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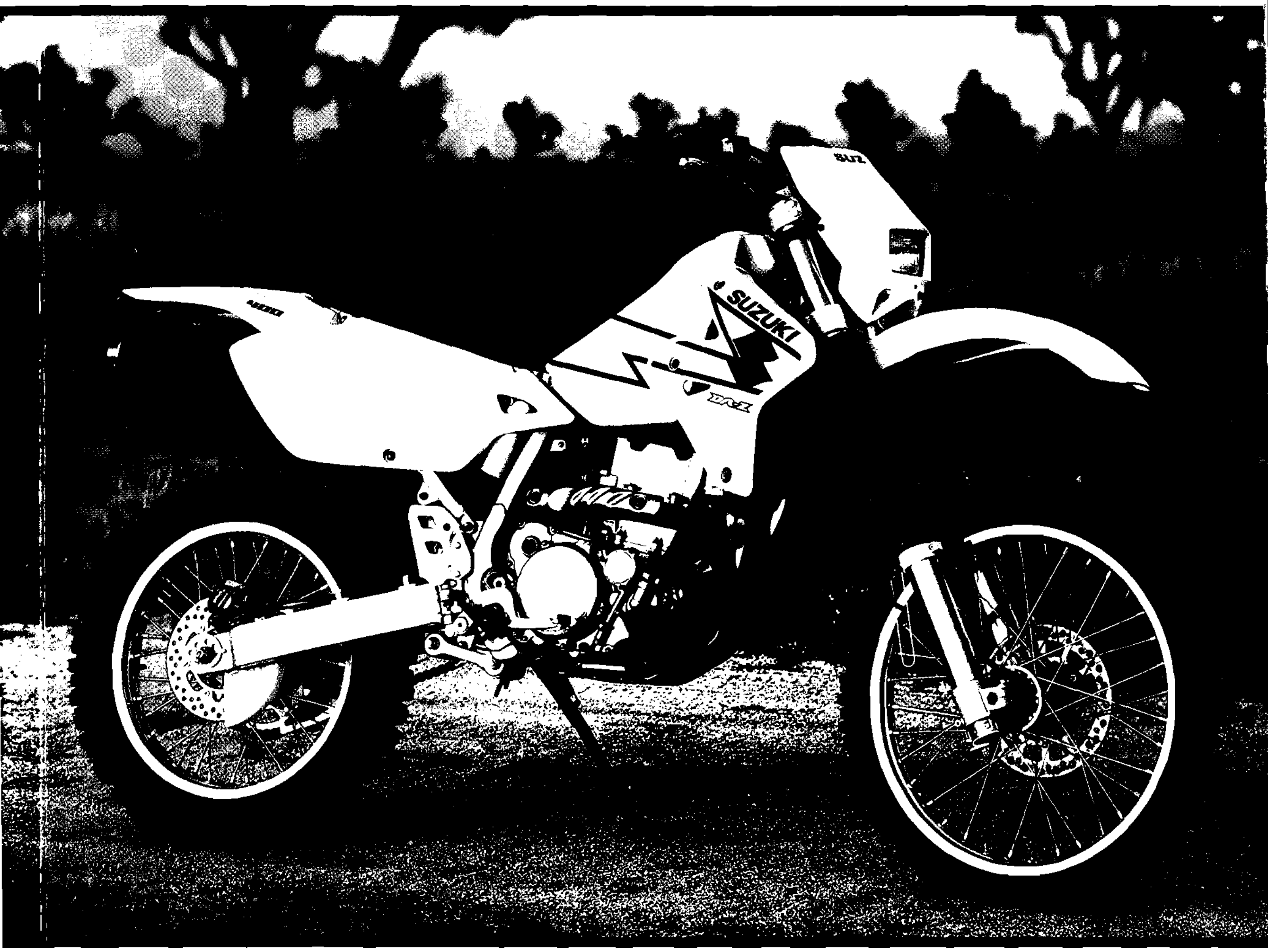


SUZUKI

DR-Z400E, S & SM • 2000-2006

SERVICE • REPAIR • MAINTENANCE

COLOR
Wiring Diagrams

A Prism Business Media Publication

CLYMER

SUZUKI

DR-Z400E, S & SM • 2000-2006

CLYMER
P.O. Box 12901, Overland Park, Kansas 66282-2901

CONTENTS

QUICK REFERENCE DATA

MOTORCYCLE INFORMATION

MODEL:______________________________YEAR:______________

VIN NUMBER:____

ENGINE SERIAL NUMBER:____________________________________

CARBURETOR SERIAL NUMBER OR I.D. MARK:___________________

MAINTENANCE SPECIFICATIONS

Battery type and capacity	
2000 models	GT7B-4, 12 volt, 6.5 amp-hour
2001-on models	YT7B-B5, 12 volt, 6 amp-hour
Brake lever free play	0.1-0.3 mm (0.004-0.012 in.)
Brake pad lining minimum thickness	1.0 mm (0.040 in.)
Brake pedal height	
E and S models	0-10 mm (0-0.4 in.) below top of peg
SM models	0-5 mm (0-0.2 in.)
Clutch lever free play	10-15 mm (0.4-0.6 in.) at lever end
Drive chain free play	40-50 mm (1.6-2.0 in.)
Drive chain length wear limit (20 pitch/21 pins)	319 mm (12.6 in.)
Radiator cap relief pressure	95-125 kPa (13.8-18.1 psi)
Rim runout (radial and lateral)	2.0 mm (0.08 in.)
Throttle grip free play	2-4 mm (0.08-0.16 in.)
Tire pressure	
E models	
Front	100 kPa (15 psi)
Rear	100 kPa (15 psi)
S models	
Front	125 kPa (18 psi)
Rear	150-175 kPa (22-25 psi)
SM models	
Front	175 kPa (25 psi)
Rear	220-225 kPa (29-33 psi)

FUEL, LUBRICANTS AND FLUIDS

Air filter	Foam air filter oil
Brake fluid type	DOT 4
Control cables	Cable lube
Cooling system capacity	1.25 liters (1.3 qt.)
Coolant type	Ethylene glycol containing anti-corrosion inhibitors for aluminum engines
Coolant mixture	50:50 (antifreeze/distilled water)
Drive chain	O-ring type chain lubricant
Engine oil	SG classified, or SH/SJ with JASO MA classification 4-stroke engine oil, SAE 10W-40
Acceptable grades for extreme temperatures	SAE 10W-30, 10W-50, 15W-40, 15W-50 or 20W-50
Engine oil capacity	
Engine rebuild	1.9 liters (2 qt.)
With filter change	1.8 liters (1.9 qt.)
Without filter change	1.7 liters (1.8 qt.)

(continued)

FUEL, LUBRICANTS AND FLUIDS (continued)

Fork oil grade	Suzuki SS-05, or equivalent 5-weight fork oil
Fork oil capacity (each leg)	
E models	720 cc (24.3 oz.)
S models	710 cc (24.0 oz.)
SM models	
Inner	182 ml (6.15 oz.)
Outer	350 ml (11.8 oz.)
Fork tube oil level (from top edge of inner tube)	
E models (without spring)	
2000-on	122 mm (4.8 in.)
S models (without spring)	
2000 and 2001	165 mm (6.5 in.)
2002-on	129 mm (5.08 in.)
SM models	
2005-on	NA
Fuel type	
E models	Unleaded gasoline; 90 octane minimum (R+M/2) Unleaded gasoline; 95 octane minimum (RON)
S and SM models	Unleaded gasoline; 87 octane minimum (R+M/2) Unleaded gasoline; 91 octane minimum (RON)
Fuel tank capacity (including reserve)	10 liters (2.6 gal.)
Reserve capacity	2.3 liters (0.61 gal.)

STANDARD FORK SETTINGS

	Spring preload adjuster	Compression adjuster clicks out*	Rebound adjuster clicks out*
E models			
2000-2003	–	12	13
2004	–	12	15
S models			
2000-2001	Third groove from top	7	–
2002-on	–	13	16
SM models			
2005-on	–	13	17

*Number of clicks out after the adjusters have been fully turned in (maximum damping force). Turning the adjusters out decreases damping force. Do not force the adjusters beyond their normal travel. Damage to the adjusters can occur.

STANDARD REAR SHOCK ABSORBER SETTINGS

	Compression damping clicks out*	Compression damping turns out*	Rebound damping clicks out*
E models			
2000-2001	12	–	13
2002-on	10 (low speed)	1 1/4 (high speed)	13
S models			
2000-2001	11	–	–
2002-on	10 (low speed)	1 1/4 (high speed)	13
SM models			
2005-on	10	1 1/8 (high speed)	14

*Number of clicks/turns out after the adjusters have been fully turned in (maximum damping force). Turning the adjusters out decreases damping force. Do not force the adjusters beyond their normal travel. Damage to the adjusters can occur.

MAINTENANCE TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Axle nut			
Front*			
E and S models			
Initial	20	–	15
Final	42	–	31
SM models			
Initial	20	–	15
Final	39	–	29
Rear	100	–	74
Coolant air bleeder bolt	6	53	–
Cylinder head cover bolts	14	–	10
Exhaust system fasteners	23	–	17
Front axle pinch bolts	18	–	13
Handlebar clamp bolts	23	–	17
Muffler clamp	20	–	15
Muffler spark arrester bolts	11	–	8
Oil drain plug			
Crankcase	21	–	15
Frame	18	–	13
Oil hose bolt and strainer	23	–	17
Spark plug	11	–	8
Spokes	3	27	–

*Refer to the text for tightening procedure.

CHAPTER ONE

GENERAL INFORMATION

This manual covers 2000-on Suzuki DR- Z400E, DR-Z400S and DR-Z400SM models.

The text provides complete information on maintenance, tune-up, repair and overhaul. Hundreds of original photographs and illustrations created during the complete disassembly of the motorcycle guide the reader through every job. All procedures are in step-by-step form and designed for the reader who may be working on the machine for the first time.

MANUAL ORGANIZATION

A shop manual is a tool and, as in all Clymer manuals, the chapters are thumb-tabbed for easy reference. Main headings are listed in the table of contents and index. Frequently used specifications and capacities from the tables at the end of each individual chapter are listed in the *Quick Reference Data* section at the front of the manual. Specifications and capacities are provided in metric and U.S. Standard units of measure.

During some of the procedures there are references to headings in other chapters or sections of the manual. When a specific heading is called out in a step it will be *italicized* as it appears in the manual. If a sub-heading is indicated as being "in this section" it is located within the same main heading. For example, the sub-heading *Handling Gasoline Safely* is located within the main heading *SAFETY.*

This chapter provides general information on shop safety, tool use, service fundamentals and shop supplies. **Tables 1-7**, at the end of the chapter, provide the following:

Table 1 lists the starting frame serial numbers.

Table 2 lists the general dimensions and weight.

Table 3 lists conversion formulas.

Table 4 lists general torque specifications.

Table 5 lists technical abbreviations.

Table 6 lists metric, decimal and fractional equivalents.

Table 7 lists metric tap and drill sizes.

Chapter Two provides methods for quick and accurate diagnosis of problems. Troubleshooting procedures present typical symptoms and logical methods to pinpoint problems.

Chapter Three explains all routine maintenance and recommended tune-up procedures necessary to keep the motorcycle running well.

Subsequent chapters describe specific systems, such as engine, transmission, clutch, drive system, fuel and exhaust systems, suspension and brakes.

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 injury.

SAFETY

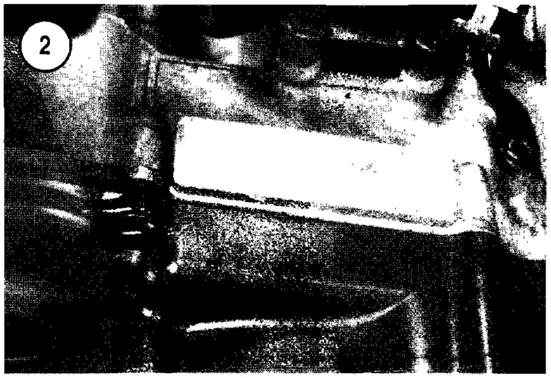
Follow these guidelines and practice common sense to safely service the motorcycle.

1. Do not operate the motorcycle 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. Properly ventilate the work area, or operate the motorcycle outside.
2. *Never* use gasoline or any extremely flammable liquid to clean parts. Refer to *Handling Gasoline Safely* and *Cleaning Parts* 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 motorcycle, move the fuel tank a safe distance away from the work area.
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 a fastener, make sure the new one is the same size and strength as the original.
9. Keep the work area clean and organized.
10. Wear eye protection *anytime* eye injury is possible. 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 cannot get caught in moving equipment.
12. Do not carry sharp tools in clothing pockets.
13. Always have an approved fire extinguisher available. Check that it is rated for gasoline (Class B) and electrical (Class C) fires.
14. Do not use compressed air to clean clothes, the motorcycle or the work area. Debris may be blown into the eyes or skin. *Never* direct compressed air at yourself or others. 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 cannot 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. In most cases these particles 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 motorcycle while someone is working under it.
18. When placing the motorcycle on a stand, check that it is secure.

Handling Gasoline Safely

Gasoline is a volatile, flammable liquid and is one of the most dangerous materials in the shop. Keep in mind when working on a motorcycle, gasoline is always present in the fuel tank, fuel line and carburetor. To avoid an accident when working around the fuel system, carefully observe the following:



1. *Never* use gasoline to clean parts. Refer to *Cleaning Parts* in this section.
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 motorcycle 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. Do not store gasoline in glass containers. If the glass breaks, a serious explosion or fire may occur.
6. Immediately wipe up spilled gasoline. Store the contaminated shop cloths in a metal container with a lid until they can be properly disposed, or place them outside in a safe place for the fuel to evaporate.
7. 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.
8. Always turn off the engine before refueling. Avoid spilling 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 time-consuming jobs performed in the home shop. Many types of chemical cleaners and solvents are available for shop use. Most are poisonous and extremely flammable. To prevent chemical exposure, vapor buildup, fire and 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 when necessary.
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. Wire brushes may cause a spark.
11. When using a parts washer, only use the solvent recommended by the manufacturer. Check that 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 motorcycle. These labels contain instructions that are important to personal safety when operating, servicing, transporting and storing the motorcycle. 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 located on the frame and engine. Record these numbers in the *Quick Reference Data* section at the front of the manual. Have these numbers available when ordering parts.

The frame number/vehicle identification number (VIN) is on the steering head (**Figure 1**). Refer to **Table 1** for model years and frame serial numbers.

The engine number is on the right crankcase (**Figure 2**), behind the cylinder.

The carburetor identification number is on the side of the carburetor.

FASTENERS

Proper fastener selection and installation is important to ensure the motorcycle operates as designed and can be serviced efficiently. Check that replacement fasteners meet all the same requirements as the originals.

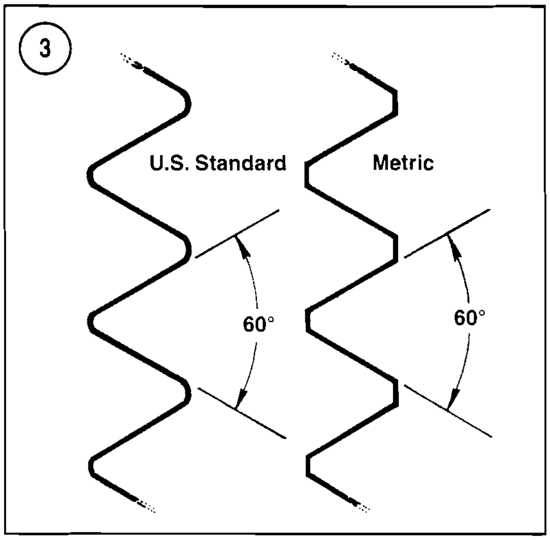
Threaded Fasteners

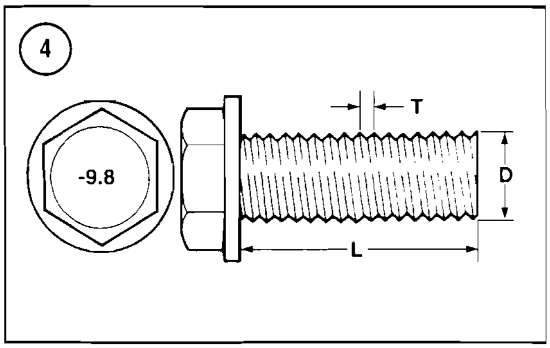
WARNING
Do not install fasteners with a strength classification lower than what was originally installed by the manufacturer. Doing so may cause equipment failure and/or damage.

Threaded fasteners secure most of the components on the motorcycle. 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 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 3**). Pay attention when working with unidentified fasteners; mismatching thread types can damage threads.





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

The length (L [**Figure 4**]), 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 a 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 L, **Figure 4**, to avoid purchasing replacements of the wrong length.

Some fasteners have numbers located on the top of the fastener (**Figure 4**) to indicate their strength. The higher the number, the stronger the fastener.

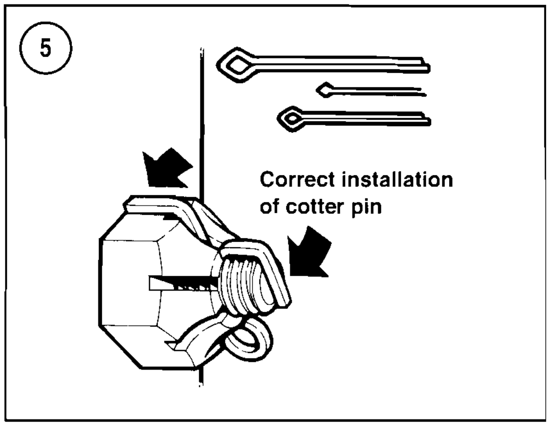
Many screws, bolts and studs are combined with nuts to secure particular components. To indicate the size of a nut, manufacturers specify the internal diameter and the thread pitch.

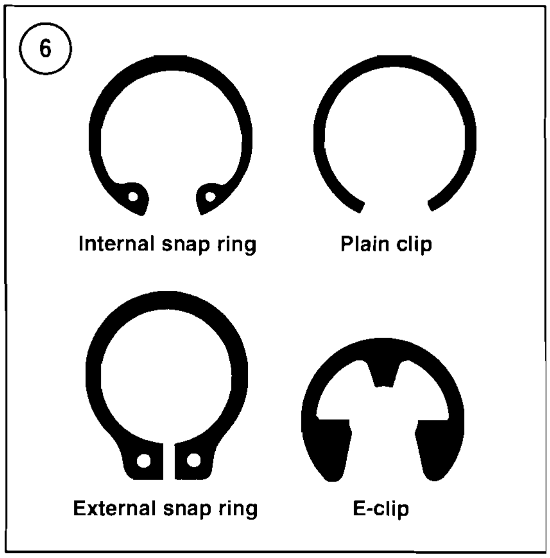
The measurement across two flats on a nut or bolt indicates the wrench size.

Torque Specifications

The materials used in the manufacture of the motorcycle may be subjected to uneven stresses if the fasteners of the 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 as 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 **Table 3** for torque conversion and **Table 4** for general torque specifications. To use **Table 4**, first determine the size of the fas-





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

Self-Locking Fasteners

Several types of bolts, screws and nuts incorporate a system that creates interference between the two fasteners. The most common types are 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. Discard and replace self-locking fasteners after their removal. Do not replace self-locking fasteners with standard fasteners.

Washers

The two basic types of washers are flat washers and lockwashers. Flat washers are 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 prevent the fastener from damaging the component.

As with fasteners, when replacing washers, make sure the replacements are 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 5**). 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 6**) are circular-shaped metal retaining clips. They are required to secure parts and gears, such as shafts, pins or rods, in place. 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 thicknesses also determine end play. These are usually called selective snap rings.

The two basic types of snap rings used are stamped and machined snap rings. Stamped snap rings (**Figure 7**) are manufactured with a sharp edge and round edge. When installing a stamped snap ring in a thrust application, install the sharp edge facing away from the part producing the thrust. Machined snap rings can be installed in either direction because both faces have sharp edges.

E-clips 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. Refer to *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, check that it seats completely.
5. Wear eye protection when removing and installing snap rings.

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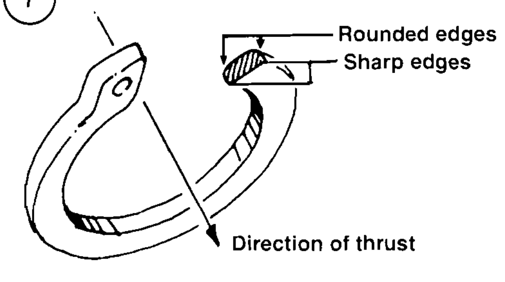


SHOP SUPPLIES

Lubricants and Fluids

Periodic lubrication helps ensure long service life for any type of equipment. Using the correct type of lubricant or fluid is as important as performing the service. This section describes the types of lubricants most often required. Follow the manufacturer's recommendations in Chapter Three for lubricant and fluid types.

Engine oils

Engine oil for four-stroke motorcycle engines is classified by two standards: the American Petroleum Institute (API) service classification and the Society of Automotive Engineers (SAE) viscosity rating. Some oils may also have passed the T903 Standard for friction, performed by the Japanese Automobile Standards Organization (JASO). These standards are indicated on the oil container label.

Two letters indicate the API service classification. The service classification indicates that the oil meets specific lubrication standards. The first letter in the classification, *S*, indicates the oil is for gasoline engines. The second letter indicates the standard the oil satisfies. If an oil has passed the JASO standards for four-stroke motorcycle engines, a registration number and certification rating are on the container. The certifications are MA (high friction applications) and MB (low friction applications).

Do not use engine oil designated as Energy Conserving on the API service label. This designation is for automotive applications and may cause engine/transmission damage when used in motorcycle applications.

Do not use oils or oil additives that contain graphite or molybdenum. These additives may cause clutch slip and damage.

The SAE viscosity rating is an indication of the oil's ability to lubricate and circulate at specific temperatures. The index number also indicates the oil's viscosity. The higher the index number, the higher the viscosity of the oil. The SAE viscosity rating for a single-grade oil is indicated by a single number (SAE 30, for example). The index numbers for a multigrade oil indicate a range (SAE 10W-40 for example). The *W* after the first number indicates the low-temperature viscosity.

When selecting engine oil, follow the manufacturer's recommendation for type, classification and viscosity. Using an oil with a classification different from the recommended may cause engine damage.

Greases

Grease is lubricating oil with thickening agents. 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 (MoS_2).

Chain lubricant

Many types of chain lubricants are available, depending on the type of chain.

The models covered in this manual use an O-ring chain as original equipment.

On O-ring (sealed) chains, the lubricant keeps the O-rings pliable and prevents corrosion. The actual chain lubricant is enclosed in the chain by the O-rings. Recommended types include aerosol sprays specifically designed for O-ring chains and conventional engine or gear oils. When using a spray lubricant, check that it is suitable for O-ring chains.

Clean an O-ring chain with kerosene. Do not use a high-pressure washer, solvents or gasoline.

Control cable lubricant

Use lithium grease to lubricate the control cable pivots. Lubricate the cable with light oil or a commercial cable lubricant.

Foam air filter oil

Filter oil is specifically designed for use on foam air filters. Most air filter oils are blended with additives making it easy to pour and apply evenly to the filter. When the additives evaporate, the filter oil is tacky. This allows the oil to remain suspended within the foam pores, trapping dirt and preventing it from being drawn into the engine.

Do not use engine oil as a substitute for foam filter oil. Engine oil does not remain in the filter. Instead, it is drawn into the engine, leaving the filter ineffective.

Brake fluid

WARNING

Never use engine oil (petroleum-based) in the brake system. Petroleum-based oil causes rubber parts in the system to swell and break apart, causing brake failure.

Brake fluid hydraulically transmits pressure (force) to the brakes. Brake fluid is classified by the Department of Transportation (DOT). Designations for brake fluid are DOT 3, DOT 4 and DOT 5. This classification appears on the fluid container. Models covered in this manual use DOT 4 brake fluid.

Each type of brake fluid has its own specific characteristics. Do not intermix different types of brake fluid. DOT 5 fluid is silicone-based and is not compatible with other fluids or in systems for which it was not designed. Mixing DOT 5 fluid with others may cause brake system failure. When adding brake fluid, *only* use the fluid recommended by the manufacturer.

Brake fluid damages plastic, painted and plated surfaces. 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 sealed.

Coolant

Coolant is a mixture of water and antifreeze used to dissipate engine heat. Ethylene glycol is the most common form of antifreeze. Check the manufacturer's recommendations when selecting an antifreeze; most require one specifically designed for use in aluminum engines. These types of antifreezes have additives that inhibit corrosion.

Only mix distilled water with antifreeze. Impurities in tap water may damage internal cooling system passages.

Cleaners, Degreasers and Solvents

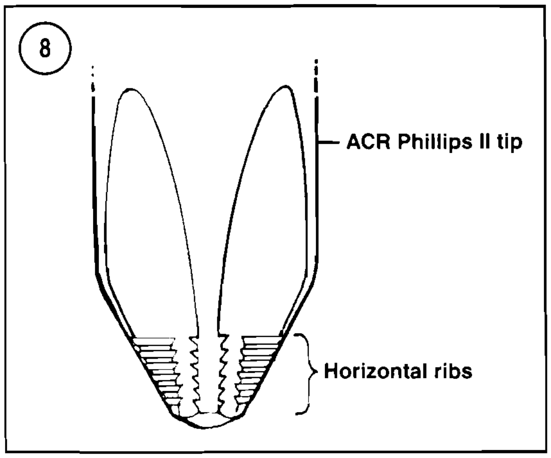
Many chemicals are available to remove oil, grease and other residue from the motorcycle.

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* in this chapter.

Use brake parts cleaner to clean brake system components. Brake parts cleaner leaves no residue. Use electrical contact cleaner to clean electrical connections and components without leaving any residue. Carburetor cleaner is a strong solvent used to remove fuel deposits and varnish from fuel system components. Use this cleaner carefully because 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

Sealant is used in combination with a gasket or seal. Follow the manufacturer's recommendation when using a sealant. Use extreme care when choosing a sealant other than the type recommended. Choose sealant based on its resistance to heat, fluids and their sealing capabilities.

A common sealant 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 to prevent 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 manufacturer's instructions for use.

Threadlocking Compound

CAUTION
Threadlocking compounds are anaerobic and damage most plastics. Use caution when using these products around plastic components.

Threadlocking compound is a fluid applied to the threads of fasteners. After tightening the fastener, the fluid sets 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 leaks.

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 a wide range of compounds for various strengths, temperatures and repair applications. Follow the manufacturer's recommendations regarding compound selection.

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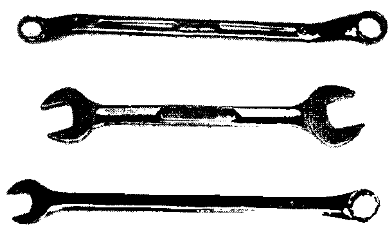

TOOLS

Most of the procedures in this manual can be carried out with 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 is carefully polished. They have easy-to-clean finishes and are comfortable to use. Quality tools are a good investment.

Some of the procedures in this manual specify special tools. In many cases the tool is illustrated in use. Home mechanics with a large tool kit may be able to use a suitable substitute or fabricate a suitable replacement. However, in some cases, the specialized equipment or expertise may make it impractical for the home mechanic to perform the procedure. When necessary, such operations come 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 equipment.

The manufacturer's part number is provided for many of the tools mentioned in this manual. These part numbers are correct at the time of first edition publication. The publisher cannot guarantee the part numbers or tools listed in this manual will be available in the future.

When purchasing tools to perform the procedures covered in this manual, consider the tool's potential frequency of use. If a tool kit is just now being started, consider purchasing a basic tool set from a quality 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. Check that 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.

Phillips-head screws are often damaged by incorrectly fitting screwdrivers. Quality Phillips screwdrivers are manufactured with their crosshead tip machined to Phillips Screw Company specifications. Poor quality or damaged Phillips screwdrivers can back out (camout) and round over the screw head. In addition, weak or soft screw materials can make removal difficult.

The best type of screwdriver to use on Phillips screws is the ACR Phillips II screwdriver, patented by the Phillips Screw Company. ACR stands for the horizontal anti-camout ribs found on the driving faces or flutes of the screwdriverss tip (**Figure 8**). ACR Phillips II screwdrivers were designed as part of a manufacturing drive system to be used with ACR Phillips II screws, but they work well on all common Phillips screws. A number of tool companies offer ACR Phillips II screwdrivers in different tip sizes and interchangeable bits to fit screwdriver bit holders.

One way to increase the grip of a Phillips screwdriver is to apply valve grinding compound, or Permatex Screw & Socket Gripper, to the screwdriver tip. After loosening or tightening the screw, clean the screw recess.

Wrenches

Open-end, box-end and combination wrenches (**Figure 9**) are available in a variety of 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 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 convenient tool.

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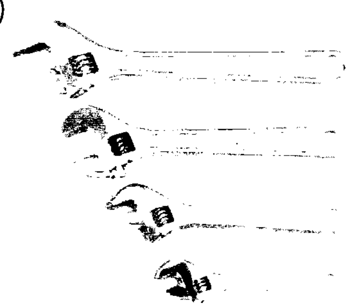

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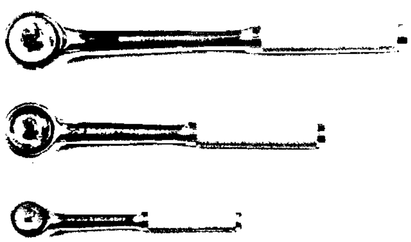

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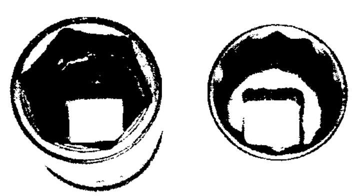

Adjustable Wrenches

An adjustable wrench, or Crescent wrench (**Figure 10**), can fit nearly any nut or bolt head that has clear access around its 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. Because one jaw is adjustable and may become loose, they are more likely to slip off the fastener. To minimize slipping, check that the fixed jaw of the wrench is the one transmitting the force.

Socket Wrenches, Ratchets and Handles

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

Sockets that attach to a ratchet handle (**Figure 11**) are available with 6-point or 12-point openings (**Figure 12**) 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 thicknesses of a 19-mm hand socket (A, **Figure 13**) and

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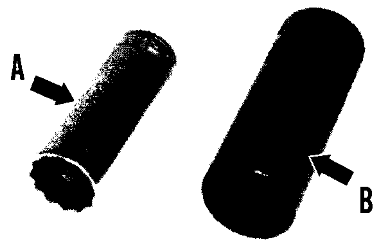

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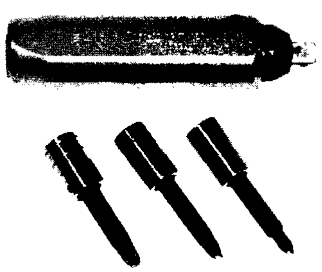

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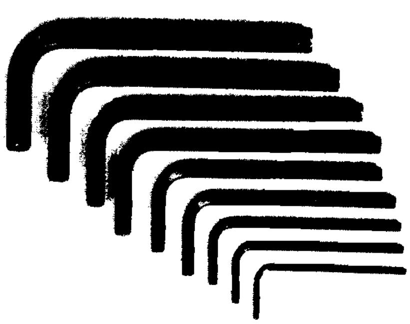

the 19-mm impact socket (B). Use impact sockets when using an impact driver or air tools. Use hand sockets with hand-driven attachments.

Various handles are available for sockets. Use the speed handle for fast operation. Flexible ratchet heads in different 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 versatile because allows the user to install or remove the nut without removing the socket.

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

Impact Driver

WARNING

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

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 14**) 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.

Allen Wrenches

Use Allen, or set screw wrenches (**Figure 15**), on fasteners with hexagonal recesses in the fastener head. These wrenches are available in a L-shaped bar, socket and T-handle types. A metric set is required when working on most motorcycles. Allen bolts are sometimes called socket bolts.

Torque Wrenches

Use a torque wrench 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 in.) 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 types of torque wrenches are the deflecting beam, dial indicator and audible click (**Figure 16**).

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 17** 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 18**), 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 using a torque adapter at a right angle to the drive head, calibration is not required because the effective length has not changed.

To recalculate a torque reading when using a torque adapter, use the following formula and refer to **Figure 18**.

$$TW = \frac{TA \times L}{L + A}$$

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 the adapter increases (or in some cases reduces) the effective lever length as measured along the centerline of the torque wrench.

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 of the torque wrench measured along the centerline of the torque wrench is the sum of L and A.

Example:

TA = 20 ft.-lb.

A = 3 in.

L = 14 in.

$$TW = \frac{20 \times 14}{14 + 3} = \frac{280}{17} = 16.5 \text{ ft.-lb.}$$

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.

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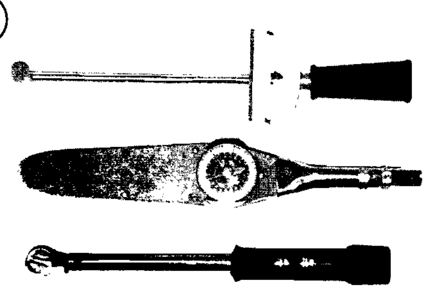

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Pliers

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 19** and **Figure 20** 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 20**), 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 because the sharp jaws damage the objects they hold.

Snap Ring Pliers

WARNING

Snap rings can spring from the pliers during removal or installation. Also, the snap ring plier tips may break. Always wear eye protection when using snap rings pliers.

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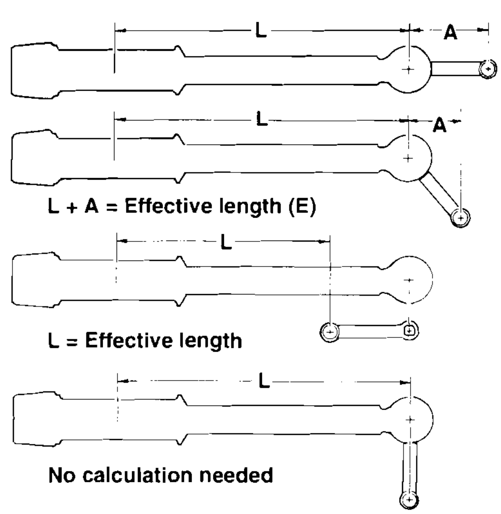

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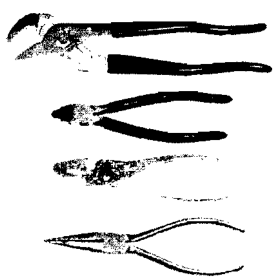

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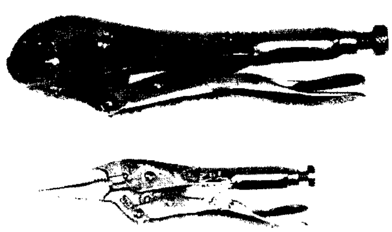

Snap ring pliers (**Figure 21**) are specialized pliers with tips that fit into the ends of snap rings to remove and install them.

Snap rings pliers are available with a fixed action (either internal or external) or convertible (one tool

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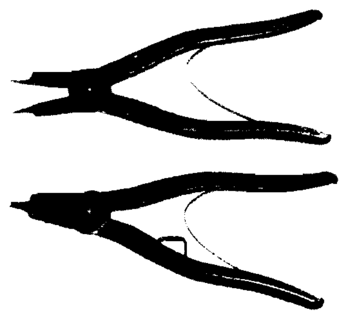

works on both internal and external snap rings). They may have fixed tips or interchangeable ones of various sizes and angles. For general use, select a convertible-type plier with interchangeable tips.

Hammers

Various types of hammers are available to fit a number of applications. Use a ball-peen hammer 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 becayse damage occurs in most cases. Select the correct hammer for the task.

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

MEASURING TOOLS

The ability to accurately measure components is essential to perform many of the procedures described in this manual. 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 (**Figure 22**) is designed to measure a dimension with a certain degree of accuracy and within a certain range. Always use a measuring tool designed for the task.

As with all tools, measuring tools provide the best results if cared for properly. Improper use can damage the tool and cause 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 produces less accurate results. Hold the tool gently with the fingertips to easily feel the point at which the tool contacts the object. This feel for the equipment produces more accurate measurements and reduces the risk of damaging the tool or component. Refer to the following sections for specific measuring tools.

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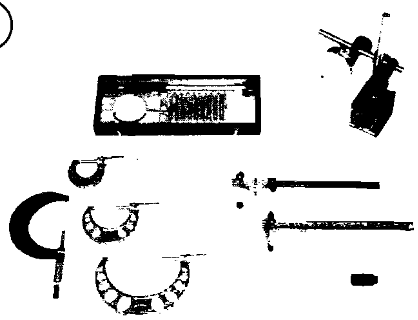

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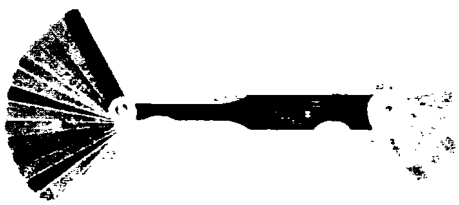

Feeler Gauge

Use a feeler, or thickness gauge (**Figure 23**), for measuring the distance between two surfaces.

A feeler gauge set consists of an assortment of steel strips of graduated thicknesses. 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.

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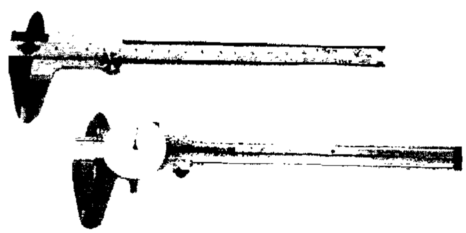


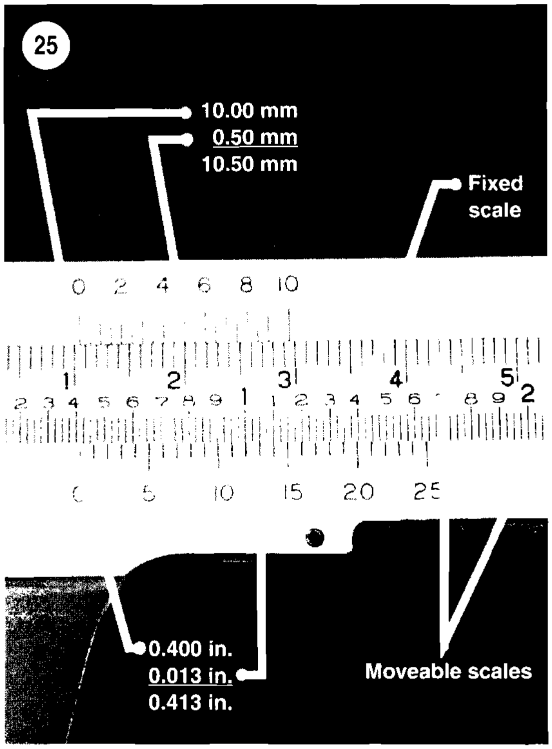
Calipers

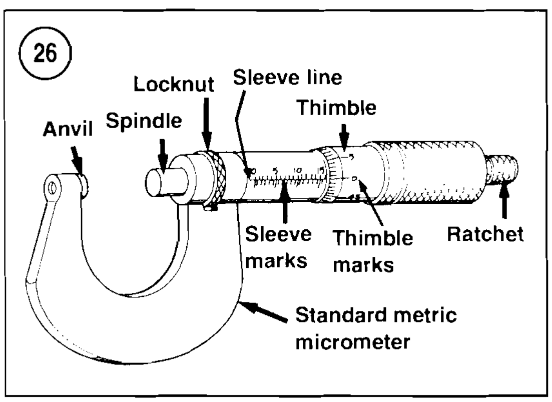
Use calipers (**Figure 24**) to determine inside, outside and depth measurements. Although not as precise as a micrometer, they allow reasonable precision, typically to within 0.05 mm (0.001 in.). Most calipers have a range up to 150 mm (6.0 in.).

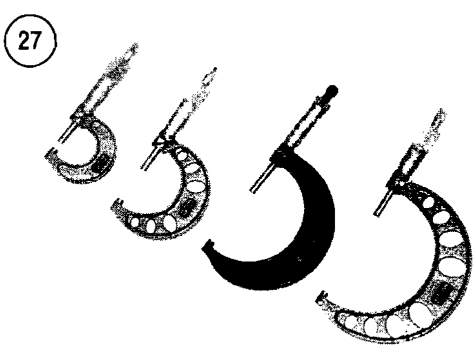
Calipers are available in dial, vernier or digital versions. Dial calipers have a dial readout that provides convenient reading. Vernier calipers have marked scales that must be compared to determine the measurement. The digital caliper uses an LCD to show the measurement.

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.

Refer to **Figure 25** to read a vernier caliper. 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 appear 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 (**Figure 26**) is an instrument designed for linear measurement using the decimal divisions of the inch or meter. While many types and styles of micrometers are available, 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 thicknesses of materials.

A micrometer's size indicates the minimum and maximum size of a part it can measure. The usual sizes (**Figure 27**) are 0-25 mm (0-1 in.), 25-50 mm (1-2 in.), 50-75 mm (2-3 in.) and 75-100 mm (3-4 in.).

Micrometers that cover a wider range of measurement are available. These use a large frame with interchangeable anvils of various lengths. This type of micrometer offers a cost savings; however, its overall size may make it less convenient.

Adjustment

Before using a micrometer, check its adjustment as follows:

1. Clean the anvil and spindle faces.

2A. To check a 0-25 mm or 0-1 in. 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 25 mm or 1 in., 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.

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

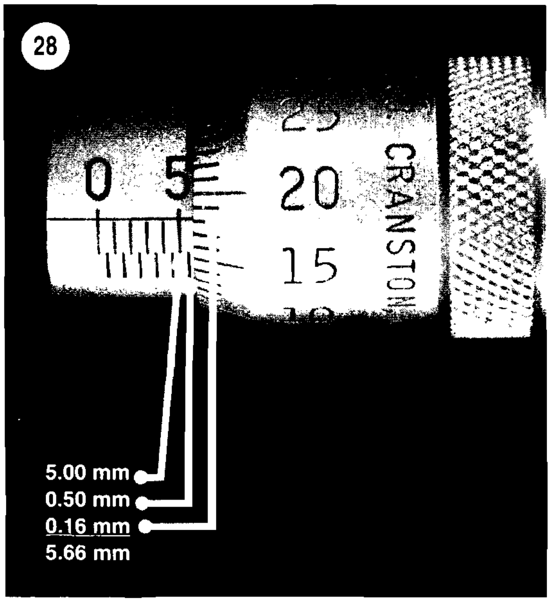
Reading

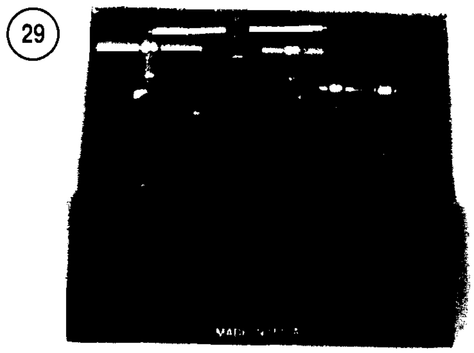
When reading a micrometer, numbers are taken from different scales and added together. The following sections describe how to read the measurements of various types of outside micrometers.

For accurate results, properly maintain the measuring surfaces of the micrometer. There cannot be any dirt or burrs between the tool and the measured object. Never force the micrometer to close around an object. Close the micrometer around the highest point so it can be removed with a slight drag.

Metric micrometer

The standard metric micrometer (**Figure 26**) 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, has 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 28**.

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 to the reading in Step 1.

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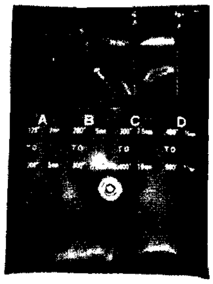

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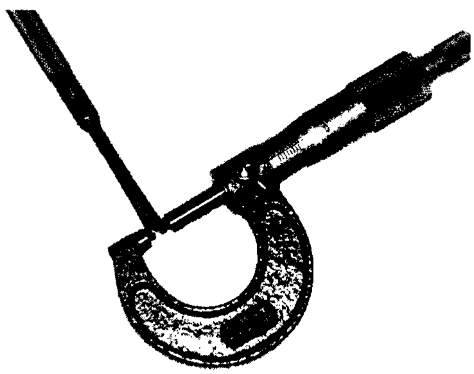

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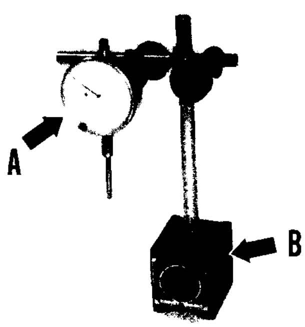

3. Read the thimble mark that aligns with the sleeve line. Each thimble mark equals 0.01 mm. If a thimble mark does not align exactly with the sleeve line, estimate the amount between the lines. For accurate readings in two-thousandths of a millimeter (0.002 mm), use a metric vernier micrometer.
4. Add the readings from Steps 1-3.

Telescoping and Small-Hole Gauges

Use telescoping gauges (**Figure 29**) and small-hole gauges (**Figure 30**) 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 moveable post and carefully insert the gauge into the bore. Carefully move the gauge in the bore to check that it is centered. Tighten the knurled end of the gauge to hold the moveable 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-hole 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 because 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 31**). Small-hole gauges are typically used to measure valve guides.

Dial Indicator

A dial indicator (A, **Figure 32**) 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 (B, **Figure 32**), 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 33** 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 34**) measures combustion chamber (cylinder) pressure, usually in psi or kg/cm^2. 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. Refer to Chapter Three.

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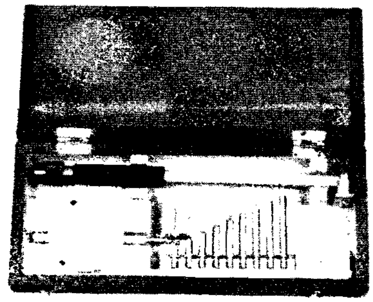

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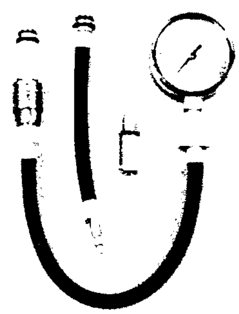

Multimeter

A multimeter (**Figure 35**) 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 manufacturer's specifications for electrical components are based on results using a specific test meter. Results may vary if using a meter not recommend by the manufacturer. 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.

ELECTRICAL SYSTEM FUNDAMENTALS

An explanation of the many types of electrical systems used in today's motorcycles is beyond the scope of this manual. However, an understanding of electrical fundamentals is necessary to perform simple diagnostic tests.

Voltage

Voltage is the electrical potential or pressure in an electrical circuit and is expressed in volts. The more pressure (voltage) in a circuit, the more work that can be performed.

Direct current (DC) voltage means the electricity flows in one direction. All circuits powered by a battery are DC circuits.

Alternating current (AC) means the electricity flows in one direction momentarily, then switches to the opposite direction. Alternator output is an example of AC voltage. This voltage must be changed, or rectified, to direct current to operate in a battery powered system.

Resistance

Resistance is the opposition to the flow of electricity within a circuit or component and is measured in ohms. Resistance causes a reduction in available current and voltage.

Resistance is measured in an inactive circuit with an ohmmeter. The ohmmeter sends a small amount of current into the circuit and measures how difficult it is to push the current through the circuit.

An ohmmeter, although useful, is not always a good indicator of a circuit's actual ability under operating conditions. This is due to the low voltage (6-9 volts) that the meter uses to test the circuit. The

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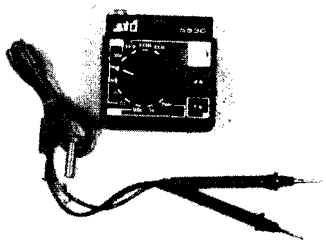

voltage in an ignition coil secondary winding can be several thousand volts. Such high voltage can cause the coil to malfunction, even though it tests acceptable during a resistance test.

Resistance increases with temperature. Perform all testing with the component or circuit at room temperature. Resistance tests performed at high temperatures may indicate high resistance readings and cause the unnecessary replacement of a component.

Amperage

Amperage is the unit of measure for the amount of current within a circuit. Current is the actual flow of electricity. The higher the current, the more work that can be performed up to a given point. If the current flow exceeds the circuit of component capacity, the system will be damaged.

BASIC SERVICE METHODS

1. Front, in this manual, refers to the front of the motorcycle. The front of any component is the end closest to the front of the motorcycle. The left and right sides refer to the position of the parts as viewed by the rider sitting on the seat facing forward.
2. When servicing an engine or suspension component, secure the motorcycle in a safe manner.
3. Tag all similar parts for location and mark all mating parts for position. Record the numbers and thicknesses of any shims as they are removed. Identify parts by placing them in sealed and labeled plastic bags.
4. Tag disconnected wires and connectors with masking tape and a marking pen.
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. Cover all openings to prevent objects or debris from falling into the engine.
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 motorcycle.
13. Repairs are much faster and easier if the motorcycle is clean before starting work. Degrease the motorcycle with a commercial degreaser; follow the directions on the container for the best results. Clean all parts as they are removed. Do not direct high-pressure water at steering bearings, carburetor hoses, wheel bearings, suspension and electrical components or O-ring drive chains. The water forces the grease out of the bearings and possibly damages the seals.
14. If special tools are required, have them available before starting the procedure. When special tools are required, they are described in the procedure.
15. Make diagrams of similar-appearing parts. For example, 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. Check that all shims and washers are reinstalled in the same location and position.

17. When 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. 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. Strike the fastener several times with a small hammer. Do not hit it so hard as to cause damage. Reapply the penetrating oil if necessary.

For frozen screws, apply penetrating oil as described, and then insert a screwdriver in the slot and strike the top of the screwdriver with a hammer. This loosens the rust so the screw can be backed out. 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 because 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 36**).

If the head breaks off flush, use a screw extractor. To do this, center-punch the exact center of the remaining portion of the screw or bolt (A, **Figure 37**), and then drill a small hole in the screw (B) and tap the extractor into the hole (C). Back the screw out with a wrench on the extractor (D, **Figure 37**).

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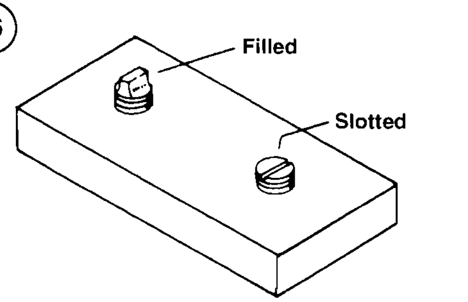

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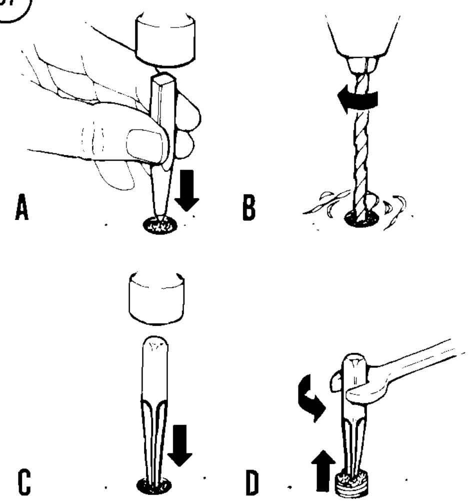

Repairing Damaged Threads

Occasionally threads are stripped because of 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 38**). 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 the insert.

If it is necessary to drill and tap a hole, refer to **Table** 7 for metric tap and drill sizes.

Stud Removal/Installation

A stud removal tool is available from most tool suppliers. This tool makes the removal and installa-

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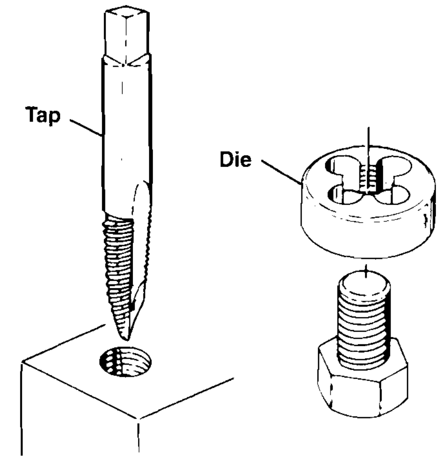

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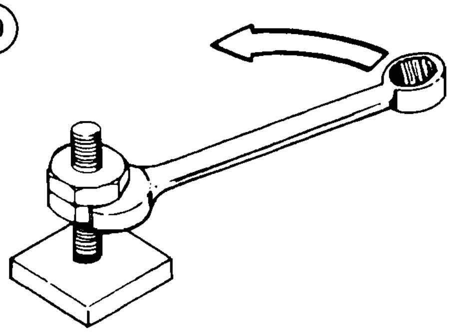

tion of studs easier. If one is not available, thread two nuts onto the stud and tighten them against each other (**Figure 39**). Remove the stud by turning the lower nut.

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.

1

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 Removal/Installation

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, make sure to prevent damaging the part. Many bearing replacement procedures are included in the chapters where applicable; however, use the following procedures as a guideline.

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 damages the bearing and maybe the shaft or case half. Note the following when removing/installing bearings.

1. When using a puller to remove a bearing from a shaft, make sure 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. Refer to **Figure 40**.
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 41**) and make sure to support both bearing races with wooden blocks, as shown.
3. The ideal method of bearing removal is with a hydraulic press. Note the following when using a press:
   a. Always support the inner and outer bearing races with a suitable size wooden or alumi-

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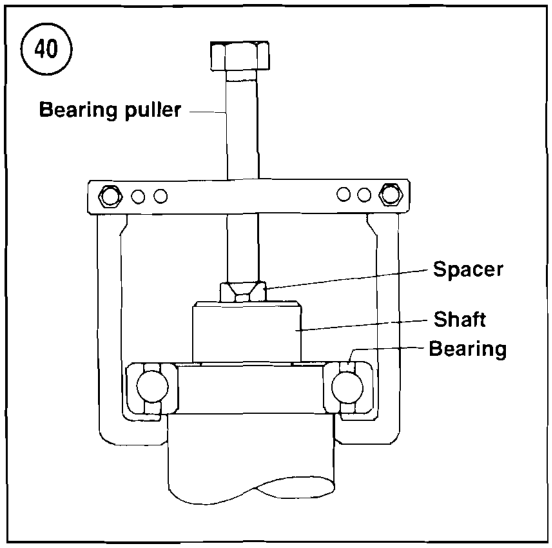

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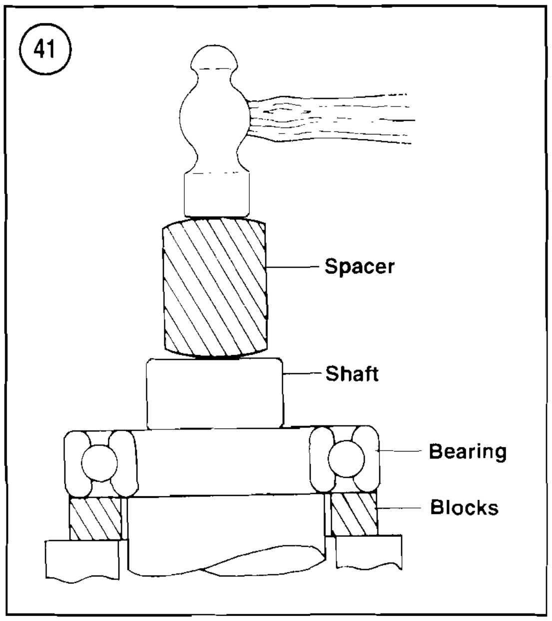

num ring (**Figure 42**). If only the outer race is supported, pressure applied against the balls and/or the inner race damages them.

b. Always check that the press arm (**Figure 42**) 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.

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

5. When installing a bearing in a housing, apply pressure to the *outer* bearing race (**Figure 43**). When installing a bearing on a shaft, apply pressure to the *inner* bearing race (**Figure 44**).

6. 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 length of pipe or a driver with a diameter that matches the bearing race. **Figure 45** shows the correct way to use a driver and hammer to install a bearing.

7. Step 1 describes how to install a bearing in a case or over a shaft. However, when installing a bearing over a shaft and into a housing at the same time, a tight fit is required for both outer and inner bearing races. In this situation, install a spacer under the driver tool so pressure is applied evenly across both races (**Figure 46**). If the outer race is not supported, the balls will push against the outer bearing race and damage it.

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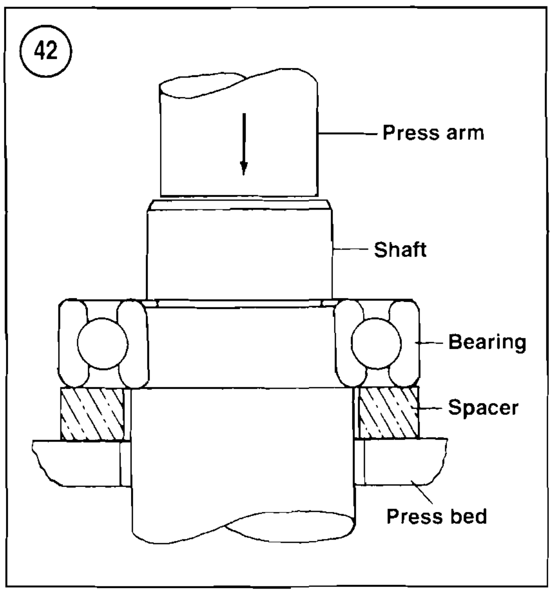

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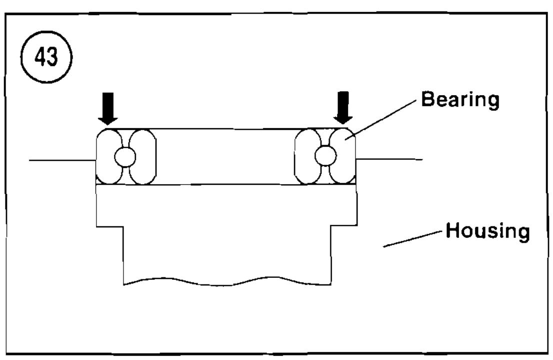

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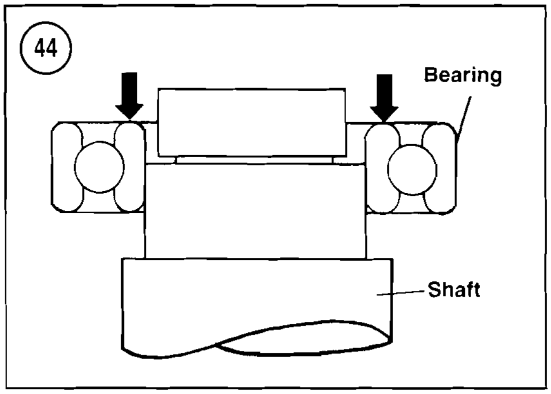

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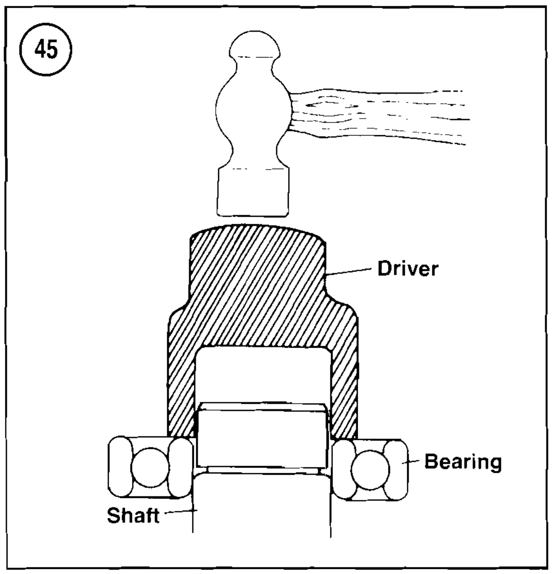

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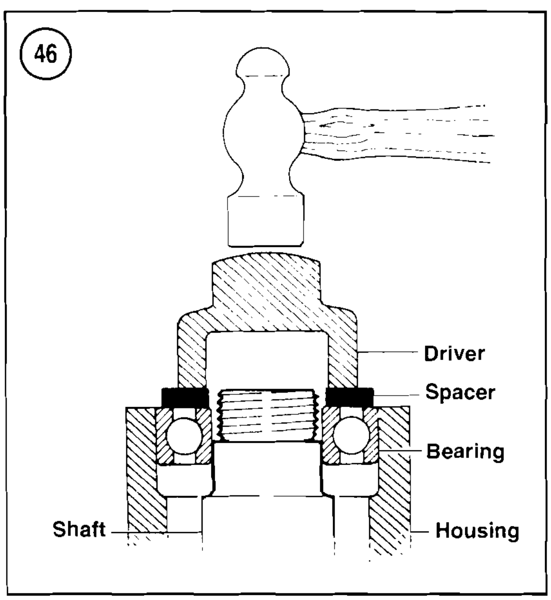

Interference fit

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. Do not heat the housing or bearing with a propane or acetylene torch.
   b. Secure the shaft so it is ready for bearing installation.
   c. Clean all residue from the bearing surface of the shaft. Remove burrs with a file or sandpaper.
   d. Fill a suitable container with clean mineral oil. Place a thermometer rated above 248° F (120° C) in the oil. Support the thermometer so it does not rest on the bottom or side of the container.
   e. Remove the bearing from its wrapper and secure it with a piece of heavy wire bent to hold it in the container. Hang the bearing so it does not touch the bottom or sides.
   f. Turn the heat on and monitor the thermometer. When the oil temperature rises to approximately 248° F (120° C), remove the bearing 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 tightens on the shaft, so installation must be done quickly. Check that 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:
   a. 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.
   b. Heat the housing to approximately 212° F (100° C) in an oven, or use a heat gun to warm the immediate area around the bearing bore. An easy way to check that it is at 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.

c. Handle the heated housing with insulated gloves or welding gloves. Do not place the housing on burnable surfaces.
d. Hold the housing with the bearing side down and tap the bearing out. Repeat for all bearings in the housing.
e. 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 makes bearing installation easier.
f. 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 43**). Do not install new bearings by driving on the inner bearing race. Install the bearing(s) until it seats completely.

Seal Replacement

Seals (**Figure 47**) contain oil, water, grease or combustion gasses in a housing or shaft. Improper removal 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 shop cloth under the pry tool (**Figure 48**) to prevent damage to the housing.
2. Pack the appropriate grease in the seal lips before the seal is installed.
3. In most cases, install seals with the manufacturer's numbers or marks facing out.
4. Install seals with a socket placed on the outside of the seal as shown in **Figure 49**. Drive the seal squarely into the housing. Drive the seal until it is flush or driven to the specified depth (**Figure 50**). Never install a seal by hitting the top of it with a hammer.

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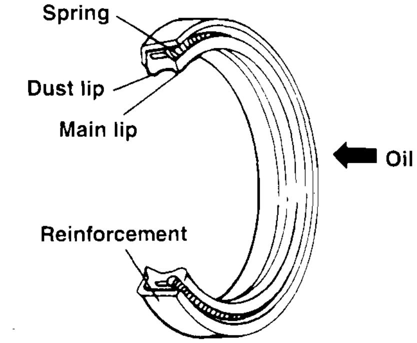

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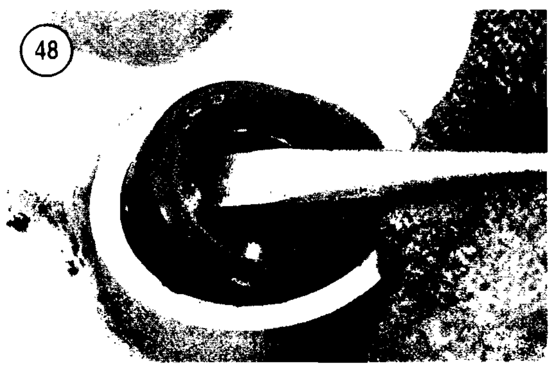

STORAGE

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

Location

When selecting a storage location, consider the following:

1. The area should be dry. A heated area is best, but not necessary. It should be insulated to minimize extreme temperature variation.
2. If the building has large window areas, cover them to keep sunlight off the motorcycle.
3. Avoid locations close to saltwater, corrosive chemicals, high humidity or industrial pollution.
4. Consider the risk of fire, theft or vandalism. Check with an insurer regarding motorcycle coverage while in storage.

Preparation

The amount of preparation a motorcycle should undergo before storage depends on the expected length of non-use, storage area conditions and per-

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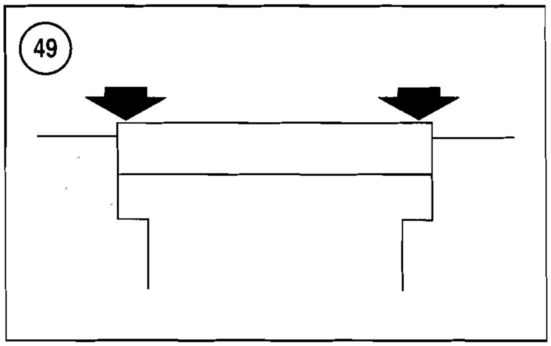

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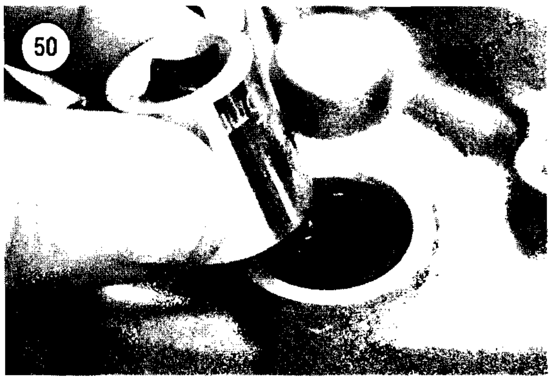


sonal preference. Consider the following list the minimum requirement:

1. Wash the motorcycle. Remove all dirt, mud and road debris.
2. Check the cooling system for proper level and mix ratio.
3. 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.
4. Perform one of the following to prepare the fuel system:
   a. Drain all fuel from the fuel tank, then run the engine until all the fuel is consumed in the carburetor.
   b. Add the appropriate amount of fuel stabilizer to the fuel tank, and then fill the fuel tank completely with fresh gasoline. Run the engine until the treated fuel has circulated to the carburetor. For E models, turn off the fuel valve. For S models, leave the fuel valve on.
5. Remove the spark plug and pour a teaspoon (15-20 ml) of engine oil into the cylinder. Place a shop cloth over the opening and turn the engine over to distribute the oil. Reinstall the spark plug.
6. Remove the battery and store it in a cool, dry location. Charge the battery monthly.
7. Cover the exhaust and intake openings.
8. Apply a commercial protectant to the plastic and rubber components. Follow the manufacturer's instructions for each type of product being used.
9. Inflate the tires to the recommended pressures, then place the motorcycle on a stand or centerstand so the tires are off the ground. To prevent sidewall distortion and a flat spot on the tread, periodically rotate tires that contact the ground.
10. Cover the motorcycle with a drop cloth or similar cover. Avoid the use of plastic covers because these trap moisture and promote corrosion.

Returning the Motorcycle to Service

The amount of service required to return a motorcycle to operating condition depends on the length of non-use and storage conditions. Follow the previous procedure and install/check each area that was prepared at time of storage. Also check that the brakes, clutch, throttle and engine stop switch work properly before operating the motorcycle. Refer to the maintenance and lubrication schedule in Chapter Three to determine which areas require additional service.

Table 1 MODEL CODE NUMBERS

Model and year	Starting frame serial number
E models	
2000 DR-Z400EY	JS1DK433 Y2100001-On
2001 DR-Z400EK1	JS1DK433 12100001-On
2002 DR-Z400EK2	JS1DK433 22100001-On
2003 DR-Z400EK3	JS1DK433 32100001-On

(continued)

Table 1 MODEL CODE NUMBERS (continued)

Model and year	Starting frame serial number
E models (continued)	
2004 DR-Z400EK4	JS1DK433 42100001-On
2005 DR-Z400EK5	JS1DK433 52100001-On
2006 DR-Z400EK6	JS1DK433 62100001-On
S models	
2000 DR-Z400SY	JS1SK43A Y2100001-On
2001 DR-Z400SK1	JS1SK43A 12100001-On
2002 DR-Z400SK2	JS1SK43A 22100001-On
2003 DR-Z400SK3	JS1SK43A 32100001-On
2004 DR-Z400SK4	JS1SK43A 42100001-On
2005 DR-Z400SK5	JS1SK43A 52100001-On
2006 DR-Z400SK6	JS1SK43A 62100001-On
SM models	
2005 DR-Z400SMK5	JS1SK44A 52100001-On
2006 DR-Z400SMK6	JS1SK44A 62100001-On

Table 2 GENERAL DIMENSIONS AND WEIGHT

E models		
Ground clearance	325 mm	12.8 in.
Overall length	2235 mm	88.0 in.
Overall width	825 mm	32.5 in.
Overall height	1245 mm	49.0 in.
Seat height	945 mm	37.2 in.
Wheelbase	1475 mm	58.1 in.
Dry weight	119 kg	262 lb.
S models		
Ground clearance	300 mm	11.8 in.
Overall length	2310 mm	90.9 in.
Overall width	875 mm	34.4 in.
Overall height	1240 mm	48.8 in.
Seat height	935 mm	36.8 in.
Wheelbase	1485 mm	58.5 in.
Dry weight	132 kg	291 lb.
SM models		
Ground clearance	260 mm	10.2 in.
Overall length	2225 mm	87.6 in.
Overall width	870 mm	34.3 in.
Overall height	1185 mm	46.7 in.
Seat height	890 mm	35 in.
Wheelbase	1460 mm	57.5 in.
Dry weight	135 kg	297 lb.

Table 3 CONVERSION FORMULAS

Multiply:	By:	To get the equivalent of:
Length		
Inches	25.4	Millimeter
Inches	2.54	Centimeter
Miles	1.609	Kilometer
Feet	0.3048	Meter

(continued)

Table 3 CONVERSION FORMULAS (continued)

Multiply:	By:	To get the equivalent of:
Length (continued)		
Millimeter	0.03937	Inches
Centimeter	0.3937	Inches
Kilometer	0.6214	Mile
Meter	3.281	Feet
Fluid volume		
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
Torque		
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
Volume		
Cubic inches	16.387064	Cubic centimeters
Cubic centimeters	0.0610237	Cubic inches
Temperature		
Fahrenheit	(°F – 32) × 0.556	Centigrade
Centigrade	(°C × 1.8) + 32	Fahrenheit
Weight		
Ounces	28.3495	Grams
Pounds	0.4535924	Kilograms
Grams	0.035274	Ounces
Kilograms	2.2046224	Pounds
Pressure		
Pounds per square inch	0.070307	Kilograms per square centimeter
Kilograms per square centimeter	14.223343	Pounds per square inch centimeter
Kilopascals	0.1450	Pounds per square inch
Pounds per square inch	6.895	Kilopascals
Speed		
Miles per hour	1.609344	Kilometers per hour
Kilometers per hour	0.6213712	Miles per hour

Table 4 GENERAL TORQUE SPECIFICATIONS

Thread diameter (mm)	N•m	ft.-lb.
Conventional or no. 4 bolts (marked on bolt head)		
4	2	1.5
5	5	3.5
6	6	4.5

(continued)

Table 4 GENERAL TORQUE SPECIFICATIONS (continued)

Thread diameter (mm)	N•m	ft.-lb.
Conventional or no. 4 bolts (marked on bolt head) (continued)		
8	13	9.5
10	29	21
12	45	3
14	65	8
16	105	77
18	160	118.5
No. 7 bolts (marked on bolt head)		
4	2	1.5
5	5	3.5
6	10	7
8	23	16.5
10	50	37
12	85	63
14	135	100
16	210	155
18	240	177

Table 5 TECHNICAL ABBREVIATIONS

A	Ampere
ABDC	After bottom dead center
AC	Alternating current
A•h	Ampere hour
ATDC	After top dead center
BBDC	Before bottom dead center
BDC	Bottom dead center
BTDC	Before top dead center
C	Celsius
cc	Cubic centimeter
CDI	Capacitor discharge ignition
cm	Centimeter
cu. in.	Cubic inch and cubic inches
cyl.	Cylinder
DC	Direct current
F	Fahrenheit
fl. oz.	Fluid ounces
ft.	Foot
ft.-lb.	Foot pounds
gal.	Gallon and gallons
hp	Horsepower
Hz	Hertz
in.	Inch and inches
in.-lb.	Inch-pounds
in. Hg	Inches of mercury
kg	Kilogram
kg/cm^2	Kilogram per square centimeter
kgm	Kilogram meter

(continued)

Table 5 TECHNICAL ABBREVIATIONS (continued)

km	Kilometer
km/h	Kilometer per hour
kPa	Kilopascals
kW	Kilowatt
L	Liter and liters
L/m	Liters per minute
lb.	Pound and pounds
m	Meter
mL	Milliliter
mm	Millimeter
MPa	Megapascal
N	Newton
N• m	Newton meter
oz.	Ounce and ounces
p	Pascal
psi	Pounds per square inch
pt.	Pint and pints
qt.	Quart and quarts
rpm	Revolution per minute
V	Volt
VAC	Alternating current voltage
VDC	Direct current voltage
W	Watt

Table 6 METRIC, DECIMAL AND FRACTIONAL EQUIVALENTS

mm	in.	Nearest fraction	mm	in.	Nearest fraction
1	0.0394	1/32	26	1.0236	1 1/32
2	0.0787	3/32	27	1.0630	1 1/16
3	0.1181	1/8	28	1.1024	1 3/32
4	0.1575	5/32	29	1.1417	1 5/32
5	0.1969	3/16	30	1.1811	1 3/16
6	0.2362	1/4	31	1.2205	1 7/32
7	0.2756	9/32	32	1.2598	1 1/4
8	0.3150	5/16	33	1.2992	1 5/16
9	0.3543	11/32	34	1.3386	1 11/32
10	0.3937	13/32	35	1.3780	1 3/8
11	0.4331	7/16	36	1.4173	1 13/32
12	0.4724	15/32	37	1.4567	1 15/32
13	0.5118	1/2	38	1.4961	1 1/2
14	0.5512	9/16	39	1.5354	1 17/32
15	0.5906	19/32	40	1.5748	1 9/16
16	0.6299	5/8	41	1.6142	1 5/8
17	0.6693	21/32	42	1.6535	1 21/32
18	0.7087	23/32	43	1.6929	1 11/16
19	0.7480	3/4	44	1.7323	1 23/32
20	0.7874	25/32	45	1.7717	1 25/32
21	0.8268	13/16	46	1.8110	1 13/16
22	0.8661	7/8	47	1.8504	1 27/32
23	0.9055	29/32	48	1.8898	1 7/8
24	0.9449	15/16	49	1.9291	1 15/16
25	0.9843	31/32	50	1.9685	1 31/32

Table 7 METRIC TAP AND DRILL SIZES

Metric size	Drill equivalent	Decimal fraction	Nearest fraction
3 × 0.50	No. 39	0.0995	3/32
3 × 0.60	3/32	0.0937	3/32
4 × 0.70	No. 30	0.1285	1/8
4 × 0.75	1/8	0.125	1/8
5 × 0.80	No. 19	0.166	11/64
5 × 0.90	No. 20	0.161	5/32
6 × 1.00	No. 9	0.196	13/64
7 × 1.00	16/64	0.234	15/64
8 × 1.00	J	0.277	9/32
8 × 1.25	17/64	0.265	17/64
9 × 1.00	5/16	0.3125	5/16
9 × 1.25	5/16	0.3125	5/16
10 × 1.25	11/32	0.3437	11/32
10 × 1.50	R	0.339	11/32
11 × 1.50	3/8	0.375	3/8
12 × 1.50	13/32	0.406	13/32
12 × 1.75	13/32	0.406	13/32

CHAPTER TWO

TROUBLESHOOTING

Diagnose problems with the motorcycle by troubleshooting in a logical and methodical manner. The first steps are:

1. Define the symptoms of the problem.
2. Determine which areas could exhibit those symptoms.
3. Test and analyze the suspect area.
4. Isolate the problem.

Always start with the simple and obvious checks when troubleshooting. This includes, engine stop switch operation, fuel level, fuel valve position and spark plug cap tightness. If the problem cannot be solved, stop and evaluate all conditions before the problem began.

For removal, installation and test procedures for some components, refer to the specific chapter in this manual. When applicable, tables at the end of each chapter provide specifications and service limits.

ENGINE OPERATING REQUIREMENTS

Three requirements are needed for an engine to run properly. These are the correct air/fuel mixture, compression and properly timed spark. If one of these requirements is not correct, the engine will not run or will run poorly. A 4-stroke engine performs these functions as shown in **Figure 1**.

ENGINE STARTING

Before starting the engine, always perform a pre-ride check of the motorcycle as described in Chapter Three.

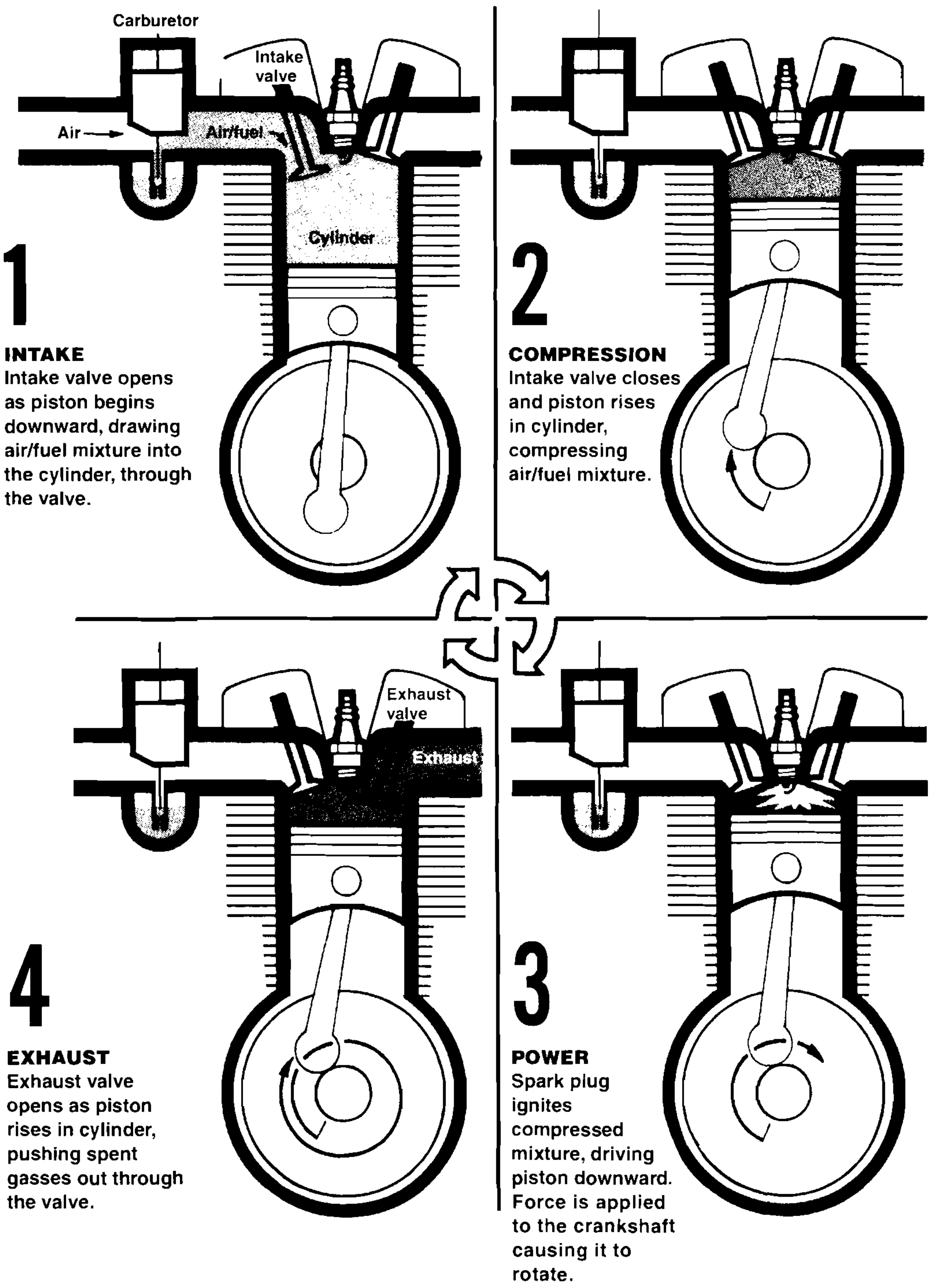
Starting Interlock Switches

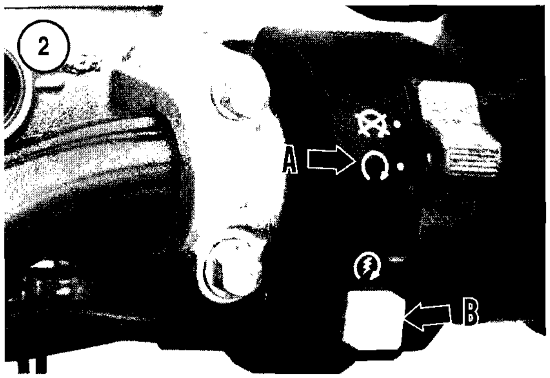
Besides the engine stop switch, the motorcycle is equipped with safety switches that prevent the engine from starting if certain conditions are not met. The following describes what conditions must be met in order to start the engine.

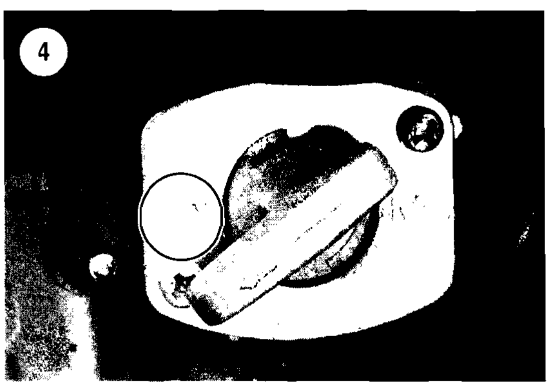
1. On all models, the engine starts if the transmission is in neutral and the clutch is disengaged.
2. On E models, the engine starts if the transmission is in gear and the clutch is disengaged.
3. On S and SM models, the engine starts if the transmission is in gear, if the side stand is up and the clutch is disengaged.

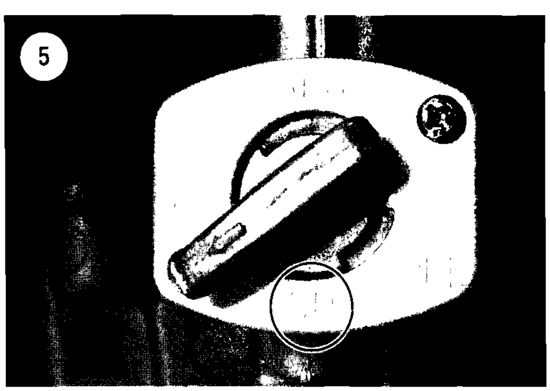
1

FOUR-STROKE ENGINE OPERATING PRINCIPLES









Starting a Cold Engine

The starting procedure varies depending on the carburetor. All S, SM and 2004-on California E models use a Mikuni carburetor. All other E models use a Keihin carburetor.

Mikuni carburetor

1. Shift the transmission into neutral.
2. Check the engine stop switch.
   a. On S and SM models, check that the engine stop switch (A, **Figure 2**) is in the run position.
   b. E models are equipped with an engine stop button (**Figure 3**). The button is always in the run position unless it is pressed.
3. Turn on the fuel valve.
   a. On S and SM models, the fuel valve should always be left on (**Figure 4**). The valve is vacuum-actuated and only passes fuel when the engine is running. Fuel flows freely from the valve if the lever is turned to the prime position. If the carburetor is known to have an empty float chamber, turn the lever to the prime position until the engine is started. Turn the lever on after the engine is running. An arrow on the fuel valve points to the lever position.
   b. On E models, turn the lever from off to on (**Figure 5**). An arrow on the fuel valve points to the lever position.

NOTE
The type of choke system used on the Mikuni carburetor is most effective if the throttle remains completely closed during startup.

4. Fully pull out the choke plunger (**Figure 6**) to richen the air/fuel mixture.
5. Turn on the ignition switch (A, **Figure 7**) and disengage the clutch.
6. On S and SM models, check that the neutral light (B, **Figure 7**) comes on.
7. Press the starter button while keeping the throttle closed.
   a. On S models, the starter button is part of the switch cluster (B, **Figure 2**).
   b. On E models, the starter button is clamped to the handlebar (**Figure 8**).

8. When the engine starts, keep the engine speed at 1800-2000 rpm and gradually push in the choke plunger. The choke should be completely off after 30 seconds. In extremely cold weather, the choke may be required for a longer period. Allow the engine to warm up until it responds smoothly.

Keihin carburetor

1. Shift the transmission into neutral.
2. Turn the fuel valve lever from off to on (**Figure 5**). An arrow on the fuel valve points to the lever position.

> NOTE
> *The type of choke system used on the Keihin carburetor is most effective if the throttle remains completely closed during startup.*

3. Fully pull out the choke plunger (**Figure 9**) to richen the air/fuel mixture.
4. If the temperature is below 0° C (32° F), quickly operate the throttle 3-5 times. This actuates the accelerator pump and richens the air/fuel mixture.
5. Turn on the ignition switch and disengage the clutch.
6. Press the starter button (**Figure 8**) while keeping the throttle closed.
7. When the engine starts, keep the engine speed at 1800-2000 rpm and gradually push in the choke plunger. If the temperature is above 25° C (77° F), push the choke plunger in immediately. In extremely cold weather, the choke may be required for a longer period. Allow the engine to warm up until it responds smoothly.

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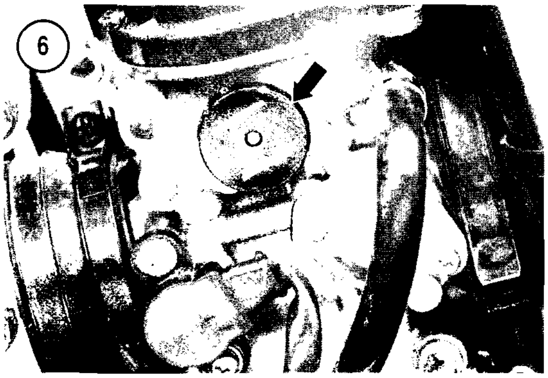

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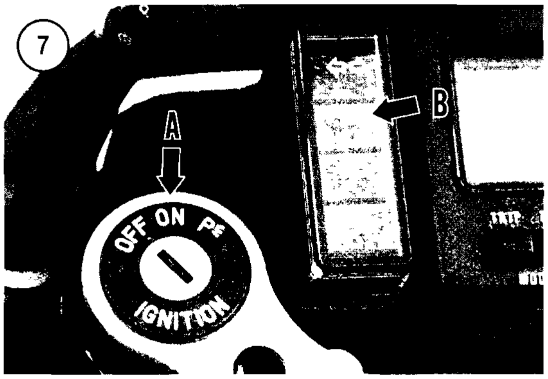

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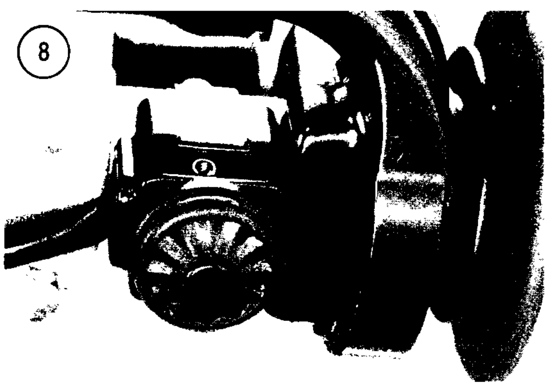

Starting a Warm or Hot Engine

The starting procedure varies depending on the carburetor. All S, SM and 2004-on California E models use a Mikuni carburetor. All other E models use a Keihin carburetor.

Mikuni carburetor

1. Shift the transmission into neutral.
2. Check the engine stop switch.
   a. On S and SM models, check that the engine stop switch (A, **Figure 2**) is in the run position.
   b. E models are equipped with an engine stop button (**Figure 3**). The button is always in the run position unless it is pressed.
3. Turn on the fuel valve.
   a. On S and SM models, the fuel valve should always be left on (**Figure 4**). The valve is vacuum-actuated and only passes fuel when the engine is running. An arrow on the fuel valve points to the lever position.
   b. On E models, turn the lever from off to on (**Figure 5**). An arrow on the fuel valve points to the lever position.

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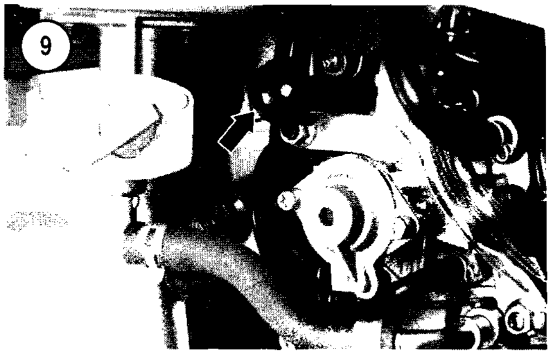

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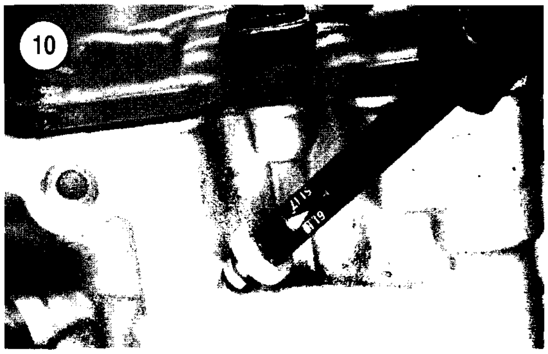


4. Turn on the ignition switch (A, **Figure 7**) and disengage the clutch.
5. On S and SM models, check that the neutral light (B, **Figure 7**) comes on.
6. Press the starter button while keeping the throttle closed.
   a. On S and SM models, the starter button is part of the switch cluster (B, **Figure 2**).
   b. On E models, the starter button is clamped to the handlebar (**Figure 8**).

Keihin carburetor

1. Shift the transmission into neutral.
2. Turn the fuel valve lever from off to on (**Figure 5**). An arrow on the fuel valve points to the lever position.
3. Turn on the ignition switch and disengage the clutch.
4. Press the starter button (**Figure 8**) while keeping the throttle closed.

Starting a Flooded Engine

If the engine fails to start after several tries (particularly if the choke has been used), it is probably flooded. This occurs when too much fuel is drawn into the engine and the spark plug fails to ignite the air/fuel mixture. The smell of gasoline is often evident when the engine is flooded. If there are no obvious signs of fuel overflow from the carburetor, start the engine by fully opening the throttle (no choke) and operating the starter. For E models equipped with a Keihin carburetor, do not twist the throttle repeatedly. This actuates the accelerator pump and compounds the flooded condition. If the engine starts, keep the engine running at a fast idle until it has burned the excess fuel from the engine.

If the engine does not start, perform the following troubleshooting steps before making other checks:

1. Make sure the choke plunger is fully pushed in.
2. Look for gasoline overflowing from the carburetor or overflow hose. If gasoline is evident, the float in the carburetor bowl is stuck or adjusted too high. Remove and repair the float assembly as described in Chapter Eight.
3. Check the air filter for excessive debris buildup.
4. Remove the spark plug and dry the electrodes. Reinstall the plug and start the engine as described in this chapter.
5. Perform the *Engine Spark Test*.

ENGINE SPARK TEST

CAUTION

*When performing a spark test, the spark plug tester must be grounded before cranking the engine. If it is not, it is possible to damage the CDI circuitry. Do not ground the plug/tester on the alloy cylinder head cover. A spark plug can be used for this test, but a spark tester (**Figure 10**) clearly shows if spark is occurring, as well as the strength of the spark.*

An engine spark test indicates whether the ignition system is providing current to the spark plug. It is a quick way to determine if a problem is in the electrical system or fuel system.

1. Remove the spark plug. Inspect the spark plug by comparing its condition to the plugs shown in Chapter Three.
2. Connect the spark plug lead to the spark plug or a spark tester.

3. Ground the plug/tester to bare metal on the engine (**Figure 11**). Position the plug/tester so the firing end can be viewed.
4. Crank the engine and observe the spark. A fat, blue spark should appear at the firing end. The spark should fire consistently as the engine is cranked.
5. If the spark appears weak or fires inconsistently, check the following areas for the possible cause:
   a. Battery voltage too low.
   b. Fouled/improperly gapped spark plug.
   c. Damaged/shorted spark plug lead and cap.
   d. Loose connection in ignition system.
   e. Damaged coil.
   f. Damaged ignition switch.
   g. Dirty/shorted engine stop switch or safety interlock switch.
   h. Damaged signal coil or pickup coil.
   i. Damaged CDI unit.
6. Refer to Chapter Nine for specific electrical system test procedures.

STARTING SYSTEM

Starter Does Not Operate

If the starter does not operate after making the following checks, refer to Chapter Nine for testing the individual starting system components.

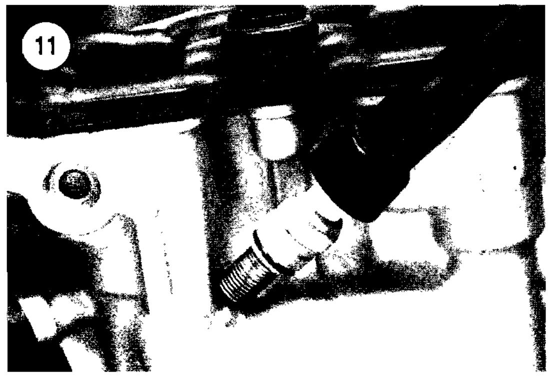
1. Make sure the engine stop switch is on (S models).
2. Make sure the clutch lever is fully pulled in.
3. Make sure the sidestand is down with the transmission in gear (S models).
4. Check for a blown fuse.
5. Check for a weak or discharged battery.

Starter Turns Slowly

1. Weak battery.
2. Poorly connected/corroded battery terminals and cables.
3. Loose starter cable.
4. Worn or damaged starter.

Starter Turns, But Does Not Crank Engine

1. Worn or damaged starter clutch.
2. Damaged starter shaft or starter idle gears.



ENGINE PERFORMANCE

If the engine does not operate at peak performance, the following possible causes may help isolate the problem.

For additional information, refer to Chapter Eight (fuel system) and Chapter Nine (electrical system).

Engine Will not Start or Starts and Dies

Fuel system

1. Fuel valve off or clogged vent hose (E models).
2. Loose or leaking vacuum hose on fuel valve (S models).
3. Fuel tank near empty.
4. Improper choke operation or choke stuck open.
5. Idle speed too low.
6. Engine flooded.
7. Contaminated fuel.
8. Clogged fuel valve, fuel line or carburetor.
9. Clogged air filter.
10. Pilot mixture screw misadjusted.
11. Float valve clogged or sticking.
12. Improper float adjustment.
13. Intake system air leaks.

Ignition system

1. Weak battery.
2. Loose/fouled/improperly gapped spark plug.
3. Damaged/shorted spark plug lead and cap.
4. Loose connection in ignition system.
5. Damaged coil.
6. Damaged ignition switch.
7. Dirty/shorted engine stop switch.
8. Damaged signal coil or ignition pickup coil.
9. Damaged CDI unit.

Engine

1. Compression release malfunctioning.
2. No valve clearance.
3. Leaking cylinder head gasket.
4. Stuck/seized valve.
5. Worn piston and/or cylinder.

Poor Idle and Low Speed Performance

Fuel system

1. Fuel valve off or clogged vent hose (E models).
2. Loose or leaking vacuum hose on fuel valve (S models).
3. Improper choke operation or choke stuck open.
4. Idle speed too low.
5. Engine flooded.
6. Contaminated fuel.
7. Clogged fuel valve, fuel line or carburetor.
8. Clogged air filter.
9. Improper pilot mixture screw adjustment.
10. Float valve clogged or sticking.
11. Improper float adjustment.
12. Intake system air leaks.
13. Loose carburetor diaphragm cover (Mikuni carburetor).
14. Torn or damaged slide diaphragm (Mikuni carburetor).
15. Dragging carburetor slide.
16. Clogged muffler.

Ignition system

1. Loose/fouled/improperly gapped spark plug.
2. Damaged/shorted spark plug lead and cap.
3. Loose connection in ignition system.
4. Damaged coil.
5. Damaged ignition switch.
6. Dirty/shorted engine stop switch.
7. Damaged signal coil or ignition pickup coil.
8. Damaged CDI unit.

Engine

1. Compression release malfunctioning.
2. Improper valve clearance.
3. Leaking cylinder head gasket.
4. Low compression.
5. Improper valve/camshaft timing.

Engine Lacks Power and Acceleration

Fuel system

1. Improper choke operation or choke stuck open.
2. Contaminated fuel.
3. Clogged fuel valve, fuel line or carburetor jets.
4. Clogged air filter.
5. Float valve clogged or sticking.
6. Improper float adjustment.
7. Intake system air leaks.
8. Loose carburetor diaphragm cover (Mikuni carburetor).
9. Torn or damaged slide diaphragm (Mikuni carburetor).
10. Dragging carburetor slide.
11. Main jet or needle jet clogged.
12. Clogged muffler.

Ignition system

1. Loose/fouled/improperly gapped spark plug.
2. Damaged/shorted spark plug lead and cap.
3. Loose connection in ignition system.
4. Damaged coil.
5. Damaged ignition switch.
6. Dirty/shorted engine stop switch.
7. Damaged signal coil or ignition pickup coil.
8. Damaged CDI unit.

Engine

1. Compression release malfunctioning.
2. Improper valve clearance.
3. Low compression.
4. Improper valve/camshaft timing.
5. Excessive amount of oil in engine.

Brakes and wheels

1. Brake pads dragging on brake disc.
2. Worn/seized wheel bearings.
3. Drive chain too tight.

Clutch

1. Clutch incorrectly adjusted.
2. Weak clutch springs.
3. Worn clutch plates and discs.

Poor High Speed Performance

Fuel system

1. Improper choke operation or choke stuck open.
2. Contaminated fuel.
3. Clogged fuel valve, fuel line or carburetor jets.
4. Clogged air filter.
5. Float valve clogged or sticking.
6. Improper float adjustment.
7. Intake system air leaks.
8. Loose carburetor diaphragm cover (Mikuni carburetor).
9. Torn or damaged slide diaphragm (Mikuni carburetor).
10. Dragging carburetor slide.
11. Main jet or needle jet clogged.
12. Worn needle and jet.
13. Clogged muffler.

Ignition system

1. Damaged signal coil or ignition pickup coil.
2. Damaged CDI unit.

Engine

1. Weak/broken valve spring(s).
2. Improper valve clearance.
3. Low compression.
4. Improper valve/camshaft timing.
5. Excessive amount of oil in engine.

Engine Backfires

1. Pilot mixture screw adjusted too lean.
2. Air leaks into exhaust system.
3. Inoperative air cutoff valve (backfiring during deceleration).
4. Damaged signal coil or ignition pickup coil.

Engine Overheating

CAUTION

Engine overheating can occur when the motorcycle is operated at slow speed at high rpm. This can occur in off-road riding conditions. Even though the fan (S models) turns on, the engine can overheat. When this occurs, stop and allow the engine to cool. If overheating continues after the bike is ridden at moderate speeds and lower rpm, check the motorcycle and determine the cause of overheating.

Cooling system

1. Coolant level low.
2. Water in system: no coolant mix.
3. Air in system.
4. Radiator(s) clogged.
5. Radiator cap damaged.
6. Water pump impeller loose.
7. Water pump impeller damaged.
8. Thermostat damaged (S models).
9. Fan sending unit faulty (S models).
10. Fan shaft seized (S models).
11. Water temperature sending unit faulty (S models).
12. Water temperature warning light faulty (S models).

Engine

1. Excessive idling.
2. Insufficient oil level or viscosity.
3. Incorrect spark plug heat range.
4. Clogged crankcase oil strainer or oil filter.
5. Damaged oil pump.
6. Excessive carbon buildup on piston/cylinder head.

Fuel system (lean fuel mixture)

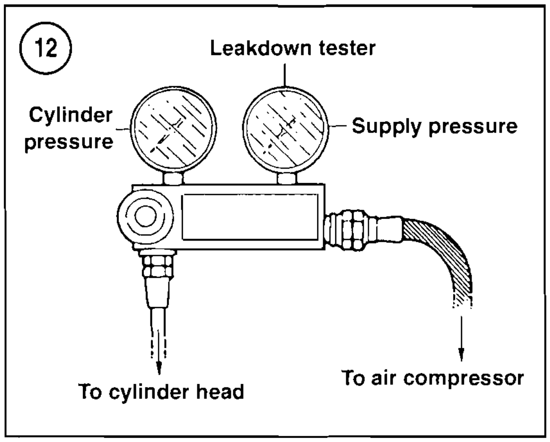
1. Intake system air leaks.
2. Wrong pilot or main jet for altitude.
3. Clogged carburetor jets.
4. Float level too low.

Ignition

1. Improper spark plug heat range.
2. Damaged signal coil or ignition pickup coil.

ENGINE NOISE

Noise is often the first indicator that something is wrong with the engine. In many cases, damage can be avoided or minimized if the rider immediately



stops the motorcycle and diagnoses the source of the noise. Anytime engine noise is ignored, even when the motorcycle seems to be running correctly, the rider risks causing more damage and injury.

Pinging During Acceleration

1. Poor quality or contaminated fuel.
2. Lean fuel mixture.
3. Excessive carbon buildup in combustion chamber.
4. Damaged signal coil or ignition pickup coil.

Knocks, Ticks or Rattles

Engine top end

1. Incorrect valve clearance.
2. Broken or weak valve spring.
3. Damaged compression release.
4. Loose cam chain/damaged tensioner.
5. Worn piston pin or piston pin bore.
6. Worn connecting rod small end.
7. Worn piston, rings and/or cylinder.

Engine bottom end

1. Worn or loose clutch components.
2. Worn connecting rod bearing.
3. Worn crankshaft bearings.
4. Worn balancer bearings.
5. Worn transmission bearings.
6. Worn or damaged transmission gears.

MOTORCYCLE NOISE

The following noises will likely occur only when the motorcycle is in motion:

1. Excessively loose drive chain.
2. Worn chain sliders.
3. Loose exhaust system.
4. Loose/missing body fasteners.
5. Loose skid plate.
6. Loose shock absorber.
7. Loose engine mounting bolts.
8. Brake pads dragging on brake disc.
9. Worn/seized wheel bearings.

ENGINE LEAKDOWN TEST

The condition of the piston rings and valves can accurately be checked with a leakdown tester. With all valves closed, the tester is screwed into the spark plug hole and air pressure is applied to the combustion chamber. The gauge on the tester is then observed to determine the leak rate from the combustion chamber. An air compressor is required to use a leakdown tester (**Figure 12**).

1. Start the engine and allow it to warm up.
2. Shut the engine off and remove the carburetor and exhaust pipe.
3. Remove the spark plug.
4. Set the piston to TDC on the compression stroke.
5. Install the leakdown tester following the manufacturer's instructions. The tester must not leak around the spark plug threads.
6. Follow the manufacturer's instructions for performing the test. When pressure is applied to the cylinder, make sure the engine remains at TDC. If necessary, put the transmission in gear.
7. While the cylinder is under pressure, listen for air leaks at the following areas:
   a. Exhaust port. If leaks are detected, the exhaust valves are leaking.
   b. Intake port. If leaks are detected, the intake valves are leaking.
   c. Crankcase breather. If leaks are detected, the piston rings are leaking.
8. A cylinder with a leakdown of 5 percent or less is ideal. A cylinder with more than 10 percent leakage should be inspected to determine if the leaks are caused by normal wear or damage. Inspection of the parts will then indicate what action should be taken.

CLUTCH

The two main clutch problems are clutch slip (clutch does not fully engage) and clutch drag (clutch does not fully disengage). These problems are often caused by incorrect clutch adjustment or a damaged/unlubricated cable. Perform the following checks before removing the clutch cover to troubleshoot the clutch:

1. Check the clutch cable routing from the handlebar to the engine. Check that the cable does not bind when the handlebar is turned lock to lock, and that the cable ends are installed correctly.
2. With the engine off, pull and release the clutch lever. If the lever is difficult to pull or the action is rough, check for the following:
   a. Damaged/kinked cable.
   b. Incorrect cable routing.
   c. Cable not lubricated.
   d. Worn/unlubricated lever at the handlebar.
   e. Damaged release lever at the engine.
3. If no damage was detected in the previous steps and the lever moves without excessive roughness or binding, check the clutch adjustment as described in Chapter Three. Note the following:
   a. If the clutch cannot be adjusted to the specifications in Chapter Three, the clutch cable is stretched or damaged.
   b. If the clutch cable is in good condition and adjustment, the clutch plates may be worn or warped.

Clutch Slip

When the clutch slips, engine acceleration is not proportional to the the actual forward speed. When continuous slipping occurs between the clutch plates, excessive heat quickly builds up in the assembly. This causes plate wear, warp and spring fatigue. One or more of the following can cause the clutch to slip:

1. Incorrect clutch adjustment.
2. Weak or damaged clutch springs.
3. Loose clutch springs.
4. Worn friction plates.
5. Warped steel plates.
6. Worn/damaged release lever assembly.
7. Damaged pressure plate.
8. Clutch housing and hub unevenly worn.
9. Incorrect oil viscosity.
10. Oil additives.
11. Incorrectly assembled clutch.

Clutch Drag

When the clutch drags, the plates are not completely separating. This causes the motorcycle to creep or lurch forward when the transmission is put into gear. Once underway, shifting is difficult. If this condition is not corrected, it can cause transmission gear and shift fork damage due to the abnormal grinding and impacts on the parts. One or more of the following can cause the clutch to drag:

1. Worn/damaged release lever assembly.
2. Warped steel plates.
3. Swollen friction plates.
4. Warped pressure plate.
5. Incorrect clutch spring tension.
6. Uneven wear on clutch housing grooves or clutch hub splines.
7. Incorrect viscosity oil.
8. Oil additives.
9. Incorrectly assembled clutch.

Clutch Noise

Clutch noise is usually caused by worn or damaged parts, and is more noticeable at idle or low engine speeds. Clutch noise can be caused by the following conditions:

1. Wear in the clutch lifter bearing and/or lifter.
2. Excessive axial play in the clutch housing.
3. Loose damper on back of clutch housing.
4. Worn input shaft splines.
5. Excessive friction plate-to-clutch housing clearance.
6. Excessive steel plate-to-clutch hub clearance.
7. Excessive wear between the clutch housing and primary drive gear.
8. Worn or damaged clutch housing and primary drive gear teeth.

SHIFT MECHANISM AND TRANSMISSION

Transmission problems are often difficult to distinguish from problems with the clutch and gear shift linkage. Often, the problem is symptomatic of one area, while the actual problem is in another area. For example, if the gears grind during shifting, the problem may be caused by a dragging clutch or a component of the shift linkage, not a damaged transmission. Of course, if the damaged part is not repaired, the transmission eventually becomes damaged, too. Therefore, evaluate all of the variables that exist when the problem occurs, and always start with the easiest checks before disassembling the engine.

When the transmission exhibits abnormal noise or operation, drain the engine oil and check it for contamination. Examine a small quantity of oil under bright light. If a metallic cast or pieces of metal are seen, excessive wear and/or part failure is occurring.

Difficult Shifting

Clutch

1. Improper clutch operation.
2. Incorrect clutch adjustment.
3. Incorrect oil viscosity.

External gearshift assembly

1. Loose/stripped shift lever.
2. Bent/damaged shift shaft.
3. Damaged shift shaft return spring or loose spring post.
4. Damaged/worn shift mechanism.

Shift drum and shift forks

1. Worn shift drum grooves and guide pins.
2. Worn/bent shift forks.
3. Worn shift drum bearings.

Gears Do Not Stay Engaged

External gearshift assembly

1. Bent/damaged shift shaft.
2. Damaged/worn shift mechanism.

Shift drum and shift forks

1. Worn shift drum grooves and guide pins.
2. Worn/bent shift forks.
3. Worn shift drum bearings.

Transmission

1. Worn gear dogs and mating recesses.
2. Worn gear grooves for shift forks.
3. Worn/damaged shaft snap rings, washers or bushings.

BRAKES

The brake system is critical to riding performance and safety. Inspect the brakes frequently and replace worn or damaged parts immediately. The brake system used on this motorcycle uses DOT 4 brake fluid in both brakes. Always use new fluid, from a sealed and closed container. Refer to **Figure 13** to troubleshoot brake problems.

When checking brake pad wear, check that the pads in each caliper squarely contact the disc. Uneven pad wear on one side of the disc can indicate a warped or bent disc, damaged caliper or pad pins.

STEERING AND HANDLING

Correct poor steering and handling immediately. Check the following areas:

Excessive Handlebar Vibration

1. Incorrect tire pressure.
2. Unbalanced tire and rim.
3. Loose/broken spokes.
4. Damaged rim.
5. Incorrect oil level in fork legs.
6. Loose or damaged handlebar clamps.
7. Loose steering stem nut.
8. Worn or damaged front wheel bearings.
9. Bent or loose axle.
10. Cracked frame or steering head.

Handlebar Is Difficult To Turn

1. Tire pressure too low.
2. Incorrect cable routing.
3. Steering stem adjustment too tight.
4. Bent steering stem.
5. Improperly lubricated or damaged steering bearings.

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BRAKE TROUBLESHOOTING

Brake fluid leaks

- Loose or damaged line fittings
- Worn caliper piston seals
- Scored caliper piston or bore
- Loose banjo bolts
- Damaged oil line washers
- Leaking master cylinder diaphragm
- Leaking master cylinder secondary seal
- Cracked master cylinder housing
- Brake fluid level too high
- Loose or damaged master cylinder

Brake overheating

- Warped brake disc
- Incorrect brake fluid
- Caliper piston and/or brake pads hanging up
- Riding brakes during riding

Brake chatter

- Warped brake disc
- Incorrect caliper alignment
- Loose caliper mounting bolts
- Loose front axle nut and/or clamps
- Worn wheel bearings
- Damaged hub
- Restricted brake hydraulic line
- Contaminated brake pads

Brake locking

- Incorrect brake fluid
- Plugged passages in master cylinder
- Caliper piston and/or brake pads hanging up
- Warped brake disc

Insufficient brakes

- Air in brake lines
- Worn brake pads
- Low brake fluid
- Incorrect brake fluid
- Worn brake disc
- Worn caliper piston seals
- Glazed brake pads
- Leaking primary cup seal in master cylinder
- Contaminated brake pads and/or disc

Brake squeal

- Contaminated brake pads and/or disc
- Dust or dirt collected behind brake pads
- Loose parts

Handlebar Pulls To One Side

1. Bent fork leg.
2. Fork oil levels uneven.
3. Bent steering stem.
4. Bent frame or swing arm.

Front Suspension Too Soft

1. Low tire pressure.
2. Low fork oil level.
3. Weak fork springs.
4. Improper fork settings.

Front Suspension Too Hard

1. Air pressure in fork.
2. High tire pressure.
3. High fork oil level.
4. Fork oil viscosity too high.
5. Improper fork settings.
6. Bent fork.

Rear Suspension Too Soft

1. Low tire pressure.
2. Weak shock absorber spring.
3. Leaking shock absorber.
4. Improper shock absorber settings.

Rear Suspension Too Hard

1. High tire pressure.
2. Bent shock absorber shaft.
3. Damaged rear suspension bearings/pivots.
4. Improper shock absorber settings.

CHAPTER THREE

LUBRICATION, MAINTENANCE AND TUNE-UP

This chapter provides procedures for lubricating, fueling and adjusting the motorcycle. Refer to **Table 1** (S and SM models) or **Table 2** (E models) for the recommended service intervals and those components that require inspection, lubrication or adjustment.

Refer to **Tables 3-6** at the end of this chapter for specifications.

Refer to Chapter One for shop safety, basic tools and general service information.

FUEL TYPE

On S and SM models, use unleaded pump-grade gasoline with an octane rating of 87 (R + M/2) or 91 RON (Research Octane Number).

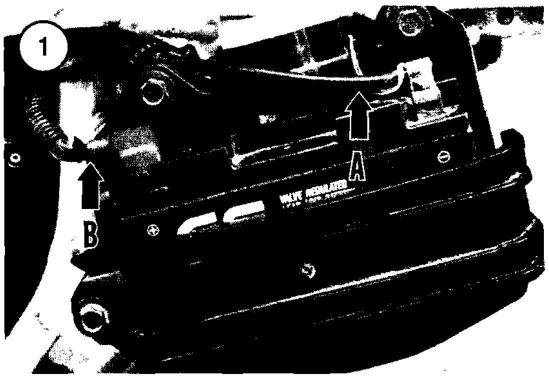
On E models, use unleaded pump-grade gasoline with an octane rating of 90 (R + M/2) or 95 RON (Research Octane Number).

Gasoline containing no more than 10 percent ethanol or 5 percent methanol can be used in either model.

PRE-RIDE INSPECTION

Perform the following inspections before riding the motorcycle. When riding the motorcycle on extended travel and over rough terrain, perform the inspection at least once daily. Perform the inspection when the engine is *cold.*

1. Inspect fuel lines and fittings for leaks.
2. Inspect fuel level.
3. Inspect engine oil level.
4. Inspect coolant level.
5. Inspect brake operation and lever/pedal free play.
6. Inspect throttle operation and free play.
7. Inspect clutch operation and free play.
8. Inspect for air pressure in the fork legs (if fitted with air release valves).
9. Inspect steering for smooth operation and no cable binding.
10. Inspect tire condition and air pressure.
11. Inspect wheel condition and spoke tightness.
12. Inspect axle nut tightness.
13. Inspect for loose fasteners.
14. Inspect exhaust system.
15. Inspect drive chain condition and adjustment.
16. Inspect the rear sprocket for tightness.
17. Inspect the air filter for dirt/debris buildup.
18. Inspect the suspension for proper settings for riding conditions.
19. Inspect the engine stop switch for proper operation.



20. Inspect the lights for proper operation.

ENGINE BREAK-IN

If the engine is new, or if the bearings, crankshaft, piston, piston rings or cylinder have been serviced, perform the following break-in procedure. Refer to the following when breaking in the engine:

1. Install a new spark plug.
2. Clean and oil the air filter.
3. Fill the engine with the proper amount and grade of engine oil.
4. Fill the cooling system.
5. Start the engine and allow it to warm up. Do not race the engine while it is warming up. During this time, check for proper idle speed and leaks.
6. On S and SM models:
   a. For the first 800 km (500 miles) do not operate the motorcycle over 1/2 throttle. At the end of the 800 km period, perform the maintenance procedures in **Table 1**.
   b. For the next 800 km (500 miles) do not operate the motorcycle over 3/4 throttle.
7. On E models:
   a. For the first 5 hours do not operate the motorcycle over 1/2 throttle. At the end of the 5-hour period, perform the maintenance procedures in **Table 2**.
   b. For the next 5 hours, do not operate the motorcycle over 1/2 throttle.
   c. For the last 5 hours, do not operate the motorcycle over 3/4 throttle.
8. During the break-in period, note the following:
   a. Do not run in sand, mud or up steep hills. This overloads and possibly overheats the engine.
   b. Do not run the engine at the same speed for extended periods.
   c. Do not lug the engine. Keep the engine speed high enough to prevent excessive loading of the engine.

SERVICE INTERVALS

The service intervals in **Table 1** and **Table 2** are based on typical motorcycle in moderate riding conditions. If the motorcycle is regularly operated in extreme weather conditions, or subjected to water, dirt or sand, perform the service procedures more frequently.

Record each service performed in the maintenance log at the end of the manual.

BATTERY

The motorcycle is equipped with a 12-volt, 6 or 6.5 amp-hour maintenance-free battery. If the motorcycle has not been used for at least two weeks, charge the battery to prevent sulfation of the battery plates.

Inspect the battery at the interval in **Table 1** or **Table 2**.

If necessary, refer to *Charging System* in Chapter Nine for additional battery and charging system tests.

Removal and Installation

1. Check that the ignition switch is off.
2. Remove the left side covers (Chapter Fifteen).
3. Disconnect the negative battery cable (A, **Figure 1**). Do not allow the loose cable to touch the frame or other metal part of the motorcycle.
4. Remove the insulator cover from the positive cable, then remove the cable from the battery (B, **Figure 1**).
5. Remove the battery holder and battery.
6. Clean and check the components for damage.
7. Reverse this procedure to install the battery. Note the following:
   a. Make sure the battery terminals face out.
   b. To prevent corrosion, apply a thin coat of dielectric grease to the battery terminals and cable ends.
   c. Install the positive cable first.
   d. Tighten the cables firmly. Do not apply excessive force.

Voltage Test

Check the unloaded voltage using a voltmeter. An unloaded test indicates the basic state of charge. If necessary, refer to Chapter Nine to perform a battery load test.

1. Disconnect the battery cables and do not disturb the battery for at least 4 hours.
2. Connect a voltmeter to the negative and positive terminals (**Figure 2**).
3. Measure the voltage.
   a. A fully charged battery has a charge of 12.8-13 volts.
   b. A battery that is approximately 75 percent charged has a minimum of 12.5 volts.
   c. A battery that is approximately 50 percent charged has a minimum of 12.0 volts.

Charging

CAUTION
To prevent possible electrical system damage, always remove the cables from the battery before charging the battery.

When recharging the battery, do not use a fixed-rate charger rated higher than 0.7 amps. Chargers that automatically determine the required output can be used. Do not use an automotive-type charger. The charge rates are too high and overheat the battery and damage the plates.

1. Remove the battery from the motorcycle as described in this section.
2. Connect the positive and negative leads of the charger to the positive and negative terminals on the battery.
3. Set the charger to 12 volts. Using a 0.7 amp constant-current charger, the suggested charge rates for a maintenance-free battery are:
   a. 75 percent charge: 3-6 hours.
   b. 50 percent charge: 5-10 hours
4. Turn on the charger and allow the battery to charge for the specified time.
5. After the battery is charged, turn off the charger and remove the leads from the terminals.
6. Check battery voltage as described in this section. If the battery voltage does not remain stable for at least 1 hour or continues to be undercharged, then replace the battery.

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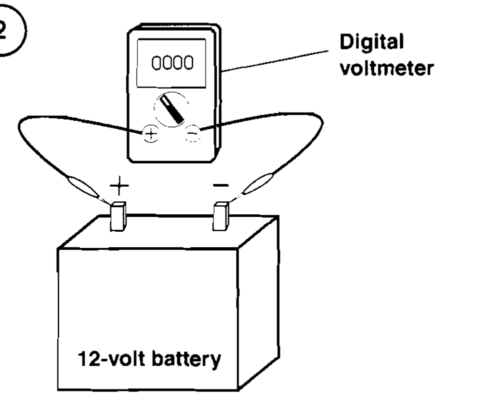

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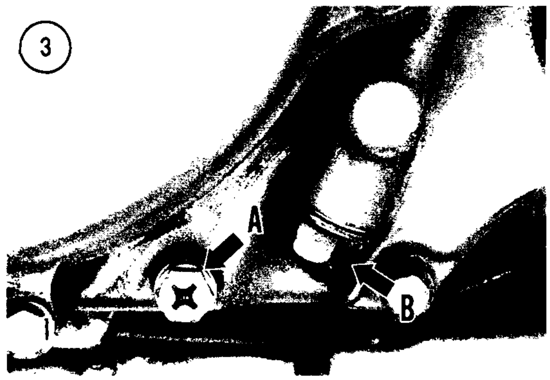

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PERIODIC LUBRICATION

Perform the following at the intervals in **Table 1** or **Table 2**.

Engine Oil Level Check

CAUTION
If the engine has not been run for at least a week, the engine oil may have

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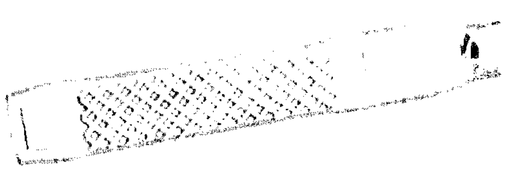

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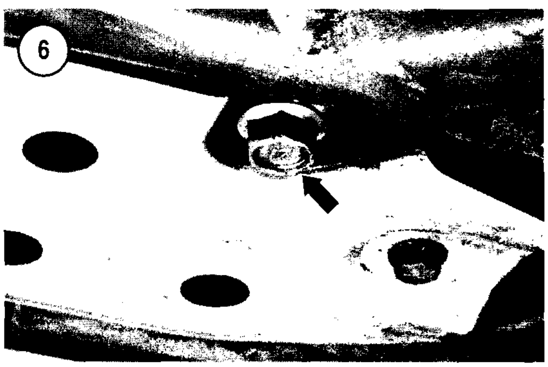

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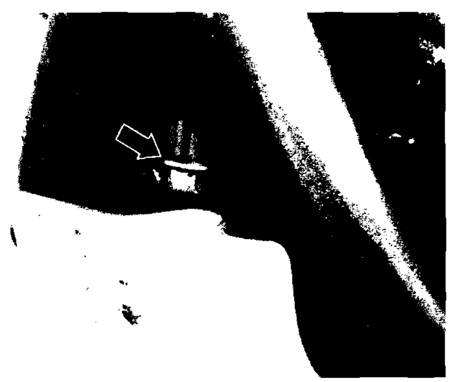


*drained into the crankcase. If the oil level is checked before starting the engine, an extremely low oil level may be indicated on the dipstick. To ensure that there is oil in the engine, remove the oil level check bolt (A, **Figure 3**), located on the right side of the engine. If oil drains from the hole, install the check bolt, then proceed to warm up the engine and check the oil level. If oil does not drain from the hole, the engine is low on oil. Add 1.5 liters (1.6 qt.) of oil, then proceed to warm up the engine and check the oil level.*

Replenish and check the oil level at the dipstick (**Figure 4**), located in the oil tank. The oil tank is integral to the frame and the dipstick is located in front of the fuel tank. Check the oil after the engine has been warmed up, then allowed to stand for a few minutes.

1. Park the motorcycle on level ground.
2. Remove the dipstick from the oil tank, and then wipe the dipstick clean.
3. Keep the motorcycle level and insert the dipstick into the oil tank. *Do not* screw the dipstick into the tank.
4. Remove the dipstick and check the oil level. The oil level should be between the low and full level marks (**Figure 5**). Preferably, keep the oil level near the full mark.
5. If the oil level is low, add the appropriate grade of oil (**Table 3**) to bring the level to the full mark. Add oil in small quantities and check the level often. Do not overfill the oil tank.
6. Screw the dipstick into place. If oil is leaking around the top of the oil tank, replace the O-ring on the dipstick.

Engine Oil and Filter Change

WARNING

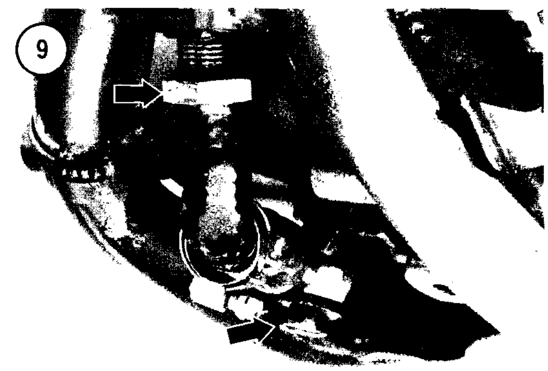
Prolonged contact with engine oil may cause skin cancer. Minimize contact with the engine oil.

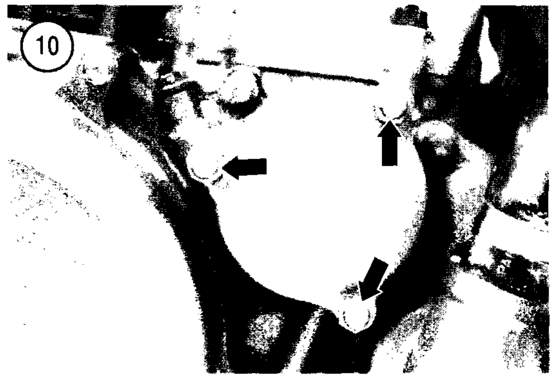
Always change the oil when the engine is warm. Contaminants remains suspended in the oil and it drains more completely and quickly.

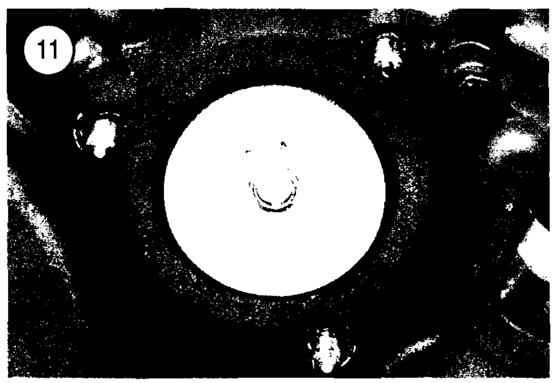
1. Support the motorcycle so it is level and secure.
2. Wipe the area around the dipstick (**Figure 4**), and then remove it from the oil tank.
3. Place a drain pan(s) below the engine drain plug (**Figure 6**) and frame drain plug (**Figure 7**). Remove the plugs and allow the oil to drain from the engine.

NOTE

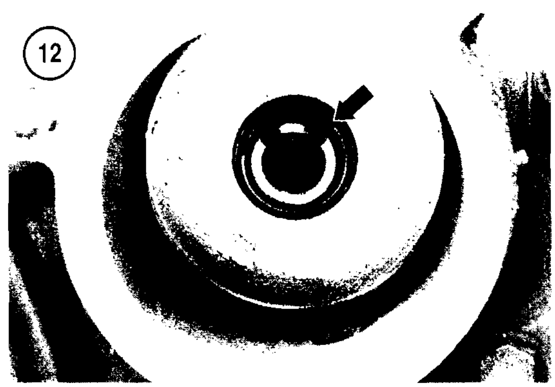
*A screen filter is located in the frame, next to the frame drain plug (**Figure 8**). Although not designated by the manufacturer, this filter should occasionally be removed, cleaned and inspected. Remove the skid plate to access the filter. Loosen the hose clamp, and then remove the filter and hose assembly at both ends (**Figure 9**).*

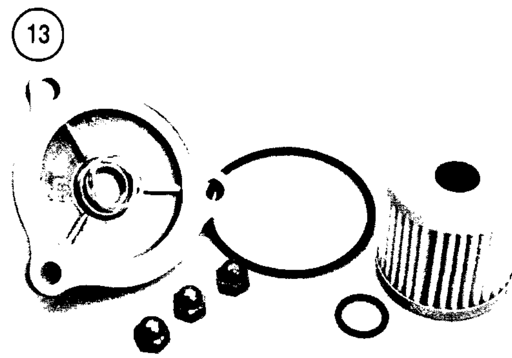






4. Remove the nuts from the oil filter cover (**Figure 10**). Before removing the cover, place a small container below the cover to catch the oil that drains from the housing.
5. Remove the filter (**Figure 11**) and the O-ring at the back of the housing (**Figure 12**).
6. Clean and inspect the filter housing and parts (**Figure 13**).
   a. Clean the magnetic drain plug (**Figure 14**).
   b. Install new seal washers on the drain plugs. Install the washers with the tapered sides facing down (**Figure 15**).
   c. Install a new, lubricated O-ring on the filter mount (**Figure 12**) and filter cover.
   d. If leaks are evident around the dipstick, replace the O-ring on the dipstick (**Figure 16**).
   e. If removed, inspect the screen filter and oil hose assembly (**Figure 17**). Install new seal washers on the filter and banjo bolt.
   f. Clean all dirt and oil from around the frame and crankcase openings.
7. If removed, install the strainer and oil hose assembly. Tighten the strainer and banjo bolt to 23 N•m (17 ft.-lb.).





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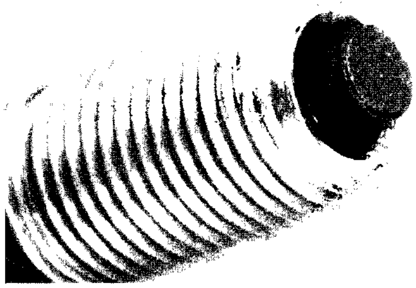

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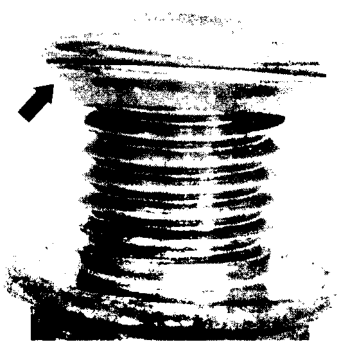

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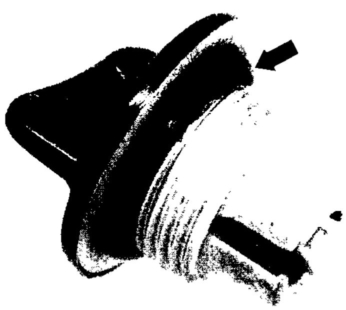

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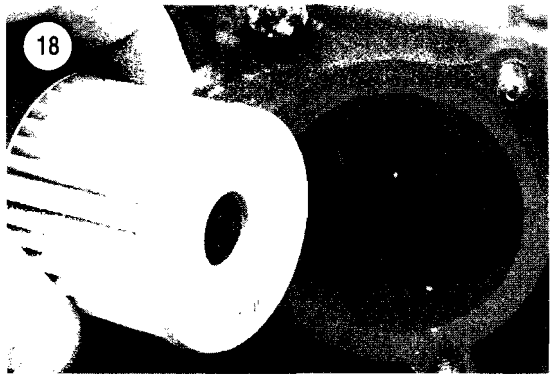

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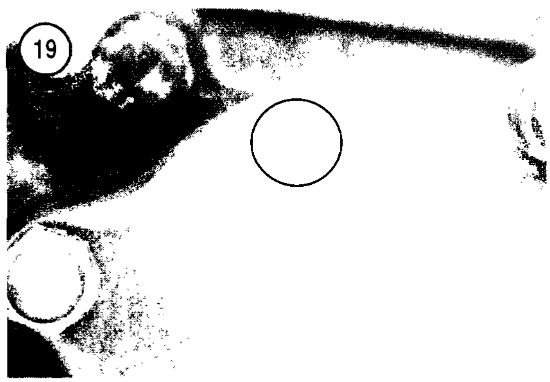

8. Install and tighten the drain plugs.
   a. Tighten the crankcase drain plug to 21 N•m (15 ft.-lb.).
   b. Tighten the frame drain plug to 18 N•m (13 ft.-lb.).

9. Install the open end of the oil filter onto the filter mount (**Figure 18**).

10. Align and install the oil filter cover. Check that the arrow on the cover (**Figure 19**) points up and the O-ring is not pinched. Tighten the nuts in several passes to avoid binding the cover.

11. Fill the oil tank with the required quantity and type of engine oil (**Table 3**).

12. Screw the dipstick into place.

13. Check the engine oil level as described in this section.

14. Check all fittings for leaks.

15. Dispose the used engine oil in an environmentally-safe manner.

Oil Pressure Check

An oil pressure check can indicate engine condition. Oil pressure that is higher or lower than the specification can indicate a damaged oil pump, a clogged oil check valve, oil filter or oil passage, a leaking O-ring or the use of oil that is not within specification. Extreme engine wear and improper engine assembly are also possibilities.

Whenever the oil pressure is checked, keep a record of the reading. Future readings can be compared to determine if normal wear is occurring. Operating the engine when oil pressure readings are abnormal can lead to engine damage. An oil pressure gauge (Suzuki part No. 09915-74510) and adapter (Suzuki part No. 09915-70610) are required.

1. Warm the engine to operating temperature.
2. The motorcycle is not equipped with a tachometer, so attach one per the manufacturer's instructions.
3. Remove the main oil gallery plug (B, **Figure 3**) and thread an oil pressure gauge into the fitting.
4. Start the engine and raise the engine speed to 3000 rpm. Note the pressure reading on the gauge. The oil pressure specification is 40-140 kPa (5.8-20.3 psi) at 3000 rpm.

Fork Oil Change

The fork legs must be removed from the motorcycle to change the fork oil. If the fork is leaking, install new seals before filling with oil. Refer to Chapter Twelve for the removal and servicing procedures.

Cable Lubrication

If binding or drag is detected in the throttle or clutch, this can indicate a lack of cable lubrication or worn parts. Use lithium grease to lubricate the control cable pivots. Lubricate the cables with light oil or cable lubricant. If the clutch or throttle cables continue to operate poorly after lubrication, disconnect the cable(s) at both ends and check for binding or drag. Replace the cable(s) if necessary. If the cable(s) is in good condition, check for binding or drag in the carburetor/clutch.

Clutch cable

1. Remove the clutch cable from the handlebar lever and release lever as described in Chapter Six.
2. Attach a cable lubricator, and then lubricate the cable with aerosol cable lubricant (**Figure 20**). If the cable is completely removed from the motorcycle, keep the cable in a vertical position so the lubricant can pass to the opposite end. Move the cable in the housing to help distribute the oil. Stop lubrication when oil is seen at the opposite end of the cable.
3. Lubricate the lever pivot and cable ends with grease.
4. Install the cable as described in Chapter Six.
5. Adjust the clutch cable as described in this chapter.

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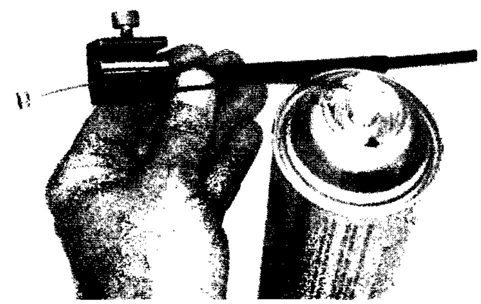

Throttle cables

1. Remove the throttle cables from the carburetor and throttle as described in Chapter Eight.
2. Attach a cable lubricator, and then lubricate the cable with aerosol cable lubricant (**Figure 20**). If the cables are completely removed from the motorcycle, keep the cables in a vertical position so the lubricant can pass to the opposite end. Move the cables in the housing to help distribute the oil. Stop lubrication when oil is seen at the opposite end of each cable.
3. Lubricate the throttle drum, cable ends and cable guide with grease.

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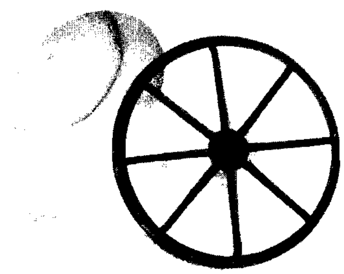

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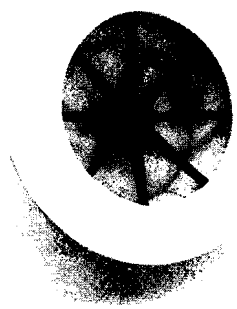

4. Install the cables as described in Chapter Six.
5. Adjust the throttle cables as described in this chapter.

Drive Chain Cleaning and Lubrication

The motorcycle is equipped with an O-ring chain that requires routine cleaning and lubrication. If the chain has been replaced with a standard chain, it too requires regular cleaning, lubrication and adjustment for long life.

Chains should never be cleaned with high-pressure water sprays or strong solvents. This is particularly true for O-ring chains. If water is forced past the O-rings, it is trapped inside the links. Strong solvents can soften the O-rings so they tear or damage easily.

Although chains are often lubricated while they are installed on the motorcycle, the chain should periodically be removed from the motorcycle and thoroughly cleaned. The following procedure describes the preferred method for cleaning and lubricating the chain:

1. Refer to Chapter Eleven to remove the chain.
2. Immerse the chain in kerosene and work the links so dirt is loosened.
3. Lightly scrub the chain with a soft-bristle brush. Brushes with coarse or wire bristles can damage O-rings.
4. Rinse the chain with clean kerosene and wipe dry.
5. Inspect the chain as described in this chapter.
6. Lubricate the chain with chain lubricant. Lubricate an O-ring chain with lubricant specifically for O-ring chains.
7. Install the chain (Chapter Eleven).
8. Adjust the chain as described in this chapter.

Air Filter Cleaning and Oiling

The engine is equipped with a reusable, foam air filter. Do not operate the engine without the air filter or with a damaged air filter. Performance will not be enhanced and rapid engine wear will occur.

When performing this procedure, wear disposable gloves. Put the filter in a plastic bag to squeeze and distribute the oil. Follow any special instructions called for by the oil manufacturer.

1. Remove the front left side cover (Chapter Fifteen).
2. Remove the retaining bail and washer from the air filter (**Figure 21**).
3. Remove the the air filter assembly from the housing.
4. Remove the frame from the air filter (**Figure 22**).
5. Wash all parts in solvent (kerosene), a commercial filter wash or hot soapy water. *Squeeze* the cleaner from the filter. Do not wring the filter because tearing may occur. Shake the filter of any particles that may remain on the filter.
6. Allow the filter to completely dry.
7. Apply filter oil to the filter, squeezing the filter so the oil is distributed evenly. Squeeze out the excess oil.
8. Install the frame into the filter, seating the filter under the foam lip (**Figure 23**).
9. Remove the drain plug in the bottom of the housing and clean the housing and filter sealing surface. clean the housing and filter sealing surface. Reinstall the drain plug after cleaning.
10. Apply grease around the perimeter of the filter lip to seal the filter against the housing.

11. Install the filter, checking that it seats against the filter housing. Install the washer and bail (**Figure 21**).
12. Install the side cover.

MAINTENANCE AND INSPECTION

Perform the following at the intervals in **Table 1** or **Table 2**.

Evaporative Emissions Control System Inspection (California S and SM Models Only)

No adjustments are required for the evaporative emissions system. Visually inspect the hoses and connections. If neccesary, refer to Chapter Eight for additional information.

Fastener Inspection

Inspect all fasteners on the motorcycle for tightness and condition.
1. Tighten fasteners to the specification at the end of each chapter. If a specific torque is not called out for a fastener, the manufacturer does not provide one. In this case, refer to the general torque specifications (**Table 4**) in Chapter One.
2. Check that all cotter pins are secure and undamaged.
3. Check that tie straps, used to secure cables and electrical wiring, are in place and secure.

Muffler Cleaning

WARNING
Do not spray solvents or other combustible liquids into the muffler. This can cause an explosion and/or fire.

For the muffler to perform correctly and not affect engine performance, clean the internal baffle of carbon buildup. This is particularly important if the engine has been running rich.
1. Remove the bolts from the end of the baffle (**Figure 24**), and then remove the baffle.
2. Clean the baffle with a bristle brush. For heavy accumulations, soak the baffle in solvent, and then scrub clean. Allow the baffle to completely dry before installing it into the muffler.

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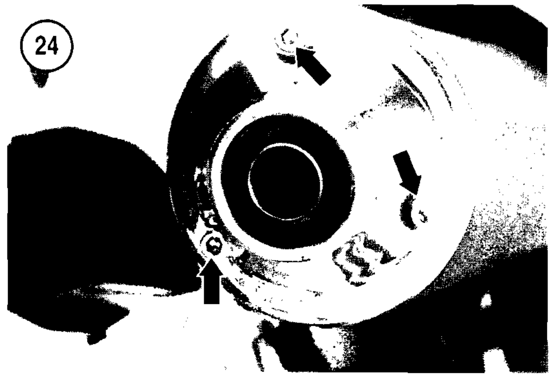

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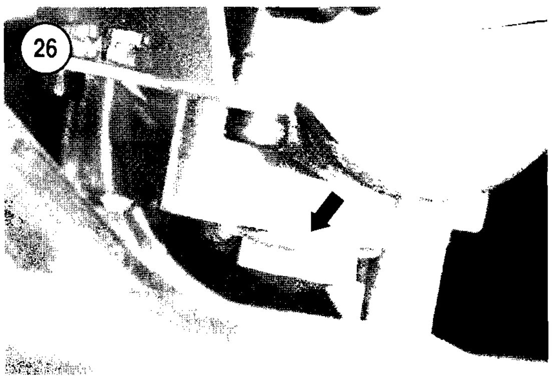
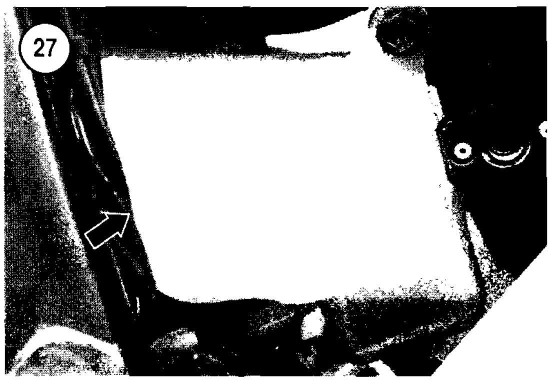
3. If accumulations are on the interior of the muffler, purge the muffler with the baffle removed as follows:
   a. Park the motorcycle in an open area, away from combustible materials.
   b. Start the engine.
   c. Wearing gloves and eye protection, use a rubber mallet to tap on the surface of the muffler as the engine speed is raised and lowered.
   d. When no more carbon particles are purged, stop the engine and allow the muffler to cool.
4. Install the baffle and tighten the bolts to 11 N•m (8 ft.-lb.).

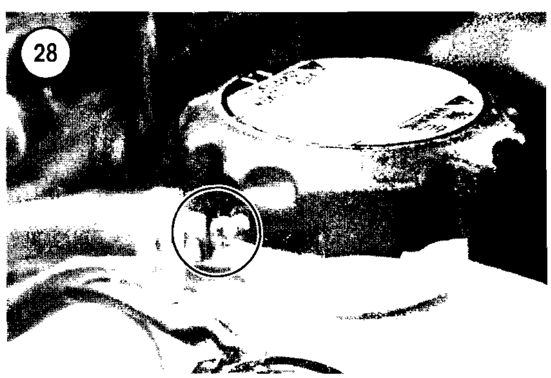
Carburetor Float Chamber Drain

There is no recommended interval for draining the float chamber.

If the motorcycle will be put into storage or not started for an extended period, drain the float chamber. Also, if moisture or sediment has contaminated the fuel system, drain the float chamber.
1. Support the motorcycle so it is vertical and level.







2. On all S, SM and California E models with a Mikuni carburetor, perform the following:
   a. On S and SM models, check that the fuel valve is on. This position is considered off for the vacuum-operated fuel valve. On E models, check that the fuel valve is off.
   b. Connect a length of hose onto the drain (**Figure 25**). Route the end of the hose into a suitable container.
   c. Turn the drain screw (**Figure 25**) out and allow the fuel to drain from the chamber. Do not remove the drain screw.
   d. Close the drain screw and disconnect the drain hose.

3. On all E models with a Keihin carburetor, perform the following:
   a. Check that the fuel valve is off.
   b. If the motorcycle will be put into storage and no moisture or sediment is suspected of being in the float chamber, start and run the engine until it stops. If moisture or sediment is suspected of being in the float chamber, do not run the engine. This could draw the contaminants into the jets.
   c. Disconnect the overflow hose, and then place shop cloths and, if possible, a shallow container under the main jet access plug at the bottom of the float chamber (**Figure 26**).
   d. Remove the plug and allow the fuel to drain from the chamber.
   e. Clean and install the plug.

Coolant Level Inspection

WARNING
Inspect the cooling system when the engine and coolant are cold. Injury could occur if the system is checked while it is hot. If the radiator cap must be removed while the coolant is still warm, cover the cap with a towel and turn it slowly to the safety stop. Do not remove the cap until all pressure is relieved.

When the engine is at operating temperature, the coolant expands and excess coolant is diverted to the overflow tank (**Figure 27**). As the engine cools, most of the coolant is drawn back into the radiator. It is normal for a small amount of coolant to be in the overflow tank. Do not assume the coolant level in the radiator is correct because coolant is visible in the tank.

1. Support the motorcycle so it is vertical and level.
2. Remove the right radiator cover and front left side cover (Chapter Fifteen).
3. Turn the radiator cap to the safety stop and allow any pressure to escape. If provided, loosen the safety stop screw (**Figure 28**) so the cap can be removed. Press down on the cap and twist it free.
4. Inspect the coolant level. The coolant should be to the bottom of the filler neck on the radiator (**Figure 29**). If the coolant level is below the filler neck,

add a 50:50 distilled water/antifreeze mixture to raise the level.

5. If the coolant level is correct, install the radiator cap. If provided, tighten the safety stop screw (**Figure 28**).

6. If the coolant level is low, make the following checks to determine the cause:

   a. Check the hoses for damage.

   b. Check the radiator fins for leaks.

   c. Install the radiator cap and start the engine. Inspect for leaks at all hoses and fittings when the engine is at operating temperature. Check for leaks near the bottom of the water pump. If coolant is evident, the mechanical seal in the water pump is leaking. If engine oil is evident the oil seal in the water pump is leaking. Refer to Chapter Ten for seal replacement.

Cooling System Inspection

WARNING

Inspect the cooling system when the engine and coolant are cold. Injury could occur if the system is checked while it is hot. If the radiator cap must be removed while the coolant is still warm, cover the cap with a towel and turn it slowly to the safety stop. Do not remove the cap until all pressure is relieved.

The radiator cap and cooling system are checked individually, using a cooling system tester. This tester applies the required pressure to the cooling system and cap. A pressure gauge attached to the tester is observed and leaks can be detected. A tester can be purchased from an automotive parts supplier. Test the radiator cap and cooling system as follows:

1. Support the motorcycle so it is vertical and level.

2. Remove the radiator cap. If provided, loosen the safety stop screw (**Figure 28**) so the cap can be removed. Press down on the cap and twist it free. Check the following on the cap (**Figure 30**):

   a. Rubber seals (A). Check for cracks, compression and pliability. Replace the cap if damage is evident.

   b. Relief valve (B). Check for damage. Replace the cap if damage is evident.

3. Check the cap relief pressure as follows:

   a. Wet the seal on the radiator cap, and then attach the cap to the tester (**Figure 31**, typical).

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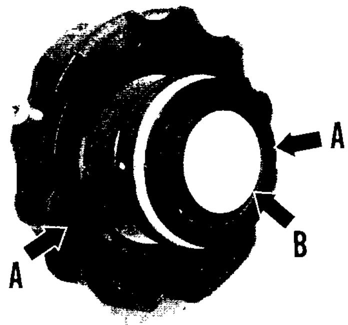

   b. Apply pressure to the cap. Relief pressure for the cap is 95-125 kPa (13.8-18.1 psi).

   c. If the gauge holds pressure up to the relief pressure range, the cap is good.

   d. If the gauge does not hold pressure or the relief pressure is too high or low, replace the cap.

CAUTION

Do not exceed 137 kPa (20 psi). Excessive pressure can damage the cooling system components.

4. Check that the radiator is filled to the bottom of the filler neck (**Figure 29**). Attach the tester to the radiator (**Figure 32**, typical), and then pump the tester to 137 kPa (20 psi).

   a. If the gauge holds the required pressure, the cooling system is in good condition. Install the radiator cap. If provided, tighten the safety stop screw (**Figure 28**).

   b. If the gauge does not hold the required pressure, check for leaks at the radiator and all fittings. If the pressure lowers and then stabilizes, check for swollen radiator hoses. Replace or repair the cooling system components so it maintains the test pressure.

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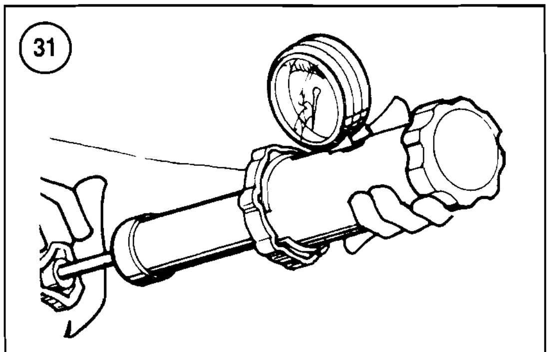

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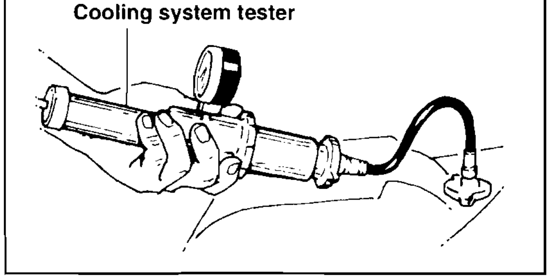

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Coolant Replacement

WARNING

Inspect the cooling system when the engine and coolant are cold. Injury could occur if the system is checked while it is hot. If the radiator cap must be removed while the coolant is still warm, cover the cap with a towel and turn it slowly to the safety stop. Do not remove the cap until all pressure is relieved.

CAUTION

Do not allow coolant to contact painted surfaces. If contact does occur, immediately wash the surface with water.

1. Support the motorcycle so it is vertical and level.
2. Remove the radiator covers and front left side cover (Chapter Fifteen).
3. Place a drain pan under the right side of the engine below the water pump. Remove the drain plug (**Figure 33**) from the water pump.
4. As coolant begins to drain from the engine, slowly loosen the radiator cap to increase flow from the engine. If provided, loosen the safety stop screw (**Figure 28**) so the cap can be removed. Be ready to reposition the drain pan because the flow immediately increases.
5. Place a drain pan under the overflow tank (**Figure 27**). Disconnect the hose and drain the coolant from the tank.
6. Before flushing the radiators, look in the filler neck and inspect for debris buildup. If buildup is noted, disconnect the lower radiator hoses and flush thoroughly. Avoid passing the buildup from the radiators to the engine.
7. Flush the cooling system with clean water. Check that all water drains from the system. Applying *light* air pressure to the radiator can aid in purging the water passages.
8. Inspect the condition of:
   a. Radiator hoses. Check for leaks, cracks and loose clamps.
   b. Radiator cores. Check for leaks, debris and tightness of mounting bolts.
   c. Radiator fan (S and SM model only). Check for damaged wiring and tight connections.
9. Install a new seal washer on the water pump drain plug, and then install and tighten the plug.
10. Connect the hose to the overflow tank.
11. Refill the radiator with a 50/50 distilled water/anitfreeze mixture.
   a. Tip the motorcycle from side to side to allow the coolant to flow through the engine and to purge air from the water jackets.
   b. Refill the radiator as the coolant level goes down.
   c. When the coolant level no longer goes down, fill the radiator to the bottom of the filler neck (**Figure 29**).
12. Bleed the air from the cooling system as follows:
   a. On S and SM models, loosen the bleeder bolt at the front of the cylinder head (**Figure 34**).

Tighten the bolt when coolant is visible to 6 N•m (53 in.-lb.).

b. Loosen the bleeder bolt at the top of the left radiator (**Figure 35**). Tighten the bolt when coolant is visible to 6 N•m (53 in.-lb.).

13. Fill the radiator to the bottom of the filler neck and install the radiator cap.
14. Start and warm up the engine. Shut off the engine and allow it to cool. Inspect for leaks at the hoses, radiators, drain bolt and bleeder bolts.
15. Remove the radiator cap and inspect the coolant level. If necessary, fill the radiator to the bottom of the filler neck.
16. Install the radiator cap. If provided, tighten the safety stop screw (**Figure 28**).
17. Rinse and dry the frame and engine where coolant was splashed.
18. Install the radiator covers and front left side cover (Chapter Fifteen).
19. Dispose the old coolant in an environmentally-safe manner.

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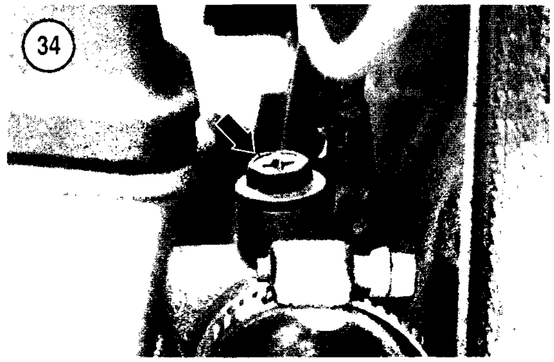

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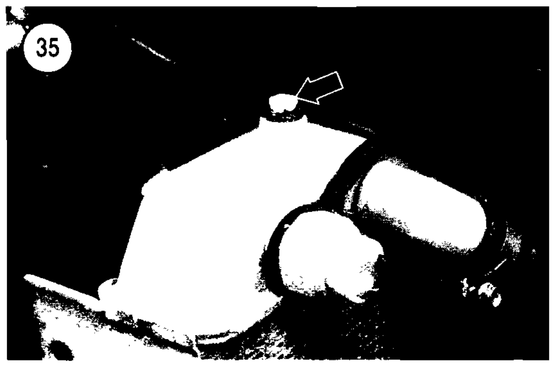

Drive Chain and Sprockets Inspection

A worn drive chain and sprockets are both unreliable and potentially dangerous. Inspect the chain and rear sprocket for wear and replace if necessary. If wear is detected, replace both sprockets and the chain. Mixing old and new parts prematurely wears the new parts.

To determine if the chain should be measured for wear, perform this general check, first pull one chain link away from the rear sprocket. Generally, if more than half the height of the sprocket tooth is visible (**Figure 36**), the chain should be accurately measured for wear. Refer to the following procedure to measure chain wear and inspect the rear sprocket:

1A. If the chain is not removed from the sprockets, remove the chain guard and loosen the axle nut (Chapter Eleven). Turn the chain adjusters equally to take all free play out of the chain along its top run.

1B. If the chain is removed from the sprockets, lay the chain on a flat surface and pull the ends of the chain to remove the slack.

2. Measure the length of any 20-link (21 pin) span (**Figure 37**). Measure center-to-center from the pins.

a. The service limit for the chain is 319 mm (12.6 in.). If the measured distance meets or exceeds the service limit, replace the chain.

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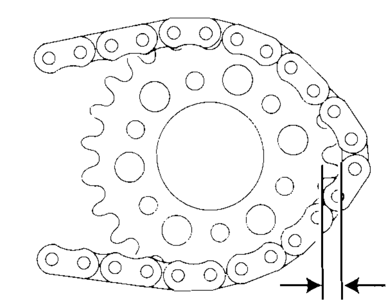

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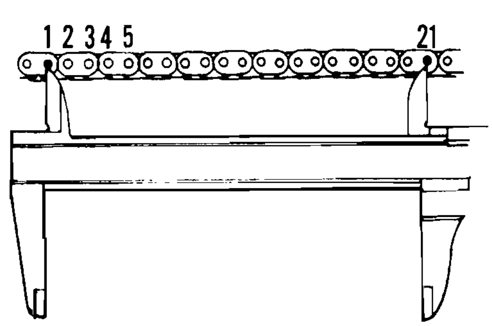

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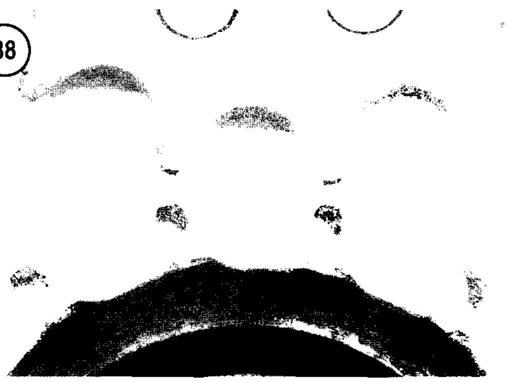

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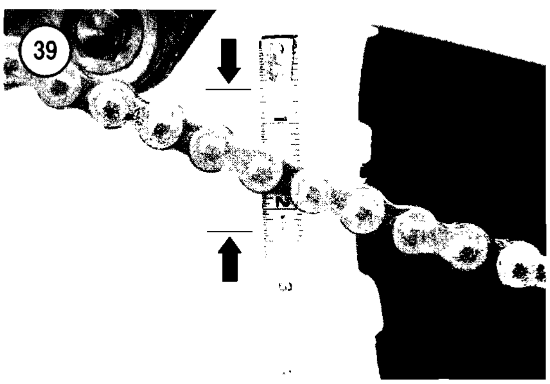

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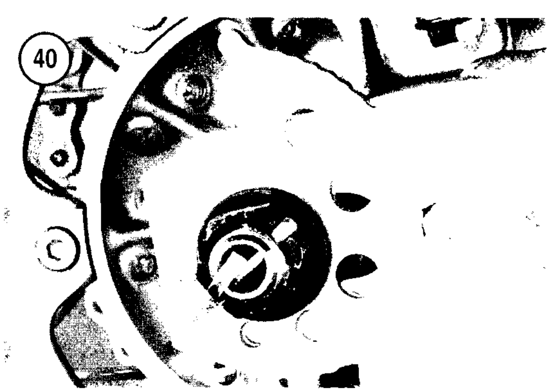

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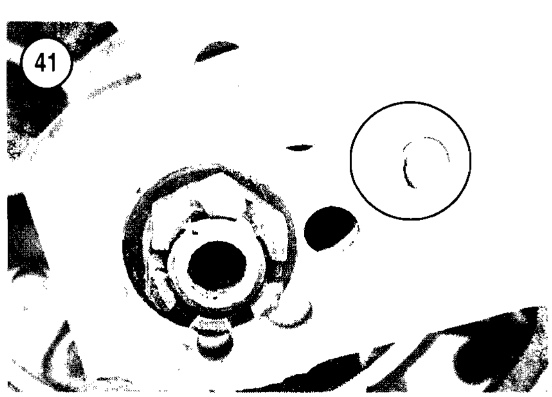

b. If the chain is within the service limit, inspect the inside surfaces of the link plates. The plates should be shiny at both ends of the chain roller. If one side of the chain is worn, the chain has been running out of alignment. This also causes premature wear of the rollers and pins. Replace the chain if abnormal wear is detected.

3. Inspect the teeth on the front and rear sprockets. Compare the sprockets to **Figure 38**. A new sprocket has symmetrical and uniform teeth. A used sprocket wears on the back side of each tooth. The lower sprocket shown in **Figure 38** has normal wear and some usable life. The sprocket should be replaced if other damage is evident or if a new chain is being installed. If either sprocket is worn out, replace both sprockets.

Drive Chain Adjustment

The drive chain must have adequate free play so it can adjust to swing arm movement. Too little free play can cause the chain to become tight and cause unnecessary wear to the components. Too much free play can cause the chain to derail.

1. Support the motorcycle so it is vertical. The rear wheel can be on or off the ground.
2. Measure the free play in the bottom length of chain (**Figure 39**) as follows:
   a. Place a tape measure so it is stable and vertical below the chain midpoint.
   b. Press the chain down and note where a chain link-pin aligns with the tape measure. Note the measurement.
   c. Push the chain up and note where the same link pin aligns with the tape measure. Note the measurement.
   d. The difference between the two measurements is the chain free play. Required free play is 40-50 mm (1.6-2.0 in.).
3. If necessary, adjust the free play on E and S models as follows:
   a. Remove the cotter pin from the axle nut, and then loosen the nut (**Figure 40**).
   b. Position both numbered chain adjusters (**Figure 41**) so the free play is correct. Both adjusters must be set identically and locked against the adjusting post. If increasing free play, push the wheel forward to take the play out of the adjusters.

4. If necessary, adjust the free play on SM models as follows:
   a. Remove the cotter pin from the axle nut and loosen the axle nut (A, **Figure 42**).
   b. Loosen the chain adjustment locknuts (B, **Figure 42**) on both sides of the wheel.
   c. Equally turn the chain adjuster nuts (C, **Figure 42**) on each side until the chain tension is correct. Use the adjustment marks (D, **Figure 42**) on the swing arm to equally adjust the chain.
5. If the free play cannot be adjusted within the limits of the adjusters, the chain is excessively worn. Replace the chain as described in Chapter Eleven.
6. Tighten the axle nut to lock the setting. Tighten the nut to 100 N•m (74 ft.-lb.).
7. Recheck the free play, and adjust if necessary.
8. Install a *new* cotter pin.

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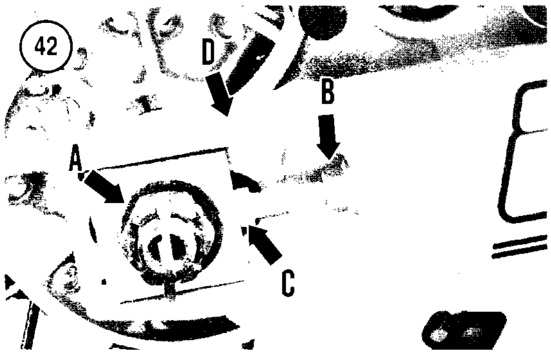

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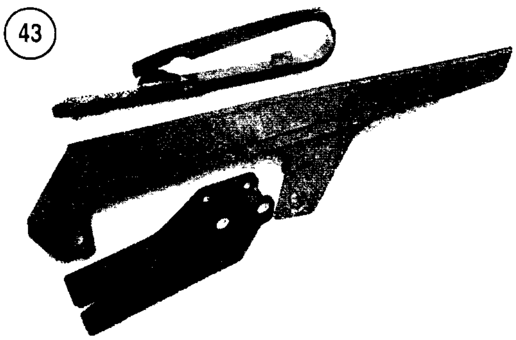

Drive Chain Slider, Guide and Guard Inspection

Periodically inspect the chain slider, chain guide and chain guard (**Figure 43**) for wear or damage.

1. Inspect the upper and lower surfaces of the chain slider for wear or damage. If the slider is worn through or missing, the chain contacts the swing arm, possibly causing damage. Check the mounting screws for tightness.
2. Inspect the sliding surface of the chain guide for wear or damage. A torn or broken guide can snag the chain, causing noise and possible damage. Check that the frame is straight and the bolts are tight.
3. Inspect the chain guard (S models only) for damage, proper clearance and alignment. Check the mounting screws for tightness.

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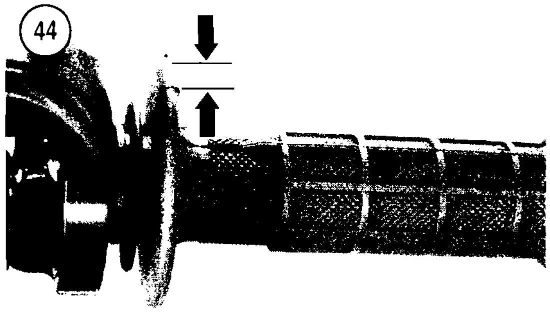
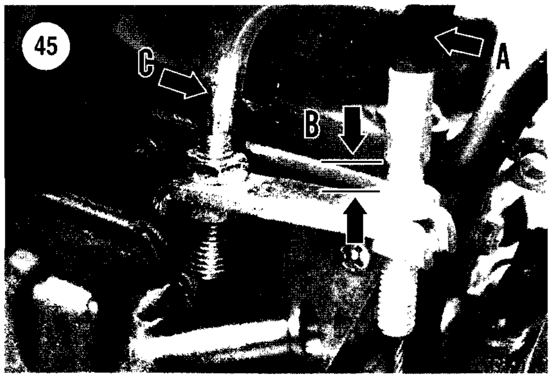
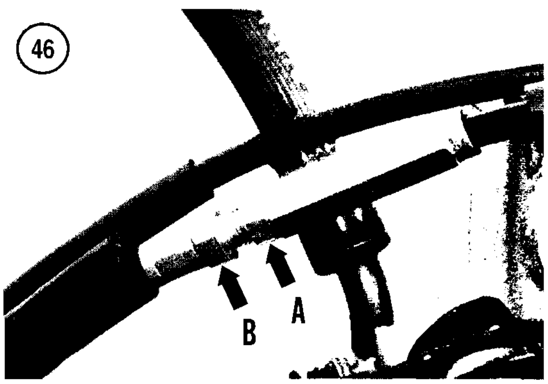


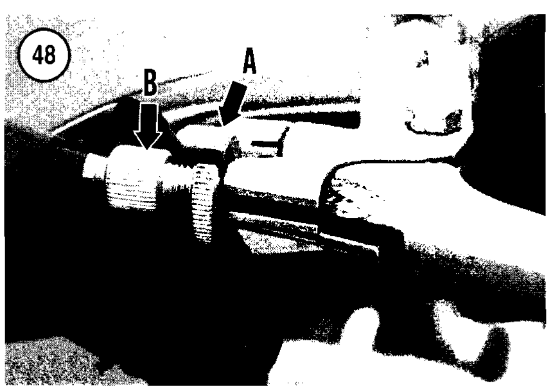
Throttle Cable Adjustment

The throttle uses two cables. One cable pulls the throttle open during acceleration, while the other ensures the throttle closes during deceleration. In operation, the cables always move in opposite directions. Before adjusting the throttle cables, make sure they are in good condition. To achieve accurate cable adjustment, the cables must not bind or drag. Engine idle speed should also be correct before adjusting the cables. If necessary, refer to Chapter Eight for throttle cable replacement procedures. The following procedure is for both Mikuni and Keihin carburetors. Any differences are noted.

1. Measure the amount of free play at the throttle grip (**Figure 44**). Correct free play is 2-4 mm (0.08-0.16 in.). If free play is incorrect, adjust the cable as described in the following steps.
2. For the Keihin carburetor, remove the cable cover at the carburetor.
3. At the carburetor, adjust the return cable (A, **Figure 45**). For the Keihin carburetor, the return cable is the lower cable.
   a. Measure the length of exposed threads at the outside of the cable holder (B, **Figure 45**). The length should measure 3 mm (0.12 in.).







b. If necessary, loosen the cable locknuts on the holder and adjust the thread length.

c. Tighten the locknuts.

4. Adjust the pull cable (C, **Figure 45**) free play. On the Keihin carburetor, the pull cable is the upper cable. The pull cable free play is the throttle grip measurement made in Step 1.

a. At the handlebar, pull back the rubber boot and loosen the pull cable locknut (A, **Figure 46**). Turn the cable adjuster (B, **Figure 46**) to increase/decrease play in the cable and throttle grip. If correct play can be achieved and the adjuster is close to the middle of its range of travel, tighten the locknut. Adjustment is complete. If correct play cannot be achieved with the adjuster or if the adjuster is fully screwed in or out, set the adjuster to the middle of its travel and tighten the locknut. Proceed to substep b to adjust the cable housing.

b. At the carburetor, loosen the pull cable (C, **Figure 45**) locknuts. Adjust the cable housing to increase/decrease play in the cable and throttle. Adjust the cable so free play at the throttle grip is 2-4 mm (0.08-0.16 in.). Tighten the locknuts.

5. Operate the throttle and watch the action of the cables and throttle valve at the carburetor. The throttle valve should fully open and close.

6. Install the rubber boot over the cable adjuster. For the Keihin carburetor, install the cable cover at the carburetor.

7. At engine startup, turn the handlebar from side to side as the engine idles. If engine speed varies, check for proper cable adjustment and cable routing.

Clutch Cable Adjustment

The clutch cable must be properly adjusted to ensure smooth shifting, full clutch engagement and minimal clutch plate wear.

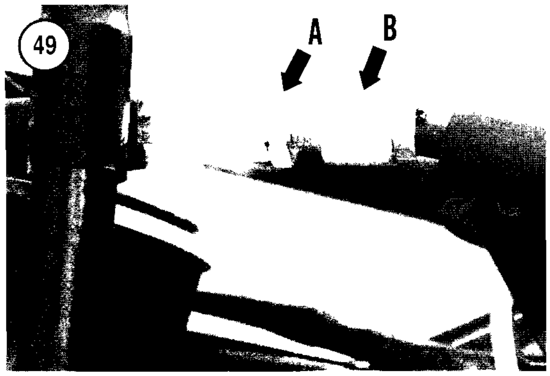
1. Measure the amount of free play at the lever end (**Figure 47**). Free play should be 10-15 mm (0.4-0.6 in.). If free play is incorrect, adjust the cable as described in the following step(s).

2. Pull back the dust cover and loosen the clutch cable locknut (A, **Figure 48**). Turn the cable adjuster (B, **Figure 48**) to increase/decrease play in the cable and lever. Note the following:

a. If correct play can be achieved and the adjuster is close to the middle of its range of travel, tighten the locknut. Adjustment is complete.

b. If correct play cannot be achieved with the adjuster or if the adjuster is fully screwed in or out, set the adjuster to the middle of its travel and tighten the locknut. Perform Step 3 to adjust the cable housing.

3. To adjust the cable housing, loosen the cable locknut (A, **Figure 49**), and then turn the adjuster (B) to increase/decrease play in the cable and lever. Adjust the cable so free play at the clutch lever end is 10-15 mm (0.4-0.6 in.). Tighten the cable locknut.



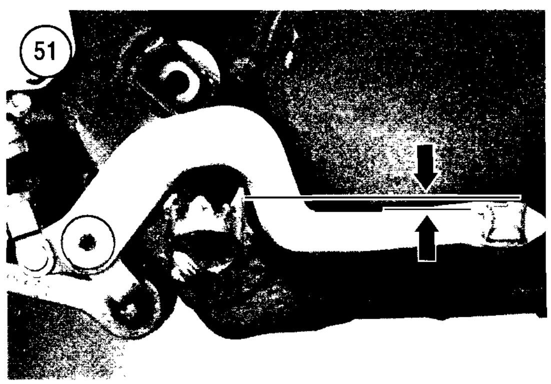
Front Brake Lever Adjustment

Measure the amount of free play between the end of the adjuster and the master cylinder pushrod (**Figure 50**). Free play should be 0.1-0.3 mm (0.004-0.012 in.). If free play is incorrect, loosen the locknut and turn the adjuster screw to achieve the correct play. Tighten the locknut.

Rear Brake Pedal Adjustment

The rear brake pedal height is adjusted in relationship to the footpeg. When the pedal height is set, the amount of free play in the rear master cylinder is also set.

1. Measure the distance between the top of the footpeg and the top of the pedal (**Figure 51**). The required pedal height is 0-10 mm (0-0.4 in.) below the footpeg.



2. If necessary, adjust the pedal height and free play as follows:

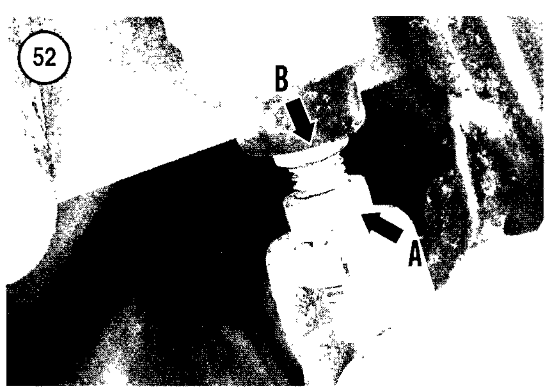
   a. Loosen the locknut (A, **Figure 52**) and turn the adjuster (B) to increase/decrease play in the pedal.

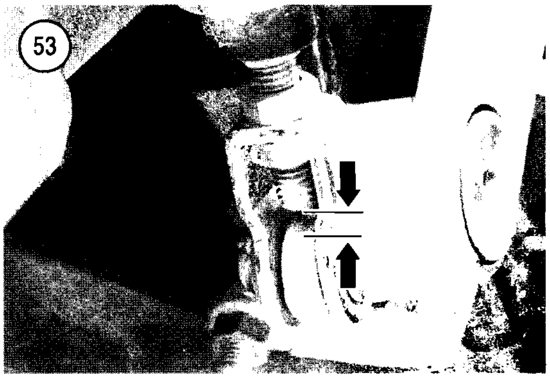
   b. Tighten the locknut.

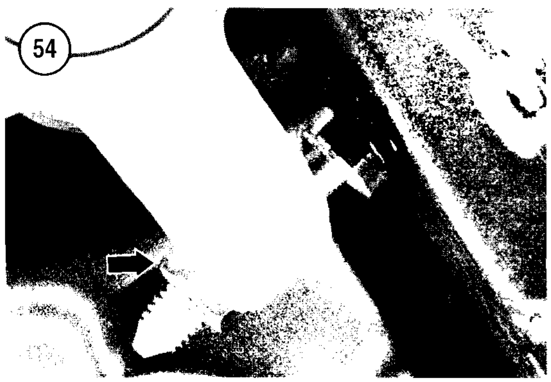
3. Check the brake pedal adjustment from the riding position, and adjust if necessary.

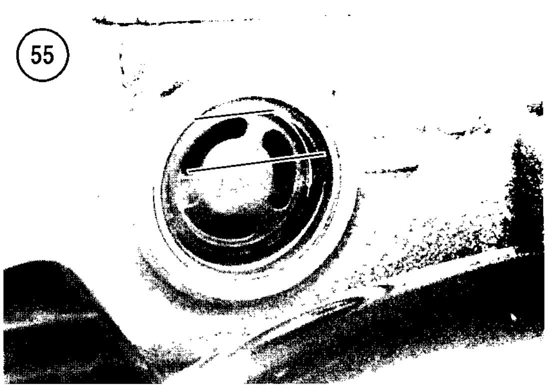
4. Measure the distance between the top of the brake arm to the end of the pushrod (**Figure 53**). The clearance should be at least 1.0 mm (0.04 in.). The pushrod should never touch the brake arm.

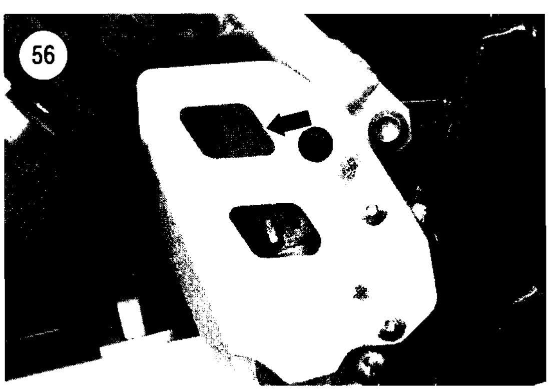
5. With the rear wheel off the ground, turn the wheel and operate the pedal to ensure the brake can be fully engaged and disengaged. If brake pedal height and free play cannot be achieved, inspect for a bent brake











pedal and worn or damaged parts. If the brake does not actuate, bleed the brake and inspect for leaks.

Rear Brake Light Switch Adjustment (S and SM Models)

The rear brake light should turn on when the brake pedal is lightly actuated. The brake light switch is located on the frame, behind the brake pedal. An adjustable bolt on the pedal actuates the switch.

1. Check the rear brake pedal adjustment before adjusting the brake light switch.
2. Turn on the ignition switch and operate the brake pedal. The light should come on as soon as or shortly after the pedal is depressed.
3. If necessary, adjust the bolt that turns on the switch. Loosen the locknut (**Figure 54**) and turn the bolt to adjust as required.
4. Tighten the locknut when adjustment is correct.
5. Turn the ignition switch off.

Brake Fluid Level Inspection

1. Support the motorcycle so the brake fluid reservoir being checked is level.
2. Inspect the front reservoir as follows:
   a. The fluid level should be between the lower level mark and the top of the sight glass (**Figure 55**).
   b. If the fluid level is below the low mark, remove the cover and diaphragm, then add DOT 4 brake fluid. Replace the diaphragm and cap.
   c. If the level is very low, inspect the brake pads and check the system for leaks.
3. Inspect the rear reservoir (**Figure 56**) as follows:
   a. The fluid level should be between the upper and lower level marks, embossed on the reservoir (**Figure 57**). The master cylinder guard and the diaphragm in the reservoir can make visible inspection difficult. If necessary, remove the guard and open the reservoir as described in the following substeps.
   b. If the fluid level is below the low mark, remove the master cylinder guard (Chapter Fourteen).
   c. Remove the reservoir retaining bolt so the cap can be removed.
   d. Remove the cap and diaphragm (**Figure 58**) and add DOT 4 brake fluid.
   e. Replace the diaphragm and cap and bolt the reservoir into place.

f. Install the guard.
4. If necessary, drain and bleed the brake system as described in Chapter Fourteen.

Brake Pad and Disc Inspection

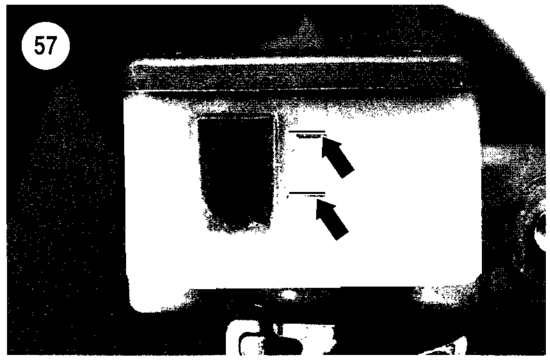
Inspect the brake discs and pads regularly to ensure they are in good condition. If damage is evident, refer to Chapter Fourteen.
1. Support the motorcycle so the wheels are off the ground.
2. Visually inspect the front and rear discs for the following:
   a. Scoring. The disc should be smooth in the friction area.
   b. Runout. Spin the wheel and visually check for lateral movement of the disc. Runout should not be evident.
   c. Disc thickness. If the disc shows wear in the friction area, measure the thicknesses of both discs.
3. Inspect the brake pads. The pads are visible by looking into the caliper on both sides of the disc. If the front or rear pads are less than 1 mm (0.04 in.) thick, replace the pad set for that wheel. Some pad sets have a wear indicator (**Figure 59**), which can be a groove or step at the edge of the pad.

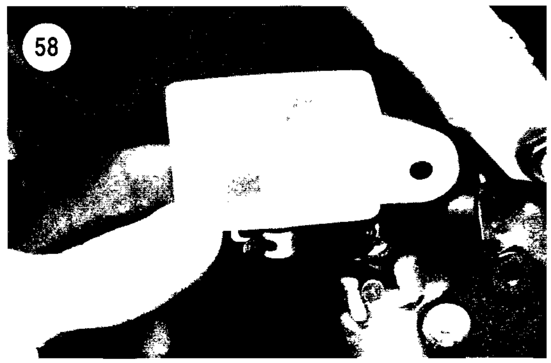
Steering Head Bearing Inspection

The steering head is fitted with tapered roller bearings and should be inspected when the steering feels loose or uncontrollable. The bearings must be greased and properly tightened to prevent wear and to maintain proper handling characteristics.
1. Support the motorcycle so the front wheel is off the ground.
2. Inspect the steering head as follows:
   a. Turn the handlebar in both directions and feel for roughness or binding.
   b. Grasp the fork legs near the axle and check for front-to-back play.
3. If roughness, binding or play is detected in the steering head, refer to Chapter Twelve to adjust the steering stem.

Swing Arm Bearing Inspection

A quick inspection of the swing arm bearings can be made by checking the lateral and vertical movement of the swing arm. To perform a more thorough inspection, refer to Chapter Thirteen.





1. Support the motorcycle so the rear wheel is off the ground.
2. Have an assistant steady the motorcycle, then grasp the ends of the swing arm and leverage it from side to side. There should be no detectable play. If play is evident, refer to Chapter Thirteen for swing arm service.

Front Suspension Adjustment

The fork is adjustable to meet riding conditions. Refer to Chapter Twelve to adjust the fork.

Rear Suspension Adjustment

The rear shock absorber is adjustable to meet riding conditions. Refer to Chapter Thirteen.

Fork Air Release Screw (All E Models and 2002-On S and SM Models)

The fork is designed to operate with a cushion of air at the top of the fork leg. When riding for ex-

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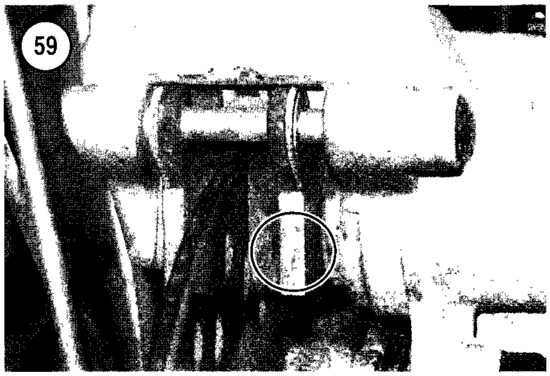

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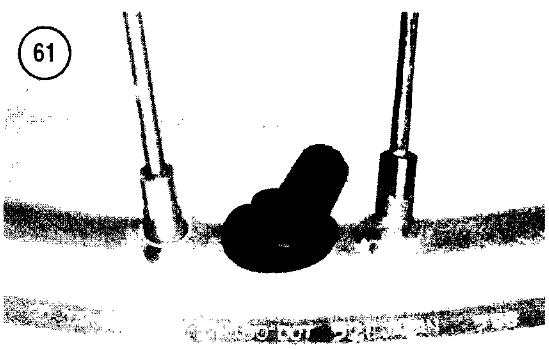

tended periods over rough terrain or when racing, the air warms and expands, increasing the pressure in the fork leg. This increase in pressure affects the action of the suspension. Release the pressure whenever possible as follows:

1. Support the motorcycle with the front wheel off the ground.
2. Remove the air screw (**Figure 60**) from the fork cap to relieve the air pressure.
3. Install and tighten the air release screw. Repeat for the other fork leg.

Tire Pressure

Inflate the tires to meet riding conditions. The standard air pressure recommendation is in **Table 5**. Slight over- or under-inflation is permissible if the riding conditions justify the change. However, do not exceed the inflation range embossed on the tire sidewall. Because inner tubes are used in the tires, too low of air pressure for the riding conditions can cause the tire to slip on the rim. This can bend the valve stem, as shown in **Figure 61**. Running with the valve stem bent can sever the valve stem and deflate the tire. Correct the condition by adjusting the tire and inner tube positions as described in this section.

Tube Alignment

WARNING
Do not over inflate the tire to seat the beads. If the beads will not seat, deflate the tire and relubricate the beads.

When the tube valve stem is bent as shown in **Figure 61**, the tube must be realigned to prevent valve stem damage. A bent valve stem can sever and deflate the tire. Align the tube as follows:

1. Wash the tire and rim.
2. Remove the valve stem core and deflate the tire.
3. With an assistant steadying the motorcycle, break the tire-to-rim seal completely around both sides of the tire.
4. Support the motorcycle so the wheel is off the ground.
5. Check that the valve stem is loose.
6. Lubricate both tire beads by spraying with soapy water.
7. Have the assistant apply the brake for the wheel being aligned.
8. Grasp the tire, and then turn it and the tube until the valve stem is straight.
9. When the tube is correctly positioned, install the valve stem and inflate the tire. If necessary, reapply the soap solution to the beads to help seat the tire on the rim. Check that the beads uniformly seat around the rim.

Spoke Tension

Regularly check spoke tension. If the wheel has been respoked, check spoke tension often during the break-in period. Refer to Chapter Eleven for wheel procedures.

TUNE-UP

When performing a tune-up, service the following items in order as described in this chapter:

1. Air filter.
2. Spark plug.
3. Compression test.
4. Valve clearance.
5. Carburetor.

VALVE CLEARANCE

Inspection/Adjustment

Valve clearance is adjusted by a shim (**Figure 62**) in the recess at the top of each valve assembly (**Figure 63**). The shim and valve assembly are covered by a valve lifter (**Figure 64**), often called a bucket. Each valve lifter is aligned below one of the camshaft lobes (**Figure 65**), which opens and closes the valve.

If the valve clearance is incorrect, the camshafts and valve lifters must be removed so the shim size can be changed to bring each valve within specification. When removing valve lifters and shims, always record the clearance and shim size for each valve location. Keep each shim and valve lifter set identified by their cylinder head locations.

Shims are available in increments of 0.05 mm (0.002 in.). Shim thickness ranges from 2.3 mm (a number 230 shim) to 3.5 mm (a number 350 shim). The number on the shim surface is the original thickness of the shim. For example, if the removed shim is marked 285, the shim is 2.85 mm thick. When removing and installing shims, measure the shims with a caliper (**Figure 66**) to verify their actual thicknesses.

Commonly, when valve clearance is near the smallest acceptable clearance, the clearance is increased, even though the valve is technically within specification. Valves more often lose clearance than gain clearance between inspections, and therefore are adjusted toward the larger clearance specification. A small, marginally-acceptable clearance may be out of specification by the next inspection interval. However, do not increase clearance beyond the largest specification.

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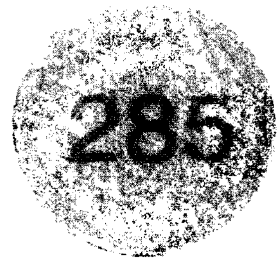

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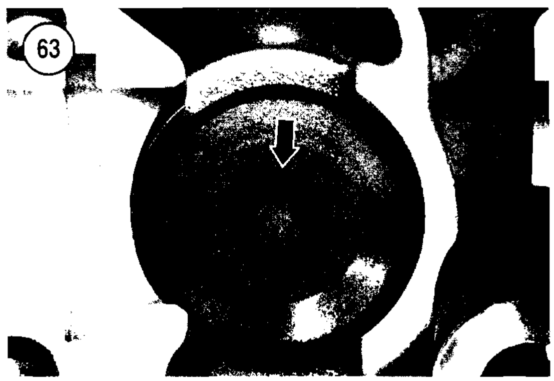

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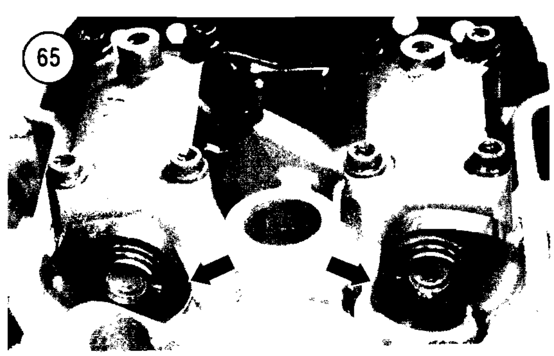

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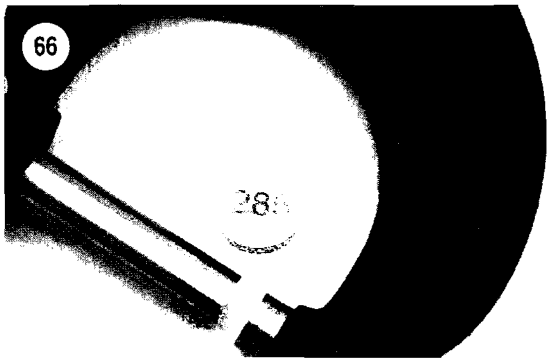

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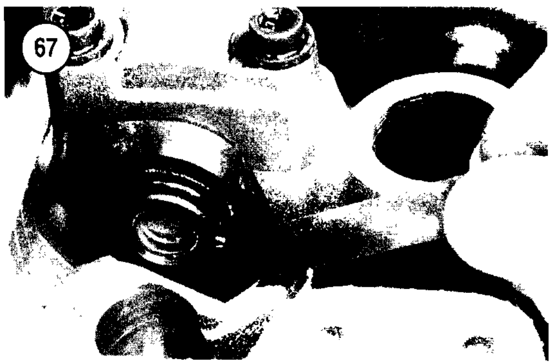

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Check the valve clearance at the specified interval (**Table 1** or **Table 2**) and when the engine is at ambient temperature.

1. Support the motorcycle so it is stable and secure.

2. Remove the cylinder head cover and set the engine at TDC as described in Chapter Four.

3. For each valve:

   a. Use a flat feeler gauge to determine the clearance between the valve lifter and cam lobe (**Figure 67**). Clearance is correct if slight resistance is felt when the gauge is inserted and withdrawn.

   b. Record the measurement and valve location. This information is necessary to determine the correct size shim to install if out of specification.

4. If adjustment is required, refer to Chapter Four for camshaft and cam chain tensioner removal. Remove the camshaft from only the valve(s) that requires adjustment.

5. For each valve that requires adjustment, remove each valve lifter and shim set as follows:

   a. Use a magnetic tool and raise the lifter straight up (**Figure 64**).

   b. Lift out the valve shim resting on top of the valve stem.

   c. Inspect each set of parts as they are removed. Both parts should be smooth on all surfaces. Light polishing on the shim, where it contacts the valve stem, is normal.

   d. Clean and inspect the shim seat at the top of the valve assembly (**Figure 63**).

   e. Mark the parts with their location in the cylinder head (**Figure 68**).

6. Determine the shim size to install as follows:

   a. Find the difference between the *specified* clearance and the *existing* clearance. This difference is the amount that must be added (loose valve) or subtracted (tight valve) from the value of the shim removed in Step 5.

   b. *For example*: If the existing clearance for an exhaust valve is 0.18 mm, and the specified clearance is 0.20-0.30 mm, the difference is 0.02-0.12 mm. In this example, the replacement shim should be this much *smaller* than the removed shim. If the removed shim is 2.85 mm thick (a number 285 shim), the replacement shim should be 2.75 mm thick (a number 275 shim). This would increase valve clearance to 0.28 mm (0.10 mm + 0.18 mm), which is within the specification.

7. Lubricate the replacement shim with engine oil, and then install the shim into the seat (**Figure 63**). Place the shim number facing up so it does not get worn away by the valve stem.

8. Lubricate the valve lifter with engine oil and install it over the shim and valve assembly (**Figure 64**).

9. Repeat the procedure for the remaining valves that are out of specification.

10. Install the camshaft(s) and cam chain tensioner as described in Chapter Four.

11. Check valve clearance as follows:

a. Rotate the engine several times to seat the shims, valve lifters and camshafts. Place the engine at TDC.
b. Measure the valve clearances. If clearance is not correct, remove the camshaft(s) and adjust the valves that are out of specification.

12. Install the cylinder head cover, timing plug and rotor nut plug as described in Chapter Four.

CARBURETOR

Idle Speed and Mixture Adjustment

The carburetor must be adjusted so the idle speed keeps the engine running, but is also low enough to provide compression braking. Additionally, the pilot mixture screw must be adjusted so throttle response is good from an idle to about 1/4 throttle. Refer to *Carburetor Systems* in Chapter Eight for the function of the carburetor jets and jet needle.

Use the following procedure to adjust the idle speed and pilot mixture screw for the *standard* jets for either the Mikuni or Keihin carburetor.

1. Make sure the throttle cables are adjusted.
2. Make sure the air filter is clean.
3. The motorcycle is not equipped with a tachometer, so attach one per the manufacturer's instructions.
4. If the pilot mixture screw is blocked by a plug, remove the carburetor from the engine and drill a hole in the plug so it can be pried out. Refer to Chapter Eight.
5. *Lightly* seat the pilot mixture screw (**Figure 69** [Mikuni] or **Figure 70** [Keihin]), and then turn the screw out the number of turns indicated in **Table 4**. This is a starting point for adjustment.
6. Start the engine and allow it to warm up.
7. Turn the throttle stop screw (**Figure 71**) and set the engine idle speed to the specification in **Table 4**. Raise and lower the engine speed a few times to ensure it returns to the set idle speed.
8. Mark the position of the pilot mixture screw. From its initial setting, turn the pilot mixture screw in and out in small increments to find the points where the engine speed begins to decrease. Set the pilot mixture screw between the two points.
9. Reset the idle speed to bring it within its required setting.
10. Test ride the motorcycle and check throttle response. If throttle response is poor from an idle, adjust the pilot mixture screw out (richer) or in (leaner) by 1/8 turn increments until the engine accelerates smoothly.
11. If necessary, adjust the throttle cables for proper play.

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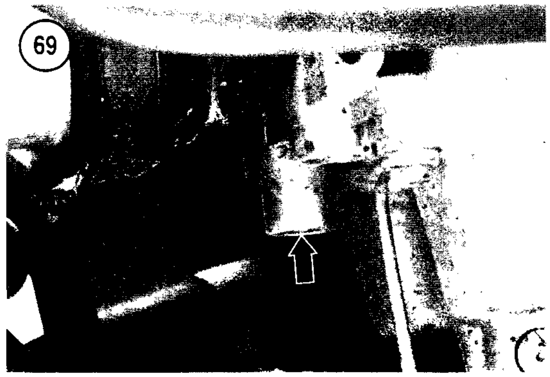

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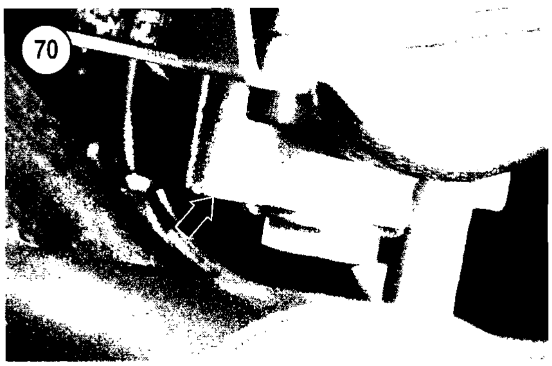

IGNITION TIMING

The ignition timing is electronically controlled by the CDI unit. No adjustment is possible to the timing. The timing can be checked to ensure the igntion system is operating correctly. However, the rotor is marked for top dead center, so the amount of advance can only be estimated.

COMPRESSION TEST

A cylinder compression test can help verify the condition of the piston, rings and cylinder head assembly without disassembling the engine. By keeping a record of the compression reading at each tune-up, readings can be compared to determine if normal wear is occurring.

If the compression is out of specification, first check the automatic compression release as de-

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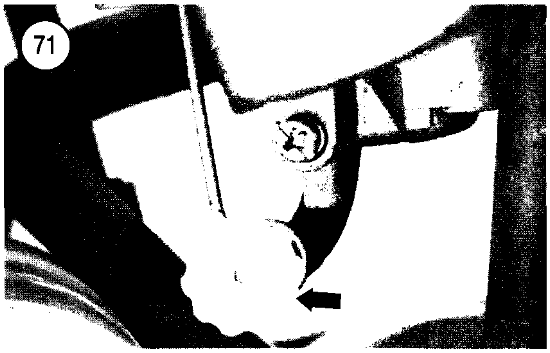

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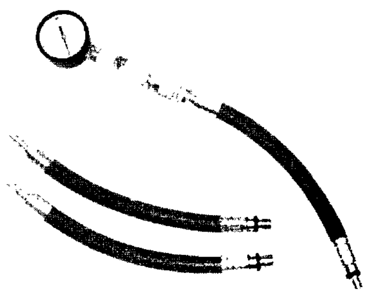

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scribed in Chapter Four. The automatic compression release opens the right exhaust valve slightly during engine cranking.

1. Warm the engine to operating temperature.
2. Remove the spark plug. Insert the spark plug into the cap, and then ground the plug to the cylinder. Do not ground the spark plug on the alloy cylinder head cover. The spark plug must be grounded to prevent CDI unit damage.
3. Thread a compression gauge (**Figure 72**, typical) into the spark plug hole. The gauge must fit airtight in the hole for an accurate reading.
4. Hold or secure the throttle fully open. The choke must also be open.
5. Operate the starter and turn the engine over until the highest gauge reading is achieved.
6. Record the reading. Compare the reading with the specifcation (**Table 4**) and/or previous readings, if available. Under normal operating conditions, compression slowly lowers from the original specification, due to wear of the piston rings and/or valve seats.
   a. If the reading is higher than normal, this can be caused by a faulty compression release. Commonly, carbon buildup in the combustion chamber is another cause of high compression. This can cause high combustion chamber temperatures and potential engine damage.
   b. If the reading is lower than normal, this can be caused by worn piston rings, valves with no clearance, worn valves, damaged piston, leaking head gasket or a combination of these parts. The compression release is less likely to be the problem in this case because the release weights are probably not spinning fast enough to stop the release of compression. This would occur when the engine fired and camshaft speed increased.
   c. To help pinpoint the low compression source, pour 15 cc (1/2 oz.) of four-stroke engine oil through the spark plug hole and into the cylinder. Turn the engine over to distribute the oil. Recheck compression. If compression increases, the piston rings are likely worn or damaged. If compression is the same, the piston, head gasket, valves or compression release are worn or damaged.

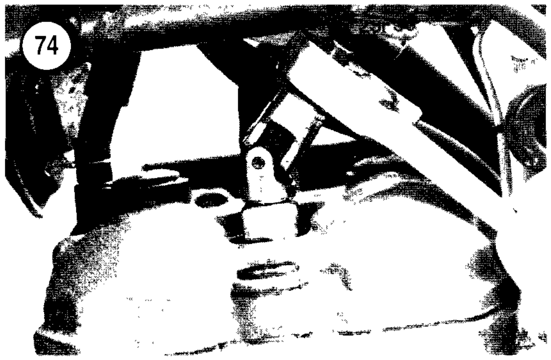
SPARK PLUGS

Removal

Careful removal of the spark plug is important in preventing grit from entering the combustion chamber. It is also important to know how to remove a plug that is seized or resistant to removal. Forcing a seized plug can damage the threads in the cylinder head.

1. Remove the fuel tank (Chapter Fifteen).
2. Clean the area around the spark plug cap (**Figure 73**), and then grasp the cap and twist it loose from the spark plug. There may be slight suction and resistance as the cap is removed.
3. Clean dirt from the plug well, preferably with compressed air.

4. Fit the spark plug socket onto the spark plug. If necessary, use a jointed or flexible extension (**Figure 74**) to reach to the bottom of the spark plug. Remove the spark plug by turning the wrench counterclockwise. If the plug is seized or drags excessively during removal, stop and perform the following:
   a. Apply a penetrating lubricant and allow it to soak in for 15 minutes.
   b. When the spark plug has been loosened, continue to apply penetrating lubricant around the spark plug threads. Slowly remove the plug, working it in and out of the cylinder.
   c. If the plug is completely seized and the motorcycle is still operable, install the spark plug cap and fuel tank, and then start the engine. Allow it to completely warm up. The heat of the engine may be enough to expand the parts and allow the plug to be removed.
   d. If necessary, clean and true the threads with a spark plug thread-chaser and extension.
5. Remove the spark plug. A magnetic tool is helpful in lifting the plug from the well (**Figure 75**).
6. Inspect the removed plug as described in this section to determine if the engine is operating properly.
7. A spark plug in good condition that is being reused after inspection, should be cleaned with electrical contact cleaner and a shop cloth. Do not use abrasives or wire brushes to clean the plugs. Do not reinstall a spark plug that was seized in the cylinder head.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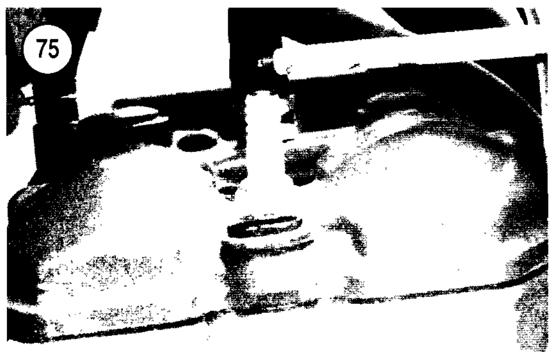
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Gap and Installation

Proper adjustment of the electrode gap is important for reliable and consistent spark. Also, the proper preparation of the spark plug threads ensures the plug can be removed easily in the future.

1. Refer to **Table 4** for the spark plug gap specification.
2. Insert a wire feeler gauge (the size of the required gap) between the center electrode and the ground electrode.
3. Pull the gauge through the gap. If there is slight drag, the setting is correct. If the gap is too large or small, adjust the gap by bending the ground electrode (**Figure 76**) to achieve the required gap. Use an adjusting tool (**Figure 77**) to bend the electrode. Do not pry the electrode with a screwdriver or other tool. Damage to the center electrode and insulator is possible.
4. Inspect the spark plug to ensure it is fitted with a crush washer.
5. Wipe a small amount of antiseize compound onto the spark plug threads. Do not allow the compound to get on the electrodes.
6. Finger-tighten the spark plug into the cylinder head. This ensures the plug is not cross-threading.
7. Tighten the spark plug to 11 N•m (8 ft.-lb.). If a torque wrench is not available, turn a new spark plug 1 4-1 2 turn from the seated position; a used spark plug 1 8-1 4 turn from the seated position.
8. Press and twist the cap onto the spark plug. The cap should fit tightly to the spark plug and be in good condition. A cap that does not seal and insulate the spark plug terminal can lead to flashover (shorting down the side of the plug), particularly when the motorcycle is operated in wet conditions. To help prevent water from migrating into the well, wipe a small amount of dielectric grease around the edge of the rubber seal before seating it in the well.

Selection

The following general information and operating fundamentals apply to all spark plugs. Before chang-

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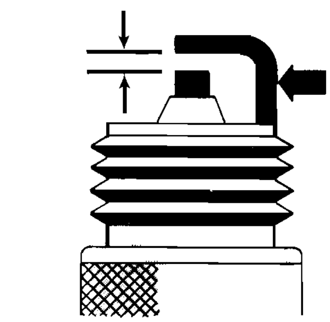

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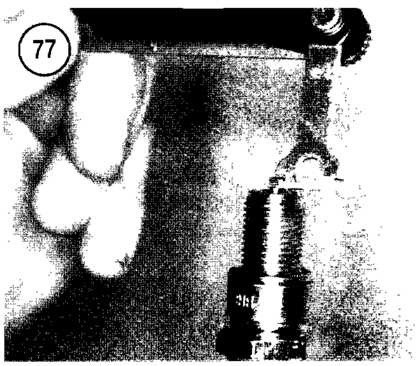

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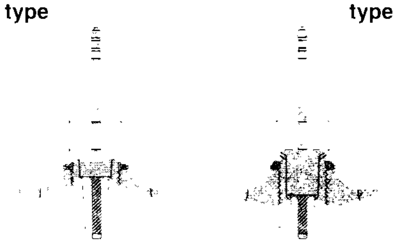


ing to a plug other than what is recommended by the manufacturer (**Table 4**), check with the spark plug manufacturer for specific equivalents that apply to this motorcycle. Poor performance or engine damage can occur by installing a non-compatible spark plug.

Replace/inspect the spark plug at the interval in **Table 1** or **Table 2**.

Heat range

Spark plugs are available in heat ranges to accommodate performance demands. The standard spark plug recommended by manufacturers is usually a medium heat-range plug that operates well over a wide range of conditions. As long as engine speeds vary, these plugs stay relatively clean and perform well.

If the engine is run in hot climates, at high speeds or under heavy loads for prolonged periods, a spark plug with a colder heat range is recommended. A colder plug quickly transfers heat away from its firing tip and to the cylinder head (**Figure 78**). This is accomplished by a short path up the ceramic insulator and into the body of the spark plug. By transferring heat quickly, the plug remains cool enough to avoid overheating and preignition problems. If the engine is run slowly for prolonged periods, this type of plug may foul and cause poor performance.

If the engine is run in cold climates or at slow speeds for prolonged periods, a spark plug with a hotter heat range is recommended. A hotter plug slowly transfers heat away from its firing tip and to the cylinder head. This is accomplished by a long path up the ceramic insulator and into the body of the spark plug (**Figure 78**). By transferring heat slowly, the plug remains hot enough to avoid fouling and buildup. If the engine is run in hot climates or fast for prolonged periods, this type of plug may overheat and cause preignition problems. Damage to the piston and cylinder assembly is possible.

If changing a spark plug to a different heat range, go one step hotter or colder from the recommended plug. Do not try to correct poor carburetor or ignition problems by using a different spark plug. This can only compound the existing problems and possibly lead to engine damage.

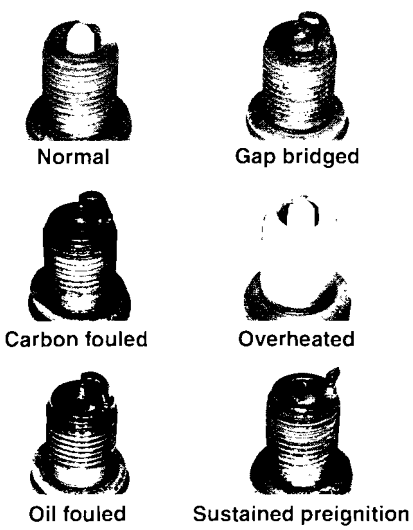
Reach

Reach is the length of the threaded portion of the plug. Always use a spark plug that is the correct reach. Too short of a reach can lead to deposits or burning of the exposed threads in the cylinder head. Misfiring can also occur since the tip of the plug is shrouded and not exposed to the fuel mixture. If the reach is too long, the exposed plug threads can burn, causing preignition. It is possible the piston may contact the plug on the upstroke, causing engine damage.

Reading

The spark plug is an excellent indicator of how the engine is operating. By correctly evaluating the condition of the plug, you can diagnose and pinpoint problems. Whenever removing the spark plug, compare the firing tip with the ones shown in **Figure 79**. The following provides a description, as well as a common cause for each of the conditions. In all cases, when the spark plug does not read normal, find the cause of the problem before continuing engine operation.

79 **SPARK PLUG CONDITIONS**



Normal

The plug has light tan or gray deposits on the tip. No erosion of the electrodes or abnormal gap is evident. This indicates an engine that has properly adjusted carburetion, ignition timing and proper fuel. This heat range of the plug is appropriate for the conditions in which the engine has been operated. The plug can be cleaned and reused.

Carbon fouled

The plug is black with a dry, sooty deposit on the entire plug surface. This dry sooty deposit is conductive and can create electrical paths that bypass the electrode gap. This often causes misfiring of the plug.
1. Fuel mixture too rich.
2. Spark plug heat range too cold.
3. Faulty ignition component.
4. Prolonged idling.
5. Clogged air filter.
6. Poor compression.

Oil fouled

The plug is wet with black, oily deposits on the electrodes and insulator. The electrodes do not show wear.
1. Incorrect carburetor jetting.
2. Prolonged idling or low idle speed.
3. Spark plug heat range too cold.
4. Worn valve guides.
5. Worn piston rings.
6. Ignition component failure.

Gap bridged

The plug is clogged with deposits between the electrodes. The electrodes do not show wear.
1. Incorrect oil being used.
2. Incorrect fuel or fuel contamination.
3. Carbon deposits in combustion chamber.
4. High-speed operation after excessive idling.

Overheated

The plug is dry and the insulator has a white or light gray cast. The insulator may also appear blistered. The electrodes may have a bluish-burnt appearance.
1. Fuel mixture too lean.
2. Spark plug heat range too hot.
3. Intake system air leak.
4. No crush washer on plug.
5. Plug improperly tightened.
6. Faulty ignition component.

Preignition

The plug electrodes are excessively eroded or melted. This condition can lead to engine damage.
1. Faulty ignition component.
2. Spark plug range too hot.
3. Intake system air leak.
4. Combustion chamber deposits.

Worn out

The plug electrodes are rounded from normal combustion. There is no indication of abnormal combustion or engine conditions. Replace the plug.

Table 1 MAINTENANCE AND LUBRICATION SCHEDULE (S AND SM MODELS)[1]

	Initial 500 miles or 800 km	Every 4000 miles or 6000 km	Every 7500 miles or 12,000 km	Other
Inspect tires and pressure				Monthly
Inspect/charge battery				Monthly
Inspect brake light operation				Monthly
Adjust and lubricate drive chain				Every 600 miles/ 300 km
Inspect air filter housing drain	x			As required
Inspect brake hoses and fluid level	x	x		Or monthly
Inspect brake pedal/lever adjustment	x	x		Or monthly
Change engine oil	x	x		Or annually
Check engine idle speed	x	x		
Inspect engine oil hoses	x	x		
Check throttle grip play	x	x		
Inspect/adjust clutch	x	x		
Inspect/replace brake pads	x	x		
Inspect/tighten spokes	x	x		
Inspect fasteners	x	x		
Replace engine oil filter	x		x	
Inspect/adjust steering bearings	x		x	
Clean air filter		x		Or as required
Inspect/replace spark plug		x		
Clean muffler		x		
Inspect/replace coolant hoses		x		
Inspect fuel hose		x		
Inspect drive chain, sprockets, slider, guide and guard		x		
Perform general lubrication		x		
Replace fork oil			x	
Inspect/lubricate swing arm linkage			x	
Inspect evaporative emission system[2]			x	
Replace air filter				Every 11,000 miles/18,000 km
Check valve clearance				Every 15,000 miles/24,000 km
Replace coolant				Every 2 years
Replace brake fluid				Every 2 years
Replace fuel hose				Every 4 years
Replace brake hoses				Every 4 years

1. The service intervals are suggested guidelines. If the motorcycle is operated in extreme conditions adjust the intervals accordingly.
2. California model only. Inspect/replace hoses and canister, as necessary.

Table 2 MAINTENANCE AND LUBRICATION SCHEDULE (E MODELS)*

	Initial 5 hours	Every 30 hours	Every 60 hours	Other
Clean air filter				Before each ride
Inspect tires and pressure				Before each ride
Inspect drive chain, sprockets, slider, guide and guard				Before each ride
Adjust and lubricate drive chain				Before each ride
Inspect/tighten spokes				Before each ride
Inspect air filter housing drain				As required
Inspect/charge battery				Monthly
Perform general lubrication	x			

(continued)

Table 2 MAINTENANCE AND LUBRICATION SCHEDULE (E MODELS)* (continued)

	Initial 5 hours	Every 30 hours	Every 60 hours	Other
Inspect/replace coolant hoses	x	x		
Inspect fuel hose	x	x		
Inspect brake hoses and fluid level	x	x		Or monthly
Inspect brake pedal/lever adjustment	x	x		Or monthly
Inspect engine oil hoses	x	x		
Check engine idle speed	x	x		
Check throttle grip play	x	x		
Inspect/adjust clutch	x	x		
Inspect/replace brake pads	x	x		
Inspect fasteners	x	x		
Change engine oil and filter	x		x	
Check valve clearance	x		x	
Inspect/adjust steering bearings	x		x	
Inspect/replace fork oil	x		x	
Inspect/lubricate swing arm linkage	x		x	
Inspect/replace spark plug		x		
Clean muffler		x		
Replace coolant				Every 2 years
Replace brake fluid				Every 2 years
Replace fuel hose				Every 4 years
Replace brake hoses				Every 4 years

*The service intervals are suggested guidelines. If the motorcycle is operated in extreme conditions adjust the intervals accordingly.

Table 3 FUEL, LUBRICANTS AND FLUIDS

Air filter	Foam air filter oil
Brake fluid type	DOT 4
Control cables	Cable lube
Cooling system capacity	1.25 liters (1.3 qt.)
Coolant type	Ethylene glycol containing anti-corrosion inhibitors for aluminum engines
Coolant mixture	50:50 (antifreeze/distilled water)
Drive chain	O-ring type chain lubricant
Engine oil	SG classified, or SH/SJ with JASO MA classification 4-stroke engine oil, SAE 10W-40
Acceptable grades for extreme temperatures	SAE 10W-30, 10W-50, 15W-40, 15W-50 or 20W-50
Engine oil capacity	
Engine rebuild	1.9 liters (2 qt.)
With filter change	1.8 liters (1.9 qt.)
Without filter change	1.7 liters (1.8 qt.)
Fork oil grade	Suzuki SS-05, or equivalent 5-weight fork oil
Fork oil capacity (each leg)	
E models	720 cc (24.3 oz.)
S models	710 cc (24.0 oz.)
SM models	
Inner	182 ml (6.15 oz.)
Outer	350 ml (11.8 oz.)
Fork tube oil level (from top edge of inner tube)	
E models (without spring)	
2000-on	122 mm (4.8 in.)
S models (without spring)	
2000 and 2001	165 mm (6.5 in.)
2002-on	129 mm (5.08 in.)
SM models	
2005-on	NA

(continued)

Table 3 FUEL, LUBRICANTS AND FLUIDS (continued)

Fuel type	
E models	Unleaded gasoline; 90 octane minimum (R+M/2) Unleaded gasoline; 95 octane minimum (RON)
S and SM models	Unleaded gasoline; 87 octane minimum (R+M/2) Unleaded gasoline; 91 octane minimum (RON)
Fuel tank capacity (including reserve)	10 liters (2.6 gal.)
Reserve capacity	2.3 liters (0.61 gal.)

Table 4 TUNE-UP SPECIFICATIONS

Compression (automatic compression release activated)	
S and SM models	950 kPa (138 psi)
E models	1000 kPa (145 psi)
Compression ratio	
E models	
except 2004 California model	12.2:1
California model	
2004	11.3:1
S and SM models	11.3:1
Idle speed	
E models	
except 2004 California model	1700-1900 rpm
California model	
2004	1500-1700 rpm
S and SM models	1400-1600 rpm
Ignition timing (not adjustable)	
E models	
except 2004 California model	7° BTDC at 1800 rpm
California	
2004	7° BTDC at 1600 rpm
S and SM models	7° BTDC at 1500 rpm
Oil pressure (engine warm)	40-140 kPa (5.8-20.3 psi) at 3000 rpm
Pilot mixture screw turns out	
E models	
except 2004 California model	1 1/2 turns out
2004 California	2 1/2 turns out
S models	3 1/2 turns out
SM models	3 turns out
Spark plug	
Type	NGK CR8E or Denso U24ESR-N
Gap	0.7-0.8 mm (0.028-0.031 in.)
Valve clearance	
Intake	0.10-0.20 mm (0.004-0.008 in.)
Exhaust	0.20-0.30 mm (0.008-0.012 in.)

Table 5 MAINTENANCE SPECIFICATIONS

Battery type and capacity	
2000 models	GT7B-4, 12 volt, 6.5 amp-hour
2001-on models	YT7B-BS, 12 volt, 6 amp-hour
Brake lever free play	0.1-0.3 mm (0.004-0.012 in.)
Brake pad lining minimum thickness	1.0 mm (0.040 in.)
Brake pedal height	0-10 mm (0-0.4 in.) below top of peg
Brake pedal to pushrod distance	10 mm (0.4 in.) minimum
Clutch lever free play	10-15 mm (0.4-0.6 in.) at lever end

(continued)

Table 5 MAINTENANCE SPECIFICATIONS (continued)

Cooling System	
Test Pressure (maximum)	137 kPa (20 psi)
Radiator cap relief pressure	95-125 kPa (13.8-18.1 psi)
Drive chain free play	40-50 mm (1.6-2.0 in.)
Drive chain length wear limit (20 pitch/21 pins)	319 mm (12.6 in.)
Rim runout (radial and lateral)	2.0 mm (0.08 in.)
Throttle cable	
exposed thread at carburetor	3.0 mm (0.12 in.)
Throttle grip free play	2-4 mm (0.08-0.16 in.)
Tire pressure	
E models	
Front	100 kPa (15 psi)
Rear	100 kPa (15 psi)
S models	
Front	125 kPa (18 psi)
Rear	150-175 kPa (22-25 psi)
SM models	
Front	175 kPa (25 psi)
Rear	220-225 kPa (29-33 psi)

Table 6 MAINTENANCE TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Axle nut			
Front*			
S and E models			
Initial	20	–	15
Final	42	–	31
SM models			
Initial	20	–	15
Final	39	–	29
Rear	100	–	74
Coolant air bleeder bolt	6	53	–
Cylinder head cover bolts	14	–	10
Exhaust system fasteners	23	–	17
Front axle pinch bolts	18	–	13
Handlebar clamp bolts	23	–	17
Muffler clamp	20	–	15
Muffler spark arrestor bolts	11	–	8
Oil drain plug			
Crankcase	21	–	15
Frame	18	–	13
Oil hose bolt and strainer	23	–	17
Spark plug	11	–	8
Spokes	3	27	–

*Refer to the text for tightening procedure.

CHAPTER FOUR

ENGINE TOP END

This chapter provides engine top end procedures. This includes the exhaust system, cylinder head, camshafts, valves, cylinder and piston. All the parts can be removed with the engine mounted in the frame. Refer to the **Tables 1-3** at the end of this chapter for specifications.

Read this chapter before performing any repair to the engine top end. Refer to Chapter One for general tool usage and techniques.

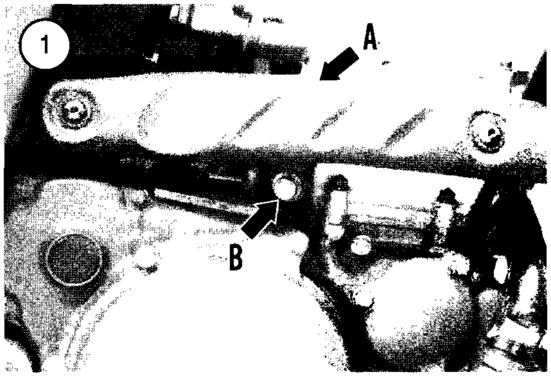
Always clean the engine before starting repairs. If the engine will remain in the frame, clean the surrounding framework, cables and harnesses.

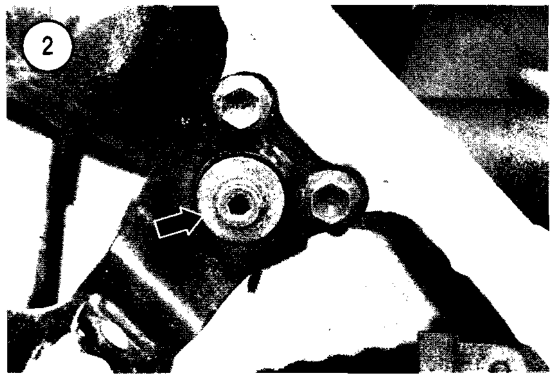
Keep the work environment as clean as possible. Store parts and assemblies in well-marked plastic bags and containers. Keep reconditioned parts wrapped until they are installed.

EXHAUST SYSTEM

Removal and Installation

1. Support the motorcycle so it is stable and secure.
2. Remove the right side cover (Chapter Fifteen).
3. Remove the muffler as follows:
   a. Remove the heat shield (A, **Figure 1**), and then loosen the clamp (B). Account for the washers and spacers when the heat shield is removed.
   b. Remove the bolt (**Figure 2**) and nut (**Figure 3**) securing the muffler to the frame.
   c. Pull the muffler from the exhaust pipe and out of the frame. Do not hammer on the muffler if it is stuck to the exhaust pipe. Twist the muffler off the pipe. If necessary, apply penetrating oil around the connection.
4. Remove the exhaust pipe as follows:
   a. Remove the nut and bolt (**Figure 4**) securing the exhaust pipe to the cylinder head. These fasteners are often corroded. To prevent thread damage, apply penetrating oil as needed during removal.
   b. Pull the exhaust pipe off the cylinder head.
   c. Remove the gasket from the exhaust port (**Figure 5**).





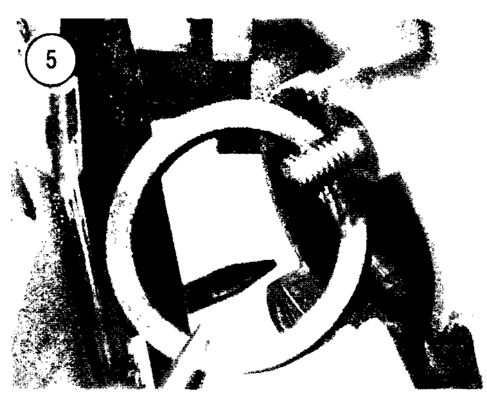
5. Reverse these steps to install the system. Note the following:
   a. Clean the exhaust port and install a new exhaust pipe gasket, seating it in the port before installing the exhaust pipe.
   b. Apply antiseize compound to all threads.
   c. Install and align the entire exhaust system with all fasteners finger-tight, and then tighten the exhaust pipe squarely into the exhaust port. Tighten the nut and bolt to 23 N•m (17 ft.-lb.).

CYLINDER HEAD COVER

Removal and Installation

CAUTION
The cylinder head cover is bolted to the camshaft caps. Set the engine at top dead center (TDC) whenever the cover is removed or installed. This removes all camshaft load from the caps.

1. Support the motorcycle so it is stable and secure.
2. Remove the fuel tank (Chapter Fifteen).
3. Remove the horn, fuel tank cushions and breather hoses (**Figure 6**).
4. Temporarily tape the wires, cables and hoses to the frame to provide maximum clearance.
5. Set the engine at TDC as follows:
   a. Remove the timing plug (A, **Figure 7**) and rotor nut plug (B). When the rotor nut plug is removed, engine oil slowly flows from the opening. If desired, drain the engine oil (Chapter Three).
   b. Fit a socket onto the rotor nut and turn the crankshaft *counterclockwise* until the T mark



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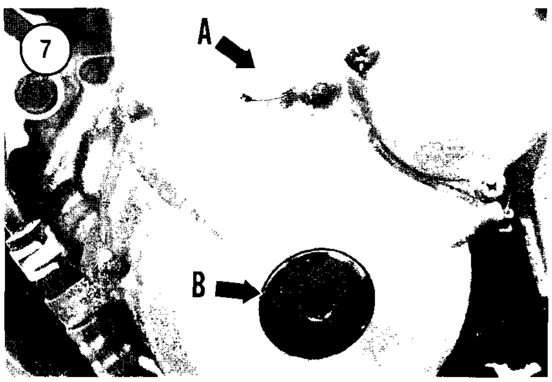

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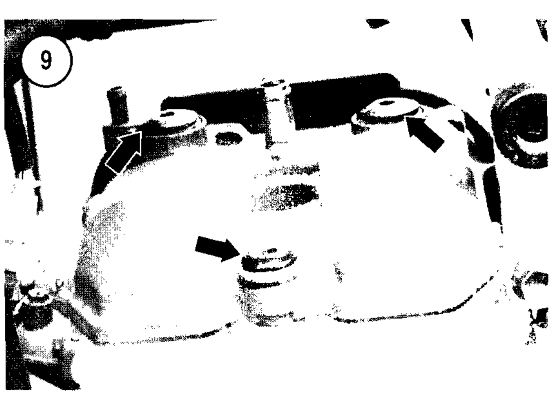

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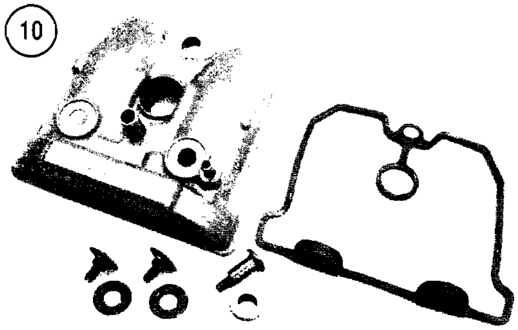
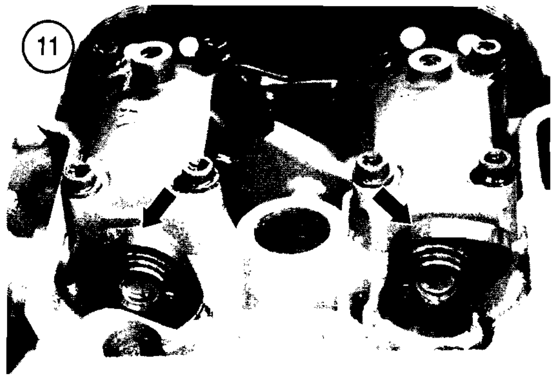


on the rotor is aligned in the center of the timing hole (**Figure 8**), on the compression stroke. If compression is not felt when making the alignment, turn the crankshaft one more revolution.

6. Remove the spark plug (Chapter Three).
7. Loosen the three cover bolts (**Figure 9**) in several passes and in a crossing pattern. Remove the bolts and washers when all the bolts are loose.
8. Raise the cylinder head cover and prevent damaging the rubber gasket. The gasket is adhered to the right side of the cylinder head and may separate itself from the cover. The gasket can be cleaned and reused if not damaged.
9. If necessary, refer to Chapter Three for valve clearance check and adjustment. If valve adjustment is required, refer to this chapter for camshaft removal.
10. Inspect the cover, gasket, bolts and washers (**Figure 10**).
   a. Clean all sealant and oil from the gasket.
   b. Replace the washers if the rubber seals are damaged or disintegrating. The rubber seals prevent oil leaks past the bolt heads. Lubricate both sides of the washers before installing.
11. Reverse this procedure to install the cover. Note the following:
   a. Verify the engine is at TDC by checking the camshaft lobes. If properly set, all camshaft lobes point *away* from the engine (**Figure 11**). If necessary, rotate the crankshaft one full turn and realign the T mark.
   b. Clean the gasket surface on the cylinder head. There can be no oil on the surface. *Lightly* apply Suzuki Bond 1207B silicone sealant (part No. 99104-31140, or equivalent) to the entire

length of the gasket surface on the right side of the cylinder head (**Figure 12**). This helps seal the plugs that are part of the gasket. Seat the gasket onto the cover (**Figure 13**), and then seat the cover onto the cylinder head.

c. Install the washers onto the cover bolts so the rubber face contacts the cover. Install the bolts.
d. Tighten the bolts in several passes and in a crossing pattern to 14 N•m (10 ft.-lb.). Do not overtighten the bolts.
e. Check that the plugs are seated and not distorted (**Figure 14**).
f. Tighten the timing hole plug to 23 N•m (17 ft.-lb.).
g. Inspect the spark plug and replace it, if necessary (Chapter Three).
h. Check the engine oil level.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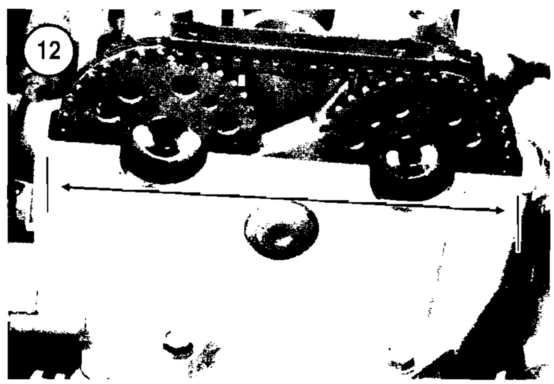
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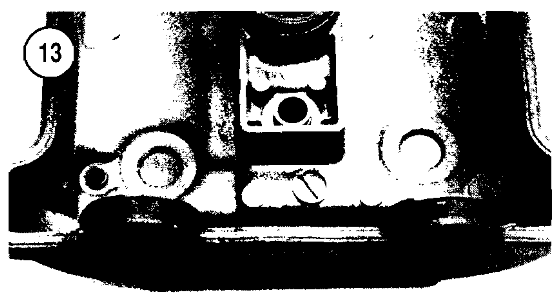
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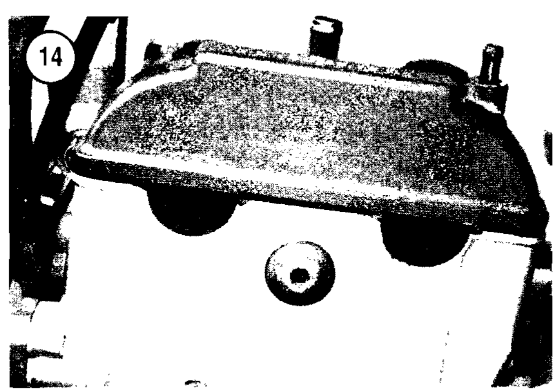
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CAMSHAFTS AND CAM CHAIN TENSIONER

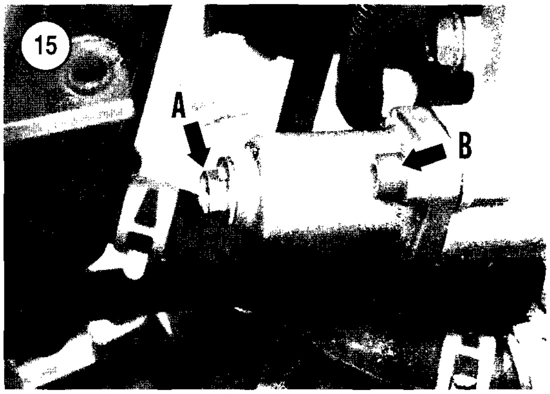
Removal

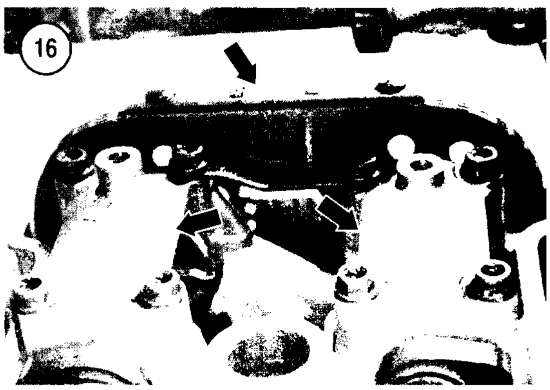
The camshafts and cam chain tensioner can be removed with the engine mounted in the frame. If performing the valve clearance check and adjustment (Chapter Three), the camshafts must be removed only when valve clearance is incorrect.

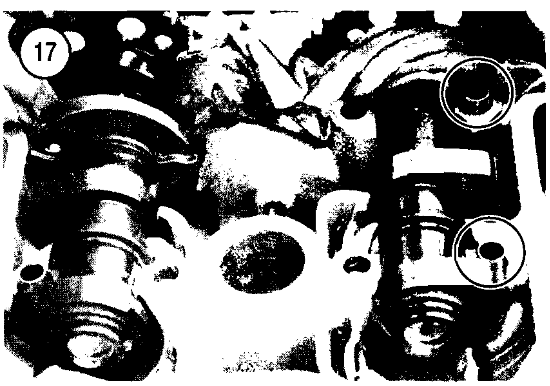
1. Remove the cylinder head cover as described in this chapter.
2. Measure and record the valve clearance for all valves. Incorrect clearances can be adjusted during the reassembly process, preventing removal of the camshafts a second time.
3. Remove the cam chain tensioner from the cam chain tunnel as follows:
   a. Remove the oil return tank so access to the tensioner is improved.
   b. Remove the center bolt (A, **Figure 15**). On 2003-on models, also remove the spring, which is under the center bolt.

CAUTION

When the tensioner mounting bolts are loosened, the tensioner must be completely removed and reset. Do not partially remove, and then retighten the bolts. The one-way plunger extends and locks itself. Retightening the bolts causes the cam chain and tensioner to







be too tight, possibly causing engine damage if the engine is operated. Also, do not turn the crankshaft when the tensioner is removed from the engine. Camshaft timing could be altered because of the slack in the cam chain. This also could cause engine damage if the engine is operated.

c. Remove the two mounting bolts (B, **Figure 15**), and then remove the tensioner and gasket.

4. Remove the camshaft caps and cam chain guide (**Figure 16**) as follows:
   a. Stuff clean shop cloths in the cam chain tunnel to prevent debris from entering the engine. If parts do fall into the tunnel, they do not enter the crankcase. The tunnel leads to the right end of the crankshaft, in the right crankcase cover.
   b. Loosen the camshaft cap bolts. Loosen each set of bolts in several passes and in a crossing pattern.
   c. Remove the chain guide and the bolt and cap sets. Slowly raise the caps straight up. If the caps are tight,use a small, soft mallet to loosen them. Do not pry on the caps or damage the machined surfaces. Account for the two dowels under each cap (**Figure 17**). The dowels may be loose and fall from the cap. If the dowels are tight in either the cap or cylinder head, they may be left in place. Keep all part sets identified.
5. Attach a length of wire to the cam chain to tension the chain. The side bolt, on the right side of the cylinder head, prevents the chain from falling into the engine. If the crankshaft must be turned while the cam chain is loose, keep tension on the chain to prevent the chain from binding on the crankshaft sprocket.
6. Raise the cam chain and remove the camshafts from the cylinder head. Secure the wire so it maintains tension on the cam chain.
7. Check that the cylinder head openings are properly covered to prevent debris from entering the engine.
8. Inspect the camshafts, caps and cam chain tensioner as described in this section.
   a. Reset the cam chain tensioner as described in the inspection procedure. The tensioner must be reset before installation.
   b. If necessary, refer to Chapter Six for cam chain removal and inspection.

Installation

1. Before installing the camshafts and cam chain tensioner, note the following:
   a. Valve clearance must be rechecked after the camshafts are installed. Adjust any valves that are out of specification as described in Chapter Three. If the valves were reconditioned, install

the original shims at this time. It is possible the camshafts will have to be removed a second time to correctly set the valves.

b. Make sure the cam chain tensioner is reset in the retracted position, as described in the inspection procedure.

c. Lubricate parts with engine oil during assembly.

2. Inspect the cylinder head and ensure that all surfaces are clean. Remove any shop cloths from the cam chain tunnel.

3. Make sure the engine is at TDC and remains in this position. If it is not at TDC, turn the crankshaft *counterclockwise* until the T mark on the rotor is aligned with the index mark in the timing hole (**Figure 18**).

4. Install and time the camshafts (**Figure 19**).

a. Identify the number 1 and number 2 arrows on the exhaust camshaft sprocket. The exhaust camshaft is fitted with the compression release mechanism (**Figure 20**).

b. Pull up on the tension side (front side) of the cam chain and install the exhaust camshaft. Place the chain on the sprocket. Check that the cam lobes point *away* from the engine.

c. Check that the engine is still at TDC when the number 1 arrow is aligned with the top of the cylinder head. If necessary, reposition the camshaft.

d. Beginning at the number 2 arrow on the exhaust camshaft sprocket, count and mark the 15th chain pin from the arrow. This pin must be aligned with the number 3 arrow on the intake camshaft sprocket.

e. Identify the number 3 arrow on the intake camshaft sprocket.

f. Keeping the chain taut, but seated on the exhaust cam sprocket, install the intake camshaft. Check that the cam lobes point *away* from the engine.

5. With the engine at TDC, inspect the installation.

a. The cam chain should be taut at the front and across the cam sprockets. The excess chain slack at the rear, between the intake camshaft and crankshaft sprocket, is taken up by the cam chain tensioner.

b. The number 1 arrow on the exhaust camshaft sprocket should point forward and be parallel to the top edge of the cylinder head.

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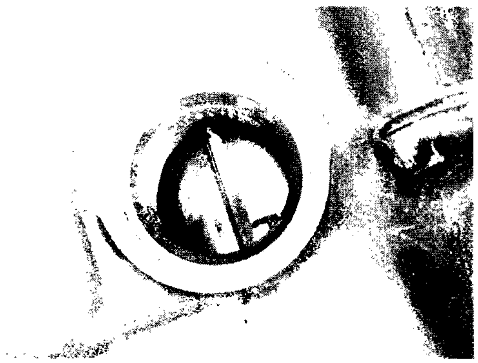

c. The number 2 arrow on the exhaust camshaft sprocket should point straight up.

d. The number 3 arrow on the intake camshaft sprocket should point straight up and be engaged 15 chain pins from the number 2 arrow on the exhaust camshaft sprocket.

6. Install the dowels, camshaft caps and cam chain guide as follows:

a. Cover the cam chain tunnel to prevent parts from entering the engine.

b. Install the two dowels (**Figure 17**) for each camshaft cap.

c. Identify and install the intake (IN) and exhaust (EX) camshaft caps. Orient the caps so the threads for the cylinder head cover bolts are located by the sprockets.

d. Install the cam chain guide on top of the camshaft caps, and then install and finger-tighten the bolts. The two long bolts must be installed at the right end of the exhaust camshaft cap (**Figure 21**).

CAUTION

Failure to evenly tighten the bolts could cause damage to the cylinder head, camshafts or caps.

e. For each camshaft, tighten the bolts in several passes and in a crossing pattern to 10 N•m (7 ft.-lb.).

CAUTION

If for any reason the tensioner mounting bolts are loosened, the tensioner must be completely removed and reset. Do not partially remove, and then retighten the bolts. The one-way plunger extends and locks itself. Retightening the bolts causes the cam chain and tensioner to be too tight,

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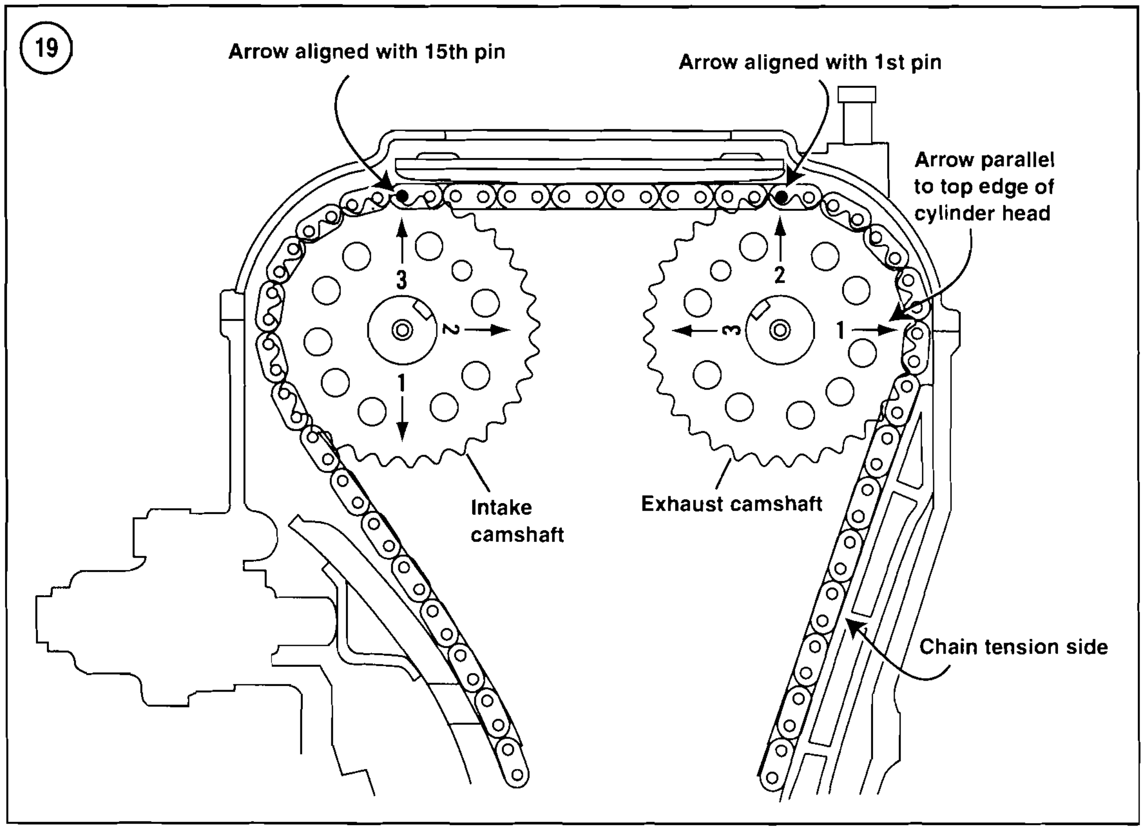

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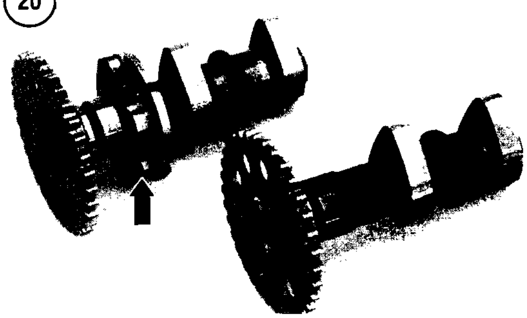

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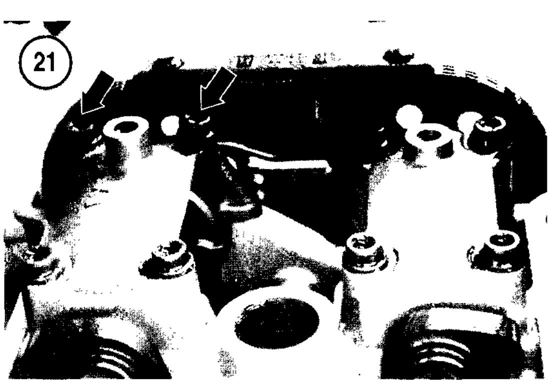

possibly causing engine damage if the engine is operated.

7. Install the cam chain tensioner as follows:
   a. Inspect the housing and determine if there is an UP mark. Early tensioners are not marked.
   b. Install a new gasket, the housing and the mounting bolts. Tighten the bolts to 10 N•m (7 ft.-lb.).
   c. On 2000-2002 models, insert a small flat-blade screwdriver into the back of the tensioner and turn the adjuster *counterclockwise* until the plunger is released (**Figure 22**). Install a new seal washer on the center bolts, and then tighten the bolt to 8 N•m (71 in.-lb.).
   d. On 2003-on models, install the seal washer and spring onto the center bolt (**Figure 23**), and then install and tighten the bolt to 30 N•m (22 ft.-lb.).

CAUTION

If abnormal resistance or noise is evident when turning the crankshaft, stop and recheck camshaft timing.

8. Remove any shop cloths from the cam chain tunnel, and then slowly turn the crankshaft *counterclockwise* several times. Place the crankshaft at TDC.
   a. Check that the camshaft sprocket marks are aligned as described in Step 5.
   b. Check valve clearances (Chapter Three). If necessary, remove the camshafts and install the proper size valve lifter shim(s).
9. Install the cylinder head cover as described in this chapter.

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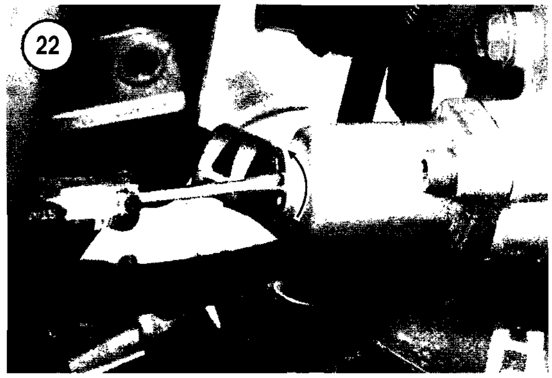

Inspection

Tensioner

The tensioner assembly is a spring-loaded, one-way tensioner. As the cam chain wears, the spring-loaded plunger extends and locks itself against the back of the rear chain guide. The guide then pivots forward and retightens the chain.

Because the tensioner is self-adjusting, there is no routine maintenance required. However, when the tensioner is loosened or removed, it must be reset. Do not partially remove and retighten the bolts. The plunger extends and locks itself. Retightening the bolts causes the cam chain and tensioner to be too tight, possibly causing engine damage if the engine is operated.

Two types of tensioners have been used on this engine, but both operate the same. The tensioners differ in how they are reset before installation into the engine.

1. Inspect the parts for cleanliness and damage.
2. Apply engine oil to the plunger.
3. Install a new gasket and seal washer during installation.
4. On 2000-2002 models, reset the plunger as follows:
   a. Insert a small flat-blade screwdriver into the back of the tensioner and turn the adjuster *clockwise* until the plunger is fully retracted and locked (**Figure 24**). The plunger is under spring pressure and resistance should be felt as the screwdriver is turned. If the plunger does not fully retract or does not stay locked in the tensioner housing, replace the tensioner.
   b. Do not install the center bolt until the tensioner housing has been mounted.

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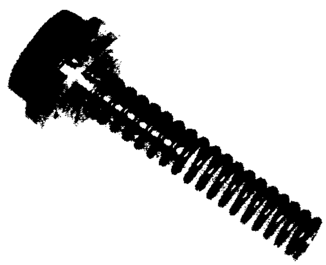

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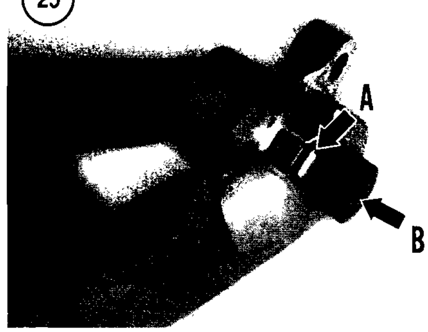

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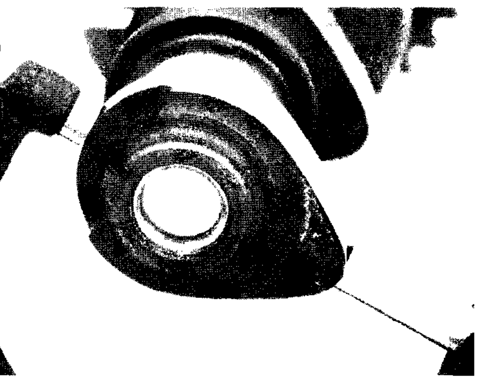

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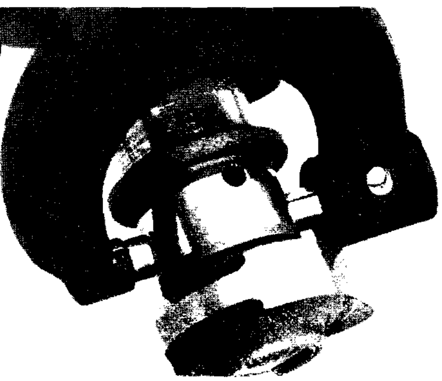

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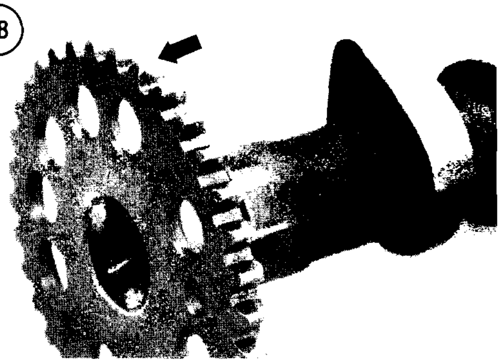

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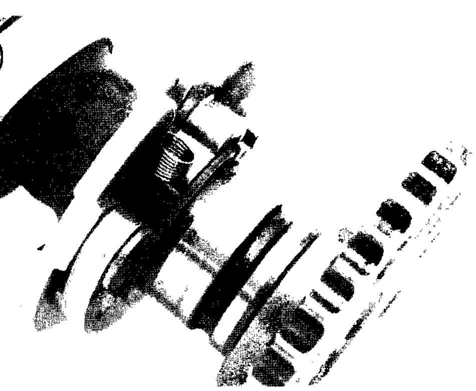


5. For 2003-on models, reset the plunger as follows:
   a. Remove the center bolt and spring from the tensioner.
   b. Press and hold the ratchet release (A, **Figure 25**).
   c. Press and seat the plunger (B, **Figure 25**) into the tensioner housing. If the plunger does not fully retract or does not stay in the tensioner housing, replace the tensioner.
   d. Do not install the spring, washer and center bolt until the tensioner housing has been mounted.

Camshafts

The automatic compression release mechanism is located at the right end of the exhaust camshaft. The release slightly opens the right exhaust valve during engine cranking. The reduction in compression makes starting easier. When the engine starts, the release is centrifugally disengaged.

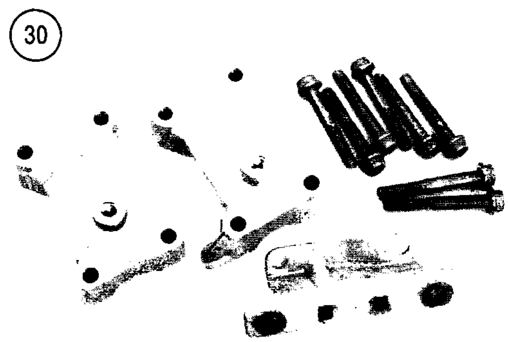
Refer to **Table 2** for specifications.

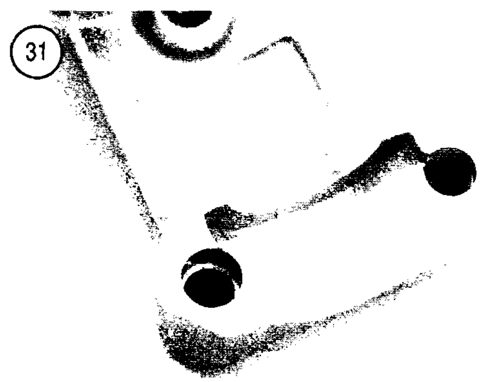
1. Clean the camshafts in solvent and dry with compressed air. Use care when drying the compression release mechansim.
2. Inspect the camshafts for scoring or damage. If cam lobe damage is detected, also inspect the mating valve lifter for damage.
3. For each camshaft, make the following checks. Record all measurements.
   a. Measure the cam lobe heights (**Figure 26**) with a micrometer.
   b. Measure the camshaft journal outside diameter, where the cap fits over the camshaft (**Figure 27**).
   c. Support the camshaft in V-blocks and measure shaft runout.
   d. Inspect the camshaft sprocket teeth (**Figure 28**) for wear or other damage. The profile of each tooth should be symmetrical. If a sprocket is worn, replace the camshafts and the cam chain as a set. When this type of damage occurs, the crankshaft sprocket, cam chain tensioner and chain guides should also be inspected for damage.
4. Inspect the automatic compression release (**Figure 29**), located on the exhaust camshaft.
   a. Inspect the spring for damage.

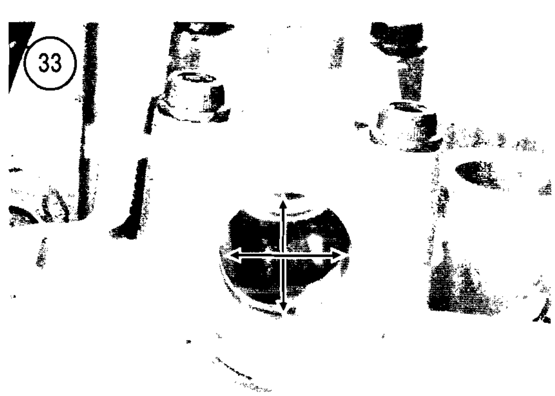
b. Pivot the weights outward and check for smooth operation. When the weights are pivoted and released, the spring should fully retract the weights.

Camshaft caps

1. Clean the camshaft caps, bolts and chain guide (**Figure 30**) in solvent and dry with compressed air. Clean and handle the caps individually, preventing any damage to the bearing surfaces.
2. For each camshaft cap, check the following:
   a. Check all threads and bores for cleanliness.
   b. Inspect the bearing surface in the cap (**Figure 31**) and the mating bearing surface in the journal holder (**Figure 32**). Check for scoring, galling or other damage. If either part is damaged, the caps and cylinder head must be replaced as a set. The caps are machined with the cylinder head, so their dimensions and alignments are unique to that cylinder head.
   c. Install the dowels and camshaft caps, and then tighten the bolts in several passes and in a crossing pattern to 10 N•m (7 ft.-lb.). Measure the inside diameter of the assembled journal holder in several directions (**Figure 33**). Record the measurements.
3. Determine the journal oil clearance (**Table 2**) by subtracting the appropriate camshaft journal outside diameter from the appropriate journal holder inside diameter.







CYLINDER HEAD

Removal

The cylinder head can be removed with the engine mounted in the frame.

1. Remove the exhaust pipe as described in this chapter.
2. Remove the carburetor (Chapter Eight).
3. Drain the engine coolant (Chapter Three).
4. Remove the upper engine mounting bracket (**Figure 34**).
5. Remove the cylinder head cover, camshafts and cam chain tensioner as described in this chapter.
6. Remove each valve lifter and shim set as follows:
   a. Use a magnetic tool and raise the lifter straight up (**Figure 35**).

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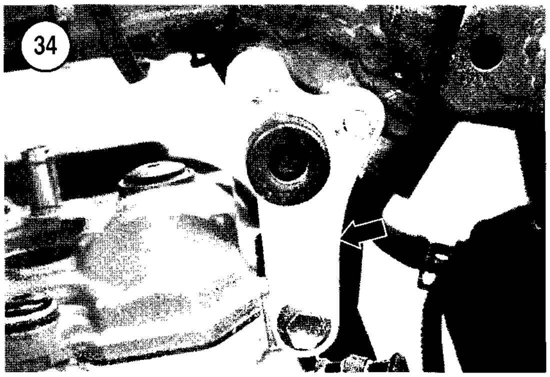

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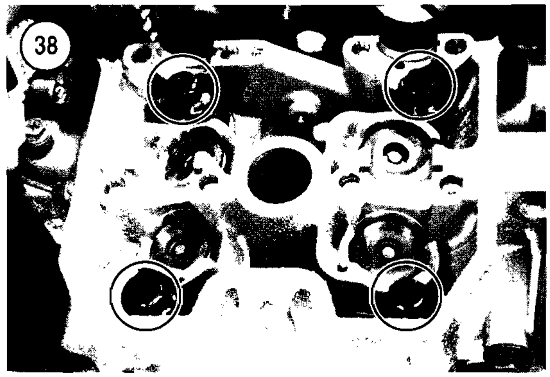

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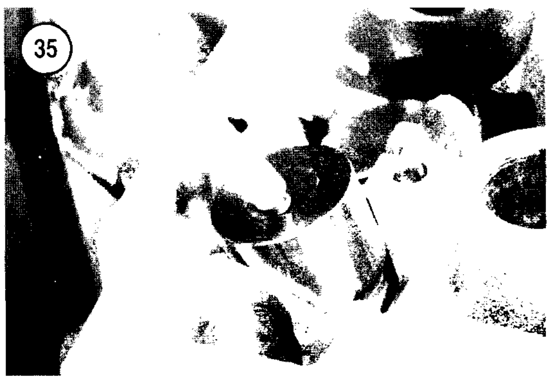

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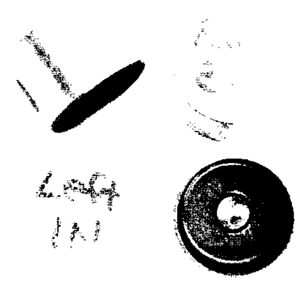

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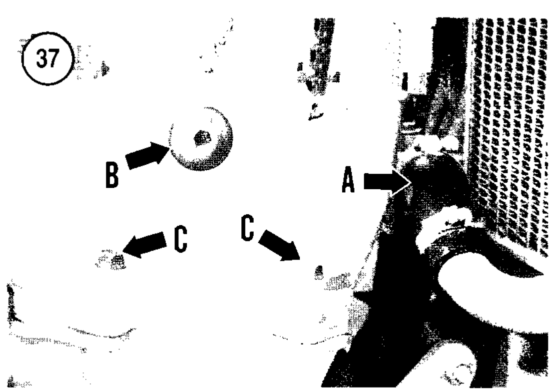

b. Lift out the valve shim resting on top of the valve stem.
c. Inspect each set of parts as they are removed. Both parts should be smooth on all surfaces. Light polishing on the shim, where it contacts the valve stem, is normal.
d. Mark the parts with their locations in the cylinder head (**Figure 36**). The shims vary in thicknesses and must be installed in their original positions.

7. Disconnect the coolant hose (A, **Figure 37**) from the front of the cylinder.
8. With the cam chain securely wired, remove the side bolt (B, **Figure 37**) from the cylinder. With the side bolt removed, the cam chain can fall into the right crankcase cover.
9. Remove the two 6-mm cylinder head bolts (C, **Figure 37**) and the two cylinder mounting nuts, directly below the bolts.

CAUTION
Do not loosen the 10-mm cylinder head bolts before removing the smaller fasteners in Step 9. Doing so overstresses the smaller fasteners.

10. Loosen the 10-mm cylinder head bolts (**Figure 38**) in several passes and in a criss cross pattern. Account for the washer on each bolt.
11. Loosen the cylinder head by lightly tapping around its base with a soft mallet. Lift the head out of the engine while routing the cam chain out of the head. Secure the chain so it does not fall into the engine.
12. Stuff clean shop cloths into the cam chain tunnel, and then remove the head gasket and two dowels (**Figure 39**). If removing the cylinder, remove the front cam chain guide at this time.

13. At the workbench, remove the thermostat housing, thermostat (S models [Chapter Ten]) and carburetor intake duct (Chapter Eight).
14. If necessary, remove and inspect the valve assembly as described in this chapter.
15. Wash the cylinder head components in solvent and dry with compressed air. Note the following:
   a. Remove all gasket residue from the cylinder head and cylinder. Do not scratch or gouge the surfaces.
   b. Remove all carbon deposits from the combustion chamber. Use solvent and a soft brush or hardwood scraper. Do not use sharp-edged tools that could scratch the valves, valve seats or combustion chamber. If the piston crown is cleaned, keep solvent and carbon deposits out of the gap between the piston and cylinder.
   c. If bead-blasting the cylinder head, wash the entire assembly in hot soapy water after it has been reconditioned. Clean and chase all threads to ensure no grit remains.
16. Inspect the cylinder head as described in this section.

Inspection

When the cylinder head is removed, test the valves for leaks with a solvent test. Refer to *Valves* in this chapter.

1. Inspect the spark plug hole threads. If the threads are dirty or mildly damaged, use a spark plug thread tap to clean and straighten the threads. Keep the tap lubricated while cleaning the threads. If the threads are galled, stripped or cross-threaded, fit the cylinder head with a steel thread insert.
2. Inspect the combustion chamber side of the cylinder head.
   a. Inspect for cracks, damage and buildup in the combustion chamber, water jackets and exhaust port.
   b. Inspect the threads for damage or looseness.
3. Inspect the camshaft side of the cylinder head.
   a. Inspect for cracks or damage around the camshaft journal holders (**Figure 40**) and spark plug hole. If cracks are found anywhere in the cylinder head, take the head to a dealership or machine shop to see if the head can be repaired. If not, replace the head and camshaft cap set.
   b. Inspect the oil passages for cleanliness.

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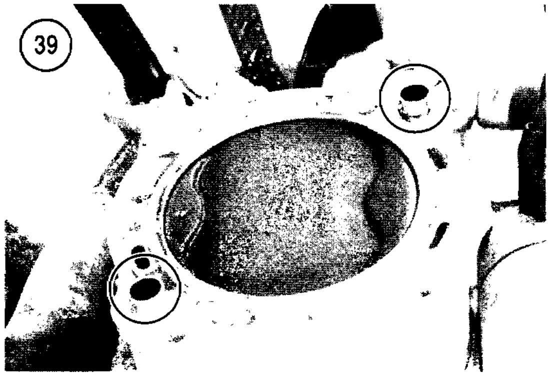

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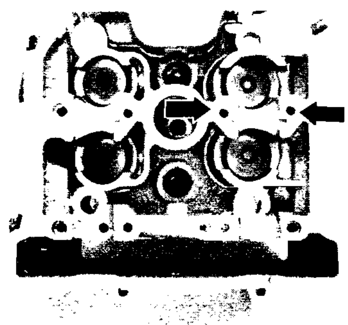

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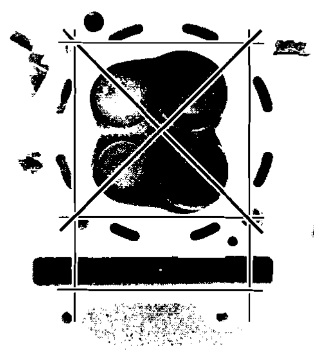

4. Inspect the cylinder head for warp as follows:
   a. Lay a machinist's straightedge across the cylinder head at the positions shown in **Figure 41**.
   b. Try to insert a flat feeler gauge between the straightedge and the machined surface of the head. If clearance exists, record the maximum measurement.
   c. Compare the measurements to the service limit in **Table 2**. If the clearance is not within the service limit, take the cylinder head to a

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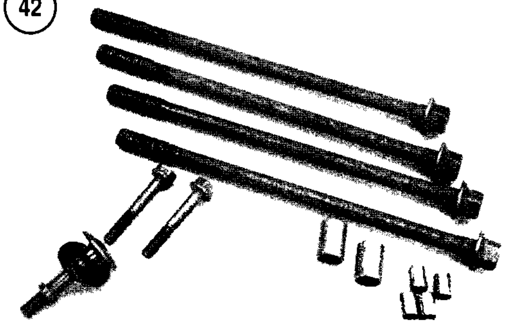

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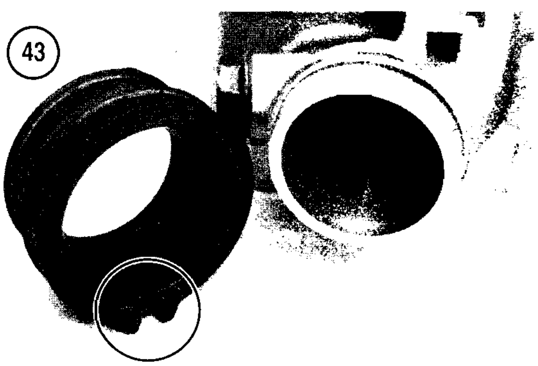

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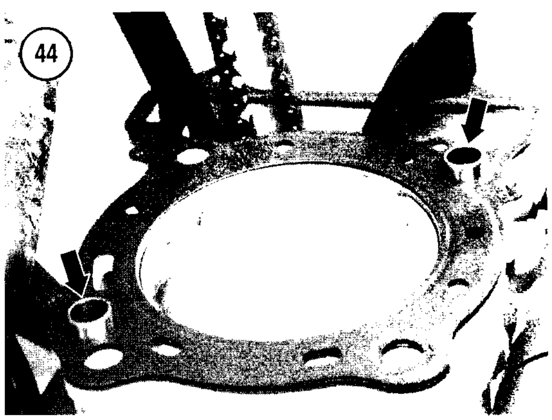


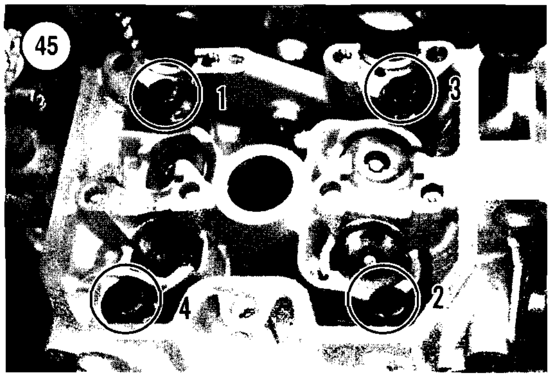
dealership or machine shop for further inspection and possible resurfacing.

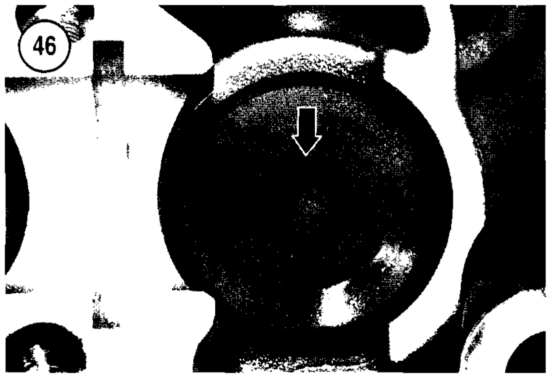
5. Inspect the cylinder head bolts, side bolt, washers and dowels for damage (**Figure 42**). Check the fit of the cylinder head dowels and camshaft cap dowels before installing the cylinder head. Often dowels fit in one location better than another. Match the dowels to the bores to prevent binding during assembly.

6. Assemble and install the cylinder head as described in this section.

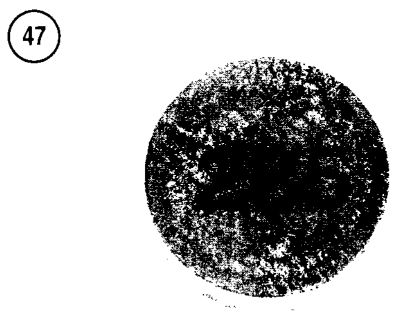
Installation

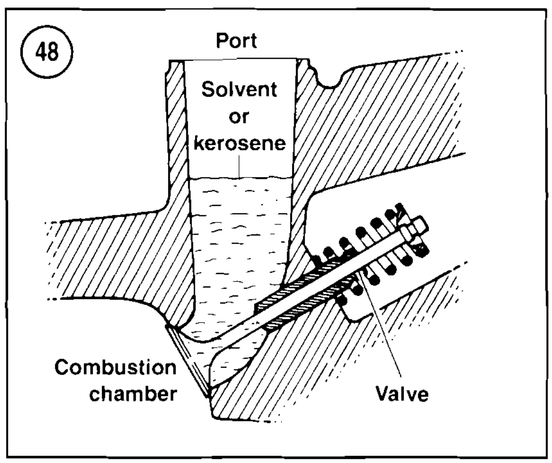
1. Note the following:
   a. Check that all gasket residue is removed from all mating surfaces. All cylinder head surfaces must be clean and dry.
   b. The valve lifters and shims can be installed after the cylinder head is installed.
2. Install the following parts onto the cylinder head:
   a. Carburetor intake duct. Check that the lock on the duct (**Figure 43**) fits around the block below the intake port.
   b. Thermostat housing. On S models, also install the thermostat. Tighten the bolts to 10 N•m (7 ft.-lb.).
3. Insert the dowels (**Figure 44**) and a new cylinder head gasket on the cylinder.
4. Lower the cylinder head onto the engine, routing the cam chain through the head.
   a. Keep adequate tension on the cam chain so it does not bind at the crankshaft sprocket. Secure the cam chain when the cylinder head is seated. If desired, install and finger-tighten the side bolt, passing it between the chain. This prevents the chain from falling into the right crankcase cover if the chain is mishandled.
   b. Make sure not to dislodge the dowels as the cylinder head is positioned.
   c. Cover engine openings as needed.
5. Install and tighten the 10-mm cylinder head bolts as follows:
   a. Apply engine oil to the bolt heads, threads and washers.
   b. Install the washers with the rounded sides facing up (against the bolt head).
   c. Tighten the bolts in sequence as shown in **Figure 45**.
   d. Tighten the bolts in two passes. In the first pass, tighten the bolts to 25 N•m (18 ft.-lb.). In the second pass, tighten the bolts to 46 N•m (34 ft.-lb.).
6. Tighten the 6-mm cylinder head bolts (C, **Figure 37**) and cylinder mounting nuts. Tighten the bolts and nuts to 10 N•m (7 ft.-lb.).
7. Tighten the side bolt to 14 N•m (10 ft.-lb.).





8. Install the shim and valve lifter sets in their appropriate locations as follows:
   a. Lubricate the parts with engine oil, and then seat the shim on top of the valve stem (**Figure 46**). If the shim size is visible (**Figure 47**), place the number facing up so it does not get worn away by the valve.
   b. If the valve assembly was not reconditioned or disturbed when the cylinder head was removed, reinstall the original shim. If clearance was incorrect before the head was removed, refer to the valve adjustment procedure in Chapter Three. If the valves were reconditioned, install the original shim at this time. Valve clearance must br rechecked after the camshafts are installed.
   c. Slide the valve lifter into place over the valve and shim assembly.
9. Install the camshafts, cam chain tensioner and cylinder head cover as described in this chapter.
10. Install the upper engine mounting bracket (**Figure 34**). Tighten the bracket to frame bolts to 40 N•m (30 ft.-lb.). Tighten the bracket to engine bolt to 66 N•m (49 ft.-lb.).
11. Install the engine coolant (Chapter Three).
12. Install the carburetor (Chapter Eight).
13. Install the exhaust pipe as described in this chapter.





VALVES

Solvent Test

A solvent test is performed with the valves installed. The test can reveal if valves are seating, as well as expose cracks in the cylinder head.

1. Remove the cylinder head as described in this chapter.
2. Check that the combustion chamber is dry and the valves are seated.
3. Support the cylinder head so the port faces up (**Figure 48**).
4. Pour solvent or kerosene into the port.
5. Inspect the combustion chamber for leaks around the valves.
6. Repeat Steps 3-5 for the other valves.
7. If leaks are detected, they can be caused by:

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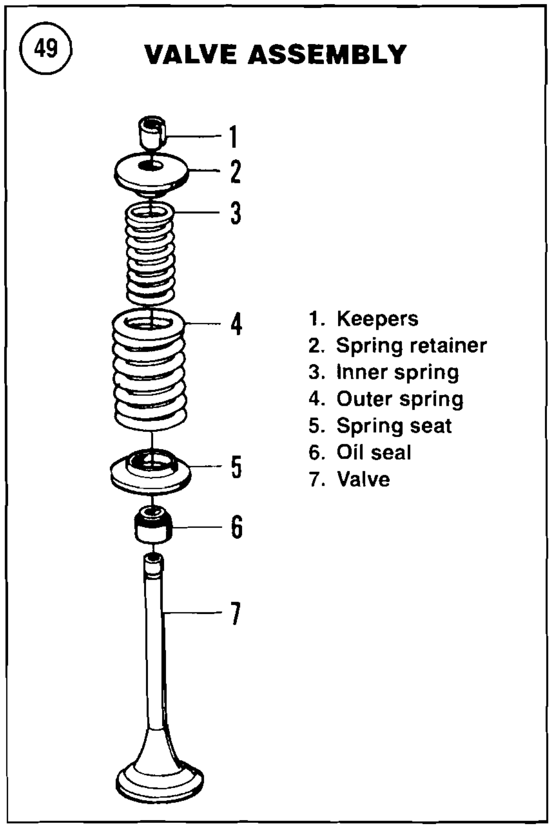

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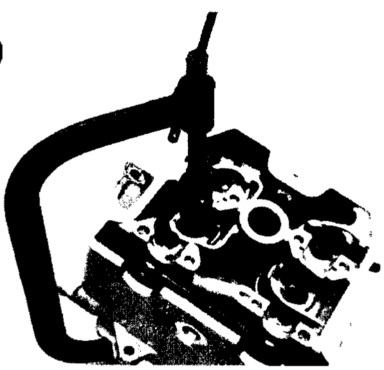

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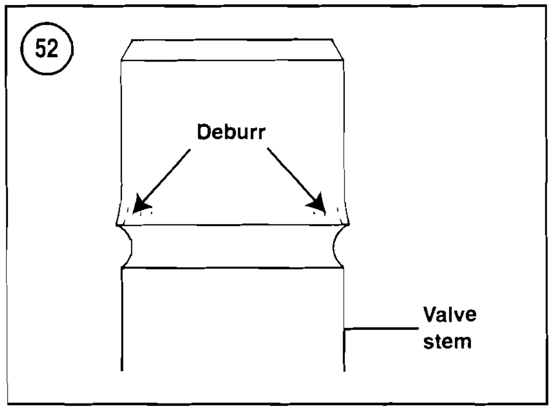

a. A worn or damaged valve face.
b. A worn or damaged valve seat (in the cylinder head).
c. A bent valve stem.
d. A crack in the combustion chamber.

Removal

Refer to **Figure 49**.

1. Remove the cylinder head, valve lifters and shims as described in this chapter.
2. Perform the *Solvent Test* described in this section.
3. Install a valve spring compressor (Suzuki part No. 09916-14510, or equivalent) and adapter (Suzuki part No. 09916-14910, or equivalent) over the valve assembly. Fit the stationary end of the tool squarely over the valve head. Fit the other end of the tool squarely on the spring retainer (**Figure 50**).

CAUTION
Do not overtighten and compress the valve springs. This can cause loss of valve spring tension.

4. Tighten the compressor until the spring retainer no longer holds the valve keepers in position. Lift the keepers from the valve stem. A magnetic tool works well (**Figure 51**).
5. Slowly relieve the pressure on the valve springs and remove the compressor from the head.
6. Remove the spring retainer, valve springs and spring seat.
7. Inspect the valve stem for sharp and flared metal (**Figure 52**) around the groove for the keepers. If necessary, deburr the valve stem before removing

the valve from the head. Burrs on the valve stem can damage the valve guide.

8. Remove the valve from the cylinder head.
9. Remove the oil seal with needlenose pliers. Avoid gripping the inside of the valve guide.
10. As each valve assembly is removed (**Figure 53**), store the parts with the shim and valve lifter for that location. Valve components that are within specification must be installed in their original positions. The oil seal will be replaced.
11. Repeat Steps 3-10 for the remaining valves.

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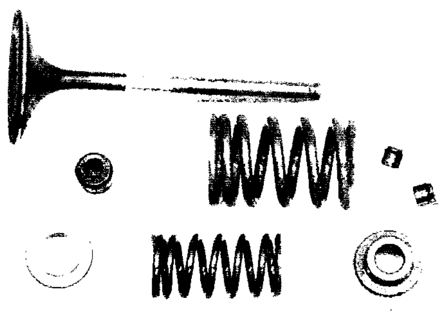

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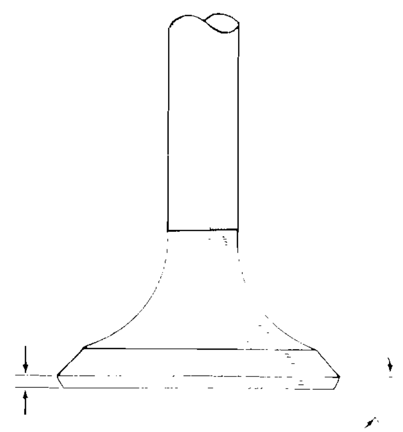

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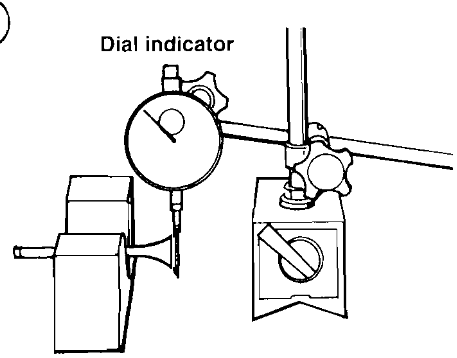

Inspection

During the cleaning and inspection of the valve assemblies, do not allow the parts sets to get intermixed. Work with one set at a time, repeating the procedure until all parts are inspected. After each set is inspected, return them to their storage container. If the valves, valve guides and valve seats require replacement or reconditioning, it is recommended that the work be done by a dealership. Replacement and servicing requires special tools. Refer to **Table 2** for specifications.

CAUTION
The valve seating surface is a critical surface and must not be damaged. Do not scrape on the seating surface or place the valve where it could roll off the work surface.

1. Clean the valve assembly in solvent.
2. Inspect the valve head as follows:
   a. Inspect the top and perimeter of each valve. Check for burning or other damage on the top and seating surface. Replace the valve if damage is evident. If the valve head appears uniform with only minor wear, the valve can be lapped and reused, if the other valve measurements are acceptable.
   b. Measure the margin, or thickness (**Figure 54**), and record the measurement.
   c. Mount the valve in a V-block and measure the radial runout of the valve head (**Figure 55**). Record the measurement.
3. Inspect the valve stem as follows:
   a. Inspect the stem for wear and scoring. Also check the end of the valve stem for flare.
   b. Measure the valve stem diameter in several locations that contact the valve guide (**Figure 56**). Record the measurements.
   c. Check the valve stem for runout. Place the valve in a V-block and measure runout with a dial indicator (**Figure 57**). Record the measurement.

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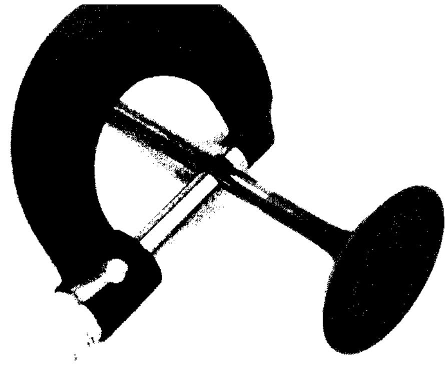

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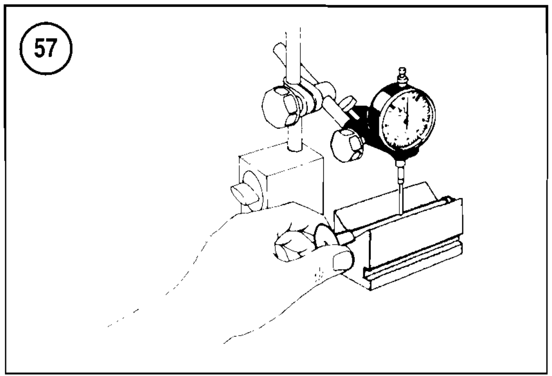

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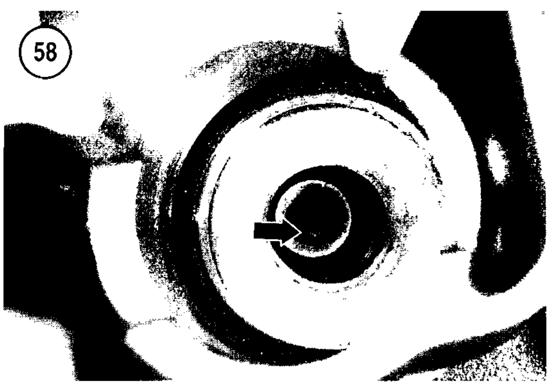

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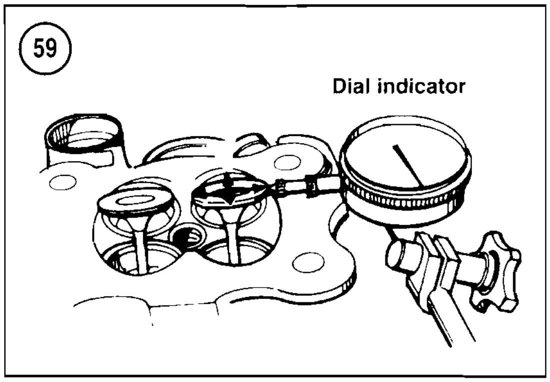

NOTE
In the following step, perform at least one of the inspections to determine the amount of wear between the valve stem and valve guide.

4. Clean the valve guides (**Figure 58**) so they are free of all carbon and varnish. Use solvent and a stiff, narrow brush.

5A. If a small hole gauge and micrometer are available, determine the valve guide to valve stem clearance as follows:

a. Measure each valve guide hole at the top, center and bottom. Record the measurements.
b. The difference between the valve stem diameter and the inside diameter of the valve guide is the clearance.

5B. If a dial indicator and stand are available, determine the valve guide to valve stem wear by measuring the valve stem deflection as follows:

a. Insert the appropriate valve into the guide, keeping the valve about 10 mm (0.4 in.) above the valve seat. Place the dial indicator in contact with the edge of the valve (**Figure 59**, typical).
b. Move the valve stem side to side in the valve guide. Record the measurement. Repeat the procedure, measuring in several directions. The largest measurement recorded is the valve stem deflection.

5C. If measuring tools are not available, inspect the valve guides as follows:

a. Insert the appropriate valve into the guide.
b. With the valve head off the seat about 10 mm (0.4 in.), move the valve stem side to side in the valve guide. Move the valve in several directions, checking for obvious perceptible play. If movement is easily detected, the valve guide and/or valve is worn. Take the valves and cylinder head to a dealership and have the parts accurately measured to determine the extent of wear.

6. Check the inner and outer valve springs as follows:

a. Visually check the springs for damage.
b. Measure the length of each valve spring (**Figure 60**).

7. Inspect the spring seat, spring retainer and keepers for wear or damage.

8. Inspect the seats on the valve and cylinder head (**Figure 61**) to determine if they must be reconditioned.
   a. Clean and dry the valve seat and valve mating area with contact cleaner.
   b. Coat the valve seat with machinist's marking fluid.
   c. Install the appropriate valve into the guide, and then *lightly* tap the valve against the seat so the fluid transfers to the valve contact area. Do not rotate the valve.
   d. Remove the valve from the guide and measure the imprinted valve seat width (**Figure 62**) at several locations. Refer to **Table 2** for specifications.
   e. Clean all marking fluid from the valves and seats.

Installation

Perform the following procedure for each set of valve components (**Figure 49**).

1. Make sure all components are clean and dry.
2. Coat the valve stem and interior of the oil seal with molybdenum disulfide grease.
3. Install a new oil seal on the valve guide, checking that the retainer seats onto the seal and valve guide.
4. Install the spring seat.
5. Insert the appropriate valve into the cylinder head. Rotate the valve stem as it enters and passes through the seal. Check that the seal remains seated, and then hold the valve in place.
6. Install the inner and outer valve springs with the *small* coil pitch facing down (**Figure 63**).
7. Install the spring retainer.
8. Install a valve spring compressor over the valve assembly. Fit the tool squarely onto the spring retainer.

CAUTION
Do not overtighten the compressor. This can cause loss of valve spring tension.

9. Tighten the compressor until the spring retainer is compressed enough to install the valve keepers.
10. Insert the keepers around the groove in the valve stem (**Figure 64**).
11. Slowly relieve the pressure on the spring retainer, and then remove the compressor from the head.

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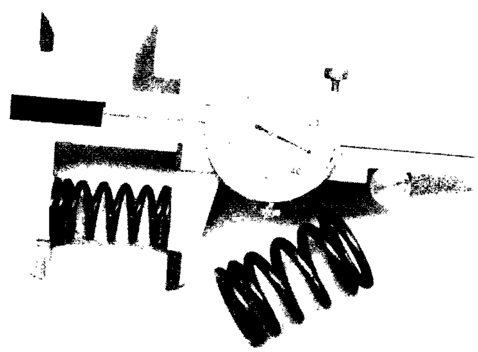

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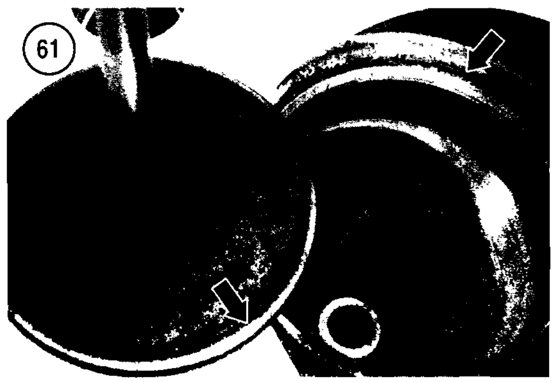

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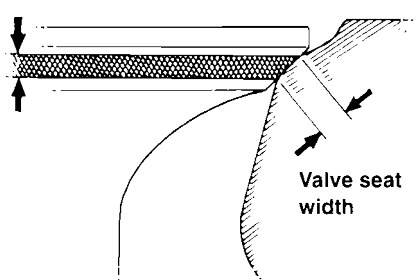

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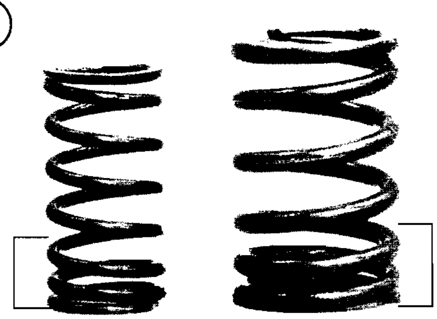

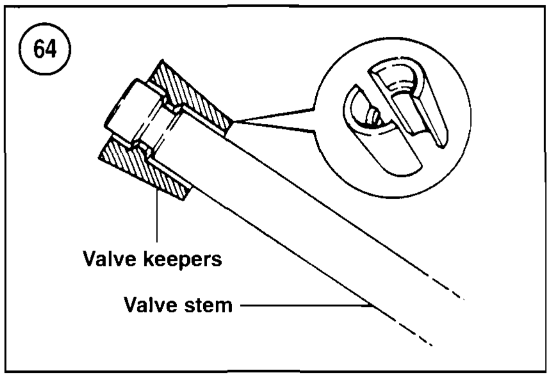

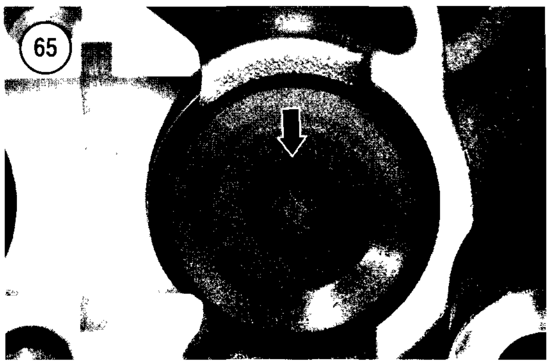

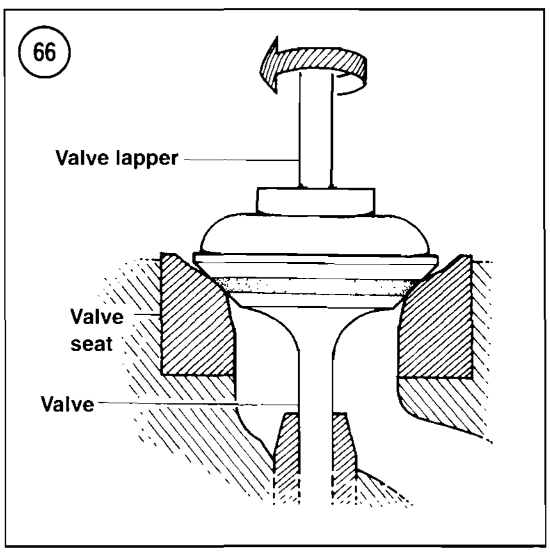

12. Tap the end of the valve stem with a soft mallet to ensure the keepers are seated in the valve stem groove (**Figure 65**).
13. After all valves are installed, perform the solvent test as described in this section.
14. Install the cylinder head as described in this chapter.

Valve Lapping

Valve lapping matches the seal between the valve seat and valve contact area without machining. Valves that are in good condition can be lapped to restore the seating area. Always lap the reconditioned valve to match the seats to one another.

1. Lightly coat the valve face with fine-grade lapping compound.
2. Lubricate the valve stem, and then insert the valve into the head.
3. Wet the suction cup on the lapping tool and press it onto the head of the valve (**Figure 66**).
4. Spin the tool back and forth between the hands to lap the valve to the seat. Every 5 to 10 seconds, rotate the valve 180° and continue to lap the valve into the seat.
5. Frequently inspect the valve seat. Stop lapping the valve when the valve seat is smooth, even and polished (**Figure 67**). Keep each lapped valve identified so it can be installed in the correct seat during assembly.
6. Clean the valves and cylinder head in solvent and remove all lapping compound. Any abrasive in the head causes premature wear to engine parts.
7. After the valves are installed in the head, perform the *Solvent Test* described in this section. If leaks are detected, remove that valve and repeat the lapping process.

CYLINDER

Removal

The cylinder and piston can be removed with the engine mounted in the frame.

1. Remove the cylinder head as described in this chapter.
2. Remove the front cam chain guide.
3. Remove the oil return tank hose at the back of the cylinder (A, **Figure 68**).
4. Remove the cylinder mounting nuts (B, **Figure 68**).
5. Loosen the cylinder by tapping around the base with a soft mallet. If necessary, apply penetrating oil to the joint.
6. *Slowly* lift the cylinder from the crankcase.
   a. Account for the two dowels under the cylinder (**Figure 69**). If loose, remove the dowels to prevent them from falling into the engine.
   b. Route and secure the cam chain out of the cylinder.
7. Remove the base gasket.
8. Stuff clean shop cloths into the cam chain tunnel and around the piston. Support the piston and rod so it does not contact the crankcase.
9. Remove the oil jet at the right side of the engine (**Figure 70**).
10. Inspect the cylinder as described in this section.

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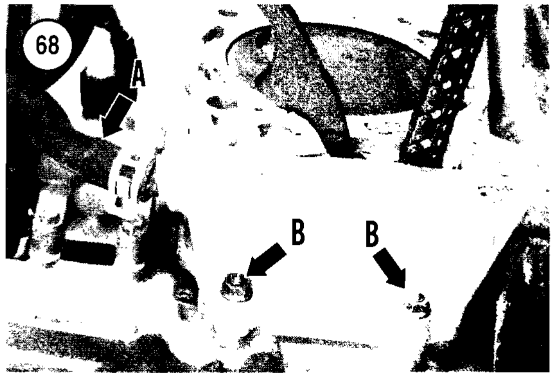

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Inspection

The cylinder is plated with nickel-silicon phosphorous carbide. If lightly damaged, the cylinder can be repaired and replated. If excessively damaged, the cylinder cannot be bored. Check with a dealership for a recommendation on reconditioning or replacing the cylinder.

1. Remove all gasket residue from the top and bottom cylinder block surfaces.
2. Wash the cylinder in solvent and dry with compressed air.
3. Inspect the cylinder (**Figure 71**) for wear or damage.
   a. Inspect the cylinder bore (A) for scoring or gouges.
   b. Inspect the water jackets (B) for deposits.
   c. Inspect all threads for condition and cleanliness.
4. Measure and check the cylinder for wear. Measure the inside diameter of the cylinder with a bore gauge or inside micrometer as follows:
   a. Measure the cylinder at three points along the bore axis (**Figure 72**). At each point, measure the cylinder front to back (measurement X)

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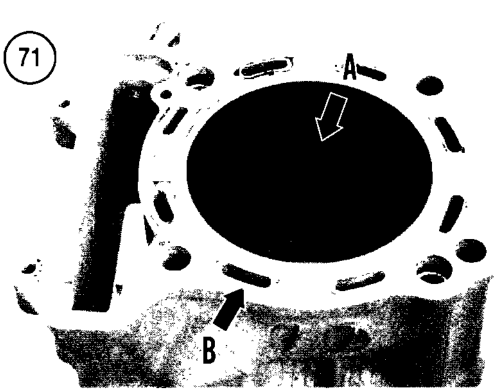

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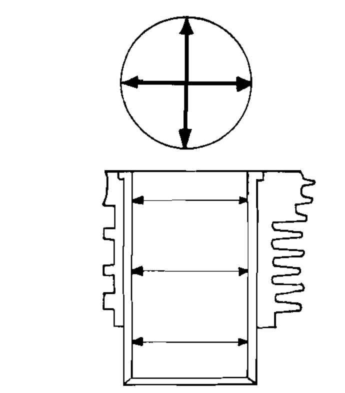

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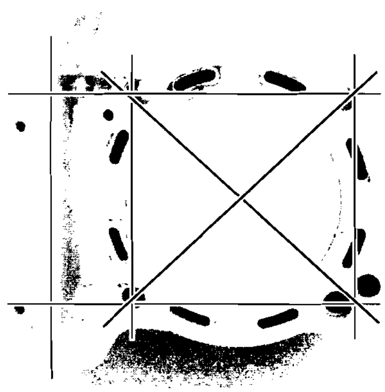

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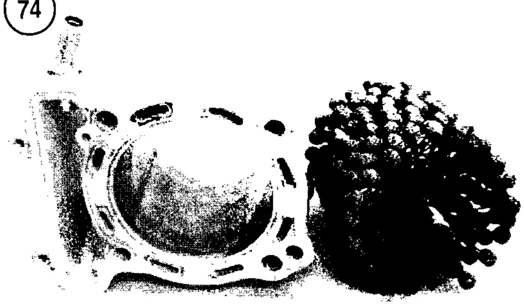

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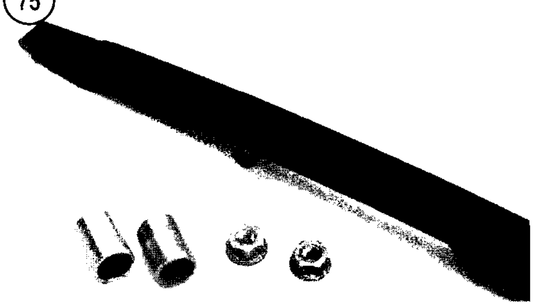

and side to side (measurement Y). Record the measurements for each location.

b. Compare the largest X or Y measurement recorded to the specifications in **Table 2**. If the cylinder bore is not within specification, replace the cylinder.

5. Inspect the cylinder gasket surface for warp as follows:

a. Lay a machinist's straightedge across the cylinder at the positions shown in **Figure 73**.

b. Try to insert a flat feeler gauge between the straightedge and the machined surface of the cylinder. If clearance exists, record the maximum measurement.

c. Compare the measurements to the service limit in **Table 2**. If the clearance is not within the service limit, take the cylinder to a dealership or machine shop for further inspection and possible resurfacing.

6. If the cylinder is within all service limits, and the current piston and rings are reusable, clean the cylinder as described in Step 7. Do not remove the carbon ridge at the top of the cylinder. If installing new piston rings, hone the cylinder so the rings will seat as follows:

a. A 240-grit Flex-Hone (**Figure 74**) is recommended.

b. Liberally apply honing lubricant to the hone and cylinder surface.

c. Insert the leading edge of the hone into the cylinder and move the hone quickly and smoothly up and down for 30 seconds to achieve a uniform 45° crosshatch pattern. Continue to spin the hone as it leaves the cylinder.

7. Thoroughly clean the cylinder in hot, soapy water after inspection and service to remove all residue left from machine operations. Check cleanliness by rubbing a clean, white cloth over the bore. No residue should be evident. When the cylinder is thoroughly clean and dry, immediately coat the cylinder bore with oil to prevent corrosion. Wrap the cylinder until engine reassembly.

8. Inspect the front chain guide, dowels and cylinder mounting nuts (**Figure 75**) for wear or damage. Check the fit of the cylinder dowels before installing the cylinder. Often dowels fit in one location better than another. Match the dowels to their preferred bores to prevent binding during assembly.

9. Perform any service to the piston assembly before installing the cylinder.

Installation

1. Check that all gasket residue is removed from all mating surfaces.
2. Install a new, lubricated O-ring on the oil jet, and then seat the jet into the crankcase (**Figure 70**).
3. Install the dowels and a new base gasket onto the crankcase (**Figure 76**).
4. Lubricate the following components with engine oil:
   a. Piston and rings.
   b. Piston pin and connecting rod.
   c. Cylinder bore.
5. Support the piston so the cylinder can be lowered into place.
6. Stagger the piston ring gaps on the piston as shown in **Figure 77**.
7. Lower the cylinder onto the crankcase.
   a. Route the cam chain and guide through the chain tunnel. Secure the cam chain so it cannot fall into the engine.
   b. As the piston enters the cylinder, compress each ring so it can enter the cylinder. A ring compressor can also be used. When the bottom ring is in the cylinder, remove any holding fixture and shop cloths from the crankcase.
8. Install and *finger-tighten* the cylinder mounting nuts (B, **Figure 68**). The nuts are tightened after the cylinder head bolts are tightened.
9. Install the oil return tank hose at the back of the cylinder (A, **Figure 68**).
10. Install the front cam chain guide. Check that the guide seats into its lower holder. If the guide is improperly installed, binding of the cam chain is possible.
11. Install the cylinder head as described in this chapter.

PISTON AND PISTON RINGS

As each component of the piston assembly is cleaned and measured, record and identify all measurements. Refer to **Table 2** for specifications.

Piston Removal

1. Remove the cylinder as described in this chapter.
2. Before removing the piston, check the piston and piston pin for obvious play. Hold the rod and try

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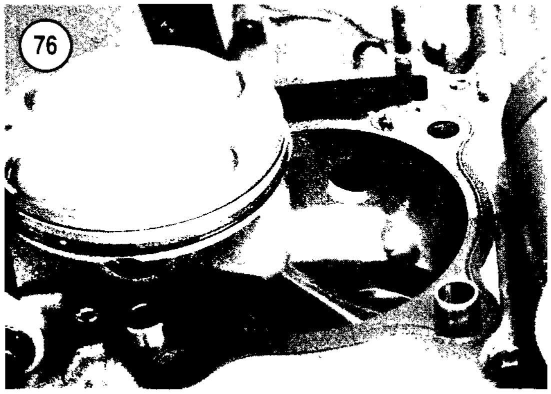

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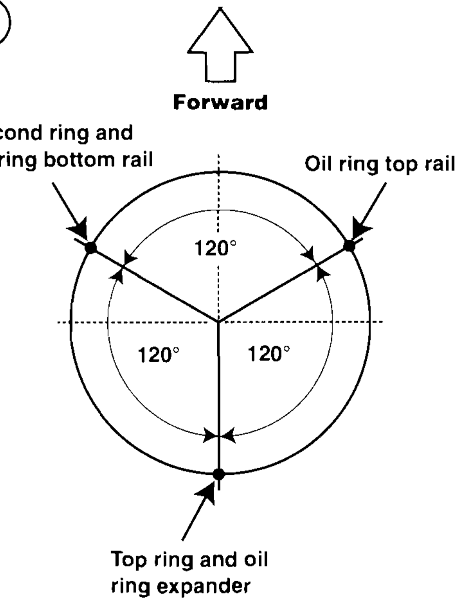

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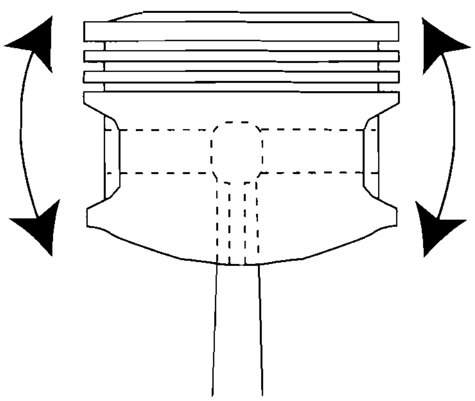

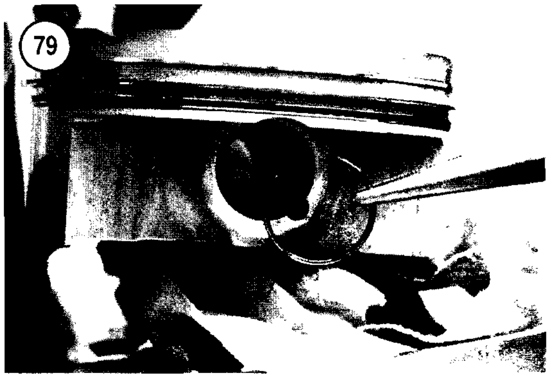
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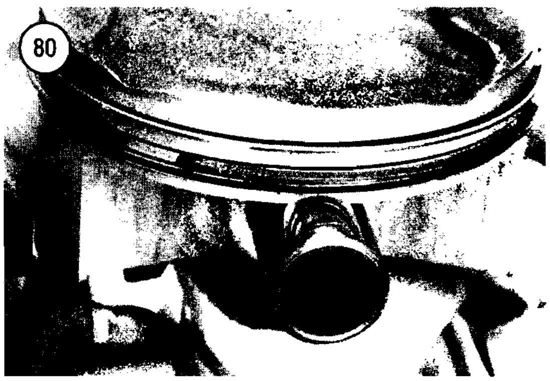
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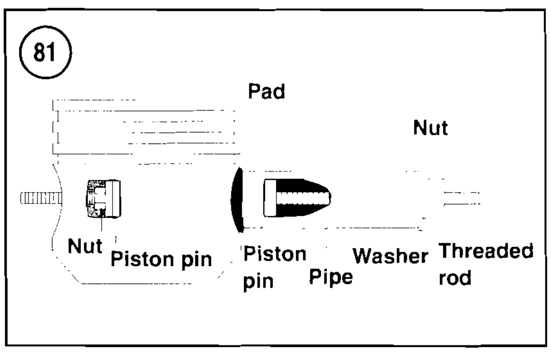

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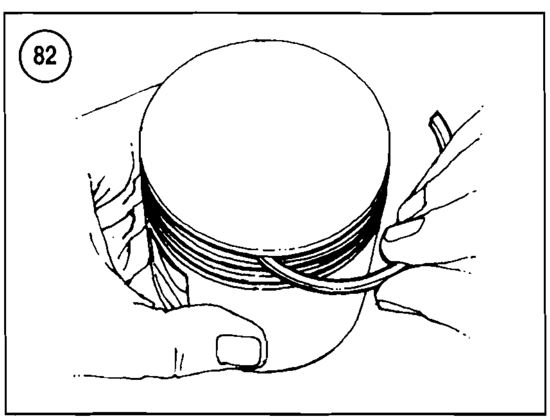
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to tilt the piston side to side (**Figure 78**). If tilting (not sliding) motion is detected, this indicates wear on either the piston pin, pin bore or connecting rod. Wear could be on any combination of the three parts. Careful inspection is required to determine which parts should be replaced.

3. Stuff clean shop cloths around the connecting rod and in the cam chain tunnel to prevent parts from entering the crankcase.
4. At the left side of the piston, rotate the ends of the circlip to the removal gaps, and then remove the circlip from the piston pin bore (**Figure 79**). Discard the circlip.
5. Press the piston pin (**Figure 80**) out of the piston by hand, and then remove the piston. Remove the remaining circlip at the workbench. If the pin is tight, use a removal tool as shown in **Figure 81**. If this tool must be used, remove the remaining circlip. Do not drive the pin out with a hammer and drift. The piston and connecting rod assembly will likely be damaged.
6. Inspect the piston and piston pin as described in this section.

Piston Inspection

1. Remove the piston rings as described in this section.
2. Clean the piston.
   a. Clean the carbon from the piston crown. Use a soft scraper, brushes and solvent. Do not use tools that can gouge or scratch the surface. This type of damage can cause hot spots on the piston during engine operation.
   b. Clean the piston pin bore, ring grooves and piston skirt. Clean the ring grooves with a soft brush, or use a broken piston ring to remove carbon and oil residue (**Figure 82**). Mild galling or discoloration can be polished off the piston skirt with fine emery cloth and oil.
3. Inspect the piston. Replace the piston if damaged.
   a. Inspect the piston crown (A, **Figure 83**) for wear or damage. If the piston is pitted, overheating is likely occurring. This can be caused by a lean fuel mixture and/or preignition.
   b. Inspect the ring grooves (B, **Figure 83**) for wear, nicks, cracks or other damage. The grooves should be square and uniform for the circumference of the piston. Particularly in-

spect the top compression ring groove. It is lubricated the least and is nearest the combustion temperatures. If the oil ring appears worn or if the oil ring was difficult to remove, the piston has likely overheated and distorted.

c. Inspect the oil drain holes (C, **Figure 83**) for buildup. The holes must be clean to allow oil to return to the crankcase. Plugged holes can result in buildup in the oil control ring.
d. Inspect the piston skirt (D, **Figure 83**). If the skirt shows signs of galling or partial seizure (bits of metal imbedded in the skirt), replace the piston.
e. Check the pin bores and circlip grooves (E, **Figure 83**) for cleanliness and damage.
f. Inspect the interior of the piston (**Figure 84**). Check the crown, skirt and bosses for cracks or other damage.

4. Measure the width of all ring grooves. Replace the piston if any measurement exceeds the specifications.

Piston-to-Cylinder Clearance Inspection

1. Measure the outside diameter of the piston (**Figure 85**). Make the measurement 15 mm (0.6 in.) from the bottom edge of the piston skirt and 90° to the direction of the piston pin. Record the measurement.
2. Determine clearance by subtracting the piston measurement from the largest cylinder measurement as determined during *Cylinder Inspection* in this chapter. If the clearance exceeds the specifications, determine which part(s) are worn.

Piston Pin Inspection

1. Clean the piston pin.
2. Inspect the pin for chrome flaking, wear or discoloration from overheating.
3. Measure the outside diameter of the piston pin (**Figure 86**). Measure the pin near both ends and in the middle and record the measurements.
4. Inspect the pin bores in the piston.
   a. Check for scoring, uneven wear and discoloration from overheating. Lubricate the piston pin and slide it into the pin bores. Check for general fit and radial play. The pin should freely and smoothly slide and rotate.
   b. Measure the inside diameter of the piston bores and record the measurements.

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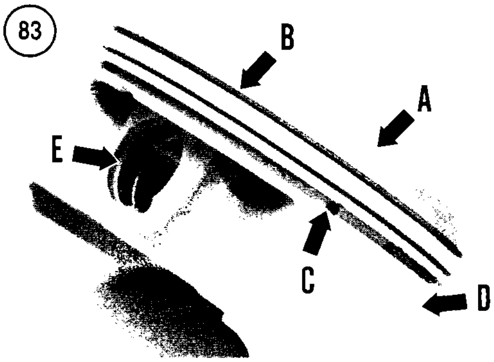

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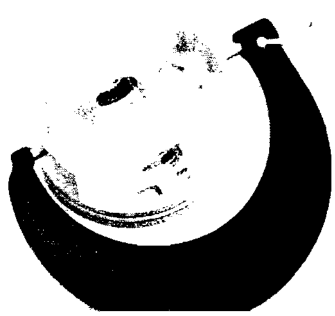

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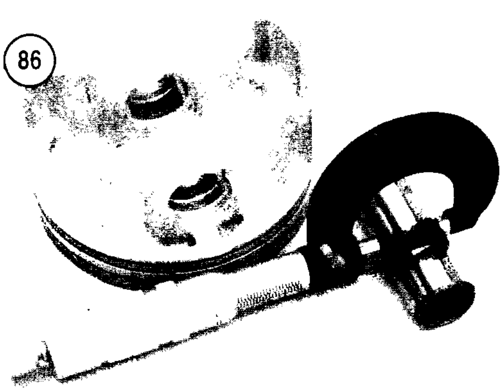

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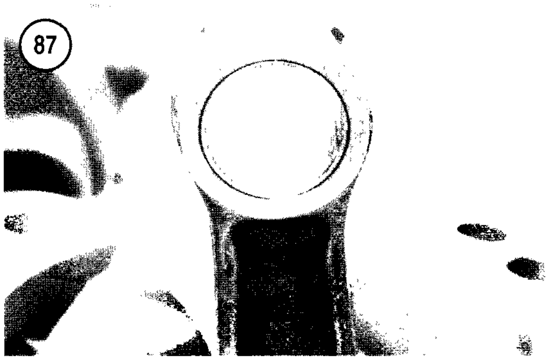

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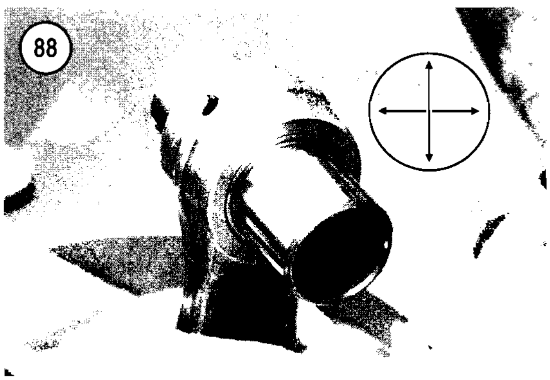

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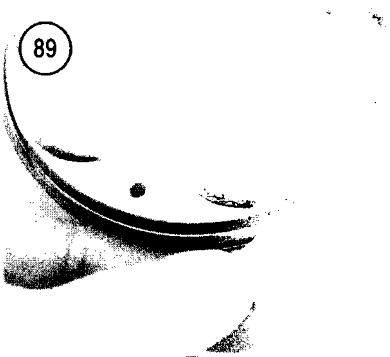

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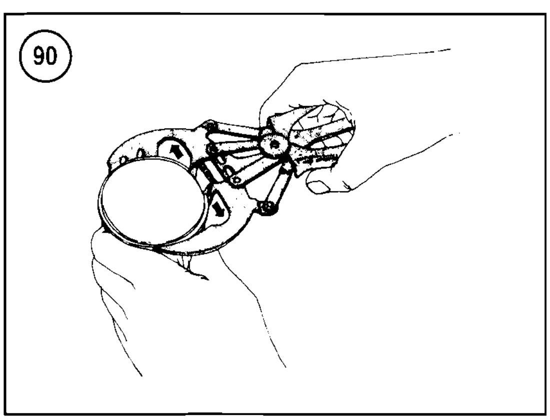

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5. Inspect the bore in the small end of the connecting rod (**Figure 87**).
   a. Check for scoring, uneven wear and discoloration from overheating. Lubricate the piston pin with engine oil and slide it into the connecting rod (**Figure 88**). Check for general fit and radial play. The pin should freely and smoothly slide and rotate.
   b. Measure the inside diameter of the bore and record the measurement.
6. If necessary, replace parts that are worn, damaged or out of specification.

Piston Ring Inspection and Removal

The piston is fitted with two compression rings and an oil control ring assembly. The oil ring assembly consists of two side rails and an expander ring.

1. Check the piston ring to ring groove clearance as follows:
   a. Clean the rings and grooves so accurate measurements can be made with a flat feeler gauge.
   b. Press the top ring into the piston groove.
   c. At the bottom side of the ring, insert a flat feeler gauge between the ring and groove (**Figure 89**). Record the measurement. Repeat this step at other points around the piston. If any measurement is out of specification, check the ring thickness as described in Step 5. Also check the ring groove width as described in *Piston Inspection* in this section. Replace the worn or damaged part(s).
   d. Repeat substep b and substep c for the second compression ring. The oil control ring is not measured.
2. Remove the top and second rings with a ring expander (**Figure 90**) or by hand (**Figure 91**).

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a. Spread the rings only enough to clear the piston.

b. As each ring is removed, mark the top surface if they will be reinstalled. The second ring is marked with an *R*, however, it will likely be worn away.

3. Remove the oil ring assembly by first removing the top rail, followed by the bottom rail. Remove (by hand) the expander ring last.

4. Clean and inspect the piston as described in *Piston Inspection* in this section.

5. Measure the thicknesses of the top and second rings (**Figure 92**). Note that the top ring is measured on its inner and outer thicknesses. Replace all the rings if any measurement is out of specification.

6. Inspect the end gap of the top and second rings as follows:

a. Measure the free end gap of both rings (**Figure 93**).

b. Measure the end gap of each ring as it is fitted in the cylinder. Insert a ring into the bottom of the cylinder, and then use the piston to square the ring to the cylinder wall (**Figure 94**). Measure the end gap with a feeler gauge (**Figure 95**). Replace the ring set if any measurement is out of specification. If installing new rings, gap the new rings after the cylinder has been serviced. If the new ring gap is too narrow, carefully widen the gap using a fine-cut file as shown in **Figure 96**. Work slowly and measure often.

7. Roll each ring around its piston groove and check for binding or snags (**Figure 97**). Repair minor damage with a fine-cut file.

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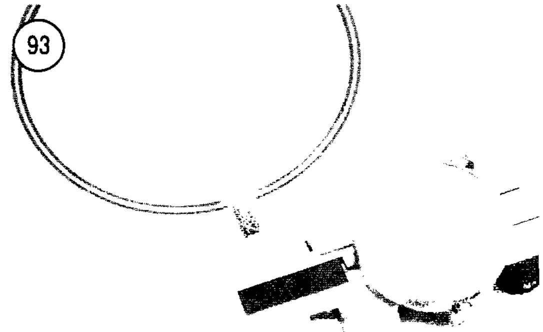

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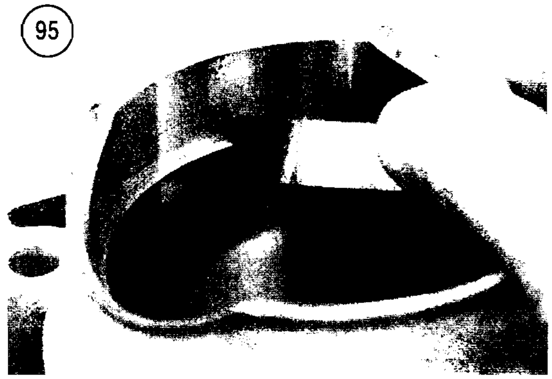
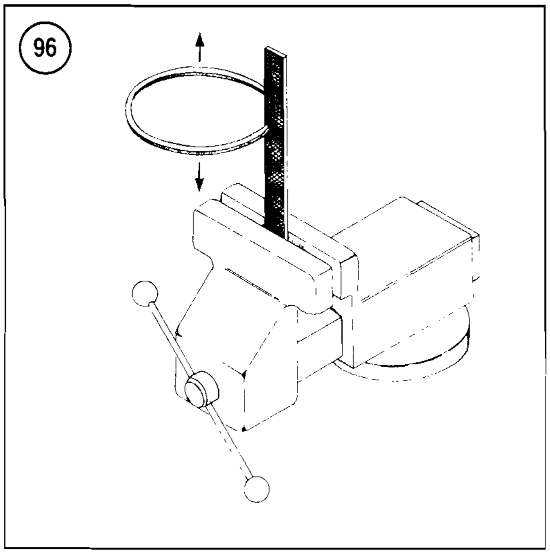
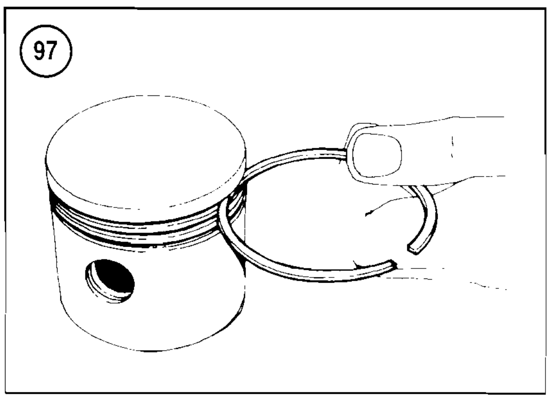


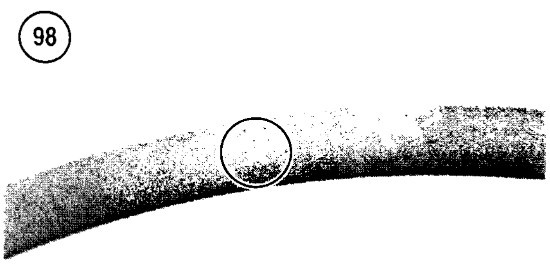
Piston Ring Installation

If installing new piston rings, deglaze the cylinder as described in *Cylinder* in this chapter. After deglazing, the crosshatching in the cylinder provides a uniform surface, capable of spreading oil and allowing the rings to seat and seal against the cylinder.

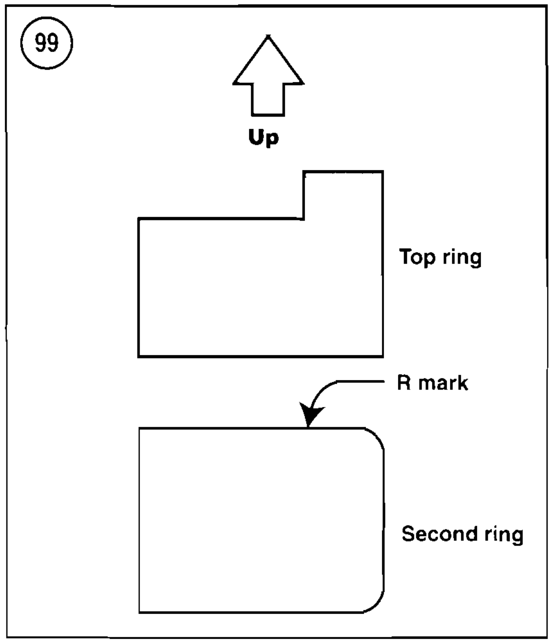
1. Make sure the piston and rings are clean and dry. When installing, spread the rings only enough to clear the piston.







2. Install the rings as follows:
   a. Install the oil ring expander in the bottom groove, followed by the bottom rail and top rail. The ends of the expander must *not* overlap. The rails can be installed in either position and direction.



   b. Install the second ring. Make sure the *R* mark (**Figure 98**) faces up. The mark on the ring installed was small and faint. Check closely.
   c. Install the top ring. If not marked, the ring must be installed as shown in **Figure 99**. The lip on the outer edge must face up.
3. Make sure all rings rotate freely in their grooves.

Piston Installation

1. Install the piston rings onto the piston as described in this section.
2. Check that all parts are clean and ready to be installed. Keep the engine openings covered.

CAUTION
Never install used circlips. Engine damage could occur. Circlips fatigue and distort when they are removed, even though they appear reusable.

3. Install a *new* circlip into the right piston pin boss. Rotate the ends of the circlip away from the gap. By installing the circlip in the right boss the remaining circlip can be installed at the left side of the engine, away from the cam chain tunnel.
4. Lubricate the following components with engine oil:
   a. Piston pin.
   b. Piston pin bores.

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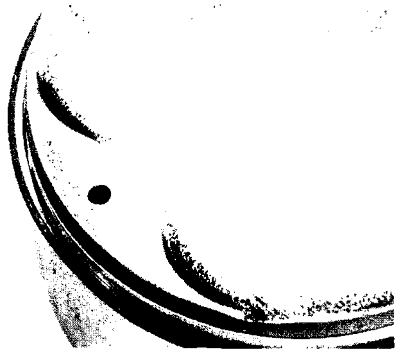

c. Connecting rod bore.

5. Start the piston pin into the open pin bore, and then place the piston over the connecting rod. The indention on the piston crown (**Figure 100**) must point forward.

CAUTION
The piston must be installed correctly. Failure to install the piston correctly can damage the engine.

6. Align the piston with the rod, and then slide the pin through the rod and into the other piston bore.

7. Install a *new* circlip into the left piston pin boss. Rotate the ends of the circlip away from the gap.

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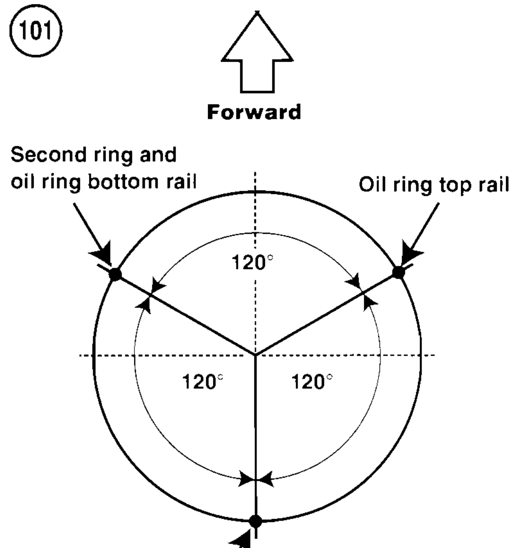

8. Stagger the piston ring gaps on the piston as shown in **Figure 101**.

9. Install the cylinder as described in this chapter.

10. Refer to Chapter Three for break-in procedures.

Table 1 GENERAL ENGINE SPECIFICATIONS

Engine type	4-stroke, single cylinder,
Valve system	Chain-driven DOHC 4-valve
Cooling system	Liquid cooled
Lubrication system	Dry sump
Engine displacement	398 cc (24.3 cu. in.)
Bore & stroke	90.0 × 62.6 mm (3.54 × 2.46 in.)
Compression ratio	
E models	
except 2004 California model	12.2:1
2004 California model	11.3:1
S models	11.3:1

Table 2 ENGINE TOP END SPECIFICATIONS

	New mm (in.)	Service limit mm (in.)
Camshaft		
Journal holder inside diameter	22.012-22.025 (0.8666-0.8671)	–
Journal oil clearance	0.019-0.053 (0.0007-0.0021)	0.15 (0.0059)
Journal outside diameter	21.972-21.993 (0.8653-0.8659)	–
Lobe height		
E models (except 2004 California model)		
Intake	36.91-36.96 (1.4531-1.4551)	36.61 (1.4413)
Exhaust	36.88-36.93 (1.4520-1.4539)	36.58 (1.4402)
E and SM models (2004 California models)		
Intake	36.49-36.54 (1.4366-1.4386)	36.19 (1.4248)
Exhaust	35.79-35.84 (1.4091-1.4110)	35.49 (1.3972)
S models		
Intake	36.43-36.54 (1.4342-1.4386)	36.19 (1.4248)
Exhaust	35.79-35.84 (1.4091-1.4110)	35.49 (1.3972)
Runout	–	0.10 (0.004)
Connecting rod		
Small end inside diameter	20.010-20.018 (0.7878-0.7881)	20.040 (0.7890)
Cylinder		
Bore	90.000-90.015 (3.5433-3.5439)	–
Warp limit	–	0.05 (0.002)
Cylinder compression		
(automatic compression release activated)		
E models	1000 kPa (145 psi)	
S and SM models	950 kPa (138 psi)	
Cylinder head warp limit	–	0.05 (0.002)
Cylinder head cover warp limit	–	0.05 (0.002)
Piston		
Mark direction	Punch mark facing forward	
Outside diameter	89.965-89.980 (3.5419-3.5425)	89.880 (3.5386)
Outside diameter measurement point	15.0 (0.6) from lower edge	–
Pin bore diameter	20.002-20.008 (0.7875-0.7877)	20.030 (0.7886)
Piston to cylinder clearance	0.030-0.040 (0.0012-0.0016)	0.120 (0.0047)
Piston pin outside diameter	19.995-20.00 (0.7872-0.7874)	19.980 (0.7866)
Piston rings		
End gap (in cylinder)		
Top and second ring	0.08-0.20 (0.003-0.08)	0.50 (0.02)
Free end gap (approximate)		
Top ring	6.9 (0.27)	5.5 (0.22)
Second ring	11.5 (0.45)	9.2 (0.36)
Ring groove width		
Top ring (inner)	0.78-0.80 (0.0307-0.0315)	–
Top ring (outer)	1.30-1.32 (0.0512-0.0520)	–
Second ring	0.81-0.83 (0.0319-0.0327)	–
Oil ring	2.01-2.03 (0.0791-0.0799)	–
Ring to groove clearance		
Top ring	–	0.180 (0.007)
Second ring	–	0.150 (0.006)
Thickness		
Top ring (inner)	0.71-0.76 (0.0280-0.0299)	–
Top ring (outer)	1.08-1.10 (0.0425-0.0433)	–
Second ring	0.77-0.79 (0.0303-0.0311)	–
Top mark identification		
Second ring		
Valve clearance		
Intake	0.10-0.20 (0.004-0.008)	–
Exhaust	0.20-0.30 (0.008-0.012)	–

(continued)

Table 2 ENGINE TOP END SPECIFICATIONS (continued)

	New mm (in.)	Service limit mm (in.)
Valve dimensions		
Head diameter		
Intake	36 (1.42)	–
Exhaust	29 (1.14)	–
Head radial runout	–	0.05 (0.02)
Head thickness (margin above seat)	–	0.03 (0.001)
Seat		
Angle	45°	–
Width	0.9-1.1 (0.035-0.043)	–
Stem deflection	–	0.035 (0.014)
Stem diameter		
Intake	4.975-4.990 (0.1959-0.1965)	–
Exhaust	4.955-4.970 (0.1951-0.1957)	–
Stem runout	–	0.05 (0.02)
Valve guide to valve stem clearance		
Intake	0.010-0.037 (0.0004-0.0015)	–
Exhaust	0.030-0.057 (0.0012-0.0022)	–
Valve spring		
Compressed pressure		
Inner (at length of 27.4 mm [1.08 in.])	56-64 N (12.6-14.4 lbs.)	–
Outer (at length of 30.9 mm [1.22 in.])	56-64 N (28.3-32.6 lbs.)	–
Free length		
Inner intake and exhaust	–	32.6 (1.28)
Outer intake and exhaust	–	36.3 (1.43)

Table 3 ENGINE TOP END TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Cam chain tensioner			
Mounting bolts	10	–	7
2000-2002 center bolt	8	71	–
2003-on center bolt	30	–	22
Camshaft cap bolts	10	–	7
Cylinder head bolts*			
6 mm	10	–	7
10 mm			
Initial	25	–	18
Final	46	–	34
Cylinder head cover bolts	14	–	10
Cylinder head side bolt	14	–	10
Cylinder mounting nuts	10	–	7
Exhaust pipe nut and bolt	23	–	17
Spark plug	11	–	8
Thermostat housing	10	–	7
Timing hole plug	23	–	17
Upper engine mounting bolts			
Mounting bracket to frame	40	–	30
Mounting bracket to engine	66	–	49

*Refer to the text.

CHAPTER FIVE

ENGINE LOWER END

This chapter provides procedures for the engine lower end.

To access and service these components, the engine must be removed.

Read this chapter before performing any repair to the engine lower end. Refer to Chapter One for general tool usage and techniques.

Before removing and disassembling the engine, clean the engine and frame.

Keep the work environment as clean as possible. Store parts and assemblies in well-marked plastic bags and containers.

Refer to **Table 1** and **Table 2** at the end of this chapter for specifications.

ENGINE

The following procedure outlines the steps necessary to remove the engine from the frame. Depending on the planned level of disassembly, consider removing top end components and those located in the crankcase covers while the engine remains in the frame. Because the frame keeps the engine stabilized, tight nuts and bolts are easier to remove if the engine is held steady. Also, if the actual engine problem is unknown, it may be discovered in an assembly other than the crankcase.

During engine removal, make note of mounting bolt directions and how cables and wire harnesses are routed.

Removal and Installation

1. Support the motorcycle so it is stable, level and the rear wheel is off the ground.
2. If possible, perform a compression test (Chapter Three) and leakdown test (Chapter Two) before dismantling the engine.
3. Remove the side covers, seat, radiator covers fuel tank, engine covers and skid plate (Chapter Fifteen).
4. Remove the footpegs (Chapter Fifteen).
5. Remove the shift lever (Chapter Six).
6. Remove the sprocket guard, and then remove the drive chain, drive sprocket and spacer (Chapter Eleven).
7. Remove the rear brake pedal (Chapter Fourteen).
8. Disconnect the battery leads (Chapter Three).
9. Drain the engine oil (Chapter Three).

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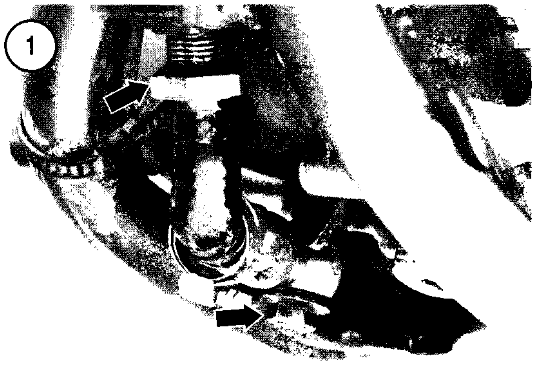

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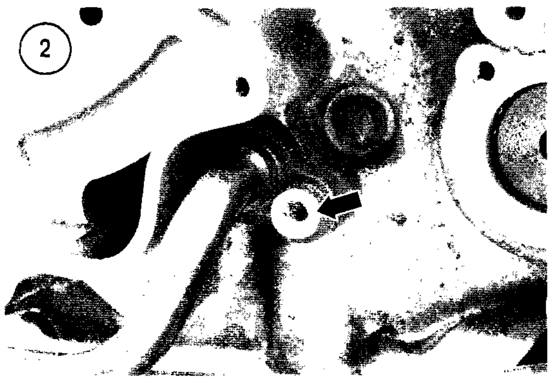

10. Remove the oil hose and strainer from the engine and frame (**Figure 1**).
11. Disconnect the oil pipe from the engine (**Figure 2**).
12. Remove the oil return tank and hose at the back of the cylinder.
13. Drain the engine coolant (Chapter Three).
14. Remove the radiators (Chapter Ten) and disconnect the coolant hoses at the engine.
15. Remove the coolant overflow tank bolt and secure the tank away from the engine.
16. Remove the exhaust system (Chapter Four).
17. Remove the spark plug lead.
18. Remove the horn (S models), fuel tank cushions and breather hoses (**Figure 3**).
19. Remove the carburetor (Chapter Eight).
20. Disconnect the clutch cable at the engine (Chapter Six).
21. Remove the starter (Chapter Nine).
22. Disconnect the wiring harness connectors leading from the alternator. Route the harness out of the frame.
23. Remove the neutral switch (**Figure 4**), and then remove the contacts (**Figure 5**) and springs from the end of the shift drum. Secure the switch and wiring harness away from the engine.
24. Remove the regulator/rectifier (**Figure 6**) from the frame.
25. Disconnect the negative battery cable from the left rear of the engine.
26. Inspect the engine and verify that it is ready for removal. If desired, remove any additional components that will make engine removal easier.

WARNING
When removing the bolts, the engine may shift in the frame. Keep hands protected and check the stability of

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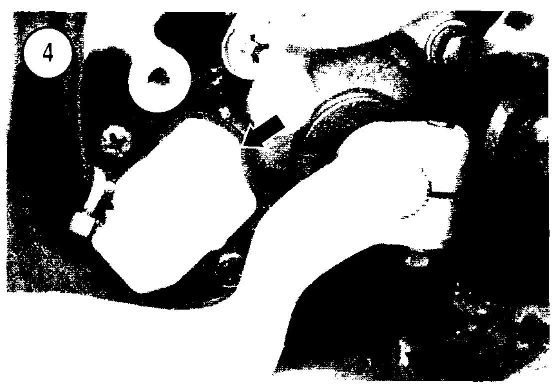

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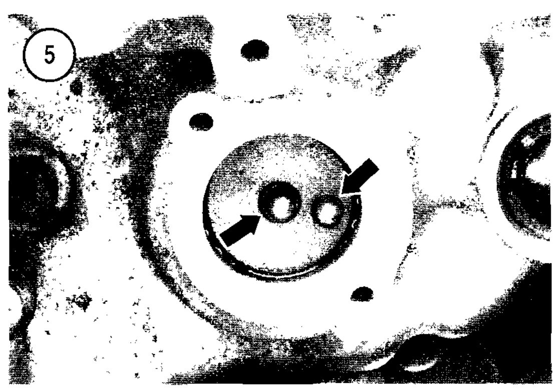

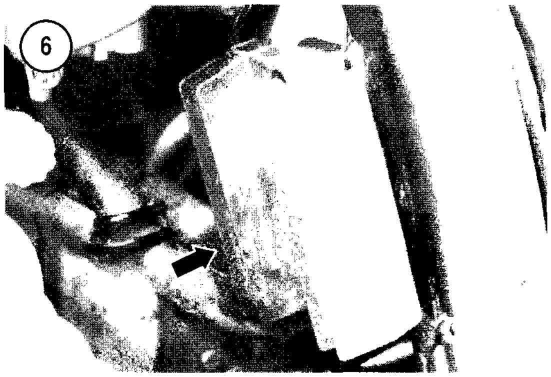

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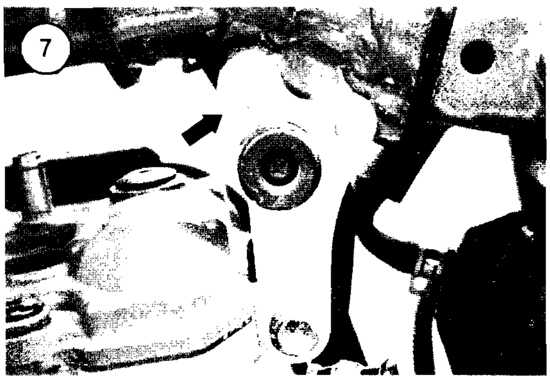

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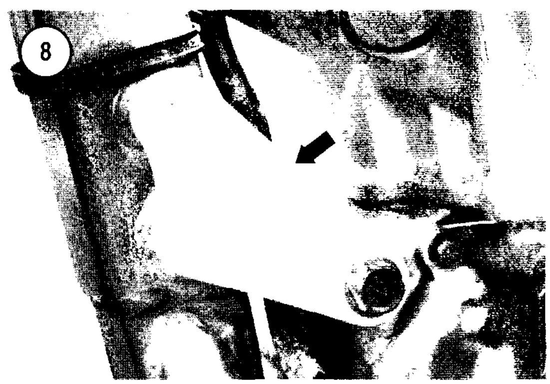

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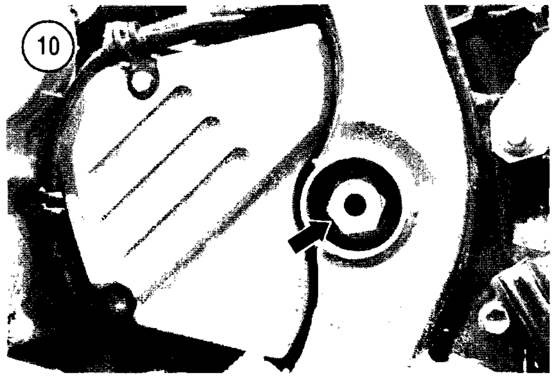

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the motorcycle and engine after each set of bolts is removed. Get assistance when removing the engine from the frame.

27. Remove the engine mounting bolts and brackets as follows:
   a. Remove the upper mounting brackets (**Figure 7**).
   b. Remove the lower mounting brackets (**Figure 8**).
   c. Remove the bottom mounting bolt (**Figure 9**).
   d. Remove the swing arm pivot nut (**Figure 10**). Do not remove the pivot bolt at this time.

WARNING
*In the following step, do not completely remove the swing arm pivot bolt (**Figure 11**) from the frame. Pull the bolt out only far enough to remove the engine. Complete removal allows the swing arm to fall.*

   e. Pull the swing arm pivot bolt out so it clears the engine, and then remove the engine from the frame.

f. Push the swing arm pivot bolt back into the frame, or insert a large drift or punch into the left side of the frame (**Figure 12**).

g. Clean and inspect the frame in the engine bay. Check for cracks and damage, particularly at welded joints.

28. Reverse this procedure to install the engine. Note the following:

a. If the chain is endless (no master link) make sure it is routed over the swing arm pivot before installing the swing arm pivot bolt (**Figure 13**).

b. Install the engine mounting brackets and bolts. Note the original directions of the bolts during installation. Install new locknuts. Lightly tighten the nuts until all brackets and bolts have been installed.

CAUTION

If the engine top end is not installed when the engine is mounted in the frame, do not tighten any mounting bolts until the upper mounting brackets have been installed and aligned with their mounting points.

c. Tighten the bracket to frame bolts to 40 N•m (33 ft.-lb.). Tighten the bracket to engine bolts to 66 N•m (49 ft.-lb.). Tighten the bottom mounting bolt to 66 N•m (49 ft.-lb.). Tighten the swing arm bolt to 77 N•m (57 ft.-lb.).

d. Install new seal washers on the the oil hose and strainer bolts (**Figure 1**). Tighten the bolts to to 23 N•m (17 ft.-lb.).

e. Carefully route electrical wires so they are not pinched or in contact with surfaces that become hot.

f. Clean the electrical connection and apply dielectric grease before reconnecting.

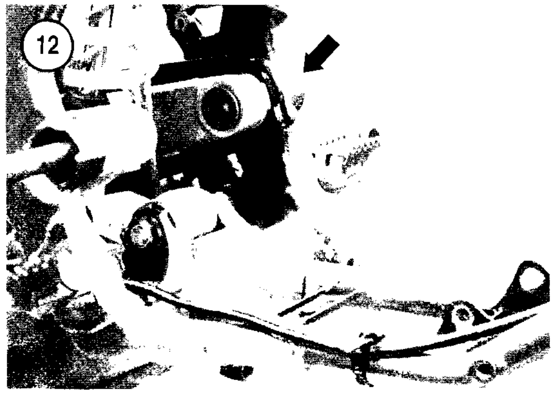
g. If assemblies have been removed from the top end or crankcase covers, install those components. Refer to the appropriate chapters for inspection and installation procedures.

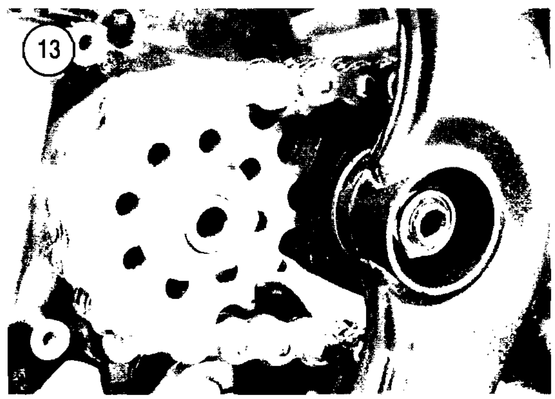
h. Fill the engine with engine oil (Chapter Three).

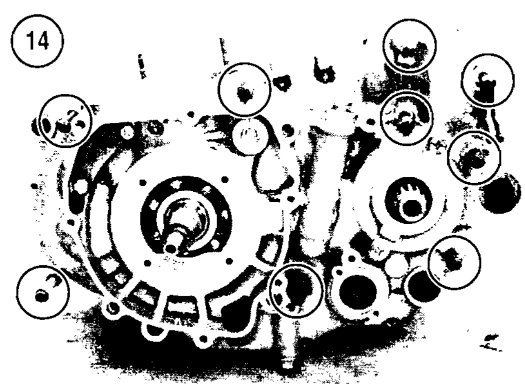
i. Fill the cooling system with coolant (Chapter Three).

j. Adjust the clutch free play (Chapter Three).

k. Check the throttle cable adjustment (Chapter Three).







l. Check the rear brake pedal height (Chapter Three).

m. Check the chain adjustment (Chapter Three).

n. Start the engine and check for leaks.

o. Check throttle and clutch operation.

p. If the engine top-end has been rebuilt, perform a compression check. Record the results for future reference.

q. Perform the *Engine Break-In* procedure in Chapter Three.

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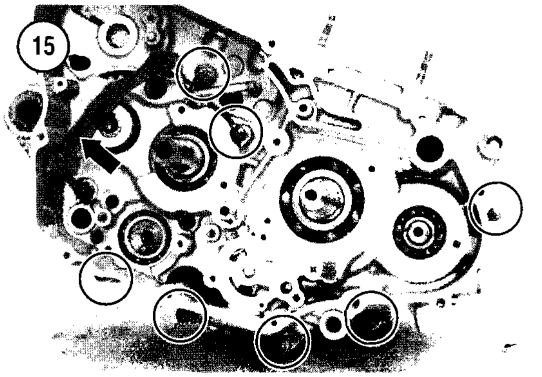

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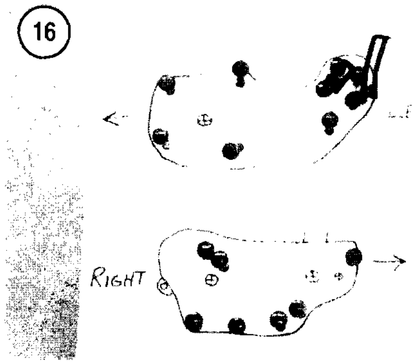

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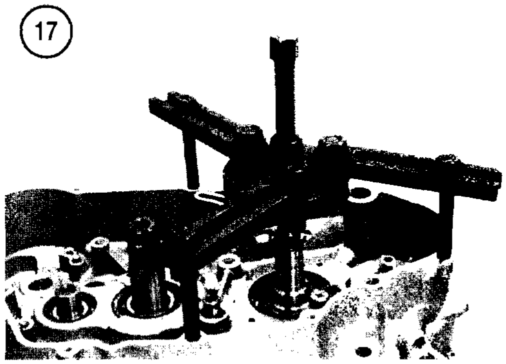

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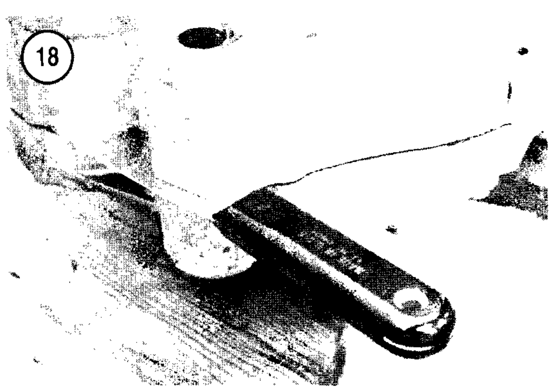

CRANKCASE

All assemblies located on the crankcase covers must be removed to separate the crankcase halves. It may be easier to remove these assemblies with the engine in the frame. The engine will remain steady during the disassembly process.

The crankcase is made of cast aluminum alloy. Do not hammer or excessively pry on the crankcase. The crankcase halves are aligned at the joint by dowels and joined with liquid sealant.

Disassembly

Reference to the *left* or *right* side of the engine refers to the side of the engine as it is mounted in the frame, not on the workbench.

1. Make a drawing of the crankcase shape on a piece of cardboard (**Figure 16**). Punch holes in the cardboard at the bolt locations.
2. Place the engine on wooden blocks and loosen the crankcase bolts on both sides of the engine (**Figure 14** and **Figure 15**). Loosen each bolt 1/4 turn, working in a crossing pattern. Loosen the bolts until they can be removed by hand. On the right case half, also remove the retainer and spacer from the output shaft.
3. As the bolts and clamps are removed from the crankcase, put each bolt in its respective hole in the template (**Figure 16**).
4. Separate the crankcase halves as follows:
   a. With the right side of the engine facing up, install a crankcase separating tool (Suzuki part No. 09920-13120, or similar puller) as shown in **Figure 17**. Thread the bolts into the crankcase, keeping the center bolt squarely positioned on the end of the crankshaft. Lubricate the tool threads and contact point on the crankshaft.
   b. Turn the center bolt and separate the crankcase. Do not force the crankcase open. If necessary, lower and reseat the crankcase. Apply penetrating lubricant around the shafts. Turn the center bolt a small amount, and then insert a putty knife at the rear of the crankcase (**Figure 18**). Carefully use the putty knife to separate the case halves. Do not pry the case with any tool that can damage the gasket surfaces. Using a mallet, tap the ends of the transmis-

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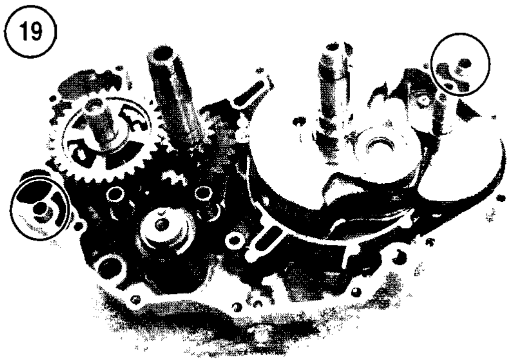

sion shafts while repeating the lowering and raising process.

c. Account for the two dowels (**Figure 19**) as the case halves are separated.

5. Remove the balancer (**Figure 20**) and inspect it as described in this chapter.

6. Remove the transmission assembly from the left case half as follows:

a. Remove the two shift fork shafts (**Figure 21**).

b. Spread the forks and remove the shift drum (**Figure 22**).

c. Remove the No. 1, No. 2 and No. 3 shift forks (**Figure 23**). Make note of the markings on each fork and its position in the case.

d. Remove the input and output shaft assemblies (**Figure 24**) together. Grip the output shaft nearest the lowest gear to prevent parts from falling from the shaft. Keep the shafts upright and locked together as they are taken to the workbench.

e. Disassemble and inspect the transmission components as described in Chapter Seven.

7. Remove the oil pipes from the outer face of the right crankcase (**Figure 25** and **Figure 26**).

8. Remove the oil sump strainer (**Figure 27**) from the right case half.

9. If necessary, remove the crankshaft. Unless obviously damaged, the crankshaft does not have to be removed for most inspection procedures. To install the crankshaft, a crankshaft installer tool will have to be used to pull the crankshaft into the case. Remove the crankshaft as follows:

a. Attach a crankcase separating tool (Suzuki part No. 09920-13120, or similar puller) as shown in **Figure 28**. Thread the bolts into the crankcase, keeping the center bolt squarely positioned on the end of the crankshaft. Lu-

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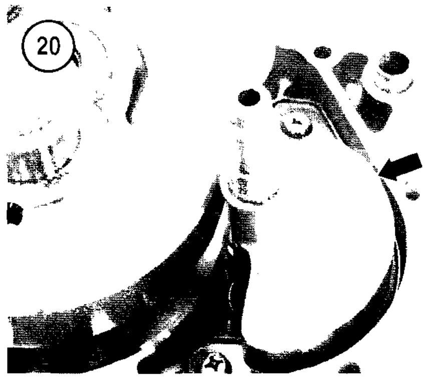

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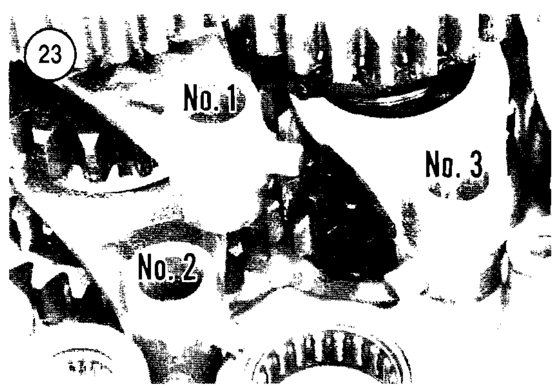

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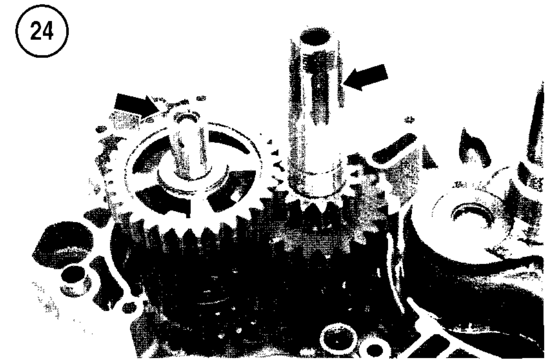

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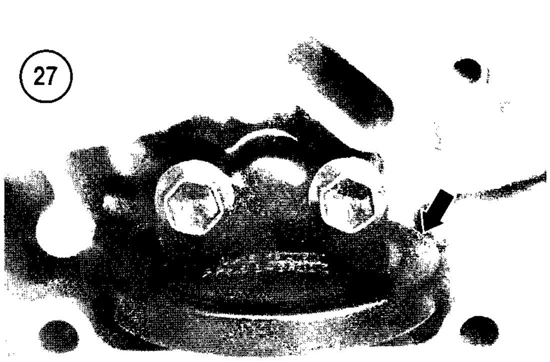

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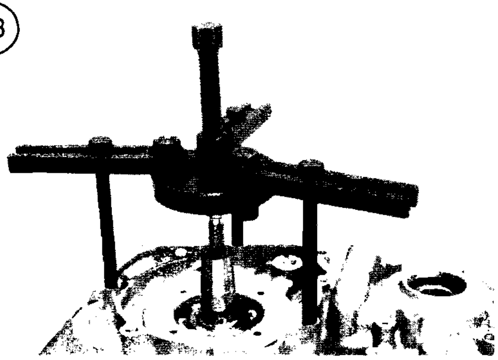

bricate the tool threads and contact point on the crankshaft with engine oil.

b. If available, use a heat gun to warm the bearing around the crankshaft. This slightly expands the bore and aids in removal. Do not use direct heat from a torch.
c. Working on a stable surface, turn the center bolt and pull the case half from the crankshaft.
d. Inspect the crankshaft assembly and cases as described in this chapter.

Assembly

1. Read the entire procedure to ensure that all tools, parts and supplies are on hand, as well as proper preparation of the case halves. Follow these practices when assembling the crankcase:
   a. Make sure all mating surfaces are smooth, clean and dry. Minor irregularities can be repaired with an oil stone. After thorough removal of the old sealant, clean all mating surfaces with a brake parts cleaner. The new sealant will not adhere to oily surfaces.
   b. Lubricate the crankshaft, bearings and transmission assembly with engine oil.
   c. Lubricate the seal lips with grease.
   d. To install the crankshaft, a crankshaft installation set, or equivalent, is required. The parts include the crankshaft installer (Suzuki part No. 09910-32812) and attachment (Suzuki part No. 09940-52861). The attachment is actually the fork seal driver for this motorcycle. The driver acts as a spacer that keeps the puller perpendicular to the case, so the crankshaft is pulled straight into the bearing. If necessary, order these part numbers from a Suzuki dealership.

e. If possible, have assistance when installing the crankshaft into the crankcase. Assemble the crankshaft installation tool and understand how it operates before actually starting the installation.
f. To seal the crankcase halves, use a liquid gasket sealant (Suzuki Bond 1207B, or equivalent) that can be submerged in oil.

2. Install the crankshaft into the left case half as follows:
   a. Lubricate the bearing bore, crankshaft and installer threads.
   b. Place the left crankcase on wooden blocks, with the open side of the case facing down.
   c. If available, use a heat gun to warm the bearing bore. This slightly expands the bore and aids in bearing installation. Do not use direct heat from a torch.
   d. Center the attachment (spacer) over the crankcase bearing, and then thread the installer onto the crankshaft (**Figure 29**).
   e. Hold the assembly stable and turn the T-handle to draw the crankshaft toward the bore. When the crankshaft is touching the bore, check all alignments (**Figure 30**).
   f. Turn the T-handle and fully seat the crankshaft into the bearing (**Figure 31**).
   g. Remove the installer tools.
3. Seat the small oil pipe into the outer face of the right crankcase (**Figure 25**). Install new, lubricated O-rings onto the pipe.
4. Install the oil sump strainer into the right crankcase (**Figure 27**). Apply threadlocking compound to the bolt threads and tighten the bolts.
5. Place the left crankcase so the open side is facing up.
6. Install the transmission as follows:
   a. Install the input and output shafts, keeping them meshed as they are seated in the bearings. Check that all gears spin freely after the shafts are in place.
   b. Identify the shift forks (**Figure 32**).
   c. Install the No. 1, No. 2 and No. 3 shift forks, engaging them with the appropriate gears (**Figure 23**).
   d. Install the shift drum, and then engage the shift forks with their appropriate grooves in the drum (**Figure 33**). Check that the guide pins on all the forks are engaged with the shift drum.

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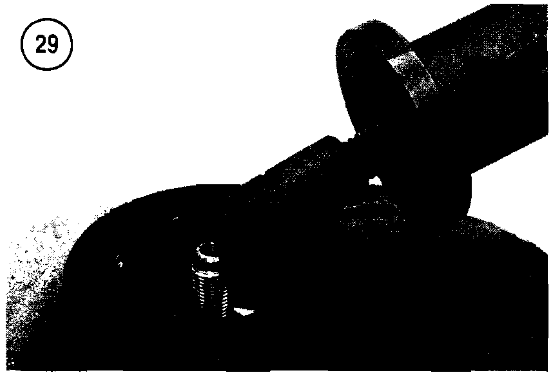

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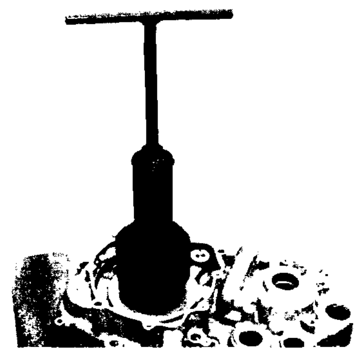

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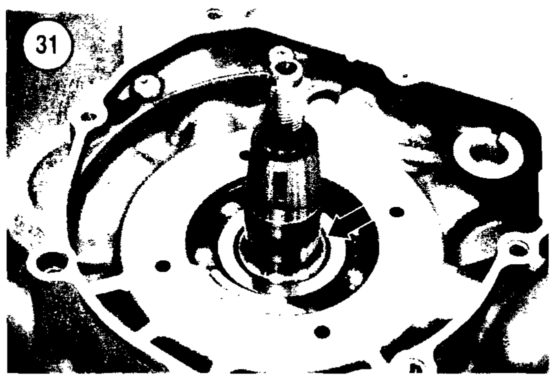

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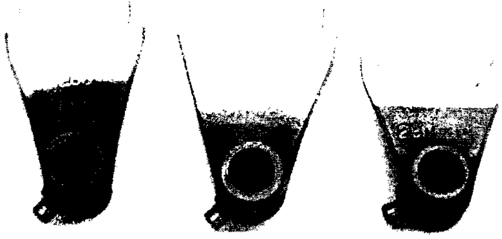

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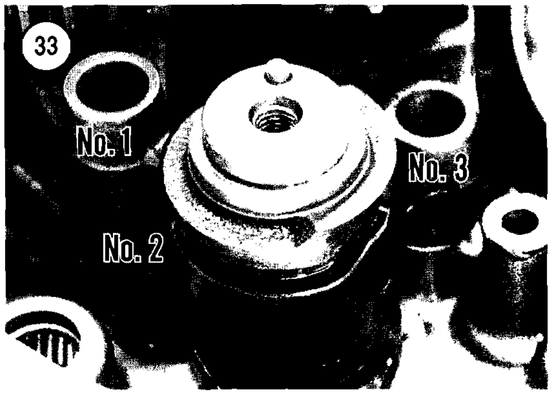

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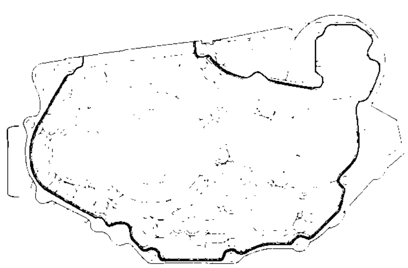

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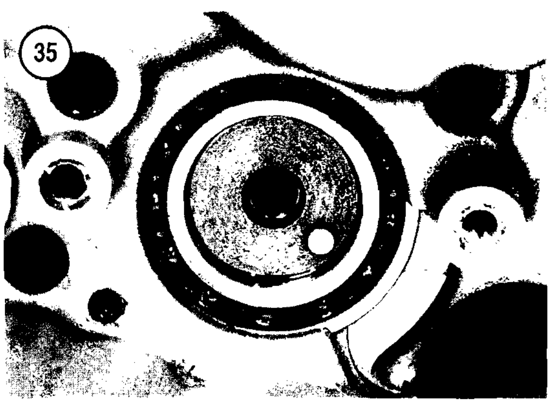

e. Install the fork shafts (**Figure 21**). Install the short shaft in the No. 3 fork.

f. Check that all parts are engaged and seated.

7. Install the balancer (**Figure 20**). The left case should appear as shown in **Figure 19**.

8. Install the right crankcase onto the left crankcase as follows:

a. Check that all mating surfaces are clean and dry.

b. On the left crankcase, insert the two dowels (**Figure 19**).

c. On the right crankcase, apply liquid gasket sealant to the mating surface shown in **Figure 34**. Apply sealant (Suzuki Bond 1207B, or equivalent) to the corresponding surfaces on the left crankcase half. Use enough sealant to fill voids and provide a continuous seal on the entire joint. Excessive amounts of sealant should be avoided.

d. Check that all shafts are aligned vertically, then fit the right case squarely onto the left case.

e. If necessary, *tap* the right case with a mallet to evenly seat the cases. Do not force the cases. If the cases are not seating, a shaft is probably misaligned with its bore. Lift the case and slightly move it side to side until the shaft(s) are properly guided.

9. Install the large oil pipe into the right crankcase (**Figure 26**). Install new, lubricated O-rings onto the pipe, and insert the pipe into the case. Use a small flashlight to verify that the long end of the pipe seats into the left case. Note that this pipe is secured by a crankcase bolt.

10. Remove each crankcase bolt from the template (**Figure 16**) and insert the bolts and guides into the appropriate holes. Finger-tighten the bolts (**Figure 14** and **Figure 15**). On the right case, also install the spacer and retainer on the output shaft. Check that the retainer is properly oriented.

11. Tighten the bolts equally in several passes and in a crossing pattern to 11 N•m (8 ft.-lb.).

12. Rotate the crankshaft and check for smooth operation. If binding is evident, lightly tap the ends of the shaft with a mallet. If binding continues, separate the cases and correct the problem.

13. Rotate the transmission shafts and check for smooth operation. If binding or poor operation is evident, lightly tap the ends of the shafts with a mallet. If binding or poor operation continues to exist, separate the cases and correct the problem. Thread a bolt and locknut into the end of the shift drum and check for proper shifting through the gears. Rotate the shafts to aid in shifting. Because the shafts are not rotating very fast, it is normal for the gears to not engage as precisely as they do in actual operation. The transmission should be in neutral when the shift drum pin is positioned as shown in **Figure 35**. Both shafts should turn independently of one another.

14. Allow the sealant to set for at least an hour before handling the crankcase. When the sealant is completely dry, trim excess sealant from the cylinder seating surface.
15. The crankcase assembly is ready for installation into the frame. If desired, top end components and those located in the side covers can be installed at this time. Refer to the appropriate chapters for inspection and installation procedures for the components in the engine top end and crankcase covers.

CRANKCASE SEALS

Output Shaft Seal Replacement

1. Remove the seal retainer (**Figure 36**).

CAUTION
*When prying, do not allow the end of the tool to touch the seal bore or snag the oil hole in the bore (**Figure 37**). Scratches in the bore cause leaks and heavy-handed prying can break the casting.*

2. Pry out the seal (**Figure 38**). If necessary, place a block of wood on the case to improve leverage and protect the crankcase. Warming the seal with a heat gun eases removal.
3. If installing a new bearing, replace the bearing before installing the new seal.
4. Clean the oil seal bore.
5. Apply grease to the lip and sides of the new seal.
6. Place the seal over the bore with the closed side of the seal facing out. The seal must be square to the bore.
7. Drive the seal until it is flush with the outside edge of the bore.
   a. Use a driver that fits at the perimeter of the seal (**Figure 39**).
   b. Check that the oil hole in the bore is not blocked (**Figure 40**).
   c. Apply threadlocking compound to the retainer bolts, and install the retainer.

Shift Shaft Seal Replacement

CAUTION
When prying, do not allow the end of the tool to touch the seal bore. Bore scratches cause leaks.

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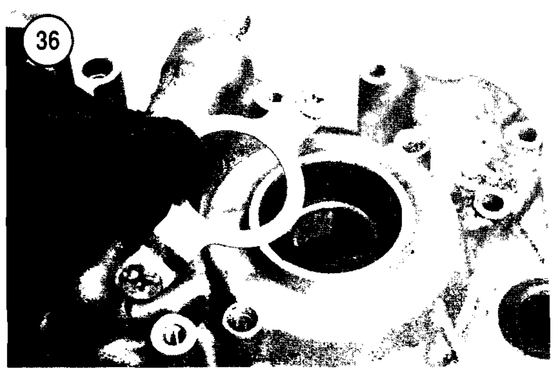

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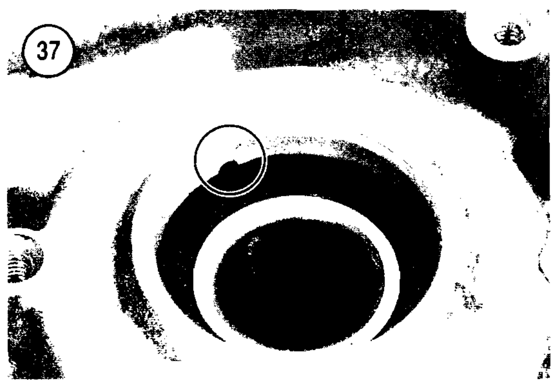

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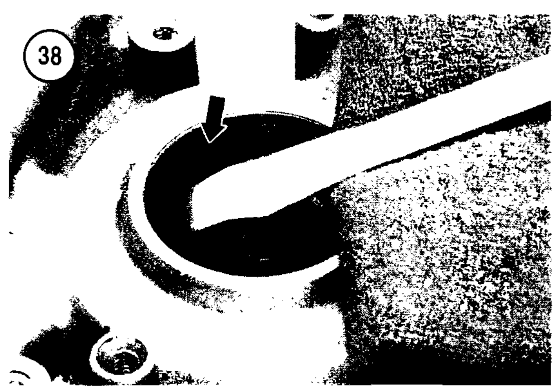

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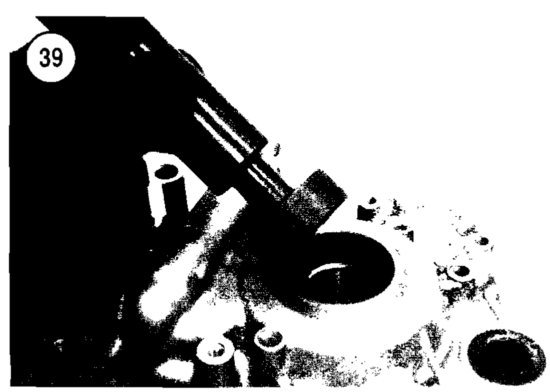

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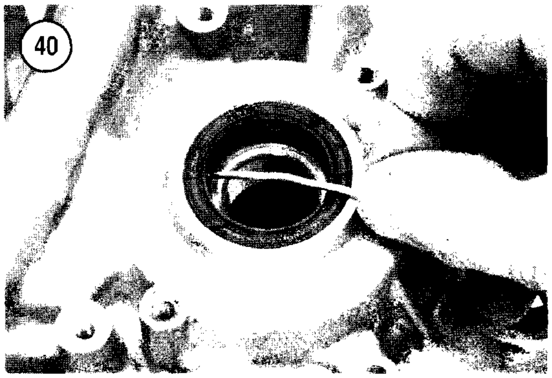

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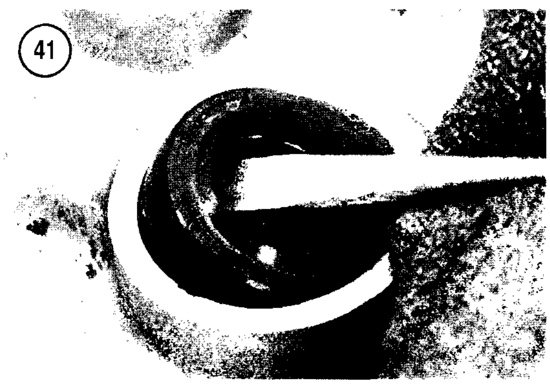

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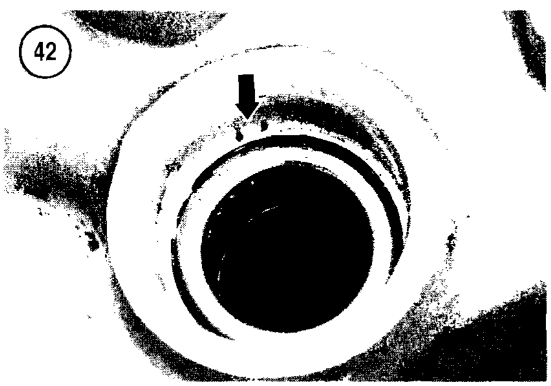

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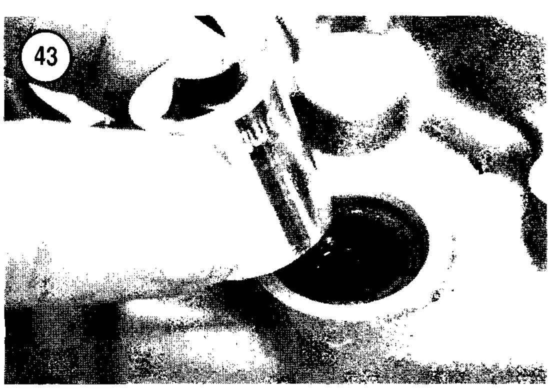


NOTE
This seal is commonly replaced when the engine is assembled. If the shift shaft is installed, cover the shaft splines with plastic wrap to prevent tearing the seal lip.

1. Pry out the old seal (**Figure 41**). If necessary, place a block of wood on the case to improve leverage and protect the crankcase.
2. If installing a new bearing, replace the bearing before installing the new seal.
3. Clean the oil seal bore (**Figure 42**).
4. Apply grease to the lip and sides of the new seal.
5. Place the seal in the bore, with the closed side of the seal facing out. The seal must be square to the bore.
6. Start the seal into the bore by hand, and use a socket or driver to squarely press the seal into its seat (**Figure 43**).

CRANKCASE BEARINGS

Refer to Chapter One for general bearing removal and installation techniques.

Tools

Preferably, remove crankcase bearings with a press. Pressure can be controlled and applied more evenly. If bearing drivers are not available, properly-sized sockets can be substituted. Always use a driver or socket that fits on the outer edge of the bearing. Do not apply pressure to the inner race and bearings.

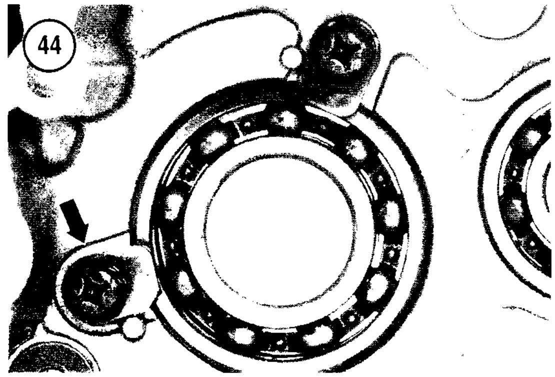
Bearings that are only accessible from one side of the case are removed with a blind bearing puller. The puller is fitted through the bearing, and then expanded to grip the back side of the bearing. A sliding weight on the tool is quickly pulled back to impact and dislodge the bearing. Suzuki recommends the following tools:

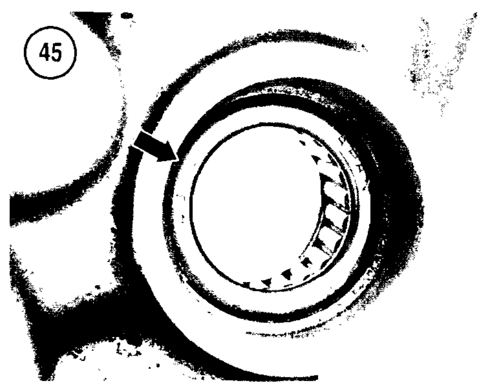
1. Bearing remover set (part No. 09921-20220), or equivalent two-leg puller and fittings.
2. Bearing installer set (part No. 09913-70210), or equivalent hand driver set.
3. Bearing remover head (part No. 09923-73210), or equivalent blind bearing remover.
4. Bearing remover head (part No. 09921-20210), or equivalent blind bearing remover.

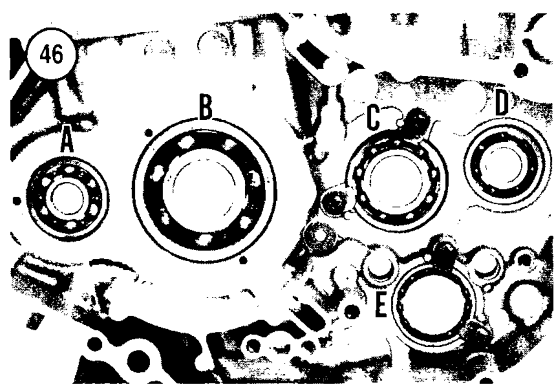
5. Sliding hammer (part No. 09930-30102), or equivalent slide hammer.

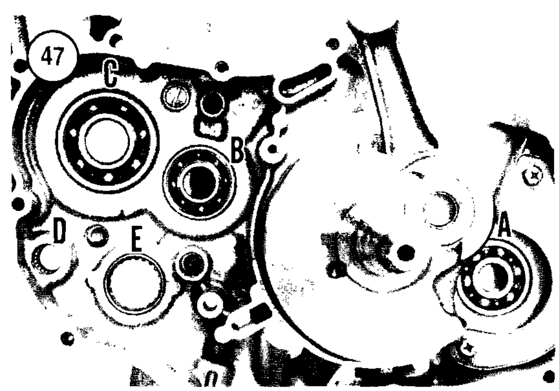
Replacement

1. When replacing crankcase bearings, note the following:
   a. Where used, remove bearing retainers (**Figure 44**) before attempting bearing removal. When installing retainers, clean the screw threads and install the screws using threadlocking compound.
   b. Identify and record the size code (**Figure 45**) of each bearing before it is removed from the case half.
   c. Record the orientation of each bearing in its bore. Note if the size code faces toward the inside or outside of the case half. Commonly, the markings should *face up* when installing the bearing. Also note the orientation of the shielded bearings. The shield side should face the outside of the case half.
   d. Use a hydraulic press or a set of bearing drivers to remove and install bearings. All crankcase bearings are an interference-fit. Removal and installation of the bearings is eased by using heat. Do not use direct heat from a torch. Use a heat gun or shop oven.
2. All the bearings, except the shift drum bearing, can be removed using the bearing remover set and bearing installer set. Use available drivers or sockets to remove and install the shift drum bearing. Refer to **Figure 46** for the right case half.
   a. Balancer shaft bearing (A).
   b. Crankshaft bearing (B).
   c. Input shaft bearing (C).
   d. Output shaft bearing (D).
   e. Shift drum bearing (E).
3. Refer to **Figure 47** for the left case half. The bearings, except the shift shaft and shift drum bearings, are identified with the tools required for removal and installation. The shift shaft and shift drum bearings can be removed with driver sockets.
   a. Balancer shaft bearing (A, **Figure 47**). Use the bearing remover head, sliding hammer and bearing installer set.
   b. Input shaft bushing (B, **Figure 47**). Use the bearing remover head, sliding hammer and bearing installer set.









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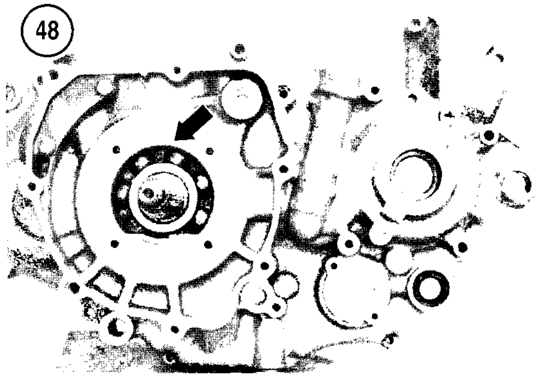

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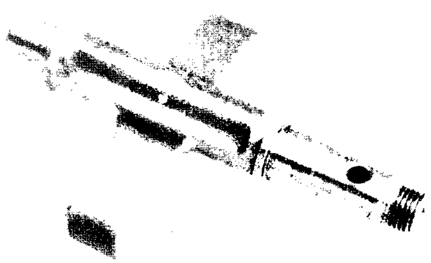

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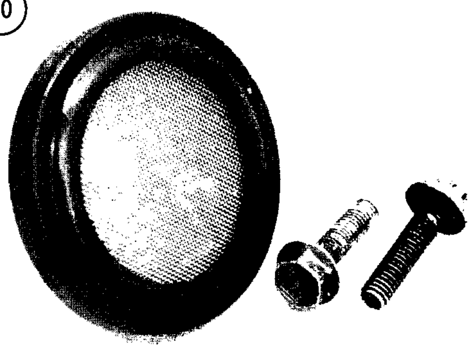

c. Output shaft bearing (C, **Figure 47**). Use the bearing remover set and bearing installer set.
d. Shift shaft bearing (D, **Figure 47**).
e. Shift drum bearing (E, **Figure 47**).
f. Crankshaft bearing (**Figure 48**). Use the bearing remover set and bearing installer set.

4. All crankcase bearings can be removed and installed using the following steps.
   a. Remove the seal from the bearing, if applicable.
   b. Heat the crankcase.
   c. Support the heated crankcase on wooden blocks, allowing space for the bearing to fall from the bore.
   d. Remove the damaged bearing from the bore, using a press, hand-driver set or bearing puller.
   e. Clean and inspect the bore. Check that all oil holes (where applicable) are clean.
   f. Place the new bearing in a freezer and chill for at least one hour.
   g. When the bearing is chilled, reheat the crankcase.
   h. Support the heated crankcase on wooden blocks, and then lubricate the mating surface of the bore and bearing. Place the bearing squarely over the bore and check that it is properly oriented.
   i. Press the bearing into place using the correct driver.
   j. If a press is not available, the bearing can be seated using a driver and socket. Place the driver/socket squarely over the bearing, and then drive the bearing into the case. Excessive force should not be required.
   k. Install the seal (if applicable) as described in this chapter.

ENGINE BALANCER

Inspection

The engine uses a rotating balancer (**Figure 49**) to dampen engine vibration. The balancer weight is synchronized with the crankshaft and is gear-driven by a gear on the right end of the crankshaft. Inspect the balancer:

1. Install the balancer into its crankcase bearings and check for play between the parts.
2. Inspect the bearing surfaces, pin hole and threads for damage and cleanliness.
3. Inspect the fit of the drive gear, pin and nut on the balancer shaft.

OIL STRAINER

Inspection

Inspect and clean the oil strainer (**Figure 50**):

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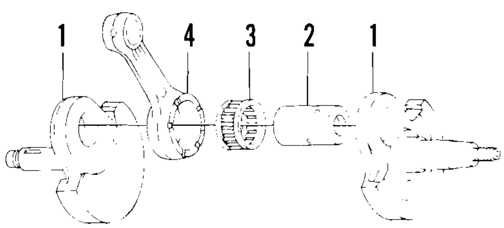
CRANKSHAFT



1. Crankshaft half
2. Connecting rod
3. Bearing
4. Crankpin

1. Flush the strainer with solvent and compressed air. Make sure the screen is completely clean.
2. Clean the bolt threads.

CRANKSHAFT

Inspection

The crankshaft (**Figure 51**) is an assembly-type, with its two halves joined by a crankpin. The crankpin is hydraulically pressed into the flywheels and aligned, both vertically and horizontally, with calibrated equipment. The assembly is supported at each end by a ball bearing. The connecting rod big end is a needle bearing.

Carefully handle the crankshaft assembly during inspection. Do not place the crankshaft where it could accidentally roll off the workbench.

Refer to **Table 1** for specifications.

1. Clean the crankshaft with *clean* solvent and dry with compressed air. Lubricate the rod bearing with engine oil.
2. Inspect both ends of the crankshaft (**Figure 52**).
   a. Inspect the oil passages (A) for cleanliness.
   b. Inspect the shaft threads (B). Light damage can be corrected with a thread file.
   c. Inspect the keyway (C). It should be square and the key should fit firmly.
   d. Inspect the bearing surface (D) for scoring, heat discoloration or other damage. Burnishing can be removed with 320-grit carborundum cloth and lubricant.

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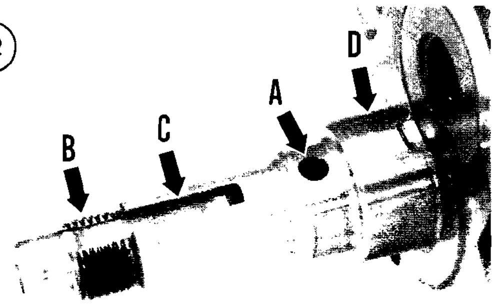

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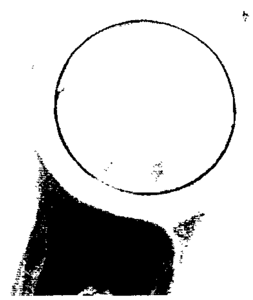

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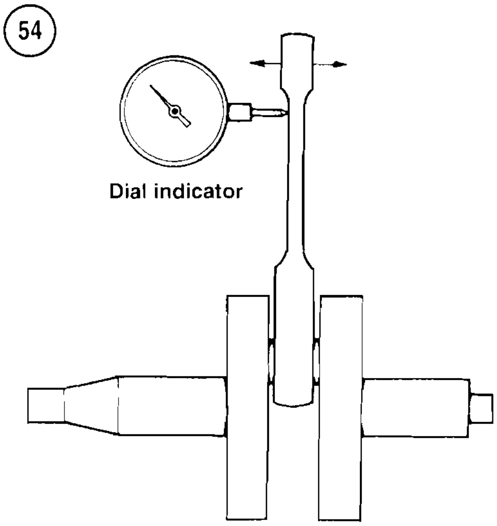

3. Inspect the connecting rod.
   a. Inspect the rod small end (**Figure 53**) for scoring, galling or heat damage. Refer to Chapter Four for rod bore, piston pin and piston inspection.

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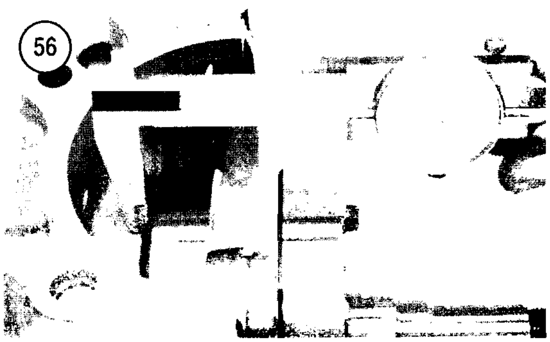

b. Inspect the rod small end for play, or tilt (**Figure 54**). Use a dial indicator, mounted on a stand to make the check.
c. Inspect the rod big end and bearing for scoring, galling or heat damage.
d. Inspect the rod for radial clearance. Although no specifications are available, an acceptable method is to grasp the rod and feel for radial play in all directions. There should be no perceptible play.
e. Measure the connecting rod side clearance (**Figure 55**). Fully seat the feeler gauge against the crankpin to make the measurement.

4. Measure the crankshaft web-to-web width (**Figure 56**). If the width is not within specification, have a dealership evaluate the crankshaft.
5. If removed from the crankcase, place the crankshaft in a flywheel alignment jig and measure the crankshaft runout with a dial indicator. Insert the jig centers into the ends of the crankshaft. Measure at the bearing surface on each side of the crankshaft. If the runout exceeds the service limit, have a dealership evaluate the crankshaft.

Table 1 ENGINE LOWER END SPECIFICATIONS

	New mm (in.)	Service limit mm (in.)
Connecting rod		
Big end side clearance	0.30-0.65 (0.012-0.026)	1.0 (0.04)
Big end width	21.95-22.0 (0.864-0.866)	–
Small end free play (tilt)	–	3.0 (0.12)
Small end inside diameter	20.010-20.018 (0.7878-0.7881)	20.040 (0.7890)
Crankshaft runout	–	0.08 (0.003)
Crankshaft web to web width	62.0 ± 0.1 (2.441 ± 0.004)	–

Table 2 ENGINE LOWER END TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Crankcase bolts	11	–	8
Engine mounting bolts			
Bottom mounting bolt	66	–	49
Mounting bracket to frame	40	–	30
Mounting bracket to engine	66	–	49
Oil hose bolt and strainer	23	–	17
Swing arm pivot bolt	77	–	57

CHAPTER SIX

CLUTCH, EXTERNAL SHIFT MECHANISM AND LUBRICATION SYSTEM

Refer to **Tables 1-3** at the end of the chapter for specifications.

This chapter provides service procedures for the following components.

1. Clutch cover.
2. Clutch.
3. Right crankcase cover.
4. Oil pump.
5. Cam chain and rear guide.
6. Balancer driven gear.
7. Primary and balancer drive gears.
8. Shift lever.
9. External shift mechanism.
10. Clutch cable.

CLUTCH COVER

All clutch components, except the clutch housing and spacer, can be removed through the clutch cover opening. If the clutch housing must be removed, remove the clutch cover and the right crankcase cover as described in this chapter. Disassemble the complete clutch after the right crankcase cover is removed.

Removal, Inspection and Installation

1. Remove the rear brake pedal (Chapter Fourteen).
2. If servicing the clutch assembly, drain the engine oil from the crankcase (Chapter Three). Although the engine is a dry sump engine, some engine oil is in the crankcase.
3. Remove the clutch cover bolts. Note the bolt (**Figure 1**) with the seal washer. This bolt and washer must be installed in this location.
4. Inspect the cover and bolts (**Figure 2**) for damage.

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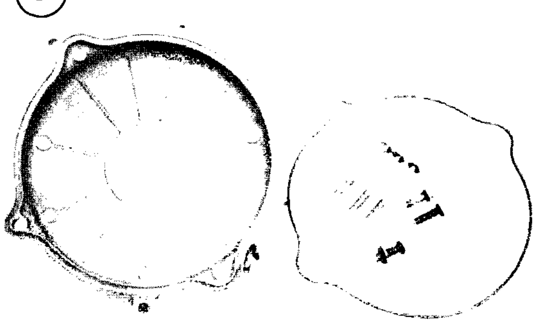

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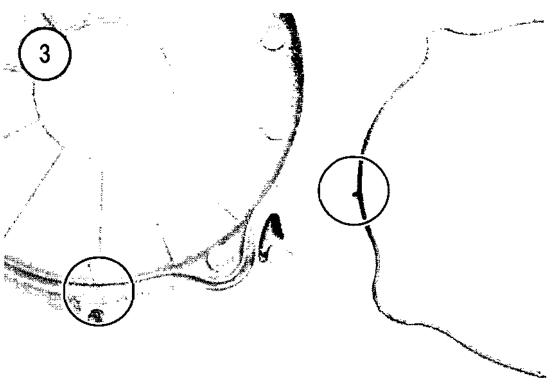


a. Install a new O-ring on the cover. Make sure the tab on the O-ring is engaged properly with the cover (**Figure 3**).

b. Install a new seal washer on the cover bolt.

5. Reverse this procedure to install the cover. Tighten the cover bolts to 10 N•m (7 ft.-lb.).

CLUTCH

The clutch assembly consists of an outer housing and a clutch hub. A set of clutch plates and friction plates are alternately locked to the two parts. The gear-driven clutch housing is mounted on the transmission input shaft and can rotate freely. The housing receives power from the primary drive gear mounted on the crankshaft. As the clutch is engaged, the housing and friction plates transfer the power to the clutch plates locked to the clutch hub. The clutch hub is splined to the input shaft and powers the transmission. The plate assembly is engaged by springs and disengaged by a cable-actuated release lever and pushrod assembly.

Removal

Refer to **Figure 4**.

1. Remove the clutch cover as described in this chapter.
2. Check that there is play in the clutch lever and cable.
3. Loosen the clutch springs bolts (**Figure 5**). Make several passes and work in a crossing pattern to relieve the pressure on the bolts. Remove the bolts, retainers and springs from the clutch.
4. Remove the pressure plate (**Figure 6**).
5. Remove the pushrod and push piece (**Figure 7**).
6. Remove the friction plates and clutch plates (**Figure 8**).
7. Remove the spring washer and spring seat (**Figure 9**).
8. Remove the clutch hub nut as follows:
   a. Bend the lockwasher tab (**Figure 10**) away from the locknut.

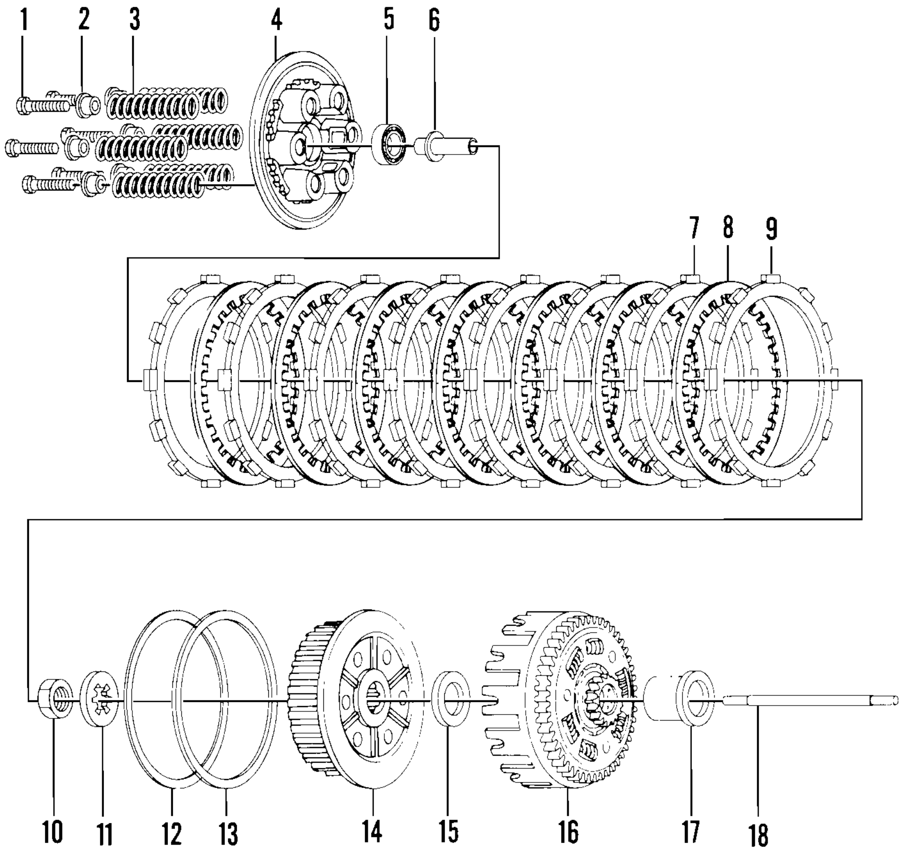
CAUTION

Do not hold the gears with screwdrivers or other tools. This can cause gear damage.

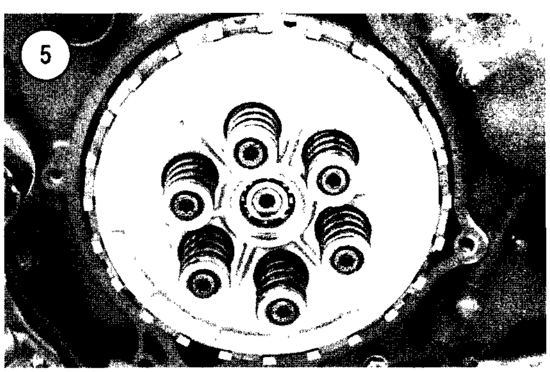
   b. Attach a clutch holder tool (Suzuki part No. 09920-53740) to the clutch hub (**Figure 11**). The tool can be braced against the frame.
   c. Using a 27 mm socket, remove the nut and lockwasher.
9. Remove the clutch hub (**Figure 12**).
10. Remove the washer (**Figure 13**).
11. The clutch housing and spacer (**Figure 14**) cannot be removed through the clutch cover opening. Remove the right crankcase cover as described in this chapter, and then remove the clutch housing.
12. Inspect the clutch assembly as described in this section.

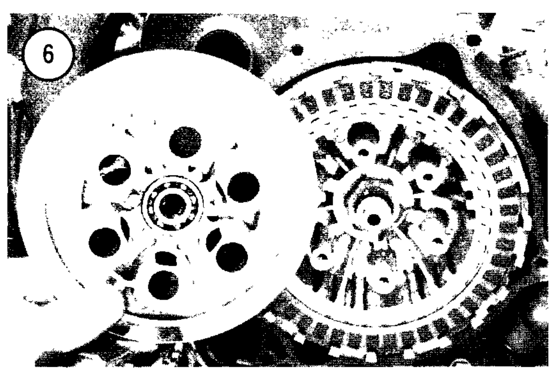
4

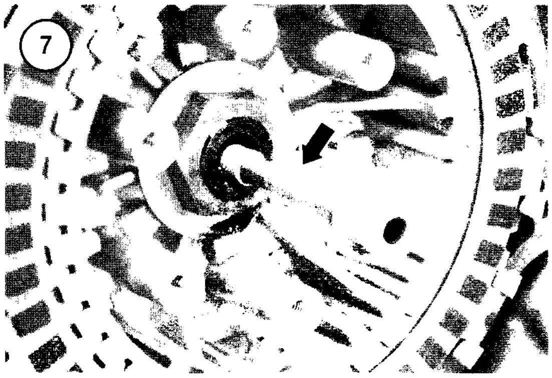
CLUTCH



1. Bolt
2. Spring retainer
3. Spring
4. Pressure plate
5. Bearing
6. Push piece
7. Friction plate No. 1 (7 plates)
8. Clutch plate (7 plates)
9. Friction plate No. 2 (1 plate)
10. Hub nut
11. Lockwasher
12. Spring washer
13. Spring seat
14. Clutch hub
15. Washer
16. Clutch housing
17. Spacer
18. Pushrod



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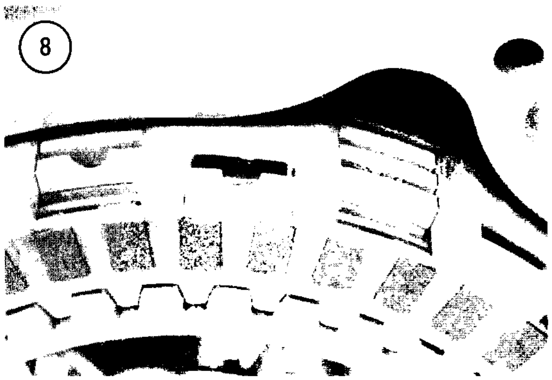
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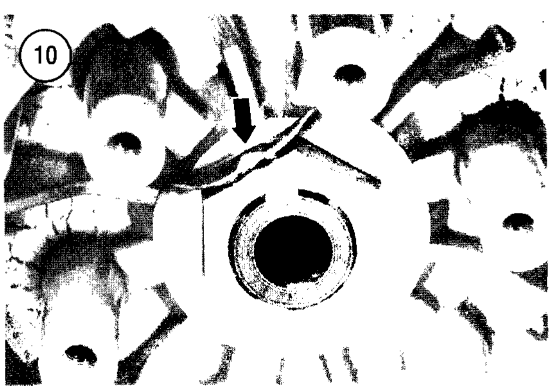
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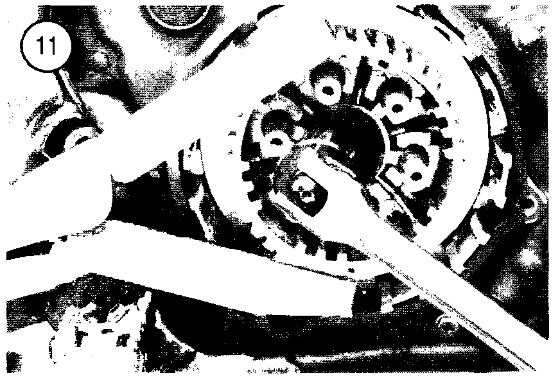
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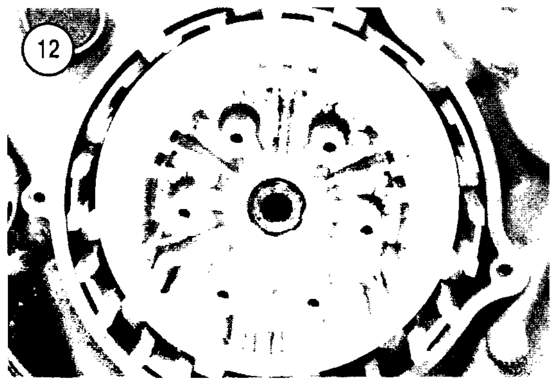
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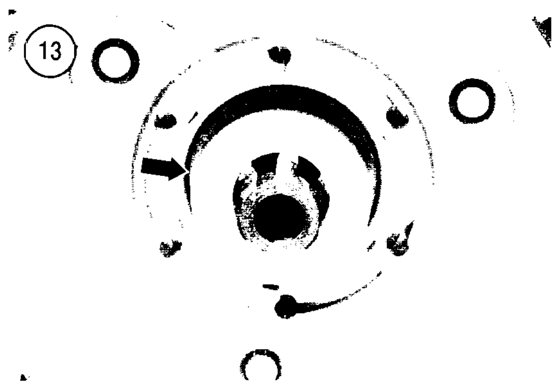
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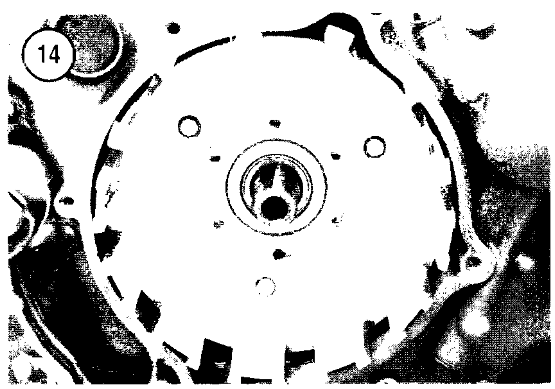
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Installation

During assembly, lubricate the parts and transmission shaft with engine oil. Refer to **Figure 4**. If the right crankcase cover is removed, the clutch assembly can be installed before installing the crankcase cover.

1. If removed, install the spacer and clutch housing as described in *Right Crankcase Cover* in this chapter.
2. Install the washer (**Figure 13**).
3. Install the clutch hub (**Figure 12**).
4. Install the clutch hub nut as follows:
   a. Install a new lockwasher (**Figure 15**).
   b. Attach a clutch holder tool to the clutch hub (**Figure 11**).
   c. Using a 27 mm socket, tighten the nut to 70 N•m (52 ft.-lb.).
   d. Bend the lockwasher tab against the locknut (**Figure 10**).
5. Install the spring seat and spring washer onto the clutch hub as follows:
   a. Install the spring seat (A, **Figure 16**) first.
   b. Install the spring washer (B, **Figure 16**) with the cupped side facing out.
6. Install the plates into the clutch housing and clutch hub as follows:
   a. Identify the No. 1 and the No. 2 friction plates (**Figure 17**). There are seven No. 1 friction plates and one No. 2 friction plate. The No. 2 friction plate has a larger inside diameter and larger sections of friction material (**Figure 18**). Friction plate No. 2 must be installed *first*.
   b. Soak the plates in engine oil. To prevent possible seizure, particularly with new friction plates, it is important that the face of the friction plates be completely coated with oil.
   c. Beginning with friction plate No. 2 (**Figure 19**), alternately install friction plates and clutch plates into the clutch housing and clutch hub. When installing the last friction plate, offset the plate by one notch in the housing (**Figure 20**).
7. Install the pushrod and push piece (**Figure 7**).
8. Install the pressure plate (**Figure 6**).
9. Lock the pressure plate to the clutch hub as follows:
   a. Install the clutch springs, retainers and bolts (**Figure 5**).
   b. Finger-tighten the bolts.

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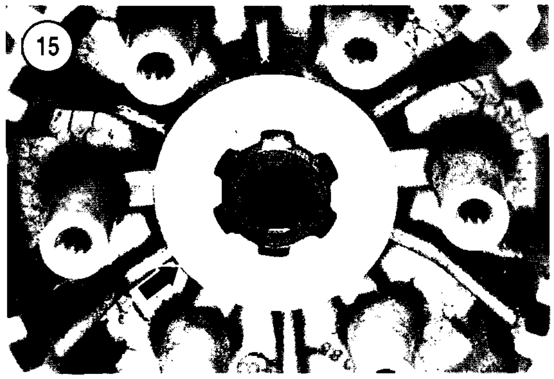

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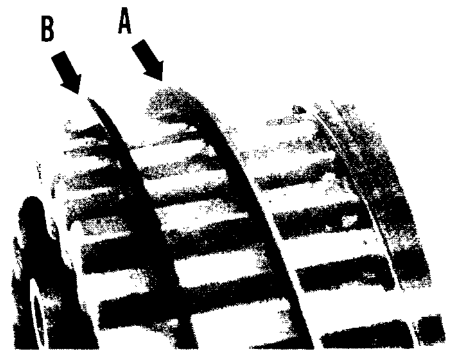

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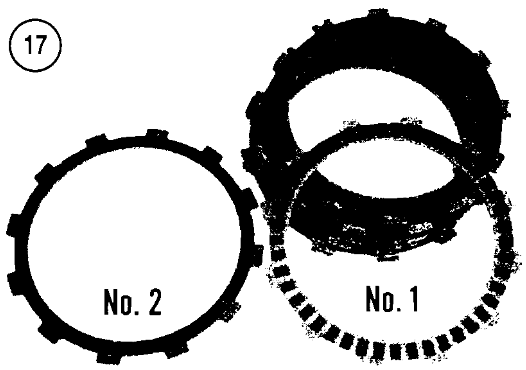

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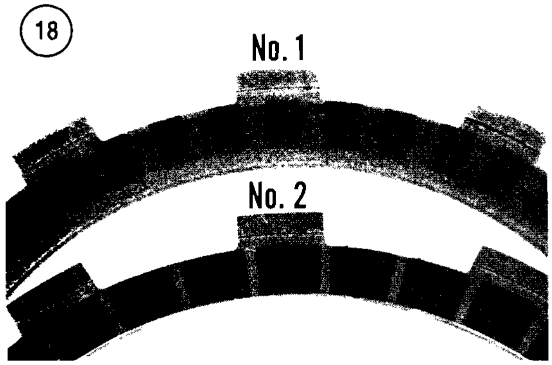

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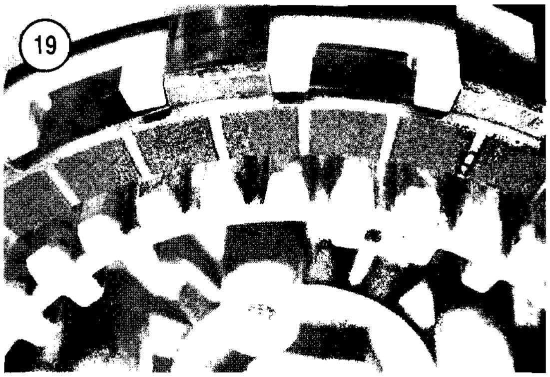

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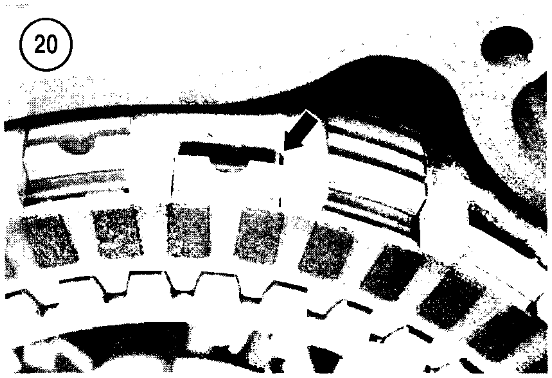

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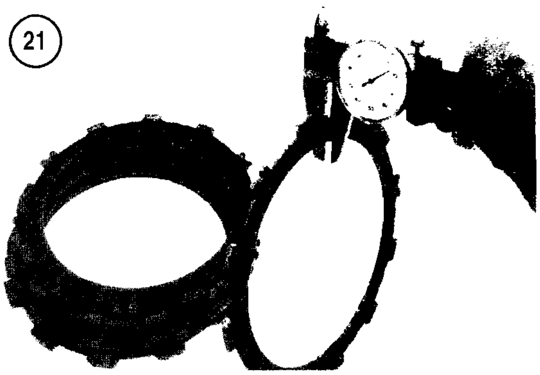

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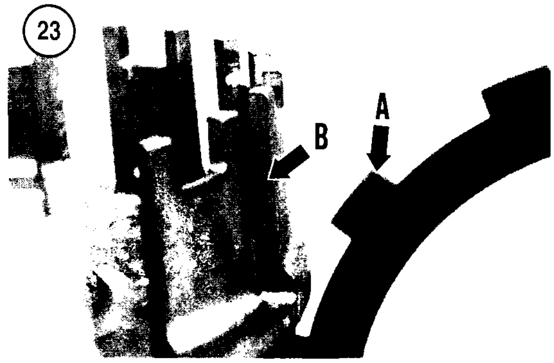

c. Tighten the bolts, working in a crossing pattern. Make several passes so all bolts are tightened in equal steps. Tighten the bolts to 10 N•m (7 ft.-lb.).

10. Install the clutch cover as described in this chapter.

11. Adjust the clutch cable (Chapter Three).

Inspection

Always replace clutch plates, friction plates or springs as a set if they do not meet specifications. If any part shows signs of wear or damage, replace it regardless of its specification. Refer to **Table 1** for specifications.

1. Clean the parts in solvent and dry with compressed air. Also clean the transmission shaft.
2. Measure the thickness of each friction plate (**Figure 21**). Measure at several locations around the perimeter.
3. Measure the width of the claws on the friction plates (**Figure 22**).
4. Inspect the claws on the friction plates (A, **Figure 23**) for damage. Check that each plate slides smoothly on the clutch housing.
5. Measure each clutch plate for warp. Lay each plate on a surface plate or thick piece of glass, and measure any gap around the perimeter of the plate (**Figure 24**). Warped plates cause erratic clutch operation.
6. Inspect the teeth on the clutch plates (A, **Figure 25**) for damage. Check that each plate slides smoothly on the clutch hub.
7. Inspect both sides of the clutch housing (**Figure 26** and **Figure 27**).
   a. Inspect the oil pockets in the housing bore for cleanliness and wear.

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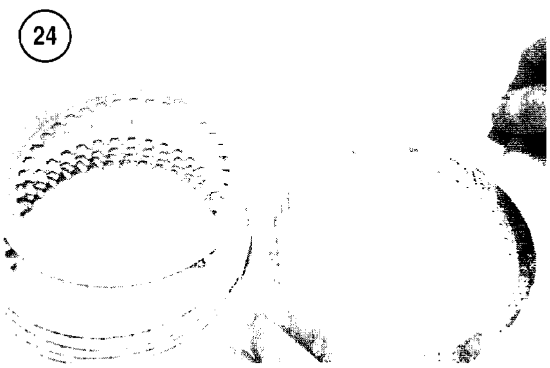

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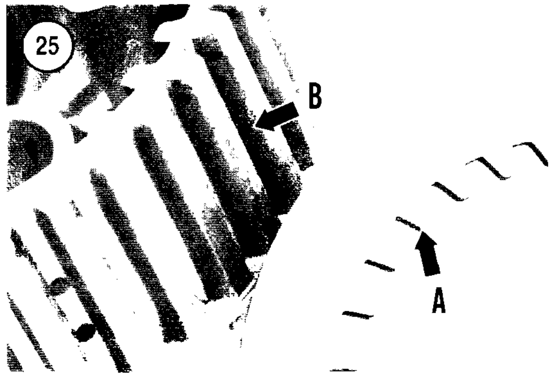

b. Inspect the gear teeth for wear or damage.
c. Inspect the damper springs and rivets on both sides of the housing for looseness or damage.
d. Inspect the slots for nicks, wear and damage (B, **Figure 23**). The slots must be smooth and free of defects so the friction plates smoothly engage and disengage. If chatter marks are evident, light damage can be smoothed using a fine-cut file or oilstone.

8. Inspect the condition of the spacer. Insert the spacer into the clutch housing (**Figure 28**) and on the transmission shaft. Check for excessive play, scoring and wear.
9. Inspect the clutch hub (**Figure 29**).
   a. Inspect the shaft splines. The hub should fit on the transmission shaft with no obvious play.
   b. Inspect the perimeter of the hub for wear and damage on the contact area.
   c. Inspect the bosses and threads for damage.
   d. Inspect the outer splines for nicks, wear and damage (B, **Figure 25**). The splines must be smooth and free of defects so the clutch plates smoothly engage and disengage. If chatter marks are evident, light damage can be smoothed using a fine-cut file or oilstone.
10. Measure the free length of each clutch spring (**Figure 30**).
11. Inspect the pressure plate (**Figure 31**).
   a. Inspect the pressure plate for cracks, particularly around the bosses and bearing seat (A).
   b. Inspect the perimeter of the pressure plate for wear and damage on the contact area (B).
   c. Inspect the bearing for smooth operation (C).
12. Inspect the pushrod and push piece (**Figure 32**) for wear and damage.

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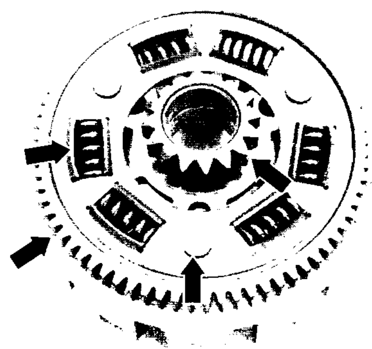

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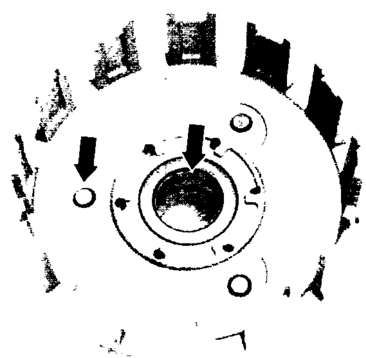

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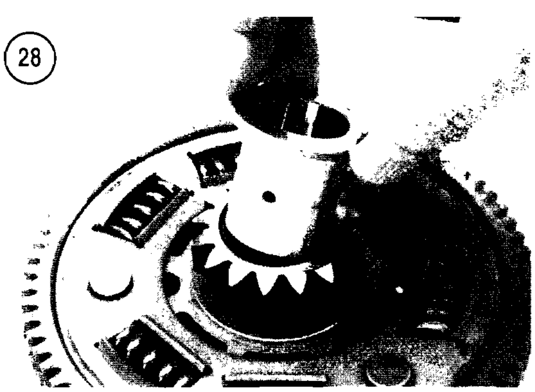

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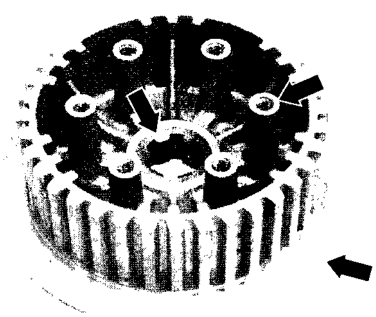

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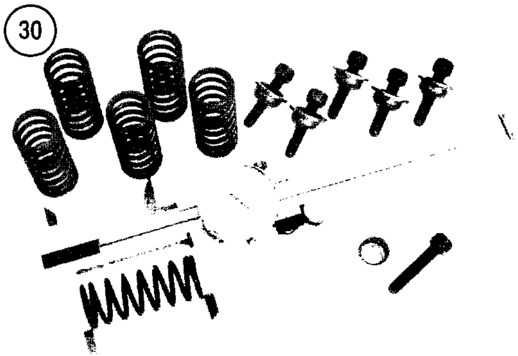

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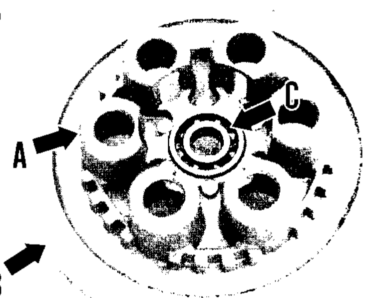

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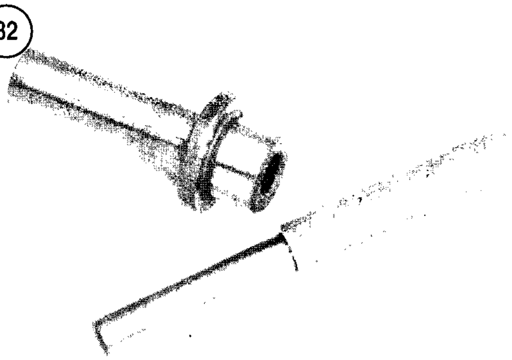

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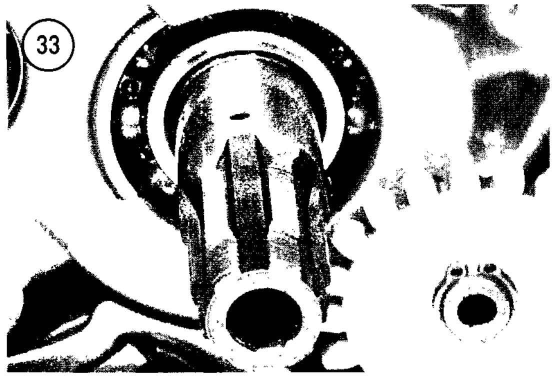

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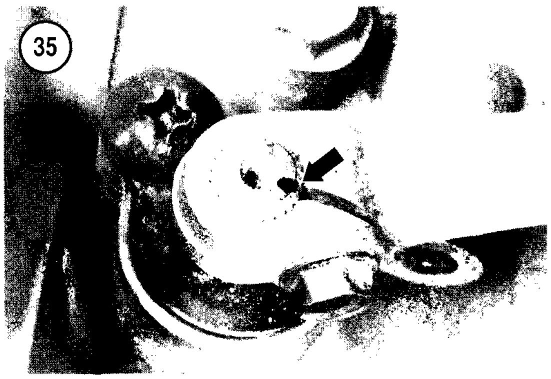
13. Inspect the washer, nut, spring washer and spring washer seat for wear and damage. The spring washer should be cupped on one side.
14. Inspect the oil hole, splines, threads and polished surfaces on the transmission shaft (**Figure 33**) for damage.
15. At the left side of the engine, inspect the clutch release lever (**Figure 34**). The release lever shaft rotates against the end of the pushrod and disengages the clutch. Inspect the lever for tightness and seal leaks. If the seal is leaking, replace it as follows:
    a. Remove the starter (Chapter Nine).
    b. Make a reference mark (**Figure 35**) on the shaft so the release lever can be installed in its original position.
    c. Remove the lever, screw and seal retainer plate.
    d. Pry out the seal (**Figure 36**).
    e. Apply grease to the new seal, and then install the seal with the closed side facing out. Cover the shaft splines with plastic wrap to prevent tearing the seal when it is passed over the shaft.
    f. Install the seal retainer, lever and starter.
16. Install the clutch assembly as described in this section.

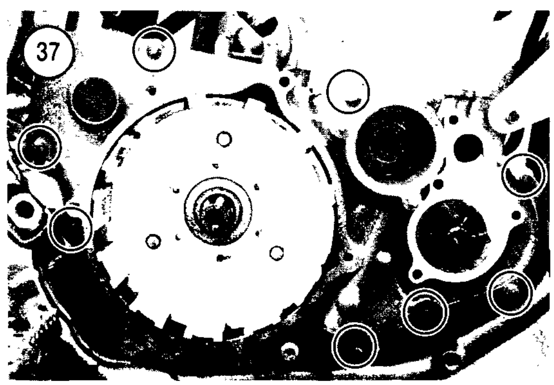


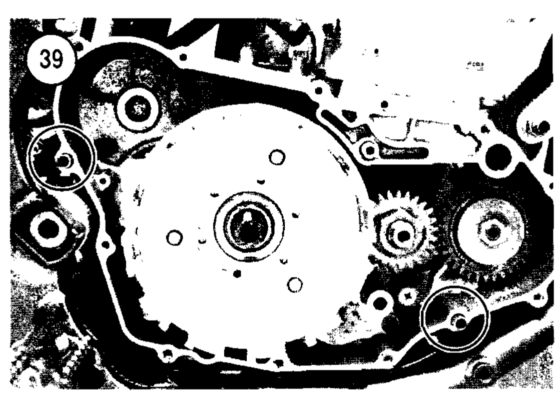
RIGHT CRANKCASE COVER

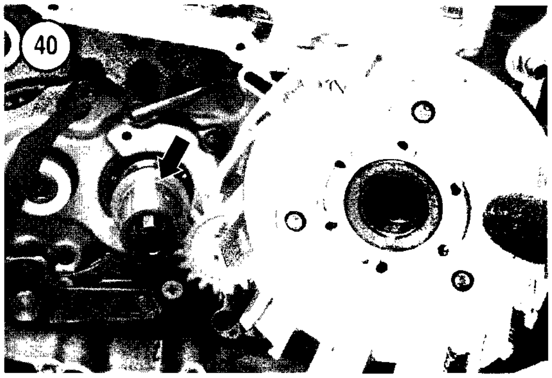
Removal and Installation

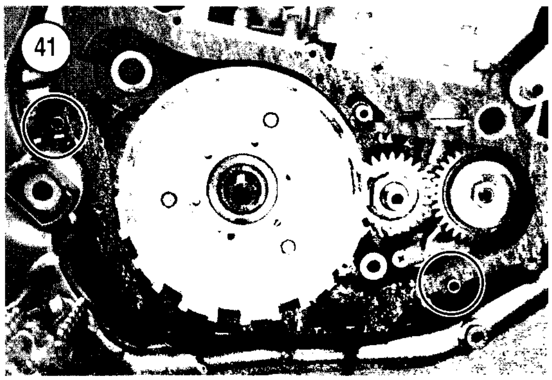
In the following procedure, the clutch assembly is removed. The clutch assembly does not have to be removed to remove the right crankcase cover.

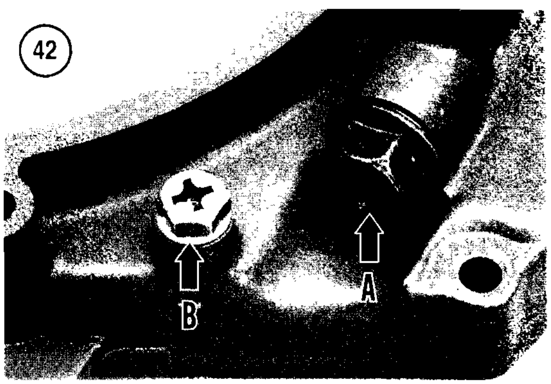
1. Drain the engine oil and remove the oil filter (Chapter Three).
2. Drain the cooling system (Chapter Three).
3. Remove the water pump cover (Chapter Ten).
4. Remove the clutch cover as described in this chapter.
5. Remove the bolts from the perimeter of the crankcase cover (**Figure 37**). Note the bolt (**Figure 38**) with the seal washer. This bolt and washer must be installed in this location.
6. Pull the cover straight out. If necessary, lightly tap the cover to loosen it from the engine.
7. Remove the gasket and account for the two dowels between the crankcase and cover (**Figure 39**).
8. If necessary, remove the remainder of the water pump assembly (Chapter Ten).
9. Inspect the cover assembly as described in this section.
10. If servicing the clutch assembly, remove the clutch housing and spacer (**Figure 40**).
11. Reverse these steps to install the right crankcase cover assembly. Note the following:
    a. Insert the spacer into the back of the clutch housing, and then install the housing. If desired, the entire clutch assembly can be installed at this time.
    b. Clean all residue and oil from the engine and cover gasket surfaces.
    c. Apply grease to the crankshaft oil seal, located in the cover.

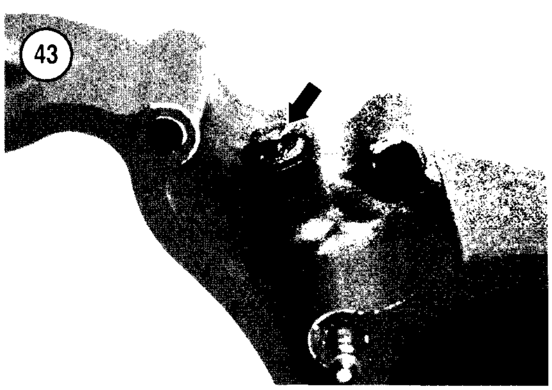


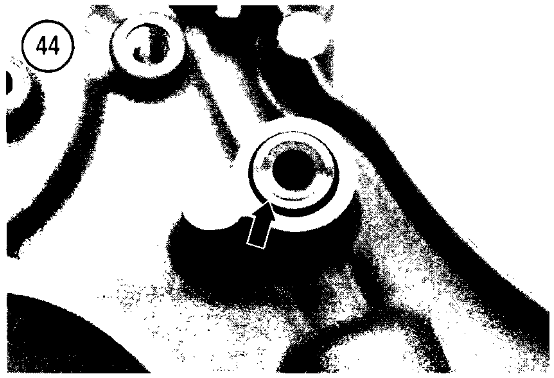












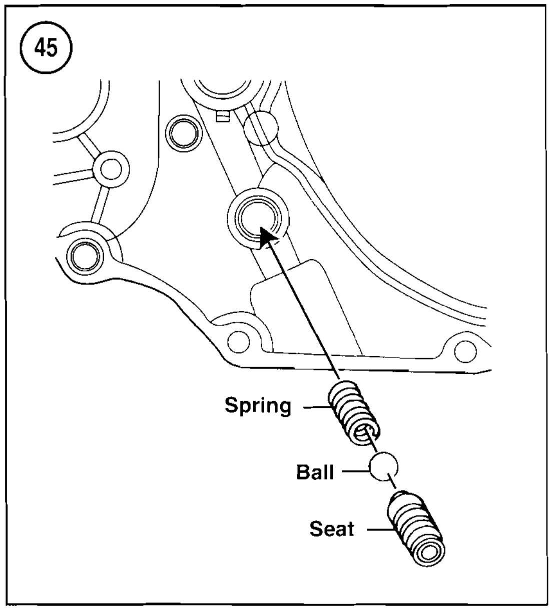
d. Install the dowels (**Figure 41**) and a new cover gasket on the crankcase. To keep the gasket in place while installing the cover, apply small spots of sealant to the crankcase gasket surface. It is not necessary to apply sealant to the entire surface.

e. Install a new seal washer on the cover bolt located near the oil filter housing (**Figure 38**).

f. Tighten the right crankcase cover bolts to 10 N•m (7 ft.-lb.).

Inspection

1. Remove the oil pressure check bolt (A, **Figure 42**) and crankcase oil level check bolt (B).
2. Remove the oil check bolt near the oil filter housing (**Figure 43**).
3. Inspect the oil check valve assembly (**Figure 44** and **Figure 45**). Insert a small screwdriver into the rubber seat and depress the ball in the valve. The ball should lift off the seat with some resistance and return when released. If the ball will not move or does not operate smoothly, remove the seat, ball and spring for cleaning or parts replacement. If the check valve operates smoothly and the oil passage is clean, the assembly can be left in place. If the check valve seat is removed, the rubber must face out when the seat is installed in the cover.
4. Clean the cover in solvent and dry with compressed air. Check that all passages are clean.
5. Inspect both sides of the crankcase cover (**Figure 46** and **Figure 47**). Inspect for cracks and thread damage.
6. Inspect the crankshaft oil seal (A, **Figure 48**) in the crankcase cover. This seal fits over the end of the crankshaft and must be in good condition. Oil under pressure passes into the end of the crankshaft,



where it then goes to the crankpin and connecting rod. If this seal leaks, oil pressure will be reduced to these parts. Replace the seal as follows:

a. Remove the seal retainer (B, **Figure 48**).
b. Pry the seal from its bore. Place a wood block under the pry tool to create leverage. Avoid applying pressure to the cover.
c. Lubricate the new seal with grease.
d. Support the cover under the seal bore with a block of wood.
e. Place the seal over the bore.
f. Place a driver or socket over the seal. The driver should fit on the perimeter of the seal.
g. Drive the seal into place.
h. Install the seal retainer.

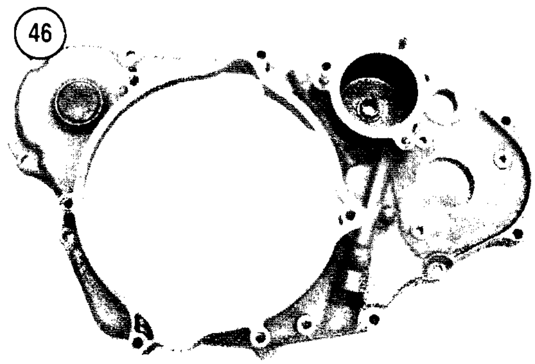
7. Install a new seal washer on the oil pressure check bolt (A, **Figure 42**) and crankcase oil level check bolt (B). Install the bolts into the cover.

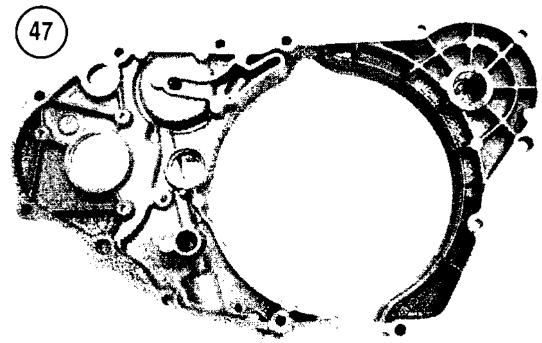
OIL PUMP

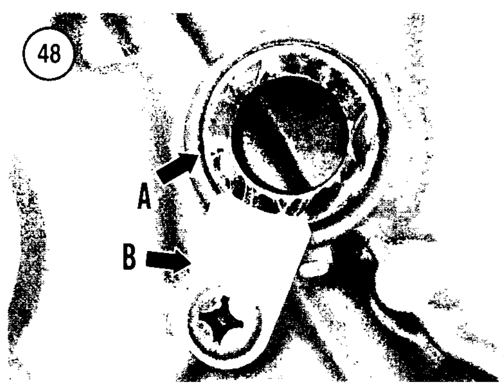
The oil pump (**Figure 49**) is behind the clutch housing and is driven by a gear on the clutch housing. The clutch assembly must be removed to service the oil pump.

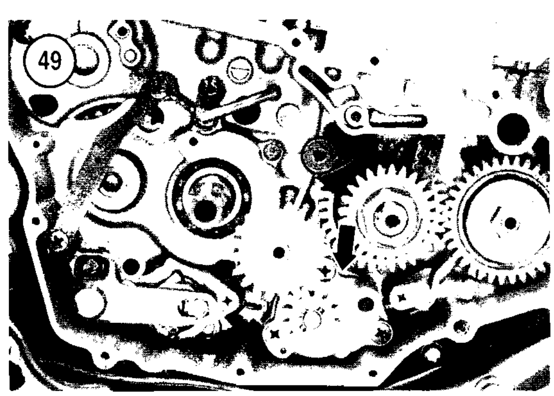
Removal and Installation

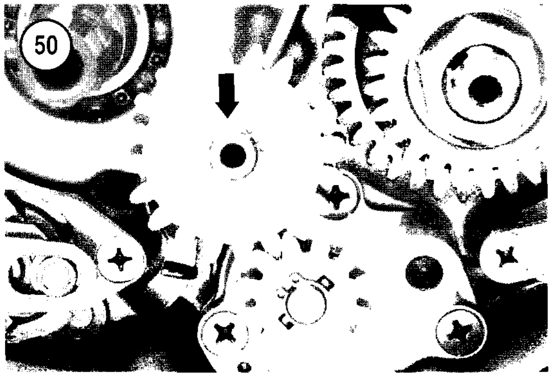
1. Remove the right crankcase cover and clutch assembly as described in this chapter.







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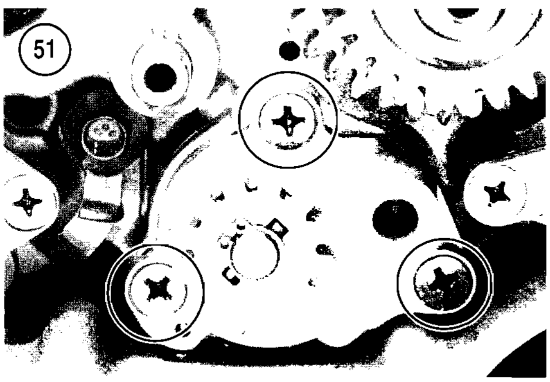
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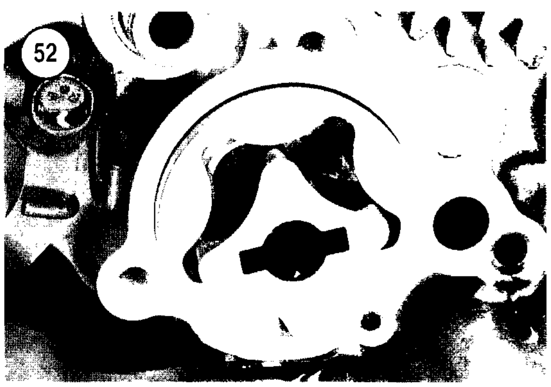
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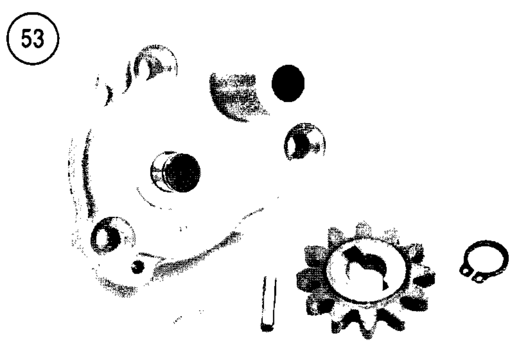
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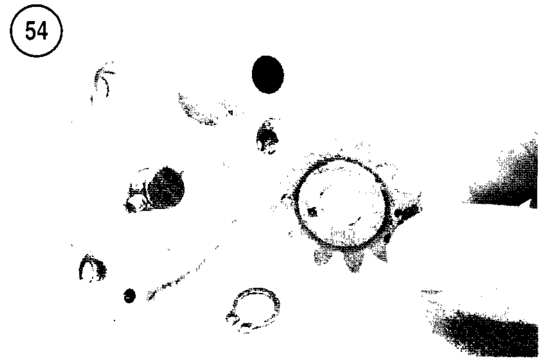
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2. Remove the snap ring (**Figure 50**) and idle gear from the shaft. Do not remove the second snap ring on the idle gear shaft because it prevents the shaft from falling into the crankcase.
3. Remove the three mounting screws and oil pump (**Figure 51**).
4. Remove the rotors (**Figure 52**). Account for the pin on the pump shaft.
5. Remove the snap ring, gear, pin and washer from the oil pump (**Figure 53**).
6. Inspect the oil pump as described in this section.
7. Assemble and install the oil pump as follows:
   a. Lubricate the pump and rotors with engine oil.
   b. Install the washer and pin, and then install the gear with the shouldered side (**Figure 54**) facing in. Install a new snap ring with the sharp edge facing out.
   c. Install the pin and rotors onto the pump shaft (**Figure 55**). The punch mark on both rotors should be visible.
   d. To ease installation of the pump, align the punch marks and pin as shown in **Figure 56**, and then install the pump.
   e. Apply threadlocking compound on the mounting screws before tightening.
   f. Install the shouldered side of the idle gear facing in. Install a new snap ring with the sharp edge facing out.
8. Install the clutch and right crankcase cover as described in this chapter.

Inspection

1. Clean the parts in solvent. Flush the pump while rotating the shaft.
2. Visually inspect all parts for obvious wear or damage.

3. Inspect the pump. The shaft should turn freely and smoothly. If roughness is detected and all debris has been flushed from the pump, the complete pump must be replaced. The pump cover is secured by a small screw that is threadlocked. Individual parts for the pump are not available.
4. Inspect the washer, pin and gear (**Figure 53**).
   a. Inspect the parts for wear.
   b. Assemble the pin and gear onto the pump shaft. The parts should fit firmly on the shaft.
5. Inspect the rotor set (**Figure 57**).
   a. Inspect each rotor for wear or scoring.
   b. Assemble the inner rotor and pin onto the pump shaft. The parts should fit firmly on the shaft.
6. Clean and inspect the pump cavity in the engine (**Figure 58**). Inspect for wear and scoring in the rotor contact area.
7. Inspect the idle gear (**Figure 59**) for wear and damage. The gear should fit firmly on its shaft.
8. Install the oil pump as described in this section.

CAM CHAIN AND REAR GUIDE

Removal, Inspection and Installation

The cam chain cannot be removed unless the camshafts are removed. If necessary, refer to Chapter Four for camshaft removal. Refer to *Primary and Balancer Drive Gears* in this chapter for removal of the cam chain sprocket.
1. Remove the right crankcase cover and clutch assembly as described in this chapter.
2. Remove the bolt (**Figure 60**) securing the cam chain guide. Account for the washer between the guide and crankcase.
3. Route the guide down and out of the engine.
4. Remove the cam chain.
5. Inspect the parts (**Figure 61**) as follows:
   a. The face of the guide should be smooth. If it is torn or disintegrating, replace the guide.
   b. Inspect the chain for wear. If the chain or any sprockets are worn or damaged, replace all the parts. Using new and old parts could cause poor engine performance and possible engine damage.
   c. Check the fit of the guide bolt in the guide bore. The bolt should fit firmly in the bore.
6. Reverse this procedure to install the cam chain and rear guide. Apply threadlocking compound to

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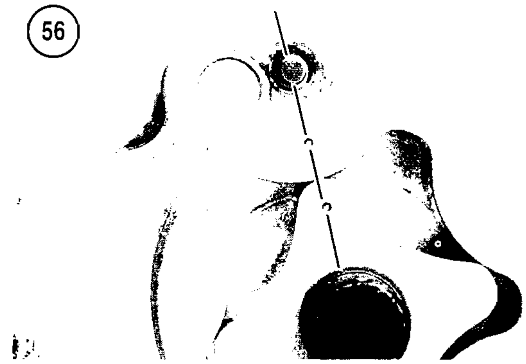

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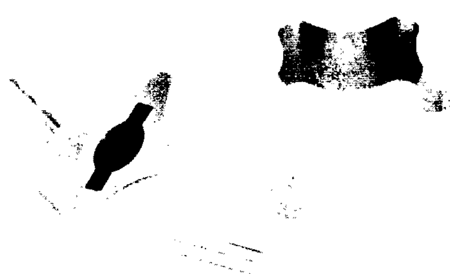

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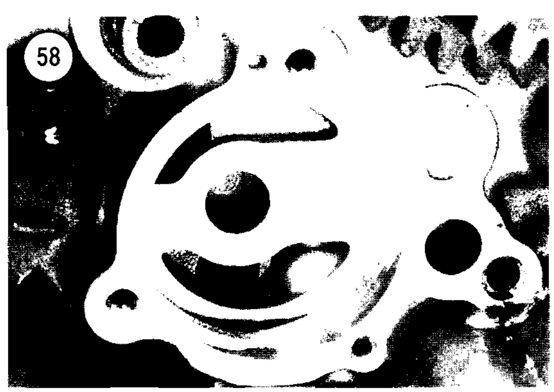

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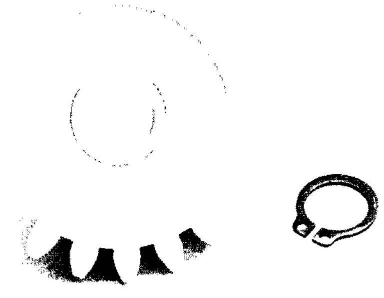

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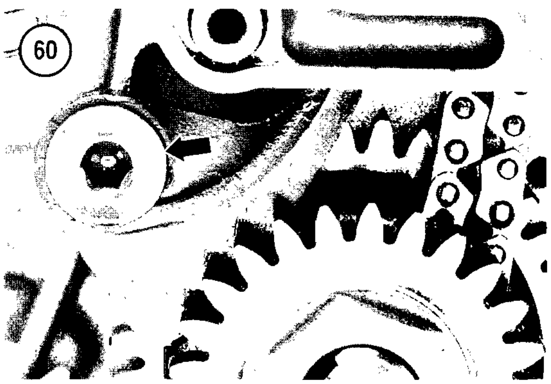

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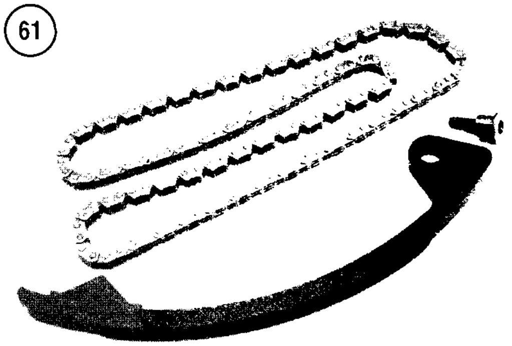

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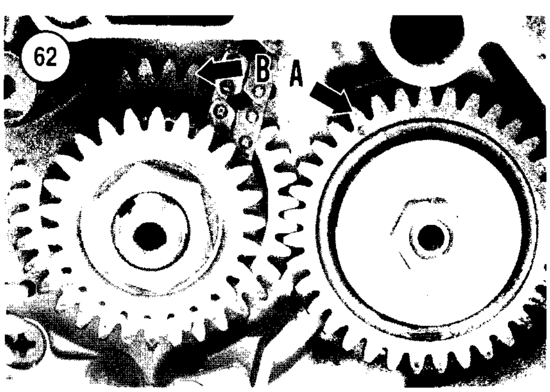


the guide bolt threads, and then tighten the bolt to 10 N•m (7 ft.-lb.).

BALANCER DRIVEN GEAR

The balancer shaft driven gear (A, **Figure 62**) is meshed with the balancer drive gear (B), located on the crankshaft. The two gears keep the crankshaft and balancer synchronized, so vibration is minimal during operation. When the balancer driven gear is removed, it must be synchronized with the balancer drive gear at time of assembly.

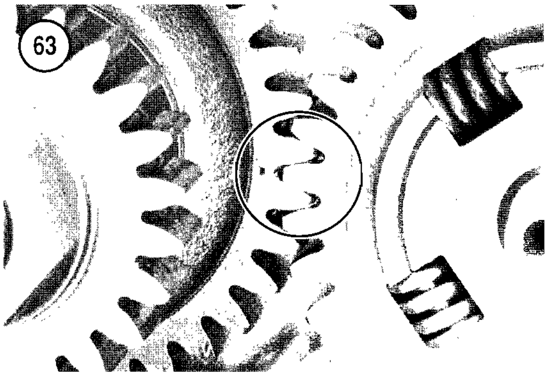
Removal, Inspection and Installation

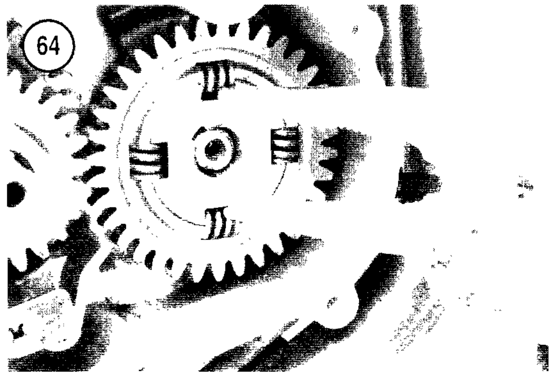
1. Remove the right crankcase cover and clutch assembly as described in this chapter.

CAUTION

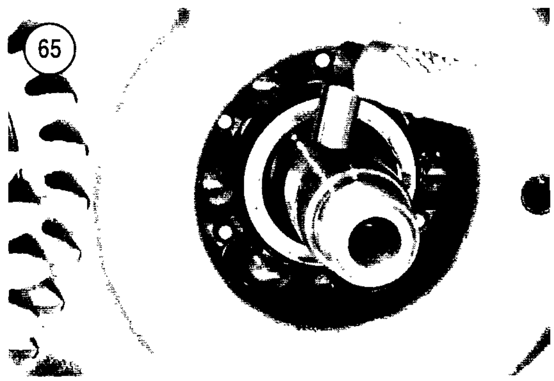
After the balancer driven gear is removed, the balancer weight hangs freely. With the weight in the down position, use caution if it is necessary to turn the crankshaft. The weight jams against the crankshaft unless it is first pivoted.

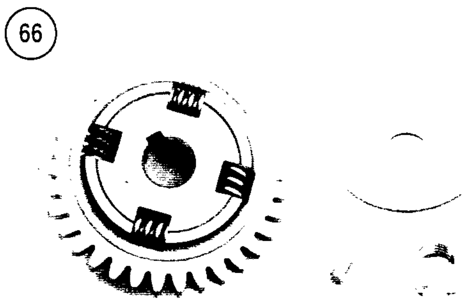
2. Remove the balancer driven gear as follows:
   a. Using a 27-mm socket, turn the crankshaft so the synchronization marks on both gears are aligned (**Figure 63**).
   b. Hold the crankshaft and remove the driven gear nut and washer.
   c. Grip the gear and pull it straight out (**Figure 64**).
   d. Remove the pin (**Figure 65**).
3. Inspect the parts (**Figure 66**) as follows:
   a. Clean the parts and shaft with solvent.
   b. Inspect the gear for worn or broken teeth.
   c. Check that the pins and springs are secure in the gear. If parts are broken, missing or excessively loose, replace the pins and springs. The gear halves can be driven apart and repaired.
   d. If the gear is disassembled, the alignment marks on the inner and outer halves of the gear must be aligned to synchronize the crankshaft and balancer.
   e. Check the fit of the pin in the gear and balancer shaft. The pin must not be worn and should fit in all parts with no excessive play.
   f. Inspect the shaft threads.





4. Install the parts as follows:
   a. Install the pin into the shaft.
   b. If not already positioned, turn the crankshaft so the synchronization marks on the drive gear and balancer driven gear can be aligned. Turn the shafts and seat the driven gear over the pin when alignment is verified (**Figure 63**).
   c. Install the washer and nut. Hold the crankshaft nut and tighten the balancer nut to 50 N•m (37 ft.-lb.).
5. Install the clutch and right crankcase cover as described in this chapter.

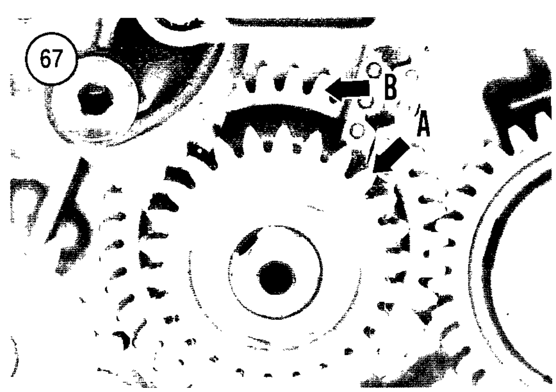




PRIMARY AND BALANCER DRIVE GEARS

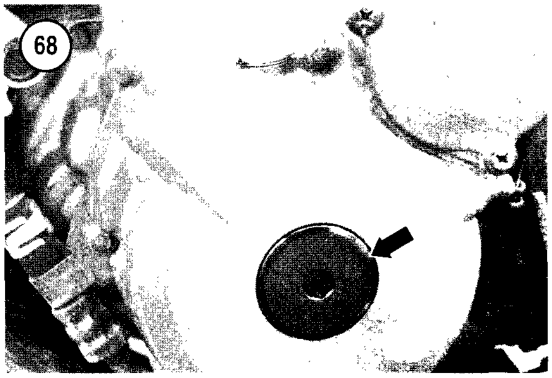
The primary drive gear, balancer drive gear and cam chain sprocket are located on the right end of the crankshaft. The primary drive gear (A, **Figure 67**) transmits power to the clutch housing while the balancer drive gear (B) powers the balancer shaft driven gear. Whenever the balancer drive gear is removed, it must be synchronized with the balancer driven gear at time of assembly.

The cam chain sprocket is located between the two gears on the crankshaft. The sprocket drives the cam chain, which rotates the camshafts.



Removal, Inspection and Installation

1. Remove the right crankcase cover and clutch assembly as described in this chapter.
2. Remove the cam chain and rear guide as described in this chapter.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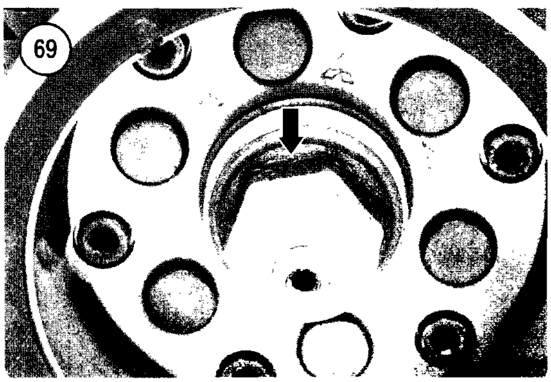
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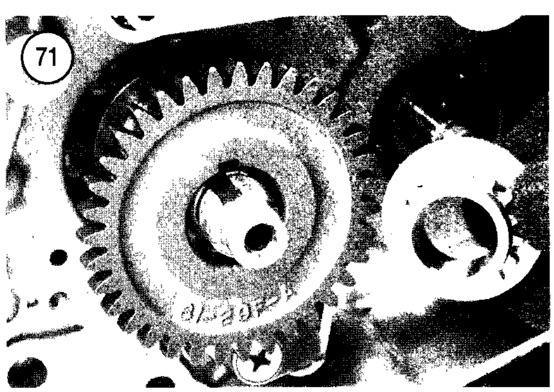
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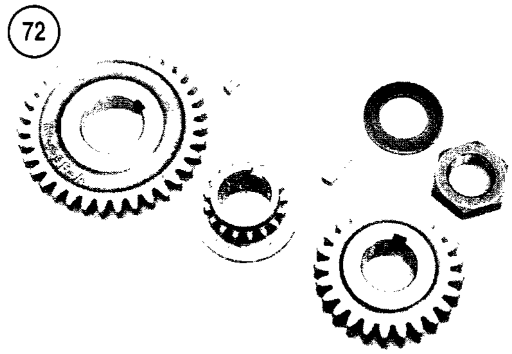
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CAUTION
After the primary gear is removed, the balancer weight hangs freely. With the weight in the down position, use caution if it is necessary to turn the crankshaft. The weight jams against the crankshaft unless it is first pivoted.

3. Remove the primary drive-gear nut as follows:
   a. Hold the rotor with a 26-mm deep-well socket or offset wrench. If using a socket, remove the rotor nut plug (**Figure 68**) to access the rotor. If using a wrench, remove the alternator cover as described in Chapter Nine. In either case, the rotor must be held at the hub (**Figure 69**) and not by the nut on the end of the shaft.
   b. Using a 27-mm socket, remove the primary drive-gear nut by turning it to the *right*. The nut is a left-hand thread.
   c. Remove the nut, lockwasher, primary gear and Woodruff key (**Figure 70**).
   d. Remove the cam chain sprocket, balancer drive gear and pin (**Figure 71**).
4. Clean the parts (**Figure 72**) and shaft with solvent.
5. Inspect the gears and sprocket for worn or broken teeth.
6. Inspect the Woodruff key and pin for damage. Both parts must not be worn and should fit firmly in the shaft.
7. Inspect the nut for damage and replace the lockwasher.
8. Inspect the shaft and shaft threads for damage.
9. Install the parts as follows:
   a. Install the pin into the shaft.
   b. If not already positioned, turn the crankshaft and/or balancer shaft so the synchronization marks on the balancer drive gear and balancer

driven gear can be aligned. Turn the shafts and seat the drive gear over the pin when alignment is verified (**Figure 63**). Install the balancer drive gear so the flat side faces out.

c. Install the cam chain sprocket and Woodruff key (**Figure 73**). The square end of the key must be locked into the sprocket.

d. Install the primary drive gear and a new lock-washer (**Figure 70**). Install the lockwasher with the cupped side facing in.

e. Lubricate the shaft threads and primary drive-gear nut with engine oil.

f. Thread the nut onto the shaft, turning the nut to the *left*.

g. Hold the rotor steady and tighten the nut to 140 N•m (103 ft.-lb.).

10. Install the cam chain and rear guide as described in this chapter.

11. Install the clutch and right crankcase cover as described in this chapter.

12. Install the alternator cover and/or the rotor nut plug.

SHIFT LEVER

Removal and Installation

The shift lever is clamped to the transmission shift shaft. The shaft operates the gearshift linkage in the right crankcase cover.

1. To retain the current shift lever position, make an alignment mark on the shaft and lever so they can be installed in their original positions.
2. Completely remove the lever bolt (**Figure 74**). The lever cannot be removed with the bolt in the lever.
3. Remove the lever. If necessary, spread the lever open to ease removal.
4. Clean the lever and shaft splines with solvent and a brush.
5. If seal replacement or shaft removal is necessary, remove the snap ring and washer (**Figure 75**). To replace the seal (**Figure 76**), refer to *Seal Replacement* in Chapter Five. To remove the shift shaft, refer to *External Shift Mechanism* in this chapter. During assembly, install a new snap ring with the sharp edge facing out.
6. Reverse these steps to install the shift lever.

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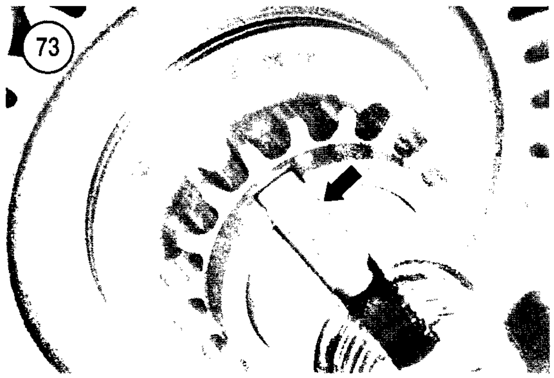

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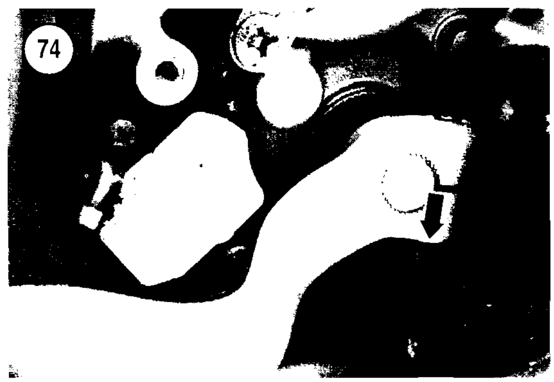

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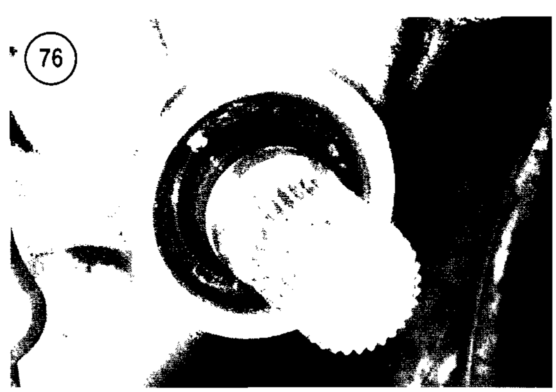
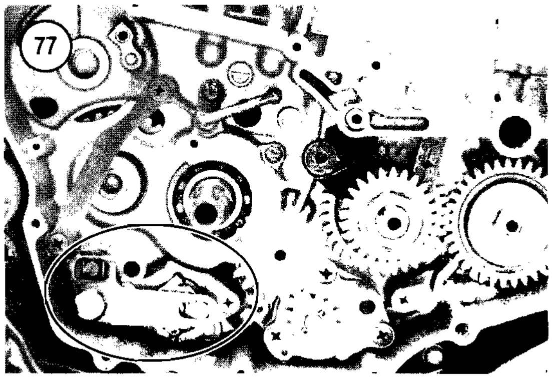
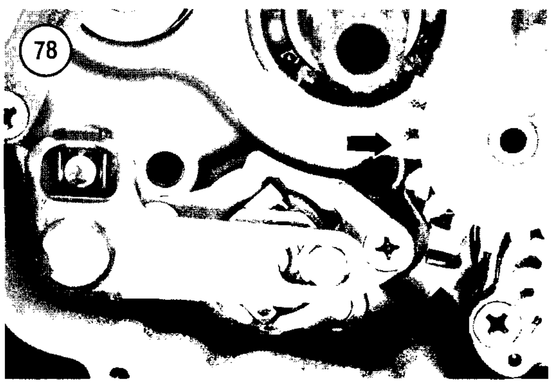
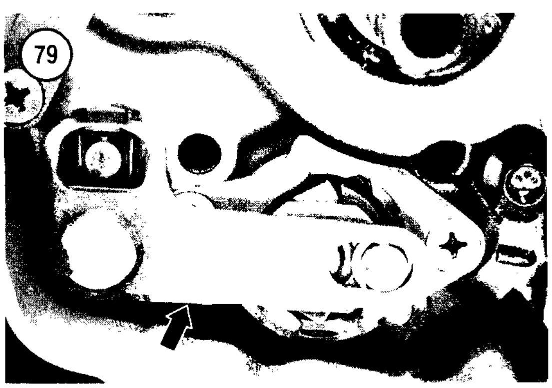
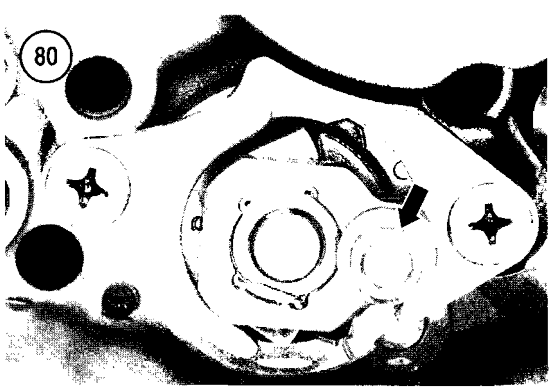










EXTERNAL SHIFT MECHANISM

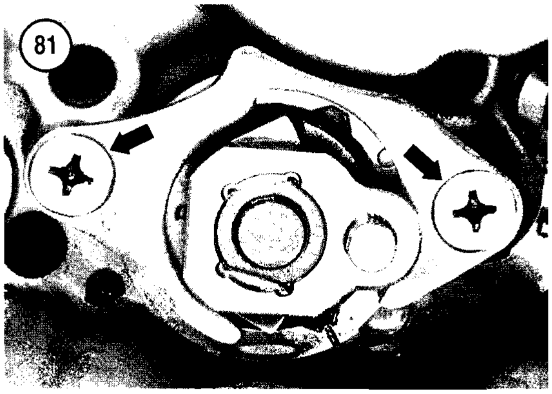
The external shift mechanism (**Figure 77**) includes all parts to shift the transmission not within the crankcase. This includes the shift lever, shaft and linkages that connect to the shift drum. Other than the shift lever, all other components of the external shift mechanism are located in the right crankcase cover. Separate the crankcase (Chapter Five) to service the internal shift mechanism (Chapter Seven).

Removal

1. Remove the right crankcase cover and clutch assembly as described in this chapter.
2. Remove the snap ring and oil pump idle gear (**Figure 78**) from the shaft. Do not remove the second snap ring on the idle gear shaft because it prevents the shaft from falling into the crankcase.
3. Put the transmission in neutral, and then remove the shift lever from the shift shaft as described in this chapter.
4. Slowly pull the shift shaft (**Figure 79**) and washer from the engine. Account for the washer on the shaft.
5. Remove the roller (**Figure 80**) from the lever.
6. Remove the bolts (**Figure 81**) securing the shift guide and lever assembly. To prevent the loss of internal parts, note the following:
   a. As the screws are removed, hold the shift guide in place to prevent the lever assembly from falling.
   b. When the screws are removed, slowly pull the guide and lever assembly from the shift drum stopper.
   c. When the spring-loaded pawls are visible at the rear of the lever, grasp the pawls to prevent the pawl pins and springs from ejecting.
7. Remove the center bolt (**Figure 82**) and shift drum stopper.
8. Remove the stopper lever and spring (**Figure 83**).
9. Inspect the parts as described in this section.

Installation

1. Install the shift drum stopper and center bolt (**Figure 82**). Note the following:
   a. Engage the shift drum pin with the notch in the shift drum stopper (**Figure 84**).
   b. Tighten the center bolt to 24 N•m (18 ft.-lb.).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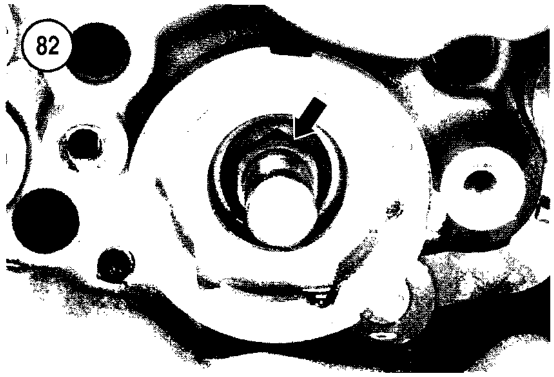
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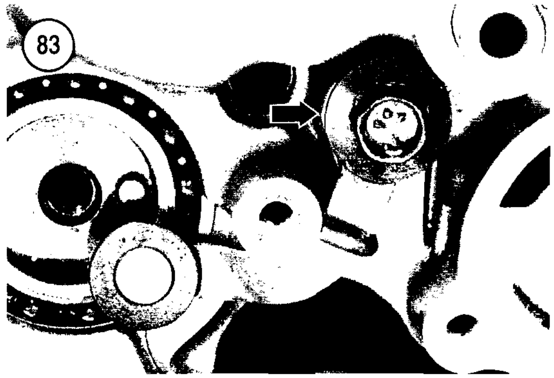
2. Install the stopper lever and spring (**Figure 85**).
   a. Install the washer behind the lever.
   b. The spring must be installed as shown in **Figure 86**.
   c. Check that the stopper lever pivots under spring pressure and the roller engages with the shift drum stopper.
3. Install the shift guide and lever assembly (**Figure 81**). Note the following:
   a. Apply threadlocking compound to the screw threads, and then place the screws within reach of the installation point.
   b. Insert the springs, pawl pins and pawls into the lever. Check that the rounded ends of the pawls are seated in the lever (**Figure 87**). The rounded end of the pawl pins should point out and contact the pawls. The pawls must compress and retract smoothly in the lever.
   c. Compress the pawls and install the shift guide onto the assembly (**Figure 88**).
   d. Install the assembly into the shift drum stopper. The lever should be positioned as shown in **Figure 81**. Hold the assembly in place and install the screws.
4. Install the roller onto the lever (**Figure 80**).
5. Install the shift shaft assembly (**Figure 79**). Note the following:
   a. Install the washer on the shaft against the snap ring.
   b. Lubricate the shaft with engine oil and slide it through the crankcase. As the lever and spring approach the engine, engage the torsion spring with the post and the lever with the roller.
6. Install the shift lever as described in this chapter.
7. Check for proper shifting.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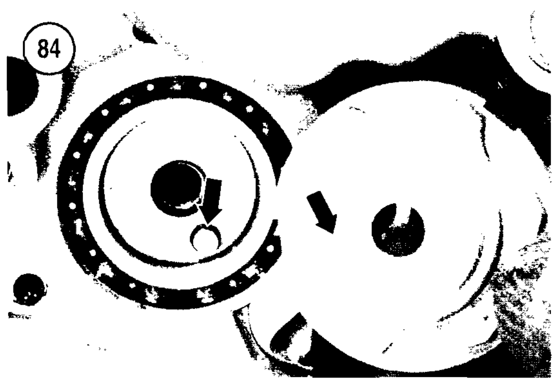
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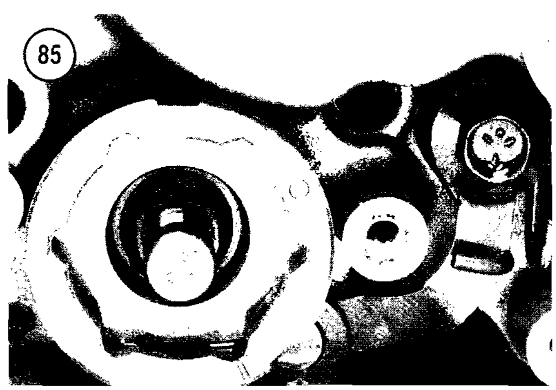
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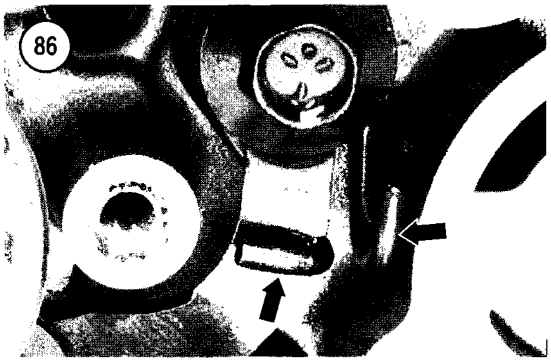

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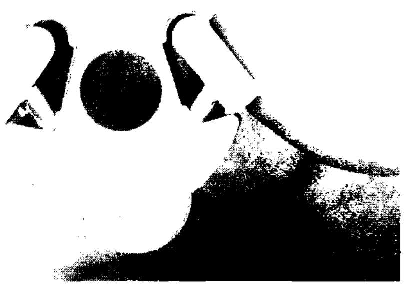

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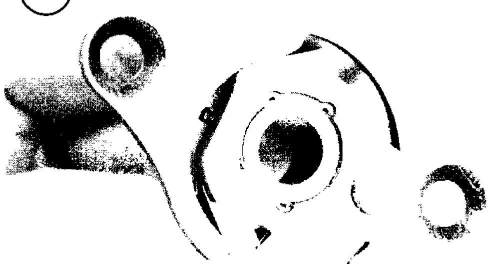

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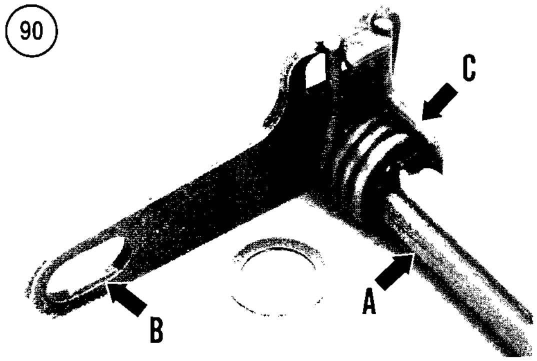

8. Install the oil pump idle gear. Install the shouldered side of the gear facing in (**Figure 78**). Install a new snap ring with the sharp edge facing out.
9. Install the clutch and right crankcase cover as described in this chapter.

Inspection

During inspection, replace parts that are worn or damaged.

1. Clean all parts in solvent, and then group the assemblies (**Figure 89**).
2. Inspect the shift shaft assembly (**Figure 90** and **Figure 91**).
   a. Inspect the shaft for straightness (A, **Figure 90**).
   b. Inspect the roller engagement hole for wear (B, **Figure 90**). The hole should be symmetrical and not excessively worn.
   c. Inspect the torsion spring (C, **Figure 90**) for looseness, wear and fatigue cracks. If the spring is worn, inspect the condition of the spring post on the crankcase.
   d. Inspect the washer (A, **Figure 91**) and snap ring (B) for wear and damage.
   e. Inspect the shaft (C, **Figure 91**) and lever splines (D) for damage. The threads in the lever bolt (E, **Figure 91**) must be in good condition. If necessary, use a tap and die to clean and straighten the threads.
3. Inspect the stopper lever assembly (**Figure 92**).
   a. Inspect the roller on the lever (A, **Figure 92**). It must be symmetrical and turn freely, but be firmly attached to the lever.
   b. Inspect the fit of the shouldered bolt (B, **Figure 92**)in the lever (D). The bolt must fit with

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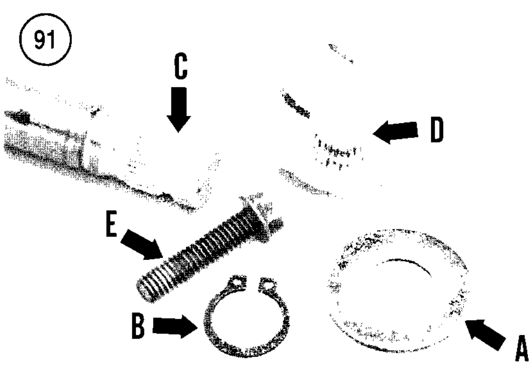

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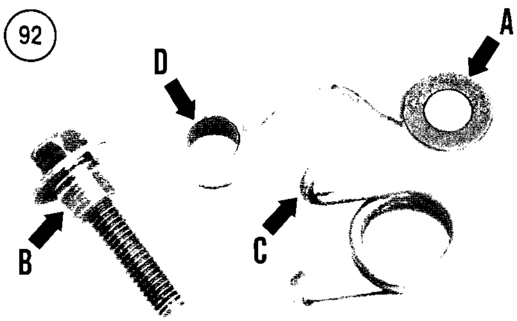

minimal play. Excessive play can cause poor shifting.

c. Inspect the spring (C, **Figure 92**) for wear or fatigue.

4. Inspect the shift drum stopper and center bolt (**Figure 93** and **Figure 94**).

a. Inspect the detents (A, **Figure 93**) inside the shift drum stopper. The detents must be uniform and symmetrical. If wear is visible, the pawls may be jammed or damaged.

b. Inspect the center bolt (B, **Figure 93**). The shaft of the bolt must be smooth to allow the lever to pivot.

c. Inspect the shift detents and ramps on the outside of the shift drum stopper (**Figure 94**). The detents and ramps must not be worn or shifting will be imprecise.

d. Inspect the fit of the shift drum stopper on the shift drum pin (**Figure 84**). The pin must be in good condition to properly engage with the notch in the back of the shift drum stopper.

5. Inspect the lever, roller and shift guide (**Figure 95**).

a. The roller (A, **Figure 95**) should be symmetrical with no visible wear. The roller and lever (B, **Figure 95**) must fit together with minimal play.

b. Inspect the shift guide (C, **Figure 95**) for obvious wear.

6. Inspect the lever and pawl assembly (**Figure 96**).

a. Inspect the springs and pawl pins for wear and fatigue.

b. Inspect the pawls for wear at their square ends. The ends must be square to stay engaged in the shift drum stopper.

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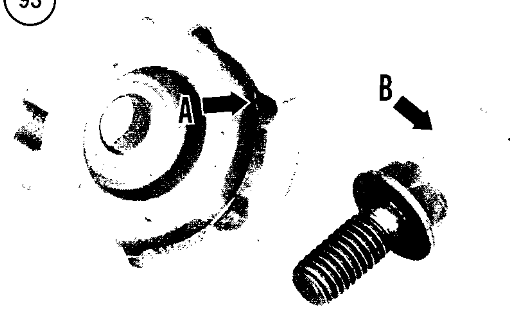

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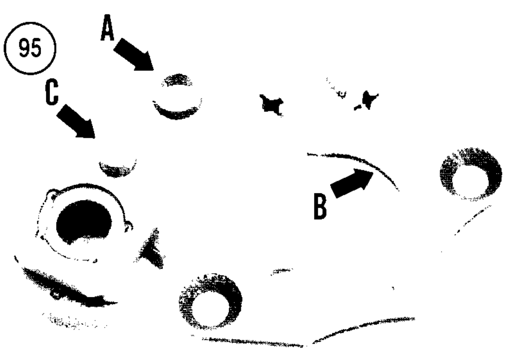

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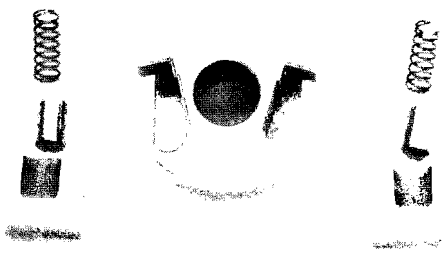

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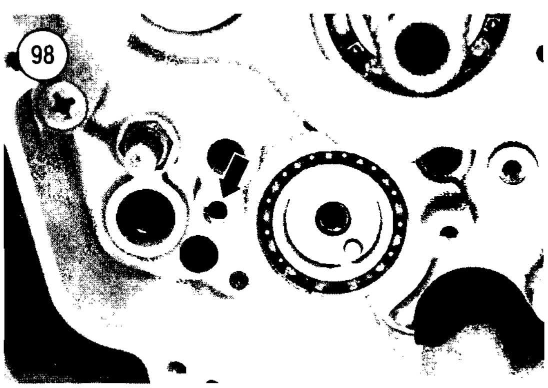

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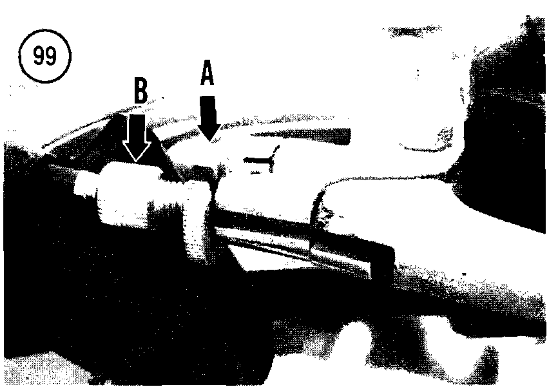

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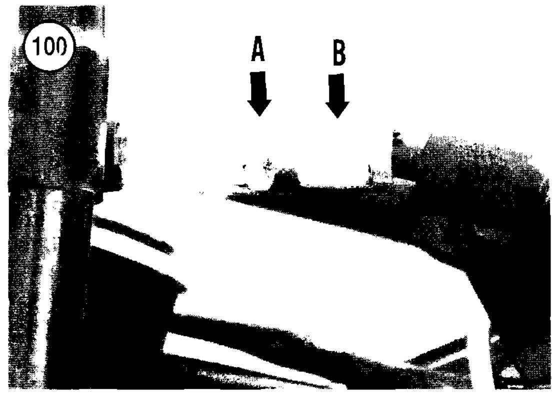

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c. Assemble the lever and pawl assembly (**Figure 97**), and then insert it into the shift drum stopper. Check that the springs fully extend the pawls against the sides of the shift drum stopper.

7. Clean the threads in the shift drum and mounting bosses (**Figure 98**). Visually inspect the crankcase openings for debris.

CLUTCH CABLE REPLACEMENT

1. Remove the cable at the handlebar as follows:
   a. Pull back the dust cover from the clutch lever.
   b. Loosen the clutch cable locknut (A, **Figure 99**), and then turn the adjuster (B) in until the cable can be removed from the lever and adjuster.
   c. If additional cable free play is needed, loosen the cable locknut (A, **Figure 100**), and then turn the adjuster (B) in until the cable can be removed from the lever.
2. At the engine, remove the cable from the release lever and cable holder (**Figure 101**).

3. Remove the cable from the motorcycle, noting the routing of the cable.
4. Clean the clutch lever, release lever and cable holder.
5. Lubricate the new cable with an aerosol cable lubricant. Lubricate the cable ends with lithium grease.
6. Install and route the cable from the engine to the handlebar lever.
7. At the handlebar, attach the cable to the lever and thread the adjuster (B, **Figure 99**) to the middle of its travel.
8. Turn the cable adjuster (B, **Figure 100**) so there is approximately 12 mm (0.5 in.) of play at the end of the clutch lever. Tighten the locknut (A, **Figure 100**).
9. Refer to Chapter Three for final adjustment and free play specifications.

Table 1 CLUTCH SPECIFICATIONS

	New mm (in.)	Service limit mm (in.)
Friction plate thickness	2.92-3.08 (0.115-0.121)	2.62 (0.103)
Friction plate claw width	13.7-13.8 (0.539-0.543)	13.2 (0.520)
Spring free length	–	49.9 (1.97)
Steel plate warp	–	0.10 (0.004)

Table 2 OIL PUMP SPECIFICATIONS

Lubrication system	Troichoid pump, forced pressure, dry sump
Oil pressure (engine warm)	40-140 kPa (5.8-20.3 psi) at 3000 rpm

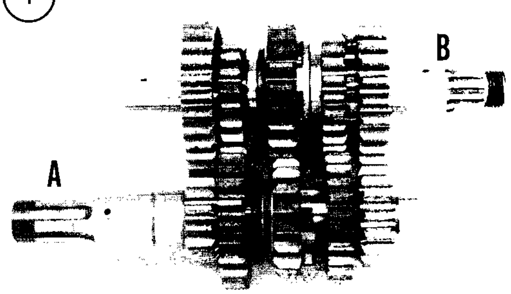
Table 3 CLUTCH AND EXTERNAL SHIFT MECHANISM TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Balancer driven gear nut	50	–	37
Cam chain guide bolt	10	–	7
Clutch cover bolts	10	–	7
Clutch hub nut	70	–	52
Clutch spring bolts	10	–	7
Primary drive gear locknut	140	–	103
Right crankcase cover bolts	10	–	7
Shift drum stopper center bolt	24	–	18
Shift shaft spring post	19	–	14

CHAPTER SEVEN

TRANSMISSION AND INTERNAL SHIFT MECHANISM

1



This chapter provides service procedures for the transmission and internal shift mechanism. Specifications are in **Table 1** and **Table 2** at the end of this chapter.

TRANSMISSION OPERATION

The gears on the input shaft (A, **Figure 1**) are meshed with the gears on the output shaft (B). Each pair of meshed gears represents one gear ratio. For each pair of gears, one of the gears is splined to its shaft, while the other gear freewheels on its shaft.

Next to each freewheeling gear is a gear that is splined to the shaft. This locked gear can slide on the shaft and lock into the freewheeling gear, making that gear ratio active. Anytime the transmission is *in gear*, one pair of meshed gears are locked to their shafts and that gear ratio is selected. All other meshed gears have one freewheeling gear, making those ratios inoperative.

To engage and disengage the various gear ratios, the splined gears are moved by shift forks. The shift forks are guided by the shift drum, which is operated by the shift lever. As the motorcycle is upshifted and downshifted, the shift drum rotates and guides the forks to engage and disengage pairs of gears on the transmission shafts. The transmission is a 5-speed.

TRANSMISSION SERVICE

The engine crankcase must be split to remove the transmission and shift assemblies (**Figure 2**). Remove and install the transmission assemblies as described in Chapter Five.

Careful inspection of the parts is required, as well as keeping the parts oriented so they can be reinstalled in the correct direction on the shafts. The gears and snap rings *must* be installed in the same direction they were before disassembly. If necessary, slide the parts onto a long dowel or screwdriver as the parts are removed, or make an identification mark on each part to indicate position and orientation.

Always install new snap rings. The snap rings fatigue and distort when they are removed. Do not reuse them although they appear to be in good condition. To install a new snap ring without distorting or binding it, hold the closed side with a pair of pliers while the open side is spread with snap ring pliers (**Figure 3**). While holding the spread ring with both tools, slide it over the shaft and into position.

Usually snap rings have one rounded edge, while the other side has a sharp edge (**Figure 4**). The inner sharp edge prevents the snap ring from lifting out of the shaft groove when lateral pressure is applied to the snap ring. Always look at the inner and outer edges of the snap ring. Some snap rings are manufactured with the inner and outer sharp edge on opposite sides. If a snap ring has no identifiable sharp edge, the snap ring can be installed in either direction. In all cases, new snap rings must be installed at assembly, and when applicable, must be installed in the same direction as the removed snap rings.

When installed on a splined shaft, position the snap ring gap over a groove in the shaft (**Figure 5**).

INPUT SHAFT

Use the following procedures to disassemble and assemble the input shaft (**Figure 6**).

Disassembly

1. Disassemble the input shaft (**Figure 7**) in the following order:
   a. Snap ring. Although not visible, a snap ring is on the end of the shaft, located in the second gear recess. To remove this captive snap ring, slide the snap ring located behind fourth gear (**Figure 8**), away from the gear so the captured snap ring can be accessed (**Figure 9**). The ends of the snap ring are nearly flat, so gripping it with snap ring pliers may be difficult.
   b. Second gear.

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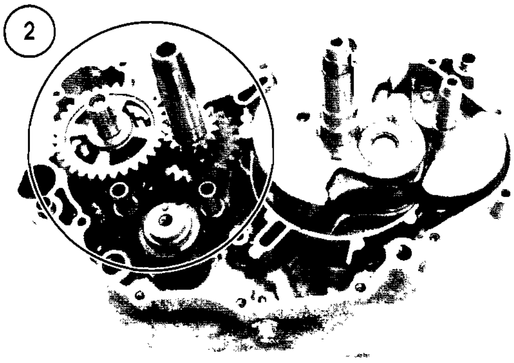

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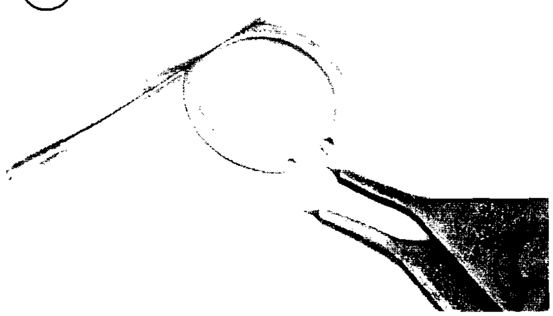

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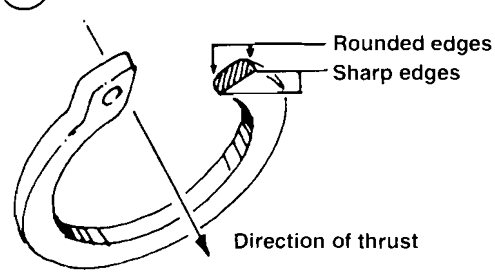

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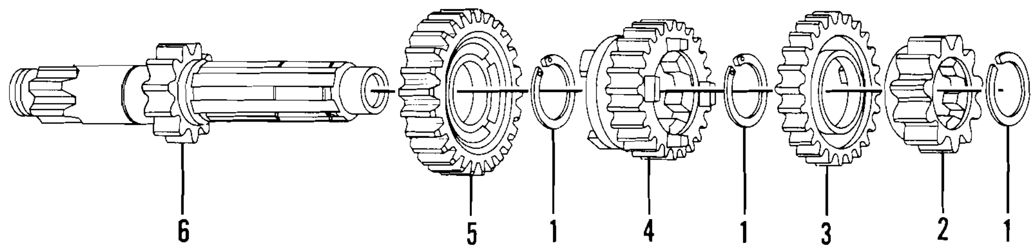
INPUT SHAFT



1. Snap ring
2. Second gear
3. Fourth gear
4. Third gear
5. Fifth gear
6. Input shaft and first gear

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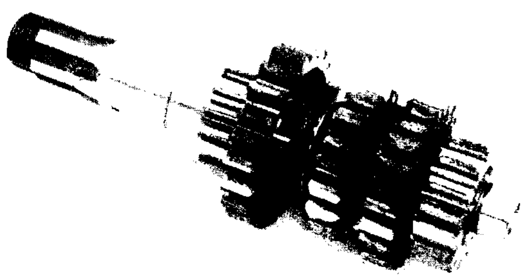

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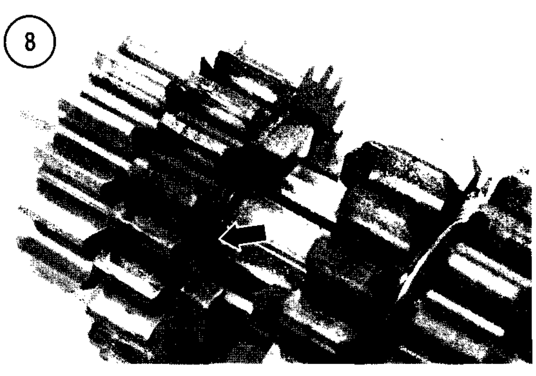

c. Fourth gear.
d. Snap ring.
e. Third gear.
f. Snap ring.
g. Fifth gear.

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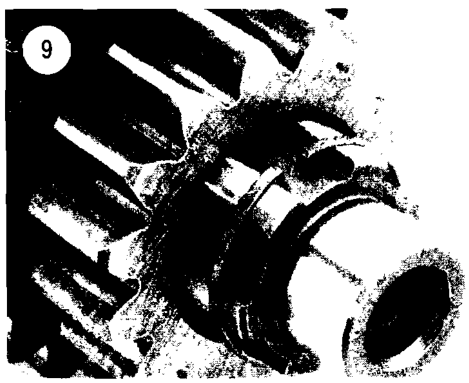

2. Inspect each part as described in this chapter. Store each piece in order and in the correct orientation to each other until reassembly.

Assembly

Before beginning assembly, have new snap rings on hand. Throughout the procedure, the orientation of the gears and snap rings is made in relation to first gear (**Figure 10**), on the input shaft. If desired, lock the lower portion of the shaft (below first gear) in a padded vise. With the shaft held stable and vertical, installation of the snap rings is easier. Refer to *Transmission Service* in this chapter. Do not allow the vise to damage the shaft.

1. Clean and dry all parts before assembly. Lubricate all parts with engine oil.

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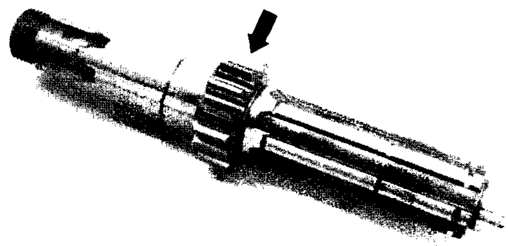

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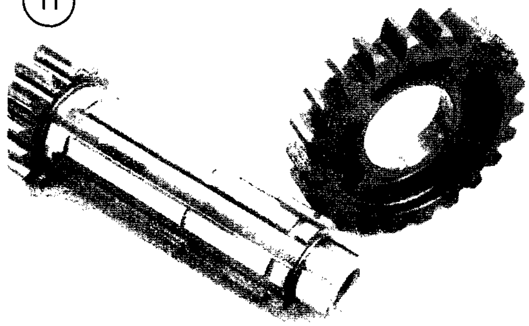
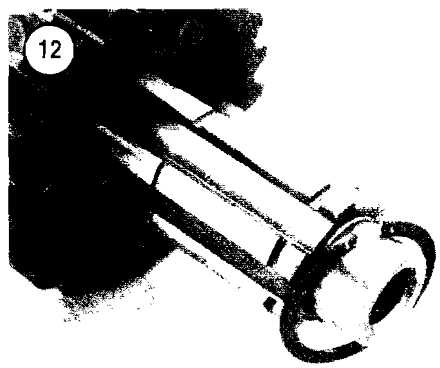
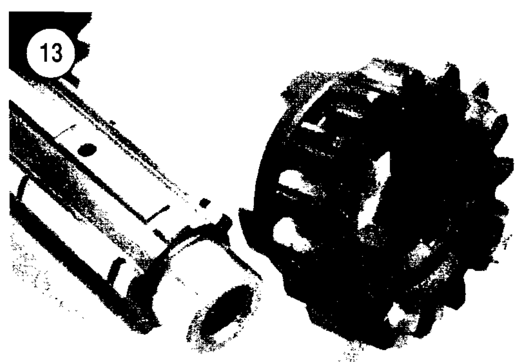
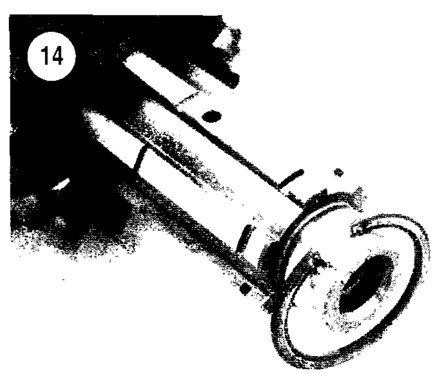


2. Install fifth gear (**Figure 11**). The gear recesses must face *out* (away from first gear).
3. Install the snap ring (**Figure 12**). The sharp edge must face *out* (away from first gear). The snap ring must seat in the shaft groove. Position the snap ring gap over a groove in the shaft.
4. Install third gear (**Figure 13**). The side of the gear with the shift fork groove must face *in* (toward first gear).
5. Temporarily place the snap ring (**Figure 14**) near third gear. The sharp edge must face *in* (toward first gear). The snap ring is seated after the remainder of the shaft is assembled.
6. Install fourth gear (**Figure 15**). The gear dogs, must face *in* (toward first gear).
7. Install second gear (**Figure 16**). The flat side of the gear must face *out* (away from first gear).
8. Install the snap ring (**Figure 17**). Both edges of the snap ring are identical. If a sharp edge is evident, install the snap ring with the sharp edge facing *out* (away from first gear). The ends of the snap ring are nearly flat, so gripping it with snap ring pliers may be difficult. The snap ring must seat in the shaft groove. Position the snap ring gap over a groove in the shaft.
9. Slide second and fourth gears toward the end of the shaft to gain access to the snap ring groove behind fourth gear.
10. Slide the unseated snap ring (**Figure 18**) into the groove behind fourth gear (**Figure 19**). The snap ring must seat in the shaft groove. Position the snap ring gap over a groove in the shaft.
11. Check that all parts are secure and correctly oriented (**Figure 20**). Check that the gears spin, slide and engage freely on the shaft. Wrap and store the assembly until it is ready for installation into the crankcase as described in Chapter Five.







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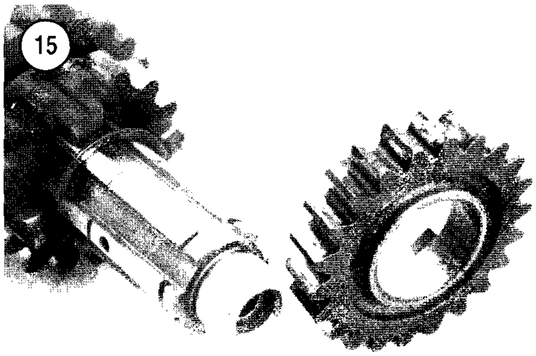

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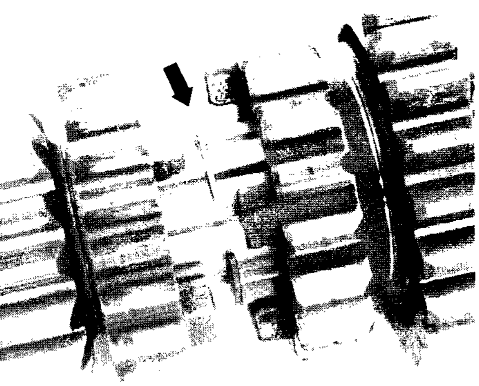

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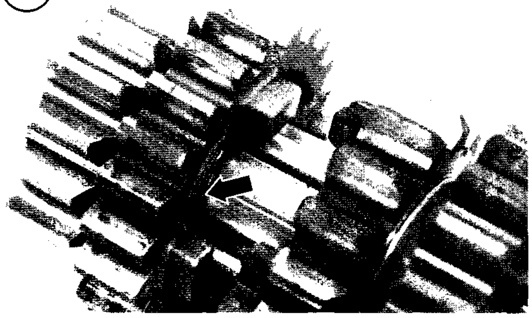

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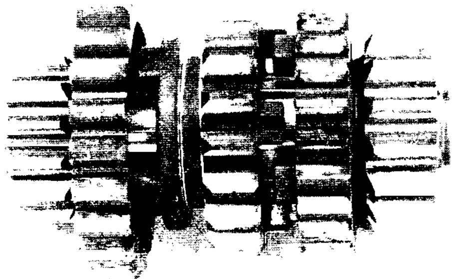

OUTPUT SHAFT

Use the following procedures to disassemble and assemble the output shaft (**Figure 21**).

Disassembly

1. Beginning at the splined end of the shaft, disassemble the output shaft (**Figure 22**) in the following order:
   a. Bushing and second gear.
   b. Washer.
   c. Fourth gear.
2. At the smooth end of the shaft, disassemble the output shaft in the following order:
   a. Washer.
   b. Bushing and first gear.
   c. Washer.
   d. Fifth gear.
   e. Snap ring and spline washer.
   f. Third gear.
3. Inspect each part as described in this chapter, and then store in order and in the correct orientation with each other until assembly.

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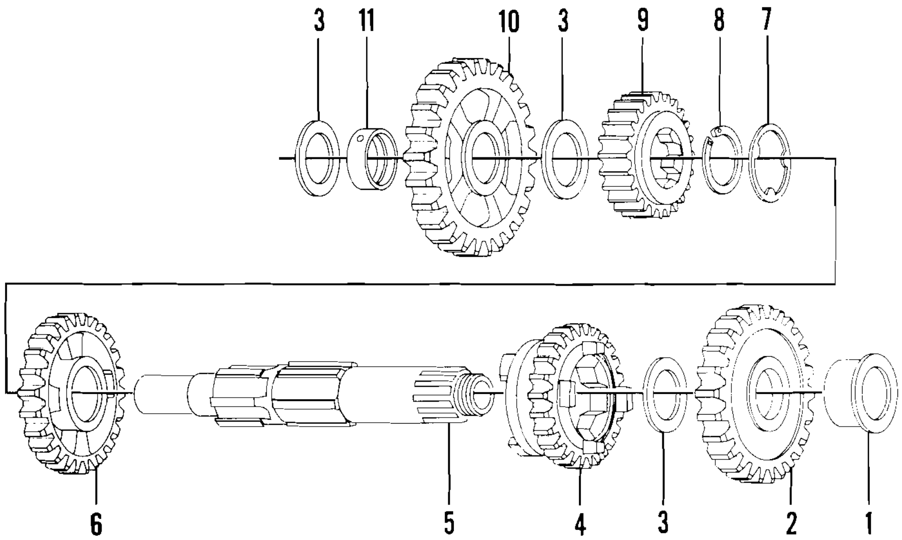

1. Second gear bushing
2. Second gear
3. Washer
4. Fourth gear
5. Output shaft
6. Third gear
7. Splined washer
8. Snap ring
9. Fifth gear
10. First gear
11. First gear bushing

Assembly

Before beginning assembly, have new snap rings on hand. Throughout the procedure, the orientation of many parts is made in relation to the splined end of the shaft (**Figure 23**). If desired, lock the end of the shaft in a padded vise. With the shaft held stable and vertical, installation of the snap rings is easier. Refer to *Transmission Service* in this chapter. Do not allow the vise to damage the shaft.

1. Clean and dry all parts before assembly. Lubricate all parts with engine oil. Begin assembly at the smooth end of the shaft.
2. Install third gear (**Figure 24**). The flat side of the gear must face *out* (away from splined end).
3. Install the spline washer and snap ring (**Figure 25**). The sharp edge must face *out* (away from the splined end). The snap ring must seat in the shaft groove. Position the snap ring gap over a groove in the shaft.
4. Install fifth gear (**Figure 26**). The side of the gear with the shift fork groove must face *in* (toward the splined end).

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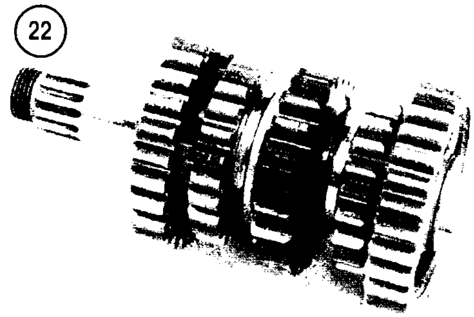

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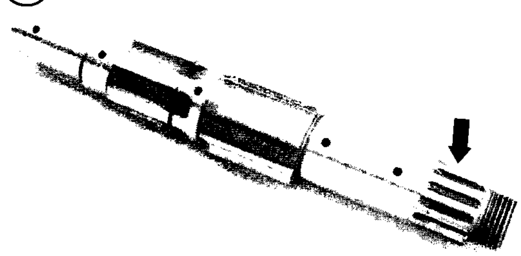

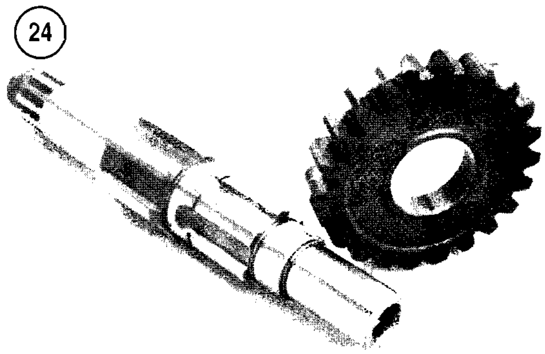

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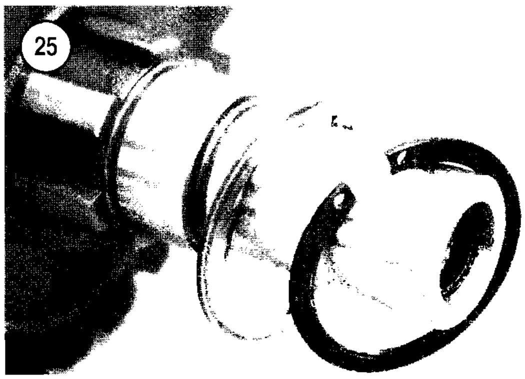

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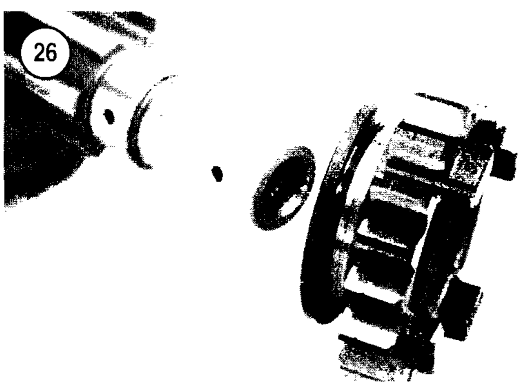

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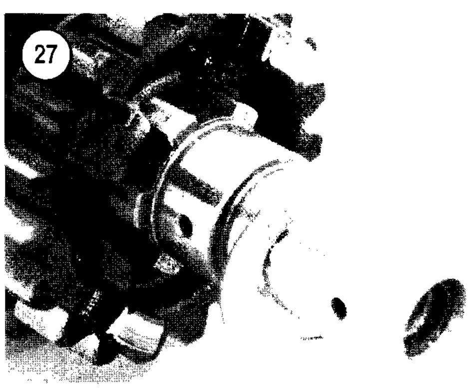

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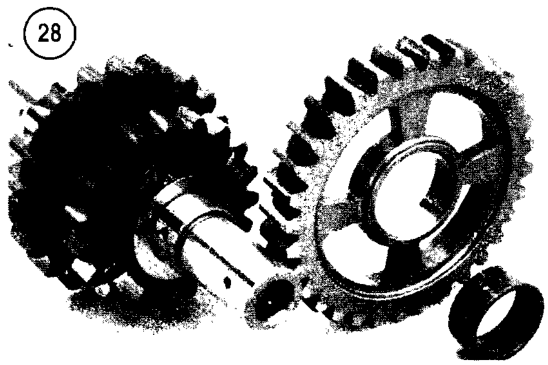

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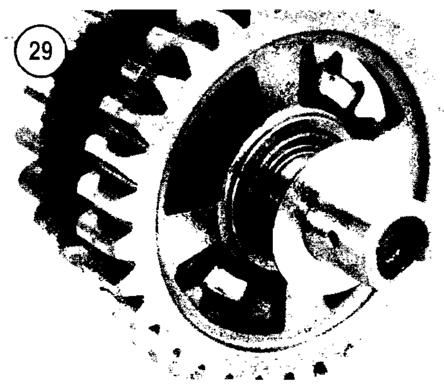

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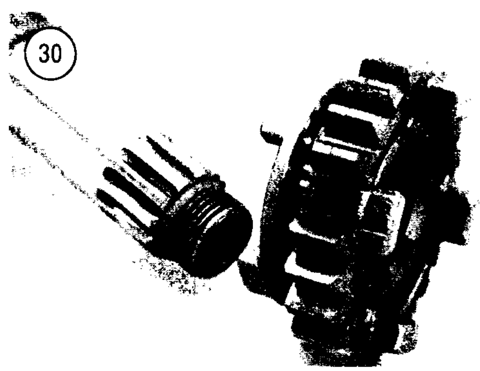

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5. Install the washer (**Figure 27**).
6. Install the bushing and first gear (**Figure 28**). The flattest side of the gear must face *out* (away from the splined end).
7. Install the washer (**Figure 29**).
8. Wrap a strong rubber band around the end of the shaft to keep the parts in place while the remainder of the shaft is assembled.
9. At the splined end of the shaft, install fourth gear (**Figure 30**). The side of the gear with the shift fork groove must face *in* (away from the splined end).
10. Install the washer (**Figure 31**).

11. Install the bushing and second gear (**Figure 32**). Fit the shouldered side of the bushing into the flat side of the gear. The flat side of the gear must face *out* (toward the splined end).
12. With the parts in their correct positions, wrap a strong rubber band around the end of the shaft.
13. Check that all parts are secure and correctly oriented (**Figure 33**). Check that the gears spin, slide and engage freely on the shaft. Wrap and store the assembly until it is ready for installation into the crankcase as described in Chapter Five.

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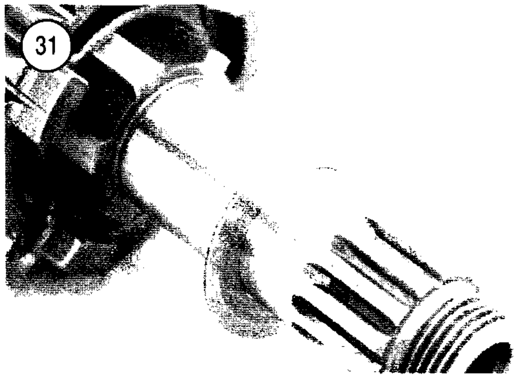

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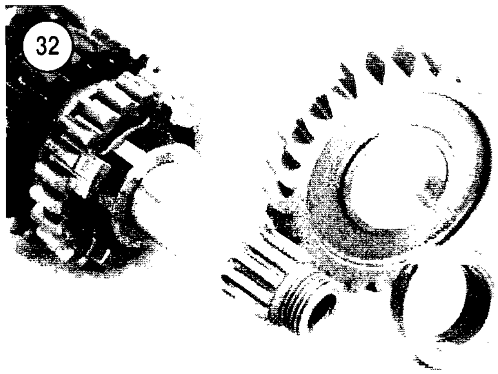

TRANSMISSION INSPECTION

Shaft Inspection

1. Inspect the shafts for the following:
   a. Broken or damaged gear teeth (A, **Figure 34**) on the input shaft.
   b. Worn or damaged splines (B, **Figure 34**).
   c. Rounded or damaged snap ring grooves (C, **Figure 34**).
   d. Clean oil holes (A, **Figure 35**).
   e. Wear, galling or other damage on the bearing bushing surfaces (B, **Figure 35**). A blue discoloration indicates heat damage. The shafts should fit firmly in their crankcase bearings with no evidence of play. It is common for some shafts to resist removal or installation into their bearings. If the shaft requires light seating with a soft mallet, this does not necessarily indicate a damaged bearing or shaft.
   f. Damaged threads (C, **Figure 35**). Mildly damaged threads can be trued with a thread die.
2. Assemble the shafts as described in this chapter.

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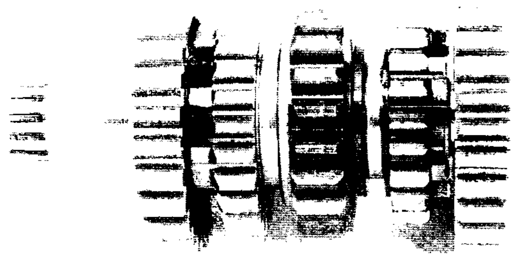

Gear, Bushing and Washer Inspection

1. Inspect the gears (**Figure 36**) for the following:
   a. Broken or damaged teeth (A).
   b. Scored, galled or fractured bore (B). A blue discoloration indicates excessive heat. For gears that use a bushing on the shaft, check the fit of the bushing in the gear and on the shaft. Replace the bushing if it does not freely fit into the gear or onto the shaft.
   c. Worn or damaged splines (C).
   d. Worn, damaged or rounded gear dogs (D). Any wear on the dogs and mating recesses should be uniform. Typically, the side of the

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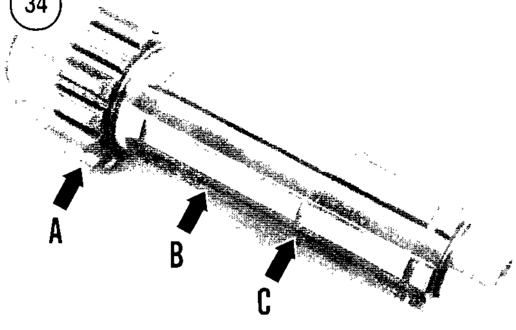

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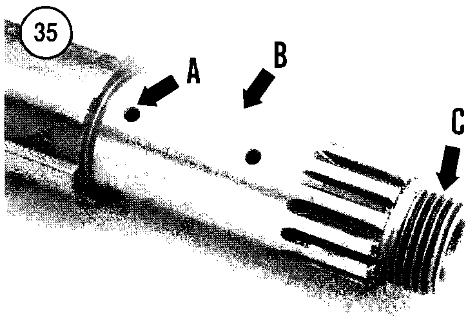

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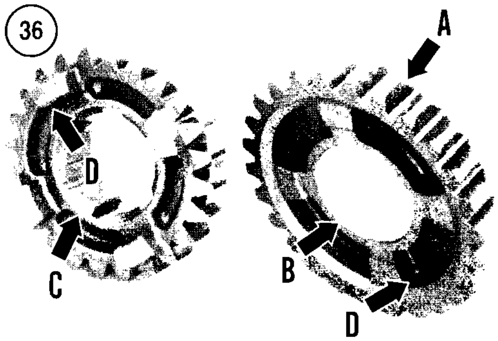

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gear dogs that carries the engine load wears and eventually becomes rounded. The unloaded side of the dogs remain unworn. If the dogs are not worn evenly, the remaining dogs become overstressed. Check the engagement of the dogs by placing the gears at their appropriate positions on the countershaft and twisting the gears together. Check for positive engagement in both directions. If damage is evident, also check the condition of the shift forks as described in this chapter.

e. Worn or damaged shift fork groove. Measure the width of the groove (**Figure 37**). Refer to **Table 2** for specifications.

f. Smooth gear operation on the shafts. Bored gears should fit firmly on shaft, yet spin smoothly and freely. Splined gears should fit snugly at their position on the shaft, yet slide smoothly and freely from side to side. If a gear is worn or damaged, also replace the gear it mates to on the other shaft.

2. Inspect the washers. The washers should be smooth and show no signs of wear or damage. The teeth on the spline washers should not be missing or damaged.

3. Install the parts onto their shafts as described in this chapter.

SHIFT DRUM AND FORKS

As the transmission is upshifted and downshifted, the shift drum and fork assembly engages and disengages pairs of gears on the transmission shafts. Gear shifting is done by the shift forks that are guided by cam grooves in the shift drum.

It is important that the shift drum grooves, shift forks and mating gear grooves be in good condition. Excessive wear between the parts causes unreliable and poor engagement of the gears. This can lead to premature wear of the gear dogs and other parts.

Inspection

When inspecting the shift fork and drum assembly, replace parts that are worn or marginally within specification.

1. Clean all parts in solvent and dry with compressed air.

2. Inspect the shift drum (**Figure 38**) for the following:

a. Worn shift drum grooves and cam points (A). The grooves should be a uniform width. Worn grooves can prevent complete gear engagement, which can cause rough shifting and allow the transmission to disengage.

b. Worn or damaged bearing surfaces (B). Besides wear, look for signs of discoloration caused by overheating and lack of lubrication. Fit the shift drum into the crankcase bearings and check for play. If necessary, replace the shift drum bearings as described in Chapter Five.

c. Worn or loose end pin (C).

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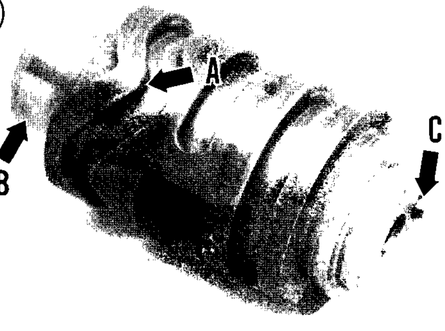

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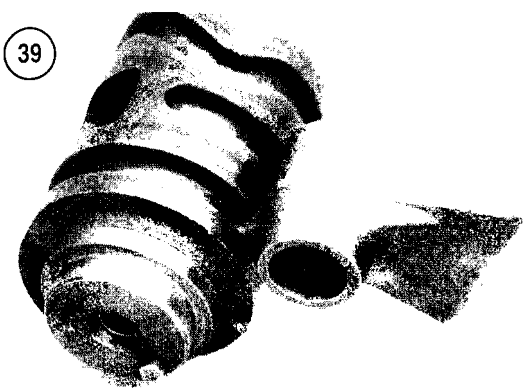

3. Inspect each shift fork for wear and damage. Inspect the:
   a. Guide pin. The pin should be symmetrical and not flat on the side. Fit each fork guide pin into its groove (**Figure 39**) in the shift drum and check for lateral play. Although there is no specified clearance, the guide pin and groove should have a consistent, small amount of play along the length of the groove. If necessary, identify the forks by positioning them as shown in **Figure 40**. Note that the claws on shift fork No. 2 are spread the widest and shift fork No. 3 is the shortest fork. Insert fork No. 1 in the groove nearest the shift drum end pin, fork No. 3 in the center groove and fork No. 2 in the last groove.
   b. Shift fork thickness. Measure both claws at the end (**Figure 41**). Refer to **Table 2** for specifications.
   c. Shift fork to gear groove clearance. Measure the side clearance between each fork and its mating gear groove (**Figure 42**). Refer to **Table 2** for specifications. Shift fork No. 1 mates with fifth gear and shift fork No. 2

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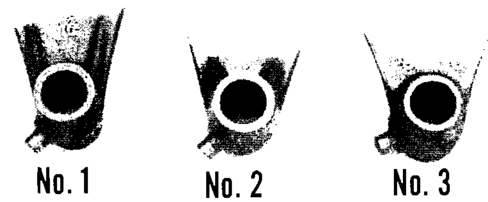

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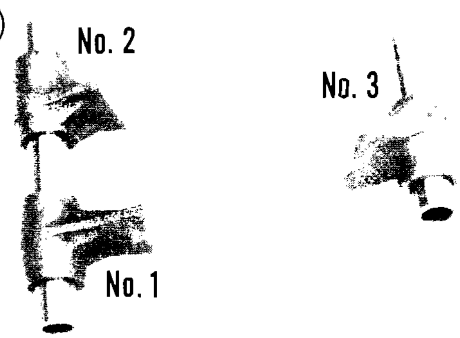


mates with fourth gear on the output shaft. Shift fork No. 3 mates with third gear on the input shaft.

4. Inspect the shift fork shafts for wear and damage.

5. Install the shift forks onto their shafts (**Figure 43**). The forks should slide and pivot smoothly with no excessive play or tightness.

6. Install the shift drum, forks and transmission assembly as described in Chapter Five.

Table 1 TRANSMISSION SPECIFICATIONS

Transmission	5-speed constant mesh
Primary reduction	
Type	Gear
Ratio	2.960 (74/25)
Final reduction ratio	
E models	3.357 (44/14)
S models	2.933 (44/15)
SM models	2.733 (41/15)
Gear ratios	
1st gear	2.285 (32/14)
2nd gear	1.733 (26/15)
3rd gear	1.375 (22/16)
4th gear	1.090 (24/22)
5th gear	0.8631 (19/22)

Table 2 TRANSMISSION SERVICE SPECIFICATIONS

	New mm (in.)	Service limit mm (in.)
Gear groove width	4.8-4.9 (0.189-0.193)	–
Shift fork claw thickness	4.6-4.7 (0.181-0.185)	–
Shift fork to gear groove clearance	0.1-0.3 (0.04-0.012)	0.5 (0.02)

CHAPTER EIGHT

FUEL SYSTEM

This chapter provides service procedures for removing, disassembling, inspecting and repairing the carburetor. Also included is information on how the different carburetor systems operate within the carburetor. **Table 1** and **Table 2** are at the end of the chapter and list the specifications for the Mikuni and Keihin carburetors.

Refer to this chapter for fuel valve servicing and throttle cable replacement. Refer to Chapter Three for air filter service, throttle cable adjustment and cable lubrication.

FUEL SYSTEM PRECAUTIONS

When working on the fuel system, observe the following:

WARNING
Gasoline and most cleaning solvents are extremely flammable. Do not smoke or use electrical tools in the vicinity of the work area. Turn off heating appliances and those with a pilot light. If gasoline can be smelled in the work area, a potential hazard exists.

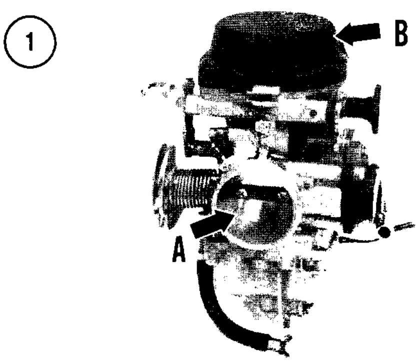
WARNING
When draining the fuel system use an approved container. Perform the draining procedure a safe distance away from the work area.

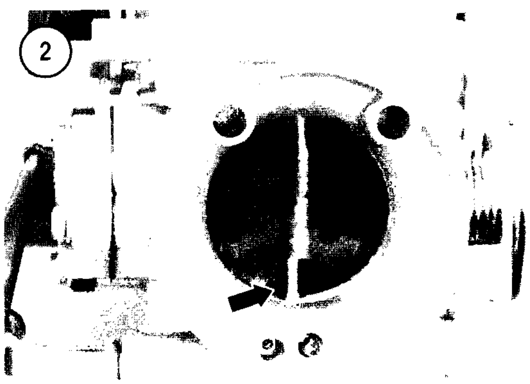
1. Turn off the fuel valve.
2. Never work on a hot engine.
3. Wipe up fuel and solvent spills immediately.
4. Work in a well-ventilated area.
5. Wear eye protection when using compressed air and when spraying solvents and degreasers.
6. Keep a fire extinguisher in the shop, rated for class B (fuel) and class C (electrical) fires.

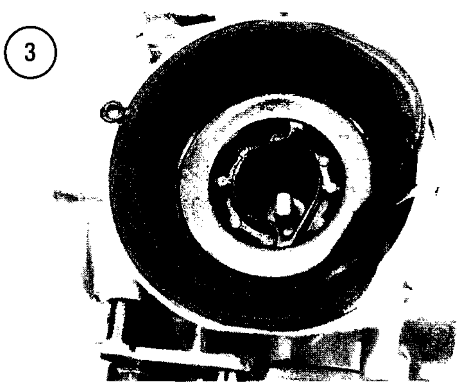
CARBURETOR (MIKUNI)

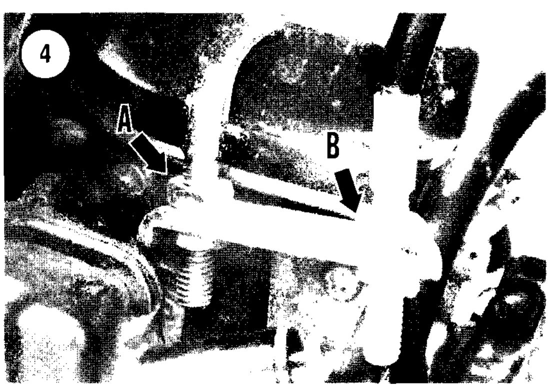
Operation

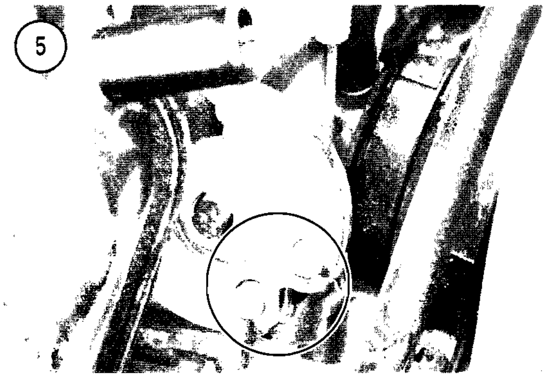
S, SM and 2004-on California E models use the Mikuni BSR constant velocity carburetor. The Mikuni BSR is a vacuum-controlled, or constant velocity, carburetor. It uses both a throttle valve and diaphragm-operated slide to regulate fuel to the engine. The throttle valve (A, **Figure 1**) is located on











the output side of the carburetor and is connected to the throttle cable. It is not connected to any fuel-regulating device. The slide and diaphragm assembly, located at the center of the carburetor, regulates fuel by a jet needle at the bottom of the slide (**Figure 2**). The diaphragm is sealed at the top of the carburetor by the vacuum chamber cover (B, **Figure 1**). The diaphragm divides and seals the large chamber into a lower and upper chamber (**Figure 3**).

During operation, when the throttle valve is opened, air demand and speed through the carburetor is increased. As air passes under the slide, air pressure drops in that area. This low air pressure is vented to the upper diaphragm chamber. The lower diaphragm chamber is vented to atmospheric pressure. This difference in pressure causes the slide and jet needle to rise, allowing fuel to pass into the carburetor throat. When the throttle valve is closed, the pressure differential lowers, allowing the slide and jet needle to lower.

Refer to the *Carburetor Systems* in this chapter for specific carburetor fuel systems.

Removal and Installation

1. Support the motorcycle so it is secure.
2. Remove the fuel tank (Chapter Fifteen).
3. Remove the throttle cables as follows:
   a. Loosen the locknuts on the pull cable (A, **Figure 4**) and return cable (B), and then remove the cables from the holder.
   b. Turn the throttle valve and remove the cable ends (**Figure 5**).
4. Disconnect the throttle position sensor at the wire connector. Do not remove the sensor from the carburetor.

5. Completely remove the clamps from the air filter housing duct and intake duct (**Figure 6**).
6. Remove the carburetor from the ducts as follows:
   a. Pry up on the ducts to break them free from the carburetor. If necessary, lightly spray penetrating lubricant under the duct.
   b. Push the carburetor forward and back and pry the ducts off the carburetor. Pull the carburetor to the left side of the engine as the ducts are worked off. Keep the carburetor upright when it is removed.
7. Open the drain on the bottom of the float chamber and drain any remaining fuel.
8. Disassemble the carburetor as described in this section.
9. Reverse this procedure to install the carburetor. Note the following:
   a. If necessary, set the pilot mixture screw to its initial setting (**Table 1**).
   b. Clean and lightly lubricate the inside edges of the ducts so the carburetor easily seats.
   c. Align and engage the boss on the carburetor (**Figure 7**) with the slot in the intake duct (**Figure 8**). Clamp the parts when they are aligned vertically.
   d. Check the fuel, vent and vacuum hose routing.
   e. Check/adjust the throttle cables (Chapter Three).
   f. Check the throttle for proper operation.
   g. Check the carburetor for leaks.
   h. Check the fuel, vent and drain hose routing.
   i. If necessary, adjust the idle speed and pilot mixture screw settings (Chapter Three).

Disassembly and Assembly

Refer to **Figure 9**.

1. Remove the vent and vacuum hoses (**Figure 10**).
2. Remove the throttle position sensor (A, **Figure 11**) as follows:
   a. If the engine is not running correctly, perform the *Throttle Position Sensor* resistance checks described in this chapter.
   b. Accurately mark the position of the sensor, and then remove it from the carburetor. Account for the rubber gasket on the back side of the sensor. If the sensor is left in the carburetor, do not submerge it in solvent.

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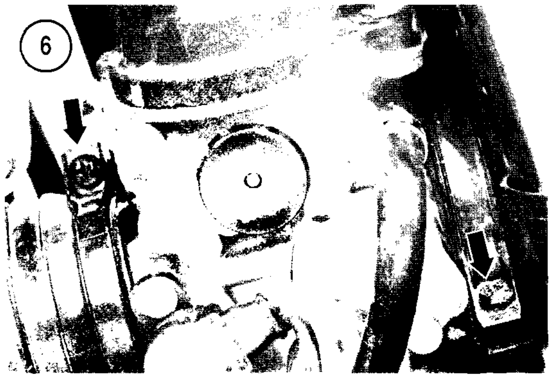

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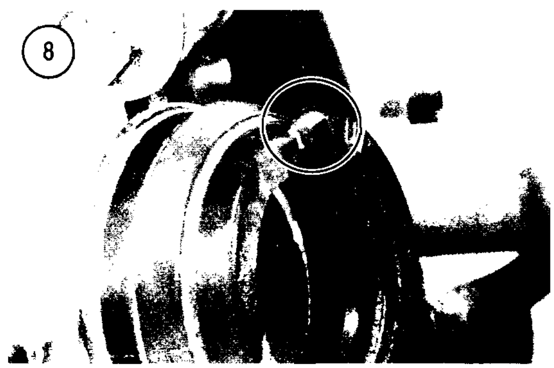
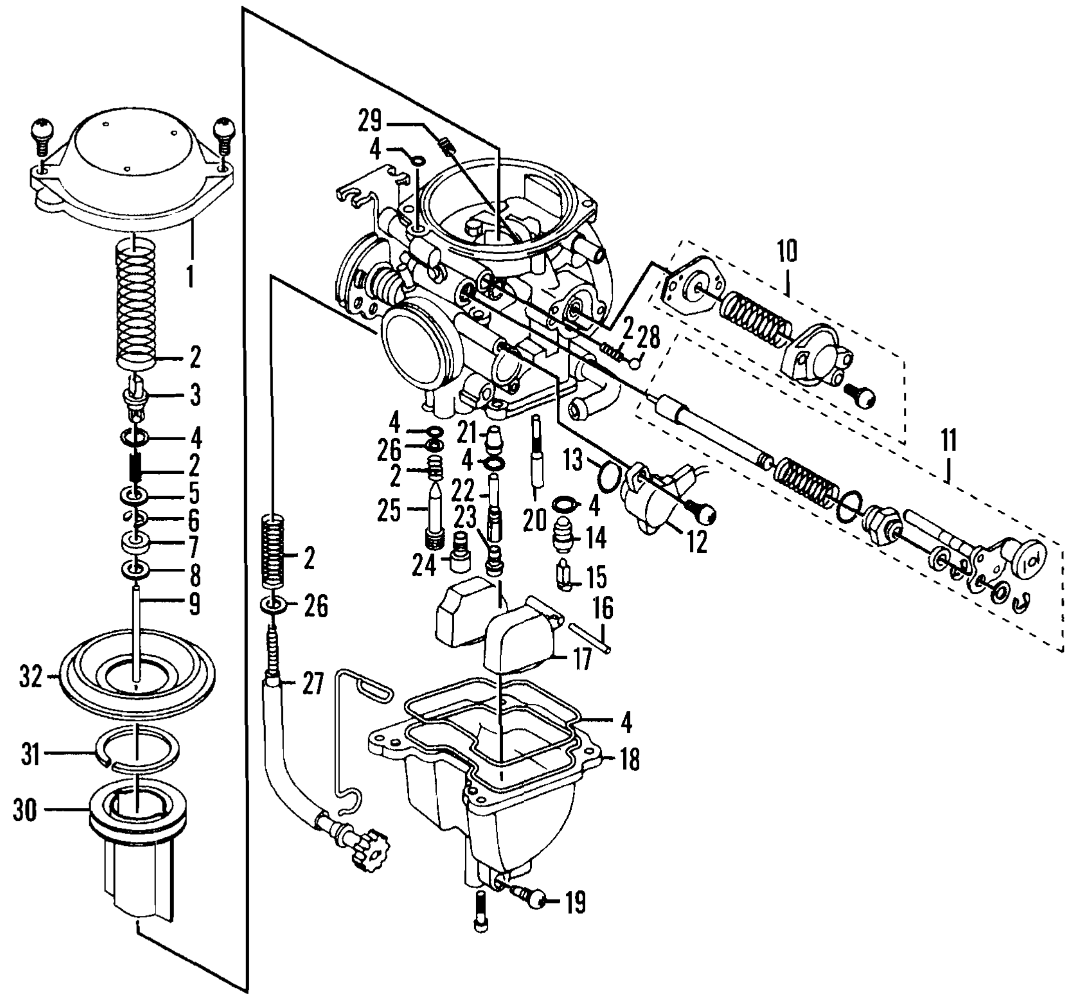


3. Remove the air cutoff valve assembly (B, **Figure 11**) as follows:
   a. Remove the screws from the cover. The cover is under spring pressure. Keep pressure on the cover as the screws are removed.
   b. Remove the cover, spring and diaphragm (**Figure 12**).
4. Remove the choke plunger assembly as follows:
   a. Remove the clip (**Figure 13**) from the plate.
   b. Pull the plate and guide assembly out of the carburetor. Also remove the position detent ball (A, **Figure 14**). The spring can be left in the carburetor.

9

CARBURETOR (MIKUNI)



1. Diaphragm cover
2. Spring
3. Jet needle stopper
4. O-ring
5. Washer (thin)
6. E-clip
7. Spacer
8. Washer (thick)
9. Jet needle
10. Air cutoff valve assembly
11. Choke assembly
12. Throttle position sensor (TPS)
13. Rubber gasket
14. Float valve seat
15. Float valve
16. Pin
17. Float
18. Float chamber
19. Drain screw
20. Pilot jet
21. Needle jet
22. Needle jet holder
23. Main jet
24. Starter (choke) jet
25. Pilot mixture screw
26. Washer
27. Throttle stop screw
28. Ball
29. Secondary pilot air jet
30. Slide
31. Ring
32. Diaphragm

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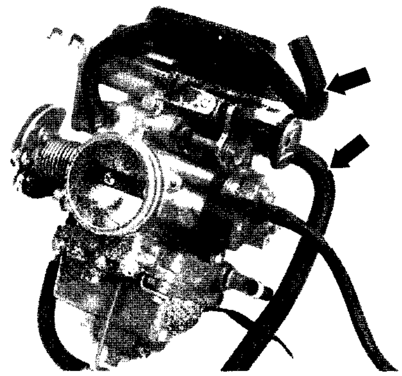

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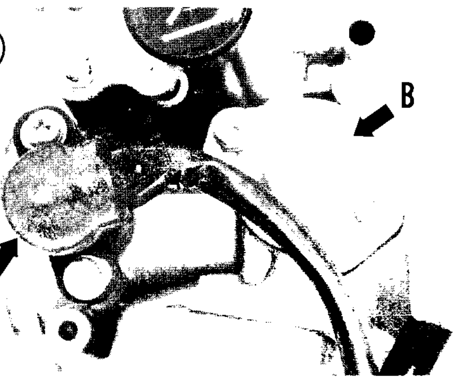

c. Remove the choke plunger (B, **Figure 14**).

5. Remove the diaphragm cover and the slide assembly as follows:

a. Remove the cover (**Figure 15**). The cover is under slight spring pressure. Hold the cover in place as the screws are removed, and then lift off the cover.
b. Remove the spring.
c. Remove the O-ring (**Figure 16**).

CAUTION
Do not lift or hold the slide by the diaphragm. Handle the jet needle carefully.

d. From the intake side, push up on the slide and lift it from the carburetor.
e. Remove the jet needle stopper from the slide, and then remove the jet needle assembly (**Figure 17**).

6. Remove the throttle stop screw (A, **Figure 18**) and float chamber (B). Remove the drain screw and O-ring from the chamber.

7. Remove and disassemble the float assembly as follows:

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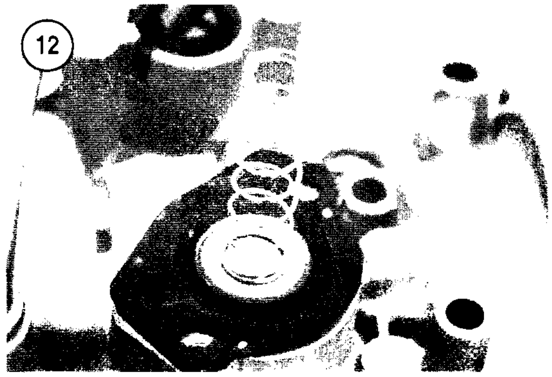

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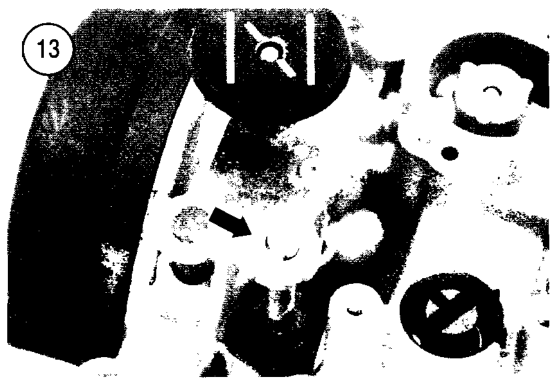

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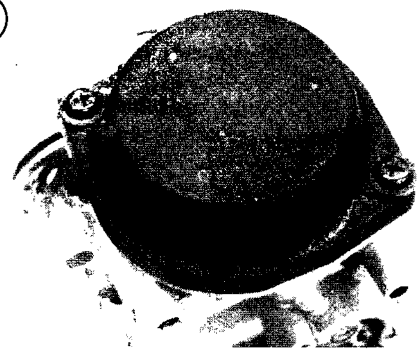

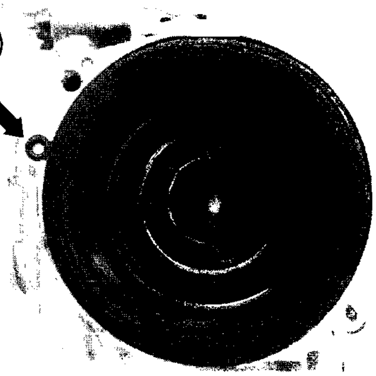

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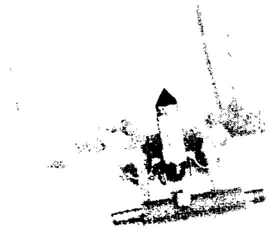

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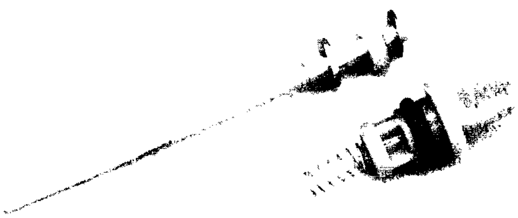

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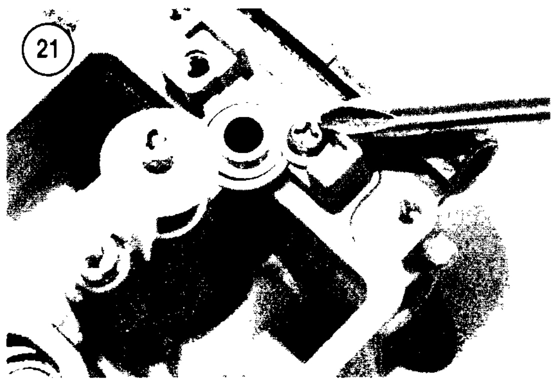

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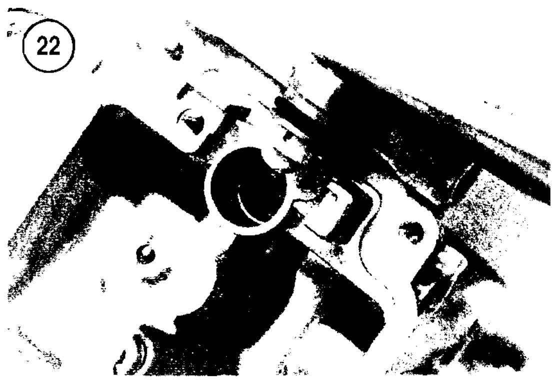

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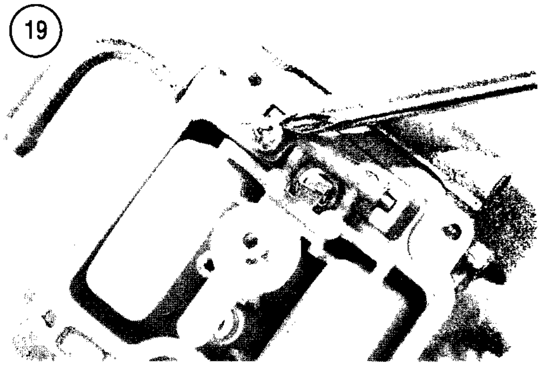

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a. Remove the pin retaining screw (**Figure 19**).

b. Carefully lift out the float, pin and float valve (**Figure 20**).

c. Slide the clip and float valve off the float tab.

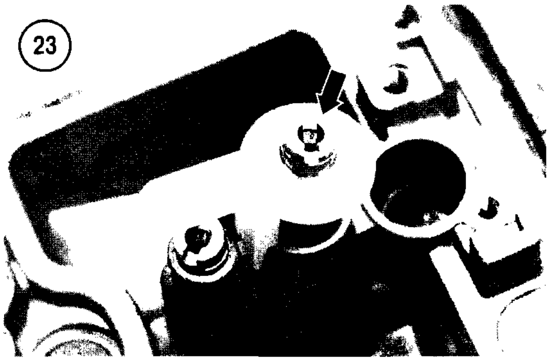
8. Remove the float valve seat as follows:

a. Remove the retaining screw (**Figure 21**).

b. Twist and remove the float seat (**Figure 22**). Do not grip the seat inside the bore. Scratches in the seat cause leaks past the float valve.

9. Remove the main jet assembly as follows:

a. Remove the baffle and main jet (**Figure 23**).



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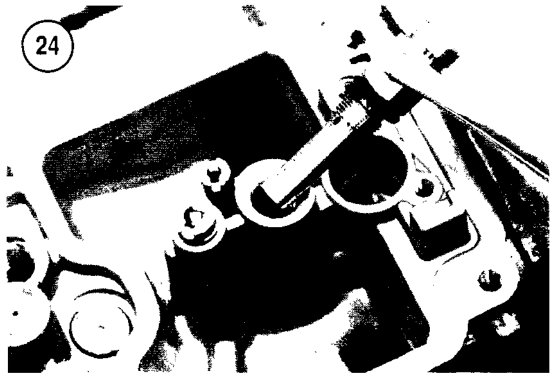

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b. Remove the needle jet holder (**Figure 24**).
c. Remove the needle jet (**Figure 25**). Unseat the jet by hand. If necessary, use a wood or plastic dowel to help unseat the jet. Do not use tools that could scratch the inner surface of the jet.

10. Remove the pilot jet (**Figure 26**).
11. Remove the starter (choke) jet (**Figure 27**).
12. Remove the pilot mixture screw as follows:
   a. If a plug is installed over the screw (**Figure 28**), remove the plug by drilling through it with a *small* drill bit. Do not use a bit larger than 1/8 in. When drilling, use a light touch and mark the bit 1/4 in. from the end. Thread a sheet metal screw into the hole, and then pull the plug from the bore (**Figure 29**).
   b. Make a scratch on the edge of the bore, in line with the slot in the screw. Use this as a reference point when installing the screw.
   c. Turn the screw clockwise and accurately count the number of turns it takes to *lightly* seat the screw into the carburetor.
   d. Record the number of turns.
   e. Remove the pilot mixture screw, spring, washer and O-ring (**Figure 30**).
13. Remove the secondary pilot air jet (**Figure 31**).
14. Clean and inspect the parts as described in this section.
15. Reverse this procedure to assemble the carburetor. Note the following:
   a. Install new, lubricated O-rings. Lubricate them with engine oil.
   b. Do not confuse the starter jet and main jet. They are similar in appearance and fit in either location. The main jet has a *large* hole in its center.
   c. When installing the pilot mixture screw, *lightly* seat the screw, and then turn it out the

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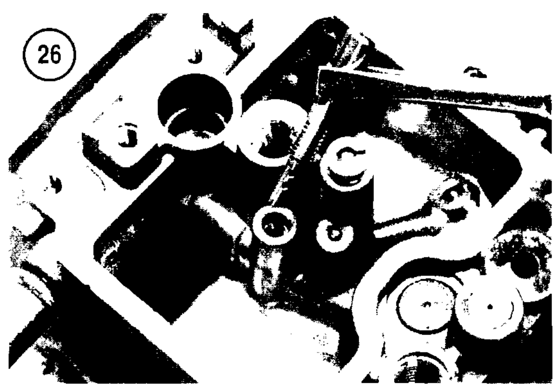

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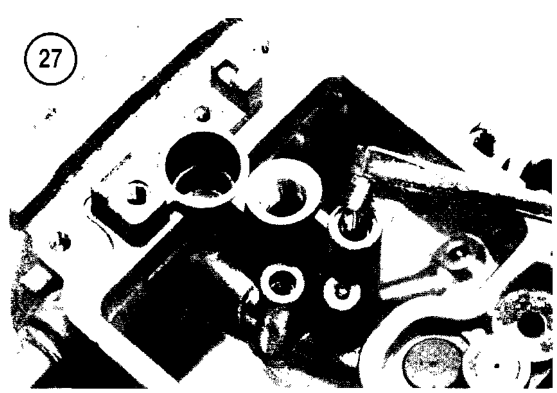

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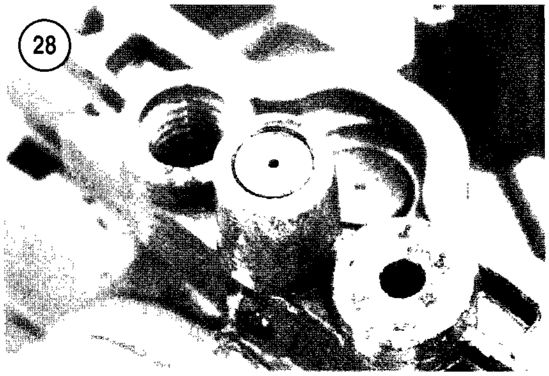

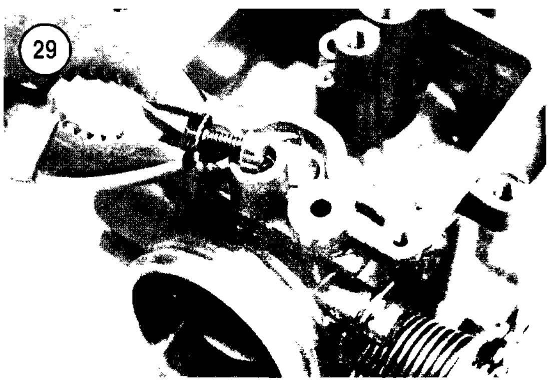

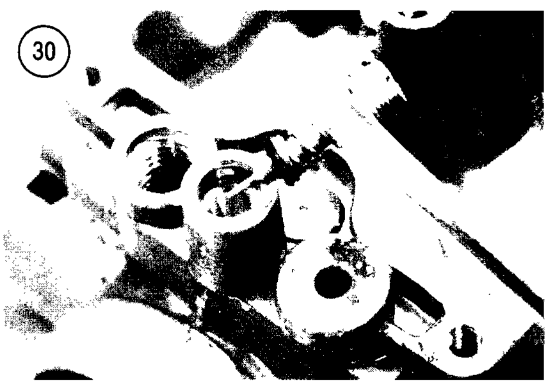

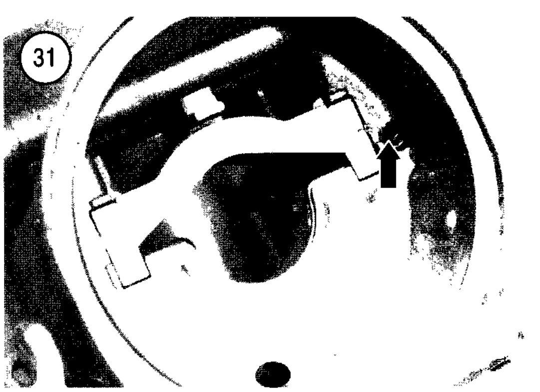

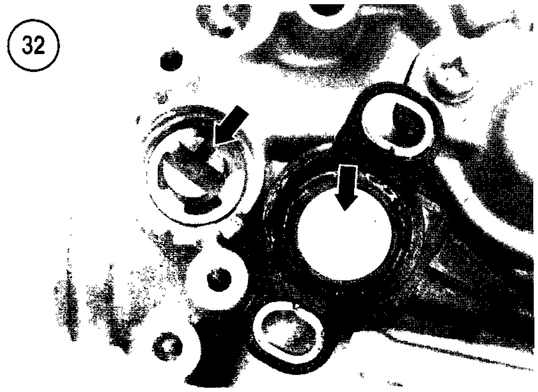

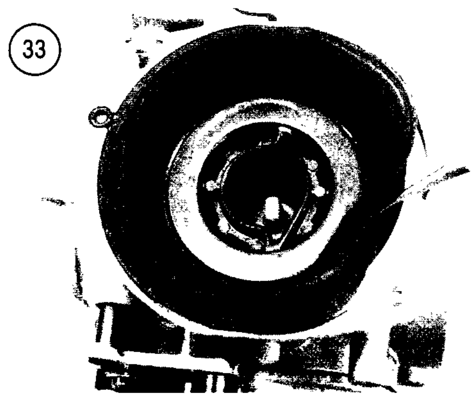

number of turns recorded during disassembly. Refer to the reference mark on the carburetor for the original setting. If the number of turns is not known, refer to **Table 1**.

d. Attach the float valve and clip to the float before installing the parts.

e. Check and adjust the float height. Refer to *Carburetor Systems* in this chapter.

f. When installing the choke plunger, apply grease to the detent ball to hold it on the spring while the parts are being assembled.

g. Align and engage the tangs in the throttle position sensor with the slots in the throttle shaft (**Figure 32**).

h. Adjust the throttle position sensor as described in this chapter.

i. Install the slide assembly and diaphragm cover last. When installing the slide and diaphragm, the diaphragm must be seated at its edge (**Figure 33**) before installing the cover.

j. Install the carburetor as described in this chapter.

Cleaning and Inspection

Use a commercial cleaner specifically for carburetors because the cleaner contains agents for removing fuel residue and buildup. Use a cleaner that will not damage rubber and plastic parts. Follow the manufacturer's instructions when using the cleaner.

CAUTION

Do not clean the jet orifices or seats with wire or drill bits. These items can scratch the surfaces and alter flow rates or cause leaks.

1. Clean all parts in carburetor cleaner. Use compressed air to clean all passages, orifices and vents in the carburetor body.
2. Inspect the main jet and needle jet assembly (A, **Figure 34**), pilot jet (B), starter (choke) jet (C) and secondary pilot air jet (not shown). Check that all holes are clean and undamaged.
3. Inspect the pilot mixture screw assembly and choke plunger (**Figure 35**).
   a. Inspect the screw and plunger tips for dents or wear.
   b. The spring coils should be resilient and not crushed.
   c. The plunger should move freely in its bore in the carburetor.
4. Inspect the jet needle assembly (**Figure 36**). The jet needle must be smooth, straight and evenly tapered. If the needle or needle jet (**Figure 37**) is stepped, dented, worn or bent, replace the parts.
5. Inspect the diaphragm, slide, vacuum chamber cover and spring (**Figure 38**).
   a. Inspect the slide for wear and scratches. Fit the slide into the carburetor body and check for smooth vertical operation. The slide should have minimal front to back play.
   b. Inspect the diaphragm for dryness, tears and holes. The diaphragm *must* be undamaged to isolate the pressure differences that are above and below the diaphragm. A leaking diaphragm prevents the slide from reaching/maintaining its normal level, for any throttle position off idle.
   c. The vacuum chamber cover *must* be undamaged to maintain low pressure in the upper chamber of the carburetor. A cracked or loose cover affects engine performance similarly to a damaged diaphragm.

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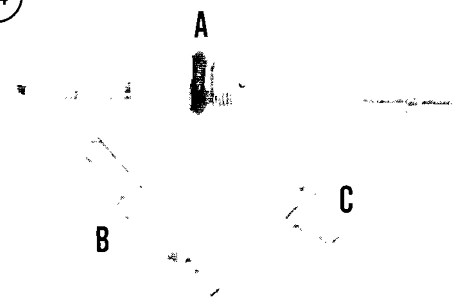

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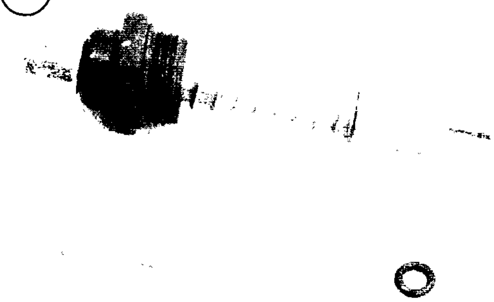

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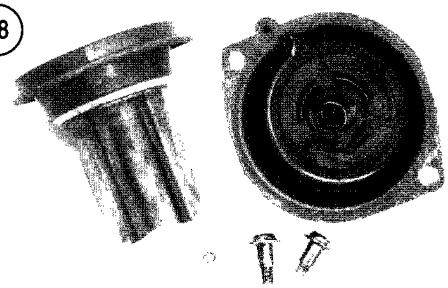

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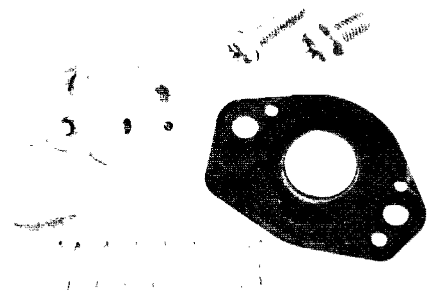

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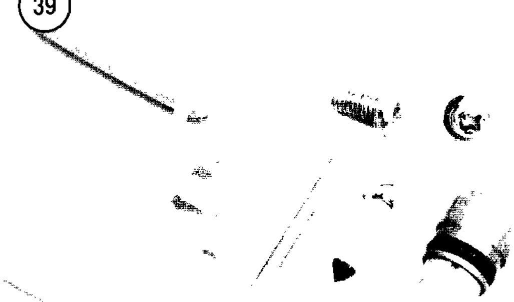

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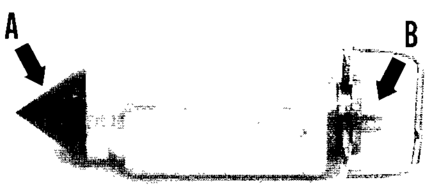

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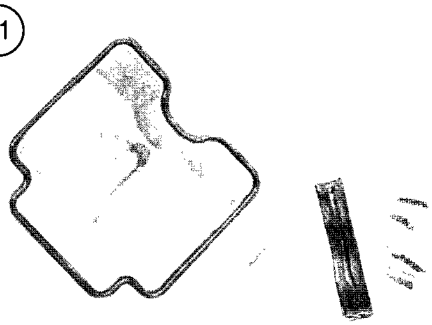

6. Inspect the float and float valve assembly (**Figure 39**).
   a. Inspect the rubber tip of the float valve (A, **Figure 40**). If it is stepped or dented, replace the float valve.
   b. Lightly press on the spring-loaded pin (B, **Figure 40**) in the float valve. The pin should easily move in and out of the valve. If it is varnished with fuel residue, replace the float valve.
   c. Inspect the float valve seat. The seat should be clean and scratch-free. If it is not, the float valve does not seat properly and the carburetor overflows.
   d. Inspect the screen on the float valve seat. The screen must be clean and not damaged.
   e. Inspect the float and pin. Submerge the float in water and check for leaks. Replace the float if water or fuel is detected inside the float. Check that the float pin is straight and smooth. It must be a slip-fit in the float.
7. Inspect the float chamber assembly (**Figure 41**).
   a. Check that all residue is removed from the interior of the bowl.
   b. Inspect screw threads for damage.
   c. Inspect the tip of the drain screw. If damaged, the drain screw allows fuel to pass out the drain.
   d. Inspect the overflow tube for cleanliness.
8. Inspect the air cutoff valve assembly (**Figure 42**).
   a. The diaphragm must be free of damage to operate properly.
   b. The pin on the back of the diaphragm should not be worn.
   c. The air passages must be clean to operate properly.

9. Inspect the air cutoff valve chamber (**Figure 43**).
   a. Inspect the vent holes and ball valve for cleanliness.
   b. Check the ball valve for free movement. Apply light pressure to unseat the ball, and then release pressure. The spring-loaded ball should seat itself.
10. Inspect the throttle position sensor (**Figure 44**).
    a. Inspect the harness and connector terminals for damage.
    b. Turn the center of the sensor and inspect for free rotation. The sensor must rotate smoothly to accurately send the signal to the CDI unit.
    c. Lightly lubricate the gasket with dielectric grease to prevent the entry of moisture.
11. Inspect the choke guide assembly (**Figure 45**). The guides must be straight and smooth. The detents on the one guide must engage and lock with the ball.
12. Inspect the throttle valve spring and cable holder (**Figure 46**). The spring must be clean between the coils and the cable holder must be tight on the shaft. The throttle valve must fully open and close.
13. Inspect the throttle stop screw assembly and clamps (**Figure 47**).
    a. Inspect the throttle stop screw for straightness and thread damage. The spring coils should be resilient and not crushed.
    b. Replace clamps that are distorted or have stripped threads. The clamps must fit tightly on the ducts to prevent air leaks.
14. Inspect the vent and vacuum hoses for damage. On S models, the vacuum hose must fit tightly to the carburetor and fuel valve diaphragm. Air leaks prevent the proper opening of the diaphragm to allow fuel to the carburetor.

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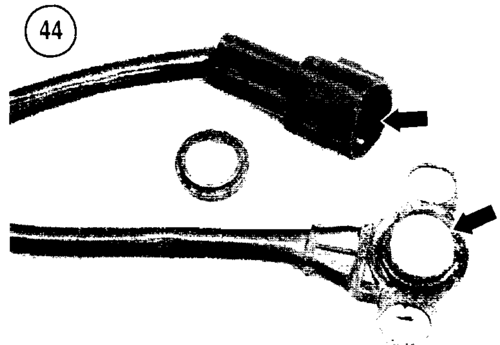

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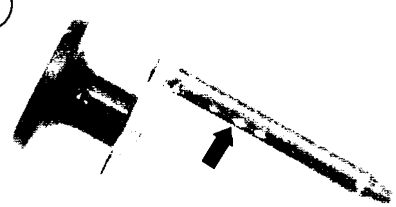

CARBURETOR (KEIHIN)

Operation

E models (except the 2004 California model) use the Keihin throttle valve carburetor. The Keihin FCR is a flat-slide carburetor that utilizes an accelerator pump.

Refer to *Carburetor Systems* in this chapter for specific carburetor fuel systems.

Removal and Installation

1. Support the motorcycle so it is secure.
2. Remove the fuel tank (Chapter Fifteen).
3. Remove the cable cover at the carburetor.
4. Remove the throttle cables as follows:
   a. Loosen the outer locknut on the pull cable (upper) and return cable (lower), and then remove the cables from the holder.

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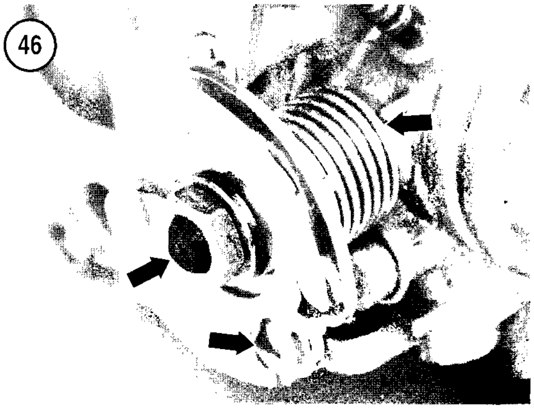

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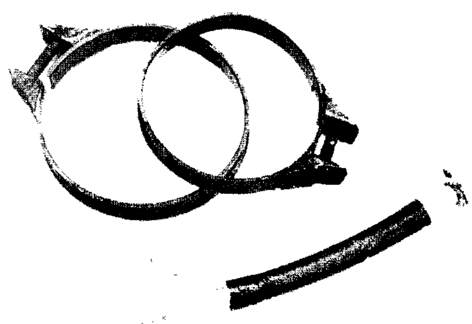

b. Turn the throttle valve and remove the cable ends.

5. At the left side of the carburetor, remove the vacuum hose from the air cutoff valve.

6. Disconnect the throttle position sensor at the wire connector. Do not remove the sensor from the carburetor.

7. Completely remove the clamps from the air filter housing duct and intake duct.

8. Remove any remaining bands or wire clamps that prevents the carburetor from being removed.

9. Remove the carburetor from the ducts as follows:

a. Pry up on the ducts to break them free from the carburetor. If necessary, lightly spray penetrating lubricant under the duct.

b. Push the carburetor forward and back and pry the ducts off the carburetor. Pull the carburetor to the left side of the engine as the ducts are worked off. Keep the carburetor upright when it is removed.

10. Remove the main jet access plug on the bottom of the float chamber and drain any remaining fuel.

11. Disassemble the carburetor as described in this section.

12. Reverse this procedure to install the carburetor. Note the following:

a. If necessary, set the pilot mixture screw to its initial setting.

b. Clean and lightly lubricate the inside edges of the ducts so the carburetor easily seats.

c. Vertically align the carburetor in the intake duct.

d. Check the fuel, vent and vacuum hose routing.

e. Check/adjust the throttle cables (Chapter Three).

f. Check the throttle for proper operation.

g. Check the carburetor for leaks.

h. Check the fuel, vent and drain hose routing.

i. If necessary, adjust the idle speed and pilot mixture screw settings (Chapter Three).

Disassembly and Assembly

Refer to **Figure 48**.

1. Remove the vent and vacuum hoses (**Figure 49**).

2. Remove the air cutoff valve assembly (**Figure 50**) as follows:

a. Remove the screws from the cover. The cover is under spring pressure. Keep pressure on the cover as the screws are removed.

b. Remove the cover, spring and diaphragm.

3. Remove the throttle position sensor (A, **Figure 51**) as follows:

a. If the engine is not running correctly, perform the *Throttle Position Sensor* resistance checks as described in in this chapter.

b. Accurately mark the position of the sensor, and remove it from the carburetor. If the sensor is left in the carburetor, do not submerge it in solvent.

4. Remove the cover and gasket from the throttle lever housing (B, **Figure 51**).

5. Remove the throttle valve assembly from the top of the carburetor as follows:

a. Remove the throttle stop locknut and adjuster (**Figure 52**). As the adjuster is removed, note the number of turns is takes to remove the adjuster.

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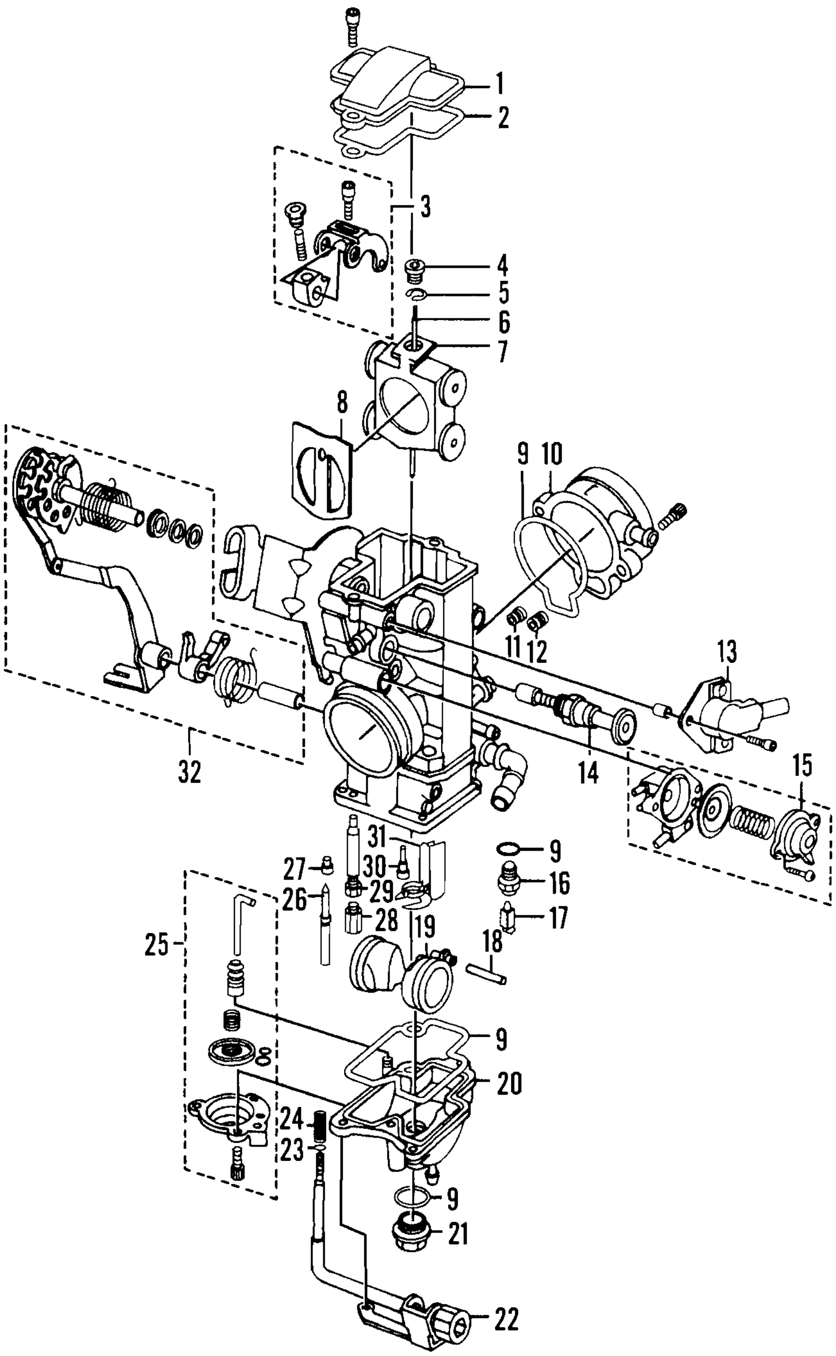
CARBURETOR (KEIHIN)



1. Cover
2. Gasket
3. Throttle lever assembly
4. Set screw
5. Clip
6. Jet needle
7. Throttle valve
8. Throttle valve plate
9. O-ring
10. Intake joint
11. Main air jet
12. Pilot air jet
13. Throttle position sensor (TPS)
14. Choke assembly
15. Air cutoff valve assembly
16. Float valve seat
17. Float valve
18. Pin
19. Float
20. Float chamber
21. Main jet access plug
22. Throttle stop screw
23. Washer
24. Spring
25. Accelerator pump assembly
26. Pilot mixture screw
27. Starter (choke) jet
28. Main jet
29. Needle jet
30. Pilot jet
31. Baffle
32. Throttle shaft assembly

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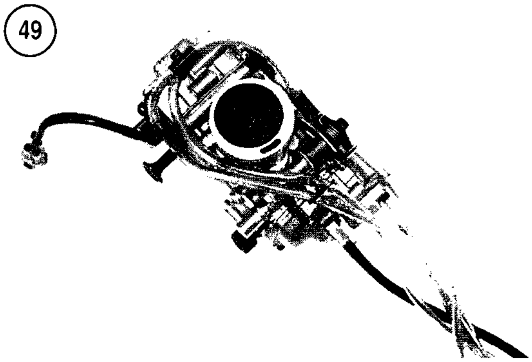

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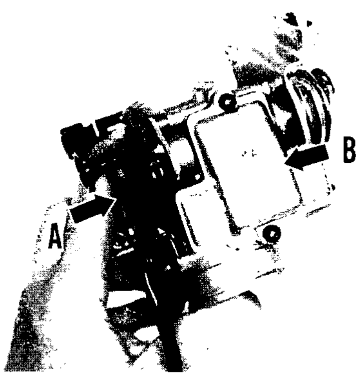

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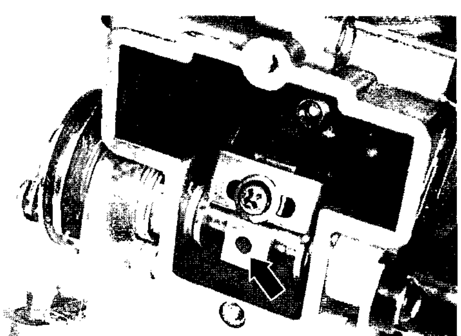

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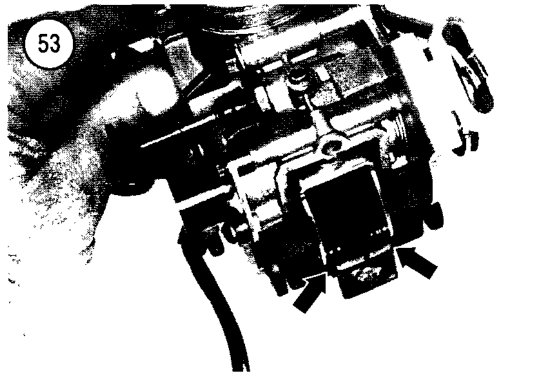

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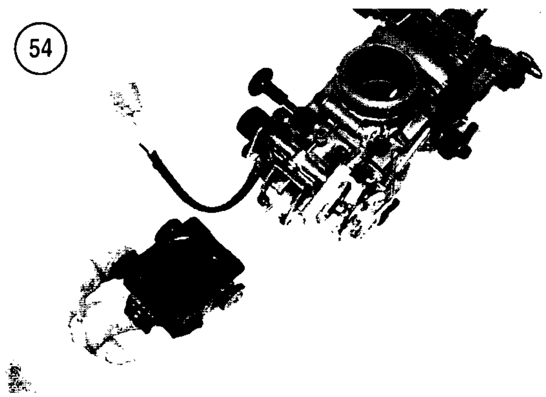

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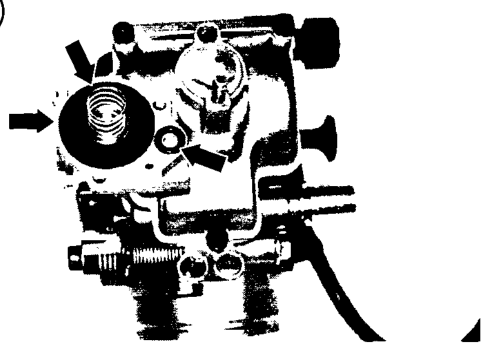
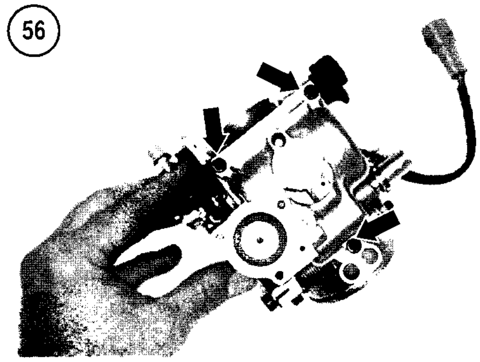


b. Turn the throttle shaft so the throttle valve assembly can be disengaged from the throttle lever rollers (**Figure 53**).

c. Carefully remove the slide assembly from the throttle lever rollers (**Figure 54**).

6. Remove the accelerator pump cover, O-ring, spring and diaphragm (**Figure 55**).

7. Remove the throttle stop screw bracket and float chamber (**Figure 56**). Use care when removing the chamber. The accelerator pump pushrod must pass straight out the boot (**Figure 57**).



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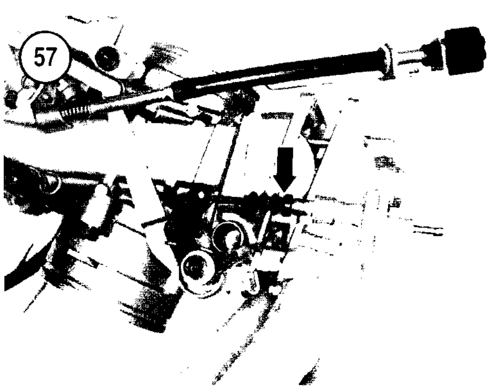

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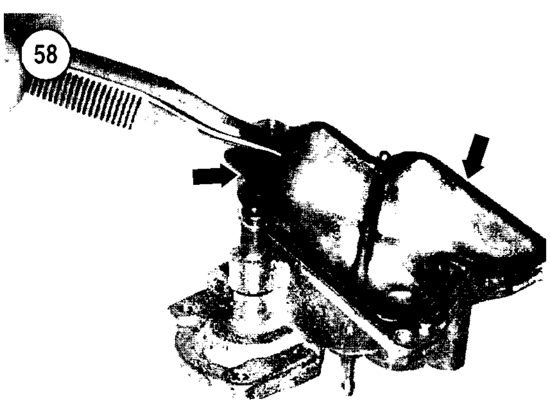

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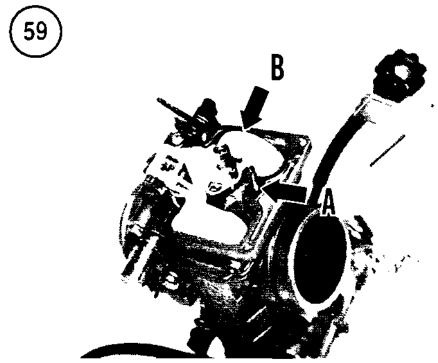
8. Remove the boot and O-ring from the float chamber (**Figure 58**).

9. Remove the pilot mixture screw (A, **Figure 59**) as follows:

   a. Make a scratch on the edge of the bore, in line with the slot in the screw. Use this as a reference point when installing the screw.
   b. Turn the screw clockwise and accurately count the number of turns it takes to seat the screw into the carburetor.
   c. Record the number of turns.



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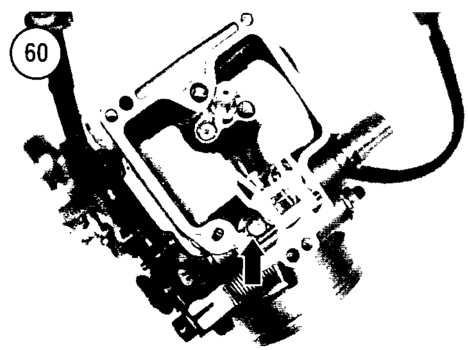

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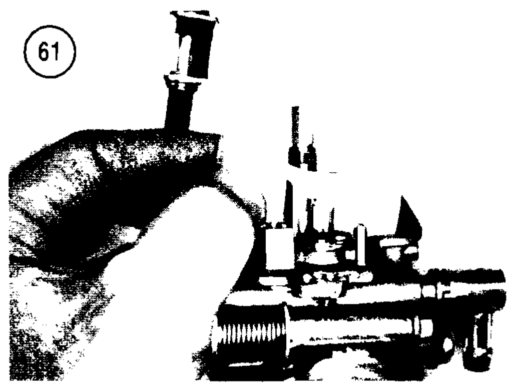

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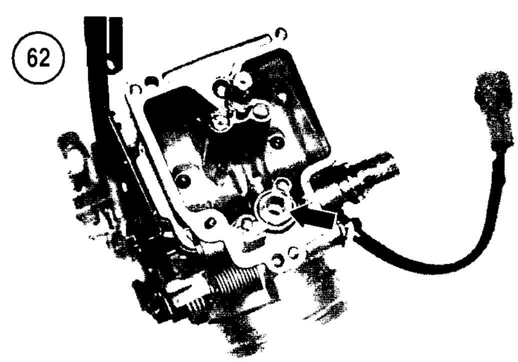

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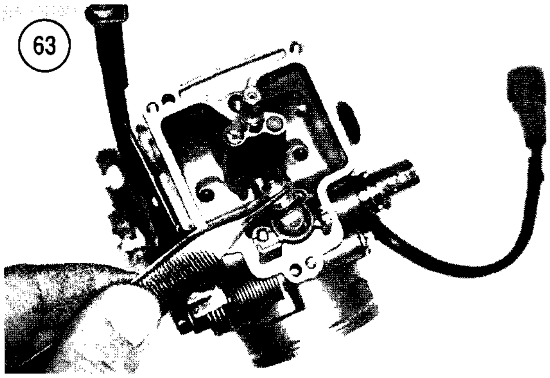

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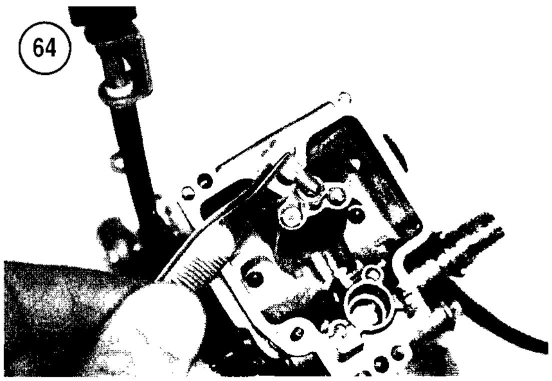

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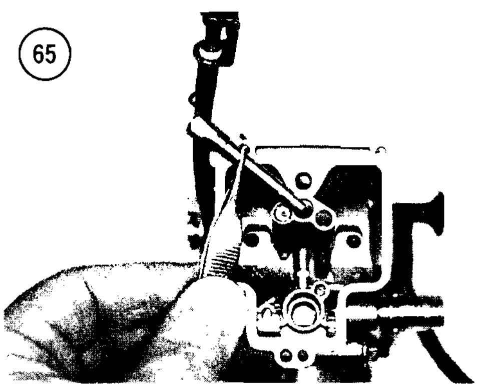

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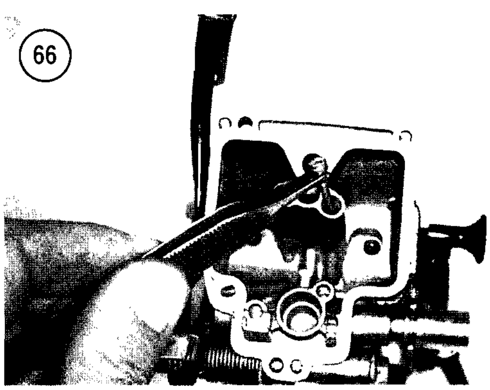

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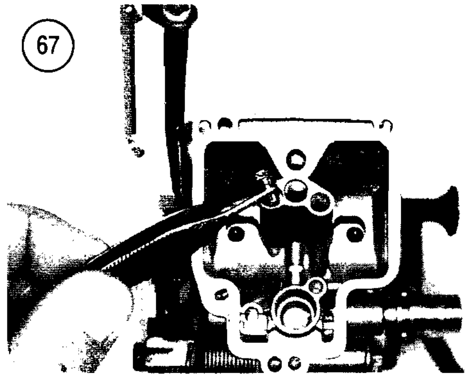

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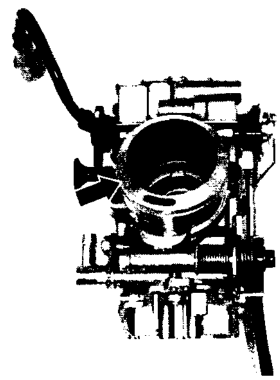

d. Remove the pilot mixture screw, spring, washer and O-ring.

10. Remove the baffle from the main jet (B, **Figure 59**).

11. Remove and disassemble the float assembly as follows:

a. Remove the pin retaining screw (**Figure 60**).

b. Carefully lift out the float, pin and float valve (**Figure 61**).

c. Slide the clip and float valve off the float tab.

12. Remove the float valve seat (**Figure 62**). Twist and remove the float seat (**Figure 63**). Do not grip the seat inside the bore. Scratches in the seat cause leaks past the float valve.

13. Remove the main jet (**Figure 64**).

14. Remove the needle jet (**Figure 65**). Unseat the jet by hand. If necessary, use a wood or plastic dowel to help unseat the jet. Do not use tools that could scratch the inner surface of the jet.

15. Remove pilot jet (**Figure 66**).

16. Remove starter (choke) jet (**Figure 67**).

17. Remove the intake joint and O-ring (**Figure 68**).

18. Remove the pilot air jet (**Figure 69**).

19. Remove the main air jet (**Figure 70**).
20. Remove the throttle stop screw.
21. If possible, remove the choke plunger. A thin-walled box wrench is required to fit in the recess.
22. Clean and inspect the parts as described in this section.
23. Reverse this procedure to assemble the carburetor. Note the following:
    a. Install new, lubricated O-rings. Lubricate them with engine oil.
    b. When installing the pilot mixture screw, lightly seat the screw, and then turn it out the number of turns recorded during disassembly. Refer to the reference mark on the carburetor for the original setting. If the number of turns is not known, refer to **Table 2**.
    c. Attach the float valve and clip to the float before installing the parts.
    d. Check and adjust the float height as described in this chapter.
    e. If removed, align and engage the throttle position sensor with the throttle shaft.
    f. To install the throttle valve assembly, turn the throttle shaft so the throttle lever rollers are at the top of the carburetor, and then carefully insert and engage the slide assembly with the rollers (**Figure 54**). The throttle valve plate must face toward the engine when the carburetor is installed. Install the throttle stop adjuster and locknut (**Figure 52**). Turn the adjuster in the same number of turns as noted during disassembly and lock the adjustment in place. Operate the throttle and check the adjustment.
    g. Adjust the throttle position sensor as described in this chapter.
    h. Install the carburetor as described in this section.

Cleaning and Inspection

Use a commercial cleaner specifically for carburetors because the cleaner contains agents for removing fuel residue and buildup. Use a cleaner that will not damage rubber and plastic parts. Follow the manufacturer's instructions when using the cleaner.

CAUTION
Do not clean the jet orifices or seats with wire or drill bits. These items can scratch the surfaces and alter flow rates or cause leaks.

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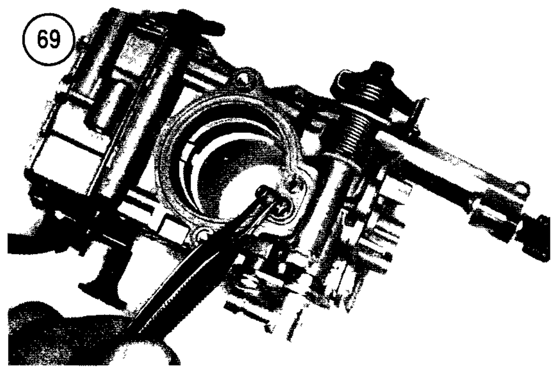

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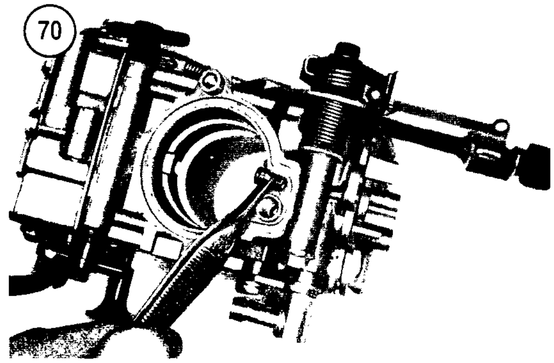

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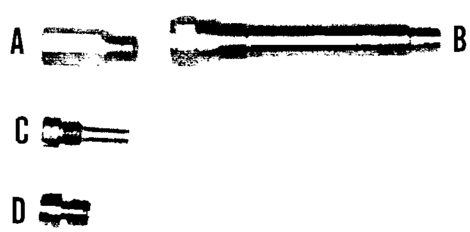

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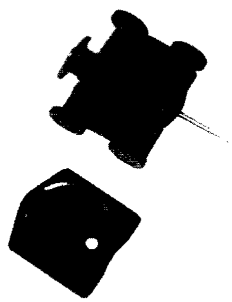

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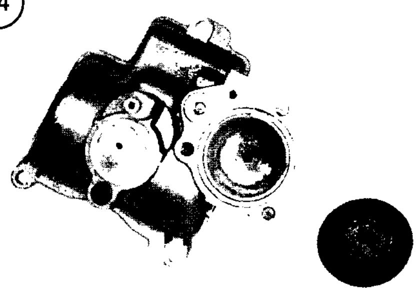

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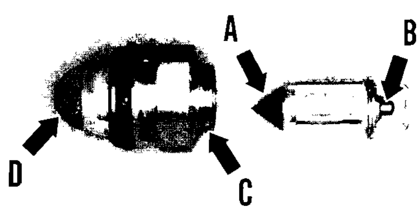
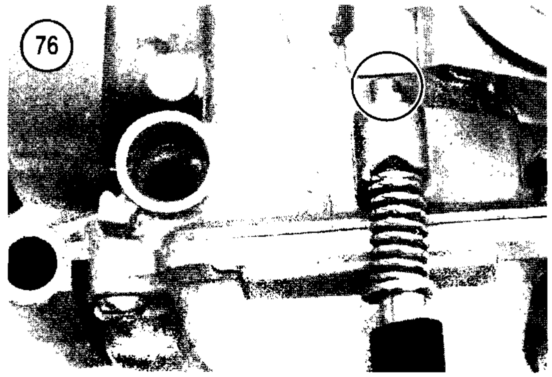
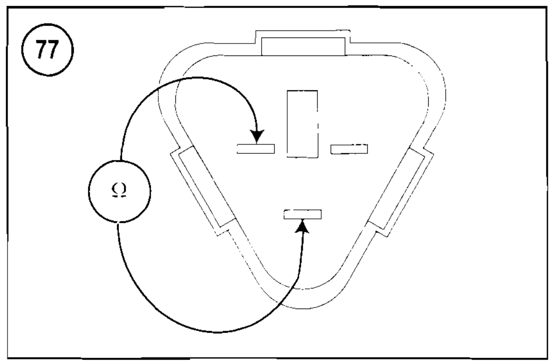


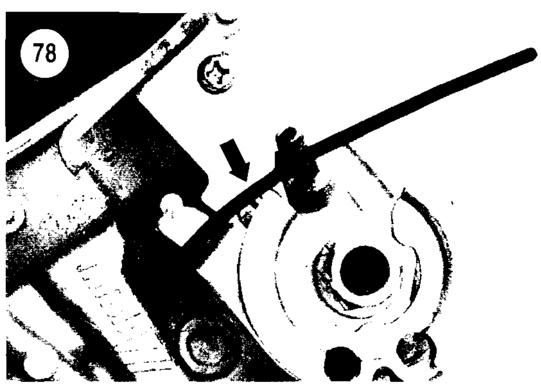
1. Clean all parts in carburetor cleaner. Use compressed air to clean all passages, orifices and vents in the carburetor body.
2. Inspect the main jet (A, **Figure 71**), needle jet (B), pilot jet (C), starter (choke) jet (D). Also check the main air jet and pilot air jet (not shown). Check that all holes are clean and undamaged.
3. Inspect the pilot mixture screw assembly (**Figure 72**).
   a. Inspect the screw tip for dents or wear.
   b. The spring coils should be resilient and not crushed.
4. Inspect the throttle valve and throttle valve plate (**Figure 73**).
   a. The needle must be smooth and evenly tapered. If it is stepped, dented, worn or bent, replace the needle.
   b. Check the throttle valve plate for cracks or other damage.
   c. Check that the rollers on the throttle valve turn freely.
   d. Inspect the fit of the throttle valve assembly in the carburetor body. The assembly should fit snugly, but easily slide through the bore. If drag or binding is felt, replace the throttle valve assembly.
5. Inspect the accelerator pump diaphragm (**Figure 74**) for cracks, tears or brittleness. Also check the air cutoff valve diaphragm for the same damage.
6. Inspect the float and float valve assembly (**Figure 75**) as follows:
   a. Inspect the tip of the float valve (A, **Figure 75**). If it is stepped or dented, replace the float valve and seat.
   b. Lightly press on the spring-loaded pin (B, **Figure 75**) in the float valve. The pin should easily move in and out of the valve. If it is varnished with fuel residue, replace the float valve and seat.
   c. Inspect the float valve seat (C, **Figure 75**). The seat should be clean and scratch-free. If it is not, the float valve does not seat properly and the carburetor overflows.
   d. Inspect the screen (D, **Figure 75**). If necessary, clean with solvent and compressed air.
   e. Inspect the float and pin. Submerge the float in water and check for leaks. Replace the float if water or fuel is detected inside the float. Check that the float pin is straight and smooth. It must be a slip-fit in the float.
7. Inspect the float chamber assembly.
   a. Check that all residue is removed from the interior of the bowl.
   b. Inspect screw threads for damage.
   c. Inspect the overflow tube for cleanliness.
8. Inspect the throttle position sensor.
   a. Inspect the harness and connector terminals for damage.
   b. Turn the center of the sensor and inspect for free rotation. The sensor must rotate smoothly to accurately send the signal to the CDI unit.

9. Inspect the throttle stop screw assembly and mounting clamps.
   a. Inspect the throttle stop screw for straightness and thread damage. The spring coils should be resilient and not crushed.
   b. Replace clamps that are distorted or have stripped threads. The clamps must fit tightly on the ducts to prevent air leaks.

10. Inspect the vent and vacuum hoses for damage. The vacuum hose must fit tightly to the air cutoff valve and intake duct. Air leaks prevent the proper operation of the air cutoff valve diaphragm.







THROTTLE POSITION SENSOR

Inspection and Adjustment

The throttle position sensor (TPS) can be checked with the carburetor installed on the engine. Anytime the sensor is removed from the carburetor, use an ohmmeter to set the position of the sensor. The correct sensor adjustment is critical to engine performance.

1. If the carburetor is installed on the engine, disconnect the wire connector leading to the sensor.
2. Turn the throttle stop screw out until it no longer touches the throttle valve (**Figure 76**). The throttle must be fully closed.
3. Measure and record the resistance at the connector terminals shown in **Figure 77**. Refer to **Table 1** or **Table 2** for the required resistance measurement.
   a. If the throttle resistance is within specifications, proceed to the next step.
   b. If the throttle resistance is not within specifications, check that the sensor is properly installed. The sensor must engage with the throttle shaft. Turn the sensor side to side and see if the specified resistance can be achieved. If it can, tighten the screws and proceed to the next step. If specified resistance cannot be achieved, replace the sensor.
4. Secure the throttle valve so it is in the fully open position with a plastic tie (**Figure 78**).
5. Measure and record the resistance at the connector terminals shown in **Figure 79**. Refer to **Table 1** or **Table 2** for the required resistance measurement.
6. If the resistance measurement is not within specification, loosen the screws and adjust the sensor until it is within specifications. Tighten the screws and recheck the resistance measurement. If specified resistance cannot be achieved, replace the sensor.

CARBURETOR SYSTEMS

Before disassembling the carburetor, review the function of the pilot, needle and main jet systems. When evaluating or troubleshooting these systems, keep in mind their operating ranges overlap during the transition from closed to fully open throttle.

Other factors that affect carburetor performance are altitude, temperature and engine load. If the en-

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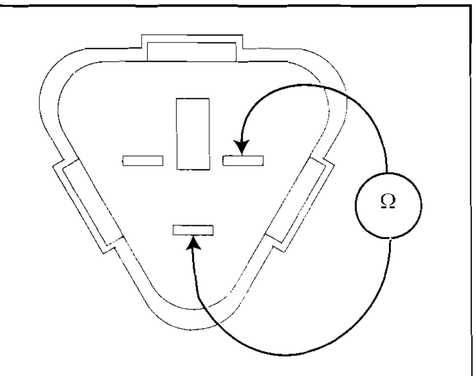

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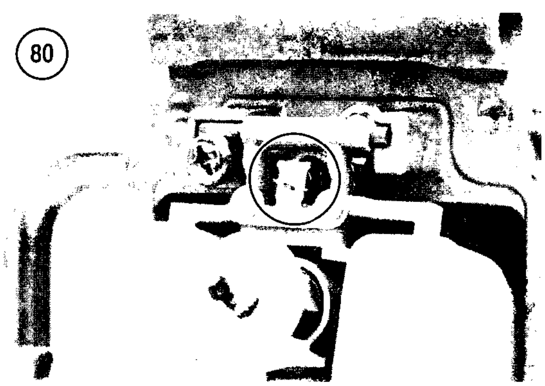

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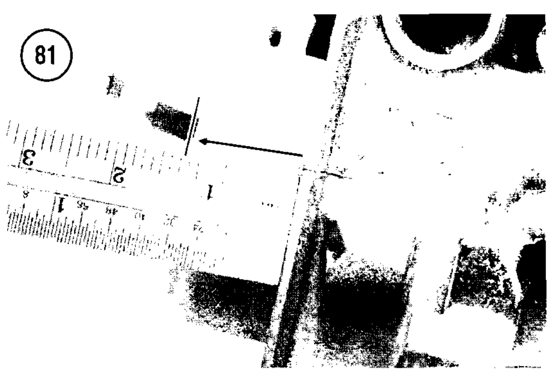

gine is not running correctly, check the following before adjusting or replacing the components in the carburetor:

1. Throttle cables. Make sure the cables are not dragging and are correctly adjusted.
2. Choke. Make sure the choke fully opens and closes.
3. Fuel flow. Make sure fuel is adequately flowing from the fuel tank to the carburetor. For S models, make sure the vacuum hose leading to the fuel valve is tight.
4. Air filter. Make sure the filter is clean.
5. Muffler. Make sure the muffler is not restricting flow.
6. Brakes. Make sure the brake pads are not dragging on the discs.

Float

The float and float valve maintain a constant and measured fuel level in the float chamber. As fuel is consumed, the float lowers and allows more fuel past the valve. As the fuel level rises, the float closes the valve when the required fuel level is reached. If the float is out of adjustment, the fuel level will be too high or low. A low fuel level causes the engine to run lean. A high fuel level causes the engine to run rich. It may also cause fuel overflow.

Adjustment

1. Remove the carburetor as described in this chapter.
2. Remove the float chamber.
3. Lightly touch the float to ensure the float valve is seated.
4. Lay the carburetor on its side so the float valve hangs freely. Tilt the carburetor until the tab on the float *lightly* touches the spring-loaded pin in the valve (**Figure 80**). The tab must not compress the pin.
5. Measure the distance from the carburetor gasket surface to the highest point on the float (**Figure 81**). Refer to **Table 1** or **Table 2** for the required float height.
6. If necessary, reset the float height as follows:
   a. Remove the float assembly from the carburetor.
   b. Remove the float valve and clip.
   c. Bend the float tab in the appropriate direction to raise or lower the float. Use care when bending the tab to prevent breaking the plastic lugs or float.
   d. Assemble the float and recheck the height. Adjust if necessary.
7. Install the float chamber.

Pilot Jet

The pilot jet system (**Figure 82**) controls the air/fuel ratio from closed throttle to about 1/4 throttle. Air enters the pilot air jet (A, **Figure 83**), where

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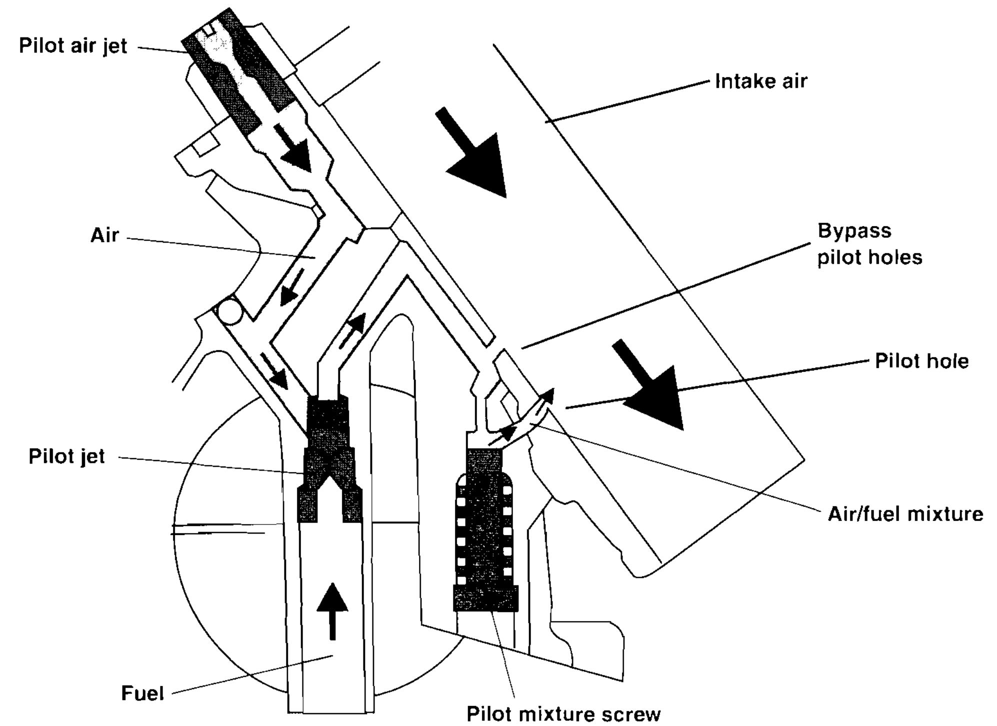
PILOT JET SYSTEM



it passes to the pilot jet (A, **Figure 84**). The pilot jet draws fuel from the float chamber and mixes it with the air from the pilot air jet. The atomized air/fuel mixture passes to the pilot mixture screw, where it is regulated into the throat of the carburetor. The mixture is discharged from the pilot hole (A, **Figure 85**). Turning the pilot mixture screw in *leans* the air/fuel mixture entering the engine, while turning the screw out *richens* the mixture.

The pilot hole and mixture screw affects idle and low engine speeds. As the throttle valve is opened, it uncovers the bypass pilot holes (B, **Figure 85**), which then become effective. These holes are connected to the passage between the pilot jet and pilot mixture screw. They are not affected by the mixture screw. As engine speed increases, fuel is drawn from these passages directly from the pilot jet.

Jet Needle

The jet needle is connected to the slide (**Figure 86**) and controls the fuel mixture from approximately 1/4 to 3/4 throttle. Air enters the main air jet

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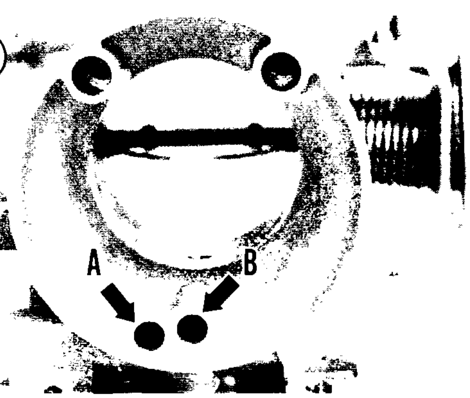

(B, **Figure 83**), where it passes and mixes with fuel that is rising to the needle jet outlet. The needle jet is located above the main jet (B, **Figure 84**). The jet needle (**Figure 87**) regulates the atomized air/fuel mixture into the throat of the carburetor. As the throttle is opened, the needle rises and fuel is regulated by the needle taper.

On the Keihin carburetor, the vertical position of the needle in the slide is adjustable to increase (richen) or decrease (lean) fuel flow from the needle

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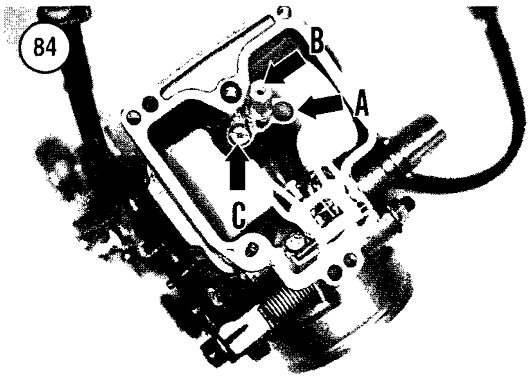

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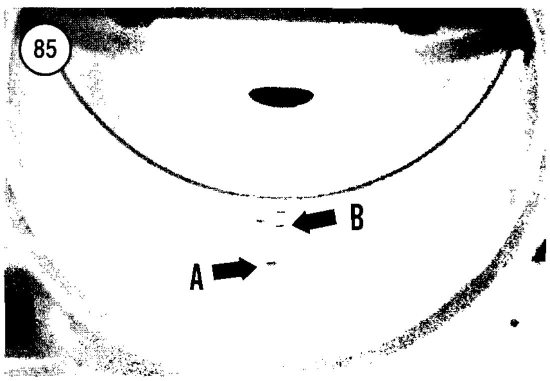

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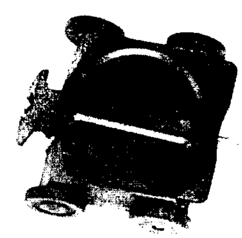

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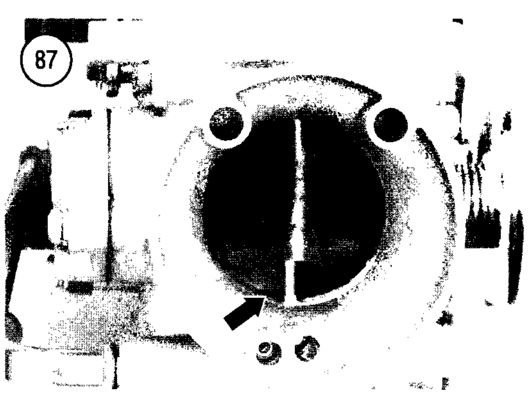

jet. Lowering the needle creates a *lean* condition. Raising the needle creates a *rich* condition. Adjust the needle only if it is determined the engine will perform better for the loads or climate in which it is operated. Do not adjust the needle to correct other problems that may exist with the carburetor. Engine damage can occur if riding conditions do not warrant an overly rich or lean mixture.

Main Jet

The main jet (B, **Figure 84**) is screwed to the bottom of the needle jet and controls the mixture from approximately 3/4 to full throttle. When the jet needle is fully raised from the needle jet, the fuel is regulated into the throat of the carburetor by the size of the bore in the main jet. Main jets are usually numbered and are interchangeable with jets that provide a leaner or richer air/fuel mixture.

Starting Enrichment (Choke)

During cold startup, a plunger assembly and starter jet (C, **Figure 84**) provide a rich air/fuel mixture.

The system does not use a choke plate to restrict air and enrich the air/fuel mixture. However, the common references for the system and actuation knob is to refer to it as a choke and choke knob.

The starter jet controls fuel flow into the plunger bore. When the choke is not in use, the plunger blocks the fuel orifice and the air passage. When the choke is operated, the plunger is withdrawn from the fuel orifice and opens the air passage. As the engine is cranked, a rich air/fuel mixture is drawn through a passage and into the carburetor throat. The passage (**Figure 88**) is located on the throttle valve.

This system is most effective with the throttle closed during startup to maintain high vacuum at the air and fuel passages.

Air Cutoff Valve

The air cutoff valve richens the pilot system air/fuel mixture during compression braking, such as descending steep grades, when the engine speed is high, but the throttle is closed. Without this valve, the engine develops a lean air/fuel mixture in the pilot system, which causes backfiring and possibly

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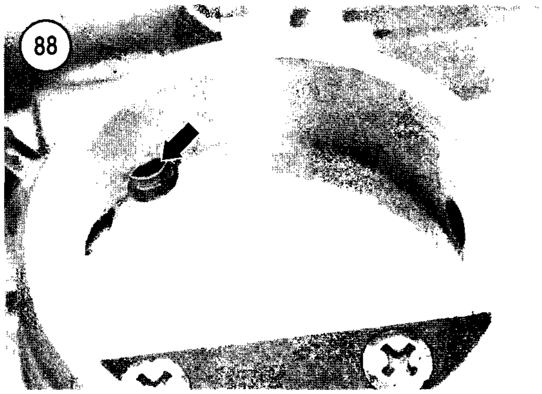

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engine damage. The air cutoff valve consists of a diaphragm, spring and cover (**Figure 89**). The function of the assembly is to open and close an air passage (**Figure 90**) that is a branch of the pilot air system.

During acceleration and steady running speeds, the spring keeps the diaphragm in the down position, allowing air to pass to the pilot jet system. During deceleration, when the throttle valve is closed, engine vacuum vents through a passage leading to the air cutoff valve cover. The vacuum pulls the diaphragm out, causing it to block the air passage in the bore. This reduces the amount of air going to the pilot jet system, and a rich fuel mixture is discharged from the pilot hole (A, **Figure 85**).

When acceleration resumes, the vacuum holding the diaphragm out is reduced, and the spring pushes the diaphragm down, again creating a normal fuel mixture in the pilot jet system.

Accelerator Pump (Keihin Carburetor)

An accelerator pump (**Figure 91**) corrects the air/fuel ratio when the throttle is quickly opened. During quick throttle openings, a lean air/fuel mixture occurs when the intake air volume increases faster than the required fuel volume. To compensate for this temporary difference, the accelerator pump immediately sprays fuel into the carburetor throat, giving the needle jet system time to adjust to the fuel needs. The accelerator pump is only active during quick throttle openings.

The accelerator pump consists of a cover, spring and diaphragm (**Figure 92**). The pump is activated by linkage that is connected to the throttle shaft. When the throttle is opened quickly, the linkage presses a pushrod, located above the diaphragm. As

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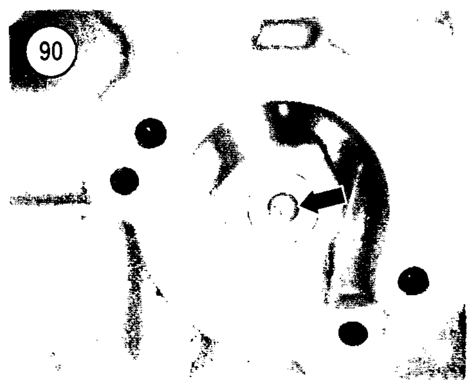

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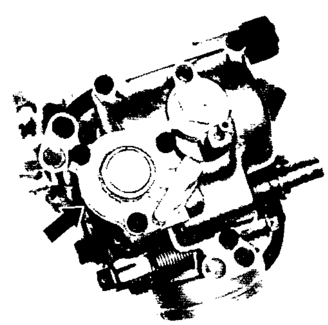

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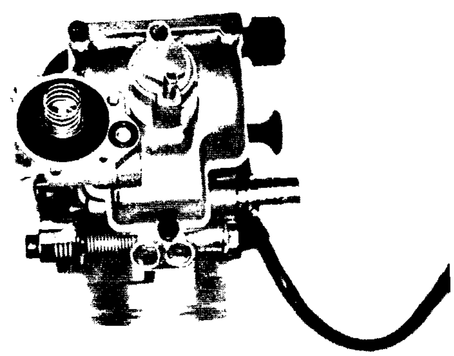

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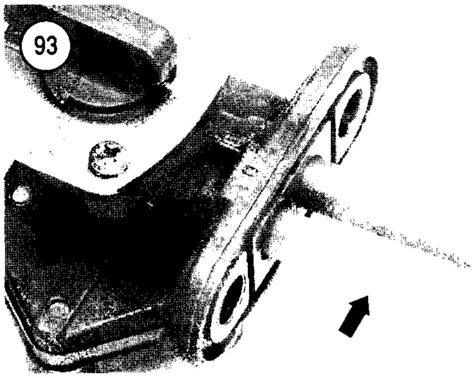

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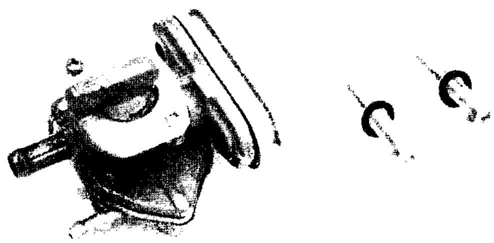

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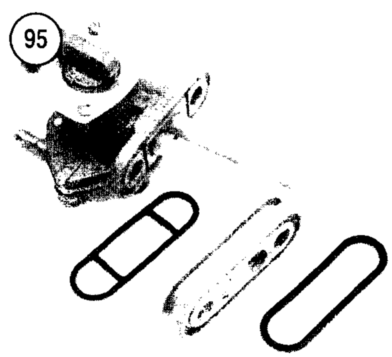

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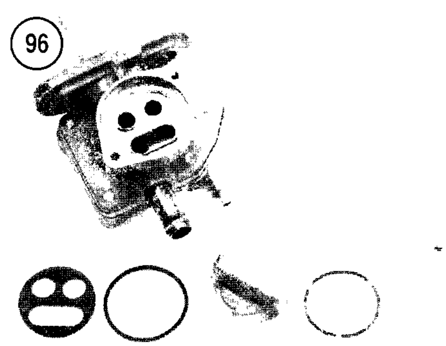

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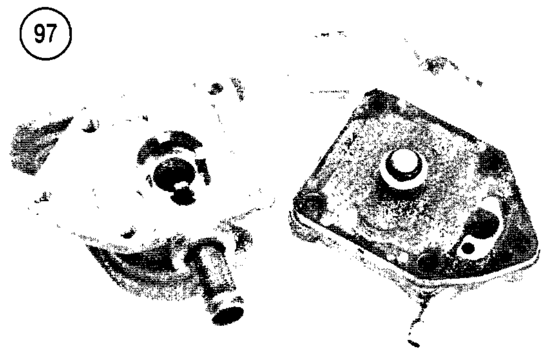

the diaphragm is depressed, the fuel below the diaphragm is forced up a passage and into the carburetor throat.

FUEL VALVE

Removal, Inspection and Installation

S and SM models are equipped with a vacuum-actuated fuel valve. This valve is always left on. It only passes fuel when the engine is running. Fuel flows freely from the valve when the lever is turned to the prime position. E, S and SM models have screen filters on the pipes for the on and reserve valve positions (**Figure 93**). To clean the filters, the fuel valve must be removed from the fuel tank.

1. Remove the fuel tank (Chapter Fifteen).
2. Drain the fuel from the tank.
3. Remove the two screws securing the fuel valve to the tank, and then pull the valve and O-ring straight out of the tank (**Figure 94**). For S models, separate the spacer and O-rings (**Figure 95**).
4. Remove the two screws from the lever plate, and then pull the complete lever and plate assembly out of the fuel valve (**Figure 96**).

CAUTION

The diaphragm is easily damaged. If necessary, use a small tool to gently separate the diaphragm from the fuel valve and cover.

5. On S and SM models, remove the diaphragm cover and *carefully* separate the diaphragm from the fuel valve (**Figure 97**) and cover (**Figure 98**).
6. Clean and inspect the valve parts.

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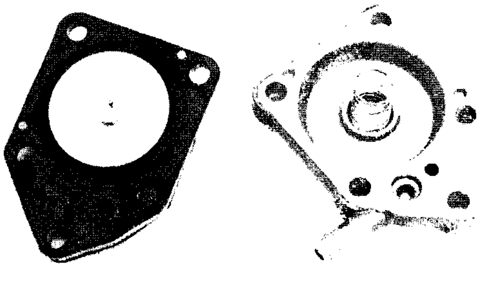

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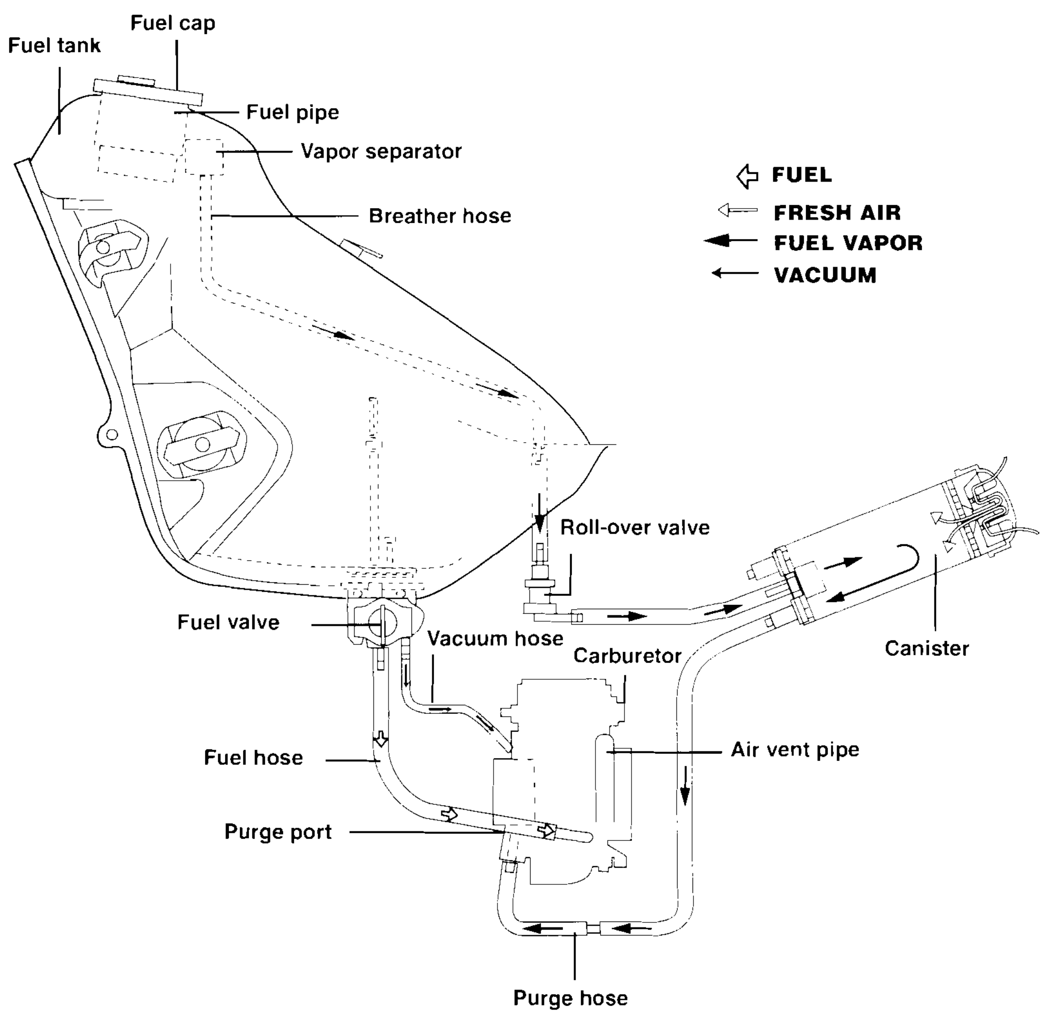
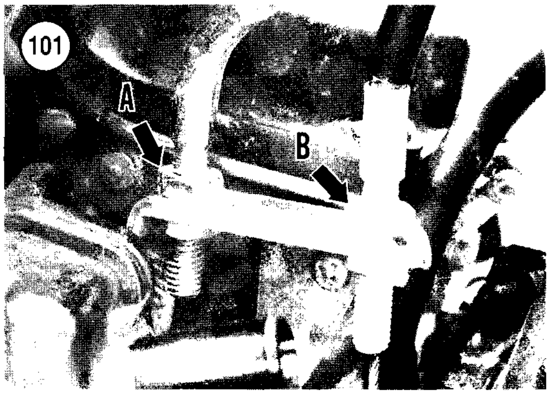
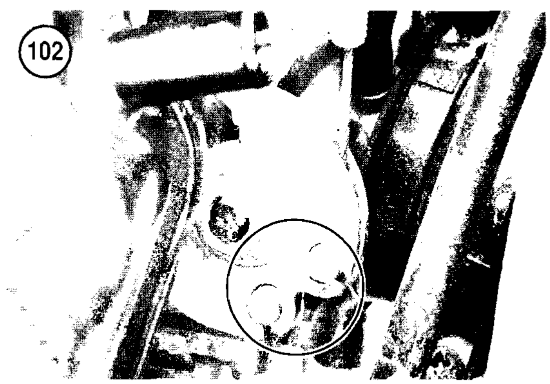
EVAPORATIVE EMISSION CONTROL SYSTEM (CALIFORNIA S AND SM MODELS)







a. Inspect for buildup in the screen filters. If buildup is evident, lightly scrub the screens with a nylon brush and solvent. Carefully blow compressed air through the screen, from the inside to the outside.
b. Inspect and clean buildup from the valve passages.
c. Replace the O-rings.
d. The wave washer must be capable of applying pressure to the outside of the lever. If resistance is not felt when tightening the lever plate screws, the washer is fatigued and must be replaced with a new washer.
e. Inspect the remaining parts for obvious damage.

7. On S models, clean and inspect the diaphragm assembly. Gently wipe the diaphragm. Do not use solvent.
a. Inspect the diaphragm for tears, holes or other damage. The diaphragm must be able to hold vacuum.
b. Inspect the diaphragm vent passage (**Figure 99**). If this vent is clogged, the diaphragm will drag open when vacuum is applied.
c. Inspect the plunger O-ring for wear or damage. The O-ring must seal the bore. If the O-ring is damaged, an exact replacement size must be used. The manufacturer does not provide a part number for this O-ring.
d. Inspect the spring.

8. Assemble the valve. Note the following:
a. Lightly lubricate the O-rings with engine oil.
b. Assemble the O-ring, lever, wave washer and plate, and then install the parts into the valve.

9. Install the fuel valve into the fuel tank and equally tighten the screws.
10. Install the fuel tank (Chapter Fifteen).
11. When filling the tank, start with a small amount of fuel and check for leaks. Operate the lever and check that all positions are leak-free.

EVAPORATIVE EMISSIONS CONTROL SYSTEM (CALIFORNIA S AND SM MODELS)

No adjustments are required for the evaporative emissions control system. Visually inspect the hoses and connections as recommended in Chapter Three. If the system is suspected of causing poor engine performance, or obvious damage has occurred to the system, refer inspection and testing of the separator and canister to a Suzuki dealership. Refer to **Figure 100** for component identification and hose routing.

THROTTLE CABLE REPLACEMENT

The throttle uses two cables. One cable pulls the throttle open during acceleration, while the other ensures the throttle closes during deceleration. In operation, the cables always move in opposite directions. The following procedure is for both Mikuni and Keihin carburetors. Any differences are noted.

1. Remove the fuel tank (Chapter Fifteen).
2. On the Keihin carburetor, remove the cable cover at the carburetor.
3. Remove the throttle cables as follows:
a. Loosen the locknuts on the pull cable (A, **Figure 101**) and return cable (B), and then remove the cables from the holder. On the Keihin carburetor, the pull cable is the upper cable.
b. Turn the throttle valve and remove the cable ends (**Figure 102**).

4. Note how the cables are routed, and then pull the cables from the frame.
5. At the handlebar, remove the screws from the housing and separate the parts.
6. Remove the pull cable (A, **Figure 103**) and return cable (B) from the throttle drum.
7. Clean the throttle assembly and handlebar.
8. Lubricate the cables with an aerosol cable lubricant. Lubricate the throttle drum and cable ends with lithium grease.
9. Install the new cables into their positions on the throttle drum. Install the pull cable (A, **Figure 103**) so the adjuster (**Figure 104**) is at the handlebar.
10. Assemble the throttle housing around the cables and throttle grip.
11. Route the cables through the frame and to the carburetor.
12. Identify and install the cables onto the throttle valve and holder.
13. Grip the cable housings, and then make sure the cables move in the correct direction when the throttle is operated.
14. Adjust the cables as described in Chapter Three.
15. Install the fuel tank when adjustment and proper operation is verified.

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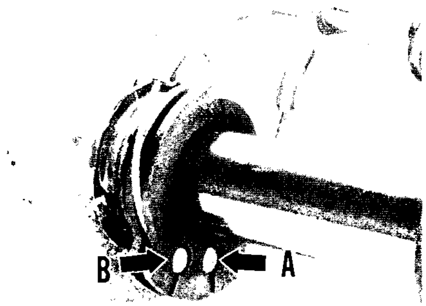

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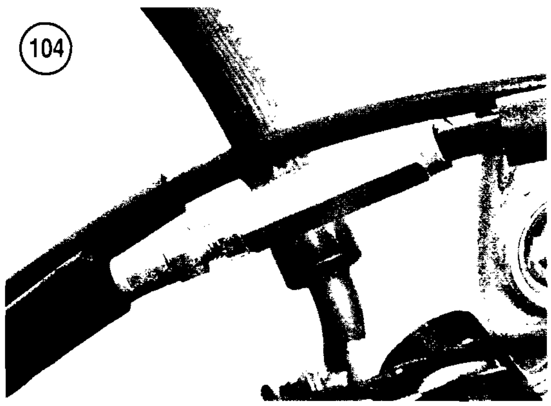

Table 1 CARBURETOR SPECIFICATIONS (MIKUNI)

Carburetor	
Type	Mikuni BSR constant velocity
Bore diameter	36 mm
Identification number	
E models	
2004 California	29F2
S and SM models	
except California	29FB
California	29FC
Float height	12-14 mm (0.47-0.55 in.)
Idle speed	
E models	
2004 California	1500-1700 rpm
S and SM models	1400-1600 rpm
Jet needle number	
E models	
2004 California	5DH36
S and SM models	5DH37
Main jet number	
E models	
2004 California	140
S and SM models	142.5

(continued)

Table 1 CARBURETOR SPECIFICATIONS (MIKUNI) (continued)

Needle jet number	P-OM
Pilot air jet number	
E models	
2004 California	155
S and SM models	135
Pilot jet number	22.5
Pilot mixture screw turns out	
E models	
2004 California	2 1/2
S and SM models	3 1/2
Throttle position switch	
Fully closed resistance	3500-6500 ohms
Fully open resistance	78% of measured fully closed resistance

Table 2 CARBURETOR SPECIFICATIONS (KEIHIN)

Carburetor	
Type	Keihin FCR throttle valve
Bore diameter	39 mm
Identification number	29F4
Air jet number	90
Float height	8-10 mm (0.31-0.40 in.)
Idle speed	1700-1900 rpm
Jet needle number and clip position	OBDXP, fourth position
Main air jet number	200
Main jet number	142
Needle jet size	2.9 (0.11 in.)
Pilot air jet number	60
Pilot jet number	45
Pilot mixture screw turns out	1 1/2
Throttle position switch	
Fully closed resistance	Approximately 5000 ohms
Fully open resistance	3090-4630 ohms

CHAPTER NINE

ELECTRICAL SYSTEM

This chapter provides service procedures for the electrical system components.

Specifications are listed in **Table 1** and **Table 2** at the end of the chapter.

TROUBLESHOOTING

Precautions

1. Do not disconnect electrical connections with the engine running or cranking.
2. Turn off the ignition switch before disconnecting electrical connections.
3. Handle components with care.
4. When performing voltage tests, particularly peak voltage tests, do not hold the electrical cables or harness. An electrical shock could result. High voltage is present in the ignition circuit while the engine is cranking and running.

Electrical Component Replacement

Most motorcycle dealerships and parts suppliers do not accept the return of any electrical part. If the *exact* cause of any electrical system malfunction cannot be determined, have a dealership retest that specific system to verify your test results. If you purchase a new electrical component(s), install it, and then find that the system still does not work properly, you will probably be unable to return the unit for a refund.

Consider any test results carefully before replacing a component that tests only *slightly* out of specification, especially resistance. A number of variables can affect test results dramatically. These include the testing meter's internal circuitry, ambient temperature and conditions under which the machine has been operated. All instructions and specifications have been checked for accuracy; however, successful test results depend to a great degree upon individual accuracy.

Electrical Testing

CAUTION

When performing general continuity/resistance checks, do not turn on the ignition switch. Damage to parts and test equipment could occur. Also

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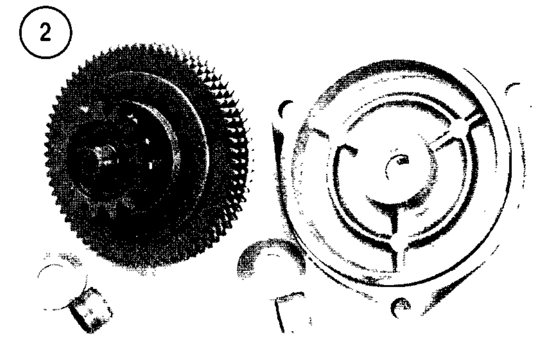

verify that power from the battery is not routed directly into the test circuit, regardless of ignition switch position.

Check components and circuits, including switches and wiring, using an ohmmeter connected at the appropriate location. Tests can be made at the connector plug or at the part itself. Test parts that interact to ensure the problem is isolated. Knowing how the system operates is critical. Use the following procedure as a guide.

1. Refer to the wiring diagram at the back of the manual. Identify the wire colors and determine what components to check. For any check, the circuit should begin at the plug, pass through the part, and then return to the plug.
2. Determine when continuity should exist.
   a. Typically, when a switch or button is turned on, it *closes* the circuit, and the meter should indicate continuity.
   b. When the switch or button is turned off, it *opens* the circuit, and the meter should not indicate continuity.
3. Trace the wires from the part to the nearest connector plug. Separate the connector plug.
4. Connect an ohmmeter to the plug half that leads to the part being checked. If the test is being made at the terminals on the part, remove all other wires connected to the terminals so they do not influence the meter reading.
5. Operate the switch/button and check for continuity.

IGNITION AND CHARGING SYSTEM OPERATION

A permanent magnet alternator is located on the left end of the crankshaft and is the source of energy for powering the ignition system and charging the battery. When the engine is running, the current produced by the signal coil in the alternator goes to the capacitor discharge ignition (CDI) unit and is stored in a capacitor. When the rotor is in the correct position for ignition, the pickup coil signals the CDI unit to release the stored charge to the coil. The charge of current into the coil primary windings induces a much higher voltage in the secondary windings, which fire the spark plug.

The battery is charged by separate coils in the alternator. When the engine is running, the current produced by the coils is sent to the regulator/rectifier. The power is converted to direct current and regulated to the battery. If the battery is fully charged, the excess current is grounded and dissipated as heat by the regulator rectifier.

UPPER IDLE GEAR COVER

The starter drives two idle gears located between the starter and starter clutch. The upper idle gear is accessed at the upper idle gear cover, while the lower idle gear is accessed by removing the alternator cover. The upper idle gear is also the slip torque limiter. If the engine kickbacks (reverse rotation), the limiter will slip, preventing damage to the engine.

Removal, Inspection and Installation

1. Remove the three screws at the perimeter of the cover (**Figure 1**).
2. Remove the cover, gear, washers and bushings (**Figure 2**).
3. Inspect the parts.
   a. Inspect the gear for damage and looseness. Twist the large and small gears and check for

play. If there is any play in the parts, the gear is damaged and must be replaced. A slip torque limiter soeket (part No. 09930-73180) and slip torque limiter holder (part No. 09930-73170) can be used to accurately measure the slip torque of the gear. The holder locks into the outer sprocket teeth and the socket fits over the small sprocket. The gear should slip when 30-55 N•m (22-41 ft.-lb.) are applied.

b. Make sure the snap ring (**Figure 3**) is tight and undamaged.

c. Inspect the cover, washers and bushings for damage.

d. Insert the bushings and gear shaft into the crankcase and cover bores. The shaft should fit firmly with no play.

4. Reverse this procedure to install the parts. Note the following:

a. Lubricate the parts with engine oil.

b. If oil leaks are evident around the cover, install a new O-ring on the cover.

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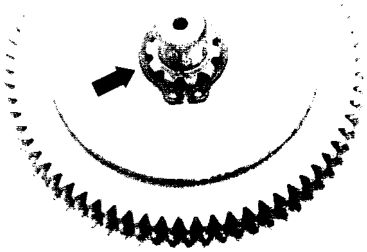

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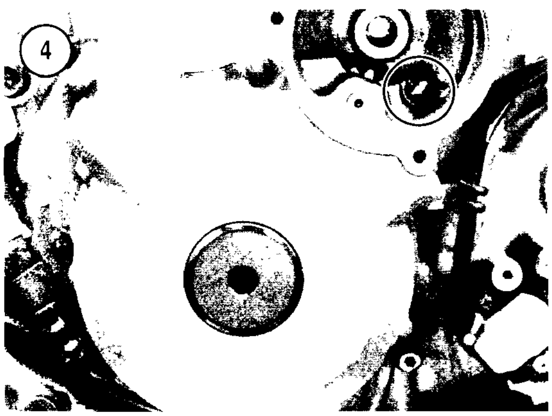

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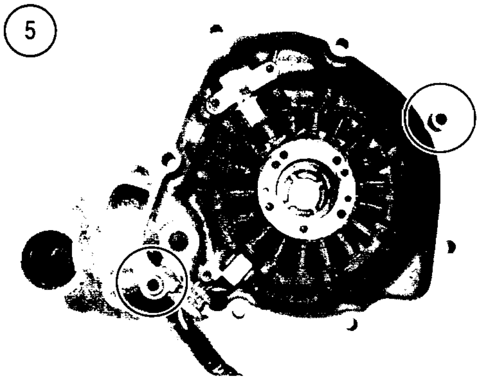

ALTERNATOR COVER

Removal and Installation

The alternator cover must be removed to access the lower idle gear for the starter, rotor and stator assembly. The stator assembly is mounted on the inside of the cover.

1. Drain the engine oil (Chapter Three).
2. Remove the shift lever (Chapter Six).
3. Disconnect the stator leads.
4. Remove the upper idle gear cover and gear as described in this chapter.
5. Remove the eight bolts securing the cover. One of the bolts (**Figure 4**) is located in the upper idle gear cavity. If necessary, disconnect the oil pipe for additional clearance when removing the bottom bolts.
6. Pull the cover away from the engine. Magnetic resistance will be felt as the cover is unseated.
7. Remove the cover gasket and account for the two cover dowels (**Figure 5**). Also account for the washer on the end of the lower idle gear shaft.
8. Remove and/or test the stator assembly as described in this chapter.
9. Reverse this procedure to install the stator and alternator cover. Note the following:

a. Lubricate the gears and lower idle gear shaft with engine oil.

b. Install a new cover gasket.

c. If necessary, apply sealant to the stator lead grommet, and then seat the grommet into the cover.

d. Make sure all wires are routed and secured.

e. Clean electrical connections, and then apply dielectric grease when assembling.

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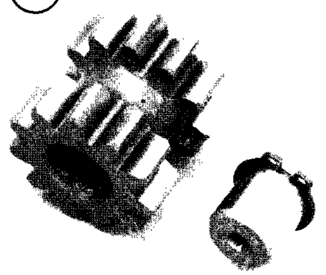

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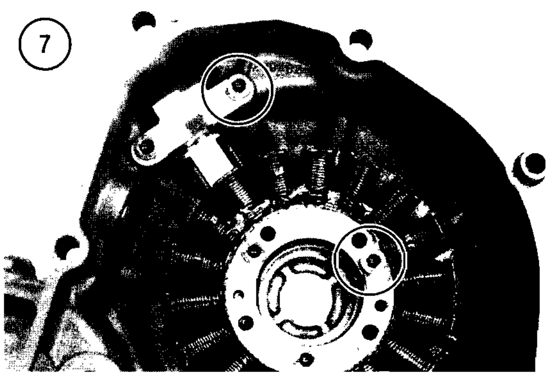

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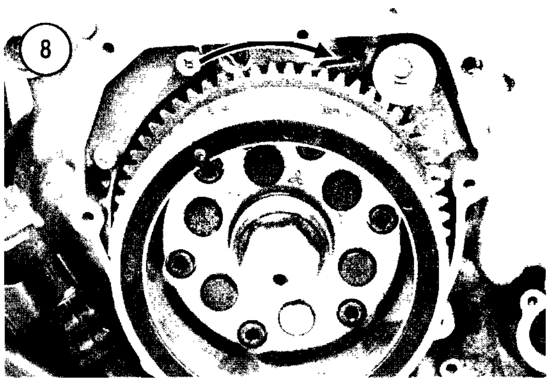

f. Tighten the cover bolts to 10 N•m (7 ft.-lb.). Make several passes and work in a crossing pattern.

LOWER IDLE GEAR

Removal, Inspection and Installation

1. Remove the alternator cover as described in this chapter.
2. Remove the lower idle gear, shaft and washers (**Figure 6**).
3. Inspect the parts.
   a. Assemble the gear and shaft. The parts should operate smoothly with no play.
   b. Insert the shaft into the crankcase and cover bores. The shaft should fit firmly with no play.
   c. Inspect the gear teeth and bore. If the gear is worn, check the condition of the starter gear, upper idle gear and starter clutch gear.
4. Reverse this procedure to install the parts. Lubricate the parts with engine oil.

STATOR ASSEMBLY

Removal and Installation

The stator and pickup coil assembly is mounted on the inside of the alternator cover. The parts can be tested without removing them from the cover at the connectors. Refer to *Charging System* to test the stator charging coil and *Ignition System* to test the signal coil and pickup coil.

1. Remove the alternator cover as described in this chapter.
2. Remove the bolts (**Figure 7**) securing the stator assembly.
3. Remove the wiring harness clamp from the cover.
4. Remove the wire grommet from the cover, and then remove the parts.
5. Reverse this procedure to install the stator assembly. Apply threadlocking compound to the bolt threads when installing the parts in the cover.

ROTOR AND STARTER CLUTCH

The starter clutch is mounted on the back of the rotor. The starter idle gears and rotor must be removed to access the clutch. To remove the rotor, it must be held with a 26-mm offset wrench to remove the nut. The rotor is then removed with a rotor puller. If the right crankcase cover is removed, the primary drive gear nut can be held while the rotor nut is loosened. If troubleshooting the starter clutch, the clutch can be checked for freewheel and lockup without removing the rotor. Turn the clutch gear (**Figure 8**) clockwise (rearward). The clutch gear should turn freely and smoothly in that direction. Turn the gear counterclockwise (forward). The gear should not freewheel. If the gear turns in both directions or is always locked up, disassemble and inspect the clutch assembly.

Removal and Installation

1. Remove the alternator cover and lower idle gear as described in this chapter.
2. Remove the rotor nut as follows:
   a. Hold the rotor stationary with a 26-mm offset wrench. Seat the wrench on the hub (**Figure 9**).
   b. Remove the rotor nut and washer.
3. Loosen the rotor and starter clutch as follows:
   a. To aid in removal, spray penetrating lubricant into the rotor bore and Woodruff key area. Apply grease to the end and threads of the rotor puller.
   b. Install the rotor nut so it is flush with the end of the shaft (**Figure 10**). This increases the area for the puller bolt to seat against.
   c. Thread the outer part of the puller onto the rotor threads.
   d. Thread the bolt into the puller and against the end of the crankshaft.
   e. Hold the puller with a wrench (**Figure 11**) and tighten the bolt to remove the rotor. Use wrenches that provide high leverage.
   f. When the rotor unseats, remove the puller and nut.
4. Remove the rotor, clutch gear and Woodruff key from the crankshaft (**Figure 12**).
5. Inspect and lubricate the parts as described in this section.
6. Reverse this procedure to install the rotor and starter clutch assembly. Note the following:
   a. Lubricate the clutch bearing and sprags with engine oil.
   b. Tighten the rotor nut to 100 N•m (74 ft.-lb.).

Inspection

1. Clean, lubricate and inspect the clutch assembly (**Figure 13**).
2. Inspect the clutch for proper operation as follows:
   a. Insert the clutch gear into the rotor. Turn the gear counterclockwise and twist it squarely into the rotor.
   b. With the clutch gear facing up, turn the gear counterclockwise. The gear should turn

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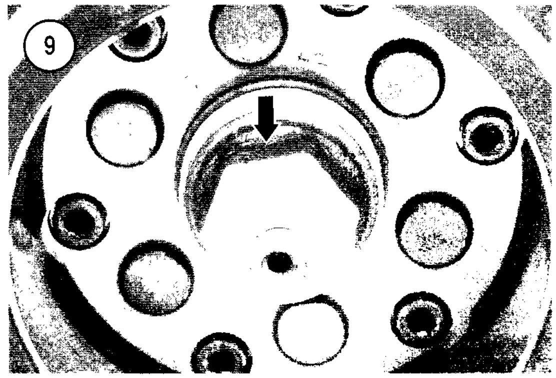

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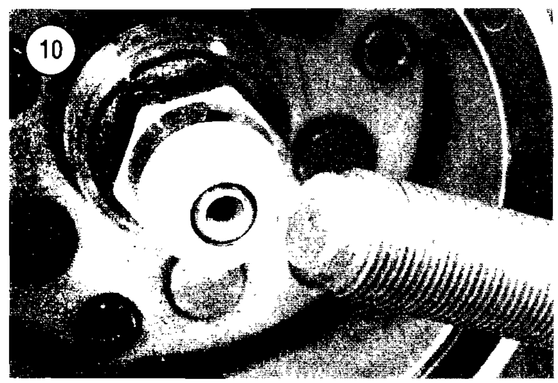

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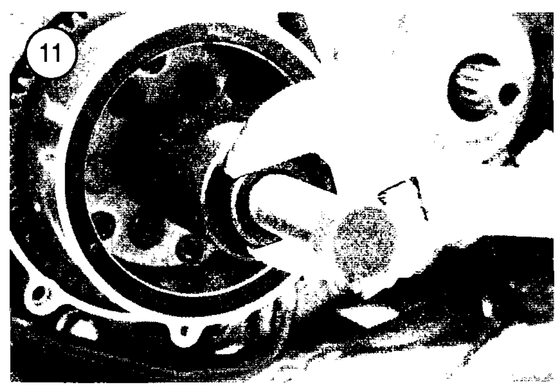

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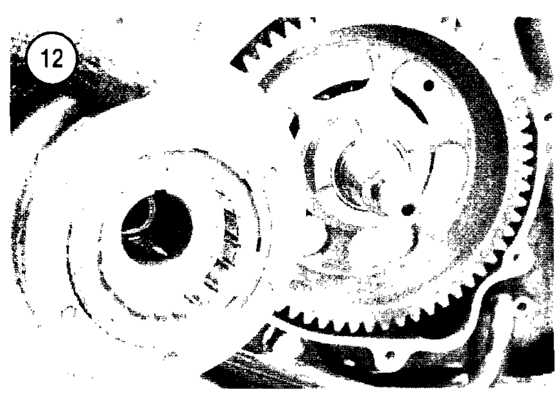

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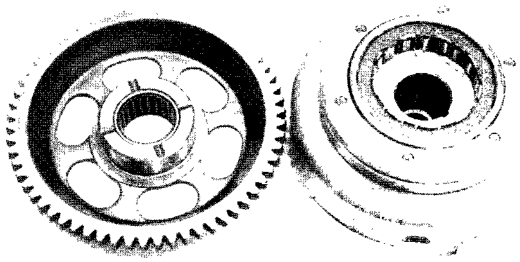

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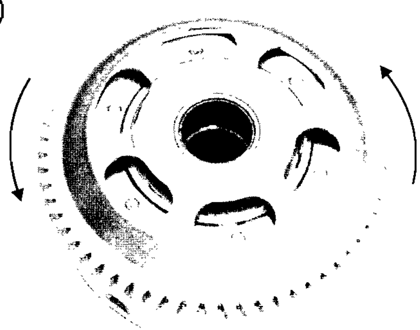

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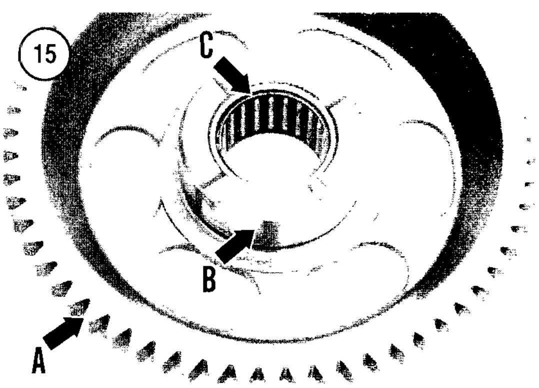

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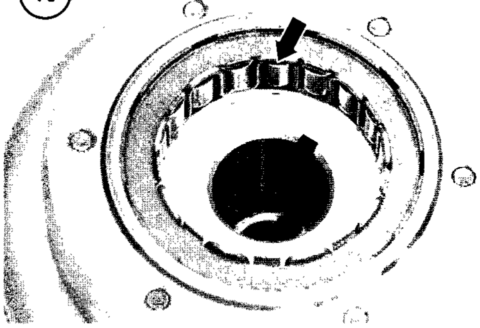

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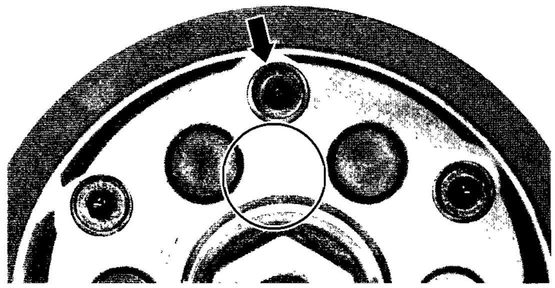


freely and smoothly in that direction (**Figure 14**).

c. Turn the gear clockwise. The gear should not turn.

d. If the gear turns in both directions or is always locked up, disassemble and inspect the clutch assembly.

3. Remove the clutch gear from the rotor. Turn the gear counterclockwise and twist it squarely away from the rotor.

4. Inspect the clutch gear (**Figure 15**).

a. Inspect the gear teeth (A) and sprag contact area (B) for wear or damage.

b. Inspect the bearing (C) for damage. Fit the gear onto the crankshaft and check for play or roughness.

5. Inspect the clutch sprags in the rotor (**Figure 16**). The sprags should be undamaged and operate smoothly.

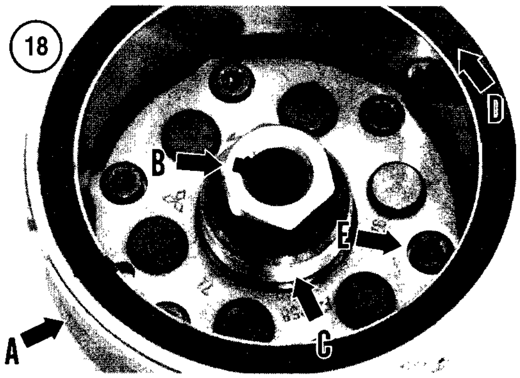
NOTE

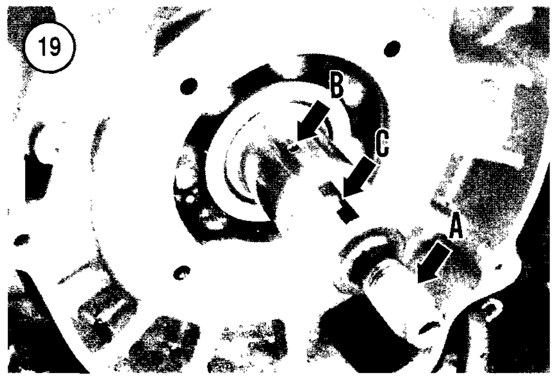
The starter clutch sprags can be damaged if the engine kicks back, during engine startup. The reversed crankshaft direction puts a high load on the sprags. To minimize potential damage, keep the starter button engaged until the engine is definitely started.

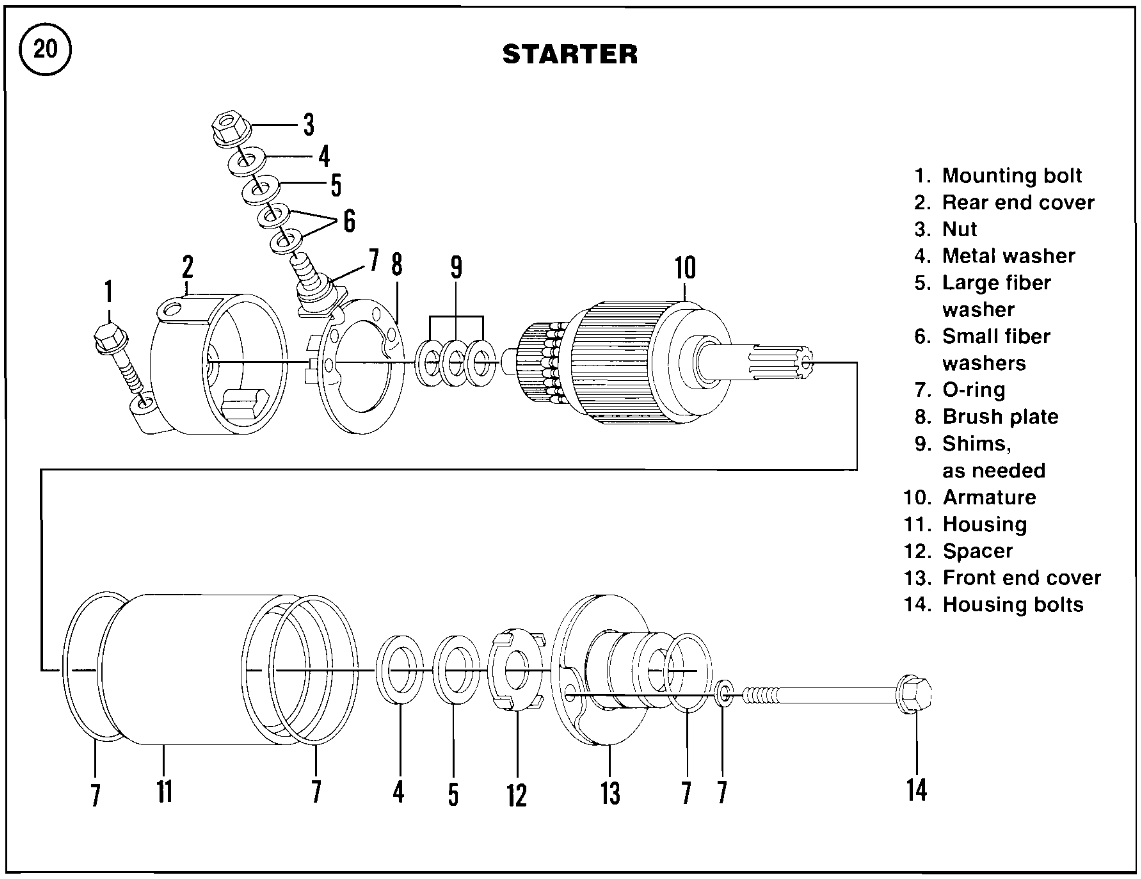
6. If the clutch sprags are damaged, remove the clutch from the rotor as follows:

a. Remove the bolts (**Figure 17**), and then remove the clutch assembly from the rotor. Use a 26-mm offset wrench to hold the rotor hub while loosening the bolts.

b. Install the new clutch assembly. The back of the clutch has a notch on its outer edge. This side of the clutch must face toward the rotor.







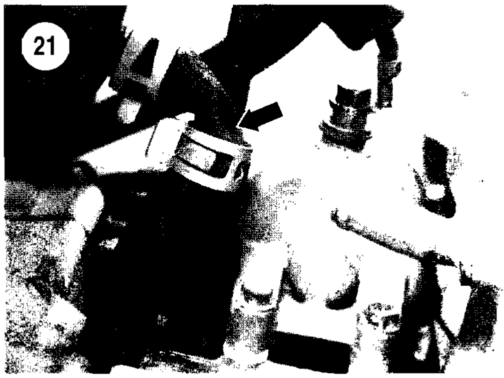
c. Apply threadlocking compound to the bolts, and then tighten the bolts in several passes, working in a crossing pattern. Tighten the bolts to 26 N•m (19 ft.-lb.).

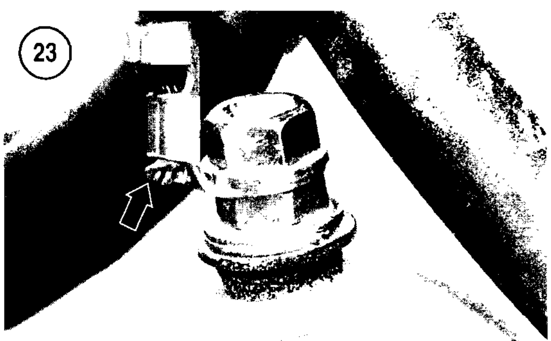
d. Insert the clutch gear into the rotor and check for correct installation. The rotor should turn freely in the direction of the arrow stamped on the rotor (**Figure 17**).

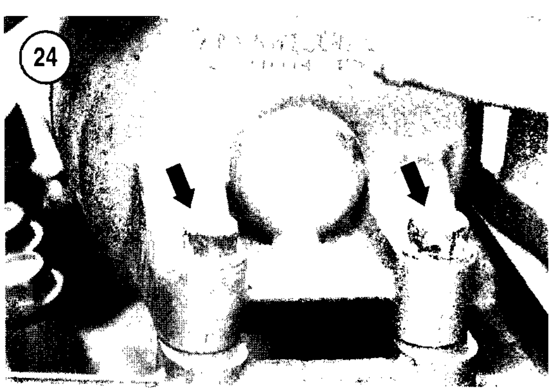
e. Lubricate the clutch sprags with engine oil.

WARNING
The rotor must be replaced if it is damaged. The rotor can break apart at high crankshaft speeds, causing injury and damage to the engine.

7. Clean and inspect the rotor (**Figure 18**).
   a. Inspect the rotor for cracks and damage (A).
   b. Inspect the bore, keyway (B) and threads (C) for damage.







c. Inspect the magnetic strip (D) on the outside of the rotor. It must not be loose or missing.
d. Check that all clutch bolts are tight (E).

8. Inspect the crankshaft (**Figure 19**).
   a. Inspect the crankshaft for scoring or other damage.
   b. Inspect the shaft threads (A) and rotor nut for damage.
   c. Inspect the oil hole (B) for cleanliness.
   d. Inspect the keyway (C) and Woodruff key. If the Woodruff key is bent or sheared, the rotor will not be properly aligned on the crankshaft, causing the engine to be out of time.
9. Install the parts as described in this section.

STARTER

Removal and Installation

Refer to **Figure 20**.

1. Disconnect the ground (negative) cable from the battery.
2. Remove the muffler (Chapter Four).
3. Disconnect the oil return tank hose (**Figure 21**).
4. Remove the clutch cable and holder (**Figure 22**). Loosen the cable at the handlebar so the cable can be removed from the release lever at the engine.
5. Disconnect the positive cable (**Figure 23**) from the starter.
6. Remove the mounting bolts (**Figure 24**), and then pull and twist the starter out of the alternator cover. The starter is sealed to the cover by an O-ring, which causes resistance during removal. If necessary, use a block of wood and a mallet to tap the starter free.
7. Disassemble, inspect and test the starter as described in this section.
8. Reverse this procedure to install the starter. Note the following:
   a. Lubricate the O-ring on the starter end cover with engine oil before inserting it into the alternator cover. If necessary, the starter can be seated in the cover using a block of wood and a mallet. Place the wood squarely against the back of the starter and tap it into place.
   b. Check that the fiber washers on the cable post are in good condition. The washers must insulate the cable from the starter housing.

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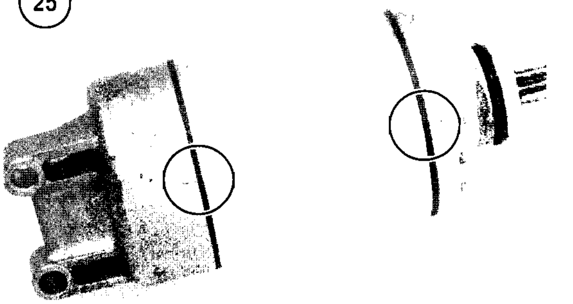

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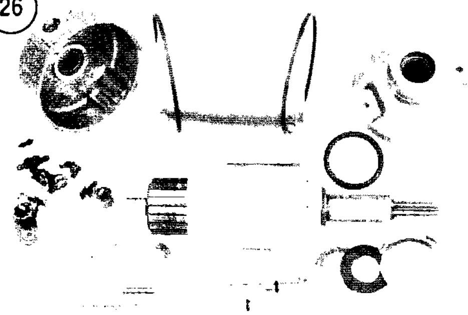

c. Clean all cable connections, then apply dielectric grease to the fittings and connectors before tightening.
d. Adjust the clutch (Chapter Three).

Disassembly and Assembly

NOTE
If disassembling the starter to check brush condition, remove only the rear end cover. The brushes can be inspected and the cover reinstalled if further disassembly is not required.

Refer to **Figure 20**.

1. Note the alignment marks on the starter housing and end covers (**Figure 25**). Mark the rear end of the housing so it can be installed in its original position. The rear end of the housing is notched to accept the brush plate.
2. Remove the two housing bolts and disassemble the starter (**Figure 26**).
3. Inspect and test the components as described in this section.
4. Assemble the starter as follows:
   a. Align and install the positive brushes and terminal into the rear end cover. The square insulator must be seated in the hole. Seat a new O-ring around the terminal (**Figure 27**). Install the washers and lower nut on the terminal. The terminal must be completely insulated from the end cover to prevent shorting.
   b. Install the armature into the housing. The commutator should be located at the notched end of the housing (**Figure 28**). Lightly lubricate the ends of the armature shaft with waterproof grease.

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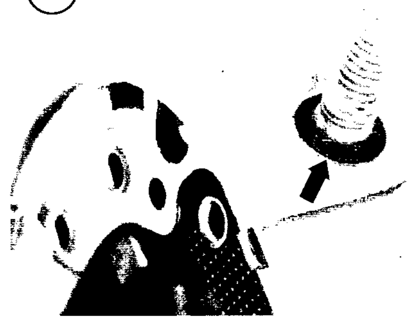

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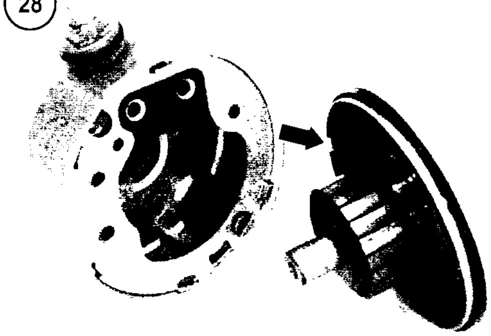

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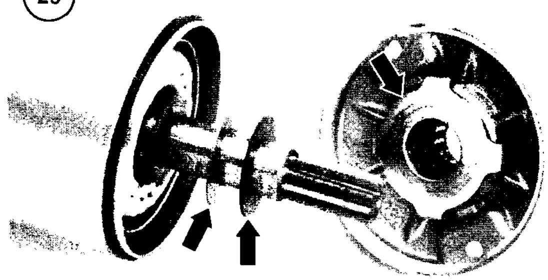

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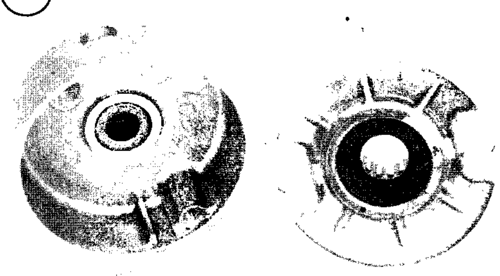

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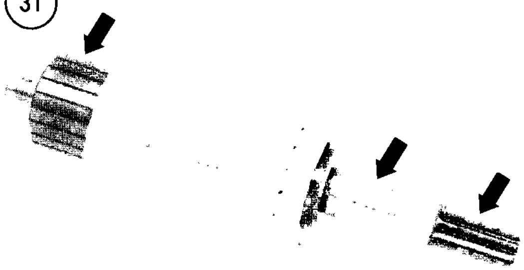

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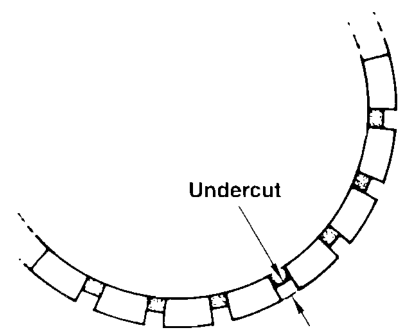

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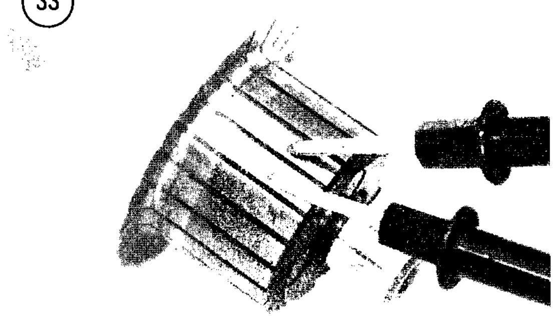

c. Install the shim(s) at the rear end of the armature shaft.

d. Spread the brushes and seat the rear end cover onto the armature and housing.

e. Install the washers on the armature and the spacer in the front end cover (**Figure 29**).

f. Install the front end cover.

g. Align the bolt holes and check the alignment marks (**Figure 25**).

h. Apply threadlocking compound to the housing bolt threads, and then install the bolts.

i. Perform an operational test as described in this section.

j. Install the starter as described in this section.

Inspection and Tests

Use an ohmmeter for all electrical tests in this procedure. If the result for any test is incorrect, the part is either shorted, or there is an open circuit between the test points. Replace or recondition parts that are worn or damaged. Refer to **Figure 20**.

1. Clean the parts as required. Use a solvent specifically for electric components to remove buildup and contamination, particularly between the commutator bars.

2. Inspect the condition of the housing and end covers (**Figure 30**).
   a. The armature should fit in the covers with little or no play.
   b. Inspect the condition of the bushing, bearing and seal. Lubricate the parts with waterproof grease. Remove excess grease that could migrate to the armature, commutator or brush assembly.

3. Inspect and test the commutator and armature (**Figure 31**).
   a. Inspect the bar height. The commutator bars should be taller than the insulation between the bars (**Figure 32**).
   b. Inspect the bars for discoloration. If a pair of bars is discolored, this indicates grounded armature coils.
   c. Inspect the bars for scoring. Mild scoring can be repaired with a fine emery cloth.
   d. Check for continuity across all adjacent pairs of commutator bars (**Figure 33**). Continuity should be across all pairs of bars.

   e. Check for continuity between each commutator bar and the armature shaft (**Figure 34**). There should be no continuity.
   f. Inspect the armature shaft and drive splines for scoring, wear and other damage. If the splines are worn, check the condition of the idle gears, located in the upper idle gear cover and alternator cover.
4. Inspect the brush plate assembly (**Figure 35**).
   a. Inspect the condition of the brush springs (A). If rusted or broken, replace the brush plate.
   b. Inspect the length of each brush (B). Replace the brushes if they are chipped, rough or when they are no longer secure in the brush housing.
5. Inspect the spacer, shims, washers and insulator for damage.
6. Lubricate new O-rings with engine oil before installing them on the housing, front end cover and bolts (**Figure 36**).
7. Assemble the starter as described in this section.

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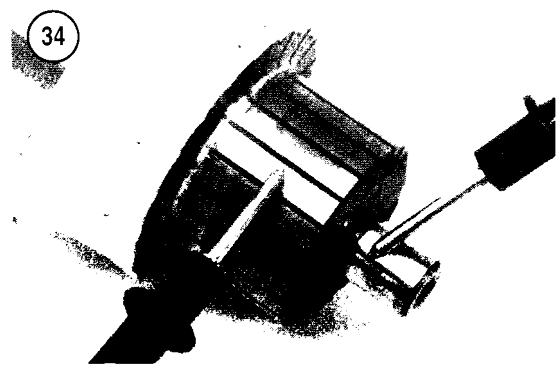

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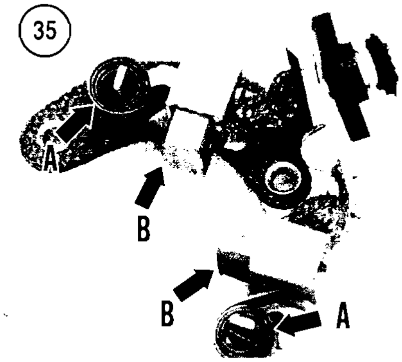

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Operational Test

The starter can be tested installed on the engine.

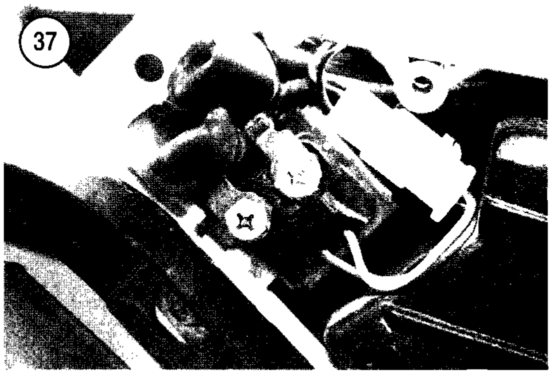
WARNING
When connecting a battery to the starter, use jumper cables to make the connections. Light gauge wire burns. Because sparks will likely occur when the test connection is made, make the check away from all flammable sources.

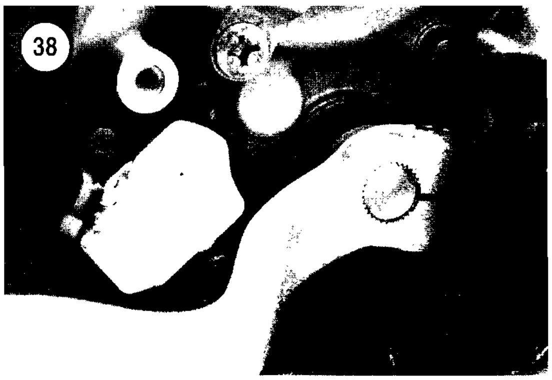
1. Shift the transmission into neutral if the starter is installed.
2. Disconnect the positive cable from the starter (**Figure 23**).
3. Connect the negative cable from a 12-volt battery to the starter mount.
4. Quickly touch and remove the positive battery cable to the positive terminal on the starter.
   a. If the starter turns, it is in good condition. Check the starter relay and cables for damage.
   b. If the starter does not turn and is not installed, it is faulty.
   c. If the starter does not turn and is installed, remove it and repeat the test. If the starter works after it is removed, check for possible jamming of the starter idle gears or starter clutch.

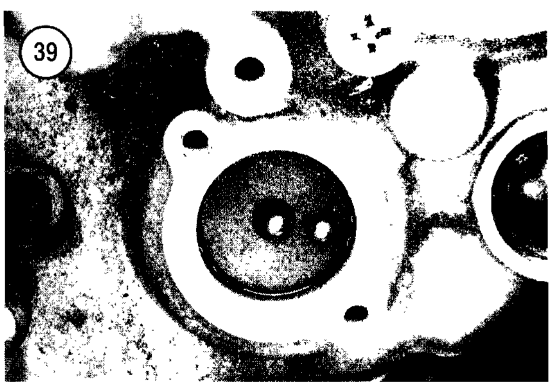
STARTING SYSTEM SWITCHES

The starting system switches include the starter relay, ignition switch, engine stop switch, starter button and clutch switch. On S models, the neutral switch, side stand switch and turn signal side stand relay are also part of the starting system. Refer to the wiring diagram at the back of the manual to identify wire colors and connectors.

Switches and relays that require a specific test procedure or special equipment, are in this section. For the remaining starting system switches, refer to







Troubleshooting in this chapter. Refer to **Table 1** at the end of this chapter for specifications.

Starter Relay Test

The starter relay (**Figure 37**) is located under the right side cover. The starter relay connects the battery to the starter. The relay is designed to temporarily carry the high electrical load during startup. The relay is activated when the starter button is pressed. All other switches in the starting system must also be in the closed position.

1. At the battery, disconnect the negative cable.
2. At the relay, disconnect the two cables and wire connector.
3. Remove the starter relay from the motorcycle.
4. Perform the relay coil resistance test as follows:
   a. Connect an ohmmeter to the terminals in the wire connector.
   b. Refer to **Table 1** for specifications. Replace the relay if it is not within specifications.
5. Perform the relay operational test as follows:
   a. Connect an ohmmeter to the cable terminals on the relay.
   b. Connect a fully charged, 12-volt battery to the relay wire connector. Connect the positive lead to the terminal for the red/white wire.
   c. Observe the meter, and touch the negative battery lead to the terminal for the black/white wire. The relay should *click* when voltage is applied. Do not apply voltage to the relay for more than 5 seconds at a time. The relay coil can overheat and become damaged.
   d. If the meter indicates continuity, the relay is in good condition. Check the starter, cables and other starting system switches for damage.
   e. If the meter does not indicate continuity, the relay is faulty.

Neutral Switch Test (S and SM Models)

1. The neutral switch connector is located under the seat. Locate and separate the connector.
2. Identify the connector half that leads to the neutral switch (**Figure 38**).
3. Shift the transmission into neutral.
4. Connect an ohmmeter to the blue and black/white wires.
   a. The meter should indicate continuity when the transmission is in neutral.
   b. Shift the transmission into gear. The meter should not indicate continuity.
   c. If the meter has the same reading when the transmission is in neutral or in gear, remove the switch and inspect the contacts on the end of the shift drum (**Figure 39**). The contacts are spring-loaded and must be free to fully extend against the switch. If the contacts are in good condition, replace the switch.

Side Stand Switch Test (S and SM Models)

The Suzuki multi-circuit tester (part No. 09900-25008, or an equivalent tester) is required for this test.

1. The side stand switch connector is located under the seat. Locate and separate the connector.
2. Identify the connector half that leads to the side stand switch. The switch is located by the side stand.
3. Connect the positive meter lead to the green wire terminal and the negative meter lead to the black/white wire.
4. Set the tester to the diode setting.
5. Measure the voltage with the side stand up and down.
6. Refer to **Table 1** for specifications.

Turn Signal/Side Stand Relay Test (S and SM Models)

A 12-volt battery and the Suzuki multi-circuit tester (part No. 09900-25008, or an equivalent tester) is required for this test. Refer to **Figure 40**.

1. The relay is located behind the headlight (**Figure 41**). To test the relay, remove it from the motorcycle.
2. Perform the relay continuity test as follows:
   a. Connect a 12-volt battery to terminals 3 and 4. Connect the negative battery lead to terminal 3.
   b. Set the tester to the continuity setting.
   c. Check for continuity between terminals 4 and 5. Replace the relay if there is no continuity.
   d. Disconnect the 12-volt battery.
3. Perform the relay voltage test as follows:
   a. Set the tester to the diode setting.
   b. Measure the voltage between terminal 1 and terminals 2 and 3. Connect the positive meter lead to terminal 1. Touch the negative meter lead to terminal 2, and then terminal 3. The voltage should be 1.4-1.5 volts at both check points.
   c. Measure the voltage between terminals 2 and 3 and terminal 1. Connect the negative meter lead to terminal 1. Touch the positive meter lead to terminal 2, and then terminal 3. The voltage should be 0.4-0.6 volts at both check points. Replace the relay if it fails any of the voltage checks.

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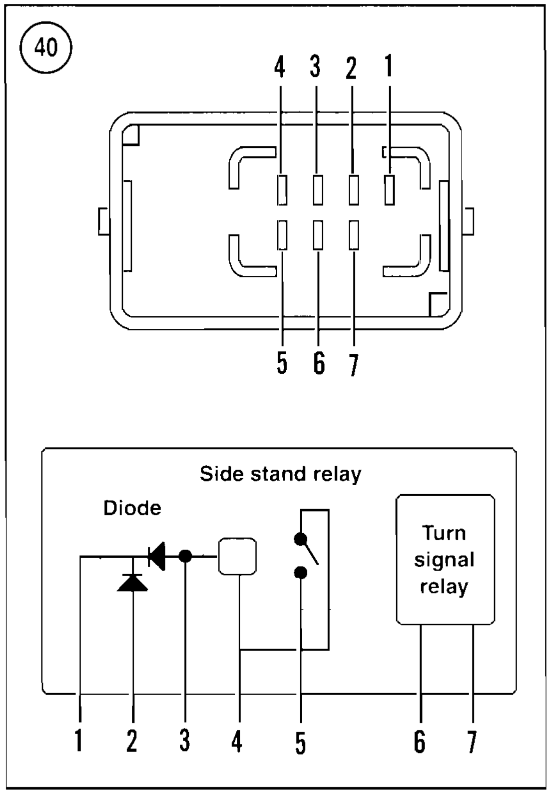

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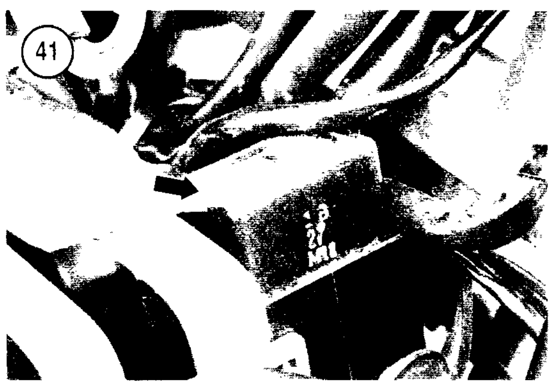

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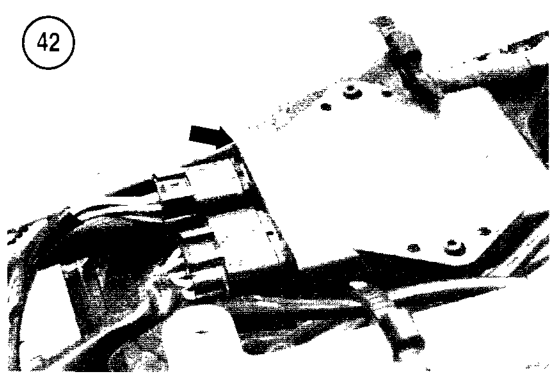

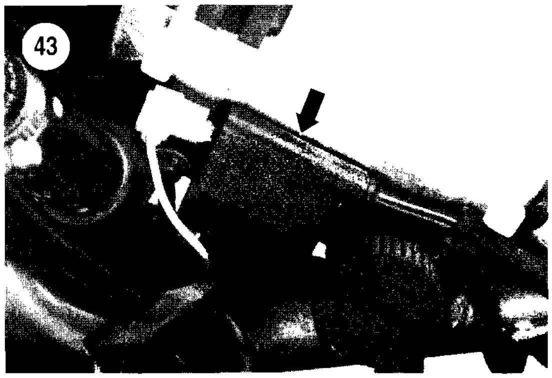

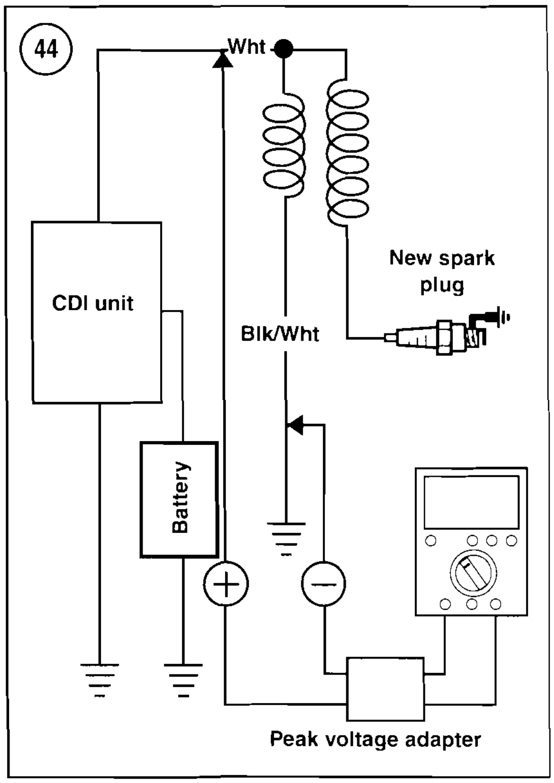

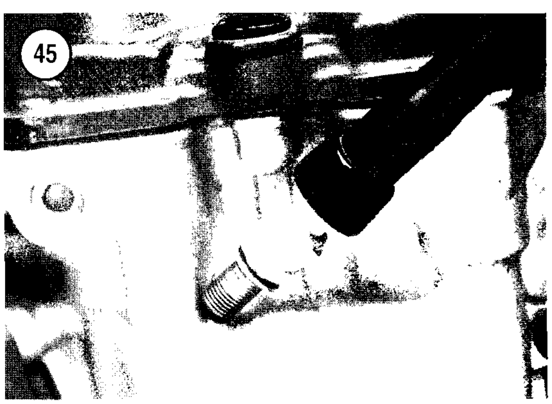

IGNITION SYSTEM

Because some components have a function in the starting and/or charging system, refer to those sections if the component is not found in this section.

Before checking in the ignition system, verify the condition of the battery, fuse, ignition switch and engine stop switch. Test switches as described in *Troubleshooting* in this chapter.

CDI Unit

No specifications are available for testing the CDI unit (**Figure 42**). If the voltage measured in the *Ignition Coil Primary Peak-Voltage Test* is out of specification, the manufacturer recommends replacing the CDI unit. The CDI unit is located under the seat.

Ignition Coil Primary Peak-Voltage Test

The ignition coil (**Figure 43**) is located under the fuel tank. The Suzuki multi-circuit tester (part No. 09900-25008) and peak voltage adapter, or an equivalent tester and adapter, are required for this test. Refer to **Figure 44**.

CAUTION
Do not ground the spark plug on the alloy cylinder head cover. The cover is coated and is a poor ground.

1. Connect a new spark plug to the spark plug cap and securely ground the plug against the cylinder head (**Figure 45**).
2. Connect the positive meter lead to the coil terminal for the white wire. The wire and lead must both be in contact with the terminal when the test is performed.
3. Connect the negative meter lead to ground.
4. Set the tester to the voltage setting.
5. Shift the transmission into neutral and crank the engine. Allow the engine to crank for a few seconds, and then note the voltage reading. Repeat this step several times to determine the highest voltage measured.
6. Refer to **Table 1** for specifications. If the voltage is below the specification, the CDI unit output is too low. Replace the CDI unit.

Ignition Coil Resistance Tests

The ignition coil (**Figure 43**) is located under the fuel tank. Refer to **Figure 46**.

1. Remove the spark plug cap from the spark plug.
2. Disconnect the white wire at the coil.
3. Remove the spark plug cap from the plug.
4. Measure primary coil resistance as follows:
   a. Connect one meter lead to the white wire terminal on the coil and the other meter lead to the coil base, or ground.
   b. Measure the resistance. Refer to **Table 1** for specifications.
5. Measure secondary coil resistance as follows:
   a. Connect one meter lead to the white wire terminal on the coil and the other meter lead to the spark plug cap.
   b. Measure the resistance. Refer to **Table 1** for specifications.

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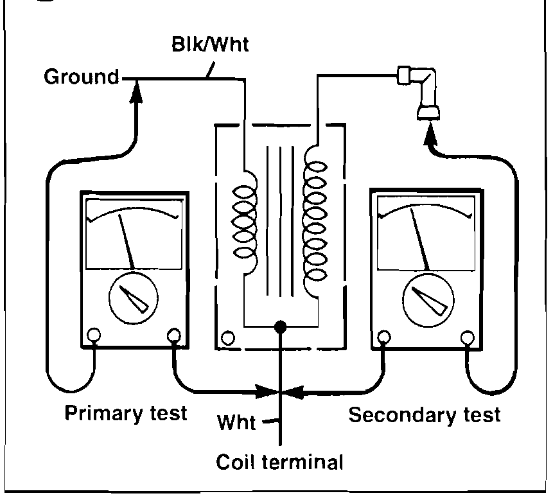

Pickup Coil and Signal Coil Peak-Voltage Test

The pickup coil and signal coil connector (**Figure 47**) is plugged into the CDI unit, located under the seat. The Suzuki multi-circuit tester (part No. 09900-25008) and peak voltage adapter, or an equivalent tester and adapter, are required for this test.

1. Remove the plug from the CDI unit.
2. Perform the pickup coil voltage test as follows:
   a. Connect the positive meter lead to the blue wire and the negative meter lead to the green wire (**Figure 48**).
   b. Set the tester to the voltage setting.
   c. Shift the transmission into neutral and crank the engine. Allow the engine to crank for a few seconds, and then note the voltage reading. Repeat this step several times to determine the highest voltage measured.
   d. Refer to **Table 1** for specifications.
3. Perform the signal coil voltage test as follows:
   a. Connect the positive meter lead to the black wire and the negative meter lead to the white wire (**Figure 49**).
   b. Set the tester to the voltage setting.
   c. Shift the transmission into neutral and crank the engine. Allow the engine to crank for a few seconds, and then note the voltage reading. Repeat this step several times to determine the highest voltage measured.
   d. Refer to **Table 1** for specifications.

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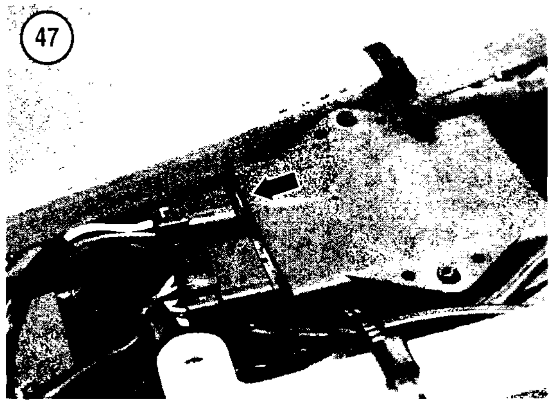

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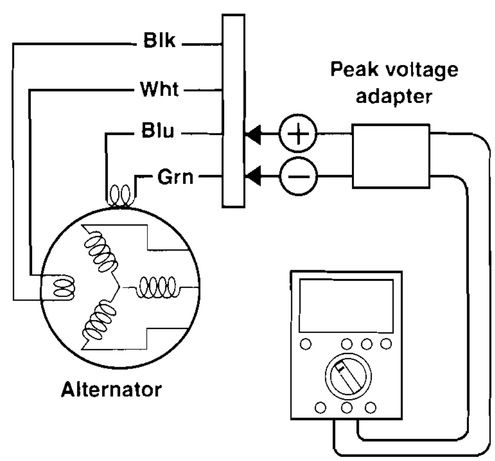

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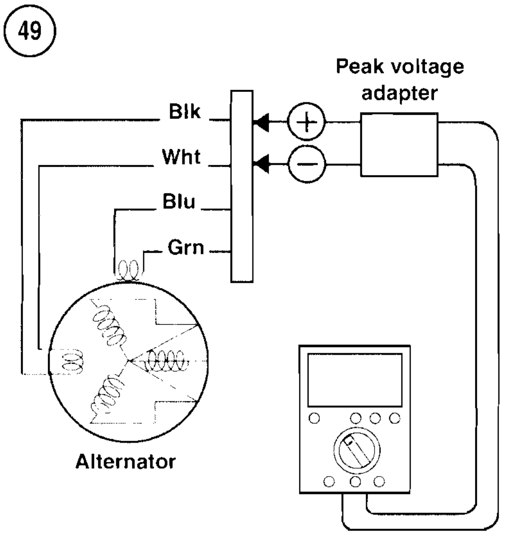

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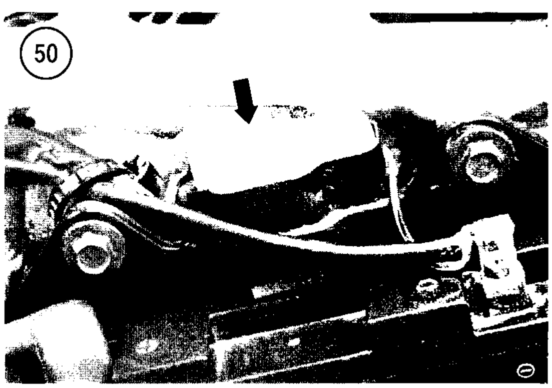


4. If either voltage is out of specification, check the resistance of both coils for additional verification that the parts are damaged. If the parts are damaged, the complete stator assembly must be replaced.

Pickup Coil and Signal Coil Resistance Test

The pickup coil and signal coil connector (**Figure 47**) are plugged into the CDI unit, located under the seat.

1. Remove the plug from the CDI unit.
2. Measure pickup coil resistance as follows:
   a. Connect one meter lead to the blue wire terminal and the other meter lead to the green wire terminal.
   b. Measure the resistance. Refer to **Table 1** for specifications.
3. Measure signal coil resistance as follows:
   a. Connect one meter lead to the black wire terminal and the other meter lead to the white wire terminal.
   b. Measure the resistance. Refer to **Table 1** for specifications.

Ignition Timing

The ignition timing is not adjustable. The rotor is marked for top dead center only. Advance timing is not indicated.

CHARGING SYSTEM

Fuse Holder

The fuse holder is located on top of the battery (**Figure 50**). Use an ohmmeter to check the fuse for continuity. Even though a fuse may appear to be in good condition, a fine break in the fuse element is not always visually detected. A fine break in the element can also indicate continuity when tested cold, and then break continuity when it is under load and heated in the circuit.

Battery Replacement and Charging

Refer to Chapter Three for battery replacement and charging.

Battery Voltage Test (Unloaded)

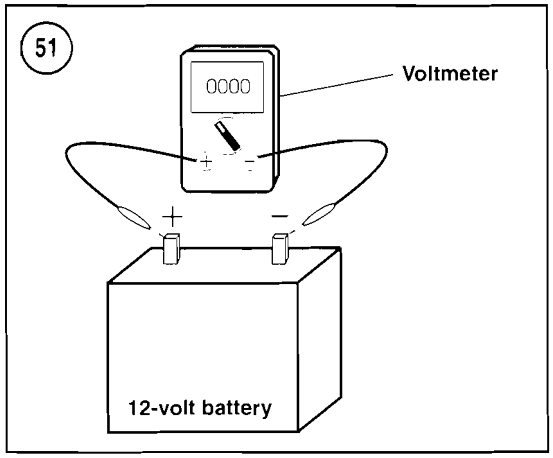
For a maintenance-free battery (original equipment), use a voltmenter to check the unloaded voltage. An unloaded test indicates the basic state of charge.

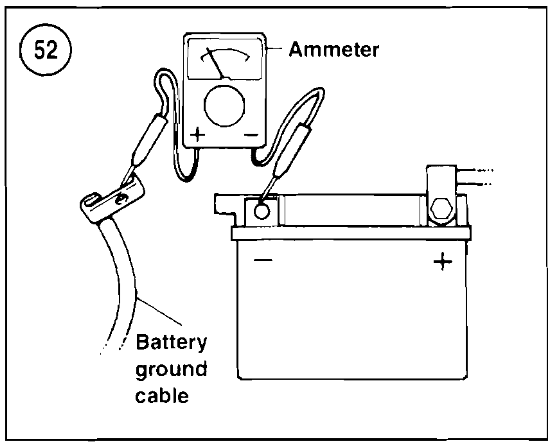
1. Disconnect the battery cables and allow the battery to remain undisturbed for at least 4 hours.
2. Unplug the headlight.
3. Connect a voltmeter to the negative and positive terminals (**Figure 51**).
4. Measure the voltage.
   a. A fully charged battery registers 12.8-13.0 volts.
   b. A battery that is approximately 75 percent charged has a minimum of 12.5 volts.
   c. A battery that is approximately 50 percent charged has a minimum of 12.0 volts.
5. If battery charging or replacement is required, refer to the procedures in Chapter Three.

Battery Voltage Test (Loaded)

For a maintenance-free battery (original equipment), use a voltmenter to check the loaded voltage. A load test requires the battery to discharge current. A load test indicates whether the battery is adequate to operate the machine.

1. Connect a voltmeter to the negative and positive terminals (**Figure 51**).
2. Turn on the headlight to the high beam.
3. Measure the voltage.
   a. A battery in good condition has a minimum of 11.5 volts.
   b. If battery charging or replacement is required, refer to the procedures in Chapter Three.





Battery Current Draw Test

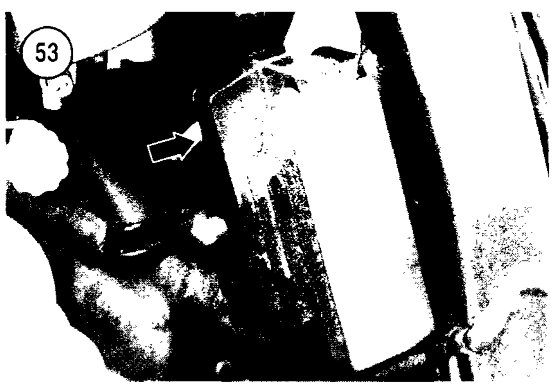
If the battery is known to be in good condition, but it discharges at a rapid rate when the machine is not used, check the electrical system for a current draw. A short in a wire or component in the electrical system can allow the battery to discharge to ground. Accumulations of dirt and moisture can also create a path to ground. It is normal for accessories, such as clocks, to draw current when the machine is turned off.

To isolate a current draw, an ammeter is connected to the battery (**Figure 52**). The meter is observed while disconnecting the wire connectors leading to components and circuits. When the meter stops indicating current flow, inspect and test the component/circuit that affects the meter.

1. Remove the bodywork so all connectors and components can be accessed.
2. Turn the ignition switch off.
3. Disconnect the negative battery cable.
4. Check that the battery is fully charged.

CAUTION
Before connecting the ammeter in the next step, set the range selector to its highest setting. If there is an excessive amount of current flow, the meter could be damaged.

5. Connect the ammeter to the negative battery cable and terminal as shown in **Figure 52**.
   a. The meter should indicate a current draw of 0-1 mA.
   b. If current draw is indicated, continue the test.



6. Check the connectors.
   a. Refer to the appropriate wiring diagram at the back of the manual for circuits isolation.
   b. Separate the individual connectors of the appropriate parts. Work one connector at a time, disconnecting and connecting the connectors until the meter indicates no current draw.

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REGULATOR/RECTIFIER TEST

Volts

- Probe of tester to:	+ Probe of tester to: R	Y1	Y2	Y3	B/W
R		0.4 ~ 0.7	0.4 ~ 0.7	0.4 ~ 0.7	0.5 ~ 0.8
Y1	Approx. 1.5		Approx. 1.5	Approx. 1.5	0.4 ~ 0.7
Y2	Approx. 1.5	Approx. 1.5		Approx. 1.5	0.4 ~ 0.7
Y3	Approx. 1.5	Approx. 1.5	Approx. 1.5		0.4 ~ 0.7
B/W	Approx. 1.5	Approx. 1.5	Approx. 1.5	Approx. 1.5	

R: Red, Y: Yellow, B/W: Black.White

When this occurs, the faulty circuit has been isolated.

Regulator/Rectifier Output Voltage Test

The regulator/rectifier (**Figure 53**) is located on the left side of the frame. The regulator rectifier converts the alternating current, produced by the alternator, into direct current to charge the battery and power the electrical system. The unit also regulates the charging voltage to the battery. Excess voltage is grounded and dissipated as heat by the regulator.

The following test checks regulator/rectifier output voltage for charging the battery. The battery must be in good condition and charged before performing the test.

1. Start the engine and allow it to reach operating temperature, and then turn off the engine.
2. Check the regulator/rectifier output voltage as follows:
   a. Set a voltmeter to DC volts.
   b. Connect the voltmeter to the negative and positive battery terminals (**Figure 51**).
   c. Start the engine and momentarily raise the engine speed to 5000 rpm.
   d. The meter should indicate 13.5-15.0 volts (unloaded) when the engine speed is raised.
   e. If the output voltage is significantly higher than 15 volts, the regulator/rectifier may not be adequately grounded or is faulty. If the output voltage does not rise with engine speed, the regulator/rectifier or stator coils are faulty. Before replacing parts, check the condition of the stator charging coils, wiring harness and battery.

Regulator/Rectifier Circuit Voltage Test

The regulator/rectifier connectors are located behind the front left side cover.

1. Locate and separate the connector containing three yellow wires and the connector containing a red and black/white wire. A multi-circuit tester (Suzuki part No. 09900-25008 or an equivalent tester) is required for this test.
2. Identify the connector halves that lead to the regulator/rectifier (**Figure 53**).
3. Connect the positive meter leads to the wires shown in **Figure 54**.
4. Set the tester to the diode setting.
5. Measure the voltage between pairs of wire terminals as shown in **Figure 54**.
6. If the voltage is out of specification for any measurement, the regulator/rectifier is damaged.

Stator Charging Coil Resistance Test

The stator coils are located in the alternator cover.

1. Locate and separate the connector containing three yellow wires. The connector is located behind

the front left side cover. Use an ohmmeter to perform the test.

2. Identify the connector half that leads to the alternator cover.
3. Measure the resistance as follows:
   a. Refer to **Table 1** for specifications.
   b. Insert the meter leads into the terminals of the yellow wires. Check all three combinations of the yellow wires (**Figure 55**). The resistance between all pairs of yellow wires should be within the specifications.
   c. If the charging coils are not within specifications, check the wiring harness for damage and shorting.
   d. If necessary, remove the alternator cover and recheck the wiring harness and coils (**Figure 56**). Individually check the full length of the harness wires for continuity. There should be near zero resistance in all wires. Flex the harness as the check is being made to detect erratic continuity.
   e. If the harness is not shorted, check the coils at the yellow wire connections on the stator. If the coils fail the check, replace the stator assembly.
4. Measure the resistance between the coils and ground. Ground one of the meter leads to the engine (or the alternator cover, if removed). Touch the other lead to each yellow wire. There should be no continuity. Any other reading indicates a short. Remove the stator from the alternator cover and determine if repair is possible. If not, replace the stator assembly.

Alternator No-Load Voltage Test

The stator coils are located in the alternator cover.

1. Locate and separate the connector containing three yellow wires. The connector is located behind the front left side cover. The Suzuki multi-circuit tester (part No. 09900-25008, or an equivalent tester) is required for this test.
2. Start the engine and allow it to reach operating temperature, and then turn off the engine.
3. Identify the connector half that leads to the alternator.
4. Measure the AC voltage as follows:
   a. Set the tester to the voltage setting.
   b. Insert the meter leads into a pair of the yellow wires as shown in (**Figure 57**).
   c. Start the engine and momentarily raise the engine speed to 5000 rpm.
   d. The meter should indicate 75 volts or greater when the engine speed is raised.
   e. Check all three combinations of the yellow wires. The voltage between all pairs of yellow wires should be 75 volts or greater.
   f. If the output voltage is significantly lower than 75 volts, check the condition of the alternator wiring harness and connectors. Also check the stator charging coil resistance and the condition of the rotor.

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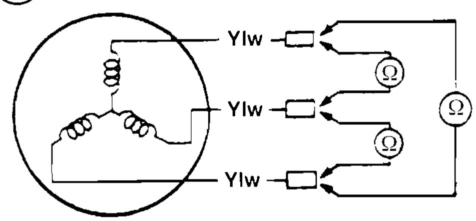

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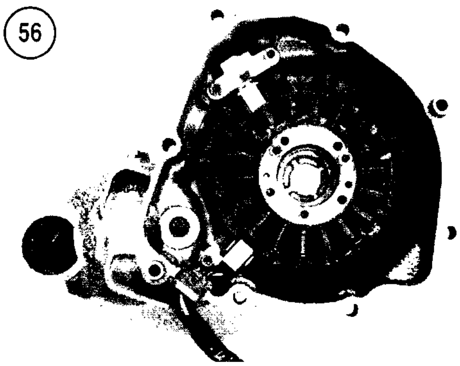

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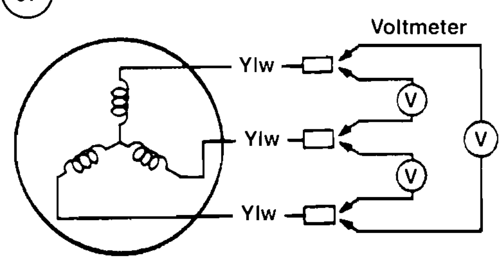

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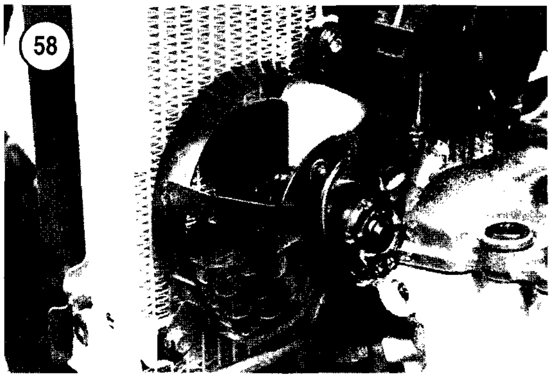

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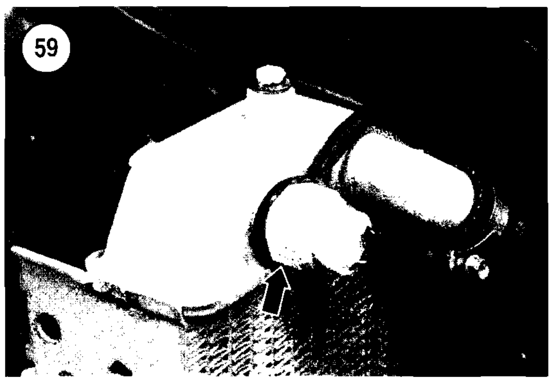

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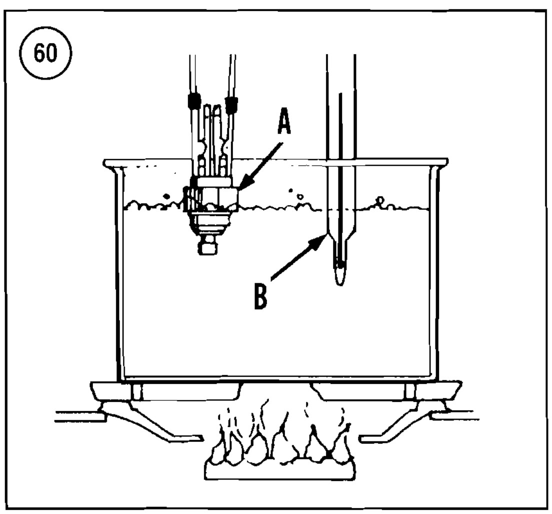

RADIATOR FAN (S AND SM MODELS)

An electric fan (**Figure 58**) located behind the left radiator maintains coolant temperature. The fan is controlled by a sending unit, located at the top of the left radiator (**Figure 59**). When the engine coolant is cold, the sending unit circuit is open and the fan is inoperative. As coolant temperature rises and exceeds the specified temperature (**Table 1**), the circuit closes and turns on. The fan runs until the coolant temperature falls below the specified off temperature, opening the circuit and turning the fan off.

When testing or troubleshooting the fan system, it is important that all connections are clean and tight. During assembly, apply dielectric grease to connections to prevent the entry of moisture and corrosion.

Fan Test

1. Separate the fan connector.
2. Identify the half of the connector that leads to the fan.
3. Connect a 12-volt battery to the fan leads. Connect the positive lead to the blue wire and the negative lead to the black wire.
   a. If the fan does not turn on, replace the fan.
   b. If the fan turns on, test the fan sending unit.

Sending Unit Test

1. Test the sending unit with the coolant at ambient temperature as follows:
   a. Disconnect the sending unit connector.
   b. Connect an ohmmeter to the sending unit terminals. Note the meter reading.
   c. If the reading indicates continuity, the sending unit is faulty.
2. Test the sending unit at operating temperature as follows:
   a. Remove the sending unit from the radiator (Chapter Ten).
   b. Connect an ohmmeter to the sending unit terminals.
   c. Suspend the unit (A, **Figure 60**) and a thermometer (B) in a container of water. The temperature sensor and threads must be submerged. Do not allow the parts to touch the bottom or side of the container.
   d. Slowly heat the water and observe the thermometer and ohmmeter readings. Do not overheat the switch.
   e. As the sending unit is heated, there should be continuity at approximately 96° C (205° F).
   f. As the sending unit is cooled, there should be no continuity at approximately 91° C (196° F).
   g. Replace the sending unit if it does not operate within the specifications.

3. Clean and inspect the sending unit and O-ring for damage.
4. Install the sending unit (Chapter Ten).

TEMPERATURE WARNING CIRCUIT (S AND SM MODELS)

The temperature warning light (**Figure 61**) is turned on and off by the sending unit, located at the top of the right radiator (**Figure 62**). At normal coolant operating temperatures, the sending unit circuit is open and the water temperature light remains off. If the coolant temperature exceeds the specification (**Table 1**), the sending unit closes (completing the circuit) and the temperature light indicates engine overheating. The light remains on until the coolant temperature falls.

Warning Light Check

The warning light (**Figure 61**) should turn on only when the sending unit grounds the circuit (high water temperature).

If the light is on at all times or turns on soon after start up, test the sending unit. If the sending unit is in good condition, check for a short in the wire between the light and sending unit. If overheating is suspected and the light does not come on, make the following checks:

1. Remove the right radiator cover, and if necessary, the fuel tank to access the wire connector leading from the sending unit.
2. Separate the black/green wire connector leading from the sending unit (**Figure 62**).
3. Identify the connector half that leads to the warning light.
4. Turn on the ignition and ground the black/green wire. Observe the warning light.
   a. If the light does not turn on, inspect the light cluster for damaged or broken wiring. The warning light is an LED and cannot be replaced separately. Replace the light cluster, or have the light assembly inspected by an electronic repair shop.
   b. If the light turns on, check the wire connections for cleanliness, and if necessary, test the sending unit.

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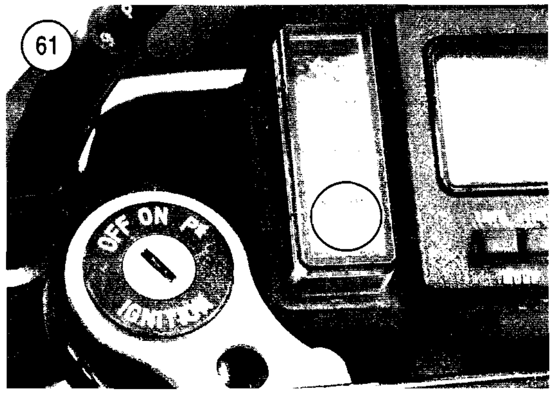

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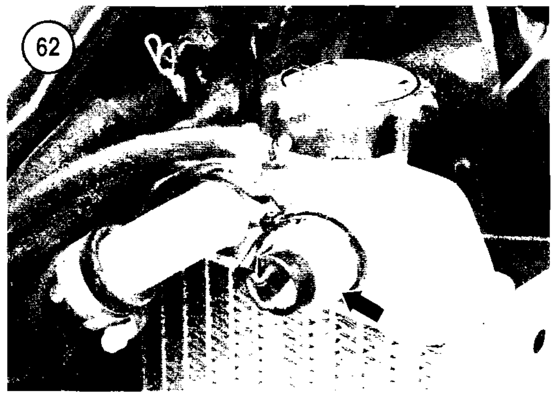
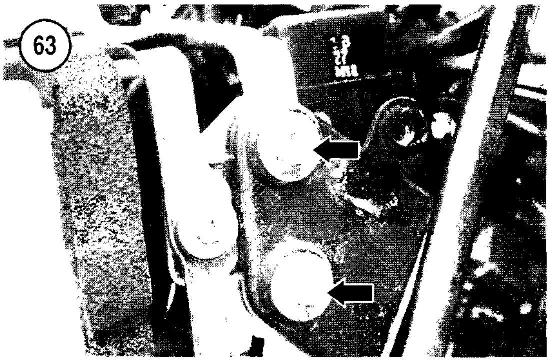
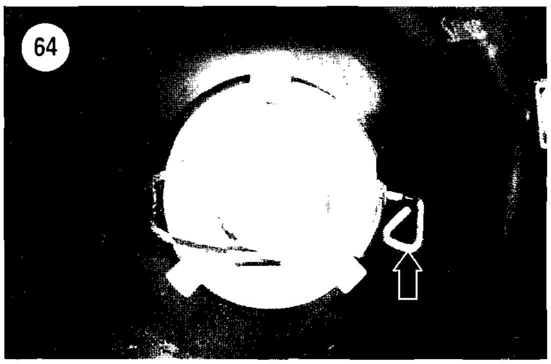


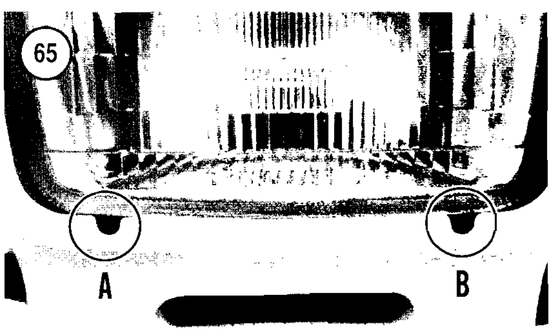
Sending Unit Test

If the warning light is on all the time or comes on soon after engine startup, perform the following:

1. Remove the right radiator cover, and if necessary, the fuel tank to access the wire connector leading from the sending unit.
2. Separate the black/green and black/white wire connectors leading from the sending unit (**Figure 62**).
3. Identify the connector halves that lead to the sending unit.
4. Connect an ohmmeter to the sending unit terminals.
5. If the reading indicates continuity, the sending unit is faulty. Replace the sending unit (Chapter Ten).
6. Start the engine and observe the meter as the engine coolant is brought to operating temperature.
7. If the meter indicates continuity at any time during the warmup, the sending unit is faulty. Replace the sending unit (Chapter Ten).
8. If the warning light does not turn on when the engine is overheating and the light and wiring are in good condition, replace the sending unit. It is not







practical to test the unit at the high temperatures required for it to achieve continuity (**Table 1**).

HEADLIGHT

Bulb Replacement

1. Remove the headlight cowl (Chapter Fifteen).
2. For S models, remove the mounting bracket bolts on each side (**Figure 63**).
3. Remove the plug from the back of the bulb.
4. Unlatch the bulb retainer (**Figure 64**) and remove the bulb.

NOTE

When handling the new bulb, do not touch the glass with bare hands. Handle the bulb with a clean cloth. Bulbs are sensitive to oil or other contaminants on their surface. Contaminants prevent heat dissipation from the bulb, which can cause shortened bulb life. If touched, clean the bulb with isopropyl alcohol.

5. Seat the new bulb in the socket.
6. Assemble and install the headlight.

Headlight Adjustment

1. For models with two adjustment screws, the left screw (A, **Figure 65**) adjusts the light vertically, and the right screw (B) adjusts the light horizontally.
2. For models with one adjustment screw, the center screw adjusts the light vertically. Horizontal adjustment is not provided.

TAILLIGHT

Bulb Replacement (S and SM Models)

1. Remove the lens from the taillight.
2. To remove the bulb, push the bulb in and turn it counterclockwise.
3. Seat the new bulb in the socket.
4. Check that the rubber seal is in place, and then install the cover. Do not overtighten the screws.

LED Replacement (E Models)

The LED taillight is not repairable. If the light fails, replace the taillight unit.

TURN SIGNALS

Bulb Replacement (S and SM Models)

1. Remove the lens from the turn signal.
2. To remove the bulb, push the bulb in and turn it counterclockwise.
3. Seat the new bulb in the socket.
4. Check that the rubber seal is in place, and then install the cover. Do not overtighten the screws.

Table 1 ELECTRICAL SYSTEM SPECIFICATIONS

Alternator	
Type	3-phase AC
Output (regulated voltage)	13.5-15 volts at 5000 rpm
Wattage	200 watts at 5000 rpm
Battery type and capacity	
2000 models	GT7B-4, 12 volt, 6.5 amp-hour
2001-on models	YT7B-BS, 12 volt, 6 amp-hour
Coolant temperature sending unit (warning light, S models)	
Off temperature	100° C (212° F)
On temperature	117° C (243° F)
Fuse	
E models	10 amp
S and SM models	20 amp
Ignition coil	
Primary peak voltage	More than 150 volts
Resistance	
Primary coil	0.1-1.0 ohm
Secondary coil	12,000-20,000 ohms
Ignition timing*	
E models	
Except 2004 California	7° BTDC at 1800 rpm
2004 California	7° BTDC at 1600 rpm
S and SM models	7° BTDC at 1500 rpm
Light bulbs	
Headlight	
E models	
2000-2001	12 volt, 55W
2002-on	12 volt, 35W
S and SM models	12 volt, 55W/60W
Indicators	LED
E models	
Taillight	LED
S and SM models	
Taillight/brake light	12 volt, 5W/21W
Turn signals	12 volt, 21W
Pickup coil	
Resistance	390-600 ohms
Peak voltage	More than 5.0 volts
Radiator fan sending unit (S and SM models)	
Off fan temperature	91° C (196° F)
On fan temperature	96° C (205° F)
Regulator/rectifier output voltage	13.5-15 volts at 5000 rpm
Side stand switch (S and SM models)	
Down position	1.4-1.5 volts
Up position	0.4-0.6 volts
Signal coil	
Resistance (black to white wires)	0.05-0.2 ohm
Peak voltage	More than 1.4 volts
Spark plug	
Type	NGK CR8E or Denso U24ESR-N
Gap	0.7-0.8 mm (0.028-0.031 in.)
Starter relay resistance	3-5 ohms
Stator	
Coil resistance	0.5-1.25 ohms
No-load voltage	75 volts AC or greater at 5000 rpm
Upper idle gear slip torque	30-55 N•m (22-41 ft.-lb.)

*Not adjustable.

Table 2 ELECTRICAL SYSTEM TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Alternator cover bolts	10	–	7
Coolant temperature sending unit	13	–	10
Radiator fan sending unit	13	–	10
Rotor nut	100	–	74
Starter clutch bolts	26	–	19

CHAPTER TEN

COOLING SYSTEM

This chapter provides service procedures for the fan, fan sending unit, radiators, water temperature sending unit, thermostat and water pump. Refer to Chapter Nine for electrical test procedures.

Refer to Chapter Three for cooling system maintenance.

Refer to **Table 1** and **Table 2** at the end of the chapter for specifications.

SAFETY PRECAUTIONS

Do not remove the radiator cap (A, **Figure 1**) immediately after or during engine operation. When the engine has been operated, the liquid in the cooling system is hot and under pressure. Removing the cap while the engine is hot can cause the coolant to spray from the radiator opening, possibly causing injury.

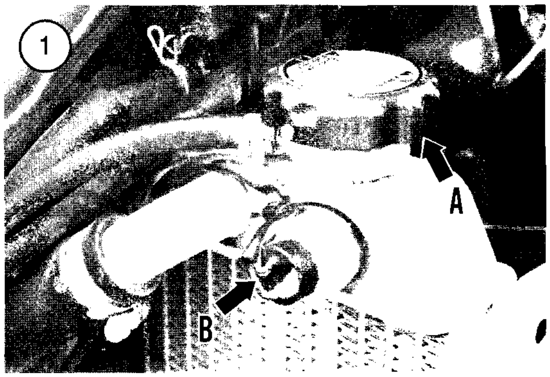
Wait for the engine to cool, and then place a shop cloth over the cap. Slowly turn the cap to relieve any pressure. Turn the cap to the safety stop and check that all pressure is relieved. To remove the cap from the radiator, back off the safety lock screw (**Figure 2**), if provided, press down on the cap and twist it free.

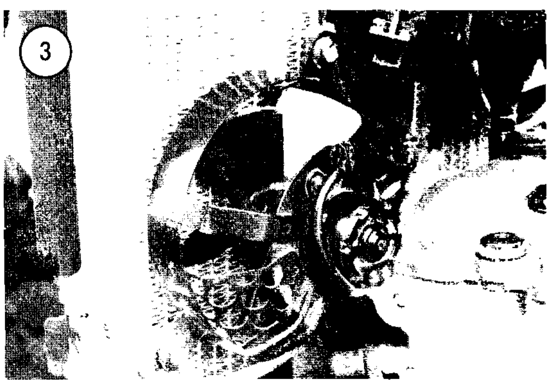
FAN AND SWITCH (S AND SM MODELS)

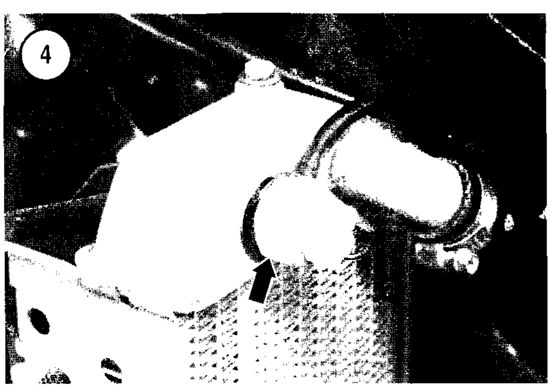
A thermostatically-controlled fan (**Figure 3**) is located behind the left radiator. The fan is turned on and off by the fan sending unit, located at the top of the left radiator (**Figure 4**). During engine operation, hot coolant from the engine circulates through the right radiator, and then the left radiator. The tempered coolant then returns to the engine to repeat the cycle. If the coolant entering the left radiator is too hot, the switch turns on the fan. The fan draws air through the radiator to aid in lowering coolant temperature. The switch is set to turn on the fan when coolant temperature is approximately 96° C (205° F). The fan shuts off when coolant temperature drops to approximately 91° C (196° F).

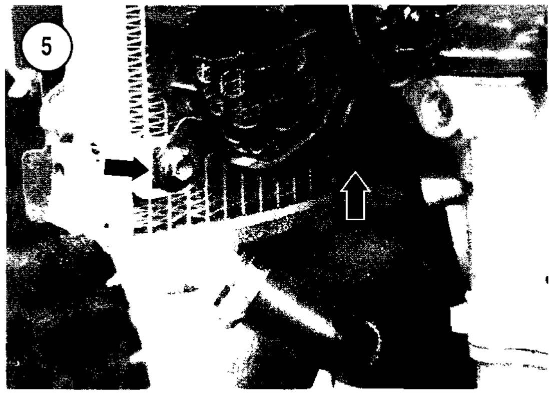
Fan Removal and Installation

1. Remove the fuel tank (Chapter Fifteen).









2. Trace the wires leading from the fan, and then disconnect the wires at the connector.
3. Remove the bolts (**Figure 5**) securing the fan to the radiator.
4. If necessary, refer to Chapter Nine to test the fan.
5. Reverse this procedure to install fan.

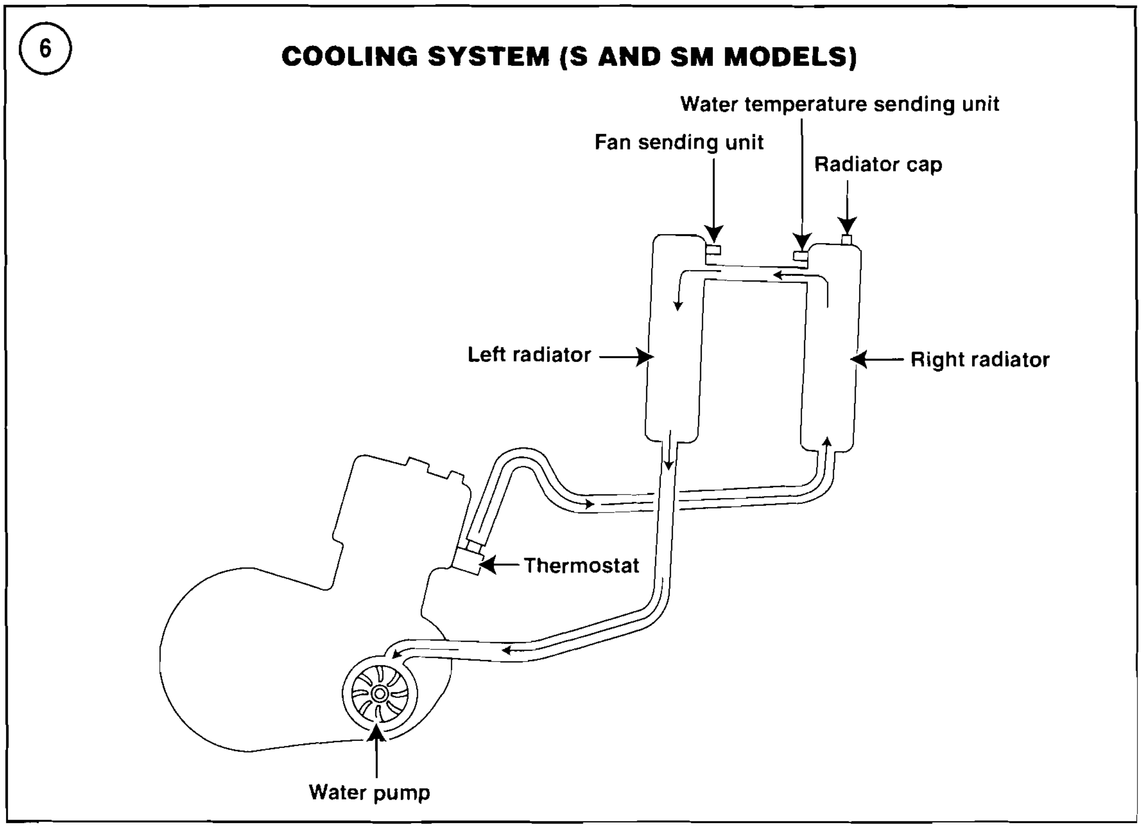
Fan Sending Unit Removal and Installation

1. Remove the fuel tank (Chapter Fifteen).
2. Trace the wires leading from the fan sending unit (**Figure 4**), and then disconnect the wires at the connector.
3. Partially drain the cooling system (Chapter Three). The coolant level in the radiators only needs to be below the switch.
4. Remove the sending unit from the left radiator.
5. Clean the sending unit and the threads in the radiator.
6. Test the sending unit as described in Chapter Nine.
7. Reverse this procedure to install sending unit.
   a. Install a new, lubricated O-ring on the sending unit. Lubricate it with anti-freeze.
   b. Tighten the sending unit to 13 N•m (10 ft.-lb.).

RADIATORS AND WARNING LIGHT SWITCH

The S, SM and E models have a left and right radiator, however, each model circulates coolant differently through the radiators.

The S and SM model circulates coolant as shown in **Figure 6**. The S and SM model systems also includes a water temperature sending unit, located at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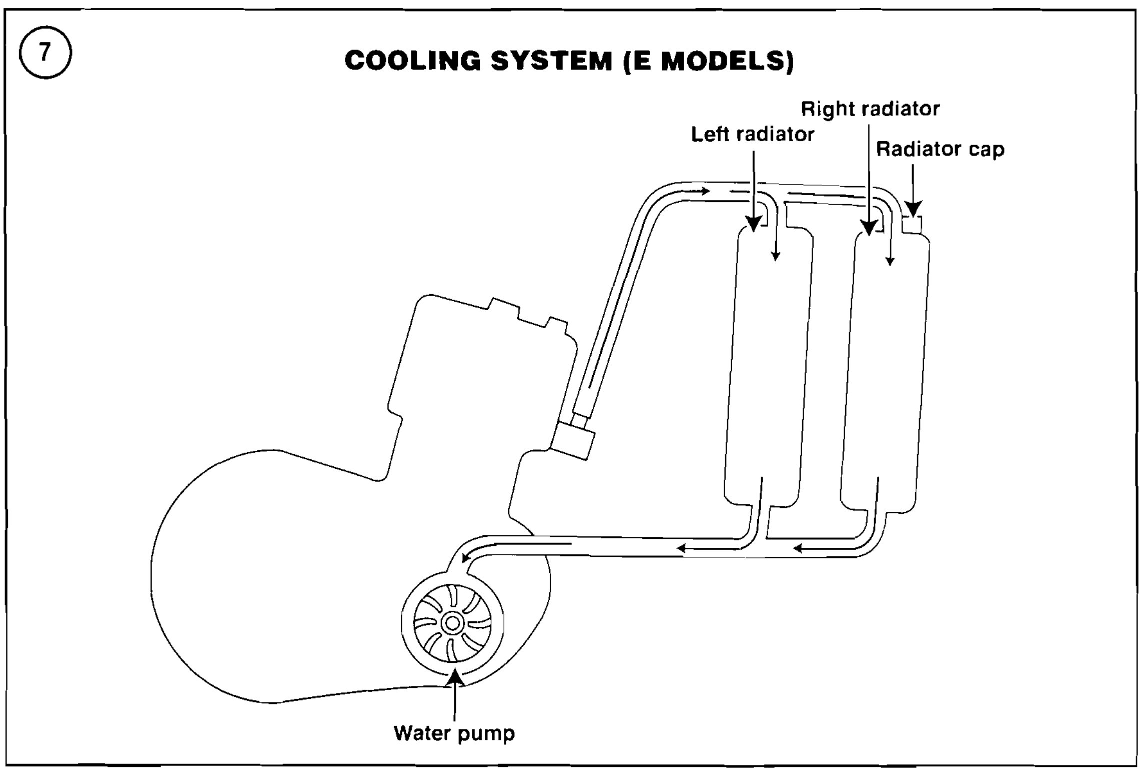
COOLING SYSTEM (S AND SM MODELS)
Water temperature sending unit
Fan sending unit
Radiator cap
Left radiator
Right radiator
Thermostat
Water pump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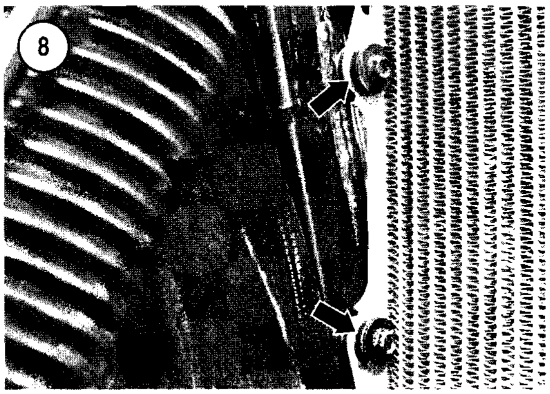
COOLING SYSTEM (E MODELS)
Right radiator
Left radiator
Radiator cap
Water pump



the top of the right radiator (**Figure 1**). If coolant temperature exceeds the specification (**Table 1**), the switch turns on the warning light at the handlebar.

The E model system circulates coolant as shown in **Figure 7**. The E model does not have a temperature sending unit or warning light.

Radiators Removal and Installation

1. Remove the fuel tank (Chapter Fifteen).
2. Drain the cooling system (Chapter Three).
3. For S models, remove the fan and disconnect the wires leading from the fan and warning light sending units.
4. Remove the hoses from the radiators. If the hoses are seized to the fittings, cut and split the hoses so they can be peeled from the fittings. Avoid scoring the fittings. Replace the hoses.
5. Remove the two bolts (**Figure 8**) at the front of each radiator.
6. Inspect the radiators as described in this chapter.
7. If necessary, on S and SM models, remove the water temperature sending unit as described in this section.
8. Reverse this procedure to install the radiators. Note the following:
   a. Replace hoses that are hard, cracked or show signs of deterioration, both internally and externally. Hold each hose and flex it in several directions to check for damage. For a hose that is difficult to install on a fitting, dip the hose end in hot water until the rubber has softened, and then install the hose.
   b. Install clamps in their original positions.
   c. On S and SM models, check that both sending units are installed and tight.
   d. Fill and bleed the cooling system (Chapter Three).
   e. Start the engine and allow it to warm up. Check for leaks.

Radiators Inspection

1. Clean the exterior of the radiators with a low-pressure water spray. Allow the radiators to dry.
2. Check for damaged cooling fins. Straighten bent fins with a screwdriver. A radiator with more than 20 percent damage in the cooling area should be replaced.
3. Check the seams and other soldered connections for corrosion (green residue). If corrosion is evident, there could be a leak in that spot. Perform a cooling system pressure check as described in *Maintenance and Inspection* in Chapter Three. If the equipment is not available, take the radiators to a radiator repair shop to have them flushed and pressure checked.
4. Fill each radiator with water and check the flow rate out of the radiator. If the flow rate is slow or if corrosion or other buildup is seen, take the radiators to a radiator repair shop to have them flushed and pressure checked.

Coolant Temperature Sending Unit Removal and Installation

1. If necessary, test the sending unit before removal as described in *Temperature Warning Circuit (S and SM models)* in Chapter Nine.
2. Remove the fuel tank (Chapter Fifteen).
3. Trace the wires leading from the temperature sending unit (B, **Figure 1**), and then disconnect the wires at the connector.
4. Partially drain the cooling system (Chapter Three). The coolant level in the radiators only needs to be below the switch.
5. Remove the sending unit from the right radiator.
6. Clean the sending unit and the threads in the radiator.
7. Reverse this procedure to install the sending unit.
   a. Install a new, lubricated O-ring on the sending unit. Lubricate it with anti-freeze.
   b. Tighten the sending unit to 13 N•m (10 ft.-lb.).

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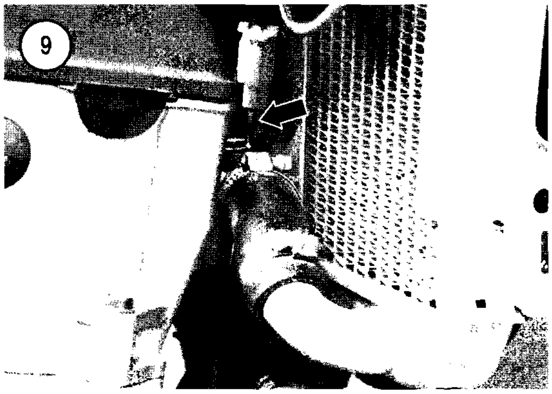

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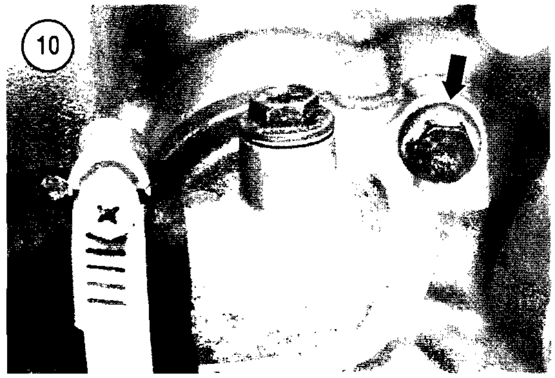

THERMOSTAT (S AND SM MODELS)

An engine thermostat is located in a housing on the front of the cylinder head (**Figure 9**). The thermostat is a temperature-sensitive valve that opens and closes, depending on the coolant temperature in the cylinder head. At startup, the thermostat is closed to retain coolant in the water jackets. When the cylinder head coolant temperature begins to exceed the ideal operating temperature, the thermostat opens and allows the coolant to pass to the right radiator. Because the temperature of the incoming coolant in the cylinder head is low, the thermostat closes and reduces the flow to the radiator. As the temperature of the coolant rises, the cycle is repeated.

For the engine to run properly, the thermostat is necessary to maintain a specific amount of heat around the cylinder and cylinder head. Do not remove the thermostat, assuming it will enhance engine performance.

Removal, Inspection and Installation

1. Remove the fuel tank (Chapter Fifteen).
2. Drain the cooling system (Chapter Three).
3. Disconnect the wires leading from the water temperature sending unit.
4. Remove the hoses from the right radiator. If the hoses are seized to the fittings, cut and split the hoses so they can be peeled from the fittings. Avoid scoring the fittings. Replace the hoses.
5. Remove the two bolts at the front of the right radiator.
6. Remove the bolts securing the thermostat housing to the cylinder head (**Figure 10**).
7. Remove the thermostat (**Figure 11**).

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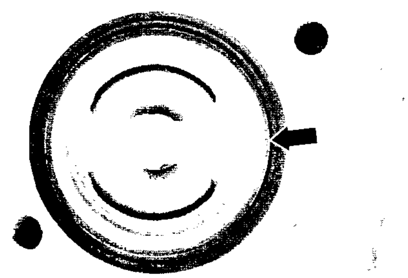

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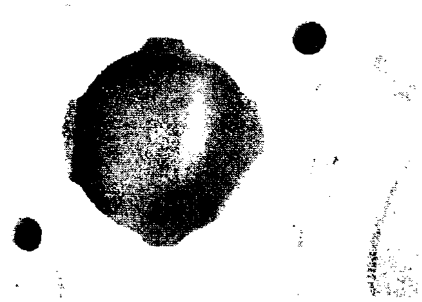

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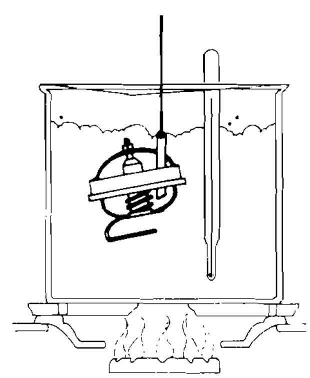

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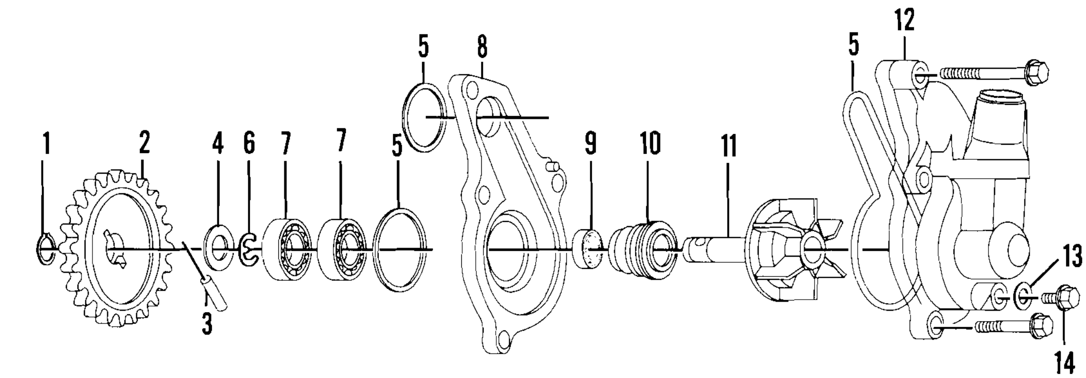
WATER PUMP

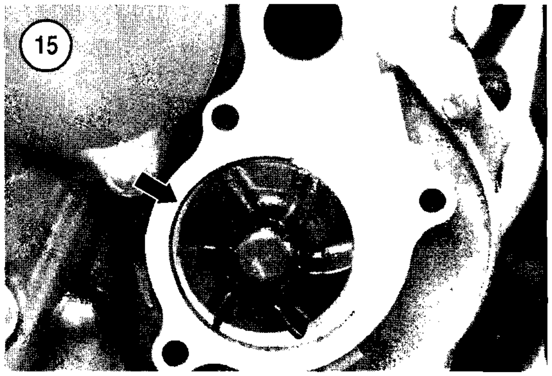


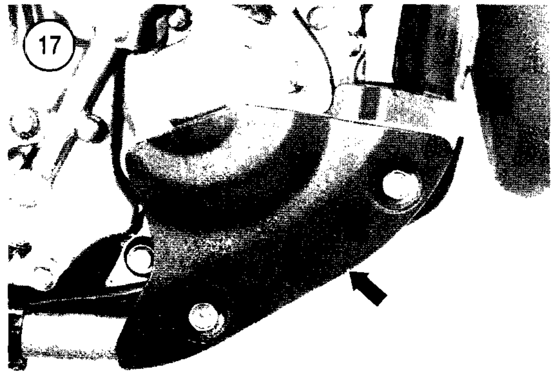
1. Snap ring
2. Driven gear
3. Pin
4. Washer
5. O-ring
6. E-clip
7. Bearings
8. Pump plate
9. Oil seal
10. Mechanical seal
11. Impeller
12. Water pump cover
13. Seal washer
14. Drain plug

8. Inspect the water jacket (**Figure 12**) for buildup, which could cause plugging or other cooling system damage. If necessary, open the drain bolt at the water pump and flush the water jackets. If heavy buildup is evident at the water pump drain, remove the water pump and clean all parts. Heavy buildup can cause water pump damage and plug the radiators.
9. Inspect and clean the thermostat.
   a. Visually inspect the valve in the thermostat. The valve should be closed when the thermostat is cold. If the valve is cold and open, replace the thermostat.
   b. Wash the thermostat in cool water. If necessary, use a soft brush to scrub accumulation off the thermostat. If accumulation of rubber particles is evident, inspect the radiator hoses for internal deterioration.
   c. Inspect the condition of the housing and the rubber seal on the thermostat.
   d. Clean the bolts and threaded bores.
   e. To test the thermostat, suspend it and an accurate thermometer in a container of water (**Figure 13**). Do not allow the parts to touch the bottom or sides of the container. Slowly heat the water and observe the thermostat valve. The thermostat should begin to open at approximately 75° C (167° F). Continue to raise the temperature to approximately 90° C (194° F). At this temperature, the thermostat valve should have lifted at least 6 mm (0.24 in.). Replace the thermostat if it does meet the conditions of the test.
10. Lubricate the rubber seal, and then seat the thermostat in the cylinder head.
11. Install the housing and tighten the bolts 10 N•m (7 ft.-lb.).
12. Install the right radiator and hoses.
13. Fill and bleed the cooling system (Chapter Three).
14. Install the fuel tank (Chapter Fifteen).
15. Start the engine and allow it to warm up. Check for leaks.

WATER PUMP

The water pump (**Figure 14**) is located in the right crankcase cover. To inspect the condition of the impeller (**Figure 15**), the water pump cover (**Figure 16**) can be removed without removing the



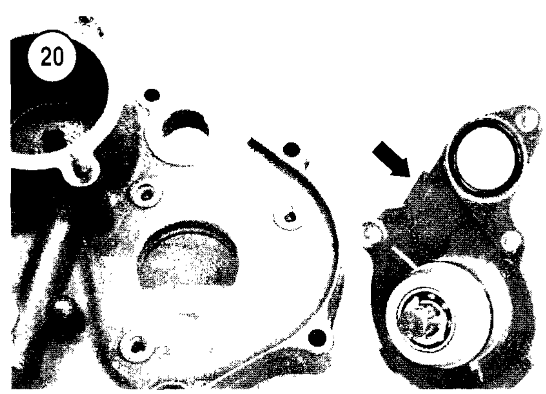


right crankcase cover. The cooling system must be drained before removing the water pump cover.

Although not visible, a drain hole for the water pump is located on the back side of the pump plate. Any leak from this hole is visible at the bottom of the pump plate where it joins the right crankcase cover. If coolant is detected, the pump mechanical seal is leaking. If oil is detected, the oil seal is leaking. Removal of the right crankcase cover is necessary to replace the seals.

Removal, Inspection and Installation

1. Remove the right engine cover (**Figure 17**).
2. Drain the cooling system (Chapter Three).
3. Drain the engine oil and remove the oil filter (Chapter Three).
4. Remove the hose from the water pump cover and loosen the bolts (**Figure 18**) securing the cover to the pump plate.
5. Remove the clutch cover and right crankcase cover (Chapter Six). It is not necessary to remove the clutch assembly.



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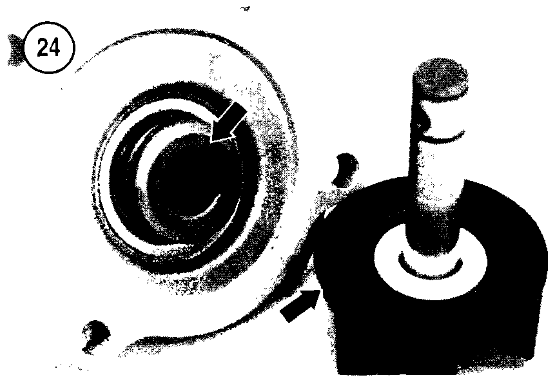

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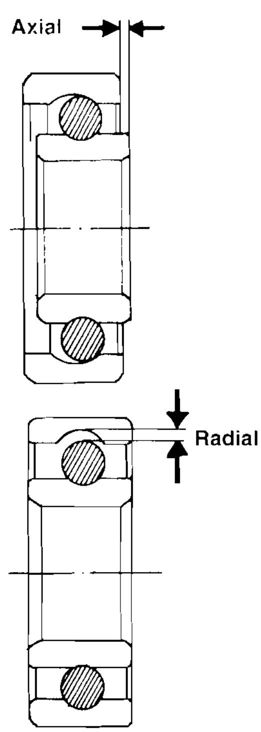

6. Remove and disassemble the water pump as follows:
   a. Remove the water pump cover.
   b. Remove the snap ring, driven gear, pin and washer (**Figure 19**).
   c. Twist and press the pump plate from the right crankcase cover (**Figure 20**). An O-ring seals the two parts together.
   d. Remove the E-clip (**Figure 21**) and impeller shaft from the bearings.
   e. Remove the O-rings from the parts.
7. Inspect the parts for wear and damage. Note the following:
   a. Replace all O-rings.
   b. Replace the seal washer on the drain bolt (**Figure 22**).
   c. Replace the snap ring and E-clip.
8. Inspect the bearings in the water pump. Inspect bearings for:
   a. Roughness. Turn each bearing by hand and check for smooth, quiet operation. Insert the impeller shaft into the bearings and feel for play and roughness.
   b. Radial and axial play (**Figure 23**). Try to push each bearing in and out to check for axial play. Try to push each bearing up and down to check for radial play. Any play should be difficult to feel. If play is easily felt, the bearing is worn out. Always replace bearings as a set. If necessary, replace the bearings as described in this section.
9. Inspect the impeller and mechanical seal (**Figure 24**) for obvious wear or damage. The face of the mechanical seal on the impeller and in the pump plate must be smooth and free of scoring or damage. When installed, the impeller seal should fit firmly against the seal in the pump plate. Because the seal

in the pump plate is spring loaded, it maintains pressure against the impeller and compensates for wear. If necessary, replace the mechanical seal and oil seal as described in this section.

10. Reverse Step 6 to assemble and install the water pump onto the right crankcase cover. Note the following:
   a. Apply waterproof grease to the impeller shaft.
   b. Install the snap ring and E-clip with their sharp edges facing out.
   c. Lubricate the water pump bearings with engine oil.
   d. Tighten the water pump cover bolts to 10 N•m (7 ft.-lb.).

11. Reverse Steps 1-5 to install the right crankcase cover and clutch cover. Refer to the referenced chapters for installation procedures and for fluid requirements and capacities.

Mechanical and Oil Seal Replacement

The water pump has a two-piece mechanical seal (A, **Figure 25**) and an oil seal (B). The mechanical seal prevents coolant in the pump chamber from passing into the right crankcase cover, which contains oil. Likewise, the oil seal prevents oil in the right crankcase cover from passing into the pump chamber, which contains coolant. A drain hole is located between the seals to allow any water or oil leaks to drain to the outside of the engine. When leaks are detected at the bottom of the pump plate, the seals should be replaced. The mechanical seal must be removed from the pump plate to remove the oil seal.

1. Replace the mechanical seal in the impeller as follows:
   a. Lift the impeller seal from the impeller (**Figure 26**). Clean the seal bore.
   b. Lightly lubricate the rubber edge of the new seal with waterproof grease.
   c. Seat the new seal into the impeller by hand.

2. In the pump plate, remove the remaining half of the mechanical seal and the oil seal as follows:
   a. Support the pump plate on wooden blocks with the mechanical seal facing down. Keep the blocks as close as possible to the seal without touching the seal.
   b. If desired, use a heat gun to warm the area around the seal. The heat softens the sealant at the outer edge of the seal, making it easier to remove.

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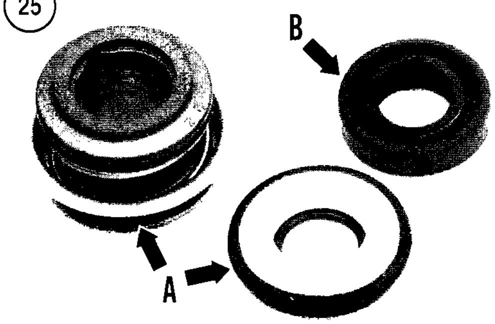

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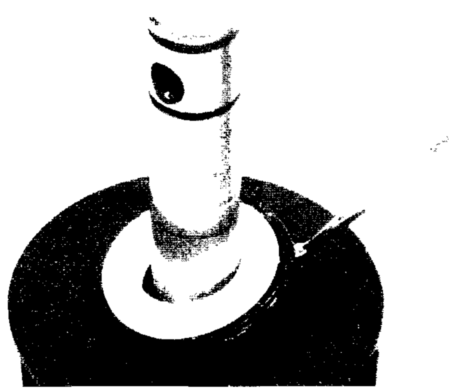

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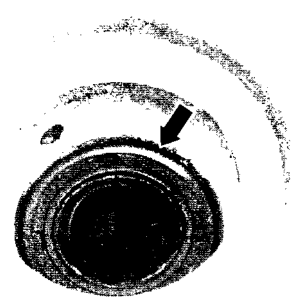

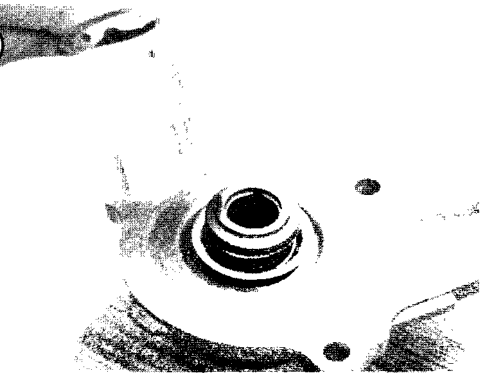

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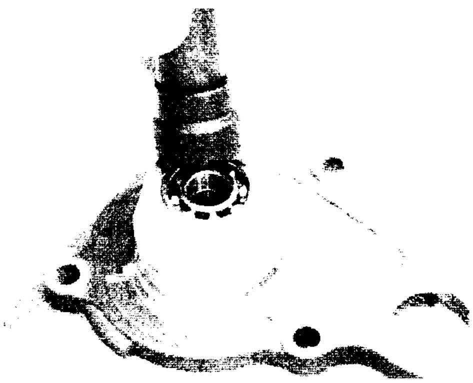

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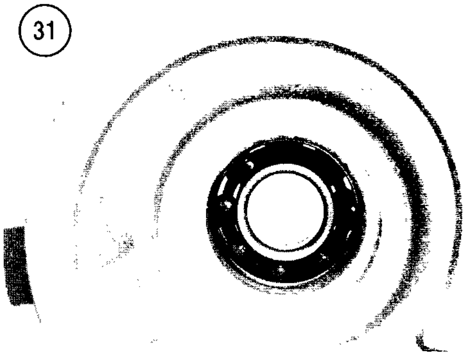

c. Place a narrow drift under the oil seal and onto the back of the mechanical seal (**Figure 27**). Work around the seal and drive it from the bore. Avoid any contact with the surface of the bore. Do not pry the seal from the front side of the pump plate.
d. Drive out the oil seal.
e. Clean the pump plate bore, drain hole and bearings. If bearing replacement is required, replace the bearings before installing a new oil seal and mechanical seal. Refer to *Bearing Replacement* in this section.

3. Install the oil seal as follows:
   a. Pack molydisulfide grease into the lip of the oil seal.
   b. Place the seal squarely over the bore with the closed side of the seal facing up.
   c. Drive the seal into the bore using a driver that fits on the perimeter of the seal. Make sure the seal (**Figure 28**) is fully seated.
4. Install the mechanical seal as follows:
   a. To ease installation, *lightly* apply Suzuki Bond 1207B sealant to the outer edge of the seal. Use only enough to lubricate the parts as they are driven together. Excess sealant can plug the drain hole.
   b. Place the seal squarely over the bore (**Figure 29**).
   c. Drive the seal into the bore. Use a driver that fits on the flange at the perimeter of the seal.
   d. Wipe any sealant from the pump plate.

Bearing Replacement

1. Remove the mechanical seal and oil seal from the pump plate as described in this section.
2. Remove the bearings in the pump plate as follows:
   a. Support the pump plate on wooden blocks with the bearings facing down. Keep the blocks as close as possible to the bearing housing.
   b. If desired, use a heat gun to warm the housing around the bearings. The heat eases removal of the bearings.
   c. Place a driver that fits on the back side of the bearings (**Figure 30**), and then remove the bearings using a hydraulic press or hammer.
   d. Clean and lubricate the bearing bore.
3. Install the bearings as follows:
   a. Support the pump plate on a wooden block.
   b. If desired, use a heat gun to warm the housing around the bearings. The heat eases installation of the bearings.
   c. Place a bearing squarely over the bore, with the manufacturer's marks facing up.
   d. Drive the bearing into the bore using a driver that fits on the perimeter of the bearing. Make sure the bearing is fully seated, and then drive the remaining bearing (**Figure 31**).
4. Install the oil seal and mechanical seal as described in this section.

Table 1 COOLING SYSTEM SPECIFICATIONS

Antifreeze type	Ethylene glycol containing anti-corrosion inhibitors for aluminum engines
Coolant mixture	50/50 (antifreeze/distilled water)
Cooling system capacity	1.25 liters (1.3 qt.)
Coolant temperature sending unit (warning light, S and SM models)	
Off temperature	100° C (212° F)
On temperature	117° C (243° F)
Radiator cap relief pressure	95-125 kPa (13.8-18.1 psi)
Radiator fan sending unit (S and SM models)	
Off temperature	91° C (196° F)
On temperature	96° C (205° F)
Thermostat (S and SM models)	
Valve opening temperature (approximate)	75° C (167° F)
Valve lift at approximately 90° C (194° F)	6 mm (0.24 in.)

Table 2 COOLING SYSTEM TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Coolant air bleeder bolt	6	53	–
Coolant temperature sending unit	13	–	10
Radiator fan sending unit	13	–	10
Thermostat housing bolts	10	–	7
Water pump cover bolts	10	–	7

CHAPTER ELEVEN

WHEELS, TIRES AND DRIVE CHAIN

This chapter provides service procedures for the wheels, drive chain, sprockets and tires. Routine maintenance procedures for these components are in Chapter Three. Refer to **Tables 1-3** at the end of this chapter for specifications.

FRONT WHEEL

Removal and Installation

1. Support the motorcycle so it is stable and the front wheel is off the ground.
2. Remove the screw (**Figure 1**) securing the meter drive unit cable.
3. Remove the nut and washer from the axle, and then loosen the pinch bolts (**Figure 2**) on both ends of the axle.
4. Pull up on the wheel to take the weight off the axle, and then remove the axle from the wheel. Roll the wheel forward and out of the fork.
5. Insert a wood block between the brake pads until the wheel is installed. This prevents the caliper piston from extending if the lever is operated.
6. Remove the speedometer drive unit from the right side of the hub (**Figure 3**).
7. Remove the axle spacer (**Figure 4**) from the left side of the hub.
8. Inspect and/or repair the wheel, axle assembly and meter drive unit as described in this chapter.
9. Reverse this procedure to install the wheel and meter drive unit. Note the following:
   a. Make sure the brake pads are spread so the brake disc can enter the brake assembly.
   b. Apply waterproof grease to the axle, left bearing seal, bearing faces, spacer, meter cable end and meter drive unit seal.

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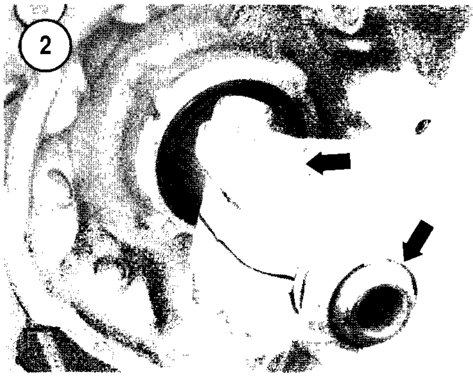

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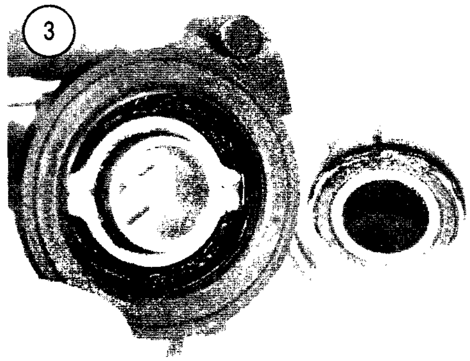

c. Install the spacer into the wheel with the shouldered end facing out (**Figure 4**).
d. Engage the tabs on the speedometer drive unit with the slots in the hub (**Figure 3**).
e. Twist and seat the cable into the meter. A short length of cable should be visible at the end of the cable housing when the cable is properly seated (**Figure 5**). Insert the cable into the drive unit and install the screw.
f. Align the speedometer drive unit so it is at the proper angle. When properly aligned, the unit rests against the stop on the fork leg.
g. Hold the axle with a 19-mm hex wrench, or similar tool (**Figure 6**), and then initially tighten the axle nut to 20 N•m (15 ft.-lb.). Tighten the pinch bolts to 18 N•m (13 ft.-lb.), then fully tighten the axle nut to 42 N•m (31 ft.-lb.). On SM models, tighten the axle bolt to 39 N•m (29 ft.-lb.).
h. Check that the wheel spins freely and the brake operates properly.

Inspection

1. Inspect the seal on the left side of the wheel for:
   a. Nicked, damaged or missing rubber.
   b. Grease or water seepage from the seal. If water or corrosion is evident in the bearing, the seal is leaking.
2. Inspect the bearing on both sides of the wheel hub for:
   a. Roughness. Turn each bearing by hand and check for smooth, quiet operation.
   b. Radial and axial play (**Figure 7**). Try to push the bearing in and out to check for axial play. Try to push the bearing up and down to check for radial play. Any play should be difficult to

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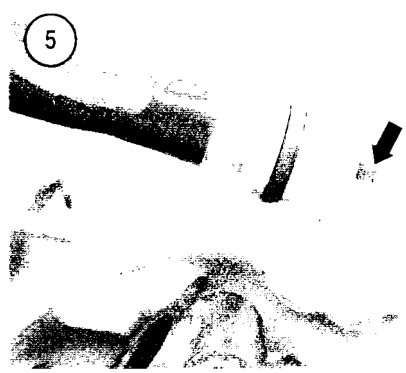

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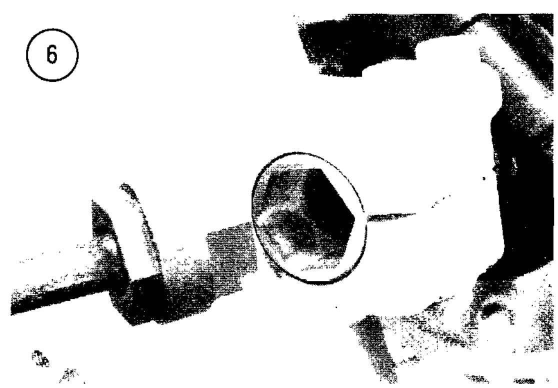

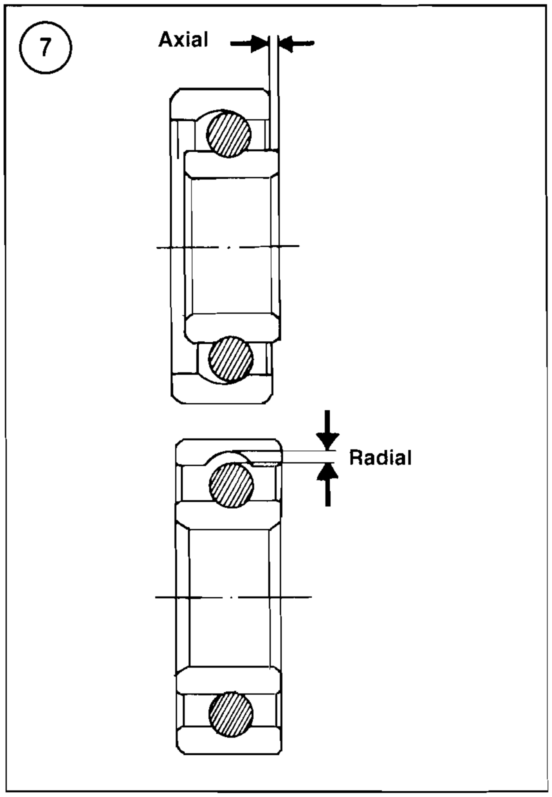

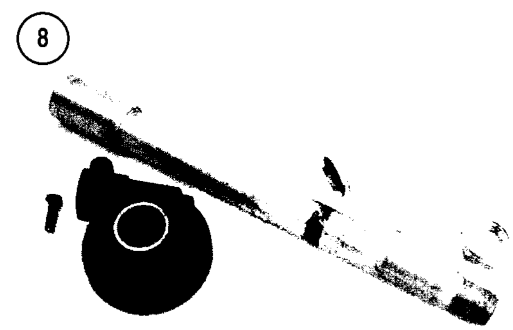

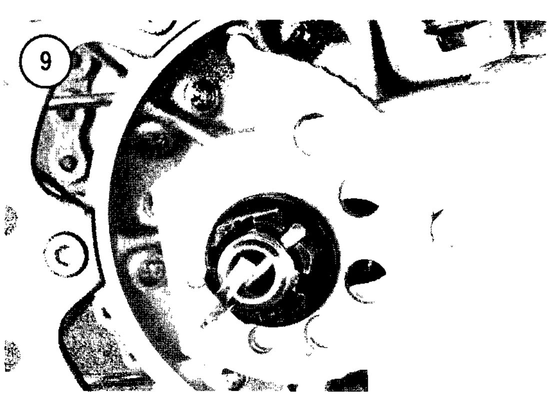

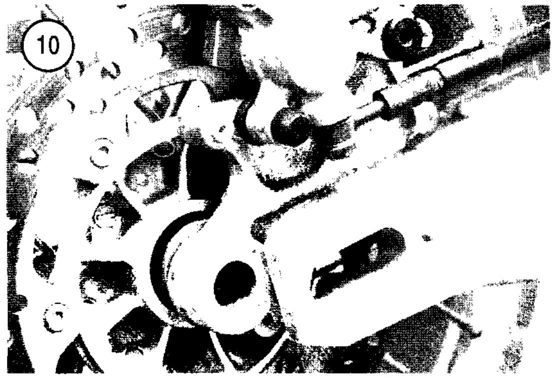

feel. If play is easily felt, the bearing is worn. Always replace bearings as a set.

c. Damage to the bearing shields. The bearings are lubricated and permanently sealed at the time of manufacture. If the shields are damaged, the bearing set must be replaced.

3. If seal or bearing damage is evident, refer to *Front and Rear Hubs* in this chapter for replacement procedures.
4. Clean the axle assembly and speedometer drive unit (**Figure 8**). Inspect for:

a. Axle straightness.
b. Damaged threads on the axle and nut.
c. Damaged spacer or washer.
d. Damaged speedometer drive unit seal.

5. Inspect the wheel as described in this chapter.

REAR WHEEL

Removal and Installation

1. Support the motorcycle so it is stable and the rear wheel is off the ground.
2. Remove the cotter pin, nut and washer from the axle (**Figure 9**).
3. Push the wheel forward and remove the chain from the sprocket.
4. Pull up on the rear wheel to take the weight off the axle, and then remove the axle.
5. Slide the wheel and brake caliper assembly out of the swing arm (**Figure 10**).
6. Insert a wood block between the brake pads until the wheel is installed. This prevents the caliper piston from extending if the pedal is operated. Slide the brake caliper assembly back into the swing arm.
7. Remove the spacer from each side of the hub (**Figure 11**).

8. Inspect and/or repair the wheel and axle assembly as described in this chapter.
9. Reverse this procedure to install the wheel. Note the following:
   a. Make sure the brake pads are spread so the brake disc can enter the brake assembly.
   b. Seat the spacers in the seals (**Figure 11**). Make sure the seal lips are not folded inward.
   c. Insert the axle from the left side.
   d. On S and E models, make sure the right adjustment plate is correctly oriented so the adjustment numbers face out. On SM models, make sure the line on the adjustment plate is facing out.
   e. Apply waterproof grease to the axle, spacers, bearing seals and bores.
   f. Loosely install the washer and axle nut.
   g. Adjust the chain (Chapter Three).
   h. Tighten the rear axle nut to 100 N•m (74 ft.-lb.) and install a *new* cotter pin.
   i. Make sure the wheel spins freely and the brake operates properly.

Inspection

1. Inspect the seal on the each side of the wheel. Inspect seals for:
   a. Nicked, damaged or missing rubber.
   b. Grease or water seepage from the seal. If water or corrosion is evident in the bearing(s), the seal is leaking.
2. Inspect the bearing(s) on both sides of the wheel hub. The left side of the hub contains two bearings. Inspect bearings for:
   a. Roughness. Turn each bearing by hand and check for smooth, quiet operation.
   b. Radial and axial play (**Figure 7**). Try to push the bearing in and out to check for axial play. Try to push the bearing up and down to check for radial play. Any play should be difficult to feel. If play is easily felt, the bearing is worn out. Always replace bearings as a set.
   c. Damage to the bearing shields. The bearings are lubricated and sealed on their outer face at time of manufacture. If the shields are damaged, the bearing set must be replaced.
3. If seal or bearing damage is evident, refer to *Front and Rear Hubs* in this chapter for replacement procedures.

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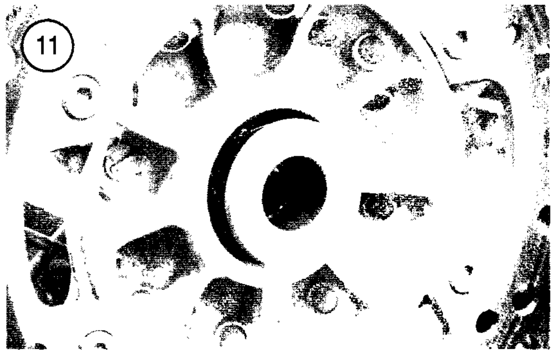

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4. Clean the axle assembly (**Figure 12**). Inspect for the following:
   a. Axle straightness.
   b. Damaged threads on the axle and locknut.
   c. Damaged bores in the spacers and adjusters.
   d. Refer to *Wheel Service* in this chapter for rim and spoke inspection.

FRONT AND REAR HUBS

The wheel hubs contain bearings and a hub spacer. Inspect the bearings any time the wheel(s) are removed from the motorcycle. This section describes two methods for bearing removal and installation.

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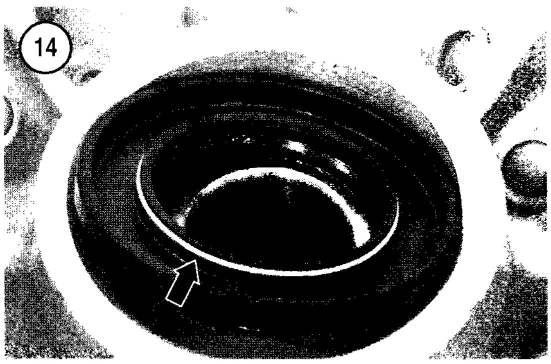

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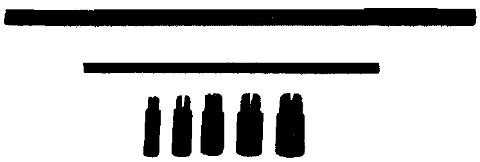

NOTE
On S and E models, the rear hub has two bearings on the left side. To service these bearings, remove the outer bearing first. On SM models, the rear hub has two bearings on the left side but one is in the removable rubber cush drive that carries the rear sprocket; the other is in the hub.

Bearing Inspection

The bearings can be inspected with the wheels mounted on the motorcycle. With the wheels mounted, a high amount of leverage can be applied to the bearings to detect wear. Also, the wheels can be spun to listen for roughness in the bearings. Use the following procedure to check the bearings while the wheels are mounted. If the wheels are dismounted, make the additional checks described in the wheel removal and inspection procedures in this chapter.

CAUTION
Do not remove bearings to check their condition or to lubricate. Bearing damage is likely to occur. If the bearings are removed, they should be replaced.

1. Support the motorcycle with the wheel to be inspected off the ground. The axle nut must be tight. If the rear wheel is being inspected, remove the chain from the sprocket.
2. Grasp the wheel, placing the hands 180° apart. Lever the wheel up and down and side to side to check for radial and axial play. Have an assistant apply the brake while the test is repeated. Play will be detected in excessively worn bearings, even though the wheel is locked.

NOTE
If the disc brake drags and the bearings cannot be heard, remove the wheel. Place the axle in the wheel, and then support the axle so the wheel spins freely.

3. Spin the wheel and listen for bearing noise. A damaged bearing inconsistently sounds rough and smooth. An excessively worn bearing sounds consistently rough. In either case, replace the bearing.
4. If damage is evident, replace the bearings as a set.

Seal Replacement

Seals prevent the entry of moisture and dirt into the bearings and hub. Replace seals when they are obviously damaged or when water or corrosion is evident in the bearings and hub.

1. Pry out the old seal (**Figure 13**). If necessary, place a block of wood on the hub to improve leverage and protect the hub from damage. Do not allow the end of the tool to touch the seal bore. Scratches in the bore cause leaks.
2. If installing a new bearing, replace it before installing the new seal.
3. Clean the seal bore.
4. Apply waterproof grease to the lip and sides of the new seal.
5. Install the seal as follows:
   a. On the rear hub, the open side of the seal faces out. This is verified by the garter spring on the outer face of the seal (**Figure 14**).
   b. On the front hub, the closed side of the seal faces out.
   c. Place the seal squarely over the bore.
   d. Press the seal into place. If a driver is used, use a driver that fits at the perimeter of the seal.

Bearing Removal

The Kowa Seiki wheel bearing remover set (**Figure 15**) is used in this procedure. The set uses a remover head wedged against the inner bearing race. The bearing is then driven from the hub. A similar tool (Suzuki part No. 09941-50111) is available.

CAUTION

In the following procedure, do not allow the wheel to rest on the brake disc. Support the wheel to prevent pressure being applied to the disc.

1. Examine the bearings. Note the following before performing the removal procedure:
   a. Make note of any manufacturer's marks or shields (**Figure 16**) on the sides of the bearings. The new bearings must be installed with the marks and shields in the same directions. Mark each bearing, indicating its original location in the hub. The replacement bearings can then be oriented correctly during installation.
   b. If bearing damage is evident, determine which bearing is damaged the least. Remove this bearing first.

NOTE

If the rear hub is being repaired, remove the right hub bearing first.

2A. Remove the bearings using the wheel bearing removal set as follows:
   a. Select the correct remover head and tapered driver (**Figure 17**). The small, split end of the remover must fit inside the bearing race.
   b. Insert the split end of the remover head into the bearing (**Figure 18**). Seat the remover head against the bearing.
   c. Insert the tapered end of the driver through the back side of the hub. Fit the tapered end into the slot of the remover head.

NOTE

When removing the outer bearing in the left side of the hub, make sure the remover head is locked into only the outer bearing. Remove each bearing individually.

   d. Position the hub so the remover head is against a solid surface, such as a concrete floor.

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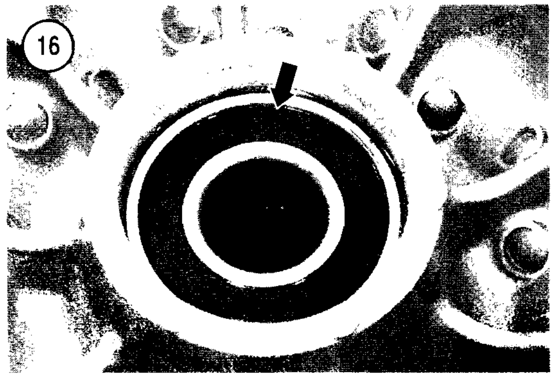

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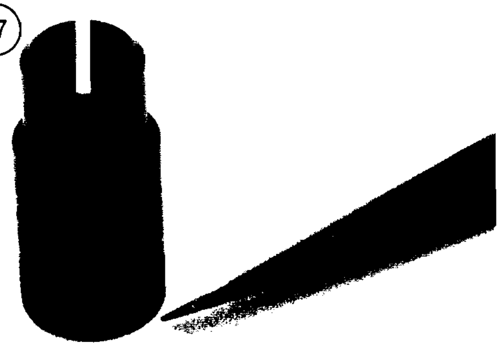

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   e. Strike the end of the driver so it wedges firmly in the remover head. Make sure the remover head is tight against the inner bearing race.
   f. Reposition the assembly so the remover head is free to move and the driver can be struck again (**Figure 19**).
   g. Strike the driver, forcing the bearing from the hub (**Figure 20**).
   h. Remove the driver from the remover head.
   i. Remove the hub spacer.

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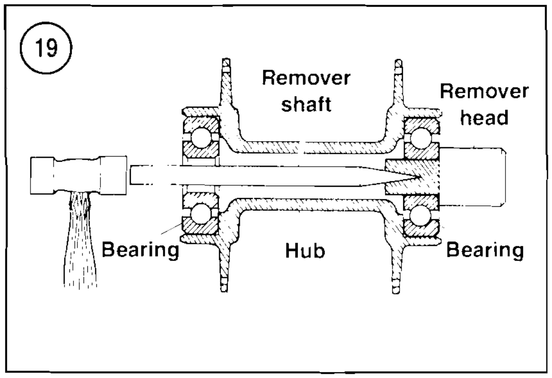

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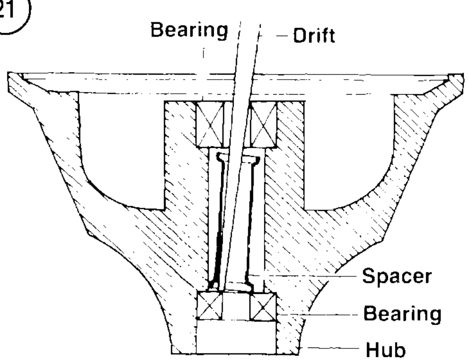

j. Repeat the procedure to remove the remaining bearing(s).

2B. Remove the bearings using a hammer, drift and heat gun. The purpose for using heat is to slightly expand the hub bores so the bearings can removed with minimal resistance. Remove the bearings as follows:

a. Insert a long drift into the hub and tilt the hub spacer away from the bearing to be removed (**Figure 21**).

WARNING

When using a heat gun, clean any solvent or lubricant from the area to be heated. Work in a well-ventilated area and away from combustible materials. Wear protective clothing, including eye protection and insulated gloves.

NOTE

If the rear hub is being repaired, remove the right hub bearing first.

b. Heat the hub around the bearing to be removed. Keep the heat source moving at a steady rate and avoid heating the bearing. A large washer placed over the bearing helps insulate the bearing from the heat.

c. Turn the wheel over and use the drift to tap around the inner bearing race. Do not allow the bearing to bind. Make several passes until the bearing is removed from the hub.

d. Remove the hub spacer.

e. Repeat the procedure to remove the remaining bearing(s). Because the hub spacer is removed, a blind bearing puller could also be used to pull the bearing(s) from the bore.

3. Clean and dry the interior of the hub. Inspect the hub for:

a. Cracks, corrosion or other damage.

b. Fit of the new bearings. The bearings are a driven-fit. If a bearing fits loosely in the hub bore, replace the hub.

4. Inspect the hub spacer for:

a. Burrs, corrosion or other damage.

b. Fit. Check the fit of the spacer against the back side of the bearings. It should fit flat against the bearings. Repair minor nicks and flaring with a file. Do not grind or shorten the spacer. The spacer must remain its full length to prevent binding of the bearings when the axle is tightened.

Bearing Installation

The front bearing installer set (Suzuki part No. 09924-84521) and rear bearing installer set (Suzuki part No. 09941-34513) are available. These types of installer sets consist of a drawbolt and sized disks (**Figure 22**) that drive the bearing into place. The driver fits against the outside diameter of the bearing and presses the bearing into the bore as the nut on the drawbolt is tightened (**Figure 23**). At the opposite side, a larger disk fits against the hub, providing resistance and keeping the parts stabilized. After each bearing is driven, the parts are rearranged to drive the remaining bearings. If desired, a similar tool can be made from a long bolt, nut, washers and sockets. Always use a socket that fits on the outside diameter of the bearing being driven (**Figure 24**).

CAUTION
In the following procedure, do not allow the wheel to rest on the brake disc. Support the wheel to prevent pressure being applied to the disc.

1. Before installing the new bearings, note the following:
   a. Inspect the new bearings and determine which side faces out. This is usually the side with the manufacturer's marks and numbers. Bearings that are shielded on one side should be installed with the shield facing out (**Figure 16**).
   b. Apply waterproof grease to bearings that are not lubricated by the manufacturer or that are not sealed on both sides. Work the grease into the cavities between the balls and races.
   c. Always support the bottom side of the hub, near the bore, when installing bearings.
   d. To aid in driving the bearings, chill them in a freezer to temporarily reduce their diameter.
2. Heat the hub around the bearing bore.

CAUTION
If the rear hub is being repaired, install the right hub bearing first. If the front hub is being repaired, install the left hub bearing first. When these bearings are seated in the bore and the hub spacer installed, the correct spacing will be established for the bearing(s) on the opposite side of the hub. The opposite hub bearings do not fully seat in their bores when installed.

3. Place a bearing *squarely* over the bearing bore.

4A. Install the bearings using the Suzuki wheel bearing installation sets as follows:
   a. Hand-tighten the nut until the tool and bearing is squarely positioned with the bore.

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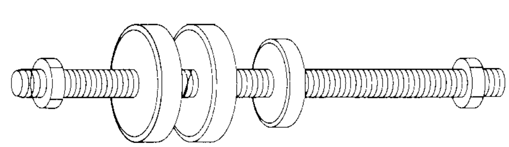

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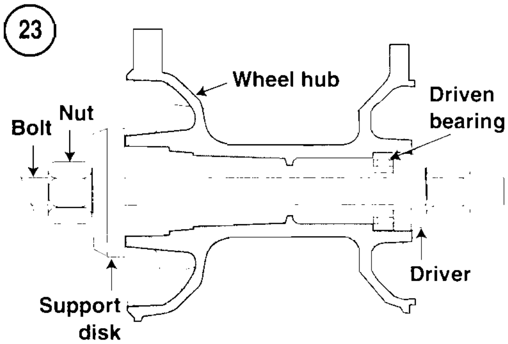

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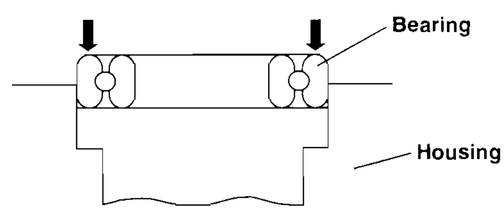

   b. Drive the bearing into the bore.
   c. Disassemble the tool and install the hub spacer.
   d. Assemble the tool to drive in the remaining bearing(s). When the second bearing is installed, check that the hub spacer is firmly between the bearings. The spacer should be capable of being aligned, but should not move freely in the hub.

4B. Install the bearings using drivers and a hammer as follows:
   a. Place a suitable-size driver or socket over the bearing. The driver should seat against the

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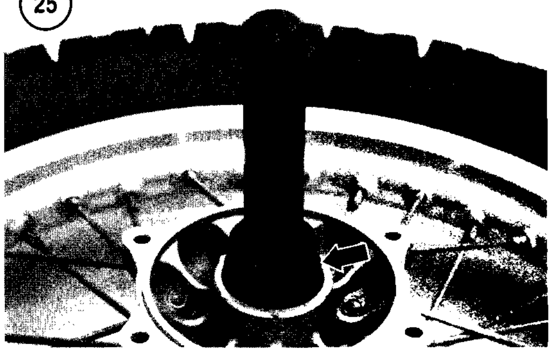

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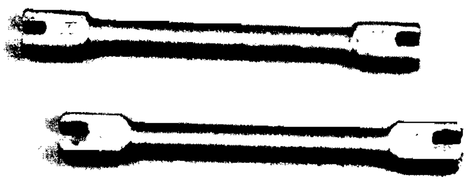

outside diameter of the bearing (**Figure 24**). The driver should also be capable of entering the bore when the bearing is driven (**Figure 25**).

CAUTION
Do not press or strike the bearing directly. Bearing damage occurs.

b. Hold the driver and squarely drive the bearing into the hub.
c. Turn the hub over and install the hub spacer.
d. Drive in the remaining bearing(s). When the second bearing is installed, make sure the hub spacer is firmly between the bearings. The spacer should be capable of being aligned, but should not move freely in the hub.

WHEEL SERVICE

The rim and hub must be concentric to ensure good handling and prevent damage to the parts. When the motorcycle is new, all spokes are tensioned equally and the rim and hub are aligned and concentric. As the motorcycle is used, the spoke tensions become unequal and the rim may become damaged. When this occurs the wheel develops radial (up and down) and lateral (side to side) runout. Wheel truing retensions the spokes, aligns the rim and hub and makes the parts concentric. Regularly inspect and correct any problems with the wheel assembly.

Rim Inspection

Inspect the rims for damage. Also check the spoke holes for enlargement. Truing a wheel with large dents can cause hub and rim damage due to the overtightened spokes. If the dent is minor and runout is minimal, the rider may find it acceptable to continue to use the rim.

Spoke Inspection

Inspect the spokes for damage and proper tightness. For new wheels or wheels that have been rebuilt, check the spokes frequently. After the tensions stabilize, check the spokes as recommended in Chapter Three.

When tightening spokes, always use the correct size spoke wrench and do not exceed the torque recommendation in **Table 3**. Spoke wrenches (**Figure 26**) grip the spoke on three sides. The spoke nipples can be rounded off or crushed if other types of tools are used. Do not true a wheel that has broken, bent or damaged spokes. The spoke can crack the hub fitting and enlarge the rim hole.

To change spoke tension, spokes must be able to turn easily in the spoke nipples. If a spoke is seized in its nipple, apply penetrating lubricant to the threads. If the spoke does not free itself or turn smoothly, replace the spoke and nipple.

Wheel Truing

Wheels can be trued with the wheel on or off the motorcycle. Before truing a wheel, check the condition of the wheel bearings. Accurate wheel truing is not possible with worn wheel bearings. Refer to **Table 1** for wheel runout specifications.

A wheel truing stand is used to measure runout (**Figure 27**), however, if runout appears minimal, the wheel can be left on the motorcycle to make the check. Raise the wheel so it is level and free to spin.

Solidly hold a pointer against the fork or swing arm. While the wheel is turned, move the pointer toward/away from the rim until maximum runout is determined. Measure the gap from the rim to the pointer. A more accurate check is to mount a dial indicator in the positions shown in **Figure 28**.

If the wheel needs major truing, mount the rim (tire and tube removed) on a truing stand to measure runout in both directions (**Figure 29**).

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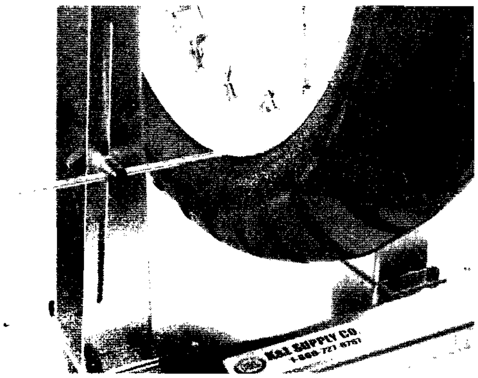

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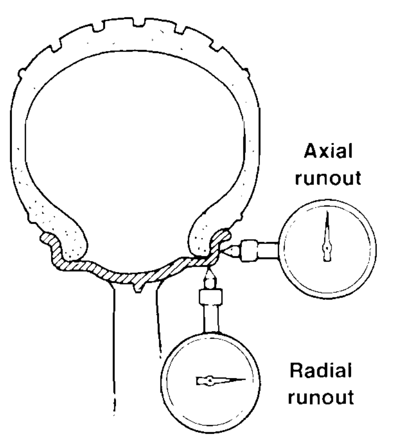

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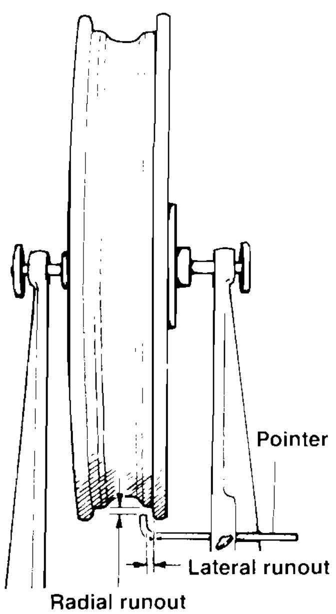


Correcting lateral runout

To move the rim to the left or right of the hub, loosen and tighten the spokes, as shown in **Figure 30**. The rim will move in the direction of the tightened spokes.

Always loosen and tighten spokes equally. Loosen a minimum of three spokes, and then tighten the opposite three spokes. If runout is over a large area, loosen and tighten a larger number of spokes.

Correcting radial runout

To make the rim concentric with the hub, loosen and tighten the spokes, as shown in **Figure 31**. The rim will move in the direction of the tightened spokes.

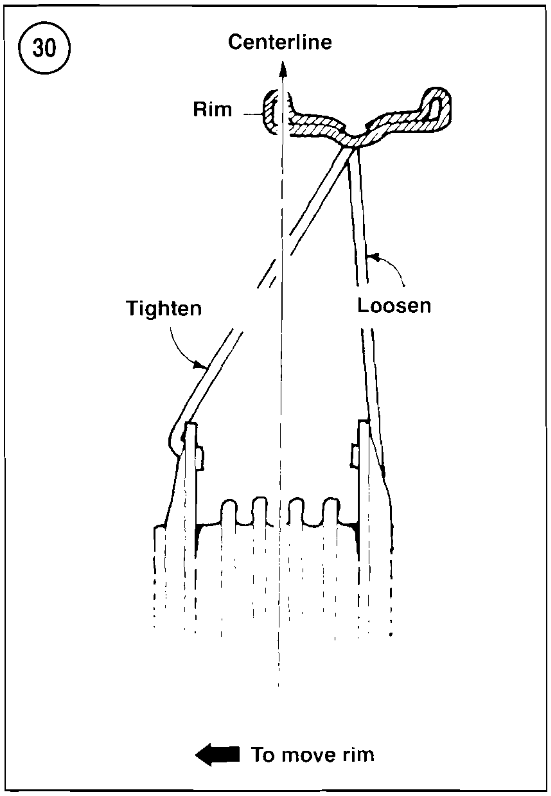
Always loosen and tighten spokes equally. Loosen a minimum of three spokes, and then tighten the opposite three spokes. If runout is over a large area, loosen and tighten a larger number of spokes.

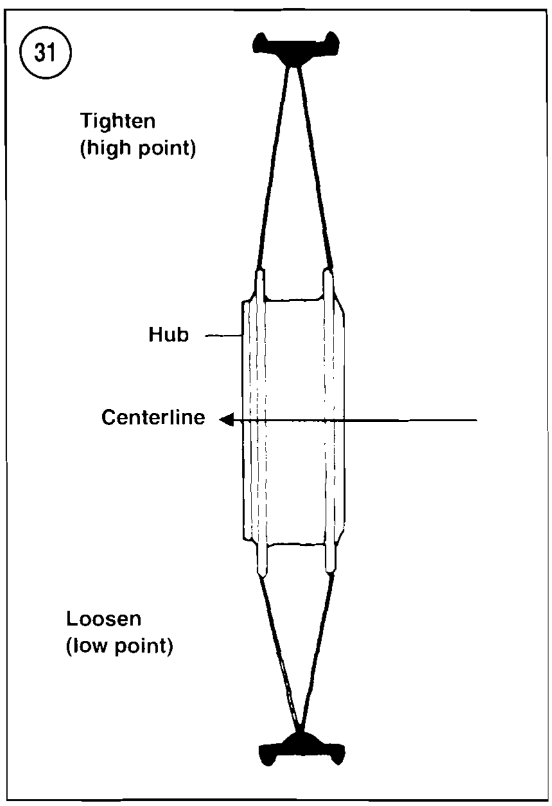
DRIVE CHAIN

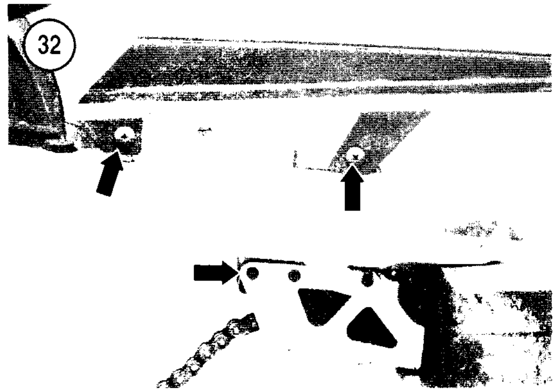
Refer to Chapter Three for drive chain cleaning, lubrication, adjustment and measurement. Refer to **Table 2** in this chapter for chain specifications.

When checking the condition of the chain, also check the condition of the sprockets as described in Chapter Three. If either the chain or sprockets are worn, replace all drive components. Using new sprockets with a worn chain or a new chain on worn sprockets shortens the life of the new part.

When new, the motorcycle is equipped with an endless O-ring type chain. This type of chain is internally lubricated and requires minimal maintenance. Because it is permanently assembled, this increases the reliability of the chain. To remove or







install this type of chain, the swing arm must be partially disassembled so the chain can pass out of the swing arm pivot.

If disassembly of the swing arm is not possible or desired, the chain can be removed using a chain breaker tool. During chain installation, a link riveting tool is used to press and stake the new master link into position. Another option is to install a clip-type master link, which requires no special tools to install. Clip-type master links are the easiest to remove and install. However, they are the least preferred for this type of motorcycle, because operating conditions may cause the clip to come apart, allowing the chain to disassemble.

Inspect the chain currently on the motorcycle and determine which method to use for chain removal.

Chain With No Master Link Removal and Installation

1. Support and raise the motorcycle under the engine. The motorcycle must be stable for wheel and bolt removal.
2. Remove the rear wheel as described in this chapter.
3. Remove the brake hose from the hose guides.
4. With the shock absorber fully extended, support the swing arm.
5. Remove the chain guide and chain guard (**Figure 32**).
6. Remove the lever arms (**Figure 33**) from the swing arm. When the lever arm bolt is removed, the swing arm will pivot freely.
7. Remove the brake pedal spring from the right swing arm pivot bore.
8. Remove the drive sprocket guard and the nut and washer from the swing arm pivot bolt (**Figure 34**).

9. Remove the chain from the drive sprocket. Turn the chain to one side and guide it away from the sprocket, resting the chain on the swing arm.
10. Have an assistant hold the swing arm while the pivot bolt is pulled from the swing arm. If a drift is used to drive out the bolt, avoid damaging the bearing assemblies.
11. Lower the swing arm and remove the chain.
12. If necessary, clean and inspect the chain (Chapter Three).
13. Reverse this procedure to install the chain. Note the following:
   a. Clean and inspect the swing arm and lever arm bores before assembly. Apply waterproof grease to the parts before installing. Do not lubricate the nut or bolt threads.
   b. Check that the chain passes over and under the swing arm (**Figure 35**) and is properly routed to the rear sprocket.
   c. Install the pivot bolts in their correct direction.
   d. Tighten the lever arm bolt to 100 N•m (74 ft.-lb.).
   e. Tighten the swing arm pivot bolt to 77 N•m (57 ft.-lb.).
   f. Adjust the chain (Chapter Three).

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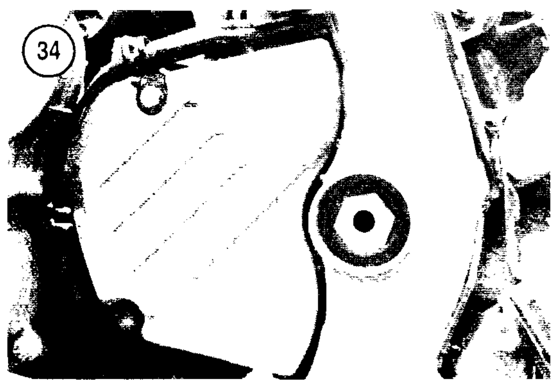

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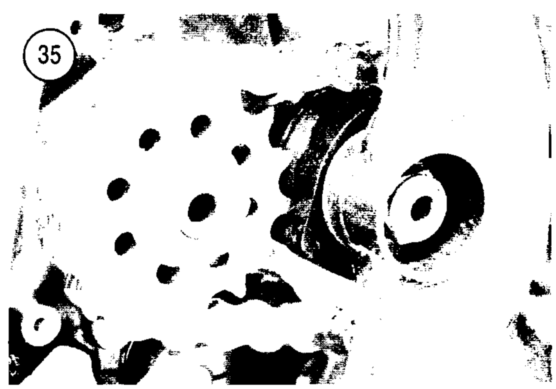

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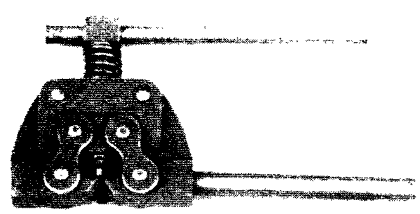

Chain with Press-Fit Master Link Removal and Installation

1. Support the motorcycle so it is stable and the rear wheel is off the ground.
2. Attach the chain breaker tool (**Figure 36**) along the bottom chain run. If possible, find the master link on the chain and remove that link.
3. Attach the tool to the drive chain and drive a link pin from the chain. Account for the O-rings under the side plates.
4. Remove the chain.
5. If necessary, clean and inspect the chain (Chapter Three).
6. To install the chain:
   a. Install an O-ring on both pins of a new master link.
   b. Route the chain, joining the ends on the rear sprocket. If necessary, loosen the rear axle and push the wheel forward to create additional chain free play. Put the transmission into gear to hold the parts in place.

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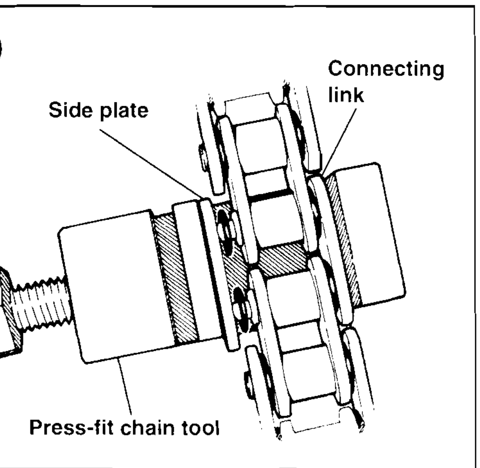

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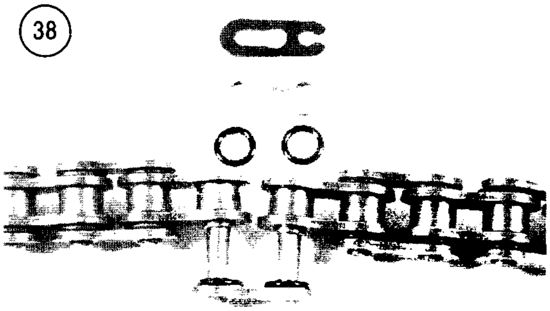

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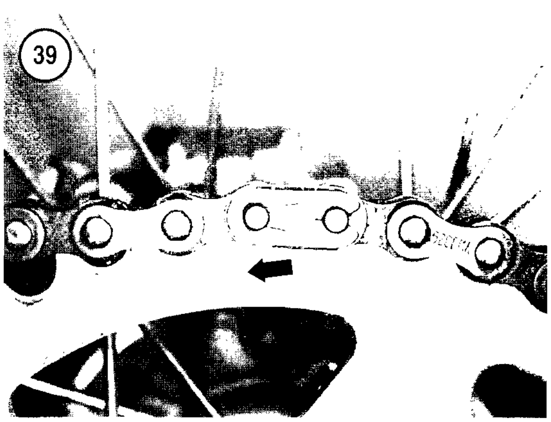

c. Secure the chain ends with the master link. Insert the link from the back side of the chain.
d. Install the outer O-rings, and then place the sideplate on the master link. The identification marks must face out.
e. Stake the link pins using a chain riveting tool (**Figure 37**).
f. Adjust the chain (Chapter Three).

Chain With Clip Master Link Removal and Installation

1. Support the motorcycle so it is stable and the rear wheel is off the ground.
2. Shift the transmission into neutral.
3. Loosen the rear axle and push the wheel forward to create additional chain free play.
4. Find the master link on the chain, and then position the link at the rear sprocket. Put the transmission into gear to hold the parts in place.
5. Remove the spring clip with a pair of pliers, and then remove the sideplate and master link. Account for the O-rings under the side plates (**Figure 38**).
6. Remove the chain.
7. If necessary, clean and inspect the chain (Chapter Three).
8. Too install the chain:
   a. Install an O-ring on both pins of a new master link.
   b. Route the chain, joining the ends on the rear sprocket. Put the transmission into gear to hold the parts in place.
   c. Secure the chain ends with the master link. Insert the link from the back side of the chain.
   d. Install the outer O-rings, and then place the sideplate on the master link. The sideplate identification marks must face out. Seat the sideplate against the O-rings so the groove for the clip is visible.
   e. Seat a new spring clip in the grooves on the master link. The clip must be installed so the closed end of the clip points toward the direction of travel (**Figure 39**).
   f. Adjust the chain (Chapter Three).

SPROCKETS

Check the condition of both sprockets and the drive chain, as described in Chapter Three. If either the chain or sprockets are worn, replace all drive components. Using new sprockets with a worn chain or a new chain on worn sprockets shortens the life of the new part.

Drive Sprocket Removal and Installation

1. Support the motorcycle so it is stable and secure. Keep the rear wheel on the ground.
2. Put the transmission in gear.
3. Remove the sprocket guard.
4. Remove the nut and lockwasher (**Figure 40**). Flatten the lockwasher and loosen the nut securing the sprocket to the shaft. A 30-mm socket is required to loosen the nut. If the rear wheel turns, have an assistant lock the brakes while the nut is loosened.
5. Raise the rear wheel and loosen the rear axle and chain adjusters. Slide the wheel assembly forward and raise the chain while removing the drive sprocket. If necessary, remove the chain from the rear sprocket to create the needed slack.
6. Clean the output shaft and the area around the shaft seal.
7. Twist and remove the output shaft spacer and shaft O-ring (**Figure 41**). A small amount of oil will drip from the engine when the spacer is removed.
8. Inspect the parts (**Figure 42**) as follows:
   a. Inspect the sprocket guard assembly for damage.
   b. Clean and inspect the output shaft spacer. Inspect the inner and outer surfaces that contact the O-ring and crankcase seal. The surfaces should be smooth and free of corrosion or damage.
   c. If the crankcase seal leaks, remove the seal retainer (**Figure 43**) and replace the seal (**Figure 44**) as described in Chapter Five. The seal can be replaced without engine removal.
   d. Install a new O-ring into the shaft spacer, and then apply grease to the seal lip, spacer and O-ring.
   e. Install the output shaft spacer into the seal. The notched edge of the spacer must face in. Check that the spacer O-ring locks onto the shaft and that the crankcase seal fully contacts the outside of the spacer.
9. Reverse this procedure to install the drive sprocket. Note the following:
   a. Install the sprocket with the flat side facing out (**Figure 45**).
   b. Install a new lockwasher with the cupped side facing out (**Figure 46**).
   c. Install the chain on the sprocket before tightening the nut.

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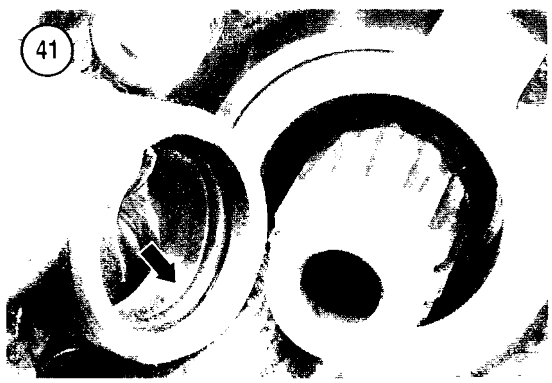

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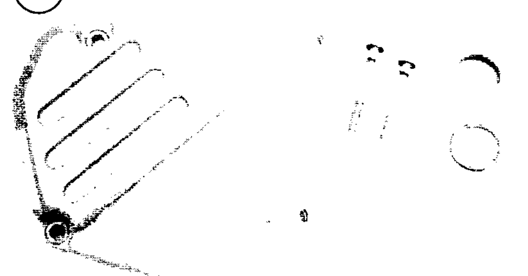

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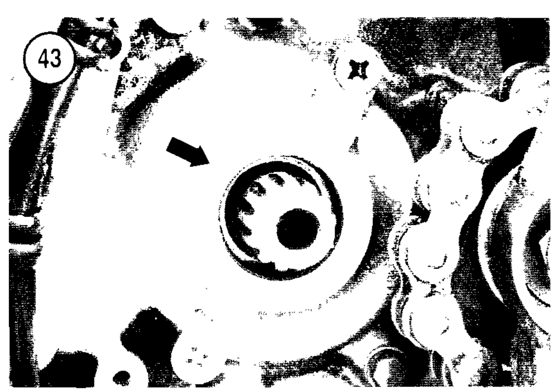

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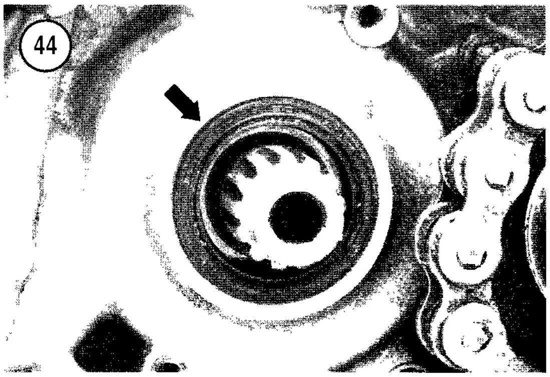

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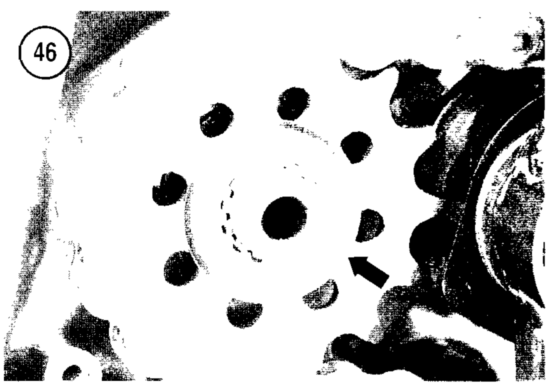

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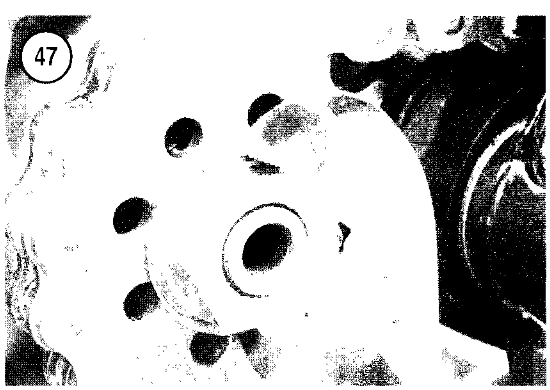

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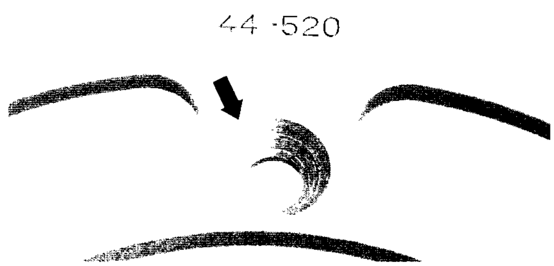


d. Tighten the sprocket nut to 110 N•m (81 ft.-lb.).

e. Flatten the lockwasher against the sprocket nut (**Figure 47**). Channel lock pliers work well in gripping and bending the locknut.

f. Adjust the chain (Chapter Three).

Driven Sprocket Removal and Installation

1. Remove the rear wheel as described in this chapter.

2. Support the wheel so it does not rest directly on the brake disc.

3. Remove the bolts securing the sprocket to the hub.

4. Inspect the sprocket (Chapter Three).

5. Inspect the hub as described in *Rear Wheel* in this chapter.

6. Reverse this procedure to install the driven sprocket and rear wheel. Note the following:

a. Mount the sprocket so the tooth identification number and countersunk bolt holes (**Figure 48**) face out.

b. Tighten the bolts in several passes, working in a crossing pattern. Tighten the bolts to 30 N•m (22 ft.-lb.).

c. Adjust the chain (Chapter Three).

d. Tighten the rear axle nut to 100 N•m (74 ft.-lb.) and install a *new* cotter pin.

TIRES

Removal

CAUTION
When changing a tire, work over a pad to prevent damage to the wheel assembly. Do not allow the wheel to rest on the brake disc.

CAUTION
If the inner tube must be reused, make sure not to pinch the tube.

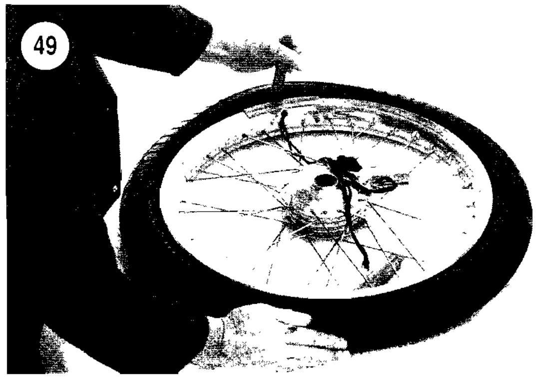
1. Remove the valve stem core and deflate the tire.
2. Press the entire bead on both sides of the tire into the rim.
3. Lubricate the beads with soapy water.
4. Insert a tire iron under the bead, next to the valve stem (**Figure 49**). Pry the bead over the rim, while forcing the bead on the opposite side of the tire into the rim.
5. Insert a second tire iron next to the first (**Figure 50**). While holding the tire with one iron, work around the perimeter of the rim with the second iron, prying the tire over the rim.
6. Remove the nut from the valve stem and remove the inner tube from the tire (**Figure 51**).
7. Pry the second tire bead over the rim (**Figure 52**).

Inspection

1. Inspect the inside and outside of the tire for damage or objects that could cause a puncture.
2. Inspect the rim for damage.
3. Make sure the spokes do not protrude through the spoke nipples.
4. Inspect the rim band for deterioration. If a new rim band is installed, place the roughest side of the band against the rim. If water is entering the rim, an alternative to the rim band is to wrap the rim with two revolutions of duct tape. Punch a hole in the tape for the valve stem.

Installation

WARNING
Depending on the make and type of tire installed, check the sidewall to determine if it must be installed in a specific direction. A direction arrow is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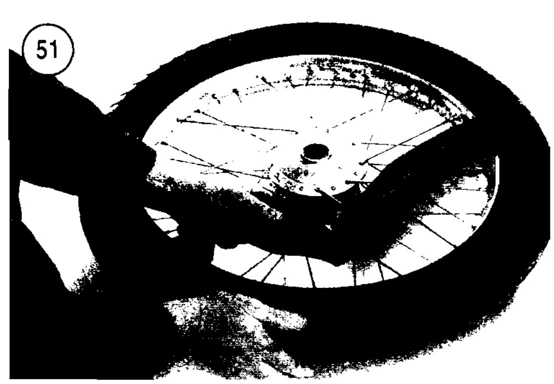
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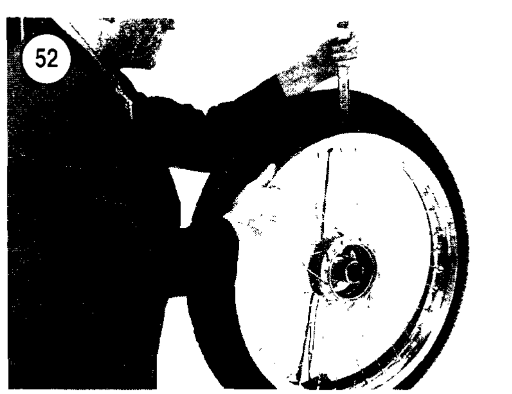
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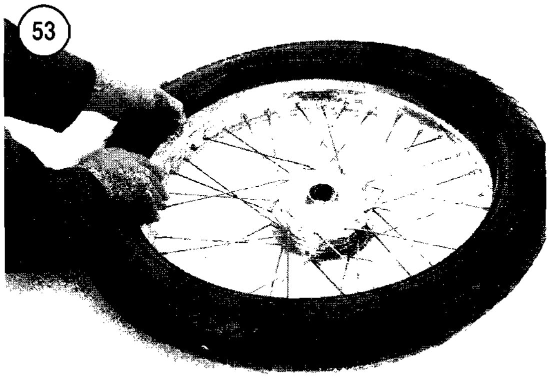

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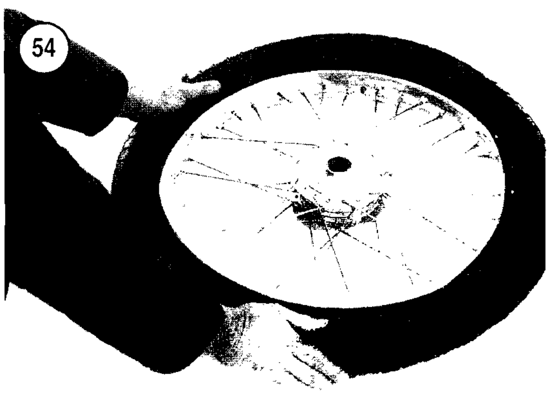

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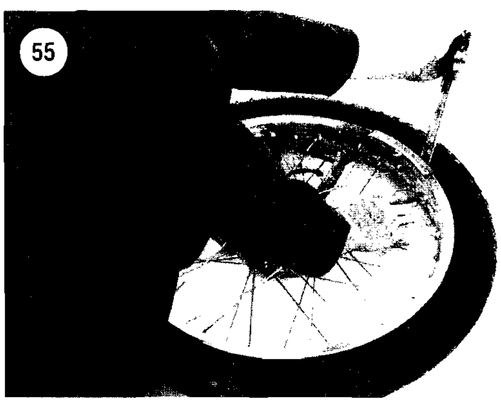

often embossed in the sidewall. Also check for a dot or mark that indicates the light side of the tire. This mark should align with the valve stem.

NOTE

Installation is easier if the tire is warm and pliable. This can be achieved by placing the tire in the sun or an enclosed vehicle.

1. Sprinkle talcum powder around the interior of the tire casing. Distribute the powder so it is on all surfaces that touch the inner tube. The powder minimizes chafing and helps the tube distribute itself when inflated.
2. Lubricate one of the tire beads, and then push it onto the rim (**Figure 53**). Use a tire iron to lever the final section of bead onto the rim.
3. Install the core into the valve stem, and then insert the tube into the tire. Check that the tube is not twisted as it is tucked into the tire. Install the valve stem nut loosely.
4. Inflate the tube until it is rounded and no longer wrinkled. Too much air makes tire installation difficult and too little air increases the chance of pinching the tube.
5. Lubricate the second tire bead, and then start installation opposite the valve stem. Hand-fit as much of the tire as possible (**Figure 54**). Before final installation, check that the valve stem is straight and the inner tube is not pinched. If necessary, relubricate the bead. Use tire irons to hold and pry the remaining section of bead onto the rim (**Figure 55**).
6. Check the bead for uniform fit on both sides of the tire.

WARNING

If the tire does not seat at the recommended pressure, do not continue to overinflate the tire. Deflate the tire and reinflate to the recommended pressure. Relubricate the beads if necessary.

7. Lubricate both beads and inflate the tire to seat the beads onto the rim. Check the sidewall for a recommended seating pressure. If none is indicated, inflate the tire to the highest recommended pressure on the sidewall.
8. Finger-tighten the valve stem nut.
9. Bleed the tire pressure to the recommended setting in **Table 1**.
10. Install the valve stem cap.
11. Balance the wheel as described in this section.

Wheel Balancing

Check the wheel balance when a new tire is installed or the wheel is removed. An unbalanced wheel shortens tire life and puts avoidable wear on the wheel bearings. Ride quality is also diminished.

Do not balance a wheel that has damaged bearings. Balance will not be accurate. Replace the bearings before balancing.

1. Place the wheel and axle assembly in a truing stand or a similar fixture that allows the axle to be level and the wheel to freely spin (**Figure 56**). Install the necessary spacers to keep the wheel from moving laterally.
2. Spin the wheel and allow it to come to a complete stop. Mark the sidewall at the top of the tire. This is the light side of the wheel. Repeat the step several times to ensure an accurate reading. If the wheel consistently stops at a different location, balance is acceptable and additional weight is not required.
3. When the light side of the wheel is verified, lightly clamp a weight (**Figure 57**) to the spoke nearest the light mark. Start with the smallest increment of weight. Adhesive-backed weights are not recommended for off-road conditions.
4. Continue to spin and check the tire for balance. Continue to add/subtract weight to the spokes until the wheel consistently stops at a different location. When balance is achieved, tightly clamp the weight(s) to the spoke(s).

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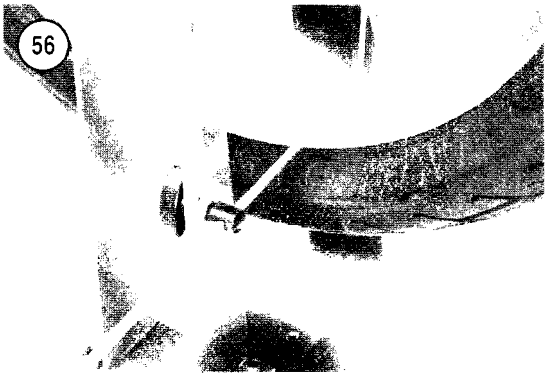

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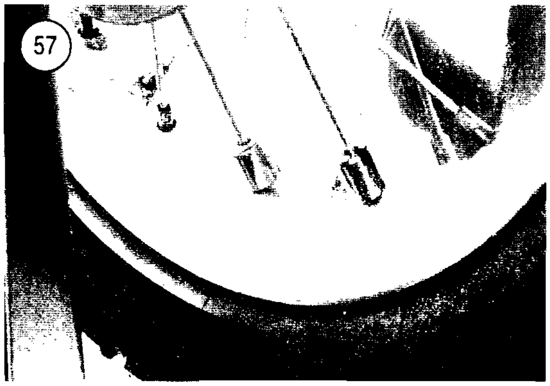


Table 1 FRONT AND REAR WHEEL SPECIFICATIONS

Axle runout	0.25 mm (0.01 in.)
Tire pressure	
E models	
Front	100 kPa (15 psi)
Rear	100 kPa (15 psi)
S models	
Front	125 kPa (18 psi)
Rear	150-175 kPa (22-25 psi)
SM models	
Front	175 kPa (25 psi)
Rear	220-225 kPa (29-33 psi)
Tire size	
Front	
E models	80/100-21 51M
S models	80/100-21 51P
SM models	120/70R17 58H
Rear	
E models	110/100-18 64M
S models	120/90-18 65P
SM models	140/70R17 66H
Wheel rim runout (radial and lateral)	2.0 mm (0.08 in.)
Wheel rim size	
E and S models	
Front	21 × 1.60
Rear	18 × 2.15
SM models	
Front	17 × 3.5
Rear	17 × 4.5

Table 2 DRIVE CHAIN AND SPROCKET SPECIFICATIONS

Drive chain	
Size	RK520KZO
Type	O-ring
Number of links	112
Drive chain free play	40-50 mm (1.6-2.0 in.)
Drive chain length wear limit (20 pitch/21 pins)	319 mm (12.6 in.)
Sprocket sizes (standard, front/rear teeth)	
E models	14/47
S and SM models	15/44

Table 3 WHEEL AND DRIVE TRAIN TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Axle nut			
Front*			
E and S models			
Initial	20	–	15
Final	42	–	31
SM models			
Initial	20	–	15
Final	39	–	29
Rear	100	–	74
Drive chain buffer bolts	40	–	30
Drive sprocket nut	110	–	81
Driven sprocket bolts	30	–	22
Front axle pinch bolts	18	–	13
Lever arm bolt	100	–	74
Spokes	3	27	–
Swing arm pivot bolt	77	–	57

*Refer to the text for the tightening procedure.

CHAPTER TWELVE

FRONT SUSPENSION AND STEERING

This chapter provides procedures for the front suspension and steering components.

Refer **Tables 1-4** to the tables at the end of the chapter for specifications.

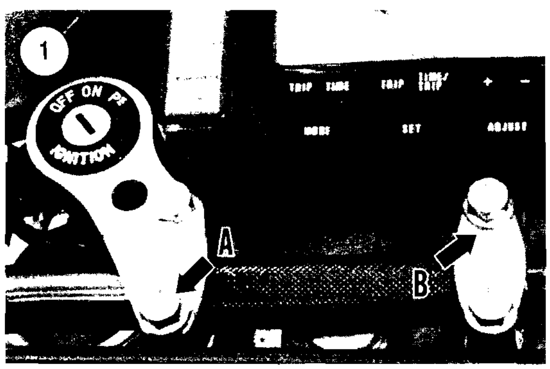
HANDLEBAR

Adjustment, Removal and Installation

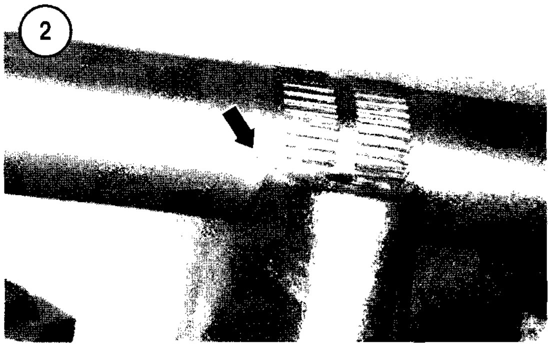
If the handlebar requires repositioning, adjustment can be made by loosening the lower holder bolts. Pivot the handlebar to the desired position, and then tighten the bolts on E and S models to 23 N•m (17 ft.-lb.) and to 45 N•m (33 ft.-lb.) on SM models.

If complete disassembly of the handlebar is necessary, disassemble the handlebar before removing it from the holders. If the handlebar assembly only needs to be moved away from the steering stem, disassembly of the handlebar is not required. Remove and secure the handlebar as follows:

1. Support the motorcycle so it is stable and secure. If installed, cover the fuel tank.
2. Remove the bolts from the holders (A, **Figure 1**).
3. Secure the handlebar either forward or back from the holders. Keep the brake fluid reservoir upright.



4. Clean the handlebar and holders.
5. Reverse this procedure to install the handlebar. Note the following:
   a. Position the holder caps so the punch marks (B, **Figure 1**) point forward.
   b. Lightly tighten the upper holder bolts, and then the lower holder bolts. Check the riding position and adjust the handlebar as necessary. If the stock handlebar position is desired, align the punch mark on the handlebar with the top edge of the lower holders (**Figure 2**).
   c. Tighten the upper handlebar bolts and then the lower bolts. Refer to **Table 4** for torque specifications.



Inspection

WARNING
Never straighten, weld or heat a damaged handlebar. The metal can weaken and possibly break while riding the motorcycle.

1. Inspect the handlebar for cracks, bends or other damage. If the handlebar is made of aluminum, check closely where the handlebar is clamped to the fork. Also check at the clamping points for the clutch lever, master cylinder and throttle housing. If cracks, scores or other damage are found, replace the handlebar. Damage in these areas may cause the handlebar to break.
2. Inspect the threads on the mounting bolts and in the holders. Clean all residue from the threads. Replace damaged bolts.
3. The handlebars on SM models are rubber mounted in the upper fork bridge. Refer to **Figure 3**. Check the rubber bushings of the handlebar holders for cracks, wear or other damage. Replace the rubber bushings if they are damaged or there is any play in the handlebar holders.
4. Clean the handlebar and holders with brake parts cleaner. Use a stiff brush to clean the residue from the knurled areas on the handlebar. Use a soft brush on aluminum handlebars.

STEERING STEM AND HEAD

The steering stem pivots in the steering head on tapered roller bearings at the top and bottom of the steering stem. The inner races (mounted in the frame) and the lower bearing (mounted on the steering stem) should not be removed unless they require replacement. Lubricate the bearings as specified in Chapter Three. Before disassembling the steering head, perform the *Steering Play Inspection* procedure in this section to determine if the bearings and races are worn, or if they require adjustment.

Steering Play Inspection

Steering adjustment removes play in the steering stem and bearings and allows the steering stem to operate with free rotation. Excessive play or tightness in the steering stem makes steering imprecise and causes bearing damage. These conditions are usually caused by improper bearing lubrication and steering adjustment. Improperly routed control cables can also affect steering operation.

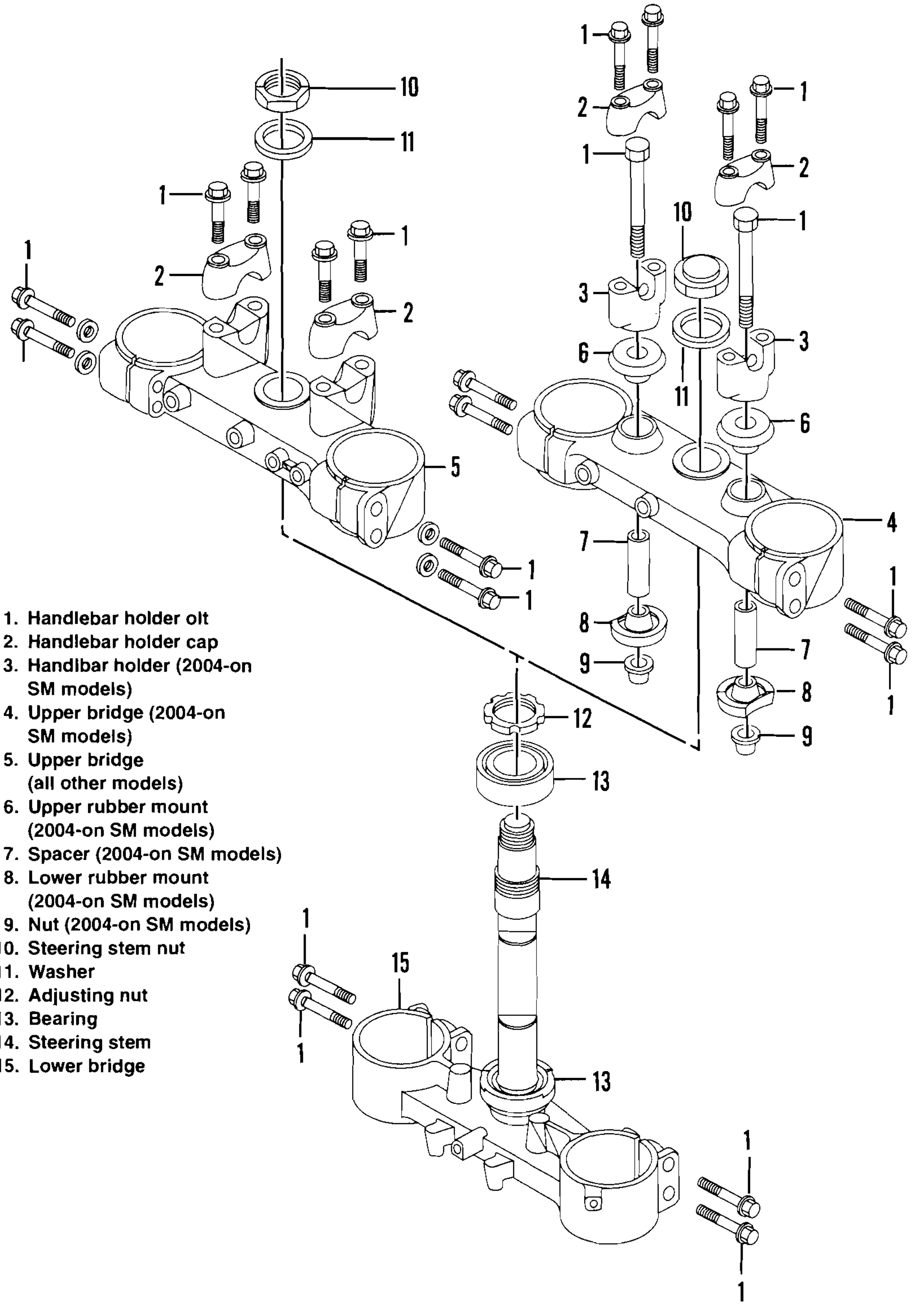
1. Support the motorcycle so the front wheel is off the ground.
2. Turn the handlebar from lock to lock and check for roughness or binding. Movement should be smooth with no resistance.
3. Position the handlebar so the front wheel points straight ahead. Lightly push the end of the handlebar. The front end should fully turn to the side from the center position, under its own weight. Check in both directions. Note the following:
   a. If the steering stem moves roughly or stops before reaching the frame stop, make sure all cables are routed properly.
   b. If cable routing is correct and the steering binds, the steering adjustment may be too tight. This condition can also occur if the bearings and races require lubrication or replacement. Perform the remaining checks.
   c. If the steering stem moves from lock to lock correctly, perform Step 4 to check for excessive looseness.
4. Position the fork legs straight ahead. Have an assistant hold the motorcycle, and then grasp the fork legs near the axle. Lever the fork legs in all directions and feel for play.
   a. If movement can be felt at the steering stem, tighten the steering as described in *Assembly and Adjustment* in this section.
   b. If no excessive movement is felt and the steering turns from lock to lock correctly, the steering is adjusted properly and in good condition.

Disassembly

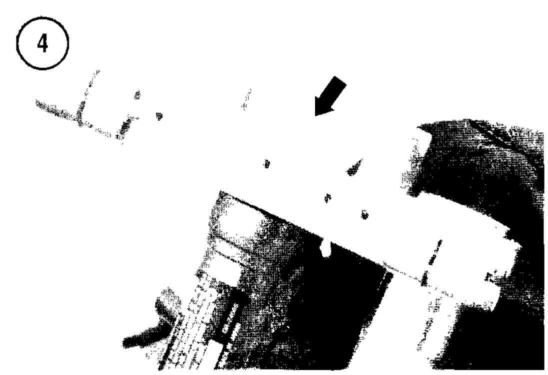
Refer to **Figure 3**.

1. Remove the front wheel (Chapter Eleven).

(3) **STEERING STEM**



1. Handlebar holder olt
2. Handlebar holder cap
3. Handlbar holder (2004-on SM models)
4. Upper bridge (2004-on SM models)
5. Upper bridge (all other models)
6. Upper rubber mount (2004-on SM models)
7. Spacer (2004-on SM models)
8. Lower rubber mount (2004-on SM models)
9. Nut (2004-on SM models)
10. Steering stem nut
11. Washer
12. Adjusting nut
13. Bearing
14. Steering stem
15. Lower bridge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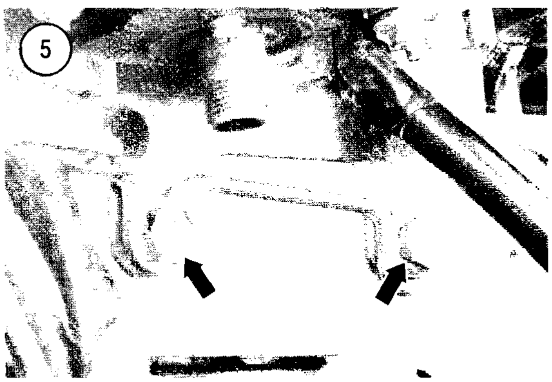
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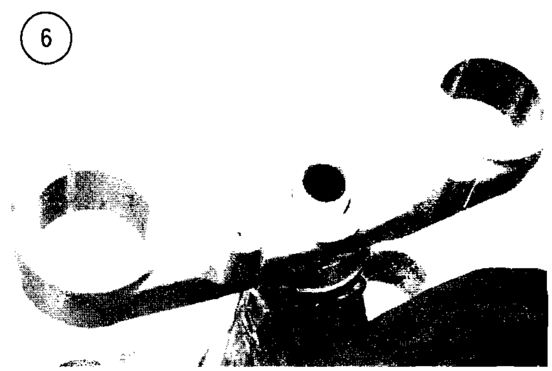
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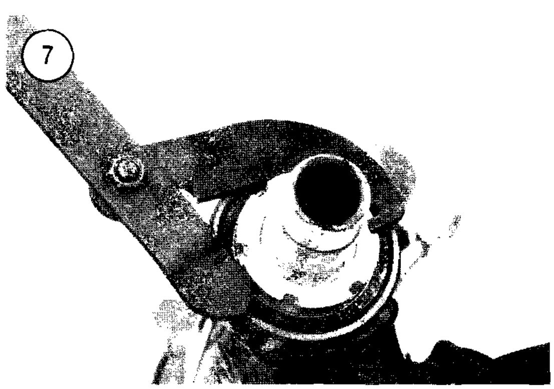
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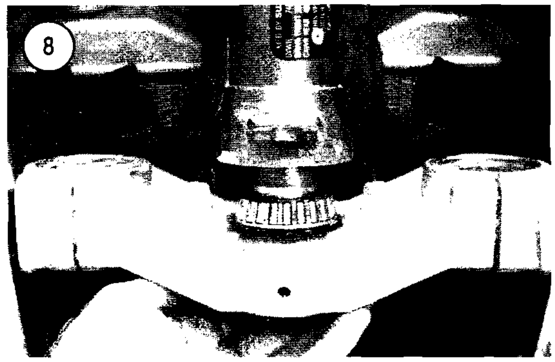
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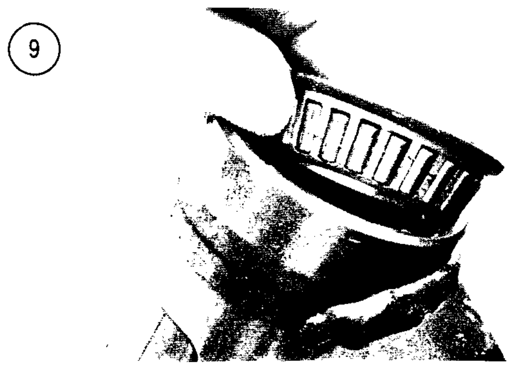
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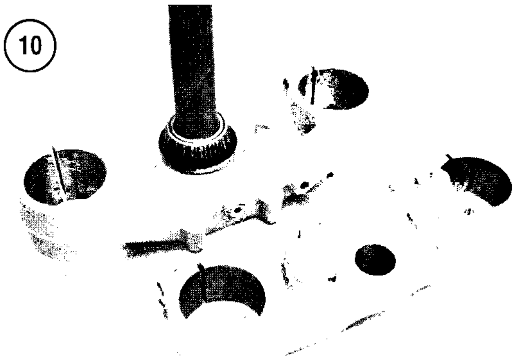
2. Remove the the front fender.
3. Remove the handlebar as described in this chapter. Loosen the stem nut (**Figure 4**) before removing the fork legs from the steering stem assembly.
4. Remove the fork legs as described in this chapter.
5. On S and SM models, disconnect the electrical connectors leading to the gauge cluster.
6. Remove the bolts (**Figure 5**) securing the odometer or gauge cluster.

NOTE
A two-piece stem nut wrench (Suzuki part No. 09940-14911 and part No. 09940-14960) is available from a dealership.

7. Remove the stem nut, washer and upper fork bridge (**Figure 6**).
8. Hold the steering stem so it cannot fall, and then remove the adjuster nut with a pin spanner wrench (**Figure 7**).
9. Lower the steering stem assembly out of the steering head (**Figure 8**).
10. Remove the top steering head bearing (**Figure 9**).



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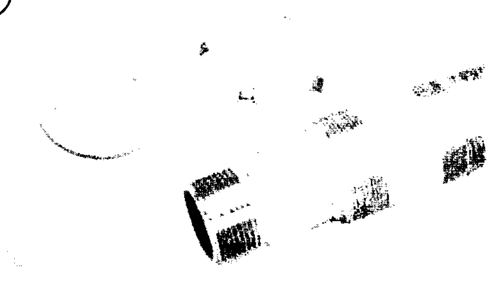

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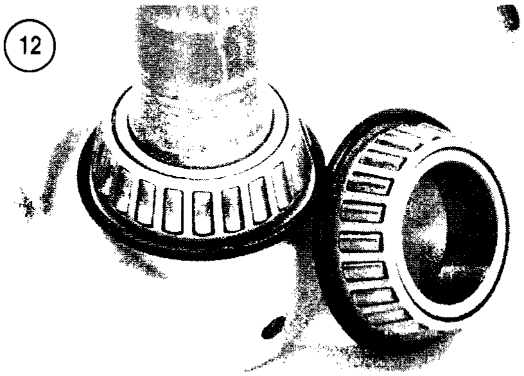

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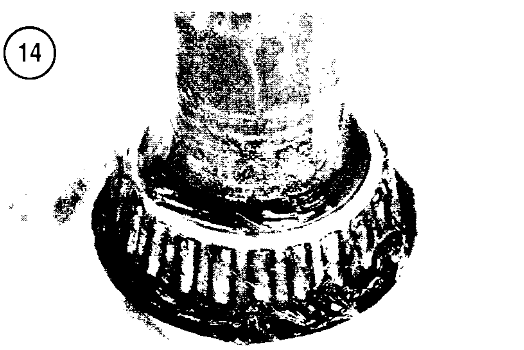
Inspection

1. Clean the bearings and races with solvent.
2. Inspect the steering head for cracks or other damage. If damage is evident, have a qualified welding shop repair the frame.
3. Inspect the steering stem assembly (**Figure 10**) for cracks or damage.
4. Inspect the steering stem threads, stem nut, washer and adjuster nut for damage (**Figure 11**).
5. Inspect the bearings for pitting, flaking, corrosion or discoloration (**Figure 12**). The outer seal must not be damaged. If the bearings are corroded or if water is in the bearings, the bearing seals are leaking.
6. Inspect the bearing races in the frame for pitting, galling or corrosion (**Figure 13**). If a race is worn or damaged, replace both races and bearings as described in this section.
7. If reusing the bearings, pack the bearings and coat the stem with waterproof grease (**Figure 14**).



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Outer Bearing Race Replacement

The bearing races are recessed in the bores, and installation requires a steering race installer (Suzuki part No. 09941-34513, or equivalent). **Figure 15** shows an

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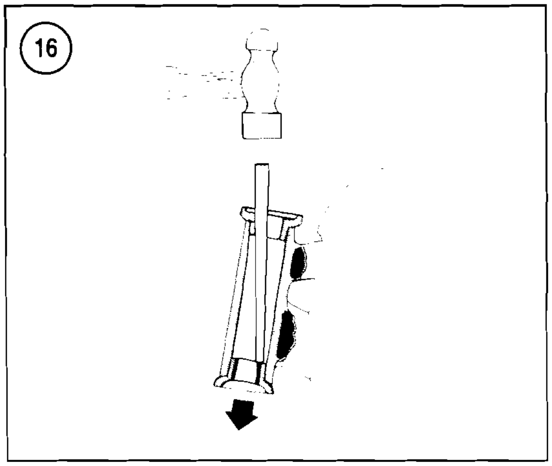

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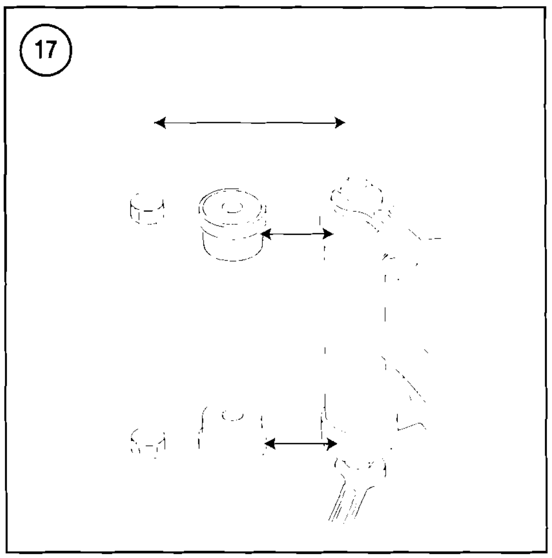

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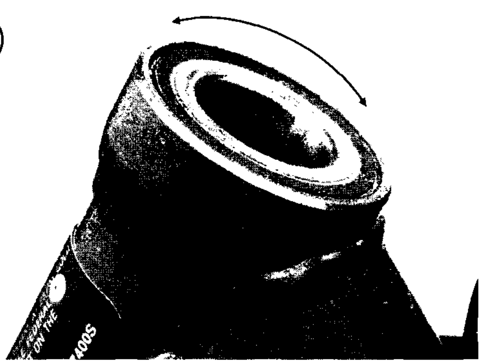

aftermarket bearing race tool with multiple collars for use in different sized bores on a variety of motorcycles (*www.parktool.com*). A similar tool can be fabricated from threaded rod and the correct sized discs (drivers).

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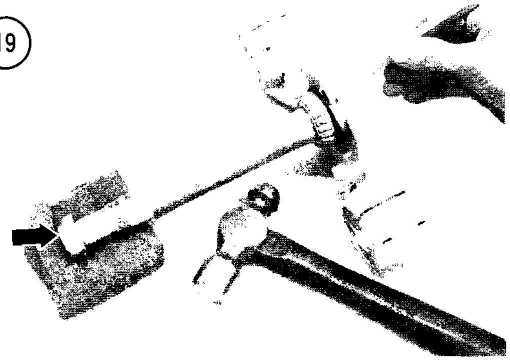

The drivers must fit at the outside edge of the races and still be capable of entering the steering head bore without contacting the race surfaces.

1. Insert an aluminum drift into the steering head and position it on the edge of the lower race (**Figure 16**). Carefully drive out the race. To prevent binding, make several passes around the perimeter of the race. Repeat the procedure to remove the upper race.
2. Clean the race bores and inspect them for damage.
3. To install the upper race, perform the following:
   a. Place a new, lubricated race squarely into the bore opening with its wide side facing out.
   b. Assemble the tool, seating a driver at the outer edge of the race. The lower driver can rest on the perimeter of the steering head or in the stepped bore (**Figure 17**).
   c. Hold the lower nut with a wrench and tighten the upper nut to seat the race.
   d. Remove the tool from the frame and make sure the race is fully seated.
   e. Repeat the procedure to install the remaining race. During installation, do not allow the driver or shaft to contact the face of the first race because damage will occur.
4. Lubricate the races with waterproof grease.
5. Check the fit and operation of the bearings in the races (**Figure 18**).

Steering Stem Bearing Replacement

The steering stem bearing is a press-fit.

1. Thread the stem nut onto the steering stem to protect the threads (**Figure 19**).

WARNING
Wear safety glasses when performing Step 2.

2. Stabilize the steering stem, and then remove the bearing and seal using a hammer and chisel (**Figure 19**). To prevent binding, make several passes around the perimeter of the bearing.
3. Clean and inspect the steering stem.
4. Pack the new bearing with waterproof grease.
5. Slide the new bearing onto the steering stem.
6. Drive the bearing into place as follows:
   a. Support the steering stem directly below the bearing.
   b. Slide a bearing driver or long pipe over the steering stem, seating the tool on the *inner* bearing race (**Figure 20**). If available, a press can be used to drive the bearing.
   c. Drive and seat the bearing onto the steering stem.

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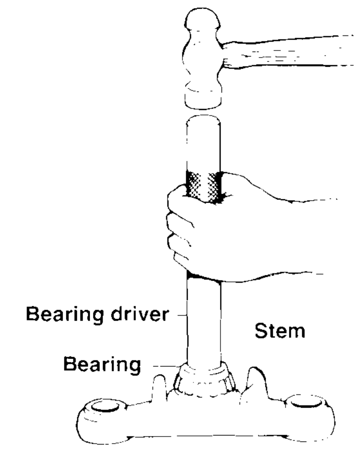

Assembly and Adjustment

Refer to **Figure 3**.

1. Make sure the upper and lower bearing races are seated in the frame.
2. Make sure the bearings and races are lubricated with waterproof grease.
3. Guide the steering stem through the bottom of the frame.
4. Install the upper bearing into its race.
5. Install and finger-tighten the adjuster nut.
6. Seat the bearings as follows:
   a. Tighten the adjuster nut with a pin spanner wrench (**Figure 21**) to seat the bearings. Tighten the nut to 45 N•m (33 ft.-lb.).
   b. Turn the steering stem from lock to lock a minimum of five times to seat the bearings.
   c. Loosen the adjuster nut 1/4 - 1/2 turn and check for horizontal and vertical play. Adjust the nut until play is eliminated in both directions. If properly adjusted, the steering stem should pivot to the lock positions under its own weight, after an initial assist.
7. Install the upper fork bridge, washer and stem nut. Finger-tighten the nut. It will be tightened after the fork legs are installed.
8. Install the odometer or gauge cluster.
9. On S and SM models, connect the electrical connectors leading to the gauge cluster.
10. Install the fork legs as described in this chapter. When installing the legs, tighten only the upper bridge pinch bolts (A, **Figure 22**). The lower bridge pinch bolts (B, **Figure 22**) must remain loose because the bridge moves slightly when the stem nut is tightened.

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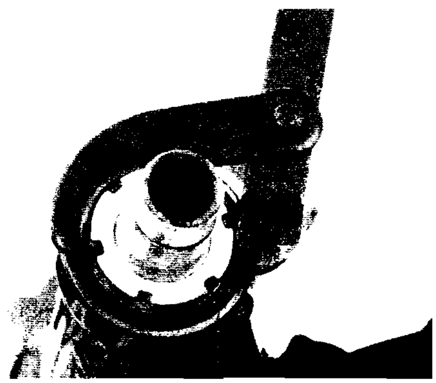

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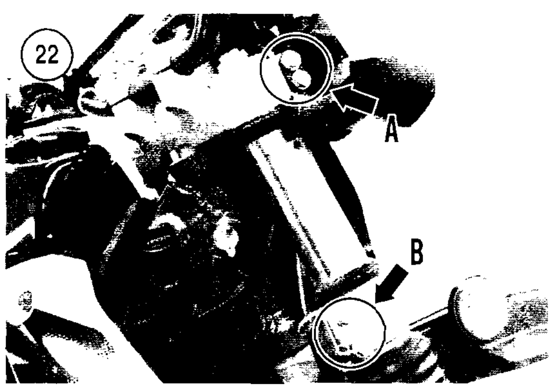
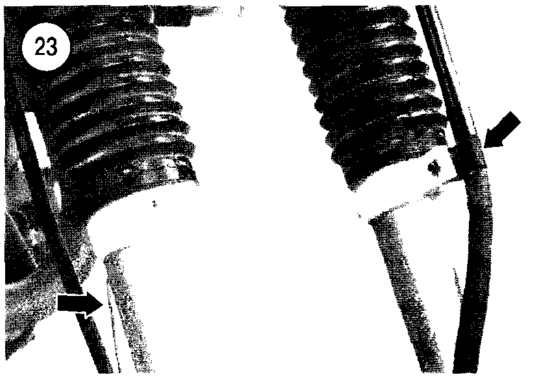
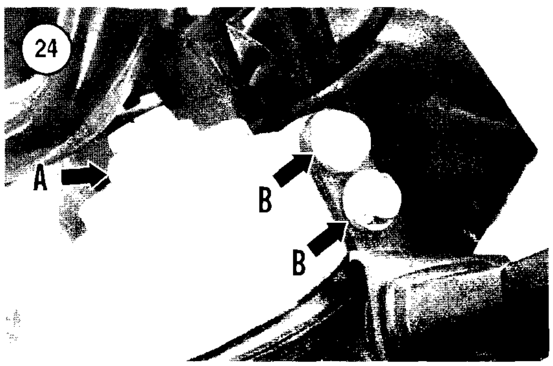


11. Tighten the steering stem nut to 90 N•m (66 ft.-lb.).
12. Tighten the lower bridge pinch bolts (B, **Figure 22**) just enough to grip the fork legs.
13. Check bearing play again as follows:





a. Turn the steering stem from lock to lock. The steering stem should turn smoothly and freely. If binding is felt, the steering stem is too tight.
b. Grasp the fork legs near the axle. Lever the fork legs in all directions and feel for play. If play is felt or heard, the steering stem is too loose. If necessary, perform substeps c-h to eliminate or add play in the steering stem.
c. Loosen the lower bridge pinch bolts (B, **Figure 22**).
d. Loosen the steering stem nut.
e. Loosen or tighten the adjust nut, as necessary.
f. Tighten the stem nut to 90 N•m (66 ft.-lb.).
g. Tighten the lower bridge pinch bolts.
h. Recheck bearing play. Adjust if necessary.

14. Tighten the lower bridge pinch bolts to 32 N•m (24 ft.-lb.).
15. Install the handlebar as described in this chapter.
16. Install the front fender.
17. Install the front wheel (Chapter Eleven).

FRONT FORK (E AND S MODELS)

Removal

1. Support the motorcycle so it is stable and the front wheel is off the ground.
2. Remove the front wheel (Chapter Eleven).

CAUTION

Do not allow the brake caliper to hang by the hose. Support it so the brake hose is not damaged. When the caliper is removed, insert a spacer block between the brake pads to prevent the pistons from being forced out if the brake lever is operated.

3. Remove the brake caliper (Chapter Fourteen).
4. Remove the brake hose guide and speedometer/odometer cable guide from the fork (**Figure 23**). Retie the caliper away from the fork.
5. If removing the steering stem assembly:
   a. Remove the handlebar as described in this chapter
   b. Loosen the steering stem nut.
6. If disassembling the fork legs, loosen (do not remove) the fork caps (A, **Figure 24**). Preferably, remove the handlebar and use a socket or box wrench to loosen the caps.

7A. On S models, disconnect the headlight wire connector.

7B. On E models, remove the headlight and straps from the fork legs.

8. Loosen the upper bridge pinch bolts on each fork leg (B, **Figure 24**).
9. Loosen the lower bridge pinch bolts (**Figure 25**), and then twist and remove the fork leg from the bridges. Repeat for the remaining fork tube. On S models, remove the headlight assembly (**Figure 26**) when removing the second fork leg.
10. Clean the fork legs, fork bridges and clamping surfaces.

11. Remove and clean the pinch bolts. Replace damaged bolts.
12. If performing a routine fork oil change, partially disassemble the fork as described in the appropriate *Front Fork Service* section in this chapter.

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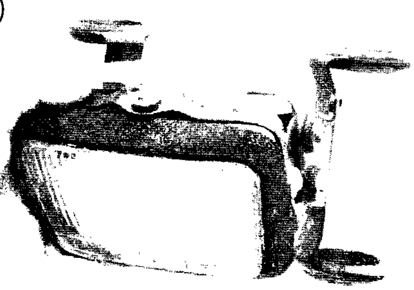

Installation

NOTE

If the steering stem assembly was removed, refer to installation and adjustment procedures in this chapter. The steering stem must be correctly adjusted before the fork legs are locked into place.

1. Install the left fork leg (with brake caliper mount) into the lower and upper fork bridges. On S models, install the headlight when installing the fork legs.
2. Adjust the fork leg clearance at the upper fork bridge. Set the top surface of the upper bridge 5 mm (0.2 in.) below the top edge of the fork tube (**Figure 27**). Note the following:
   a. Do not include the fork cap in the measurement.
   b. Some fork legs are machined with a reference line indicating the 5 mm setting.
   c. On cartridge fork legs, make sure the air release valve (**Figure 28**) is accessible.

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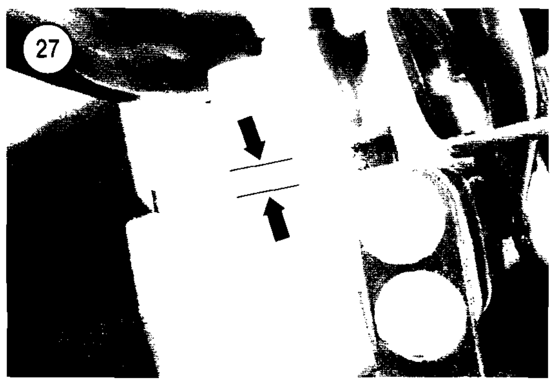

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3. Lightly tighten the upper (B, **Figure 24**)and lower bridge bolts (**Figure 25**) to hold the fork leg in place. Repeat Steps 1-3 to install the right fork leg.
4. Tighten the bridge pinch bolts.
   a. Tighten the lower bolts to 32 N•m (24 ft.-lb.).
   b. Tighten the upper bolts to 30 N•m (22 ft.-lb.).
5. On E models, install the headlight and connect the wiring.
6. If the fork legs were disassembled, tighten the fork caps (A, **Figure 24**) to 23 N•m (17 ft.-lb.).
7. Install the brake hose guide and speedometer/odometer cable guide onto the fork (**Figure 23**).
8. Install the brake caliper (Chapter Fourteen).
9. Install the front wheel (Chapter Eleven).
10. If the fork legs were rebuilt, align the fork boots and tighten the upper clamp. The vertical holes in the boots should face the rear.
11. If necessary, refer to **Table 3** for the standard fork settings.

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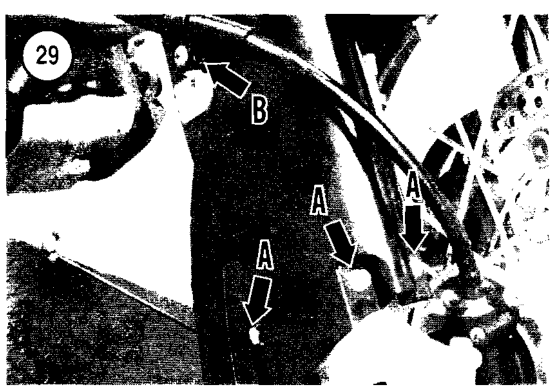

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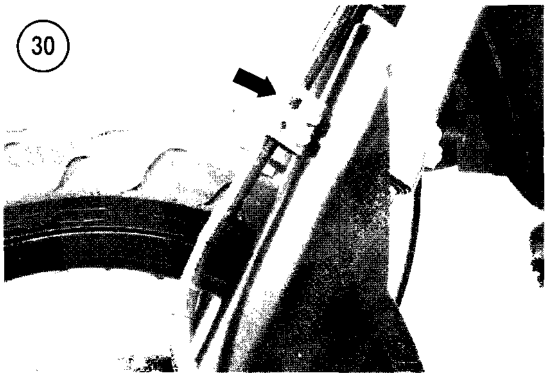

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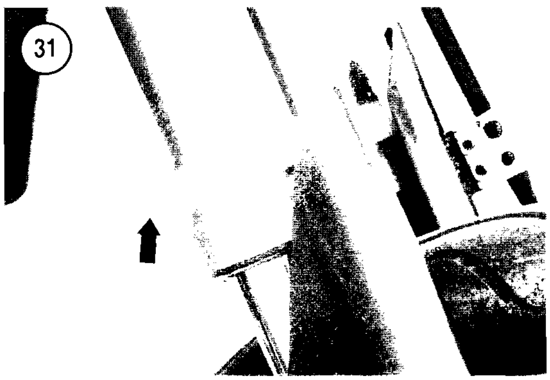

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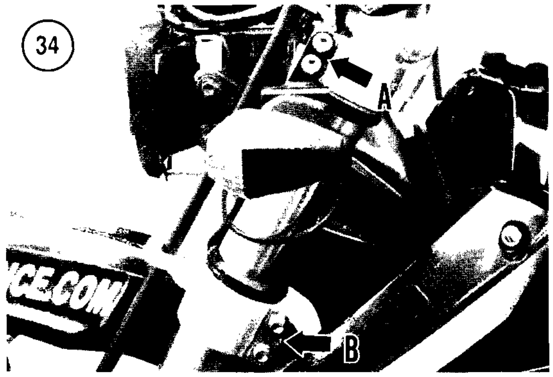


FRONT FORK (2005-ON SM MODELS)

Removal

1. Support the motorcycle so it is stable and the front wheel is off the ground.
2. Remove the bolts from the bottom of the fork protector (A, **Figure 29**).
3. Remove the brake hose guide (**Figure 30**) and speedometer odometer cable guide from the fork (B, **Figure 29**).
4. Loosen the bolt on the fork protector guide (**Figure 31**). Rotate the fork protector and guide (**Figure 32**) to the outside of the fork leg and slide the fork protector off the fork leg.
5. Remove the front wheel (Chapter Eleven).

CAUTION
Do not allow the brake caliper to hang by the brake hose. Support it so the brake hose is not damaged. When the caliper is removed, insert a spacer block between the brake pads to prevent the pistons from being forced out if the brake lever is operated.

6. Remove the front caliper (Chapter Fourteen).
7. If removing the steering stem assembly:
   a. Remove the handlebar as described in this chapter.
   b. Loosen the steering stem nut before removing the fork legs.
8. If disassembling the fork legs, loosen, but do not remove, the fork caps (**Figure 33**).
9. Loosen the upper bridge pinch bolts on each fork leg (A, **Figure 34**).
10. Loosen the lower bridge pinch bolts (B, **Figure 34**).

11. Pull the fork legs from the bridges. Twist them if necessary. It is not necessary to remove the headlight to remove the fork legs.
12. Clean the fork legs, fork bridges and clamping surfaces.
13. Remove and clean the pinch bolts. Replace any damaged bolts.
14. If performing a routine fork oil change, partially disassemble the fork as described in *Front Fork Service (2005-on SM models)* in this chapter.

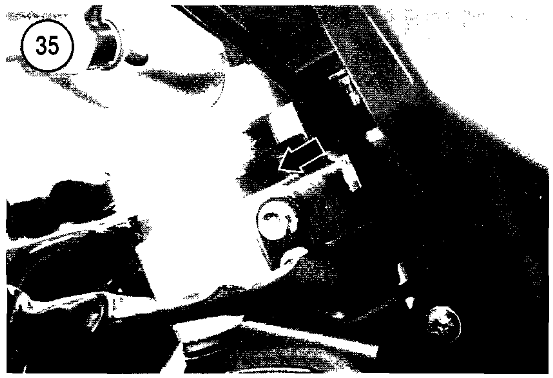
Installation

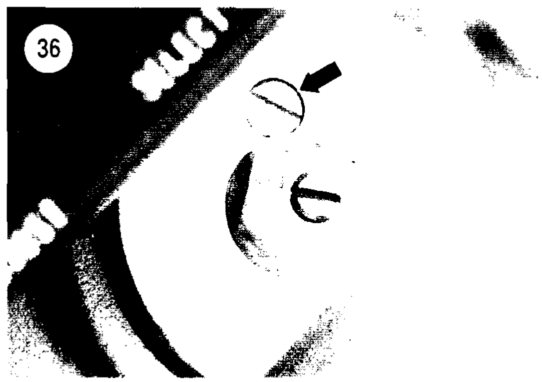
NOTE
*The steering stem must be correctly adjusted before the fork legs are locked into place. Refer to **Steering Head and Stem** in this chapter.*

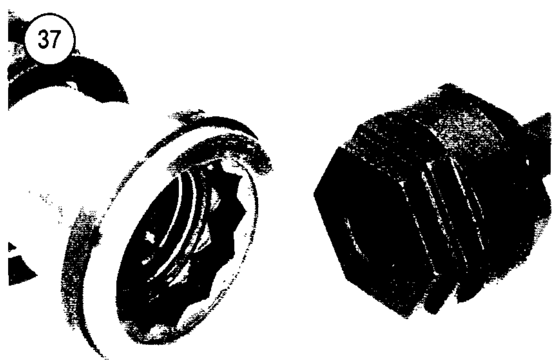
1. Install the left fork leg with the brake caliper mount in the lower and upper fork bridges. Install the fork through the openings of the headlight bracket while installing the fork legs.
2. Adjust the fork leg height at the upper fork bridge. Align the line on the fork with the top surface of the fork bridge (**Figure 35**). Make sure the air release valve is accessible (**Figure 36**).
3. Lightly tighten the upper (A, **Figure 35**) and lower pinch bolts (B) to hold the fork leg in place. Repeat Steps 1-3 to install the right fork leg.

NOTE
If the fork was disassembled for service, tighten the fork cap to specification before tightening the upper fork bridge pinch bolts.

4. Tighten the upper and lower pinch bolts to 23 N•m (17 ft.-lb.).
5. Install the front brake caliper (Chapter Fourteen).
6. Install the front wheel (Chapter Eleven).
7. Slide the fork protector onto the guide (**Figure 31**). Rotate the fork protector and guide into position and tighten the bolt on the fork protector guide (**Figure 30**).
8. Install the bolts on the bottom of the fork protector (A, **Figure 29**).
9. Install the brake hose guide (**Figure 30**) and speedometer/odometer cable guide onto the fork (B, **Figure 29**).
10. Refer to **Table 3** for the standard fork settings.







FRONT FORK SERVICE (2000 AND 2001 S MODELS)

Tools

The following tools are required to disassemble and reassemble the fork legs:
1. A 49-mm fork seal driver (Suzuki part No. 09940-52861, or equivalent).
2. Inner rod holder (Suzuki part No. 09940-54821, or equivalent). The inner rod holder is a T-handle with a 27-mm hexagon on the end. The hexagon fits

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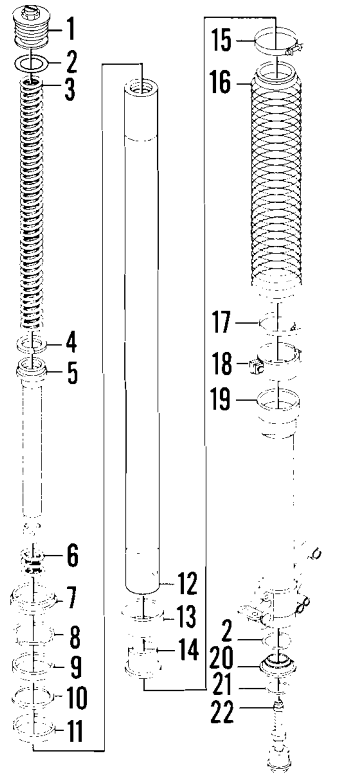
FORK LEG ASSEMBLY 2000 AND 2001 S MODELS



1. Fork cap
2. O-ring
3. Spring
4. Damper rod bushing
5. Damper rod
6. Rebound spring
7. Dust seal
8. Stop ring
9. Oil seal
10. Backup ring
11. Guide bushing
12. Inner tube
13. Slide bushing
14. Oil end piece
15. Clamp
16. Boot
17. Plastic tie
18. Holder
19. Outer tube
20. End plate
21. Seal washer
22. Damper rod bolt

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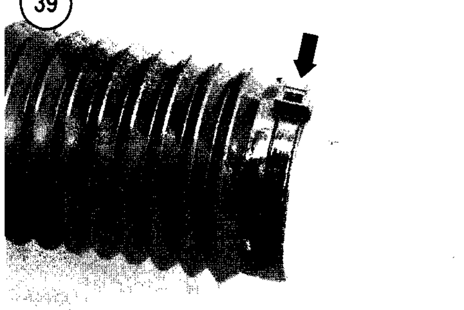

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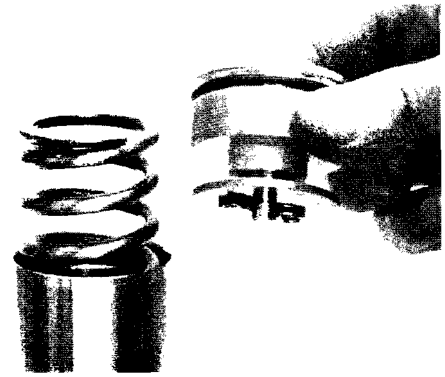

into the top of the damper rod and holds it steady while the damper rod bolt is loosened. An alternative to this tool is to weld a 27-mm hex nut to the end of a T-handle. The T-handle must be at least 406 mm (16 in.) long. Any other 27-mm hex tool that adapts to a T-handle (**Figure 37**) is also acceptable.

Disassembly

Rebuild one fork leg before rebuilding the remaining leg. Do not intermix parts. If performing a routine fork oil change, perform Steps 1-5, and then go to *Fork Oil Refilling and Final Assembly* in this section. Refer to **Figure 38**.

1. Set the spring preload and compression damping adjusters to their softest setting.
   a. At the fork cap, record the number of grooves that are visible on the spring preload adjuster.
   b. At the compression adjuster at the bottom of the fork leg, turn the adjuster clockwise and count the number of clicks required to seat the adjuster. Record the number, and then turn the adjuster counterclockwise to the softest position.
2. Remove the fork boot. At the top of the boot, loosen the clamp. If completely disassembling the fork leg, cut the plastic tie at the bottom of the boot (**Figure 39**).
3. Clean the fork tubes and fork cap area.
4. Hold the fork leg upright, and then remove the cap and spring (**Figure 40**). Note that the end of the spring with the smaller diameter coils is pointing *down*.
5. Drain the oil from the fork tube. Pump the fork tube to aid in draining the oil.
6. Remove the dust seal (**Figure 41**). Use a wide-blade tool to carefully lift the seal.

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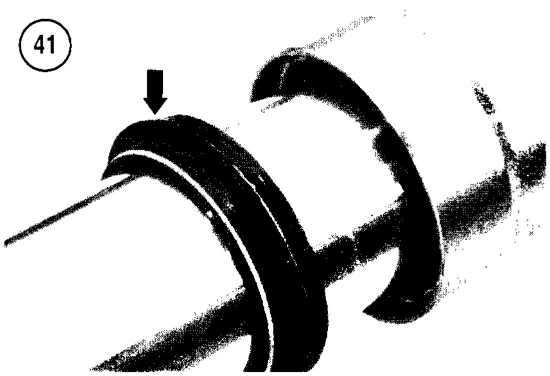

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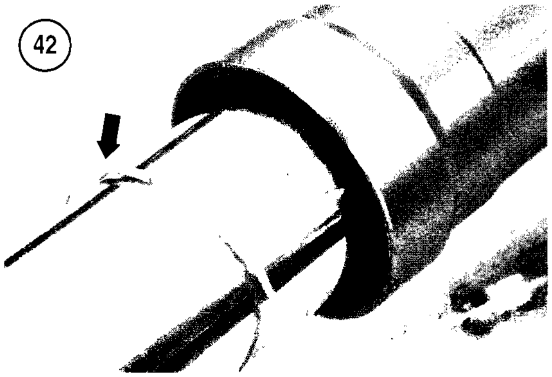

7. Remove the stop ring (**Figure 42**).
8. Remove the damper rod as follows:
   a. Push the fork tubes together, and then seat the damper rod tool (**Figure 43**) into the damper rod.
   b. Lock the axle holder in a vise fitted with soft jaws (**Figure 44**). Do not overtighten the vise. If desired, lock the T handle in the vise and have an assistant support the fork leg while the damper rod bolt is loosened.
   c. Using a 21-mm socket, remove the damper rod bolt from the fork leg, and then twist the end plate from the outer tube (**Figure 45**).
   d. Remove the damper rod and rebound spring (**Figure 46**).
9. Pull out the inner tube and oil lock piece (**Figure 47**). Some resistance may be felt as the tubes are separated.
10. *Carefully* spread open the slide bushing (A, **Figure 48**), and then remove it from the fork tube. Do not spread the bushing more than necessary. Remove the guide bushing (B, **Figure 48**), backup ring (C) and oil seal (D) from the fork leg.

NOTE

Unless damaged, do not disassemble the fork cap or damper rod bolt. If either part is damaged, the complete assembly must be replaced.

11. Clean and inspect the parts as described in this section.

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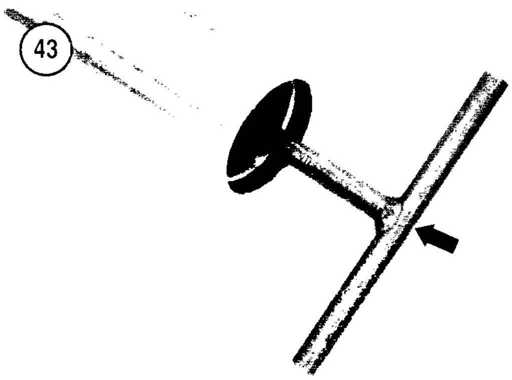

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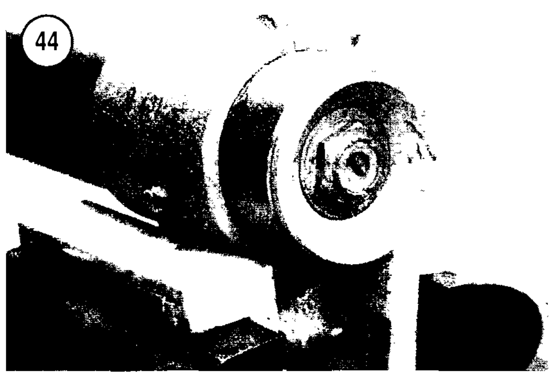

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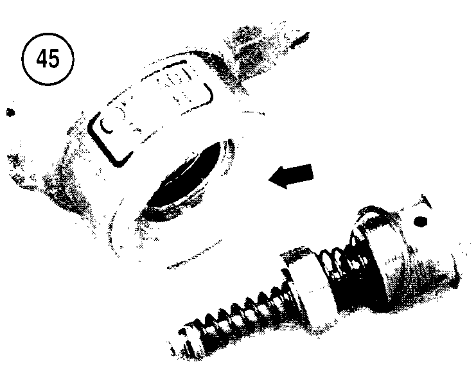
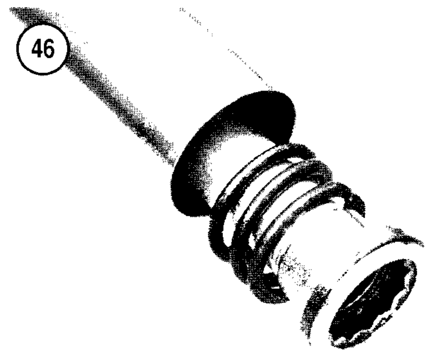
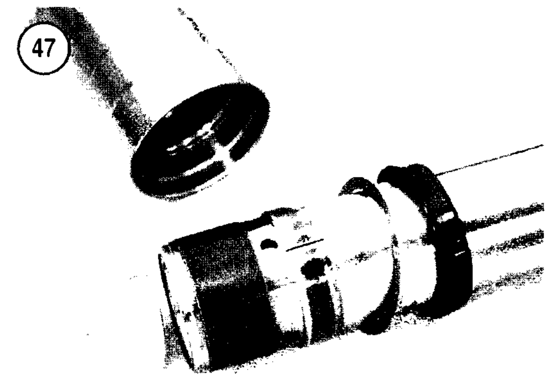
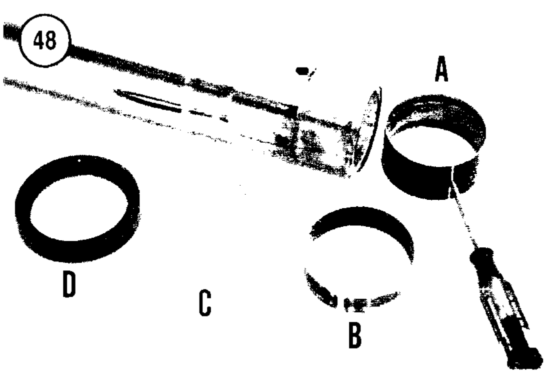


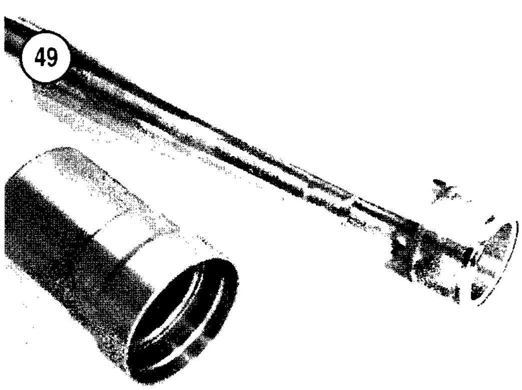
Inspection

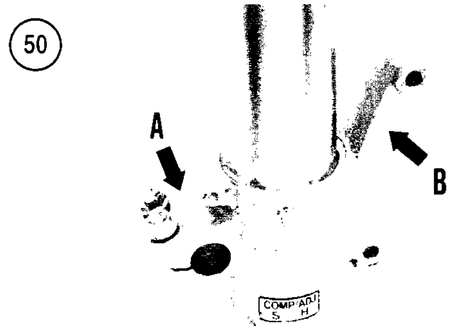
Refer to **Figure 38**.











CAUTION
Carefully handle and clean the parts. Harsh cleaning and some solvents damage the bushings.

1. Initially clean all parts in solvent, making sure the solvent is compatible with the rubber parts and the coating on the bushings. Immediately wash the parts a second time with soap and water. Rinse the parts with clean water, and then dry them with compressed air.
2. Inspect the fork tubes (**Figure 49** and **Figure 50**) for:
   a. Nicks, rust, flaking chrome or creasing along the length of the inner tube. These conditions damage the seals. Repair minor roughness with 600 grit sandpaper and solvent.
   b. Clean orifices in the inner tube.
   c. Pitting or abrasion in the the outer tube.
   d. Wear and stress cracks at the axle holder (A, **Figure 50**) and brake caliper mount (B).
   e. Damage at the seal and bushing areas.
   f. Damaged threads.
3. Inspect the oil lock piece (**Figure 51**) for damage.
4. Inspect the end plate (**Figure 52**) for damage. Replace the O-ring.

5. Inspect the fork cap and damper rod bolt (**Figure 53**).
   a. Inspect the threads for damage.
   b. Inspect the springs for damage (A).
   c. Inspect the compression damping adjuster for consistent operation throughout the adjustment range.
   d. Install a new O-ring on the fork cap (B).
   e. Install a new seal washer (C) on the damper rod bolt.
6. Inspect and measure the spring (**Figure 54**). Refer to **Table 1** for specifications.
7. Inspect the rebound spring, damper rod and damper rod bushing (**Figure 55**).
   a. Remove minor metallic buildup from the bushing with fork oil and a nylon brush. Replace the bushing if discolored or if the coating is excessively worn and the metal base is visible.
   b. Clean and inspect the small holes in the damper rod
   c. Inspect the spring for damage.
8. Inspect the slide bushing and guide bushing for scoring, scratches and excessive wear. Inspect the exterior of the slide bushing (A, **Figure 56**) and the interior of the guide bushing (B). It is normal for the exterior of the guide bushing to appear worn. Minor metallic buildup can be removed from the bushings with fork oil and a nylon brush. Replace the bushings if discolored or if the coating is excessively worn and the metal base is visible. Replace both bushings as a set.
9. Inspect the dust seal and stop ring (**Figure 57**) for distortion or damage.
10. Inspect the backup ring for damage.
11. Inspect the fork boot and clamp (**Figure 58**). If damaged, replace the boot.

Fork Tube and Seal Assembly

Before assembly, make sure the work area and all parts are clean.

1. Lubricate the parts with fork oil as they are assembled. Refer to **Table 2** for the recommended fork oil.
2. Install the end plate into the outer tube.
3. Install the oil seal onto the inner tube as follows:
   a. Cover the end of the inner tube with plastic wrap, and then coat it with fork oil. The plas-

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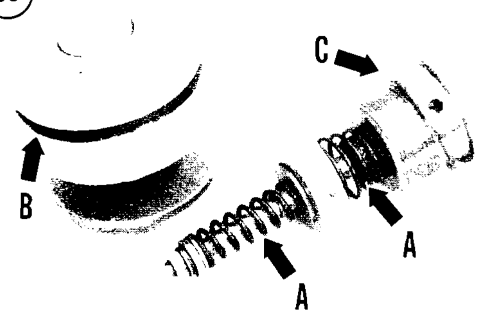

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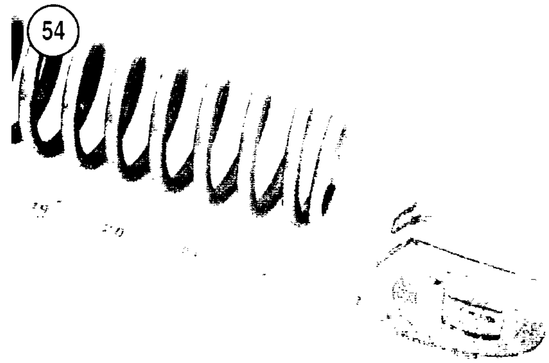

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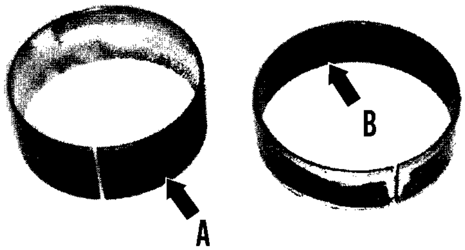

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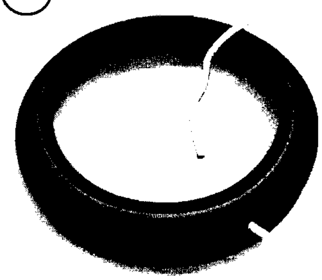

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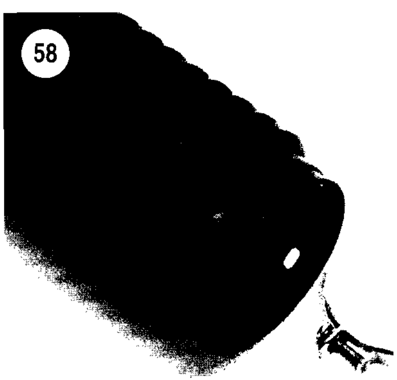

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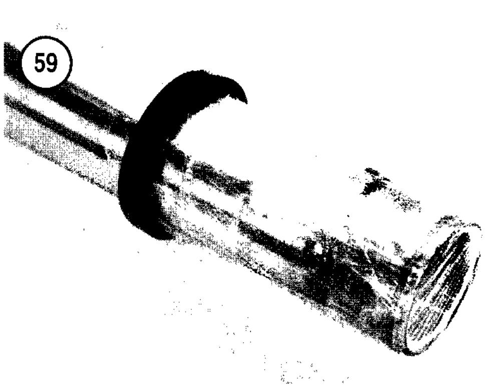

tic prevents the edge of the tube from tearing the oil seal during installation.

b. Lubricate the seal with fork oil. If desired, lubricate the parts with an anti-stiction lubricant specifically for fork seals.

c. Slide the oil seal onto the inner tube (**Figure 59**) with the numbers facing the top of the tube. Remove the plastic wrap.

4. Install the backup ring, guide bushing, slide bushing and oil lock piece onto the inner tube (**Figure 47**). Spread the bushings only enough to slip over the tube. Avoid scratching the coating on the bushings.

5. Stand the inner tube vertically with the oil lock piece pointing up, and then lubricate the length of the tube with fork oil. This allows the oil seal to slide freely when the tubes are joined.

6. Slide the outer tube over the inner tube, seating the tubes together. The oil seal will be seated in a later step. When handling the fork leg, keep the tubes compressed so the oil lock piece remains in place. The tubes must remain compressed until the damper rod bolt is installed.

7. Install the rebound spring and damper rod into the inner tube (**Figure 46**). Push the damper rod to the bottom of the inner tube.

8. Install and tighten the damper rod bolt (**Figure 45**) as follows:

a. Make sure the compression damping adjuster is fully backed out.

b. Install the damper rod bolt and seal washer while threading the bolt through the end plate and into the damper rod.

c. Seat the damper rod tool into the damper (**Figure 43**).

d. Lock the axle holder in a vise fitted with soft jaws (**Figure 44**). Do not overtighten the vise. If desired, lock the T handle in the vise and have an assistant support the fork leg while the damper rod bolt is tightened.

e. Apply threadlocking compound to the damper rod bolt.

f. Using a 21-mm socket, tighten the damper rod bolt to 80 N•m (59 ft.-lb.).

9. Seat the oil seal as follows:

a. Position the seal squarely in the bore (**Figure 60**).

b. Use the fork seal driver like a slide hammer and drive the seal into the fork tube. Drive the

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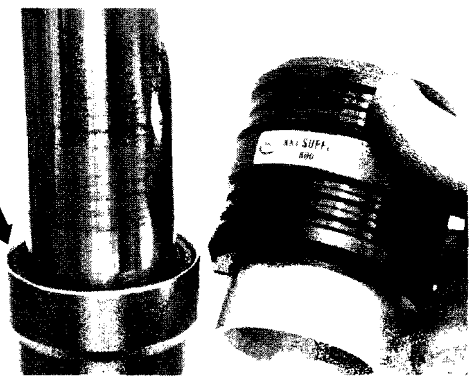

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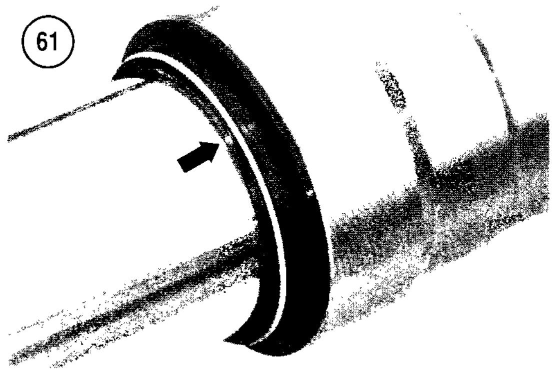

seal until the stop ring groove is visible above the seal.

10. Install and seat the stop ring in the groove.
11. Install and seat the dust seal (**Figure 61**) by hand.
12. Slide the fork tubes together several times and check for smooth operation. If roughness or binding is detected, disassemble the parts and determine the cause.
13. Install the fork boot. Seat the end of the boot with the drain holes (**Figure 62**) into the holder. Secure the boot with a new plastic tie. Do not tighten the upper clamp until the fork leg has been installed on the motorcycle.
14. Refer to *Fork Oil Refilling and Final Assembly* in this section.

Fork Oil Refilling and Final Assembly

Use the following procedure to fill the fork legs with oil, either after rebuilding the fork legs, or during a routine fork oil change. This procedure also details the assembly of the fork legs after the oil level has been set. Refer to **Table 2** for the recommended fork oil and quantity.

1. With the fork leg held vertically, fill the fork leg with the approximate amount of fork oil (**Figure 63**).
2. Slowly pump the inner tube (**Figure 64**) for several minutes to distribute the oil and purge air pockets. Note the following:
   a. Make full strokes when pumping the inner tube.
   b. If small air bubbles are visible, allow the fork leg to stand undisturbed. This allows the bubbles to consolidate into larger air pockets that are easier to purge.
3. Measure the oil level as follows:
   a. Compress the inner tube into the outer tube.

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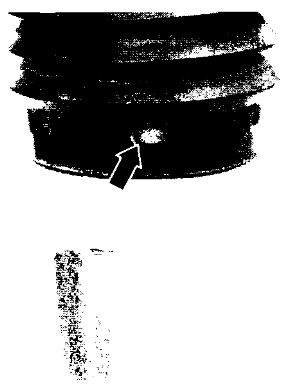

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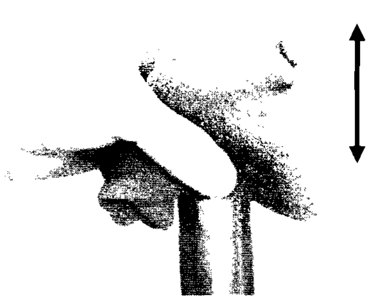

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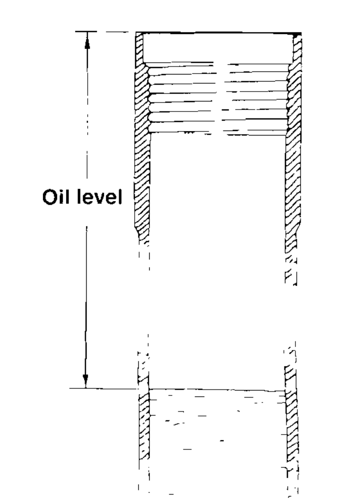

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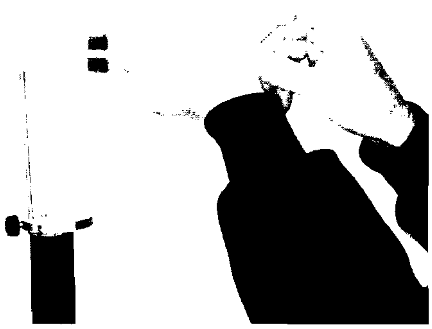

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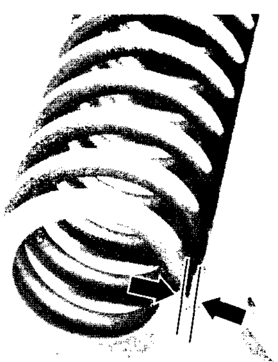

b. Refer to **Table 2** for the required distance from the top edge of the fork leg to the surface of the fork oil (**Figure 65**).
c. Set a fork oil level gauge to the required distance, and then add or remove oil (**Figure 66**) to set the level to the specification. Both legs must have identical levels.

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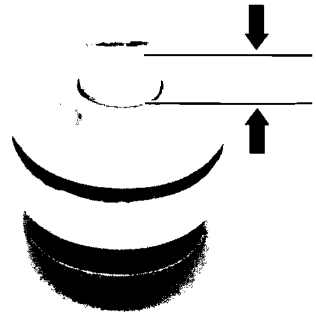

NOTE

The oil level establishes the air pocket that is above the oil. Because the air pocket contributes to fork damping, ***slight*** *variation of the oil level is permissible to meet the riding conditions. More oil in the fork leg (small air pocket) makes damping harder. Less oil in the fork leg (large air pocket) makes damping softer.*

4. Install the spring and fork cap as follows:
   a. Extend the fork leg, and then install the spring. The end of the spring with the smaller diameter coils must point *down*. If in doubt, place a straightedge against the coils. A gap will be visible at the smaller coils (**Figure 67**).
   b. Make sure the spring preload adjuster in the fork cap is fully backed out (**Figure 68**).
   c. Install and tighten the fork cap (**Figure 69**). Tighten the cap enough to prevent the fork leg from leaking. The cap will be tightened to specification after the fork leg is installed.
5. Lightly tighten the fork boot clamp. The boot will be adjusted and clamped after the fork leg is installed on the motorcycle.
6. Refer to **Table 3** for the standard fork settings.
7. Install the fork legs as described in this chapter.

FRONT FORK SERVICE (ALL E MODELS AND 2002-ON S MODELS)

Tools

The following tools are required to disassemble and reassemble the fork legs:
1. A 49-mm fork seal driver (Suzuki part No. 09940-52861, or equivalent).
2. Inner rod holder (Suzuki part No. 09940-54821, or equivalent).

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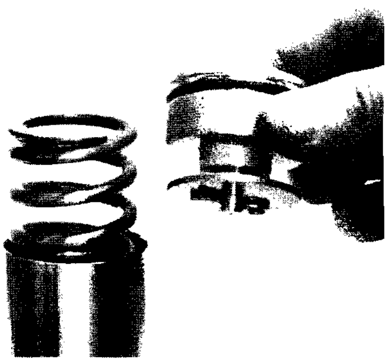

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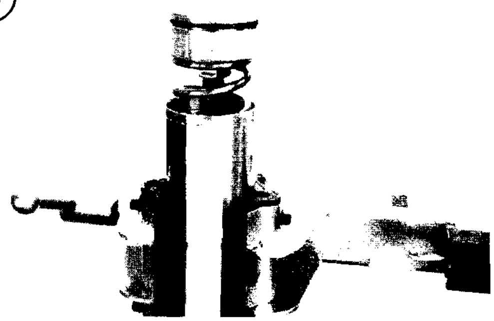


3. Front fork stopper plate (Suzuki part No. 09940-94922, or equivalent). The stopper plate is used to hold down the fork spring, allowing access to the fork cap locknut. However, a wrench can be inserted between the spring coils and fitted on the nut, or the spring can be compressed by hand and the nut can be accessed.

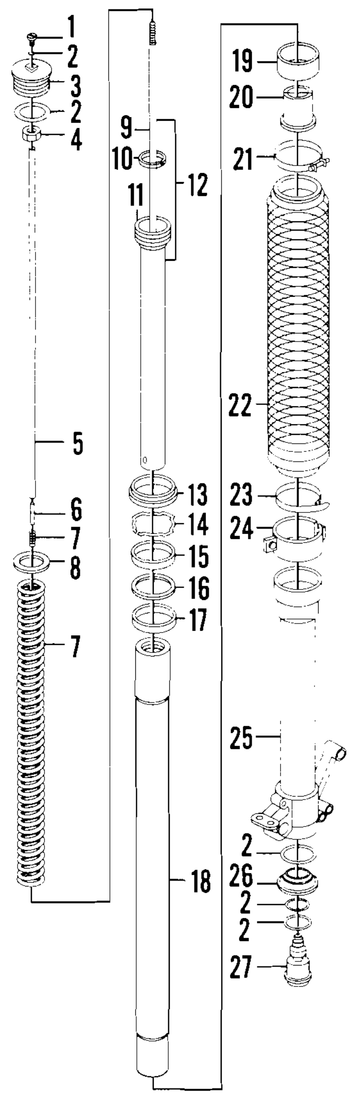
Although not required, a workstand makes the following procedures easier to perform. The work stand (PRS-4M) shown in **Figure 70** is available from Park Tool distributors (***www.parktool.com***).

Disassembly

Rebuild one fork leg at a time. Do not intermix parts. If performing a routine fork oil change, perform Steps 1-5, and then go to *Fork Oil Refilling and Final Assembly* in this section. Refer to **Figure 71**.

1. Set the rebound and compression damping adjusters to their softest settings. Turn each adjuster and count the number of clicks required to seat the adjuster. Record the number, and then turn the adjuster to the softest position.
2. Remove the fork boot. At the top of the boot, loosen the clamp. If completely disassembling the

71 **FORK LEG ASSEMBLY ALL E MODELS AND 2002-ON S MODELS**



1. Air release valve
2. O-ring
3. Fork cap
4. Nut
5. Pushrod
6. Needle
7. Spring
8. Washer
9. Piston rod
10. Damper rod bushing
11. Damper chamber
12. Damper rod
13. Dust seal
14. Stop ring
15. Oil seal
16. Backup ring
17. Guide bushing
18. Inner tube
19. Slide bushing
20. Oil end piece
21. Clamp
22. Boot
23. Plastic tie
24. Holder
25. Outer tube
26. End plate
27. Damper rod bolt

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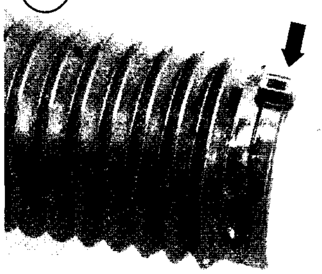

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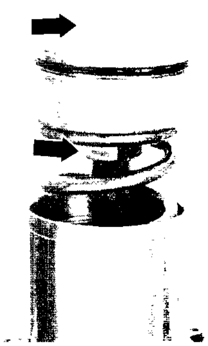

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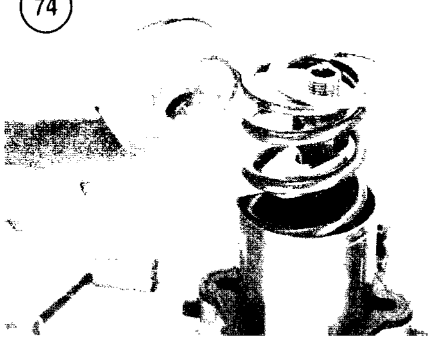

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fork leg, cut the plastic tie at the bottom of the boot (**Figure 72**).

3. Clean the fork tubes and fork cap area.

4. Hold the fork leg upright, and then remove the cap and spring assembly (**Figure 70**). If a vise is used to grip the fork leg, it must have rubber-lined jaws that are designed to grip tubing. Do not overtighten the vise.

5. Remove the fork cap from the piston rod nut (**Figure 73**) as follows:
   a. Insert a 17-mm open-end wrench between the spring coils and grip the nut. If desired, compress the spring by hand and access the nut.
   b. Use a 17-mm box wrench or socket and loosen the fork cap.
   c. Remove the fork cap, washer and spring (**Figure 74**). Note that the end of the spring with the smaller diameter coils is pointing *down*.

NOTE

If performing a routine fork oil change, insert the spring, needle and pushrod into the piston rod. The shouldered end of the needle must be against the pushrod. Refer to ***Fork Oil Refilling and Final Assembly*** *in this section.*

6. Drain the oil from the fork tube. Pump the fork tube to aid in draining the oil. When draining the fork tube, the pushrod, needle and spring (**Figure 75**) fall from the piston rod. Account for the parts before fork oil disposal.

7. Carefully remove the dust seal (**Figure 76**) with a wide-blade tool.

8. Remove the stop ring (**Figure 77**).

9. Remove the damper rod as follows:

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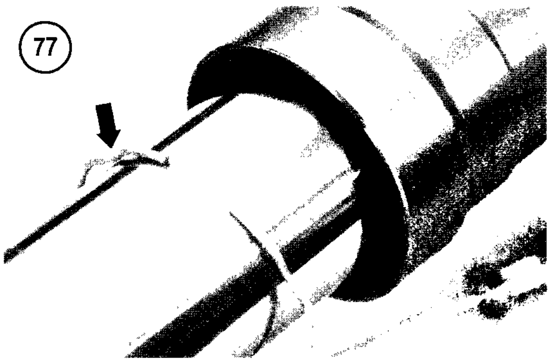

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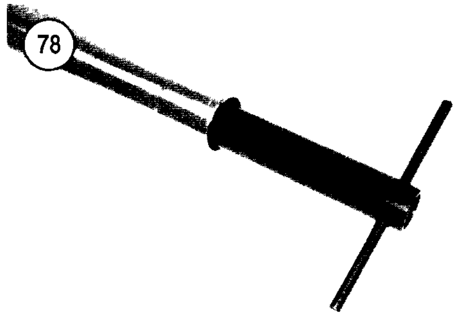

a. Push the fork tubes together, and then seat the damper rod tool into the damper rod (**Figure 78**).
b. Lock the axle holder in a vise fitted with soft jaws (**Figure 79**). Do not overtighten the vise. If desired, lock the T handle in the vise and have an assistant support the fork leg while the damper rod bolt is loosened.
c. Using a 21-mm socket, remove the damper rod bolt (**Figure 80**) from the fork leg, and then twist the end plate from the outer tube.
d. Remove the damper rod from the inner tube.

CAUTION
Do not remove the piston rod from the damper chamber. The threads on the rod can damage the seal where the rod enters the chamber.

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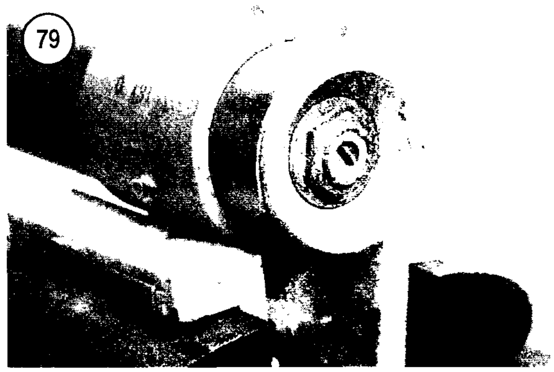

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10. Slowly pull out the inner tube and oil lock piece (**Figure 81**). Some resistance may be felt as the tubes are separated.
11. Spread open the slide bushing (A, **Figure 82**), and then remove it from the fork tube. Do not spread the bushing more than necessary. Remove the guide bushing (B, **Figure 82**), backup ring (C) and oil seal (D) from the fork leg.

NOTE
Unless obviously damaged, do not disassemble the fork cap adjuster or damper rod bolt. If either part is damaged, replace the complete assembly.

12. Clean and inspect the parts as described in this section.

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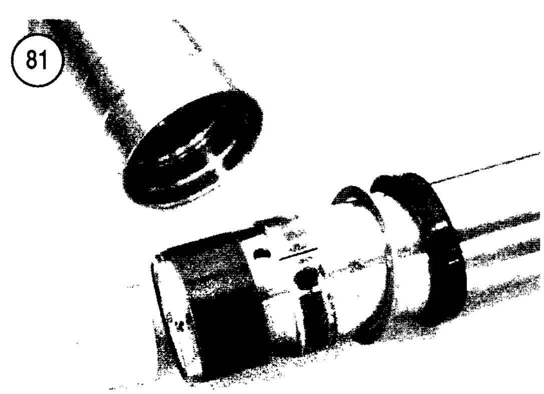

Inspection

Refer to **Figure 71**.

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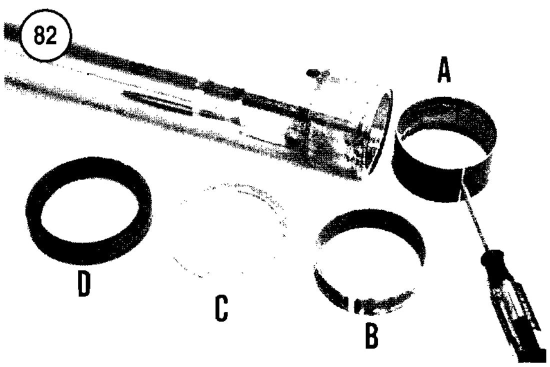

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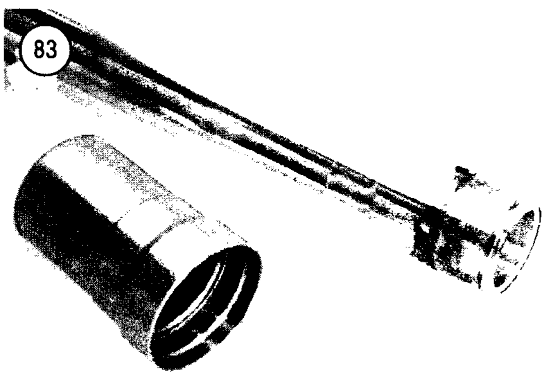

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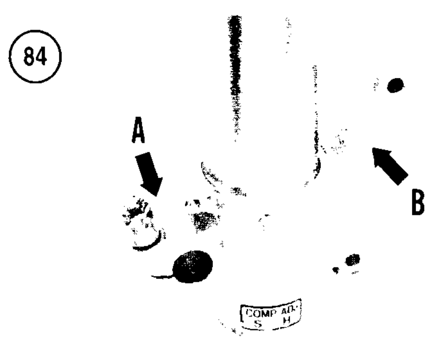

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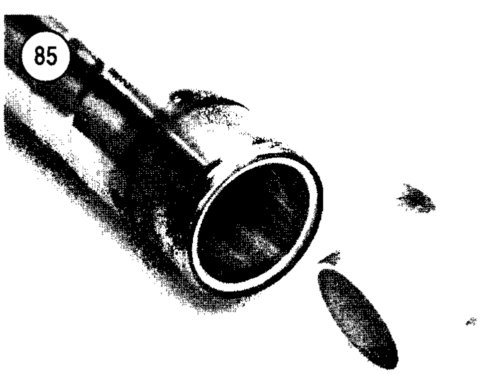

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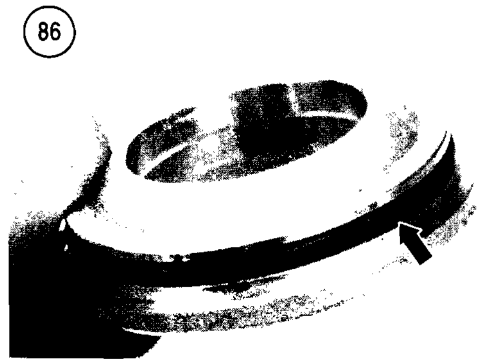

CAUTION
Carefully handle and clean the parts. Harsh cleaning and some solvents can damage the bushings.

1. Initially clean all parts in solvent, making sure the solvent is compatible with the rubber parts and the coating on the bushings. Immediately wash the parts a second time with soap and water. Rinse the parts with clean water, and then dry with compressed air.
2. Inspect the fork tubes (**Figure 83** and **Figure 84**) for:
   a. Nicks, rust, flaking chrome or creasing along the length of the inner tube. These conditions damage the dust and oil seals. Repair minor roughness with 600 grit sandpaper and solvent.
   b. Clean orifices in the inner tube.
   c. Pitting or abrasion in the the outer tube.
   d. Wear and stress cracks at the axle holder (A, **Figure 84**) and brake caliper mount (B).
   e. Damage at the seal and bushing areas.
   f. Damaged threads.
3. Inspect the oil lock piece (**Figure 85**) for damage.
4. Inspect the end plate for damage. Replace the O-ring (**Figure 86**).
5. Inspect the fork cap.
   a. Inspect the threads for damage.
   b. Inspect the tip of the rebound adjuster for damage (A, **Figure 87**).
   c. Inspect the rebound damping adjuster for consistent operation throughout the adjustment range (**Figure 88**).
   d. Install a new O-ring on the fork cap and air release valve (B, **Figure 87**).
6. Inspect the damper rod bolt and compression damping adjuster.
   a. Inspect the threads for damage.

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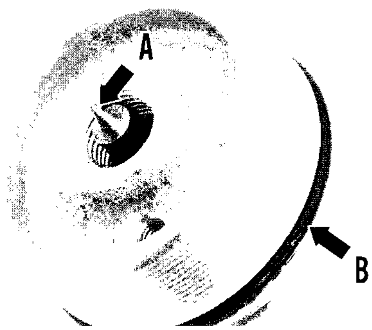

b. Inspect the compression damping adjuster for consistent operation throughout its range.

c. Install new O-rings on the damper rod bolt and compression damping adjuster (**Figure 89**).

7. Inspect the pushrod, needle and spring (**Figure 90**).

a. Inspect the tips of the needle for damage.

b. Inspect the pushrod for straightness and square ends.

c. The spring should be clean and resilient.

8. Inspect the damper rod assembly.

a. Inspect the damper rod bushing (**Figure 91**). Remove minor metallic buildup from the bushing with fork oil and a nylon brush. Replace the bushing if discolored or if the coating is excessively worn and the metal base is visible.

b. Pull on the threaded end of the piston rod and inspect it for smooth operation for the length of the damper chamber. If binding is felt, the chamber or rod may be bent. Do not completely remove the rod from the damper chamber. The threads on the rod can damage the seal where the rod enters the chamber.

c. Slightly extend the piston rod so the valve assembly is visible. Inspect the bushing and shim stack (**Figure 92**) for cleanliness and wear. If any parts are damaged, the complete damper rod assembly must be replaced.

9. Inspect and measure the spring (**Figure 93**). Refer to **Table 1** for specifications.

10. Inspect the slide bushing and guide bushing for scoring, scratches and wear. Inspect the exterior of the slide bushing (A, **Figure 94**) and the interior of the guide bushing (B). It is normal for the exterior of the guide bushing to appear worn. Minor metallic buildup can be removed from the bushings with fork

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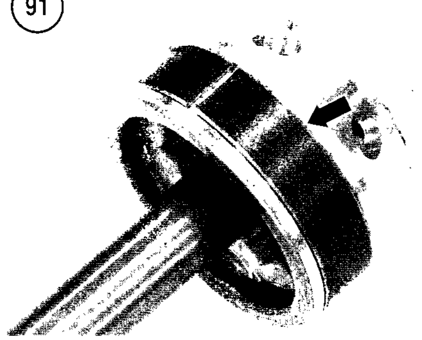

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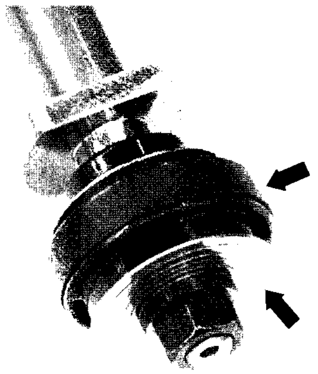

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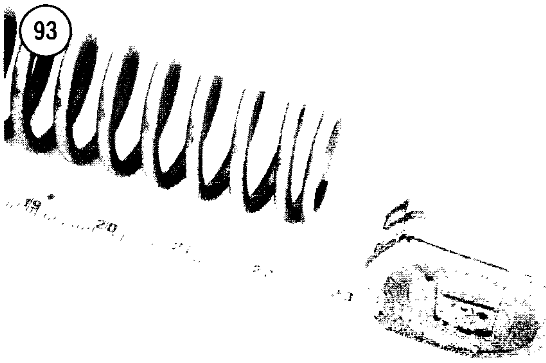

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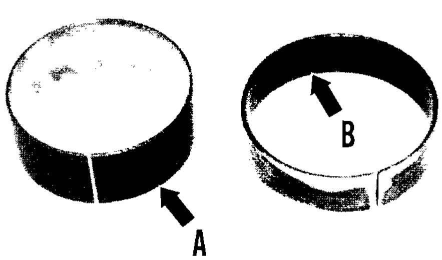

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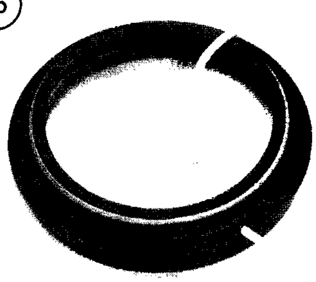

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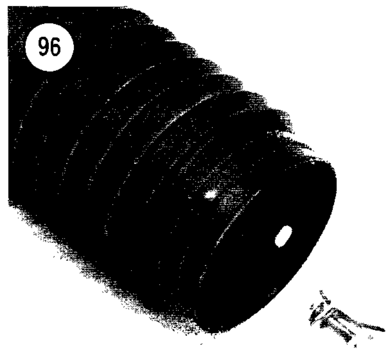

oil and a nylon brush. Replace the bushings if discolored or if the coating is excessively worn and the metal base is visible. Replace both bushings as a set.

11. Inspect the dust seal and stop ring (**Figure 95**) for distortion or damage.
12. Inspect the backup ring for damage.
13. Inspect the fork boot and clamp (**Figure 96**). If damaged, replace the boot.

Fork Tube and Seal Assembly

Before assembly, make sure the work area and all parts are clean.

1. Lubricate the parts with fork oil as they are assembled. Refer to **Table 2** for the recommended fork oil, or equivalent.
2. Install the end plate into the outer tube.
3. Install the oil seal onto the inner tube as follows:
   a. Cover the end of the inner tube with plastic wrap, and then coat it with fork oil. The plastic prevents the edge of the tube from tearing the oil seal during installation.
   b. Lubricate the seal with fork oil. If desired, lubricate the parts with an anti-stiction lubricant that is specifically for fork seals.
   c. Slide the oil seal onto the inner tube (**Figure 97**). The numbers on the seal should face toward the top of the tube. Remove the plastic wrap.
4. Install the backup ring, guide bushing, slide bushing and oil lock piece onto the inner tube (**Figure 81**). Spread the bushings only enough to slip over the tube. Avoid scratching the coating on the bushings.
5. Stand the inner tube vertically with the oil lock piece pointing up, and then lubricate the length of

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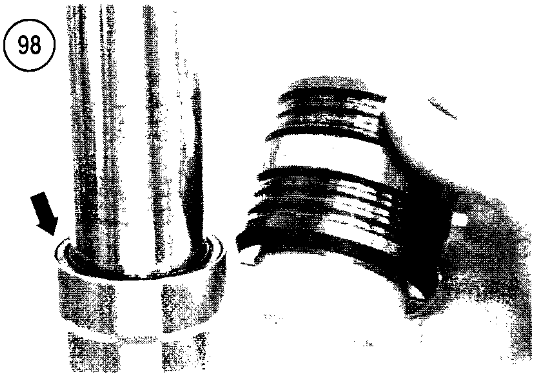

the tube with fork oil. This allows the oil seal to freely slide when the tubes are joined.

6. Slide the outer tube over the inner tube, seating the tubes together. The oil seal will be seated in a later step. When handling the fork leg, keep the tubes compressed so the oil lock piece remains in place. The tubes must remain compressed until the damper rod bolt is installed.
7. Install the damper rod into the inner tube. Push the damper rod to the bottom of the inner tube.
8. Install and tighten the damper rod bolt (**Figure 80**) as follows:
   a. Make sure the compression damping adjuster is fully backed out.
   b. Install the damper rod bolt, threading the bolt through the end plate and into the damper rod.
   c. Seat the damper rod tool into the damper (**Figure 78**).
   d. Lock the axle holder in a vise fitted with soft jaws (**Figure 79**). Do not overtighten the vise. If desired, lock the T handle in the vise and have an assistant support the fork leg while the damper rod bolt is tightened.
   e. Apply threadlocking compound to the damper rod bolt.
   f. Using a 21-mm socket, tighten the damper rod bolt to 80 N•m (59 ft.-lb.).
9. Seat the oil seal as follows:
   a. Position the seal squarely in the bore (**Figure 98**).
   b. Use the fork seal driver like a slide hammer and drive the seal into the fork tube. Drive the seal until the stop ring groove is visible above the seal.
10. Install and seat the stop ring in the groove.
11. Install and seat the dust seal (**Figure 99**) by hand.
12. Slide the fork tubes together several times and check for smooth operation. If roughness or binding

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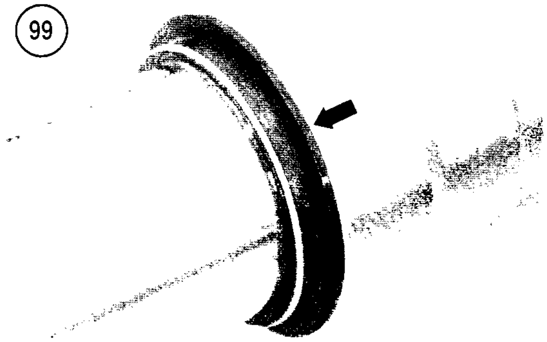

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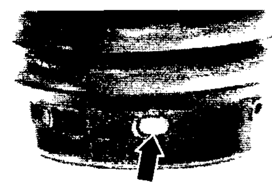

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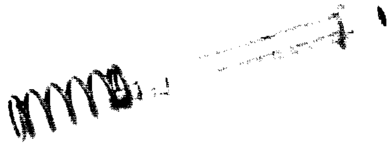

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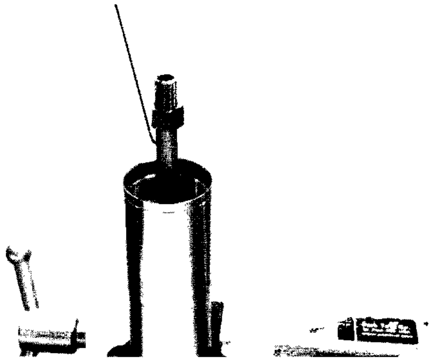

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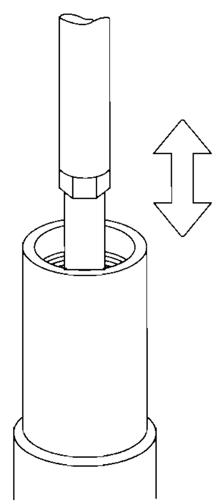

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is detected, disassemble the parts and determine the cause.

13. Install the fork boot. Seat the end of the boot with the drain holes (**Figure 100**) into the holder. Secure the boot with a new plastic tie. Do not tighten the upper clamp until the fork leg has been installed on the motorcycle.

14. Insert the spring, needle and pushrod (**Figure 101**) into the piston rod. The shouldered end of the needle must be against the pushrod.

15. Thread the nut onto the piston rod. Thread the nut to the bottom of the threads.

16. Refer to *Fork Oil Refilling and Final Assembly* in this section.

Fork Oil Refilling and Final Assembly

Use the following procedure to fill the fork legs with oil, either after rebuilding the fork legs or during a routine fork oil change. This procedure also details the assembly of the fork legs after the oil level has been set. Refer to **Table 2** for the recommended fork oil and quantity.

1. Compress the inner tube into the outer tube. Keep the tubes compressed for the entire bleeding procedure.
2. Attach a length of wire to the piston rod (**Figure 102**). This aids in raising the rod if it drops into the tube. Use a piston rod holder (Suzuki part No. 09940-52841) to aid in the fork oil bleeding procedure. The holder is threaded onto the end of the piston rod and is used to stroke the air from the fork leg (**Figure 103**).
3. With the fork leg held vertically, fill the fork leg with the approximate amount of fork oil (**Figure 104**). The oil level must remain over the top of the damper chamber for the entire bleeding procedure.
4. Cover the end of the piston rod, and then slowly pump the rod for several minutes to distribute the oil and purge the air pockets. Note the following:
   a. Make full strokes when pumping the rod.
   b. If the rod is pumped too fast, fork oil sprays from the vent hole near the top of the rod.
   c. If small air bubbles are visible, allow the fork leg to stand undisturbed. This allows the bubbles to consolidate into larger air pockets, which are easier to purge.

NOTE

The oil level establishes the air pocket that is above the oil. Because the air pocket contributes to fork damping, a ***slight*** *variation of the oil level is permissible to meet the riding conditions. More oil in the fork leg (small air pocket) makes damping harder. Less oil in the fork leg (large air pocket) makes damping softer.*

5. Measure the oil level as follows:
   a. Make sure the inner tube is seated in the outer tube.
   b. Refer to **Table 2** for the required distance from the top edge of the fork leg to the surface of the fork oil (**Figure 105**).
   c. Set a fork oil level gauge to the required distance, and then add or remove oil (**Figure 106**) to set the level to the specification. Both legs must have identical levels.
6. Install the spring, washer and fork cap (**Figure 107**) as follows:
   a. Securely hold the fork leg in an upright position. If a vise is used to grip the fork leg, it must have rubber-lined jaws that are designed to grip tubing. Do not overtighten the vise.
   b. Raise the piston rod and make sure the nut is seated at the bottom of the threads.
   c. Install the spring. The end of the spring with the smaller diameter coils must point *down*. If in doubt, place a straightedge against the coils. A gap is visible at the smaller coils (**Figure 108**).
   d. Make sure the rebound damping adjuster is fully backed out.
   e. To support the piston rod, place a small open-end wrench under the nut, and then install the washer and fork cap (**Figure 109**). Thread the fork cap fully onto the piston rod.
7. Tighten the fork cap against the piston rod nut (**Figure 110**).
   a. Insert a 17-mm open-end wrench between the spring coils and grip the nut. If desired, compress the spring by hand and access the nut.
   b. Tighten the fork cap to 22 N•m (16 ft.-lb.).
8. Tighten the fork cap to the fork leg to prevent leaking. The cap is tightened to specification after the fork leg is installed.
9. Lightly tighten the fork boot clamp. The boot is adjusted and clamped after the fork leg is installed.
10. Refer to **Table 3** for the standard fork settings.
11. Install the fork legs as described in this chapter.

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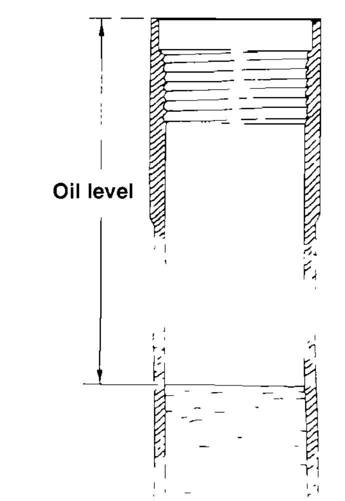

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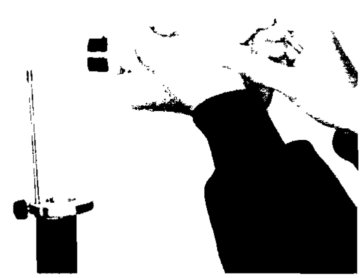

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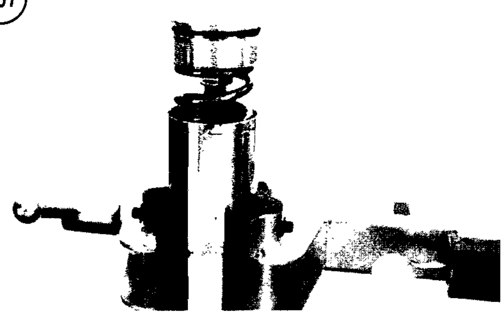

FRONT FORK SERVICE (2005-ON SM MODELS)

Tools

The following special tools or equivalents are required for disassembly and assembly of the fork legs:

1. Fork cap wrench (Suzuki part No. 09941-53630 or Motion Pro part No. 08-236).
2. Split fork seal driver (Suzuki part No. 09940-52861 or equivalent).
3. Connecting rod holder (Suzuki part No. 09910-20115 or equivalent). This is a slotted piece of steel or aluminum (**Figure 111**) that prevents the damper connecting rod from drawing back into the fork

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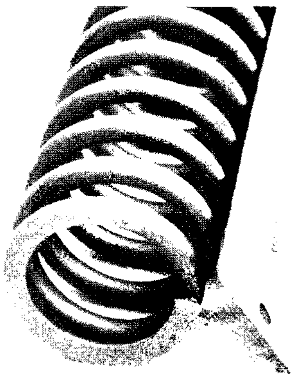

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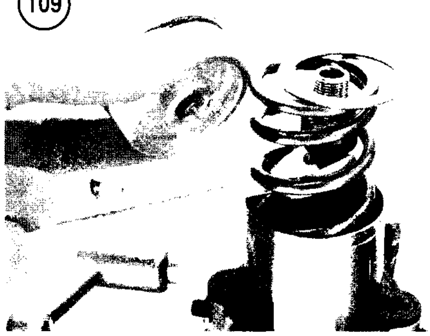

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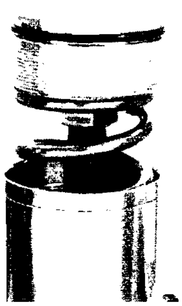

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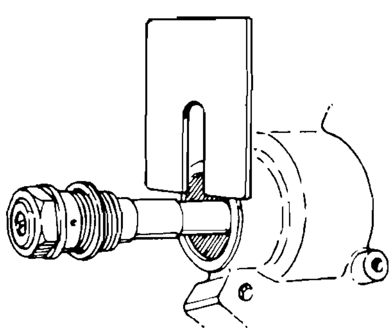

while the center bolt is removed. It can be made from a piece of metal plate at least 3/16-inch thick with a 1/2-inch wide slot cut into it.

Although not required, a work stand makes the following procedures easier to perform. The work stand (PRS-4M) shown is available from Park Tool distributors (***www.parktool.com***).

Disassembly

CAUTION

All the pieces of the fork are made of soft alloys and easily damaged. Be careful when disassembling and reassembling the fork.

Completely rebuild one fork leg before rebuilding the other leg. Do not mix up the parts. If performing a routine fork oil change, perform steps 1-5, and then go to *Assembly and Fork Oil Refilling* in this section. Refer to **Figure 112**.

1. Clean the fork tubes and fork cap before disassembling the fork tube.
2. Turn the compression adjuster (**Figure 113**) to its softest setting. Count and record the number of clicks from its original position.
3. Turn the rebound adjuster (**Figure 114**) to its softest setting. Count and record the number of clicks from its original position.
4. Hold the fork tube vertically, and then remove the fork cap assembly. Loosen the assembly during fork removal. Slowly lower the outer tube.
5. Drain the oil from the tube (**Figure 115**).
6. Clamp the axle holder in a fork holder or soft-jawed vise.
7. Remove the 21-mm center bolt.

NOTE

The fork leg springs are under pressure. Compressing the springs is easier with an assistant to help steady the fork in the vise while the holder is installed.

8. Press the outer tube over the inner and slip a connecting rod holder (Suzuki part No. 09910-20115) or a retaining tool onto the end of the damper rod to prevent the rod from withdrawing into the fork tube (**Figure 111**). This can be done with a variety of tools including an adjustable wrench (**Figure 116**).
9. Hold the locknut with a wrench and remove the center bolt (**Figure 117**).

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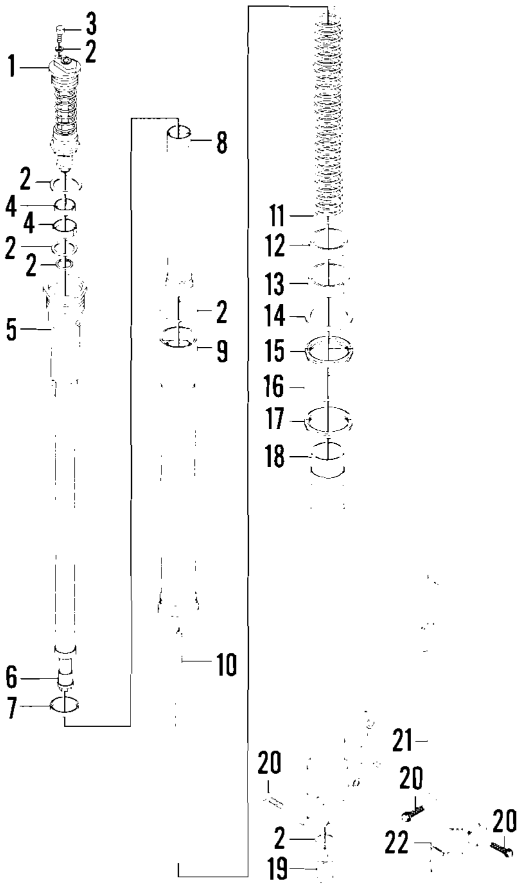
FRONT FORK (2005-ON SM MODELS)



1. Air release screw
2. O-ring
3. Fork cap
4. Bushings
5. Subtank/ damper rod
6. Locknut
7. Spring seat
8. Spring guide
9. Outer tube
10. Pushrod
11. Spring
12. Slide bushing
13. Guide bushing
14. Seal spacer
15. Oil seal
16. Stopper ring
17. Dust seal
18. Inner tube
19. Center bolt
20. Bolt
21. Fork protector
22. Fork protector guide

10. Remove the pushrod from the end of the damper rod (**Figure 118**).

11. Remove the damper rod/subtank assembly (A, **Figure 119**), spring (B) and spring guide (C) from the fork tubes (D).

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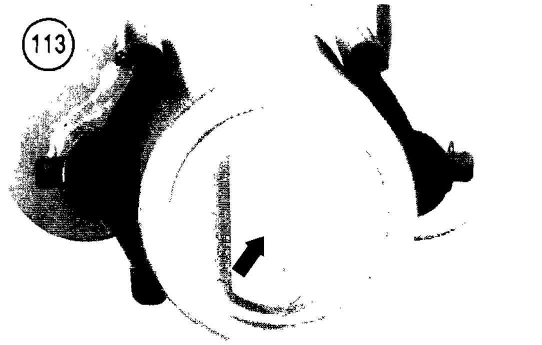

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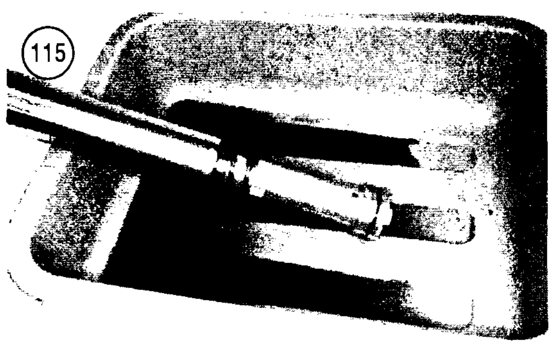

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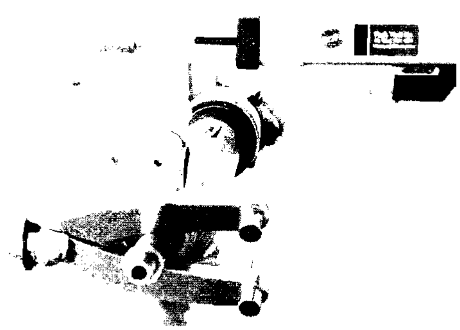

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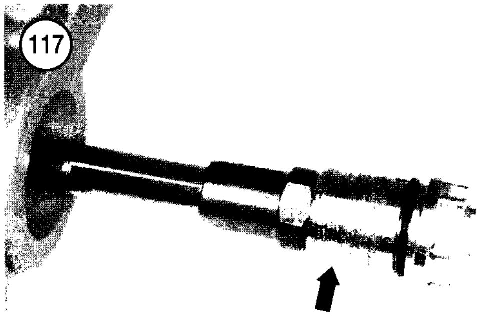

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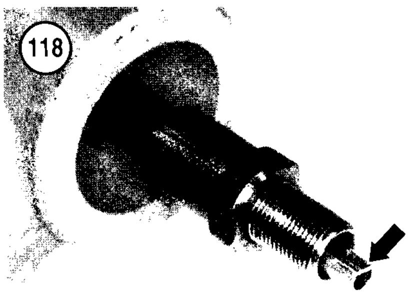

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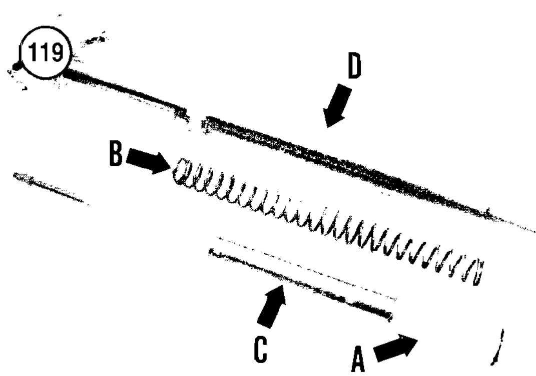

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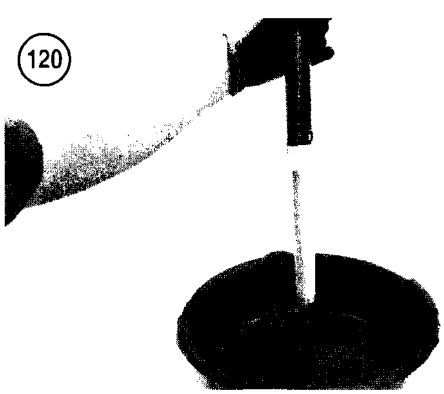

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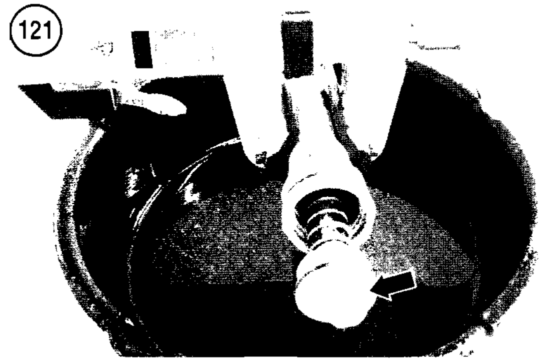

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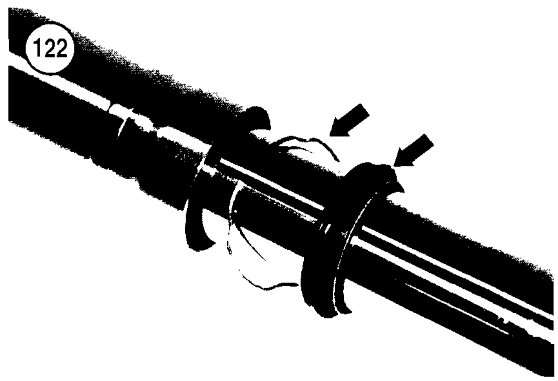
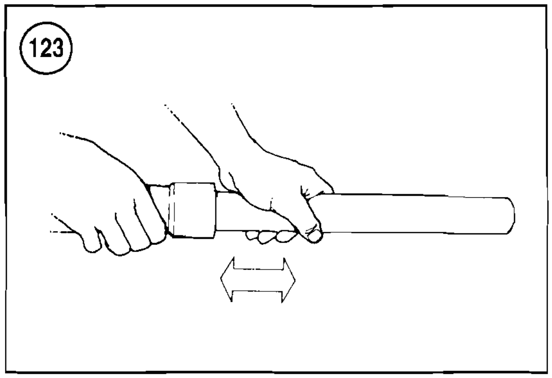
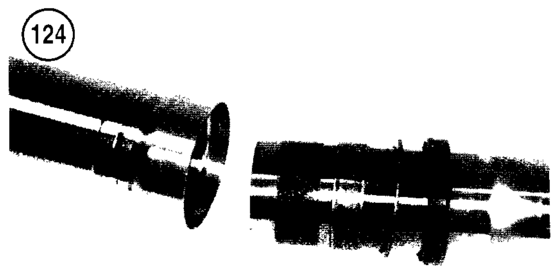


12. Hold the damper rod over an oil pan and pump all the remaining oil out of the rod (**Figure 120**).
13. Remove the fork cap damper from the subtank assembly (**Figure 121**).
14. Separate the inner and outer tubes as follows:
   a. Remove the dust seal and stop ring (**Figure 122**).
   b. Before disassembling the fork tubes, slide the tubes together and check for roughness and binding. If the action is not smooth, inspect the tubes for damage when they are disassembled.
   c. There is an interference fit between the outer tube, bushings and oil seal. To remove the inner tube as well as the parts, quickly and firmly pull the tubes apart (**Figure 123**). Repeat as necessary until the parts are separated (**Figure 124**).
15. Spread open the slide bushing (**Figure 125**) to remove it. Do not scratch or spread the bushing more than necessary. Remove the slide bushing (A, **Figure 126**), guide bushing (B), seal spacer (C), oil seal (D), stop ring (E) and dust seal (F) from the inner tube.
16. Clean and inspect the parts as described in this section.





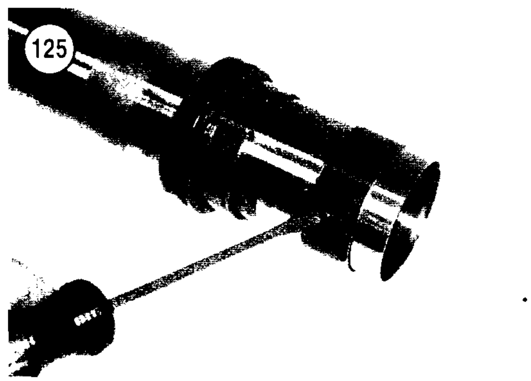
Inspection

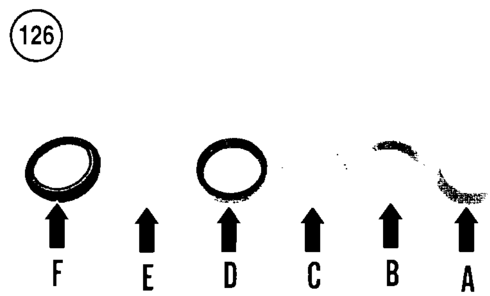
CAUTION
Carefully handle and clean the parts. Harsh cleaning habits and some solvents can remove or damage the coatings on the bushings.

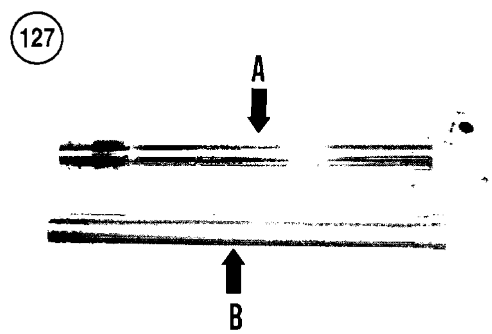
The following procedure assumes the complete fork tube has been disassembled. Clean and inspect each set of fork parts as follows:

1. Clean all parts in solvent, making sure the solvent is compatible with rubber parts and the coatings on the bushings. Immediately wash the parts a second time with soap and water. Rinse the parts with clean water. Dry all parts with a lint-free cloth.
2. Inspect the inner tube (A, **Figure 127**) for:
   a. Nicks, rust, flaking chrome or creasing along the length of the tube. These conditions will damage the dust and oil seals. Repair minor roughness with 600-grit sandpaper and solvent. Replace the inner tube, if necessary.
   b. Wear and stress cracks at the axle holder.
   c. Place the inner tube in V-blocks and measure at the middle of the tube for runout. If runout is 0.4 mm (0.02 in.) or greater, replace the tube. Do *not* straighten the tube.
   d. Damaged threads.
3. Inspect the outer tubes (B, **Figure 127**) for:
   a. Damage along the length of the tube.
   b. Damaged threads.
   c. Damage at the dust seal and stop ring areas.

NOTE
*If the fork cap is damaged, replace it as a complete assembly. If the cap is in good condition, install new O-rings on the cap damper and air release screw (**Figure 128**).*







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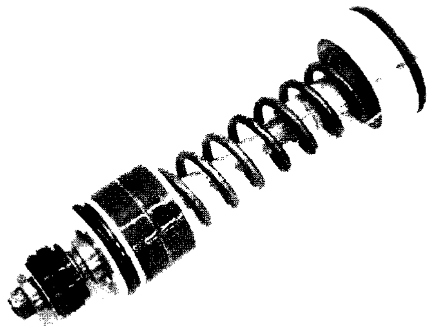

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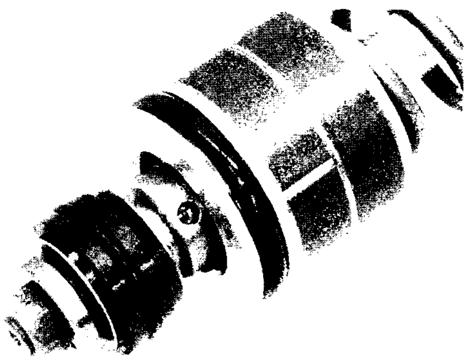

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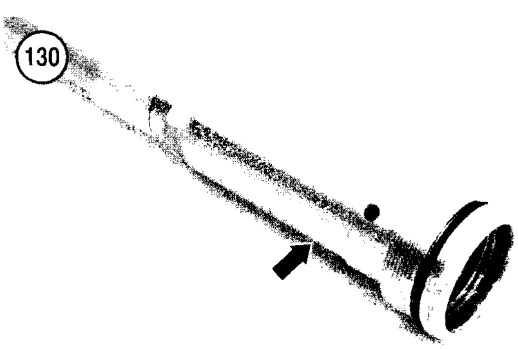

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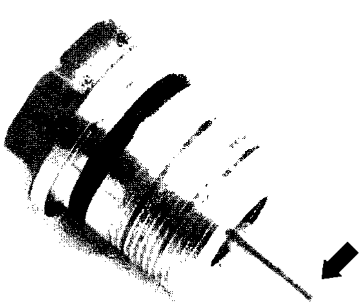

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4. Inspect the fork cap assembly for:
   a. Damage and wear, particularly at the damper bushing (**Figure 129**). Minor buildup can be removed with fork oil and a nylon brush. If the coating is worn and the base metal is visible across the surface, either replace the assembly or refer disassembly and service to a suspension specialist.
   b. Spring fatigue or damage.
   c. Compression adjuster operation.
   d. Damaged threads.
5. Inspect the subtank of the damper rod (**Figure 130**).
   a. Check for damaged threads and ensure they are clean.
   b. Replace the O-ring.

NOTE

If the center bolt is damaged, replace it as a complete assembly. If the bolt is in good condition install a new O-ring.

6. Inspect the center bolt and pushrod for:
   a. Damage and buildup.
   b. Pushrod straightness.
   c. Stepped wear or damage on the adjuster rod (**Figure 131**).
   d. Rebound adjuster operation.
7. Inspect the fork damper (**Figure 132**) for bending, wear or damage along the length of the parts.
8. Measure the fork spring free length (**Figure 133**). Refer to **Table 1** for the service limit. Replace both springs as a pair.
9. Inspect the spring guide and spring seat (**Figure 134**) for damage and wear.
10. Inspect the slide bushing and guide bushing for scoring, scratches and excessive wear. Remove mi-

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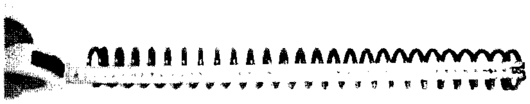

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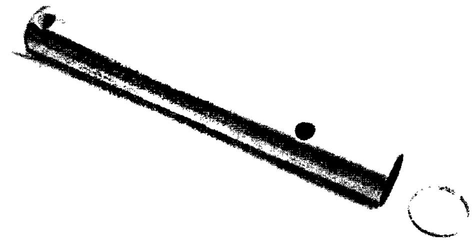

nor metallic buidup with fork oil and a nylon brush. Replace the bushings if discolored or if the coating is excessively worn and the base metal is visible across the surface, as shown in **Figure 135**. Replace both bushings as a set.

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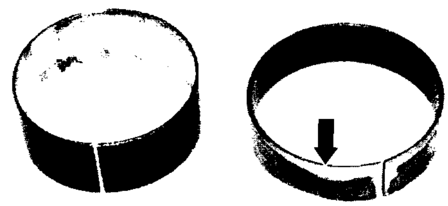

Fork Tube and Seal Assembly

If the fork tubes were not separated, go to *Assembly and Fork Oil Refilling* in this section. Refer to *Tools* in this section before beginning assembly of the tubes and seals. Before assembly, have a new oil seal, dust seal and any other replacement parts on hand. Clean the work area and all parts before starting assembly.

CAUTION
Using grease instead of fork oil when installing the oil seal can cause a fork oil leak. Grease also attracts dirt, which may accumulate and damage the dust seal lip and oil seal lip.

1. Lubricate the parts with fork oil. Use the same fork oil used for refilling the fork. Refer to **Table 2** for the recommended fork oil or equivalent.
2. Cover the end of the inner tube with plastic wrap, and then coat it with fork oil. The plastic prevents the edge of the inner tube from tearing the dust and oil seals during installation (**Figure 136**).
3. Install the following parts in order on the inner tube (**Figure 137**):
   a. Dust seal (A).
   b. Stop ring (B).
   c. Oil seal (C). Install the seal so the manufacturer's mark faces the dust seal. Remove the plastic from the slider.
   d. Seal spacer (D).

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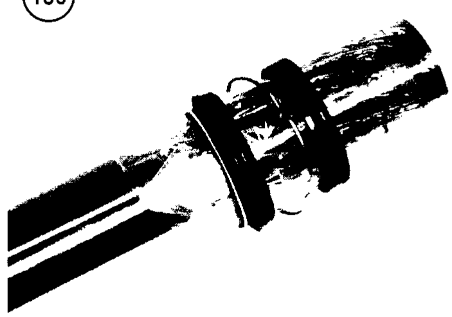

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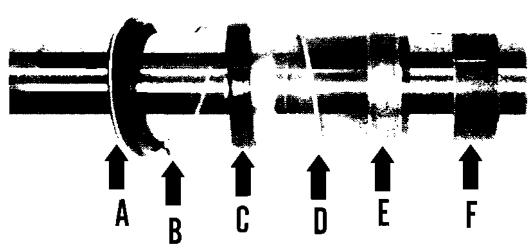

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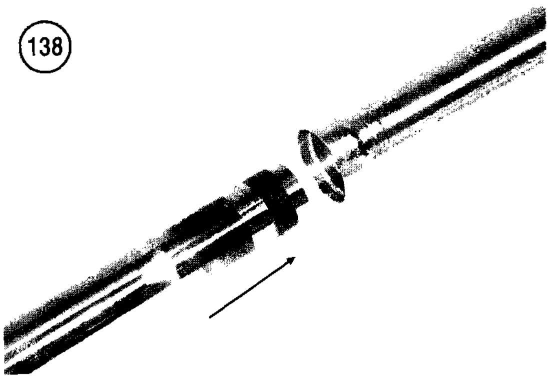

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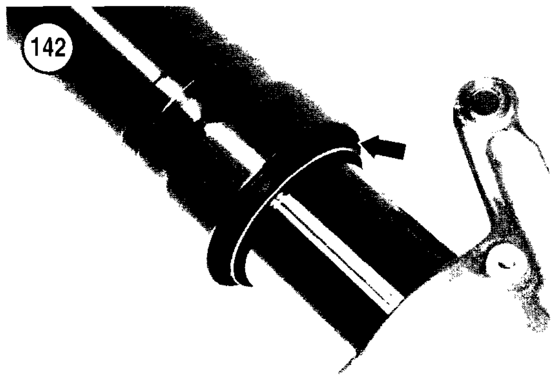

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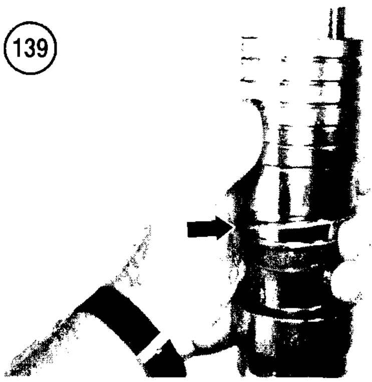

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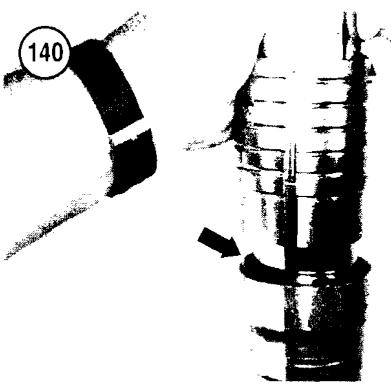

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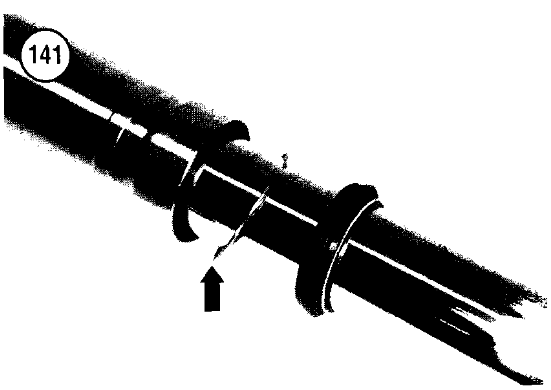
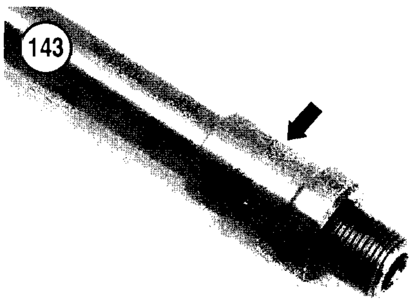
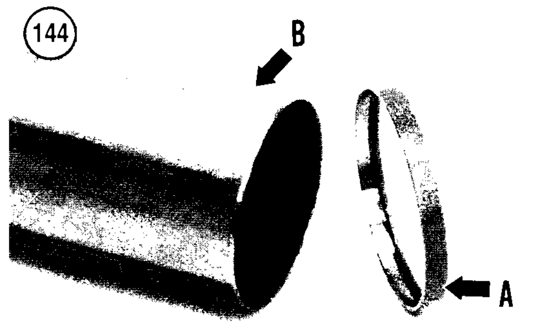


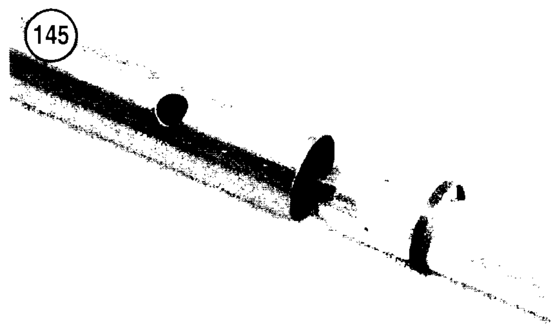
e. Guide bushing (E).
f. Slide bushing (F). Spread the bushing only far enough to slip it onto the tube. Avoid scratching the coating on the bushing. Seat the bushing in the groove.

4. Assemble the inner and outer tubes (**Figure 138**) as follows:
   a. Lubricate the parts with fork oil.
   b. Support the outer tube so its bottom end is facing up.
   c. Insert the inner tube into the outer tube, and then move the guide bushing and seal spacer against the outer tube.
   d. Fit a fork seal driver around the inner tube and against the spacer (**Figure 139**).
   e. Use the fork seal driver like a slide hammer and drive the guide bushing and seal spacer into the outer tube. Make sure the parts are completely seated.
   f. Slide the oil seal down the inner tube until it starts to enter the outer tube. Make sure the seal is seated squarely against the bore.
   g. Use the fork seal driver like a slide hammer and drive the oil seal into the fork tube (**Figure 140**). Drive the seal until the stop ring groove is visible above the seal.
   h. Install and seat the stop ring (**Figure 141**) in the groove.
   i. Lightly apply fork oil to the outer tube, where the dust seal will be seated.
   j. Seat the dust seal (**Figure 142**) into the top of the fork tube.
   k. Slide the fork tubes together several times and check for smooth operation. If roughness or binding is detected, disassemble the parts and determine the cause.





5. Refer to *Assembly and Fork Oil Refilling* in this section to fill the fork leg and complete assembly.

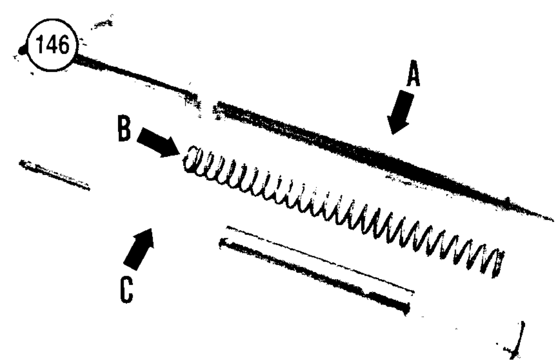


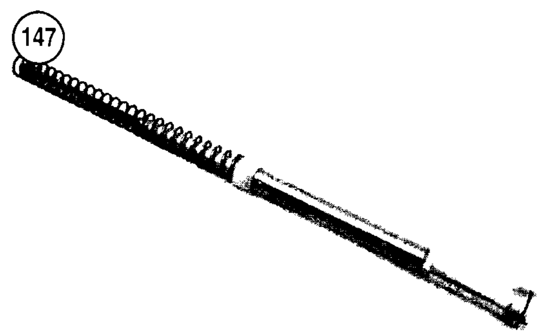
Assembly and Fork Oil Refilling

Use the following procedure to refill the fork legs with oil, either after rebuilding the forks or during a routine fork oil change. This procedure also details the assembly of the fork legs after the oil level has been set.

NOTE
*Clean each threaded part before reinstalling. Apply the front fork oil specified in **Table 2** when installing the O-rings, bushings, damper unit and other sliding parts.*

1. Make sure the locknut on the end of the damper rod is threaded all the way onto the rod (**Figure 143**). There should be at least 10 mm (0.39 in.) of exposed thread on the end of the rod.
2. Fit the spring seat (A, **Figure 144**) onto the end of the spring guide (B).
3. Install the spring seat and the spring guide over the end of the damper rod assembly (**Figure 145**).
4. Completely wipe off the fork oil from the fork (A, **Figure 146**), spring (B) and damper rod assembly (C).
5. Insert the spring and damper rod (**Figure 147**) into the fork tube (**Figure 148**).
6. Hand tighten the fork cap/damper into the subtank of the damper (**Figure 149**).
7. Hand tighten the damper assembly into the fork tube.
8. Clamp the axle holder in a fork holder or soft-jawed vise.





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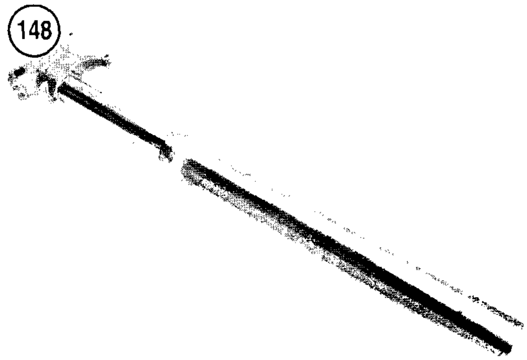

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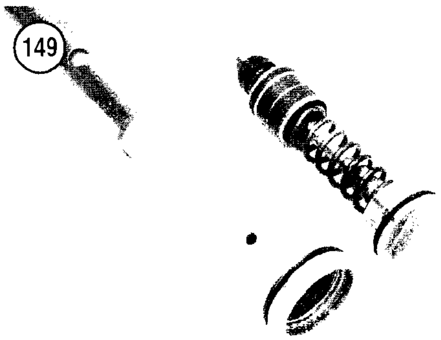

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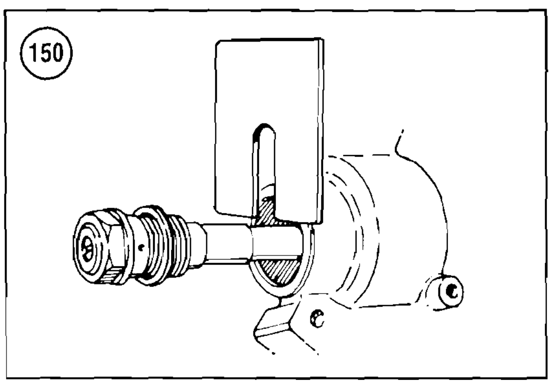

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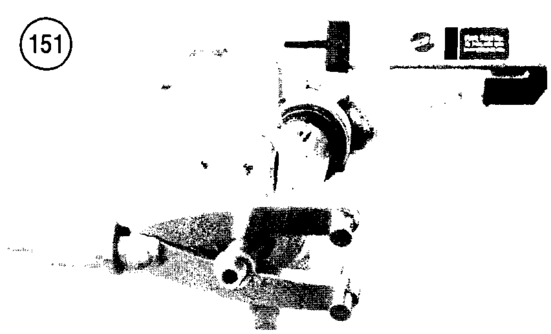

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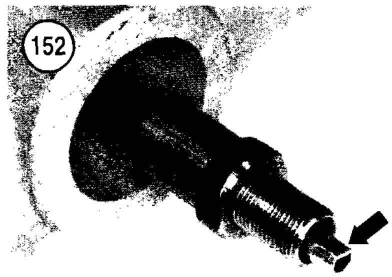

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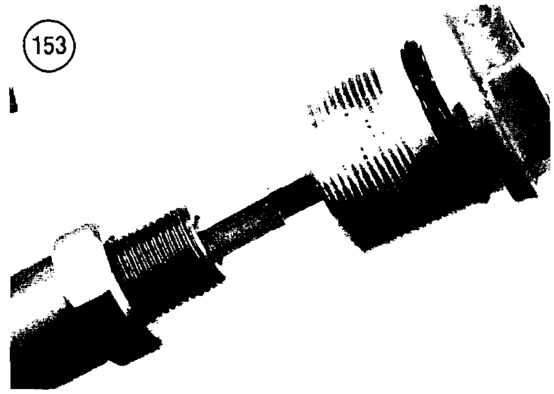

NOTE

The fork leg springs are under pressure. Compressing the springs is easier with an assistant to help steady the fork in the vise while the holder is installed.

9. Compress the fork leg and install a holder (**Figure 150** [Suzuki part No. 09910-20115]) or equivalent on the end of the damper rod. This can be done with a variety of tools including an adjustable wrench (**Figure 151**).

10. Install the pushrod into the end of the damper and turn it until it is engaged (**Figure 152**).

11. Install the adjuster of the center bolt into the end of the pushrod (**Figure 153**). Make sure the center bolt is aligned with the flat of the pushrod.

12. Hold the piston rod and turn the rebound adjuster (**Figure 154**) counterclockwise until it stops.

13. Thread the center bolt onto the end of the damper until there is resistance. There should be at least 1 mm (0.04 in.) between the locknut and center bolt (**Figure 155**).

14. Hold the center bolt with a wrench and tighten the locknut (**Figure 156**) against it to 23 N•m (17 ft.-lb.).
15. Apply threadlock to the threads of the center bolt (**Figure 157**).
16. Tighten the center bolt (**Figure 158**) 70 N•m (52 ft.-lb.).
17. Unscrew the fork cap compression unit from the damper unit and pour in 182 ml (6.15 oz.) of fork oil into the subtank (**Figure 159**).
18. Screw the fork cap compression unit into the damper and unscrew the damper from the fork tube slowly slide down the fork tube.
19. Pour 350 ml (11.83 oz.) of fork oil into the fork tube (**Figure 160**).
20. Screw the fork cap into the outer tube and tighten the cap to 35 N•m (26 ft.-lb.).
21. Tighten the fork cap compression unit to 30 N•m (22 ft.-lb.).
22. Refer to **Table 3** for the standard fork settings.
23. Install the fork legs as described in this chapter.

FRONT FORK ADJUSTMENT

When making changes to the suspension settings, keep accurate records of all settings. A record of each adjustment makes setting the suspension easier.

Spring Preload

On 2000 and 2001 S models, a spring preload adjuster is located in the center of the fork cap (**Figure 161**). The adjuster is marked with reference lines for setting the fork legs identically. Spring preload adjustment affects the initial force required to compress the fork springs. Turning the adjuster *clockwise* increases preload. Turning the adjuster *counterclockwise* decreases preload. Refer to **Table 3** for the standard preload setting.

Air Release Screw

On all E and SM models and 2002-on S models, an air release screw is located at the top of the fork cap (A, **Figure 162**). When riding, the cushion of air in the fork leg warms and expands, increasing the pressure in the fork leg. This increase in pressure affects the action of the suspension. Release the pressure often, usually between race heats or

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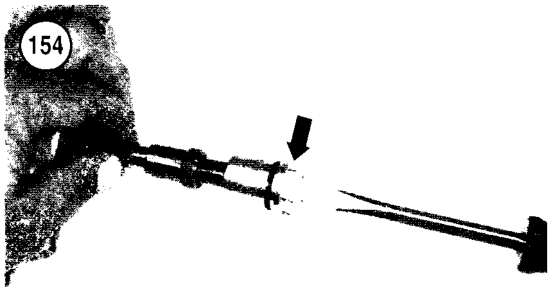

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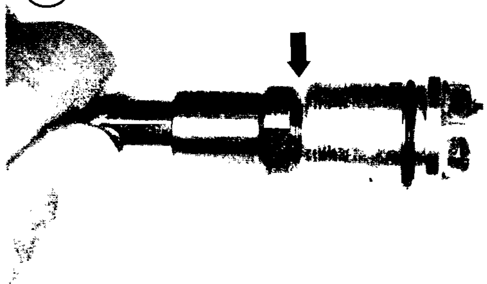

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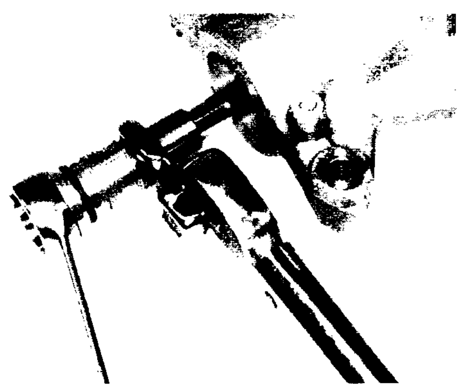

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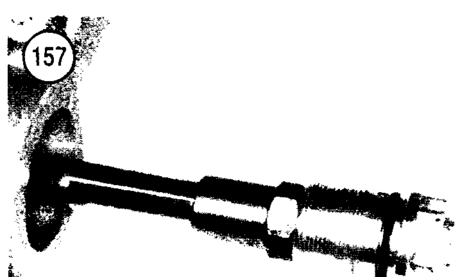

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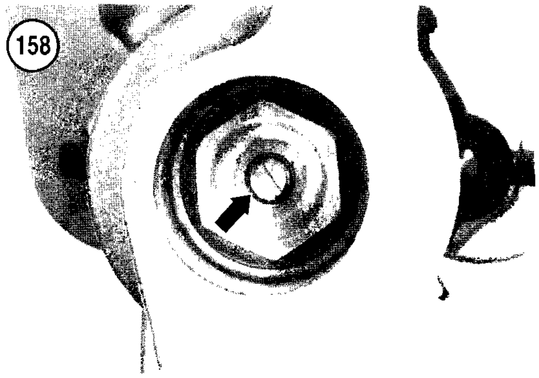

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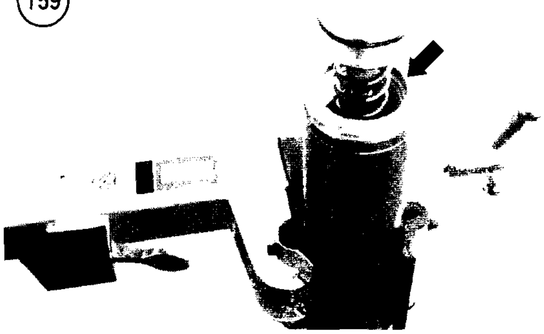

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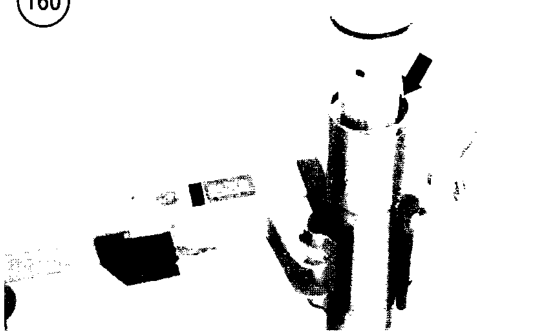

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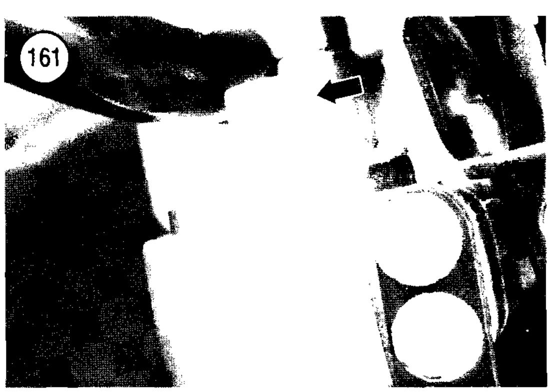

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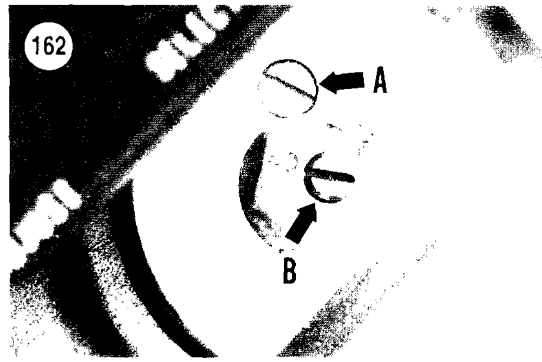

when riding in extremely rough terrain. Release the pressure as follows:

1. Support the motorcycle with the front wheel off the ground.
2. Remove the air screw (A, **Figure 162**) from the fork cap to relieve the air pressure.
3. Install and tighten the air release screw. Repeat for the other fork leg. Set the fork legs identically.

Rebound Damping

On all E and SM models and 2002-on S models, a rebound damping adjuster is located in the center of the fork cap (B, **Figure 162**). Rebound damping adjustment affects the rate of fork extension after it has been compressed. Turning the adjuster *clockwise* increases damping (stiffens fork action). Turning the adjuster *counterclockwise* decreases damping (softens fork action). Refer to **Table 3** for the standard rebound setting. Set rebound damping as follows:

1. Turn the adjuster to the maximum hard position (clockwise). Do not force the adjuster beyond its normal range of travel.
2. Turn the adjuster counterclockwise while counting the number of clicks. When it is in the final position, make sure the adjuster is seated in a detent and is not between detents.
3. Repeat the procedure on the other fork leg. Set the fork legs identically.

Compression Damping

The compression damping adjuster is located in the end of the fork leg (**Figure 163**). Compression damping adjustment affects the rate of fork compression. Turning the adjuster *clockwise* increases damping (stiffens fork action). Turning the adjuster *counterclockwise* decreases damping (softens fork action). Refer to **Table 3** for the standard compression setting. Set compression damping as follows:

1. Turn the adjuster to the maximum hard position (clockwise). Do not force the adjuster beyond its normal range of travel.
2. Turn the adjuster counterclockwise while counting the number of clicks. When it is in the final position, make sure the adjuster is seated in a detent and is not between detents.
3. Repeat the procedure on the other fork leg. Set the fork legs identically.

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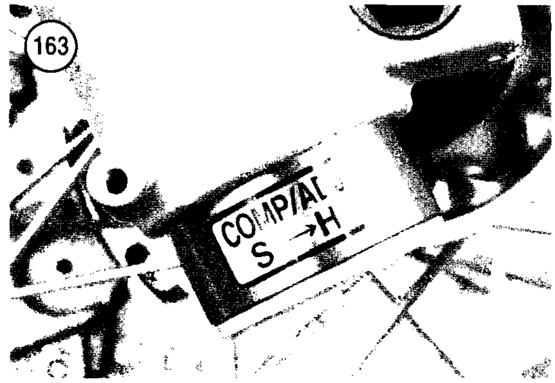


Table 1 STEERING AND FRONT SUSPENSION SPECIFICATIONS

Fork leg top end clearance	
S models	
2000-2001	5 mm (0.2 in.)
All other models	Align to groove in fork leg
Fork leg runout	
E and S models	NA
SM models	2 mm (0.08 in.)
Fork spring free length	
E models	510.6 mm (20.1 in.)
Service limit	500 mm (19.69 in.)
S models	573.2 mm (22.6 in.)
Service limit	561 mm (22.1 in.)
SM models	450 mm (17.7 in.)
Service limit	441 mm (17.4 in.)
Fork travel	288 mm (11.3 in.)
SM models	260 mm (10.2 in.)
Steering	
Angle	45° left and right
Caster (rake angle)	
E models	27° 20'
S models	27° 10'
SM models	26° 15'
Trail	
E models	112 mm (4.41 in.)
S models	107 mm (4.21 in.)
Turning radius (minimum)	
E and S models	2.2 m (7.2 ft.)
SM models	2.6 m (8.5 ft.)

Table 2 FORK OIL LEVEL AND CAPACITY

Fork oil grade	Suzuki SS-05, or equivalent 5-weight fork oil
Fork oil capacity (each leg)	
E models	720 cc (24.4 oz.)
S models	710 cc (24.0 oz.)
SM models	
Inner	182 ml (6.15 oz.)
Outer	350 ml (11.84 oz.)
Fork tube oil level (from top edge of inner tube)	
E models (without spring)	
2000-on	122 mm (4.8 in.)
S models (without spring)	
2000-2001	165 mm (6.5 in.)
2002-on	129 mm (5.08 in.)
SM models	NA

Table 3 STANDARD FORK SETTINGS

	Spring preload adjuster	Compression adjuster clicks out*	Rebound adjuster clicks out*
E models			
2000-2003	–	12	13
2004	–	12	15
S models			
2000-2001	Third groove from top	7	–
2002-on	–	13	16
SM models	NA	13	17

*Number or clicks out after the adjusters have been fully turned in (maximum damping force). Turning the adjusters out decreases damping force. Do not force the adjusters beyond their normal travel. Damage to the adjusters can occur.

Table 4 FRONT SUSPENSION TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Axle nut			
Front*			
E and S models			
Initial	20	–	15
Final	42	–	31
SM models			
Initial	20	–	15
Final	39	–	29
Bridge pinch bolts			
E and S models			
Lower	32	–	24
Upper	30	–	22
SM models			
Lower	23	–	17
Upper	23	–	17
Damper rod bolt			
S and S models	80	–	59
SM models			
Center bolt locknut	23	–	17
Center bolt	70	–	52
Fork caps			
S and E models	23	–	17
SM models			
Damper rod/subtank	35	–	26
Fork cap/compression unit	30	–	22
Fork cap to piston rod nut			
E models	22	–	16
S models			
2002-on	22	–	16
Front axle pinch bolts	18	–	13
Handlebar holder bolts			
E and S models	23	–	17
SM models	45	–	33
Steering stem adjuster nut (seating torque)	45	–	33
Steering stem nut	90	–	66

*Refer to the text for the tightening procedure.

CHAPTER THIRTEEN

REAR SUSPENSION

This chapter provides service procedures for the rear shock absorber, swing arm and linkage assembly. Refer to **Tables 1-3** at the end of the chapter for specifications and recommended shock absorber settings.

The link suspension includes the swing arm, single shock absorber and a three-piece linkage system.

The function of the linkage is to vary the speed of shock absorber compression, depending on the position of the swing arm. During the transition from low to high swing arm movement, the linkage system pivots, increasing its leverage on the shock absorber. This change in compression speed varies the damping curve of the shock absorber. Small bumps cause the swing arm to compress slightly, and the shock absorber provides a compliant ride. The damping curve is relatively flat and soft under this condition. As riding conditions become more severe (large bumps) and swing arm travel increases, the same damping curve is no longer effective. The damping curve must rise to prevent bottoming of the suspension. To raise the curve, shock absorber speed must be increased to raise hydraulic resistance (damping) in the shock absorber.

SHOCK ABSORBER

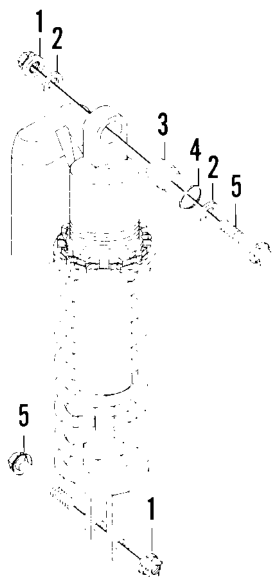
The shock absorber (**Figure 1** and **Figure 2**) is a spring-loaded, hydraulically-damped unit with an integral oil/nitrogen reservoir. On 2000-2001 S models, only the upper bushing and seals are replaceable. On all E, SM and 2002-on S models, the upper bushing, seals, spring and compression adjuster assembly are replaceable. To adjust the shock absorber, refer to *Shock Absorber Adjustment* in this chapter.

Removal and Installation

1. Remove the side covers and seat (Chapter Fifteen).
2. Remove the rear wheel (Chapter Eleven).
3. Remove the muffler (Chapter Four).
4. Support the swing arm, but do not compress the shock absorber.
5. Remove the lever arms from the swing arm so the lower mounting bolt (**Figure 3**) is accessible. When the lever arm bolt is removed, the swing arm pivots freely.

1

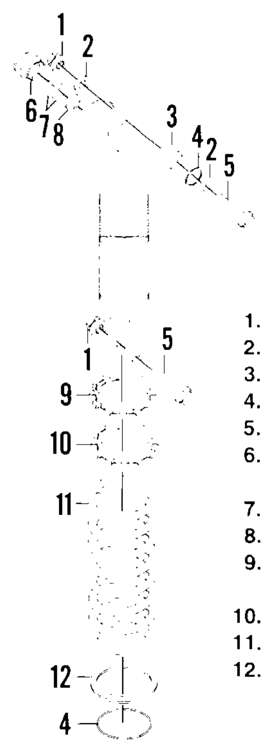
SHOCK ABSORBER 2000-2001 S MODELS



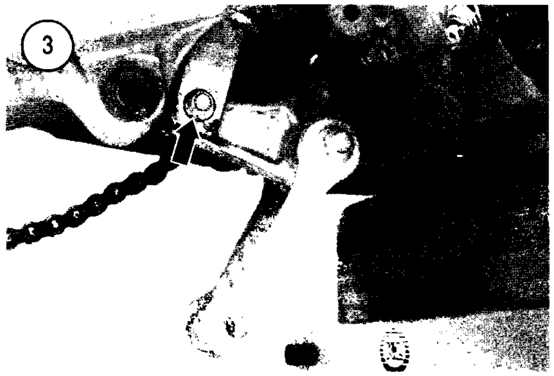
1. Nut
2. Seal
3. Bushing
4. Circlip
5. Bolt

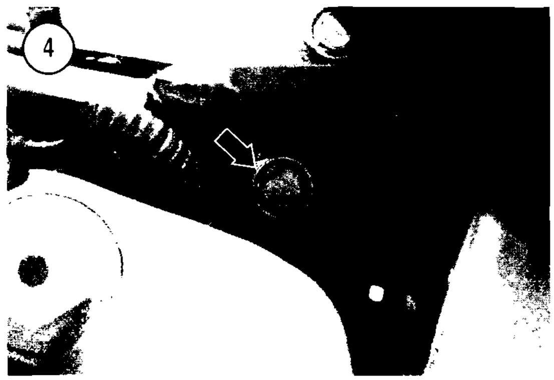
2

SHOCK ABSORBER ALL E, SM AND 2002-ON S MODELS



1. Nut
2. Seal
3. Bushing
4. Circlip
5. Bolt
6. Compression adjuster
7. O-ring
8. Orifice
9. Spring adjuster lockring
10. Spring adjuster nut
11. Spring
12. Spring seat





6. Remove the lower shock absorber mounting bolt.
7. Remove the upper mounting bolt (**Figure 4**).
8. Raise the swing arm and remove the shock absorber out of the right side of the frame. Inspect the unit as described in this chapter.
9. Refer to **Table 2** for shock absorber settings.
10. Reverse this procedure to install the shock absorber. Note the following:
   a. Lubricate the bores with waterproof grease.
   b. Install the shock absorber so the adjuster(s) face the right side of the motorcycle.
   c. Install both mounting bolts from the left side.
   d. Tighten the bolts to 55 N•m (41 ft.-lb.).

Inspection

WARNING

On all E models and 2002-on S models, if disassembly of the compression adjuster is required, it is recommended that it be disassembled by a dealership. The reservoir is pressurized and could cause injury if it is not properly disassembled.

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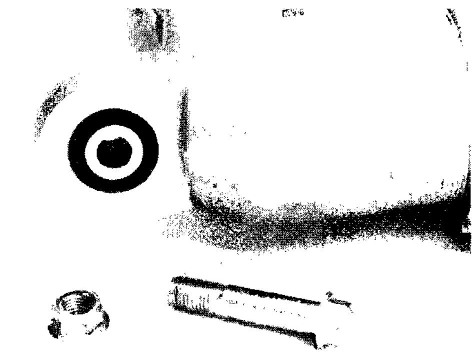

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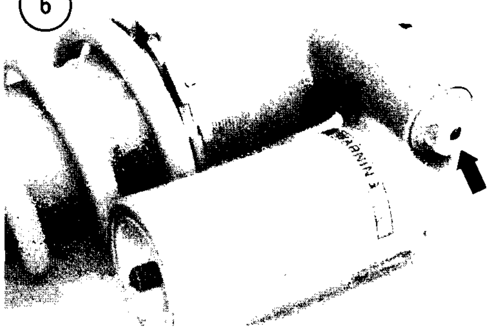

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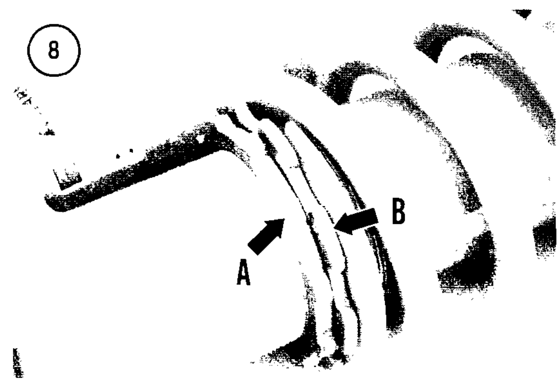

1. Inspect the upper bushing and mounting bolt (**Figure 5**) for wear or damage. The bolt must be a firm fit in the bore. The bushing must be tight in the rubber mounting. If the bushing is worn, remove the seals and snap ring, and then press out the bushing. Install a new bushing and mounting bolt.
2. Turn the compression damping adjuster(s) (**Figure 6**) and check for proper operation. Each setting should have a perceptible click. Also inspect for reservoir leaks around the adjuster. For 2000-2001 S models, adjuster repair parts are not available.
3. Inspect the damper rod for leaks at the seal (**Figure 7**). The damper rod should be smooth and shiny.
4. Inspect the spring for cracks or other damage. On all E, SM and 2002-on S models, the spring can be replaced by backing off the spring adjuster locknut (A, **Figure 8**), and then relieving spring pressure with the adjuster nut (B). The snap ring, spring seat and spring can then be removed.
5. Inspect the spring preload length (**Figure 9**). Refer to **Table 1** for spring preload lengths. Adjust spring length by backing off the spring adjuster locknut (A, **Figure 8**), and then adjusting spring length with the adjuster nut (B). Tighten the locknut against the adjuster nut when spring length is set.

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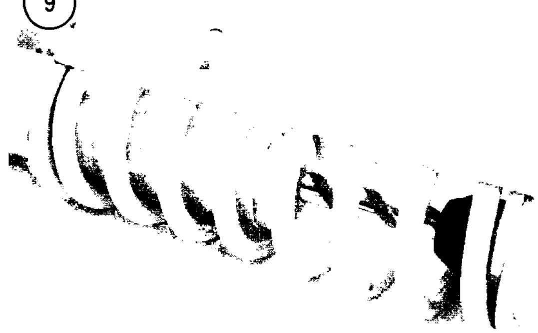

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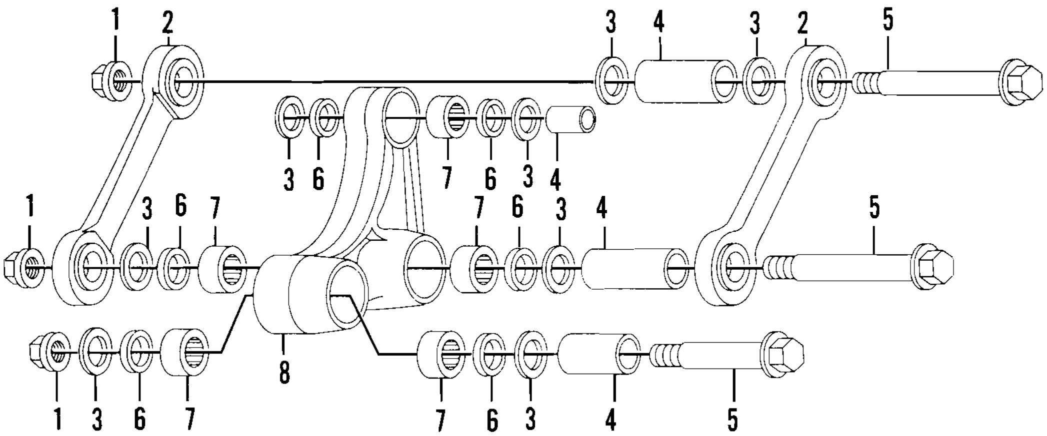
SHOCK ABSORBER LINKAGE



1. Nut
2. Lever arm
3. Washer
4. Pivot spacer
5. Pivot bolt
6. Seal
7. Bearing
8. Lever

6. Inspect the lower clevis and mounting bolt (**Figure 10**) for wear or damage. The bolt must be a firm fit in the bore.
7. On all E models and 2002-on S models, turn the rebound damping adjuster(s) and check for proper operation. Each setting should have a perceptible click.

SHOCK ABSORBER LINKAGE

The shock absorber linkage (**Figure 11**) consists of the lever, lever arms, pivot bolts, seals, pivot spacers and needle bearings. The lever is joined to the swing arm by the lever arms. Lubricate the linkage at the intervals indicated in Chapter Three. If the linkage is subjected to harsh riding conditions, service the linkage more frequently.

Lever and Lever Arms Removal and Installation

The lever and lever arms (**Figure 11**) can be removed for service without removing the swing arm or rear wheel. However, to improve handling and access to the parts, it is recommended to remove the rear wheel.

During assembly, install the bolts in their original directions.

Do not remove or allow the pivot spacers to slide out of the bearings. For some bearings, the needle bearings are held in place only by the grease on the bearings. Keep any removed rollers with their respective bearing housing.

1. Support and raise the motorcycle under the engine. The motorcycle must be stable for bolt removal.
2. With the shock absorber fully extended, support the swing arm.
3. Remove the lever arms from the swing arm (**Figure 3**). If disassembling the lever assembly, also loosen the pivot bolt connecting the lever arms to the lever. Loosen the bolt before removing the lever arms from the swing arm. The bolt is very tight and must be held stable to remove the nut. This may not be possible at the workbench.
4. Raise and secure the swing arm to improve access to the shock absorber and linkage.

5. Remove the bolt securing the shock absorber.
6. Remove the pivot bolt/nut (**Figure 12**) connecting the lever to the frame.
7. Inspect and service the lever and lever arms as described in this section.
8. Reverse these steps to install the parts. Note the following:
   a. Lubricate all bearings, seals, washers and pivot bolts with molybdenum disulfide grease. Do not lubricate the nut or bolt threads.
   b. Clean the frame and swing arm mounting bores, and then lubricate with grease.
   c. Install all linkage bolts and the shock absorber bolts from the left side.
   d. Finger-tighten all bolts.
   e. Tighten all linkage bolts to 100 N•m (74 ft.-lb.).
   f. Tighten the shock absorber bolt to 55 N•m (41 ft.-lb.).

Lever Arms Inspection

The lever arms (**Figure 11**) do not contain any bearings and can be visually inspected. Replace parts that show any signs of wear or damage.

1. Inspect for the following:
   a. Worn pivot bolts. Check the fit of the bolts in the lever arms (**Figure 13**). The bolts should be a snug fit. Replace nuts and bolts that have rounded flats. Proper tightening may not be achieved if the nuts and bolts cannot be gripped by a socket.
   b. Inspect the lever arms for cracks, bends or twisting. The arms should lay flat.
   c. Inspect the lever arm bores for damage and elongation (**Figure 14**). If worn or damaged, also replace the pivot bolts.
   d. Inspect the contact point where the lever arm and pivot spacer mate. If the area is worn or scored, the pivot bolts have been inadequately tightened.
2. Install the lever arms as described in this section.

Lever Inspection

1. At each bearing, remove the pivot spacer and seals. Pry the seals at their outer edges. On some bearings, the needles are held in place only by the bearing grease. Keep any removed rollers with their respective bearing housing.

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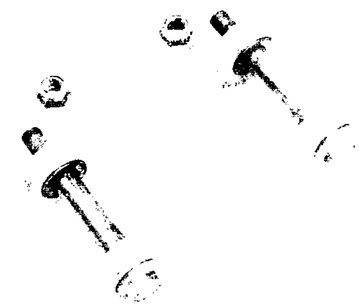

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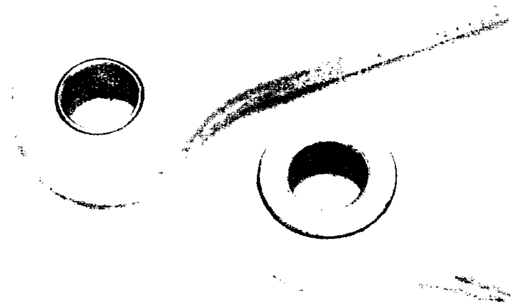

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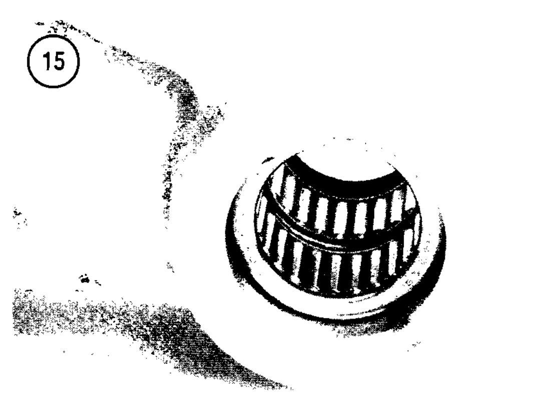

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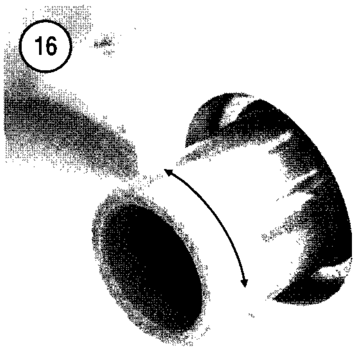

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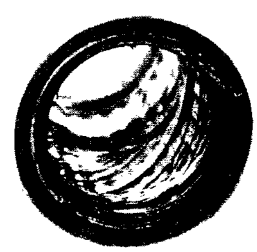

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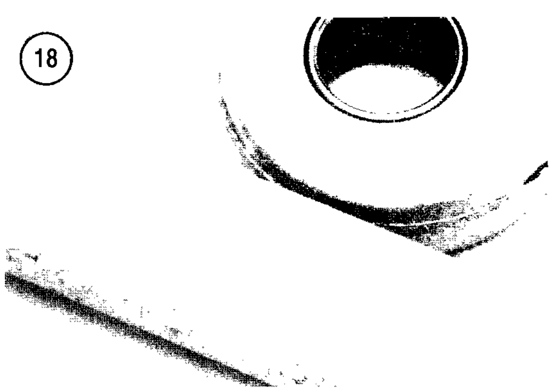

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2. Clean the lever assembly in clean solvent, and then carefully dry all parts.
3. Inspect the following:
   a. Inspect the lever for cracks, particularly around the bearing bores.
   b. Inspect the frame pivot bolt and nut for scoring, wear and other damage. Replace the nut and bolt if it has rounded flats. Proper tightening may not be achieved if the nut and bolt cannot be gripped by a socket.
   c. Inspect the needle bearings (**Figure 15**) for wear, flat spots, rust or discoloration. If the rollers are blue, overheating has occurred. If water or rust is present in the bearings, the seals are leaking.
   d. Inspect the pivot spacers for scoring, wear or other damage.
   e. Lightly lubricate the bearings and pivot spacers, and then insert each spacer into its respective bearing (**Figure 16**). The parts should turn freely and smoothly. If play or roughness exists, replace the bearing(s) as described in *Lever Bearing Replacement* in this section. For bores containing two bearings, always replace both.
   f. Inspect the seals for cracks, wear or distortion.
4. Pack the bearings, bearing bores, seals and pivot spacers with grease (**Figure 17**).
5. Press the seals into position by hand. If the seals do not seat, inspect the bearing depth. If necessary, adjust the depth of the bearing(s).
6. Assemble the lever and lever arm components (**Figure 18**) with *Suzuki* facing out. Make sure all seals remain seated as the pivot spacers pass through the seals. Lightly tighten pivot bolts. If there is no identification on the arms, install the arms so the small shoulder on the bushing faces out (**Figure 19**).
7. Install the lever as described in this section.

Lever Bearing Replacement

WARNING

If necessary, use a heat gun to slightly expand the bore so the bearing(s) can be removed with minimal resistance. This is particularly helpful when removing corroded bearings. Always keep the heat source moving at a steady rate and avoid heating the bearing.

Work in a well-ventilated area and away from combustible materials. Wear protective clothing, including eye protection and insulated gloves.

On bores that contain two bearings, always replace both bearings. Mixing new and worn bearings on the same pivot bolt shortens the life of the new part.

It is recommended to remove the bearings with a press. If the bearings and bores are not corroded, hand tools and a drawbolt can be used. The following procedures describe removal and installation of the bearings using both methods. Do not perform the following procedures until all seals and spacers have been removed from the lever.

Press method

1. On bearings that are not flush to the edge of the bore, measure and record the depth of the bearing in the bore (**Figure 20**).
2. Apply penetrating oil to the bearing(s) and bore.
3. If necessary, heat the immediate area around the bearing(s) to be removed.
4. Support the lever in a press. Place the bearing bore over a large socket or similar tool (A, **Figure 21**) so the bearing(s) can be driven out of the bore. The lower socket must fit on the perimeter of the bore but also be large enough to accept the removed bearing.
5. Place a socket or driver (B, **Figure 21**) squarely against the bearing. The driver must be capable of passing through the bore and be longer than the bore depth.
6. Press the bearing(s) out of the lever.
7. Clean and inspect the bore.
8. Lubricate the new bearing(s) and bore with grease.
9. Support the lever bore on a flat, stable surface. The lower socket is not required.
10. Fit the new bearing squarely over the bore with the manufacturer's marks facing out. If two bearings are required, each bearing is driven from its respective side of the lever.
11. Place a socket or driver squarely against the bearing and press the bearing into the lever. As the driver begins to enter the bore, frequently check the bearing depth. Install the bearing to the depth noted in Step 1 so the seal can be properly seated in the bore.

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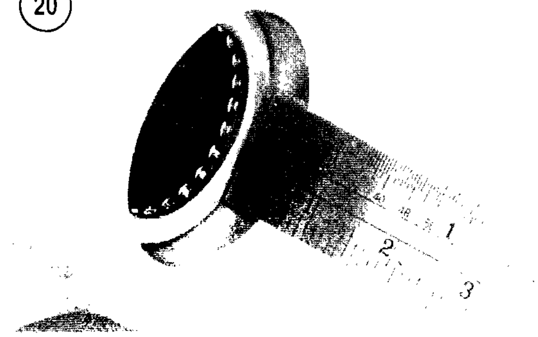

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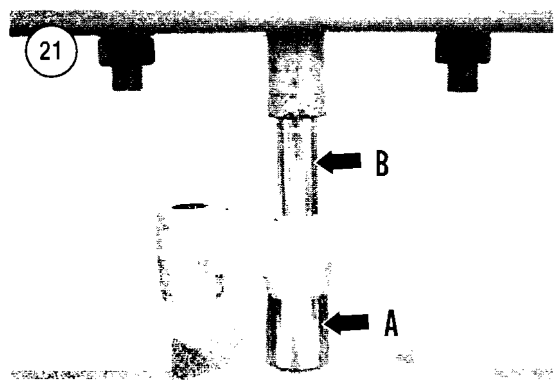

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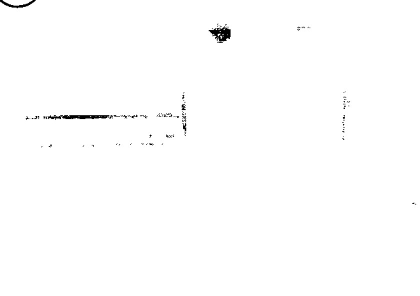

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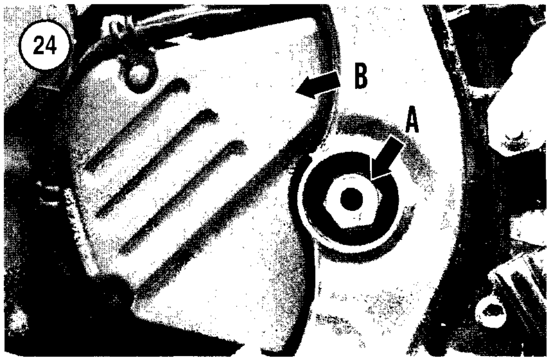

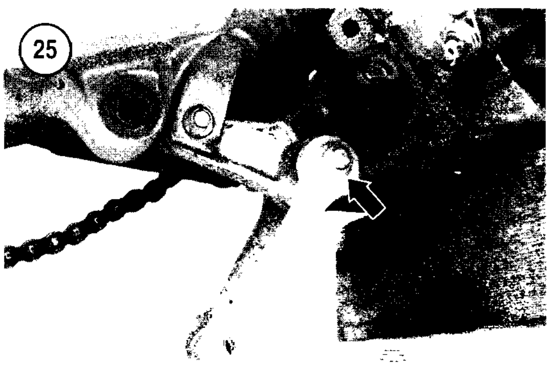

12. If necessary, turn the lever over and press in the remaining bearing.

Draw bolt method

In the following procedure, a bearing removal/installation tool, or drawbolt (**Figure 22**), is made from a bolt, nut, washers and sockets. The driver is a socket capable of passing through the bore, and is longer than the bore depth. The larger socket fits on the perimeter of the bore but is also large enough to accept the removed bearing(s).

1. On bearings that are not flush to the edge of the bore, measure and record the depth of the bearing in the bore (**Figure 20**).
2. Apply penetrating oil to the bearing(s) and bore.
3. If necessary, heat the immediate area around the bearing(s) to be removed.
4. Assemble the tool as shown in **Figure 23**.
5. Hand-tighten the nut until the assembly is squarely positioned against the bearing and lever contact points.
6. Turn the nut and drive the bearing(s) into the large socket.
7. Clean and inspect the bore.
8. Lubricate the new bearing(s) and bore with grease.
9. Fit the new bearing squarely over the bore with the manufacturer's marks facing out. If two bearings are required, each bearing is driven from its respective side of the lever.
10. Reverse the direction of the tool and hand-tighten the nut until the tool and bearing is squarely positioned with the bore. Note that a large-diameter, thick washer can now be substituted for the large socket.
11. Drive the bearing into the lever. As the driver begins to enter the bore, frequently check the bearing depth. Install the bearing to the depth noted in Step 1 so the seal can be properly seated in the bore.
12. If necessary, turn the lever over and drive in the remaining bearing.

SWING ARM

Bearing Inspection

The swing arm bearings can be inspected with the swing arm mounted on the motorcycle. Periodically check the bearings for play, roughness or damage.

1. Remove the rear wheel (Chapter Eleven).
2. Loosen the swing arm pivot nut (A, **Figure 24**) and tighten it to 77 N•m (57 ft.-lb.).
3. Remove the pivot bolt/nut (**Figure 25**) from the swing arm and lever arms.
4. Separate the linkage so the swing arm action is only influenced by the swing arm pivot bolt.
5. Check the bearings as follows:
   a. Have an assistant steady the motorcycle.
   b. Grasp the ends of the swing arm and leverage it from side to side. There should be no detectable play in the bearings.
   c. Pivot the swing arm up and down, through its full travel. The bearings must pivot smoothly.
   d. If there is play or roughness in the bearings, remove the swing arm and inspect the bearing and pivot assembly for wear.
6. Install the lever arms and tighten the pivot bolt to 100 N•m (74 ft.-lb.).

Removal and Installation

If the components of the shock absorber linkage are removed and inspected, remove or loosen all pivot bolts before removing the swing arm. The bolts are easier to loosen while the linkage is

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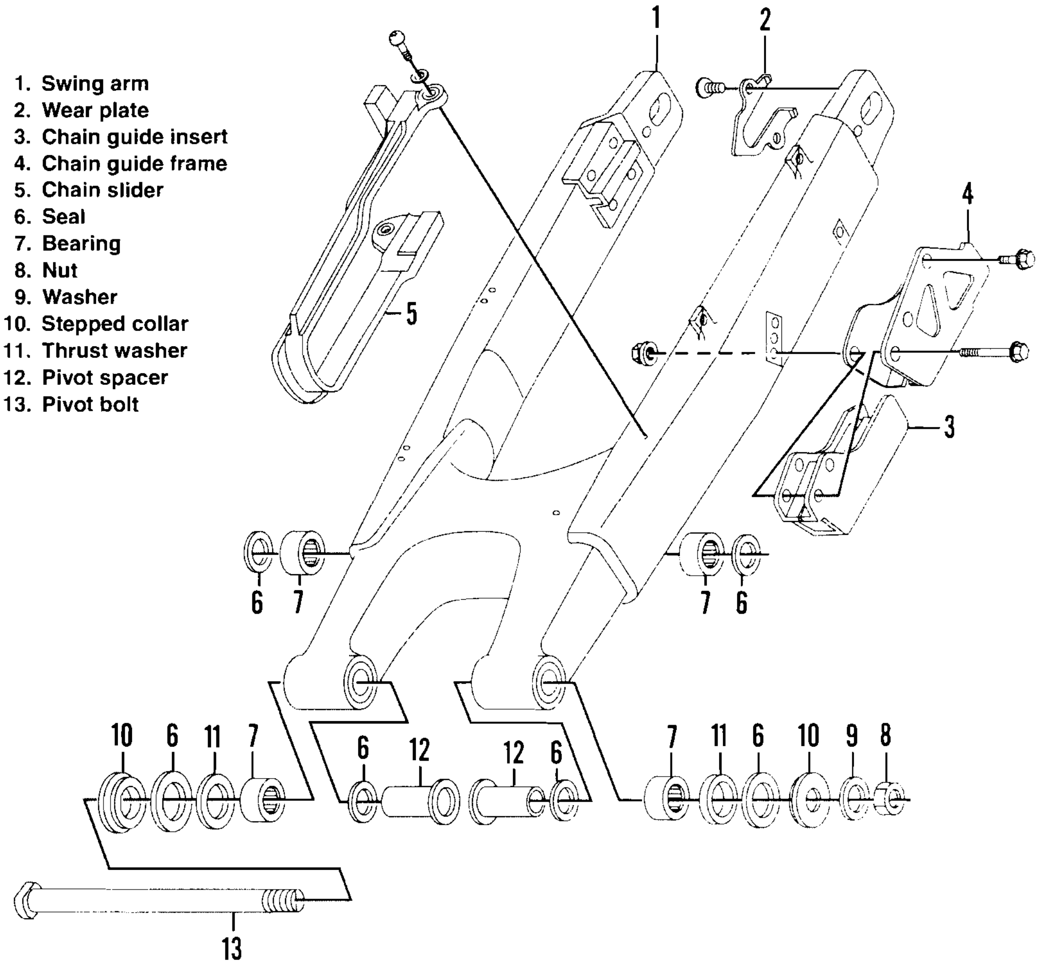
SWING ARM

1. Swing arm
2. Wear plate
3. Chain guide insert
4. Chain guide frame
5. Chain slider
6. Seal
7. Bearing
8. Nut
9. Washer
10. Stepped collar
11. Thrust washer
12. Pivot spacer
13. Pivot bolt



mounted on the motorcycle. Make note of the direction of all pivot bolts that are removed. Refer to **Figure 26**.

1. Support and raise the motorcycle under the engine. The motorcycle must be stable for wheel and bolt removal.
2. Remove the rear wheel (Chapter Eleven).
3. Remove the brake hose from the hose guides.
4. With the shock absorber fully extended, support the swing arm.
5. Remove the chain guide and chain guard (**Figure 27**).
6. Remove the lever arms from the swing arm (**Figure 25**). When the lever arm bolt is removed, the swing arm pivots freely.
7. Remove the brake pedal return spring from the swing arm pivot bore.
8. Remove the drive sprocket guard (B, **Figure 24**).
9. Remove the nut and washer from the swing arm pivot bolt (A, **Figure 24**).
10. Have an assistant hold the swing arm while the pivot bolt is pulled from the swing arm. If a drift is used to drive out the bolt, avoid damaging the bearing assemblies.
11. Remove the swing arm from the frame.
12. Inspect and service the swing arm as described in this chapter.
13. Reverse these steps to install the swing arm. Note the following:

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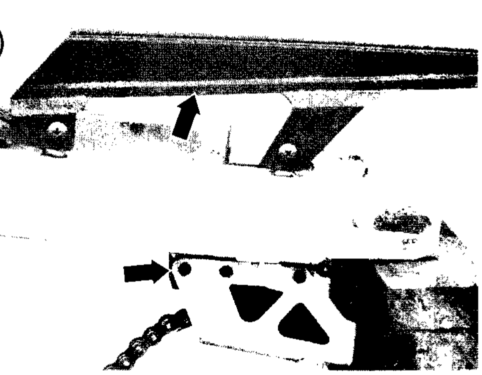

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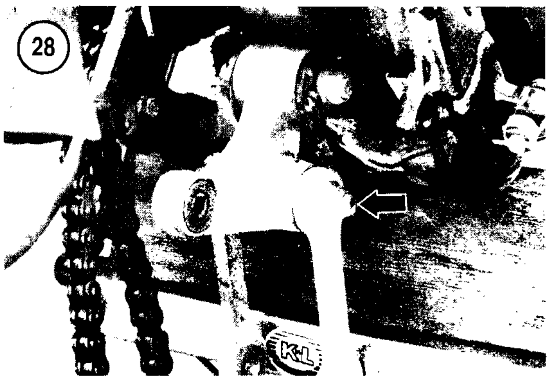

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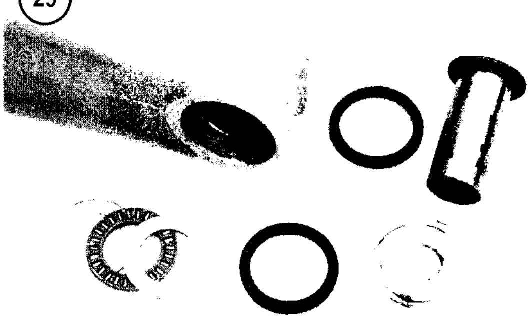

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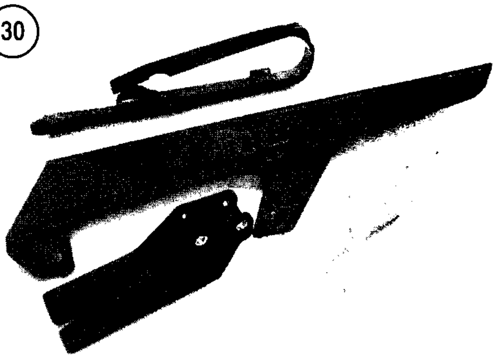

a. Lubricate all bearings, seals and pivot bolts with molybdenum disulfide grease. Do not lubricate the nut or bolt threads.
b. If the complete shock absorber linkage (**Figure 28**) needs to be installed, install the linkage on the frame before installing the swing arm. Refer to *Shock Absorber Linkage*.
c. Make sure the chain passes over and under the swing arm pivot bolt and is properly routed to the rear sprocket (Chapter Eleven).
d. Install the pivot bolts in their correct directions.
e. Tighten the shock absorber bolt to 55 N•m (41 ft.-lb.).
f. Tighten all linkage bolts to 100 N•m (74 ft.-lb.).
g. Tighten the swing arm pivot bolt to 77 N•m (57 ft.-lb.).

SWING ARM SERVICE

Inspection

1. Clean the swing arm (**Figure 26**), particularly around the pivot bores.
2. At each bearing, remove the stepped collar, pivot spacer, seals and thrust bearing (**Figure 29**). Pry the seals at their outer edges. Flush the bearings and wash the parts with clean solvent.
3. Inspect the chain guard, chain guide and slider (**Figure 30**). Replace the slider if it is worn for more than half its thickness. Damage can occur if the chain is allowed to directly contact the swing arm. Also check the chain buffers that are mounted on the frame.
4. Inspect the swing arm and pivot bolt for the following:
   a. Inspect the swing arm for cracks, particularly around the bearing bores.
   b. Inspect the swing arm pivot bolt and nut for scoring, wear and other damage. Replace the nut and bolt if it has rounded flats. Proper tightening may not be achieved if the nut and bolt cannot be gripped by a socket.
   c. Inspect the axle mounts, wear plates and chain adjuster posts (**Figure 31**). Inspect the axle mounts for cracks and wear. Make sure the posts accurately fit in the chain adjusters.
5. Inspect the thrust bearing assemblies (**Figure 32**). Replace the thrust bearing if the rollers are rusted or fall from the race.

6. Inspect the bearings and pivot spacers as follows:
   a. Inspect the bearings (**Figure 33**) for wear, flat spots, rust or discoloration. If the rollers are blue, overheating has occurred. If water or rust is present in the bearings, the seals are leaking.
   b. Inspect the pivot spacers for scoring, wear or rust.
   c. Lightly lubricate the bearings and pivot spacers, and then insert each spacer into its respective bearing (**Figure 34**). The parts should turn freely and smoothly with no play. If play or roughness exists, replace the bearing set as described in *Bearing Replacement* in this section.
7. Inspect the seals for cracks, wear or distortion.
8. Pack grease into the bearings and bores (**Figure 35**). Also apply grease to the seals, thrust bearings, pivot spacers, stepped collars, washer and swing arm pivot bolt. Do not lubricate the nut or bolt threads.
9. Install each thrust bearing and seal set. Press the seals into position by hand. If the seals do not seat, inspect the bearing depth. If necessary, adjust the depth of the bearing.
10. Install the pivot spacers. Grip the seals while twisting the pivot spacers into place.
11. Install the stepped collars.
12. Install the chain slider. Do not install the chain guide or guard until the swing arm and chain are installed.
13. Install the swing arm as described in this chapter.

Bearing Replacement

On the lever arm bore, always replace both bearings. On the swing arm pivot bores, always replace the bearing in each bore. Mixing new and worn bearings on the same pivot bolt shortens the life of the new part.

It is recommended to remove the bearings with a press as described in the following procedure. If the bearing(s) and bore are not corroded, a drawbolt can be used. Refer to *Shock Absorber Linkage* and *Lever Bearing Replacement* in this chapter. Do not perform the following procedure until all seals, spacers and guards have been removed from the swing arm.

WARNING
If necessary, use a heat gun to slightly expand the bore so the bearing(s) can be removed with minimal resistance.

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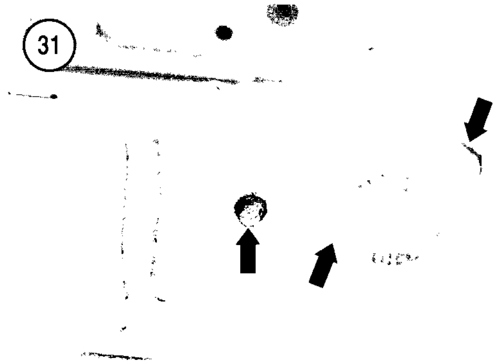

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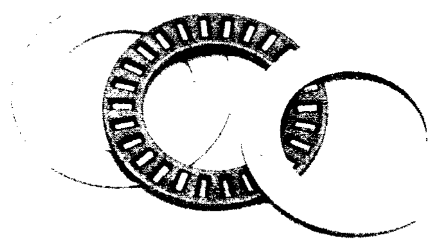

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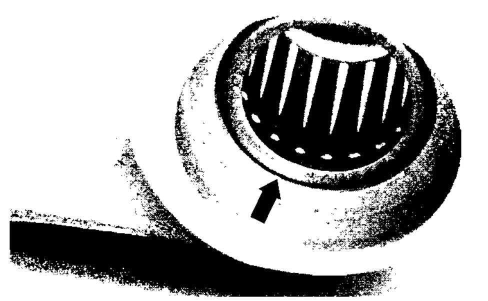

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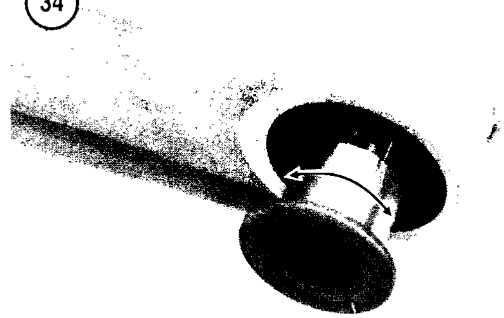

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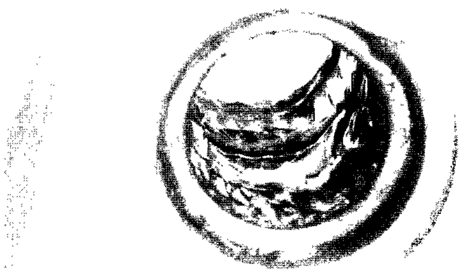

This is particularly helpful when removing corroded bearings. Always keep the heat source moving at a steady rate and avoid heating the bearing. Work in a well-ventilated area and away from combustible materials. Wear protective clothing, including eye protection and insulated gloves.

Press method

1. On bearings that are not flush to the edge of the bore, measure and record the depth of the bearing in the bore (**Figure 36**).
2. Apply penetrating oil to the bearing(s) and bore.
3. If necessary, heat the immediate area around the bearing(s) to be removed.
4. Support the swing arm in a press. Place the bearing bore over a large socket or similar tool (A, **Figure 37**) so the bearing can be driven out of the bore. The lower socket must fit on the perimeter of the bore but also be large enough to accept the removed bearing.
5. Pass a driver through the upper swing arm bore (B, **Figure 37**) and to the lower bore.
6. Place a socket or driver (C, **Figure 37**) squarely against the bearing. The driver must be capable of passing through the bore and be longer than the bore depth.
7. Press the bearing out of the arm. Turn the swing arm over and repeat for the other arm.
8. Clean and inspect the mounting bores.
9. Lubricate the new bearings with grease.
10. Support the swing arm bore on a flat, stable surface. The lower socket is not required.
11. Fit the new bearing (A, **Figure 38**) squarely over the bore with the manufacturer's marks facing out.
12. Place a socket or driver (B, **Figure 38**) squarely against the bearing and drive the bearing into the swing arm. As the bearing driver begins to enter the bore, frequently check the bearing depth. The correct depth is required so the seals can be seated in the bore.
13. Turn the swing arm over and press in the remaining bearing.
14. At each bearing, install the stepped collar, pivot spacer, seals and thrust bearing (**Figure 29**).

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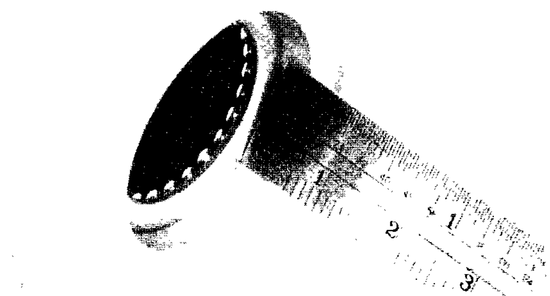

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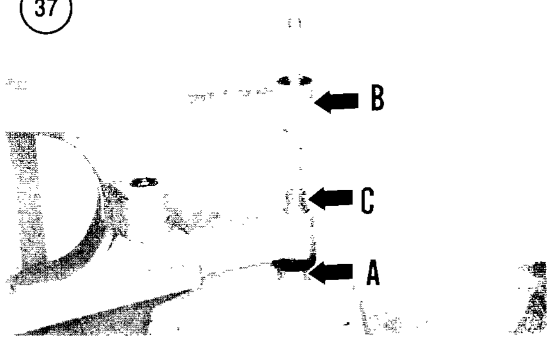

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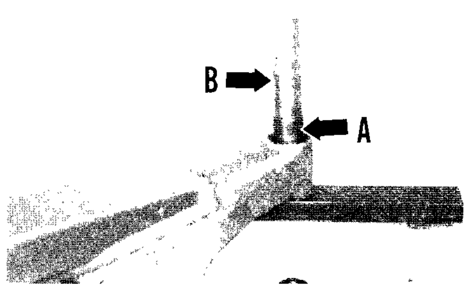

SHOCK ABSORBER ADJUSTMENT

When making changes to the shock absorber settings, record each setting. It is easier to determine where changes should be made so fine-adjustment can be achieved with a running record. Refer to **Table 2** for applicable adjustments for standard settings.

Shock Spring Preload

Shock spring preload is determined by the length of the spring as it is mounted on the shock absorber. Refer to *Shock Absorber Inspection* in this chapter for measuring and setting the spring length. Refer to **Table 1** for spring preload lengths.

Rebound Damping

Rebound damping controls the rate of extension of the shock absorber after it has been compressed. This setting has no affect on the compression rate of the shock. If rebound damping is set too high, the rear suspension does not extend quickly enough to prevent bottoming on subsequent bumps. Rebound damping that is set too low can cause the rear wheel to kick up and the handling to be unstable.

The rebound damping adjuster (**Figure 39**) is located at the bottom of the shock. The standard setting for the adjuster is in **Table 2**. To decrease (soften) damping, turn the adjuster counterclockwise. To increase (harden) damping, turn the adjuster clockwise. Set the adjuster as follows:

1. Turn the adjuster to the maximum hard position (clockwise). Do not force the adjuster beyond its normal range of travel.
2. Turn the adjuster counterclockwise while counting the number of clicks. When it is in the final position, make sure the adjuster is seated in a detent and is not between detents.

Compression Damping

Compression damping controls the shock absorber compression rate after hitting a bump. This setting has no affect on the rebound rate of the shock. If compression damping is set too high, the rear suspension is too stiff and the ride feels harsh. Compression damping that is set too low can cause the rear suspension to bottom on moderate bumps.

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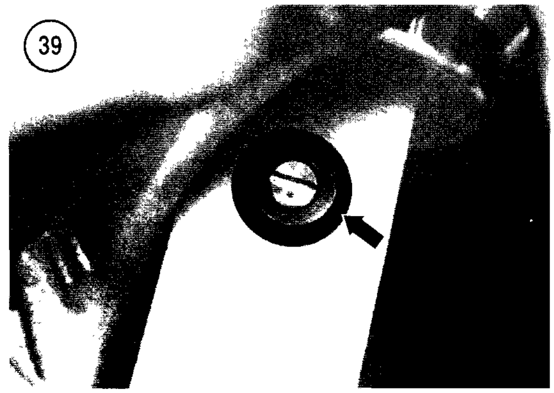

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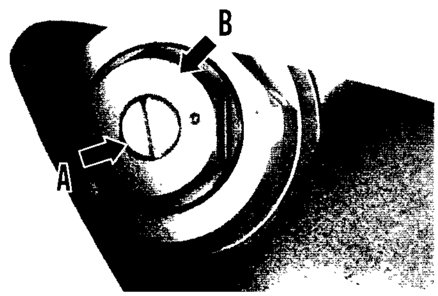


The compression damping adjuster is located at the top of the shock reservoir (**Figure 40**). On 2002-on models, there are low- and high-speed adjusters. The standard setting(s) for the adjuster(s) is listed in **Table 2**. To decrease (soften) damping, turn the adjuster(s) counterclockwise. To increase (harden) damping, turn the adjuster clockwise.

1. Turn the adjuster (A, **Figure 40**) to the maximum hard position (clockwise). Do not force the adjuster beyond its normal range of travel.
2. Turn the adjuster counterclockwise while counting the number of clicks. When it is in the final position, make sure the adjuster is seated in a detent and is not between detents. On 2002-on models, this adjuster sets the low-speed compression damping.
3. On 2002-on models, adjust the high-speed compression damping as follows:
   a. Turn the outer adjuster (B, **Figure 40**) to the maximum hard position (clockwise). Do not force the adjuster beyond its normal range of travel.
   b. Turn the adjuster counterclockwise while counting the number of turns, as recommended in **Table 2**.

Table 1 REAR SUSPENSION SPECIFICATIONS

Rear wheel travel	
E and S models	295 mm (11.6 in.)
SM models	276 mm (10.9 in.)
Shock absorber type	Nitrogen-charged
E models	
2000-2001	Adjustable for compression and rebound
2002-on	Adjustable for compression (high and low speed) and rebound
S models	
2000-2001	Adjustable for compression
2002-on	Adjustable for compression (high and low speed) and rebound
SM models	Adjustable for compression (high and low speed) and rebound
Shock absorber rebuild specifications	
Gas pressure	
E and 2002-on S models	900 kPa (130 psi)
SM models	981 kPa (139 psi)
Oil type	Suzuki SS-25, or equivalent 25-weight shock absorber oil
Oil capacity	380 cc (12.8 U.S. oz.)
Spring preload length	
Maximum length (soft)	259.5 mm (10.22 in.)
Minimum length (hard)	247.5 mm (9.74 in.)
Standard length	
E and S models	258 mm (10.2 in.)
SM models	254 mm (10 in.)
Suspension	Link-type
Swing arm pivot bolt runout	0.3 mm (0.01 in.)

Table 2 STANDARD REAR SHOCK ABSORBER SETTINGS

	Compression damping clicks out*	Compression damping turns out*	Rebound damping clicks out*
E models			
2000-200	12	–	13
2002-on	10 (low speed)	1 1/4 (high speed)	13
S models			
2000-2001	11	–	–
2002-on	10 (low speed)	1 1/4 (high speed)	13
SM models	10	1 1/8 (high speed)	14

*Number of clicks/turns out after the adjusters have been fully turned in (maximum damping force). Turning the adjusters out decreases damping force. Do not force the adjusters beyond their normal travel. Damage to the adjusters can occur.

Table 3 REAR SUSPENSION TORQUE SPECIFICATIONS

	N•m	ft.-lb.
Lever arm to lever bolt	100	74
Lever arm to swing arm bolt	100	74
Lever to frame bolt	100	74
Rear axle nut	100	74
Shock absorber mounting bolts	55	41
Swing arm pivot bolt	77	57

CHAPTER FOURTEEN

BRAKES

This chapter provides service procedures for the front and rear brake systems.

For specifications, refer to **Table 1** and **Table 2** at the end of the chapter. Chapter Three includes information for brake fluid level inspection, brake pad/disc inspection, brake pedal and lever adjustment.

BRAKE SERVICE

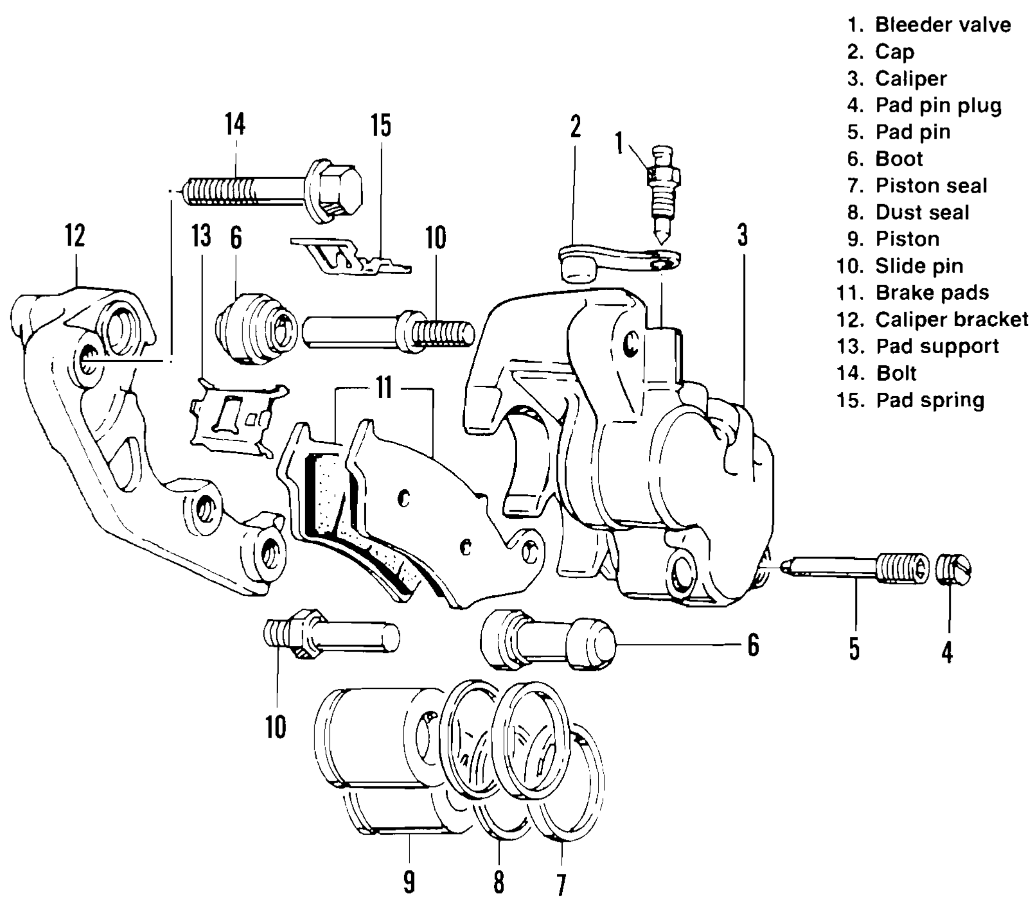
The front and rear brakes are hydraulically actuated. When pressure is applied to the brake pedal or lever, the brake fluid is compressed in the brake line and pushes one brake pad toward the brake disc. Because the caliper and second brake pad are not locked in a stationary position, the assembly slides toward the disc when the first pad contacts the disc. This motion allows both pads to contact the disc, as well as center the caliper around the disc. When pressure is relieved, the first pad and the caliper assembly slightly retract from the disc, allowing the wheel to spin freely. As the pads wear, the piston in the caliper extends, automatically keeping the pads adjusted and centered around the disc. It is important to not only ensure that the piston can extend and retract, but that the caliper is free to move.

Observe the following practices when maintaining or working on a hydraulic brake system:

1. The brake system requires DOT 4 brake fluid.
2. Keep brake fluid off painted surfaces, plastic and decals. The fluid damages these surfaces. If fluid does contact these surfaces, flush the surface thoroughly with clean water.
3. Keep the fluid reservoirs closed except when changing the fluid.
4. Replace brake fluid often. The fluid absorbs moisture from the air and causes internal corrosion of the brake system. Fresh fluid is clear to slightly yellow. If the fluid is obviously colored, it is contaminated.
5. Do not reuse brake fluid or use new fluid that has been in a partially-used container for any length of time. Dispose used brake fluid in an environmentally-safe manner.
6. When rebuilding brake system components, lubricate new parts with fresh brake fluid before assembly. Do not use petroleum-based solvents. These can swell and damage rubber components.

1

FRONT BRAKE CALIPER



7. Bleed the brake system whenever a banjo bolt or other connector in the brake line has been loosened. Air is in the system and brake action is spongy.

FRONT BRAKE PADS

Brake pad life depends on the riding conditions and brake pad material. Replace the pads when they are worn to within 1 mm (0.040 in.) of the backing plate or have been contaminated with oil or other chemicals.

Replacement

The brake pads can be replaced with the caliper mounted on the motorcycle. Refer to **Figure 1**.

CAUTION

Monitor the level of fluid in the master cylinder reservoir. Brake fluid back flows to the reservoir as the caliper pistons are pressed into their bores. Do not allow brake fluid to spill from the reservoir, or damage can occur to painted and plastic surfaces. Immediately clean up any spills with water.

1. Grasp the caliper and press it firmly toward the brake disc. This pushes the caliper pistons down into their bores, creating room for the new pads.
2. Remove the pad pin plug and pad pin (**Figure 2**).
3. Remove the brake pads (**Figure 3**). Do not operate the brake lever with the pads removed. The caliper pistons can come out of the bores.

4. Clean the interior of the caliper and inspect for the following:
   a. Leaks or damage around the pistons and hose connection.
   b. Leaks at the fork seals. Fork oil contaminates brake pads.
5. Inspect the pad pin and plug (**Figure 4**). Replace the parts if worn, corroded or damaged.
6. Inspect the pads for contamination, scoring and wear.
   a. Replace the pads if they are worn to the wear indicator groove (**Figure 5**) or are less than 1 mm (0.040 in.) thick.
   b. If the pads are worn unevenly, the caliper may not be sliding correctly on the slide pins. The caliper must be free to float on the pins. Buildup or corrosion on the pins can hold the caliper in one position, causing brake drag and excessive pad wear.
7. Install the pads on each side of the disc, seating the pointed ends of the pads against the pad support.
8. Press the pads against the pad spring to align all holes, and then install the pad pin. Tighten the pad pin to 18 N•m (13 ft.-lb.).
9. Install the pad pin plug.
10. Operate the brake lever several times to seat the pads.
11. Check the brake fluid reservoir and replenish or remove fluid as necessary.
12. With the front wheel raised, make sure the wheel spins freely and the brake operates properly.

FRONT BRAKE CALIPER

Removal and Installation

Refer to **Figure 1**.

1A. If disassembling the caliper, drain the brake fluid as described in this chapter. After draining, loosen the brake hose banjo bolt (A, **Figure 6**) while the caliper is stable on the fork, and then lightly tighten the bolt. It is removed in a later step.

1B. Remove the caliper mounting bolts (B, **Figure 6**), and then remove the caliper from the fork. Avoid kinking the brake hose.

2A. If disassembling the caliper, do the following:
   a. Hold the caliper away from the motorcycle, and then remove the banjo bolt and seal washers from the brake hose. Have a shop cloth ready to absorb residual brake fluid.

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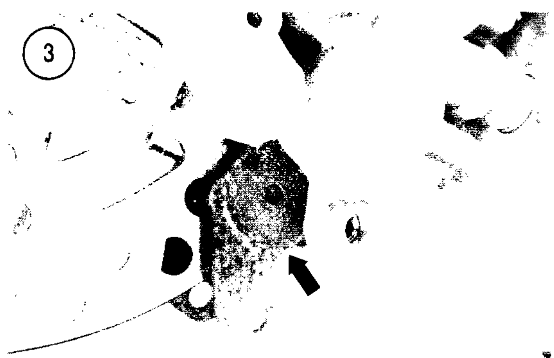

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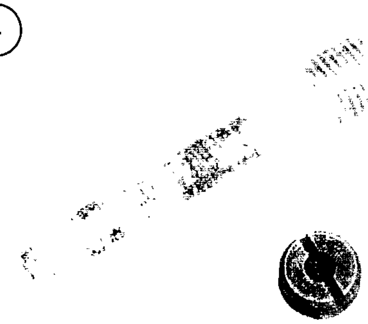

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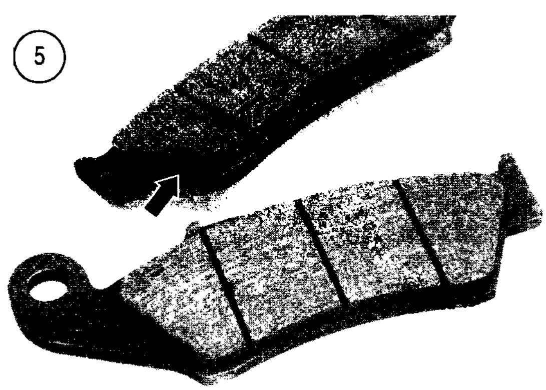

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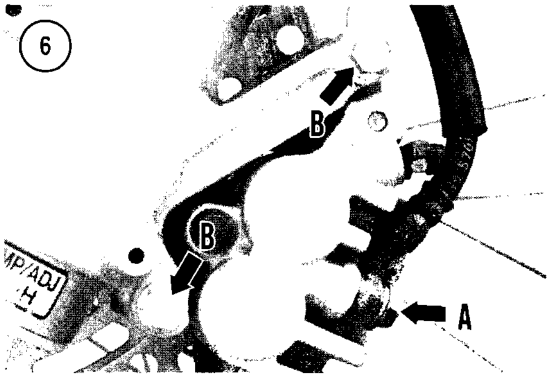

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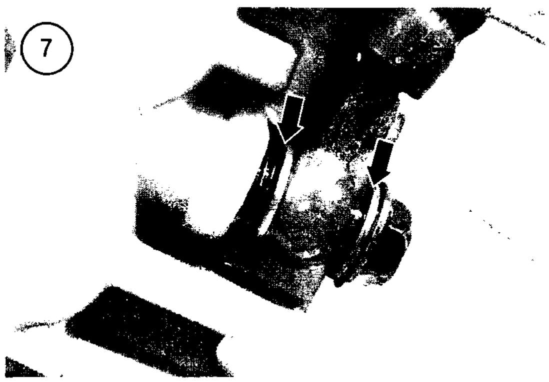

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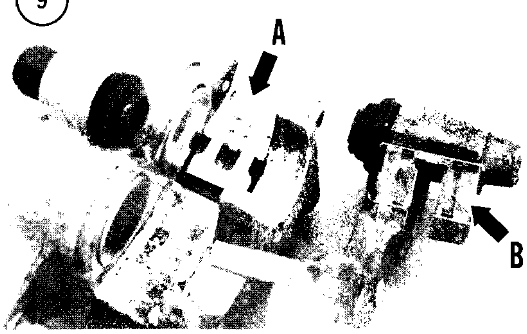

b. Wrap the hose end to prevent brake fluid from damaging other surfaces.
c. Drain the brake fluid from the caliper.

2B. If leaving the caliper attached to the brake hose, but not disassembling and servicing it:

a. Attach a wire to the caliper and hang the caliper on the motorcycle. Do not let the caliper hang by the brake hose.
b. Insert a small wood block between the brake pads. This prevents the caliper pistons from extending from the bores, if the brake lever is operated.

3. Repair the caliper as described in this section.
4. Reverse this procedure to install the caliper. Note the following:

a. Position the caliper over the brake disc and guide the disc between the pads.
b. Install and tighten the caliper mounting bolts to 26 N•m (19 ft.-lb.).
c. Position the brake hose fitting so it is against the caliper.
d. Install new seal washers on the banjo bolt (**Figure 7**). Tighten the banjo bolt to 23 N•m (17 ft.-lb.). Fill and bleed the brake system as described in this chapter.

5. Operate the brake lever several times to seat the pads.
6. Check the brake fluid reservoir and replenish or remove fluid as necessary.
7. With the front wheel raised, make sure the wheel spins freely and the brake operates properly.

Repair

Refer to **Figure 1**.

1. Remove the caliper as described in this section.
2. Remove the pad pin plug and pad pin. Press down on the pads to relieve the pressure on the pad pin as it is removed.
3. Remove the outer pad, and then remove the inner pad (**Figure 8**).
4. Separate the caliper and caliper bracket, and then remove the pad spring (A, **Figure 9**)and pad support (B).

WARNING

Wear eye protection when using compressed air. Keep fingers away from the piston discharge area. Injury can occur if an attempt is made to stop the pistons by hand.

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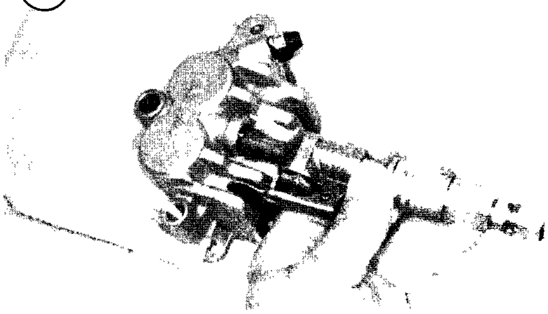

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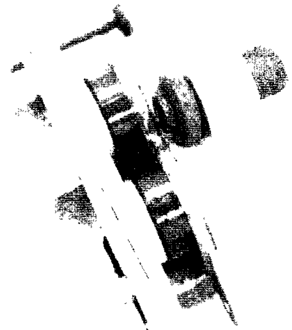

5. Remove the piston from the caliper bore using compressed air (**Figure 10**) as follows. Do not pry the pistons out of the caliper.
   a. Place the caliper on a padded work surface.
   b. Close the bleeder valve on the caliper so air cannot escape.
   c. Place several strips of wood in the caliper. The wood cushions the pistons when they come out of the caliper, as well as allows the pistons to be removed progressively. In some cases, one piston may be seized in the caliper and it is necessary to prevent the other piston from fully ejecting.
   d. Lay the caliper so the pistons discharge downward.
   e. Insert an air nozzle into the brake hose fitting. If the nozzle does not have a rubber tip, wrap the nozzle with tape. This allows the nozzle to seal tightly and prevent thread damage.
   f. Place a shop cloth over the entire caliper to catch any spray that may discharge from the caliper.
   g. Apply pressure and listen for the pistons to eject from the caliper (**Figure 11**). When both pistons have contacted the wood strips, remove one of the strips and again apply pressure. Continue this process until both pistons can be removed by hand.
6. Remove the boots from the caliper and caliper bracket.
7. Remove the bleeder valve and cap from the caliper.
8. Remove the dust seals and piston seals from the bores (**Figure 12**).
9. Inspect the caliper assembly.
   a. Clean all parts being reused with fresh brake fluid. Use a wood or plastic-tipped tool to clean the caliper seal and boot grooves. Use

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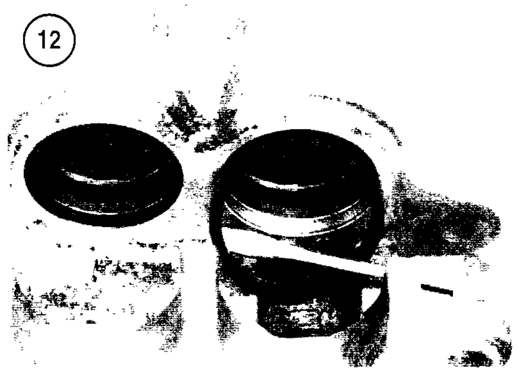

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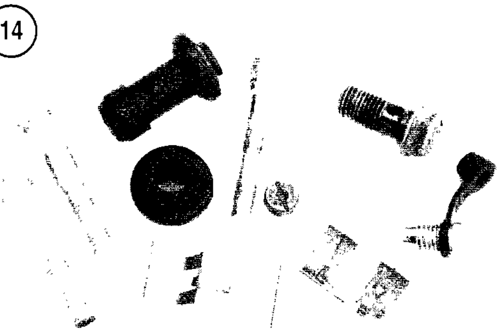

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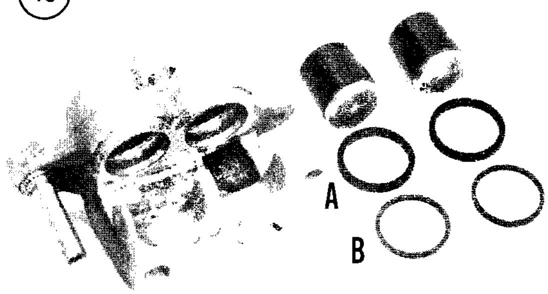

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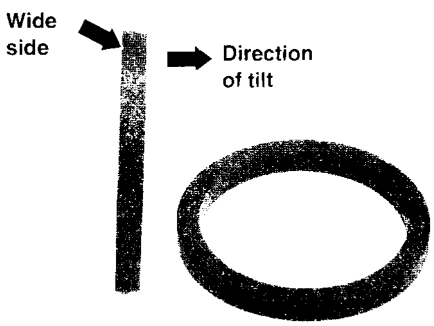

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clean brake fluid to aid in cleaning the pistons, bores and seal grooves.

b. Inspect the cylinder bores and pistons (**Figure 13**) for wear, pitting or corrosion. Measure the inside diameter of the caliper bores and the outside diameter of the pistons. Refer to **Table 1** for specifications.

c. Inspect the slide pins on the caliper and caliper bracket for wear, pitting or corrosion.

d. Inspect the remaining parts (**Figure 14**) for wear, pitting or corrosion. The pad pin, spring and support must be in good condition to allow slight pad movement when installed.

e. Inspect the pads for contamination, scoring and wear. Replace the pads if they are worn to the wear indicator groove (**Figure 5**) or are less than 1 mm (0.040 in.) thick. If the pads are worn unevenly, the caliper may not be sliding correctly on the slide pins. The caliper must be free to *float* on the pins. Buildup or corrosion on the pins can hold the caliper in one position, causing brake drag and excessive pad wear.

NOTE

Use new brake fluid (rated DOT 4) to lubricate the parts in the following steps.

10. Install the new piston seals (A, **Figure 15**) and dust seals (B) as follows:

a. Identify the widest side of the piston seals. One method is to stand the seals on edge and determine which direction they tilt. The wide side will be opposite the direction of tilt (**Figure 16**). When the wide side is identified, mark that side of the seal. A light-colored permanent marking pen works well.

b. Soak the seals in brake fluid for 15 minutes.

c. Coat the caliper bores and pistons with brake fluid.

d. Seat the piston seals, and then the dust seals (**Figure 17**) in the caliper grooves. The piston seals go in the back grooves with the *wide side facing out.*

e. Install the pistons with the closed sides facing out (**Figure 18**). Twist the pistons past the seals, and then press the pistons to the bottom of the bores.

11. Apply silicone brake grease to the interior of the boots, and then install the boots onto the caliper.

If necessary, apply a light coat of grease on the exterior of the large boot to aid in passing it through the caliper.

12. Install the pad spring and pad support (**Figure 9**). Make sure the pad spring is locked against the edge of the caliper.
13. Lubricate the slide pins on the caliper and caliper bracket, and then insert them into the boots. Press the parts together and lift the boots onto the slide pin seats.
14. Install the inner pad, seating it into the pad support (A, **Figure 19**) and pad spring (B).
15. Install the outer pad, seating it into the pad support and pad spring.
16. Press down on the pads, and then align and install the pad pin. Tighten the pad pin to 18 N•m (13 ft.-lb.).
17. Install the bleeder valve and cap.
18. Install the caliper as described in this section.

FRONT MASTER CYLINDER

Removal and Installation

The master cylinders used on the E and S models differ slightly. These differences are noted in the procedure. Refer to **Figure 20**.

CAUTION
Do not allow brake fluid to splash from the reservoir or hose. Brake fluid can damage painted and plastic surfaces. Immediately clean up any spills with water.

1. Cover and protect the fuel tank and area surrounding the master cylinder.
2. Drain the brake system as described in this chapter.
3. On S models, remove the mirror and disconnect the brake light switch (A, **Figure 21**).
4. Loosen the brake hose banjo bolt (B, **Figure 21**), and then lightly tighten the bolt. It is removed in a later step.
5. Remove the bolts (A, **Figure 22**) securing the master cylinder to the handlebar, and then remove the master cylinder and holder.
6. Hold the master cylinder away from the motorcycle, and then remove the banjo bolt and seal washers from the brake hose. Have a shop cloth ready to absorb residual brake fluid. Wrap the hose

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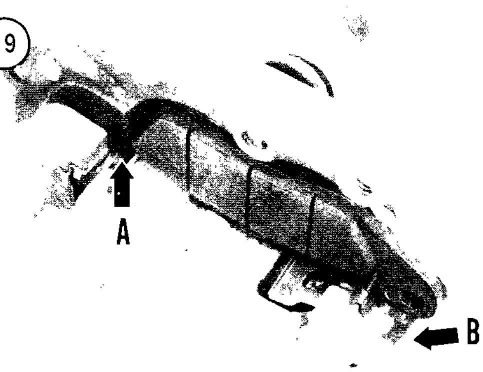

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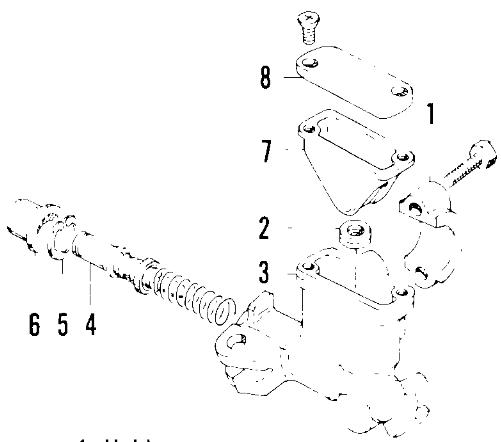
FRONT BRAKE MASTER CYLINDER (TYPICAL)



1. Holder
2. Separator
3. Master cylinder
4. Piston assembly
5. Snap ring
6. Boot
7. Diaphragm
8. Cap

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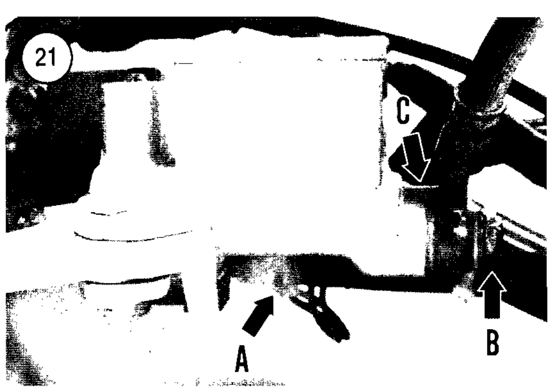

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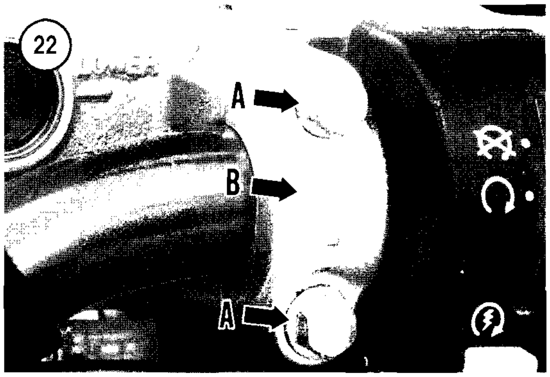

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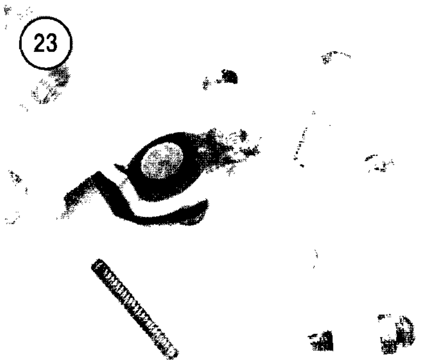

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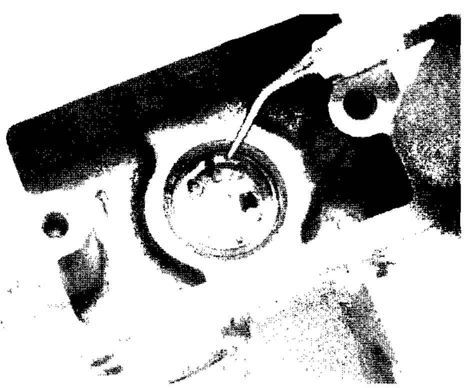

end to prevent brake fluid from damaging other surfaces.

7. Repair the master cylinder as described in this section.

8. Reverse this procedure to install the master cylinder. Note the following:

   a. Align the lower gap between the master cylinder and mounting bracket with the punch mark on the underside of the handlebar.
   b. Install the mounting bracket so *UP* and the arrow (B, **Figure 22**) are facing up. Tighten the upper bolt first and then the bottom bolt. Tighten the bolts to 10 N•m (7 ft.-lb.).
   c. On S models, apply dielectric grease to the brake switch connectors.
   d. On S models, position the brake hose fitting so it is against the hose support (C, **Figure 21**).
   e. On E models, position the brake hose fitting so it is between the hose supports.
   f. Install new seal washers on the banjo bolt. Tighten the bolt to 23 N•m (17 ft.-lb.).

9. Fill the brake fluid reservoir and bleed the brake system as described in this chapter.

10. Adjust the brake lever free play (Chapter Three).

Repair

Refer to **Figure 20**.

1. Remove the master cylinder as described in this section.
2. Remove the pivot bolt, lever and spring (**Figure 23**).
3. On S models, remove the brake switch (**Figure 24**).
4. Remove the cap and diaphragm from the reservoir. Drain and wipe excess fluid from the reservoir.
5. Lift out the separator (**Figure 25**). Use small pliers to grip the tabs on the separator, or carefully unseat it with a curved pick.
6. Remove the boot from the piston (**Figure 26**). The boot is a friction fit. If reusing the boot, apply penetrating lubricant around the perimeter of the boot to prevent damage. Carefully pull the bottom edge back so the lubricant can loosen the boot.
7. Remove the snap ring (**Figure 27**) from the master cylinder as follows:

   a. Lock the cylinder in a vise with soft jaws. A shop cloth placed between the jaws helps fluid absorb drips. Do not overtighten the vise or cylinder damage could occur.

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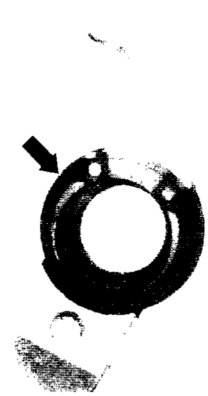

b. Use a screwdriver to press down on the piston to relieve pressure on the snap ring, and then remove the snap ring (**Figure 28**).

c. Slowly relieve the pressure on the piston.

8. Remove the piston assembly from the bore (**Figure 29**).

9. Inspect the master cylinder assembly.

a. Clean all parts being reused with fresh brake fluid.

b. Inspect the cylinder bore and piston for wear, pitting or corrosion. Measure the inside diameter of the cylinder bore and the outside diameter of the piston. Refer to **Table 1** for specifications.

c. Inspect and clean the threads and orifices (**Figure 30**) in the reservoir. Clean with compressed air.

d. Inspect the brake lever bore and pivot bolt for wear (**Figure 31**).

e. Inspect the diaphragm and reservoir cap for damage (**Figure 32**).

f. Inspect the boot, snap ring, separator and mounting hardware (**Figure 33**) for corrosion and damage. Replace the banjo bolt seal washers.

g. On S and SM models, inspect the brake switch. Clean the switch with electrical contact cleaner by spraying into the holes in the case (**Figure 34**). Operate the switch while flushing the contacts. If the condition of the switch is not known, attach an ohmmeter to the terminals on the switch. The meter should indicate continuity with the switch out and no continuity when the switch is pressed.

10. Assemble the piston, seals and spring as follows:

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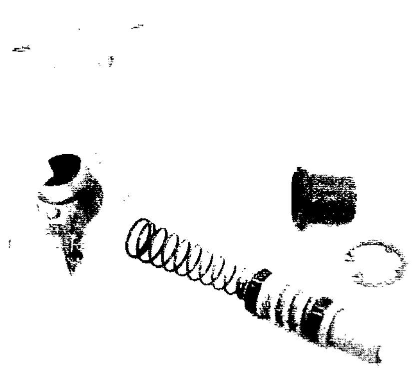

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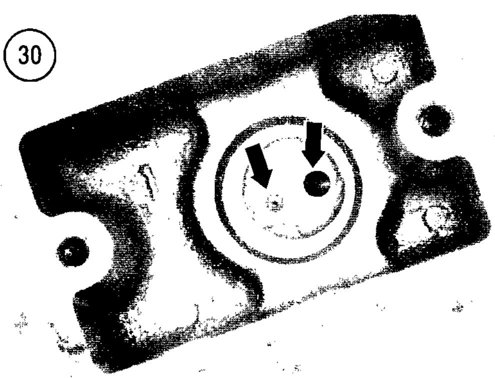

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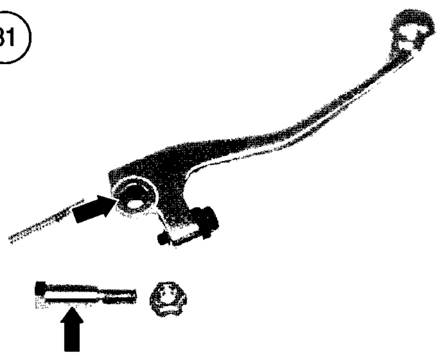

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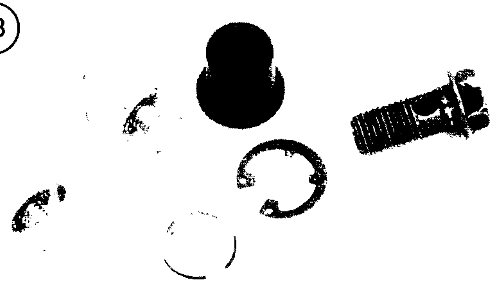

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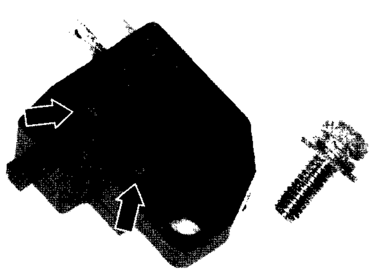

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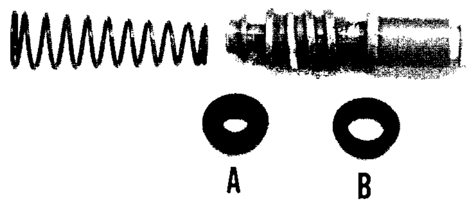

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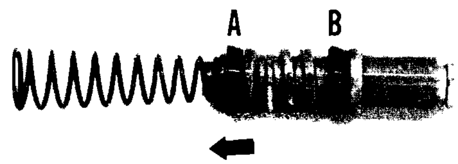

a. Soak the primary seal (A, **Figure 35**) and secondary seal (B) in fresh brake fluid for 15 minutes. This softens and lubricates the cups.

b. Apply brake fluid to the piston so the seals can slide over the ends.

c. Identify the wide (open) side of the primary seal. When installed, the wide side of the seal *must* face in the direction of the arrow (**Figure 36**). Install the primary seal onto the piston.

d. Identify the wide (open) side of the secondary seal. When installed, the wide side of the seal *must* face in the direction of the arrow (**Figure 36**). Install the secondary seal on the piston.

e. Install and seat the *small end* of the spring onto the piston.

11. Install the piston and snap ring into the master cylinder (**Figure 29**) as follows:

a. Lock the cylinder in a vise with soft jaws. Do not overtighten the vise or cylinder damage could occur.

b. Lubricate the cylinder bore and piston assembly with brake fluid.

c. Rest the piston assembly in the cylinder.
d. Place the snap ring over the end of the piston. resting it on the edge of the bore. The flat side of the snap ring must face out.
e. Place a screwdriver over the end of the piston and compress the snap ring with snap ring pliers.
f. Press the piston into the cylinder while guiding the snap ring into position. If the snap ring does not easily seat, release the snap ring and use the tip of the pliers to press it into the groove. Keep the piston in position until the snap ring is seated.

12. Remove the cylinder from the vise.
13. Apply silicone brake grease to the end of the piston and inside the boot. Seat the boot into the cylinder.
14. Install the separator into the reservoir. Use a socket that fits on the outside edge of the separator to squarely press the separator into place.
15. On S and SM models, screw the brake switch to the master cylinder. Seat the contact points on the switch with the points on the cylinder.
16. Install the spring, lever and pivot bolt (**Figure 37**). Lubricate the pivot point with waterproof grease.
17. Loosely screw the diaphragm and cap onto the reservoir.
18. Install the master cylinder as described in this section.

REAR BRAKE PADS

Brake pad life depends on the riding conditions and the brake pad material. Replace the pads when they are worn to within 1 mm (0.040 in.) of the backing plate or have been contaminated with oil or other chemicals.

Replacement

The brake pads can be replaced with the caliper mounted on the motorcycle. Refer to **Figure 38**.

CAUTION
Monitor the level of fluid in the master cylinder reservoir. Brake fluid back flows to the reservoir as the caliper piston is pressed into its bore. Do not allow brake fluid to spill from the reservoir, or damage can occur to painted and plastic surfaces. Immediately clean up any spills with water.

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1. Grasp the caliper and press it firmly toward the brake disc. This pushes the caliper piston down into its bore, creating room for the new pads.
2. Remove the pad pin plug and pad pin (**Figure 39**).
3. Remove the brake pad assemblies (**Figure 40**). Make sure the insulator and metal shim on the back of each pad are also removed. Do not operate the brake pedal with the pads removed. The piston in the caliper can come out of the bore.
4. Clean the interior of the caliper and inspect for leaks or damage.
5. Inspect the pad pin and plug (**Figure 41**). Replace the parts if worn, corroded or damaged.
6. Inspect the pads for contamination, scoring and wear.
   a. Replace the pads if they are worn to the wear indicator groove or are less than 1 mm (0.040 in.) thick.
   b. If the pads are worn unevenly, the caliper may not be sliding correctly on the slide pins. The caliper must be free to float on the pins. Buildup or corrosion on the pins can hold the caliper in one position, causing brake drag and excessive pad wear.
7. Assemble the pads. On the back side of the pad (A, **Figure 42**), install the insulator (B) and metal shim (C). The tab on the shim should fit over the pad.
8. Install the pad assemblies on each side of the disc, seating the pointed ends of the pads against the pad support (**Figure 43**).
9. Install the pad pin, guiding it through the holes in the pads. Tighten the pad pin to 18 N•m (13 ft.-lb.).
10. Install the pad pin plug.

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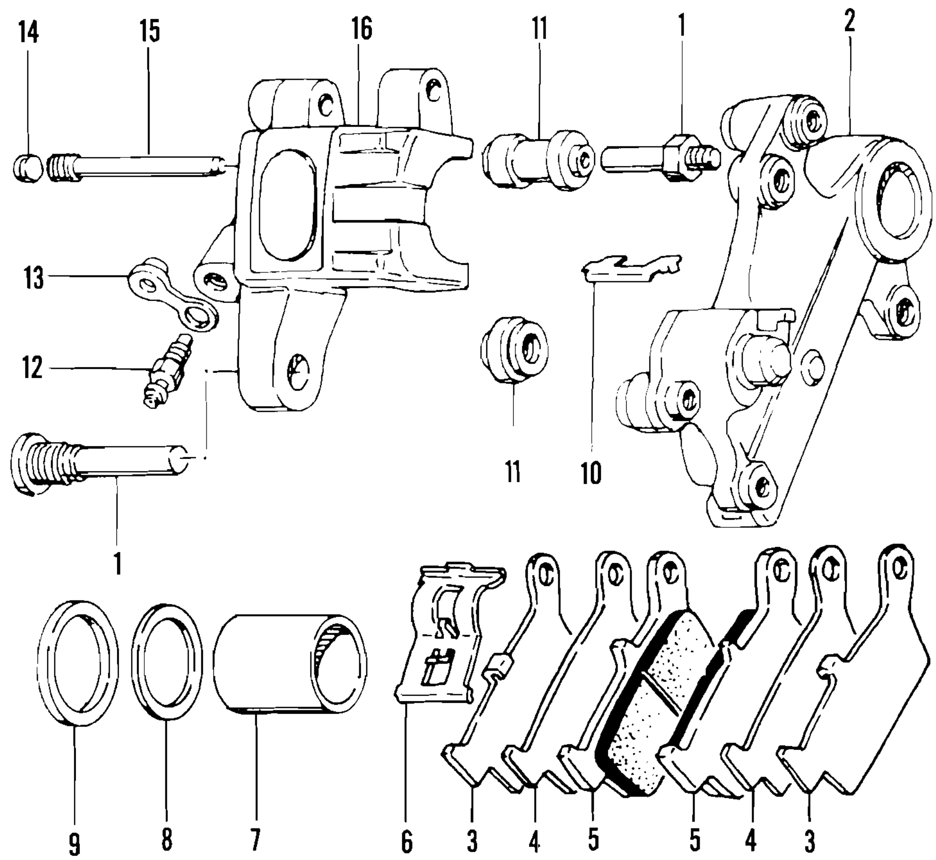
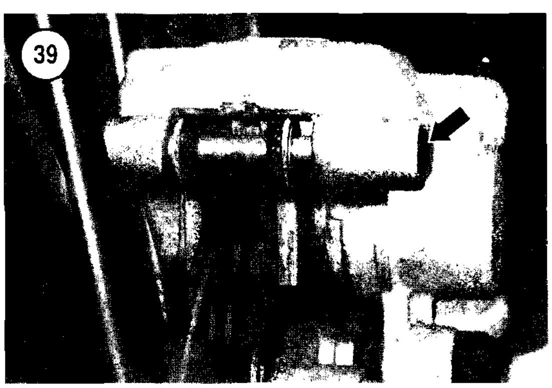
REAR BRAKE CALIPER



1. Slide pin
2. Caliper bracket
3. Shim
4. Insulator
5. Brake pad
6. Pad spring
7. Piston
8. Dust seal
9. Piston seal
10. Pad support
11. Boot
12. Bleeder valve
13. Cap
14. Pad pin plug
15. Pad pin
16. Caliper



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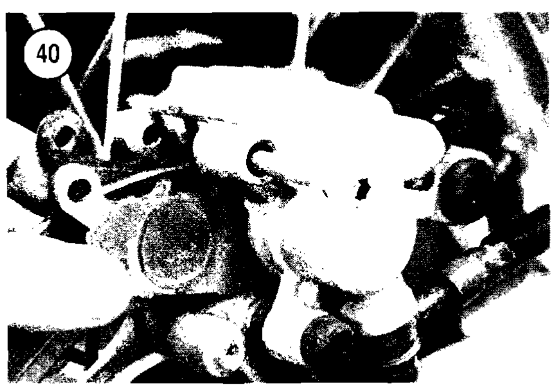

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11. Operate the brake pedal several times to seat the pads.
12. Check the brake fluid reservoir and replenish or remove fluid as necessary.
13. With the rear wheel raised, make sure the wheel spins freely and the brake operates properly.

REAR BRAKE CALIPER

Removal and Installation

Refer to **Figure 38**.

1A. If disassembling the caliper, drain the brake fluid as described in this chapter. After draining, loosen the brake hose banjo bolt (**Figure 44**) while the caliper is stable on the swing arm, and then lightly tighten the bolt. It is removed in a later step.

1B. Remove the rear wheel (Chapter Eleven). Slide the caliper out of the swing arm as the rear wheel is removed.

2A. If disassembling the caliper, do the following:

a. Hold the caliper away from the motorcycle, and then remove the banjo bolt and seal washers from the brake hose. Have a shop cloth ready to absorb excess brake fluid that drips from the hose.
b. Wrap the hose end to prevent brake fluid from damaging other surfaces.
c. Drain the brake fluid from the caliper.

2B. If leaving the caliper attached to the brake hose, but not disassembling and servicing it:

a. Attach a wire to the caliper and hang the caliper on the motorcycle. Do not let the caliper hang by the brake hose.
b. Insert a small wood block between the brake pads. This prevents the caliper piston from extending from the bore if the brake pedal is operated.

3. Repair the caliper as described in this section.
4. Reverse this procedure to install the caliper. Note the following:

a. As the wheel and caliper are installed, guide the brake disc between the pads.
b. Install new seal washers on the banjo bolt.
c. Position the brake hose fitting so it is against the support.
d. Tighten the banjo bolt to 23 N•m (17 ft.-lb.).
e. Bleed the brake system as described in this chapter.

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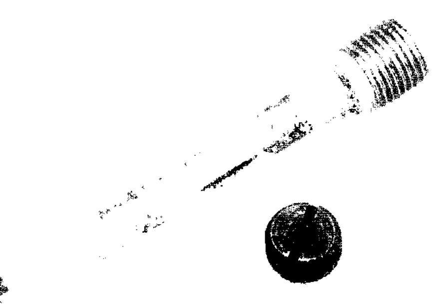

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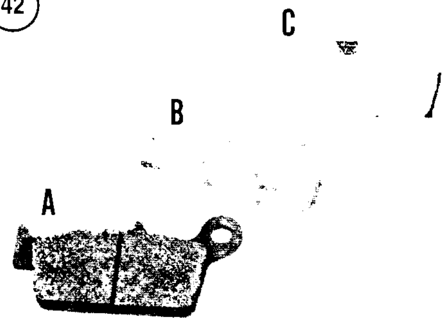

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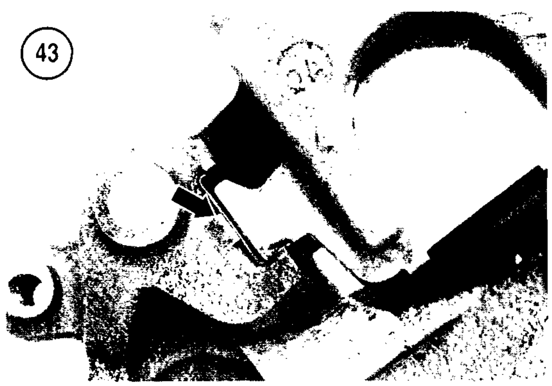

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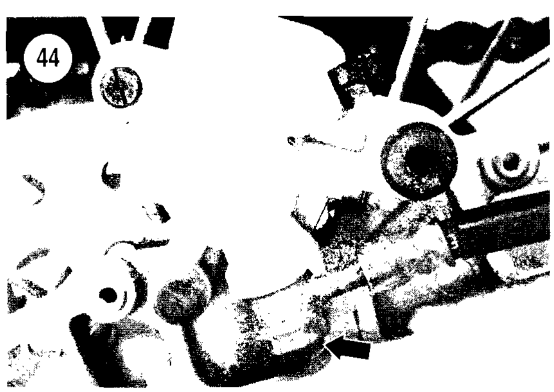

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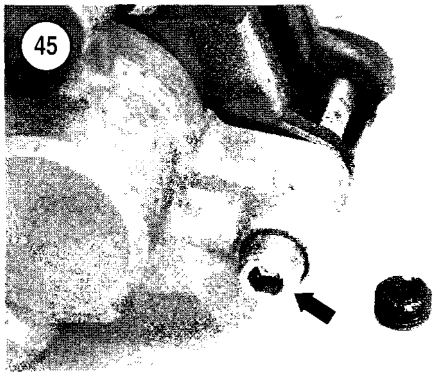

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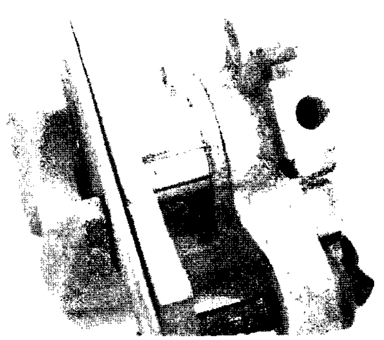

5. Operate the brake pedal several times to seat the pads.
6. Check the brake fluid reservoir and replenish or remove fluid as necessary.
7. With the rear wheel raised, make sure the wheel spins freely and the brake operates properly.

Repair

Refer to **Figure 38**.
1. Remove the caliper as described in this section.
2. On E models, remove the disc and caliper guards.
3. Remove the pad pin plug and pad pin (**Figure 45**). Press down on the pads to relieve the pressure on the pad pin as it is removed.
4. Remove the pads.
5. Separate the caliper and caliper bracket, and then remove the pad spring and pad support (**Figure 46**).
6. Remove the boots from the caliper and caliper bracket.

WARNING
Wear eye protection when using compressed air. Keep fingers away from the piston discharge area. Injury can occur if an attempt is made to stop the piston by hand.

7. Remove the piston from the caliper bore using compressed air (**Figure 47**) as follows. Do not pry the piston out of the caliper.
   a. Place the caliper on a padded work surface.
   b. Close the bleeder valve on the caliper so air cannot escape.
   c. Place a strip of wood, or similar pad, in the caliper. The pad cushions the piston when it comes out of the caliper.
   d. Lay the caliper so the piston will discharge downward.
   e. Insert an air nozzle into the brake hose fitting (**Figure 47**). If the nozzle does not have a rubber tip, wrap the nozzle with tape. This allows the nozzle to seal tightly and prevents thread damage.
   f. Place a shop cloth over the entire caliper to catch any spray that may discharge from the caliper.
   g. Apply pressure and listen for the piston to pop from the caliper (**Figure 48**).

8. Remove the bleeder valve and cap from the caliper.
9. Remove the dust seal and piston seal from the bore (**Figure 49**).
10. Inspect the caliper assembly.
   a. Clean all parts being reused with fresh brake fluid. Use a wood or plastic-tipped tool to clean the caliper seal and boot grooves.
   b. Inspect the cylinder bore and piston for wear, pitting or corrosion. Measure the inside diameter of the caliper bore and the outside diameter of the piston (**Figure 50**). Refer to **Table 1** for specifications.
   c. Inspect the slide pins (**Figure 51**) on the caliper and caliper bracket for wear, pitting or corrosion.
   d. Inspect the pad pin (**Figure 41**) for wear, pitting and corrosion. The pin must be in good condition to allow slight pad movement when installed.
   e. Inspect the remaining parts (**Figure 52**) for wear, pitting or corrosion. The spring and support must be in good condition to allow slight pad movement when installed.
   f. Inspect the pads for contamination, scoring and wear. Replace the pads if they are worn to the wear indicator groove or are less than 1 mm (0.040 in.) thick. If the pads are worn unevenly, the caliper is probably not sliding correctly on the slide pins. The caliper must be free to float on the pins. Buildup or corrosion on the pins can hold the caliper in one position, causing brake drag and excessive pad wear.
11. Install the new piston seal (A, **Figure 53**) and dust seal (B) as follows:
   a. Identify the widest side of the piston seal. One method is to stand the seal on edge and determine which direction it tilts. The wide side is opposite the direction of tilt (**Figure 54**). When the wide side is identified, mark that side of the seal. A light-colored permanent marking pen works well.
   b. Soak the seals in brake fluid for 15 minutes.
   c. Coat the caliper bore and piston with brake fluid.
   d. Seat the piston seal, and then the dust seal (**Figure 55**) in the caliper grooves. The piston seal goes in the back groove with the *wide side facing out*.

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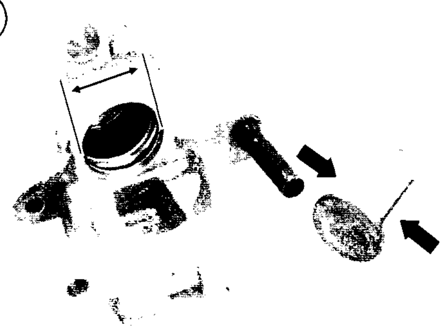

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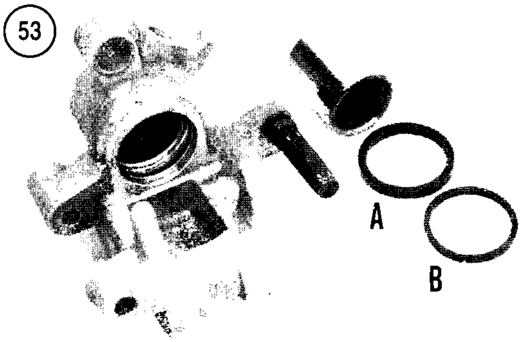

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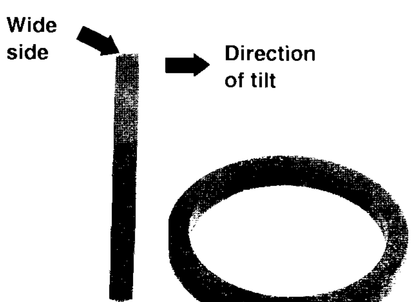

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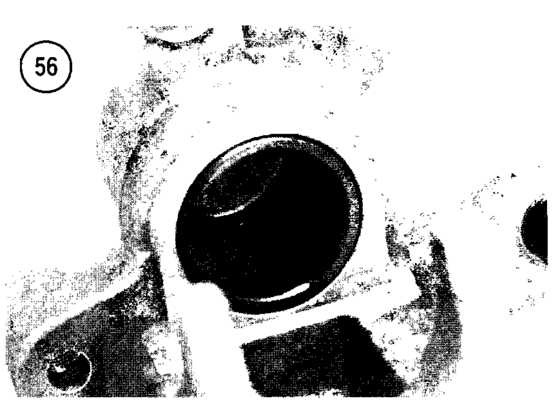


e. Install the piston with the open side facing out (**Figure 56**). Twist the piston past the seals, then press the piston to the bottom of the bore.

12. Apply silicone brake grease to the interior of the boots, and then install the boots onto the caliper. If necessary, apply a light coat of grease on the exterior of the large boot to aid in passing it through the caliper.

13. Install the pad spring and pad support (**Figure 46**). Make sure the pad spring is locked against the edge of the caliper.

14. Lubricate the slide pins on the caliper and caliper bracket with silicone brake grease, and then insert them into the boots. Press the parts together and lift the boots onto the slide pin seats.

15. Assemble the pads. On the back side of the pad, install the insulator (A, **Figure 42**) and metal shim (B). The tab on the shim should fit over the pad.

16. Install the pad assemblies, seating the pointed ends of the pads against the pad support (**Figure 43**).

17. Press down on the pads, and then align and install the pad pin and plug. Tighten the pad pin to 18 N•m (13 ft.-lb.).

18. Install the bleeder valve and cap.

19. Install the caliper as described in this section.

20. On E models, install the disc and caliper guards.

REAR MASTER CYLINDER

Removal and Installation

Refer to **Figure 57**.

1. Drain the brake system as described in this chapter.
2. Remove the cotter pin, washer and clevis pin (**Figure 58**) that secure the master cylinder clevis to the brake pedal.
3. Remove the master cylinder guard (**Figure 59**).
4. Remove the reservoir retaining bolt (A, **Figure 60**).
5. Loosen the brake hose banjo bolt (B, **Figure 60**), and then lightly tighten the bolt. It is removed in a later step.
6. Remove the master cylinder mounting bolts (C, **Figure 60**).
7. Hold the master cylinder away from the motorcycle, and then remove the banjo bolt and seal washers from the brake hose. Have a shop cloth

ready to absorb residual brake fluid. Wrap the hose end to prevent brake fluid from damaging other surfaces.

8. Repair the master cylinder as described in this section.

9. Reverse this procedure to install the master cylinder and reservoir. Note the following:
   a. Tighten the master cylinder mounting bolts to 10 N•m (7 ft.-lb.).
   b. Position the brake hose fitting so it is between the hose supports (**Figure 61**).
   c. Install new seal washers on the banjo bolt. Tighten the bolt to 23 N•m (17 ft.-lb.).
   d. Install a new cotter pin on the clevis pin.
   e. Do not mount the brake fluid reservoir until it has been filled and the brake system has been bled.

10. Fill the brake fluid reservoir and bleed the brake system as described in this chapter.

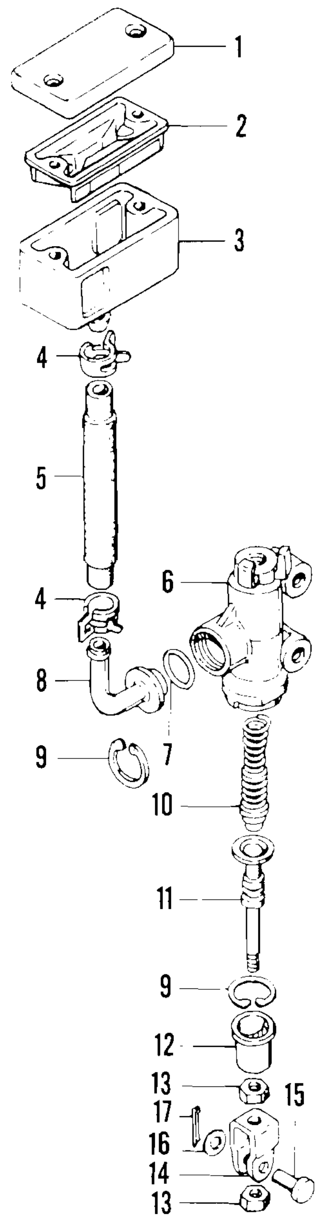
11. Adjust brake pedal height (Chapter Three).

Repair

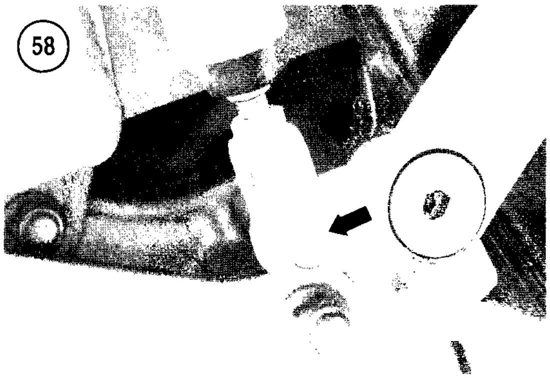
Refer to **Figure 57**.

1. Remove the master cylinder and reservoir as described in this section.
2. Remove the snap ring that retains the hose and fitting against the master cylinder (**Figure 62**). Remove the hose assembly and O-ring.
3. Remove the snap ring from the master cylinder as follows:
   a. Unseat the boot from the cylinder bore and fold it toward the clevis. If reusing the boot, apply penetrating lubricant around the perimeter of the boot to prevent damage. Carefully pull the bottom edge back so the lubricant can loosen the boot.
   b. If desired, lock the cylinder in a vise with soft jaws. Grip the cylinder at the mounts. Do not overtighten the vise or cylinder damage could occur.
   c. Press and tilt the pushrod to relieve pressure on the snap ring, and then remove the snap ring with snap ring pliers (**Figure 63**).
   d. Slowly relieve the pressure on the piston.
4. Remove the pushrod and piston assemblies from the bore (**Figure 64**).
5. Loosen the locknut (A, **Figure 65**) from the clevis (B). Remove the parts from the pushrod shaft (**Figure 66**).

57 **REAR MASTER CYLINDER**



1. Cap
2. Diaphragm
3. Reservoir
4. Clamp
5. Hose
6. Master cylinder
7. O-ring
8. Hose fitting
9. Snap ring
10. Piston assembly
11. Pushrod
12. Boot
13. Nut
14. Clevis
15. Clevis pin
16. Washer
17. Cotter pin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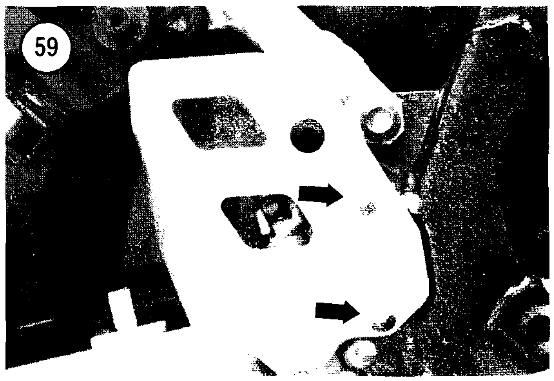
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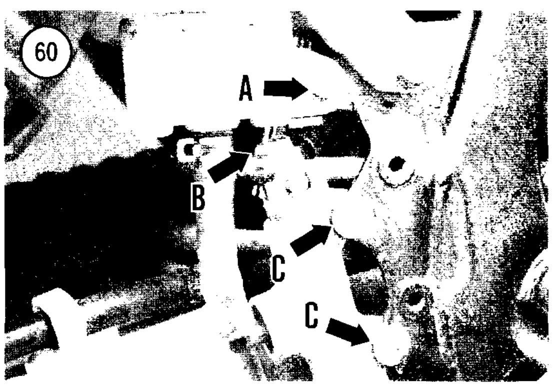
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A
B
C
C


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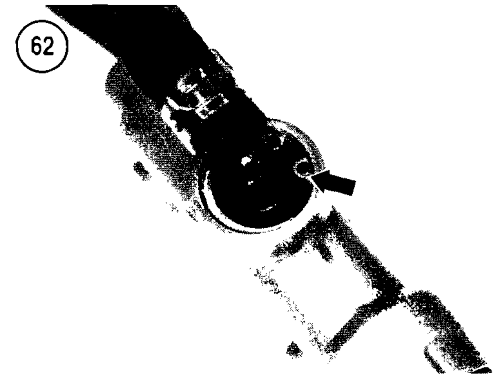
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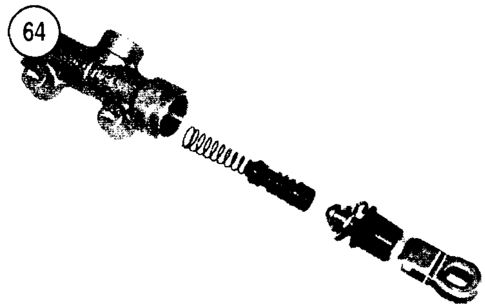
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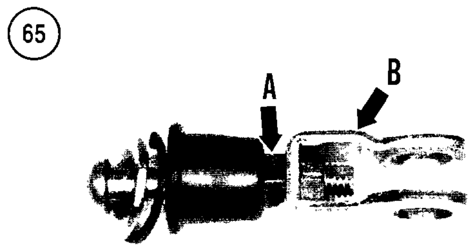
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A
B

6. Remove the cap and diaphragm from the reservoir.
7. Inspect the master cylinder assembly.
   a. Clean all parts being reused with fresh brake fluid.
   b. Inspect the cylinder bore for wear, pitting or corrosion.
   c. Measure the inside diameter of the cylinder bore (**Figure 67**). Refer to **Table 1** for specifications.
   d. Measure the outside diameter of the piston (**Figure 68**). Refer to **Table 1** for specifications.
   e. Inspect and clean the threads and orifices (**Figure 69**) in the master cylinder. Clean with compressed air.
   f. Inspect the pushrod assembly. Check the parts for corrosion and wear. Install a new snap ring on the pushrod, with the sharp edge of the snap ring facing out.
   g. Inspect the mounting hardware for wear or damage.
   h. Inspect the reservoir, diaphragm and cap for damage (**Figure 70**).
8. Assemble the piston, seals and spring as follows. **Figure 71** shows both an assembled and unassembled piston.
   a. Soak the primary seal (A, **Figure 71**) and secondary seal (B) in fresh brake fluid for 15 minutes. This softens and lubricates the seals.
   b. Apply brake fluid to the piston so the seals can slide over the ends.
   c. Identify the wide (open) side of the primary seal. When installed, the wide side of the seal *must* face in the direction of the arrow (**Figure 71**). Install the primary seal onto the piston.
   d. Identify the wide (open) side of the secondary seal. When installed, the wide side of the seal *must* face in the direction of the arrow (**Figure 71**). Install the secondary seal on the piston.
   e. Install the *small end* of the spring onto the piston.
   f. The assembled piston should appear as in **Figure 72**.
9. Install the piston and pushrod assembly into the master cylinder as follows:
   a. Lubricate the cylinder bore and piston assembly with brake fluid.

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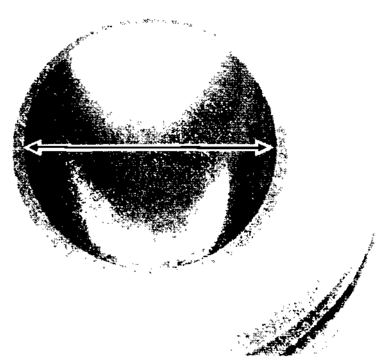

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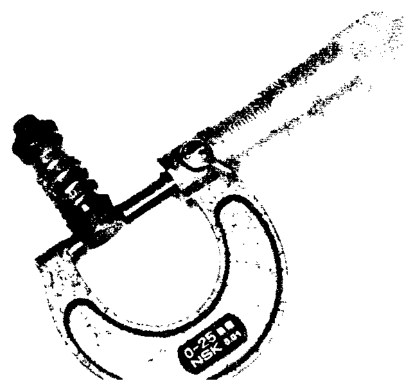

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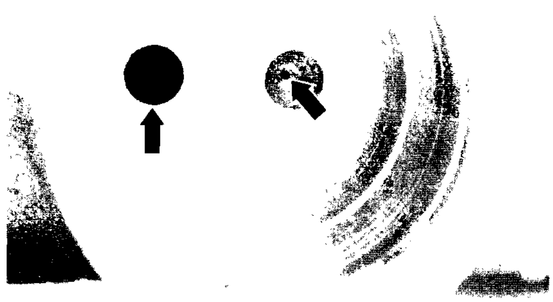

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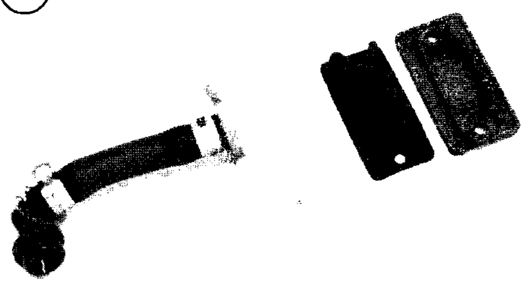

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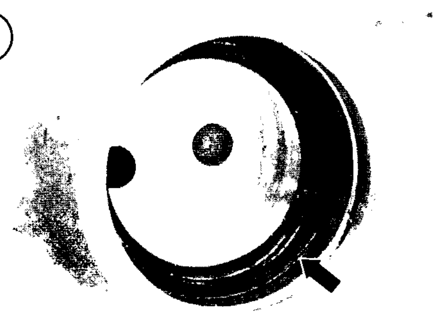

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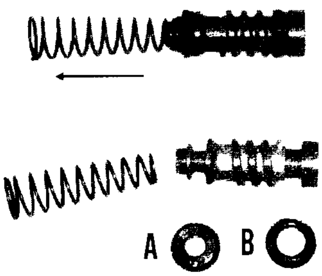

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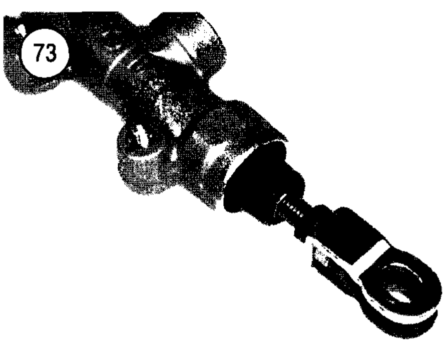

b. If desired, lock the cylinder in a vise with soft jaws. Grip the cylinder at the mounts. Do not overtighten the vise or cylinder damage could occur.

c. Apply a small amount of silicone brake grease to the contact area of the pushrod.

d. Rest the piston assembly in the cylinder.

e. Compress the snap ring with snap ring pliers.

f. Press and tilt the pushrod in the cylinder while guiding the snap ring into position. If the snap ring does not easily seat, release the snap ring and use the tip of the pliers to press it into the groove. Keep the pushrod compressed until the snap ring is seated to prevent the piston from coming out of the cylinder.

10. Apply silicone brake grease to the inside of the boot. Seat the boot into the cylinder.

11. Install the locknuts and clevis onto the pushrod (**Figure 73**). Do not tighten the locknuts until the brake pedal height has been checked.

12. Install a new, lubricated O-ring into the master cylinder (**Figure 74**), and then lock the hose fitting into the O-ring. Install a new snap ring with the flat side facing out.

13. Loosely install the diaphragm and cap onto the reservoir.

14. Install the master cylinder as described in this section.

REAR BRAKE PEDAL

Removal and Installation

Refer to **Figure 75**.

1. Remove the brake pedal return spring from the swing arm pivot bore.

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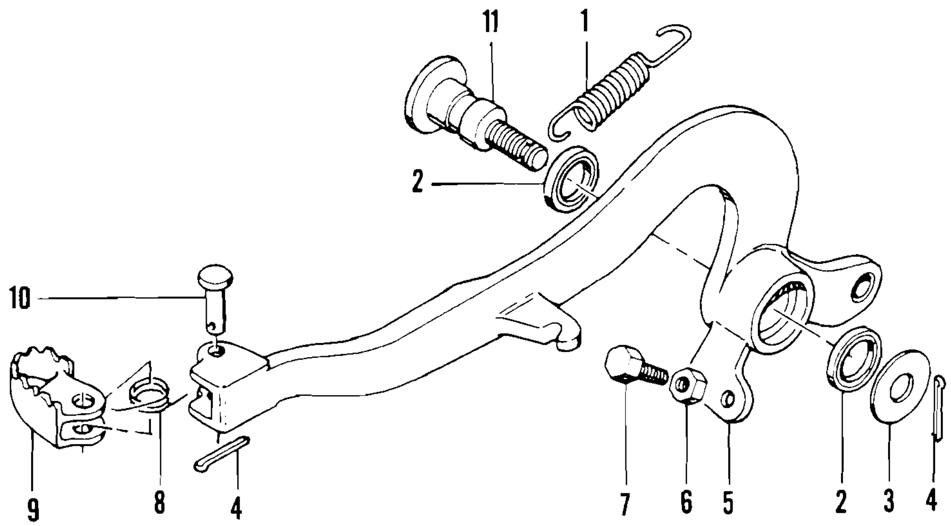
BRAKE PEDAL



1. Return spring
2. Seal
3. Washer
4. Cotter pin
5. Brake pedal
6. Locknut
7. Brake switch adjuster bolt (S models)
8. Return spring
9. Pedal
10. Clevis pin
11. Pivot shaft

2. Remove the cotter pin, washer and clevis pin (A, **Figure 76**) that secure the master cylinder clevis to the brake pedal.
3. Remove the cotter pin and washer from the pivot shaft, and then remove the pivot shaft (B, **Figure 76**) and pedal.
4. Clean and inspect the parts as follows:
   a. Inspect the pivot shaft and bore for scoring, damage or the entry of water and dirt.
   b. If contamination has entered the bore, replace the seals, located on both sides of the pedal.
   c. Inspect the clevis pin and clevis. The pin must be a firm fit in the clevis and pedal.
5. Reverse this procedure to install the pedal. Note the following:
   a. Apply waterproof grease to the seals, bore and pivot shaft.
   b. Install new cotter pins.
   c. Check pedal height and operation (Chapter Three). If the pedal is not level with the footpeg, inspect for bent or damaged parts.

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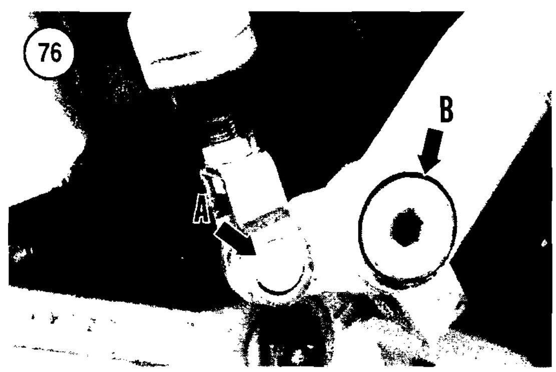

   d. On S and SM models, check brake light operation. (Chapter Three).

BRAKE SYSTEM BLEEDING

CAUTION

Before bleeding brakes, always secure the motorcycle so it is stable and locked in place, particularly the fork. This minimizes the chance of spilled

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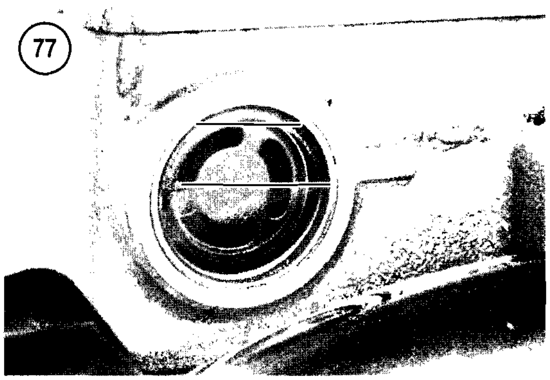

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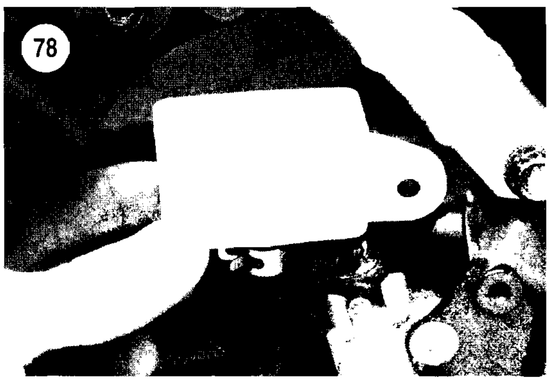

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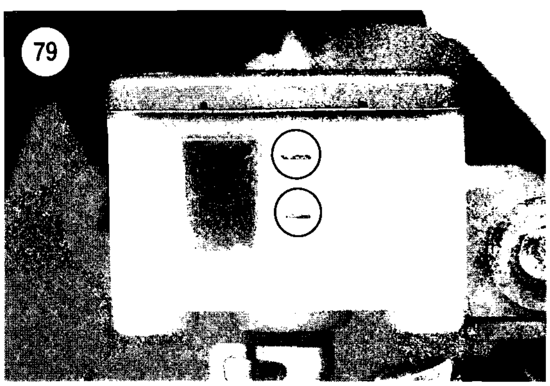

fluid from an open reservoir. Refer to ***Brake Service*** *in this chapter.*

When the brake fluid is replaced or if the brake lever or pedal feels spongy, the brakes should be bled to purge all air from the system. Before bleeding the brakes, determine where the air is entering the system. Check all brake components for leaks. Check the fittings and hoses for deterioration, damage or looseness. The brake system can be bled manually or by using a vacuum pump.

Brake Fluid Reservoirs

Regardless of the bleeding method used, the master cylinder reservoir cap must be removed so the reservoir can be filled with brake fluid. The reservoir must not be over or under filled. Note the following when working with each reservoir.

1. Front brake reservoir.
   a. After removing the cap, remove the diaphragm from the reservoir before filling with fluid.
   b. Keep the reservoir filled between the top of the sight glass and the lower mark on the reservoir (**Figure** 77) during the bleeding procedure.
   c. After bleeding, replenish the reservoir to the upper mark, and then install the diaphragm and cap.
2. Rear brake reservoir.
   a. Remove the master cylinder guard.
   b. Remove the reservoir retaining bolt so the cap can be removed. Remove the cap and diaphragm (**Figure 78**).
   c. Keep the reservoir filled between the upper and lower marks on the reservoir during the bleeding procedure (**Figure 79**).
   d. After bleeding, replenish the reservoir to the upper mark, and then install the diaphragm and cap.
   e. Bolt the reservoir into place and install the master cylinder guard.

Draining Brake Fluid

To drain the brake fluid from the system, have an 8-mm wrench, tip-resistant container and a length of clear tubing that fits tightly on the bleeder valve. Use the following procedure to drain either the front or rear brakes.

CAUTION
Brake fluid can damage painted and finished surfaces. Use water to immediately wash any surface that becomes contaminated with brake fluid.

1. Attach one end of the tubing to the bleeder valve and place the other end into the container (**Figure 80**).
2. Open the bleeder valve so fluid can pass into the tubing.

3. Pump the brake lever/pedal to force the fluid from the system.
4. When the system no longer drips fluid, close the bleeder valve.

Manual Bleeding

To manually bleed the brake system, have an 8-mm wrench, tip-resistant container and a length of clear tubing that fits tightly on the brake bleeder. Bleeding the system is easier with two people. One person can open and close the bleeder valve while the other person operates the brake lever or pedal. Use the following procedure to bleed either the front or rear brake:

NOTE
During the bleeding process, the reservoir must contain fluid during the entire procedure. If the reservoir is allowed to become empty, air will be in the system and the bleeding process will have to be repeated.

1. Attach one end of the tubing to the bleeder valve and place the other end into the container (**Figure 80**).
2. Fill the reservoir to the upper level with brake fluid.
3. Apply pressure (do not pump) to the brake lever or pedal, and then open the bleeder valve. As the fluid is forced from the system, the lever/pedal travels its full length of operation. When the lever/pedal can move no farther, hold the lever/pedal in the *down* position and close the bleeder valve. Do not allow the lever or pedal to return to its *up* position before the bleeder valve is closed. Air is drawn into the system.

CAUTION
In the following step, release the lever/pedal slowly. This minimizes the chance of fluid splashing out of the reservoir as excess fluid in the brake line is returned to the reservoir.

4. When the bleeder valve is closed, release the lever/pedal so it returns to its *up* position. Check the fluid level in the reservoir and replenish if necessary.
5. Repeat Step 3 and Step 4 until clear fluid (minimal air bubbles) is seen passing out of the bleeder valve.

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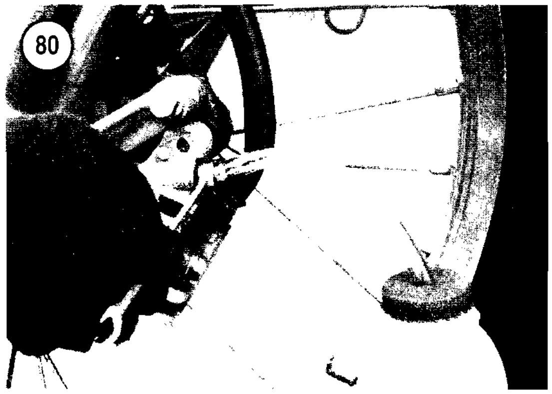

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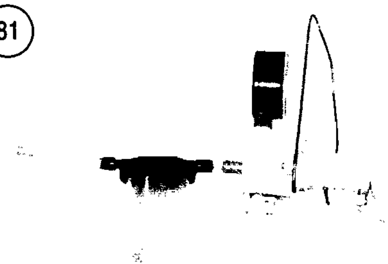

NOTE
If small bubbles (foam) remain in the system after several bleeding attempts, close the reservoir and allow the system to stand undisturbed for a few hours. The system stabilizes and the air can be purged as large bubbles.

NOTE
If air continues to be in the system after repeated bleed, inspect the bleeder valve threads. It may be necessary to wrap the valve threads with Tefelon tape or apply a small amount of silicone brake grease.

6. The bleeding procedure is completed when the feel of the lever/pedal is firm.
7. Check the brake fluid reservoir and fill the reservoir to the upper level, if necessary.
8. Tighten the bleeder valve to 7 N•m (62 in.-lb.).
9. Dispose the waste brake fluid in an environmentally-safe manner.

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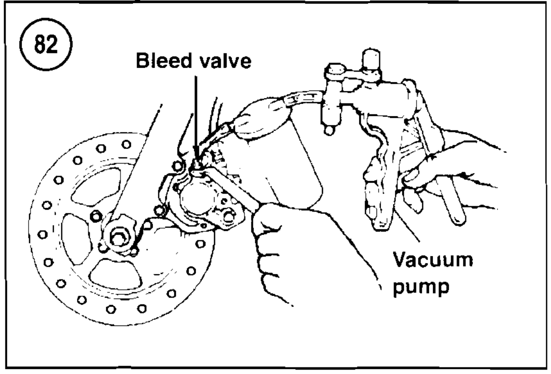

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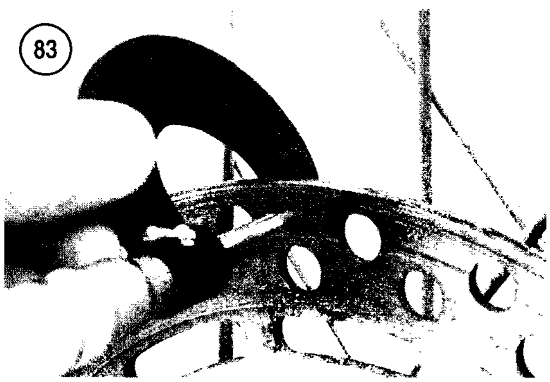


Vacuum Bleeding

To vacuum-bleed the brake system, have an 8-mm wrench and a vacuum pump, such as the Mityvac pump shown in (**Figure 81**). Use the following procedure to bleed either the front or rear brake:

NOTE
During the bleeding process, the reservoir must contain fluid during the entire procedure. If the reservoir is allowed to become empty, air will be in the system and the bleeding process will have to be repeated.

1. Make sure the banjo bolts are tight at the master cylinder and caliper.
2. Attach the brake bleeder to the bleeder valve (**Figure 82**). Suspend the tool with wire. This allows the tool to be released when the fluid reservoir needs to be refilled.
3. Fill the reservoir to the upper level with brake fluid.
4. Pump the handle on the brake bleeder to create a vacuum.
5. Open the bleeder valve and draw the air and fluid from the system. Close the valve *before* the fluid stops moving. If the vacuum pump is equipped with a gauge, close the bleeder before the gauge reads 0. Replenish the fluid level in the reservoir.
6. Repeat Steps 4-5 until clear fluid (minimal air bubbles) is seen passing out of the bleeder. The bleeding procedure is completed when the feel of the lever/pedal is firm.

NOTE
If air continues to be in the system after repeated bleed, inspect the bleeder valve threads. It may be necessary to wrap the valve threads with Teflon tape or apply a small amount of silicone brake grease.

7. Check the brake fluid reservoir and fill the reservoir to the upper level, if necessary.
8. Tighten the bleeder valve to 7 N•m (62 in.-lb.).
9. Dispose the waste brake fluid in an environmentally-safe manner.

BRAKE DISC

The condition of the brake discs and pads are often a reflection of one another. If disc scoring is evident, inspect the pads and disc as soon as possible. Visually inspect the discs and pads with the wheels mounted on the motorcycle (Chapter Three). If damage is noted, perform the inspection described in this section. The brake disc cannot be machined to compensate for warp or wear. Maintain the discs by keeping them clean and corrosion-free. Use a solvent that is not oil-based to wipe grit that accumulates on the discs and at the edge of the pads.

Inspection

1. Measure the thickness of each disc at several locations around its perimeter (**Figure 83**). Replace the disc if it is out of specification.
2. Measure disc runout as follows:
   a. Mount a dial indicator on a stable surface and in contact with the disc (**Figure 84**).
   b. Zero the gauge.
   c. Turn the wheel and watch the amount of runout measured on the gauge. Replace the disc if it is out of specification.

d. If the disc runout is out of specification, check the condition of the wheel bearings before replacing the disc. If the bearings are not in good condition, replace the bearings and remeasure the disc runout.

Removal and Installation

The discs are mounted to the hubs with bolts. Remove and install either disc as follows:

1. Remove the wheel from motorcycle (Chapter Eleven).
2. Remove the disc bolts (**Figure 85**).
3. Clean the bolts and mounting holes.
4. Reverse this procedure to install the discs. Note the following:
   a. Install the disc with the thickness marking facing out.
   b. Apply nonpermanent threadlocking compound to the bolt threads.
   c. Tighten the bolts in several passes and in a crossing pattern.
   d. Tighten the bolts to 10 N•m (7 ft.-lb.).
   e. Check the disc for runout as described in this section.

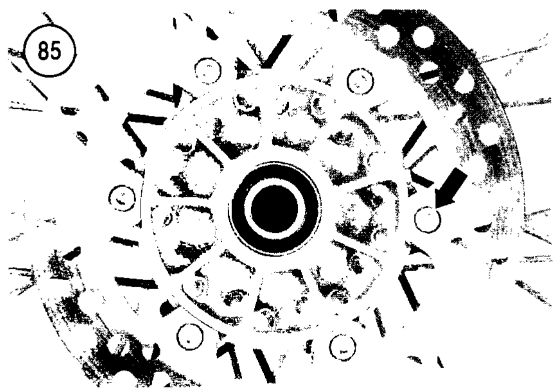


Table 1 BRAKE SPECIFICATIONS

	New mm (in.)	Service limit mm (in.)
Brake caliper inside diameter	27.00-27.05 (1.063-1.065)	–
Brake caliper piston diameter	26.90-26.95 (1.059-1.061)	–
Disc runout	–	0.30 (0.012)
Disc thickness		
E and S models		
Front	2.8-3.2 (0.11-0.13)	2.5 (0.10)
Rear	4.3-4.7 (0.17-0.19)	4.0 (0.16)
SM models		
Front	3.8-4.2 (0.15-0.17)	3.5 (0.14)
Rear	4.3-4.7 (0.17-0.19)	4.0 (0.16)
Front master cylinder inside diameter		
E models	11.000-11.043 (0.4331-0.4348)	–
S and SM models	12.700-12.743 (0.5000-0.5017)	–
Front master cylinder piston diameter		
E models	10.957-10.984 (0.4314-0.4324)	–
S and SM models	12.657-12.684 (0.4983-0.4994)	–
Pad lining minimum thickness	–	1.0 (0.040)
Rear master cylinder inside diameter	12.700-12.743 (0.5000-0.5017)	–
Rear master cylinder piston diameter	12.657-12.684 (0.4983-0.4994)	–

Table 2 BRAKE SYSTEM TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Brake bleeder valve	7	62	–
Brake disc bolts	10	–	7
Brake hose banjo bolts	23	–	17
Caliper bracket slide pin	13	–	10
Caliper mounting bolts	26	–	19
Caliper slide pin	23	–	17
Master cylinder mounting bolts	10	–	7
Pad pin	18	–	13

CHAPTER FIFTEEN

BODY

This chapter provides removal and installation procedures for the side covers, seat, radiator covers, fuel tank, headlight cowl, engine covers, skid plate and subframe.

Refer to **Table 1** for torque specifications.

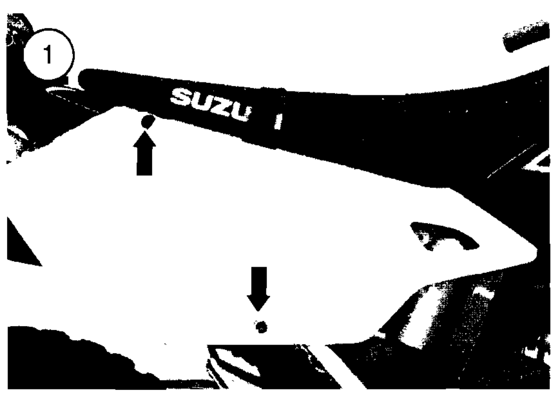
SIDE COVERS

Right Side Removal and Installation

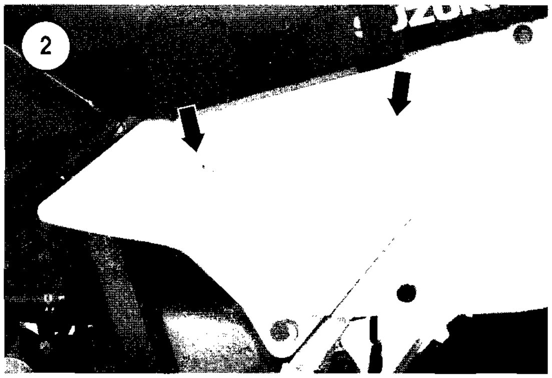
1. Remove the bolts and washers at the top and bottom of the cover (**Figure 1**).
2. Pull the bottom of the cover out and down to disengage the cover from the seat and fender.
3. To install the cover:
   a. Insert the edge of the cover under the seat and fender.
   b. Install the washers and bolts.

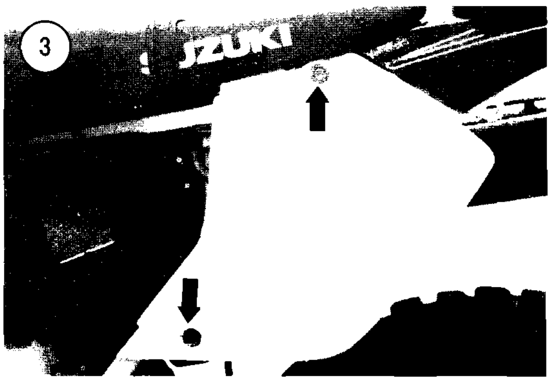
Left Side Removal and Installation

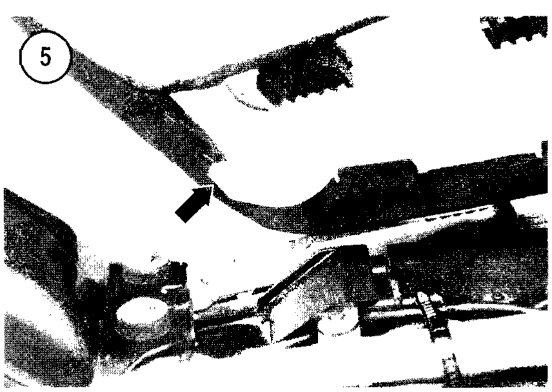
1. Disengage the Dzus fasteners (**Figure 2**) securing the front cover.



2. Pull the bottom of the cover out and down to disengage the cover from the seat.
3. Remove the bolts at the top and bottom of the rear cover (**Figure 3**).
4. Pull the bottom of the cover out and down to disengage the cover from the seat and fender.
5. To install the covers:
   a. Insert the edge of the front cover under the seat.
   b. Lock the Dzus fasteners.







c. Insert the edge of the rear cover under the seat and fender.
d. Install the washers and bolts.

SEAT

Removal and Installation

1A. On S and SM models, remove the right side cover as described in this chapter, and then unbolt the strap (**Figure 4**) at the right side.
1B. On E models, remove the bolt and washer from both sides at the rear of the seat.
2. Grasp the front and rear of the seat, and then pull it backward to disengage it from the fuel tank.
3. Reverse this procedure to install the seat. Make sure the seat hook (**Figure 5**) is engaged with the fuel tank. On E models, a small hook is at the front edge of the seat.

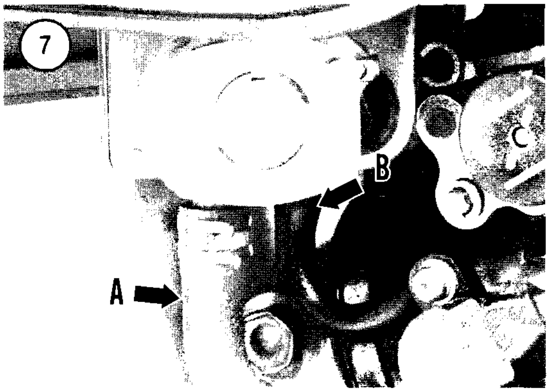
RADIATOR COVERS

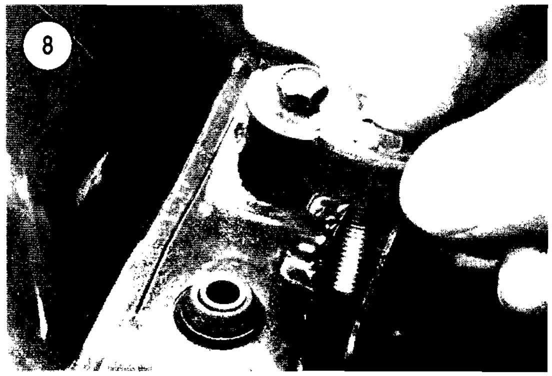
The radiator covers are attached by three screws and washers in each cover (**Figure 6**). On S models, install the long screw at the bottom of the cover.

FUEL TANK

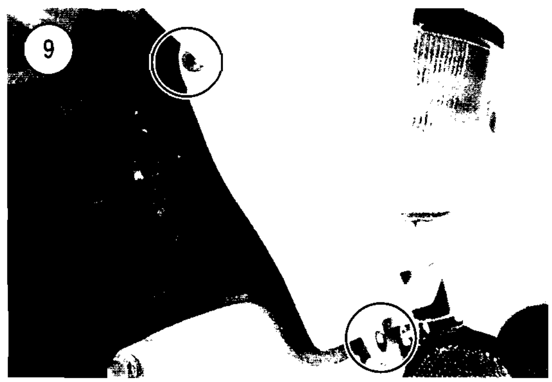
Removal and Installation

1. Remove the seat, side covers and radiator covers as described in this chapter.
2. Turn the fuel valve off. Because the fuel valve is vacuum-actuated on S models, the on position is also the off position.
3. Remove the fuel hose (A, **Figure 7**) from the fuel valve assembly. On S models, also remove the vacuum hose (B, **Figure 7**).





4A. On S and SM models, remove the bolts, rubber cushions and spacers at the rear of the fuel tank (**Figure 8**).
4B. On E models, remove the strap at the rear of the fuel tank.
5. Remove the fuel tank, moving it toward the rear of the motorcycle.
6. Reverse this procedure to install the fuel tank.

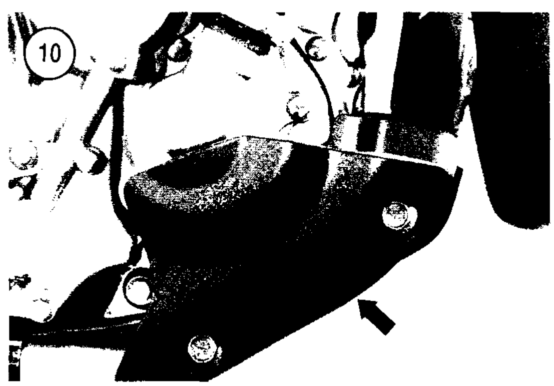


HEADLIGHT COWL

The cowl covers the headlight, gauges and some electrical connections. On S and SM models, the cowl is attached by a screw and washer at the bottom and each side of the cowl (**Figure 9**). On E models, the cowl is attached by a screw and washer at the bottom and a band at each side.

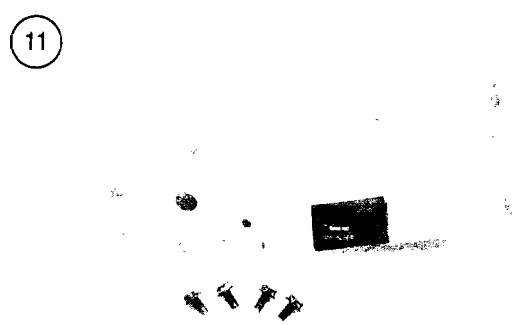
ENGINE COVERS

The engine covers (**Figure 10**) are attached to the frame by two bolts.



SKID PLATE

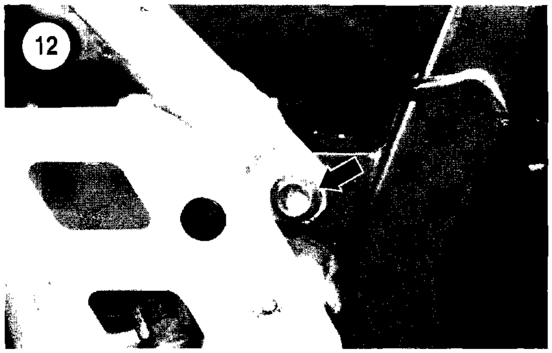
The skid plate is attached to the frame by four bolts (**Figure 11**). If the motorcycle is used in rough terrain, inspect the skid plate often.

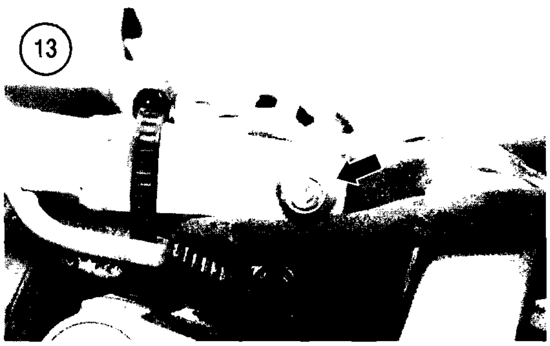


SUBFRAME

Removal and Installation

1. Remove the side covers and seat as described in this chapter.
2. Remove the muffler (Chapter Four).





3. Remove the battery (Chapter Three).
4. Disconnect the air cleaner hoses and loosen the carburetor clamp.
5. Remove the coolant overflow tank.
6. Disconnect all hoses and wires passing from the front to the rear of the motorcycle. Route the hoses and wires out of the subframe.

CAUTION
Have an assistant aid in the next steps, by holding the subframe and preventing it from falling when the upper subframe bolts are removed.

7. Remove the lower subframe bolts (**Figure 12**).
8. Remove the upper subframe bolts (**Figure 13**).
9. To install the subframe, reverse this procedure. Note the following:
   a. Inspect and replace subframe mounting bolts that are corroded or damaged.
   b. Apply threadlocking compound to the subframe mounting bolts.
   c. Finger-tighten all subframe mounting bolts, and then tighten them to 35 N•m (26 ft.-lb.).

Table 1 BODY TORQUE SPECIFICATIONS

	N•m	in.-lb.	ft.-lb.
Subframe mounting bolts	35	–	26

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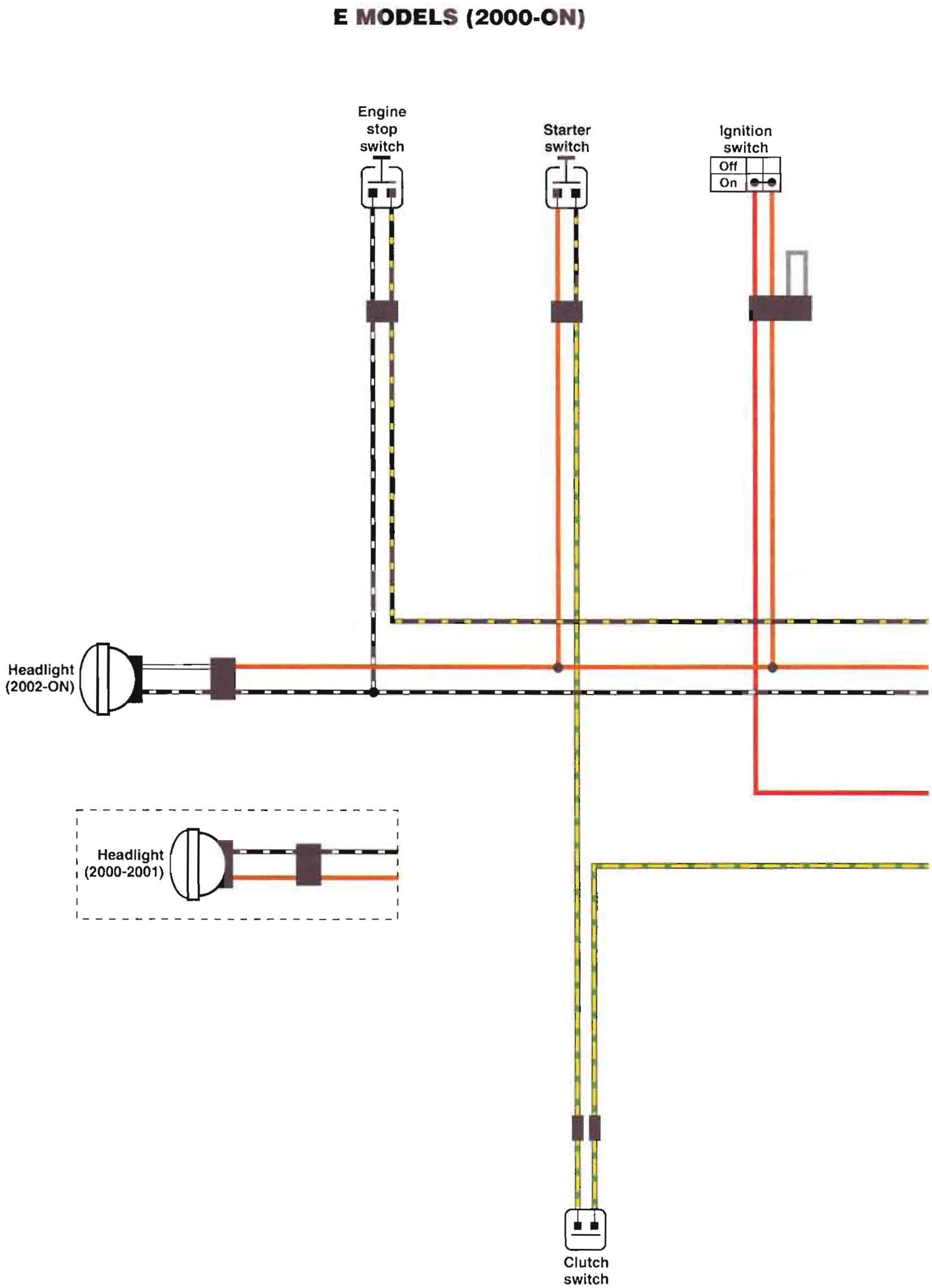
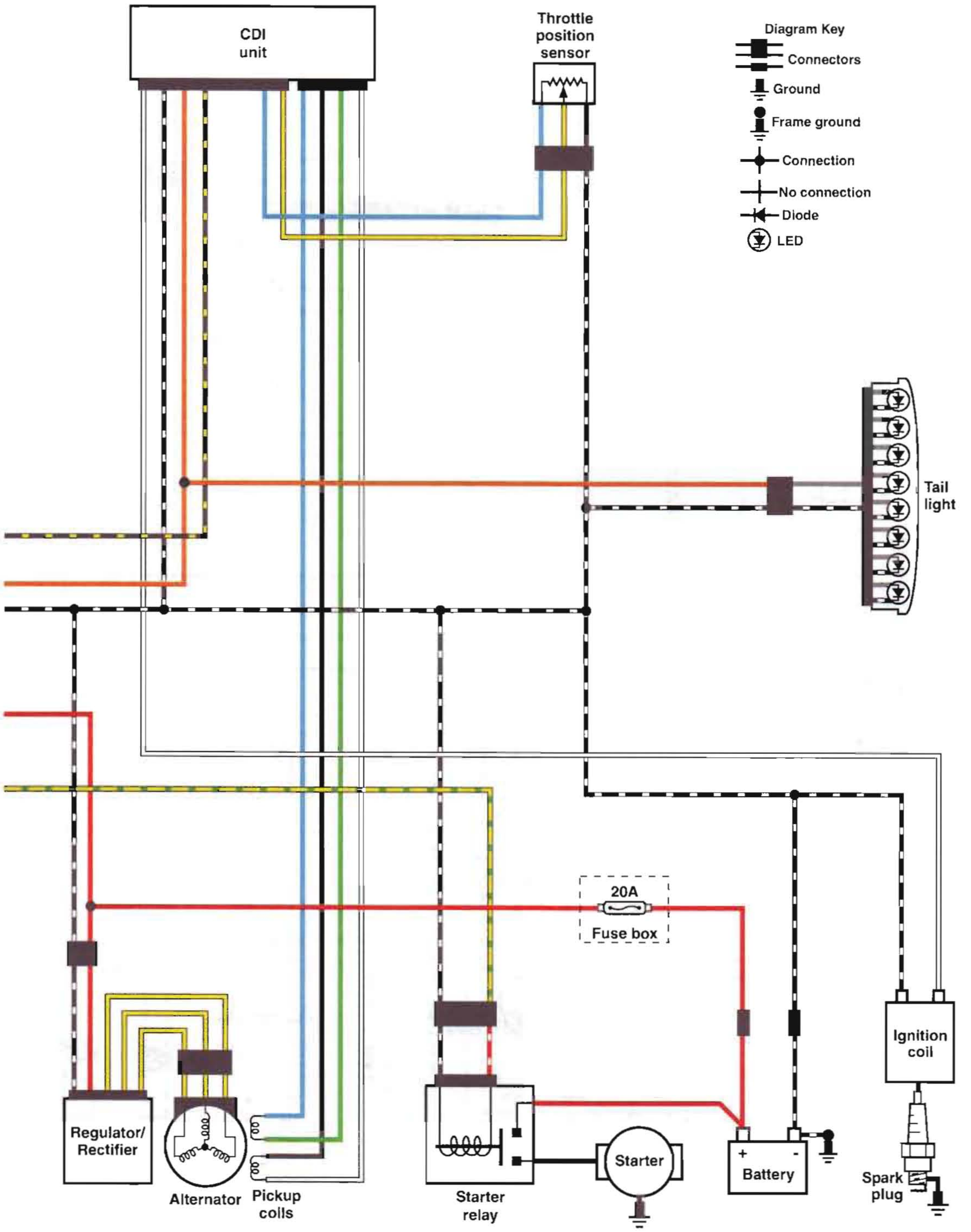
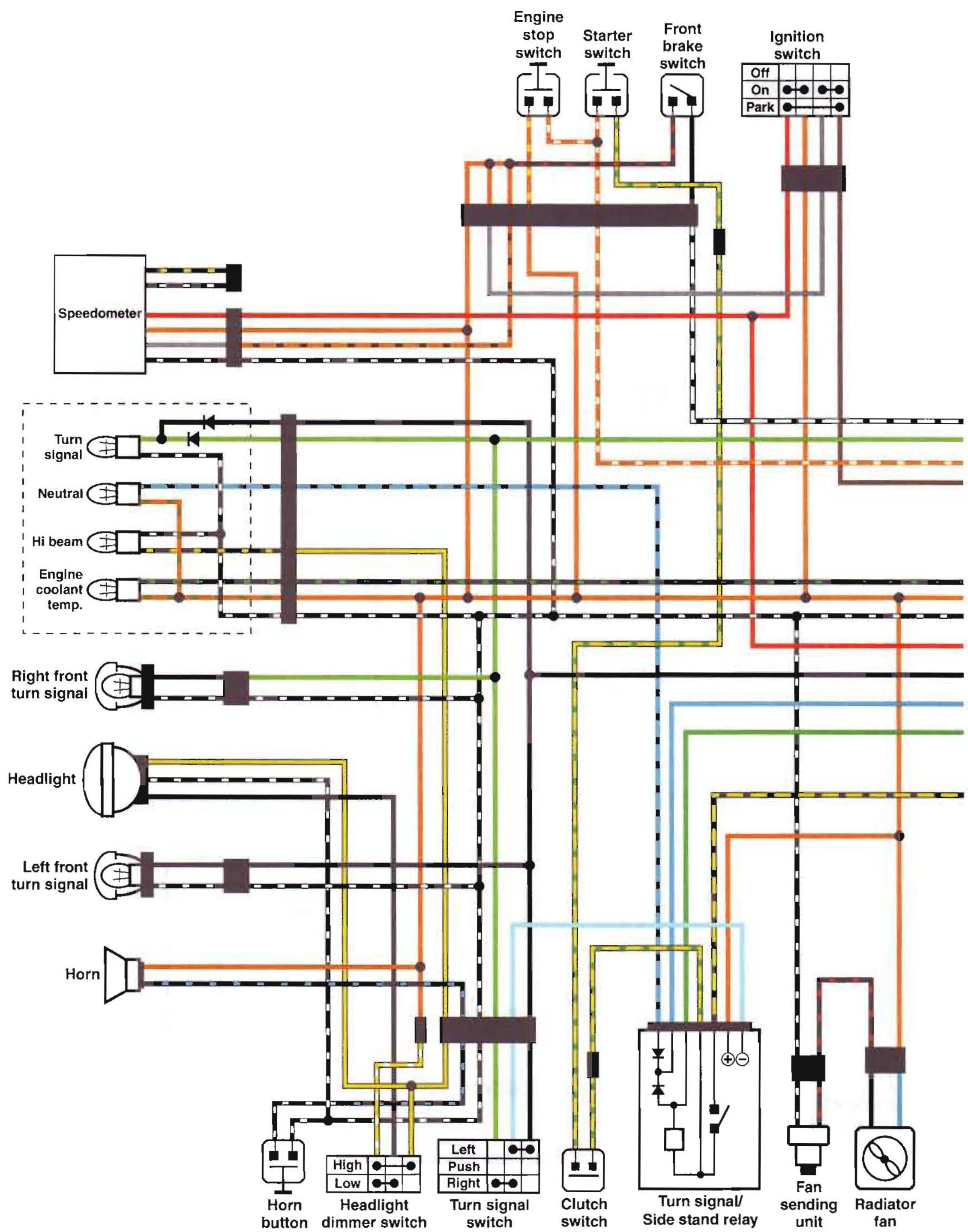
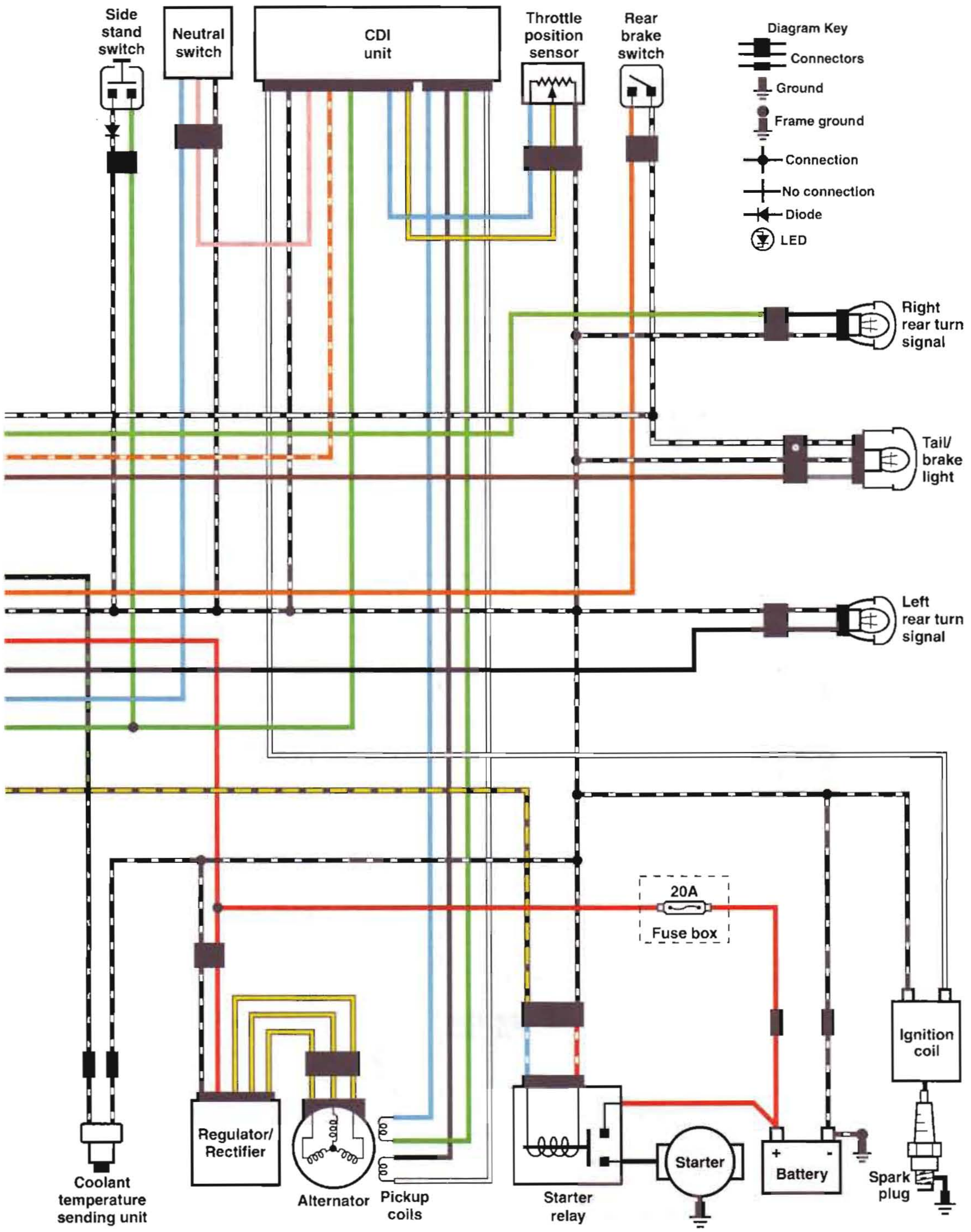

E MODELS (2000-ON)
Engine stop switch
Starter switch
Ignition switch
Off
On
Headlight (2002-ON)
Headlight (2000-2001)
Clutch switch


CDI
unit
Throttle
position
sensor
Diagram Key
Connectors
Ground
Frame ground
Connection
No connection
Diode
LED
Tail
light
20A
Fuse box
Ignition
coil
Regulator/
Rectifier
Alternator
Pickup
coils
Starter
relay
Starter
+
-
Battery
Spark
plug

17

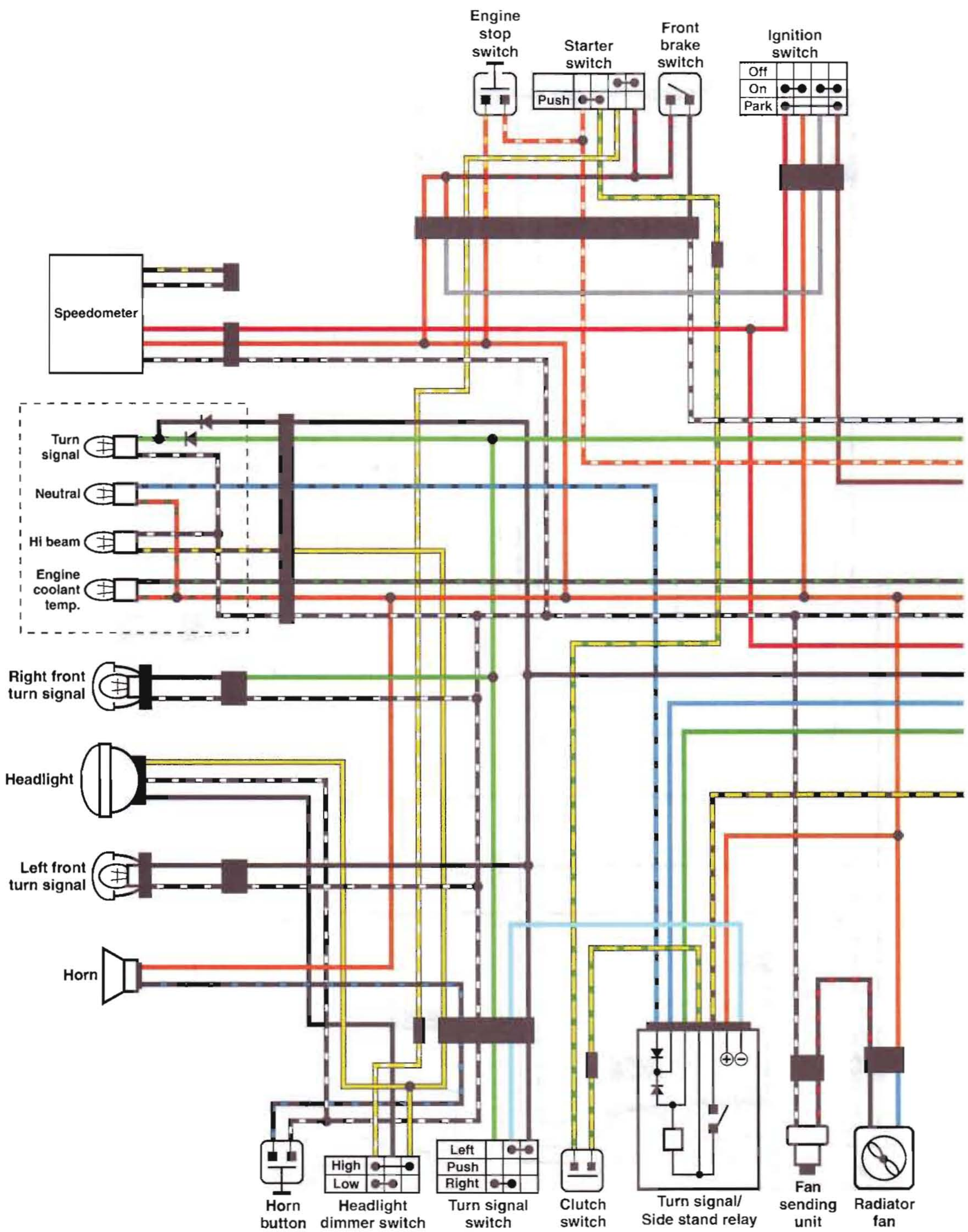
S MODELS (2000-2004)

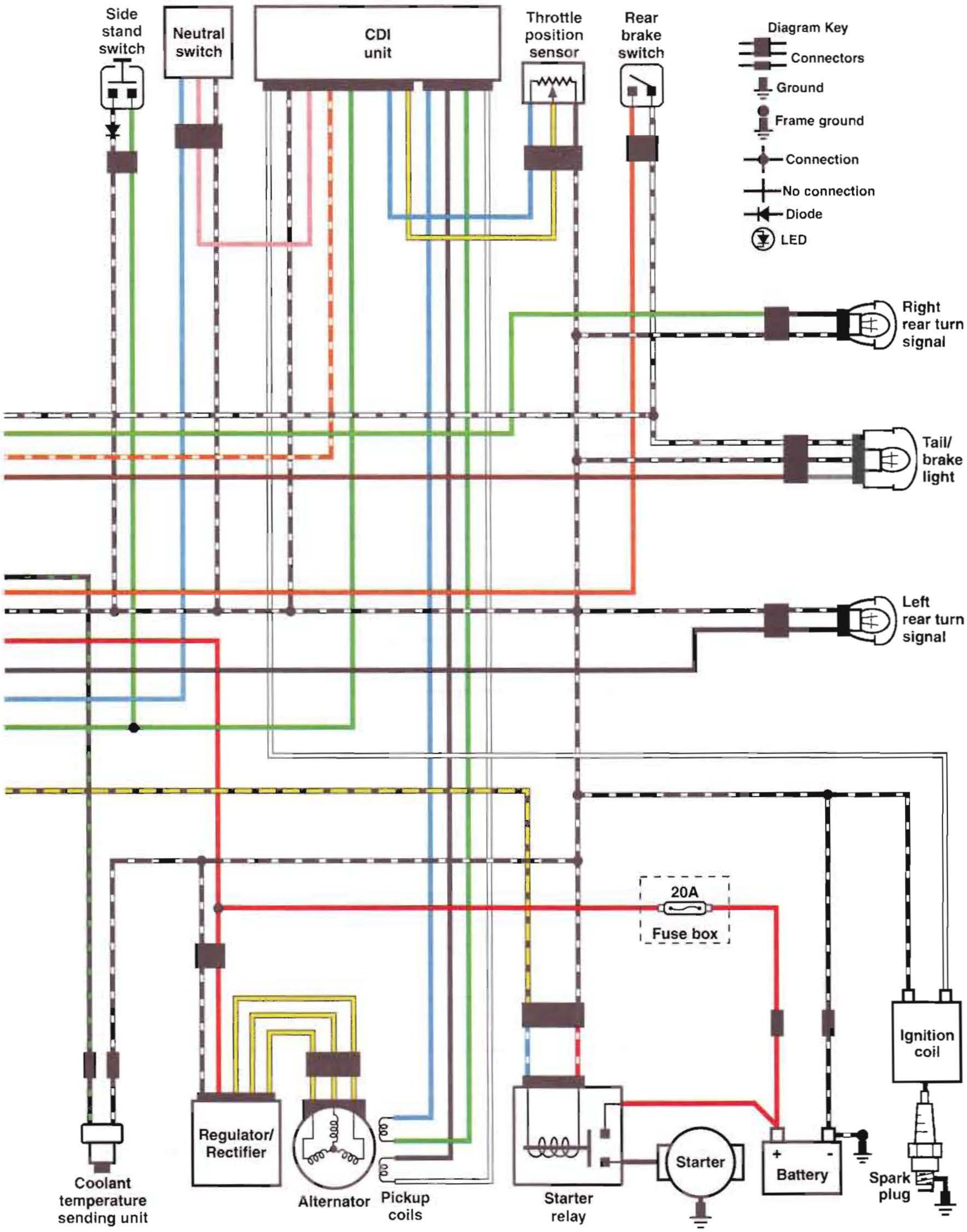



Side stand switch
Neutral switch
CDI unit
Throttle position sensor
Rear brake switch
Diagram Key
Connectors
Ground
Frame ground
Connection
No connection
Diode
LED
Right rear turn signal
Tail/ brake light
Left rear turn signal
20A
Fuse box
Ignition coil
Coolant temperature sending unit
Regulator/ Rectifier
Alternator
Pickup coils
Starter relay
Starter
Battery
Spark plug

17

S AND SM MODELS (2005-ON)




Side stand switch
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Regulator/ Rectifier
Alternator
Pickup coils
Starter relay
Starter
Battery
Spark plug

MAINTENANCE LOG

Date	Miles	Type of Service