NOTE

*In the following procedure, the ball bearing at each end of the shaft can be removed either with a gear puller or with a hydraulic press and a special tool insert.*

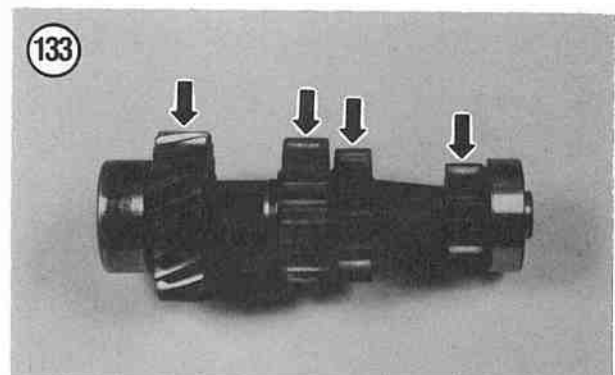
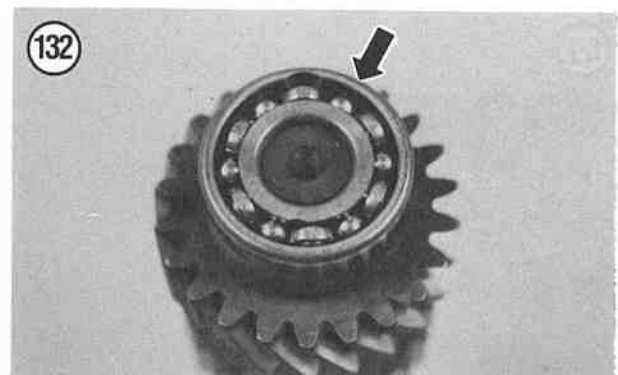
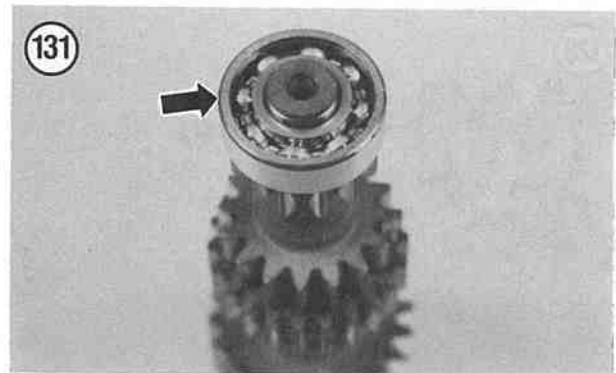
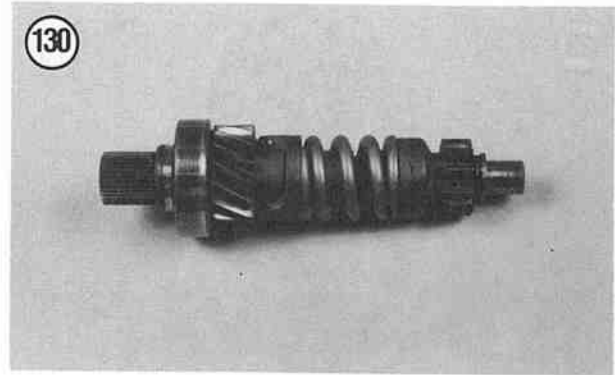
1. If not cleaned in the *Transmission Shaft Preliminary Inspection* sequence, place the shaft assembly into a large can or plastic bucket and thoroughly clean with solvent and a stiff brush. Dry with compressed air or let it sit on rags to dry.

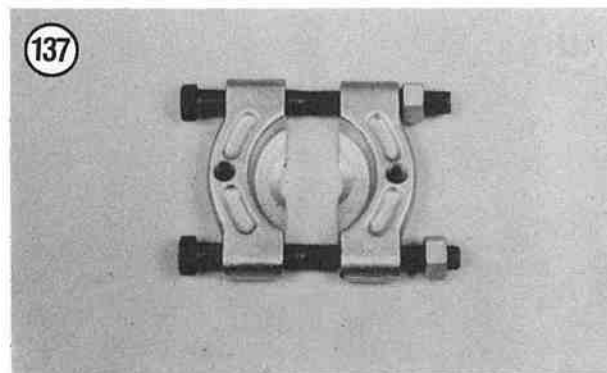
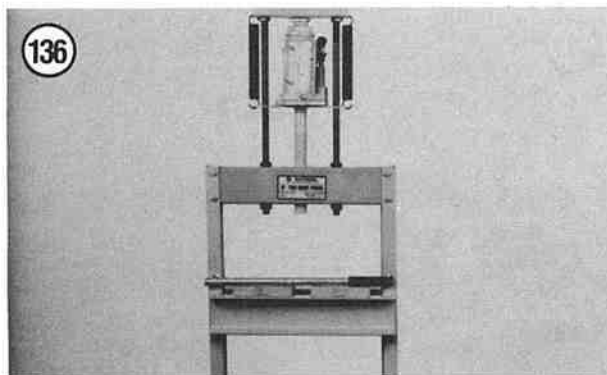
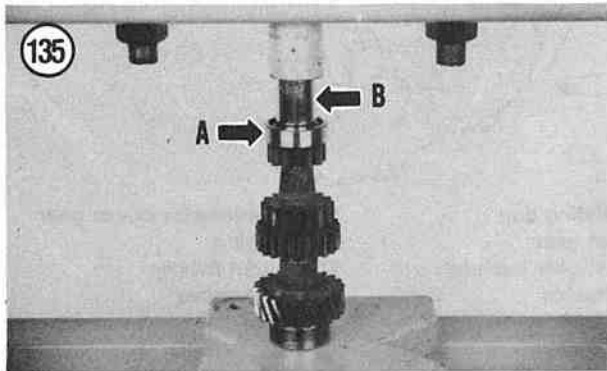
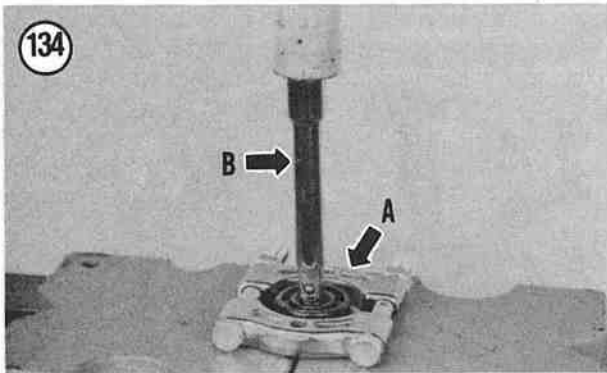
2. Inspect the ball bearing on each end of the shaft. Refer to **Figure 131** and **Figure 132**. Rotate each bearing with your fingers and check for roughness, pitting, galling and play. Make sure it rotates freely. If any roughness or play can be felt, the bearing(s) must be replaced.

3. Check each gear (**Figure 133**) for excessive wear, burrs, pitting or chipped or missing teeth.

4. If damaged, remove the ball bearing(s) from the end(s) of the intermediate shaft with a bearing puller or hydraulic press as follows:

- a. Install the insert under the front bearing and thrust washer.
- b. Install the intermediate shaft assembly in the hydraulic press (A, **Figure 134**).
- c. Place a 1/2 inch socket drive extension (B, **Figure 134**) between the end of the shaft and the press.
- d. While holding onto the intermediate shaft assembly, slowly press the shaft off of the bearing.
- e. Release the hydraulic pressure and remove the intermediate shaft assembly from the hydraulic press.





5. To install the bearing, perform the following:
  - a. Position the bearing (A, **Figure 135**) on the end of the intermediate shaft.

**CAUTION**

*Do not press the bearing into place using the bearing outer race, as the bearing will be damaged.*

- b. Install the intermediate shaft assembly in the hydraulic press.
  - c. Place a suitable size socket (B, **Figure 135**) on the inner race of the bearing.
  - d. While holding onto the intermediate shaft assembly, slowly press the bearing onto the shaft until it bottoms out. Relax the hydraulic pressure and remove the shaft assembly from the hydraulic press.
  - e. Rotate the bearing (**Figure 131**) by hand to make sure it rotates freely and that it was not damaged during installation.
6. Repeat Step 4 and Step 5 for the other bearing if necessary.

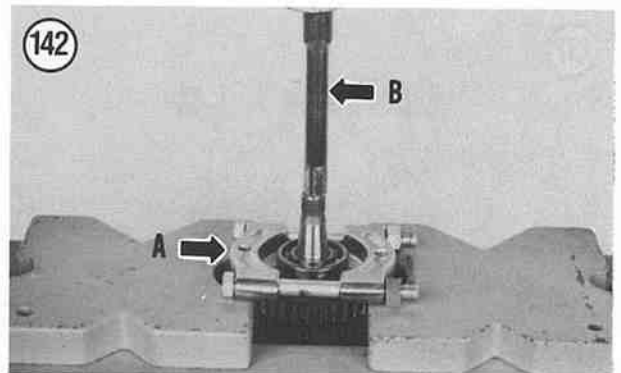
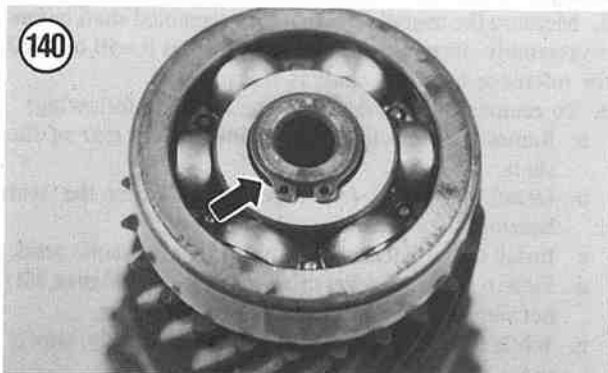
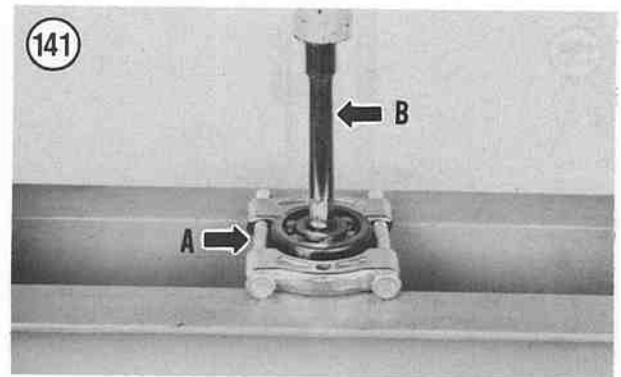
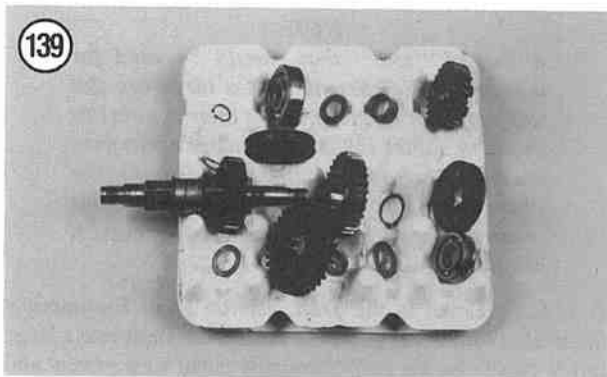
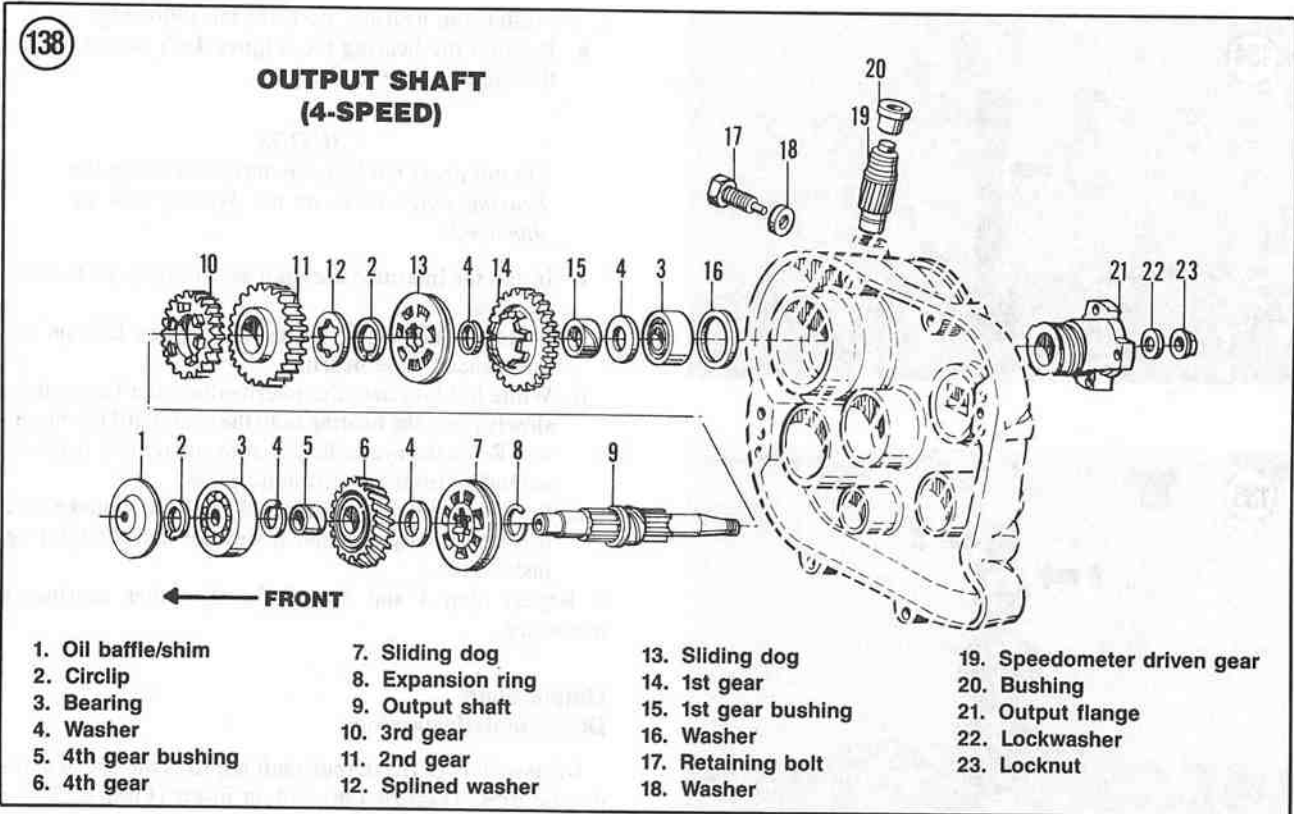
**Output Shaft  
Disassembly/Inspection**

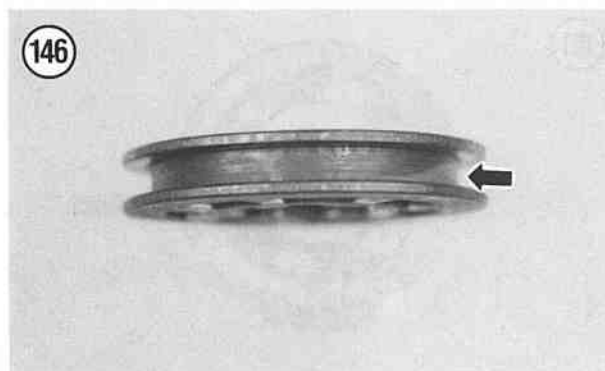
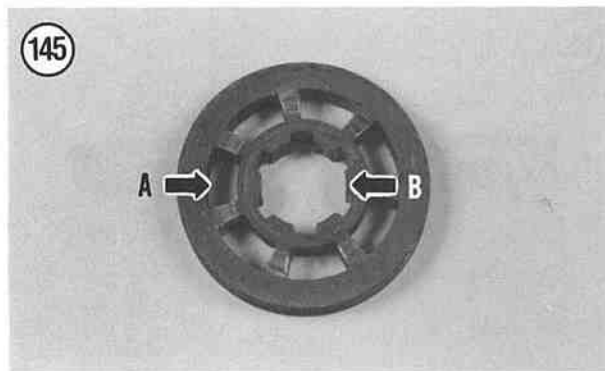
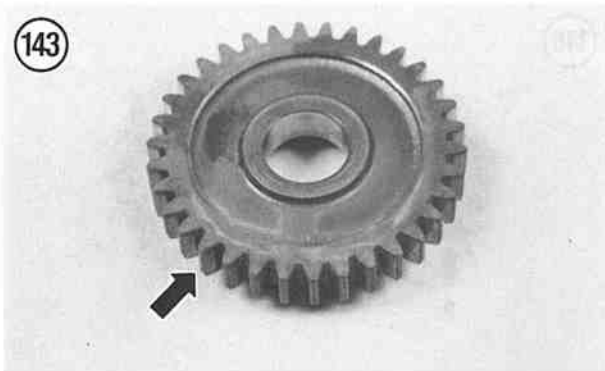
Disassembly of the output shaft requires the use of a hydraulic press (**Figure 136**) and an insert (**Figure 137**). Refer to **Figure 138** for this procedure.

**NOTE**

*A helpful "tool" that should be used for transmission disassembly is a large egg flat (the type that restaurants get their eggs in) as shown in **Figure 139**. As you remove a part from the shaft, set it in one of the depressions in the same position from which it was removed. This is an easy way to remember the correct relationship of all parts.*

1. If not cleaned in the *Transmission Shaft Preliminary Inspection* sequence, place the assembled shaft into a large can or plastic bucket and thoroughly clean with solvent and a stiff brush. Dry with compressed air or let it sit on rags to dry.
2. Measure the overall length of the assembled shaft before disassembly. Write this dimension down as it will be used for reference after the shaft is reassembled.
3. To remove the rear bearing, perform the following:
  - a. Remove the circlip (**Figure 140**) at the rear of the shaft.
  - b. Install the insert (A, **Figure 141**) under the rear bearing.
  - c. Install the output shaft assembly in the hydraulic press.
  - d. Place a 1/2 inch socket drive extension (B, **Figure 141**) between the end of the shaft and the press.
  - e. While holding onto the output shaft assembly, slowly press the rear bearing off of the shaft.





- f. Release the hydraulic pressure.
- g. Remove the shaft assembly from under the hydraulic press plates and hold it in the upright position to avoid losing parts from the shaft assembly.
4. Slide off the thrust washer, 4th gear, 4th gear bushing and thrust washer.
5. Slide off the sliding coupling.
6. If necessary, remove the expansion ring.
7. To remove the front bearing, perform the following:
  - a. Install the insert (A, **Figure 142**) under the rear bearing.
  - b. Install the output shaft assembly in the hydraulic press.
  - c. Place a 1/2 inch socket drive extension (B, **Figure 142**) between the end of the shaft and the press.
  - d. While holding onto the output shaft assembly, slowly press the front bearing off of the shaft.
  - e. Release the hydraulic pressure.
  - f. Remove the shaft assembly from under the hydraulic press plates and hold it in the upright position to avoid losing parts from the shaft assembly.
8. Slide off the thrust washer, 1st gear, 1st gear bushing and thrust washer.
9. Slide off the sliding coupling.
10. Remove the circlip and splined washer.
11. Slide off the 2nd gear.
12. Slide off the 3rd gear.

#### NOTE

*Defective gears should be replaced. It is a good idea to replace the intermediate shaft assembly even though it may not show as much wear or damage. If you feel that the intermediate shaft requires replacement, discuss it with a BMW dealer and get their opinion as this shaft is very expensive.*

13. Check each gear for excessive wear, burrs, pitting or chipped or missing teeth (**Figure 143**).
14. Make sure the lugs (**Figure 144**) on the gears are in good condition. If worn, chipped or rounded off, the gear should be replaced.
15. Inspect the lug receptacles in each sliding coupling (A, **Figure 145**).
16. Check the inner splines in each sliding coupling (B, **Figure 145**) for excessive wear or burrs.
17. Inspect the machined groove (**Figure 146**) for the gear selector fork in each sliding coupling. Check for wear, gouges or other damage. Replace the sliding coupling if necessary.
18. Install the gear selector fork in the machined groove of each sliding coupling (**Figure 147**). Check for excessive clearance between the 2 parts. BMW does not provide specifications for either the inside dimension of the machined groove or the outer dimension of the gear selector

fork tab. If there is excess play between the fork tab and the groove, replace the worn part.

**NOTE**

*BMW provides some clearance specifications for some gears and bushings. Refer to Table I and inspect the clearance on those parts listed.*

19. Check the 1st and 4th gear bushing surfaces (A, **Figure 148**) and the bushings (B, **Figure 148**) for excessive wear, pitting or damage. BMW does not provide specifications for either the inside diameter of the gear or the inside or outside diameter of the bushings. If there is excess play between the bushing and the gear, replace the worn part.

20. Check the 3rd gear bushing surfaces (A, **Figure 149**) on the output shaft for excessive wear, pitting or damage. BMW does not provide specifications for the outside diameter of the bushing. If there is excess play between the bushing and the gear, replace the worn part. The bushing is an integral part of the output shaft and cannot be replaced separately.

21. Make sure the oil holes (B, **Figure 149**) are clean and free of sludge. Clean out with a piece of wire and solvent. Blow out with compressed air.

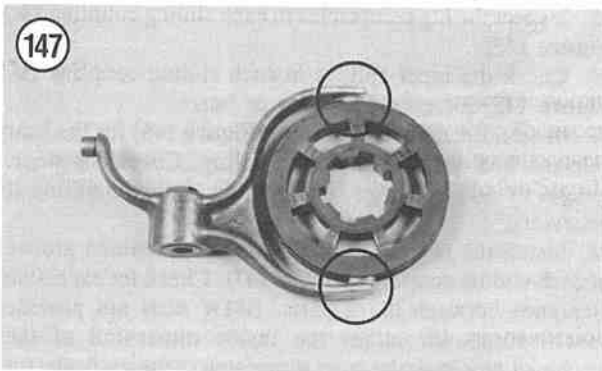
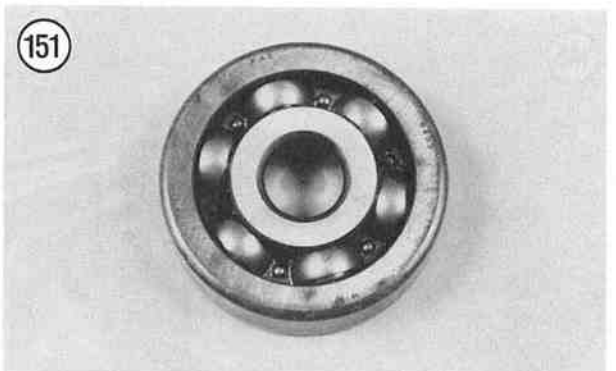
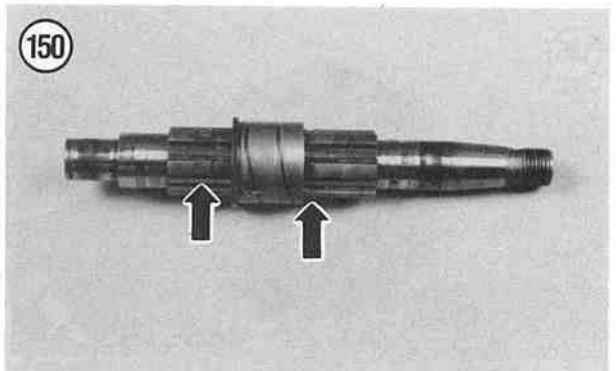
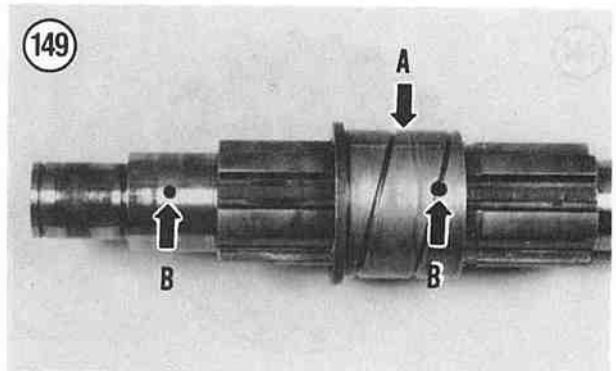
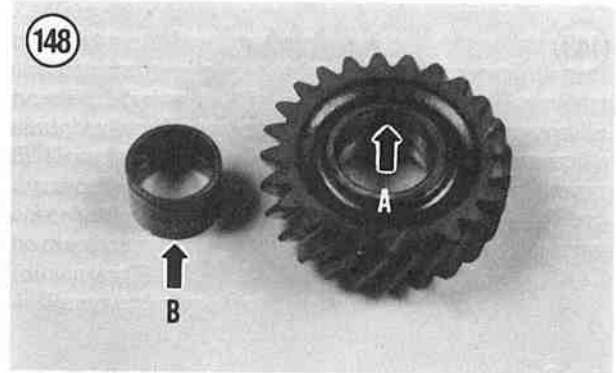
22. Make sure that all gears and bushings slide smoothly on the output shaft.

23. Inspect the splines and circlip grooves (**Figure 150**) on the output shaft. If any are damaged, the shaft must be replaced.

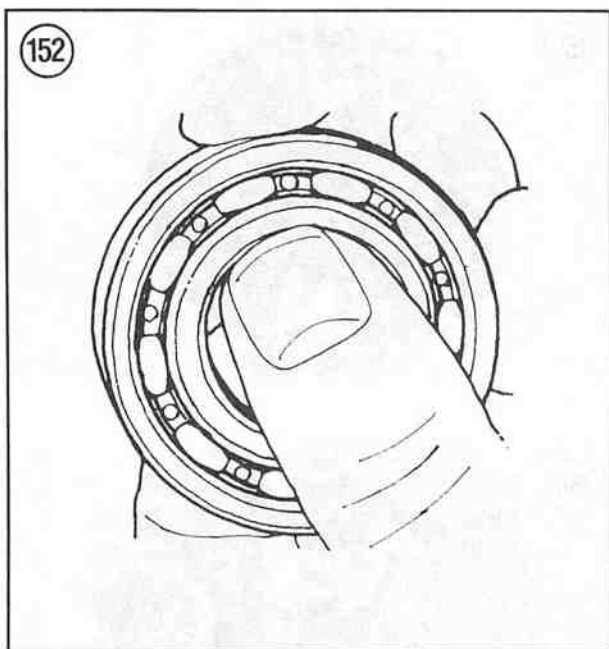
24. Inspect the ball bearings (**Figure 151**). Rotate the bearing with your fingers (**Figure 152**) and check for roughness, pitting, galling and play. Make sure it rotates freely. If any roughness or play can be felt, the bearing(s) must be replaced.

25. Inspect the output shaft flange mounting tags and threaded holes (**Figure 153**) for wear or damage. Replace if necessary.

26. Inspect the speedometer drive gear (**Figure 154**) portion of the output shaft flange for wear or damage. Check for excessive wear, burrs, pitting or chipped or missing teeth. Replace if necessary.





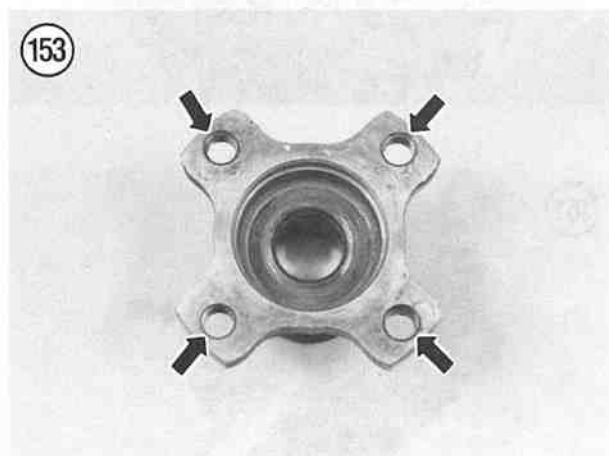


27. Inspect the speedometer driven gear (Figure 155) for wear or damage. Check for excessive wear, burrs, pitting or chipped or missing teeth. Replace if necessary.

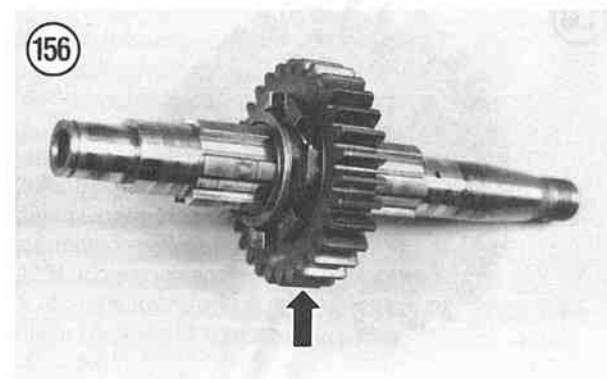
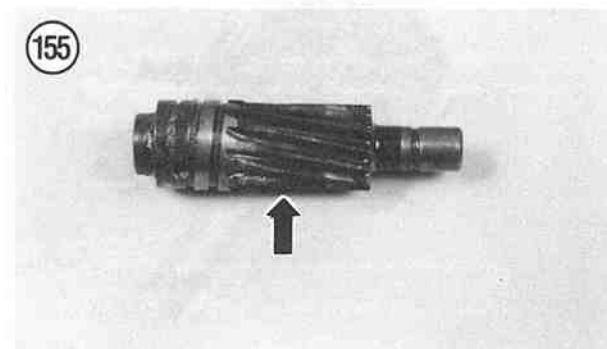
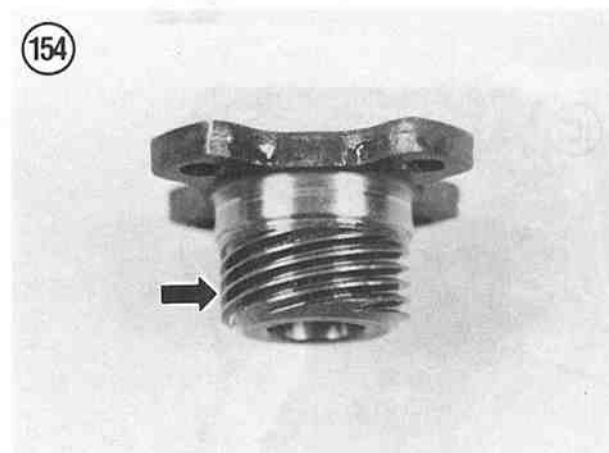
#### Output Shaft Assembly

##### NOTE

All circlips should be replaced every time the transmission is disassembled to ensure proper gear alignment. Transmission circlips become worn with use and increase gear side play. For this reason, it is always better to use new circlips whenever the transmission shaft is being reassembled. When installing circlips, slide them onto the shaft with the rounded side going on first. This will position the sharp side outward to take the gear thrust correctly. Do not expand a circlip more than necessary to slide it over the shaft. If the circlip is expanded too far, it will become distorted and will not grip the shaft sufficiently, resulting in a loose fit.



1. Apply a light coat of clean gear oil to all sliding surfaces of the gears, bushings and shaft before installing any parts.
2. Position the 3rd gear with the engagement coupling side going on first and slide it onto the rear end of the shaft (Figure 156).

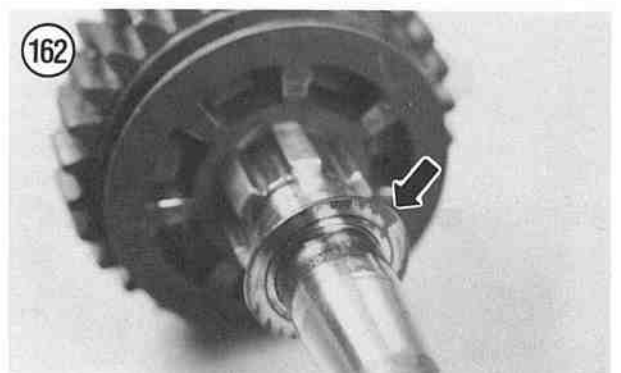
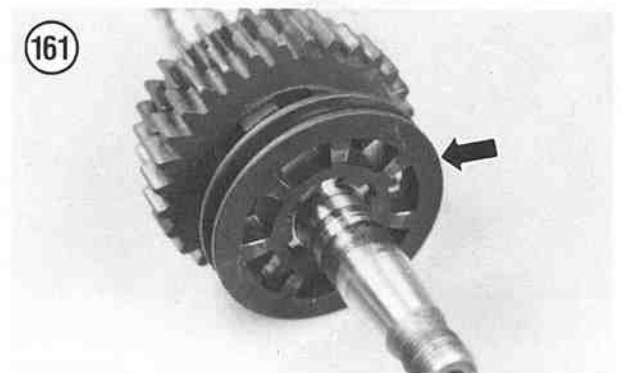
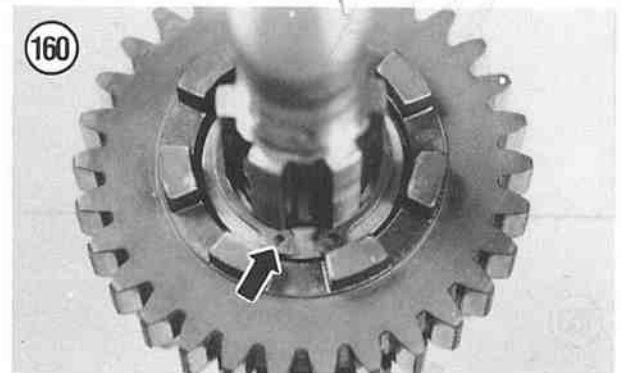
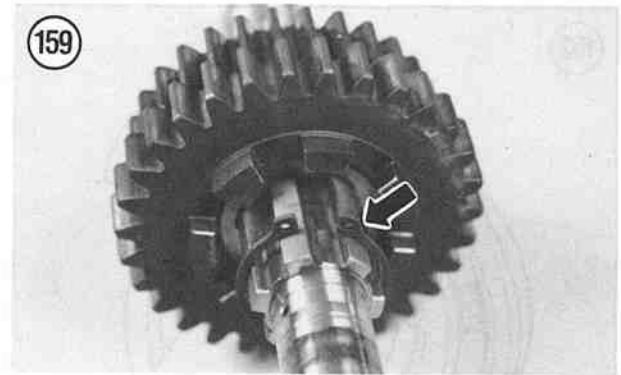
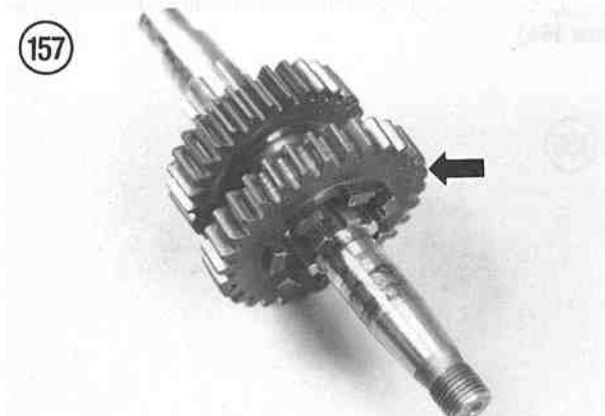


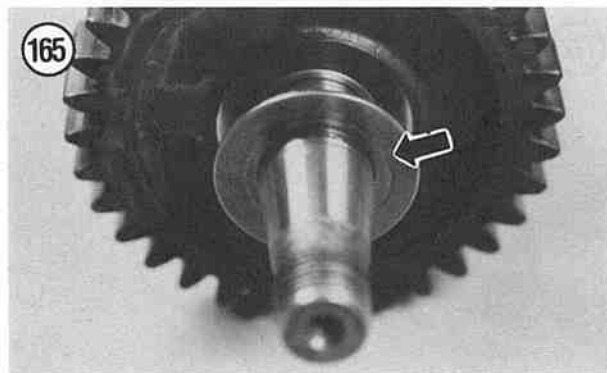
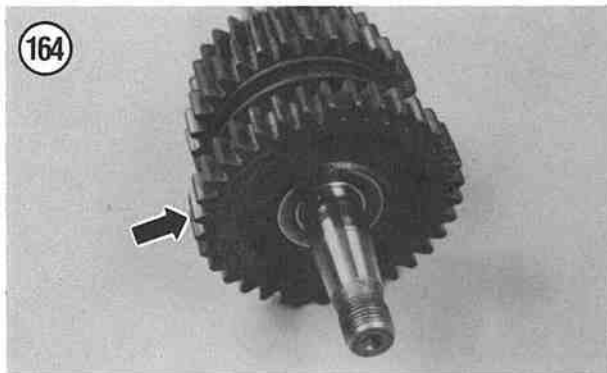
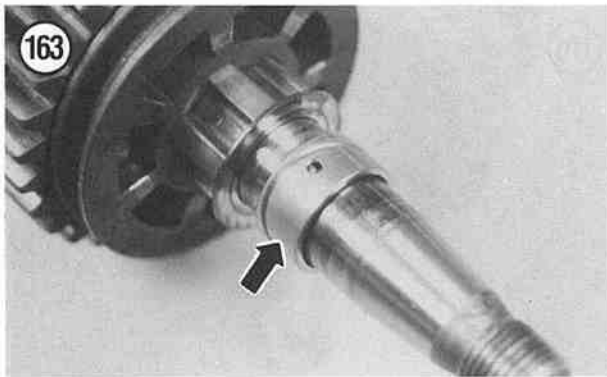
3. Position the 2nd gear with the engagement coupling side going on last and slide it onto the shaft (Figure 157).
4. Slide on the splined washer (Figure 158) and install a new circlip (Figure 159). Make sure it is correctly seated in the shaft groove (Figure 160).
5. Slide on the sliding coupling (Figure 161) and thrust washer (Figure 162).
6. Slide on the 1st gear bushing (Figure 163).
7. Position the 1st gear with the engagement coupling side going on first and slide it onto the shaft (Figure 164).
8. Slide on the thrust washer (Figure 165).

**CAUTION**

*When installing the ball bearing, apply pressure only on the inner race. If pressure is applied to the outer race, the bearing will be damaged.*

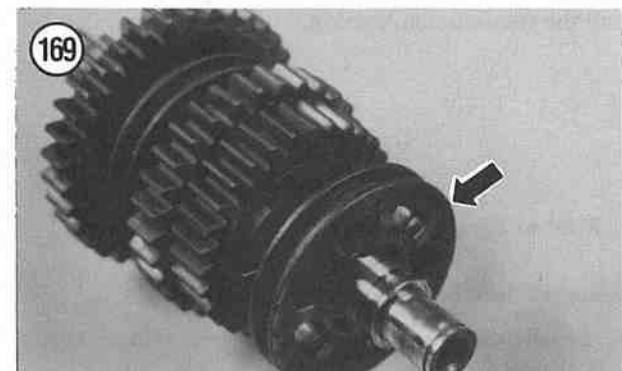
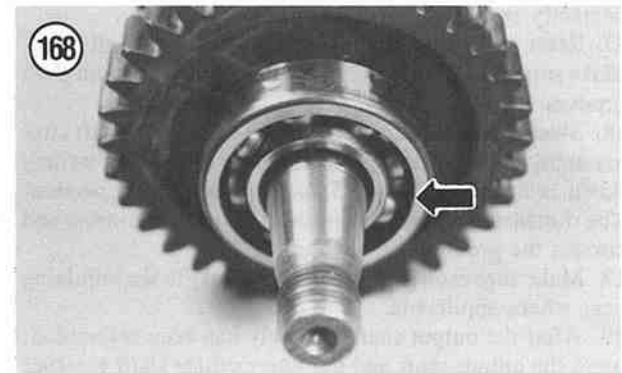
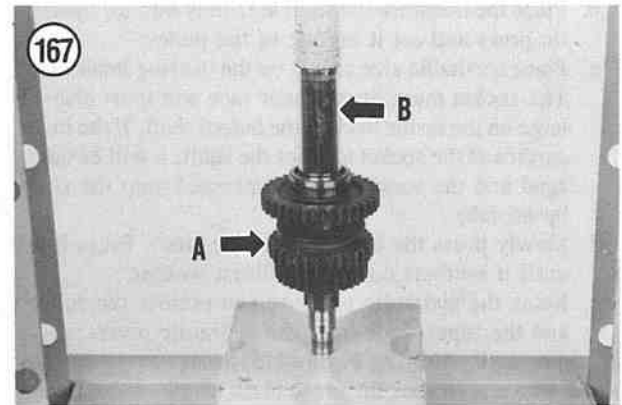
9. To install the front ball bearing (Figure 166), perform the following:
  - a. Place the transmission shaft assembly (A, Figure 167) into the hydraulic press and set it on one of the plates.
  - b. Place a suitable size socket (B, Figure 167) on the bearing inner race. The socket must fit the inner race and must also be large on the inside to clear the output





shaft. If the inner surface of the socket touches the shaft it will be damaged and the socket may get pressed onto the shaft by mistake.

- c. Slowly press the bearing onto the shaft. Press it on until it bottoms out on the thrust washer.
  - d. Relax the hydraulic pressure and remove the socket and the output shaft from the hydraulic press.
10. After the bearing (Figure 168) has been pressed into place, spin it with your fingers to make sure it rotates freely with no binding.
  11. Slide on the sliding coupling (Figure 169) and thrust washer (Figure 170) onto the front end of the shaft.



12. Slide on the 4th gear bushing (Figure 171) and the 4th gear (Figure 172).
13. Slide on the thrust washer (Figure 173).

**CAUTION**

*When installing the ball bearing, apply pressure only on the inner race. If pressure is applied to the outer race, the balls and the inner and outer races will be damaged.*

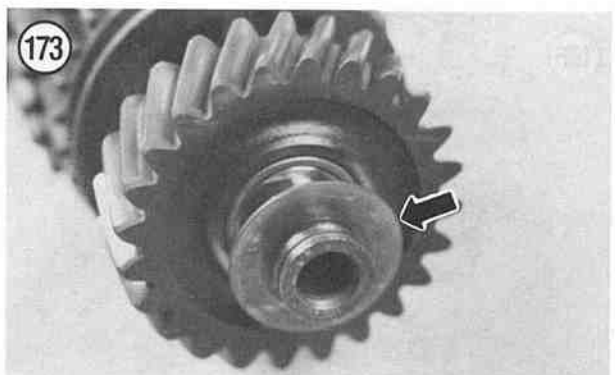
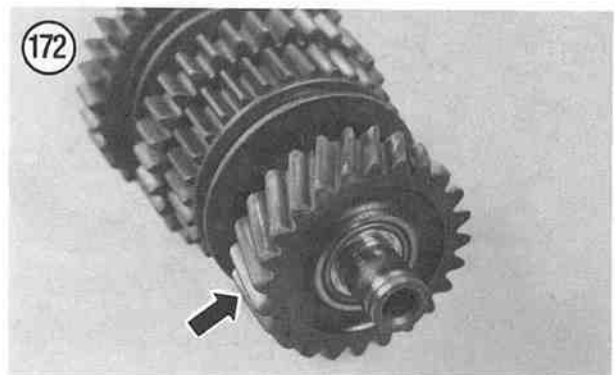
14. To install the front ball bearing, perform the following:
  - a. Place the ball bearing (Figure 174) on the end of the shaft.
  - b. Place the transmission shaft assembly into the hydraulic press and set it on one of the plates.
  - c. Place a suitable size socket on the bearing inner race. The socket must fit the inner race and must also be large on the inside to clear the output shaft. If the inner surface of the socket touches the shaft, it will be damaged and the socket may get pressed onto the shaft by mistake.
  - d. Slowly press the bearing onto the shaft. Press it on until it bottoms out on the thrust washer.
  - e. Relax the hydraulic pressure and remove the socket and the input shaft from the hydraulic press.
15. After the bearing (A, Figure 175) has been pressed into place, spin it with your fingers to make sure it rotates freely with no binding.
16. Install a new circlip (B, Figure 175). Make sure it is correctly seated in the shaft groove.
17. Refer to Figure 176 for correct placement of all gears. Make sure all circlips are seated correctly in the output shaft grooves.
18. Measure the overall length of the assembled shaft after assembly is complete. Compare to the dimension written down in Step 2 of *Output Shaft Disassembly/Inspection*. The dimension should be the same. If not, determine and correct the problem.
19. Make sure each gear engages properly to the adjoining gear where applicable.
20. After the output shaft assembly has been assembled, mesh the output shaft and the intermediate shaft together in their correct position. Check that all gears meet correctly. This is your last check before installing both assemblies into the transmission housing.

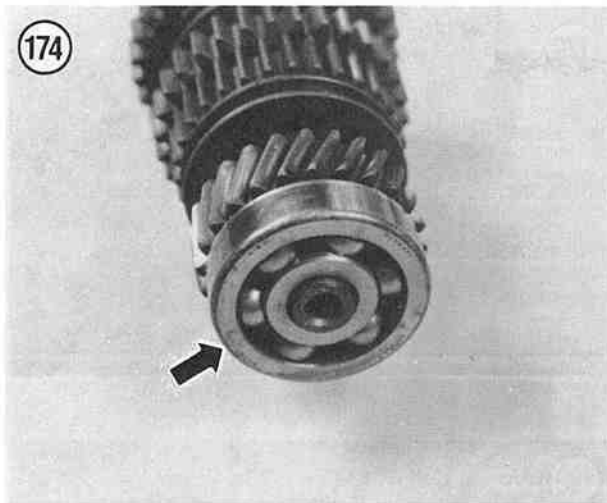
**KICKSTARTER  
(4-SPEED MODELS)**

Refer to Figure 177 for this procedure.

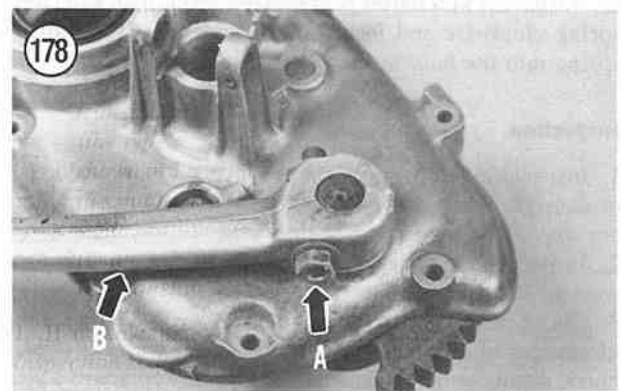
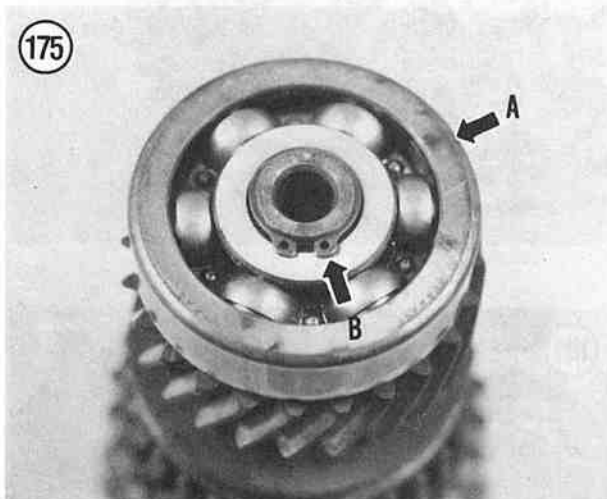
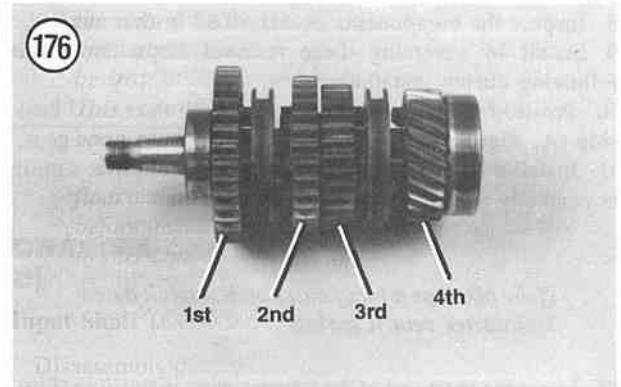
**Removal/Installation**

1. Remove the transmission housing cover as described in this chapter.

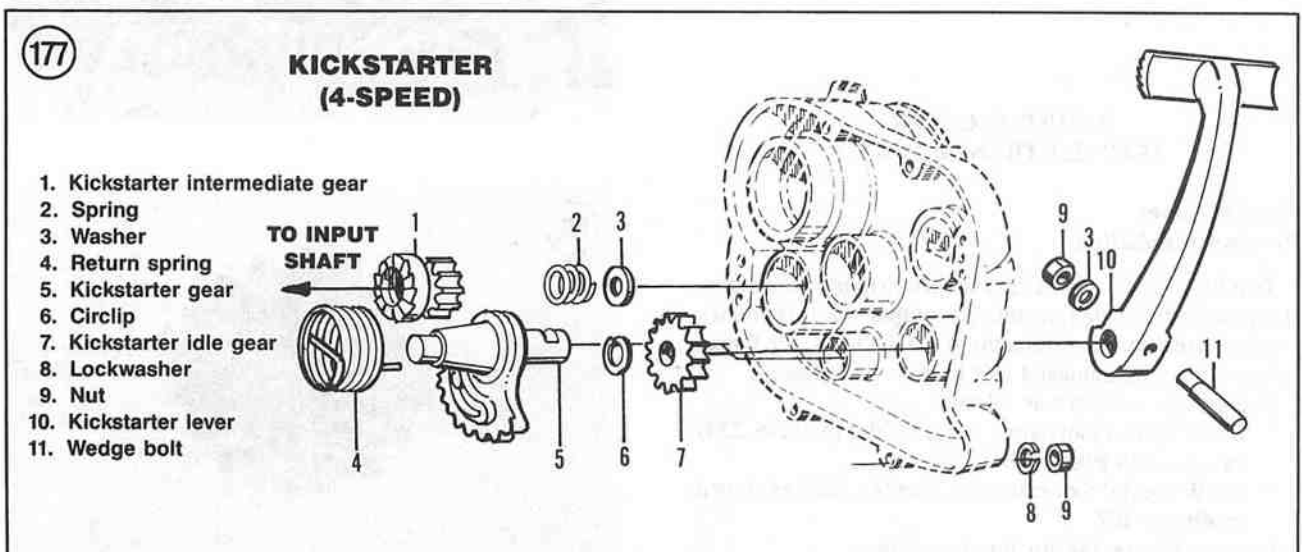




2. Remove the nut and washer (A, Figure 178) securing the kickstarter lever (B, Figure 178).
3. Using a soft-faced mallet, carefully tap out the wedge bolt and remove the wedge bolt.
4. Remove the kickstarter lever from the kickstarter gear shaft.



6





5. Using Vise Grips, disconnect the return spring from the receptacle (Figure 179) in the transmission housing cover.
6. Remove the return spring (A, Figure 180) and the kickstarter gear (B, Figure 180) from the transmission housing cover.
7. Remove the circlip (A, Figure 181) securing the kickstarter idle gear and remove the idle gear (B, Figure 181).
8. Inspect the components as described in this chapter.
9. Install by reversing these removal steps. Note the following during installation.
10. Position the kickstarter idle gear with the raised boss side (A, Figure 182) going on first and install the gear.
11. Install a new circlip (A, Figure 181) and make sure it is correctly seated in the shaft groove.

**NOTE**

*If the bike has a lot of miles on it, install a new kickstarter return spring.*

12. Insert the shaft end of the return spring in the hole (Figure 183) in the kickstarter gear shaft.
13. Install the kickstarter gear into the cover, then wind the spring *clockwise* and install the other end of the return spring into the hole in the cover (Figure 179).

**Inspection**

1. Inspect the return spring (A, Figure 184) for weakness or damage. Replace if necessary. BMW does not provide any specifications for the spring.
2. Inspect the kickstarter gear shaft (B, Figure 184) for wear or damage. Replace if necessary.
3. Check the kickstarter gear (Figure 185) and the kickstarter idle gear (B, Figure 182) for excessive wear, burrs, pitting or chipped or missing teeth. Replace as a set if necessary.

**HOUSING COVER  
(5-SPEED TRANSMISSION)**

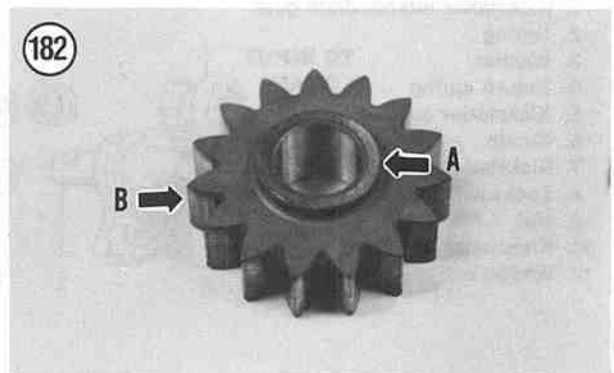
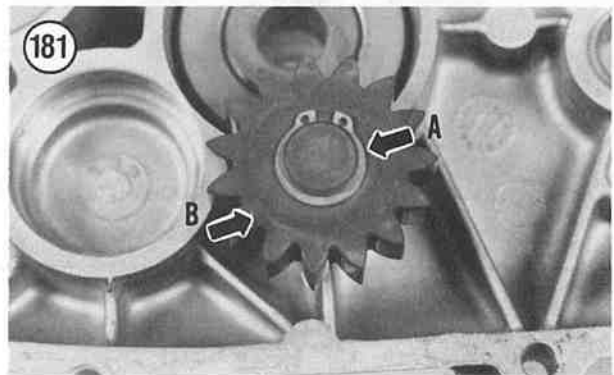
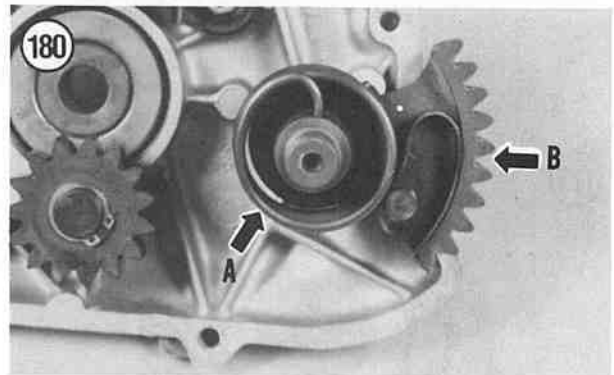
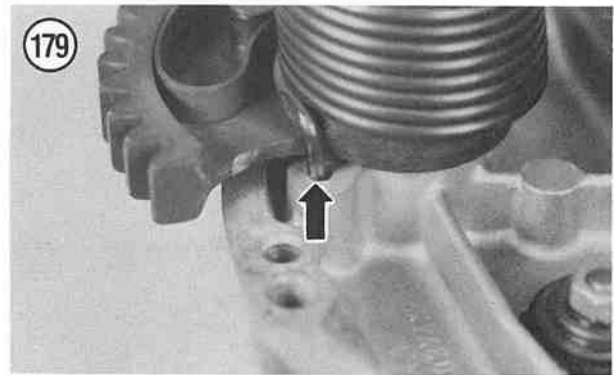
**Housing Cover  
Removal/Installation**

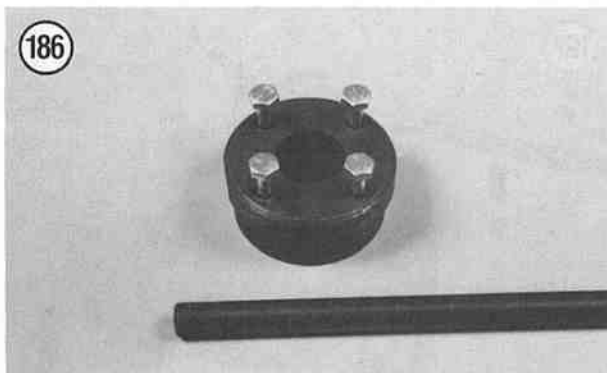
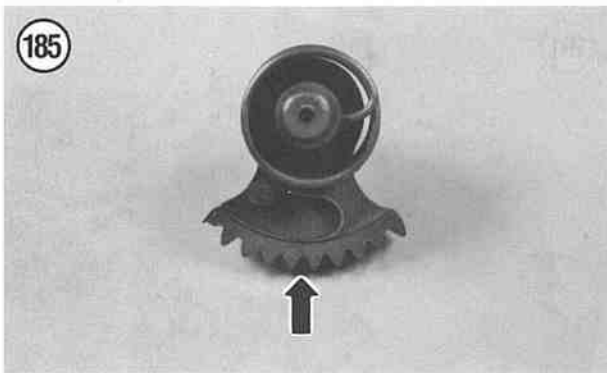
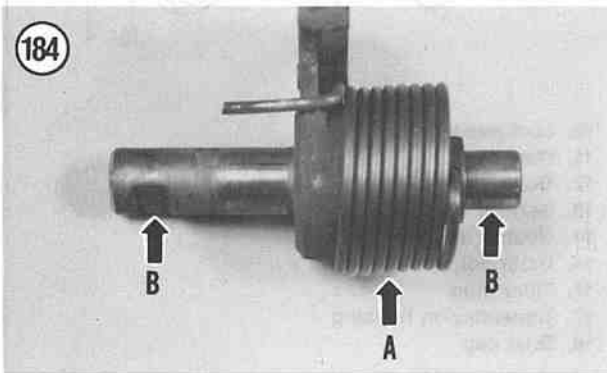
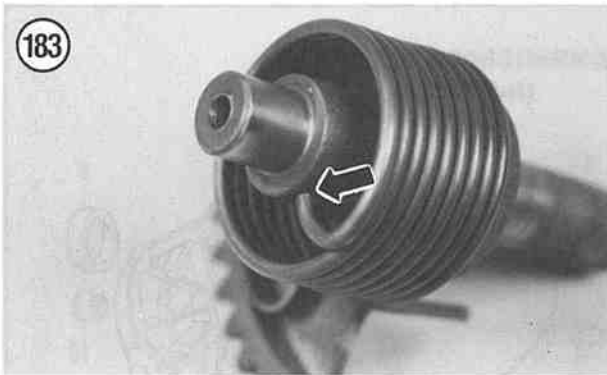
Two BMW special tools are required to remove the output shaft flange from the transmission output shaft. If you try to remove the flange without these special tools, the flange will probably be damaged and have to be replaced.

The special tools are as follows:

- a. BMW special tool output flange holder (part No. 234) as shown in Figure 186.
- b. BMW special tool extractor (part No. 232) as shown in Figure 187.

Refer to Figure 188 for this procedure.





1. If not already performed, drain the transmission oil as follows:

- a. Place a drain pan under the transmission.
  - b. Remove the drain bolt and washer and drain the transmission oil. Allow the oil to drain for at least 15 minutes.
  - c. Install the drain bolt and washer and tighten securely.
2. Remove the clutch release mechanism from the transmission housing cover as described under *Clutch Release Mechanism* in Chapter Five.

**CAUTION**

*Do not set the transmission housing so that the input shaft touches the workbench top. If the shaft touches the workbench top, the shaft components will be damaged.*

**CAUTION**

*Do not clamp the input shaft in a vise in order to secure the transmission housing.*

3. Place the transmission on 2 blocks of wood on the workbench with the housing cover facing up. This will protect the input shaft and keep it from touching the workbench.

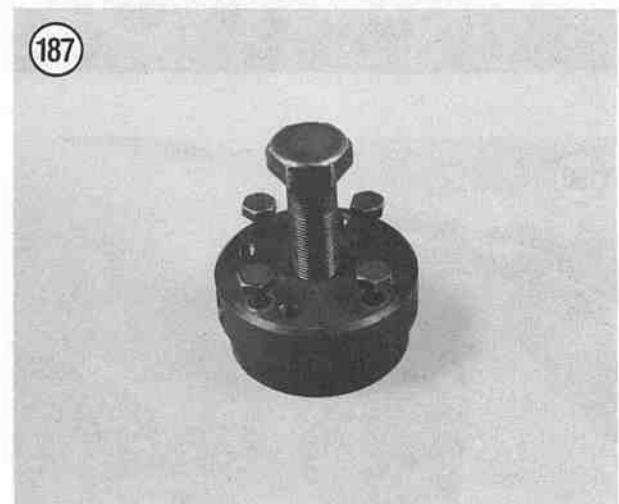
4. Remove the speedometer drive gear retaining bolt and washer.

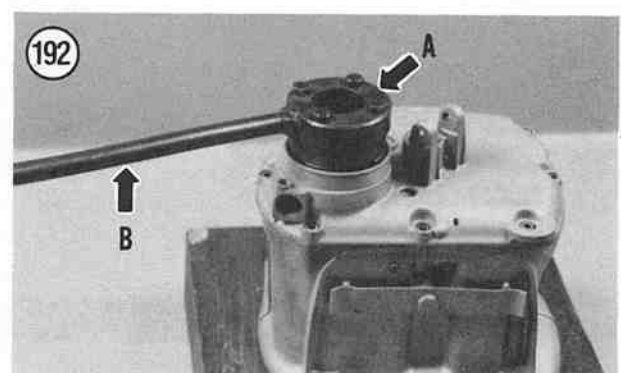
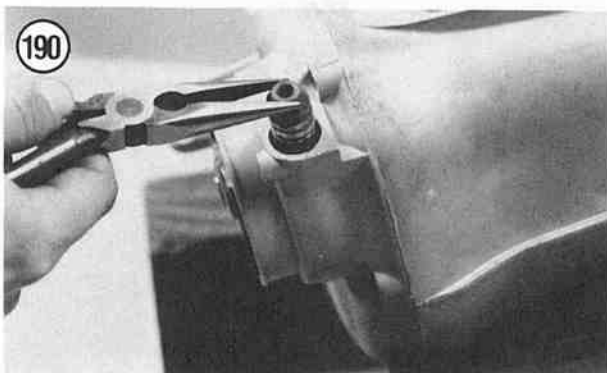
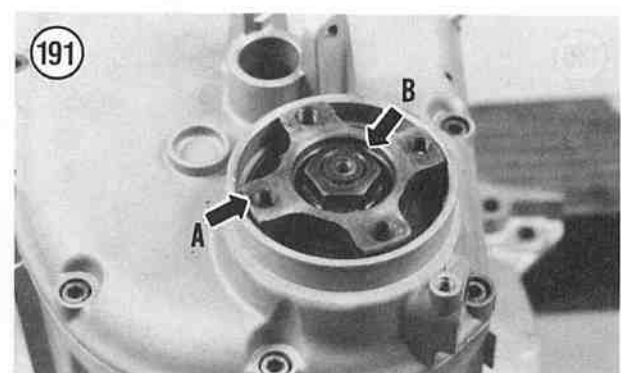
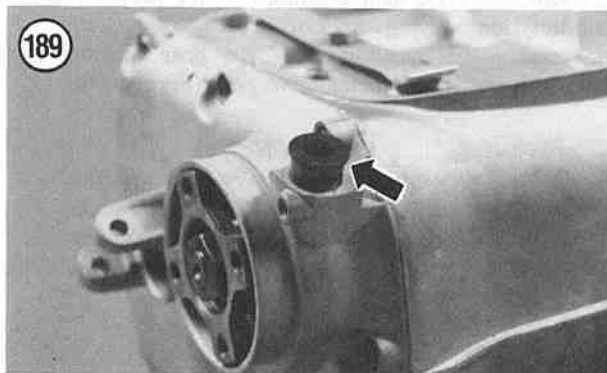
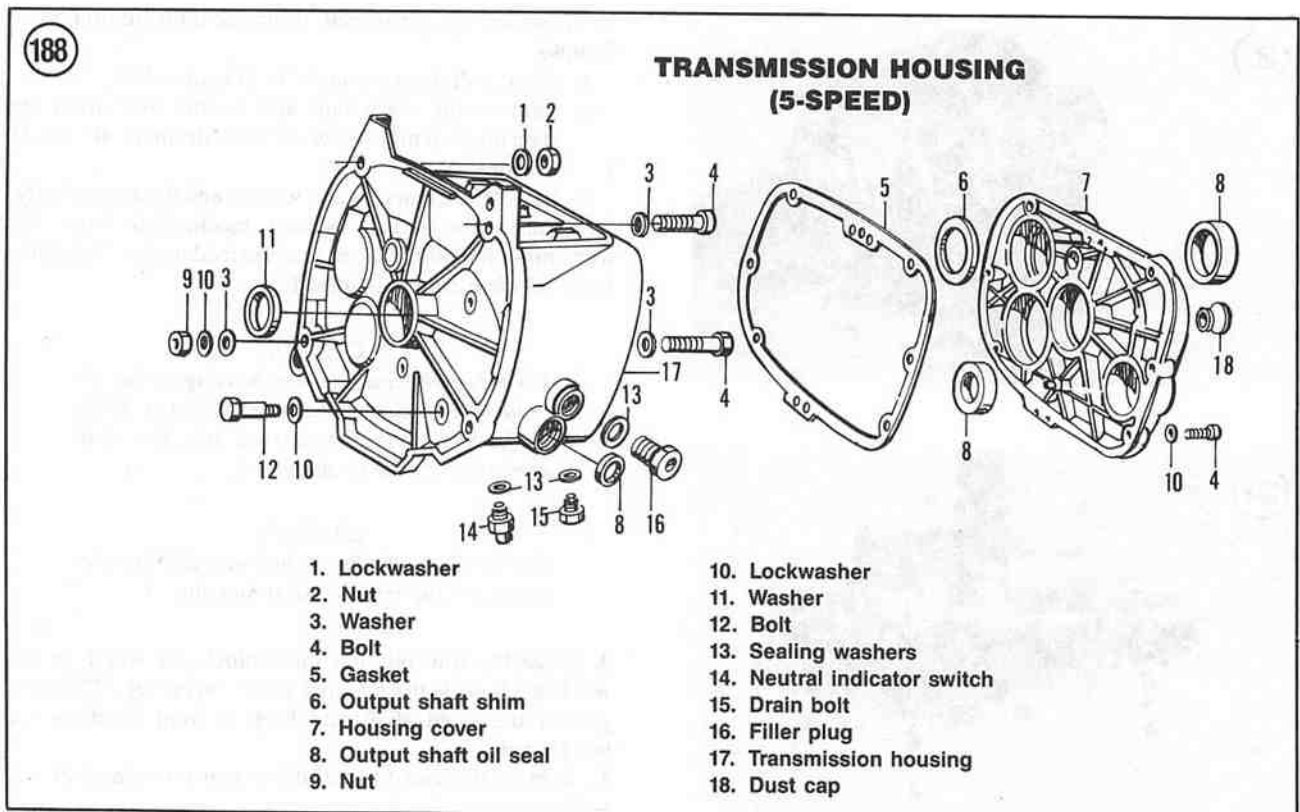
5. Using 2 flat-bladed screwdrivers, carefully pry the speedometer drive gear bushing (Figure 189) out of the transmission housing.

6. Remove the speedometer drive gear bushing and withdraw the speedometer drive gear (Figure 190).

**CAUTION**

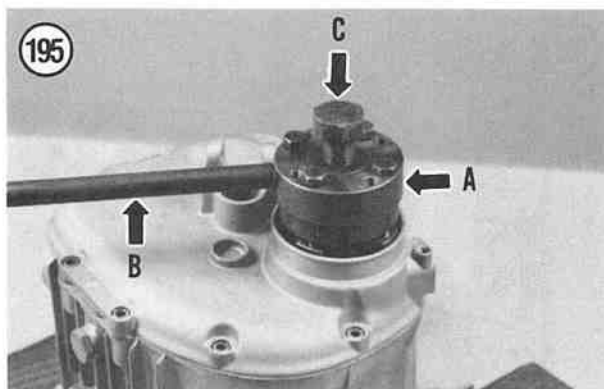
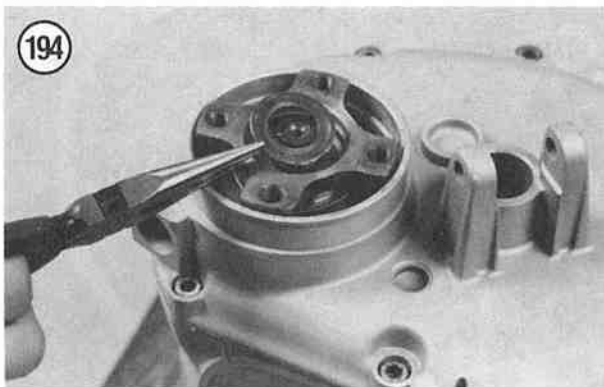
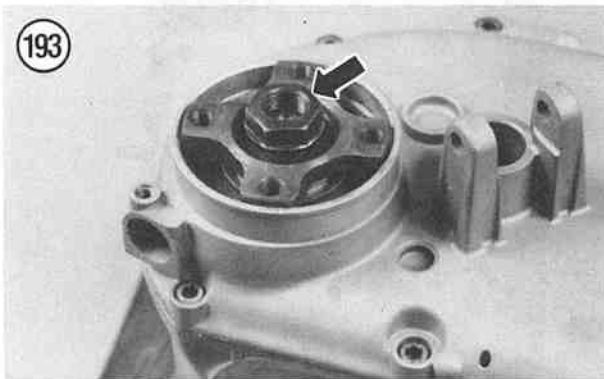
*The following steps are very difficult and require the aid of a helper. The special tools listed are required to avoid damage to the*





output flange which is expensive to replace if damaged. Do not try to remove the output flange without these special tools. The output flange is attached to the output shaft with a locking taper and is not equipped with a Woodruff key. The flange is long and the 24 mm nut is tightened to a high torque. The combination of these two factors securely locks the flange onto the transmission shaft.

7. Install BMW special tool output flange holder (part No. 234) to the output flange (A, **Figure 191**) and secure with



- 4 bolts (A, **Figure 192**). Tighten the 4 bolts in a crisscross pattern in 2-3 stages until they are tight. Make sure the bolts are tight and that the special tool is completely up against the flange holder.

8. Insert the bar into the flange holder (B, **Figure 192**).

**CAUTION**

Do not allow the bar to rest against the clutch release arm pivot posts as they will be damaged.

**CAUTION**

The 24 mm nut (B, **Figure 191**) was tightened to 221 N·m (163 ft.-lb.), and is very difficult to loosen. If you are unable to loosen the nut, take the transmission to a BMW dealer and have it loosened.

9. Have the helper hold onto the holder. Then, using a 24 mm socket, loosen the 24 mm nut securing the flange.  
10. Remove the nut (**Figure 193**) and lockwasher (**Figure 194**).  
11. Remove the special tools used in Steps 7-9.

**NOTE**

If you have the extra time, apply a lot of Liquid Wrench, or equivalent, to the area of the flange where the 24 mm nut was removed. Fill up the flange inner area and let this sit overnight. This will allow some of the penetrating oil to work its way between the output shaft flange and the transmission shaft.

**CAUTION**

Make sure the bolts are tightened securely and that the extractor is snug up against the output flange. If the bolts are not tight, the output flange will be distorted due to the amount of pressure exerted in Step 14.

12. Install the BMW special tool extractor (part No. 232) onto the output flange and secure with 4 bolts. Tighten the 4 bolts in a crisscross pattern in 2-3 stages until they are tight (A, **Figure 195**). Make sure the bolts are tight and that the special tool is completely up against the flange holder.

13. Insert the bar (B, **Figure 195**) into the extractor.

**CAUTION**

Do not allow the bar to rest against the clutch release arm pivot posts as they will be damaged.

14. Have an assistant hold onto the bar.

**NOTE**

Tap on the end of the threaded stud with a hammer while tightening it. This may help break the flange loose.

**CAUTION**

The output shaft flange is very difficult to remove. If you are unable to break it loose, take the transmission to a BMW dealer and have it removed. Do not try other means of loosening the flange as this will lead to expensive damage.

**NOTE**

When the output shaft flange works loose from the transmission shaft it will usually make a loud "crack" or "pop" sound similar to something metallic that has just broken. In this case, it has not broken, but simply broken loose from the locking taper of the transmission output shaft.

15. Tighten the center threaded stud (C, **Figure 195**), in the extractor, slowly until the output shaft flange works loose from the output shaft.
16. Remove the special tools and output shaft flange.
17. Remove the special tool from the flange.
18. Using a crisscross pattern, loosen, then remove the bolts and lockwashers (**Figure 196**) securing the housing cover.
19. Using a soft-faced mallet, carefully tap around the perimeter of the housing cover to loosen it from the housing.

**NOTE**

BMW recommends that the cover be heated to 100° C (212° F) to aid in the removal of the cover. If you are unable to remove the cover in Step 20, heat the cover with rags and hot water. We found that this was not necessary as the cover slipped off easily.

**CAUTION**

Do **not** heat the cover with a torch (propane or acetylene); never bring a flame into contact with the cover. The direct heat will warp the cover.

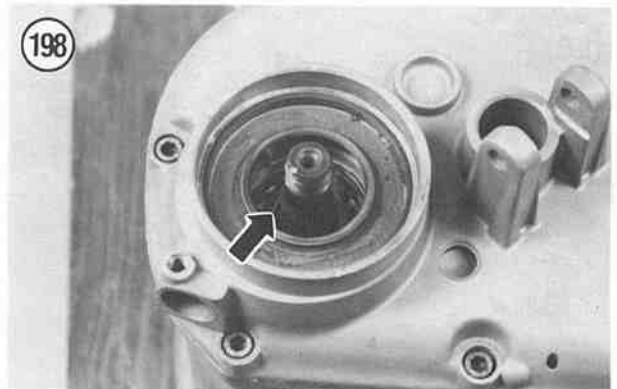
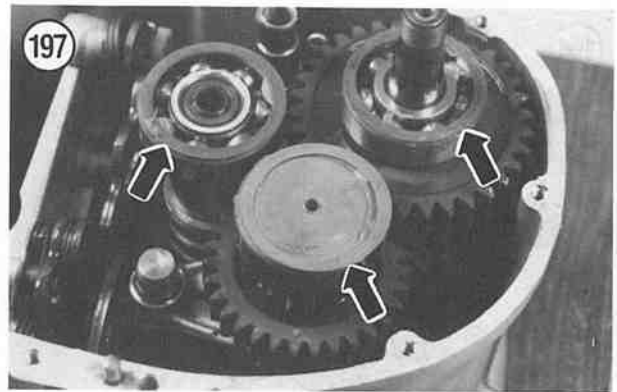
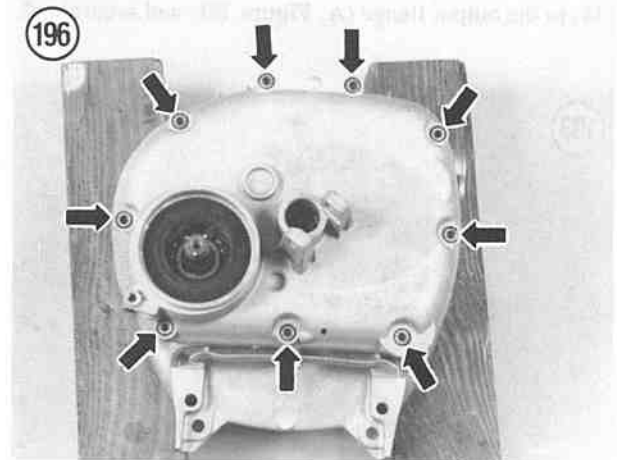
20. If necessary, use a broad-tipped screwdriver and carefully pry the cover loose. It may be necessary to gently tap on the output shaft with a soft-faced mallet to aid in removal.
21. If equipped with a kickstarter, slightly depress the kickstarter pedal while removing the cover.

**NOTE**

Don't lose any of the end float shims that will either stay on the end of the transmission shafts

or in the bearing recesses in the cover. They must be reinstalled on the appropriate transmission shafts during assembly.

22. Slowly remove the cover from the housing. While removing the cover, look inside to see if any of the end float shims are working loose and may fall out of the cover. If they are coming off, immediately place them on the end of the correct transmission shaft assembly.



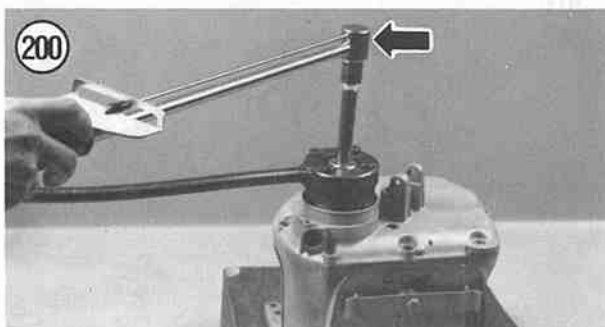
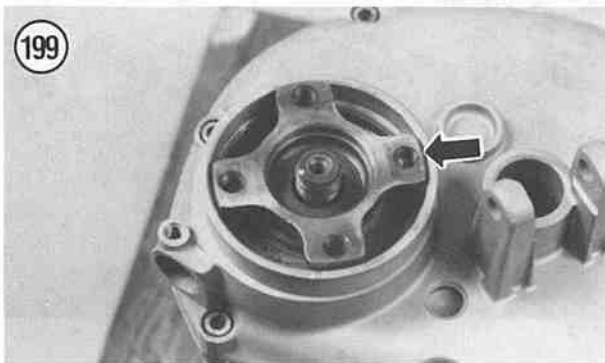


23. Remove the cover and gasket.
24. Thoroughly clean and inspect the cover as described in this chapter.
25. Clean off all old gasket material from the mating surface of the cover and the transmission housing with solvent. Thoroughly dry with compressed air.
26. After the surfaces have been cleaned, clean once again with aerosol electrical contact cleaner and a lint free cloth to remove any traces of solvent.
27. Install a new gasket to the transmission housing.
28. Apply a light coat of grease to the end float shims and place them on their respective transmission shafts (**Figure 197**). They must be reinstalled on the same transmission shafts.
29. Apply a light coat of transmission gear oil or engine oil to the outer surfaces of the transmission shaft ball bearings where they ride in the transmission cover. This will make cover installation easier.

**NOTE**

*BMW recommends that the cover be heated to 100° C (212° F) to aid in the installation of the cover. If you are unable to install the cover in Step 29, heat the cover with rags and hot water. We found that this was not necessary as the cover slipped on easily.*

30. Position the cover onto the transmission housing and start it down into place. If necessary, move the ends of the transmission shaft assemblies so that the bearings are aligned with their respective receptacles in the cover.



31. If equipped with a kickstarter, slightly move the kickstarter up and down while installing the cover.
32. Push the cover down until the bearings have started to enter the cover. After you are sure the bearings are properly started, *carefully* tap the cover into place with a soft-faced mallet. Tap on the cover directly over the bearing locations and around the perimeter until the cover is completely seated against the transmission housing.

**CAUTION**

*The cover should fit down completely on the transmission housing. If the cover does not fit completely, do not try to pull the cover down with the cover bolts. Remove the cover, investigate and correct the interference.*

33. Install the lockwashers and bolts (**Figure 196**). Tighten them in a crisscross pattern and to the torque specification listed in **Table 2**.
34. To install the output shaft flange, perform the following:
  - a. Thoroughly clean off all oil residue from the outer taper on the output shaft (**Figure 198**) and inner taper on the flange. Use an aerosol electrical contact cleaner and wipe clean with a lint free cloth.
  - b. Install the output shaft flange (**Figure 199**) onto the transmission output shaft.
  - c. Carefully tap the flange down until it is completely seated on the transmission shaft.
  - d. Apply engine oil to the nut threads on the output shaft.
  - e. Install the lockwasher (**Figure 194**) and the 24 mm nut (**Figure 193**).

**CAUTION**

*Do not allow the bar to rest against the clutch release arm pivot posts as they will be damaged.*

- f. Use the same tool setup used during removal and hold the flange while tightening the nut.
- g. Use a 24 mm socket and torque wrench (**Figure 200**) and tighten the 24 mm nut to the torque specification listed in **Table 2**.
- h. Remove the special tool.
35. Install the speedometer drive gear (**Figure 190**).
36. Position the speedometer drive gear bushing in the receptacle in the transmission housing. Carefully tap the bushing (**Figure 189**) into place with a soft-faced mallet.
37. Install the speedometer drive gear retaining bolt and washer. Tighten the bolt only finger-tight as it will have to be removed for speedometer drive cable installation.

### Cover Inspection and Output Shaft Seal Replacement

1. Thoroughly clean the cover in solvent and dry with compressed air.

2. Inspect the cover for any cracks or damage. Check around the ribs and the transmission sealing surface. If damaged, replace the cover.
3. Inspect the clutch release lever pivot posts (**Figure 201**) for damage or cracks. If damaged, replace the cover.
4. Inspect the output shaft oil seal (**Figure 202**) in the cover. If it is worn or if the sealing lips are damaged in any way, replace the seal as follows:
  - a. On models so equipped, remove the kickstarter assembly as described in this chapter.
  - b. Use a suitable size socket and hammer, drive out the old seal from the *inside* surface of the cover.
  - c. Thoroughly clean out the seal receptacle (**Figure 203**) in the cover with solvent and dry with compressed air.
  - d. Apply a light coat of multipurpose grease to the outer surface of the new seal and the seal receptacle in the cover.
  - e. Position the new seal with the open side facing *out* toward the output shaft flange.

#### NOTE

*In the following step, BMW special tools can be used to install the oil seal but a carefully used socket will perform the same job for a lot less money. If you choose to use the special tools, use BMW impact tool (part No. 23 1 750) for oil seal installation.*

- f. Use a hammer and a suitable size socket that matches the outer diameter of the seal, carefully tap the new seal into the cover from the *outside* surface of the cover. Tap the seal in squarely and evenly until it bottoms out in the cover.
- g. Apply a light coat of multipurpose grease to the sealing lips of the new seal.

### GEARSHIFT MECHANISM (5-SPEED MODELS)

#### Removal

Refer to **Figure 204** for this procedure.

1. Remove the transmission housing from the engine as described in this chapter.
2. Remove the transmission housing cover as described in this chapter.
3. Remove the clutch release mechanism as described under *Clutch Release Mechanism* in Chapter Five.

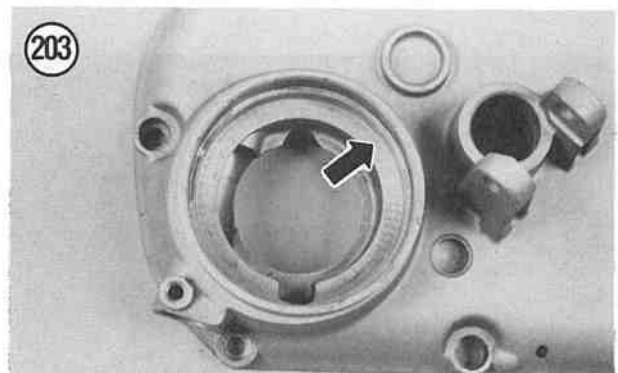
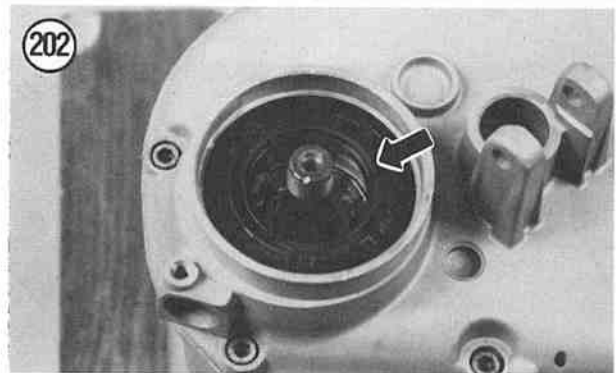
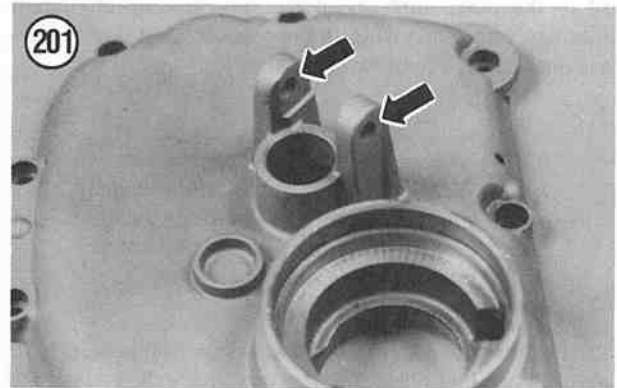
#### NOTE

*Refer to **Figure 205** and **Figure 206** for the gearshift linkage assembly on models equipped with a gearshift linkage other than the standard lever.*

#### CAUTION

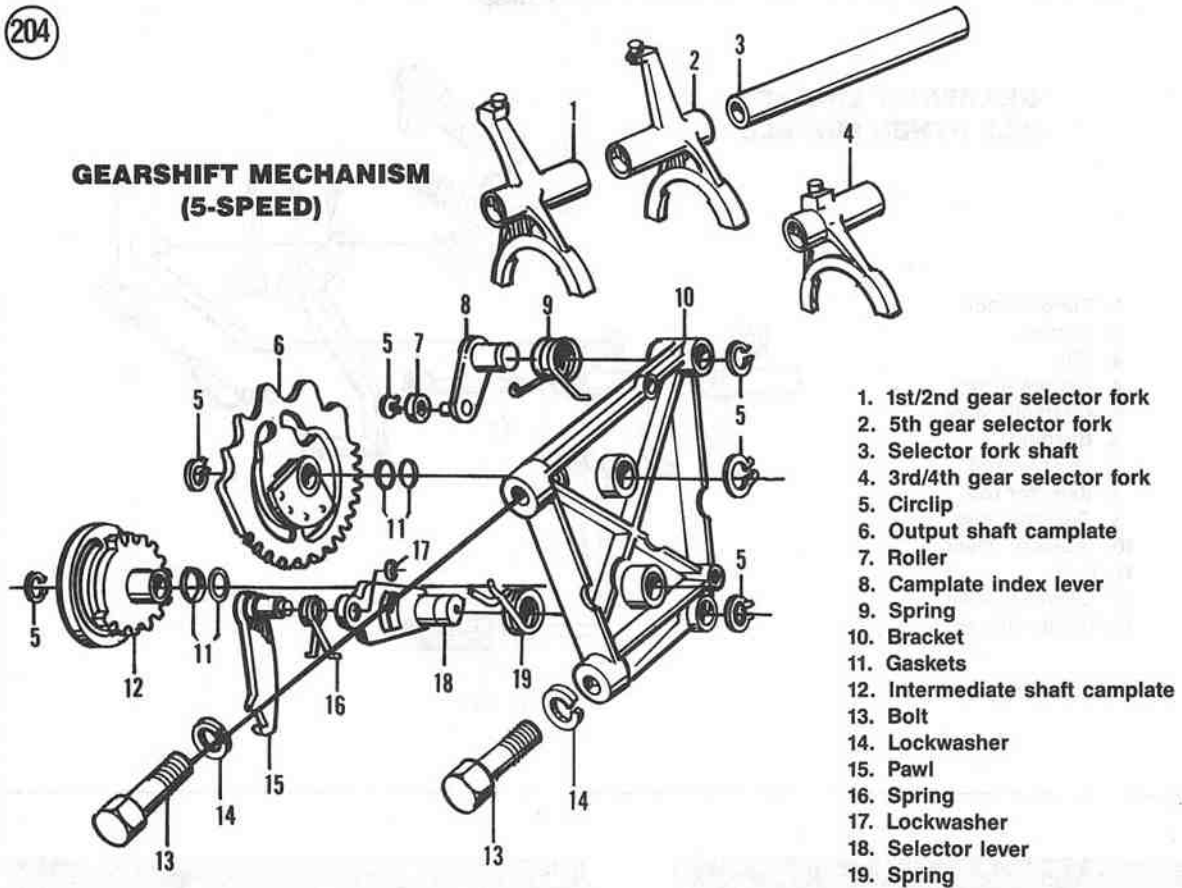
*In Step 4, if the selector lever does not come out of the housing easily, stop. There may be a burr on the inner end of the selector shaft and if it is withdrawn, the housing bushing will be damaged. Remove any burrs from the selector shaft with a fine-cut file prior to removal.*

- 4A. On early models, if not already removed, remove the bolt (A, **Figure 207**) securing the gearshift lever/selector lever and remove the lever assembly (B, **Figure 207**) from the housing. See previous CAUTION.



204

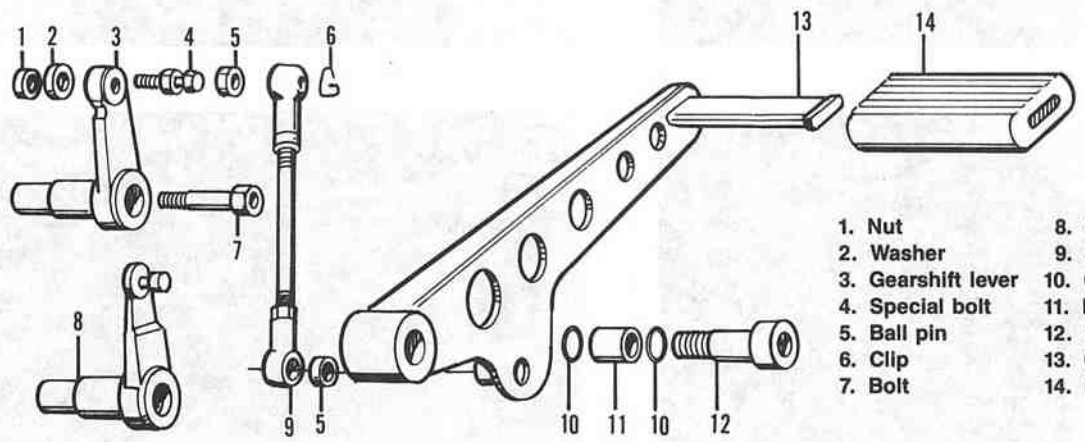
**GEARSHIFT MECHANISM  
(5-SPEED)**



- 1. 1st/2nd gear selector fork
- 2. 5th gear selector fork
- 3. Selector fork shaft
- 4. 3rd/4th gear selector fork
- 5. Circlip
- 6. Output shaft camplate
- 7. Roller
- 8. Camplate index lever
- 9. Spring
- 10. Bracket
- 11. Gaskets
- 12. Intermediate shaft camplate
- 13. Bolt
- 14. Lockwasher
- 15. Pawl
- 16. Spring
- 17. Lockwasher
- 18. Selector lever
- 19. Spring

205

**GEARSHIFT LINKAGE  
(R100GS)**

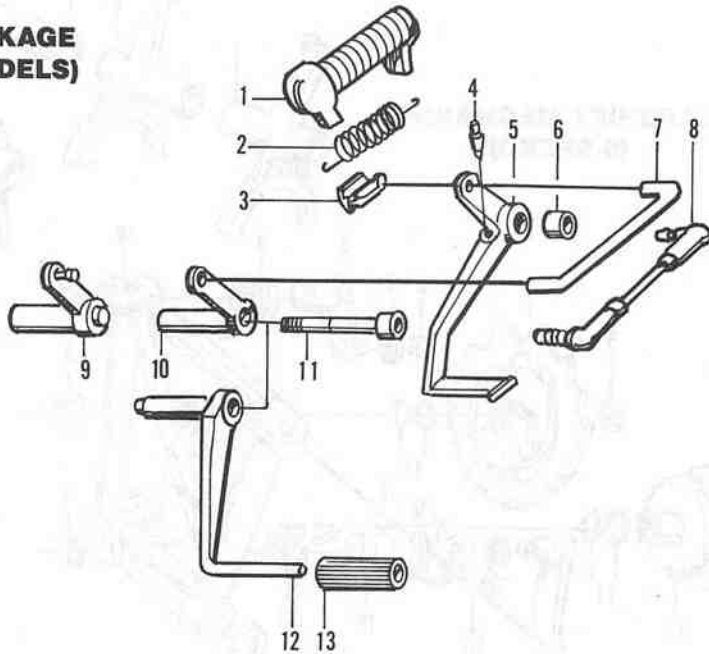


- 1. Nut
- 2. Washer
- 3. Gearshift lever
- 4. Special bolt
- 5. Ball pin
- 6. Clip
- 7. Bolt
- 8. Gearshift lever
- 9. Selector rod
- 10. O-ring
- 11. Bushing
- 12. Bolt
- 13. Gearshift lever
- 14. Rubber cover

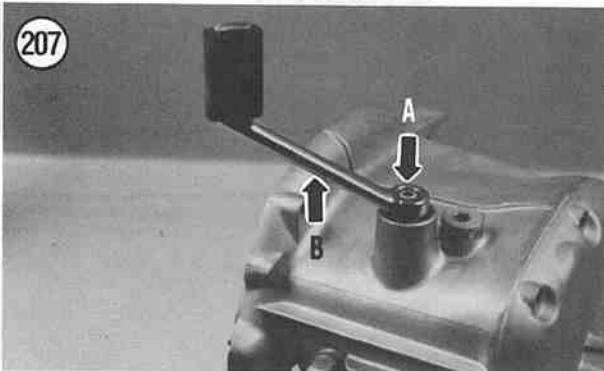
206

### GEARSHIFT LINKAGE (ALL OTHER MODELS)

1. Rubber boot
2. Spring
3. Clip
4. Grease fitting
5. Gearshift lever
6. Bushing
7. Selector rod
8. Selector rod
9. Gearshift lever
10. Gearshift lever
11. Bolt
12. Gearshift lever
13. Rubber cover



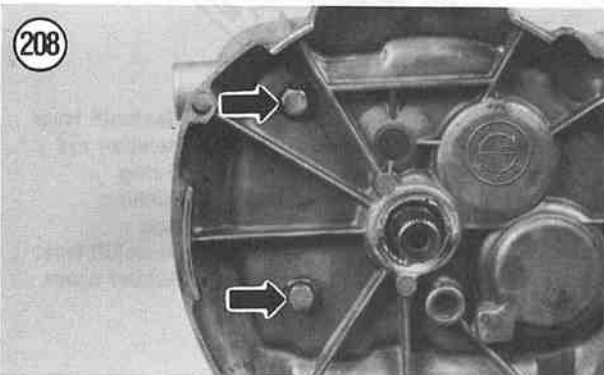
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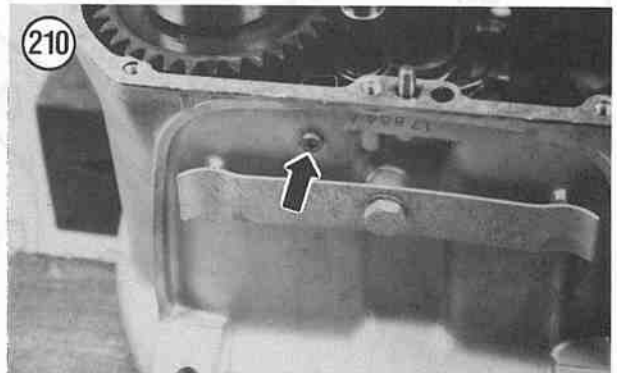
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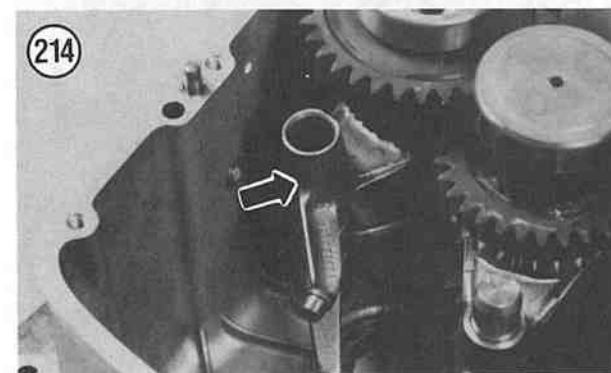
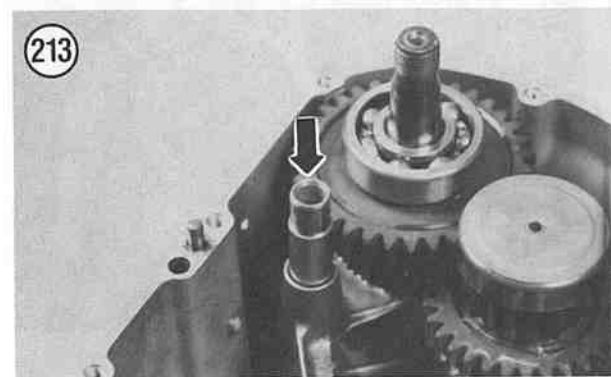
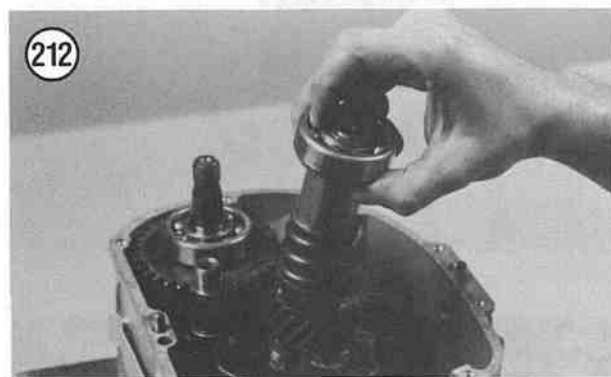
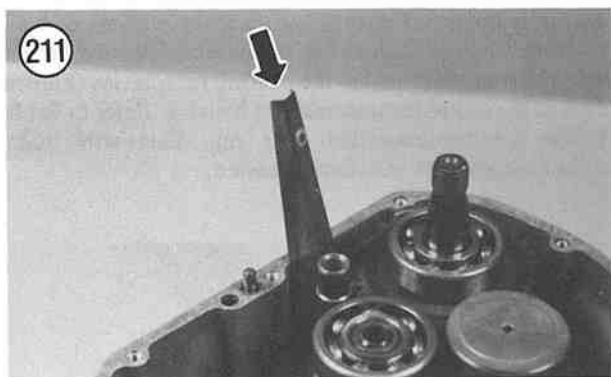


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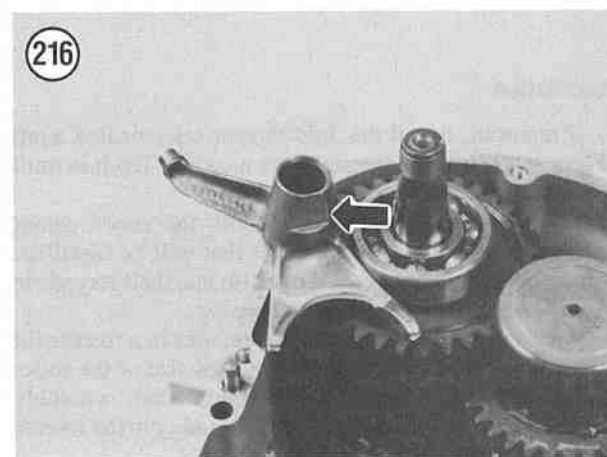
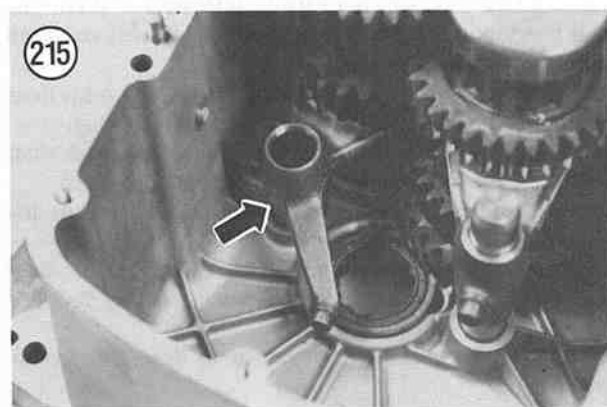


210





- 4B. On all other models, perform the following:
  - a. If not already removed, remove the bolt securing the gearshift lever and remove the lever from the selector shaft.
  - b. Withdraw the selector shaft from the housing. See previous CAUTION.
5. At the engine side of the transmission housing, remove the bolts (Figure 208) securing the gearshift mechanism bracket assembly.
6. Carefully withdraw the gearshift mechanism bracket assembly from the housing (Figure 209).
7. Remove the bolt (Figure 210) securing the oil channel and remove the oil channel (Figure 211).
8. Withdraw the input shaft (Figure 212) from the housing. The input shaft bearing will stay in the housing and will be removed later in this procedure.
9. Remove the 1st/2nd gear and 5th gear selector fork shaft (Figure 213).
10. Remove the 5th gear selector fork (Figure 214) and the 1st/2nd gear selector fork (Figure 215). Note that the 1st/2nd gear selector fork has a flat on the boss (Figure 216). This will be helpful during installation.
11. The 3rd/4th gear selector fork shaft will stay in the transmission housing. Do not try to remove it at this time.





**NOTE**

*BMW recommends that the clutch side of the transmission housing be heated to 100° C (212° F) to aid in the removal of the transmission shaft assemblies. If you are unable to remove the shaft assemblies in Step 12, heat the housing with rags and hot water. We found that this was not necessary as the transmission shaft bearings slipped out of the housing easily.*

**CAUTION**

*Do not heat the cover with a torch (propane or acetylene); never bring a flame into contact with the cover. The direct heat will warp the housing.*

**CAUTION**

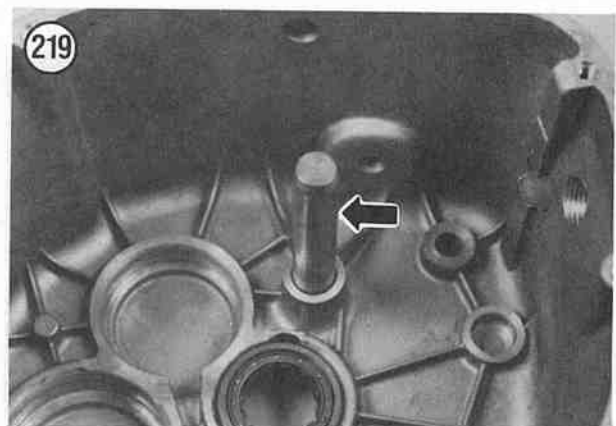
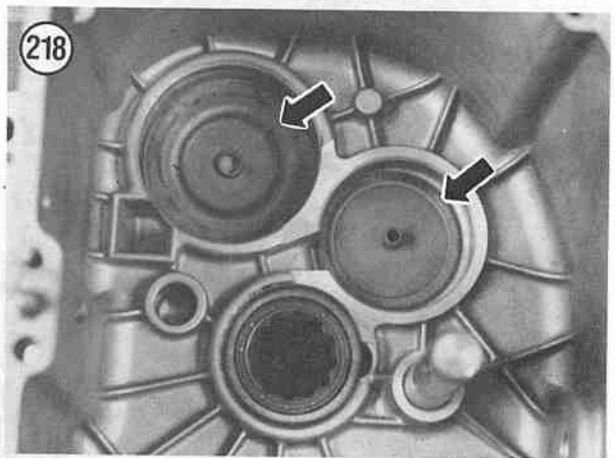
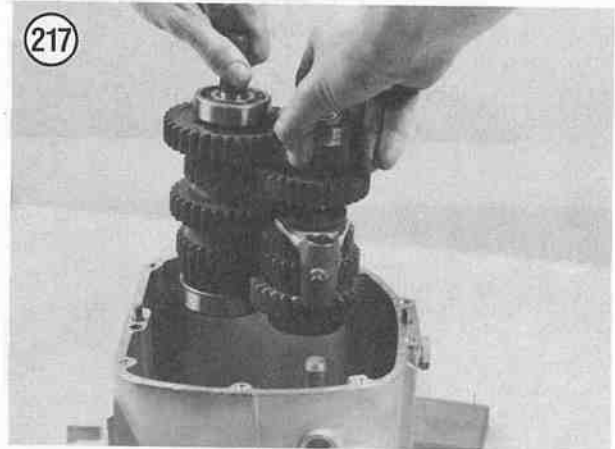
*In the following step, do not try to remove one shaft without the other shaft as the bevel gears (5th gear) will be damaged. The shafts must be withdrawn as an assembly.*

12. Pull straight up on the output and intermediate transmission shaft assemblies (**Figure 217**) and remove them from the transmission housing. The 3rd/4th gear selector fork will come out with the intermediate shaft. The ball bearing on the front end of each shaft will stay with each shaft assembly.
13. Remove the oil baffle plates (**Figure 218**) from their receptacle in the base of the transmission housing.
14. If damaged, remove the 3rd/4th gear selector fork shaft (**Figure 219**) from the transmission housing.
15. Inspect the transmission housing as described in this chapter.
16. Inspect the transmission shaft assemblies as described under *Transmission Shaft Preliminary Inspection (5-Speed Models)* in this chapter.
17. Inspect the gearshift mechanism as described in this chapter.

**Installation**

1. If removed, install the 3rd/4th gear selector fork shaft (**Figure 219**) into the transmission housing. Tap it in until it bottoms out.
2. Position the oil baffle plates with the raised center portion facing up toward the shaft that will be installed. Install the oil baffle plates (**Figure 218**) into their receptacle in the base of the transmission housing.
3. Place the transmission shaft assemblies in a freezer for 30 minutes. This will reduce the overall size of the roller bearings and will make transmission shaft assembly installation much easier. Leave the assembly in the freezer until it is ready to be installed.

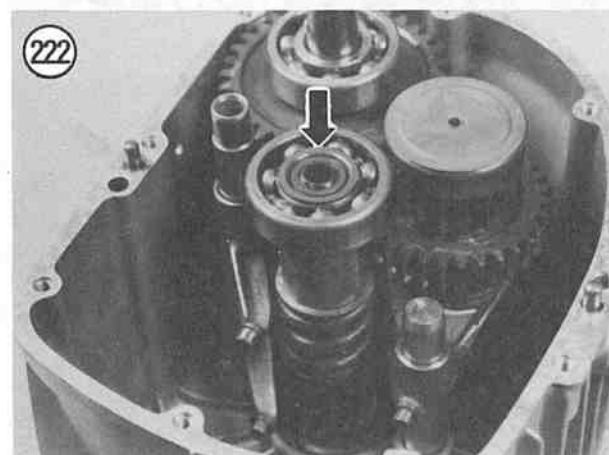
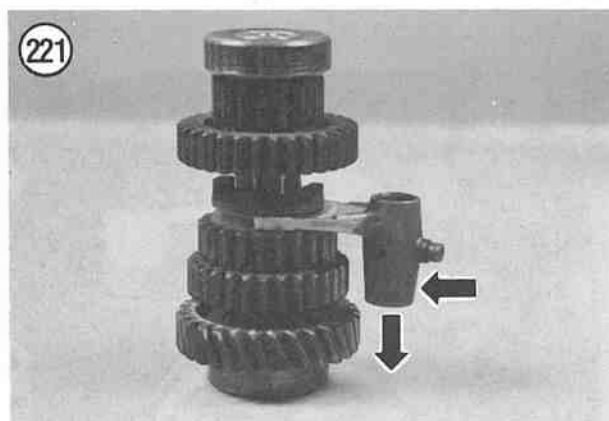
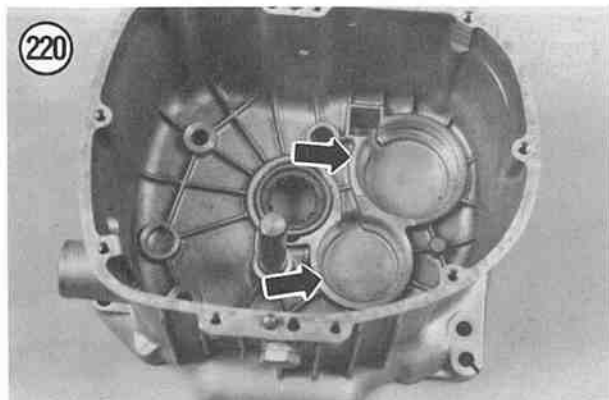
4. Apply the specified type and viscosity of clean gear oil to the bearings at each end of the intermediate and output transmission shafts and to the bearing receptacles (**Figure 220**) in the end of the transmission housing. Refer to **Table 1** for the recommended gear oil. This will make transmission shaft installation easier.



**CAUTION**

*In the following step, do not try to install one shaft without the other shaft as the bevel gears (5th gear) will be damaged. The shafts must be installed as an assembly.*

5. Install the 3rd/4th gear selector fork into the intermediate shaft assembly with the long side facing down (Figure 221).



6. Properly mesh the intermediate shaft and the output shaft together as an assembly.
7. Install the transmission shaft assemblies and the 3rd/4th gear selector fork as an assembly into the transmission housing (Figure 217). Guide the 3rd/4th gear selector fork onto the gear selector fork shaft in the base of the transmission housing.
8. Make sure the bearings are properly aligned with their respective bearing receptacles in the transmission housing. Carefully tap on the ends of the transmission shaft assemblies with a plastic or soft-faced mallet. Tap on the shaft assemblies until they are completely seated.
9. Apply the specified type and viscosity of clean gear oil to the gear selector forks and shafts. Refer to Table 1 for the recommended gear oil. This will make shaft installation easier.

**NOTE**

*Position both gear selector forks onto their shaft with the long bosses facing away from each other. The 1st/2nd gear selector fork has the machined flat on it and this fork must be positioned at the top (Figure 216).*

10. Install the 1st/2nd gear selector fork (Figure 215) and the 5th gear selector fork (Figure 214) into the correct groove in the output shaft assembly gears.
11. Insert the gear selector fork shaft (Figure 213) through the 1st/2nd gear and the 5th gear selector forks. Press the shaft down until it is completely seated.
12. Spin each transmission shaft and make sure it rotates freely. If it binds or does not spin at all, correct the problem at this time.
13. Remove the input shaft from the freezer.
14. Apply the specified type and viscosity of clean gear oil to the rear bearing and to the shaft end where it goes into the installed bearing in the transmission housing. Refer to Table 1 for the recommended gear oil. This will make transmission shaft installation easier.
15. Install the input shaft (Figure 212) with the helical cut gear end going in first. Tilt the input shaft slightly away from the shaft assemblies already installed.
16. Make sure the shaft is properly aligned with the bearing in the transmission housing. Carefully tap on the end of the transmission shaft assembly (Figure 222) with a plastic or soft-faced mallet. Tap on the shaft assembly until it is completely seated.
17. Install the oil channel (Figure 211) and the attachment bolt (Figure 210). Tighten the bolt securely.
18. Unscrew the neutral indicator switch from the base of the transmission housing. Only unscrew it far enough so that the plunger is flush with the inside surface of the transmission housing. This will keep the switch from being damaged when the gearshift mechanism bracket assembly is installed.

19. Carefully install the gearshift mechanism bracket assembly into the housing (**Figure 209**) and engage the gear selector forks properly. Make sure the shift fork guide pins are properly engaged in the shift mechanism. Refer to **Figure 223** and **Figure 224**.

20. Shift the mechanism and the gear sets to the NEUTRAL position.

21. At the engine side of the transmission housing, install the bolts (**Figure 208**) securing the gearshift mechanism bracket assembly. Tighten the bolts securely.

#### NOTE

*Remember that the input shaft's front bearing is already installed in the transmission housing.*

22. If any of the transmission shaft assemblies were disassembled (even for bearing replacement), perform *Transmission Shaft End Float Measurement and Adjustment* as described in this chapter. This procedure is necessary if any component has been removed, since the overall length of the transmission shaft(s) has changed.

23A. On early models, install the gearshift lever/selector lever (B, **Figure 207**) and install the bolt (A, **Figure 207**). Tighten the bolt securely.

23B. On all other models, perform the following:

- a. Install the selector shaft into the housing.
- b. Install the bolt securing the gearshift lever and tighten securely.

24. If either transmission shaft assembly was disassembled (even for bearing replacement), perform *Transmission Shaft End Float Measurement and Adjustment* as described in this chapter. This procedure is necessary if any component has been removed, since the overall length of the transmission shaft(s) is different than original.

25. Install the housing cover as described in this chapter, but do not install the bolts until Step 28.

26. Set the transmission on the workbench in the horizontal position—same as it would sit in the bike's frame.

27. Spin the transmission shafts and shift through all 5 gears using the shift lever. Make sure you can shift into all gears. This is the time to find that something may be installed incorrectly—not after the transmission is completely assembled and installed onto the engine.

28. If the transmission shifts through all gears correctly, install the housing cover bolts and tighten to the torque specification listed in **Table 2**.

29. Tighten the neutral indicator switch securely.

30. Install the transmission housing as described in this chapter.

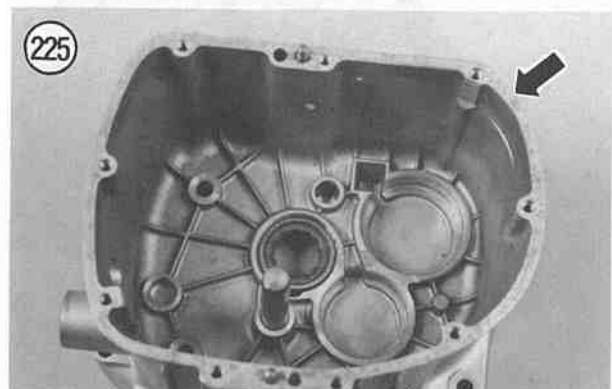
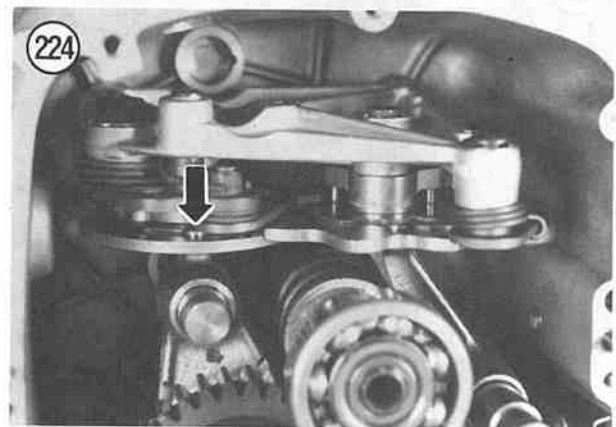
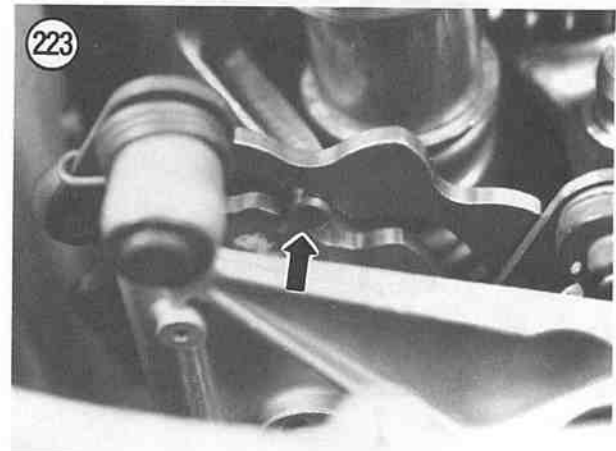
#### Housing Inspection and Input Shaft Oil Seal and Bearing Replacement

1. Thoroughly clean the housing in solvent and dry with compressed air.

2. Inspect the housing for any cracks or damage. Check around the ribs and the transmission sealing surface (**Figure 225**). If damaged, replace the housing.

3. Inspect the input shaft bearing in the housing. It must rotate freely with no signs of wear or damage. If the bearing requires replacement, perform the following:

- a. Remove the oil seal (**Figure 226**) from the outer surface of the transmission housing.

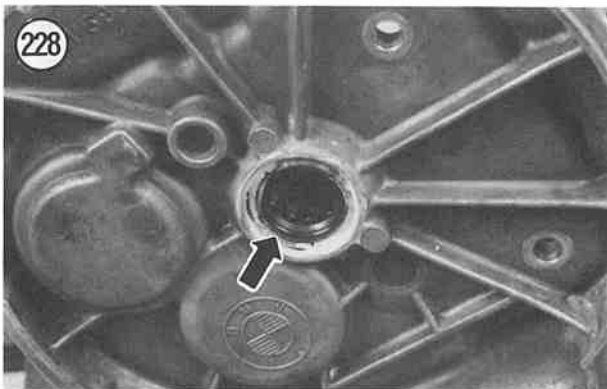
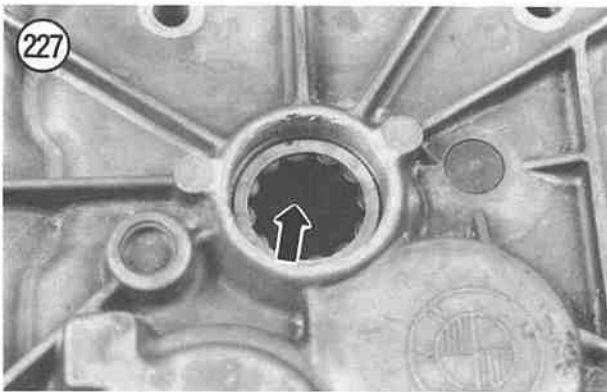
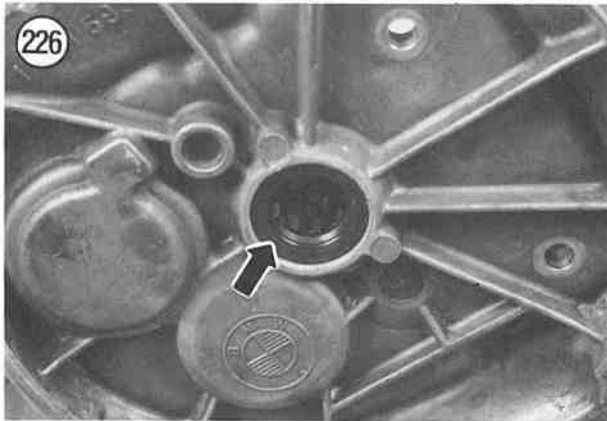


**NOTE**

Heat the clutch side of the transmission housing to 100° C (212° F) to aid in the removal of the input shaft bearing that stayed in the housing.

**CAUTION**

Do not heat the housing with a torch (propane or acetylene); never bring a flame into contact with the housing. The direct heat will warp the housing.



- b. Place the housing on wood blocks to protect the sealing surface from damage.
- c. Use a suitable size socket and hammer; drive out the bearing (**Figure 227**) from the *outer* surface of the cover.
- d. Thoroughly clean out the seal receptacle in the housing with solvent and dry with compressed air.
- e. Apply a light coat of multipurpose grease to the outer surface of the new bearing and the bearing receptacle in the housing.
- f. Using a hammer and a suitable size socket that matches the outer diameter of the bearing, carefully tap the new bearing into the housing from the *inner* surface of the housing. Tap the bearing in squarely and evenly until it bottoms out in the cover.
- g. Apply a light coat of multipurpose grease to the bearing cavity.
- h. Position the oil baffle/shim with the raised perimeter section facing toward the bearing.
- i. Carefully tap the flanged sleeve and shim into the bearing. Tap the flanged sleeve in until it is completely seated in the bearing.
- j. Thoroughly clean out the seal receptacle (**Figure 228**) in the case with solvent and dry with compressed air.
- k. Apply a light coat of multipurpose grease to the outer surface of the new seal and the seal receptacle in the housing.
- l. Working from the outer surface of the transmission housing, carefully tap the new input shaft seal (**Figure 226**) into the transmission housing. Tap the seal in until it bottoms out.

### Transmission Shaft End Float Measurement and Adjustment

The transmission shafts' end float must be checked whenever the transmission shafts have been serviced or removed from the transmission housing.

The end float is the play or free space between the ends of the transmission shafts and the transmission housing cover. The ball bearings must have a certain amount of freedom or end float. If the end float is not correct, the bearings will wear prematurely.

The transmission shaft rear bearings must be completely seated in the transmission housing or cover (input shaft) in order for this adjustment to be correct. If they are not completely seated, the transmission shaft will sit up too high and throw off the measurements taken in this procedure.

Use a metric vernier caliper or depth gauge as it will be easier to calculate shim selection in this procedure.

The BMW special tool (part No. 23 3 650) (**Figure 229**) can be used but it is expensive and unnecessary. A machined straightedge or a depth gauge can be used at a substantial cost savings.



**NOTE**

The oil baffle must be installed under the output shaft or the dimension taken will be incorrect.

Use a metric vernier caliper or depth gauge as it will be easier to calculate shim selection in this procedure.

1. Make sure the transmission shaft assemblies are properly seated in the transmission housing and are sitting perfectly upright—they cannot be tilted to one side.
2. Install a new gasket on the top surface of the transmission housing.

**NOTE**

To avoid confusion, measure and calculate one shaft assembly at a time.

3. Using a metric vernier caliper or depth gauge, measure the distance from the top surface of the transmission housing to the top surface of the transmission shaft bearing (Figure 230). Write down this dimension (dimension A).
4. Place a machined straightedge across the housing cover.
5. Using a vernier caliper or depth gauge (Figure 231), measure the distance from the top surface of the transmission housing cover to the shoulder (Figure 232) where the shaft's rear bearing bottoms out in the cover. Write down this dimension (dimension B).
6. For correct shim(s) selection, proceed as follows:

**NOTE**

The specified amount of free play is 0.05-0.15 mm. For calculations, use the low-point of the specified free play—i.e., 0.05 mm.

**NOTE**

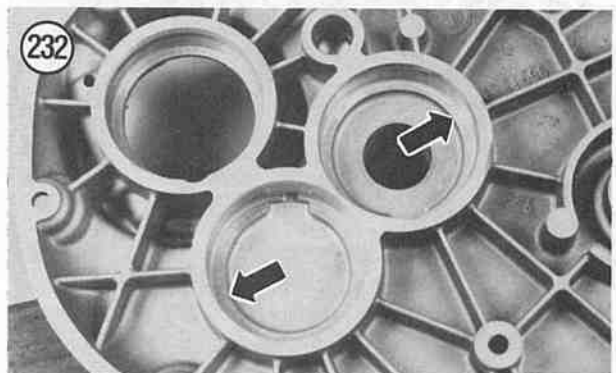
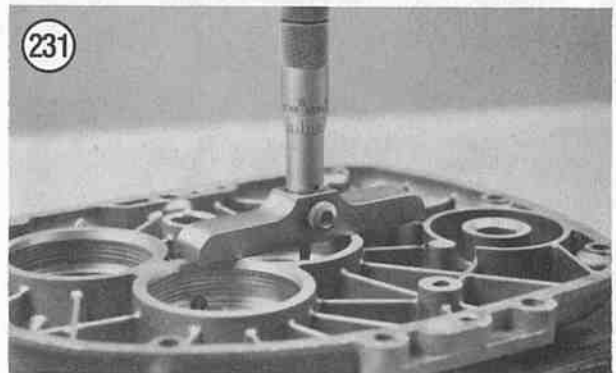
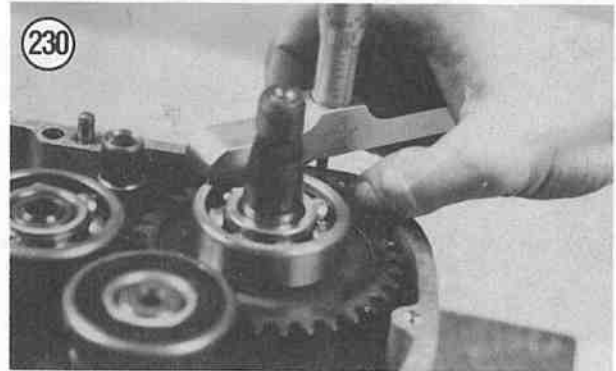
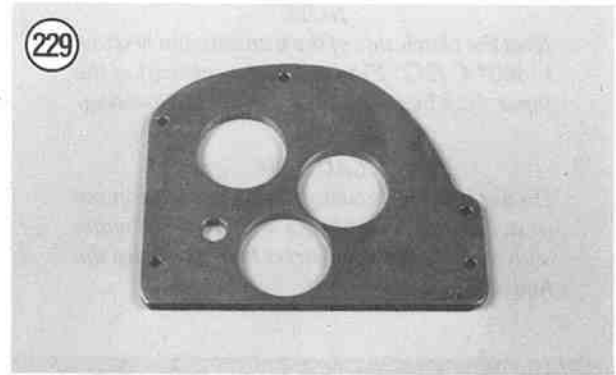
The following numbers are examples only. Use the numbers written down during this procedure.

**Example:**

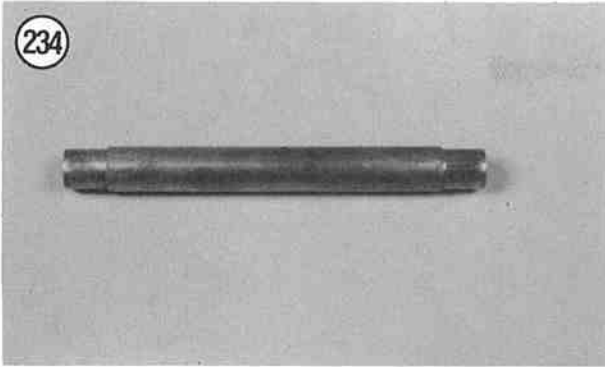
Actual measured distance	
Measurement B	36.50 mm
Subtract measurement A	<u>-36.05 mm</u>
Equals excess clearance (without any shims)	0.55 mm
Specified free play	<u>-0.05 mm</u>
Equals required shim thickness (round off to the nearest shim thickness)	0.50 mm

**NOTE**

Shims are available from BMW dealers in the following thicknesses: 0.20, 0.28, 0.38 and 0.50 mm. Use the correct thickness of one shim or a combination of shims to achieve the specified preload.



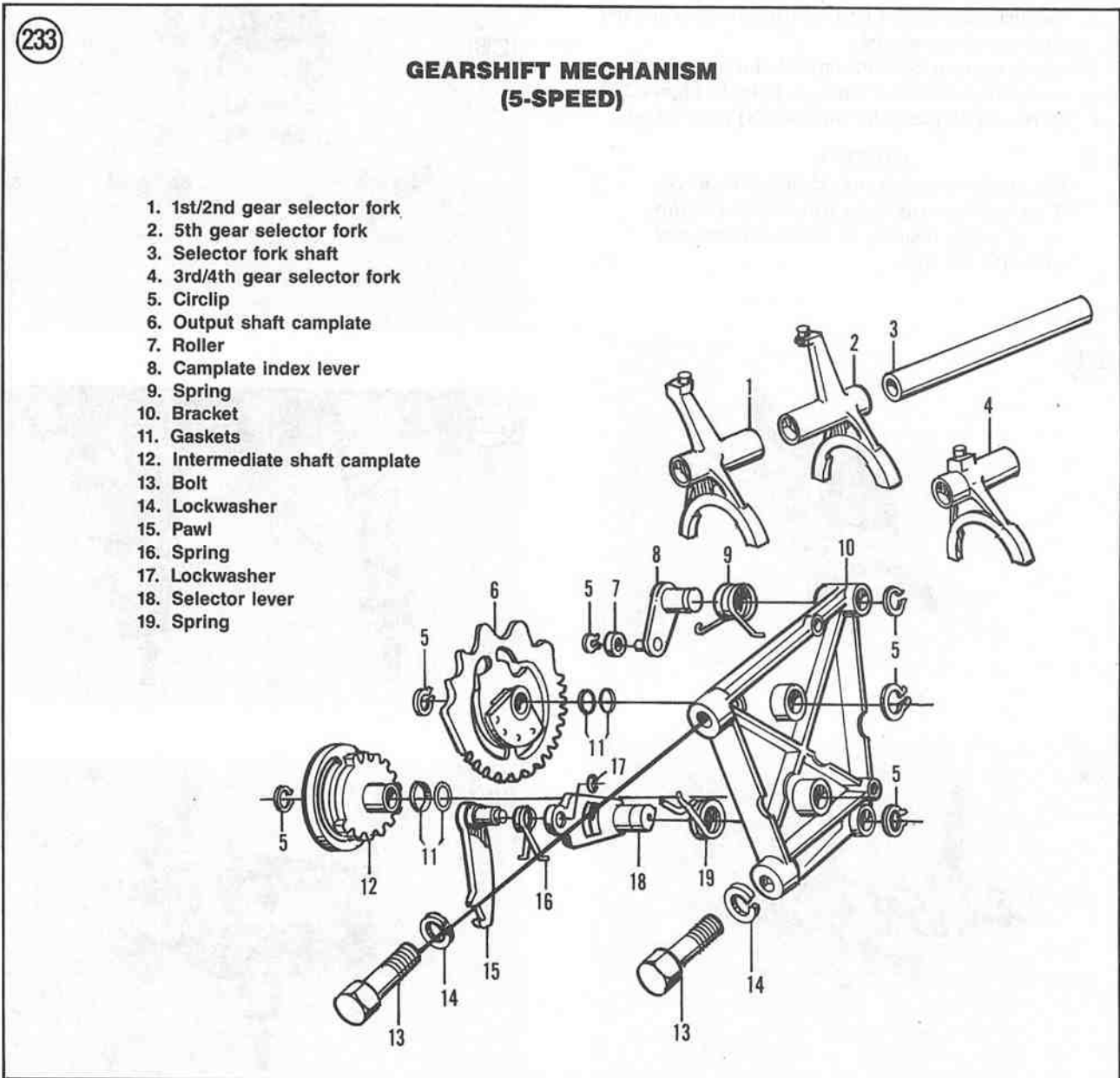




7. The shim(s) is placed between the rear bearing outer race and the oil baffle plate.
8. Repeat Steps 3-7 for the intermediate shaft and the output shaft.

**Gearshift Forks and Shafts  
Inspection**

- Refer to **Figure 233** for this procedure.
1. Clean all parts in solvent and thoroughly dry.
  2. Roll each shift fork shaft (**Figure 234**) on a flat surface such as a piece of plate glass and check for any bends. If the shaft is bent, it must be replaced.



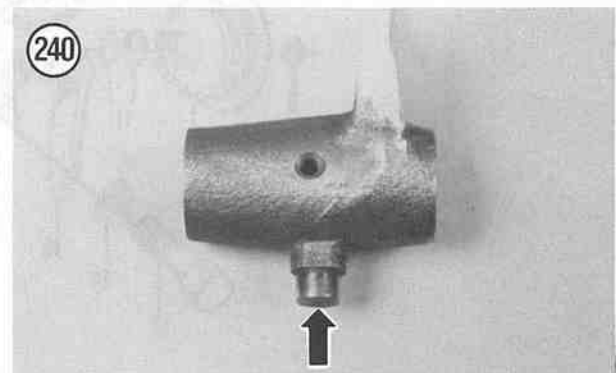
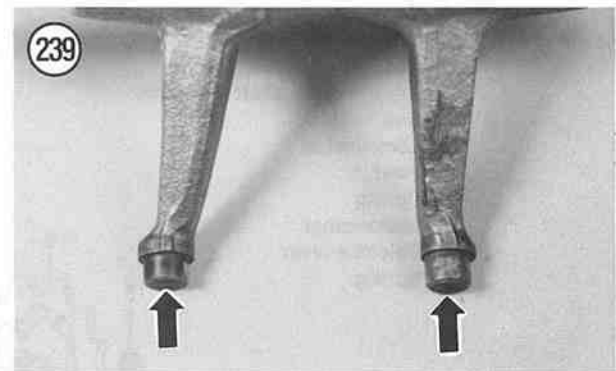
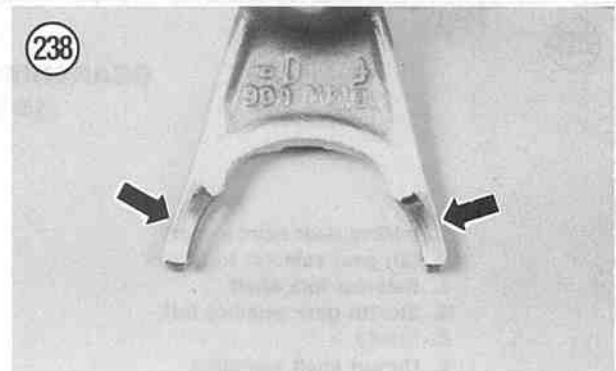
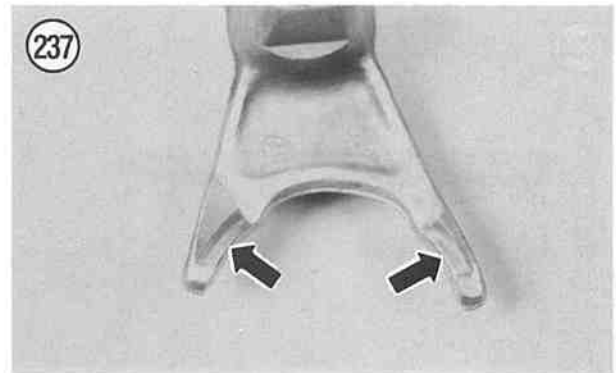
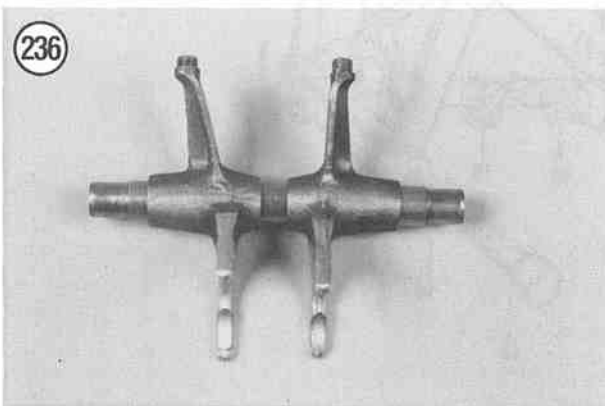
**NOTE**

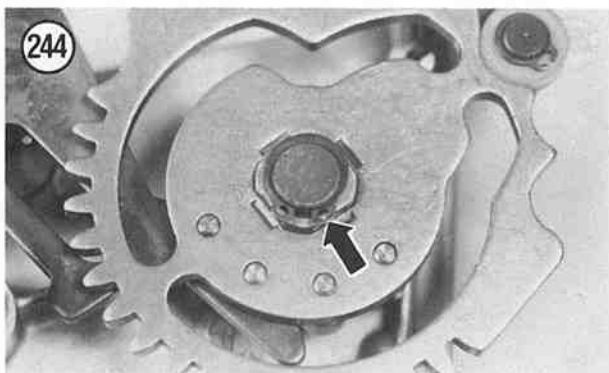
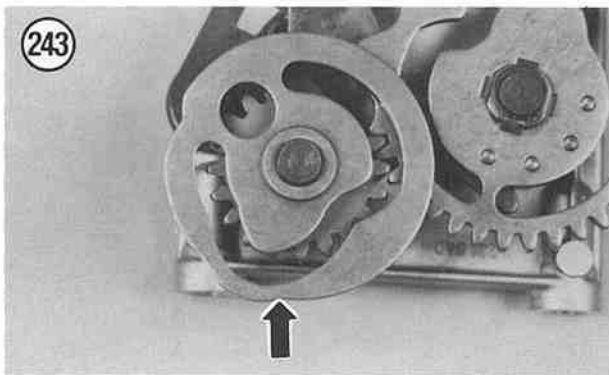
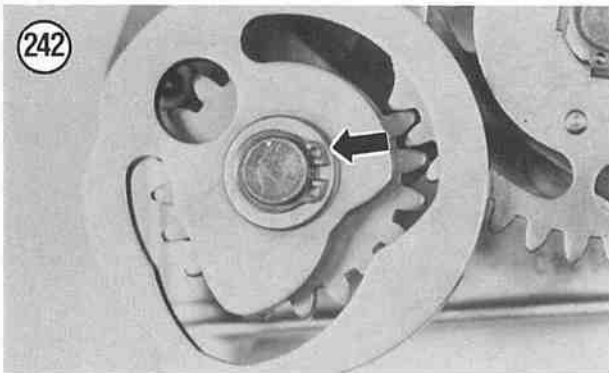
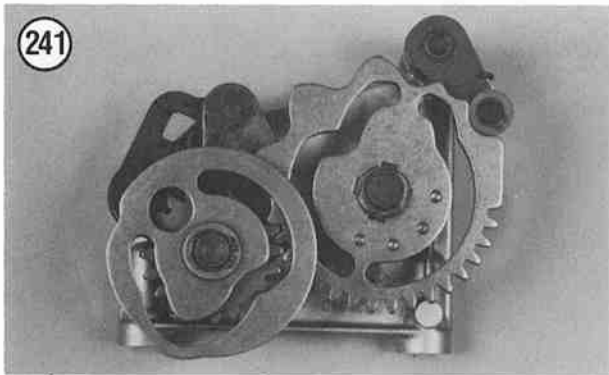
*BMW does not provide specifications for the inside diameter of the shift forks or the outside diameter of the shift fork shafts. If play is noticeable, take the parts to a BMW dealer for their opinion on which part(s) is worn. Replace the worn part(s).*

3. Inspect each shift fork (**Figure 235**) for signs of wear or cracking. Check for bending and make sure each fork slides smoothly on the shaft (**Figure 236**). Replace any worn or damaged forks.
4. Check for any arc-shaped wear or burn marks on the shift fork fingers. Refer to **Figure 237** and **Figure 238**. This indicates that the shift fork has come in contact with the gear. The fork fingers have become excessively worn and the fork(s) must be replaced.
5. Check the cam pin followers on each shift fork that rides in the cam plate for wear or damage. Refer to **Figure 239** and **Figure 240**. Replace the shift fork(s) as necessary.

**CAUTION**

*Marginally worn shift forks should be replaced. Worn forks can cause the transmission to slip out of gear, leading to more serious and expensive damage.*

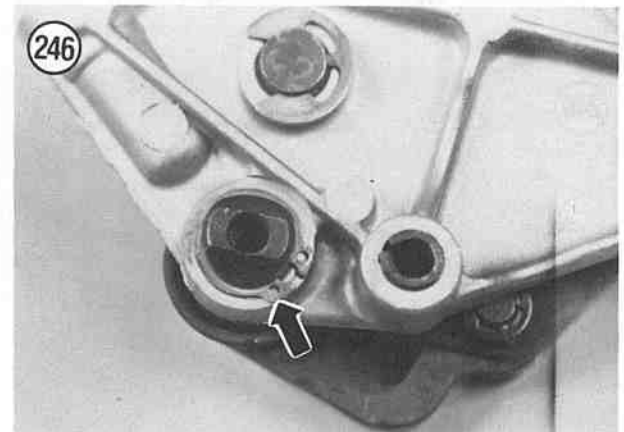
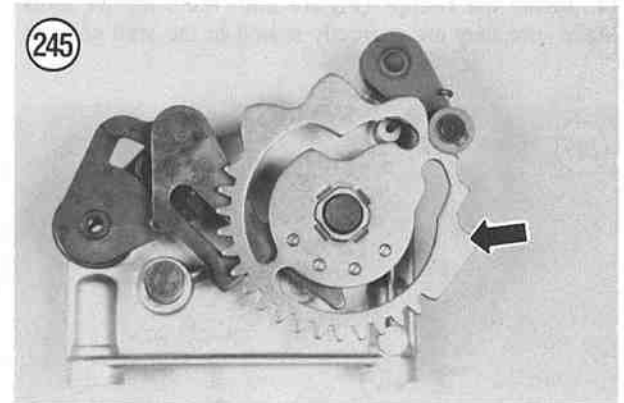




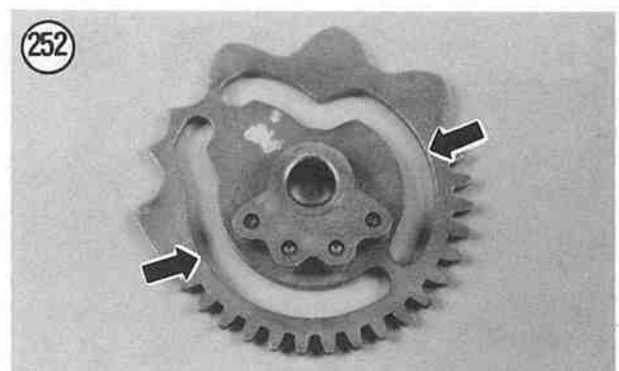
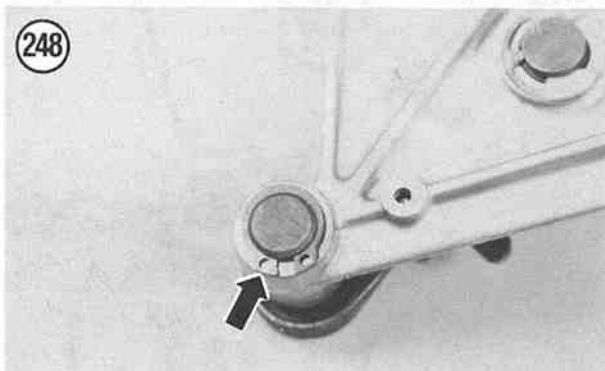
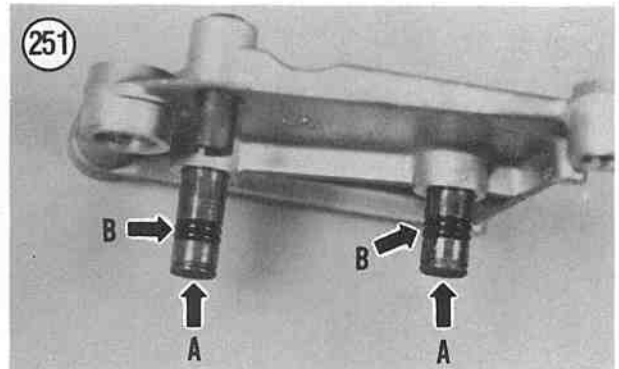
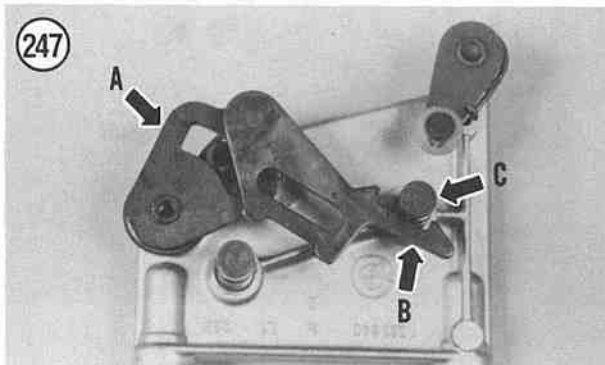
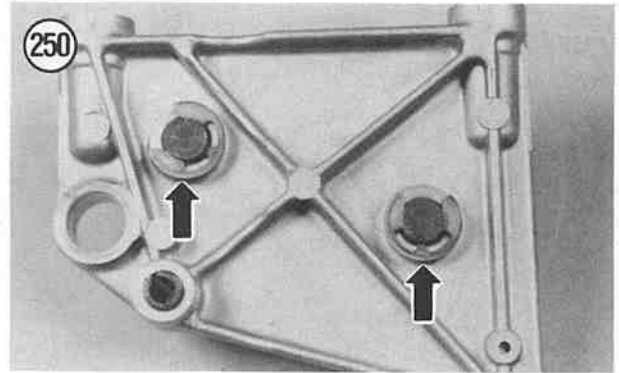
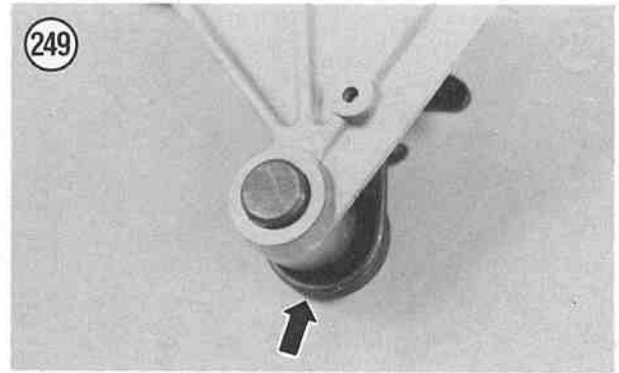
### Gearshift Mechanism Disassembly/Inspection/Assembly

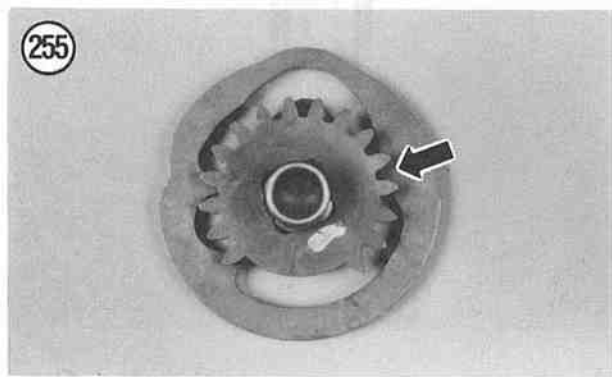
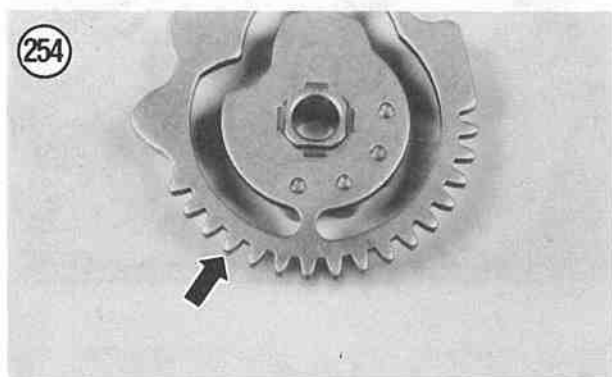
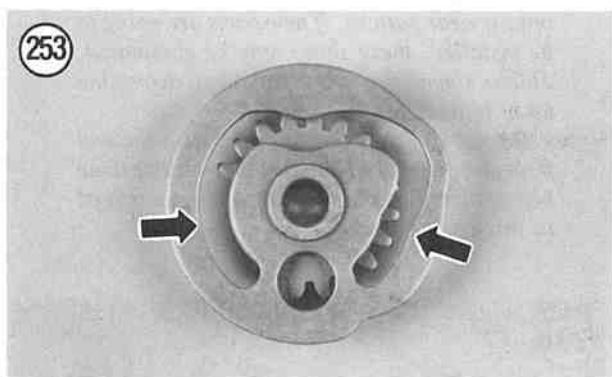
This procedure is for complete disassembly of the gearshift mechanism that is assembled onto the bracket. Refer to **Figure 233** for this procedure.

1. Clean the gearshift mechanism assembly in solvent and thoroughly dry.
2. Refer to **Figure 241** and perform a preliminary inspection as follows:
  - a. Visually check the ramps and gear teeth on the cam plates.
  - b. Inspect the cam plate index lever and other levers for free movement.
  - c. Make sure the springs are applying force as necessary.
  - d. If anything appears to be incorrect, worn or damaged, continue with the rest of the procedure.
3. Remove the circlip (**Figure 242**) securing the intermediate shaft cam plate and remove the cam plate (**Figure 243**).
4. Remove the circlip (**Figure 244**) securing the output shaft cam plate and remove the cam plate (**Figure 245**).
5. Turn the bracket assembly over and remove the circlip (**Figure 246**) securing the selector lever and spring to the bracket assembly.



6. Turn the bracket assembly over and remove the selector lever, pawl and spring assembly (A, **Figure 247**).
7. Remove the circlip (**Figure 248**) securing the cam plate index lever and remove the lever and spring (**Figure 249**).
8. Remove the E-clip (**Figure 250**) securing the pivot studs and remove the studs (A, **Figure 251**) from the bracket assembly. Note the location of the longer stud as it must be reinstalled in the same location. Inspect the O-rings (B, **Figure 251**) for deterioration; replace if necessary.
9. Inspect the ramps on both cam plates for wear, roughness or damage. Refer to **Figure 252** and **Figure 253**. Replace the cam plate(s) if necessary.
10. Inspect the gear teeth on both cam plates for wear, roughness or damage. Refer to **Figure 254** and **Figure 255**. Replace the cam plate(s) if necessary.
11. Inspect the selector lever, pawl and spring assembly (**Figure 256**) for wear or damage. Make sure the spring is operating correctly.
12. Inspect the cam plate index lever assembly for wear or damage. Make sure the roller (**Figure 257**) rotates freely. Also check the pivot shaft (**Figure 258**) for wear or damage. Replace if necessary.
13. Install the pivot studs (A, **Figure 251**) into the bracket assembly. Be sure to install the studs in the correct location as noted during disassembly. Install new O-rings (B, **Figure 251**) onto the pivot studs.
14. Install the E-clips (**Figure 250**) securing the studs. Make sure they are correctly seated in the stud grooves.



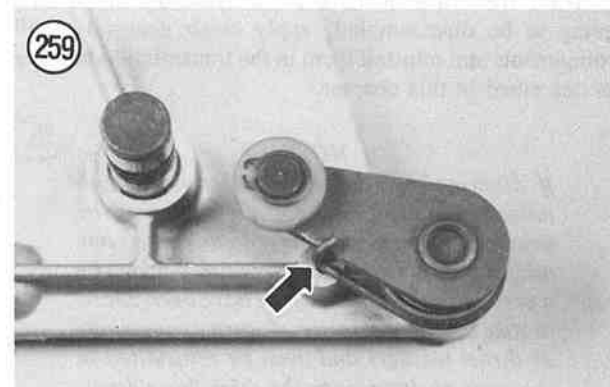
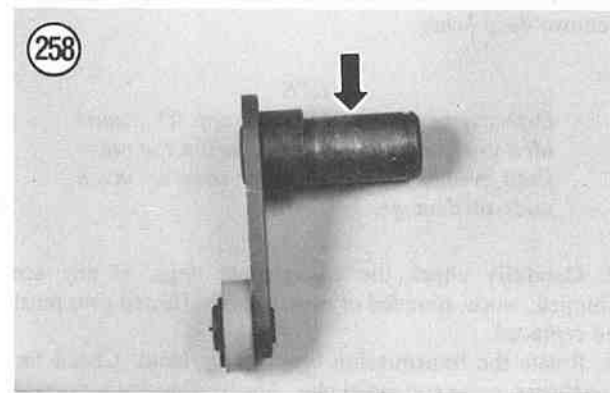
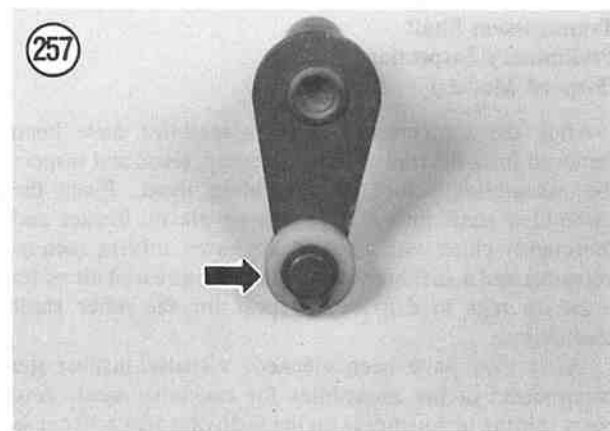


15. Install the cam plate index lever and index the spring end into the hole in the mounting plate (Figure 259). This is necessary for proper index lever operation.

16. Install the circlip (Figure 248) securing the cam plate index lever. Make sure it is correctly seated in the groove.

17. Install the selector lever, pawl and spring assembly (A, Figure 247). Locate the end of the pawl (B, Figure 247) below the stud (C, Figure 247).

18. Turn the bracket assembly over and install the circlip (Figure 246). Make sure it is correctly seated in the groove.





19. Partially install the output shaft cam plate. Move the pawl away from the backside of the cam plate and push the cam plate the rest of the way on.
20. Install the circlip (Figure 244) and make sure it is correctly seated in the groove.
21. Partially install the intermediate shaft cam plate. Align the 1st gear tooth of each cam plate as shown in Figure 260 and push the cam plate the rest of the way down.
22. Install the circlip (Figure 242) and make sure it is correctly seated in the groove.

### Transmission Shaft Preliminary Inspection (5-speed Models)

After the transmission shaft assemblies have been removed from the transmission housing, clean and inspect the assemblies before disassembling them. Place the assembled shaft into a large can or plastic bucket and thoroughly clean with a petroleum-based solvent such as kerosene and a stiff brush. Dry with compressed air or let it sit on rags to drip dry. Repeat for the other shaft assemblies.

1. After they have been cleaned, visually inspect the components of the assemblies for excessive wear. Any burrs, pitting or roughness on the teeth of a gear will cause wear on the mating gear. Minor roughness can be cleaned up with an oilstone but there's little point in attempting to remove deep scars.

#### NOTE

*Defective gears should be replaced. It's a good idea to replace the mating gear on the other shaft even though it may not show as much wear or damage.*

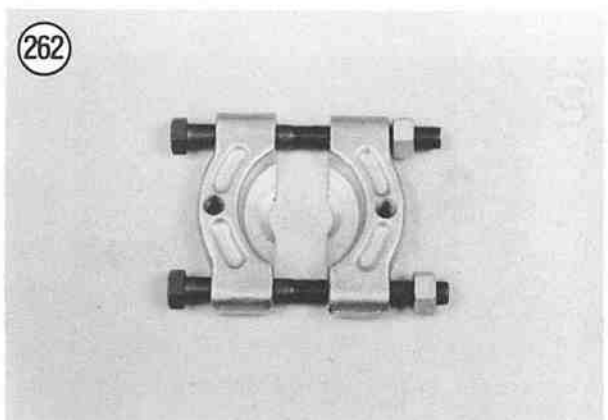
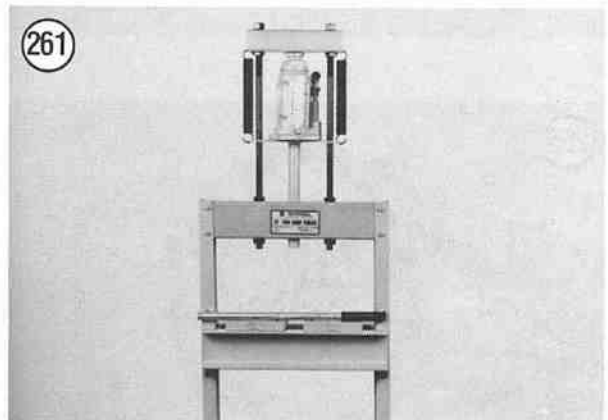
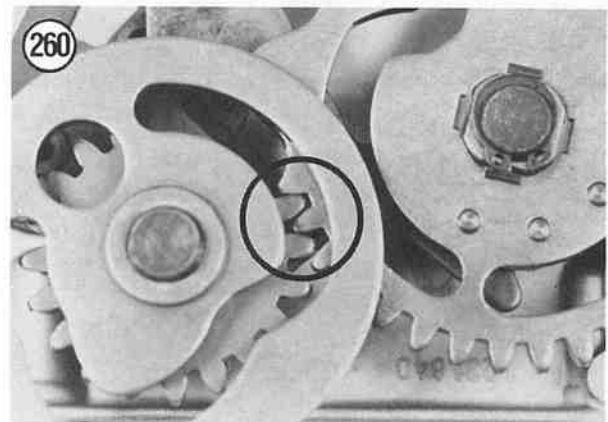
2. Carefully check the engagement dogs. If any are chipped, worn, rounded or missing, the affected gear must be replaced.
3. Rotate the transmission bearings by hand. Check for roughness, noise and radial play. Any bearing that is suspect should be replaced as described in this chapter.
4. If the transmission shafts are satisfactory and are not going to be disassembled, apply clean gear oil to all components and reinstall them in the transmission housing as described in this chapter.

#### NOTE

*If disassembling a used, well run-in (high mileage) transmission for the first time by yourself, pay particular attention to any additional shims that may have been added by a previous owner. These may have been added to take up the tolerance of worn components or thrust washers and must be reinstalled in the same position since the shims have devel-*

*oped a wear pattern. If new parts are going to be installed, these shims may be eliminated. This is something you will have to determine upon reassembly.*

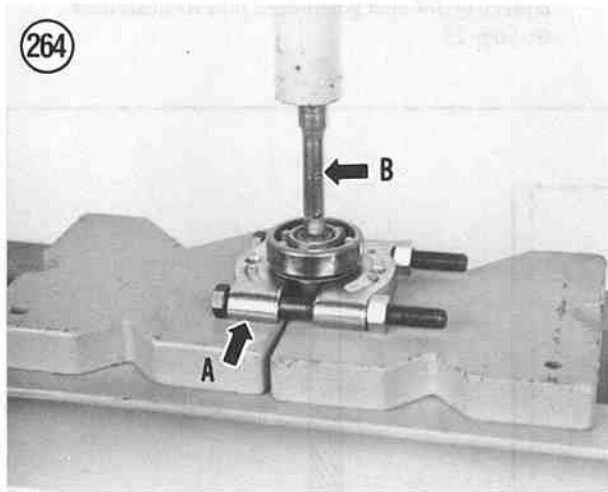
*Do not confuse this statement with the end float and preload adjustment that must be done before installing the shaft assemblies as noted in this chapter.*



**Input Shaft Disassembly**

Disassembly of the input shaft requires the use of a hydraulic press (Figure 261), an insert (Figure 262) and a bearing puller.

Refer to Figure 263 for this procedure.

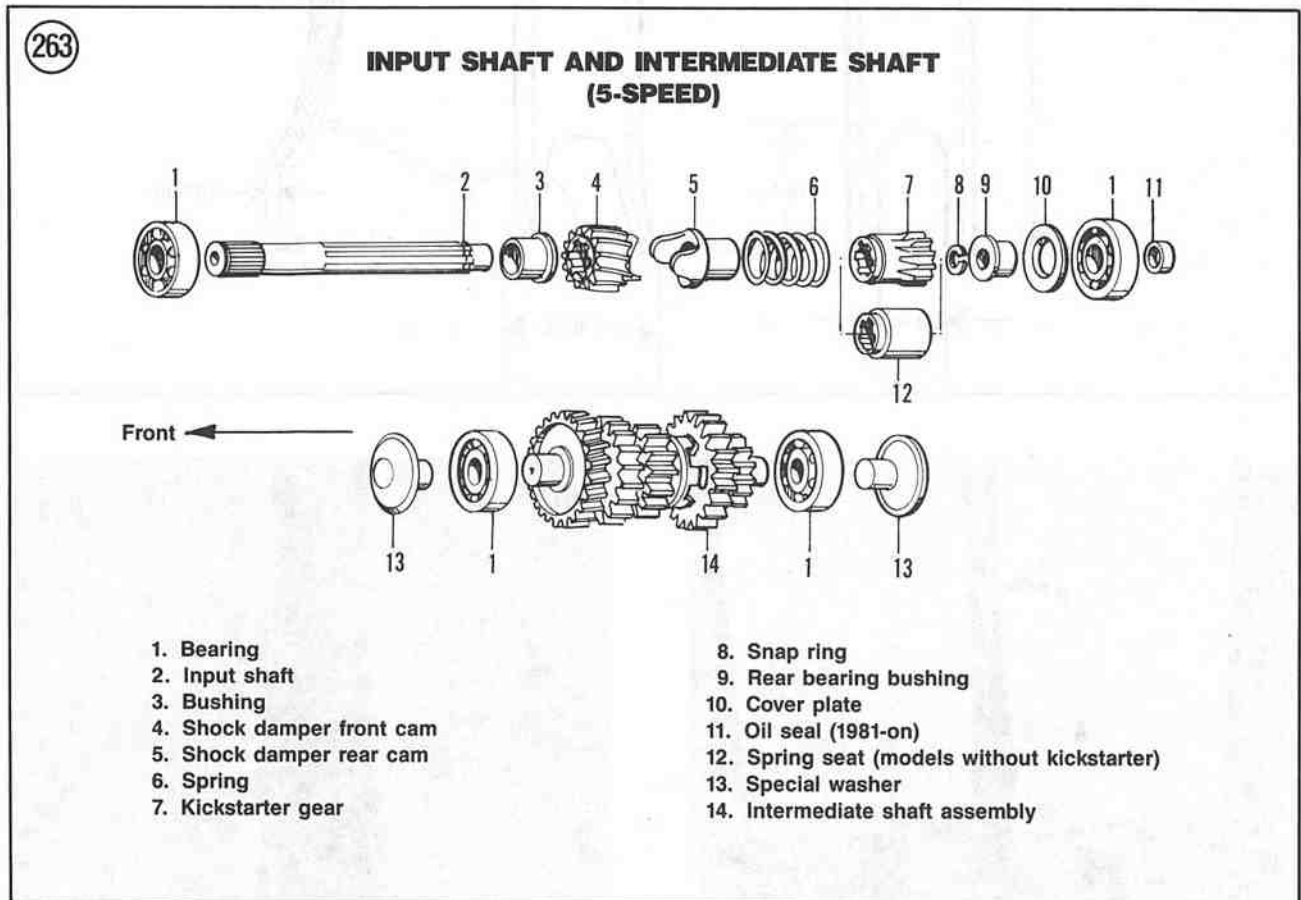


**NOTE**

A helpful "tool" that should be used for transmission disassembly is a large egg flat (the type that restaurants get their eggs in). As you remove a part from the shaft, set it in one of the depressions in the same position from which it was removed. This is an easy way to remember the correct relationship of all parts.

1. If not cleaned in the *Transmission Shaft Preliminary Inspection (5-Speed Models)* sequence, place the assembled shaft into a large can or plastic bucket and thoroughly clean with solvent and a stiff brush. Dry with compressed air or let it sit on rags to dry.
2. Measure the overall length of the assembled shaft before disassembly. Write this dimension down as it will be used for reference after the shaft is reassembled.
3. Install the insert under the rear ball bearing and cover plate as shown in A, Figure 264.
4. Install the input shaft assembly in the hydraulic press.
5. Place a 1/2 inch socket drive extension (B, Figure 264) between the shaft end and hydraulic press.
6. While holding onto the input shaft assembly, slowly press the shaft off of the rear bearing. Remove the shaft assembly from the hydraulic press.

6

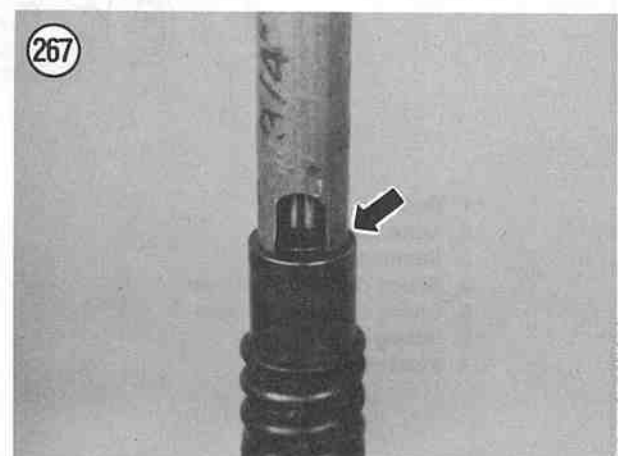
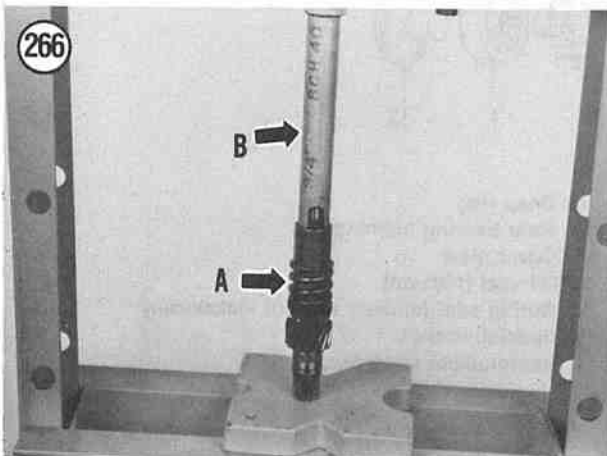
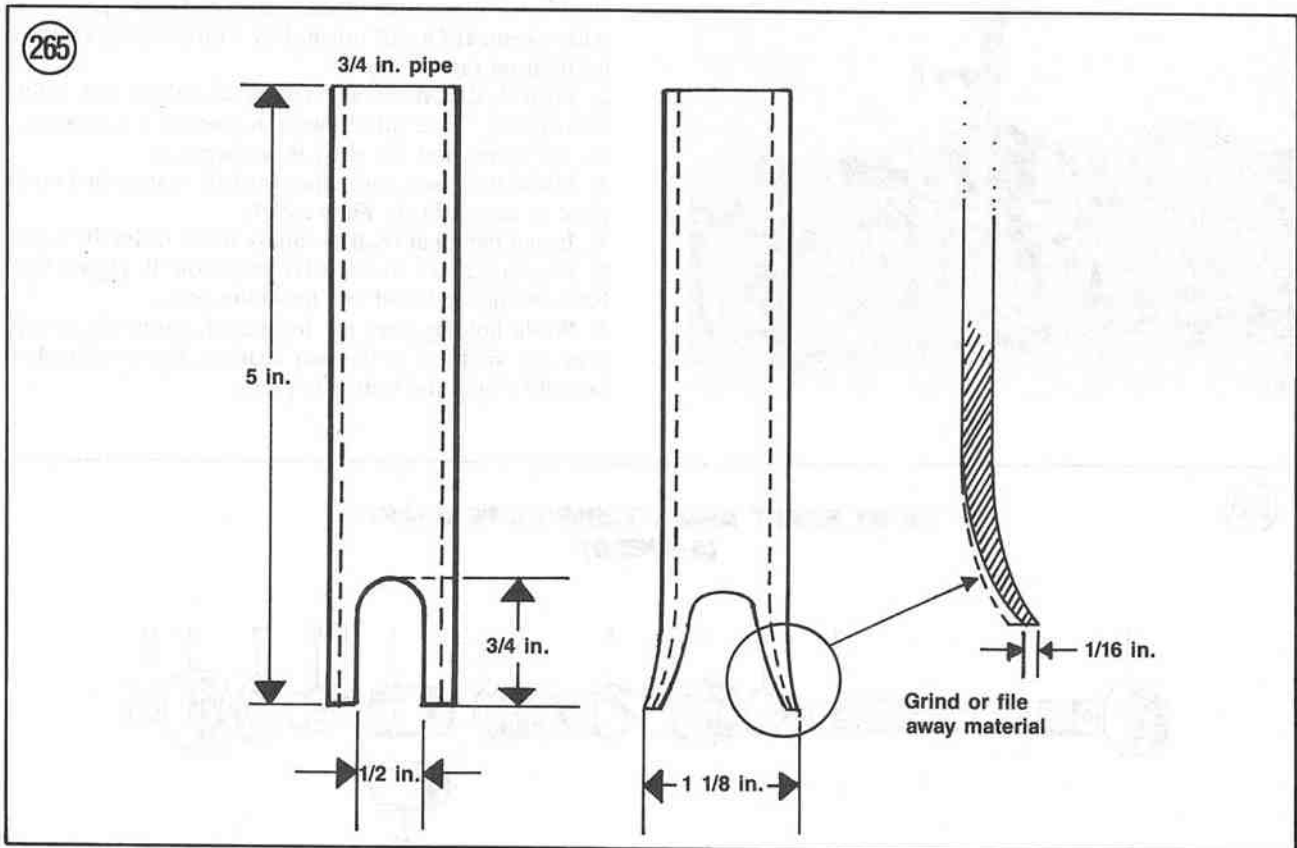


7. Relax the hydraulic pressure and remove the rear bearing and cover plate from the hydraulic press.
8. On 1981-on models, remove the small seal from the end of the shaft.
9. Install the insert under the rear ball-bearing bushing.
10. Install the input shaft assembly in the hydraulic press.
11. While holding onto the input shaft assembly, slowly press the shaft off the rear bearing bushing. Remove the shaft assembly from the hydraulic press.

12. Release the hydraulic pressure and remove the rear bearing bushing and insert from the hydraulic press.

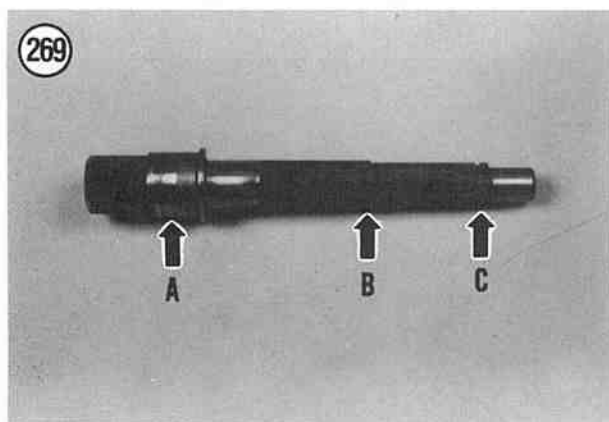
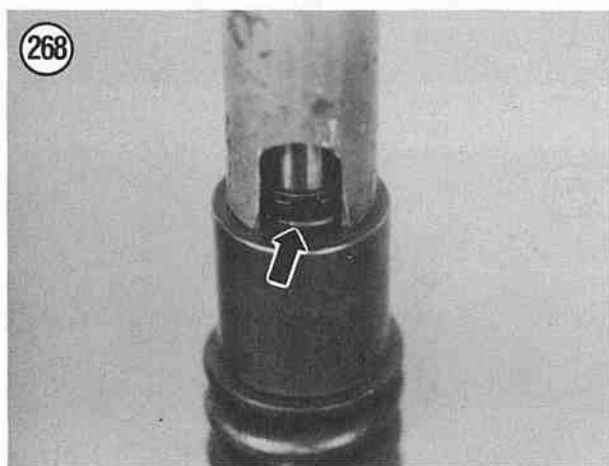
**NOTE**

*A special tool is required for Step 14, but a homemade tool can easily be fabricated from a piece of 3/4 inch galvanized pipe as described in Step 13.*



13. Refer to **Figure 265** and fabricate the special tool as follows:

- a. Use a piece of 3/4 in. galvanized pipe approximately 4-6 inches long. The end of the piece of pipe that is going to be modified must be cut off at 90°. It cannot be cut off at a slight angle.
- b. Use a hacksaw and make 2 cuts on each side of the piece of pipe about 1/2 in. apart and about 1/2 in. deep.
- c. Use a pair of Vise Grips and bend the pieces of pipe between the cuts back and forth until they break off.
- d. Use a rattail file and file the ends of the slots until they are round and the end is approximately 3/4 in. from the end of the pipe.
- e. Bend the "ears" of the pipe out until they are spread out approximately 1 1/8 in. apart as shown in **Figure 265**.
- f. Use a rattail file or rotary grinder and relieve the inner surface of the "ears" on the pipe. File or grind the surface down until it is approximately 1/16 in. thick. Grind the inner surface away up in the pipe beyond the "ears." This material must be removed to allow room for the snap ring to slide up after it is removed from the shaft.



#### NOTE

*In Step 14, there will be either a kickstarter coupling or a spring seat. These 2 parts vary depending on whether the bike is equipped with a kickstarter or not.*

14. Remove the snap ring as follows:

- a. Install the input shaft assembly (A, **Figure 266**) in the hydraulic press with the splined end facing down.
- b. Place the special tool (B, **Figure 266**) fabricated in Step 12 onto the end of the input shaft assembly.
- c. Center the special tool on the ledge of the kickstarter coupling or spring seat as shown in **Figure 267**.

#### WARNING

*The spring is very strong. Protect yourself accordingly in the event that the input shaft assembly and the special tool should accidentally move off of the hydraulic press plate.*

- d. While holding onto the input shaft assembly and the special tool, have an assistant slowly apply pressure.
- e. Compress the shaft only enough to gain access to the snap ring (**Figure 268**). The snap ring and groove must be visible.

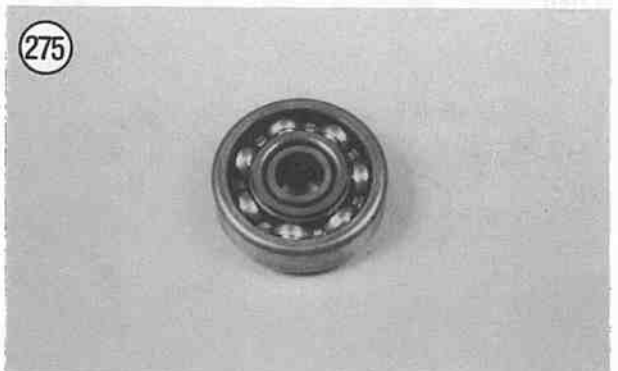
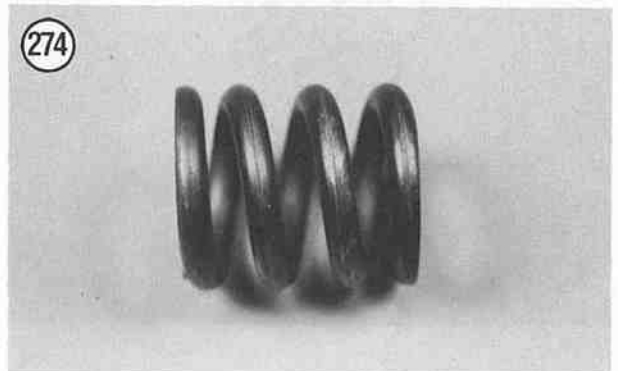
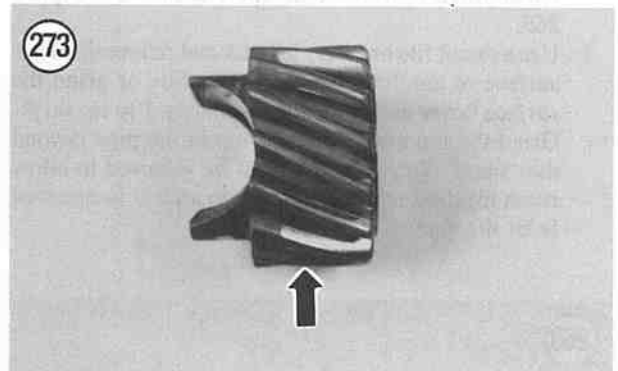
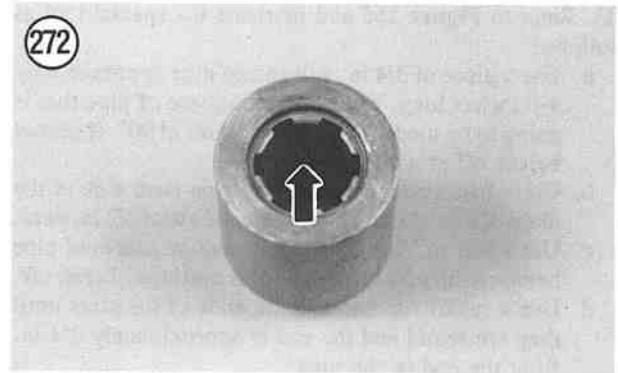
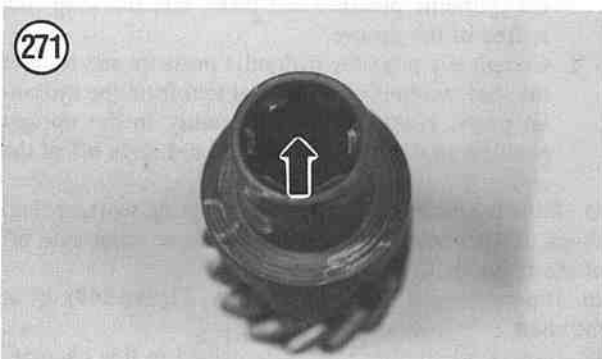
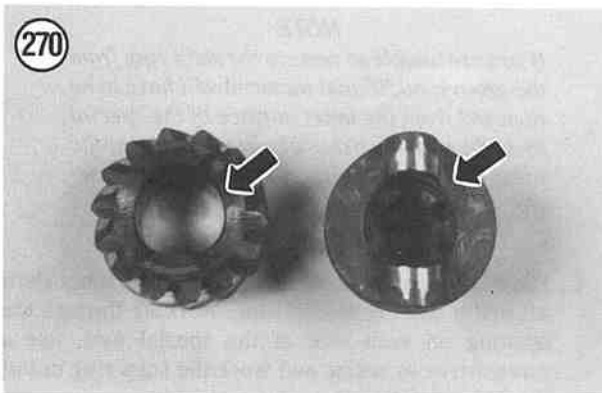
#### NOTE

*If you are unable to remove the snap ring from the groove, additional material will have to be removed from the inner surface of the special tool. Remove the assembly from the hydraulic press and grind or file away additional material from the special tool.*

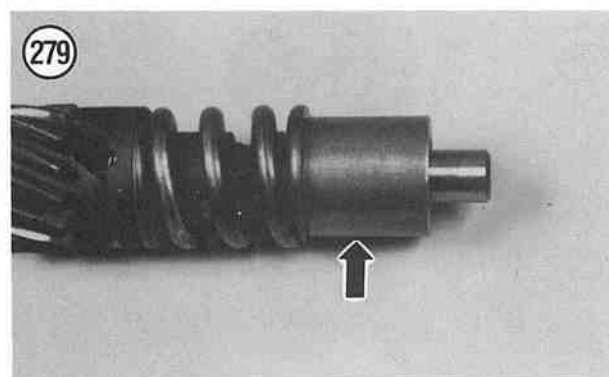
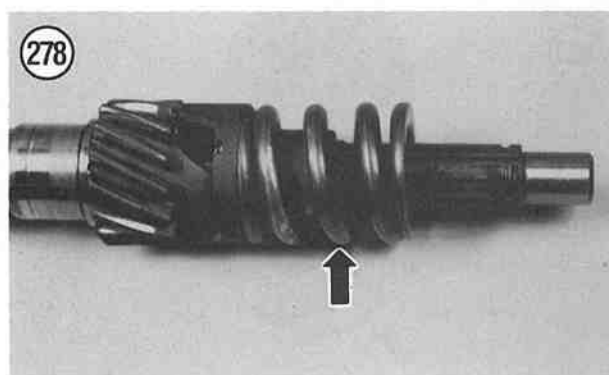
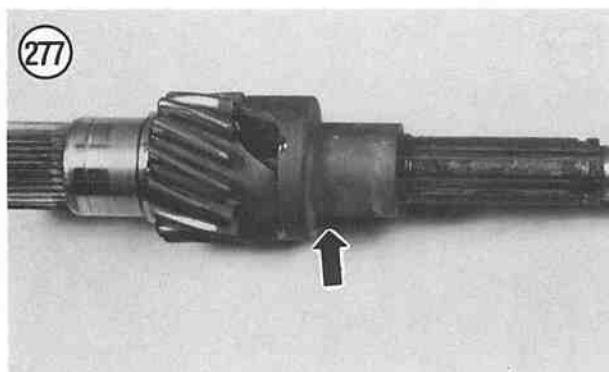
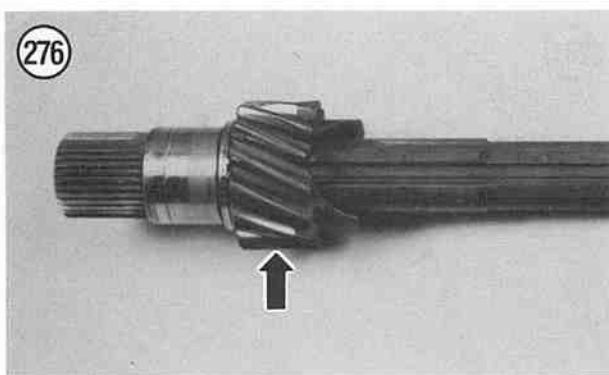
- f. Have the assistant securely hold onto the input shaft assembly and the special tool. Working through the opening on each side of the special tool, use a screwdriver or scribe and work the snap ring out of the transmission groove on each side.
  - g. After the snap ring is out of the groove, gradually relax the hydraulic pressure and make sure the snap ring is free of the groove.
  - h. Completely relax the hydraulic pressure and remove the shaft assembly and special tool from the hydraulic press. Hold the shaft assembly in the upright position so the components will not slide off of the end.
15. Slide the kickstarter coupling (or spring seat), spring, shock damper rear cam and shock damper front cam off of the input shaft.
16. If necessary, slide the bushing (A, **Figure 269**) off of the shaft.
17. Inspect all components as described in this chapter.

### Input Shaft Inspection

1. Inspect the ramps of both the front and rear shock dampers (Figure 270). Check for excessive wear, burrs, pitting or chipped areas. Replace if necessary.
2. Inspect the inner splines (Figure 271) of the shock damper front cam for wear or damage. Replace if necessary.
3. Inspect the inner splines (Figure 272) of the kickstarter coupling (or spring seat) for wear or damage. Replace if necessary.
4. On models so equipped, check for chipped or missing teeth on the kickstarter gear. Replace if necessary.
5. Inspect the shock damper front cam gear (Figure 273) for chipped or missing teeth. Replace if necessary.
6. Inspect the splines (B, Figure 269) on the input shaft for wear or damage. If worn or damaged, replace the shaft.
7. Make sure that the shock dampers slide smoothly on the input shaft splines and sliding surfaces.
8. Inspect the snap ring groove (C, Figure 269) on the input shaft for wear or damage. It must not be rounded off as it must hold the snap ring securely after the shaft is assembled. If worn or damaged, replace the shaft.
9. Inspect the spring (Figure 274). If broken or weak, replace the spring. BMW does not provide specifications for the overall length of the spring in the relaxed position.
10. Rotate the input shaft bearing (Figure 275) by hand. Check for roughness, noise and radial play. Any bearing that is suspect should be replaced.







### Input Shaft Assembly

1. Apply a light coat of clean transmission gear oil to all sliding surfaces before installing any parts.
2. If the bushing was removed, perform the following:
  - a. Position the bushing with the shoulder side going on last.
  - b. Slide the bushing onto the shaft until it bottoms out (A, **Figure 269**).
3. Slide on the shock damper front cam (**Figure 276**), the shock damper rear cam (**Figure 277**), the spring (**Figure 278**) and the kickstarter gear or spring seat (**Figure 279**) onto the input shaft.

#### NOTE

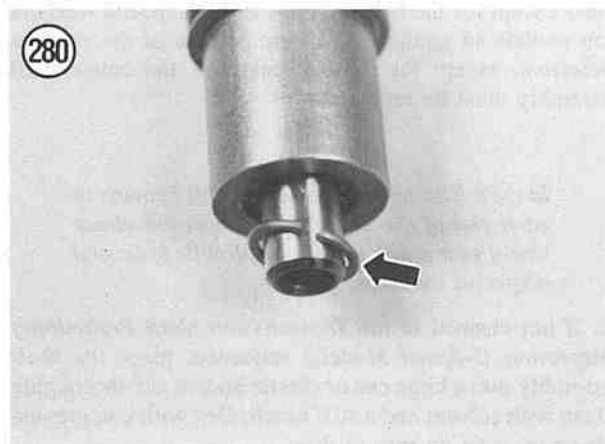
*The snap ring should be replaced every time the transmission is disassembled to ensure proper retention.*

4. Slide the new snap ring (**Figure 280**) onto the end of the input shaft.
5. Install the snap ring as follows:
  - a. Install the input shaft assembly (A, **Figure 266**) in the hydraulic press with the snap ring end facing up.
  - b. Place the special tool (B, **Figure 266**) fabricated in *Input Shaft Disassembly*, Step 13 onto the end of the input shaft assembly.
  - c. Center the special tool on the ledge of the kickstarter coupling or spring seat as shown in **Figure 267**.

#### WARNING

*The spring is very strong. Protect yourself accordingly in the event that the input shaft assembly and the special tool should move off of the hydraulic press plate.*

- d. While holding onto the input shaft assembly and the special tool, have an assistant slowly apply pressure.
- e. Compress the shaft only enough to gain access to the snap ring groove. The snap ring and groove must be visible.



- f. Have the assistant securely hold onto the input shaft assembly and the special tool. Working through the opening on each side of the special tool, use a narrow screwdriver and work the snap ring into the transmission groove on each side.
  - g. After the snap ring is completely installed into the groove, gradually relax the hydraulic pressure and make sure the snap ring is indexed properly in the groove.
  - h. Completely relax the hydraulic pressure and remove the shaft assembly and special tool from the hydraulic press.
6. On 1981-on models, install the small seal onto the end of the shaft.
  7. Position the cover plate (A, **Figure 281**) with the center raised shoulder going on first onto the front surface of the rear bearing.
  8. Position the rear ball-bearing bushing (B, **Figure 281**) into the front surface of the rear bearing and cover plate.
  9. Install the rear ball-bearing onto the end of the shaft.
  10. Position the input shaft on the press plates.

#### CAUTION

*When installing the ball-bearing, apply pressure only on the inner race. If pressure is applied to the outer race, the bearing will be damaged.*

11. Place a suitable size socket on the ball-bearing. The socket must fit onto the inner race of the bearing. Press the bearing on until it stops.
12. Measure the overall length of the assembled shaft (**Figure 282**) after assembly is complete. Compare to the dimension written down in Step 2 of *Input Shaft Disassembly*. The dimension should be the same. If not, determine and correct the problem.

#### Intermediate Shaft

##### Inspection and Bearing Replacement

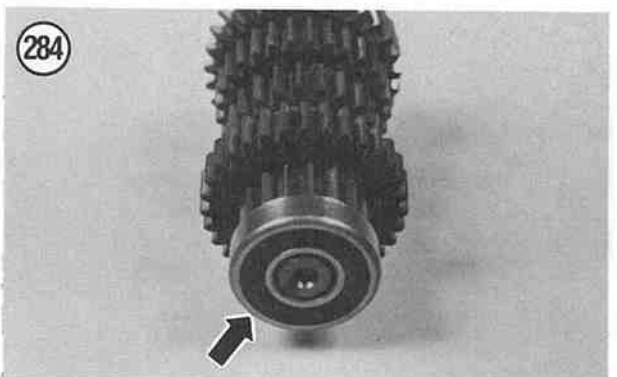
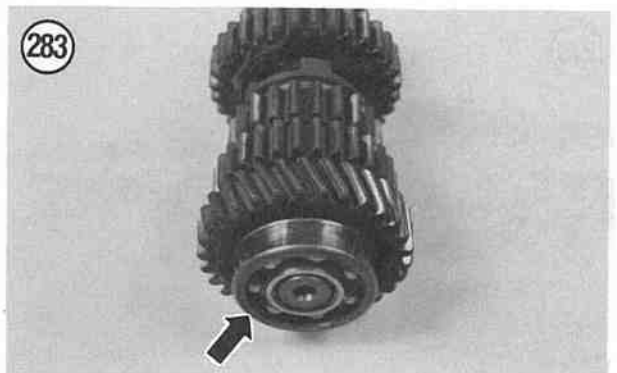
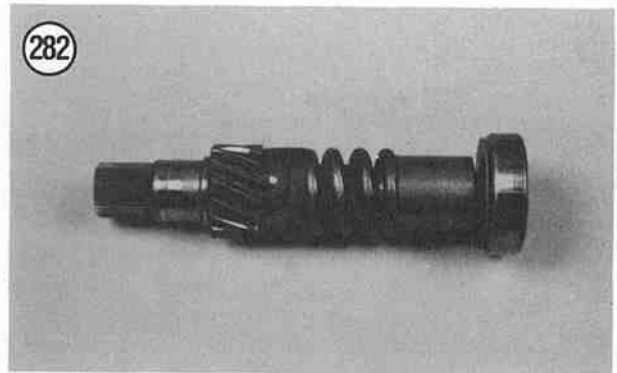
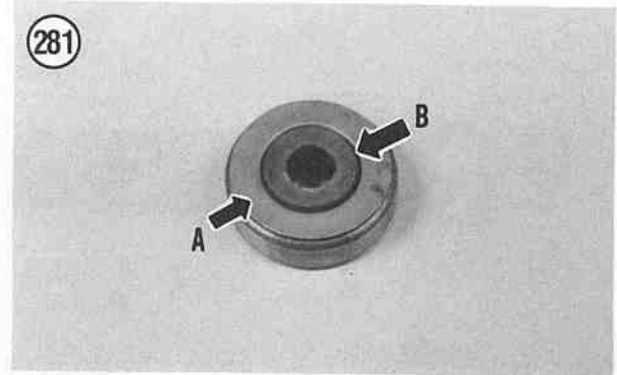
Refer to **Figure 263** for this procedure.

The intermediate shaft is one assembly with no removable parts except for the ball-bearings and the special washers (on models so equipped). If any portion of the shaft is defective, except for the ball-bearings, the entire shaft assembly must be replaced.

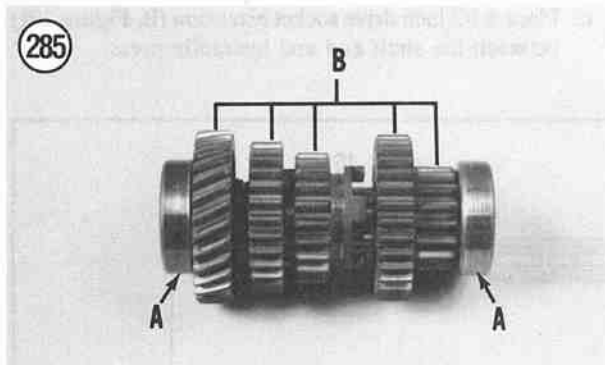
#### NOTE

*In the following procedure, the ball-bearing at each end of the shaft can be removed either with a gear puller or with a hydraulic press and a special tool insert.*

1. If not cleaned in the *Transmission Shaft Preliminary Inspection (5-Speed Models)* sequence, place the shaft assembly into a large can or plastic bucket and thoroughly clean with solvent and a stiff brush. Dry with compressed air or let it sit on rags to dry.



2. On models so equipped, remove the special washer from each end of the shaft.
3. Inspect the ball-bearing on each end of the shaft. Refer to **Figure 283** and **Figure 284**. Rotate each bearing with your fingers and check for roughness, pitting, galling and play. Make sure it rotates freely. If any roughness or play can be felt, the bearing(s) must be replaced.
4. If damaged, remove the ball-bearing(s) (A, **Figure 285**) from the end(s) of the intermediate shaft with a bearing puller or hydraulic press.



5. Check each gear for excessive wear, burrs, pitting or chipped or missing teeth (B, **Figure 285**).

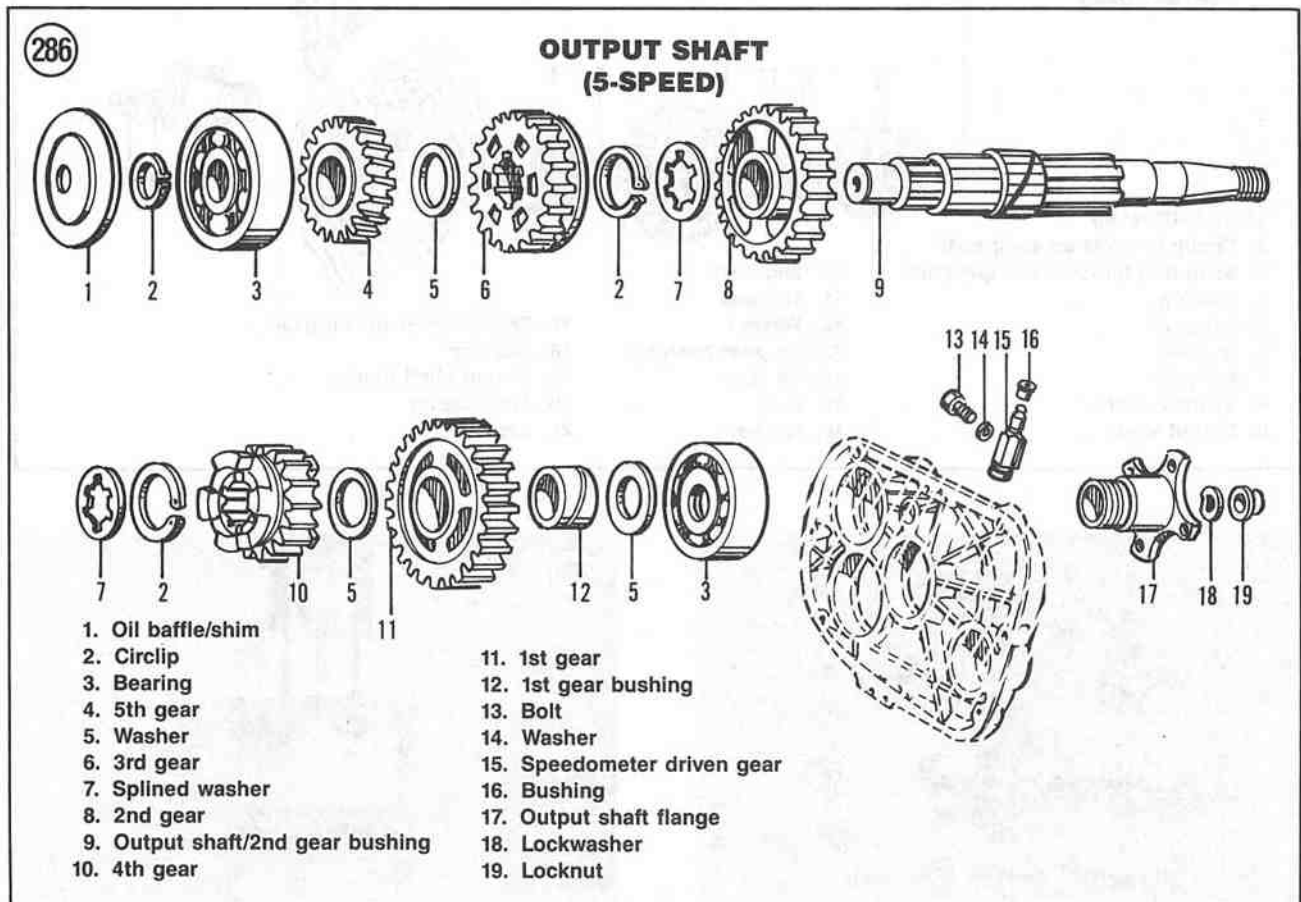
**CAUTION**

*When installing the ball-bearing, apply pressure only on the inner race. If pressure is applied to the outer race, the bearing will be damaged.*

6. Install the ball-bearing. Either press the bearing into place or tap it into place with a suitable size socket and hammer. Install the bearing until it stops.
7. On models so equipped, install the special washer onto each end of the shaft.

**Output Shaft Disassembly**

Refer to **Figure 286** or **Figure 287** for this procedure. The only difference between the two output shaft assemblies is the design and number of some of the gear engagement dogs. Some models have an additional circlip or two and these are identified in the procedure.

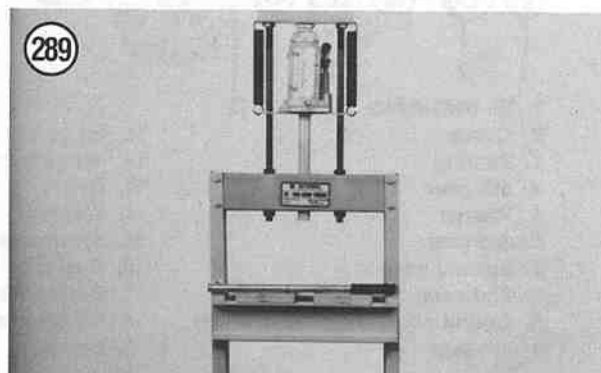
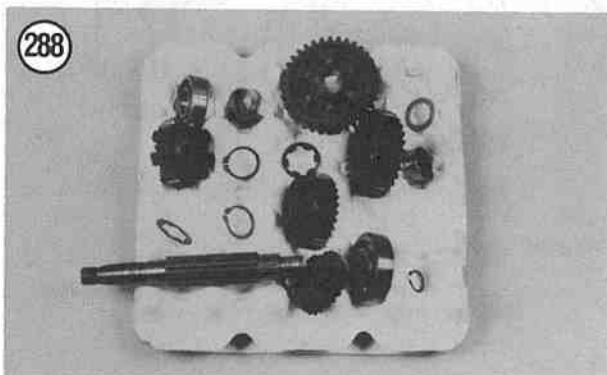
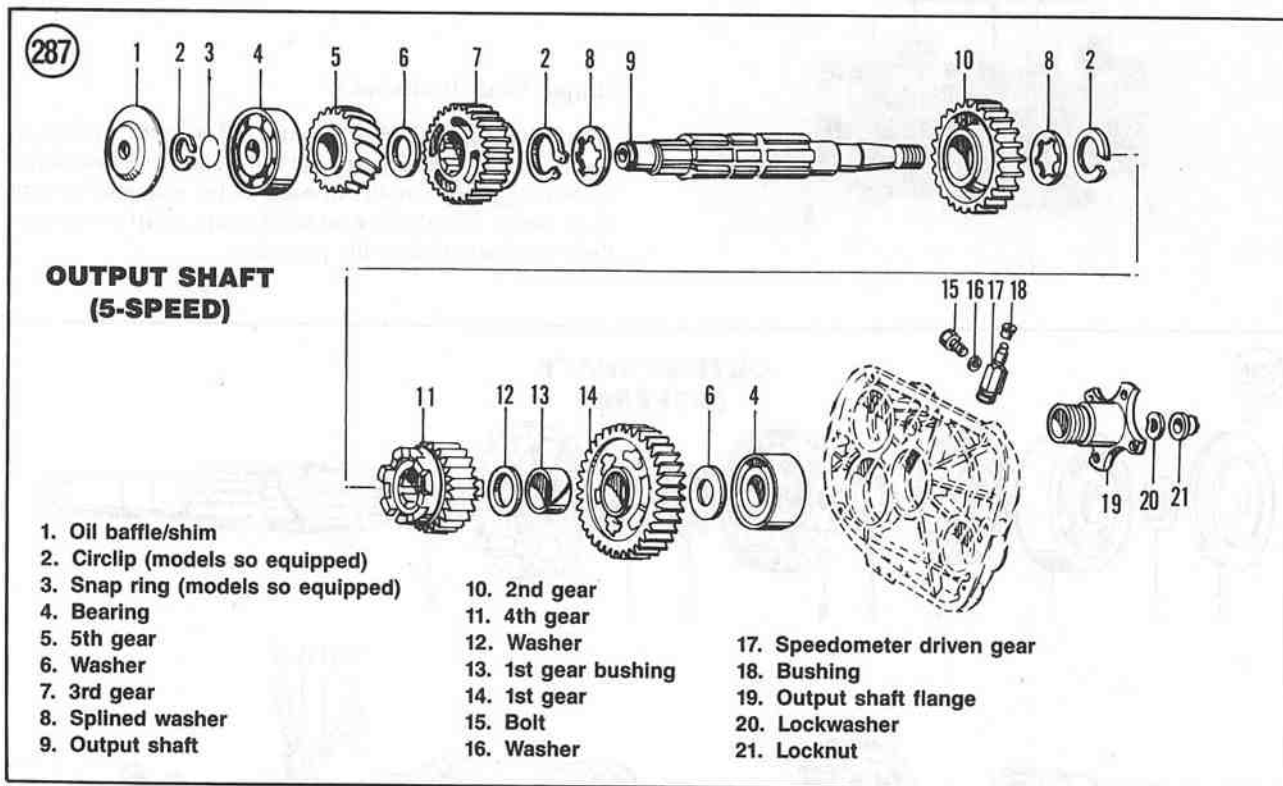


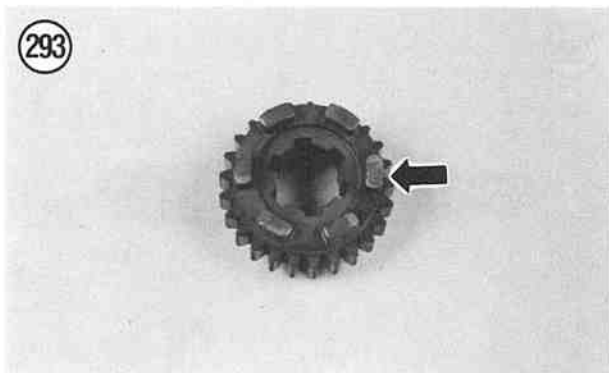
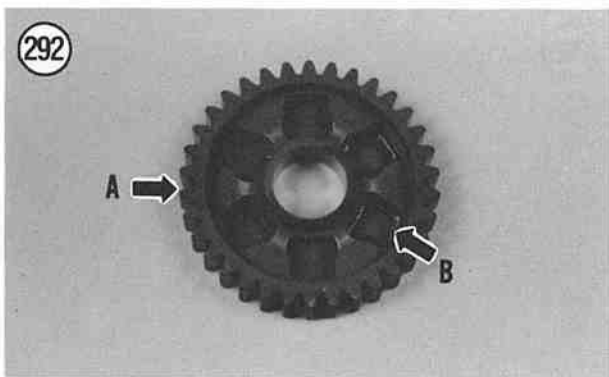
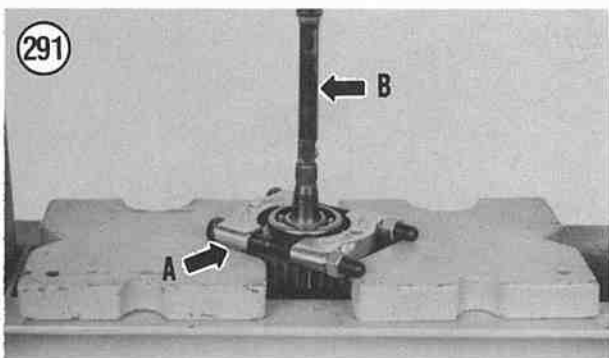
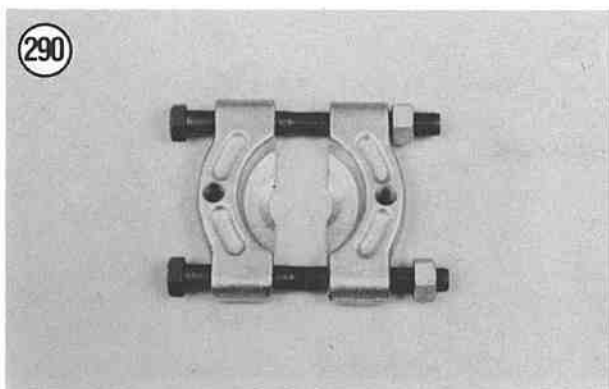
**NOTE**

A helpful "tool" that should be used for transmission disassembly is a large egg flat (the type that restaurants get their eggs in) as shown in **Figure 288**. As you remove a part from the shaft, set it in one of the depressions in the same position from which it was removed. This is an easy way to remember the correct relationship of all parts.

Disassembly of the input shaft requires the use of a hydraulic press (**Figure 289**), an insert (**Figure 290**) and a bearing puller.

1. If not cleaned in the *Transmission Shaft Preliminary Inspection (5-Speed Models)* sequence, place the assembled shaft into a large can or plastic bucket and thoroughly clean with solvent and a stiff brush. Dry with compressed air or let it sit on rags to dry.
2. Measure the overall length of the assembled shaft before disassembly. Write this dimension down, as it will be used for reference after the shaft is reassembled.
3. To remove the rear bearing, perform the following:
  - a. Install the insert (A, **Figure 291**) under the bearing at the front end of the shaft.
  - b. Place the transmission assembly in the hydraulic press.
  - c. Place a 1/2 inch drive socket extension (B, **Figure 291**) between the shaft end and hydraulic press.





- d. While holding onto the output shaft assembly, slowly press the bearing off of the shaft.
- e. Release the hydraulic pressure, then remove the drive socket extension and shaft assembly from the hydraulic press.
4. Slide off the thrust washer, 1st gear and the 1st gear bushing.
5. Slide off the thrust washer and the 4th gear.
6. Remove the circlip and slide off the splined washer and the 2nd gear.
7. Slide off the splined washer and remove the circlip.
8. Slide off the 3rd gear.
9. From the other end of the shaft, if still installed, slide off the oil baffle plate.
10. Remove the circlip and on models so equipped, the snap ring.
11. To remove the front bearing, perform the following:
  - a. Install the insert under the bearing.
  - b. Place the transmission assembly in the hydraulic press.
  - c. Place a 1/2 inch drive socket extension between the shaft end and hydraulic press.
  - d. While holding onto the output shaft assembly, slowly press the bearing off of the shaft.
  - e. Release the hydraulic pressure, remove the extension and shaft assembly from the hydraulic press.
12. Slide off the 5th gear and thrust washer.

### Output Shaft Inspection

#### NOTE

*Defective gears should be replaced. It is a good idea to replace the intermediate shaft assembly even though it may not show as much wear or damage. If you feel that the intermediate shaft requires replacement, discuss it with a BMW dealer and get their opinion as this shaft is very expensive.*

1. Check each gear for excessive wear, burrs, pitting or chipped or missing teeth (A, **Figure 292**).
2. Make sure the lugs (**Figure 293**) on the gears are in good condition. If chipped or damaged, replace the gear.
3. Inspect the lug receptacles (B, **Figure 292**) in each gear. If chipped, worn or damaged, replace the gear.
4. Check the inner splines (**Figure 294**) of the 3rd and 4th gears for excessive wear or burrs. Replace if necessary.
5. Inspect the machined gearshift fork groove (**Figure 295**) in each gear. Check for wear, gouges or other damage. Replace the gear if necessary.

#### NOTE

*BMW provides some clearance specifications for some gears and bushings. Refer to **Table I** and inspect the clearance on those listed.*



6. Check the 1st gear bushing (A, **Figure 296**) for excessive wear, pitting or damage. Replace the bushing if necessary. BMW does not provide specifications for either the inside or outside diameter of the bushings.

7. Make sure the bushing oil hole (**Figure 297**) is clear. Clean out with solvent and use a piece of wire if necessary.

8. Check 1st gear bushing surface (B, **Figure 296**) for excessive wear, pitting or damage. Replace the gear if necessary. BMW does not provide specifications for the inside diameter of the gear.

9. Check the inner splines (**Figure 298**) of the 2nd gear bushing for excessive wear or burrs. Replace if necessary.

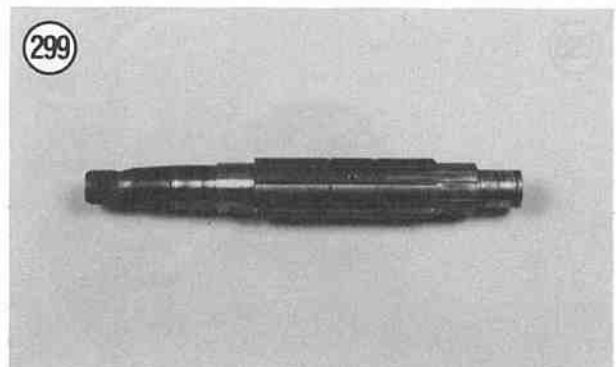
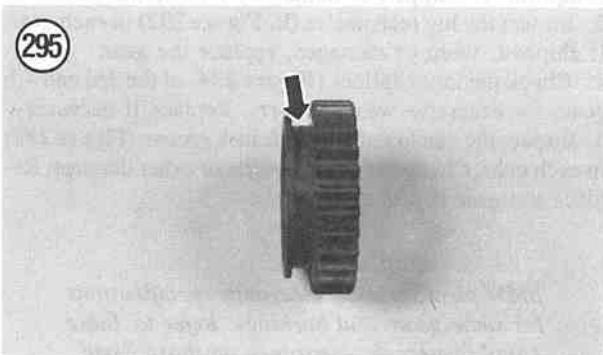
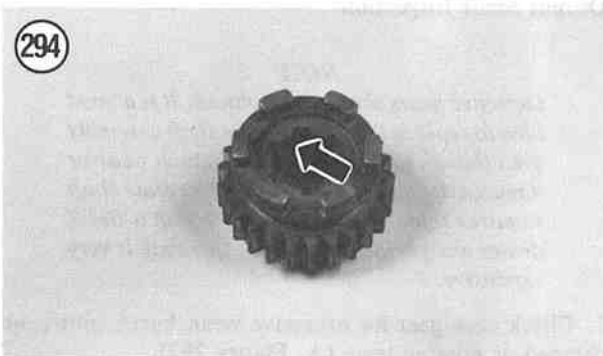
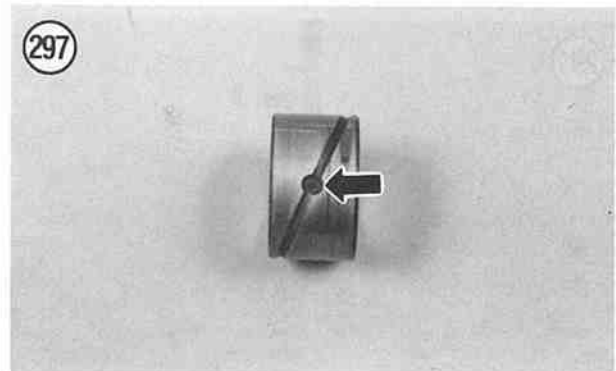
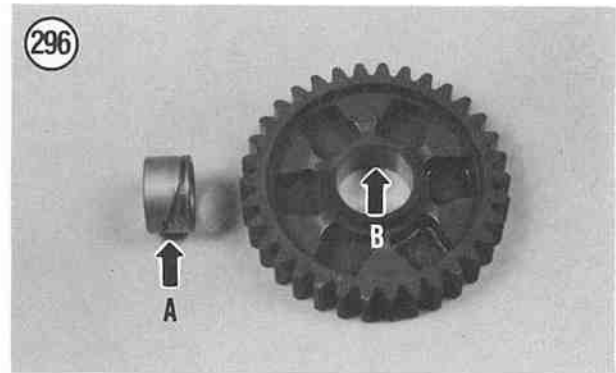
10. Make sure that all gears and bushings slide smoothly on the output shaft.

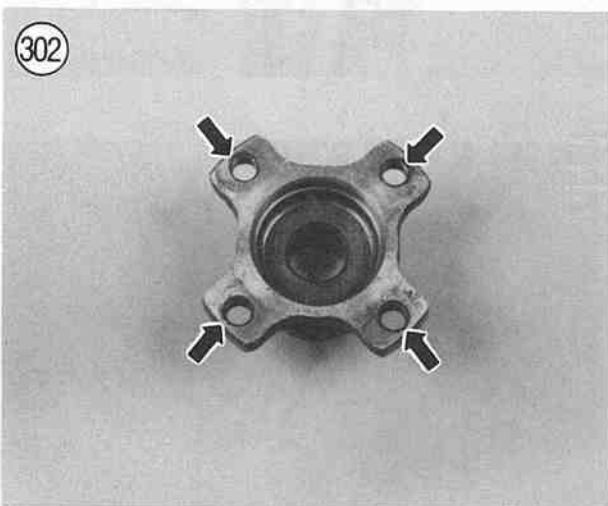
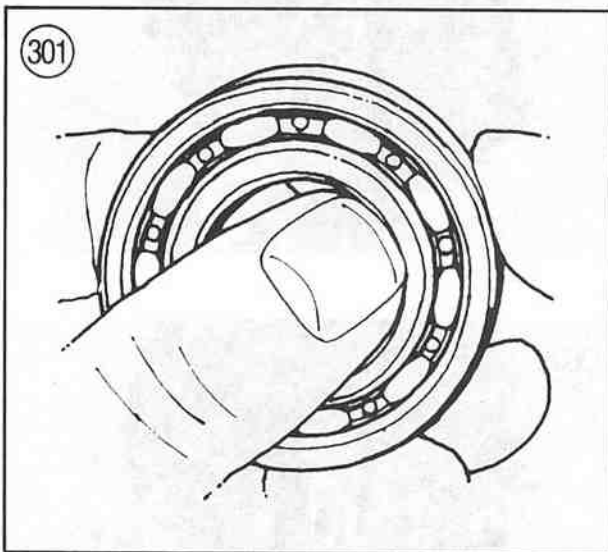
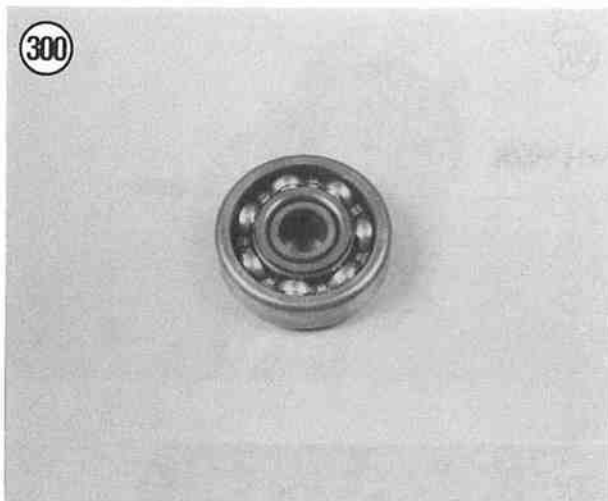
11. Inspect the splines and circlip grooves (**Figure 299**) on the output shaft. If any are damaged, the shaft must be replaced.

12. Inspect the ball bearings (**Figure 300**). Rotate the bearing with your fingers (**Figure 301**) and check for roughness, pitting, galling and play. Make sure it rotates freely. If any roughness or play can be felt, the bearing(s) must be replaced.

13. Inspect the output shaft flange mounting tangs and threaded holes (**Figure 302**) for wear or damage. Replace if necessary.

14. Inspect the speedometer drive gear (**Figure 303**) portion of the output shaft flange for wear or damage. Check for excessive wear, burrs, pitting or chipped or missing teeth. Replace if necessary.





### Output Shaft Assembly

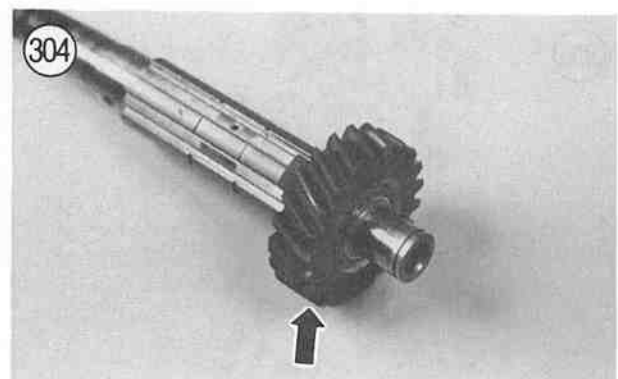
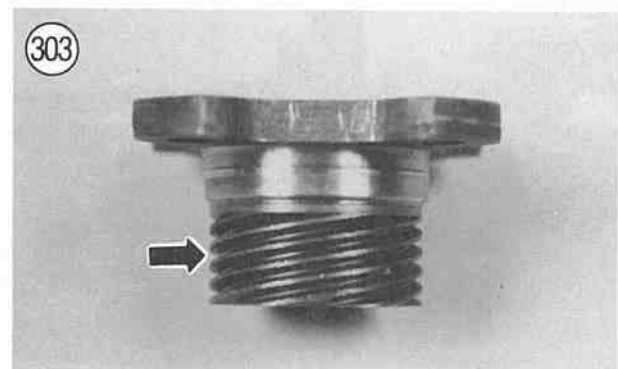
#### NOTE

All circlips should be replaced every time the transmission is disassembled to ensure proper gear alignment. Transmission circlips become worn with use and increase gear side play. For this reason, it is always better to use new circlips whenever the transmission shaft is being reassembled. When installing circlips, slide them onto the shaft with the rounded side going on first. This will position the sharp side outward to take the gear thrust correctly. Do not expand a circlip more than necessary to slide it over the shaft. If the circlip is expanded too far it will become distorted and will not grip the shaft sufficiently, resulting in a loose fit.

#### NOTE

The tapered end of the output shaft is threaded to accept the output shaft flange and its retaining nut.

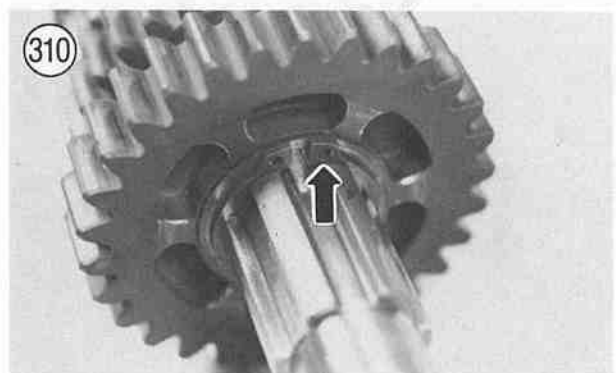
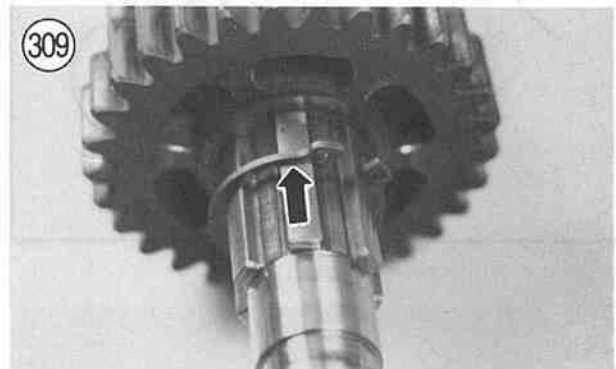
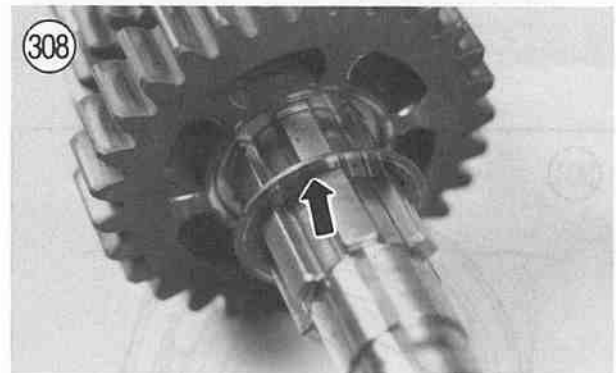
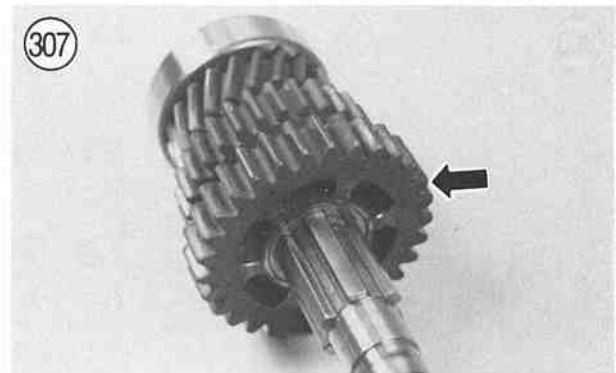
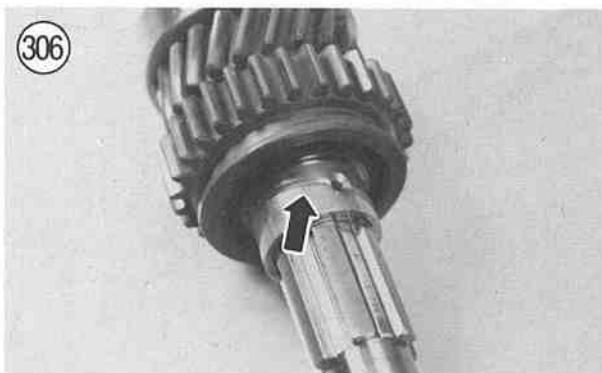
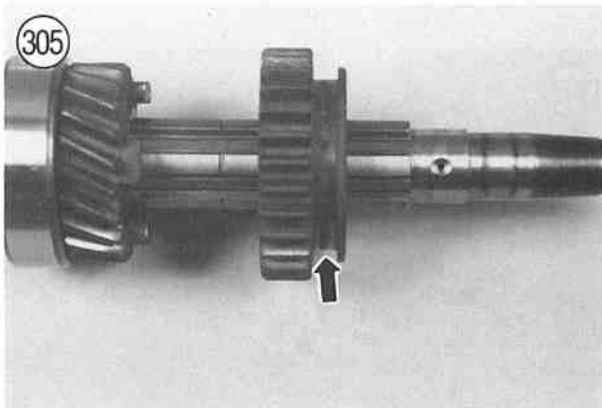
1. Apply a light coat of clean gear oil to all sliding surfaces of the gears, bushings and shaft before installing any parts.
2. Slide the thrust washer onto the front end of the shaft.
3. Position the 5th gear with the engagement dog side going on first and slide on the 5th gear (Figure 304).

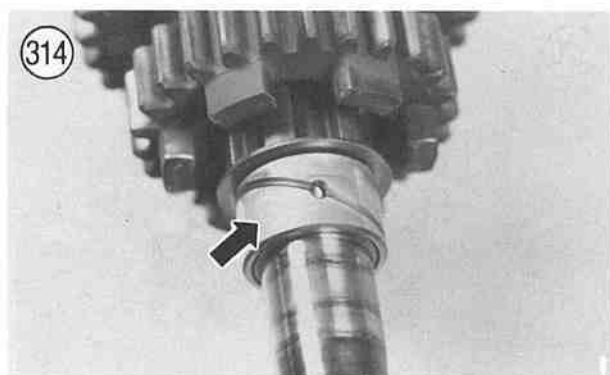
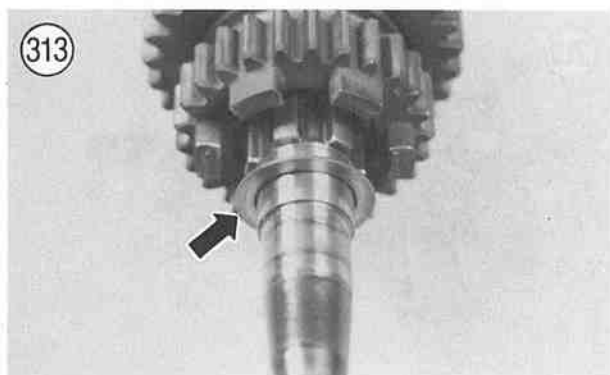
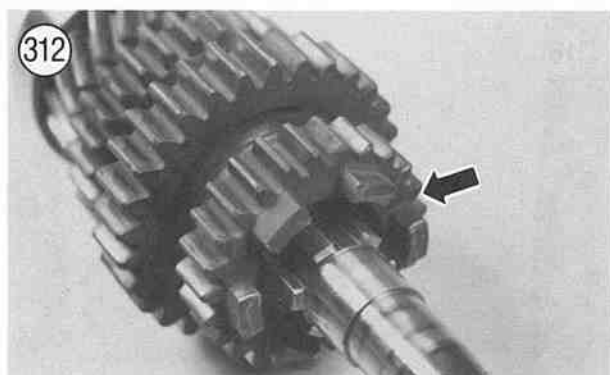
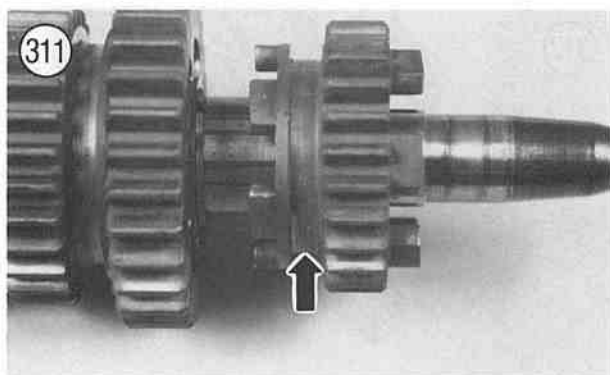


**CAUTION**

*When installing the ball bearing, apply pressure only on the inner race. If pressure is applied to the outer race, the balls and the inner and outer races will be damaged.*

4. To install the ball bearing, perform the following:
  - a. Place the insert on the plates of the hydraulic press.
  - b. Place the transmission shaft assembly into the hydraulic press.
  - c. Place a suitable size socket onto the inner race of the bearing.
  - d. Slowly apply pressure on the socket and press the ball bearing onto the output shaft.
  - e. Press the bearing on until it bottoms out.
  - f. Release the hydraulic pressure and remove the shaft assembly from the hydraulic press.
5. After the bearing has been pressed into place, spin it with your fingers to make sure it rotates freely with no binding.
6. On models so equipped, install a new snap ring. Make sure the snap ring is correctly seated in the output shaft groove.
7. Install the *new* circlip. Make sure the circlip is correctly seated in the output shaft groove.
8. Position the 3rd gear with the gear selector fork groove going on last (**Figure 305**) and slide on the 3rd gear.

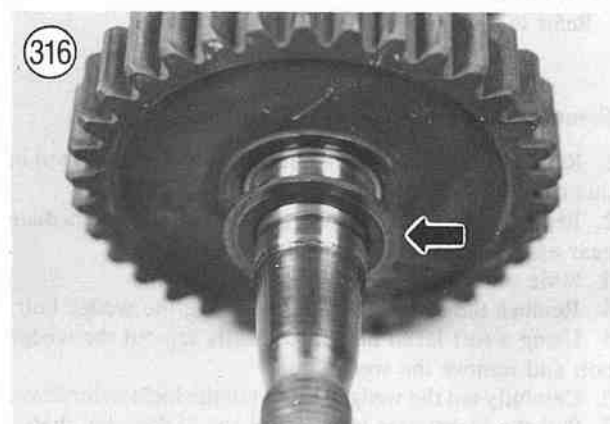
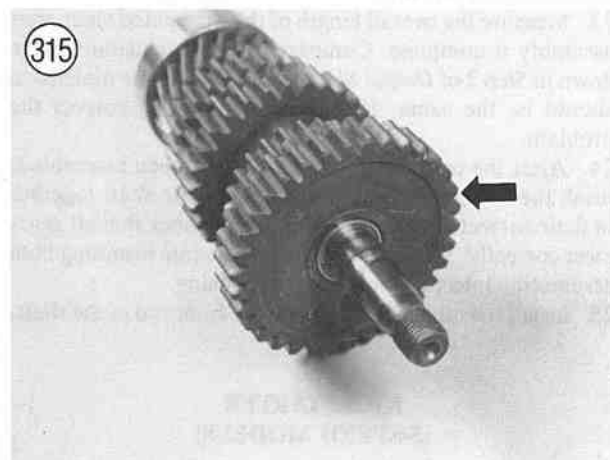




9. Install the *new* circlip. Make sure the circlip is correctly seated in the output shaft groove.
10. Slide on the splined washer.
11. Slide on the 2nd gear bushing (Figure 306).
12. Position the 2nd gear with the flush side going on last and slide on the 2nd gear (Figure 307).
13. Slide on the splined washer (Figure 308).
14. Install the *new* circlip (Figure 309). Make sure the circlip is correctly seated in the output shaft groove (Figure 310).
15. Position the 4th gear with the gear selector fork groove (Figure 311) side going on first and slide on the 4th gear (Figure 312).
16. Slide on the thrust washer (Figure 313) and the 1st gear bushing (Figure 314).
17. Slide on the 1st gear (Figure 315).
18. Slide on the thrust washer (Figure 316).

#### CAUTION

*When installing the ball-bearing, apply pressure only on the inner race. If pressure is applied to the outer race, the bearing will be damaged.*



19. To install the ball-bearing bushing, perform the following:

- a. Install the ball bearing onto the end of the shaft (**Figure 317**).
- b. Place the transmission shaft assembly (**A, Figure 318**) on the plate of the hydraulic press.
- c. Place a suitable size deep socket (**B, Figure 318**) onto the ball bearing (**C, Figure 318**). The socket must fit the inner race and must also be large on the inside to clear the threads on the end of the output shaft. If the inner surface of the socket touches the shaft the threads will be damaged and the socket may get pressed onto the shaft by mistake.
- d. Slowly press the ball bearing onto the shaft. Press it on until it bottoms out.
- e. Relax the hydraulic pressure and remove the socket and the output shaft from the hydraulic press.

20. After the bearing has been pressed into place, spin it with your fingers to make sure it rotates freely with no binding.

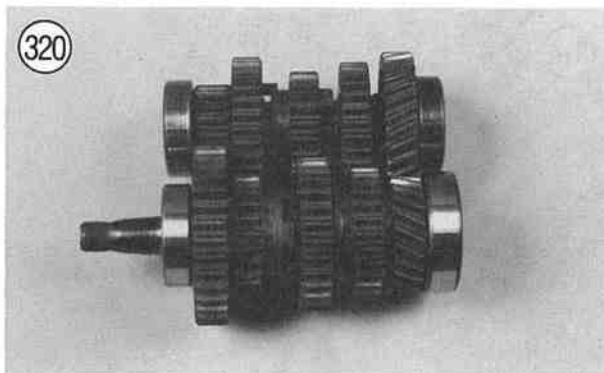
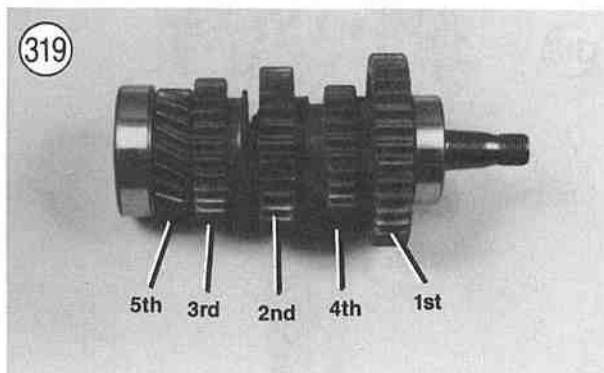
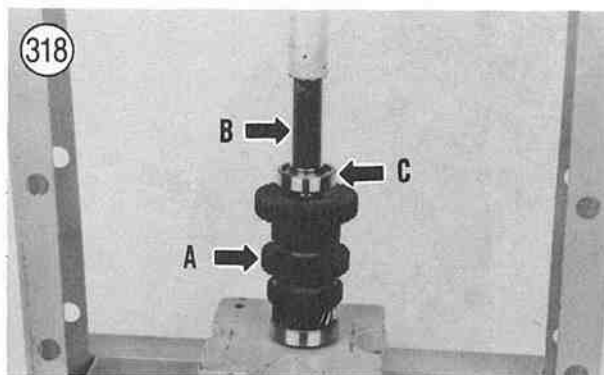
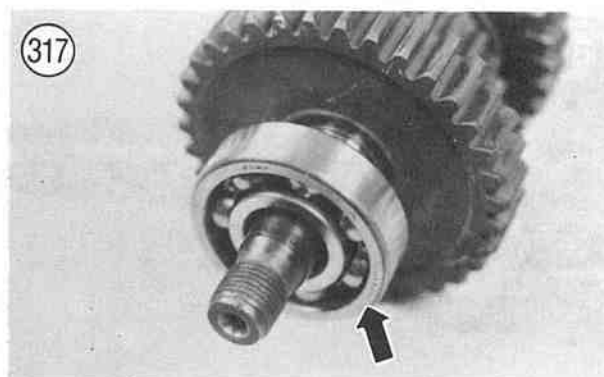
21. Refer to **Figure 319** for correct placement of all gears. Make sure all circlips are seated correctly in the output shaft grooves.

22. Make sure each gear engages properly to the adjoining gear where applicable.

23. Measure the overall length of the assembled shaft after assembly is complete. Compare to the dimension written down in Step 2 of *Output Shaft Disassembly*. The dimension should be the same. If not, determine and correct the problem.

24. After the output shaft assembly has been assembled, mesh the output shaft and the intermediate shaft together in their correct position (**Figure 320**). Check that all gears meet correctly. This is your last check before installing both assemblies into the transmission housing.

25. Install the oil baffle plate onto the front end of the shaft.



### KICKSTARTER (5-SPEED MODELS)

The kickstarter is an optional item on all models except the R80G/S.

Refer to **Figure 321** for this procedure.

#### Removal/Installation

1. Remove the transmission housing cover as described in this chapter.
2. Remove the circlip securing the kickstarter intermediate gear and remove the intermediate gear.
3. Slide off the shim.
4. Remove the nut and washer securing the wedge bolt.
5. Using a soft-faced mallet, carefully tap out the wedge bolt and remove the wedge bolt.
6. Carefully tap the wedge bolt out of the kickstarter lever.
7. Pull the kickstarter lever off of the kickstarter shaft.



8. Carefully withdraw the kickstarter shaft and gear assembly from the housing cover.
9. Remove the return spring and special washer from the kickstarter shaft.
10. Install by reversing these removal steps. Note the following during installation.
11. Install a new circlip and make sure it is correctly seated in the shaft groove.

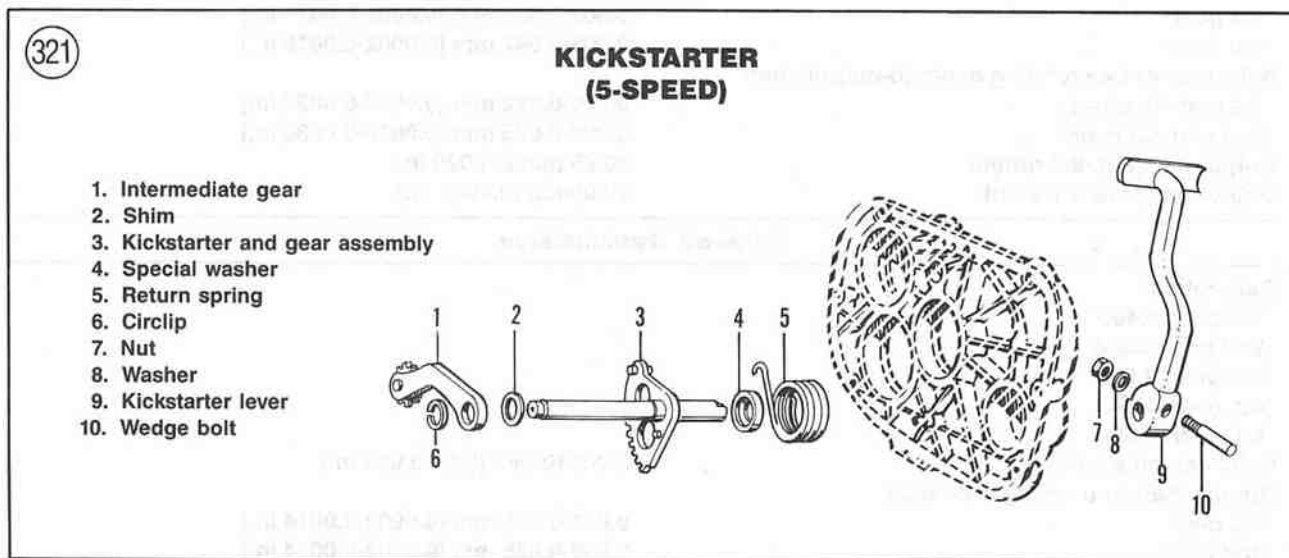
**NOTE**

*If the bike has a lot of miles on it, install a new kickstarter return spring.*

12. Install the return spring into the hole in the cover, then wind the spring *clockwise* and insert the other end in the hole in the gear shaft.

**Inspection**

1. Inspect the spring for weakness or damage. Replace if necessary. BMW does not provide any specifications for the spring.
2. Check each gear for excessive wear, burrs, pitting or chipped or missing teeth. Replace as a set if necessary.



**Table 1 TRANSMISSION AND GEARSHIFT MECHANISM SPECIFICATIONS**

4-speed (1970-1973) and 5-speed (1974-on) constant mesh transmission with integral spring damper Claw-type shift fork shifting mechanism Foot-operated shift lever	
<b>4-Speed Transmission</b>	
Gear ratios	
1st gear: 3.896	
2nd gear: 2.578	
3rd gear: 1.875	
4th gear: 1.500	
End float (all shafts)	0.0-0.10 mm (0.00-0.004 in.)
Output shaft-to-bushing clearance	
1st gear	0.005-0.035 mm (0.0002-0.0014 in.)
4th gear	0.005-0.047 mm (0.0002-0.0019 in.)
Axial play of free rotating gears-to-output shaft	
1st and 4th gears	0.040-0.082 mm (0.0016-0.0032 in.)
2nd and 3rd gears	0.025-0.075 mm (0.0010-0.0030 in.)
Output flange radial runout	±0.05 mm (0.0020 in.)
Output flange face runout	±0.05mm (0.0020 in.)
<b>5-Speed Transmission</b>	
Gear ratios:	
1st gear: 4.400	
2nd gear: 2.860	
3rd gear: 2.070	
4th gear: 1.670	
5th gear: 1.500	
End float (all shafts)	0.0-0.10 mm (0.00-0.004 in.)
Output shaft-to-bushing clearance	
1st gear	0.005-0.035 mm (0.0002-0.0014 in.)
2nd gear	0.005-0.035 mm (0.0002-0.0014 in.)
Axial play of free rotating gears-to-shaft	0.15-0.30 mm (0.006-0.012 in.)
Output flange radial runout	±0.05 mm (0.0020 in.)
Output flange face runout	±0.05 mm (0.0020 in.)
Transmission oil (4-speed and 5-speed)	
Capacity: 800 cc (1.7 pt.)	
Hypod gear oil GL5	
SAE 80W/90	

**Table 2 TRANSMISSION TORQUE SPECIFICATIONS**

Item	N•m	in.-lb.	Ft.-lb.
Transmission housing-to-engine mounting bolt/nuts			
1970-1980	20-24	—	15-18
1981-on	33	—	24
Transmission housing cover nuts/bolts	7-9	62-80	—
Transmission output flange nuts			
4-speed	220-240	—	162-177
5-speed	221	—	163
Transmission filler plug	28-31	—	21-23
Transmission drain plug	23-26	—	17-19

**NOTE:** If you own a 1990 or later model, first check the Supplement at the back of this book for any new service information.

## CHAPTER SEVEN

# CARBURETORS, EMISSION CONTROLS AND EXHAUST SYSTEM

The fuel system consists of the fuel tank, two shutoff valves, two carburetors (one for each cylinder) and an air filter assembly. The exhaust system consists of two exhaust pipes and, depending on model and year, either a single or dual muffler assembly.

The emission controls consist of a crankcase emission system and, on 1980-on California models, an evaporative emission control system.

This chapter includes service procedures for all parts of the fuel system and exhaust system. Air filter service is covered in Chapter Three.

The stock BMW carburetor specifications are covered in **Table 1** located at the end of this chapter.

### CARBURETOR OPERATION

For proper operation, a gasoline engine must be supplied with fuel and air mixed in proper proportions by weight. A mixture in which there is an excess of fuel is said to be rich. A lean mixture is one which contains insufficient fuel. A properly adjusted carburetor supplies the proper mixture to the engine under all operating conditions.

The carburetor consists of several major systems. A float and float valve mechanism maintain a constant fuel level in the float bowl. The pilot system supplies fuel at low speeds. The main fuel system supplies fuel at medium and high speeds. A starter (choke) system supplies the very rich mixture needed to start a cold engine.

### CARBURETOR SERVICE

Major carburetor service (removal and cleaning) should be performed at the intervals indicated in **Table 1** in Chapter Three or when poor engine performance, hesitation and little or no response to mixture adjustment is observed. Alterations in jet size, needle position, etc., should be attempted only if you're experienced in this type of "tuning" work; a bad guess could result in costly engine damage or, at least, poor performance. If, after servicing the carburetors and making the adjustments described in this chapter, the bike does not perform correctly (and assuming that other factors affecting performance are correct, such as proper compression and ignition component condition, etc.), the bike should be checked by a BMW dealer or a qualified performance tuning specialist.

Slight variations exist between different model carburetors. Pay particular attention to the location and order of parts during carburetor disassembly.

### SLIDE-TYPE CARBURETOR (BING AND DELL'ORTO)

Because of the number of models and years covered in this manual, the carburetors are separated by manufacturer. If you are working on an older used bike, it may not still be equipped with the original carburetors. The carburetors may have been replaced with different types. Refer to the carburetor itself and not to the BMW owner's manual that will refer to the type of carburetor originally installed on the bike.

### Removal/Installation (All Models)

#### WARNING

*Do not attempt to remove the carburetor(s) while the engine is still hot. Any spilled fuel that may land on a hot cylinder could ignite leading to a dangerous fire. Allow the engine to cool down before removing the carburetor.*

1. Turn the fuel shutoff valve on each side to the OFF position (A, **Figure 1**).
2. Disconnect the fuel line (B, **Figure 1**) from the fuel shutoff valve. Plug the end with a golf tee to prevent the dribbling of fuel and prevent the entry of foreign matter.
- 3A. On Bing carburetors, perform the following:
  - a. Unscrew the large ring nut securing the top cover of the carburetor body and carefully lift out the throttle slide valve. Keep the ring nut and O-ring seal on the top cover.
  - b. If the slide valve is not to be removed, carefully move the throttle cable up and out of the way.
  - c. Place the slide valve assembly in a plastic bag and tape it closed around the throttle cable. Make sure the jet needle is not damaged.
- 3B. On Dell'Orto carburetors, perform the following:
  - a. Remove the small screws securing the top cover to the carburetor body and carefully lift out the throttle slide valve.
  - b. If the slide valve is not to be removed, carefully move the throttle cable up and out of the way.
  - c. Place the slide valve assembly in a plastic bag and tape it closed around the throttle cable. Make sure the jet needle is not damaged.
  - d. Loosen the choke cable adjuster locknut and unscrew the choke cable guide from the carburetor body. Pull the choke cable and choke slide out of the choke body.
4. Loosen the hose clamps on the intake tube (A, **Figure 2**). Move the clamps away from the ends of the tube.
5. Carefully remove the intake tube from the engine and carburetor.
6. Loosen the hose clamps on the rubber intake tube (B, **Figure 2**) on the cylinder head.
7. Carefully turn and pull the carburetor back out of the engine cylinder head.
8. Using duct tape, cover the inlet opening in the cylinder to keep out foreign matter.
9. Install by reversing these removal steps. Note the following.
10. Apply a light film of rubber lubricant such as Armor All around both ends of the rubber intake tube and to the intake tube to ease carburetor installation.

#### CAUTION

*Make sure that all carburetor mounting points are well secured and air-tight. Any leaks*

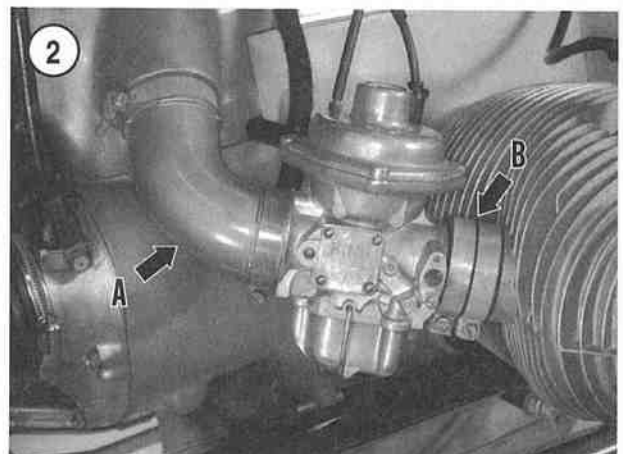
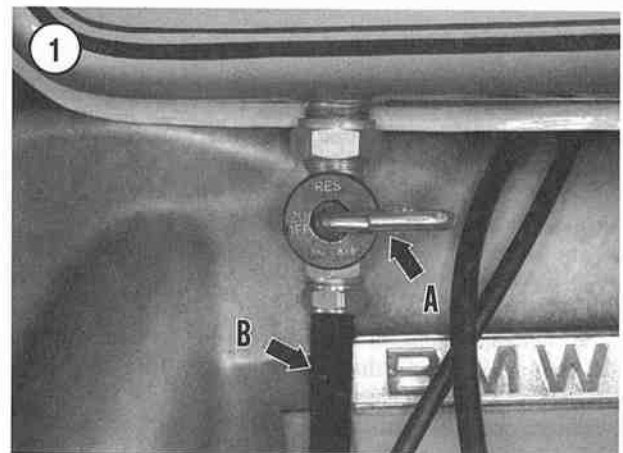
*around the engine intake tube or rubber intake tube can easily cause serious engine damage from dirt or a too-lean fuel mixture.*

11. Make sure that the carburetor is properly positioned and tighten all clamp screws evenly and securely.
12. If necessary, adjust the carburetor as described in Chapter Three.
13. On Dell'Orto carburetors, apply a small amount of blue Loctite Threadlocker No. 242 to the screws securing the top cover.
14. Repeat for the other carburetor if necessary.
15. Connect the fuel lines and turn the fuel shutoff valves to the ON position. Check for fuel leaks and correct before starting the engine.

### Disassembly/Assembly (Bing Slide Valve Carburetor)

It is suggested that only one carburetor be serviced at a time to avoid the intermixing of parts.

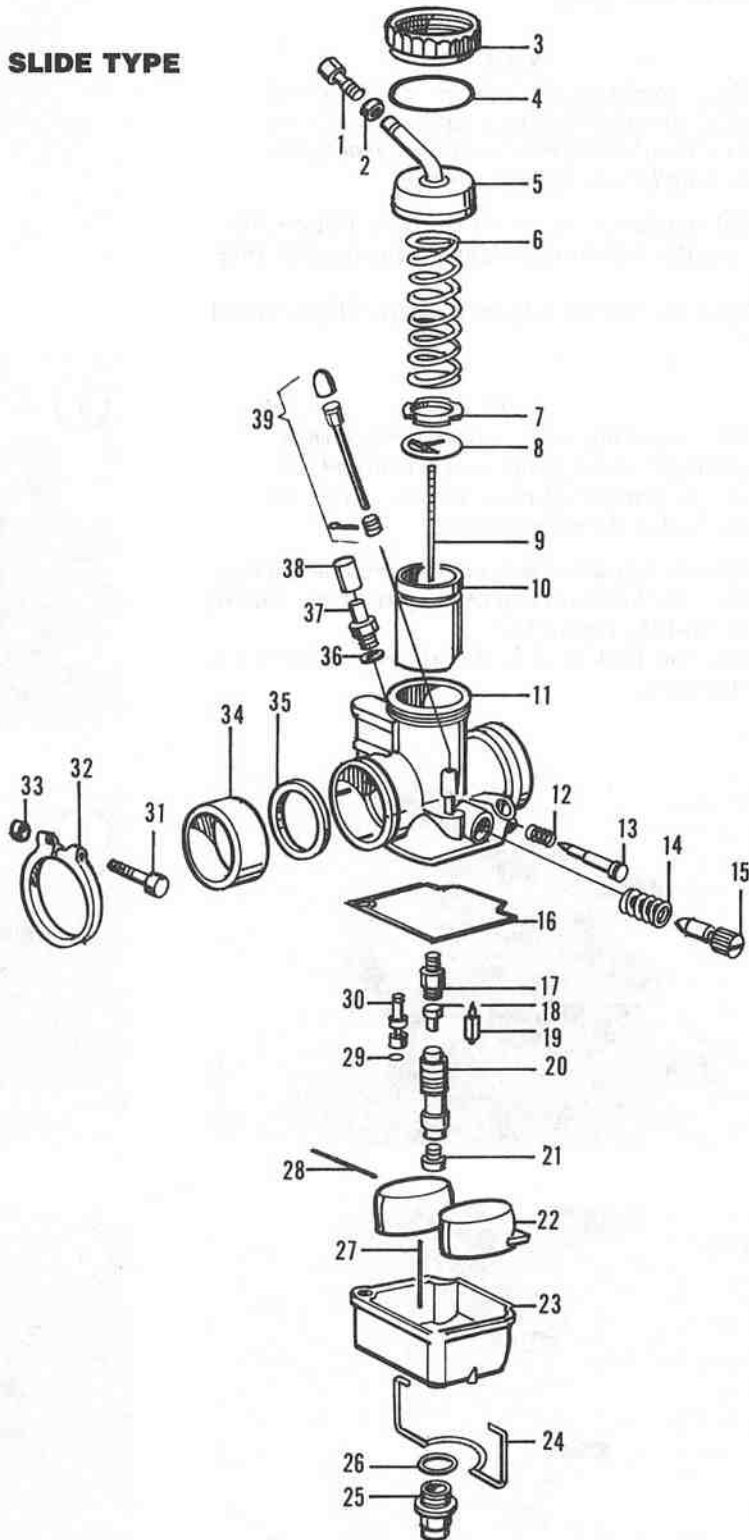
Refer to **Figure 3** for this procedure.



3

**CARBURETOR—BING SLIDE TYPE**

1. Cable adjuster
2. Locknut
3. Ring nut
4. O-ring
5. Top cover
6. Spring
7. Washer
8. Needle retainer
9. Slide needle
10. Slide valve
11. Carburetor body
12. Spring
13. Mixture adjust screw
14. Spring
15. Idle adjust screw
16. Float bowl gasket
17. Needle jet holder
18. Needle jet
19. float needle valve
20. Accelerator pump assembly
21. Main jet
22. Float
23. Float bowl
24. Float bowl clip
25. Drain bolt
26. Gasket
27. Vent tube
28. Float pivot pin
29. O-ring
30. Pilot jet
31. Bolt
32. Clamp
33. Nut
34. Insulating bushing
35. Insulating washer
36. O-ring
37. Fuel inlet nipple
38. Filter
39. Tickler assembly





1. Remove the large drain plug from the bottom of the float bowl and drain any residual fuel from the carburetor. Reinstall the drain plug.

**NOTE**

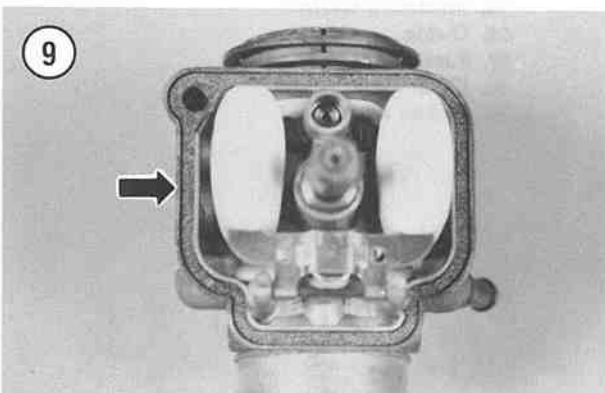
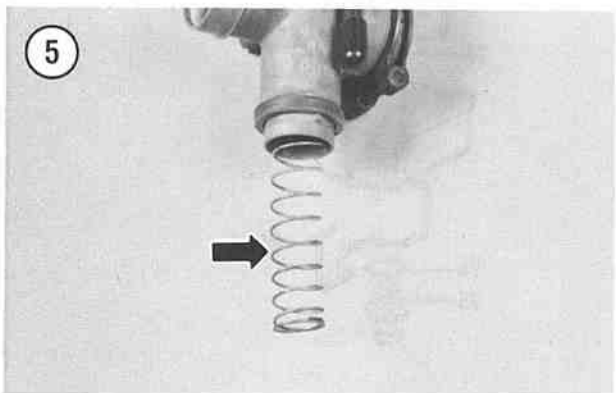
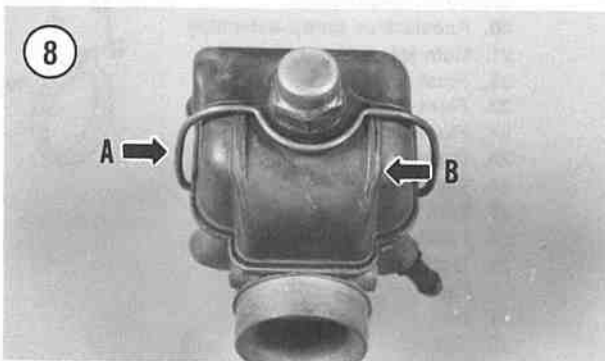
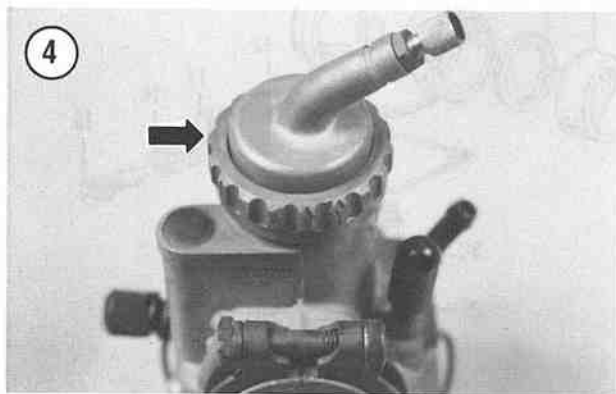
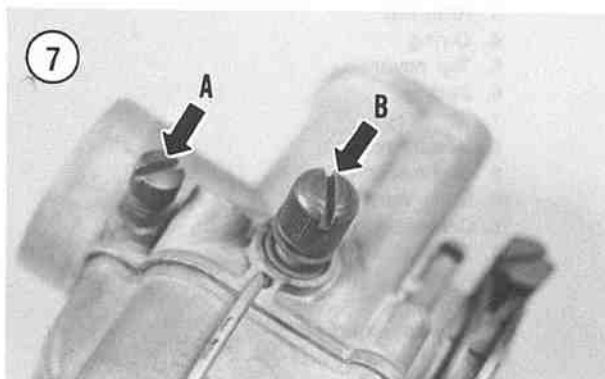
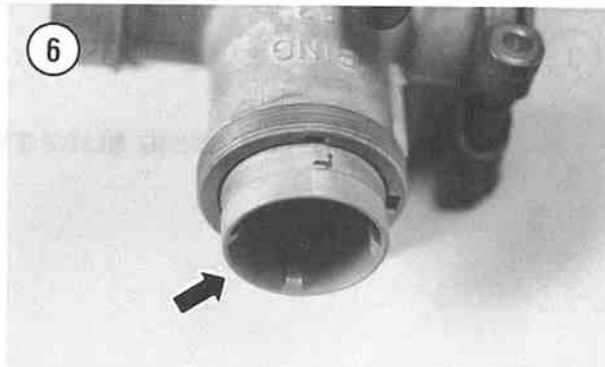
*Before removing the mixture adjust screw, carefully screw it in until it **lightly** seats. Count and record the number of turns so that it can be installed in the same position.*

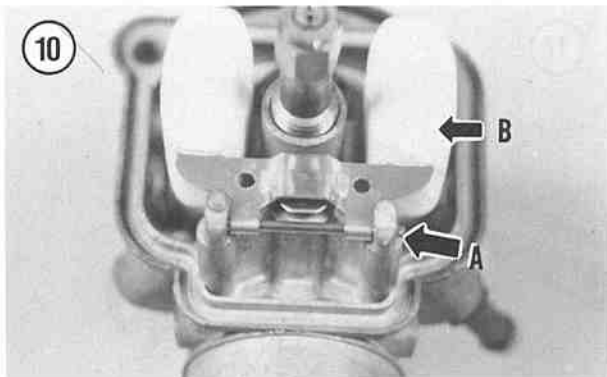
2. If still attached, unscrew the top cover (Figure 4).
3. Remove the slide spring (Figure 5) and the slide (Figure 6).
4. Unscrew the mixture adjust screw (A, Figure 7) and spring.

**NOTE**

*Before removing the idle adjust screw, carefully screw it in until it **lightly** seats. Count and record the number of turns so that it can be installed in the same position.*

5. Unscrew the idle adjust screw (B, Figure 7) and spring.
6. Unhook the float bowl clip (A, Figure 8) and remove the float bowl (B, Figure 8).
7. Remove the float bowl gasket (Figure 9) from the carburetor body.





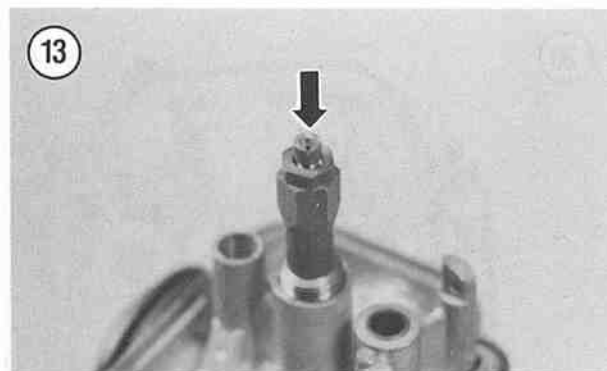
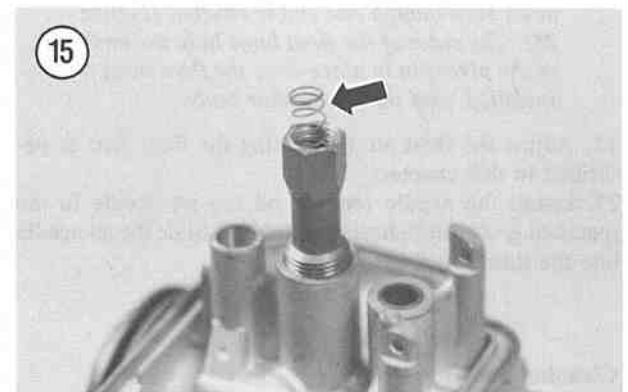
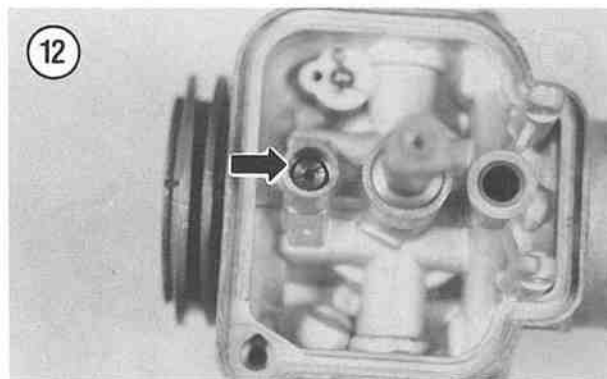
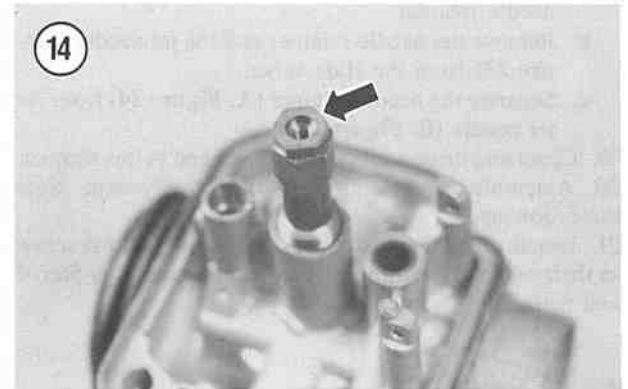
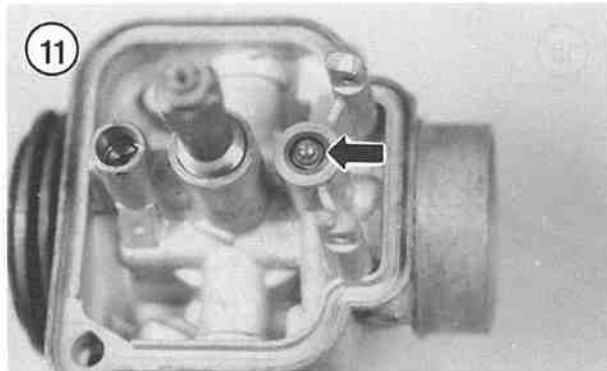
8. Slide out the pivot pin (A, Figure 10) securing the float and lift off the float (B, Figure 10).

9. Remove the float needle valve (Figure 11). Take care not to damage the end of the needle valve.

10. Unscrew and remove the pilot jet (Figure 12).

11. Remove the following parts from the accelerator pump housing:

- a. Unscrew the main jet (Figure 13).
- b. Unscrew the cap nut (Figure 14).
- c. Remove the spring (Figure 15) and the plunger (Figure 16).



12. Unscrew the accelerator pump housing (Figure 17).
13. Unscrew the needle jet (Figure 18) and the needle jet holder (Figure 19).
14. Remove the cotter pin (Figure 20) securing the choke assembly.
15. Withdraw the choke assembly (A, Figure 21).
16. If necessary, unscrew the fuel inlet nipple and gasket (B, Figure 21).
17. Remove the insulating bushing and its washer from the carburetor outlet.
18. To remove the jet needle from the throttle slide valve, perform the following:
  - a. Remove the washer (Figure 22) from the top of the needle retainer.
  - b. Remove the needle retainer and the jet needle (Figure 23) from the slide valve.
  - c. Separate the needle retainer (A, Figure 24) from the jet needle (B, Figure 24).
19. Clean and inspect all parts as described in this chapter.
20. Assemble by reversing these disassembly steps. Note the following.
21. Install the idle adjust screw and mixture adjust screw in their original positions as noted in *Disassembly* Step 4 and Step 5.

#### NOTE

The float pivot pin is **not** secured in the pivot posts even though one end is knurled (Figure 25). The sides of the float bowl hold the ends of the pivot pin in place once the float bowl is installed onto the carburetor body.

22. Adjust the float after installing the float arm as described in this chapter.
23. Install the needle retainer on the jet needle in the specified groove as indicated in Table 1. Slide the jet needle into the throttle valve.

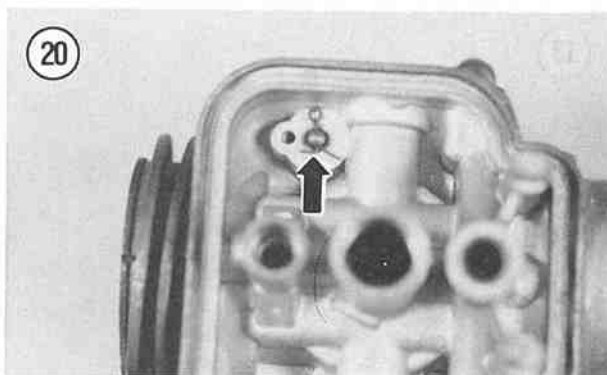
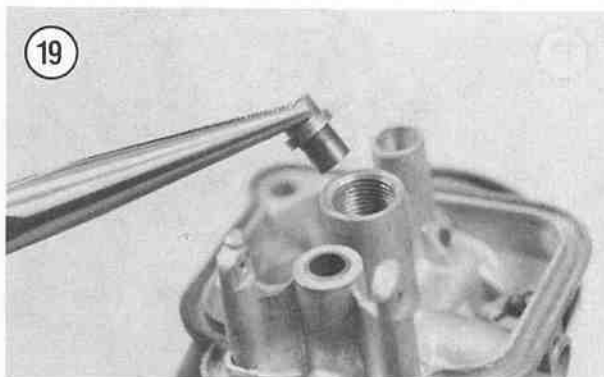
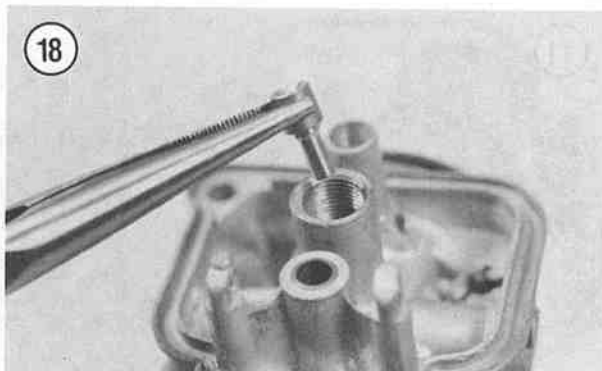
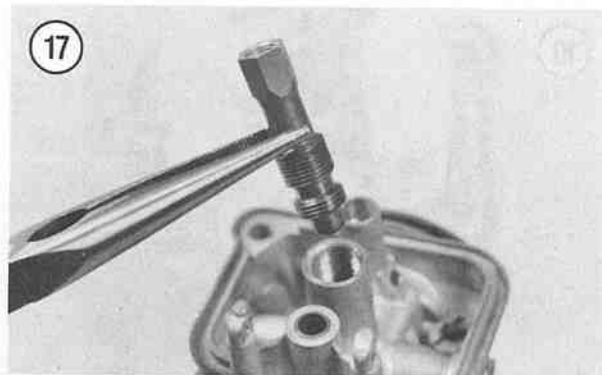
#### Cleaning and Inspection

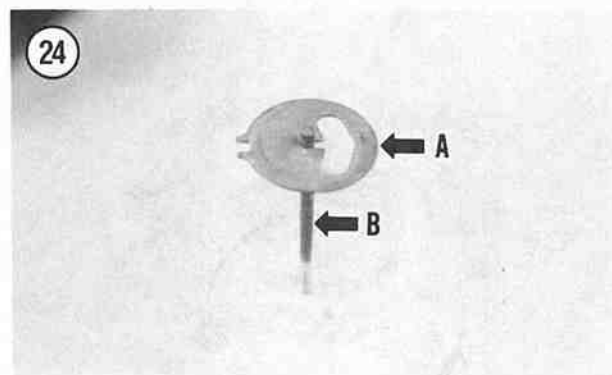
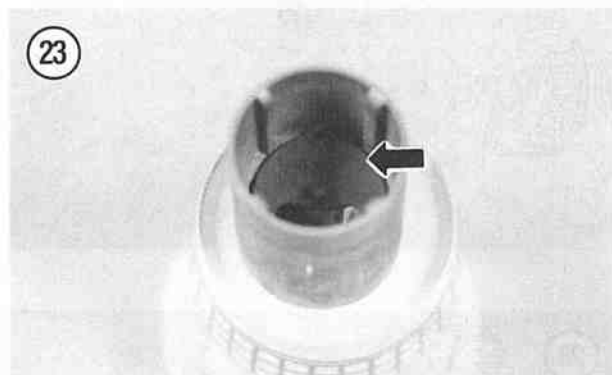
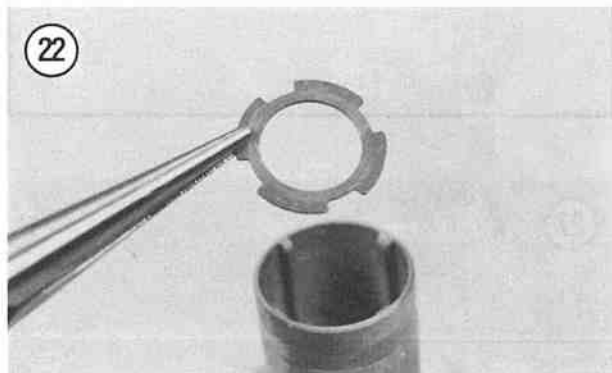
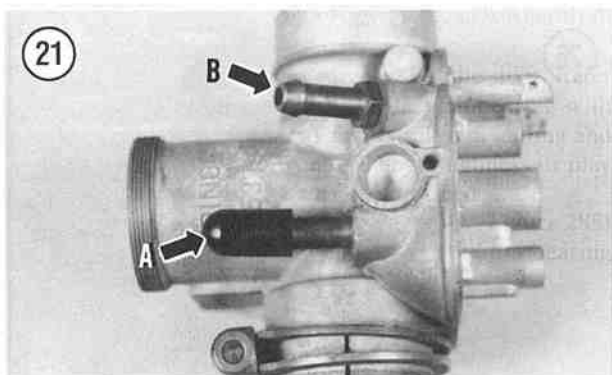
#### WARNING

Carburetor cleaner is extremely caustic and can cause permanent eye damage. Always wear eye protection when using any type of carburetor cleaner.

The carburetors are best cleaned by completely disassembling them and cleaning the fuel and air orifices with an aerosol carburetor cleaner. Never use a wire to clean out jets or orifices; such a process could enlarge the passage which would adversely affect the air-to-fuel ratio.

Motorcycle carburetors have much smaller air and fuel passages than automotive carburetors. For this reason, soaking the carburetor parts in an automotive type





carburetor cleaner is not recommended. Motorcycle carburetors are usually coated with a corrosion-protective clear coating. Caustic liquid cleaners will remove the protective coatings from the outside of the carburetor body. The dissolved coating could plug passages in the carburetor as well as damage the appearance of the carburetors. Also, if the cleaner was used previously there will be sediment held in suspension within the solution. These could also plug a passage.

Clean the carburetor parts in a good grade of solvent and thoroughly dry with compressed air. Many good aerosol carburetor cleaners (i.e. Zep Choke and Carburetor Cleaner) can help remove any residue not removed with the solvent. Thoroughly rinse off all parts with clean water and dry with compressed air. If you do not have access to compressed air, place the cleaned parts on a piece of newspaper and allow to dry.

Never use carburetor cleaner on gaskets, O-rings or plastic parts. These non-metal parts could be damaged by the cleaner.

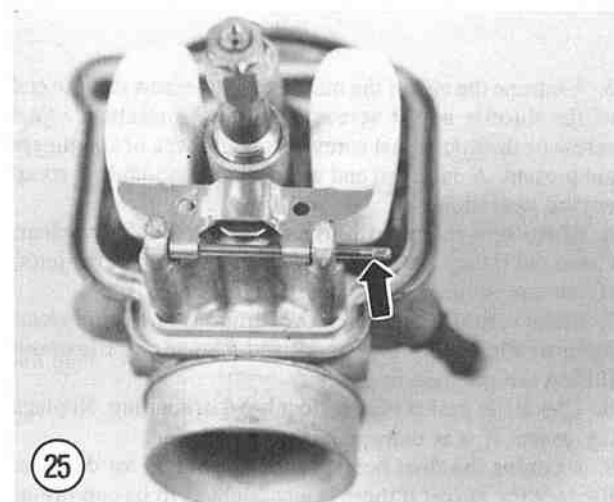
1. Clean all parts, except rubber or plastic parts, in a good grade of aerosol carburetor cleaner or cleaning solvent.

**NOTE**

*A special carburetor cleaner is **not** usually necessary to clean a carburetor unless it is very dirty or corroded. A good grade of parts cleaning solvent will usually clean most carburetors sufficiently.*

**CAUTION**

*Do not put non-metallic parts such as floats, gaskets and O-rings in special carburetor cleaners as these components will be damaged. Clean these components in common solvent or kerosene.*



- Blow out all the jets and passages in the carburetor body with compressed air.

**CAUTION**

*If compressed air is not available, allow the parts to air dry or use a clean lint-free cloth. Do not use paper towels to dry carburetor parts, as small paper particles may plug openings in the carburetor body or jets.*

**CAUTION**

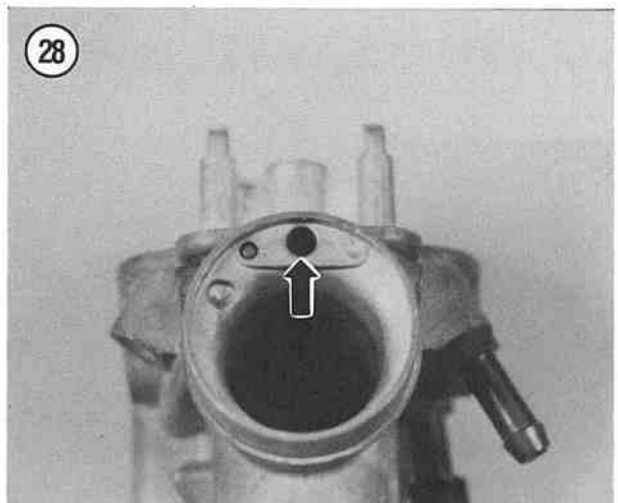
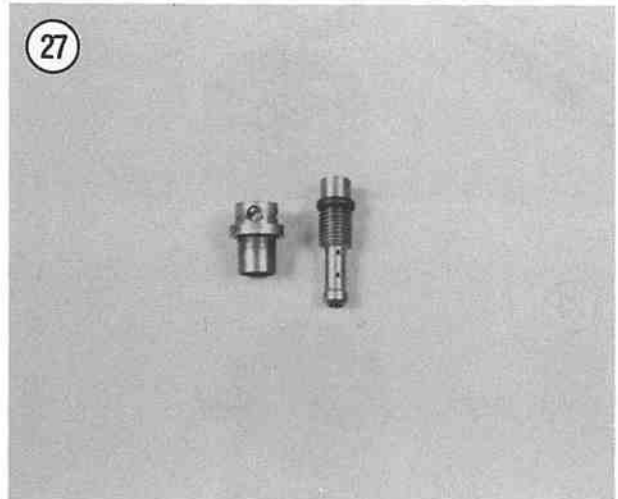
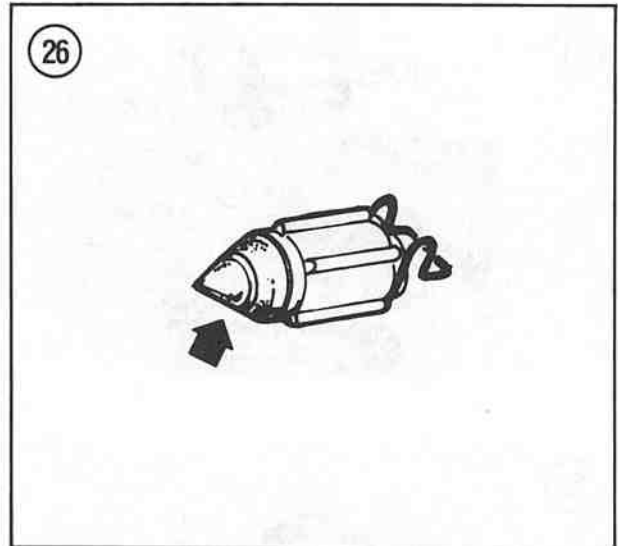
*Never use wire to clean any jets or orifices in the carburetor body. The wire could enlarge and damage the precise sizes of the jets or openings, resulting in poor carburetor performance.*

- Check the tip of the needle valve (**Figure 26**) and the inside of the needle valve body. Replace the complete needle valve assembly if the tip is scored or damaged. A damaged needle valve or a particle of dirt or grit in the needle valve assembly will cause the carburetor to flood and overflow fuel.
- Inspect the throttle slide valve for scoring or galling. Replace the throttle valve if not perfect.

**WARNING**

*A damaged throttle slide valve can cause the carburetor to stick open resulting in loss of throttle control that may cause a serious accident.*

- Examine the end of the mixture adjust screw and the end of the throttle adjust screw. Replace the mixture adjust screw or throttle adjust screw if any grooves or roughness are present. A damaged end will prevent smooth low-speed engine operation.
- Make sure the holes in the jets (**Figure 27**) are clear. Clean out if they are plugged in any way. Replace the jet(s) if you cannot unplug the hole(s).
- Make sure all openings in the carburetor body are clear. Refer to **Figure 28**, **Figure 29** and **Figure 30**. Clean out if they are plugged in any way.
- Check the gasket on the float bowl drain plug. Replace the gasket if it is damaged.
- Examine the float bowl gasket (**Figure 9**) for damage. Replace the gasket if there is any doubt as to its condition.

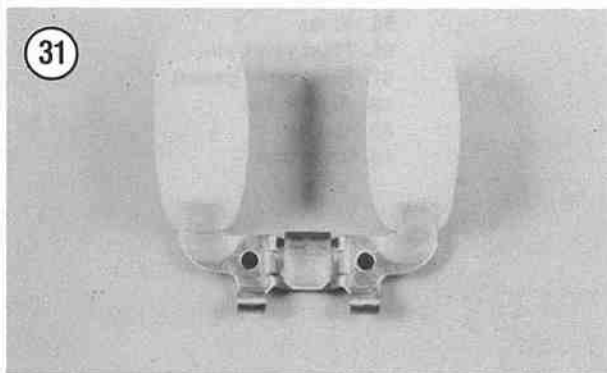
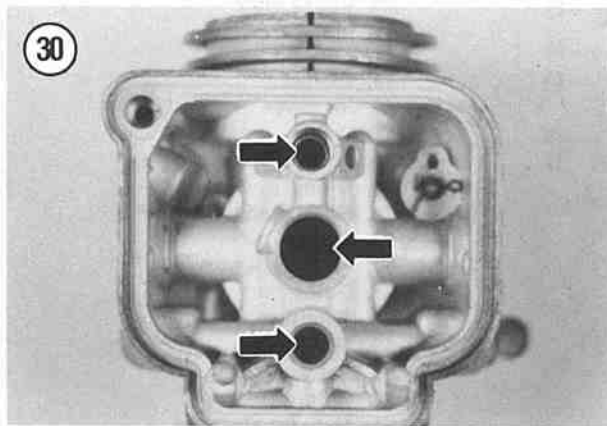
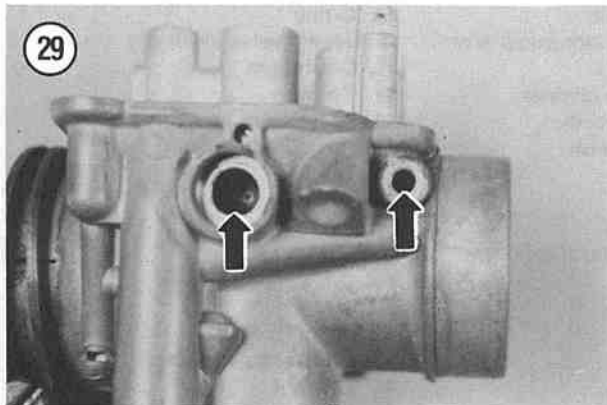




10. Shake the float assembly (Figure 31). Listen for fuel sloshing around inside, indicating that the float has leaked. Replace the float if there is any indication of fuel within the float.

**Disassembly/Assembly  
(Dell'Orto Slide Carburetor)**

It is suggested that only one carburetor be serviced at a time to avoid the intermixing of parts.



Refer to Figure 32 for this procedure.

1. If still installed, remove the bolts (A, Figure 33) securing the top cover (B, Figure 33) and remove the cover, spring and slide.
2. Loosen the clamp bolt and remove the clamp (Figure 34) from the outlet side of the carburetor.

**NOTE**

*Before removing the mixture adjust screw, carefully screw it in until it lightly seats. Count and record the number of turns so that it can be installed in the same position.*

3. Unscrew the mixture adjust screw (Figure 35), spring, flat washer and O-ring seal (Figure 36).

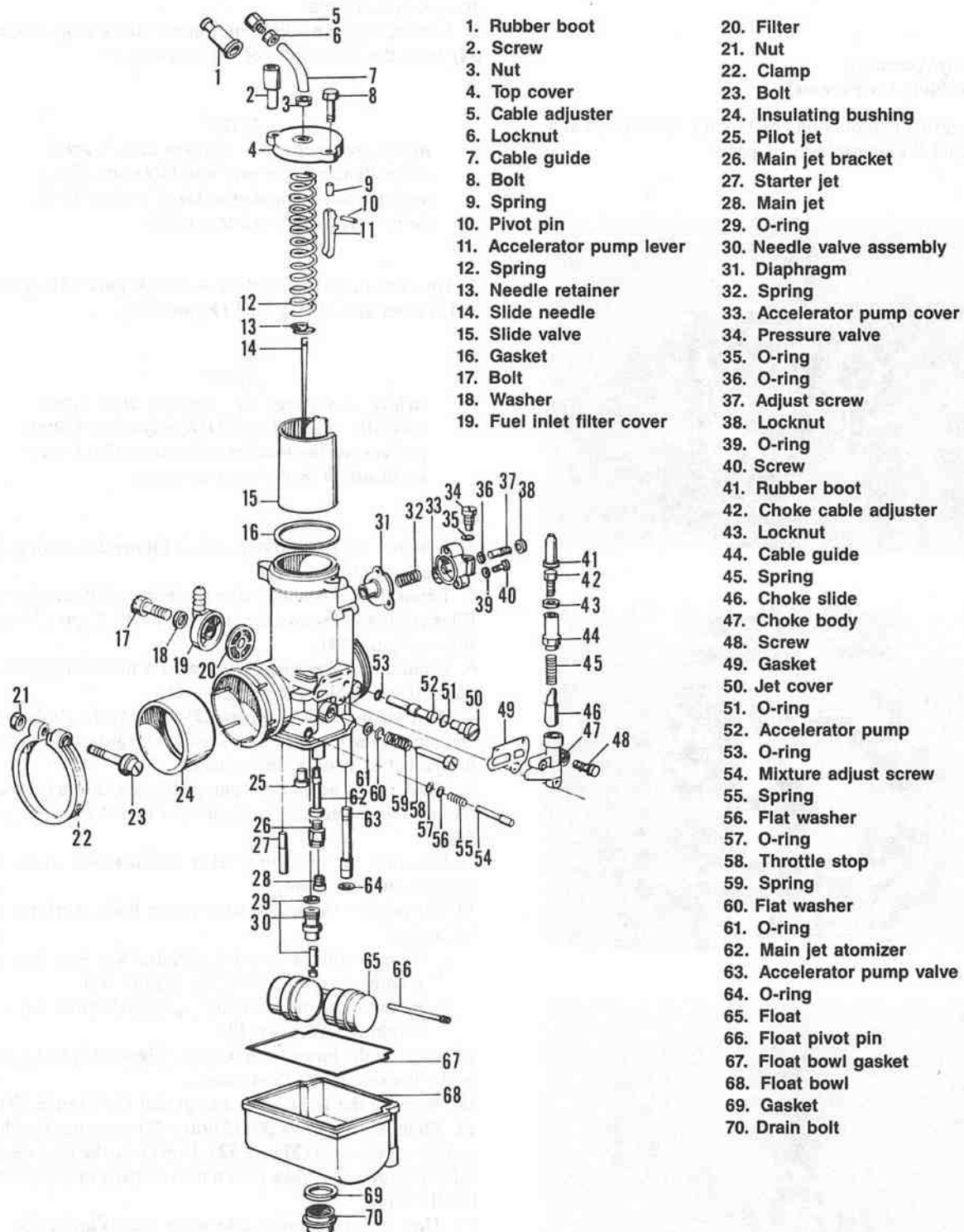
**NOTE**

*Before removing the throttle stop screw, carefully screw it in until it lightly seats. Count and record the number of turns so that it can be installed in the same position.*

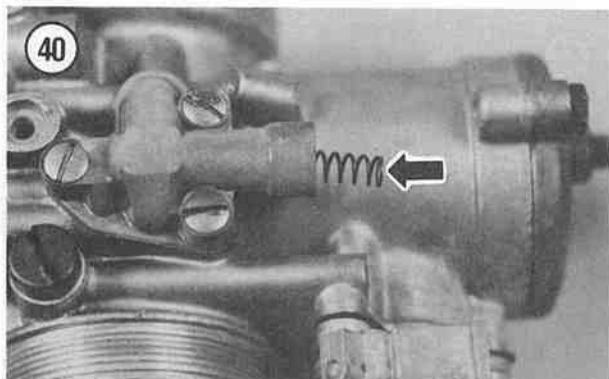
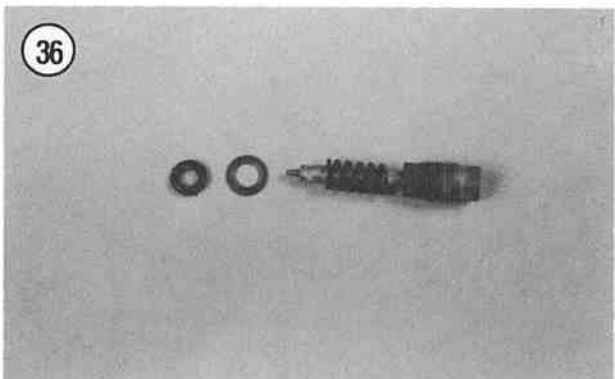
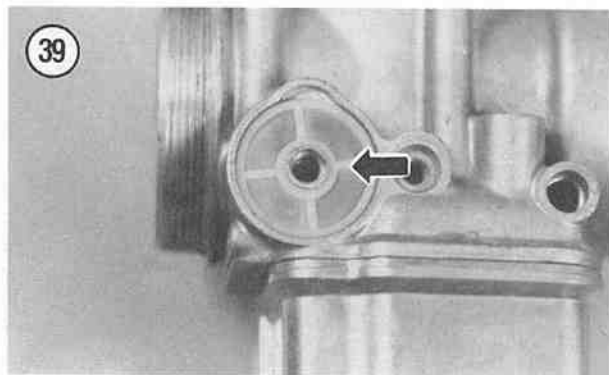
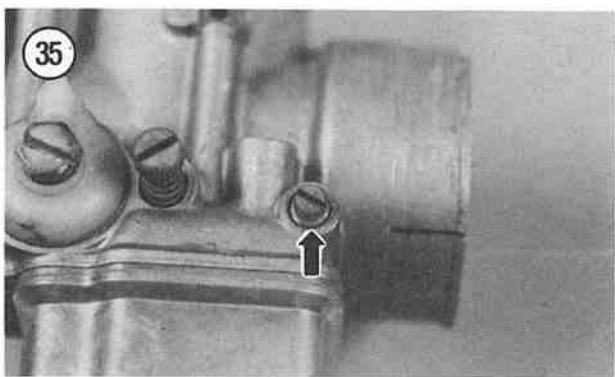
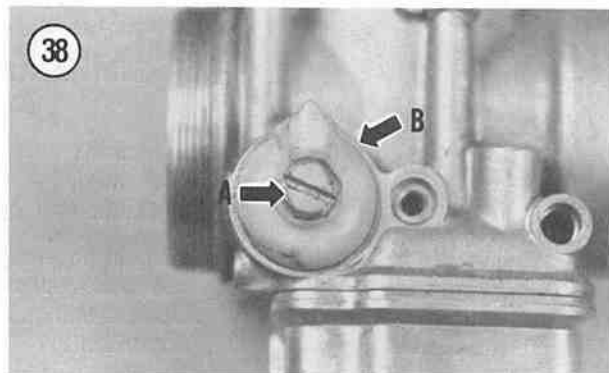
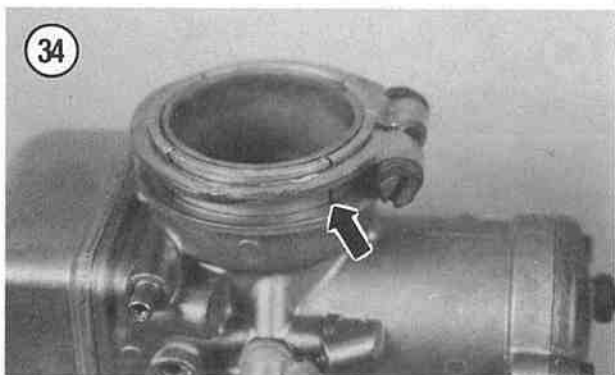
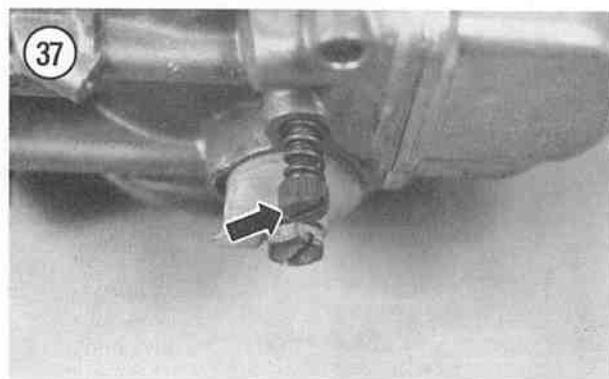
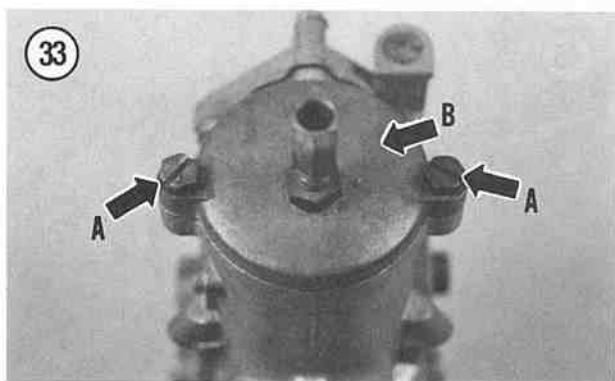
4. Unscrew the throttle stop screw (Figure 37), spring, flat washer and O-ring seal.
5. Remove the bolt and O-ring (A, Figure 38) securing the filter cover and remove the filter cover (B, Figure 38) and filter (Figure 39).
6. From the choke receptacle, remove the spring (Figure 40) and the choke slide (Figure 41).
7. Remove the screws (Figure 42) securing the choke body and remove the choke body and gasket (Figure 43). Discard the gasket as it must be replaced.
8. Unscrew the accelerator pump jet cover (Figure 44) and remove the accelerator pump jet and two O-rings (Figure 45).
9. Unscrew the pressure valve (Figure 46) from the accelerator pump body.
10. To remove the accelerator pump body, perform the following:
  - a. Remove the screws (A, Figure 47) securing the accelerator pump body (B, Figure 47).
  - b. Remove the pump body, spring (Figure 48) and diaphragm (Figure 49).
11. Remove the large drain bolt (A, Figure 50) and gasket in the bottom of the float bowl.
12. Remove the float bowl and gasket (B, Figure 50).
13. Slide out the pivot pin (Figure 51) securing the float and lift off the float (Figure 52). Don't lose the float needle valve (Figure 53). Take care not to damage the end of the needle valve.
14. Unscrew the float needle valve seat (Figure 54).
15. Unscrew the accelerator pump valve and O-ring (Figure 55).
16. Unscrew the starter jet (Figure 56).

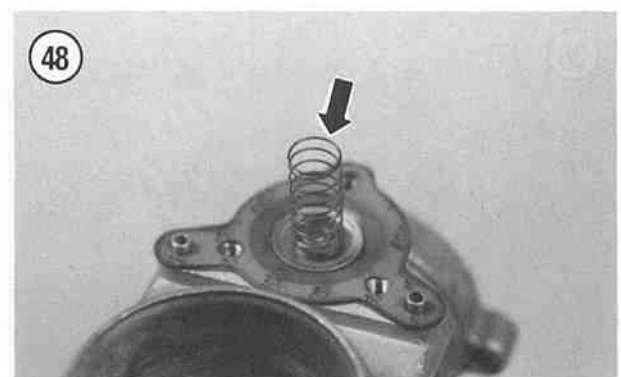
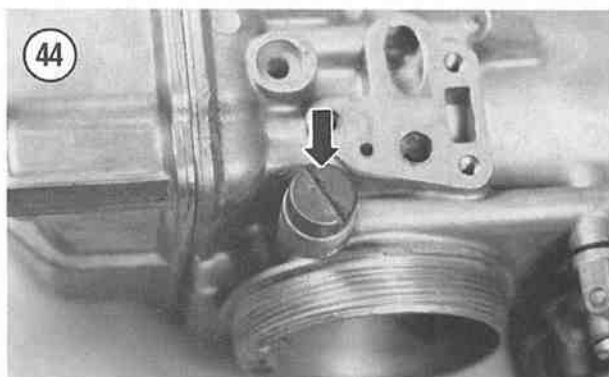
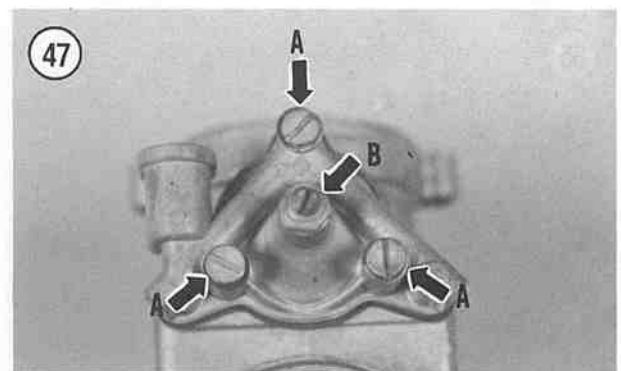
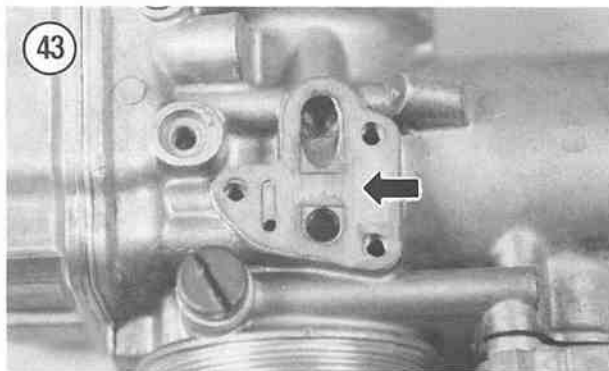
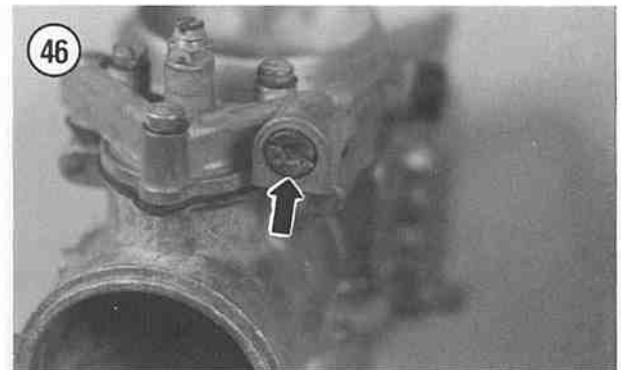
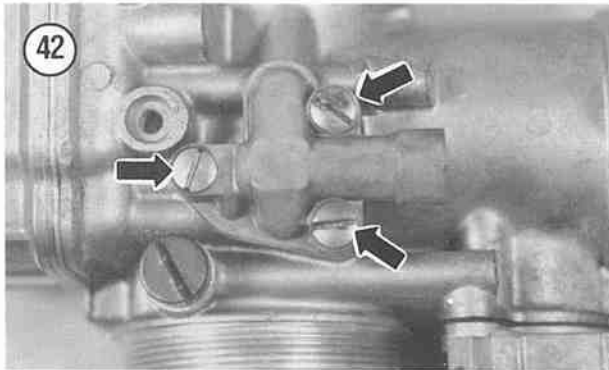
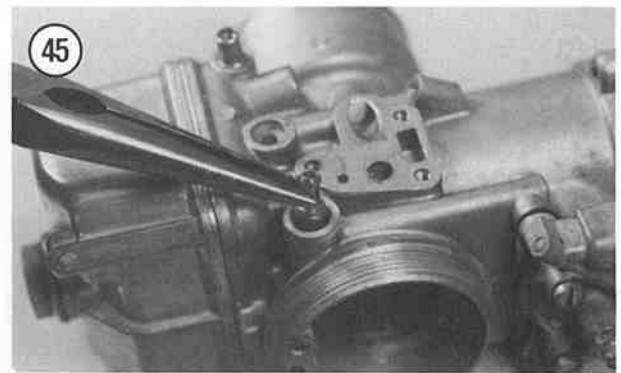
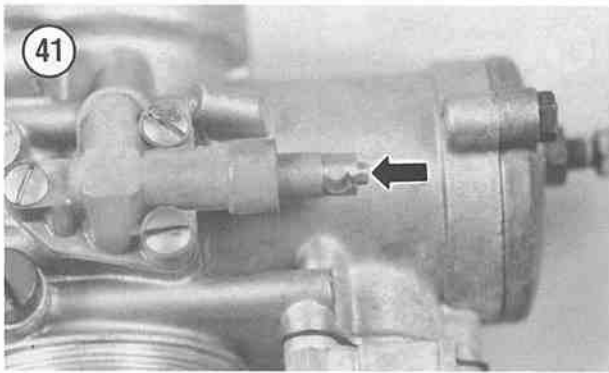
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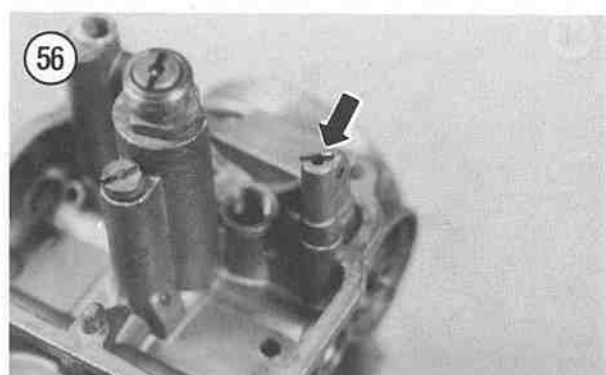
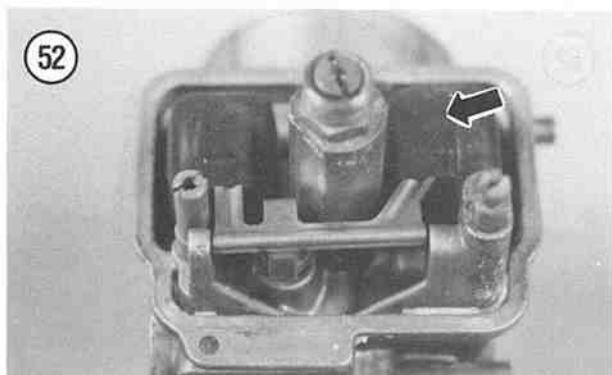
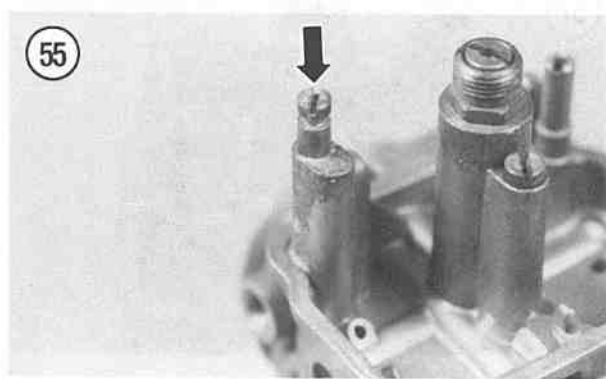
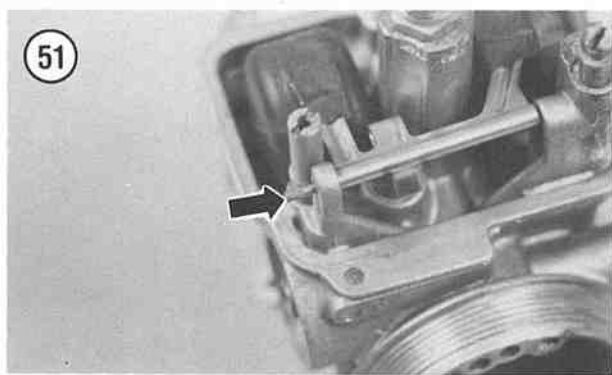
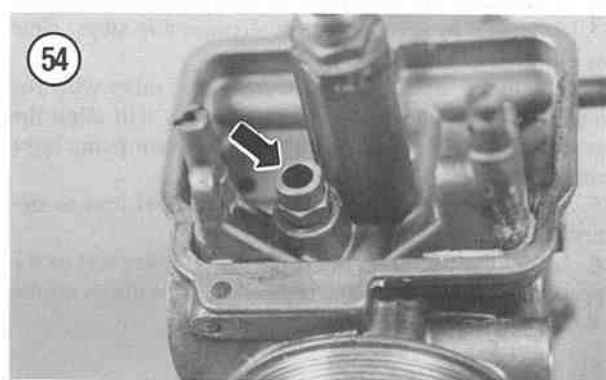
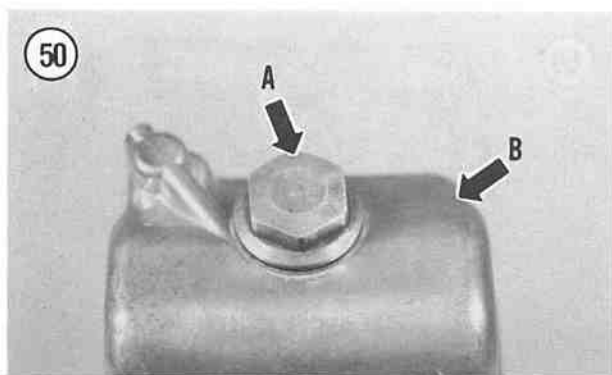
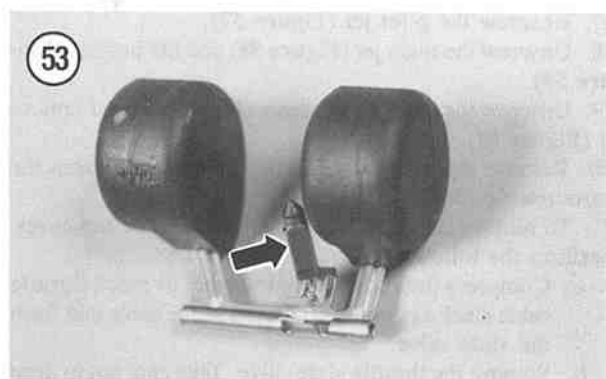
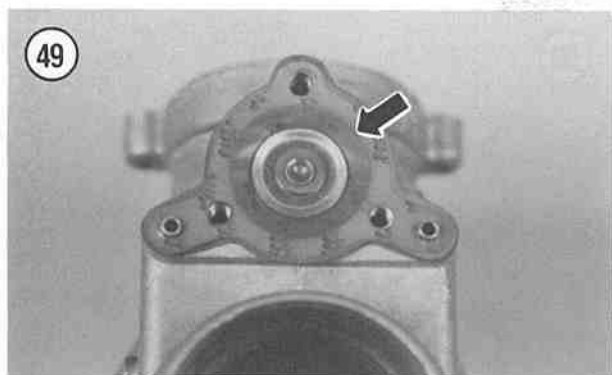
## CARBURETOR—DELL 'ORTO SLIDE TYPE



- |                             |                            |
|-----------------------------|----------------------------|
| 1. Rubber boot              | 20. Filter                 |
| 2. Screw                    | 21. Nut                    |
| 3. Nut                      | 22. Clamp                  |
| 4. Top cover                | 23. Bolt                   |
| 5. Cable adjuster           | 24. Main jet bracket       |
| 6. Locknut                  | 25. Pilot jet              |
| 7. Cable guide              | 26. Main jet bracket       |
| 8. Bolt                     | 27. Starter jet            |
| 9. Spring                   | 28. Main jet               |
| 10. Pivot pin               | 29. O-ring                 |
| 11. Accelerator pump lever  | 30. Needle valve assembly  |
| 12. Spring                  | 31. Diaphragm              |
| 13. Needle retainer         | 32. Spring                 |
| 14. Slide needle            | 33. Accelerator pump cover |
| 15. Slide valve             | 34. Pressure valve         |
| 16. Gasket                  | 35. O-ring                 |
| 17. Bolt                    | 36. O-ring                 |
| 18. Washer                  | 37. Adjust screw           |
| 19. Fuel inlet filter cover | 38. Locknut                |
|                             | 39. O-ring                 |
|                             | 40. Screw                  |
|                             | 41. Rubber boot            |
|                             | 42. Choke cable adjuster   |
|                             | 43. Locknut                |
|                             | 44. Cable guide            |
|                             | 45. Spring                 |
|                             | 46. Choke slide            |
|                             | 47. Choke body             |
|                             | 48. Screw                  |
|                             | 49. Gasket                 |
|                             | 50. Jet cover              |
|                             | 51. O-ring                 |
|                             | 52. Accelerator pump       |
|                             | 53. O-ring                 |
|                             | 54. Mixture adjust screw   |
|                             | 55. Spring                 |
|                             | 56. Flat washer            |
|                             | 57. O-ring                 |
|                             | 58. Throttle stop          |
|                             | 59. Spring                 |
|                             | 60. Flat washer            |
|                             | 61. O-ring                 |
|                             | 62. Main jet atomizer      |
|                             | 63. Accelerator pump valve |
|                             | 64. O-ring                 |
|                             | 65. Float                  |
|                             | 66. Float pivot pin        |
|                             | 67. Float bowl gasket      |
|                             | 68. Float bowl             |
|                             | 69. Gasket                 |
|                             | 70. Drain bolt             |

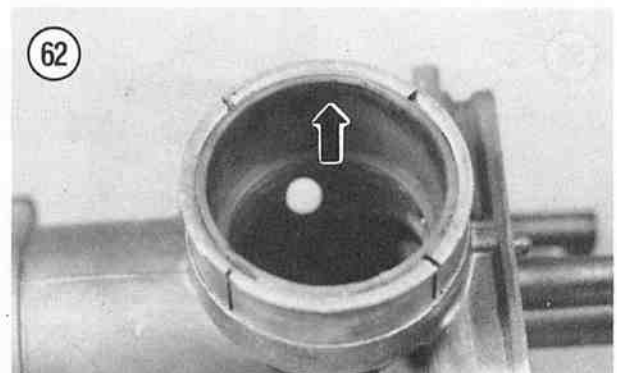
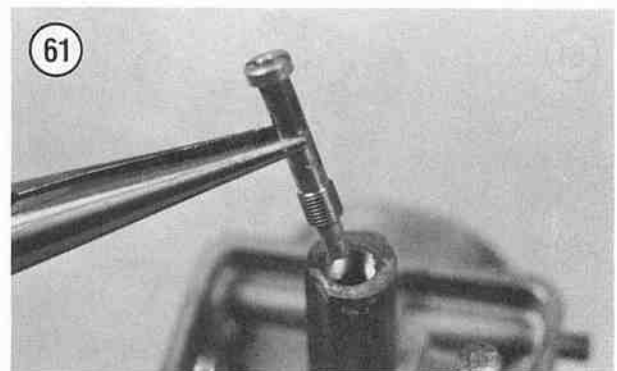
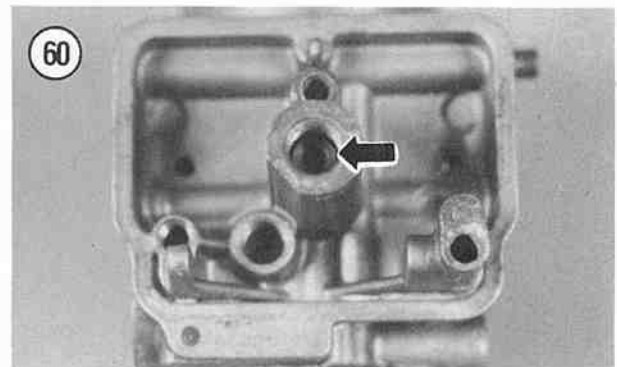
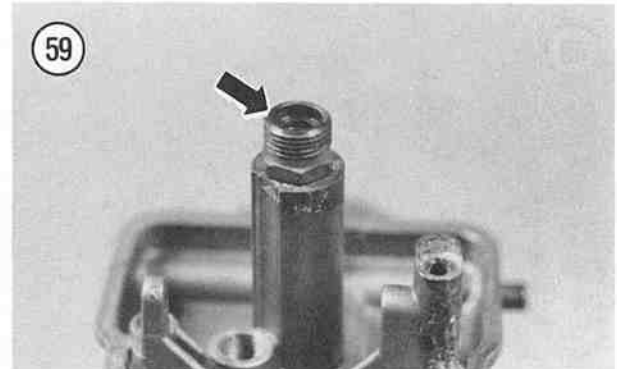
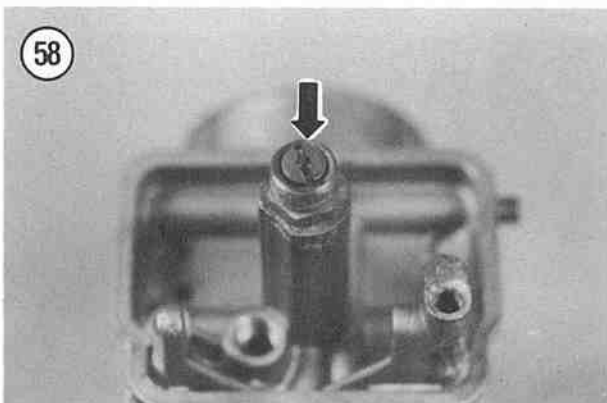
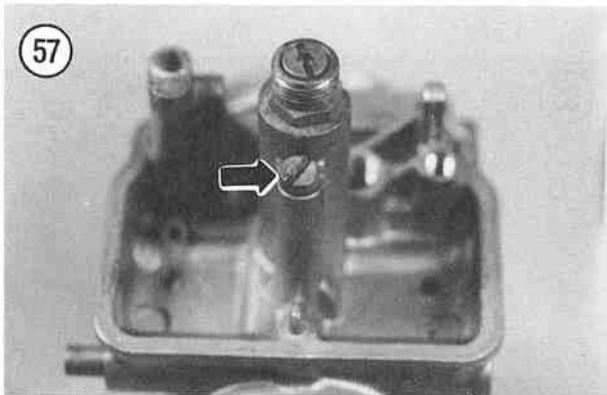


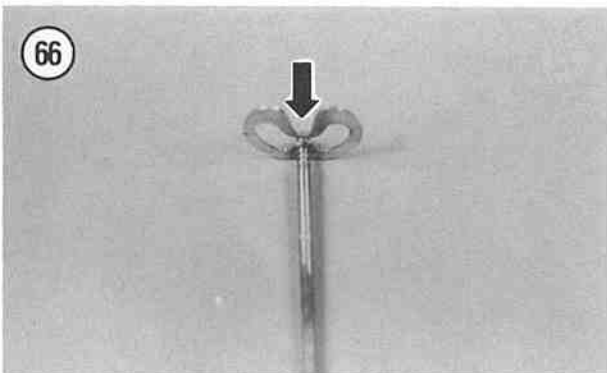
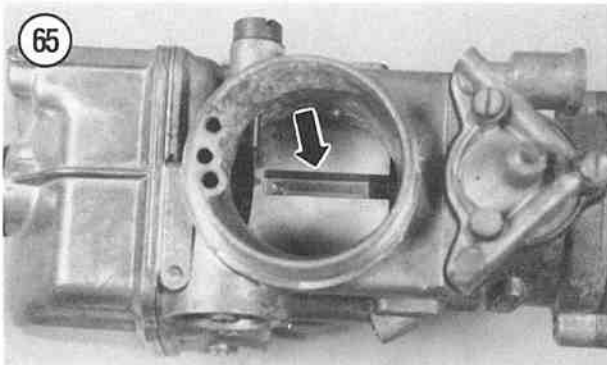
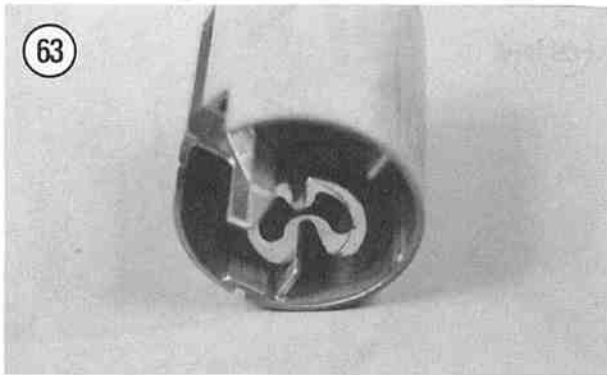






17. Unscrew the pilot jet (Figure 57).
18. Unscrew the main jet (Figure 58) and the bracket (Figure 59).
19. Unscrew the main jet atomizer (Figure 60) and remove it (Figure 61).
20. Remove the insulating bushing (Figure 62) from the carburetor outlet.
21. To remove the throttle slide valve from the top cover, perform the following:
  - a. Compress the slide spring to obtain as much throttle cable slack as possible. Disengage the cable end from the slide valve.
  - b. Remove the throttle slide valve. Take care not to drop the jet needle out of the slide valve (Figure 63).
22. Clean and inspect all parts as described in this chapter.
23. Assemble by reversing these disassembly steps. Note the following.
24. Align the small groove in the slide valve with the locating pin as shown in Figure 64. This will align the larger groove (Figure 65) with the accelerator pump lever when the top cover is installed.
25. Adjust the float after installing the float arm as described in this chapter.
26. Install the E-clip on the jet needle (Figure 66) in the specified groove as indicated in Table 1. Slide the jet needle into the throttle valve.





27. When installing the top cover, align the accelerator pump lever (A, Figure 67) with the large groove (B, Figure 67) in the slide valve.

**Cleaning and Inspection**

**WARNING**

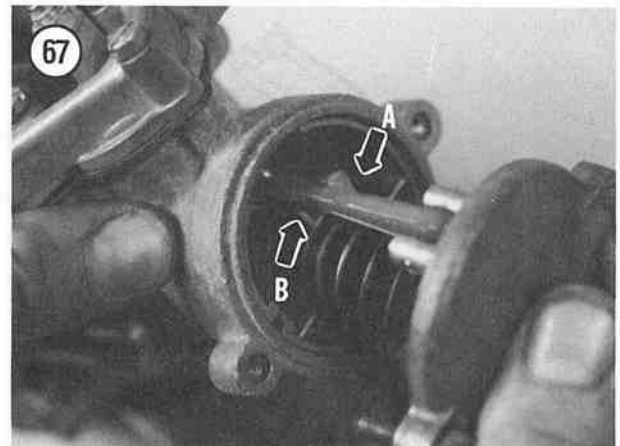
*Carburetor cleaner is extremely caustic and can cause permanent eye damage. Always wear eye protection when using any type of carburetor cleaner.*

The carburetors are best cleaned by completely disassembling them and cleaning the fuel and air orifices with an aerosol carburetor cleaner. Never use a wire to clean out jets or orifices; this could enlarge the passage and adversely affect the air-to-fuel ratio.

Motorcycle carburetors have much smaller air and fuel passages than automotive carburetors. For this reason, soaking the carburetor parts in an automotive type carburetor cleaner is not recommended. Motorcycle carburetors are usually coated with a corrosion-protective clear coating. Caustic liquid cleaners will remove the protective coatings from the outside of the carburetor body. The dissolved coating could plug passages in the carburetor as well as damage its appearance. Also, if the cleaner was used previously there will be sediment held in suspension within the solution. This could also plug a passage.

Clean the carburetor parts in a good grade of solvent and dry thoroughly with compressed air. Many good aerosol carburetor cleaners (i.e. Zep Choke and Carburetor Cleaner) can help remove any residue not removed with the solvent. Thoroughly rinse off all parts with clean water and dry with compressed air. If you do not have access to compressed air, place the cleaned parts on a piece of newspaper and allow to dry.

Never use carburetor cleaner on gaskets, O-rings or plastic parts. These non-metal parts could be damaged by the cleaner.



1. Clean all parts, except rubber or plastic parts, in a good grade of aerosol carburetor cleaner or cleaning solvent.

**NOTE**

A special carburetor cleaner is **not** usually necessary to clean a carburetor unless it is very dirty or corroded. A good grade of parts cleaning solvent will usually clean most carburetors.

**CAUTION**

Do not put non-metallic parts such as floats, gaskets and O-rings in special carburetor cleaners as these components will be damaged. Clean these components in common solvent or kerosene.

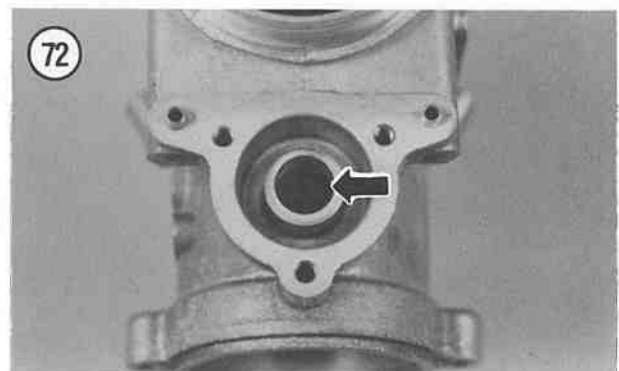
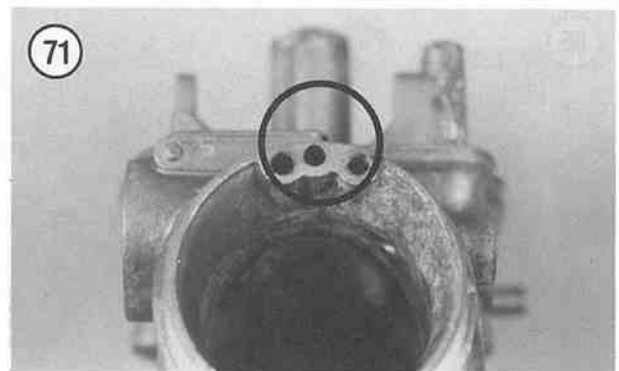
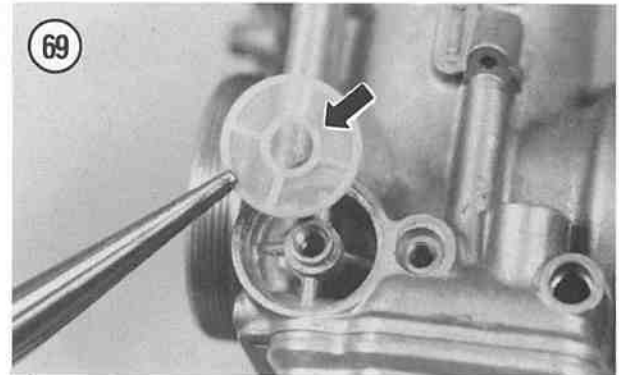
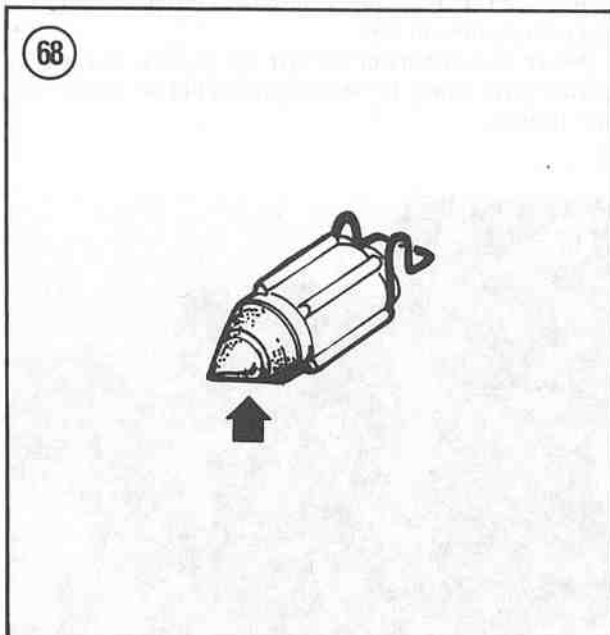
2. Blow out all the jets and passages in the carburetor body with compressed air.

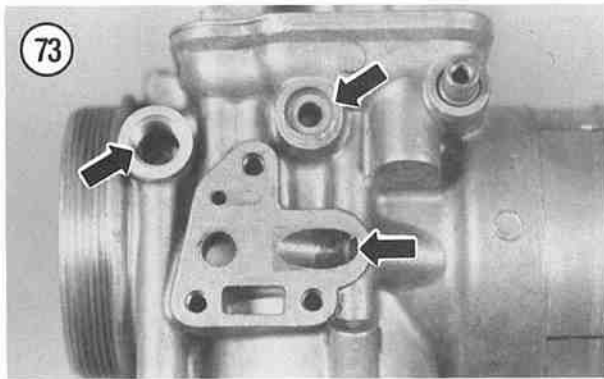
**CAUTION**

If compressed air is not available, allow the parts to air dry or use a clean lint-free cloth. Do not use paper towels to dry carburetor parts, as small paper particles may plug openings in the carburetor body or jets.

**CAUTION**

Never use wire to clean any jets or orifices in the carburetor body. The wire could enlarge and damage the precise sizes of the jets or openings, resulting in poor carburetor performance.

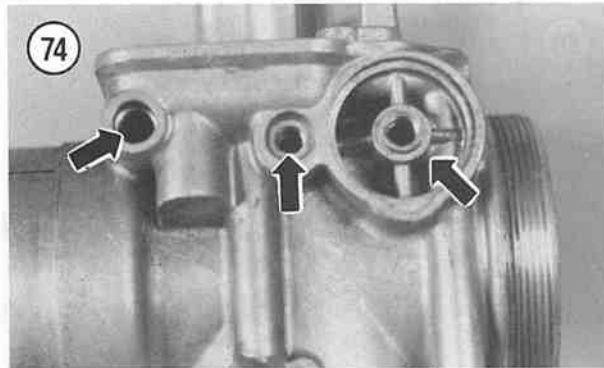




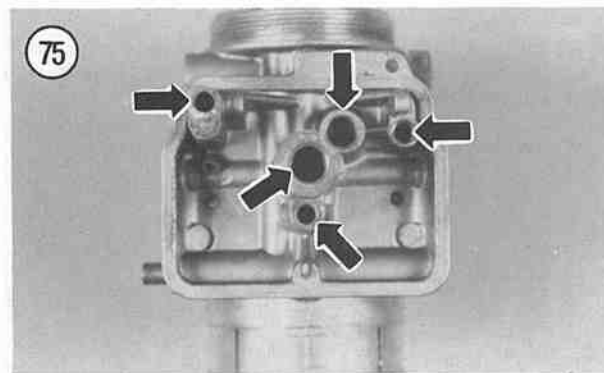
3. Check the tip of the needle valve (Figure 68) and the inside of the needle valve body. Replace the complete needle valve assembly if the tip is scored or damaged. A damaged needle valve or a particle of dirt or grit in the needle valve assembly will cause the carburetor to flood and overflow fuel.
4. Inspect the throttle slide valve for scoring or galling. Replace the throttle valve if not perfect.

**WARNING**

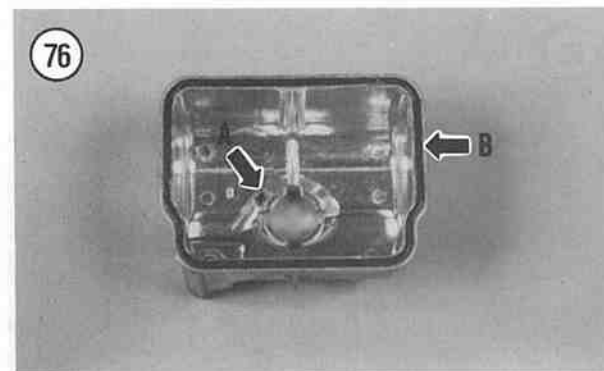
*A damaged throttle slide valve can cause the carburetor to stick open, resulting in loss of throttle control that may cause a serious accident.*



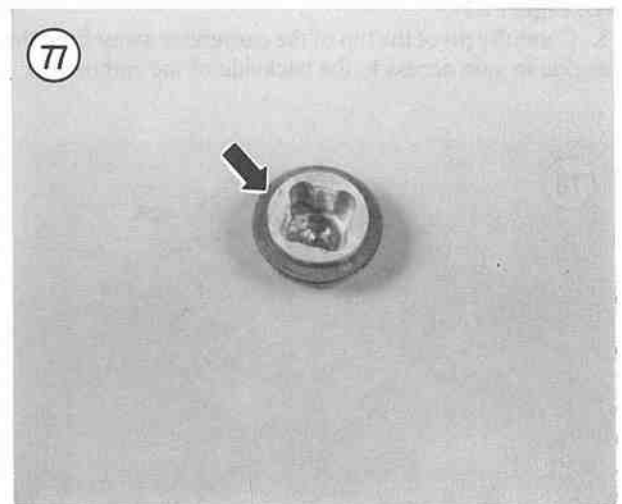
5. Examine the end of the mixture adjust screw and the end of the throttle adjust screw. Replace the mixture adjust screw or throttle adjust screw if any grooves or roughness are present. A damaged end will prevent smooth low-speed engine operation.



6. Inspect the accelerator pump rubber diaphragm for deterioration or damage. Replace as necessary.
7. Inspect the fuel inlet filter (Figure 69) for deterioration or damage. Replace as necessary.
8. Inspect the O-ring on each end of the accelerator pump jet for deterioration or damage. Replace as necessary.
9. Make sure the holes in the remaining jets (Figure 70) are clear. Clean out if they are plugged in any way. Replace the jet(s) if you cannot unplug the hole(s).
10. Make sure all openings in the carburetor body are clear. Refer to Figures 71 through 75. Clean out if they are plugged in any way.



11. Be sure to clean out opening (A, Figure 76) in the float bowl.
12. Check the gasket (Figure 77) on the float bowl drain bolt. Replace the gasket if it is damaged.



13. Check the O-ring gasket (**Figure 78**) on the top cover. Replace the gasket if it is damaged.
14. Examine the float bowl gasket (B, **Figure 76**) for damage. Replace the gasket if there is any doubt as to its condition.
15. Shake the float assembly (**Figure 79**). Listen for fuel sloshing around inside, indicating that the float has leaked. Replace the float if there is any indication of fuel within the float.
16. Inspect the accelerator pump lever (**Figure 80**) for wear or damage. Make sure it moves freely. Replace the lever if necessary.

### BING CONSTANT VELOCITY (CV) TYPE CARBURETOR

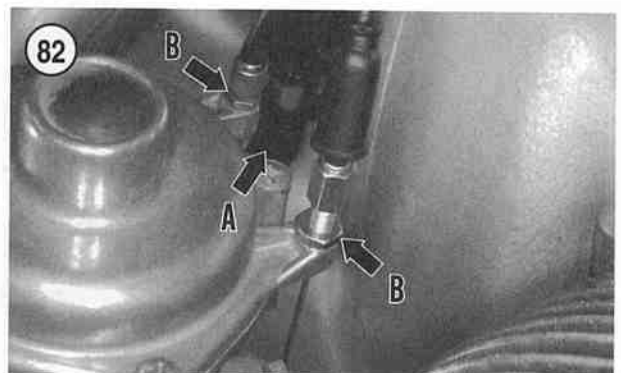
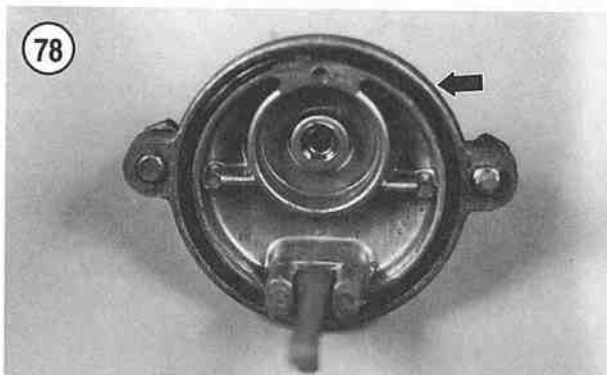
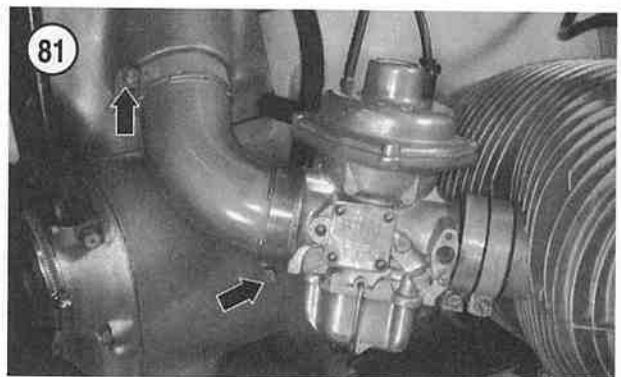
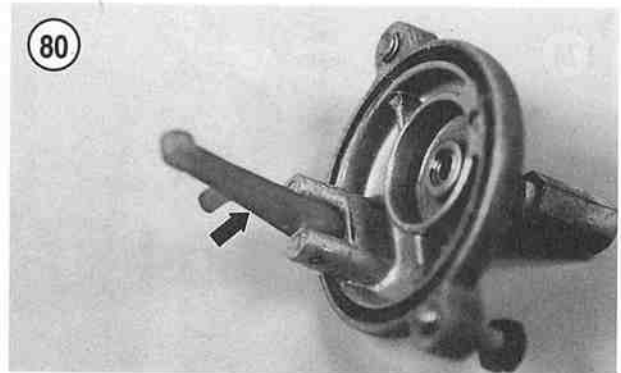
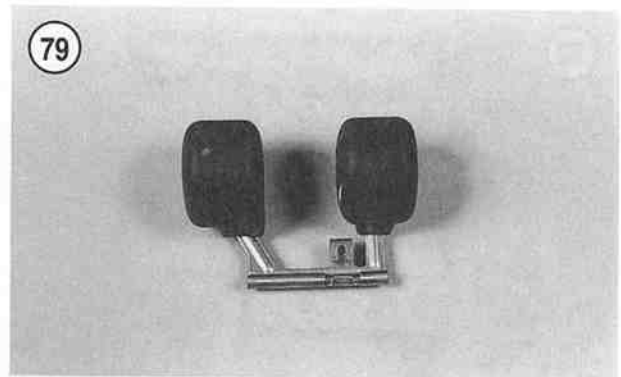
Due to the number of carburetor types used on the various models covered in this manual and the possibility that the motorcycle may no longer be equipped with the original types, always refer to model identification on the carburetor and compare this to those listed in **Table 1** at the end of this chapter to determine the carburetor type.

#### Removal/Installation

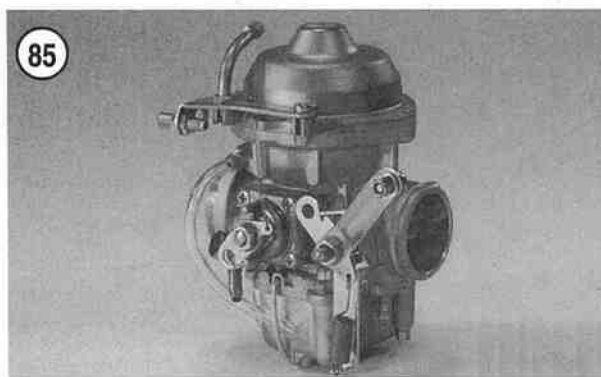
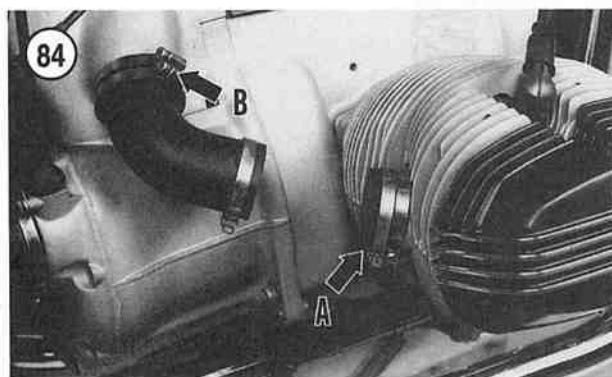
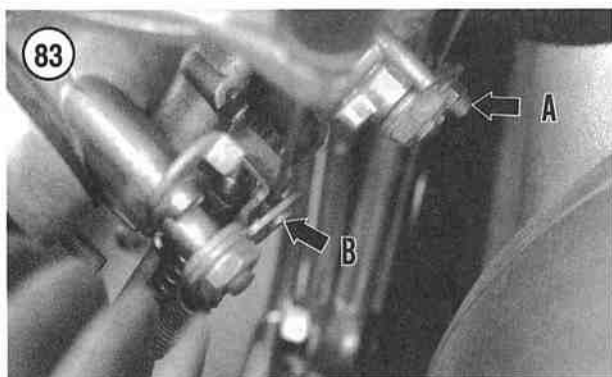
##### WARNING

*Do not attempt to remove the carburetor(s) while the engine is hot. Spilled fuel could ignite.*

1. Turn the fuel shutoff valve on each side to the OFF position.
2. Loosen the hose clamps (**Figure 81**) on the intake tubes on each side of the carburetor. Move the clamps away from the ends of the tubes.
3. Disconnect the fuel line (A, **Figure 82**) from the carburetor. Plug the end with a golf tee to prevent the dribbling of fuel and prevent the entry of foreign matter.
4. Loosen the choke and throttle cable adjuster locknuts (B, **Figure 82**).
5. Carefully pivot the top of the carburetor away from the engine to gain access to the backside of the carburetor.



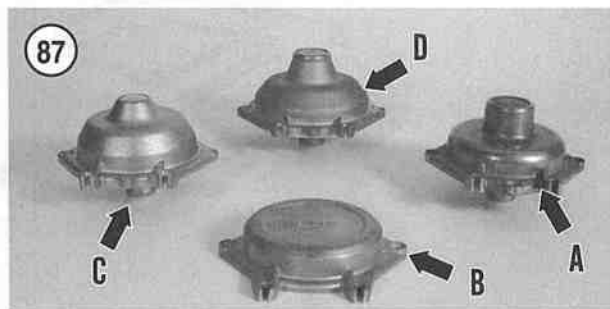




6. Loosen the nut on the choke cable retaining bolt (A, **Figure 83**) and disconnect the cable end from the carburetor linkage.
7. Disconnect the throttle cable end (B, **Figure 83**) from the carburetor linkage.
8. Carefully remove the carburetor assembly from the rubber intake tubes on the engine and carburetor.
9. To remove the rubber intake tubes, perform the following:
  - a. Loosen the hose clamp (A, **Figure 84**) on the rubber intake tube on the cylinder head. Move the clamp away from the end of the tube and remove the tube from the cylinder head (B).
  - b. Loosen the hose clamps (**Figure 84**) on the intake tube on the air filter housing. Move the clamps away from the end of the tube and remove the tube from the air filter housing.
10. Using duct tape, cover the inlet opening in the cylinder head to keep out foreign matter.
11. Install by reversing these removal steps. Note the following.
12. Apply a light film of rubber lubricant such as WD-40 or Armor All around both ends of each rubber intake tube to ease carburetor installation.
13. Make sure that the carburetor is properly positioned and tighten all clamp screws evenly and securely.
14. Repeat for the other carburetor.
15. Connect the fuel line and turn the fuel shutoff valves to the ON position. Check for fuel leaks and correct before starting the engine.
16. If necessary, adjust the carburetor as described under *Carburetor Idle Mixture and Idle Speed Adjustment* in Chapter Three.

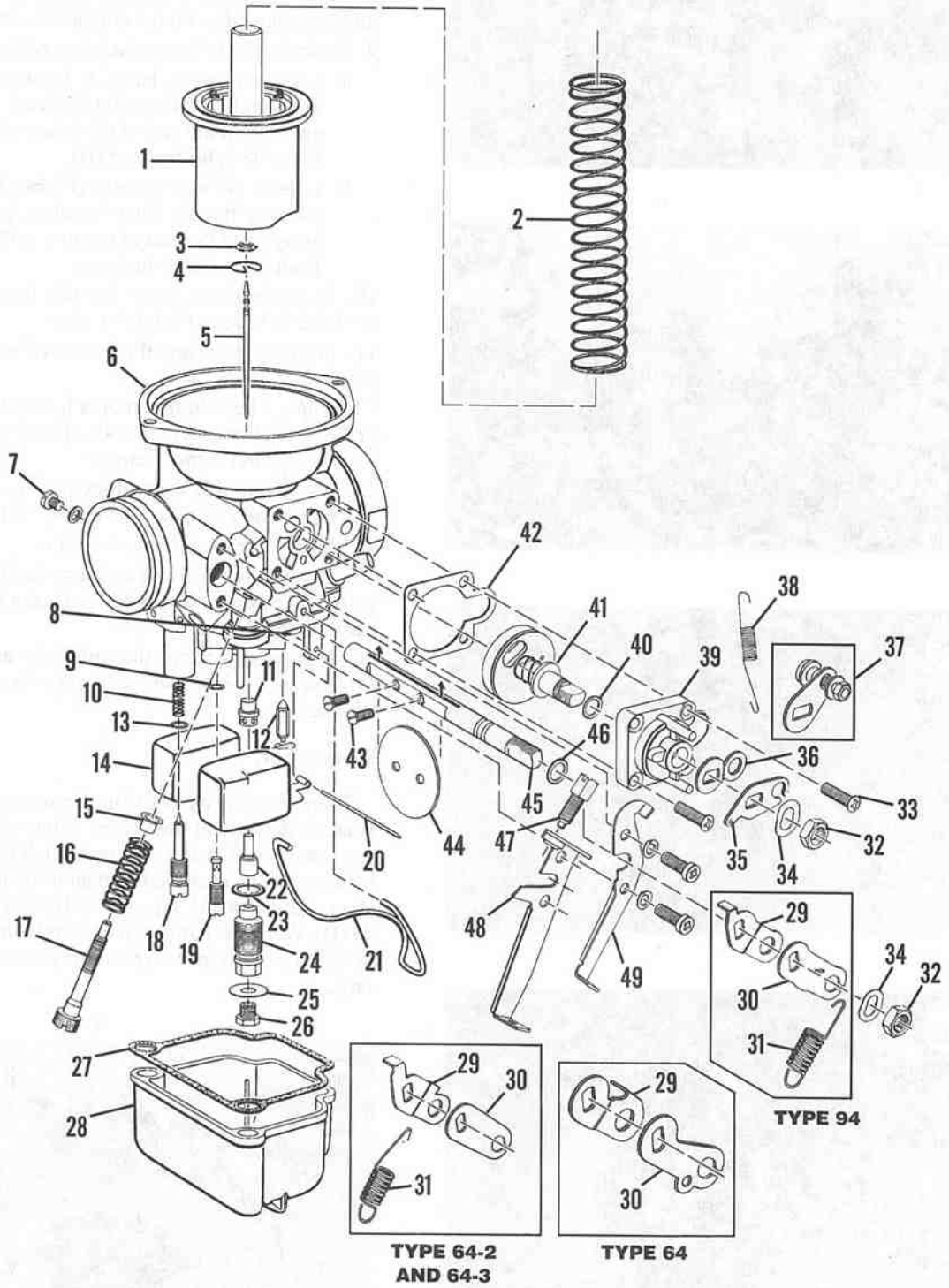
**Disassembly**

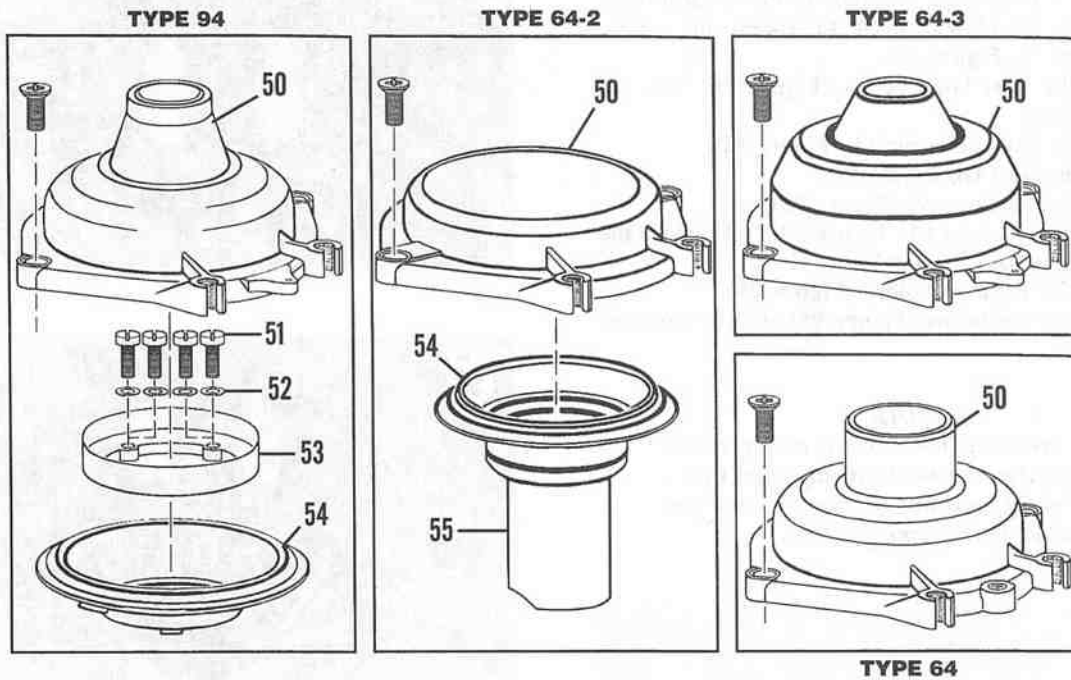
There are four types of Bing constant velocity (CV) or constant depression carburetors (**Figure 85** and **Figure 86**, type 64-3) used on the various Models (**Table 1**). The carburetors can be identified by their different tops. **Figure 87** shows a type 64 (A), type 64-2 (B), type 64-3 (C) and type 94 (D). While the individual tops and some linkage components vary from type to type, the operation is essentially the same



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**CONSTANT VELOCITY (CV) CARBURETOR ASSEMBLY**



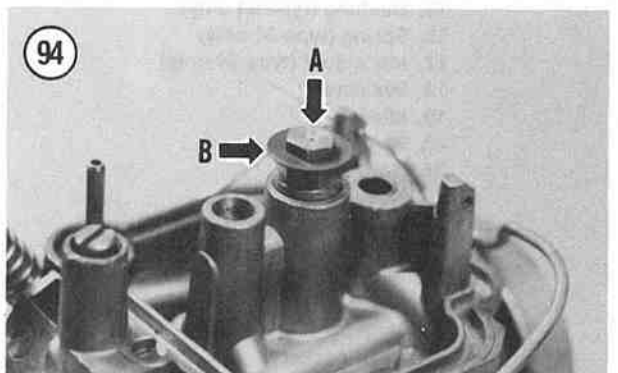
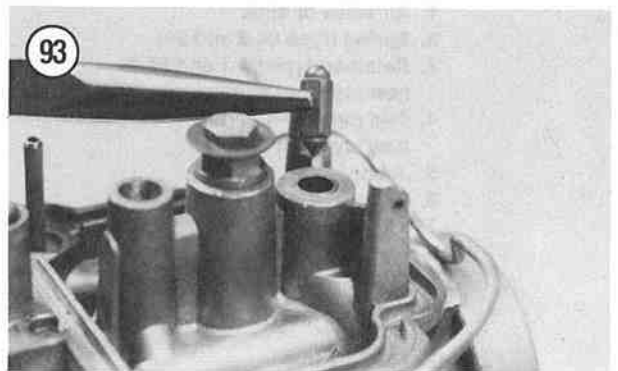
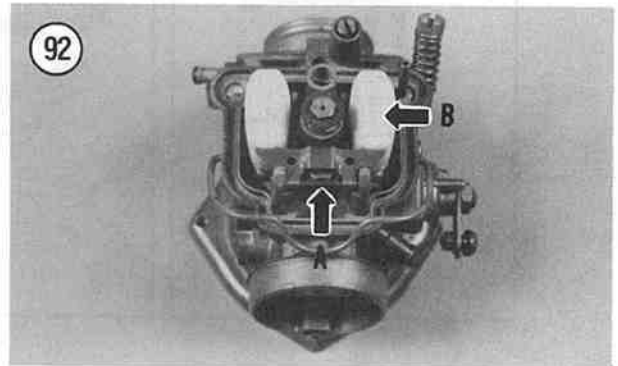
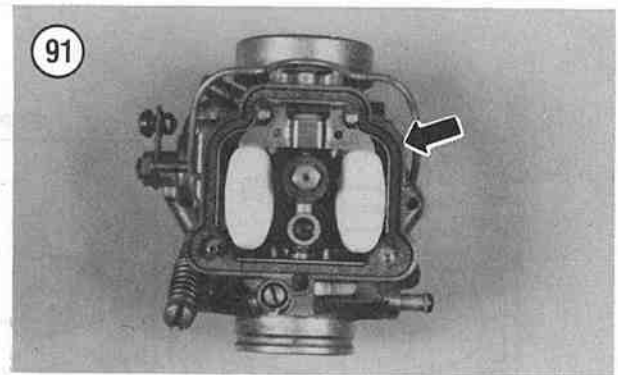
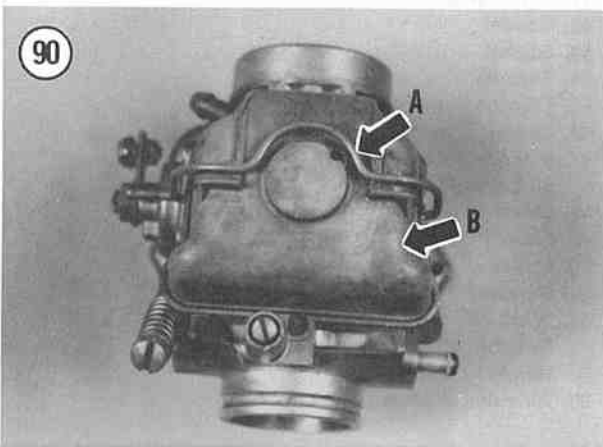
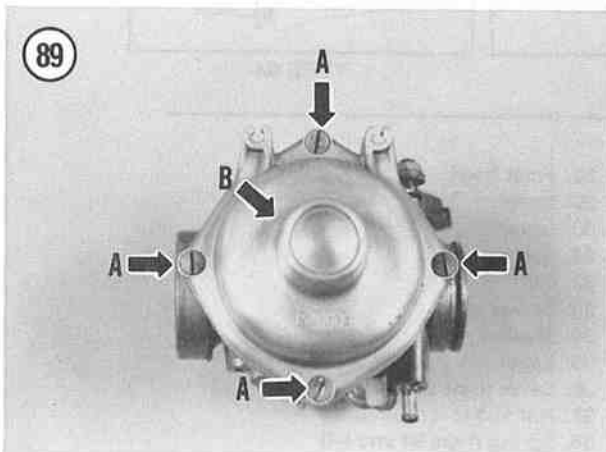


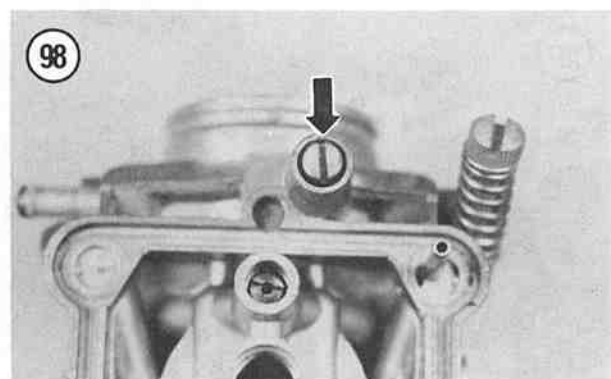
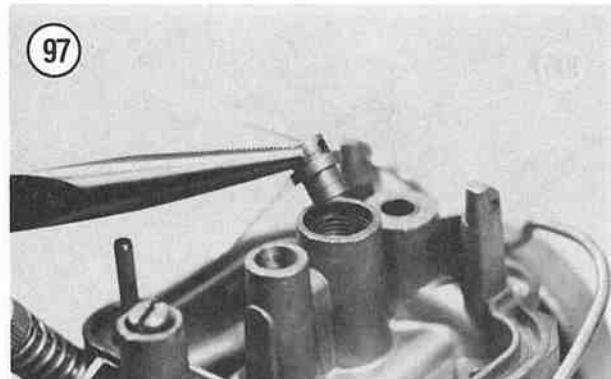
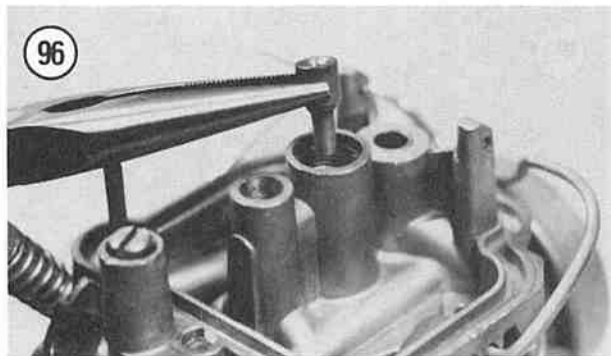
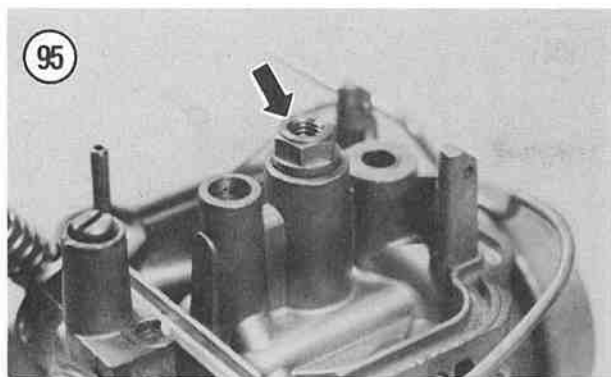
- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Air valve or slide</li> <li>2. Spring (type 64-3 and 94)</li> <li>3. Retainer (type 64-1 and 64-2--<br/>new style not shown)</li> <li>4. Clip (type 64-1 and 64-2--<br/>new style not shown)</li> <li>5. Jet needle</li> <li>6. Body</li> <li>7. Plug screw and gasket</li> <li>8. Flat needle seat</li> <li>9. O-ring</li> <li>10. Spring</li> <li>11. Atomizer</li> <li>12. Float needle</li> <li>13. O-ring</li> <li>14. Float (typical)</li> <li>15. Bushing (type 64 only)</li> <li>16. Spring (type 64 only)</li> <li>17. Idle adjust (type 64 only)</li> <li>18. Mix screw</li> <li>19. Idle jet</li> <li>20. Pivot pin</li> <li>21. Bowl clip</li> <li>22. Needle jet</li> <li>23. O-ring</li> <li>24. Jet stock</li> <li>25. Washer (screen<br/>not shown)</li> <li>26. Main jet</li> <li>27. Bowl gasket</li> </ol> | <ol style="list-style-type: none"> <li>28. Float bowl</li> <li>29. Lever</li> <li>30. Lever</li> <li>31. Spring</li> <li>32. Nut</li> <li>33. Screw</li> <li>34. Washer</li> <li>35. Lever</li> <li>36. Lever (type 94, 64, 64-3)</li> <li>37. Nut and lever assembly</li> <li>38. Spring (type 94 and 64)</li> <li>39. Housing</li> <li>40. O-ring</li> <li>41. Start valve</li> <li>42. Gasket</li> <li>43. Gasket</li> <li>44. Throttle</li> <li>45. Throttle shaft</li> <li>46. O-ring</li> <li>47. Idle adjust (type 94,<br/>64-2 and 64-3)</li> <li>48. Lever (left)</li> <li>49. Lever (right)</li> <li>50. Cover</li> <li>51. Screws</li> <li>52. Washers</li> <li>53. Retainer (32 or 40 mm)</li> <li>54. Diaphragm (32 or 40 mm)</li> <li>55. Air valve or slide</li> </ol> |
|---|---|

1. Remove the screws (A, **Figure 89**) securing the top cover and remove the cover (B, **Figure 89**).
2. On models so equipped, remove the spring.
3. Remove the diaphragm assembly from the carburetor.
4. Unhook the float bowl clip (A, **Figure 90**) and remove the float bowl (B, **Figure 90**).
5. Remove the float bowl gasket (**Figure 91**) from the carburetor body.
6. Remove the float pivot pin (A, **Figure 92**).
7. Remove the float (B, **Figure 92**).
8. Remove the needle valve (**Figure 93**).
9. Unscrew the main jet (A, **Figure 94**) and remove the main jet washer (B, **Figure 94**).
10. Remove the main jet holder (**Figure 95**).
11. Remove the needle jet (**Figure 96**) and the atomizer (**Figure 97**).

**NOTE**

*Before removing the mixture adjust screw, carefully screw it in until it lightly seats. Count and record the number of turns so that it can be installed in the same position.*

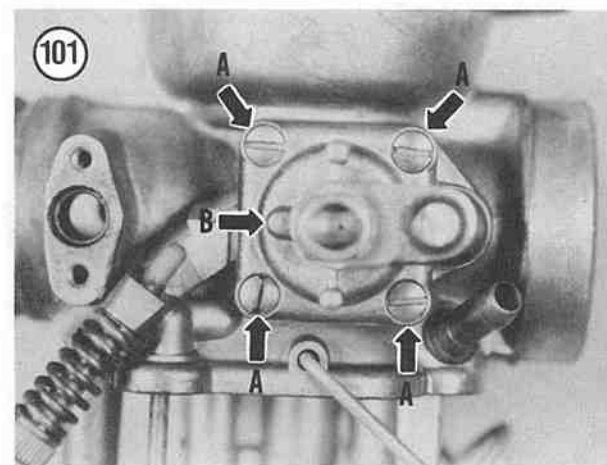
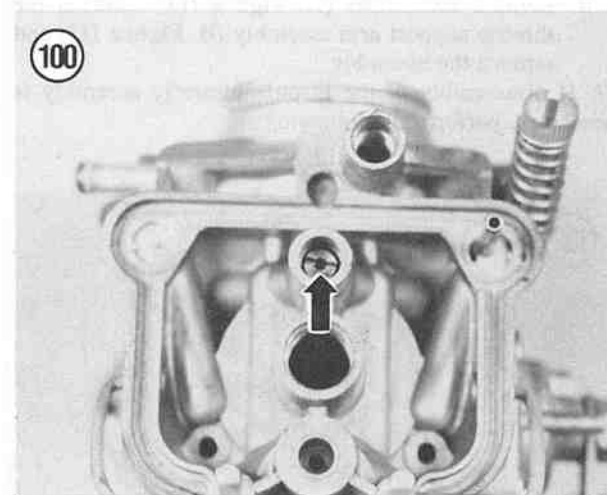
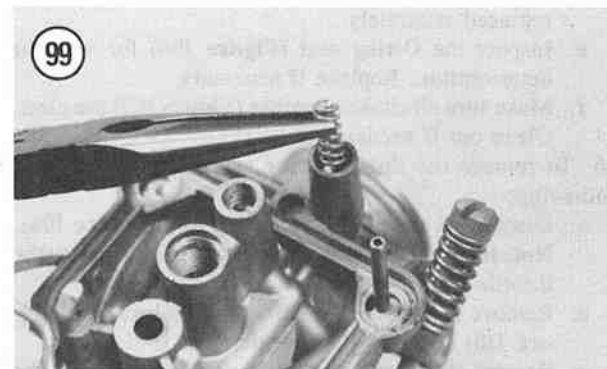




12. Unscrew the mixture adjust screw (Figure 98) and spring (Figure 99).

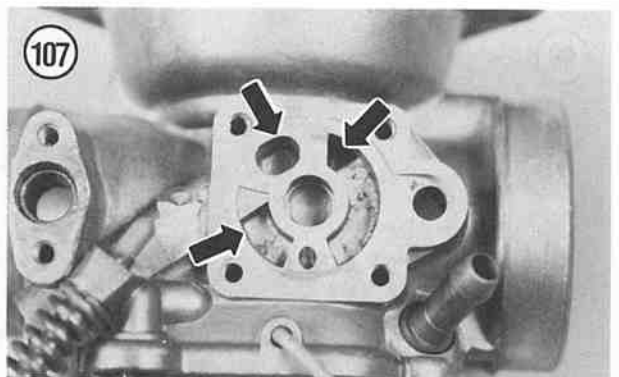
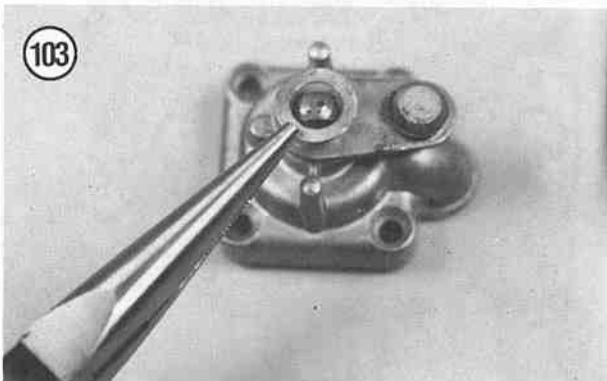
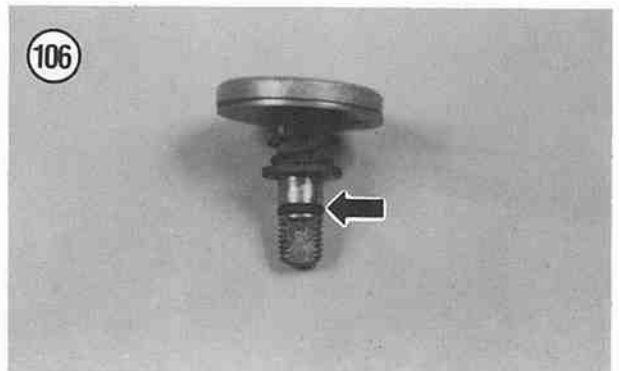
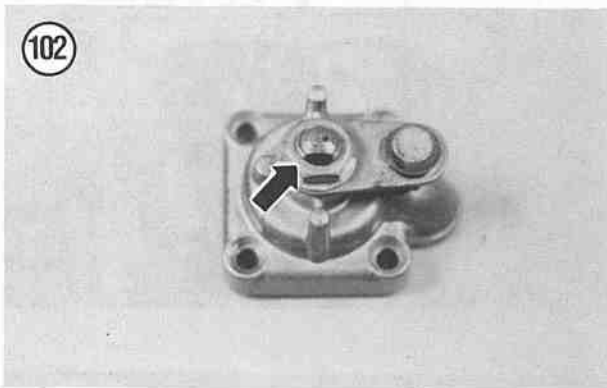
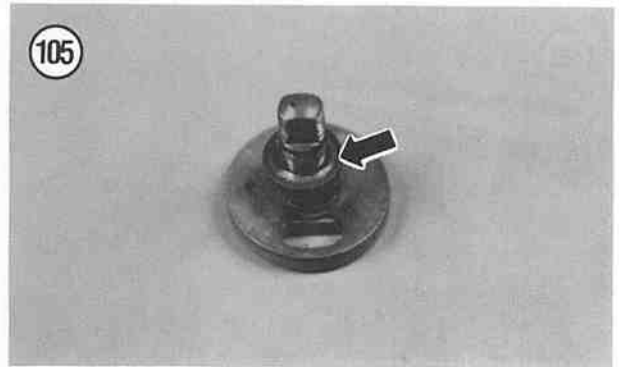
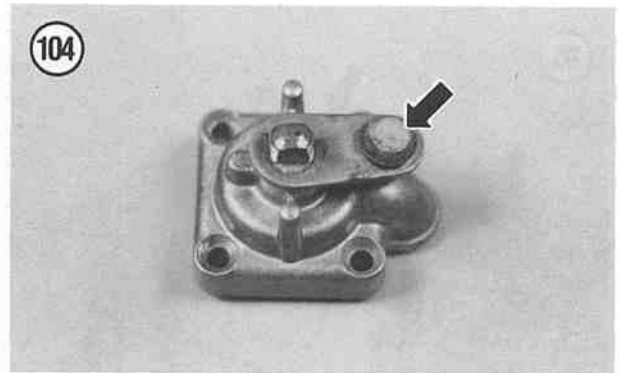
13. Unscrew the idle jet (Figure 100).

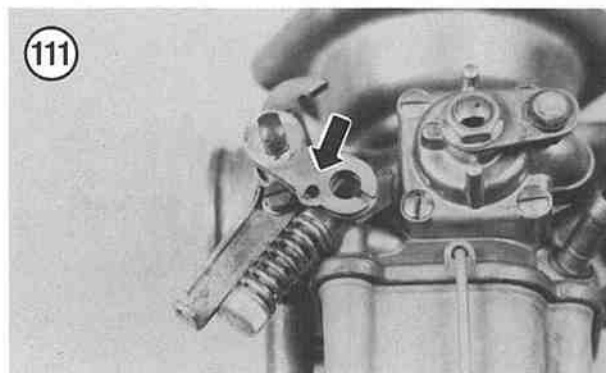
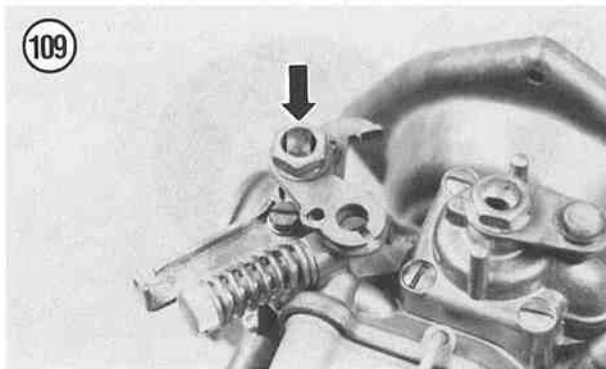
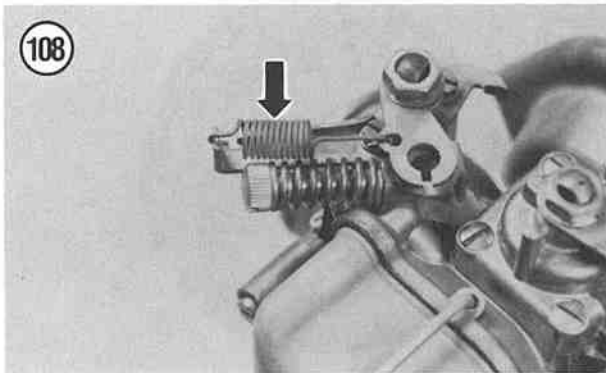
14. Remove the screws (A, Figure 101) securing the choke housing and remove the choke housing assembly (B, Figure 101). Discard the gasket.



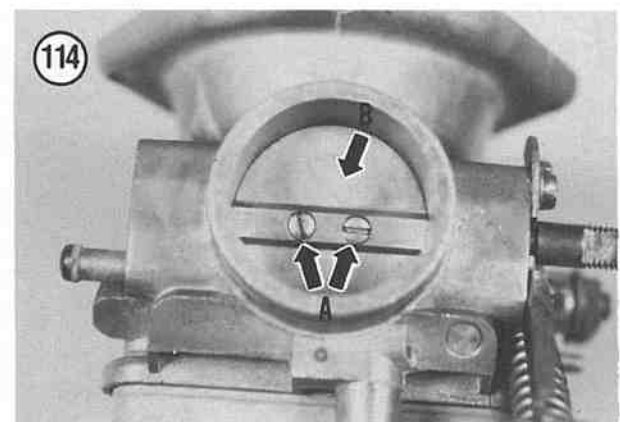
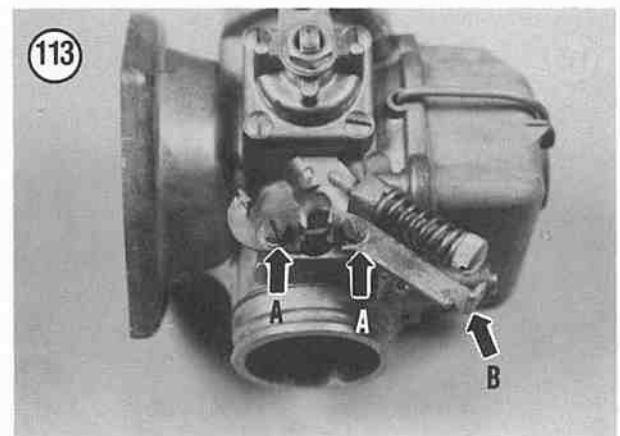
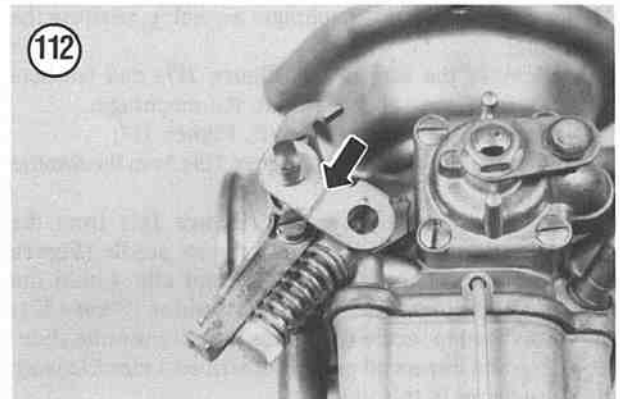


15. Disassemble the choke housing as follows:
  - a. Remove the nut (Figure 102) securing the choke lever to the housing.
  - b. Remove the washer (Figure 103) and the choke lever (Figure 104).
  - c. Withdraw the choke body from the choke housing.
  - d. It is not necessary to remove the washer and spring (Figure 105) from the choke body. They cannot be replaced separately.
  - e. Inspect the O-ring seal (Figure 106) for wear or deterioration. Replace if necessary.
  - f. Make sure all choke openings (Figure 107) are clear. Clean out if necessary.
16. To remove the throttle lever assembly, perform the following:
  - a. Disconnect the throttle return spring (Figure 108). Note that the long end of the spring is attached to the throttle lever.
  - b. Remove the nut (Figure 109) and lockwasher (Figure 110) securing the throttle lever to the shaft.
  - c. Remove the throttle outer lever (Figure 111) and the inner lever (Figure 112).
  - d. Remove the screws (A, Figure 113) securing the throttle support arm assembly (B, Figure 113) and remove the assembly.
17. If disassembly of the throttle butterfly assembly is necessary, perform the following:

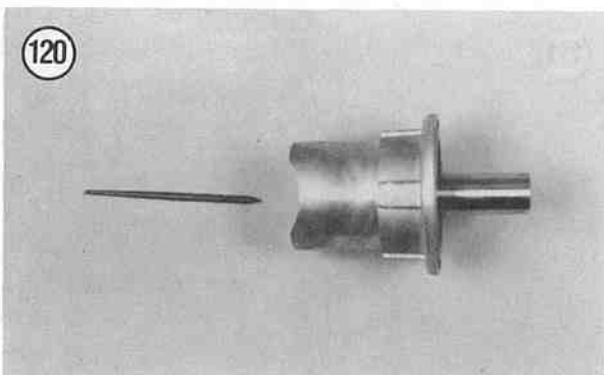
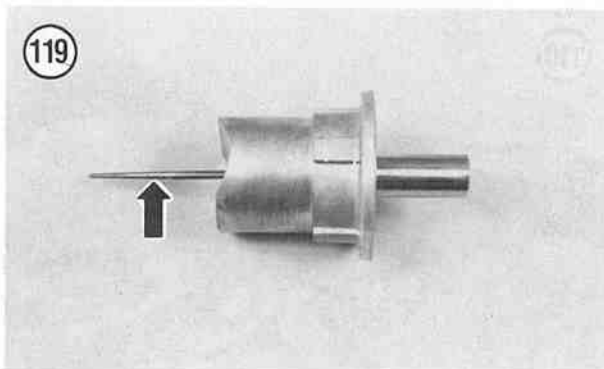
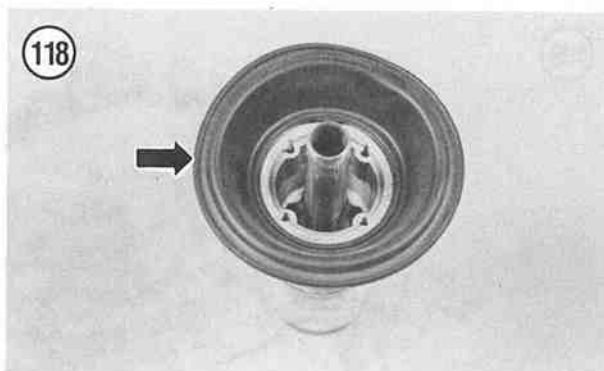
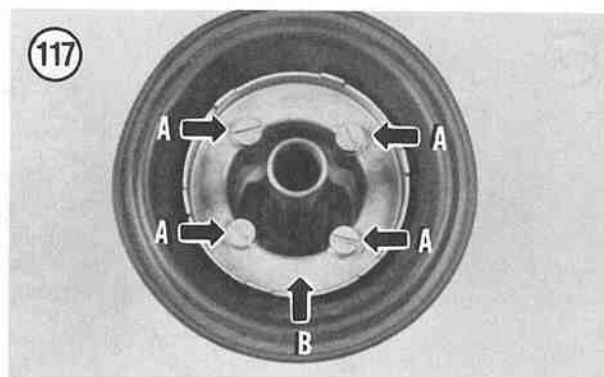
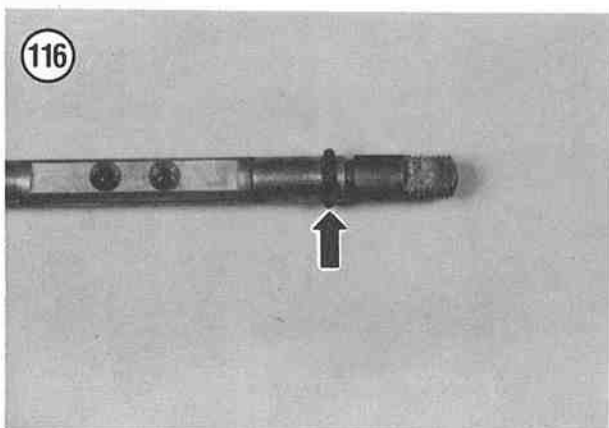
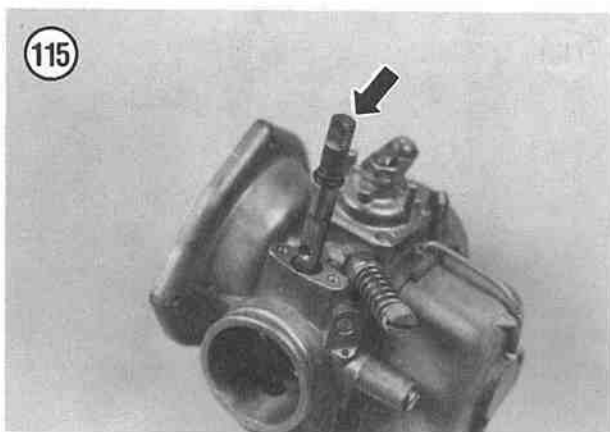


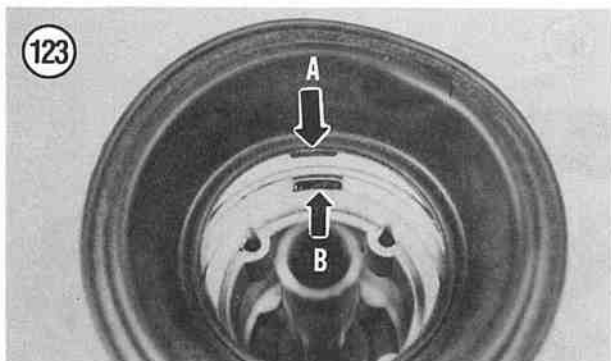
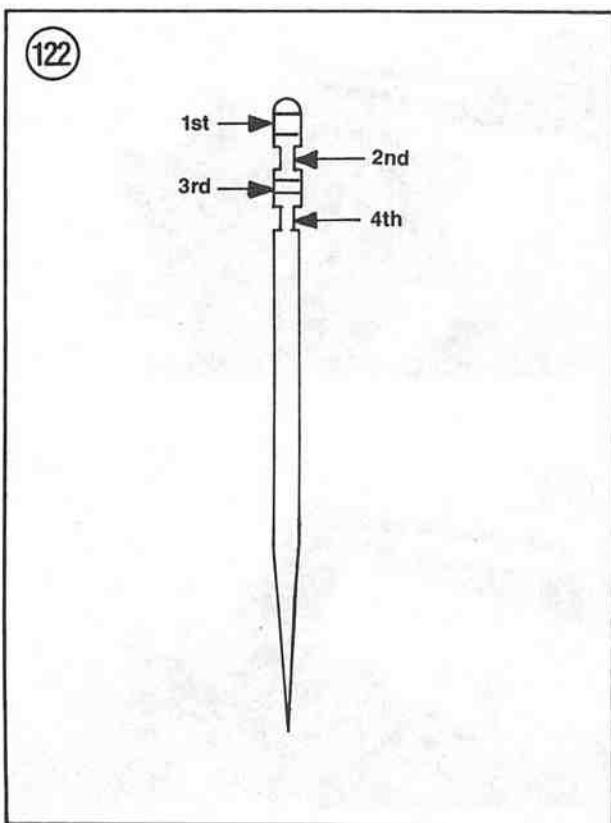
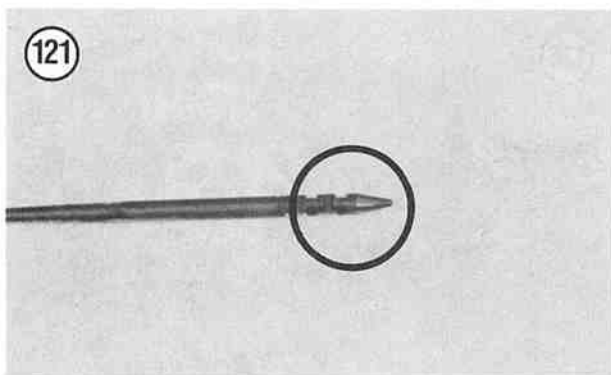


- a. Remove the throttle lever assembly as described in Step 16.
- b. Carefully remove the screws (A, **Figure 114**) securing the throttle butterfly. The screws may have had a locking agent applied to them during installation and may be difficult to remove.
- c. Rotate the throttle shaft and slide the throttle butterfly (B, **Figure 114**) out of the shaft.



- d. Withdraw the throttle shaft (Figure 115) from the carburetor body.
  - e. Inspect all parts for wear or damage; replace as necessary.
  - f. Assemble the throttle butterfly by reversing these disassembly steps. Note the following.
  - g. Install new O-ring seal (Figure 116) onto the shaft.
  - h. Apply a *small* amount of blue Loctite (No. 242) to the screw threads prior to installation. Tighten the screws securely.
18. To disassemble the diaphragm assembly, perform the following:
- a. Remove the screws (A, Figure 117) and washers securing the support ring to the diaphragm.
  - b. Remove the support ring (B, Figure 117).
  - c. Remove the diaphragm (Figure 118) from the throttle slide.
  - d. To remove the jet needle (Figure 119) from the throttle slide, carefully pull the jet needle (Figure 120) out of the notch holder and clip within the throttle slide. Note what notch position (Figure 121) was used to secure the jet needle in the throttle slide.
19. Clean and inspect all parts as described under *Cleaning and Inspection* in this chapter.

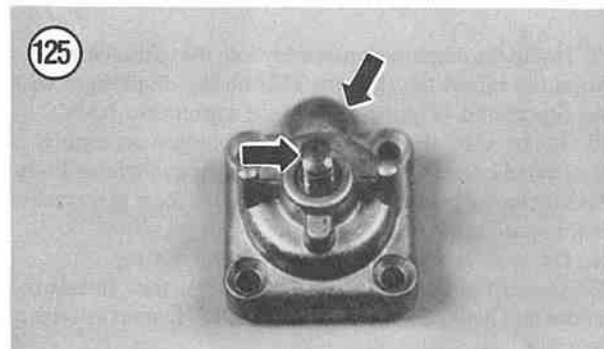
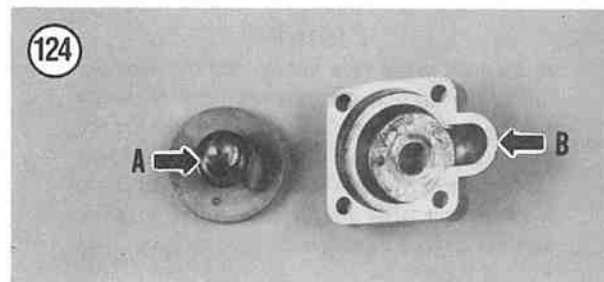




**Assembly**

1. Assemble the diaphragm assembly by reversing the disassembly steps while noting the following.
  - a. Install the jet needle into the throttle slide in the same position as noted during removal. Push the jet needle into the throttle slide until you feel the first click. This is the first notch (Figure 122). If you want to install the jet needle into the next notch, rotate the jet needle 90° in either direction and gently push in until the next notch is achieved. Continue, if necessary, to rotate the jet needle and push until the correct notch is achieved.
  - b. Align the raised tab (A, Figure 123) on the diaphragm with the matching depression (B, Figure 123) in the throttle slide and install the diaphragm. Install the support ring, lockwashers and screws. Tighten the screws securely.
2. Assemble the throttle butterfly by reversing the disassembly steps while noting the following.
  - a. Install new O-ring seal (Figure 116) onto the shaft.
  - b. Apply a small amount of blue Loctite (No. 242) to the screw threads prior to installation. Tighten the screws securely.
3. Assemble the choke housing by reversing the disassembly steps while noting the following.
  - a. Position the choke body so that the dimple (A, Figure 124) on the threaded stud is aligned with the inlet portion of the housing (B, Figure 124) and install the choke body.
  - b. After installation, recheck the alignment (Figure 125).

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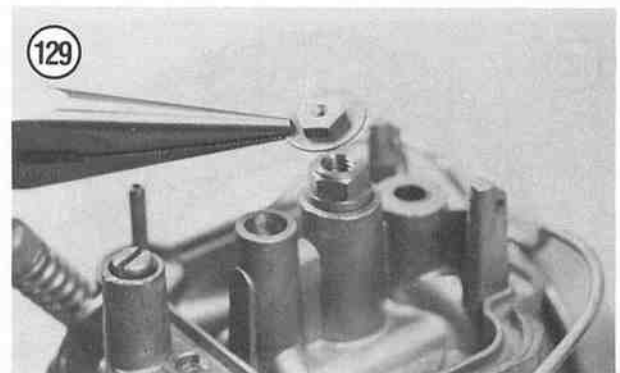
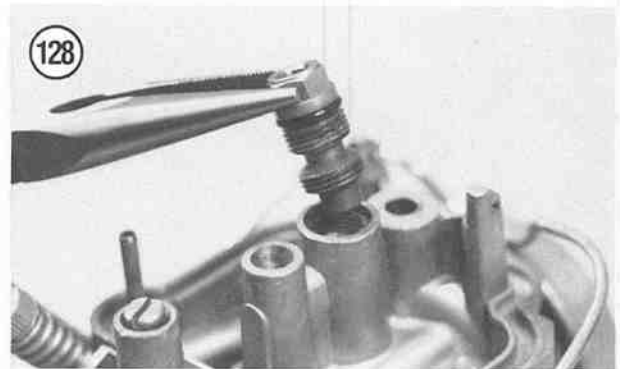
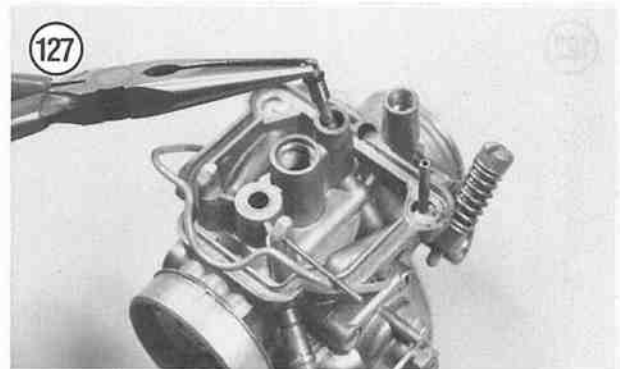
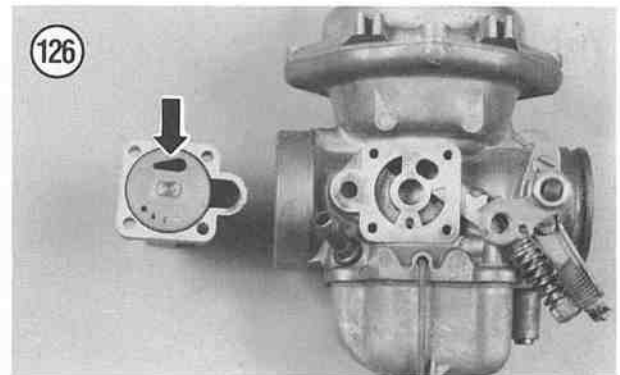


4. Install a new choke housing gasket.
5. Make sure the choke body is positioned as shown in **Figure 126** with the tear-shaped opening at the top.
6. Install the choke housing assembly (B, **Figure 101**) and tighten the screws (A, **Figure 101**) securely.
7. Install the idle jet (**Figure 127**).
8. Install the mixture adjust screw spring (**Figure 99**).
9. Install the mixture adjust screw (**Figure 98**) and lightly seat. Turn the screw out to the position noted during removal.
10. Install the atomizer with the long side going in first as shown in **Figure 97**.
11. Install the needle jet (**Figure 96**).
12. Install the main jet holder (**Figure 128**) and tighten securely.
13. Install the main jet washer and the main jet (**Figure 129**) and tighten securely.
14. Install the needle valve (**Figure 93**).
15. Install the float (A, **Figure 130**) and the float pivot pin (B, **Figure 130**). Make sure the pivot pin (A, **Figure 92**) is correctly seated in both pivot posts.
16. Install a new float bowl gasket (**Figure 91**) into the carburetor body.
17. Install the float bowl (B, **Figure 90**) onto the carburetor body, carefully inserting the hollow portion (A, **Figure 131**) of the float bowl over the raised tube (B, **Figure 131**) on the carburetor body.
18. Hook the float bowl clip (A, **Figure 90**) into position on the float bowl. Make sure it is properly secured to avoid a fuel leak.

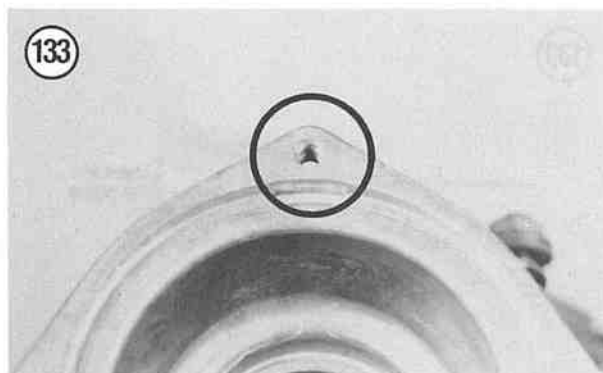
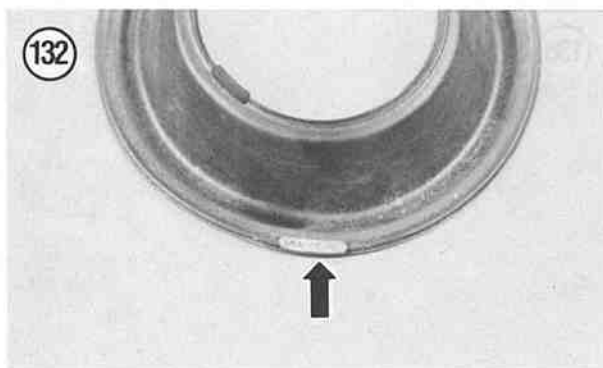
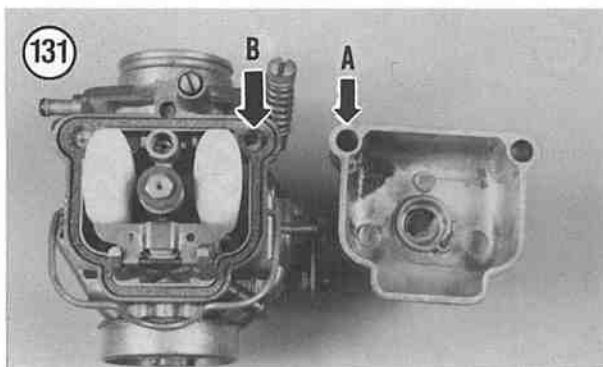
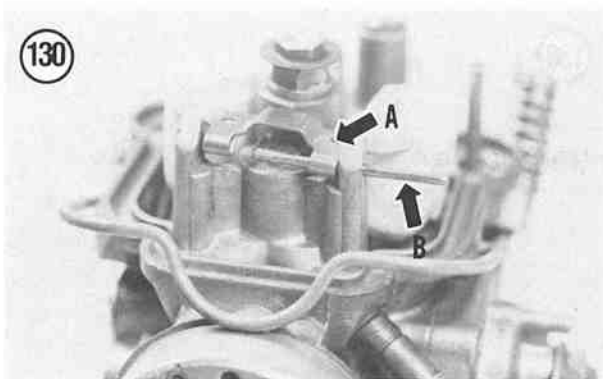
#### CAUTION

*In Step 19, make sure the lip and the locating tab of the diaphragm assembly are correctly seated in the groove and locating tab in the carburetor body. If the lip does not seat correctly there will be a vacuum leak that could lead to very poor performance and possible serious engine damage.*

19. Install the diaphragm assembly into the carburetor body. Align the raised tab (**Figure 132**) on the diaphragm with the depression (**Figure 133**) in the carburetor body.
20. Make sure the lip on the diaphragm assembly is positioned correctly in the groove in the carburetor body. Push up on the piston valve just enough so there is no crease in the diaphragm lip.
21. On models so equipped, install the spring.
22. Install the top cover (B, **Figure 89**), then install the screws and lockwashers (A, **Figure 89**). Tighten the screws securely.







### Cleaning and Inspection

#### WARNING

*Carburetor cleaner is extremely caustic and can cause permanent eye damage. Always wear eye protection when using any type of carburetor cleaner.*

The carburetors are best cleaned by completely disassembling them and cleaning the fuel and air orifices with an aerosol carburetor cleaner. Never use a wire to clean out jets or orifices; such a process could enlarge the passage, which would adversely affect the air-to-fuel ratio.

Motorcycle carburetors have much smaller air and fuel passages than automotive carburetors. For this reason, soaking the carburetor parts in an automotive type carburetor cleaner is not recommended. Motorcycle carburetors are usually coated with a corrosion-protective clear coating. Caustic liquid cleaners will remove the protective coatings from the outside of the carburetor body. The dissolved coating could plug passages in the carburetor as well as damage the appearance of the carburetors. Also, if the cleaner was used previously there will be sediment held in suspension within the solution. This could also plug a passage.

Clean the carburetor parts in a good grade of solvent and thoroughly dry with compressed air. Many good aerosol carburetor cleaners (i.e. Zep Choke and Carburetor Cleaner) can help remove any residue not removed with the solvent. Thoroughly rinse off all parts with clean water and dry with compressed air. If you do not have access to compressed air, place the cleaned parts on a piece of newspaper and allow to dry.

Whichever cleaning method (spray or soak) you choose, never use carburetor cleaner on gaskets, O-rings or plastic parts. These non-metal parts could be damaged by the cleaner.

1. Clean all parts, except rubber or plastic parts, in a good grade of aerosol carburetor cleaner or cleaning solvent.

#### NOTE

*A special carburetor cleaner is **not** usually necessary to clean a carburetor unless it is very dirty or corroded. A good grade of parts cleaning solvent will usually clean most carburetors.*

#### CAUTION

*Do not put non-metallic parts such as floats, gaskets and O-rings in special carburetor cleaner as these components will be damaged. Clean these components in common solvent or kerosene.*

2. Blow out all the jets and passages in the carburetor body with compressed air. Refer to **Figure 134** and **Figure 135**.
3. Make sure all openings in the carburetor body are clear. Refer to **Figure 136** and **Figure 137**. Clean out if they are plugged in any way.

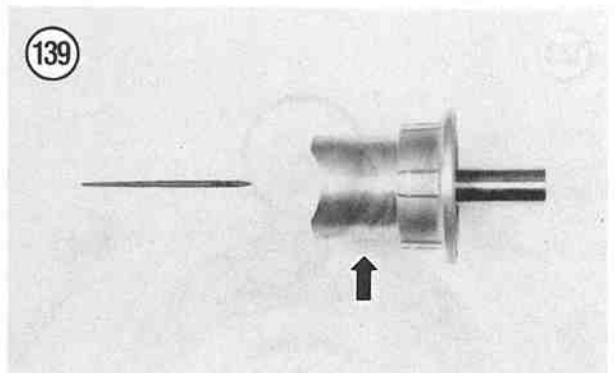
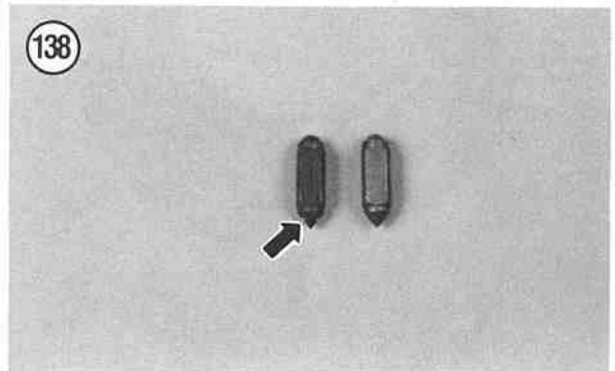
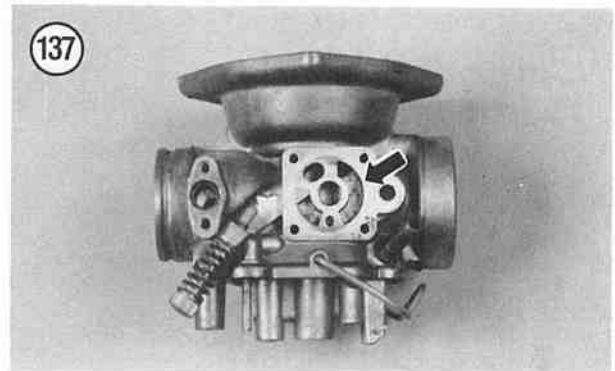
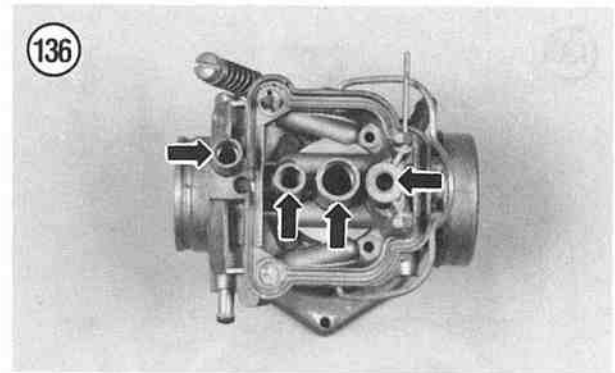
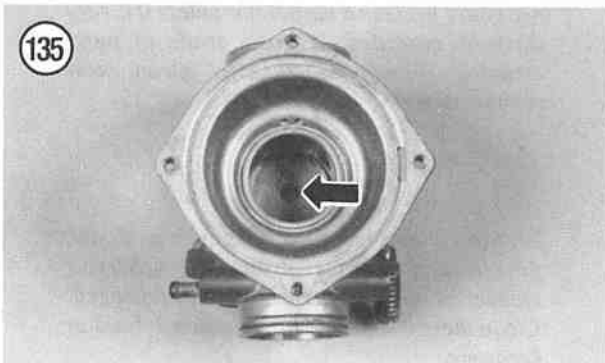
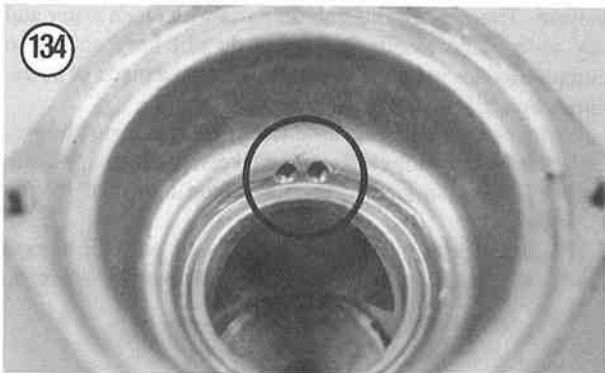
**CAUTION**

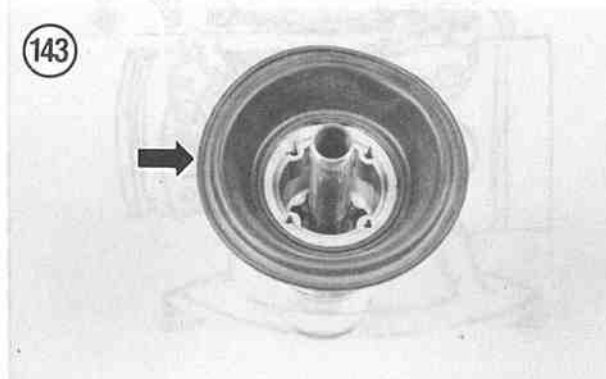
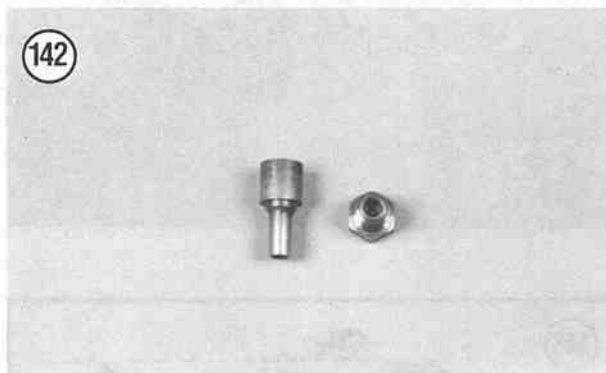
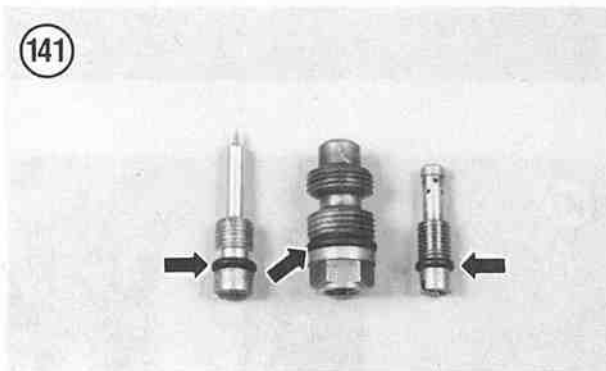
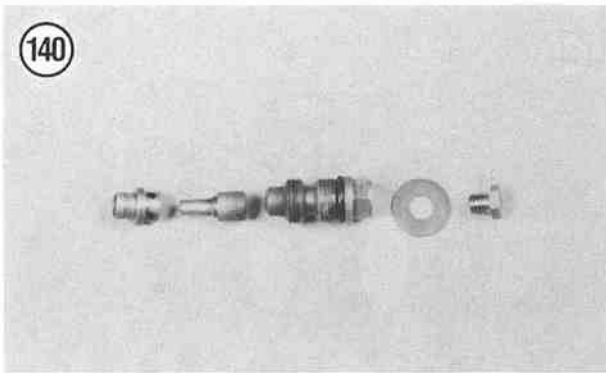
*If compressed air is not available, allow the parts to air dry or use a clean lint-free cloth. Do not use paper towels to dry carburetor parts, as small paper particles may plug openings in the carburetor body or jets.*

**CAUTION**

*Never use wire to clean any jets or orifices in the carburetor body. The wire could enlarge and damage the precise sizes of the jets or openings, resulting in poor carburetor performance.*

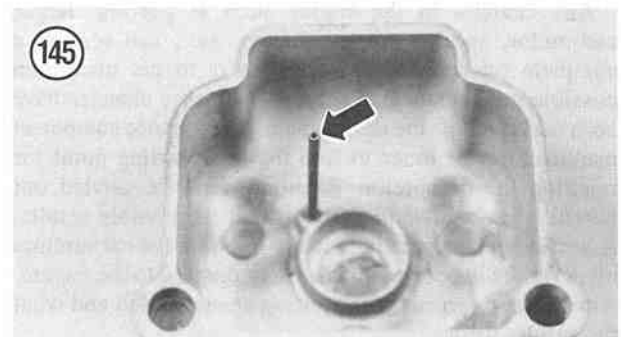
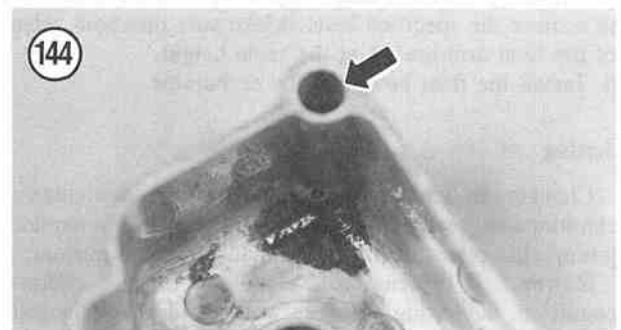
4. Check the tip of the needle valve and the inside of the needle valve body. Replace the needle valve assembly if the tip is scored or damaged. A damaged needle valve face (**Figure 138**) with a wear groove or a particle of dirt or grit in the needle valve assembly will cause the carburetor to flood and overflow fuel.
5. Inspect the throttle slide (**Figure 139**) for scoring or galling. Replace the throttle slide if not perfect.





- WARNING**  
*A damaged throttle slide can cause the carburetor to stick open, resulting in loss of throttle control that may cause a serious accident.*
6. Examine all parts of the main jet group (Figure 140) for wear or damage. Replace if necessary.
  7. Examine the end of the mixture adjust screw. Replace the screw if any grooves or roughness are present. A damaged end will prevent smooth engine operation.
  8. Examine the O-ring seals (Figure 141) on the mixture adjust screw, main jet holder and idle jet. Replace if they are deteriorated or starting to harden.
  9. Inspect the atomizer and needle jet (Figure 142) for wear or damage. Replace any damaged or worn parts.
  10. Examine all parts of the diaphragm assembly for wear or damage. Make sure the diaphragm (Figure 143) is not torn or cracked. Replace any damaged or worn parts.
  11. Examine all parts of the choke valve assembly for wear or damage. Replace any damaged or worn parts.
  12. Make sure the holes in the needle jet are clear. Clean out if they are plugged in any way. Replace the needle jet if you cannot unplug the holes.
  13. Make sure the holes in the remaining jets are clear. Clean out if they are plugged in any way. Replace the jet(s) if you cannot unplug the hole(s).
  14. Be sure to clean out opening (Figure 144) in the float bowl. Blow out with compressed air if necessary.
  15. Clean out the overflow tube (Figure 145) in the float bowl. Blow out with compressed air if necessary.

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16. Examine the float bowl gasket (**Figure 146**) for damage. Replace the gasket if there is any doubt as to its condition.

17. Shake the float assembly (**Figure 147**). Listen for fuel sloshing around inside indicating that the float has leaked. Replace the float if there is any indication of fuel within the float.

## CARBURETOR ADJUSTMENT

### Float Adjustment

The float adjustment is important for proper engine operation. The float valve maintains a constant fuel level in the float bowl to supply the demands of the engine at all engine speeds. As the chamber fills with fuel, the float rises, thereby pushing the float valve needle into the valve to shut off the incoming fuel. As the fuel level drops, so does the float valve needle, permitting fuel to flow into the bowl and replenish the supply.

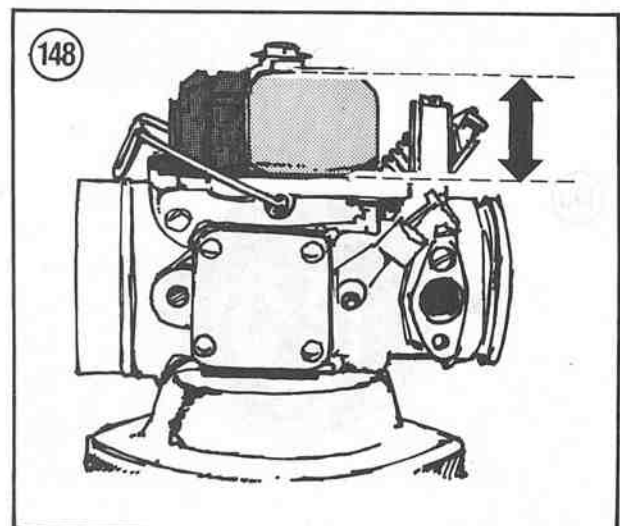
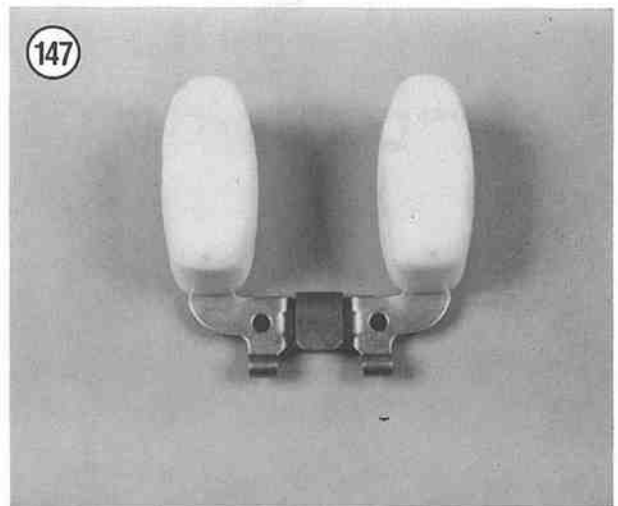
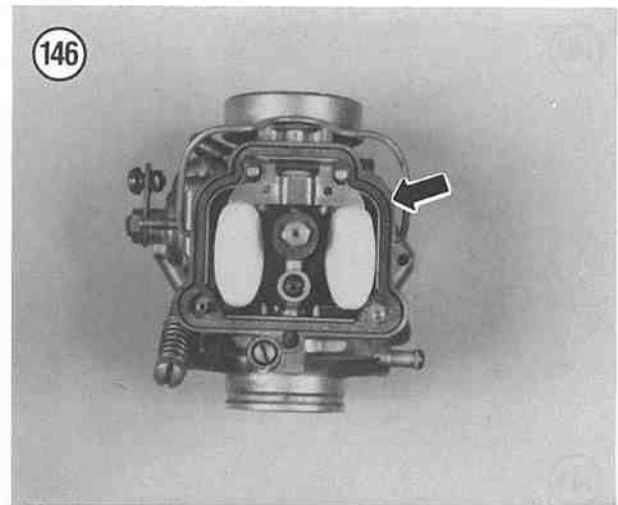
1. Remove the carburetor. Leave the throttle and choke cables attached.
2. Remove the float bowl and drain out all fuel.
3. Turn the carburetor upside down.
4. Hold the carburetor so that the float is parallel to the float bowl sealing surface (**Figure 148**).
5. The tab on the float assembly must *just touch* the end of the float valve needle—but not compress it.
6. If adjustment is necessary, remove the float pivot pin and remove the float.
7. Carefully bend the tang (**Figure 149**) on the float arm to achieve the specified level. Make sure that both sides of the float arm are set at the same height.
8. Install the float bowl and the carburetor.

### Jetting

Changes in temperature, humidity and particularly elevation can greatly affect engine performance. Carburetor jetting changes can bring performance back to normal.

However, if the engine is stock and in good overall condition, the jetting probably won't need to be changed unless you go from one elevation to another. Refer to **Table I** for stock carburetor specifications.

Any changes in the engine such as porting, larger carburetor, special exhaust system, etc., can require a complete rejetting of the carburetors to get maximum possible performance. If such performance changes have been made, follow the advice of the performance equipment manufacturer or tuner to find the best starting point for rejetting the carburetor. Rejetting must be carried out *carefully and systematically* for the best possible results. A hurried or random approach to rejetting the carburetors often results in poor performance or damage to the engine. Always keep records of the jetting changes tried and what the results were.



**CAUTION**

A too-lean mixture caused by running a too small pilot, needle or main jet can cause serious engine damage in a matter of seconds. When changing jetting, always start out rich and move toward a leaner mixture, one step at

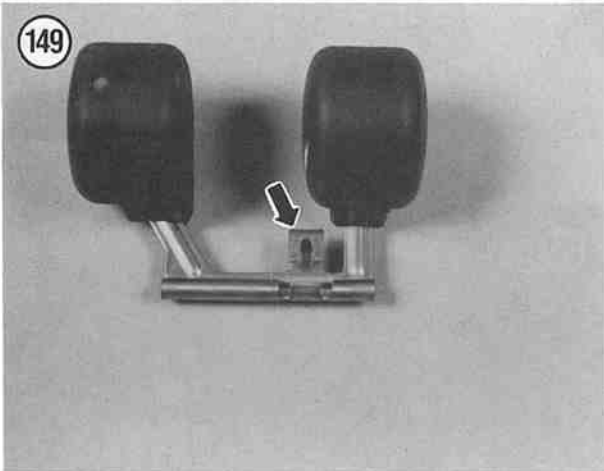
a time. The engine must be at full operating temperature achieved by hard riding. Trying to jet an engine that is not up to temperature can result in a too-lean mixture when the engine reaches full operating temperature.

**AIR FILTER CASE**

**Removal/Installation  
(1970-1979 Models)**

Refer to **Figure 150** for this procedure. The illustrations show the left-hand components. The right-hand components are an exact mirror image and all parts are the same with the exception of the air filter element and its retaining bracket.

1. Place the bike on the centerstand.
2. On models so equipped, move the kickstarter down until it bottoms out. Tie it in this position to get it out of the way.
3. On 1979 models, perform the following:
  - a. Remove the fuel tank as described in Chapter Seven.
  - b. Remove the screws securing the starter cover and remove the cover.
  - c. Disconnect the engine breather hose from the air filter housing.

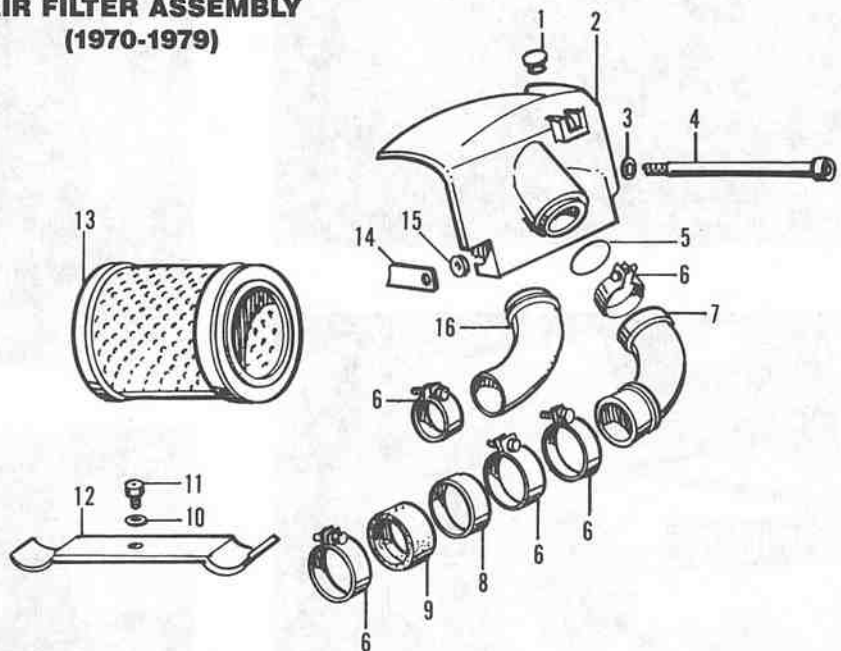


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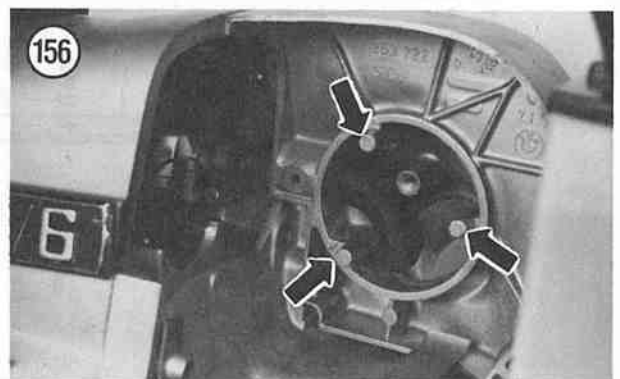
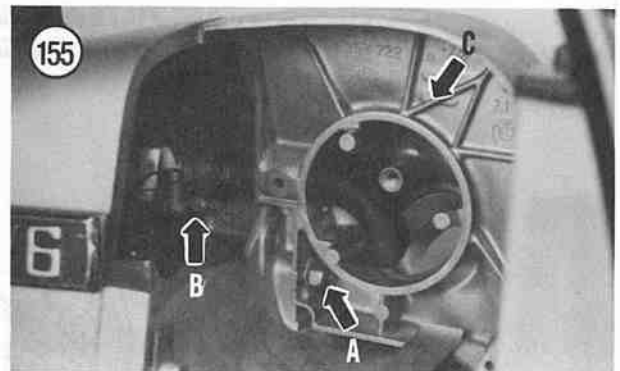
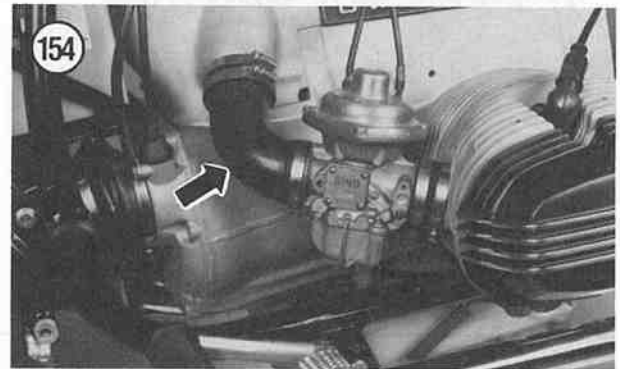
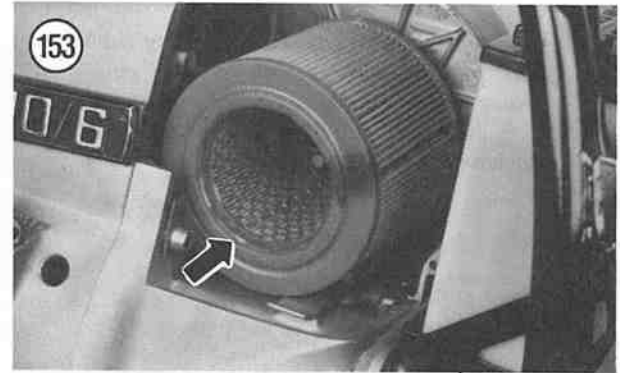
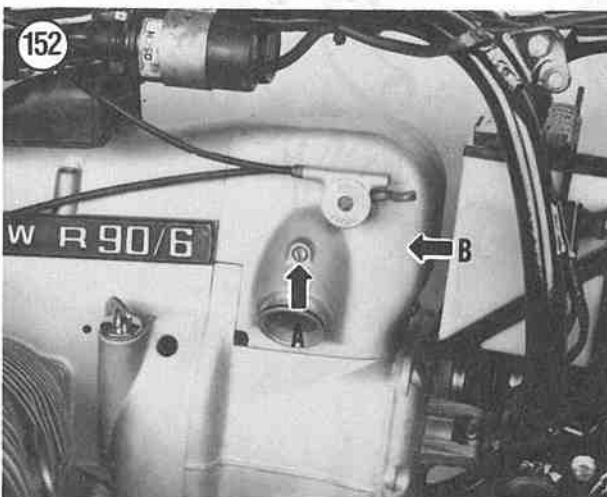
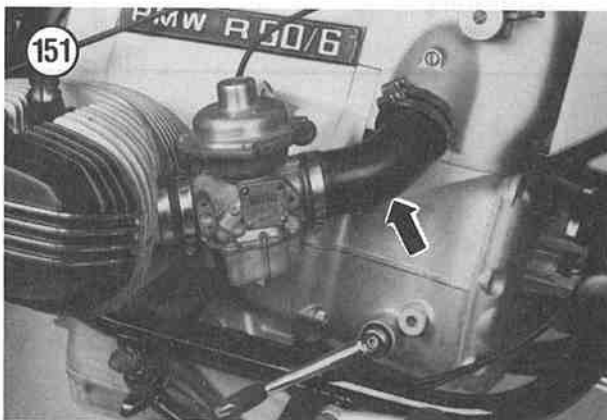
**AIR FILTER ASSEMBLY  
(1970-1979)**

1. Plug
2. Air filter housing
3. Lockwasher
4. Bolt
5. O-ring
6. Clamp
7. Intake tube
8. Ring stiffener
9. Sleeve
10. Lockwasher
11. Bolt
12. Strap
13. Air filter element
14. Spring clamp
15. Spacer
16. Intake tube





4. Loosen the hose clamps on the left-hand rubber intake tube (Figure 151).
5. Carefully remove the left-hand rubber intake tube from the engine air filter housing and the carburetor. Cover the carburetor inlet with tape or a plastic bag to keep out foreign matter.
6. Remove the screw (A, Figure 152) securing the left-hand air filter housing (B, Figure 152) and remove the housing from the crankcase. Move the housing out of the way, being careful not to kink or damage the choke cables.
7. Withdraw the air filter element (Figure 153) from the crankcase air filter housing air box. If the element is in good condition, place it in a resealable plastic bag and keep it clean so that it can be reused.
8. Loosen the hose clamps on the right-hand rubber intake tube (Figure 154).
9. Carefully remove the right-hand rubber intake tube from the engine air filter housing and the carburetor. Cover the carburetor inlet with tape or a plastic bag to keep out foreign matter.
10. Remove the nut (A, Figure 155) securing the right-hand air filter housing to the crankcase.



11. Loosen the hose clamp (B, **Figure 155**) on the crankcase breather assembly and remove the housing (C, **Figure 155**) from the crankcase.

12. Install by reversing these removal steps. Note the following during installation.

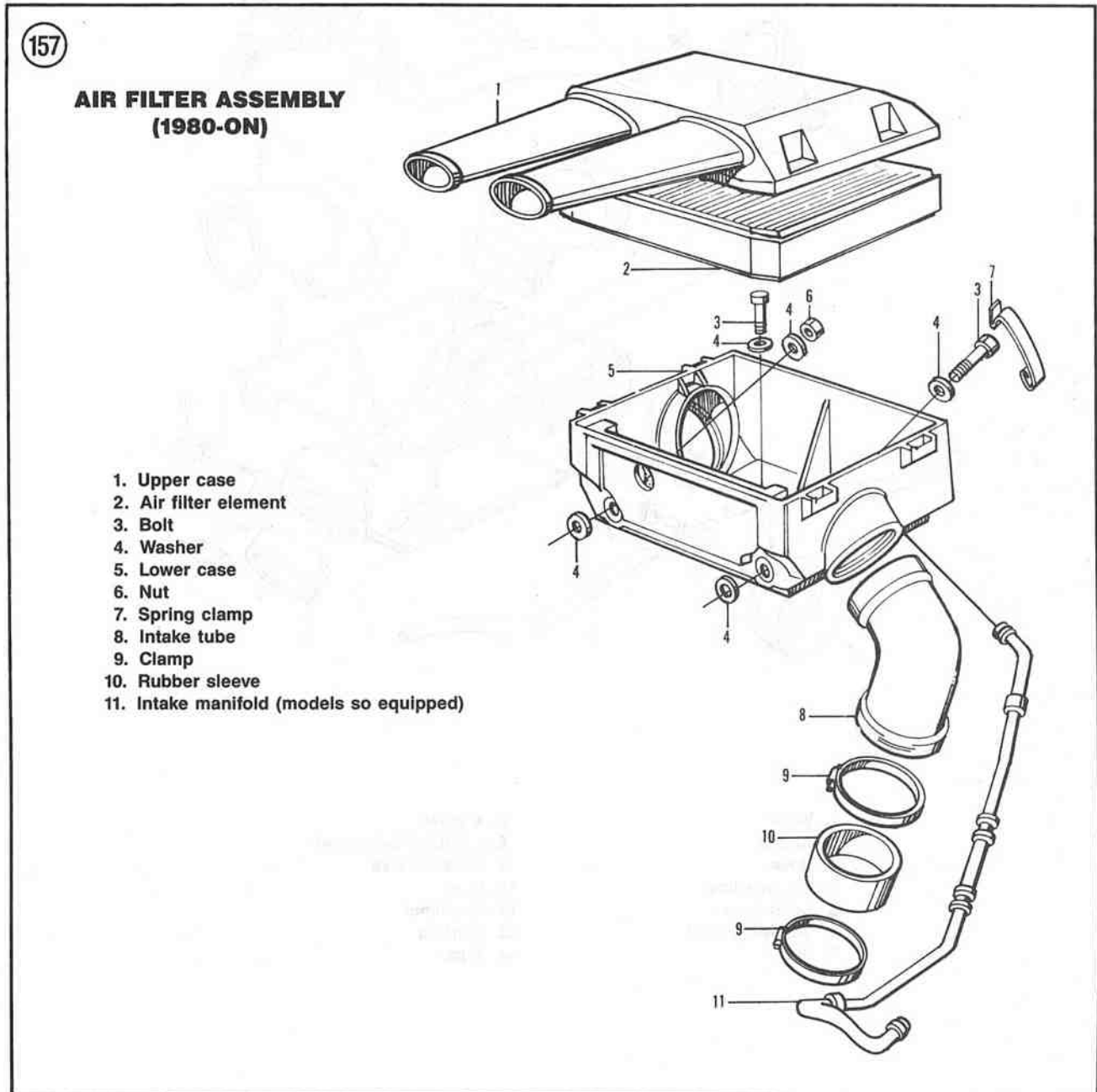
13. Install the air filter element into the crankcase and press it in until it seats correctly onto the three studs (**Figure 156**) in the air filter housing. Make sure the element is correctly seated into the air box so the sealing surface is tight up against the air box surface.

14. Make sure the intake tube clamp screws are secure to prevent a vacuum leak.

**Removal/Installation  
(1980-on Models)**

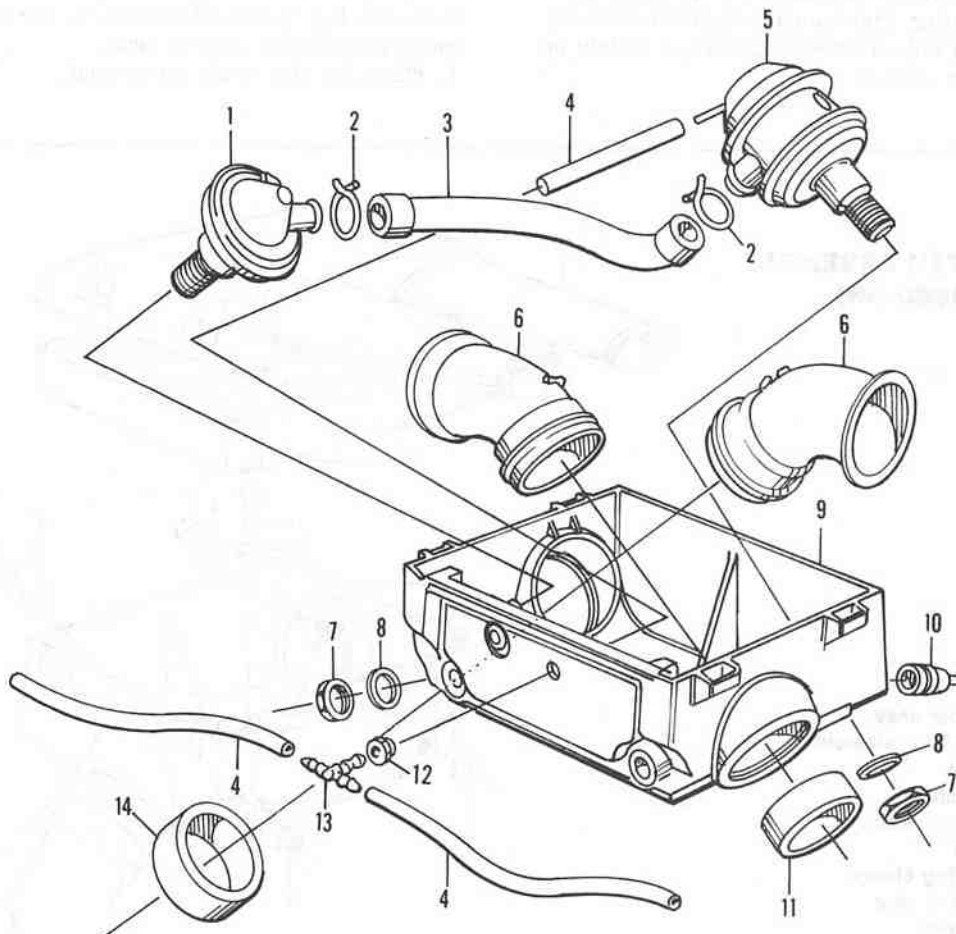
Refer to **Figure 157** and **Figure 158** for this procedure. In **Figure 157** some components are shown for the left-hand side only. The right-hand components are an exact mirror image and all parts are the same.

1. Place the bike on the centerstand.



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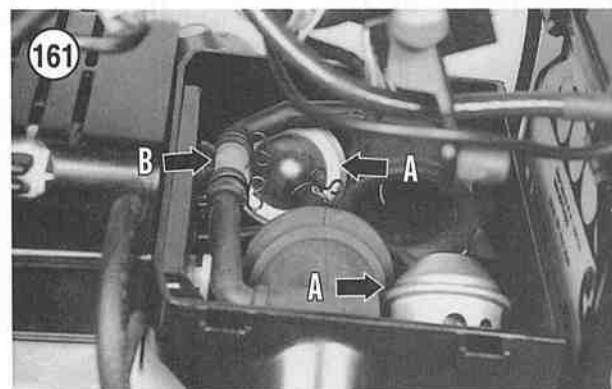
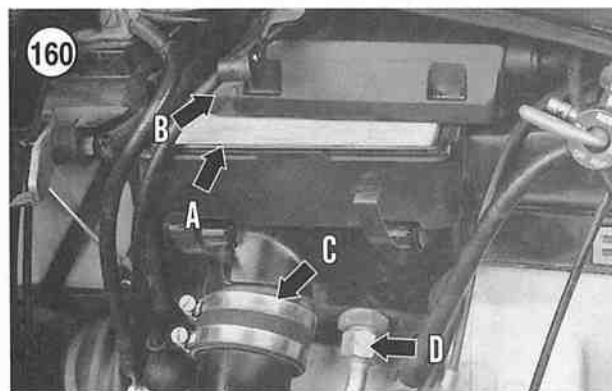
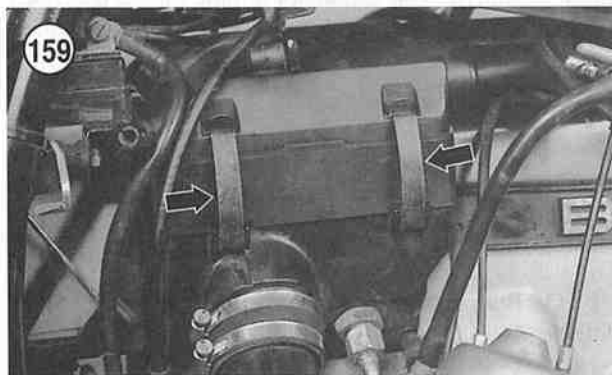
### AIR FILTER AND AIR INJECTION SYSTEM (1980-ON)



1. Valve
2. Clamp
3. Hose
4. Vacuum line
5. Reed valve
6. Suction funnel
7. Nut

8. Gasket
9. Air filter lower case
10. Rubber valve
11. Pipe
12. Grommet
13. T-fitting
14. Pipe

2. On models so equipped, remove both front fairing lower sections as described under *Front Fairing Removal/Installation* in Chapter Twelve.
3. Unhook the spring clamps (Figure 159) on each side securing the upper case to the lower case.
4. Raise the upper case away from the lower case and withdraw the air filter element (A, Figure 160) out through the left-hand side. If the element is in good condition, place it in a resealable plastic bag and keep it clean so that it can be reused.
5. Remove the upper case (B, Figure 160).



6. Loosen the hose clamps on the right-hand rubber intake tube (C, Figure 160).
7. Carefully remove the right-hand rubber intake tube from the air filter housing intake neck and from the carburetor. Cover the carburetor inlet with tape or a plastic bag to keep out foreign matter.
8. Repeat Step 6 and Step 7 and remove the left-hand rubber intake tube.
9. Unscrew the nut (D, Figure 160) securing the right-hand air line to the lower case. Move the air line out of the way. It is not necessary to disconnect the air line from the cylinder head.
10. Repeat Step 9 for the left-hand air line.
11. Remove the valves within the lower case as follows:
  - a. Unscrew the nut and washer on each side securing the reed valve (A, Figure 161) and other valve to the lower case.
  - b. Disconnect the reed valve vacuum line from the T-fitting (B, Figure 161) at the front of the lower case.
  - c. Remove the reed valve and the other valve and their interconnecting hose from the lower case as an assembly.
12. Remove the battery and the battery case as described under *Battery Case Removal/Installation* in Chapter Eight.
13. Carefully withdraw the T-fitting and vacuum hoses from the rubber grommet on the front of the lower case.
14. Remove the nut and washer securing the front of the lower case to the engine.
15. Remove the bolts and washers securing the front and bottom of the lower case to the engine. Don't lose the washer between the lower case and the engine on the front bolts.
16. Remove the lower case from the engine.
17. Install by reversing these removal steps. Note the following during installation.
18. Be sure to install the washer between the lower case and the engine on the front bolts.
19. Make sure all vacuum lines and air lines are properly attached.
20. Apply a light coat of multipurpose grease to the sealing edges of the air filter element. This will assure an air-tight fitting of the element to the air filter case.
21. Position the air filter element with the TOP-OBEN arrow facing up.
22. Install the air filter into the lower case and press it down to make sure it seats correctly. Make sure the element is correctly seated into the air box so the sealing surface is tight up against the air box surfaces.
23. Install the upper case onto the lower case and make sure it is correctly seated all the way around the perimeter. Secure the upper case to the lower case with the spring clamps. Make sure the spring clamps have snapped over-center and are holding tight.
24. On models so equipped, install both front fairing lower sections as described under *Front Fairing Removal/Installation* in Chapter Twelve.

## THROTTLE CABLE REPLACEMENT

### 1970-1973 Models

On 1970-1973 models, a single upper throttle cable travels from the hand-throttle grip to the cable distributor located at the left-hand side of the engine timing chain cover. At the cable distributor, the single upper throttle grip cable pulls on the two lower cables with one cable going to each carburetor.

Refer to **Figure 162** for this procedure.

1. Remove the fuel tank as described in this chapter.
2. Pull the throttle cable rubber boot away from the throttle grip.

#### NOTE

*When the throttle cable cover is removed, the throttle grip becomes loose and may fall off of the end of the handlebar. Either secure the throttle grip in place or remove it from the handlebar.*

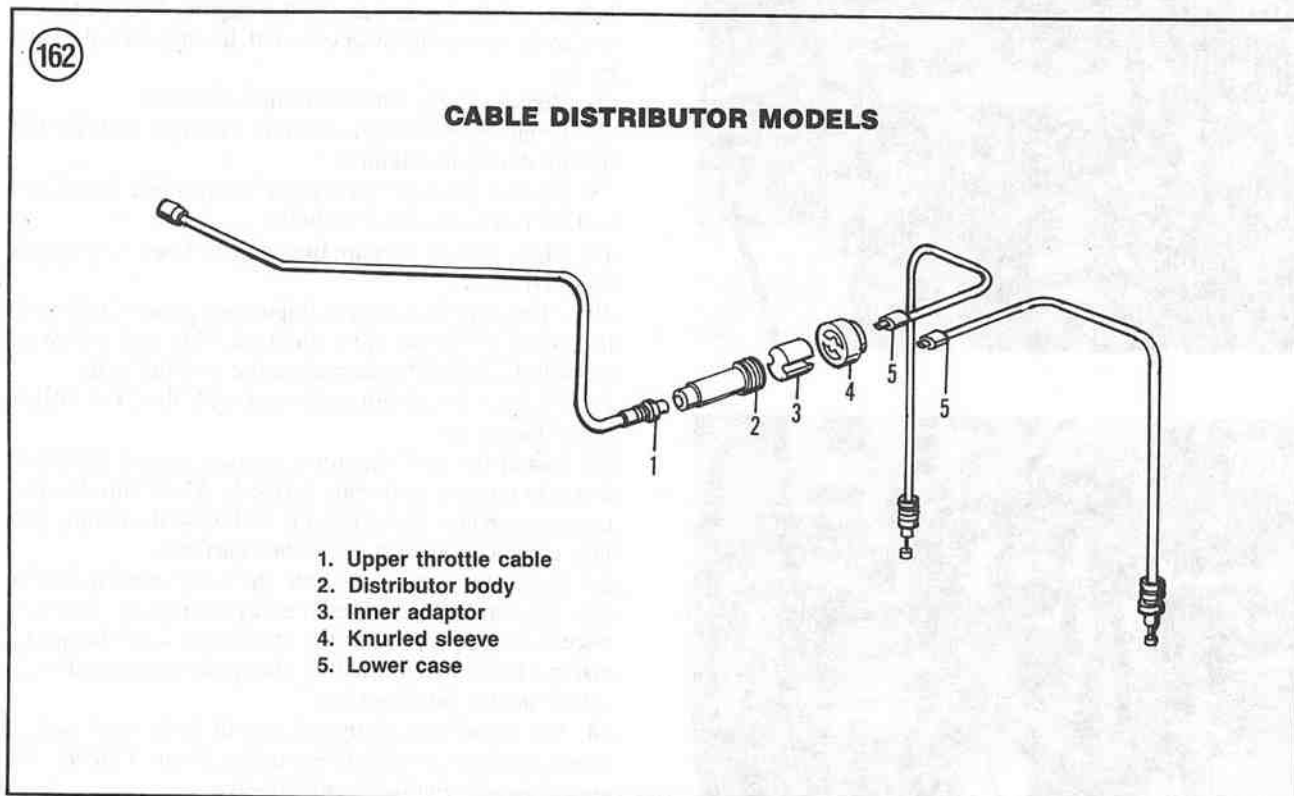
3. Remove the screw securing the throttle cable cover and remove the cover.
4. Pull up and disengage the cable end cap, then disengage the upper throttle cable end from the throttle wheel chain.

5. To disconnect the upper cable, perform the following:
  - a. On the front left-hand side of the timing chain cover, hold onto the knurled sleeve and unscrew the cable distributor body until the 2 parts separate.
  - b. To disconnect the upper throttle cable, unscrew the locknut on the end of the cable and disconnect the upper cable from the distributor body.
6. To disconnect the lower cables, perform the following:
  - a. Push the cables and inner adaptor out of the knurled sleeve.
  - b. Disconnect the cable ends from the inner adaptor and pull them out of the knurled sleeve.
- 7A. On Bing slide-type carburetors, disconnect the lower throttle cable from the carburetor throttle slide as described under *Carburetor Disassembly/Assembly* in this chapter.

#### NOTE

*Depending on the size of your hands, it may be easier to remove the carburetor from the cylinder head to gain access to the throttle linkage on the backside of the carburetor.*

- 7B. On Bing constant velocity carburetors, perform the following:
  - a. Loosen the throttle cable locknut and the adjuster.
  - b. Disconnect the throttle cable end from the carburetor throttle linkage.





8. Repeat Step 7A or 7B and disconnect the lower throttle cable from the other carburetor.

**NOTE**

*The piece of string attached in the next steps will be used to pull the new throttle cable back through the frame so it will be routed in exactly the same position as the old cable.*

9. Tie a piece of heavy string or cord (approximately 3 ft./1 meter long) to the throttle grip end of the upper throttle cable. Wrap this end with masking or duct tape. Do not use a lot of tape as it must be pulled through the frame during removal. Tie the other end of the string to the throttle grip housing.

10. At the cable distributor end of the cable, carefully pull the cable (and attached string) out through the frame. Make sure the attached string follows the same path as the cable through the frame.

11. Remove the tape and untie the string from the old cable.

12. Lubricate the new cable as described under *Control Cable Lubrication* in Chapter Three.

13. Tie the string to the throttle grip end of the new upper throttle cable and wrap it with tape.

14. Carefully pull the string back through the frame toward the throttle grip routing the new cable through the same path as the old cable.

15. Remove the tape and untie the string from the cable and the frame.

16. Tie a piece of heavy string or cord (approximately 3 ft./1 meter long) to the cable distributor end of one of the lower throttle cables. Wrap this end with masking or duct tape. Do not use a lot of tape as it must be pulled through the frame during removal. Tie the other end of the string to the frame.

17. At the carburetor end of the lower cable, carefully pull the cable (and attached string) out through the frame. Make sure the attached string follows the same path as the lower cable through the frame.

18. Remove the tape and untie the string from the old cable.

19. Lubricate the new cable as described under *Control Cable Lubrication* in Chapter Three.

20. Tie the string to the cable distributor end of the new lower throttle cable and wrap it with tape.

21. Carefully pull the string back through the frame toward the cable distributor routing the new cable through the same path as the old cable.

22. Remove the tape and untie the string from the cable and the frame.

23. Repeat Steps 16-22 for the other lower throttle cable.

24. Connect the new throttle upper and lower cables by reversing Steps 2-8 and noting the following.

25. Attach the throttle cable onto the throttle wheel chain and place the cable end into the receptacle in the throttle housing lower half.

26. Apply a coat of lithium-based grease to the end of the throttle grip and insert the throttle grip into the housing.

Align the index marks of the throttle grip and the throttle chain gear.

27. Make sure the throttle cable end is still engaged properly in the throttle wheel chain.

28. Hold the throttle grip in place and install the throttle cable cover. Install the screw and tighten securely.

29. Slide the rubber boot back into place.

30. Operate the throttle grip and make sure the throttle housing throttle linkage is operating correctly, with no binding. If operation is incorrect or there is binding, carefully check that the cable(s) are attached correctly and there are no tight bends in the cable(s).

31. Install the fuel tank as described in this chapter.

32. Adjust the throttle cable as described under *Carburetor Idle Mixture and Speed Adjustment* in Chapter Three.

33. Test ride the bike slowly at first and make sure the throttle is operating correctly.

### 1974-on Models

On 1974-on models, there are 2 separate throttle cables and each cable travels from each carburetor to the throttle lever.

1. Remove the fuel tank as described in this chapter.

**NOTE**

*When the throttle cable cover is removed, the throttle grip becomes loose and may fall off of the end of the handlebar. Either secure the throttle grip in place or remove it from the handlebar.*

2. Pull the throttle cable rubber boot (A, **Figure 163**) away from the throttle grip.

3. Remove the screw (B, **Figure 163**) securing the throttle cable cover (C, **Figure 163**) and remove the cover.

4. Pull up and disengage the cable end cap, then disengage the upper throttle cable end (**Figure 164**) from the throttle wheel chain.

5A. On Bing and Dell'Orto slide-type carburetors, disconnect the throttle cable from the carburetor throttle slide as described under *Carburetor Disassembly/Assembly* in this chapter.

**NOTE**

*Depending on the size of your hands, it may be easier to remove the carburetor from the cylinder head to gain access to the throttle linkage on the backside of the carburetor.*

5B. On Bing constant velocity carburetors, perform the following:

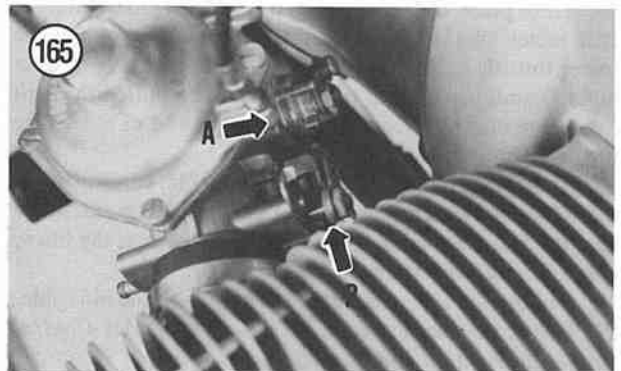
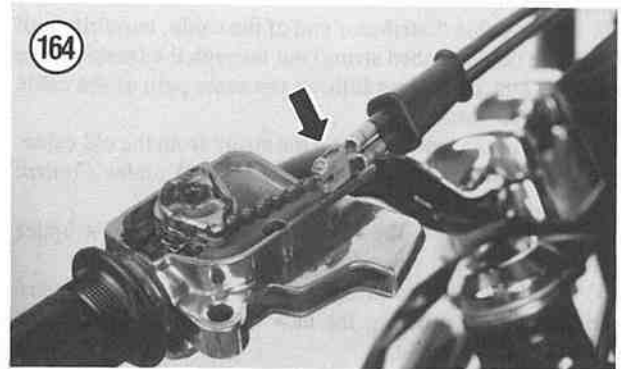
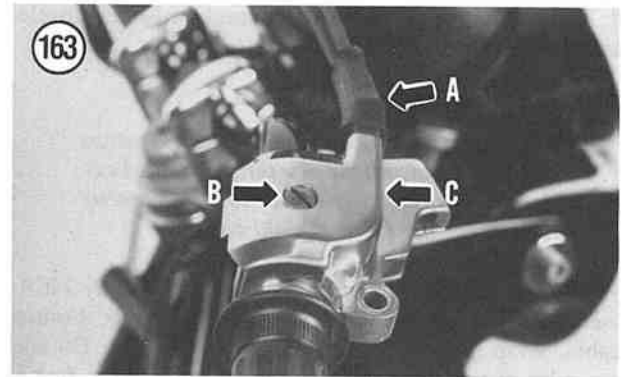
- a. Loosen the throttle cable locknut and the adjuster (A, **Figure 165**).
- b. Disconnect the throttle cable end from the carburetor throttle linkage (B, **Figure 165**).

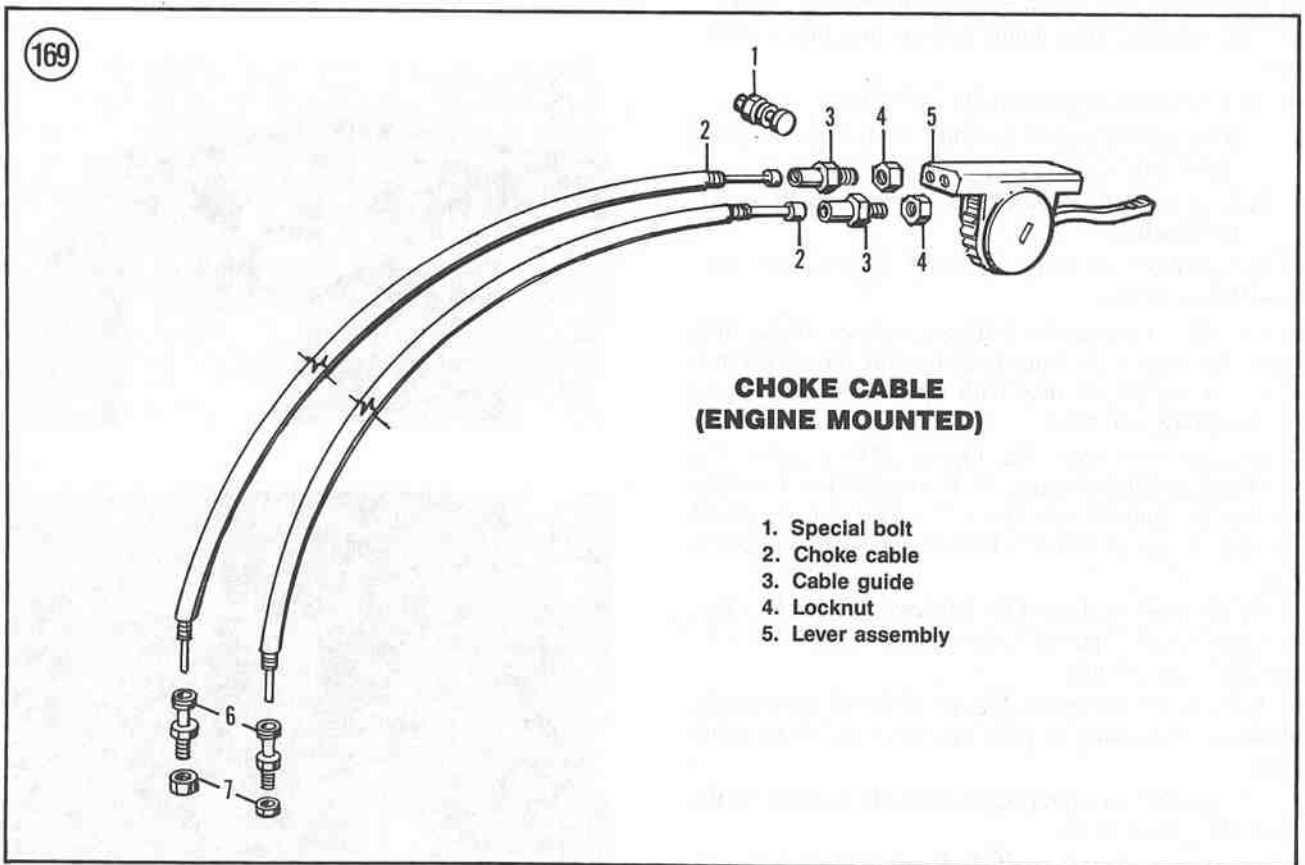
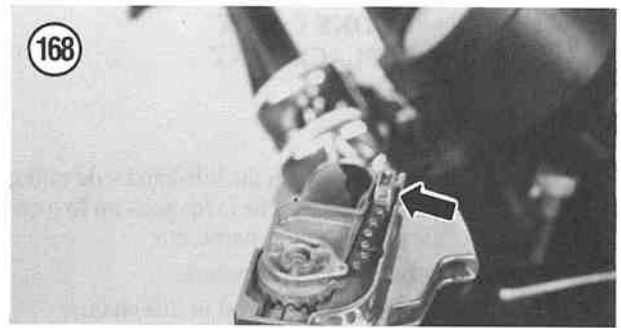
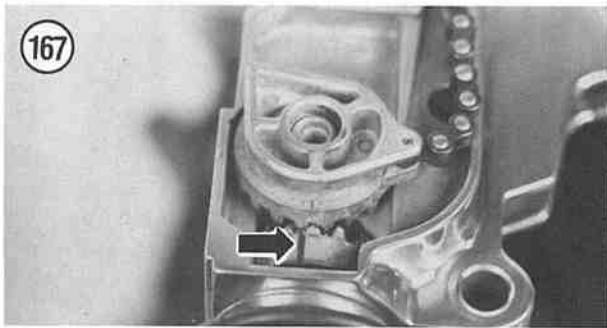
6. Repeat Step 5A or 5B and disconnect the throttle cable from the other carburetor.

**NOTE**

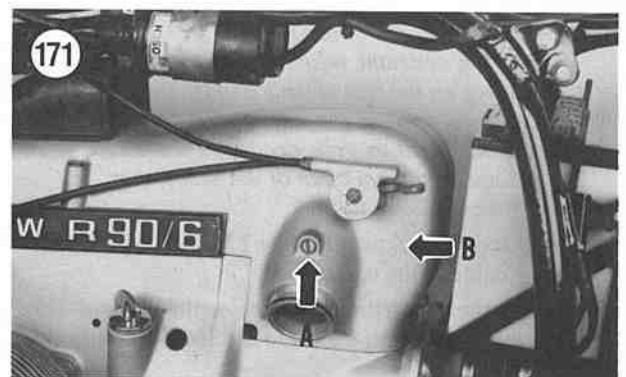
*The piece of string attached in the next step will be used to pull the new throttle cable back through the frame so it will be routed in exactly the same position as the old cable.*

7. Tie a piece of heavy string or cord (approximately 3 ft./1 meter long) to the throttle grip end of the throttle cable. Wrap this end with masking or duct tape. Do not use a lot of tape as it must be pulled through the frame during removal. Tie the other end of the string to the throttle grip housing.
8. At the carburetor end of the cable (**Figure 166**), carefully pull the cable (and attached string) out through the frame. Make sure the attached string follows the same path as the cable through the frame.
9. Remove the tape and untie the string from the old cable.
10. Lubricate the new cable as described under *Control Cable Lubrication* in Chapter Three.
11. Tie the string to the throttle grip end of the new throttle cable and wrap it with tape.
12. Carefully pull the string back through the frame toward the throttle grip routing the new cable through the same path as the old cable.
13. Remove the tape and untie the string from the cable but leave the string attached to the throttle grip.
14. Repeat Steps 7-13 for the other throttle cable.
15. Connect the new throttle cables to the carburetors by reversing Step 5A or Step 5B. Untie the string from the throttle grip.
16. Attach the throttle cable(s) onto the throttle wheel chain and place the cable end (**Figure 164**) into the receptacle in the throttle housing lower half.
17. Apply a coat of lithium-based grease to the end of the throttle grip and insert the throttle grip into the housing. Align the index marks of the throttle grip and the throttle chain gear (**Figure 167**).
18. Make sure the throttle cable end is still engaged properly in the throttle wheel chain (**Figure 168**).
19. Hold the throttle grip in place and install the throttle cable cover (C, **Figure 163**). Install the screw (B, **Figure 163**) and tighten securely.
20. Slide the rubber boot (A, **Figure 163**) back into place.
21. Operate the throttle grip and make sure the throttle housing throttle linkage is operating correctly, with no binding. If operation is incorrect or there is binding, carefully check that the cable(s) are attached correctly and there are no tight bends in the cable(s).
22. Install the fuel tank as described in this chapter.
23. Adjust the throttle cable as described under *Carburetor Idle Mixture and Speed Adjustment* in Chapter Three.
24. Test ride the bike slowly at first and make sure the throttle is operating correctly.





7



## CHOKE CABLE REPLACEMENT

### Engine Mounted Lever

The choke lever is mounted on the left-hand side of the engine on the air filter housing. The lever pulls on two cables with one cable going to each carburetor.

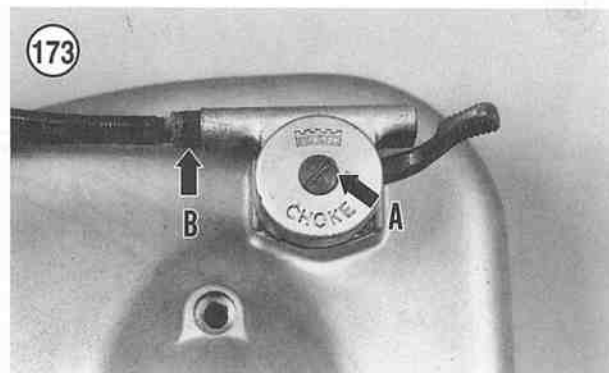
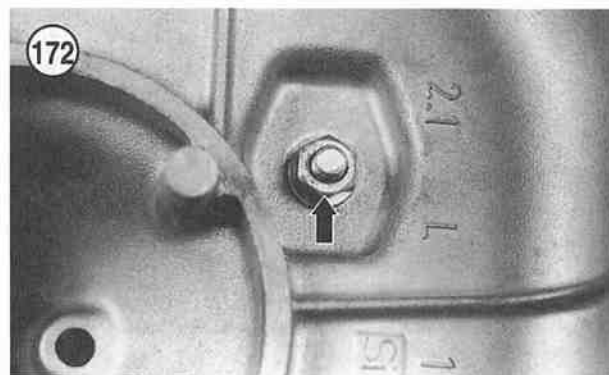
Refer to **Figure 169** for this procedure.

1. Remove the fuel tank as described in this chapter.
2. Place the bike on the centerstand.
3. On models so equipped, move the kickstarter down until it bottoms out. Tie it in this position to get it out of the way.
4. On 1979 models, perform the following:
  - a. Remove the screws securing the starter cover and remove the cover.
  - b. Disconnect the engine breather hose from the air filter housing.
5. Loosen the hose clamps on the left-hand rubber intake tube (**Figure 170**).
6. Carefully remove the left-hand rubber intake tube from the engine air filter housing and the carburetor. Cover the carburetor inlet with tape or a plastic bag to keep out foreign matter.
7. Remove the screw (A, **Figure 171**) securing the left-hand air filter housing (B, **Figure 171**) and remove the housing from the crankcase. Move the housing out of the way, being careful not to kink or damage the choke cables.
8. On the inside surface of the left-hand air filter housing, remove the nut (**Figure 172**) securing the choke lever assembly to the housing.
9. Remove the screw (A, **Figure 173**) and separate the choke lever housing to gain access to the choke cable ends.
10. On models so equipped, unscrew the locknut on the lever end of the cable.
11. Unscrew the cable guide (B, **Figure 173**) from the lever assembly.

#### NOTE

*On Bing constant velocity carburetors, depending on the size of your hands, it may be easier to remove the carburetor from the cylinder head to gain access to the choke linkage on the backside of the carburetor.*

12. Unscrew the locknut (**Figure 174**) on the carburetor end of the cable at the carburetor.
13. Loosen the nut on the choke cable retaining bolt (**Figure 175**) and disconnect the cable end from the carburetor linkage.

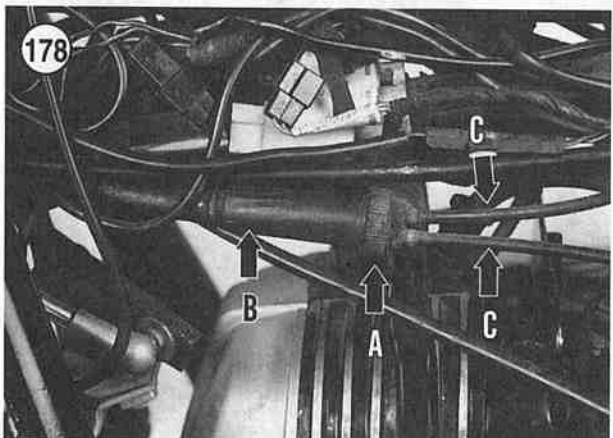
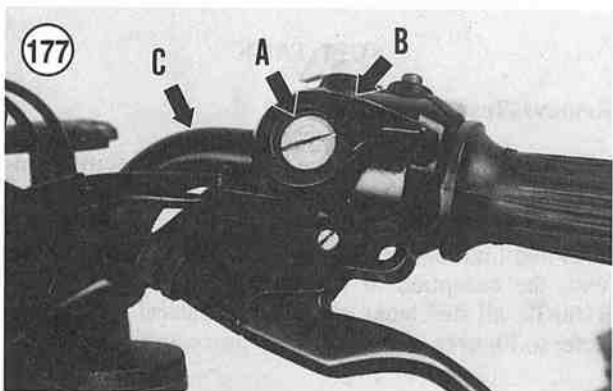
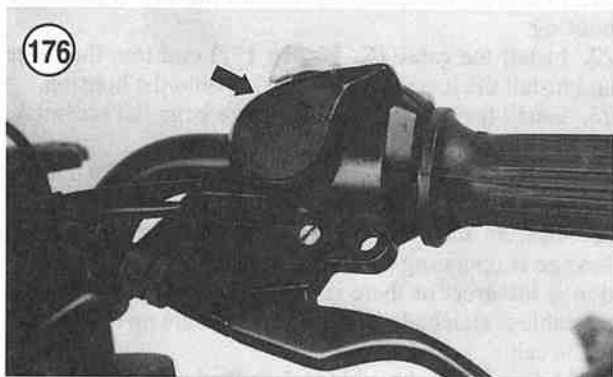




**NOTE**

The piece of string attached in the next steps will be used to pull the new choke cable back through the frame so it will be routed in exactly the same position as the old cable.

- 14A. On the right-hand carburetor, perform the following:
- Tie a piece of heavy string or cord (approximately 3 ft./1 meter long) to the choke lever end of the choke cable. Wrap this end with masking or duct tape. Tie



the remaining end of the heavy string or cord to a frame location near the choke lever.

- At the carburetor end of the cable, carefully pull the cable (and attached string) out and over the top of the engine. Make sure the attached string follows the same path as the cable.
  - Remove the tape and untie the string from the old cable.
  - Lubricate the new cable as described in Chapter Three.
  - Tie the string to the choke lever end of the new choke cable and wrap it with tape.
  - Carefully pull the string back over the top of the engine routing the new cable through the same path as the old cable.
  - Remove the tape and untie the string from the cable and the frame.
  - Reattach the new cable to the carburetor and to the choke lever.
- 14B. On the left-hand carburetor, perform the following:
- Remove the cable.
  - Lubricate the new cable as described in Chapter Three.
  - Reattach the new cable to the carburetor and to the choke lever.
15. Adjust the choke cables as follows:
- Move the lever to the OFF position (warm engine position).
  - At the carburetor end of the choke cable, pull up on the choke cable. There should be 0.5-1.0 mm (0.02-0.04 in.) of free play.
  - If adjustment is necessary, turn the cable guide in either direction until the correct amount of free play is achieved.
  - Tighten the locknut securely.
  - Repeat for the other choke cable.
16. Operate the choke lever and make sure the choke linkage is operating correctly, with no binding. If operation is incorrect or there is binding, carefully check that the cable(s) are attached correctly and there are no tight bends in the cable(s).
17. Install the fuel tank as described in this chapter.

**Handlebar Mounted Lever**

Refer to **Figure 162** for this procedure.

- Remove the fuel tank as described in this chapter.

**NOTE**

Removal of the front fairing is not absolutely necessary but it does allow additional working area if the upper cable is going to be replaced.



2. On models so equipped and if so desired, remove the front fairing as described under *Front Fairing Removal/Installation* in Chapter Twelve.
3. Carefully pry off the cover (**Figure 176**) on the choke operating lever.
4. Unscrew the large flat screw (A, **Figure 177**) and remove the special washer.
5. Remove the lever (B, **Figure 177**) from the housing and disconnect the upper cable (C, **Figure 177**) from the lever.
6. Push the cable sleeve out and remove the upper cable from the slot in the cable housing.
7. On the front left-hand side of the timing chain cover, hold onto the knurled sleeve (A, **Figure 178**) and unscrew the cable distributor body (B, **Figure 178**) until the 2 parts separate.
8. To disconnect the lower choke cables, perform the following:
  - a. Push the cables (C, **Figure 178**) and inner adaptor out of the knurled sleeve.
  - b. Disconnect the lower cable ends from the inner adaptor and pull them out of the knurled sleeve.
9. Unscrew the locknut (**Figure 174**) on the carburetor end of the cable at the carburetor.
10. Loosen the nut on the choke cable retaining bolt (**Figure 179**) and disconnect the lower cable end from the carburetor linkage.
11. Repeat Step 9 and Step 10 for the other lower choke cable.
12. Lubricate the new lower cables as described under *Control Cables* in Chapter Three.

#### NOTE

*Steps 12-18 are necessary only for replacement of the upper choke cable section.*

#### NOTE

*The piece of string attached in the next step will be used to pull the new upper choke cable back through the frame so it will be routed in the same position as the old cable.*

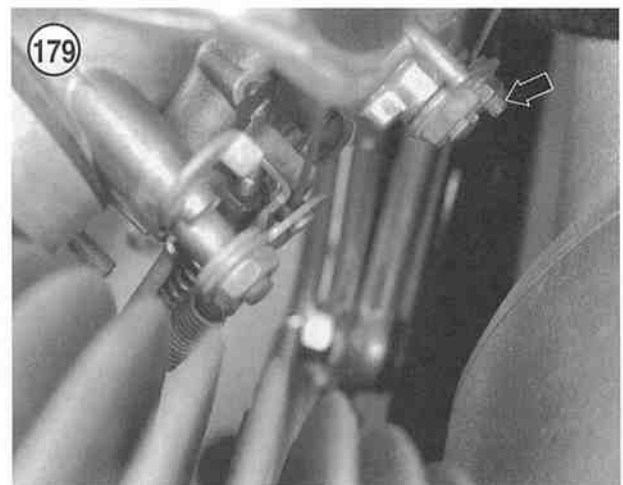
13. Tie a piece of heavy string or cord (approximately 3 ft./1 m long) to the distributor end of the upper choke cable. Wrap this end with masking or duct tape. Do not use an excessive amount of tape as it must be pulled through the frame during removal. Tie the other end of the string to the frame or air box.
14. At the choke lever end of the upper cable, carefully pull the upper cable (and attached string) out through the frame and steering stem area. Make sure it follows the same path as the old cable goes through the frame.

15. Remove the tape and untie the string from the old cable.
16. Lubricate the new cable as described under *Control Cables* in Chapter Three.
17. Tie the string to the distribution end of the new choke cable and wrap it with tape.
18. Carefully pull the string back through the frame, routing the new cable through the same path as the old cable.
19. Remove the tape and untie the string from the cable and the frame.
20. Connect the upper and lower choke cables by reversing Steps 3-10 and noting the following.
21. Install the cable and sleeve into the slot in the cable housing.
22. Install the cable (C, **Figure 177**) end into the lever and install the lever (B, **Figure 177**) onto the housing.
23. Install the special washer and the large flat screw (A, **Figure 177**). Tighten the flat screw securely.
24. Install the cover (**Figure 176**) onto the choke operating lever.
25. Operate the choke lever and make sure the choke linkage is operating correctly, with no binding. If operation is incorrect or there is binding, carefully check that the cable is attached correctly and there are no tight bends in the cable.
26. Adjust the choke cable as described in Chapter Three.
27. Install the fuel tank as described in this chapter.

## FUEL TANK

### Removal/Installation

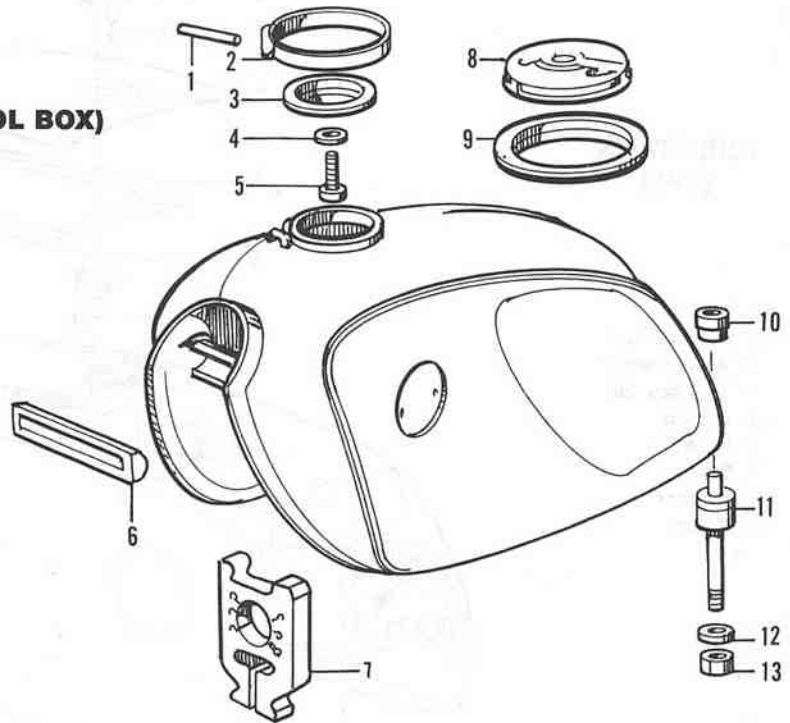
The different fuel tanks are designed for specific models and years; however, a previous owner may have changed to a different tank. Therefore refer to the illustrations and find the specific fuel tank that is on your bike. With the exception of the R65, R65LS, R80G/S and R100GS, all fuel tanks are attached basically the same. Refer to **Figures 180-185** for this procedure.



180

**FUEL TANK  
(1970-1976 WITHOUT TOOL BOX)**

- 1. Pin
- 2. Clamp
- 3. Gasket
- 4. Washer
- 5. Bolt
- 6. Rubber mount
- 7. Rubber support
- 8. Filler cap
- 9. Gasket
- 10. Rubber grommet
- 11. Mounting stud
- 12. Washer
- 13. Nut

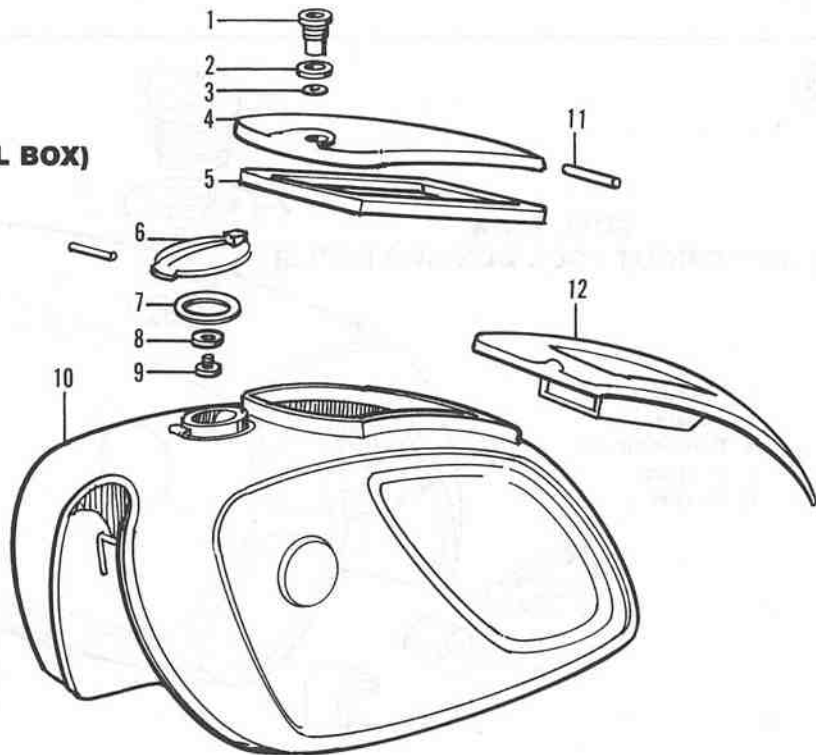


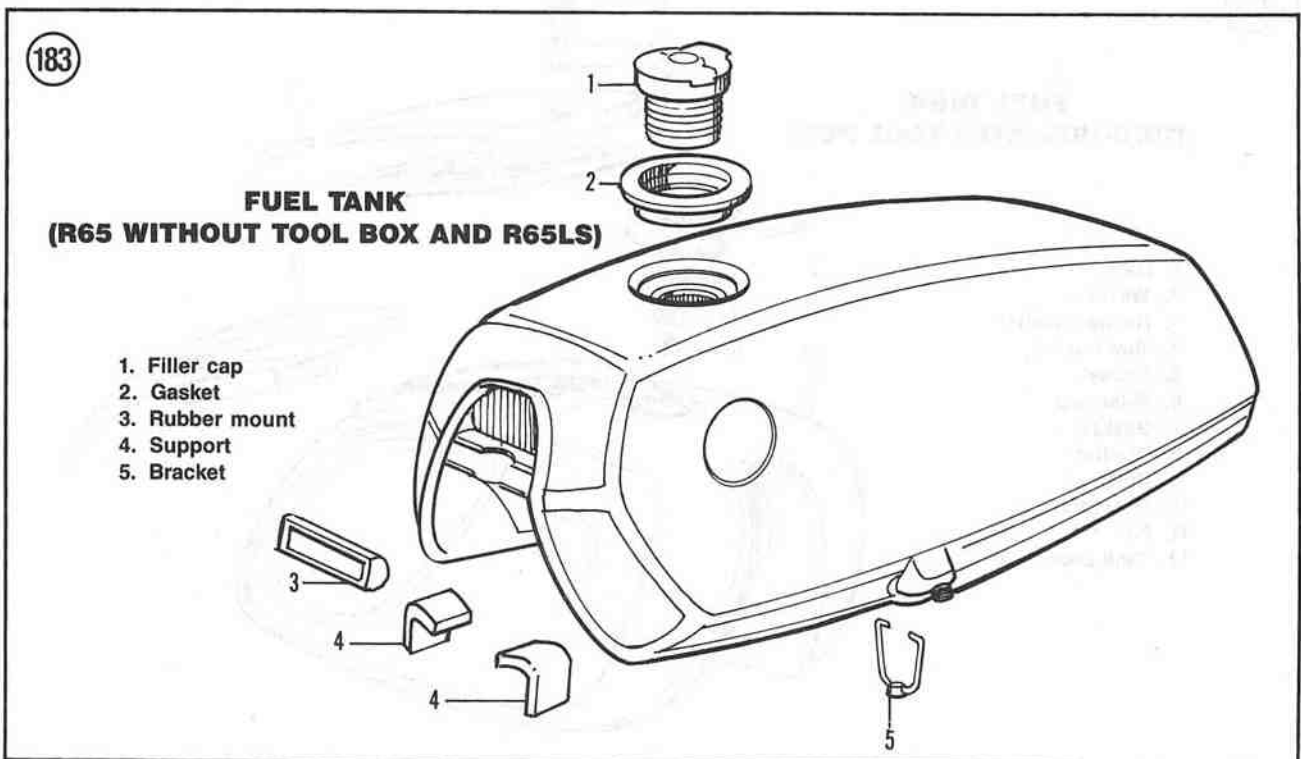
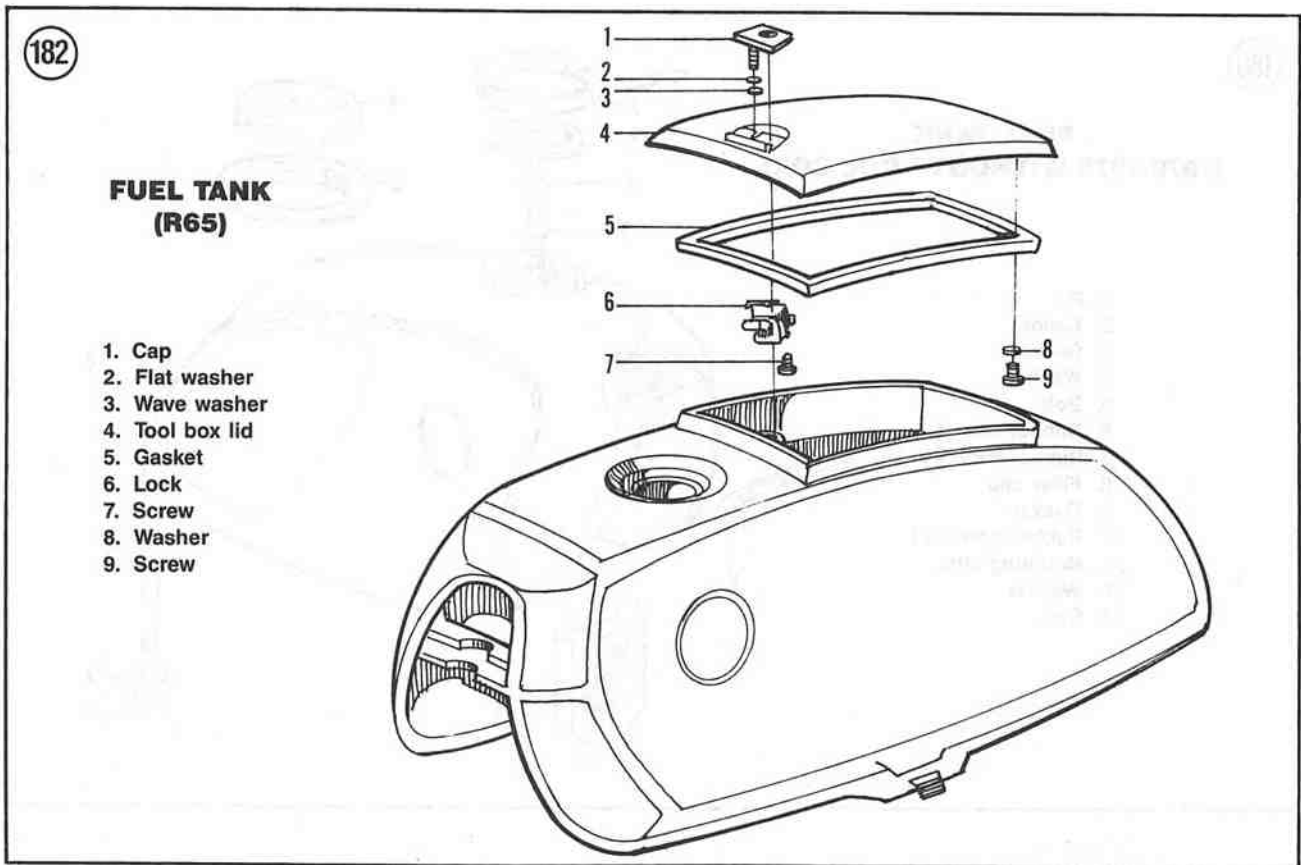
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181

**FUEL TANK  
(1970-1976 WITH TOOL BOX)**

- 1. Lock
- 2. Washer
- 3. Rubber washer
- 4. Tool box lid
- 5. Gasket
- 6. Filler cap
- 7. Gasket
- 8. Washer
- 9. Bolt
- 10. Fuel tank
- 11. Pin
- 12. Tank cover

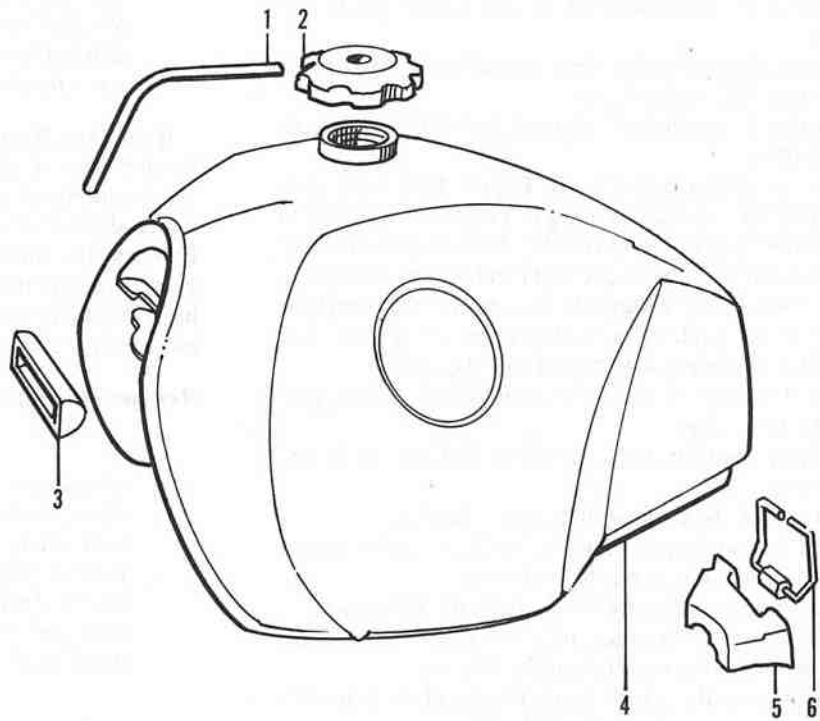




184

**FUEL TANK  
(R80G/S, R100GS)**

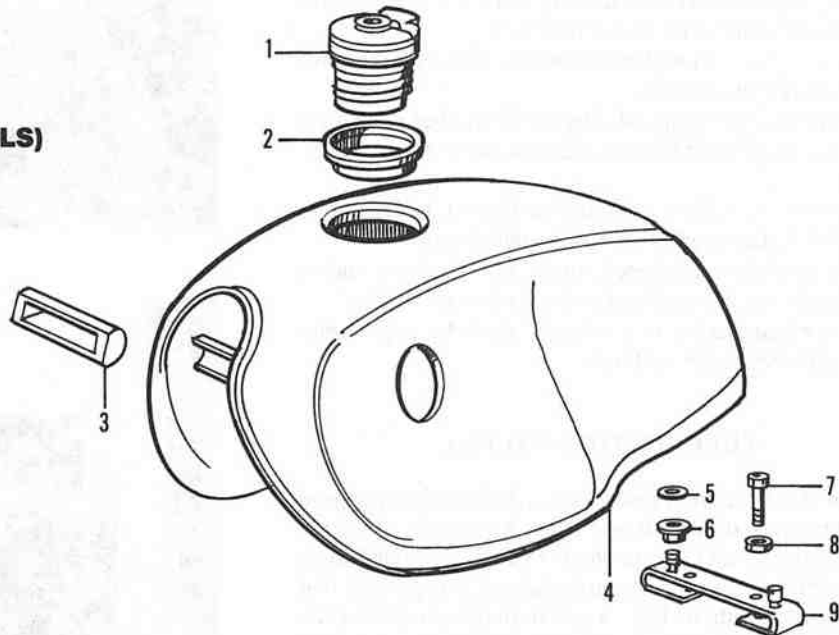
- 1. Vent tube
- 2. Filler cap
- 3. Rubber mount
- 4. Fuel tank
- 5. Support
- 6. Bracket



185

**FUEL TANK  
(ALL OTHER MODELS)**

- 1. Filler cap
- 2. Gasket
- 3. Rubber mount
- 4. Fuel tank
- 5. Clip
- 6. Rubber grommet
- 7. Bolt
- 8. Nut
- 9. Mounting bracket



7

1. Place the bike on the centerstand.
2. Remove the seat and tool box as described in Chapter Twelve.
3. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
4. Turn both fuel shutoff valves to the OFF position (A, **Figure 186**).
5. Disconnect the fuel line (B, **Figure 186**) from each shutoff valve and install a plug (C) into the fuel hose to prevent the entry of foreign matter. Also plug the fuel line fittings on the fuel tank to prevent fuel from dribbling out.
6. On models so equipped, disconnect the overflow and/or vent line(s) from the fuel tank. Install a golf tee into the line(s) to prevent the entry of foreign matter.
- 7A. On R65, R65LS, R80G/S and R100GS models, perform the following:
  - a. Push down on the rear of the fuel tank with one hand.
  - b. Unhook the catch with the other hand.
  - c. Lift up on the rear of the fuel tank and pull it toward the rear and remove the fuel tank.
- 7B. On all other early models, perform the following:
  - a. Unscrew the knurled nuts or wing nuts (**Figure 187**) securing the fuel tank at the rear.
  - b. Lift up on the rear of the fuel tank and pull it toward the rear and remove the fuel tank.
- 7C. On all other later models, perform the following:
  - a. Unscrew the knurled nut or wing nut securing the fuel tank at the rear.
  - b. Using a pair of pliers, remove the clip (**Figure 188**) on each side securing the tank at the rear.
  - c. Lift up on the rear of the fuel tank and pull it toward the rear and remove the fuel tank.
8. Install by reversing these removal steps. Note the following during installation.
9. On models so equipped, inspect the rubber grommets at the rear. Replace if they are damaged or starting to deteriorate.
10. Inspect the rubber mounting cushion at the front. Replace if it is damaged or starting to deteriorate.
11. On models so equipped, make sure the vent and/or overflow hoses are installed correctly and not kinked.
12. After installation is complete, start the engine and thoroughly check for fuel leaks.

### FUEL SHUTOFF VALVES

There are 4 different models of fuel shutoff valves used among the various models and years. All shutoff valves are interchangeable and if your shutoff valve(s) is found to be faulty while performing this procedure, it is suggested that you replace it with the latest version. In this procedure, the fuel shutoff valves are referred to as Model No. 1, No. 2, etc. This relates to the sequence in which they were placed into production and does not designate a model number.

#### NOTE

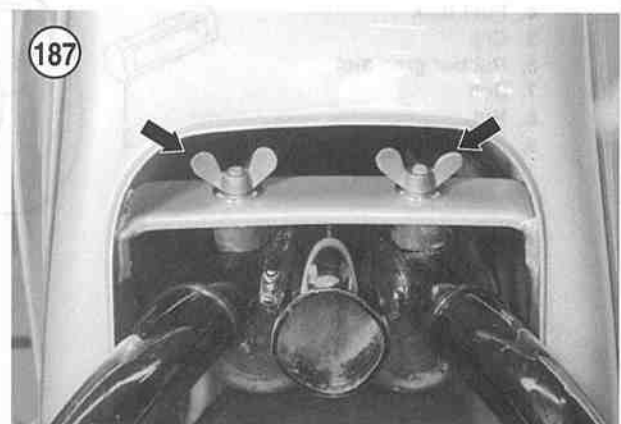
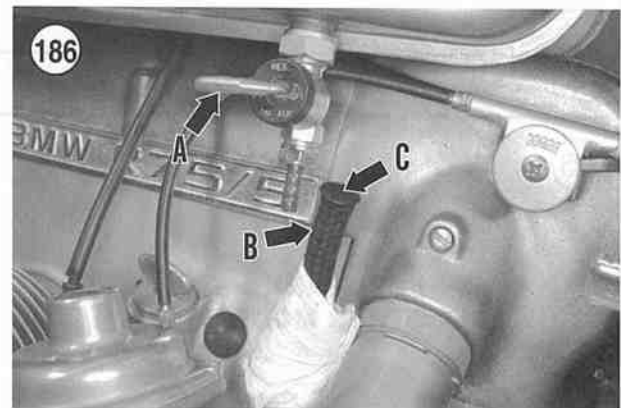
*The No. 1 valve cannot be serviced except for fuel filter cleaning and replacement. Other than that there are no replacement parts for the unit.*

If the shutoff valve is not operating correctly or fuel is leaking from it, disassemble the valve and service it. If any replacement parts are required, be sure to identify which shutoff valve(s) your bike is equipped with. There is no specific shutoff valve used on any specific model or year. If you are not the original owner, a prior owner may have installed a newer valve(s). The fuel system may even have 2 different shutoff valves.

#### Removal/Installation

#### WARNING

*Gasoline is very volatile and presents an extreme fire hazard. Be sure to work in a well-ventilated area away from any open flames (including pilot lights on household appliances). Do not allow anyone to smoke in the area and have a fire extinguisher rated for gasoline fires handy.*

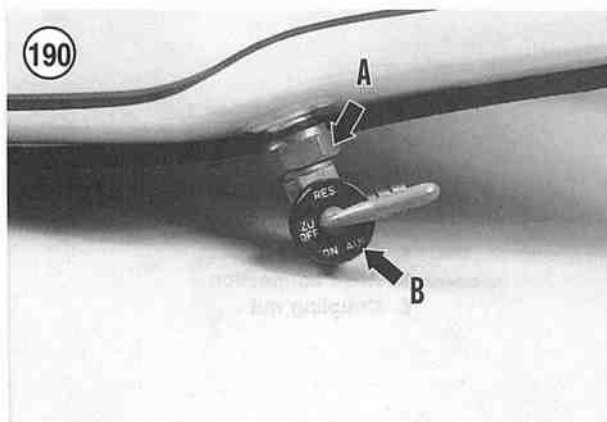
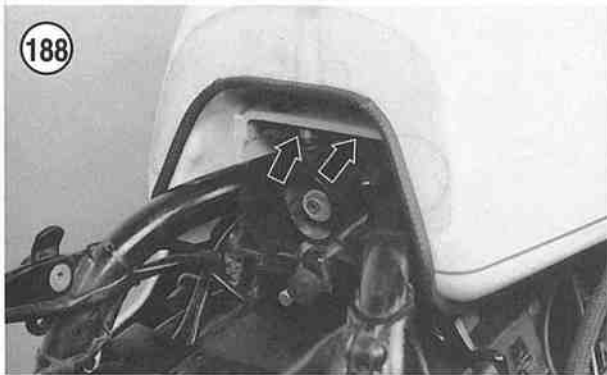




1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Turn the fuel shutoff valve to the OFF position (A, **Figure 189**) and disconnect the fuel line (B, **Figure 189**) from the valve.
3. Install a plug (C, **Figure 186**) into the fuel hose to prevent the entry of foreign matter.

**NOTE**

The fuel tank can either be removed or left in place on the frame; drain all fuel from the fuel tank in either case.



4. Install a longer piece of clean fuel line to the valve and place the loose end into a clean, sealable metal container. If the fuel is kept clean it can be reused.
5. Turn the fuel shutoff valve to the RES position and open the fuel filler cap. This will speed up the flow of fuel. Drain the fuel tank completely. Close the fuel filler cap.

**CAUTION**

On the No. 2 valve, the retaining nut has *left-hand* threads. Unscrew the nut *clockwise*.

6. Unscrew the retaining nut (A, **Figure 190**) securing the valve to the fuel tank. Remove the valve (B, **Figure 190**), retaining nut and gasket. Discard the gasket.
7. After removing the valve assembly, insert a corner of a clean shop cloth into the opening in the tank to stop the dripping of fuel onto the engine and frame.
8. Install by reversing these removal steps. Note the following during installation.
9. Be sure to install a new gasket between the fuel filter and the fuel tank.
10. Tighten the retaining nut securely.
11. Refill the fuel tank and check for fuel leaks.

7

**Disassembly/Inspection/Assembly**

Refer to **Figures 191-194** for this procedure.

1. On Model No. 1 and No. 3, perform the following:
  - a. Unscrew the coupling nut securing the hose connector to the shutoff valve.
  - b. Remove the hose connector, gasket(s) and the fuel filter from the shutoff valve assembly.
  - c. Remove the fuel filter from the valve body.
2. On Model No. 2, perform the following:
  - a. Unscrew the hose connector from the shutoff valve assembly.
  - b. Remove the fuel filter from the valve body.
3. Clean the fuel filter(s) with a medium-soft toothbrush and blow out with compressed air.
4. Inspect the fuel filter(s) for damage and replace if defective.
5. On all models except No. 1, refer to the illustrations and remove the valve lever and related parts.
6. Clean all parts in solvent and thoroughly dry with compressed air.
7. Inspect all parts for wear or damage. O-ring seals tend to harden with use and heat and should be replaced when the valve is disassembled.
8. Reassemble all parts in reverse order. Lubricate the index plates.

### FUEL FILTER

The bike is equipped with a small fuel filter screen in the fuel shutoff valve. Considering the dirt and residue that is often found in today's gasoline, it is good idea to install an inline fuel filter to help keep the carburetor clean.

A good-quality inline fuel filter (A.C. part No. GF453 or equivalent) is available at most auto and motorcycle supply stores. Just cut the fuel line from the fuel tank to the carburetor and install the filter. Cut out a section of the fuel line the length of the filter so the fuel line does not kink and restrict fuel flow. Insert the fuel filter and make sure the fuel line is secured to the filter at each end.

### GASOLINE/ALCOHOL BLEND TEST

Gasoline blended with alcohol is available in many areas. Most states and most fuel suppliers require labeling of gasoline pumps that dispense gasoline containing a certain percentage of alcohol. If in doubt, ask the service station operator if their fuel contains any alcohol. A gasoline/alcohol blend, even if it contains cosolvents and corrosion inhibitors for methanol, may damage the fuel system. It may also cause poor performance, hot-engine restart or hot-engine running problems.

If you are not sure if the fuel you purchased contains alcohol, run this simple and effective test. A blended fuel doesn't look any different from straight gasoline so it must be tested.

#### WARNING

*Gasoline is very volatile and presents an extreme fire hazard. Be sure to work in a well-ventilated area away from any open flames (including pilot lights on household appliances). Do not allow anyone to smoke in the area and have a fire extinguisher rated for gasoline fires handy.*

During this test keep the following facts in mind:

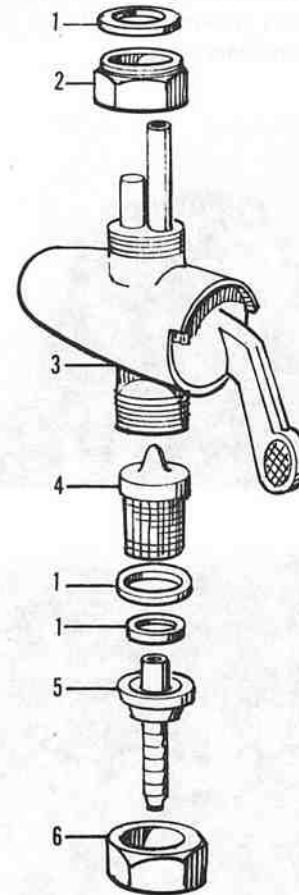
- a. Alcohol and gasoline mix together.
- b. Alcohol mixes *easier* with water.
- c. Gasoline and water do *not* mix.

#### NOTE

*If cosolvents have been used in the gasoline, this test may not work with water. Repeat this test using automotive antifreeze instead of water.*

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### FUEL SHUTOFF VALVE NO. 1



1. Gasket
2. Nut
3. Valve body
4. Filter
5. Hose connection
6. Coupling nut

**NOTE**

A very handy item is now available at some motorcycle dealers and motorcycle supply houses that is designed specifically for this test. It is a glass vial with a screw-on cap. There are instructions printed on the side of the glass as to how to perform the test. If you purchase one of these items, follow the manufacturer's instructions.

Use an 8 oz. transparent baby bottle with a sealable cap.

1. Set the baby bottle on a level surface and add water up to the 1.5 oz. mark. Mark this line on the bottle with a fine-line permanent marking pen. This will be the reference line used later in this test.
2. Add the suspect fuel into the baby bottle up to the 8 oz. mark.
3. Install the sealable cap and shake the bottle vigorously for about 10 seconds.
4. Set the baby bottle upright on the level surface used in Step 1 and wait for a few minutes for the mixture to settle down.
5. If there is *no* alcohol in the fuel, the gasoline/water separation line will be exactly on the 1.5 oz. reference line made in Step 1.

6. If there *is* alcohol in the fuel, the gasoline/water separation line will be *above* the 1.5 oz. reference line made in Step 1. The alcohol has separated from the gasoline and mixed in with the water (remember it is easier for the alcohol to mix with water than gasoline).

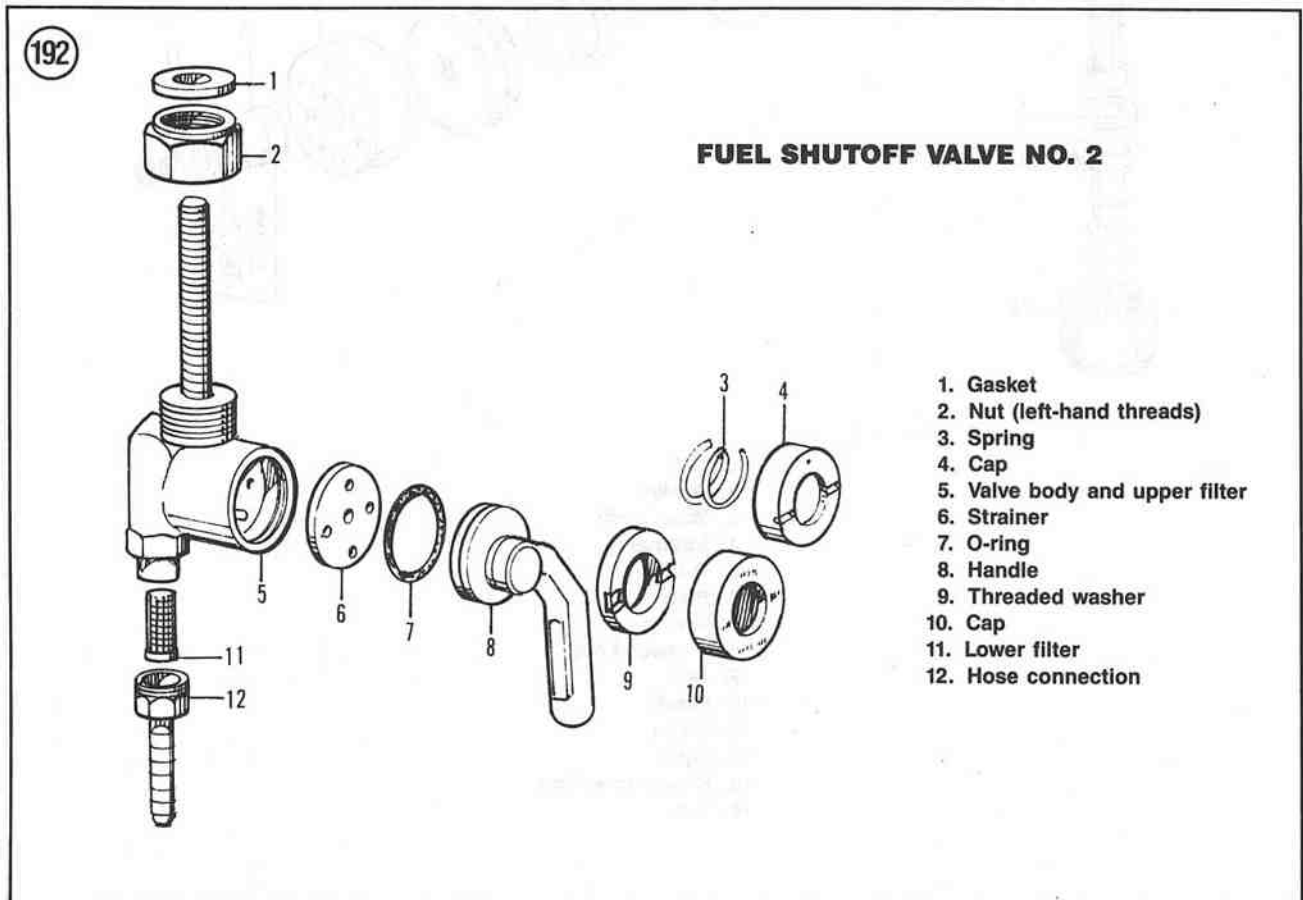
**WARNING**

After the test, discard the baby bottle or place it out of reach of small children. There will always be a gasoline and alcohol residue in it and it should **not** be used to drink out of.

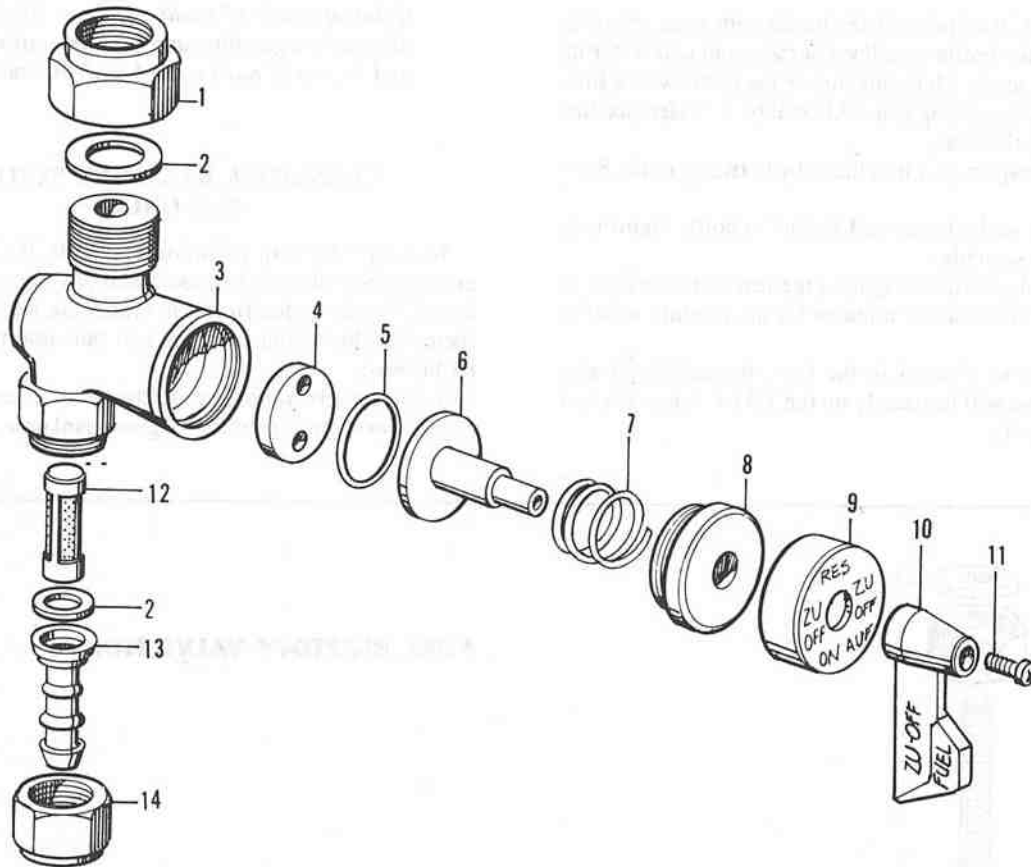
**CRANKCASE BREATHER SYSTEM  
(U.S. ONLY)**

To comply with air pollution standards, the BMW twins are equipped with a crankcase breather system. The system draws blowby gases from the crankcase and recirculates them into the fuel/air mixture and thus into the engine to be burned.

All of the valves, hoses and fittings are located under the starter cover on top of the engine crankcase.



193

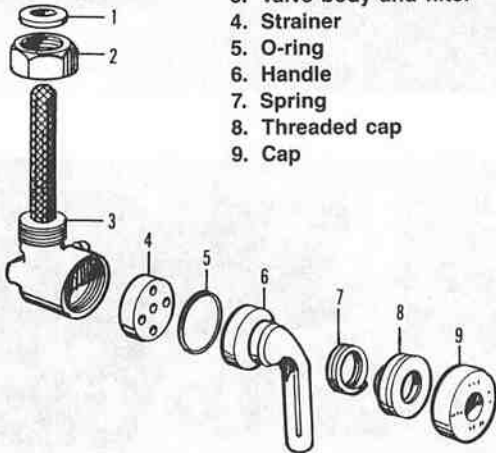
**FUEL SHUTOFF VALVE NO. 3**

1. Nut
2. Gasket
3. Valve body
4. Strainer
5. O-ring
6. Plate
7. Spring
8. Threaded cap
9. Cap
10. Handle
11. Screw
12. Filter
13. Hose connection
14. Nut

194

**FUEL SHUTOFF VALVE NO. 4**

1. Gasket
2. Nut
3. Valve body and filter
4. Strainer
5. O-ring
6. Handle
7. Spring
8. Threaded cap
9. Cap



**Inspection (1970-1976 Models)**

Refer to **Figure 195** for this procedure.

**NOTE**

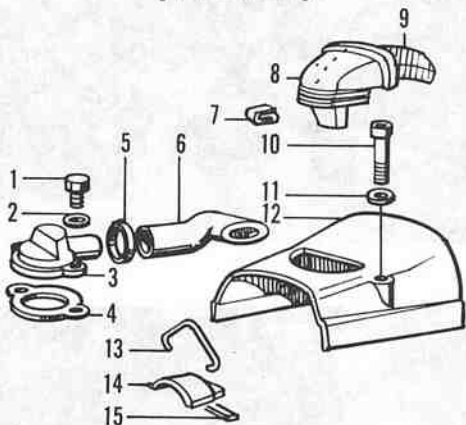
*The early type of check valve has been replaced with a new reed valve type that is more effective and requires less maintenance. The new reed valve also eliminates the flapping sound associated with the early unit when the engine is cold. It is suggested that the reed valve be installed in place of the older unit.*

1. Remove the fuel tank as described in this chapter.
2. Remove the air filter case as described in this chapter.
3. Remove the bolts and washers securing the starter cover (**Figure 196**) and remove the cover.
4. Make sure the hose clamps are tight.
5. Check the hose for deterioration and replace as necessary.
6. To inspect the check valve, perform the following:
  - a. Remove the bolts and washers securing the breather housing (**Figure 197**).
  - b. Remove the housing and the gasket.

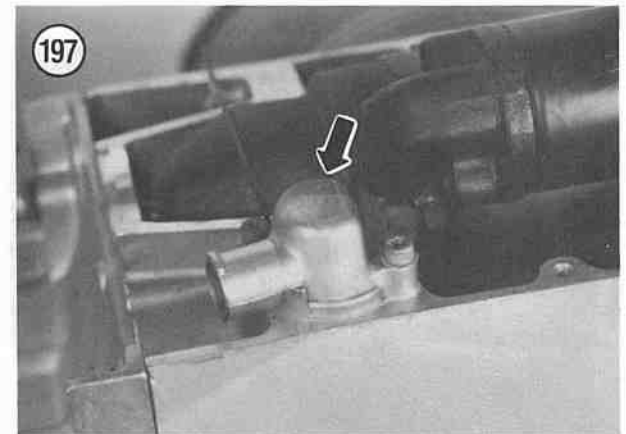
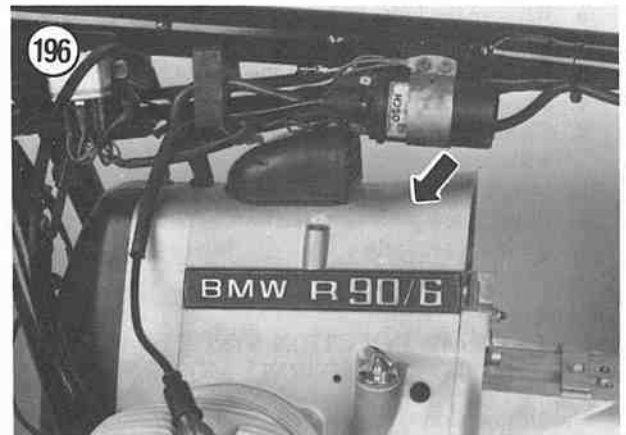
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195

**CRANKCASE VENTILATION SYSTEM (1970-1976)**



- |                     |                   |
|---------------------|-------------------|
| 1. Bolt             | 9. Screen         |
| 2. Washer           | 10. Bolt          |
| 3. Breather housing | 11. Washer        |
| 4. Gasket           | 12. Starter cover |
| 5. Hose clamp       | 13. Hook          |
| 6. Hose             | 14. Cover         |
| 7. Clip             | 15. Gasket        |
| 8. Intake scoop     |                   |





- c. Remove the retaining clip (Figure 198), the upper washer (Figure 199), the spring (Figure 200), the lower washer (Figure 201) and the valve disc assembly (Figure 202) from the crankcase.
  - d. Install the new reed valve type check valve.
  - e. Install a new gasket and the breather housing. Tighten the bolts securely.
7. Install all components removed.

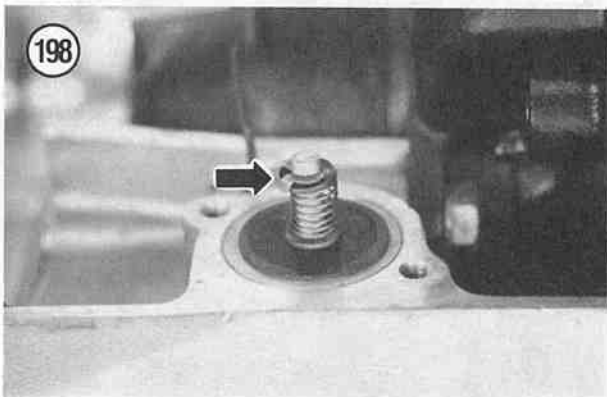
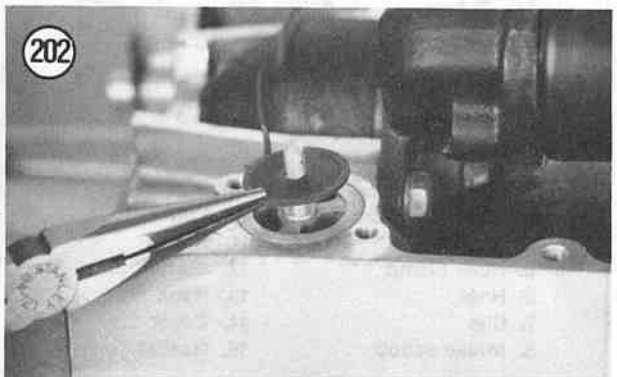
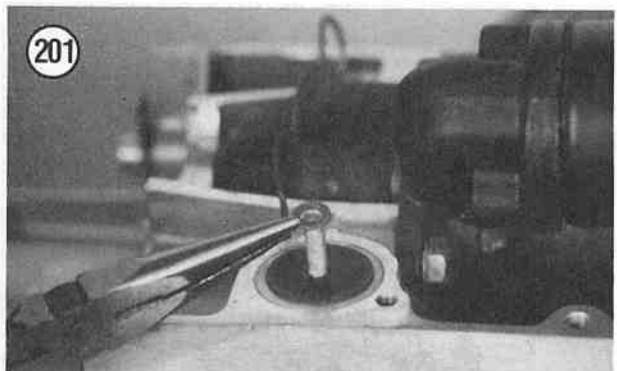
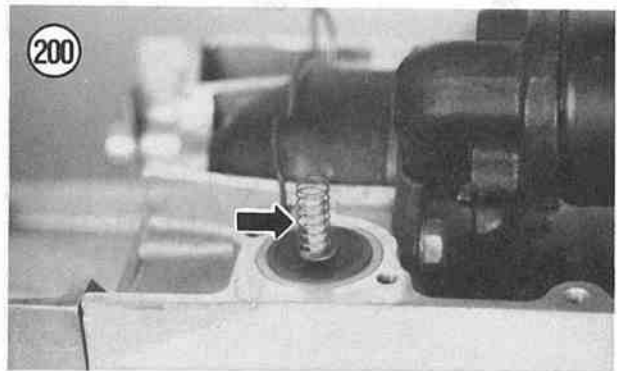
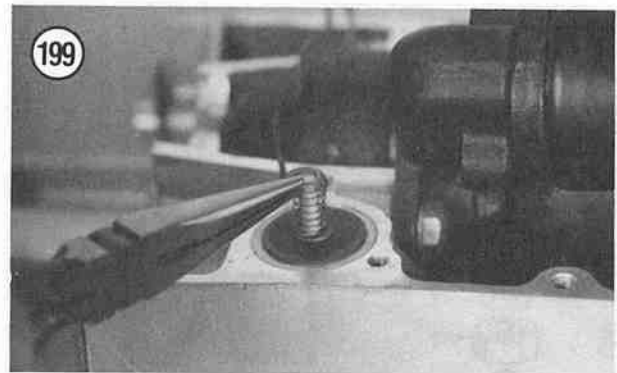
#### Inspection (1977-on Models)

Refer to the following illustrations for this procedure:

- a. **Figure 203:** R60/7, R75/7, R65, R65LS, R80 (1978-1979) and R80RT.
  - b. **Figure 204:** R80G/S, R80ST (1981-on), R80 (1985-1987), R100, R100GS, R100RS, R100RT.
1. Remove the fuel tank as described in this chapter.
  2. Remove the bolts and washers securing the starter cover (A, Figure 205) and remove the cover.
  3. Remove the air filter case (B, Figure 205) as described in this chapter.
  4. Make sure the hose clamps are tight.
  5. Check the hoses for deterioration and replace as necessary.
  6. To inspect the reed valve, perform the following:
    - a. Remove the bolts and washers securing the breather housing.
    - b. Remove the housing and the gasket.
    - c. Remove the reed valve assembly from the crankcase.
    - d. Clean the reed valve in solvent and thoroughly dry with compressed air.
    - e. Install the reed valve.
    - f. Install a new gasket and the breather housing. Tighten the bolts securely.
  7. Install all components removed.

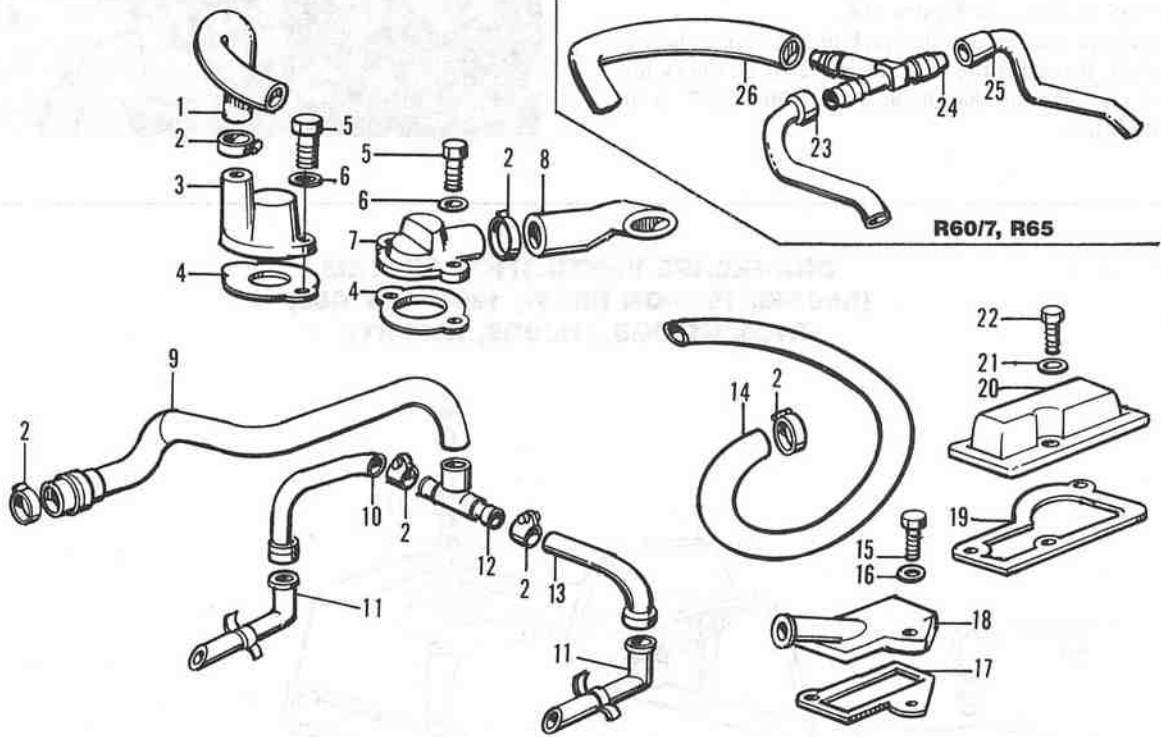
#### AIR INJECTION SYSTEM (1980-ON CALIFORNIA MODELS)

The air injection system injects fresh air into the exhaust port in each cylinder head adjacent to the exhaust valve. This oxygen-rich fresh air helps burn the hydrocarbons that



203

**CRANKCASE VENTILATION SYSTEM  
(R60/7, R65, R65LS, R75/7,  
1978-1979 R80, R80RT)**



R60/7, R65

- 1. Hose
- 2. Hose clamp
- 3. Breather housing
- 4. Gasket
- 5. Bolt
- 6. Washer
- 7. Breather housing (early models)
- 8. Hose
- 9. Hose
- 10. Hose
- 11. Fitting
- 12. T-fitting
- 13. Hose

- 14. Hose
- 15. Bolt
- 16. Washer
- 17. Gasket
- 18. Cover
- 19. Gasket
- 20. Cover
- 21. Washer
- 22. Bolt
- 23. Hose
- 24. T-fitting
- 25. Hose
- 26. Hose

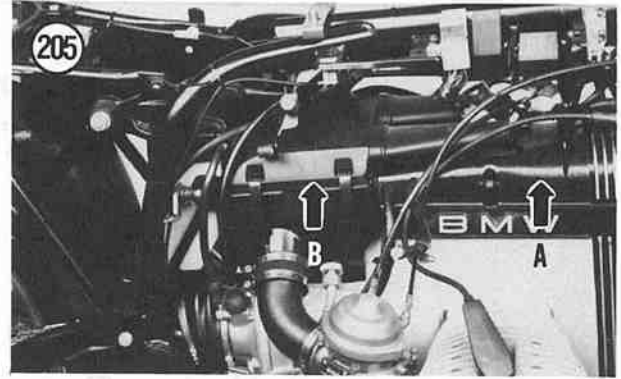
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still remain in the exhaust gases. The fresh air is drawn in automatically and does not require any type of air pump.

The system incorporates a vacuum function that stops the fresh air from being injected into the exhaust gases during deceleration. Severe backfiring will occur if fresh air is injected during deceleration.

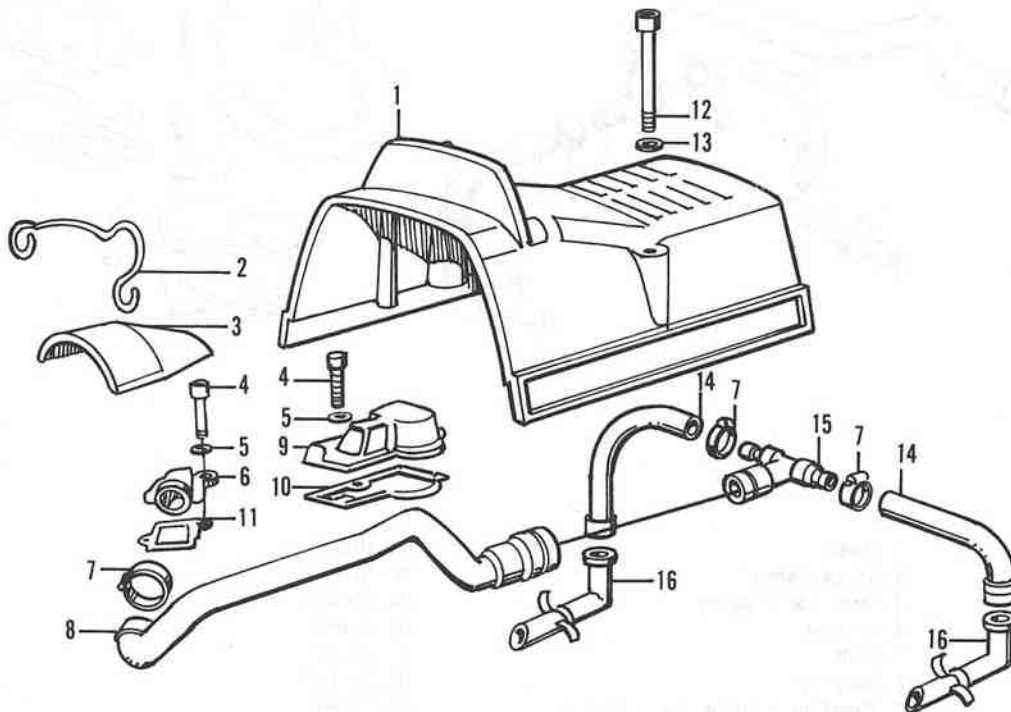
The system is incorporated in the air filter assembly and is very basic. It does not require any routine maintenance. The system is shown in **Figure 206**.

The only maintenance is to check that the hose clamps are on tight, that all fittings (A, **Figure 207**) on the cylinder head are tight and that the hose (B, **Figure 207**) is in good condition.

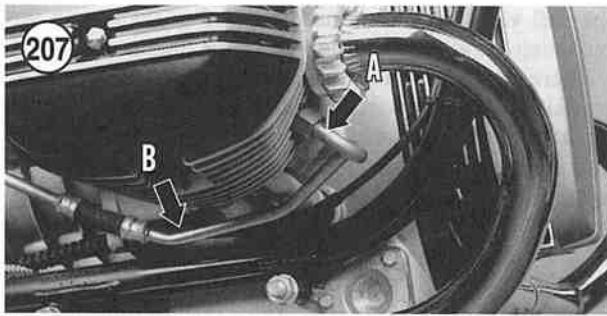


204

**CRANKCASE VENTILATION SYSTEM  
(R80G/S, 1981-ON R80ST, 1985-1987 R80,  
R100, R100GS, R100RS, R100RT)**

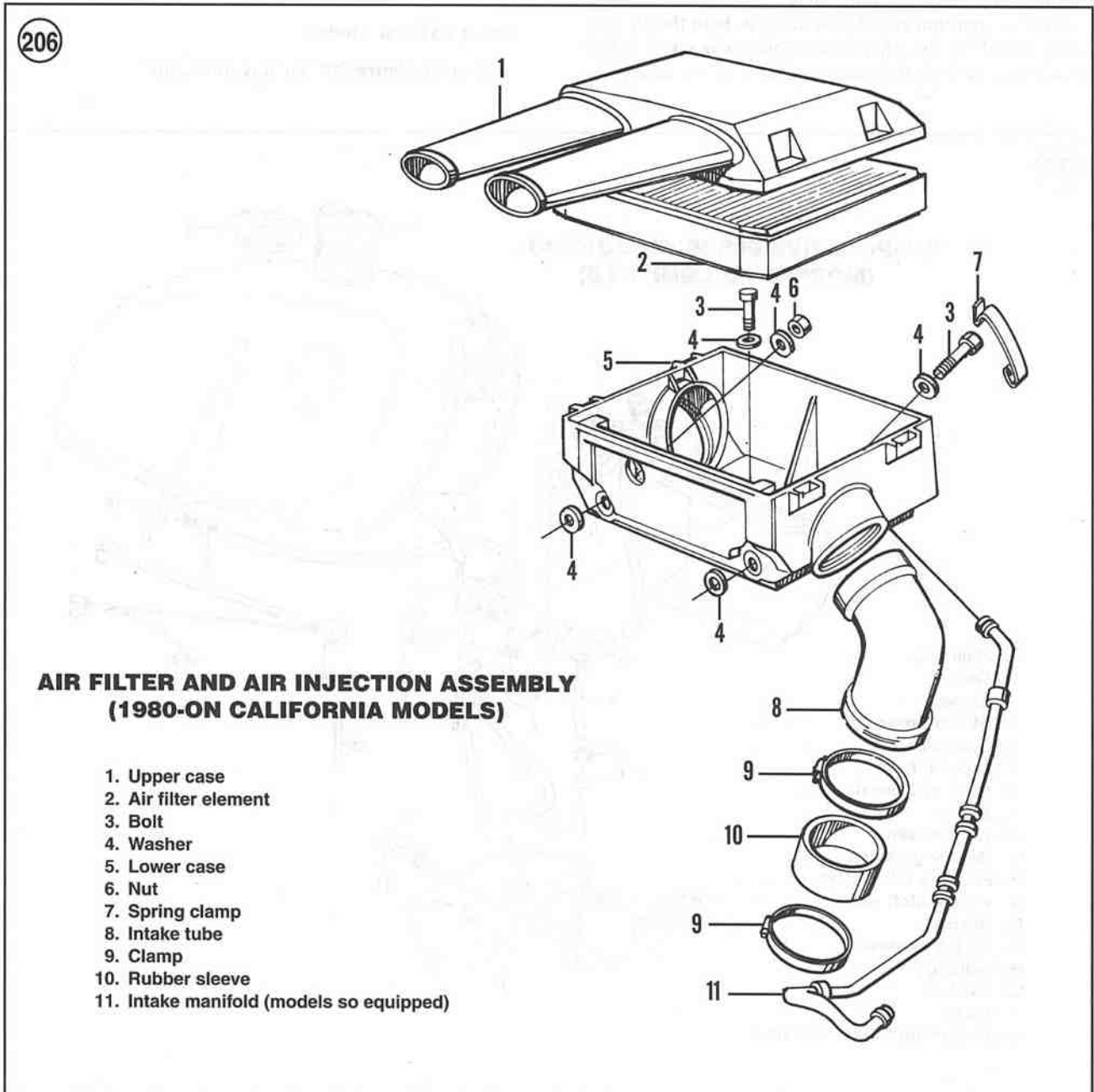


- |                  |                     |
|------------------|---------------------|
| 1. Starter cover | 9. Breather housing |
| 2. Hook          | 10. Gasket          |
| 3. Cover         | 11. Gasket          |
| 4. Bolt          | 12. Bolt            |
| 5. Washer        | 13. Washer          |
| 6. Cover         | 14. Hose            |
| 7. Hose clamp    | 15. T-fitting       |
| 8. Hose          | 16. Fitting         |



**EVAPORATIVE EMISSION CONTROL SYSTEM (MODELS SO EQUIPPED)**

The evaporative emission control system (Figure 208), located under the starter cover, controls the amount of fuel vapor that is released into the atmosphere. The fuel filler cap assembly in the fuel tank is equipped with a flap. This flap assembly prevents the fuel tank from being filled to the maximum. This allows an air space in the fuel tank for fuel vapor expansion.



When the bike is stopped after a ride, the fuel and fuel vapor in the fuel tank expands due to engine heat (or ambient temperature). When the pressure within the fuel tank reaches 15 kPa (2.2 psi), the pressure relief valve opens, allowing the fuel vapor to pass through the air vent solenoid to enter the engine crankcase via a vent hose where it is stored.

When the engine is turned off, the ignition system turns off the air vent solenoid and the fuel shutoff solenoid. The fuel shutoff solenoid turns off the fuel supply to the carburetors via the fuel shutoff valves on the fuel tank. This prevents any excess fuel vapor from venting through the carburetors and to the atmosphere.

When the ignition switch is turned on, both the air vent solenoid and the fuel shutoff solenoid are opened. When the bike is restarted, the vacuum in the air filter case pulls

the fuel vapor from the crankcase and mixes it with the incoming fresh air to be burned in the engine.

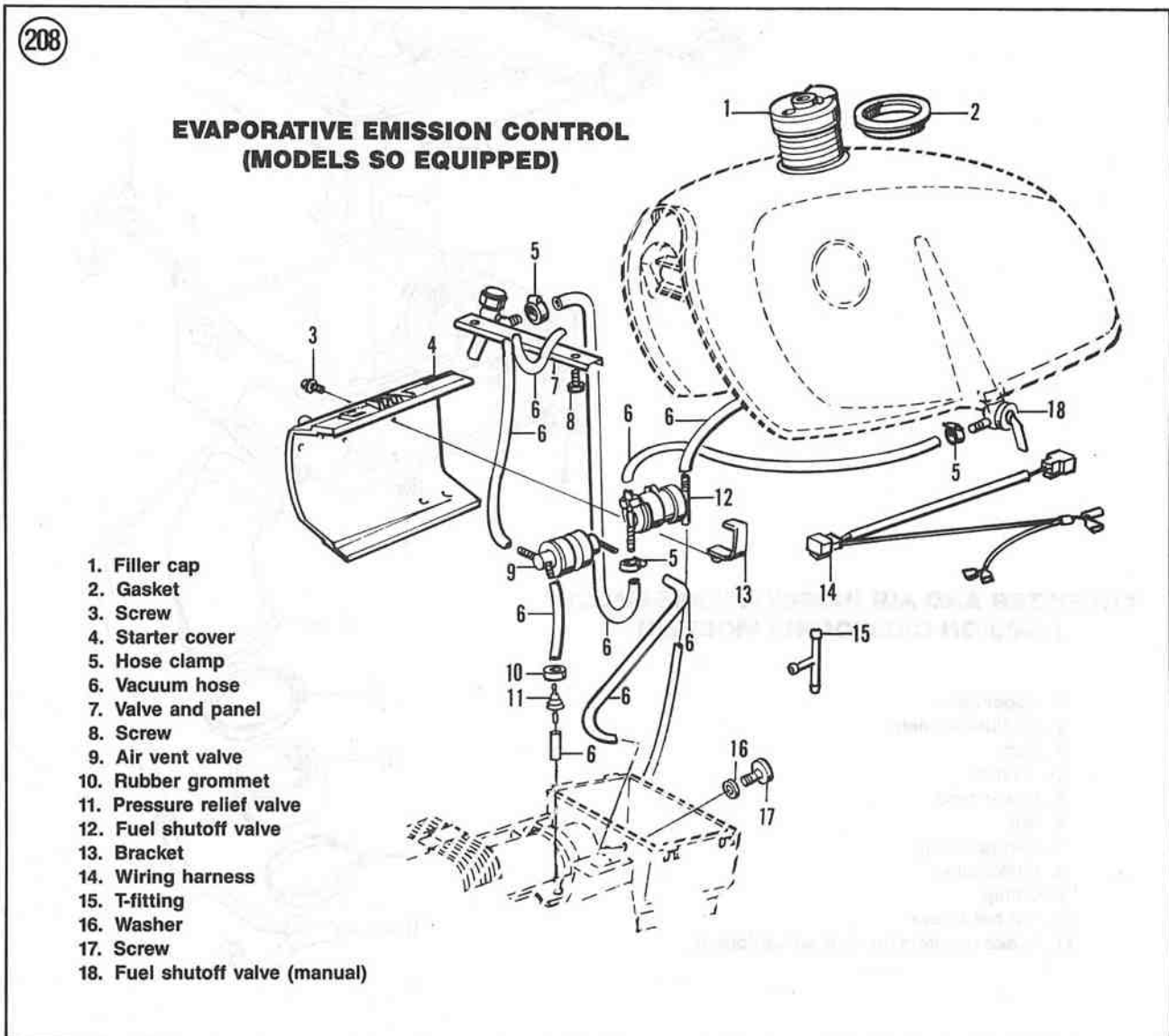
There is no routine maintenance on the evaporation emission control system other than to inspect the hoses to make sure they are not kinked or damaged. Make sure all hoses are correctly routed and attached. Inspect the hoses and replace any if necessary.

## EXHAUST SYSTEM

The exhaust system consists of two exhaust pipes and either one or two mufflers.

### Single Exhaust Models

Refer to **Figure 209** for this procedure:





**Secondary muffler removal/installation**

**WARNING**

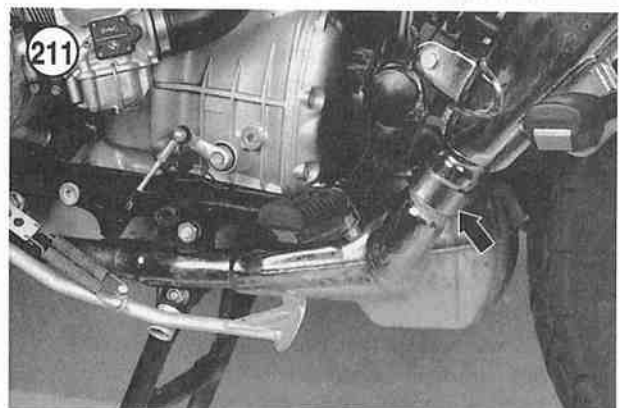
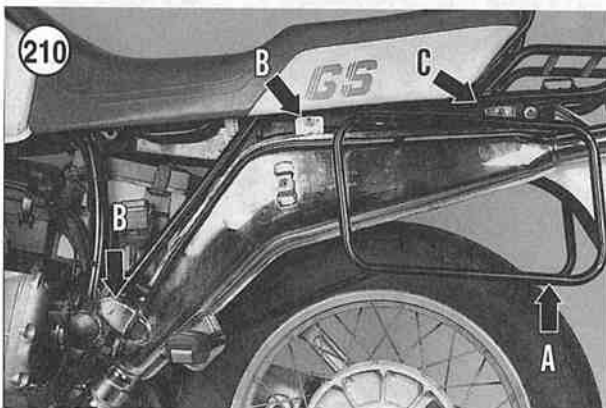
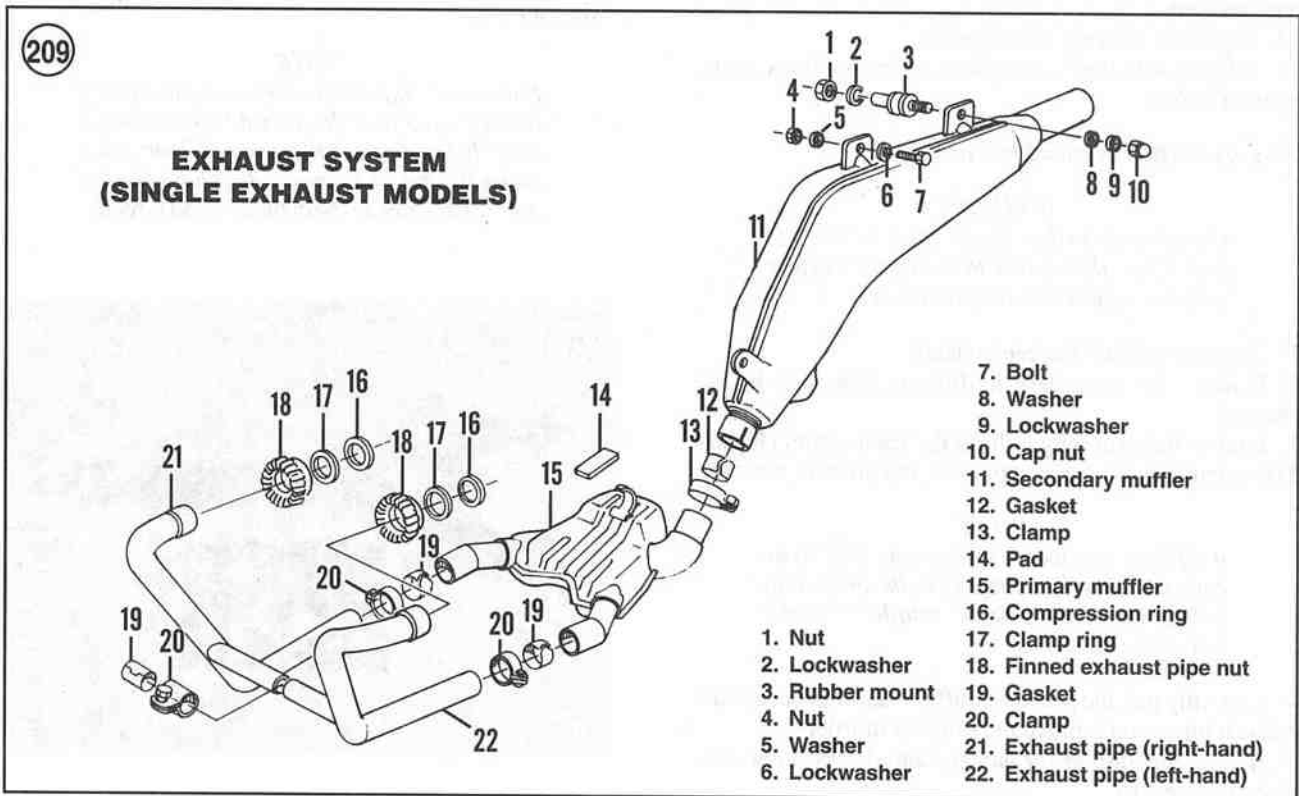
*Do not work on the exhaust system when it is hot. Allow the system to cool down before performing any service procedures.*

1. Place the bike on the centerstand.
2. Remove the frame left-hand side cover.
3. On models so equipped, remove the luggage rack (A, **Figure 210**) as described in Chapter Twelve.

4. Loosen the bolts and nuts (B, **Figure 210**) securing the secondary muffler to the frame.
5. Loosen the clamping bolt on the clamp (**Figure 211**) securing the secondary muffler to the primary muffler.
6. Remove the bolts, nuts and washers securing the secondary muffler to the frame.

**NOTE**

*If difficult to remove, spray some WD-40 or equivalent on the clamping bolt and clamp to help loosen the secondary muffler from the primary muffler.*



7. Carefully pull the secondary muffler out of the primary muffler.
8. On models so equipped, inspect the heat shield for damage. Replace if necessary.
9. Install a new gasket into the inlet opening of the secondary muffler.
10. Make sure the clamp is in place on either muffler prior to secondary muffler installation.
11. Install the secondary muffler onto the primary muffler outlet and push it in until it bottoms out. Do not tighten the clamping bolt at this time.
12. Hold the secondary muffler in place and install the mounting bolts, washers and nuts. Tighten these bolts and nuts securely.
13. Tighten the clamp bolt securely.
14. After installation is complete, make sure there are no exhaust leaks.

### Primary muffler removal/installation

#### WARNING

*Do not work on the exhaust system when it is hot. Allow the system to cool down before performing any service procedures.*

1. Place the bike on the centerstand.
2. Remove the secondary muffler as described in this chapter.
3. Loosen the clamping bolt on the each clamp (**Figure 211**) securing both exhaust pipes to the primary muffler.

#### NOTE

*If difficult to remove, spray some WD-40 or equivalent on the clamping bolts and clamp to help loosen the primary muffler from the exhaust pipe outlets.*

4. Carefully pull the primary muffler back and out of both exhaust pipes and remove the primary muffler.
5. Inspect the muffler for damage and deterioration. Replace if necessary.
6. Make sure the clamps are in place on the primary muffler prior to installation.
7. Install the primary muffler onto the exhaust pipe outlets and hook the rear of the muffler on the frame.
8. Tighten the clamp bolts securely.
9. Install the secondary muffler as described in this chapter.
10. After installation is complete, make sure there are no exhaust leaks.

### Exhaust pipes removal/installation

#### WARNING

*Do not work on the exhaust system when it is hot. Allow the system to cool down before performing and service procedures.*

The exhaust pipes can be removed separately or as an assembly.

1. Loosen the clamping bolt on each clamp (**Figure 211**) securing both exhaust pipes to the primary muffler.

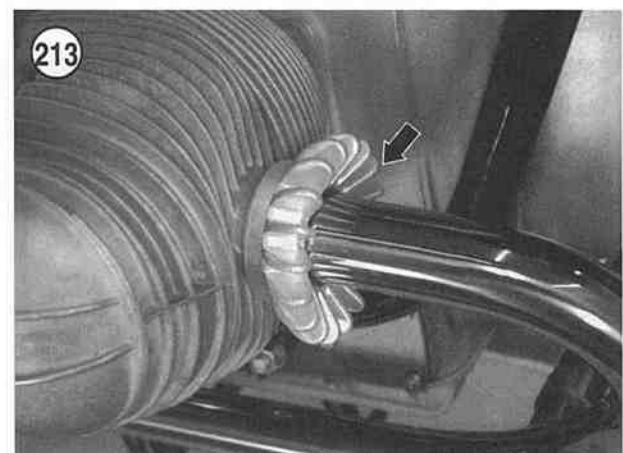
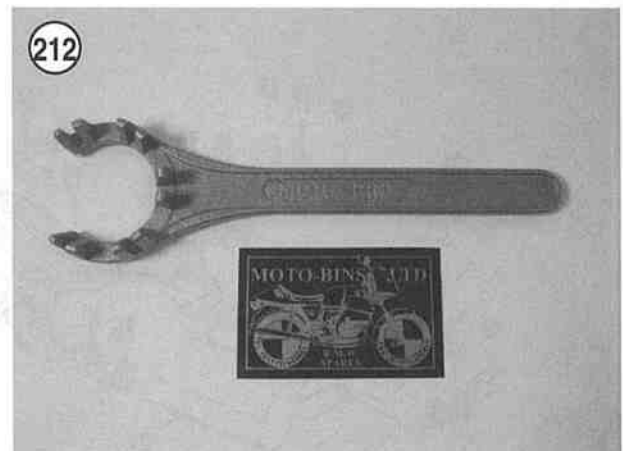
#### CAUTION

*Do not try to loosen the finned nut with a punch and hammer as the fins will break off. Use only the BMW special tool or an equivalent as shown in **Figure 212**.*

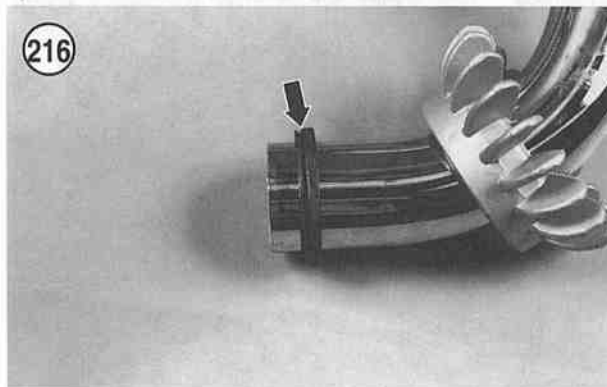
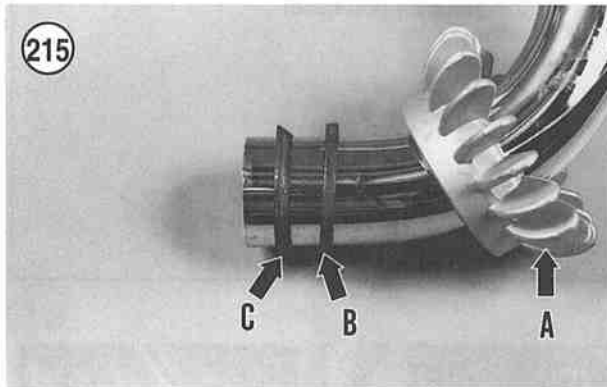
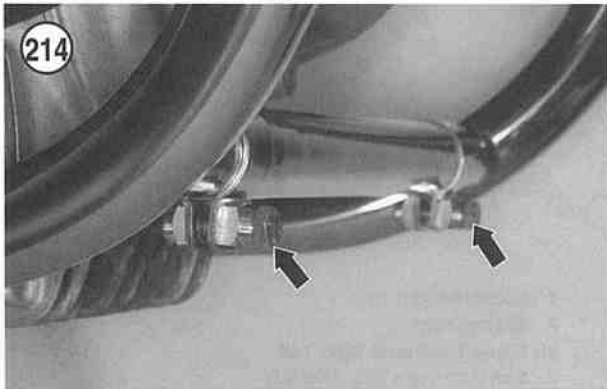
2. Using special tool, loosen the finned exhaust pipe nut (**Figure 213**) on each exhaust pipe. It is not necessary to completely remove the finned nut in order to remove the exhaust pipe.

#### NOTE

*If the nut is difficult to remove, pour a pot of boiling water over the nut while the engine is cold. If this fails, drill a row of 2mm holes along the nut and remove it with a chisel to prevent damage to the cylinder head threads.*



3. If only one exhaust pipe is going to be removed, loosen the bolt(s) (**Figure 214**) on the clamp on the front cross-over pipe.
4. Carefully pull one or both exhaust pipes straight forward and out of the primary muffler inlet(s) and the cylinder head(s). Leave the clamps on the primary muffler.
5. Inspect the exhaust pipe(s) for damage and deterioration. Replace the exhaust pipe(s) if necessary.
6. If there has been an exhaust leak at the cylinder head, perform the following:



- a. Completely unscrew the finned exhaust pipe nut from the cylinder head.
- b. Remove the clamping ring and the compression ring from within the nut. Note the way they were installed. Discard both rings as they must be replaced.
- c. Thoroughly clean the nut in solvent and scrub the inner threads with a stiff brush. Dry with compressed air.
- d. If there is a carbon buildup on the cylinder head exhaust port threads, also thoroughly clean them with a stiff brush and solvent. Dry with compressed air.

**NOTE**

*If the exhaust pipes are installed as an assembly, the aid of a helper makes installation of the assembly easier.*

- 7A. If the finned exhaust pipe nut was not removed, perform the following:

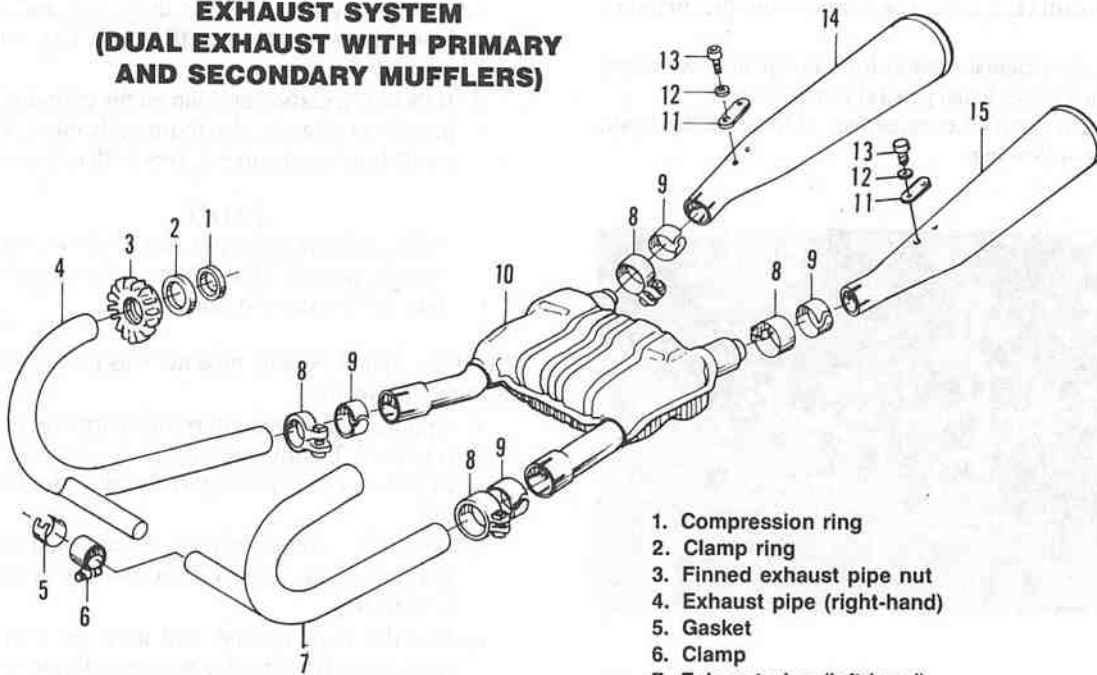
- a. Apply a high-temperature anti-corrosive compound (Optimol T Anti-seize Paste or equivalent) to the cylinder head exhaust port threads prior to installation.
- b. Install the exhaust pipe(s) through the nut(s) and into the cylinder head(s) and into the primary muffler inlet(s).
- c. Use the same special tool used for removal and tighten the finned exhaust pipe nut(s) to securely.
- d. Tighten the clamp bolt(s) securely.
- e. Repeat for the other side if necessary.

- 7B. If the finned exhaust pipe nut was removed, perform the following:

- a. Apply a high-temperature anti-corrosive compound (Optimol T Anti-seize paste or equivalent) to the cylinder head exhaust port threads prior to installation.
- b. Position the finned exhaust pipe nut (A, **Figure 215**) with the threaded portion going on last and slide it onto the exhaust pipe.
- c. Next position the clamp ring (B, **Figure 215**) with the flat side going on first so that the tapered side is facing out.
- d. Then position the compression ring (C, **Figure 215**) with the tapered side on first. This will position both rings with their tapered sides facing each other (**Figure 216**). This is necessary to obtain a leak-free seal.
- e. Apply a high-temperature anti-corrosive compound to the cylinder head exhaust port threads prior to installation.
- f. Install the exhaust pipe(s) into the cylinder head(s) and into the primary muffler inlet(s).
- g. Slide the compression ring, clamp ring and finned nut against the cylinder head exhaust port threads.
- h. Start the finned thread by hand and then using the same special tool used for removal, tighten the finned exhaust pipe nut(s) securely.

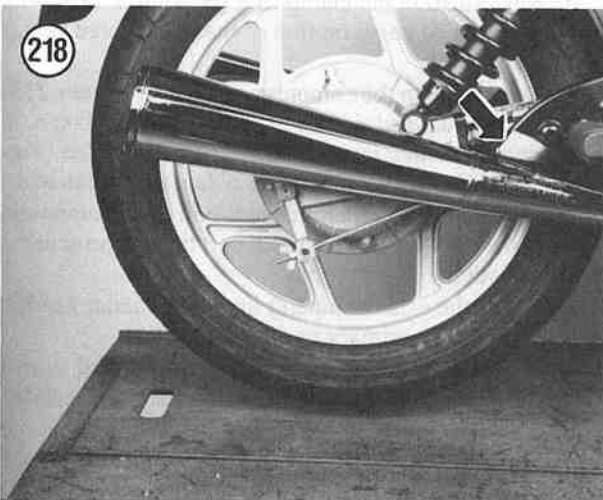
217

**EXHAUST SYSTEM  
(DUAL EXHAUST WITH PRIMARY  
AND SECONDARY MUFFLERS)**

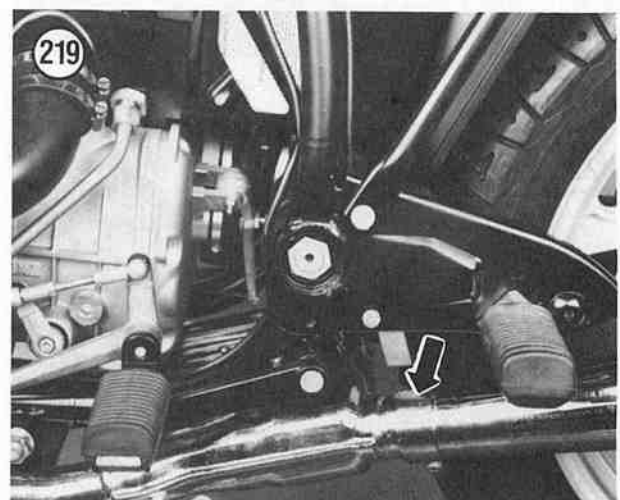


1. Compression ring
2. Clamp ring
3. Finned exhaust pipe nut
4. Exhaust pipe (right-hand)
5. Gasket
6. Clamp
7. Exhaust pipe (left-hand)
8. Clamp
9. Gasket
10. Primary muffler
11. Mounting plate
12. Washer
13. Bolt
14. Secondary muffler (right-hand)
15. Secondary muffler (left-hand)

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- i. Tighten the clamp bolt(s) securely.
  - j. Repeat for the other side if necessary.
8. If only one exhaust pipe was removed, tighten the front crossover pipe clamp bolt securely.
  9. After installation is complete, make sure there are no exhaust leaks.

**Dual Exhaust Models  
With Primary and Secondary Mufflers**

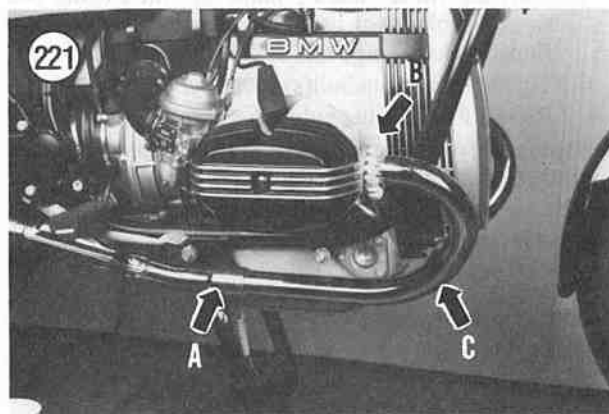
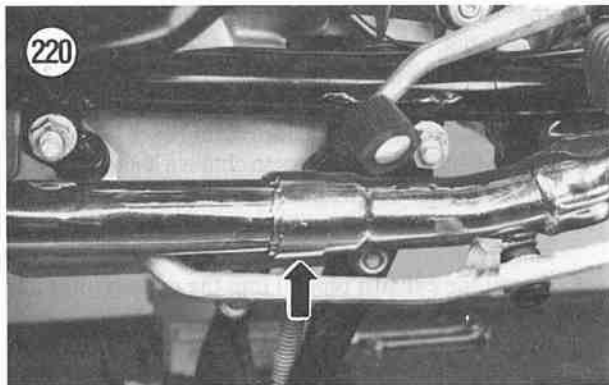
Refer to **Figure 217** for this procedure.

*Secondary muffler removal/installation*

**WARNING**

*Do not work on the exhaust system when it is hot. Allow the system to cool down before performing any service procedures.*

1. Place the bike on the centerstand.
2. Loosen the bolts and nuts (**Figure 218**) securing the secondary muffler to the rear footpeg mounting bracket.
3. Loosen the clamping bolt (**Figure 219**) securing the secondary muffler to the primary muffler.
4. Remove the bolts, nuts and washers securing the secondary muffler to the rear footpeg mounting bracket.



**NOTE**

*If difficult to remove, spray some WD-40 or equivalent on the clamping bolt and clamp to help loosen the secondary muffler from the primary muffler.*

5. Carefully pull the secondary muffler out of the primary muffler.
6. Install a new gasket into the inlet opening of the secondary muffler.
7. Make sure the clamp is in place on either muffler prior to secondary muffler installation.
8. Install the secondary muffler onto the primary muffler outlet and push it in until it bottoms out. Do not tighten the clamping bolt at this time.
9. Hold the secondary muffler in place and install the mounting bolts, washers and nuts. Tighten these bolts and nuts securely.
10. Tighten the clamp bolt securely.
11. After installation is complete, make sure there are no exhaust leaks.

*Primary muffler removal/installation*

**WARNING**

*Do not work on the exhaust system when it is hot. Allow the system to cool down before performing any service procedures.*

1. Place the bike on the centerstand.
2. Remove both secondary mufflers as described in this chapter.
3. Loosen the clamping bolt on each clamp (**Figure 220**) securing both exhaust pipes to the primary muffler.

**NOTE**

*If difficult to remove, spray some WD-40 or equivalent on the clamping bolts and clamp to help loosen the primary muffler from the exhaust pipe outlets.*

4. Carefully pull the primary muffler back and out of both exhaust pipes and remove the primary muffler.
5. Inspect the muffler for damage and deterioration. Replace if necessary.
6. Make sure the clamps are in place on the primary muffler prior to installation.
7. Install the primary muffler onto the exhaust pipe outlets and hook the rear of the muffler on the frame.
8. Tighten the clamp bolts securely.
9. Install the secondary mufflers as described in this chapter.
10. After installation is complete, make sure there are no exhaust leaks.



**Exhaust pipes removal/installation****WARNING**

*Do not work on the exhaust system when it is hot. Allow the system to cool down before performing any service procedures.*

The exhaust pipes can be removed separately or as an assembly. This procedure is for removal of the complete assembly. If only one exhaust pipe is to be removed, work on that specific side of the bike only.

1. Loosen the clamping bolt on each clamp (A, **Figure 221**) securing both exhaust pipes to the primary muffler.

**CAUTION**

*Do not try to loosen the finned nut with a punch and hammer as the fins will break off. Use only the BMW special tool or equivalent as shown in **Figure 212**.*

2. Using BMW special tool (part No. 18 0 600), loosen the finned exhaust pipe nut (B, **Figure 221**) on each exhaust pipe. It is not necessary to completely remove the finned nut in order to remove the exhaust pipe.

**NOTE**

*If the nut is difficult to remove, pour a pot of boiling water over the nut while the engine is cold. If this fails, drill a row of 2mm holes along the nut and remove it with a chisel to prevent damage to the cylinder head threads.*

3. If only one exhaust pipe is going to be removed, loosen the bolt on the clamp on the front crossover pipe.
4. Carefully pull one or both exhaust pipe(s) (C, **Figure 221**) straight forward and out of the primary muffler inlet(s) and the cylinder head(s). Leave the clamps on the primary muffler.
5. Inspect the exhaust pipe(s) for damage and deterioration or slight "burn-through areas." Replace the exhaust pipe(s) if necessary.
6. If there has been an exhaust leak at the cylinder head, perform the following:
  - a. Completely unscrew the finned exhaust pipe nut from the cylinder head.
  - b. Remove the clamping ring and the compression ring from within the nut. Note the way they were installed. Discard both rings as they must be replaced.
  - c. Thoroughly clean the nut in solvent and scrub the inner threads with a stiff brush. Dry with compressed air.
  - d. If there is a carbon buildup on the cylinder head exhaust port threads, also thoroughly clean them with a stiff brush and solvent. Dry with compressed air.

**NOTE**

*If the exhaust pipes are installed as an assembly, the aid of a helper makes installation of the assembly easier.*

- 7A. If the finned exhaust pipe nut was not removed, perform the following:
  - a. Apply a high-temperature anti-corrosive compound (Optimol T Anti-seize Paste or equivalent) to the cylinder head exhaust port threads prior to installation.
  - b. Install the exhaust pipe(s) through the nut(s) and into the cylinder head(s) and into the primary muffler inlet(s).
  - c. Using the same special tool used for removal, tighten the finned exhaust pipe nut(s) securely.
  - d. Tighten the clamp bolt(s) securely.
  - e. Repeat for the other side if necessary.
- 7B. If the finned exhaust pipe nut was removed, perform the following:
  - a. Apply a high-temperature anti-corrosive compound (Optimol T Anti-seize Paste or equivalent) to the cylinder head exhaust port threads prior to installation.
  - b. Onto the exhaust pipe, position the finned exhaust pipe nut (A, **Figure 215**) with the threaded portion going on last and slide it onto the exhaust pipe.
  - c. Next position the clamp ring (B, **Figure 215**) with the flat side going on first so that the tapered side is facing out.
  - d. Next position the compression ring (C, **Figure 215**) with the tapered side on first. This will position both rings with their tapered sides facing each other (**Figure 216**). This is necessary to obtain a leak-free seal.
  - e. Apply a high-temperature anti-corrosive compound to the cylinder head exhaust port threads prior to installation.
  - f. Install the exhaust pipe(s) into the cylinder head(s) and into the primary muffler inlet(s).
  - g. Slide the compression ring, clamp ring and finned nut against the cylinder head exhaust port threads.
  - h. Start the finned nut by hand and then using the same special tool used for removal, tighten the finned exhaust pipe nut(s) securely.
  - i. Tighten the clamp bolt(s) securely.
  - j. Repeat for the other side if necessary.
8. If only one exhaust pipe was removed, tighten the front crossover pipe clamp bolt securely.
9. After installation is complete, make sure there are no exhaust leaks.

**Dual Exhaust Models  
With Single Mufflers**

Refer to **Figure 222** for this procedure.

**Muffler removal/installation**

**WARNING**

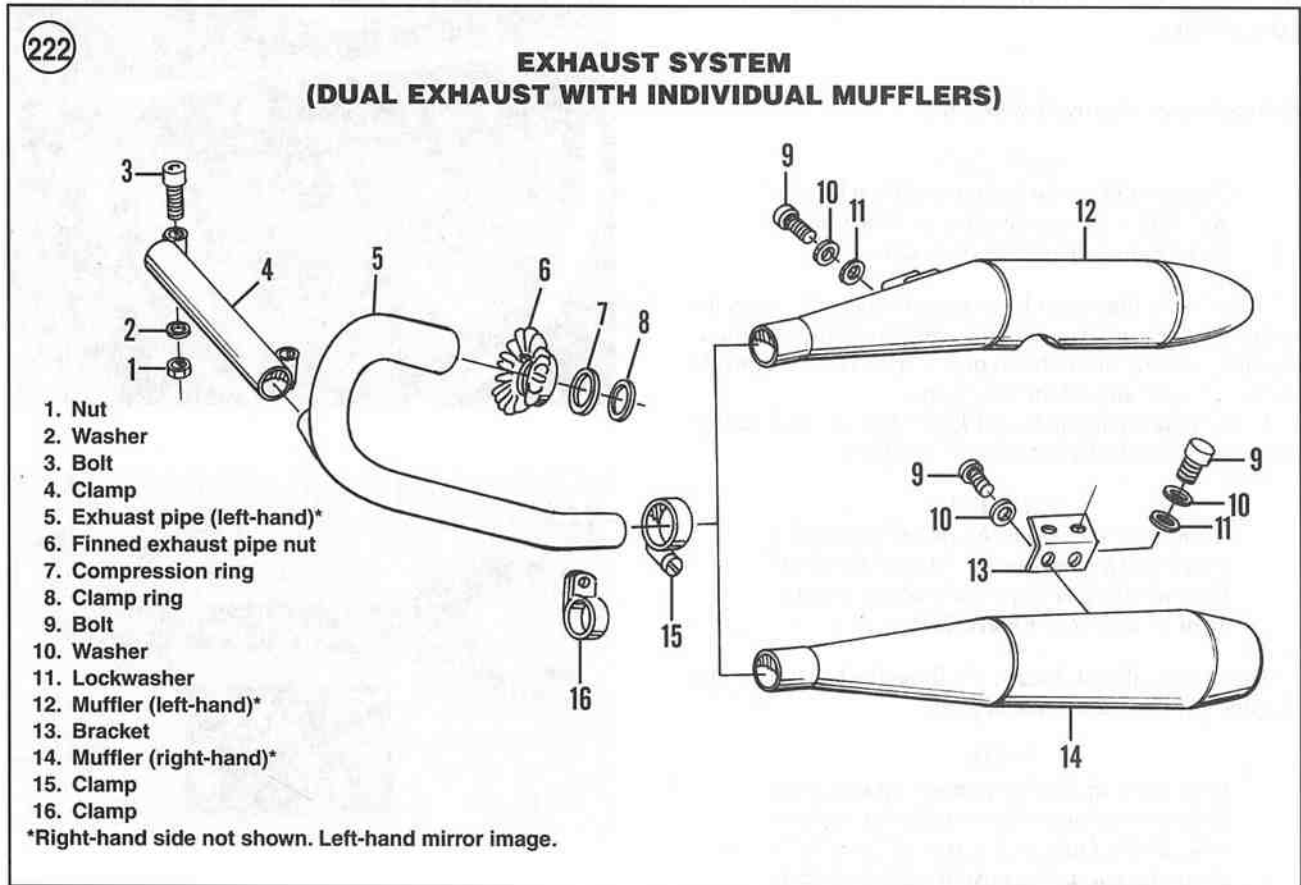
*Do not work on the exhaust system when it is hot. Allow the system to cool down prior to performing any service procedures.*

1. Place the bike on the centerstand.
2. Loosen the bolts and nuts (Figure 223) securing the muffler to the frame.

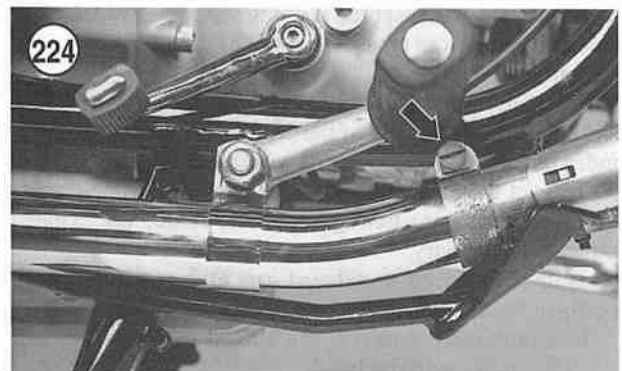
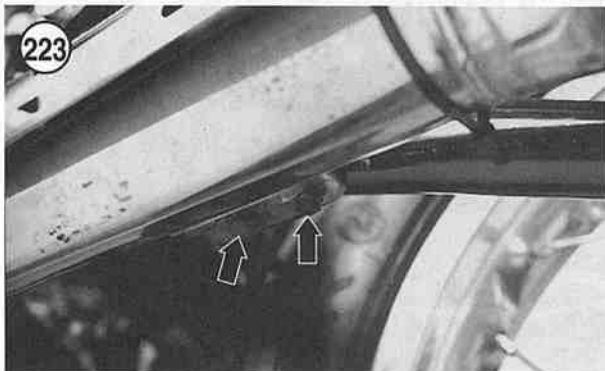
3. Loosen the clamping bolt (Figure 224) securing the muffler to the exhaust pipe.
4. Remove the bolts, nuts and washers securing the muffler to the frame.

**NOTE**

*If difficult to remove, spray some WD-40 or equivalent on the clamping bolt and clamp to help loosen the secondary muffler from the primary muffler.*



7



5. Carefully pull the muffler (**Figure 225**) toward the rear and out of the exhaust pipe.
6. Make sure the clamp is in place on either the muffler or exhaust pipe prior to muffler installation.
7. Install the muffler onto the exhaust pipe outlet and push it in until it bottoms out. Do not tighten the clamping bolt at this time.
8. Hold the muffler in place and install the mounting bolts, washers and nuts. Tighten these bolts and nuts securely.
9. Tighten the clamp bolt securely.
10. After installation is complete, make sure there are no exhaust leaks.

### Exhaust pipes removal/installation

#### WARNING

*Do not work on the exhaust system when it is hot. Allow the system to cool down before performing any service procedures.*

The exhaust pipes can be removed separately or as an assembly. This procedure is for removal of the complete assembly. If only one exhaust pipe is to be removed, work on that specific side of the bike only.

1. Loosen the clamping bolt (**Figure 224**) on each clamp securing both exhaust pipes to the mufflers.

#### CAUTION

*Do not try to loosen the finned nut with a punch and hammer as the fins will break off. Use only the BMW special tool or an equivalent as shown in **Figure 226**.*

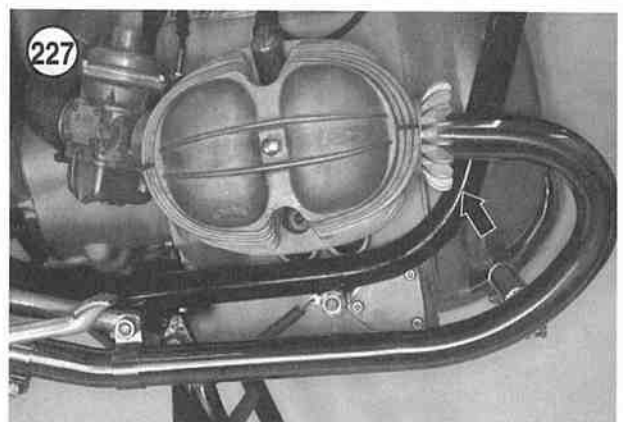
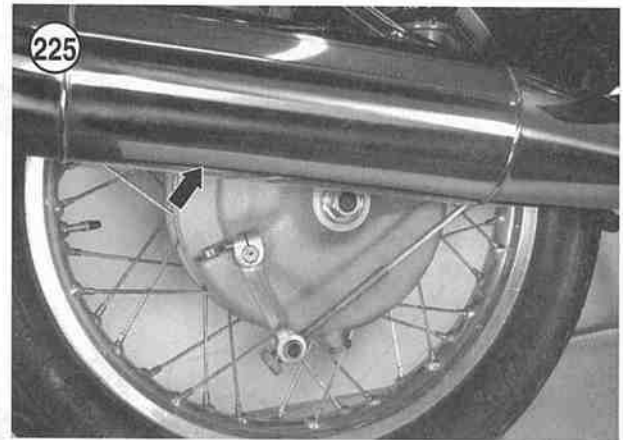
2. Using special tool, loosen the finned exhaust pipe nut (**Figure 227**) on each exhaust pipe.

#### NOTE

*If the nut is difficult to remove, pour a pot of boiling water over the nut while the engine is cold. If this fails, drill a row of 2mm holes along the nut and remove it with a chisel to prevent damage to the cylinder head threads.*

3. If only one exhaust pipe is going to be removed, loosen the bolt on the front crossover pipe (**Figure 228**) closest to the pipe to be removed.
4. Carefully pull one or both exhaust pipes (**Figure 229**) straight forward and out of the muffler inlet(s) and the cylinder head(s). Leave the clamps on the muffler.
5. Inspect the exhaust pipe(s) for damage and deterioration or slight "burn-through areas." Replace the exhaust pipe(s) if necessary.
6. If there has been an exhaust leak at the cylinder head, perform the following:
  - a. Completely unscrew the finned exhaust pipe nut from the cylinder head.

- b. Remove the clamping ring and the compression ring from within the nut. Note the way they were installed. Discard both rings as they must be replaced.
- c. Thoroughly clean the nut in solvent and scrub the inner threads with a stiff brush. Dry with compressed air.
- d. If there is a carbon buildup on the cylinder head exhaust port threads, also thoroughly clean them with a stiff brush and solvent. Dry with compressed air.

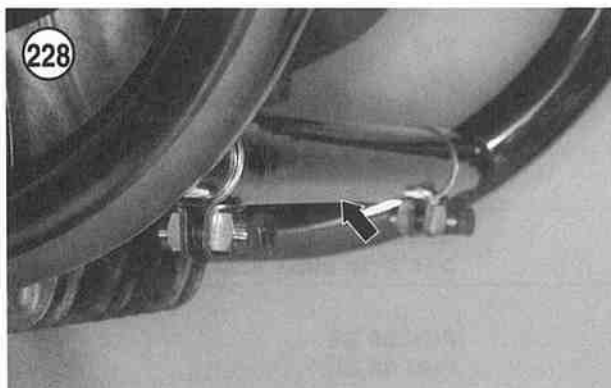


**NOTE**

*If the exhaust pipes are installed as an assembly, the aid of a helper makes installation of the assembly easier.*

7A. If the finned exhaust pipe nut was not removed, perform the following:

- a. Install the exhaust pipe(s) through the nut(s) and into the cylinder head(s) and into the muffler inlet(s).



- b. Use the same special tool used for removal and tighten the finned exhaust pipe nut(s) to securely.
  - c. Tighten the clamp bolt(s) securely.
  - d. Repeat for the other side if necessary.
- 7B. If the finned exhaust pipe nut was removed, perform the following:
- a. Apply a high-temperature anti-corrosive compound (Optimol T Anti-seize Paste or equivalent) to the cylinder head exhaust port threads prior to installation.
  - b. Position the finned exhaust pipe nut (A, **Figure 215**) with the threaded portion going on last and slide it onto the exhaust pipe.
  - c. Next position the clamp ring (B, **Figure 215**) with the flat side going on first so that the tapered side is facing out.
  - d. Next position the compression ring (C, **Figure 215**) with the tapered side on first. This will position both rings with their tapered sides facing each other (**Figure 216**). This is necessary to obtain a leak-free seal.
  - e. Apply a high-temperature anti-corrosive compound to the cylinder head exhaust port threads prior to installation.
  - f. Install the exhaust pipe(s) into the cylinder head(s) and into the muffler inlet(s).
  - g. Slide the compression ring, clamp ring and finned nut against the cylinder head exhaust port threads.
  - h. Start the finned thread by hand and then using the same special tool used for removal, tighten the finned exhaust pipe nut(s) securely.
  - i. Tighten the clamp bolt(s) securely.
  - j. Repeat for the other side if necessary.
8. If only one exhaust pipe was removed, tighten the front crossover pipe clamp bolt securely.
  9. After installation is complete, make sure there are no exhaust leaks.

Table 1 CARBURETOR SPECIFICATIONS

<b>Model Type</b>	<b>R50/5 Bing slide valve</b>	<b>R60/5, R60/6 Bing slide valve</b>
<b>Model No.</b>		
Left-hand	1/26/113	1/26/111
Right-hand	1/26/114	1/26/112
Slide diameter	26 mm (1.02 in.)	26 mm (1.02 in.)
Main jet	135	140
Needle jet	2.68	2.68
Needle jet No.	4	4
Needle clip position from top	3rd	2nd
Idle jet No.	35	40
Mixture adjust screw opening from full closed	1/2-1 1/2 turns out	1/2-1 1/2 (R60/5) turns out 1/4-1 1/4 (R60/6) turns out
Float valve diameter	2.2 mm (0.086 in.)	2.2 mm (0.086 in.)
Float weight	10 grams (0.35 oz.)	10 grams (0.35 oz.)
<b>Model Type</b>	<b>R60/7 Bing slide valve</b>	<b>R90S Dell'Orto slide valve</b>
<b>Model No.</b>		
Left-hand	1/26/123	PHM 38 BS
Right-hand	1/26/134	PHM 38 BD
Slide diameter	26 mm (1.02 in.)	38 mm (1.50 in.)
Main jet	140	155
Needle jet	2.68	2.60
Needle jet No.	4	K4
Needle clip position from top	2nd	3rd
Idle jet No.	40	60
Idle jet diameter	—	1.2 mm (0.046 in.)
Mixture adjust screw opening from full closed	1/4-1 1/4 turns out	1-1 1/2 turns out
Float valve diameter	2.2 mm (0.086 in.)	3.0 mm (0.118 in.)
Float weight	NA	10 grams (0.35 oz.)
<b>Model (year) Type</b>	<b>R65 (1979-1980), R65LS (1982) Bing constant velocity</b>	<b>R65 (1981-1982) Bing constant velocity</b>
<b>Model No.</b>		
Left-hand	64/32/303	64/32/325
Right-hand	64/32/304	64/32/326
Slide diameter	32 mm (1.26 in.)	32 mm (1.26 in.)
Main jet	145	145
Needle jet	2.66	2.66
Needle jet No.	46-241	46-241
Needle clip position from top	3rd	3rd
Idle jet No.	45	40
Idle jet diameter	1.0 mm (0.040 in.)	1.0 mm (0.040 in.)
Mixture adjust screw opening from full closed	3/4 turn out	3/4 turn out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)

(continued)



**Table 1 CARBURETOR SPECIFICATIONS (continued)**

<b>Model (year) Type</b>	<b>R65LS (1983-1984) R65LS (1983-1984) Bing constant velocity</b>	<b>R65 (1986-1987) Bing constant velocity</b>
Model No.		
Left-hand	64/32/335	64/32/361
Right-hand	64/32/336	64/32/362
Slide diameter	32 mm (1.26 in.)	32 mm (1.26 in.)
Main jet	135	130
Needle jet	2.64	2.66
Needle jet No.	46-242	46-251
Needle clip position from top	3rd	3rd
Idle jet No.	40	40
Idle jet diameter	1.0 mm (0.040 in.)	1.0 mm (0.040 in.)
Mixture adjust screw opening from full closed	3/4 turn out	3/4 turn out
Float valve diameter	NA	NA
<b>Model Type</b>	<b>R75/5, R75/6 Bing constant velocity</b>	<b>R75/7 Bing constant velocity</b>
Model No.		
Left-hand	64/32/9	64/32/13
Right-hand	64/32/10	64/32/14
Slide diameter	32 mm (1.26 in.)	32 mm (1.26 in.)
Main jet	135	145
Needle jet	2.70	2.66
Needle jet No.	46-241	46-251
Needle clip position from top	3rd	3rd
Idle jet No.	44-950	50
Idle jet diameter	1.0 mm (0.040 in.)	1.0 mm (0.040 in.)
Mixture adjust screw opening from full closed	1/2-1 turn out	1/2-1 turn out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	10 grams (0.35 oz.)	NA
<b>Model (year) Type</b>	<b>R80 (1985-1987) Bing constant velocity</b>	<b>R80/7 (1978) Bing constant velocity</b>
Model No.		
Left-hand	64/32/357	64/32/221
Right-hand	64/32/358	64/32/222
Slide diameter	32 mm (1.26 in.)	32 mm (1.26 in.)
Main jet	130 or 135	145
Needle jet	2.66	2.66
Needle jet No.	46-241	46-241
Needle clip position from top	3rd	2nd
Idle jet No.	45	45
Idle jet diameter	NA	1.0 mm (0.040 in.)
Mixture adjust screw opening from full closed	1/2-1 turn out	1/2 turn out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	10 grams (0.35 oz.)	NA

(continued)

Table 1 CARBURETOR SPECIFICATIONS (continued)

<b>Model (year) Type</b>	<b>R80/7 (1979) Bing constant velocity</b>	<b>R80ST (1983) Bing constant velocity</b>
Model No.		
Left-hand	64/32/201	64/32/221
Right-hand	64/32/202	64/32/222
Slide diameter	32 mm (1.26 in.)	32 mm (1.26 in.)
Main jet	145	150
Needle jet	2.66	2.66
Needle jet No.	46-241	46-241
Needle clip position from top	3rd	3rd
Idle jet No.	50	45
Mixture adjust screw opening from full closed	1/2-1 turn out	3/4-1 turn out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	10 grams (0.35 oz.)	NA
<b>Model (year) Type</b>	<b>R80ST (1984) Bing constant velocity</b>	<b>R80G/S (1981) Bing constant velocity</b>
Model No.		
Left-hand	64/32/351	64/32/357
Right-hand	64/32/352	64/32/358
Slide diameter	32 mm (1.26 in.)	32 mm (1.26 in.)
Main jet	132	130
Needle jet	2.66	2.66
Needle jet No.	46-242	46-251
Needle clip position from top	3rd	3rd
Idle jet No.	45	45
Mixture adjust screw opening from full closed	3/4-1 turn out	3/4-1 turn out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	10 grams (0.35 oz.)	NA
<b>Model (year) Type</b>	<b>R80G/S (1983-1986) Bing constant velocity</b>	<b>R80RT (1983) Bing constant velocity</b>
Model No.		
Left-hand	64/32/305	64/32/321
Right-hand	64/32/306	64/32/322
Slide diameter	32 mm (1.26 in.)	32 mm (1.26 in.)
Main jet	150	150
Needle jet	2.64	2.66
Needle jet No.	46-241	46-241
Needle clip position from top	3rd	3rd
Idle jet No.	40	45
Mixture adjust screw opening from full closed	3/4-1 turn out	3/4-1 turn out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	10 grams (0.35 oz.)	NA

(continued)

Table 1 CARBURETOR SPECIFICATIONS (continued)

<b>Model (year) Type</b>	<b>R80RT (1984) Bing constant velocity</b>	<b>R80RT (1985-1987) Bing constant velocity</b>
Model No.		
Left-hand	64/32/351	64/32/357
Right-hand	64/32/352	64/32/358
Slide diameter	32 mm (1.26 in.)	32 mm (1.26 in.)
Main jet	132	135
Needle jet	2.66	2.66
Needle jet No.	46-242	46-251
Needle clip position from top	3rd	3rd
Idle jet No.	45	45
Mixture adjust screw opening from full closed	3/4-1 turn out	3/4-1 turn out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	10 grams (0.35 oz.)	NA
<b>Model (year) Type</b>	<b>R90/6 Bing constant velocity</b>	<b>R90/S Dell'Orto slide</b>
Model No.		
Left-hand	64/32/11	PHM 38 BS
Right-hand	64/32/12	PHM 38 BD
Slide diameter	32 mm (1.26 in.)	38 mm (1.50 in.)
Main jet	150	155
Needle jet	2.68	2.60
Needle jet No.	46-241	K4
Needle clip position from top	1st	3rd
Idle jet No.	45	60
Mixture adjust screw opening from full closed	1/2-1 turn out	1-1/2 turns out
Float valve diameter	2.5 mm (0.098 in.)	3.0 mm (0.118 in.)
Float weight	13 grams (0.46 oz.)	10 grams (0.35 oz.)
<b>Model (year) Type</b>	<b>R100CS, R100RS and R100RT (1981-1984) Bing constant velocity</b>	<b>R100/7 Bing constant velocity Bing constant velocity</b>
Model No.		
Left-hand	94/40/113	64/32/223
Right-hand	94/40/114	64/32/224
Slide diameter	40 mm (1.57 in.)	32 mm (1.50 in.)
Main jet	160	160
Needle jet	2.66	2.64
Needle jet No.	46-341	46-241
Needle clip position from top	2nd	2nd
Idle jet No.	45	45
Mixture adjust screw opening from full closed	1-1/4 turns out	1/2 turn out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	NA	NA

(continued)

**Table 1 CARBURETOR SPECIFICATIONS (continued)**

<b>Model (year) Type</b>	<b>R100S (1977) Bing constant velocity</b>	<b>R100S (1978) Bing constant velocity</b>
Model No.		
Left-hand	94/40/103	94/40/107
Right-hand	94/40/104	94/40/108
Slide diameter	40 mm (1.57 in.)	40 mm (1.57 in.)
Main jet	170	160
Needle jet	2.66	2.64
Needle jet No.	46-341	46-341
Needle clip position from top	3rd	2nd
Idle jet No.	45	45
Mixture adjust screw opening from full closed	1-1/4 turns out	1/2 turn out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	NA	NA
<b>Model (year) Type</b>	<b>R100T (1979) Bing constant velocity</b>	<b>R100RS (1977) Bing constant velocity</b>
Model No.		
Left-hand	94/40/103	94/40/105
Right-hand	94/40/104	94/40/106
Slide diameter	40 mm (1.57 in.)	40 mm (1.57 in.)
Main jet	170	170
Needle jet	2.66	2.68
Needle jet No.	46-341	46-341
Needle clip position from top	3rd	2nd
Idle jet No.	45	45
Mixture adjust screw opening from full closed	1-1/4 turns out	1-1/4 turns out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	NA	NA
<b>Model (year) Type</b>	<b>R100RS (1978) Bing constant velocity</b>	<b>R100S, R100RS and R100RT (1979) Bing constant velocity</b>
Model No.		
Left-hand	94/40/107	94/40/105
Right-hand	94/40/108	94/40/106
Slide diameter	40 mm (1.57 in.)	40 mm (1.57 in.)
Main jet	160	170
Needle jet	2.64	2.68
Needle jet No.	46-341	46-341
Needle clip position from top	2nd	2nd
Idle jet No.	45	45
Mixture adjust screw opening from full closed	1/2 turn out	1-1/4 turns out
Float valve diameter	2.5 mm (0.098 in.)	2.5 mm (0.098 in.)
Float weight	NA	NA

(continued)

Table 1 CARBURETOR SPECIFICATIONS (continued)

Model (year) Type	R100S, R100T, R100RS, and R100RT (1980) Bing constant velocity	R100RS, R100RT and R100GS (1988-1989) Bing constant velocity
Model No.		
Left-hand	94/40/109	64/32/357
Right-hand	94/40/110	64/32/358
Slide diameter	40 mm (1.57 in.)	32 mm (1.26 in.)
Main jet	160	135
Needle jet	2.66	2.66
Needle jet No.	46-241	46-251
Needle clip position from top	2nd	3rd
Idle jet No.	45	45
Mixture adjust screw opening from full closed	1/2 turn out	1/2 turn out
Float valve diameter	2.5 mm (0.098 in.)	NA
Float weight	NA	NA
NA = Information not available from BMW.		



**NOTE:** If you own a 1990 or later model, first check the Supplement at the back of this book for any new service information.

## CHAPTER EIGHT

# ELECTRICAL SYSTEM

The electrical system consists of the following:

- a. Charging system.
- b. Ignition system.
- c. Starting system.
- d. Lighting system.
- e. Directional signal system.
- f. Switches.
- g. Electrical components.

**Tables 1-4** are located at the end of this chapter. Color wiring diagrams for all models are at the end of the manual.

For complete spark plug and battery information and service procedures, refer to Chapter Three.

### CHARGING SYSTEM

The charging system consists of the battery and a 3-phase 12-volt alternator that is driven off of the front end of the crankshaft. The voltage regulator and rectifier are separate units.

Alternating current generated by the alternator is rectified to direct current. The voltage regulator maintains the voltage to the battery and additional electrical loads (lights, ignition, etc.) at a constant voltage regardless of variations in engine speed and load.

#### Leakage Test

Perform this test before performing the output test.

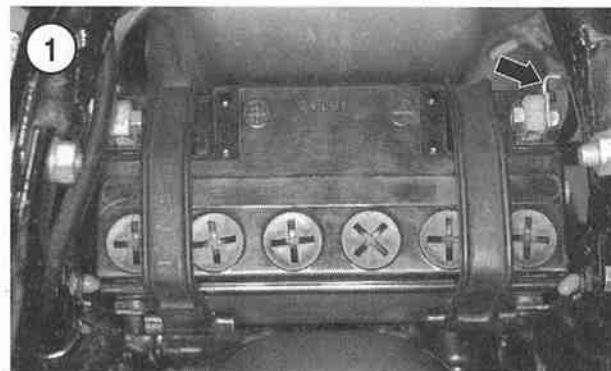
1. Turn the ignition switch to the OFF position.
2. Refer to *Battery* in Chapter Three and disconnect the battery negative (-) lead (**Figure 1**).

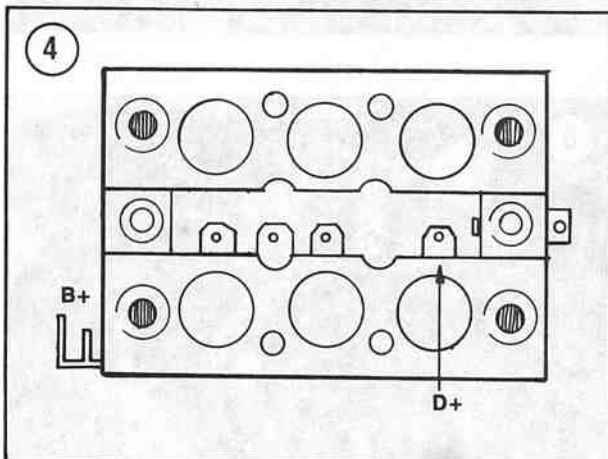
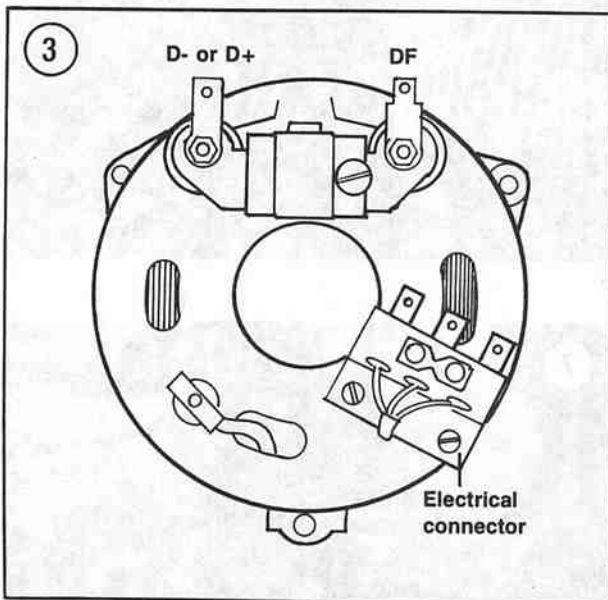
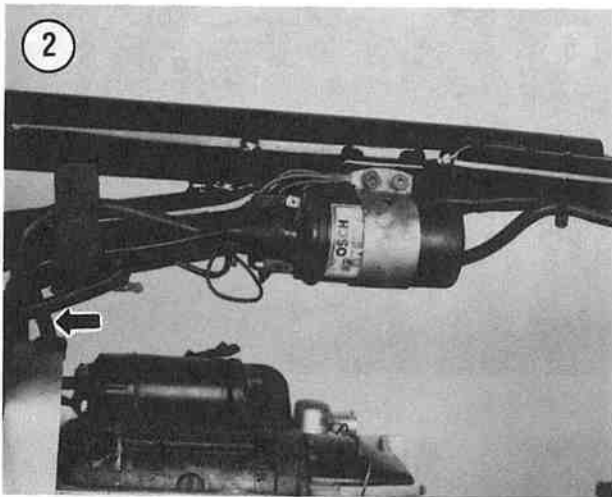
4. The voltmeter should read 0 volts.
5. If there is a voltage reading, this indicates a voltage drain in the system that will drain the battery.
6. Check all components of the charging system for any bare wires that may be shorting out which could cause the drain.

#### Alternator and Voltage Regulator Quick Test

Whenever charging system trouble is suspected, make sure the battery is fully charged and in good condition before going any further. Clean and test the battery as described under *Battery* in Chapter Three.

If the charge warning light remains lit when the engine is running and the battery is known to be in good condition, this simple test can be run to see if the problem is in the voltage regulator or in the alternator.





1. Turn the ignition switch to the ON position. The charge warning light on the instrument cluster should come on. If the light does not come on, refer to *Instrument Cluster* in this chapter and see if the charge light bulb is burned out.
2. Start the bike and increase idle speed. The charge light should now go off. If the light does not go off, shut off the engine and continue with this test.
3. Remove the fuel tank as described in Chapter Seven.

#### NOTE

The location of the 3-pin electrical connector varies among the different models. The electrical cable exits the top rear portion of the timing chain cover (Figure 2) and travels toward the rear against the frame top tube.

4. Disconnect the 3-pin electrical connector from the voltage regulator.
5. Use a piece of insulated electrical wire and jumper the electrical connector between the D+ (blue wire) and the DF (black wire) terminals.
6. Start the engine and let it idle at 1,000-1,200 rpm.
7. If the charge warning light goes off, the regulator is faulty.
8. If the charge warning light stays on, the alternator is faulty.
9. Disconnect the jumper wire installed in Step 5 and test the faulty unit as described in this chapter.

#### Voltage Regulator Test

Whenever charging system trouble is suspected, make sure the battery is fully charged and in good condition before going any further. Clean and test the battery as described under *Battery* in Chapter Three.

Refer to Figure 3 and Figure 4 for this procedure.

1. Start the bike and let it reach normal operating temperature. Usually 10-15 minutes of stop-and-go riding is sufficient. Shut off the engine.
2. Turn the ignition switch to the OFF position.
3. Remove the fuel tank as described in Chapter Seven.
4. Disconnect the battery negative lead as described under *Battery* in Chapter Three.

#### CAUTION

The battery negative lead **must** be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating replacement of the entire diode board.

5. Remove the engine front cover as described in Chapter Four.
6. Reconnect the battery negative lead.

7. Disconnect the electrical connector from the B+ terminal on the end of the diode board (Figure 5).
8. Connect a voltmeter between the B+ terminal on the diode board and the D+ (or D-) terminal on the alternator brush assembly (Figure 6).
9. Start the engine and let it idle.
10. Increase engine speed just a little above idle speed and note the voltmeter reading. The reading should be between 13.5-14.25 volts. Shut the engine off.
11. If the reading is less than specified, inspect the alternator.
12. Reconnect the electrical connector onto the B+ terminal on the end of the diode board.
13. Connect a voltmeter between the D+ terminal on the diode board and ground.
14. Start the engine and let it idle.
15. Increase engine speed just a little above idle speed and note the voltmeter reading. The reading should be between 13.5-14.25 volts.
16. If the difference between the reading in Step 10 and Step 15 is only 0.5 volt, inspect the voltage regulator.
17. If the difference between the reading in Step 10 and Step 15 is 1.5-4.0 volts, the diode board is faulty and must be replaced.
18. Shut the engine off and disconnect the voltmeter.

#### CAUTION

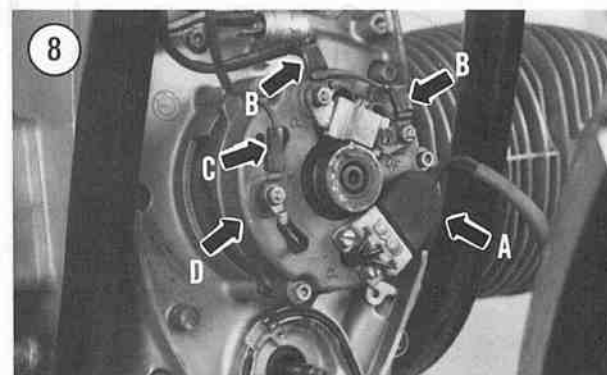
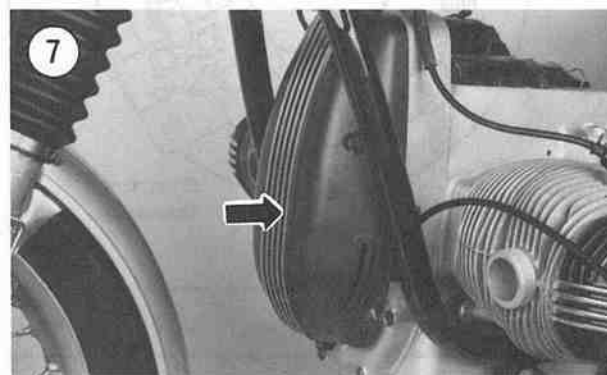
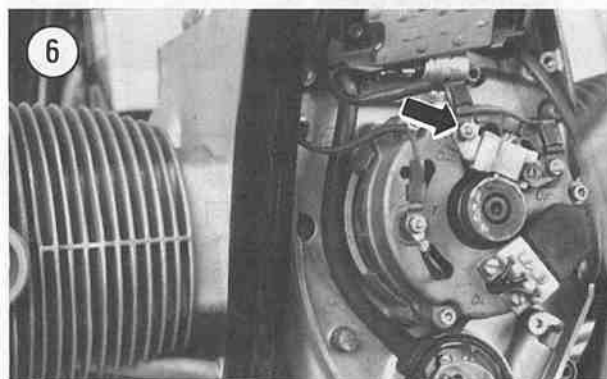
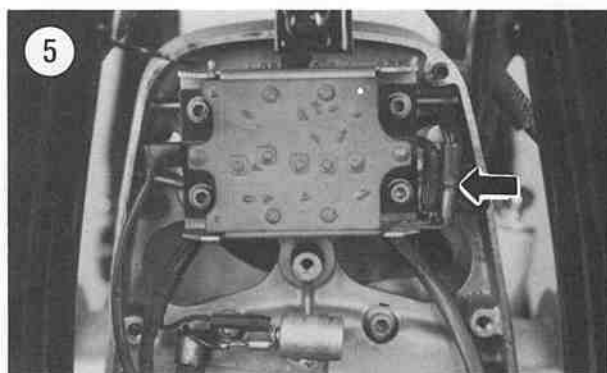
*The battery negative lead must be disconnected prior to installing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating replacement of the entire diode board.*

19. Disconnect the battery negative lead.
20. Install the engine front cover as described in Chapter Four.
21. Reconnect the battery negative lead.

#### ALTERNATOR

The alternator is a form of electrical generator in which a rotor, which produces a magnetized field, revolves within a set of stationary coils called a stator assembly. As the rotor revolves, alternating current is induced in the stator coils. The current is then rectified to direct current and is used to operate the electrical systems on the motorcycle and to keep the battery charged.

The alternator rotor is driven off of the front end of the crankshaft. The rotor is an electromagnet, rather than a permanent magnet, and is energized by a demand signal from the voltage regulator through contact brushes and slip rings.



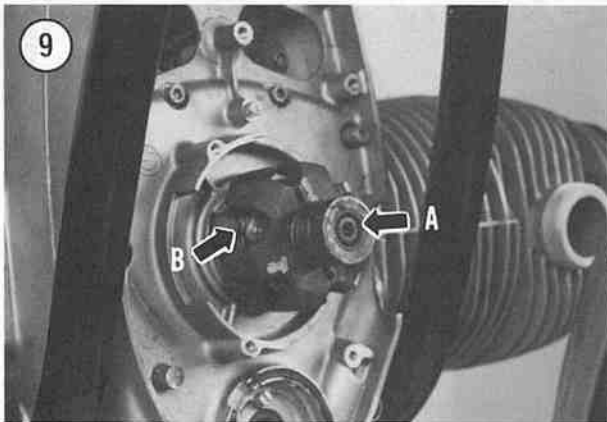
**Removal/Installation**

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.

**CAUTION**

The battery negative lead **must** be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating replacement of the entire diode board.

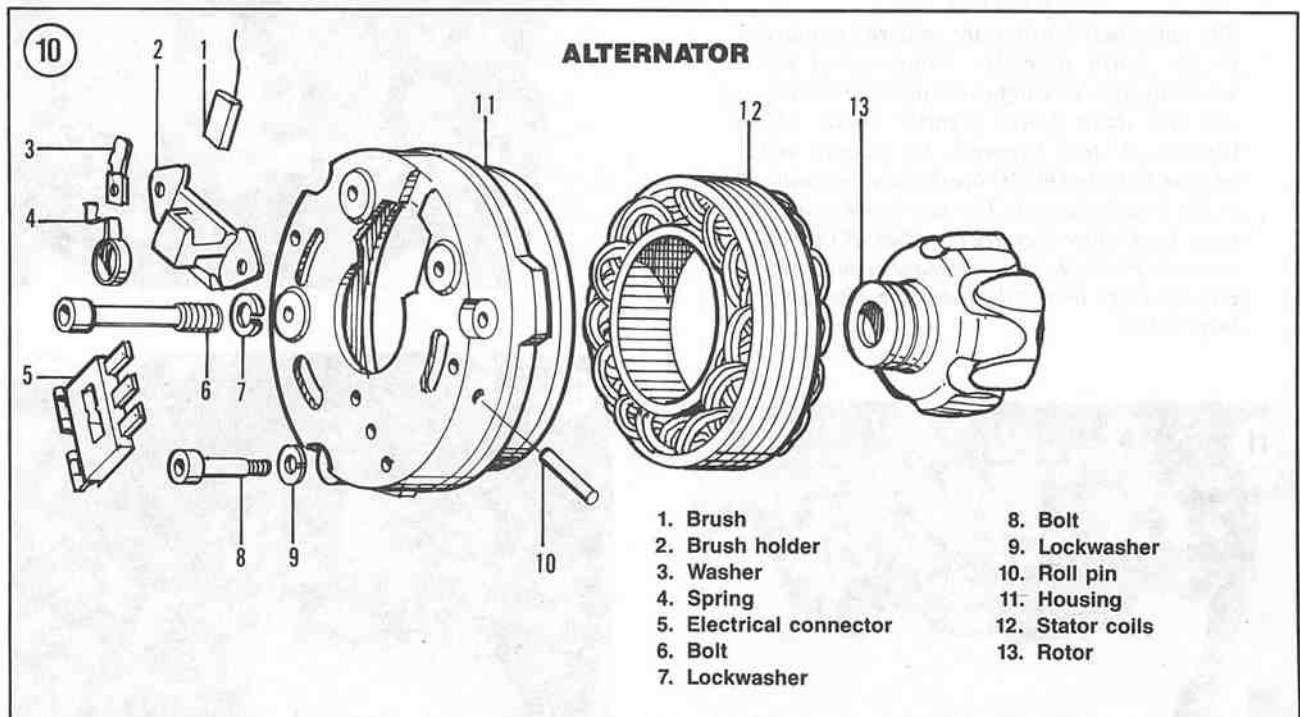
2. Remove the engine front cover (**Figure 7**) as described in Chapter Four.



3. Disconnect the 3-pin electrical connector (A, **Figure 8**) from the alternator.
4. Disconnect the electrical connectors (B, **Figure 8**) from each end of the brush assembly.
5. Disconnect the electrical connector (C, **Figure 8**) from the "Y" terminal.
6. Pull up on the brush springs and disengage them from the brushes.
7. Pull the brushes up and out of their receptacles.
8. Remove the bolts and lockwashers securing the alternator stator (D, **Figure 8**) to the front of the crankcase.
9. Pull the stator assembly straight off of the rotor and remove it.
10. Remove the center bolt (A, **Figure 9**) and lockwasher securing the rotor to the end of the crankshaft.
11. Screw the BMW special tool (rotor puller part No. 12 3 600) into the end of the rotor.
12. Turn the special tool with a wrench and break the rotor loose from the crankshaft taper.
13. Remove the rotor (B, **Figure 9**) and special tool. Unscrew the tool from the rotor.
14. Install by reversing these removal steps. Note the following during installation.
15. Install the mounting bolts and tighten to the torque specification listed in **Table 1**.
16. Make sure the electrical connector is free of corrosion and is pushed tightly onto the alternator.

**Brush Replacement**

Refer to **Figure 10** for this procedure.





This procedure is shown with the alternator removed for clarity. It is not necessary to remove the alternator for brush replacement.

1. Using a scribe, unhook the spring (A, **Figure 11**) from the rear surface of the brush (B, **Figure 11**).
2. Pull the brush out of its receptacle (**Figure 12**).
3. Measure the length of the brushes with a vernier caliper (**Figure 13**). If worn to the service limit projection listed in **Table 2**, the brushes must be replaced.
4. If the brush is within specification, reinstall it in the brush receptacle and reinstall the spring. Make sure the spring is properly seated against the backside of the brush.
5. If the brush is worn, proceed to Step 7 and remove the brush assembly from the rear of the alternator.

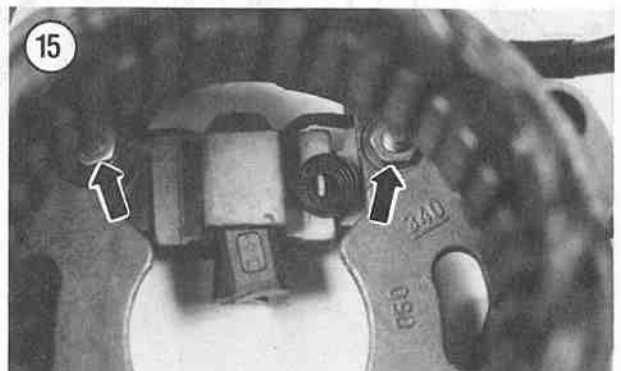
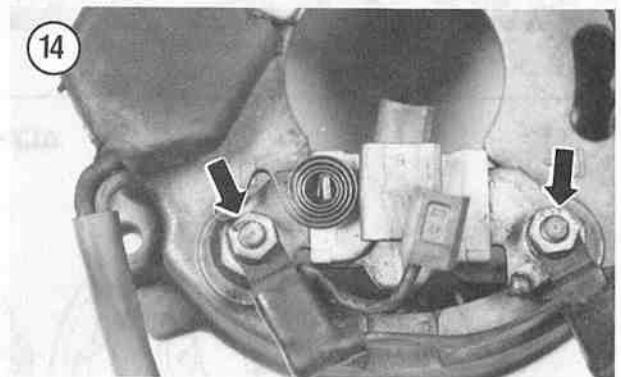
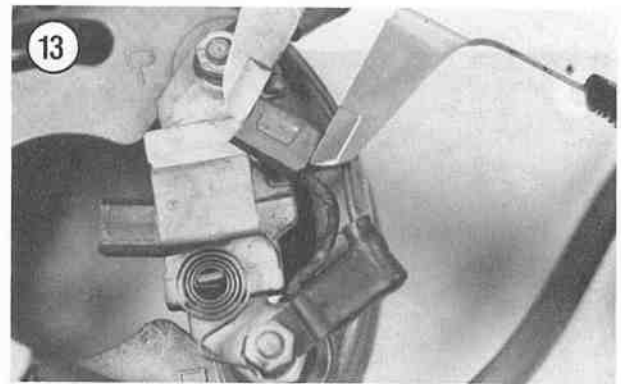
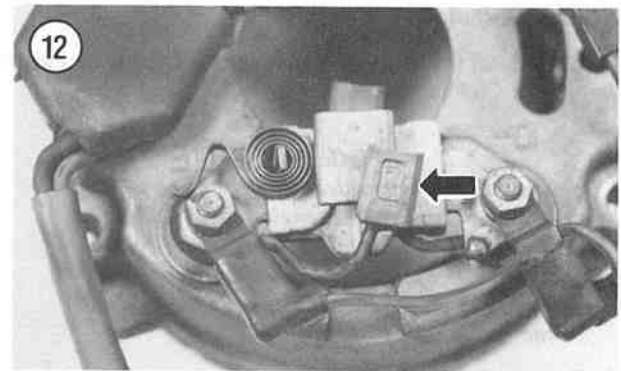
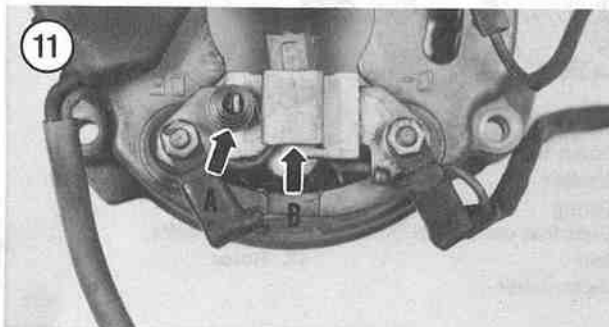
#### NOTE

*The nuts (**Figure 14**) on the outer surface of the brush holder only secure the electrical connector terminal blades in place. Do not remove them.*

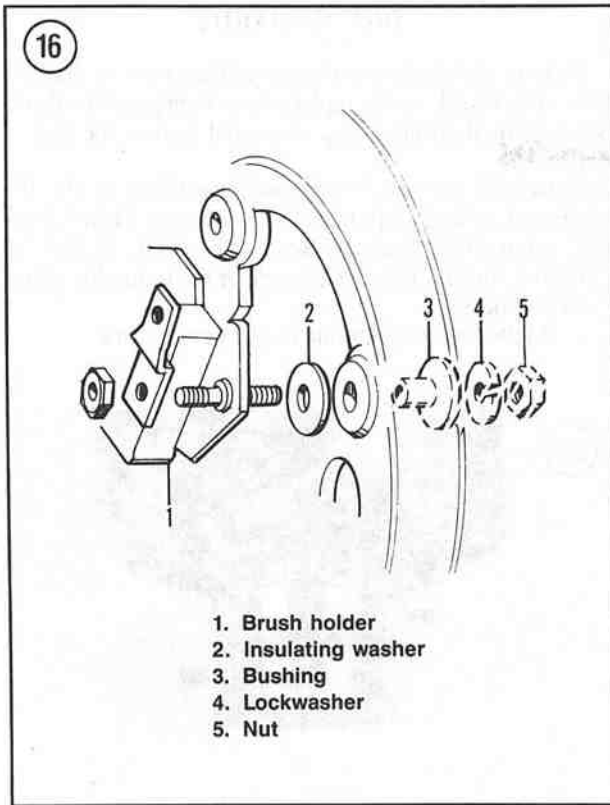
6. On the inner surface of the stator assembly, remove the nuts (**Figure 15**) securing the brush assembly. The left-hand stud is insulated from the alternator stator. Don't lose the insulating and insulation washers (**Figure 16**) on that stud.
7. Remove the brush assembly from the rear of the alternator.
8. Using a soldering gun on the low heat range, unsolder the individual brush from the assembly. Remove the brush and repeat for the other brush. Replace the brushes as a set even if only one may be worn to the service limit.

#### CAUTION

*The individual brushes are soldered in place in the brush assembly. While using the soldering gun, be careful and don't let the solder run down brush pigtails toward the brushes. If this happens, the pigtail will become rigid and hinder brush movement within the brush channel. The new brushes must move freely after they are installed. If they do not move freely, they will not make contact with the slip rings and will render the alternator inoperative.*







9. Install the new brushes as follows:
  - a. Solder the new brush pigtails in place using the low heat range setting.
  - b. Make sure that the solder *does not* run down the brush pigtails during soldering.
  - c. The brushes must move freely in order to maintain contact on the slip rings.
10. Install the brush assembly onto the alternator stator.
11. Install the nuts (**Figure 15**) securing the brush assembly. Be sure to install the insulating and insulation washers (**Figure 16**) on the left-hand stud. Tighten the nuts securely.

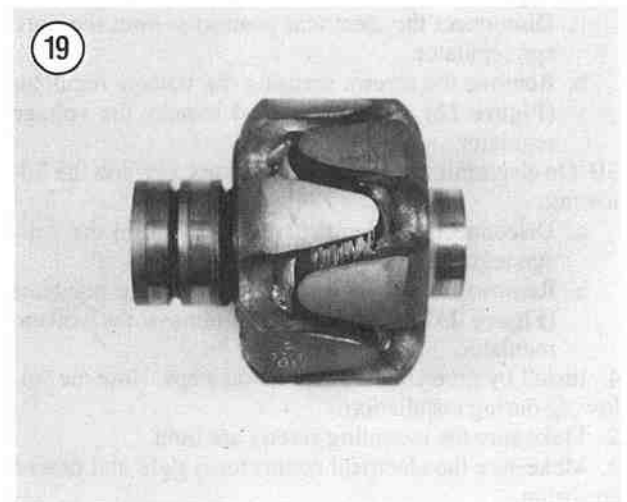
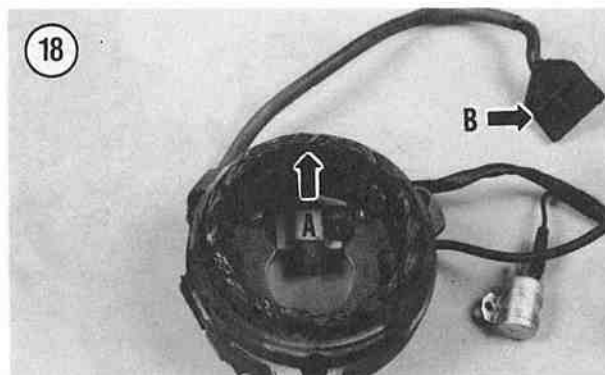
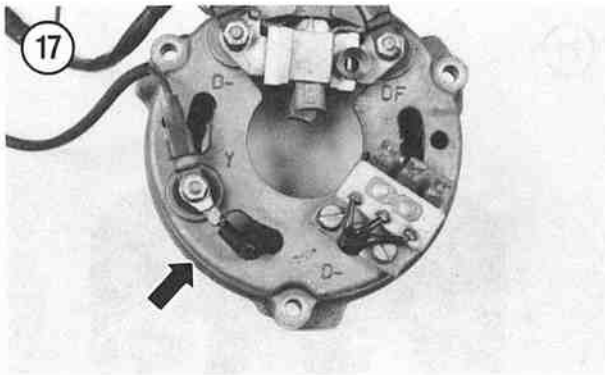
### Inspection

The only possible alternator service is replacing the brushes, checking continuity of the rotor slip rings and checking the resistance of the stator coils.

1. Inspect the housing (**Figure 17**) for cracks or damage. Replace if necessary.
2. Inspect the stator windings (A, **Figure 18**) for wear or damage. Replace the stator assembly if necessary.
3. Inspect the rotor (**Figure 19**) for wear or damage. Replace the rotor assembly if necessary.

### NOTE

*If the slip rings are deeply scored, they can be turned on a lathe. If the rings are going to be turned, do not exceed the minimum outside diameter listed in Table 2.*



4. Inspect the slip rings (**Figure 20**) for wear or corrosion. Clean off with solvent. If corrosion is severe, carefully clean off with 600 wet and dry sandpaper. Then clean with aerosol electrical contact cleaner. Wipe clean with a lint-free cloth.

5. Inspect the bearing surface (**Figure 21**) for wear or corrosion. Clean off with solvent. If corrosion is severe, carefully clean off with 600 wet and dry sandpaper. If worn or damaged, replace the rotor assembly.

#### Rotor Testing

1. Using an ohmmeter, measure the exciter coil resistance across the slip rings (**Figure 20**).
2. Compare the resistance values listed in **Table 2**. If the readings are not within the specifications listed in **Table 2**, replace the rotor assembly.

#### Stator Testing

1. Using an ohmmeter, measure the coil resistance between all 3 sets of coils at the electrical connector (B, **Figure 18**).
2. Compare the resistance values listed in **Table 2**. If the readings are not within the specifications listed in **Table 2**, replace the stator assembly.

### VOLTAGE REGULATOR

#### Replacement

##### NOTE

*A simple test of the regulator can be performed by unplugging it and connecting the blue and black wires together with the engine running. A significant increase in voltage indicates a faulty regulator. Solid-state units must be replaced, however, cleaning the internal contacts may repair electromechanical types.*

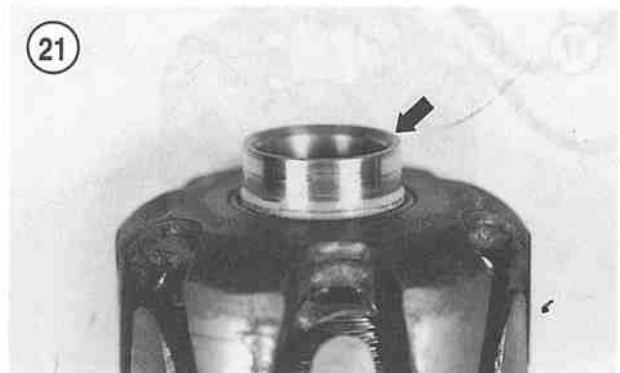
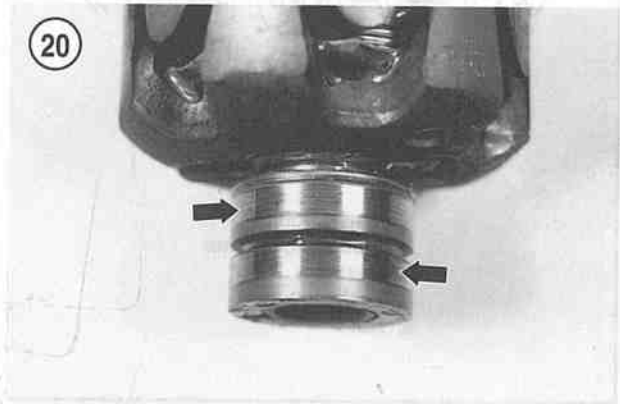
1. Disconnect the battery negative lead as described in Chapter Three.
2. Remove the fuel tank as described in Chapter Seven.
- 3A. On mechanical type voltage regulators, perform the following:
  - a. Disconnect the electrical connector from the voltage regulator.
  - b. Remove the screws securing the voltage regulator (**Figure 22**) to the frame and remove the voltage regulator.
- 3B. On electronic type voltage regulators, perform the following:
  - a. Disconnect the electrical connector from the voltage regulator.
  - b. Remove the screws securing the voltage regulator (**Figure 23**) to the frame and remove the voltage regulator.
4. Install by reversing these removal steps. Note the following during installation.
5. Make sure the mounting screws are tight.
6. Make sure the electrical connector is tight and free of corrosion.

#### DIODE BOARD

Early model diode boards use resilient mounts that fail over time. Check and/or replace them to prevent the diode board from short circuiting to ground against the timing cover.

Some 1981-on models may have a problem with the diode board grounding points due to corrosion (BMW Service Information Bulletin, September 1988, 12 012 88 (2323)). If this problem exists, one of the following situations will occur:

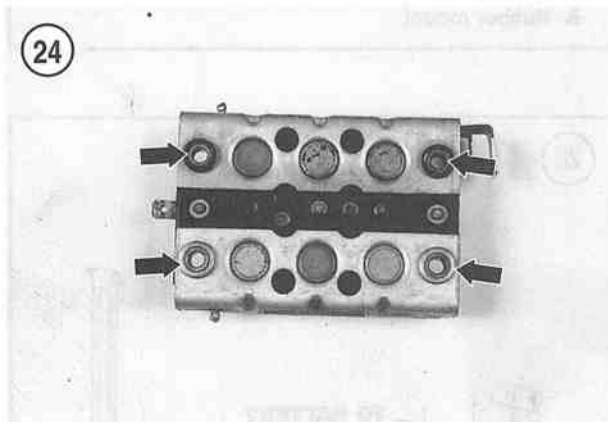
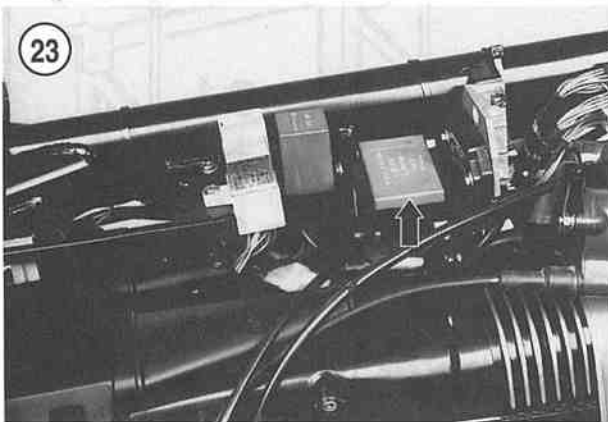
- a. Melted soldered points on the diode board.



- b. A low battery charge rate.
- c. The battery charge warning light glows at half intensity.

Correct the problem as follows.

1. Remove the diode board as described in this chapter.
2. Using a metal scraper, scrape all of the black paint from the diode board mounting posts on the timing chain cover.



3. If the diode board has rubber grommets (Figure 24) at the mounting holes, perform the following:
  - a. Check the ground wire for overheating or corrosion.
  - b. If the existing ground wire is good condition, thoroughly clean each terminal end.
  - c. If the existing ground wire is damaged, replace with a new one. Make sure that the terminal at each end of the wire is soldered in place to make a good electrical contact.
  - d. Make sure there is a good bare metal connection where the ground wire is attached to the timing chain cover. Clean off all corrosion or paint.
4. Remove the bolts securing the timing chain cover, one at a time. Remove and clean each bolt head and threads. Using a metal scraper, scrape all of the black paint from the area of the timing chain cover where each bolt attaches. This will ensure a good ground connection between the timing chain cover and the crankcase.
5. Before installing the diode board, spray the mounting posts or ground wire attachment point on the timing chain with aerosol electrical contact cleaner. Wipe dry with a lint-free cloth. Apply dielectric grease to prevent corrosion.
6. Install the diode board as described in this chapter.

### Replacement

#### CAUTION

The battery negative lead **must** be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating replacement of the entire diode board.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the engine front cover (Figure 7) as described in Chapter Four.
3. Remove the nuts or bolts and washers (Figure 25) securing the diode board to the engine timing chain cover.

#### NOTE

Before disconnecting the electrical connectors, mark each connector and the terminal it was connected to. This will make installation easier.

4. Partially pull the diode board away from the timing chain cover and disconnect the electrical connectors from it.
5. Install by reversing these removal steps. Note the following during installation.
6. Make sure the mounting nuts or bolts are tight.
7. Make sure all electrical connections are tight and free of corrosion.

## BATTERY CASE

Removal/Installation  
(1970-1973 Models)

There is no battery case on these models as the battery sits on the frame member. Refer to **Figure 26** for the battery hold down and related parts.

Removal/Installation  
(All Other Models)

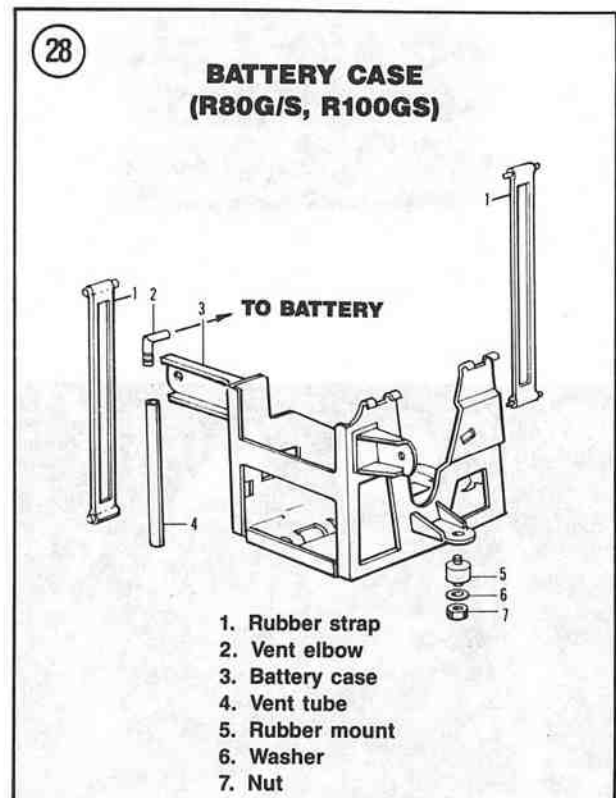
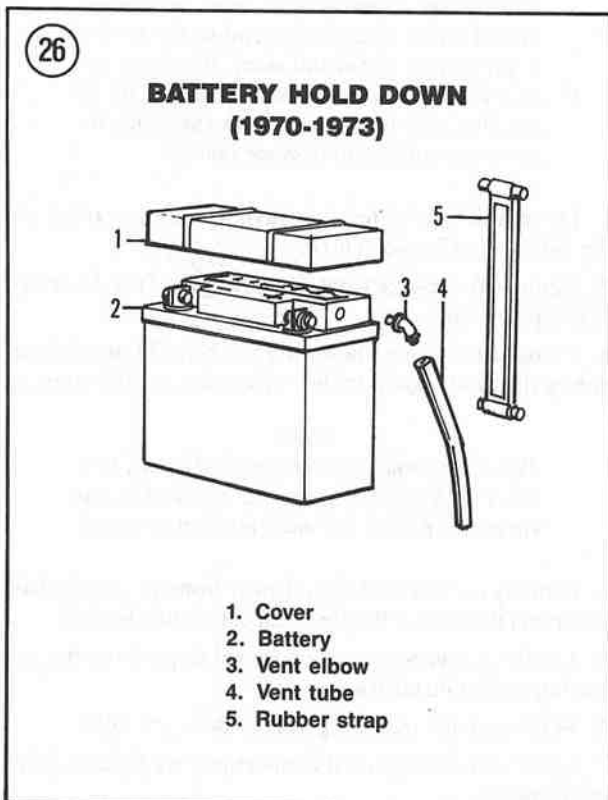
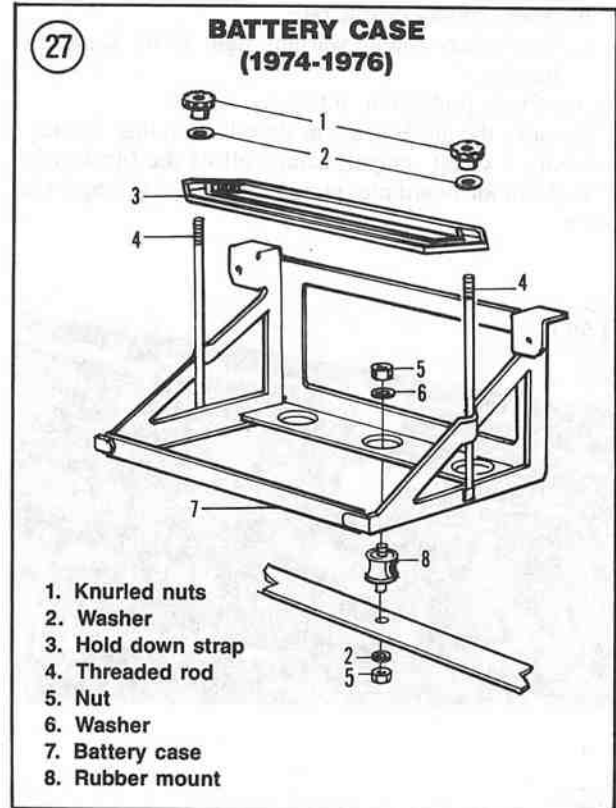
This procedure represents a typical removal and installation of the battery case. Refer to the illustrations for your specific model and year for any additional brackets and fasteners that may require removal.

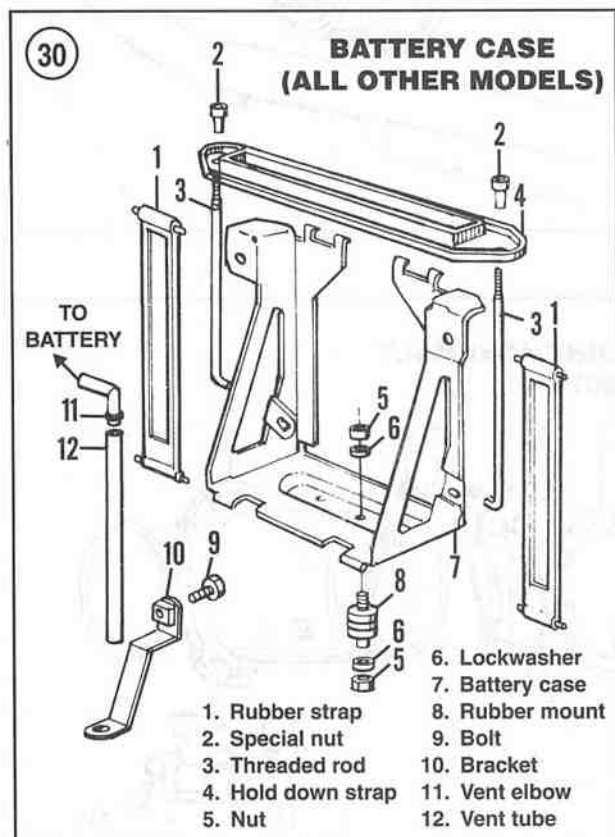
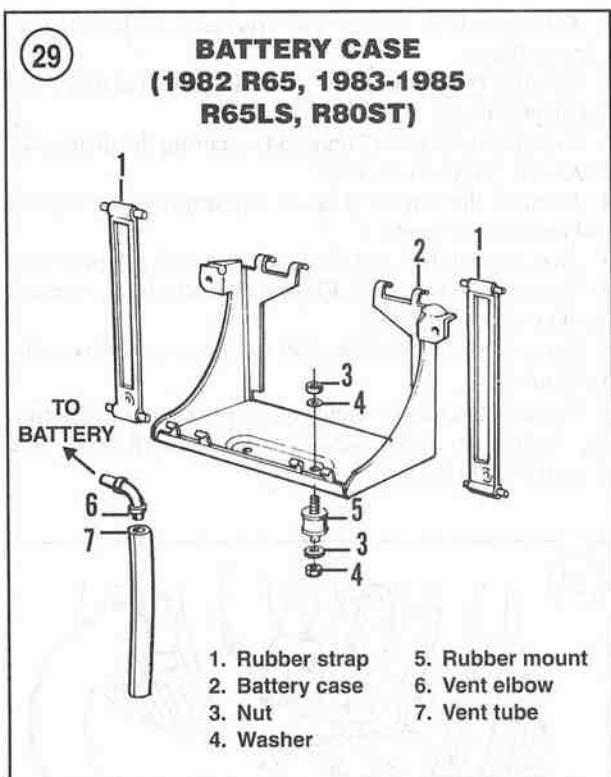
Refer to **Figure 27** through **Figure 30** for this procedure.

1. Remove the battery as described in Chapter Three.

**WARNING**

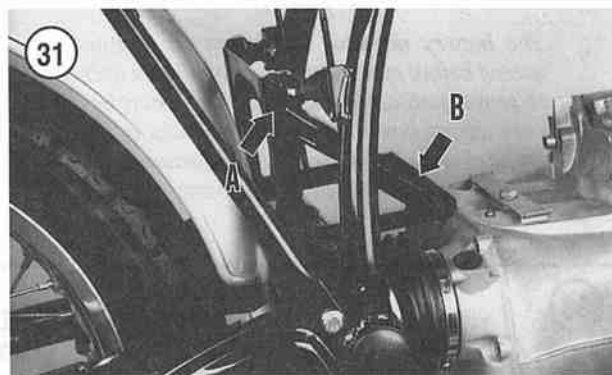
If there is any dry white powder (battery corrosion) on the battery case—**do not** try to blow this powder away with your mouth as it may come back in your face and eyes causing serious injury. Do not touch your face, eyes or mouth if you have any of this powdered corrosion on your hands. Wash your hands thoroughly after handling any battery.



**CAUTION**

Using a paper towel moistened in water, wipe up any dried white powder (battery corrosion) from the battery case before removing the case. Discard this paper towel properly and wash your hands thoroughly in soap and hot water. Be sure to remove all traces of this powdered corrosion from your skin and clothes.

2. Remove the nuts and lockwashers (A, **Figure 31**) on each side securing the back of the battery case to the frame.
3. Remove the nuts and lockwashers securing the base of the battery case to the frame.
4. Remove the battery case (B, **Figure 31**) from the frame.
5. Inspect the frame area directly under the battery case for any signs of corrosion. If there is any, use a paper towel moistened in water to wipe up any dried white powder (battery corrosion) from the frame and surrounding areas. Discard this paper towel properly and wash your hands thoroughly in soap and hot water. Be sure to remove all traces of this powdered corrosion from your skin and clothes.
6. If the battery case has leaked sufficiently to corrode the battery case and/or frame area, refer to Chapter Twelve and clean and repaint the battery case and/or frame area.
7. Inspect the rubber mounts where the battery case mounts to the frame. If any are damaged or starting to deteriorate, replace them.





8. On models so equipped, inspect the rubber straps for wear or deterioration. If any are damaged or starting to deteriorate, replace them.
9. Install by reversing these removal steps. Note the following during installation.
10. Apply a light coat of multipurpose grease to the rubber mount threads to protect them from rust and corrosion.

### CONTACT BREAKER-POINT IGNITION SYSTEM (1970-1980 MODELS)

The ignition system on 1970-1980 models is a contact breaker-point type. The cam on the end of the camshaft opens the contact breaker-point assembly when the pistons reach their firing positions.

Refer to *Tune-up* in Chapter Three for service procedures.

A number of electronic ignition kits are available for retrofit on older models. They provide improved performance and reliability, along with reduced maintenance by eliminating the points and in most cases, depending on the system, the mechanical advance mechanism. The one shown in **Figure 32** is a Boyer Brandson system available from Moto-Bins Ltd. at [www.motobins.co.uk](http://www.motobins.co.uk).

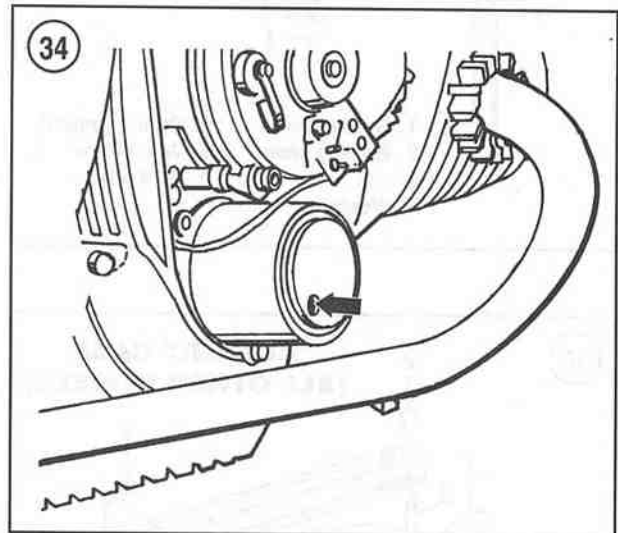
### Distributor Removal/Installation (1979-1980 Models)

Refer to **Figure 33** for this procedure.

#### CAUTION

The battery negative lead **must** be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating replacement of the entire diode board.

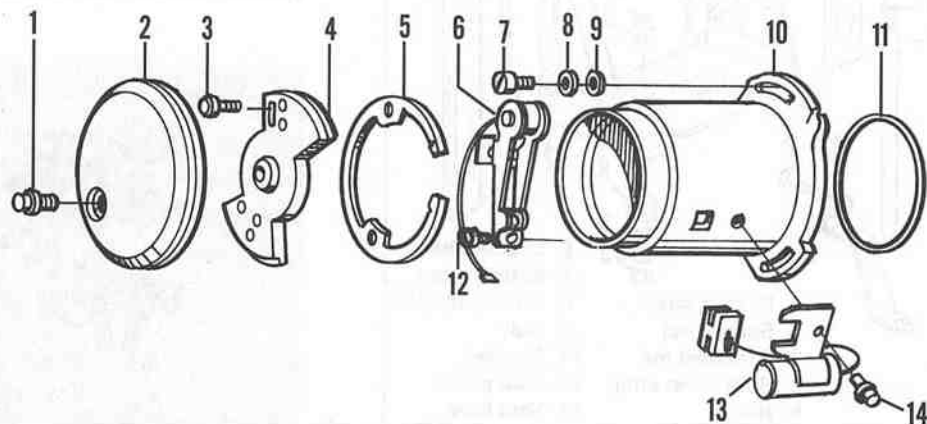
1. Disconnect the battery negative lead as described in Chapter Three.
2. Remove the engine front cover (**Figure 7**) as described in Chapter Four.
3. Remove the screw (**Figure 34**) securing the distributor cover and remove the cover.
4. Remove the screws (**Figure 35**) securing the support and remove the support.
5. Disconnect the electrical connector (A, **Figure 36**).
6. Remove the screw (B, **Figure 36**) securing the contact breaker-point assembly.
7. Remove the contact breaker-point assembly from the distributor.
8. Remove the screws securing the distributor to the timing chain cover and remove the distributor. Remove and discard the O-ring seal.



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### CONTACT BREAKER-POINT ASSEMBLY (1979-1980)

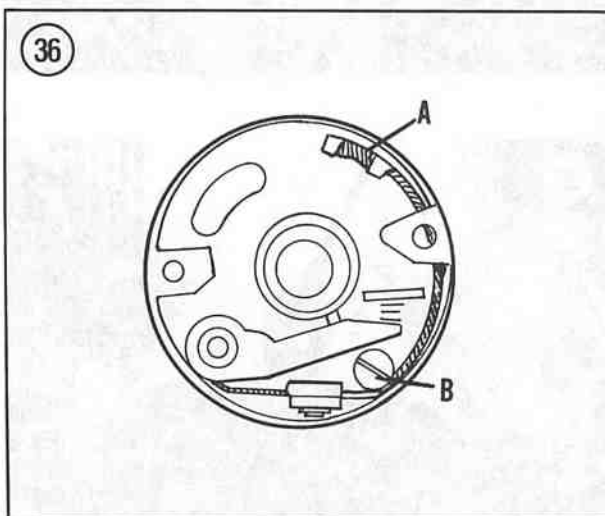
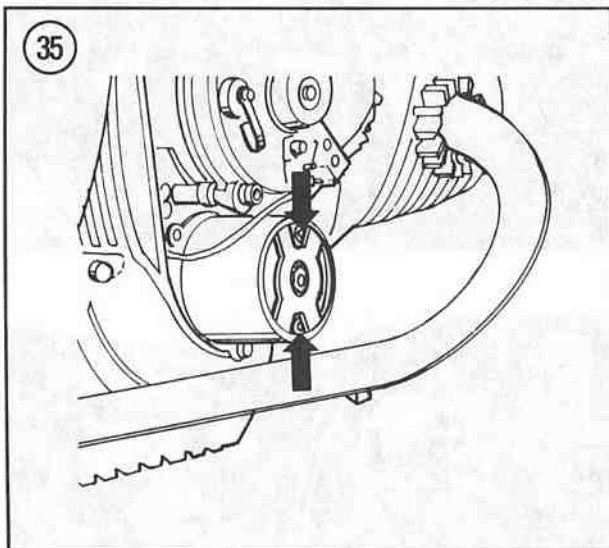
1. Screw
2. Cover
3. Screw
4. Support
5. Ring
6. Breaker-points
7. Screw
8. Washer
9. Lockwasher
10. Distributor housing
11. O-ring
12. Screw
13. Condenser
14. Screw



9. Install by reversing these removal steps. Note the following during installation.
10. Make sure all mounting screws are tight.
11. Make sure all electrical connectors are tight and free of corrosion.
12. Adjust the contact breaker-point gap as described in Chapter Three.

### ELECTRONIC IGNITION SYSTEM (1981-ON MODELS)

All 1981-on models are equipped with a solid-state transistorized ignition system that uses no breaker points. This system provides a longer life for components and delivers a more efficient spark throughout the entire speed range of the engine. Ignition timing is not fixed and can be adjusted as described in Chapter Three.



The ignition system consists of an ignition control unit (computer), an ignition trigger unit (Hall-effect transmitter), an individual ignition coil for each cylinder and 2 spark plugs.

The ignition trigger unit is attached to the front end of the camshaft. The ignition signal is triggered by this trigger unit and is sent to the ignition control unit. The ignition control unit then evaluates this information in addition to engine rpm. There is a steady voltage on the primary side of the ignition coil. The control unit interrupts this steady voltage, triggering the collapse of the the coils.

### Ignition System Precautions

Certain measures must be taken to protect the transistorized ignition system. Instantaneous damage to the semiconductors in the system will occur if the following precautions are not observed.

#### WARNING

*This ignition system produces a very high electrical output that could be **very dangerous** or even **fatal** if any of the components or any uninsulated electrical connections are touched while the engine is running or if the ignition switch is in the ON position. Be very careful even if you are using a pair of insulated pliers—the best advice is **hands off**.*

1. Always keep the battery fully charged and with the correct electrolyte level. Refer to *Battery* in Chapter Three.
2. Never connect the battery backwards. If the connected battery polarity is wrong, ignition system components will be damaged.
3. Do not disconnect the battery when the engine is running (not even briefly). A voltage surge will occur which will damage the ignition components and possibly burn out the lights.
4. Never jump start the engine with an outside source greater than 16 volts.
5. Whenever working on any part of the ignition system, always turn the ignition switch OFF or disconnect the battery negative (-) lead.
6. With the ignition switch ON or with the engine running, *never* disconnect the ignition coil(s) electrical connectors (primary or secondary). Not only will you receive severe (maybe fatal) electrical shocks, but also the ignition coil and ignition control unit will be damaged.
7. Keep all connections between the various units clean and tight. Be sure that the wiring connections are pushed together firmly to help keep out moisture.
8. Use only genuine BMW components whenever replacing any faulty component (e.g. spark plugs, spark plug wires, ignition coils, etc.). These components are matched to the ignition control unit. If another type or brand is used the system may not function properly and may also damage the ignition control unit.

9. If ignition component is mounted within a rubber vibration isolator, always be sure that the isolator is in place when installing these units in the system.
10. Make sure all ground wires are properly attached and are free of oil and corrosion.
11. Do not try to modify or change any of the components within the ignition system. All components of the original ignition system are designed to work with each other.
12. Do not shorten the length of the spark plug secondary cables.

### Troubleshooting

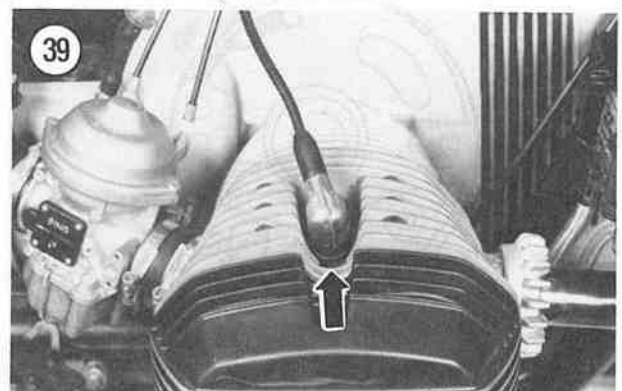
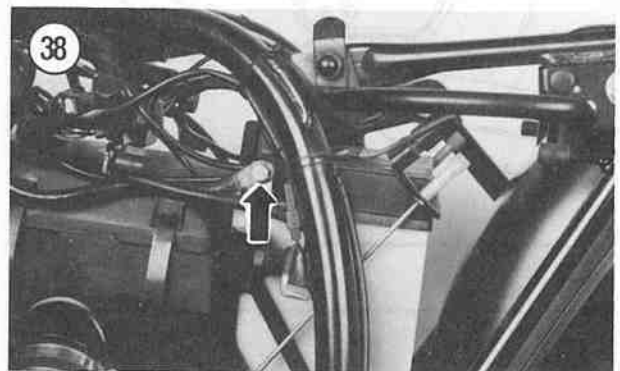
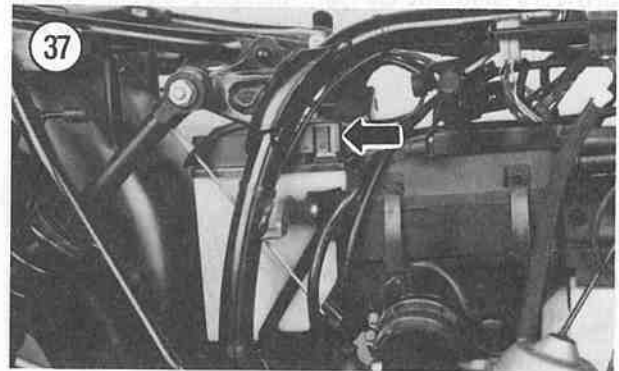
This troubleshooting procedure covers the entire ignition system and all of its components. During the procedure, if you find a problem with a particular component, replace it at that time. Chances are that it may be the only problem and if so, there is no need to continue with the rest of the procedure.

1. Before starting to troubleshoot the ignition system, perform the following:
  - a. Make sure the battery is fully charged and with the correct electrolyte level. Refer to *Battery* in Chapter Three.
  - b. Make sure that the battery electrical cables are securely attached. Refer to **Figure 37** and **Figure 38**. Also make sure that the battery terminals are not corroded.
  - c. Make sure that both spark plugs are in good condition and that the gap is properly set. Replace the spark plugs if they are questionable.
  - d. Make sure that both spark plug secondary wires are in good condition and that they are securely attached to each spark plug (**Figure 39**).
  - e. Make sure that all ignition system electrical wires and connections are tight and free of corrosion and/or oil. Check for bare wires or worn-through insulation. Make sure that each wire is securely attached to its specific component in the system.
2. Remove the fuel tank as described in Chapter Seven.
3. Check for battery voltage at each ignition coil as follows:
  - a. Turn the ignition switch ON.
  - b. Connect a voltmeter between the ignition coil terminal No. 15 and a good ground. There should be battery voltage (approximately 12 volts). Repeat for the other ignition coil.
  - c. If the voltage is less than specified, check for a broken wire or loose connection.
4. If there is battery voltage (12 volts), check the voltage drop as follows:
  - a. Turn the ignition switch OFF.
  - b. Disconnect the electrical wire from the ignition coil terminal No. 1.

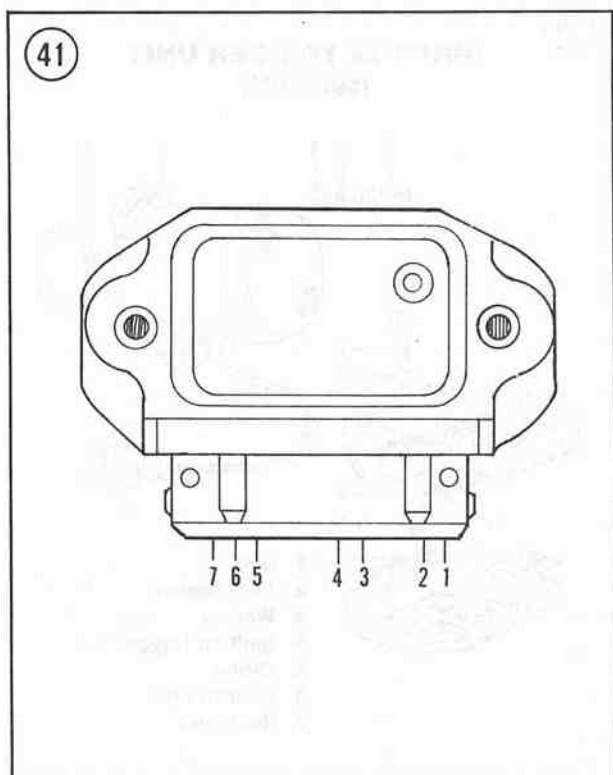
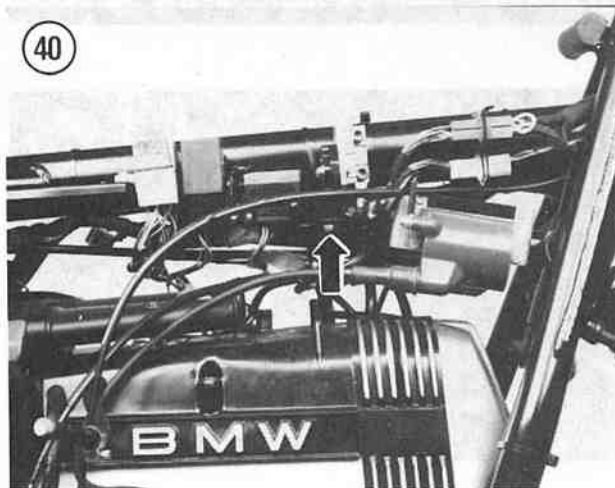
### CAUTION

*In the following step, do not attach the jumper wire any longer than 1 minute. If attached any longer, the ignition coil will overheat and be damaged.*

- c. Connect a jumper wire from the ignition coil terminal wire No. 1 to ground.
- d. Connect a voltmeter between the ignition coil terminal No. 15 and the battery positive (+) terminal.
- e. Turn the ignition switch ON.
- f. The voltage reading should be within 1.5 volts of the reading taken in Step 3.



- g. Disconnect the jumper wire from the ignition coil terminal wire No. 1 and ground.
- h. Reconnect the electrical wire onto the ignition coil terminal No. 1.
- i. If the voltage varies by more than 1.5 volts, check the electrical connections between the battery, ignition switch and engine kill switch. Also make sure the ignition switch and kill switch are working properly.
- j. Repeat for the other ignition coil.



5. Check the battery voltage to the ignition control unit as follows:

- a. Carefully pull the rubber boot (**Figure 40**) back off of the ignition control unit electrical connector. Do *not* disconnect the electrical connector while pulling the rubber boot back. Push on the electrical connector after the boot is pulled back to make sure it is still properly connected.
- b. Turn the ignition switch ON.
- c. Refer to **Figure 41** and connect a voltmeter between the ignition control unit terminals No. 2 and No. 4.
- d. There should be battery voltage (approximately 12 volts).
- e. If the voltage is less than specified, check for a broken wire or loose connection between the ignition switch and the ignition control unit.
- f. Carefully push the rubber boot (**Figure 40**) back onto the ignition control unit electrical connector.

**NOTE**

*Perform Step 6 only if the correct battery voltage is reaching the ignition control unit. If the battery voltage to the ignition control unit is not correct, performing Step 6 will be useless.*

6. Check the battery voltage to the ignition trigger unit as follows:

- a. Turn the ignition switch OFF.
  - b. Carefully pull the rubber boot (**Figure 40**) back off of the ignition control unit electrical connector. Do *not* disconnect the electrical connector while pulling the rubber boot back. Push on the electrical connector after the boot is pulled back to make sure it is still properly connected.
  - c. Refer to **Figure 41** and connect a voltmeter between the ignition control unit terminals No. 3 and No. 5.
  - d. There should be at least 5 volts.
  - e. If the voltage is less than specified, proceed to Step 7.
7. Carefully disconnect the 7-pin electrical connector from the ignition control unit and perform the following:
- a. Pull the No. 5 terminal wire out of the 7-pin electrical connector (**Figure 41**).
  - b. Reconnect the 7-pin electrical connector onto the ignition control unit.
  - c. Set an ammeter to the milliamp range. Connect the ammeter between the disconnected No. 5 wire and the No. 4 terminal on the ignition control unit.
  - d. Turn the ignition ON.
  - e. If the reading is between 3-20 milliamps, replace the ignition control unit.
  - f. If the reading is less than 3 milliamps or greater than 20 milliamps, replace the ignition trigger unit.
  - g. Disconnect the 7-pin electrical connector from the ignition control unit.
  - h. Reconnect the No. 5 wire into the terminal in the 7-pin electrical connector.



- i. Reconnect the 7-pin electrical connector onto the ignition control unit.
8. To inspect the ignition trigger unit, perform the following:
  - a. Disconnect the battery negative lead as described under *Battery* in Chapter Three.

**CAUTION**

*The battery negative lead must be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating replacement of the entire diode board.*

- b. Remove the engine front cover (Figure 7) as described in Chapter Four.
- c. Reconnect the battery negative lead.
- d. Remove both spark plugs as described under *Spark Plug Removal/Inspection* in Chapter Three.
- e. Reconnect the spark plug cap to each spark plug. Rest the spark plug on the cylinder head and make sure spark plug metal body is making good contact with the cylinder head or cylinder (Figure 42). Position the spark plugs so that you can see the electrode gap. The spark plug must ground out against the cylinder head for this test to be correct.

**WARNING**

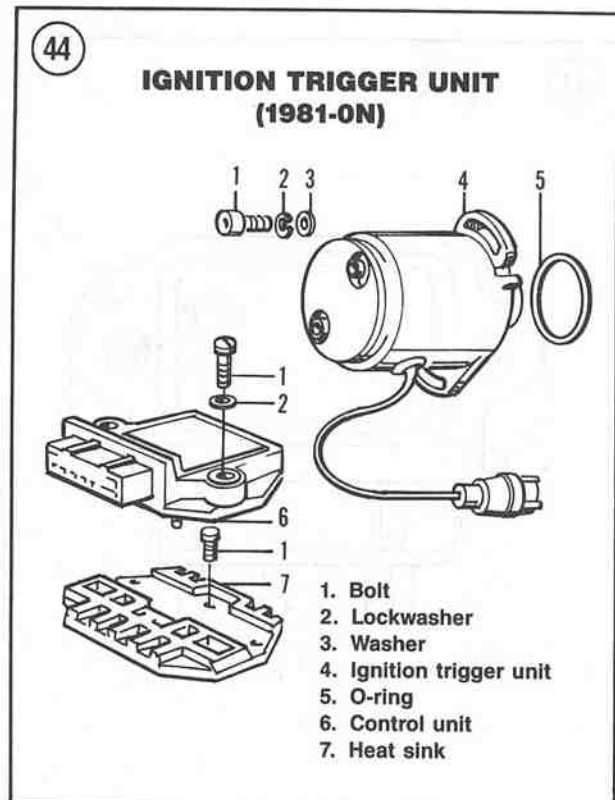
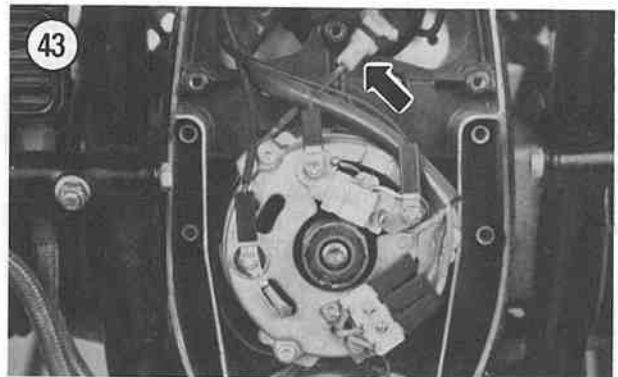
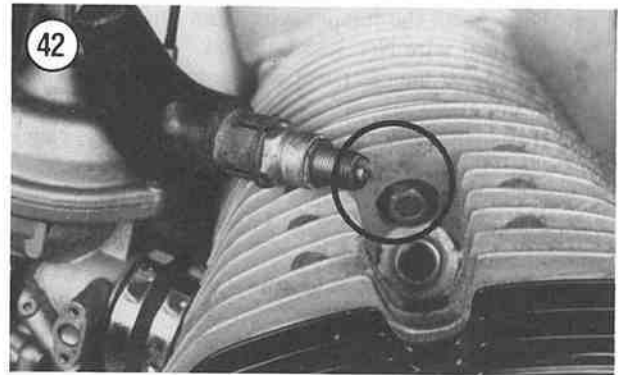
*If it is necessary to hold the high voltage lead, do so with an insulated pair of pliers. The high voltage generated could produce serious or fatal shocks.*

- f. Disconnect the electrical connector (Figure 43) from the ignition trigger unit.
- g. Insert an insulated jumper wire into the center pin of the wiring harness side of the electrical connector.
- h. Turn the ignition switch ON.

**NOTE**

*This portion of the test is bypassing the ignition trigger unit to eliminate it from the circuit.*

- i. Briefly touch the other end of the jumper wire to ground several times. Each time the jumper wire is grounded, the spark plugs should fire.
  - j. If the spark plugs fire as indicated, the ignition coils and the ignition control unit are performing correctly.
  - k. If the spark plugs do not fire, either the ignition trigger unit, ignition coil(s) or ignition control unit may be faulty. Continue to the next steps.
9. Inspect the contacts in the ignition trigger unit electrical connector for oil contamination or corrosion. Clean all contact points if necessary. Repeat Step 8. If there is still no spark, the ignition trigger unit is faulty and must be replaced.





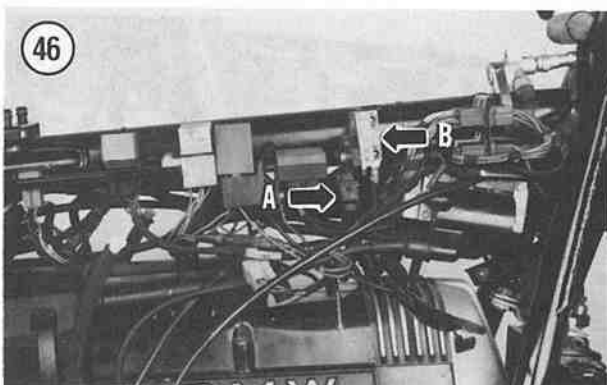
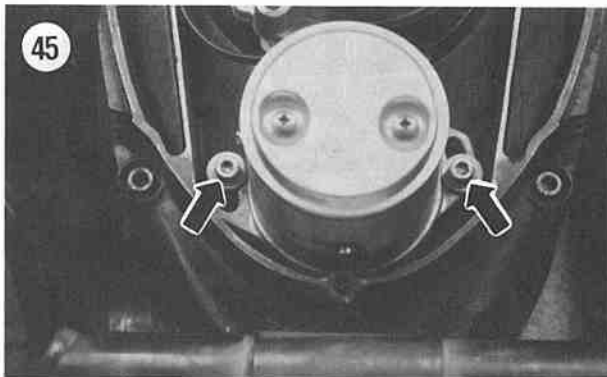
10. Inspect the ignition coil resistance as described in this chapter. Replace the ignition coil(s) if necessary.
11. Inspect the spark plug secondary wires and connectors for damage. Replace if necessary.
12. If the ignition coils and spark plug secondary wires are in good working order, the fault must be with the ignition control unit as all other ignition components have been tested and found to be in good working condition. Replace the ignition control unit. There are no tests for the ignition control unit.
13. Install all parts removed. Note the following during installation.
14. Make sure the electrical connector is tight and free of corrosion.

### Ignition Trigger Unit Replacement

Refer to **Figure 44** for this procedure.

#### CAUTION

*The battery negative lead must be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating replacement of the entire diode board.*



1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the engine front cover as described in Chapter Four.
3. Disconnect the ignition trigger unit electrical connector (**Figure 43**).
4. Remove the screws (**Figure 45**) securing the ignition trigger unit to the timing chain cover.
5. Pull the ignition trigger unit away from the timing chain cover.
6. Remove the ignition trigger unit.
7. Install by reversing these steps. Note the following during installation.
8. Make sure the electrical connector is tight and free of corrosion.

### IGNITION CONTROL UNIT

#### Testing

BMW does not provide any test procedures for the ignition control unit. If you feel that this component is faulty, remove it and take it to a BMW dealer and have it checked out.

#### Replacement

1. Remove the fuel tank as described in Chapter Seven.
2. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
3. Carefully pull back the rubber boot (**Figure 40**).
4. Disconnect the electrical connector from the ignition control unit.

#### CAUTION

*The ignition control unit and heat sink are fragile and must be handled carefully during removal and installation. Always use a wrench on the nut while removing and installing the mounting bolts. Never overtighten the mounting bolts as the assemblies may fracture.*

5. Remove the bolts, washers and nuts securing the ignition control unit (A, **Figure 46**) to the heat sink.
6. Carefully pull the ignition control unit toward the rear and remove it from the heat sink.
7. Inspect the heat sink (B, **Figure 46**) on the frame for damage or deterioration. Replace if necessary.
8. Inspect the exterior of the ignition control unit on the frame for damage or deterioration. Replace if necessary.
9. Inspect the contacts of the electrical connector on the ignition control unit for damage or corrosion. Clean off the contacts with an aerosol electrical contact cleaner. Replace if necessary.
10. Install by reversing these removal steps. Note the following during installation.

#### CAUTION

*Do not attach the ignition control unit to the heat sink without first applying the heat*

transfer compound. This is an expensive component and if the compound is not used, the ignition control unit will overheat and will fail prematurely.

11. Apply an even coat of heat transfer and anti-corrosion compound to the heat sink before installing the ignition control unit onto it. Use GE Silicone Compound No. Z5, Dow Corning Heat Sink Compound No. 340, or equivalent.
12. Do not overtighten the mounting bolts as the ignition control unit will be damaged.
13. Make sure the electrical connector is tight and free of corrosion and that the rubber boot is securely in place.

### IGNITION COILS

The ignition coil is a form of transformer which develops the high voltage required to jump the spark plug gap. The only maintenance required is that of keeping the electrical connections clean and tight and occasionally checking to see that the coils are mounted securely.

Depending on year and model, there is either a dual coil system with a coil for each cylinder or a single coil that serves both cylinders.

#### Dynamic Test

Disconnect the high voltage lead from one of the spark plugs. Remove the spark plug from the cylinder head. Connect a new or known good spark plug to the high voltage lead and place the spark plug base on a good ground like the engine cylinder head. Position the spark plug so you can see the electrodes (Figure 42).

#### WARNING

*If it is necessary to hold the high voltage lead, do so with an insulated pair of pliers. The high voltage generated could produce serious or fatal shocks.*

Use the kickstarter or push the starter button to turn the engine over a couple of times. If a fat blue spark occurs, the coil is in good condition; if not, it must be replaced. Make sure that you are using a known good spark plug for this test. If the spark plug used is defective, the test results will be incorrect.

Reinstall the spark plug in the cylinder head and reconnect the spark plug lead.

#### Testing

#### NOTE

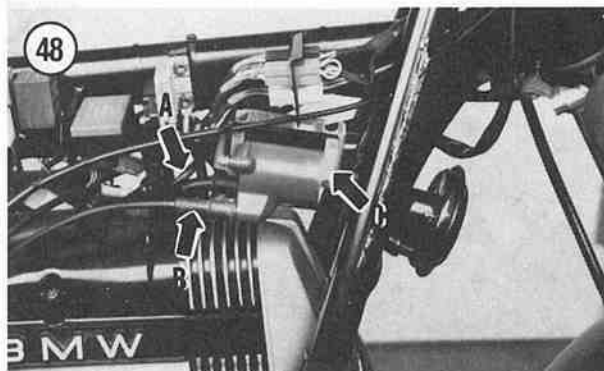
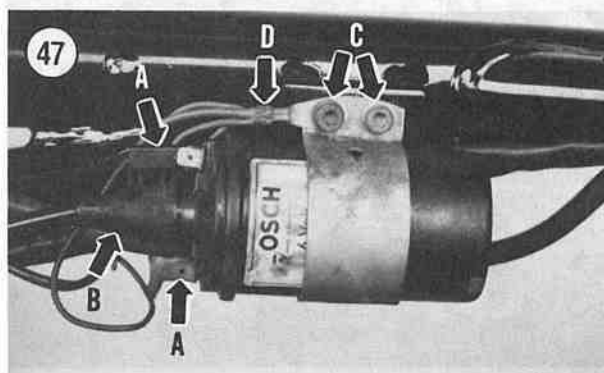
*In order to get accurate resistance measurement, the coil must be warm (minimum temperature is 20° C/68° F). If necessary, start the engine and let it warm up to normal operating temperature. If the engine will not run, warm the coil(s) with a hair dryer.*

1. Disconnect the electrical wire connectors from the primary spade terminals (No. 1 and No. 15) on the ignition coil.
2. Use an ohmmeter set at  $R \times 1$  and measure the primary coil resistance between the primary terminals No. 1 and No. 15. Refer to the resistance values listed in **Table 2**.
3. Disconnect the high tension leads (spark plug wires) from the ignition coil(s).
- 4A. On models equipped with a coil for each spark plug, use an ohmmeter set at  $R \times 1,000$  ( $R \times K$ ) and measure the secondary coil resistance between the primary terminal No. 15 and the high tension terminal. Refer to the resistance values listed in **Table 2**.
- 4B. On models equipped with a dual coil for the spark plugs, use an ohmmeter set at  $R \times 1,000$  ( $R \times K$ ) and measure the secondary coil resistance between both high tension terminals. Refer to the resistance values listed in **Table 2**.

#### NOTE

*If the coil test readings are marginal, before replacing the coil, have the coil(s) tested by a BMW dealer using a spark gap tester. This test is a better indication of the coil's performance.*

5. If the coil(s) resistance does not meet either of these specifications, the coil(s) must be replaced. If the coil exhibits visible damage, it should be replaced.



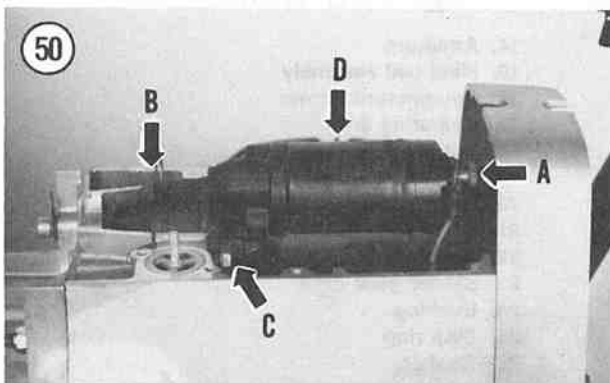
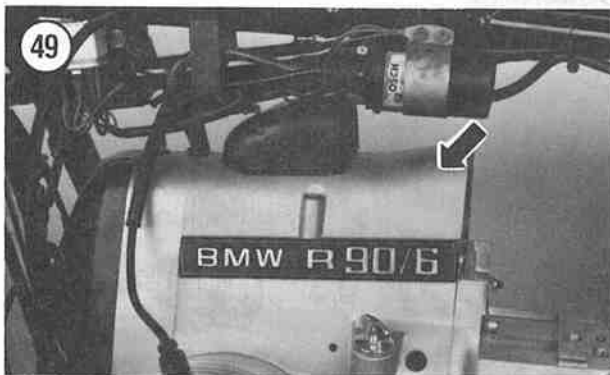
**Removal/Installation**

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
- 2A. On dual coil models, perform the following:
  - a. Disconnect the electrical wire connectors from the primary spade terminals (No. 1 and No. 15) (A, **Figure 47**) on the ignition coil.
  - b. Disconnect the high tension lead (spark plug wire) (B, **Figure 47**) from the ignition coil.
  - c. Repeat for the other coil if necessary.
- 2B. On single coil models, perform the following:
  - a. Disconnect the electrical wire connectors from the primary spade terminals (No. 1 and No. 15) (A, **Figure 48**) on each side of the ignition coil.
  - b. Disconnect both high tension leads (spark plug wires) (B, **Figure 48**) from the ignition coil.

**NOTE**

*Before removing the mounting bolts, note the location of the electrical ground connectors. They must be reinstalled in the same location.*

3. Remove the bolts and washers securing the ignition coil to the mounting boss on the frame. Refer to C, **Figure 47**, and C, **Figure 48**.
4. Install by reversing these removal steps. Note the following during installation.



5. Make sure that the mounting surfaces of each ignition coil(s) and the mounting boss on the frame are clean and free of oil. There must be a good metal-to-metal contact at all contact points.
6. On dual coil models, be sure to attach the ground wires (D, **Figure 47**) under the rear mounting bolt.
7. Make sure all electrical connections are tight and free of corrosion. Be sure to attach the ground connectors to the correct mounting bolts as noted during removal.

**STARTING SYSTEM**

The starting system consists of the starter motor, starter solenoid, starter relay and the starter button.

When the starter button is pressed, it allows current flow from the battery, through the starter relay to the starter motor. The starter solenoid moves the starter gear into mesh with the engine flywheel ring gear and turns the engine over.

**CAUTION**

*Do not operate the starter for more than 5 seconds at a time. Let it rest approximately 10 seconds, then use it again.*

**Table 3**, at the end of the chapter, lists possible starter problems, probable causes and most common remedies.

**STARTER**

There are 2 different starters used among the various models and years. The Bosch unit was installed on all early models through 1983. The 1984-on models are equipped with a French built Valeo unit. If an early Bosch unit is faulty, replace it with the newer and better Valeo unit as the 2 units are interchangeable.

Removal and installation is the same for both starters but disassembly is different and is covered under separate procedures.

**Removal/Installation**

1. Disconnect the battery ground cable as described under *Battery* in Chapter Three.
2. Remove the fuel tank as described in Chapter Seven.
3. Remove the diode board as described in this chapter.
- 4A. On 1970-1979 models, remove the air filter case as described in Chapter Three.
- 4B. On all other models, perform the following:
  - a. Remove the air filter element as described in Chapter Three.
  - b. Remove the screws securing the starter cover (**Figure 49**) and remove the cover.
5. Disconnect the electric starter cables (A, **Figure 50**) from the starter.
6. Remove the bolts securing the wire retainer (B, **Figure 50**) at the rear and remove the retainer.

**CAUTION**

The battery negative lead **must** be disconnected before removing the engine front cover to prevent an accidental short. If a short occurs during cover removal, the diodes in the rectifier may be damaged, necessitating replacement of the entire diode board.

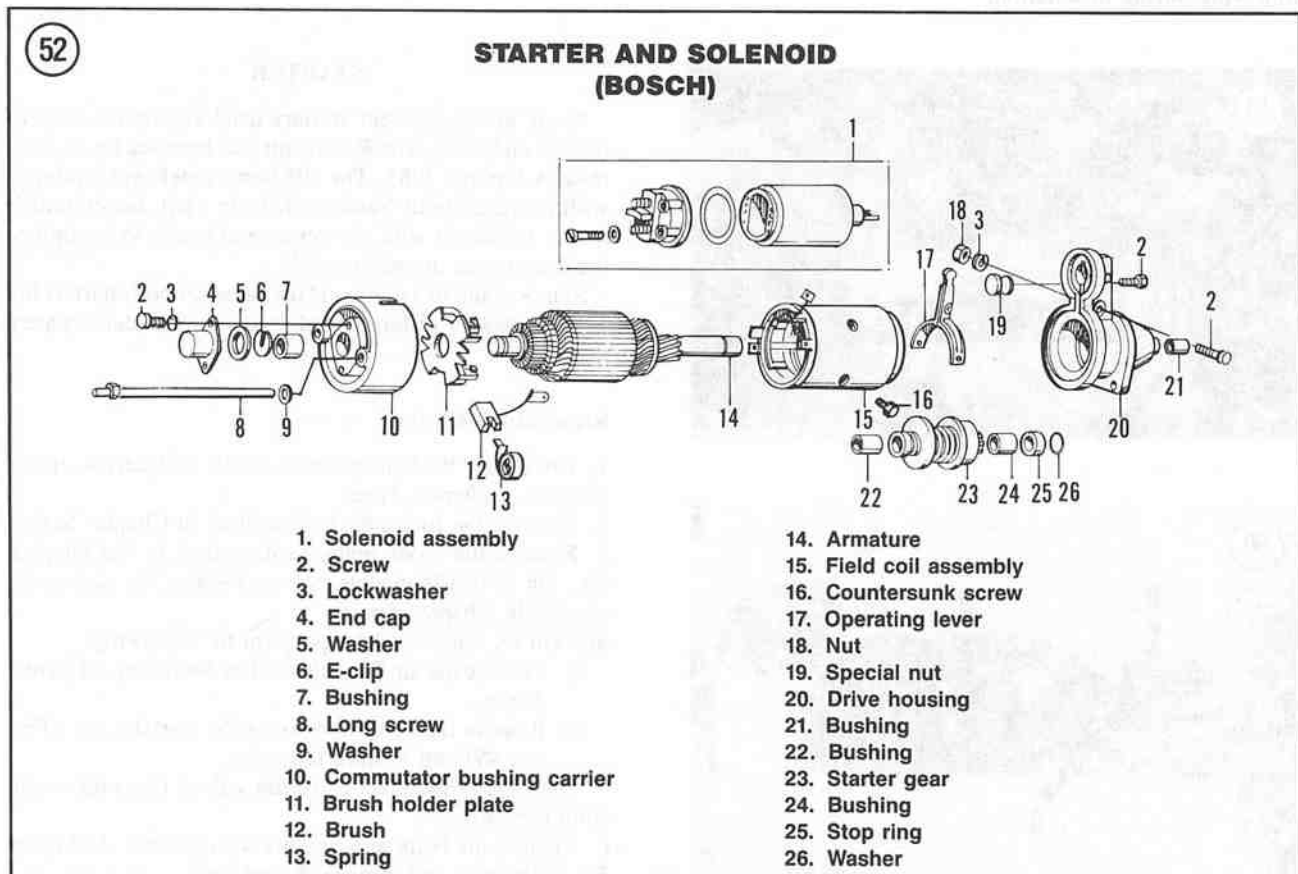
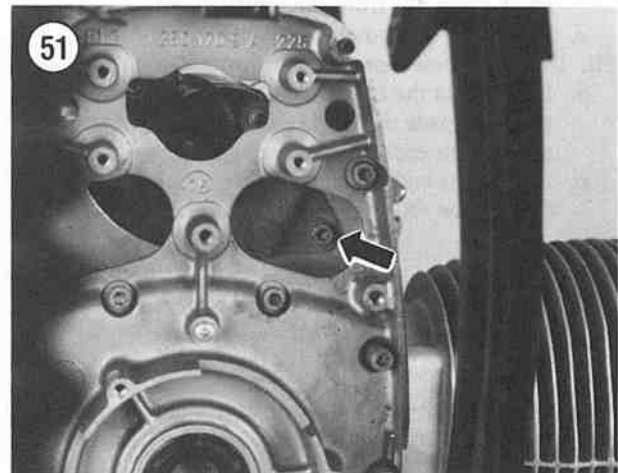
7. Remove the engine front cover as described in Chapter Four.
8. Remove the rear mounting bolt (C, **Figure 50**) on each side securing the starter to the engine crankcase.
9. Remove the front mounting bolt (**Figure 51**) securing the starter to the timing chain cover.
10. Carefully withdraw the starter (D, **Figure 50**) toward the rear and out of the top of the crankcase.
11. Install by reversing these removal steps. Note the following during installation.
12. Make sure the electrical wire connections are tight and free of corrosion.

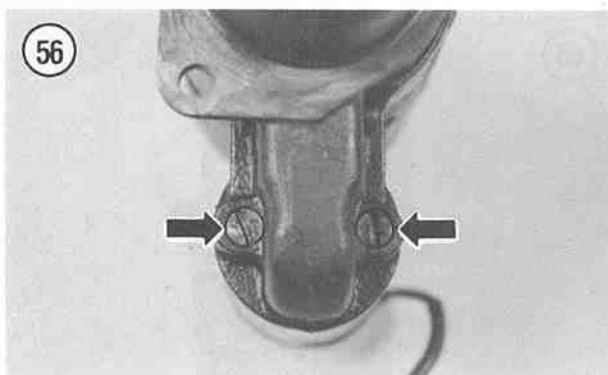
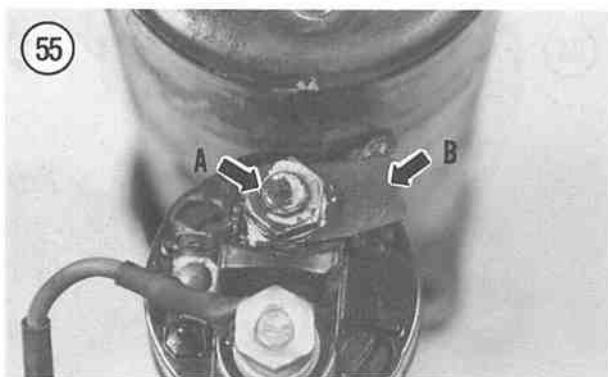
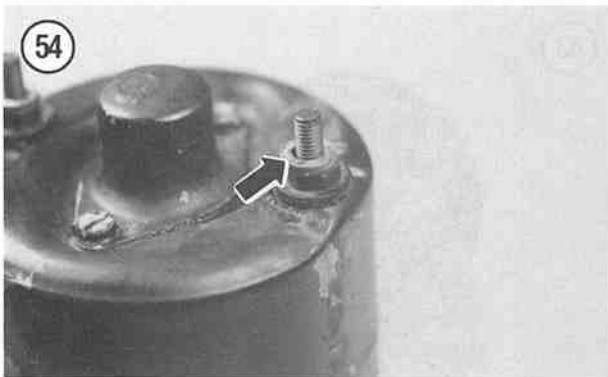
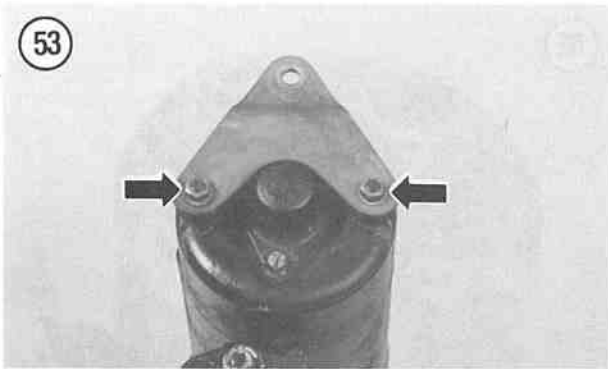
### Disassembly/Assembly (Bosch Starter)

The overhaul of a starter motor is best left to an expert. This procedure shows how to detect a defective starter.

Refer to **Figure 52** for this procedure.

1. Remove the nuts and washers (**Figure 53**) securing the mounting bracket and remove the bracket.
2. Remove the washer (**Figure 54**) on each long screw.
3. Remove the nut and washer (A, **Figure 55**) securing the electrical connector (B, **Figure 55**) to the solenoid. Disconnect the electrical connector from the solenoid.



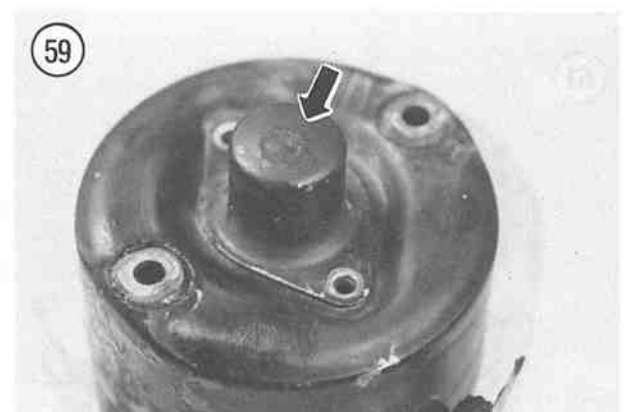
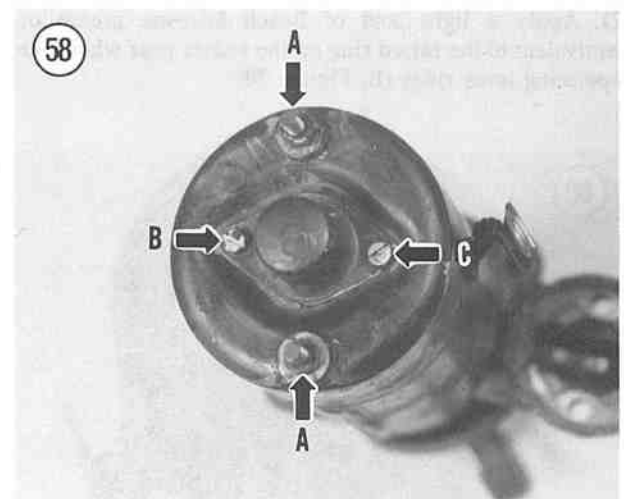
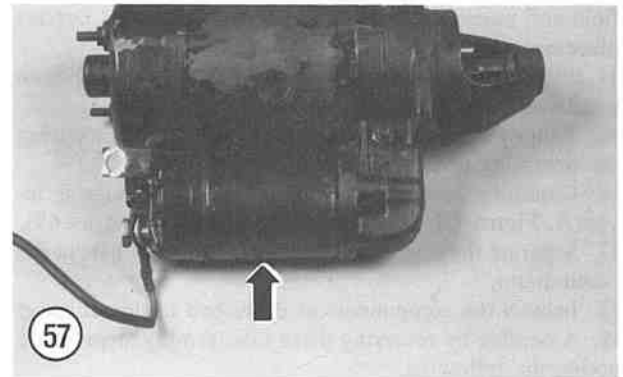


4. Remove the bolts (Figure 56) securing the solenoid to the drive housing.

5. Remove the solenoid (Figure 57) from the drive housing.

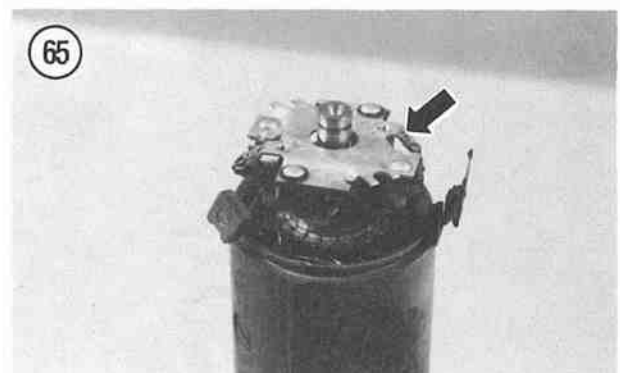
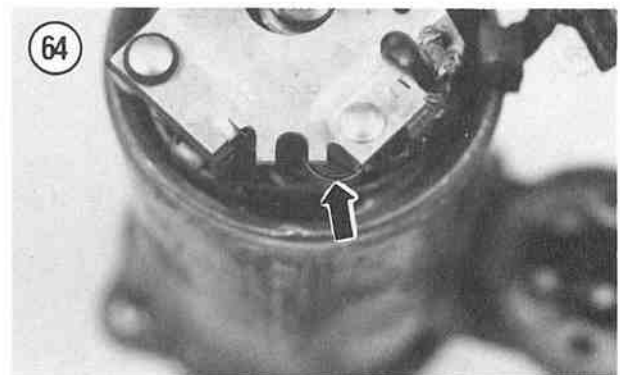
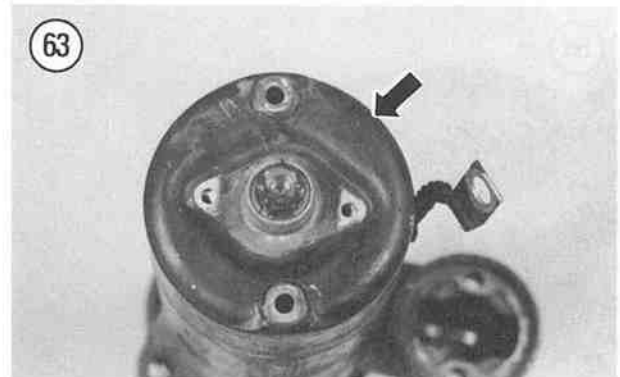
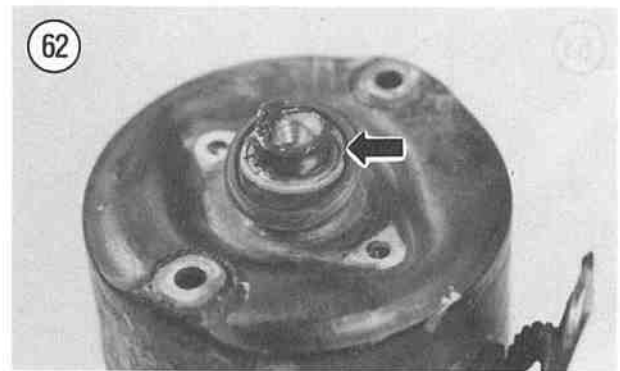
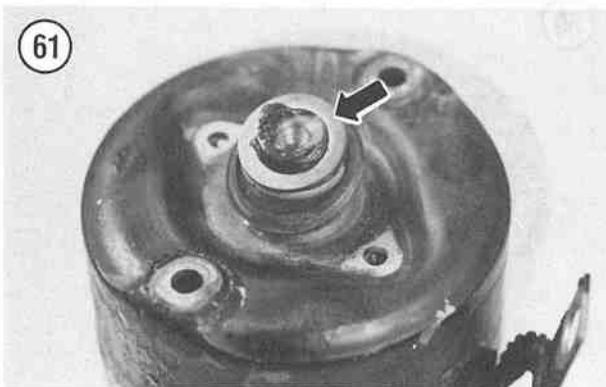
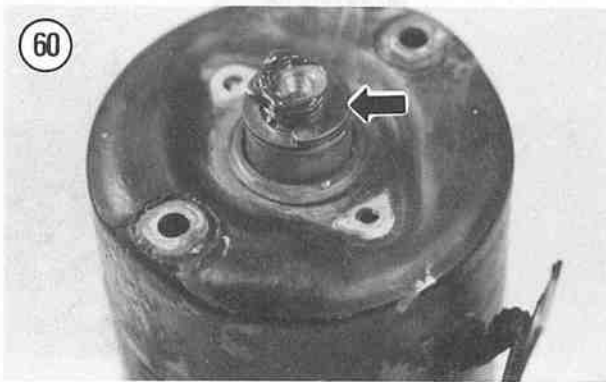
6. Unscrew the long screws (A, Figure 58) securing the commutator bearing carrier to the field coil assembly.

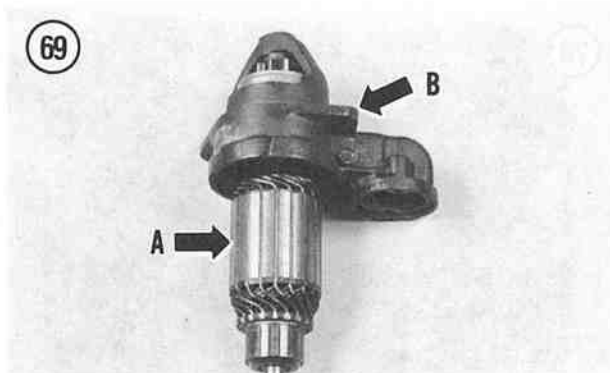
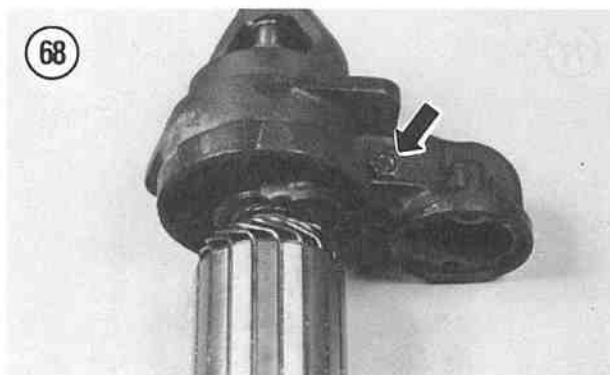
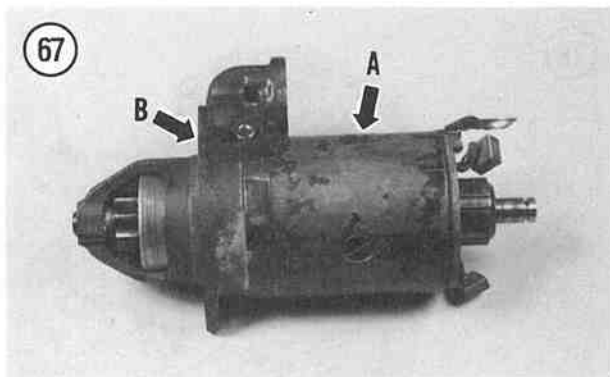
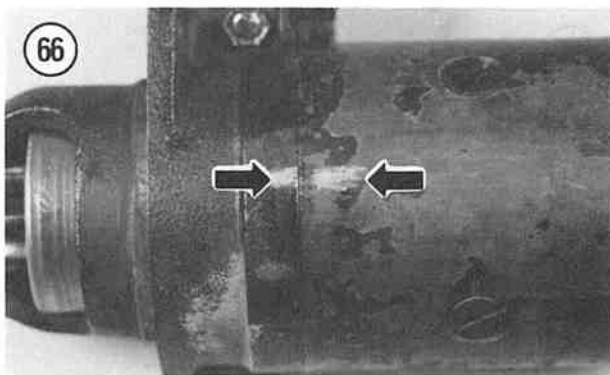
7. Remove the screws and lockwasher (B, Figure 58) securing the end cap and remove the end cap (Figure 59).





8. Remove the E-clip (Figure 60), outer washer (Figure 61) and inner washer (Figure 62).
9. Remove the commutator bearing carrier (Figure 63).
10. Unhook the spring (Figure 64) on each brush and pull each brush out of its receptacles.
11. Remove the brush holder plate (Figure 65).
12. On models so equipped, slide off the insulated washer and regular washer(s) from the end of the commutator.
13. Make alignment marks on the drive housing and the field coil assembly (Figure 66). This will assure correct placement during assembly.
14. Separate the field coil assembly (A, Figure 67) from the drive housing (B, Figure 67).
15. Remove the bolt, nut and washer (Figure 68) securing the operating lever to the drive housing.
16. Carefully withdraw the commutator and operating lever (A, Figure 69) from the drive housing (B, Figure 69).
17. Separate the operating lever (A, Figure 70) from the commutator.
18. Inspect the components as described in this chapter.
19. Assemble by reversing these disassembly steps while noting the following.
20. Make sure the spring is correctly seated in the backside of each brush as shown in Figure 71.
21. Apply a light coat of Bosch Silicone grease or equivalent to the raised ring on the starter where the operating lever rides (B, Figure 70).

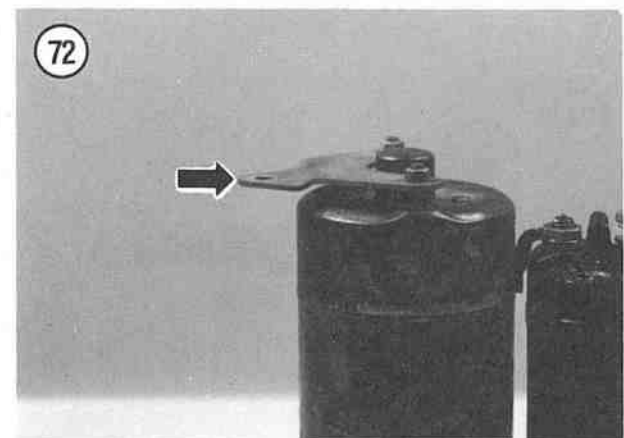
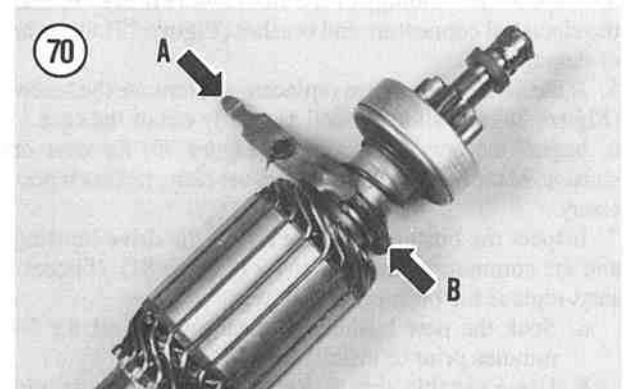




22. Position the mounting bracket onto the starter as shown in **Figure 72**. Install the washers and nuts (**Figure 53**) and tighten securely.

#### Inspection (Bosch Starter)

1. Clean all grease, dirt and carbon from all components.
2. Inspect the engagement hook (**Figure 73**) where the operating lever attaches to the solenoid. Check for cracks or fractures. Replace the solenoid if necessary.



3. Inspect the engagement dogs (**Figure 74**) of the operating lever for wear or damage. Replace the operating lever if necessary. If the damage is severe, also check the raised ring (**Figure 75**) on the starter gear for wear or damage.

**CAUTION**

*Do not immerse the wire windings in the case or the armature coil in solvent as the insulation may be damaged. Wipe the windings with a cloth lightly moistened with solvent and thoroughly dry.*

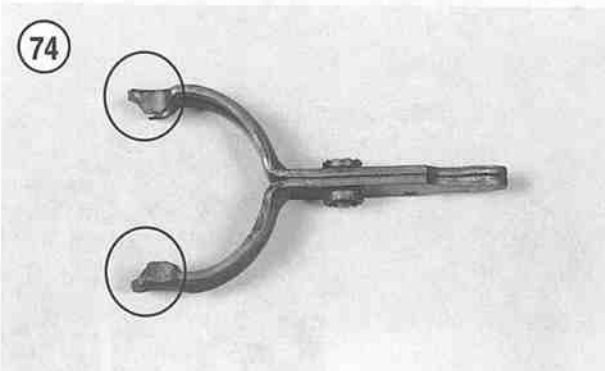
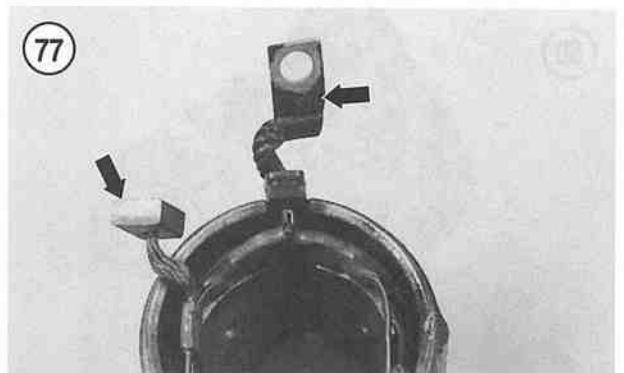
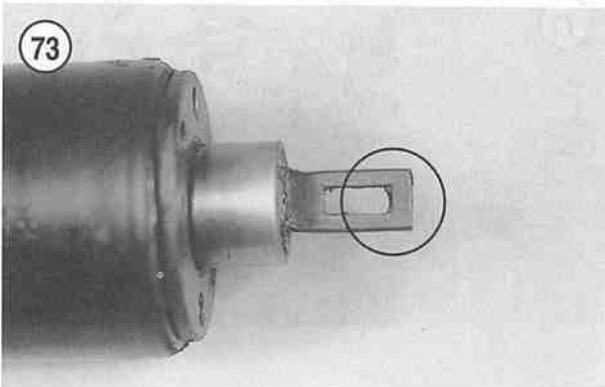
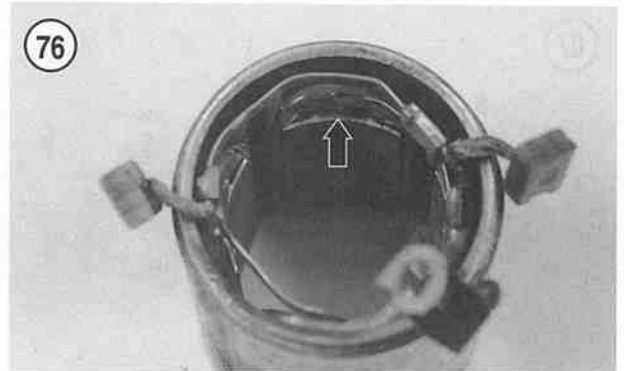
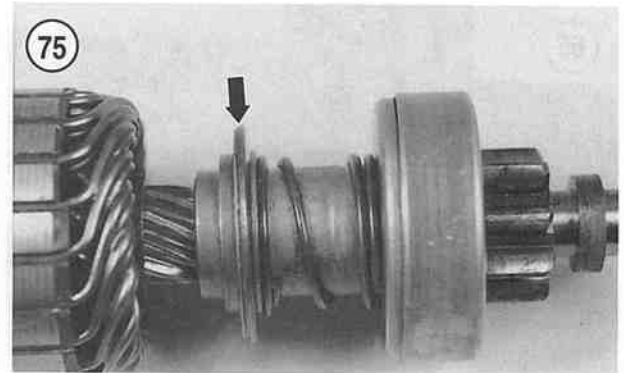
4. Inspect the windings of the field coil (**Figure 76**) and the electrical connectors and brushes (**Figure 77**) for wear or damage.

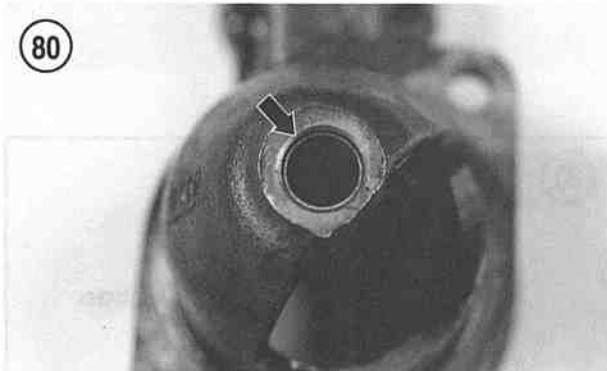
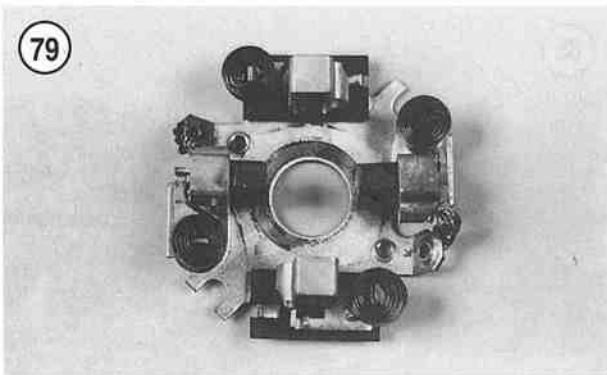
5. If the field coil requires replacement, remove the screw (**Figure 78**) and slide the coil assembly out of the case.

6. Inspect the brush holder plate (**Figure 79**) for wear or damage. Make sure the brush springs are okay; replace if necessary.

7. Inspect the bushing (**Figure 80**) in the drive housing and the commutator bearing cover (**Figure 81**). If necessary, replace the bushing as follows:

- a. Soak the new bushing in clean engine oil for 30 minutes prior to installation.
- b. Use a suitable size socket and hydraulic press and press out the old bushing.





- c. Use a suitable size socket and hydraulic press and press the new bushing in until it is flush with the outer surface of the drive housing or commutator bearing cover.
8. Inspect the drive housing (**Figure 82**) for cracks or damage. Replace if necessary.
9. Inspect the gear (**Figure 83**) on the starter gear assembly. Check for chipped or missing teeth. If damaged, replace the starter gear assembly.
10. Neither BMW nor Bosch provides a wear limit length specification for the brushes. A good rule of thumb is that the brushes should be replaced when worn to 6 mm (0.24 in.) in length. Measure the length of each brush with a vernier caliper. Replace the brushes if necessary.
11. Replace the brushes as follows:
  - a. Using a soldering gun on the low heat range, unsolder the individual brush from the assembly. Remove the brush and repeat for the remaining brushes. Replace the brushes as a set even if only one may be worn to the service limit.

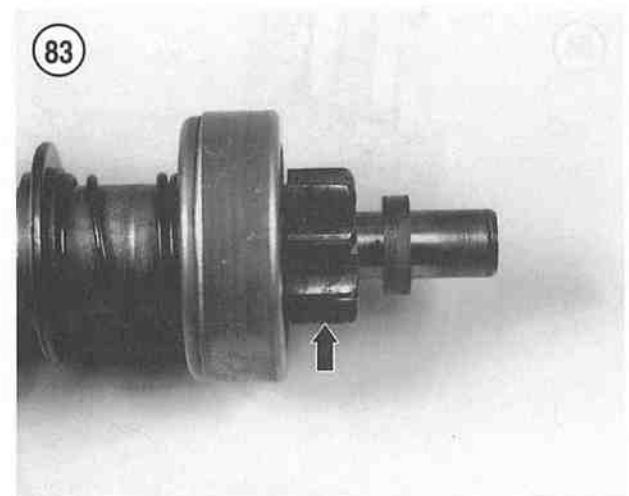
**CAUTION**

*The new brushes must move freely after they are installed. If they do not move freely, they will not make contact with the armature and will make the starter inoperative.*

- b. Solder the new brush pigtails in place using the low heat range setting.
- c. Make sure that the solder does not run down the brush leads during soldering.
- d. The brushes must move freely in order to maintain contact on the commutator.

**CAUTION**

*If the commutator must be serviced, first measure the outside diameter with a*



*micrometer or vernier caliper as shown in Figure 84. The minimum outside diameter is 33 mm (1.29 in.). Do not service a commutator if the finished OD will be down to this minimum dimension or less.*

12. Inspect the commutator (Figure 85). The mica in a good commutator is below the surface of the copper bars as shown in Figure 86. On a worn commutator, the mica and copper bars may be worn to the same level (Figure 86). If necessary, have the commutator serviced by a dealer or electrical repair shop.

13. Inspect the commutator copper bars for discoloration. If a pair of bars are discolored, grounded armature coils are indicated.

14. Use an ohmmeter and perform the following:

- a. Check for continuity between the commutator bars (Figure 87); there should be continuity (indicated resistance) between pairs of bars.
- b. Check for continuity between the commutator bars and the shaft (Figure 88); there should be *no* continuity (infinite resistance).
- c. If the unit fails either of these tests, replace the armature.

#### Disassembly/Assembly (Valeo Starter Motor)

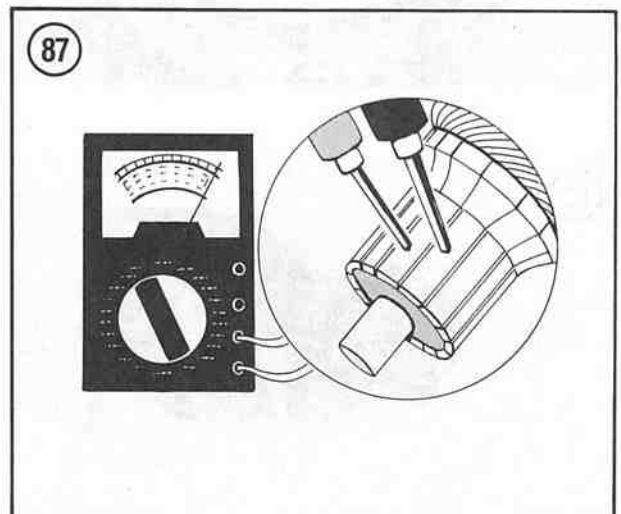
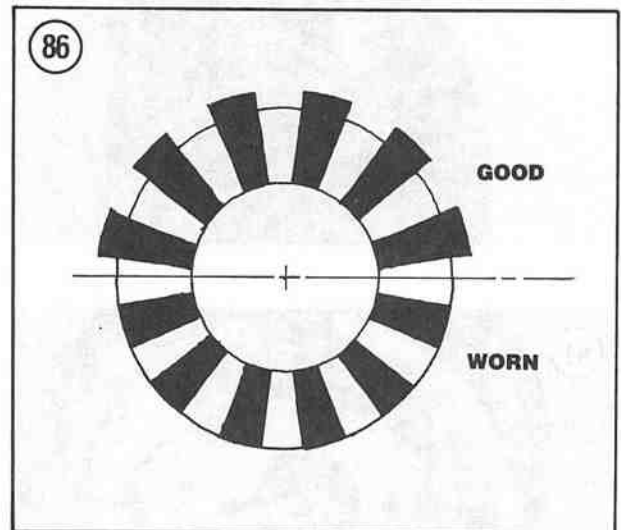
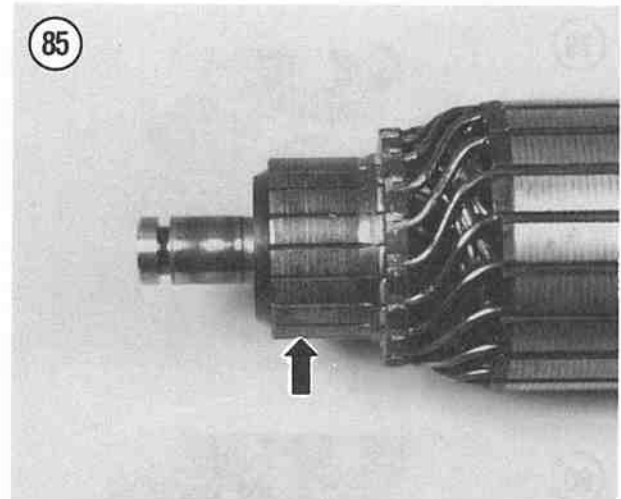
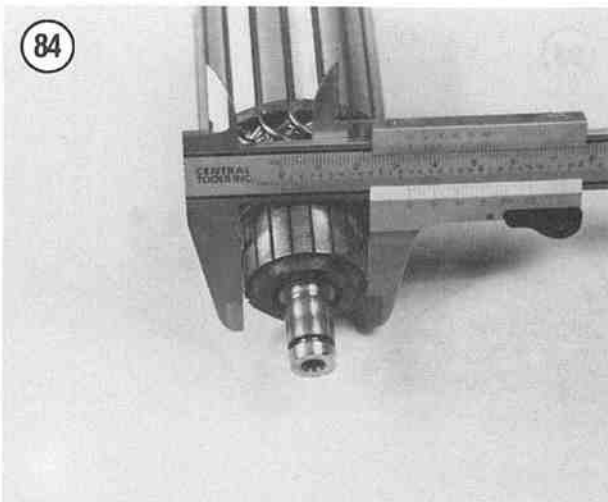
The overhaul of a starter motor is best left to an expert. This procedure shows how to detect a defective starter.

Refer to Figure 89 for this procedure.

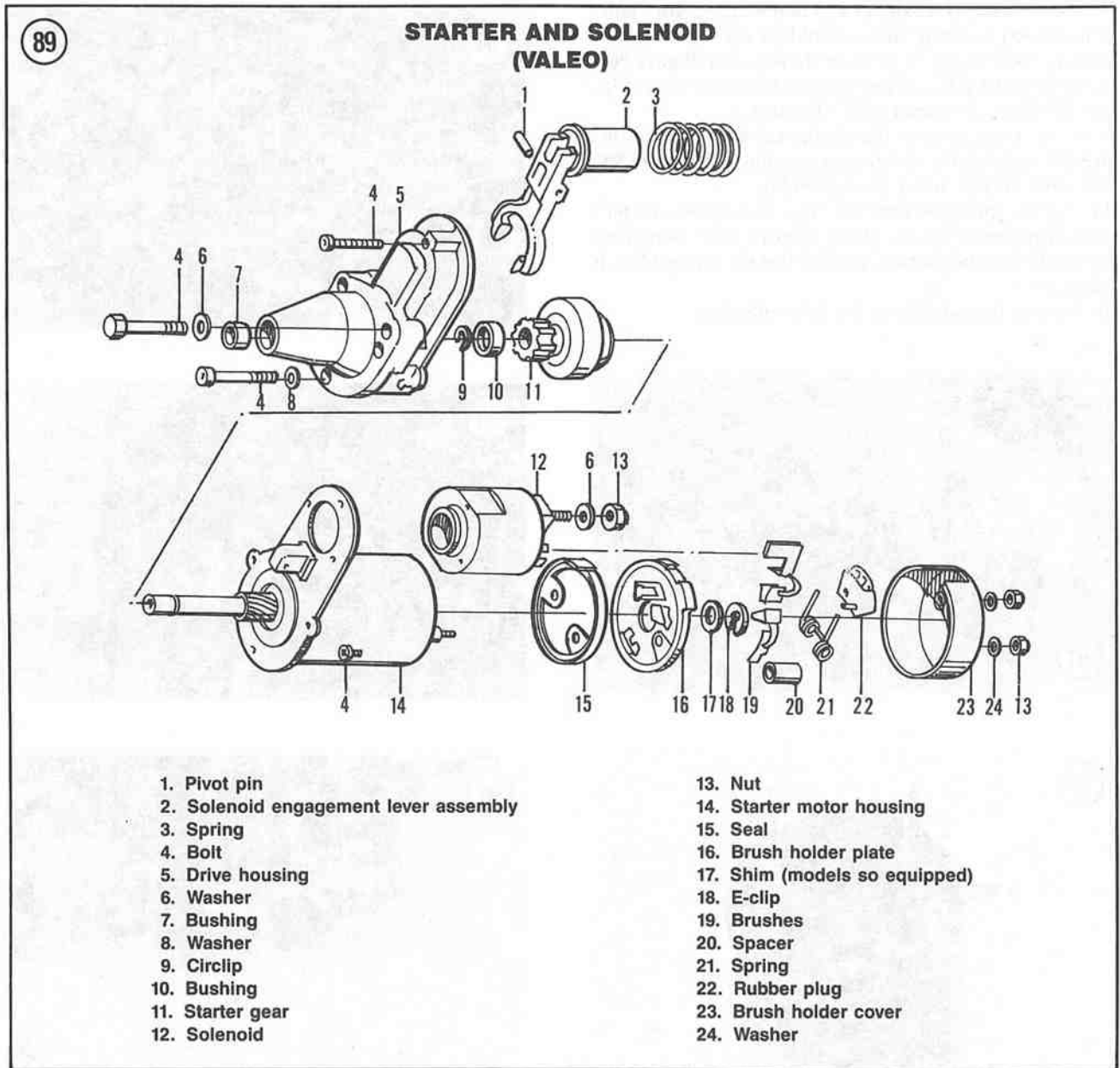
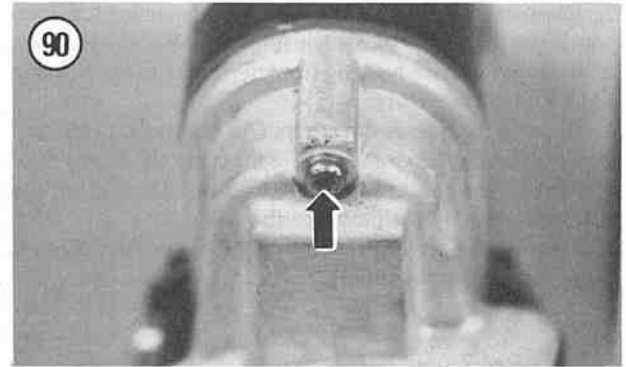
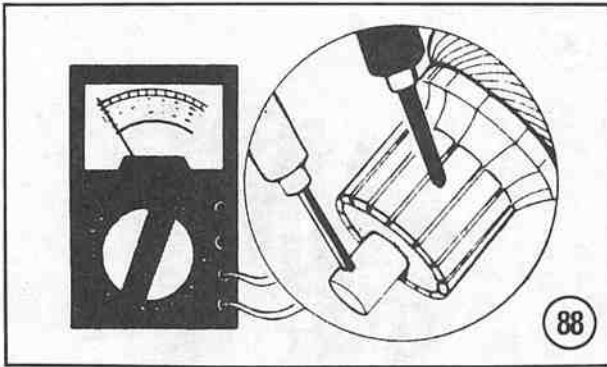
1. Use an A20X Torx driver and remove the Torx bolt (Figure 90) securing the drive housing to the starter motor housing and solenoid assembly.

#### NOTE

*In Step 2, only 2 of the bolts are visible. Remove all 3 bolts.*





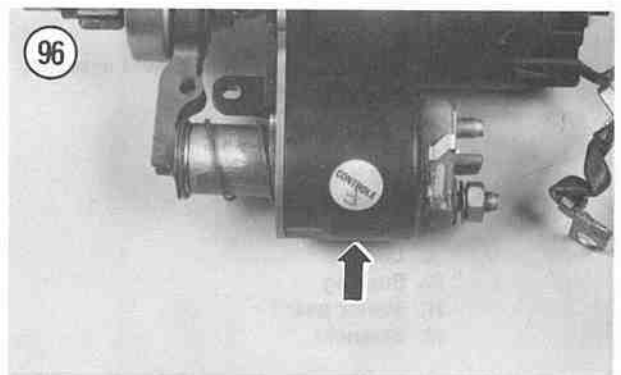
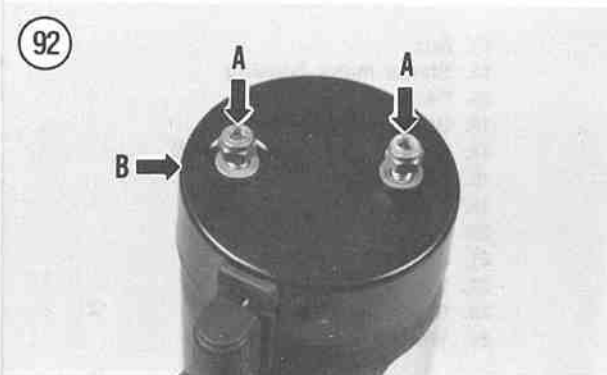
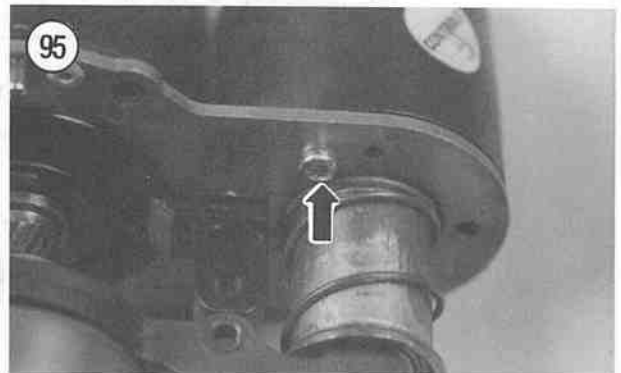
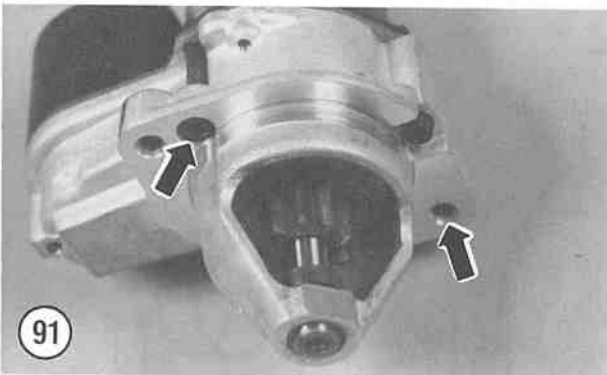
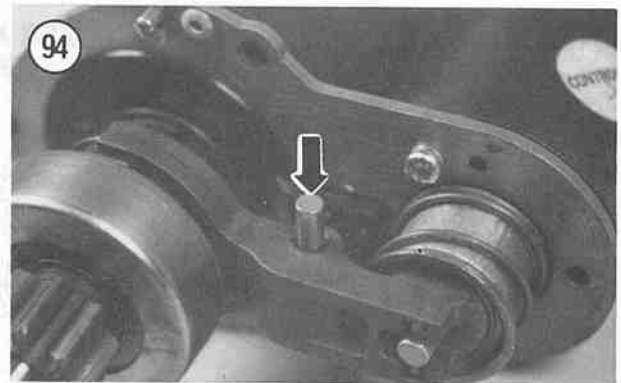


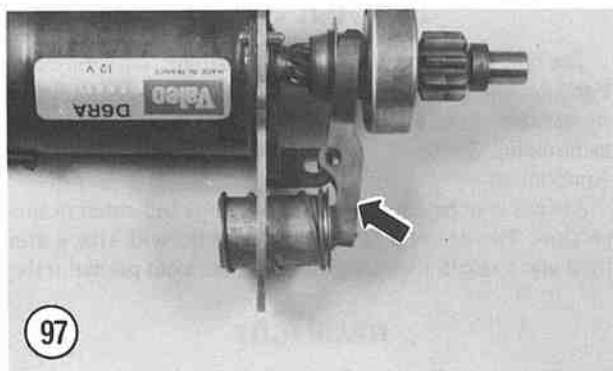
2. Remove the 3 Allen bolts (Figure 91) securing the drive housing to the starter motor housing and solenoid assembly.
3. Remove the drive housing from the starter motor housing and solenoid assembly.
4. Remove the nuts and washers (A, Figure 92) securing the brush holder cover and remove the cover (B, Figure 92).
5. Remove the nut and washer (Figure 93) securing the wire from the starter motor to the solenoid.
6. Remove the pivot pin (Figure 94) from the solenoid engagement lever assembly.

**NOTE**

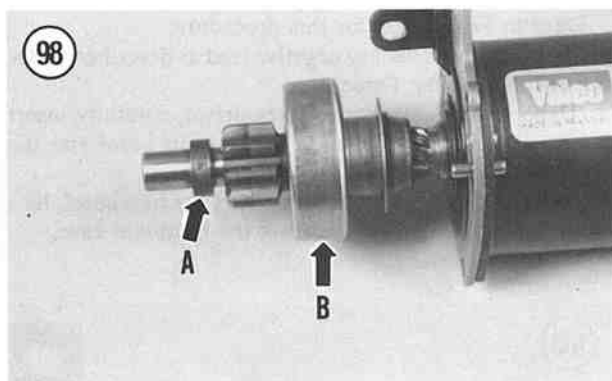
*In Step 7, only 1 of the bolts is shown. Remove both bolts.*

7. Use an A20X Torx driver and remove the 2 Torx bolts (Figure 95) securing the solenoid to the starter motor housing mounting plate. Remove the solenoid (Figure 96).
8. Remove the solenoid engagement lever assembly (Figure 97) from the starter motor housing.
9. If necessary, remove the circlip and bushing (A, Figure 98) securing the starter gear assembly (B, Figure 98) and slide off the starter gear assembly.
10. Pry the spring (Figure 99) off of each brush and pull each brush out of its receptacle (Figure 100). Don't lose the small piece of plastic insulation that sits on top of each brush.
11. Further disassembly is not recommended.

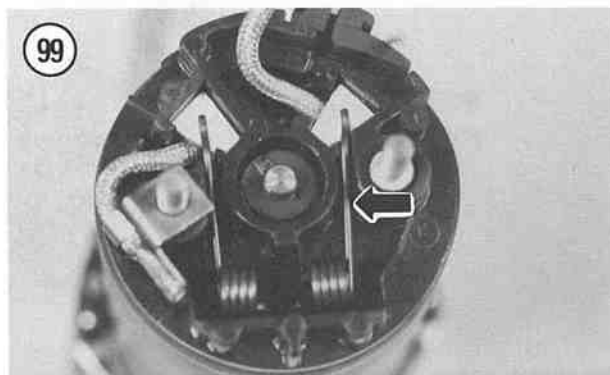




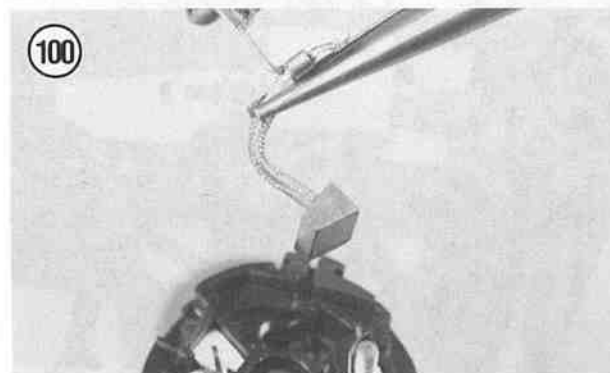
97



98



99



100

12. Inspect the components as described in this chapter.  
13. Assemble by reversing these disassembly steps while noting the following.

14. Make sure the small piece of plastic insulation (**Figure 101**) is in place on top of the brush before reinstalling the spring.

#### Inspection (Valeo Starter)

1. Clean all grease, dirt and carbon from all components.

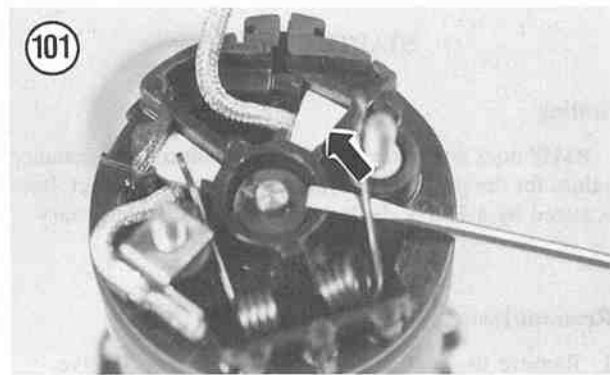
#### CAUTION

*Do not immerse the wire windings in the case or the armature coil in solvent as the insulation may be damaged. Wipe the windings with a cloth lightly moistened with solvent and thoroughly dry.*

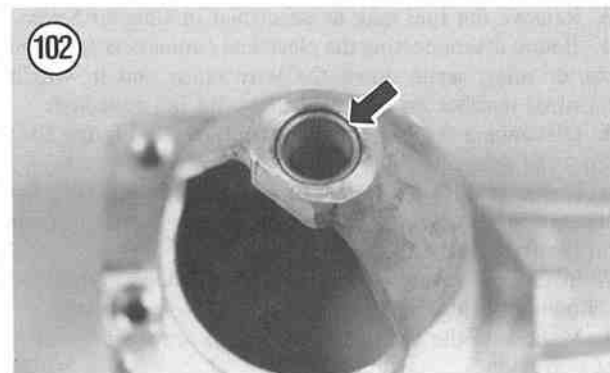
2. Inspect the brush holder plate for wear or damage. Make sure the brush spring (**Figure 99**) is in good condition; replace if necessary.

3. Inspect the bushing in the drive housing (**Figure 102**). If necessary, replace the bushing as follows:

- Soak the new bushing in clean engine oil for 30 minutes prior to installation.
- Use a suitable size socket and hydraulic press and press out the old bushing.



101



102

- c. Use a suitable size socket and hydraulic press and press the new bushing in until it is flush with the outer surface of the drive housing.
4. Inspect the drive housing for cracks or damage. Replace if necessary.
5. Inspect the gear (**Figure 103**) on the starter gear assembly. Check for chipped or missing teeth. If damaged, replace the starter gear assembly.

**NOTE**

*The brushes are separate pieces and can be replaced without any soldering, unlike the Bosch unit. Simply remove the brush assembly and install a new one.*

6. Neither BMW or Valeo provides a wear limit length specification for the brushes. New brushes are about 14 mm (0.55 in.) in length and a good rule of thumb is that the brushes should be replaced when worn to 6 mm (0.24 in.) in length. Measure the length of each brush with a vernier caliper. Replace the brushes if necessary. Replace the brushes as a set even if only one may be worn to the service limit.
7. Further inspection should be entrusted to a BMW dealer or electrical repair shop.

**STARTER RELAY****Testing**

BMW does not provide any test procedures or resistance values for the starter relay. If a starter relay is suspect, have it tested by a BMW dealer and replace it if necessary.

**Removal/Installation**

1. Remove the seat as described in Chapter Twelve.
2. Disconnect the negative battery lead as described under *Battery* in Chapter Three.
3. Remove the fuel tank as described in Chapter Seven.
4. Before disconnecting the electrical connectors from the starter relay, write down the wire color and to which terminal number on the relay that wire is connected.
5. Disconnect the electrical connectors (A, **Figure 104**) from the relay.
6. Either remove the bolts (B, **Figure 104**) securing the starter relay or carefully pull the starter relay from its mount on the frame tube.
7. Install by reversing these removal steps. Note the following during installation.
8. Make sure the electrical connectors are tight and free of corrosion.

**LIGHTING SYSTEM**

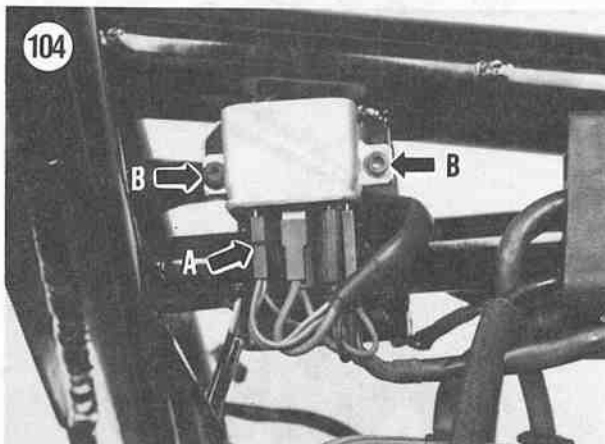
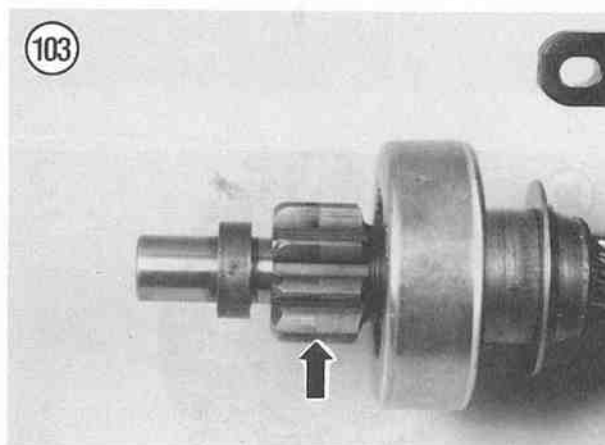
The lighting system consists of a headlight, taillight/brake light combination, license plate light, turn signals, indicator lights and illumination lights for the speedometer and tachometer. **Table 4** lists replacement bulbs for these components.

Always use the correct wattage bulb as indicated in this section. The use of a larger wattage bulb will give a dim light and a smaller wattage bulb will burn out prematurely.

**HEADLIGHT****Headlight and Parking Light Bulb Replacement (1970-1973 Models)**

Refer to **Figure 105** for this procedure.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Using a wide flat-bladed screwdriver, carefully insert it between the lower portion of the trim bezel and the headlight case.
3. Slowly turn the screwdriver and pry the trim bezel, lens and reflector assembly free from the headlight case.



4. Pull the headlight assembly out of the case.
5. On the backside of the reflector portion of the headlight assembly, rotate the bulb holder and remove it from the reflector.
6. Push in and rotate the headlight bulb and remove it from the bulb holder.

**NOTE**

*If the parking light is to be replaced, do so at this time before installing the headlight bulb holder.*

7. Install a new headlight bulb and install the bulb holder into the reflector.
8. To replace the parking light, perform the following:
  - a. If not already removed, remove the headlight bulb holder as described in Steps 1-5.
  - b. Insert your index finger into the headlight bulb holder receptacle in the reflector.
  - c. Carefully push the parking lamp and bulb holder out of the reflector.
  - d. Remove the bulb and install a new one.
  - e. Install the bulb and bulb holder into the reflector until it bottoms out.
  - f. Install the headlight bulb holder.
9. Install by reversing these removal steps. Note the following during installation.

10. If disconnected from the headlight bulb holder, make sure the electrical connectors are tight and free of corrosion.
11. Adjust the headlight as described in this chapter.

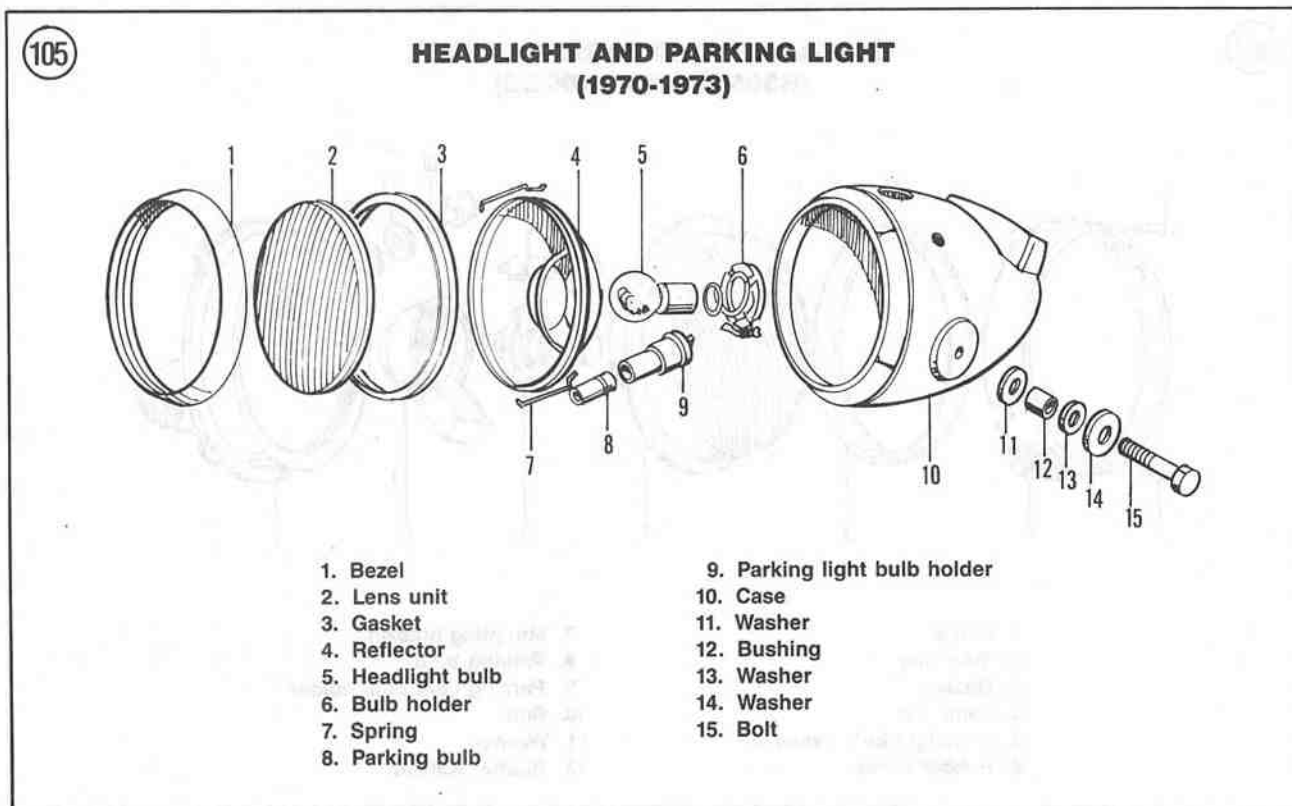
**Headlight and Parking Light Bulb Replacement (1974-on Models)**

The headlight on all models from 1974-on is equipped with an H4 quartz halogen bulb. Special handling of the quartz halogen bulb is required in order to prolong bulb life. The bulb has 3 side prongs where it fits into the headlight reflector. These prongs are offset so the bulb can only be installed one way. When fitting the bulb, if it will not go into the reflector receptacle, rotate the bulb until the prongs align with the cutouts in the reflector receptacle and push it in.

**CAUTION**

*Carefully read all instructions shipped with the replacement quartz halogen bulb. Do not touch the bulb glass with your fingers because of oil on your skin. Any traces of oil on the glass will drastically reduce the life of the bulb. Clean any traces of oil from the bulb with a cloth moistened in alcohol or lacquer thinner.*

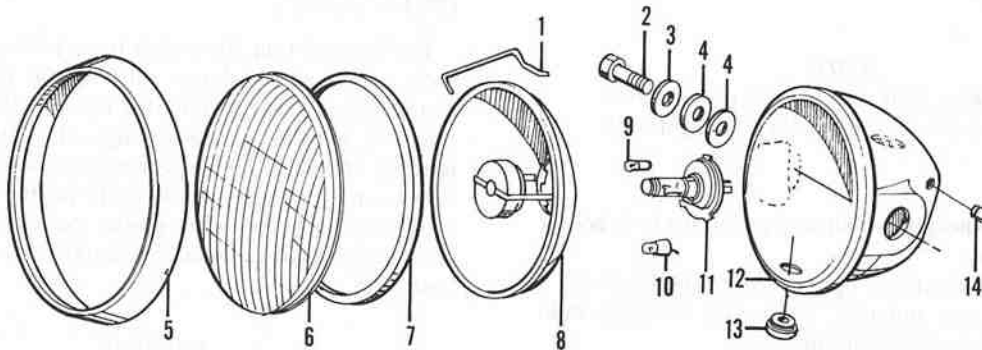
Refer to **Figure 106** through **Figure 109** for this procedure.





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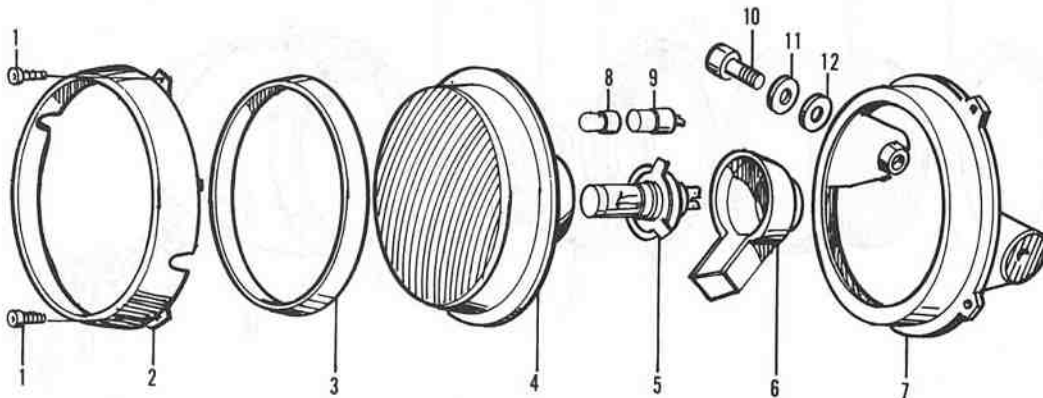
### HEADLIGHT AND PARKING LIGHT (R65, R65LS, R80, R80RT AND R100)



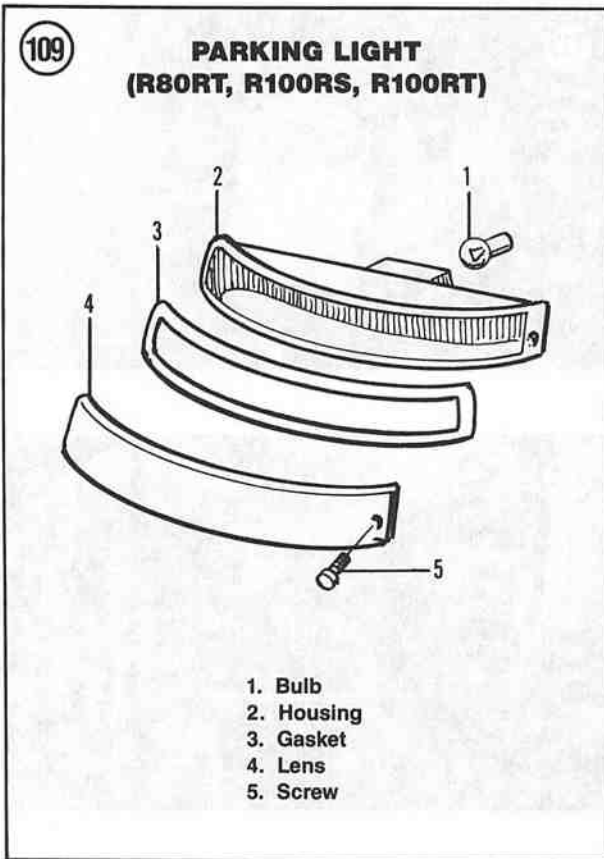
- |              |  |
|--------------|--|
| 1. Spring    | 8. Reflector                                       |
| 2. Bolt      | 9. Parking bulb (models so equipped)               |
| 3. Washer    | 10. Parking light bulb holder (models so equipped) |
| 4. Washer    | 11. Headlight bulb assembly                        |
| 5. Bezel     | 12. Case   |
| 6. Lens unit | 13. Rubber plug                                    |
| 7. Gasket    | 14. Rubber plug                                    |

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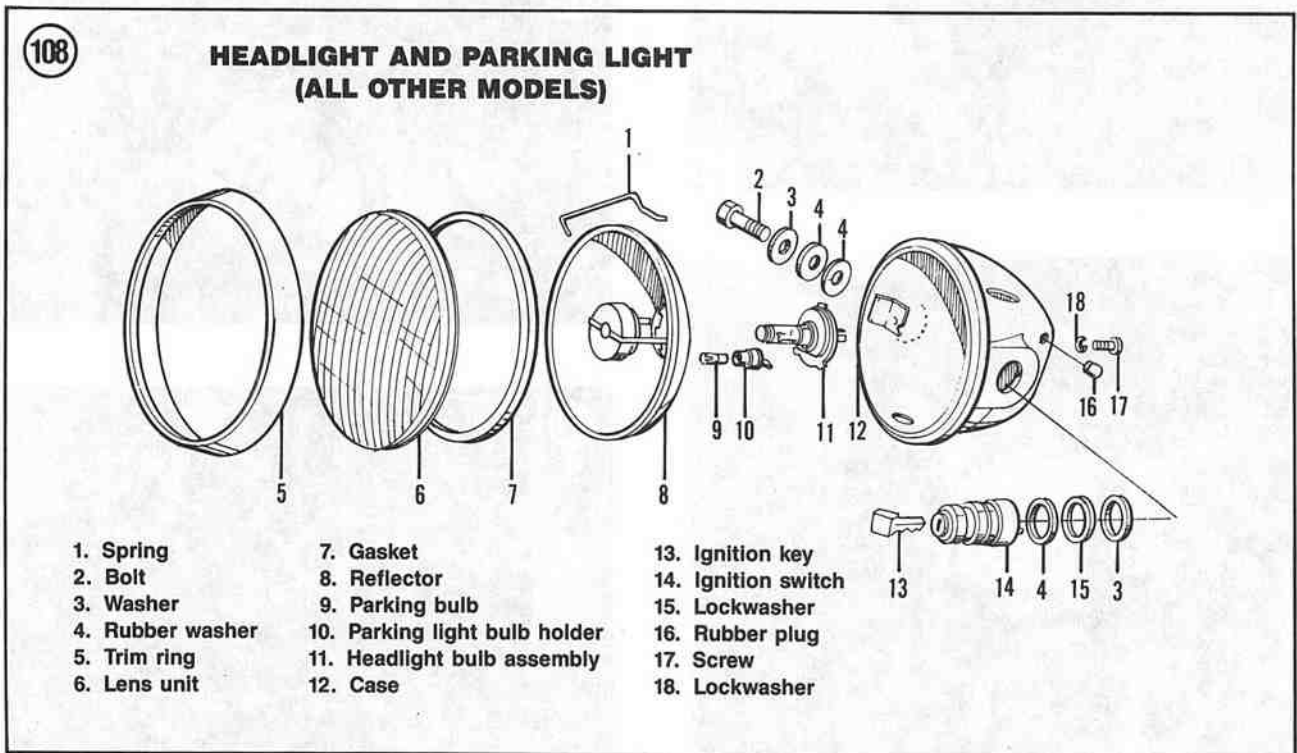
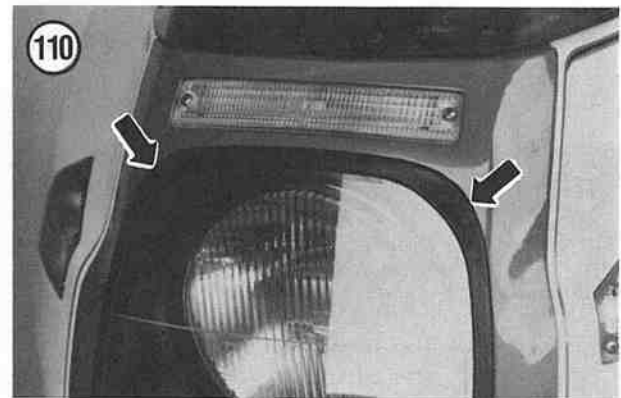
### HEADLIGHT AND PARKING LIGHT (R80G/S AND R100GS)



- |                            |                              |
|----------------------------|------------------------------|
| 1. Screw                   | 7. Mounting bracket          |
| 2. Trim ring               | 8. Parking bulb              |
| 3. Gasket                  | 9. Parking light bulb holder |
| 4. Lens unit               | 10. Bolt                     |
| 5. Headlight bulb assembly | 11. Washer                   |
| 6. Rubber cover            | 12. Rubber washer            |



1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
- 2A. On R65LS models, remove the upper section of the headlight fairing as described in Chapter Twelve.
- 2B. On R80G/S models, perform the following:
  - a. Remove the upper section of the instrument cluster as described in this chapter.
  - b. Remove the bolt and washer on each side securing the headlight assembly to the mounting tabs in the instrument cluster lower section and pull the headlight assembly straight out.
- 2C. On R100RS models, perform the following:
  - a. Remove the knurled nut in each corner (**Figure 110**) of the headlight glass protective cover.

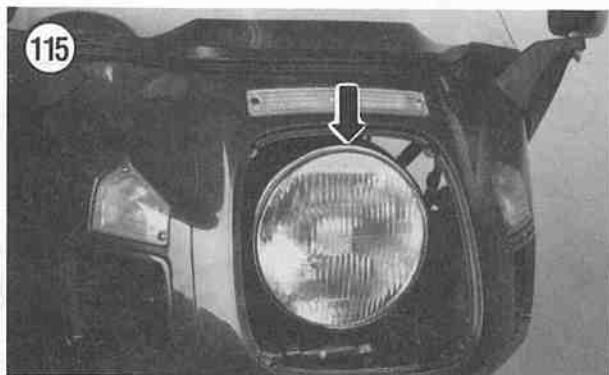
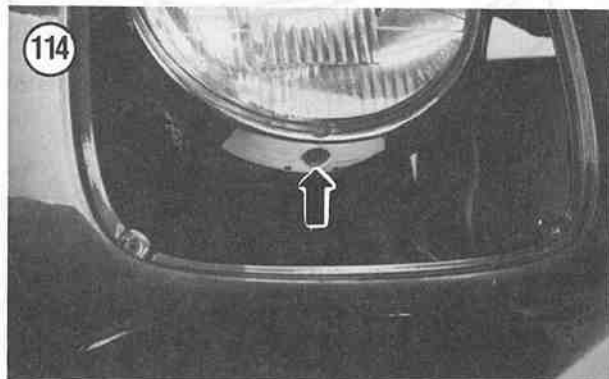
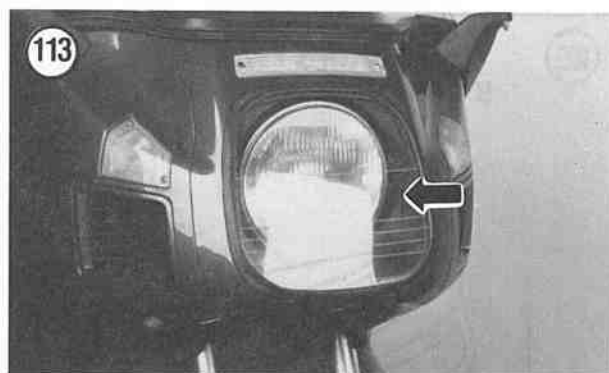


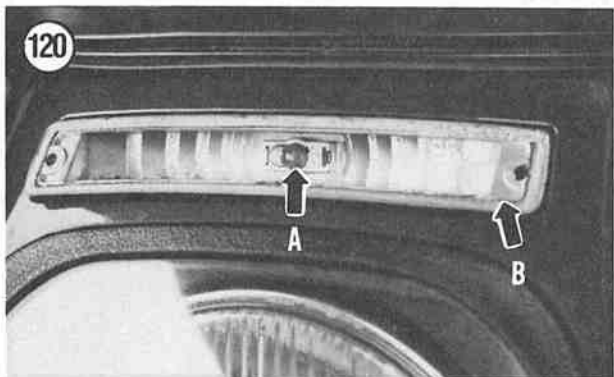
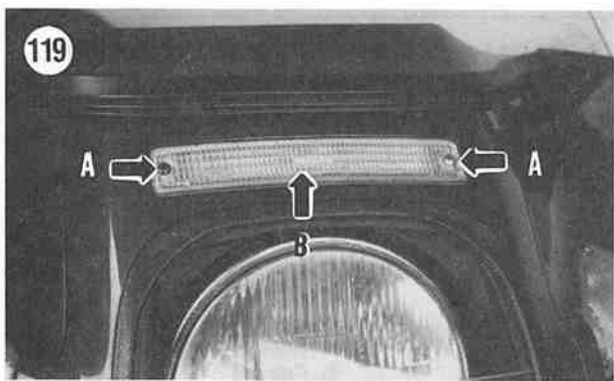
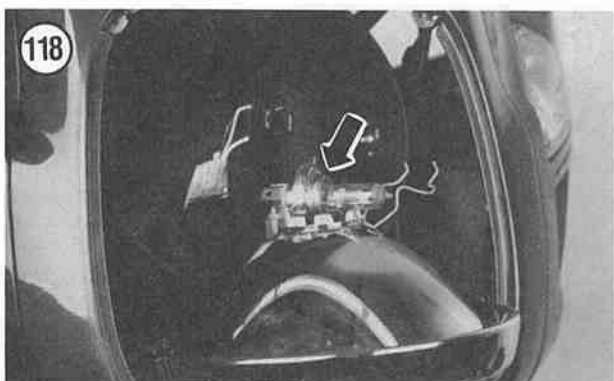
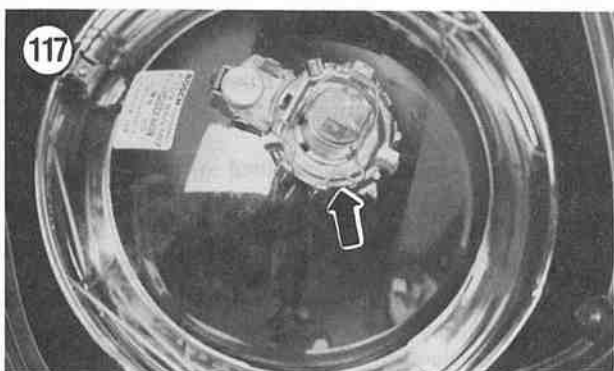
- b. Remove the glass protective cover and the light duct (Figure 111).

**CAUTION**

*Do not allow the screwdriver to slip off of the screw as it may damage the glass protective cover.*

- 2D. On R100RT models, perform the following:
  - a. Remove the Phillips screw in each corner of the headlight glass protective cover (Figure 112).
  - b. Remove the glass protective cover and the light duct (Figure 113).
3. On all models except the R80G/S, perform the following:
  - a. Carefully tip the upper portion of the headlight assembly toward the back to gain access to the lower portion of the trim bezel.
  - b. Remove the screw (Figure 114) at the base of the trim bezel.





- c. Carefully tip the lower portion of the headlight assembly back down to the normal position.
  - d. Carefully pull the headlight assembly (Figure 115) straight out.
4. Disconnect the electrical connector(s) (Figure 116) from the base of the headlight assembly.
  5. On models so equipped, remove the rubber boot from the base of the headlight assembly.
  6. Unhook the bulb locking clip (Figure 117).
  7. Remove the bulb assembly (Figure 118).
  8. Replace with a new bulb assembly—do not touch the bulb with your fingers. Refer to CAUTION at the beginning of this procedure.
- 9A. To replace the parking light on all models except R80RT, R100RT and R100RS, perform the following:
    - a. If not already removed, remove the headlight bulb as described in Steps 1-7.
    - b. Insert your index finger into the headlight bulb receptacle in the reflector.
    - c. Carefully push the parking lamp and bulb holder out of the reflector.
    - d. Remove the bulb and install a new one.
    - e. Install the bulb and bulb holder into the reflector until it bottoms out.
    - f. Install the headlight bulb.
  - 9B. To replace the parking light on R80RT, R100RT and R100RS models, perform the following:
    - a. Remove the screws (A, Figure 119) securing the parking light lens.
    - b. Remove the lens and gasket (B, Figure 119).
    - c. Remove the bulb (A, Figure 120) and install a new one.
    - d. Inspect the gasket (B, Figure 120) for deterioration and hardness. Replace if necessary.
    - e. Inspect the socket assembly and replace if damaged or deteriorated.
    - f. Assemble by reversing these disassembly steps while noting the following.
    - g. Install the lens and install the screw. Tighten the screw securely. Don't overtighten the screws as the plastic lens may be damaged.
  10. Install by reversing these removal steps. Note the following during installation.
  11. Make sure the electrical connectors are tight and free of corrosion.
  12. Adjust the headlight as described in this chapter.

#### Headlight Housing Removal/Installation

1. On models so equipped, remove the front fairing as described under *Front Fairing Removal/Installation* in Chapter Twelve.

2. Remove the headlight lens (A, **Figure 121**) and light bulb as described in this chapter.
3. Disconnect all electrical connectors within the headlight housing.
4. Remove the bolts, washers and rubber washers (B, **Figure 121**) securing the headlight housing to the mounting bracket on each side.
5. Carefully pull the headlight housing forward and pull the electrical wires and connectors out of the rear of the housing.
6. Install by reversing these removal steps. Note the following during installation.
7. Make sure the electrical connectors are tight and free of corrosion.
8. Adjust the headlight as described in this chapter.

### Headlight and Instrument Panel Mounting Bracket (R65 and R65LS Models) Removal/Installation

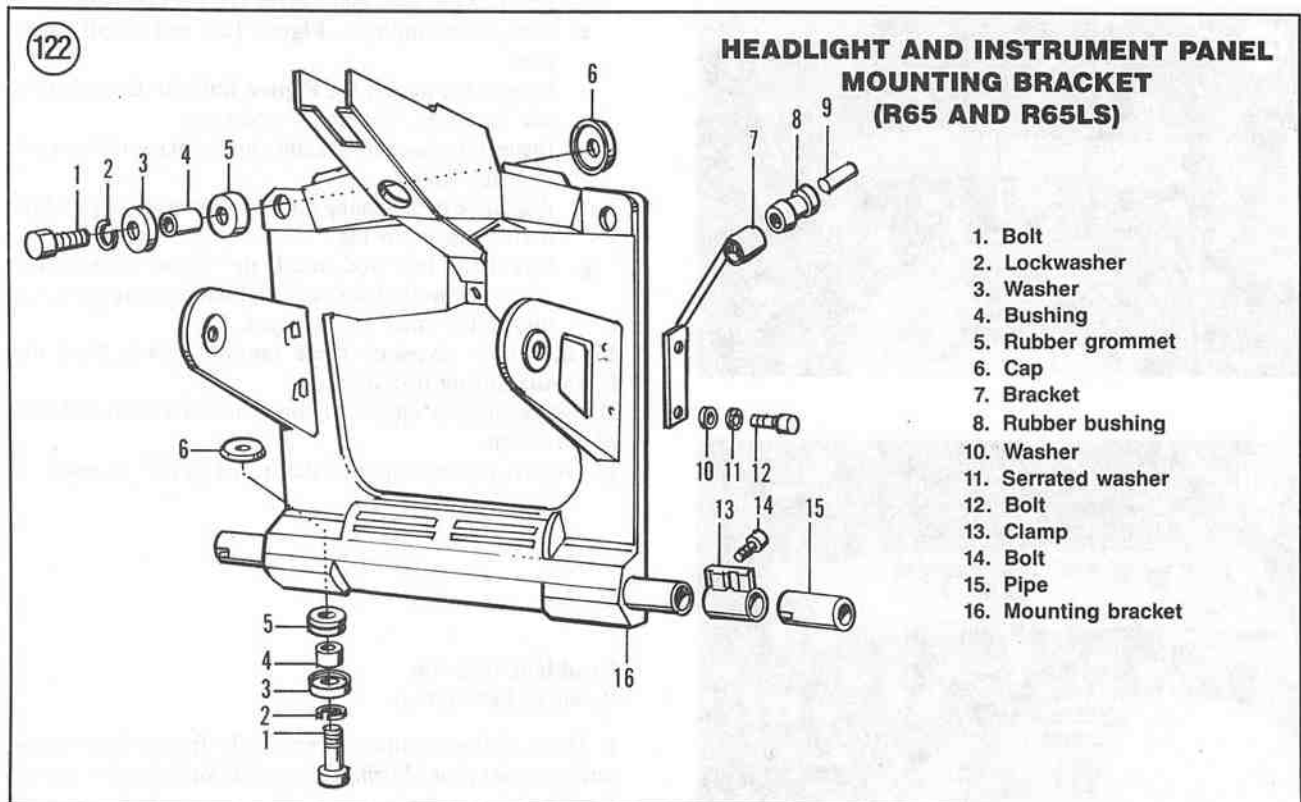
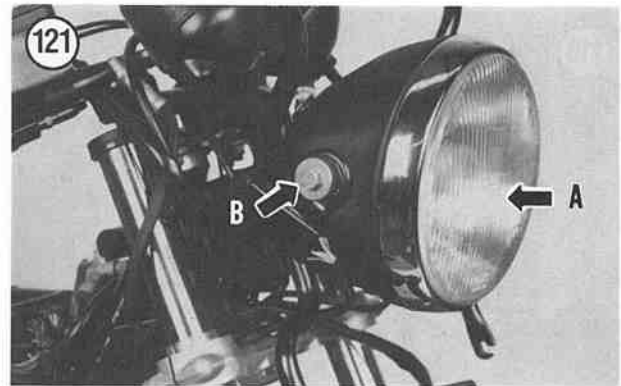
Refer to **Figure 122** for this procedure.

1. Remove the headlight lens and light bulb as described in this chapter.
2. Remove the headlight housing as described in this chapter.
3. Remove the bolts, lockwashers, washers and caps securing the top and bottom of the headlight and instrument panel mounting bracket.

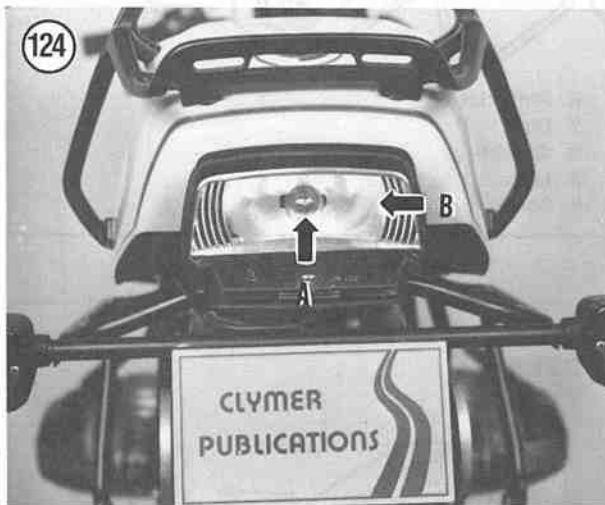
4. Remove the bracket and don't lose the bushings within each rubber grommet.
5. Install by reversing these removal steps. Note the following during installation.
6. Tighten the bolts securely.
7. Adjust the headlight as described in this chapter.

### Headlight Adjustment

Adjust the headlight vertically according to Department of Motor Vehicles regulations in your area. The headlight assembly on all models is not equipped with a horizontal adjustment mechanism.







1. To adjust the headlight vertically, loosen the headlight case mounting bolts (B, Figure 121) where the case is attached to the front fork.
2. Move the headlight case until the alignment is correct.
3. Tighten the headlight case mounting bolts securely.

### TAILLIGHT AND BRAKE LIGHT

#### Light Replacement

This procedure shows a typical light replacement. Variations exist among the different models.

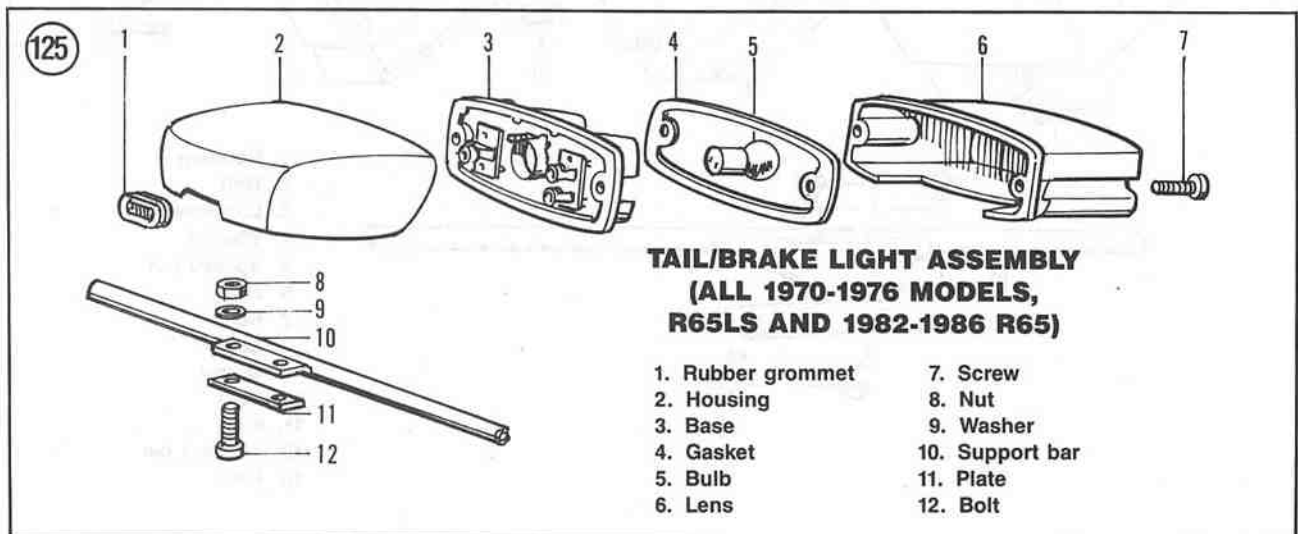
1. Remove the screws (A, Figure 123) securing the lens and remove the lens and gasket (B, Figure 123).
2. To remove the light bulb, push in on the bulb (A, Figure 124), turn it *counterclockwise* and remove the bulb from the socket.
3. Wash the inside and outside of the lens assembly with a mild detergent and wipe dry.
4. Wipe off the reflector (B, Figure 124) with a soft cloth.
5. Inspect the gasket for deterioration and hardness. Replace if necessary.
6. Inspect the socket assembly(ies) and replace if damaged or deteriorated.
7. Assemble by reversing these disassembly steps while noting the following.
8. Install the lens and install the screws. Tighten the screws securely. Don't overtighten the screws as the plastic lens may be damaged.

#### Housing Removal/Installation

(All 1970-1976 Models, R65LS and 1982-1986 R65 Models)

Refer to Figure 125 for this procedure.

1. Remove the taillight bulb as described in this chapter.
2. Carefully pull the base out of the housing. Do not damage the electrical wires in this process.



#### TAIL/BRAKE LIGHT ASSEMBLY (ALL 1970-1976 MODELS, R65LS AND 1982-1986 R65)

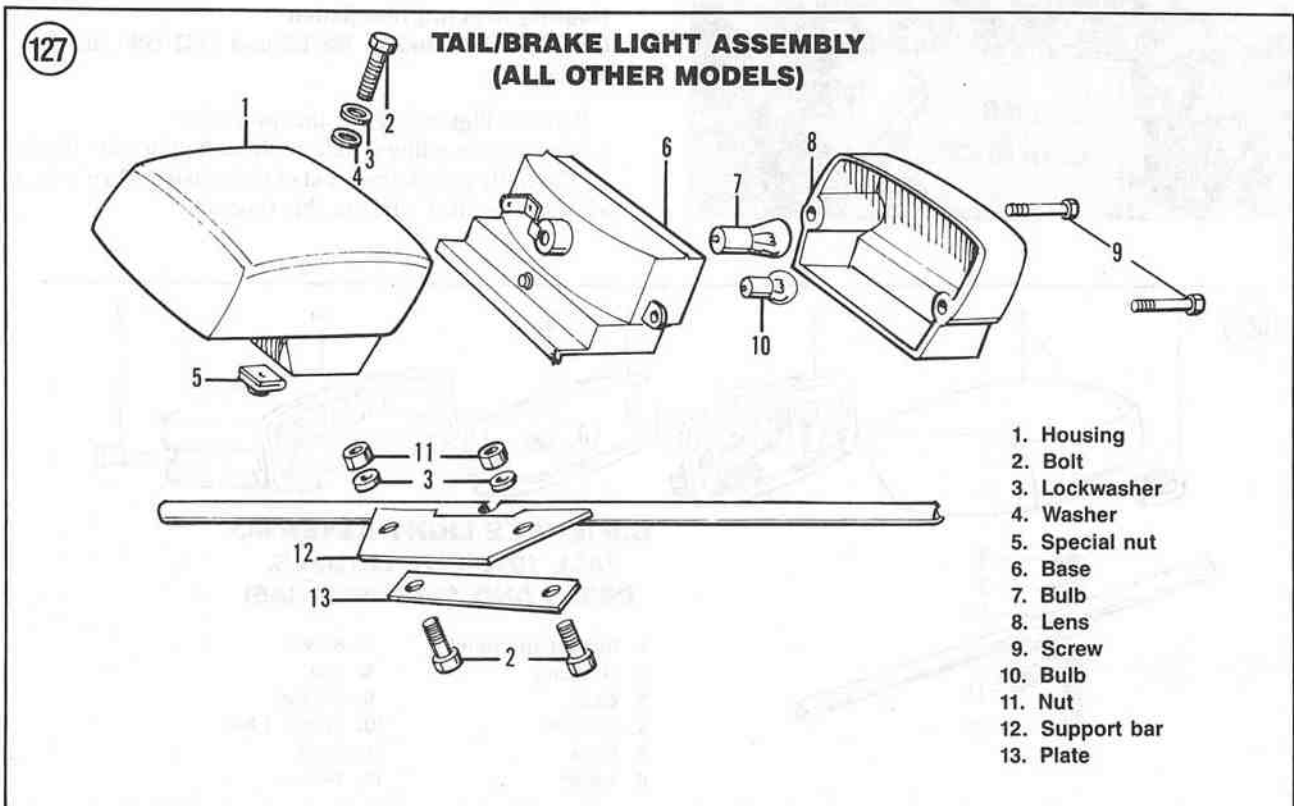
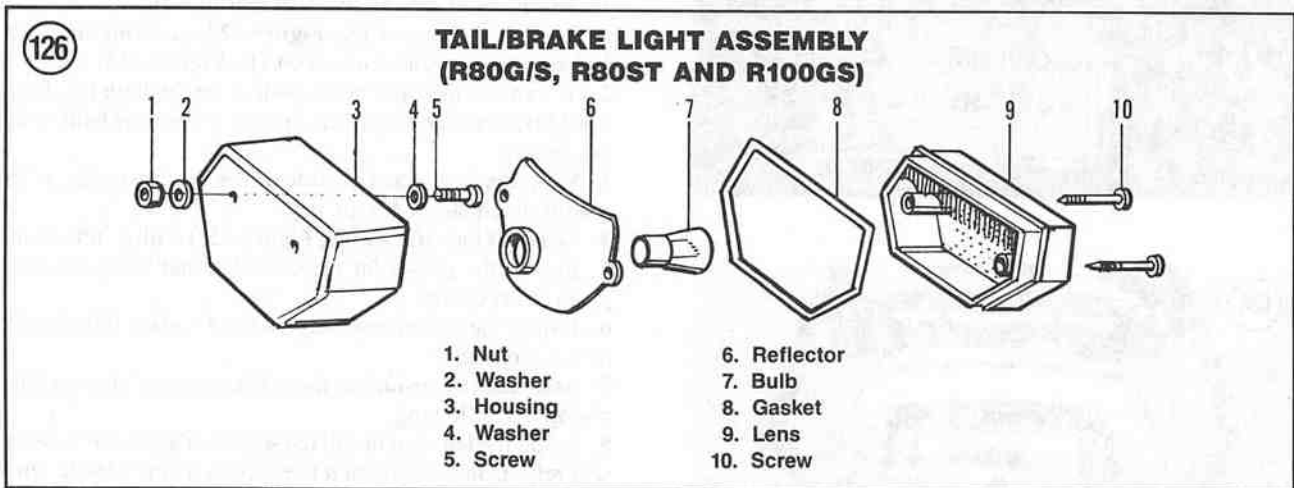
- |                   |                 |
|-------------------|-----------------|
| 1. Rubber grommet | 7. Screw        |
| 2. Housing        | 8. Nut          |
| 3. Base           | 9. Washer       |
| 4. Gasket         | 10. Support bar |
| 5. Bulb           | 11. Plate       |
| 6. Lens           | 12. Bolt        |

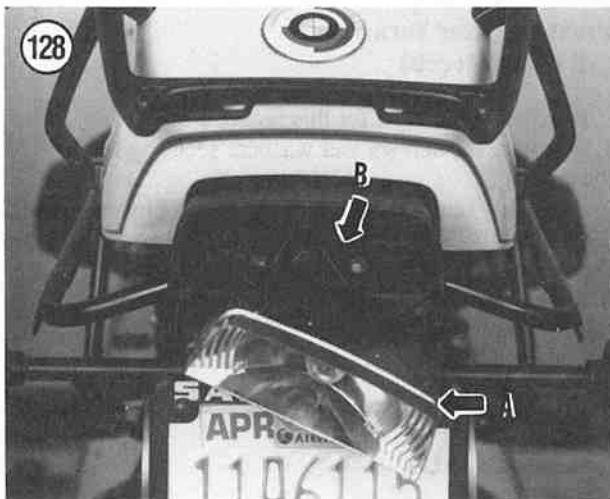
3. Disconnect the electrical connector from the main wiring harness.
4. Remove the bolts, washers and nuts securing the housing to the support bar.
5. Remove the housing.
6. Install by reversing these removal steps. Note the following during installation.
7. Make sure the electrical connectors are tight and free of corrosion.

### Housing Removal/Installation (R80G/S, R80ST and R100GS Models)

Refer to **Figure 126** for this procedure.

1. Remove the taillight bulb as described in this chapter.
2. Carefully pull the reflector out of the housing. Do not damage the electrical wires in this process.
3. Disconnect the electrical connector from the main wiring harness.



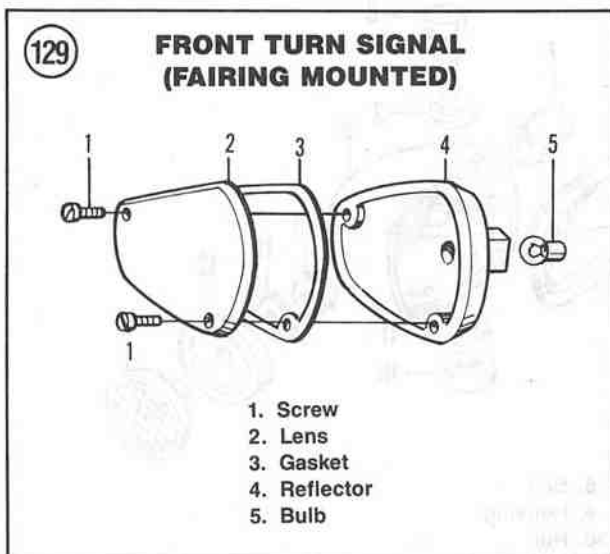


4. Remove the bolts, washers and nuts securing the housing to rear fender assembly.
5. Remove the housing.
6. Install by reversing these removal steps. Note the following during installation.
7. Make sure the electrical connectors are tight and free of corrosion.

#### Housing Removal/Installation (All Other Models)

Refer to **Figure 127** for this procedure.

1. Remove the taillight and license plate bulbs as described in this chapter.
2. Carefully pull the base (A, **Figure 128**) out of the housing. Do not damage the electrical wires in this process.
3. Disconnect the electrical connector from the main wiring harness (B, **Figure 128**).
4. Remove the bolts, washers and nuts securing the housing to the support bar.
5. Remove the housing.
6. Install by reversing these removal steps. Note the following during installation.
7. Make sure the electrical connectors are tight and free of corrosion.



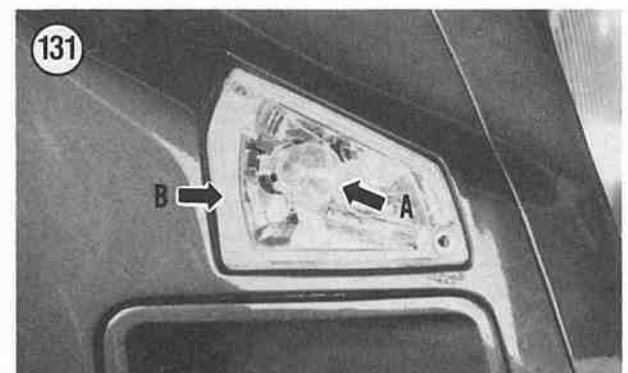
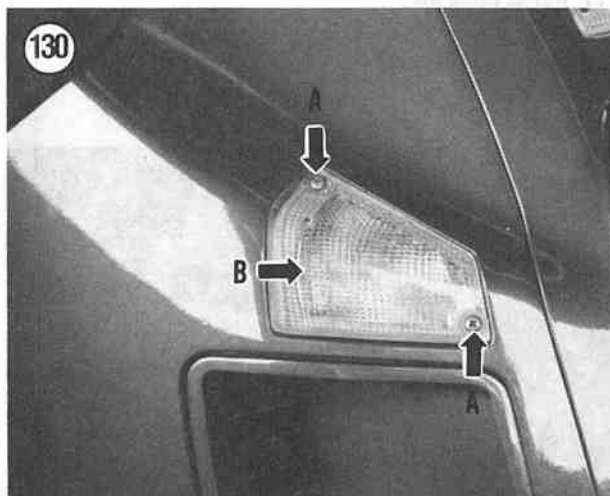
#### TURN SIGNALS

The front and rear turn signals are the same on all models with the exception of the front turn signal on R80RT, R100RT and R100RS models. On these models, the front turn signal is integrated into the front fairing.

#### Front Turn Signal Light Replacement (R80RT, R100RT and R100RS Models)

Refer to **Figure 129** for this procedure.

1. Remove the screws (A, **Figure 130**) securing the lens to the front fairing.
2. Remove the lens and gasket (B, **Figure 130**).
3. To remove the light bulb, push in on the bulb (A, **Figure 131**), turn it *counterclockwise* and remove the bulb from the socket.

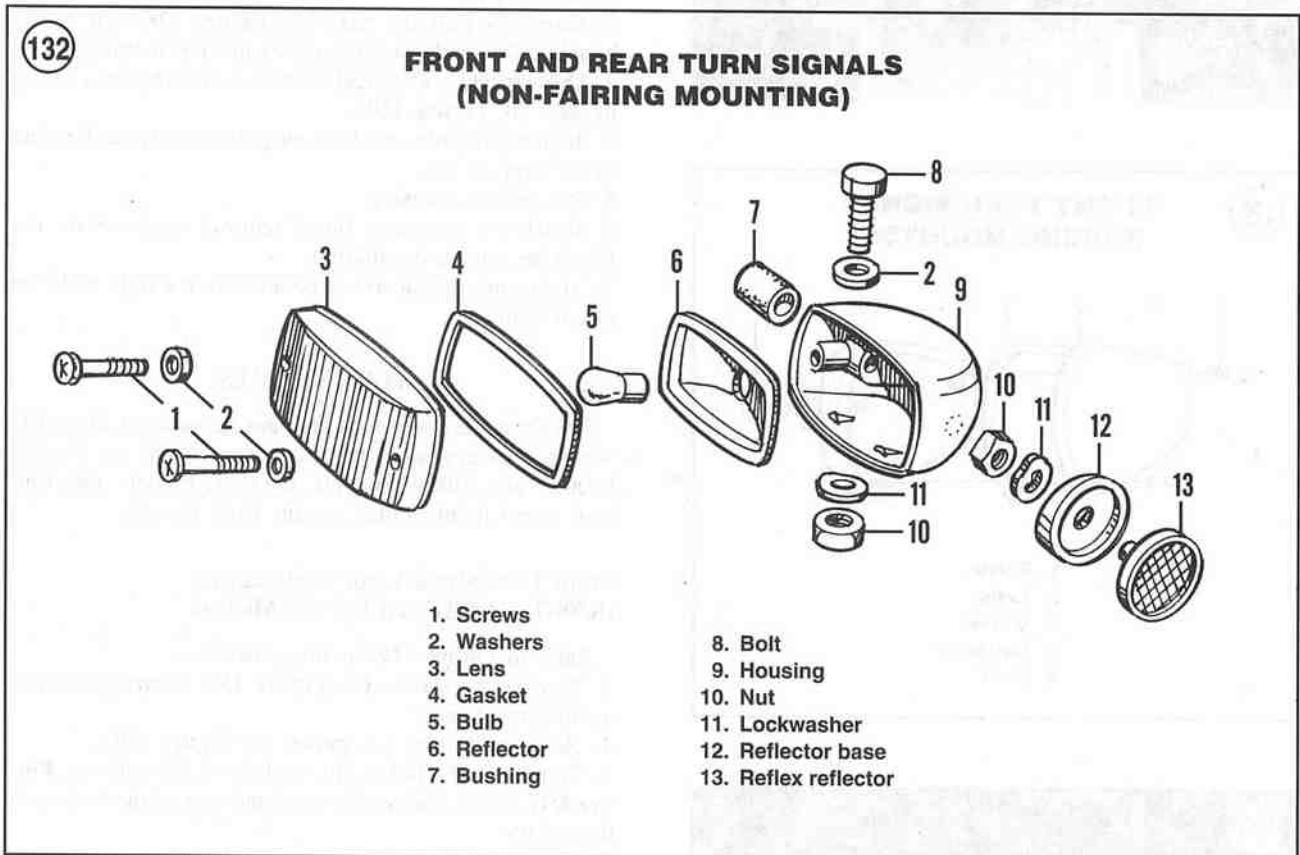


4. Wash the lens with a mild detergent and wipe dry.
5. Wipe off the reflector with a soft cloth.
6. Inspect the gasket (B, **Figure 131**) for deterioration and hardness. Replace if necessary.
7. Inspect the socket assembly and replace if damaged or deteriorated.
8. Assemble by reversing these disassembly steps while noting the following.
9. Install the lens and install the screws. Tighten the screws securely. Don't overtighten the screws as the plastic lens may be damaged.

### Front and Rear Turn Signals (All Other Models)

Refer to **Figure 132** for this procedure.

1. Remove the screws and washers securing the lens to the housing.
2. Carefully remove the lens and gasket (**Figure 133**).
3. Inspect the lens gasket and replace if it is damaged or deteriorated.
4. Wash the inside and outside of the lens with a mild detergent and wipe dry.



5. Carefully remove the bulb from the socket.
6. Replace the bulb.
7. Install the lens and gasket and install the screws and washers. Tighten the screws securely. Don't overtighten the screws as the plastic lens may be damaged.

### Rear Turn Signal Assembly

#### Removal/Installation

(All Models Except R80RT, R100RT and R100RS)

Refer to **Figure 132** for this procedure.

1. Disconnect the electrical connectors from the main wiring harness.
- 2A. On early models, remove the clamping bolt, washer, lockwasher and nut securing the housing to the mounting bracket.

- 2B. On later models, loosen the clamping screws within the housing securing the housing to the mounting bracket.
3. Slide the housing off of the mounting bracket.
4. Install by reversing these removal steps. Note the following during installation.
5. Install the housing and tighten the bolt and nut securely. Don't overtighten the bolt as the housing may be damaged.
6. Make sure the electrical connectors are tight and free of corrosion.

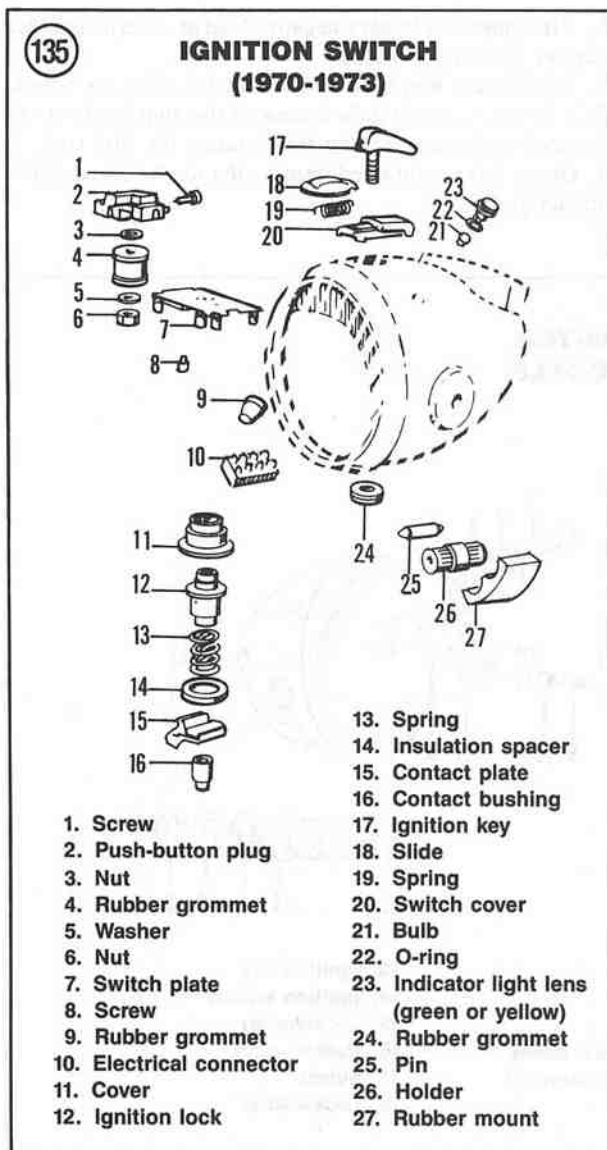
### Rear Turn Signal Assembly

#### Removal/Installation

(R80RT, R100RT and R100RS Models)

Refer to **Figure 132** for this procedure.

1. Disconnect the electrical connectors from the main wiring harness.
2. Remove the clamping bolt, washer, lockwasher and nut securing the housing (**Figure 134**) to the mounting bracket.
3. Slide the housing off of the mounting bracket.
4. Install by reversing these removal steps. Note the following during installation.
5. Install the housing and tighten the bolt and nut securely. Don't overtighten the bolt as the housing may be damaged.
6. Make sure the electrical connectors are tight and free of corrosion.



## SWITCHES

### Ignition and Combination Switch Testing

BMW does not provide test information for these control switches on the bike. If you suspect a faulty switch, perform the following test.

1. Disconnect the switch electrical connector from the main wiring harness.
2. Refer to the electrical diagrams at the end of this manual and locate the switch and switch electrical wire colors.
3. To check continuity of the switch, use an ohmmeter and perform the following:
  - a. Connect the ohmmeter test leads to the indicated wires in the switch side of the electrical connector and check for continuity (indicated resistance) in all switch positions.
  - b. Also check for continuity (indicated resistance) of all related electrical wires.
  - c. If the switch fails any portion of this test, replace the switch as described in this chapter.

### Ignition Switch Removal/Installation (1970-1973 Models)

Refer to **Figure 135** for this procedure.



1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the headlight lens as described under *Headlight and Parking Light Bulb Replacement (1970-1973 Models)* in this chapter.
3. Before disconnecting the electrical connectors, note their terminal locations. They must be reinstalled on the same terminal.
4. Remove the screws securing the switch assembly to the headlight housing and remove the assembly.
5. Install by reversing these removal steps.
6. Make sure all electrical connections are attached to the correct terminals and that they are tight and free of corrosion.

### Ignition Switch Removal/Installation (1974-1976 Models)

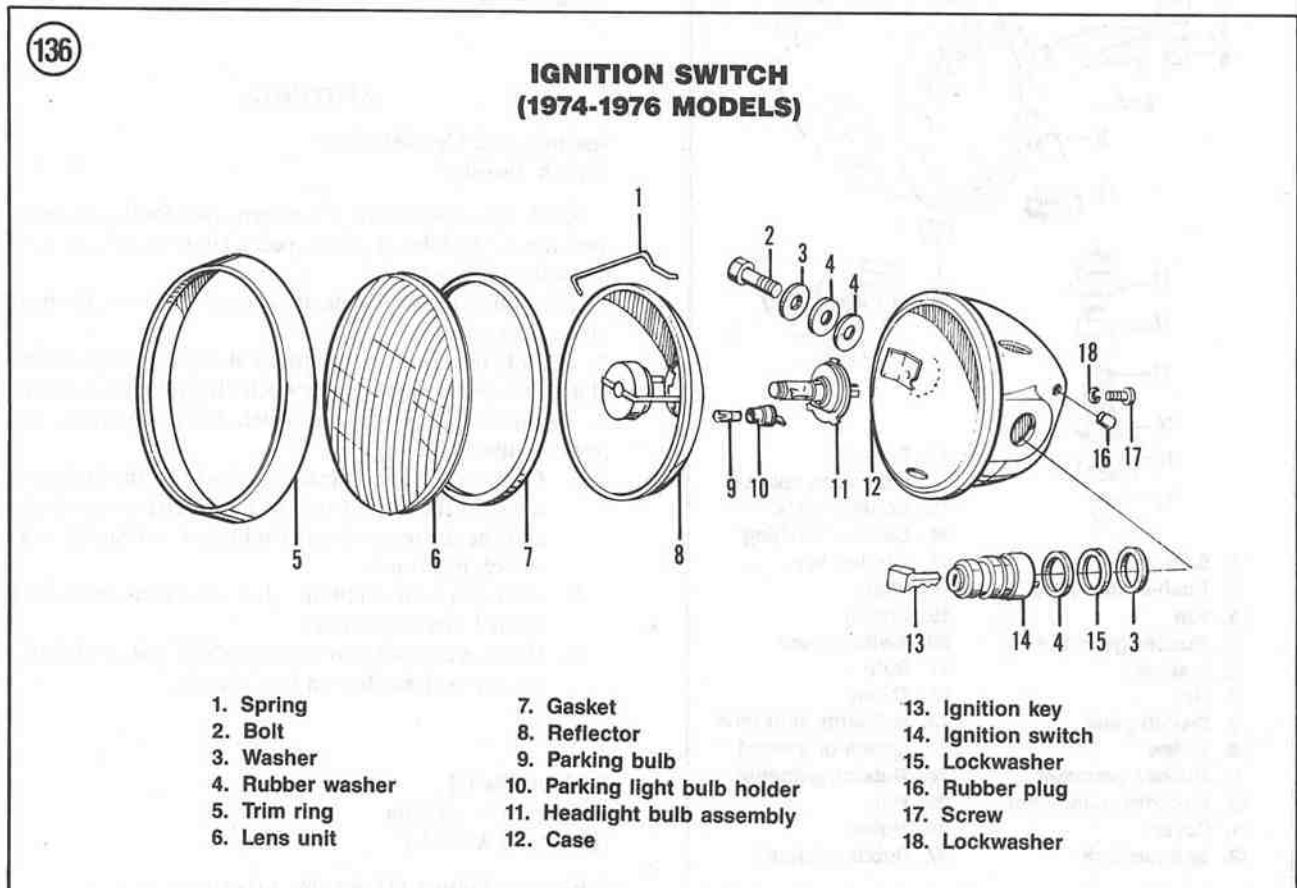
Refer to **Figure 136** for this procedure.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the headlight lens as described under *Headlight and Parking Light Bulb Replacement (1974-on Models)* in this chapter.

3. Before disconnecting the electrical connectors, note their terminal locations. They must be reinstalled on the same terminal.
4. Disconnect the electrical connectors (A, **Figure 137**) from the backside of the ignition switch.
5. Unscrew the large nut (A, **Figure 138**) securing the ignition switch to the headlight case.
6. Remove the trim ring (B, **Figure 137**) and withdraw the ignition switch (B, **Figure 137**) from the headlight case.
7. Install by reversing these removal steps.
8. Make sure all electrical connections are attached to the correct terminals and that they are tight and free of corrosion.

### Ignition Switch Removal/Installation (All Other Models Without a Front Fairing)

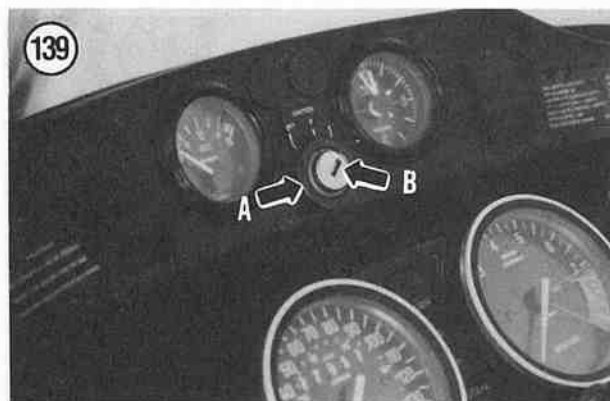
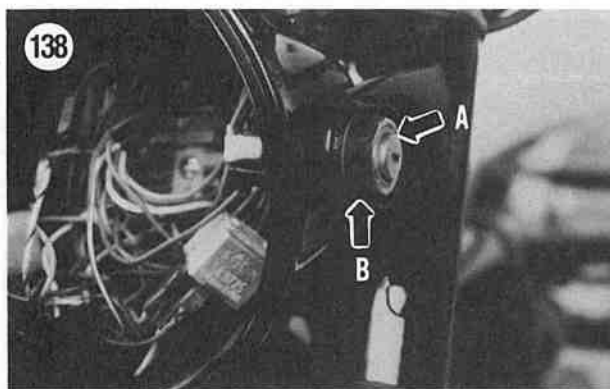
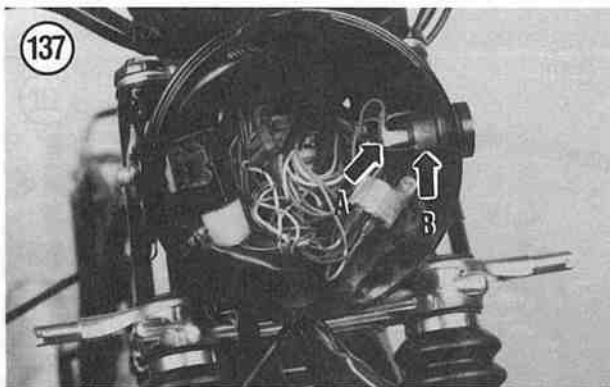
1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the fuel tank as described in Chapter Seven. This is necessary to gain access to the switch electrical connections located on the frame under the fuel tank.
3. On models so equipped, remove the screws securing the impact pad.



4A. On models with no auxiliary switches, remove the impact pad.

4B. On models equipped with auxiliary switches, perform the following:

- a. Partially pull up on the impact pad and move it out of the way. Don't move the pad too far as there is very little slack in the electrical wires at this time.
- b. Follow the electrical wires from the impact pad back to their electrical connectors at the main wiring harness. If necessary, remove any tie wrap(s) securing the electrical wires to the frame.



- c. Pull the electrical wires away from the frame to allow slack in wires.
  - d. Pull the impact pad up and away from the steering head area. It is not necessary to completely remove the impact pad, just move it out of the way.
5. Follow the electrical wires from the ignition switch back to its electrical connectors at the main wiring harness. If necessary, remove any tie wrap(s) securing the electrical wires to the frame.
  6. Pull the electrical wire away from the frame and disconnect the electrical connector.
  7. Remove the ignition switch from its mounting bracket.
  8. If necessary, test the switch as described in this chapter.
  9. Install by reversing these removal steps.
  10. Make sure all electrical connections are tight and free of corrosion.

### Ignition Switch Removal/Installation

(All Other Models With a Front Fairing)

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the fuel tank as described in Chapter Seven. This is necessary to gain access to the switch electrical connections located on the frame under the fuel tank.
3. Use a pair of circlip pliers and unscrew the trim ring (A, **Figure 139**) from the base of the ignition switch.
4. Push the ignition switch (B, **Figure 139**) out through the instrument panel portion of the front fairing.
5. Follow the electrical wiring from the ignition switch back to its electrical connectors at the main wiring harness. If necessary, remove any tie wrap(s) securing the electrical wires to the frame.
6. Pull the electrical wires away from the frame and disconnect the electrical connector.
7. Remove the ignition switch and its wires from the frame.
8. If necessary, test the switch as described in this chapter.
9. Install by reversing these removal steps.
10. Make sure all electrical connections are tight and free of corrosion.

### Right-hand and Left-hand Combination Switch Removal/Installation

The right-hand combination switch assembly contains the engine stop switch, starter button and right-hand turn signal switch. The left-hand combination switch assembly contains the headlight switch, the horn button and the left-hand turn signal switch.

All of the switches are an integral part of their respective combination switch assemblies and if any portion of the switch is faulty, the entire switch assembly must be replaced.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.

2. Remove the fuel tank as described in Chapter Seven. This is necessary to gain access to the switch electrical connections located on the frame under the fuel tank.
3. On models so equipped, remove the impact pad as described in this chapter.

**NOTE**

*It is necessary to remove the impact pad in order to gain access to the area behind it for electrical wire and connector removal.*

**NOTE**

*On some models it is necessary to remove the instrument cluster in order to gain access to the area in front of it for electrical wire and connector removal.*

4. If necessary, remove the instrument cluster as described in this chapter.
- 5A. To remove the right-hand combination switch assembly (**Figure 140**), remove the screw securing the switch to the handlebar. Move the switch up and off of the handlebar.
- 5B. To remove the left-hand combination switch assembly (**Figure 141**), remove the screw securing the switch to the handlebar. Move the switch up and off of the handlebar.
6. Unhook any tie wraps securing the switches electrical wires and any other wires to the handlebar.
7. Carefully pull on the switch and electrical wire assembly and follow the electrical wires down in front of the steering stem and the frame to where the electrical connector is located.
8. Disconnect the electrical connector.
9. Carefully pull the switch and electrical wire assembly out from in front of the steering stem and the frame.
10. If necessary, test the switch as described in this chapter.
11. Install a new switch by reversing these removal steps. Note the following during installation.
12. Make sure all electrical connections are tight and free of corrosion.

**Front Brake Light Switch****NOTE**

*1970-1973 models are not equipped with a front brake light switch.*

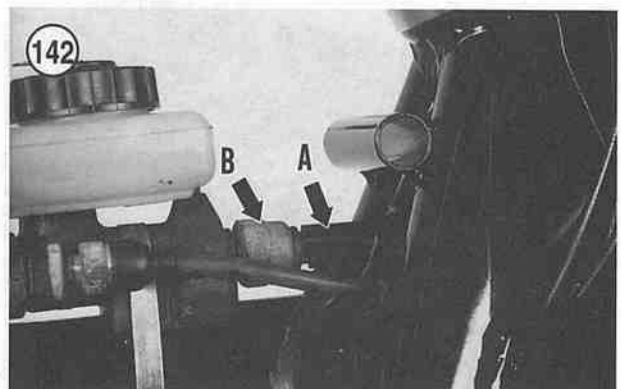
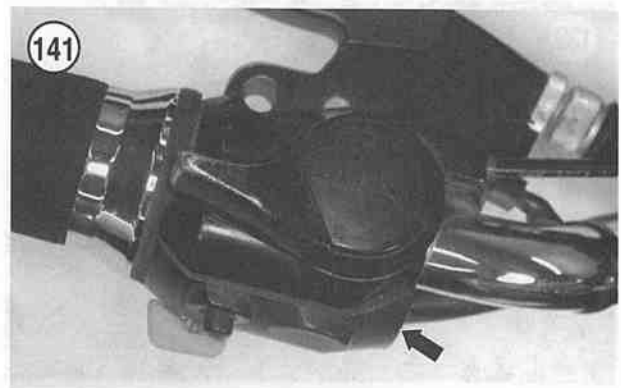
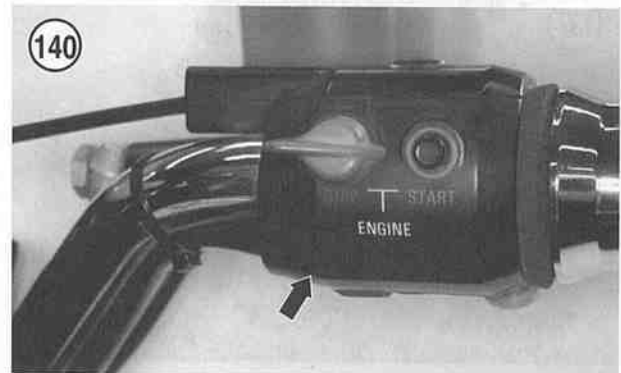
**Testing (1974-1977 models)**

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the fuel tank as described in Chapter Seven.
3. Disconnect the front brake light switch 2-pin electrical connector (A, **Figure 142**) from the master cylinder.
4. Use an ohmmeter and check for continuity between the 2 terminals on the brake light switch electrical connector. There should be no continuity (infinite resistance) with

the brake lever released. With the brake lever applied, there should be continuity (low resistance). If the switch fails either of these tests, the switch must be replaced as described in this chapter.

**Testing (1978-on models)**

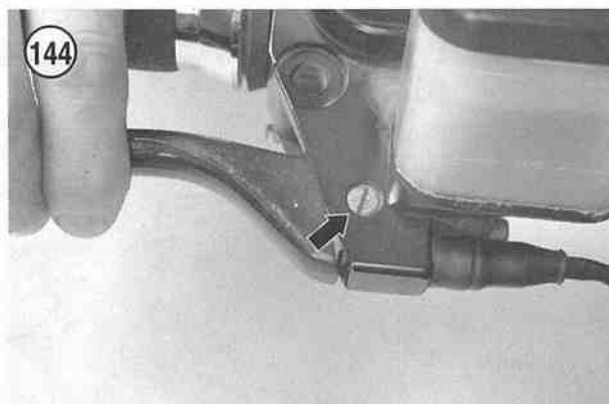
1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the fuel tank as described in Chapter Seven. This is necessary to gain access to the switch electrical connections located on the frame under the fuel tank.



3. Disconnect the front brake light switch 2-pin electrical connector (containing 2 wires – 1 green/black and 1 green/red) (**Figure 143**).
4. Use an ohmmeter and check for continuity between the 2 terminals on the brake light switch electrical connector. There should be no continuity (infinite resistance) with the brake lever released. With the brake lever applied, there should be continuity (low resistance). If the switch fails either of these tests, the switch must be replaced as described in this chapter.

#### Removal/installation (1974-1977 models)

1. If not already removed, perform the following:
  - a. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
  - b. Remove the fuel tank as described in Chapter Seven.
2. Disconnect the front brake light switch 2-pin electrical connector (A, **Figure 142**) from the master cylinder.
3. Carefully unscrew the brake switch (B, **Figure 142**) from the front of the master cylinder.
4. Install a new switch by reversing these removal steps. Note the following during installation.
5. Make sure all electrical connections are tight and free of corrosion.



#### Removal/installation (1978-on models)

1. If not already removed, disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Disconnect the front brake light switch 2-pin electrical connector (**Figure 143**) from the master cylinder.
3. Remove the impact pad as described in this chapter.

#### NOTE

*It is necessary to remove the impact pad in order to gain access to the area behind it for electrical wire and connector removal.*

#### NOTE

*On some models, it is necessary to remove the instrument cluster in order to gain access to the area in front of it for electrical wire and connector removal.*

4. If necessary, remove the instrument cluster as described in this chapter.

#### NOTE

*If the plastic pin on the end of the switch is bent, refer to **Brake Lever Modification** following this procedure to eliminate this problem in the future.*

5. Unhook any tie wraps securing the switch electrical wires and any other wires to the handlebar.
6. Carefully pull on the switch and electrical wire assembly and follow the electrical wires down in front of the steering stem and the frame to where the electrical connector is located on the right-hand side.
7. Disconnect the front brake light switch 2-pin electrical connector. The connector is located on the right-hand side of the frame center tube that runs back from the steering head.
8. Carefully pull the switch and electrical wire assembly out from in front of the steering stem and the frame.
9. Install a new switch by reversing these removal steps. Note the following during installation.
10. Make sure all electrical connections are tight and free of corrosion.

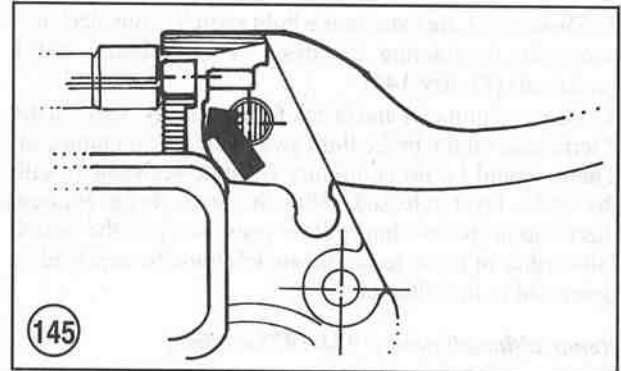
#### Brake lever modification

If the plastic pin on the end of the brake light switch is bent, the switch will not function properly. BMW has determined that a slight modification to the brake lever will eliminate this problem. The sharp corner on the hand lever tends to snag the plastic pin and bend it as the lever moves past the pin during full brake application.

1. Remove the screw (**Figure 144**) securing the front brake lever and remove the lever.



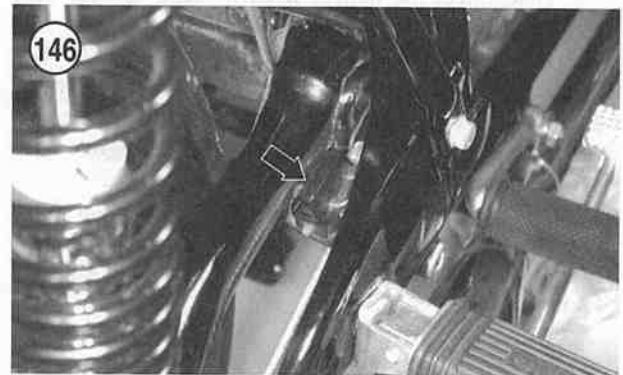
2. File or grind off the sharp corner of the lever shown in **Figure 145**. Only remove the sharp corner as shown.
3. Do not remove any material in the area where the lever normally contacts the brake switch. This area is used to push the switch to the OFF position. If material is removed from this area, the brake switch will not work in the OFF position.
4. Make sure all burrs are removed and that all surfaces are smooth.
5. Install the front brake lever and screw. Tighten the screw securely.



### Rear Brake Light Switch

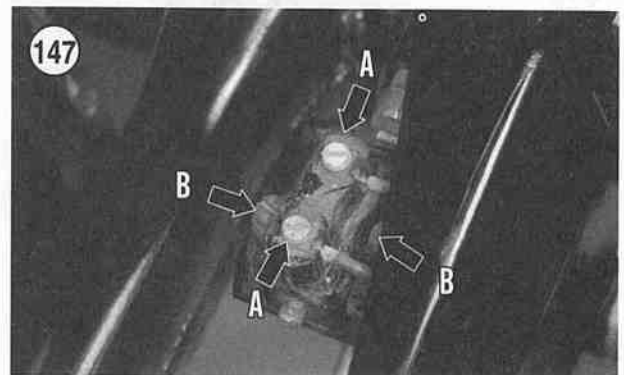
#### Testing

1. If necessary, remove the right-side cover.
2. Remove the rear brake light switch cover (**Figure 146**).
3. Disconnect the electrical connectors (A, **Figure 147**) from the rear brake light switch.
4. Use an ohmmeter and check for continuity between the 2 terminals on the brake light switch as follows:
  - a. There should be no continuity (infinite resistance) with the brake pedal not applied (plunger protruding out of switch).
  - b. There should be continuity (low resistance) with the brake pedal applied (plunger pressed into the switch).



#### Removal/installation

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the cover (**Figure 146**) from the switch.
3. Disconnect the electrical connectors (A, **Figure 147**) from the rear brake light switch.
4. Remove the screws and washers securing the rear brake light switch (B, **Figure 147**) to the frame.
5. Remove the rear brake light switch.



#### NOTE

*If the plastic pin plunger on the end of the switch is bent, refer to **Brake Pedal Modification** following this procedure to eliminate this problem in the future.*

6. Install a new switch by reversing these removal steps. Note the following during installation.
7. Make sure all electrical connections are tight and free of corrosion. Apply dielectric grease (**Figure 148**) to switch terminals.
8. Move the electrical wires back into position and secure with tie wrap(s) if necessary.

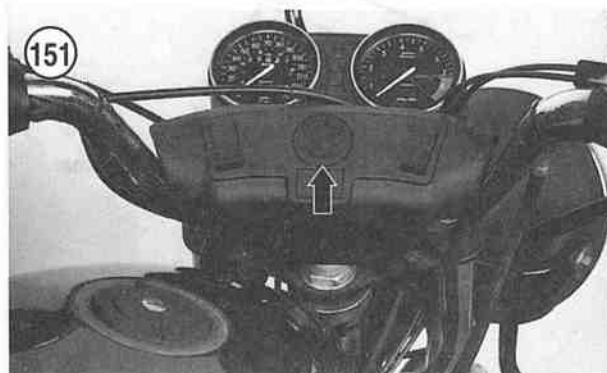
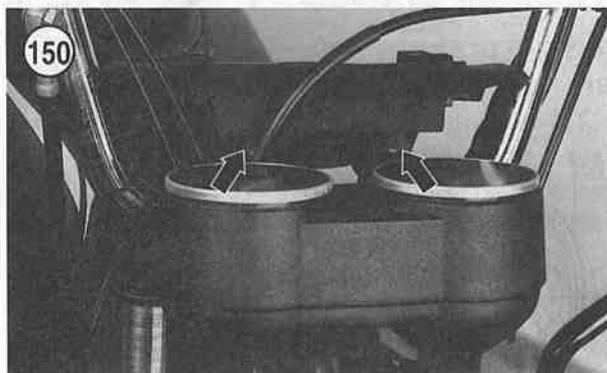
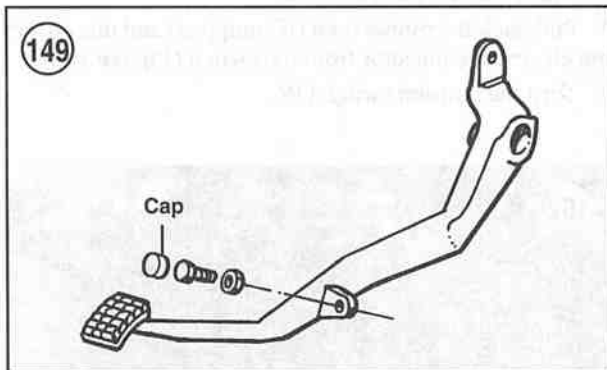




**Brake pedal modification**

If the plastic pin plunger on the end of the brake light switch is bent, the switch will not function properly. BMW has determined that adding a plastic cap to the brake light switch bolt on the brake pedal will eliminate this problem.

1. Remove the brake light switch as described in this chapter.
2. Add a plastic cap (BMW part No. 35 21 1 244 520) to the bolt head as shown in **Figure 149**.
3. Install the brake light switch as described in this chapter.



4. Adjust the bolt (with cap) so there is 3.5 mm (0.138 in.) clearance between the plastic cap and the brake switch.

**Impact Pad Auxiliary Switch Replacement**

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the fuel tank as described in Chapter Seven. This is necessary to gain access to the switch electrical connections located on the frame under the fuel tank.
3. Remove the screws (**Figure 150**) securing the impact pad.
4. Partially pull up on the impact pad (**Figure 151**) and move it out of the way. Don't move the pad too far as there is very little slack in the electrical wires at this time.
5. Follow the electrical wires from the impact pad back to their electrical connectors at the main wiring harness. If necessary, remove any tie wrap(s) securing the electrical wires to the frame.
6. Pull the electrical wires away from the frame to allow slack in wires. Disconnect all electrical wires going to the impact pad electrical switches.
7. Pull the impact pad up and away from the steering head area.
8. Carefully pull all switch electrical wires out from in front of the steering stem and the frame.
9. Remove the impact pad.
10. Insert a narrow flat-bladed screwdriver into each locking tab of the switch. Push the tabs in toward the switch to release them from the impact pad.
11. Pull the switch assembly out through the front of the impact pad.
12. Repeat for any additional switches that require replacement.
13. Install a new switch by reversing these removal steps. Note the following during installation.
14. Make sure the locking tabs are locked correctly in place.
15. Make sure all electrical connections are tight and free of corrosion.
16. Move the electrical wires back into position and secure with tie wrap(s). Make sure the wires are not above the frame members as they may be damaged by the fuel tank when it is installed.

**Clutch Switch****Testing**

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the fuel tank as described in Chapter Seven. This is necessary to gain access to the switch electrical connections located on the frame under the fuel tank.
3. Follow the electrical wires from the clutch switch back to the electrical connector at the main wiring harness. If necessary, remove any tie wrap(s) securing the electrical wires to the frame.
4. Disconnect the clutch switch 2-pin electrical connector.

5. Use an ohmmeter and check for continuity between the 2 terminals on the clutch switch electrical connector. There should be no continuity (infinite resistance) with the clutch lever released. With the clutch lever pulled, there should be continuity (low resistance). If the switch fails either of these tests, the switch must be replaced.

### Removal/installation

1. If not already removed, perform the following:
  - a. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
  - b. Remove the fuel tank as described in Chapter Seven. This is necessary to gain access to the switch electrical connections located on the frame under the fuel tank.
2. Follow the electrical wires from the clutch switch back to the electrical connector at the main wiring harness. If necessary, remove any tie wrap(s) securing the electrical wires to the frame.
3. Disconnect the clutch switch 2-pin electrical connector.

#### NOTE

*On some models it is necessary to remove the instrument cluster in order to gain access to the area in front of it for electrical wire and connector removal.*

4. If necessary, remove the instrument cluster as described in this chapter.
5. Remove the clutch switch from the clutch lever assembly.
6. Unhook any tie wraps securing the switch electrical wires and any other wires to the handlebar.
7. Carefully pull on the switch and electrical wire assembly and follow the electrical wires down in front of the steering stem and the frame.
8. Carefully pull the switch and electrical wire assembly out from in front of the steering stem and the frame.
9. Install a new switch by reversing these removal steps. Note the following during installation.
10. Make sure all electrical connections are tight and free of corrosion.
11. Move the electrical wires back into position and secure with tie wrap(s). Make sure the wires are not above the frame members as they may be damaged by the fuel tank when it is installed.

### Oil Pressure Warning Switch Testing/Replacement

The oil pressure warning light on the instrument cluster is designed to come on when the ignition is turned ON, be-

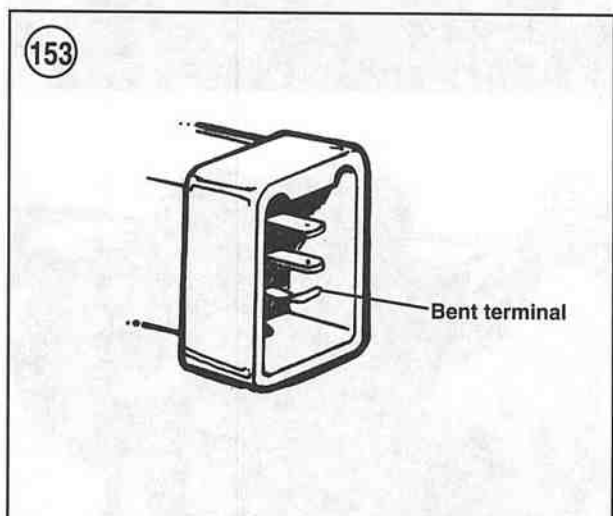
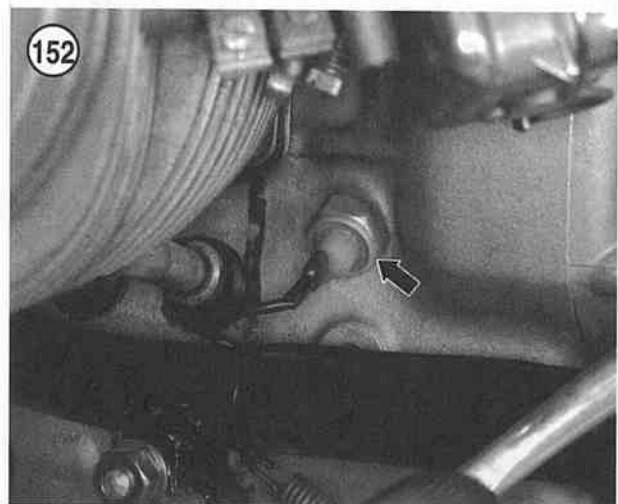
fore starting the engine. As soon as the engine is started and the oil pressure rises to the correct level, the warning light should go out.

If the light fails to come on, check the bulb as described under *Instrument Cluster* in this chapter. Replace the bulb if necessary.

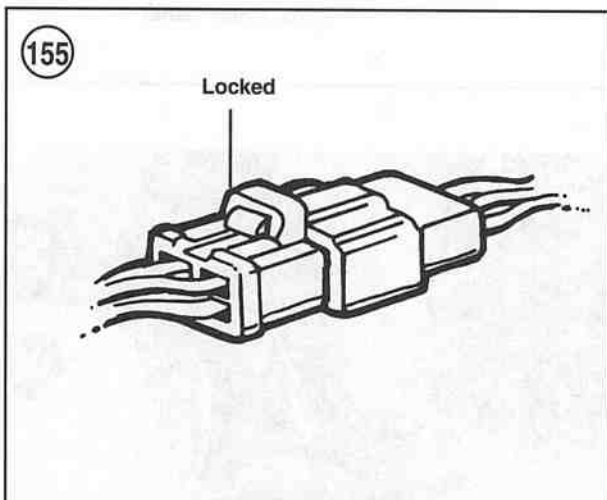
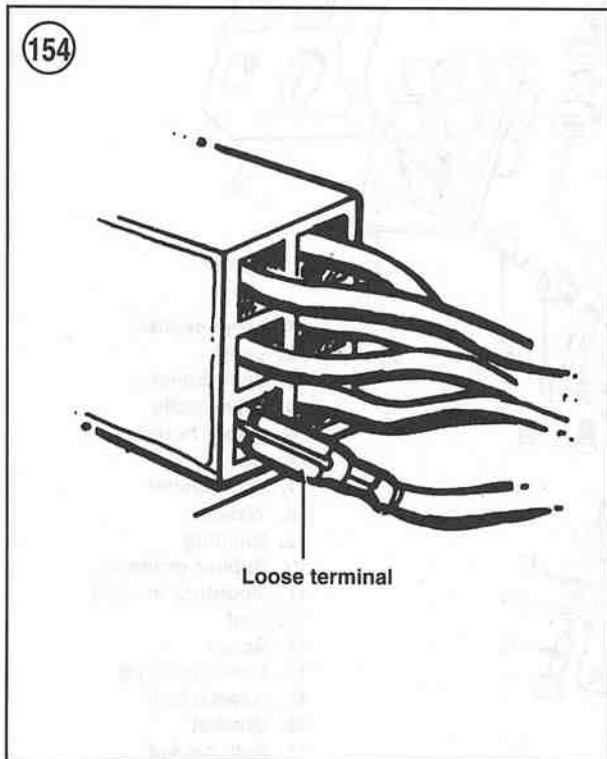
If the oil warning light stays on after the engine is running, stop the engine and check the oil level as described under *Engine Oil Level* in Chapter Three. If the oil level and pressure correct, the oil pressure switch may be faulty. The switch is designed to provide a ground for the warning light circuit when the oil pressure is less than 3-7 psi.

The oil pressure warning switch is located on the lower left-hand side of the crankcase.

1. Pull back the rubber boot (if equipped) and disconnect the electrical connector from the switch (**Figure 152**).
2. Turn the ignition switch ON.



3. Briefly ground the switch electrical connector. The warning light should come on. If the light does not come on, the switch wiring is faulty and must be repaired.
4. If the oil pressure is sufficient and the switch does not provide a ground path, replace it.
5. To replace the oil pressure warning light switch (**Figure 152**) unscrew it from the crankcase.
6. Install the new oil pressure warning light switch into the crankcase and tighten securely.



7. Attach the electrical connector to the switch. Make sure the connection is free from oil and corrosion.
8. If equipped, slide the rubber boot back into position and make sure it is on tight.

### ELECTRICAL CONNECTIONS

Connector problems may cause trouble in any part of the electrical system. If you are having trouble with some of these components, some quick preliminary checks may save you a lot of time.

1. Disconnect each electrical connector and check that there are no bent terminals in the electrical connector (**Figure 153**). A bent terminal will not connect to its mating receptacle in the other connector, causing an open circuit.
2. Make sure the terminals on the end of each wire are pushed all the way into the plastic connector (**Figure 154**). If not, carefully push them in with a narrow-bladed screwdriver.
3. Check all electrical wires where they enter the individual metal terminals in both the male and female plastic connector.
4. After all is checked out, push the connectors together and make sure they are fully engaged and locked together (**Figure 155**).

### INSTRUMENT CLUSTER

BMW has determined that on early production R100RS models there may be a problem with instrument cluster vibration. This vibration may cause the speedometer and tachometer needles to become loose or to disengage from their drive shafts. This is due to faulty rubber mounting bushings. The BMW Service Information Bulletin relating to this specific problem is BMW Service Information Bulletin March 1988, 62 005 88 (2295).

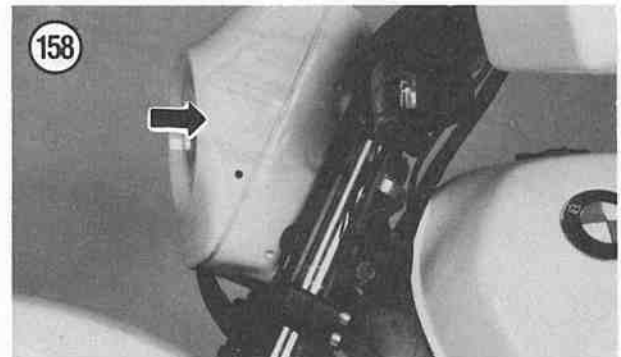
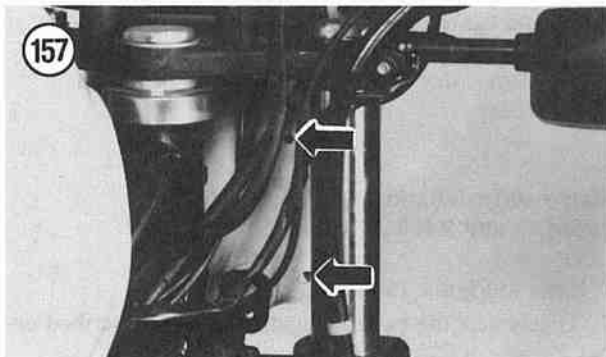
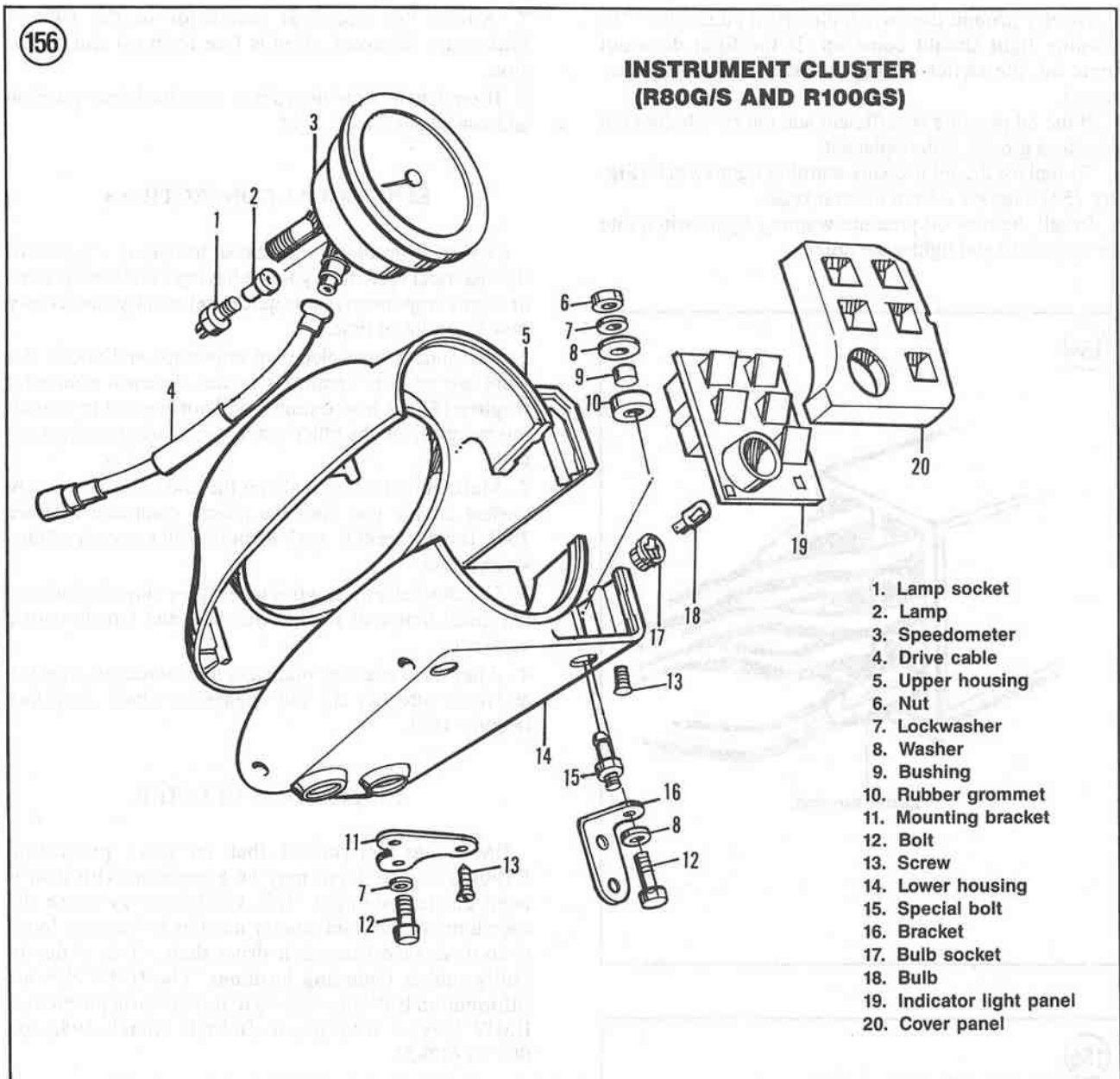
#### NOTE

*The 4 faulty rubber mounting bushings are either gray or white in color. The replacement bushings, which are of a softer durometer rubber, are black in color.*

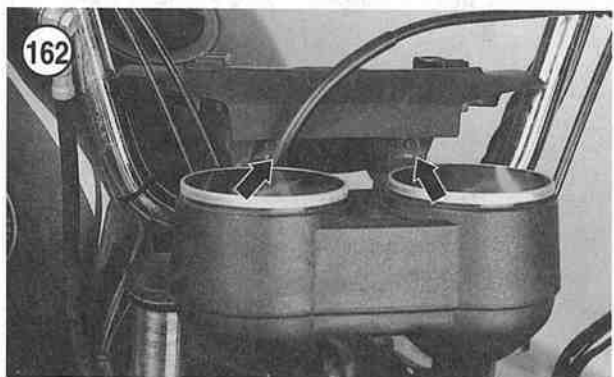
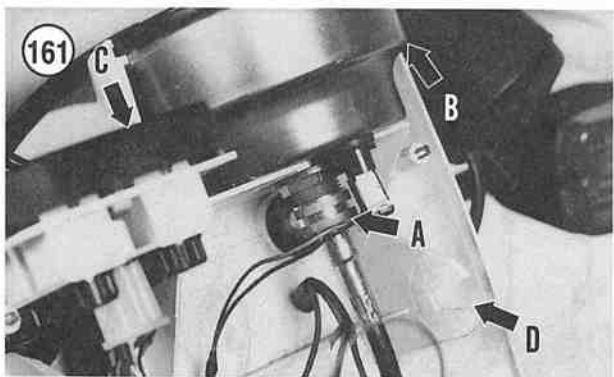
#### Removal/Installation (R80G/S and R100GS Models)

Refer to **Figure 156** for this procedure.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.





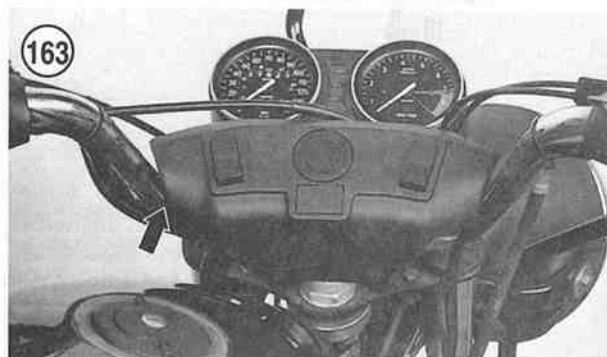


2. Remove the screws (Figure 157) on each side of the backside of the instrument cluster lower housing.
3. Carefully pull the upper housing (Figure 158) off of the lower housing and headlight assembly.
4. Remove the bolt (A, Figure 159) on each side securing the headlight assembly. Pull the headlight assembly (B, Figure 159) forward and disconnect the electrical connector (Figure 160) from the backside of the headlight assembly. Remove the headlight assembly.
5. Unscrew the speedometer drive cable nut (A, Figure 161).
6. Unscrew the speedometer attachment nut and remove the speedometer (B, Figure 161) from the lower housing.
7. Carefully pull the indicator light panel assembly (C, Figure 161) free from the lower housing. If necessary, disconnect the electrical connectors from the assembly. Move the assembly out of the way.
8. Remove the nuts and washers securing the lower housing (D, Figure 161) to the mounting brackets.
9. Carefully remove the lower housing while working the speedometer drive cable and electrical wires through the rubber grommet in the lower housing.
10. Install by reversing these removal steps. Note the following during installation.
11. Make sure the electrical connectors are tight and free of corrosion.

#### Removal/Installation

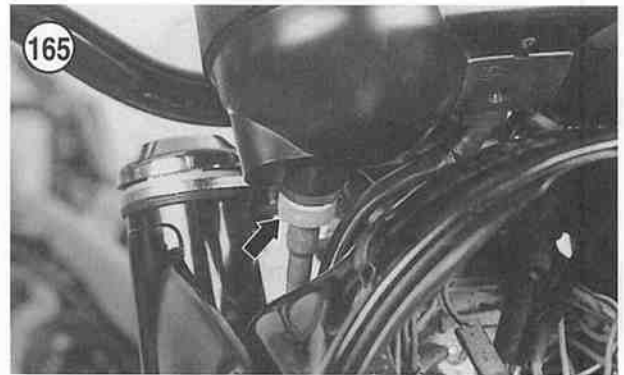
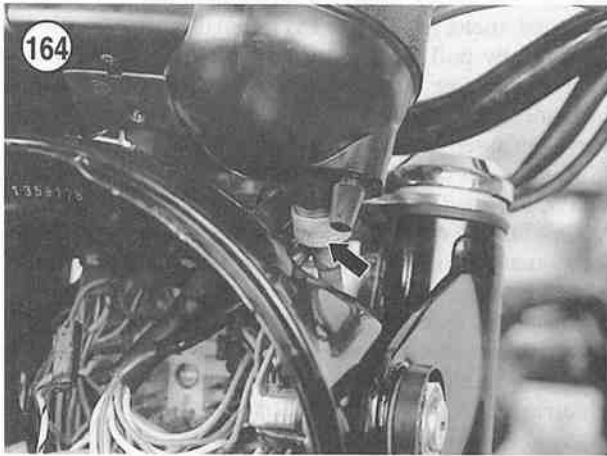
(All Models Except R80G/S and R100GS)

1. On models so equipped, remove the front fairing as described in Chapter Twelve.
2. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
3. On models so equipped, remove the screws (Figure 162) securing the impact pad.
- 4A. On models with no auxiliary switches, remove the impact pad (Figure 163).
- 4B. On models equipped with auxiliary switches, perform the following:
  - a. Partially pull up on the impact pad and move it out of the way. Don't move the pad too far as there is very little slack in the electrical wires at this time.



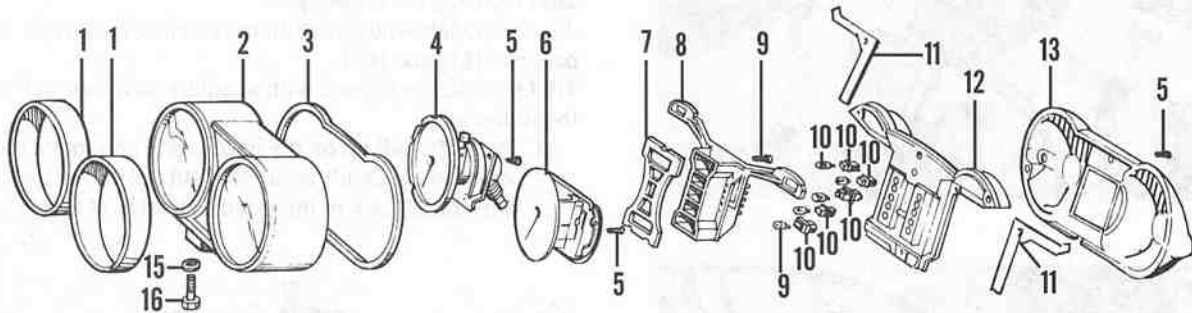


- b. Follow the electrical wires from the impact pad back to their electrical connectors at the main wiring harness. If necessary, remove any tie wrap(s) securing the electrical wires to the frame.
- c. Pull the electrical wires away from the frame to allow slack in wires.
- d. Pull the impact pad up and away from the steering head area. It is not necessary to completely remove the impact pad, just move it out of the way.



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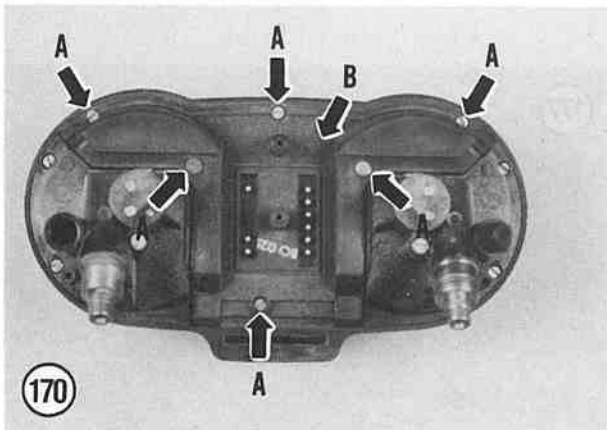
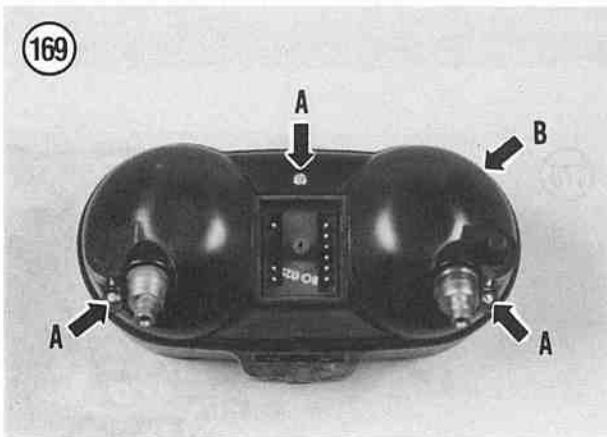
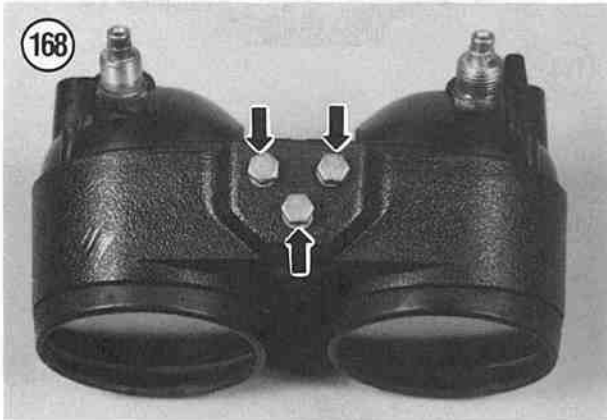
**INSTRUMENT CLUSTER  
(ALL MODELS EXCEPT R80G/S AND R100GS)**



- 1. Trim ring
- 2. Housing
- 3. Gasket
- 4. Speedometer
- 5. Screw
- 6. Tachometer
- 7. Gasket
- 8. Printed circuit board and lamp support

- 9. Bulb
- 10. Bulb socket
- 11. Gasket
- 12. Cap
- 13. Rear cover
- 14. Washer
- 15. Bolt

5. Unscrew the knurled nut (Figure 164) on the speedometer drive cable.
6. On models with a mechanical tachometer, unscrew the knurled nut (Figure 165) on the tachometer drive cable.
7. Loosen the bolts and washers (Figure 166) securing the instrument cluster to the mounting bracket.

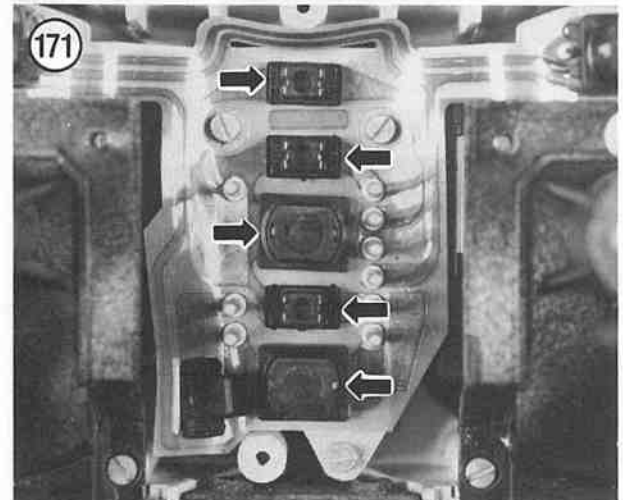


8. Carefully pull the instrument cluster upward to gain access to the backside of the instrument cluster.
9. Remove the screw securing the electrical connector cover panel and remove the cover panel.
10. Carefully disconnect the electrical connector from the instrument cluster.
11. Remove the instrument cluster.
12. Install by reversing these removal steps. Note the following during installation.
13. Tighten the bolts securely. Don't overtighten the bolts as the plastic mounting bosses may be damaged.
14. Make sure the electrical connector is free of corrosion and is tight.

#### Disassembly/Assembly, Component and Lamp Replacement (All Models Except R80G/S and R100GS)

Refer to Figure 167 for this procedure.

1. Remove the instrument cluster as described in this chapter.
2. Remove the instrument cluster mounting bolts and lockwashers (Figure 168).
3. Remove the screws (A, Figure 169) securing the rear cover and remove the rear cover (B, Figure 169).
4. Remove the screws (A, Figure 170) securing the cap and remove the cap (B, Figure 170).
5. To replace the various bulbs, perform the following:
  - a. Pull the socket and bulb out of the printed circuit board and lamp support. Refer to Figure 171 or Figure 172.
  - b. Install a new bulb(s) and push it into place. Be sure to push the bulb in all the way to make good electrical contact on the printed circuit board.
6. Remove the mounting plate (Figure 173).

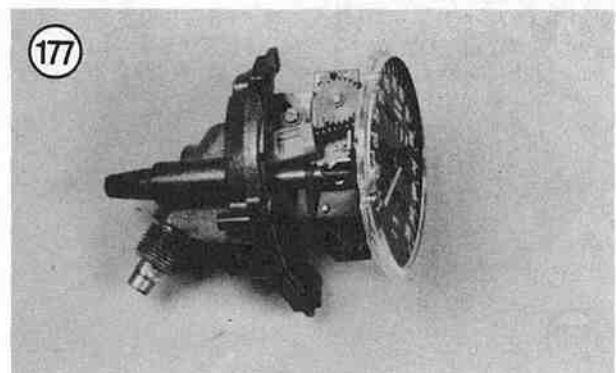
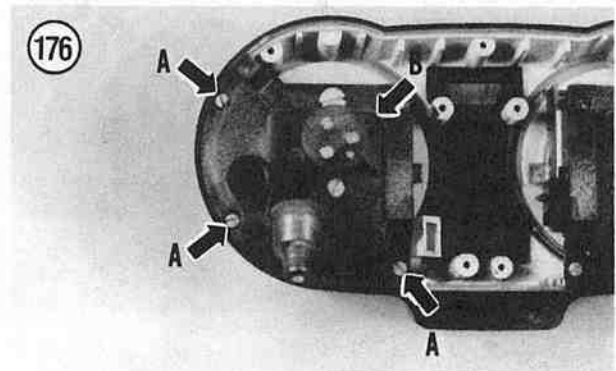
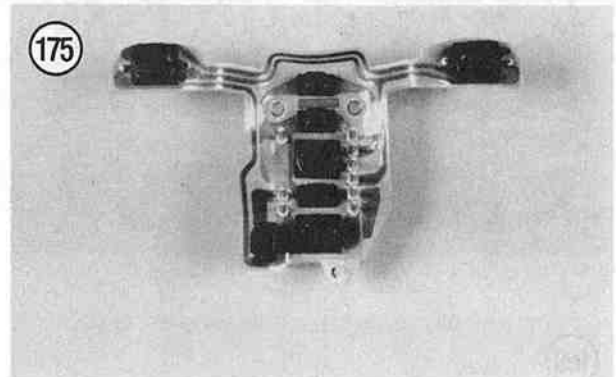
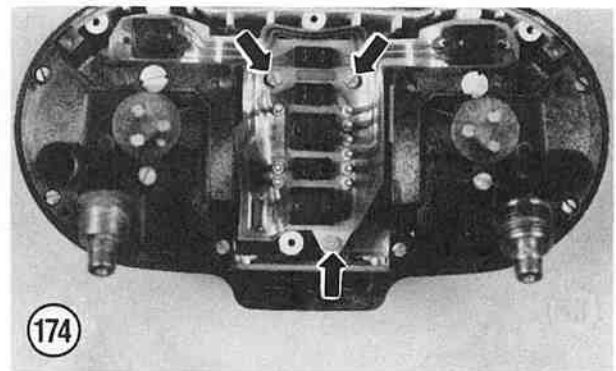
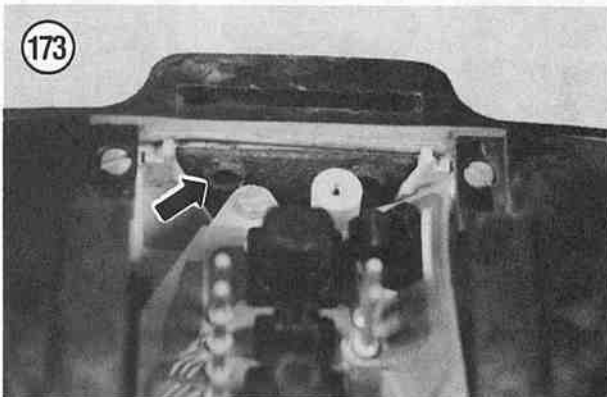
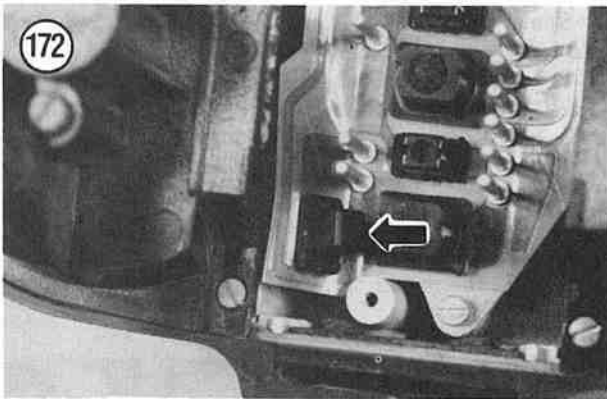


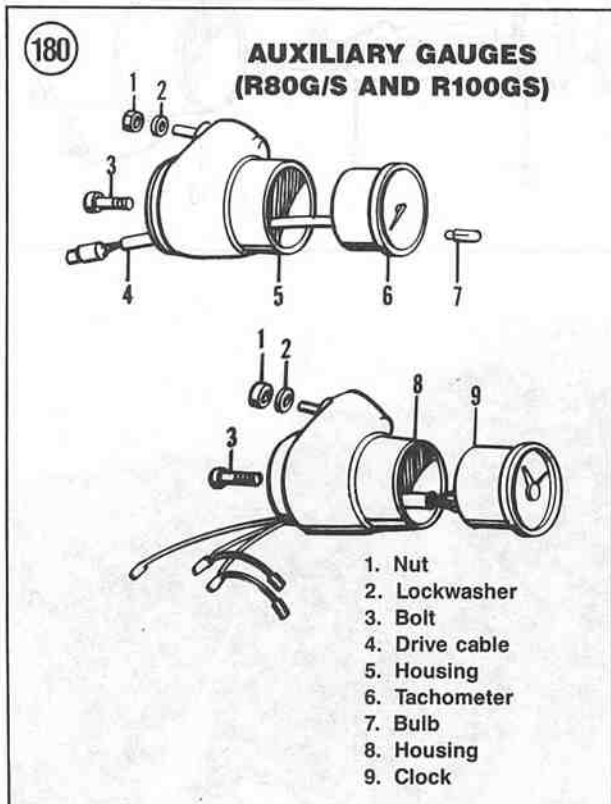
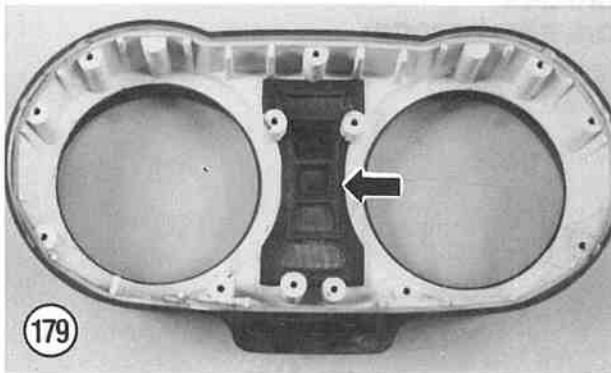
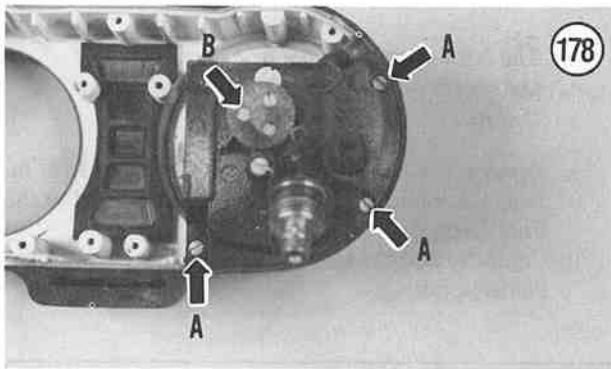
7. To remove and install the lamp support, perform the following:

- a. Remove the lamp and socket assembly (Figure 172) on the left-hand side.
- b. Remove the screws (Figure 174) securing the printed circuit board and lamp support.
- c. Carefully remove the printed circuit board and lamp support from the housing.
- d. Inspect the printed circuit board and lamp support (Figure 175) for damage. Make sure there are no breaks in any of the printed circuits. Replace the assembly if necessary.
- e. Install and tighten the screws securely. Do not overtighten as the plastic mounting bosses may be damaged.

8. To remove and install the tachometer, perform the following:

- a. Remove the screws (A, Figure 176) securing the tachometer assembly to the housing.
- b. Remove the tachometer assembly (B, Figure 176).
- c. Inspect the tachometer for wear or damage. There are no replacement parts available for the tachometer and if faulty the entire assembly must be replaced.
- d. Install and tighten the screws securely. Do not overtighten as the plastic mounting bosses may be damaged.





9. To remove and install the speedometer, perform the following:

- a. Remove the screws (A, **Figure 178**) securing the speedometer assembly to the housing.
- b. Remove the speedometer assembly (B, **Figure 178**).
- c. Inspect the speedometer (**Figure 177**) for wear or damage. There are no replacement parts available for the speedometer, and if faulty, the entire assembly must be replaced.
- d. Install and tighten the screws securely. Do not overtighten as the plastic mounting bosses may be damaged.

10. If necessary, remove the gasket (**Figure 179**) and replace with a new one.

#### Auxiliary Gauges Removal/Installation (R80G/S and R100GS Models)

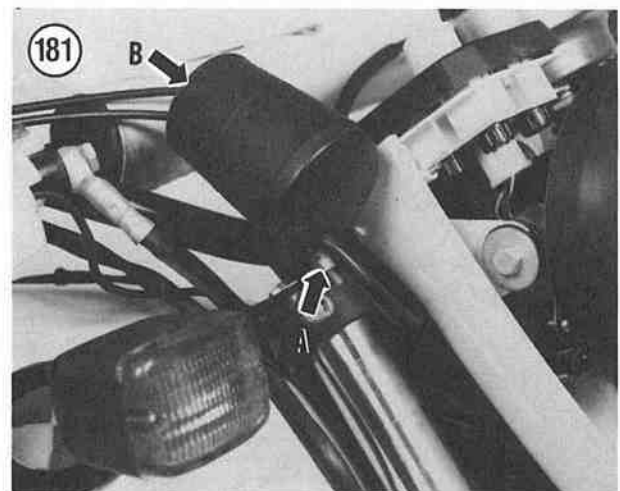
Refer to **Figure 180** for this procedure.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Disconnect the electrical connector going to the auxiliary gauge to be removed.
3. Remove the nut and lockwasher (A, **Figure 181**) securing the gauge to the mounting bracket.
4. Remove the gauge (B, **Figure 181**).
5. Install by reversing these removal steps. Note the following during installation.
6. Make sure the electrical connector is free of corrosion and is tight.

#### Auxiliary Gauges Removal/Installation (1974-on Models Except R80G/S and R100GS)

Refer to **Figure 182** for this procedure.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.

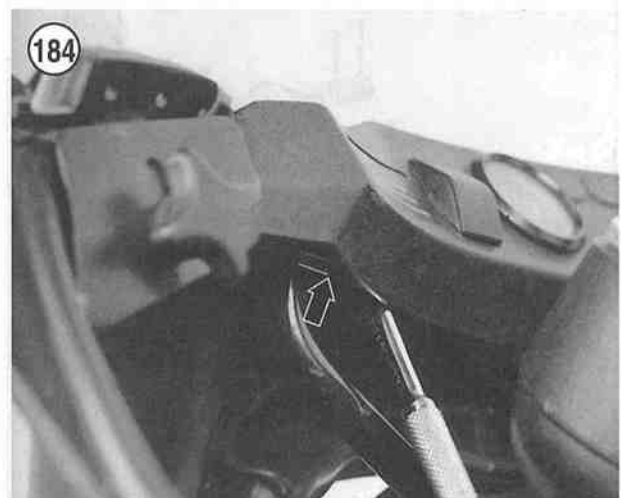
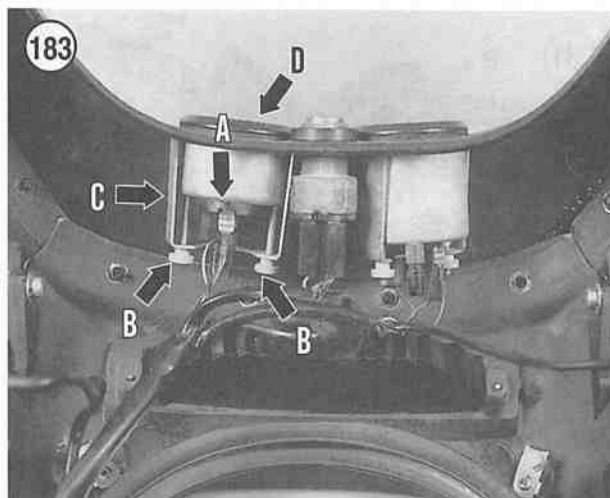
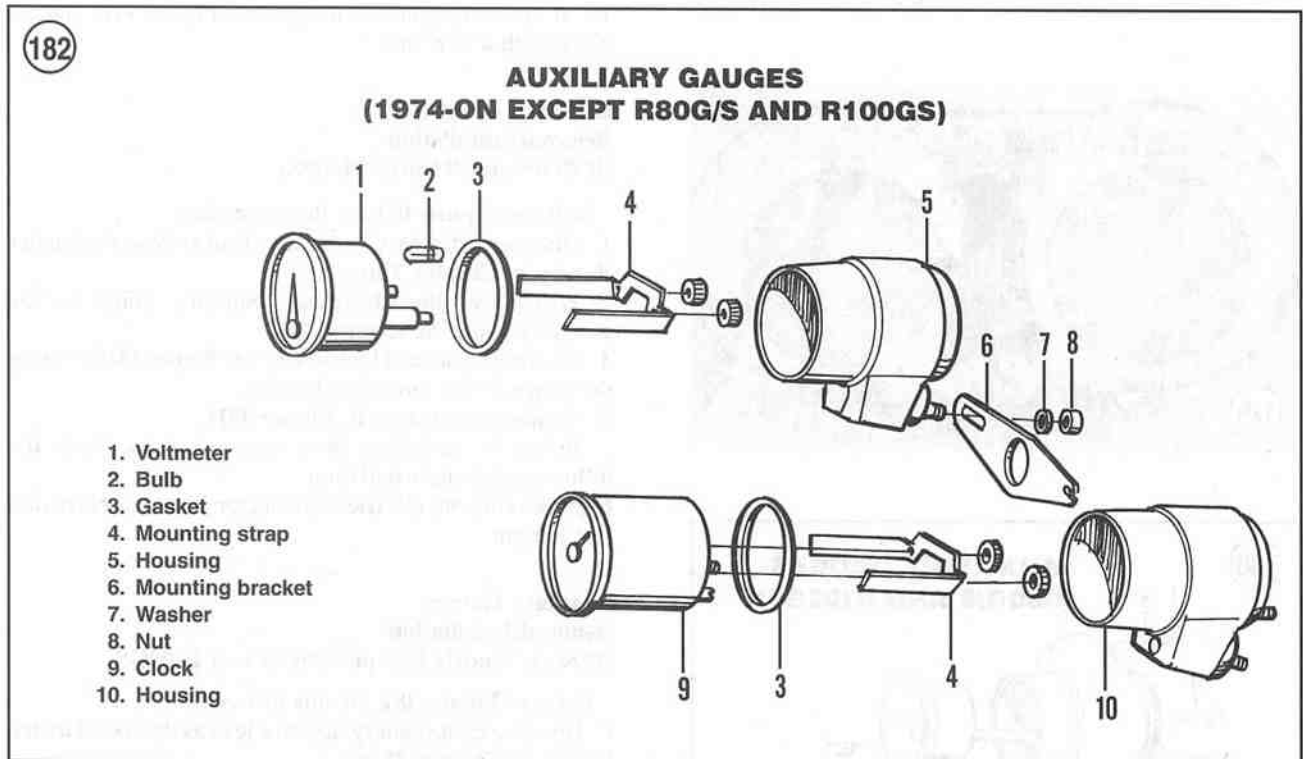


- 2A. On R100RS models, perform the following:
- Remove the upper section of the front fairing as described under *Body Panels* in Chapter Twelve.
  - Disconnect the electrical connectors (A, **Figure 183**) going to the auxiliary gauge to be removed.
  - Unscrew the mounting screws (B, **Figure 183**) securing the gauge mounting bracket.
  - Remove the mounting bracket (C, **Figure 183**) and auxiliary gauge (D, **Figure 183**).
- 2B. On R80RT and R100RT models, perform the following:

## NOTE

The bolts are not visible in **Figure 184**, but the socket and wrench are installed on the bolt head.

- Remove the bolt and lockwasher (**Figure 184**) on each side securing the auxiliary gauge panel to the front fairing.
- Carefully pull the auxiliary gauge panel away from the front fairing.



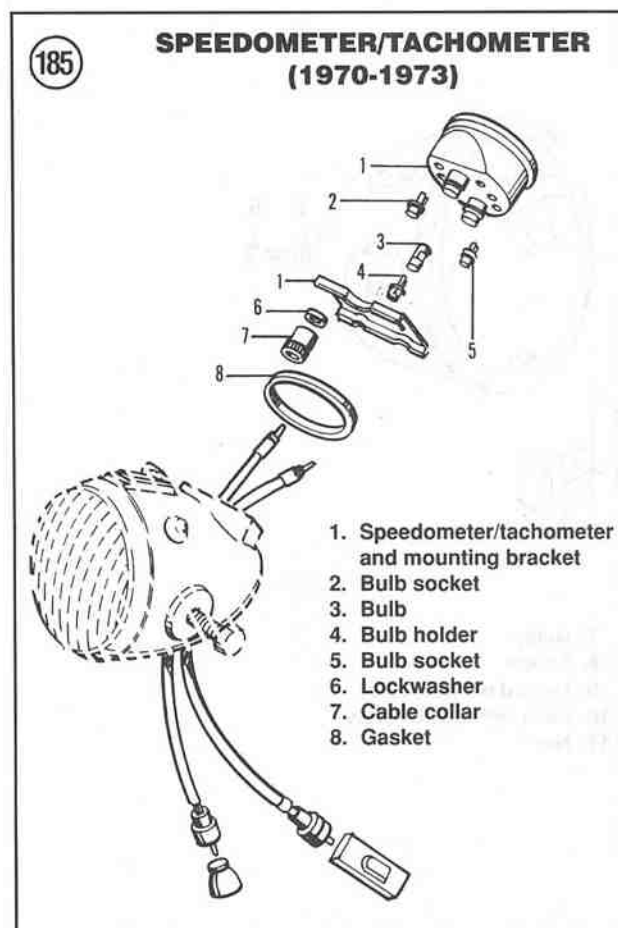


- c. Disconnect the electrical connectors going to the auxiliary gauge to be removed.
  - d. Unscrew the screws securing the gauge mounting bracket.
  - e. Remove the mounting bracket and auxiliary gauge.
3. Install by reversing these removal steps. Note the following during installation.
  4. Make sure the electrical connectors are tight and free of corrosion.

### Speedometer/Tachometer Removal/Installation (1970-1973 Models)

Refer to **Figure 185** for this procedure.

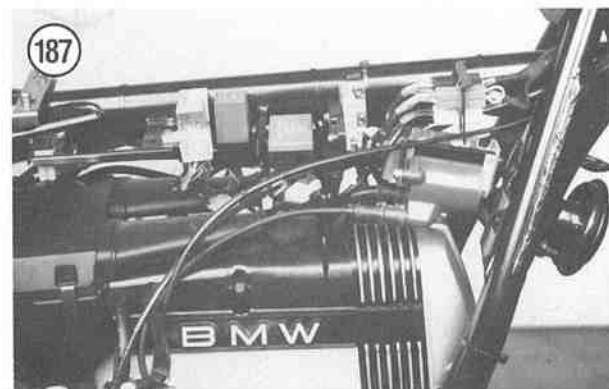
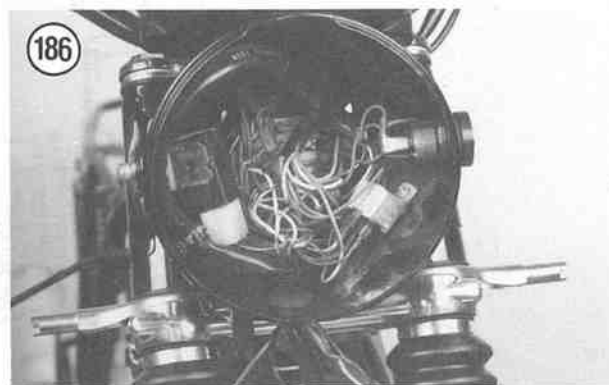
1. Remove the headlight lens assembly as described under *Headlight and Parking Light Bulb Replacement (1970-1973 Models)* in this chapter.
2. Disconnect the electrical connector from the turn signal flasher unit and remove the flasher unit.
3. Carefully pull the illumination light and warning light sockets from the backside of the speedometer/tachometer assembly.
4. Unscrew the drive cable collars from the speedometer and tachometer assembly.



5. Remove the mounting nuts securing the speedometer/tachometer assembly to the headlight case.
6. Carefully withdraw the speedometer/tachometer assembly out through the top of the headlight case.
7. Inspect the gasket between the speedometer/tachometer assembly and the headlight case. Replace if it is starting to deteriorate or become hard.
8. Install by reversing these removal steps. Note the following during installation.
9. Make sure the electrical connectors are tight and free of corrosion.

### RELAYS

The BMW R-series bikes are equipped with various relays that are used in conjunction with the different electrical systems. The relays are either located in the headlight case on some early models (**Figure 186**) or under the fuel tank on the frame top rail (**Figure 187**) on other models. BMW does not provide service information for the relays. If you are having troubles within a specific system that has a relay in the circuit, check the circuit thoroughly before replacing the relay. Don't purchase a new relay prematurely without checking out the circuit as this may lead to the unnecessary purchase of an expensive electrical part that cannot be returned for a refund. Most dealers and parts houses will not accept any returns on electrical parts.



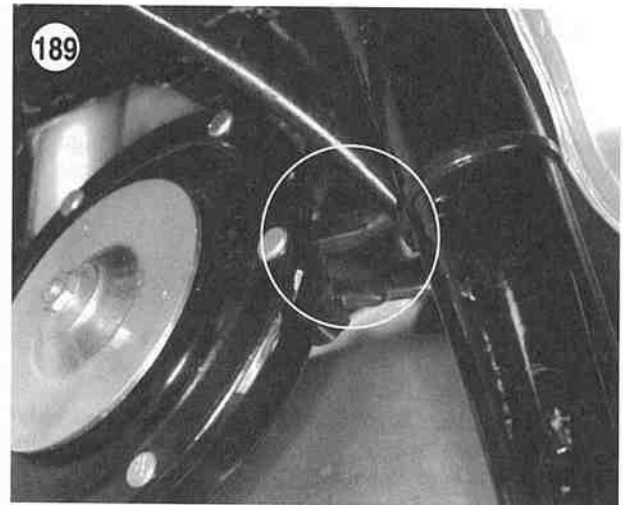
## Relay Replacement

### NOTE

Individual connectors are used on the main light switch relay connections on /6 and /7 models. See **Figure 188** for proper connections. Block connectors are used on all other relay connections.

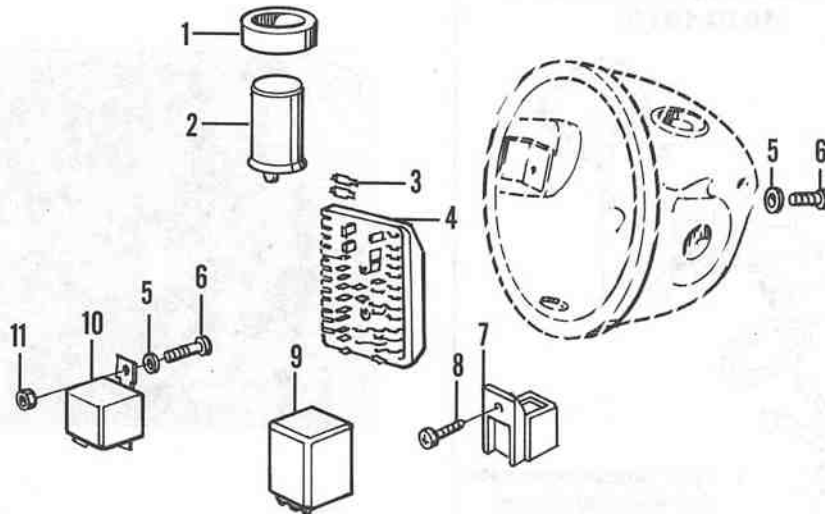
Refer to **Figure 188** for relay location in the headlight case.

1. Remove the fuel tank as described in Chapter Seven.
2. Remove the headlight lens assembly as described in this chapter.
3. Before removing and disconnecting any electrical wires from a relay, mark the wire and to which relay terminal number it is attached. This will ensure a correct wire connection when the new relay is installed.



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### COMPONENTS WITHIN THE HEADLIGHT CASE (1970-1979 MODELS)



1. Rubber ring
2. Turn signal relay
3. Fuse
4. Fuse panel
5. Washer
6. Screw

7. Relay
8. Screw
9. Hazard warning relay
10. Main light switch relay
11. Nut

4. Remove the relay from its mount.
5. Install by reversing these removal steps. Note the following during installation.
6. Make sure the electrical connectors are tight and free of corrosion.

## HORN

### Removal/Installation

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. On models equipped with a front fairing, remove the center lower cover of the front fairing as described under *Body Panels* in Chapter Twelve.
3. Disconnect the electrical connectors (**Figure 189**) to the horn(s).
4. Remove the bolt securing each horn (**Figure 189**) and remove the horn(s).
5. Install by reversing these removal steps. Note the following during installation.
6. Make sure the electrical connectors are tight and free of corrosion.

### Horn Testing

Remove the horn as described in this chapter. Connect a 12-volt battery to the horn. If the horn is good, it will sound. If not, replace it.

## FUSES

The number of fuses differs among the various models. They are located as follows:

- a. 1970-1979: Located within the headlight case (**Figure 188**).
- b. R80G/S and R100GS: Next to the battery.
- c. All other models: Under the seat and tool tray.

### CAUTION

*When replacing a fuse, make sure the ignition switch is in the OFF position. This will lessen the chance of a short circuit.*

### Fuse Replacement

If a fuse in the fuse holder blows, perform the following.

### NOTE

*On R80G/S and R100GS models, the fuses are not the typical glass tube with metal*

*ends but are the spade type. Carry extra fuses in your tool box.*

Remove the old fuse and install a new one.

Whenever a fuse blows, find out the reason for the failure before replacing the fuse. Usually the trouble is a short circuit in the wiring. This may be caused by worn-through insulation or a disconnected wire shorted to ground.

### CAUTION

*Never substitute aluminum foil or wire for a fuse. Never use a higher amperage fuse than specified. An overload could cause a fire and complete loss of the motorcycle.*

## WIRING CIRCUIT INSPECTION

### NOTE

*If the bike was involved in a fire, the chemical compounds used in some fire extinguishers will severely corrode any electrical connectors that they come in contact with. All extinguisher chemicals must be thoroughly cleaned.*

1. Inspect all electrical connections for corrosion. Clean off all corrosion and do a final cleaning with an aerosol electrical contact cleaner.
2. Make sure all electrical connections are tight. If possible, use a pair of pliers to tighten the male portion of the connector.
3. Where possible, check out the continuity of the electrical wire from one end to the other. Connect one test lead of an ohmmeter to one end of the wire in the electrical connector. Attach the other end to the other end of the wire in the electrical connector. There should be continuity (indicated resistance). If there is no continuity (infinite resistance), there is an open in the wire or electrical connector and it must be repaired or replaced. Disconnect the ohmmeter.
4. If a light bulb is used in the circuit, make sure the bulb has not blown. If so, replace the bulb.
5. If a fuse is used in the circuit, make sure the fuse has not blown. If so, replace the fuse as described in this chapter.
6. Make sure a switch in the circuit is functioning properly. Refer to *Switches* in this chapter.
7. If all of these simple tests prove to be okay, then replace the relay.

## WIRING DIAGRAMS

Color wiring diagrams for all models are located at the end of this manual.

**Tables are on the following pages.**

**Table 1 ELECTRICAL SYSTEM TORQUE SPECIFICATION**

Item	N·m	in.-lb.	ft.-lb.
Alternator rotor bolt	23-27	—	17-20
Alternator stator bolts	4.7	35	—
Advance unit retaining nut	6	53	—
Starter mounting bolt	47	—	35

**Table 2 ELECTRICAL SYSTEM SPECIFICATIONS**

<b>Battery specifications</b>	
Model/year	Amperage
1970-1973	15 amp/hour
1974-1976	25 amp/hour
1977-1980	28 amp/hour
R65 (1979-1980)	16 amp/hour
R65 (1981-on), R65LS, R80G/S (with electric starter) and R80ST	15 amp/hour
R80RT (1983-1984)	28 amp/hour
R80G/S (without electric starter)	9 amp/hour
R80, R80RT (1985-on)	20 amp/hour
R100	28 amp/hour
R100S (1980)	28 amp/hour
R100CS (1981-1982)	28 amp/hour
R100T, R100RS and R100RT (1981)	28 amp/hour
R100RS (1988-on)	25 amp/hour
R100RT (1988-on)	25 amp/hour
R100GS (1981-1987)	28 amp/hour
R100GS (1988-on)	25 amp/hour
<b>Alternator</b>	
Manufacturer: Bosch, 3-phase with direct drive	
Brush projection service limit: 8 mm (0.32 in.)	
Slip ring minimum O.D.: 26.8 mm (1.0551 in.)	
Stator winding resistance value:	
1970-1976: 6.9-7.6 ohms	
1977-on: 0.62 ohms	
Rotor exciter coil resistance value: 3.40-3.74 ohms (Between rotor slip rings)	
<b>Starter</b>	
Manufacturer:	
R100GS models: Valeo	
All other models: Bosch	
Permanent magnet field coil	
<b>Ignition coil resistance values</b>	
Single coils:	
Primary: 0.67-0.77 ohms	
Secondary: 3.7-5.3 K ohms	
Dual coils:	
Primary: 1.15-1.32 ohms	
Secondary: 7.5-9.15 K ohms	

**Table 3 STARTER TROUBLESHOOTING**

<b>Symptom</b>	<b>Probable cause</b>	<b>Remedy</b>
<b>Starter does not work</b>	Low battery Worn brushes Defective relay Defective switch Defective wiring connection Internal short circuit	Recharge battery Replace brushes Repair or replace Repair or replace Repair wire or clean connection Repair or replace defective component
<b>Starter action is weak</b>	Low battery Pitted relay contacts Worn brushes Defective connection Short circuit in commutator	Recharge battery Clean or replace Replace brushes Clean and tighten Replace armature
<b>Starter runs continuously</b>	Stuck relay	Replace relay
<b>Starter turns; does not turn engine</b>	Defective starter clutch	Replace starter clutch



Table 4 BULB REPLACEMENT

Year, model, wattage (all bulbs 12-volt)				
Item	1970-1973	1974-1976	1977-1978	
		R80, R80RT	R100S, R100RS	R60/7, R75/7, R80/7, R100/7, R80GS
Headlight	45/40	60/55	60/55 (H4)	60/55 (H4)
Parking lamp	4	4	4	4
Taillight/brakelight	21/5	21/5	21/5	21/5
Turn signals	21	21	21	21
Instrument lighting	2	3	1.2	3
Low brake fluid	—	1.2	—	—
Indicators				
Neutral	2	1.2	1.2	3
Oil pressure	2	1.2	1.2	3
Charge	4	3	3	3
High beam	2	1.2	1.2	3
Turn indicator	2	3	3	3
Year, model, wattage (all bulbs 12 volt)				
Item	R65, R65LS	1979-1980	1981-1983	1980-on
		R100T, R100S, R100RT, R100RS	R100, R100CS, R100RS R100RT	R100RS, R100RT
Headlight	60/55 (H4)	60/55 (H4)	60/55 (H4)	60/55 (H4)
Parking lamp	4	4	4	4
Taillight/brakelight	21/5	21/5	21/5	21/5
Turn signals	21	21	21	21
Instrument lighting	3	1.2	3	3
Indicators				
Neutral	3	1.2	1.2	3
Oil pressure	1.2	1.2	1.2	3
Charge	1.2	3	3	3
High beam	3	1.2	1.2	3
Turn indicator	3	3	3	3
Brake indicator	—	1.2	—	—

**NOTE:** If you own a 1990 or later model, first check the Supplement at the back of this book for any new service information.

## CHAPTER NINE

# FRONT SUSPENSION AND STEERING

This chapter describes repair and maintenance procedures for the front wheel, front forks and steering.

Front suspension torque specifications are listed in **Table 1**. **Tables 1-3** are at the end of this chapter.

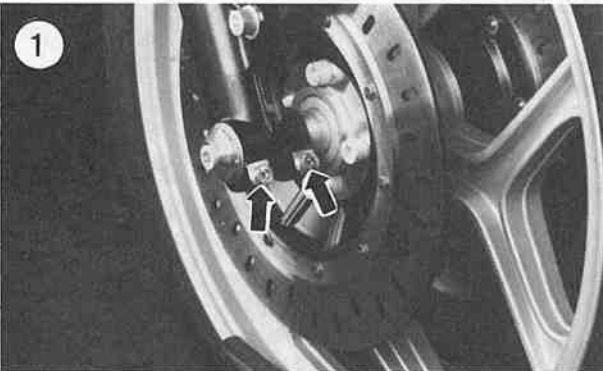
### FRONT WHEEL

**Removal**  
(1985-on R80RT, 1988-on R100RS  
and R100RT Models)

#### CAUTION

Care must be taken when removing, handling and installing a wheel with disc brake rotor(s).

*The disc rotor(s) is relatively thin in order to dissipate heat and to minimize unsprung weight. The rotor(s) is designed to withstand tremendous rotational loads but can be damaged when subjected to side impact loads. If the rotor(s) is knocked out of true by a side impact, a pulsation will be felt in the front brake lever when braking. The rotor is too thin to be trued and must be replaced with a new one. Protect the rotor(s) when transporting a wheel to a dealer or tire specialist for tire service. Do **not** place a wheel in a car trunk or pickup bed without protecting the rotor(s) from side impact damage.*



1. Place the bike on the centerstand, then place wood blocks under the engine oil pan to support it securely with the front wheel off the ground.

#### NOTE

*The front wheel can be removed with the brake caliper(s) still attached to the front fork slider.*

2. Loosen the front axle clamping bolts (**Figure 1**) on the right-hand fork leg.
3. Remove the bolt (A, **Figure 2**) and special washer (B, **Figure 2**) from the right-hand side of the front axle.

- Loosen the front axle clamping bolts (Figure 3) on the left-hand fork leg.

**NOTE**

Prior to removing the front wheel, note the direction of the tire rotation arrow (Figure 4). If the tire is not marked, mark a rotation arrow either on the tire or wheel. The wheel must be reinstalled the same way so the arrow will be pointing in the correct direction.

- Insert a drift or Allen wrench into the hole (Figure 5) in the left-hand side of the front axle.
- Rotate the axle back and forth and withdraw the front axle from both fork legs.
- Let the wheel come down and forward and remove it. Don't lose the spacer on each side of the front hub. Don't intermix them as they must be installed on the correct side of the wheel during installation.

**CAUTION**

Do not set the wheel down on the disc surface as it may get scratched or warped. Set the tire sidewalls on 2 wood blocks as shown in Figure 6.

- Insert a piece of vinyl tubing or wood in the caliper(s) in place of the brake disc(s). That way if the brake lever is inadvertently squeezed, the pistons will not be forced out of the cylinders. If this does happen, the calipers may have to be disassembled to reseat the pistons and the system will have to be bled.
- Inspect the front wheel as described in this chapter.

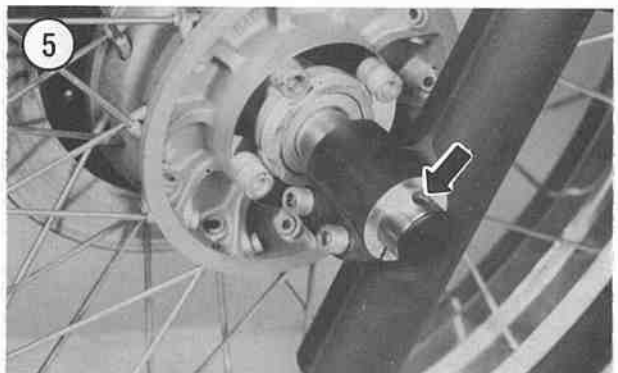
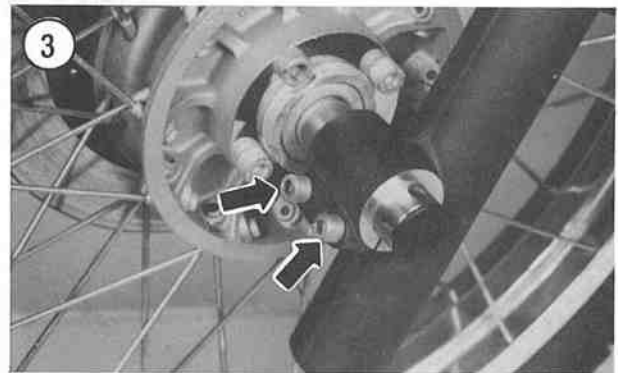
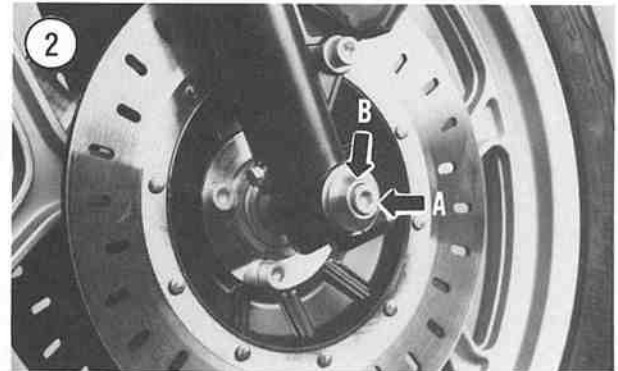
**Installation**

(1985-on R80RT, 1988-on R100RS and R100RT Models)

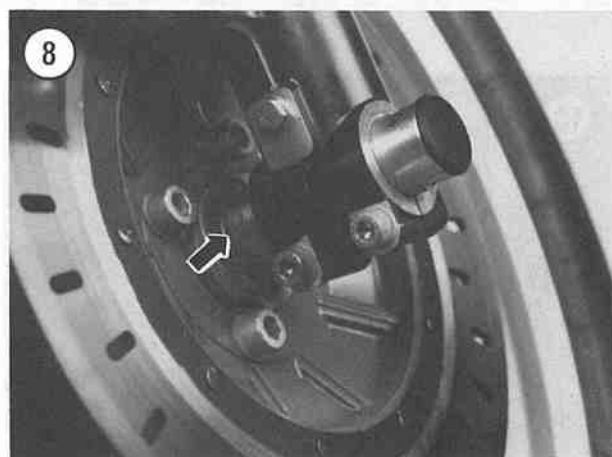
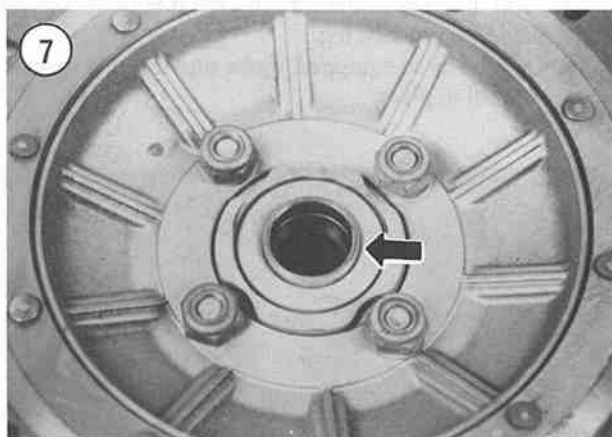
- Remove the vinyl tubing or pieces of wood from the brake caliper(s).
- Make sure the axle bearing surfaces of both fork sliders and the axle are free from burrs and nicks.
- Apply a small amount of cold grease to the inner surfaces of the spacers. This will help hold them in place.
- Position the spacers onto the correct side of the wheel hub. The narrow spacer (Figure 7) goes on the left-hand side.
- Make sure the front wheel tire rotation arrow (Figure 4) is pointing in the correct direction.
- Apply a light coat of multipurpose grease to the front axle prior to installation.

**CAUTION**

When installing the front wheel, carefully insert the brake discs into the caliper assemblies. Do not damage the leading edges of the brake pads during installation.



7. Roll the wheel into position. Lift the wheel up and install the front axle in from the left-hand side. Push the axle all the way in until it bottoms out on the right-hand fork leg. Make sure the axle spacers (Figure 8) are still in place.
8. Install the special washer (B, Figure 2) and the Allen bolt (A, Figure 2) into the front axle.



9. Install a drift or Allen wrench into the hole in the left-hand end of the front axle. This is to prevent the axle from turning while tightening the Allen bolt on the opposite end.
10. Tighten the Allen bolt to the torque specification listed in Table 1.
11. Remove the wood block(s) from under the engine oil pan and take the bike off the centerstand.
12. Apply the front brakes and pump the front forks up and down several times to seat and center the front axle within the fork tubes.
13. Tighten the front axle clamp bolts on each fork leg to the torque specification listed in Table 1.
14. After the wheel is completely installed, rotate it several times and apply the brakes a couple of times to make sure the wheel rotates freely and that the brake pads are positioned against the discs correctly.

#### Removal (All Other Models)

##### NOTE

Due to the number of models and years covered in this manual, this procedure represents a typical front wheel removal and installation.

##### CAUTION

Care must be taken when removing, handling and installing a wheel with disc brake rotor(s). The disc rotor(s) is relatively thin in order to dissipate heat and to minimize unsprung weight. The rotor(s) is designed to withstand tremendous rotational loads but can be damaged when subjected to side impact loads. If the rotor(s) is knocked out of true by a side impact, a pulsation will be felt in the front brake lever when braking. The rotor is too thin to be trued and must be replaced with a new one. Protect the rotor(s) when transporting a wheel to a dealer or tire specialist for tire service. Do **not** place a wheel in a car trunk or pickup bed without protecting the rotor(s) from damage.

1. Place the bike on the centerstand, then place wood block(s) under the engine oil pan to support it securely with the front wheel off the ground.

##### NOTE

On disc brake models, the front wheel can be removed with one of the brake calipers still attached to the front fork slider.

2. On drum brake models, remove the bolt and nut securing the brake panel torque link to the front fork. Install the bolt and nut onto the fork slider to avoid misplacing them.

3. Remove the front axle nut and washer (**Figure 9**).
4. If so equipped, loosen the front axle clamping bolt(s) (**Figure 10**) on the right-hand fork.
5. Loosen the front axle clamping bolt(s) (**Figure 11**) on the left-hand fork leg.

**NOTE**

*Prior to removing the front wheel, note the direction of the tire rotation arrow (**Figure 4**). If the tire is not marked, mark a rotation arrow either on the tire or wheel. The wheel must be reinstalled the same way so the arrow will be pointing in the correct direction.*

6. Insert a drift or Allen wrench into the hole in the end of the front axle.
7. Rotate the axle back and forth and withdraw the front axle from both fork legs.
- 8A. On disc brake models, perform the following:
  - a. Let the wheel come down and forward and remove it.
  - b. Insert a piece of vinyl tubing or wood in the caliper(s) in place of the brake disc(s). That way if the brake lever is inadvertently squeezed, the pistons will not be forced out of the cylinders. If this does happen, the calipers may have to be disassembled to reseat the pistons and the system will have to be bled.
- 8B. On drum brake models, perform the following:
  - a. Let the wheel come down and forward.
  - b. Carefully pull the drum brake assembly out of the brake drum and remove the wheel.
  - c. Tie the drum brake assembly up to the front fork to relieve the strain on the brake cable.
9. On models so equipped, don't lose the spacer on each side of the front hub. Don't intermix them as they must be reinstalled on the correct side of the wheel during installation.

**CAUTION**

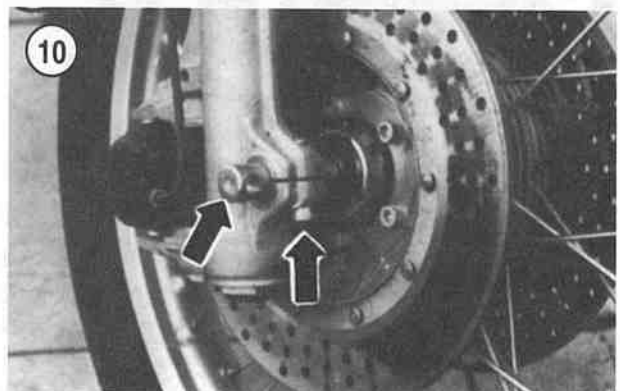
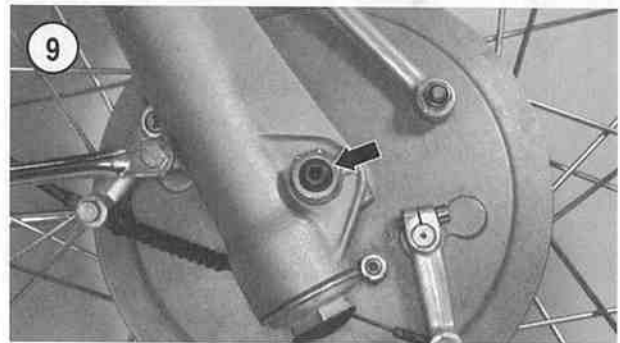
*On disc brake models, do not set the wheel down on the disc surface as it may get scratched or warped. Set the tire sidewalls on 2 wood blocks as shown in **Figure 6**.*

10. Inspect the front wheel as described in this chapter.

**Installation****(All Other Models)**

1. On disc brake models, remove the vinyl tubing or pieces of wood from the brake caliper(s).
2. Make sure the axle bearing surfaces of both fork sliders and the axle are free from burrs and nicks.

3. On models equipped with spacers, perform the following:
  - a. Apply a small amount of cold grease to the inner surface of the spacers. This will help hold them in place.
  - b. Position the spacers onto the correct side of the wheel hub.
4. Make sure the front wheel tire rotation arrow (**Figure 4**) is pointing in the correct direction.
5. Apply a light coat of multipurpose grease to the front axle prior to installation.
- 6A. On disc brake models, perform the following:
  - a. Roll the wheel into position. Lift the wheel up and install the front axle from the right-hand side.
  - b. Push the axle all the way in until it bottoms out on the left-hand fork leg.
  - c. On models so equipped, make sure the axle spacers are still in place.
- 6B. On drum brake models, perform the following:
  - a. Roll the wheel back toward the front forks.
  - b. Install the drum brake assembly into the brake drum.
  - c. Lift the wheel up and install the front axle from the right-hand side.
  - d. Push the axle all the way in until it bottoms out on the left-hand fork leg.
  - e. On models so equipped, make sure the axle spacers are still in place.





7. Install the washer and the axle nut (**Figure 9**) onto the front axle.
8. Install a drift or Allen wrench into the hole in the end of the front axle. This is to prevent the axle from turning while tightening the axle nut on the opposite end.
9. Tighten the axle nut to the torque specification listed in **Table 1**.
10. On disc brake models, remove the vinyl tubing or pieces of wood from both brake calipers.
11. On drum brake models, perform the following:
  - a. Install the adjust nut and pivot collar from the brake cable.
  - b. Install the pivot collar onto the brake lever.
  - c. Insert the front brake cable into the pivot collar and brake lever and install the adjust nut.
  - d. Move the brake panel torque link into position on the fork slider and install the mounting bolt and nut. Tighten the bolt and nut securely.
12. Remove the wood block(s) from under the engine oil pan and take the bike off the centerstand.
13. Apply the front brakes and pump the front forks up and down several times to seat and center the front axle within the fork tubes.
14. Tighten the front axle clamp bolts on each fork leg to the torque specification listed in **Table 1**.
15. After the wheel is completely installed, rotate it several times and apply the brakes a couple of times to make sure

the wheel rotates freely. On disc brake models, make sure the brake pads are positioned against the disc(s) correctly.

### Inspection (All Models)

Install the wheel in a wheel truing stand (**Figure 12**). Measure the axial and radial runout of the wheel with a dial indicator. The maximum axial and radial runout is 2.0 mm (0.08 in.). If the runout exceeds this dimension, check the wheel bearing condition.

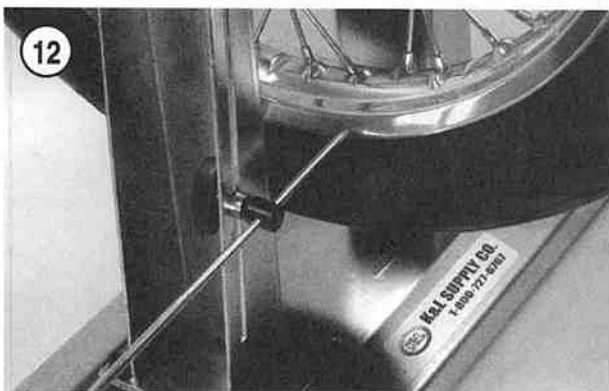
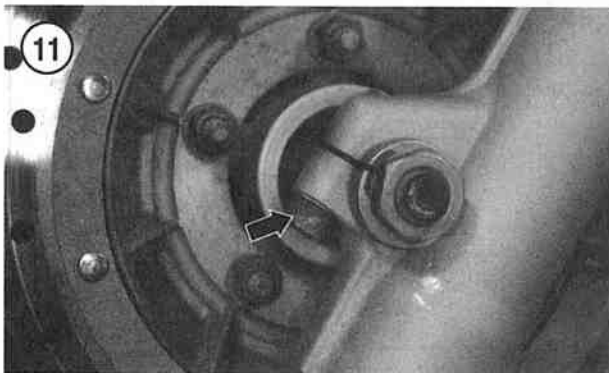
On the cast alloy wheels, if the wheel bearings are okay, the alloy wheel will have to be replaced as it cannot be serviced. Inspect the wheel for signs of cracks, fractures, dents or bends. If it is damaged in any way, it must be replaced.

#### WARNING

*Do not try to repair any damage to the BMW or any alloy wheel as it will result in an unsafe riding condition.*

On wire wheels, if the wheel bearings are okay, some of the condition can be corrected by either tightening or replacing any loose or bent spokes. Refer to *Spoke Adjustment or Spoke Inspection and Replacement* in this chapter.

Check axle runout as described under *Front Hub Inspection* in this chapter.



### FRONT HUB

Most early models are equipped with tapered front roller bearings. On these models the bearings must have a certain amount of bearing preload to operate correctly. If the preload is not correct, the bearing will wear prematurely. This type of hub requires the use of BMW special tools and is covered in a separate procedure to avoid confusion.

### Inspection (All Models)

Inspect each wheel bearing prior to removing it from the wheel hub.

#### CAUTION

*Do not remove the wheel bearings for inspection purposes as they will be damaged during the removal process. Remove wheel bearings only if they are to be replaced.*

1. Remove the front wheel as described in this chapter.
2. Turn each bearing by hand. Make sure bearings turn smoothly. Replace the bearing(s) if they are noisy or have excessive play.

3. On non-sealed bearings, check the rollers or balls for evidence of wear, pitting or excessive heat (bluish tint). Replace the bearings if necessary; always replace as a complete set. When replacing the bearings, be sure to take your old bearings along to ensure a perfect matchup.

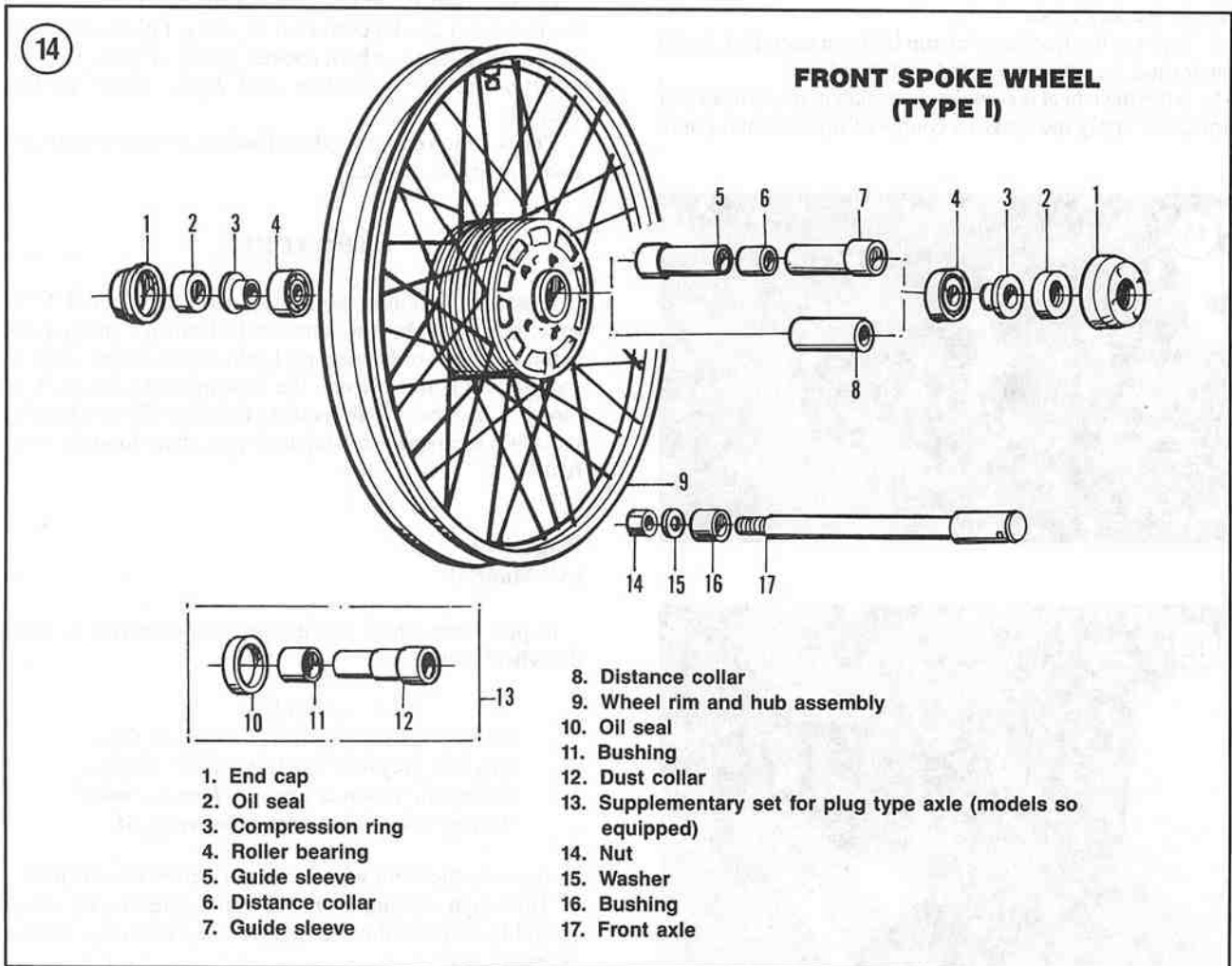
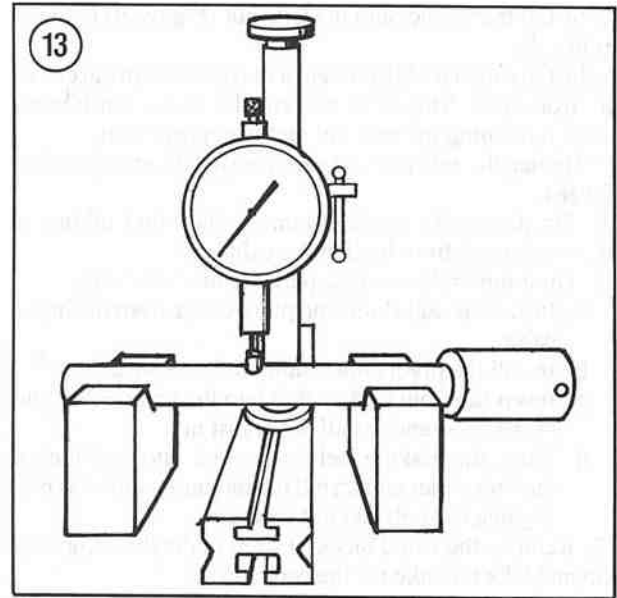
**NOTE**

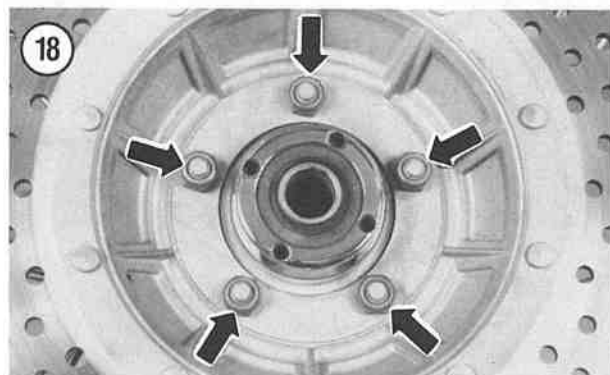
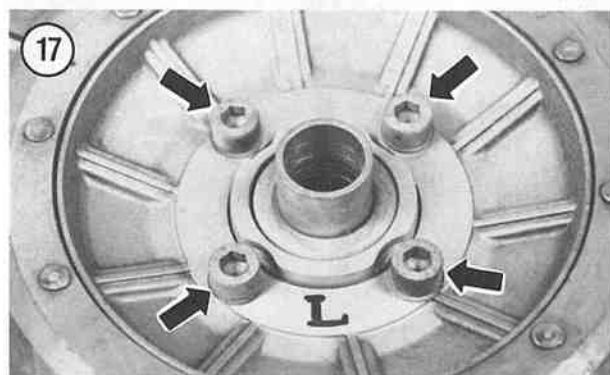
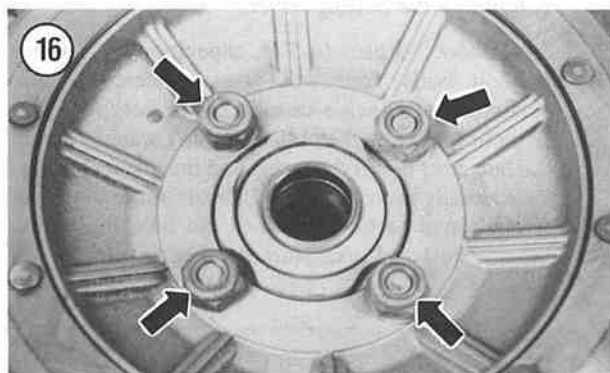
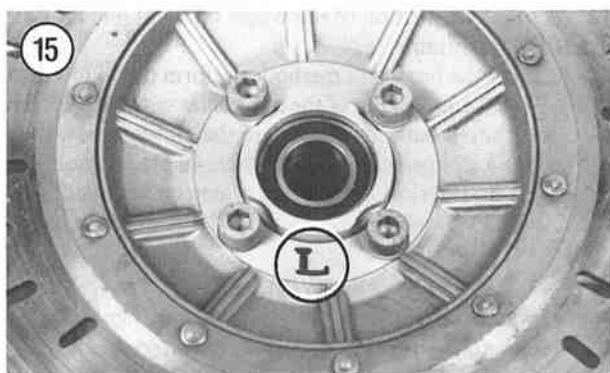
*Fully sealed ball bearings are available from many bearing specialty shops. Fully sealed bearings provide better protection from dirt and moisture that may get into the hub.*

4. Check the axle for wear and straightness. Use V-blocks and a dial indicator as shown in **Figure 13**. If the runout is 0.2 mm (0.01 in.) or greater, the axle should be replaced.

**Disassembly—Type I Wheels with Roller Bearings**

On these models, the tapered roller bearings must have a certain amount of bearing preload to operate correctly.





If the preload is not correct, the bearing will wear prematurely. This type of hub requires the use of BMW special tools.

Refer to **Figure 14** for this procedure:

#### CAUTION

Care must be taken when handling a wheel with disc brake rotor(s). The disc rotor(s) is relatively thin in order to dissipate heat and to minimize unsprung weight. The rotor(s) is designed to withstand tremendous rotational loads, but can be damaged when subjected to side impact loads. If the rotor(s) is knocked out of true by a side impact a pulsation will be felt in the front brake lever when braking. The rotor is too thin to be trued and must be replaced with a new one. Protect the rotor(s) when transporting a wheel to a dealer or tire specialist for tire service. Do **not** place a wheel in a car trunk or pickup bed without protecting the rotor(s) from side impact damage.

1. Remove the front wheel as described in this chapter.
2. Inspect the wheel bearings as described in this chapter. If they must be replaced, proceed as follows.

#### NOTE

On dual disc models, if working on a well run-in bike (high mileage), mark the brake discs with an 'R' and an 'L' (**Figure 15**) (on an attached piece of masking tape) so they will be reinstalled on the same side of the wheel from which they were removed. Older parts tend to form a wear pattern and should be reinstalled in the same location. The BMW discs are not marked to indicate right-hand or left-hand side placement.

- 3A. On dual disc models, to remove the brake discs, perform the following:

- a. Hold onto the nut (**Figure 16**) on the right-hand side of the wheel and loosen the Allen bolt (**Figure 17**) on the left-hand side. Loosen all bolts and nuts.
- b. Remove all but one of the bolts, washers and nuts.
- c. Place the wheel in the horizontal position on wood blocks.
- d. Hold onto the lower brake disc and remove the remaining bolt, washers and nut.
- e. Remove the lower brake disc, then the upper brake disc.

- 3B. On single disc models, to remove the brake disc, perform the following:

- a. Hold onto the nut (**Figure 18**) on the right-hand side of the wheel and loosen the Allen bolt (**Figure 19**) on the left-hand side. Loosen all bolts and nuts.

- b. Remove all but one of the bolts, washers and nuts.
  - c. Place the wheel in the horizontal position on wood blocks.
  - d. Remove the remaining bolt, washers and nut.
  - e. Remove the upper brake disc.
4. Unscrew the left-hand end cap (Figure 20) with BMW special tool (part No. 36 3 650), or equivalent. Remove the left-hand end cap/bearing assembly.

**NOTE**

When the right-hand end cap (A, Figure 21) is removed in the following steps, the oil seal (B, Figure 21), compression ring and roller bearing will come out with it on each side.

5. Remove the Allen bolts (Figure 22) securing the right-hand end cap (A, Figure 21) on the other side and remove the right-hand end cap/bearing assembly and the distance collar.
6. Press the guide sleeve out of the end cap.
7. Press the roller bearing off of the guide sleeve.
8. Clean the inside and the outside of the hub with solvent. Dry with compressed air.
9. If the roller bearing outer race requires replacement, use a drift and hammer and carefully tap the outer race out of each side of the wheel.

### Type I Wheels with Roller Bearings Assembly

The wheel bearing outer races are such a tight fit that BMW recommends the front hub be heated to 100° C (212° F) in order to expand the hub bearing receptacle. The entire wheel is so large that it is very difficult for a home mechanic to find a large enough oven. If the entire wheel is heated, the tire, valve stem, brake discs and balance weights must be removed first.

An alternate way is to heat only the bearing receptacle area by placing the hub portion on a hot plate or with rags and boiling hot water. Also, place the wheel bearing outer races in a freezer for approximately 30 minutes. This will reduce their overall size and will make installation easier.

**CAUTION**

Do not heat the hub area with a torch (propane or acetylene); never bring a flame into contact with the bearing receptacle of the front hub. The direct heat will destroy the painted finish, remove any case hardening and could lead to wheel warpage.

1. Blow any dirt or foreign matter out of the hub prior to installing the bearings.
2. Place the new wheel bearing outer races in a freezer if possible. Chilling them will slightly reduce their overall diameter while the hot wheel hub is slightly larger due to heat expansion. This will make installation easier.

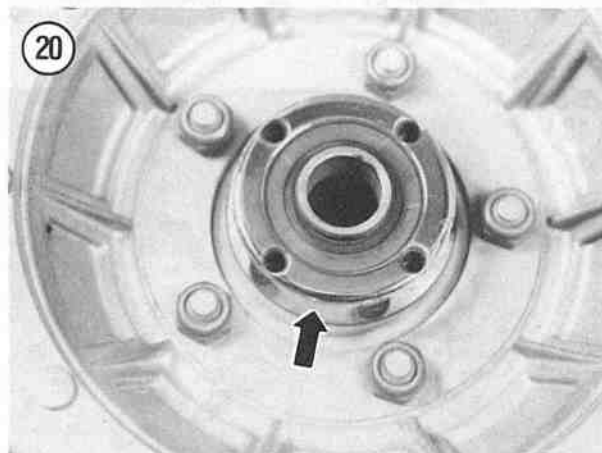
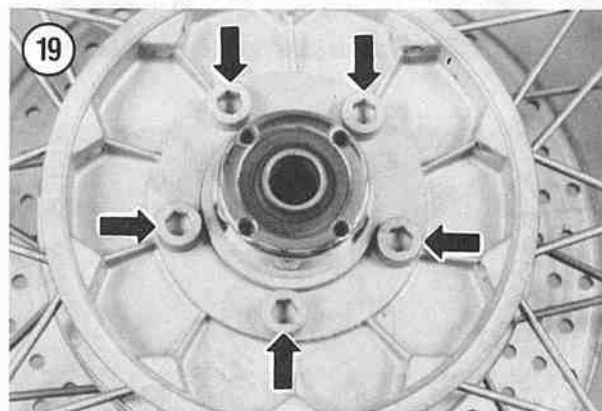
3A. Set the hub portion of the wheel on a hot plate set on the HIGH position.

- 3B. If using the hot water method, perform the following:
- a. Wrap the both sides of the hub center with shop cloths or a small bath towel. Secure the cloths or towel(s) with a Bungee cord to hold them in place since you will be pouring boiling hot water on both sides of the hub.

**WARNING**

Protect yourself accordingly in the next step as you will be working with boiling water. Wear long pants and shoes (no shorts or sandals). Use pot holders to handle the hot pans containing the boiling water.

- b. Heat about 2-3 pans (4-5 qt. capacity pan) of water until it boils. You will want to heat the hub sufficiently to enable installation of both bearings without reheating the hub. You don't want to reheat the hub after the first bearing and the distance collar have already been installed. If this is done, some water is bound to be trapped in the hub, leading to bearing rust and premature bearing failure.





- c. Slowly and carefully pour the boiling water onto *both sides* of the hub. Try to heat both sides to the same approximate temperature.

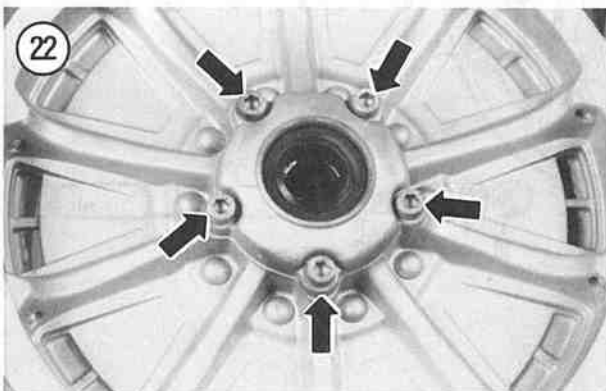
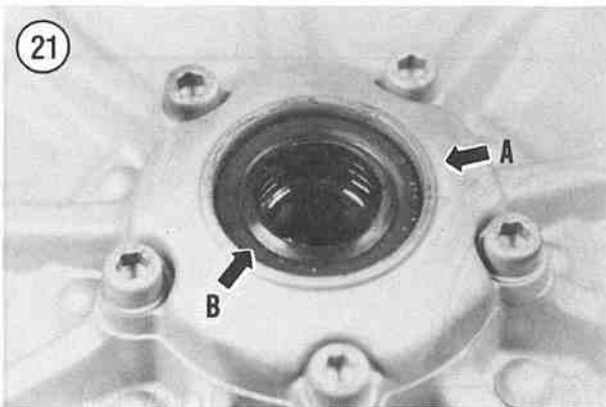
**WARNING**

*Do not operate the electric hair dryer or heat gun in the area where there is a residual water puddle that was used to heat the wheel hub.*

**NOTE**

*While installing the bearing outer race on the one side, try to keep the other side of the hub warm with a portable hair dryer or heat gun.*

4. Correctly position the bearing outer race into the hub and tap it squarely into place until it is flush with the outer surface of the hub. Use a socket that matches the outer race diameter.
5. Turn the wheel over and install the other bearing outer race.
6. Place the guide sleeves in a freezer if possible. Chilling them will slightly reduce their overall diameter while the hot wheel bearing is slightly larger due to heat expansion. This will make installation easier.
7. Place the bearings in an oven and heat them to 100° C (212° F) in order to expand the bearing inner race.



8. Correctly position the bearing onto the guide sleeve and tap it on until it bottoms out on the guide sleeve shoulder.
9. Install the other bearing onto the other guide sleeve.

**NOTE**

*Place the hot guide sleeve and bearing assemblies in a freezer to cool them down.*

10. After the bearings have cooled down, pack the bearings with a good-quality bearing grease. Work the grease in between the rollers thoroughly; turn the bearing by hand a couple of times to make sure the grease is distributed evenly inside the bearing.
11. Install the sleeve guide into the end cap. Repeat for the other sleeve guide and end cap.
12. Install the end cap/bearing assembly and the distance collar into the side of the wheel where the end cap is secured with the Allen bolts.
13. Install the Allen bolts (**Figure 22**) securing the right-hand end cap (**A**, **Figure 21**) and tighten the bolts securely.
14. Install the other end cap/bearing assembly into the other side of the wheel.

**NOTE**

*BMW dealers have a special torque meter tool (part No. not available) to correctly adjust bearing preload. If you so desire, take the wheel to a BMW dealer and have them check the bearing preload with the special tool.*

15. Screw the left-hand end cap (**Figure 20**) on with BMW special tool (part No. 36 3 650), or equivalent. Tighten the end cap/bearing assembly on securely so there is a small amount of preload on the roller bearings. Insert your finger into the guide sleeve and rotate it on each side. The guide sleeves should rotate freely with no side play.
16. On dual disc models, position the brake discs on the correct side. Refer to marks made in Step 3 of *Disassembly*.
17. On models so equipped, be sure to place a washer under the bolt head and between the brake disc and the nut. Install the bolt from the left-hand side and install the washer and nut.
18. Tighten the brake disc bolts and nuts securely.
19. Install the front wheel as described in this chapter.

### Type II Wheels with Roller Bearings Disassembly

On these models the tapered roller bearings must have a certain amount of bearing preload to operate correctly. If the preload is not correct, the bearing will wear prematurely. This type of hub requires the use of BMW special tools.

Refer to the following illustrations for this procedure:

**Figure 23**—1978-1985 R65, R80G/S and R80ST.

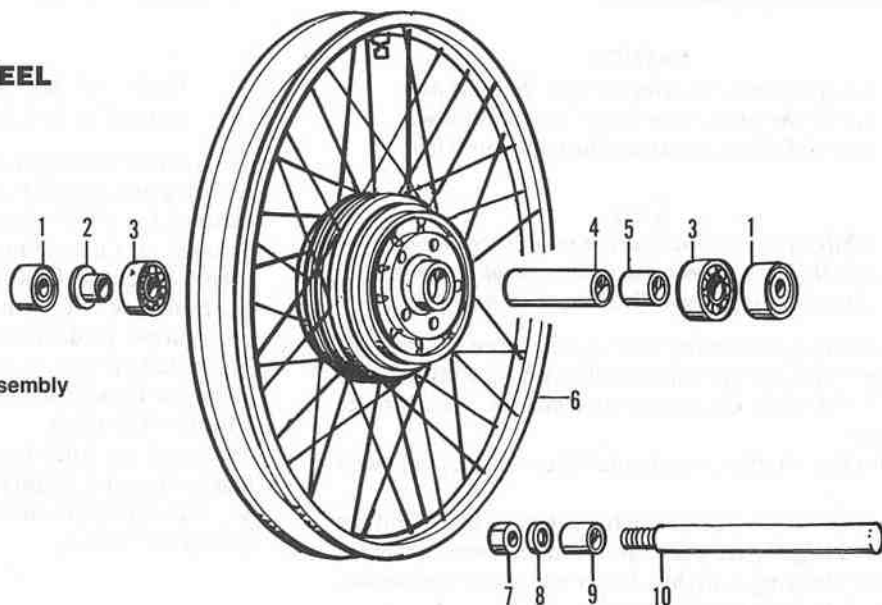
**Figure 24**—R60/7, R75/7, 1983-1984 R80, R80RT, 1978 and 1981-1985 R65, 1978-1984 R100RT and 1977-1984 R100RS.



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### FRONT SPOKE WHEEL (TYPE II)

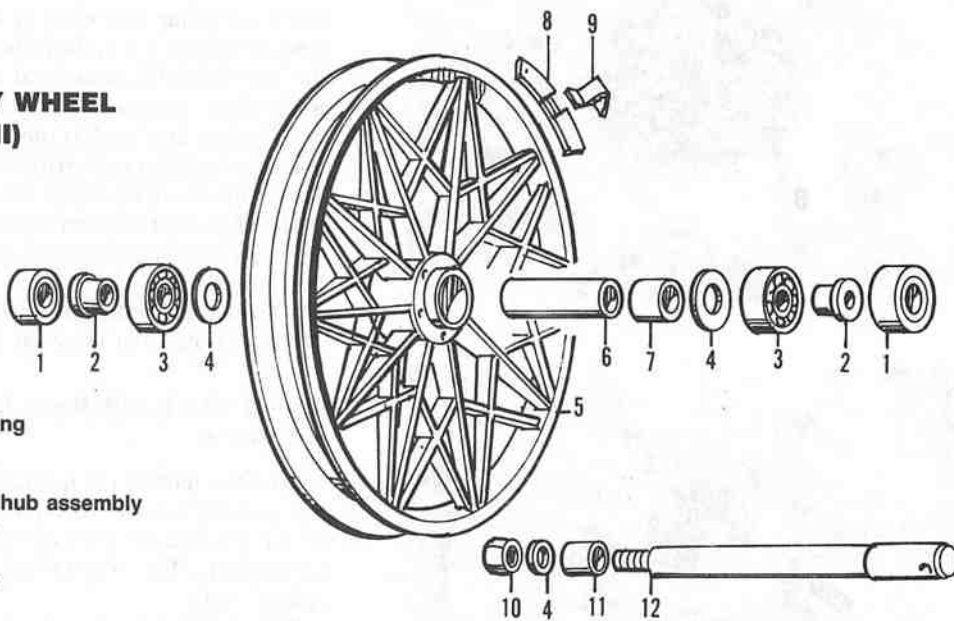
1. Oil seal
2. Compression ring
3. Roller bearing
4. Distance collar
5. Adjust sleeve
6. Wheel rim and hub assembly
7. Nut
8. Washer
9. Bushing
10. Front axle



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### FRONT ALLOY WHEEL (TYPE II)

1. Oil seal
2. Compression ring
3. Roller bearing
4. Washer
5. Wheel rim and hub assembly
6. Distance collar
7. Adjust sleeve
8. Balance weight
9. Clip
10. Nut
11. Bushing
12. Front axle



**CAUTION**

Care must be taken when handling a wheel with disc brake rotor(s). The disc rotor(s) is relatively thin in order to dissipate heat and to minimize unsprung weight. The rotor(s) is designed to withstand tremendous rotational loads but can be damaged when subjected to side impact loads. If the rotor(s) is knocked out of true by a side impact, a pulsation will be felt in the front brake lever when braking. The rotor is too thin to be trued and must be replaced with a new one. Protect the rotor(s) when transporting a wheel to a dealer or tire specialist for tire service. Do not place a wheel in a car trunk or pickup bed without protecting the rotor(s) from side impact damage.

1. Remove the front wheel as described in this chapter.
2. Inspect the wheel bearings as described in this chapter. If they must be replaced, proceed as follows.

**NOTE**

On dual disc models, if working on a well run-in bike (high mileage), mark the brake discs with an "R" and an "L" (Figure 15) (on an attached piece of masking tape) so they will be reinstalled on the same side of the wheel from which they were removed. Older parts tend to form a wear pattern and should be reinstalled in the same location. The BMW discs are not marked indicate to right-hand or left-hand side placement.

- 3A. On dual disc models, to remove the brake discs, perform the following:
  - a. Hold onto the nut (Figure 16) on the right-hand side of the wheel and loosen the Allen bolt (Figure 17) on the left-hand side. Loosen all bolts and nuts.
  - b. Remove all but one of the bolts, washers and nuts.
  - c. Place the wheel in the horizontal position on wood blocks.
  - d. Hold onto the lower brake disc and remove the remaining bolt, washers and nut.
  - e. Remove the lower brake disc, then the upper brake disc.
- 3B. On single disc models, to remove the brake disc, perform the following:
  - a. Hold onto the nut (Figure 18) on the right-hand side of the wheel and loosen the Allen bolt (Figure 19) on the left-hand side. Loosen all bolts and nuts.
  - b. Remove all but one of the bolts, washers and nuts.
  - c. Place the wheel in the horizontal position on wood blocks.
  - d. Remove the remaining bolt, washers and nut.
  - e. Remove the upper brake disc.

4. To remove the right- and left-hand bearings, distance collar and adjust sleeve, perform the following:
  - a. Using a flat-bladed screwdriver, carefully pry the oil seal and pressure sleeve out of each side of the hub. Discard the oil seal.
  - b. Remove the roller bearing from each side of the hub.
  - c. On models so equipped, remove the washer from each side of the hub.
  - d. Remove the distance collar and adjust sleeve from the front hub.
  - e. Install BMW special tool, Kukko puller, (part No. 00 8 551) onto either wheel bearing outer race.
  - f. Tighten the special tool and withdraw the wheel bearing outer race from that side of the front hub.
  - g. Turn the wheel over and install the BMW special tool onto the other wheel bearing outer race.
  - h. Tighten the special tool and withdraw the wheel bearing outer race from that side of the front hub.
5. Clean the inside and the outside of the hub with solvent. Dry with compressed air.

### Type II Wheels with Roller Bearings Assembly

The wheel bearing outer races are such a tight fit that BMW recommends the front hub be heated to 80° C (176° F) in order to expand the hub bearing receptacle. The entire wheel is so large that it is very difficult for a home mechanic to find a large enough oven. If the entire wheel is heated, the tire, valve stem, brake discs and balance weights must be removed first.

An alternate way is to heat only the bearing receptacle area by placing the hub portion on a hot plate or with rags and boiling hot water. Also, place the wheel bearing outer races in a freezer for approximately 30 minutes. This will reduce their overall size and will make installation easier.

**CAUTION**

Do not heat the hub area with a torch (propane or acetylene); never bring a flame into contact with the bearing receptacle of the front hub. The direct heat will destroy the painted finish, remove any case hardening and could lead to wheel warpage.

1. Blow any dirt or foreign matter out of the hub prior to installing the bearings.
2. Place the new wheel bearing outer races in a freezer if possible. Chilling them will slightly reduce their overall diameter while the hot wheel hub is slightly larger due to heat expansion. This will make installation easier.
- 3A. Set the hub portion of the wheel on a hot plate set on the HIGH position.

- 3B. If using the hot water method, perform the following:
- Wrap the both sides of the hub center with shop cloths or a small bath towel. Secure the cloths or towel(s) with a Bungee cord to hold them in place since you will be pouring boiling hot water on both sides of the hub.

**WARNING**

Protect yourself accordingly in the next step as you will be working with boiling water. Wear long pants and shoes (no shorts or sandals). Use pot holders to handle the hot pans containing the boiling water.

- Heat about 2-3 pans (4-5 qt. capacity pan) of water until it boils. You will want to heat the hub sufficiently to enable installation of *both bearings* without reheating the hub. You don't want to reheat the hub after the first bearing and the distance collar have already been installed. If this is done, some water is bound to be trapped in the hub, leading to bearing rust and premature bearing failure.
- Slowly and carefully pour the boiling water onto *both sides* of the hub. Try to heat both sides to the same approximate temperature.

**WARNING**

Do not operate the electric hair dryer or heat gun in the area where there is a residual water puddle that was used to heat the wheel hub.

**NOTE**

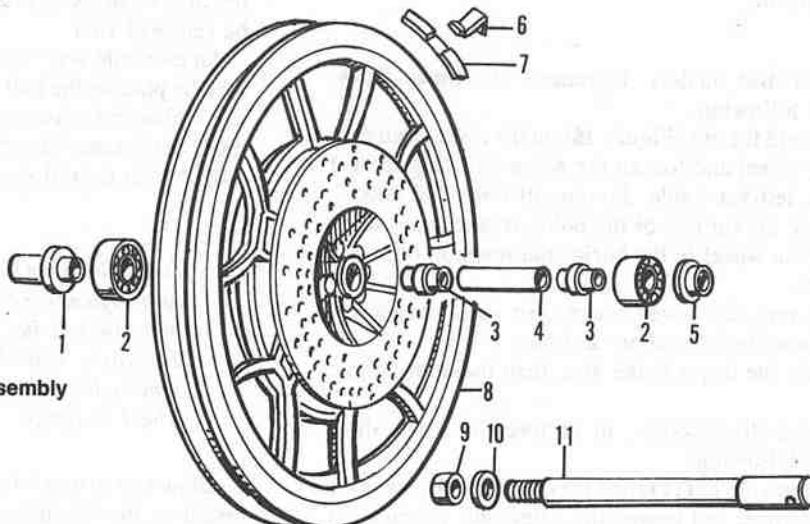
While installing the bearing outer race on the one side, try to keep the other side of the hub warm with a portable hair dryer or heat gun.

- Correctly position the bearing outer race into the hub and tap it squarely into place until it is flush with the outer surface of the hub. Use a socket that matches the outer race diameter or use BMW special impact mandrel tool (part No. 00 8 551).
- Turn the wheel over and install the other bearing outer race.
- If the hub was heated with hot water, use compressed air and thoroughly dry the inside surfaces of the hub.
- Pack the bearings with a good-quality bearing grease. Work the grease in between the rollers thoroughly; turn the bearing by hand a couple of times to make sure the grease is distributed evenly inside the bearing.
- Install the bearing, pressure sleeve and new oil seal into one side of the hub. Tap the oil seal in until it is flush with the hub surface.

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### FRONT ALLOY WHEEL (R65LS)

- Left-hand spacer
- Ball bearing
- Spacer
- Bushing
- Right-hand spacer
- Clip
- Balance weight
- Wheel rim and hub assembly
- Nut
- Bushing
- Front axle



**NOTE**

If the adjust sleeve is replaced, install a new adjust sleeve of the same length. The sleeves are available from 6.30-7.20 mm in 0.05 mm length variations. This is necessary to maintain the correct amount of bearing preload.

9. Into the other side of the hub, install the washer (models so equipped), adjust sleeve, distance collar and washer (models so equipped).
10. Install the other bearing, pressure sleeve and new oil seal into the hub. Tap the oil seal in until it is flush with the hub surface.

**NOTE**

BMW dealers have a special stub axle, spacer and torque meter tool (part No. not available) to correctly adjust bearing preload. If you so desire, take the wheel to a BMW dealer and have them check the bearing preload with the special tool. This should only be necessary if the adjust sleeve was damaged to the point that it could not be measured for replacement.

11. After all components are installed in the hub and the oil seals are flush, there should be a small amount of preload

on the roller bearings. Insert your finger into the bearing and rotate it on each side. The bearings should rotate freely with no side play.

12. On dual disc models, position the brake discs on the correct side. Refer to marks made prior to Step 3 of *Disassembly*.

13. On models so equipped, be sure to place a washer under the bolt head and between the brake disc and the nut. Install the bolt from the left-hand side and install the washer and nut.

14. Tighten the brake disc bolts and nuts securely.

15. Install the front wheel as described in this chapter.

**Disassembly****(Ball Bearing Models)**

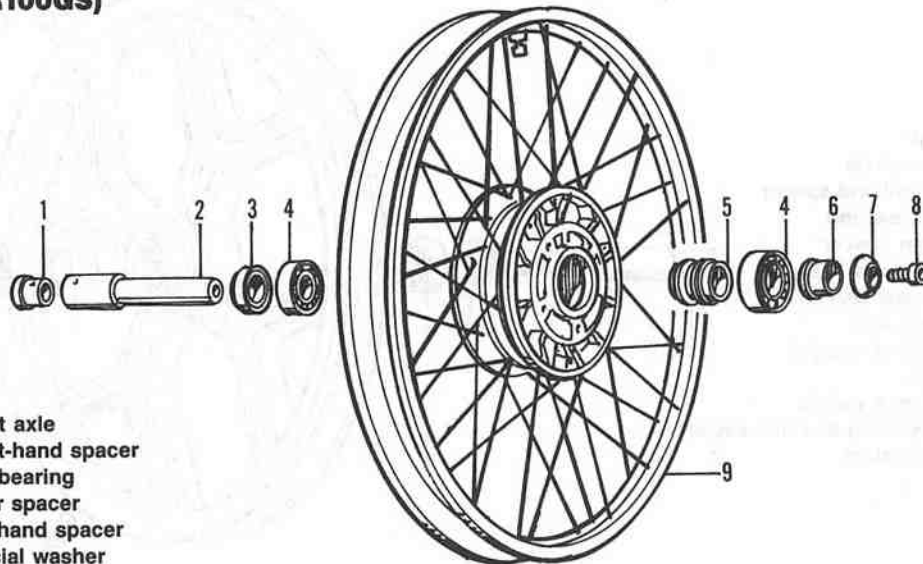
Refer to the following illustrations for this procedure:

- a. **Figure 25:** R65LS (alloy wheel).
- b. **Figure 26:** R100GS (spoke wheel).
- c. **Figure 27:** 1986-1987 R65, 1986-1987 R80, 1985-on R80RT, 1988-on R100RT and 1988-on R100RS (alloy wheel).

The distance collar is a very tight fit between both bearings. There is a shoulder at each end of the distance collar and it covers the inner bearing race. This shoulder

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### FRONT SPOKE WHEEL (R100GS)



1. Cap
2. Front axle
3. Right-hand spacer
4. Ball bearing
5. Inner spacer
6. Left-hand spacer
7. Special washer
8. Allen bolt
9. Wheel rim and hub assembly

makes it impossible to move the distance collar over to one side in order to tap the first bearing out with a drift and hammer. A special BMW tool is required.

#### CAUTION

Care must be taken when handling a wheel with disc brake rotor(s). The disc rotor(s) is relatively thin in order to dissipate heat and to minimize unsprung weight. The rotor(s) is designed to withstand tremendous rotational loads but can be damaged when subjected to side impact loads. If the rotor(s) is knocked out of true by a side impact, a pulsation will be felt in the front brake lever when braking. The rotor is too thin to be trued and must be replaced with a new one. Protect the rotor(s) when transporting a wheel to a dealer or tire specialist for tire service. Do **not** place a wheel in a car trunk or pickup bed without protecting the rotor(s) from side impact damage.

1. Remove the front wheel as described in this chapter.
2. Inspect the wheel bearings as described in this chapter. If they must be replaced, proceed as follows.

#### NOTE

On dual disc models, if working on a well run-in bike (high mileage), mark the brake discs with an "R" and an "L" (Figure 15) (on an attached piece of masking tape) so they will be reinstalled on the same side of the wheel from which they were removed. Older parts tend to form a wear pattern and should be reinstalled in the same location. The BMW discs are not marked to indicate right-hand or left-hand side placement.

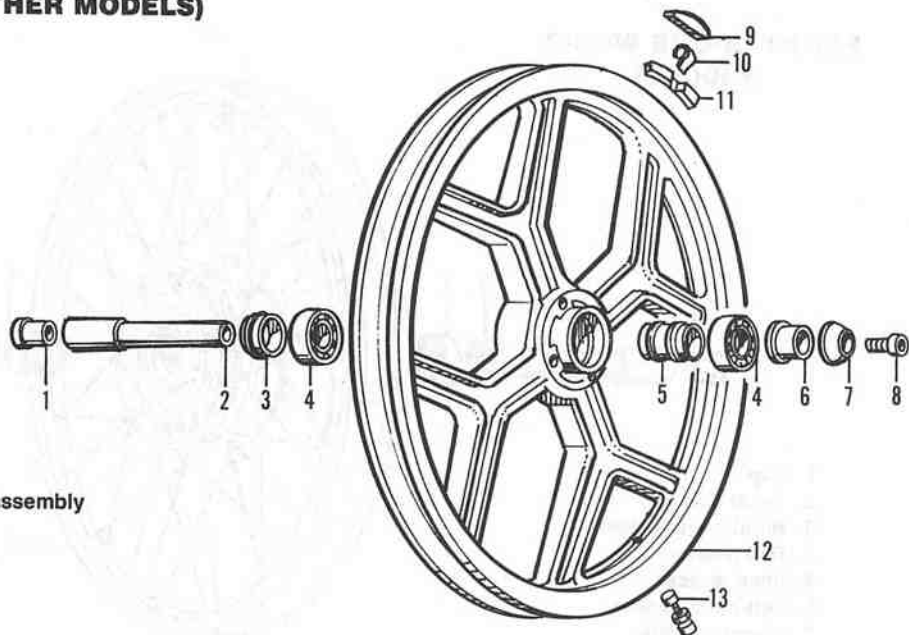
3A. On dual disc models, to remove the brake discs, perform the following:

- a. Hold onto the nut (Figure 16) on the right-hand side of the wheel and loosen the Allen bolt (Figure 17) on the left-hand side. Loosen all bolts and nuts.
- b. Remove all but one of the bolts, washers and nuts.
- c. Place the wheel in the horizontal position on wood blocks.
- d. Hold onto the lower brake disc and remove the remaining bolt, washers and nut.
- e. Remove the lower brake disc then the upper brake disc.

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#### FRONT ALLOY WHEEL (ALL OTHER MODELS)

1. Cap
2. Front axle
3. Right-hand spacer
4. Ball bearing
5. Inner spacer
6. Left-hand spacer
7. Special washer
8. Allen bolt
9. Balance weight
10. Clip
11. Balance weight
12. Wheel rim and hub assembly
13. Valve stem





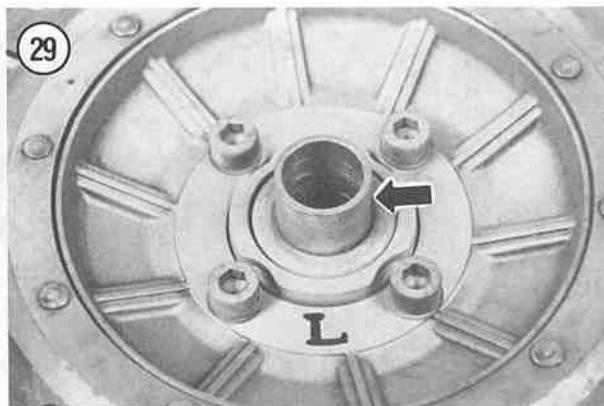
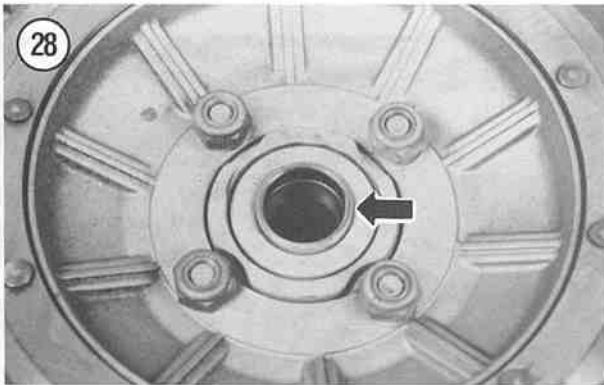
3B. On single disc models, to remove the brake disc, perform the following:

- a. Hold onto the nut on the right-hand side of the wheel and loosen the Allen bolt on the left-hand side. Loosen all bolts and nuts.
  - b. Remove all but one of the bolts, washers and nuts.
  - c. Place the wheel in the horizontal position on wood blocks.
  - d. Remove the remaining bolt, washers and nut.
  - e. Remove the upper brake disc.
4. If still installed, remove the right-hand (**Figure 28**) and left-hand (**Figure 29**) spacers from the hub assembly.
5. To remove the right- and left-hand bearings and distance collar, perform the following:

- a. Install BMW special tool (part No. 00 8 570) onto either wheel bearing.
- b. Tighten the special tool and withdraw the wheel bearing from that side of the front hub.
- c. Depending on hub design, remove the inner spacer or inner spacers and bushing from the front hub.

#### NOTE

*After the first wheel bearing and spacer(s) are removed, it is then possible to drive out the opposite bearing with a drift and hammer if you so desire.*



- d. Turn the wheel over and install the BMW special tool onto the other wheel bearing.
  - e. Tighten the special tool and withdraw the wheel bearing from that side of the front hub.
6. Clean the inside and the outside of the hub with solvent. Dry with compressed air.

#### Assembly

##### (Ball Bearing Models)

The wheel bearings are such a tight fit that BMW recommends the front hub be heated to 80-100° C (176-212° F) in order to expand the hub bearing receptacle. The entire wheel is so large that it is very difficult for a home mechanic to find a large enough oven. If the entire wheel is heated, the tire, valve stem, brake discs and balance weights must be removed first.

An alternate way is to heat only the bearing receptacle area by placing the hub portion on a hot plate or with rags and boiling hot water. Also, place the wheel bearing outer races in a freezer for approximately 30 minutes. This will reduce their overall size and will make installation easier.

#### CAUTION

*Do not heat the hub area with a torch (propane or acetylene); never bring a flame into contact with the bearing receptacle of the front hub. The direct heat will destroy the painted finish, remove any case hardening and could lead to wheel warpage.*

1. On non-sealed bearings, pack the bearings with a good-quality bearing grease. Work the grease in between the balls thoroughly; turn the bearing by hand a couple of times to make sure the grease is distributed evenly inside the bearing.
2. Blow any dirt or foreign matter out of the hub prior to installing the bearings.
3. Place the new wheel bearing outer races in a freezer if possible. Chilling them will slightly reduce their overall diameter while the hot wheel hub is slightly larger due to heat expansion. This will make installation easier.
- 4A. Set the hub portion of the wheel on a hot plate set on the HIGH position.
- 4B. If using the hot water method, perform the following:
  - a. Wrap both sides of the hub center with shop cloths or a small bath towel. Secure the cloths or towel(s) with a Bungee cord to hold them in place since you will be pouring boiling hot water on both sides of the hub.

#### WARNING

*Protect yourself accordingly in the next step as you will be working with boiling water. Wear long pants and shoes (no shorts or sandals). Use pot holders to handle the hot pans containing the boiling water.*

- b. Heat about 2-3 pans (4-5 qt. capacity pan) of water until it boils. You will want to heat the hub sufficiently to enable installation of both bearings without reheating the hub. You don't want to reheat the hub after the first bearing and the distance collar have already been installed. If this is done, some water is bound to be trapped in the hub, leading to bearing rust and premature bearing failure.
- c. Slowly and carefully pour the boiling water onto both sides of the hub. Try to heat both sides to the same approximate temperature.

#### WARNING

*Do not operate the electric hair dryer or heat gun in the area where there is a residual water puddle that was used to heat the wheel hub.*

#### NOTE

*While installing the bearing on the one side, try to keep the other side of the hub warm with a portable hair dryer or heat gun.*

#### CAUTION

*Install the bearings with the single sealed side facing outward (Figure 30).*

5. Correctly position the bearing into the hub and tap it squarely into place on the outer race only. Use a socket (Figure 31) that matches the outer race diameter. Do not tap on the inner race or the bearing might be damaged. Be sure that the bearing is completely seated in the hub receptacle.
6. Turn the wheel over.
7. If the hub was heated with hot water, use compressed air and thoroughly dry the inner surface of the hub.
8. Depending on hub design, install the inner spacer or inner spacers and bushing into the front hub.
9. Correctly position the bearing into the hub and tap it squarely into place on the outer race only. Use a socket (Figure 31) that matches the outer race diameter. Do not tap on the inner race or the bearing might be damaged. Be sure that the bearing is completely seated in the hub and that the distance collar is correctly positioned between the 2 bearings.
10. Use compressed air and thoroughly dry the wheel on both sides.
11. On dual disc models, position the brake discs on the correct side. Refer to marks made in Step 3 of *Disassembly*.
12. Be sure to place a washer under the bolt head and between the brake disc and the nut. Install the bolt from the left-hand side and install the washer and nut.
13. Tighten the brake disc bolts and nuts securely.
14. Install the front wheel as described in this chapter.

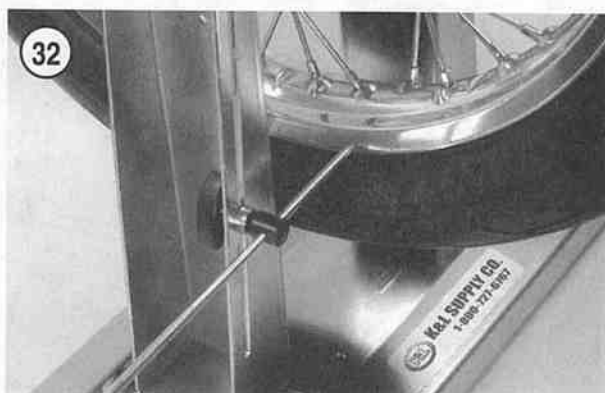
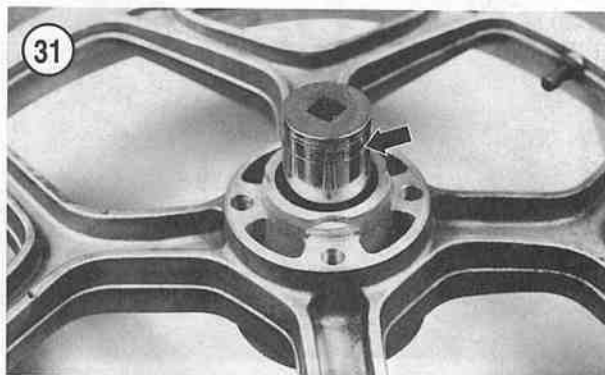
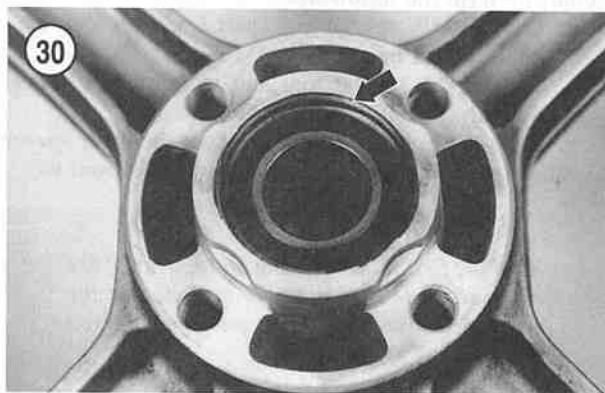
### WHEEL BALANCE

An unbalanced wheel is unsafe. Depending on the degree of unbalance and the speed of the motorcycle, the

rider may experience anything from a mild vibration to a violent shimmy, which may even result in loss of control.

This procedure covers static balancing, which requires only a wheel stand in which a wheel can be rotated. Dynamic balancing is more costly and requires the use of a machine that spins the wheel. For dynamic wheel balancing, take the wheel(s) to a motorcycle dealer.

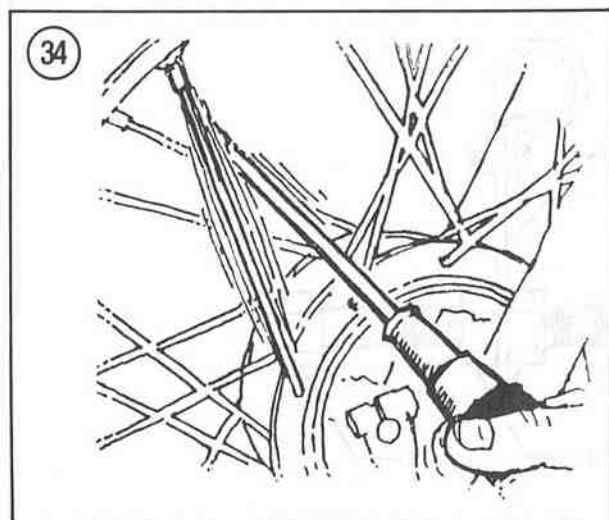
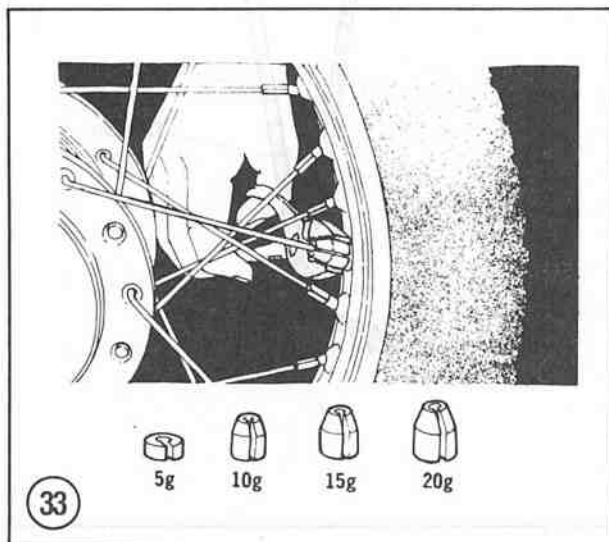
On wire spoke wheels, weights are attached to the spokes on the light side of the wheel to correct the condition. A kit of weights may be purchased from most BMW dealers or motorcycle supply stores.



On alloy wheels, weights are attached to the rim. A kit of adhesive-backed weights may be purchased from most BMW dealers or motorcycle supply stores. This kit contains test weights and strips of adhesive-backed weights that can be cut to the desired weight and attached directly to the rim.

Before you attempt to balance the wheel, check to be sure that the wheel bearings are in good condition and properly lubricated and that the brakes do not drag. The wheel must rotate freely.

1. Remove the wheel as described in this chapter or Chapter Ten.
2. Mount the wheel on a fixture such as the one shown in **Figure 32** so it can rotate freely.
3. Give the wheel a spin and let it coast to a stop. Mark the tire at the lowest point.
4. Spin the wheel several more times. If the wheel keeps coming to rest at the same point, it is out of balance.



- 5A. On wire spoke wheels, perform the following:
  - a. Attach a weight to the upper or light side of the wheel on the spoke (**Figure 33**). Crimp the weights onto the spoke with slip-joint pliers.
  - b. Experiment with different weights until the wheel, when spun, comes to a rest at a different position each time. When this happens, consider the wheel balanced.
  - c. Tighten the weights so they won't be thrown off (**Figure 33**).
- 5B. On alloy wheels, perform the following:
  - a. Tape a test weight to the upper (or light) side of the wheel.
  - b. Experiment with different weights until the wheel, when spun, comes to a rest at a different position each time. When this happens, consider the wheel balanced.
  - c. Remove the test weight and install the correct size adhesive-backed or clamp-on weight.

## SPOKE WHEEL SERVICE

### Wheel Service for R100GS Models

Due to the unique design of the wheel and spokes on the R100GS, wheel service must be performed by a BMW dealer as a special fixture is required. Each spoke has a 4 mm setscrew located inside the end of each spoke nipple. This setscrew acts like a locknut by applying pressure on the spoke and nipple threads. This pressure keeps the spoke from working loose.

BMW informed its dealers in a Service Information Bulletin (No. 00 050 88/2300, March 1988) that only the replacement of a few spokes can be accomplished at this time. BMW is investigating a source for a truing fixture that is required for this type of wheel and spoke arrangement. If the wheel is damaged or multiple spokes require replacement, the entire wheel must be replaced.

### Spoke Inspection (All Models Except R100GS)

Spokes loosen with use and should be checked periodically. The "tuning fork" method for checking spoke tightness is simple and works well. Tap the center of each spoke with a spoke wrench or the shank of a screwdriver (**Figure 34**) and listen for a tone. A tightened spoke will emit a clear, ringing tone and a loose spoke will sound flat or dull. All spokes in a correctly tightened wheel will emit tones of similar pitch but not necessarily the same precise tone. The tension of the spokes does not determine wheel balance.

Bent, stripped or broken spokes should be replaced, as soon as they are detected, as they can destroy an expensive hub.

**NOTE**

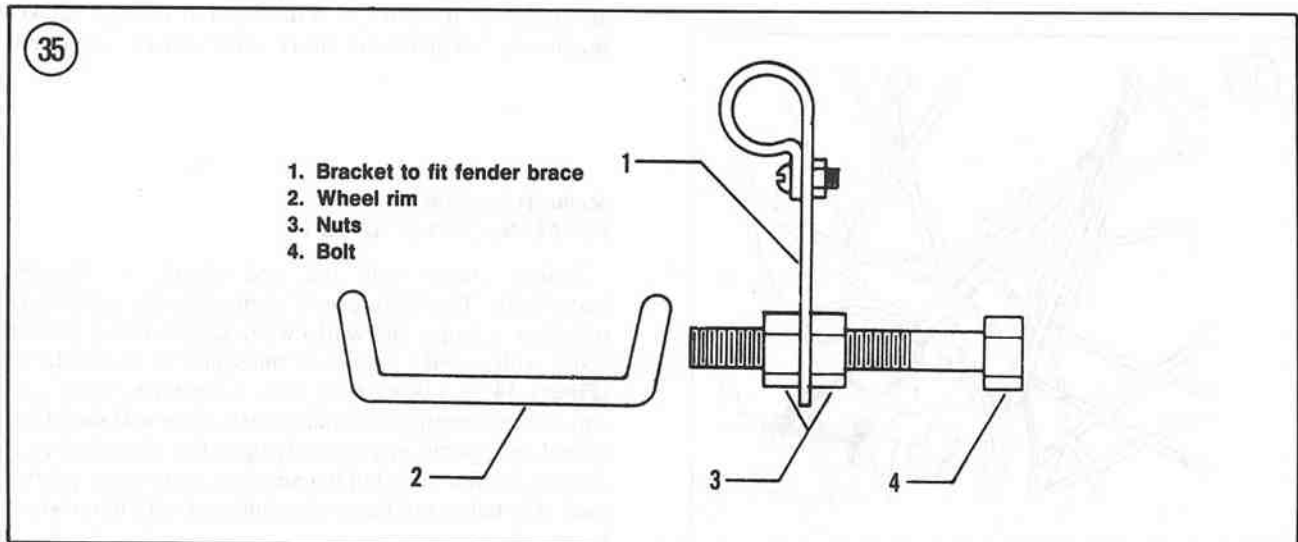
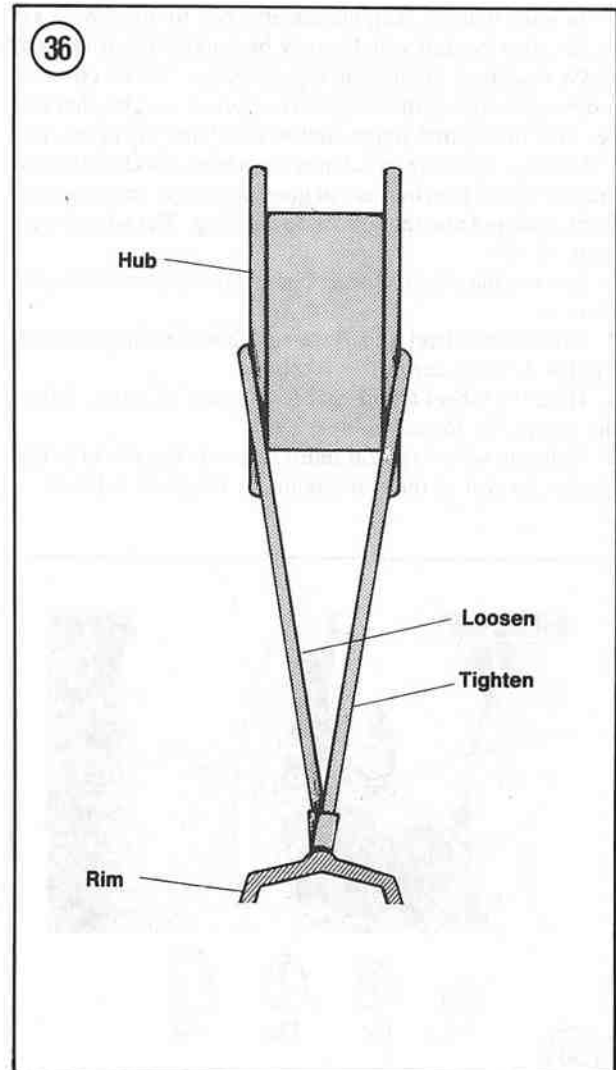
*If you are riding and one or more of the spokes should break, tie the broken spoke(s) to an attached spoke with wire, tape or string until you can ride home and replace it. This will prevent the broken spoke from dangling loose and eventually damaging the fork tubes or the rear sprocket.*

**Spoke Replacement  
(All Models Except R100GS)**

1. Unscrew the nipple from the spoke and depress the nipple into the wheel rim far enough to free the end of the spoke. Do not press the nipple all the way in.
2. Remove the damaged spoke from the wheel hub and use it to match a new spoke of identical length. If necessary, trim the new spoke to match the original length. Dress the end of the threads with the correct size thread die.
3. Install the new spoke in the hub and screw on the nipple. Tighten the nipple until the spoke's tone is similar to the tone of the other spokes in the wheel.
4. Periodically check the new spoke; it will stretch and must be retightened several times until it takes a final set.

**Spoke Adjustment  
(All Models Except R100GS)**

1. If all of the spokes appear loose, tighten all on one side of the hub, then tighten all on the other side. One-half to one turn should be sufficient; do not overtighten.
2. After tightening the spokes, check the rim runout to be sure you haven't pulled the rim out of shape.





**NOTE**

If you don't have a dial indicator, improvise one as shown in **Figure 35**.

3. Check the rim runout with a dial indicator attached either to the front fork or swing arm as follows:
  - a. Adjust the position of the dial indicator or bolt until it just clears the rim.
  - b. Rotate the rim and note whether the clearance increases or decreases.
  - c. Mark the tire with chalk or light crayon at areas that produce significantly large or small clearances. Clearance must not change by more than 2.0 mm (0.08 in).

**NOTE**

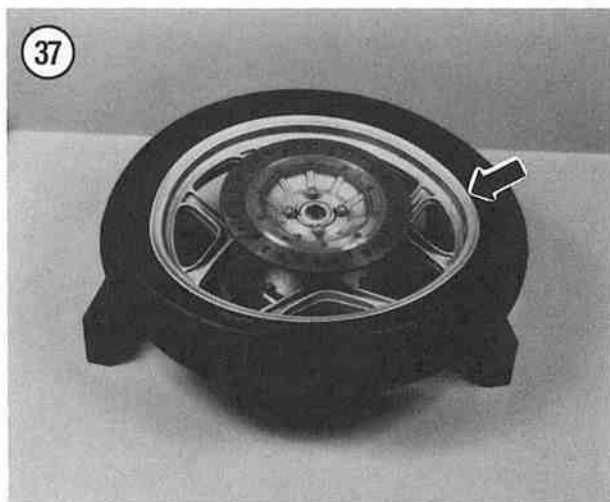
In most cases, only a slight amount of adjustment is necessary to true a rim.

4. To pull the rim out, tighten the spokes which terminate on the same side of the hub and loosen the spokes which terminate on the opposite side of the hub (**Figure 36**).
5. After adjustment, rotate the wheel and make sure another area has not been pulled out of true.
6. Continue adjustment and checking until the wheel rim runout is less than 2.0 mm (0.08 in).
7. Remove the dial indicator.

### Rim Replacement (All Models Except R100GS)

If the wheel rim becomes bent or damaged, it must be replaced. A bent or distorted wheel (**Figure 37**) is very dangerous to the handling of the bike.

If the spokes are not bent or damaged, they may be reused. This procedure describes how to replace the rim without removing the spokes from the hub.



1. Remove the tire from the wheel as described in this chapter.
2. Remove the rim band.
3. Securely fasten the spokes together with wire, tape or string where they cross each other.
4. Place the replacement rim on top of the existing rim and align the nipple holes of both rims. This is to make sure the replacement rim is the correct one. When the rims are aligned correctly, mark one spoke and its corresponding nipple hole on the new rim.
5. Using a spoke wrench, loosen, then remove all nipples from the spokes.
6. If the nipples are coated with dirt or rust, clean them in solvent and dry with compressed air. Inspect the nipples for signs of cracking or other damage. If the spoke nipples are damaged they can strip out when the wheel is later trued. Replace all damaged nipples.
7. Lift the hub and spokes out of the old rim, making sure not to knock the spokes out of alignment.
8. Position the hub and spokes into the new rim, making sure to align the marks made in Step 4.
9. Insert the spokes into the correct holes in the rim until they are all in place.
10. Place a drop of light oil onto the threaded end of each spoke.
11. Install the nipples onto the spokes and thread them halfway on. Stop before the nipple makes contact with the rim surface.
12. Lift the wheel and stand it up on the workbench. Make sure that the hub is centered in the rim; reposition if necessary.
13. Lay the wheel back down on the workbench.
14. Tighten the nipples until they just seat against the rim. True the wheel as described under *Spoke Adjustment* in this chapter.
15. Install the rim band with the rough side facing the wheel rim. Replace the rim band if it is starting to harden or deteriorate.
16. Install the tire onto the wheel as described in this chapter.

### Spoke Seating (All Models Except R100GS)

When spokes loosen or when installing new spokes, the head of the spoke should be checked for proper seating in the hub. If it is not seated correctly, it can loosen further and may cause severe damage to the hub.

If one or more spokes require reseating, hit the head of the spoke with a punch and hammer to seat it correctly in the hub.

True the wheel as described under *Spoke Adjustment* in this chapter.



## TIRE CHANGING

The rim of the cast alloy wheel, and some of the wire spoke wheels, are aluminum and the exterior appearance can easily be damaged. Special care must be taken with tire irons when changing a tire to avoid scratches and gouges to the outer rim surface. Insert scraps of leather between the tire iron and the rim to protect the rim from gouges. Depending on model and year, the bikes are equipped with tube-type or tubeless tires.

### WARNING

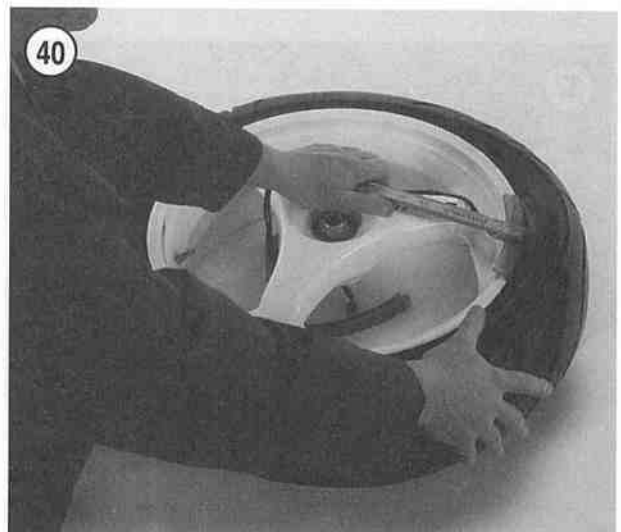
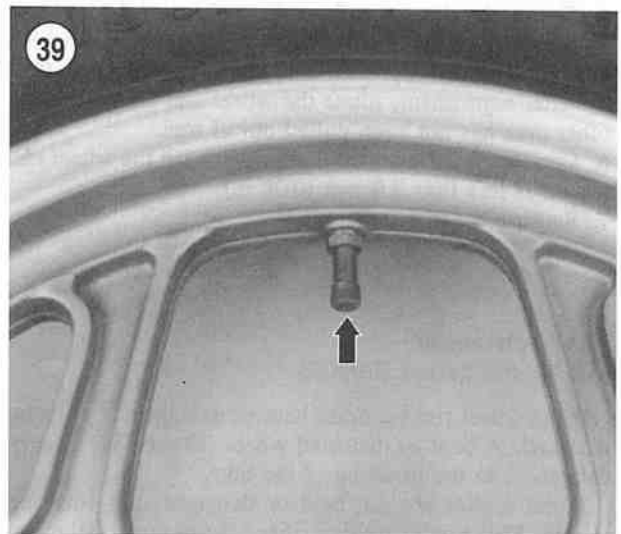
*Do not install tubeless tires on wheels designed for use only with tube-type tires. Personal injury and tire failure may result from rapid tire deflation while riding. Some wheels for use with tubeless tires are so marked. Tubeless tires may be labeled (Figure 38).*

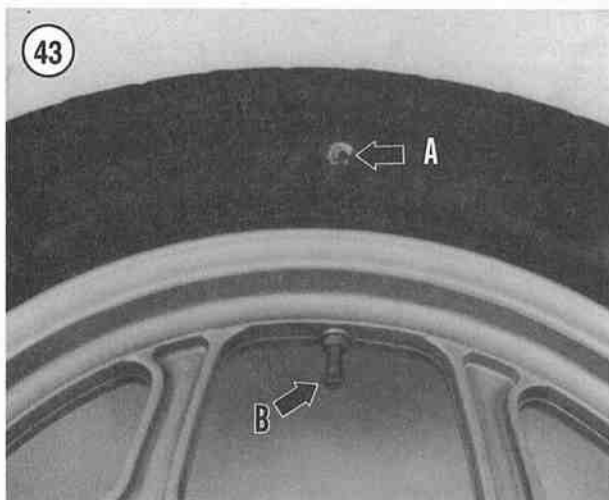
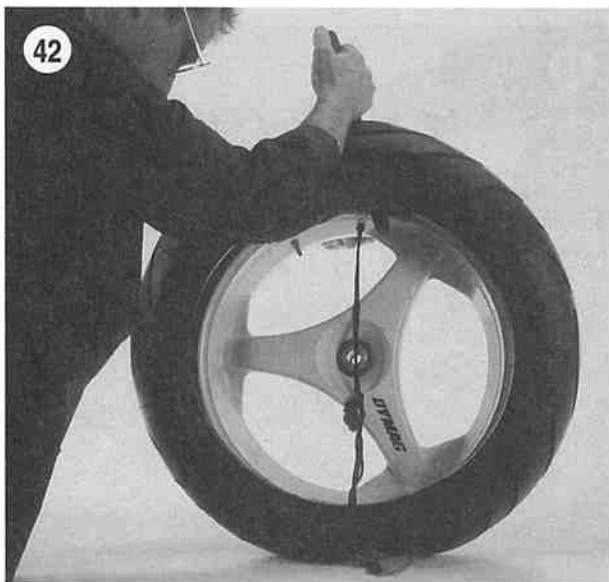
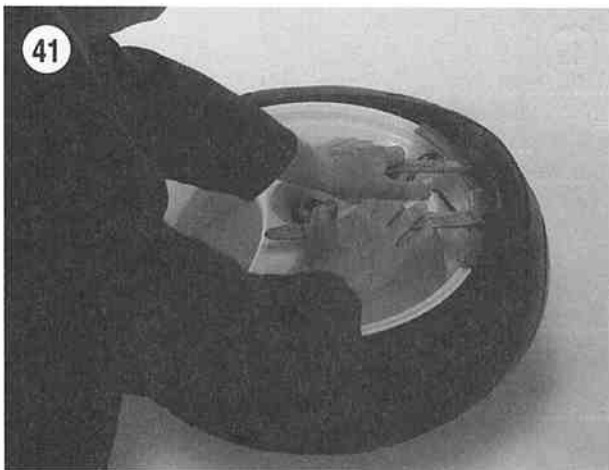
### CAUTION

*Care must be taken when handling a wheel with disc brake rotor(s). The disc rotor(s) is relatively thin in order to dissipate heat and to minimize unsprung weight. The rotor(s) is designed to withstand tremendous rotational loads but can be damaged when subjected to side impact loads. If the rotor(s) is knocked out of true by a side impact, a pulsation will be felt in the front brake lever when braking. The rotor is too thin to be trued and must be replaced with a new one. Protect the rotor(s) when transporting a wheel to a dealer or tire specialist for tire service. Do not place a wheel in a car trunk or pickup bed without protecting the rotor(s) from side impact damage.*

### Removal

1. Remove the valve cap and core (Figure 39) and deflate the tire.
2. Press the entire bead on both sides of the tire into the center of the rim. Lubricate the beads with soapy water.
3. Insert the tire iron under the bead next to the valve (Figure 40). Force the bead on the opposite side of the tire into the center of the rim and pry the bead over the rim with the tire iron.
4. Insert a second tire iron next to the first to hold the bead over the rim. Then work around the tire with the first tire iron, prying the bead over the rim (Figure 41). On tube-type tires, be careful not to pinch the inner tube with the tire irons.
5. On tube-type tires, remove the valve stem from the rim hole and remove the inner tube from the tire.



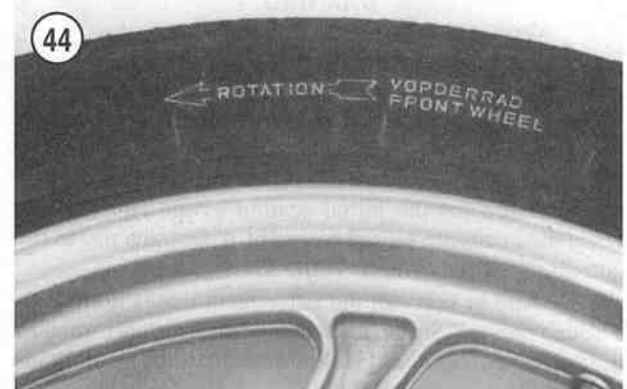


**NOTE**  
Step 6 is necessary only if the tire is to be completely removed from the rim.

6. Stand the tire upright. Insert the tire iron between the second bead and the side of the rim that the first bead was pried over (Figure 42). Force the bead on the opposite side from the tire iron into the center of the rim. Pry the second bead off the rim, working around as with the first.
7. On tubeless tires, it is recommended that the tire valve stem be replaced whenever the tire is removed from the wheel.

### Installation

1. Carefully inspect the tire for any damage, especially inside.
2. A new tire may have balancing rubbers inside. These are not patches and should not be disturbed. A colored spot (A, Figure 43) near the bead indicates a lighter point on the tire. This spot should be placed next to the valve stem (B, Figure 43).
3. On tube-type tires, perform the following:
  - a. Remove the rim band.
  - b. Check that the spoke ends do not protrude through the nipples into the center of the rim where they can puncture the inner tube.
  - c. File off any protruding spoke ends.
  - d. Install the rim band with the rough side facing the wheel rim.
4. If the tire was completely removed, install the tire so that it revolves in the proper direction. The tire is marked with an arrow and "Direction" on the sidewall. Refer to Figure 44 for the front wheel or Figure 45 for the rear wheel.
5. On tube-type tires, perform the following:
  - a. Install the valve stem core and tighten securely.
  - b. Inflate the inner tube just enough to round it out. Too much air will make it difficult to install it in the tire and too little will increase the chances of pinching the tube with the tire irons.
  - c. Install the tube into the tire.



6. Lubricate both beads of the tire with soapy water.
- 7A. On tube-type tires, perform the following:
  - a. Pull the inner tube partly out of the tire at the valve stem.
  - b. Squeeze the beads together to hold the tube and insert the valve stem into the hole in the rim.
- 7B. On tubeless tires, place the backside of the tire into the center of the rim. The lower bead should go into the center of the rim and the upper bead outside (**Figure 46**).
8. Work around the tire in both directions. Use a tire iron for the last few inches of bead.
9. Press the upper bead into the rim opposite the valve. Pry the bead into the rim on both sides of the initial point with a tire iron, working around the rim to the valve. If the tire wants to pull up on one side, use another tire iron or a knee to hold the tire in place. The last few inches are usually the toughest to install. If possible, continue to push the tire into the rim by hand. Relubricate the bead if necessary. If the tire bead wants to pull out from under the rim use both of your knees to hold the tire in place. If necessary, use a tire iron for the last few inches (**Figure 47**).
10. On tube-type tires, wiggle the valve stem to be sure the inner tube is not trapped under the tire bead. Set the valve stem squarely in the rim hole.
11. Check the bead on both sides of the tire for even fit around the rim.
12. Bounce the wheel several times, rotating it each time. This will force the tire beads against the rim flanges.
13. On tubeless tires, install the valve stem core and tighten securely.
14. After the tire beads are in contact with the rim evenly, inflate the tire to seat the beads (**Figure 48**).

#### NOTE

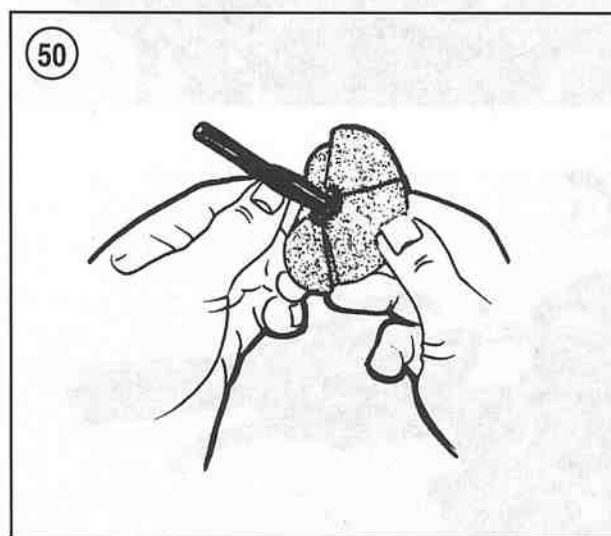
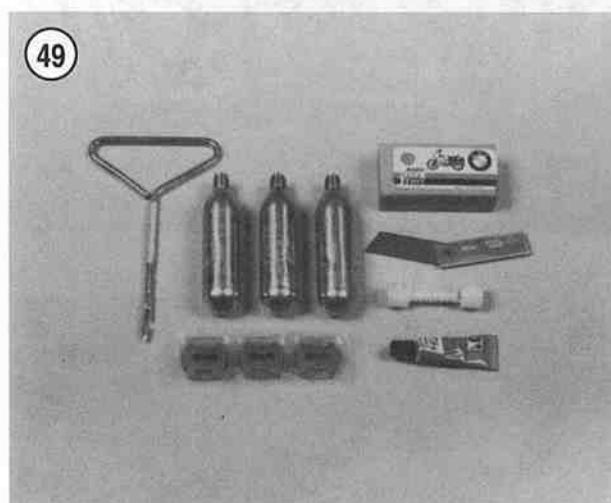
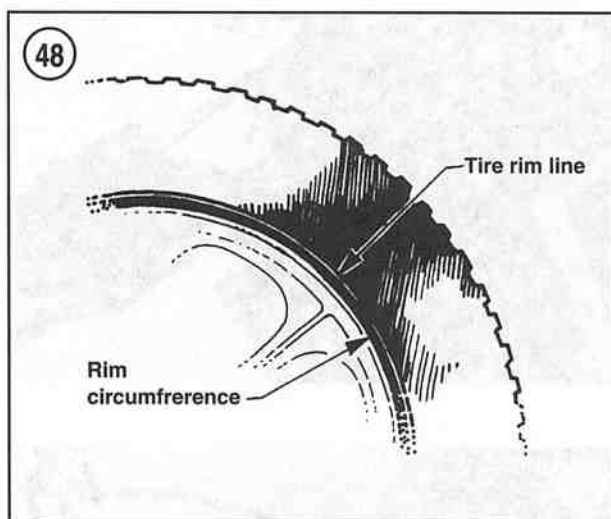
*On tubeless tires, if you are unable to get an airtight seal this way, install an inflatable band around the circumference of the tire. Slowly inflate the band until the beads are seated against the rim flanges, then inflate the tire*

#### WARNING

*Never exceed 40 kPa (56psi) inflation pressure in Step 15 as the tire could burst, causing severe injury. Never stand directly over the tire while inflating it.*

15. Inflate the tire to more than the recommended inflation pressure for the initial seating of the rim flanges. Once the beads are seated correctly, deflate the tire to the correct pressure. Refer to **Table 2**.
16. Be sure to reinstall the valve stem cap (**Figure 39**). The cap prevents small pebbles and dirt from collecting in the valve stem; this could allow air leakage or result in incorrect tire pressure readings.





## TIRE REPAIRS

### Tube-type Tires

BMW offers an emergency tire repair kit (**Figure 49**) that can be used to patch the inner tube. Remember that this is only a temporary fix. The tube flexes too much and the patch could rub right off. However a patched tire will get you far enough to buy a new tube which must be replaced as soon as possible.

#### NOTE

*A can of pressurized tire sealant and inflation air can be carried in your tool box. It may be able to inflate and seal the hole. This is only a temporary fix.*

### Tubeless Tires

Patching a tubeless tire on the road is very difficult. If both beads are still in place against the rim, a can of pressurized tire sealant may inflate the tire and seal the hole. The beads must be against the wheel for this method to work.

BMW offer an emergency tire repair kit (**Figure 50**) that can be used on a nail hole puncture of up to 4 mm (0.016 in.) in diameter. This is only a temporary fix and the tire must be replaced as soon as possible.

#### WARNING

*After fixing a flat tire with a temporary patch, do not ride the bike faster than 37 mph (60 km/h) or farther than 250 miles (400 km).*

Another solution is to carry a spare inner tube that could be temporarily installed and inflated. This will enable you to get to a tire dealer or motorcycle shop where the tire can be replaced. Be sure that the tube is designed for use with a tubeless tire.

A combination plug/patch (**Figure 50**), applied from inside the tire, is another alternative.

Due to the variations of material supplied with different tubeless tire repair kits, follow the instructions and recommendations supplied with the repair kit.

BMW recommends that the valve stem be replaced each time the tire is removed from the wheel.

## HANDLEBAR

### Removal

1. Disconnect the battery negative lead as described under Battery in Chapter Three.
2. Remove the fuel tank as described in Chapter Seven.
3. On models equipped with a steering damper unit, remove the screw securing the damper adjust knob and remove the adjust knob (**Figure 51**).
4. On models so equipped, remove the screws (**Figure 52**) securing the impact pad.



5A. On models with no auxiliary switches, remove the impact pad (Figure 53).

5B. On models equipped with auxiliary switches, perform the following:

- a. Partially pull up on the impact pad and move it out of the way. Don't move the pad too far as there is very little slack in the electrical wires at this time.
  - b. Follow the electrical wires from the impact pad back to their electrical connectors at the main wiring harness. If necessary, remove any tie wrap(s) securing the electrical wires to the frame.
  - c. Pull the electrical wires away from the frame and disconnect them.
  - d. Pull the impact pad up and away from the steering head area. It is not necessary to completely remove the impact pad, just move it out of the way.
6. On models so equipped, unscrew the rear view mirrors from the handlebar switch assemblies.
7. Remove the tie wrap(s) (A, Figure 54) securing the electrical cables to the handlebar.

#### CAUTION

*On disc brake models, cover the instrument cluster, front fairing (models so equipped) and frame with a heavy cloth or plastic tarp to protect it from accidental spilling of brake fluid. Wash any spilled brake fluid off any painted or plated surface immediately, as it will destroy the finish. Use soapy water and rinse thoroughly.*

8. Remove the Allen bolt securing the right-hand combination switch, throttle grip and, on models so equipped, the front master cylinder assembly (B, Figure 54) to the handlebar. Carefully slide this assembly off of the right-hand end of the handlebar.

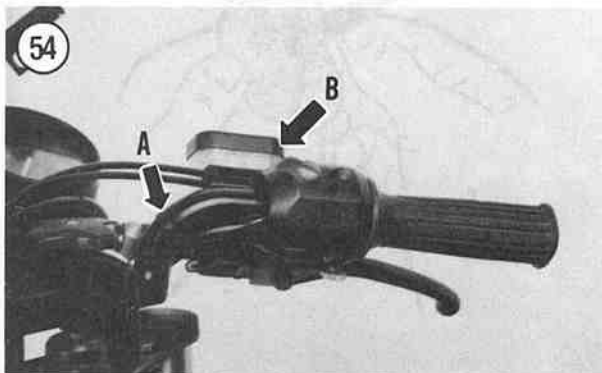
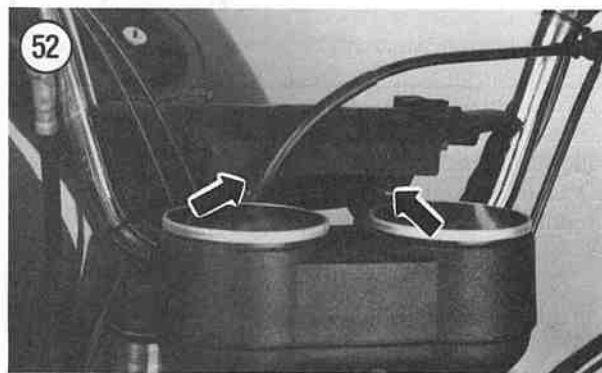
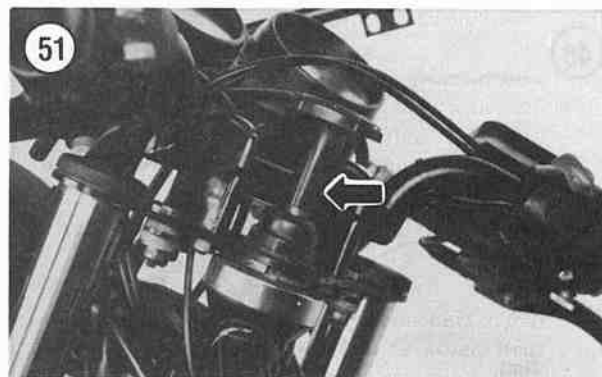
9. Remove the left-hand hand grip as follows:

- a. Hold onto the left-hand rubber grip (A, Figure 55) so that it will not fly off in the next step.
- b. Apply compressed air to the right-hand end of the handlebar and "blow off" the left-hand rubber hand grip.
- c. If the rubber grip will not come off, use a sharp knife and make a cut along the length of the rubber grip. Peel the rubber grip off of the handlebar.
- d. Remove all rubber hand grip residue from the handlebar.

10. Remove the Allen bolt securing the left-hand combination switch and clutch lever assembly (B, Figure 55) to the handlebar. Carefully slide this assembly off of the left-hand end of the handlebar.

#### NOTE

*Depending on the model and year, the bolts or nuts securing the handlebar upper holders are attached either from the top or bottom.*



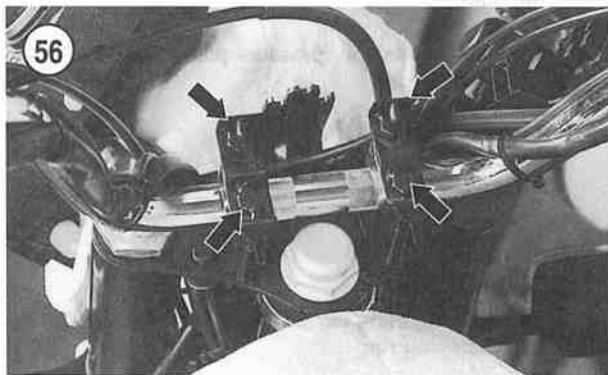
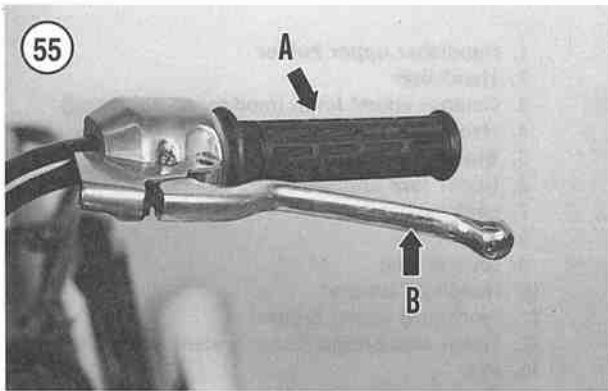


11A. On models with top-mounted bolts, perform the following:

- a. Remove the bolts (**Figure 56**) and, on models so equipped, the washers, securing the handlebar upper holders.
- b. Remove the upper holders and the handlebar.

11B. On models with bottom-mounted nuts, perform the following:

- a. Remove the nuts (**Figure 57**) and the washers securing the handlebar upper and lower holders.
- b. Remove the upper holders, the handlebar and the lower holders.



## Installation

1A. On models with top-mounted bolts, perform the following:

- a. Install the handlebar and the upper holders onto the lower holders.
- b. Install the bolts and, on models so equipped, the washers securing the handlebar upper holders.
- c. Align the index mark on the handlebar with the top surface of the handlebar lower holders.
- d. Tighten the bolts securely. After the bolts are tightened, recheck the alignment of the handlebar index mark. Readjust if necessary.

1B. On models with bottom mounted nuts, perform the following:

- a. Position the lower holders on the top fork bridge.
- b. Install the handlebar and the upper holders onto the lower holders.
- c. Install the nuts and the washers securing the handlebar upper and lower holders.
- d. Align the index mark on the handlebar with the top surface of the handlebar lower holders.
- e. Tighten the nuts securely. After the bolts are tightened, recheck the alignment of the handlebar index mark. Readjust if necessary.

2. Slide the left-hand combination switch and clutch lever assembly onto the left-hand end of the handlebar. Position the assembly so that it is comfortable and tighten the Allen bolt.

3. Apply a contact cement (Loctite No. 469 or equivalent) to the handlebar area for the left-hand grip. Install the left-hand grip and move it into position.

4. Slide the right-hand combination switch, throttle grip and, on models so equipped, the front master cylinder assembly onto the right-hand end of the handlebar. Position the assembly so that it is comfortable and tighten the Allen bolt.

5. If so equipped, install new tie wrap(s) securing the electrical cables to the handlebar.

### WARNING

*After installation is completed, make sure the brake lever does not come in contact with the throttle grip assembly when it is completely pulled. If it does, the brake fluid may be low in the reservoir; refill as necessary. Refer to Chapter Eleven.*

6. On models so equipped, screw the rear view mirrors onto the handlebar switch assemblies.

7A. On models with no auxiliary switches, install the impact pad.

7B. On models equipped with auxiliary switches, perform the following:

- a. Connect the electrical wires going to the switches.

- b. Move the electrical wires back into position and secure with tie wrap(s).
  - c. Push the impact pad back into position and install the mounting screws. Tighten the screws securely.
8. Install the fuel tank as described in Chapter Seven.
  9. On models equipped with a steering damper unit, install the damper adjust knob and screw. Tighten the screw securely.
  10. Connect the battery negative lead as described under *Battery* in Chapter Three.

### STEERING HEAD AND STEM

#### Disassembly

This procedure represents a typical steering stem and head disassembly. Where differences occur they are identified.

Refer to the following illustrations for this procedure:

- a. **Figure 58:** all 1970-1976 models, 1977-1978 R60 and R75, R80 and R80RT.
  - b. **Figure 59:** R80G/S and R80ST.
  - c. **Figure 60:** R65 and R65LS.
  - d. **Figure 61:** R100GS.
  - e. **Figure 62:** R100, R100RS, R100RT and R100/7.
1. Remove the front wheel as described in this chapter.
  2. Remove the fuel tank as described in Chapter Seven.
  3. On models so equipped, remove the front fairing as described in Chapter Twelve. Be sure to remove the fairing mounting bracket and headlight assemblies also.
  4. Remove the instrument cluster as described in Chapter Eight.
  5. Remove the handlebar assemblies as described in this chapter.
  6. Remove the front fork assemblies as described in this chapter.
  7. On models so equipped, remove the steering damper assembly as described in this chapter.
  8. Remove the steering stem nut (**Figure 63**) and, on models so equipped, the washer.

#### NOTE

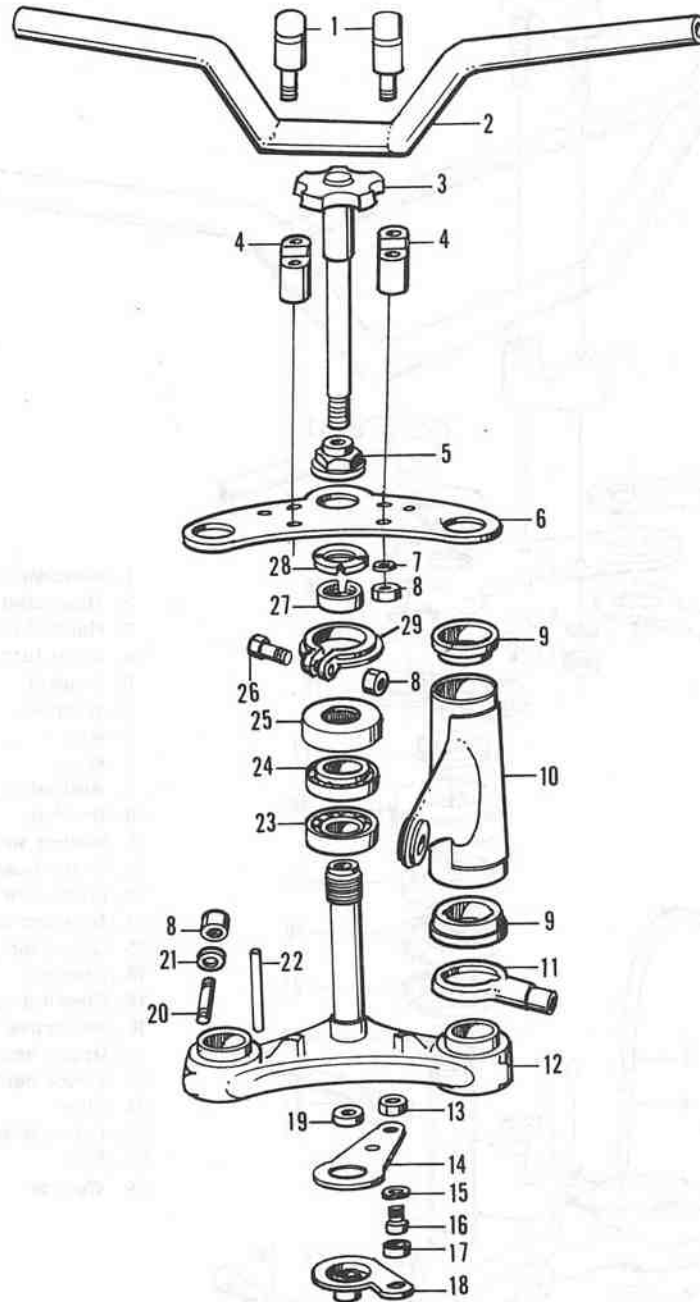
*On models so equipped, leave the instrument cluster mounting bracket attached to the upper fork bracket. There is no need to remove it unless it is damaged.*

9. Remove the upper fork bracket (**Figure 64**) or fork bridge.

58

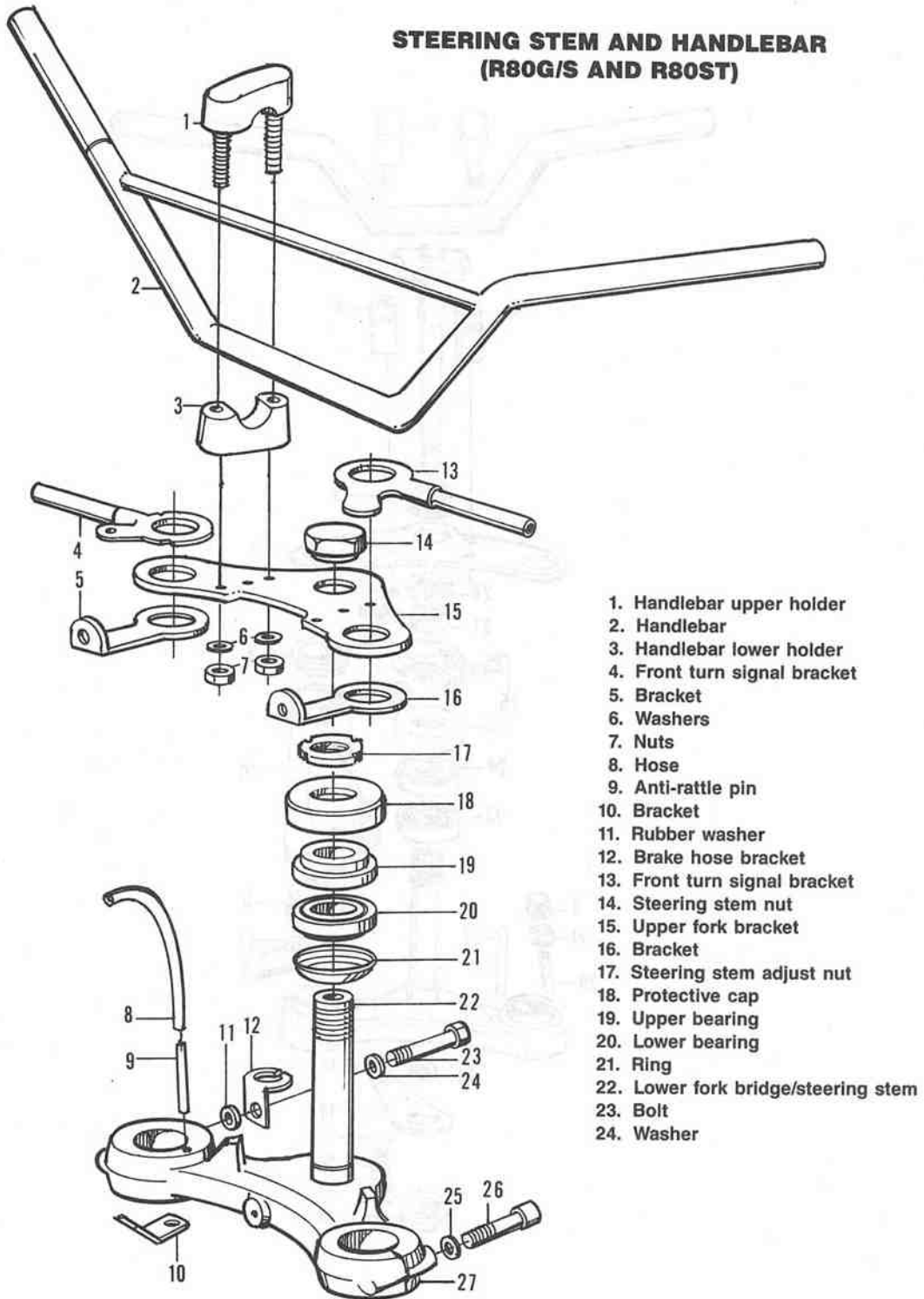
### STEERING STEM AND HANDLEBAR (ALL 1970-1976 MODELS, 1977-1978 R60 AND R75, R80 AND R80RT)

1. Handlebar upper holder
2. Handlebar
3. Damper adjust knob (models so equipped)
4. Handlebar lower holder
5. Steering stem nut
6. Upper fork bracket
7. Lockwasher
8. Nut
9. Rubber ring
10. Headlight bracket
11. Front turn signal bracket
12. Lower fork bridge/steering stem assembly
13. Nut
14. Steering damper plate
15. Lockwasher
16. Bolt
17. Cap
18. Steering damper pressure plate
19. Support ring
20. Threaded stud
21. Washer
22. Yoke
23. Lower bearing
24. Upper bearing
25. Protective cap
26. Bolt
27. Split nut
28. Steering stem adjust nut
29. Clamping ring



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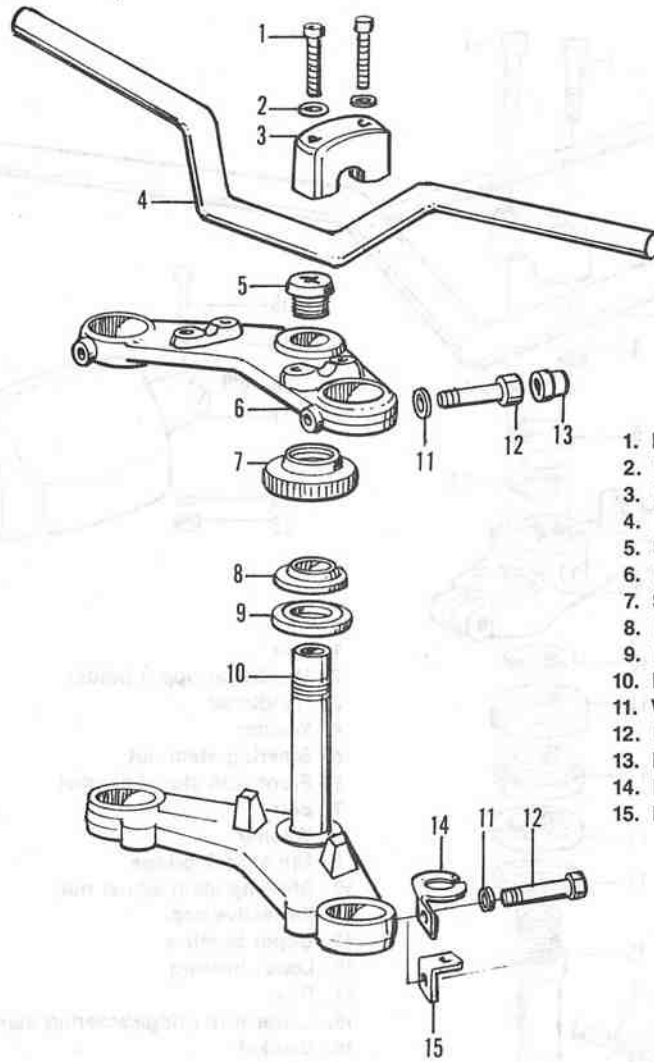
### STEERING STEM AND HANDLEBAR (R80G/S AND R80ST)



1. Handlebar upper holder
2. Handlebar
3. Handlebar lower holder
4. Front turn signal bracket
5. Bracket
6. Washers
7. Nuts
8. Hose
9. Anti-rattle pin
10. Bracket
11. Rubber washer
12. Brake hose bracket
13. Front turn signal bracket
14. Steering stem nut
15. Upper fork bracket
16. Bracket
17. Steering stem adjust nut
18. Protective cap
19. Upper bearing
20. Lower bearing
21. Ring
22. Lower fork bridge/steering stem
23. Bolt
24. Washer

60

**STEERING STEM AND HANDLEBAR  
(R65 AND R65LS)**

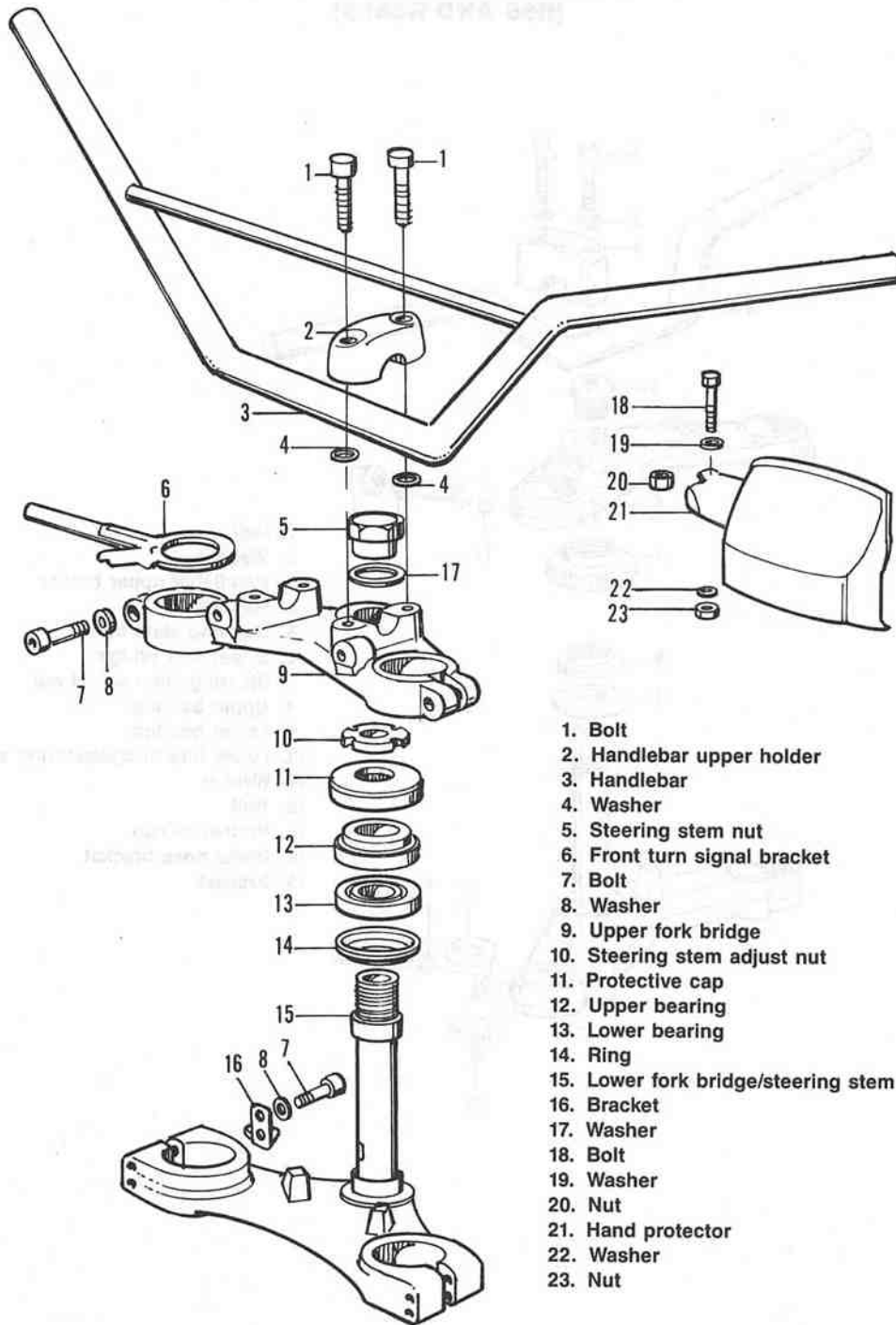


- 1. Bolt
- 2. Washer
- 3. Handlebar upper holder
- 4. Handlebar
- 5. Steering stem bolt
- 6. Upper fork bridge
- 7. Steering stem adjust nut
- 8. Upper bearing
- 9. Lower bearing
- 10. Lower fork bridge/steering stem
- 11. Washer
- 12. Bolt
- 13. Protective cap
- 14. Brake hose bracket
- 15. Bracket



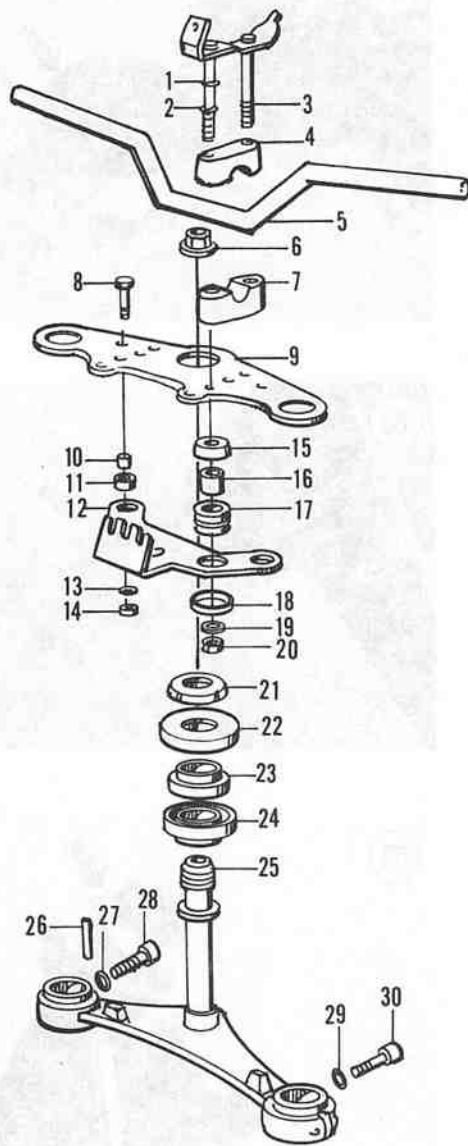
61

### STEERING STEM AND HANDLEBAR (R100GS)



1. Bolt
2. Handlebar upper holder
3. Handlebar
4. Washer
5. Steering stem nut
6. Front turn signal bracket
7. Bolt
8. Washer
9. Upper fork bridge
10. Steering stem adjust nut
11. Protective cap
12. Upper bearing
13. Lower bearing
14. Ring
15. Lower fork bridge/steering stem
16. Bracket
17. Washer
18. Bolt
19. Washer
20. Nut
21. Hand protector
22. Washer
23. Nut

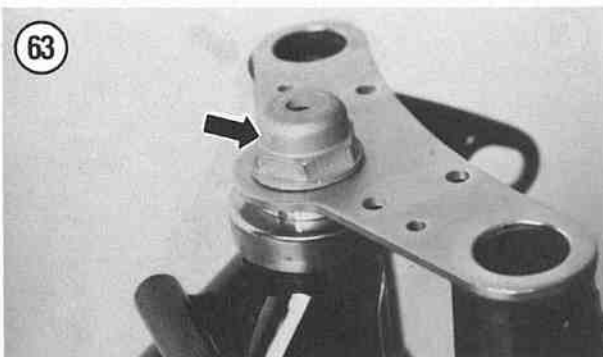
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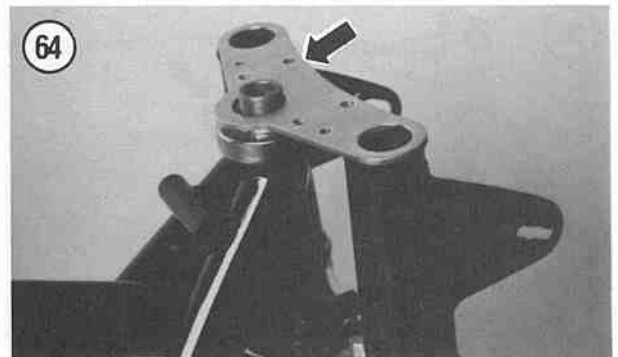
**STEERING STEM AND HANDLEBAR  
(R100, R100RS, R100RT, AND R100/7)**

1. O-ring
2. O-ring
3. Bolt and bracket assembly
4. Handlebar upper holder
5. Handlebar
6. Steering stem nut
7. Handlebar upper holder
8. Bolt
9. Upper fork bracket
10. Bushing
11. Rubber grommet
12. Instrument cluster bracket
13. Lockwasher
14. Nut
15. Cap
16. Bushing
17. Rubber grommet
18. Cap
19. Lockwasher
20. Nut
21. Steering stem adjust nut
22. Protective cap
23. Upper bearing
24. Lower bearing
25. Lower fork bridge/steering stem
26. Anti-rattle pin
27. Washer
28. Bolt
29. Washer
30. Bolt

63



64



10. On models equipped with a headlight bracket, perform the following:

- a. Remove the upper rubber ring (Figure 65) and the headlight bracket (Figure 66).
- b. Remove the lower rubber ring (Figure 67) and the front turn signal bracket (Figure 68).

11. Remove the steering stem adjust nut (Figure 69).

12. On models so equipped, loosen the bolt and nut on the clamp ring. Remove the clamp ring and remove the split nut.

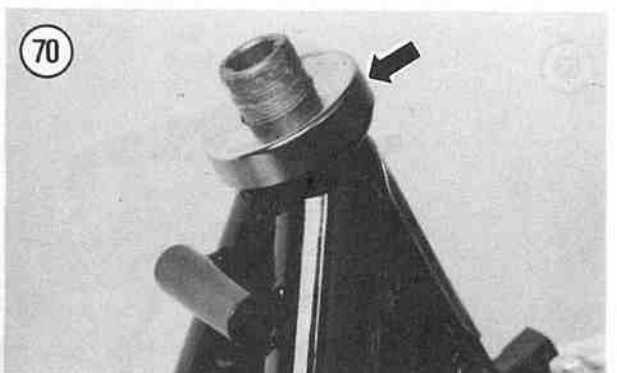
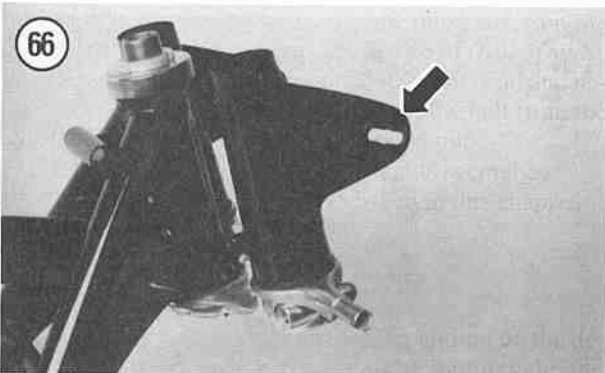
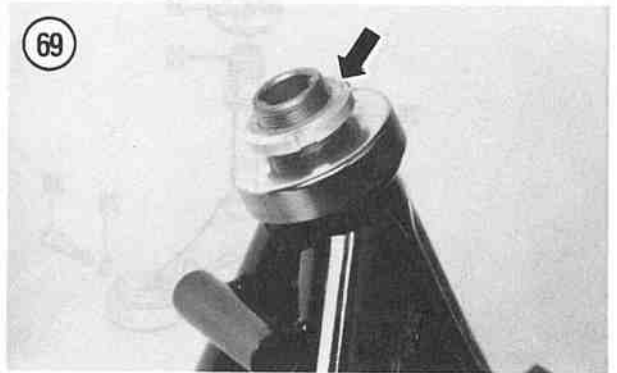
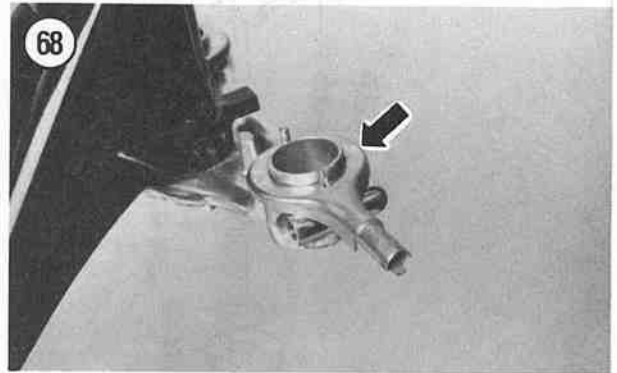
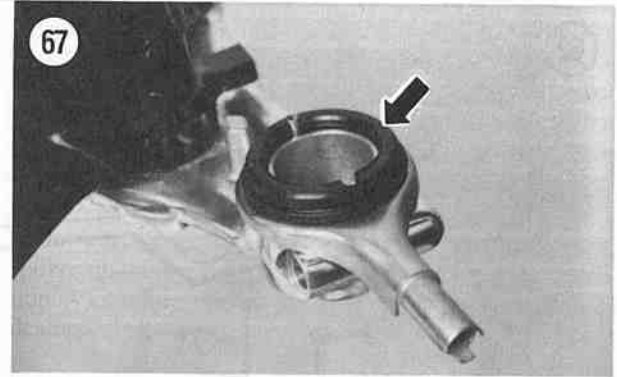
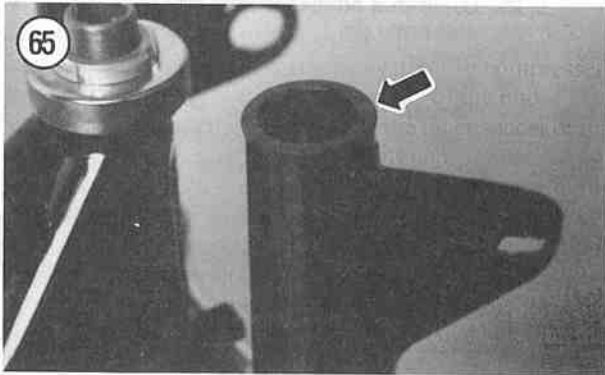
13. On models so equipped, remove the protective cap (Figure 70).

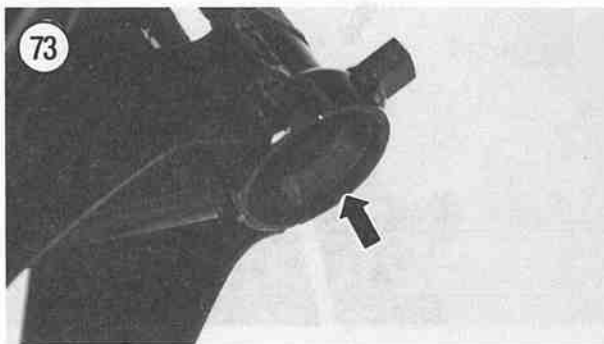
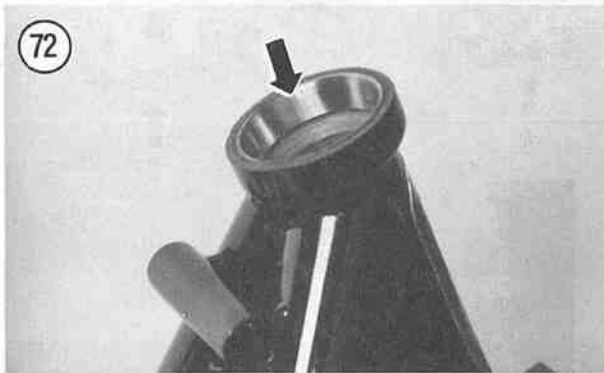
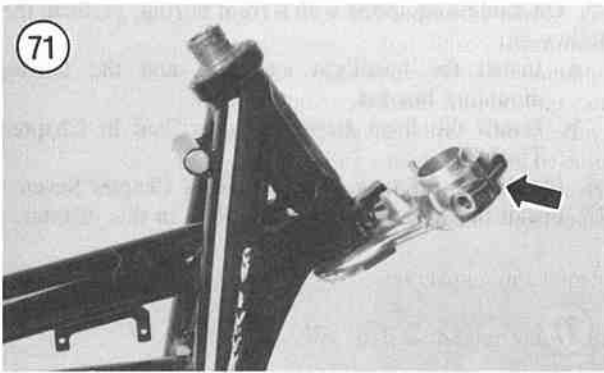
14. Have an assistant hold onto the steering stem, and using a soft-faced mallet or plastic hammer, carefully tap the steering stem down (Figure 71) and out of the steering stem bearings. Don't worry about catching any loose steel balls as the steering stem is equipped with assembled roller bearings.

15. Remove the upper roller bearing from the top of the steering head.

### Inspection

1. Clean the bearing races in the steering head and the bearings with solvent and wipe dry. Refer to Figure 72 for the upper race and Figure 73 for the lower race.
2. Check the welds around the steering head for cracks and fractures. If any are found, have them repaired by a competent frame shop or welding service.





3. Check the bearings for pitting, scratches or discoloration indicating wear or corrosion. Refer to **Figure 74** for the upper bearing and **Figure 75** for the lower bearing. Replace as necessary.

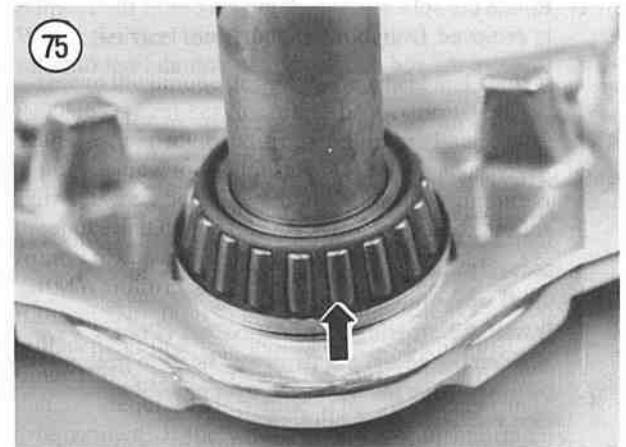
4. Check the races for pitting, galling and corrosion. Refer to **Figure 72** for the upper race and **Figure 73** for the lower race. If any of these conditions exist, replace the races as described in this chapter.

5. Check the steering stem (**Figure 76**) for cracks, damage or wear. Replace if necessary.

6. Thread the steering stem adjust nut onto the steering stem. Make sure it screws on easily with no roughness. Unscrew the steering stem adjust nut. If necessary, clean the threads on the steering stem (A, **Figure 77**), the adjust nut (B, **Figure 77**) and the steering stem nut (C, **Figure 77**) with a wire brush or tap or die of the correct thread type and size.

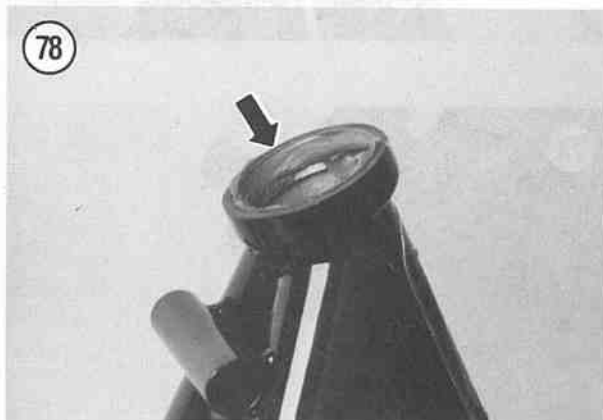
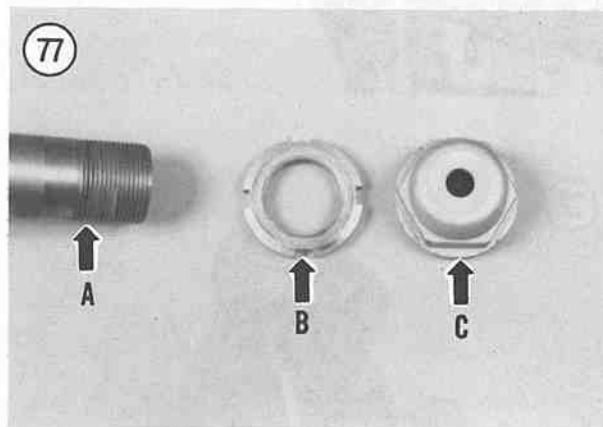
#### Assembly

1. Make sure both steering head bearing outer races are properly seated in the steering head tube.



2. Pack the bearing cavities of the lower roller bearings with bearing grease. Coat the outer bearing races (**Figure 78**), within the steering head, with bearing grease also.
3. Install the steering stem (**Figure 79**), with the lower bearing in place, into the steering head and hold it firmly in place. If necessary, using a soft-faced mallet or plastic hammers carefully tap the steering stem up and into the steering stem bearings.
4. Pack the upper bearing with bearing grease and install it onto the steering stem (**Figure 80**) and into the steering head.
5. On models so equipped, install the protective cap (**Figure 70**) onto the upper bearing and steering head.
6. Apply a coat of grease to the threads of the steering stem and steering stem adjust nut.
- 7A. On models equipped with the clamp ring and split nut, perform the following:
  - a. Install the split nut and screw it on until it is finger-tight.
  - b. Remove the bolt and nut from the clamp ring.
  - c. Install the clamp ring onto the split nut.
  - d. Insert a 4 mm (0.156 in.) rod into the split of the clamp ring and split nut. This rod is furnished in the factory tool kit.
  - e. Rotate the split nut and clamp ring until the freeplay is removed from the steering stem bearings.
  - f. Remove the rod and install the bolt and nut onto the clamp ring.
  - g. Tighten the bolt and nut securely, making sure the split nut does not move during the process.
  - h. After the bolt and nut are tightened, recheck the steering stem freeplay. Readjust if necessary.
  - i. Install the steering stem adjust nut and tighten securely.
- 7B. On all other models, perform the following:
  - a. Install the steering stem adjust nut (**Figure 69**).
  - b. Tighten the adjust nut firmly by hand to preload the bearings, then loosen the adjust nut until the bearing free play is all but eliminated.
8. On models equipped with a headlight bracket, perform the following:
  - a. Install the front turn signal bracket (**Figure 68**) and the lower rubber ring (**Figure 67**).
  - b. Install the headlight bracket (**Figure 66**) and the upper rubber ring (**Figure 65**).
9. Install the upper fork bracket (**Figure 64**) or fork bridge.
10. Install the steering stem nut (**Figure 63**) and on models so equipped, the washer. Tighten the nut to the torque specification listed in **Table 1**.
11. On models so equipped, install the steering damper assembly as described in this chapter.
12. Install the front fork assemblies as described in this chapter.
13. Install the handlebar assemblies as described in this chapter.
14. Install the instrument cluster as described in Chapter Eight.

15. On models equipped with a front fairing, perform the following:
  - a. Install the headlight assembly and the fairing mounting bracket.
  - b. Install the front fairing as described in Chapter Twelve.
16. Install the fuel tank as described in Chapter Seven.
17. Install the front wheel as described in this chapter.



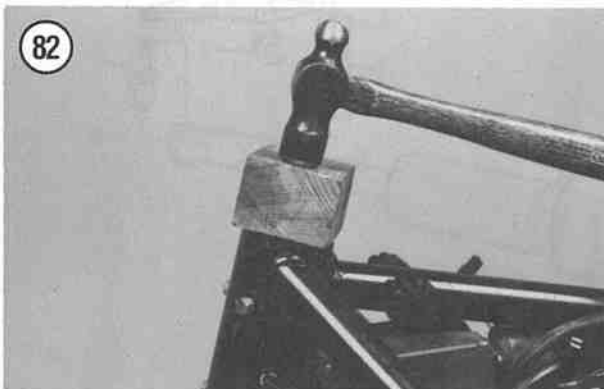
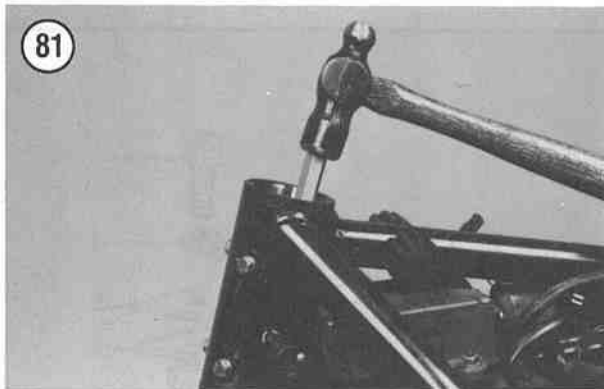
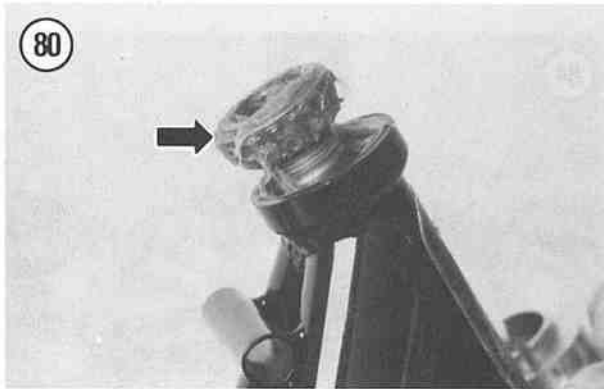


### Steering Stem Adjustment

If play develops or there is binding in the steering system, it may only require adjustment. However, don't take a chance on it. Disassemble the steering stem assembly and look for possible damage as described in this chapter.

#### STEERING HEAD BEARING RACE

The headset and steering stem bearing races are pressed into place. Because they are easily bent, do not remove them



unless they are worn and require replacement. The top and bottom bearings and bearing races are identical, both having the same BMW part number.

#### Steering Head Bearing Outer Race Replacement

- To remove the headset race, insert a hardwood stick or soft punch into the head tube (Figure 81) and carefully tap the race out from the inside. After it is started, tap around the race so that neither the race nor the steering head tube is damaged. Repeat for the other bearing race if necessary.
- Thoroughly clean out the steering head of all old grease.
- To install the upper bearing race, perform the following:
  - Place the upper bearing race in a freezer for 30 minutes. This will reduce the overall size of the race for easier installation.
  - Make sure that the race is squarely seated in the steering head race bore before tapping it into place.
  - Tap it in slowly with a block of wood (Figure 82), a suitable size socket or piece of pipe.
  - Tap the race in until it is flush with the steering head surface and make sure it has bottomed out.
- To install the lower bearing race, perform the following:
  - Place the lower bearing race in a freezer for 30 minutes. This will reduce the overall size of the race for easier installation.
  - Make sure that the race is squarely seated in the steering head race bore before tapping it into place.
  - Tap it in slowly with a block of wood, a suitable size socket or piece of pipe.
  - Tap the race in until it is flush with the steering head surface and make sure it has bottomed out.

#### Steering Stem Lower Bearing Assembly Removal/Installation

##### NOTE

Do not remove the steering stem lower bearing unless it is going to be replaced with a new bearing. Do not reinstall a bearing that has been removed as it is no longer true to alignment.

- In order to remove the lower bearing, the steering stem must be pressed out of the lower fork bridge with a press.
- Prior to removing the steering stem, make a mark (A, Figure 83) on the lower fork bridge in alignment with the steering lock receptacle (B, Figure 83) in the steering stem. These 2 parts must align after assembly.
  - Heat the steering stem assembly to 120-130° C (250-265° F).

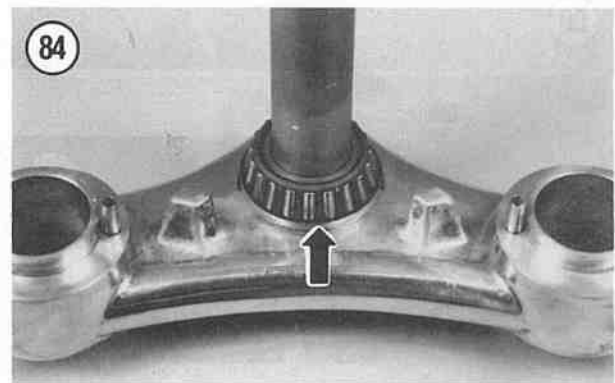
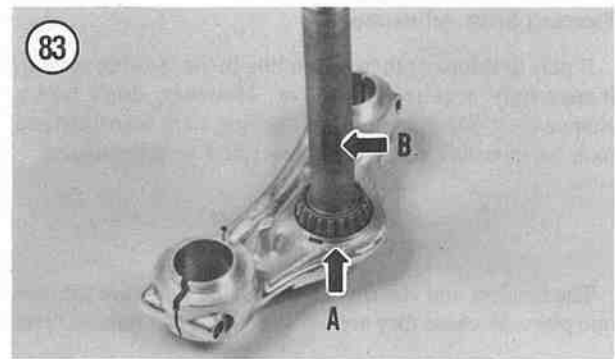
##### WARNING

Use insulated gloves or thick pot holders to hold onto the steering stem after it has been heated.

**NOTE**

*It is not necessary to completely remove the steering stem from the lower fork bridge unless either part is going to be replaced.*

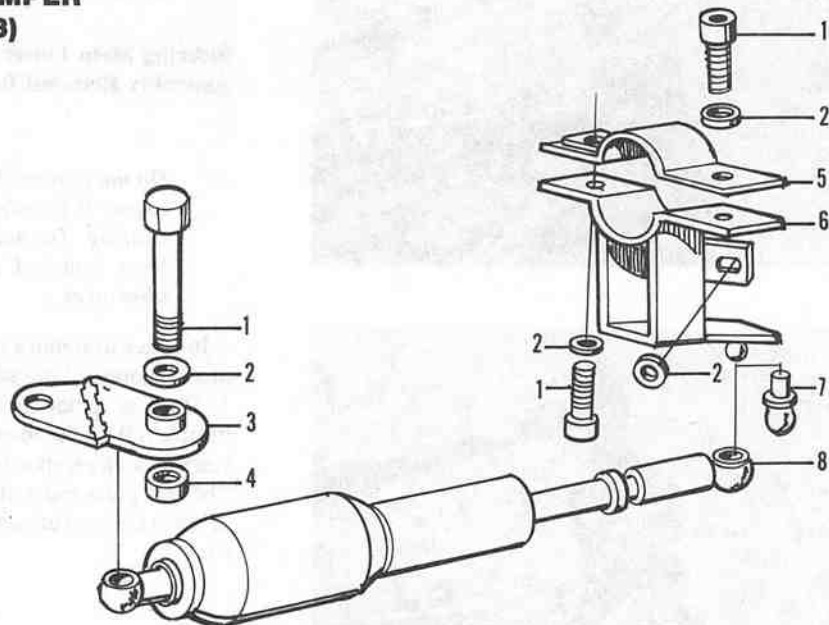
3. Place the steering stem in a hydraulic press and press the steering stem partially out of the lower fork bridge until the bearing assembly can be removed from the steering stem.
4. Remove the bearing assembly and, on models so equipped, the ring.
5. While the steering stem is still hot, turn the assembly over in the press and press the steering stem back into the lower fork bridge. Check the alignment marks made in Step 1 during the removal procedure. These marks must align in order for the steering lock to operate properly.
6. Press the steering stem into the lower fork bridge until the circlip on the steering stem bottoms out on the lower surface of the lower fork bridge.
7. On models so equipped, slide a new ring over the steering stem.
8. Heat the new lower roller bearing to 80° C (176° F) for easy installation.
9. Install the new roller bearing onto the steering stem.
10. Use a long piece of pipe that matches the inner race diameter and tap the bearing down the steering stem and into place. Make sure it is seated squarely and is all the way down (Figure 84).



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### STEERING DAMPER (1970-1973)

1. Bolt
2. Washer
3. Bracket
4. Nut
5. Clamp
6. Mounting bracket
7. Ball fitting
8. Steering damper unit



11. After the lower bearing has cooled down, thoroughly pack it with bearing grease.

### Friction Type Steering Damper Unit (1970-1973 Models)

The 1970-1973 models are equipped with a friction type steering damper assembly as standard equipment. A hydraulic damper unit was offered as an option on 1970-on models.

#### Removal/installation

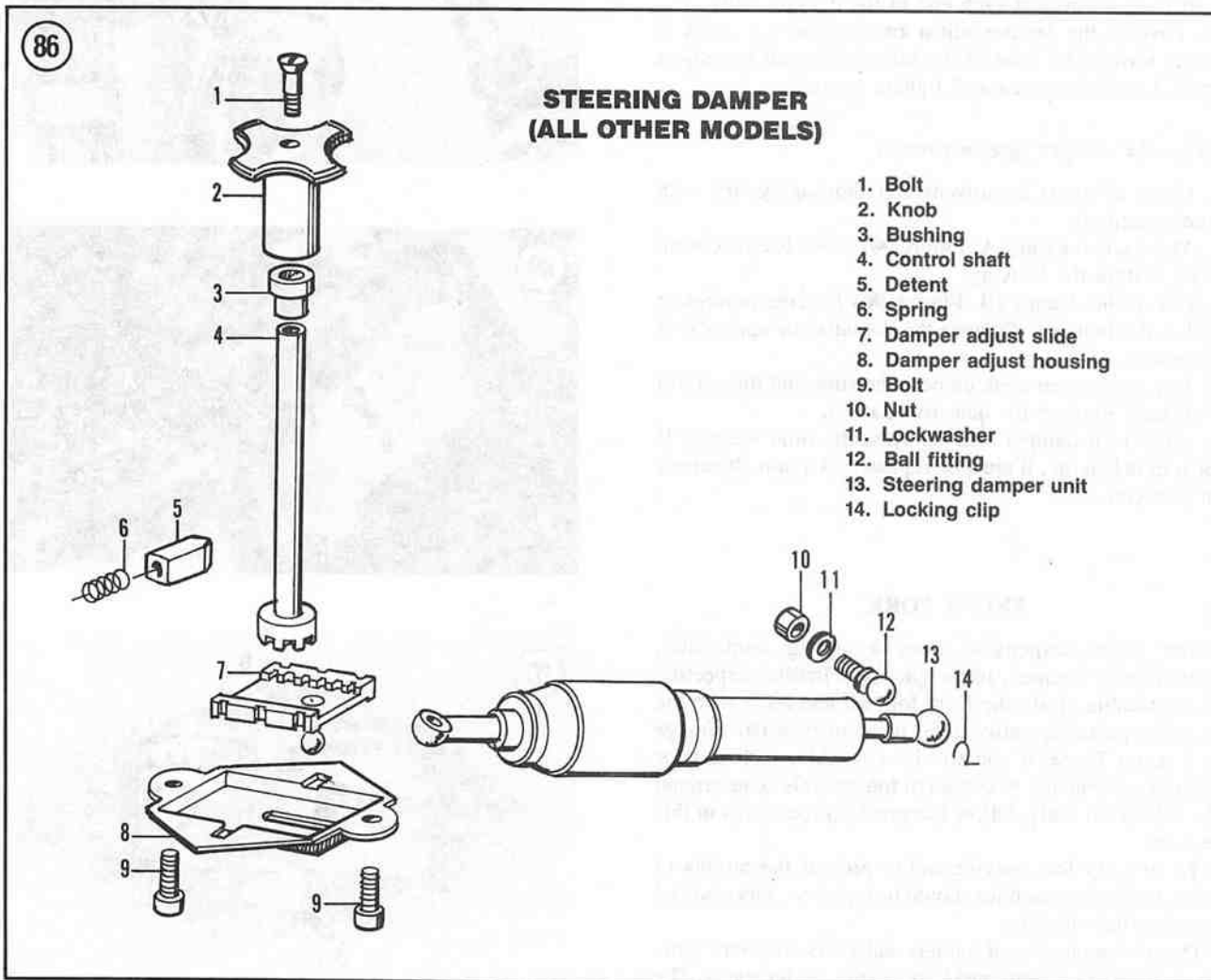
1. Remove the circlip from the lower end of the damper adjust knob shaft.
2. Completely unscrew the damper adjust knob and remove it from the steering stem.
3. Remove the steering damper pressure plate and support ring.

4. Remove the bolt and lockwasher securing the steering damper plate and remove the damper plate.
5. Inspect the contact surfaces of the damper plate and pressure plate for wear or damage. Replace if necessary.
6. Install by reversing these removal steps. Note the following during installation.
7. Tighten the bolt securely and make sure the circlip is correctly seated in the adjust knob shaft.

### Hydraulic Type Steering Damper Unit (1970-on Models)

A hydraulic steering damper is optional on 1970 and later models. Refer to the following illustrations for this procedure:

- a. **Figure 85:** 1970-1973 models (optional equipment).
  - b. **Figure 86:** all other models.
1. On models so equipped, remove the front fairing as described in Chapter Twelve. Also, be sure to remove the fairing mounting bracket and headlight assemblies.



2. Rotate the damper adjust knob so the "O" mark is facing toward the front of the bike.
3. Remove the screw securing the damper adjust knob.
4. Remove the knob (Figure 87) and the bushing from the control shaft.
5. Disconnect the ring clips securing the ends (Figure 88) of the damper unit to the ball joints.
6. Remove the damper unit (A, Figure 89).
7. If necessary, remove the screws securing the damper adjuster housing (B, Figure 89) to the lower fork bridge.
8. Inspect the components as described in this chapter.
9. Install by reversing these removal steps. Note the following during installation.
10. Position the damper adjust slide so that the ball joint is in the center of the housing (toward the right-hand end of the slot).
11. Apply a light coat of grease to the ball joints prior to installing the damper unit onto them.
12. Make sure the ring clips are properly seated in their respective grooves at each end of the damper unit.
13. Position the damper adjust knob so the "O" mark is facing toward the front of the bike and install the adjust knob. Install the screw and tighten securely.

#### Hydraulic damper type inspection

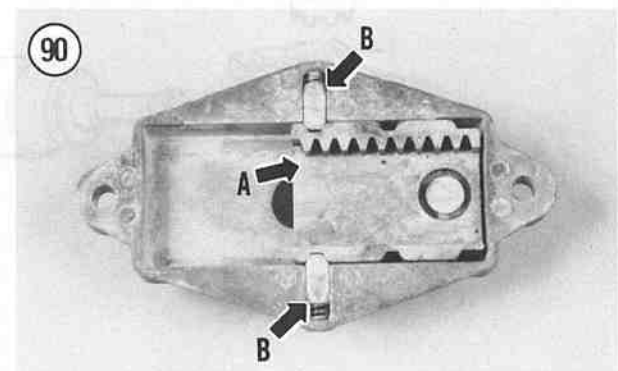
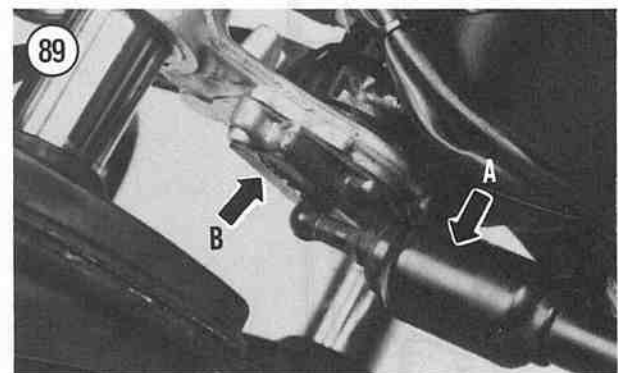
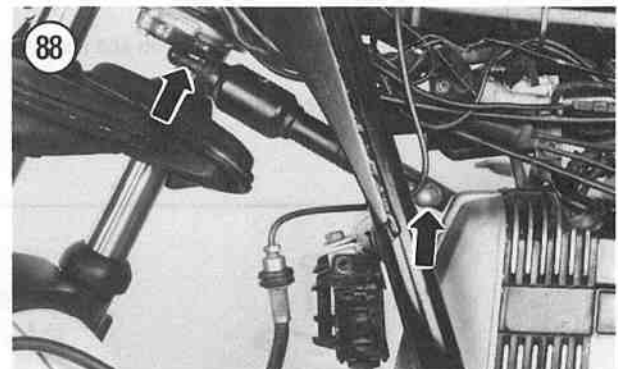
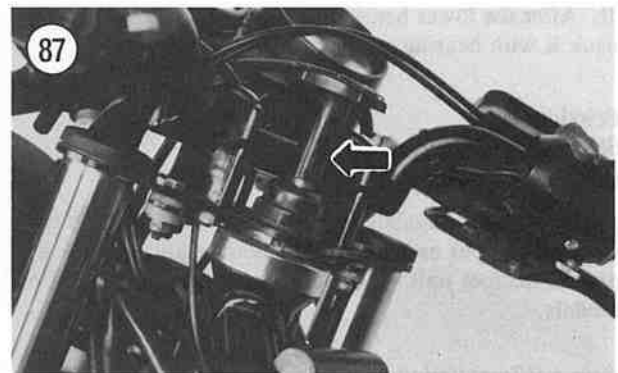
1. Clean all parts in solvent and thoroughly dry with compressed air.
2. Make sure the slide (A, Figure 90) moves back and forth easily within the housing.
3. Check the detents (B, Figure 90) for free movement within the housing. Replace the detent(s) or spring(s) if necessary.
4. Inspect the gear teeth on both the slide and the control shaft end. Replace the defective part(s).
5. Inspect the damper unit for hydraulic fluid leakage. If the unit is leaking, it must be replaced as a unit. It cannot be serviced.

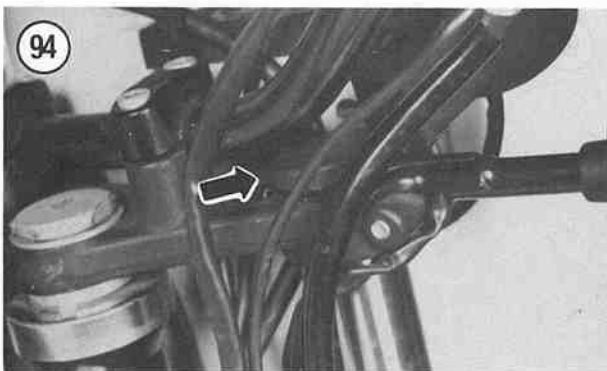
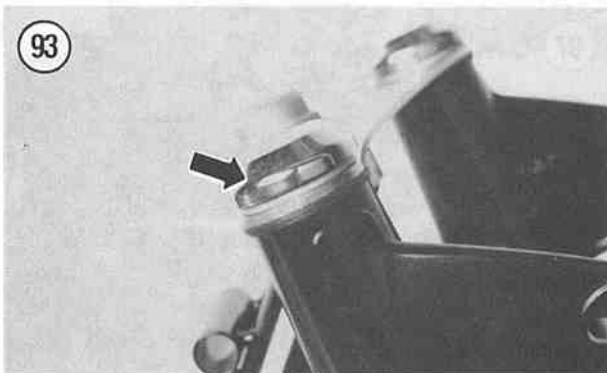
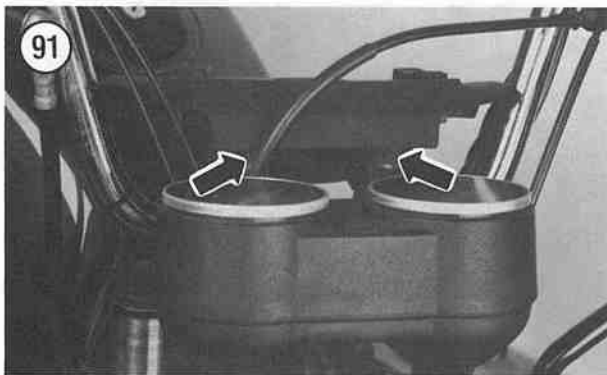
### FRONT FORK

The front suspension uses a spring controlled, hydraulically damped, telescopic fork. Before suspecting major trouble, drain the front fork oil and refill with the proper type and quantity; refer to *Front Fork Oil Change* in Chapter Three. If you still have trouble, such as poor damping, a tendency to bottom or top out or leakage around the rubber oil seals, follow the service procedures in this section.

To simplify fork service and to prevent the mixing of parts, the fork assemblies should be removed, serviced and installed individually.

Due to the number of models and years covered in this book, the forks are grouped into "Type" designations. The





service procedure for each group is presented separately under the "Type" designations. This is to keep the service procedures as easy to use as possible.

The removal, installation and inspection procedures are covered as single procedures since all models are similar in that respect. Where differences occur, they are specified.

## FRONT FORK REMOVAL AND INSTALLATION

### Removal (All Models)

#### NOTE

*During the removal and installation procedure, reference is made to fork Type I, Type II, etc. Refer to the disassembly procedures that follow to find the correct procedure for your bike.*

1. Remove the fuel tank as described in Chapter Seven.
2. On models equipped with a full front fairing, remove the fairing in order to gain access to the lower fork bridge clamping bolts. Refer to *Front Fairing Removal/Installation* in Chapter Twelve.
3. Remove the front wheel as described in this chapter.
4. Remove the front fender as described under *Front Fender Removal/Installation* in Chapter Twelve.
5. On models so equipped, be sure to remove the bolts securing the fork brace that bridges both fork legs. Remove the fork brace.
6. On models equipped with a steering damper unit, remove the screw securing the damper adjust knob. Remove the knob (**Figure 87**).
7. On models so equipped, remove the screws (**Figure 91**) securing the impact pad.
- 8A. On models with no auxiliary switches, remove the impact pad.
- 8B. On models equipped with auxiliary switches, perform the following:
  - a. Partially pull up on the impact pad (**Figure 92**) and move it out of the way. Don't move the pad too far as there is very little slack in the electrical wires at this time.
  - b. Follow the electrical wires from the impact pad back to their electrical connectors at the main wiring harness. If necessary, remove any tie wrap(s) securing the electrical wires to the frame.
  - c. Pull the electrical wires away from the frame and disconnect them.
  - d. Pull the impact pad up and away from the steering head area. It is not necessary to completely remove the impact pad, just move it out of the way.
- 9A. On models, unscrew the top trim cap (**Figure 93**).
- 9B. On all other models, carefully pry off the top trim cap (**Figure 94**).



10. On disc brake models, remove the bolt (Figure 95) securing the brake line to the fork slider.
- 11A. On R100GS models, remove the slotted nut (A, Figure 96), washer and turn signal mounting bracket (B, Figure 96), from the top of the fork tube.
- 11B. On all other models, remove the fork top cap bolt (Figure 97) and on models so equipped, the washer (Figure 98) from the fork tube.
12. Loosen the upper (models so equipped) and lower (Figure 99) fork bridge clamp bolt(s).

**NOTE**

*On Type I forks, the fork tube also holds the headlight mounting bracket (A, Figure 100) in place. Secure the mounting bracket on each side after the fork tube is withdrawn.*

13. Lower the fork assembly (B, Figure 100) down and out of the upper and lower fork bridge. It may be necessary to slightly rotate the fork tube while pulling it down and out.

**Installation  
(All Models)**

1. Clean off any corrosion or dirt on the upper and lower fork bridge fork receptacles.

**NOTE**

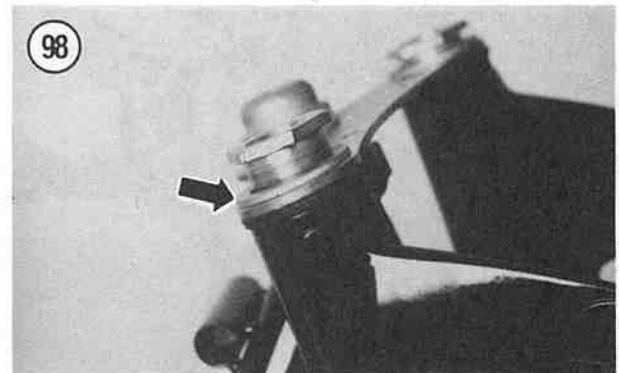
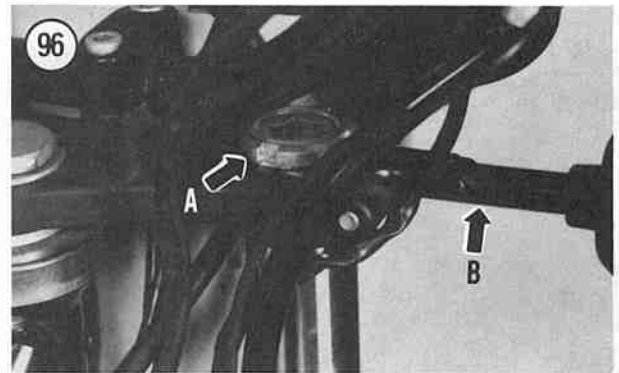
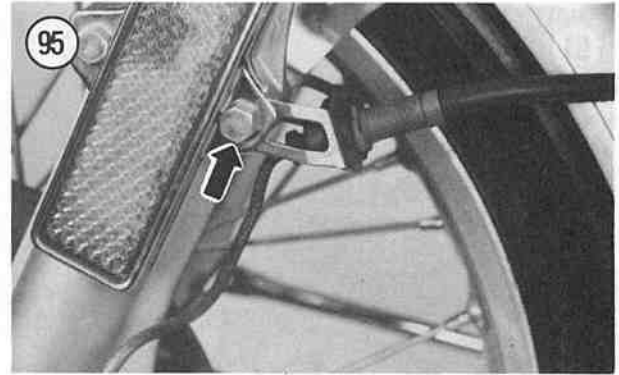
*The fork assemblies must be reinstalled on the correct side of the bike so the brake calipers (models so equipped) and front fender can be installed. If the fork assemblies are installed on the wrong side, these components cannot be installed onto the fork sliders.*

2. Install the fork assemblies on the correct side so that the front caliper(s) (models so equipped) and fender can be installed.

**NOTE**

*On Type I forks, while installing the fork tube (B, Figure 100) guide it through the headlight mounting bracket (A, Figure 100).*

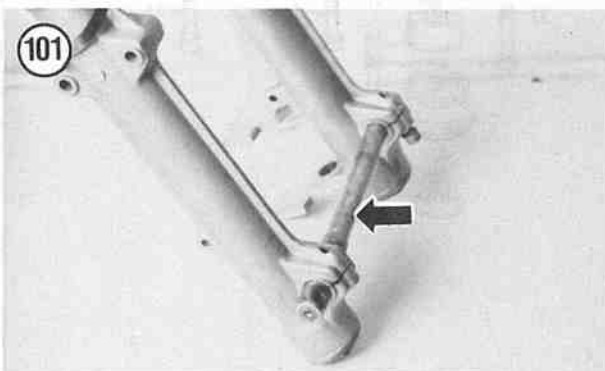
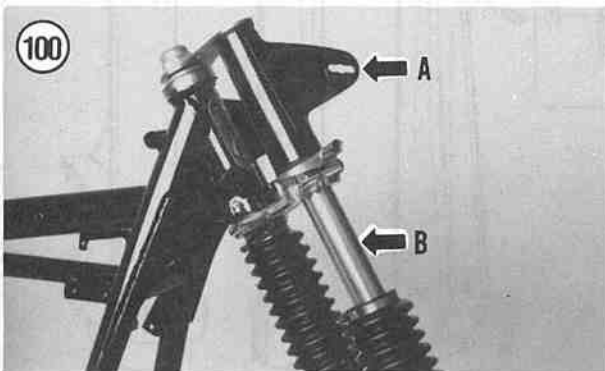
3. Install the fork tube up through the lower and upper fork bridges.
  - 4A. On Type I, III and IV forks, perform the following:
    - a. Push the fork tube up until it bottoms out against the bottom side of the upper fork bracket or bridge.
    - b. Tighten the lower fork bridge bolts finger-tight at this time.
    - c. Install the front axle (Figure 101) and tighten the bolts securing the front axle. This is necessary to align the fork tubes to each other prior to tightening the fork clamp bolts.
    - d. On models so equipped, install the washer.



- e. Install the fork top cap bolt. Push down on the bolt to compress the fork spring. Start the bolt slowly; don't cross-thread it.
- f. Tighten the lower fork bridge bolts to the torque specification listed in **Table 1**.

**NOTE**

If the fork top cap bolt torque specification for your specific model is not listed in **Table 1**, tighten the bolt securely. BMW does not provide torque specifications for all models, especially the early models.



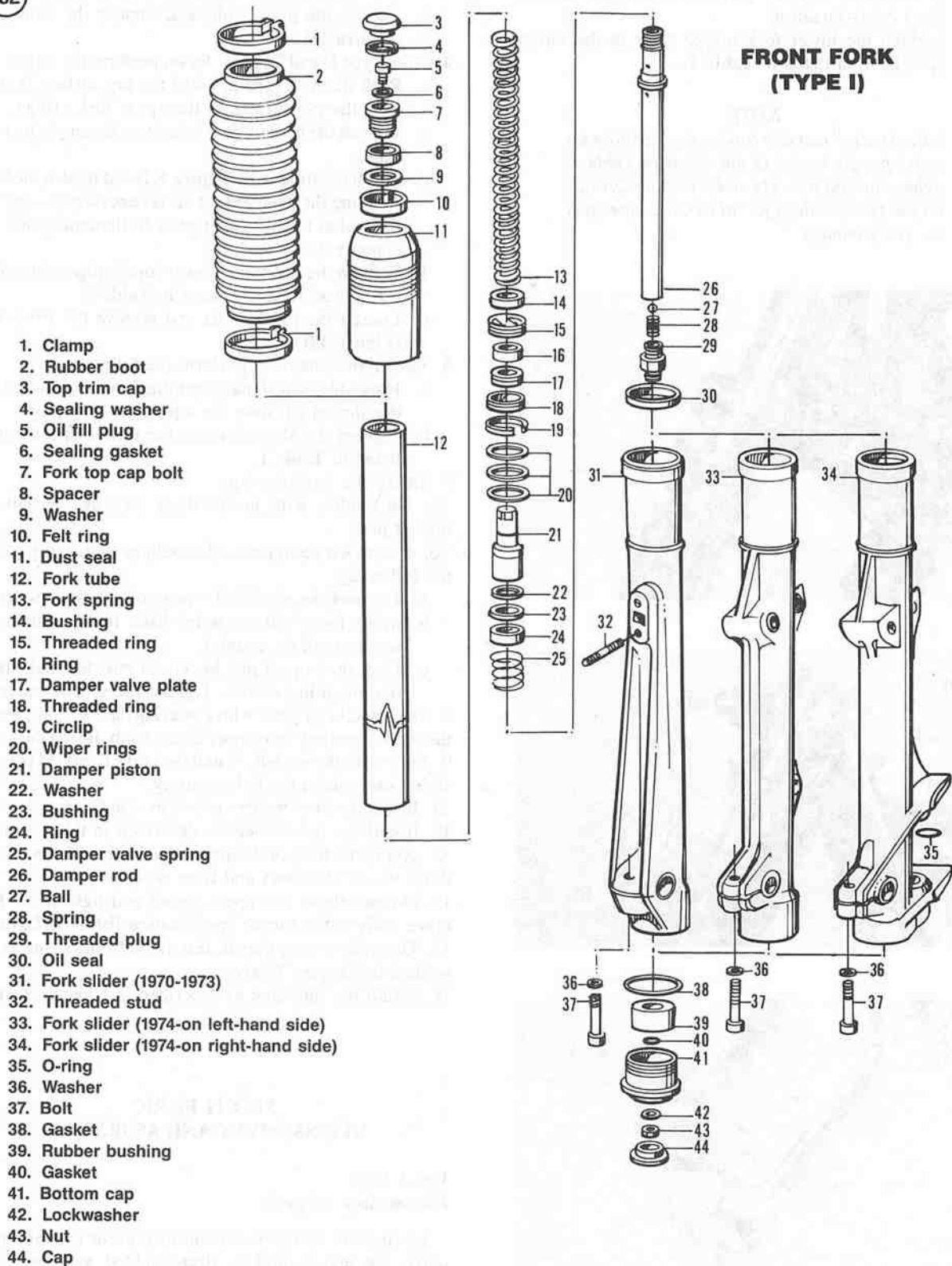
- g. Tighten the fork top cap bolt to the torque specification listed in **Table 1** or securely.
  - h. Loosen the pinch bolts and remove the front axle (**Figure 101**).
- 4B. On Type II and Type IV forks, perform the following:
    - a. Push the fork tube up until the top surface is flush with the top surface of the upper fork bridge.
    - b. Tighten the lower fork bridge bolts finger-tight at this time.
    - c. Install the front axle (**Figure 101**) and tighten the bolts securing the front axle. This is necessary to align the fork tubes to each other prior to tightening the fork clamp bolts.
    - d. Tighten the upper and lower fork bridge bolts to the torque specification listed in **Table 1**.
    - e. Loosen the pinch bolts and remove the front axle (**Figure 101**).
  5. On R100GS models, perform the following:
    - a. Install the turn signal mounting bracket, washer and the slotted nut onto the top of the fork tube.
    - b. Tighten the slotted nut to the torque specification listed in **Table 1**.
  6. Install the top trim cap.
  - 7A. On models with no auxiliary switches, install the impact pad.
  - 7B. On models equipped with auxiliary switches, perform the following:
    - a. Connect the electrical wires going to the switches.
    - b. Move the electrical wires back into position and secure with tie wrap(s).
    - c. Push the impact pad back into position and install the mounting screws. Tighten the screws securely.
  8. On models equipped with a steering damper unit, install the screw securing the damper adjust knob. Install the knob.
  9. On disc brake models, install the brake line(s) to the fork slider and tighten the bolt securely.
  10. Install the front fender as described in Chapter Twelve.
  11. Install the front wheel as described in this chapter.
  12. Apply the front brake and pump the front forks several times to seat the forks and front wheel.
  13. On models so equipped, install and tighten the fork brace bolts to the torque specification listed in **Table 1**.
  14. On models so equipped, install the front fairing as described in Chapter Twelve.
  15. Install the fuel tank as described in Chapter Seven.

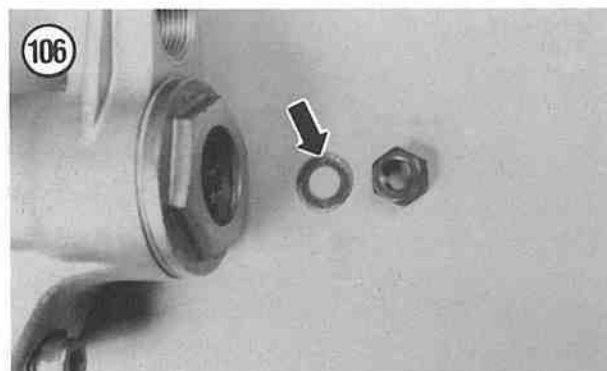
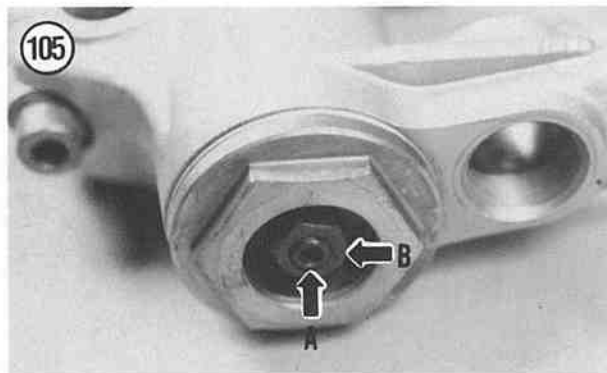
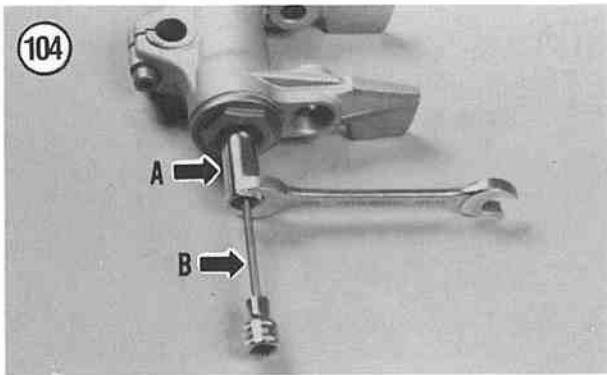
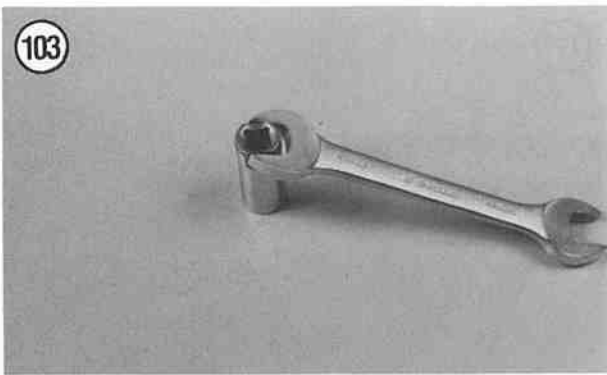
### FRONT FORK DISASSEMBLY AND ASSEMBLY

#### Front Fork Disassembly (Type I)

To simplify fork service and to prevent the mixing of parts, the legs should be disassembled and assembled individually.

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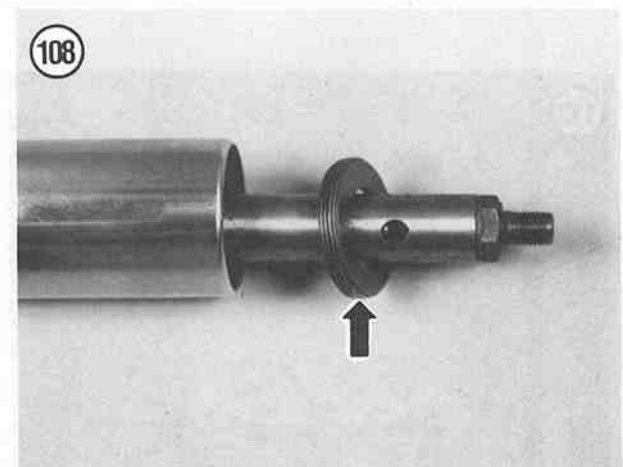
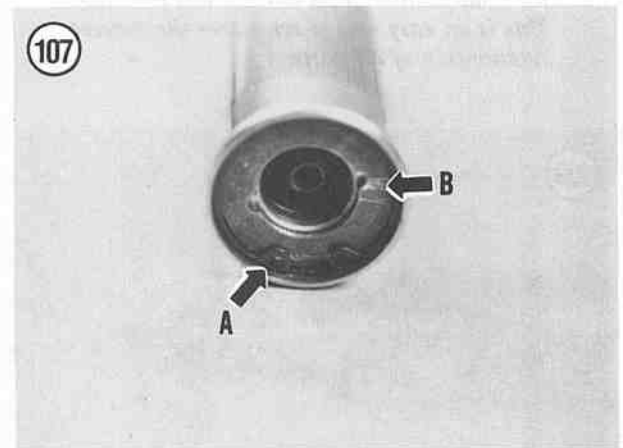




Refer to **Figure 102** for this procedure. The following models are covered in this procedure:

- a. R50.
- b. R60.
- c. R75.
- d. R80.
- e. R90 and R90S.
- f. R100/7.

1. Unscrew the cap from the lower cap on the base of the fork slider.
2. Grind 2 flats on the top of a socket so that it will accept an open end wrench (15 mm) as shown in **Figure 103**.
3. Install the socket (A, **Figure 104**) and wrench onto the lower nut and insert an Allen wrench (B, **Figure 104**) through the socket and into the threaded plug (A, **Figure 105**) on the lower end of the damper rod.
4. Hold onto the Allen wrench and loosen, then remove the nut (B, **Figure 105**) and the washer (**Figure 106**).
5. Separate the fork tube from the fork slider.
6. Remove circlip (A, **Figure 107**) then unscrew the lower threaded ring (B, **Figure 107**) from the base of the fork tube.
7. Remove the lower threaded ring (**Figure 108**).



8. Slide off the spacer (A, **Figure 109**) and unscrew the upper threaded ring (B, **Figure 109**) from the base of the fork tube.
9. Unscrew the fork top cap bolt from the top of the fork tube.
10. Remove the spacer and withdraw the fork spring from the top of the fork tube.

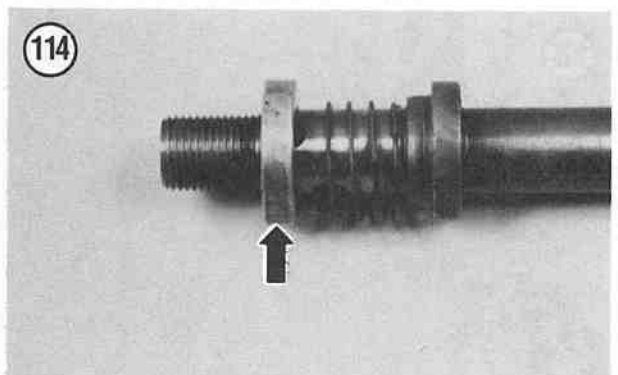
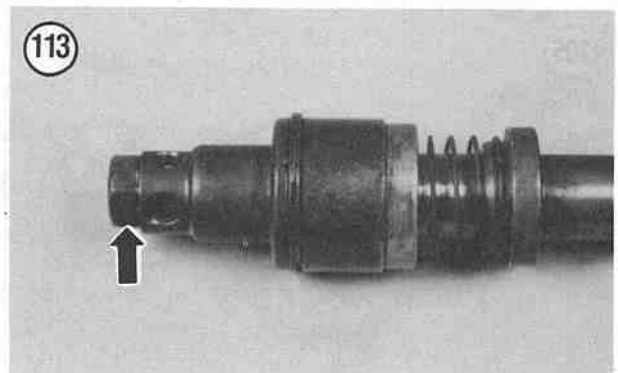
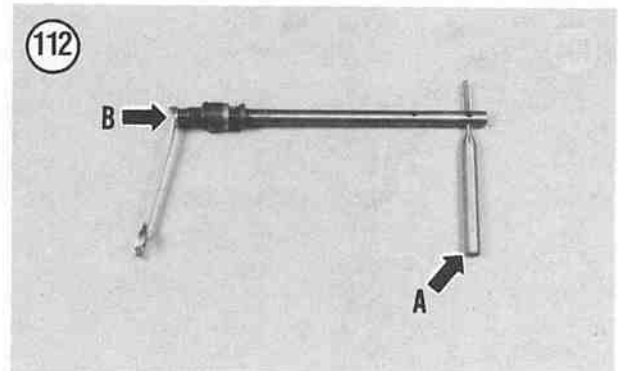
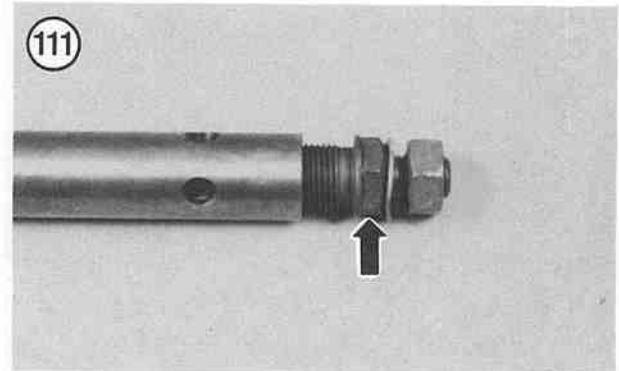
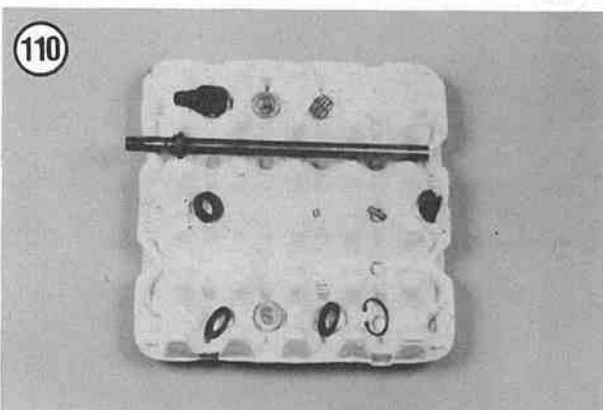
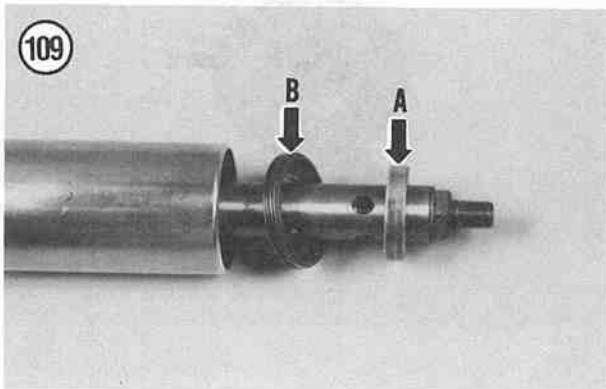
**CAUTION**

*In the next step, withdraw the damper rod assembly slowly. This will minimize damage to the thin metal wiper rings at the top of the damper rod as they pass the fork tube threads.*

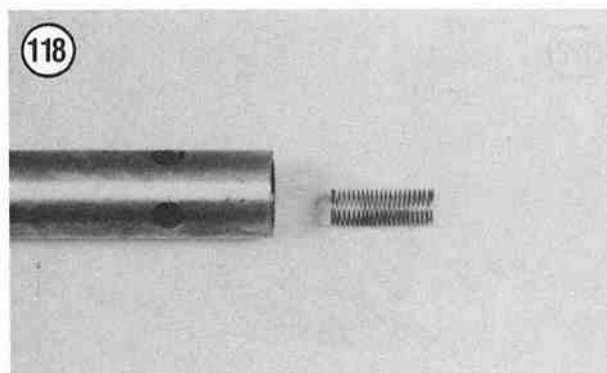
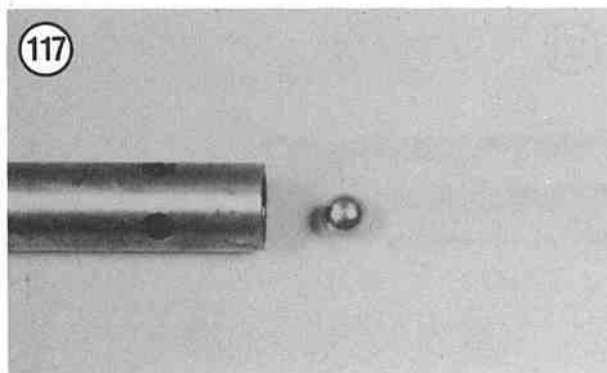
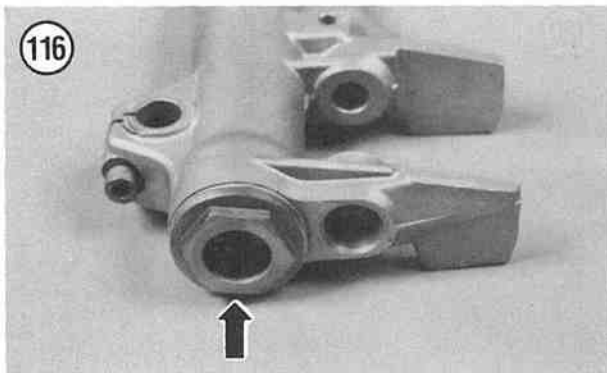
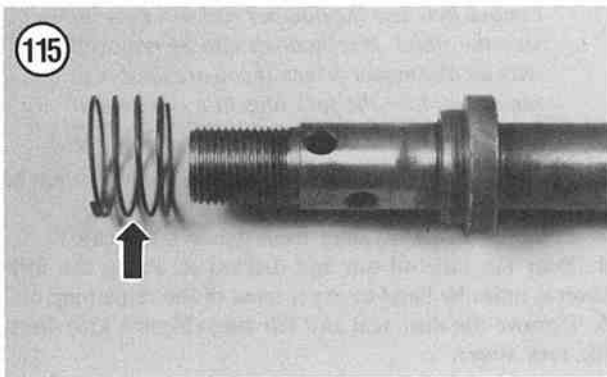
11. Remove the damper rod assembly from the top of the fork tube.

**NOTE**

*A helpful "tool" that should be used for damper rod disassembly is a large egg flat (the type that restaurants get their eggs in) as shown in **Figure 110**. As you remove a part from the damper rod, set it in one of the depressions in the same position from which it was removed. This is an easy way to remember the correct relationship of all parts.*







12. If necessary, disassemble the damper rod as follows:
  - a. Unscrew the threaded plug (Figure 111), then remove the spring and ball from the base of the damper rod.
  - b. Insert a suitable size drift (A, Figure 112) into one of the holes in the base of the damper rod.
  - c. Use a wrench and loosen the damper piston (B, Figure 112) from the top of the damper rod.
  - d. Remove the damper piston (Figure 113).
  - e. Remove the washer, bushing and ring (Figure 114).
  - f. Remove the spring (Figure 115).
13. Unscrew the bottom cap (Figure 116) and gasket and remove the rubber bushing.
14. Inspect all parts as described under *Inspection (Type I Models)* in this chapter.

#### Front Fork Assembly (Type I)

1. If disassembled, assemble the damper rod as follows:
  - a. Install the spring (Figure 115).
  - b. Install the ring, bushing and washer (Figure 114).
  - c. Install the damper piston (Figure 113).
  - d. Insert a suitable size drift (A, Figure 112) into one of the holes in the base of the damper rod.
  - e. Use a wrench and tighten the damper piston (B, Figure 112) on the damper rod. Securely tighten the damper piston.
  - f. Install the steel ball (Figure 117), spring (Figure 118) and the threaded plug (Figure 111). Securely tighten threaded plug.
2. Partially install the damper rod assembly into the top of the fork tube (Figure 119).
3. Rotate the thin wiper rings until all ring gaps are aligned.

#### CAUTION

*Do not try to install damper rod without the aid of the flat-feeler gauges, as the thin wiper rings will be damaged as they pass the inner threads in the top of the fork tube.*



4. Install a 0.04 mm and a 0.05 mm flat-feeler gauge (**Figure 120**) between the top of the fork tube and the damper rod assembly. Align the ring gaps aligned in Step 3 with one of the feeler gauges. This will make installation easier as the ring ends will slide on the feeler gauge and will not snag on the threads.
5. Slowly push the damper rod assembly into the fork tube (**Figure 121**) and past the threads. Remove the feeler gauges.
6. Push the damper rod assembly down until it extends out through the bottom of the fork tube.
7. Slide on the upper threaded ring (B, **Figure 109**) and tighten it securely.
8. Slide on the spacer (A, **Figure 109**).
9. Slide on the lower threaded ring (**Figure 108**) and tighten securely.
10. Install the circlip (A, **Figure 107**) into the base of the fork tube. Make sure it is completely seated in the groove.
11. If removed, use a suitable size socket and install a new fork seal (**Figure 122**) in the slider. Drive the oil seal in until it is completely seated.
12. Install the fork tube into the fork slider (**Figure 123**).
13. Position the fork spring with the closer wound coils going in first (**Figure 124**) and install the fork spring.
14. Install the spacer (A, **Figure 125**) and the fork top cap bolt (B, **Figure 125**). Press down on the top cap bolt and thread it into the fork tube. Don't cross thread it.
15. Install the washer and nut (**Figure 106**) onto the lower end of the damper rod.
16. Install the socket (A, **Figure 104**) and wrench onto the lower nut and insert an Allen wrench (B, **Figure 104**) through the socket and into the threaded plug (A, **Figure 105**) on the lower end of the damper rod.
17. Hold onto the Allen wrench and tighten the nut (B, **Figure 105**) securely.
18. Install the cap onto the lower cap on the base of the fork slider.
19. Install the fork assembly as described in this chapter.
20. Repeat for the other fork assembly.

### Front Fork Disassembly (Type II)

To simplify fork service and to prevent the mixing of parts, the legs should be disassembled and assembled individually.

Refer to **Figure 126** for this procedure. The following models are covered in this procedure:

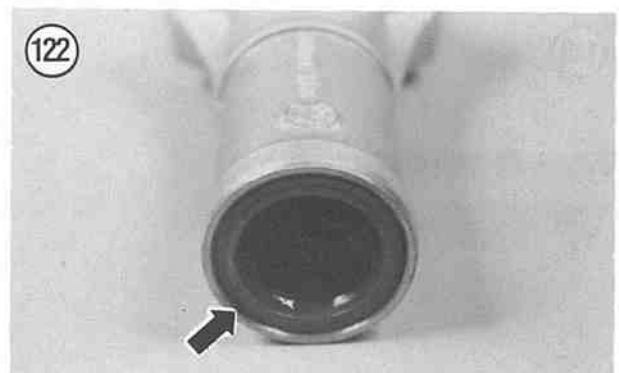
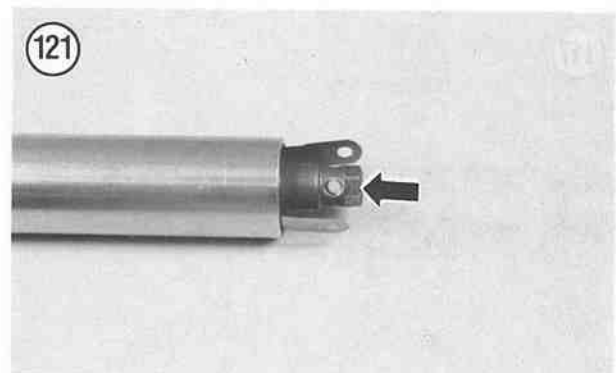
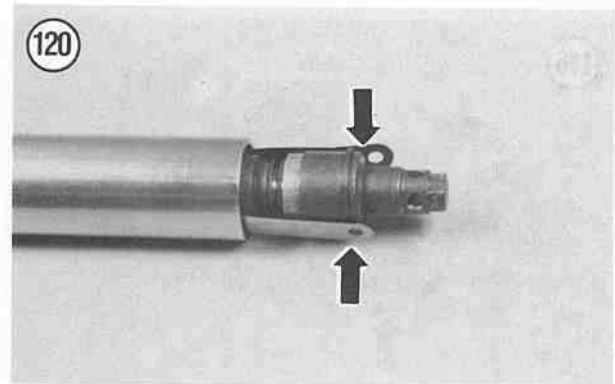
- a. 1978-1985 R65.
  - b. R65LS.
1. Using the front brake caliper mounting bosses, clamp the slider in a vise with soft jaws.

#### NOTE

*This Allen screw has been secured with a locking compound and is often very difficult to*

*remove because the damper rod will turn inside the slider. It sometimes can be removed with an air impact driver. If you are unable to remove it, take the fork legs to a dealer and have the screws removed.*

2. Loosen the Allen screw (**Figure 127**) on the bottom of the slider. Remove the fork slider from the vise.
3. Remove the oil fill plug from the fork top cap.
4. Pour the fork oil out and discard it. Pump the fork several times by hand to expel most of the remaining oil.
5. Remove the dust seal and felt ring (**Figure 128**) from the fork slider.

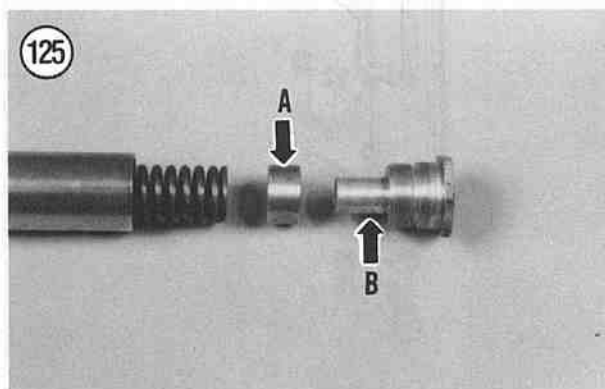
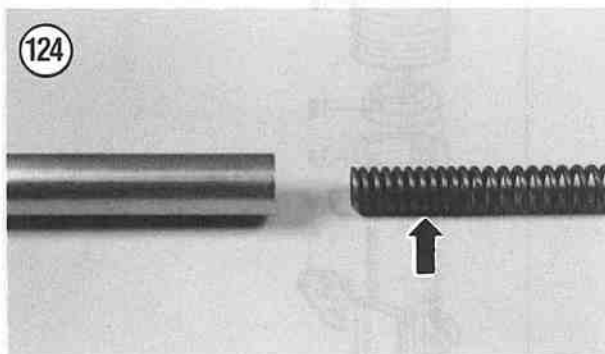
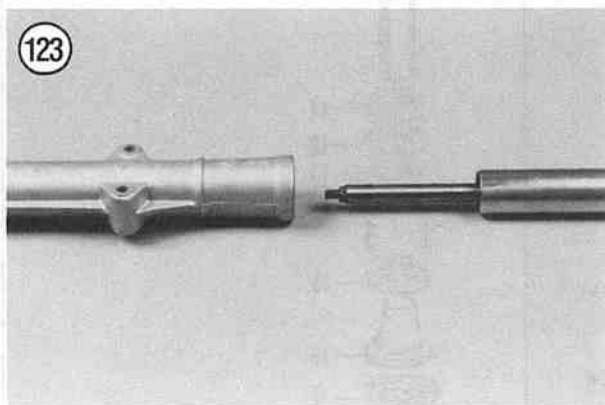


6. Hold the upper fork tube in a vise with soft jaws.
7. Compress the fork top cap with a drift or socket extension.

**WARNING**

*Be careful when removing the fork top cap as the spring is under pressure. Protect your eyes accordingly.*

8. Using a small flat-bladed screwdriver, pry out and remove the snap ring (Figure 129) securing the fork top cap into the tube.

**NOTE**

*The spring pressure should push the fork top cap out of the fork tube after the circlip is removed. If it does not come out after the circlip is removed, install a bolt (Figure 130) into the oil fill plug threaded hole in the fork top cap. Pull the fork top cap out with a pair of pliers. Unscrew the bolt from the cap.*

9. Remove the fork top cap and O-ring (A, Figure 131) and on models so equipped, the spacer (B, Figure 131).
10. Slide out the fork spring (Figure 132) from the top of the fork tube.
11. Remove the Allen screw and sealing washer (Figure 127) from the bottom of the slider.
12. Withdraw the fork tube from the slider.
13. Remove the damper rod support (Figure 133) from the end of the damper rod.
14. Remove the circlip (Figure 134) from the bottom of the fork tube.

**CAUTION**

*Slowly remove the damper rod assembly when it is almost out of the fork tube. This will lessen the chance of damage to the thin wiper rings on the damper piston as they pass the circlip groove in the end of the fork tube.*

15. Withdraw the damper rod assembly from the fork tube (Figure 135).
16. Unscrew the damper rod piston (Figure 136) from the end of the damper rod.
17. Slide off the valve housing, washer, valve washer and stop ring from the damper rod.
18. Using a broad-tipped screwdriver, carefully pry the oil seal (Figure 137) out of the fork slider. Protect the edge of the fork slider with a piece of wood or plastic to keep the screwdriver from making contact with the slider while prying out the oil seal.
19. Remove the drain screw and sealing washer (Figure 138) from the fork slider.
20. Inspect all parts as described under *Inspection (Type II Models)* in this chapter.

### Front Fork Assembly (Type II)

Refer to Figure 126 for this procedure.

1. Apply fork oil to the inner surface of the fork slider and to the outer surface of the oil seal.

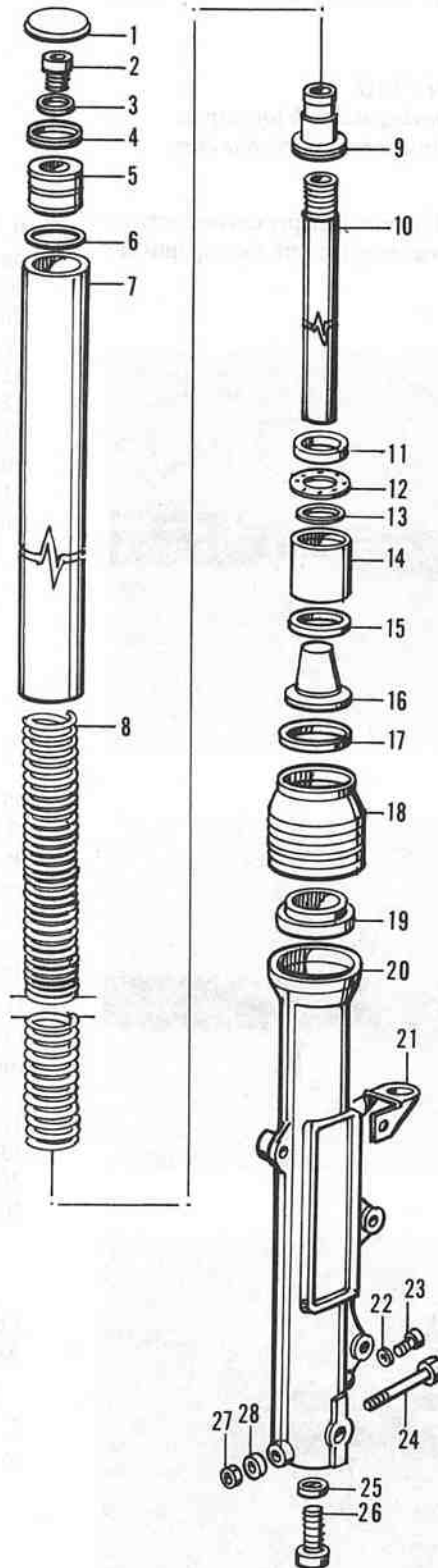
**CAUTION**

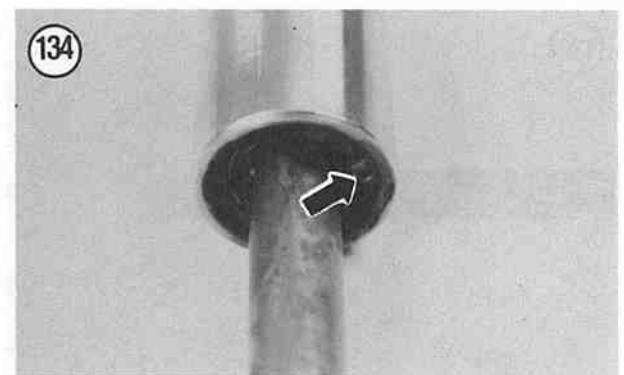
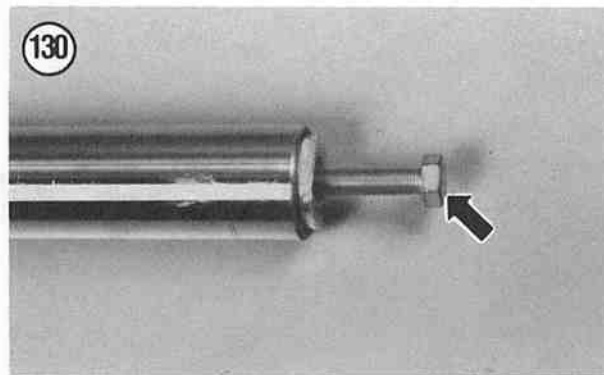
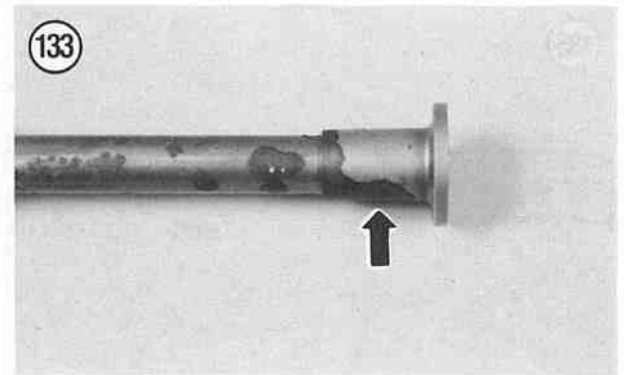
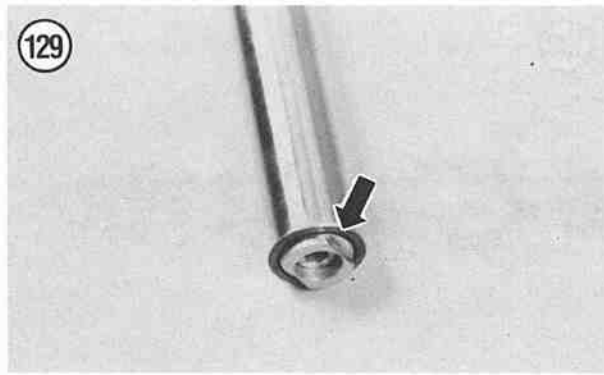
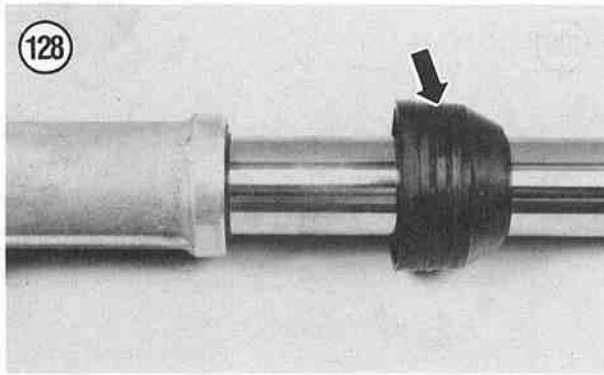
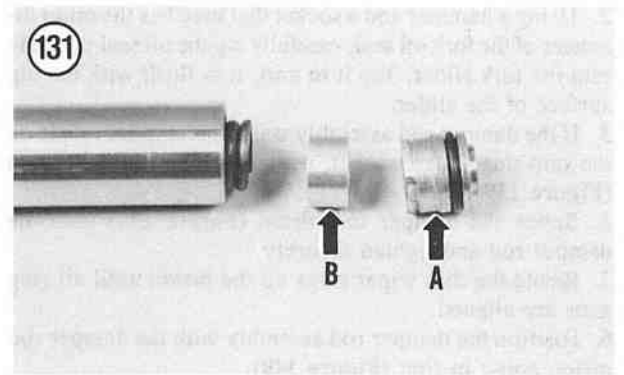
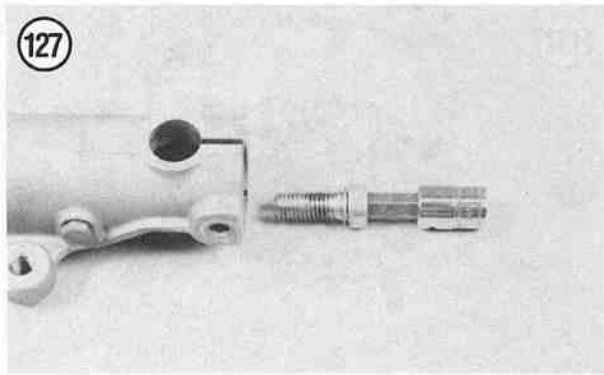
*Do not install the oil seal into the fork slider any farther than specified as the seal will be distorted resulting in an oil leak.*

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### FRONT FORK (TYPE II)

1. Top trim cap
2. Oil fill plug
3. Sealing gasket
4. Snap ring
5. Fork top cap
6. O-ring
7. Fork tube
8. Fork spring
9. Damper piston and wiper rings
10. Damper rod
11. Stop ring
12. Valve washer
13. Washer
14. Valve housing
15. Circlip
16. Damper rod support
17. Felt ring
18. Dust seal
19. Oil seal
20. Fork slider
21. Brake hose bracket
22. Sealing washer
23. Drain bolt
24. Bolt
25. Sealing washer
26. Allen bolt
27. Nut
28. Washer





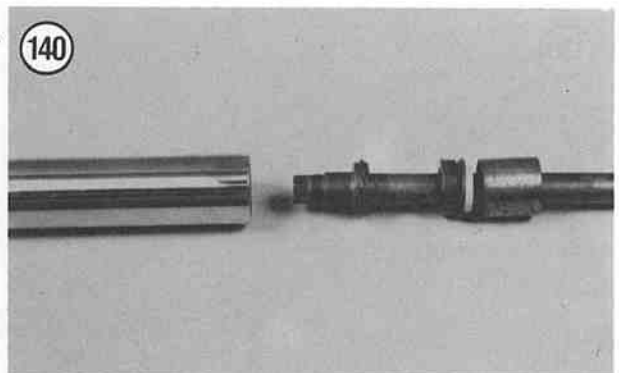
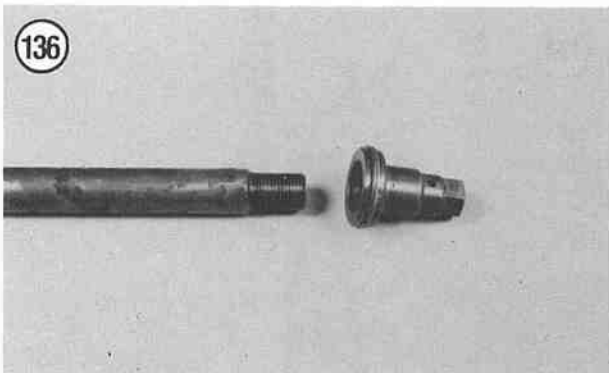
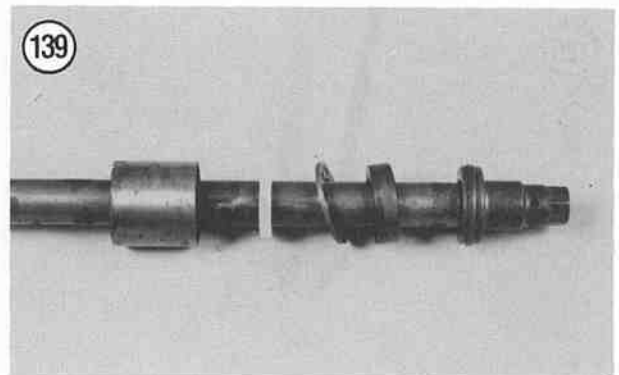
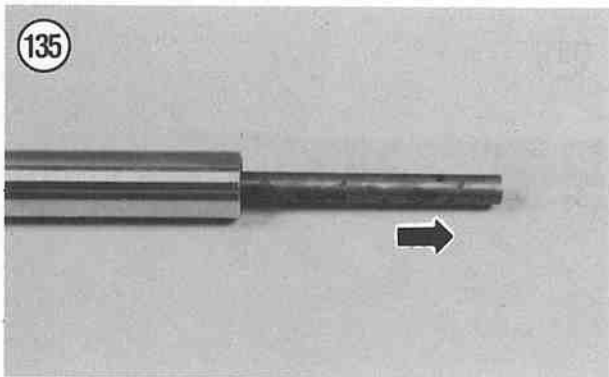
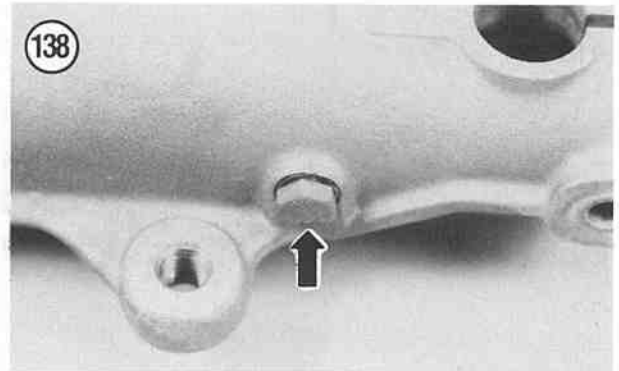
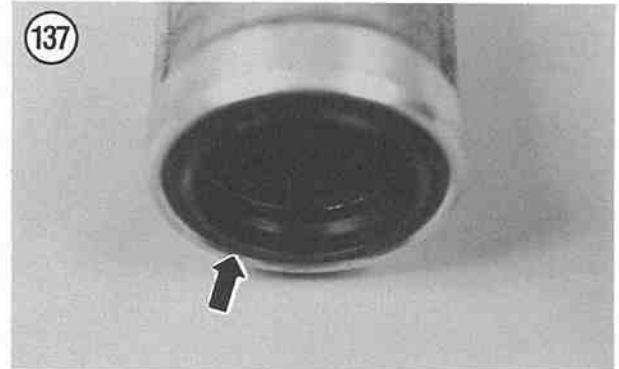


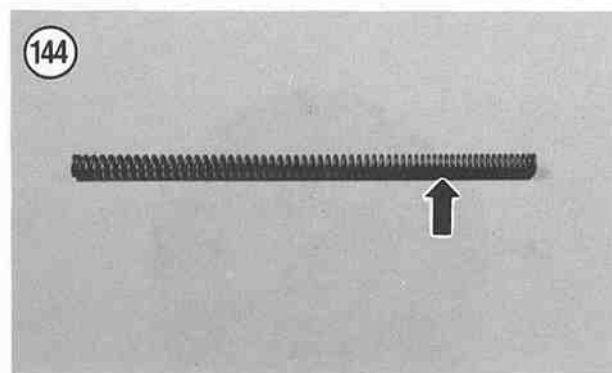
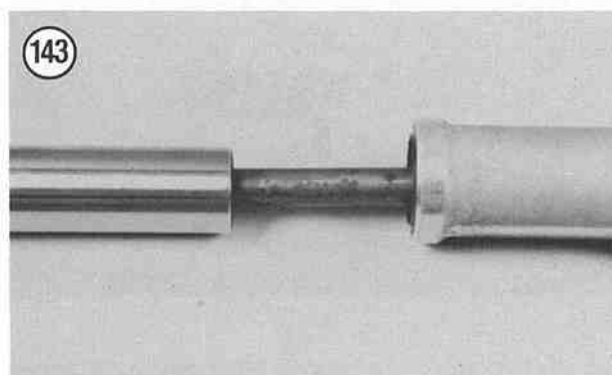
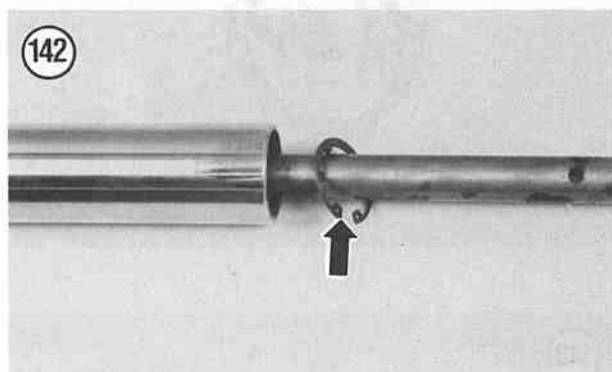
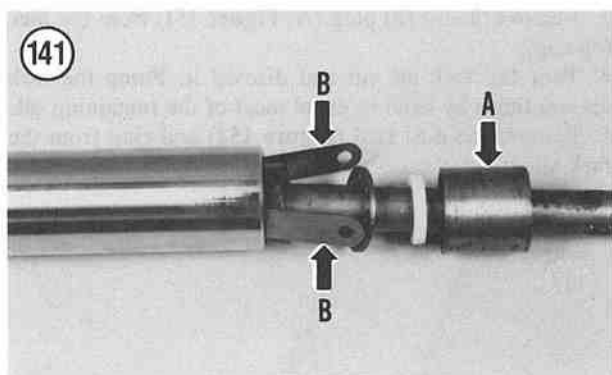
2. Using a hammer and a socket that matches the outer diameter of the fork oil seal, carefully tap the oil seal squarely into the fork slider. Tap it in until it is flush with the top surface of the slider.
3. If the damper rod assembly was disassembled, slide on the stop ring, valve washer, washer and the valve housing (Figure 139).
4. Screw the damper rod piston (Figure 136) onto the damper rod and tighten securely
5. Rotate the thin wiper rings on the piston until all ring gaps are aligned.
6. Position the damper rod assembly with the damper rod piston going in first (Figure 140).
7. Partially install the damper rod assembly (A, Figure 141) into the top of the fork tube.

**CAUTION**

*Do not try to install damper rod without the aid of the flat-feeler gauges, as the thin wiper rings will be damaged as they pass the inner threads in the top of the fork tube.*

8. Install a 0.04 mm and a 0.05 mm flat-feeler gauge (B, Figure 141) between the end of the fork tube and the damper rod assembly. Align the ring gaps aligned in Step 5 with one of the feeler gauges. This will make installation easier as the ring ends will slide on the feeler gauge and not snag on the circlip groove.





9. Slowly push the damper rod assembly into the fork tube and past the circlip groove. Remove the feeler gauges.

10. Position the circlip (Figure 142) with the sharp side facing out.

11. Install the circlip (Figure 134) securing the damper rod assembly in the fork tube.

12. Install the damper rod support (Figure 133) onto the end of the damper rod.

13. Apply a coat of fork oil to the outer surface of the fork tube and install the fork tube into the slider (Figure 143).

14. Position the fork spring with the closer wound coils (Figure 144) going in last and install the fork spring (Figure 132) into the fork slider.

15. Hold the upper fork tube in a vise with soft jaws.

16. Inspect the O-ring seal (Figure 145) on the fork top cap; replace if necessary.

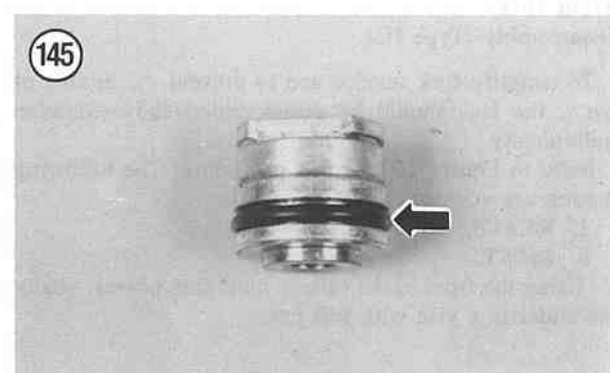
17. On models so equipped, install the spacer (B, Figure 131) on top of the fork spring.

18. Install the fork top cap and O-ring (A, Figure 131).

19. Press down on the fork top cap with a drift or socket extension. While holding the fork top cap down, install the snap ring (Figure 129). Make sure the snap ring is correctly seated in the fork tube groove.

20. Make sure the sealing washer is in place on the Allen screw.

21. Install the Allen screw and sealing washer (Figure 146) in the bottom of the slider. Tighten the Allen screw to the torque specification listed in Table 1.



22. Install the drain screw and sealing washer (Figure 138) into the fork slider and tighten securely.
23. Remove the oil fill plug (Figure 147) from the fork top cap.
24. Insert a small funnel in the opening in the fork top cap.
25. Add the recommended type and specified amount of fork oil through the small opening in the fork top cap. Refer to Table 3 for fork oil capacity.
26. Make sure the sealing washer (Figure 148) is in place on the oil fill plug.
27. Install the oil fill plug and tighten it securely.

**NOTE**

Figure 149 is shown without the fork tube in place for clarity.

28. Slide the dust seal (A, Figure 149) and felt ring (B, Figure 149) down the fork tube. Push them down until the dust seal snaps into place on the fork slider.
29. Install the fork assembly as described in this chapter.
30. Repeat for the other fork assembly.

**Front Fork  
Disassembly (Type III)**

To simplify fork service and to prevent the mixing of parts, the legs should be disassembled and assembled individually.

Refer to Figure 150 for this procedure. The following models are covered in this procedure:

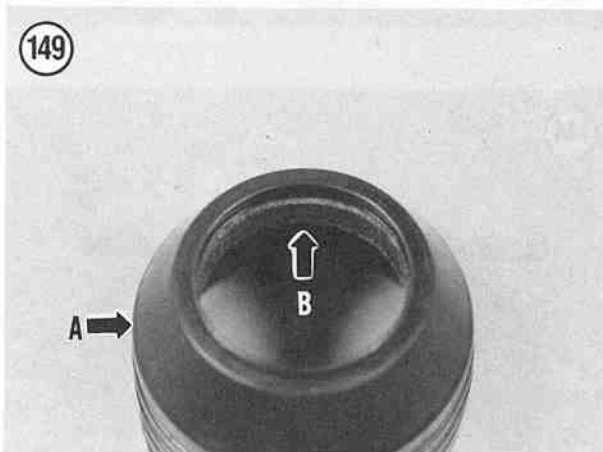
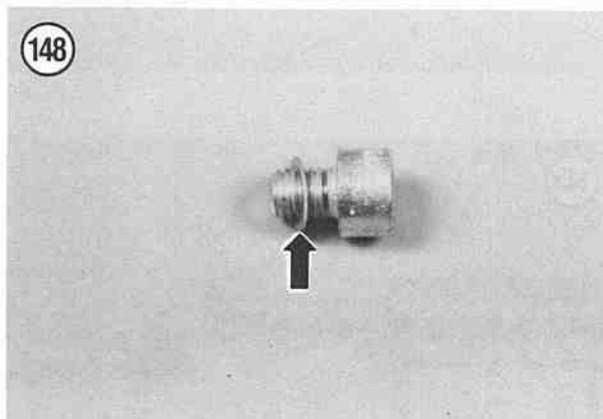
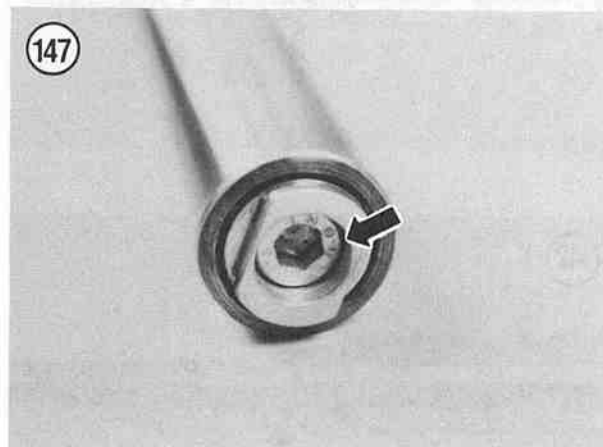
- a. R80G/S.
  - b. R80ST.
1. Using the front brake caliper mounting bosses, clamp the slider in a vise with soft jaws.

**NOTE**

This Allen screw has been secured with a locking compound and is often very difficult to remove because the damper rod will turn inside the slider. It sometimes can be removed with an air impact driver. If you are unable to remove it, take the fork legs to a dealer and have the screws removed.

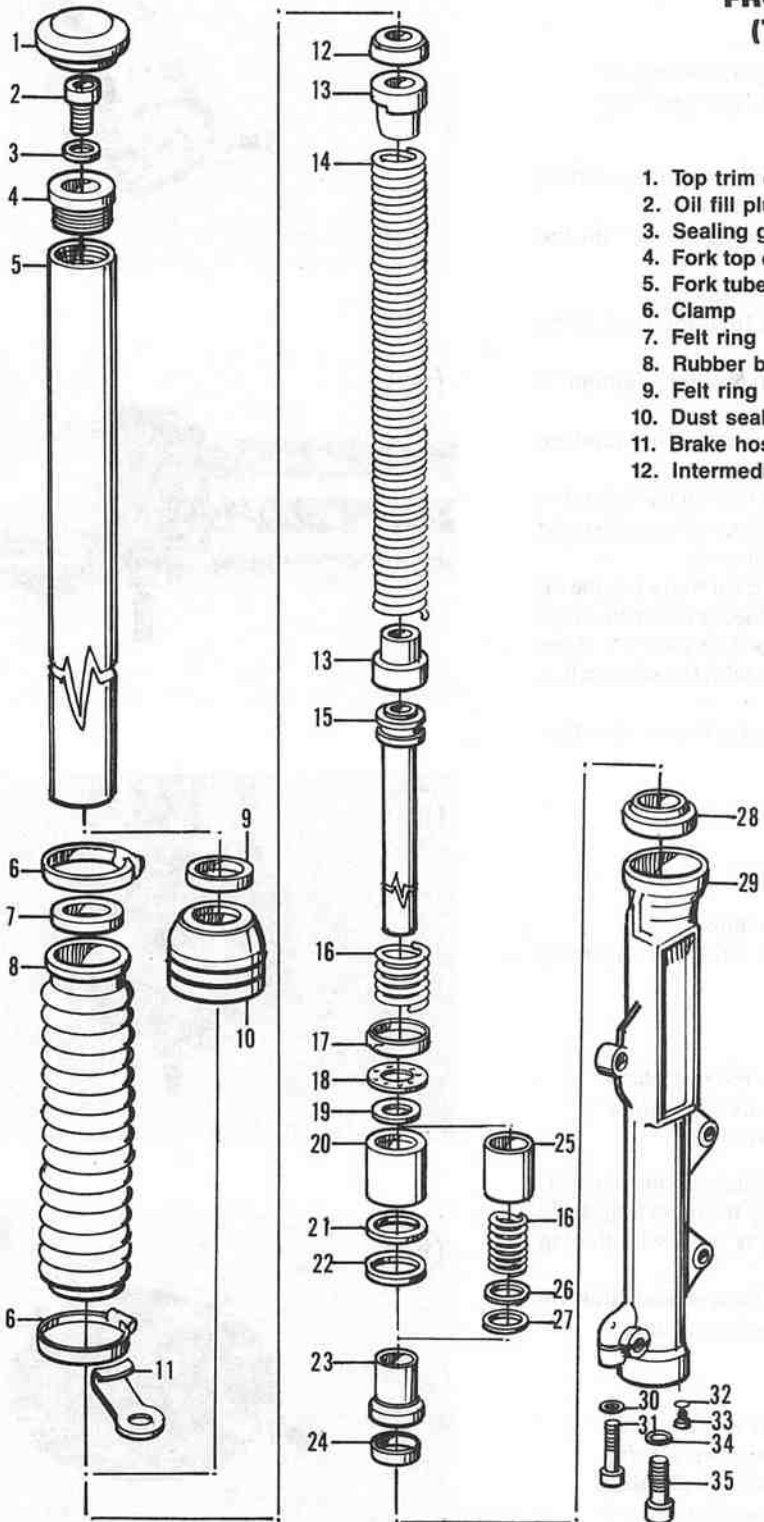
2. Loosen the Allen screw on the bottom of the slider. Remove the fork slider from the vise.

3. Remove the oil fill plug (A, Figure 151) from the fork top cap.
4. Pour the fork oil out and discard it. Pump the fork several times by hand to expel most of the remaining oil.
5. Remove the dust seal (Figure 152) and ring from the fork slider.



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**FRONT FORK  
(TYPE III)**



- 1. Top trim cap
- 2. Oil fill plug
- 3. Sealing gasket
- 4. Fork top cap bolt and O-ring
- 5. Fork tube
- 6. Clamp
- 7. Felt ring
- 8. Rubber boot (models so equipped)
- 9. Felt ring
- 10. Dust seal (models so equipped)
- 11. Brake hose bracket
- 12. Intermediate ring
- 13. Spring seat
- 14. Fork spring
- 15. Damper rod
- 16. Compression spring
- 17. Piston ring
- 18. Valve washer
- 19. Washer
- 20. Valve body
- 21. Shim
- 22. Circlip
- 23. Damper rod support
- 24. Ring
- 25. Valve body
- 26. Shim
- 27. Circlip
- 28. Oil seal
- 29. Fork slider
- 30. Washer
- 31. Bolt
- 32. O-ring
- 33. Screw
- 34. Sealing washer
- 35. Allen bolt

6. Hold the upper fork tube in a vise with soft jaws.
7. Loosen, then unscrew the fork top cap bolt (B, **Figure 151**) from the fork tube.

**WARNING**

*Be careful when removing the fork top cap as the spring is under pressure. Protect your eyes accordingly.*

8. Slide out the intermediate ring, the fork spring and both spring seats from the top of the fork tube.
9. Remove the Allen screw and sealing washer on the bottom of the slider.
10. Withdraw the fork tube from the slider.
11. Remove the damper rod support from the base of the damper rod.
12. Remove the circlip (**Figure 153**) from the bottom of the fork tube.
13. Remove the shim(s) located between the circlip and the valve housing.
14. Withdraw the damper rod assembly from the fork tube.
15. Slide off the valve housing, washer, valve washer and compression spring from the damper rod.
16. Using a broad-tipped screwdriver, carefully pry the oil seal (**Figure 154**) out of the fork slider. Protect the edge of the fork slider with a piece of wood or plastic to keep the screwdriver from making contact with the slider while prying out the oil seal.
17. Inspect all parts as described under *Inspection (Type III and IV Models)* in this chapter.

### Front Fork Assembly (Type III)

Refer to **Figure 150** for this procedure.

1. Apply fork oil to the inner surface of the fork slider and to the outer surface of the oil seal.

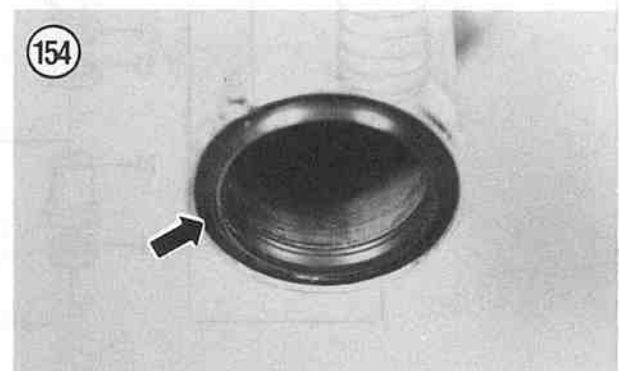
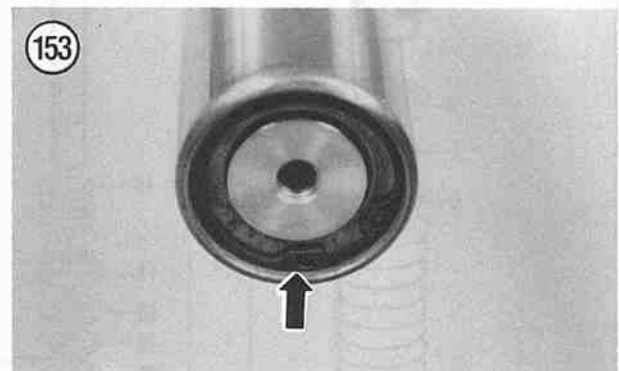
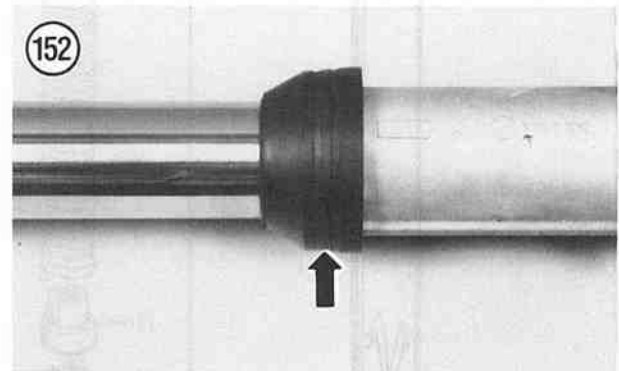
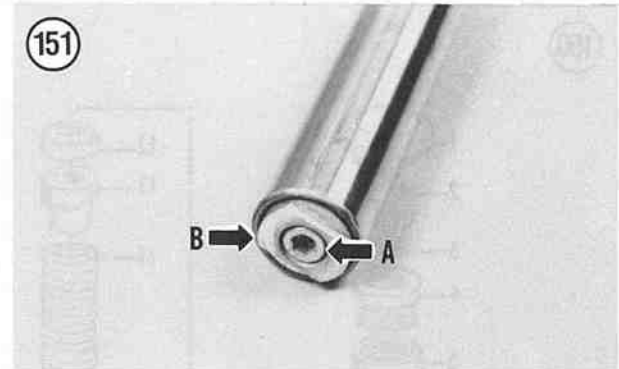
**CAUTION**

*Do not install the oil seal into the fork slider any farther than specified, as the seal will be distorted resulting in an oil leak.*

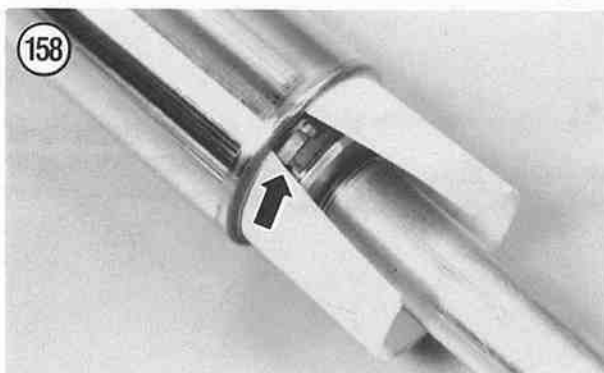
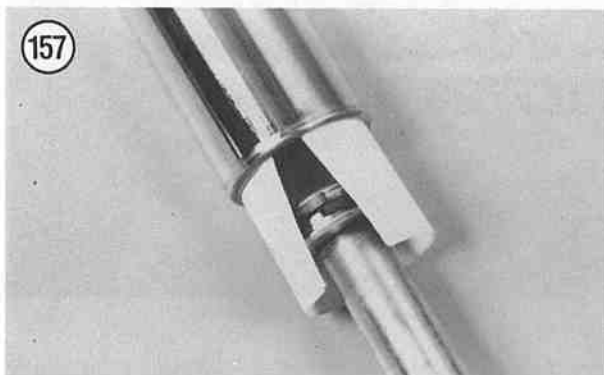
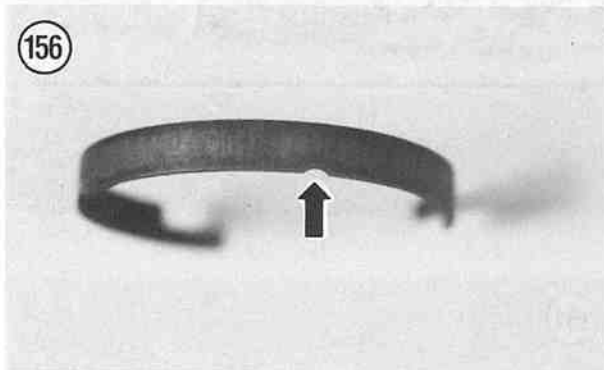
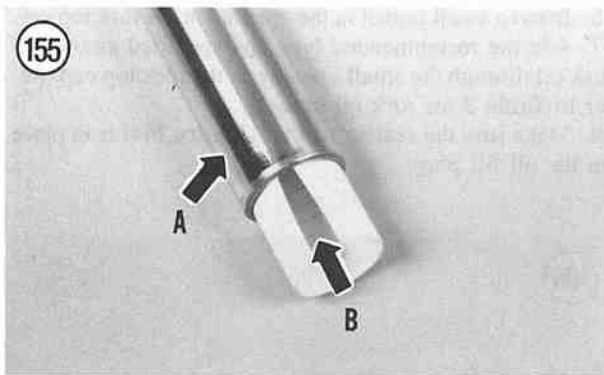
2. Using a hammer and a socket that matches the outer diameter of the fork oil seal, carefully tap the oil seal squarely into the fork slider. Tap it in until it is flush with the top surface of the slider.
3. If the damper rod assembly was disassembled, slide on the valve washer, washer and the valve housing.

**NOTE**

*There is a shoulder on the inner surface of the lower end of the fork slider. The valve housing bottoms out on this shoulder when it is installed later in this procedure. Shim material must be temporarily installed into the lower end of the fork slider to fill in the lower area, thus elimi-*

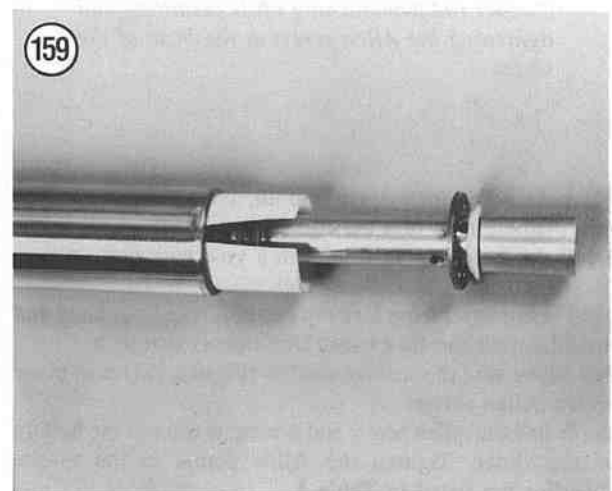






nating the shoulder. Don't try to install the damper rod assembly without adding this shim material as the piston ring will snag on the shoulder and "pop off" during installation.

4. Install the damper rod assembly as follows:
  - a. Cut three 3 × 5 index cards so they are only 4 inches long. The thickness of the 3 cards is sufficient to fill in the area, thus eliminating the fork slider shoulder.
  - b. Wrap the long side of the 3 × 4 cards around the exterior of the fork slider so that they take on the natural curve of the slider. Continue to contour the cards so that they have a natural curve that follows the fork slider.
  - c. Insert the three 3 × 4 cards into the fork slider (A, **Figure 155**). The cards were trimmed down from 5 inches to 4 inches so there will be a gap (B, **Figure 155**) that will allow you to see the piston ring in the next step.
  - d. Apply some fork oil to the piston ring then position the piston ring onto the damper piston with its notched end facing down (**Figure 156**). Install the piston ring onto the damper piston.
  - e. Hold the piston ring onto the damper piston and partially insert the damper rod into the 3 × 4 cards in the fork slider (**Figure 157**). The piston ring ends must be visible so position the ring ends facing up toward the gap in the cards.
  - f. Make sure the piston ring ends are meshed properly and that the piston ring is correctly seated in the damper piston groove (**Figure 158**).
  - g. Slowly push the damper rod assembly into the fork slider and past the shoulder (**Figure 159**). You will feel a slight hesitation when the piston ring slides past the 3 × 4 cards and into the fork slider. Once you have passed the shoulder, move the damper rod assembly farther in, then carefully move it in and out to make sure the piston ring stayed in place within the piston groove.



- h. Hold onto the damper rod assembly and the fork slider and turn this assembly up to a vertical position with the damper rod end facing down. If the piston ring did not stay in the piston groove it will slide down the damper rod assembly. If this has happened, repeat this procedure until the damper rod is installed correctly with the piston ring in place in the piston groove.
- i. Hold the damper rod in place and remove the 3 × 4 cards from the fork slider.

**NOTE**

*In the following step, do not allow the damper rod assembly to come out far enough so that the piston ring travels past the fork slider shoulder or you will have to start all over again.*

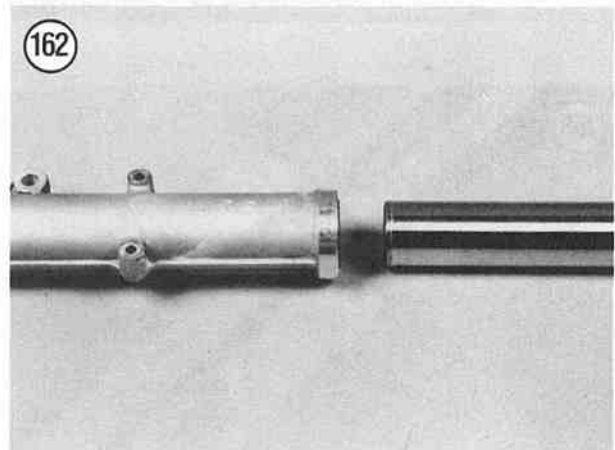
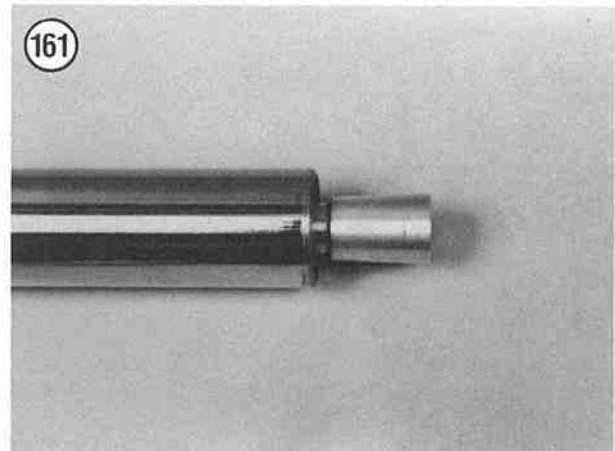
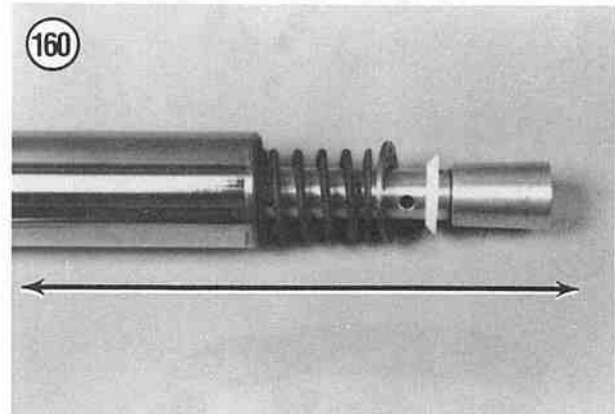
- j. Move the damper rod in and out (**Figure 160**) to make sure the piston ring is properly seated within the piston groove.
5. Push the damper rod assembly the rest of the way into the fork slider (**Figure 161**).
6. Install the damper rod support.
7. Position the circlip with the sharp side facing out.
8. Install the shim(s) and the circlip (**Figure 153**) securing the damper rod support and damper rod assembly in the fork tube.
9. Apply a coat of fork oil to the outer surface of the fork tube and install the fork tube into the slider (**Figure 162**).

**NOTE**

*Steps 10-13 are necessary to help hold the damper rod from turning while installing and tightening the Allen screw at the base of the slider.*

10. Install the fork spring, both spring seats and the intermediate ring into the fork slider.
11. Hold the upper fork tube in a vise with soft jaws.
12. Install the fork top cap bolt.
13. Press down on the fork top cap bolt with your hand and thread it into the fork tube. Don't cross thread it.
14. Make sure the sealing washer (**Figure 163**) is in place on the Allen screw.
15. Install the Allen screw and sealing washer in the bottom of the slider. Tighten the Allen screw to the torque specification listed in **Table 1**.

16. Insert a small funnel in the opening in the fork top cap.
17. Add the recommended type and specified amount of fork oil through the small opening in the fork top cap. Refer to **Table 3** for fork oil capacity.
18. Make sure the sealing washer (**Figure 164**) is in place on the oil fill plug.



19. Install the oil fill plug and tighten it securely.
20. Slide the dust seal and felt ring (**Figure 152**) down the fork tube. Push it down until it snaps into place on the fork slider.
21. Install the fork assembly as described in this chapter.
22. Repeat for the other fork assembly.

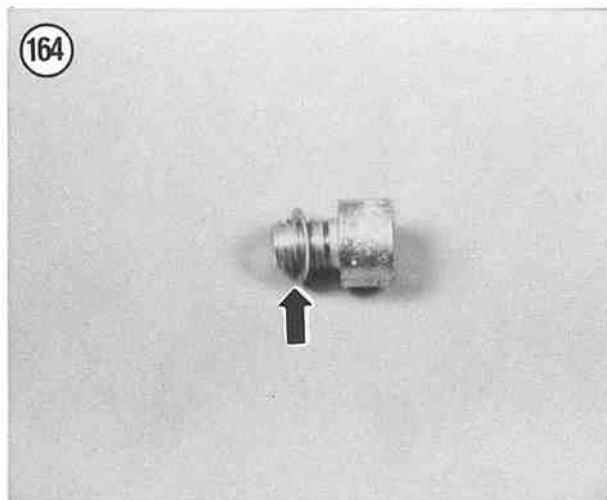
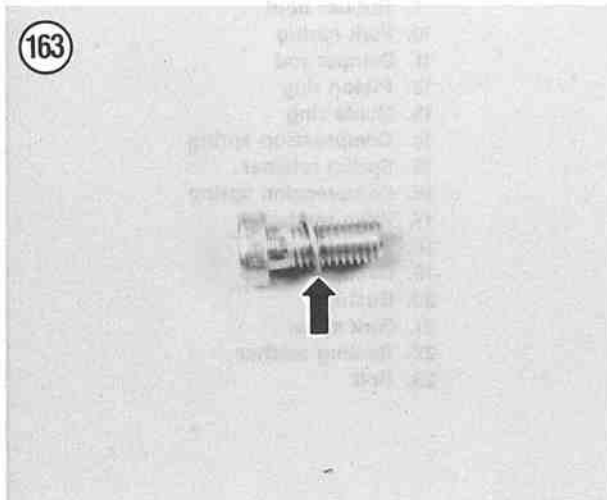
### Front Fork Disassembly (Type IV)

To simplify fork service and to prevent the mixing of parts, the legs should be disassembled and assembled individually.

Refer to **Figure 165** for the right-hand fork leg and **Figure 166** for the left-hand fork leg for this procedure.

The RI00GS models are covered in this procedure.

1. Slide the rubber boot off of the fork tube.
2. Using the front brake caliper mounting bosses, clamp the slider in a vise with soft jaws.



#### NOTE

*This Allen screw has been secured with a locking compound and is often very difficult to remove because the damper rod will turn inside the slider. It sometimes can be removed with an air impact driver. If you are unable to remove it, take the fork legs to a dealer and have the screws removed.*

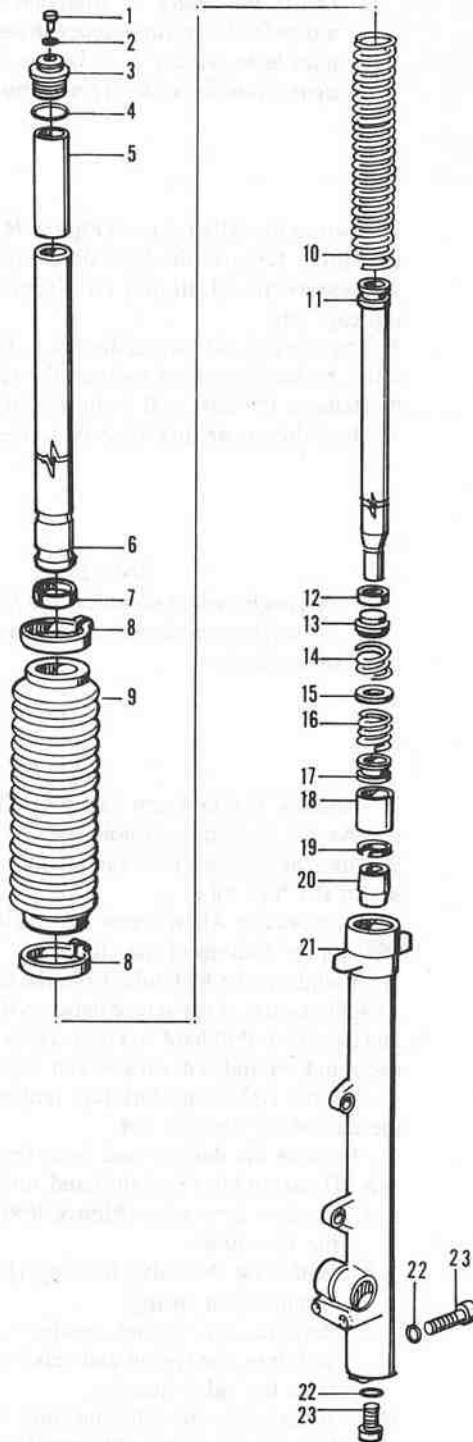
3. Loosen the Allen screw (**Figure 167**) on the bottom of the slider. Remove the fork slider from the vise.
4. Remove the oil fill plug (A, **Figure 168**) from the fork top cap bolt.
5. Pour the fork oil out and discard it. Pump the fork several times by hand to expel most of the remaining oil.
6. Remove the dust seal from the fork slider.
7. Hold the upper fork tube in a vise with soft jaws.

#### WARNING

*Be careful when removing the fork top cap as the spring is under pressure. Protect your eyes accordingly.*

8. Unscrew the fork top cap bolt (B, **Figure 168**) and remove the fork top cap bolt and O-ring.
9. Slide the distance tube and the fork spring out from the top of the fork tube.
10. Remove the Allen screw and sealing washer (**Figure 167**) on the bottom of the slider.
11. Withdraw the fork tube from the slider. There may be a slight amount of resistance between the fork tube bushing and the slider. Pull hard and they will separate. If necessary, use quick in-and-out strokes and separate the 2 parts.
12. On the right-hand fork leg, remove the bushing from the end of the damper rod.
13. Remove the damper rod from the fork tube.
- 14A. Disassemble the right-hand fork leg as follows:
  - a. Remove the circlip (**Figure 169**) from the bottom of the fork tube.
  - b. Withdraw the valve housing (**Figure 170**) and the compression spring.
  - c. Remove the spring retainer (**Figure 171**) and withdraw the spring and valve washer (**Figure 172**) from the valve housing.
- 14B. Disassemble the left-hand fork leg as follows:
  - a. Remove the circlip (**Figure 169**) from the bottom of the fork tube.
  - b. Withdraw the valve housing (**Figure 173**), washer and the compression spring.

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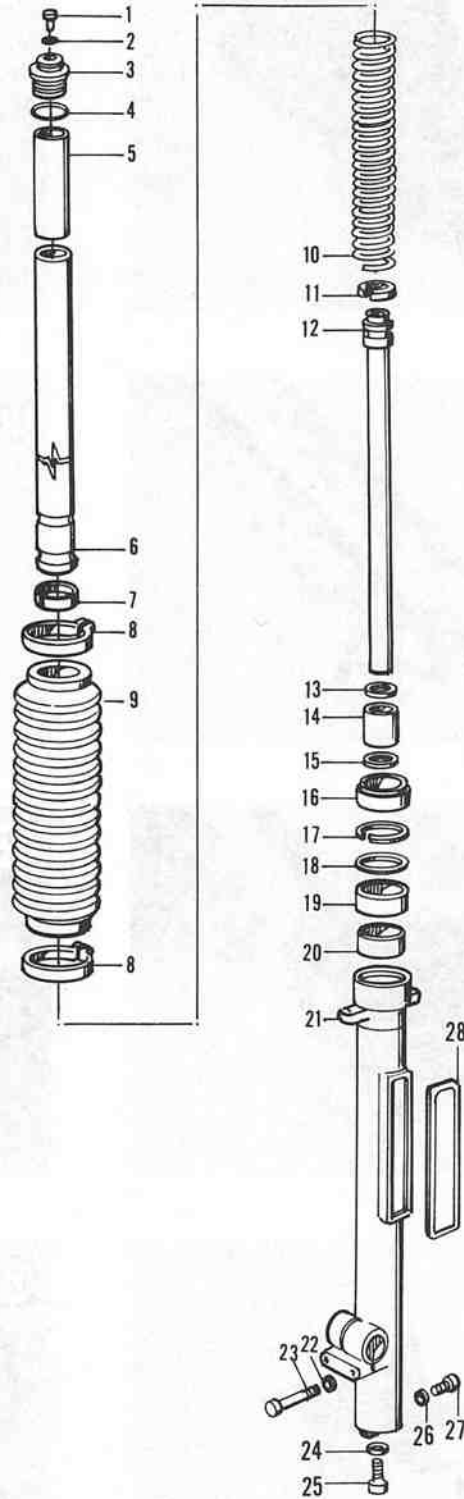
### FRONT FORK (TYPE IV, RIGHT-HAND SIDE)

1. Oil fill plug
2. Sealing gasket
3. Fork top cap bolt
4. O-ring
5. Distance tube
6. Fork tube
7. Slider bushing
8. Clamp
9. Rubber boot
10. Fork spring
11. Damper rod
12. Piston ring
13. Guide ring
14. Compression spring
15. Spring retainer
16. Compression spring
17. Valve washer
18. Valve housing
19. Circlip
20. Bushing
21. Fork slider
22. Sealing washer
23. Bolt

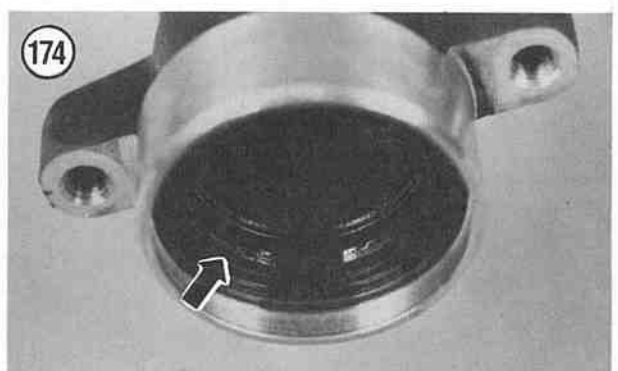
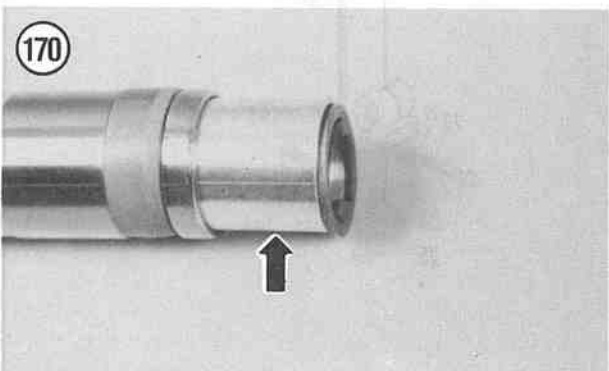
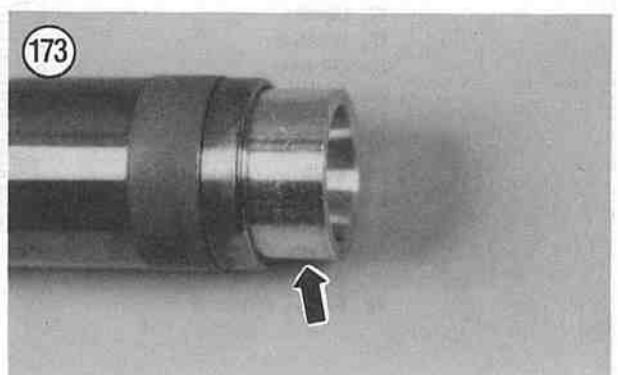
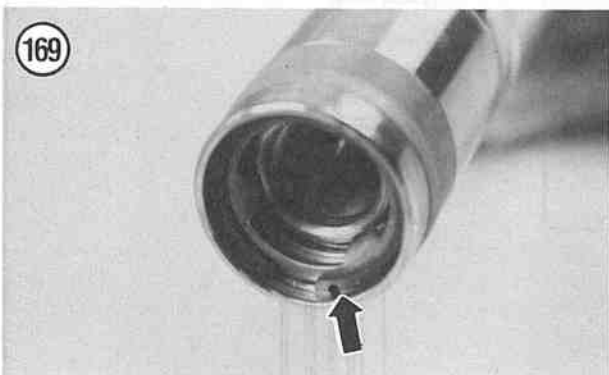
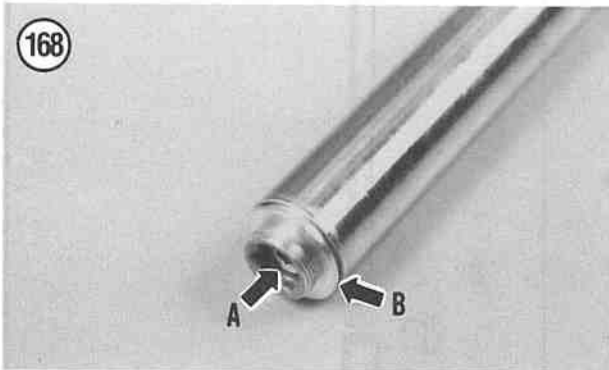
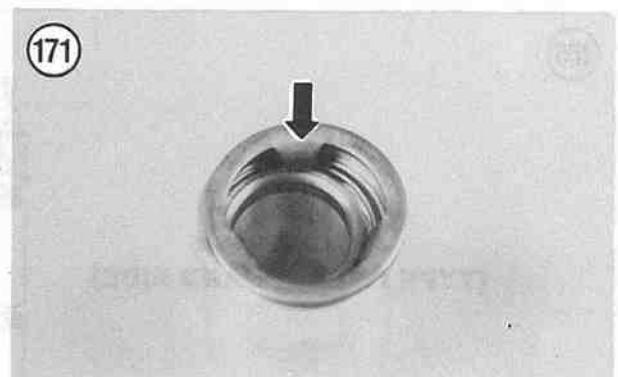
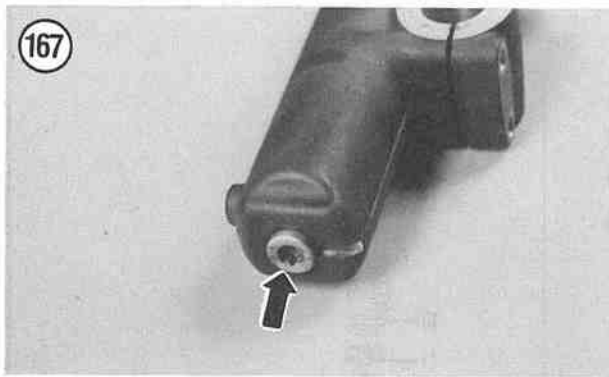
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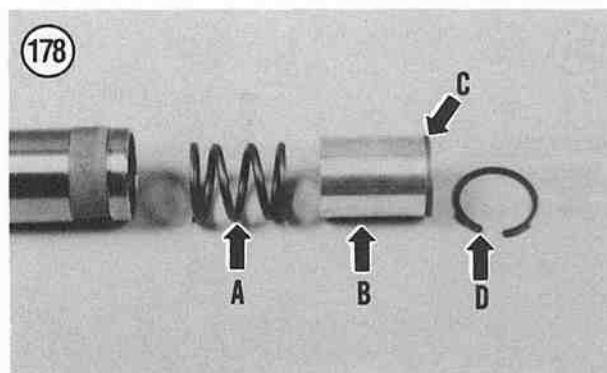
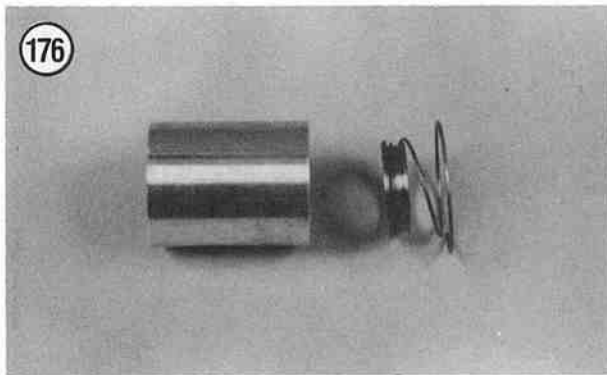
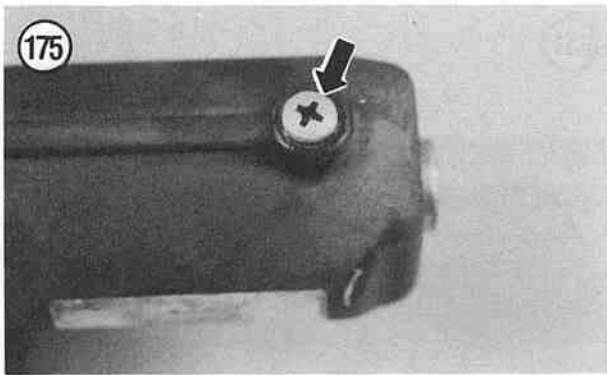
**FRONT FORK  
(TYPE IV, LEFT-HAND SIDE)**

1. Oil fill plug
2. Sealing gasket
3. Fork top cap bolt
4. O-ring
5. Distance tube
6. Fork tube
7. Slider bushing
8. Clamp
9. Rubber boot
10. Fork spring
11. Piston ring
12. Damper rod
13. Washer
14. Valve housing
15. Circlip
16. Valve washer
17. Circlip
18. Washer
19. Oil seal
20. Bushing
21. Fork slider
22. Washer
23. Bolt
24. Sealing washer
25. Allen bolt
26. Sealing washer
27. Drain bolt
28. Reflex reflector









15. Using a broad-tipped screwdriver, carefully pry the oil seal (Figure 174) out of the fork slider. Protect the edge of the fork slider with a piece of wood or plastic to keep the screwdriver from making contact with the slider while prying out the oil seal.

16. Unscrew the drain screw and O-ring seal (Figure 175) from the fork slider.

17. Inspect all parts as described under *Inspection (Type III and IV Models)* in this chapter.

#### Front Fork Assembly (Type IV)

Refer to Figure 165 for the right-hand fork leg and Figure 166 for the left-hand fork leg for this procedure.

1. Inspect the O-ring seal on the drain screw (Figure 175). Replace if necessary. Install the drain screw (Figure 175) and O-ring seal into the fork slider.

2. Apply fork oil to the inner surface of the fork slider and to the outer surface of the oil seal.

#### CAUTION

*Do not install the oil seal into the fork slider any farther than specified, as the seal will be distorted resulting in an oil leak.*

3. Using a hammer and a socket that matches the outer diameter of the fork oil seal, carefully tap the new oil seal squarely into the fork slider. Tap it in until it is flush with the top surface of the slider.

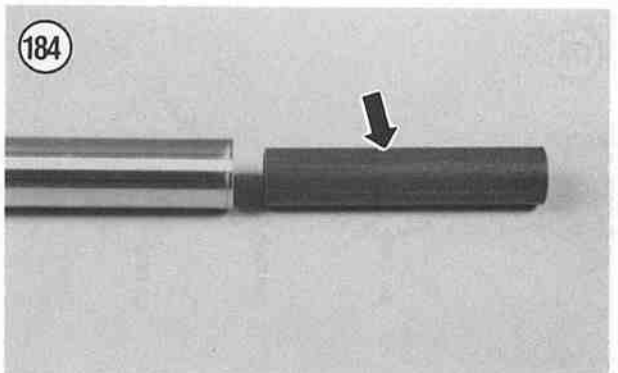
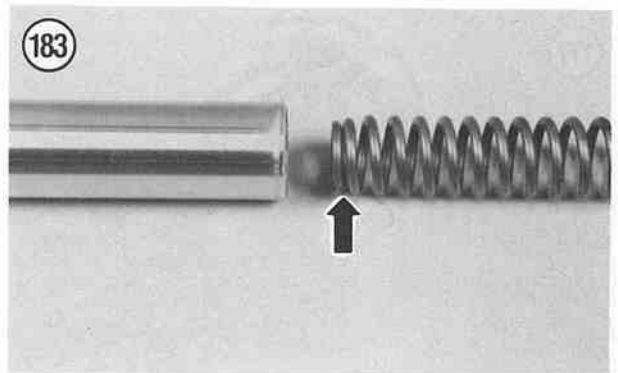
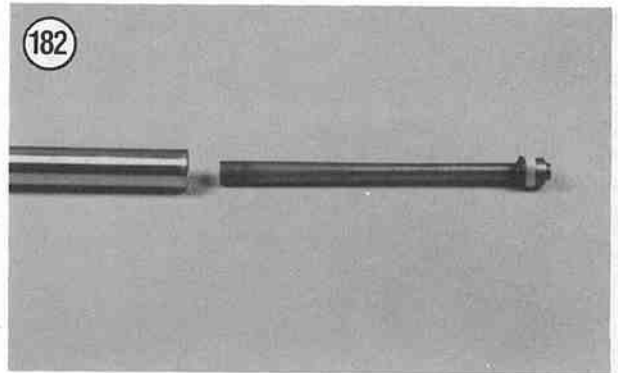
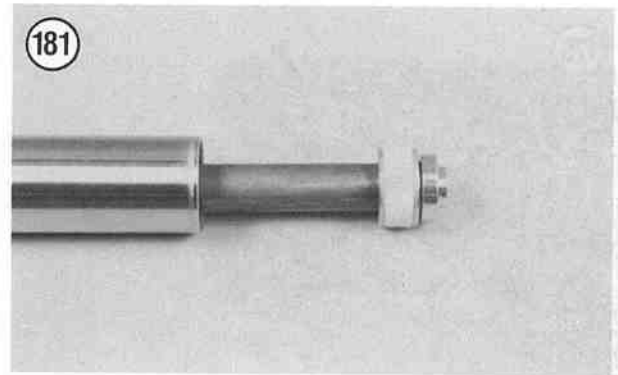
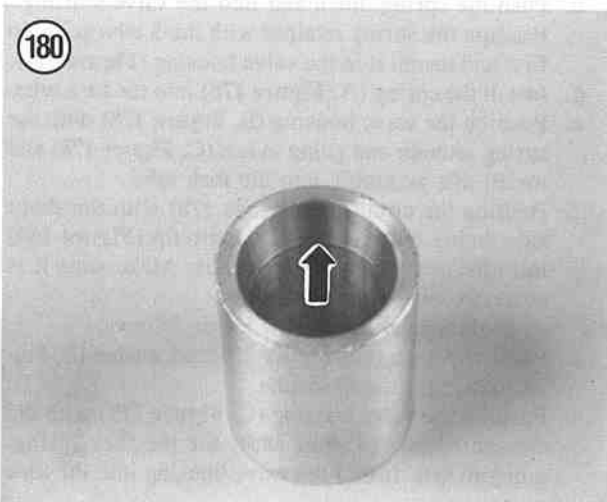
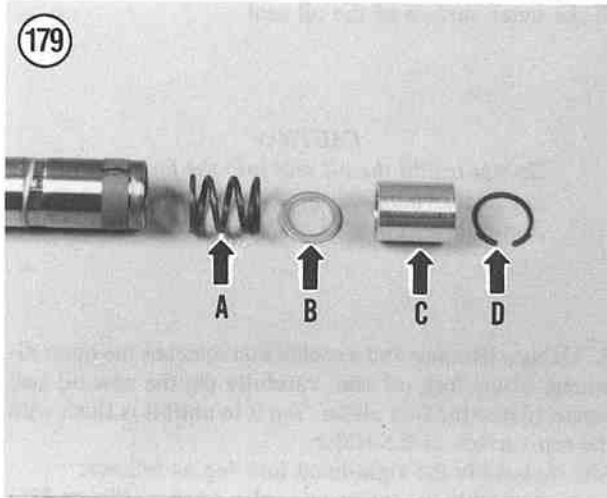
4A. Assemble the right-hand fork leg as follows:

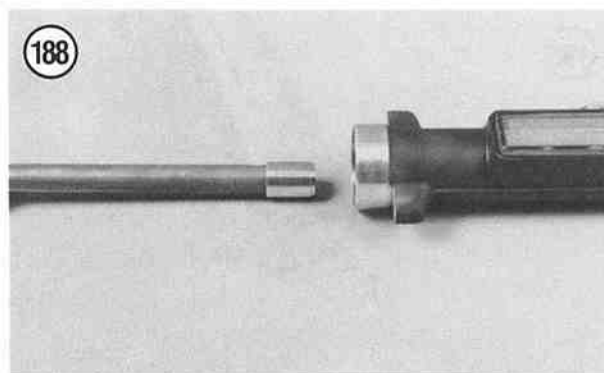
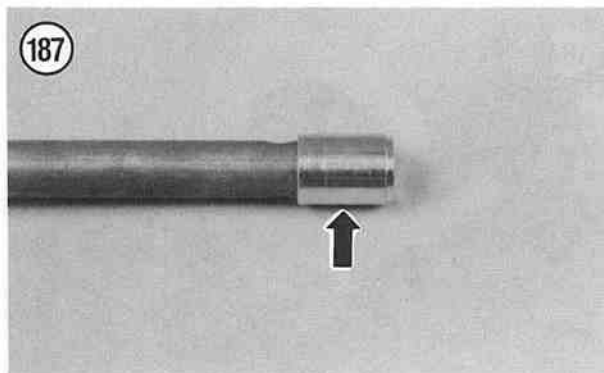
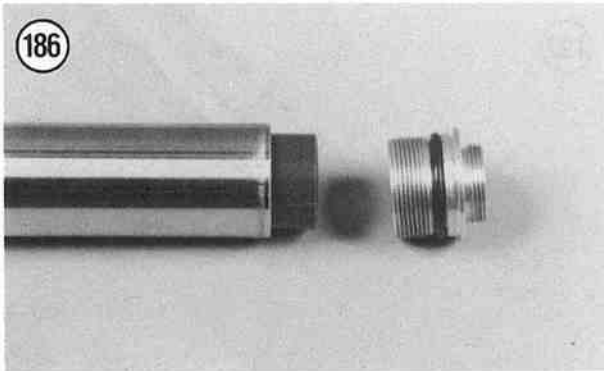
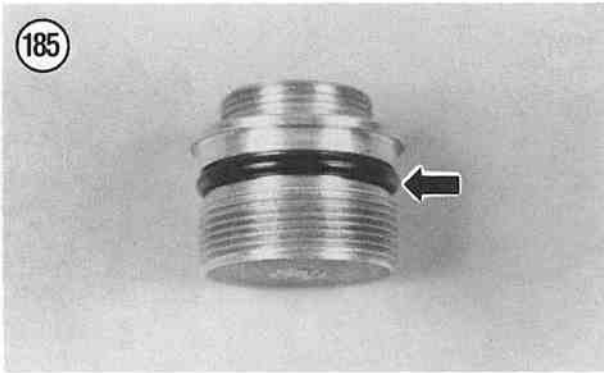
- a. Assemble the spring and valve washer (Figure 176) and install it into the valve housing (Figure 177).
- b. Push the spring down and into the valve housing.
- c. Position the spring retainer with the 3 tabs going in first and install it in the valve housing (Figure 171).
- d. Install the spring (A, Figure 178) into the fork tube.
- e. Position the valve housing (B, Figure 178) with the spring retainer end going in last (C, Figure 178) and install this assembly into the fork tube.
- f. Position the circlip (D, Figure 178) with the sharp side facing out and install the circlip (Figure 169) into the bottom of the fork tube. Make sure it is correctly seated in the groove.

4B. Assemble the left-hand fork leg as follows:

- a. Install the spring (A, Figure 179) and washer (B, Figure 179) into the fork tube.
- b. Position the valve housing (C, Figure 179) with the chamfered end (Figure 180), for the fork spring, going in last. Install the valve housing into the fork tube.

- c. Position the circlip (D, **Figure 179**) with the sharp side facing out and install the circlip (**Figure 169**) into the bottom of the fork tube. Make sure it is correctly seated in the groove.
5. Install the damper rod into the fork tube. Refer to **Figure 181** for the right-hand fork tube and **Figure 182** for the left-hand fork tube.
6. Position the fork spring with the tapered end (**Figure 183**) going in first and install it into the fork tube.
7. Install the distance tube (**Figure 184**) into the fork tube.
8. Hold the upper fork tube in a vise with soft jaws.
9. Inspect the O-ring seal (**Figure 185**) on the fork top cap bolt; replace if necessary.
10. Install the fork top cap bolt and O-ring (**Figure 186**).
11. Press down on the fork top cap bolt with your hand and thread it into the fork tube. Don't cross thread it. Tighten it to the torque specification listed in **Table 1**.
12. Apply a coat of fork oil to the outer surface of the fork tube.





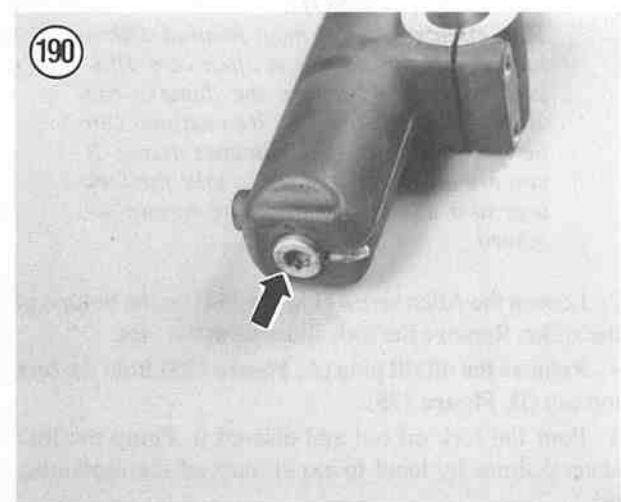
- 13A. On the right-hand fork leg, perform the following:
- Install the bushing (Figure 187) onto the end of the damper rod.
  - Insert the fork tube into the slider (Figure 188). There may be a slight amount of resistance between the fork tube bushing and the slider. Push hard and the fork tube will insert easily.

13B. On the left-hand fork leg, insert the fork tube into the slider (Figure 189). There may be a slight amount of resistance between the fork tube bushing and the slider. Push hard and the fork tube will insert easily.

14. Make sure the sealing washer is in place on the Allen screw.

15. Apply a few drops of blue Loctite (No. 271) to the Allen screw threads prior to installation.

16. Install the Allen screw (Figure 190) and sealing washer in the bottom of the slider. Tighten the Allen screw to the torque specification listed in Table 1.



17. Install the dust seal (A, **Figure 191**) and push it down until it snaps into place on the fork slider
18. Install the rubber boot (B, **Figure 191**) onto the fork slider.
19. Remove the oil fill plug (**Figure 192**) from the fork top cap bolt.
20. Insert a small funnel in the opening in the fork top cap.
21. Add the recommended type and specified amount of fork oil through the small opening in the fork top cap. Refer to **Table 3** for fork oil capacity.
22. Make sure the sealing washer is in place on the oil fill plug.
23. Install the oil fill plug. Tighten the plug securely.
24. Install the fork assembly as described in this chapter.
25. Repeat for the other fork assembly.

### Front Fork Disassembly (Type V)

To simplify fork service and to prevent the mixing of parts, the legs should be disassembled and assembled individually.

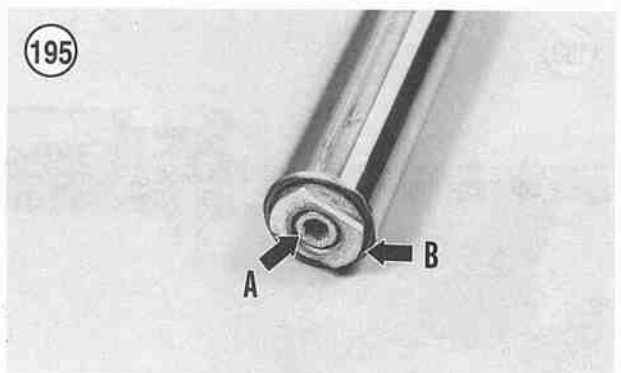
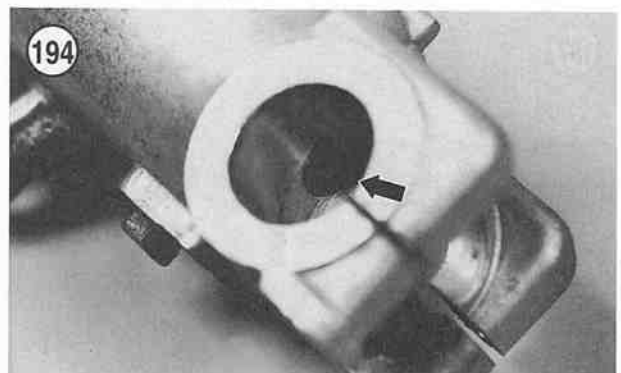
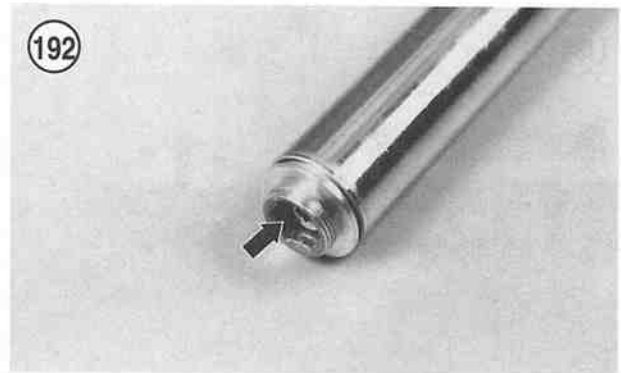
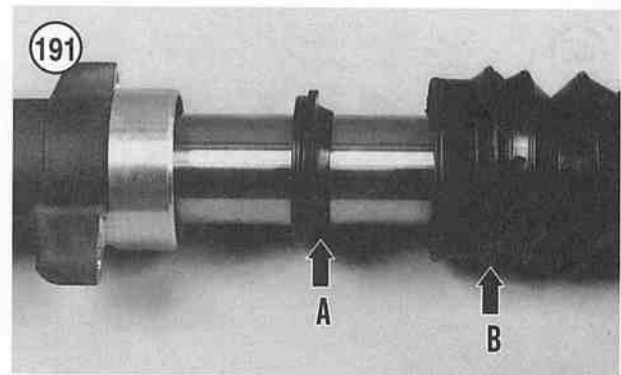
Refer to **Figure 193** for this procedure. The following models are covered in this procedure:

- a. 1986-1987 R65 monolever.
  - b. R80.
  - c. R80RT.
  - d. 1988-on R100RS.
  - e. 1988-on R100RT.
1. Using the front brake caliper mounting bosses, clamp the slider in a vise with soft jaws.

#### NOTE

*This Allen screw has been secured with a locking compound and is often very difficult to remove because the damper rod will turn inside the slider. It sometimes can be removed with an air impact driver. If you are unable to remove it, take the fork legs to a dealer and have the screws removed.*

2. Loosen the Allen screw (**Figure 194**) on the bottom of the slider. Remove the fork slider from the vise.
3. Remove the oil fill plug (A, **Figure 195**) from the fork top cap (B, **Figure 195**).
4. Pour the fork oil out and discard it. Pump the fork several times by hand to expel most of the remaining oil.

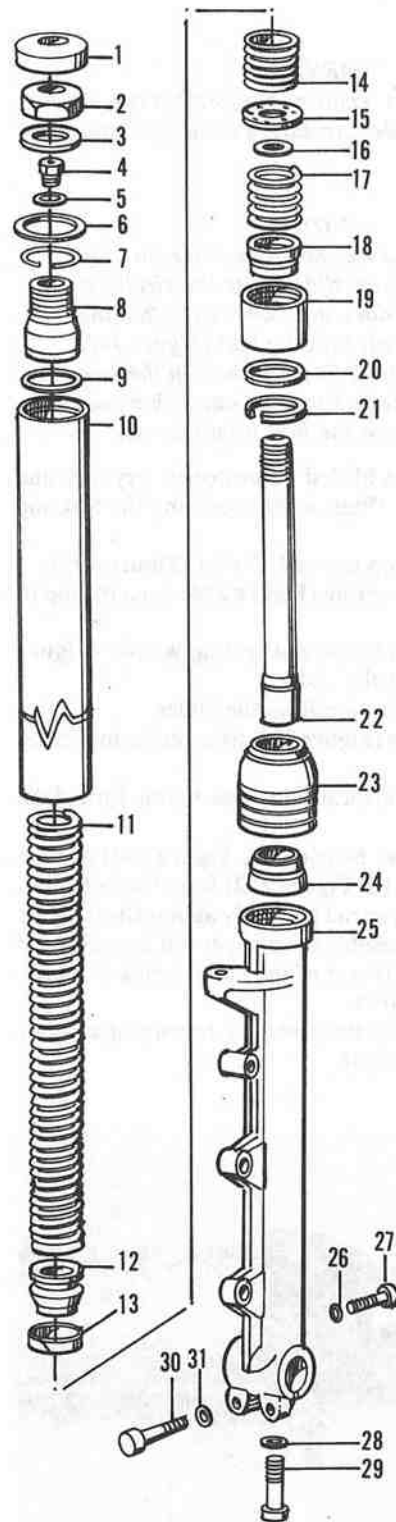




193

**FRONT FORK  
(TYPE V)**

1. Top trim cap
2. Nut
3. Washer
4. Oil fill plug
5. Sealing gasket
6. Washer
7. Snap ring
8. Fork top cap
9. O-ring
10. Fork legs
11. Fork spring
12. Damper piston
13. Piston ring
14. Compression spring
15. Valve washer
16. O-ring
17. Spring
18. Valve
19. Valve housing
20. Shim
21. Circlip
22. Damper rod
23. Dust seal
24. Oil seal
25. Fork slider
26. Sealing washer
27. Drain bolt
28. Sealing washer
29. Allen bolt
30. Bolt
31. Washer



5. Remove the dust seal (**Figure 196**) from the fork slider.
6. Hold the upper fork tube in a vise with soft jaws.
7. Compress the fork top cap with a drift or socket extension.

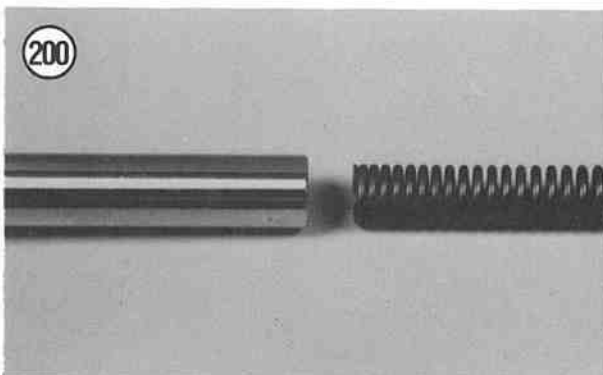
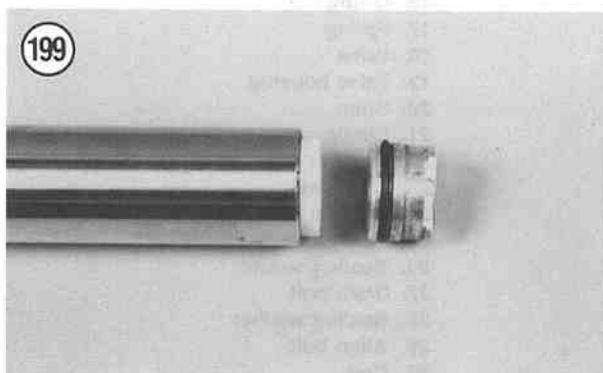
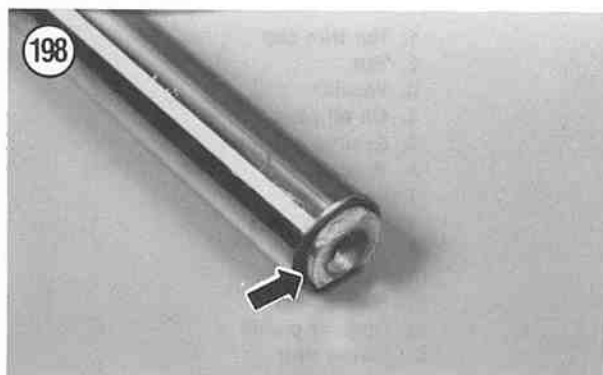
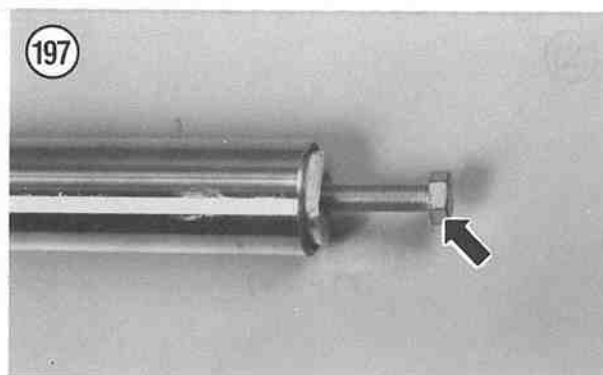
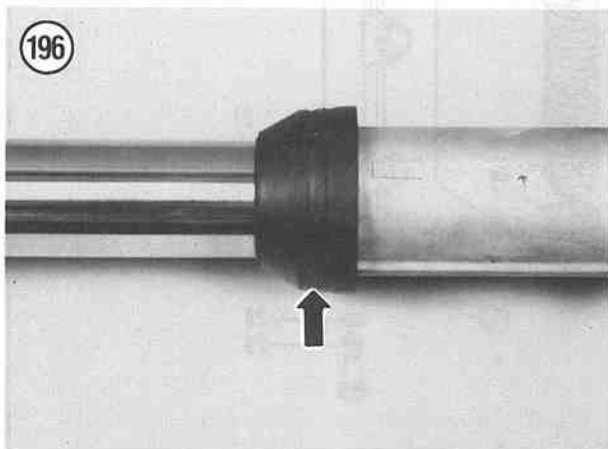
**WARNING**

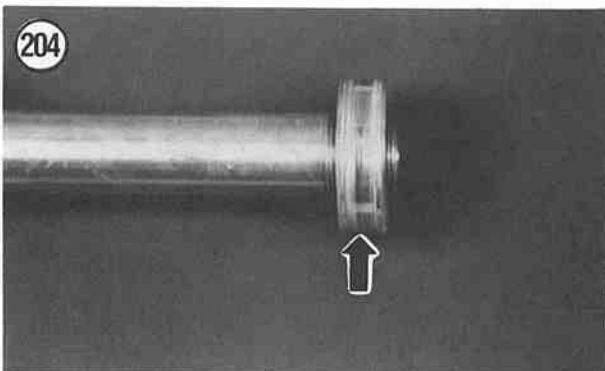
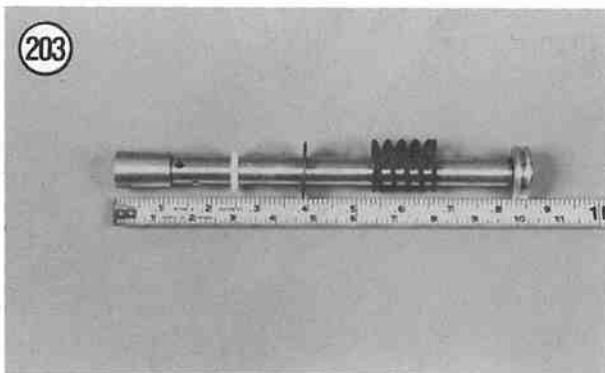
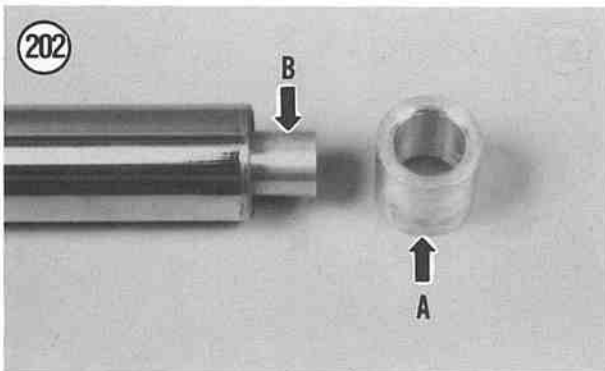
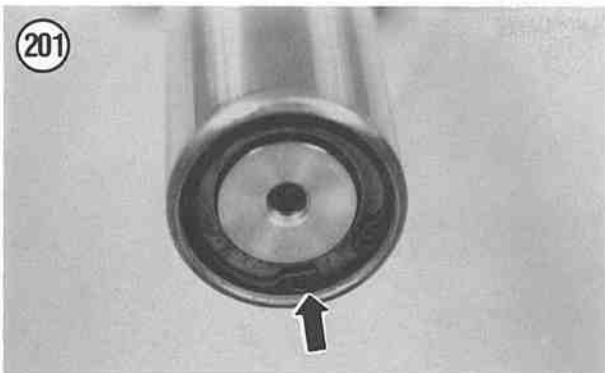
*Be careful when removing the fork top cap as the spring is under pressure. Protect your eyes accordingly.*

**NOTE**

*The spring pressure should push the fork top cap out of the fork slider after the circlip is removed. If it does not come out after the circlip is removed, install a bolt (**Figure 197**) into the oil fill plug threaded hole in the fork top cap. Pull the fork top cap out with a pair of pliers. Unscrew the bolt from the cap.*

8. Using a small flat-bladed screwdriver, pry out and remove the snap ring (**Figure 198**) securing the fork top cap into the slider.
9. Remove the fork top cap and O-ring (**Figure 199**).
10. Slide out the fork spring (**Figure 200**) from the top of the fork tube.
11. Remove the Allen screw and sealing washer (**Figure 194**) on the bottom of the slider.
12. Withdraw the fork tube from the slider.
13. Remove the circlip (**Figure 201**) from the bottom of the fork tube.
14. Remove the shim(s) located between the circlip and the valve housing.
15. Withdraw the valve housing (A, **Figure 202**) and the damper rod assembly (B, **Figure 202**) from the fork tube.
16. Examine the damper rod assembly as described in this chapter. Do not disassemble the damper rod assembly for inspection purposes. If one of the components is faulty, disassemble it as follows:
  - a. Thoroughly clean the assembly in solvent and dry with compressed air.





- b. Wash the assembly in soap and hot water to remove all traces of cleaning solvent and fork oil.

**WARNING**

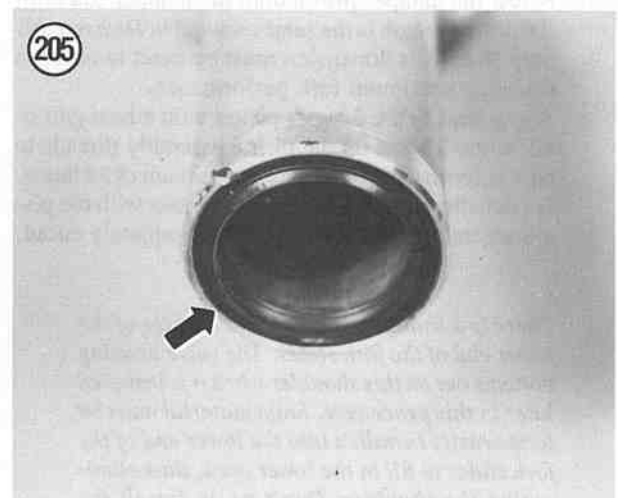
*Make sure all traces of solvent are removed from the damper rod assembly. The damper rod is going to be heated and must be thoroughly free of all solvent residue to avoid a fire hazard.*

- c. Measure the overall length of the damper rod assembly (Figure 203) and write it down.  
 d. Lay the damper rod on a piece of paper or cardboard and make an outline around each part and identify each part so that they will be reinstalled in the same location.

**NOTE**

*The damper piston has been secured to the damper rod with a locking compound and is very difficult to remove without first heating the damper piston.*

- e. Place the damper rod in a vise with soft jaws so the damper piston is sticking out to one side.  
 f. Using a propane torch, heat the damper piston (Figure 204) until the Loctite starts to burn (approximate temperature of 250° C/482° F).  
 g. Using a pair of pliers, unscrew the damper piston from the end of the damper rod.  
 h. Remove the components from the damper rod.  
 17. Using a broad-tipped screwdriver, carefully pry the oil seal (Figure 205) out of the fork slider. Protect the edge of the fork slider with a piece of wood or plastic to keep the screwdriver from making contact with the slider while prying out the oil seal.  
 18. Inspect all parts as described under *Inspection (Type V Models)* in this chapter.



### Front Fork Assembly (Type V)

Refer to **Figure 193** for this procedure.

#### NOTE

*R80 and R100 models produced since 1985 are equipped with a new designed dual-lip oil seal. If the bike has the old design seal, replace it with the new oil seal (BMW part No. 31 42 2 310 199) as it seals better.*

1. Apply fork oil to the inner surface of the fork slider and to the outer surface of the oil seal.

#### CAUTION

*Do not install the oil seal into the fork slider any farther than specified, as the seal will be distorted resulting in an oil leak.*

2. Using a hammer and a socket that matches the outer diameter of the fork oil seal, carefully tap the oil seal squarely into the fork slider. Tap it in until it is flush with the top surface of the slider (**Figure 205**).
3. If the damper rod assembly was disassembled, assemble it as follows:

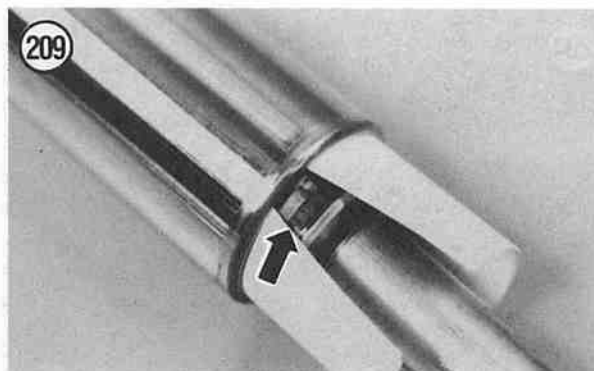
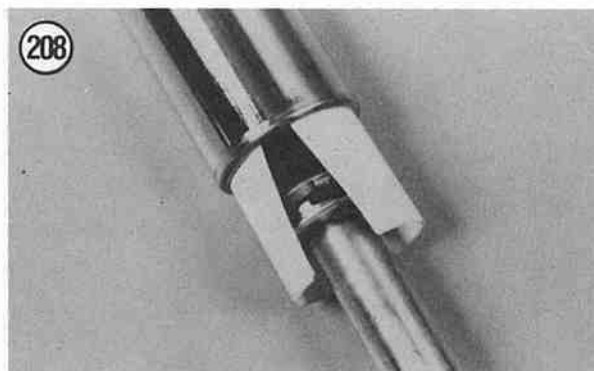
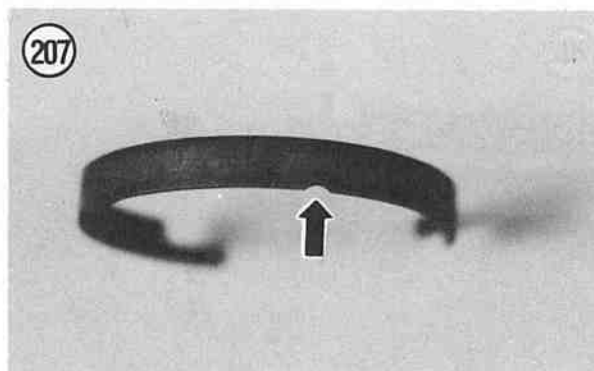
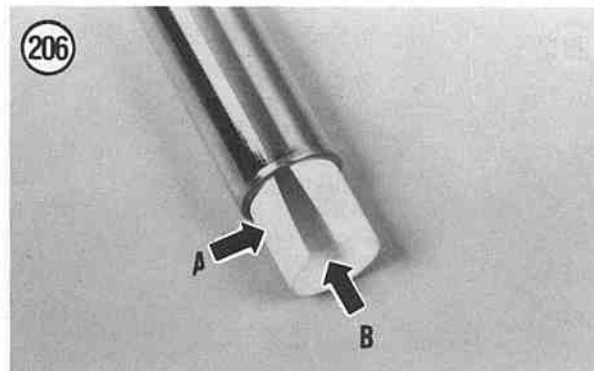
#### NOTE

*If an outline was made of the damper rod assembly, lay it down and refer to it during the assembly procedure.*

- a. Slide on the valve with the O-ring end going on last, then install the spring and the O-ring seal.
- b. Slide the valve washer and compression spring onto the damper rod.
- c. Apply one drop of Loctite Threadlocker No. 638 or No. 273 to the threads on the end of the damper rod and install the damper piston (**Figure 204**).
- d. Screw the damper piston onto the damper rod until the overall length is the same as noted in *Disassembly Step 16 c*. This dimension must be exact in order to maintain maximum fork performance.
- e. Apply heat to the damper piston with a heat gun *or* allow the Loctite on the piston assembly threads to cure at room temperature for a minimum of 24 hours. Do not allow fork oil to come in contact with the piston assembly until the Loctite is completely cured.

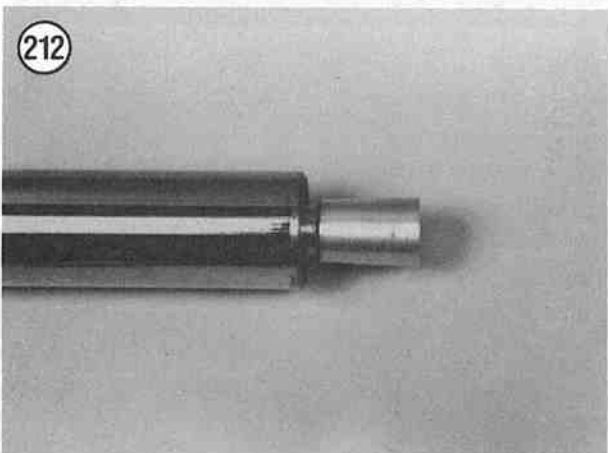
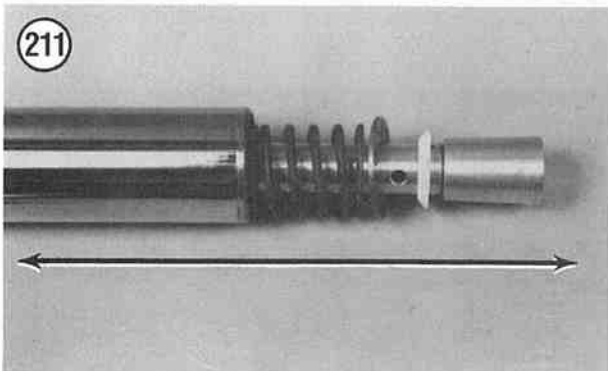
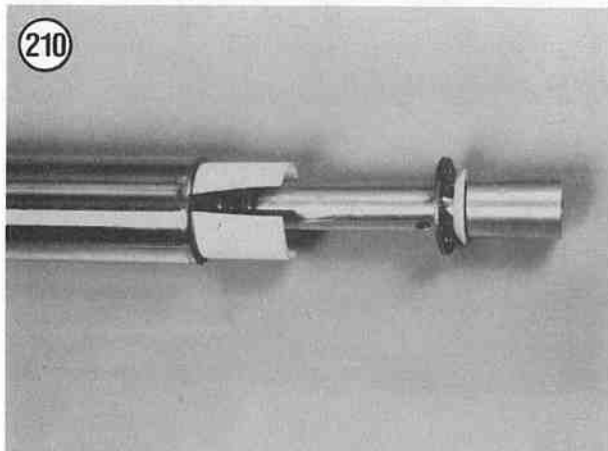
#### NOTE

*There is a shoulder on the inner surface of the lower end of the fork slider. The valve housing bottoms out on this shoulder when it is installed later in this procedure. Shim material must be temporarily installed into the lower area of the fork slider to fill in the lower area, thus eliminating the shoulder. Don't try to install the*



*damper rod assembly without adding this shim material as the piston ring will snag on the shoulder and "pop off" during installation.*

4. Install the damper rod assembly as follows:
  - a. Cut three 3 × 5 index cards so they are only 4 inches long. The thickness of the 3 cards is sufficient to fill in the area, thus eliminating the fork slider shoulder.



- b. Wrap the long side of the 3 × 4 cards around the exterior of the fork slider so that they take on the natural curve of the slider. Continue to contour the cards so that they have a natural curve that follows the fork slider.
  - c. Insert the three 3 × 4 cards into the fork slider (A, **Figure 206**). The cards were trimmed down from 5 in. to 4 inches so there will be a gap (B, **Figure 206**) that will allow you to see the piston ring in the next step.
  - d. Apply some fork oil to the piston ring, then position the piston ring onto the damper piston with its notched end facing down (**Figure 207**). Install the piston ring onto the damper piston.
  - e. Hold the piston ring onto the damper piston and partially insert the damper rod into the 3 × 4 cards in the fork slider (**Figure 208**). The piston ring ends must be visible, so position the ring ends facing up toward the gap in the cards.
  - f. Make sure the piston ring ends are meshed properly and that the piston ring is correctly seated in the damper piston groove (**Figure 209**).
  - g. Slowly push the damper rod assembly into the fork slider and past the shoulder (**Figure 210**). You will feel a slight hesitation when the piston ring slides past the 3 × 4 cards and into the fork slider. Once you have passed the shoulder, move the damper rod assembly farther in, then carefully move it in and out to make sure the piston ring stayed in place within the piston groove.
  - h. Hold onto the damper rod assembly and the fork slider and turn this assembly up to a vertical position with the damper rod end facing down. If the piston ring did not stay in the piston groove, it will slide down the damper rod assembly. If this has happened, repeat this procedure until the damper rod is installed correctly with the piston ring in place in the piston groove.
  - i. Hold the damper rod in place and remove the 3 × 4 cards from the fork slider.

#### NOTE

*In the following step, do not allow the damper rod assembly to come out far enough so that the piston ring travels past the fork slider shoulder or you will have to start all over again.*

- j. Move the damper rod in and out (**Figure 211**) to make sure the piston ring is properly seated within the piston groove.
5. Push the damper rod assembly the rest of the way into the fork slider (**Figure 212**).

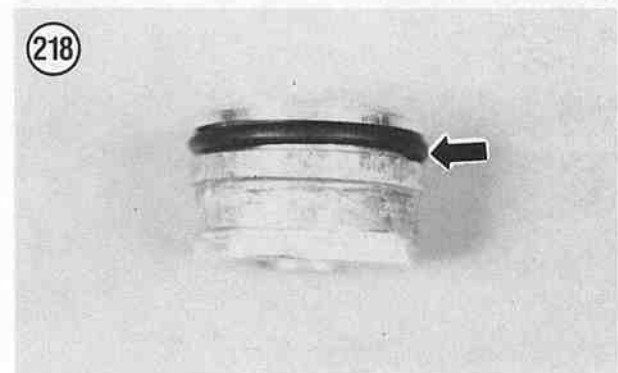
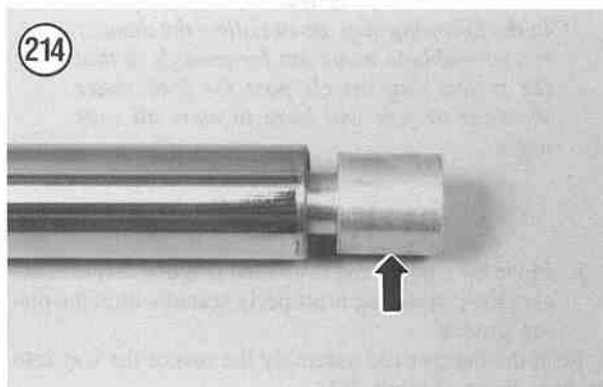
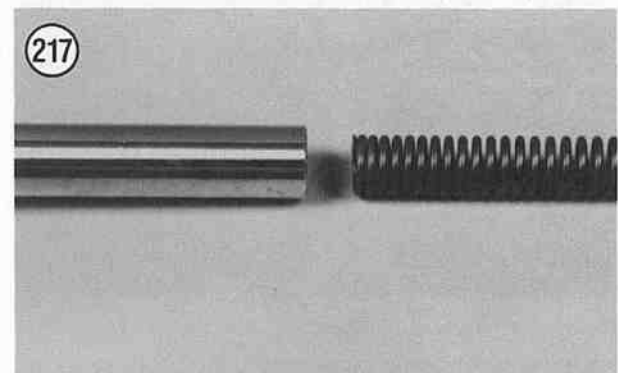
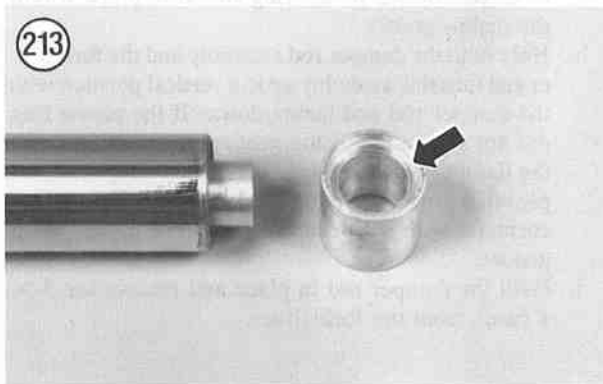
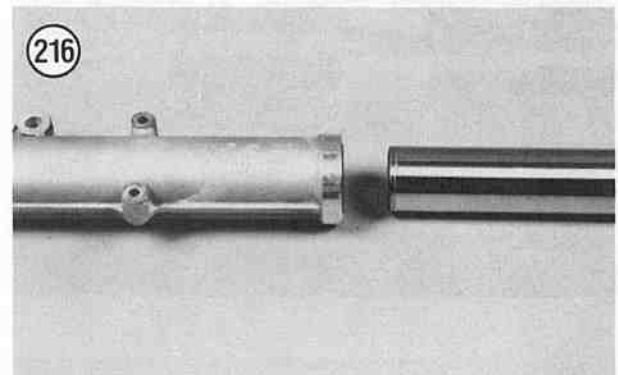
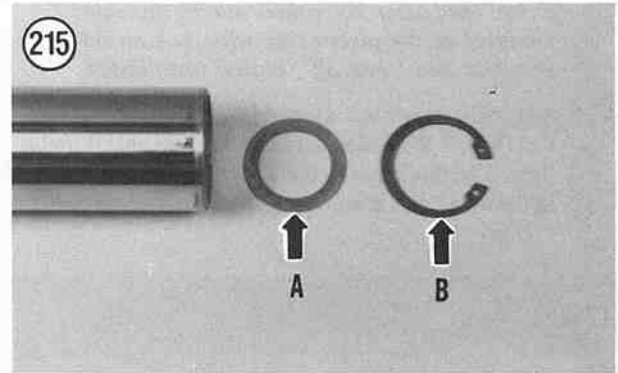


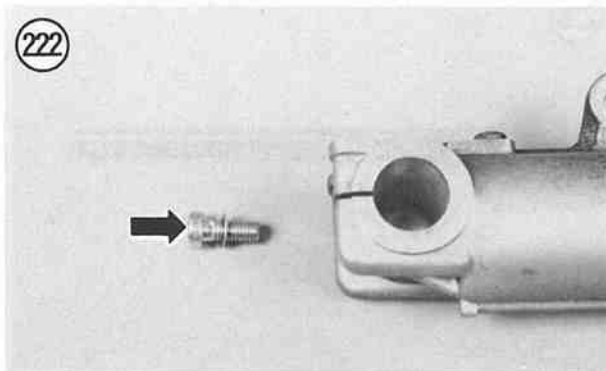
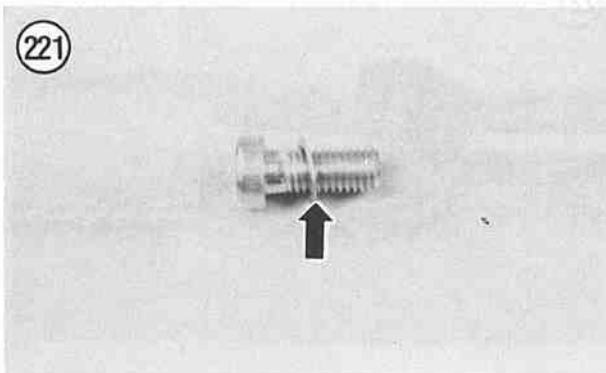
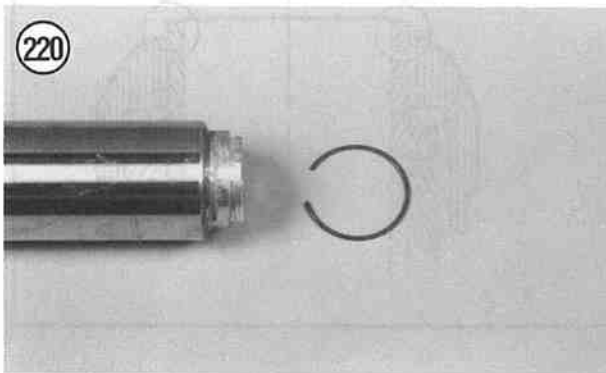
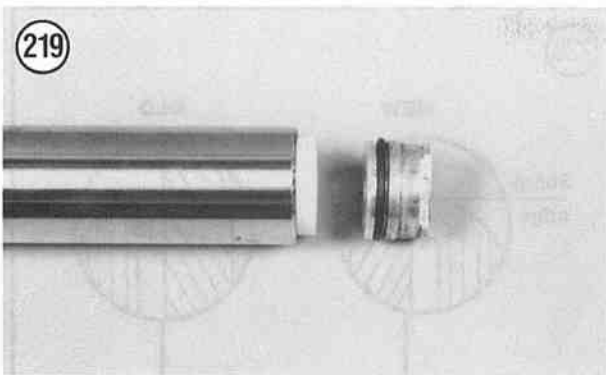
6. Position the valve housing with the recessed end (**Figure 213**) going on first.
7. Install the valve housing (**Figure 214**) onto the end of the damper rod assembly, then push the assembly into the fork tube until it stops.
8. Install the same number of shims (A, **Figure 215**) that were located between the circlip and the valve housing as noted during disassembly.

**NOTE**

*If the damper rod assembly was disassembled and reassembled, the overall length may be slightly different than the original length. If so, the number of shims used between the valve housing and the circlip may be different from those originally used.*

9. Position the circlip (B, **Figure 215**) with the sharp side facing out.
10. Install the circlip (**Figure 201**) securing the valve housing and damper rod assembly in the fork tube. If the circlip will not seat correctly, one or more of the shims installed in Step 11 may have to be removed to make additional room. Reinstall the circlip.
11. After the circlip is correctly seated, push down on the valve housing. There should be no play between the bottom surface of the circlip and the top surface of the valve





housing. If there is play between the 2 parts, additional shim(s) must be added. The shims are available from BMW dealers.

12. Apply a coat of fork oil to the outer surface of the fork tube and install the fork tube into the slider (Figure 216).

13. Install the fork spring (Figure 217) into the fork slider.

14. Hold the upper fork tube in a vise with soft jaws.

15. Inspect the O-ring seal (Figure 218) on the fork top cap; replace if necessary.

16. Install the fork top cap and O-ring (Figure 219).

17. Press down on the fork top cap with a drift or socket extension. While holding the fork top cap down, install the snap ring (Figure 220). Make sure the snap ring is correctly seated in the fork tube groove.

18. Make sure the sealing washer (Figure 221) is in place on the Allen screw.

19. Apply a few drops of blue Loctite (No. 271) to the Allen screw threads prior to installation.

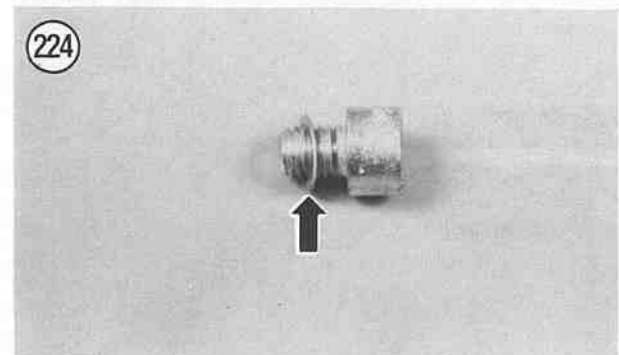
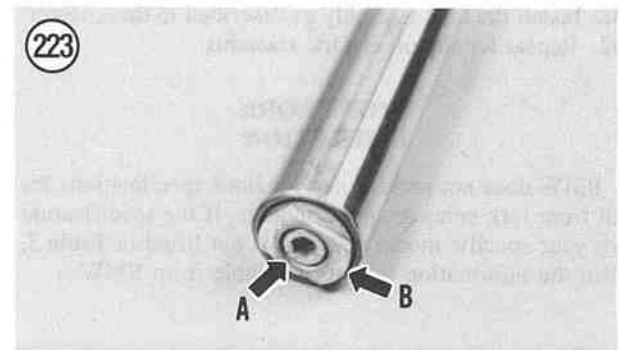
20. Install the Allen screw and sealing washer (Figure 222) in the bottom of the slider. Tighten the Allen screw to the torque specification listed in Table 1.

21. Remove the oil fill plug (A, Figure 223) from the fork top cap (B, Figure 223).

22. Insert a small funnel in the opening in the fork top cap.

23. Add the recommended type and specified amount of fork oil through the small opening in the fork top cap. Refer to Table 3 for fork oil capacity.

24. Make sure the sealing washer (Figure 224) is in place on the oil fill plug.



25. Install the oil fill plug (Figure 225). Tighten the plug securely.

**NOTE**

R80 and R100 models produced since 1985 are equipped with a new design dust seal. The new dust seal has a sharper upper edge which enables it to seat better against the fork tube. The contours of the old and new seals are shown in Figure 226. If the bike has the old design seal, replace it with the new dust seal (BMW part No. 31 42 1 454 392). The new dust seal requires the addition of a spacer ring (BMW part No. 31 42 1 458 474) under the seal to prevent the fork oil seal from coming in contact with the lower lip of the dust seal.

26. Clean the inside of the fork seal in solvent and thoroughly dry. Make sure all old grease is removed from the grease pocket.

27. Slide the dust seal onto the fork tube and slide it back and forth. It must slide back and forth but still be tight. There is to be no clearance between the fork tube and the dust seal. Make sure the sharp edge of the seal is tight up against the fork tube and that it is straight without any distortion. Replace if necessary.

28. Fill the grease pocket in the dust seal with Shell Retinax A grease, or equivalent.

29. Install the spacer ring.

30. Slide the dust seal (Figure 227) down the fork tube.

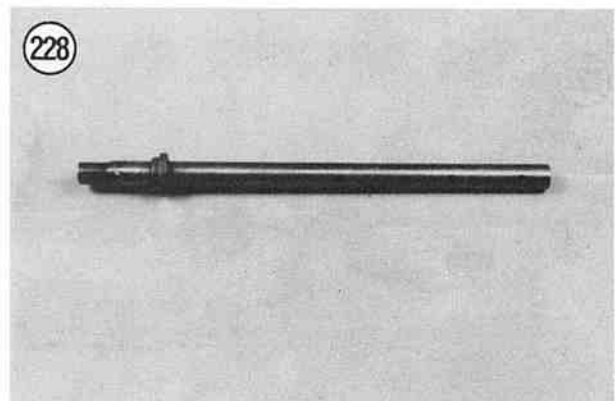
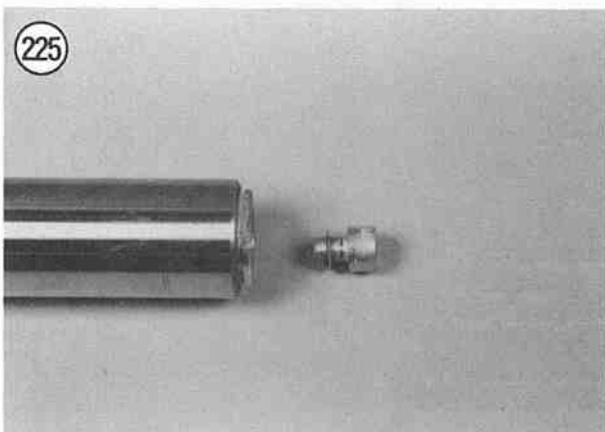
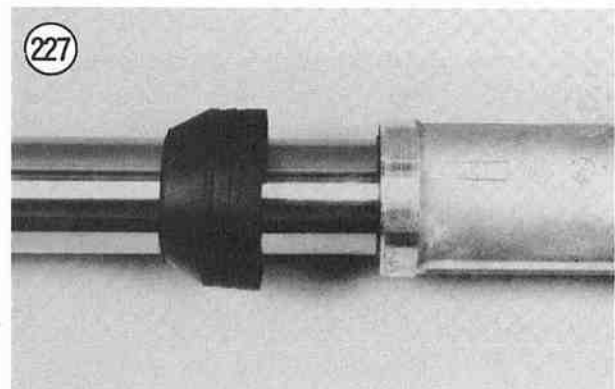
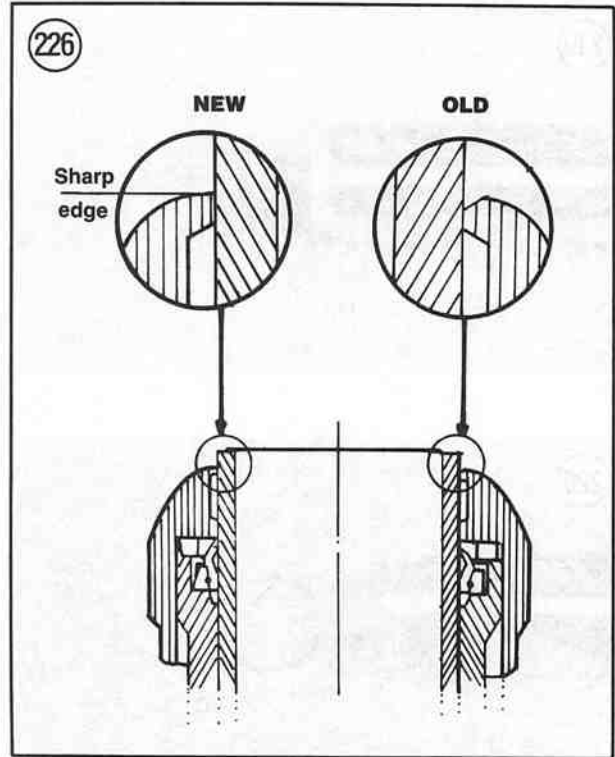
Push it down until it snaps into place on the fork slider

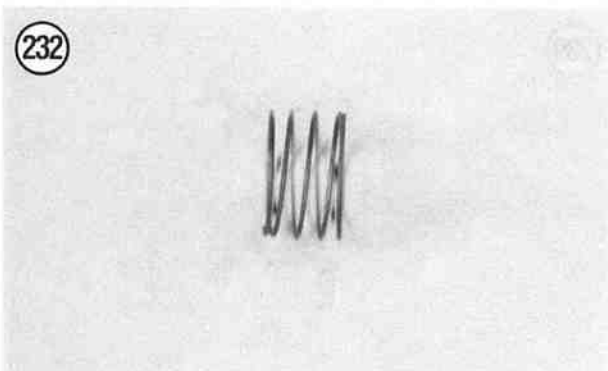
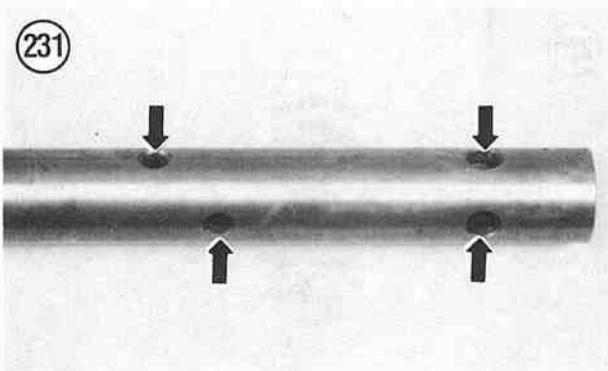
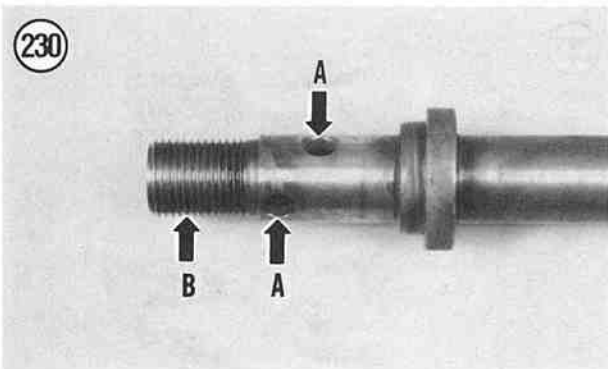
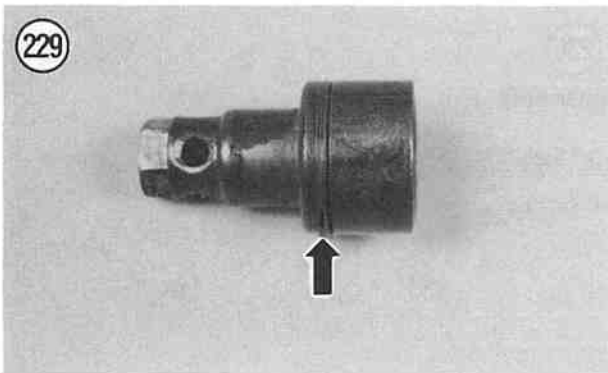
31. Install the fork assembly as described in this chapter.

32. Repeat for the other fork assembly.

**FRONT FORK  
INSPECTION**

BMW does not provide service limit specifications for all front fork components or models. If the specification for your specific model and year is not listed in Table 3, then the information was not available from BMW.



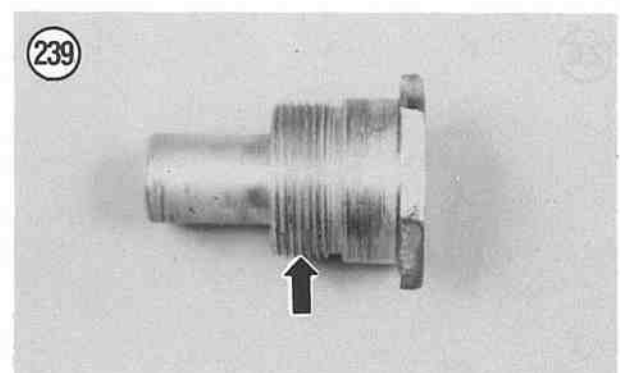
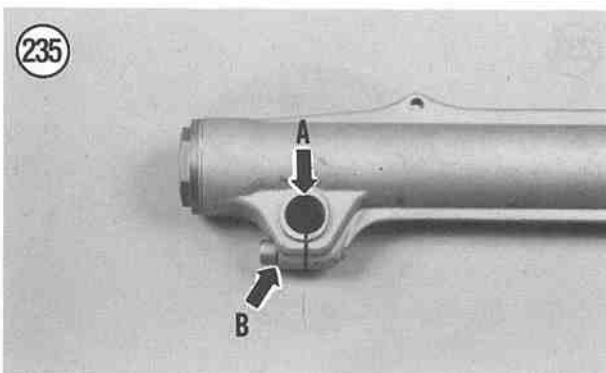
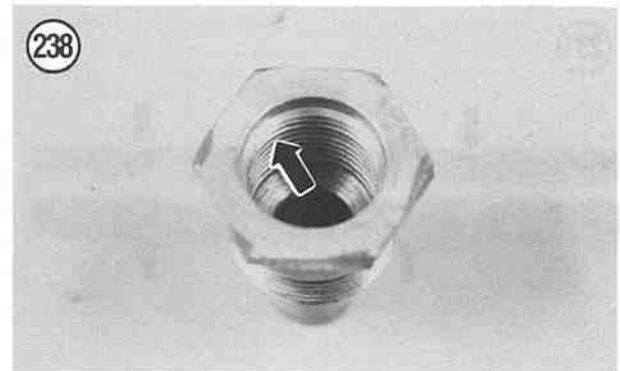
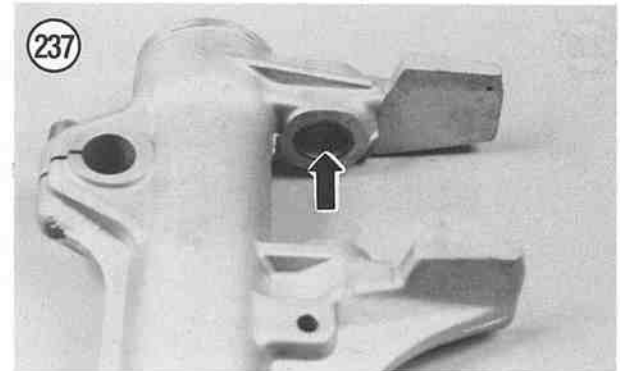
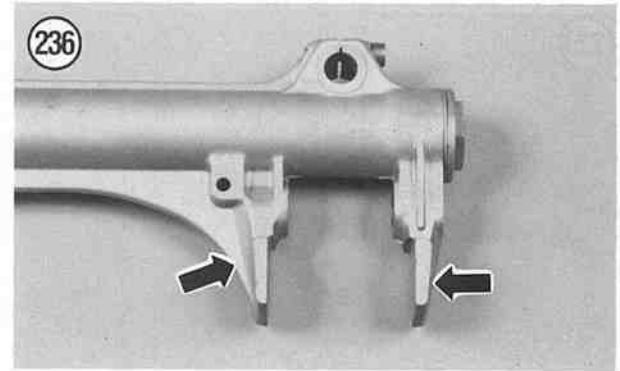
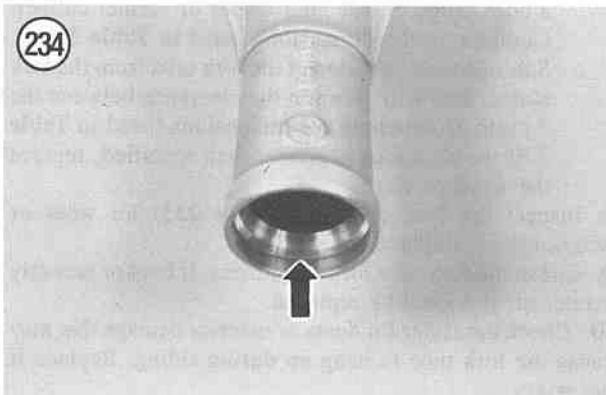


### Inspection (Type I Models)

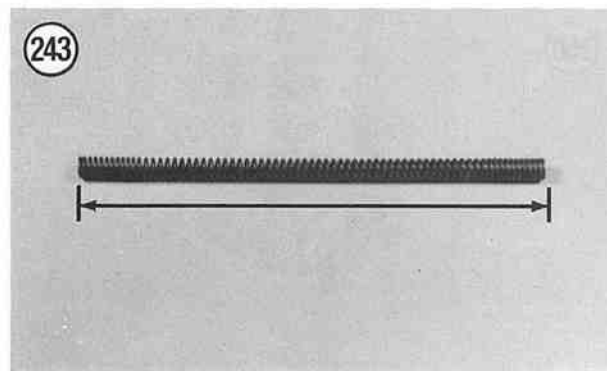
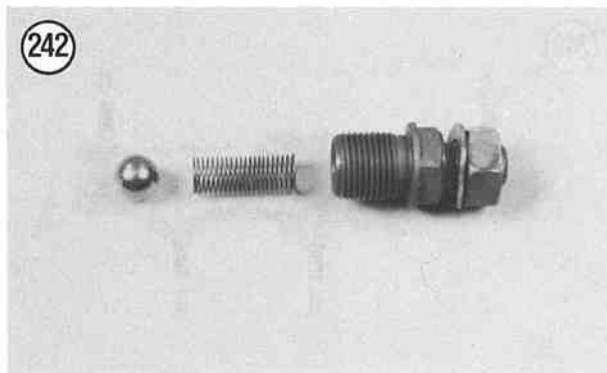
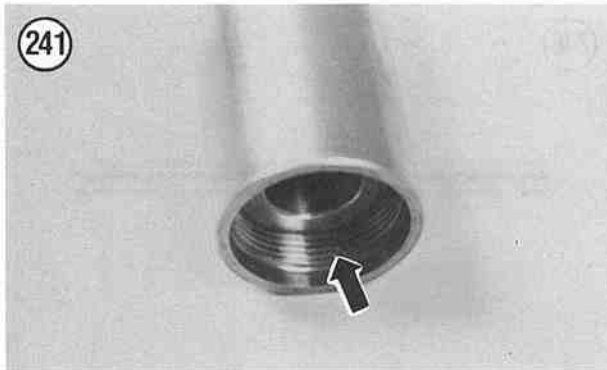
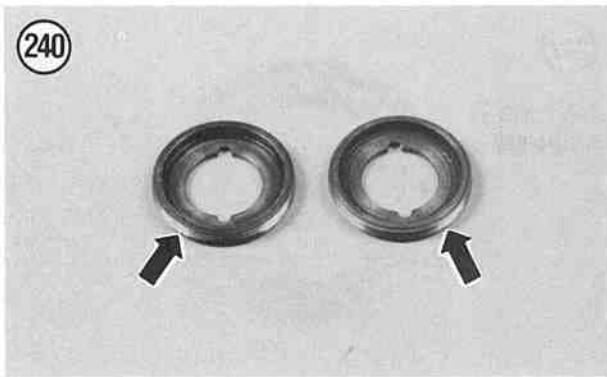
1. Thoroughly clean all parts in solvent and dry them. Check the fork tube for signs of wear or scratches.
2. Check the damper rod (Figure 228) for straightness. If the damper rod assembly was disassembled, roll it on a piece of plate glass and check for any runout. BMW does not provide service limit specifications for runout. Replace if necessary.
3. Carefully check the wiper rings (Figure 229) on the damper piston for wear or damage. Replace the wiper rings if necessary.
4. Make sure the upper oil passage holes (A, Figure 230) and the lower oil passage holes (Figure 231) in the damper rod are clean. If clogged or congested, clean out with solvent and dry with compressed air.
5. Inspect the threads (B, Figure 230) on the damper rod for wear or damage. Clean out the threads with the correct size thread tap or replace the damper rod if necessary.
6. Inspect the damper piston spring (Figure 232) for wear or damage. BMW does not provide service limit specifications for the spring. Replace if necessary.
7. To determine the clearance between the fork tube and the fork slider, perform the following:
  - a. Measure the outside diameter of the fork tube with a micrometer or vernier caliper. Compare to the dimensions listed in Table 3.
  - b. Measure the inside diameter of the fork slider with a bore gauge, inside micrometer or vernier caliper. Compare to the dimensions listed in Table 3.
  - c. Subtract the dimension of the fork tube from the fork slider. This will give you the clearance between the 2 parts. Compare to the dimensions listed in Table 3. If the clearance is greater than specified, replace the worn part(s).
8. Inspect the fork oil seal (Figure 233) for wear or deterioration. Replace if necessary.
9. Check the fork tube for straightness. If bent or severely scratched, it should be replaced.
10. Check the slider for dents or exterior damage that may cause the fork tube to hang up during riding. Replace if necessary.



11. Check the slider in the area (Figure 234) where the fork seal is installed for wear or damage. Replace if necessary.
12. Check the axle bearing surfaces of the slider (A, Figure 235) for wear or gouges. Clean up the surfaces or replace the slider if necessary.
13. Inspect the axle clamping lugs (B, Figure 235) on the slider for cracks or fractures from overtightening the clamping bolts. If any evidence of cracks is found, replace the fork slider.
14. On the left-hand fork leg slider, inspect the following:
  - a. Check the caliper mounting brackets (Figure 236) for wear, cracks or damage. Replace the slider if necessary.
  - b. Inspect the bushing (Figure 237) for the brake caliper eccentric adjuster for wear or damage. Replace the slider if necessary.
15. Inspect the threads on the following parts for wear or damage. Clean out the threads with the correct size thread tap or replace the damaged part if necessary.
  - a. Top cap bolt inner threads (Figure 238) and outer threads (Figure 239).
  - b. Threaded rings (Figure 240).
  - c. Fork tube inner threads (Figure 241).
16. Inspect the threaded plug, spring and ball (Figure 242) for wear or damage. Replace all worn parts.
17. Inspect the dust seal for cracks or deterioration. Replace if necessary.





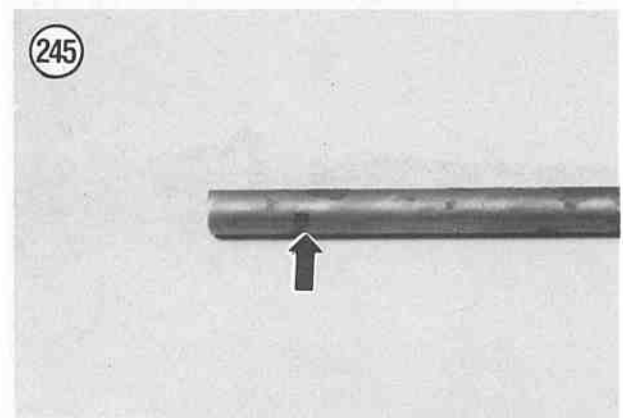
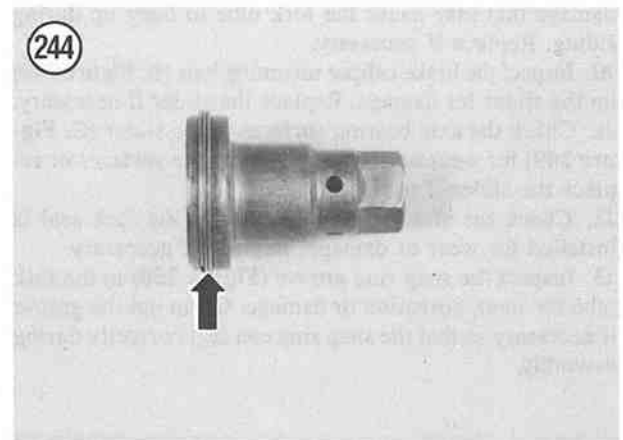


18. Measure the uncompressed length of the fork spring as shown in **Figure 243**. The standard length of a new spring is listed in **Table 3**. If the spring has sagged to less than the standard dimension listed in **Table 3**, the spring must be replaced.

19. Any parts that are worn or damaged should be replaced. Simply cleaning and reinstalling unserviceable components will not improve performance of the front suspension.

#### Inspection (Type II Models)

1. Thoroughly clean all parts in solvent and dry them. Check the fork tube for signs of wear or scratches.
2. Check the damper rod for straightness. If the damper rod assembly was disassembled, roll it on a piece of plate glass and check for any runout. BMW does not provide service limit specifications for runout. Replace if necessary.
3. Carefully check the wiper rings (**Figure 244**) on the damper piston for wear or damage. Replace the wiper rings if necessary.
4. Make sure the oil passage holes (**Figure 245**) in the damper rod are clean. If clogged or congested, clean out with solvent and dry with compressed air.



5. Inspect the threads on the damper rod (A, **Figure 246**) and the damper rod piston (B, **Figure 246**) for wear or damage. Clean out the threads with the correct size thread tap or die or replace the damaged part(s).

6. To determine the clearance between the fork tube and the fork slider, perform the following:

- a. Measure the outside diameter of the fork tube with a micrometer or vernier caliper. Compare to the dimensions listed in **Table 3**.
- b. Measure the inside diameter of the fork slider with a bore gauge, inside micrometer or vernier caliper. Compare to the dimensions listed in **Table 3**.
- c. Subtract the dimension of the fork tube from the fork slider. This will give you the clearance between the 2 parts. Compare to the dimensions listed in **Table 3**. If the clearance is greater than specified, replace the worn part(s).

7. Inspect the fork oil seal (**Figure 247**) for wear or deterioration. Replace if necessary,

8. Check the fork tube (**Figure 248**) for straightness. If bent or severely scratched, it should be replaced.

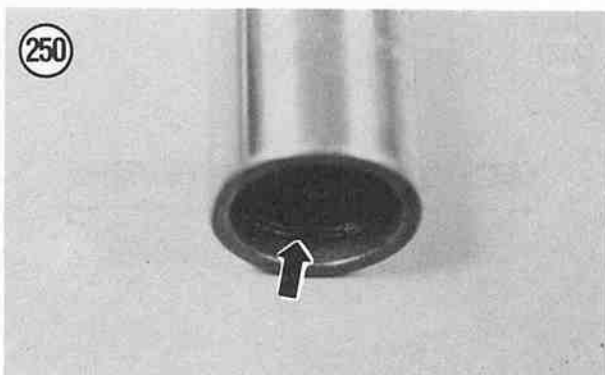
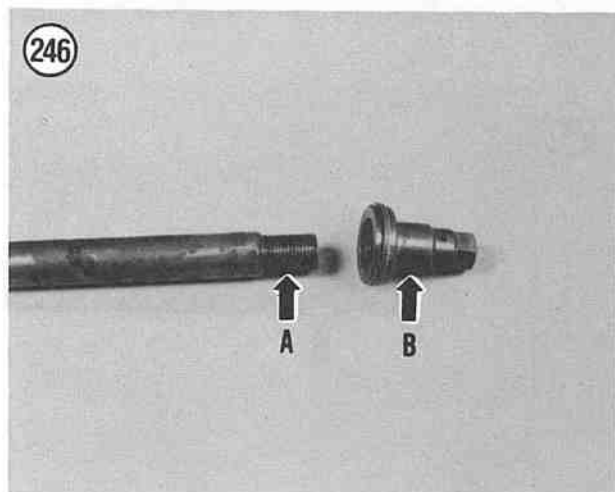
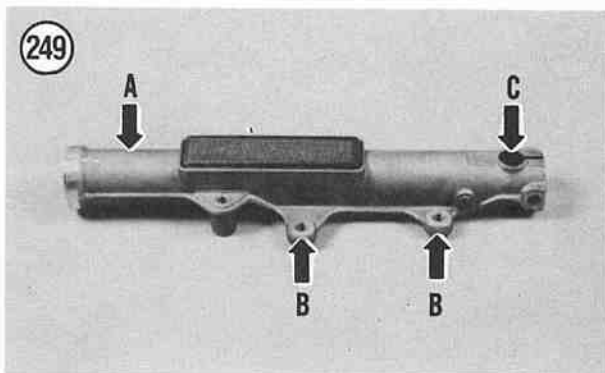
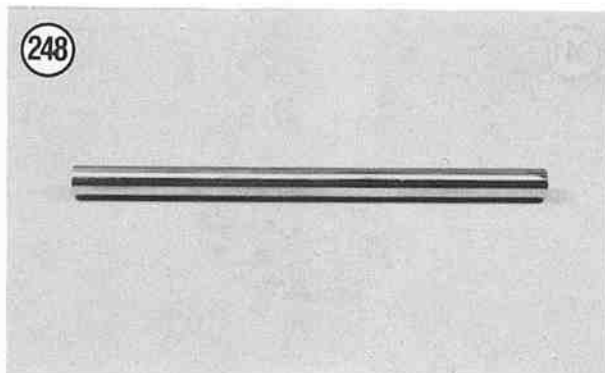
9. Check the slider (A, **Figure 249**) for dents or exterior damage that may cause the fork tube to hang up during riding. Replace if necessary.

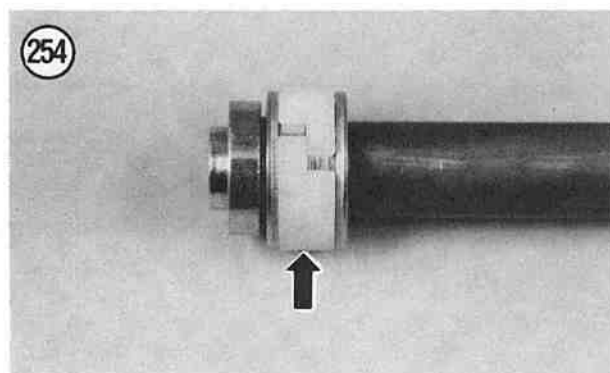
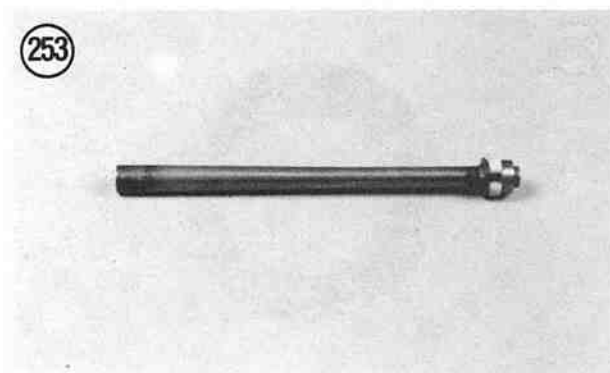
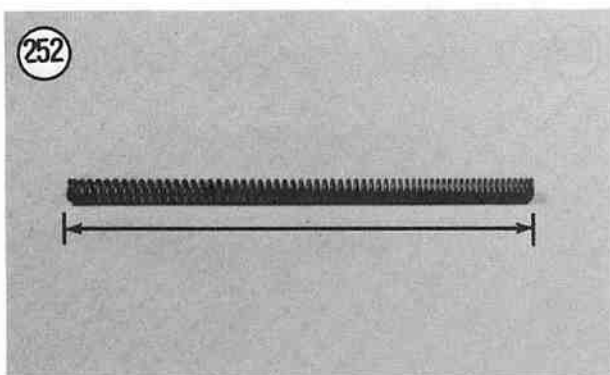
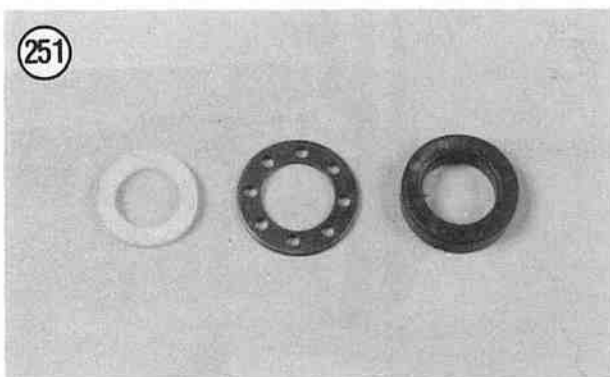
10. Inspect the brake caliper mounting lugs (B, **Figure 249**) on the slider for damage. Replace the slider if necessary.

11. Check the axle bearing surfaces of the slider (C, **Figure 249**) for wear or gouges. Clean up the surfaces or replace the slider if necessary.

12. Check the slider in the area where the fork seal is installed for wear or damage. Replace if necessary.

13. Inspect the snap ring groove (**Figure 250**) in the fork tube for wear, corrosion or damage. Clean out the groove if necessary so that the snap ring can seat correctly during assembly.





14. Inspect the stop ring, valve washer and washer (**Figure 251**) for wear or damage. Replace any worn or damaged parts.

15. Inspect the dust seal for cracks or deterioration. Replace if necessary.

16. Measure the uncompressed length of the fork spring as shown in **Figure 252**. The standard length of a new spring is listed in **Table 3**. If the spring has sagged to less than the standard dimension listed in **Table 3**, the spring must be replaced.

17. Any parts that are worn or damaged should be replaced. Simply cleaning and reinstalling unserviceable components will not improve performance of the front suspension.

### Inspection (Type III and Type IV Models)

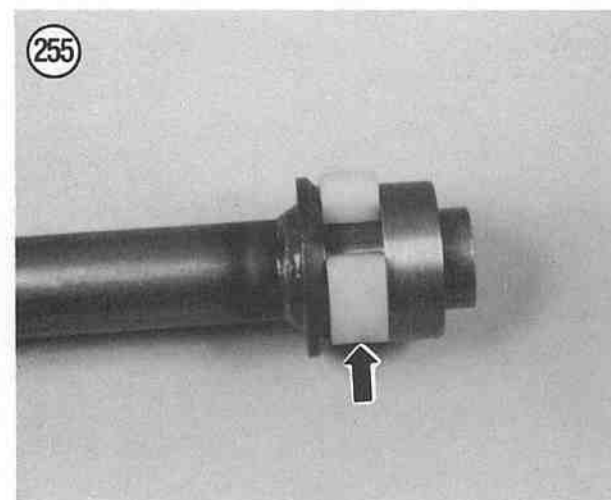
Components shown in this procedure are from a Type IV fork assembly. Minor variations exist among the various models and are identified in this procedure. Not all models are equipped with the same features.

1. Thoroughly clean all parts in solvent and dry them. Check the fork tube for signs of wear or scratches.

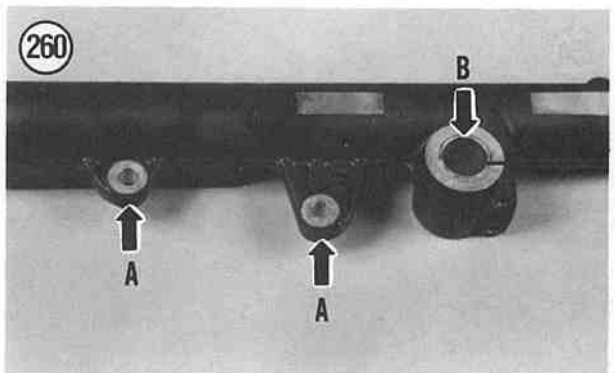
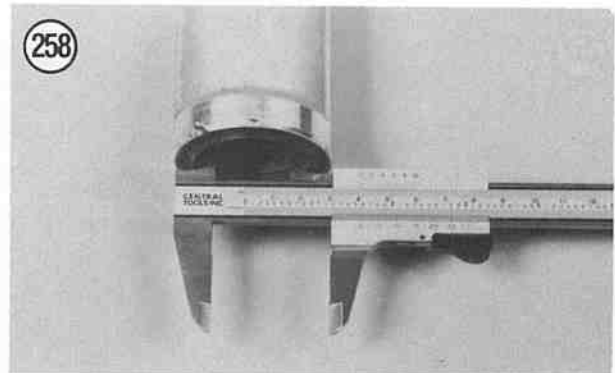
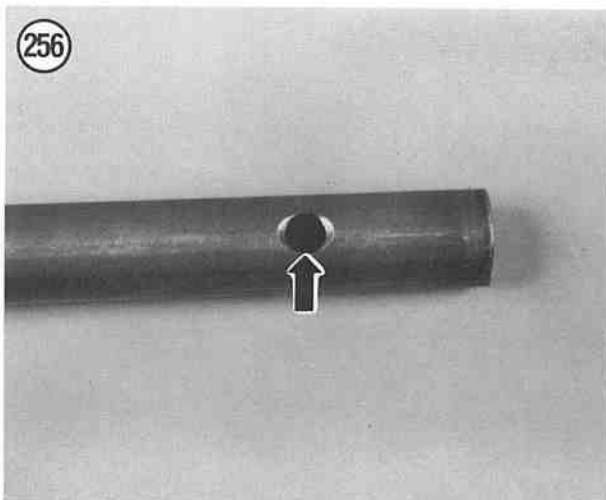
2. Check each damper rod (**Figure 253**) for straightness. If the damper rod assembly was disassembled, roll it on a piece of plate glass and check for any runout. BMW does not provide service limit specifications for runout.

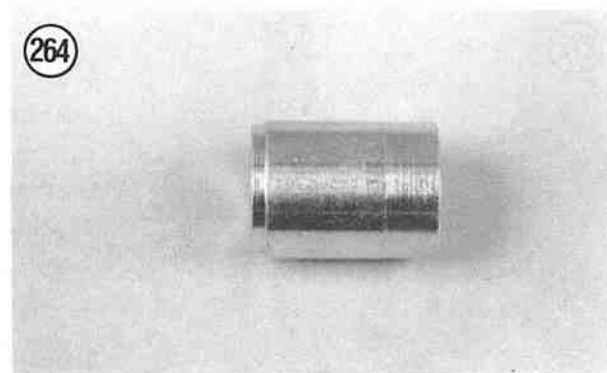
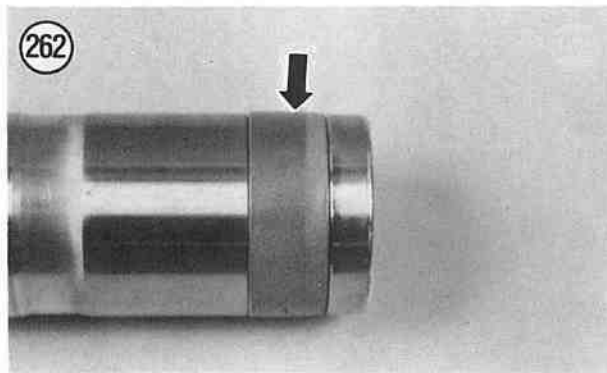
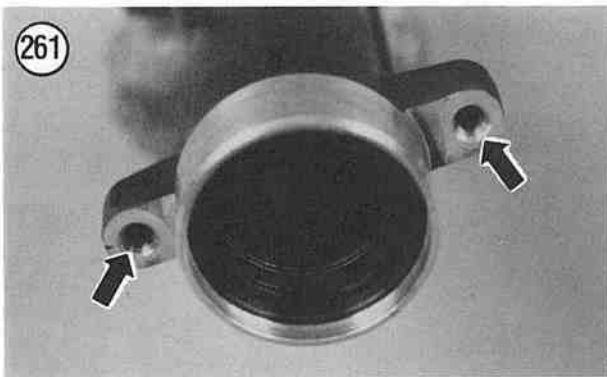
3A. On Type III models, carefully check the damper rod piston ring for wear or damage (**Figure 254**). Replace if necessary.

3B. On Type IV models, carefully check the damper rod piston ring for wear or damage. Refer to **Figure 254** for the right-hand fork leg or **Figure 255** for the left-hand fork leg. Replace if necessary.



4. Make sure the oil passage holes (**Figure 256**) in the damper rod are clean. If clogged or congested, clean out with solvent and dry with compressed air.
5. To determine the clearance between the fork tube and the fork slider, perform the following:
  - a. Measure the outside diameter of the fork tube with a micrometer or vernier caliper (**Figure 257**). Compare to the dimensions listed in **Table 3**.
  - b. Measure the inside diameter of the fork slider with a bore gauge, inside micrometer or vernier caliper (**Figure 258**). Compare to the dimensions listed in **Table 3**.
  - c. Subtract the dimension of the fork tube from the fork slider. This will give you the clearance between the 2 parts. Compare to the dimensions listed in **Table 3**. If the clearance is greater than specified, replace the worn part(s).
6. Inspect the fork oil seal (**Figure 259**) for wear or deterioration; replace if necessary.
7. Check the fork tube for straightness. If bent or severely scratched, it should be replaced.
8. Check the slider for dents or exterior damage that may cause the fork tube to hang up during riding. Replace the slider if necessary.
9. Inspect the drain screw threads on the slider for damage. If necessary, clean out the threads with the proper size thread tap.
10. Make sure the brake caliper mounting lugs (**A**, **Figure 260**) on the slider are not damaged. Replace the slider if necessary.
11. Check the axle bearing surfaces of the slider (**B**, **Figure 260**) for wear or gouges. Clean up the surfaces or replace the slider if necessary.
12. Check the slider in the area where the fork seal is installed for wear or damage. Replace if necessary.
13. Inspect the fork brace mounting lugs (**Figure 261**) on the slider for cracks or fractures. If any evidence of cracks is found, replace the fork slider.





14. On Type IV models only, inspect the fork tube bushing (Figure 262) and fork slider bushing (Figure 263). If either is scratched or scored, they must be replaced. If the Teflon coating is worn off so that the copper base material is showing on approximately 3/4 of the total surface, the bushing(s) must be replaced.

15. Inspect the valve housing (Figure 264) for wear or damage. Replace if necessary.

16. Measure the uncompressed length of the fork spring as shown in Figure 265. The standard length of a new spring is listed in Table 3. If the spring has sagged to less than the standard dimension listed in Table 3, the spring must be replaced.

17. On Type IV models only, inspect the threads (Figure 266) in the slotted nut for damage. If necessary, clean out the threads with the proper size thread tap.

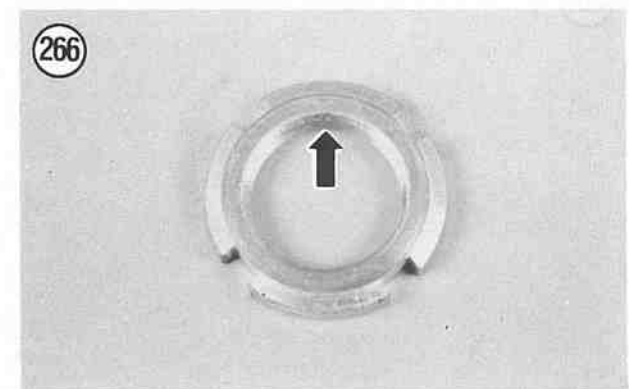
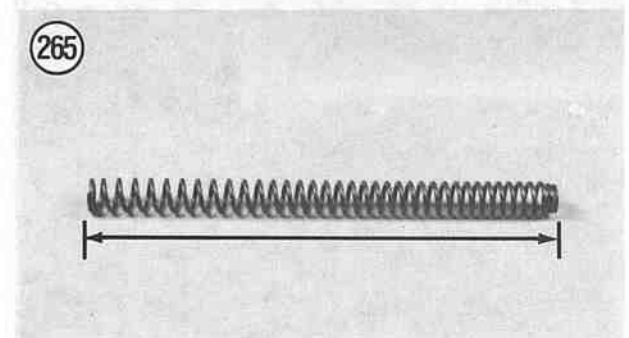
18. Inspect the rubber boot for cracks or deterioration. Replace if necessary.

19. Any parts that are worn or damaged should be replaced. Simply cleaning and reinstalling unserviceable components will not improve performance of the front suspension.

#### Inspection

##### (Type V Models)

1. Thoroughly clean all parts in solvent and dry them. Check the fork tube for signs of wear or scratches.





2. Check the damper rod for straightness. If the damper rod assembly was disassembled, roll it on a piece of plate glass and check for any runout. BMW does not provide service limit specifications for runout.

3. Carefully check the damper piston (Figure 267) and piston ring (Figure 268) for wear or damage. Replace if necessary.

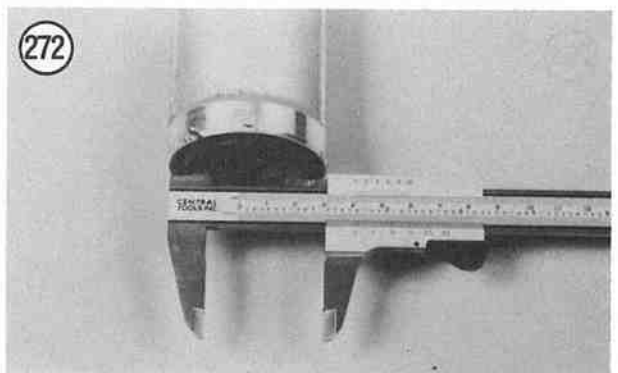
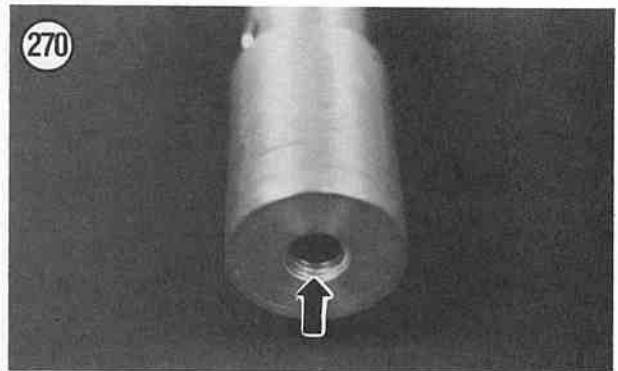
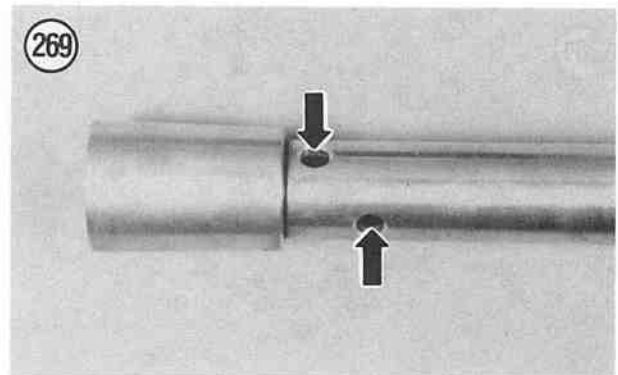
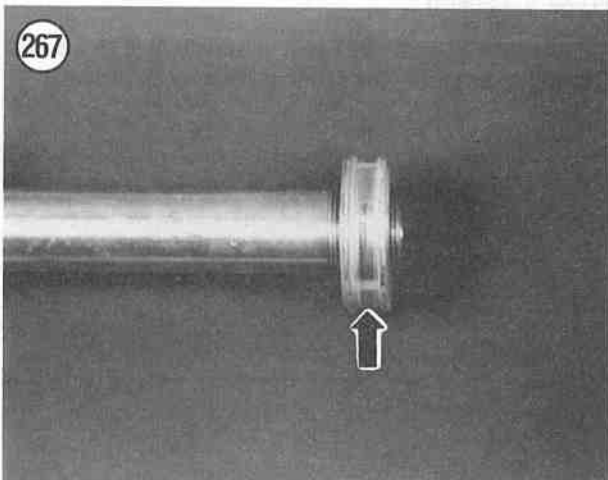
4. Make sure the oil passage holes (Figure 269) in the damper rod are clean. If clogged or congested, clean out with solvent and dry with compressed air.

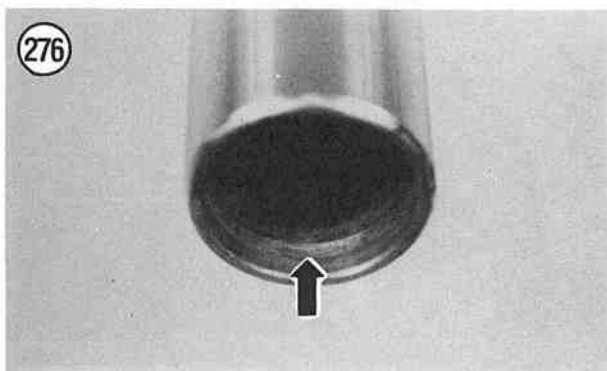
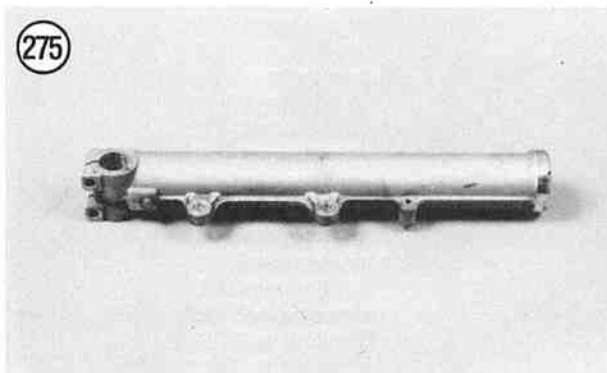
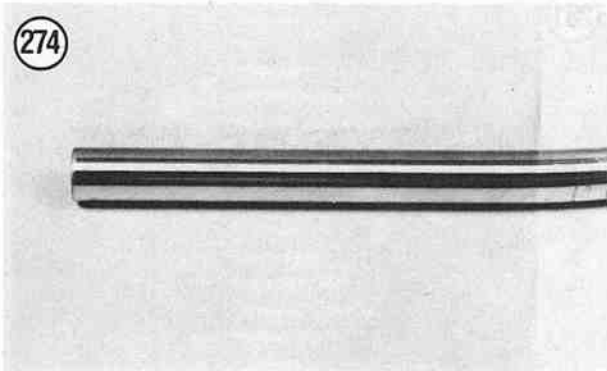
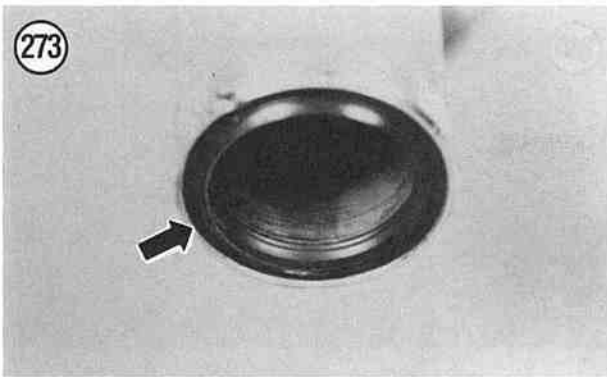
5. Inspect the threads in the valve housing (Figure 270) for wear or damage. Clean out the threads with the correct size thread tap or replace the valve housing if necessary.

6. To determine the clearance between the fork tube and the fork slider, perform the following:

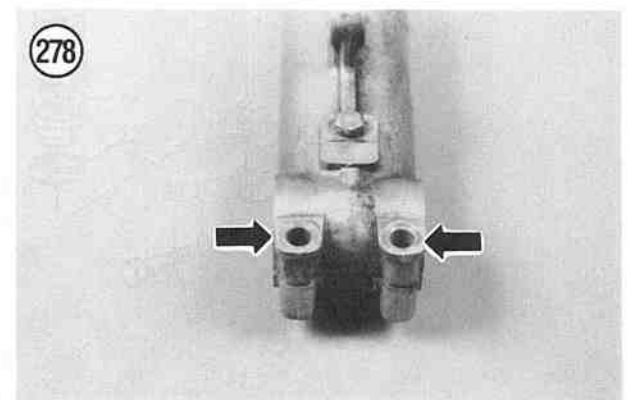
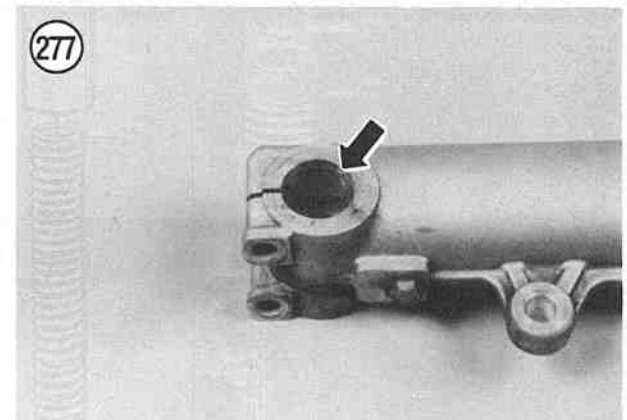
a. Measure the outside diameter of the fork tube with a micrometer or vernier caliper (Figure 271). Compare to the dimensions listed in Table 3.

b. Measure the inside diameter of the fork slider with a bore gauge, inside micrometer or vernier caliper (Figure 272). Compare to the dimensions listed in Table 3.

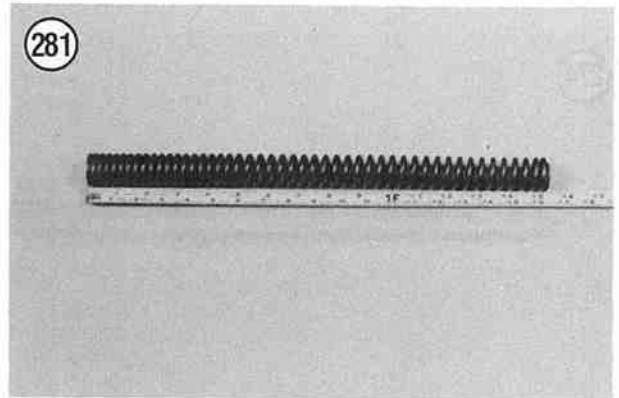
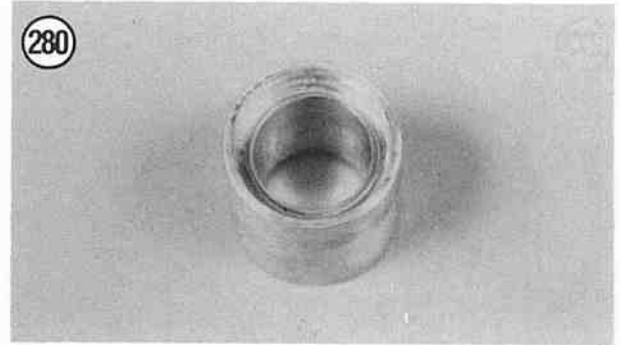
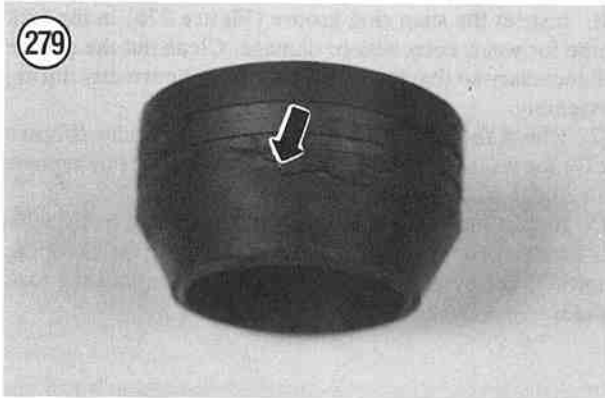




- c. Subtract the dimension of the fork tube from the fork slider. This will give you the clearance between the 2 parts. Compare to the dimensions listed in **Table 3**. If the clearance is greater than specified, replace the worn part(s).
7. Inspect the fork oil seal (**Figure 273**) for wear or deterioration. Replace if necessary.
8. Check the fork tube for straightness (**Figure 274**). If bent or severely scratched, it should be replaced.
9. Check the slider (**Figure 275**) for dents or exterior damage that may cause the fork tube to hang up during riding. Replace if necessary.
10. Check the slider in the area where the fork seal is installed for wear or damage. Replace if necessary.
11. Inspect the snap ring groove (**Figure 276**) in the fork tube for wear, corrosion or damage. Clean out the groove if necessary so that the snap ring can seat correctly during assembly.
12. Check the axle bearing surfaces of the slider (**Figure 277**) for wear or gouges. Clean up the surfaces or replace the slider if necessary.
13. Inspect the axle clamping lugs (**Figure 278**) on the slider for cracks or fractures from overtightening the clamping bolts. If any evidence of cracks is found, replace the fork slider.



14. Inspect the rubber boot (Figure 279) for cracks or deterioration. Replace if necessary.
15. Inspect the valve housing (Figure 280) for wear or damage. Replace if necessary.
16. Measure the uncompressed length of the fork spring as shown in Figure 281. The standard length of a new spring is listed in Table 3. If the spring has sagged to less than the standard dimension listed in Table 3, the spring must be replaced.
17. Any parts that are worn or damaged should be replaced. Simply cleaning and reinstalling unserviceable components will not improve performance of the front suspension.



**Table 1 FRONT SUSPENSION TORQUE SPECIFICATIONS**

<b>Item</b>	<b>N-m</b>	<b>ft.-lb.</b>
<b>Front axle</b>		
Nut	45-50	33-37
Allen bolt	31-35	23-25
Clamp bolts	13-17	9-13
<b>Steering stem hex nut</b>		
1970-1980 models	120-130	88-96
R65, R65LS	80-90	59-65
R80, R80RT	106	80
<b>Fork top cap bolt</b>		
1970-1980 models	120-130	88-96
R80, R80RT	93-119	68-87
All other models	120	88
<b>Fork bridge upper clamping bolts</b>		
R65, R65LS, R100GS	40-45	29-33
<b>Fork bridge lower clamping bolts</b>		
1970-1980	35-40	25-29
R65, R65LS	40-45	29-33
R80, R80RT	25-33	18-24
R100GS	14-17	10-13
All other models	40	29
<b>Fork bridge lower clamping nuts</b>		
1970 models	33-35	24-25
<b>Fork slotted nut (R100GS)</b>	40	29
<b>Front fork brace bolts</b>	14-17	10-13
<b>Fork slider Allen screw</b>		
R65, R65LS	30-40	22-29
R80, R80RT	13-17	9-13
All other models	35	25
<b>Fork slider 8 mm nut</b>		
1970-1980	23-26	17-19

**Table 2 TIRE INFLATION PRESSURE (COLD)\***

Model/Speed	Rider only		Rider and passenger	
	psi	kPa	psi	kPa
<b>1970-1973</b>				
Up to speed limit				
Front	27	186	30	206
Rear	30	206	35	241
Up to 100 mph (160 kmh)				
Front	30	206	33	227
Rear	33	227	38	262
<b>1974-1976</b>				
Up to speed limit				
Front	27	186	28	193
Rear	28	193	32	220
Up to 100 mph (160 kmh)				
Front	30	206	31	213
Rear	31	213	35	241
<b>1977-1987</b>				
Up to speed limit				
Front	27	186	30	206
Rear	26	179	32	220
Up to 100 mph (160 kmh)				
Front	27	186	30	206
Rear	29	199	32	220
<b>1988-on**</b>				
Up to speed limit				
Front	31	213	34	234
Rear	36	248	41	283
* Tire inflation pressure for factory equipped tires. Aftermarket tires may require different inflation pressure.				
** BMW does not provide inflation pressures for speeds over the speed limit on these models.				



Table 3 FRONT SUSPENSION SPECIFICATIONS

Fork tube outer diameter		
R80, 1985-1986 R80RT	38.425-38.450 mm (1.5128-1.5138 in.)	
R100GS	39.936-39.975 mm (1.5723-1.5738 in.)	
All other models	35.925-35.950 mm (1.4144-1.4154 in.)	
Fork slider inside diameter		
R80, 1985-1986 R80RT	38.500-38.539 mm (1.5158-1.5173 in.)	
R100GS	40.160-40.199 mm (1.5811-1.5826 in.)	
All other models	36.000-36.025 mm (1.4173-1.4183 in.)	
Clearance between fork tube and slider		
R80, 1985-1986 R80RT	0.050-0.114 mm (0.0020-0.0045 in.)	
All other models	0.050-0.100 mm (0.0020-0.0039 in.)	
Maximum clearance between fork tube and slider		
1977-1978 R60, R75,		
R80, R100, R100S, R100RS	0.24 mm (0.009 in.)	
All other models	NA	
Fork tube runout (maximum)	0.1 mm (0.004 in.)	
Fork spring free length		
1970-1976 models	530-542 mm (20.866-21.339 in.)	
1977-1978 R60, R75, R80,		
R100, R100S	567 mm (22.323 in.)	
R65, R65LS, R80ST	490-502 mm (19.291-19.764 in.)	
R80G/S, 1981-1984 R80RT,		
R100, R100CS, R100RS, R100RT	539-551 mm (21.220-21.693 in.)	
1977-1980 R100RS, R100RT	543 mm (21.378 in.)	
R80, 1985-1987 R80RT,		
1988-on R100RS and R100RT	472-484 mm (18.583-19.055 in.)	
R100GS	445-450 mm (17.520-17.716 in.)	
Fork oil <sup>1</sup>		
1970-1976	280 cc (9.5 oz.)/	Bel Ray SAE 5wt,
	265 cc (8.96 oz.)	Golden Spectro Very
1977-1979 and R100RT	250 cc (8.4 oz.)/	Light, Aero Shell 4,
	235 cc (7.9 oz.)	BMW 7.5wt <sup>2</sup> , Esso
R65 (1979-1985, R65LS and R80ST	190-200 cc (6.5-6.8 oz.)/	Comfort and Shell
	190 cc (6.5 oz.)	EB/B/33 (R100GS)
R80RT (1983-1984), R80G/S		
(1981-1981), R100, R100CS,	220-230 cc (7.4-7.8 oz.)/	
R100RS, R100RT (1976-1984)	220 cc (7.4 oz.)	
R80 (1985-on), R65 (1986-on)	290-310 cc(9.6-10.2 oz.)/same	
R80RT (1985-on), R100RS and		
R100RT (1987-on)	310-330 cc (10.5-11.2 oz.)/same	
R100GS		
Right fork leg	430-450 cc (14.2-14.8 oz.)/same	
Left fork leg	400-420 cc (13.2-13.8 oz.)/same	
1. First quantity is at rebuild; second is quantity at oil change.		
2. Many BMW dealerships recommend this fork oil for all R-series applications.		

**NOTE:** If you own a 1990 or later model, first check the Supplement at the back of this book for any new service information.

## CHAPTER TEN

# REAR SUSPENSION AND FINAL DRIVE

This chapter includes repair and replacement procedures for the rear wheel, the rear suspension components and the final drive unit. Power from the engine is transmitted to the rear wheel via a drive shaft and a final drive unit similar to an automobile differential.

There are three different types of rear suspensions used on the models covered in this book.

A dual shock system was used on all 1970-1978 models and carried through on some models until 1985. This system uses a shock absorber on each side of the swing arm. The Monolever system was introduced on the 1983 R80RT and R80ST, and was added to all models in 1986.

In 1988 the R100GS was introduced with Paralever rear suspension system. The Paralever is a modification of the Monolever system. The swing arm operates in a parallelogram configuration with the aid of a torque link. The drive shaft on the Paralever system is equipped with 2 universal joints while all other models are equipped with only a single universal joint at the front.

The swing arm pivots on the frame in tapered roller bearings. The final drive unit is attached to the swing arm on the right-hand side and the drive shaft runs through the hollow swing arm on the same side. The drive shaft is splined at the rear end where it attaches to the final drive unit. The universal joint and splines allow for the up-and-down movement of the swing arm and the slight in-and-out movement of the drive shaft.

The shock absorber(s) has a progressively wound coil and is hydraulically damped. The spring preload can be ad-

justed to any one of 3 positions to compensate for additional load (passenger or luggage). The shock is matched to the spring and damping rate of the front forks.

The self-leveling Nivomat shock absorber is an option on some models. This shock is unique in that it will automatically return the bike to the correct height after a short ride regardless of additional weight. This allows a consistent ground clearance and headlight aim. It also maintains the same spring rate.

Tire changing, tire repair and wheel balancing are covered in Chapter Nine.

Refer to **Table 1** for rear suspension torque specifications. **Table 1** and **Table 2** are located at the end of this chapter.

### REAR WHEEL

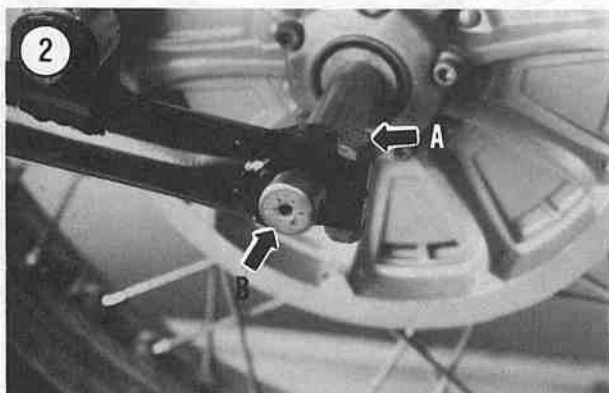
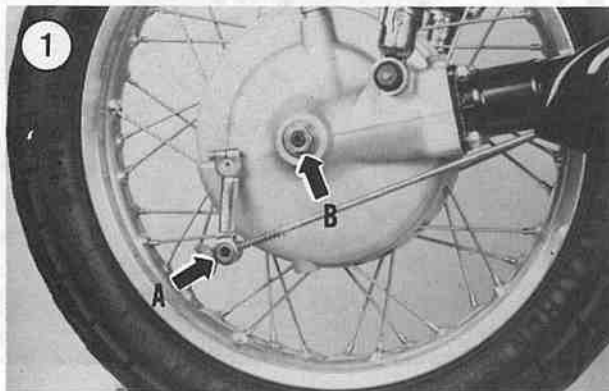
#### Removal (Dual-Shock Models)

#### CAUTION

*Care must be taken when removing, handling and installing a wheel with disc brake rotor(s). The disc rotor(s) is relatively thin in order to dissipate heat and to minimize unsprung weight. The rotor(s) is designed to withstand tremendous rotational loads but can be damaged when subjected to side impact loads. If the rotor(s) is knocked out of true by a side impact, a pulsation will be felt in the brake ped-*

al when braking. The rotor is too thin to be trued and must be replaced with a new one. Protect the rotor(s) when transporting a wheel to a dealer or tire specialist for tire service. Do not place a wheel in a car trunk or pickup bed without protecting the rotor(s) from side impact damage.

1. Place the bike on the centerstand, then place wood blocks under the engine oil pan to support it securely with the rear wheel off the ground.
- 2A. On drum brake models, loosen the rear brake adjust nut (A, **Figure 1**). This will make wheel removal easier as the brake drum will not drag on the brake linings.
- 2B. On disc brake models, perform the following:
  - a. Remove the brake caliper assembly as described under *Rear Caliper Removal* in Chapter Eleven.
  - b. Insert a piece of vinyl tubing or wood into the caliper in place of the brake disc. That way if the brake lever is inadvertently squeezed, the pistons will not be forced out of the cylinders. If this does happen, the calipers may have to be disassembled to reseal the pistons and the system will have to be bled.
3. Remove the rear axle nut (B, **Figure 1**) on the right-hand side.
4. Loosen the rear axle pinch bolt (A, **Figure 2**) on the left-hand side.



5. Insert a drift into the hole in the left-hand end of the rear axle (B, **Figure 2**).
6. Carefully withdraw the rear axle from the left-hand side.
7. On disc brake models, secure the brake caliper carrier to the swing arm.
8. Pull the rear wheel toward the left-hand side to disengage it from the final drive unit.

**NOTE**

*It may be necessary to tilt the bike toward the right-hand side. If necessary, have an assistant tilt the bike while you remove the rear wheel.*

9. Roll the wheel toward the rear and remove it.
10. Inspect the rear wheel as described in this chapter.

**Installation  
(Dual-Shock Models)**

1. Make sure the mating surface of the rear wheel and the final drive unit are clean. They must be free of road dirt and grease. If necessary, wipe clean with a cloth and cleaning solvent. Thoroughly dry prior to installation.
2. Apply a light coat of molybdenum disulfide grease to the splines on the wheel hub and final drive unit.

**NOTE**

*It may be necessary to tilt the bike toward the right-hand side. If necessary, have an assistant tilt the bike while you install the rear wheel.*

3. Roll the wheel into position next to the final drive unit.
4. Shift the transmission into either 4th or 5th gear. This will prevent the final drive unit splines from rotating during the next step.
5. Lift the wheel and push it into mesh with the final drive unit splines. If necessary, slightly rotate the rear wheel until the splines align.
6. Push the rear wheel toward the right-hand side until it bottoms out.
7. On disc brake models, unhook the brake caliper carrier and align the rear axle hole in the carrier with the hole in the wheel hub.
8. Insert the rear axle from the left-hand side. Slide it through the caliper carrier and the rear wheel. Push it in until it bottoms out.
9. Install the rear axle nut (B, **Figure 1**).
10. Insert a drift into the hole in the left-hand end of the rear axle (B, **Figure 2**).
11. Using the drift to keep the rear axle from rotating, tighten the rear axle nut to the torque specification listed in **Table 1**.

12. Tighten the rear axle pinch bolt (A, **Figure 2**) to the torque specification listed in **Table 1**.

#### NOTE

*If you are on the road and have to remove and install the rear wheel, tighten the bolts as securely as possible with the tools in the factory tool kit. As soon as possible, check and retighten the bolts with a torque wrench to the correct torque specifications listed in **Table 1**.*

13A. On drum brake models, adjust the rear brake as described under *Rear Drum Brake Pedal Freeplay Adjustment* in Chapter Three.

13B. On disc brake models, install the brake caliper assembly as described under *Rear Caliper Installation* in Chapter Eleven.

14. Remove the block(s) from under the engine.

#### Removal/Installation (Single-Shock Models)

1. Place the bike on the centerstand, then place wood blocks under the engine oil pan to support it securely with the rear wheel off the ground.

2. Either shift the transmission into 5th gear or have an assistant apply the rear brake to prevent the rear wheel from rotating.

3. Using a crisscross pattern, loosen the bolts (**Figure 3**), or nuts, securing the rear wheel to the final drive unit.

4. Loosen the rear brake adjust nut (**Figure 4**). This will make wheel removal easier as the brake drum will not drag on the brake linings.

5. Remove the bolts, or nuts, and special steel washers.

#### NOTE

*Depending on tire size and the area in which you are performing the tire removal, it may be necessary to remove the license plate bracket assembly to allow the rear wheel to be removed out through the back of the fender area. If necessary, refer to **License Plate Bracket Removal/Installation** in Chapter Twelve.*

6. Pull the rear wheel toward the left-hand side to disengage it from the final drive unit and roll the wheel toward the rear and remove it.

7. Inspect the rear wheel as described in this chapter.

8. Make sure the mating surface of the rear wheel and the final drive unit are clean. They must be free of road dirt and grease. If necessary, wipe clean with a cloth and cleaning solvent. Thoroughly dry prior to installation.

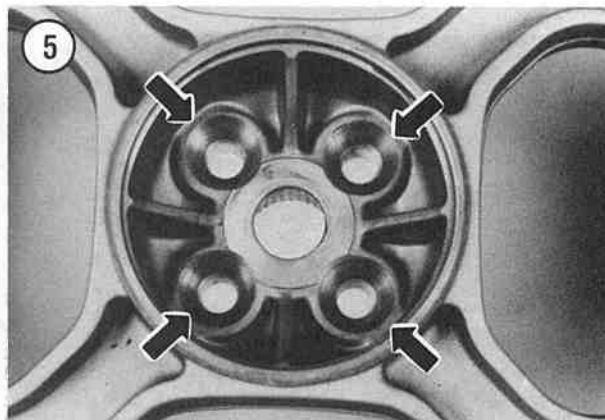
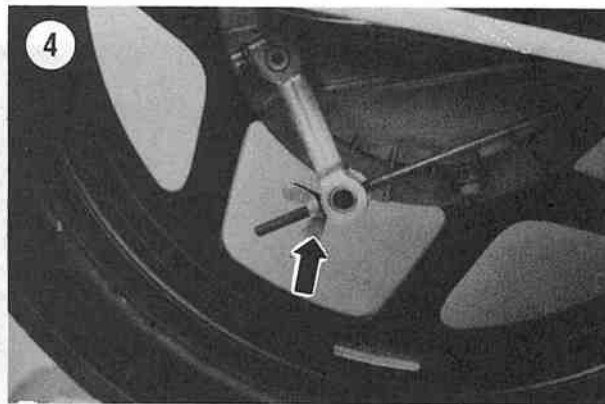
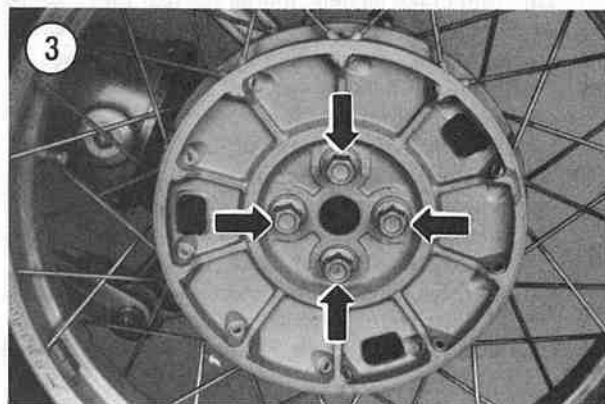
9. Make sure the tapered recesses (**Figure 5**) in the wheel are free of dirt and any gouges or burrs. Clean off all surfaces so the steel washers (**Figure 6**) will seat properly.

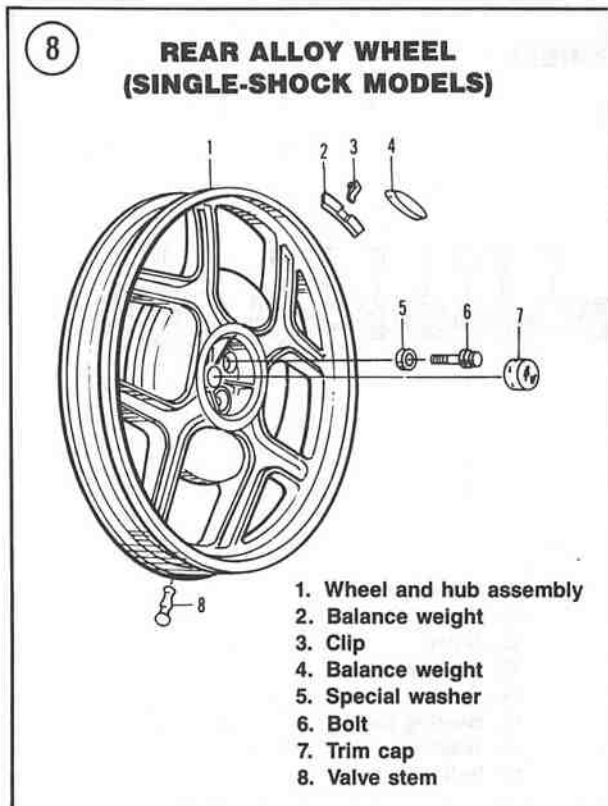
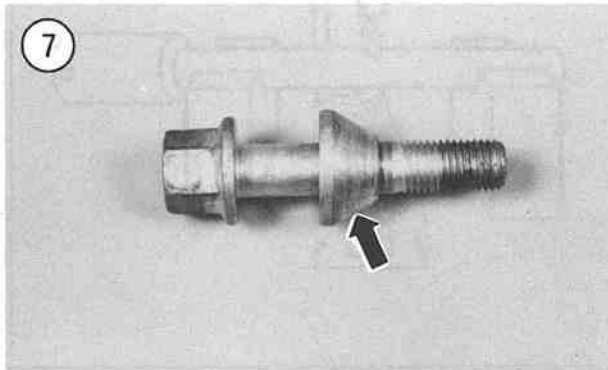
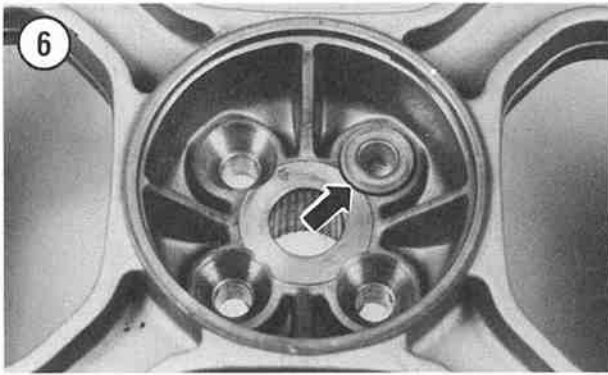
10A. On R80G/S models, correctly position the rear wheel on the threaded studs of the final drive unit.

10B. On all other models, correctly position the rear wheel next to the final drive unit and align the bolt holes.

#### CAUTION

*Always use the special steel washer (**Figure 7**) along with the wheel bolt or nut. The taper on the washer matches the bolt hole taper in the wheel and correctly locates the rear wheel onto the final drive unit.*





**WARNING**

On all models except R80G/S, never install the bolts without the special steel washers (Figure 7). The bolts cannot correctly locate the wheel to the final drive unit without these washers. The wheel will not be centered on the final drive unit and will vibrate severely, leading to an unsafe ride and possible accident.

11A. On R80G/S models, install the special steel washer and the nuts.

11B. On all other models, install the bolts and special steel washers.

12. If not already done, either shift the transmission into 5th gear or have an assistant apply the rear brake to prevent the rear wheel from rotating.

**NOTE**

If you are on the road and have to remove and install the rear wheel, tighten the bolts as securely as possible with the tools in the factory tool kit. As soon as possible, check and retighten the bolts with a torque wrench to the correct torque specification listed in Table 1.

13. Using a crisscross pattern, tighten the bolts to the torque specification listed in Table 1.

14. If removed, install the license plate bracket assembly.

15. Adjust the rear brake as described under *Rear Drum Brake Pedal Freeplay Adjustment* in Chapter Three.

16. If used, remove the block(s) from under the engine.

**Rear Wheel Inspection  
(Single-Shock Models)**

The rear wheel is not equipped with any wheel bearings. The bearings for the rear wheel are located within the final drive unit and all service procedures for this unit are also covered in this chapter.

Refer to Figure 8 for this procedure.

**WARNING**

Do not try to repair any damage to the alloy wheel as it will result in an unsafe riding condition.

1. Inspect the wheel for signs of cracks, fractures, dents or bends. If it is damaged in any way, it must be replaced.
2. Inspect the tapered recesses (Figure 5) in the wheel for dirt, gouges or burrs. Clean off all surfaces so the steel washers will seat properly.
3. Check the raised ribs within the hub center for cracks or damage. If damaged, the wheel must be replaced.



### Wheel Runout Check (All Models)

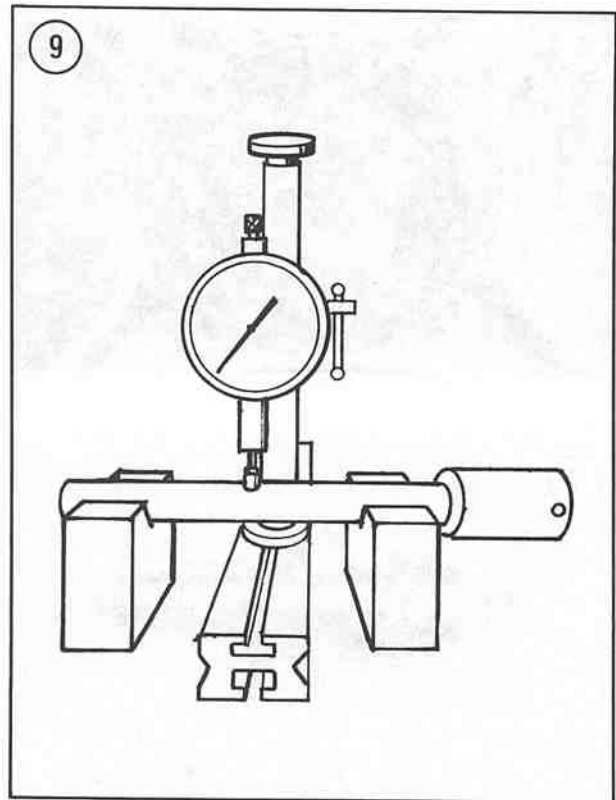
Rear wheel runout must be checked with the wheel installed on the final drive unit in the bike.

1. Place the bike on the centerstand so the rear wheel clears the ground.
2. Shift the transmission into neutral.
3. Attach a dial indicator to the right-hand side of the swing arm and measure the runout at the rim surface.
4. Slowly rotate the wheel and measure the axial and radial runout of the wheel with a dial indicator. The maximum axial and radial runout is 0.5 mm (0.02 in.). If the runout exceeds this dimension, the wheel will have to be replaced, as it cannot be serviced.

### REAR HUB (DUAL-SHOCK MODELS)

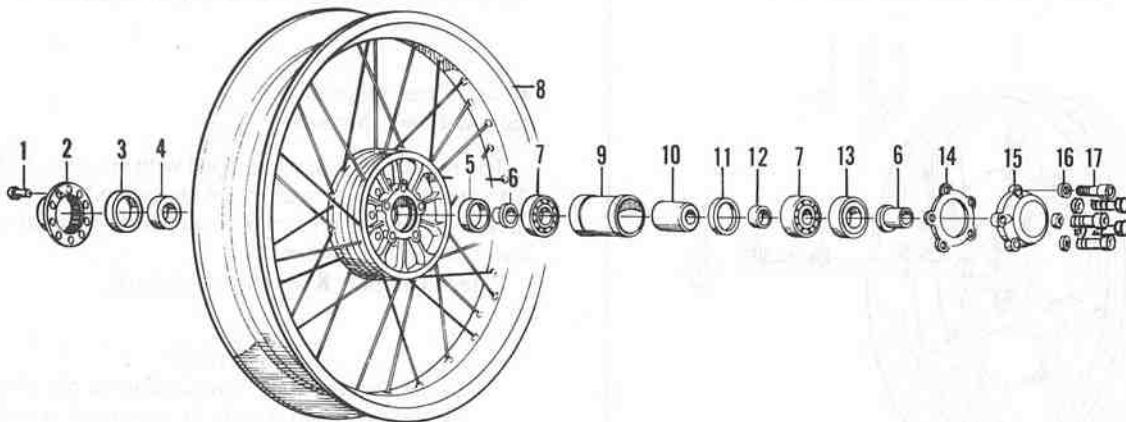
The rear wheel hub on dual-shock models is equipped with wheel bearings. On single shock models the bearings for the rear wheel are located within the final drive unit, not in the hub.

All rear wheel hubs on dual-shock models are equipped with tapered roller bearings. The bearings must have a certain amount of bearing preload to operate correctly. If the preload is not correct, the bearing will wear prematurely.



10

### REAR SPOKE WHEEL



1. Bolt
2. Drive coupling spline
3. Felt seal cover (1970-1973 only)
4. Felt seal (1970-1973 only)
5. Felt seal
6. Thrust sleeve
7. Bearing
8. Wheel and hub assembly
9. Outer spacer

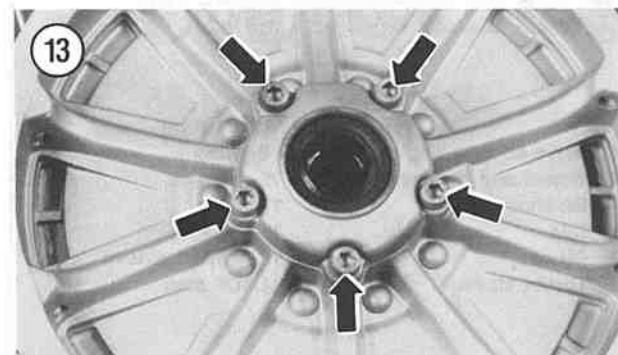
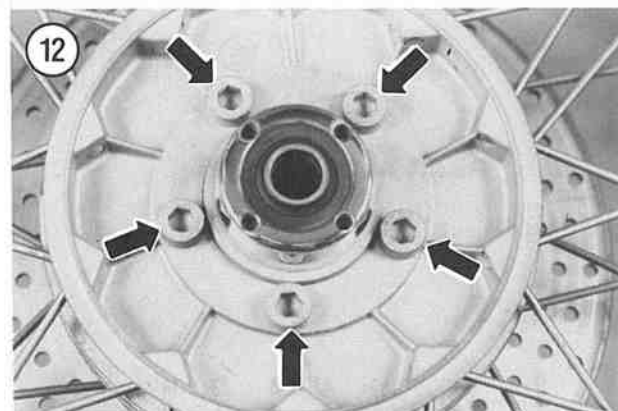
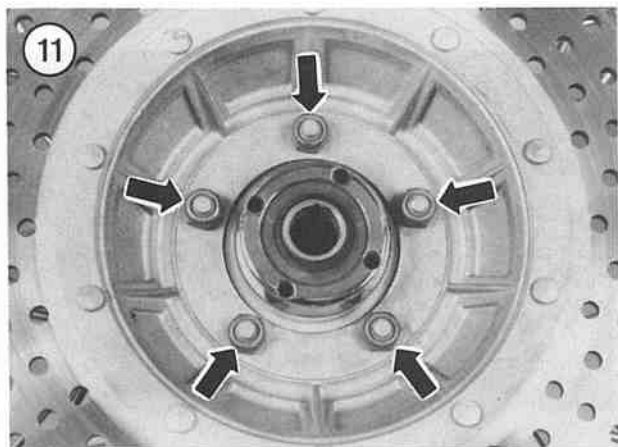
10. Inner spacer
11. Ring
12. Shim
13. Oil seal
14. Gasket
15. Bearing cap
16. Washer
17. Bolt

**Inspection**

Inspect each wheel bearing prior to removing it from the wheel hub.

**CAUTION**

*Do not remove the wheel bearings for inspection purposes as they will be damaged during the removal process. Remove wheel bearings only if they are to be replaced.*



1. Remove the rear wheel as described in this chapter.
2. Turn each bearing by hand. Make sure bearings turn smoothly. Replace the bearing(s) if they are noisy or have excessive play.
3. Check the rollers for evidence of wear, pitting or excessive heat (bluish tint). Replace the bearings if necessary; always replace as a complete set. When replacing the bearings, be sure to take your old bearings along to ensure a perfect matchup.
4. Check the axle for wear and straightness. Use V-blocks and a dial indicator as shown in **Figure 9**. If the runout is 0.2 mm (0.01 in.) or greater, the axle should be replaced.

**Disassembly  
(Wire-Spoke Wheels)**

Refer to **Figure 10** for this procedure.

**CAUTION**

*Care must be taken when removing, handling and installing a wheel with disc brake rotor(s). The disc rotor(s) is relatively thin in order to dissipate heat and to minimize unsprung weight. The rotor(s) is designed to withstand tremendous rotational loads but can be damaged when subjected to side impact loads. If the rotor(s) is knocked out of true by a side impact, a pulsation will be felt in the brake pedal when braking. The rotor is too thin to be trued and must be replaced with a new one. Protect the rotor(s) when transporting a wheel to a dealer or tire specialist for tire service. Do not place a wheel in a car trunk or pickup bed without protecting the rotor(s) from side impact damage.*

1. Remove the rear wheel as described in this chapter.
2. Inspect the wheel bearings as described in this chapter. If they must be replaced, proceed as follows.
3. On disc brake models, to remove the brake disc, perform the following:
  - a. Hold onto the nut (**Figure 11**) on the right-hand side of the wheel and loosen the Allen bolt (**Figure 12**) on the left-hand side. Loosen all bolts and nuts.
  - b. Remove all but one of the bolts, washers and nuts.
  - c. Place the wheel in the horizontal position on wood blocks.
  - d. Remove the remaining bolt, washers and nut.
  - e. Remove the upper brake disc.
4. Remove the bolts and washers (**Figure 13**) securing the bearing cap on the left-hand side. Remove the bearing cap and gasket.
5. Remove the left-hand thrust sleeve.
- 6A. On 1970-1973 models, remove the felt seal cover, felt seal and thrust sleeve from the right-hand side.

- 6B. On all other models, remove the felt seal and thrust sleeve (Figure 14) from the right-hand side.
7. Remove the roller bearing from the left-hand side.
8. Remove the oil seal from the left-hand side.
9. Remove the roller bearing from the left-hand side.
10. Insert a drift into the brake drum side (right-hand side) of the wheel.
11. Using the drift and hammer, carefully tap all of the hub.
12. Clean all components of the hub with solvent. Dry with compressed air.
13. Clean the inside and the outside of the hub with solvent. Dry with compressed air.

#### Assembly (Wire-Spoke Wheel)

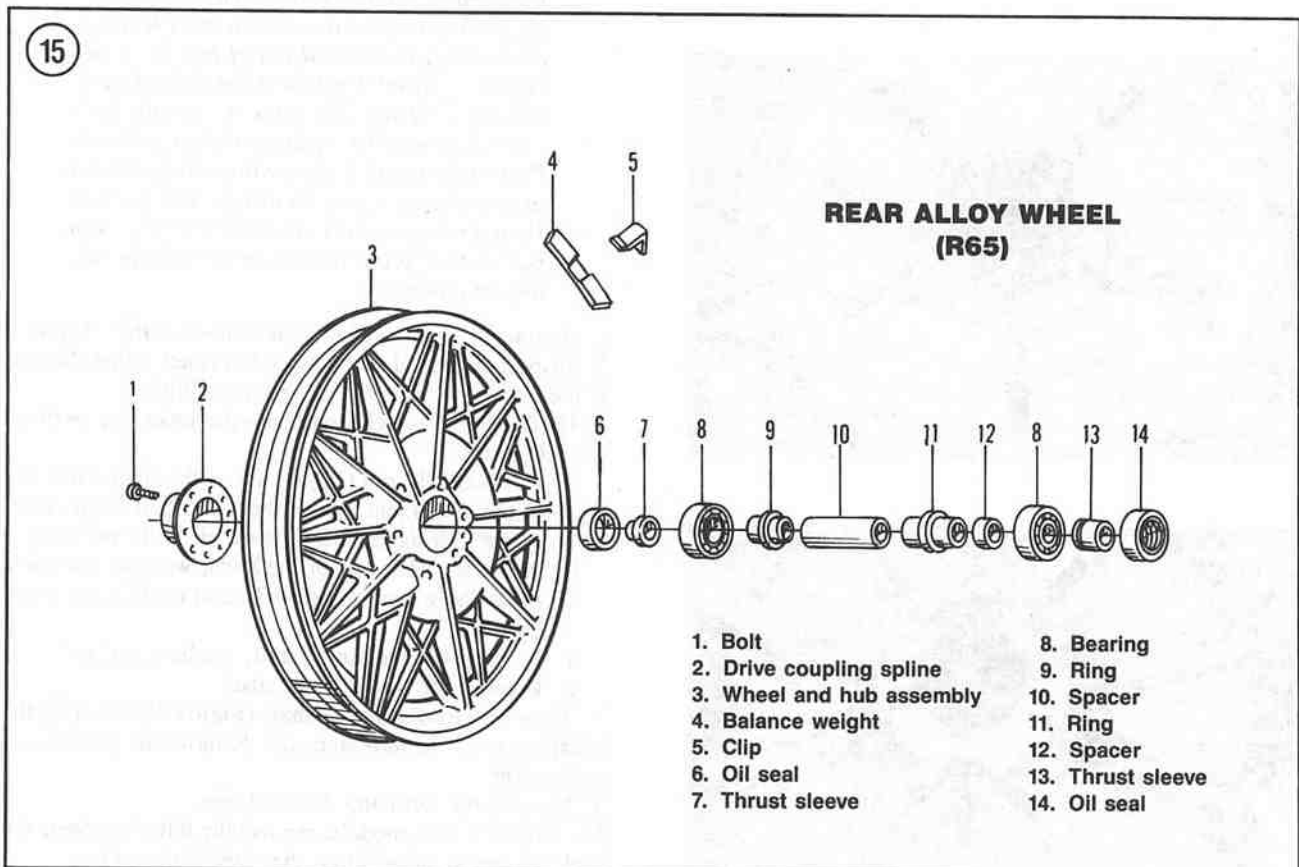
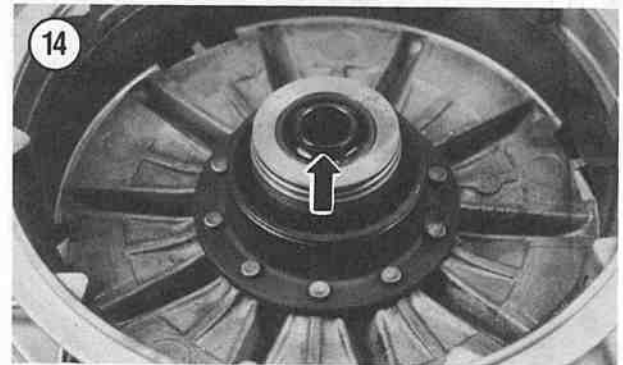
The wheel bearing outer races are such a tight fit that BMW recommends the front hub be heated to 80° C (176° F) in order to expand the hub bearing receptacle. The entire wheel is so large that it is very difficult for a home mechanic to find a large enough oven. If the entire wheel is heated, the tire, valve stem, brake discs and balance weights must be removed first.

An alternate way is to heat only the bearing receptacle area by placing the hub portion on a hot plate or with rags

and boiling hot water. Also, place the wheel bearing outer races in a freezer for approximately 30 minutes. This will reduce their overall size and will make installation easier.

#### CAUTION

*Do not heat the hub area with a torch (propane or acetylene); never bring a flame into contact with the bearing receptacle of the front hub. The direct heat will destroy the painted finish, remove any case hardening and could lead to wheel warpage.*



1. Blow any dirt or foreign matter out of the hub prior to installing the bearings.
2. Place the new wheel bearings in a freezer if possible. Chilling them will slightly reduce their overall diameter while the hot wheel hub is slightly larger due to heat expansion. This will make installation easier.
- 3A. Set the hub portion of the wheel on a hot plate set on the HIGH position.
- 3B. If using the hot water method, perform the following:
  - a. Wrap both sides of the hub center with shop cloths or a small bath towel. Secure the cloths or towel(s) with a Bungee cord to hold them in place since you will be pouring boiling hot water on both sides of the hub.

**WARNING**

*Protect yourself accordingly in the next step as you will be working with boiling water. Wear long pants and shoes (no shorts or sandals). Use pot holders to handle the hot pans containing the boiling water.*

- b. Heat about 2-3 pans (4-5 qt. capacity pan) of water until it boils. You will want to heat the hub sufficiently to enable installation of both bearings without reheating the hub. You don't want to reheat the hub after the first bearing has been installed. If this is done, some water is bound to be trapped in the hub, leading to bearing rust and premature bearing failure.
- c. Slowly and carefully pour the boiling water onto both sides of the hub. Try to heat both sides to the same approximate temperature.

**WARNING**

*Do not operate the electric hair dryer or heat gun in the area where there is a residual water puddle that was used to heat the wheel hub.*

**NOTE**

*While installing the bearing on the one side, try to keep the other side of the hub warm with a portable hair dryer or heat gun.*

4. Correctly position the bearing outer race into the hub and tap it squarely into place until it is flush with the outer surface of the hub. Use a socket that matches the outer race diameter or use BMW special impact mandrel tool (part No. 00 8 550).
5. Turn the wheel over and install the other bearing outer race.
6. If the hub was heated with hot water, use compressed air and thoroughly dry the inside surfaces of the hub.
7. Pack the bearings with a good-quality bearing grease. Thoroughly work the grease in between the rollers; turn the bearing by hand a couple of times to make sure the grease is distributed evenly inside the bearing.

8. Install the bearing into the right-hand side.
- 9A. On 1970-1973 models, install the thrust sleeve, felt seal and the felt seal cover.
- 9B. On all other models, install the thrust sleeve and the felt seal.
10. Turn the wheel over.
11. Apply bearing grease to the inner spacer and the outer spacer.
12. Install the inner spacer and then the outer spacer.
13. Install the ring and the shim.
14. Install the left-hand bearing into the hub.
15. Install the oil seal into the left-hand side. Tap the oil seal in until it completely seats.
16. Install the bearing cap and new gasket on the left-hand side.
17. Install the left-hand thrust sleeve (**Figure 14**).
18. Install the bolts and washers and tighten securely.
19. On disc brake models, to install the brake disc, perform the following:
  - a. Install the brake disc onto the wheel.
  - b. Install the mounting bolts, washers and nuts.
  - c. Tighten the bolts and nuts to the torque specification listed in **Table 1**.
20. Install the rear wheel as described in this chapter.

**Disassembly  
(Alloy Wheels)**

Refer to the following illustrations for this procedure:

- a. **Figure 15:** R65 alloy wheel.
- b. **Figure 16:** R65LS alloy wheel.

1. Remove the rear wheel as described in this chapter.
2. Inspect the wheel hearings as described in this chapter. If they must be replaced, proceed as follows.
- 3A. On R65 models, on the left-hand side perform the following:
  - a. Using a flat-bladed screwdriver, carefully pry out the oil seal.
  - b. Remove the thrust sleeve from the hub.
  - c. Remove the roller bearing.
- 3B. On R65LS models, on the left-hand side perform the following:
  - a. Remove the thrust sleeve from the hub.
  - b. Using a flat-bladed screwdriver, carefully pry out the oil seal.
  - c. Remove the roller bearing.
4. Remove the seal and the thrust sleeve from the right-hand side.
5. Remove the roller bearing from the right-hand side.
6. To remove the wheel bearing outer race from the hub, perform the following:
  - a. Install BMW special tool, Kukko puller, (part No. 00 8 551) onto either wheel bearing outer race.
  - b. Tighten the special tool and withdraw the wheel bearing outer race from that side of the hub.

- c. Turn the wheel over and install the BMW special tool onto the other wheel bearing outer race.
  - d. Tighten the special tool and withdraw the wheel bearing outer race from that side of the hub.
7. Remove spacer and ring assembly from the hub.
  8. Clean the inside and the outside of the hub with solvent. Dry with compressed air.

### Assembly (Alloy Wheels)

The wheel bearings are such a tight fit that BMW recommends the front hub be heated to 100° C (212° F) in order to expand the hub bearing receptacle. The entire wheel is so large that it is very difficult for a home mechanic to find a large oven. If the entire wheel is heated the tire, valve stem, brake discs and balance weights must be removed first.

An alternate way is to heat only the bearing receptacle area by placing the hub portion on a hot plate or with rags and boiling hot water. Also, place the wheel bearing outer races in a freezer for approximately 30 minutes. This will reduce their overall size and will make installation easier.

#### CAUTION

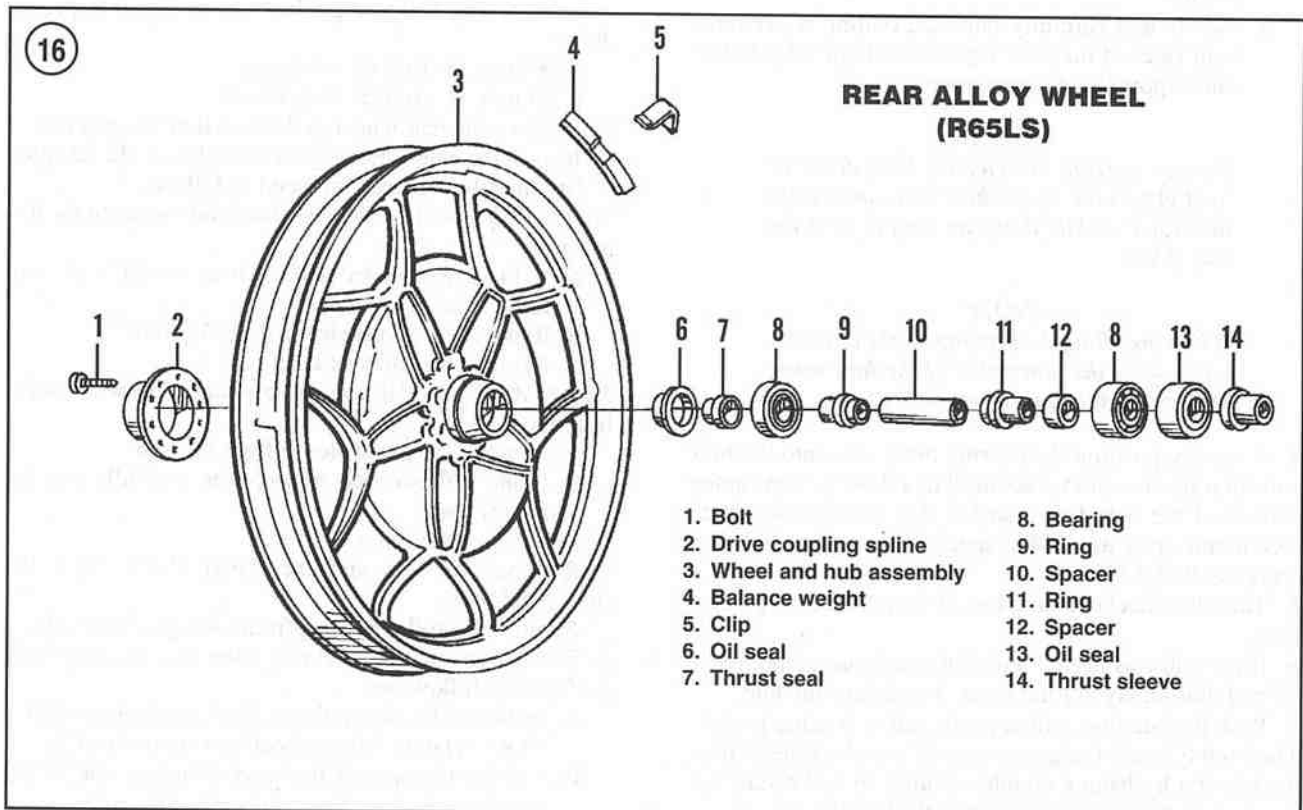
*Do not heat the hub area with a torch (propane or acetylene); never bring a flame into*

*contact with the bearing receptacle of the front hub. The direct heat will destroy the painted finish, remove any case hardening and could lead to wheel warpage.*

1. Blow any dirt or foreign matter out of the hub prior to installing the bearings.
2. Place the new wheel bearing outer races in a freezer if possible. Chilling them will slightly reduce their overall diameter while the hot wheel hub is slightly larger due to heat expansion. This will make installation easier.
- 3A. Set the hub portion of the wheel on a hot plate set on the HIGH position.
- 3B. If using the hot water method, perform the following:
  - a. Wrap both sides of the hub center with shop cloths or a small bath towel. Secure the cloths or towel(s) with a Bungee cord to hold them in place since you will be pouring boiling hot water on both sides of the hub.

#### WARNING

*Protect yourself accordingly in the next step as you will be working with boiling water. Wear long pants and shoes (no shorts and sandals). Use pot holders to handle the hot pans containing the boiling water.*





- b. Heat about 2-3 pans (4-5 qt. capacity pan) of water until it boils. You will want to heat the hub sufficiently to enable installation of *both bearings* without reheating the hub. You don't want to reheat the hub after the first bearing and the distance collar have already been installed. If this is done, some water is bound to be trapped in the hub, leading to bearing rust and premature bearing failure.
- c. Slowly and carefully pour the boiling water onto *both sides* of the hub. Try to heat both sides to the same approximate temperature.

**WARNING**

*Do not operate the electric hair dryer or heat gun in the area where there is a residual water puddle that was used to heat the wheel hub.*

**NOTE**

*While installing the bearing outer race on the one side, try to keep the other side of the hub warm with a portable hair dryer or heat gun.*

- 4. Correctly position the bearing outer race into the hub and tap it squarely into place until it is flush with the outer surface of the hub. Use a socket that matches the outer race diameter or use BMW special impact mandrel tool (part No. 00 8 551).
- 5. Install the spacer and ring assembly into the hub.
- 6. Turn the wheel over and install the other bearing outer race.
- 7. If the hub was heated with hot water, use compressed air and thoroughly dry the inside surfaces of the hub.
- 8. Pack the bearings with a good-quality bearing grease. Work the grease in between the rollers thoroughly; turn the bearing by hand a couple of times to make sure the grease is distributed evenly inside the bearing.
- 9. Install the roller bearing into the right-hand side.



- 10. Install the thrust sleeve and oil seal into the right-hand side.
- 11A. On R65 models, perform the following on the left-hand side:
  - a. Install the roller bearing.
  - b. Install the thrust sleeve into the hub.
  - c. Install the oil seal into the hub until it is flush with the hub surface.
- 11B. On R65LS models, perform the following on the left-hand side:
  - a. Install the roller bearing.
  - b. Install the oil seal into the hub until it is flush with the hub surface.
  - c. Install the thrust sleeve into the hub.
- 12. Install the rear wheel as described in this chapter.

**SHOCK ABSORBER  
(DUAL-SHOCK MODELS)**

**Spring Preload Adjustment  
(Non-Nivomat Shocks)**

**NOTE**

*The optional Nivomat shock absorber is not adjustable.*

The spring preload setting can be adjusted to any of 3 settings as follows:

- a. Normal spring setting: solo rider with no luggage.
- b. Medium spring setting: with a passenger or heavy luggage.
- c. Hard spring setting: Maximum loads.

Using the built in adjust lever (**Figure 17**) on the shock absorber, rotate the adjuster at the base of the spring to the desired position. Rotating the ring *clockwise* achieves the normal or softest setting. Rotating the ring *counterclockwise* compresses the spring and achieves the hardest setting.

The adjuster must be positioned on the same setting on both shocks.

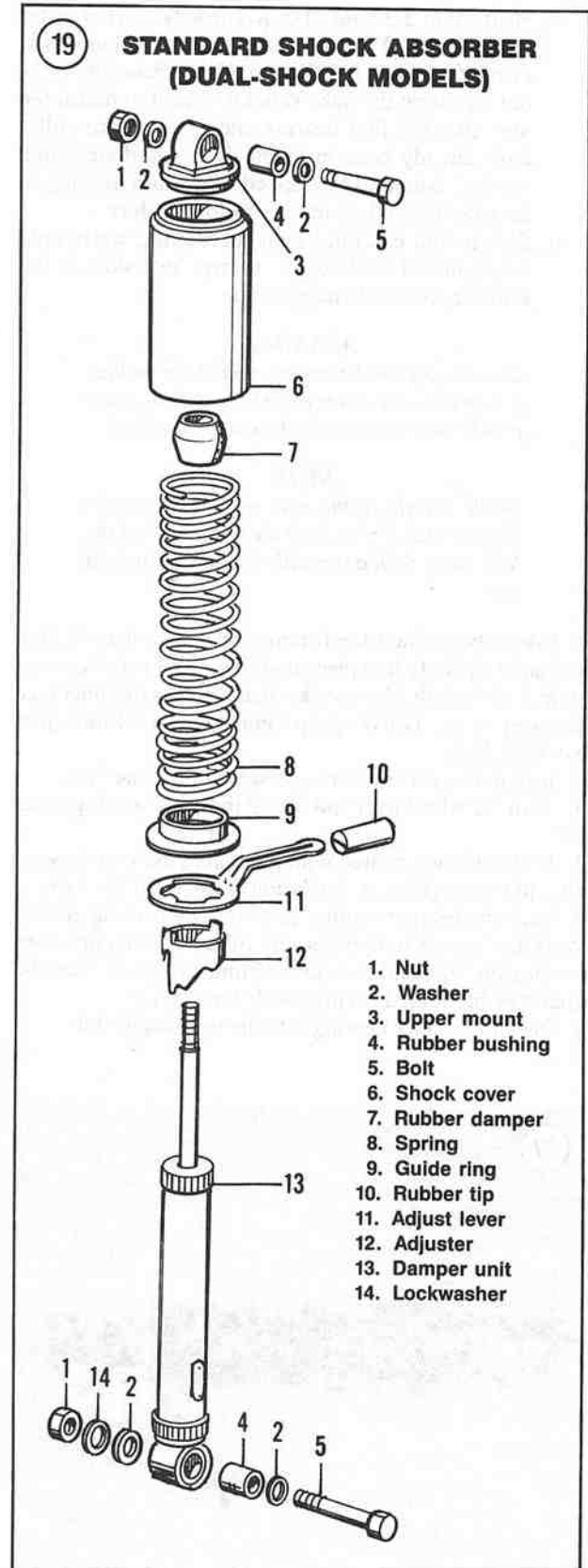
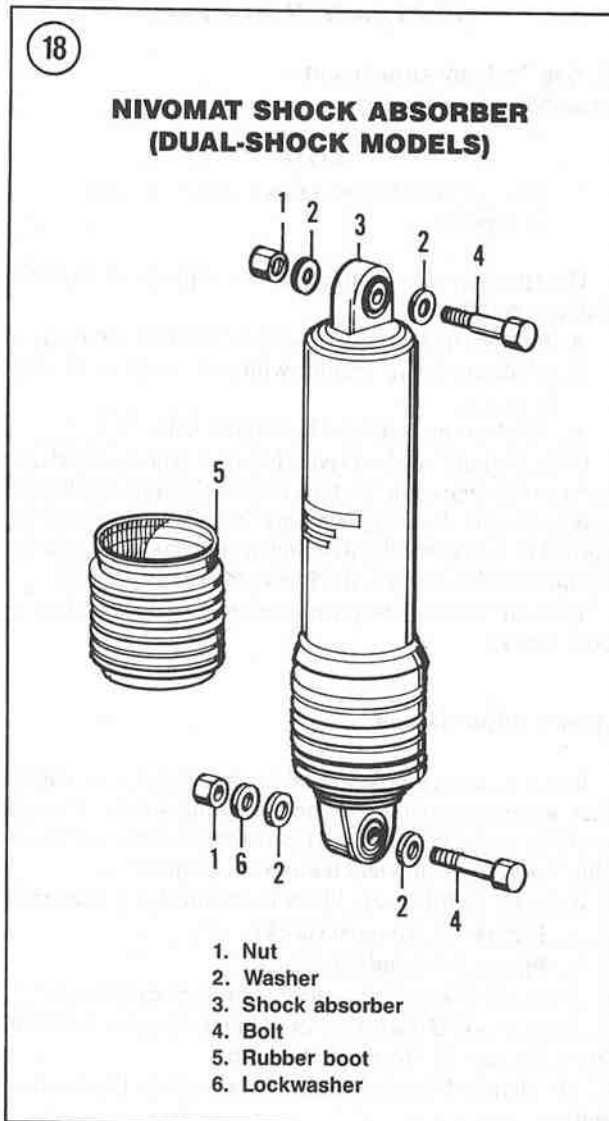
**Removal/Installation**

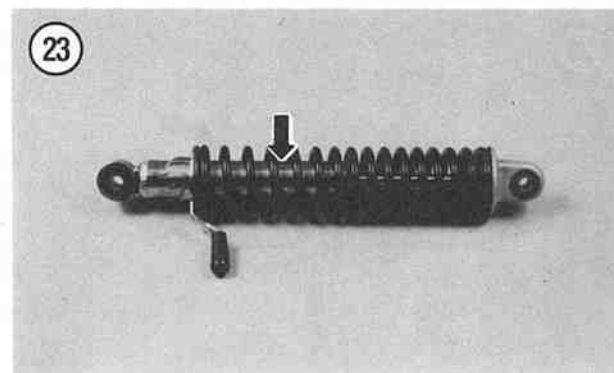
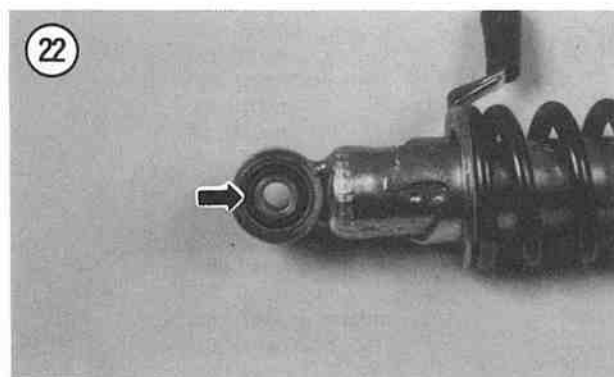
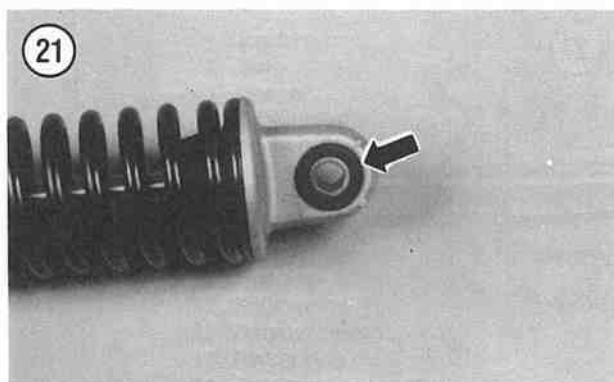
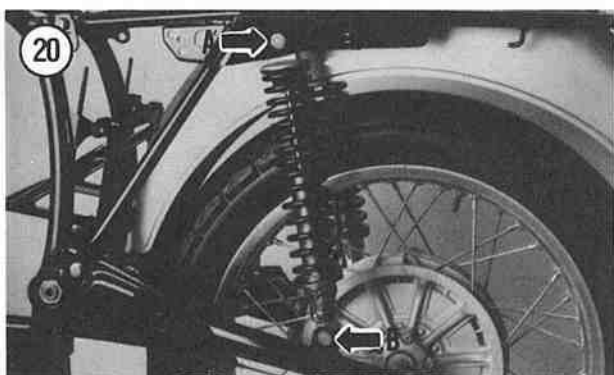
Removal and installation of the rear shocks is easier if they are done separately. The remaining shock will support the rear of the bike and maintain the correct relationship between the top and bottom shock mounts.

Refer to the following illustrations for this procedure:

- a. **Figure 18:** Nivomat shocks.
  - b. **Figure 19:** standard shocks.
1. Place the bike on level ground on the centerstand.
  2. Place wood block(s) under the rear wheel to maintain the swing arm in the at-rest position.
  3. On standard shocks, adjust the shocks to their softest setting.

4. On models so equipped, remove the luggage and rack on the right-hand side as described under *Luggage and Rack* in Chapter Twelve.
5. Remove the upper mounting bolt, lockwashers and nut (A, **Figure 20**) securing the shock absorber to the frame.
6. Remove the lower nut, washer and lockwashers securing the shock absorber to the swing arm.
7. Have an assistant sit on the seat to depress the rear of the bike.
8. Remove the lower bolt and lockwashers (B, **Figure 20**) over the top of the muffler.
9. Remove the shock absorber from the mounting area in the frame and swing arm.
10. Inspect the shock absorber unit as described in this chapter.
11. Install by reversing these removal steps. Note the following during installation.





12. Apply a light coat of molybdenum disulfide paste grease to the upper and lower rubber bushings on the shock absorber.

13. Install the shock absorber mounting bolts, lockwashers, washers and nuts. Tighten the bolts and nuts finger-tight at this time.

14. Remove the wood block(s) from under the rear wheel.

15. Take the bike off of the centerstand. Push down on the rear of the bike and make sure the rear suspension is operating properly.

16. Tighten the bolts and nuts to the torque specification listed in **Table 1**.

17. Repeat this procedure for the other shock absorber.

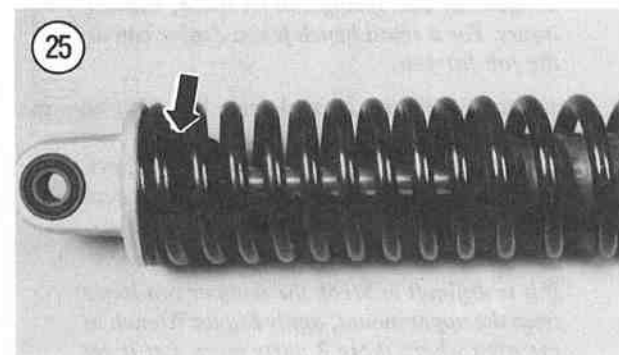
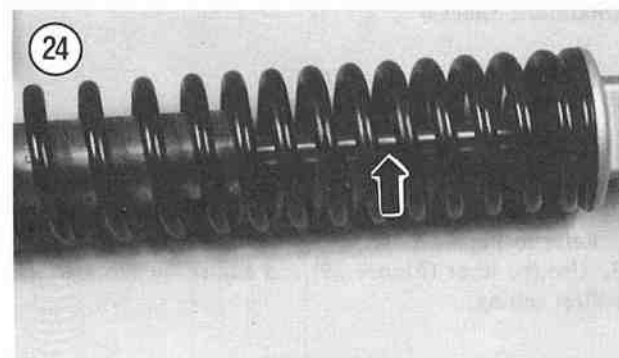
**Inspection  
(Standard Models)**

1. Inspect the shock absorber upper mounting bushings (**Figure 21**) and lower mounting bushings (**Figure 22**) where they attach to the frame and swing arm. Replace the mounting bushings if they are damaged.

2. Clean the mounting bushings with solvent. Thoroughly dry and apply molybdenum disulfide grease to the mounting bushings.

3. Check the damper unit (**Figure 23**) for leakage. If it is leaking, replace the damper unit.

4. Make sure the damper rod (**Figure 24**) is straight and that the rubber bumper (**Figure 25**) is not damaged or worn. If either is faulty, replace the damper unit or rubber bumper.



### Inspection (Nivomat Models)

#### WARNING

The shock absorber damper unit contains high-pressure nitrogen gas. Do not tamper with or attempt to open the damper unit. Do not place it near an open flame or other extreme heat. Do not dispose of the shock absorber unit yourself. Take the unit to a BMW dealer where it can be deactivated and disposed of properly. Never attempt to remove the 2 screws (A, Figure 26) on the damper unit as this will release the internal gas.

1. Inspect the shock absorber upper mounting bushings (B, Figure 26) and lower mounting bushings (Figure 27) where they attach to the frame and swing arm. Replace the mounting bushings if they are damaged.
2. Clean the mounting bushings with solvent. Thoroughly dry and apply molybdenum disulfide grease to the mounting bushings.
3. Check the damper unit for leakage. If it is leaking, replace the damper unit.
4. If the rubber boot (Figure 28) is torn or deteriorated, carefully pull the rubber boot from the damper unit and replace with a new one.

### Disassembly/Assembly (Standard Shocks)

#### NOTE

The Nivomat shock absorber cannot be disassembled. The only replacement parts are the rubber mounting bushings and the rubber boot.

Refer to Figure 19 for this procedure.

1. Use the lever (Figure 29) and adjust the shock to its softest setting.

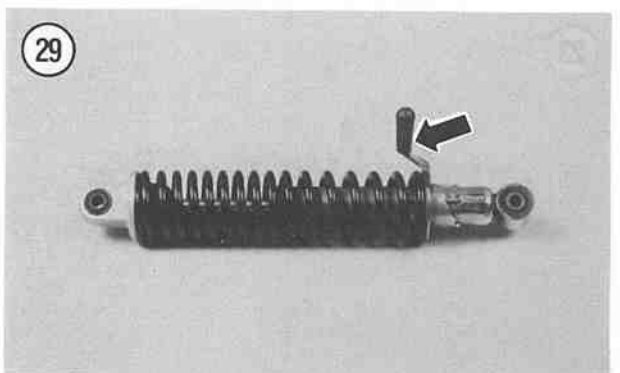
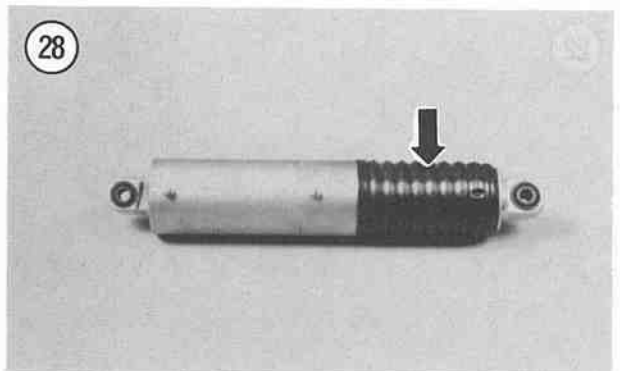
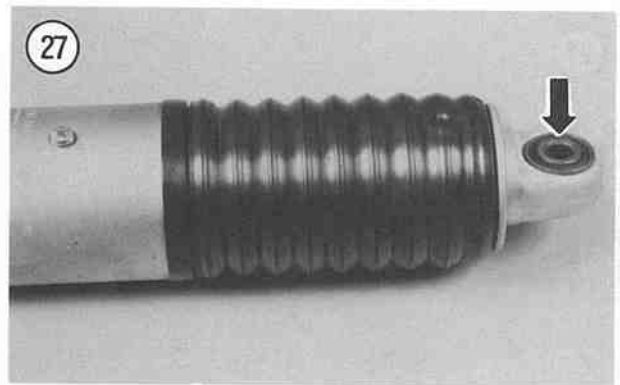
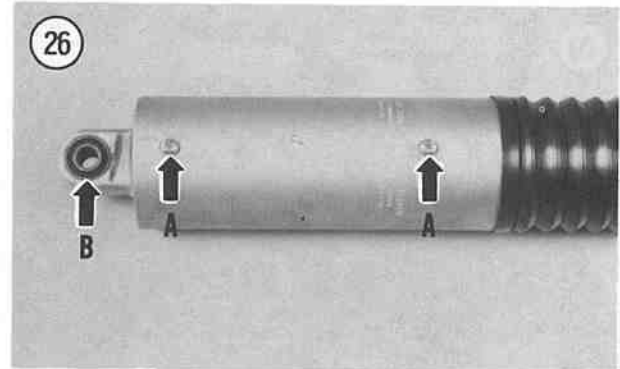
#### WARNING

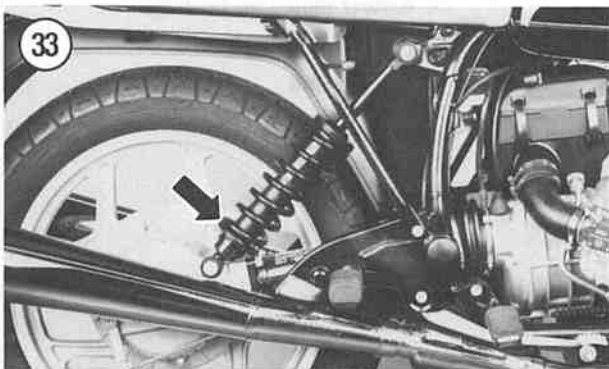
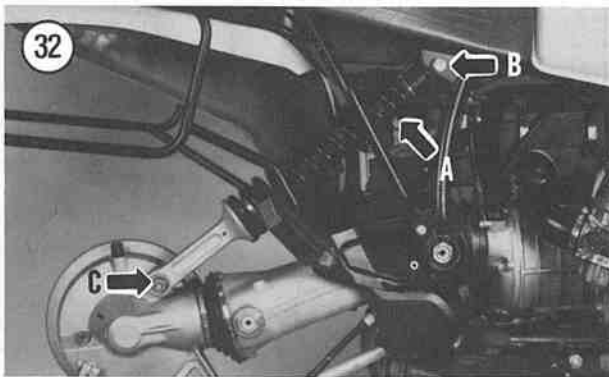
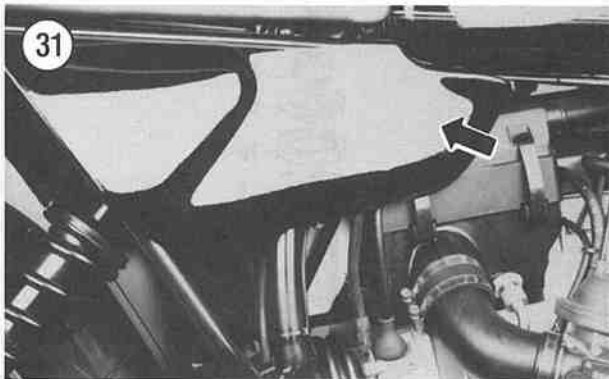
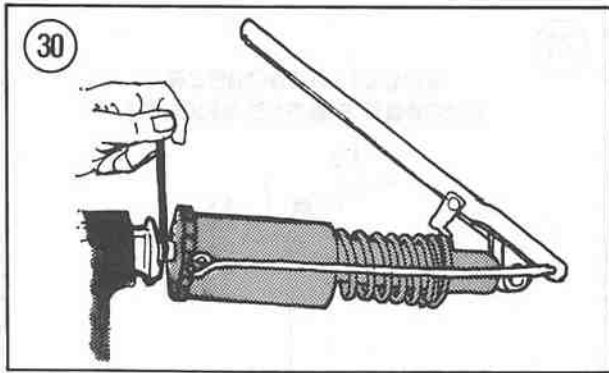
Without the proper tool, this procedure can be dangerous. The spring can fly loose, causing injury. For a small bench fee, a dealer can do the job for you.

2. Install the BMW special tool (part No. 550) onto the shock absorber.
3. Place the upper mount in a vise with soft jaws.
4. Compress the shock absorber within the special tool.

#### NOTE

If it is difficult to break the damper rod loose from the upper mount, apply Liquid Wrench to the area where these 2 parts meet. Let it set





for 10-15 minutes. If this does not work, clean off all Liquid Wrench and apply heat to the area where the 2 parts meet.

5. Using a 9mm open end wrench, unscrew the damper rod from the upper mount (Figure 30). Completely unscrew the upper mount from the damper rod.
6. Release the special tool from the shock absorber and remove it.
7. On models so equipped, slide off the spring cover.
8. Slide off the spring, guide ring adjuster lever, adjuster and rubber bumper from the damper unit.
9. Measure the spring free length and compare to the dimension listed in Table 2. Replace if necessary.
10. Inspect the performance of the damper unit as described under *Damper Unit Test (All Models)* in this chapter.
11. Assemble by reversing these disassembly steps, noting the following.
12. If Liquid Wrench was used, use an aerosol electrical contact cleaner and clean off all Liquid Wrench residue from the threads of the upper mount and the damper rod.
13. Tighten the upper mount to the damper rod to the torque specification listed in Table 1.

**SHOCK ABSORBER  
(SINGLE-SHOCK MODELS)**

The single shock absorber is mounted to the swing arm on the right-hand side.

**Spring Preload Adjustment  
(Non-Nivomat Shocks)**

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*NOTE*

*The optional Nivomat shock absorber is not adjustable.*

The spring preload can be adjusted to any of 3 or 4 settings as follows:

- a. Normal spring setting: solo rider with no luggage.
- b. Medium spring setting(s): With a passenger or heavy luggage.
- c. Hard spring setting: Maximum loads.

1. Remove the frame right-hand side cover (Figure 31).

*NOTE*

*The R100GS is the only model with 4 settings.*

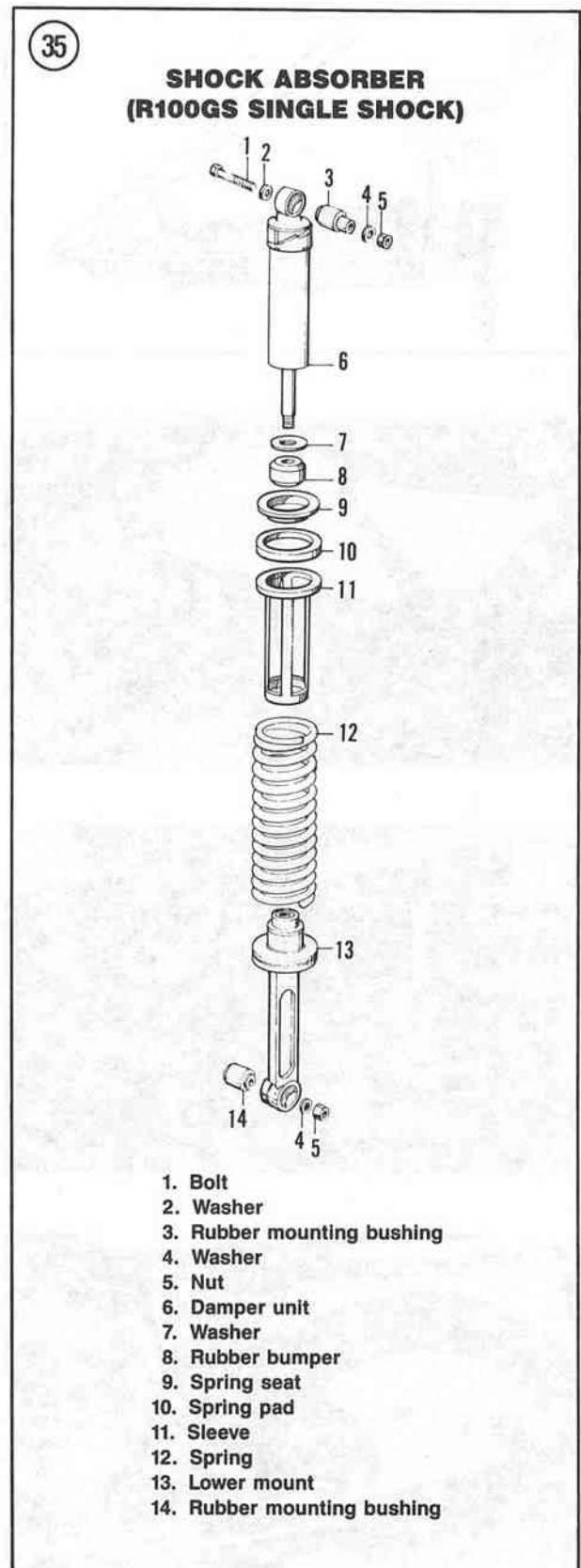
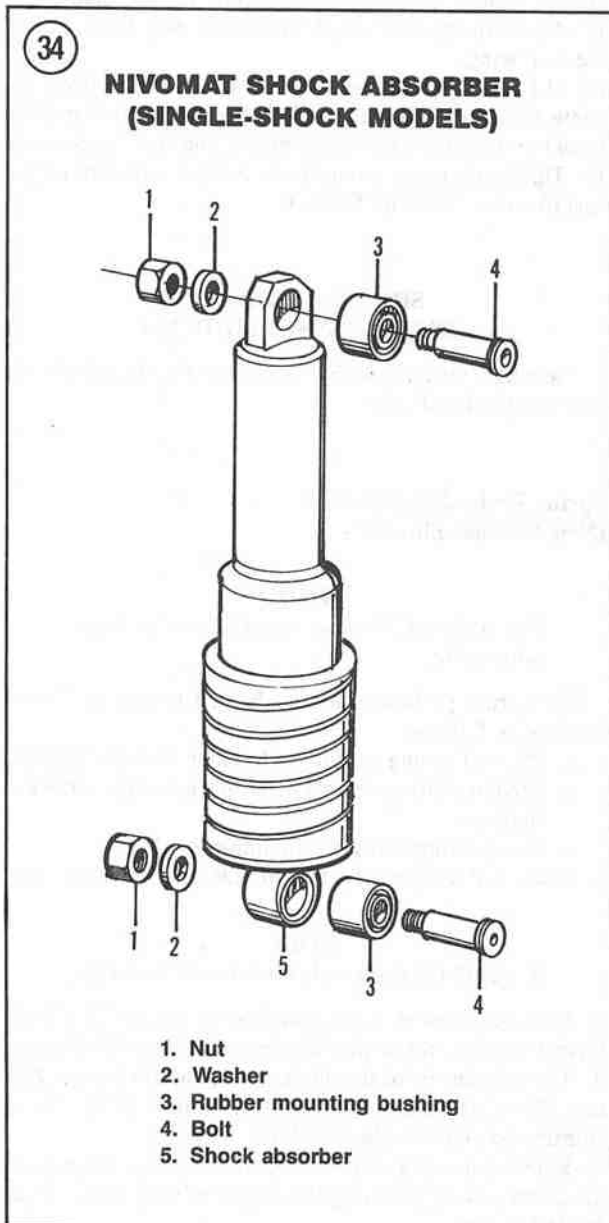
2. Using the spanner wrench and extension provided in the factory tool kit, rotate the adjuster to the desired position.
3. The adjuster is located at the top of the spring (A, Figure 32) on R100GS models or at the bottom of the spring (Figure 33) on all other models.
4. Rotating the ring *counterclockwise* achieves the normal or softest setting. Rotating the ring *clockwise* achieves the hardest setting.



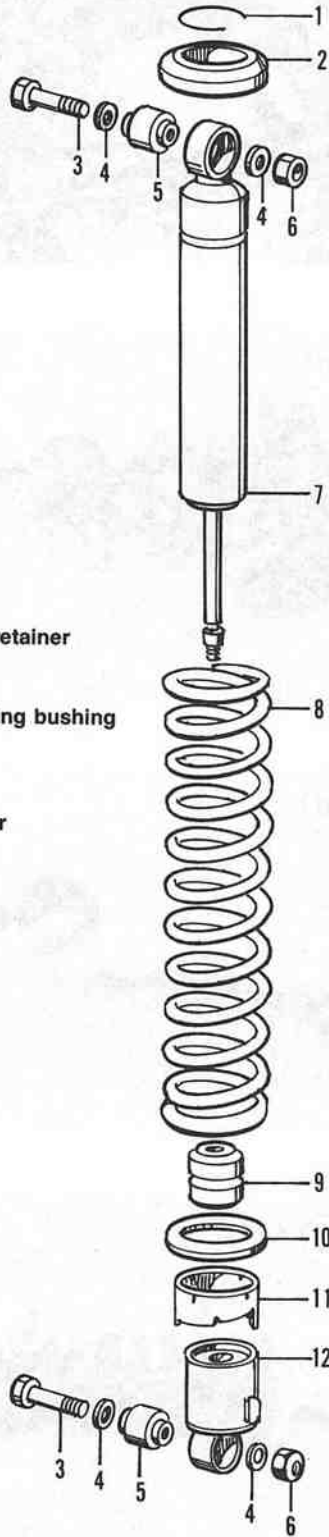
### Removal/Installation

Refer to the following illustrations for this procedure:

- Figure 34:** Nivomat shocks.
  - Figure 35:** R100GS models.
  - Figure 36:** R80G/S, R80ST models.
  - Figure 37:** all other shocks.
- Place the bike on level ground on the center stand.
  - Place wood block(s) under the rear wheel to maintain the swing arm in the at-rest position.
  - Remove the frame right-hand side cover (**Figure 31**).
  - On models so equipped, remove the luggage and rack on the right-hand side as described under *Luggage and Rack* in Chapter Twelve.



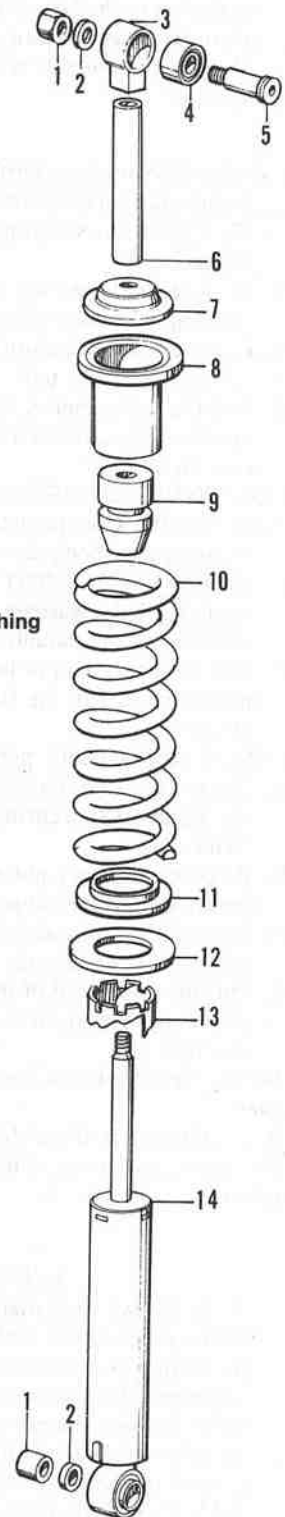
**SHOCK ABSORBER  
(R80G/S AND R80ST SINGLE SHOCK)**



- 1. Snap ring
- 2. Spring upper retainer
- 3. Bolt
- 4. Washer
- 5. Rubber mounting bushing
- 6. Nut
- 7. Damper unit
- 8. Spring
- 9. Rubber bumper
- 10. Washer
- 11. Adjuster
- 12. Lower mount

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**SHOCK ABSORBER  
(SINGLE SHOCK, ALL OTHER MODELS)**



- 1. Nut
- 2. Washer
- 3. Upper mount
- 4. Rubber mounting bushing
- 5. Bolt
- 6. Distance tube
- 7. Spring upper seat
- 8. Spring sleeve
- 9. Rubber bumper
- 10. Spring
- 11. Spring lower seat
- 12. Washer
- 13. Adjuster
- 14. Damper unit

37

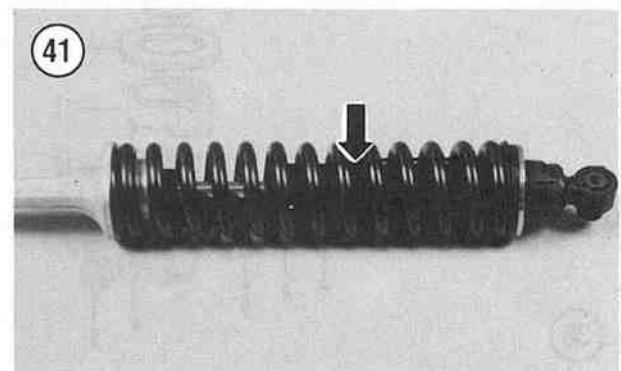
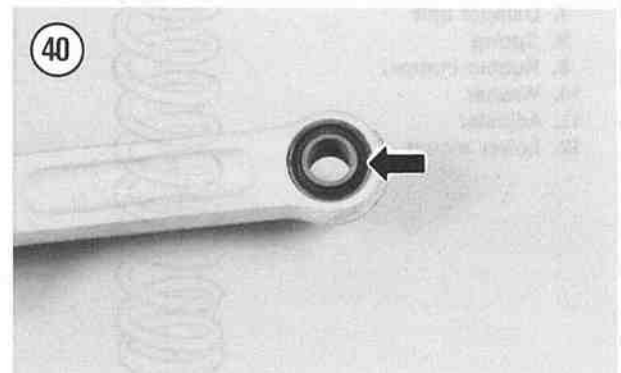
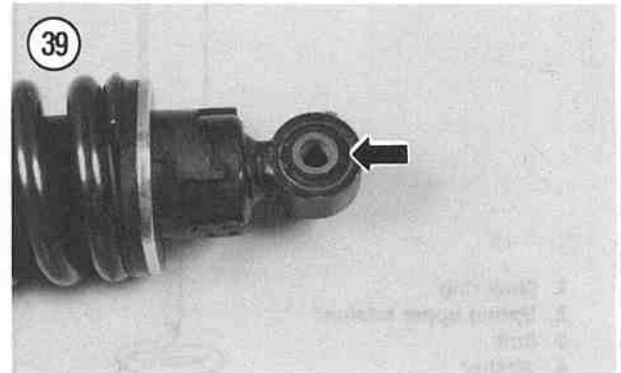
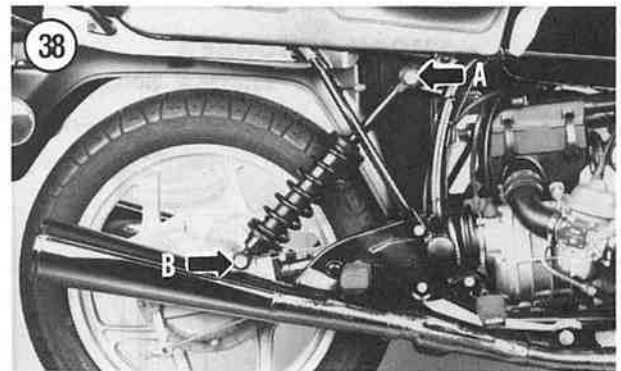
**NOTE**

On R100GS models, note that the rubber mounting bushing in the upper mount is offset with the bushing shoulder facing toward the centerline of the bike. This positions the shock absorber assembly away from the rear wheel. The bushing must be reinstalled in this same position.

- 5A. On R100GS models, perform the following:
- Remove the upper mounting bolt, lockwasher and nut (B, **Figure 32**) securing the shock absorber to the frame.
  - Remove the lower nut and washer (C, **Figure 32**) securing the shock absorber to the final drive unit.
  - Remove the shock absorber from the mounting stud on the final drive unit.
  - Pull the upper end of the shock absorber from the mounting area in the frame and remove the shock absorber.
- 5B. On R80G/S and R80ST models, perform the following:
- Remove the upper mounting bolt, lockwasher and nut securing the shock absorber to the frame.
  - On R80G/S and R80ST models, remove the lower mounting bolt, washers and nut securing the shock absorber to the mounting tabs on the swing arm.
  - Pull the upper end of the shock absorber from the mounting area in the frame and remove the shock absorber.
- 5C. On all other models, perform the following:
- Remove the upper mounting bolt, lockwasher and nut (A, **Figure 38**) securing the shock absorber to the frame.
  - Remove the lower nut and washer (B, **Figure 38**) securing the shock absorber to the final drive unit.
  - Remove the shock absorber from the mounting stud on the final drive unit.
  - Pull the upper end of the shock absorber from the mounting area in the frame and remove the shock absorber.
6. Inspect the shock absorber unit as described in this chapter.
7. Apply a light coat of molybdenum disulfide paste grease to the upper and lower rubber bushings on the shock absorber.

**WARNING**

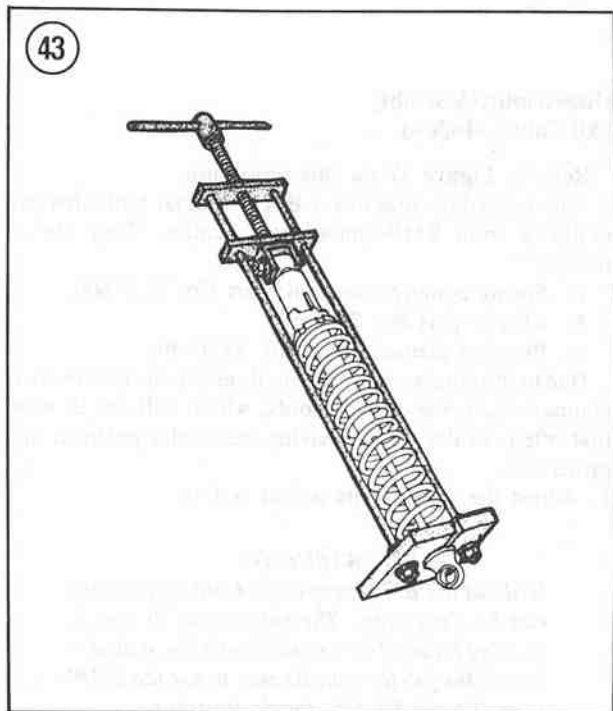
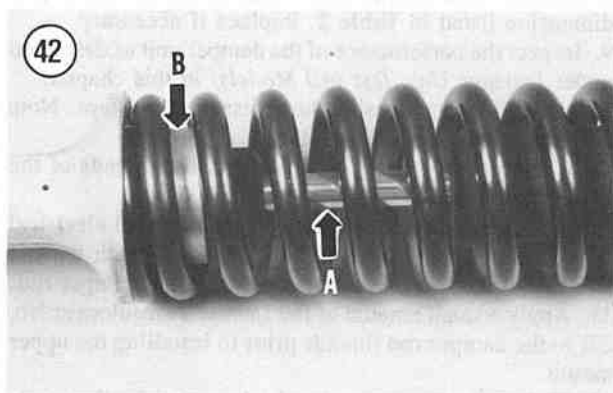
All bolts and nuts used on the single shock suspension must be replaced with parts of the same type. Do not use a replacement part of lesser quality or substitute design, as this may affect the performance of the system or result in failure of the part which will lead to loss of control of the bike. Torque values listed in **Table I** must be used during installation to assure proper retention of these parts.



**CAUTION**

On R100GS models, be sure to install the upper end of the shock assembly with the bushing shoulder facing toward the centerline of the bike. This positions the shock absorber assembly away from the rear wheel. The bushing must be installed in this manner.

8. Move the shock absorber into position and align the upper mounting hole with the hole in the frame.
9. Install the bolt, lockwasher and nut securing the upper portion to the frame.
- 10A. On R80G/S and R80ST models, install the shock absorber into the mounting tabs of the swing arm and install the bolt, washers and nut. Tighten only finger tight at this time.



- 10B. On all other models, perform the following:
  - a. Install the shock absorber onto the mounting stud on the final drive unit.
  - b. Install the washer and nut and tighten only finger tight at this time.
11. Tighten the bolt (R80G/S and R80ST) and nuts to the torque specification listed in **Table 1**.
12. On models so equipped, install the luggage and rack on the right-hand side as described under *Luggage and Rack* in Chapter Twelve.
13. Remove the wood block(s) from under the rear wheel.
14. Take the bike off of the centerstand. Push down on the rear of the bike and make sure the rear suspension is operating properly.
15. Install the frame right-hand side cover.

**Inspection (All Models)**

1. Inspect the shock absorber upper mounting bushing (**Figure 39**) and lower mounting bushing (**Figure 40**) where they attach to the frame and swing arm. If they are damaged, replace the mounting bushings.
2. Clean the mounting bushings with solvent. Thoroughly dry and apply molybdenum disulfide grease to the mounting bushings.
3. Check the damper unit (**Figure 41**) for leakage. If it is leaking, replace the damper unit.
4. On non-Nivomat models, make sure the damper rod (A, **Figure 42**) is straight and that the rubber bumper (B, **Figure 42**) is not damaged or worn. If either is faulty, replace the damper unit or rubber bumper.
5. On Nivomat models, if the rubber boot is torn or deteriorated, carefully pull the rubber boot from the damper unit and replace with a new one.

**NOTE**

The Nivomat shock absorber cannot be disassembled. The only replacement parts are the rubber mounting bushings and the rubber boot.

**Disassembly/Assembly (R80G/S and R80ST Models)**

Refer to **Figure 36** for this procedure.

1. Adjust the shock to its softest setting.

**WARNING**

Without the proper tool, this procedure can be dangerous. The spring can fly loose, causing injury. For a small bench fee, a dealer can do the job for you.

2. Install the shock absorber in a spring compression tool as shown in **Figure 43**. These special tools are available from motorcycle dealers and mail order houses or you can use the BMW special tool (part No. 33 5 600).

3. Secure the upper mounting in the compression tool and compress the shock absorber within the special tool.
4. Remove the circlip securing the upper spring retainer.
5. Release the special tool from the shock absorber and remove it.
6. Remove the upper spring retainer and slide off the spring, the washer and the adjuster.
7. Place the lower mount end of the damper rod in a vise with soft jaws.

**NOTE**

*If it is difficult to break the lower mount loose from the damper rod, apply Liquid Wrench to the area where these 2 parts meet. Let it set for 10-15 minutes. If this does not work, clean off all Liquid Wrench and apply heat to the area where the 2 parts meet.*

8. Using a drift through the lower mount bolt hole or a pair of channel lock pliers, unscrew the damper rod from the upper mount. Completely unscrew the lower mount from the damper rod.
9. Measure the spring free length and compare to the dimension listed in **Table 2**. Replace if necessary.
10. Inspect the performance of the damper unit as described under *Damper Unit Test (All Models)* in this chapter.
11. Assemble by reversing these disassembly steps. Note the following during installation.
12. Clean off all Loctite residue from the threads of the upper mount and the damper rod.
13. If Liquid Wrench was used, use an aerosol electrical contact cleaner and clean off all Liquid Wrench residue from the threads of the upper mount and the damper rod.
14. Apply a small amount of red Loctite Threadlocker No. 271 to the damper rod threads prior to installing the upper mount.
15. Tighten the upper mount to the damper rod to the torque specification listed in **Table 1**.

**Disassembly/Assembly  
(R100GS Models)**

Refer to **Figure 35** for this procedure.

1. Adjust the shock to its softest setting.

**WARNING**

*Without the proper tool, this procedure can be dangerous. The spring can fly loose, causing injury. For a small bench fee, a dealer can do the job for you.*

2. Install the shock absorber in a spring compression tool as shown in **Figure 43**. These special tools are available from motorcycle dealers or mail order houses.
3. Secure the upper mounting in the compression tool and compress the shock absorber within the special tool.

4. Place the lower mount in a vise with soft jaws.

**NOTE**

*If it is difficult to break the lower mount loose from the damper rod, apply Liquid Wrench to the area where these 2 parts meet. Let it set for 10-15 minutes. If this does not work, clean off all Liquid Wrench and apply heat to the area where the 2 parts meet.*

5. Unscrew the damper rod from the lower mount and remove the lower mount.
6. Release the special tool from the shock absorber and remove it.
7. Slide off the spring, the spring sleeve, spring pad, spring seat and washer.
8. Measure the spring free length and compare to the dimension listed in **Table 2**. Replace if necessary.
9. Inspect the performance of the damper unit as described under *Damper Unit Test (All Models)* in this chapter.
10. Assemble by reversing these disassembly steps. Note the following during installation.
11. Clean off all Loctite residue from the threads of the upper mount and the damper rod.
12. If Liquid Wrench was used, use an aerosol electrical contact cleaner and clean off all Liquid Wrench residue from the threads of the upper mount and the damper rod.
13. Apply a small amount of red Loctite Threadlocker No. 271 to the damper rod threads prior to installing the upper mount.
14. Tighten the upper mount to the damper rod to the torque specification listed in **Table 1**.

**Disassembly/Assembly  
(All Other Models)**

Refer to **Figure 37** for this procedure.

This procedure requires 3 BMW special tools that are available from BMW motorcycle dealers. They are as follows:

- a. Spring compression tool: part No. 33 5 600.
- b. Clamp: part No. 33 5 605.
- c. Pressure element: part No. 33 5 610.

Due to the number of special tools and their relative cost, compare the price of these tools, which will not be used that often, to the cost of having the dealer perform this procedure.

1. Adjust the shock to its softest setting.

**WARNING**

*Without the BMW proper tool, this procedure can be dangerous. The spring can fly loose, causing injury. For a small bench fee, a dealer can do the job for you. Be sure to use the BMW special tools for this shock absorber.*



2. Install the shock absorber in the BMW spring compression tool (part No. 33 5 600).
3. Secure the upper mounting in the compression tool and position the clamp (part No. 33 5 605) between the 3rd and 4th spring coil from the bottom.
4. Slide the pressure element (part No. 33 5 610) over the clamp and position the end of the pressure element into the end of the compression tool.
5. Compress the shock absorber within the special tool enough for the upper mount to come out past the end of the compression tool.
6. Insert a drift into the upper mount to keep it from turning during the next step.

**NOTE**

*If it is difficult to break the upper mount loose from the damper rod, apply Liquid Wrench to the area where these 2 parts meet. Let it set for 10-15 minutes. If this does not work, clean off all Liquid Wrench and apply heat to the area where the 2 parts meet.*

7. Using an open end wrench on the flats on the damper rod, unscrew the damper rod from the upper mount.
8. Release the special tool from the shock absorber and remove the special tools from the shock absorber.
9. Slide off the distance tube, upper seat, spring sleeve, spring, lower seat, washer and the adjuster.
10. Measure the spring free length and compare to the dimension listed in **Table 2**. Replace if necessary.
11. Inspect the performance of the damper unit as described under *Damper Unit Test (All Models)* in this chapter.
12. Assemble by reversing these disassembly steps. Note the following during installation.
13. Clean off all Loctite residue from the threads of the upper mount and the damper rod.
14. If used, use an aerosol electrical contact cleaner and clean off all Liquid Wrench residue from the threads of the upper mount and the damper rod.
15. Apply a small amount of red Loctite Threadlocker No. 271 to the damper rod threads prior to installing the upper mount.
16. Tighten the upper mount to the damper rod to the torque specification listed in **Table 1**.

### Damper Unit Test (All Models)

1. Hold the damper unit in the vertical position and pump the damper rod several times to displace the air from the upper chamber.

**NOTE**

*Be sure to test both shock absorbers and compare their movements against each other. For best handling performance, it is a good*

*idea to replace the shock absorbers as a pair even though only one is not operating as good as expected.*

2. Test the relationship of compression and rebound damping capabilities as follows:
  - a. First compress the shock absorber and then extend it.
  - b. The force required for compression should be noticeably less than for extension.
  - c. The damper rod should move smoothly and steadily, requiring the same force throughout the length of the stroke.
  - d. If the stroke is uneven, the damper unit is worn and should be replaced.
  - e. If the force required to compress the shock is about equal to the force required to extend it, or if the extension force is less, the damper unit is worn and should be replaced.

### SWING ARM AND DRIVE SHAFT (DUAL-SHOCK MODELS)

All 1970-1978 models are equipped with dual-shock absorbers.

The swing arm pivots on the frame in tapered roller bearings. The final drive unit is attached to the swing arm on the right-hand side and the drive shaft runs through the hollow swing arm on the same side. The drive shaft has a splined universal joint at the rear end where it attaches to the final drive unit. The universal joint and splines allow for the up-and-down movement of the swing arm and the slight in-and-out movement of the drive shaft. The drive shaft automatically comes out with the swing arm as one assembly and must be removed from the swing arm after the swing arm is removed from the frame.

In time, the pivot roller bearings will wear and will have to be replaced. The condition of the bearings can greatly affect handling performance, and if worn parts are not replaced, they can produce erratic and dangerous handling. Common symptoms are wheel hop, pulling to one side during acceleration and pulling to the other side during braking.

Refer to the following illustrations for these procedures:

- a. **Figure 44**: swing arm assembly.
- b. **Figure 45**: drive shaft assembly.

In **Figure 44** the bearing and pivot pin assembly is shown on the left-hand side only. The exact same parts are used on the right-hand side and all are a mirror image. The only exception is the grease retainer that is used only on the left-hand side.

### Swing Arm Removal

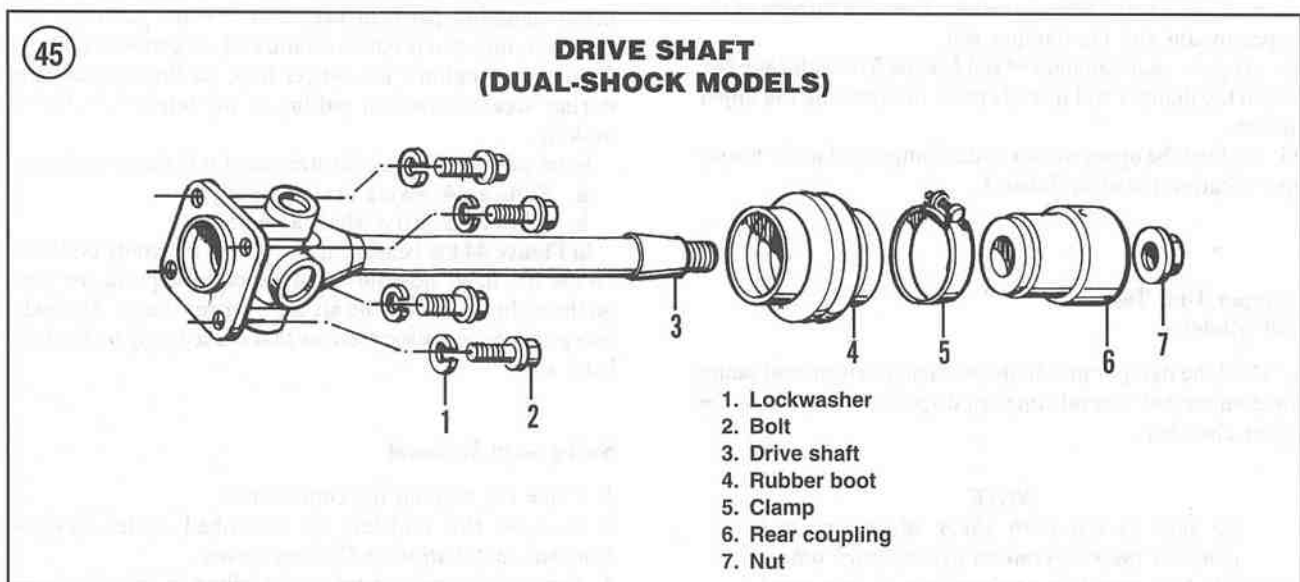
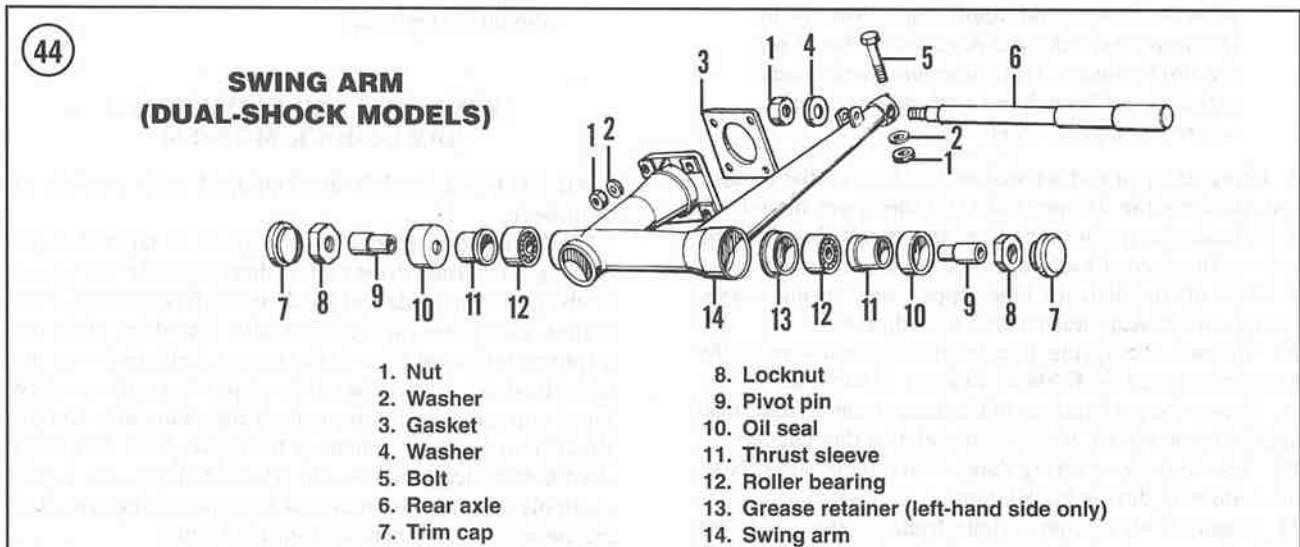
1. Place the bike on the centerstand.
2. Remove the mufflers as described under *Muffler Removal/Installation* in Chapter Seven.
3. Remove the rear wheel as described in this chapter.

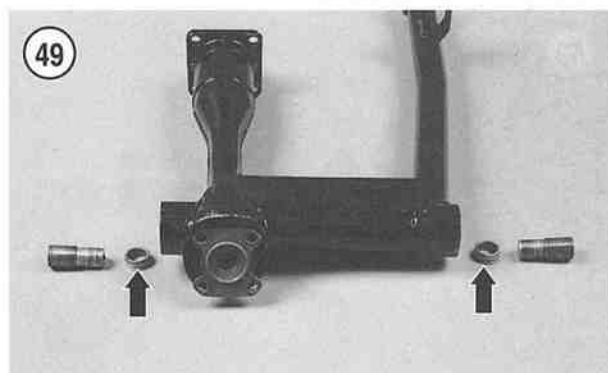
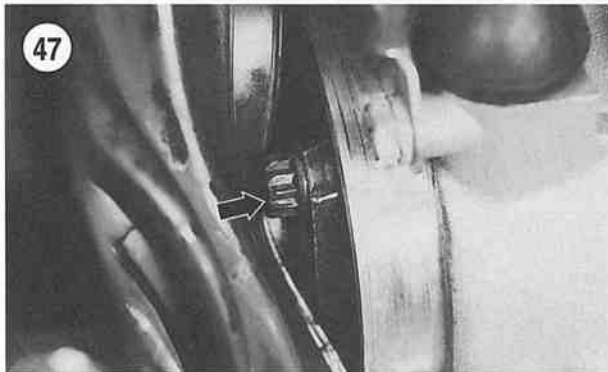
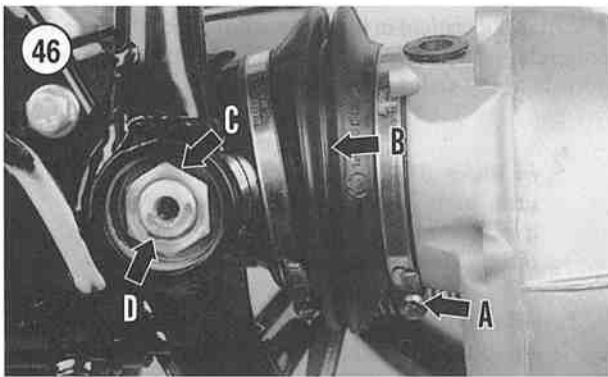
4. Grasp the rear end of the swing arm and try to move it from side-to-side in a horizontal arc. There should be no noticeable side play. If play is evident and the pivot pins are tightened correctly, the bearings should be replaced.
5. Drain the drive shaft oil as described under *Drive Shaft Oil Change* in Chapter Three.
6. Remove the final drive unit as described in this chapter.
7. Remove the shock absorbers as described in this chapter.
8. Place a wood box or block(s) under the swing arm at the rear to hold the swing arm in position after the pivot pins are removed.
9. Loosen the front clamping band screw (A, **Figure 46**) on the rubber boot. Slide the rubber boot (B, **Figure 46**) off of the transmission housing and onto the swing arm.

10. Shift the transmission into 4th or 5th gear. This will prevent the drive shaft from turning in the following steps.
11. Remove the bolts and lockwashers (**Figure 47**) securing the drive shaft to the transmission output shaft. Discard the bolts and lockwashers. The bolts are the stretch type and they must be replaced.
12. Remove the swing arm pivot pin trim cap on each side.

**CAUTION**

The leading edge of the 27mm socket (**Figure 48**) may have to be ground off a little since there is very little room within the swing arm receptacle for the socket. In order to loosen the





*locknut, the socket must fit all the way onto the locknut. If the socket does not get a good perch on the locknut, the outer edge of the locknut may be rounded off, making removal very difficult.*

13. Using a 27 mm socket, loosen the locknut (C, Figure 47) on each side.
14. Using a 6 mm Allen wrench, completely unscrew the pivot pin (D, Figure 46) and locknut on each side. Remove both pivot pins and locknuts.
15. Pull the swing arm toward the rear and remove it from the frame. The rubber boot will usually stay on the swing arm.
16. Inspect the swing arm as described in this chapter.

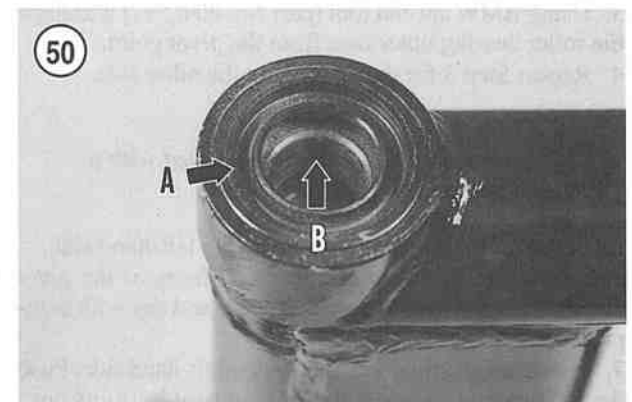
**Swing Arm Inspection**

1. Inspect the swing arm for wear, cracks or damage. Replace if necessary.
2. Remove the thrust sleeve (Figure 49) and the oil seal (A, Figure 50) from each side of the swing arm. Discard the oil seals as they must be replaced whenever they are removed.

*NOTE*

*If the roller bearings do not require replacement, they must be reinstalled to their original locations. Mark the bearings and keep them separated so they will be installed correctly.*

3. Remove the roller bearing (B, Figure 50) from each side.
4. Thoroughly clean the roller bearings, grease retainer and thrust sleeve in solvent and dry with compressed air.
5. Inspect the roller bearings for wear or damage. Rotate them with your fingers. They should rotate freely with no signs of drag or roughness. Replace if necessary.
6. Wipe off all old grease from the roller bearing outer race on each side.
7. Inspect the roller bearing outer race on each side of the swing arm. If either shows signs of wear or damage, replace the outer race as described in this chapter.



8. Inspect the mounting tabs for the left-hand shock absorber for cracks, wear or damage. Replace the swing arm if necessary.
9. Inspect the pivot pins (**Figure 51**) and locknut for wear, cracks or damage. If the threads are damaged, clean out the threads with the correct size and pitch thread tap or die or replace if necessary.
10. Inspect the rubber boot for cracks or damage. If any cracks or damage are evident, replace the rubber boot.
11. Inspect the final drive unit mounting flange of the swing arm for wear, damage or distortion. This flange must be free of any damage or distortion to enable the final drive unit to fit correctly for proper alignment. If any damage is found, replace the swing arm.
12. Thoroughly pack the roller bearings and the bearing outer races in the swing arm with grease (**Figure 52**), available from BMW dealers. Make sure the rollers are completely covered with grease.
13. Install the roller bearing.
14. Position the thrust sleeve with the shoulder side going in first (**Figure 53**) and install the thrust sleeve.
15. Install a *new oil seal* and press it in until it is completely seated in the swing arm receptacle.
16. Repeat Steps 13-15 for the other side.

### Swing Arm Roller Bearing Outer Race Replacement

Refer to **Figure 44** for this procedure.

#### CAUTION

*Do not remove the bearing outer race for inspection purposes. Never reinstall a bearing outer race that has been removed. During removal it becomes slightly damaged and is no longer true to alignment. If installed, it will create an unsafe riding condition.*

1. Remove the swing arm as described in this chapter.
2. Remove the bearings as described under *Swing Arm Inspection* in this chapter.
3. Using BMW special tool (part No. 00 8 551) withdraw the roller bearing outer race from the pivot point.
4. Repeat Step 3 for the bearing on the other side.

#### NOTE

*The right-hand side is not equipped with a grease retainer.*

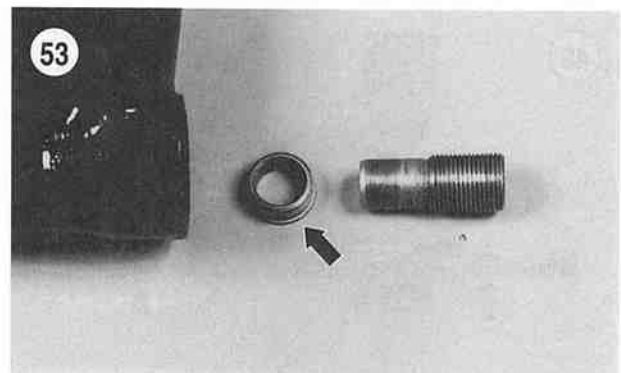
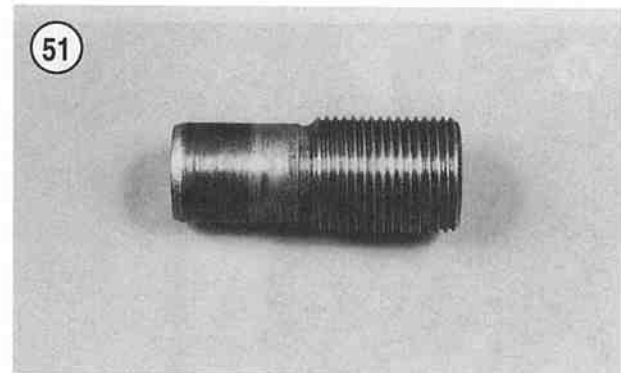
5. Remove the grease retainer from the left-hand side.
6. Thoroughly clean out the inside surfaces of the pivot portions of the swing arm with solvent and dry with compressed air.
7. Install a new grease retainer on the left-hand side. Push the retainer in squarely and evenly until it bottoms out.

The fit is not critical in that it does not affect the bearing. It only retains the grease to keep it from going into the inner portion of the swing arm.

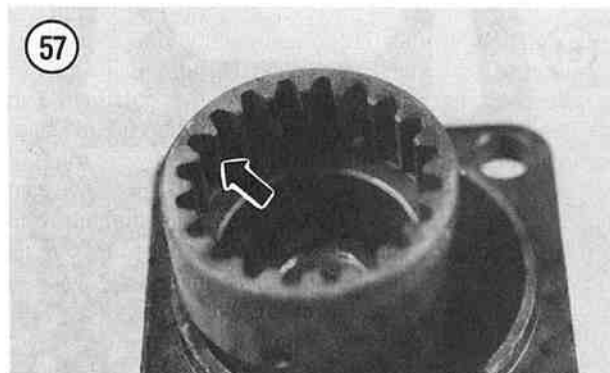
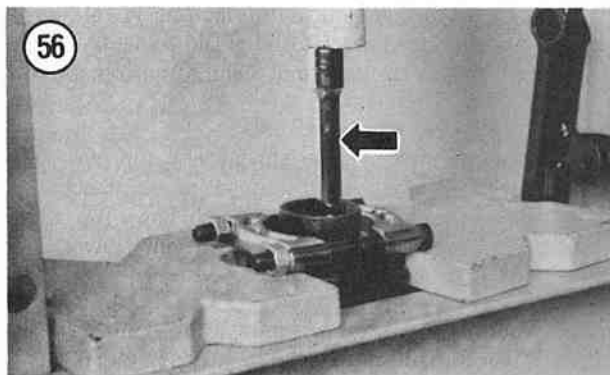
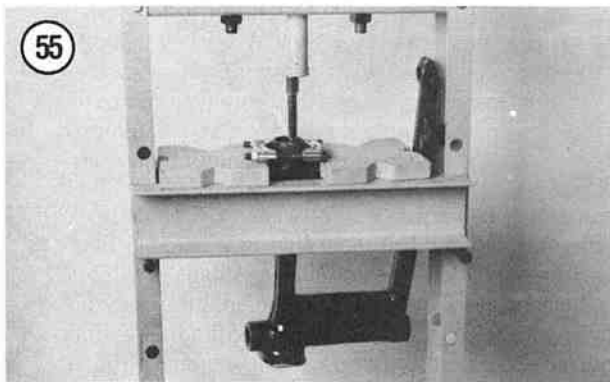
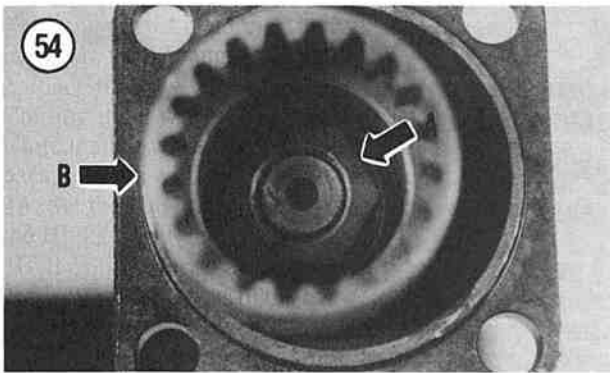
#### CAUTION

*In order to prevent damage to the swing arm, place the opposite end of the swing arm on a piece of soft wood when installing the bearing outer race into the other side.*

8. Install the new bearing inner race into the swing arm. Use a suitable size socket that matches the outer circle of







- the race. Tap the bearing outer race in slowly and squarely until it seats completely. Make sure it is properly seated.
- 9. Repeat Step 8 for the bearing outer race on the other side.
- 10. Install the bearings as described under *Swing Arm Inspection* in this chapter.
- 11. Install the swing arm as described in this chapter.

**Drive Shaft  
Removal/Installation**

Refer to **Figure 45** for this procedure.

- 1. Remove the swing arm as described in this chapter.
- 2. Remove the rubber boot and clamps from the swing arm.
- 3. Secure the universal joint end of the drive shaft in a vise with soft jaws.
- 4. Loosen the nut (A, **Figure 54**) securing the rear coupling (B, **Figure 54**) to the drive shaft. Remove the nut.
- 5. Place the swing arm in a hydraulic press (**Figure 55**). Use an insert and a 1/2 in. drive socket extension (**Figure 56**) to press the rear coupling off of the drive shaft. Remove the rear coupling.
- 6. Withdraw the drive shaft from the swing arm.
- 7. Inspect the drive shaft as described in this chapter.
- 8. Thoroughly clean all oil and grease from the taper on the rear end of the drive shaft and the inner taper of the rear coupling. These two surfaces must be completely free of any oil residue in order for them to lock together on their taper when the nut is tightened.
- 9. Install the drive shaft by reversing these removal steps. Note the following during installation.
- 10. Apply a light coat of Staburags NBU 30PT grease (**Figure 52**), available from BMW dealers, to the outer splines of the transmission output shaft and the inner splines of the drive shaft rear coupling.
- 11. Install the rubber boot and clamps onto the end of the swing arm.
- 12. Install the snap ring into the inner surface of the rubber boot securely to the swing arm.
- 13. Tighten the nut securing the rear coupling to the drive shaft to the torque specification listed in **Table 1**.

**Drive Shaft Inspection**

- 1. Inspect the inner splines (**Figure 57**) of the rear coupling where it attaches to the final drive unit. If they are damaged or worn, the rear coupling must be replaced.

**NOTE**

*If the splines are damaged, also check the splines of the final drive unit; it may also have to be replaced.*



2. Inspect the mounting plate (**Figure 58**) of the universal joint end of the drive shaft. If it is damaged or cracked, the drive shaft must be replaced. The universal joint is integral with the drive shaft and cannot be replaced separately.
3. Inspect the universal joint pivot points for play (**Figure 59**). Rotate the joint in both directions. If there is noticeable side play, the drive shaft must be replaced.

### Swing Arm Installation

Refer to **Figure 44** for this procedure.

#### NOTE

*This procedure is shown with the engine and transmission assembly removed for clarity.*

1. Position the swing arm, rubber boot and both clamps into the mounting area of the frame (**Figure 60**).
2. Align the holes in the swing arm with the holes in the frame. Position the swing arm on the wood block(s) used during removal.
3. Center the swing arm within the mounting area of the frame (**Figure 61**).
4. Install the pivot pin in from each side. Make sure the swing arm is still centered and that the gap between the swing arm and frame is equal on each side. Check the clearance with a vernier caliper as shown in **Figure 62**. Correctly position the swing arm until the clearance is correct.
5. Screw both pivot pins in all the way—maintain the equal clearance on each side (**Figure 62**).

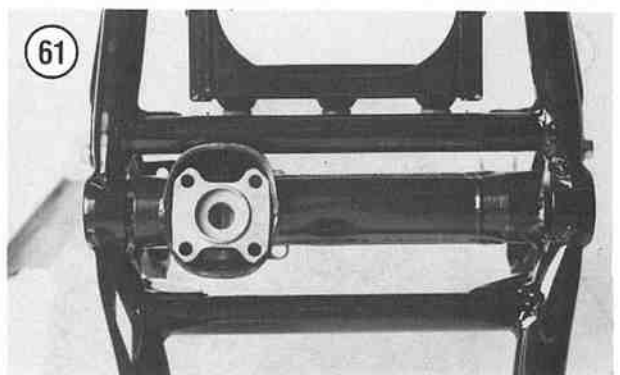
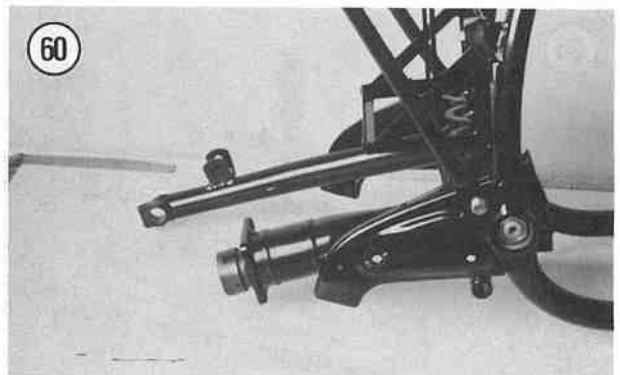
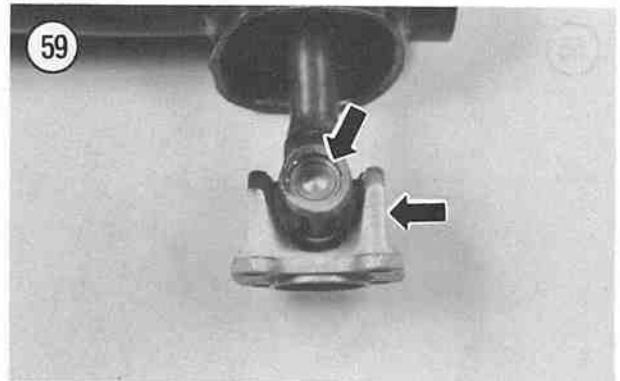
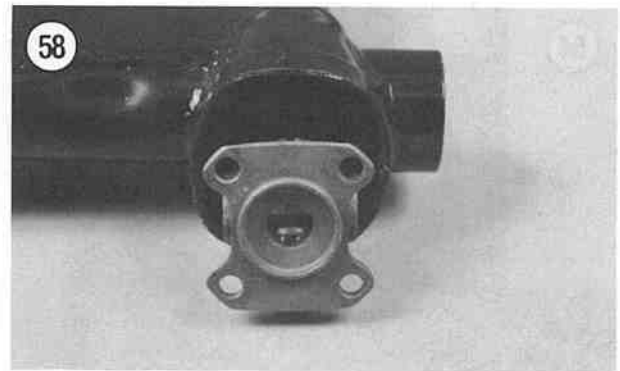
#### CAUTION

*In Step 6 the initial torque specification is used only to seat and preload the bearings. Never leave the pivot pins tightened to this initial torque specification as the bearings will be damaged.*

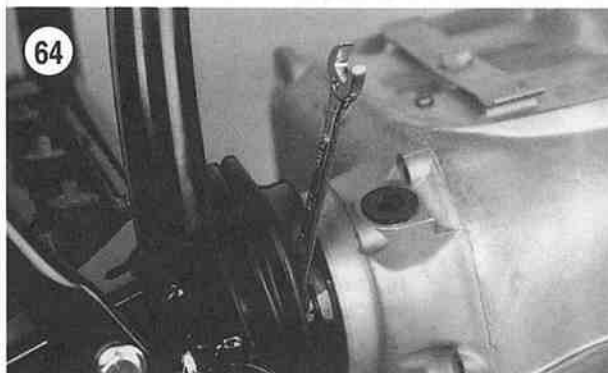
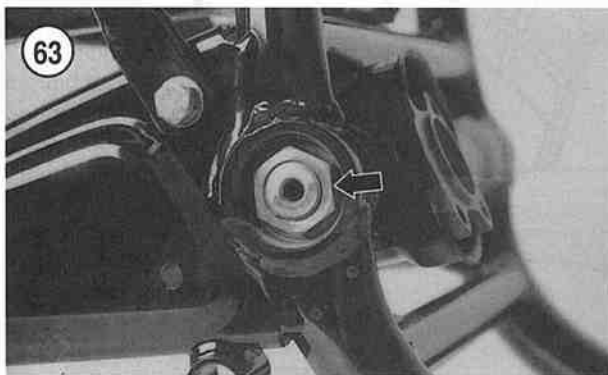
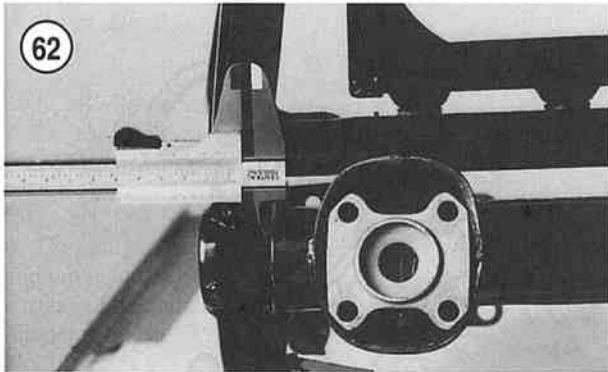
6. Tighten both pivot pins to the *initial torque to preload bearings* to the specification listed in **Table 1**. Remember to maintain the equal clearance on each side (**Figure 62**). Readjust if necessary.
7. Partially screw the locknut (**Figure 63**) onto each pivot pin, but do not let them make contact within the receptacle in the swing arm.
8. Loosen the pivot pins and then retighten to the final torque specification listed in **Table 1**.

#### CAUTION

*Make sure the pivot pin does not move while tightening the locknut. If the pivot pin moves, it will be tighter than specified and the bearing will wear prematurely.*



9. Hold onto the pivot pin and tighten the locknut (**Figure 63**) on each side to the torque specification listed in **Table 1**.
10. Remove the box from under the swing arm. Move the swing arm up and down and make sure it moves freely – but not loosely.
11. Again check and make sure there is still an equal clearance between the swing arm and frame. Readjust if necessary.
12. Install the swing arm pivot pin trim cap on each side.
13. If not already in gear, shift the transmission into 4th or 5th gear. This will prevent the drive shaft from turning in the following steps.



**NOTE**  
*The bolts used to secure the drive shaft to the transmission output shaft have been redesigned to eliminate the need for a lockwasher. This new bolt has better retention qualities and is shorter than the one used with the lockwasher.*

**CAUTION**  
*Always replace the bolts every time they are removed. These bolts are the stretch type and will break off if used for the second time.*

**CAUTION**  
*Do not oil the bolt threads prior to installation – they must be dry. They must be installed dry in order to be tightened to the correct torque specification.*

14. Install the bolts (**Figure 64**) securing the drive shaft to the transmission output shaft. Tighten in a crisscross pattern to the torque specification listed in **Table 1**.

**CAUTION**  
*The rubber boot must be installed correctly on both the swing arm and the transmission housing flange. This boot protects the universal joint from moisture and foreign matter. If the boot is not installed correctly, the universal joint will wear out prematurely.*

15. Slide the rubber boot onto the transmission housing and onto the swing arm. Make sure it is properly seated on both components.
16. Correctly position both clamping bands and tighten the screws securely.
17. Remove the wood box or block(s) from under the swing arm.
18. Install the shock absorbers as described in this chapter.
19. Install the final drive unit as described in this chapter.
20. Install the rear wheel as described in this chapter.
21. Install the mufflers as described in Chapter Seven.
22. Lubricate the swing arm as described in Chapter Three.

**SWING ARM AND DRIVE SHAFT  
 (SINGLE-SHOCK R100GS MODELS)**

In time, the pivot roller bearings will wear and will have to be replaced. The condition of the bearings can greatly affect handling performance and if worn parts are not replaced, they can produce erratic and dangerous handling. Common symptoms are wheel hop, pulling to one side during acceleration and pulling to the other side during braking.

The cast alloy swing arm on the R100GS models is unique to the rest of the models covered in this book. The front pivot bearings are lubricated during manufacture and do

not require any additional lubrication. The swing arm is vented through the front bearings, and if lubrication is applied to these bearings, the swing arm air venting will be blocked. If the air venting is blocked, the front and rear rubber boots may swell up and enlarge due to swing arm action. They may then rub against the wheel or other moving parts and become damaged.

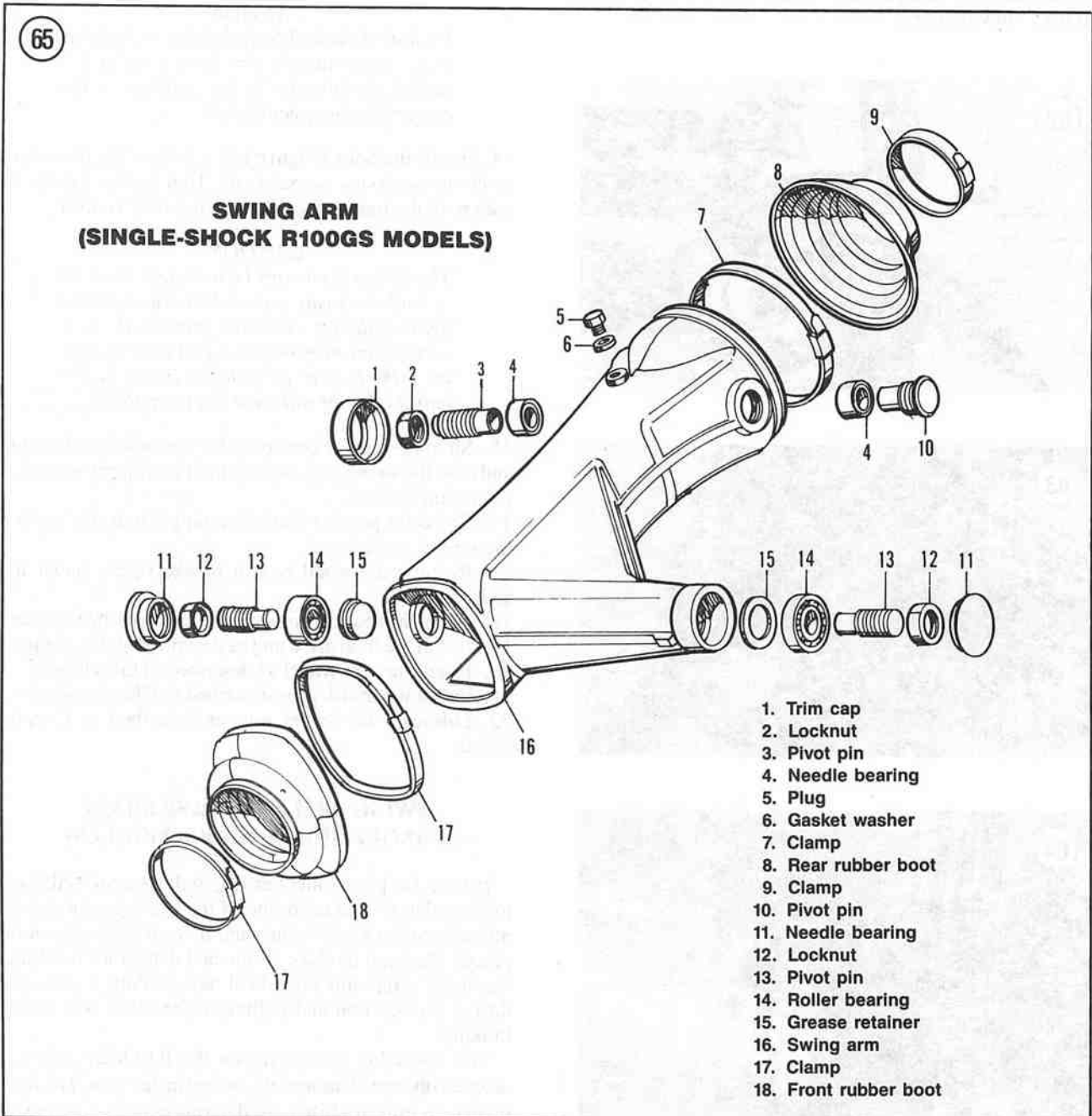
Refer to the following illustrations for these procedures:

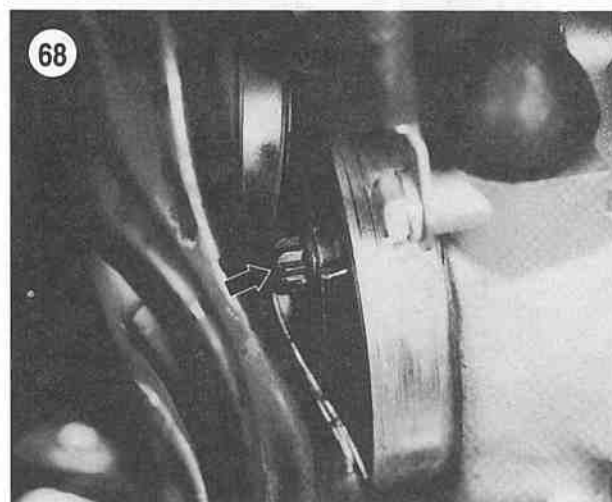
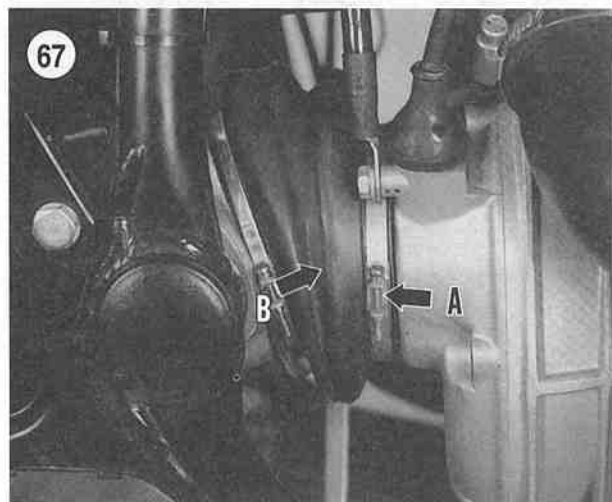
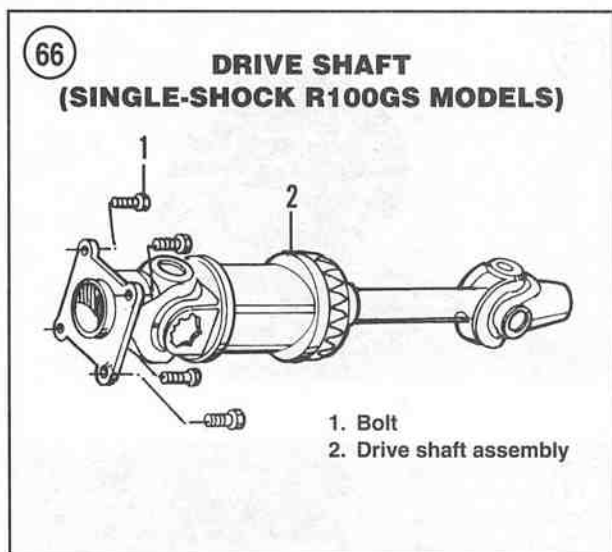
- a. **Figure 65:** swing arm assembly.
- b. **Figure 66:** drive shaft assembly.

### Swing Arm and Drive Shaft Removal

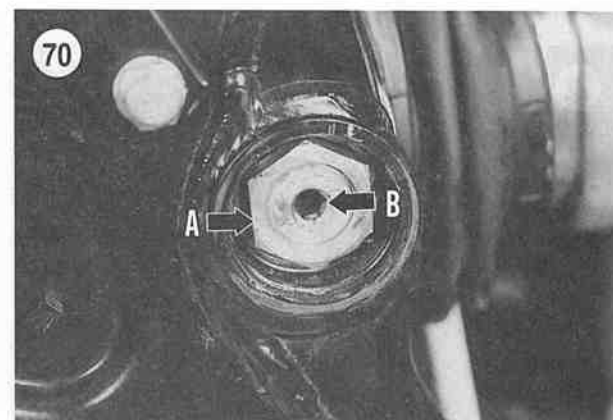
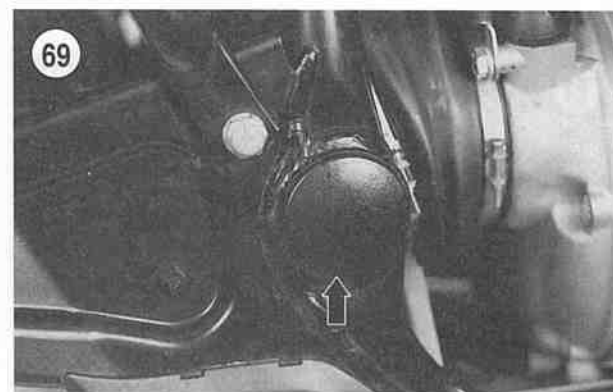
The drive shaft can remain in place after the swing arm is removed. It is impossible to remove the drive shaft with the swing arm in place since it is too large to pass through the swing arm.

1. Place the bike on the centerstand.
2. Remove the rear wheel as described in this chapter.





3. Grasp the rear end of the swing arm and try to move it from side-to-side in a horizontal arc. There should be no noticeable side play. If play is evident and the pivot pins are tightened correctly, the bearings should be replaced.
4. Remove the shock absorber as described in this chapter.
5. Remove the final drive unit as described in this chapter.
6. Place a wood box or wood block(s) under the swing arm at the rear to hold the swing arm in position after the pivot pins are removed.
7. Loosen the front clamping band screw (A, Figure 67) on the rubber boot. Slide the rubber boot (B, Figure 67) off of the transmission housing.
8. To remove the drive shaft, perform the following:
  - a. Shift the transmission into 5th gear. This will prevent the drive shaft from turning in the following steps.
  - b. Remove the bolts (Figure 68) securing the drive shaft to the transmission output shaft. Discard the bolts, as they are the stretch type and they must be replaced.
9. Remove the swing arm pivot pin trim cap (Figure 69) on each side.
10. Using a socket, loosen the locknut (A, Figure 70) on each side.
11. Using an Allen wrench, completely unscrew the pivot pin (B, Figure 70) and locknut on each side. Remove both pivot pins and locknuts.



12. Pull the swing arm (**Figure 71**) toward the rear and remove it from the frame and off of the drive shaft, together or with the drive shaft. The front rubber boot will usually stay on the swing arm.

13. Inspect the swing arm and drive shaft as described in this chapter.

#### Swing Arm Inspection

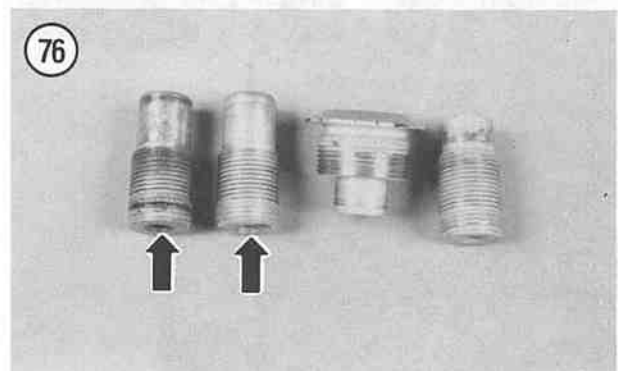
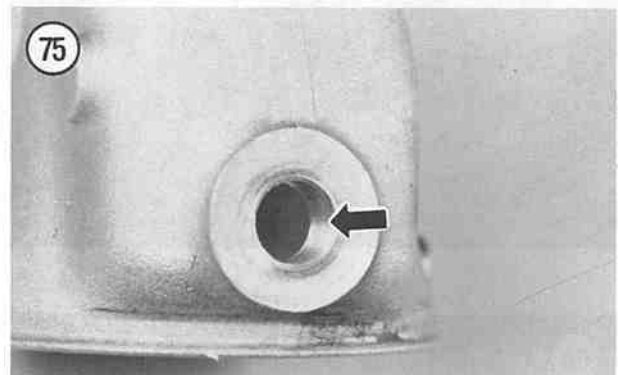
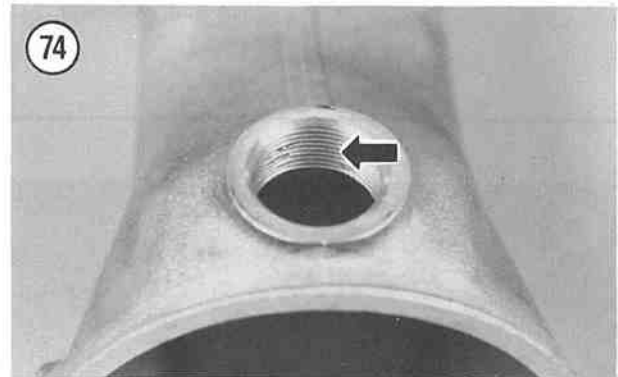
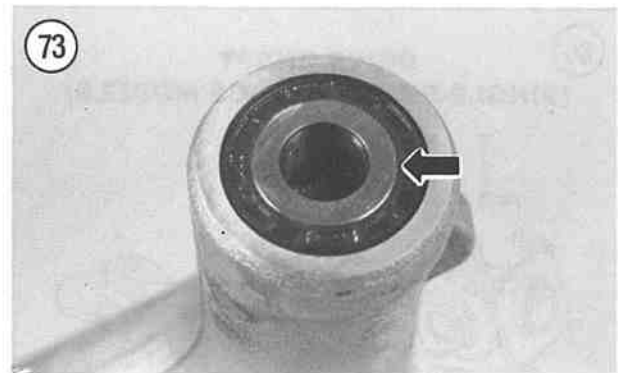
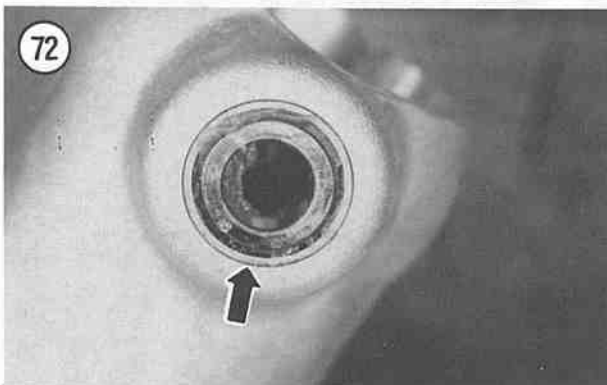
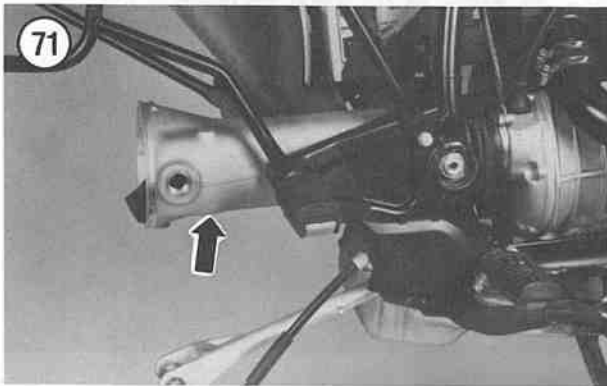
1. Inspect the swing arm for wear, cracks or damage. Replace if necessary.

2. Inspect the pivot bearing on each side for wear or damage. Refer to **Figure 72** for the right-hand side and **Figure 73** for the left-hand side. Rotate the bearings with your fingers. They should rotate freely with no signs of drag or roughness. Replace if necessary as described in this chapter.

3. Inspect the final drive unit pivot pin threaded holes for wear or damage. Refer to **Figure 74** and **Figure 75**. Clean out the threads with the correct size and pitch thread tap if necessary.

4. Inspect the pivot pins (**Figure 76**) and locknuts for wear, cracks or damage. If the threads are damaged, clean out the threads with the correct size and pitch thread tap or die or replace if necessary.

5. Inspect the front and rear rubber boots (**Figure 77**) for cracks or damage. If any cracks or damage are evident, replace the rubber boot.







**Drive Shaft Inspection**

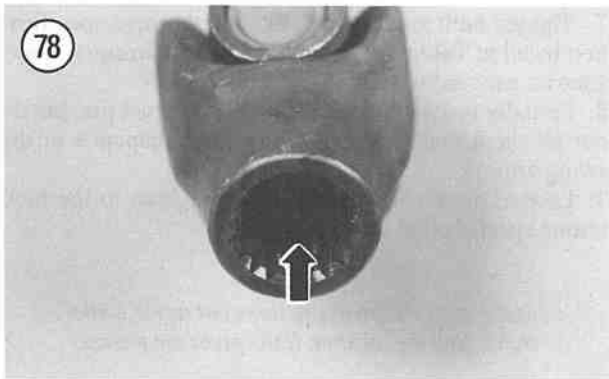
**CAUTION**

*The torsional damper unit, which is an integral part of the drive shaft, will be damaged if oil comes in contact with it. Never apply any type of lubricant to this portion of the drive shaft.*

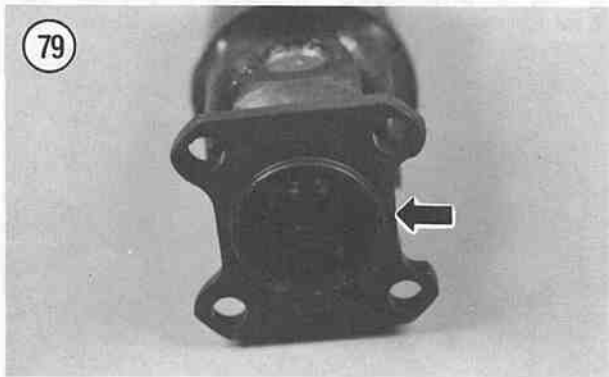
1. Inspect the inner splines (Figure 78) of the rear universal joint where it attaches to the final drive unit. If they are damaged or worn, the drive shaft must be replaced. The universal joint cannot be replaced separately.

**NOTE**

*If the splines are damaged, also check the splines of the final drive unit; it may also have to be replaced.*



2. Inspect the mounting flange (Figure 79) of the front universal joint. If it is damaged or worn, the drive shaft must be replaced. The universal joint cannot be replaced separately.



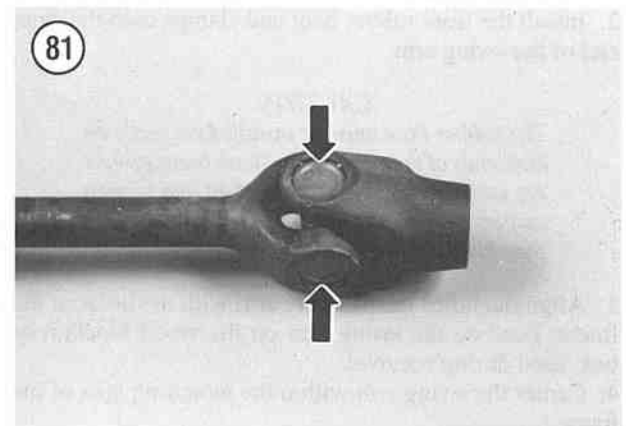
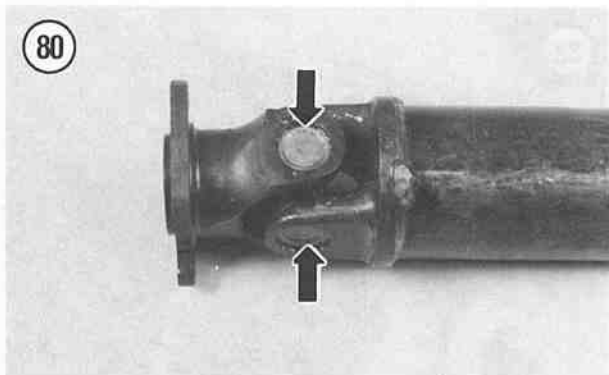
3. Inspect both universal joint pivot points for play. Refer to Figure 80 for the front or Figure 81 for the rear. Rotate both joints in both directions. If there is noticeable side play, the drive shaft must be replaced. The universal joints cannot be replaced separately.

**Pivot Bearing and Grease Retainer Replacement**

The swing arm is equipped with a roller bearing on each side of the swing arm.

**CAUTION**

*Do not remove the bearing for inspection purposes. Never reinstall a bearing that has been removed. During removal, it becomes slightly damaged and is no longer true to alignment. If installed, it will create an unsafe riding condition.*



1. Remove the swing arm as described in this chapter.
2. Using special tool (BMW part No. 00 8 572 or Kukko Extractor No. 21/3 and Support 22-1), withdraw the roller bearing from the pivot point.
3. Repeat Step 2 for the bearing on the other side.
4. If necessary, remove the grease retainer located behind the roller bearing as follows:
  - a. If still installed, remove the rubber boot from the swing arm.
  - b. Insert a drift through the drive shaft opening on the right-hand side and tap out the right-hand grease retainer.
  - c. Insert a long drift through the right-hand bearing area and tap out the left-hand grease retainer.
5. Thoroughly clean out the inside surfaces of the pivot portions of the swing arm with solvent and dry with compressed air.
6. If removed, install new grease retainers on each side. Tap the retainers in squarely and evenly until they bottom out. Their fit is not critical in that they do not affect the bearing. They only retain the grease and keep it from going into the inner portion of the swing arm.

**CAUTION**

*In order to prevent damage to the swing arm, place the opposite end of the swing arm on a piece of soft wood when installing the bearing into the other side.*

7. Install the new bearing into the swing arm. Use a suitable size socket that matches the outer race of the bearing. Tap the bearing in slowly and squarely until it seats completely. Make sure it is properly seated.
8. Repeat Step 7 for the bearing on the other side.
9. Install the swing arm as described in this chapter.

### Swing Arm and Drive Shaft Installation

1. If removed, position the drive shaft with the mounting flange toward the front and install the drive shaft into the swing arm. The drive shaft cannot be installed after the swing arm is installed.
2. Install the front rubber boot and clamps onto the front end of the swing arm.

**CAUTION**

*The rubber boot must be installed correctly on both ends of the swing arm. These boots protect the universal joints from moisture and foreign matter. If the boots are not installed correctly, the universal joints will wear out prematurely.*

3. Align the holes in the swing arm with the holes in the frame. Position the swing arm on the wood block(s) or box, used during removal.
4. Center the swing arm within the mounting area of the frame.

5. Install the pivot pin from each side. Make sure the swing arm is still centered and that the gap between the swing arm and frame is equal on each side. Check the clearance with a vernier caliper. Correctly position the swing arm until the clearance is correct.
6. Screw both pivot pins in all the way – maintain equal clearance on each side.

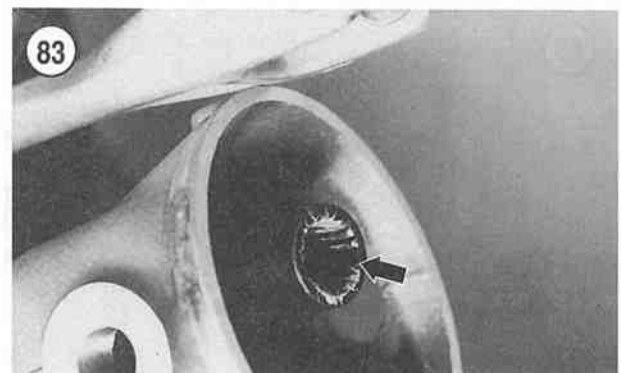
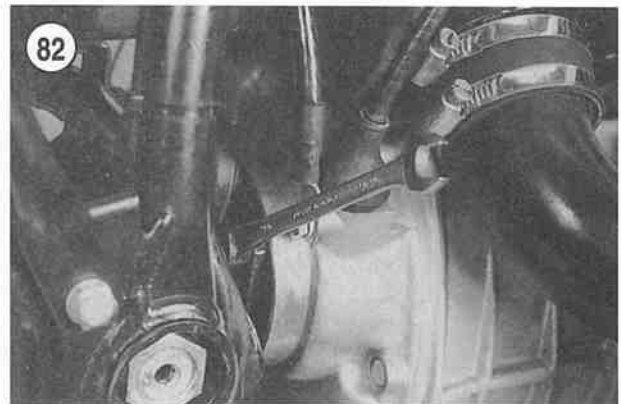
**CAUTION**

*In Step 7, the initial torque specification is used only to seat and preload the bearings. Never leave the pivot pins tightened to this initial torque specification as the bearings will be damaged.*

7. Tighten both pivot pins to the initial torque specification listed in **Table 1**. Remember to maintain equal clearance on each side. Readjust if necessary.
8. Partially screw the locknut onto each pivot pin, but do not let them make contact within the receptacle in the swing arm.
9. Loosen the pivot pins and then retighten to the final torque specification listed in **Table 1**.

**CAUTION**

*Make sure the pivot pin does not move while tightening the locknut. If the pivot pin moves,*



*it will be tighter than specified and the bearing will wear prematurely.*

10. Hold onto the pivot pin (B, **Figure 70**) and tighten the locknut (A, **Figure 70**) on each side to the torque specification listed in **Table 1**.
11. Remove the box from under the swing arm. Move the swing arm up and down and make sure it moves freely—but not loosely.
12. Again check and make sure there is still an equal clearance between the swing arm and frame. Readjust if necessary.
13. Install the swing arm pivot pin trim cap on each side.

**CAUTION**

*Always replace the bolts every time they are removed. These bolts are the stretch type and will break off if used for the second time.*

**CAUTION**

*Do not oil the bolt threads prior to installation—they must be dry. They must be installed dry in order to be tightened to the correct torque specification.*

14. Install the bolts securing the drive shaft to the transmission output shaft. Tighten the bolts (**Figure 82**) in a crisscross pattern to the torque specification listed in **Table 1**.

**CAUTION**

*The rubber boot must be installed correctly on both the swing arm and the transmission housing flange. This boot protects the universal*

*joint from moisture and foreign matter. If the boot is not installed correctly, the universal joint will wear out prematurely.*

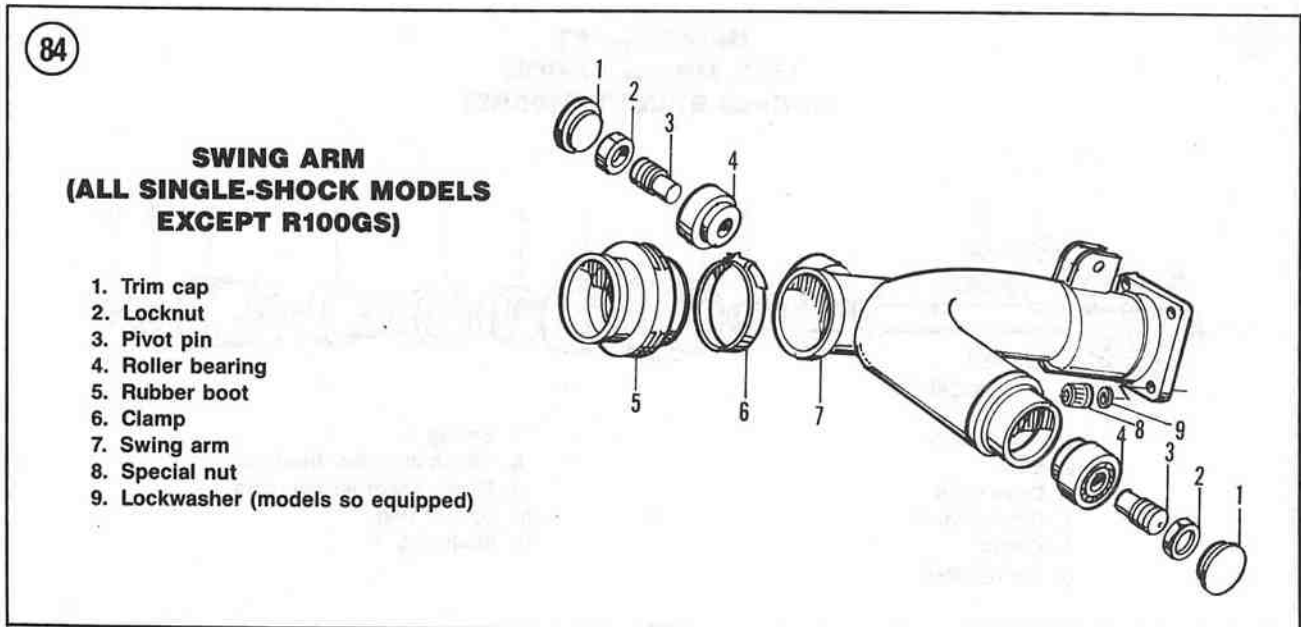
15. Slide the rubber boot (B, **Figure 67**) onto the transmission housing and onto the swing arm. Make sure it is properly seated on both components.
16. Correctly position both clamping bands and tighten the screws securely (A, **Figure 67**).
17. Remove the wood box or block(s) from under the swing arm.
18. Apply a light coat of Staburags NBU 30PT grease (**Figure 52**), available from BMW dealers, to the outer splines of the transmission output shaft and the inner splines (**Figure 83**) of the drive shaft universal joint.
19. Install the shock absorber as described in this chapter.
20. Install the final drive unit as described in this chapter.
21. Install the rear wheel as described in this chapter.

**SWING ARM AND DRIVE SHAFT  
(ALL SINGLE-SHOCK MODELS EXCEPT R100GS)**

In time the pivot roller bearings will wear and will have to be replaced. The condition of the bearings can greatly affect handling performance, and if worn parts are not replaced they can produce erratic and dangerous handling. Common symptoms are wheel hop, pulling to one side during acceleration and pulling to the other side during braking.

Refer to the following illustrations for these procedures:

- a. **Figure 84**: swing arm assembly.
- b. **Figure 85**: drive shaft assembly.



## Swing Arm Removal

### NOTE

When the swing arm is removed, the drive shaft will automatically come out with it. There is no way to remove one without the other.

1. Place the bike on the centerstand.
2. Remove the mufflers as described under *Muffler Removal/Installation* in Chapter Seven.
3. Remove the rear wheel as described in this chapter.
4. Grasp the rear end of the swing arm and try to move it from side-to-side in a horizontal arc. There should be no noticeable side play. If play is evident and the pivot pins are tightened correctly, the bearings should be replaced.
5. Drain the drive shaft oil as described under *Drive Shaft Oil Change* in Chapter Three.
6. Remove the final drive unit as described in this chapter.
7. Remove the shock absorber as described in this chapter.
8. Place a wood box or block(s) under the swing arm at the rear to hold the swing arm in position after the pivot pins are removed.
9. Loosen the front clamping band screw (A, **Figure 86**) on the rubber boot. Slide the rubber boot off of the transmission housing and onto the swing arm.
10. Shift the transmission into 5th gear. This will prevent the drive shaft from turning in the following steps.
11. Remove the bolts and lockwashers (**Figure 87**) securing the drive shaft to the transmission output shaft. Discard the bolts and lockwashers. The bolts are the stretch type and they must be replaced.
12. Remove the swing arm pivot pin trim cap (B, **Figure 86**) on each side.

### CAUTION

The leading edge of the 27 mm socket (**Figure 88**) may have to be ground off a little since there is very little room within the swing arm receptacle for the socket. In order to loosen the locknut, the socket must fit all the way onto the locknut. If the socket does not get a good perch on the locknut, the outer edge of the locknut may be rounded off making removal very difficult.

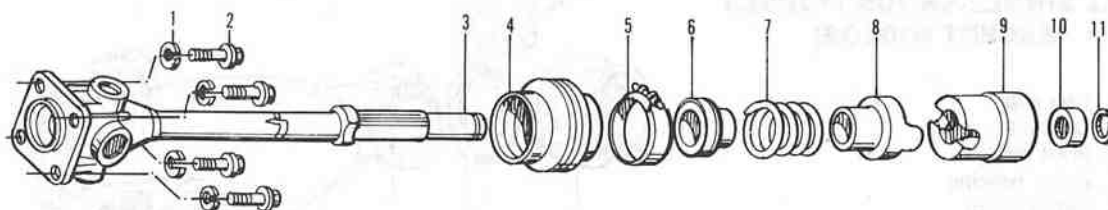
13. Using a 27 mm socket, loosen the locknut (A, **Figure 89**) on each side.
14. Using a 6 mm Allen wrench, completely unscrew the pivot pin (B, **Figure 89**) and locknut on each side. Remove both pivot pins and locknuts.
15. Pull the swing arm toward the rear and remove it from the frame. The rubber boot will usually stay on the swing arm.
16. Inspect the swing arm as described in this chapter.

## Swing Arm Inspection

1. Inspect the swing arm for wear, cracks or damage. Replace if necessary.
2. Inspect the roller bearings for wear or damage. Rotate them with your fingers. They should rotate freely with no signs of drag or roughness. Replace if necessary as described in this chapter.
3. Inspect the mounting tabs for the shock absorber for cracks, wear or damage. Replace the swing arm if necessary.

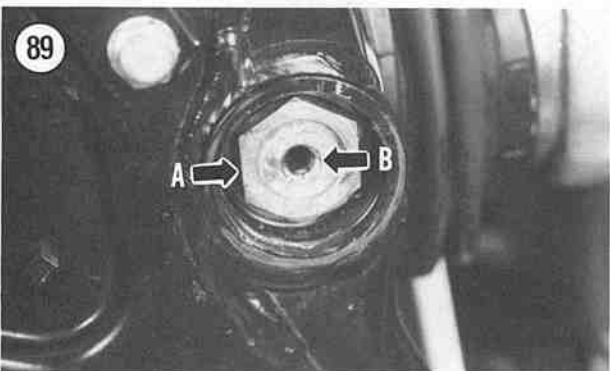
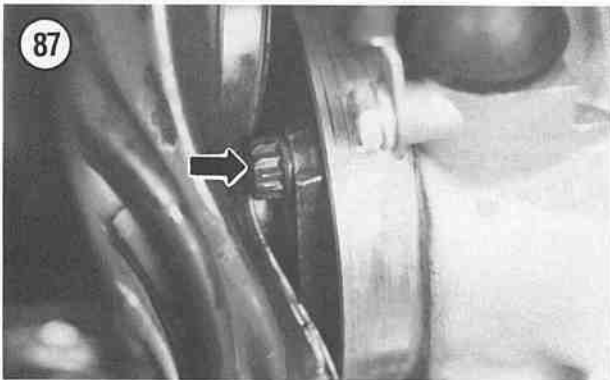
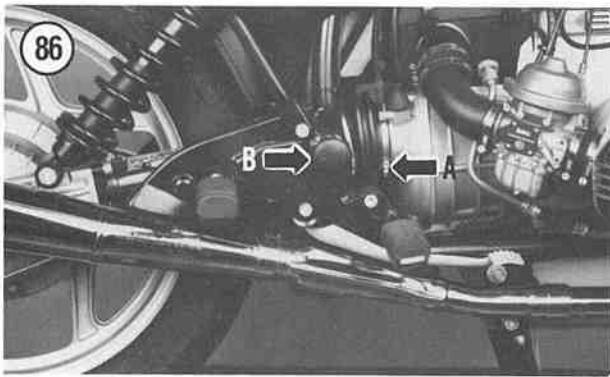
85

## DRIVE SHAFT (ALL SINGLE-SHOCK MODELS EXCEPT R100GS)



1. Lockwasher
2. Bolt
3. Drive shaft
4. Rubber boot
5. Clamp
6. Spring seat

7. Spring
8. Shock absorber front cam
9. Shock absorber rear cam
10. Spacer ring
11. Snap ring



4. Inspect the pivot pins and locknut for wear, cracks or damage. If the threads are damaged, clean out the threads with the correct size and pitch thread tap or die or replace if necessary.
5. Inspect the rubber boot for cracks or damage. If any cracks or damage are evident, replace the rubber boot.
6. Inspect the final drive unit mounting flange of the swing arm for wear, damage or distortion. This flange must be free of any damage or distortion to enable the final drive unit to fit correctly for proper alignment. If any damage is found, replace the swing arm.

**Drive Shaft Removal**

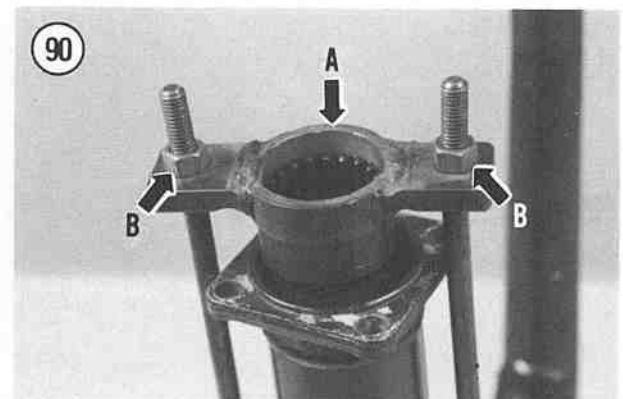
A BMW special tool is required for this procedure. Do not attempt to remove the drive shaft from the swing arm without the correct BMW tool (part No. 33 17 350).

**WARNING**

*Without the BMW proper tool, this procedure can be dangerous and may damage internal parts of the drive shaft. For a small bench fee, a dealer can do the job for you.*

Refer to **Figure 85** for this procedure.

1. Remove the swing arm as described in this chapter.
2. Remove the rubber boot and clamps from the swing arm.
3. Install the BMW special tool (part No. 33 17 350) in a vise to hold the tool secure.
4. Insert the drive shaft side of the swing arm into the BMW special tool.
5. Install the upper plate (A, **Figure 90**) onto the fixture and onto the end of the drive shaft shock absorber rear cam.
6. Slide on the spacer sleeves (if needed) and screw both nuts (B, **Figure 90**) onto the threaded rod.
7. Tighten the two nuts evenly in small increments and compress the drive shaft spring within the swing arm.
8. Compress the spring enough to gain access to the snap ring at the end of the drive shaft.
9. Remove the snap ring and spacer ring from the shock absorber rear cam. Discard the snap ring, as a new one should be installed.





10. Gradually and evenly, unscrew both nuts and release the spring pressure.
11. Remove both nuts, both spacer sleeves (if used) and the upper plate from the special tool.

**CAUTION**

*In the next step, if you turn the swing arm over, the remaining drive shaft components will slide off and be damaged.*

12. Place your hand over the rear end of the swing arm to prevent the drive shaft components from falling out of the open end.
13. Remove the swing arm from the special tool and lay it on the workbench.
14. Remove the shock absorber rear cam, the front cam, spring and spring seat from the rear end of the drive shaft.
15. Withdraw the drive shaft from the front end of the swing arm.
16. Inspect the drive shaft as described in this chapter.

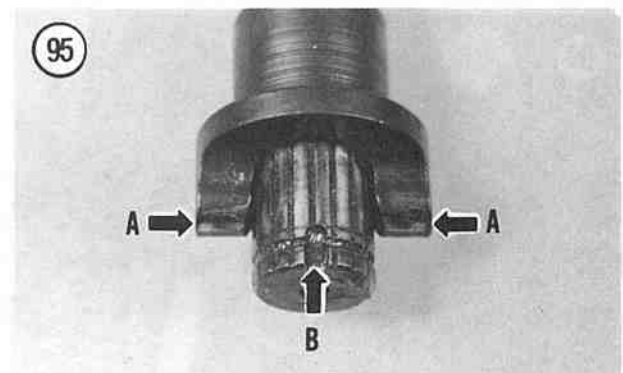
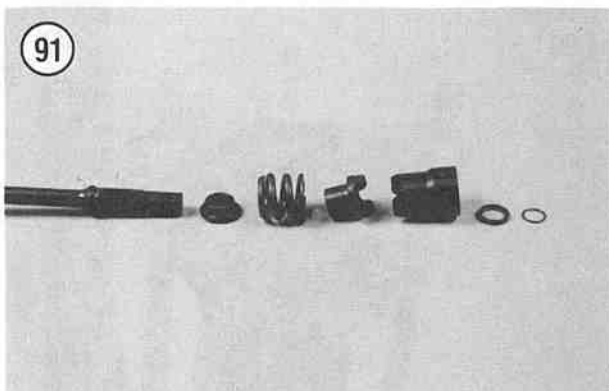
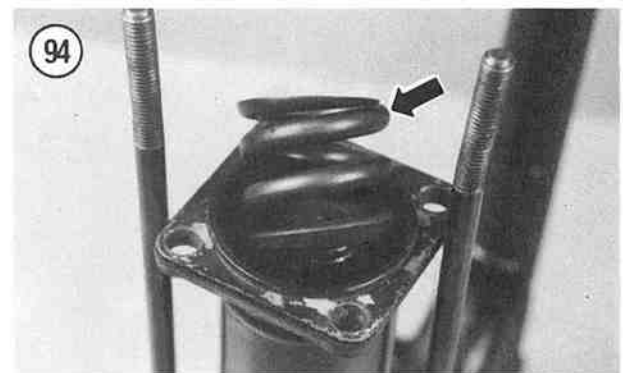
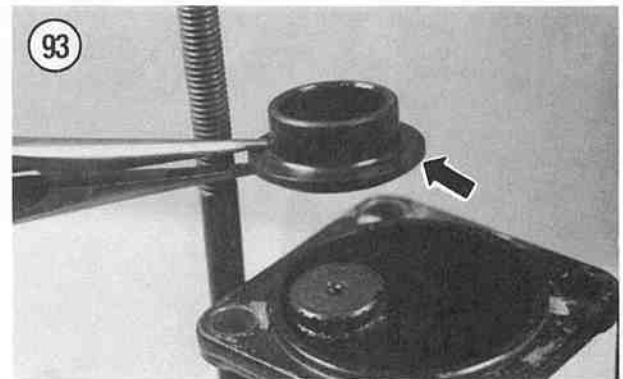
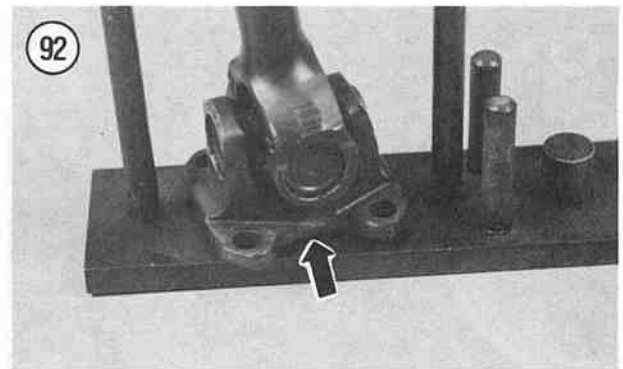
### Drive Shaft Installation

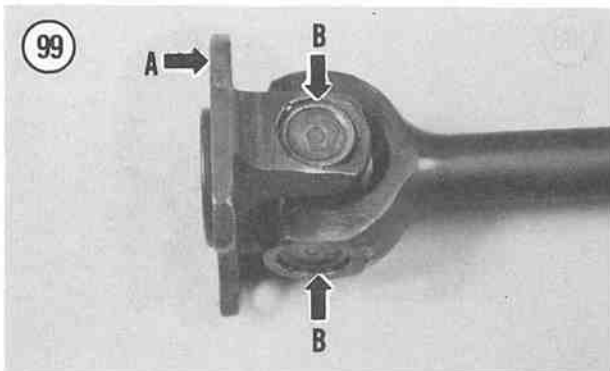
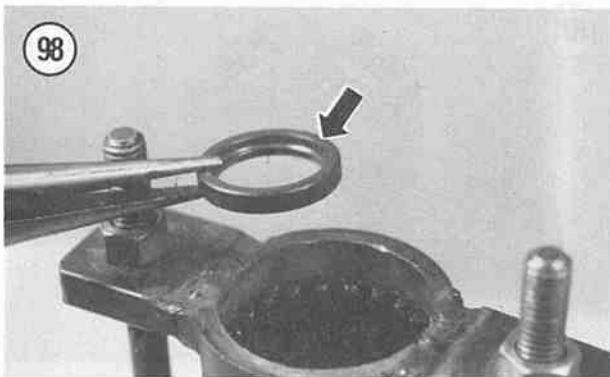
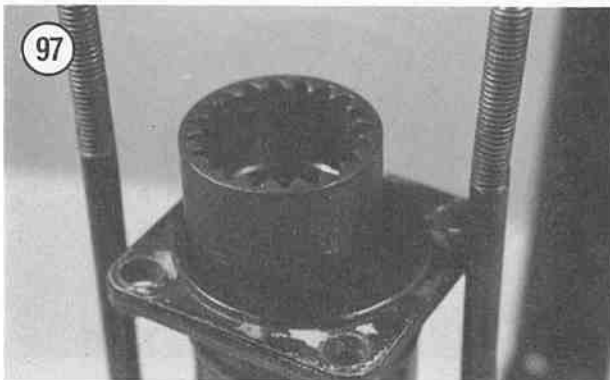
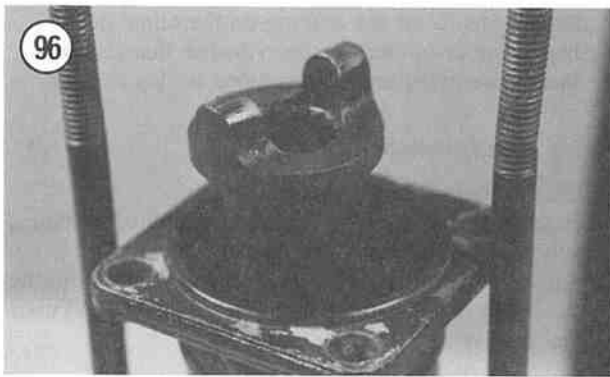
**WARNING**

*Without the BMW proper tool, this procedure can be dangerous and may damage internal ports of the drive shaft. For a small bench fee, a dealer can do the job for you.*

Refer to **Figure 85** and **Figure 91** for this procedure.

1. Install the drive shaft onto the raised boss on the special tool (**Figure 92**).
2. Install the swing arm onto the drive shaft.
3. Position the spring seat with the shoulder end (**Figure 93**) going in first and install the spring seat onto the drive shaft.
4. Install the spring (**Figure 94**).
5. Position the shock absorber front cam so the cam lobes (A, **Figure 95**) are 90° away from the depressed notch (B, **Figure 95**) in the drive shaft splines. If the front cam is not aligned in this manner, the cam will *not* slide down all the way and reach the spring.





6. Install the shock absorber front cam (Figure 96) and slide it down until it contacts the spring. If it doesn't contact the spring, refer to Step 5 for correct alignment.
7. Install the shock absorber rear cam (Figure 97).
8. Install the upper plate (A, Figure 90) onto the fixture and onto the end of the drive shaft shock absorber rear cam.
9. Slide on the spacer sleeves (if needed) and screw both nuts (B, Figure 90) onto the threaded rod.
10. Tighten the two nuts evenly in small increments and compress the drive shaft spring within the swing arm.
11. Compress the spring enough to install the spacer ring and the snap ring.
12. Position the spacer ring with the recess side facing out (Figure 98). This is necessary in order to accept the snap ring.
13. Install a new snap ring onto the end of the drive shaft and into the recess in the spacer ring. Make sure the snap ring is properly seated in the groove.
14. Gradually and evenly, unscrew both nuts and release the spring pressure. Make sure the snap ring is still properly seated in the groove.
15. Remove both nuts, both spacer sleeves (if used) and the upper plate from the special tool.
16. Apply a light coat of Staburags NBU 30PT grease (Figure 52), available from BMW dealers, to the inner splines of the shock absorber rear cam.
17. Install the rubber boot and clamps onto the end of the swing arm.
18. Install the swing arm as described in this chapter.

### Drive Shaft Inspection

1. Clean all parts in solvent and thoroughly dry with compressed air.
2. Inspect the mounting plate (A, Figure 99) of the universal joint end of the drive shaft. If it is damaged or cracked, the drive shaft must be replaced. The universal joint is integral with the drive shaft and cannot be replaced separately.
3. Inspect the universal joint pivot points for play (B, Figure 99). Rotate the joint in both directions. If there is noticeable side play, the drive shaft must be replaced.
4. Inspect the inner splines (Figure 100) of the rear cam where it attaches to the final drive unit. If they are damaged or worn, the rear cam must be replaced.

### NOTE

*If the inner splines are damaged, also check the splines of the final drive unit; it may also have to be replaced.*

5. Inspect the inner splines (**Figure 101**) of the front cam where it slides onto the drive shaft splines. If they are damaged or worn, the front cam must be replaced.

#### NOTE

*If the inner splines are damaged, also check the splines of the drive shaft; it may also have to be replaced.*

6. Inspect both of the shock absorber front and rear cam surfaces (**Figure 102**) for wear or damage. For the best performance and smooth operation, replace both cams even if only one cam surface is damaged.
7. Inspect the spring (**Figure 103**) for wear or damage; replace if necessary. BMW does not provide a service limit dimension for the spring free length.
8. Inspect the drive shaft splines (**Figure 104**) for wear or damage; replace if necessary.
9. Inspect the spring seat for wear or damage, especially where it comes in contact with the spring. Replace if necessary.
10. Inspect the spacer ring (**Figure 105**) for wear or damage, especially where it comes in contact with the snap ring. Replace if necessary.
11. Apply clean gear oil to all parts prior to reassembly.

#### Swing Arm Roller Bearing Replacement

Refer to **Figure 84** for this procedure.

#### CAUTION

*Do not remove the bearing for inspection purposes. Never reinstall a bearing that has been removed. During removal it becomes slightly damaged and is no longer true to alignment. If installed, it will create an unsafe riding condition.*

1. Remove the swing arm as described in this chapter.
2. Remove the drive shaft as described in this chapter.
3. Using special tool (Kukko Extractor No. 21/3 and Support 22-1), withdraw the roller bearing from the pivot point.
4. Repeat Step 3 for the bearing on the other side.
5. Thoroughly clean the inside of the swing arm with solvent and dry with compressed air.

#### CAUTION

*In order to prevent damage to the swing arm, place one end of the swing arm on a piece of soft wood when installing the bearing into the opposite side.*

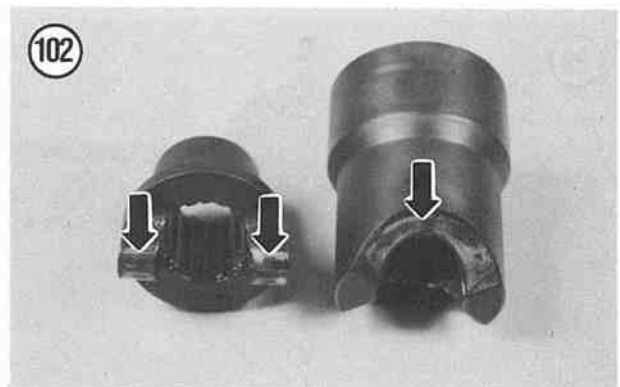
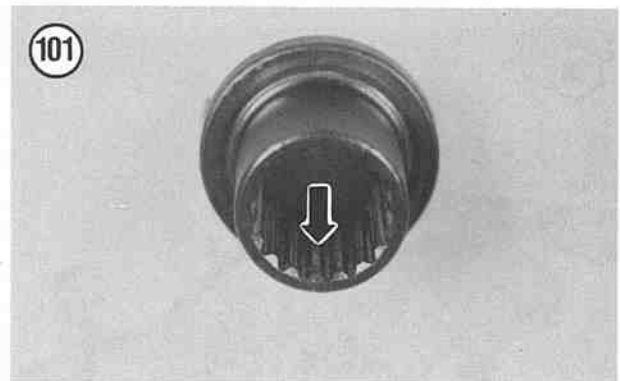
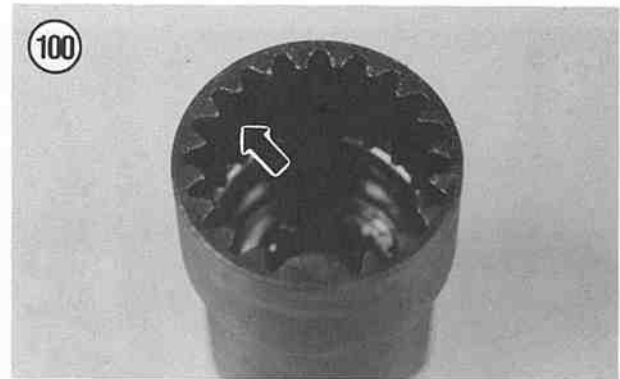
6. Install the new bearing onto the swing arm. Use a suitable size socket that matches the outer race. Tap the bearing in slowly and squarely until it seats completely. Make sure it is properly seated.

7. Repeat Step 6 for the bearing on the other side.
8. Install the drive shaft as described in this chapter.
9. Install the swing arm as described in this chapter.

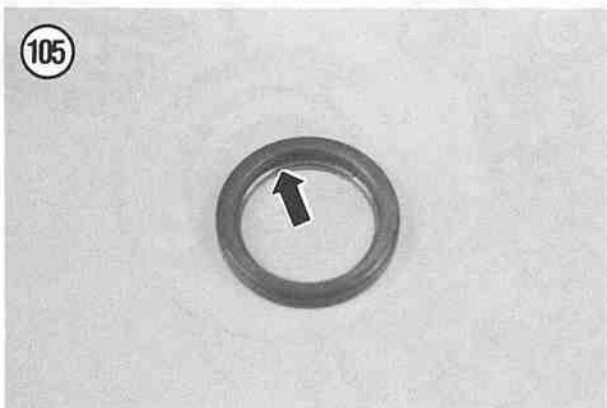
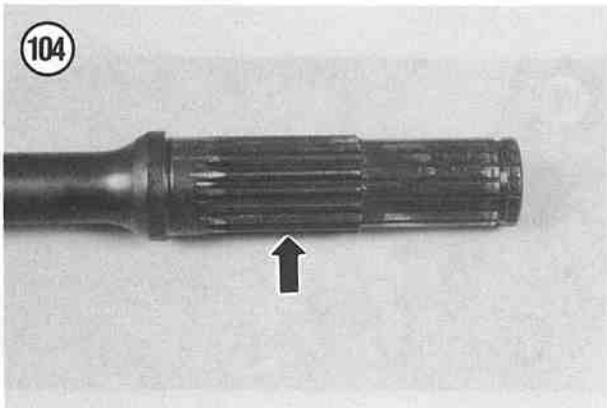
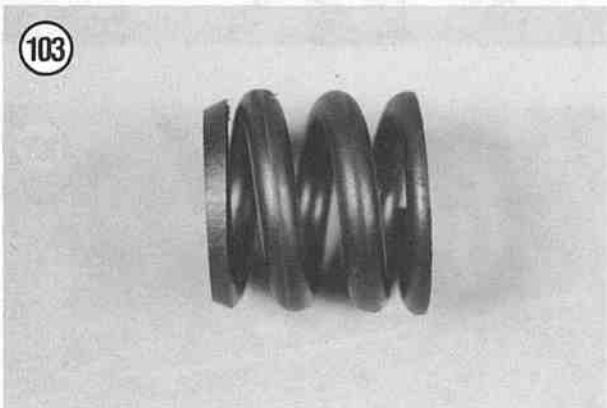
#### Swing Arm Installation

Refer to **Figure 84** for this procedure.

1. Position the swing arm, rubber boot and both clamps into the mounting area of the frame.
2. Align the holes in the swing arm with the holes in the frame. Position the swing arm on the wood block(s) used during removal.



3. Center the swing arm within the mounting area of the frame.
4. Install the pivot pin in from each side. Make sure the swing arm is still centered and that the gap between the swing arm and frame is equal on each side. Check the clearance with a vernier caliper. Correctly position the swing arm until the clearance is correct.
5. Screw both pivot pins in all the way—maintain equal clearance on each side.



**CAUTION**  
*In Step 6 the initial torque specification is used only to seat and preload the bearings. Never leave the pivot pins tightened to this initial torque specification as the bearings will be damaged.*

6. Tighten both pivot pins to the *initial torque specification* listed in **Table 1**. Remember to maintain the equal clearance on each side. Readjust if necessary.
7. Partially screw the locknut onto each pivot pin, but do not let them make contact within the swing arm receptacle.
8. Loosen the pivot pins and then retighten to the final torque specification listed in **Table 1**.

**CAUTION**  
*Make sure the pivot pin does not move while tightening the locknut. If the pivot pin moves, it will be tighter than specified and the bearing will wear prematurely.*

9. Hold onto the pivot pin (B, **Figure 89**) and tighten the locknut (A, **Figure 89**) on each side to the torque specification listed in **Table 1**.
10. Remove the box from under the swing arm. Move the swing arm up and down and make sure it moves freely—but not loosely.
11. Again check and make sure there is still an equal clearance between the swing arm and frame. Readjust if necessary.
12. Install the swing arm pivot pin trim cap on each side.
13. If not already in gear, shift the transmission into 5th gear. This will prevent the drive shaft from turning in the following steps.

**NOTE**  
*The bolts used to secure the drive shaft to the transmission output shaft have been redesigned to eliminate the need for a lockwasher. This new bolt has better retention qualities and is shorter than the one used with the lockwasher.*

**CAUTION**  
*Always replace the bolts every time they are removed. These bolts are the stretch type and will break off if used for the second time.*

**CAUTION**  
*Do not oil the bolt threads prior to installation—they must be dry. They must be installed dry in order to be tightened to the correct torque specification.*

14. Install the bolts (Figure 87) and lockwashers securing the drive shaft to the transmission output shaft. Tighten the bolts (Figure 106) in a crisscross pattern to the torque specification listed in Table 1.

#### CAUTION

*The rubber boot must be installed correctly on both the swing arm and the transmission housing flange. This boot protects the universal joint from moisture and foreign matter. If the boot is not installed correctly, the universal joint will wear out prematurely.*

15. Slide the rubber boot onto the transmission housing and onto the swing arm. Make sure it is properly seated on both components.
16. Correctly position both clamping bands and tighten the screws securely.
17. Remove the wood box or block(s) from under the swing arm.
18. Install the shock absorber as described in this chapter.
19. Install the final drive unit as described in this chapter.
20. Install the rear wheel as described in this chapter.
21. Refill the swing arm lubricant as described in Chapter Three.

### FINAL DRIVE UNIT (ALL MODELS EXCEPT R100GS)

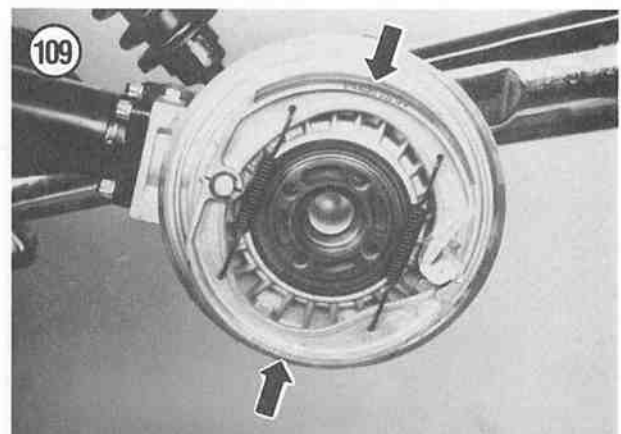
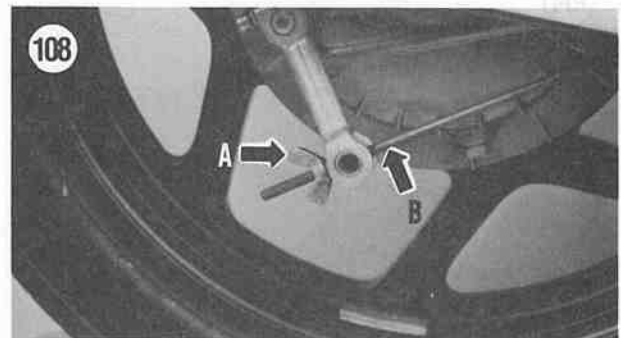
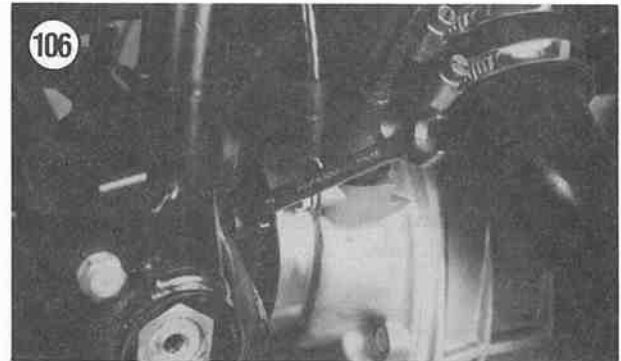
#### Removal

1. Remove the rear wheel (A, Figure 107) as described in this chapter.

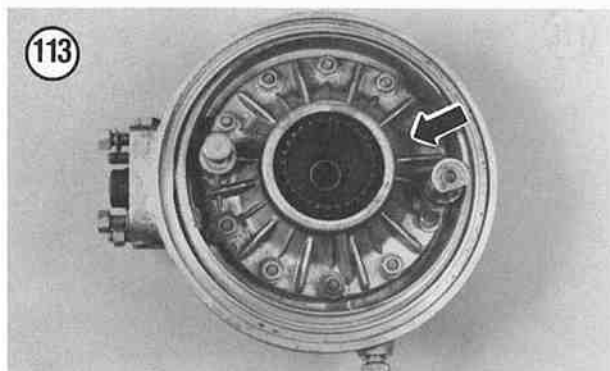
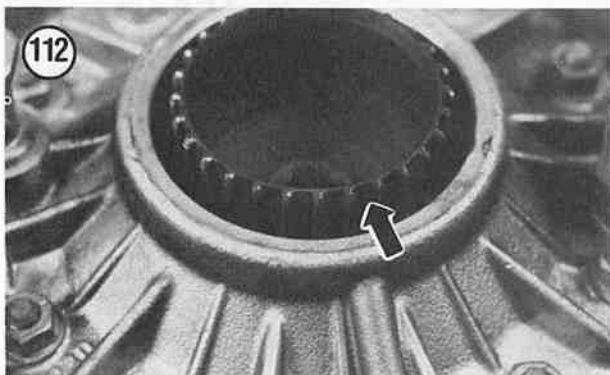
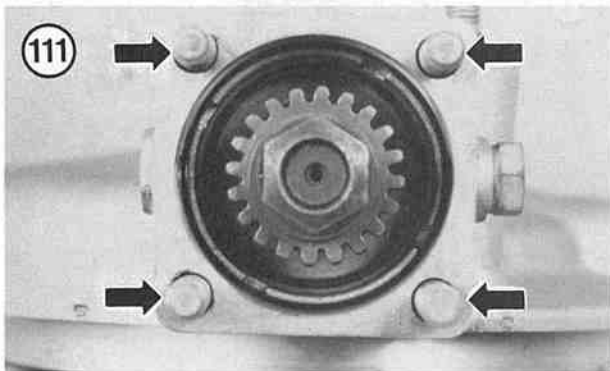
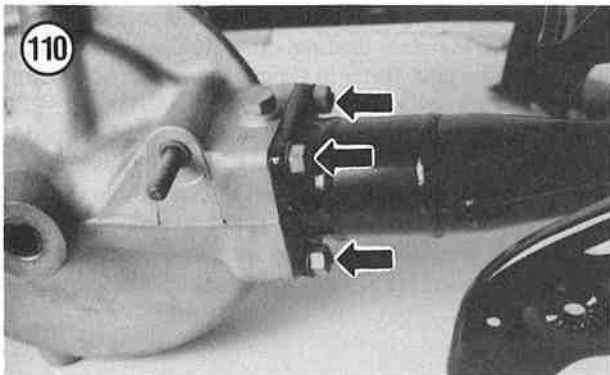
#### NOTE

*Removal of the right-hand muffler is not necessary but it does provide additional working space and eliminates the possibility of any damage to the muffler during this procedure.*

2. Remove the right-hand muffler (B, Figure 107) as described under *Muffler Removal/Installation* in Chapter Seven.
3. On drum brake models, perform the following:
  - a. Completely unscrew the brake adjuster nut (A, Figure 108).
  - b. Depress the brake pedal to withdraw the brake rod (B, Figure 108) from the actuating arm.
  - c. Remove the pivot pin from the brake actuating arm.
  - d. Reinstall the pivot pin and the adjuster nut on the brake rod to avoid misplacing them.
  - e. Remove the brake shoes (Figure 109) as described in Chapter Eleven.







4. Place a wood block under the swing arm to support it after the shock absorber(s) is removed.
5. Remove the shock absorber from the final drive unit as described in this chapter.
6. Drain the drive shaft oil from the swing arm as described under *Drive Shaft Oil Change* in Chapter Three.
7. Unscrew the nuts and lockwashers (Figure 110) securing the final drive unit to the swing arm.
8. Place a drain pan under the swing arm where the final drive unit attaches. When the final drive unit is removed, some residual oil will drain out.
9. Pull back on the final drive unit and separate it from the drive shaft and swing arm. If necessary, gently tap on the final drive unit with a soft-faced mallet or plastic hammer to separate it.
10. Remove the final drive unit and take it to your workbench for inspection or disassembly. Don't lose the locating dowels. It is not necessary to remove them if they are secure and are in good condition.
11. Inspect all parts as described in this chapter.

**Inspection**

1. Inspect the exterior of the final drive unit housing for cracks or damage. If damaged, replace the housing as described under *Final Drive Overhaul* in this chapter.
2. Inspect the exterior of the final drive unit housing cover for cracks or damage. Replace if necessary as described under *Final Drive Overhaul* in this chapter.
3. Inspect the threaded studs (Figure 111) where the final drive unit attaches to the swing arm. If damaged, clean up the threads with the correct size and pitch thread die. If the threads cannot be fixed, replace the threaded stud(s).
4. Inspect the splines (Figure 112) of the coupling hub. If the splines are worn or damaged, the coupling hub must be replaced as described under *Final Drive Overhaul* in this chapter.

**NOTE**

*If the splines are worn or damaged, also inspect the splines on the end of the drive shaft for damage as described in this chapter; it may also need to be replaced.*

5. Check for any signs of oil leakage at the spline portion. If the oil seal has been leaking, it must be replaced as described under *Final Drive Overhaul* in this chapter.
6. Make sure the cover (Figure 113) mounting nuts are tight. Refer to Table 1 for torque specifications.
7. Inspect the shock absorber lower mounting stud for wear or damage. If necessary, clean out the threads with the correct size and pitch thread die or replace if necessary.

## Installation

1. Apply a thick coat of LM47 rear drive spline lubricant (**Figure 114**) to the final drive unit coupling hub splines (**Figure 115**) and to the drive shaft splines (**Figure 116**).
2. Make sure the swing arm is in the correct height position.

### CAUTION

*The final drive unit must bottom out on the mating surface of the swing arm prior to installing the mounting nuts. Do not install or tighten any mounting nuts to try to pull the 2 assemblies together. If there is interference, pulling the 2 parts together will only damage internal parts, leading to costly parts replacement.*

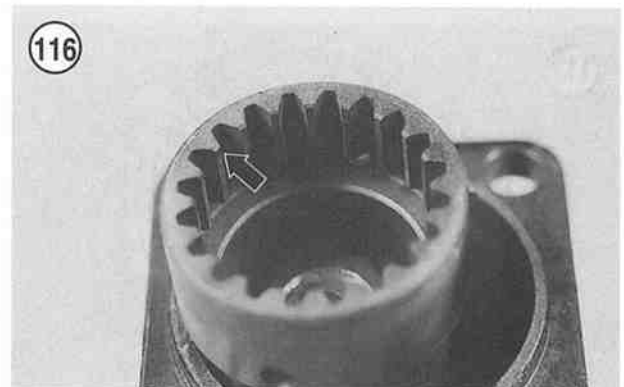
3. Install the final drive unit onto the swing arm. If necessary, slightly rotate the ring gear until the splines align with the drive shaft. Push the final drive unit on until it completely bottoms out. If the 2 parts will not seat correctly, remove the final drive unit and correct the problem.
4. Install the lockwashers and nuts (**Figure 110**) securing the final drive unit to the swing arm. Using a crisscross pattern, tighten the nuts to the torque specification listed in **Table 1**.
5. Install the shock absorber as described in this chapter.
6. Remove the wood block from under the swing arm.
7. On drum brake models, perform the following:
  - a. Install the brake shoes (**Figure 109**) as described in Chapter Eleven.
  - b. Completely unscrew the brake adjuster nut from the brake rod and remove the pivot pin also.
  - c. Install the pivot pin into the brake actuating lever.
  - d. Depress the brake pedal and reinstall the brake rod into the pivot pin in the actuating arm.
  - e. Loosely reinstall the adjuster nut on the brake rod.
  - f. Adjust the rear brake as described under *Rear Drum Brake Height and Freeplay Adjustment* in Chapter Three.
8. Install the rear wheel as described in this chapter.
9. Install the right-hand muffler as described in Chapter Seven.

## Overhaul (All Models Except R100GS)

Complete final drive service requires a number of special tools, including a heat gun or hot plate in some instances. However, it is possible to partially disassemble the unit to replace the ring gear seal. This can be accomplished with suitable substitutes for the BMW tools listed in the procedure. A leaking ring gear seal, a typical occurrence, is indicated if there is gear lubricant noticed at the weep hole

in the bottom of the final drive unit. If this seal is leaking, make sure to maintain the final drive fluid level to prevent damage to the unit. Refer to Chapter Three for service intervals and service procedures.

The following procedure describes a complete reconditioning of the final drive unit. It may be possible, as with the ring gear seal, to partially disassemble the unit without affecting the backlash. If the remaining components are in good condition and were not effected by the failed component(s), do not unnecessarily disassemble the entire unit.



Prior to starting, carefully read the entire procedure. Disassembling the unit is complicated but not nearly as complicated as reassembling it. During assembly critical tolerances must be calculated as described under *Pinion Gear-to-Ring Gear Adjustment*. Also the proper gear backlash between the ring and pinion gear must be achieved in order to have the correct gear tooth contact between the 2 parts. If the gear backlash is incorrect, the ring and pinion gears will wear prematurely and will also emit a "howl" when riding.

The following BMW special tools are required for the overhaul procedure:

- a. Case holding fixture (part No. 33 1 600).
- b. Assembly sleeve (part No. 33 1 000).
- c. Cover oil seal mandrel and driver (part No. 33 1 850 and No. 00 5 500).
- d. Housing oil seal mandrel and driver (part No. 33 1 880 and No. 00 5 500).
- e. Pinion gear nut backplate (part No. 33 1 650).
- f. Threaded ring remover (part No. 33 1 700).
- g. Threaded ring seal mandrel and driver (part No. 33 1 750 and No. 00 5 500).
- h. Needle bearing remover (Kukko) (part No. 23/1).
- i. Drive pinion ball bearing puller (part No. 00 7 500).

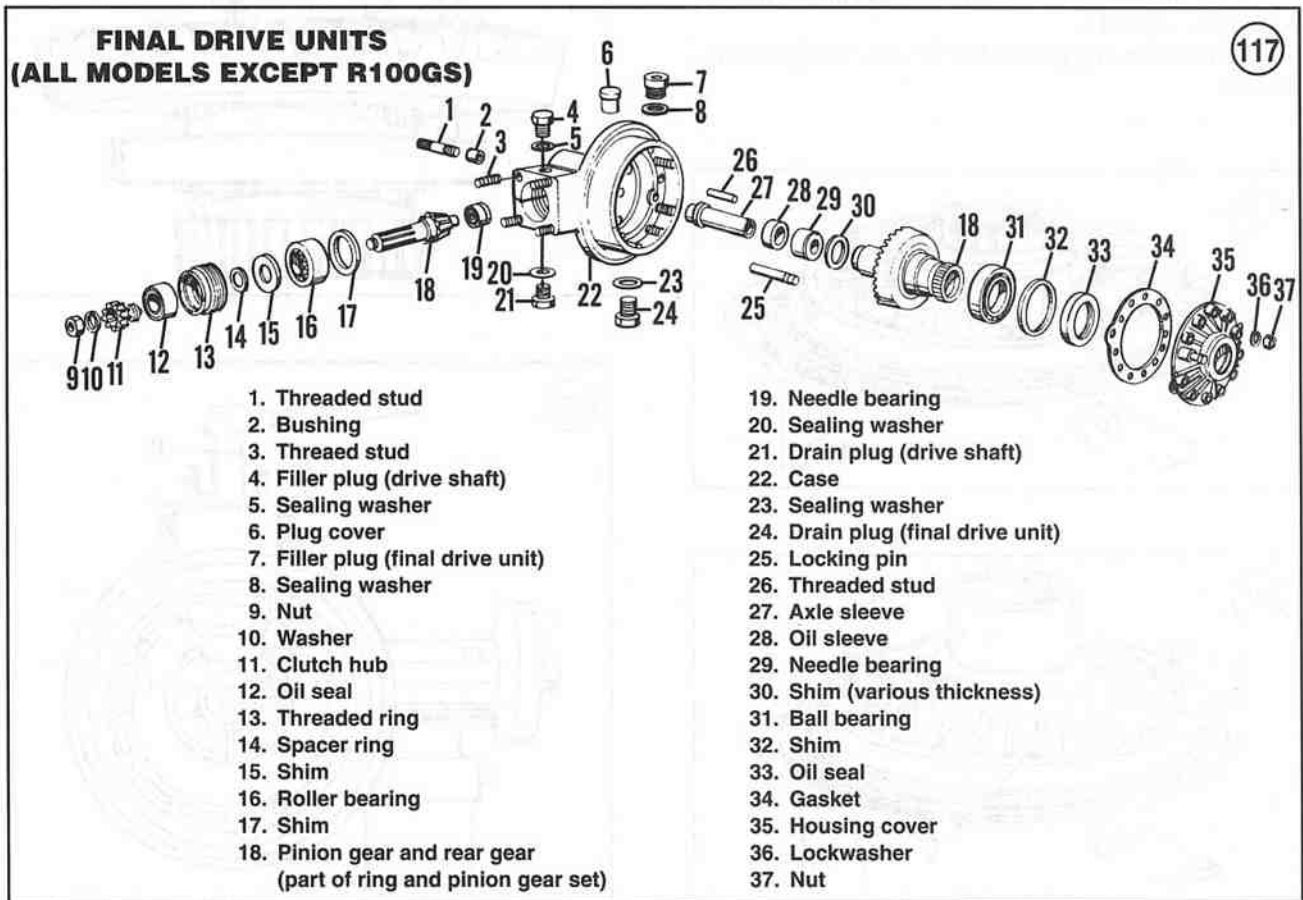
**Disassembly**

Refer to **Figure 117** for this procedure.

**WARNING**

*During this procedure many of the components must be heated for removal. Protect your hands when handling hot components. Either wear thick gloves or use heavy household pot holders to hold onto hot parts.*

1. On drum brake models, if not already removed, remove the brake shoes as described under *Rear Drum Brake* in Chapter Eleven.
2. If not already drained, remove the drain plug and the filler cap. Drain out all of the gear oil, then reinstall the drain plug and filler cap and tighten both securely.
3. Secure the final drive unit in the BMW special tool (part No. 33 1 600) and secure the special tool in a vise as shown in **Figure 118**.
4. Make alignment marks on the case and cover. This will ensure correct alignment of the 2 parts during assembly.
5. Remove the nuts and lockwashers securing the housing cover.



6. To protect the ring gear oil seal, install the BMW special tool assembly sleeve (part No. 33 1 000) onto the ring gear (A, **Figure 119**).

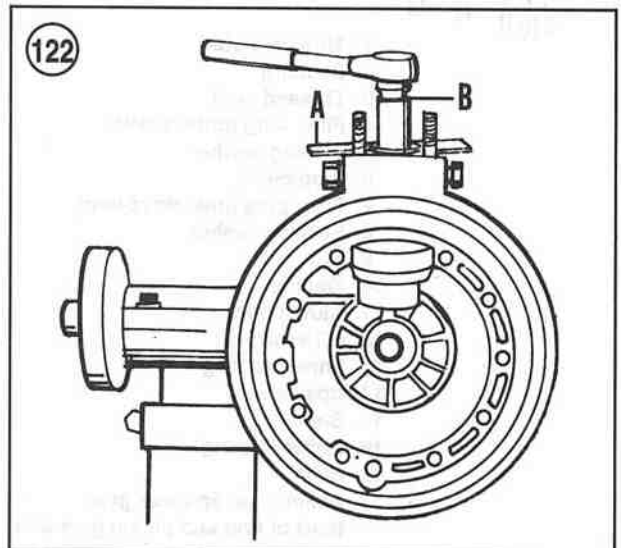
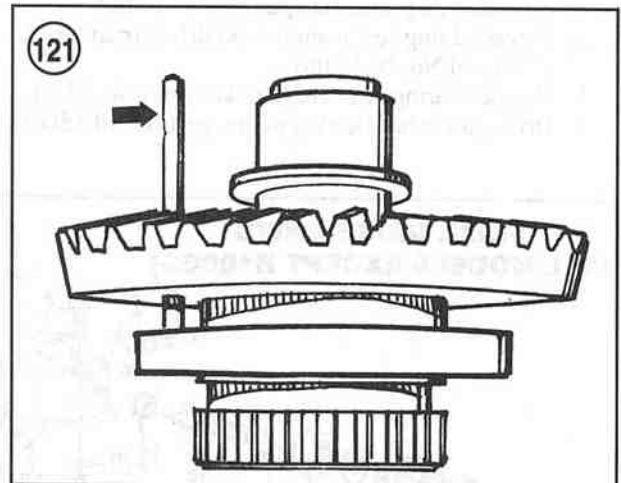
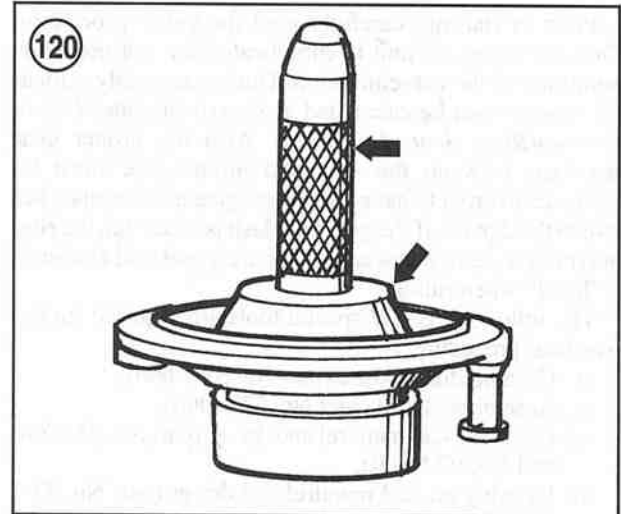
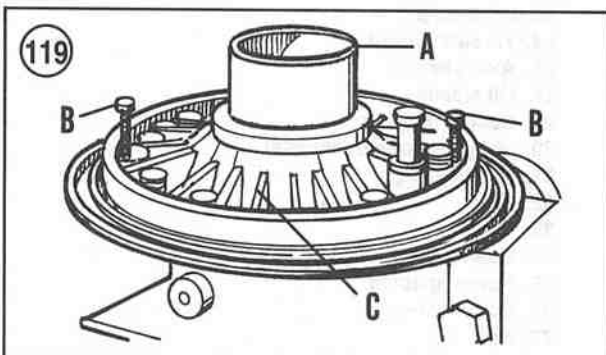
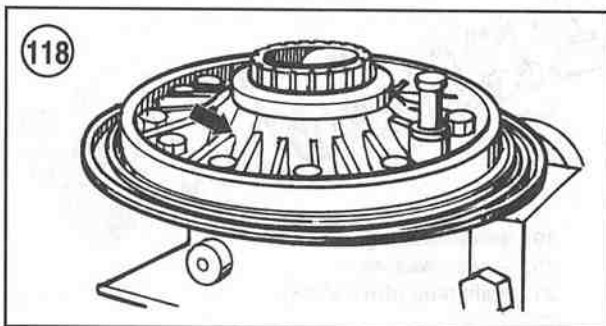
7. Thread a pair of M5 × 30 bolts (B, **Figure 119**) into the threaded holes in the housing cover provided for this purpose.

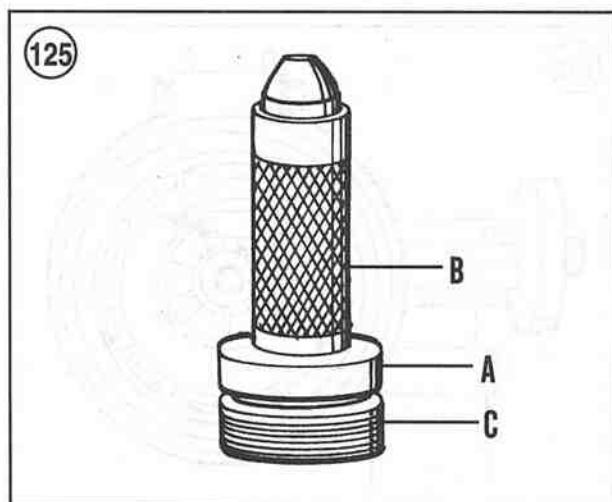
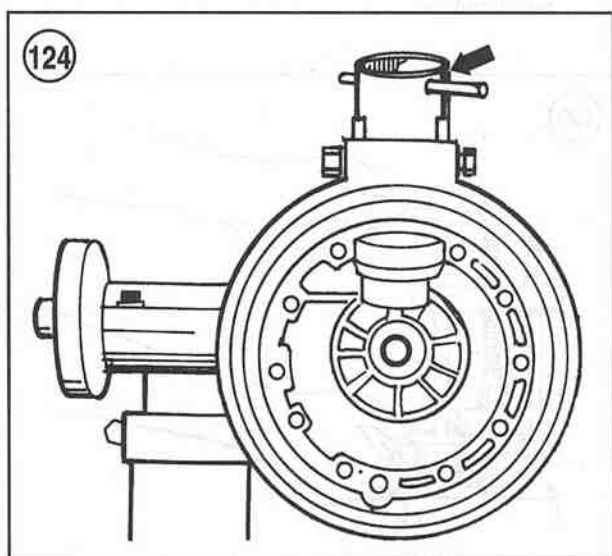
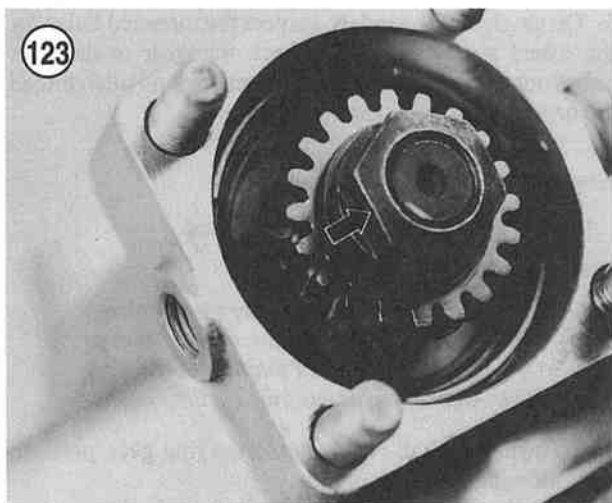
8. Carefully remove the housing cover (C, **Figure 119**) and gasket. Discard the gasket. Don't lose the shim located between the ring gear and the housing cover. If necessary, use a heat gun to heat the housing cover to about 100° C (215° F).

9. To replace the ring gear oil seal in the cover, perform the following:

- Note the installed position of the seal. The new must be installed in the same position.
- Use a hammer and drift and work around the perimeter of the oil seal and carefully tap the seal out of the cover. Discard the oil seal. Be careful not to damage the cover in the area of the oil seal.
- Clean out the oil seal area of the cover with solvent and thoroughly dry.
- Apply a light coat of oil to the outer surface of the new oil seal.
- Using BMW seal driver (part No. 33 1 850 and No. 00 5 500 or an equivalent), carefully tap the new oil seal into the case (**Figure 120**). Be sure to tap the oil seal in squarely. Make sure the seal does not cover the weep hole.

10. Remove the ring gear and bearing assembly from the housing.





11. To remove the ball bearing assembly from the ring gear, perform the following:

- a. Insert a soft-aluminum or brass drift through the holes in the ring gear (Figure 121).
- b. Working around the perimeter of the bearing, carefully tap the bearing off of the ring gear shaft.
- c. Remove the ball bearing from the ring gear shaft.

12. Install the BMW special tool, backplate for the pinion (part No. 33 1 650) (A, Figure 122). Using a socket and wrench (B, Figure 122), remove the nut (Figure 123), plastic ring (models so equipped) and washer securing the clutch hub.

13. Remove the clutch hub from the pinion gear shaft.

14. Using BMW special tool, socket wrench (part No. 33 1 700) (Figure 124), unscrew the threaded ring from the final drive unit neck.

15. Remove the threaded ring and oil seal from the pinion gear shaft.

16. Remove the spacer ring and the shim from the pinion gear shaft.

17. To remove the oil seal from the threaded ring, perform the following:

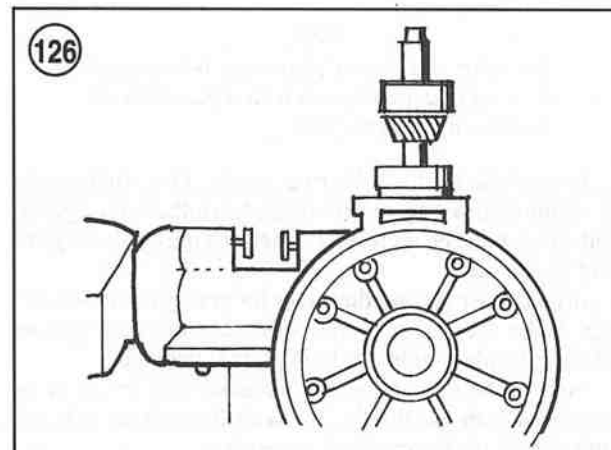
- a. Using BMW special tools, arbor (part No. 33 1 750) (A, Figure 125) and handle (part No. 00 5 500) (B, Figure 125), carefully tap the oil ring out of the threaded ring (C, Figure 125).
- b. Using the same tool setup, install a new oil seal into the threaded ring.

18. Using a heat gun, heat the final drive unit neck (surrounding the roller bearing outer race) to 125° C (260° F).

**CAUTION**

*Do not damage the splines on the pinion gear while removing the pinion gear and roller bearing from the final drive unit neck.*

19. Use a pair of slip-joint pliers or Vise Grips and carefully withdraw the pinion gear and the ball bearing from the final drive unit neck (Figure 126).





20. To remove the roller bearing assembly from the pinion gear, perform the following:
  - a. Place the pinion gear and roller bearing in a vise with soft jaws to protect the gears.
  - b. Install BMW special tools (part No. 00 7 500) onto the pinion gear and bearing assembly (**Figure 127**).
  - c. Withdraw the bearing assembly from the pinion gear.
21. To remove the pinion gear needle bearing from the case, perform the following:
  - a. On models so equipped, remove the screw (**Figure 128**) securing the needle bearing in the housing.
  - b. Insert Kukko internal extractor (part No. 21/3) into the neck of the case and position it behind the needle bearing. Turn the special tool end to expand it behind the needle bearing.
  - c. Install a commercial bearing puller to the extractor.
  - d. Using a heat gun, heat the final drive unit neck (surrounding the needle bearing) to 120° C (250° F).
  - e. Carefully and slowly tighten the bearing puller and withdraw the tapered roller bearing from the case.
22. To remove the ring gear oil seal from the housing, perform the following:
  - a. Use a hammer and drift and work around the perimeter of the oil seal and carefully tap the seal out of the housing. Discard the oil seal. Be careful not to damage the housing in the area of the oil seal.
  - b. Clean out the oil seal area of the housing with solvent and thoroughly dry.
  - c. Apply a light coat of oil to the outer surface of the new oil seal.
  - d. Using BMW special tools (part No. 33 1 850 and No. 00 5 500), carefully tap the new oil seal into the case (**Figure 129**). Be sure to tap the oil seal in squarely and tap it in until it bottoms out in the cover.

### Inspection

1. Wash all parts in solvent and, dry thoroughly with compressed air.

#### NOTE

*The ring and pinion gear must be replaced as a set and are marked with a pair code on each gear (**Figure 130**).*

2. Inspect the teeth on the ring gear and the pinion gear set. If the teeth are worn or damaged on either of the gears, both gears must be replaced as a set (the only way they are sold is as a set).
3. Inspect the case and the cover for cracks or other damage. Make sure all ribs and bosses are not damaged or missing. Replace either or both parts if damaged.
4. Inspect the threads on the threaded ring for wear or damage. Clean out the threads with the correct size and pitch thread tap or replace if necessary.

5. On single shock models, inspect the threaded holes for the wheel mounting bolts. Check for wear or damage. Clean out the threads with the correct size and pitch thread tap or replace if necessary.

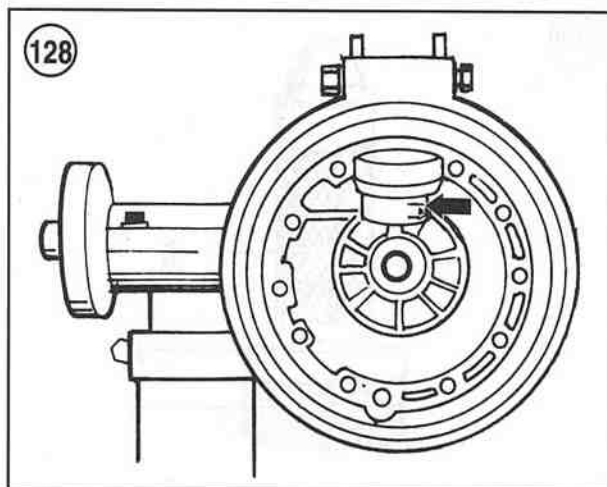
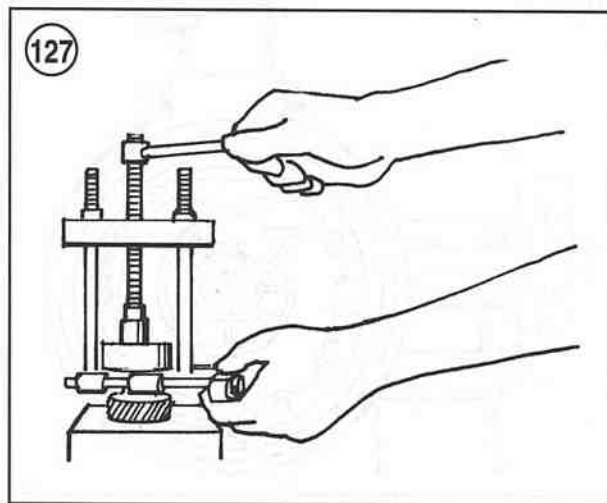
### Assembly

Refer to **Figure 117** for this procedure.

#### NOTE

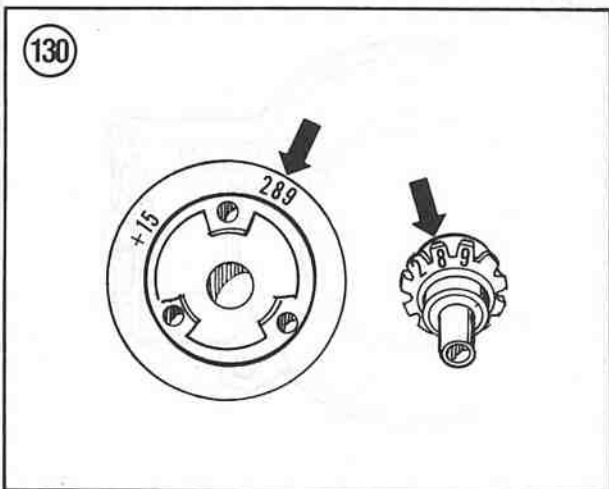
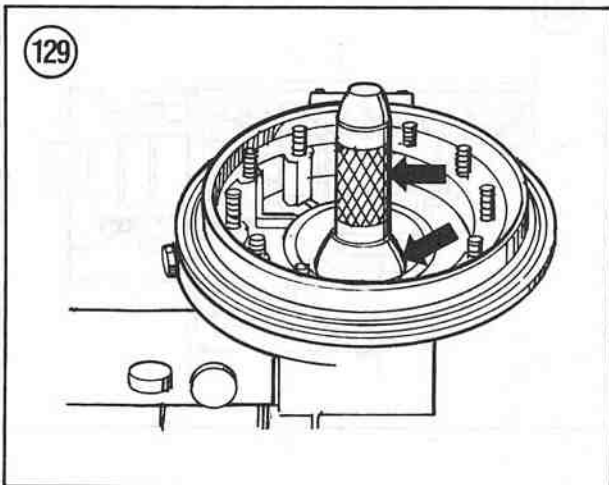
*If the pinion gear and ring gear were replaced with a new gear set, or any of the bearings were replaced, perform **Pinion Gear-To-Ring Gear Adjustment** as described in this chapter.*

1. To install the ball bearing onto the ring gear, perform the following:
  - a. Using a heat gun or hot plate, heat the bearing assembly to 100° C (215° F). This will expand the inner diameter.



- b. Also place the ring gear assembly in a freezer for 30 minutes. This will reduce its overall size.
  - c. Position the ring gear with the portion where the ball bearing rides facing up.
  - d. Secure the ring gear in a vise with soft jaws.
  - e. Install the bearing onto the ring gear and tap it down until it bottoms out. If the bearing is heated and the ring gear is chilled, the bearing should slide down into place without any force required.
  - f. Apply fresh gear oil to the ball bearing.
  - g. Remove the ring gear from the vise.
2. To install the needle bearing on the ring gear, perform the following:
- a. Place the ring gear assembly in a freezer for 30 minutes. This will reduce its overall size.
  - b. Using a heat gun or hot plate, heat the bearing assembly to 80° C (175° F). This will expand the inner diameter.
  - c. Position the ring gear with the portion where the needle bearing rides facing up.

- d. Secure the ring gear in a vise with soft jaws.
  - e. Install a shim of the correct thickness onto the ring gear.
  - f. Install the bearing onto the ring gear and tap it down until it bottoms out. If the bearing is heated and the ring gear is chilled, the bearing should slide down into place without any force required.
  - g. Apply fresh gear oil to the needle bearing.
  - h. Remove the ring gear from the vise.
3. To install the pinion gear needle bearing into the case, perform the following:
- a. Clamp the final drive case in the BMW special tool (part No. 33 1 600).
  - b. Place the pinion gear needle bearing in a freezer for 30 minutes. This will reduce its overall size.
  - c. Using a heat gun, heat the case in the area where the needle bearing is to be located. Heat the case to 100° C (212° F).
  - d. Position the needle bearing with the identification marks facing out.
  - e. Install the needle bearing into the case. Tap it in with a suitable size socket or use the pinion gear. Tap it in until it bottoms out in the case. Make sure the needle bearing is installed straight in and that it does not get cocked in the case during installation.
  - f. On models so equipped, install the screw (Figure 128) and tighten securely.
  - g. Apply fresh gear oil to the roller bearing.
4. Place the ring gear assembly in a freezer for about 30 minutes. This will reduce its overall size.
5. Install the ring gear into the housing. Push it down until it bottoms out.
6. Install the shim on the ring gear.
7. To install the housing cover, perform the following:
- a. Install BMW special tool assembly sleeve (part No. 33 1 000) onto the ring gear (A, Figure 119) to protect the cover oil seal during installation.
  - b. Install a new cover gasket onto the housing.
  - c. Using a heat gun, heat the case in the housing cover to 80° C (175° F).
  - d. Using the alignment marks made in Step 4 of *Disassembly*, align and install the housing cover.
  - e. If necessary, use a plastic hammer or soft-faced mallet to tap around the perimeter of the housing cover until it bottoms out.
  - f. Install the lockwashers and nuts securing the housing cover to the housing. Tighten the nuts in a crisscross pattern and tighten to the torque specification listed in Table 1.
8. To install the roller bearing assembly onto the pinion gear, perform the following:
- a. Place the pinion gear in a freezer for about 30 minutes. This will reduce its overall size.
  - b. Using a heat gun or hot plate, heat the roller bearing to 120° C (250° F).
  - c. Install a shim of the correct thickness onto the pinion gear shaft.



- d. Install the roller bearing assembly onto the pinion gear shaft.
  - e. Carefully tap the roller bearing assembly into place until it bottoms out.
  - f. Apply fresh gear oil to the roller bearing.
9. To install the needle bearing assembly into the final drive housing neck, perform the following:
    - a. Place the needle bearing in a freezer for about 30 minutes. This will reduce its overall size.
    - b. Using a heat gun, heat the final drive housing neck (surrounding the needle bearing) to 120° C (250° F).
    - c. Install the needle bearing into the final drive unit neck and carefully tap it into place with a suitable size socket that matches the bearing outer race.
    - d. Apply fresh gear oil to the needle bearing.
  10. Install the pinion gear into the final drive housing neck. Push it in until it bottoms out.
  11. Install the shim and spacer ring onto the pinion gear.
  12. Thoroughly clean the threaded ring of all oil and/or grease.
  13. Secure the final drive unit in the BMW special tool (part No. 33 1 600) and secure the special tool in a vise.
  14. Coat the threaded ring with a coat of Hylomar SQ 37 grease and place it in a freezer for about 15 minutes. This will reduce its overall size.
  15. Using a heat gun, heat the final drive unit neck (surrounding the ball bearing outer race) to between 80-100° C (175-215° F).

#### CAUTION

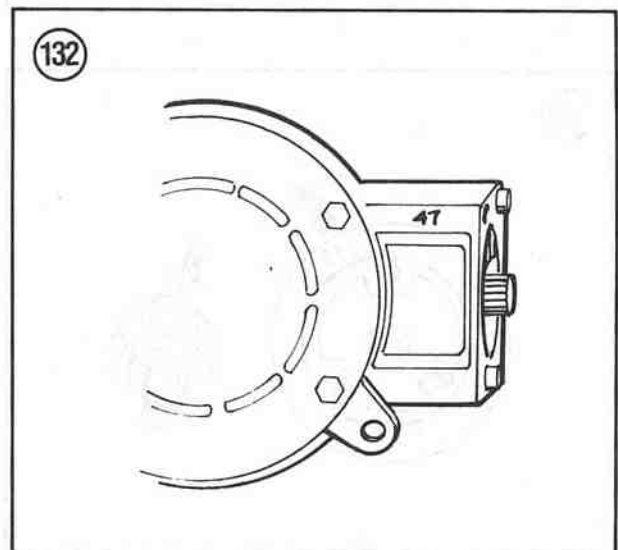
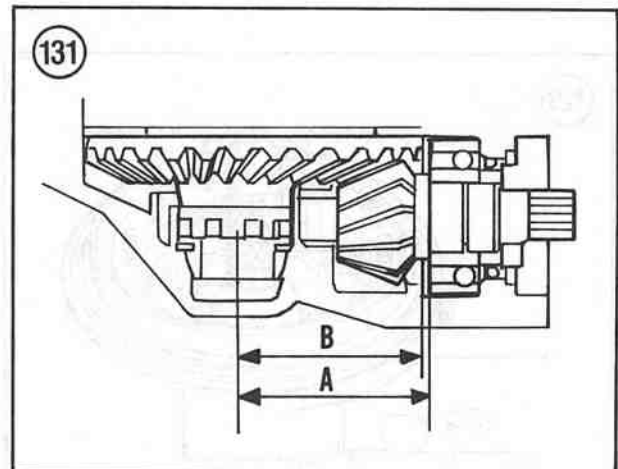
*Do not damage the new oil seal in the threaded ring during installation. After the threaded ring is installed, make sure the oil seal lip is seated correctly around the pinion gear shaft. This is necessary to prevent an oil leak.*

16. Start the threaded ring by hand, then using BMW special tool (part No. 33 1 700), screw in the threaded ring. Tighten the threaded ring to the torque specification listed in **Table 1**.
17. Install the clutch hub onto the pinion gear shaft.
18. Install the plastic ring (models so equipped) and washer.
19. Apply about 0.1 gram of Loctite No. 273 to the gear nut and install the nut.
20. Using a suitable size socket, tighten the gear nut to the torque specification listed in **Table 1**.
21. Install the drain plug and new sealing washer. Tighten the drain plug to the torque specification listed in **Table 1**.
22. On drum brake models, install the brake shoes as described under *Rear Drum Brake* in Chapter Eleven.
23. Refill the final drive unit with the recommended type and quantities of oil. See Chapter Three.

### PINION GEAR-TO-RING GEAR ADJUSTMENT (ALL MODELS EXCEPT R100GS)

If the ring and pinion gear set is being replaced, make sure they are from the same pair that was tested together and "designated as a compatible pair" at the BMW factory. The gears are run on a factory test stand and paired up in sets. This is to provide smooth running and the correct amount of backlash. After testing, they are then given a *pair code mark* that appears on both gears (**Figure 130**). Only accept a ring and pinion gear set from a BMW dealer with matching numbers—don't accept a set with 2 different numbers.

If a *new* ring and pinion gear set is going to be installed into a used case or a *new case* is going to be used with the used ring and pinion set, the tolerance between these parts must be checked. There is a specified distance that provides the correct relation of the ring gear to the pinion gear.



The pinion gear is installed in the case and the ring gear is installed in the cover. When the cover and case are attached to each other, the relationship between the ring gear and pinion gear must be correct.

**NOTE**

*If any of the bearings have been replaced within the final drive unit, all of the following procedures must be followed.*

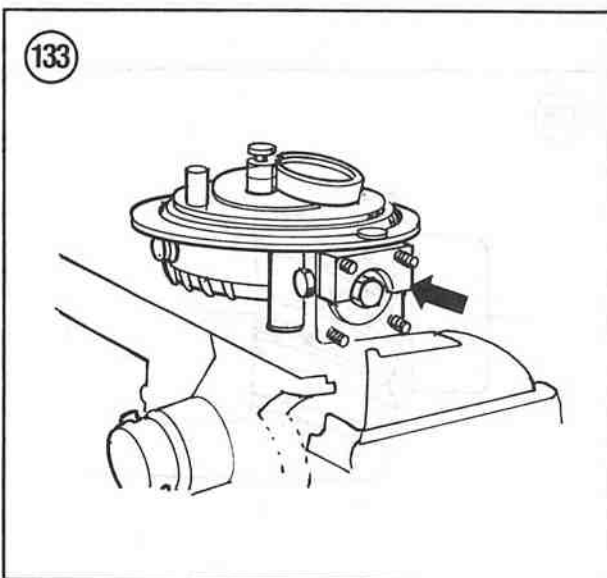
The *first section* of the procedure is for the pinion gear adjustment. This adjustment is made to correctly locate the pinion gear in relation to the case. A shim is used to achieve the in-and-out location of the pinion gear in the case and to correctly align it to the center of the ring gear.

The *second section* of the procedure is the adjustment of the ring gear backlash to the pinion gear. This adjustment is made to correctly locate the ring gear to the pinion gear. A shim is used to achieve the up-and-down location of the ring gear in the cover and to correctly align it with the pinion gear.

The *third section* is the tooth contact pattern or how the pinion gear and ring gear teeth mate to each other. The gear contact must be centered, otherwise, there will be abnormal stress placed on the gear teeth causing premature wear.

**Pinion Gear-to-Case Adjustment**

There is a specified distance for the location of the pinion gear within the case. This dimension is the distance from the inner surface of the pinion gear roller bearing to the centerline of the ring gear axis once the case and cover are assembled. The specified *drive pinion basic distance* is



77.50 mm; refer to dimension "A" in **Figure 131**. If the drive gear pinion is *not within specification* it is so marked on the outer surface of the ring gear. This number (e.g. +10) is a metric dimension in 1/100 of a millimeter and it is to be substituted for the standard number (e.g. +10 changes 77.50 mm to 77.60 mm).

Within the case is a shoulder where the pinion gear roller bearing stops during installation. This is called the "case basic distance" and it is 75.50 mm (3.022 in.); refer to dimension "B" in **Figure 131**. If the case has the exact finished distance, there will be no marking on it. If the case is *not within specification*, it is so marked on the inner surface with a number (e.g. 47) as shown in **Figure 132**. This number (e.g. 47) is a metric dimension in 1/100 of a millimeter and it is to be substituted for the standard number (e.g. 47 changes 75.50 mm to 75.47 mm).

Shims are available from BMW dealers in increments of 0.005 mm and range from 1.500-2.500 mm.

To determine the thickness of the shim required, perform the following:

If both the case and the pinion gear are within specification, subtract the case basic distance from the pinion gear basic distance:

$$\begin{array}{r} 77.50 \text{ mm} \\ -75.50 \text{ mm} \\ \hline 2.00 \text{ mm shim required} \end{array}$$

If the case is *not* within specification but the pinion is, subtract the case basic distance (minus any dimensional deviation—e.g. 47 = 75.47 mm) from the pinion gear basic distance:

$$\begin{array}{r} 77.50 \text{ mm} \\ -75.47 \text{ mm} \\ \hline 2.03 \text{ mm shim required} \end{array}$$

If the case is within specification but the pinion gear is *not* within specification, subtract the case basic distance from the pinion gear basic distance (plus any dimensional deviation—e.g. +10 = 77.60 mm):

$$\begin{array}{r} 77.60 \text{ mm} \\ -75.50 \text{ mm} \\ \hline 2.10 \text{ mm shim required} \end{array}$$

**Backlash Adjustment**

To check and adjust the backlash, several BMW special tools are required. They are as follows:

- a. Gear holding tool (part No. 33 2 620).
- b. Backlash adjuster (special dial indicator) (part No. 33 2 610).

1. Attach the gear holding tool (part No. 33 2 620) (**Figure 133**) so the pinion gear cannot rotate. The gear must remain stationary during this procedure, otherwise the results will be incorrect.



2. Attach the backlash adjuster (special dial indicator) (part No. 33 2 610) (**Figure 134**) to the final drive unit case.
3. Adjust the tool so that the dial gauge point is  $90^\circ$  to the rod on the special tool.
4. Adjust the dial gauge to zero.
5. Slightly rotate the ring gear back and forth and note the dial gauge reading.
6. Reposition the special tool and check the backlash  $120^\circ$  from the point tested in Step 5. Note the reading.
7. Again reposition the special tool and check the backlash  $120^\circ$  from the point tested in Step 6. Note the reading. The specified backlash is listed in **Table 2**.
- 8A. If the backlash is within specification, remove the special tools from the final drive unit case.
- 8B. If the backlash is incorrect, remove the special tools from the final drive unit case and perform the following:
  - a. Remove the ring gear from the final drive case.
  - b. Remove the shim and replace it with a thicker or thinner one.
  - c. Install the ring gear into the case and into mesh with the pinion drive gear.
  - d. Repeat Steps 1-7 until the correct amount of backlash is obtained.
9. Inspect the tooth contact pattern as described in this chapter.

### Tooth Contact Pattern

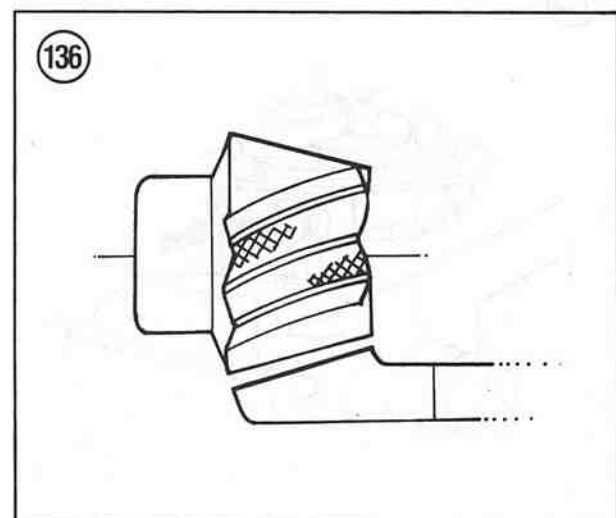
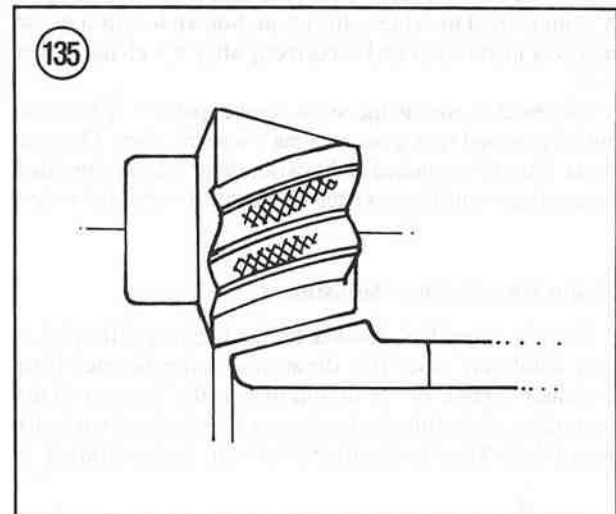
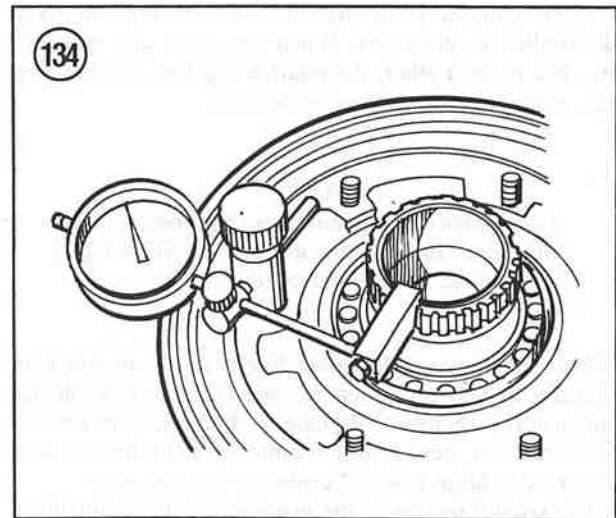
After completing the *Backlash Adjustment*, the tooth contact pattern must be checked.

1. Remove the ring gear from the final drive case as described in this chapter.
2. Apply a light coat of gear marking compound to both sides of a couple of teeth on the pinion gear.
3. Install the ring gear into the final drive case and pinion gear.
4. Press down firmly on the ring gear and rotate it back and forth several times so the gear marking compound will transfer onto the ring gear teeth.
5. Remove the ring gear from the final drive case.
6. Observe the pattern on the pinion gear. If it looks like that in **Figure 135**, the tooth contact pattern is correct. If so, wipe off all marking compound residue from each gear.

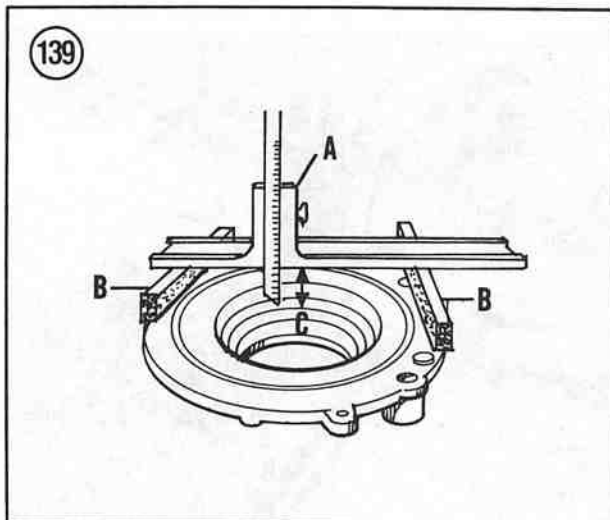
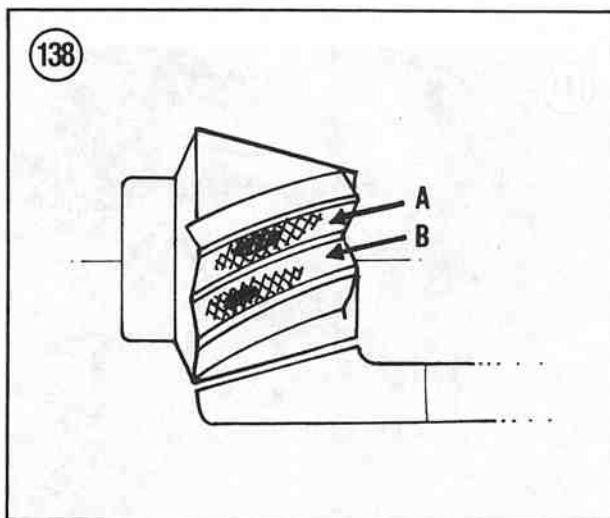
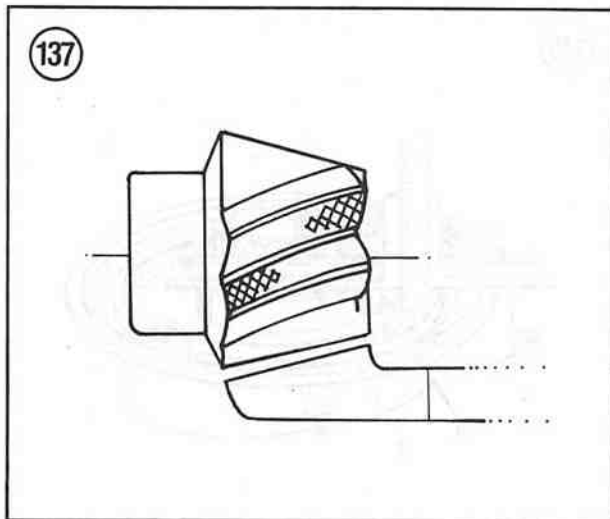
#### NOTE

*Perform Steps 7-14 only if the tooth contact pattern is not correct and requires shim replacement.*

7. If the pattern does not look like **Figure 135**, compare to the following illustrations:
  - a. **Figure 136**: pinion gear must be moved farther out in the final drive case. Replace the existing shim with a *thicker* shim between the pinion gear and the final drive case.







- b. **Figure 137:** pinion gear must be moved farther back into the final drive case. Replace with a existing shim with a *thinner* shim between the pinion gear and the final drive case.
- 8. Replace the shim between the pinion gear and the final drive case as described in this chapter.
- 9. Re-apply a light coat of gear marking compound to both sides of a couple of teeth on the pinion gear.
- 10. Install the ring gear into the final drive case and pinion gear.
- 11. Press down firmly on the ring gear and rotate it back and forth several times so the marking compound will transfer onto the ring gear teeth.
- 12. Remove the ring gear from the final drive case.
- 13. Observe the pattern on the pinion gear. If it looks like that in **Figure 135**, the tooth contact pattern is correct. If not, repeat this procedure until the tooth contact pattern is correct.
- 14. After the tooth contact pattern is correct in the loaded condition, check in the unloaded condition as follows:
  - a. Reapply a light coat of gear marking compound to both sides of a couple of teeth on the pinion gear.
  - b. Install the ring gear into the final drive case and pinion gear.
  - c. *Press down firmly* on the ring gear and rotate it back and forth several times so the marking compound will transfer onto the ring gear teeth.
  - d. This time do *not* press down firmly on the ring gear, just rotate it back and forth with no pressure, several times so the gear marking compound will form an additional pattern within the one made in sub-step 14c. The new pattern should be centered (A, **Figure 138**) on the forward side of the gear and should be toward the larger end of the teeth on the reverse side of the gear (B, **Figure 138**).
- 15. Remove the ring gear from the final drive case. Wipe off all gear marking compound from both gears.

**Ring Gear End Float**

The ring gear end float is controlled by the shim placed between the ball bearing, located on the left-hand side of the ring gear and the case cover. The correct spacing of this ball bearing determines the ring gear end float. A specific amount of end float is necessary for the ball bearing to operate properly. The preload thickness is listed in **Table 2**. The shims are available from BMW dealers in the following thicknesses: 0.180, 0.280, 0.380, 0.500, 0.630, 0.750 and 0.880 mm.

1. Place the case cover on the workbench with the inner surface facing up.
2. Place the BMW special tool (distance or depth gauge—part No. 00 2 550) (A, **Figure 139**) on spacers (B, **Figure 139**) on the case-to-cover mating surface of the cover.

3. Measure the distance from the mating surface down to the ball bearing seating shoulder of the cover (C, **Figure 139**). Subtract the thickness of the spacers from this dimension. This is dimension "A."
4. Install the ring gear (with ball bearing correctly installed) into the final drive case and pinion gear.
5. Place the BMW special tool (distance or depth gauge—part No. 00 2 550) (A, **Figure 140**) on the upper surface of the ball bearing on the ring gear. Place the special tool in the opening in the gauge ring.
6. Measure the distance from the ball bearing upper surface to the case mating surface of the case. This is dimension "B" (B, **Figure 140**).
7. Subtract dimension "B" from dimension "A." This dimension is the shim thickness required *without preload*.
8. Add the thickness of the dimension without preload, determined in Step 7, to the preload specified in **Table 2**. This will give you the dimension for the shim thickness to provide the correct amount of preload.
9. Remove the special tool.

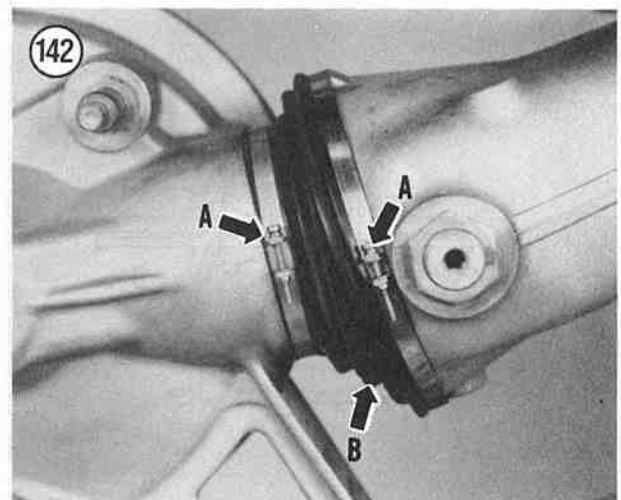
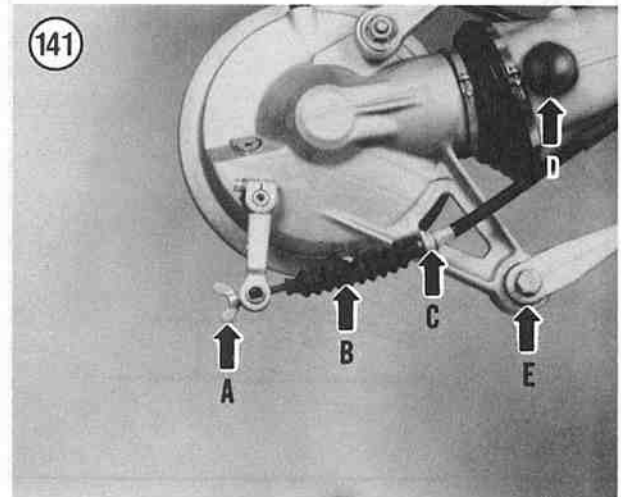
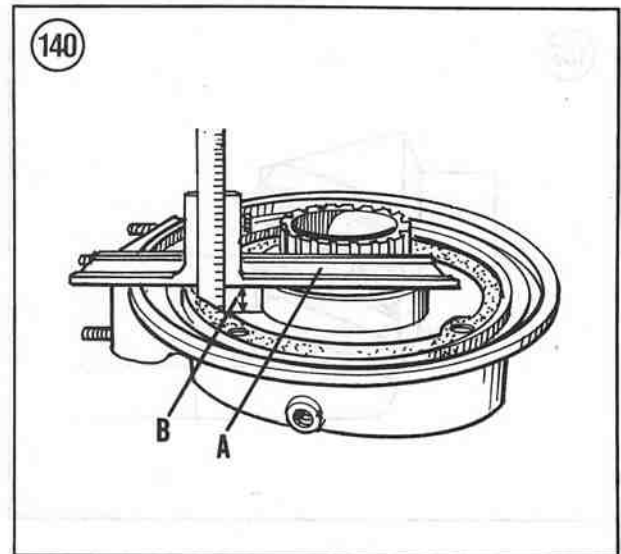
### FINAL DRIVE UNIT (R100GS MODELS)

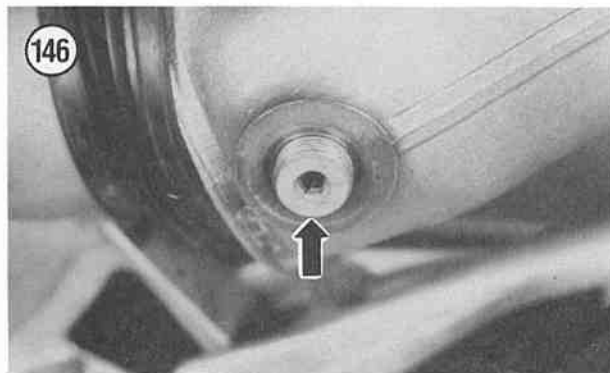
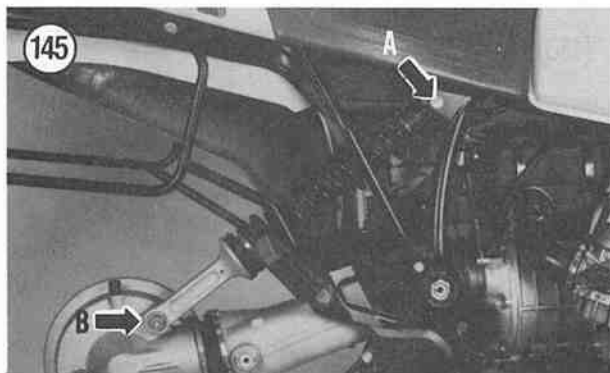
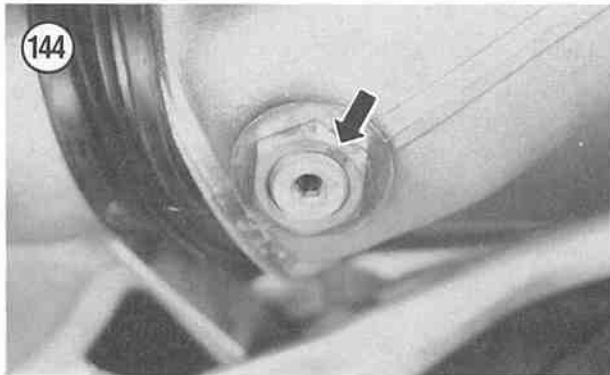
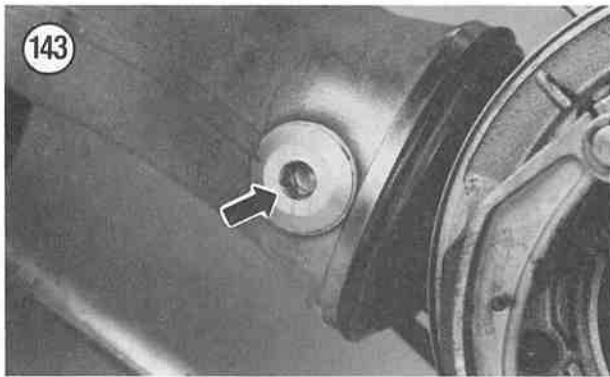
#### Removal

1. Remove the rear wheel as described in this chapter.
2. Remove the frame right-hand side cover.
3. If the final drive unit is going to be serviced, drain the oil from the unit as described under *Final Drive Oil Change* in Chapter Three.
4. Completely unscrew the brake adjuster nut (A, **Figure 141**).
5. Depress the brake pedal to withdraw the brake cable from the actuating arm.
6. Remove the pivot pin from the brake actuating arm.
7. Slide the rubber boot (B, **Figure 141**) off of the brake cable.
8. Remove the brake cable from the receptacle (C, **Figure 141**) on the final drive unit.
9. Reinstall the rubber boot, pivot pin and the adjuster nut onto the brake cable to avoid misplacing them.
10. Place a wood block under the swing arm to support it after the shock absorber is removed.
11. Remove the plastic trim cap (D, **Figure 141**) on the right-hand rear pivot point.

#### NOTE

The left-hand pivot pin had a locking agent applied to the threads during assembly and will be very difficult to break loose. Use a good





quality Allen wrench to avoid rounding off the flats within the pivot pin receptacle for the Allen wrench. It will also be necessary to use a piece of pipe on the end of the Allen wrench in order to gain enough leverage on the wrench to break the pivot pin loose.

12. Unscrew both clamping screws (A, **Figure 142**) on the rear rubber boot. Remove both clamps from the rubber boot.
13. Slide the rubber boot (B, **Figure 142**) off of the final drive unit and the swing arm.
14. Loosen the left-hand pivot pin (**Figure 143**) and the right-hand pivot pin locknut (**Figure 144**).
15. Loosen the shock absorber upper mounting bolt and nut (A, **Figure 145**). It is not necessary to completely remove the bolt and nut since the shock absorber is not going to be removed.
16. Remove the shock absorber lower mounting nut and washer (B, **Figure 145**).
17. Pull the shock absorber off of the mounting stud on the final drive unit.
18. Pivot the shock absorber up and tie it up and out of the way.
19. Loosen the nut and washer (E, **Figure 141**) securing the control rod to the final drive unit. Let the control rod hang down—there is no need to completely remove it.

**CAUTION**

Place a wood box under the final drive unit. The final drive unit is heavy and it must be supported prior to removing the pivot pins securing it to the swing arm.

20. Remove the right-hand pivot pin locknut (**Figure 144**).
21. Completely unscrew both the right-hand (**Figure 146**) and left-hand (**Figure 143**) pivot pins from the swing arm.

**NOTE**

The final drive unit is equipped with 2 pivot bearings that have loose inner races. These races are held in place with the pivot pins. The left-hand inner race may come out with the pivot pin. When the final drive unit is removed from the swing arm, these bearing inner races may fall out. Be prepared to catch them so they will not fall onto the ground and be damaged.

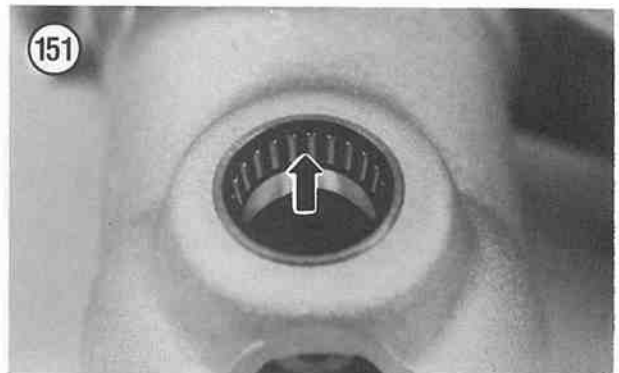
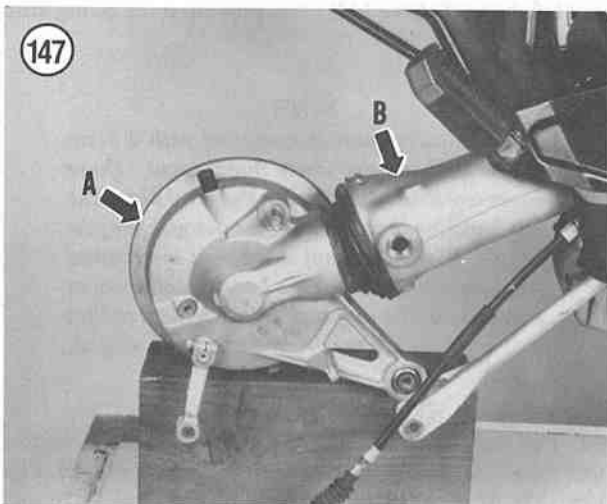
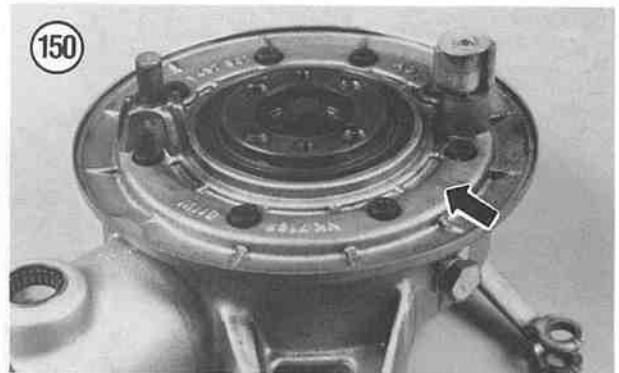
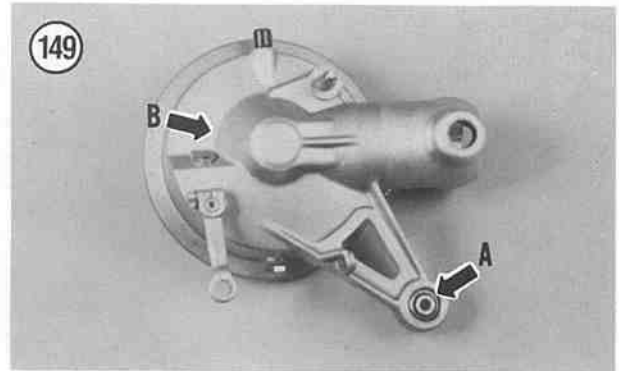
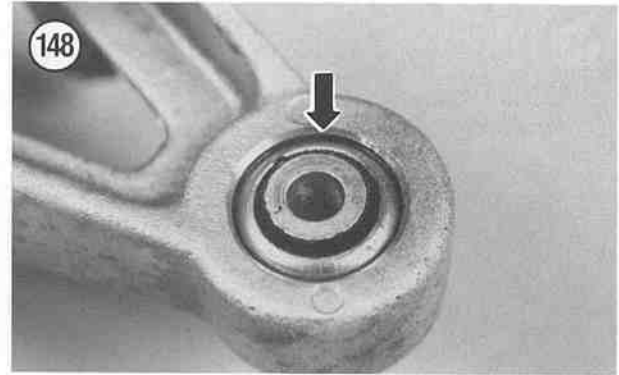
22. Pull the final drive unit (A, **Figure 147**) toward the rear and separate it from the drive shaft and swing arm (B, **Figure 147**). If necessary, gently tap on the final drive unit

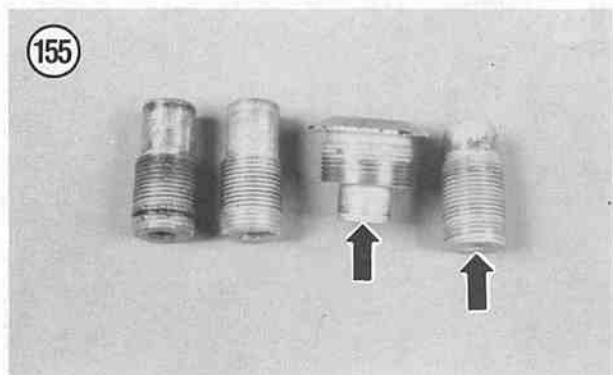
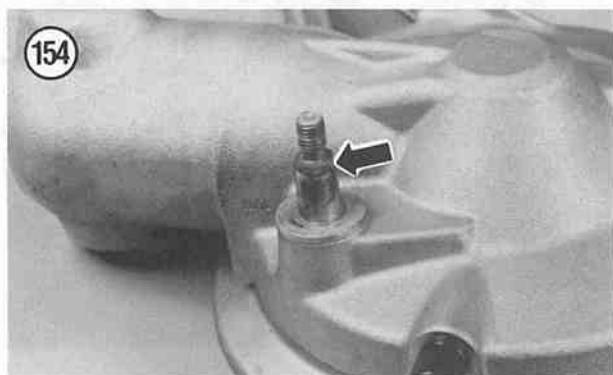
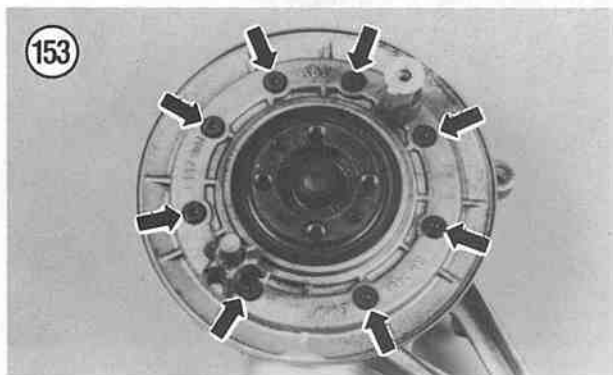
with a soft-faced mallet or plastic hammer to separate it. Remove the final drive unit and take it to your workbench for inspection or disassembly.

23. Remove the pivot needle bearing from each side of the receptacle in the final drive unit. Mark each bearing as to which side it was removed from. The pivot needle bearings must be reinstalled on the same side during installation.
24. Remove the rear rubber boot from the final drive unit.
25. Inspect all parts as described in this chapter.

### Inspection

1. Inspect the exterior of the final drive unit housing for cracks or damage. Replace if necessary as described under *Final Drive Overhaul* in this chapter.
2. Inspect the rubber bushing (Figure 148) in the control arm attachment point on the final drive unit. If worn or damaged, replace the bushing.
3. Check the control rod attachment point bracket (A, Figure 149) on the final drive unit for cracks, damage or hole elongation. Replace the final drive unit housing if necessary.
4. Inspect the exterior of the final drive unit housing (B, Figure 149) and the cover (Figure 150) for cracks or damage. Replace if necessary as described under *Final Drive Overhaul* in this chapter.
5. Thoroughly clean the pivot pin needle bearings and inner races in solvent and dry with compressed air.
6. Rotate the bearings (Figure 151) with your fingers and check for wear. The bearings should rotate freely with no binding. Replace the bearing if necessary.
7. Inspect the bearing inner races (Figure 152) for wear or damage. If the inner race is worn or damaged, replace the entire bearing assembly.
8. Inspect the pinion gear splines. If the splines are worn or damaged, the ring and pinion gear assembly must be replaced as described under *Final Drive Overhaul* in this chapter.





**NOTE**  
 If the splines are worn or damaged, also inspect the splines on the end of the drive shaft for damage as described in this chapter; it may also need to be replaced.

9. Check for any signs of oil leakage at the spline portion. If the oil seal has been leaking, it must be replaced as described under *Final Drive Overhaul* in this chapter.
10. Make sure the cover mounting bolts (Figure 153) are tight. Refer to Table 1 for torque specifications.
11. Inspect the shock absorber lower mounting stud (Figure 154) for wear or damage. If necessary, clean out the threads with the correct size and pitch thread die or replace if necessary.
12. Thoroughly clean off all old locking agent from the threads of the left-hand pivot pin and from the pivot pin threads in the swing arm.
13. After the locking compound has been removed, screw the left-hand pivot pin into the thread hole in the swing arm to make sure the threads are clean and in good condition. Unscrew the pivot pin.
14. Inspect the threads of both pivot pins (Figure 155) for wear or damage. If necessary, clean out the threads with the correct size and pitch thread die or replace if necessary.
15. Inspect the rear rubber boot (Figure 156) for wear, tears or deterioration. If its condition is in doubt, replace it at this time while the final drive unit is removed.

10

**Installation**

1. Shift the transmission into 5th gear. This will prevent the drive shaft from rotating while aligning the final drive splines to the drive shaft splines.





2. Apply a thick coat of grease (**Figure 114**) to the final drive unit splines and to the drive shaft splines (**Figure 157**).
3. Apply a thin coat of grease (available from BMW dealers) to the pivot needle bearings and to the outer surface of the inner races. Refer to **Figure 158** and **Figure 159**. Avoid getting the grease on the inner race as it will be coated with a different material.
4. Install the inner race into the pivot needle bearing in each side of the receptacle in the final drive unit.
5. Apply a light coat of aluminum anti-seize compound (**Figure 160**) to the inner race of the pivot needle bearings.
6. Install the rear rubber boot (A, **Figure 161**) onto the final drive unit.
7. Make sure the swing arm (B, **Figure 161**) is in the correct height position.

**NOTE**

*The next step is easier with the aid of an assistant. Have the assistant position the drive shaft rear universal joint so it is correctly aligned with the final drive unit. If it is not held correctly, it will tend to pivot down out of alignment. Insert a narrow screwdriver in through both pivot pin holes in the swing arm to help position the universal joint.*

8. Install the final drive unit onto the swing arm. If necessary, slightly rotate the rear wheel flange until the splines align with the drive shaft. Push the final drive unit on until it stops.

**NOTE**

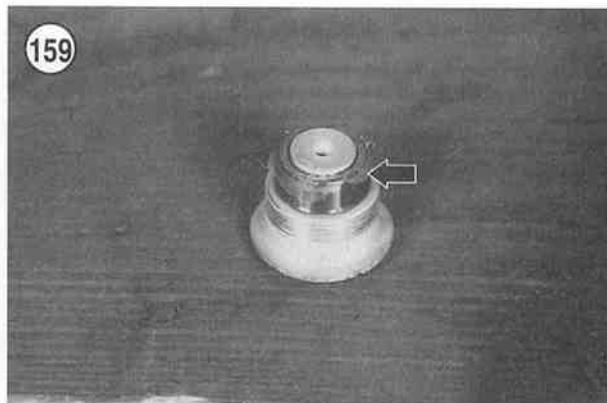
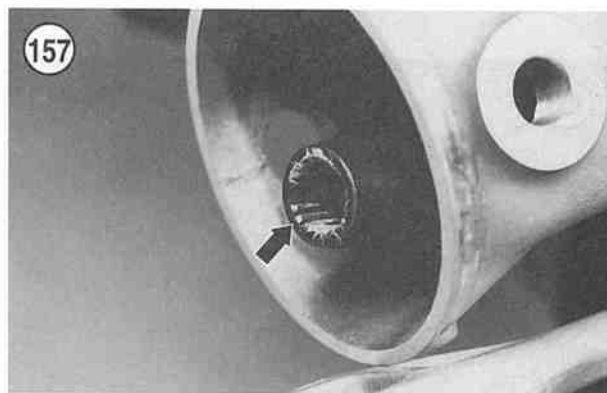
*In Step 9, do not tighten the pivot pins. They are installed at this time to temporarily hold the final drive unit in place until the control rod and shock absorber can be installed.*

9. Hold the final drive unit in this position and install the right-hand and left-hand pivot pins into the swing arm and into the final drive unit's pivot needle bearing inner races. Slightly move the final drive unit in and out to correctly align the pivot pins to the pivot pin needle bearing inner races.
10. Untie the shock absorber and swing it down into position. Install it onto the lower mounting stud on the final drive unit. Install the washer and nut and tighten the nut firmly finger-tight at this time.
11. Move the control arm up and into position. Install it onto the mounting receptacle on the final drive unit. Install the bolt, washer and nut and tighten the nut firmly finger-tight at this time.

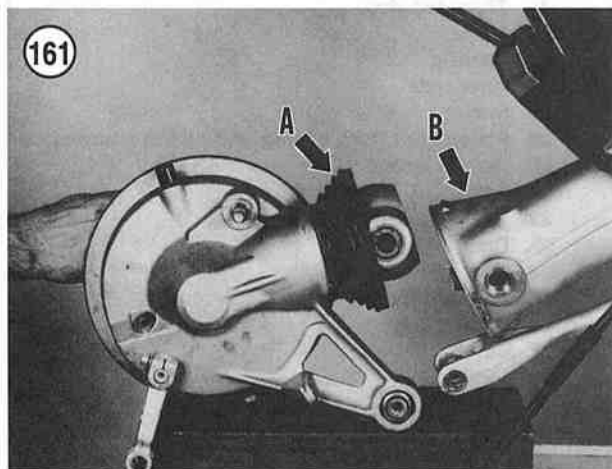
**NOTE**

*In Step 12, do not completely unscrew the left-hand pivot pin as the pivot bearing inner race may come out with it and fall off of the pivot pin. If this happens, you will have to remove the final drive unit and start all over.*

12. Hold onto the final drive unit and partially unscrew the left-hand pivot pin. Apply 2 drops of red Loctite Threadlocker No. 273 to the threads and screw the pivot pin back in.



13. Tighten the left-hand pivot pin to the torque specification listed in **Table 1**.
14. Using an Allen wrench, hand-tighten the right-hand pivot pin to a "firm hand tightness." This will seat the final drive unit and both pivot needle bearings.
15. Loosen the right-hand pivot pin and retighten to the torque specification listed in **Table 1**.
16. Remove the shock absorber lower mounting nut and washer and disconnect the shock from the mounting stud.
17. Move the final drive unit, swing arm and control rod up and down to make sure the entire assembly is moving freely. If everything is okay, proceed to the next step. If not, determine the problem and correct it at this time.
18. Reinstall the shock absorber onto the final drive unit and install the washer and nut finger-tight.
19. Using an Allen wrench, hold onto the right-hand pivot pin and tighten the locknut (**Figure 144**) to the torque specification listed in **Table 1**. Make sure the pivot pin does not turn while tightening the locknut, as it will apply too much pressure on the pivot needle bearings and cause them to wear out prematurely.



20. Install the plastic trim cap over the right-hand pivot pin and locknut.
21. Tighten the shock absorber upper mounting bolt and nut to the torque specification listed in **Table 1**.
22. Tighten the shock absorber lower mounting nut to the torque specification listed in **Table 1**.
23. Tighten the control rod front and rear mounting bolt and nuts to the torque specification listed in **Table 1**.

#### CAUTION

*Make sure the rubber boot is installed correctly, otherwise, moisture and foreign matter will enter this area and cause damage.*

24. Install the rear rubber boot onto the swing arm and final drive unit. Make sure it is installed straight with no wrinkles. Install the clamps into position and tighten the screws.
25. Remove the wood block from under the swing arm.
26. Completely unscrew the brake adjuster nut from the brake cable and remove the pivot pin and rubber boot.
27. Install the cable through the receptacle in the final drive unit.
28. Slide on the rubber boot and install the pivot pin into the brake actuating lever.
29. Depress the brake pedal and reinstall the brake cable into the pivot pin in the actuating arm.
30. Reinstall the adjuster nut on the brake rod loosely.
31. Install the frame right-hand side cover.
32. If the final drive unit was serviced, refill the oil as described in Chapter Three.
33. Install the rear wheel as described in this chapter.
34. Adjust the rear brake as described under *Rear Drum Brake Height and Freeplay Adjustment* in Chapter Three.
35. Take the bike off of the centerstand and depress the rear suspension to make sure all components are working properly.

#### Overhaul

Overhauling the final drive unit requires many BMW special tools along with a heat gun or hot plate. Before overhauling the final drive unit yourself, compare the price of the expensive BMW special tools to the cost of having the unit overhauled by a BMW dealer. This unit is almost "bulletproof" and rarely requires any type of service. Many units have over 150,000 miles on them without any type of problems. To maintain the final drive unit in good condition, the gear oil should be changed at the intervals recommended in Chapter Three.

The following procedure is provided if you choose to perform this procedure yourself.

This procedure is presented as a complete, step-by-step, major overhaul of the final drive unit that should be followed if a final drive unit is to be completely reconditioned. However, if you are replacing a part that you know has failed, the disassembly should be carried out only

until the failed part is accessible; there is no need to disassemble the final drive unit beyond that point so long as you know the remaining components are in good condition and that they were not affected by the failed part.

Before starting, carefully read the entire procedure. Disassembling the unit is complicated but not nearly as complicated as reassembling it. During assembly there are many tolerances that must be calculated. Also the proper gear backlash between the ring and pinion gear must be achieved in order to have the correct gear tooth contact between the 2 parts. If the gear backlash is incorrect, the ring and pinion gears will wear prematurely and will also emit a "howl" when riding.

The following BMW special tools are required for the overhaul procedure:

- a. Case holding fixture (part No. 33 1 500).
- b. Cover oil seal mandrel and driver (part No. 33 1 860 and No. 00 5 500).
- c. Bearing puller and insert (part No. 33 1 830 and No. 33 1 307).
- d. Threaded ring remover (part No. 33 1 700).
- e. Needle bearing remover (part No. 40 0 151/T2 or 00 8 570).
- f. Tapered roller bearing remover (part No. 00 8 560).

- g. Shaft seal installer (part No. 33 1 760).
- h. Drive pinion ball bearing puller (part No. 00 7 500).
- i. Backlash adjuster (special dial indicator) (part No. 33 2 600).
- j. Gear holding tool (part No. 33 2 630).
- k. Distance (or depth) gauge (part No. 00 2 550).
- l. Drum brake models only—sleeve remover (part No. 33 2 640).
- m. Special drift (part No. 33 2 640).

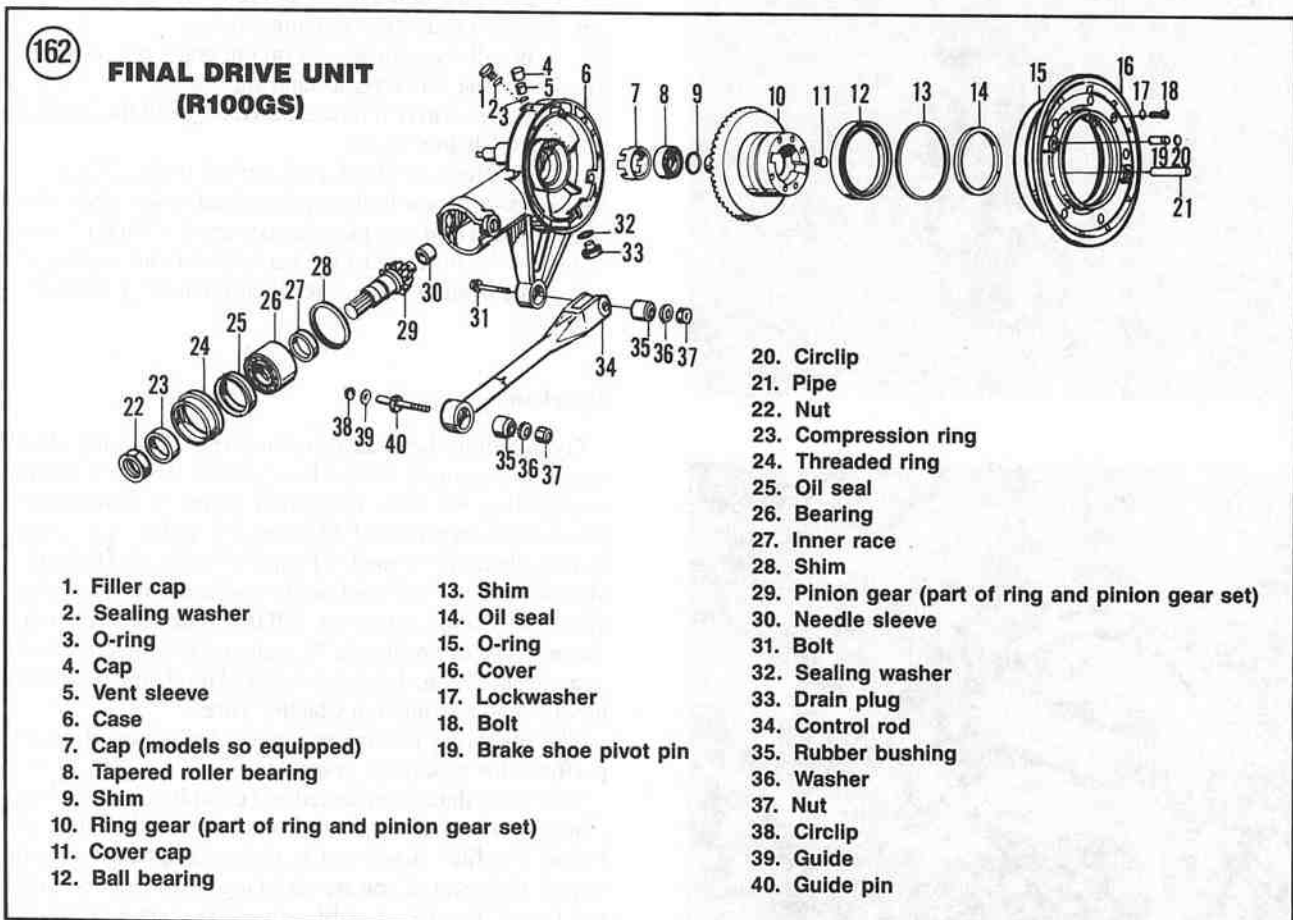
Also needed is a hot plate or a heat gun with a heat capacity of approximately 130° C (266° F).

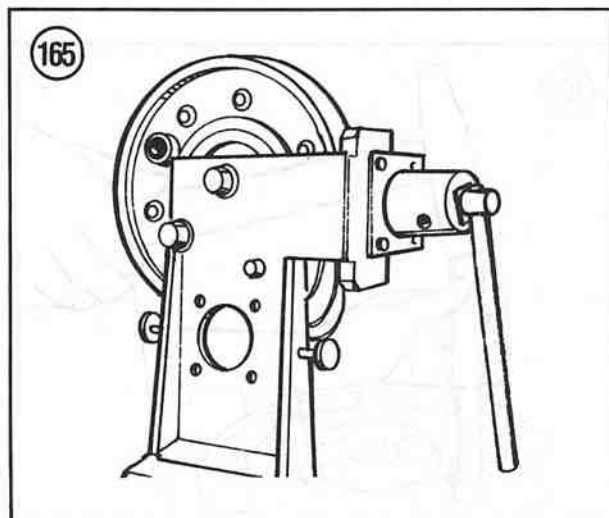
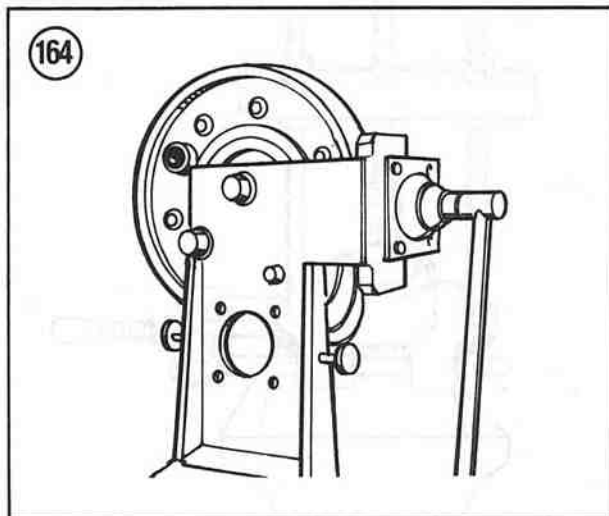
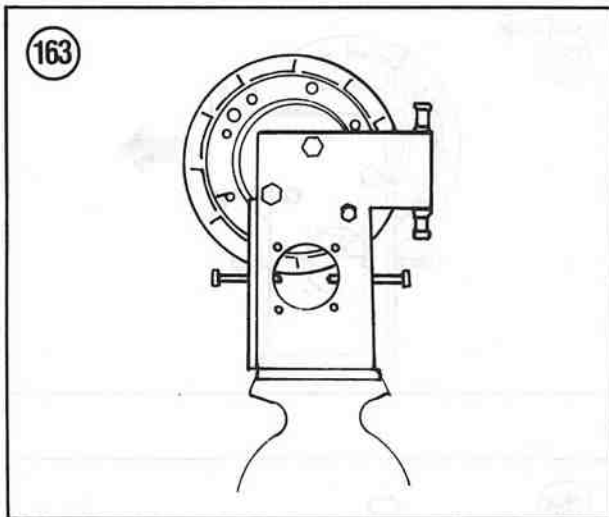
### Disassembly

Refer to **Figure 162** for this procedure.

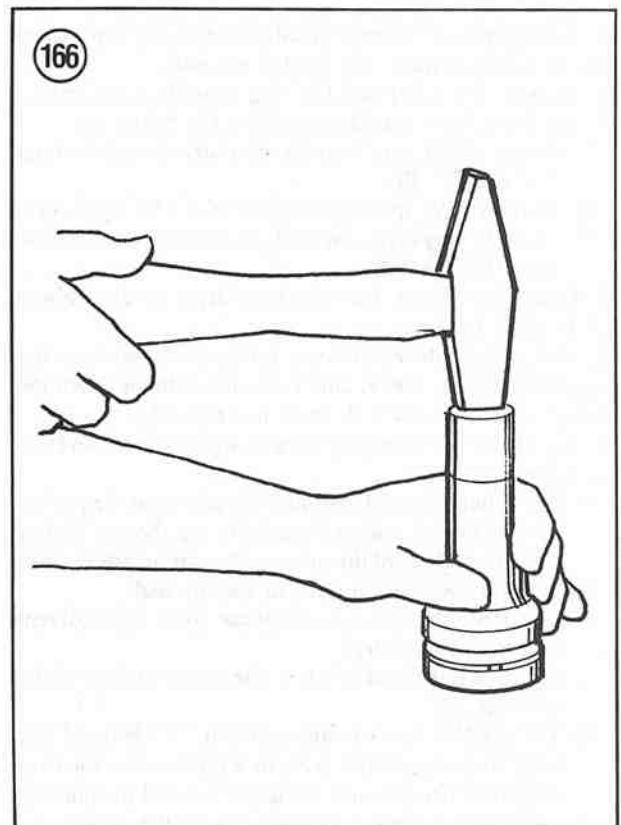
#### WARNING

*During this procedure many of the components must be heated for removal. Protect your hands when handling hot components. Either wear thick gloves or use heavy household pot holders to hold onto hot parts.*





1. If not already removed, remove the brake shoes as described under *Rear Drum Brake* in Chapter Eleven.
2. If not already drained, remove the drain plug and the filler cap. Drain out all of the gear oil, then reinstall the drain plug and filler cap and tighten both securely.
3. Secure the final drive unit in the BMW special tool (part No. 33 1 500) and secure the special tool in a vise as shown in **Figure 163**. Tighten the mounting bolts to the torque specification listed in **Table 1**.
4. Using a heat gun, heat the pinion gear nut to 100° C (215° F).
5. Using a suitable size socket, completely unscrew the gear nut (**Figure 164**).
6. Using a heat gun, heat the final drive unit neck to 120° C (250° F).
7. Using BMW special tool (part No. 33 1 700), completely unscrew the threaded ring and oil seal (**Figure 165**).
8. To remove the oil seal from the threaded ring, perform the following:
  - a. Using a suitable size socket, press the oil seal out of the threaded ring.
  - b. Position the new oil seal with the lettering facing toward the outside surface of the threaded ring.
  - c. Using BMW special tool (part No. 33 1 760 and part No. 00 5 500) drive the new oil seal into place in the threaded ring (**Figure 166**).
  - d. Remove the special tools.



9. Using a heat gun, heat the final drive unit neck (surrounding the ball bearing outer race) to 125° C (260° F).

**CAUTION**

*Do not damage the splines on the pinion gear while removing the pinion gear and ball bearing from the final drive unit neck.*

10. Use a pair of slip-joint pliers or Vise Grips and carefully withdraw the pinion gear and the ball bearing from the final drive unit neck (**Figure 167**). Remove the compression ring from the shaft.

11. To remove the bearing assembly from the pinion gear, perform the following:

- a. Secure the pinion gear and ball bearing in a vise with soft jaws to protect the gears.
- b. Install BMW special tools (part No. 00 7 500) onto the pinion gear and bearing assembly (**Figure 168**).
- c. Hold a pan under the vise as the bearing assembly may separate during removal and the loose bearing balls may fall out.
- d. Withdraw the bearing assembly from the pinion gear.
- e. Disassemble the bearing assembly and place all parts in a box to keep all the small parts together.

12. Make alignment marks on the case and cover. This will ensure correct alignment of the 2 parts during assembly.

13. Remove the screws (**Figure 153**) securing the cover to the case.

14. Using a plastic hammer or soft-faced mallet, tap around the perimeter of the cover until it is loose.

15. Remove the cover and the ring gear from the case.

16. On drum brake models, perform the following:

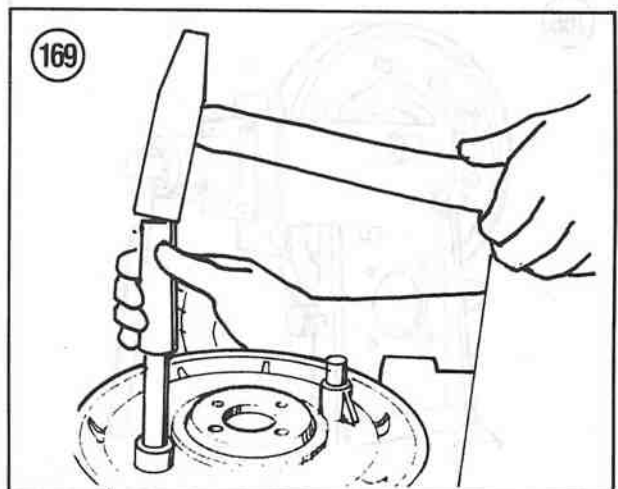
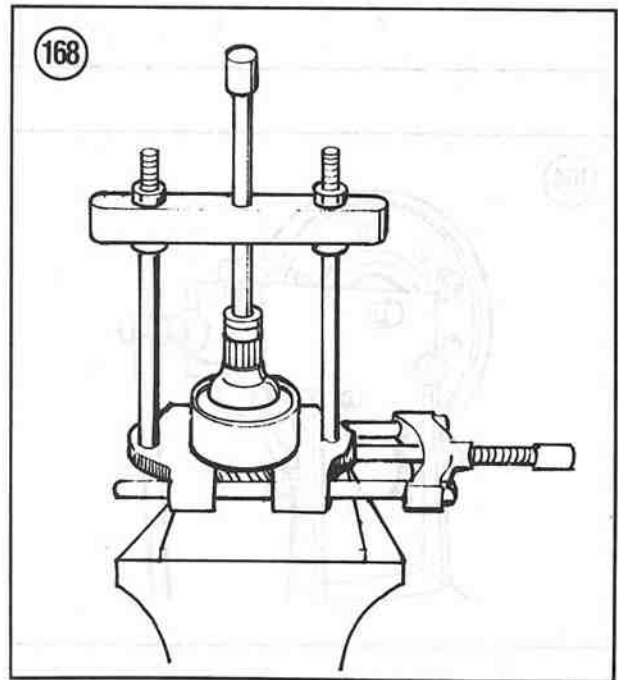
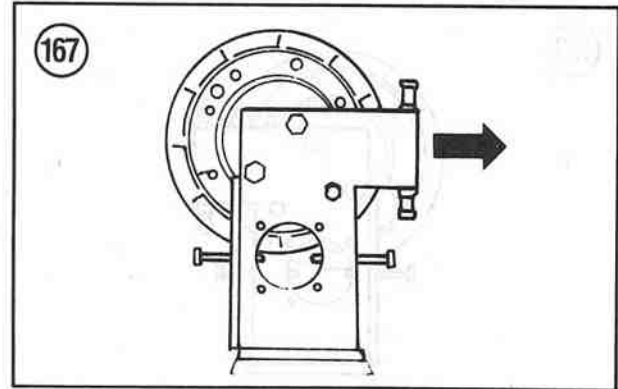
- a. Using a heat gun, heat the final drive case to about 80° C (175° F).
- b. Using BMW special tool (part No. 33 2 640), or a suitable size drift, carefully tap the pipe out of the case (**Figure 169**).

17. Using a heat gun, heat the final drive cover to about 80° C (175° F).

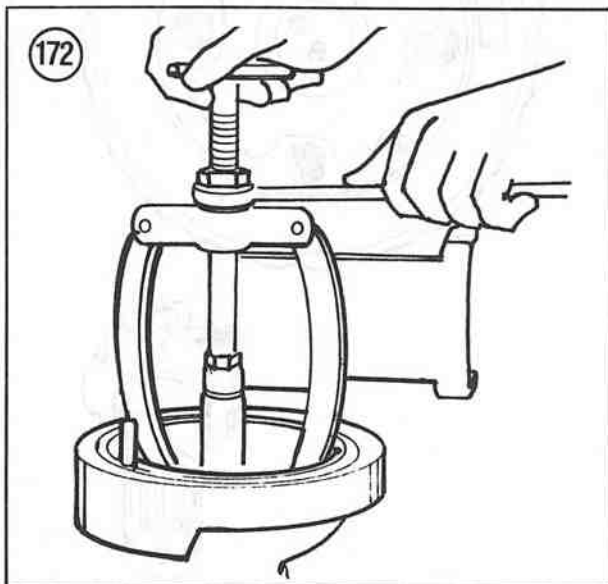
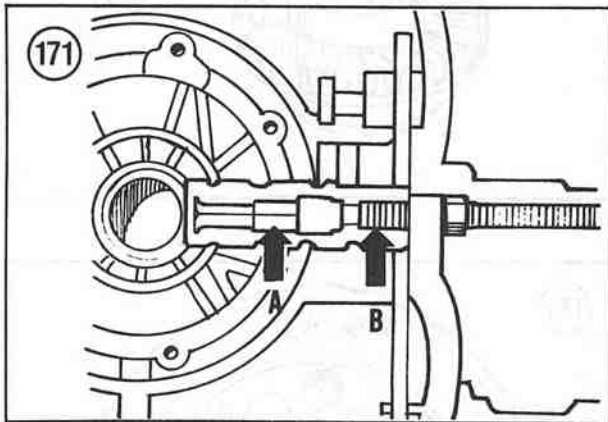
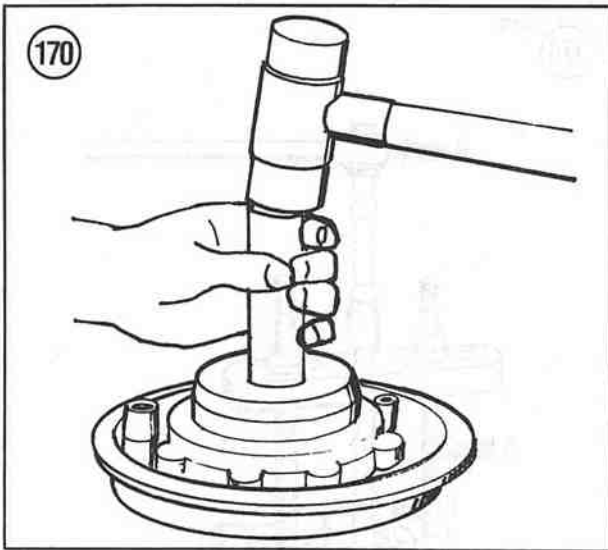
18. Using thick gloves or heavy pot holders, separate the ring gear from the cover. Don't lose the shim between the ring gear and the cover. It must be reinstalled.

19. To replace the ring gear oil seal in the cover, perform the following:

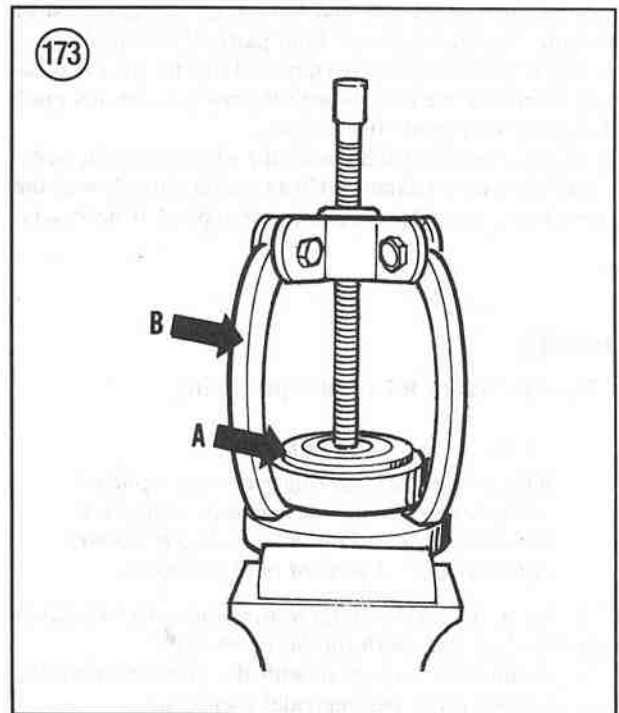
- a. Use a hammer and drift and work around the perimeter of the oil seal and carefully tap the seal out of the cover. Discard the oil seal. Be careful not to damage the cover in the area of the oil seal.
- b. Clean out the oil seal area of the cover with solvent and thoroughly dry.
- c. Apply a light coat of oil to the outer surface of the new oil seal.
- d. Using BMW special tools (part No. 33 1 860 and No. 00 5 500), carefully tap the new oil seal into the case (**Figure 170**). Be sure to tap the oil seal in squarely and tap it in until it bottoms out in the cover.







20. To remove the pinion gear needle bearing from the case, perform the following:
  - a. Insert BMW special tool (part No. 00 8 570 or No. 40 0 151/T2) into the neck of the case and position it behind the needle bearing (A, **Figure 171**). Turn the special tool end to expand it behind the needle bearing.
  - b. Attach a suitable size commercial bearing puller (B, **Figure 171**) onto the backside of the BMW special tool.
  - c. Using a heat gun, heat the final drive unit neck (surrounding the needle bearing) to 120° C (250° F).
  - d. Carefully and slowly tighten the bearing puller and withdraw the tapered roller bearing from the case.
21. To remove the ring gear tapered roller bearing outer race from the case, perform the following:
  - a. Secure the final drive unit in a vise with soft jaws with the open portion of the case facing up to gain access to the ring gear tapered roller bearing outer race.
  - b. Install the bearing puller, BMW special tool (part No. 00 8 560) onto the outer race (**Figure 172**).
  - c. Carefully and slowly tighten the bearing puller and withdraw the outer race from the case.
  - d. Remove the final drive case from the vise.
22. To remove the ball bearing on the ring gear, perform the following:
  - a. Secure the ring gear, ball bearing side up, in a vise with soft jaws.
  - b. Insert BMW special tool (part No. 33 1 307) into the center of the ring gear (A, **Figure 173**).



- c. Install the bearing puller, BMW special tool (part No. 33 1 830) onto the ball bearing (B, **Figure 173**).
  - d. Carefully and slowly tighten the bearing puller and withdraw the ball bearing from the ring gear.
  - e. Remove the special tools from the ring gear.
23. To remove the tapered roller bearing, inner race and shim from the ring gear, perform the following:
- a. Secure the ring gear, tapered roller bearing side up, in a vise with soft jaws.
  - b. Install the bearing puller, BMW special tool (part No. 00 7 500) onto the tapered roller bearing (A, **Figure 174**).
  - c. Carefully and slowly tighten the bearing puller (B, **Figure 174**) and withdraw the tapered roller bearing from the ring gear.
  - d. Remove the tapered roller bearing, inner race and shim from the ring gear.

### Inspection

1. Wash all parts in solvent and thoroughly with compressed air.

#### NOTE

*The ring and pinion gear must be replaced as a set and are marked with a pair code on each gear (**Figure 175**).*

2. Inspect the teeth on the ring gear and the pinion gear set. If the teeth are worn or damaged on either of the gears, both gears must be replaced as a set (the only way they are sold is as a set).
3. Inspect the case and the cover for cracks or other damage. Make sure all ribs and bosses are not damaged or missing. Replace either or both parts, if damaged.
4. Inspect the threads on the threaded ring for wear or damage. Clean out the threads with the correct size and pitch thread tap or replace if necessary.
5. Inspect the threaded holes for the wheel mounting bolts. Check for wear or damage. Clean out the threads with the correct size and pitch thread tap or replace if necessary.

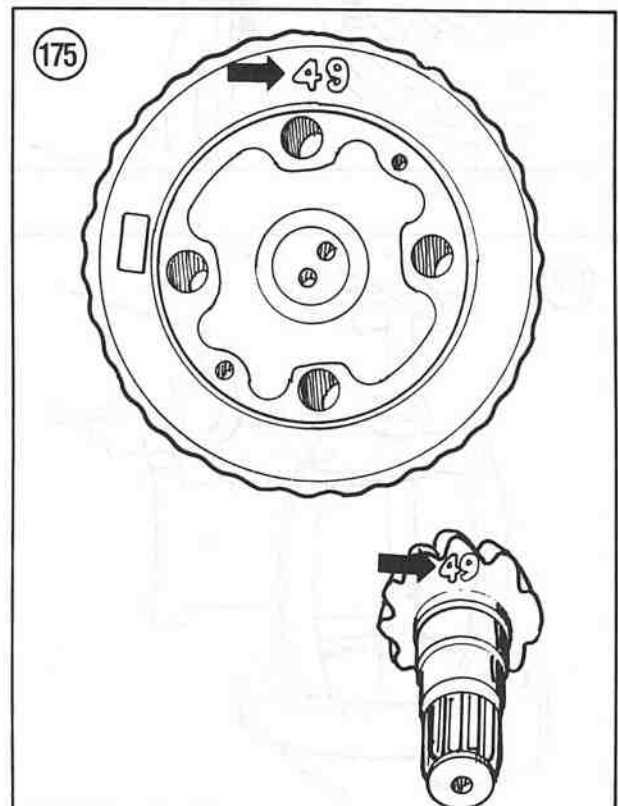
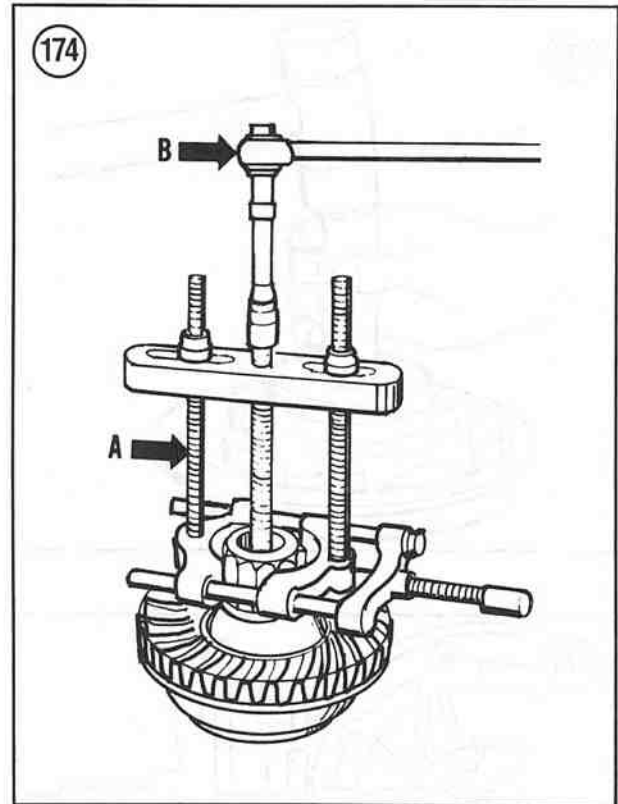
### Assembly

Refer to **Figure 162** for this procedure.

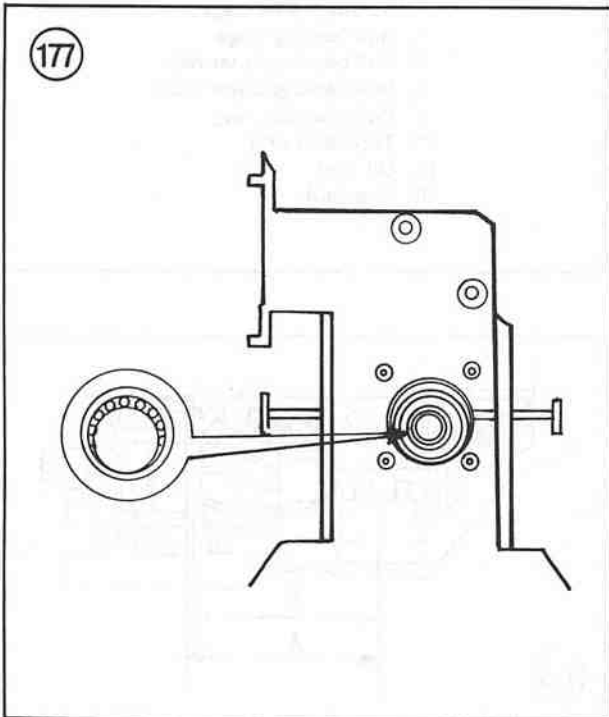
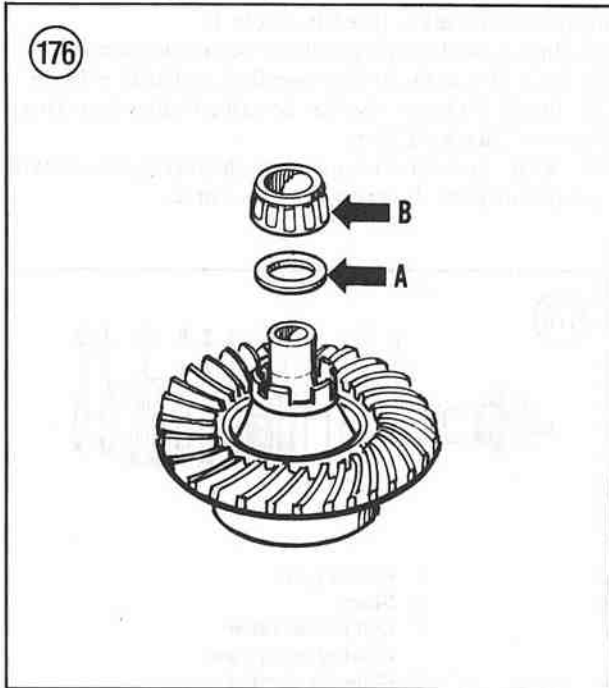
#### NOTE

*If the pinion gear and ring gear were replaced with a new gear set, or any of the bearings were replaced, perform **Pinion Gear-To-Ring Gear Adjustment** as described in this chapter.*

1. To install the tapered roller bearing, inner race and shim onto the ring gear, perform the following:
  - a. Position the ring gear with the portion where the tapered roller bearing rides facing up.



- b. Secure the ring gear in a vise with soft jaws.
- c. Position the shim of the correct thickness with the inner diameter chamfer facing down toward the ring gear and install the shim (A, **Figure 176**) onto the ring gear.



- d. Using a heat gun or hot plate, heat the bearing and inner race to 80° C (175° F).
  - e. Install the bearing (B, **Figure 176**) onto the ring gear and tap it down until it bottoms out.
  - f. Remove the ring gear from the vise.
2. To install the ball bearing onto the ring gear, perform the following:
    - a. Position the ring gear with the portion where the ball bearing rides facing up.
    - b. Secure the ring gear in a vise with soft jaws.
    - c. Install a shim of the correct thickness onto the ring gear.
    - d. Using a heat gun or hot plate, heat the bearing assembly to 80° C (175° F).
    - e. Install the bearing onto the ring gear and tap it down until it bottoms out.
    - f. Remove the ring gear from the vise.
  3. To install the ring gear tapered roller bearing outer race into the case, perform the following:
    - a. Place the tapered roller bearing outer race in a freezer for 10-15 minutes. This will reduce its overall size.
    - b. Using a heat gun or hot plate, heat the case to 120° C (250° F).
    - c. Set the case on wood blocks with the open portion of the case facing up.
    - d. Install the tapered roller bearing outer race into the case and tap it down in until it bottoms out in the case. Make sure the outer race is installed straight down and that it does not get cocked during installation.
  4. To install the pinion gear needle bearing into the case, perform the following:
    - a. Clamp the final drive case in the BMW special tool (part No. 33 1 630) (**Figure 177**).
    - b. Place the pinion gear needle bearing in a freezer for 10-15 minutes. This will reduce its overall size.
    - c. Using a heat gun, heat the case in the area where the needle bearing is to be located. Heat the case to 120° C (250° F).
    - d. Position the needle bearing with the identification marks facing out.
    - e. Install the needle bearing into the case and tap it in with a suitable size socket or use the pinion gear. Tap it in until it bottoms out in the case. Make sure the needle bearing is installed straight in and that it does not get cocked in the case during installation.
  5. Place the ring gear assembly in a freezer for about 15-30 minutes. This will reduce its overall size.
  6. Install the shim on the cover.
  7. Install the ring gear into the cover.
  8. Install a new O-ring seal into the groove in the cover.
  9. Install the cover and the ring gear onto the case.
  10. Using a plastic hammer or soft-faced mallet, tap around the perimeter of the cover until it bottoms out.
  11. Install the screws securing the cover to the case. Tighten the screws to the torque specification listed in **Table 1**.
  12. Place the pipe in a freezer for about 15 minutes. This will reduce its overall size.

13. Using BMW special tool (part No. 33 2 640), or a suitable size drift, carefully tap the pipe into the case until it bottoms out.

14. To install the bearing assembly (**Figure 178**) onto the pinion gear, perform the following:

- a. Place the pinion gear in a freezer for about 30 minutes. This will reduce its overall size.
- b. Using a heat gun or hot plate, heat the cylindrical roller bearing inner race to 120° C (250° F) and install the bearing inner race onto the pinion gear shaft.
- c. Carefully tap the cylindrical roller bearing inner race into place until it bottoms out.
- d. Install the cylindrical needle bearing outer race and the cylindrical roller bearing cage into place on the inner race.
- e. Using a heat gun or hot plate, heat the ball bearing inner race to 120° C (250° F) and install the bearing inner race onto the pinion gear shaft.
- f. Carefully tap the ball bearing inner race into place until it bottoms out.
- g. Install the ball bearing cage in place over the inner race and install each individual ball bearing into place in these 2 parts. Install all ball bearings.
- h. Using a heat gun or hot plate, heat the compression ring to 120° C (250° F) and install the compression ring onto the pinion gear shaft.
- i. Install a shim of the correct thickness.
- j. Place the ball bearing outer race in a freezer for about 30 minutes. This will reduce its overall size.
- k. Using a heat gun, heat the final drive unit neck (surrounding the ball bearing outer race) to 120° C (250° F).
- l. Install the ball bearing outer race into the final drive unit neck and over the ball bearings in the bearing cage.

15. Thoroughly clean the threaded ring of all oil and/or grease.

16. Secure the final drive unit in the BMW special tool (part No. 33 1 500) and secure the special tool in a vise as shown in **Figure 163**. Tighten the mounting bolts to the torque specification listed in **Table 1**.

17. Coat the threaded ring with a coat of Hylomar SQ 37 grease and place it in a freezer for about 15 minutes. This will reduce its overall size.

18. Using a heat gun, heat the final drive unit neck (surrounding the ball bearing outer race) to between 80-100° C (175-215° F).

19. Start the threaded ring by hand, then using BMW special tool (part No. 33 1 700), screw in the threaded ring. Tighten the threaded ring to the torque specification listed in **Table 1**.

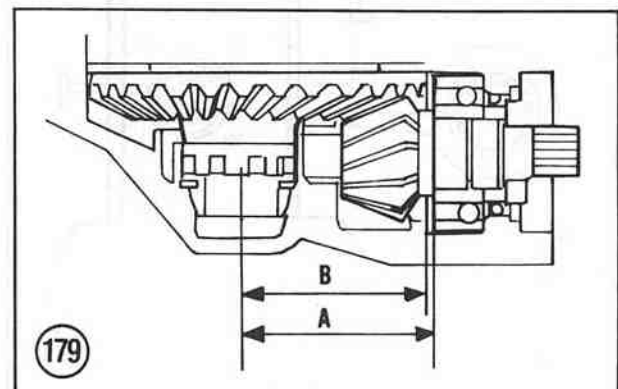
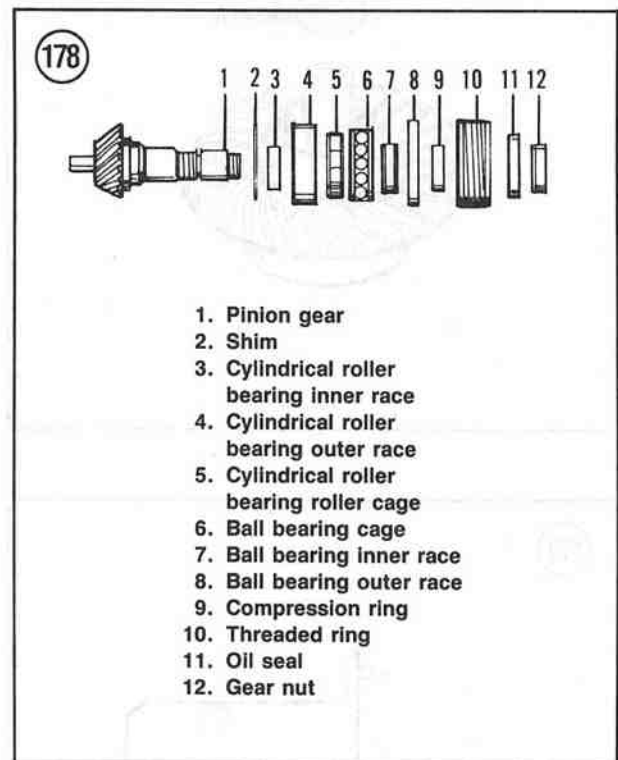
20. Apply about 0.1 gram of Loctite No. 273 to the gear nut and install the nut.

21. Using a suitable size socket, tighten the gear nut to the torque specification listed in **Table 1**.

22. Install the drain plug and new sealing washer. Tighten the drain plug to the torque specification listed in **Table 1**.

23. Install the brake shoes as described under *Rear Drum Brake* in Chapter Eleven.

24. Refill the final drive unit with the recommended type and quantity oil. Refer to Chapter Three.



#### CAUTION

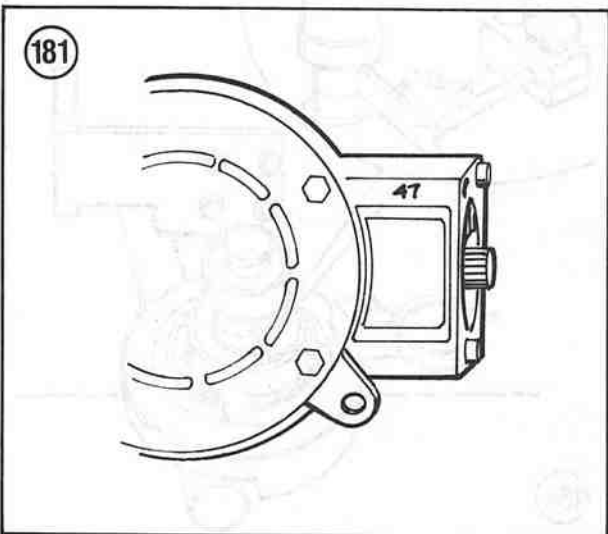
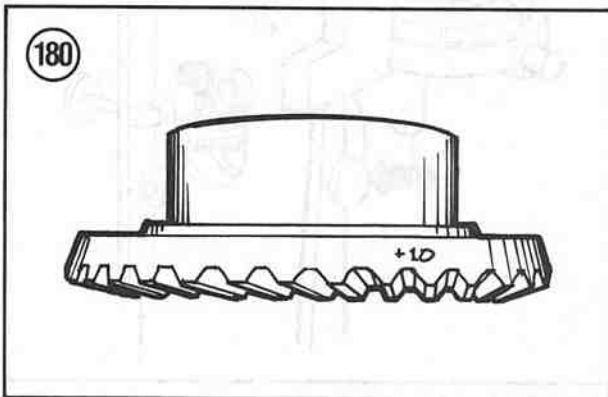
*Do not damage the new oil seal in the threaded ring during installation. After the threaded ring is installed, make sure the oil seal lip is seated correctly around the pinion gear shaft. This is necessary to prevent an oil leak.*

**PINION GEAR-TO-RING GEAR ADJUSTMENT  
(R100GS MODELS)**

If the ring and pinion gear set is being replaced, make sure they are from the same pair that was tested together and "designated as a compatible pair" at the BMW factory. The gears are run on a factory test stand and paired up in sets. This is to provide smooth running and the correct amount of backlash. After testing they are then given a *pair code mark* that appears on both gears (Figure 175). Only accept a ring and pinion gear set from a BMW dealer with matching numbers—don't accept a set with 2 different numbers.

If a *new* ring and pinion gear set is going to be installed into a used case or a *new case* is going to be used with the used ring and pinion set, the tolerance between these parts must be checked. There is a specified distance that provides the correct relation of the ring gear to the pinion gear.

The pinion gear is installed in the case and the ring gear is installed in the cover. When the cover and case are attached to each other, the relationship between the ring gear and pinion gear must be correct.



**NOTE**

*If any of the bearings have been replaced within the final drive unit, all of the following procedures must be followed.*

The *first section* of the procedure is for the pinion gear adjustment. This adjustment is made to correctly locate the pinion gear in relation to the case. A shim is used to achieve the in-and-out location of the pinion gear in the case and to correctly align it to the center of the ring gear.

The *second section* of the procedure is the adjustment of the ring gear backlash to the pinion gear. This adjustment is made to correctly locate the ring gear to the pinion gear. A shim is used to achieve the up-and-down location of the ring gear in the cover and to correctly align it with the pinion gear.

The *third section* is the tooth contact pattern or how the pinion gear and ring gear teeth mate to each other. The gear contact must be centered, otherwise, there will be abnormal stress placed on the gear teeth causing premature wear.

**Pinion Gear-to-Case Adjustment**

There is a specified distance for the location of the pinion gear within the case. This dimension is the distance from the inner surface of the pinion gear roller bearing to the centerline of the ring gear axis once the case and cover are assembled. The specified *drive pinion basic distance* is 77.50 mm; refer to dimension "A" in Figure 179. If the drive gear pinion is *not within specification*, it is so marked on the outer surface of the ring gear as shown in Figure 180. This number (e.g. +10) is a metric dimension in 1/100 of a millimeter and it is to be substituted for the standard number (e.g. +10 changes 77.50 mm to 77.60 mm).

Within the case is a shoulder where the pinion gear roller bearing stops during installation. This is called the "case basic distance" and it is 75.50 mm (3.022 in.); refer to dimension "B" in Figure 179. If the case has the exact finished distance, there will be no marking on it. If the case is *not within specification*, it is so marked on the inner surface with a number (e.g. 47) as shown in Figure 181. This number (e.g. 47) is a metric dimension in 1/100 of a millimeter and it is to be substituted for the standard number (e.g. 47 changes 75.50 mm to 75.47 mm).

Shims are available from a BMW dealer in increments of 0.005 mm and range from 1.500-2.500 mm.

To determine the thickness of the shim required, perform the following:

If both the case and the pinion gear are within specification, subtract the case basic distance from the pinion gear basic distance:

$$\begin{array}{r}
 77.50 \text{ mm} \\
 -75.50 \text{ mm} \\
 \hline
 2.00 \text{ mm shim required}
 \end{array}$$



If the case is *not* within specification but the pinion is, subtract the case basic distance (minus any dimensional deviation—e.g.  $47 = 75.47$  mm) from the pinion gear basic distance:

$$\begin{array}{r} 77.50 \text{ mm} \\ -75.47 \text{ mm} \\ \hline 2.03 \text{ mm shim required} \end{array}$$

If the case is within specification but the pinion gear is *not* within specification, subtract the case basic distance from the pinion gear basic distance (plus any dimensional deviation—e.g.  $+10 = 77.60$  mm):

$$\begin{array}{r} 77.60 \text{ mm} \\ -75.50 \text{ mm} \\ \hline 2.10 \text{ mm shim required} \end{array}$$

### Backlash Adjustment

To check and adjust the backlash, several BMW special tools are required. They are as follows:

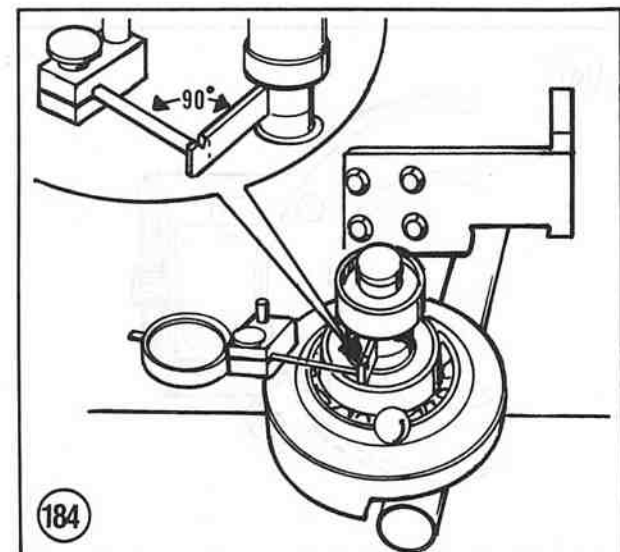
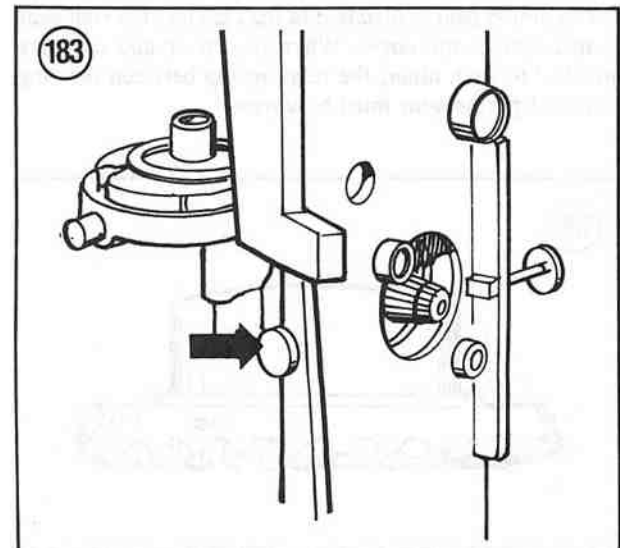
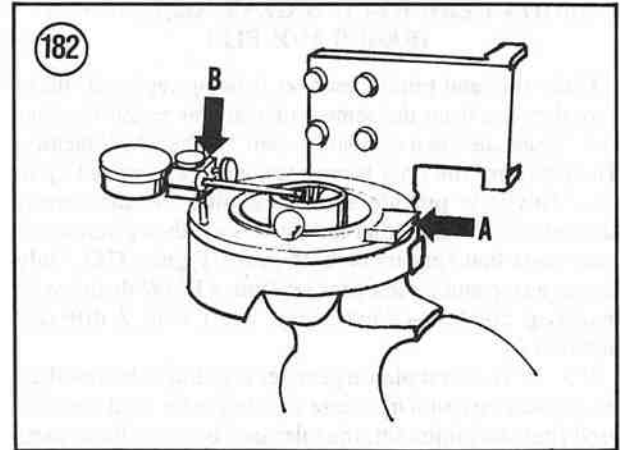
- a. Gear holding tool (part No. 33 2 630).
- b. Backlash adjuster (special dial indicator) (part No. 33 2 600).

1. If the ring gear's tapered roller bearing outer race was removed from the case, perform the following:
  - a. Heat the final drive case to about  $80^{\circ}\text{C}$  ( $175^{\circ}\text{F}$ ).
  - b. Install the bearing outer race. Install the bearing race until it bottoms out.
2. For a preliminary backlash adjustment, install a 2.35 mm shim between the roller bearing and the ring gear.
3. Position the shim with the inner chamfer facing toward the ring gear and install the shim onto the ring gear (A, **Figure 176**).
4. Heat the tapered roller bearing to about  $80^{\circ}\text{C}$  ( $175^{\circ}\text{F}$ ).
5. Install the tapered roller bearing (B, **Figure 176**) onto the ring gear. Make sure it is completely seated on the ring gear.

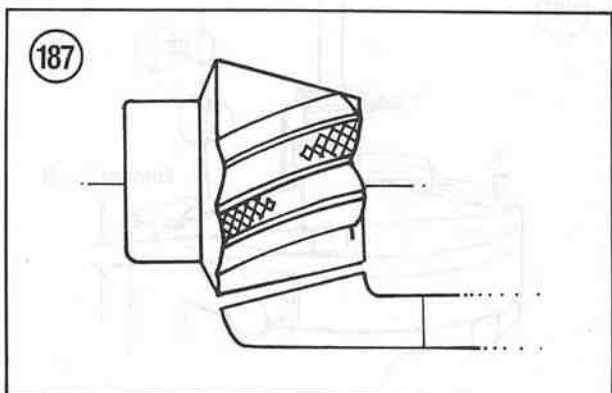
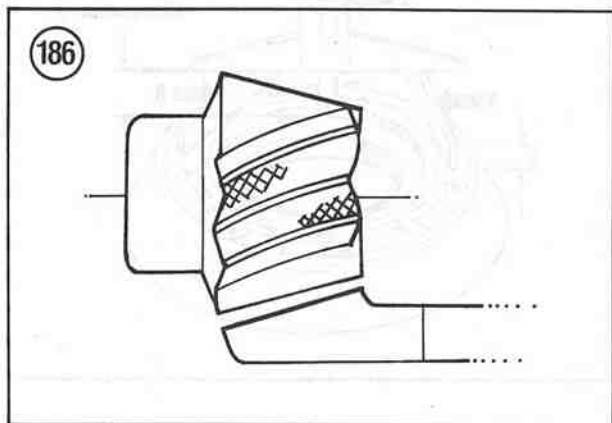
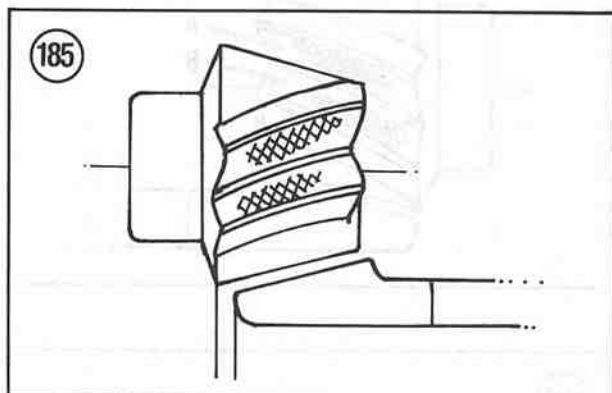
#### NOTE

*Before proceeding, allow the case and the bearing to cool down to room temperature. If they are still hot it will affect the following readings and give a false reading.*

6. Install the ring gear into the case and into mesh with the pinion drive gear.
7. Attach the gear holding tool (part No. 33 2 630) (A, **Figure 182**) so the pinion gear can not rotate. The gear must remain stationary during this procedure, otherwise the results will be incorrect.
8. Attach the backlash adjuster (special dial indicator) (part No. 33 2 600) (B, **Figure 182**) to the final drive unit case.
9. Tighten the arresting screw (**Figure 183**) so that the pinion gear will not move.
10. Adjust the tool so that the dial gauge point is  $90^{\circ}$  to the rod on the special tool (**Figure 184**).



11. Adjust the dial gauge to zero.
12. Slightly rotate the ring gear back and forth and note the dial gauge reading.
13. Reposition the special tool and check the backlash  $120^\circ$  from the point tested in Step 12. Note the reading.
14. Again reposition the special tool and check the backlash  $120^\circ$  from the point tested in Step 13. Note the reading. The specified backlash is listed in **Table 2**.
- 15A. If the backlash is within specification, remove the special tools from the final drive unit case.



- 15B. If the backlash is incorrect, remove the special tools from the final drive unit case and perform the following:
  - a. Remove the ring gear from the final drive case.
  - b. Remove the shim and replace it with a thicker or thinner one. Remember to position the shim with the inner chamfer facing toward the ring gear.
  - c. Install the ring gear into the case and into mesh with the pinion drive gear.
  - d. Repeat Steps 7-15A until the correct amount of backlash is obtained.
16. Inspect the tooth contact pattern as described in this chapter.

**Tooth Contact Pattern**

After completing the *Backlash Adjustment*, the tooth contact pattern must be checked.

1. Remove the ring gear from the final drive case.
2. Apply a light coat of gear marking compound to both sides of a couple of teeth on the pinion gear.
3. Install the ring gear into the final drive case and pinion gear.
4. Press down firmly on the ring gear and rotate it back and forth several times so the gear marking compound will transfer onto the ring gear teeth.
5. Remove the ring gear from the final drive case.
6. Observe the pattern on the pinion gear. If it looks like that in **Figure 185**, the tooth contact pattern is correct. If so, wipe off all gear marking compound residue from each gear.

**NOTE**

*Perform Steps 7-14 only if the tooth contact pattern is not correct and requires shim replacement.*

7. If the pattern does not look like **Figure 185**, compare to the following illustrations:
  - a. **Figure 186**: pinion gear must be moved farther out in the final drive case. Replace the existing shim with a *thicker* shim between the pinion gear and the final drive case.
  - b. **Figure 187**: pinion gear must be moved farther back into the final drive case. Replace the existing shim with a *thinner* shim between the pinion gear and the final drive case.
8. Replace the shim between the pinion gear and the final drive case as described in this chapter.
9. Re-apply a light coat of gear marking compound paint to both sides of a couple of teeth on the pinion gear.
10. Install the ring gear into the final drive case and pinion gear.
11. Press down firmly on the ring gear and rotate it back and forth several times so the gear marking compound will transfer onto the ring gear teeth.
12. Remove the ring gear from the final drive case.

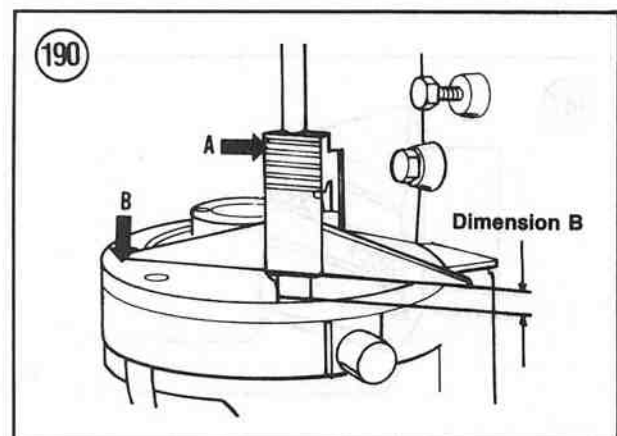
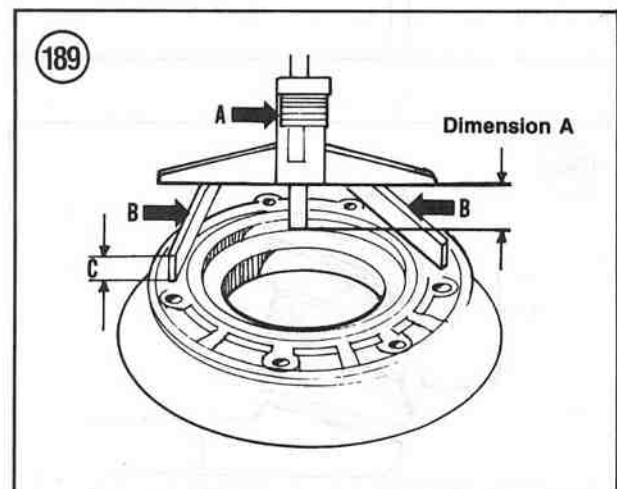
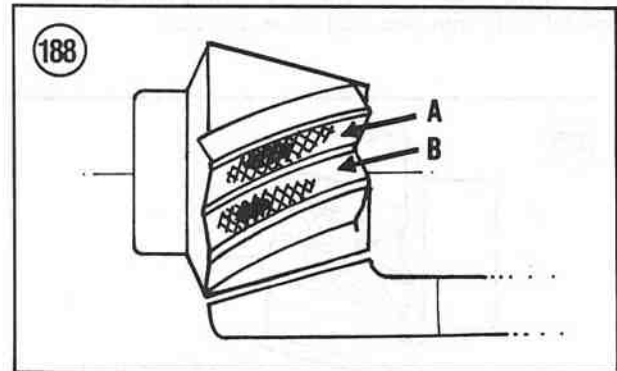
13. Observe the pattern on the pinion gear. If it looks like that in **Figure 185**, the tooth contact pattern is correct. If not, repeat this procedure until the tooth contact pattern is correct.
14. After the tooth contact pattern is correct in the loaded condition, check in the unloaded condition as follows:
  - a. Reapply a light coat of gear marking compound to both sides of a couple of teeth on the pinion gear.
  - b. Install the ring gear into the final drive case and pinion gear.
  - c. *Press down firmly* on the ring gear and rotate it back and forth several times so the gear marking compound will transfer onto the ring gear teeth.
  - d. This time do *not* press down firmly on the ring gear, just rotate it back and forth with no pressure, several times so the marking compound will form an additional pattern within the one made in Step 14c. The new pattern should be centered (A, **Figure 188**) on the forward side of the gear and should be toward the larger end of the teeth on the reverse side of the gear (B, **Figure 188**).
15. Remove the ring gear from the final drive case. Wipe off all gear marking compound residue from both gears.

#### TAPER ROLLER BEARING PRELOAD (R100GS MODELS)

The preload on the taper roller bearing, located on the right-hand side of the ring gear, is controlled by the shim placed between the ball bearing, located on the left-hand side of the ring gear, and the case cover. The correct spacing of this ball bearing determines the preload on the tapered roller bearing. A specific amount of preload is necessary for the tapered roller bearing to seat correctly and operate properly. The preload thickness is listed in **Table 2** and the shims are available from BMW dealers in the following thicknesses: 0.180, 0.280, 0.380, 0.500, 0.630, 0.750 and 0.880 mm.

1. Place the case cover on the workbench with the inner surface facing up.
2. Place the BMW special tool (distance or depth gauge—part No. 00 2 550) (A, **Figure 189**) on spacers (B, **Figure 189**) on the case-to-cover mating surface of the cover.
3. Measure the distance from the mating surface down to the ball bearing seating shoulder of the cover. Subtract the thickness of the spacers (C, **Figure 189**) from this dimension. This is dimension "A."
4. Install the ring gear into the final drive case and pinion gear.
5. Install the ball bearing onto the ring gear.
6. Place the BMW special tool (distance or depth gauge—part No. 00 2 550) (A, **Figure 190**) on the upper surface of the ball bearing on the ring gear. Place the special tool in the opening in the gauge ring (B, **Figure 190**).
7. Measure the distance from the ball bearing upper surface to the case mating surface of the case. This is dimension "B" (**Figure 190**).

8. Subtract dimension "B" from dimension "A." This dimension is the shim thickness required *without preload*.
9. Add the thickness of the dimension without preload, determined in Step 8, to the specified preload listed in **Table 2**. This will give you the dimension for the shim thickness to provide the correct amount of preload.
10. Remove the special tool.



**Table 1 REAR SUSPENSION TORQUE SPECIFICATIONS**

Item	N•m	in.-lb.	ft.-lb.
Rear wheel (dual-shock models)			
Rear axle nut	45-48	—	33-35
Rear axle pinch bolt	14-18	—	10-13
Rear wheel (single-shock models)			
Mounting nuts (R80G/S)	85	—	62
Mounting bolts	106	—	78
Brake disc mounting bolts and nuts	22-24	—	16-17
Shock absorber (dual-shock models)			
Upper mounting bolts or nuts			
1970-1976 models and			
1979-1980 R65	30-34	—	22-25
1977-1980 R60/7, R80/7, R100/7	34-39	—	25-28
Lower right-hand side	35-40	—	26-29
Lower left-hand side	30-35	—	22-26
Shock absorber (single-shock models)			
Upper and lower mounts			
R80GS, R80ST	43-48	—	31-35
1988-on R100GS, R100RS, R100RT	25-34	—	18-25
Swing arm (dual-shock models)			
Pivot pin			
Initial torque to preload bearings	20	—	15
Final torque	10-12	88-106	—
Pivot pin locknut	100-110	—	73-80
Swing arm (single-shock models)			
Pivot pin			
Initial torque to preload bearings	18-20	—	13-15
Final torque	8-12	—	6-9
Pivot pin locknut	95-119	—	69-86
Drive shaft-to-transmission output shaft bolts			
1970-1978	22-24	—	16-17
1979-on (except R100GS)	32-42	—	23-30
R100GS	35-45	—	26-33
Drive shaft rear coupling retaining nut			
1970-1978	240-260	—	177-191
1979-on	200-220	—	147-162
Final drive until (all models except R100GS)			
Final drive unit-to-swing arm nuts			
1970-1976 models	NA	NA	NA
R80GS, R80ST, R80, R80RT	65	—	47
All other models	47	—	35
Housing cover nuts	18	—	13
Housing-to-swing arm mounting nuts	46	—	34
Fill plug			
Combined level/filler plug	28-31	—	20-22
Separate filler plug	20	—	15
Separate level plug	8-10	71-88	—

(continued)

**Table 1 REAR SUSPENSION TORQUE SPECIFICATION (continued)**

Item	N•m	in.-lb.	ft.-lb.
Drain plug	23	—	17
Threaded ring	118	—	87
Pinion gear nut	150-165	—	110-121
Final drive unit (R100GS)			
Final drive unit-to-swing arm nuts	26-32	—	19-24
Final drive unit-to-BMW special tool (No. 33-1-500)	100	—	73
Cover bolts	19-23	—	14-17
Oil fill plug	18-22	—	13-16
Drain plug	22-28	—	16-20
Threaded ring	106-130	—	78-96
Pinion gear nut	180-220	—	132-162
Final drive unit-to-swing arm			
Left-hand pivot pin	98-112	—	72-82
Right-hand pivot pin	6.8-7.8	60-69	—
Right-hand pivot pin locknut	98-112	—	71-82
Control rod mounting bolts (R100GS)			
Control rod-to-frame	38-46	—	28-34
Control rod-to-final drive unit	31-35	—	22-26

Table 2 is on the following page.



**Table 2 REAR SUSPENSION SPECIFICATIONS**

Drive shaft	Located within the swing arm. The R100GS models have a universal joint at each end of shaft. All other models have a universal joint at front end of shaft only.
Drive shaft oil*	Hypoid gear oil GL5 SAE 80W 90
100 cc (0.21 pt.) /5 models with short wheel base (1970-to-mid 1973)	
150 cc (0.32 pt.) all other models	
Shock absorber (dual shock models)	
Spring free length	
1970-1979 models and 1983-1984 R80RT	251 mm (9.88 in.)
R65, R65LS	240-248 mm (9.45-9.76 in.)
R80S	272-276 mm (10.71-10.86 in.)
R80T, R80RT	212-214 mm (8.35-8.43 in.)
All other models	251 mm (9.88 in.)
Shock absorber (single shock models)	
Spring free length	
R100GS	251 mm (9.88 in.)
R100RS, R100RT	212-214 mm (9.88 in.)
Final drive unit (all models except R100GS)	
Manufacturer	Klingenberg
Ring and pinion type	
Gear tooth backlash	
1970-1980 models	nil
1981-on models	0.10 mm (0.0039 in.)
Final drive unit oil	Hypoid gear oil GL5 SAE 80W/90
1970-1980	
250 cc (8.45 oz.)	
All other models	
350 cc (11.8 oz.)	
Final drive unit (R100GS)	
Manufacturer	Klingenberg
Ring and pinion type	
Tapered roller bearing pre-load	0.05-0.10 mm (0.002-0.004 in.) with 600-1,600 N (132-353 lb.) of preload force
Gear tooth backlash	0.07-0.16 mm (0.0028-0.0063 in.)
Final drive unit oil	Hypoid gear oil GL5 SAW 80W/90
260 cc (8.89 oz.)	
*Except R100GS models as this model's drive shaft does not require lubrication.	

## CHAPTER ELEVEN

# BRAKES

The front wheel is equipped with a drum brake, single disc or dual discs on the front wheel. The rear wheel is equipped with either a drum brake or a single disc.

The drum brakes are actuated by cable or rod and are controlled by the right-hand hand lever for the front brake or right-hand foot pedal for the rear brake.

The disc brake(s) are actuated by hydraulic fluid and are controlled by the right-hand hand lever for the front brakes or right-hand foot pedal for the rear brake. The brake pedal is connected to the master cylinder. As the brake pads wear, the caliper pistons move out automatically to keep lever or pedal freeplay constant. Over a period of time, this gradual repositioning of the pistons in response to brake pad wear will drop the level of the hydraulic fluid in the master cylinder reservoir. The cable-operated front master cylinder (models so equipped) does require a routine adjustment due to cable stretch and is covered in Chapter Three.

When working on hydraulic brake systems, it is necessary that the work area and all tools be absolutely clean. Any tiny particles of foreign matter and grit in the caliper assembly or the master cylinder can damage the components.

Refer to **Table 1** for brake specifications and **Table 2** for torque specifications. **Table 1** and **Table 2** are located at the end of this chapter.

### FRONT DRUM BRAKE

#### Disassembly

Refer to **Figure 1** for this procedure.

#### WARNING

*When working on the brake system, do not inhale brake dust. It may contain asbestos, which can cause lung injury and cancer. Wear a disposable face mask and wash your hands thoroughly after completing the work.*

1. Remove the front wheel as described under *Front Wheel Removal* in Chapter Nine.
2. Using a vernier caliper, measure the thickness of the brake linings (**Figure 2**). They should be replaced as a set if either lining is worn to the service limit listed in **Table 1**.

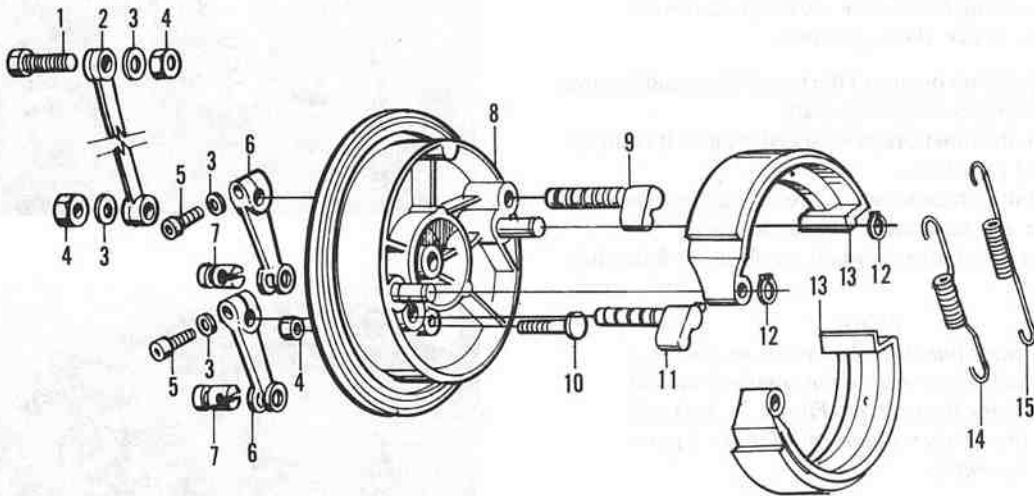
#### NOTE

*If the brake linings are in good condition and are going to be reinstalled, place a clean shop cloth on the linings to protect them from oil and grease during removal.*

3. Completely unscrew the brake cable adjuster from the end of the brake cable.
4. Slide out the slotted pivot pin from each brake lever.
5. Completely withdraw the brake cable from both upper and lower brake levers on the backing plate. Reinstall the pivot pins and cable adjuster onto the brake cable to prevent their accidental loss.
6. Remove the brake assembly and take it to your workbench for disassembly.
7. Prior to removing the return springs, note that the front spring is the stronger of the 2 and must be reinstalled in the same position.
8. If the same brake shoes are going to be reinstalled, make an index mark on one of the brake shoes and the backing plate (**Figure 3**). This will ensure correct placement during installation.

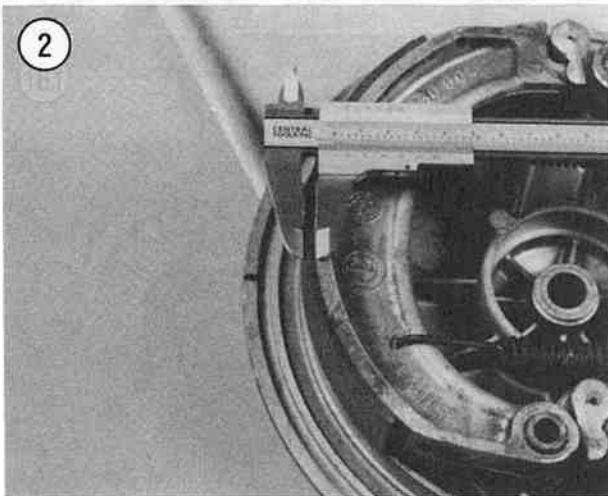
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## FRONT DRUM BRAKE

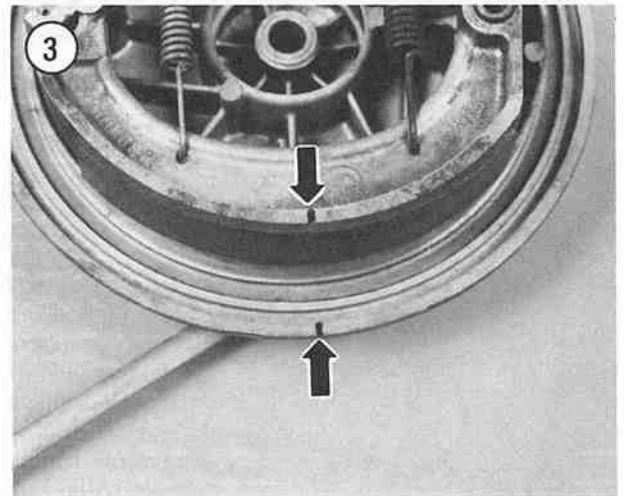


1. Bolt
2. Torque arm
3. Washer
4. Nut
5. Bolt
6. Brake arm
7. Brake cable pivot pin
8. Backing plate
9. Upper camshaft
10. Eccentric adjuster
11. Lower camshaft
12. Circlip
13. Brake shoes
14. Front return spring
15. Rear return spring

2



3



9. Remove the circlip (Figure 4) securing each brake shoe to its pivot pin.

**WARNING**

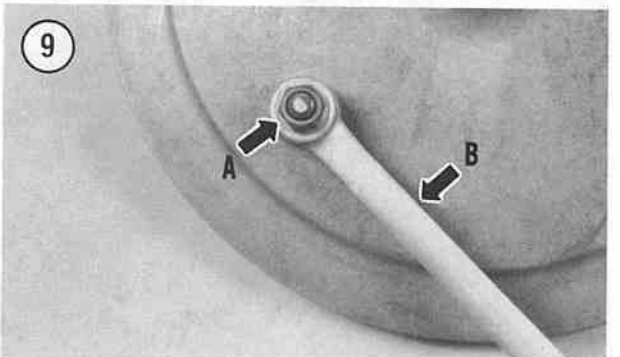
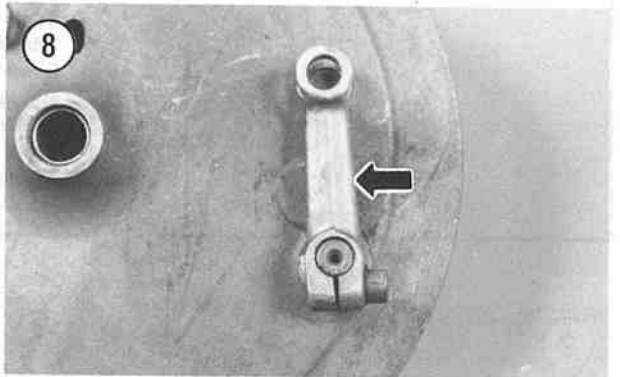
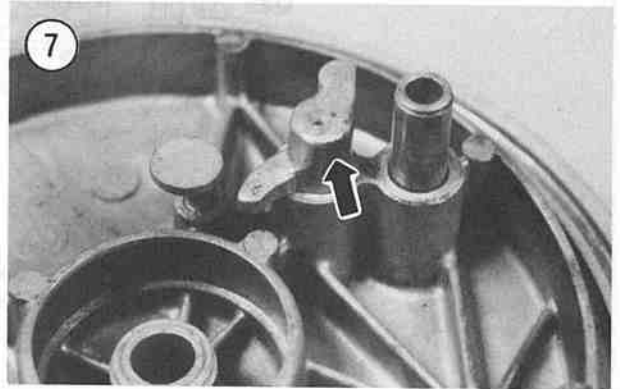
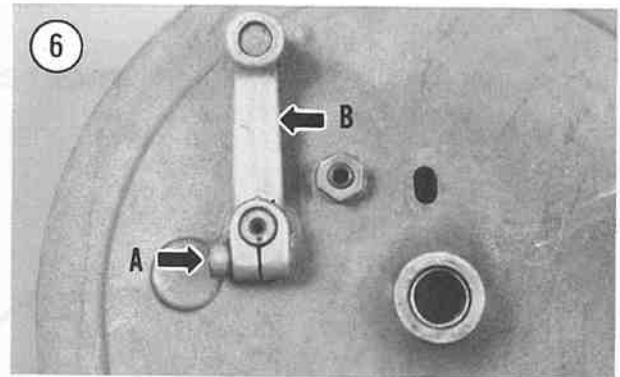
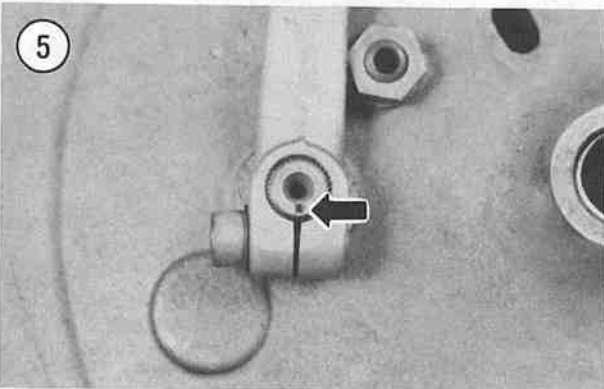
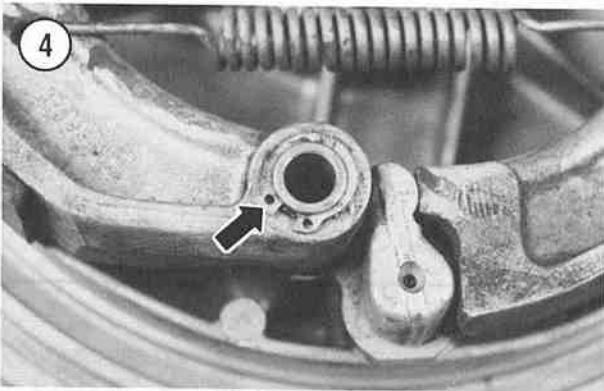
*The return springs are strong. Protect your fingers during brake shoe removal and remove only one brake shoe at a time.*

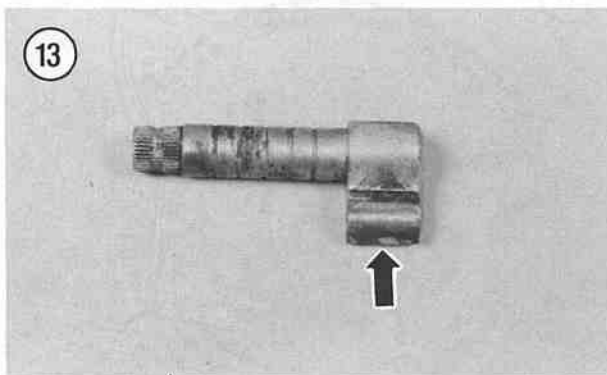
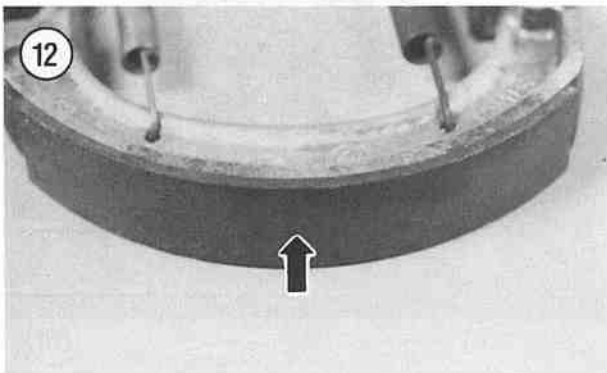
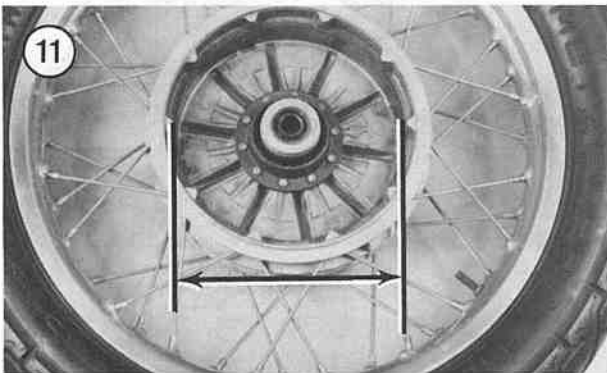
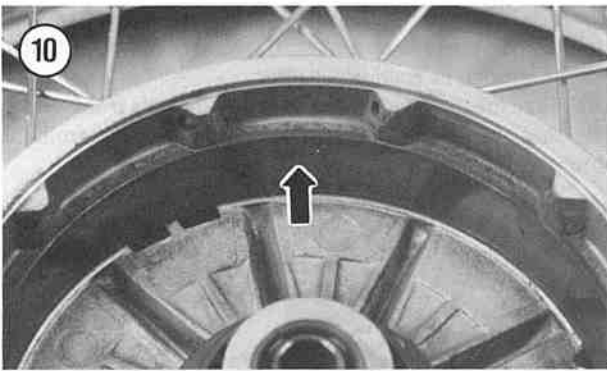
10. Carefully pull up on one of the brake shoes and remove it from the pivot post and camshaft.  
 11. Pull up on the other brake shoe and remove it from the pivot post and camshaft.  
 12. Remove both brake shoes and return springs from the backing plate and separate the brake shoes.  
 13. To remove each brake camshaft, perform the following:

**NOTE**

*Use a center punch and hammer and make a small mark on the end of the camshaft next to the gap in the brake lever (Figure 5). This will ensure the correct alignment of these 2 parts during assembly.*

- Remove the bolt and washer (A, Figure 6) from the brake lever.
- Slide the brake lever (B, Figure 6) off of the camshaft.

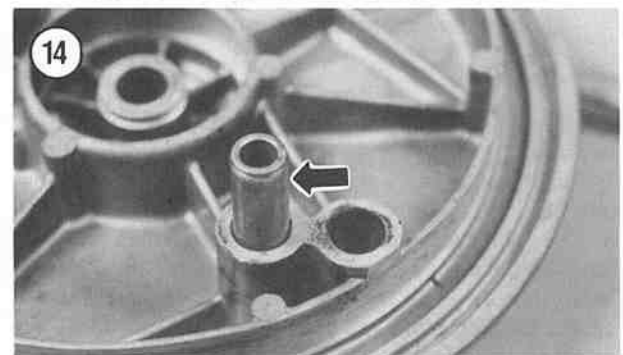




- c. Withdraw the camshaft (Figure 7) from the backing plate.
  - d. Repeat for the other brake lever (Figure 8).
14. If necessary, remove the nut and lockwasher (A, Figure 9) securing the torque arm (B, Figure 9) and remove the torque arm.

### Inspection

1. Thoroughly clean and dry all parts except the brake linings.
2. Check the contact surface of the brake drum (Figure 10) for scoring. If there are grooves deep enough to snag a fingernail, the drum should be reground.
3. Measure the inside diameter (Figure 11) of the brake drum with a vernier caliper. If the dimension is worn to or greater than the service limit listed in Table 1, the front hub or wheel must be replaced. The brake drum is an integral part of the front wheel hub.
4. If the drum is scored or grooved, have it turned providing the finished dimension is still within the maximum diameter listed in Table 1.
5. If the drum is turned, the linings will have to be replaced and arced to conform to the new drum contour.
6. If reusing old brake shoes, inspect the linings (Figure 12) for embedded foreign material. Dirt can be removed with a stiff wire brush. Check for any traces of oil or grease; if they are contaminated, they must be replaced.
7. If not measured prior to removal, measure the thickness of the brake linings with a vernier caliper (Figure 2). They should be replaced if the lining portion is worn to the service limit listed in Table 1.
8. Inspect the camshaft lobes (Figure 13) for wear or corrosion. Minor roughness can be removed with a fine emery cloth. Replace if necessary.
9. Inspect the pivot posts (Figure 14) on the backing plate for wear or corrosion. Minor roughness can be removed with fine emery cloth. If the roughness cannot be removed, replace the front wheel or hub.
10. Inspect the brake shoe return springs for wear or weakness. If they are stretched, they will not fully retract the brake shoes, leading to premature wear. Replace the springs as a pair if necessary.





11. Inspect the front axle bushing surface (**Figure 15**) for wear or damage. If the bushing is damaged, the backing plate must be replaced.

### Assembly

1. If the brake camshafts were removed, install them by performing the following:
  - a. Apply a light coat of molybdenum disulfide grease to the camshaft.
  - b. Position the camshaft with the index mark made during removal toward the top.
  - c. Install the camshaft into the backside of the backing plate. Push it in until it bottoms out.
  - d. Using the mark (**Figure 5**) made during removal, align the brake lever with the camshaft and install the brake lever onto the camshaft (B, **Figure 6**).
  - e. Install the bolt and washer (A, **Figure 6**) onto the brake lever. Tighten the bolt securely.
  - f. Repeat for the other brake lever.
2. Apply a light coat of high-temperature grease to the camshafts and pivot posts; avoid getting any grease on the backing plate surface where the brake linings may come in contact with it.
3. Attach the brake springs to the brake linings. Make sure the stronger spring is located at the front of the brake backing plate.
4. Position the brake shoes and return springs onto the backing plate. If the same brake shoes are being reinstalled, align the marks (**Figure 3**) made during removal to ensure proper installation.
5. Install one of the brake shoes onto the pivot pin and camshaft (**Figure 16**). Push the brake shoe down all the way until it is completely seated on the backing plate.

#### NOTE

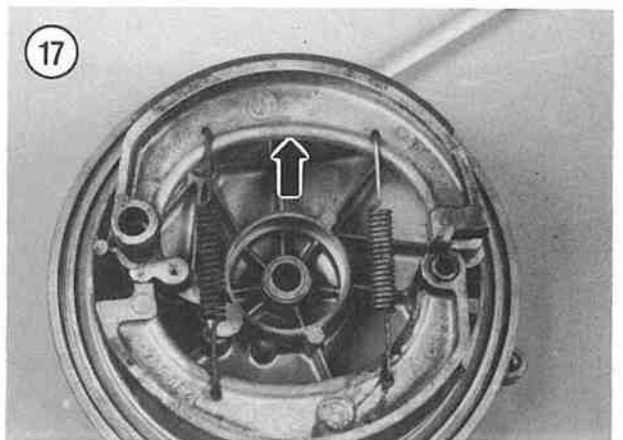
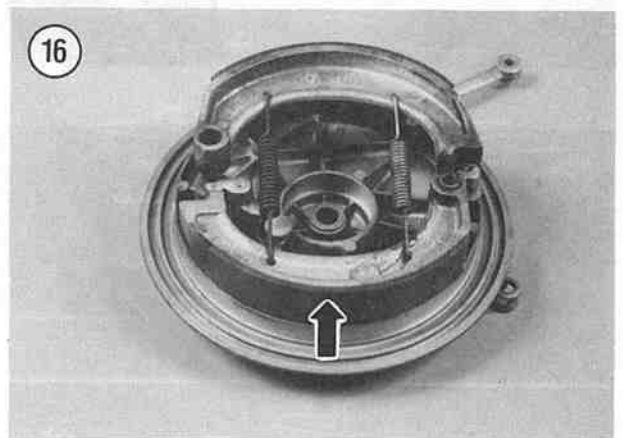
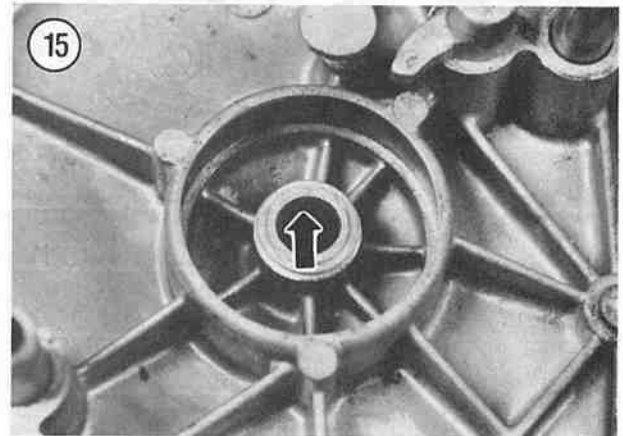
*The next step is easier with the aid of an assistant.*

#### WARNING

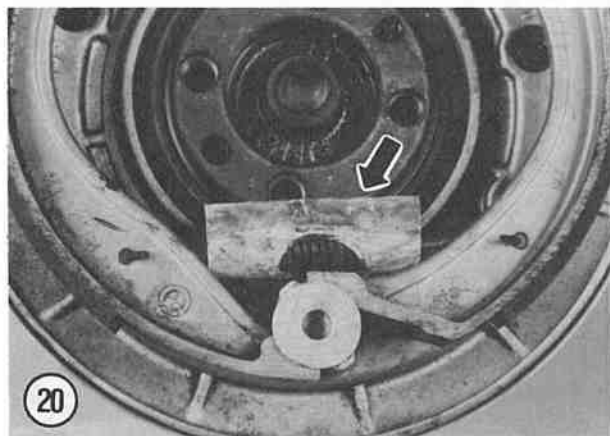
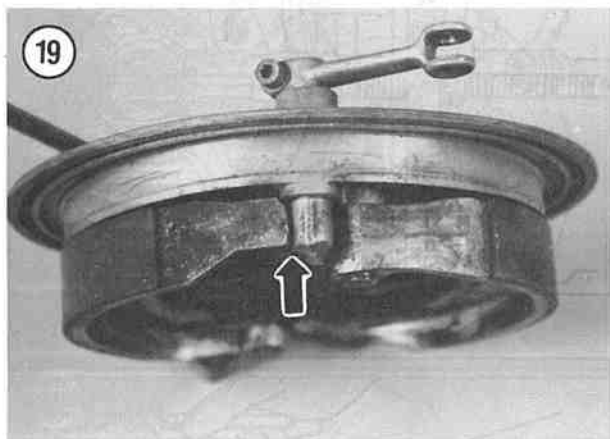
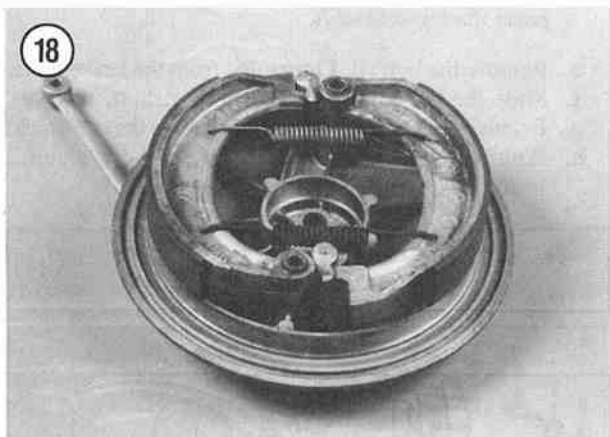
*The return springs are strong. Protect your fingers during brake shoe installation.*

6. Have the assistant hold the already installed brake shoe in place.
7. Pull the other brake shoe (**Figure 17**) and return springs into place on the pivot pin and camshaft.
8. Use a soft-faced mallet and carefully tap the brake shoe down on the pivot pin and camshaft (**Figure 18**). Push the brake shoe down all the way until it is completely seated on the backing plate and is correctly positioned on the camshaft (**Figure 19**).

9. Install the circlip (**Figure 4**) securing each brake shoe to the pivot pin. Make sure each circlip is correctly seated in the groove in each pivot pin.
10. Take the brake assembly over to the bike's front wheel.
11. Remove the cable adjuster and both pivot pins from the brake cable.



12. Carefully install the brake cable into both upper and lower brake levers on the backing plate.
13. Slide the slotted pivot pin into position and over the brake cable in each brake lever.
14. Install the brake cable adjuster onto the end of the brake cable.



15. Insert the brake backing plate into the brake drum.
16. Install the front wheel as described under *Front Wheel Installation* in Chapter Nine.
17. Adjust the front brake as described under *Front Drum Brake Adjustment* in Chapter Three.

### REAR DRUM BRAKE

On all models starting with 1985, BMW has determined that under certain slow braking conditions the brake shoe spring will vibrate, emitting an annoying noise. A rubber damper (**Figure 20**) was added to the lower return spring and this solved some of the noise problems.

In some cases, this rubber damper will not completely solve the noise problem. The next thing to do is to change to updated brake shoes. The part numbers are as follows:

- a. Upper brake shoe: BMW part No. 34 21 1 242 401.
- b. Lower brake shoe: BMW part No. 34 21 1 242 402.

These brake shoes have relocated brake spring attachment points which make the return springs exert more pressure on the shoes, thus pressing them harder against the camshaft and pivot post. This along with the rubber damper should cut down on the noise.

The new brake shoes are marked with an "86" within a double circle containing 10 dots.

If you have experienced this noise problem, replace the brake shoes as well as the springs since they have weakened due to the abnormal vibration.

### Disassembly

Refer to **Figure 21** for this procedure.

#### WARNING

*When working on the brake system, do not inhale brake dust. It may contain asbestos, which can cause lung injury and cancer. Wear a disposable face mask and wash your hands thoroughly after completing the work.*

1. Remove the rear wheel as described under *Rear Wheel Removal* in Chapter Ten.
2. Using a vernier caliper, measure the thickness of the brake linings (**Figure 22**). They should be replaced if the lining portion is worn to the service limit listed in **Table 1**.

#### NOTE

*The following steps, except for Step 6, are shown with the final drive unit removed for clarity. It is not necessary to remove the final drive unit for this procedure.*

#### NOTE

*If the brake linings are in good condition and are going to be reinstalled, place a clean shop cloth on the linings to protect them from oil and grease during removal.*

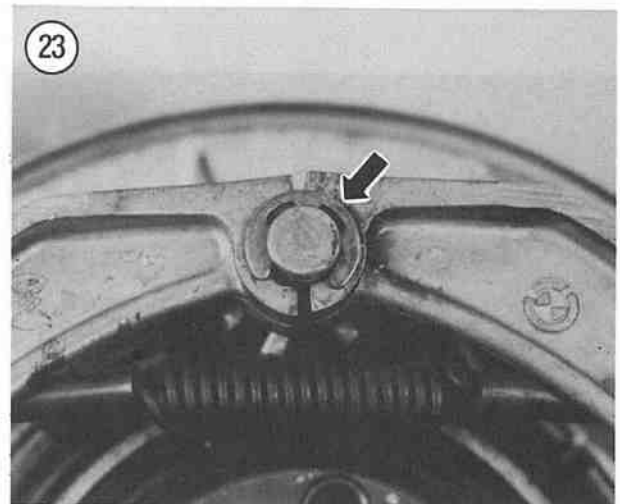
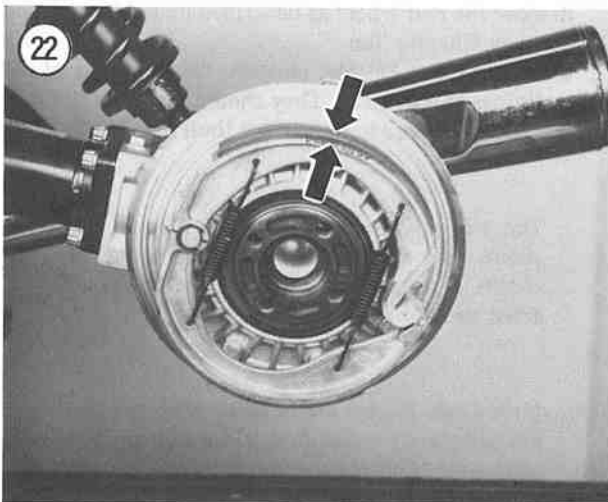
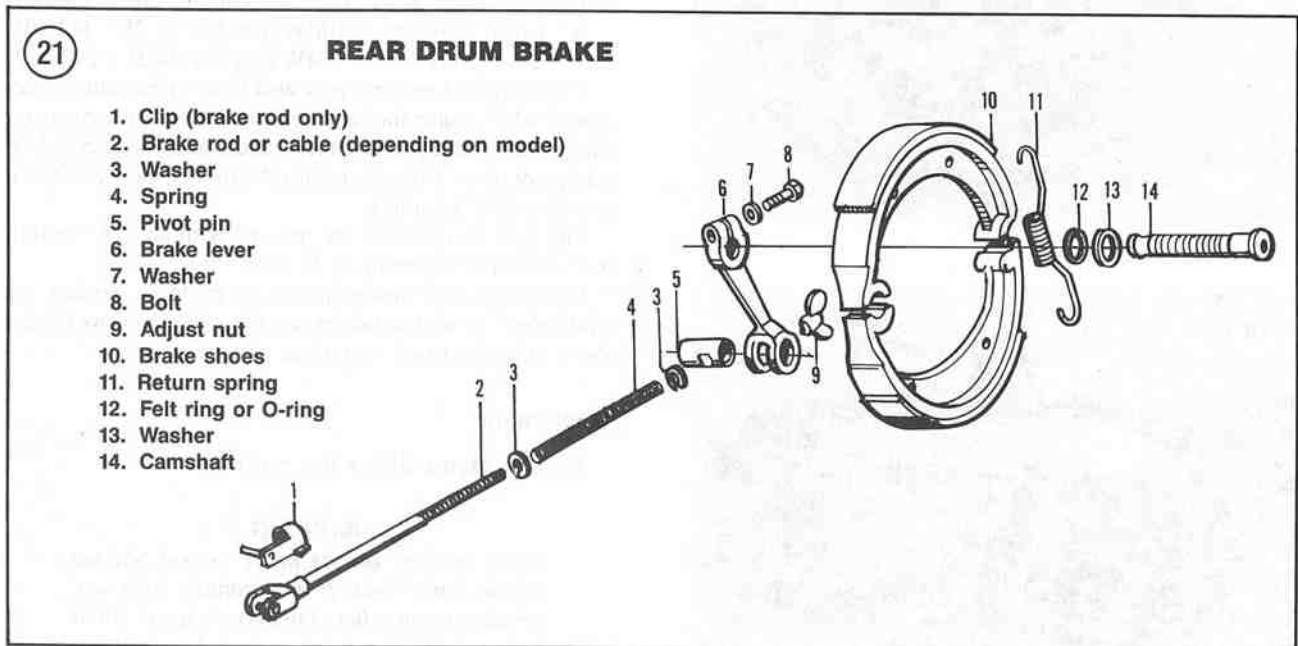
3. On models so equipped, remove the E-clip (Figure 23) securing the brake shoes to the pivot pin.
4. Pull up on the center of each brake shoe and remove the brake shoes (Figure 24) from the backside of the final drive unit.
5. Remove the return springs and separate the brake shoes.
6. To remove the brake camshaft, perform the following:
  - a. Completely unscrew the adjust nut (A, Figure 25) from the end of the brake rod or cable.
  - b. Depress the brake pedal and withdraw the brake rod (B, Figure 25) or cable from the brake lever. On models so equipped, don't lose the washer between the spring and the pivot pin.
  - c. Remove the pivot pin from the brake lever.

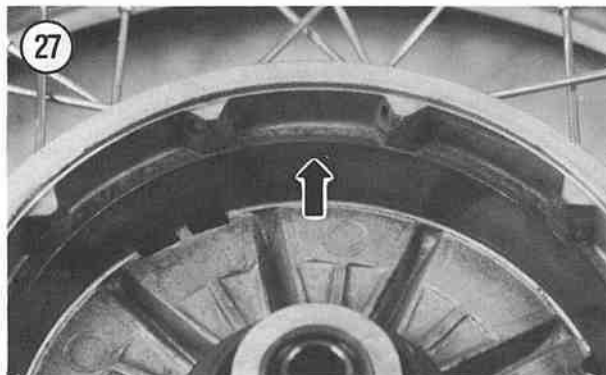
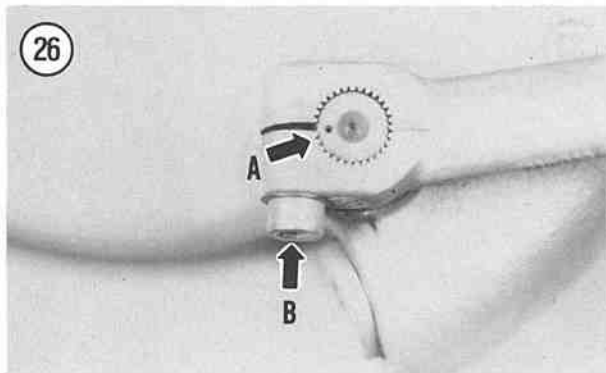
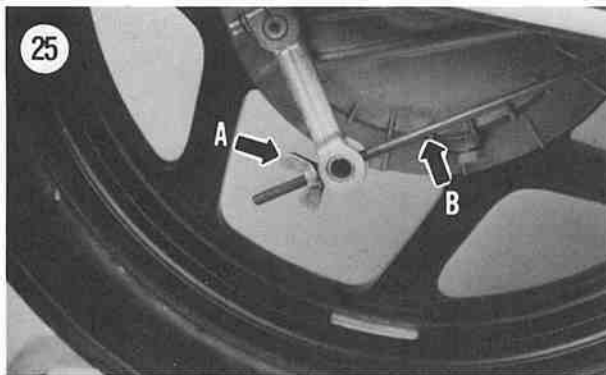
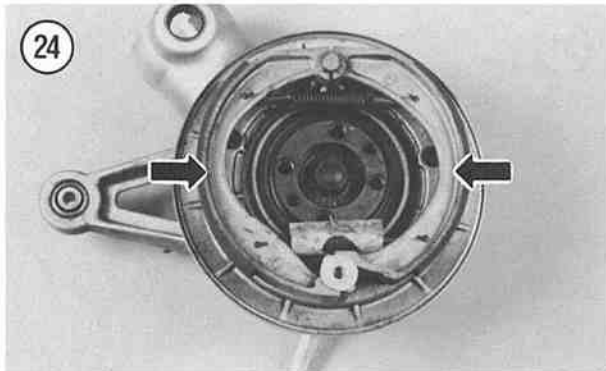
- d. Install the pivot pin and adjust nut onto the brake rod or cable to avoid misplacing them.

**NOTE**

Use a center punch and hammer and make a small mark on the end of the camshaft next to the gap in the brake lever (A, Figure 26). This will ensure the correct alignment of these 2 parts during assembly.

- e. Remove the bolt (B, Figure 26) from the brake lever.
- f. Slide the brake lever off of the camshaft.
- g. Remove the O-ring or felt washer from the camshaft.
- h. Withdraw the camshaft from the final drive unit.





### Inspection

1. Thoroughly clean and dry all parts except the brake linings.
2. Check the contact surface of the brake drum (Figure 27) for scoring. If there are grooves deep enough to snag a fingernail, the drum should be reground.

#### NOTE

*On a cast alloy wheel, if the dimension is more than the service limit listed in Table 1, the rear wheel must be replaced. The brake drum is an integral part of the wheel and cannot be replaced separately.*

3. Measure the inside diameter (Figure 28) of the brake drum with a vernier caliper. If the dimension is worn to or beyond the service limit listed in Table 1, the rear hub or wheel must be replaced. The brake drum is an integral part of the cast wheel or wheel hub and cannot be replaced separately.
4. If the drum is scored or grooved, have it turned providing the finished dimension is still within the maximum diameter listed in Table 1.
5. If the drum is turned, the linings will have to be replaced and arced to conform to the new drum contour.
6. If reusing old linings, inspect the linings (Figure 29) for embedded foreign material. Dirt can be removed with





a stiff wire brush. Check for any traces of oil or grease; if they are contaminated they must be replaced.

7. If not measured prior to removal, measure the thickness of the brake linings with a vernier caliper (Figure 30). They should be replaced if the lining portion is worn to the service limit listed in Table 1.

8. Inspect the camshaft lobe (Figure 31) and the pivot post (Figure 32) on the final drive unit for wear or corrosion. Minor roughness can be removed with fine emery cloth.

9. Inspect the camshaft bearing surfaces in the final drive unit for wear or corrosion. Refer to Figure 33 and Figure 34. Minor roughness can be removed with fine emery cloth on a wood dowel. If damage is severe, the final drive unit must be replaced.

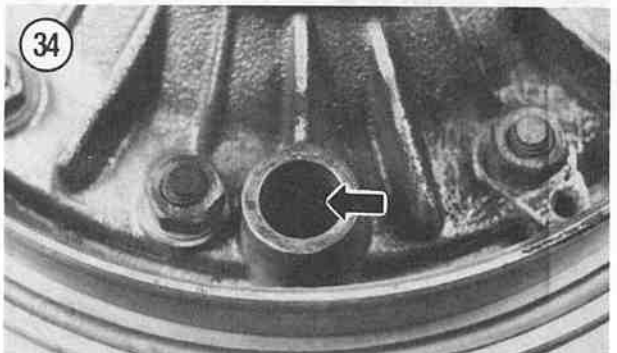
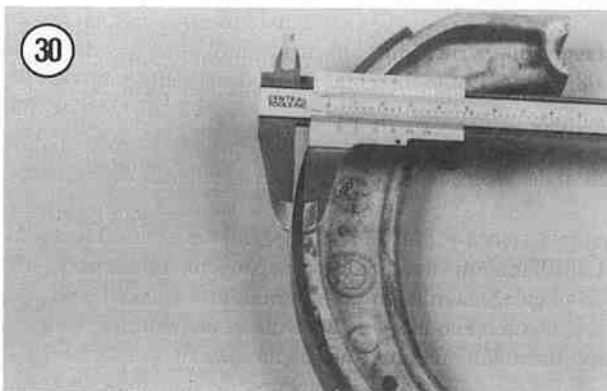
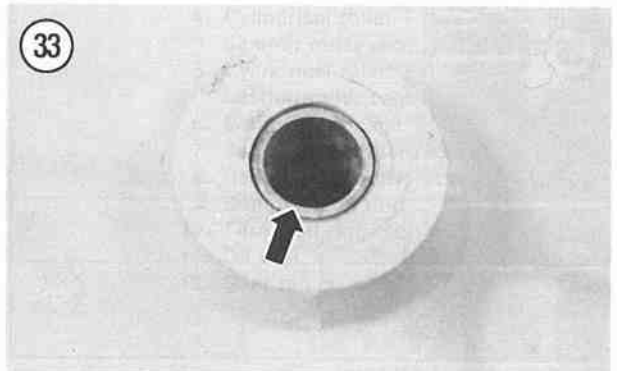
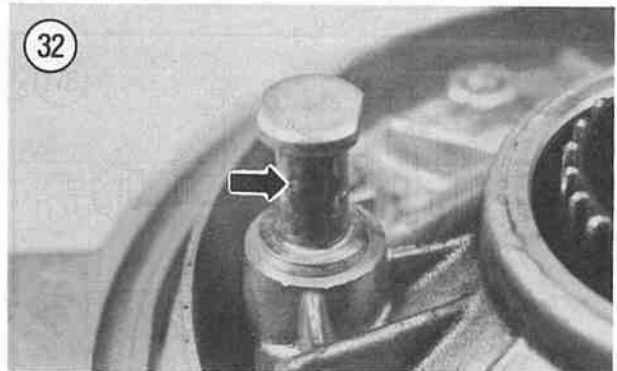
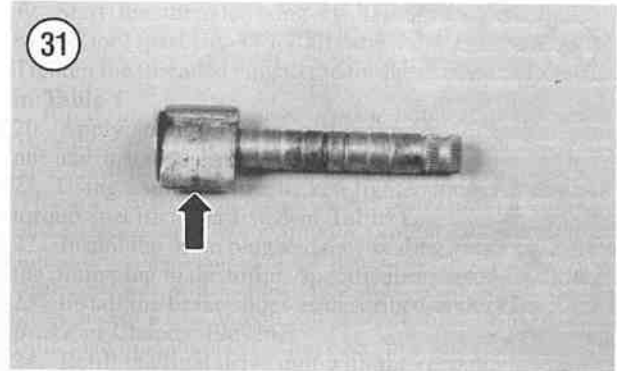
10. Inspect the felt washer or O-ring seal for wear or deterioration; replace if necessary.

11. Inspect the brake shoe return springs (Figure 35) for wear or weakness. If they are stretched, they will not fully retract the brake shoes, leading to premature wear. Replace the springs as a pair if necessary.

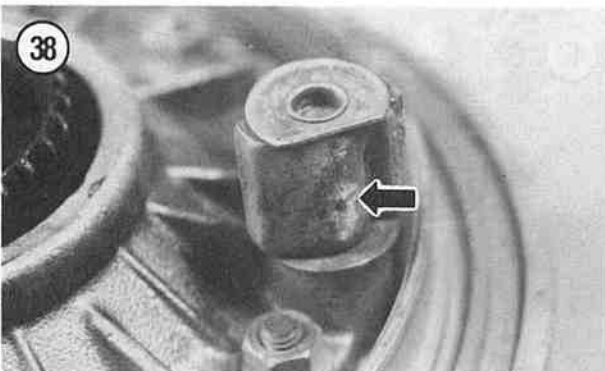
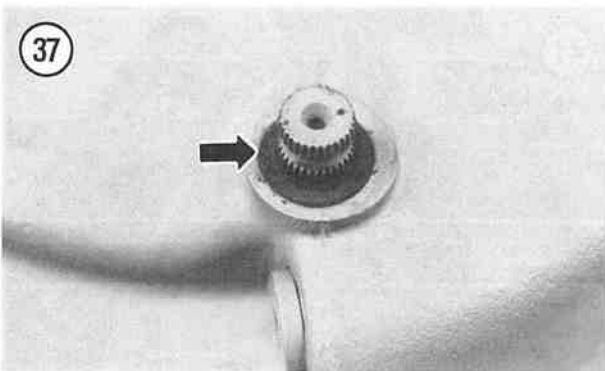
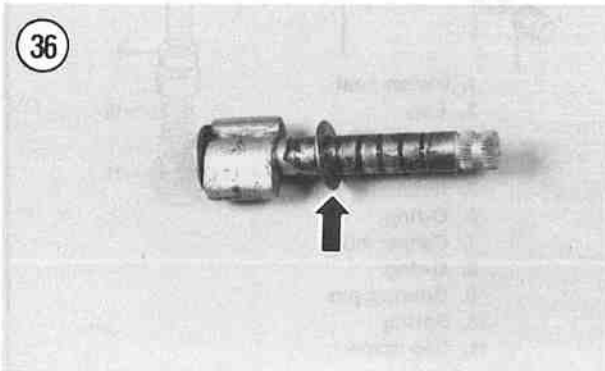
### Assembly

1. If the brake camshaft was removed, install by performing the following:

- a. If removed, install the washer (Figure 36) onto the camshaft.
- b. Apply a light coat of molybdenum disulfide grease to the camshaft.
- c. Position the camshaft with the index mark made during removal toward the top.
- d. Install the camshaft into the backside of the final drive unit. Push it in until it bottoms out.
- e. Install the O-ring seal, or felt ring (Figure 37) onto the camshaft.
- f. Install the wear indicator (models so equipped) onto the camshaft.
- g. Using the mark (A, Figure 26) made during removal, align the brake lever with the camshaft and install the brake lever onto the camshaft.
- h. Install bolt (B, Figure 26) into the brake lever and tighten securely.







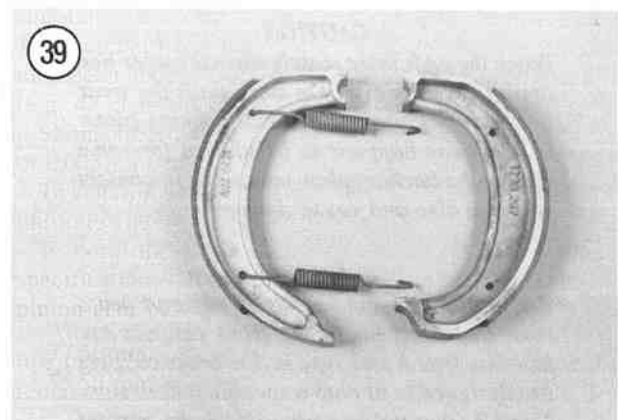
- i. Remove the adjust nut and the pivot pin from the brake rod.
  - j. Install the pivot pin into the brake lever and align the hole to accept the brake rod.
  - k. Make sure the washer is in place next to the spring on the brake rod.
  - l. Depress the brake pedal and install the brake rod into the pivot pin in the brake lever.
  - m. Install the adjust nut onto the brake rod. Tighten only enough to hold the adjust nut in place. If it is screwed on too far, it may expand the brake linings and make rear wheel installation difficult.
2. Apply a light coat of high-temperature grease to the camshaft (Figure 38) and pivot post (Figure 32); avoid getting any grease on the final drive unit surface where the brake linings may come in contact with it.
  3. Attach the springs to one of the brake shoes (Figure 39) and then to the other one.
  4. Hold the shoes in a "V" formation with the return springs attached and snap one of the shoes into place on the final drive unit.
  5. Pivot the other shoe down into place. Make sure both brake shoes are firmly seated on the final drive unit (Figure 24).
  6. If so equipped, make sure the rubber damper is in place on the lower return spring.
  7. On models so equipped, install the E-clip (Figure 23) securing the brake shoes to the pivot pin.
  8. Install the rear wheel as described under *Rear Wheel Installation* in Chapter Ten.
  9. Adjust the rear brake as described under *Rear Drum Brake Freeplay Adjustment* in Chapter Three.

## DISC BRAKE SYSTEM

### Disc Brake System Service Hints

Consider the following when servicing the front and rear disc brake systems.

1. Disc brake components rarely require disassembly, so do not disassemble them unless necessary.



2. Use only DOT 4 brake fluid from a sealed container.

**WARNING**

*Do not intermix silicone based (DOT 5) brake fluid as it can cause brake component damage leading to brake system failure.*

3. Do not allow disc brake fluid to contact any plastic, painted or plated surfaces or surface damage will occur.  
 4. Always keep the master cylinder's reservoir cover closed to prevent dust or moisture from entering.  
 5. Use only DOT 4 brake fluid to wash parts. Never clean any internal brake components with solvent or any other petroleum-based cleaners. Solvents will cause the seals to swell and distort and require replacement.  
 6. Whenever any component has been removed from the brake system, the system is considered "opened" and must be bled to remove the air bubbles. Also, if the brake feels "spongy," this usually means there is air in the system and it must be bled. For safe brake operation, refer to *Bleeding the System* as described in this chapter.

**WARNING**

*When working on the brake system, do not inhale brake dust. It may contain asbestos, which can cause lung injury and cancer. Wear a disposable face mask and wash your hands thoroughly after completing the work.*

**FRONT BRAKE PAD REPLACEMENT**

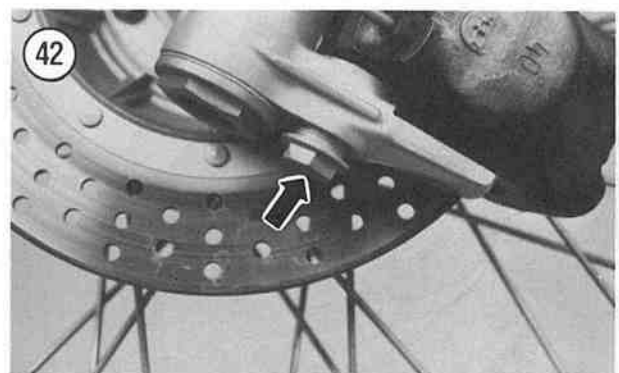
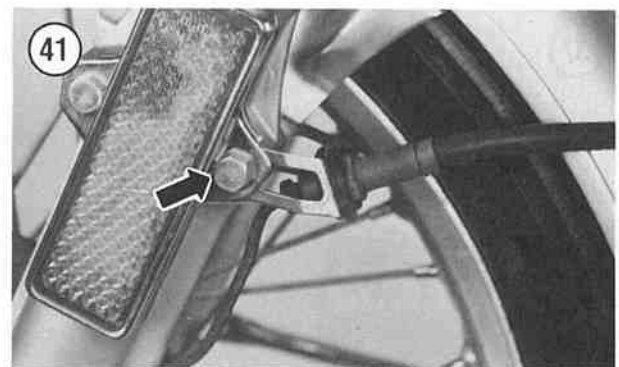
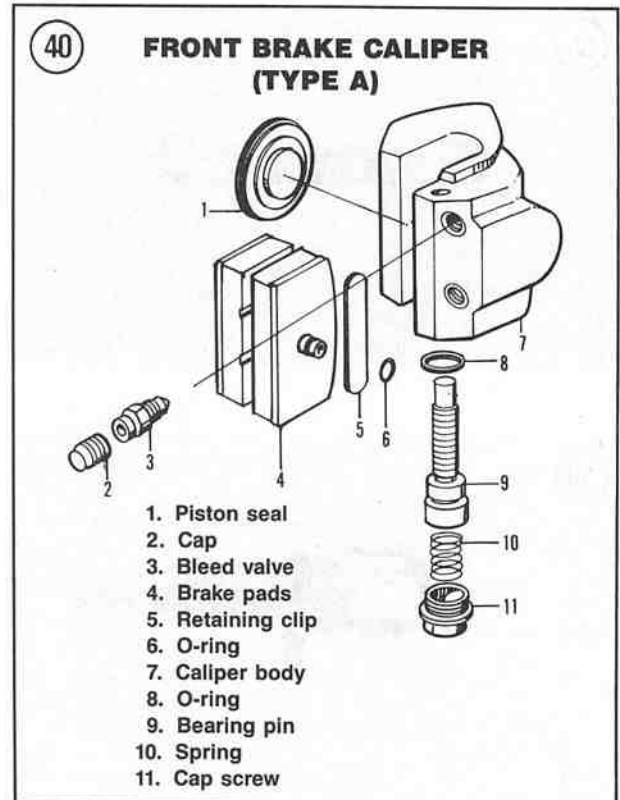
There is no recommended mileage interval for changing the friction pads in the disc brake. Pad wear depends greatly on riding habits and conditions. The pads should be checked for wear every 7,240 km (4,500 miles) and replaced when the lining thickness reaches the minimum thickness listed in **Table 1**. To maintain an even brake pressure on the disc, always replace both pads in both calipers at the same time. Always use brake pads from the same manufacturer in both front calipers—never intermix different brands.

**CAUTION**

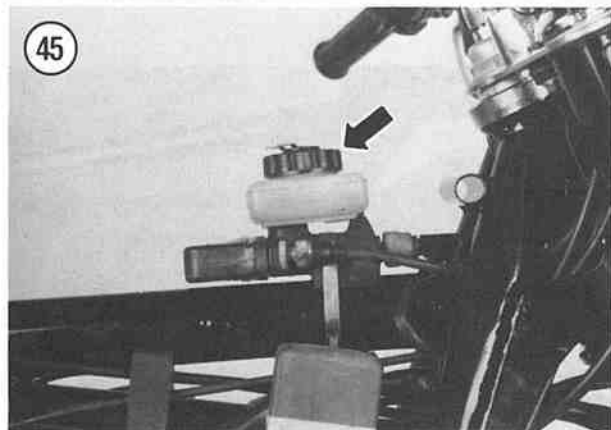
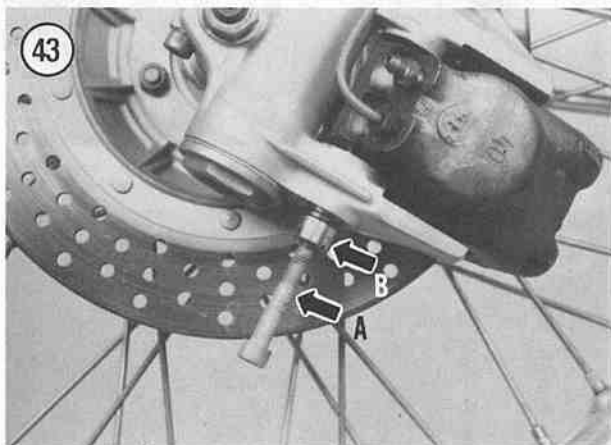
*Watch the pads more closely when the wear line approaches the disc. On some pads the wear line is very close to the metal backing plate. If pad wear happens to be uneven for some reason the backing plate may come in contact with the disc and cause damage.*

**NOTE**

*Because of the number of models and years covered in this book, the front calipers are listed as Type A and Type B. The brake calipers are designed to fit onto a specific fork design. Your bike may not be equipped with the original*



front forks, therefore the caliper will not be original either. The exterior appearance of the two different brake calipers is quite different. Compare your brake caliper with the illustration used with each brake pad replacement procedure.



### Pad Replacement (Type A Caliper)

Refer to **Figure 40** for this procedure. This brake caliper was originally equipped on most 1974-1979 models.

#### WARNING

When working on the brake system, do **not** inhale brake dust. It may contain asbestos, which can cause lung injury and cancer. Wear a disposable face mask and wash your hands thoroughly after completing the work.

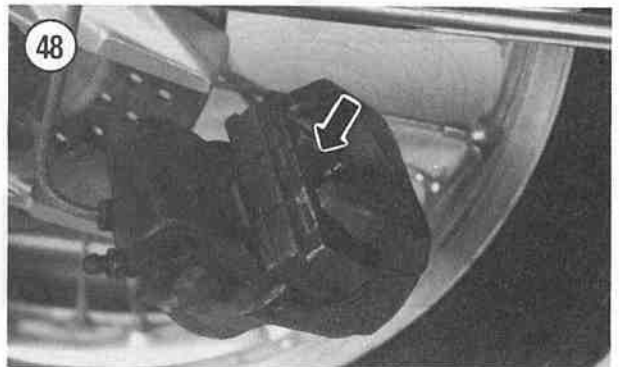
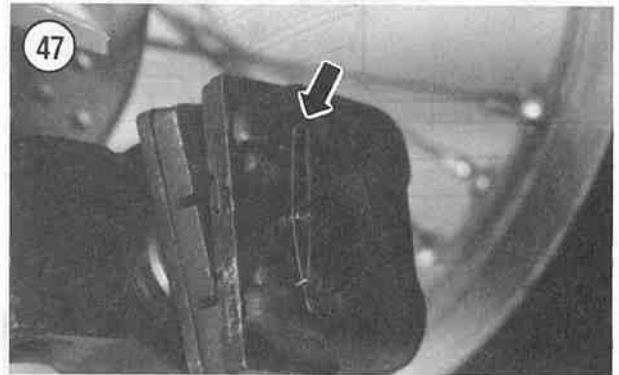
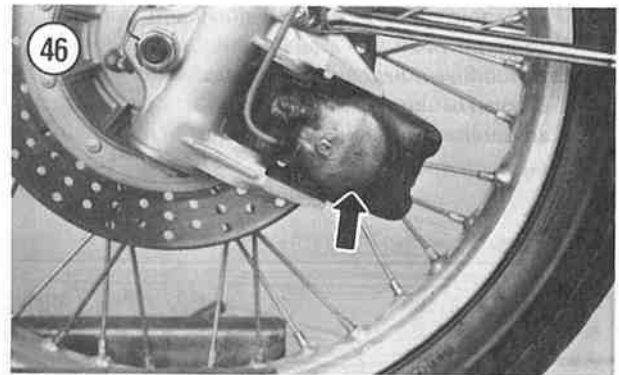
1. Place the bike on the centerstand with the front wheel off of the ground.
2. To prevent accidental application of the front brake lever, place a spacer between the front brake lever and the hand grip. Hold the spacer in place with a large rubber band, a tie wrap or a piece of tape.
3. To allow slack in the hydraulic brake lines, remove the bolt (**Figure 41**) securing the brake lines and bracket to the front fork.
4. Unscrew the cap screw (**Figure 42**) from the base of the fork boss. Remove the cap screw and spring.
5. Thread an 8 mm  $\times$  1.25  $\times$  50 mm bolt (A, **Figure 43**) into the bearing pin (B, **Figure 43**). Withdraw the bearing pin from the brake caliper and fork slider.
6. The piston must be repositioned within the caliper assembly prior to installing the new *thicker* brake pads. The front master cylinder brake fluid level will rise as the caliper piston is being repositioned. Perform the following:
  - a. Remove the fuel tank as described under *Fuel Tank Removal/Installation* in Chapter Seven.
  - b. Remove the electrical connector (**Figure 44**) from the master cylinder top cover.
  - c. Clean the top of the front master cylinder of all dirt and foreign matter.
  - d. Unscrew the top cover (**Figure 45**) from the master cylinder.
  - e. Note the brake fluid level in the reservoir. If it is up to, or close to, the top surface of the reservoir, siphon off some of the fluid at this time.
  - f. Push the caliper assembly toward the brake disc until it stops. This will reposition the piston into the caliper cylinder.
  - g. Constantly check the reservoir to make sure the brake fluid does not overflow. Remove brake fluid, if necessary, before it overflows.
  - h. The piston should move freely during repositioning. If it doesn't, and there is evidence of it sticking in the cylinder, the caliper should be removed and serviced as described under *Front Caliper Rebuilding* in this chapter.

7. Slide the caliper assembly off of the brake disc (**Figure 46**).
8. Remove the retaining clip (**Figure 47**) and remove the inboard brake pad (**Figure 48**) from the caliper assembly.
9. Remove the outboard brake pad (**Figure 49**) from the caliper assembly. Remove and discard the O-ring seal (**Figure 50**) on the brake pad.
10. Clean the pad recess and the end of the piston with a soft brush. Do not use solvent, a wire brush or any hard tool which would damage the piston.
11. Clean the caliper, the caliper mounting surface in the front fork and the bearing pin bolt. Remove all road dirt and grease.
12. Install a new O-ring seal (**Figure 51**) on the bearing pin bolt.
13. Carefully remove any rust or corrosion from the disc.
14. Lightly coat the end of the piston and the backs of the new brake pads (*not the friction material*) with disc brake lubricant.

#### NOTE

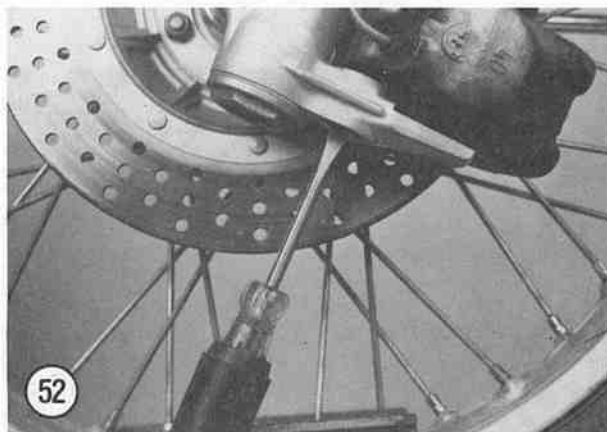
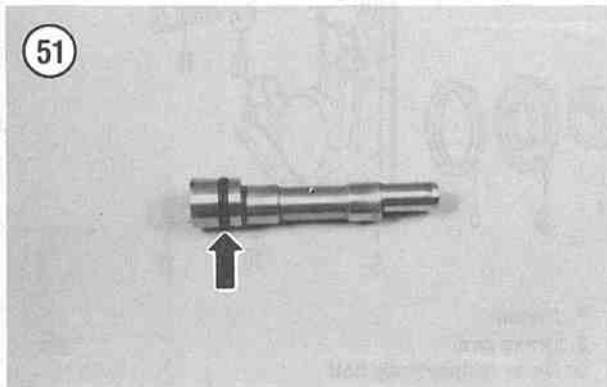
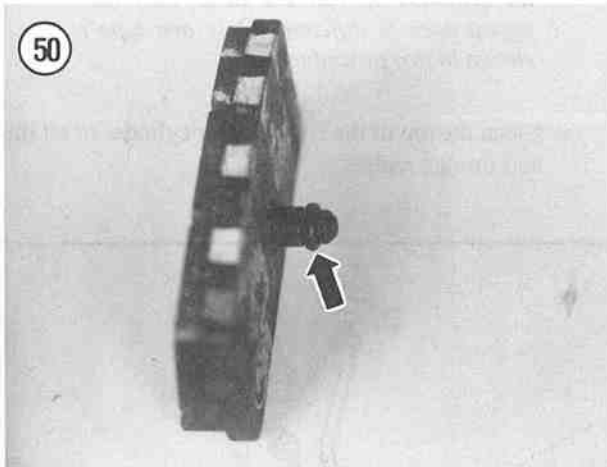
*When purchasing new brake pads, check with your dealer to make sure the friction compound of the new pad is compatible with the disc material. Remove any roughness from the backs of the new brake pads with a fine-cut file; wipe them clean with a lint-free cloth.*

15. Install a new O-ring seal (**Figure 50**) on the outboard brake pad stud.
16. Install the outboard brake pad into the caliper piston (**Figure 49**).
17. Install the inboard brake pad (**Figure 48**) into the caliper. Make sure the pad boss is positioned correctly in the recess of the caliper.
18. Install the retaining clip (**Figure 47**).
19. Thoroughly lubricate the bearing pin bolt and the bolt receptacle in the front fork and the pivot portion of the brake caliper with a good grade of silicone brake grease (Molykote BR2 or equivalent).
20. Install the front caliper onto the mounting boss on the fork slider.
21. Make sure the O-ring seal (**Figure 51**) is in place, then install the bearing pin. Push it all the way in.
22. Take the bike off of the centerstand.
23. Carefully roll the bike back and forth and activate the brake lever as many times as it takes to refill the cylinder in the caliper.
24. Align the caliper assembly to the disc as follows:
  - a. Insert a flat-bladed screwdriver (**Figure 52**) up into the receptacle in the fork.
  - b. Rotate the eccentric adjuster (bearing pin) until the caliper assembly is positioned the farthest distance away from the brake disc.





- c. Slowly turn the eccentric in the opposite direction until the fixed brake pad (inboard pad) is parallel to the brake disc.
- d. Apply radial marks to the inboard surface of the brake disc with a wide-tip felt marking pen.
- e. Remove the spacer between the front brake lever and the hand grip.



- f. Spin the front wheel and apply the front brake several times.
  - g. Observe how the felt marker radial lines have been wiped off. If the marks are removed evenly and completely, the inner pad is making full contact, indicating that the caliper is aligned correctly. If the marks are only wiped off a portion of the disc, readjust the caliper.
25. Install the spring and cap screw (Figure 42). Tighten the cap screw to the torque specification listed in Table 2.
  26. Move the hydraulic brake lines and bracket into position on the front fork and install the bolt (Figure 41). Tighten the bolt securely.

#### WARNING

Use brake fluid clearly marked DOT 4 from a sealed container. Other types may vaporize and cause brake failure. Always use the same brand name; do not intermix silicone based (DOT 5) brake fluid as it can cause brake component damage leading to brake system failure.

27. Refill the master cylinder reservoir, if necessary, to maintain the correct fluid level.
28. Install the top cover and tighten securely.
29. Install the electrical connector onto the master cylinder top cover.
30. Install the fuel tank as described under *Fuel Tank Removal/Installation* in Chapter Seven.

#### WARNING

Do not ride the motorcycle until you are sure the brakes are operating correctly with full hydraulic advantage. If necessary, bleed the brake as described in this chapter.

31. Bed the pads in gradually for the first 80 km (50 miles) by using only light pressure as much as possible. Immediate hard application will glaze the new friction pads and greatly reduce the effectiveness of the brake.

#### Pad Replacement (Type B Caliper)

Refer to Figure 53 for this procedure. This brake caliper was originally equipped on most 1980-on models.

#### WARNING

When working on the brake system, do not inhale brake dust. It may contain asbestos, which can cause lung injury and cancer. Wear a disposable face mask and wash your hands thoroughly after completing the work.

#### NOTE

It is not necessary to remove the caliper assembly in order to replace the brake pads.



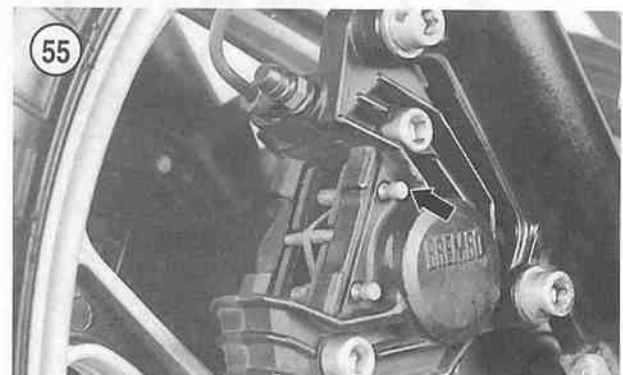
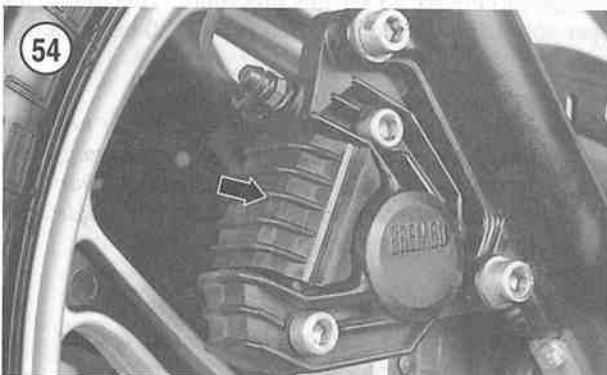
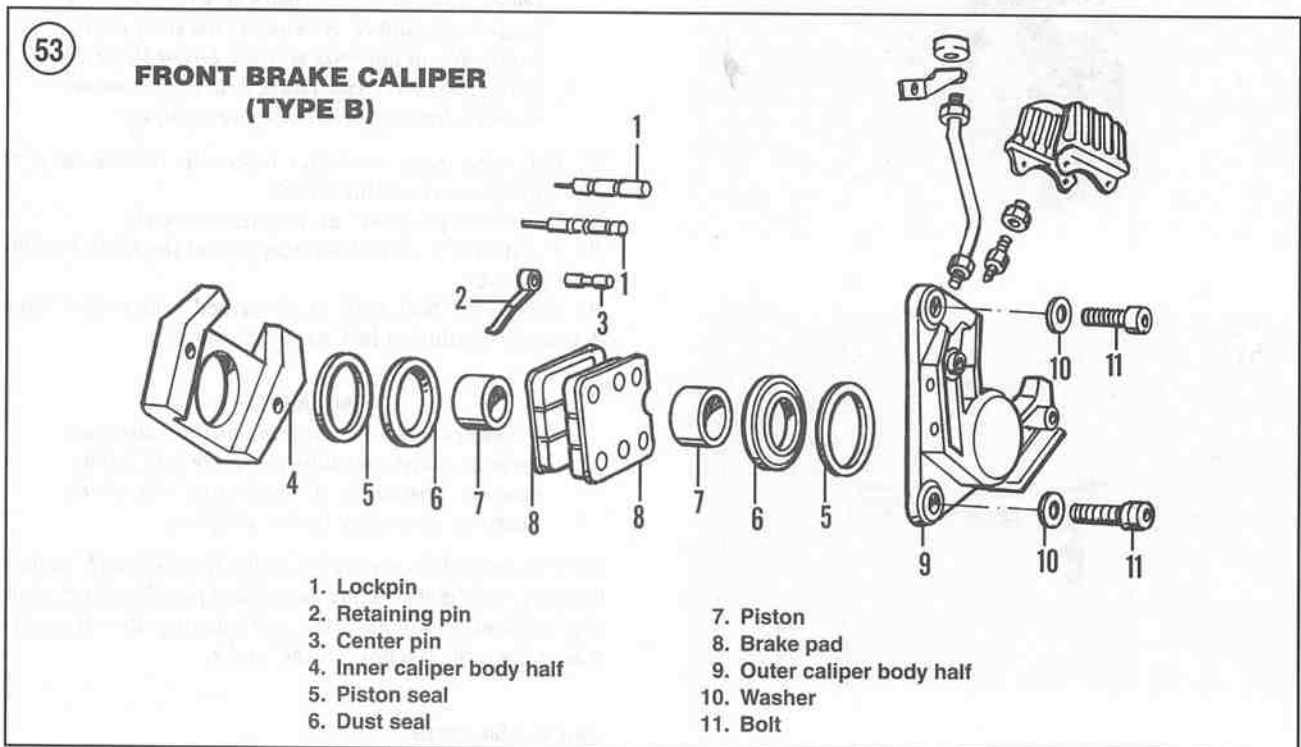
1. To prevent accidental application of the front brake lever, place a spacer between the front brake lever and the hand grip. Hold the spacer in place with a large rubber band, a tie wrap or a piece of tape.
2. Using a large flat-bladed screwdriver, carefully remove the brake caliper cover (Figure 54).
3. Using a drift and small hammer, carefully tap the top lockpin (Figure 55) out from the backside of the caliper.
4. Hold a finger over the center pin and retaining spring and remove the upper lockpin.
5. Remove the center pin (Figure 56).
6. Using a drift and small hammer, carefully tap the lower lockpin (A, Figure 57) out from the backside of the caliper. Remove the spring retainer (B, Figure 57) and the lower lockpin.

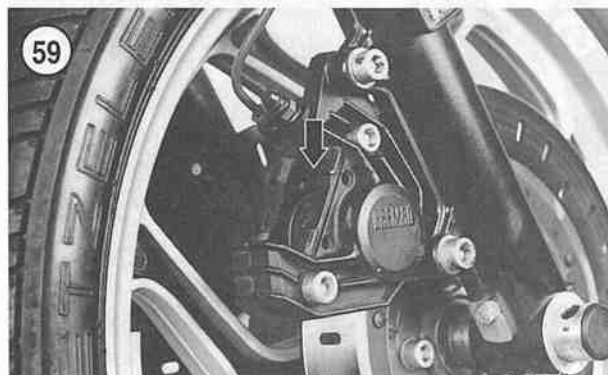
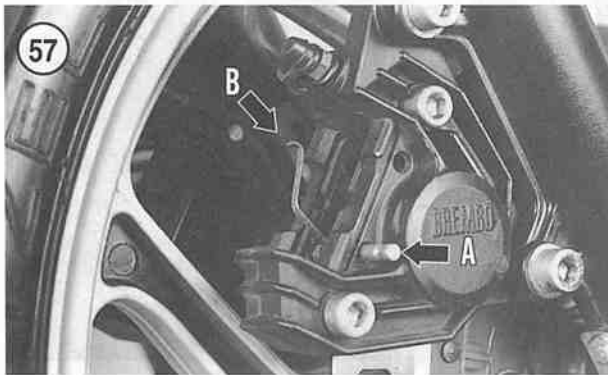
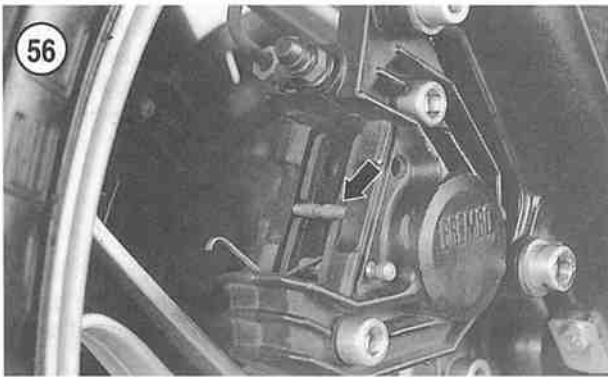
7. The pistons must be repositioned within the caliper assembly prior to installing the new thicker brake pads. The front master cylinder brake fluid level will rise as the caliper pistons are being repositioned. Perform the following:

**NOTE**

There are 2 different types of master cylinders used with the Type B caliper. Both master cylinders operate the same; only their appearance is different. Only one type is shown in this procedure.

- a. Clean the top of the front master cylinder of all dirt and foreign matter.



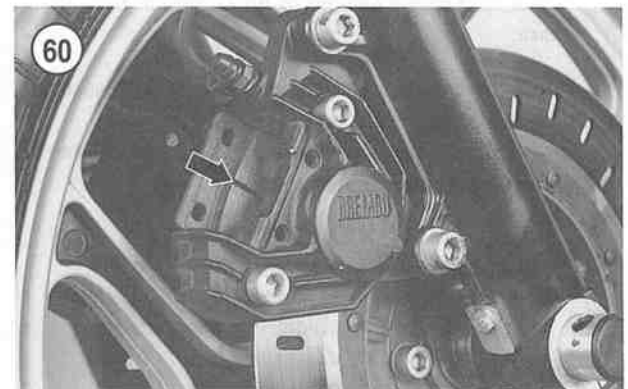


- b. Remove the screws securing the top cover (**Figure 58**) and remove the top cover, the gasket and the rubber diaphragm from the master cylinder.
  - c. Note the brake fluid level in the reservoir. If it is up to, or close to, the top surface of the reservoir, siphon off some of the fluid at this time.
  - d. First push the caliper assembly toward the brake disc until it stops. This will reposition the outboard piston into the caliper cylinder.
  - e. Then pull the caliper assembly toward the brake disc until it stops. This will reposition the inboard piston into the caliper cylinder.
  - f. Constantly check the reservoir to make sure the brake fluid does not overflow. Remove brake fluid, if necessary, before it overflows.
  - g. The pistons should move freely during repositioning. If they don't, and there is evidence of them sticking in the cylinders, the caliper should be removed and serviced as described under *Front Caliper Rebuilding* in this chapter.
8. Remove both brake pads.
  9. Clean the pad recess and the ends of the pistons (**Figure 59**) with a soft brush. Do not use solvent, a wire brush or any hard tool which would damage the pistons or disc.
  10. Carefully remove any rust or corrosion from the disc.
  11. Lightly coat the ends of the pistons and the backs of the new pads (not the friction material) with disc brake lubricant.

**NOTE**

*When purchasing new pads, check with your dealer to make sure the friction compound of the new pad is compatible with the disc material. Remove any roughness from the backs of the new pads with a fine-cut file; wipe them clean with a lint-free cloth.*

12. Install the inboard pad (**Figure 60**) and then the outboard pad (**Figure 61**). The pads will slide down within the caliper assembly until they stop.
13. Pull both brake pads up until the lockpin holes align with the brake pads and caliper assembly.



14. Partially install the lower lockpin (A, **Figure 57**) through the outboard brake pad.

15. Install the retaining spring with the arched side facing up (B, **Figure 57**). Push the lower lockpin through the retaining spring, inboard brake pad and the caliper assembly. Tap it in until it stops and locks in place.

16. Install the center pin (**Figure 56**) into the notch in both brake pads.

17. Pivot the retaining spring down over the center pin (**Figure 62**).

18. Press the retaining spring down (A, **Figure 63**) and partially install the upper lockpin (B, **Figure 63**). Push the upper lockpin in, over the retaining spring end and through the inboard brake pad and caliper. Tap it in until it stops and locks in place.

19. Make sure the retaining spring is correctly hooked under the top lockpin and is located within the lockpin recess. Make sure both lockpins (**Figure 64**) are completely seated.

20. Install the brake caliper cover (**Figure 54**) and push it down until it locks in place.

21. If so equipped, repeat Steps 2-20 for the other caliper assembly.

22. Remove the spacer between the front brake lever and the hand grip.

#### CAUTION

*In Step 23, don't come to fast stops as the brake fluid may slosh out of the open master cylinder reservoir.*

23. Carefully roll the bike back and forth and activate the brake lever as many times as it takes to refill the cylinders in both calipers and correctly locate all pads.

#### WARNING

*Use brake fluid clearly marked DOT 4 from a sealed container. Other types may vaporize and cause brake failure. Always use the same brand name; do not intermix silicone based (DOT5) brake fluid as it can cause brake component damage leading to brake system failure.*

24. Refill the master cylinder reservoir, if necessary, to maintain the correct fluid level.

25. Install the rubber diaphragm, gasket and top cover. Install the screws and tighten securely.

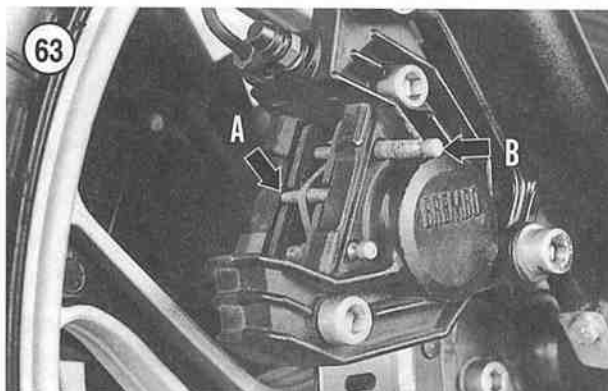
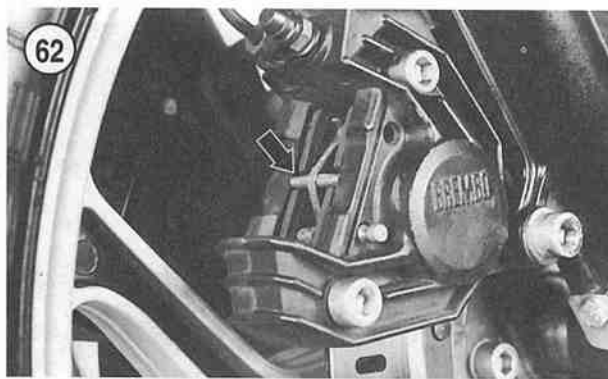
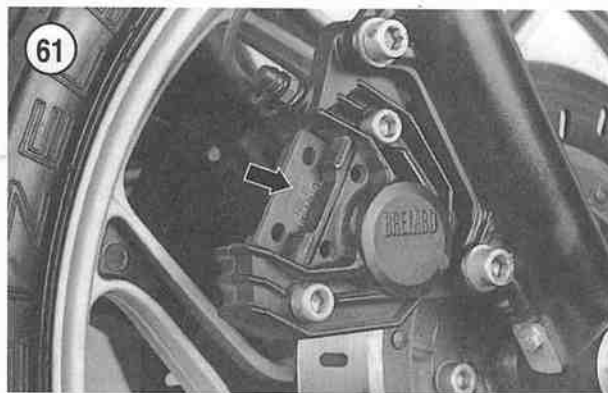
#### WARNING

*Do not ride the motorcycle until you are sure the brakes are operating correctly with full hydraulic advantage. If necessary, bleed the brake as described in this chapter.*

26. Bed the pads in gradually for the first 80 km (50 miles) by using only light pressure as much as possible. Immediate hard application will glaze the new friction pads and greatly reduce the effectiveness of the brake.

### DRAINING HYDRAULIC FLUID FROM THE BRAKE SYSTEM

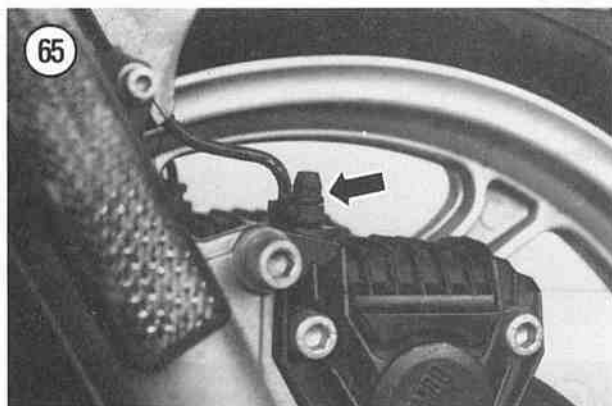
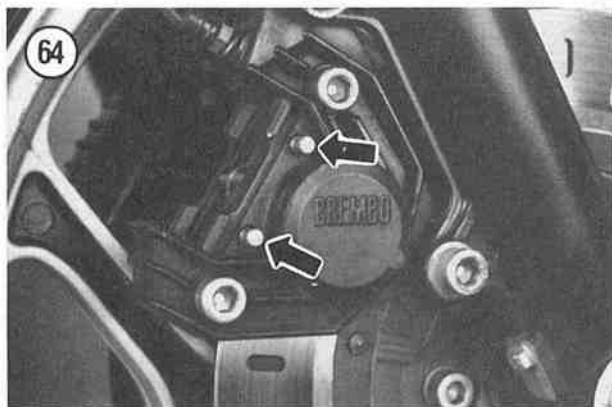
Prior to removing components of the hydraulic brake system, it is necessary to drain the fluid from the brake system. This will minimize the accidental spilling of large



quantities of hydraulic brake fluid onto surrounding components that could be damaged by the fluid.

#### CAUTION

Cover the area surrounding the master cylinder with a heavy cloth or plastic tarp to protect them from accidental brake fluid spills. Wash brake fluid off any painted or plated surfaces immediately, as it will destroy the finish. Use soapy water and rinse completely.



1. Attach a hose to the bleed valve (**Figure 65**) on the caliper assembly.
2. Place the loose end of the hose in a container to catch the brake fluid (**Figure 66**).

#### NOTE

If only the master cylinder is going to be removed, pump the fluid out only until the master cylinder and its adjacent hose(s) are empty. It is not necessary to completely drain the system.

3. Open the bleed valve and continue to apply the front brake lever or rear brake pedal until the brake fluid is pumped out of the system.
4. Disconnect the hose and tighten the bleed valve.
5. Repeat for dual front disc models.
6. Dispose of this brake fluid—*never* reuse brake fluid. Contaminated brake fluid may cause brake failure leading to a dangerous—even deadly—accident.

### FRONT MASTER CYLINDER

Due to the number of models and years covered in this book the front master cylinders are listed as Type A, Type B and Type C. The master cylinders are designed to fit with specific brake systems on specific models and years.

Your bike may not be equipped with the original brake system, therefore the master cylinder will not be original either. The exterior appearance of the three different master cylinders is quite different.

Compare your master cylinder with the illustration used with each procedure.

### FRONT MASTER CYLINDER (TYPE A)

This master cylinder is unique in that it is mounted on the frame top tube under the fuel tank. It is actuated by a cable attached to the right-hand brake lever. The cable runs from the hand lever to the master cylinder. The cable actuates a lever that moves the piston assembly within the master cylinder.

#### Removal/Installation

Refer to **Figure 67** for this procedure.

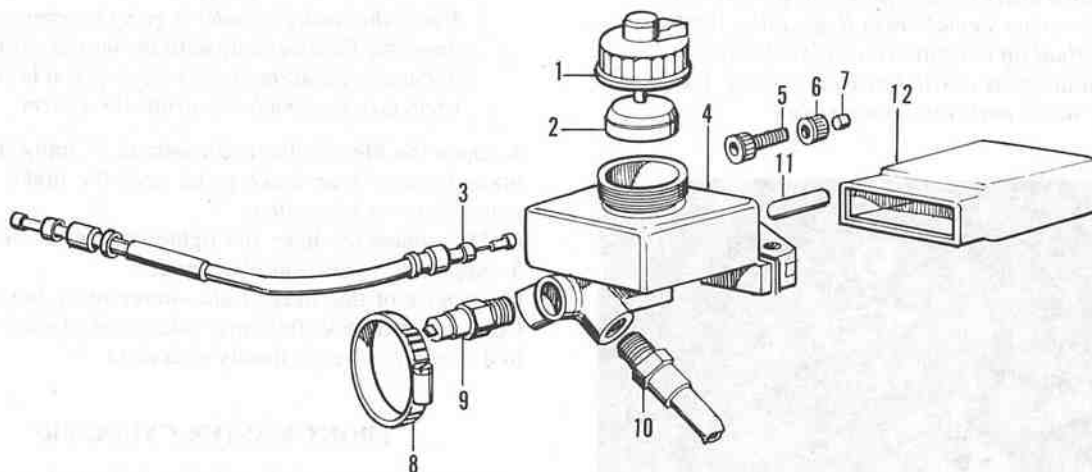
1. Place the bike on the centerstand.
2. Remove the fuel tank as described under *Fuel Tank Removal/Installation* in Chapter Seven.
3. Drain the hydraulic fluid from the master cylinder as described under *Draining Hydraulic Fluid From the Brake System* in this chapter.

#### CAUTION

Cover the frame and engine surrounding the master cylinder with a heavy cloth or plastic tarp to protect them from accidental residual

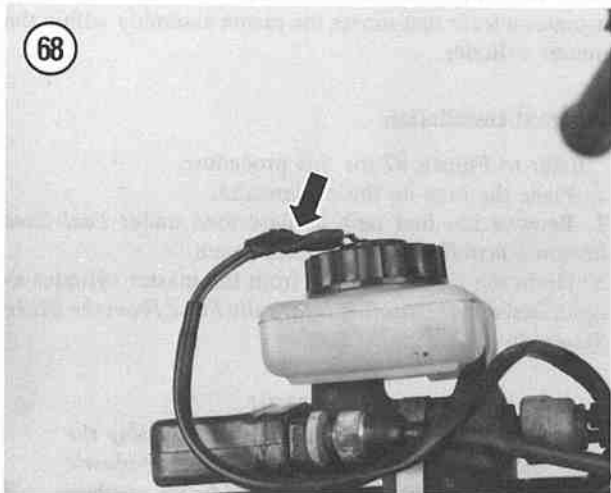
67

### FRONT MASTER CYLINDER (TYPE A)

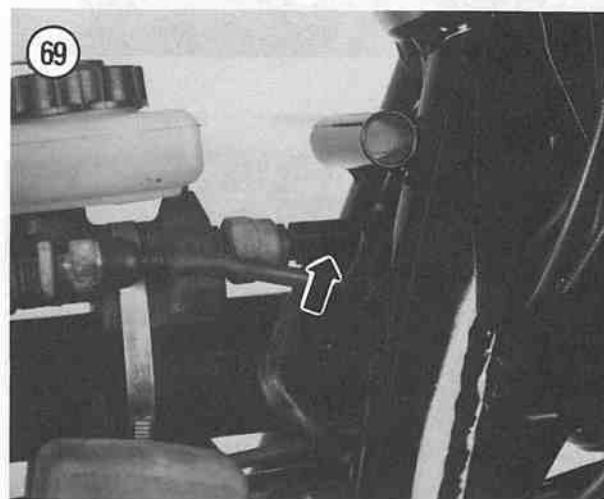


1. Top cap
2. Float
3. Brake control cable
4. Reservoir
5. Cable adjuster
6. Knurled nut
7. Felt plug
8. Clamp
9. Brake light switch
10. Brake hose
11. Rod
12. Rubber boot

68



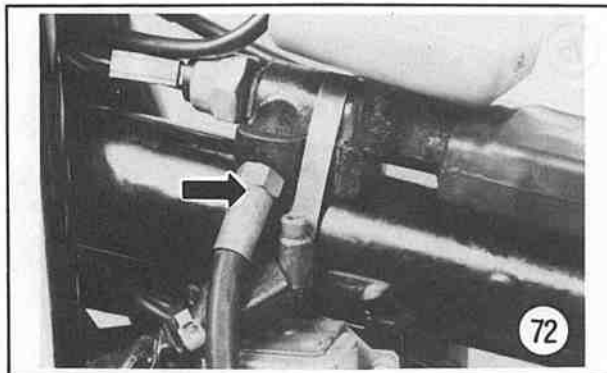
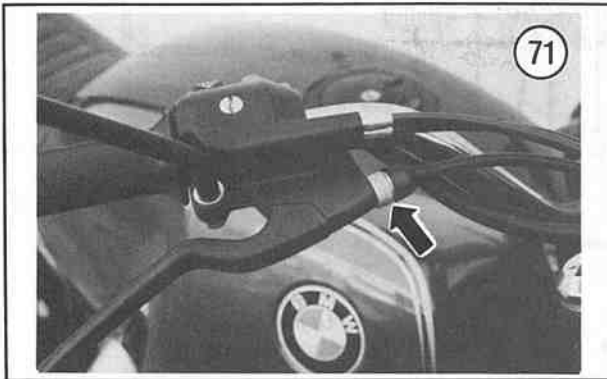
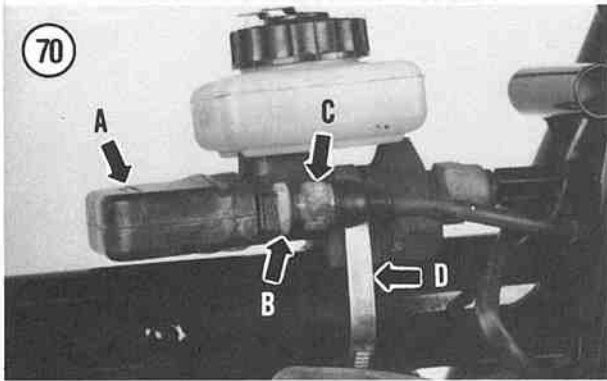
69





*brake fluid spills. Wash brake fluid off any painted or plated surfaces immediately, as it will destroy the finish. Use soapy water and rinse completely.*

4. Remove the electrical connector (Figure 68) from the master cylinder top cover.
5. Clean the top of the front master cylinder of all dirt and foreign matter.
6. Remove the electrical connector (Figure 69) from the front brake light switch on the master cylinder.
7. Remove the rubber boot (A, Figure 70) from the rear of the master cylinder.



8. At the right-hand lever, loosen the locknut and turn the adjuster (Figure 71) to achieve maximum cable slack.
9. At the master cylinder, loosen the locknut (B, Figure 70) and turn the adjuster (C, Figure 70) to achieve maximum cable slack.
10. Unhook the cable and pivot pin from the master cylinder lever.
11. Place a couple of shop cloths under the brake hose where the brake hose is attached to the master cylinder. Unscrew the brake hose (Figure 72). Tie the brake hose up and cover the end with a resealable plastic bag to prevent the entry of foreign matter.
12. Completely unscrew the clamp (D, Figure 70) and remove the master cylinder from the frame.
13. Install by reversing these removal steps. Note the following during installation.
14. Make sure the brake cable is routed properly and is properly attached to the master cylinder lever.
15. Apply Molykote BR2 lubricant to the cable nipple prior to installing it onto the lever.
16. Install the brake hose onto the master cylinder and tighten securely.
17. Bleed the brake as described in this chapter.
18. Adjust the brake as described under *Front Master Cylinder (Cable Operated) Cable Adjustment* in Chapter Three.

### Disassembly

Refer to Figure 67 and Figure 73 for this procedure.

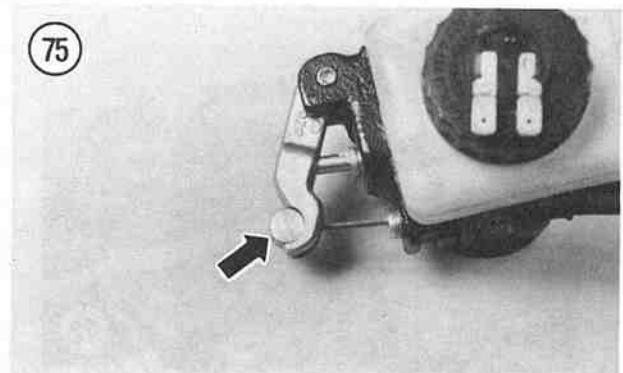
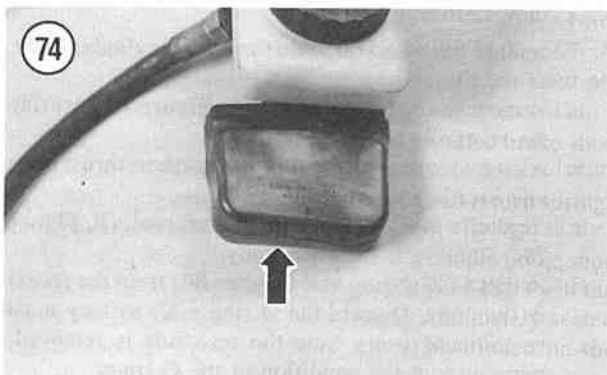
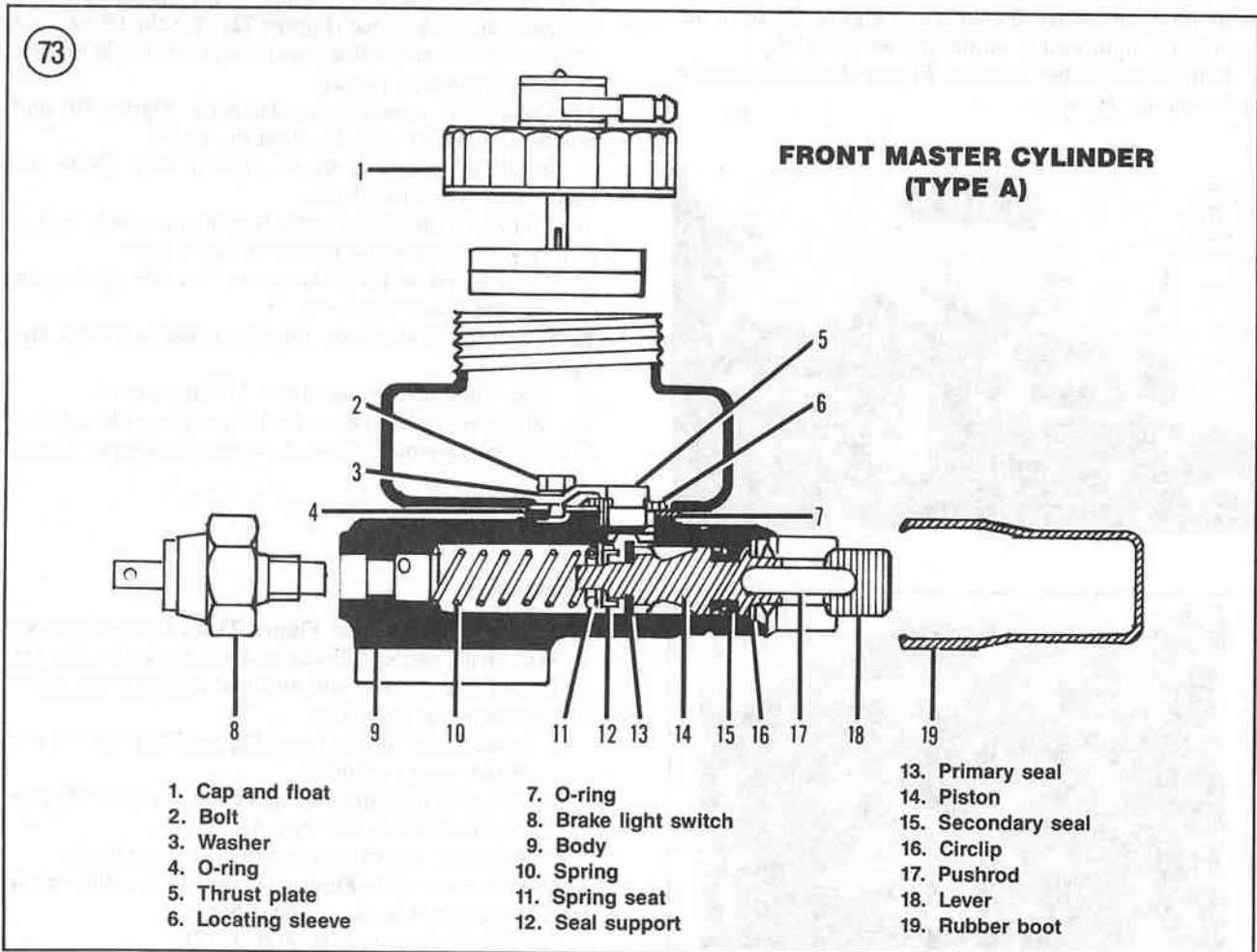
1. Remove the master cylinder as described in this chapter.
2. If the brake cable is still attached to the master cylinder, perform the following:
  - a. Remove the rubber boot (Figure 74) from the end of the master cylinder.
  - b. Unhook the pivot pin (Figure 75) and cable (Figure 76) from the master cylinder lever.
  - c. Withdraw the cable from the master cylinder.
3. Move the lever (A, Figure 77) over to the side—away from the pushrod in the cylinder bore.
4. Remove the pushrod (B, Figure 77).
5. Unscrew and remove the top cover (Figure 78). Pour out any residual brake fluid and discard it. *Never reuse brake fluid.*
6. To remove the reservoir from the master cylinder body, perform the following:
  - a. Remove the hex retainer bolt (A, Figure 79) securing the reservoir to the body.
  - b. Along with the bolt, remove the washer, thrust plate and locating sleeve.
  - c. Carefully pull up and rotate the reservoir (B, Figure 79). Remove it from the body.
  - d. Remove the O-ring seal (Figure 80) from the recess in the body. Discard the O-ring seals as they must be replaced every time the reservoir is removed, regardless of the condition of the O-rings.

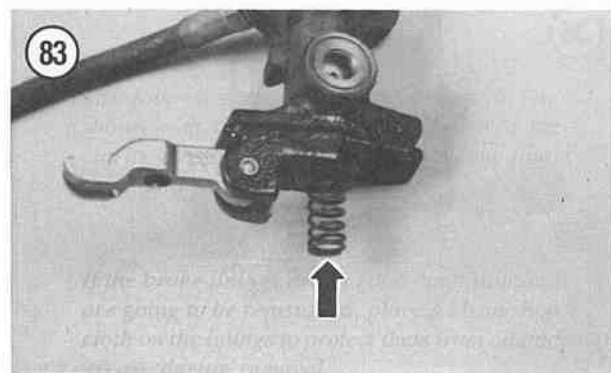
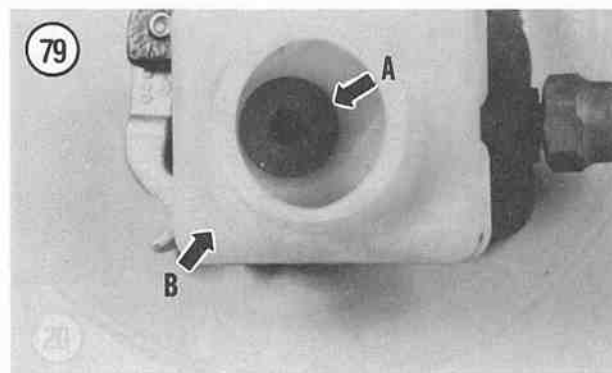
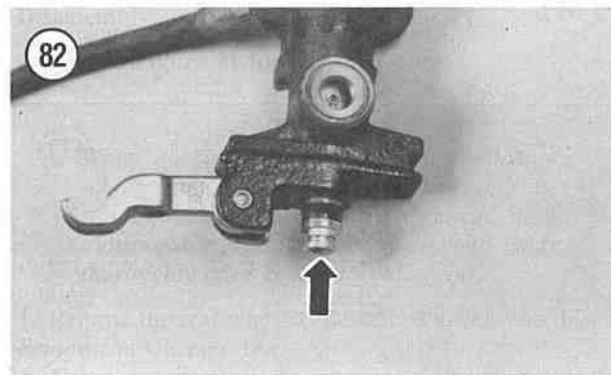
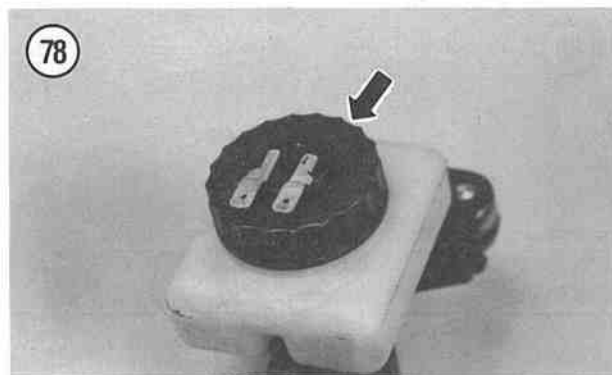
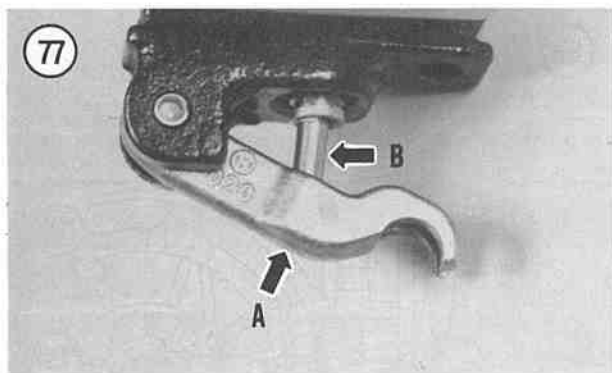
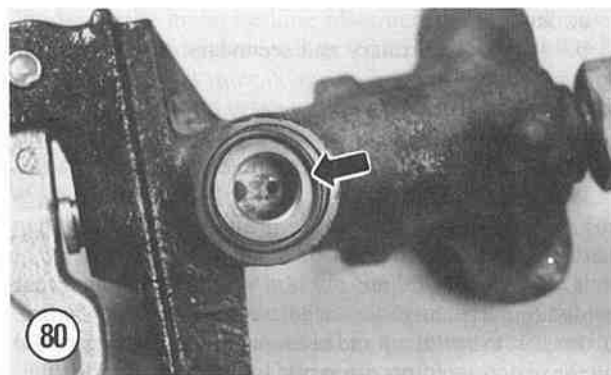
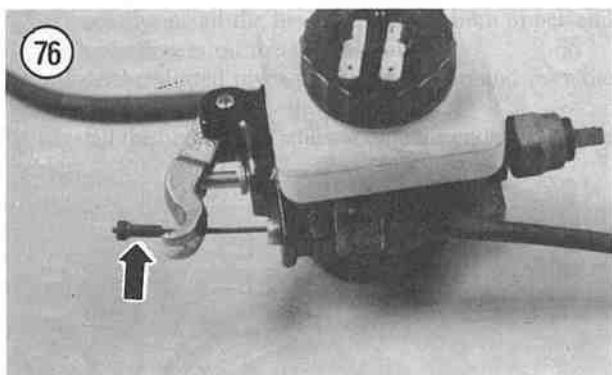
7. Press in on the piston and using circlip pliers, remove the internal circlip (Figure 81) from the body.
8. Withdraw the piston assembly (Figure 82) and spring (Figure 83) from the body.
9. Inspect the master cylinder components as described in this chapter.

### Inspection

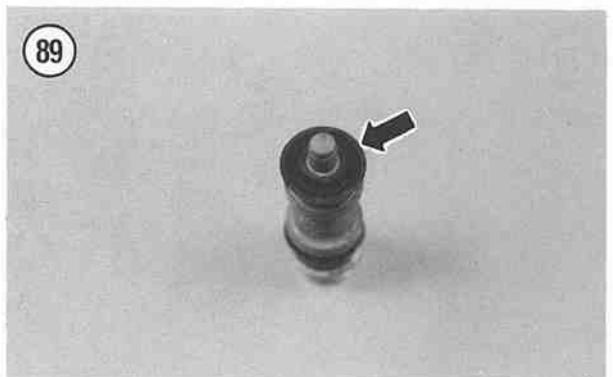
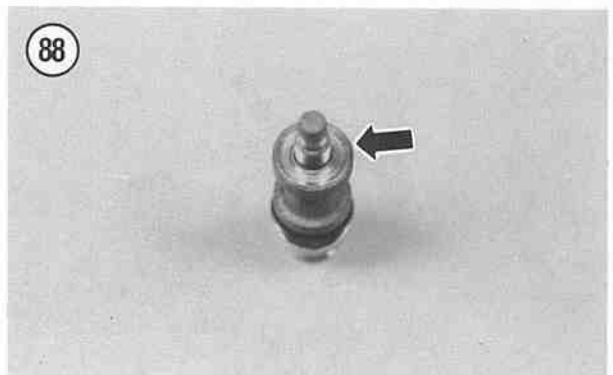
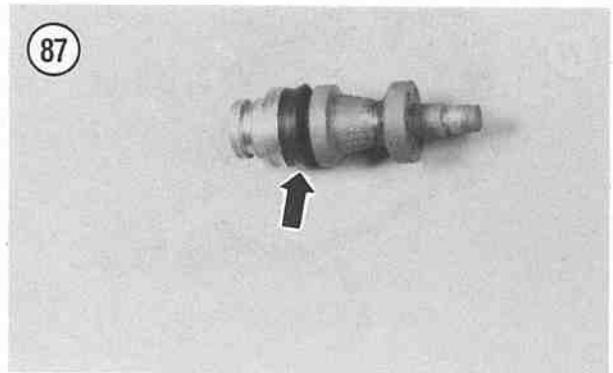
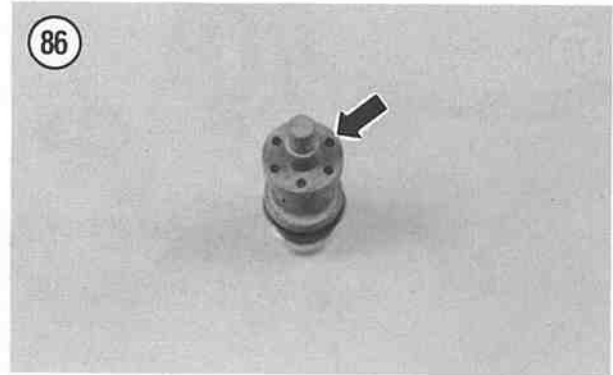
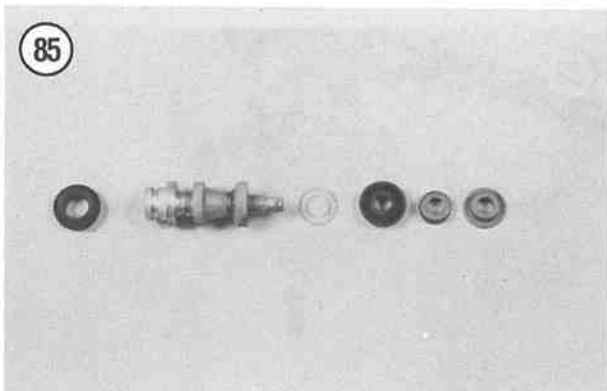
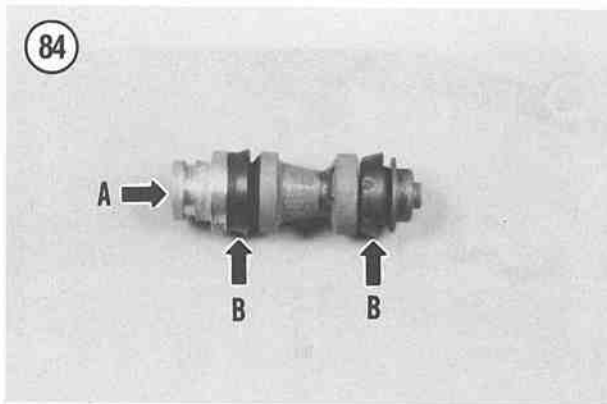
BMW does not provide any specifications for wear limits on any of the master cylinder components. Replace any parts that appear to be damaged or worn.

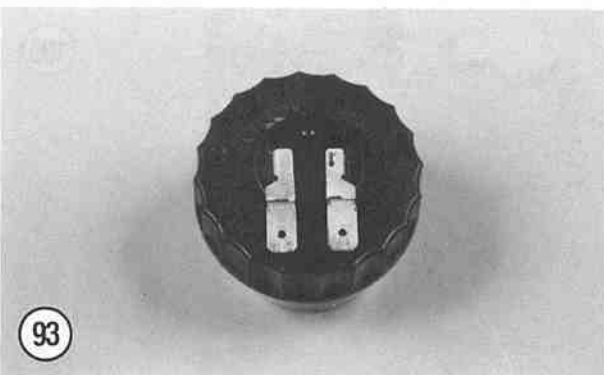
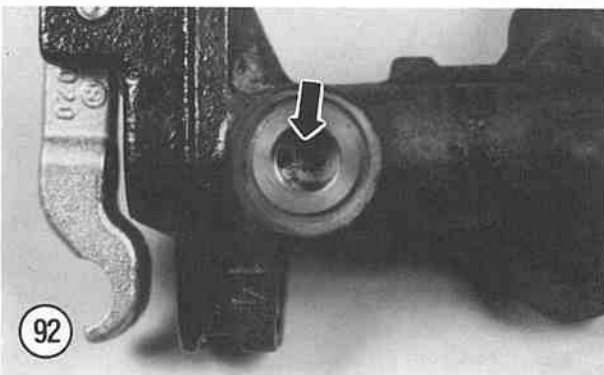
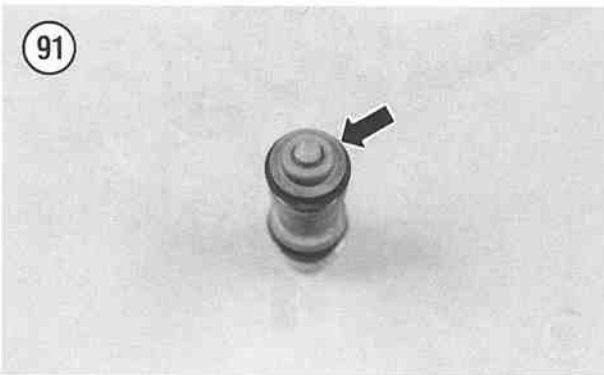
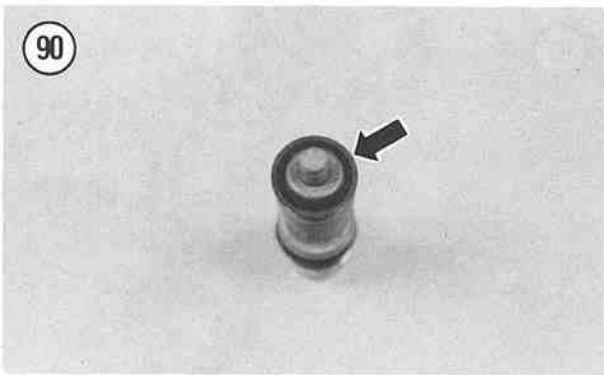
The master cylinder repair kit, available from BMW dealers, contains the following:



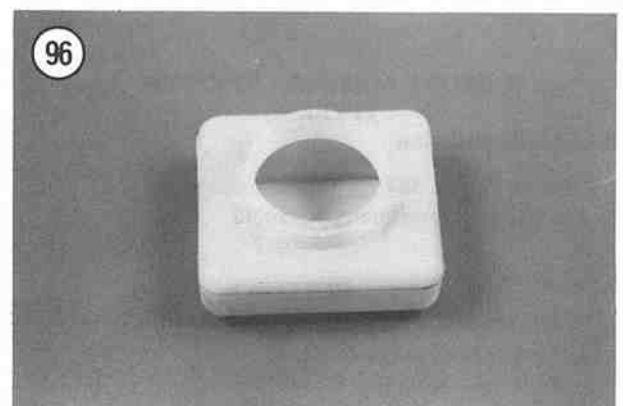
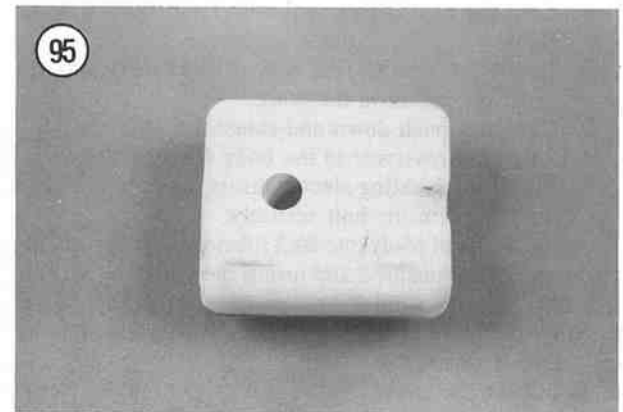


- a. Rubber boot.
  - b. Piston and primary and secondary cups.
  - c. Circlip.
  - d. Spring seat.
  - e. O-ring seal.
1. Clean all parts in denatured alcohol or fresh brake fluid. Inspect the cylinder bore and piston contact surfaces for signs of wear and damage. If either part is less than perfect, replace it.
  2. Check the end of the piston (A, **Figure 84**) for wear caused by the pushrod. Replace the piston assembly if worn.
  3. Inspect the primary and secondary cups (B, **Figure 84**) on the piston assembly. To replace, perform the following:
    - a. Remove all components from the piston assembly (**Figure 85**). Discard the cups as they must be replaced.
    - b. Make sure the piston openings (**Figure 86**) are clear. Clean out if necessary.
    - c. Install the secondary seal (**Figure 87**).
    - d. Install the backing washer (**Figure 88**), primary seal (**Figure 89**), seal support (**Figure 90**) and the spring seat (**Figure 91**).
  4. Inspect the piston assembly spring for wear or deterioration. Replace if necessary.
  5. Make sure the passage (**Figure 92**) on the top of the body is clear. Clean out if necessary.





6. Check the reservoir top cap for damage and deterioration and replace as necessary. Refer to **Figure 93** and **Figure 94**.
7. Check the reservoir for damage and deterioration and replace as necessary. Refer to **Figure 95** and **Figure 96**.
8. Inspect the brake hose threads in the body for wear or damage. If the threads are slightly damaged, clean them up with a proper size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the master cylinder body.





9. Inspect the piston bore (Figure 97) in the body for wear, corrosion or damage. Replace the body if necessary.
10. If necessary, unscrew the brake light switch (Figure 98) from the master cylinder body.
11. Make sure the pivot arm (Figure 99) moves freely. If damaged, the master cylinder body must be replaced.

### Assembly

1. Soak the new piston assembly in fresh brake fluid for at least 15 minutes to make the cups pliable. Coat the inside of the cylinder bore with fresh brake fluid before assembling parts.

#### CAUTION

*When installing the piston assembly, do not allow the cups to turn inside out as they will be damaged and allow brake fluid leakage within the cylinder bore.*

2. Install the spring (A, Figure 100) and the piston assembly (B, Figure 100) into the cylinder bore.
3. Push the piston assembly in and install the circlip (Figure 81). Make sure it is correctly seated in the cylinder groove.
4. To install the reservoir onto the master cylinder body, perform the following:
  - a. Coat the new O-ring seal with fresh DOT 4 brake fluid.
  - b. Install the new O-ring seal (Figure 101) into the reservoir recess in the body.
  - c. Carefully push down and rotate the reservoir.
  - d. Align the reservoir to the body (Figure 102).
  - e. Install the locating sleeve, thrust plate, washer and bolt. Tighten the bolt securely.
5. Apply a coat of Molykote BR2 lubricant, or equivalent, to the end of the pushrod and install the pushrod (A, Figure 103).
6. Move the lever (B, Figure 103) back over and onto the end of the pushrod.
7. Install the top cover.
8. Install the master cylinder as described in this chapter.

## FRONT MASTER CYLINDER (TYPE B)

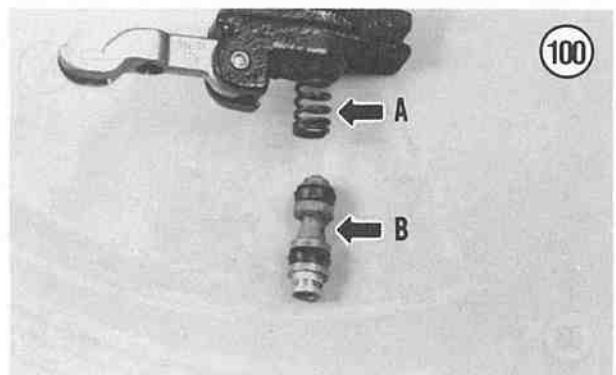
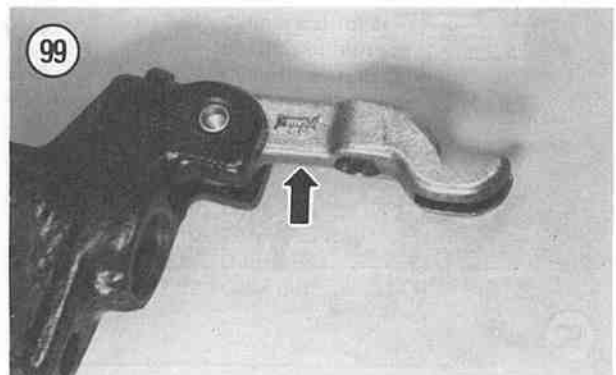
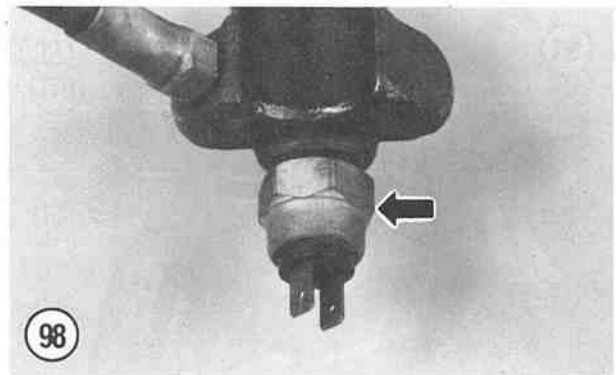
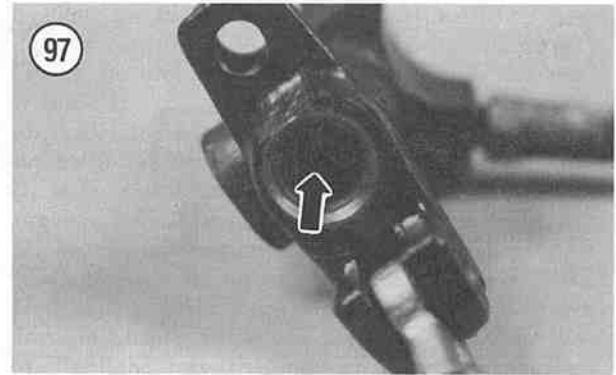
### Removal/Installation

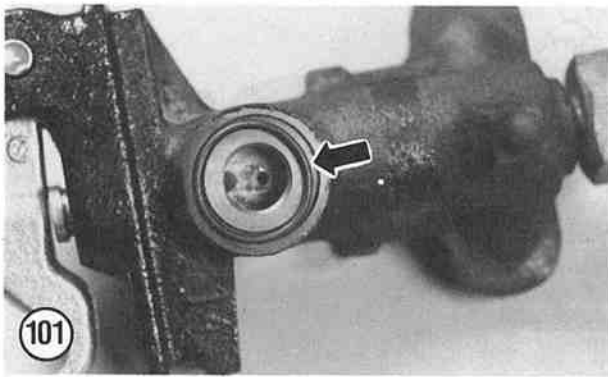
Refer to Figure 104 for this procedure.

1. Place the bike on the centerstand.

#### NOTE

*On models so equipped, you may want to remove the front fairing to allow more working space. This depends on your ability to work in cramped areas.*

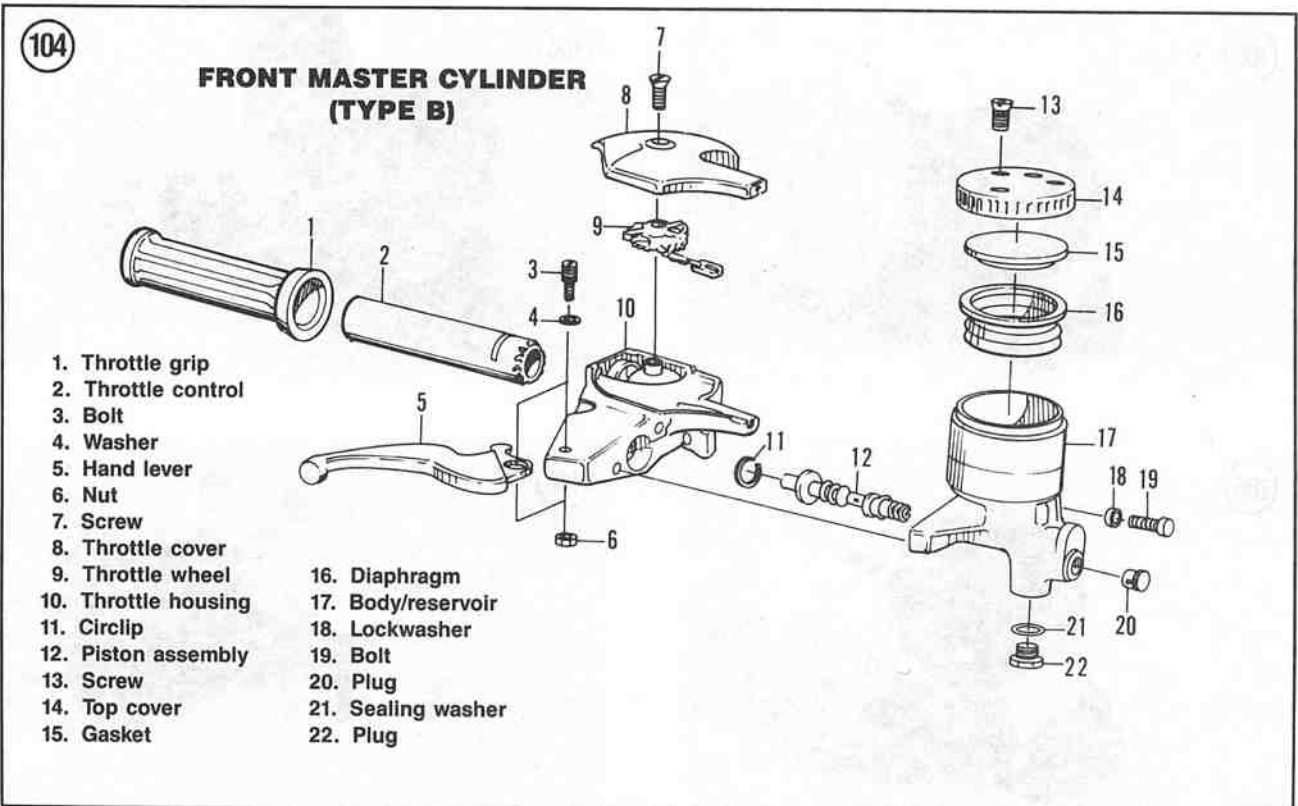
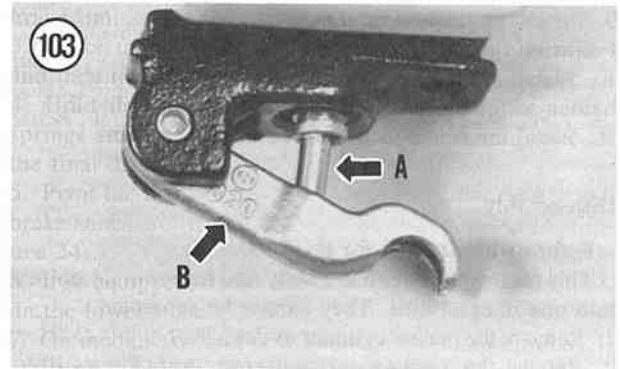
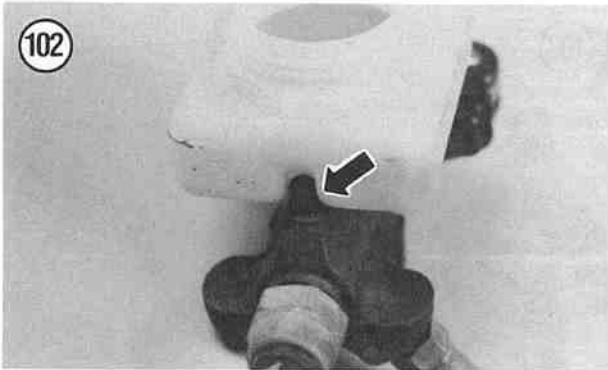




2. Drain the hydraulic fluid from the master cylinder as described under *Draining Hydraulic Fluid From the Brake System* in this chapter.

**CAUTION**

*Cover the front fairing (models so equipped), headlight and fuel tank with a heavy cloth or plastic tarp to protect them from accidental residual brake fluid spills. Wash brake fluid off any painted or plated surfaces immediately, as it will destroy the finish. Use soapy water and rinse completely.*



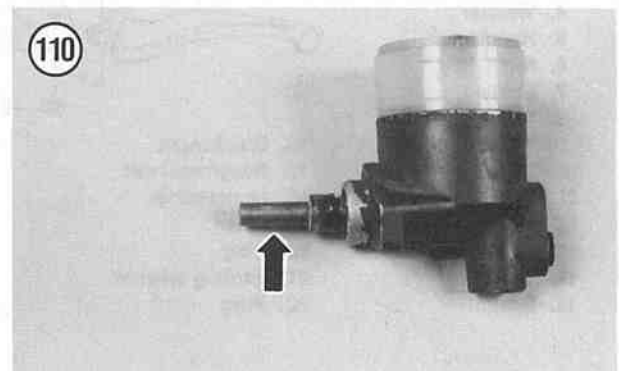
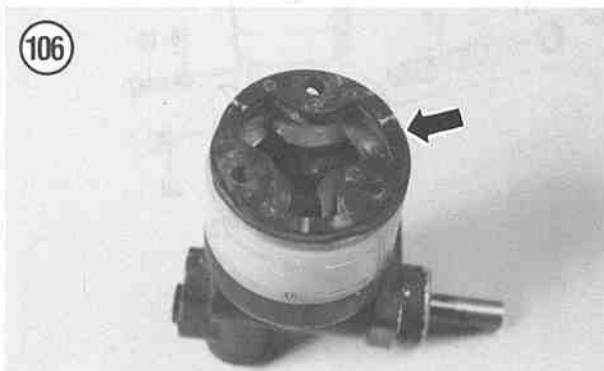
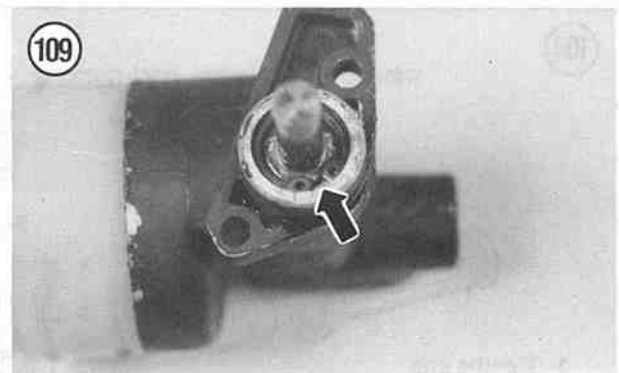
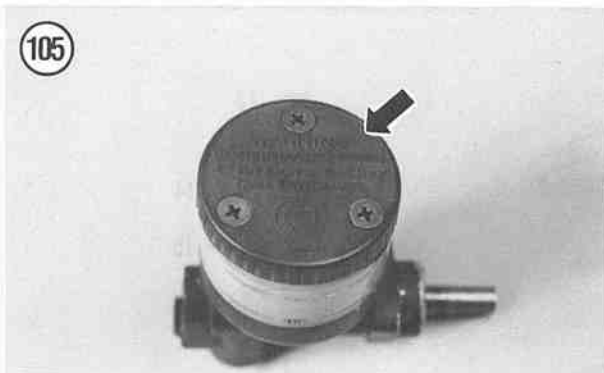
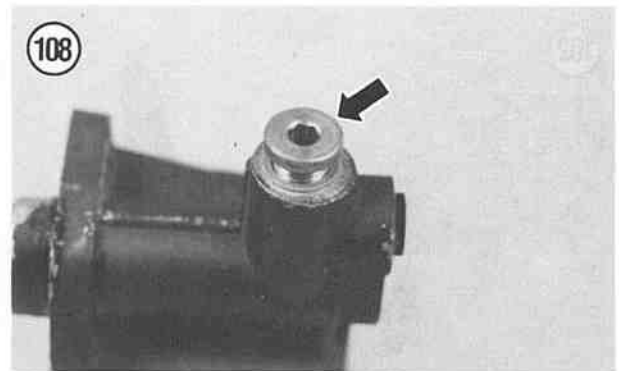
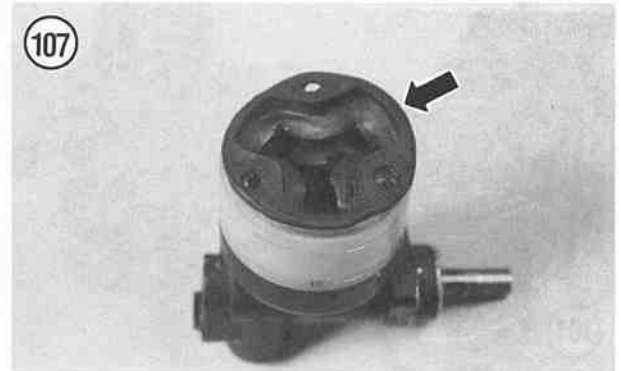
3. Clean the top of the front master cylinder of all dirt and foreign matter.
4. On models so equipped, remove the impact pad from the handlebars.
5. Place a couple of shop cloths under the brake hose fitting where it attaches to the master cylinder. Some residual hydraulic fluid will probably leak out when this fitting is loosened.
6. Loosen the brake hose fitting at the master cylinder.
7. Remove the Allen bolts securing the master cylinder to the throttle housing and remove the master cylinder.
8. Pull the master cylinder off of the throttle housing and completely unscrew the brake hose from the master cylinder. Tie the brake hose up and cover the end with a resealable plastic bag to prevent the entry of foreign matter.
9. Install by reversing these removal steps. Note the following during installation.
10. Install the brake hose onto the master cylinder and tighten to the torque specification listed in **Table 2**.
11. Bleed the brake as described in this chapter.

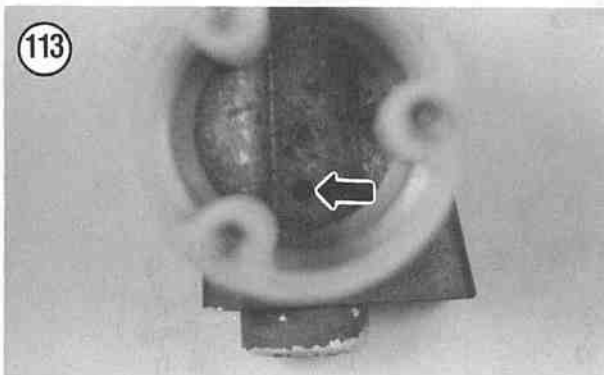
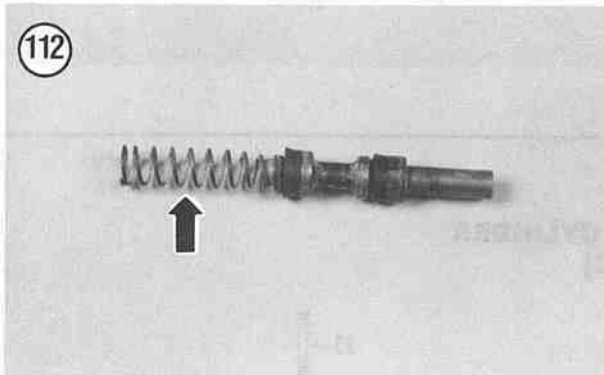
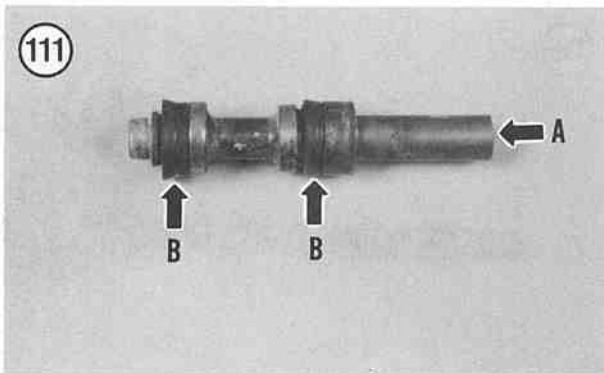
#### Disassembly

Refer to **Figure 104** for this procedure.

This master cylinder has a body and reservoir combined into one integral unit. They cannot be separated.

1. Remove the master cylinder as described in this chapter.
2. Remove the screws securing the top cover (**Figure 105**).



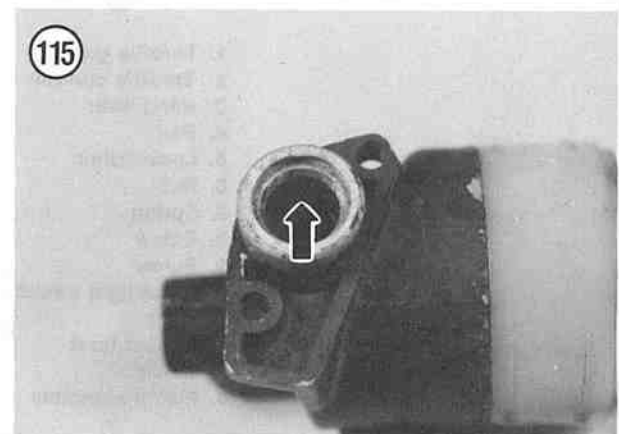


3. Remove the top cover, the gasket (Figure 106) and rubber diaphragm (Figure 107).
4. Pour out any residual brake fluid and discard it. *Never reuse brake fluid.*
5. Remove the plug and sealing washer (Figure 108) from the base of the master cylinder.
6. Using circlip pliers, remove the internal circlip (Figure 109) from the body.
7. Withdraw the piston assembly and spring (Figure 110) from the body.

### Inspection

BMW provides some specifications for the master cylinder components. Replace any parts that appear to be damaged or worn.

1. Clean all parts in denatured alcohol or fresh brake fluid. Inspect the cylinder bore and piston contact surfaces for signs of wear and damage. If either part is less than perfect, replace it.
2. Check the end of the piston (A, Figure 111) for wear caused by the hand lever. Replace the piston assembly if worn.
3. Replace the piston assembly if the piston cups (B, Figure 111) require replacement.
4. Inspect the piston assembly spring (Figure 112) for wear or deterioration. Replace if necessary.
5. Make sure the passages (Figure 113) on the bottom of the body/reservoir are clear. Clean out if necessary.
6. Check the reservoir top cap, gasket and rubber diaphragm (Figure 114) for damage and deterioration. Replace as necessary.
7. Inspect the piston bore (Figure 115) in the body for wear, corrosion or damage. Replace the body if necessary.
8. Inspect the brake hose threads in the master cylinder body bore. If the threads are slightly damaged, clean them up with a proper size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the master cylinder body.



### Assembly

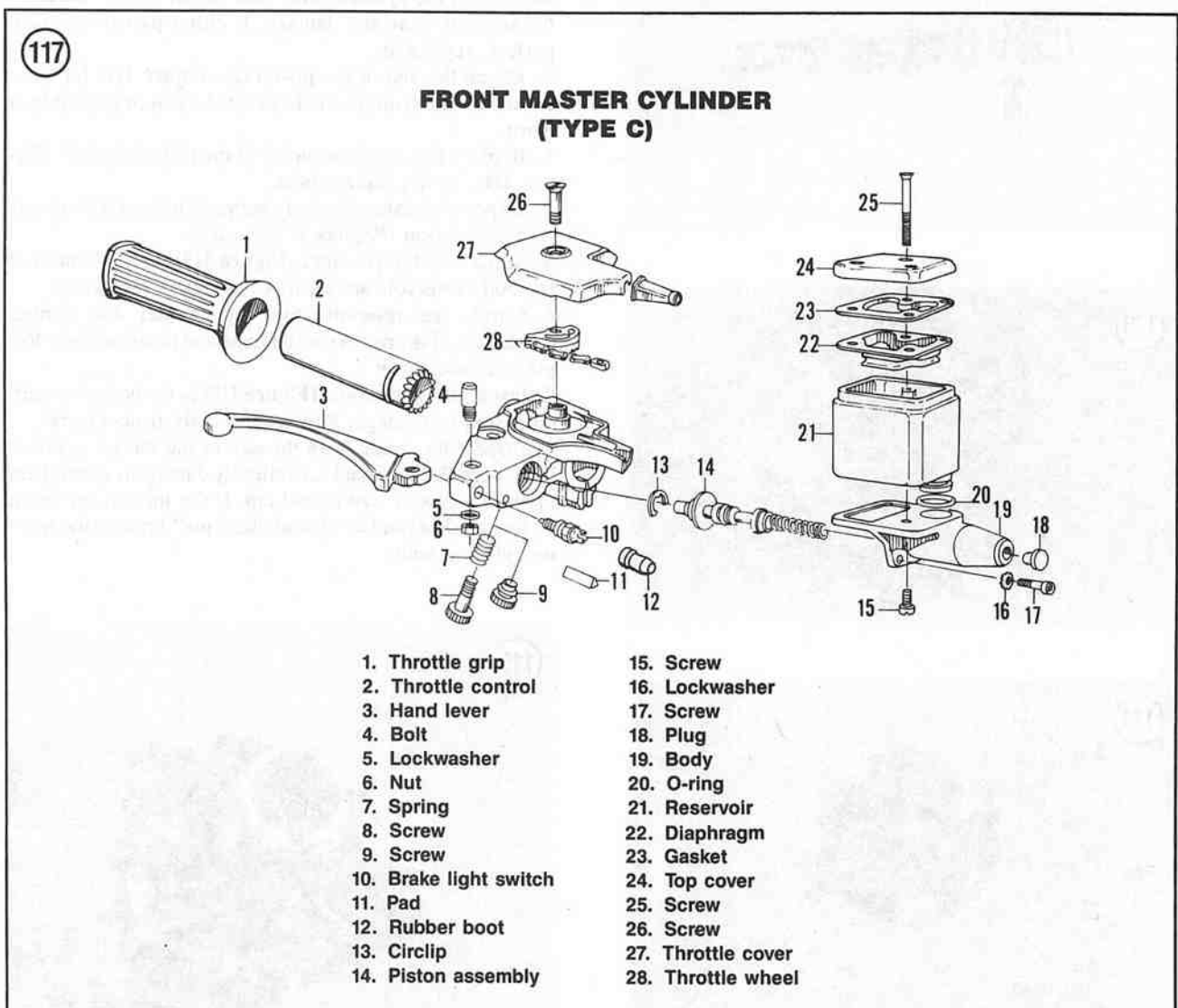
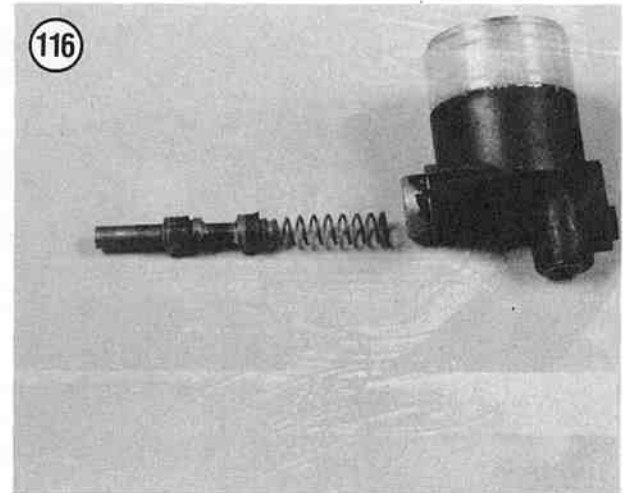
1. Soak the new piston assembly in fresh brake fluid for at least 15 minutes to make the cups pliable. Coat the inside of the cylinder bore with fresh brake fluid prior to the assembly of parts.

#### CAUTION

*When installing the piston assembly, do not allow the cups to turn inside out as they will be damaged and allow brake fluid leakage within the cylinder bore.*

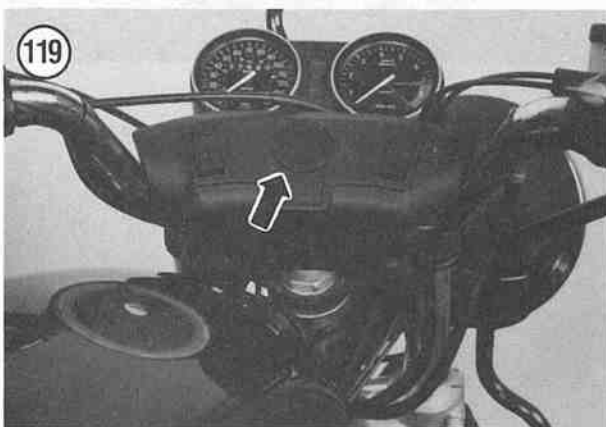
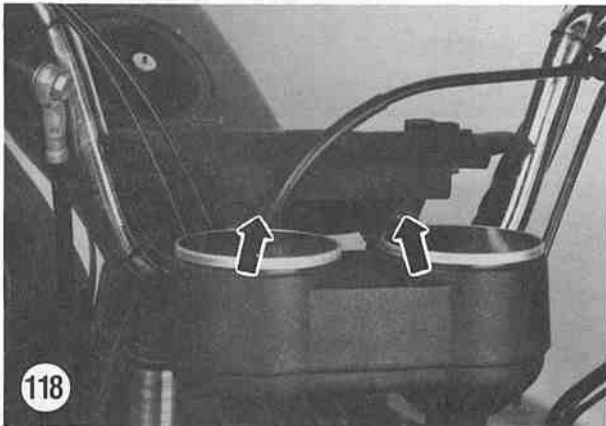
2. Install the piston assembly and spring into the reservoir cylinder (Figure 116).

3. Push the piston assembly in and install the circlip (Figure 109). Make sure it is correctly seated in the cylinder groove.





4. Install the plug and sealing washer (Figure 108) into the base of the master cylinder.
5. Install the rubber diaphragm (Figure 107), the gasket (Figure 106) and top cover (Figure 105). Loosely install, but do not tighten the cover screws at this time as fluid will have to be added later.
6. Install the master cylinder as described in this chapter.



## FRONT MASTER CYLINDER (TYPE C)

### Removal/Installation

Refer to Figure 117 for this procedure.

1. Place the bike on the centerstand.

#### NOTE

*On models so equipped, you may want to remove the front fairing to allow more working space. This depends on your ability to work in cramped areas.*

2. Drain the hydraulic fluid from the master cylinder as described under *Draining Hydraulic Fluid From the Brake System* in this chapter.

#### CAUTION

*Cover the front fairing (models so equipped), headlight and fuel tank with a heavy cloth or plastic tarp to protect them from accidental residual brake fluid spills. Wash brake fluid off any painted or plated surfaces immediately, as it will destroy the finish. Use soapy water and rinse completely.*

3. Clean the top of the front master cylinder of all dirt and foreign matter.
4. On models so equipped, remove the screws (Figure 118) securing the impact pad. Remove the impact pad (Figure 119) from the handlebars.
5. Place a couple of shop cloths under the brake hose fitting where it attaches to the master cylinder. Some residual hydraulic fluid will probably leak out when this fitting is loosened.
6. Loosen the brake hose fitting (A, Figure 120) at the master cylinder.
7. Remove the Allen bolts securing the master cylinder (B, Figure 120) to the throttle housing and remove the master cylinder.
8. Pull the master cylinder off of the throttle housing and completely unscrew the brake hose from the master cylinder. Tie the brake hose up and cover the end with a resealable plastic bag to prevent the entry of foreign matter.
9. Install by reversing these removal steps. Note the following during installation.
10. Install the brake hose onto the master cylinder and tighten to the torque specification listed in Table 2.
11. Bleed the brake as described in this chapter.

### Disassembly

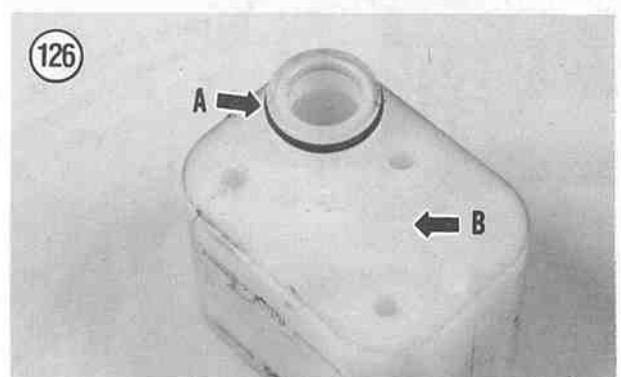
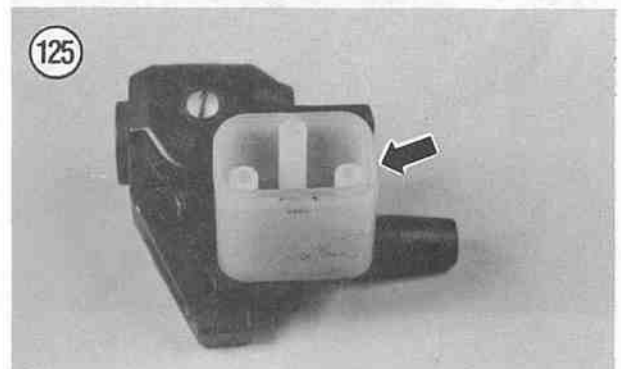
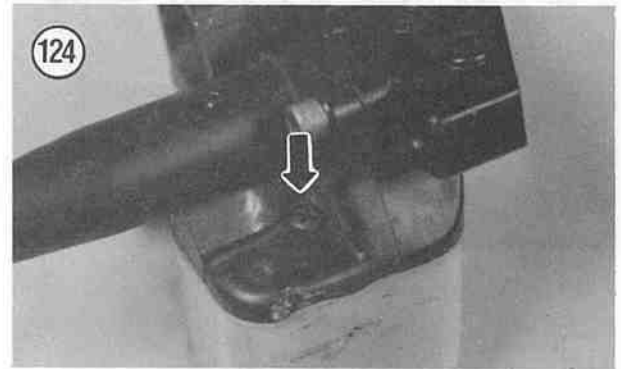
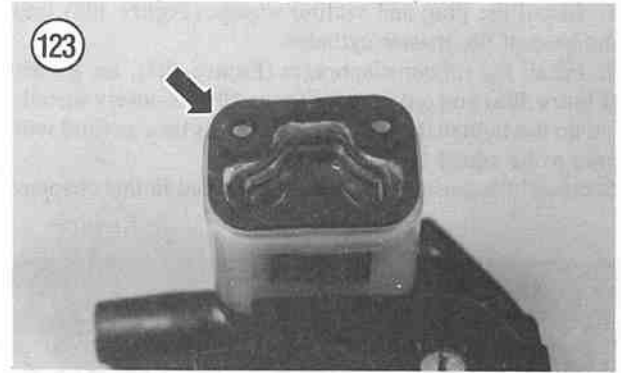
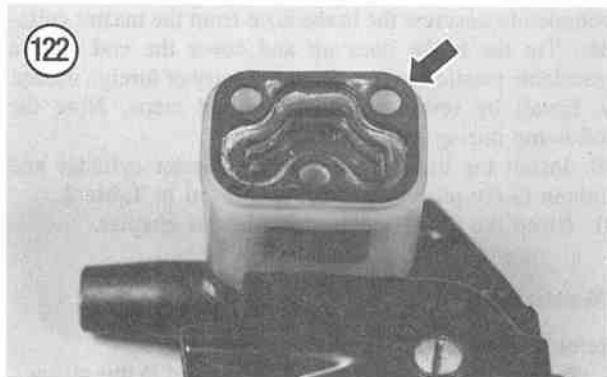
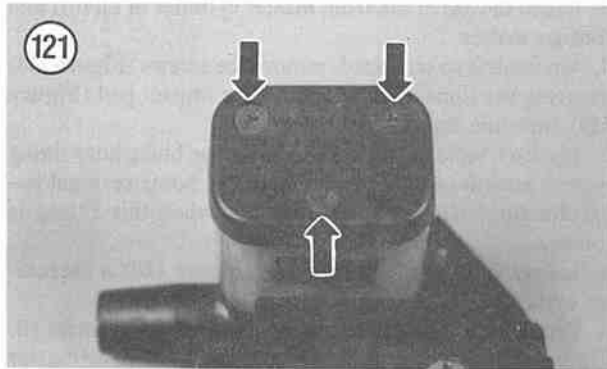
Refer to Figure 117 for this procedure.

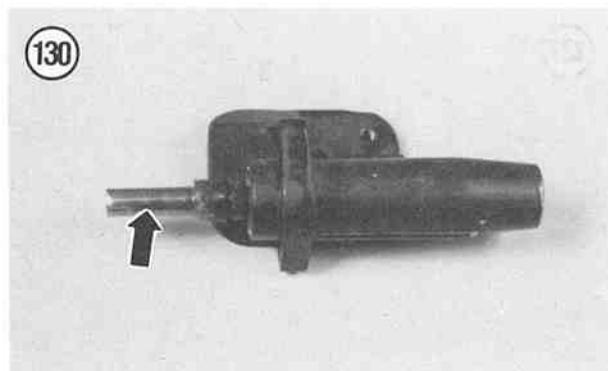
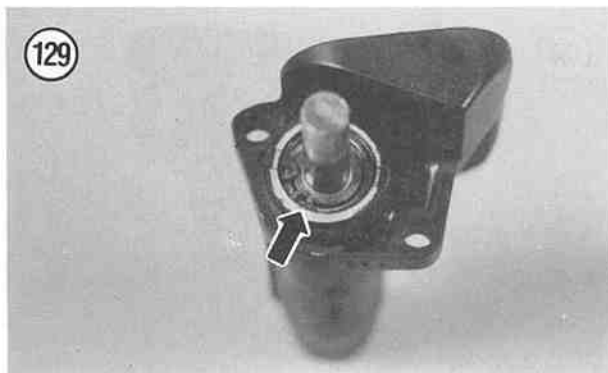
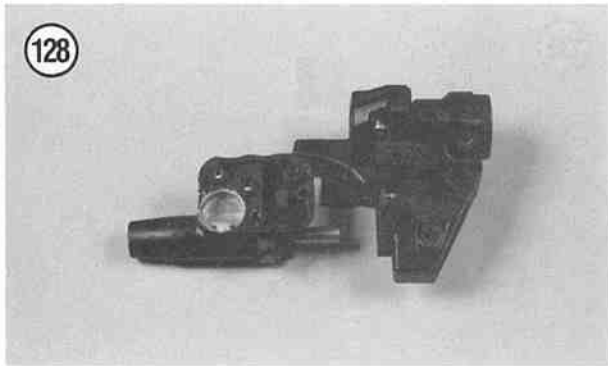
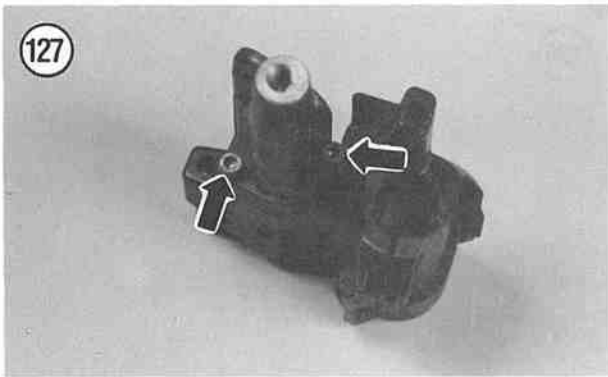
1. Remove the master cylinder as described in this chapter.

2. Remove the screws (Figure 121) securing the top cover.
3. Remove the top cover, the gasket (Figure 122) and rubber diaphragm (Figure 123).
4. Pour out any residual brake fluid and discard it. *Never reuse brake fluid.*
5. To remove the reservoir from the master cylinder body, perform the following:
  - a. Remove the screw (Figure 124) securing the reservoir to the body.
  - b. Carefully pull up and rotate the reservoir (Figure 125). Remove it from the body.
  - c. Remove the O-ring seal (A, Figure 126) from the recess in the reservoir neck. Discard the O-ring seal as it must be replaced every time the reservoir is removed, regardless of the condition of the O-ring.
6. Remove the screws (Figure 127) securing the master cylinder body to the throttle housing and remove the body (Figure 128).
7. Using circlip pliers, remove the internal circlip (Figure 129) from the body.
8. Withdraw the piston assembly and spring (Figure 130) from the body.

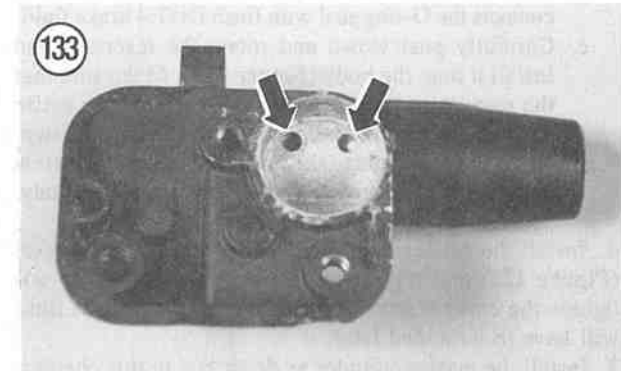
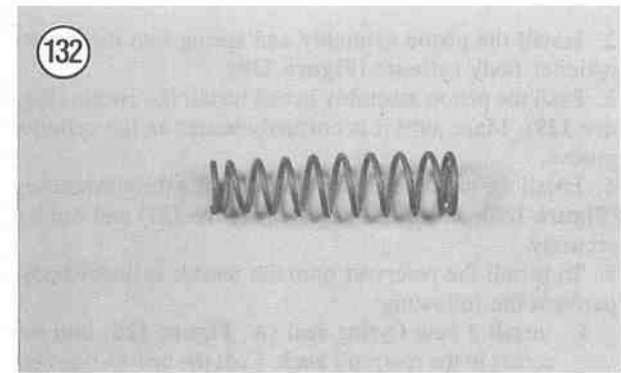
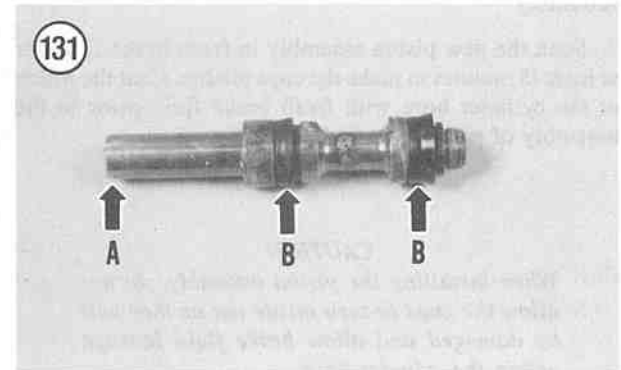
### Inspection

BMW provides some specifications for the master cylinder components. Replace any parts that appear to be damaged or worn.





1. Clean all parts in denatured alcohol or fresh brake fluid. Inspect the cylinder bore and piston contact surfaces for signs of wear and damage. If either part is less than perfect, replace it.
2. Check the end of the piston (A, **Figure 131**) for wear caused by the hand lever. Replace the piston assembly if worn.
3. Replace the piston assembly if the piston cups (B, **Figure 131**) require replacement.
4. Inspect the piston assembly spring (**Figure 132**) for wear or deterioration. Replace if necessary.
5. Make sure the passages (**Figure 133**) on the bottom of the body are clear. Clean out if necessary.



6. Check the reservoir top cap, the gasket, rubber diaphragm (Figure 134) and reservoir (B, Figure 126) for damage and deterioration. Replace as necessary.
7. Inspect the brake hose threads (Figure 135) in the master cylinder body bore. If the threads are slightly damaged, clean them up with a proper size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the master cylinder body.
8. Inspect the piston bore (Figure 136) in the body for wear, corrosion or damage. Replace the body if necessary.
9. Make sure the fluid passage hole (Figure 137) on the union bolt is clear. Clean out if necessary.

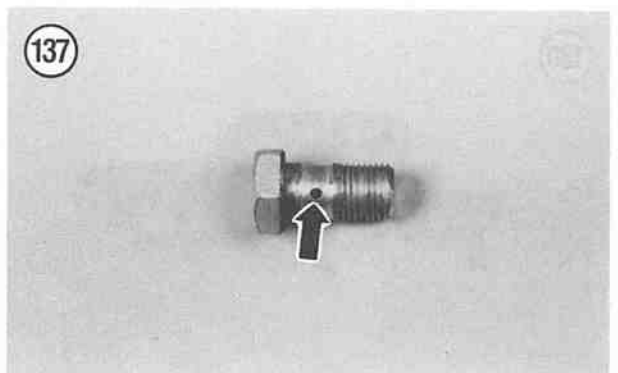
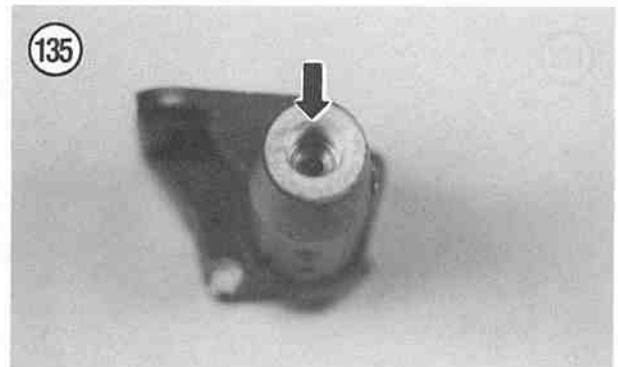
### Assembly

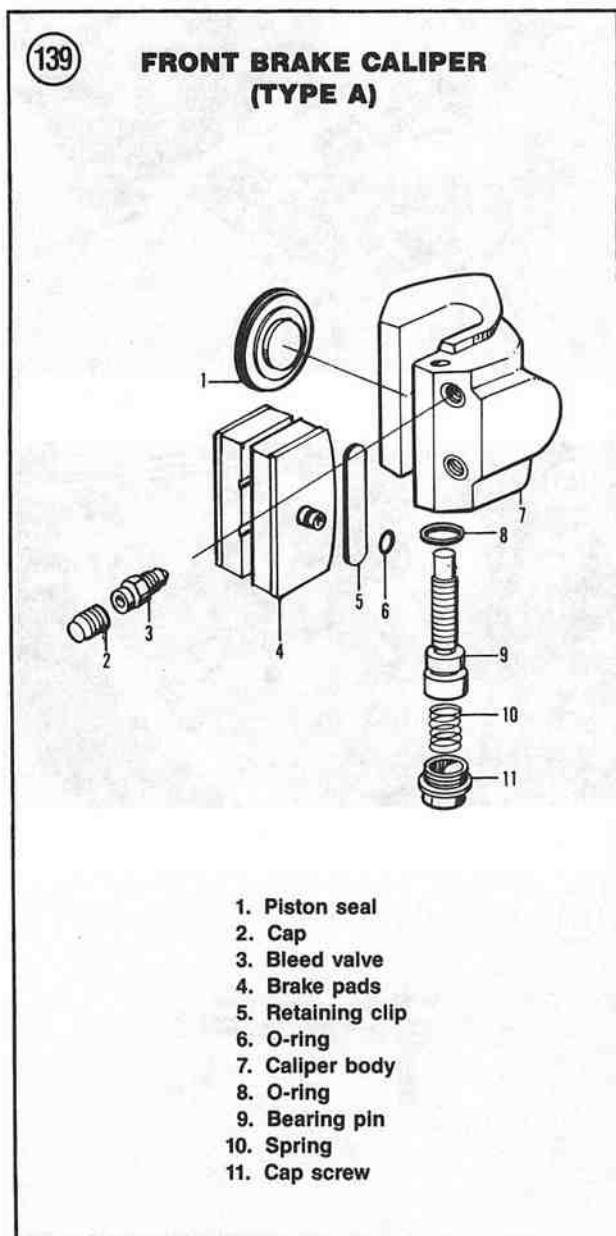
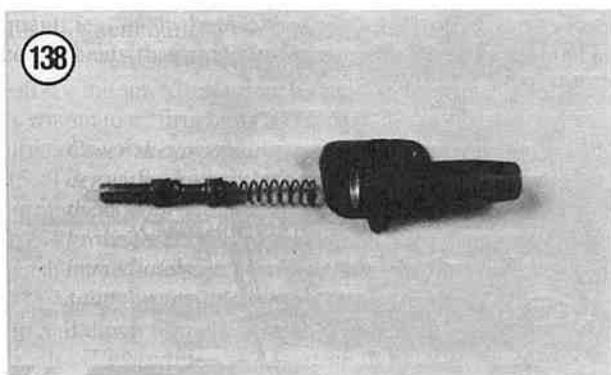
1. Soak the new piston assembly in fresh brake fluid for at least 15 minutes to make the cups pliable. Coat the inside of the cylinder bore with fresh brake fluid prior to the assembly of parts.

#### CAUTION

*When installing the piston assembly, do not allow the cups to turn inside out as they will be damaged and allow brake fluid leakage within the cylinder bore.*

2. Install the piston assembly and spring into the master cylinder body cylinder (Figure 138).
3. Push the piston assembly in and install the circlip (Figure 129). Make sure it is correctly seated in the cylinder groove.
4. Install the master cylinder body onto the throttle housing (Figure 128). Install the screws (Figure 127) and tighten securely.
5. To install the reservoir onto the master cylinder body, perform the following:
  - a. Install a new O-ring seal (A, Figure 126) into the recess in the reservoir neck. Coat the new O-ring seal with fresh DOT 4 brake fluid.
  - b. Coat the inner surface of the reservoir where it contacts the O-ring seal with fresh DOT 4 brake fluid.
  - c. Carefully push down and rotate the reservoir and install it onto the body (Figure 125). Make sure that the reservoir is completely seated around the entire perimeter prior to installing the screw in the next step.
  - d. Align the reservoir to the body and install the screw (Figure 124) securing the reservoir to the body. Tighten the screw securely.
6. Install the rubber diaphragm (Figure 123), the gasket (Figure 122) and top cover. Loosely install, but do not tighten the cover screws (Figure 121) at this time as fluid will have to be added later.
7. Install the master cylinder as described in this chapter.





### FRONT CALIPER

Due to the number of models and years covered in this book the front calipers are listed as Type A and Type B. The brake calipers are designed to fit onto a specific fork design.

Your bike may not be equipped with the original front forks, therefore the caliper will not be original either. The exterior appearance of the two different brake calipers is quite different.

Compare your brake caliper with the illustration used with each brake pad replacement procedure.

### FRONT CALIPER (TYPE A)

#### Removal

Refer to **Figure 139** for this procedure. This brake caliper was originally equipped on most 1974-1979 models.

#### WARNING

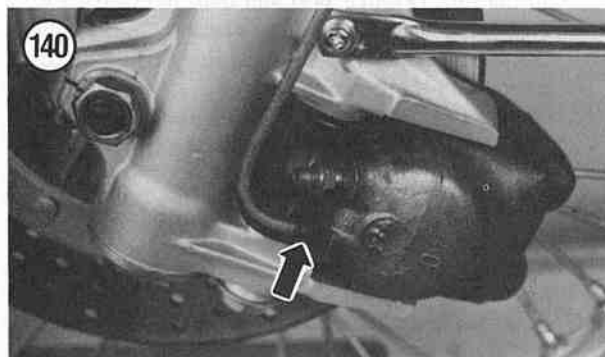
*When working on the brake system, do not inhale brake dust. It may contain asbestos, which can cause lung injury and cancer. Wear a disposable face mask and wash your hands thoroughly after completing the work.*

1. Place the bike on the centerstand with the front wheel off of the ground.
2. Drain the hydraulic fluid from the master cylinder as described under *Draining Hydraulic Fluid From the Brake System* in this chapter.

#### CAUTION

*Cover the wheel with a heavy cloth or plastic tarp to protect it from brake fluid spills. Wash brake fluid off any painted or plated surfaces immediately, as it will destroy the finish. Use soapy water and rinse completely.*

3. Using a brake flare nut wrench, loosen the brake line nut (**Figure 140**) securing the brake lines to the caliper assembly.

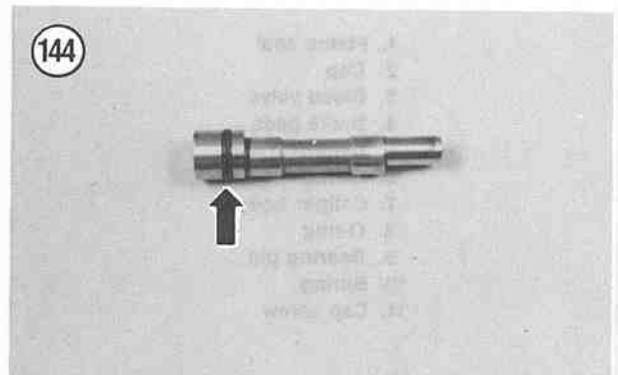
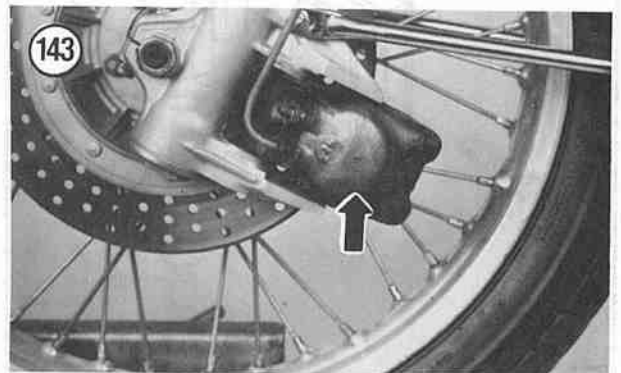
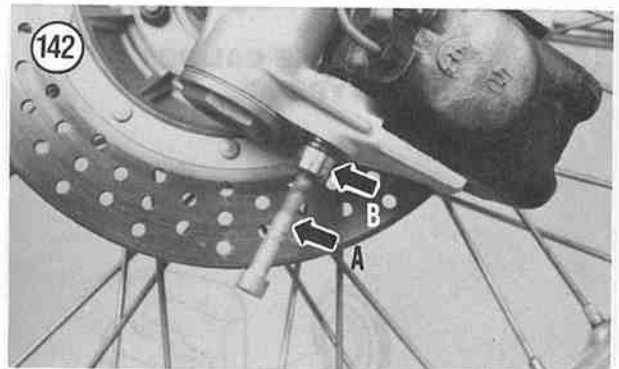
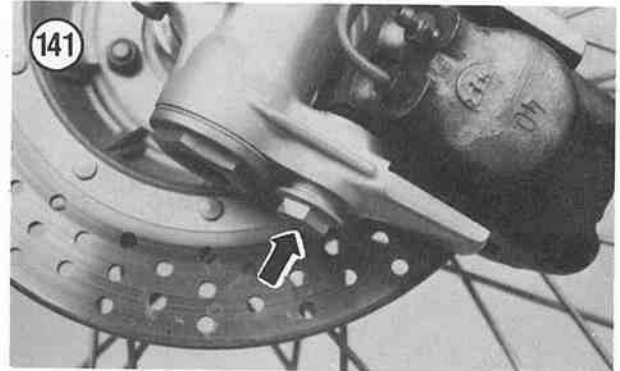


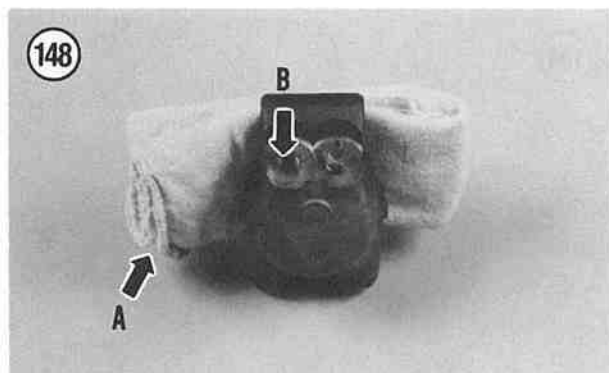
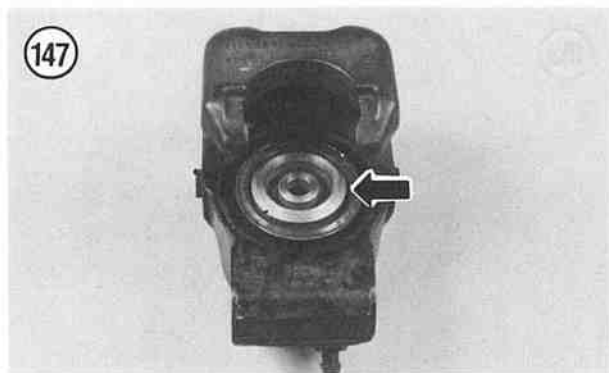
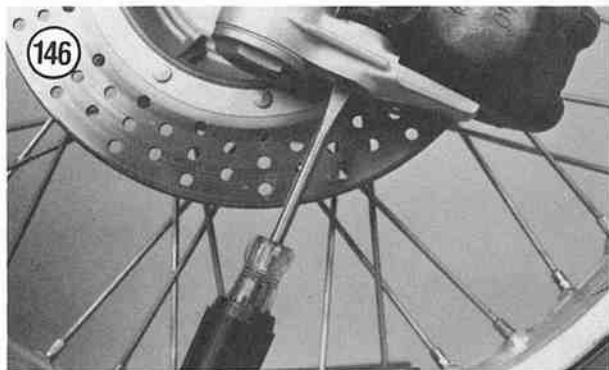
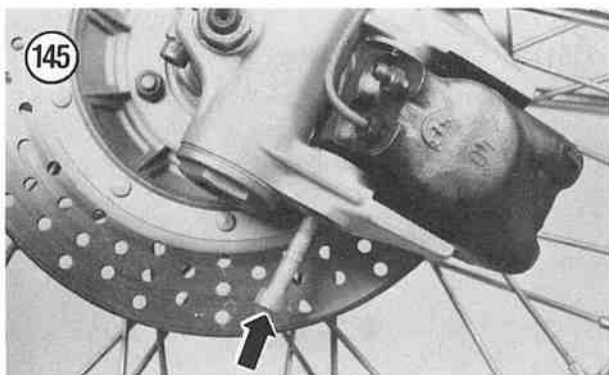


4. Unscrew the cap screw (**Figure 141**) from the base of the fork boss. Remove the cap screw and spring.
5. Thread an 8 mm  $\times$  1.25  $\times$  50 mm bolt (A, **Figure 142**) into the bearing pin (B, **Figure 142**). Withdraw the bearing pin from the brake caliper and fork slider.
6. Slide the caliper assembly off of the brake disc (**Figure 143**). Completely unscrew the brake line nut from the caliper.
7. To prevent the entry of moisture and dirt, cap the end of the brake line.
8. On dual-disc models, repeat Steps 3-7 for the other caliper assembly.

### Installation

1. Inspect the O-ring seal (**Figure 144**) on the bearing pin. Replace if it is starting to deteriorate or harden.
2. Thoroughly lubricate the bearing pin, the pin receptacle in the front fork and the pivot portion of the brake caliper with a good grade of silicone brake grease (Molykote BR2 or equivalent).
3. Carefully install the caliper assembly onto the disc. Be careful not to damage the leading edges of the pads during installation.
4. Install the front caliper into the mounting boss on the fork slider.
5. Make sure the O-ring seal is in place and install the bearing pin bolt. Install the bearing pin bolt (**Figure 145**) and screw it in all the way.
6. Attach the brake line to the caliper as follows:
  - a. Move the brake line into alignment with the threaded hole in the caliper assembly.
  - b. Make sure the alignment is correct, then screw the brake line nut in by hand—don't cross thread it.
  - c. After the brake line nut is finger-tight, use a brake flare nut wrench and tighten the nut (**Figure 140**) to the torque specification listed in **Table 2**.
7. On dual-disc models, repeat Steps 1-6 for the other caliper assembly.
8. Refill and bleed the front brake system as described in this chapter.
9. If the caliper(s) was serviced, perform the following:
  - a. Insert a flat-bladed screwdriver up into the receptacle in the fork (**Figure 146**) and onto the bearing pin.
  - b. Rotate the eccentric adjuster (bearing pin) until the caliper assembly is positioned the farthest distance away from the brake disc.
  - c. Slowly turn the eccentric in the opposite direction until the fixed brake pad (inboard pad) is parallel to the brake disc.
  - d. Apply radial marks to the inboard surface of the brake disc with a wide-tip felt marking pen.
  - e. Remove the spacer between the front brake lever and the hand grip.
  - f. Spin the front wheel and apply the front brake several times.





- g. Observe how the felt marker radial lines have been wiped off. If the marks are removed evenly and completely, the inner pad is making full contact indicating that the caliper is aligned correctly. If the marks are only wiped off a portion of the disc, readjust the caliper.
  - h. Repeat this step for the other caliper assembly if necessary.
10. Install the spring and cap screw (Figure 141). Tighten the cap screw to the torque specification listed in Table 2.

#### WARNING

*Do not ride the motorcycle until you are sure the brakes are operating correctly with full hydraulic advantage. If necessary, bleed the brake as described in this chapter.*

#### Rebuilding

Refer to Figure 139 for this procedure.

1. Remove the caliper assembly as described in this chapter.
2. Remove the brake pads as described in this chapter.
3. Withdraw the piston (Figure 147) and piston seal from the caliper body. If you cannot remove the piston easily, perform the following:
  - a. Either wrap the caliper body and piston with a heavy cloth or place a shop cloth (A, Figure 148) or piece of soft wood over the end of the piston.
  - b. Perform this step over and close down to a workbench top. Hold the caliper body with the piston facing away from you.

#### WARNING

*In the next step, the piston may shoot out of the caliper body like a bullet. Keep your fingers out of the way. Wear shop gloves and apply air pressure gradually. Do not use high pressure air or place the air hose nozzle directly against the hydraulic fluid passageway in the caliper body. Hold the air nozzle away from the inlet, allowing some of the air to escape during the procedure.*

- c. Apply the air pressure in short spurts to the hydraulic fluid passageway (B, Figure 148) and force the piston out of the caliper body. Cover the other fluid passageways to prevent the air from escaping. Use a service station air hose if you don't have an air compressor.

#### CAUTION

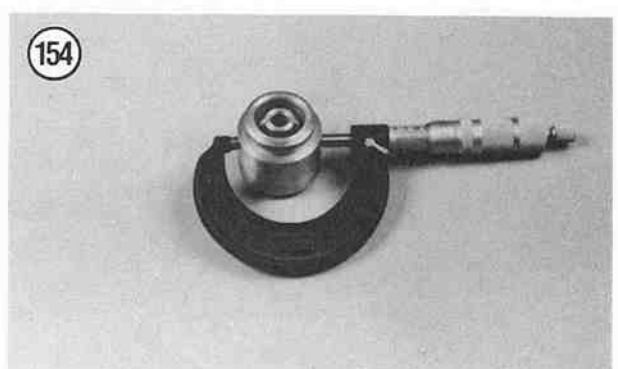
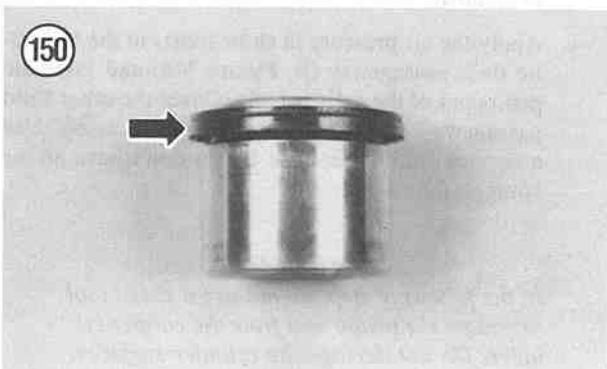
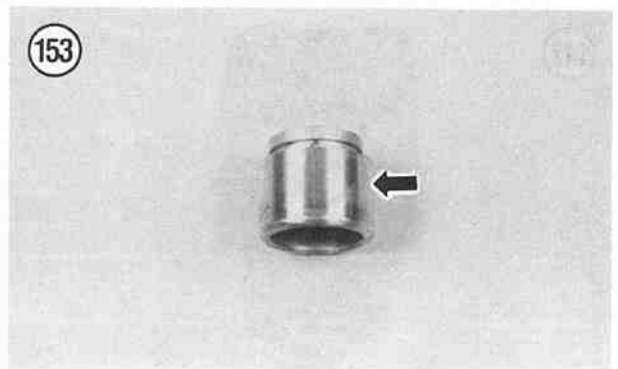
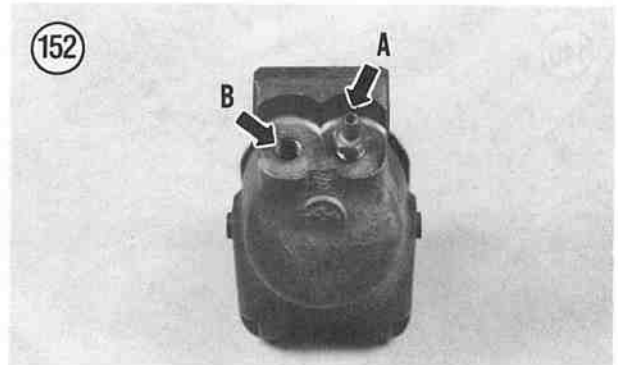
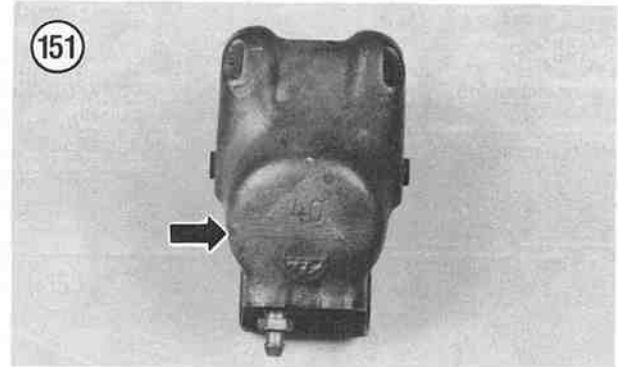
*In the following step, do not use a sharp tool to remove the piston seal from the caliper cylinder. Do not damage the cylinder surfaces.*

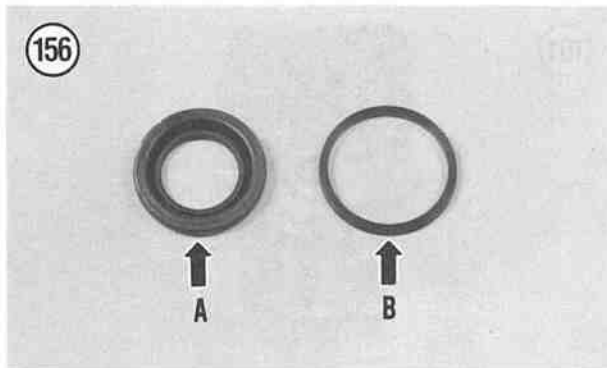
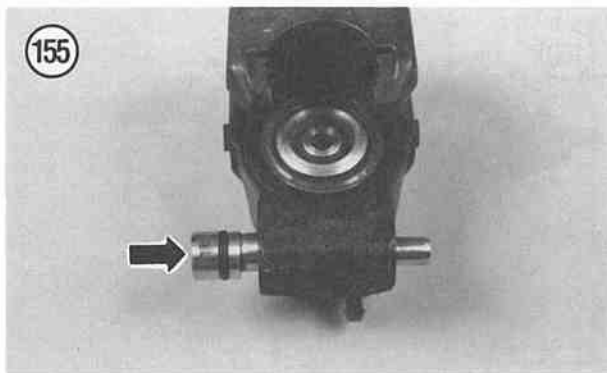
4. Use a piece of plastic or wood and carefully push the piston seal (Figure 149) in toward the caliper cylinder and out of its groove. Remove the piston seal from the caliper body. Discard the piston seal. It cannot be reused after removal as it will no longer seal effectively.
5. Inspect the seal groove in the caliper body for damage. If damaged or corroded, replace the caliper assembly.
6. Remove the dust seal (Figure 150) from the piston. Discard the dust seal. It cannot be reused after removal as it will no longer seal effectively.

**NOTE**

*The caliper body cannot be replaced separately. If it is damaged in any way, the entire caliper assembly must be replaced.*

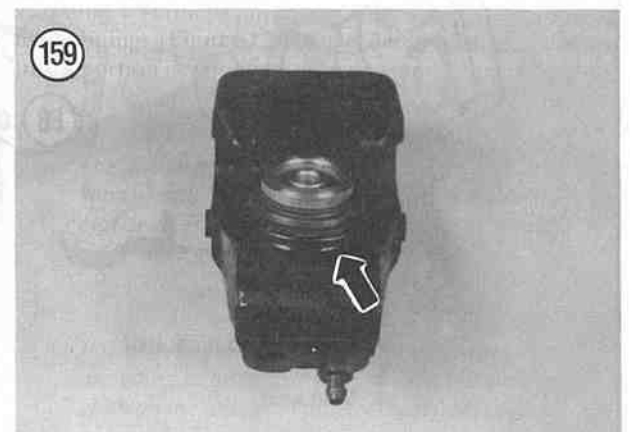
7. Inspect the caliper body (Figure 151) for damage; replace the caliper if necessary.
8. Remove the bleed valve (A, Figure 152) from the caliper body.
9. Inspect the hydraulic fluid passageway in the base of the cylinder bore. Make sure it is clean and open. Apply compressed air to the opening and make sure it is clear. Clean out if necessary with fresh brake fluid.
10. Inspect the cylinder wall and the piston (Figure 153) for scratches, scoring or other damage. If either is rusty or corroded, replace the caliper assembly. The piston cannot be replaced separately.





- NOTE*
- BMW does not provide specifications for the caliper bore.*
11. Use a micrometer and measure the outside diameter of the piston (Figure 154). Compare to the dimension listed in Table 1. Replace if worn to the service limit or less.
  12. Inspect the bearing pin hole in the caliper. Insert the bearing pin (Figure 155) into the caliper assembly and check for looseness. Replace the bearing pin if necessary.
  13. Inspect the brake line nut hole threads (B, Figure 152). If the threads are slightly damaged, clean them up with a proper size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the caliper assembly.
  14. Make sure the hole in the bleed screw is clean and open. Apply compressed air to the opening and make sure it is clear. Clean out if necessary with fresh brake fluid.
  15. If serviceable, clean the caliper body with rubbing alcohol and rinse with clean brake fluid.

- NOTE*
- Never reuse a piston or dust seal that has been removed. Very minor damage or age deterioration can make the seal useless.*
16. Coat the new dust seal (A, Figure 156) and piston seal (B, Figure 156) with fresh DOT 4 brake fluid.
  17. Carefully install the new piston seal (Figure 149) in the groove in the caliper cylinder. Make sure the seal is properly seated in the groove.
  18. Install the new dust seal (Figure 157) onto the groove in the piston.
  19. Coat the piston and the caliper cylinder with fresh DOT 4 brake fluid.
  20. Install the piston into the caliper cylinder (Figure 158).
  21. Push the piston in until the dust seal makes contact (Figure 159) with the caliper.
  22. Use a suitable size socket (Figure 160) and carefully press the piston in until it bottoms out (Figure 161).
  23. Install the bleed screw.
  24. Install the brake pads as described in this chapter.



25. Install the brake caliper assembly as described in this chapter.

### FRONT CALIPER (TYPE B)

#### Removal

Refer to **Figure 162** for this procedure.

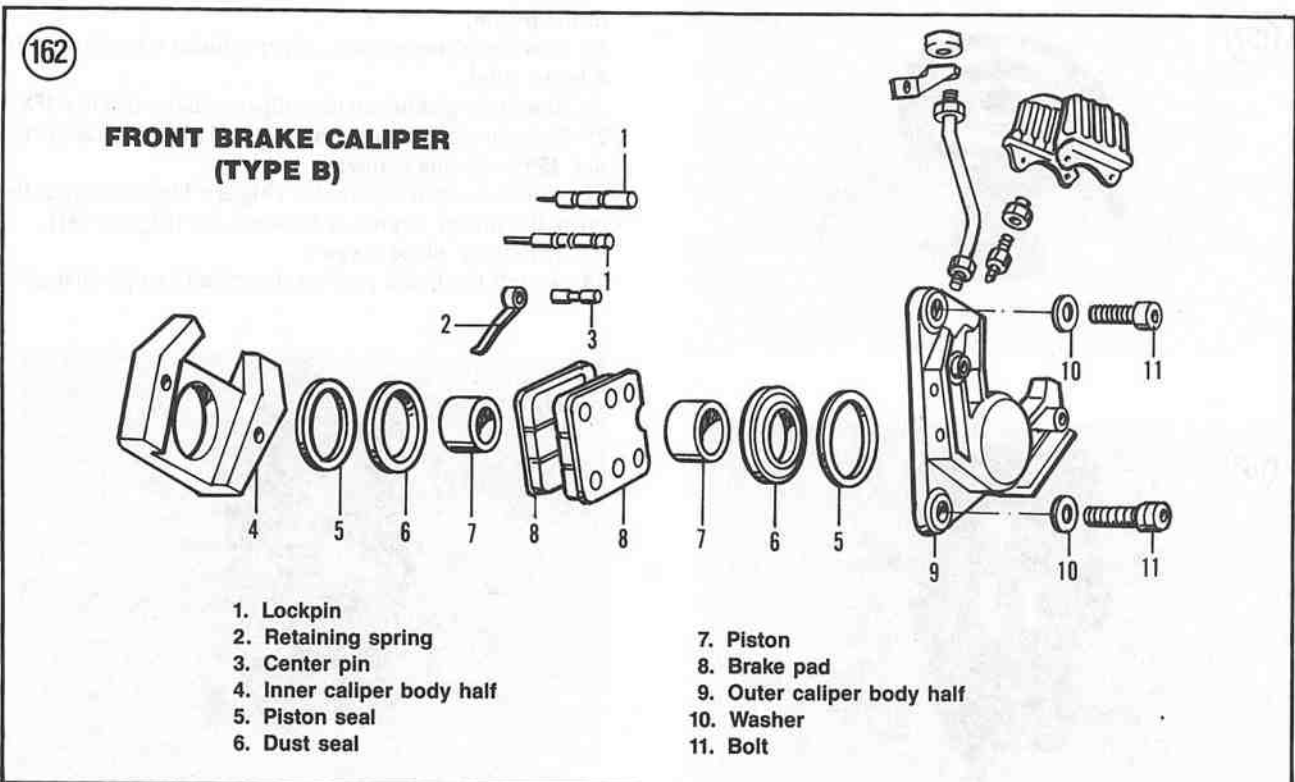
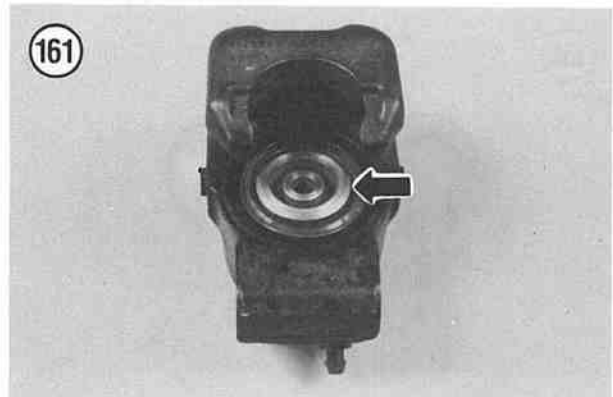
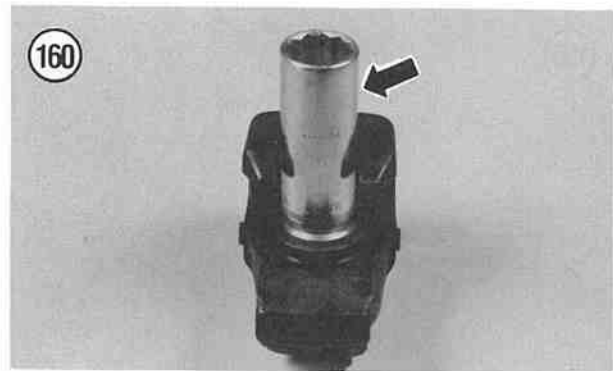
It is not necessary to remove the front wheel in order to remove either or both caliper assemblies.

1. Place the bike on the centerstand with the front wheel off of the ground.
2. Drain the hydraulic fluid from the master cylinder as described under *Draining Hydraulic Fluid From the Brake System* in this chapter.

#### CAUTION

*Cover the wheel with a heavy cloth or plastic tarp to protect them from accidental residual brake fluid spills. Wash brake fluid off any painted or plated surfaces immediately, as it will destroy the finish. Use soapy water and rinse completely.*

3. Using a brake flare nut wrench, loosen the brake line nut (A, **Figure 163**) securing the brake line to the caliper assembly. Completely unscrew the brake line nut from the caliper.

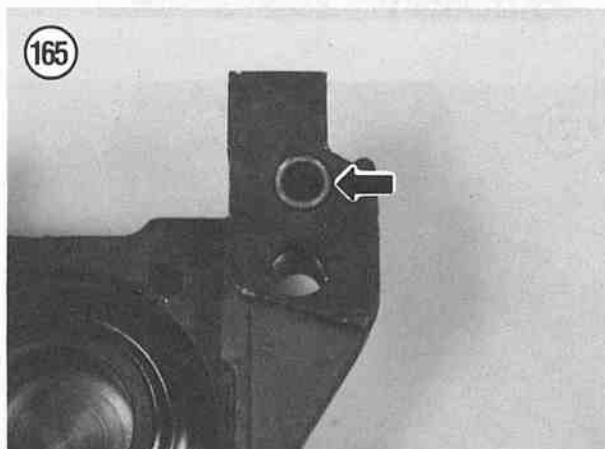
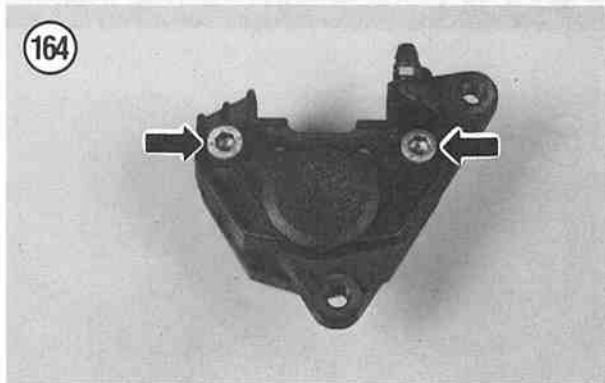
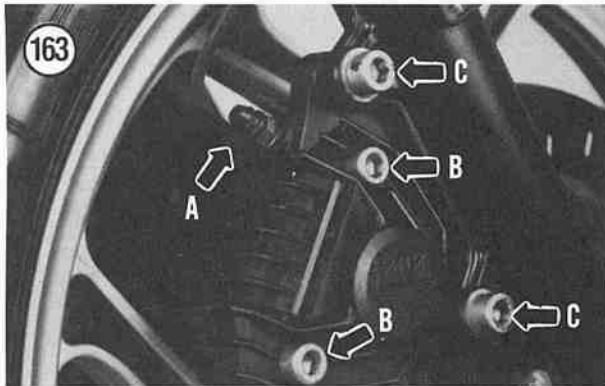




- To prevent the entry of moisture and dirt, cap the end of the brake hose.

**NOTE**

If the caliper assembly is going to be disassembled for service, loosen the Allen bolts (B, Figure 163) securing the caliper assembly halves together. The fork slider makes a good holding fixture.



- Remove the Allen bolts (C, Figure 163) securing the caliper to the fork slider.
- Pivot the caliper assembly up and off the disc and remove the caliper assembly.
- On models so equipped, repeat for the other brake caliper assembly.

**Installation**

- Carefully install the caliper assembly onto the disc. Be careful not to damage the leading edges of the pads during installation.
- Install the caliper mounting bolts (C, Figure 163) and tighten to the torque specifications listed in Table 2.

**NOTE**

If the caliper assembly was disassembled for service, securely tighten the Allen bolts (B, Figure 163) securing the caliper assembly halves together.

- Connect the brake line(s) to the caliper assembly. Tighten the flare nut(s) (A, Figure 163) to the torque specification listed in Table 2.
- Refill the system and bleed the brake as described in this chapter.

**WARNING**

Do not ride the motorcycle until you are sure that the brakes are operating properly.

**Rebuilding**

Refer to Figure 162 for this procedure.

- Remove the caliper assembly as described in this chapter.
- Remove the brake pads as described in this chapter.
- Remove the Allen bolts (Figure 164) securing the caliper assembly halves together.
- Separate the caliper halves.
- Remove the small O-ring seal (Figure 165) from the inboard caliper half. Discard the O-ring seal as it must be replaced.

**CAUTION**

In the following step, do not use a sharp tool to remove the dust seals from the caliper body. Do not damage the cylinder surfaces.

- Remove the dust seal (Figure 166) from each caliper body half. Discard the dust seals. They cannot be reused after removal as they will no longer seal effectively.

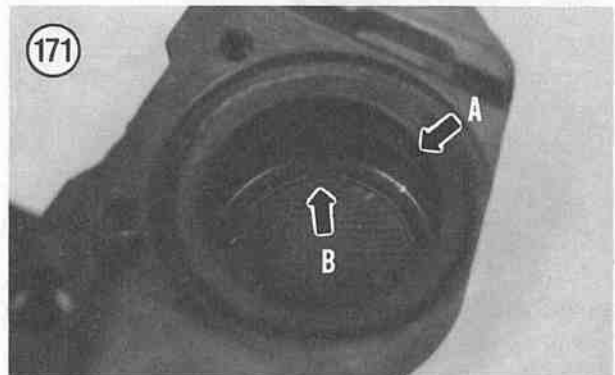
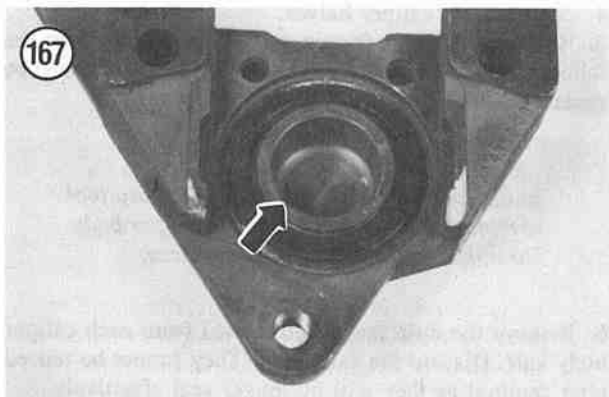
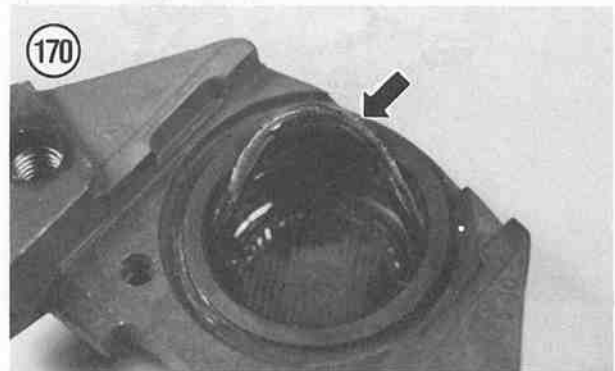
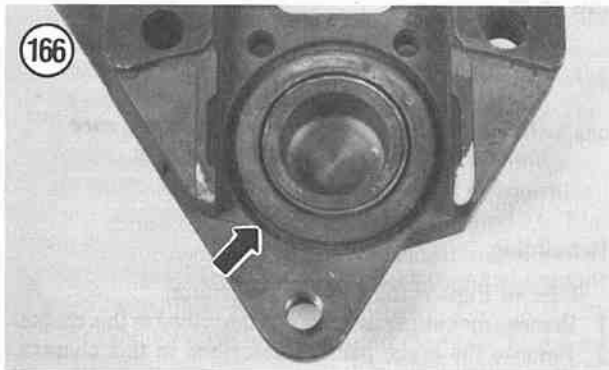
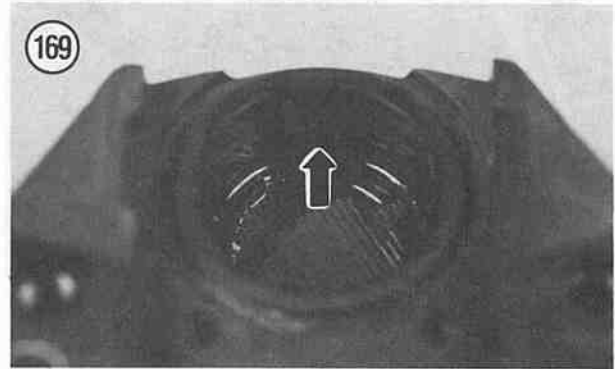
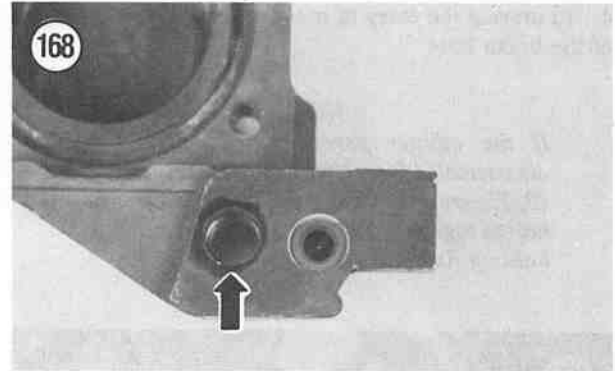
7. Withdraw the piston (Figure 167) from each caliper body half. If you cannot remove the piston easily, perform the following:

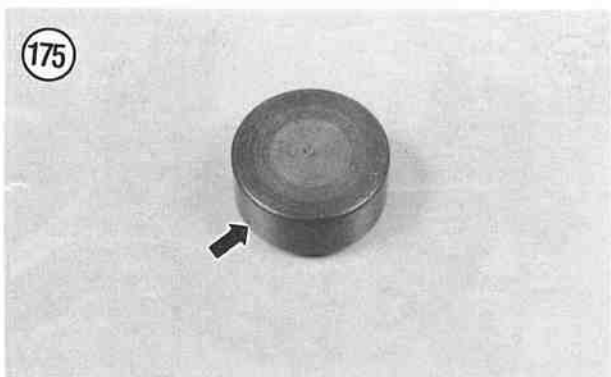
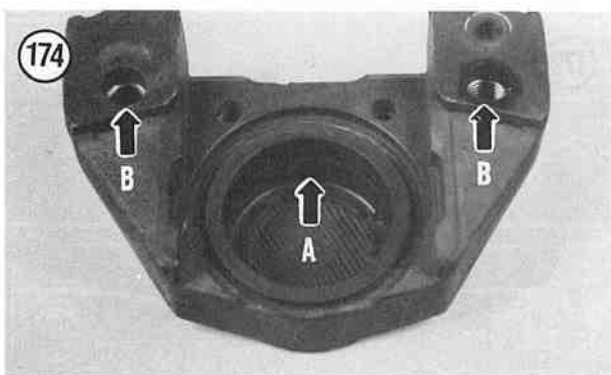
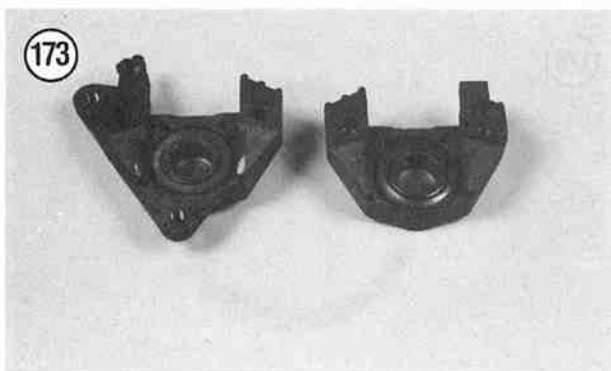
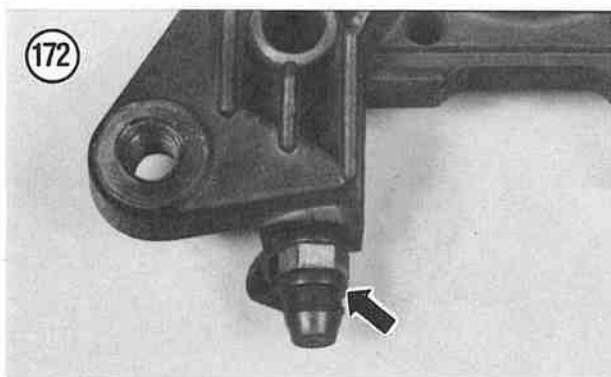
- a. Either wrap the caliper half and piston with a heavy cloth or place a shop cloth or piece of soft wood over the end of the piston.
- b. Perform this step over and close down to a workbench top. Hold the caliper body with the piston facing away from you.

**WARNING**

*In the next step, the piston may shoot out of the caliper body like a bullet. Keep your fingers out of the way. Wear shop gloves and apply air pressure gradually. Do not use high pressure air or place the air hose nozzle directly against the hydraulic fluid passageway in the caliper body. Hold the air nozzle away from the inlet, allowing some of the air to escape during the procedure.*

- c. Apply the air pressure in short spurts to the hydraulic fluid passageway (Figure 168) and force the piston out of the caliper body. Cover the other fluid passageways to prevent the air from escaping. Use a service station air hose if you don't have an air compressor.



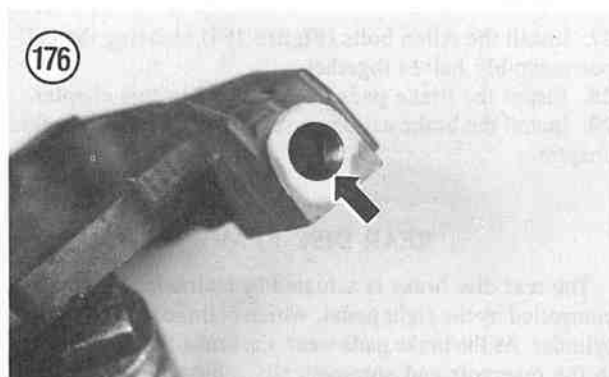


**CAUTION**  
In the following step, do not use a sharp tool to remove the piston seals from the caliper cylinders. Do not damage the cylinder surfaces.

8. Use a piece of plastic or wood and carefully push the piston seal (Figure 169) in toward the caliper cylinder and out of its groove. Remove the piston seal (Figure 170) from each caliper body half. Discard the piston seals. They cannot be reused after removal as they will no longer seal effectively.
9. Inspect the seal groove in each caliper body half (A, Figure 171) for damage. If damaged or corroded, replace the caliper assembly.

**NOTE**  
The caliper body cannot be replaced separately. If it is damaged in any way, the entire caliper assembly must be replaced.

10. Unscrew and remove the bleed screw and cap (Figure 172).
11. Inspect the caliper body halves (Figure 173) for damage, replace the caliper body if necessary.
12. Inspect the hydraulic fluid passageway (B, Figure 171) in the base of each cylinder bore. Make sure it is clean and open. Apply compressed air to the opening and make sure it is clear. Clean out if necessary with fresh brake fluid.
13. Inspect the cylinder walls (A, Figure 174) and the pistons (Figure 175) for scratches, scoring or other damage. If either is rusty or corroded, replace the caliper assembly. The pistons cannot be replaced separately.
14. Inspect the caliper mounting bolt holes. If the threads are slightly damaged, clean them up with a proper size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the caliper assembly.
15. Inspect the caliper halves' assembly bolt holes (B, Figure 174). If the threads are slightly damaged, clean them up with a proper size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the caliper assembly.
16. Inspect the union bolt hole threads (Figure 176). If the threads are slightly damaged, clean them up with a proper



size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the caliper assembly.

17. Make sure the hole in the bleed screw is clean and open. Apply compressed air to the opening and make sure it is clear. Clean out if necessary with fresh brake fluid.

18. If serviceable, clean the caliper body halves with rubbing alcohol and rinse with clean brake fluid.

**NOTE**

*Never reuse a dust seal or piston seal that has been removed. Very minor damage or age deterioration can make the seals useless.*

19. Coat the new dust seals (**Figure 177**) and piston seals (**Figure 178**) with fresh DOT 4 brake fluid.

20. Carefully install the new piston seal (**Figure 170**) in the groove in each caliper cylinder. Make sure the seal is properly seated in the groove (**Figure 169**).

21. Coat the pistons and the caliper cylinders with fresh DOT 4 brake fluid.

22. Position the pistons with the *open end facing out* (**Figure 179**) toward the brake pads and install the piston into each caliper cylinder (**Figure 180**). Push the pistons in until they bottom out (**Figure 181**).

23. Carefully install the new dust seal (**Figure 182**) in the groove in each caliper cylinder. Make sure the seal is properly seated in the caliper half.

24. Install the bleed screw and cap (**Figure 172**).

25. Install a new O-ring seal (**Figure 165**) into the recess in the inboard caliper half.

26. Lay the inboard caliper half down and install the outboard half on top of it. This is to prevent the small O-ring seal from falling out during assembly.

**NOTE**

*There are 2 different length Allen bolts of the same diameter and thread size. The longer bolts (A, **Figure 183**) are used to assemble the 2 caliper halves together and the shorter ones (B, **Figure 183**) are used as mounting bolts to hold the caliper assembly onto the fork slider.*

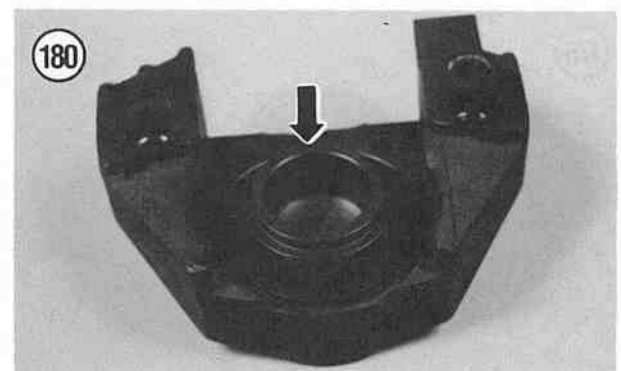
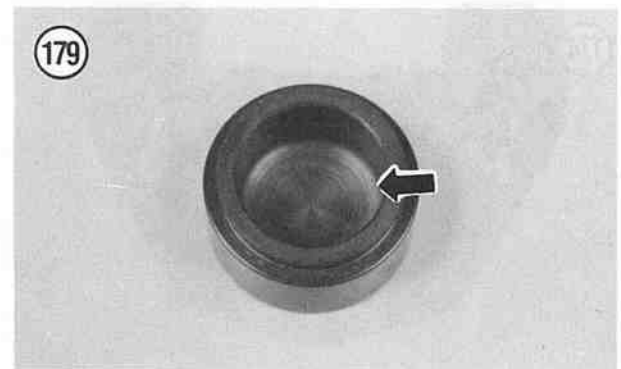
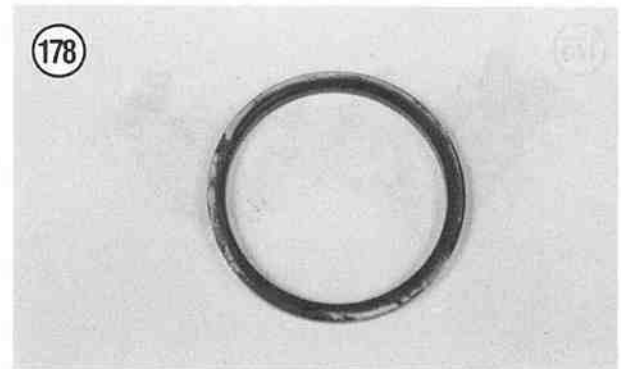
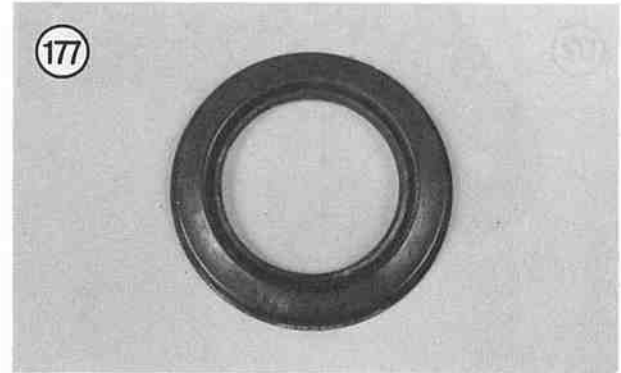
27. Install the Allen bolts (**Figure 164**) securing the caliper assembly halves together.

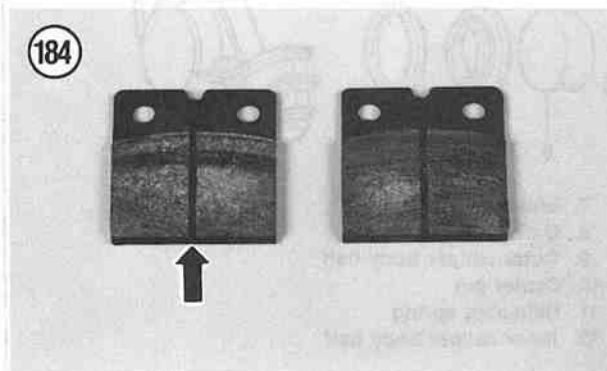
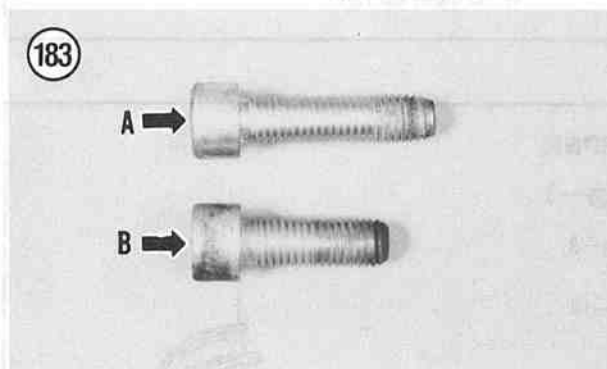
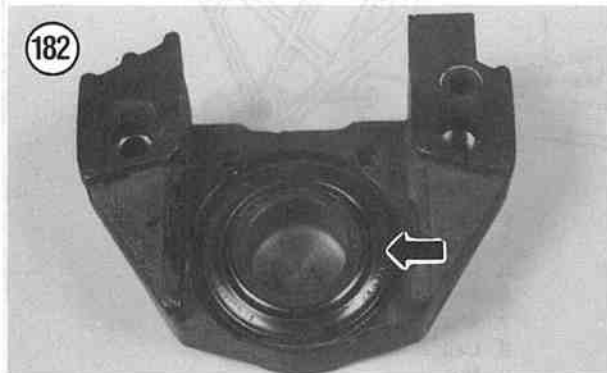
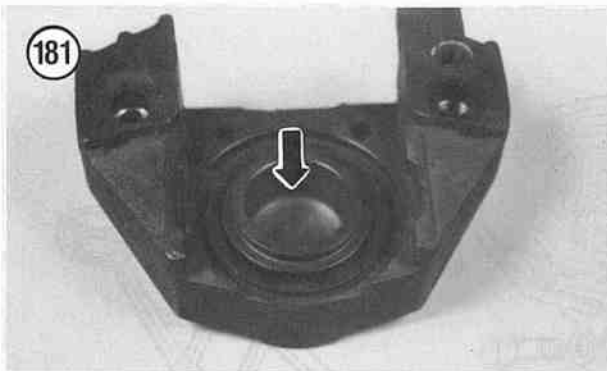
28. Install the brake pads as described in this chapter.

29. Install the brake caliper assembly as described in this chapter.

### REAR DISC BRAKE

The rear disc brake is actuated by hydraulic fluid and is controlled by the right pedal, which is linked to the master cylinder. As the brake pads wear, the brake fluid level drops in the reservoir and automatically adjusts for wear.





## REAR BRAKE PAD REPLACEMENT

There is no recommended mileage interval for changing the friction pads in the disc brake. Pad wear depends greatly on riding habits and conditions. The pads should be checked for wear every 7,240 km (4,500 miles) and replaced when the lining thickness reaches 1.5 mm (1/16 in.) from the brake pad backing plate. To maintain an even brake pressure on the disc, always replace both pads in both calipers at the same time.

### CAUTION

*Watch the pads more closely when the wear line (Figure 184) approaches the disc. On some pads, the wear line is very close to the metal backing plate. If pad wear happens to be uneven for some reason, the backing plate may come in contact with the disc and cause damage.*

Refer to **Figure 185** and **Figure 186** for this procedure.

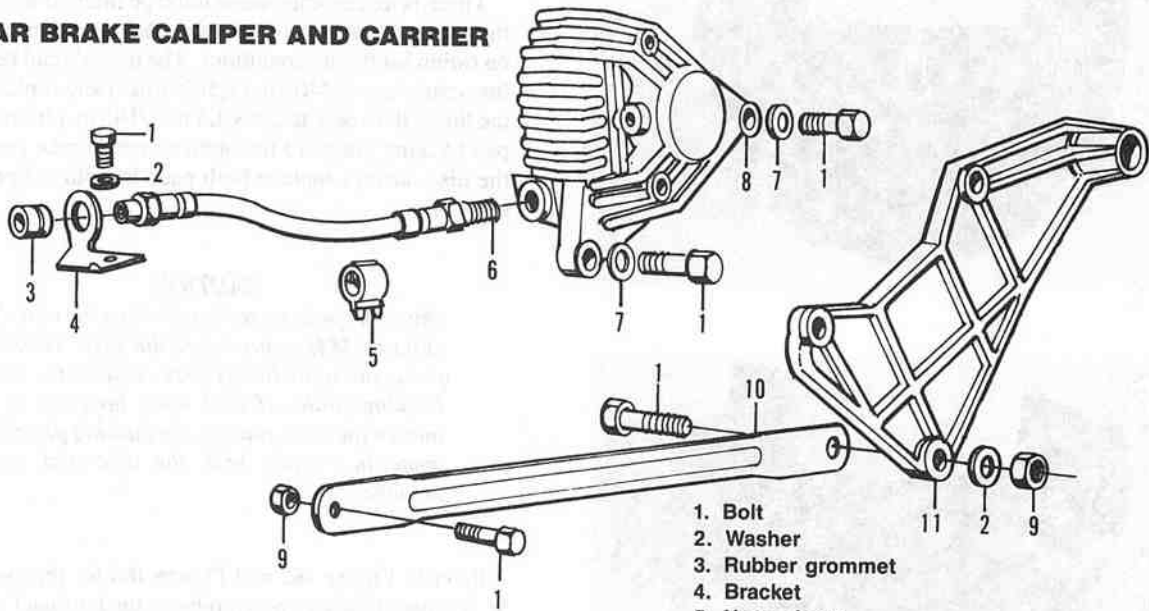
1. On models so equipped, remove the left-hand saddlebag as described under *Saddlebag Removal/Installation* in Chapter Twelve.
2. To prevent accidental application of the rear brake pedal, tie the pedal up to the frame so it cannot be depressed.
3. Place the bike on the centerstand, then place wood blocks under the engine oil pan to support it securely with the rear wheel off the ground.
4. Tape several shop cloths to the top surface of the left-hand muffler to protect its finish while working on the brake caliper.
5. Remove the bolt, washer and nut (**Figure 187**) securing the torque link to the caliper carrier. Let the torque link swing down and out of the way.
6. Remove the rear axle nut on the right-hand side.
7. Loosen the rear axle pinch bolt on the left-hand side.
8. Insert a drift into the hole in the left-hand end of the rear axle.
9. Partially withdraw the rear axle from the left-hand side sufficiently to clear the rear caliper carrier. It is not necessary to completely remove the rear axle.
10. Release the rear brake hose from the clip on the left-hand side of the swing arm.
11. Carefully lift the rear caliper and caliper carrier assembly up and off of the rear disc.
12. Pull the caliper assembly over toward the left and remove the brake pads as follows.

### NOTE

*The following steps are shown with the caliper assembly removed for clarity. It is not necessary to completely remove the caliper for this procedure.*

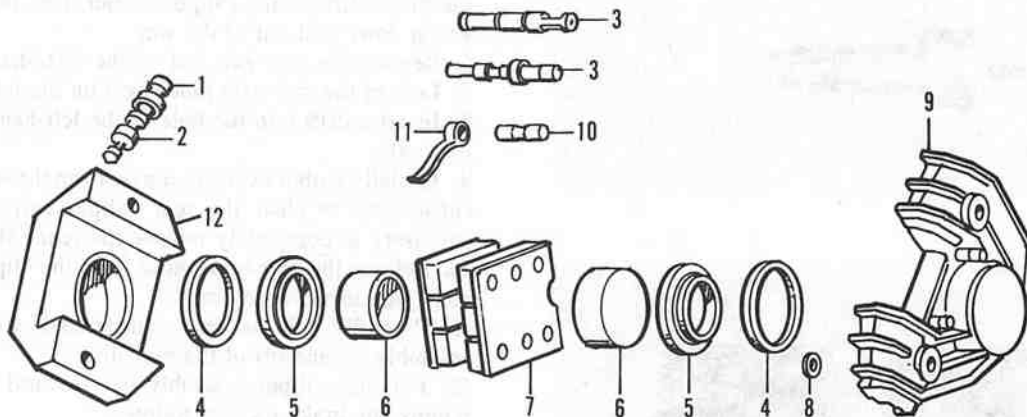


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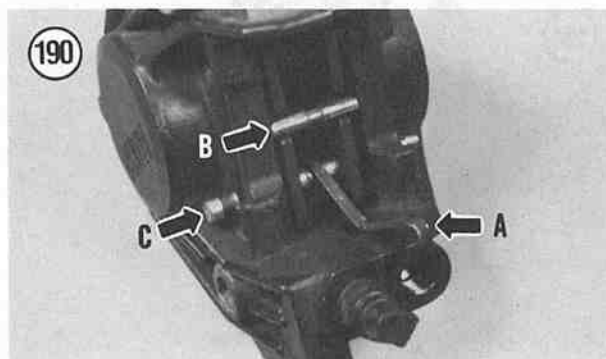
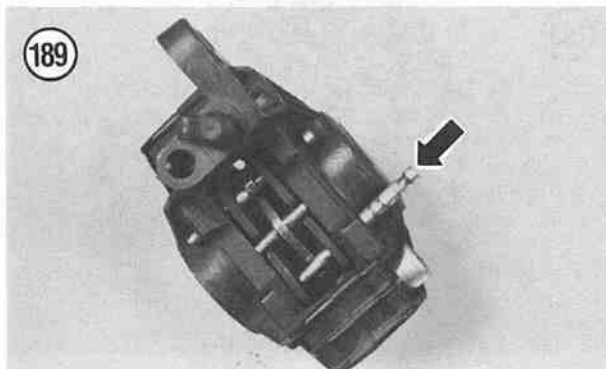
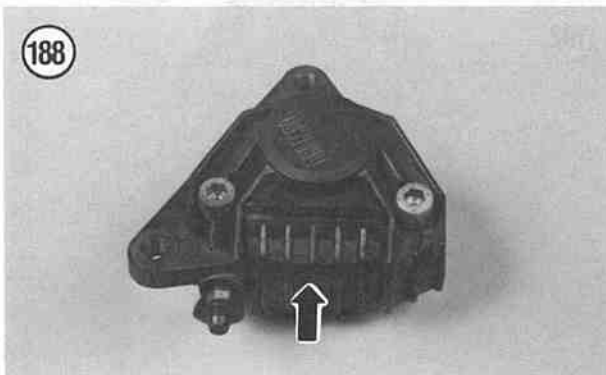
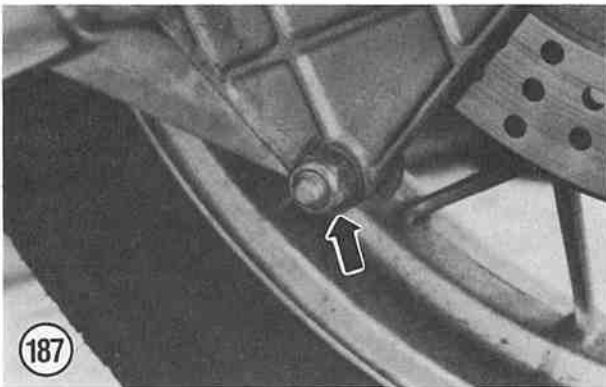
**REAR BRAKE CALIPER AND CARRIER**

1. Bolt
2. Washer
3. Rubber grommet
4. Bracket
5. Hose clamp
6. Brake hose
7. Washer
8. Caliper body
9. Nut
10. Torque link
11. Caliper carrier

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**REAR CALIPER**

1. Bleed valve cap
2. Bleed valve
3. Lockpin
4. Piston seal
5. Dust seal
6. Piston
7. Brake pad set
8. O-ring
9. Outer caliper body half
10. Center pin
11. Retaining spring
12. Inner caliper body half



13. Using a large flat-bladed screwdriver, carefully remove the brake caliper cover (Figure 188).

#### CAUTION

*In the following steps, be careful to not damage the flexible brake hose while working on the rear caliper assembly. Move the caliper assembly in small amounts and observe the hose to make sure it is not getting kinked or severely twisted.*

14. Have an assistant hold onto the rear caliper assembly and turn it over to gain access to the backside of the caliper.  
15. Using a drift and small hammer, carefully tap one of the lockpins (Figure 189) loose from the backside of the caliper.

16. Hold a finger over the center pin and retaining spring and remove the lockpin that was loosened in Step 15.

17. Lift up the retaining spring (A, Figure 190) and remove the center pin (B, Figure 190).

18. Using a drift and small hammer, carefully tap the other lockpin (C, Figure 190) out from the backside of the caliper. Remove the lockpin.

19. The pistons must be repositioned within the caliper assembly prior to installing the new *thicker* brake pads. The rear master cylinder brake fluid level will rise as the caliper pistons are being repositioned. Perform the following:

- a. Remove the frame right-hand side cover.
- b. Clean the top of the rear master cylinder of all dirt and foreign matter.
- c. Disconnect the electrical connectors from the top cover.
- d. Remove the top cover and the rubber diaphragm from the master cylinder reservoir.
- e. Note the brake fluid level in the reservoir. If it is up to, or close to, the top surface of the reservoir, siphon off some of the fluid at this time.
- f. Place a large flat-tipped screwdriver in between both brake pads.
- g. Using the screwdriver, slowly press on one brake pad and push the piston back into the caliper cylinder. Repeat for the other piston.
- h. Constantly check the reservoir to make sure the brake fluid does not overflow. Remove brake fluid, if necessary, prior to it overflowing.
- i. The pistons should move freely during repositioning. If they don't, and there is evidence of them sticking in the cylinders, the caliper should be removed and serviced as described under *Rear Caliper Rebuilding* in this chapter.

20. Remove both brake pads and measure them with a micrometer (Figure 191) or vernier caliper. Replace the pads if worn to the service limit listed in Table 1 or less.

#### WARNING

*When working on the brake system, do not inhale brake dust. It may contain asbestos,*

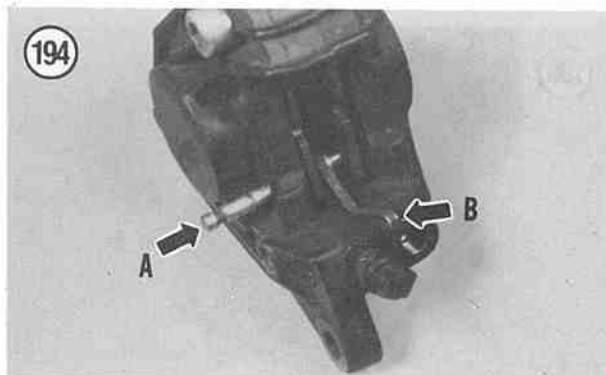
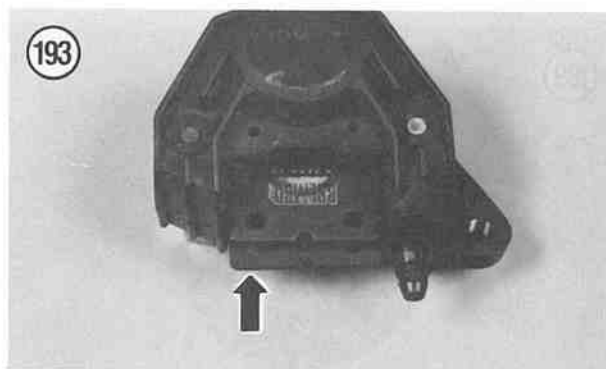
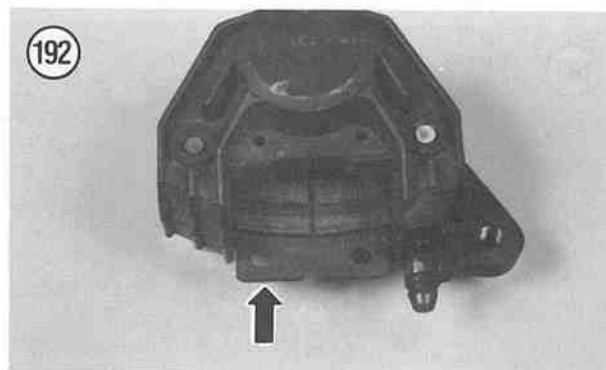
*which can cause lung injury and cancer. Wear a disposable face mask and wash your hands thoroughly after completing the work.*

21. Clean the pad recess and the ends of the pistons with a soft brush. Do not use solvent, a wire brush or any hard tool which would damage the pistons or disc.
22. Carefully remove any rust or corrosion from the disc.
23. Lightly coat the ends of the pistons and the backs of the new pads (*not the friction material*) with disc brake lubricant.

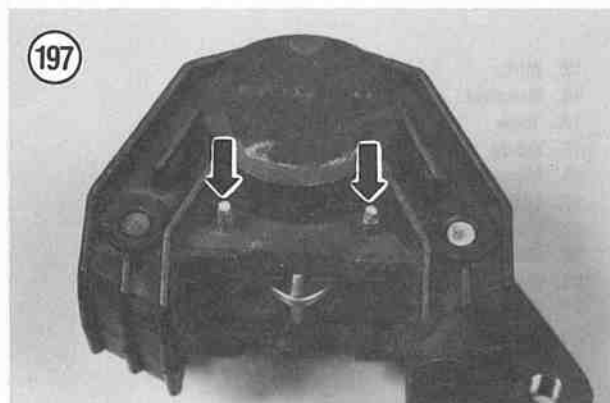
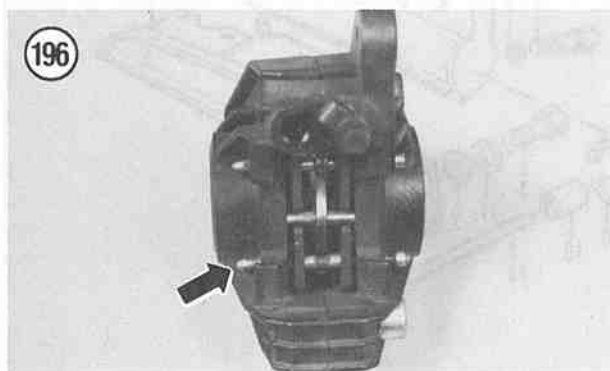
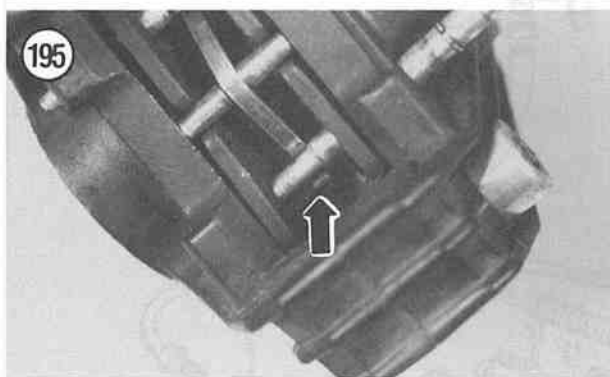
#### NOTE

*When purchasing new pads, check with your dealer to make sure the friction compound of the new pad is compatible with the disc material. Remove any roughness from the backs of the new pads with a fine-cut file; wipe them clean with a lint-free cloth.*

24. Install the inboard pad (**Figure 192**) and then the outboard pad (**Figure 193**). The brake pads may slip down within the caliper assembly since there is no stop for them.
25. If necessary, pull the brake pads up until the holes align with the caliper assembly.
26. Install one lockpin (A, **Figure 194**) and the retaining spring (B, **Figure 194**) through the holes in the caliper and both brake pads. Tap it in until it stops and locks in place.
27. Install the center pin (B, **Figure 190**) into the notch in both brake pads.
28. Partially install the other lockpin through the outer hole in the caliper and outboard brake pad.
29. Press the retaining spring down and push the lockpin over the retaining spring end (**Figure 195**) and through the inboard brake pad and caliper (**Figure 196**). Tap it in until it stops and locks in place. Make sure the retaining spring is correctly hooked under both lockpins and is located within the lockpin recess.
30. Make sure both lockpins (**Figure 197**) have bottomed out in the caliper assembly.
31. Install the brake caliper cover (**Figure 188**).
32. Move the caliper and caliper carrier assembly into position and onto the rear disc. Be careful not to damage the leading edges of the brake pads during caliper installation.
33. Align the rear axle hole in the caliper carrier with the hole in the wheel hub.
34. Push the rear axle through the caliper carrier and the swing arm. Push it in until it bottoms out.
35. Install the rear axle nut.
36. Insert a drift into the hole in the left-hand end of the rear axle.
37. Move the rear caliper torque link into position and install the bolt, washer and nut securing the torque link to the caliper carrier. Tighten the bolt and nut securely.
38. Using the drift to keep the rear axle from rotating; tighten the rear axle nut to the torque specification listed in **Table 2**.



39. Tighten the rear axle pinch bolt to the torque specification listed in **Table 2**.
40. Insert the rear brake hose into the clip on the left-hand side of the swing arm.
41. Remove the tape and shop cloths from the top surface of the left-hand muffler.
42. Remove the wood blocks from under the engine oil pan.
43. Remove the rear brake pedal restraint securing the pedal up to the frame.
44. On models so equipped, install the left-hand saddlebag as described under *Saddlebag Removal/Installation* in Chapter Twelve.

**CAUTION**

*In Step 45, don't come to fast stops as the brake fluid may slosh out of the open master cylinder reservoir.*

45. Carefully roll the bike back and forth and activate the brake pedal as many times as it takes to refill the cylinders in the caliper and correctly locate both brake pads.

**WARNING**

*Use brake fluid clearly marked DOT 4 from a sealed container. Other types may vaporize and cause brake failure. Always use the same brand name; do not intermix silicone based (DOT 5) brake fluid as it can cause brake component damage leading to brake system failure.*

46. Refill the master cylinder reservoir, if necessary, to maintain the correct fluid level.
47. Install the rubber diaphragm and top cover.

**WARNING**

*Do not ride the motorcycle until you are sure the brakes are operating correctly with full hydraulic advantage. If necessary, bleed the brake as described in this chapter.*

48. Bed the pads in gradually for the first 80 km (50 miles) by using only light pressure as much as possible. Immediate hard application will glaze the new friction pads and greatly reduce the effectiveness of the brake.
49. Reattach the electrical connectors to the top of the master cylinder reservoir top cap.
50. Install the frame right-hand side cover.

## REAR MASTER CYLINDER AND RESERVOIR

### Removal/Installation

Refer to **Figure 198** for this procedure.

1. Place the bike on the centerstand.
2. Drain the hydraulic fluid from the master cylinder and reservoir as described under *Draining Hydraulic Fluid From the Brake System* in this chapter.

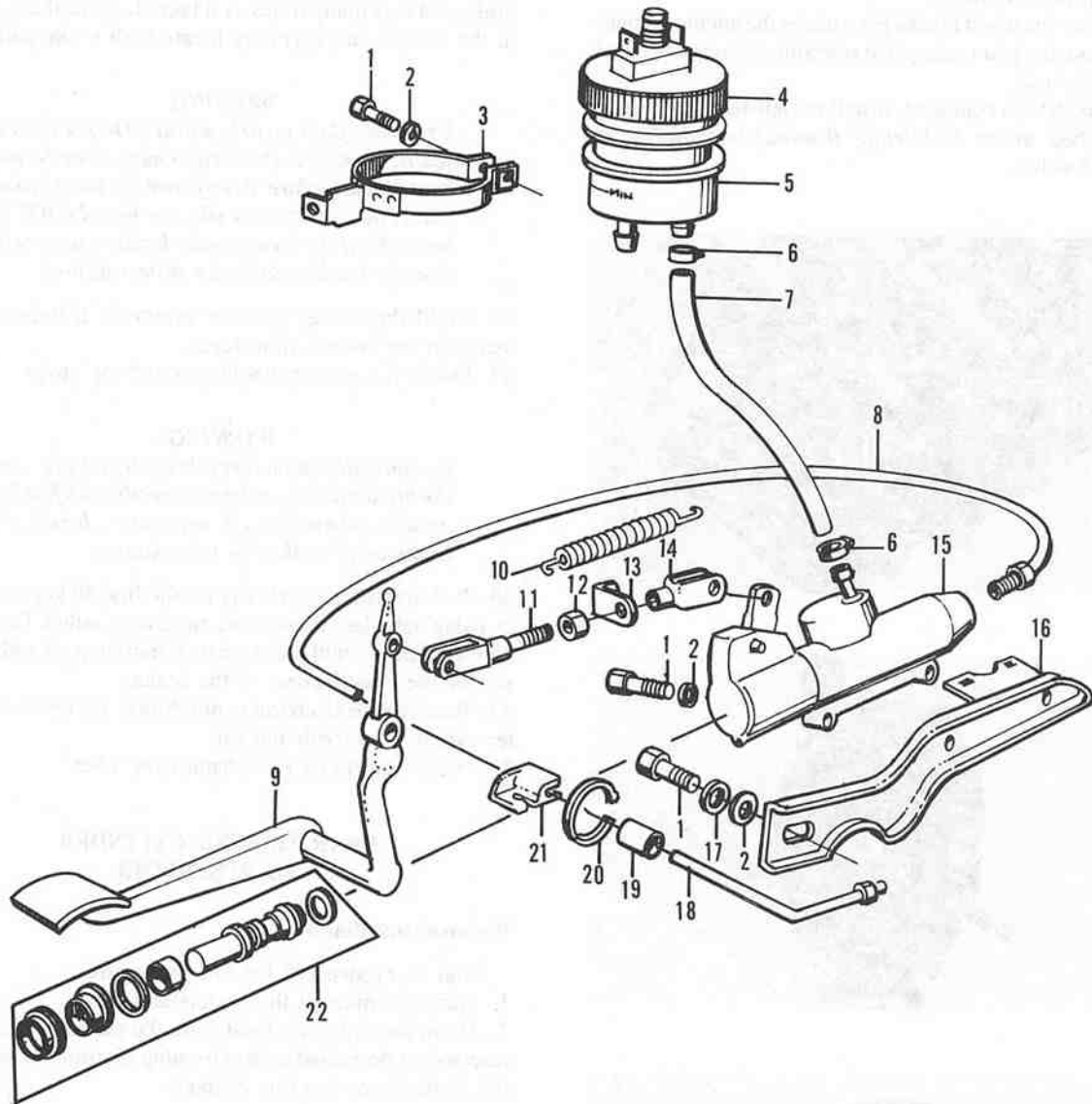
**CAUTION**

*Cover the frame and engine surrounding the master cylinder with a heavy cloth or plastic tarp to protect them from accidental residual brake fluid spills. Wash brake fluid off any painted or plated surfaces immediately, as it will destroy the finish. Use soapy water and rinse completely.*

3. On models so equipped, remove the right-hand saddlebag as described under *Saddlebag Removal/Installation* in Chapter Twelve.

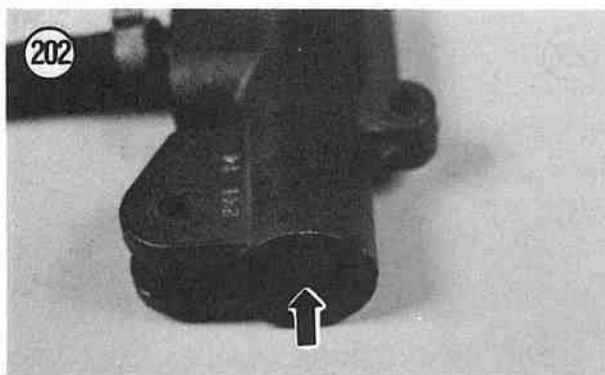
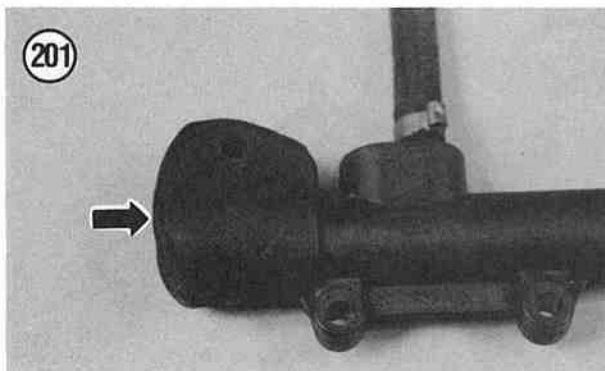
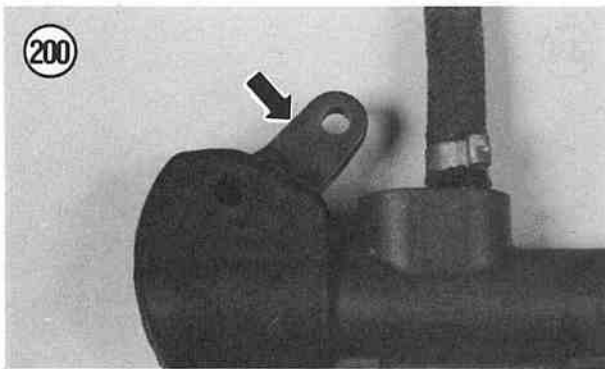
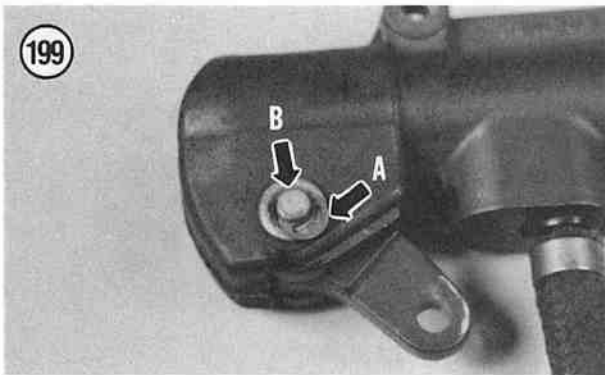
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### REAR MASTER CYLINDER, RESERVOIR AND BRAKE PEDAL



- |                        |                      |
|------------------------|----------------------|
| 1. Bolt                | 12. Nut              |
| 2. Washer              | 13. Bracket          |
| 3. Clamp               | 14. Yoke             |
| 4. Top cover           | 15. Body             |
| 5. Reservoir           | 16. Mounting bracket |
| 6. Hose clamp          | 17. Lockwasher       |
| 7. Flexible brake hose | 18. Metal brake line |
| 8. Metal brake line    | 19. Grommet          |
| 9. Brake pedal         | 20. Strap            |
| 10. Return spring      | 21. Brake line clip  |
| 11. Pull rod           | 22. Piston assembly  |





4. Remove the rear wheel as described under *Rear Wheel Removal (Dual Shock Models)* in Chapter Ten.
5. Remove the frame right-hand side cover.
6. Disconnect the electrical connectors from the reservoir top cover.
7. Remove the lower hose clamp securing the flexible brake hose between the reservoir and the rear master cylinder. Disconnect the flexible brake hose from the rear master cylinder.
8. Insert a golf tee into the end of the flexible brake hose and cover the end with a resealable plastic bag to prevent the entry of foreign matter.
9. Remove the clamp bolt and washer securing the reservoir to the frame.
10. Remove the reservoir from the clamp and reinstall the bolt and washer to avoid misplacing them.
11. Remove the brake pedal assembly as described in this chapter.
12. Using a flare nut wrench, loosen the brake line flare nut from the end of the master cylinder. Remove the brake line from the rear end of the master cylinder.
13. Remove the bolt and washer securing the rear master cylinder mounting bracket to the frame.
14. Remove the rear master cylinder and mounting bracket assembly from the frame.
15. Remove the bolts and washers securing the master cylinder to the mounting bracket and remove the mounting bracket.
16. Take the master cylinder to your work bench for further disassembly.
17. Install by reversing these removal steps. Note the following during installation.
18. Tighten the hose fittings to the torque specification listed in **Table 2**.
19. Fill the reservoir and bleed the brake as described in this chapter.

### Disassembly

Refer to **Figure 198** for this procedure.

1. Remove the master cylinder as described in this chapter.
2. Remove the E-clip (A, **Figure 199**) securing the pivot pin and remove the pivot pin (B, **Figure 199**).
3. Remove the linkage arm (**Figure 200**) from the front end of the master cylinder.
4. Remove the rubber boot (**Figure 201**) from the front end of the master cylinder.
5. Insert a small rod or drill bit into the brake line threaded hole at the rear end of the master cylinder. Carefully push on and remove the piston assembly (**Figure 202**) from the master cylinder body.

### NOTE

*It may be necessary to apply a small amount of air pressure to the brake line threaded hole to remove the piston assembly. If necessary, apply the air in short spurts and catch the piston assembly as it comes out.*

### Inspection

BMW provides only some specifications for the master cylinder components. Replace any parts that appear to be damaged or worn.

1. Clean all parts in denatured alcohol or fresh brake fluid.
2. Apply compressed air to all openings in the master cylinder body to thoroughly dry it out.
3. Inspect the cylinder bore and piston contact surfaces for signs of wear and damage. If either part is less than perfect, replace it.
4. Replace the piston assembly if the cups require replacement. The cups can not be replaced individually.
5. Check the end of the piston assembly for wear caused by the adjust bolt. Replace if worn.
6. Inspect the flexible brake hose (**Figure 203**) on the reservoir. Remove and replace if necessary.
7. Inspect the rubber boot for deterioration, cracking and wear. Replace if necessary.
8. Inspect the pivot pin hole in the lever (**Figure 204**) and the master cylinder body (**Figure 205**) for wear or elongation. Replace the worn parts.
9. Inspect the pivot pin (**Figure 206**) for wear or damage; replace if necessary.
10. Remove the cap (**Figure 207**) and rubber diaphragm (**Figure 208**) from the reservoir.
11. Inspect the rubber diaphragm (**Figure 209**) for wear, deterioration or damage; replace if necessary.

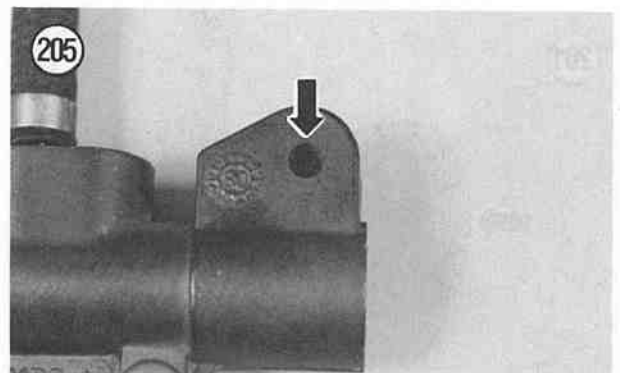
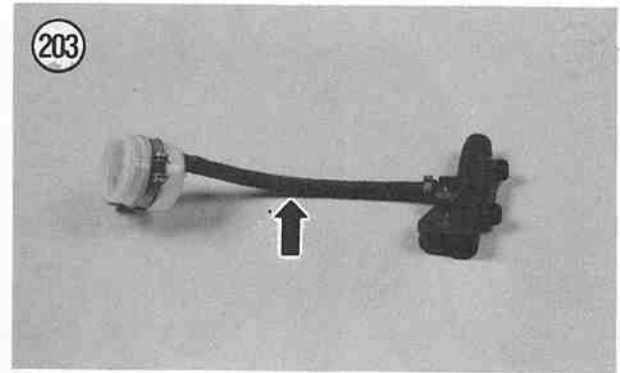
### Assembly

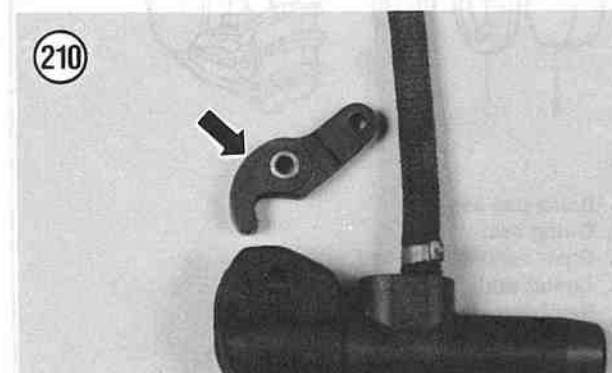
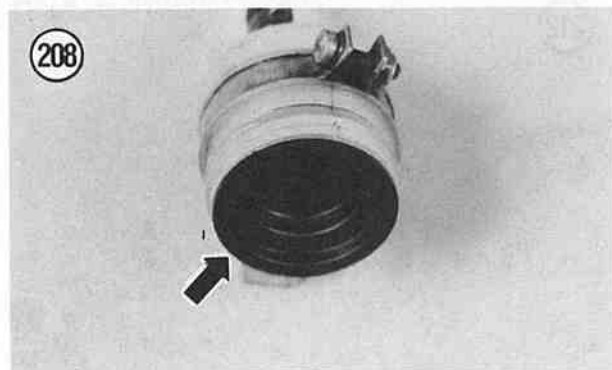
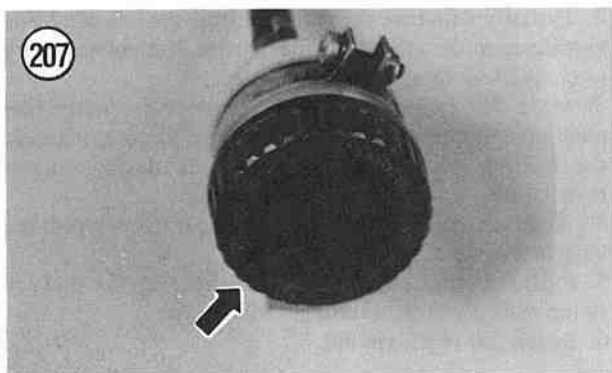
1. Soak the piston assembly in fresh brake fluid for at least 15 minutes to make the primary cup pliable. Coat the inside of the cylinder with fresh brake fluid before assembly.

#### CAUTION

*When installing the piston assembly, do not allow the cups to turn inside out as they will be damaged and allow brake fluid leakage within the cylinder bore.*

2. Place the master cylinder in a vise with soft jaws. Do not overtighten the jaws or the master cylinder may be distorted or damaged.
3. Install the piston assembly into the cylinder.
4. Press the piston assembly into the master cylinder body.
5. Install the rubber boot (**Figure 201**) and make sure it snaps correctly into the groove in the master cylinder body.
6. Position the linkage as shown in **Figure 210** and install the linkage.
7. Install the pivot pin (B, **Figure 199**) through the master cylinder pivot tabs and linkage. Push it in until it bottoms out.
8. Install the E-clip (A, **Figure 199**) and make sure it snaps correctly into the groove in the pivot pin.
9. Install the master cylinder as described in this chapter.





## REAR CALIPER

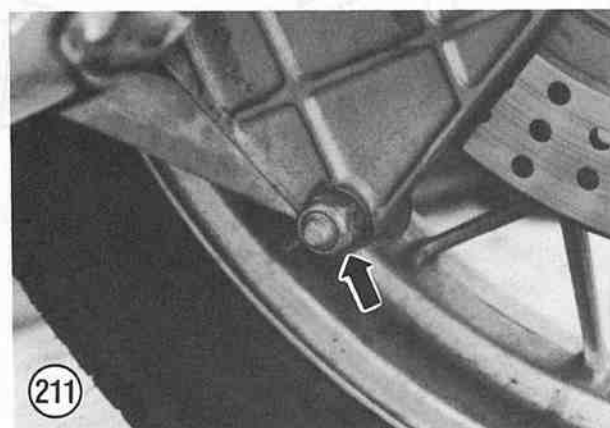
### Removal

1. On models so equipped, remove the left-hand saddlebag as described under *Saddlebag Removal/Installation* in Chapter Twelve.
2. Drain the hydraulic fluid from the master cylinder as described under *Draining Hydraulic Fluid From the Brake System* in this chapter.

### CAUTION

*Cover the swing arm and rear wheel surrounding the master cylinder with a heavy cloth or plastic tarp to protect them from accidental residual brake fluid spills. Wash brake fluid off any painted or plated surfaces immediately, as it will destroy the finish. Use soapy water and rinse completely.*

3. Place the bike on the centerstand, then place wood blocks under the engine oil pan to support it securely with the rear wheel off the ground.
4. Use a brake flare nut wrench to loosen, then unscrew the fitting securing the brake line to the rear caliper.
5. To prevent the entry of moisture and dirt, cap the end of the brake line. Place the loose end in a resealable plastic bag and tie the loose end up to the frame.
6. Tape several shop cloths to the top surface of the left-hand muffler to protect its finish while working on the brake caliper.
7. Remove the bolt, washer and nut (Figure 211) securing the torque link to the caliper carrier. Let the torque link swing down and out of the way.
8. Remove the rear axle nut on the right-hand side.
9. Loosen the rear axle pinch bolt on the left-hand side.
10. Insert a drift into the hole in the left-hand end of the rear axle.
11. Partially withdraw the rear axle from the left-hand side to clear the rear caliper carrier. It is not necessary to completely remove the rear axle.



12. Release the rear brake hose from the clip on the left-hand side of the swing arm.
13. Carefully lift the rear caliper and caliper carrier assembly up and off of the rear disc.

**NOTE**

If the caliper assembly is going to be disassembled for service, loosen the Allen bolts (A, Figure 212) securing the caliper assembly halves together. The caliper carrier makes a good holding fixture.

14. Push the axle back into position in both sides of the swing arm.
15. Remove the caliper mounting bolts and lockwashers (B, Figure 212) securing the caliper assembly to the caliper carrier and remove the caliper assembly.

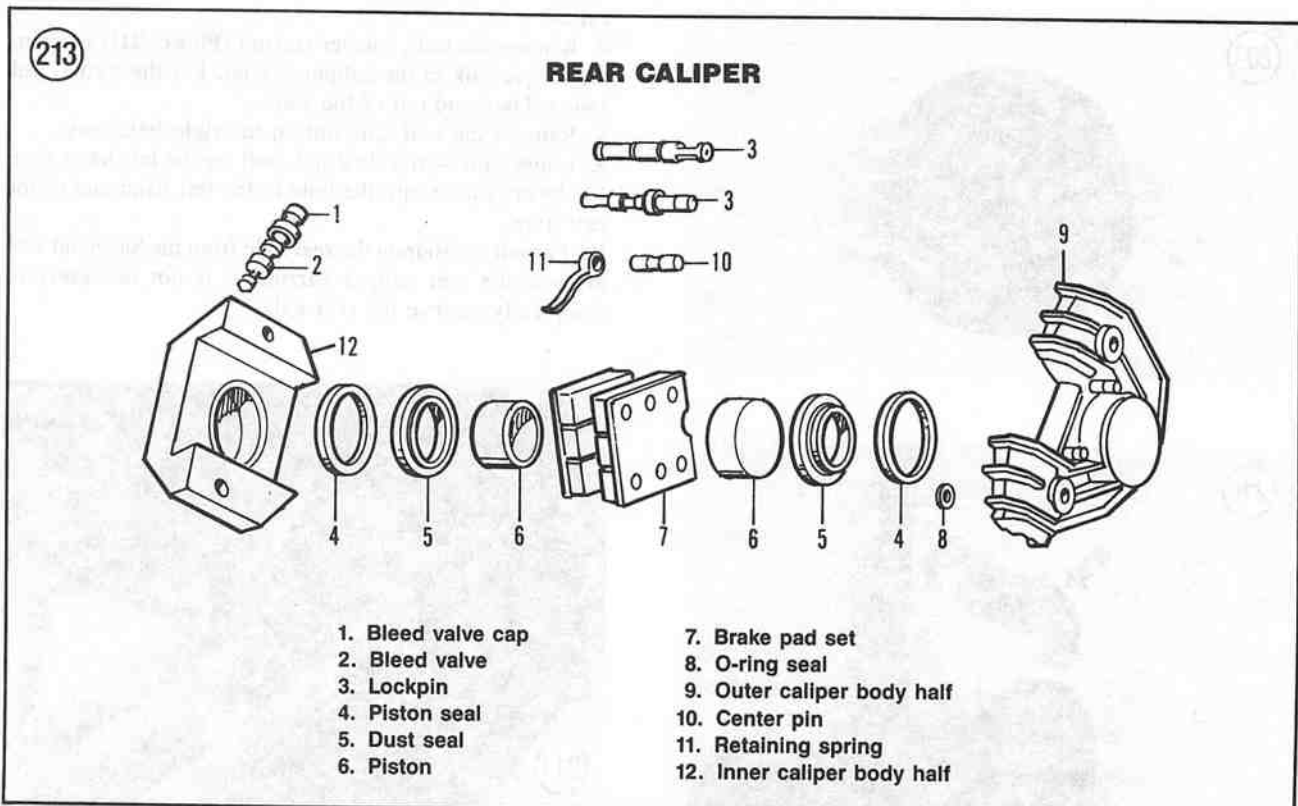
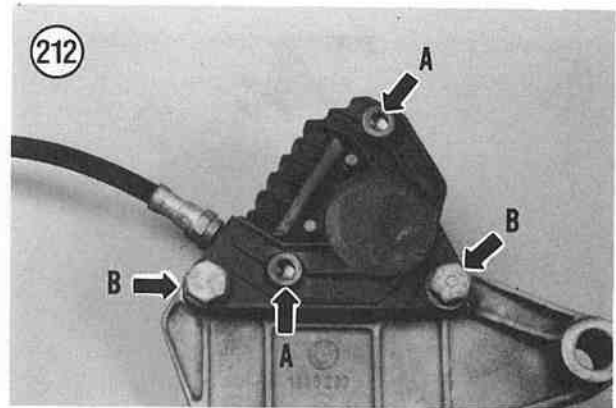
**Installation**

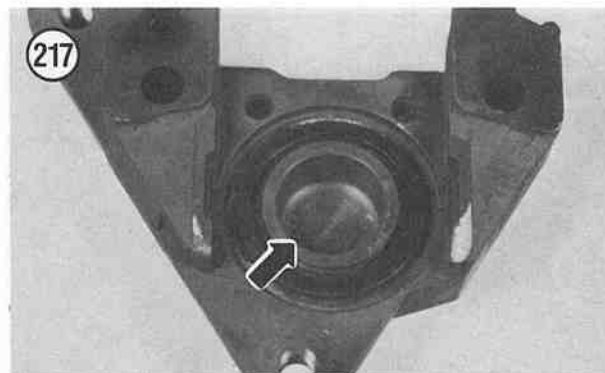
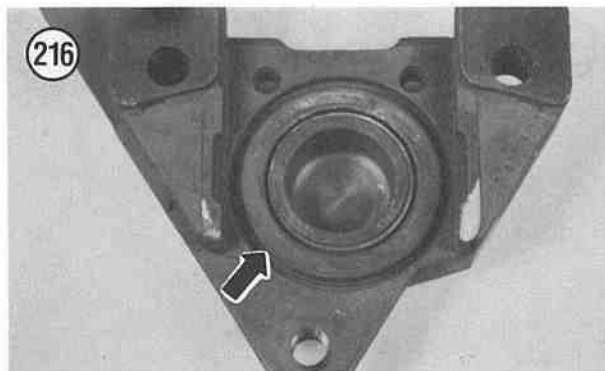
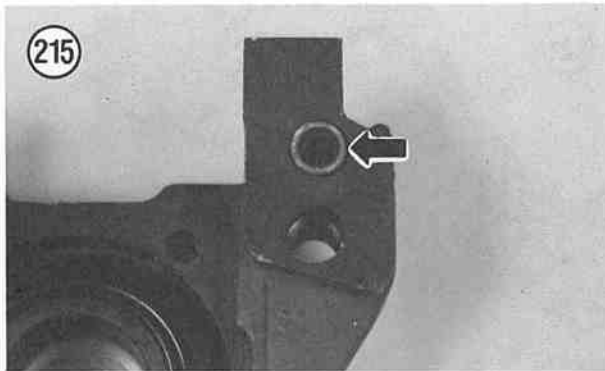
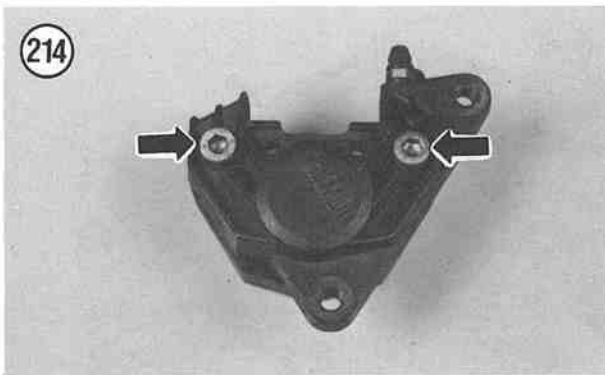
1. Install the caliper assembly, lockwashers and mounting bolts onto the caliper carrier. Tighten the bolts securely.

**NOTE**

If the caliper assembly was disassembled for service, securely tighten the Allen bolts (A, Figure 212) securing the caliper assembly halves together.

2. Partially withdraw the rear axle from the left-hand side to make room for the rear caliper carrier. It is not necessary to completely remove the rear axle.
3. Move the caliper and caliper carrier assembly into position and onto the rear disc. Be careful not to damage the leading edges of the brake pads during caliper installation.
4. Align the rear axle hole in the caliper carrier with the hole in the wheel hub.
5. Push the rear axle through the caliper carrier and the swing arm. Push it in until it bottoms out.
6. Install the rear axle nut.





7. Insert a drift into the hole in the left-hand end of the rear axle.

8. Move the rear caliper torque link into position and install the bolt, washer and nut securing the torque link to the caliper carrier. Tighten the bolt and nut securely.

9. Using a drift to keep the rear axle from rotating, tighten the rear axle nut to the torque specification listed in **Table 1**.

10. Tighten the rear axle pinch bolt to the torque specification listed in **Table 1**.

11. Insert the rear brake hose into the clip on the left-hand side of the swing arm.

12. Remove the tape and shop cloths from the top surface of the left-hand muffler.

13. On models so equipped, install the left-hand saddlebag as described under *Saddlebag Removal/Installation* in Chapter Twelve.

14. Refill the rear brake system and bleed the brake as described in this chapter.

#### WARNING

*Do not ride the motorcycle until you are sure that the brake is operating properly.*

#### Rebuilding

Refer to **Figure 213** for this procedure.

BMW provides only some specifications for the rear caliper components. Replace any parts that appear to be damaged or worn.

1. Remove the caliper assembly as described in this chapter.
2. Remove the brake pads as described in this chapter.
3. Remove the Allen bolts (**Figure 214**) securing the caliper assembly halves together.
4. Separate the caliper halves.
5. Remove the small O-ring seal (**Figure 215**) from the inboard caliper half. Discard the O-ring seal as it must be replaced.

#### CAUTION

*In the following step, do not use a sharp tool to remove the dust seals from the caliper body. Do not damage the cylinder surfaces.*

6. Remove the dust seal (**Figure 216**) from each caliper body half. Discard the dust seals. They cannot be reused after removal as they will no longer seal effectively.

7. Withdraw the piston (**Figure 217**) from each caliper body half. If you cannot remove the piston easily, perform the following:

- a. Either wrap the caliper half and piston with a heavy cloth or place a shop cloth or piece of soft wood over the end of the piston.
- b. Perform this step over and close down to a workbench top. Hold the caliper body with the piston facing away from you.



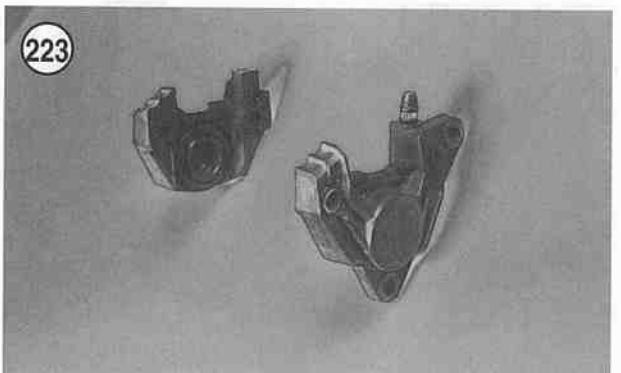
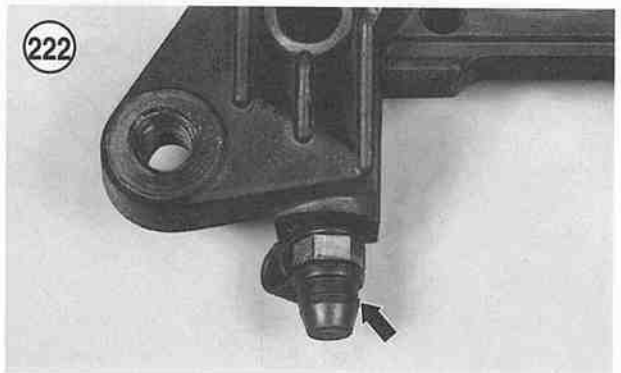
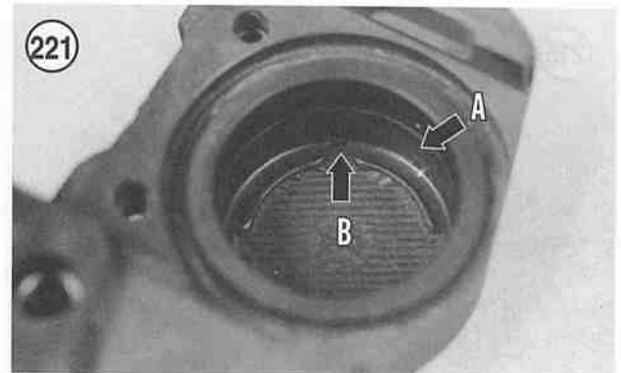
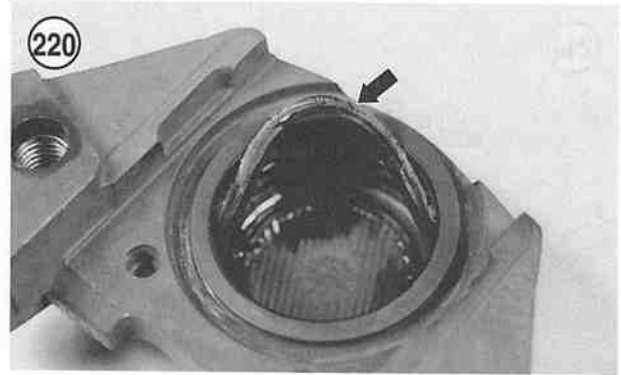
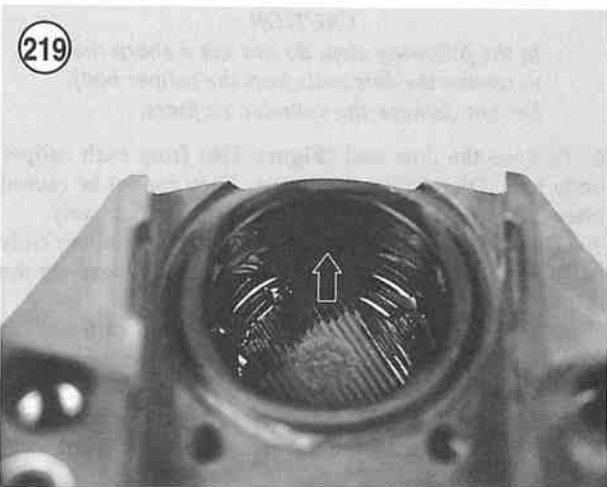
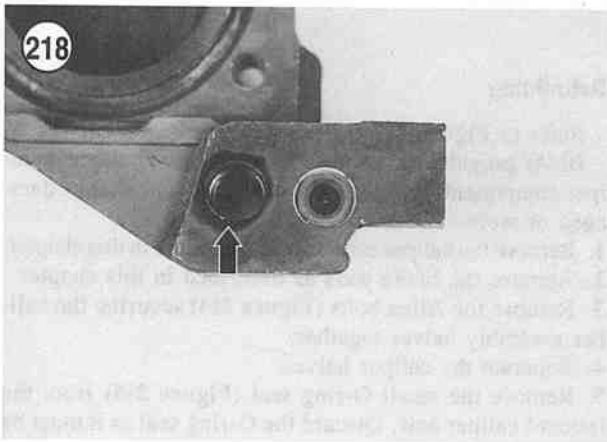
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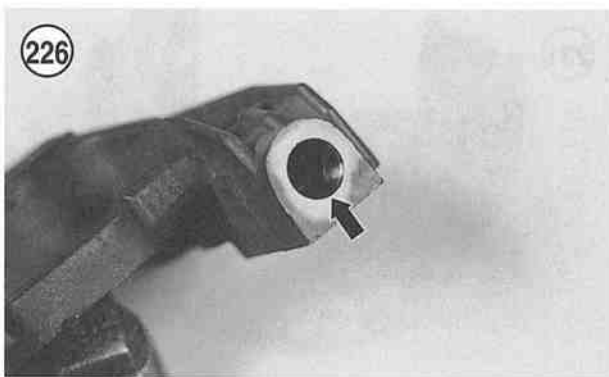
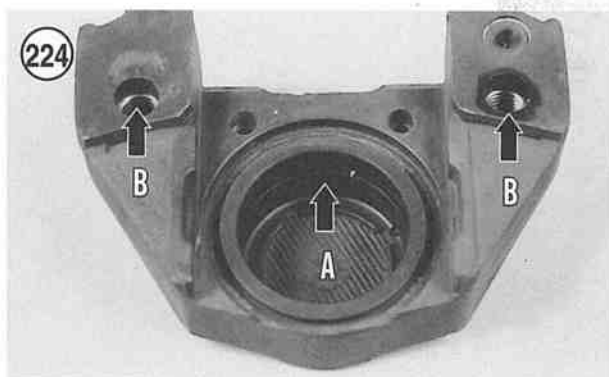
In the next step, the piston may shoot out of the caliper body like a bullet. Keep your fingers out of the way. Wear shop gloves and apply air pressure gradually. Do not use high pressure air or place the air hose nozzle directly against the hydraulic fluid passageway in the caliper body. Hold the air nozzle away from the inlet, allowing some of the air to escape during the procedure.

- c. Apply the air pressure in short spurts to the hydraulic fluid passageway (**Figure 218**) and force the piston out of the caliper body. Cover the other fluid passageways to prevent the air from escaping. Use a service station air hose if you don't have an air compressor.

**CAUTION**

In the following step, do not use a sharp tool to remove the piston seals from the caliper cylinders. Do not damage the cylinder surfaces.





8. Use a piece of plastic or wood and carefully push the piston seal (**Figure 219**) in toward the caliper cylinder and out of its groove. Remove the piston seal (**Figure 220**) from each caliper body half. Discard the piston seals. They cannot be reused after removal as they will no longer seal effectively.

9. Inspect the seal groove in each caliper body half (**A**, **Figure 221**) for damage. If damaged or corroded, replace the caliper assembly.

**NOTE**

*The caliper body cannot be replaced separately. If it is damaged in any way, the entire caliper assembly must be replaced.*

10. Unscrew and remove the bleed screw and cap (**Figure 222**).

11. Inspect the caliper body halves (**Figure 223**) for damage. Replace the caliper body if necessary.

12. Inspect the hydraulic fluid passageway (**B**, **Figure 221**) in the base of each cylinder bore. Make sure it is clean and open. Apply compressed air to the opening and make sure it is clear. Clean out if necessary with fresh brake fluid.

13. Inspect the cylinder walls (**A**, **Figure 224**) and the pistons (**Figure 225**) for scratches, scoring or other damage. If either is damaged, rusty or corroded, replace the caliper assembly. The pistons cannot be replaced separately.

14. Inspect the caliper mounting bolt holes. If the threads are slightly damaged, clean them up with a proper size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the caliper assembly.

15. Inspect the caliper halves' assembly bolt holes (**B**, **Figure 224**). If the threads are slightly damaged, clean them up with a proper size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the caliper assembly.

16. Inspect the brake line hole threads (**Figure 226**). If the threads are slightly damaged, clean them up with a proper size thread tap. If the threads are worn or damaged beyond a "thread clean up," replace the caliper assembly.

17. Make sure the hole in the bleed screw is clean and open. Apply compressed air to the opening and make sure it is clear. Clean out if necessary with fresh brake fluid.

18. If serviceable, clean the caliper body halves with rubbing alcohol and rinse with clean brake fluid.

**NOTE**

*Never reuse a dust seal or piston seal that has been removed. Very minor damage or age deterioration can make the seals useless.*

19. Coat the new dust seals (**Figure 227**) and piston seals (**Figure 228**) with fresh DOT 4 brake fluid.

20. Carefully install the new piston seal (**Figure 220**) in the groove in each caliper cylinder. Make sure the seal is properly seated in the groove (**Figure 219**).

21. Coat the pistons and the caliper cylinders with fresh DOT 4 brake fluid.
22. Position the pistons with the open end facing out (**Figure 229**) toward the brake pads and install the piston into each caliper cylinder (**Figure 230**). Push the pistons in until they bottom out (**Figure 231**).
23. Carefully install the new dust seal (**Figure 232**) in the groove in each caliper cylinder. Make sure the seal is properly seated in the caliper half.
24. Install the bleed screw and cap (**Figure 222**).
25. Install a new O-ring seal (**Figure 215**) into the recess in the inboard caliper half.
26. Lay the inboard caliper half down and install the outboard half on top of it. This is to prevent the small O-ring seal from falling out during assembly.

#### NOTE

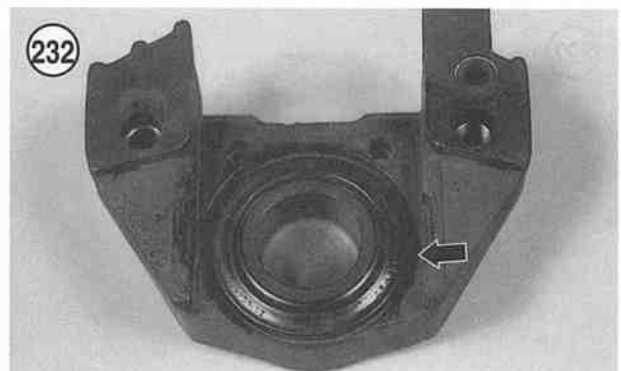
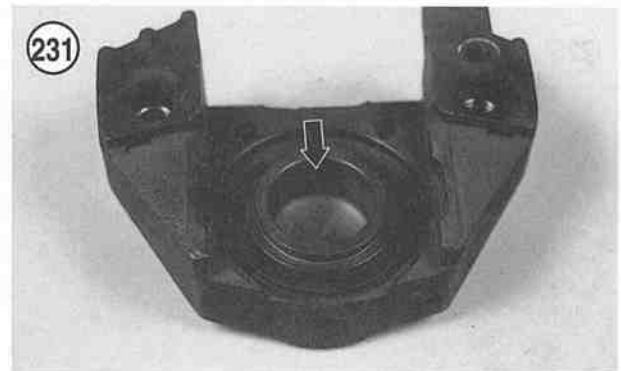
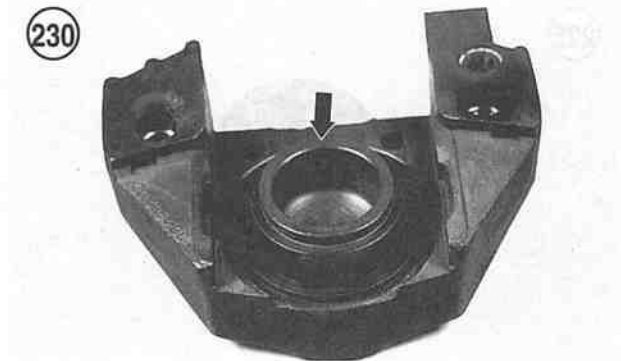
*There are 2 different length Allen bolts of the same diameter. The longer bolts (A, **Figure 233**) are used to assemble the 2 caliper halves together and the shorter ones (B, **Figure 233**) are used as mounting bolts to hold the caliper assembly onto the final drive unit.*

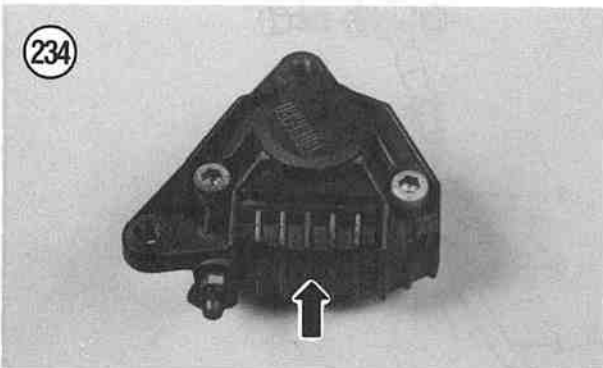
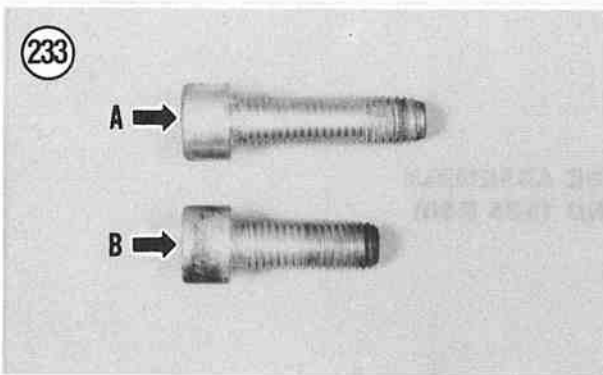
27. Install the Allen bolts (**Figure 214**) securing the caliper assembly halves together.
28. Install the brake pads as described in this chapter.
29. Install the brake caliper cover (**Figure 234**).
30. Install the brake caliper assembly as described in this chapter.

### BRAKE HOSE AND LINE REPLACEMENT

There is no factory-recommended replacement interval, but it is a good idea to replace all flexible brake hoses every four years or when they show signs of cracking or damage.

The metal brake lines do not require routine replacement unless they are damaged or the end fittings are leaking. While replacing the flexible brake hoses, inspect the metal brake lines for damage. If they have been hit, the lines may be restricted, thus decreasing braking effectiveness.





This procedure is covered in a basic format due to the number of model variation.

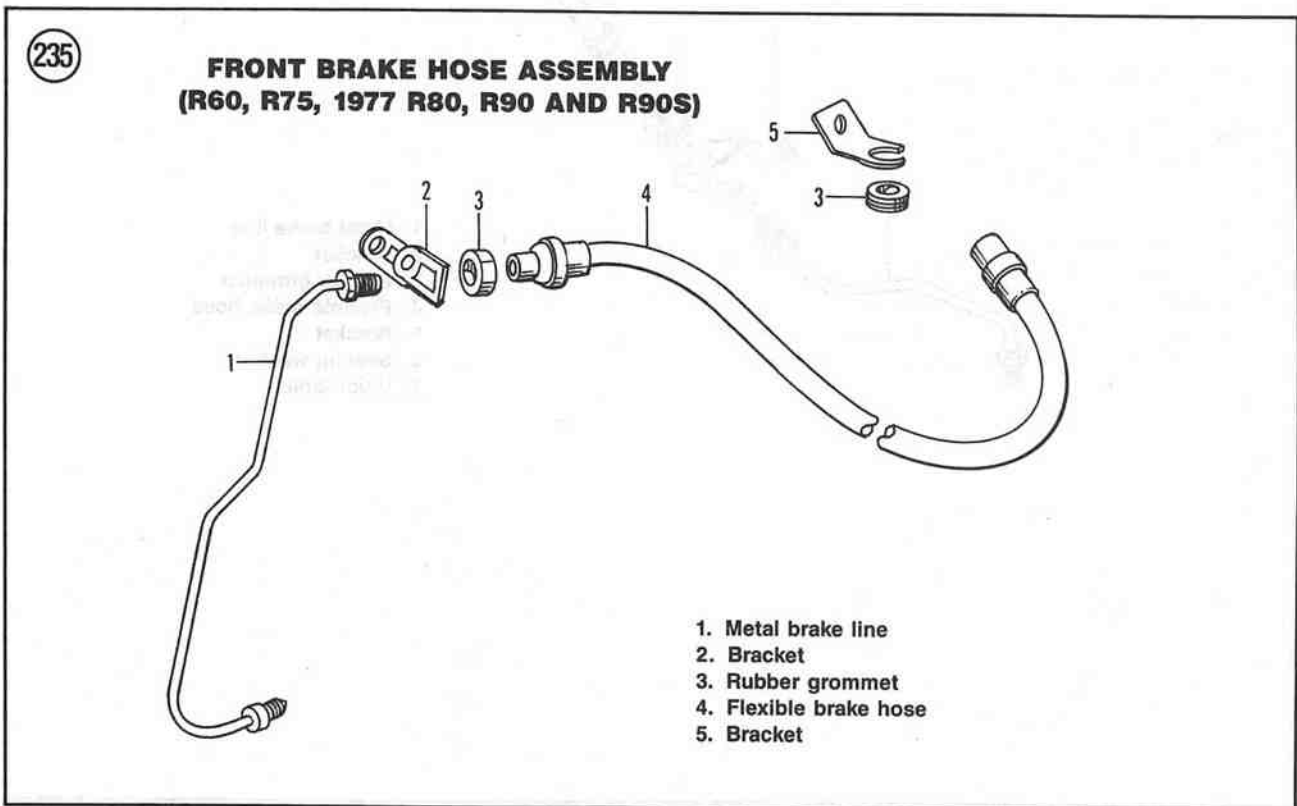
Your bike may not be equipped with the original brake system, therefore the master cylinder and/or caliper assembly will not be original either. Compare your brake system to the illustrations to determine which one applies to your bike.

#### CAUTION

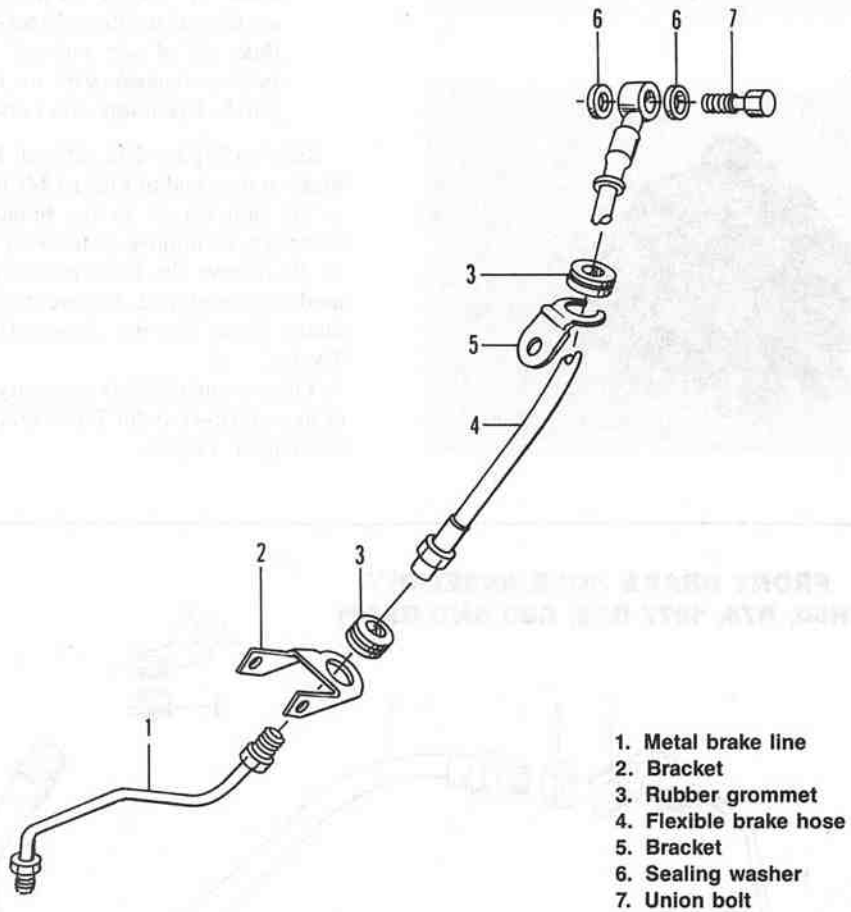
*Cover the area surrounding the brake hose or line that is going to be removed with a heavy cloth or plastic tarp to protect it from accidental spilling of brake fluid. Wash brake fluid off of any painted, plastic or plated surface immediately, as it will destroy the finish. Use soapy water and rinse completely.*

Refer to **Figure 235** through **Figure 240** for the front brake system and to **Figure 241** for the rear brake system.

1. To gain access to the brake lines and hoses, it is necessary to remove some body components.
2. To remove the front master cylinder brake hose, on models so equipped, remove the front fairing as described under *Front Fairing Removal/Installation* in Chapter Twelve.
3. On some models it is necessary to remove the front fender as described under *Front Fender Removal/Installation* in Chapter Twelve.



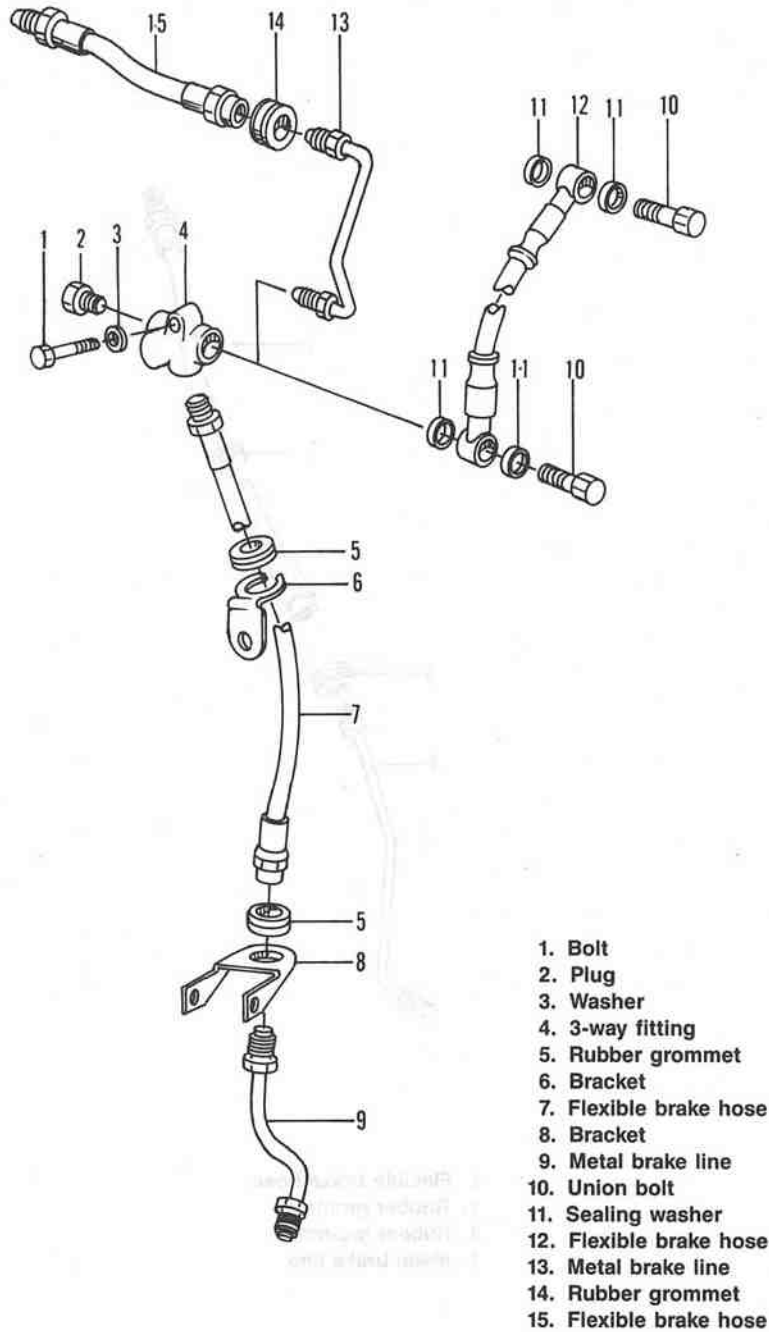
236

**FRONT BRAKE HOSE ASSEMBLY  
(1986-1987 R65 AND 1985 R80)**

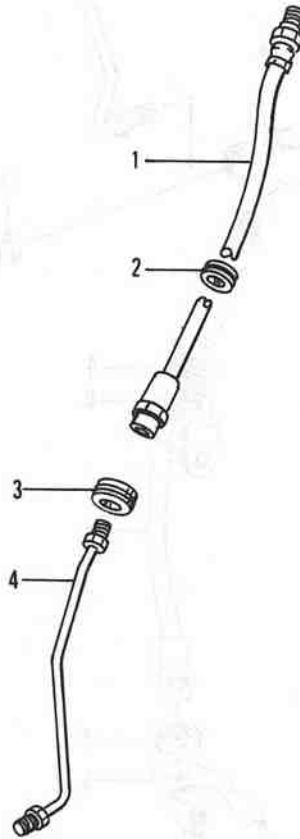


237

### FRONT BRAKE HOSE ASSEMBLY (1978-1985 R65, R65LS)

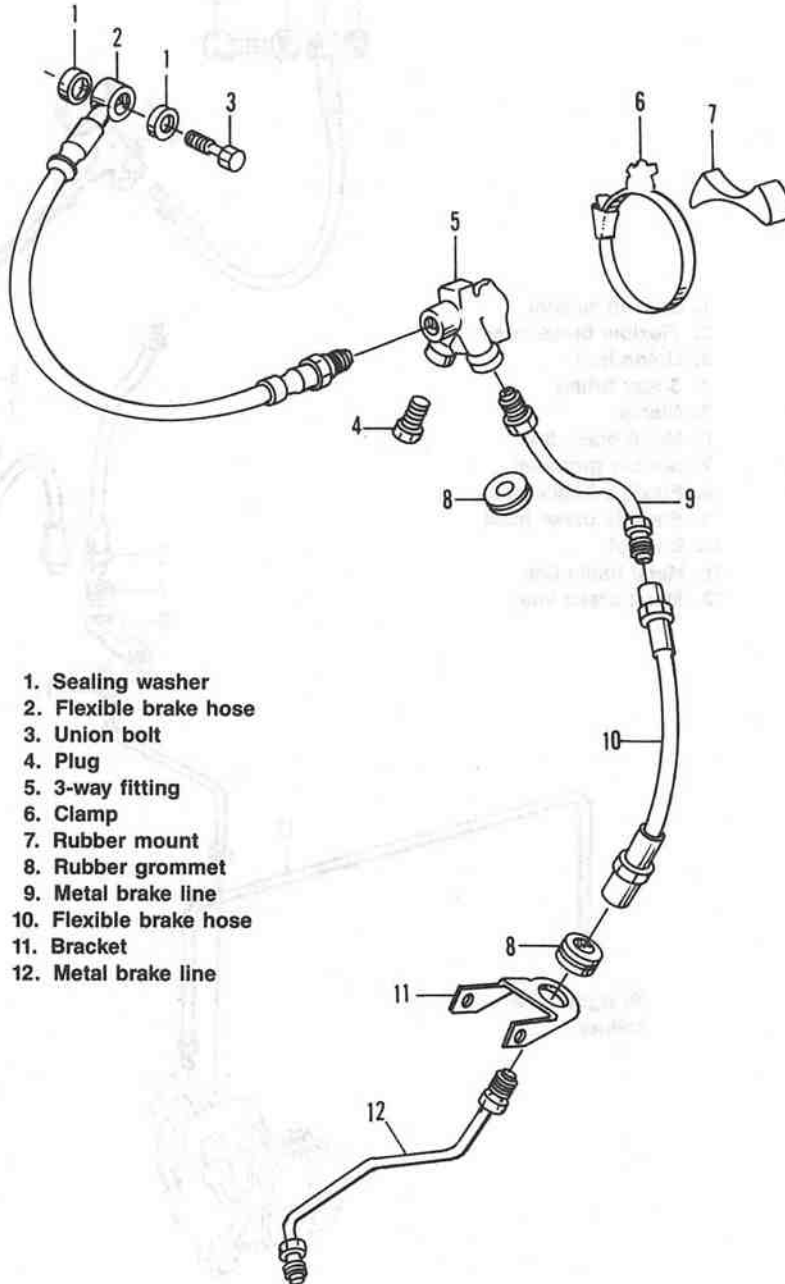


238

**FRONT BRAKE HOSE ASSEMBLY  
(R80G/S, R80ST AND R100GS)**

1. Flexible brake hose
2. Rubber grommet
3. Rubber grommet
4. Metal brake line

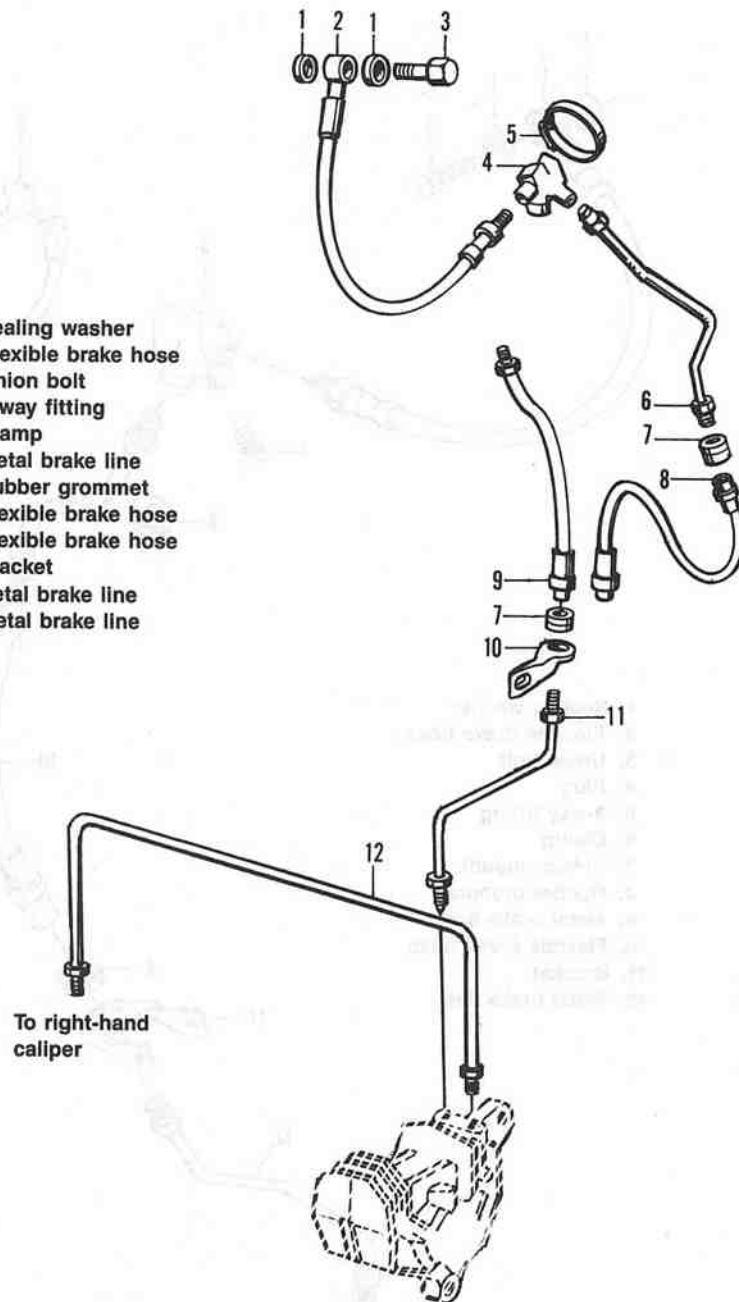
239

**FRONT BRAKE HOSE ASSEMBLY  
(R80RT, R100RS AND R100RT)**

240

### FRONT BRAKE HOSE ASSEMBLY (OPTIONAL DUAL DISC)

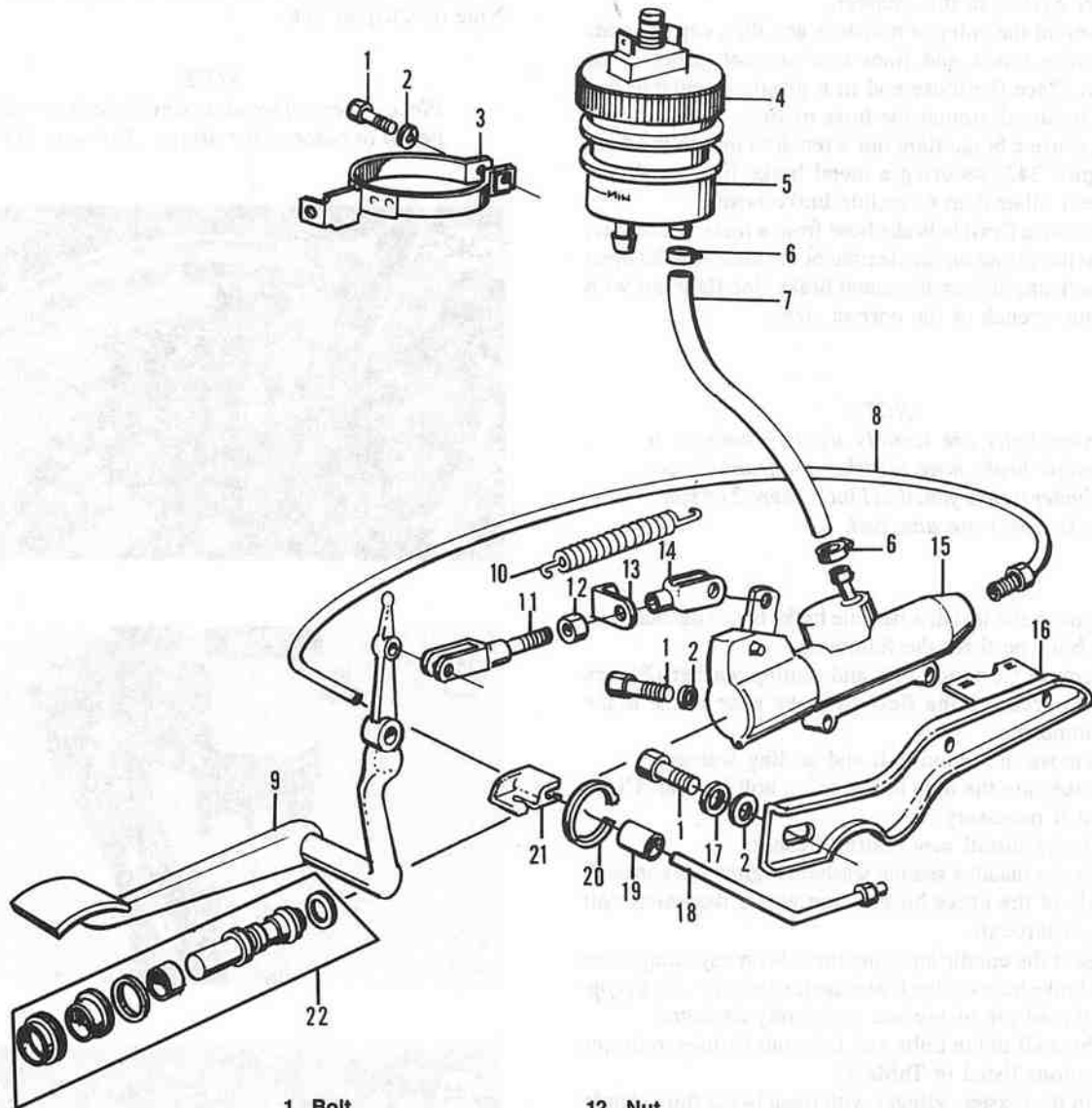
1. Sealing washer
2. Flexible brake hose
3. Union bolt
4. 3-way fitting
5. Clamp
6. Metal brake line
7. Rubber grommet
8. Flexible brake hose
9. Flexible brake hose
10. Bracket
11. Metal brake line
12. Metal brake line



To right-hand  
caliper

241

## REAR BRAKE SYSTEM



- |                        |                      |
|------------------------|----------------------|
| 1. Bolt                | 12. Nut              |
| 2. Washer              | 13. Bracket          |
| 3. Clamp               | 14. Yoke             |
| 4. Top cover           | 15. Body             |
| 5. Reservoir           | 16. Mounting bracket |
| 6. Hose clamp          | 17. Lockwasher       |
| 7. Flexible brake hose | 18. Metal brake line |
| 8. Metal brake line    | 19. Grommet          |
| 9. Brake pedal         | 20. Strap            |
| 10. Return spring      | 21. Brake line clip  |
| 11. Pull rod           | 22. Piston assembly  |



4. To remove the rear master cylinder and/or rear caliper brake hose, on models so equipped, remove the saddlebag as described under *Saddlebag Removal/Installation* in Chapter Twelve.
5. Drain the hydraulic fluid from the front and/or rear brake system as described under *Draining Hydraulic Fluid From the Brake System* in this chapter.
6. To prevent the entry of moisture and dirt, cap the ends of the brake hoses and lines that are not going to be replaced. Place the loose end in a plastic resealable bag and zip it closed around the hose or line.
7. Always use a brake flare nut wrench to loosen the flare nut (**Figure 242**) securing a metal brake line to a brake component other than a flexible brake hose.
8. To remove a flexible brake hose from a metal brake line, hold onto the fitting on the flexible brake hose with an open end wrench and loosen the metal brake line flare nut with a flare nut wrench of the correct size.

**NOTE**

*Union bolts are usually used to connect a flexible brake hose to either the front master cylinder or to a junction block where 2 or more brake hoses are attached.*

9. To remove and install a flexible brake hose attached with a union bolt, perform the following:
  - a. Remove the union bolt and sealing washer (**Figure 243**) securing the flexible brake hose to the brake component.
  - b. Remove the union bolt and sealing washers.
  - c. Make sure the hole in the union bolt is clear. Clean out if necessary.
  - d. Always install *new* sealing washers.
  - e. Always install a sealing washer (**Figure 244**) on each side of the brake hose fitting where the union bolt goes through.
10. Inspect the condition of the threads on any component where a brake hose or line is attached. Clean up with a proper size thread die or replace if severely damaged.
11. Tighten all union bolts and flare nut fittings to torque specifications listed in **Table 2**.
12. Refill the master cylinder with fresh brake fluid clearly marked DOT 4. Bleed the front brake system as described in this chapter.

**WARNING**

*Do not ride the motorcycle until you are sure that the brakes are operating properly.*

13. On models so equipped, install all body components removed as described in Chapter Twelve.

## BRAKE DISC (FRONT AND REAR)

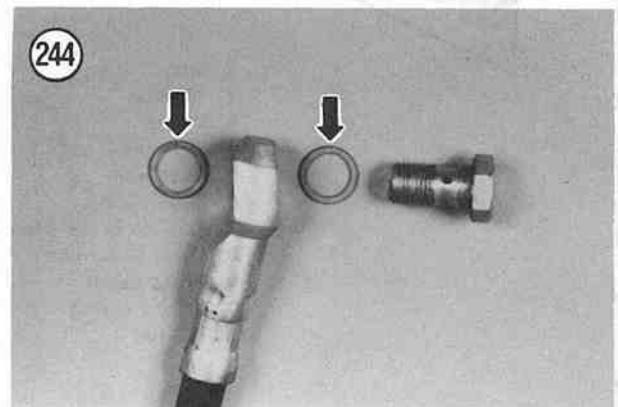
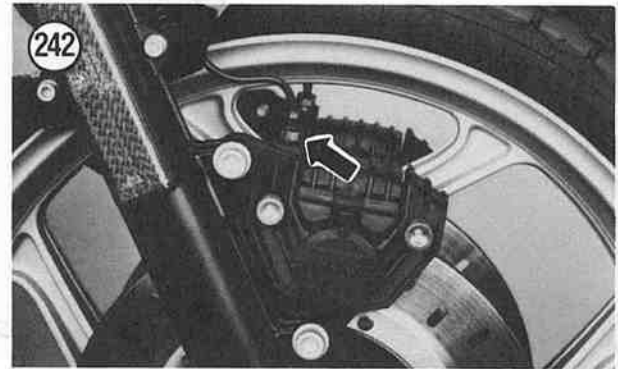
### Removal/Inspection/Installation

Refer to **Figure 245** for this procedure.

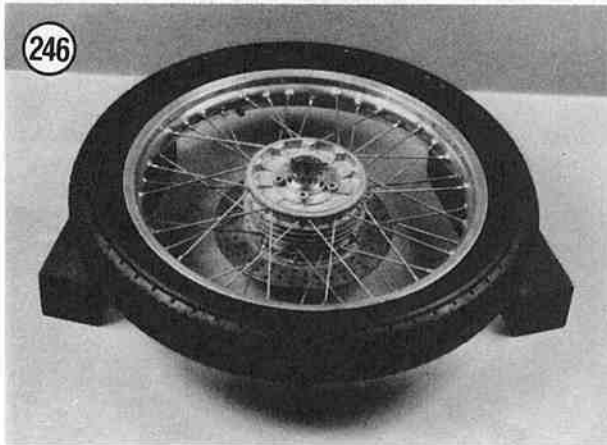
1. Remove the front or rear wheel as described in Chapter Nine or Chapter Ten.

**NOTE**

*Place a piece of wood or vinyl tube in the caliper(s) in place of the disc(s). This way, if the*

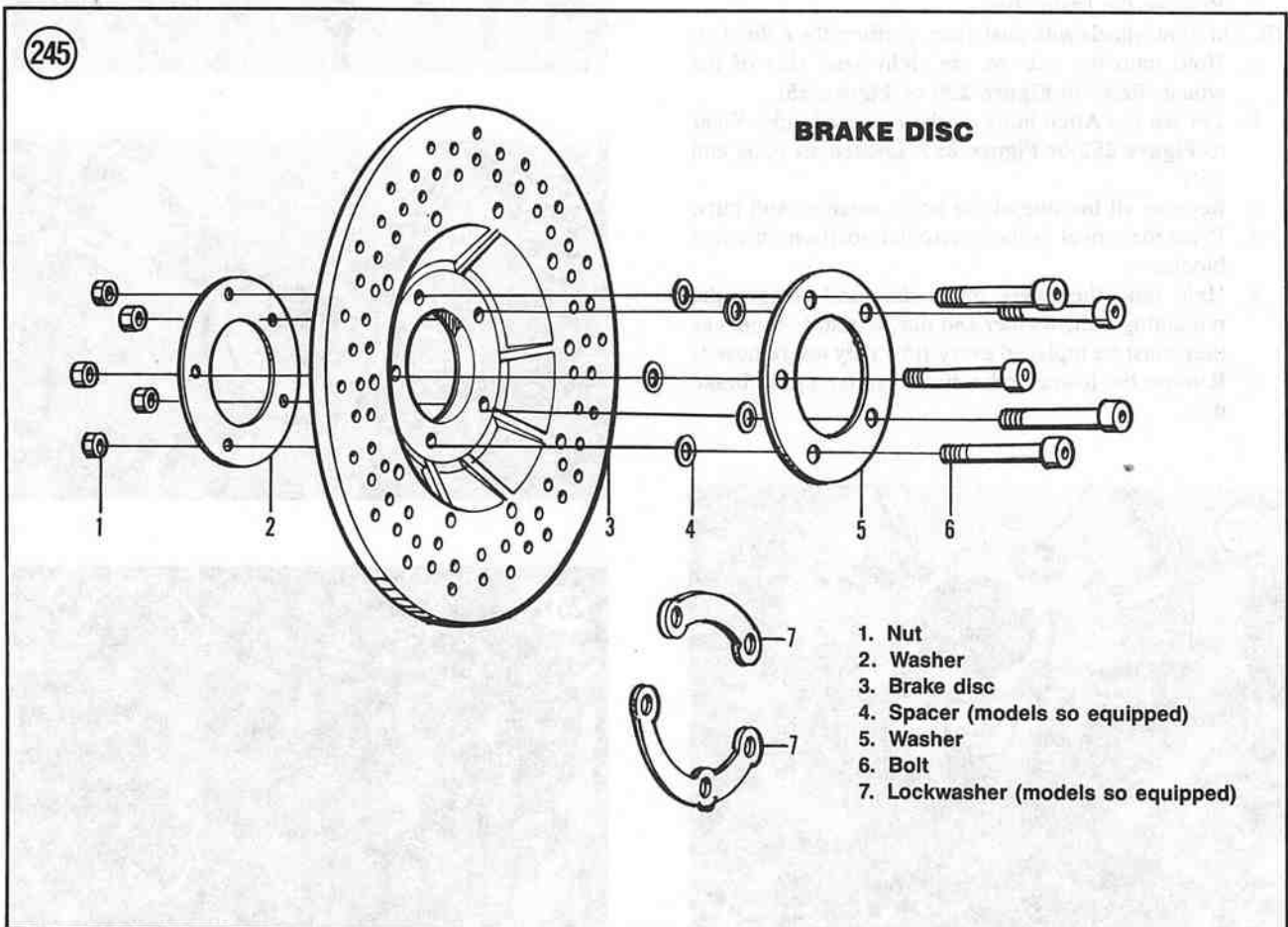


brake lever is inadvertently squeezed, or the brake pedal depressed, the pistons will not be forced out of the cylinders. If this does happen, the caliper may have to be disassembled to reset the pistons and the system will have to be bled.



**CAUTION**  
Care must be taken when removing, handling and installing a wheel with disc brake rotor(s). The disc rotor(s) is relatively thin in order to dissipate heat and to minimize unsprung weight. The rotor(s) is designed to withstand tremendous rotational loads but can be damaged when subjected to side impact loads. If the rotor(s) is knocked out of true by a side impact, a pulsation will be felt in the front brake lever or rear brake pedal when braking. The rotor is too thin to be trued and must be replaced with a new one. Protect the rotor(s) when transporting a wheel to a dealer or tire specialist for tire service. Do **not** place a wheel in a car trunk or pickup bed without protecting the rotor(s) from side impact damage.

**CAUTION**  
Do not set the wheel down on the disc rotor surface, as it may get scratched or warped. Set the tire sidewall on 2 blocks of wood (Figure 246).



**NOTE**

On front wheels equipped with dual discs, the bolts go through both brake discs and through the wheel hub.

**NOTE**

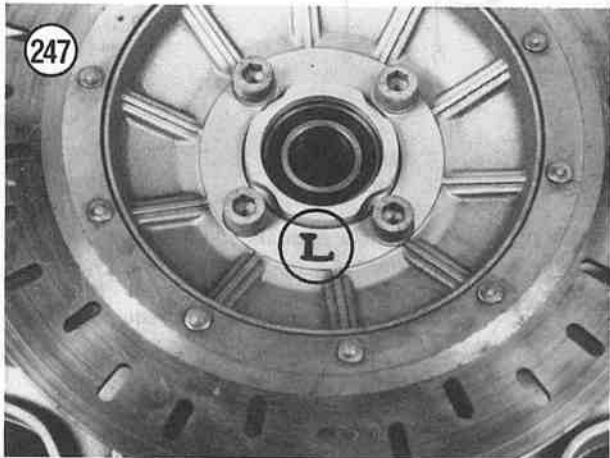
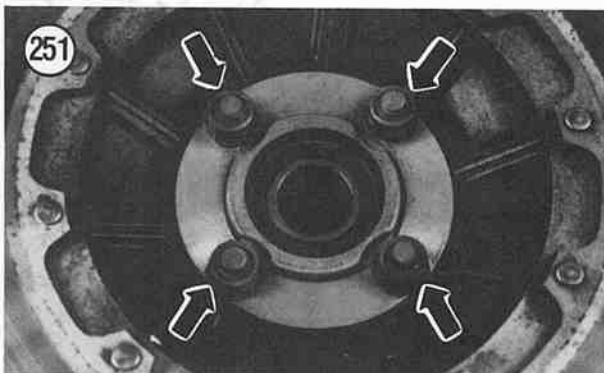
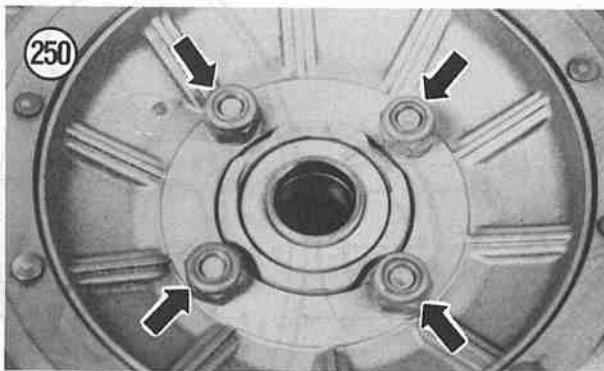
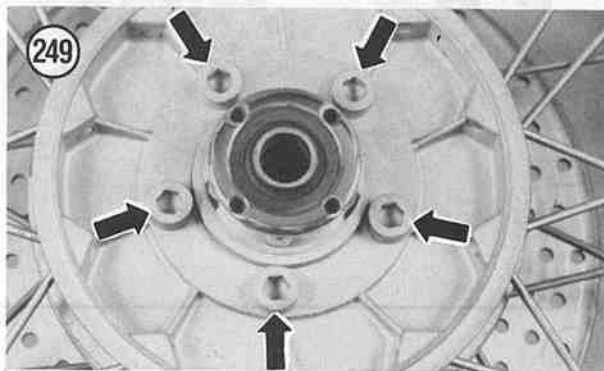
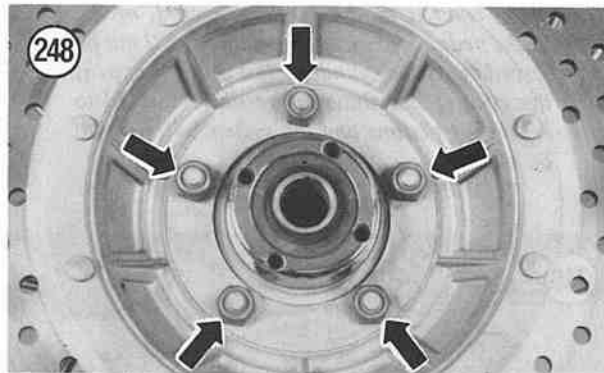
On front wheels equipped with dual discs, if working on a well run-in bike (high mileage), mark the brake discs with 'R' and 'L' (Figure 247) (on an attached piece of masking tape) so they will be reinstalled on the same side of the wheel from where they were removed. Older parts tend to form a wear pattern and should be reinstalled in the same location. The BMW discs are not marked to indicate right-hand or left-hand sides.

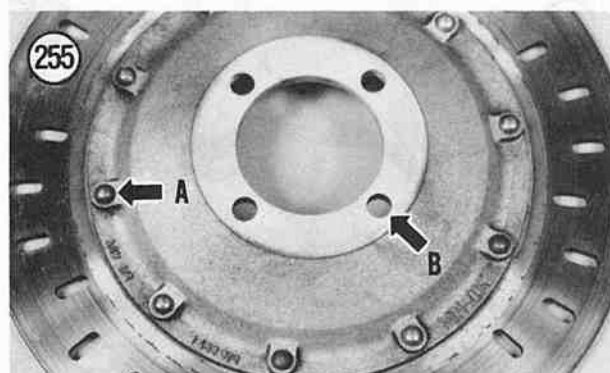
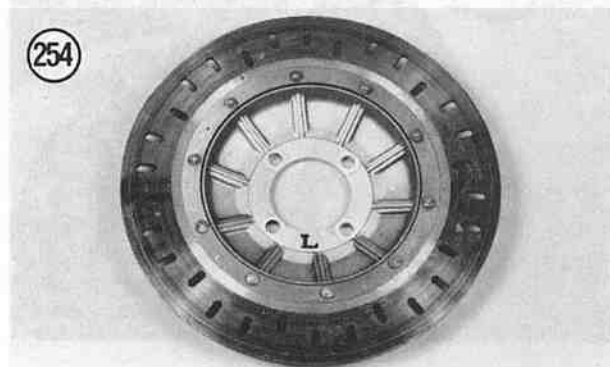
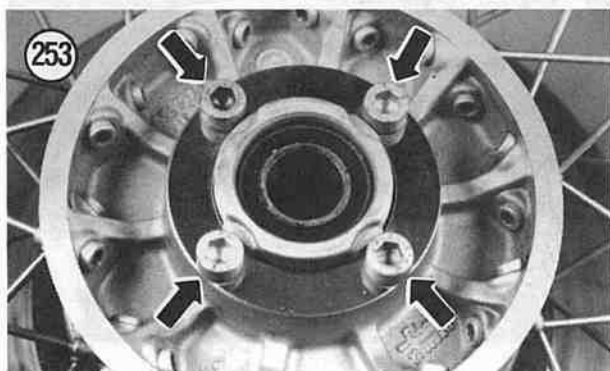
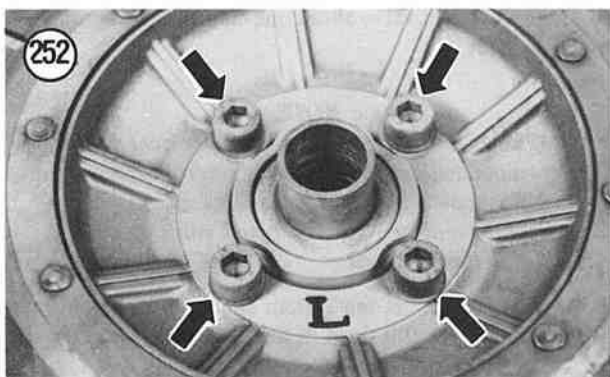
2A. On front wheels with single discs, perform the following:

- a. Hold onto the nuts (Figure 248) on the right-hand side of the wheel and loosen the Allen bolts (Figure 249) on the left-hand side.
- b. Remove the Allen bolts, large washers (models so equipped) and nuts.
- c. Remove the brake disc.

2B. On front wheels with dual discs, perform the following:

- a. Hold onto the nuts on the right-hand side of the wheel. Refer to Figure 250 or Figure 251.
- b. Loosen the Allen bolts on the left-hand side. Refer to Figure 252 or Figure 253. Loosen all bolts and nuts.
- c. Remove all but one of the bolts, washers and nuts.
- d. Place the wheel in the horizontal position on wood blocks.
- e. Hold onto the lower brake disc and remove the remaining bolt, washer and nut. Discard all nuts as they must be replaced every time they are removed.
- f. Remove the lower brake disc, then the upper brake disc.





3. On the rear wheel, remove the Allen bolts and washers securing the disc to the wheel.

4. Inspect the brake discs (Figure 254) for wear or damage. Make sure the attachment rivets (A, Figure 255) and the mounting holes (B, Figure 255) are not damaged. Replace the brake disc(s) if necessary.

5. Replace the self-locking nuts every time they are removed. During removal, the locking ring (Figure 256) may be damaged and its retention qualities lessened.

6. Install by reversing these removal steps. Note the following during installation.

7. On models so equipped, be sure to place a washer under the bolt head and between the brake disc and the nut.

8. Tighten the bolts and nuts (front wheel) to the torque specification listed in Table 2.

### Inspection on Bike

It is not necessary to remove the disc from the wheel to inspect it. Small marks on the disc are not important, but deep radial scratches, deep enough to snag a fingernail, reduce braking effectiveness and increase brake pad wear. If these grooves are found, the disc should be replaced.

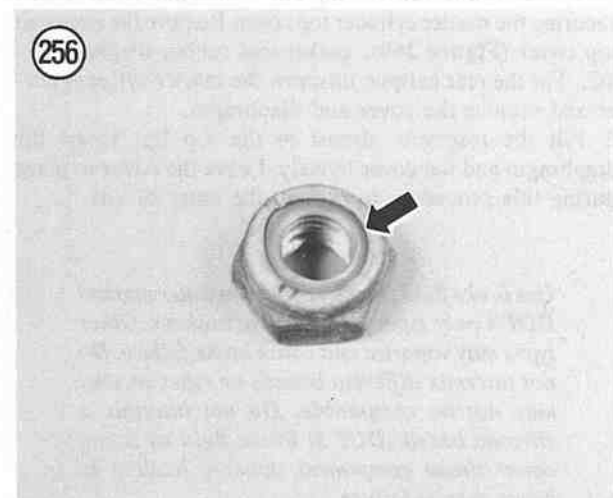
1. Measure the thickness of the disc at several locations around the disc with a micrometer or vernier caliper. The disc must be replaced if the thickness, in any area, is less than that specified in Table 1.

2. Make sure the disc mounting bolts and nuts are tight prior to running this check.

3. Check the disc runout with a dial indicator mounted either to the front fork or to the swing arm.

4. Slowly rotate the wheel and watch the dial indicator. On all models, if the runout exceeds that listed in Table 1, the disc(s) must be replaced.

5. Clean the disc of any rust or corrosion and wipe clean with lacquer thinner. Never use an oil-based solvent that may leave an oil residue on the disc.





### BLEEDING THE SYSTEM

This procedure is not necessary unless the brakes feel spongy, there has been a leak in the system, a component has been replaced or the brake fluid has been replaced.

When bleeding the front brakes equipped with dual discs, bleed one caliper at a time. It doesn't make any difference which one is done first.

#### Brake Bleeder Process

This procedure uses a brake bleeder that is available from motorcycle or automotive supply stores or from mail order outlets.

1. Remove the dust cap (Figure 257) from the bleed valve on the caliper assembly.
2. Connect the brake bleeder (Figure 258) to the bleed valve on the caliper assembly.

#### CAUTION

*Cover the front and rear wheels with a heavy cloth or plastic tarp to protect it from the accidental spilling of brake fluid. Wash any brake fluid off of any plastic, painted or plated surface immediately; as it will destroy the finish. Use soapy water and rinse completely.*

3. Clean the top of the master cylinder of all dirt and foreign matter.
- 4A. For the front caliper with a frame mounted master cylinder, perform the following:
  - a. Remove the fuel tank as described under *Fuel Tank Removal/Installation* in Chapter Seven.
  - b. Remove the electrical connector (A, Figure 259) from the master cylinder top cover.
  - c. Unscrew and remove the top cover (B, Figure 259).
- 4B. For the front caliper with a handlebar mounted master cylinder, unscrew the top cover or remove the screws securing the master cylinder top cover. Remove the reservoir top cover (Figure 260), gasket and rubber diaphragm.
- 4C. For the rear caliper, unscrew the master cylinder cover and remove the cover and diaphragm.
5. Fill the reservoir almost to the top lip; insert the diaphragm and the cover loosely. Leave the cover in place during this procedure to prevent the entry of dirt.

#### WARNING

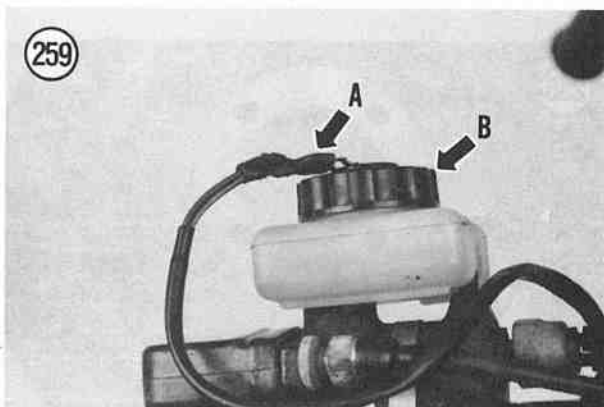
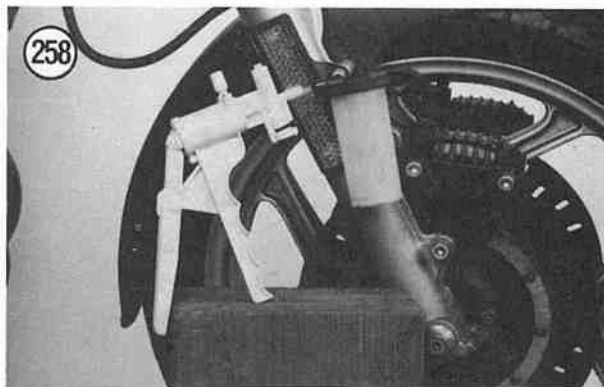
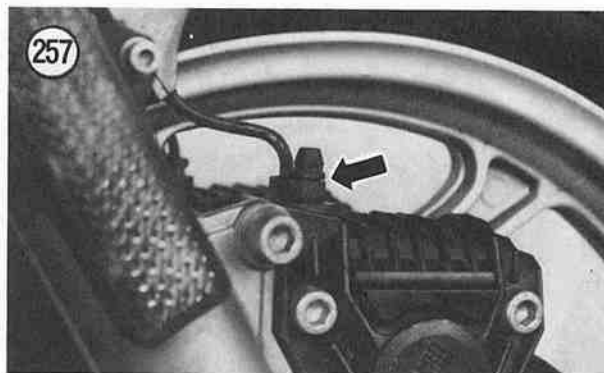
*Use brake fluid from a sealed container marked DOT 4 only (specified for disc brakes). Other types may vaporize and cause brake failure. Do not intermix different brands or types as they may not be compatible. Do not intermix a silicone based (DOT 5) brake fluid as it can cause brake component damage leading to brake system failure.*

6. Open the bleed valve about one-half turn and pump the brake bleeder.

#### NOTE

*If air is entering the brake bleeder hose from around the bleed valve, apply several layers of Teflon tape to the bleed valve. This should make a good seal between the bleed valve and the brake bleeder hose.*

7. As the fluid enters the system and exits into the brake bleeder, the level will drop in the reservoir. Maintain the





level to just about the top of the reservoir to prevent air from being drawn into the system.

8. Continue to pump the lever on the brake bleeder until the fluid emerging from the hose is completely free of bubbles.

9. Tap on the brake hoses to help free any bubbles stuck to the walls of the hoses.

#### NOTE

*Do not allow the reservoir to empty during the bleeding operation or more air will enter the system. If this occurs, the entire procedure must be repeated.*

10. When the brake fluid is free of bubbles, tighten the bleed valve, remove the brake bleeder tube and install the bleed valve dust cap.

11. If necessary, add fluid to correct the level in the reservoir. It should be to the upper level line.

12. On dual disc front brakes, repeat sub-steps 1-11 for the other front caliper assembly.

13A. For the front master cylinder, install the rubber diaphragm, gasket and top cover.

13B. For the rear master cylinder, install the diaphragm and screw on the master cylinder cover securely.

14. Test the feel of the brake lever or pedal. It should be firm and should offer the same resistance each time it's

operated. If it feels spongy, it is likely that there is still air in the system and it must be bled again. When all air has been bled from the system and the fluid level is correct in the reservoir, double-check for leaks and tighten all fittings and connections.

#### WARNING

*Before riding the bike, make certain that the brake is operating correctly by operating the lever several times.*

15. Test ride the bike slowly at first to make sure that the brakes are operating properly.

#### Without a Brake Bleeder

1. Remove the dust cap (**Figure 257**) from the bleed valve on the caliper assembly(ies).

2. Connect a piece of clear tubing (A, **Figure 261**) to the bleed valve on the caliper assembly.

#### CAUTION

*Cover the front and rear wheels with a heavy cloth or plastic tarp to protect them from the accidental spilling of brake fluid. Wash any brake fluid off of any plastic, painted or plated surface immediately, as it will destroy the finish. Use soapy water and rinse completely.*

3. Clean the top of the master cylinder of all dirt and foreign matter.

4A. On models equipped with a frame mounted master cylinder, perform the following:

a. Remove the fuel tank as described under *Fuel Tank Removal/Installation* in Chapter Seven.

b. Remove the electrical connector (A, **Figure 259**) from the master cylinder top cover.

c. Unscrew and remove the top cover (B, **Figure 259**).

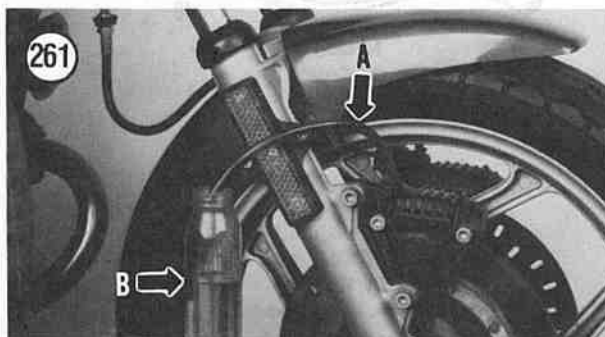
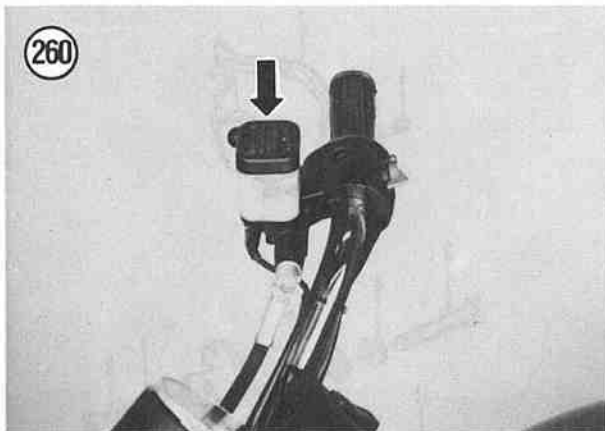
4B. On models equipped with a handlebar mounted master cylinder, unscrew the top cover. Remove the screws securing the master cylinder top cover and remove the reservoir top cover (**Figure 260**), gasket and rubber diaphragm.

4C. For the rear caliper, unscrew the master cylinder cover and remove the cover and diaphragm.

5. Place the other end of the tube into a clean container (B, **Figure 261**). Fill the container with enough fresh brake fluid to keep the end submerged. The tube should be long enough so that a loop can be made higher than the bleed valve to prevent air from being drawn into the caliper during bleeding.

#### CAUTION

*Cover the front fender and front wheel with a heavy cloth or plastic tarp to protect it from the accidental spilling of brake fluid. Wash any*



brake fluid off of any plastic, painted or plated surface immediately, as it will destroy the finish. Use soapy water and rinse completely.

6. Fill the reservoir almost to the cover lip; insert the diaphragm and the cover loosely. Leave the cover in place during this procedure to prevent the entry of dirt.

#### WARNING

Use brake fluid from a sealed container marked DOT 4 only (specified for disc brakes). Other types may vaporize and cause brake failure. Do not intermix different brands or types as they may not be compatible. Do not intermix a silicone based (DOT 5) brake fluid as it can cause brake component damage leading to brake system failure.

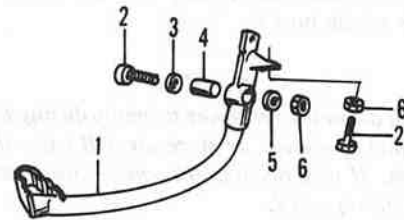
#### NOTE

During this procedure, all the hose junctions in the brake system will be bled of air. It is very important to check the fluid level in the brake master cylinder reservoir often. If the reservoir runs dry, you'll introduce more air into the system, which will require starting over.

7. If the master cylinder was drained, it must be bled first. Remove the union bolt and hose from the master cylinder. Slowly apply the brake lever, or brake pedal, several times while holding your thumb over the opening in the master cylinder and perform the following:
- With the lever or pedal held depressed, slightly release your thumb pressure. Some of the brake fluid and air bubbles will escape.
  - Apply thumb pressure and pump lever or pedal once more.
  - Repeat this procedure until you can feel resistance at the lever or pedal.
8. Refill the master cylinder and quickly reinstall the hose, sealing washers and the union bolt.
9. Tighten the union bolt and pump the lever or pedal again and perform the following:
- Loosen the union bolt 1/4 turn. Some brake fluid and air bubbles will escape.
  - Tighten the union bolt and repeat this procedure until no air bubbles escape.
10. If working on the front brakes, each union bolt or brake line fitting, all the way down to the caliper assembly, must be bled using the same procedure detailed in Step 7.
- Bleed the union bolt and fittings in this order: first, the end of the upper flexible hose at the brake pipe; second, the fitting at the top of the middle flexible brake hose; third, the fitting at the lower metal brake line.
  - Refill the master cylinder.
11. Tighten all brake line fittings and union bolts to the torque specification listed in **Table 2**.

262

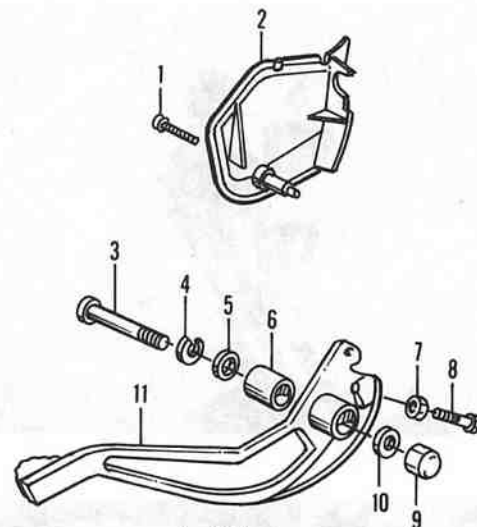
### REAR BRAKE PEDAL (R80G/S AND R80ST)



1. Brake pedal
2. Bolt
3. Washer
4. Bushing
5. Lockwasher
6. Nut

263

### REAR BRAKE PEDAL (R100GS)



1. Bolt
2. Cover
3. Bolt
4. Lockwasher
5. Washer
6. Bushing
7. Locknut
8. Adjust bolt
9. Cap nut
10. Washer
11. Brake pedal

12. Slowly apply the brake lever, or brake pedal, several times as follows:

- a. Pull the lever in or depress the pedal. Hold the lever in the applied position or the pedal in the depressed position.
- b. Open the bleed valve about one-half turn. Allow the lever or pedal to travel to its limit.
- c. When this limit is reached, tighten the bleed valve.

13. As the fluid enters the system, the level will drop in the reservoir. Maintain the level to just about the top of the reservoir to prevent air from being drawn into the system.

14. Continue to pump the lever and fill the reservoir until the fluid emerging from the hose is completely free of bubbles.

#### NOTE

*Do not allow the reservoir to empty during the bleeding operation or more air will enter the system. If this occurs, the entire procedure must be repeated.*

15. Hold the lever in, tighten the bleed valve, remove the bleed tube and install the bleed valve dust cap.

16. If necessary, add fluid to correct the level in the reservoir.

17. On dual disc front brakes, repeat Steps 1-16 for the other front caliper assembly.

18A. For the front master cylinder, install the rubber diaphragm, gasket and top cover.

18B. For the rear master cylinder, install the diaphragm and screw on the master cylinder cover securely.

19. Test the feel of the brake lever. It should be firm and should offer the same resistance each time it's operated. If it feels spongy, it is likely that there is still air in the system and it must be bled again. When all air has been bled from the system and the fluid level is correct in the reservoir, double-check for leaks and tighten all fittings and connections.

#### WARNING

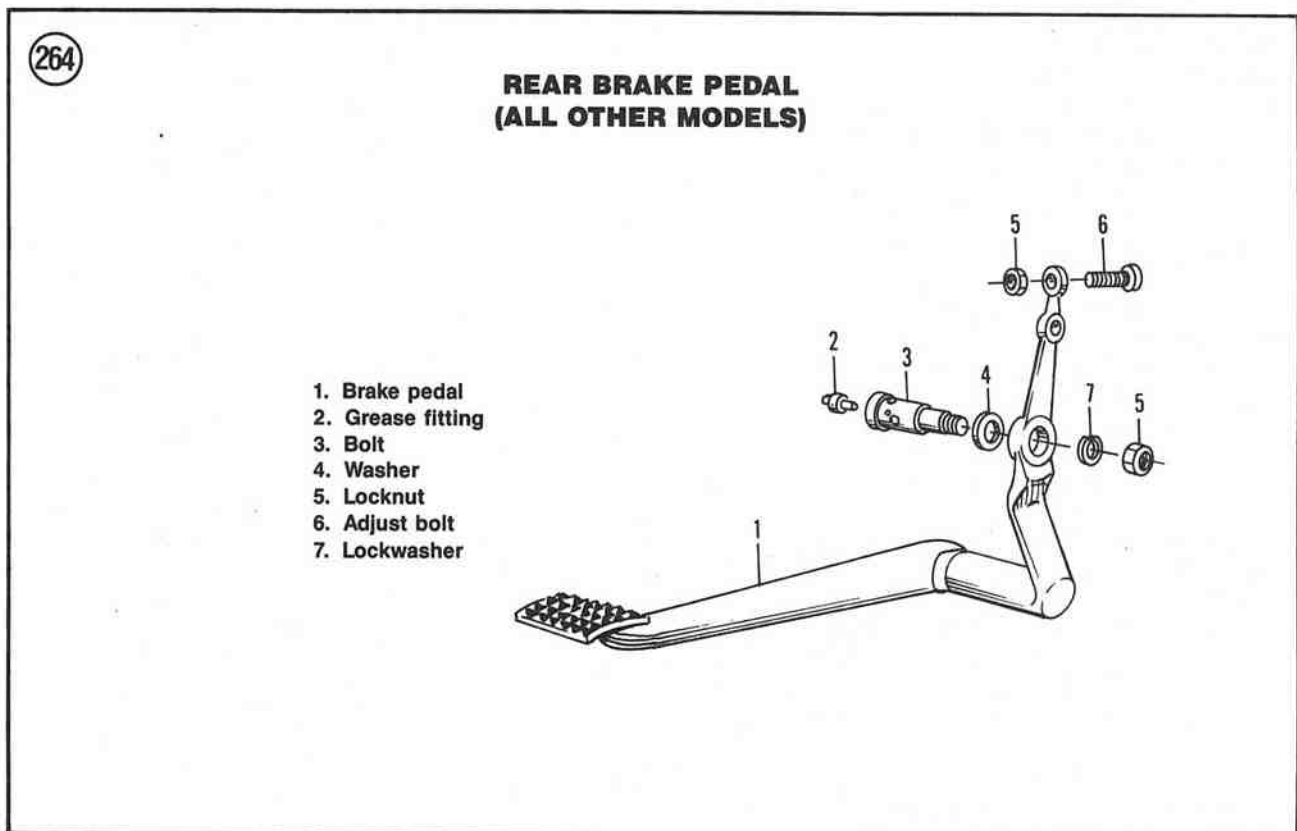
*Before riding the bike, make certain that the brakes are operating correctly by operating the lever or pedal several times.*

20. Test ride the bike slowly at first to make sure that the brakes are operating properly.

### REAR BRAKE PEDAL

#### Removal/Inspection/Installation (All Models)

Refer to **Figure 262** through **Figure 264** for this procedure.



1. Secure the nut with a wrench and loosen the bolt (A, **Figure 265**) securing the brake pedal to the frame.
2. Remove the bolt, nut and washers.
3. On disc brake models, unhook the clip securing the rear brake pedal to the rear master cylinder plunger. Disconnect the brake lever from the master cylinder.
4. Carefully pull the rear brake pedal (B, **Figure 265**) down and away from the frame and right-hand rear footpeg assembly.
5. On drum brake models, unhook the rear brake pedal from the brake rod.
6. On models so equipped, remove the bushing (A, **Figure 266**) from the brake pedal.
7. On models so equipped, inspect the bushing (A, **Figure 266**) and the bushing receptacle in the brake pedal (B, **Figure 266**) for wear or damage; replace either or both if necessary.
8. Inspect the pedal height adjust bolt and locknut for wear or damage. Replace if necessary.
9. Install by reversing these removal steps. Note the following during installation.
10. Apply a light coat of multi-purpose grease to all pivot areas prior to installing any components.
11. Tighten the pivot bolt and nut securely.
12. Adjust the rear brake pedal as described under *Rear Brake Pedal Height Adjustment* and *Rear Drum Brake Pedal Freeplay Adjustment* in Chapter Three.

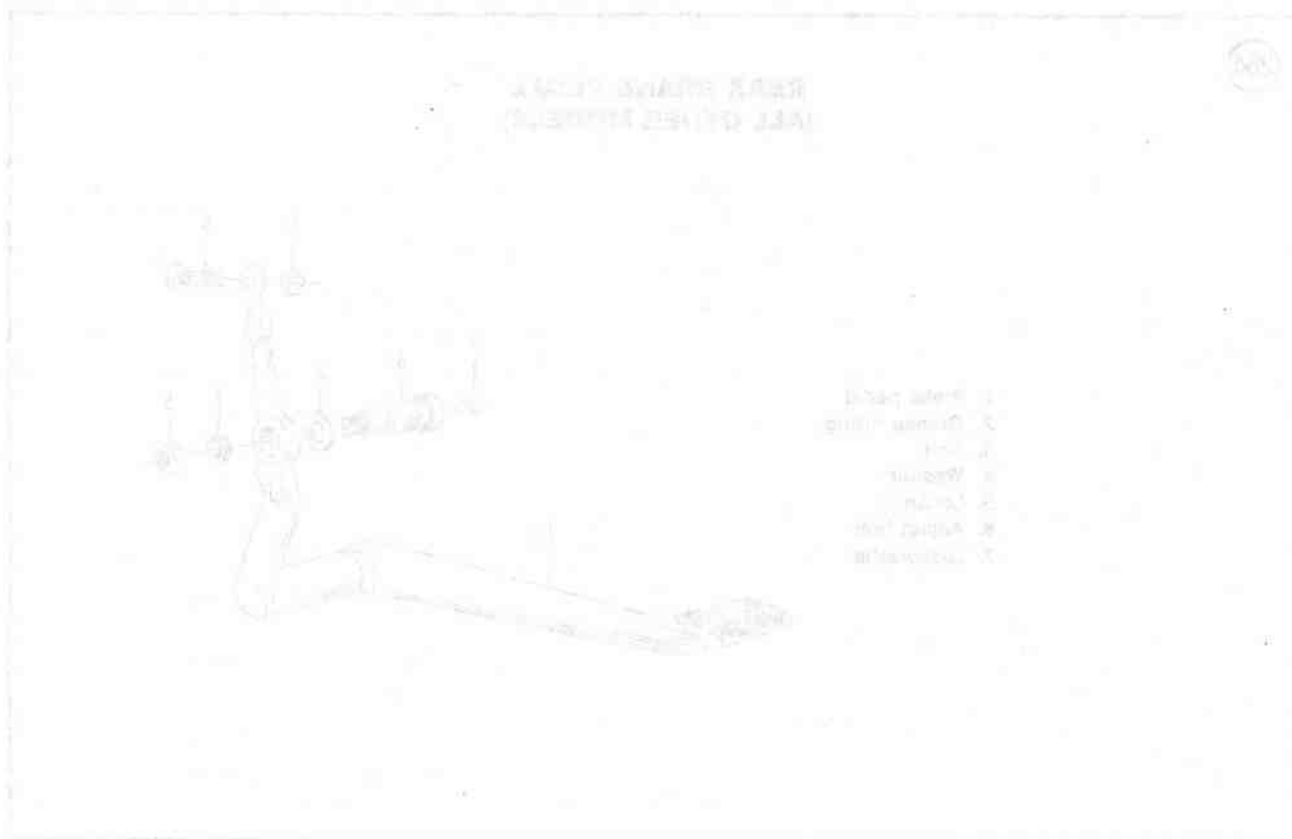
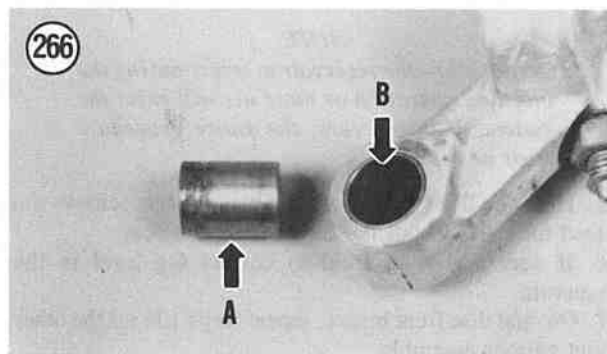
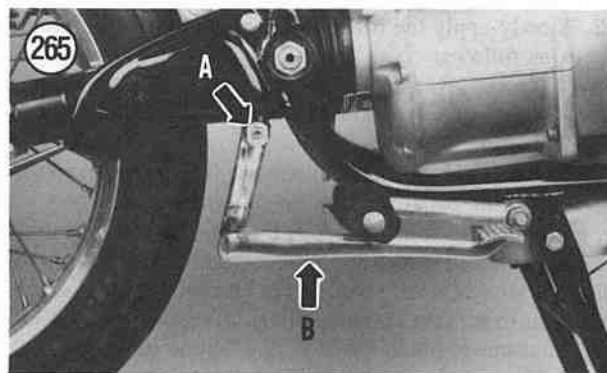


Table 1 BRAKE SPECIFICATION

DRUM BRAKES	
Front drum brake	
Drum diameter	
Standard	200 mm (7.874 in.)
Maximum	201.50 mm (7.93 in.)
Brake lining minimum thickness	1.5 mm (0.059 in.)
Rear drum brake	
Drum diameter (R65LS)	
Standard	220 mm (8.661 in.)
Maximum	221.50 mm (8.720 in.)
Drum diameter (all other models)	
Standard	200 mm (7.874 in.)
Maximum	201.50 mm (7.933 in.)
Brake lining minimum thickness	1.5 mm (0.059 in.)
DISC BRAKES	
Brake fluid	DOT 4
Front brake disc	
Diameter	
1977-1980 models	264 mm (10.39 in.)
R80, 1985-on R80RT	285 mm (11.22 in.)
All other models	260 mm (10.23 in.)
Thickness (minimum)	
/6 to 1984	4.6 mm (0.181 in.)
1985-on	
Dual	4.0 mm (0.157 in.)
Single	5.0 mm (0.197 in.)
Lateral runout (maximum)	0.2 mm (0.008 in.)
Radial runout (maximum)	0.3 mm (0.012 in.)
Brake pad minimum thickness	1.5 mm (0.059 in.)
Rear brake disc	
Diameter	260 mm (10.23 in.)
Thickness (minimum)	1.5 mm (0.059 in.)
Lateral runout (maximum)	0.2 mm (0.008 in.)
Radial runout (maximum)	0.3 mm (0.012 in.)
Brake pad minimum thickness	1.5 mm (0.059 in.)

Table 2 BRAKE SYSTEM TORQUE SPECIFICATIONS

Item	N•m	in.-lb.	ft.-lb.
Brake hose union bolts	8-11	71-93	—
Front brake caliper			
Cap screw (Type A)	60-65	—	44-48
Mounting bolts (Type B)	32-34	—	24-25
Brake hose-to-master cylinder			
Type A	NA	—	NA
Type B	12-15	—	9-11
Brake line-to-caliper nut			
Type A	NA	—	NA
Type B	12-15	—	9-11
Brake disc mounting bolts and nuts	22-24	—	17-18
Brake caliper bleed screw	6-8	53-93	—
Rear master cylinder mounting bolts	NA	—	NA
Rear axle nut	45-48	—	33-35
Rear axle pinch bolt	14-18	—	10-13



**NOTE:** If you own a 1990 or later model, first check the Supplement at the back of this book for any new service information.

## CHAPTER TWELVE

# FRAME AND BODY

This chapter includes replacement procedures for components attached to the frame that are not covered in the rest of the book. Also included are the body panels and luggage components, some of which are optional.

BMW makes it possible to interchange many different components from bike-to-bike. This not only refers to the mechanical components (e.g. front forks, brake calipers, etc.), but also the many items that are attached to the frame.

Your bike may not be equipped with the original footpegs, front and rear fender, front fairing, seat, etc. When using the procedures in this chapter, compare your bike's components with the illustration(s) that are presented along with each procedure.

This chapter also describes procedures for completely stripping and repainting the frame.

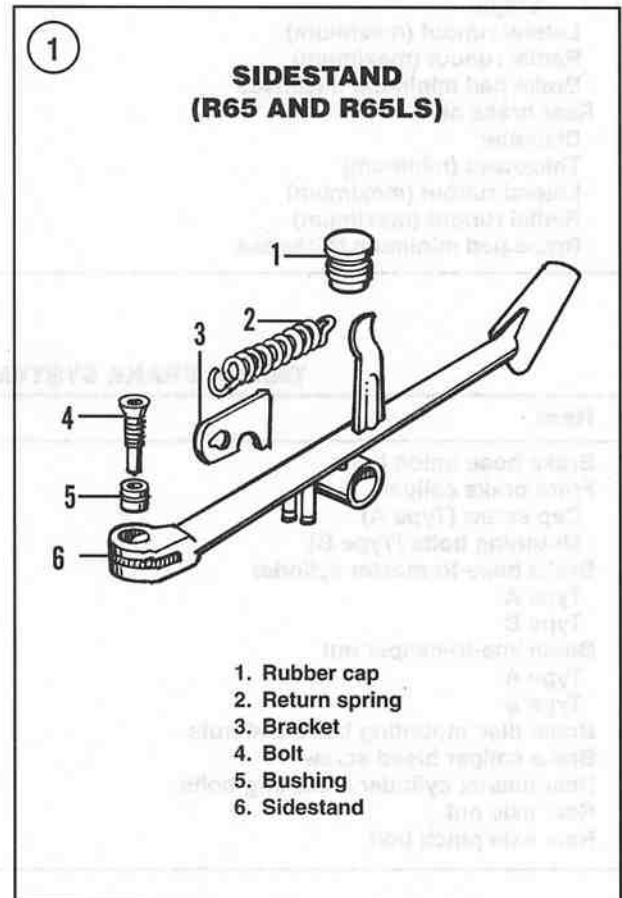
### KICKSTAND (SIDE STAND)

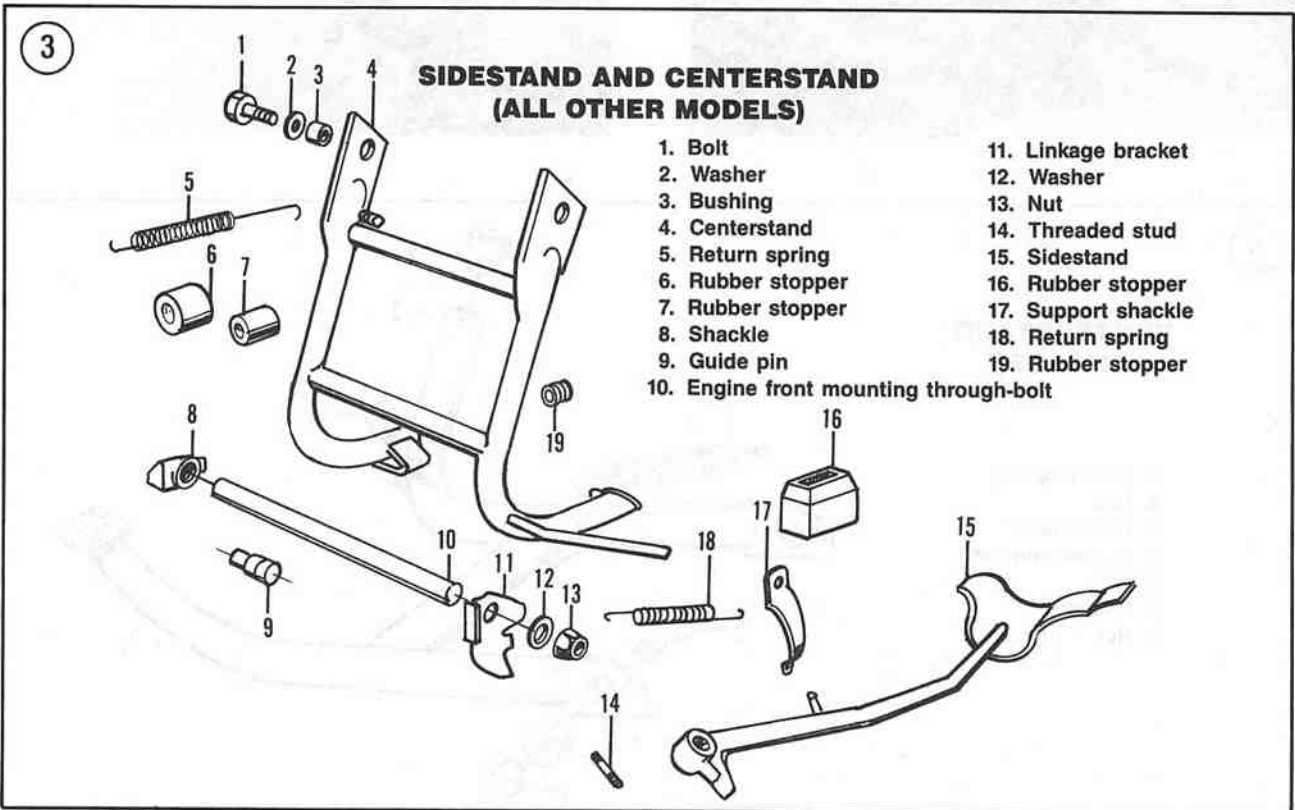
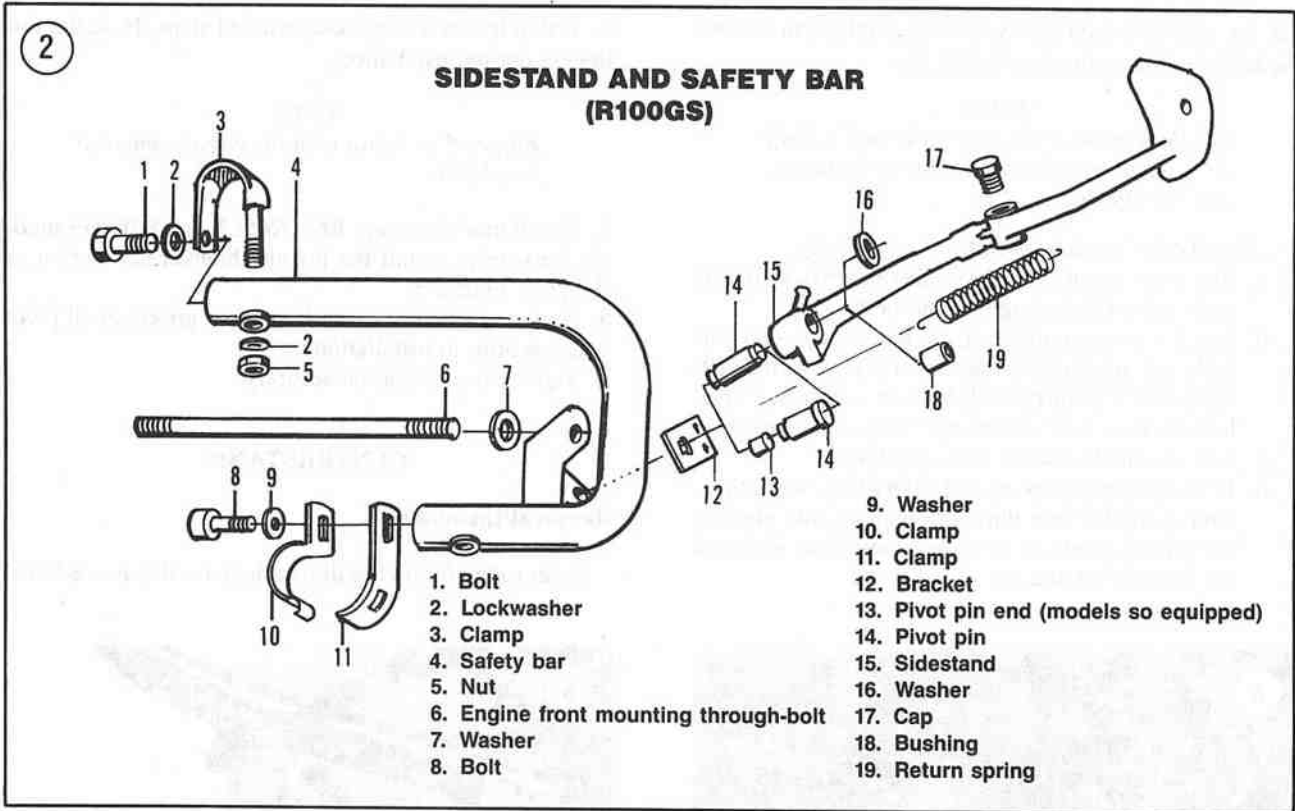
#### Removal/Installation

Refer to the following illustrations for this procedure:

- Figure 1;** R65 and R65LS models.
- Figure 2;** R100GS models.
- Figure 3;** all other models.

- Place the bike on the centerstand.
- Raise the kickstand and disconnect the return spring from the frame with Vise Grips.
- 3A. On R65 and R65LS models, remove the pivot bolt and remove the kickstand from the frame. Don't lose the pivot bolt bushing.





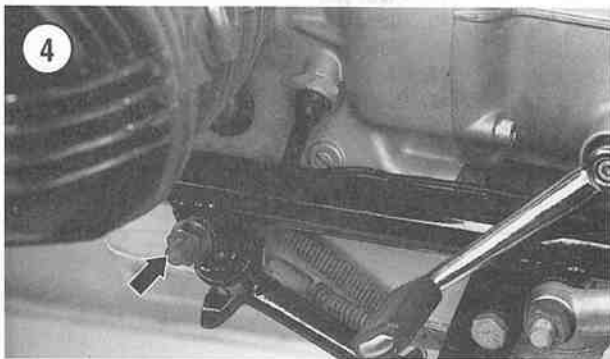
3B. On R100GS models, remove the circlip and remove the kickstand from the front safety bar.

**NOTE**

*On these models the side kickstand is held onto the frame with the engine front mounting through-bolt.*

3C. On all other models, perform the following.

- a. Remove the nut and lockwasher (Figure 4) on the engine front mounting through-bolt.
- b. Using a hammer and drift, tap the through-bolt partially out toward the frame receptacle on the left-hand side. Tap the through-bolt out sufficiently to allow the kickstand and linkage bracket to come free.
- c. Remove the kickstand from the frame.
- d. If the kickstand is going to be left off for some time, tap the engine front through-bolt back into place in the frame receptacle in the left-hand side. Reinstall the lockwasher and nut.



4. Install by reversing these removal steps. Note the following during installation,

**NOTE**

*Figure 5 is shown with the engine removed for clarity.*

5. On all models except R65, R65LS and R100GS models, be sure to install the linkage bracket and spring as shown in Figure 5.

6. Apply a light coat of multipurpose grease to all pivot surfaces prior to installation.
7. Tighten the bolt or nut securely.

**CENTERSTAND**

**Removal/Installation**

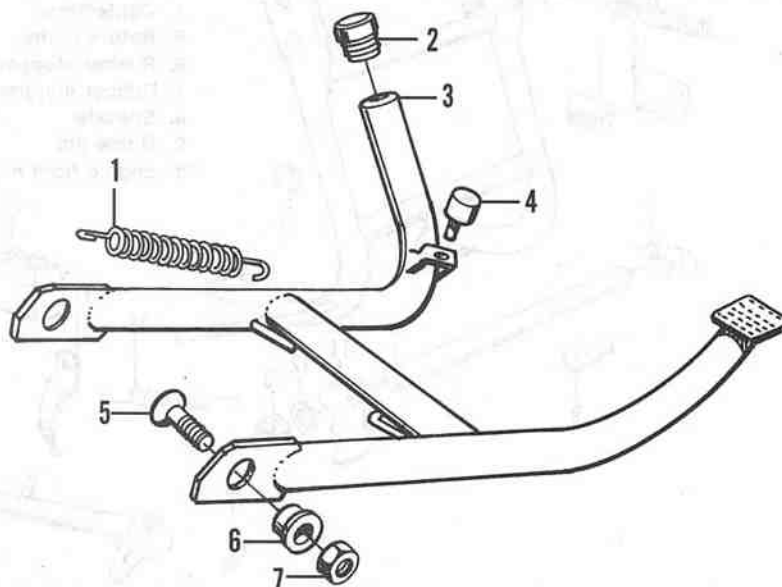
Refer to the following illustrations for this procedure:

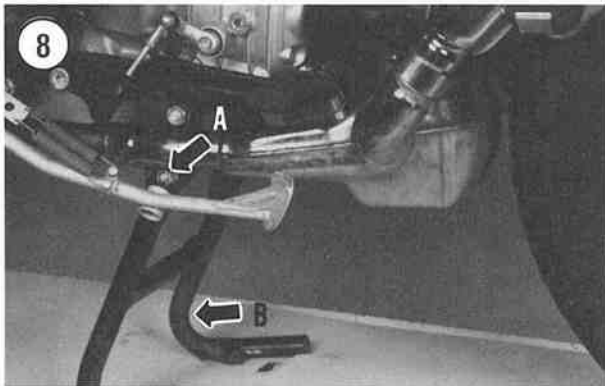
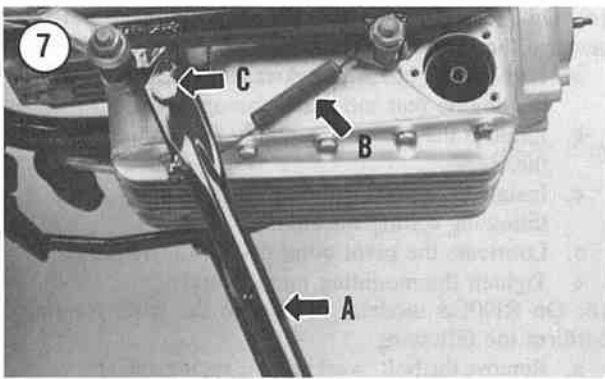


6

**CENTERSTAND  
(R100GS)**

1. Return spring
2. Cap
3. Centerstand
4. Rubber stopper
5. Bolt
6. Bushing
7. Nut



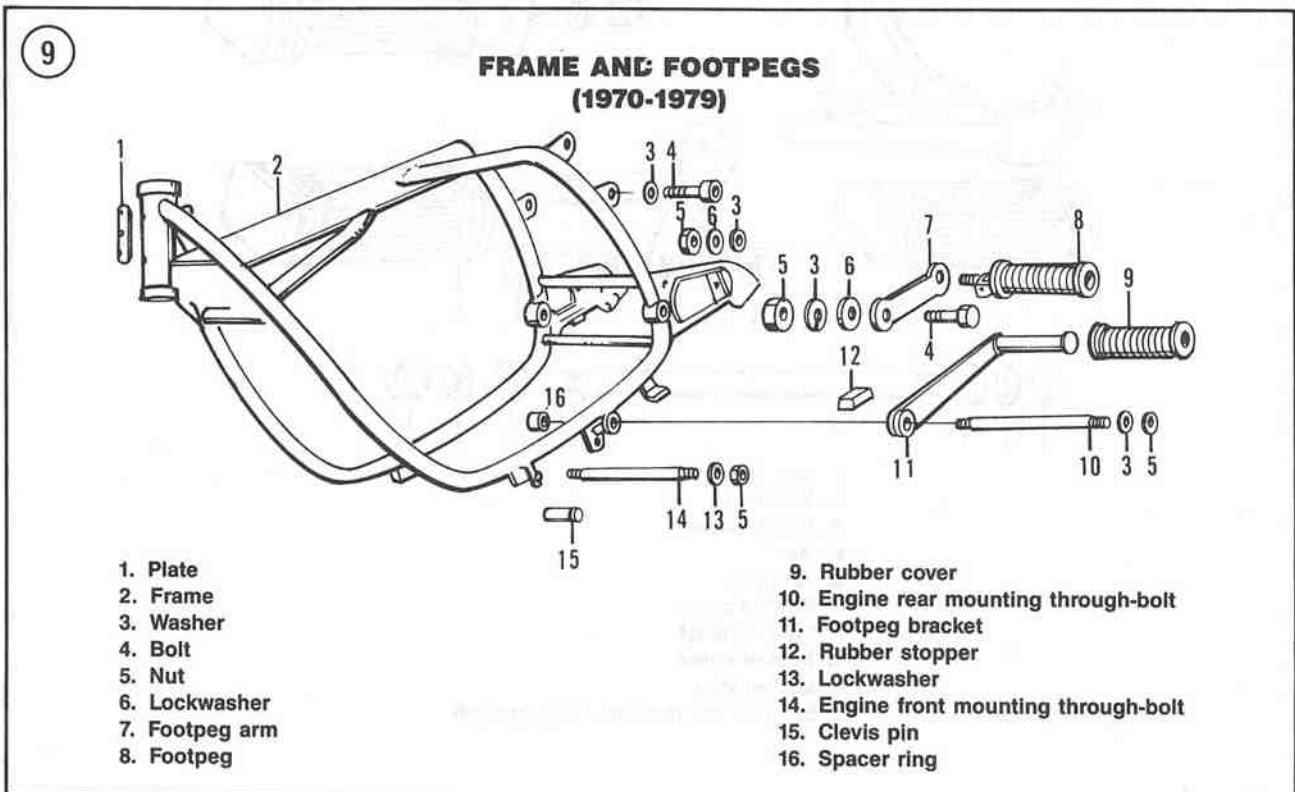


- a. **Figure 6:** R100GS models.
  - b. **Figure 3:** all other models.
1. Place the bike on the centerstand.
  2. Place a wood block(s) under the engine oil pan to hold the bike securely in place. Raise the bike sufficiently so that the centerstand hangs free.
  3. Raise the centerstand (A, **Figure 7**) and use Vise Grip pliers to unhook the return springs (B, **Figure 7**) either from the frame or the centerstand.
  - 4A. On R100GS models, remove the bolt and nut (A, **Figure 8**) on each side securing the centerstand (B, **Figure 8**) to the mounting bracket on the frame.
  - 4B. On all other models, remove the bolt and washer (C, **Figure 7**) on each side securing the centerstand to the mounting bracket on the frame.
  5. Remove the centerstand from the mounting bracket on the frame. Don't lose the bushing in each pivot point.
  6. Install by reversing these removal steps. Note the following during installation.
  7. Apply multipurpose grease to the pivot bolts.
  8. Tighten the pivot bolts securely.

**FOOTPEGS**

**Removal/Installation**

Refer to the following illustrations for this procedure:  
 a. **Figure 9:** All 1970-1979 models.



- b. **Figure 10:** R65 and R65LS models.
- c. **Figure 11:** all R80 models.
- d. **Figure 12:** R100GS models.
- e. **Figure 13:** all R100 models, except RG100S.

These illustrations show the left-hand footpeg assembly. The right-hand assembly is an exact mirror image and all parts are identical.

**NOTE**

Many of the footpeg assemblies are interchangeable, and if your bike was previously owned, it may **not** be equipped with the original foot pegs. Compare your footpeg assemblies with the illustrations for the replacement parts.

**NOTE**

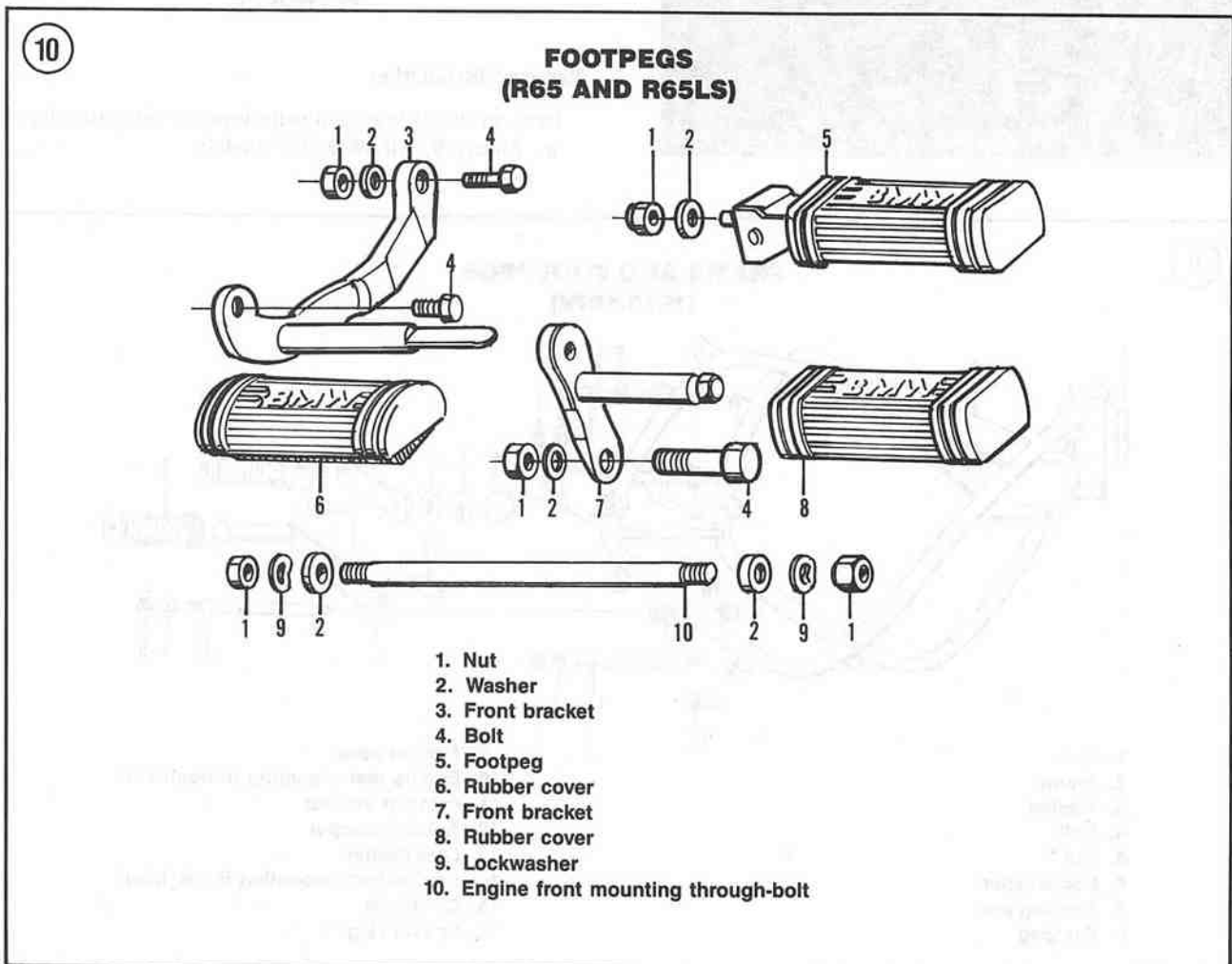
On 1970-1979 models, the front footpeg assembly is held onto the frame with the engine rear mounting through-bolt.

1A. On 1970-1979 models, to remove the front footpegs, perform the following:

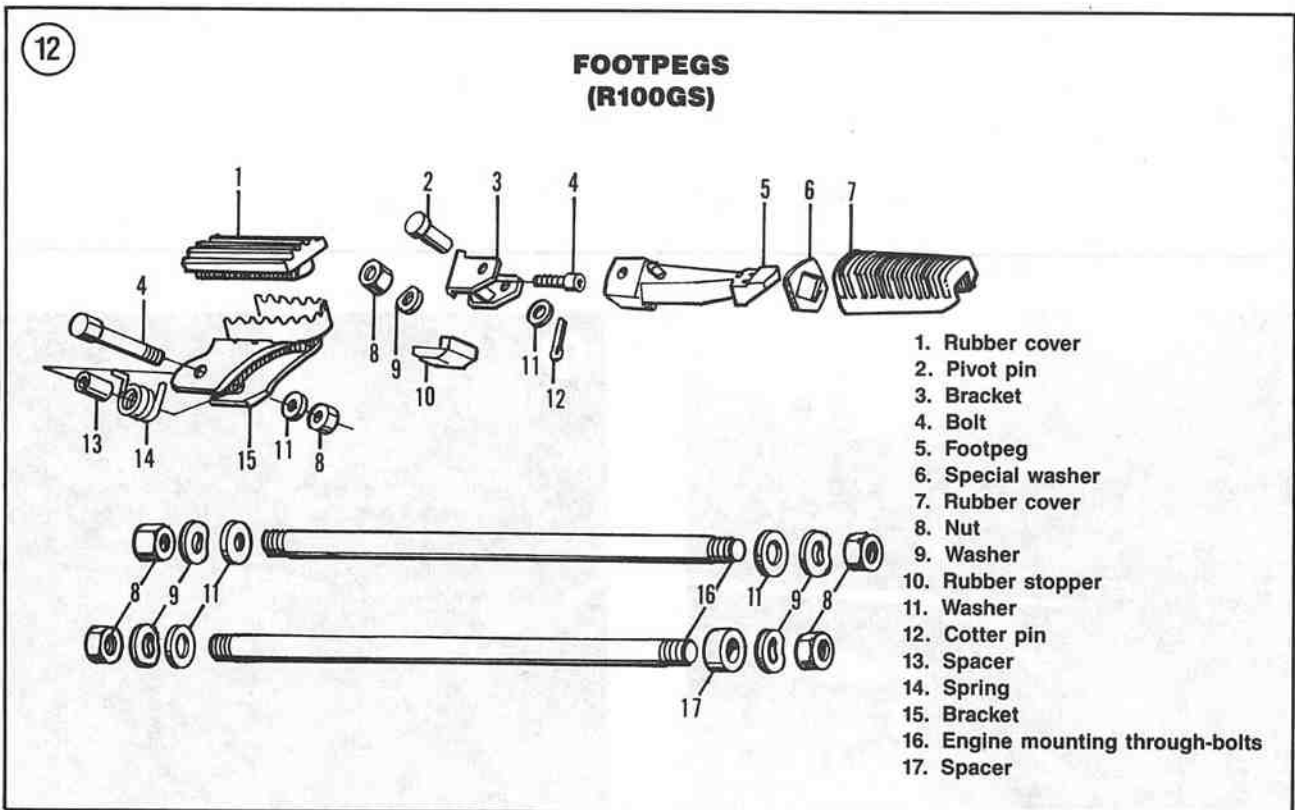
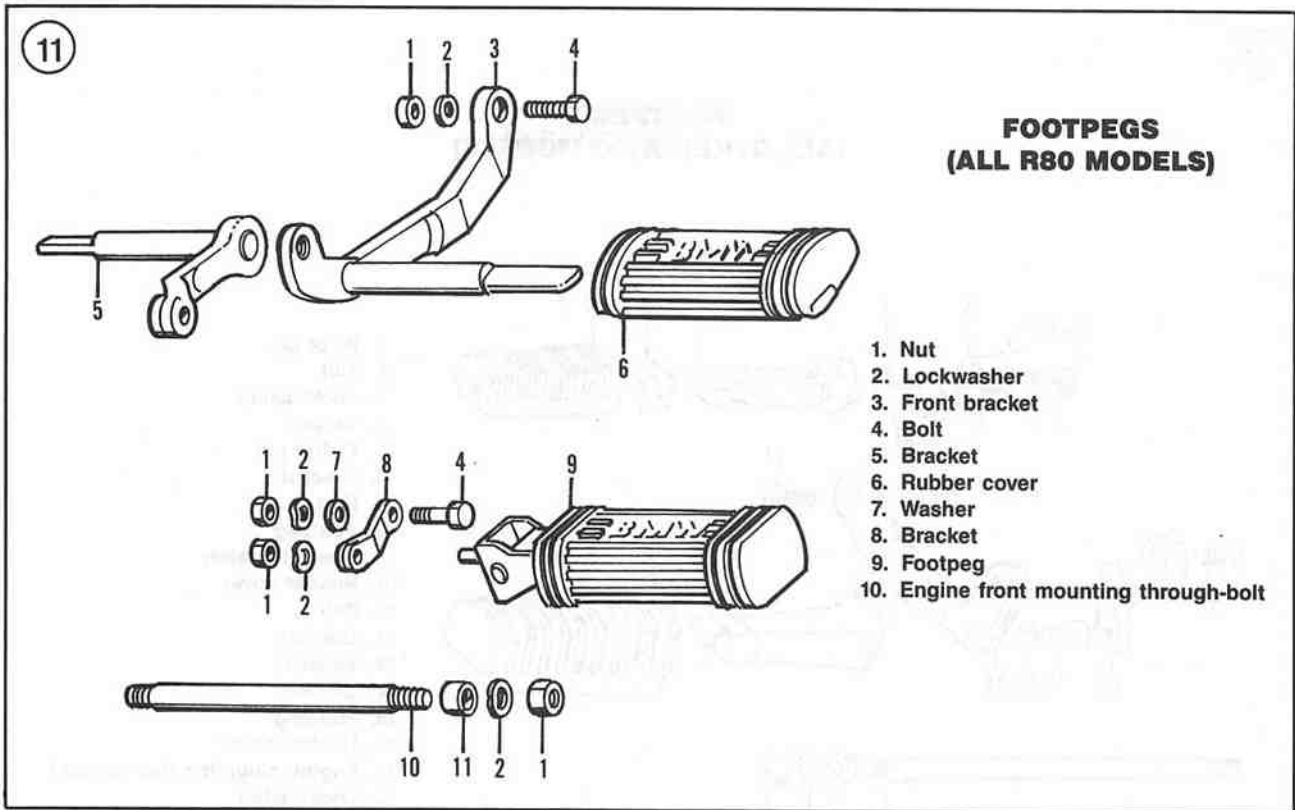
- a. Remove the nut and lockwasher (A, **Figure 14**) on the engine rear mounting through-bolt.
- b. Remove the footpeg assembly (B, **Figure 14**) from the frame.
- c. Install by reversing these removal steps. Note the following during installation.
- d. Lubricate the pivot point prior to installation.
- e. Tighten the mounting nuts securely.

1B. On R100GS models, to remove the front footpegs, perform the following:

- a. Remove the bolt, washer, nut, spring and spacer (A, **Figure 15**) securing the footpeg assembly to the frame.
- b. Remove the footpeg assembly (B, **Figure 15**) from the frame.
- c. Install by reversing these removal steps. Note the following during installation.
- d. Lubricate the pivot point prior to installation.
- e. Tighten the mounting bolt and nut securely.

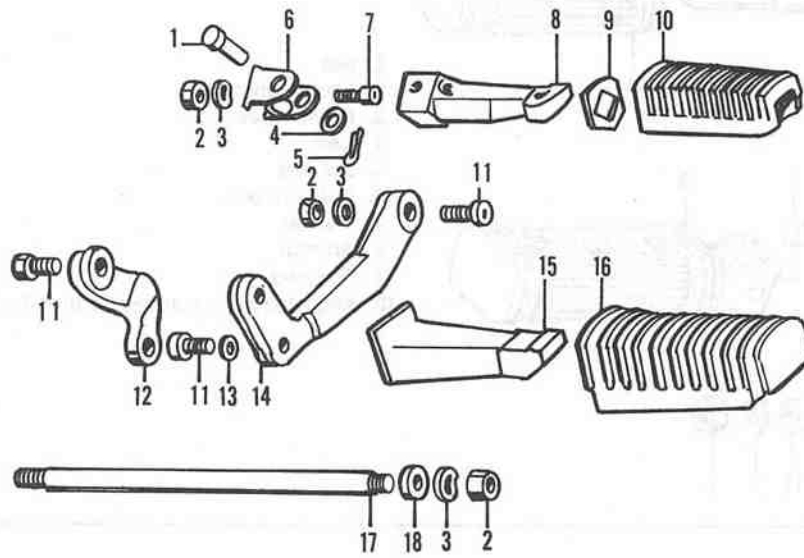




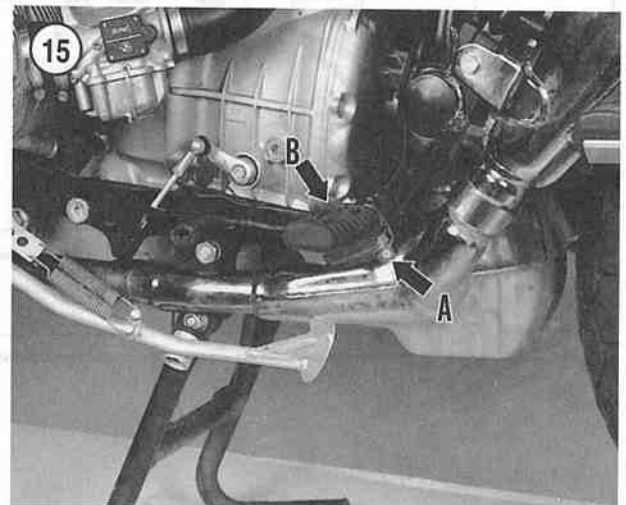
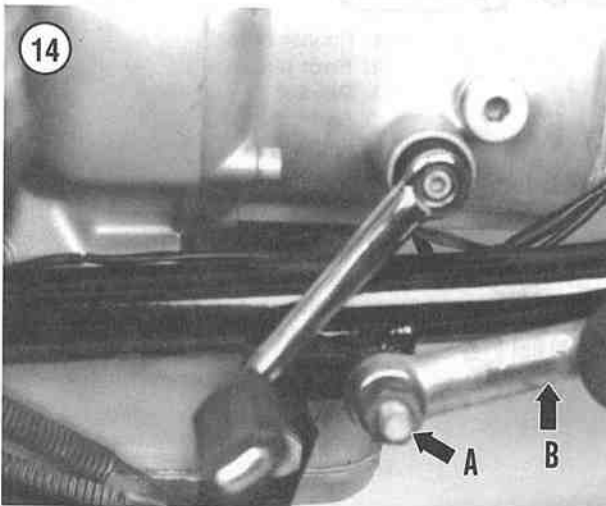


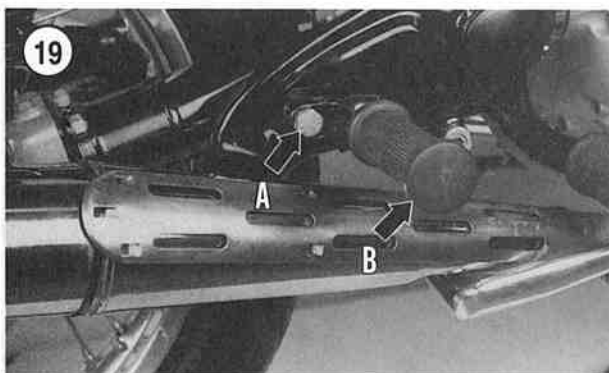
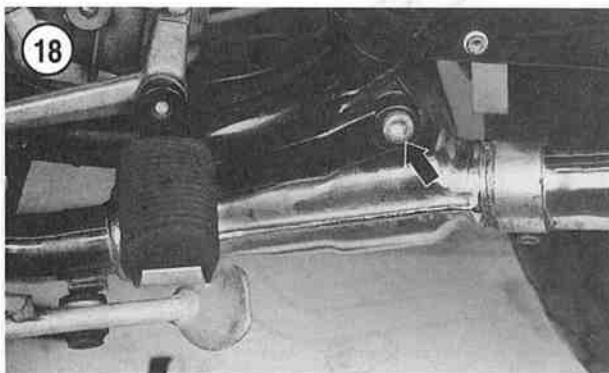
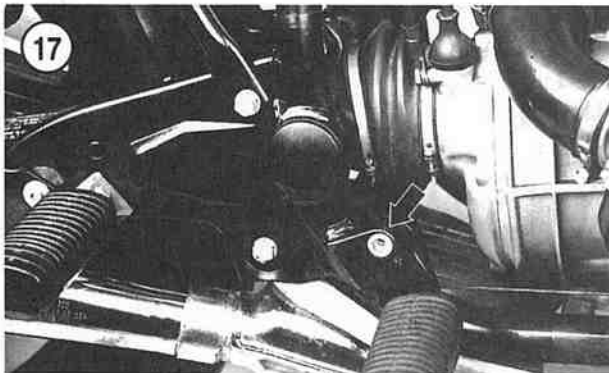
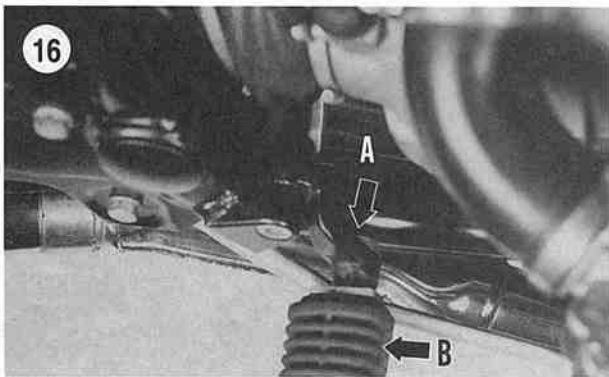
13

### FOOTPEGS (ALL OTHER R100 MODELS)



1. Pivot pin
2. Nut
3. Lockwasher
4. Washer
5. Cotter pin
6. Bracket
7. Bolt
8. Footpeg
9. Special washer
10. Rubber cover
11. Bolt
12. Bracket
13. Washer
14. Bracket
15. Footpeg
16. Rubber cover
17. Engine mounting through-bolt
18. Lockwasher





1C. To remove the front footpeg on all other models, perform the following:

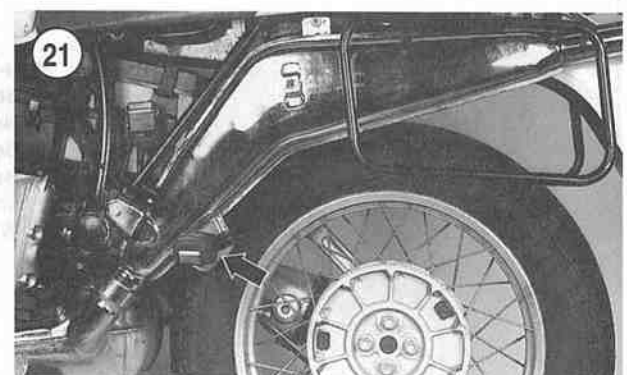
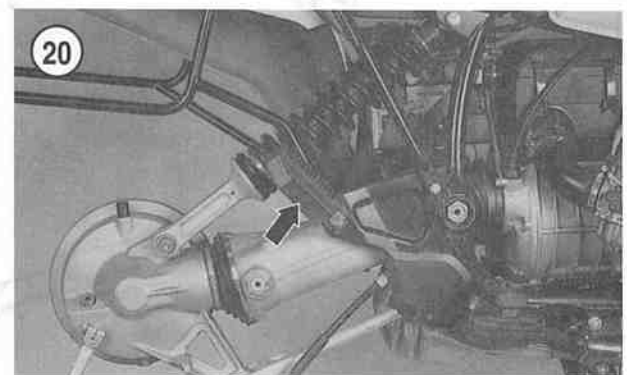
- a. Remove the bolt and washer (A, **Figure 16**) securing the footpeg to the bracket.
- b. Remove the footpeg (B, **Figure 16**) from the bracket.
- c. To remove the bracket, remove the bolt, washer and nut securing the bracket to the frame and remove the bracket. Refer to **Figure 17** for the right-hand side or **Figure 18** for the left-hand side.
- d. Install by reversing these removal steps. Note the following during installation.
- e. Tighten the bolts and/or nuts securely.

2A. On 1970-1979 models, to remove the rear footpegs, perform the following:

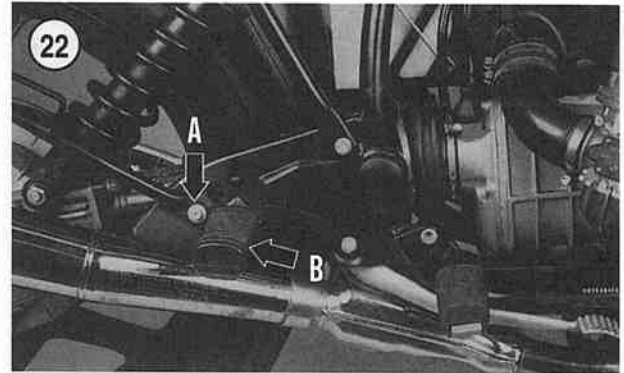
- a. Remove the bolt, nut and lockwasher (A, **Figure 19**) securing the rear footpeg assembly.
- b. Remove the footpeg assembly (B, **Figure 19**) from the frame.
- c. Install by reversing these removal steps. Note the following during installation.
- d. Tighten the mounting bolt and nut securely.

2B. On R100GS models, to remove the rear footpegs, perform the following:

- a. Remove the bolt, washer, nut, spring and spacer securing the footpeg assembly to the frame.
- b. Remove the footpeg assembly from the frame. Refer to **Figure 20** for the right-hand side or **Figure 21** for the left-hand side.

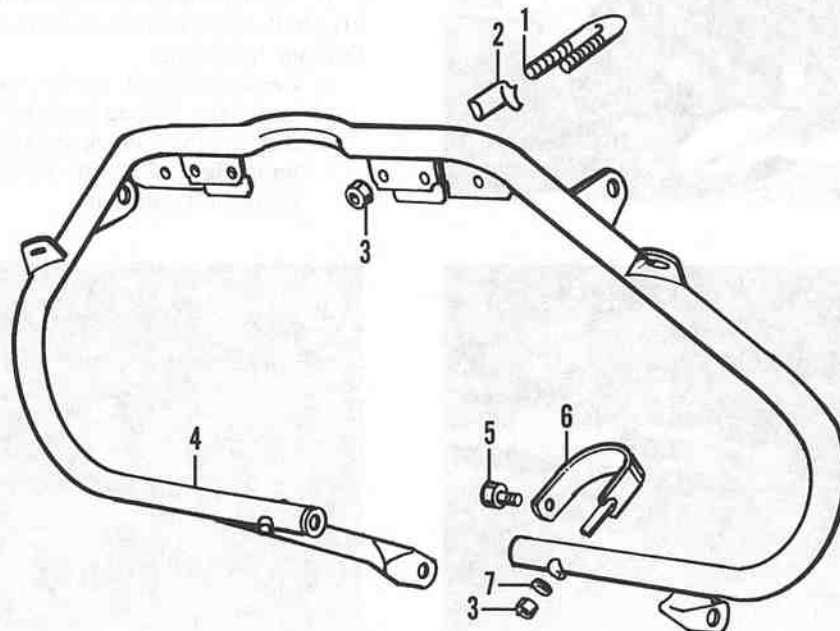


- c. Install by reversing these removal steps. Note the following during installation.
  - d. Lubricate the pivot point prior to installation.
  - e. Tighten the mounting bolt and nut securely.
- 2C. To remove the rear footpeg on all other models, perform the following:
- a. Remove the bolt and washer (A, **Figure 22**) securing the footpeg to the bracket.
  - b. Remove the footpeg (B, **Figure 22**) from the bracket.
  - c. Install by reversing these removal steps. Note the following during installation.
  - d. Tighten the bolts and/or nuts securely.

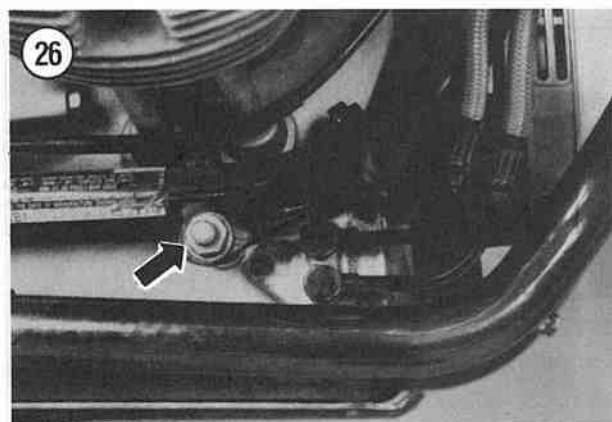
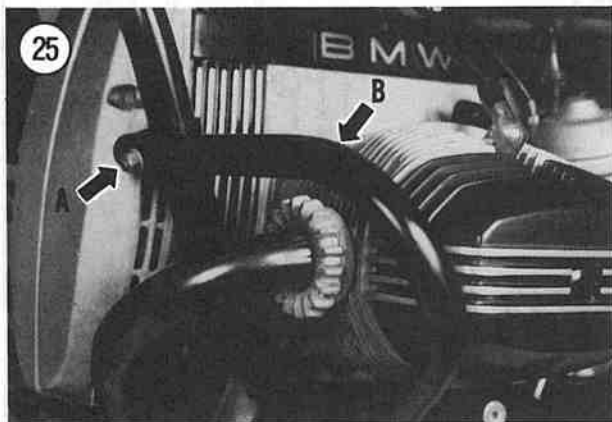
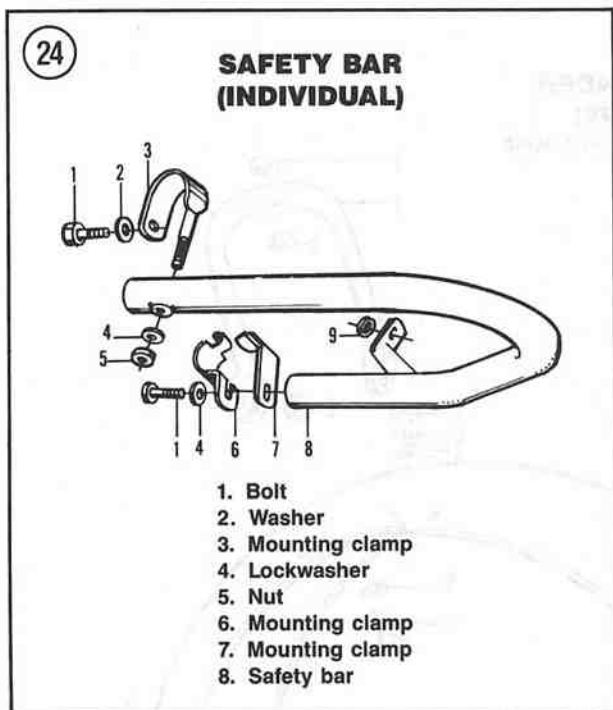


23

### SAFETY BAR (ONE-PIECE UNIT)



- 1. U-bolt
- 2. Strap
- 3. Nut
- 4. Safety bar
- 5. Bolt
- 6. Mounting clamp
- 7. Washer



**SAFETY BARS**

**Front Safety Bars  
Removal/Installation**

- a. **Figure 23:** one-piece unit.
- b. **Figure 24:** individual.

**Figure 24** shows the left-hand assembly. The right-hand assembly is an exact mirror image and all parts are identical.

**CAUTION**

*The mounting clamps can scratch the paint off of the frame during removal and installation. Be careful to not scratch the paint from the frame.*

1. On models so equipped, remove the oil cooler from the right-hand crash bar as described under *Oil Cooler* in Chapter Four.
- 2A. On the one-piece unit, perform the following:
  - a. Remove the nuts securing the U-clamp at the upper portion of the safety bar to the frame. Remove the U-clamps.
  - b. Remove the bolt and washer securing the mounting clamp(s) to the end of the safety bar.
  - c. Remove the nut and washer securing the mounting clamp(s) to the end of the safety bar.
  - d. Remove the nut and washer securing the end brackets to the frame.
- 2B. On individual units, perform the following:
  - a. Remove the bolt and washer securing the mounting clamp(s) to the end of the safety bar.
  - b. Remove the nut and washer (A, **Figure 25**) securing the mounting clamp(s) to the end of the safety bar.
  - c. Remove the nut and washer (**Figure 26**) securing the end bracket to the frame.
  - d. Remove the safety bar (B, **Figure 25**) from the frame.
3. Inspect the frame where the safety bar mounting clamps were attached. Some of the paint may be scratched off. Retouch the paint as described in this chapter.
4. On individual safety bars, repeat for the other side if necessary.
5. Install by reversing these removal steps. Note the following during installation.
6. Tighten the mounting bolts and nuts securely.

**FENDERS**

**Front Fender  
Removal/Installation**

Refer to the following illustrations for this procedure:

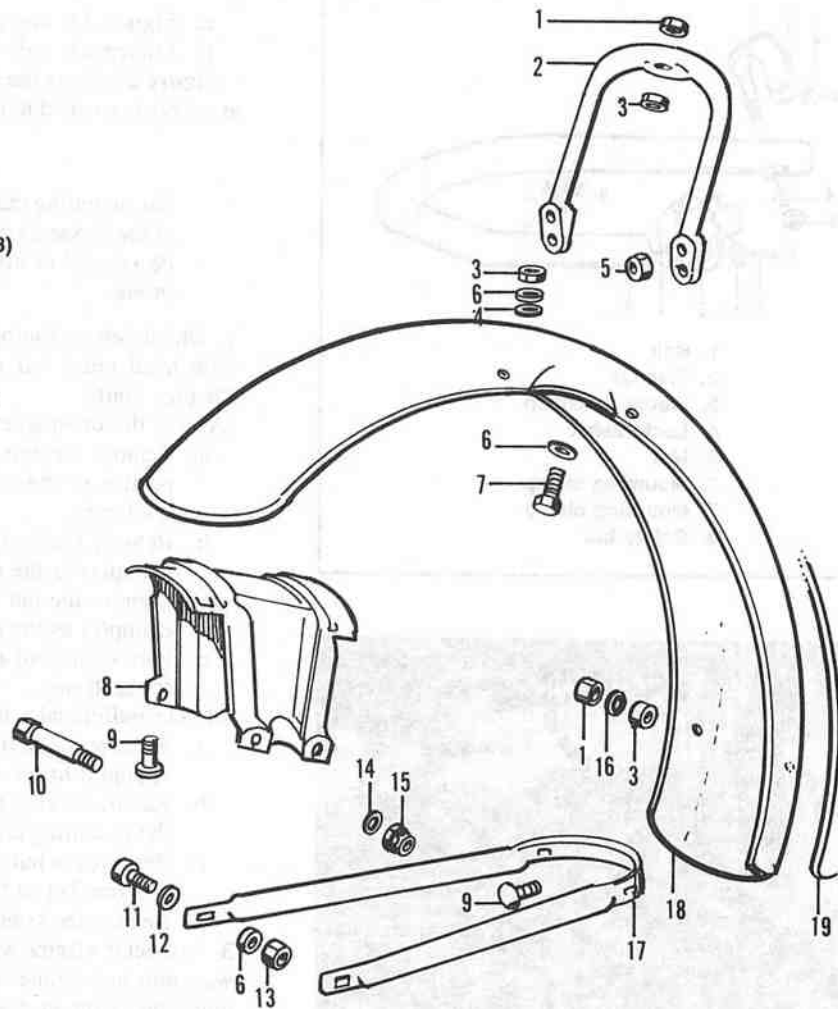
- a. **Figure 27:** 1970-1976 models.
- b. **Figure 28:** R100GS models.
- c. **Figure 29:** R100ST and R100RT models.
- d. **Figure 30:** all other models.



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### FRONT FENDER (1970-1976)

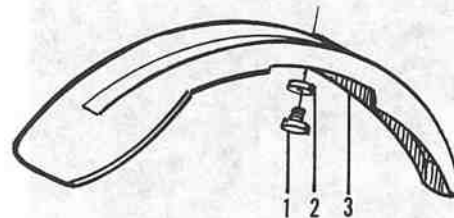
1. Nut
2. Upper bracket (1970-1973)
3. Nut
4. Rubber washer
5. Nut
6. Washer
7. Bolt
8. Center brace (1974-1976)
9. Bolt
10. Bolt
11. Bolt
12. Washer
13. Nut
14. Washer
15. Nut
16. Washer
17. Lower bracket
18. Front fender
19. Trim strip



28

### FRONT FENDER (R100GS)

1. Bolt
2. Washer
3. Fender

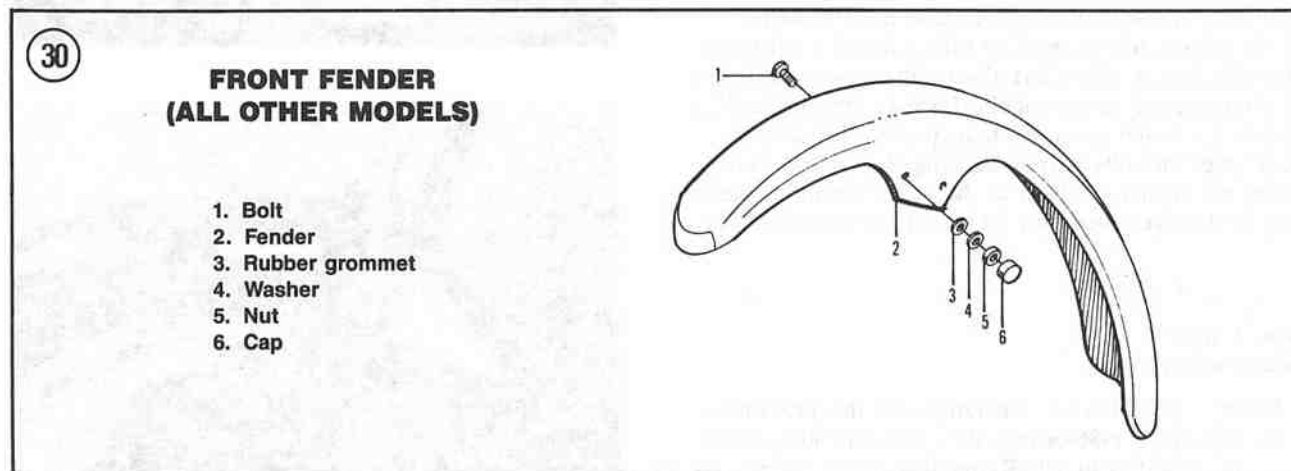
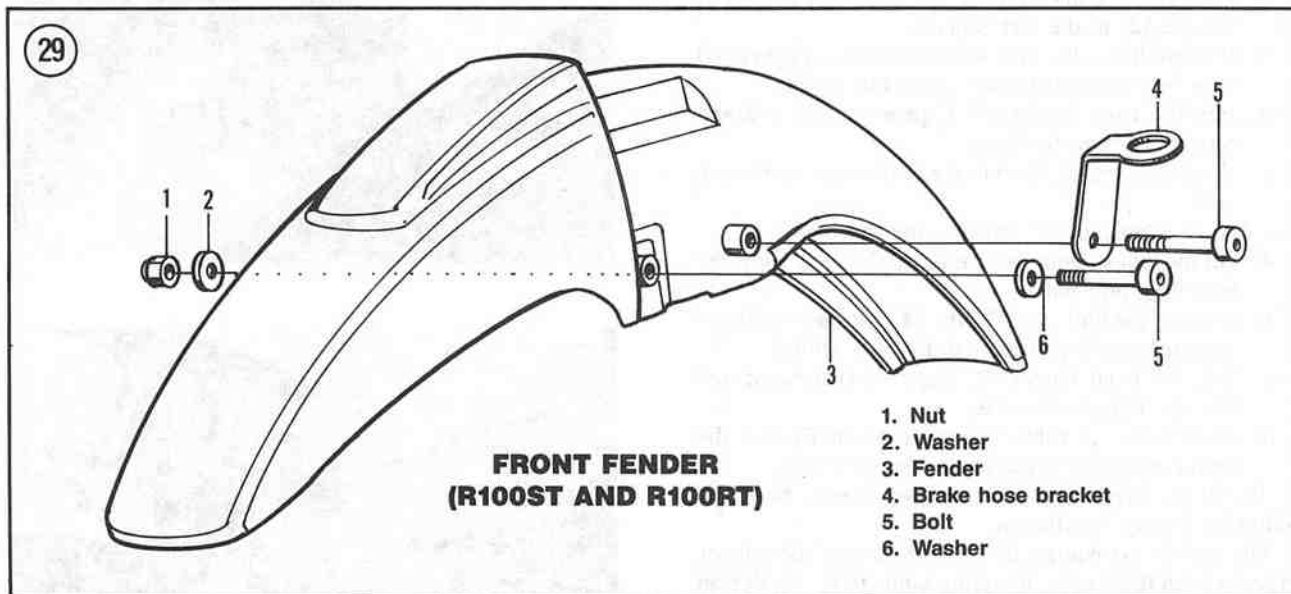


**NOTE**

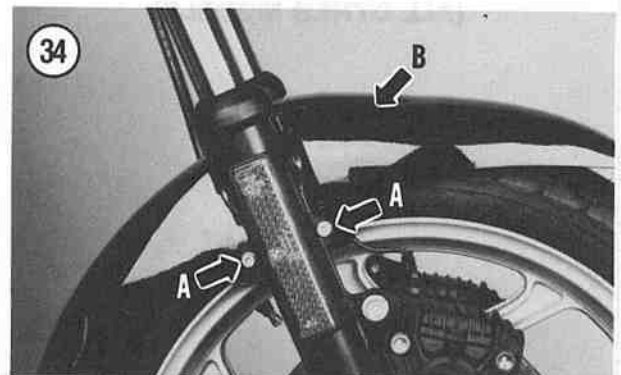
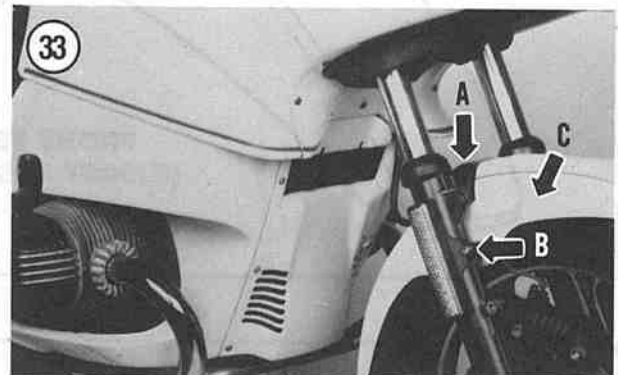
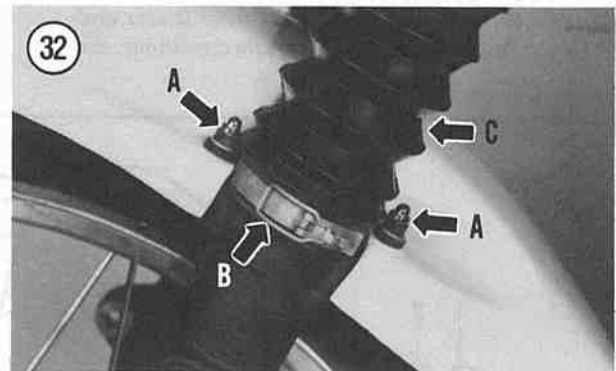
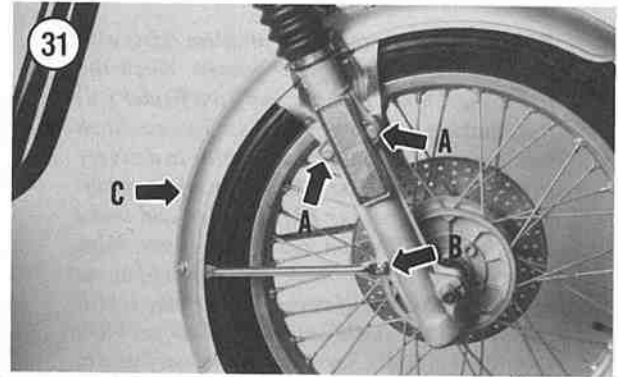
BMW has determined that a problem exists with the 1988-on R100GS front fender. When the front wheel hits a pothole, the front fender will flex, making an abnormal noise. This problem was supposed to be corrected prior to delivery to the customer. If your bike has this noise problem, return it to your BMW dealer and make sure this modification was made. If not, have them correct the problem. There should be no charge for this modification if your bike is still covered by the BMW warranty. This problem is covered in BMW Service Information Bulletin No. 46 019 88, April 1988. To fix the problem, an energy absorbing elastomer is added to the fender stiffener between the front fender and the fender brace. Under certain conditions, the

front fender may still make a slight knocking noise while going over potholes or railroad tracks in warm weather. The front fender is flexing and snapping back into its normal position. This slight knock **cannot** be corrected with this stiffener modification.

1. Place the bike on the centerstand.
2. Remove the front wheel as described under *Front Wheel Removal* in Chapter Nine.
- 3A. On 1970-1976 models, perform the following:
  - a. On 1970-1973 models, remove the nuts securing the upper brace to both front forks.
  - b. On 1974-1976 models, to remove the front fender without the center brace, remove the nuts, washers and rubber washers securing the front fender to the center brace.



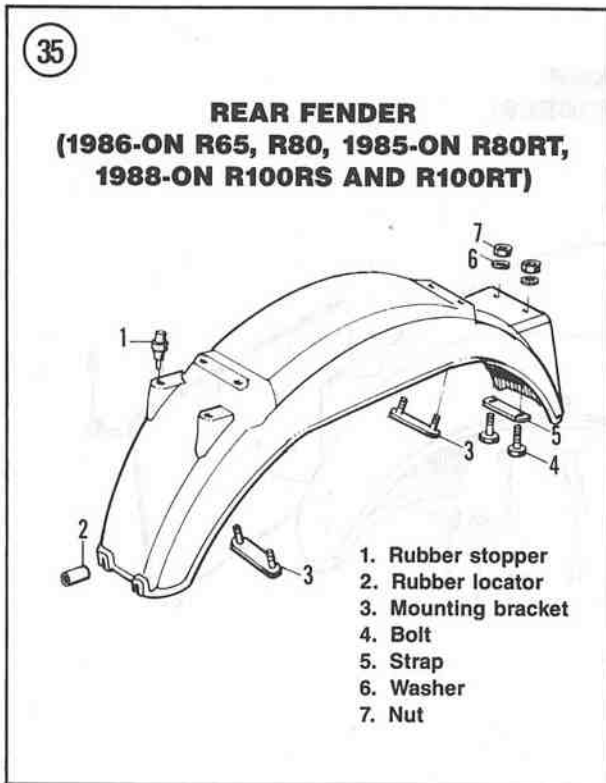
- c. On 1974-1976 models, to remove the front fender with the center brace, remove the bolts, nuts and washers (A, **Figure 31**) securing the center brace to both front forks.
  - d. Remove the bolt, washers and nuts (B, **Figure 31**) securing the front end of the lower brace to the front forks.
  - e. Carefully pull the front fender (C, **Figure 31**) off of the front fork and remove the front fender.
- 3B. On R100GS models, perform the following:
- a. Remove the bolts, washers and nuts (A, **Figure 32**) securing the front fender to the lower fork bridge.
  - b. Release the front fork boot clamp (B, **Figure 32**) and slide the boot (C, **Figure 32**) up on the fork tube.
  - c. Pull the front fender up and forward and remove it from the forks.
- 3C. On R100ST and R100RT models, perform the following:
- a. Remove the bolts securing the front fork brace (A, **Figure 33**) to the fork sliders.
  - b. Remove the bolts, nuts and washers (B, **Figure 33**) securing the front fender to the fork slider.
  - c. Pull the front fender (C, **Figure 33**) forward and remove it from the forks.
  - d. Don't damage the front brake hose brackets on each side.
- 3D. On all other models, perform the following:
- a. On models so equipped, remove the caps from the mounting bolt nuts.
  - b. Remove the bolts (A, **Figure 34**), washers and nuts securing the front fender to the fork slider.
  - c. Pull the front fender (B, **Figure 34**) forward and remove it from the forks.
  - d. Don't lose the rubber grommets that fit into the mounting areas of the fender on each side.
4. Install by reversing these removal steps. Note the following during installation.
5. On models so equipped, be sure to use the rubber grommets on the fender mounting holes in the fender on each side. If the rubber grommets are not in place and the bolt and nut are tightened, the fender mounting areas will be damaged and the fender will have to be replaced.
6. On models so equipped, be sure to install the front reflex reflector to the front fork along with the mounting bolts.
7. Apply a *small* amount of blue Loctite Threadlocker No. 242 to the fender mounting bolts prior to installation.
8. Tighten the bolts and nuts securing the fender securely. Don't overtighten the bolts as the fender mounting areas may be damaged even with the rubber grommets in place.



### Rear Fender Removal/Installation

Refer to the following illustrations for this procedure:

- a. **Figure 35:** 1986-on R65, R80, 1985-on R80RT, 1988-on R100RS and R100RT models.



b. **Figure 36:** R100GS models.

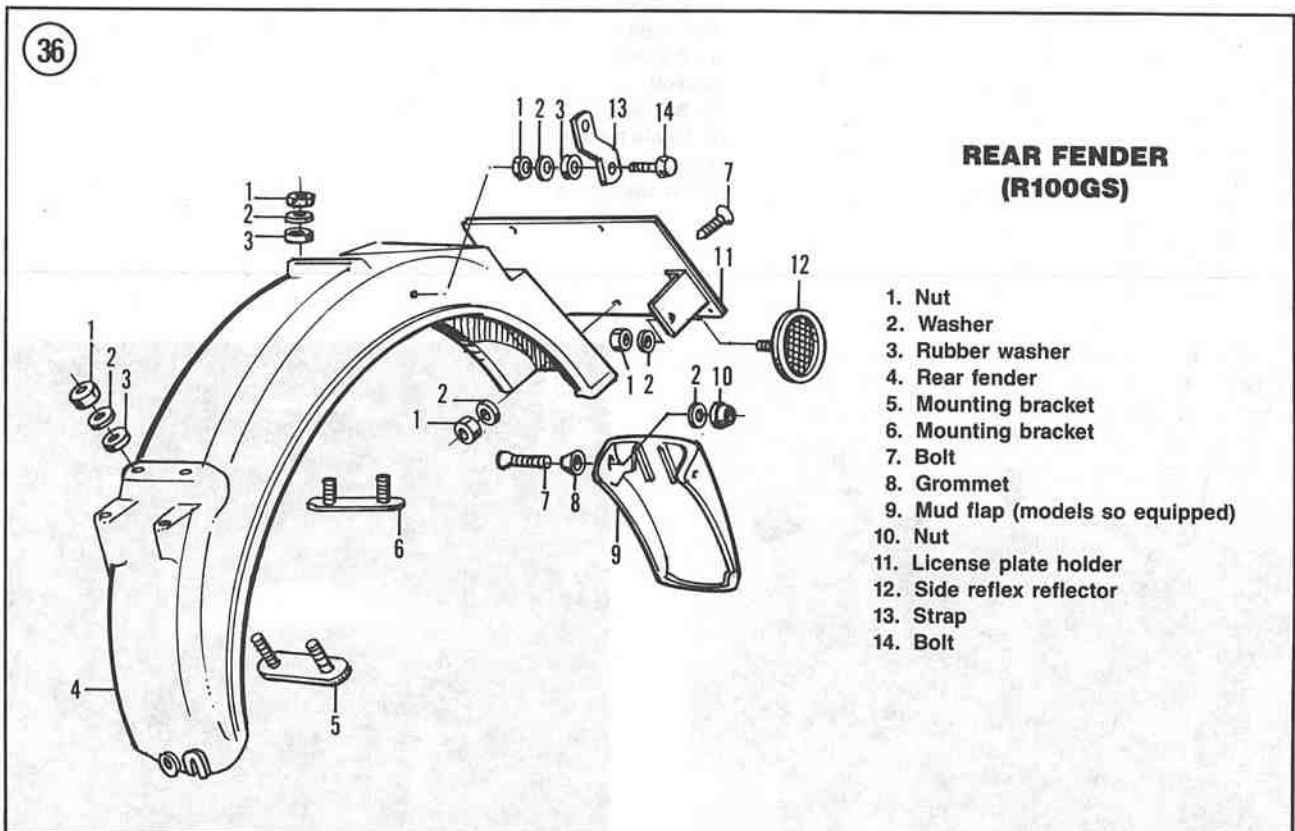
c. **Figure 37:** all other models.

1. Place the bike on the centerstand.
2. Remove the rear wheel as described under *Rear Wheel Removal* in Chapter Ten.
3. Remove the seat as described in this chapter.
4. On models so equipped, remove the rear cowl as described in this chapter.
5. Remove the taillight assembly as described under *Taillight and Brake Light* in Chapter Eight.
6. Remove the rear turn signal assembly as described under *Rear Turn Signal Assembly* in Chapter Eight.
- 7A. On 1986-on R65, R80, 1985-on R80RT, 1988-on R100RS, R100RT and R100GS models, perform the following:

- a. Remove the nuts and washers (A, **Figure 38**) securing the mid-point of the fender to the frame.
- b. Remove the nuts and washers (B, **Figure 38**) securing the rear of the fender to the frame.
- c. Pull the fender (C, **Figure 38**) toward the back and out of the receptacles at the front where it is indexed into the frame.

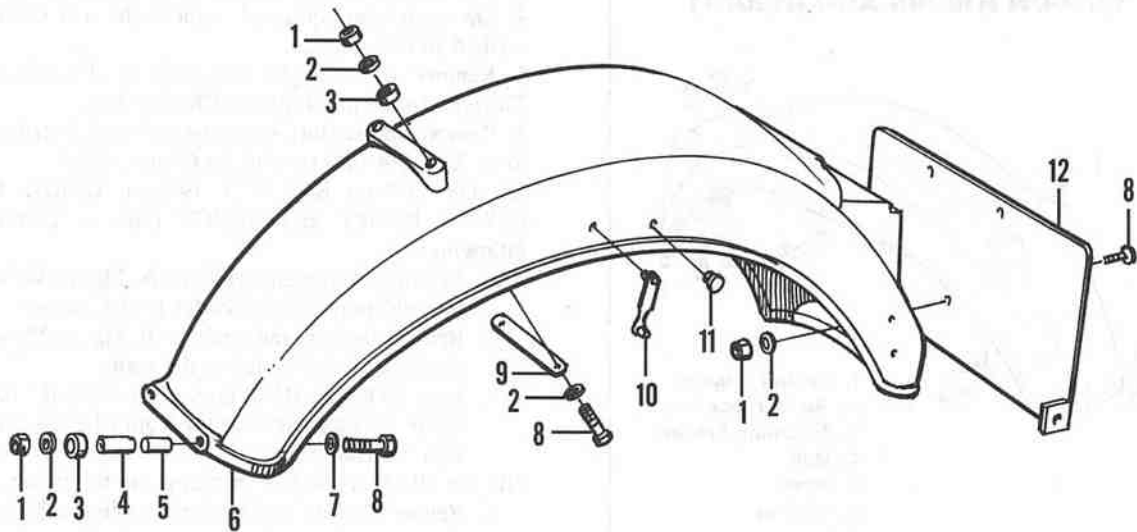
7B. On all other models, perform the following:

- a. Remove the nuts and washers (A, **Figure 39**) securing the mid-point of the fender to the frame.
- b. Remove the nuts and washers (B, **Figure 39**) securing the rear of the fender to the frame.



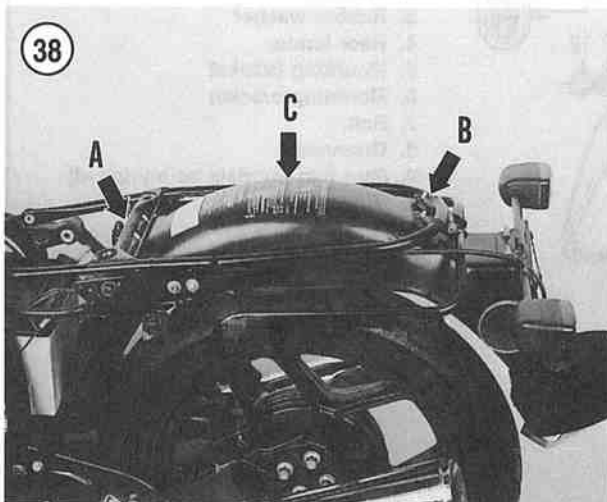
37

### REAR FENDER (ALL OTHER MODELS)

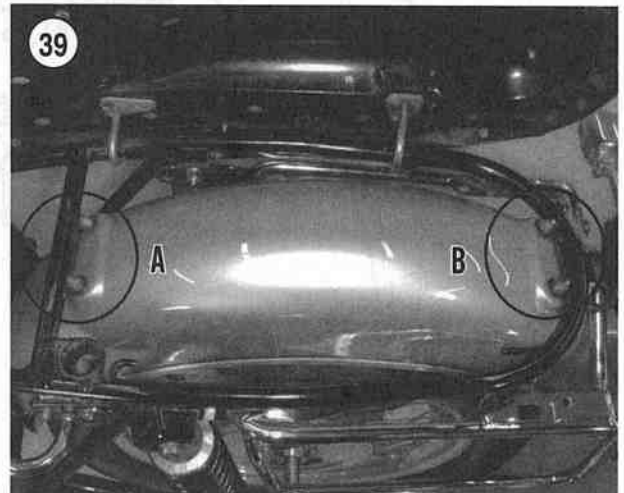


1. Nut
2. Washer
3. Rubber washer
4. Bushing
5. Rubber insert
6. Fender
7. Washer
8. Bolt
9. Bracket
10. Cable holder
11. Rubber plug
12. License plate

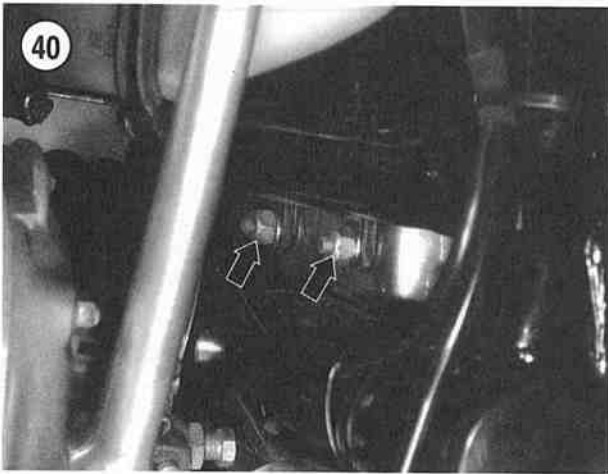
38



39







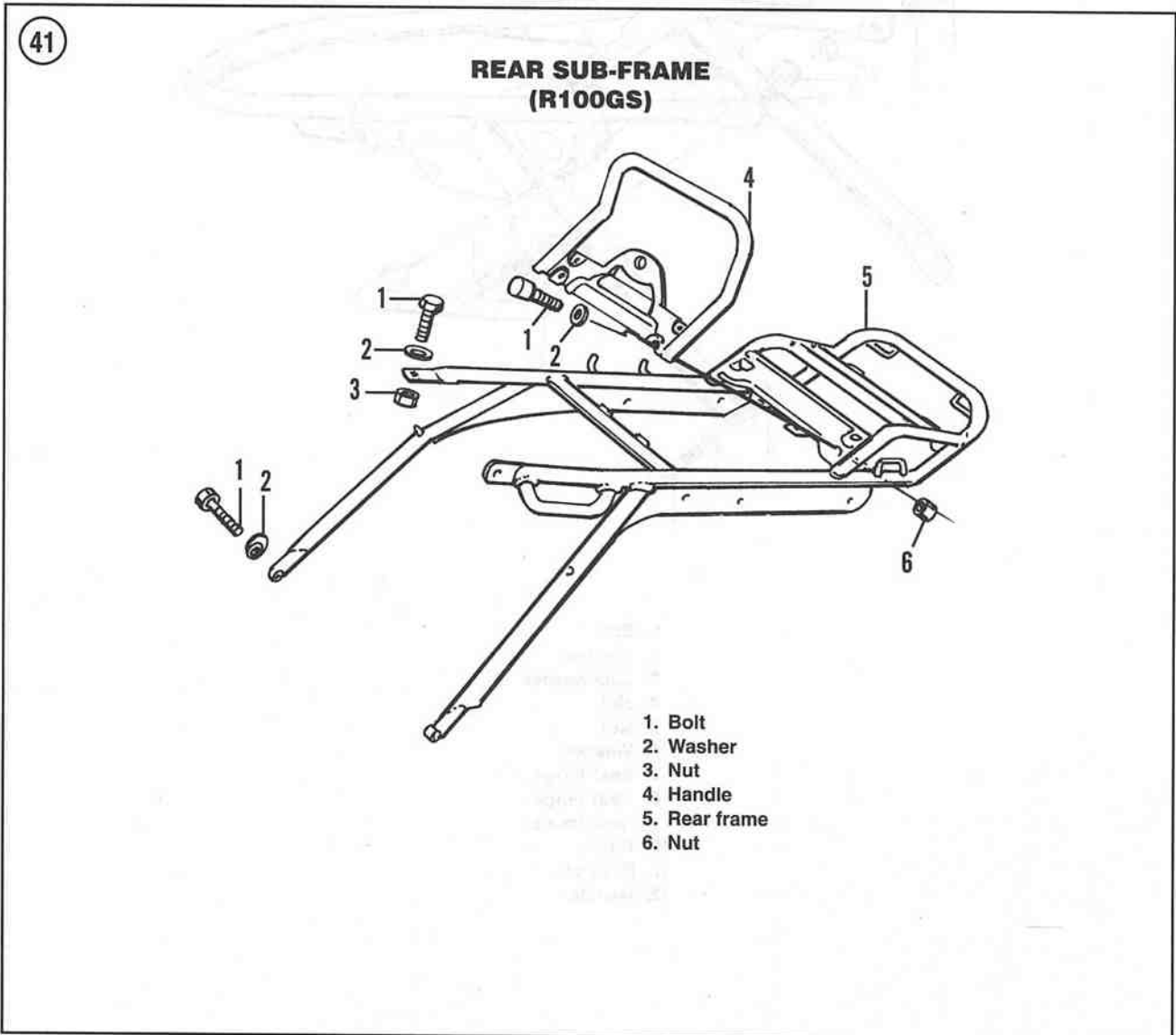
- c. Remove nuts and washer at the front of the fender (Figure 40). Pull the fender toward the back and out of the frame.
- 8. Install by reversing these removal steps. Note the following during installation.
- 9. Tighten the nuts securing the fender securely. Don't overtighten the nuts as the fender may be damaged.

**REAR SUB-FRAME**

**Removal/Installation**

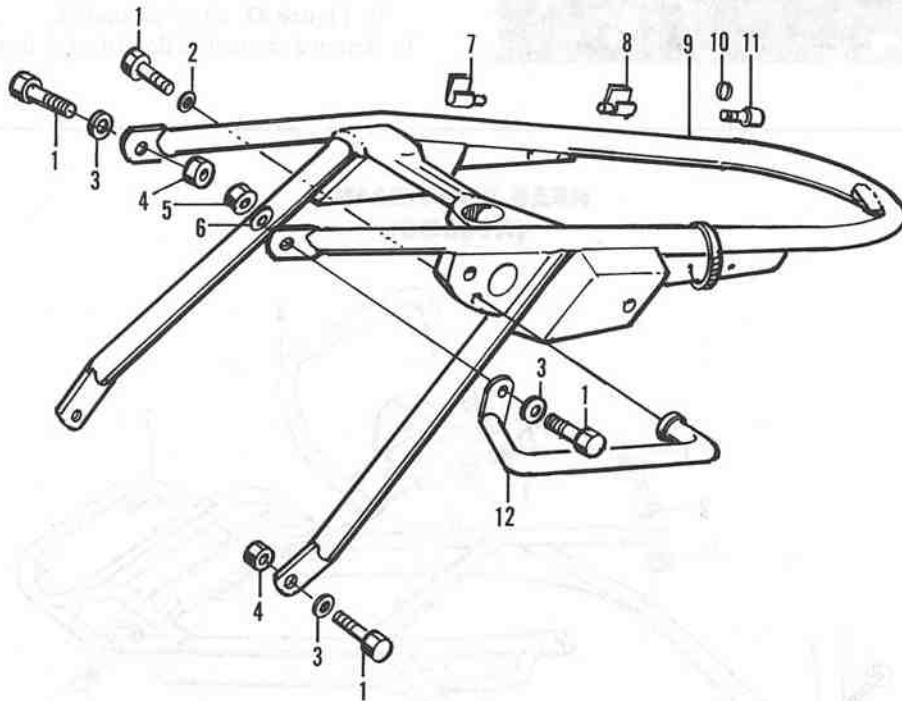
Refer to the following illustrations for this procedure:

- a. Figure 41: R100GS models.
- b. Figure 42: all other models.
- 1. Remove the seat as described in this chapter.

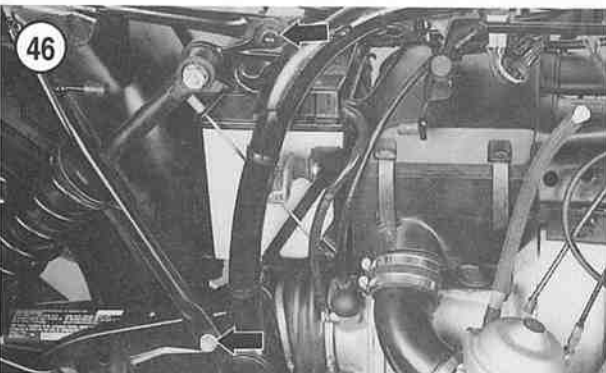
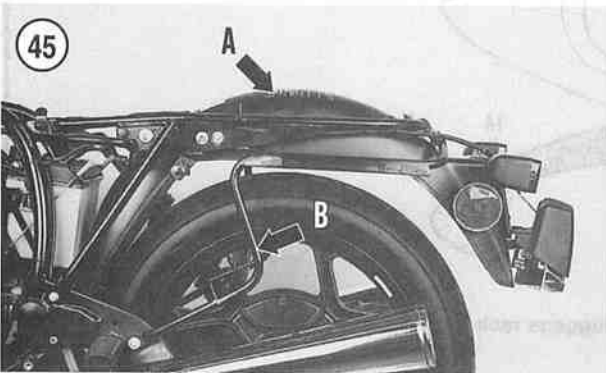
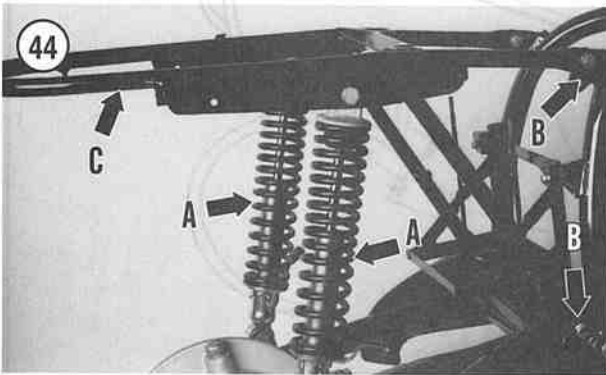
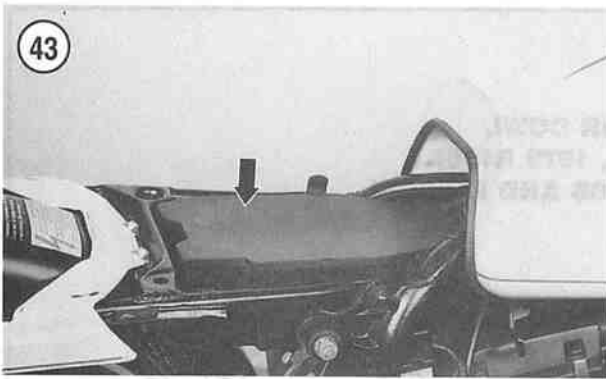


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### REAR SUB-FRAME (ALL OTHER MODELS)



1. Bolt
2. Washer
3. Lockwasher
4. Nut
5. Nut
6. Washer
7. Seat hinge
8. Seat hinge
9. Rear frame
10. Circlip
11. Pivot pin
12. Handle



2. On models so equipped, remove the tool box storage compartment (**Figure 43**).
- 3A. On dual shock models, perform the following:
  - a. Remove the rear fender as described in this chapter.
  - b. Remove the rear shock absorbers (A, **Figure 44**) as described under *Shock Absorber (Dual Shock Models)* in Chapter Ten.
  - b. Remove the bolts, washers, lockwashers and nuts (B, **Figure 44**) securing the sub-frame to the frame.
  - c. Remove the sub-frame (C, **Figure 44**) from the main frame assembly.
- 3B. On all other models, perform the following:
  - a. Remove the rear fender (A, **Figure 45**) as described in this chapter.
  - b. Remove the bolts, washers, lockwashers and nuts (**Figure 46**) securing the sub-frame to the frame.
  - c. Remove the sub-frame (B, **Figure 45**) from the main frame assembly.
4. Install by reversing these removal steps. Note the following during installation.
5. Tighten the bolts and nuts securely.

## SEAT AND TOOL BOX

### Removal/Installation

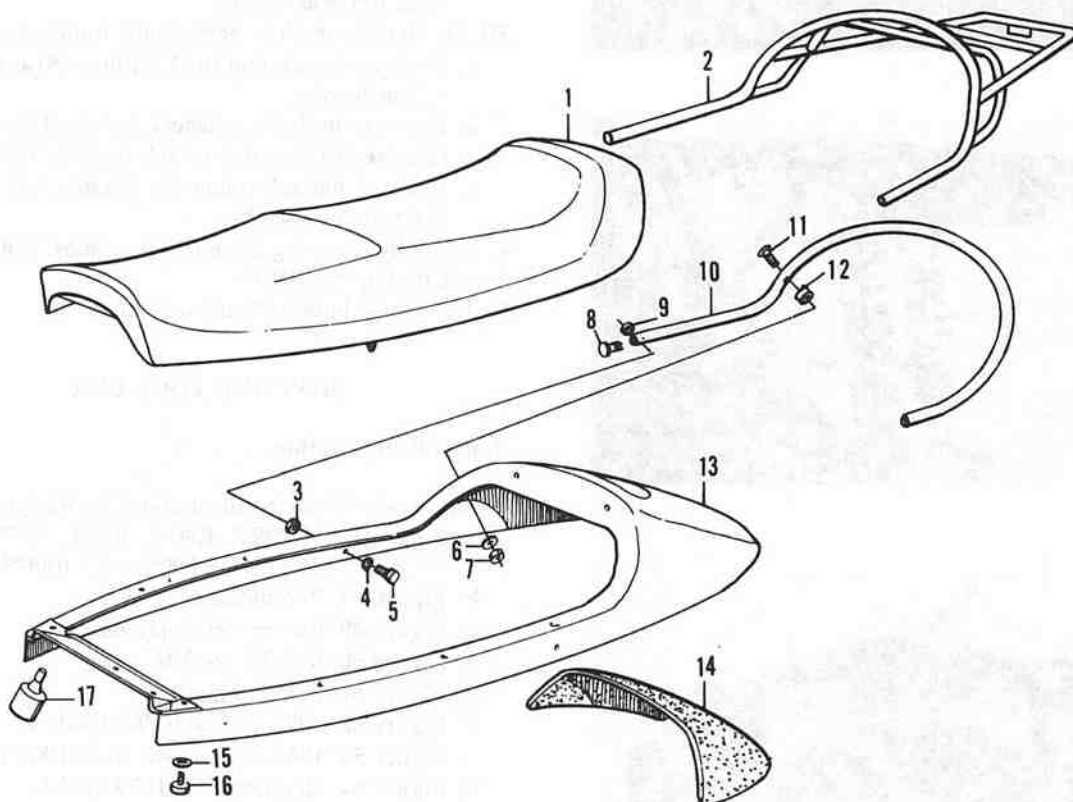
- Refer to the following illustrations for this procedure:
- a. **Figure 47**: R80RT, R90/6, R90S, 1979 R100T, 1978- 1987 R100RT, R100S and R100CS models.
  - b. **Figure 48**: R65 models.
  - c. **Figure 49**: R65 models (optional).
  - d. **Figure 50**: R80G/S models.
  - e. **Figure 51**: R100GS models.
  - f. **Figure 52**: 1977-1978 R100RS models.
  - g. **Figure 53**: 1988-on R100RS and R100RT models.
  - h. **Figure 54**: all other 1970-1979 models.

### NOTE

*BMW has determined that a problem exists with the 1988 R100GS dual seat locating arm. The original locating arm was hot-glued in place at the factory and the glue has a tendency to become brittle with age. Also, if the seat is not installed correctly and this locating arm sits on top of the frame tab instead of under it, the locating arm will break off. If your bike has this problem, return it to your BMW dealer and have them install the new type of locating arm. There should be no charge for this modification if your bike is still covered by the BMW warranty. This problem is covered in BMW Service Information Bulletin No. 52 006 88, August 1988. The locating tab is no longer being attached using this method.*

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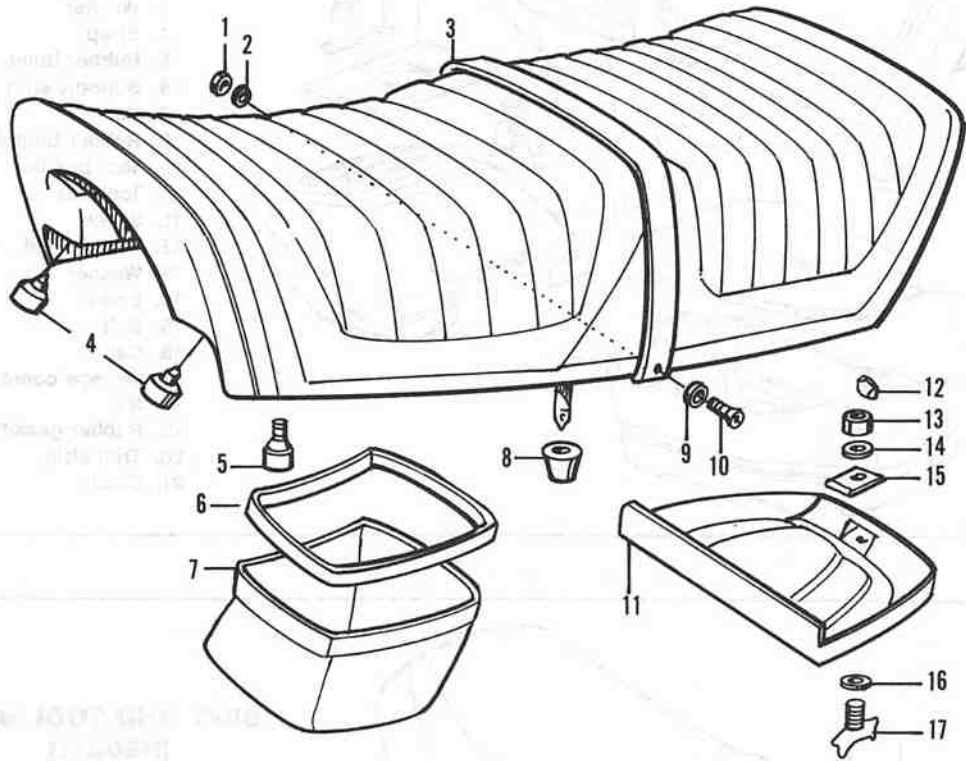
**SEAT AND REAR COWL  
(R80RT, R90/6, R90S, 1979 R100RT,  
1978-1987 R100RT, R100S AND R100CS)**



1. Seat
2. Rear handle and luggage rack
3. Special washer
4. Washer
5. Bolt
6. Washer
7. Nut
8. End plug
9. Nut
10. Rear handle
11. Screw
12. Sleeve
13. Rear cowl
14. Inner gasket
15. Lockwasher
16. Screw
17. Rubber bumper

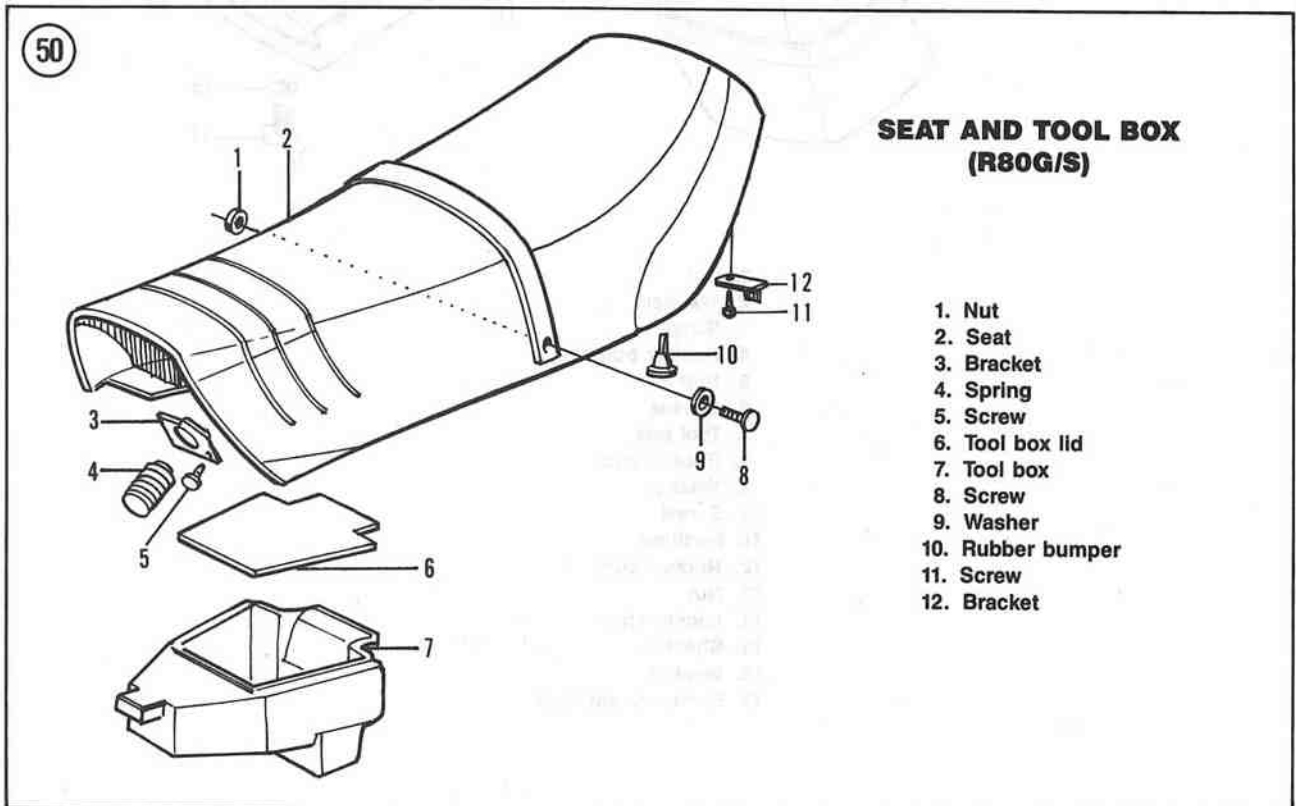
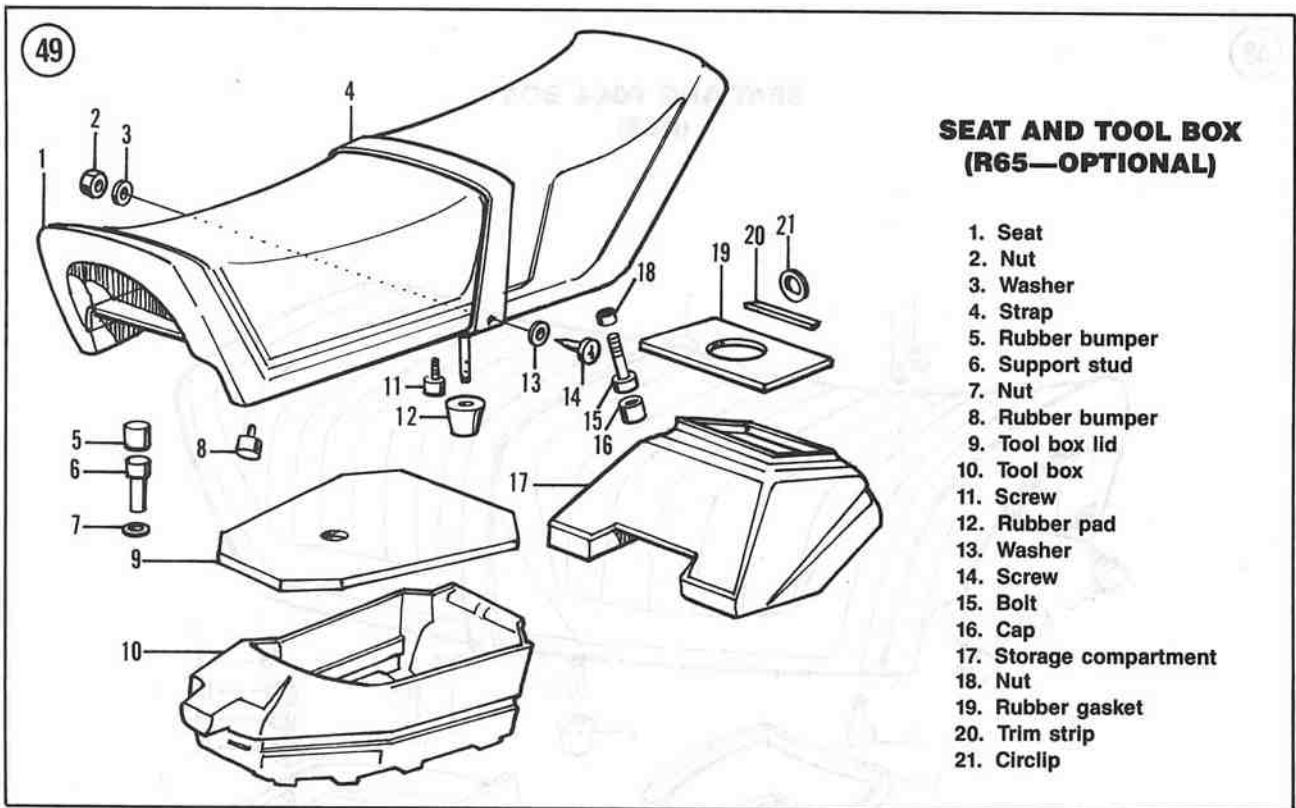
48

**SEAT AND TOOL BOX  
(R65)**



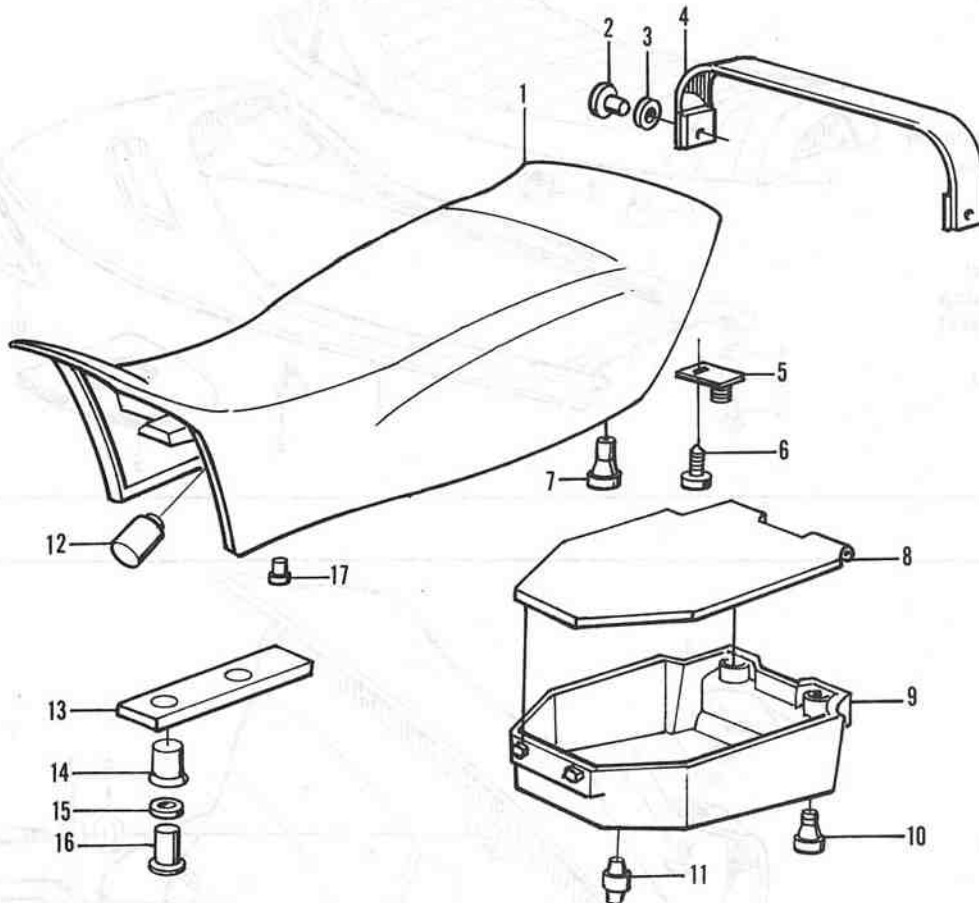
- 1. Nut
- 2. Washer
- 3. Strap
- 4. Rubber bumpers
- 5. Bolt
- 6. Gasket
- 7. Tool box
- 8. Rubber pad
- 9. Washer
- 10. Screw
- 11. Partition
- 12. Rubber stop
- 13. Nut
- 14. Lockwasher
- 15. Shackle
- 16. Washer
- 17. Frame mount stud





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**SEAT AND TOOL BOX  
(R100GS)**

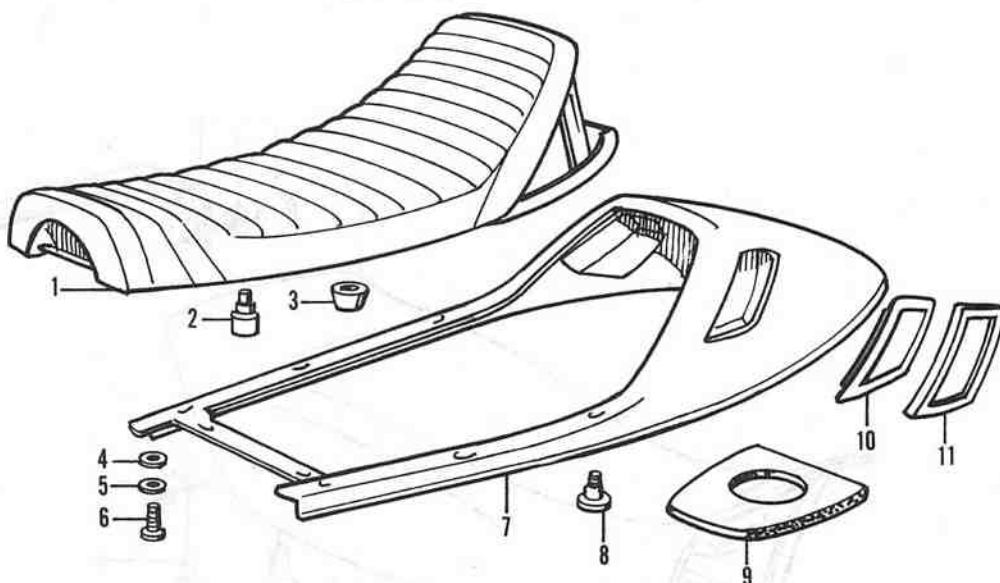


- 1. Seat
- 2. Rivet
- 3. Washer
- 4. Strap
- 5. Bracket
- 6. Strap
- 7. Rubber bumper
- 8. Tool box lid
- 9. Tool box
- 10. Rubber bumper
- 11. Rubber bumper
- 12. Rubber stop
- 13. Bracket
- 14. Rivet
- 15. Flat washer
- 16. Rivet
- 17. Rubber bumper

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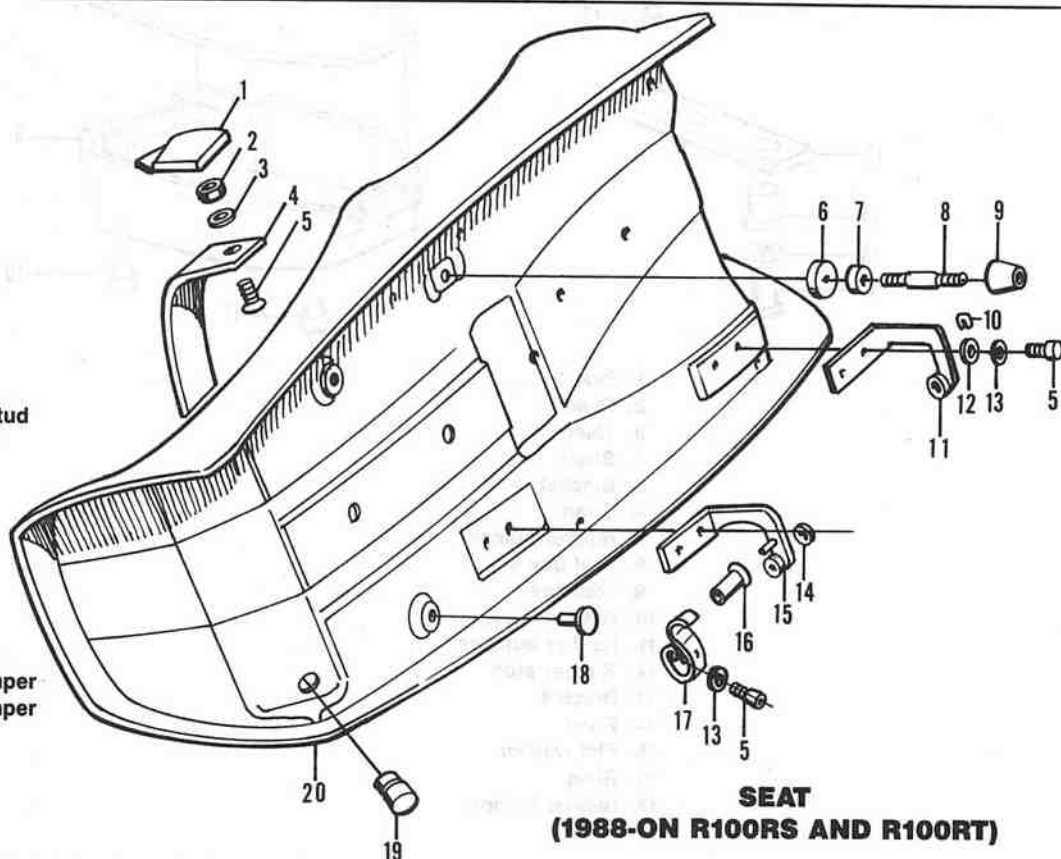
### SEAT AND REAR COWL (1977-1978 R100RS)

1. Seat
2. Rubber bumper
3. Rubber stop
4. Washer
5. Washer
6. Screw
7. Rear cowl
8. Rubber stop
9. Inner gasket
10. Cover
11. Trim strip



53

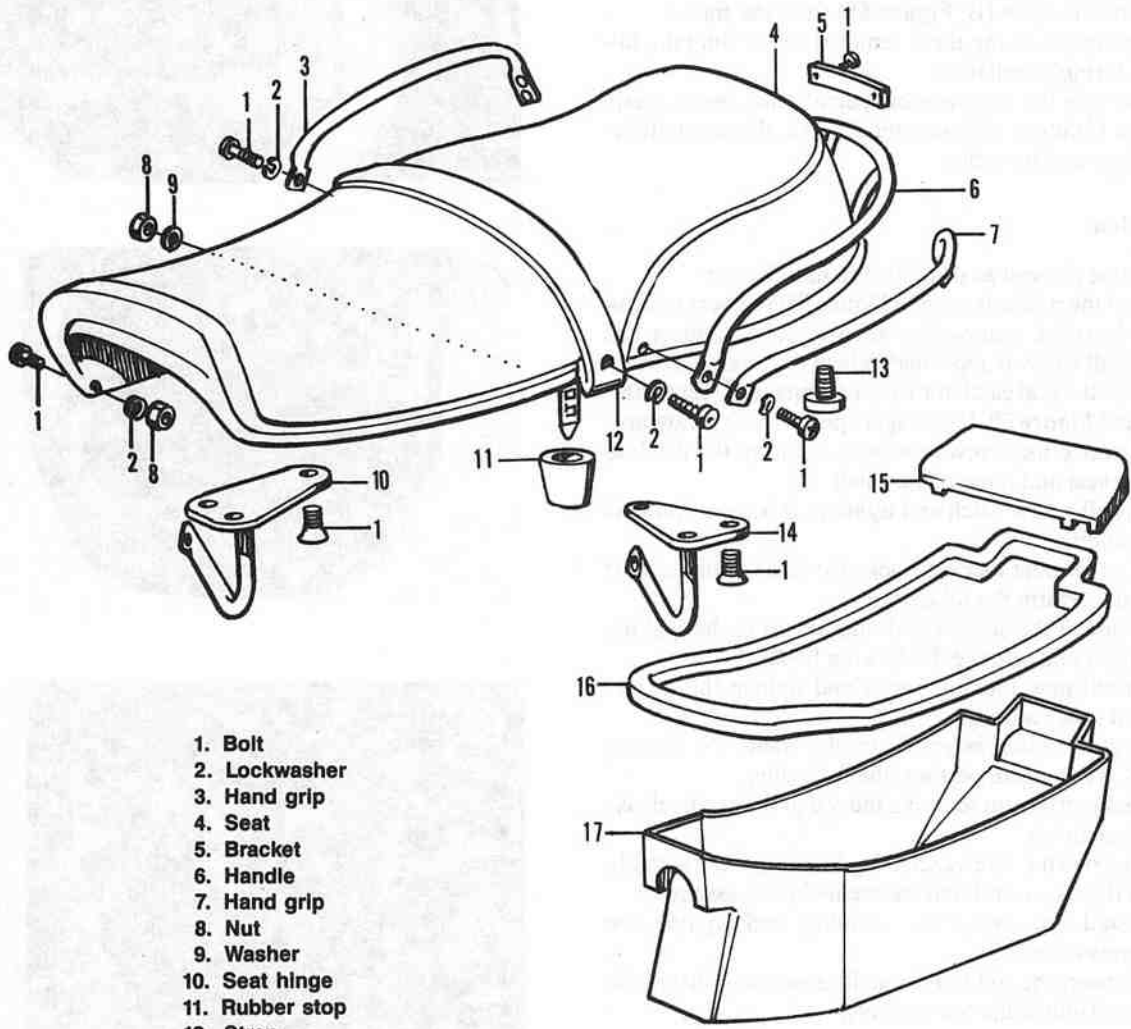
1. Cap
2. Nut
3. Washer
4. Strap
5. Screw
6. Washer
7. Grommet
8. Threaded stud
9. Rubber cap
10. Clip
11. Seat hinge
12. Washer
13. Washer
14. Screw
15. Seat hinge
16. Pivot pin
17. Retainer
18. Rubber bumper
19. Rubber bumper
20. Seat



### SEAT (1988-ON R100RS AND R100RT)

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**SEAT  
(ALL OTHER 1970-1979 MODELS)**

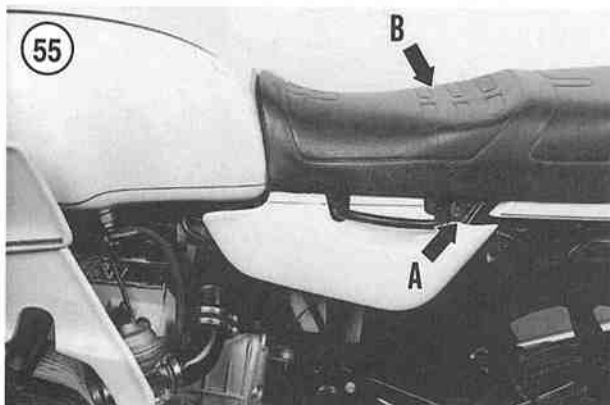
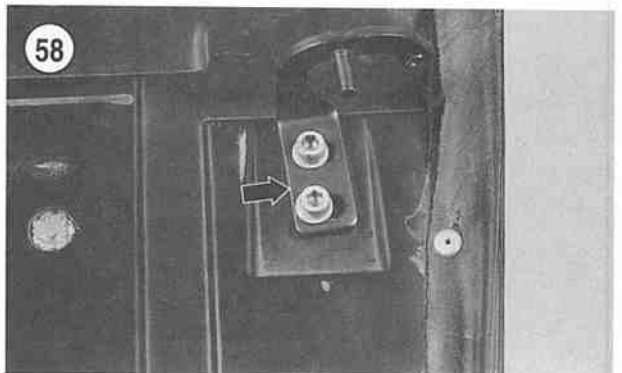
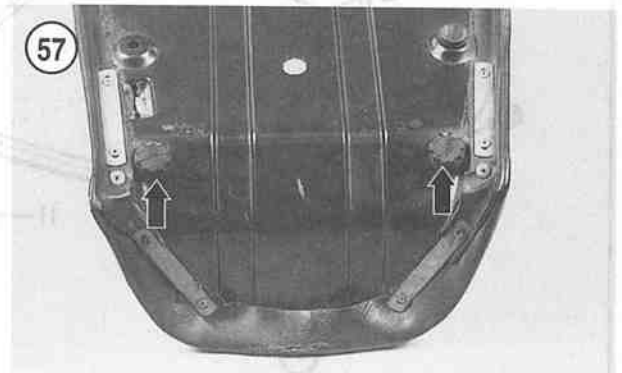
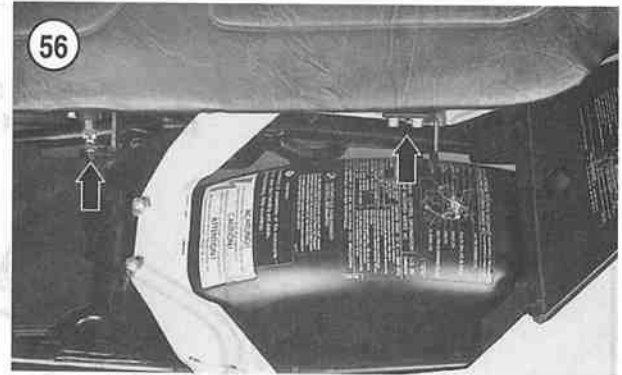


- 1. Bolt
- 2. Lockwasher
- 3. Hand grip
- 4. Seat
- 5. Bracket
- 6. Handle
- 7. Hand grip
- 8. Nut
- 9. Washer
- 10. Seat hinge
- 11. Rubber stop
- 12. Strap
- 13. Bolt
- 14. Seat hinge
- 15. Cap
- 16. Gasket
- 17. Tool box

1. Place the bike on the centerstand.
2. Release the seat with the lock (A, **Figure 55**) either on the left-hand side or at the rear of the seat.
3. Pull up on the left-hand side of the seat and hinge it open.
4. Remove the fasteners (**Figure 56**) or special clips securing the seat to the hinges.
5. Remove the seat (B, **Figure 55**) from the frame.
6. Install by reversing these removal steps. Note the following during installation.
7. Make sure the fasteners or special clips are correctly installed. If they work loose and fall out, the seat will become loose and unstable.

### Inspection

1. Remove the seat as described in this chapter.
2. Inspect the rubber bumpers (**Figure 57**) for wear or damage. If damaged, remove the screws, rubber bumper and plate. Install a new bumper and tighten the screws securely.
3. Inspect the seat catch for wear or damage. Refer to **Figure 58** and **Figure 59**. If damaged, perform the following:
  - a. Remove the screws and nuts securing the catch to the seat and remove the catch.
  - b. Install a new catch and tighten the screws and nuts securely.
4. Inspect the seat locking hooks for wear or damage. If damaged, perform the following:
  - a. Remove the screws and nuts securing the locking hooks and remove the locking hooks.
  - b. Install new locking hooks and tighten the screws and nuts securely.
5. Inspect the catch assembly on the frame for wear or damage. If damaged, perform the following:
  - a. Remove the nut securing the rod to the catch release mechanism.
  - b. Remove the screws securing the lockplate assembly to the frame and remove the lockplate assembly.
  - c. Install the lockplate assembly and tighten the screws securely.
  - d. Connect the rod to the catch release and install the nut. Tighten the nut securely.





REAR COWL

Removal/Installation

(R65LS, 1986-1987 R65, R80, R80RT, 1988-on R100RS and R100RT Models)

Refer to the following illustrations for this procedure:

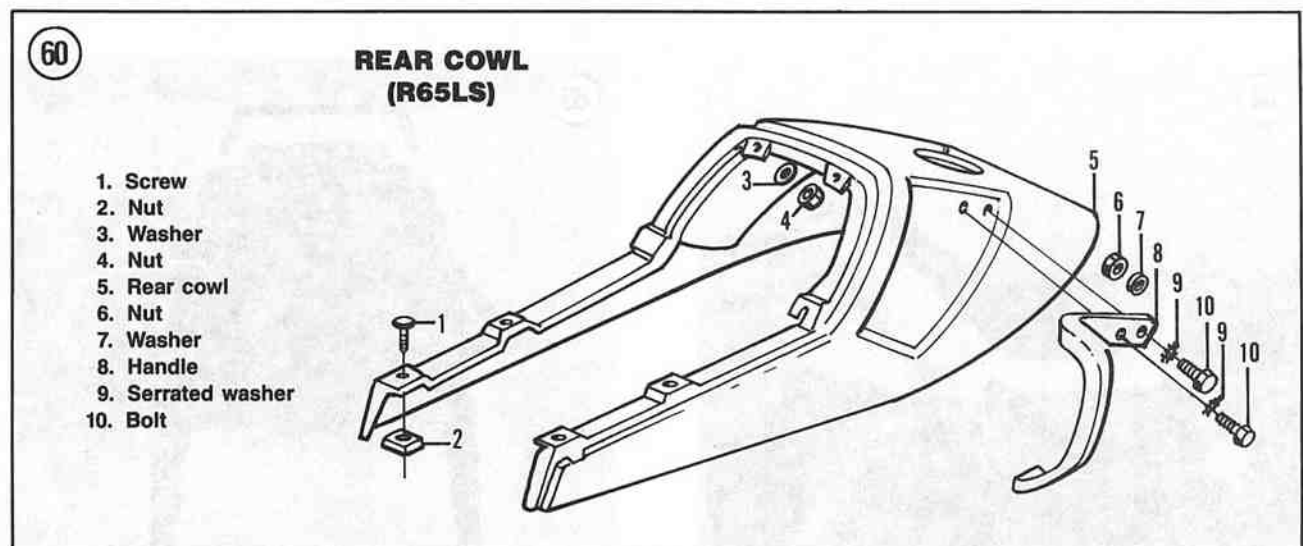
- a. **Figure 60:** R65LS models.
  - b. **Figure 61:** 1986-1987 R65, R80, R80RT, 1988-on R100RS and R100RT models.
1. Remove the side covers and the seat as described in this chapter.
  2. Remove the bolts and washers or self-tapping screws securing the rear cowl (Figure 62) to the frame.
  3. Pull the rear cowl assembly straight up and off of the frame and rear fender.
  4. To separate the lower portion from the upper portion, perform the following:
    - a. Lay a blanket or shop cloths on the workbench to protect the paint finish of the cowl assembly.
    - b. Turn the rear cowl assembly upside down on the blanket or shop cloths.
    - c. Remove the nuts, lockwashers and washers securing the lower portion (Figure 63) to the upper portion.
    - d. Remove the lower portion.
    - e. Install the lower portion onto the upper portion and secure with the nuts and washers. Tighten the nuts securely.
  5. To remove the rear handle from the upper portion, refer to Figure 64 and perform the following:
    - a. Remove the lower portion from the upper portion as described in this procedure.
    - b. Turn the upper portion over in a blanket or shop cloths.
    - c. Remove the bolts, nuts, lockwashers and washers securing the rack (Figure 65).
    - d. Remove the rack.

- e. Install the rack and secure with the bolts, nuts, lockwashers and washers. Tighten the nuts securely.
6. Install by reversing these removal steps. Note the following during installation.
7. Securely tighten the bolts or self-tapping screws retaining the rear cowl. Don't overtighten the fasteners as the plastic mounting bosses may be damaged.

Removal/Installation  
(All Other Models)

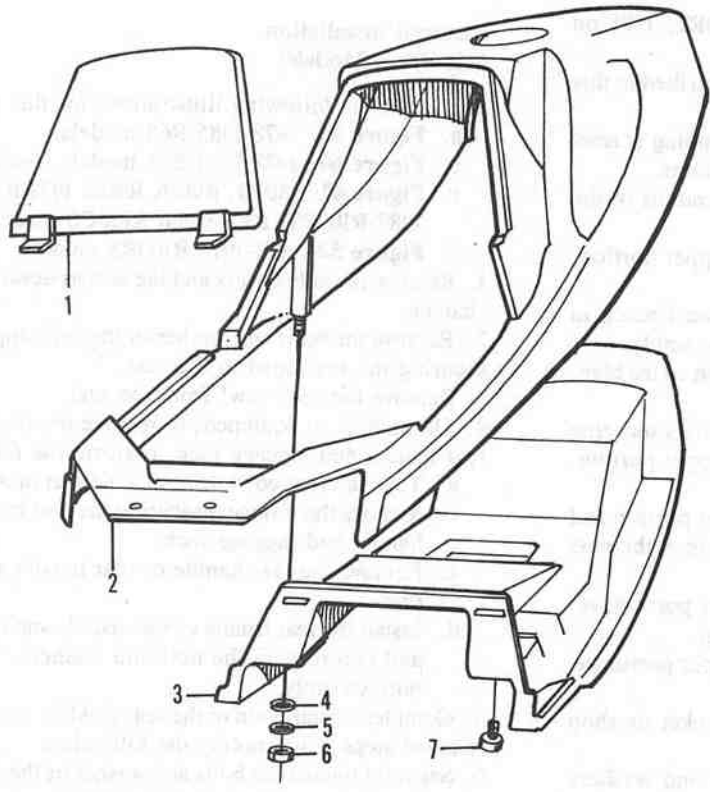
Refer to the following illustrations for this procedure:

- a. **Figure 66:** 1978-1985 R65 models.
  - b. **Figure 67:** 1978-1985 R65 models (optional).
  - c. **Figure 47:** R80RT, R90/6, R90S, 1979 R100T, 1978-1987 R100RT, R100S and R100CS models.
  - d. **Figure 52:** 1977-1978 R100RS models.
1. Remove the side covers and the seat as described in this chapter.
  2. Remove the bolts and washer or the self-tapping screws securing the rear cowl to the seat.
  3. Remove the rear cowl from the seat.
  4. On models so equipped, to remove the rear handle or rear handle and luggage rack, perform the following:
    - a. Turn the rear cowl over on a blanket or shop cloths.
    - b. Remove the fasteners securing the rear handle or rear handle and luggage rack.
    - c. Remove the rear handle or rear handle and luggage rack.
    - d. Install the rear handle or rear handle and luggage rack and secure with the nuts and washers. Tighten the nuts securely.
  5. Complete installation of the rear cowl by reversing these removal steps while noting the following.
  6. Securely tighten the bolts and washer or the self-tapping screws. Don't overtighten the fasteners as the plastic mounting bosses may be damaged.



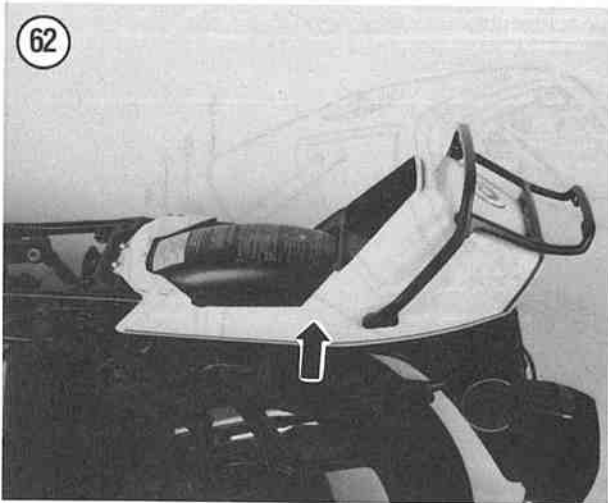
61

**REAR COWL  
(1986-1987 R65, R80,  
R80RT, 1988-ON R100RS AND R100RT)**

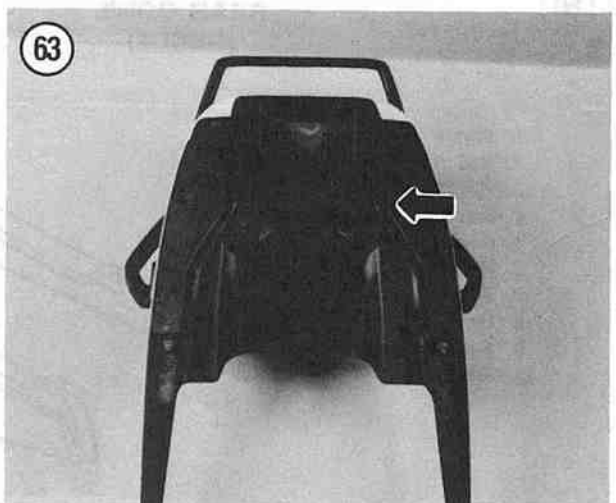


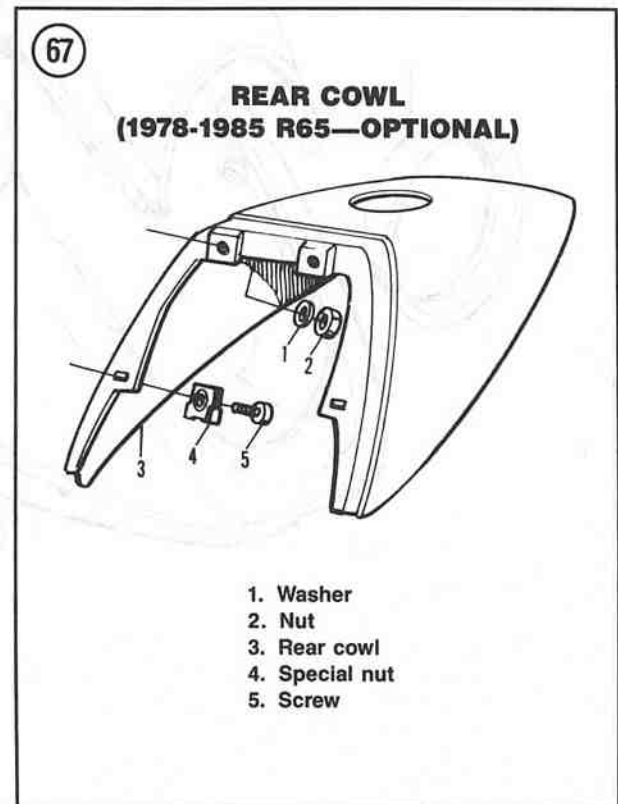
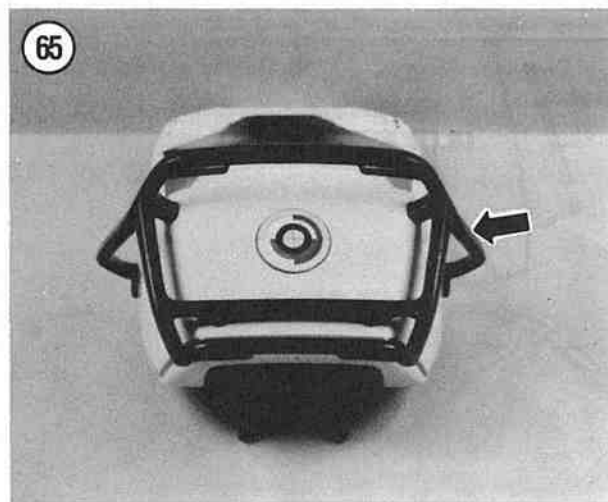
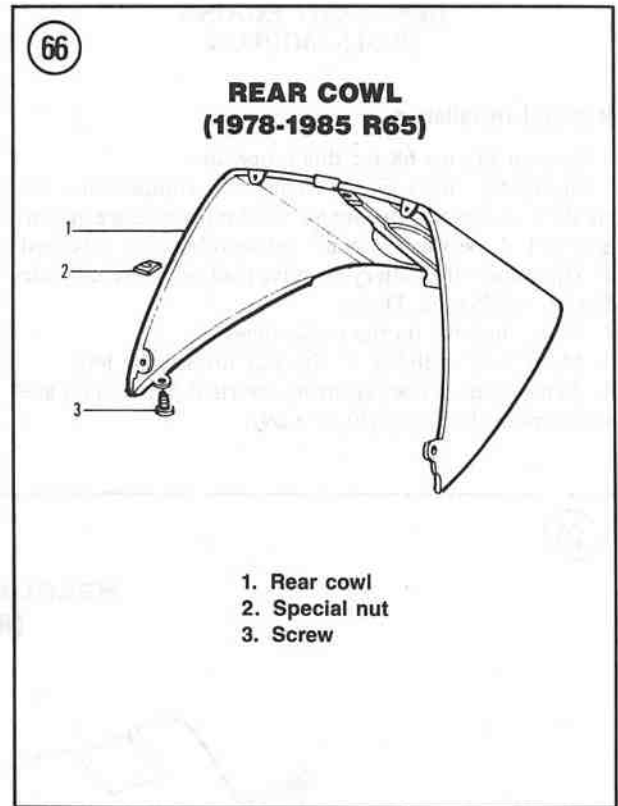
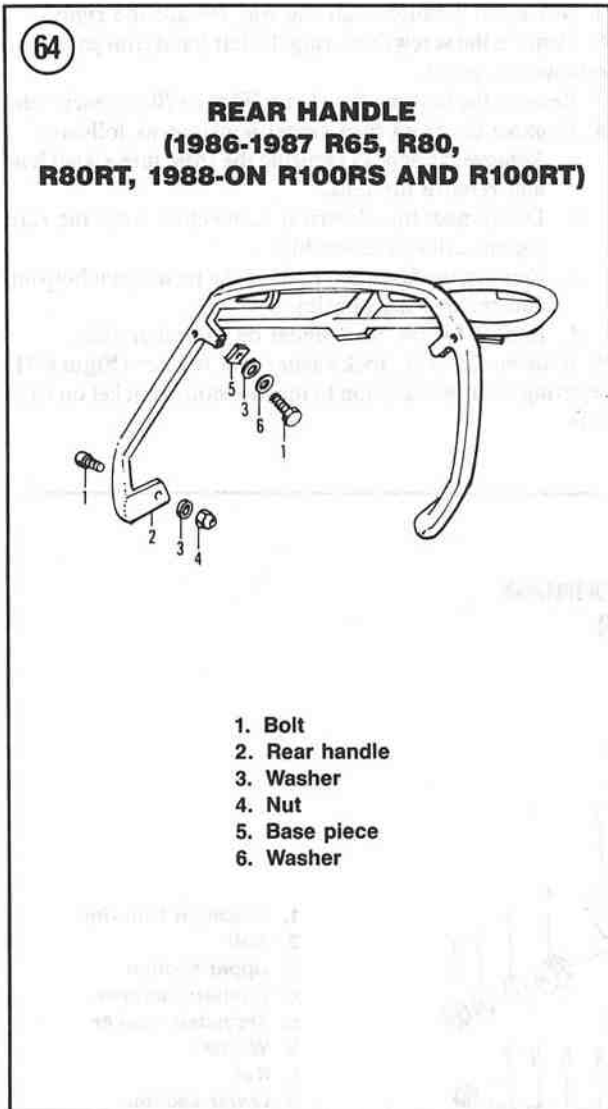
- 1. Storage lid
- 2. Rear cowl
- 3. Lower section
- 4. Washer
- 5. Lockwasher
- 6. Nut
- 7. Screw

62



63





### HEADLIGHT FAIRING (R65LS MODELS)

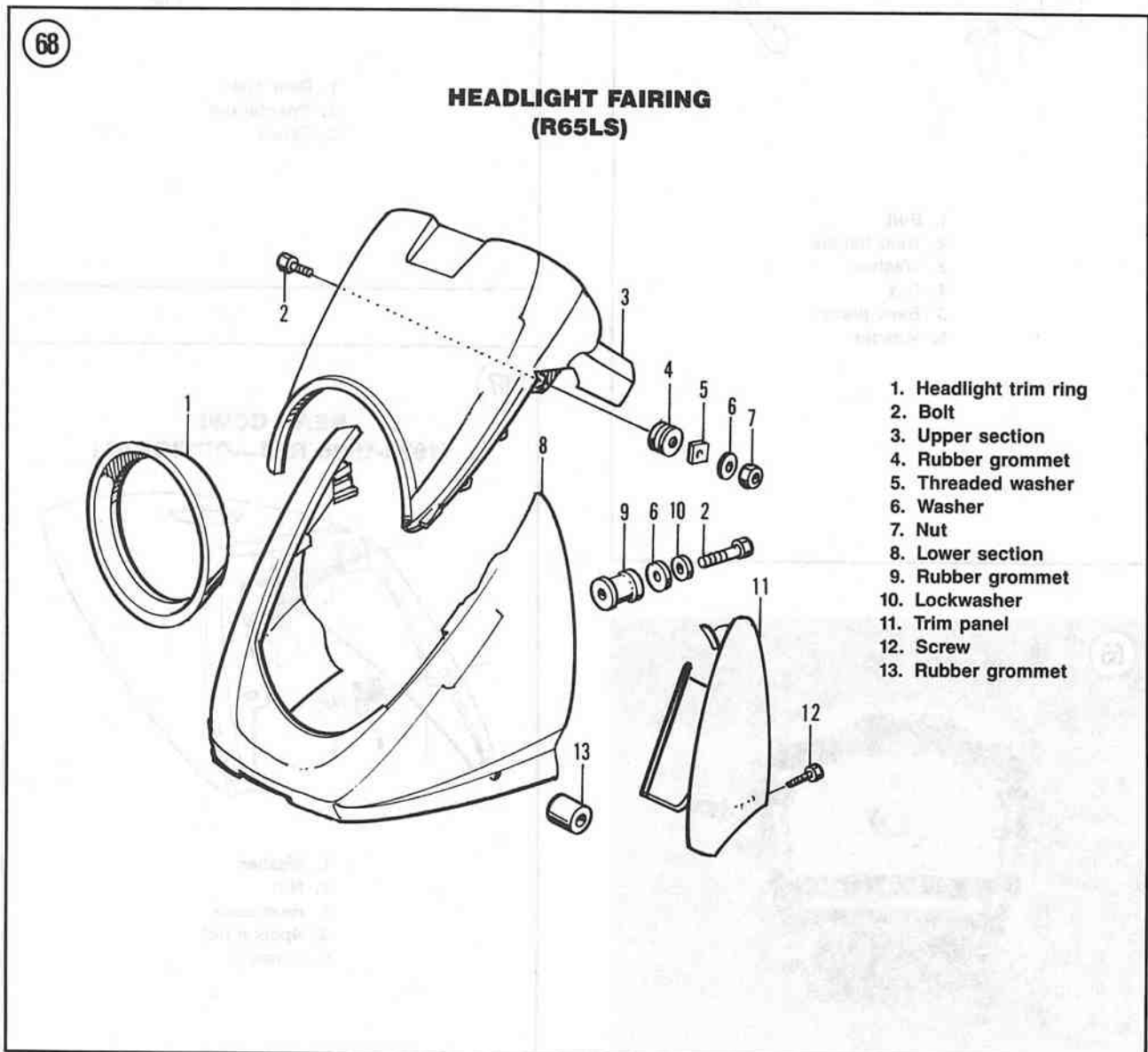
#### Removal/Installation

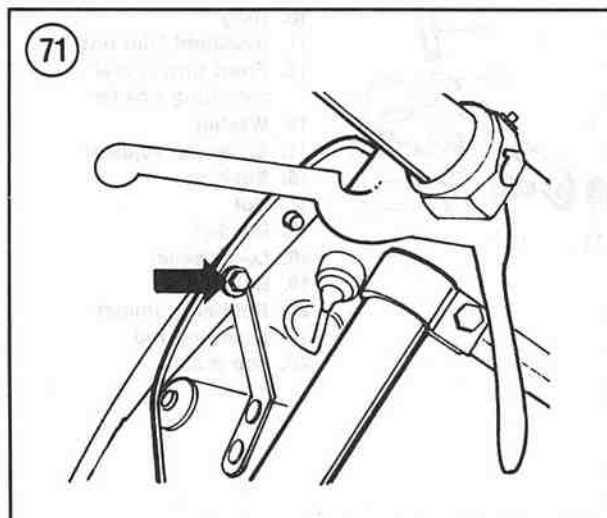
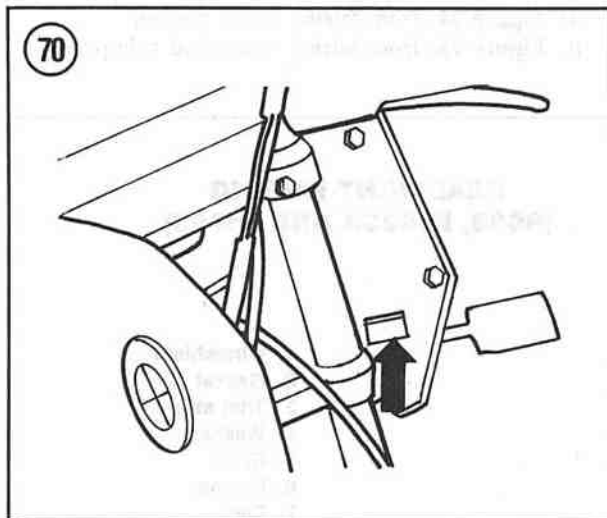
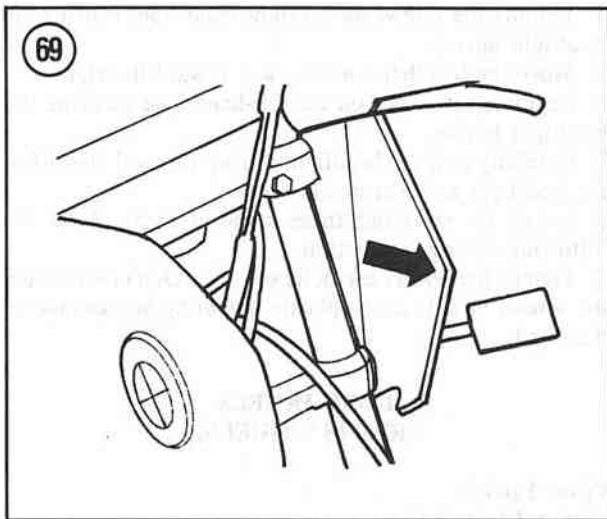
Refer to **Figure 68** for this procedure.

**Figure 68** shows the left-hand side components. The right-hand components are an exact mirror image and are attached in the same manner unless otherwise specified.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Place the bike on the centerstand.
3. Move the handlebar all the way toward the left.
4. Remove the screws securing the right-hand trim panel and remove the panel (**Figure 69**).

5. Move the handlebar all the way toward the right.
6. Remove the screws securing the left-hand trim panel and remove the panel.
7. Remove the bolts on the clamp (**Figure 70**) on each side.
8. Remove the front turn signal housings as follows:
  - a. Remove the screws securing the front turn signal lens and remove the lens.
  - b. Disconnect the electrical connectors from the turn signal reflector assembly.
  - c. Remove the fastener securing the turn signal housing and remove the housing.
  - d. Repeat for the turn signal on the other side.
9. Remove the bolt, lockwasher and washer (**Figure 71**) securing the lower section to the mounting bracket on each side.





10. Carefully pull the lower section forward and off of the mounting bracket.
11. Remove the ring nut on the ignition switch.
12. Partially pull the upper section off of the instrument cluster, then tilt it forward enough to gain access to the instrument warning light electrical connectors.
13. Disconnect the electrical connectors from the instrument warning lights.
14. Carefully pull the upper section off of the instrument cluster and remove it.
15. Install by reversing these removal steps. Note the following during installation.
16. Tighten the screws and bolts securely. Don't overtighten the screws or nuts as the plastic mounting bosses may be damaged.
17. Make sure all electrical connectors are free of corrosion and are tight.

### HEADLIGHT FAIRING (R90S, R100CS AND R100S MODELS)

#### Removal/Installation

Refer to **Figure 72** for this procedure.

**Figure 72** shows the majority of the components for the left-hand side. The right-hand components are an exact mirror image and are attached in the same manner unless otherwise specified.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Place the bike on the centerstand.
3. Remove the front turn signal housings as follows:
  - a. Remove the screws securing the front turn signal lens and remove the lens.
  - b. Disconnect the electrical connectors from the turn signal reflector assembly.
  - c. Remove the fastener securing the turn signal housing and remove the housing from the support arm.
  - d. Repeat for the turn signal on the other side.
4. Disconnect the electrical connectors from the clock and voltmeter.
5. Remove the bolt, washer and nut on each side securing the mounting rod to the top plate located at the top of each fork assembly.
6. Remove the rubber bushing and grommet from the right-hand turn signal bracket.
7. Carefully tilt the front fairing forward until it clears the headlight assembly.

#### CAUTION

*Do not pull too hard on the lower portion of the front fairing when removing it from the turn signal brackets. The front fairing is fiberglass and the lower portion will crack or break if it is spread out too much during removal.*



8. Carefully move the front fairing toward the right-hand side until it clears the right-hand turn signal bracket.
9. Pull the right-hand side forward and then toward the left-hand side until it clears the left-hand turn signal bracket.
10. Remove the front fairing from the bike.
11. Install by reversing these removal steps. Note the following during installation.
12. Tighten the bolts and nuts securely.

### HEADLIGHT FAIRING (R100GS MODELS)

#### Removal/Installation

Refer to **Figure 73** for this procedure.

**Figure 73** shows the right-hand side fasteners. The left-hand fasteners are an exact mirror image.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Place the bike on the centerstand.
3. Move the handlebar all the way toward the left.

4. Remove the screws on the right-hand side securing the headlight fairing.
5. Move the handlebar all the way toward the right.
6. Remove the screws on the left-hand side securing the headlight fairing.
7. Carefully pull the headlight fairing forward and off of the headlight and instrument cluster.
8. Install by reversing these removal steps. Note the following during installation.
9. Tighten the screws and bolts securely. Don't overtighten the screws or nuts as the plastic mounting bosses may be damaged.

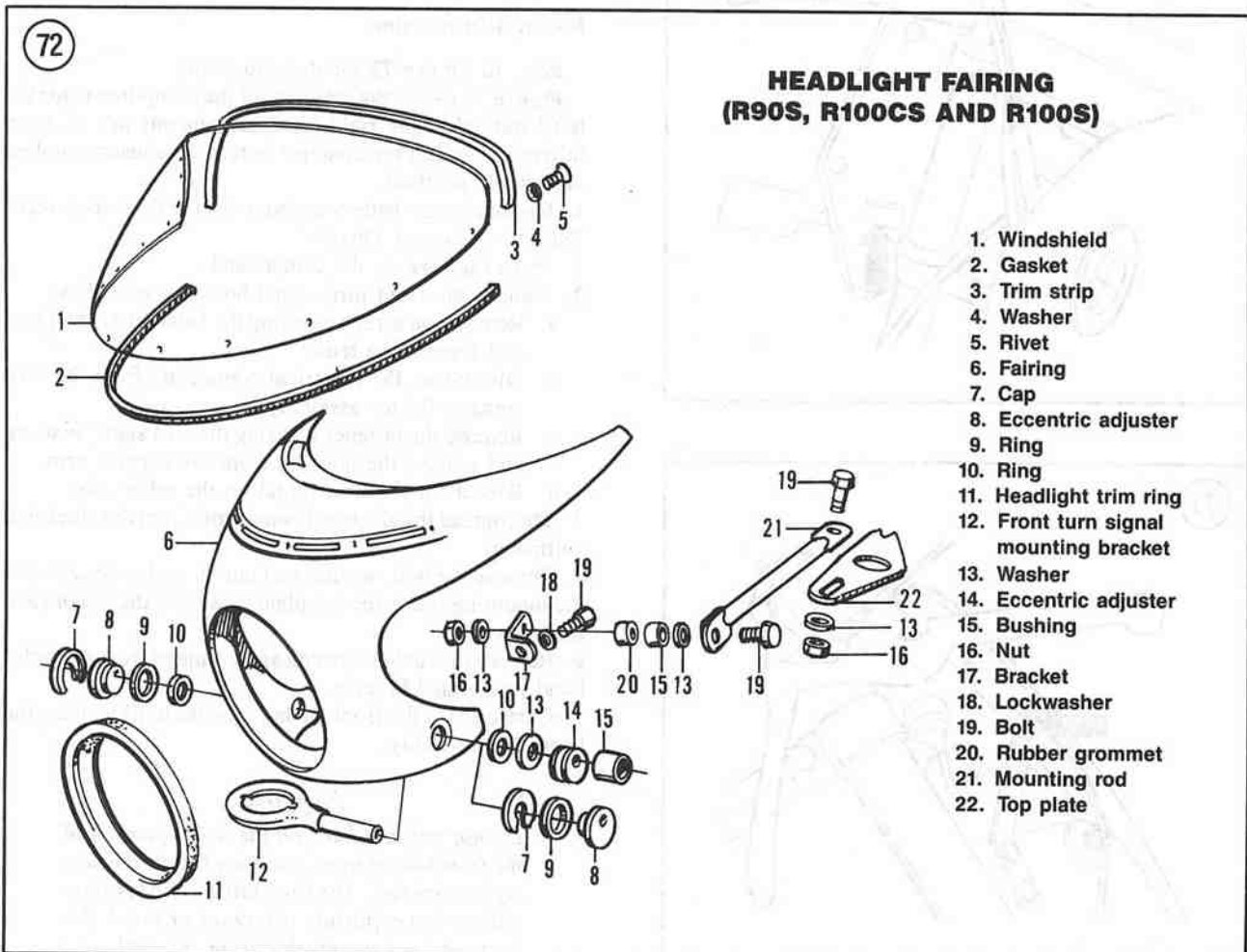
### BODY PANELS (R100RS MODELS)

#### Front Fairing

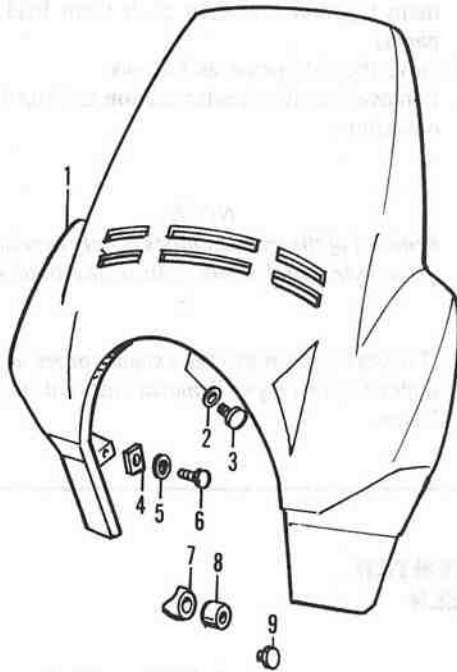
#### Removal/Installation

Refer to the following illustrations for this procedure:

- a. **Figure 74:** front fairing upper portion.
- b. **Figure 75:** front fairing center and side panels.



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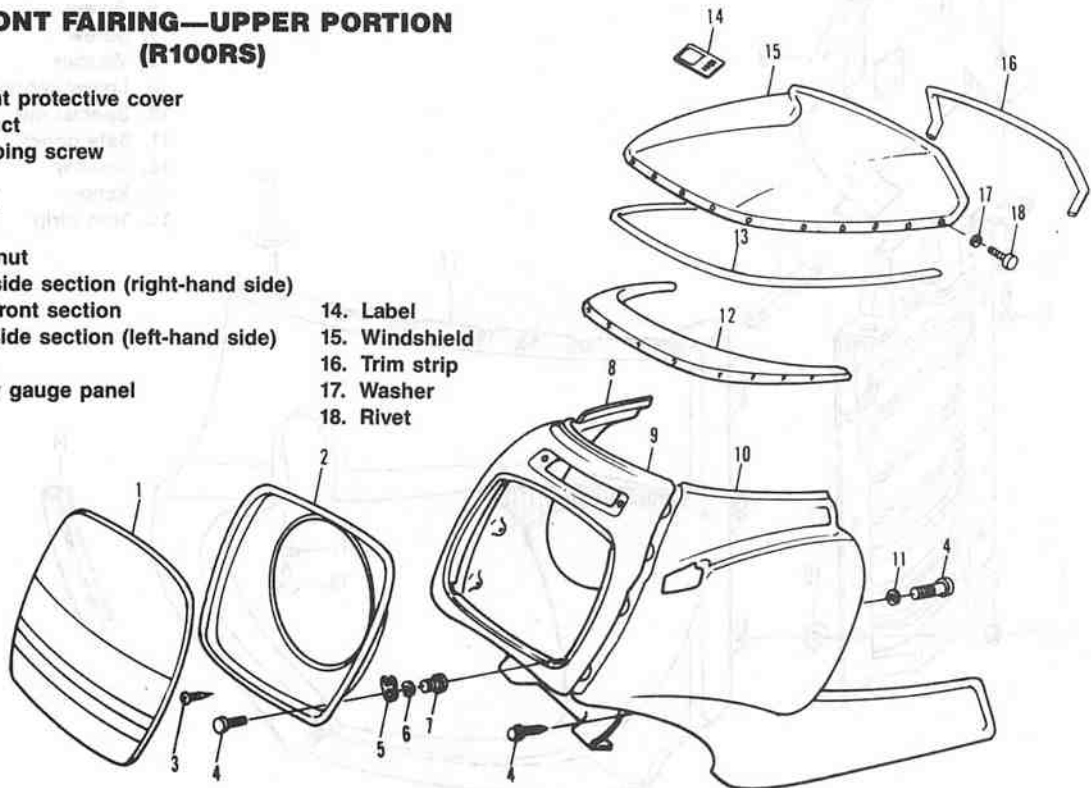
**HEADLIGHT FAIRING  
(R100GS)**

- 1. Fairing
- 2. Washer
- 3. Screw
- 4. Nut
- 5. Washer
- 6. Screw
- 7. Pad
- 8. Bushing
- 9. Plug

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**FRONT FAIRING—UPPER PORTION  
(R100RS)**

- 1. Headlight protective cover
- 2. Light duct
- 3. Self-tapping screw
- 4. Bolt
- 5. Support
- 6. Washer
- 7. Special nut
- 8. Fairing side section (right-hand side)
- 9. Fairing front section
- 10. Fairing side section (left-hand side)
- 11. Washer
- 12. Auxiliary gauge panel
- 13. Gasket
- 14. Label
- 15. Windshield
- 16. Trim strip
- 17. Washer
- 18. Rivet



With the exception of the front fairing upper portion, the illustrations show the left-hand side components. The right-hand components are an exact mirror image and are attached in the same manner unless otherwise specified.

1. Disconnect the battery negative lead as described under *Battery* in Chapter Three.
2. Remove the fuel tank (Figure 76) as described under *Fuel Tank* in Chapter Seven.
3. Remove the lower center section as follows:
  - a. Remove the screws and washers around the outer perimeter of the lower center section (Figure 77).
  - b. Slide the lower center section down slightly and push in at the top.
  - c. Remove the lower center section from the side panels. Don't lose the special nuts on the attachment points of each side panel. If the nuts are loose on the

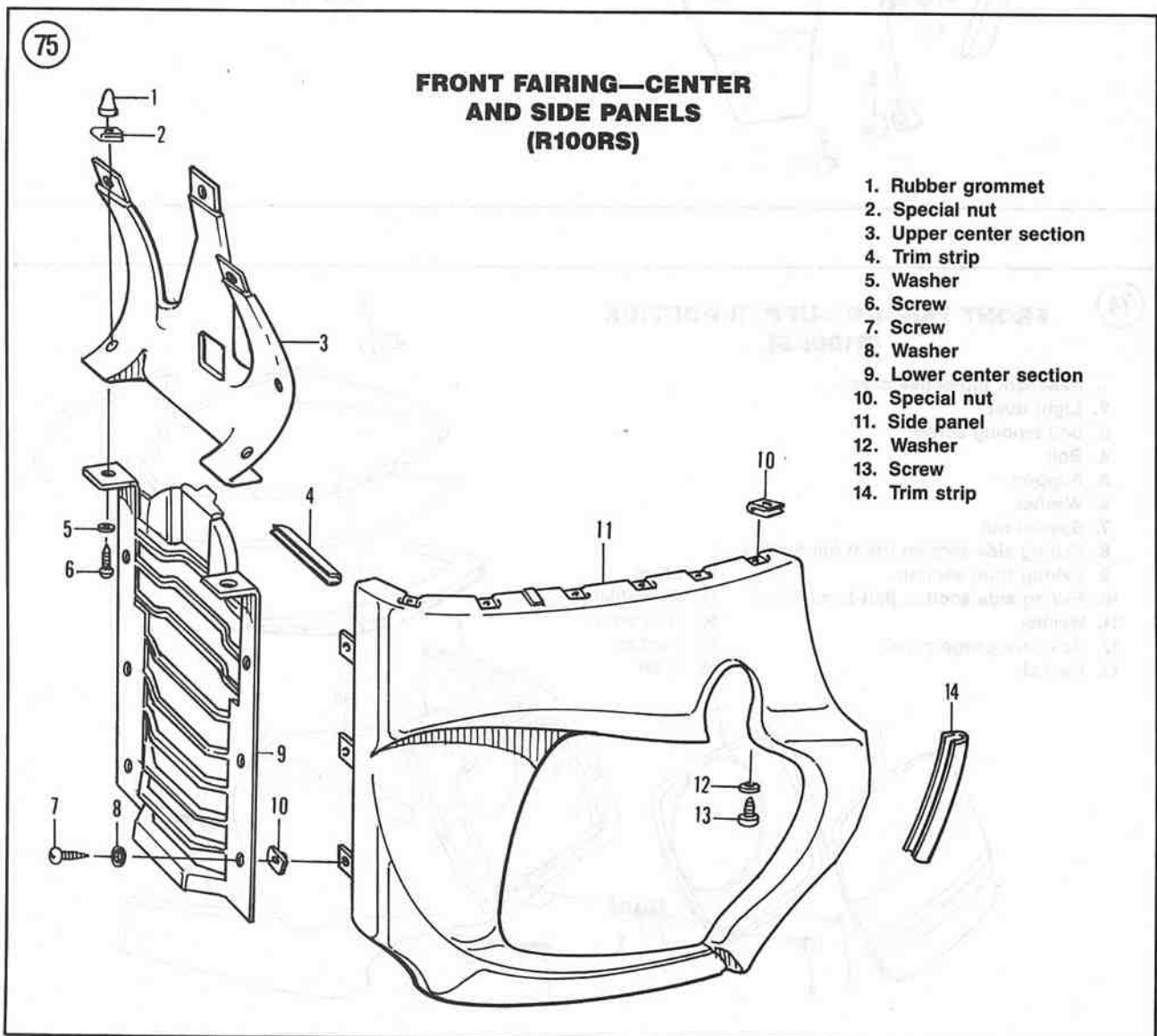
mounting tabs, remove them from the panel, squeeze them together and then push them back onto the panel.

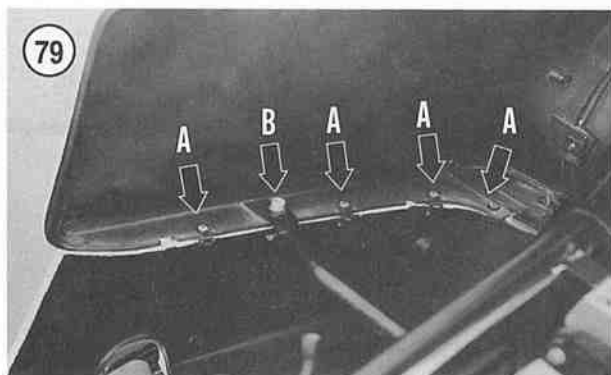
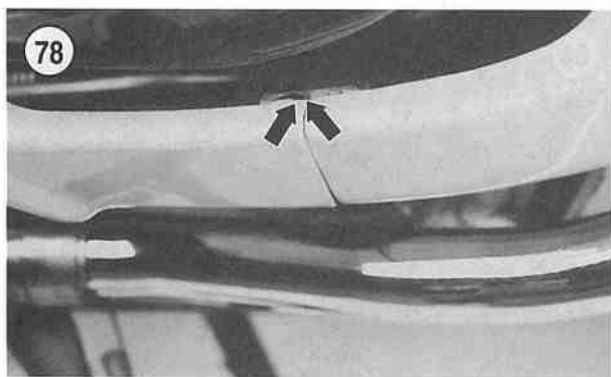
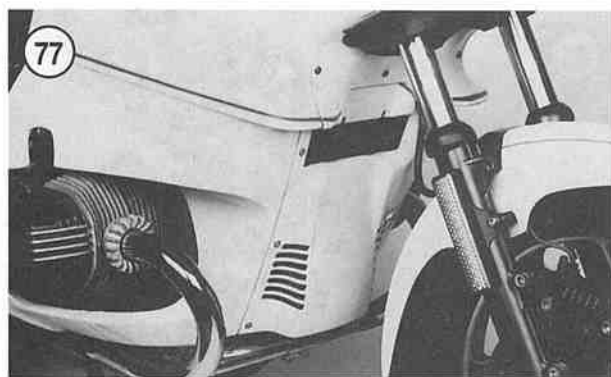
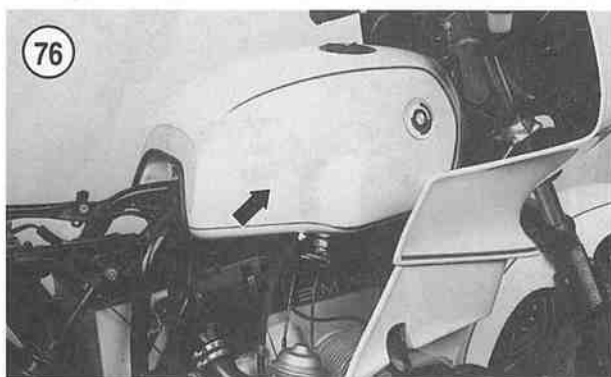
4. Remove the side panel as follows:
  - a. Remove the lower center section as described in this procedure.

**NOTE**

*Removal of the exhaust pipes is only necessary if the side panel is not split at the bottom.*

- b. If necessary, remove the exhaust pipes as described under *Exhaust Pipes Removal/Installation* in Chapter Seven.





**NOTE**

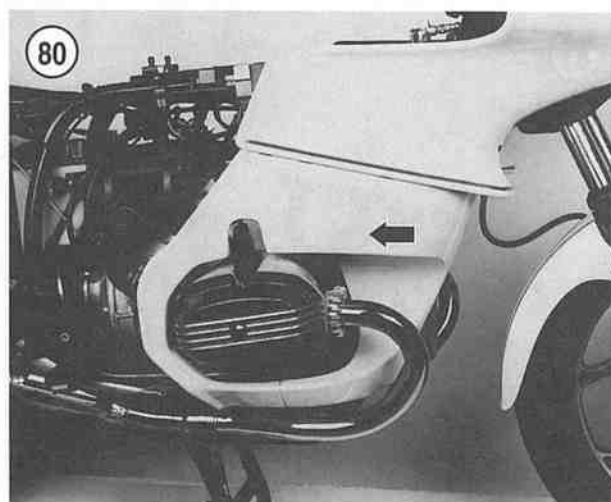
*In Figure 78 the bolts and nuts are not visible. They are located on either side of the split in the body panel.*

- c. Remove the bolts and nuts (**Figure 78**) securing the bottom of the side panel to the lower mounting bracket.
- d. Remove the screws (A, **Figure 79**) securing the top of the side panel to the front fairing upper portion.
- e. Remove the bolt, washer and nut (B, **Figure 79**) securing the top of the side panel and the front fairing upper portion to the rear mounting bracket.

**CAUTION**

*Do not pull too hard on the lower portion of the side panel when removing it from around the exhaust pipes. The side panel is fiberglass and the lower portion will crack or break if it is spread out too much during removal.*

- f. Pull the side panel (**Figure 80**) away from the upper section and maneuver the lower portion away from the exhaust pipe.
  - g. Repeat this step for the side panel assembly on the other side.
5. Remove the upper center section as follows:
- a. Remove the side panel assembly on each side as described in this procedure.
  - b. Carefully pull the front fork rubber boots (**Figure 81**) down and off of the upper center section. Slide the boots down.
  - c. Carefully slide the metal brake line and the rubber grommet (**Figure 82**) up and out of the groove in the upper center section.

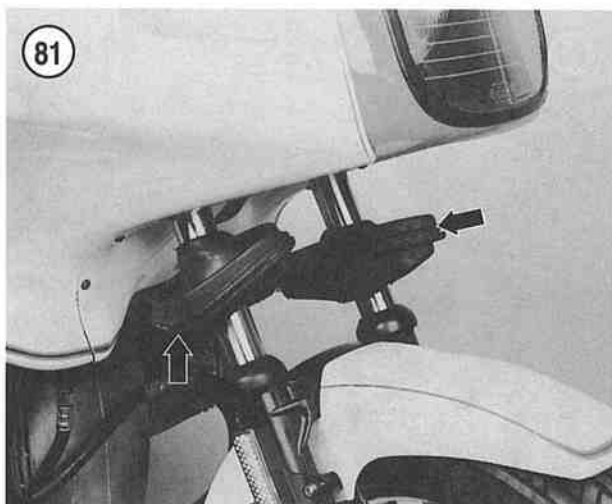
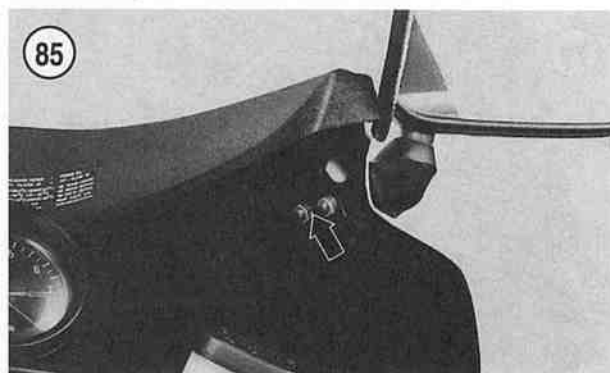
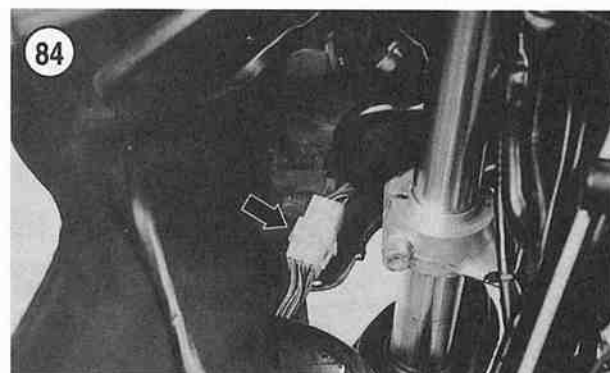
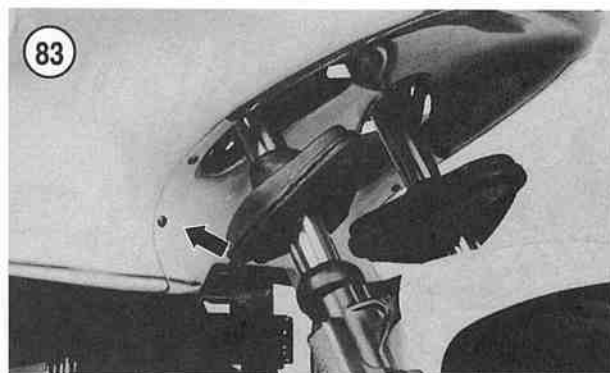
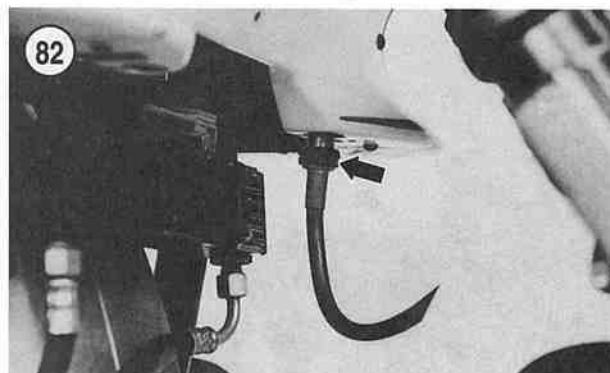


- d. Remove the screws securing the upper center section (**Figure 83**).
- e. Remove the upper center section.
6. Remove the front fairing upper portion as follows:
  - a. To protect the finish, place a couple of blankets on the workbench or floor for the upper portion of the front fairing to sit on after removal.
  - b. Remove all of the front fairing components below the upper portion as described in this procedure.
  - c. On the left-hand side next to the headlight, disconnect the 6-pin electrical connector (**Figure 84**).
  - d. Remove the nuts and washer (**Figure 85**) securing the rear view mirrors and remove both mirrors (A, **Figure 86**). These nuts also secure the fairing to the front mounting bracket.

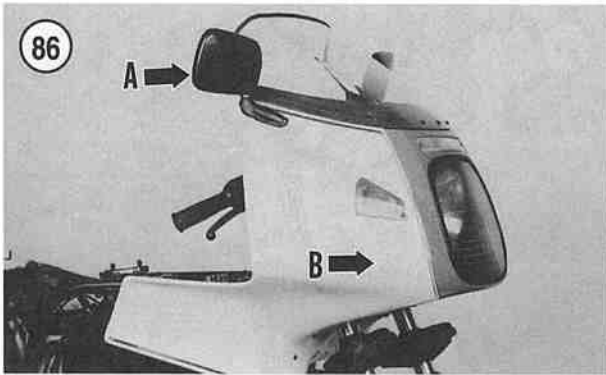
**NOTE**

*The next step requires the aid of an assistant. The upper portion of the fairing is not heavy but is difficult to hold in place while removing the mounting bolts and nuts.*

- e. Have an assistant hold onto the front of the upper portion of the front fairing.
- f. Remove the front bolt (**Figure 87**) on each side securing the front fairing upper portion to the front mounting bracket.
- g. Carefully pull the upper portion of the front fairing (B, **Figure 86**) forward and remove it from the mounting bracket.
- h. Set it on the blankets.
7. Install by reversing these removal steps. Note the following during installation.
8. Tighten the screws and nuts securely. Don't overtighten the screws or nuts as the plastic mounting bosses may be damaged.
9. Make sure all electrical connectors are free of corrosion and are tight.







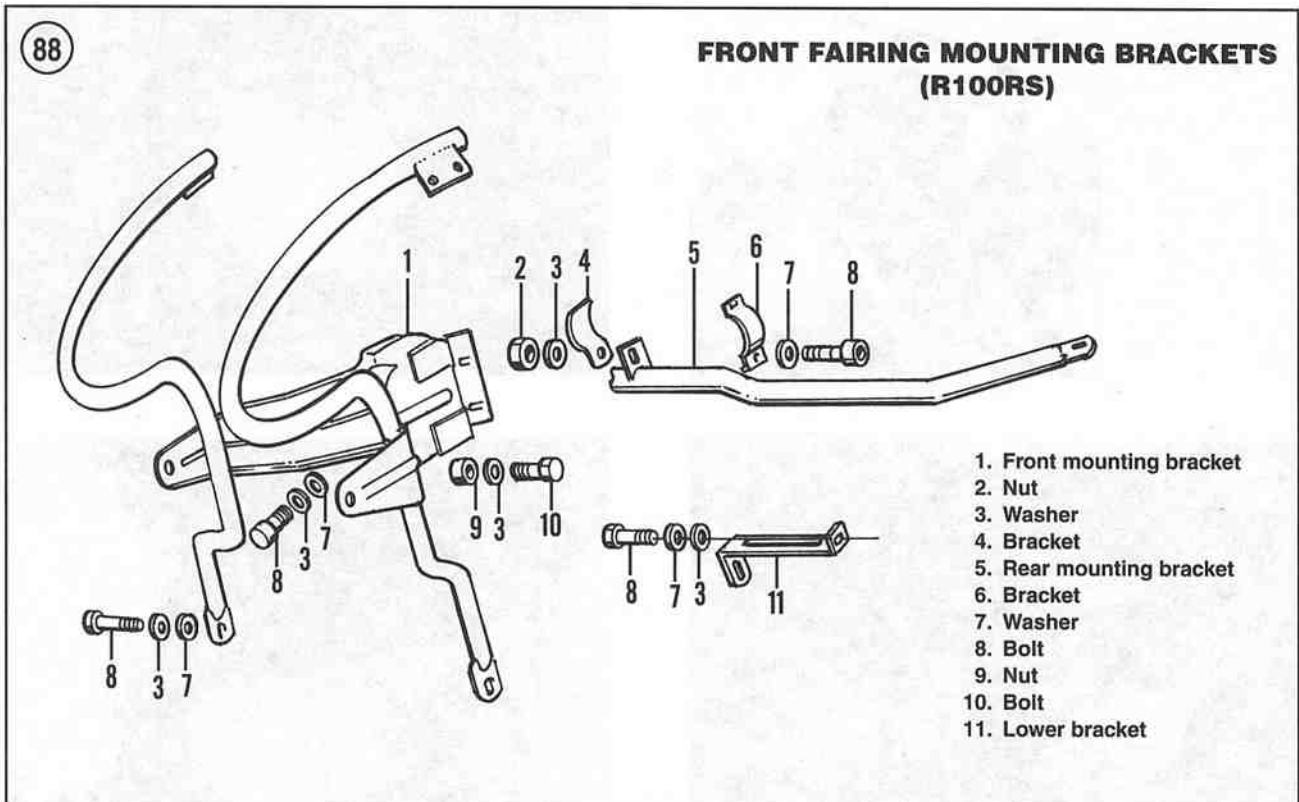
10. Apply Sicomet 8200, or a "super glue" equivalent, to the fork boots at 6 equally spaced points around the perimeter where they are attached to the upper center cover. Slide the front fork boots up and in place onto the upper center cover.

**Front Fairing Mounting Brackets  
Removal/Installation**

Refer to **Figure 88** for this procedure.

**Figure 88** shows mainly the left-hand side components. The right-hand components are an exact mirror image.

1. Remove all of the front fairing components as described in this chapter.
2. Remove the headlight assembly as described in Chapter Eight.
3. Remove the bolts securing the front mounting bracket (**Figure 89**) to the frame and remove the front mounting bracket.
4. Remove the bolt, nut and washers (**Figure 90**) securing the rear mounting bracket (**Figure 91**) to the frame and remove the rear mounting bracket.
5. Remove the nut and washer (A, **Figure 92**) securing the lower mounting bracket (B, **Figure 92**) and remove the bracket.
6. Inspect the mounting bracket for cracks or other visible damage. Repair any damaged areas.



7. Repaint any areas that are rusted or where the paint has worn thin. Refer to the frame repainting procedure in this chapter.

8. Install by reversing these removal steps. Note the following during installation.

9. Tighten the bolts securely.

### Headlight Duct Removal/Installation

Refer to **Figure 74** for this procedure.

1. Remove all of the front fairing components as described in this chapter.

2. Remove the nuts and washers (A, **Figure 93**) securing the headlight duct and remove the headlight duct (B, **Figure 93**).

3. Install by reversing these removal steps. Note the following during installation.

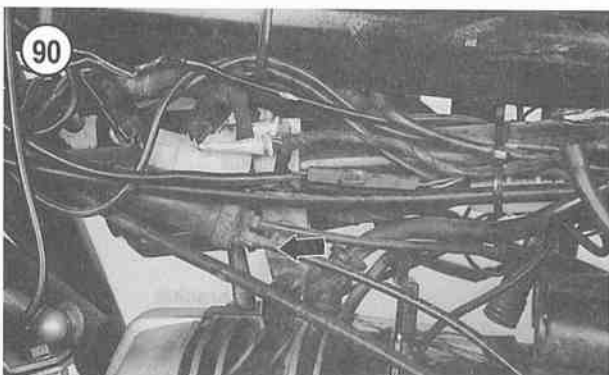
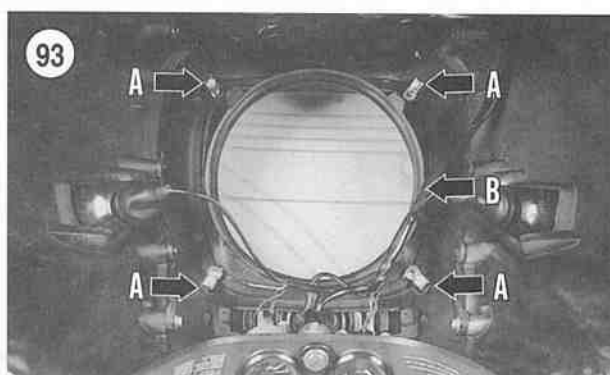
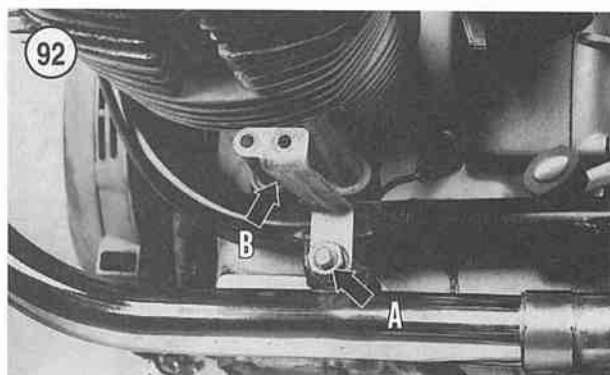
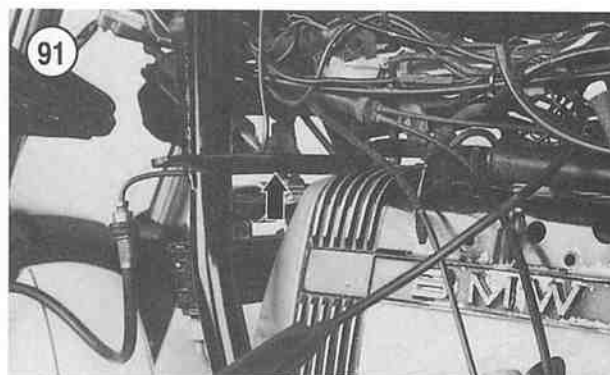
4. Tighten the nuts securely.

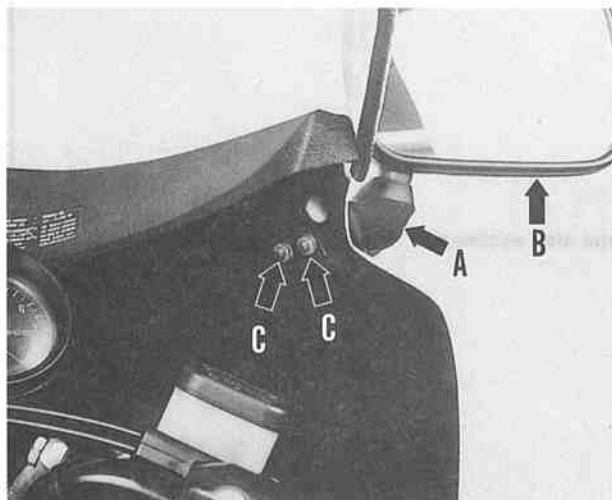
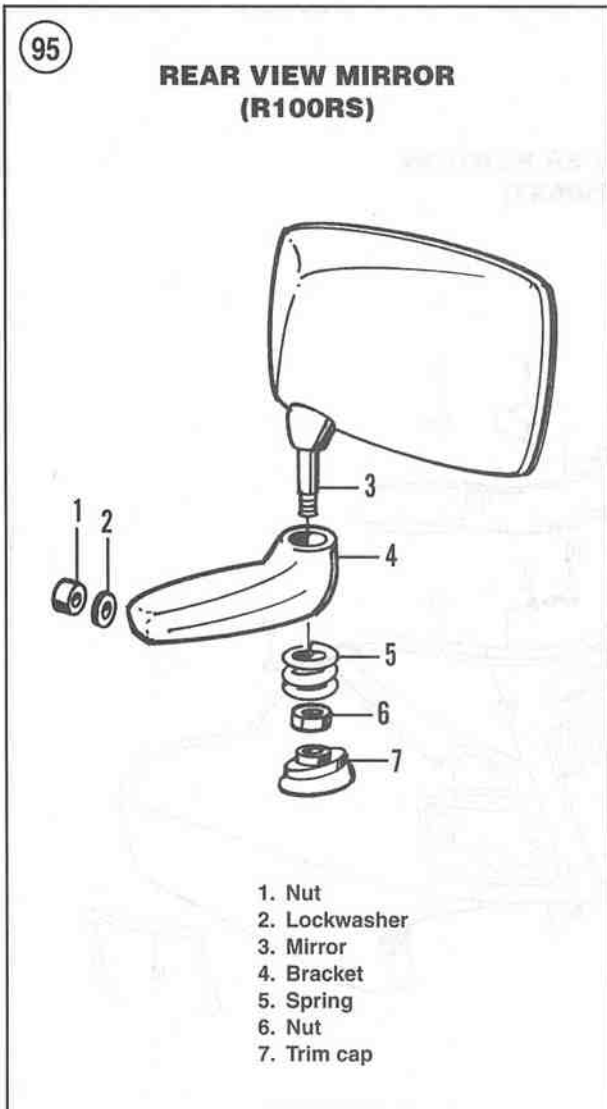
### Front Fairing Upper Portion Disassembly/Assembly

Refer to **Figure 74** for this procedure.

1. Remove all of the front fairing components as described in this chapter.

2. Remove the windshield and the auxiliary gauge panel (A, **Figure 94**) as described in this chapter.





3. Remove the bolts and washers securing the front section (B, **Figure 94**) to the side section (C, **Figure 94**).
4. Install by reversing these removal steps. Note the following during installation.
5. Tighten the bolts securely. Don't overtighten the bolts as the plastic mounting bosses may be damaged.

**Front Fairing Windshield  
and Auxiliary Gauge Panel  
Removal/Installation**

Refer to **Figure 74** for this procedure.

It is suggested that this procedure be performed by a BMW dealer as special rivet tools and expertise are required to correctly carry out this job.

The windshield is expensive and is also fragile. If you try to perform this job yourself and break the windshield while installing it, you will have to purchase a new one and start all over. If the dealer breaks it during installation and has to use another one, they can only charge you for one windshield.

Also, the front fairing and instrument panel can be damaged while drilling out the old rivets, if the process is not done correctly.

**Front Fairing Rear View Mirror Assembly  
Removal/Installation**

Refer to **Figure 95** for this procedure.

**Figure 95** shows the left-hand mirror assembly. The right-hand components are an exact mirror image and the parts are attached in the same manner.

1. Remove the trim cap (A, **Figure 96**) from the mounting nut.
2. Using a socket, remove the nut and spring securing the rear view mirror to the mounting bracket.
3. Pull the rear view mirror (B, **Figure 96**) straight up and out of the mounting bracket.
4. To remove the mounting bracket, remove the nuts and washers (C, **Figure 96**) securing the mounting bracket and remove it.
5. If necessary, repeat for the rear view mirror on the other side.
6. Install by reversing these removal steps. Note the following during installation.
7. Be sure to install the spring prior to installing the nut. Tighten the nut securely.

**BODY PANELS  
(R80RT AND R100RT MODELS)**

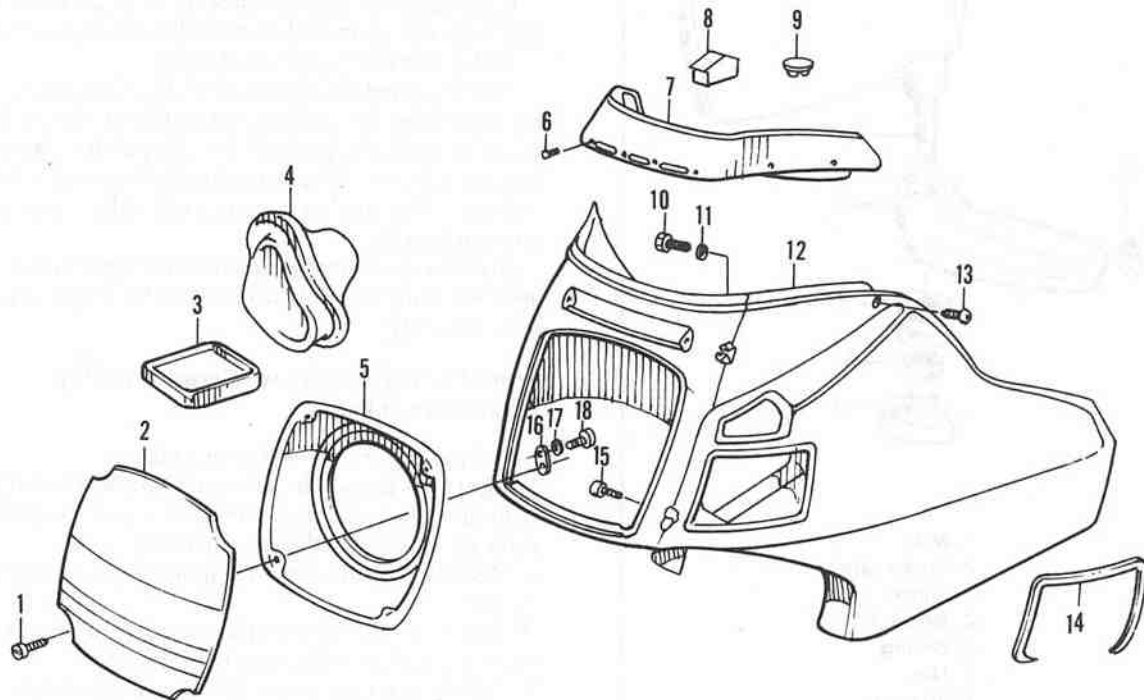
**Front Fairing  
Removal/Installation**

Refer to the following illustrations for this procedure:

- a. **Figure 97**: front fairing upper portion.
- b. **Figure 98**: front fairing center and side panels.
- c. **Figure 99**: front fairing air ducts.

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**FRONT FAIRING—UPPER PORTION  
(R80RT AND R100RT)**

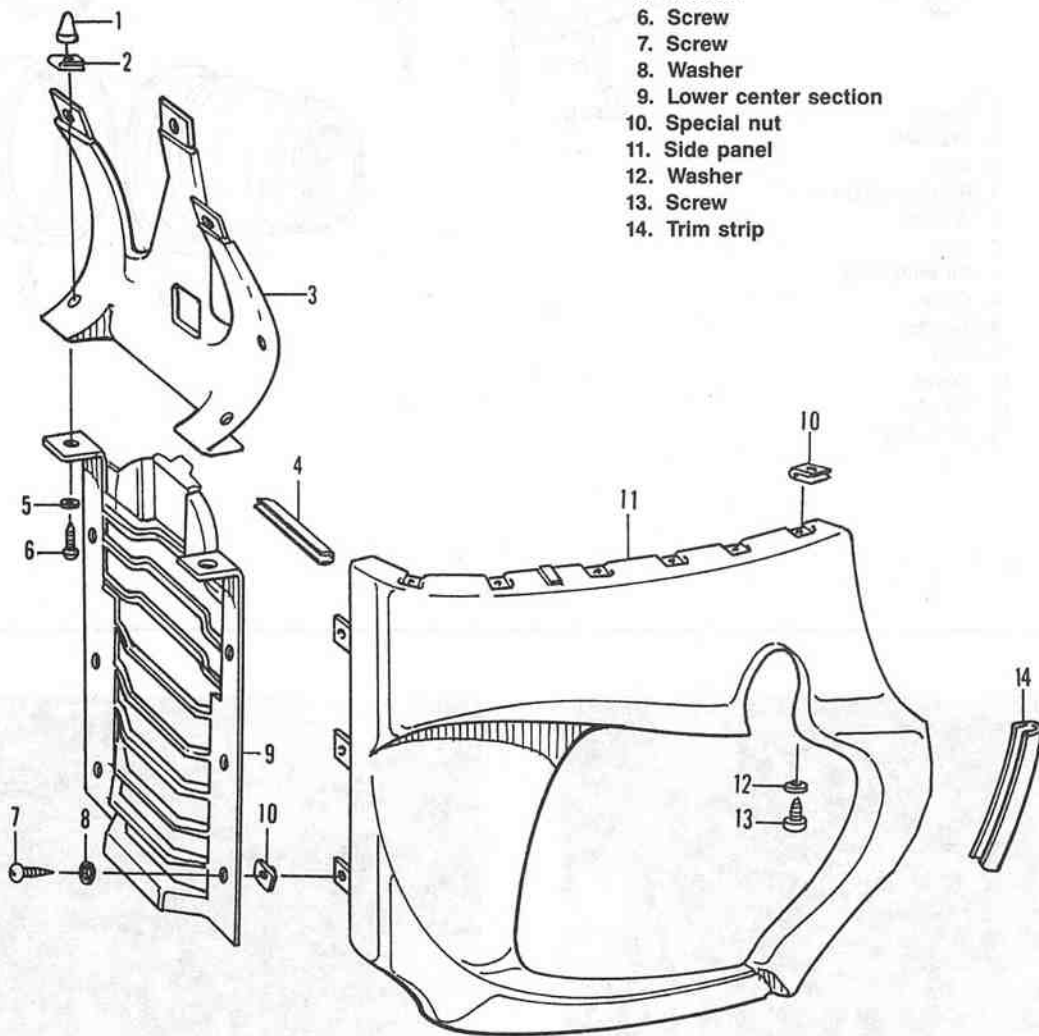


1. Screw
2. Headlight protective cover
3. Gasket
4. Rubber boot
5. Light duct
6. Rivet
7. Auxiliary gauge panel
8. Cap
9. Cap
10. Screw
11. Washer
12. Front fairing (center and side sections)
13. Screw
14. Trim strip

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**FRONT FAIRING—CENTER  
AND SIDE PANELS  
(R80RT AND R100RT)**

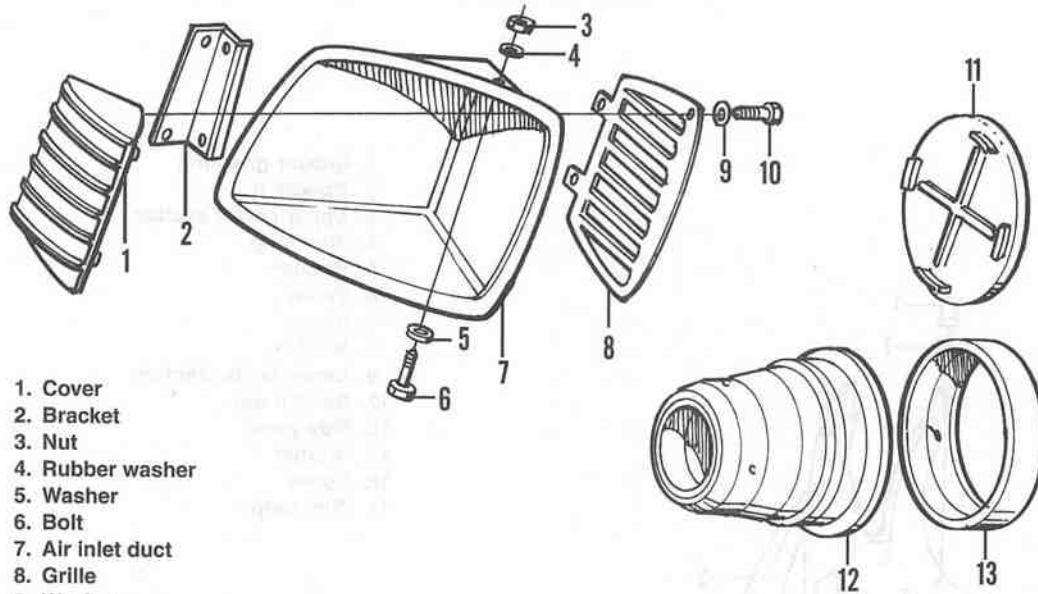
- 1. Rubber grommet
- 2. Special nut
- 3. Upper center section
- 4. Trim strip
- 5. Washer
- 6. Screw
- 7. Screw
- 8. Washer
- 9. Lower center section
- 10. Special nut
- 11. Side panel
- 12. Washer
- 13. Screw
- 14. Trim strip



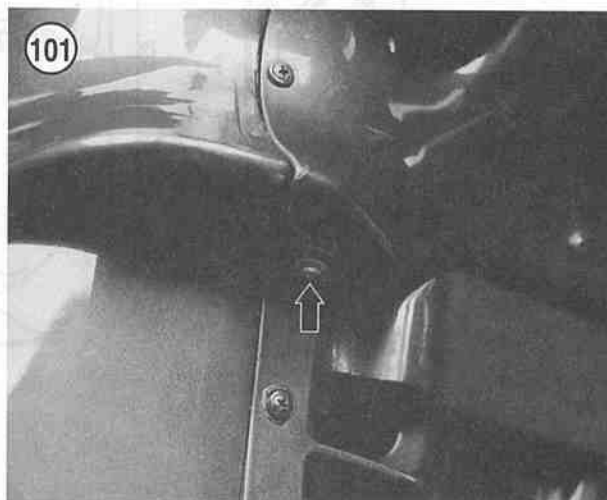
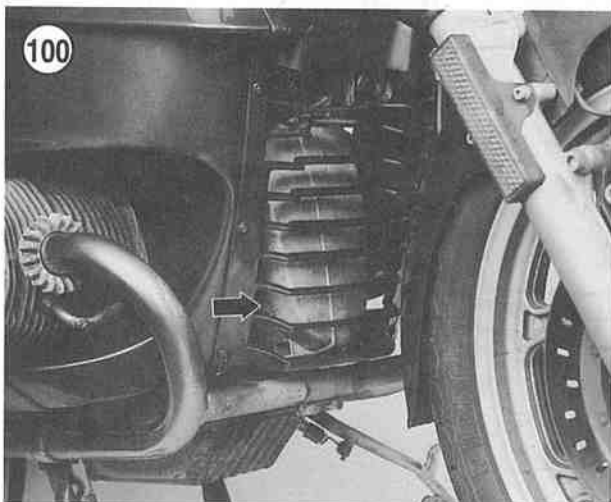


99

### FRONT FAIRING AIR DUCTS (R80RT AND R100RT)



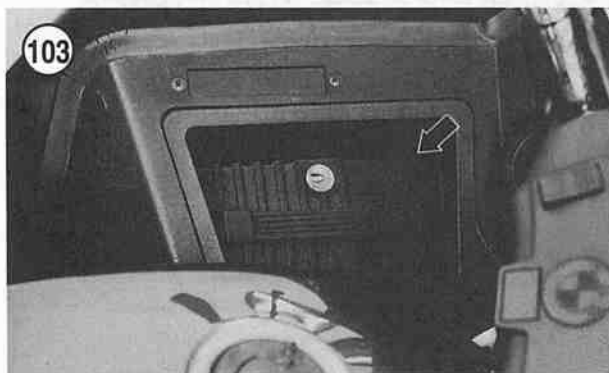
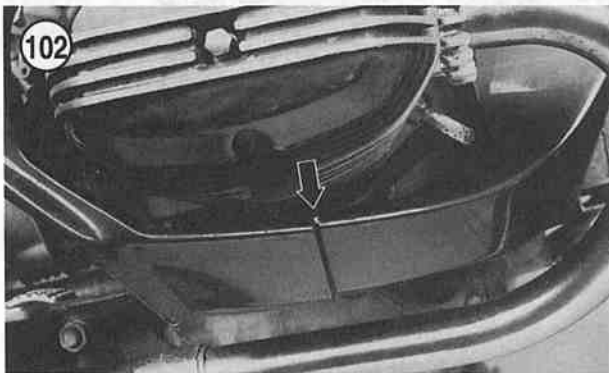
1. Cover
2. Bracket
3. Nut
4. Rubber washer
5. Washer
6. Bolt
7. Air inlet duct
8. Grille
9. Washer
10. Bolt
11. Cover
12. Nozzle
13. Trim ring



With the exception of the front fairing upper portion, the illustrations show the left-hand side components. The right-hand components are an exact mirror image and are attached in the same manner unless otherwise specified.

**NOTE**

*BMW has determined that a problem exists with the early 1988-on R80RT and R100RT with the inner saddlebag rubbing against the fuel tank. If this rubbing persists, it will rub through the paint on the fuel tank. To correct this problem, remove the saddle-*



*bag lid and loosen the bolts that secure the front fairing upper portion. Within the saddlebag area, push out on the front fairing and retighten the mounting bolts. This will push the front fairing and inner saddlebag out and away from the fuel tank. This problem is covered in BMW Service Information Bulletin No. 46 020 88 (2325), September 1988.*

1. Disconnect the battery negative lead as described under Battery in Chapter Three.
2. Remove the lower center section as follows:
  - a. Remove the screws and washers around the outer perimeter of the lower center section (**Figure 100**). Don't forget the top screw (**Figure 101**) on each side.
  - b. Slide the lower center section down slightly and push it in at the top.
  - c. Remove the lower center section from the side panels. Don't lose the special nuts on the attachment points of each side panel. If the nuts are loose on the mounting tabs, squeeze them together and then push them back on.
3. Remove the side panel and inner saddlebag assembly as follows:
  - a. Remove the lower center section as described in this procedure.

**NOTE**

*Removal of the exhaust pipes is necessary only if the side panel is not split at the bottom.*

- b. If necessary, remove the exhaust pipes as described under Exhaust Pipes Removal/Installation in Chapter Seven.

**NOTE**

*In Figure 102, the bolts and nuts are not visible. They are located on either side of the split in the body panel.*

- c. Remove the bolts and nuts (**Figure 102**) securing the bottom of the side panel to the lower mounting bracket.
- d. Remove the inner saddlebag lid (**Figure 103**).

**NOTE**

*In Step 3e and Step 3f, the bolts, nuts and screws are not visible. They are located at the bottom of the inner saddlebag out of sight.*

- e. At the bottom of the inner saddlebag (**Figure 104**), remove the bolt and nut securing the bottom of the side panel to the lower mounting bracket.

- f. Remove the screws securing the top of the side panel to the front fairing upper portion.

**CAUTION**

*Do not pull too hard on the lower portion of the side panel when removing it from around the exhaust pipes. The side panel is fiberglass and the lower portion will crack or break if it is spread out too much during removal.*

- g. Pull the side panel (**Figure 105**) away from the upper section and maneuver the lower portion away from the exhaust pipe.
- h. Repeat this step for the side panel assembly on the other side.
4. Remove the upper center section as follows:
- Remove the lower center section and both side panels as described in this procedure.
  - Carefully pull the front fork rubber boots (A, **Figure 106**) down and off of the upper center section. Slide the boots down until they stop on the fork dust seals.
  - Remove the screws securing the upper center section (B, **Figure 106**).
  - Carefully slide the metal brake line (A, **Figure 107**) and the rubber grommet out of the grooves in the upper center section. Remove the upper center section.
5. Remove the upper portion as follows:
- To protect the finish, place a couple of blankets on the workbench or floor for the upper portion of the front fairing to sit on after removal.
  - Remove all of the front fairing components below the upper portion as described in this procedure.
  - Disconnect the 6-pin electrical connector (B, **Figure 107**) and if so equipped, remove the tie-wraps securing the electrical wires to the front mounting bracket.
  - Remove the Phillips screw in each corner of the headlight glass protective cover (**Figure 108**).
  - Remove the glass protective cover and the light duct (**Figure 109**).

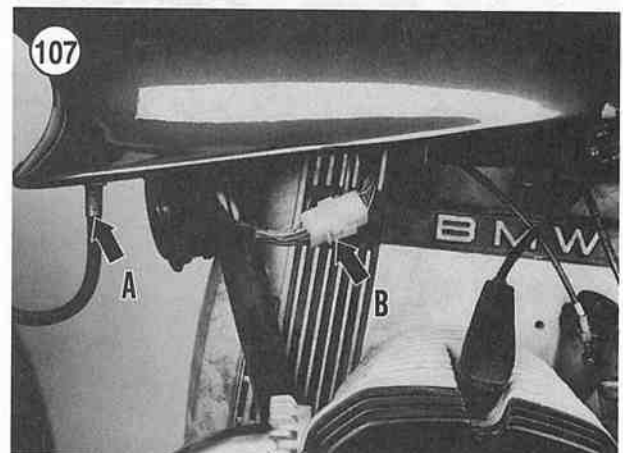
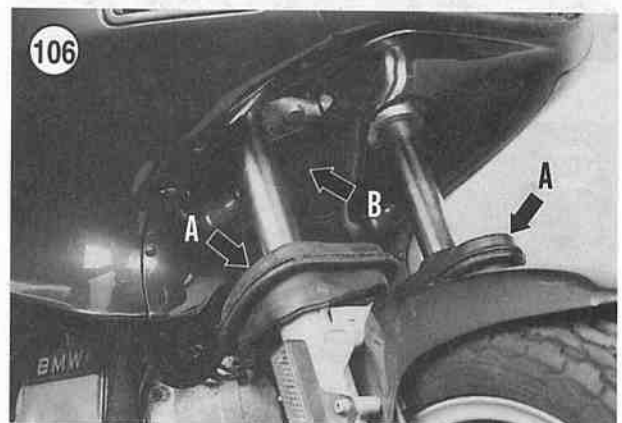
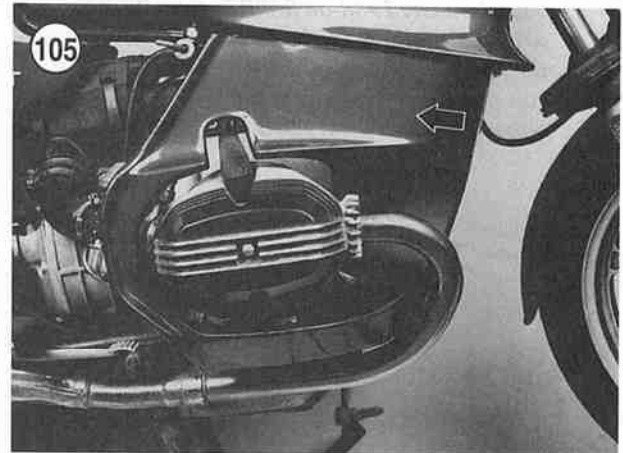
**NOTE**

*The next step requires the aid of an assistant. The upper portion of the fairing is not heavy but is difficult to hold in place while removing the mounting bolts and nuts.*

- f. Have an assistant hold onto the front of the upper portion of the front fairing.

**NOTE**

*In Step 5g, the bolts are not visible. They are located under the auxiliary gauge panel and are out of sight. They are also very difficult to reach. **Figure 110** shows the socket and wrench located on the bolt.*





- g. Remove the bolt (**Figure 110**) on each side securing the upper portion of the front fairing upper portion to the front mounting bracket.
  - h. Carefully pull the upper portion of the front fairing forward (**Figure 111**) and remove it from the mounting bracket.
  - i. Set the front fairing on the blankets.
6. Install by reversing these removal steps. Note the following during installation.
  7. Tighten the screws and nuts securely. Don't overtighten the screws or nuts as the plastic mounting bosses may be damaged.
  8. Make sure the electrical connector is free of corrosion and is tight.
  9. Apply Sicomet 8200, or a "super glue" equivalent, to the fork boots at 6 equally spaced points around the perimeter where they are attached to the upper center cover. Slide the front fork boots up and into place onto the upper center cover.

#### Front Fairing Mounting Brackets Removal/Installation

Refer to **Figure 112** for this procedure.

**Figure 112** shows the left-hand side components. The right-hand components are an exact mirror image.

1. Remove all of the front fairing components as described in this chapter.
2. Remove the headlight assembly as described in Chapter Eight.
3. Remove the bolts securing the front mounting bracket (**Figure 113**) to the frame and remove the front mounting bracket.
4. Remove the bolt, nut and washers (**Figure 114**) securing the rear mounting bracket (**Figure 115**) to the frame and remove the rear mounting bracket.
5. Remove the nut and washer (A, **Figure 116**) securing the lower mounting bracket (B, **Figure 116**) and remove the bracket.
6. Inspect the mounting bracket for cracks or other visible damage. Repair any damaged areas.
7. Repaint any areas that are rusted or where the paint has worn thin. Refer to the frame repainting procedure in this chapter.
8. Install by reversing these removal steps. Note the following during installation.
9. Tighten the bolts securely.

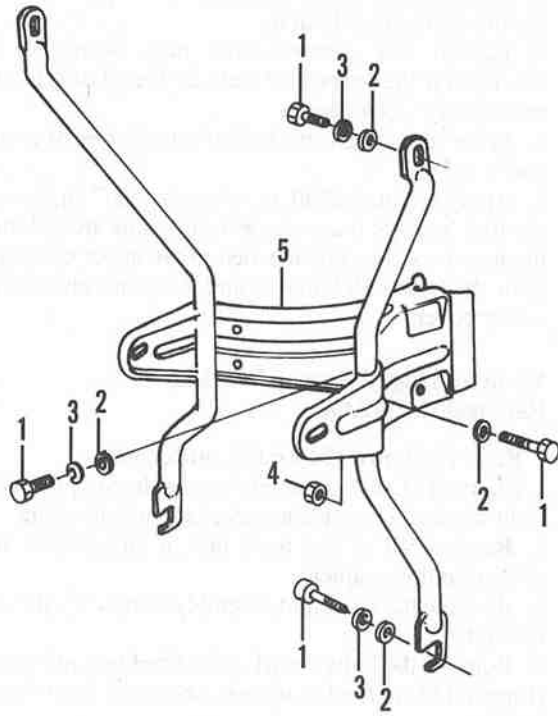
#### Front Fairing Windshield and Auxiliary Gauge Panel Removal/Installation

Refer to **Figure 117** for this procedure.

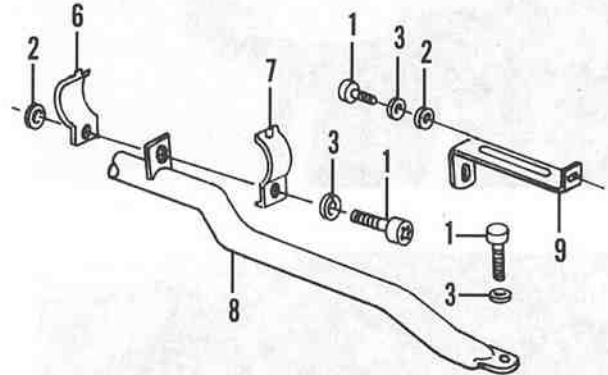
It is suggested that this procedure be performed by a BMW dealer as special expertise is required to correctly carry out this job. This procedure is included in case you choose to perform it yourself.

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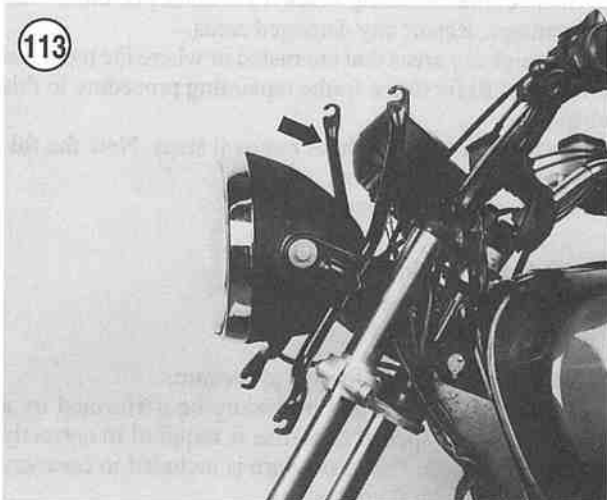
### FRONT FAIRING MOUNTING BRACKETS (R80RT AND R100RT)



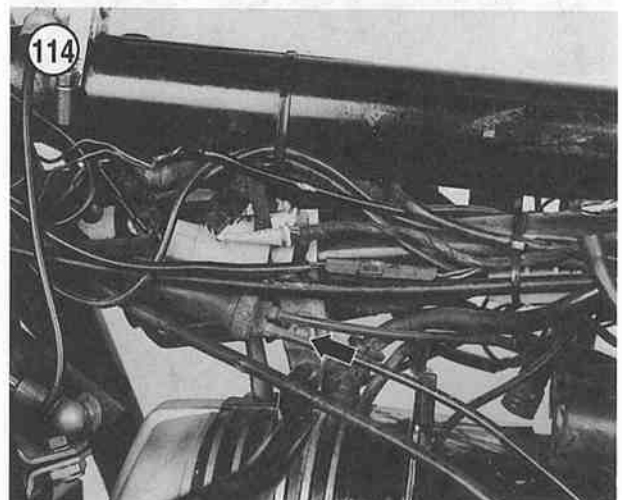
1. Bolt
2. Washer
3. Lockwasher
4. Nut
5. Front mounting bracket
6. Bracket
7. Bracket
8. Rear mounting bracket
9. Lower bracket



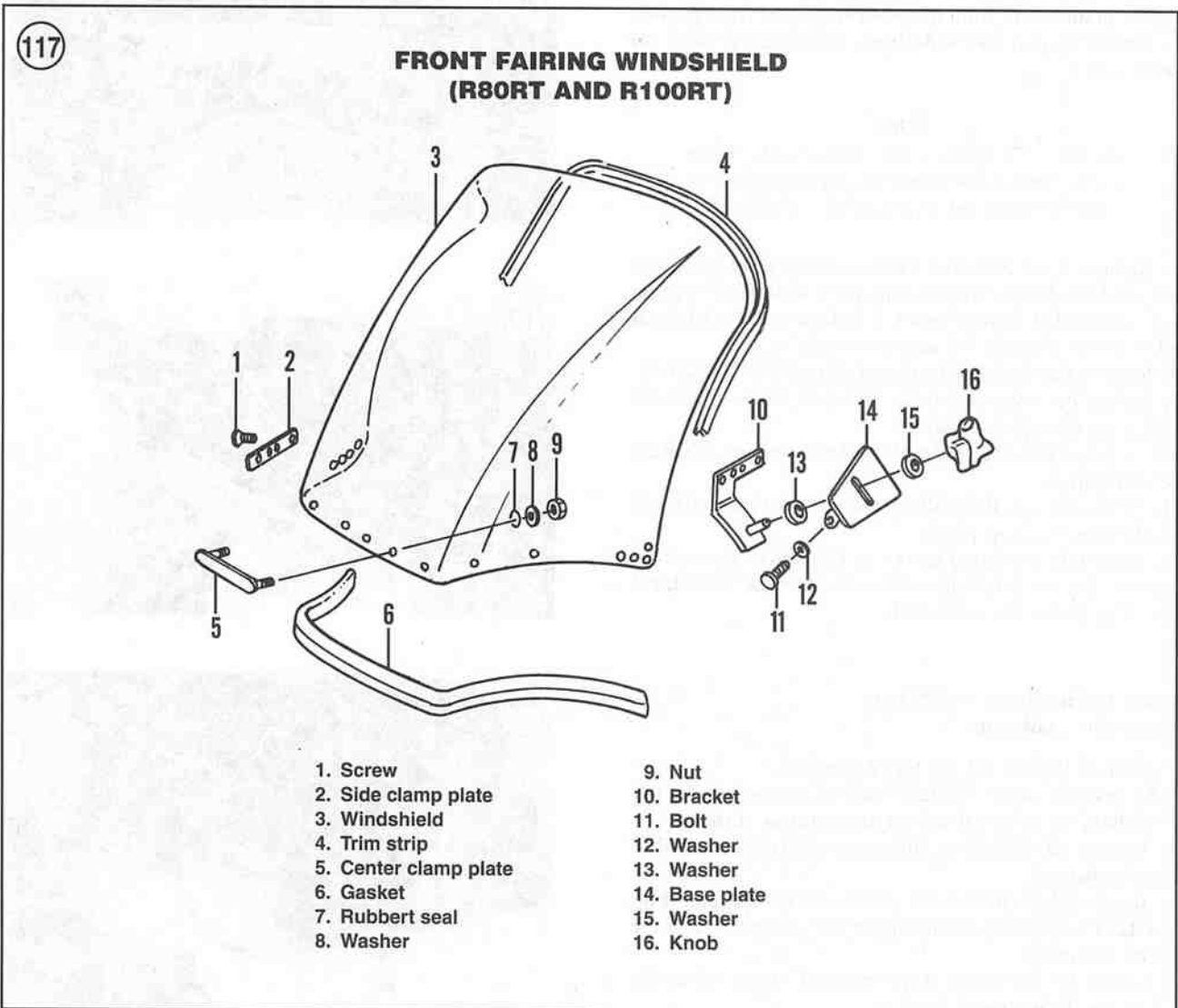
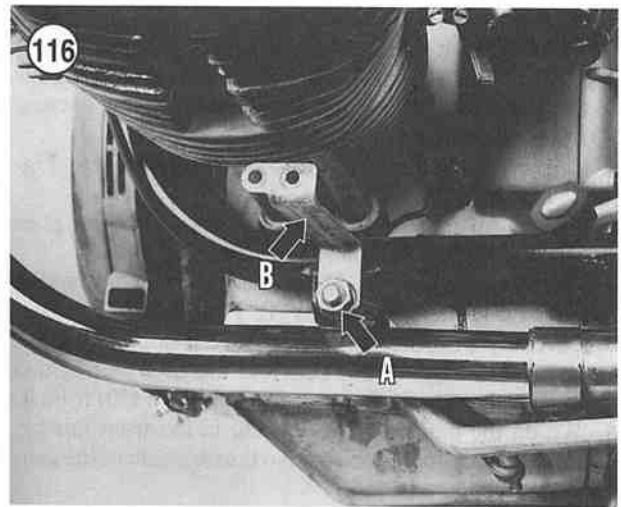
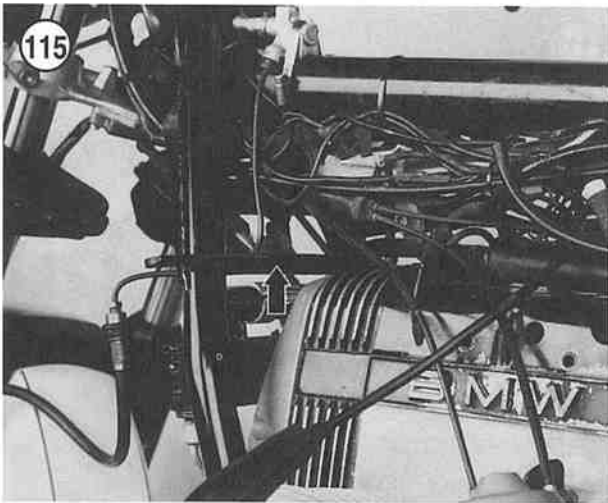
113



114







The windshield is expensive and is also *fragile*. Be careful when handling it during removal and installation.

1A. On 1978-1980 models, remove the screws securing the locking latches on each side. Remove the locking latches.

1B. On 1981-on models, perform the following:

- a. Unscrew and remove the knob and washer (A, **Figure 118**).
- b. Remove the bolts and washers securing the base plate (B, **Figure 118**) and remove the base plate.

2. Remove the screws (A, **Figure 119**) securing the parking light lens and remove the lens (B, **Figure 119**).

3. Carefully pull the parking light reflector and socket assembly (A, **Figure 120**) out from the front fairing and disconnect the electrical connector (B, **Figure 120**) from it.

4. Within the parking light opening in the front fairing, remove the nuts and washers from the backside of the center clamp plate.

5. Carefully pull the center portion of the windshield gasket (C, **Figure 120**) away from the windshield. Remove the center clamp plate from the windshield and front fairing.

6. Carefully pull the windshield gasket away from the windshield.

#### NOTE

*In Step 7, work from side-to-side when removing the screws in a staggered pattern to avoid placing any stress on the windshield.*

7. Remove the screws and the side clamp plates securing the windshield to the front fairing. If the windshield is going to be reinstalled, have an assistant hold onto the windshield when there are only 2-3 screws remaining.

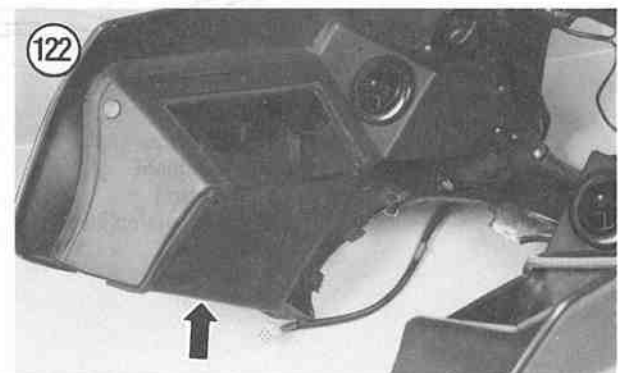
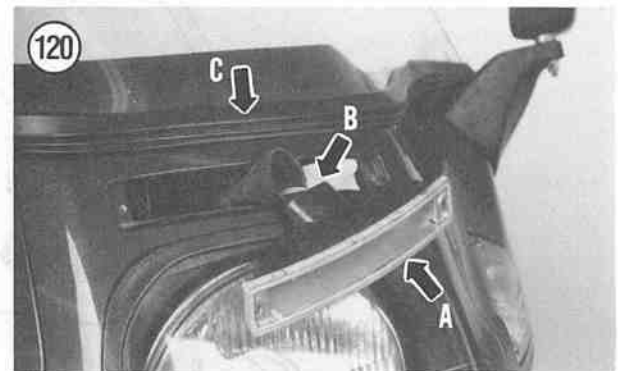
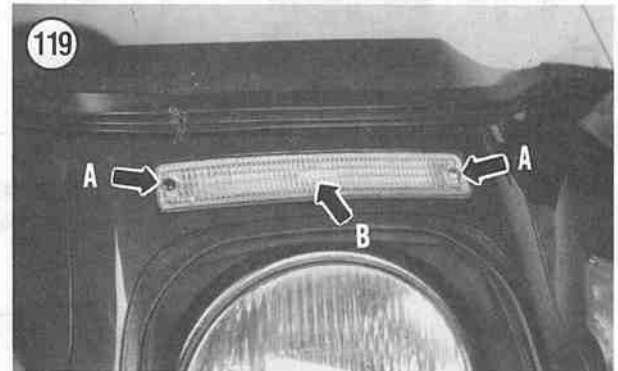
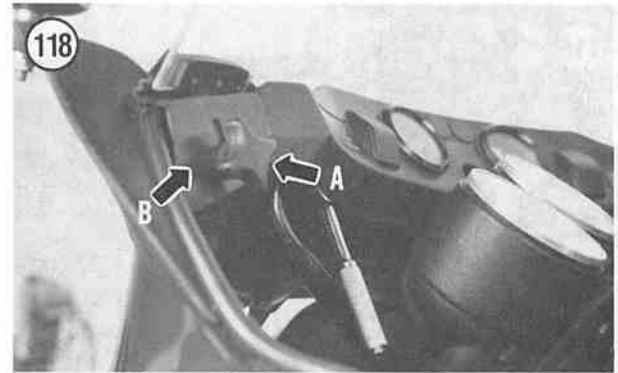
8. Remove the windshield and gasket from the front fairing.

9. Install by reversing these removal steps. Note the following during installation.

10. Inspect the gasket and replace if it is starting to harden or deteriorate.

11. Be sure to install a rubber gasket on the threaded studs on the center clamp plate.

12. Install the mounting screws and tighten in a crisscross pattern. Do not overtighten the screws as the windshield may fracture at the screw holes.



#### Front Fairing Inner Saddlebag Removal/Installation

Refer to **Figure 121** for this procedure.

**Figure 121** shows the left-hand side components. The right-hand components are an exact mirror image.

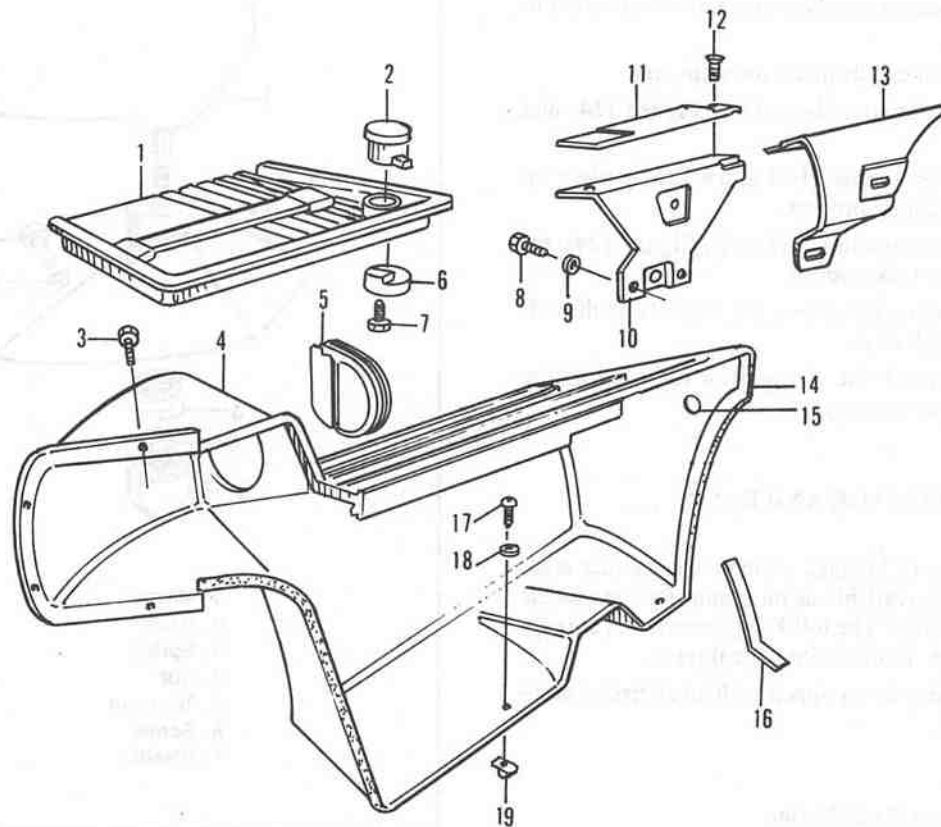
1. Remove all of the front fairing components as described in this chapter.

2. Remove the screws securing the inner saddlebag (**Figure 122**) to the front fairing upper portion and remove the inner saddlebag.

3. Install by reversing these removal steps. Note the following during installation.

121

**FRONT FAIRING INNER SADDLEBAGS  
(R80RT AND R100RT)**



- |                    |                 |
|--------------------|-----------------|
| 1. Lid             | 11. Trim panel  |
| 2. Lock            | 12. Screw       |
| 3. Screw           | 13. Trim panel  |
| 4. Inner saddlebag | 14. Trim strip  |
| 5. Cover           | 15. Plug        |
| 6. Retainer        | 16. Bracket     |
| 7. Screw           | 17. Screw       |
| 8. Screw           | 18. Washer      |
| 9. Washer          | 19. Special nut |
| 10. Metal bracket  |                 |

4. Tighten the screws securely. Don't overtighten the screws as the plastic mounting bosses may be damaged.

### Front Fairing Rear View Mirror Assembly Removal/Installation

**Figure 123** shows the left-hand mirror assembly. The right-hand components are the same and are attached in the same manner.

1. Remove the trim cap from the mounting nut.
2. Using a socket, remove the nut (A, **Figure 124**) and spring.
3. Pull the rear view mirror (B, **Figure 124**) straight up and out of the mounting bracket.
4. To remove the mounting bracket (C, **Figure 124**), remove the bolts and lockwashers.
5. Install by reversing these removal steps. Note the following during installation.
6. Make sure to install the spring prior to installing the nut. Tighten the nut securely.

### LUGGAGE AND RACK

Numerous types of luggage systems were either standard equipment or available as an option for the models covered in this manual. The following procedures are representative of some of the more typical types.

Also, the bike may be equipped with an aftermarket replacement system.

### Saddlebag Removal/Installation

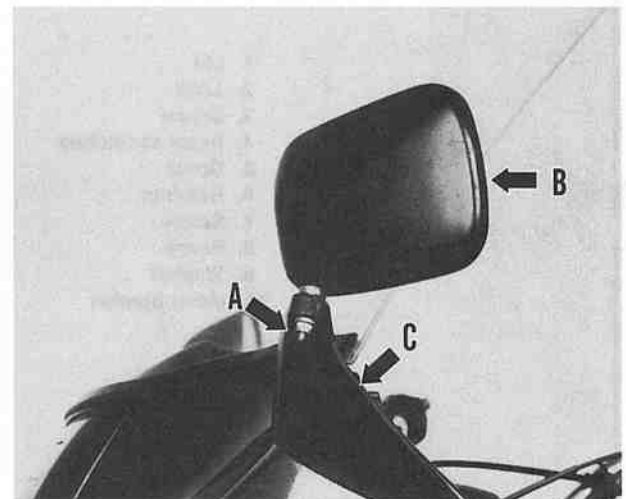
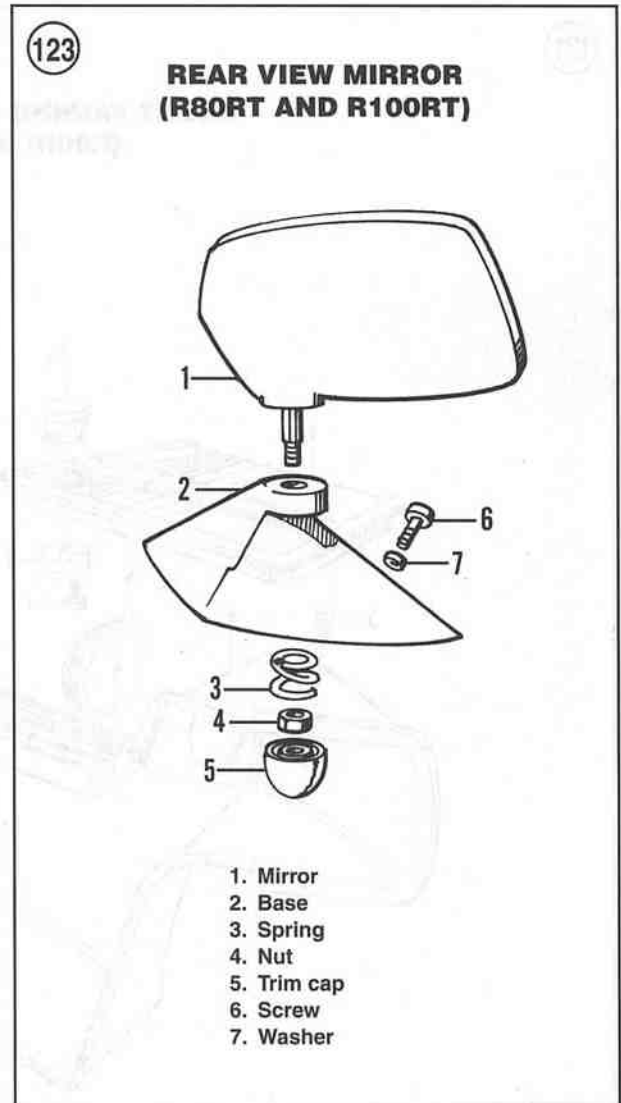
Refer to **Figures 125-127** for this procedure.

1. Release the catch (**Figure 128**).
2. Pull out on the rear of the saddlebag and slide it toward the rear. Unhook and remove the saddlebag from the rack.
3. Install the saddlebag and make sure the catch is securely fastened to the rack.

### Top Case Removal/Installation

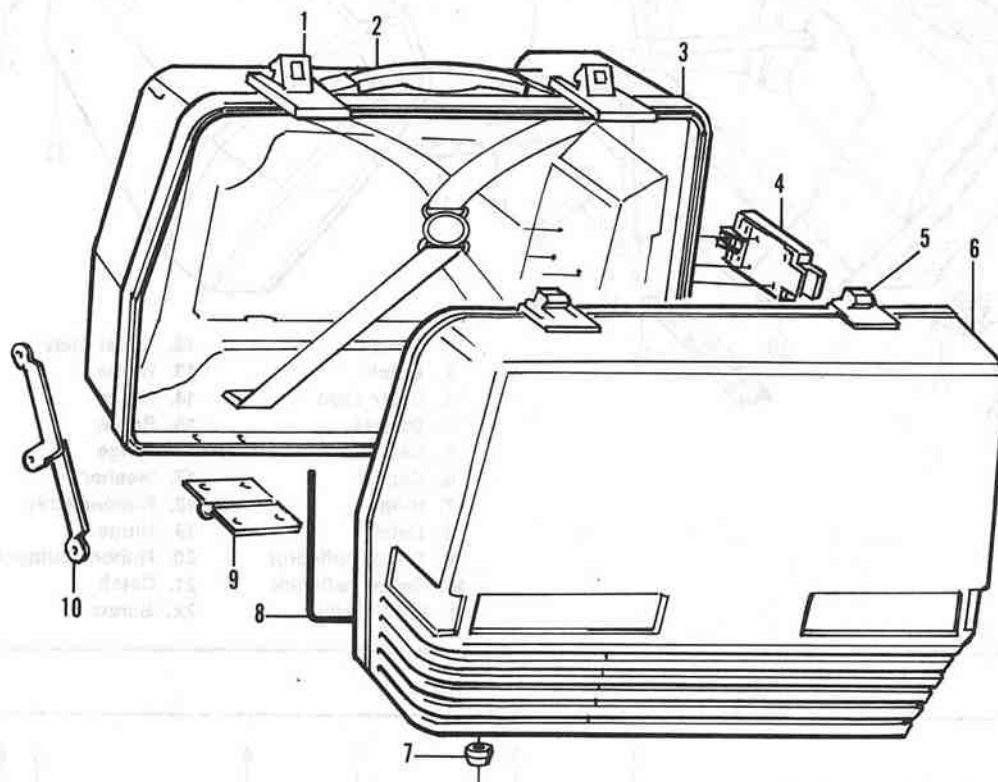
Refer to **Figure 129** for this procedure.

1. Unlock the catch and open the top cover.
2. Within the lower case, rotate the locking catch and remove the top case from the carrier.
3. Install the top case and make sure the locking catch is securely fastened to the carrier.



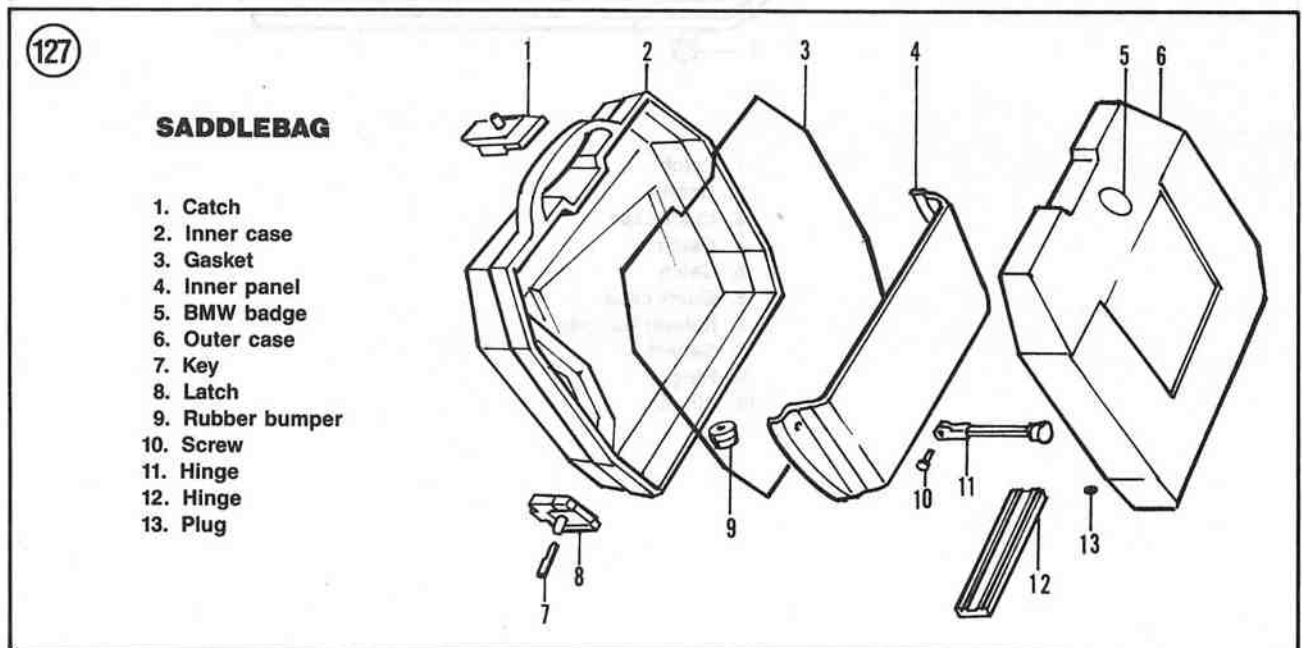
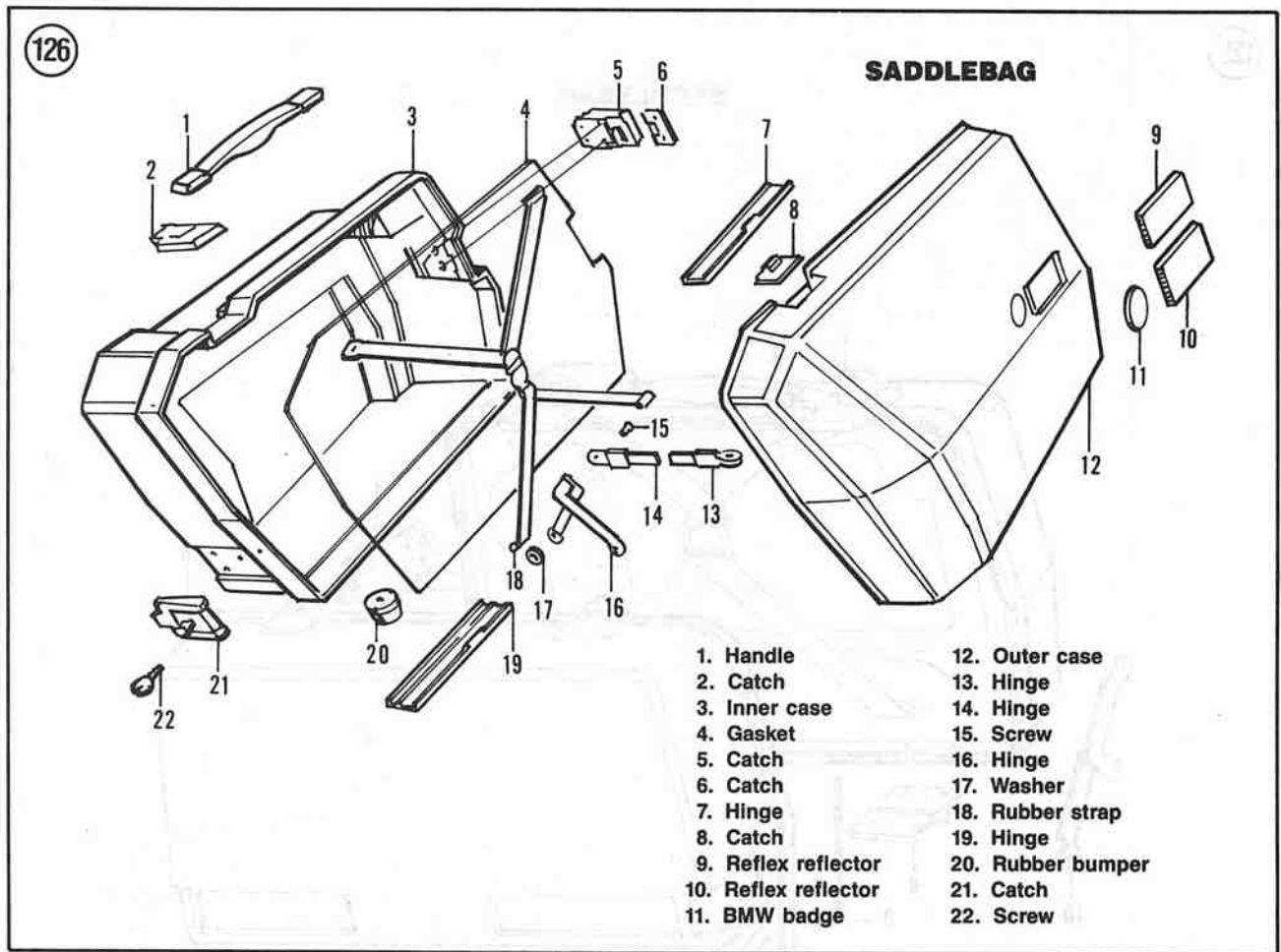
125

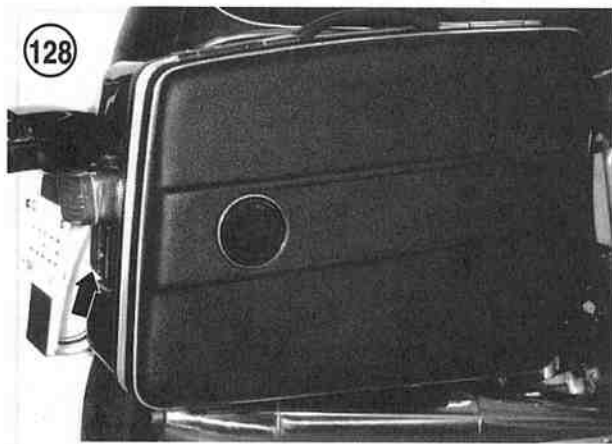
**SADDLEBAG**



- 1. Catch
- 2. Handle
- 3. Inner case
- 4. Catch
- 5. Catch
- 6. Outer case
- 7. Rubber bumper
- 8. Gasket
- 9. Hinge
- 10. Hinge





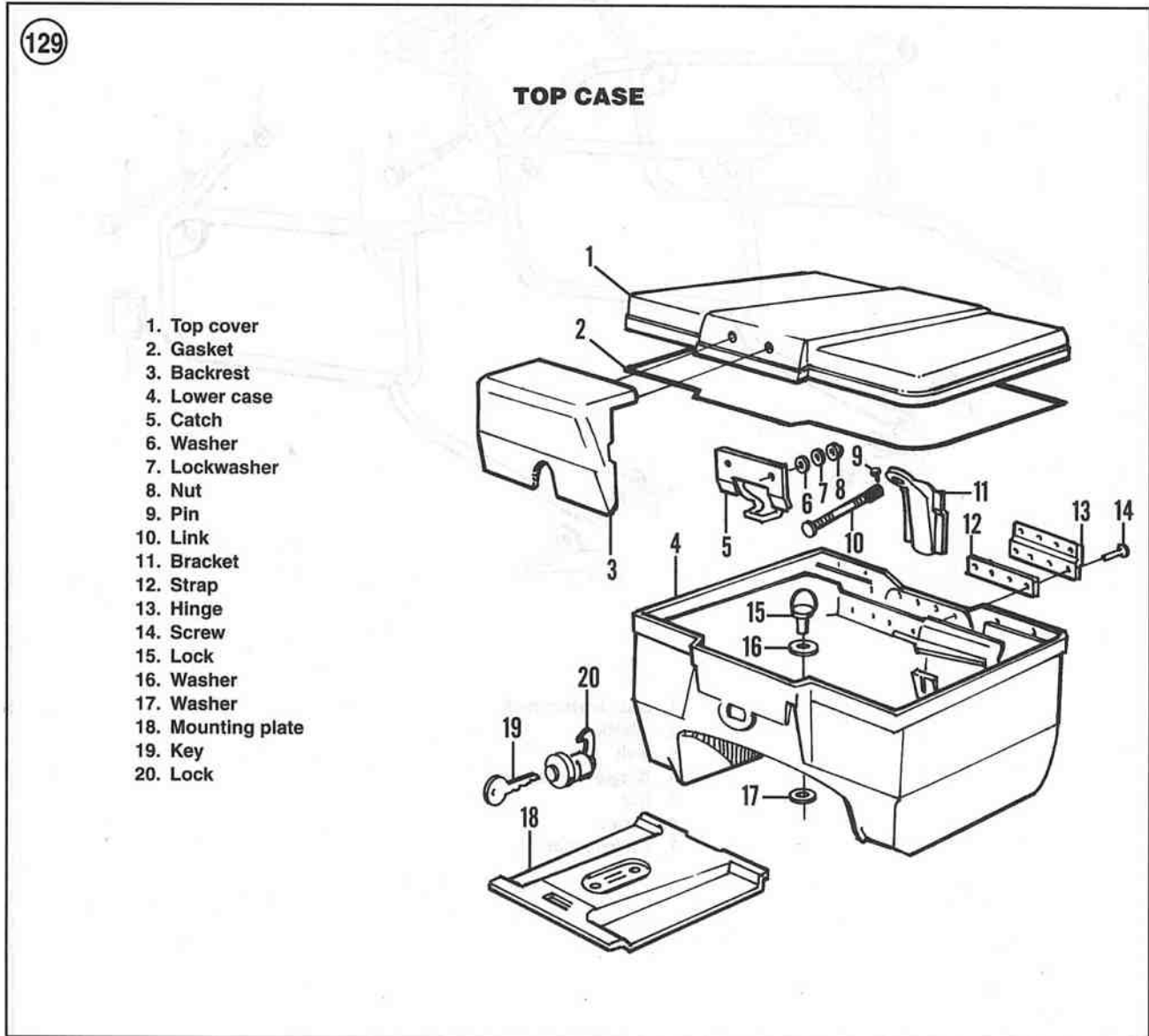


**Saddlebag Rack  
Removal/Installation**

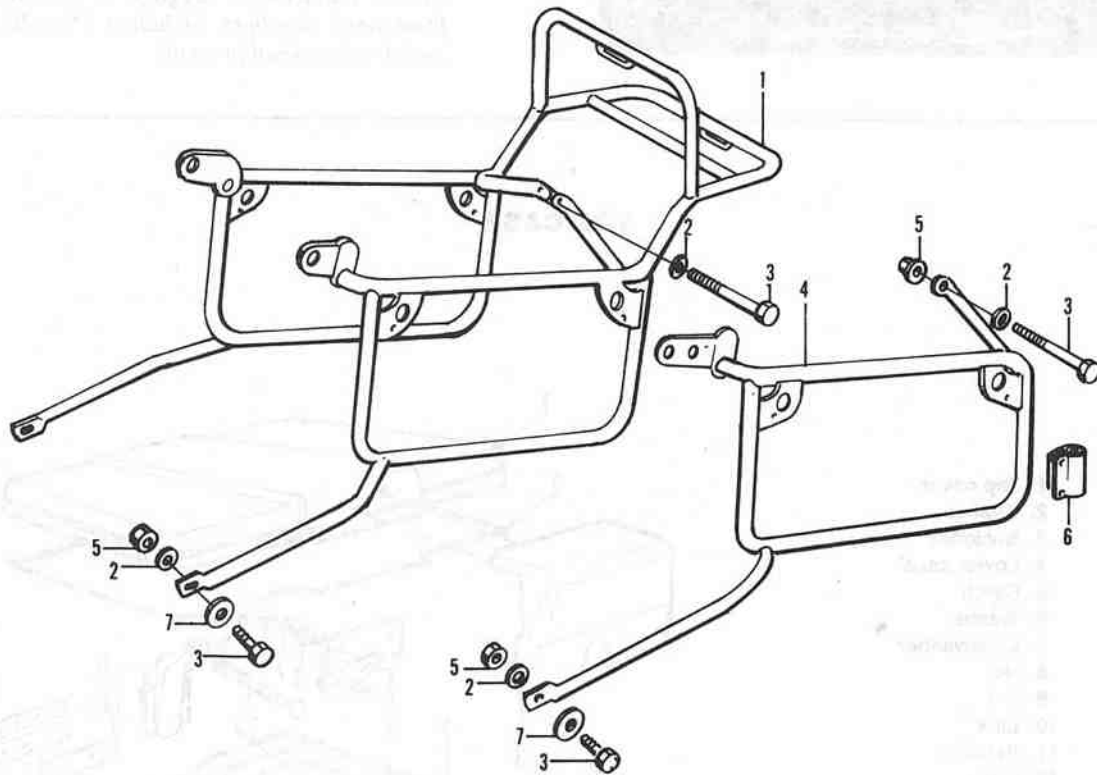
Refer to the following illustrations for this procedure:  
 a. **Figure 130:** All 1970-1976 models.  
 b. **Figure 131:** 1988-on R100RS and R100RT models.  
 c. **Figure 132:** R100GS models.

*NOTE*

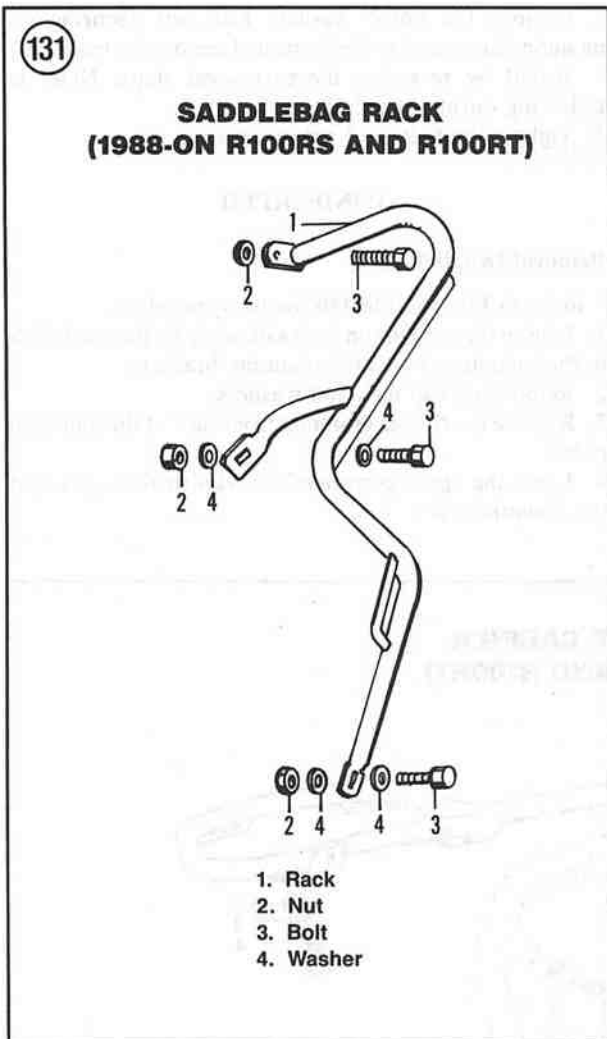
*The saddlebag rack assemblies are interchangeable and your bike may not be equipped with the original rack. Hepco and Becker replacement luggage is available from many suppliers, including Moto-Bins Ltd. at [www.motobin.co.uk](http://www.motobin.co.uk).*



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**SADDLEBAG RACKS  
(1970-1976 MODELS)**

1. Dual carrier rack
2. Washer
3. Bolt
4. Single carrier rack
5. Nut
6. Clamp
7. Lockwasher

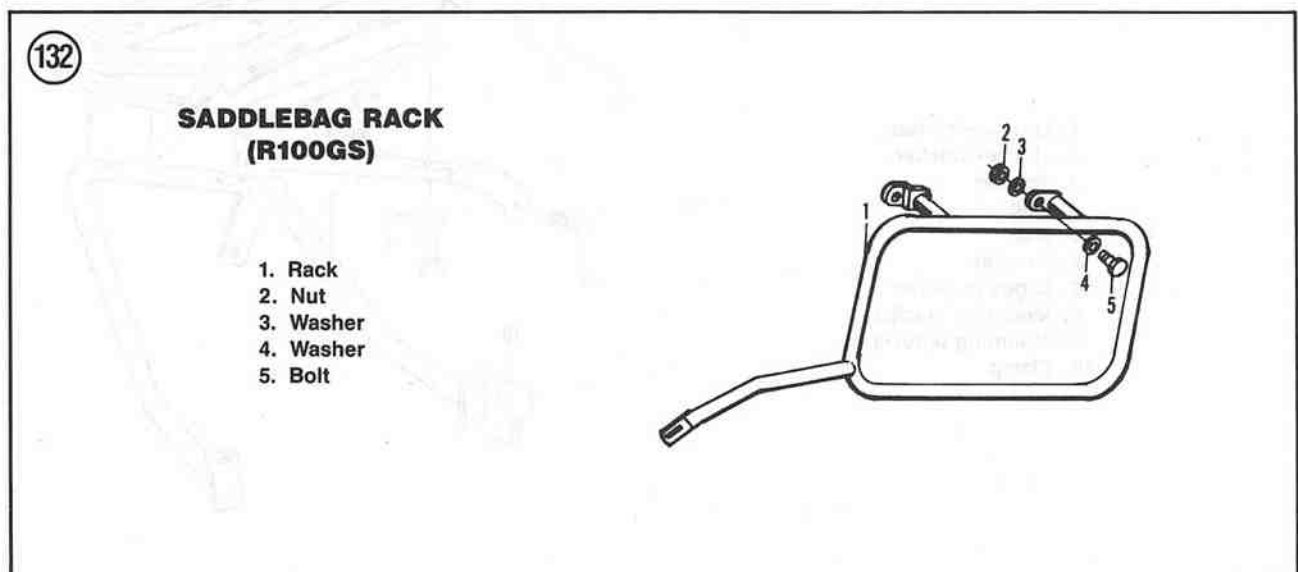


1. Remove the saddlebags and/or top case as described in this chapter.
2. On 1970-1976 models equipped with the dual carrier rack, perform the following:
  - a. Remove the long bolt and nut at the rear securing the rack and the taillight/rear turn signal bracket assembly.
  - b. Carefully pull on the taillight/rear turn signal bracket assembly and the electrical wires toward the rear.
  - c. Remove the bolts, washers and nuts securing the rack to the frame.

**NOTE**

*The next step requires the aid of an assistant. The luggage rack is not heavy but is difficult to remove while moving the taillight/rear turn signal bracket assembly at the same time.*

- d. Have an assistant hold onto the taillight/rear turn signal bracket assembly while you maneuver the rack assembly back and off of the frame. Work the taillight/rear turn signal bracket assembly through the rear of the rack assembly.
- e. Set the taillight/rear turn signal bracket assembly up onto the rear fender assembly. Do not allow this assembly to hang down as the electrical wires will be damaged.
3. On 1970-1976 models equipped with a single carrier rack on each side and all other models, perform the following:
  - a. Remove the bolts, lockwasher and nuts securing the saddlebag rack to the frame.
  - b. Remove the saddlebag rack.
  - c. Repeat for the other side if necessary.
4. Install by reversing these removal steps. Note the following during installation.
5. Tighten the bolts and nuts securely.



**Upper Luggage Carrier  
(1988-on R100RS and R100RT Models)  
Removal/Installation**

Refer to **Figure 133** for this procedure.

**Figure 133** shows the attachment hardware for one side only. The opposite side's components are an exact mirror image.

**NOTE**

*The upper luggage carrier assembly is interchangeable and your bike may not be equipped with the original carrier. Compare your luggage carrier assembly with the illustration for the correct replacement parts.*

1. Remove the seat as described in this chapter.
2. Remove the bolts, washers and nuts securing the luggage carrier to its mounting brackets.

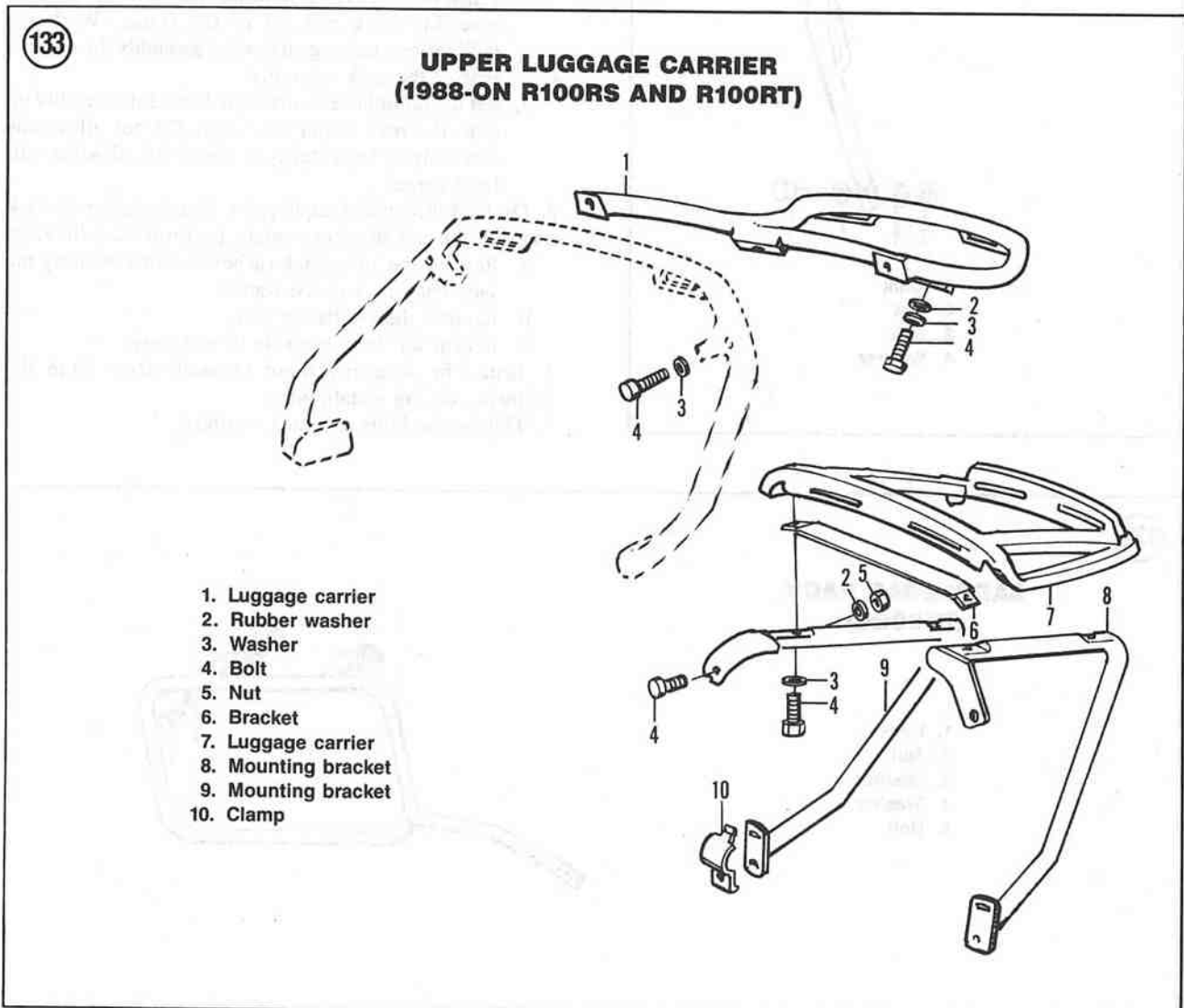
3. Remove the bolts, washers and nuts securing the mounting bracket(s) to the frame and remove the bracket(s).
4. Install by reversing these removal steps. Note the following during installation.
5. Tighten the bolts and nuts securely.

**WINDSHIELD**

**Removal/Installation**

Refer to **Figures 134-136** for this procedure.

1. Loosen the cap nuts on each side securing the windshield to the mounting rods and mounting brackets.
2. Remove all cap nuts and washers.
3. Remove the rubber grommet from each of the mounting rods.
4. Leave the upper portion of the windshield in place on the mounting rods.





5. Remove the bushings and rubber grommet and then remove the bolt and washer from the lower mounting bracket.
6. Carefully pull the windshield off of the upper mounting rod ends and remove the windshield.
7. Install by reversing these removal steps. Note the following during installation.
8. Be sure to install all rubber grommets and bushings at all attachment points. If the grommets and bushings are not used, the plastic windshield will crack and fracture when the mounting cap nuts are tightened. Do not overtighten the cap nuts.

**Windshield Cleaning  
(All Models)**

Be careful cleaning the windshield as it can be easily scratched or damaged. Do not use a cleaner with an abrasive or a combination cleaner and wax. Never use gasoline or cleaning solvent. These products will either scratch or totally destroy the surface of the windshield.

For normal cleaning, use a soft cloth or sponge and plenty of water. Dry thoroughly with a soft cloth (like an old plain white T-shirt) or chamois—do not press hard.

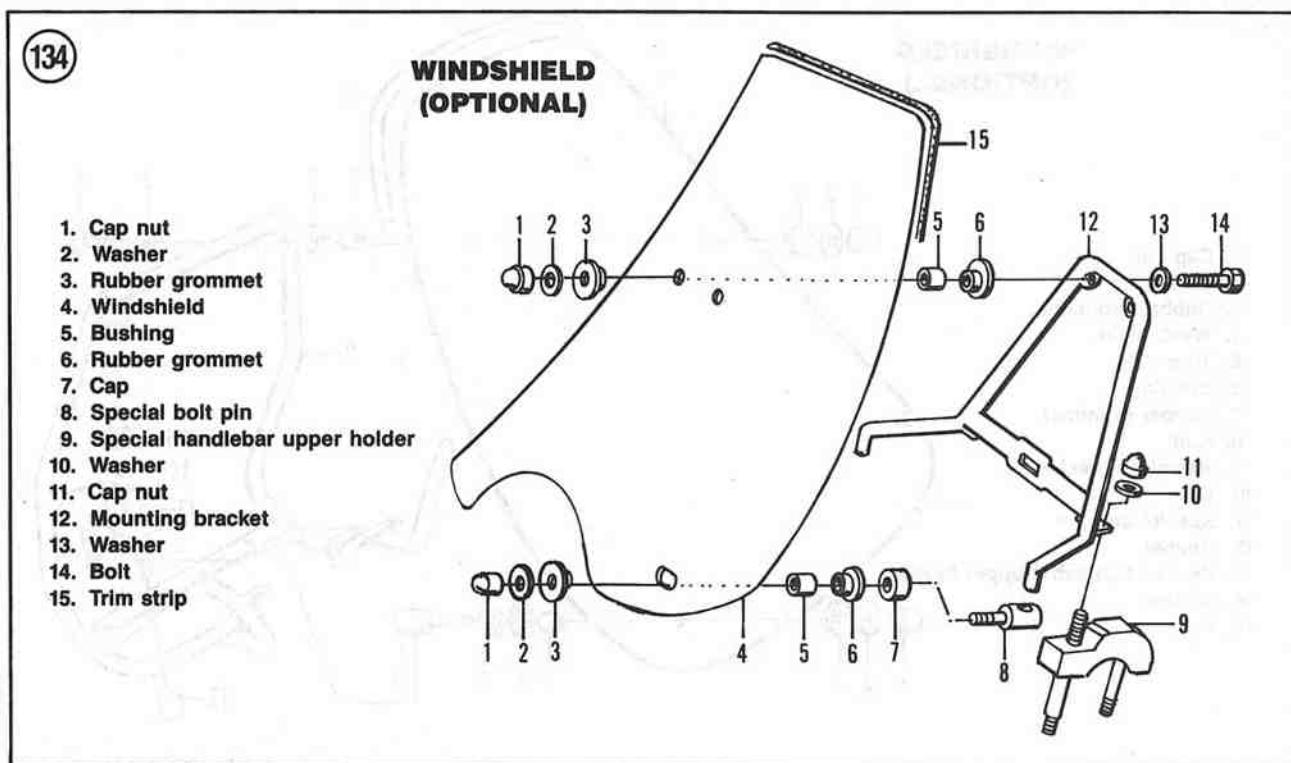
To remove oil, grease or road tar, use isopropyl alcohol or kerosene. Then wash the windshield with a solution of mild soap and lots of water. Dry thoroughly with a soft cloth or a chamois—do not press hard.

**FRAME**

The frame does not require routine maintenance. However, it should be inspected immediately after any accident or spill.

**Component Removal/Installation**

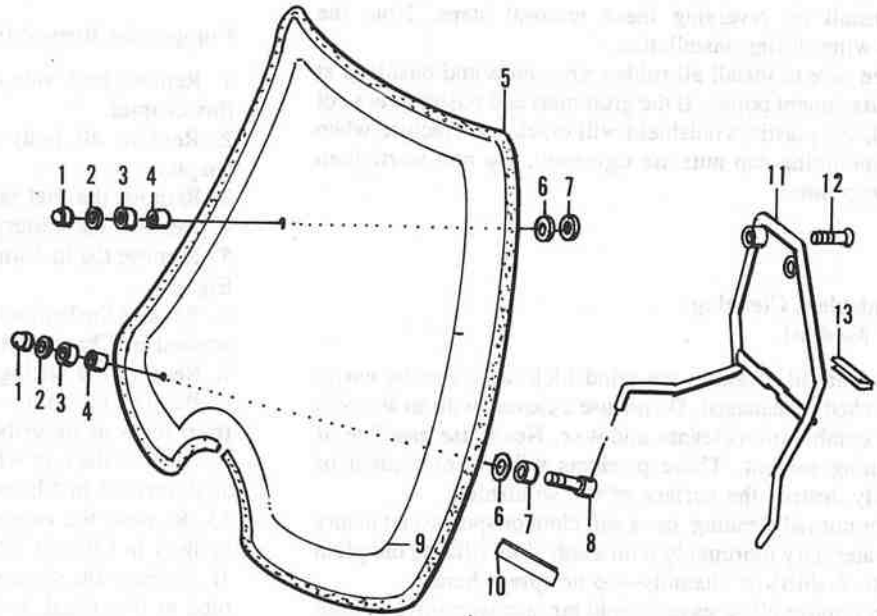
1. Remove both side covers and the seat as described in this chapter.
2. Remove all body components as described in this chapter.
3. Remove the fuel tank as described in Chapter Seven.
4. Remove the battery as described in Chapter Three.
5. Remove the instrument cluster as described in Chapter Eight.
6. Remove the hydraulic brake system flexible hoses as described in Chapter Eleven.
7. Remove the wiring harness from the frame.
8. Remove the front wheel, handlebar, steering head and front forks as described in Chapter Nine.
9. Remove the rear wheel, shock absorber and swing arm as described in Chapter Ten.
10. Remove the engine and transmission housing as described in Chapter Four.
11. Remove the steering head races from the steering head tube as described in Chapter Nine.
12. Inspect the frame for bends, cracks or other damage, especially around welded joints and areas that are rusted.
13. Assemble by reversing these removal steps.



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### WINDSHIELD (OPTIONAL)

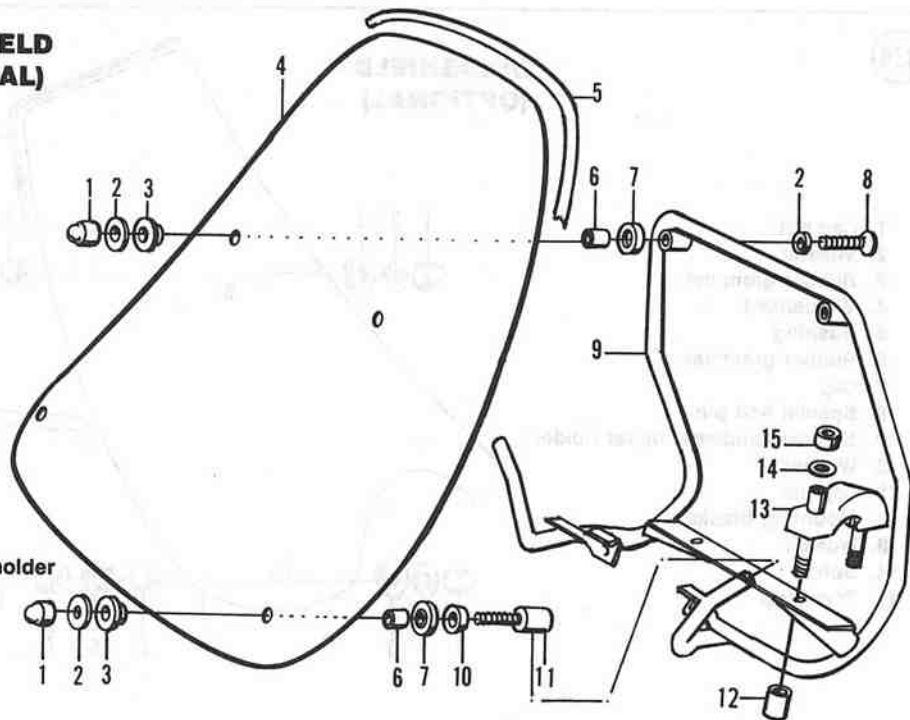
1. Cap nut
2. Washer
3. Rubber grommet
4. Bushing
5. Trim strip
6. Rubber grommet
7. Washer
8. Special bolt pin
9. Windshield
10. Label
11. Mounting bracket
12. Bolt
13. Trim strip



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### WINDSHIELD (OPTIONAL)

1. Cap nut
2. Washer
3. Rubber grommet
4. Windshield
5. Trim strip
6. Bushing
7. Rubber grommet
8. Bolt
9. Mounting bracket
10. Cap
11. Special bolt pin
12. Spacer
13. Special handlebar upper holder
14. Washer
15. Nut



## Stripping and Painting

Remove all components from the frame. Thoroughly strip off all old paint. The best way is to have it sand-blasted down to bare metal. If this is not possible, you can use a liquid paint remover and steel wool and a fine, hard wire brush.

### CAUTION

*Some of the fenders, side covers, frame covers and air box are molded plastic. If you wish to change the color of these parts, consult an automotive paint supplier for the proper procedure. Do not use any liquid paint remover on these components as it will damage the surface. The color is an integral part of some of these components and cannot be removed.*

When the frame is down to bare metal, have it inspected for hairline and internal cracks. Magnaflux is the most common and complete process.

Make sure that the primer is compatible with the type of paint you are going to use for the finish color. Spray on one or two coats of primer as smoothly as possible. Let it dry thoroughly and use a fine grade of wet sandpaper (400-600 grit) to remove any flaws. Carefully wipe the surface clean, then spray a couple of coats of the final color. Use either lacquer or enamel base paint and follow the manufacturer's instructions.

A shop specializing in painting will probably do the best job. However, you can do a surprisingly good job with a good grade of spray paint. Spend a few extra dollars and get a good grade of paint as it will make a difference in how well it looks and how long it will stand up. It's a good idea to shake the can and make sure the ball inside the can is loose when you purchase the can of paint. Shake

the can as long as is stated on the can. Then immerse the can *upright* in a pot or bucket of warm water (not over 120° F).

### WARNING

*Higher temperatures could cause the can to burst. Do not place the can in direct contact with any flame or heat source.*

Leave the can in the water for several minutes. When thoroughly warmed, shake the can again and spray the frame. Be sure to get into all the crevices where there may be rust problems. Several light mist coats are better than one heavy coat. Spray painting is best done in temperatures of 70-80° F (21-26° C); any temperature above or below this will give you problems.

After the final coat has dried completely, at least 48 hours for lacquer or 7 days for enamel, any overspray or orange peel may be removed with a *light application* of Dupont rubbing compound (red color) and finished with Dupont polishing compound (white color). Be careful not to rub too hard or you will go through the finish. Finish off with a couple coats of good wax prior to reassembling all the components.

It's a good idea to keep the frame touched up with fresh paint if any minor rust spots, chips or scratches appear.

An alternative to painting is powder coating. The process involves spraying electrically charged particles of pigment and resin on the object to be coated, which is negatively charged. The charged powder particles adhere to the electrically grounded object until heated and fused into a smooth coating in a curing oven. Powder coated surfaces are more resistant to chipping, scratching, fading and wearing than other finishes. A variety of colors and textures are available. Powder coating also has advantages over paint as no environmentally hazardous solvents are used.

## SUPPLEMENT

# 1990 AND LATER SERVICE INFORMATION

This supplement contains all procedures and specifications unique to the 1990 and later models. If a service procedure is not included, refer to the main body. If a service procedure is not included for the R100GS PD (Paris-Dakar), refer to the R100GS procedures in the main body.

The headings in this supplement correspond to those in other chapters of this book.

**Table 1** is located within this supplement.

## CHAPTER ONE

## GENERAL INFORMATION

Refer to **Table 1** for model, year and engine serial numbers.

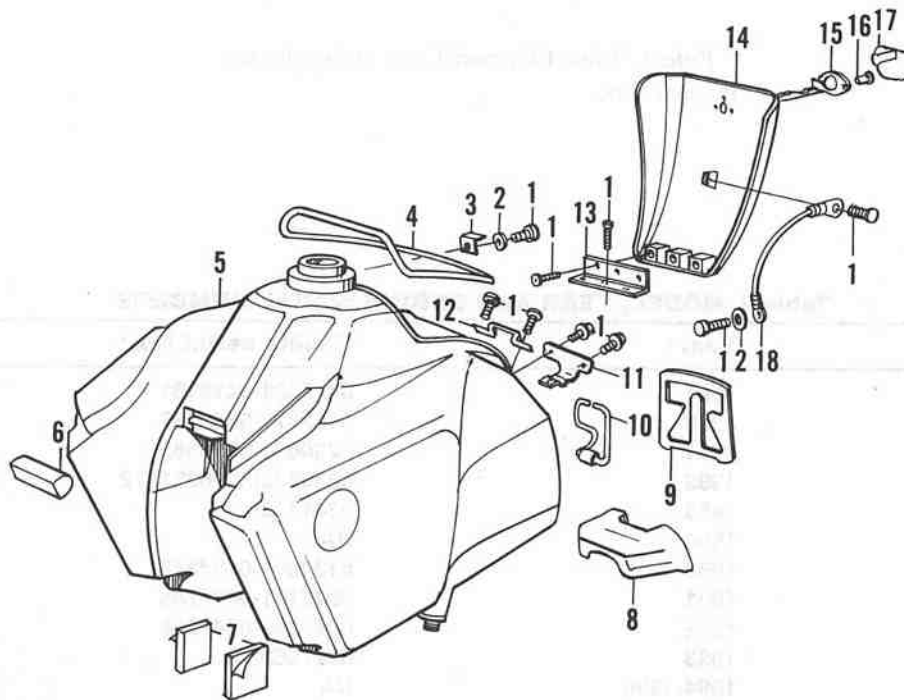
**Table 1 MODEL, YEAR AND ENGINE SERIAL NUMBERS**

Model	Year	Engine serial No.
R100	1991	6419001-6419181
R100GS (cont.)	1990	6153378-6153468
	1991	0230001-0230382
	1992	0230383001-0231172
	1993	0231173-on
	1994	NA
R100GS PD	1990	6134001-6134348
	1991	0047101-0047248
	1992	0047249-0047568
	1993	0047569-on
	1994-1996	NA
R100RS (cont.)	1990-1991	NA
	1992	6247598-6247690
	1993	6247691-on
R100RT	1990	6293399-6293519
	1991	6293520-6293710
	1992	6293711-6293875
	1993	6293876-on
	1994-1995	NA
NA = Not available		



1

### FUEL TANK (R100GS PD MODELS)



1. Bolt
2. Washer
3. Cover plate
4. Gasket
5. Fuel tank
6. Support
7. Rubber pad
8. Rubber pad
9. Plate
10. Holder
11. Bracket
12. Strap
13. Hinge
14. Cover
15. Catch
16. Rivet
17. Cap
18. Holding strap

## CHAPTER SEVEN

## CARBURETORS, EMISSION CONTROLS AND EXHAUST SYSTEM

### FUEL TANK (R100GS PD MODELS)

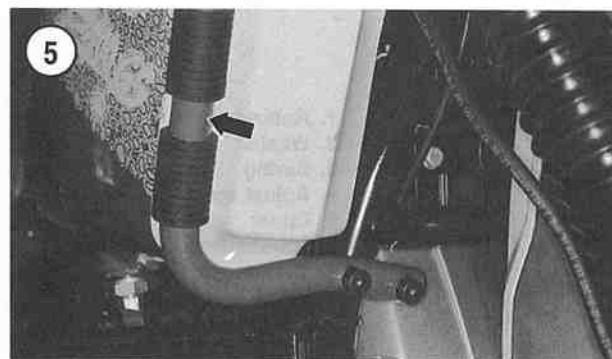
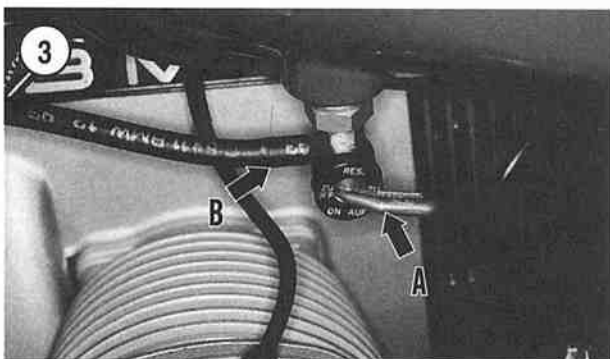
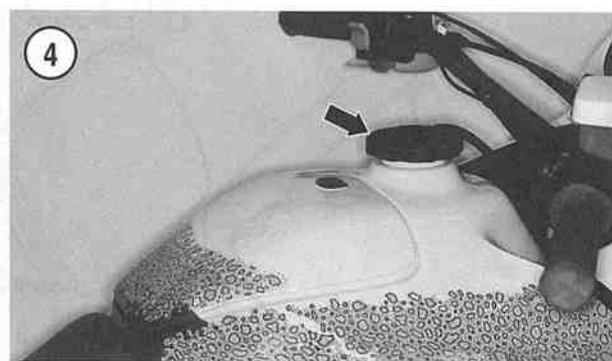
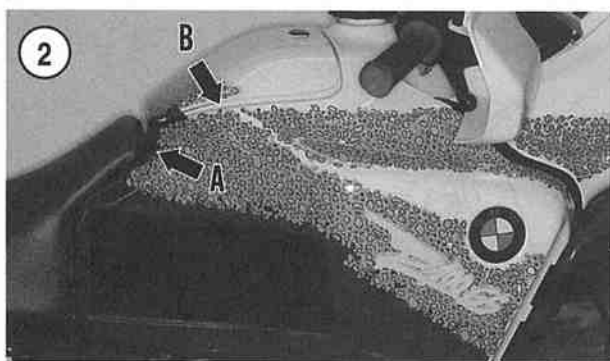
#### Removal/Installation

Refer to **Figure 1** for this procedure.

1. Place the bike on the centerstand.
2. Remove the seat (A, **Figure 2**) as described in this supplement.
3. Disconnect the battery negative lead as described under *Battery* in Chapter Three in the main body of this book.
4. Turn both fuel shutoff valves to the OFF position (A, **Figure 3**).
5. Disconnect the fuel line (B, **Figure 3**) from each fuel shutoff valve and install a golf tee into the fuel hose to prevent the entry of foreign matter. Also install a golf tee into

the fuel line fittings on the fuel tank to prevent fuel from dribbling out.

6. Disconnect the vent line from the filler cap (**Figure 4**).
7. Push down on the rear of the fuel tank with one hand.
8. Unhook the catch with the other hand.
9. Lift up on the rear of the fuel tank and pull it toward the rear and remove the fuel tank (B, **Figure 2**). Be careful not to scratch the fuel tank on the front fairing mounting bracket (**Figure 5**).
10. Install by reversing these removal steps. Note the following during installation.
11. Inspect the rubber pads at the front. Replace if they are damaged or starting to deteriorate.
12. Make sure the vent hose is installed correctly and is not kinked.
13. After installation is complete, start the engine and thoroughly check for fuel leaks.



## CHAPTER EIGHT

## ELECTRICAL SYSTEM

## HEADLIGHT

### Headlight and Parking Light Bulb Replacement (R100GS and R100GS PD Models)

The headlight is equipped with a H4 quartz halogen bulb. Special handling of the bulb is required in order to prolong bulb life. The bulb has 3 side prongs where it fits into the headlight reflector. These prongs are offset so the

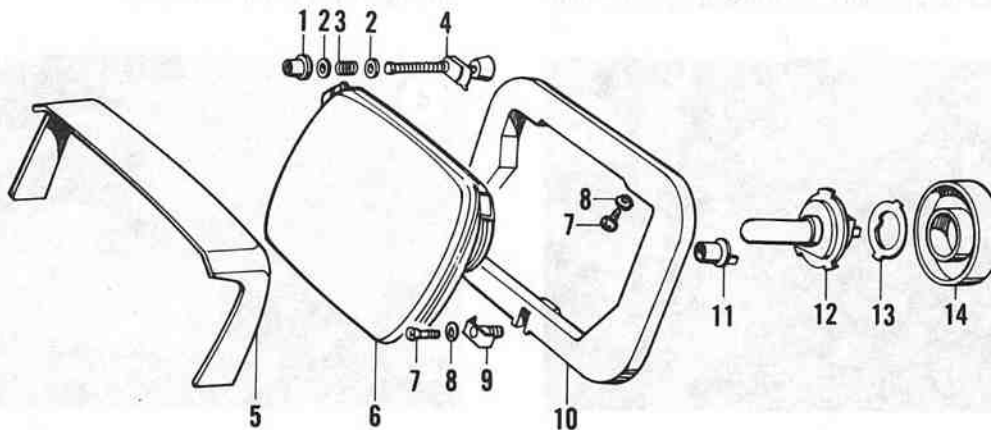
bulb can only be installed one way. When fitting the bulb, if it will not go into the reflector receptacle, rotate the bulb until the prongs align with the cutouts in the reflector receptacles and push it in.

**CAUTION**

*Carefully read all instructions shipped with the replacement quartz halogen bulb. Do not touch the bulb glass with your fingers because*

6

### HEADLIGHT AND PARKING LIGHT (R100GS AND R100GS PD MODELS)

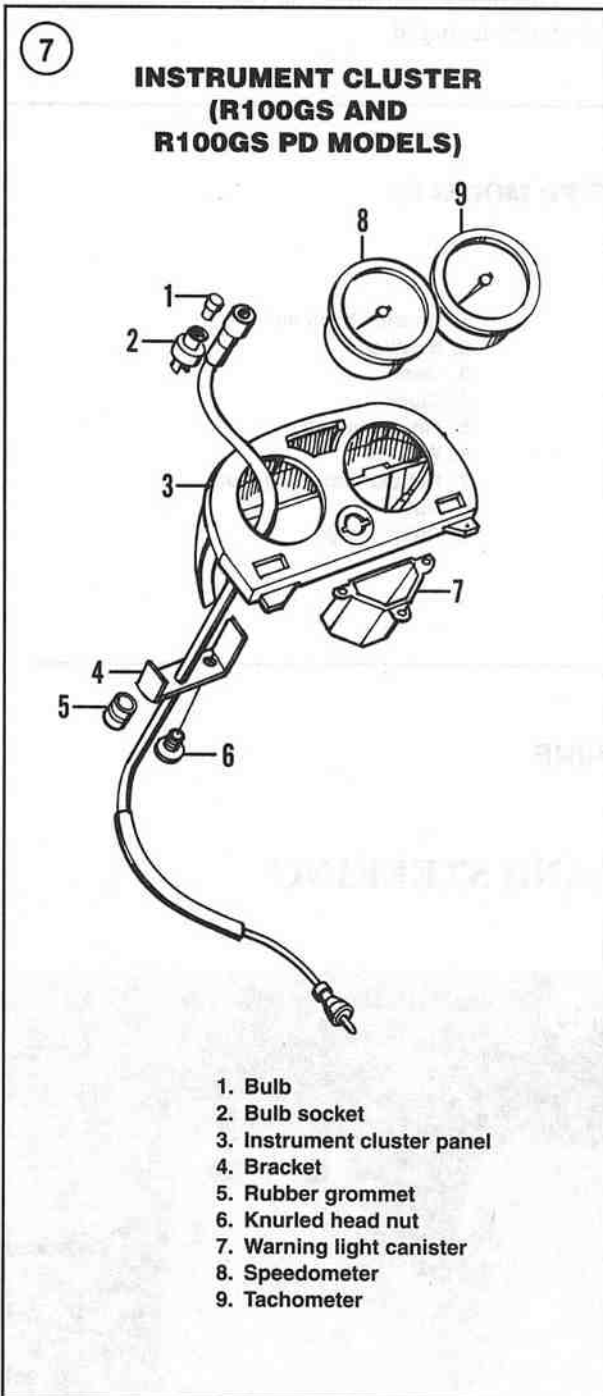


1. Rubber bushing
2. Washer
3. Spring
4. Adjust screw
5. Cover
6. Lens/reflector assembly
7. Screw

8. Washer
9. Nut holder
10. Frame
11. Clamp
12. Bulb
13. Bulb clip
14. Rubber boot

of oil on your skin. Any traces of oil on the glass will drastically reduce the life of the bulb. Clean any traces of oil from the bulb with a cloth moistened in alcohol or lacquer thinner.

Refer to **Figure 6** for this procedure.



1. Place the bike on the centerstand.
2. Disconnect the battery negative lead as described under *Battery* in Chapter Three in the main body of this book.
3. Disconnect the electrical connector from the base of the headlight assembly.
4. Remove the rubber boot from the base of the headlight reflector.
5. Rotate the bulb clip and remove it.
6. Remove the bulb assembly.
7. To replace the parking light bulb, perform the following:
  - a. Carefully pull the bulb and bulb holder out of the headlight assembly.
  - b. Remove the bulb from the socket assembly and install a new bulb.
  - c. Install the bulb and bulb holder into the headlight assembly until it bottoms out.
8. Install by reversing these removal steps. Note the following during installation.
9. Make sure the electrical connector is tight and free of corrosion.

### INSTRUMENT CLUSTER (R100GS AND R100GS PD MODELS)

#### Removal/Installation

Refer to **Figure 7** for this procedure.

1. Remove the front fairing assembly (A, **Figure 8**) as described in this supplement.
2. Remove the fasteners securing the instrument cluster (B, **Figure 8**) to the center section of the front fairing and remove the cluster assembly.
3. To remove the speedometer and/or tachometer, remove the knurled nuts securing the bracket to the backside of the meter housing and remove the meter through the front side of the cluster panel.
4. Install by reversing these removal steps.



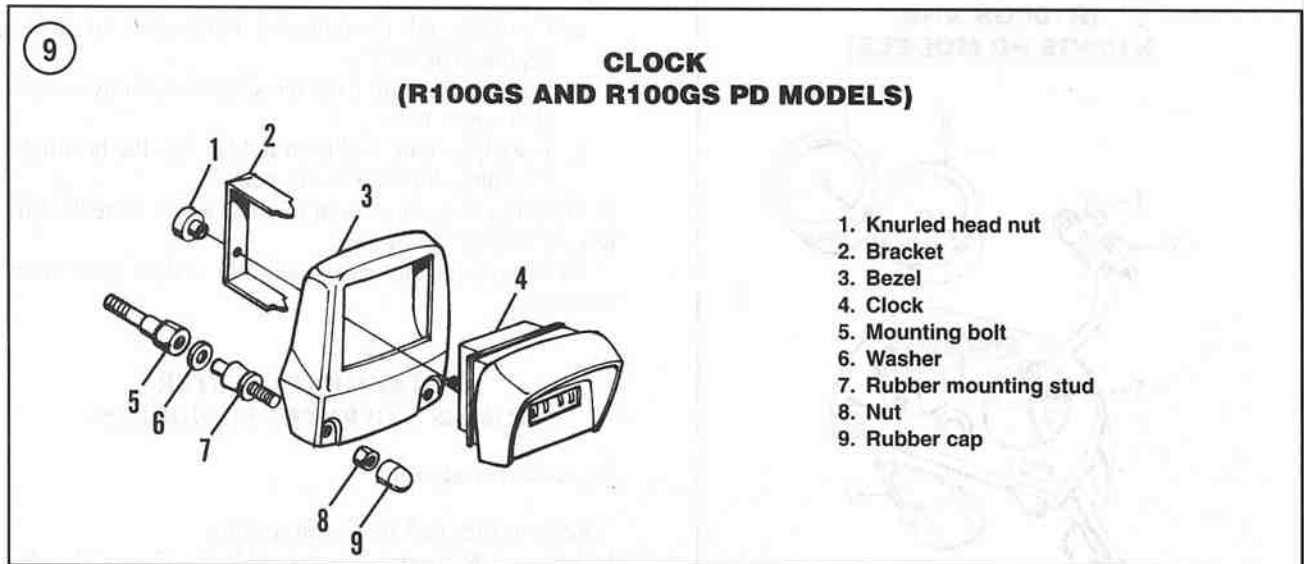
### CLOCK (OPTIONAL) (R100GS AND R100GS PD MODELS)

#### Removal/Installation

Refer to **Figure 9** for this procedure.

1. Place the bike on the centerstand.
2. Remove the rubber caps from the front mounting nuts.
3. Remove the nuts securing the clock assembly to the mounting bolt assembly.

4. Remove the clock assembly.
5. If necessary, disassemble the clock. Remove the knurled nuts, remove the bracket and separate the clock from the bezel.
6. Install by reversing these removal steps. Note the following during installation.
7. Tighten the nuts securing the clock assembly securely. Don't overtighten the nuts as the clock bezel mounting areas may be damaged.



## CHAPTER NINE

### FRONT SUSPENSION AND STEERING

#### HANDLEBAR (R100GS PD MODELS)

#### Removal/Installation

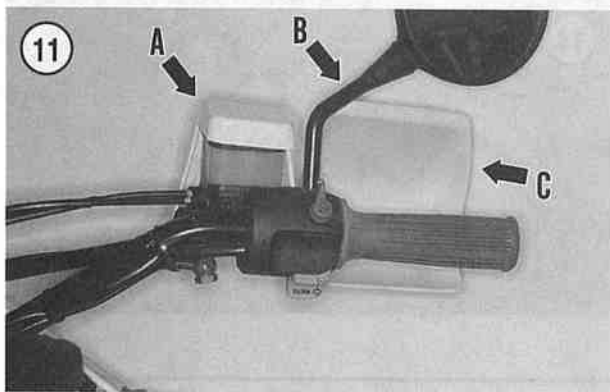
Handlebar removal and installation are the same as on previous models with the exception of the protective hand guards. To remove the hand guards, perform the following:

1. Remove the screws (**Figure 10**) securing the master cylinder protective cover and remove the cover (A, **Figure 11**).
2. Unscrew and remove the rear view mirror. Refer to B, **Figure 11** for the right-hand side and A, **Figure 12** for the left-hand side.

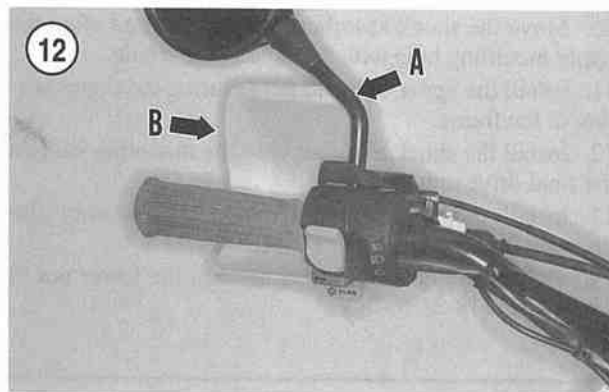




3. Remove the bolt, washers and nut securing the hand guard and remove the hand guard. Refer to C, **Figure 11** for the right-hand side and B, **Figure 12** for the left-hand side. Don't lose the spacer on the bolt.
4. Install by reversing these removal steps. Note the following during installation.



5. Be sure to install the spacer on the bolt between the 2 plastic surfaces of the hand grip.
6. Tighten the bolts and nuts securing the hand guard securely. Don't overtighten the bolts and nuts as the mounting areas may be damaged.



## CHAPTER TEN

# REAR SUSPENSION AND FINAL DRIVE

## SHOCK ABSORBER (SINGLE SHOCK MODELS)

### Removal/Installation (R100GS and R100GS PD Models)

Refer to **Figure 13** for this procedure.

1. Place the bike on the centerstand.
2. Place wood block(s) under the rear wheel to maintain the swing arm in the at-rest position.
3. Remove the frame right-hand side cover.

#### NOTE

*The rubber mounting bushing in the upper mount is offset with the bushing shoulder facing toward the centerline of the bike. This positions the shock absorber assembly away from the rear wheel. If removed, this bushing must be reinstalled in this same position.*

4. Remove the upper mounting bolt and nut securing the shock absorber to the frame.
5. Remove the lower nut and washer (**Figure 14**) securing the shock absorber to the final drive unit.

6. Remove the shock absorber from the mounting stud on the final drive unit.
7. Pull the upper end of the shock absorber from the mounting area in the frame and remove the shock absorber.
8. Inspect the shock absorber unit as described under *Inspection (All Models)* in Chapter Ten in the main body of this book.
9. Apply a light coat of molybdenum disulfide grease to the upper and lower bushings on the shock absorber.

#### WARNING

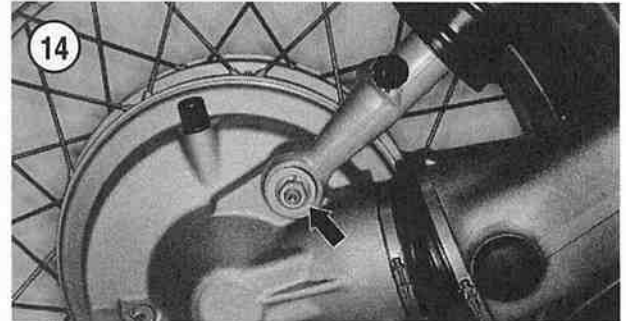
*All bolts and nuts used on the single shock suspension must be replaced with parts of the same type. Do not use a replacement part of lesser quality or substitute design, as it may affect the performance of the system or result in failure of the part which will lead to loss of control of the bike. Torque values listed in this procedure must be used during installation to assure proper retention of these parts.*

**CAUTION**

*Be sure to install the upper end of the shock absorber with the bushing shoulder facing toward the centerline of the bike. This positions the shock absorber assembly away from the rear wheel. If removed, this bushing must be reinstalled in this same position.*

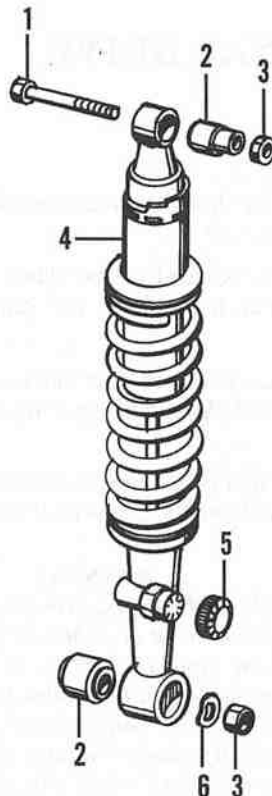
10. Move the shock absorber into position and align the upper mounting hole with the hole in the frame.
11. Install the upper bolt and nut securing the upper portion to the frame.
12. Install the shock absorber onto the mounting stud on the final drive unit.
13. Install the washer and nut and tighten only finger-tight at this time.
14. Tighten the upper bolt and nut and the lower nut to 25-34 N•m (18-25 ft.-lb.).

15. Remove the wood block(s) from under the rear wheel.
16. Take the bike off the centerstand. Push down on the rear of the bike and make sure the rear suspension is operating correctly.
17. Install the frame right-hand side cover.



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**SHOCK ABSORBER  
(R100GS AND R100GS PD MODELS)**



1. Bolt
2. Bushing
3. Nut
4. Shock absorber assembly
5. Cover
6. Washer

## CHAPTER TWELVE

## FRAME AND BODY

### FRONT FENDER (R100GS PD MODELS)

#### Removal/Installation

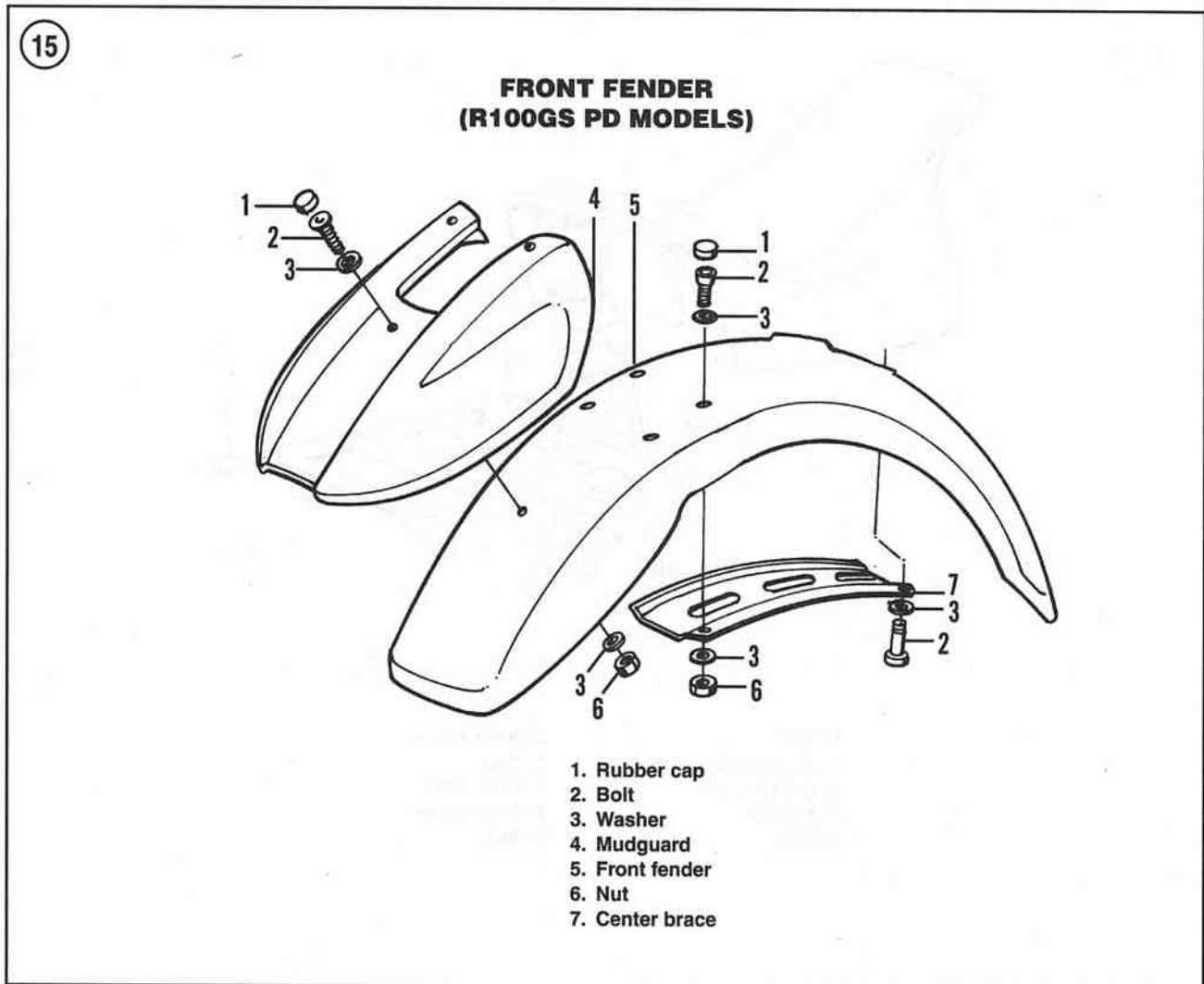
Refer to **Figure 15** for this procedure.

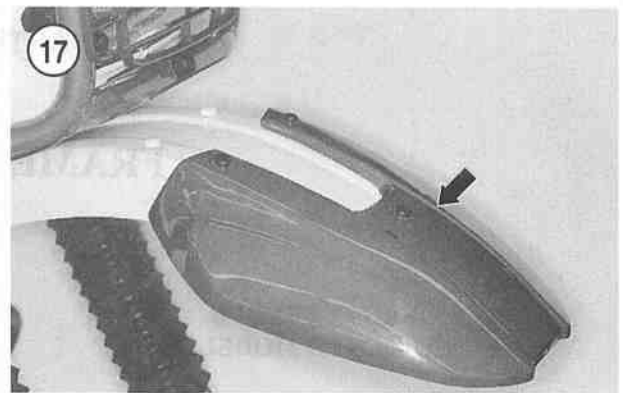
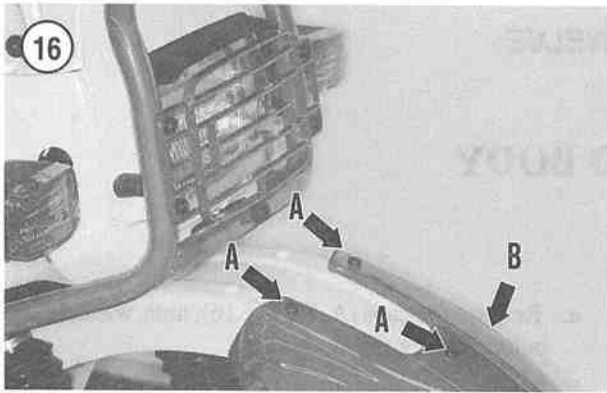
1. Place the bike on the centerstand.
2. To remove the mudguard, perform the following:

- a. Remove the caps (A, **Figure 16**), nuts, washers and bolts securing the mudguard.
- b. Remove the mudguard (B, **Figure 16**) from the fender.

**NOTE**

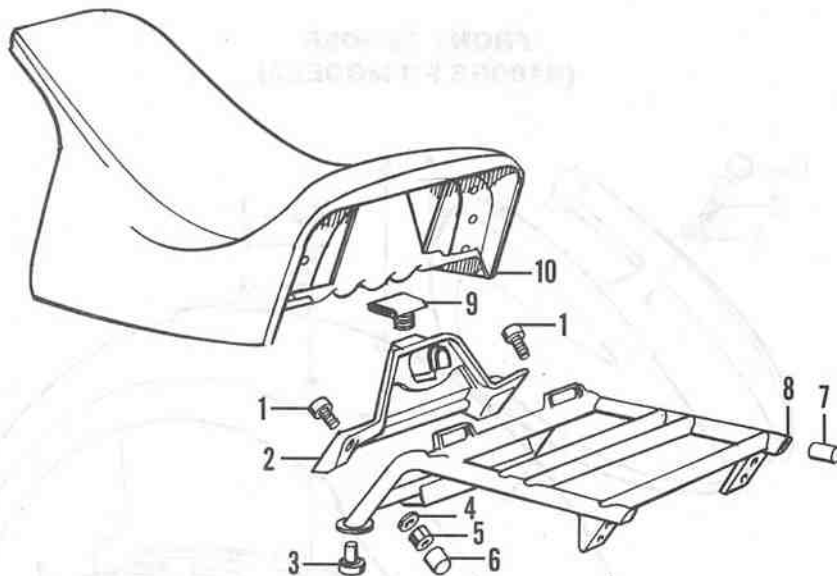
*The center brace will stay with the front fender during removal.*



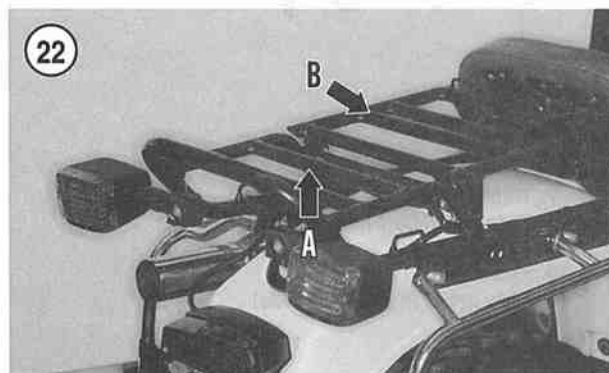
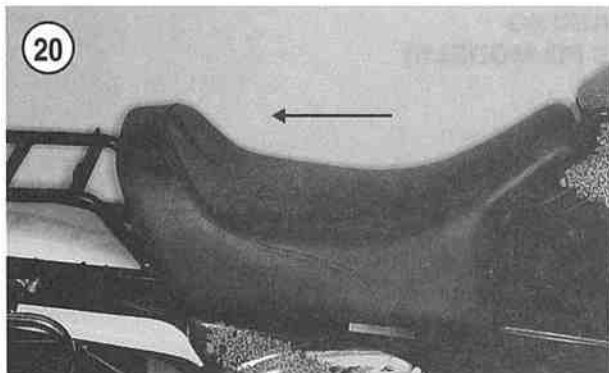


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### SEAT AND REAR CARRIER (R100GS PD MODELS)



- |                     |                |
|---------------------|----------------|
| 1. Bolt             | 6. Rubber cap  |
| 2. Mounting bracket | 7. Cap         |
| 3. Rubber pad       | 8. Rear rack   |
| 4. Washer           | 9. Seat holder |
| 5. Nut              | 10. Seat       |



3. Remove the bolts and washers securing the front fender and mudguard assembly (**Figure 17**) to the fork bridge.
4. Carefully pull the front fender down past the fork rubber boots being careful not to damage the boots.
5. Remove the fender assembly.
6. If necessary, remove the bolts and nuts securing the center brace and/or the mudguard and remove them.
7. Install by reversing these removal steps. Note the following during installation.
8. Tighten the bolts securing the fender securely. Don't overtighten the bolts as the fender mounting areas may be damaged.

### SEAT AND REAR CARRIER (R100GS PD MODELS)

#### Removal/Installation

Refer to **Figure 18** for this procedure.

1. Place the bike on the centerstand.
2. Release the seat lock (**Figure 19**) with the key.
3. Pull the seat toward the rear (**Figure 20**) and remove it.
4. To remove the rear carrier, perform the following:
  - a. Remove the rubber caps from the front mounting nuts.
  - b. Remove the bolts, washers and nuts securing the front mounting bracket (**Figure 21**). Remove the mounting bracket.
  - c. Remove the bolts (A, **Figure 22**) securing the back of the rear carrier to the sub-frame.
  - d. Remove the rear carrier (B, **Figure 22**).
5. Removal of the rear sub-frame (**Figure 23**) is the same as on previous R100GS models.
6. Install by reversing these removal steps. Note the following during installation.
7. Tighten the bolts and nuts securing the rear carrier securely.





### HEADLIGHT FAIRING AND MOUNTING BRACKET (R100GS AND R100GS PD MODELS)

#### Removal/Installation

Refer to the following illustrations for this procedure:

- a. **Figure 24:** front fairing.
- b. **Figure 25:** front fairing mounting bracket.

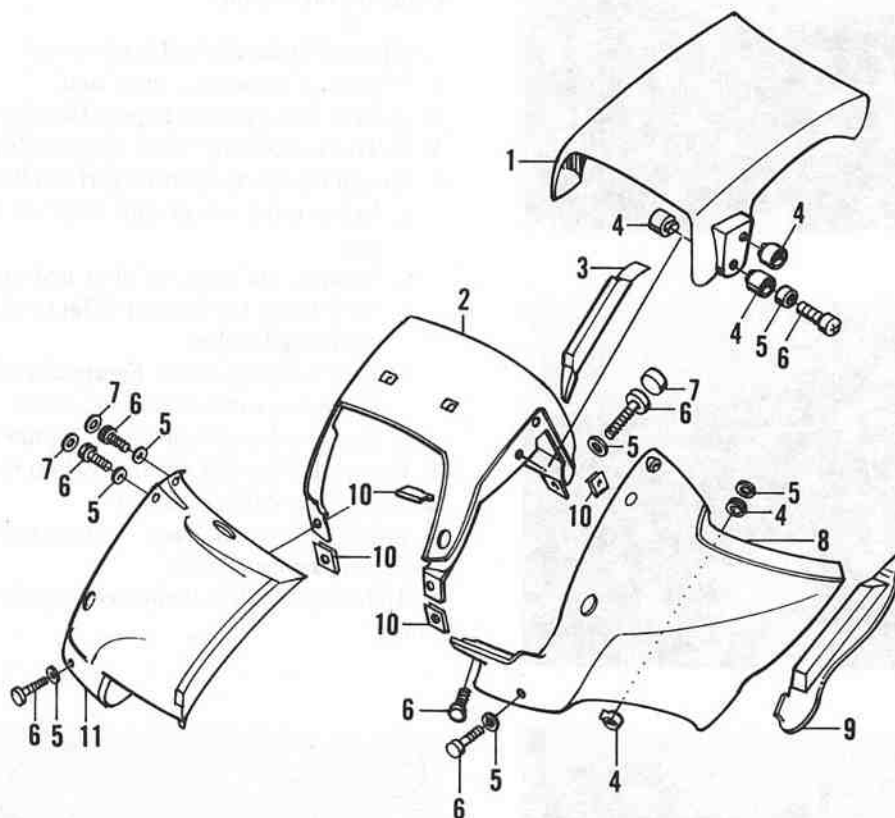
#### NOTE

*Figure 24 illustrates the front fairing side panels used on the R100GS PD. The R100GS side panels are smaller but the removal and installation procedures are identical.*

1. Place the bike on the centerstand.
2. To avoid damage to the front fender, remove the front fender as described in this supplement.

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### HEADLIGHT FAIRING (R100GS AND R100GS PD MODELS)

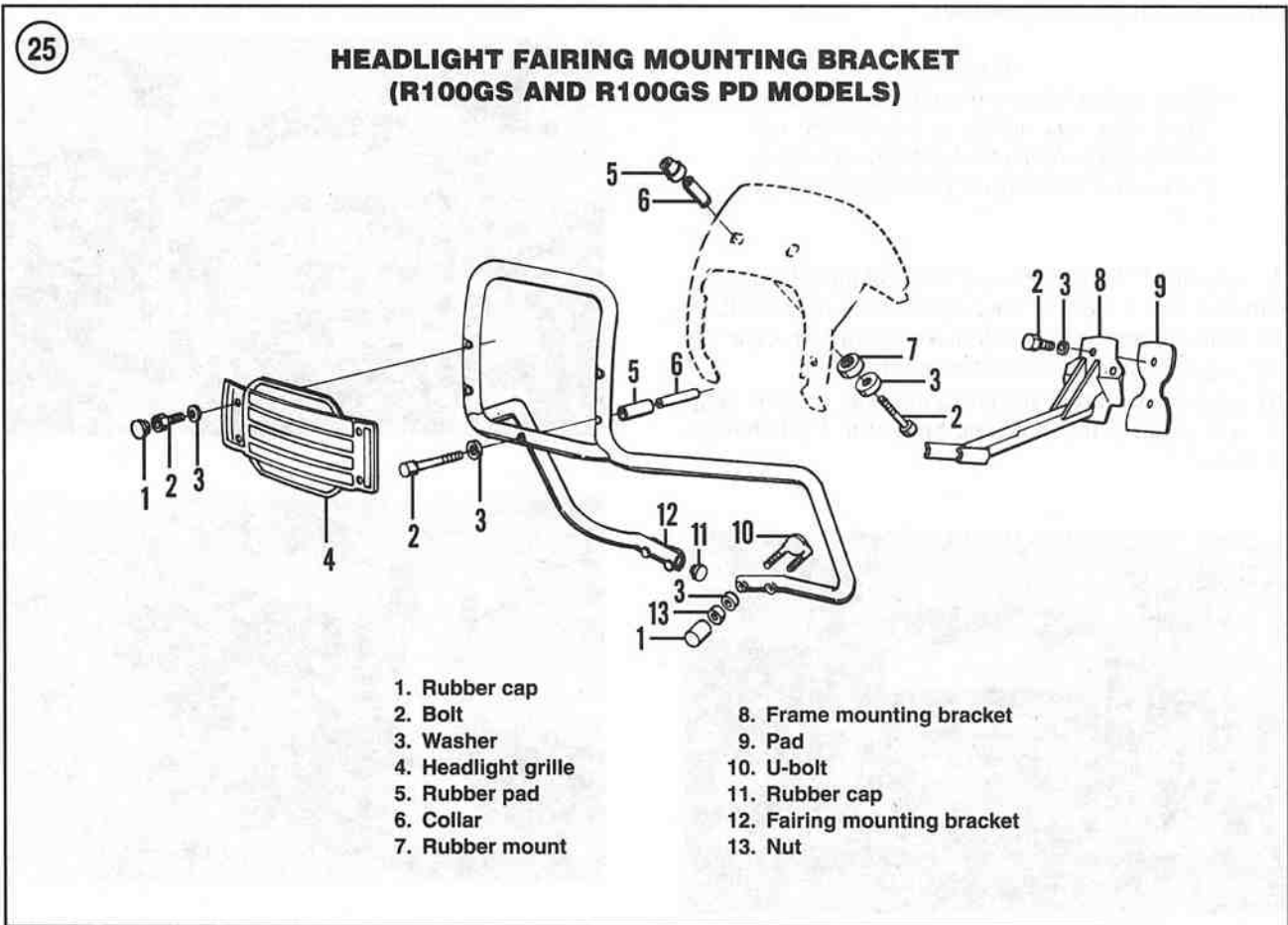


1. Windshield
2. Center panel
3. Rubber trim
4. Distance rubber pad
5. Distance rubber pad
6. Bolt

7. Rubber cap
8. Side panel (left-hand side)
9. Rubber trim
10. Special nut
11. Side panel (right-hand side)

3. Disconnect the battery negative lead as described under *Battery* in Chapter Three in the main body of this book.
4. Reach under the meter assembly and disconnect the following:
  - a. Headlight electrical connector.
  - b. Meter electrical connector.
  - c. Turn signal electrical connectors.
  - d. Speedometer drive cable.

- e. Tachometer electrical connector.
5. To avoid damage to the windshield during removal, remove the screws and washers (Figure 26) securing the windshield to the front fairing and remove the windshield (Figure 27).
6. If necessary, remove the caps (A, Figure 28) then the bolts and washers securing the headlight guard and remove the guard (B, Figure 28).



**NOTE**

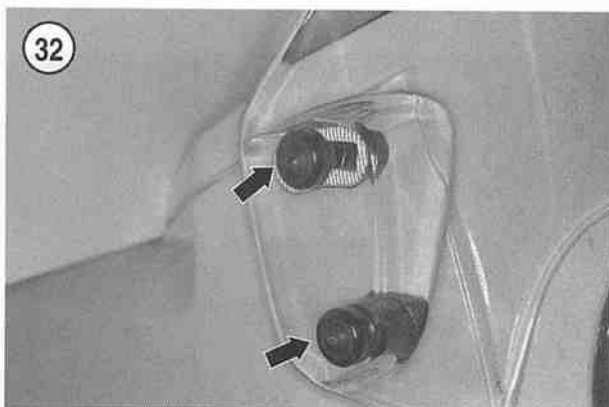
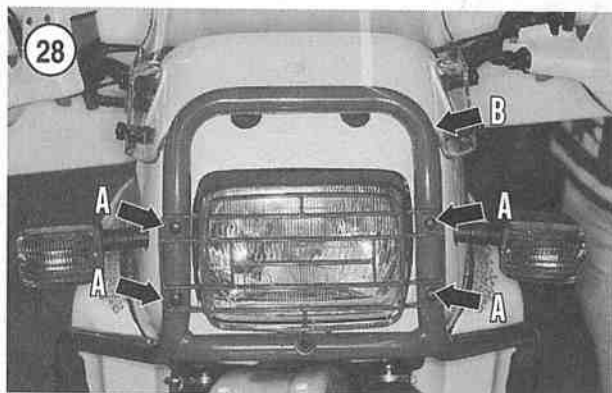
*The front fairing, the mounting bracket and headlight are removed as an assembly and then disassembled if necessary.*

7. To protect the finish, place a couple of blankets on the workbench or floor for the fairing assembly to sit on after removal.
8. On the mounting bracket, remove the rubber caps from the lower mounting nuts (**Figure 29**) and from the upper center mounting bolt (**Figure 30**).

**NOTE**

*The next step requires the aid of an assistant. The fairing and mounting bracket are not heavy but it is difficult to hold the assembly in place while removing the mounting bolts and nuts.*

9. Since the U-bolts will usually fall off after the nuts are removed, use a piece of duct tape to hold the U-bolts in place on the frame. This will make installation easier by keeping the U-bolts in the correct position.
10. Remove the lower mounting nuts and washers (**Figure 29**) securing the mounting bracket to the U-bolt on each side.



11. Have an assistant hold onto the fairing assembly, then remove the upper center bolt and washer (**Figure 30**). Don't lose the rubber cushion and inner metal collar on the bolt.
12. Make sure all electrical connectors have been disconnected.
13. Carefully pull the fairing and mounting bracket assembly (**Figure 31**) forward and remove it from the frame and mounting bracket.

14. Set the assembly on the blankets.
15. If necessary, refer to the preceding illustrations and disassemble any parts from the fairing assembly.
16. Install by reversing these removal steps. Note the following during installation.
17. Be sure to reinstall all rubber spacers in their respective locations.
18. Tighten the bolts and nuts securely.
19. Make sure all electrical connectors are free of corrosion and are tight. Don't forget to reconnect the speedometer cable.

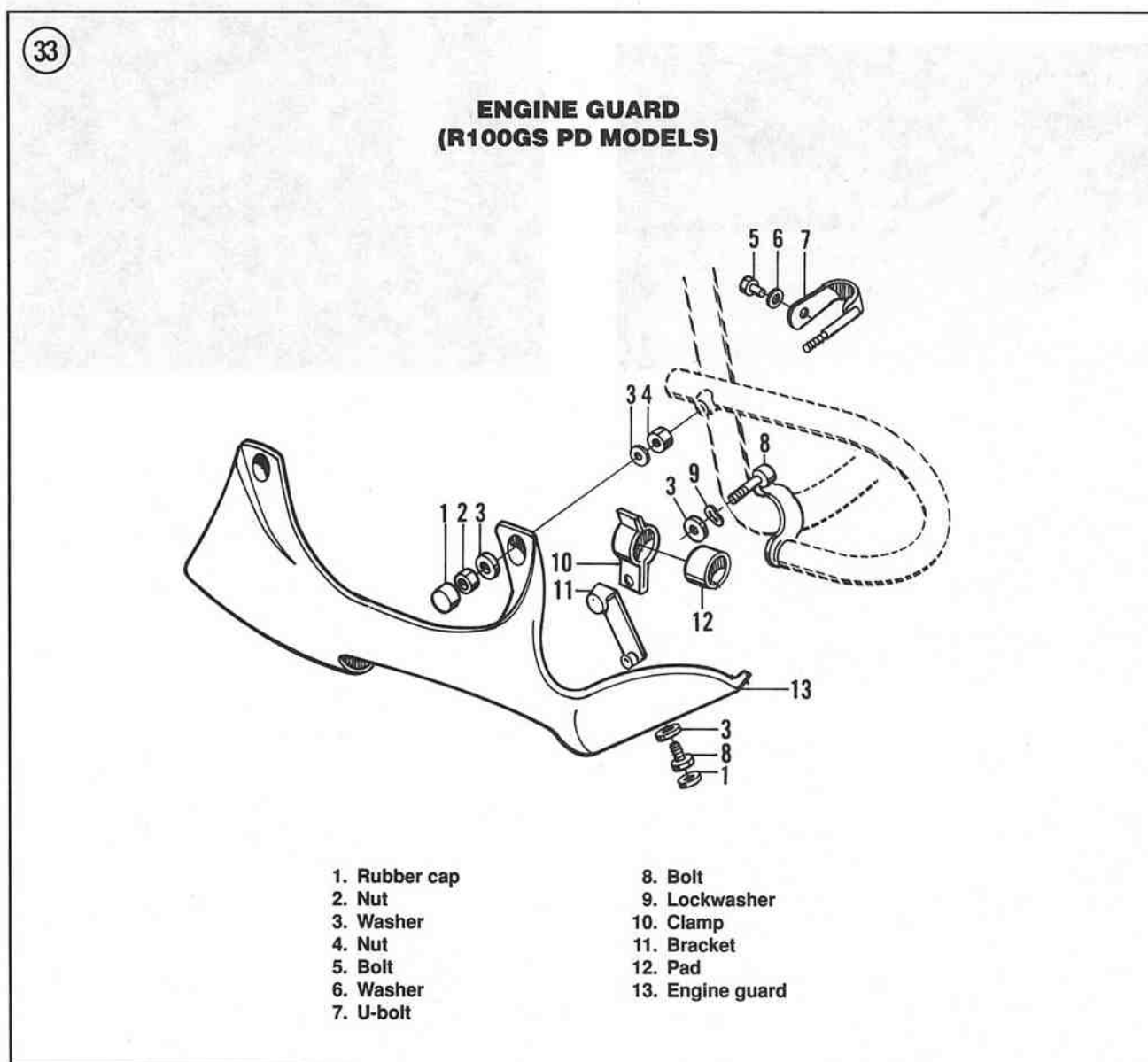
### Windshield Adjustment

To adjust the angle of the windshield, loosen both upper and lower mounting Allen bolts (**Figure 32**) on each side and reposition the windshield by pivoting it on the lower bolt. Tighten the Allen bolts securely.

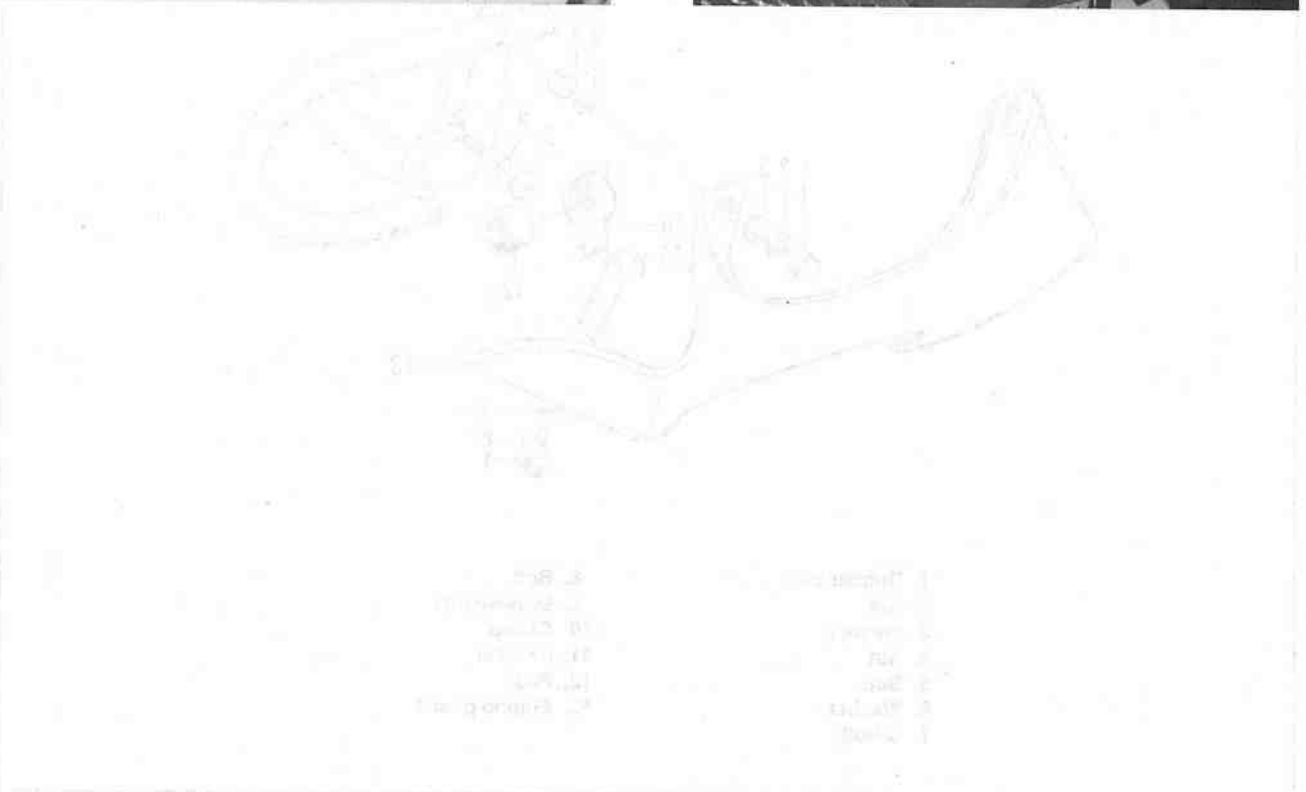
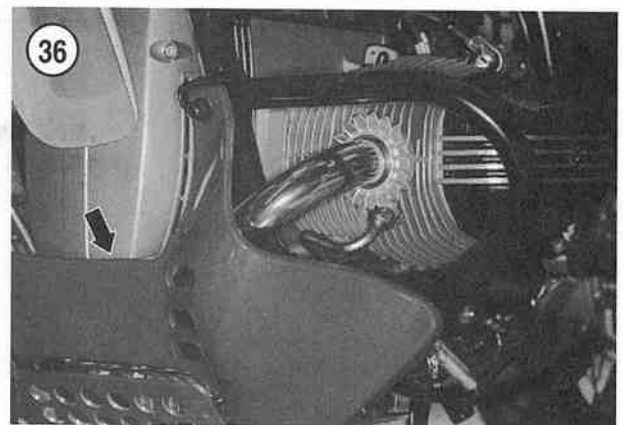
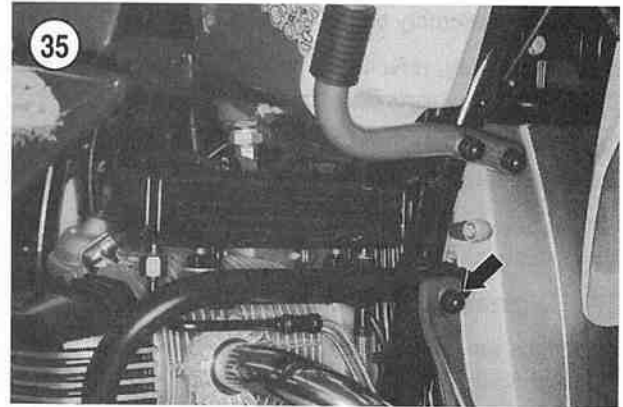
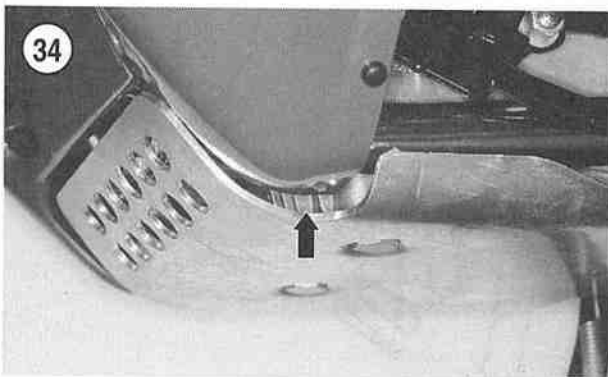
### ENGINE GUARD (R100GS PD MODELS)

#### Removal/Installation

Refer to **Figure 33** for this procedure.



1. Place the bike on the centerstand.
2. Remove the rubber caps from the lower mounting bolts and from the upper mounting nuts.
3. Remove the lower mounting bolt and washer from each side (**Figure 34**).
4. Remove the upper mounting nut and washer from each side (**Figure 35**).
5. Remove the engine guard (**Figure 36**) from the frame. The mounting brackets will stay on the frame.
6. Install by reversing these removal steps. Note the following during installation.
7. Tighten the bolts and nuts securely. Don't overtighten the bolts and nuts as the engine guard mounting areas may be damaged.





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1. The first part of the document discusses the importance of maintaining accurate records. It emphasizes that proper record-keeping is essential for the smooth operation of any organization. This section also touches upon the legal implications of record management, particularly in the context of audits and litigation.

2. The second part of the document focuses on the various methods used for data collection and analysis. It compares different statistical techniques and their applicability in different scenarios. The author highlights the need for a clear understanding of the underlying data and the choice of appropriate statistical tools.

3. The third part of the document discusses the challenges faced in the implementation of quality control systems. It identifies common pitfalls and offers practical solutions to overcome them. The importance of employee training and a strong quality culture is stressed throughout this section.

4. The fourth part of the document explores the role of technology in modern business operations. It discusses how digital tools and automation can streamline processes, reduce errors, and improve overall efficiency. The author also addresses the security concerns associated with the use of technology.

5. The fifth part of the document provides a comprehensive overview of the current state of the global economy. It analyzes the impact of various economic factors and offers insights into the future outlook. The author discusses the role of international trade and the challenges posed by global economic uncertainty.

6. The sixth part of the document discusses the importance of effective communication in the workplace. It highlights the benefits of clear and concise communication and provides tips for improving communication skills. The author also discusses the role of communication in team building and conflict resolution.

7. The seventh part of the document focuses on the management of human resources. It discusses the various aspects of HR, including recruitment, training, and performance management. The author emphasizes the need for a strategic approach to HR management that aligns with the organization's overall goals.

8. The eighth part of the document discusses the importance of financial management in business. It covers topics such as budgeting, cost control, and financial reporting. The author provides practical advice on how to manage the organization's finances effectively and ensure long-term financial stability.

9. The ninth part of the document discusses the role of marketing in business success. It explores various marketing strategies and their effectiveness in different markets. The author emphasizes the need for a data-driven marketing approach that targets the right audience and delivers the right message at the right time.

10. The tenth part of the document discusses the importance of innovation in business. It explores the various ways in which innovation can drive growth and create a competitive advantage. The author provides examples of successful innovative companies and offers insights into the factors that contribute to their success.

11. The eleventh part of the document discusses the importance of risk management in business. It identifies the various types of risks that organizations face and provides strategies for identifying, assessing, and mitigating these risks. The author emphasizes the need for a proactive risk management approach that integrates risk management into the organization's overall strategy.

12. The twelfth part of the document discusses the importance of sustainability in business. It explores the various ways in which businesses can contribute to social and environmental sustainability. The author discusses the benefits of sustainable business practices and offers practical advice on how to implement them.

13. The thirteenth part of the document discusses the importance of customer relationship management (CRM) in business. It explores the various ways in which CRM can improve customer satisfaction and loyalty. The author provides examples of successful CRM implementations and offers insights into the factors that contribute to their success.

14. The fourteenth part of the document discusses the importance of intellectual property protection in business. It explores the various types of intellectual property and provides strategies for protecting them. The author emphasizes the need for a strong intellectual property strategy that aligns with the organization's overall business strategy.

15. The fifteenth part of the document discusses the importance of corporate governance in business. It explores the various aspects of corporate governance, including board structure, executive compensation, and shareholder rights. The author emphasizes the need for a strong corporate governance framework that promotes transparency and accountability.

16. The sixteenth part of the document discusses the importance of digital marketing in business. It explores the various digital marketing channels and provides strategies for reaching the target audience. The author emphasizes the need for a data-driven digital marketing approach that tracks and measures the effectiveness of marketing efforts.

17. The seventeenth part of the document discusses the importance of supply chain management in business. It explores the various aspects of supply chain management, including procurement, inventory management, and logistics. The author provides practical advice on how to optimize the supply chain and reduce costs.

18. The eighteenth part of the document discusses the importance of mergers and acquisitions in business. It explores the various reasons for M&A and provides strategies for successful M&A transactions. The author emphasizes the need for thorough due diligence and a clear integration plan.

19. The nineteenth part of the document discusses the importance of public relations in business. It explores the various ways in which public relations can enhance the organization's reputation and build relationships with the media and the public. The author provides examples of successful public relations campaigns and offers insights into the factors that contribute to their success.

20. The twentieth part of the document discusses the importance of crisis management in business. It explores the various types of crises that organizations face and provides strategies for preventing and managing them. The author emphasizes the need for a strong crisis management plan that outlines the organization's response to various types of crises.

21. The twenty-first part of the document discusses the importance of employee engagement in business. It explores the various ways in which employee engagement can improve productivity and reduce turnover. The author provides practical advice on how to create a work environment that fosters employee engagement.

22. The twenty-second part of the document discusses the importance of diversity and inclusion in business. It explores the various ways in which diversity and inclusion can drive innovation and improve organizational performance. The author emphasizes the need for a strong diversity and inclusion strategy that promotes a culture of respect and inclusivity.

23. The twenty-third part of the document discusses the importance of social media in business. It explores the various ways in which social media can be used for marketing and customer engagement. The author provides examples of successful social media marketing campaigns and offers insights into the factors that contribute to their success.

24. The twenty-fourth part of the document discusses the importance of data analytics in business. It explores the various ways in which data analytics can be used to gain insights into customer behavior and optimize business operations. The author emphasizes the need for a strong data analytics strategy that integrates data analytics into the organization's overall decision-making process.

25. The twenty-fifth part of the document discusses the importance of artificial intelligence (AI) in business. It explores the various ways in which AI can be used to automate tasks and improve efficiency. The author provides examples of successful AI implementations and offers insights into the factors that contribute to their success.

26. The twenty-sixth part of the document discusses the importance of blockchain technology in business. It explores the various ways in which blockchain can be used to improve transparency and security in business transactions. The author provides examples of successful blockchain implementations and offers insights into the factors that contribute to their success.

27. The twenty-seventh part of the document discusses the importance of virtual reality (VR) in business. It explores the various ways in which VR can be used for training and customer engagement. The author provides examples of successful VR implementations and offers insights into the factors that contribute to their success.

28. The twenty-eighth part of the document discusses the importance of augmented reality (AR) in business. It explores the various ways in which AR can be used to enhance the customer experience and improve product demonstrations. The author provides examples of successful AR implementations and offers insights into the factors that contribute to their success.

29. The twenty-ninth part of the document discusses the importance of cloud computing in business. It explores the various ways in which cloud computing can be used to improve scalability and flexibility in business operations. The author emphasizes the need for a strong cloud computing strategy that aligns with the organization's overall IT strategy.

30. The thirtieth part of the document discusses the importance of cybersecurity in business. It explores the various ways in which cybersecurity can be used to protect the organization's data and systems from cyber threats. The author provides practical advice on how to implement a strong cybersecurity strategy that protects the organization's assets and ensures business continuity.

# NOTES

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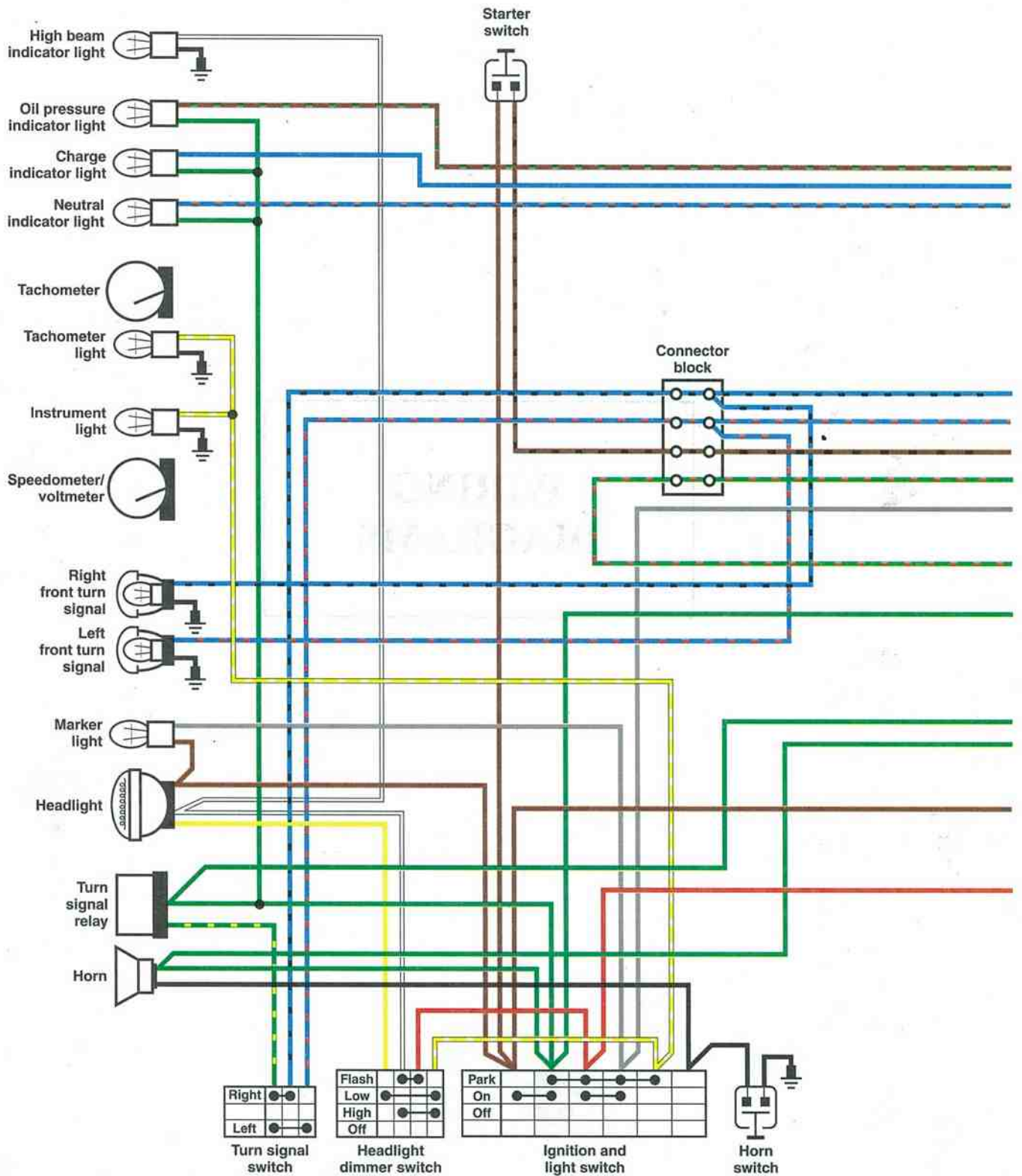
# NOTES

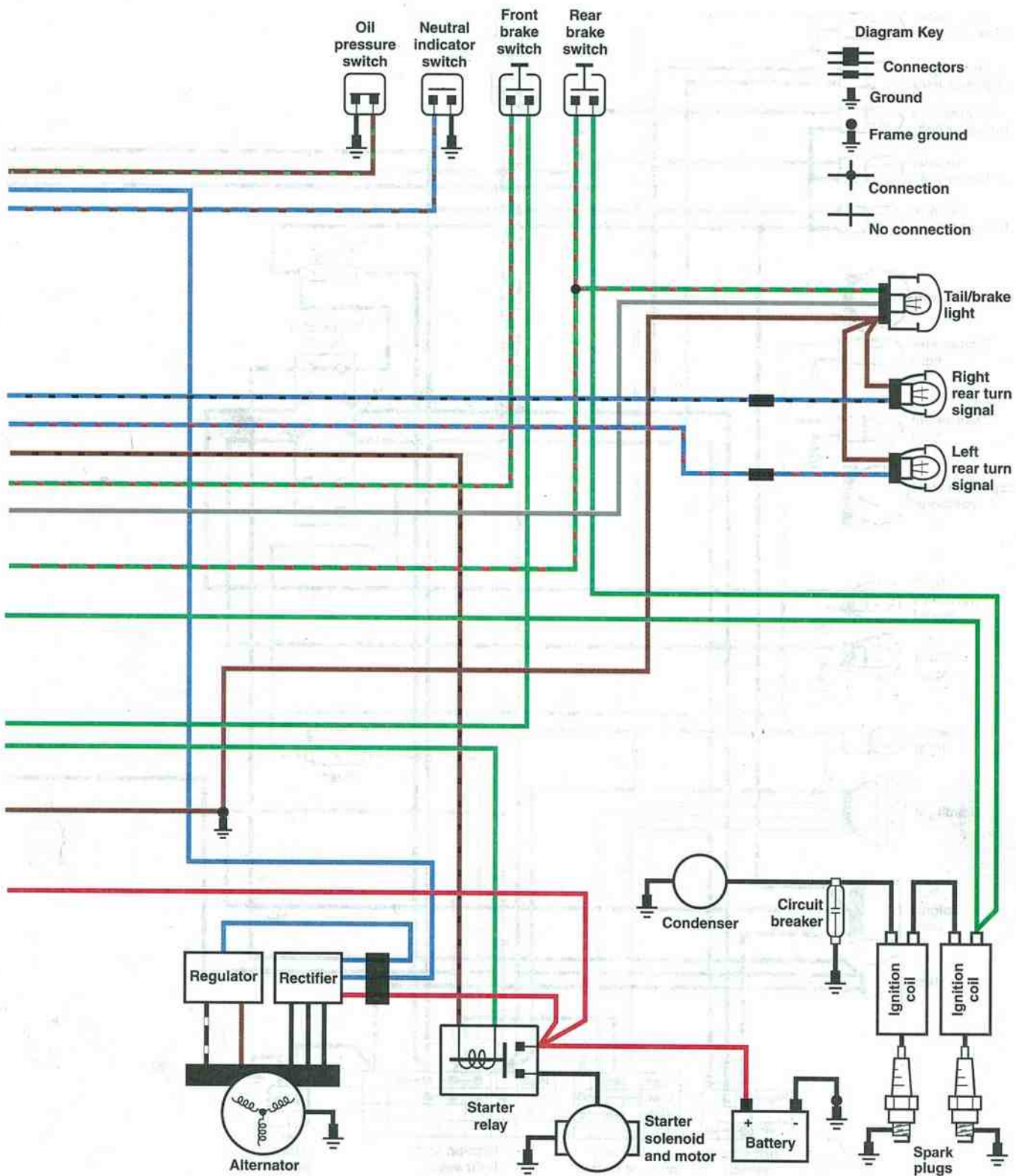
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WIRING DIAGRAMS

**WIRING  
DIAGRAMS**

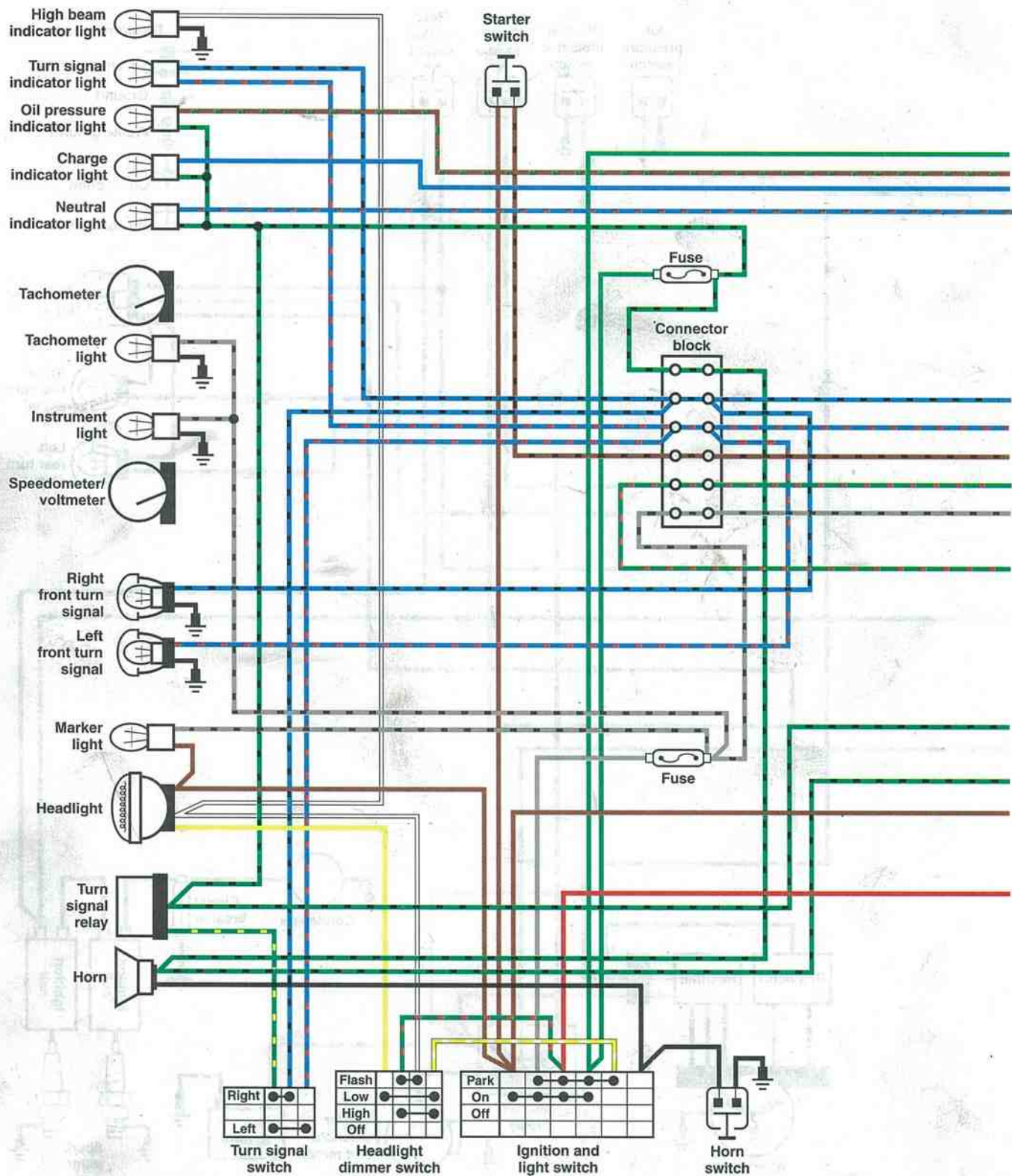
R50, R60/5 and R75/5 (Without Fuses)



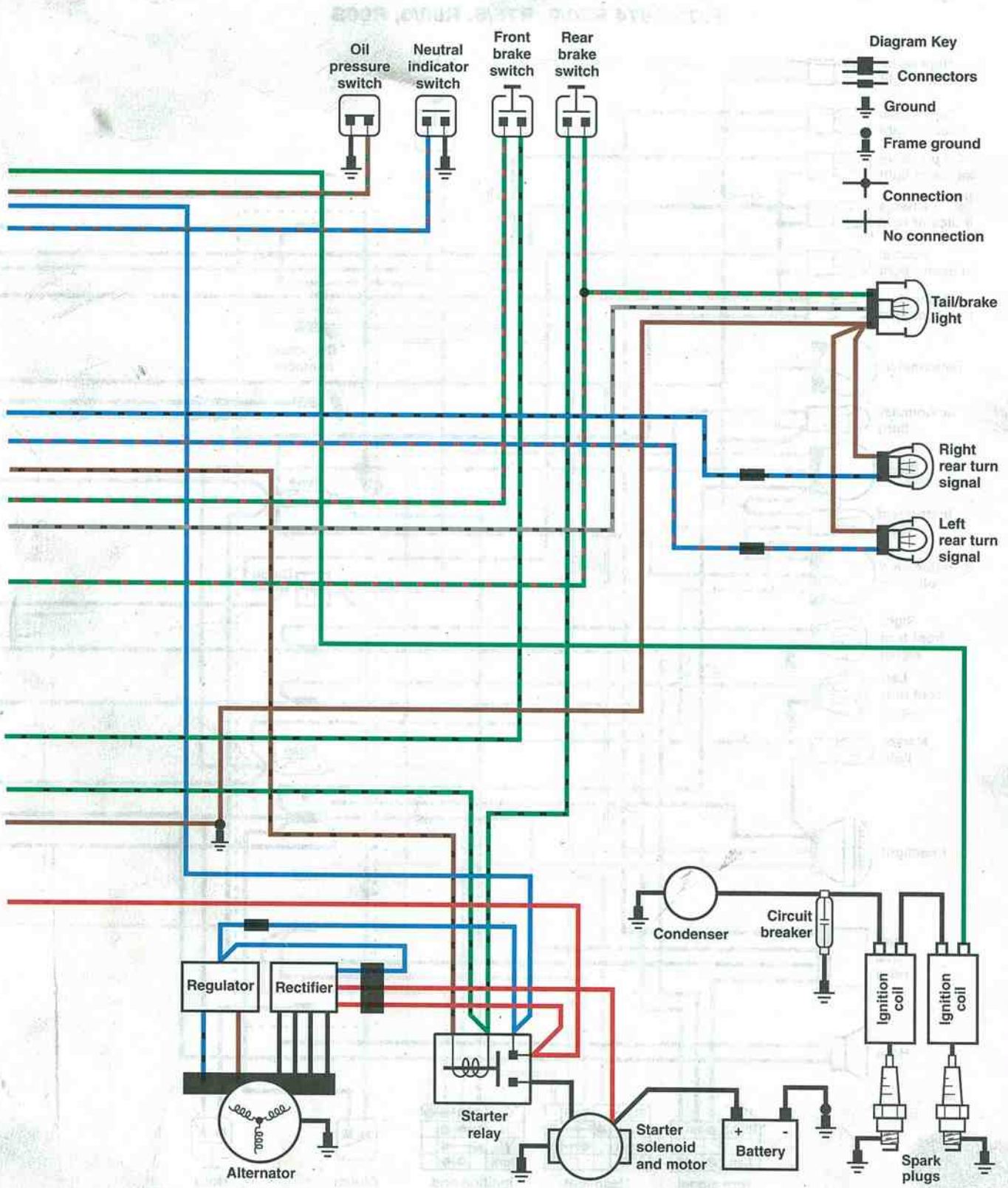




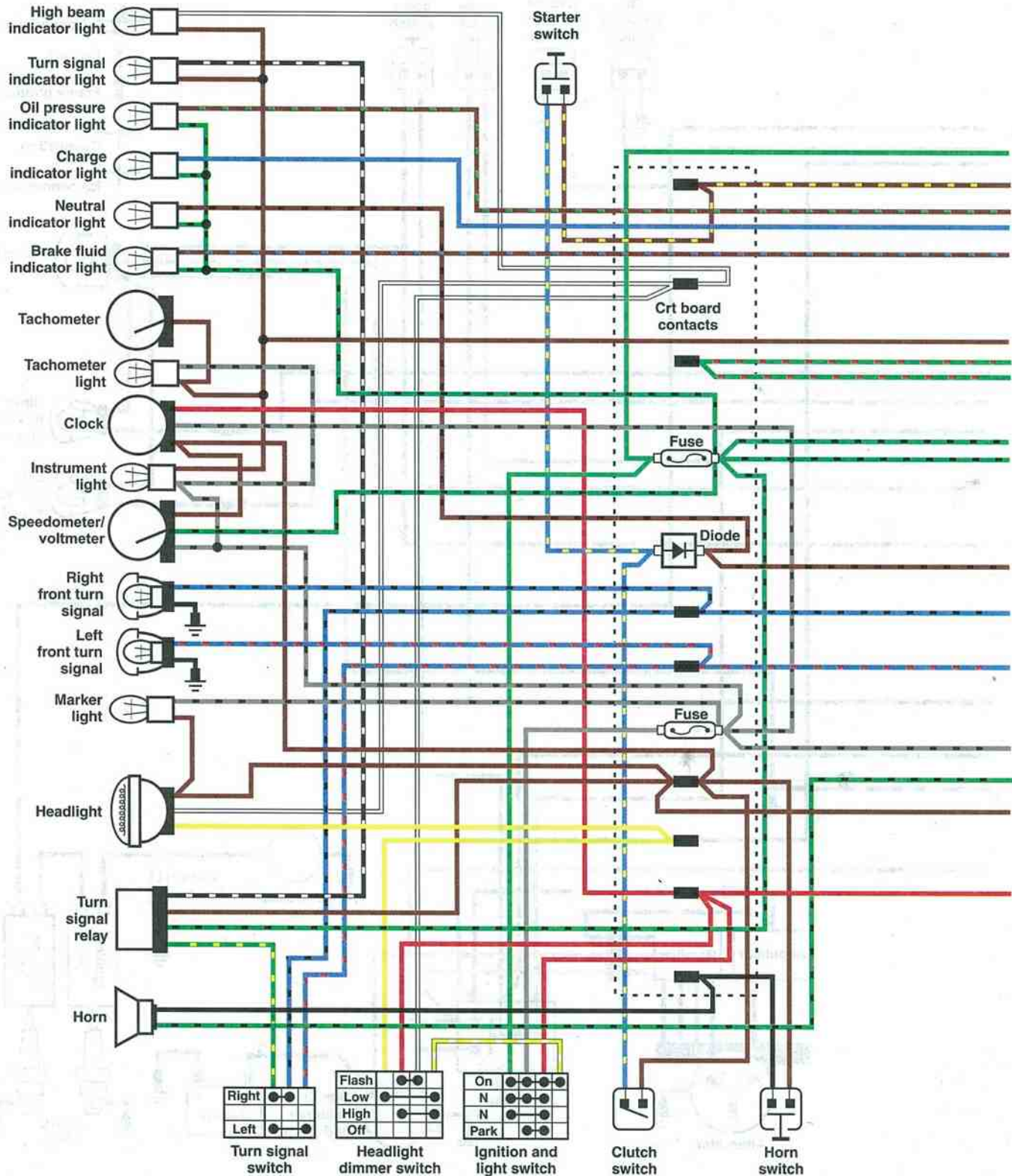
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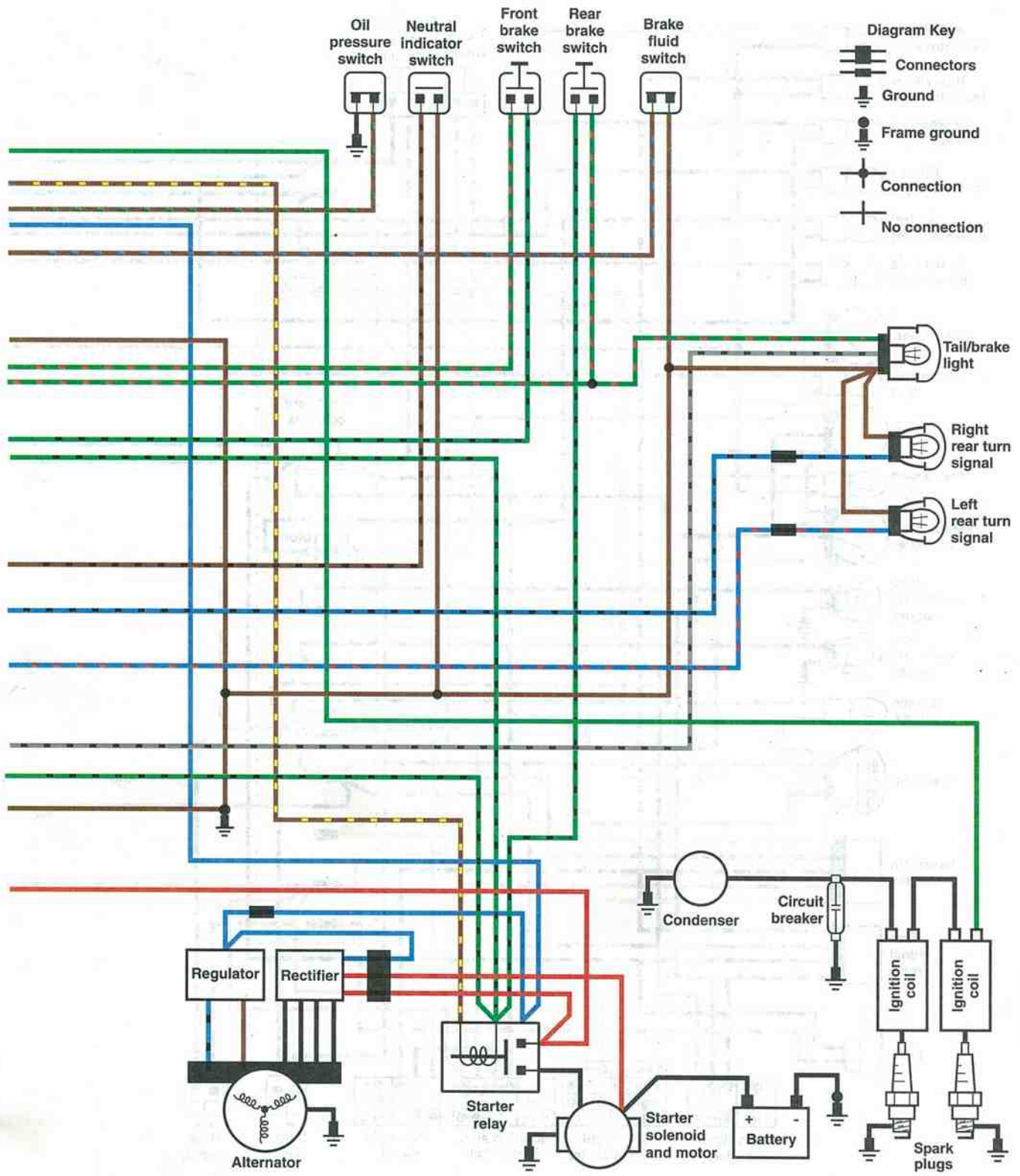




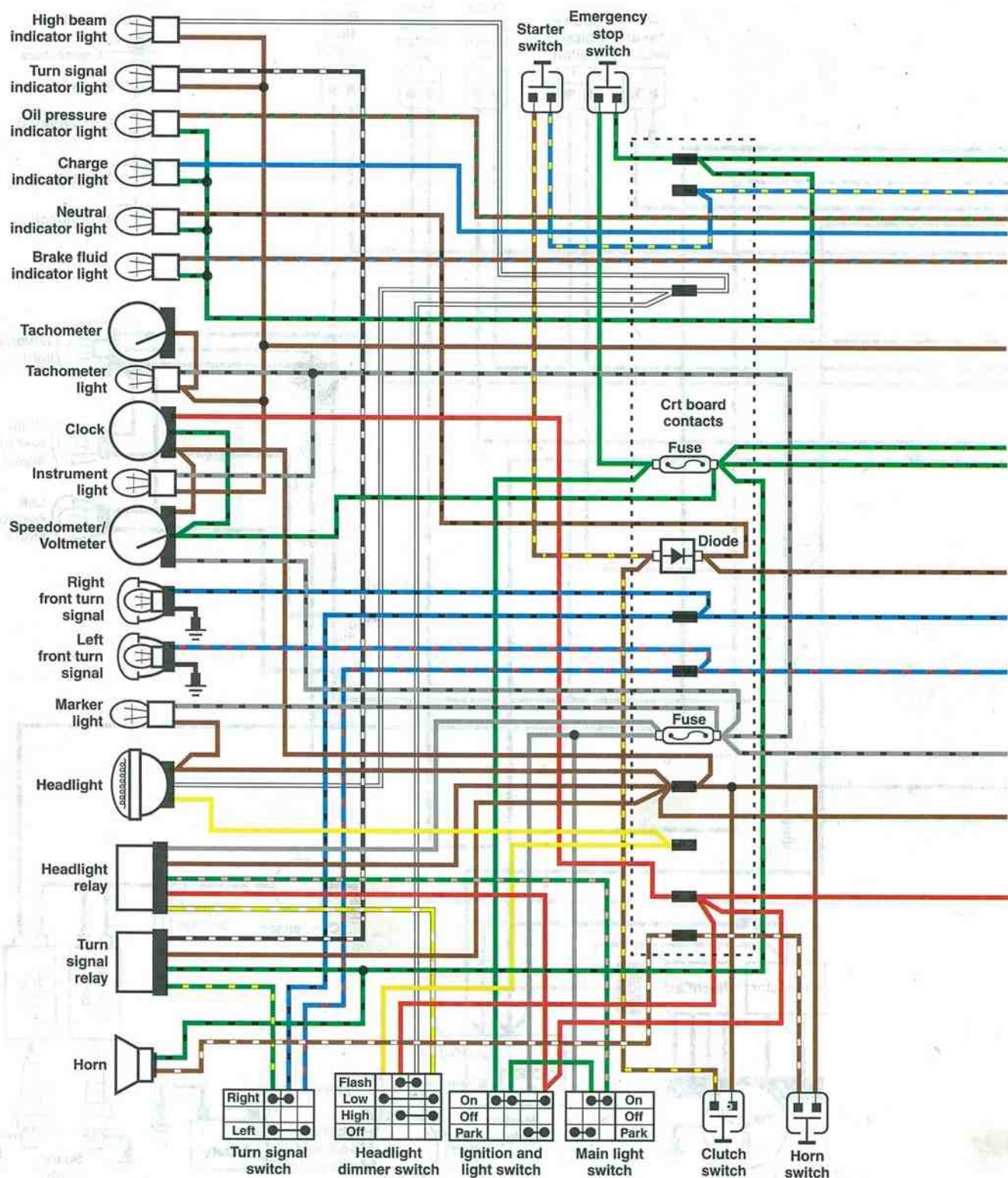
1973-1974 R60/6, R75/6, R90/6, R90S



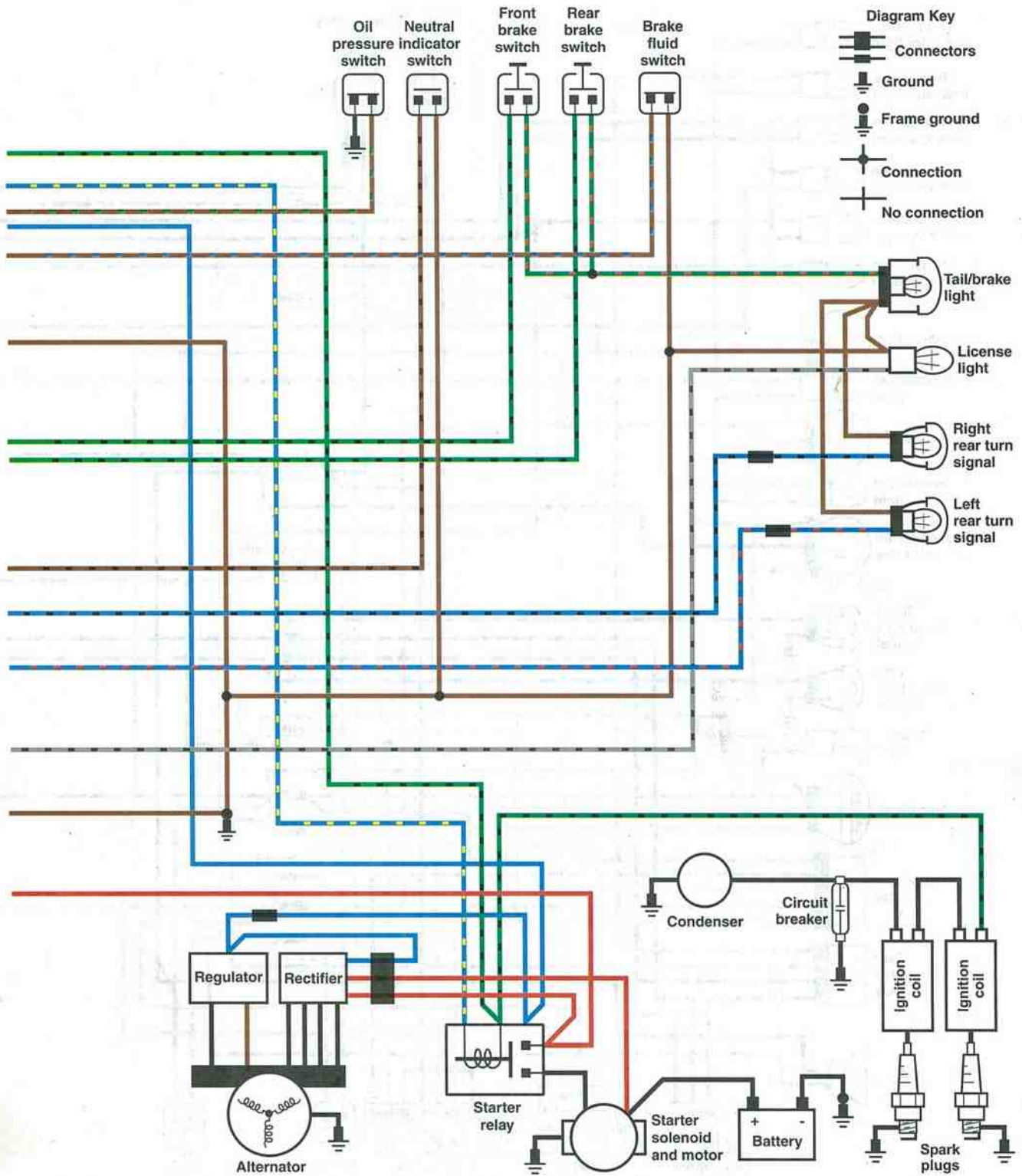




1975-1976 R60/6, R75/6, R90/6, R90S

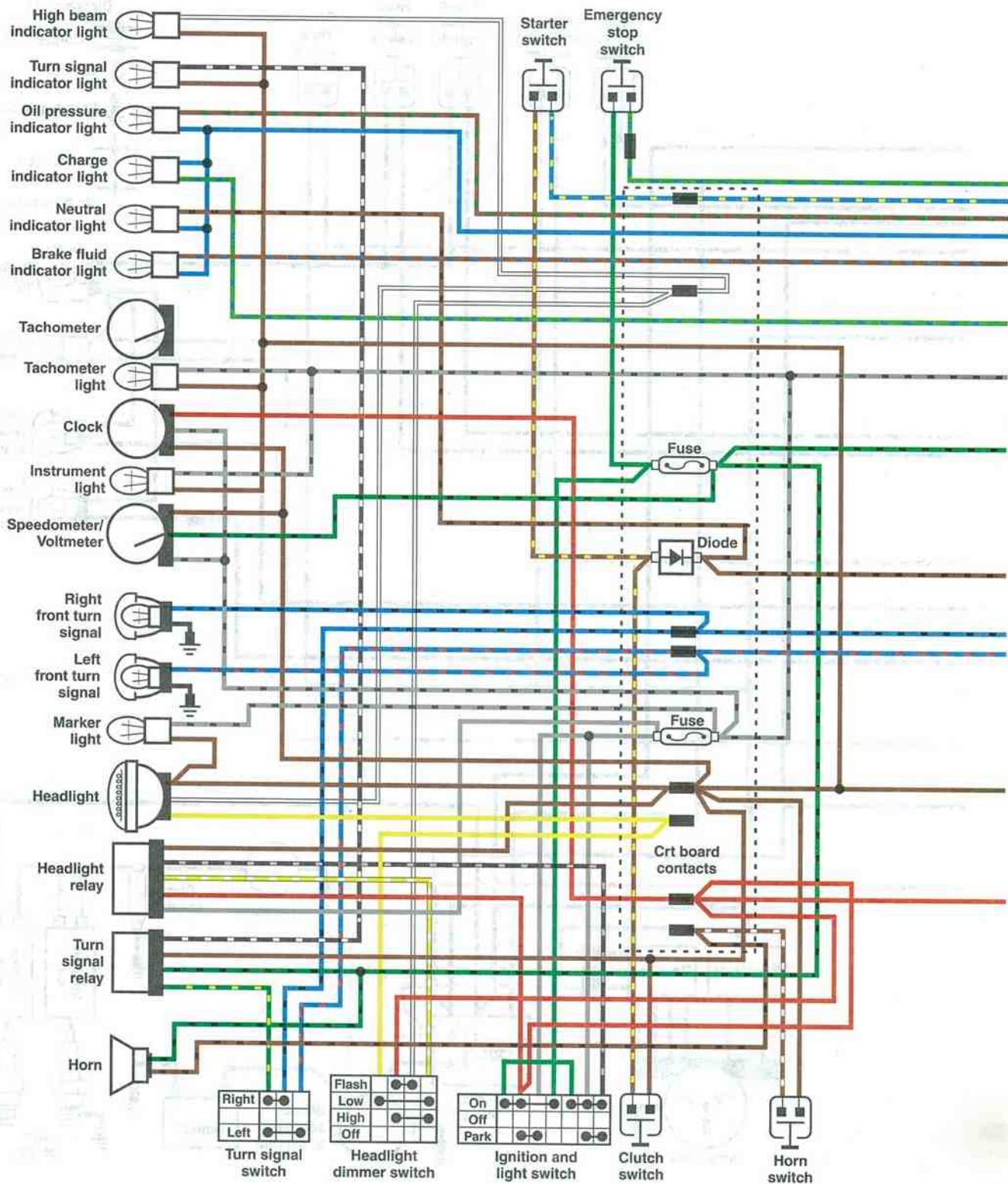


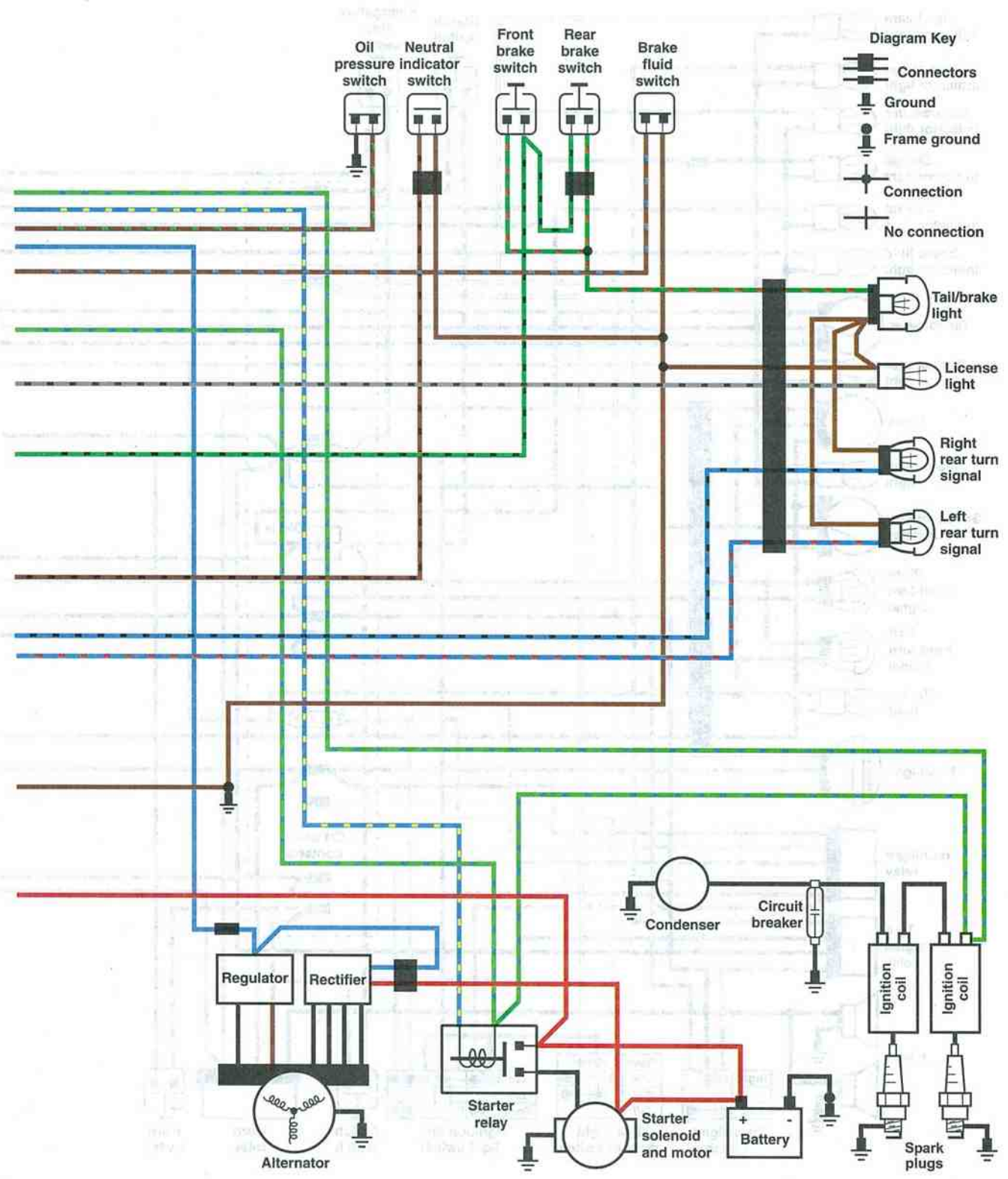






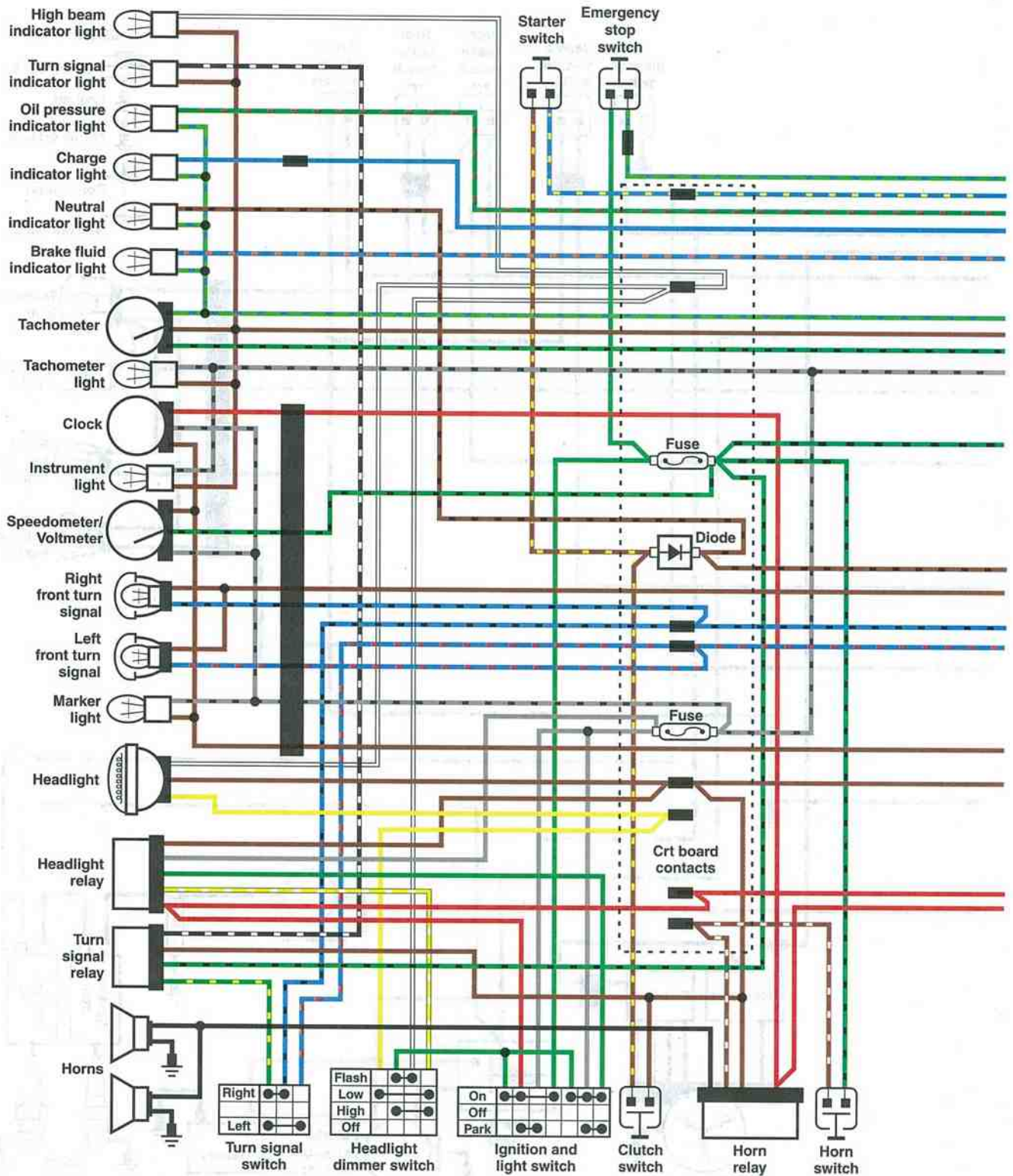
1976-1977 R60/7, R75/7, R100/7, R100S

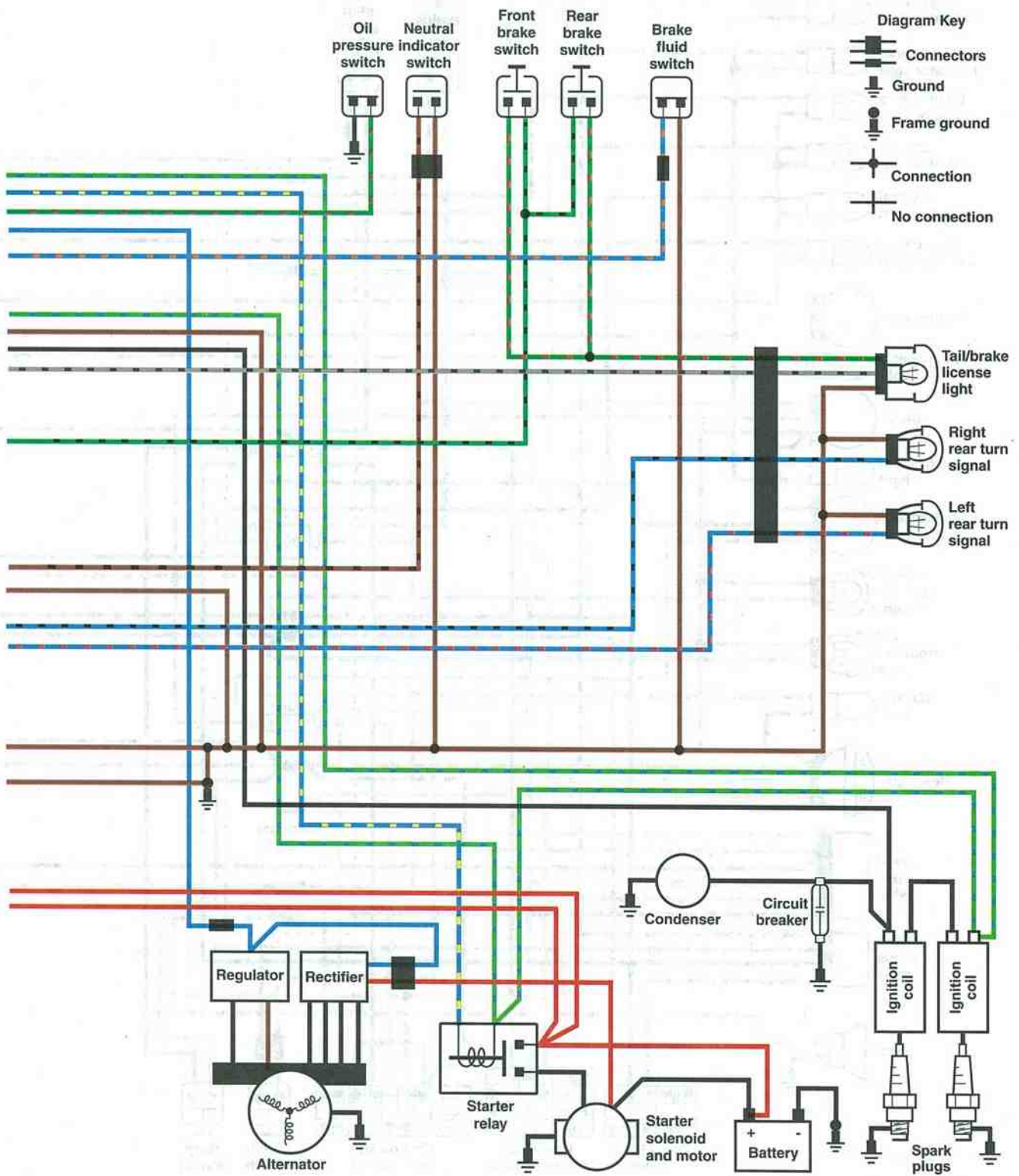






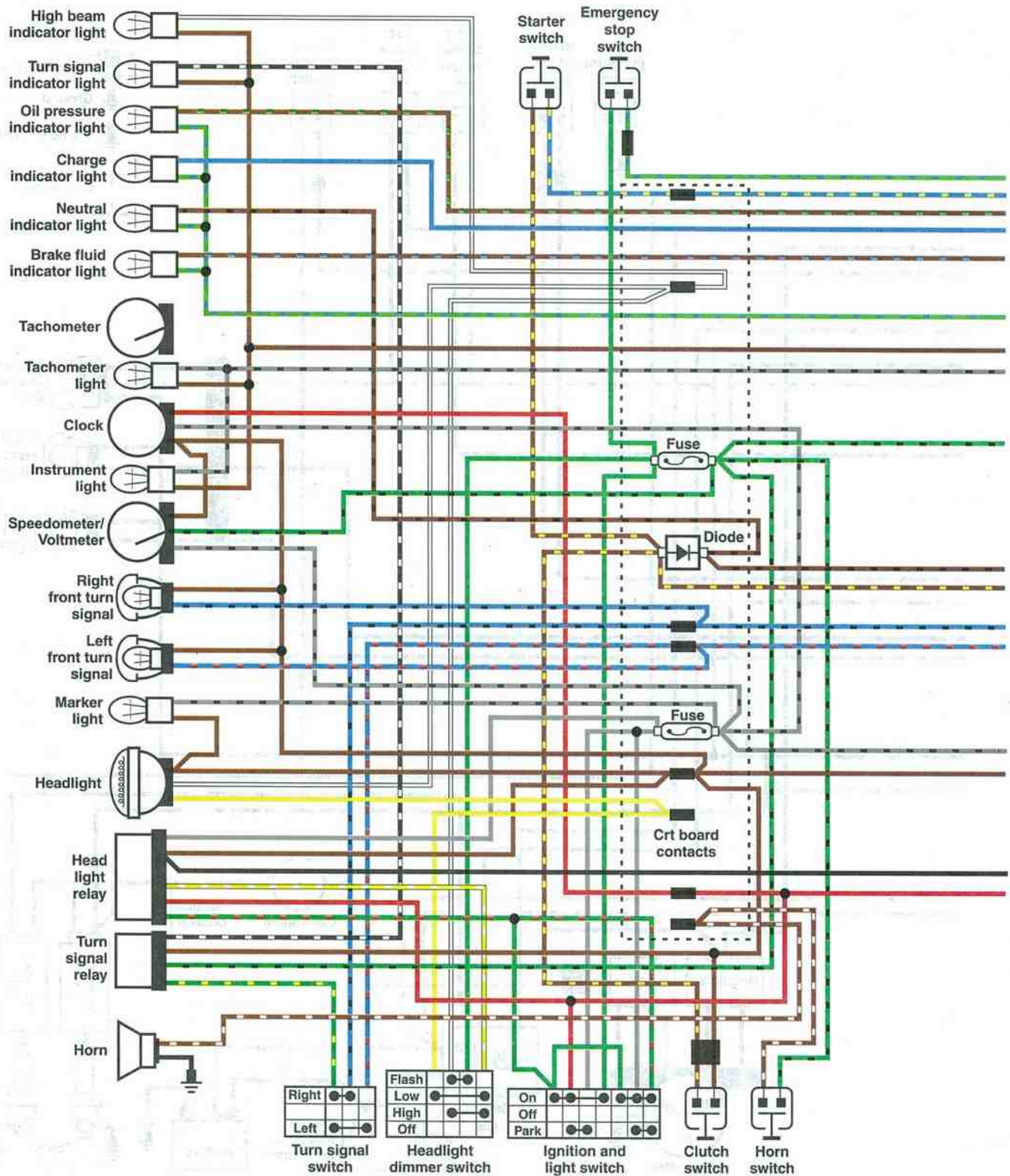
1977 R100RS





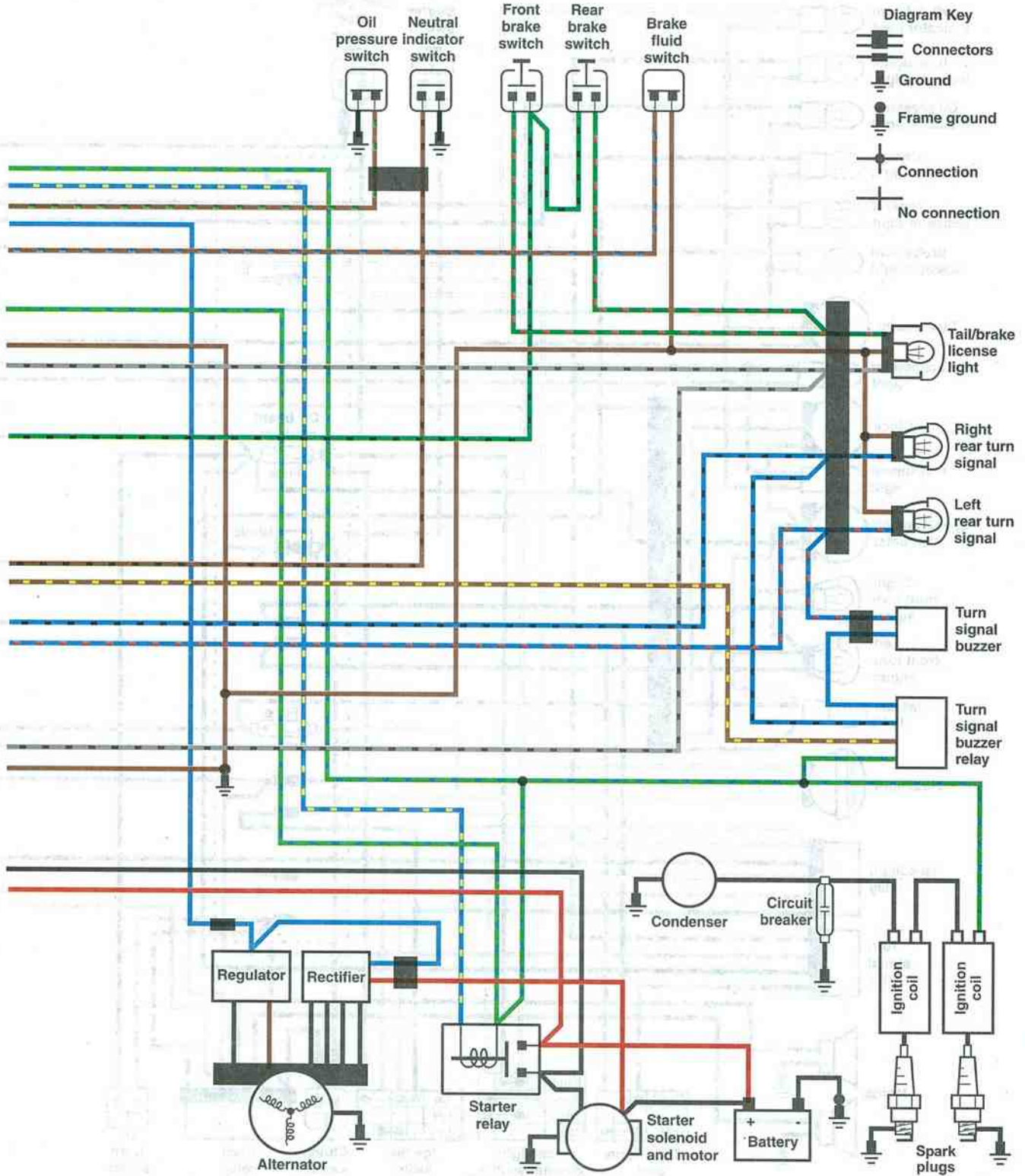


1978 R60/7, 1978-1980 R80/7, 1978-1979 R100/7, 1978 R100S

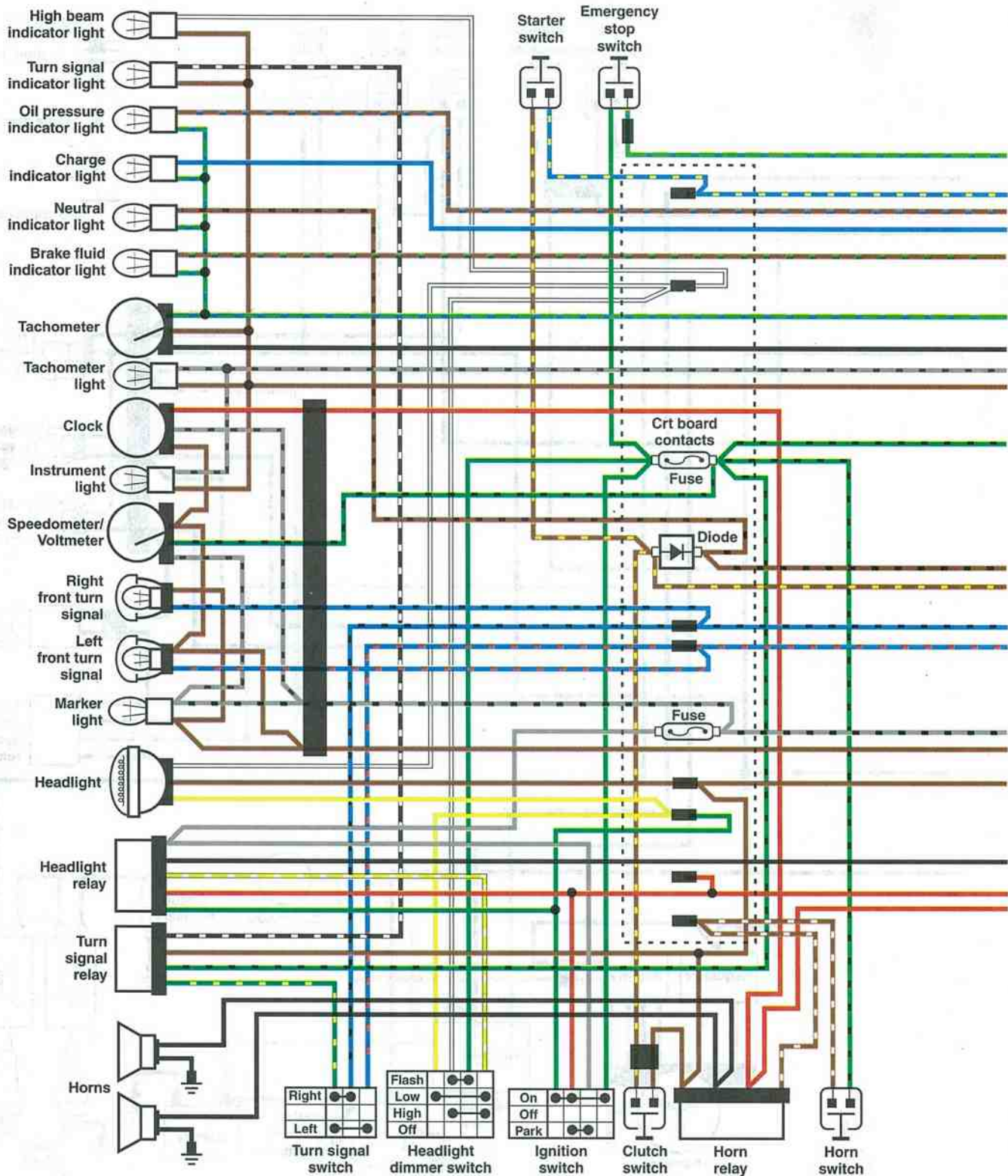




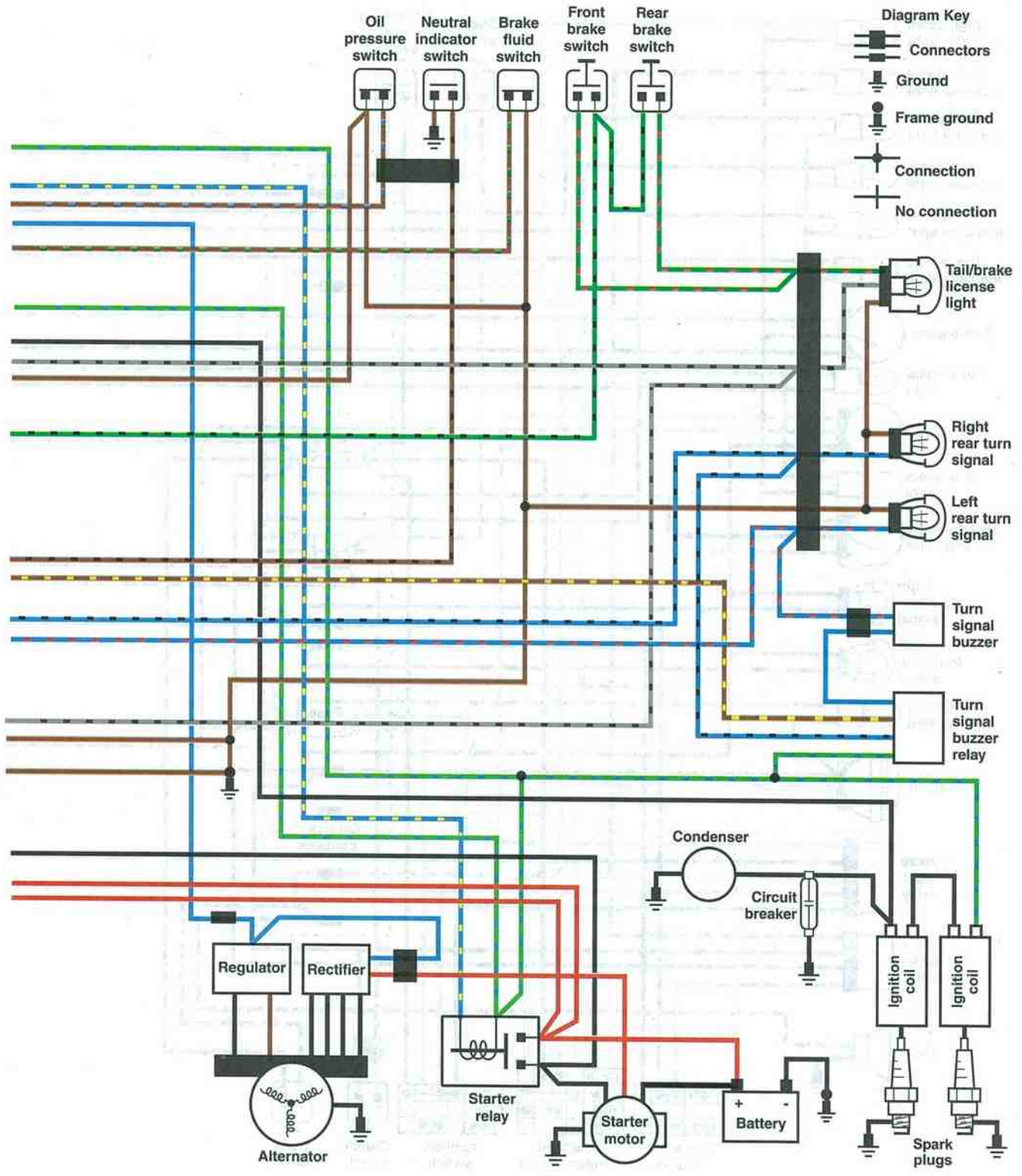
STARTER MOTOR



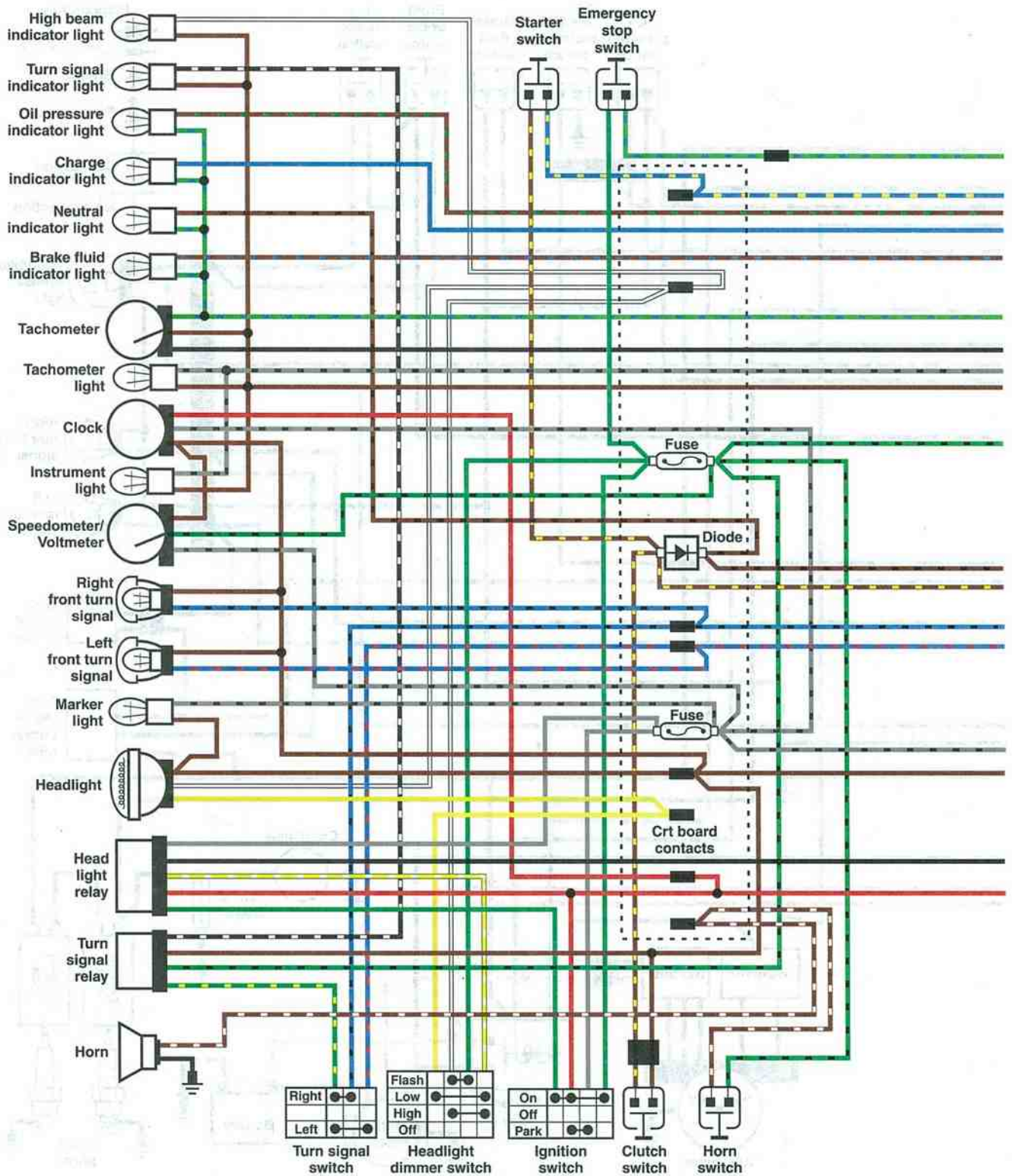
1978 R100RS



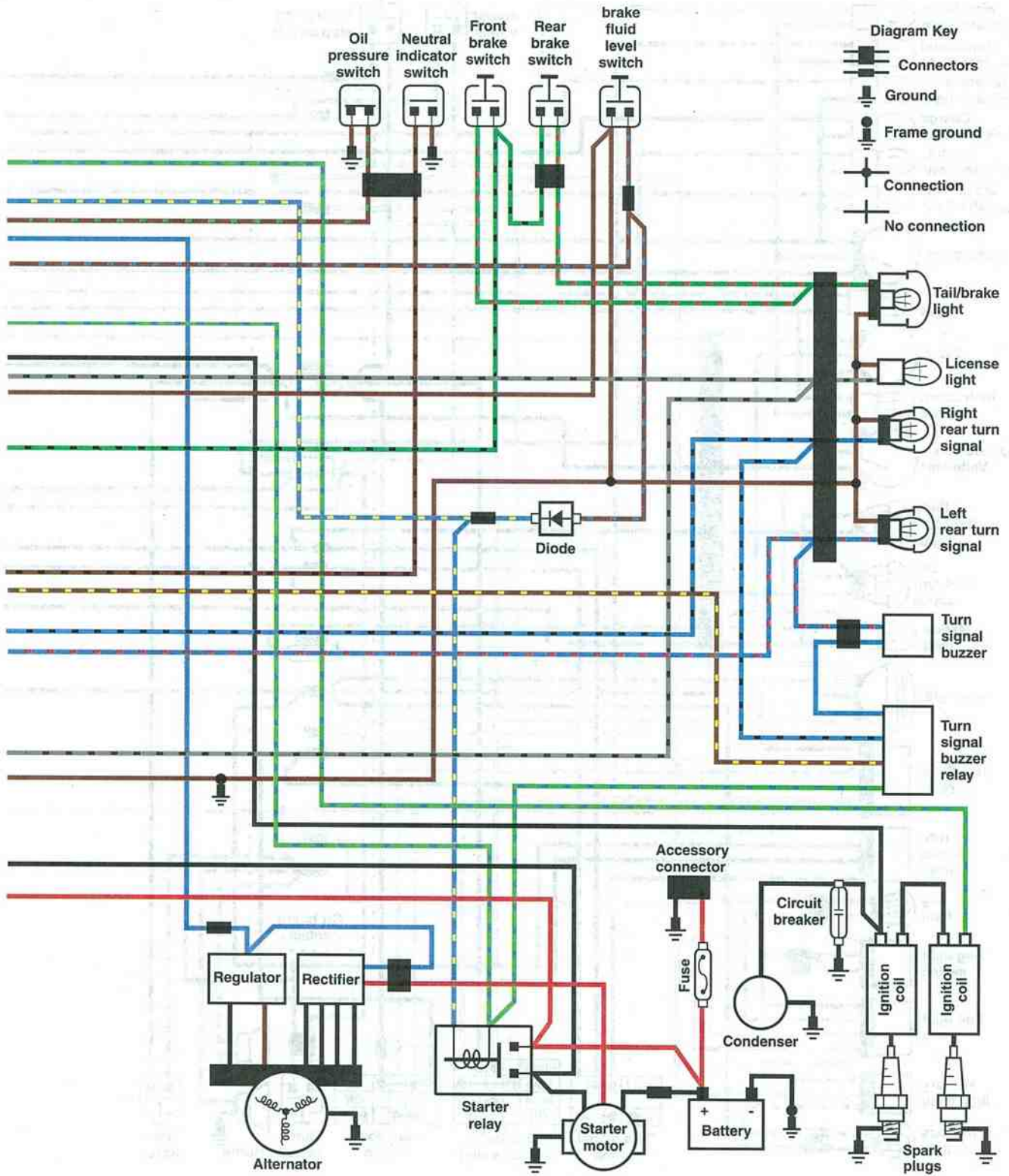




1979 R80/7, 1979-1980 R100T, R100S

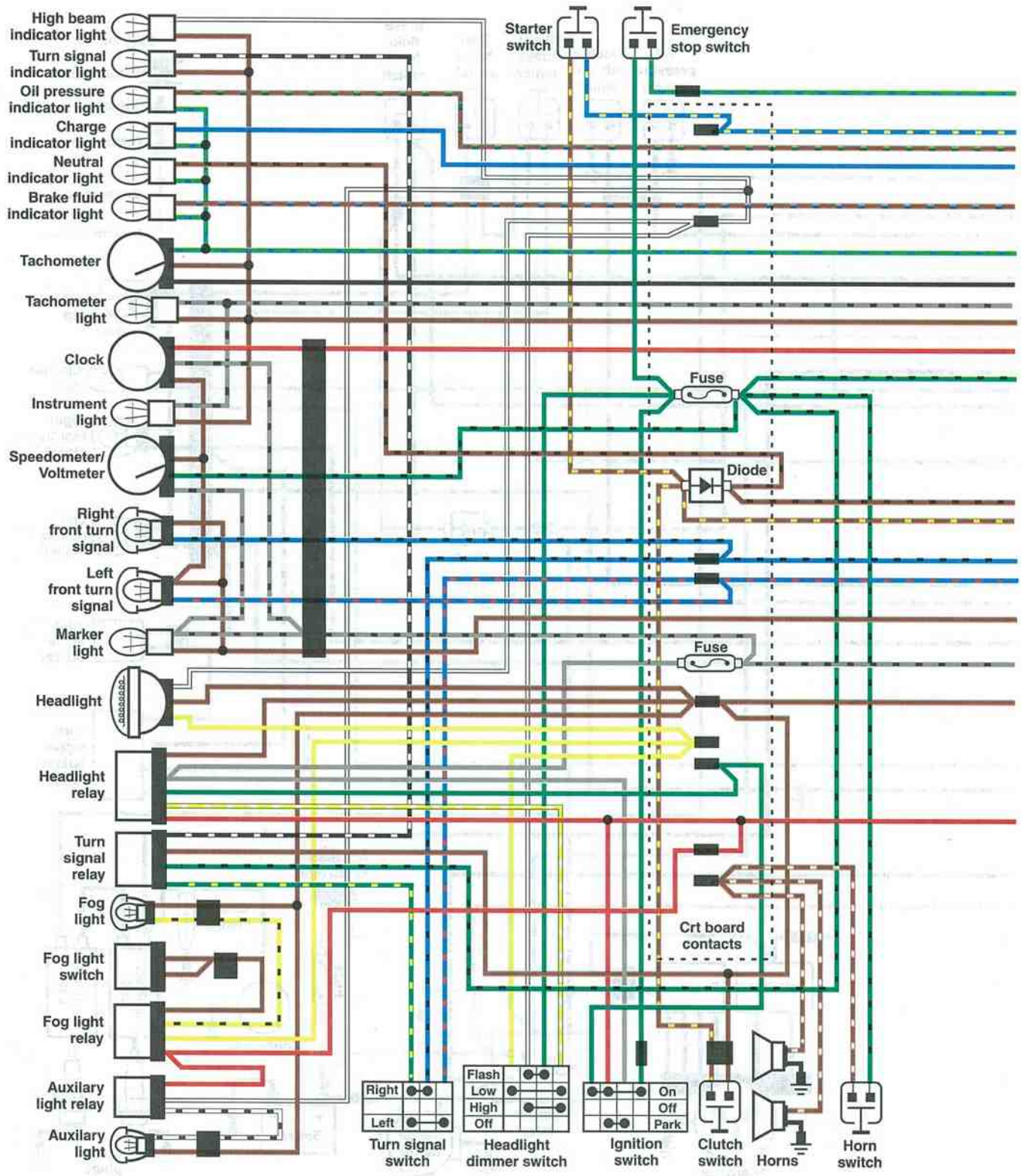


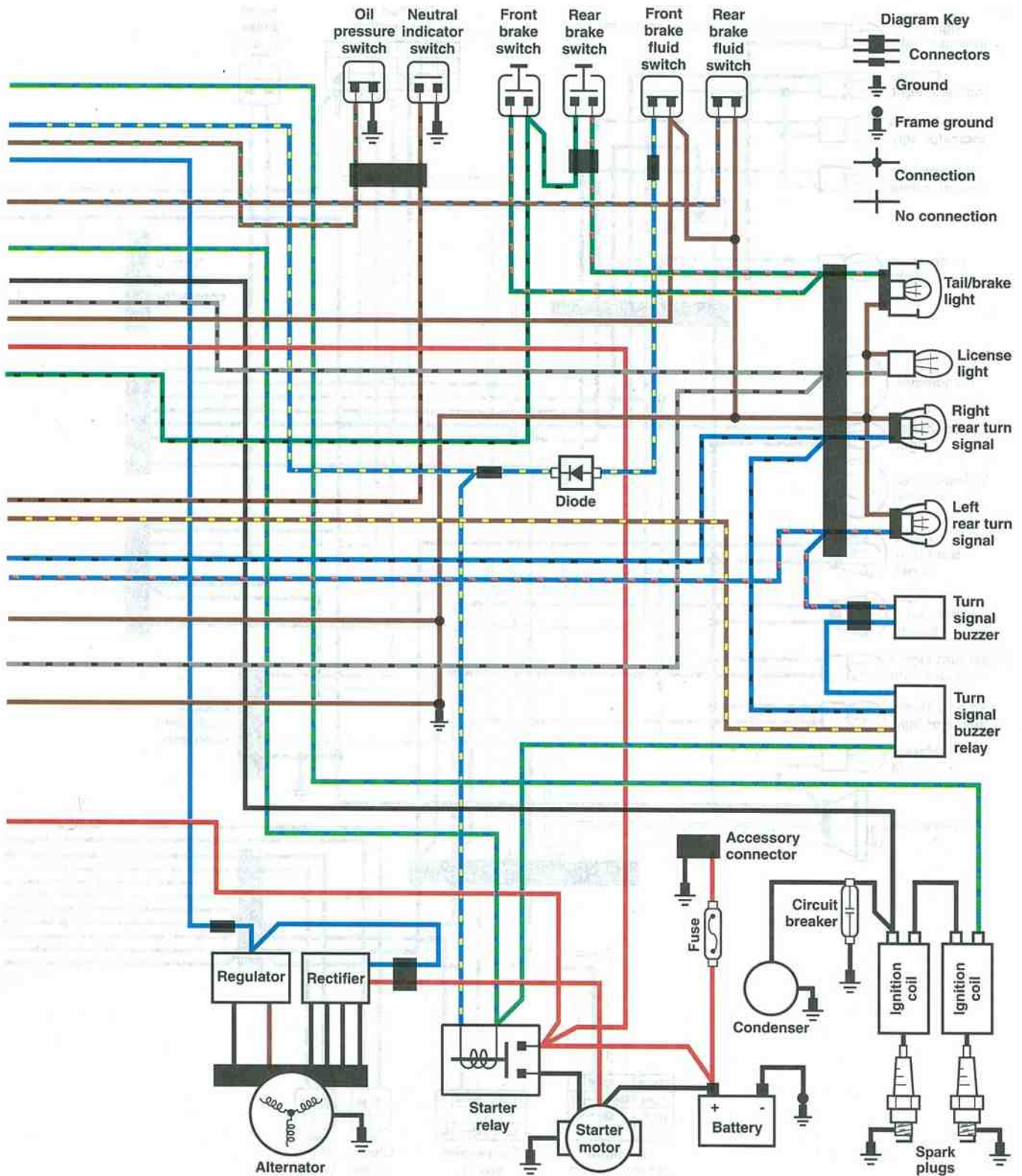






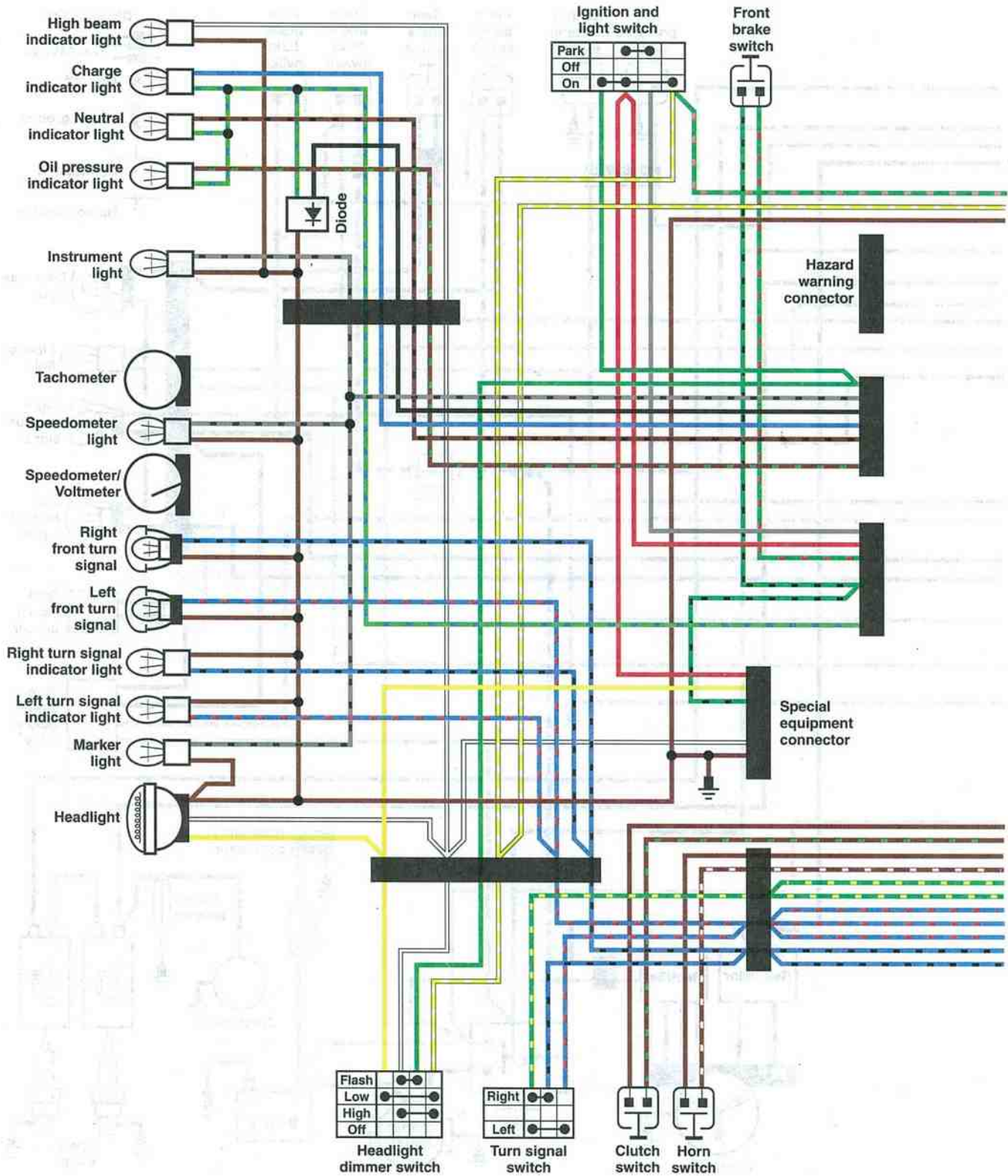
1979-1980 R100RS, R100RT

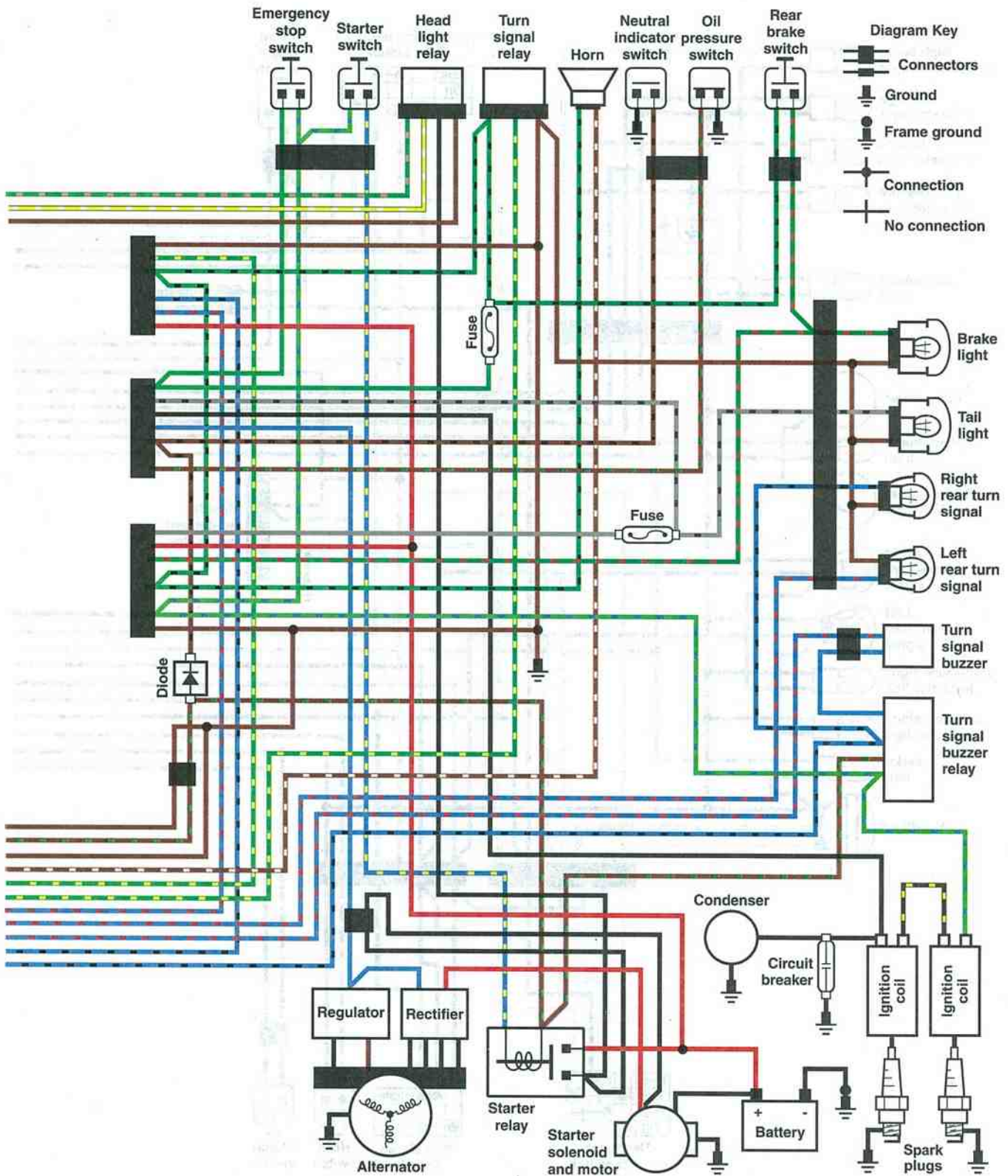






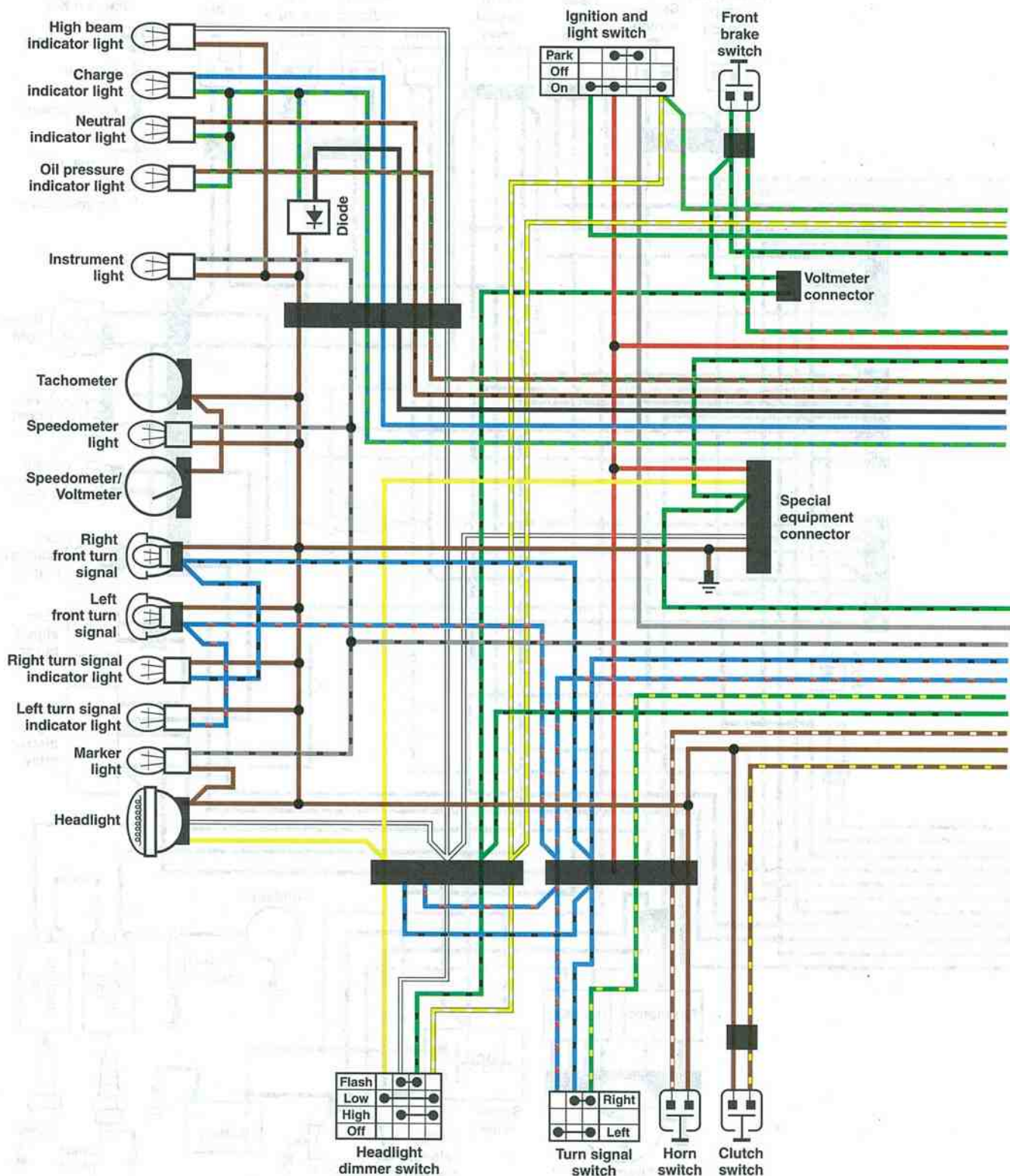
1978-1980 R65



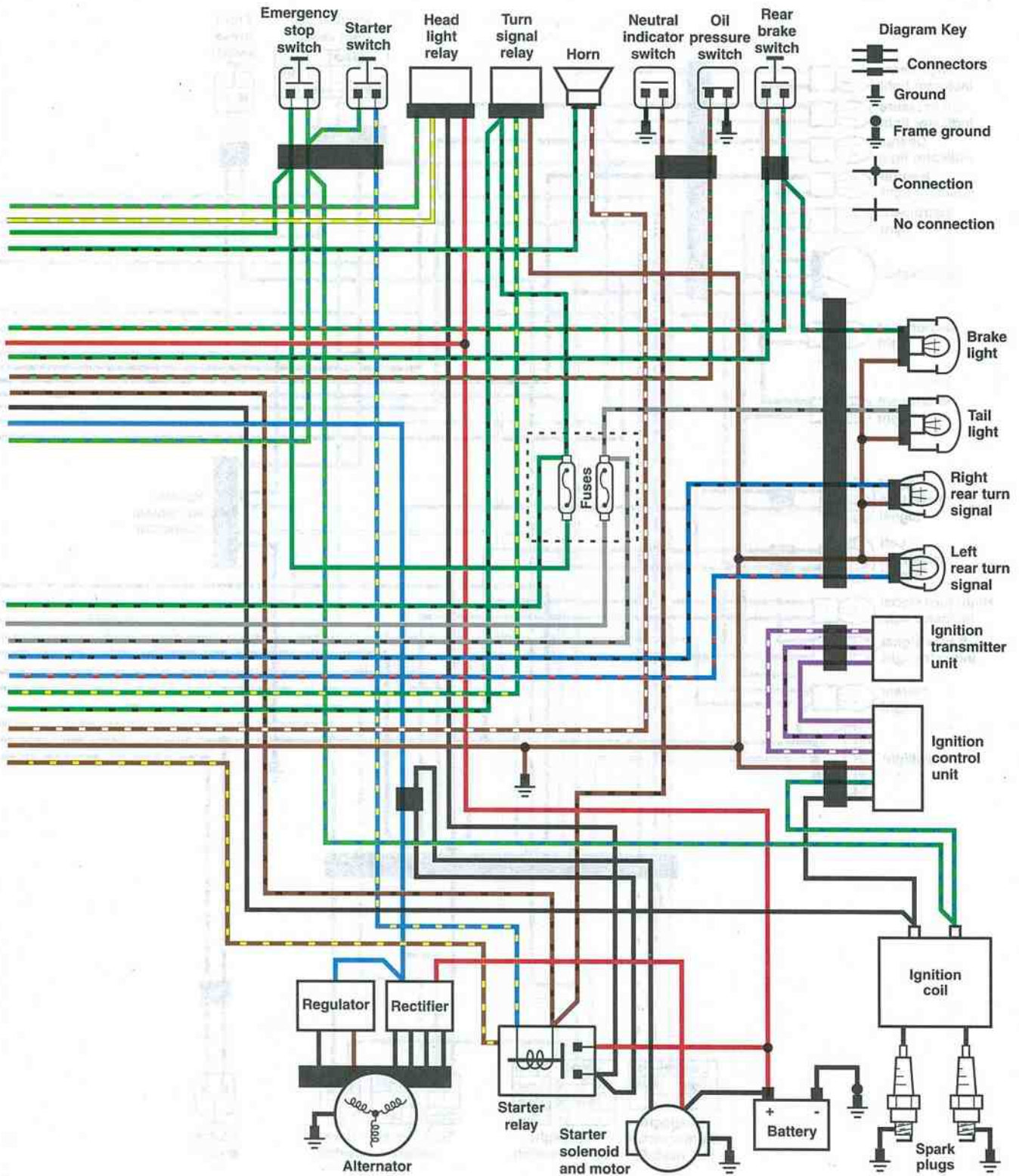




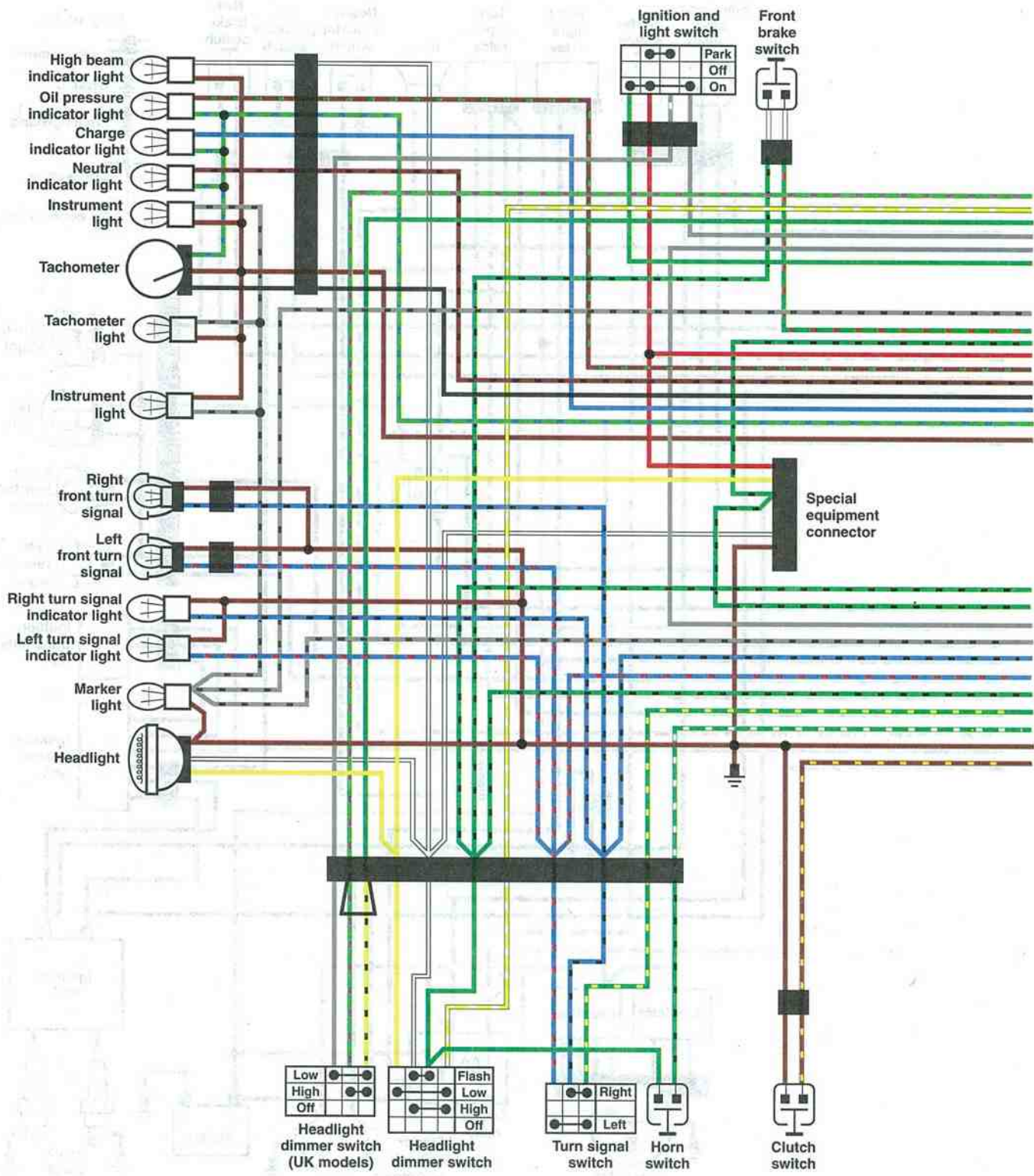
1981-1985 R65, 1982-1984 R65LS, 1982-1984 R80ST



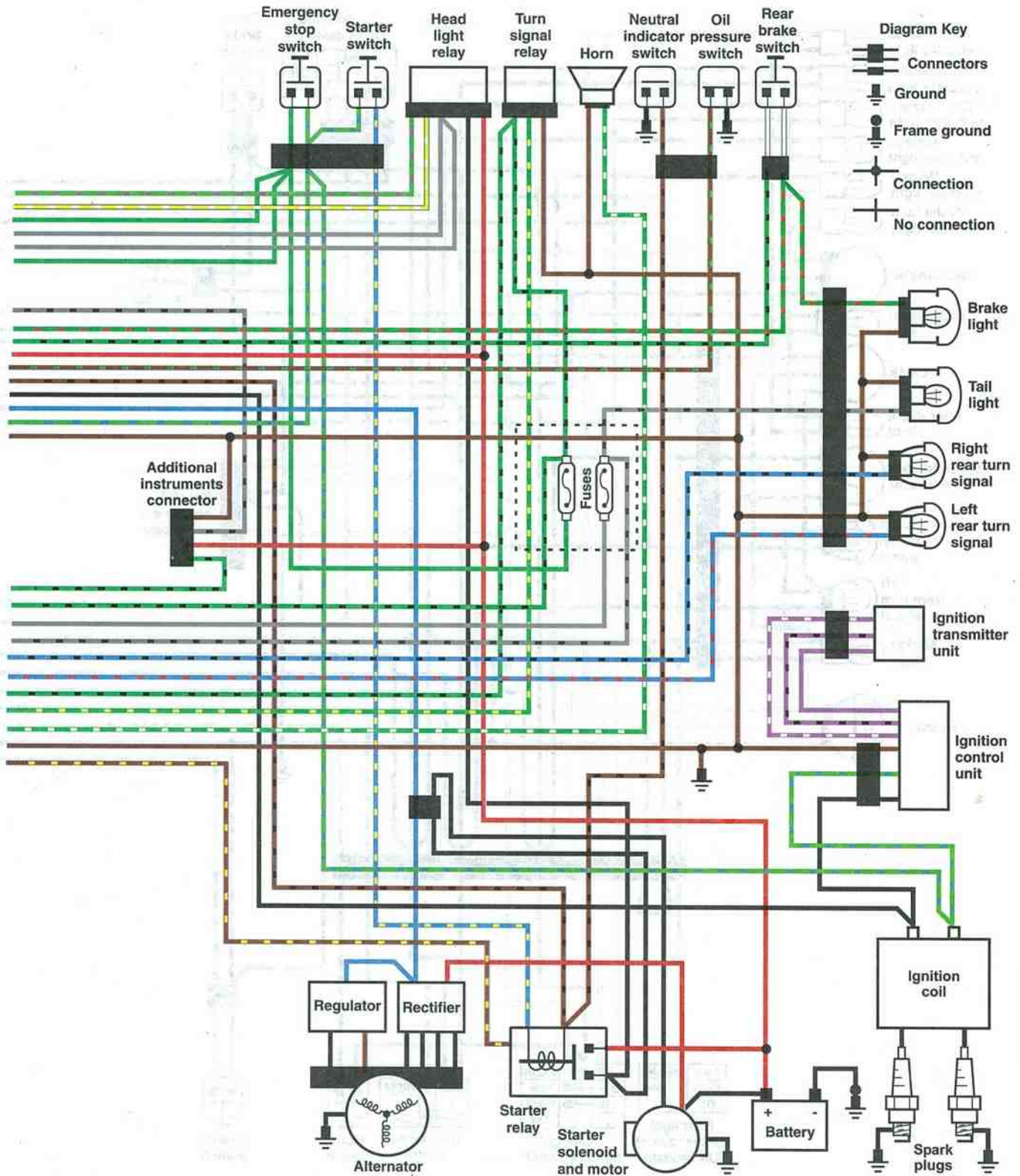




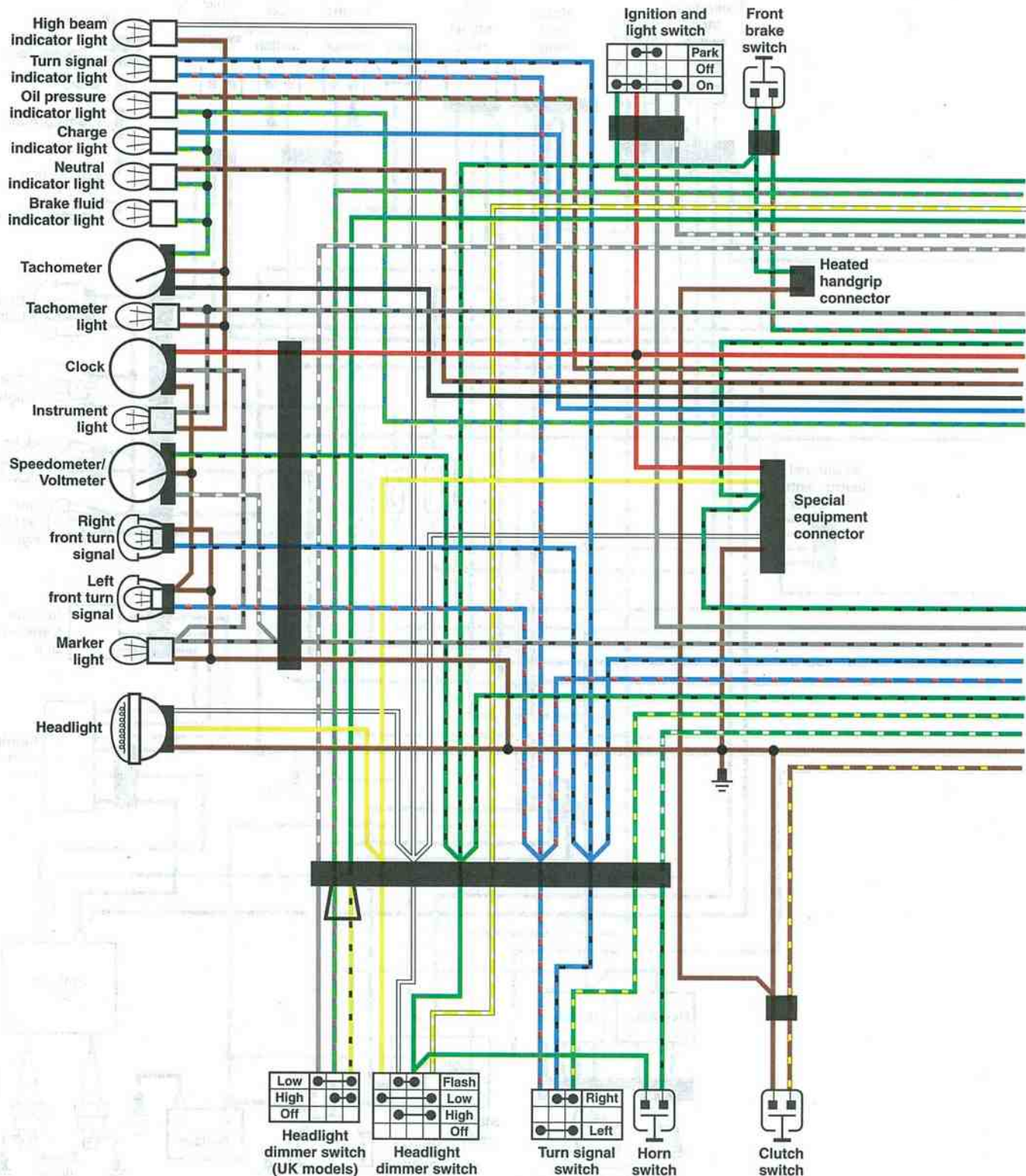
1985-1987 R65/85, 1985-1987 R80



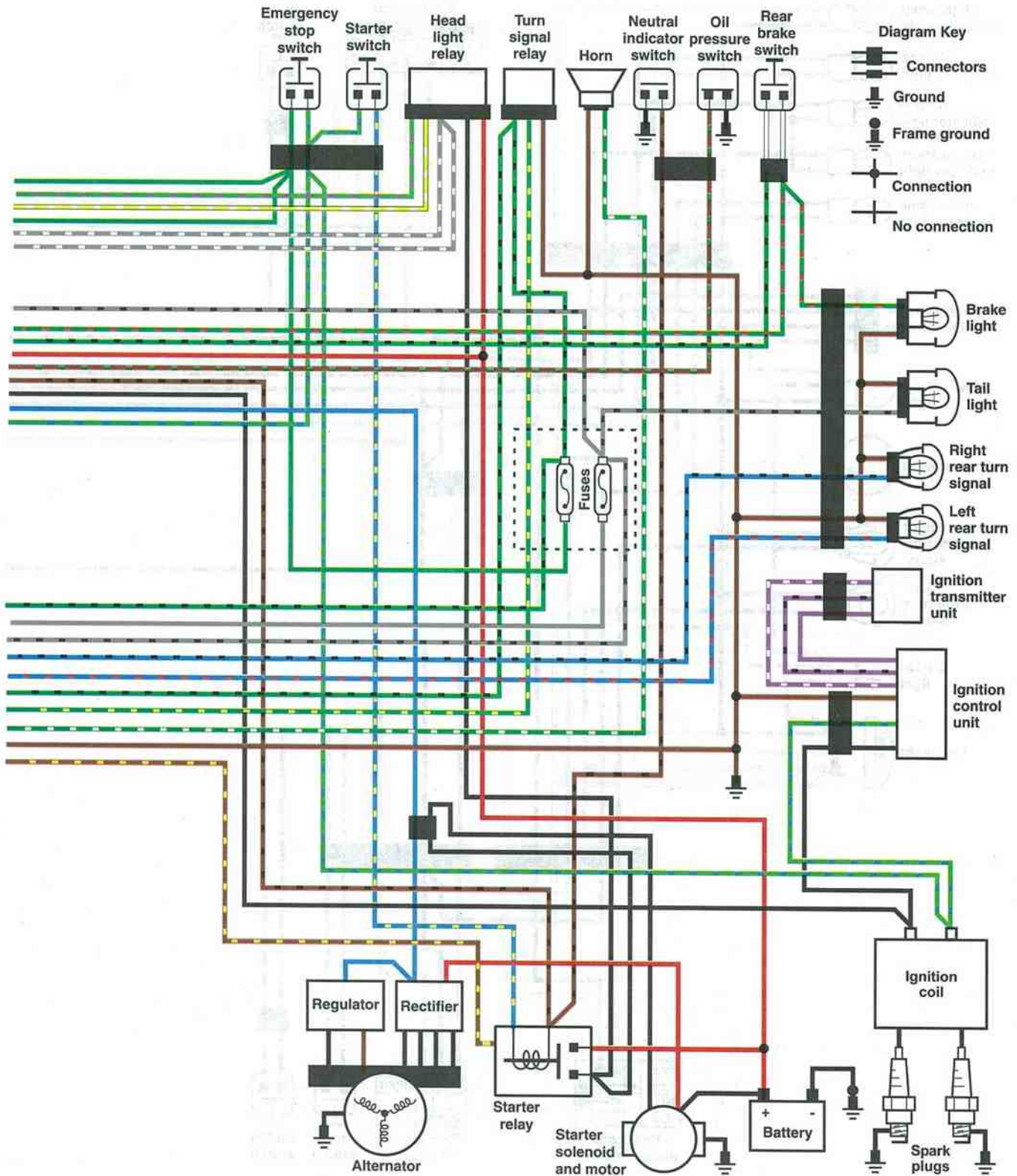




1986-1987 R80RT

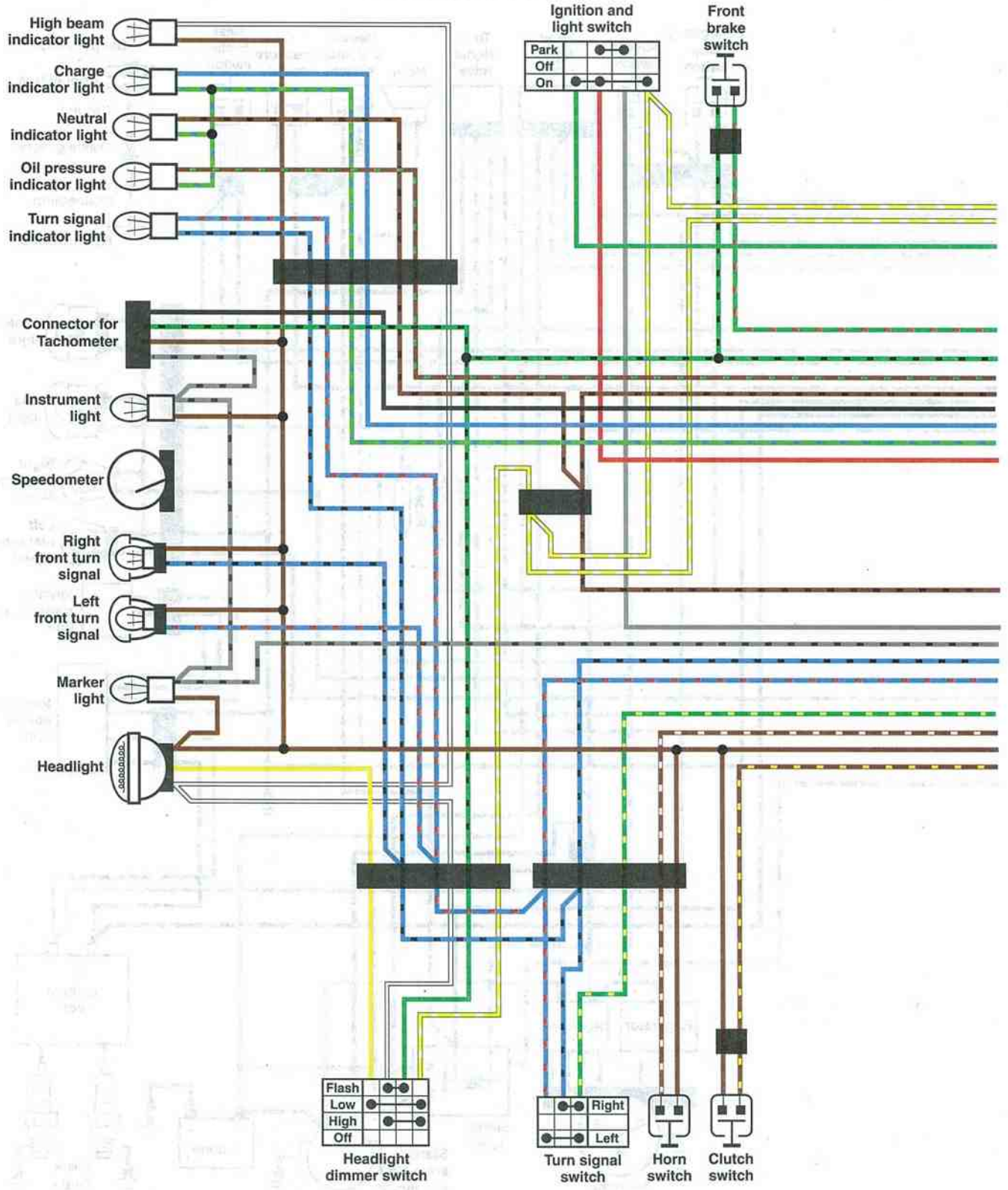


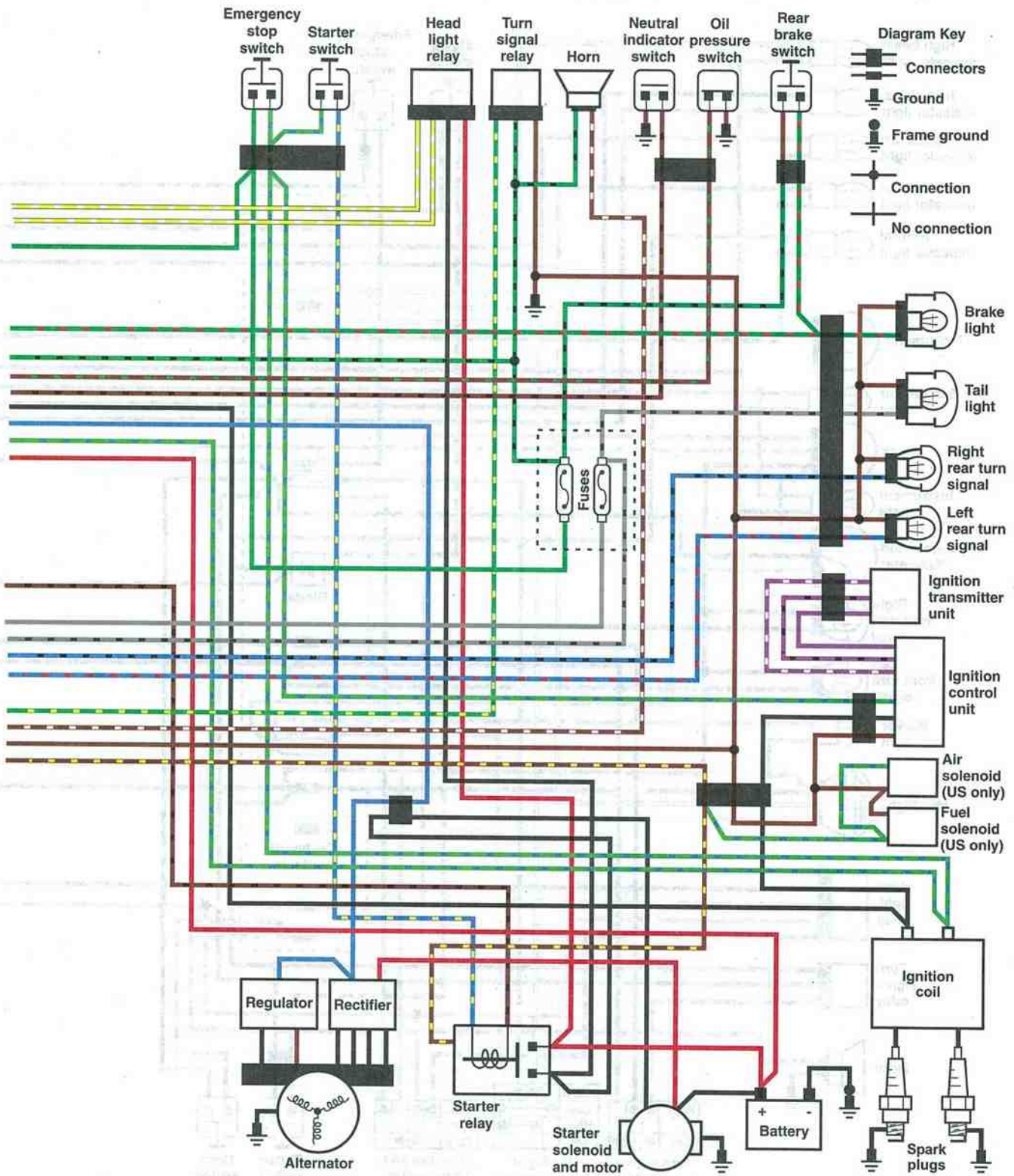






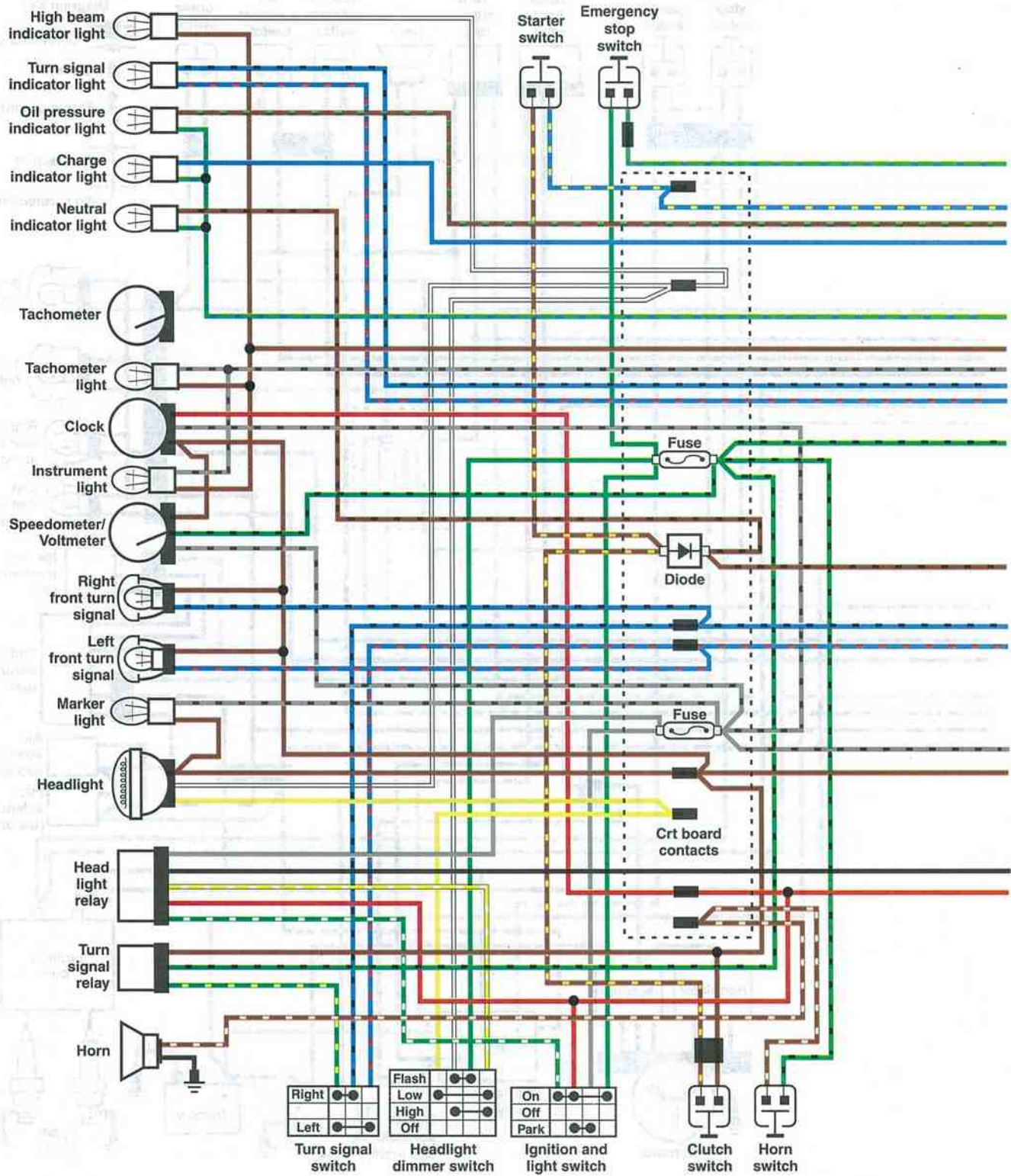
1980-1986 R80G/S

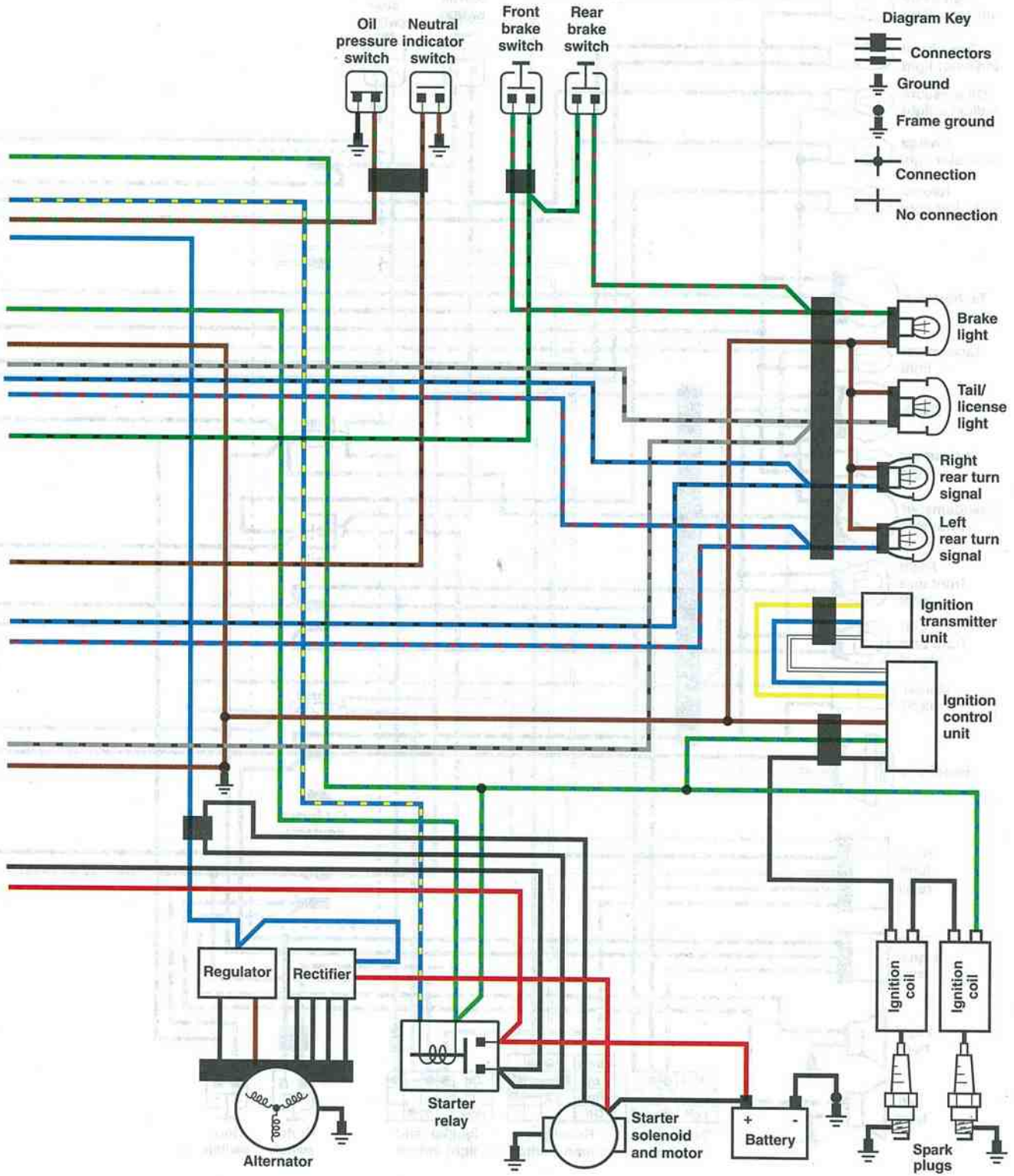






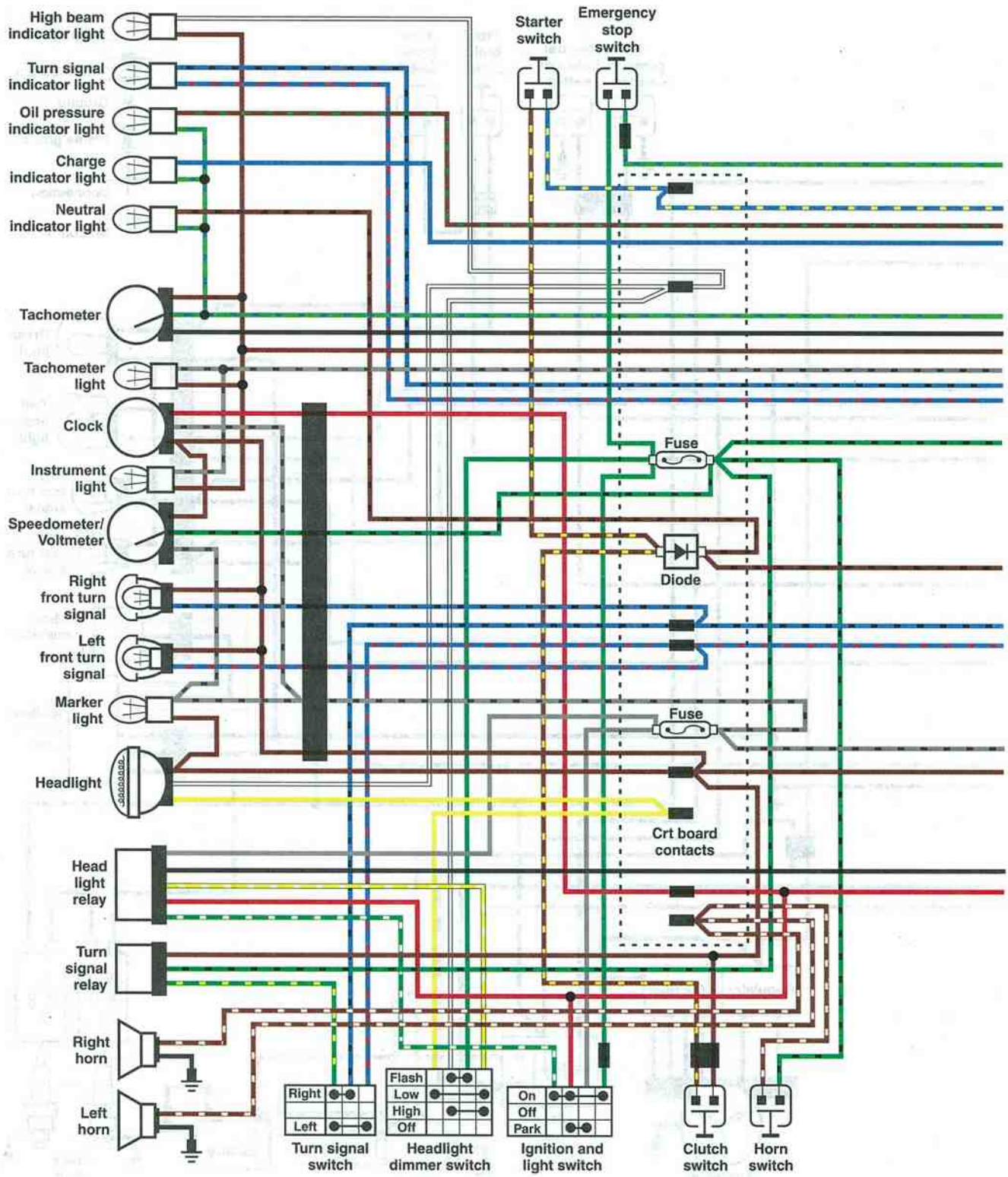
1981-1984, 1991 R100, 1981-1984 R100CS



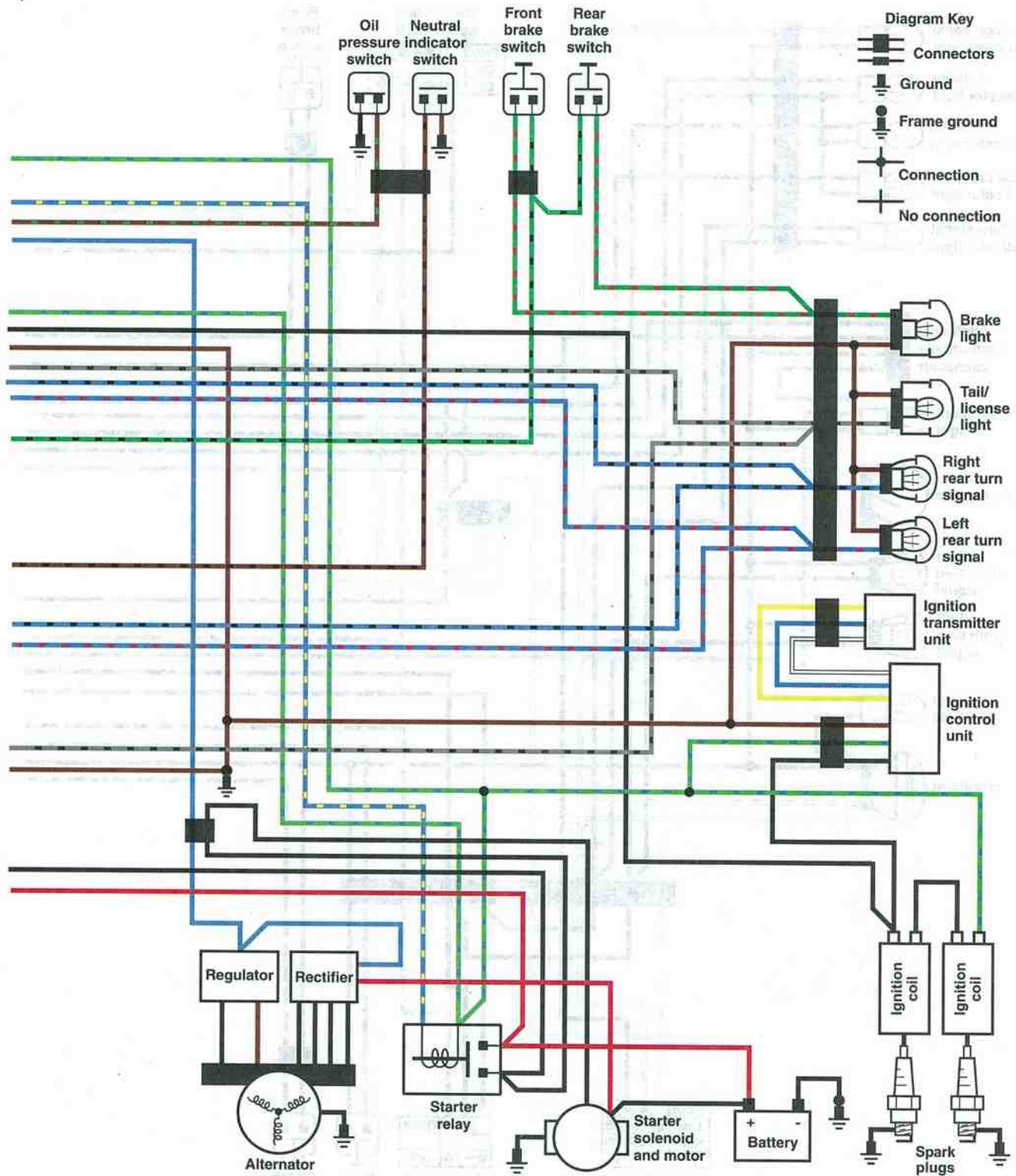




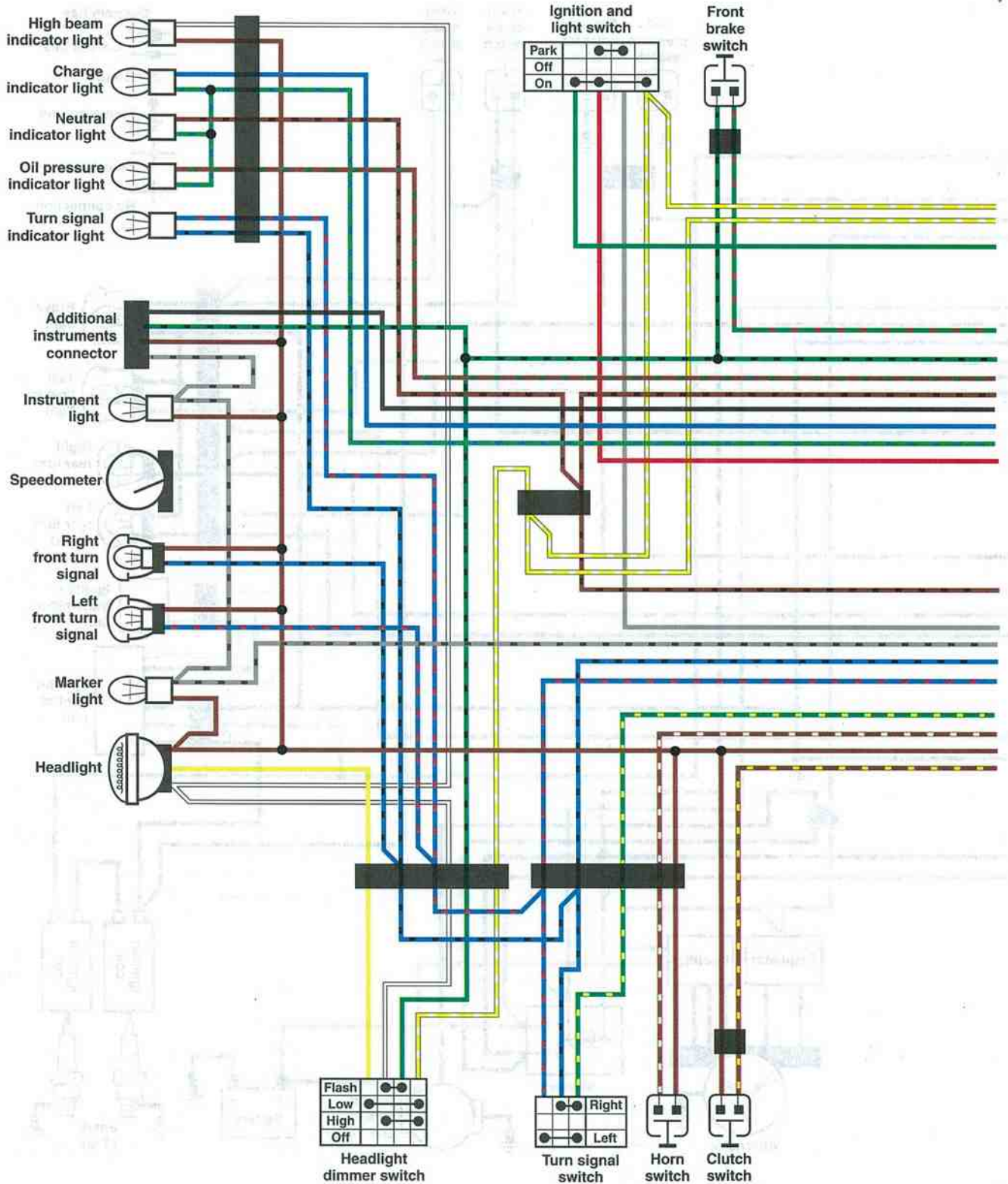
1982-1985 R80RT, 1981-1984 R100RS, 1981-1984 R100RT



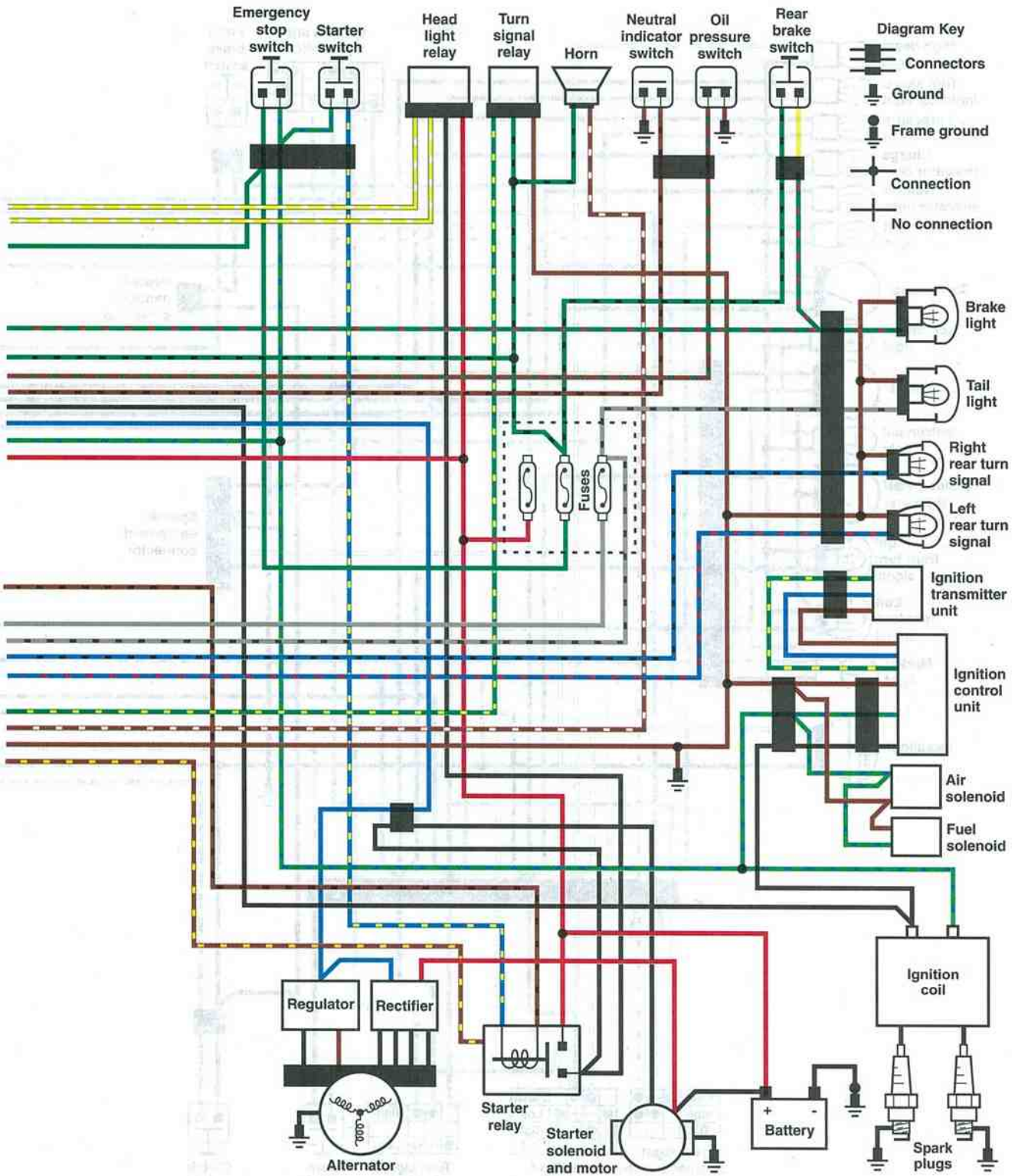




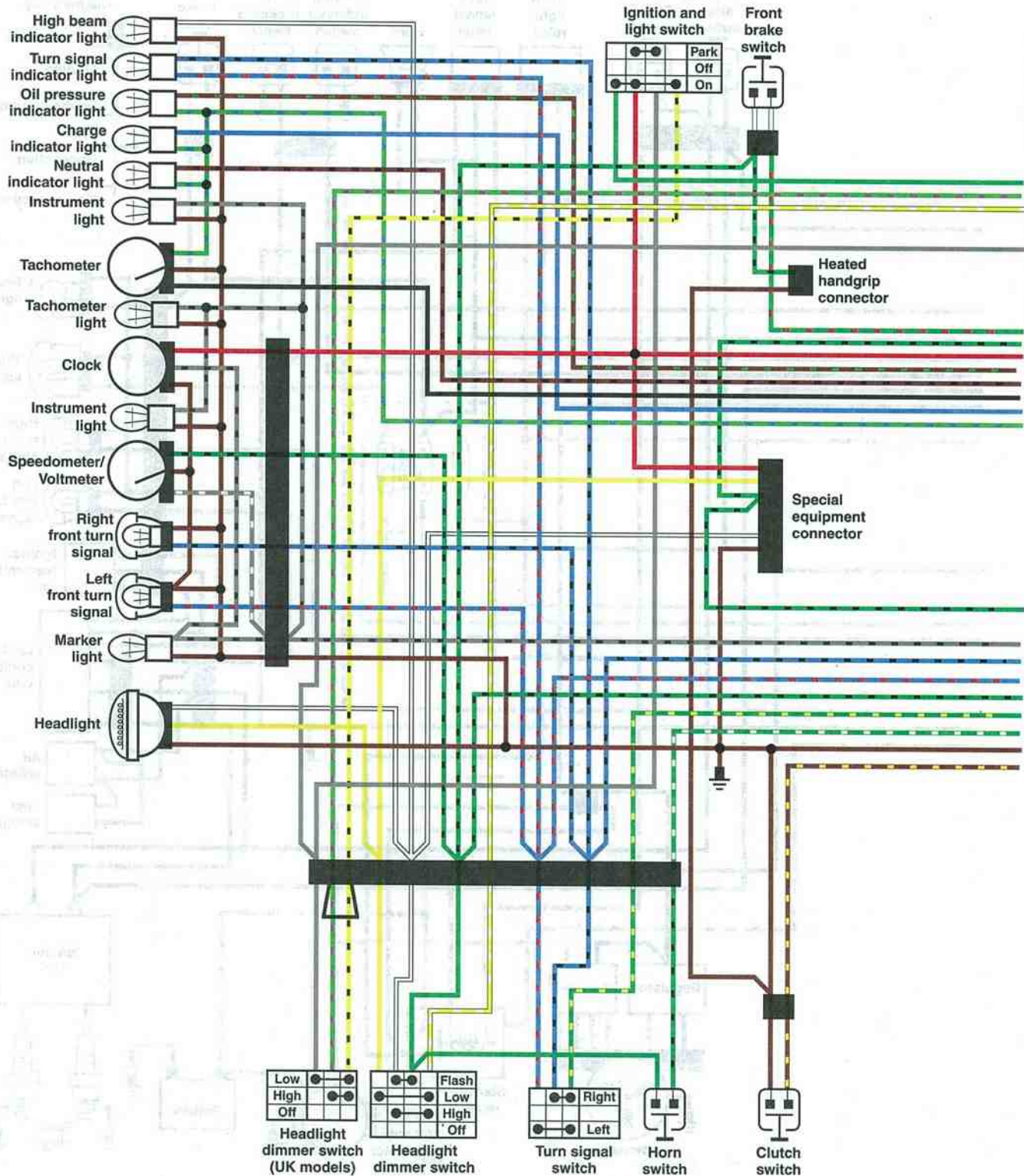
1988-1990 R100GS



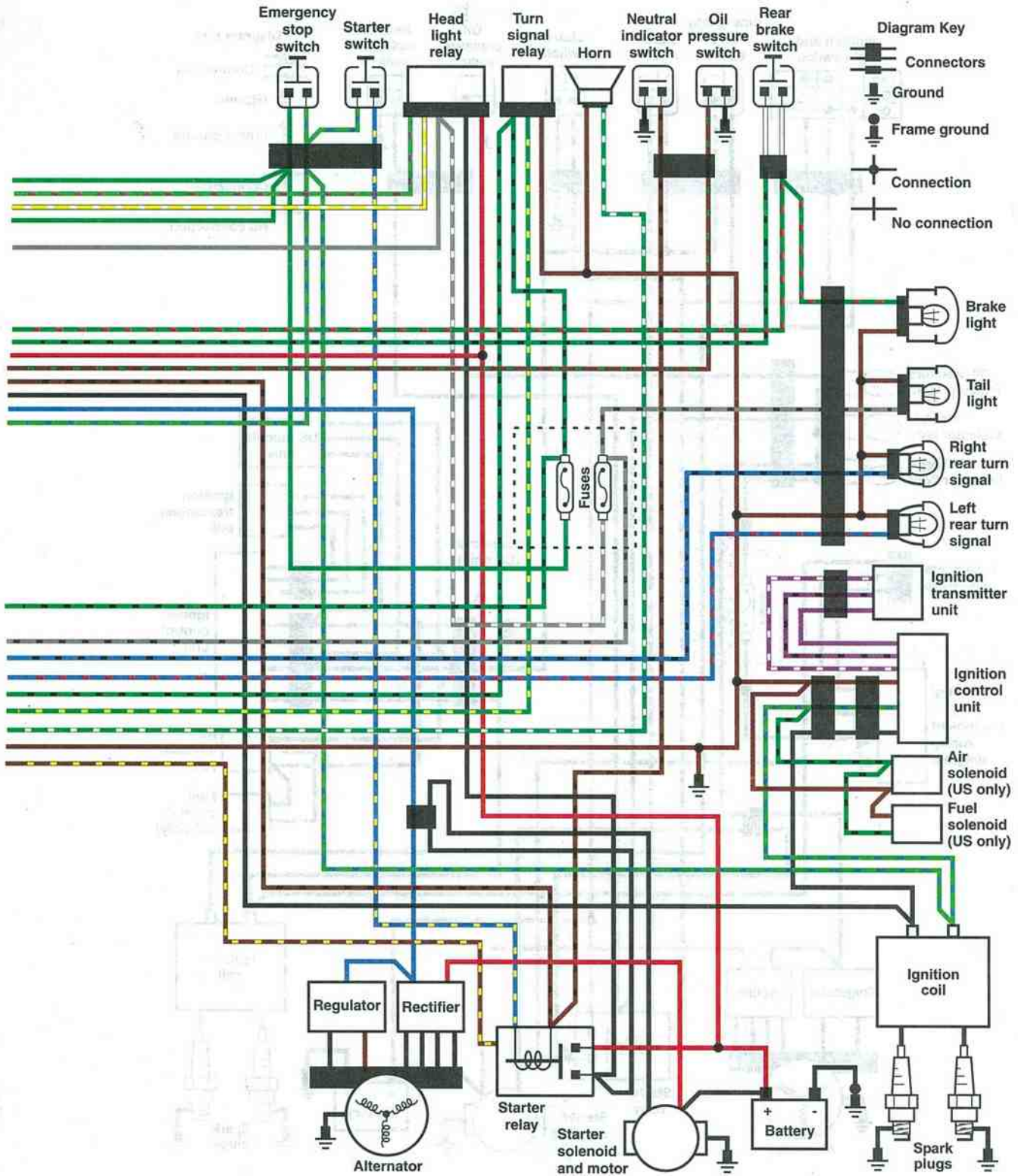




1987-ON R100RS, 1987-ON R100RT

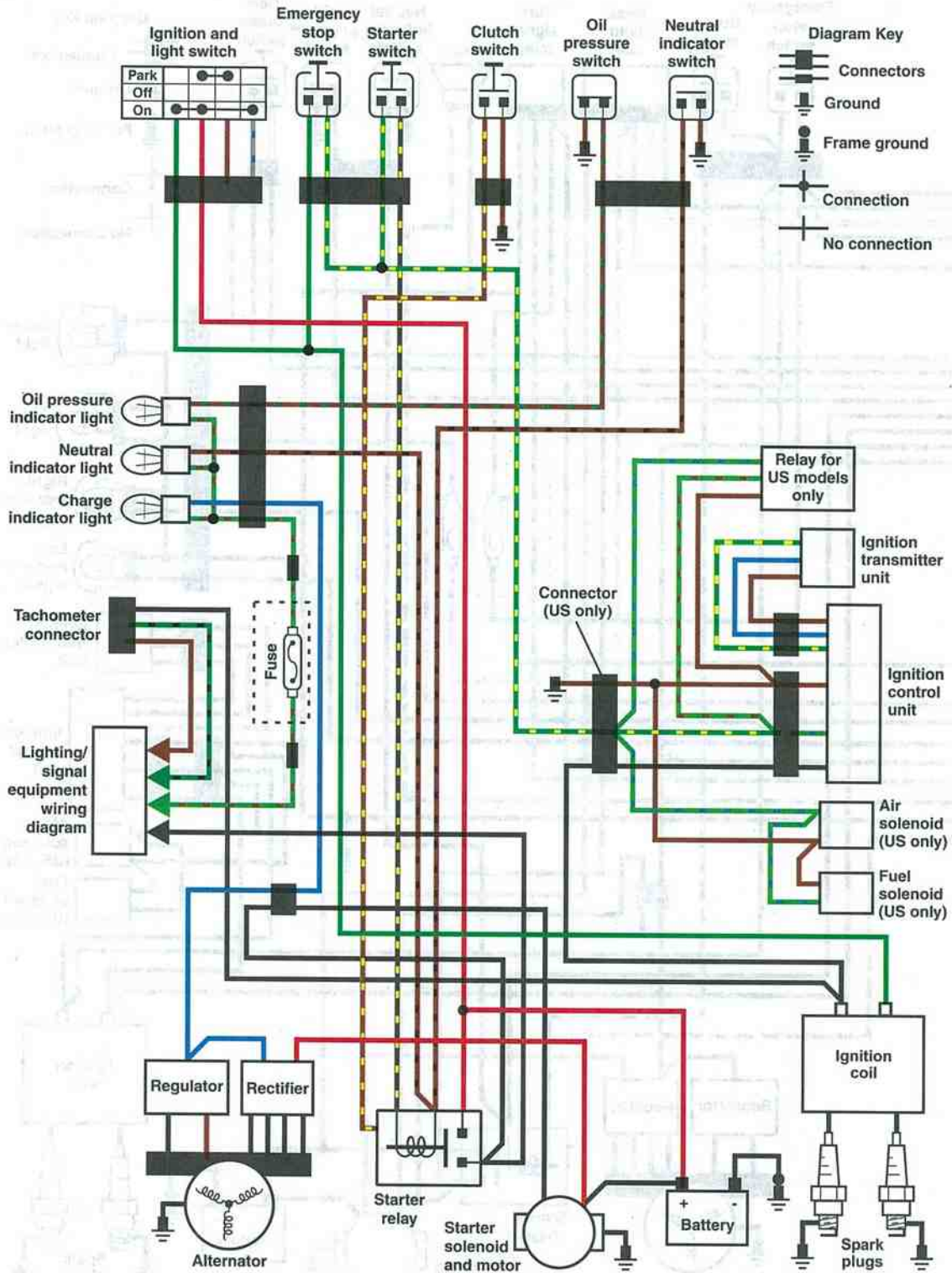




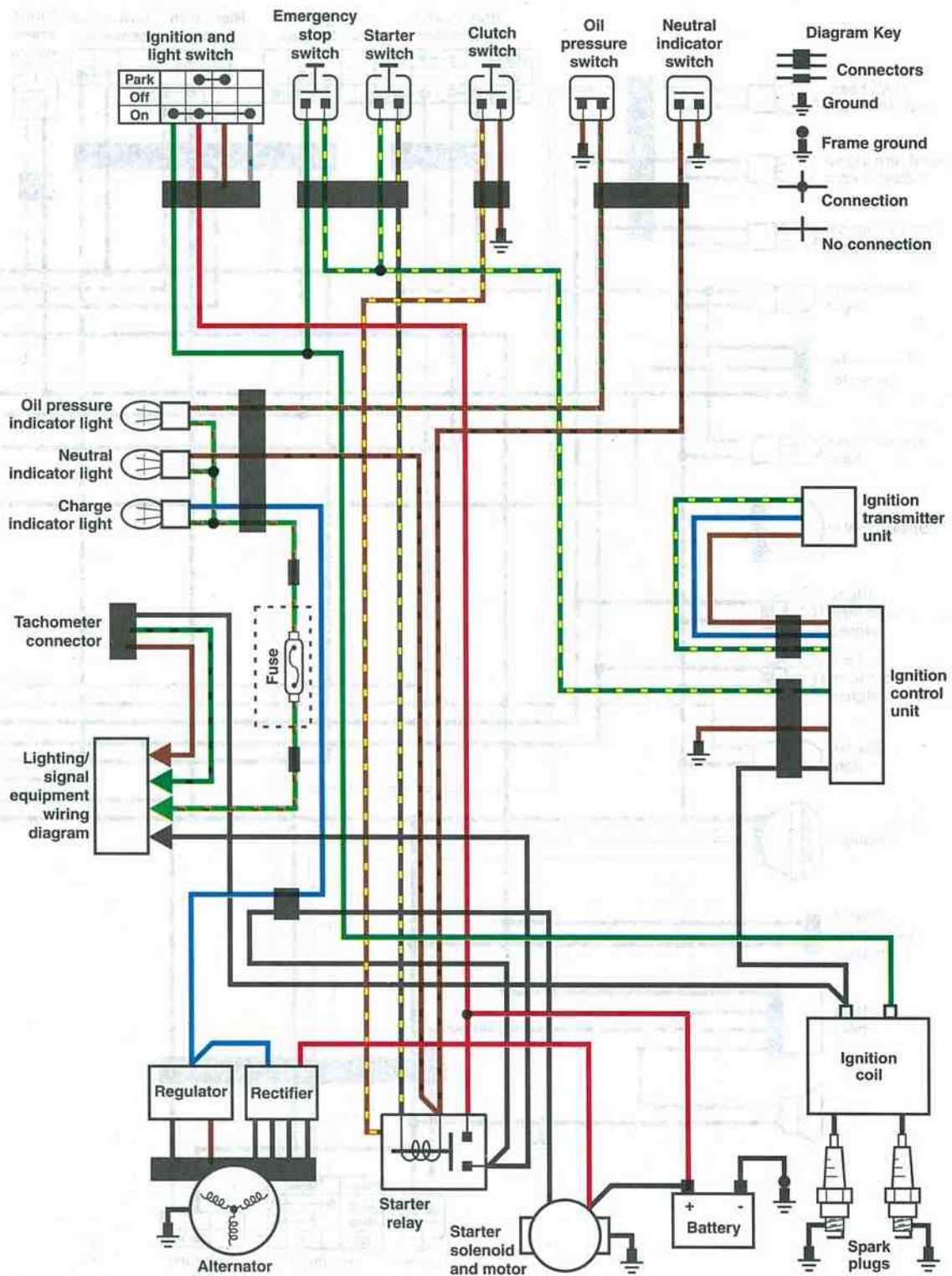




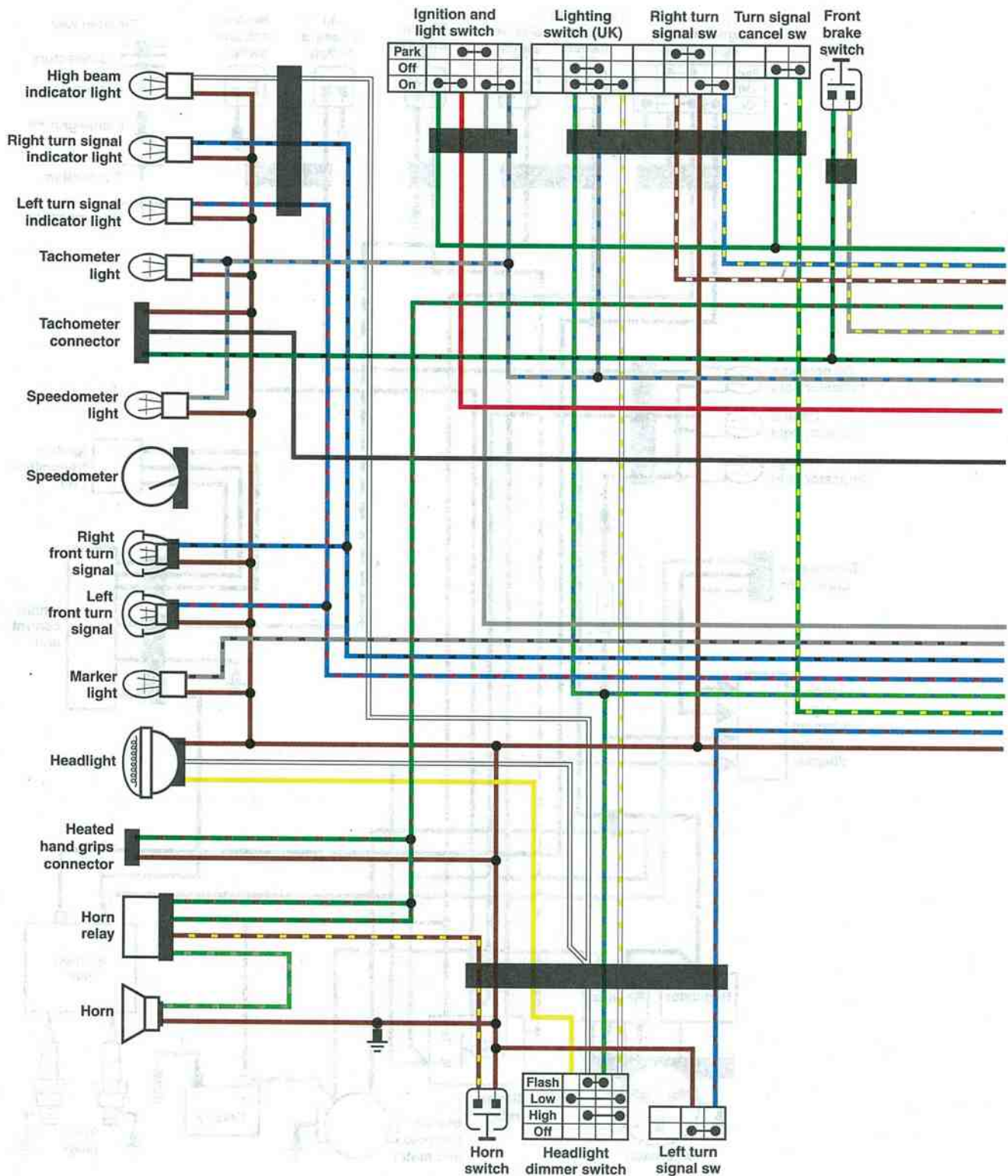
**R100GS (1991-ON U.S.), R100GS PD (1990-ON U.S)  
ENGINE CIRCUIT DIAGRAM**



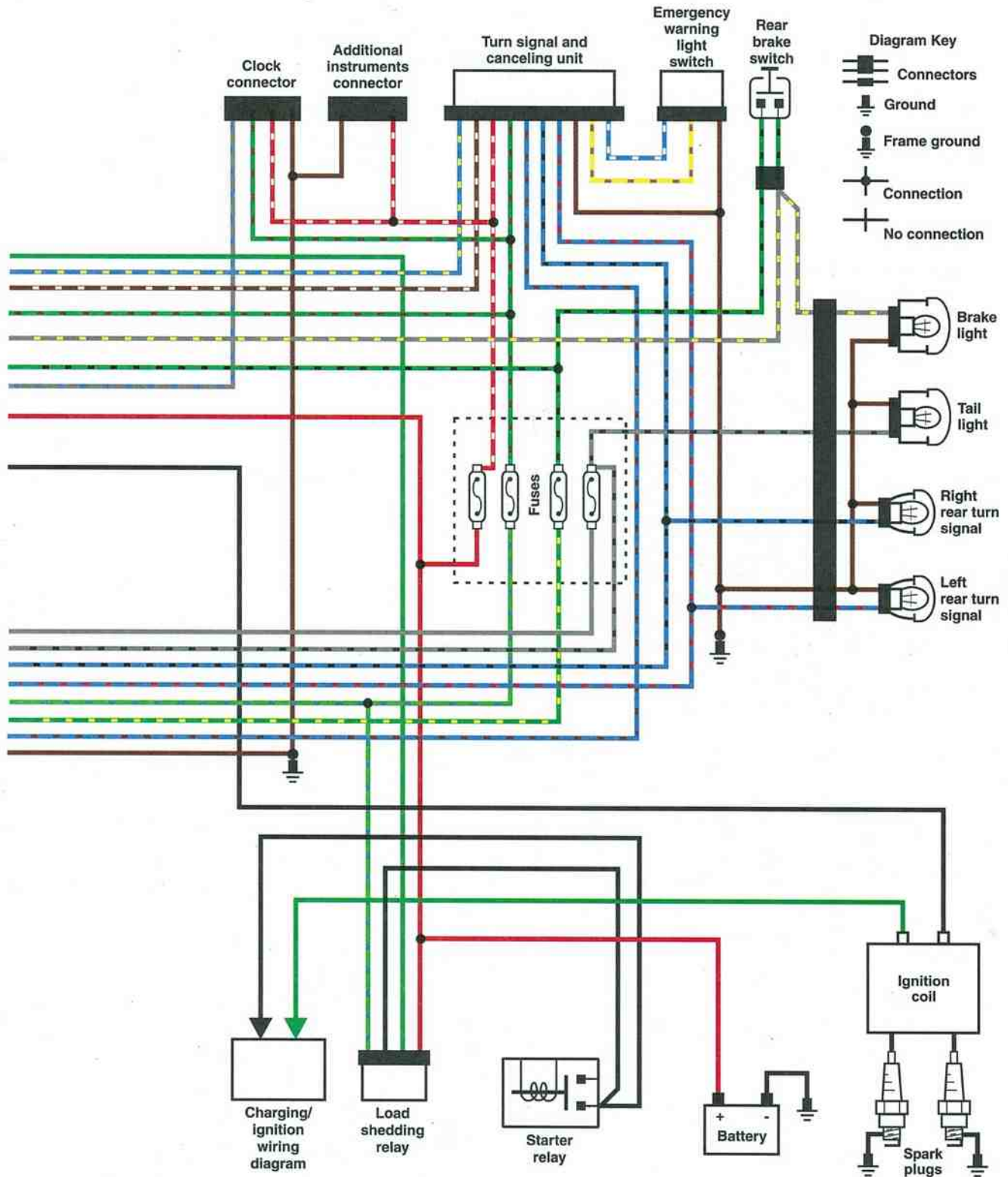
**R100GS (1991-ON NON-U.S.), R100GS PD (1990-ON NON-U.S.)  
ENGINE CIRCUIT DIAGRAM**

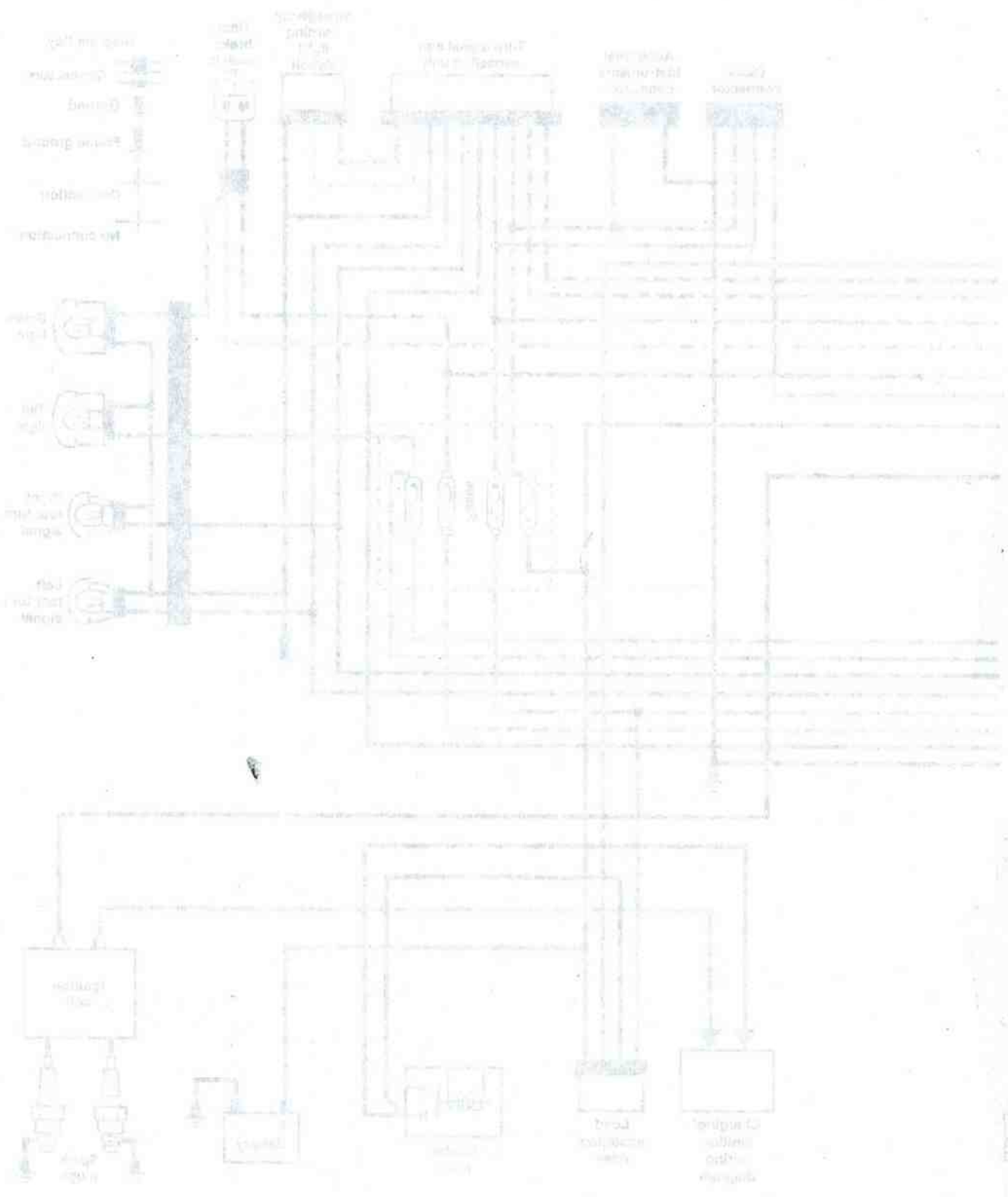


### R100GS AND R100GS PD (1990-ON) FRAME CIRCUIT DIAGRAM











# NOTES

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# NOTES

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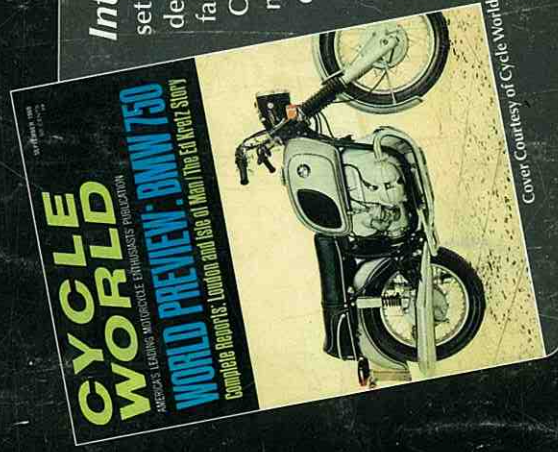


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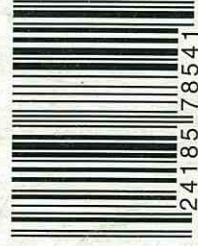
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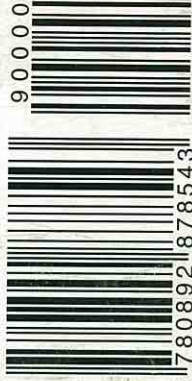
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