

9. CYLINDER HEAD

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SERVICE INFORMATION

- Refer to Engine Testing, section 3, for cylinder compression and leak-down testing.
- Remove accumulated carbon from the cylinder head of two-stroke engines as described in the Model Specific manual.
- Camshaft lubricating oil is fed through oil passages in the cylinder head. Clean the oil passages before assembling the cylinder head.
- Clean all disassembled parts with cleaning solvent and dry them by blowing them off with compressed air before inspection.
- Before reassembly, lubricate the sliding surfaces of the parts (see each Model Specific manual for lubrication).
- When disassembling, mark and store the disassembled parts to ensure that they are reinstalled in their proper locations.
- Loosen the cylinder head bolts in a crisscross pattern in two or three steps from outside to center and from small diameter to large diameter.
- When tightening cylinder head bolts:
 - tighten the bolts and nuts to the specified torque in the sequence described in Model Specific manual, or if the sequence is not described, tighten according to the following general rule.
 - hand-tighten the bolts and nuts, then torque large bolts and nuts before small ones in a crisscross pattern from inner-to-outer in two or three gradual steps.
- If it is no longer clear which bolt belongs in which hole, insert all bolts in the holes and check the exposed lengths; each should be exposed the same amount.

TROUBLESHOOTING

Engine top-end problems usually affect engine performance. These can be diagnosed by a compression or leak down test, or by tracing noises to the top-end with a sounding rod or stethoscope.

Low compression

- Valves
 - Incorrect valve adjustment (see section 2)
 - Burned or bent valves
 - Incorrect valve timing
 - Broken valve spring
 - Uneven valve seating
- Cylinder head
 - Leaking or damaged head gasket
 - Warped or cracked cylinder head
- Cylinder, piston (see section 10)
- Leaking crankcase primary compression (2-stroke engine)
 - Blown crankcase gasket
 - Damaged crankshaft oil seal

Rough idle

- Low cylinder compression
- Incorrect decompression adjustment

Compression too high

- Excessive carbon build-up on piston or combustion chamber

Excessive noise

- Incorrect valve adjustment
- Sticking valve or broken valve spring
- Damaged or worn camshaft
- Loose or worn cam chain
- Worn or damaged cam chain tensioner
- Worn cam sprocket teeth
- Worn rocker arm and/or shaft

Kick starting difficult

- Incorrect decompressor adjustment
- Seized engine

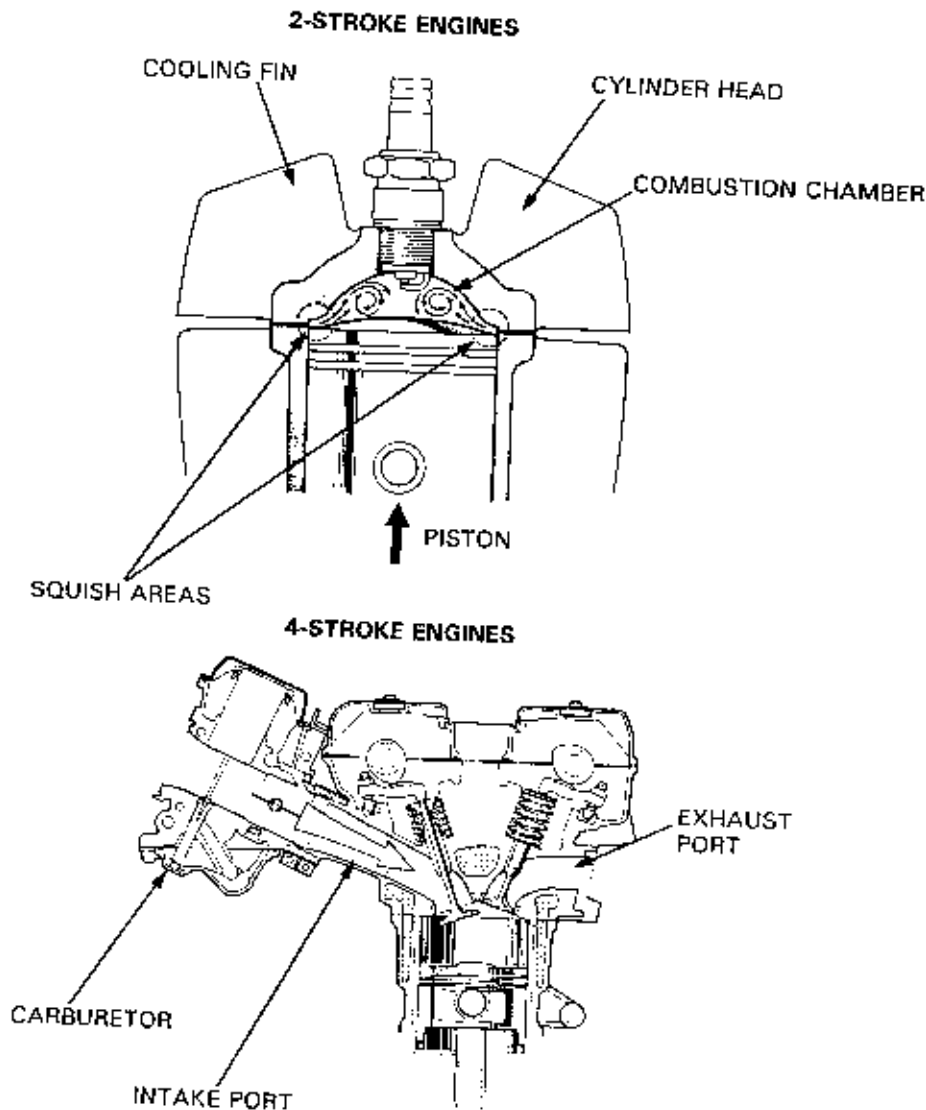
SYSTEM DESCRIPTION

CONSTRUCTIONS

As cylinder heads are subject to considerable combustion heat and pressure, they are made of a one-piece aluminum casting with considerable strength and cooling capability. Air-cooled engines are provided with air cooling fins, and liquid-cooled engines with a water jacket, respectively, necessary to cool the engine.

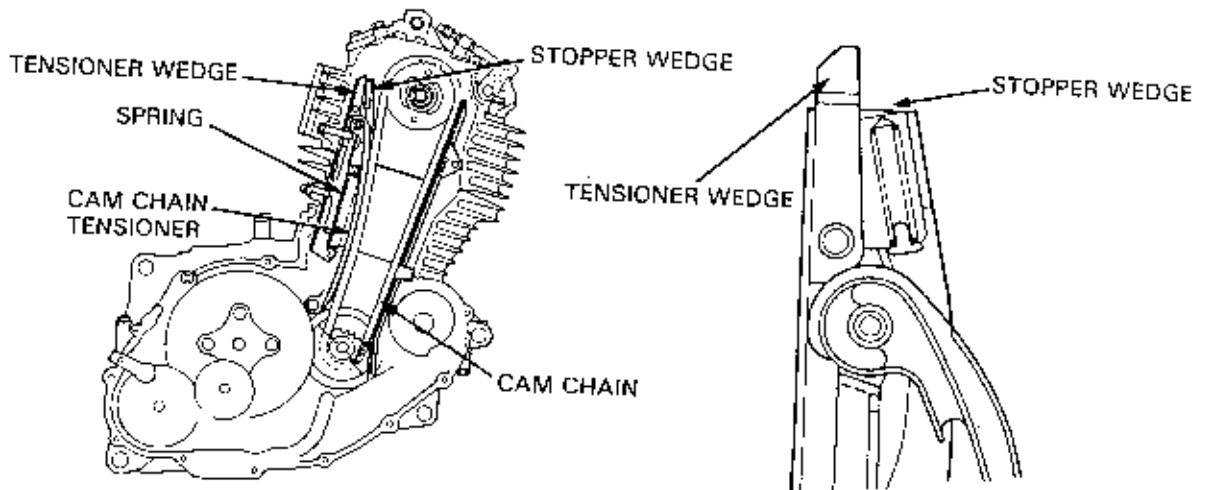
The cylinder head encloses a combustion chamber. A hemisphere shape is most common, providing a minimum possible space for improved combustion efficiency. Where four valves per cylinder are used in a 4-stroke engine, the combustion chamber is shaped like a shed roof, according to the valve arrangement. Some models, of both 2 and 4-stroke engines, are provided with squish areas on the outer circumference of the combustion chamber. This has the effect of improving combustion efficiency at the final stage of the compression process by extra compression of the air/fuel mixture in the squish areas between the piston and cylinder head and forcing it to the center of the combustion chamber. There is also the added advantage of decreased carbon adhesion.

The construction of the cylinder head with 2-stroke engines is simple. 4-stroke engines, however, have a complicated configuration containing extra parts, due to the necessity of valve actuating mechanisms and exhaust ports. Furthermore, the intake/exhaust port configuration of a 4-stroke engine has a direct relation to the engine performance. There is therefore a tendency to adopt a layout allowing a very direct inlet for a smoother air/fuel mixture, by aligning the intake port from the carburetor to the combustion chamber.

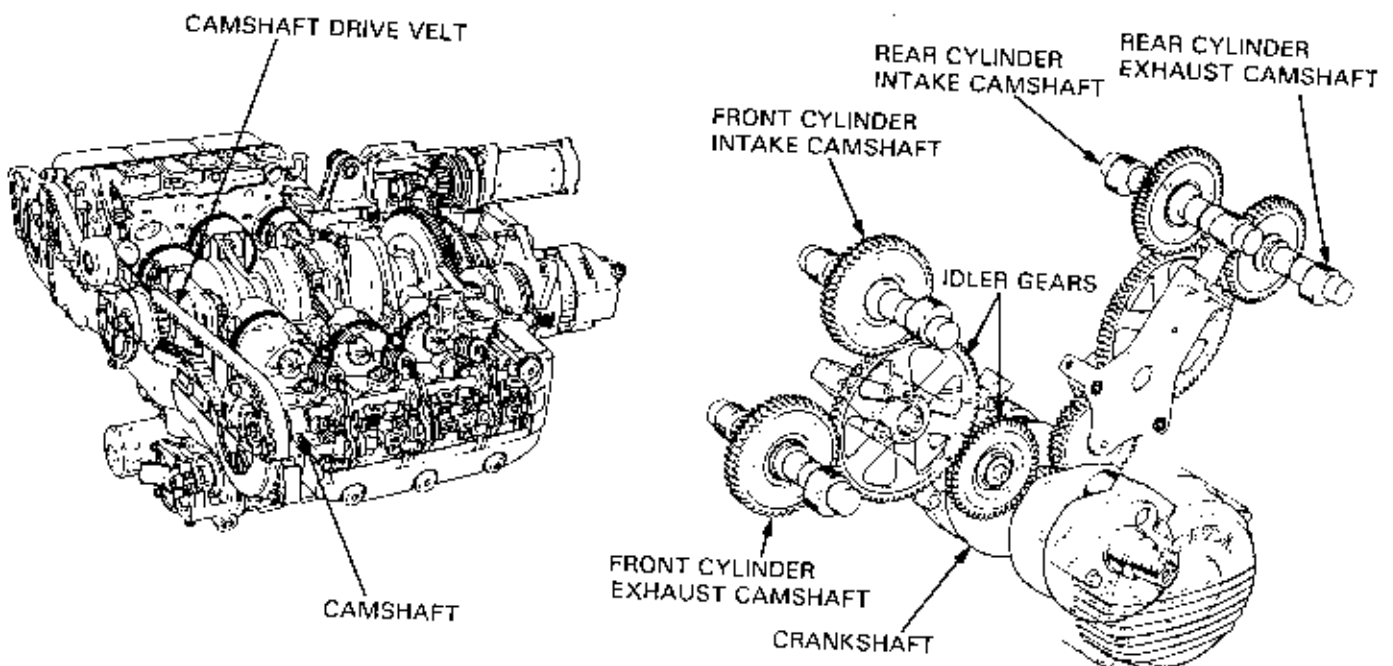


VALVE TRAIN

The current valve train designs used on 4-stroke engines is divided into 3 types: a conventional chain drive, a belt drive (with considerable noise reduction), and a gear drive used in high performance engines. A chain drive is the most commonly used mechanism for current valve train design. Its simple construction allows for lower cost of manufacture. Some maintenance is required, however, because eventually chain elongation increases chain noise. Chain maintenance is not required with types using an "automatic cam chain tensioner". The automatic cam chain tensioner provides spring support by pressing the chain in the direction of tension and locking against any counter-pressure. This provides the automatic elimination of chain slack.



The GOLDWINGS adopt a belt drive system similar to that used on Honda automobiles. This type is used on engines requiring less noise. There are also models adopting valve drive by gear. This type has minimal friction loss from valve drive and maintains accurate valve timing even at high engine speeds. Accordingly, this type is adopted for sport machines. The camshaft drive gear mechanism between the crankshaft and the camshaft is of a cassette type, allowing easier mounting/removal of the camshaft and gear case in comparison to the chain drive. Both types require no maintenance and provide reliable strength and durability.



CYLINDER HEAD

VALVE LIFTER MECHANISM/ARRANGEMENT

The current camshaft arrangement in 4-stroke engines can be divided into Single Over Head Camshaft (SOHC) and Double Over Head Camshaft (DOHC) configurations.

The SOHC follows the basic design of 4-stroke engines, operating IN and EX valves through rocker arms with one camshaft. Compared to the DOHC, the SOHC type is less expensive to manufacture and is easier to maintain due to the reduced number of parts. However, "valve jump" (where the valve cannot accurately follow the cam when the engine rotates at high speed) can occur, causing the valve to contact the piston, and causing severe engine damage. To decrease valve mass and reduce the possibility of engine damage during high engine speeds, 4-stroke engines requiring high power generally use the DOHC design in which the valves are operated directly with two separate camshafts for IN and EX valves.

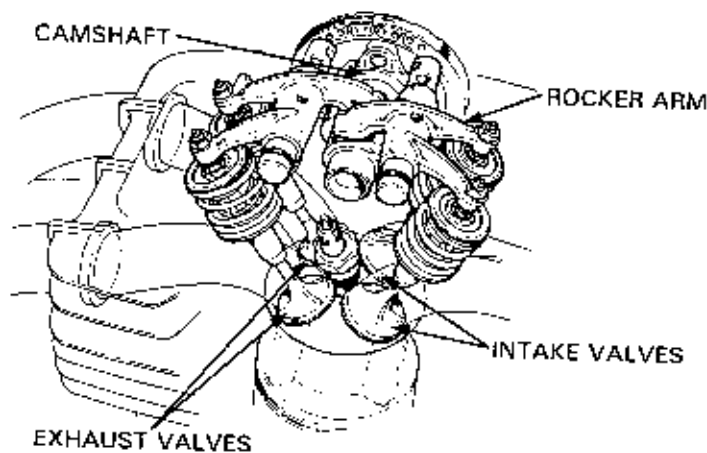
The DOHC configuration can be of two designs: a type pressing the valve bucket directly, or a type lifting the valve through the use of a rocker arm. For the former, a shim is provided in the bucket for valve clearance adjustment. The shim is usually provided between the bucket and the cam lobe.

Some types have a small shim inserted between the under side of the bucket and the valve stem, allowing less valve actuating mechanism weight.

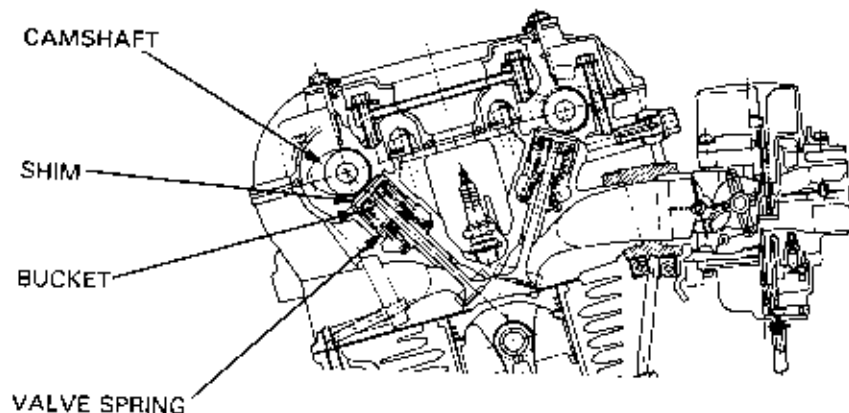
Some DOHC types are also equipped with rocker arms, allowing easier adjustment of valve clearance.

The DOHC has a further advantage when combined with the 4-valves per cylinder engine type. A larger valve area can be provided in the 4-valve type in comparison to that of the 2-valve type, enabling a greater intake volume of air/fuel mixture and a smoother exhaust. Valve weight is also less, consequently reducing the likelihood of valve jump associated with high engine speeds. Furthermore, with a 4-valve type the spark plug can be placed at the center of the combustion chamber, allowing an easy flame propagation balance during combustion.

EXAMPLE OF SOHC-4 VALVE SYSTEM



EXAMPLE OF DOHC WITH VALVE BUCKET TYPE



CAMSHAFT

CAMSHAFT INSPECTION

Inspect the cam lobes and replace cams that are worn, scored or scratched.

NOTE

- Inspect the rocker arm if the cam lobe is worn or damaged.

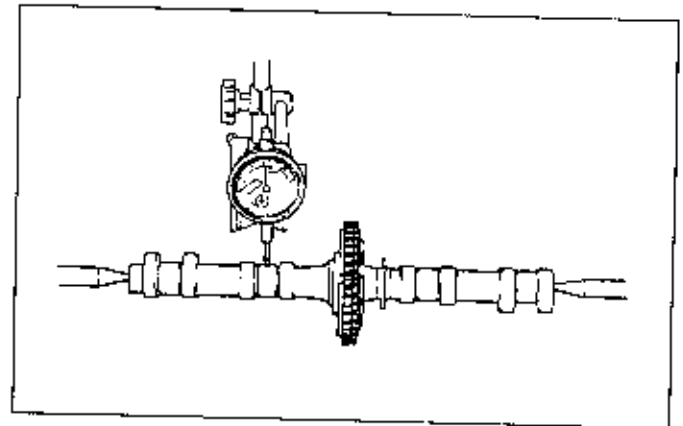
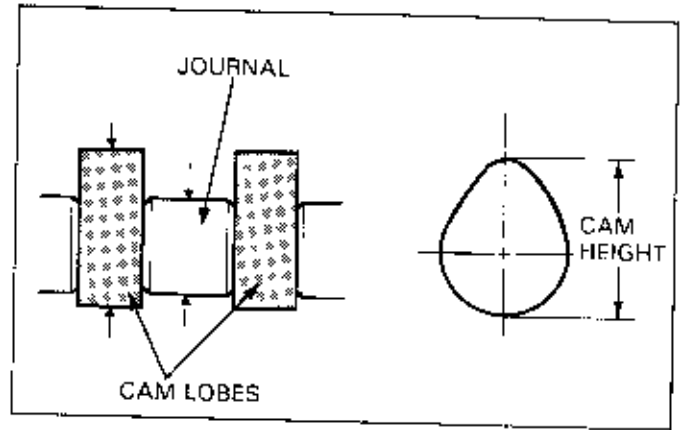
Inspect the journal surfaces. Replace the camshaft if any of the working surfaces are worn, scored or scratched.

NOTE

- Inspect the oil passages and camshaft holders for wear or damage if the journal surface is worn or damaged.

Measure the journal O.D. and cam height. Replace any camshaft if its measurements are beyond the service limits.

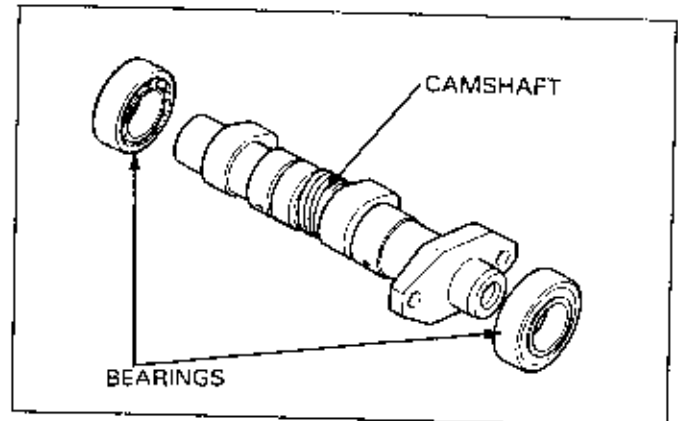
Check camshaft runout with a dial indicator. Support both ends of the camshaft with V-blocks.



CAMSHAFT BEARING INSPECTION

Check that the bearing inner race fits the camshaft tightly without play.

Turn the outer race and check that the bearing turns smoothly and quietly.



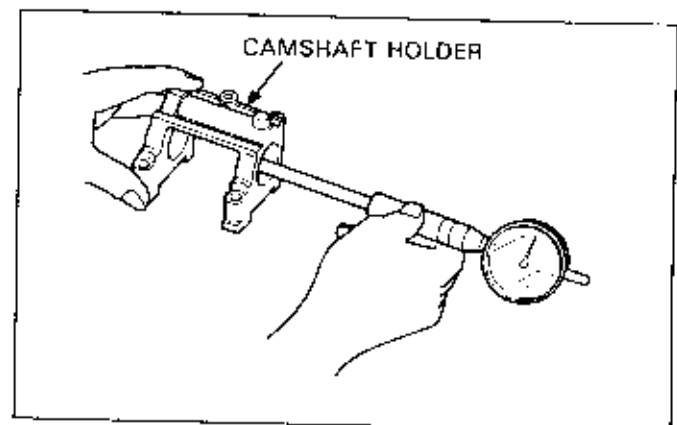
CAMSHAFT OIL CLEARANCE INSPECTION

The oil clearance is the difference between the camshaft holder I.D. and the journal O.D.

Measure the camshaft holder journal I.D. with a dial indicator. Subtract the camshaft journal O.D. from the camshaft holder journal I.D. to obtain the oil clearance.

When the service limits are exceeded, replace the camshaft and recheck the oil clearance.

Replace the cylinder head and camshaft holders if the clearance still exceeds service limits.

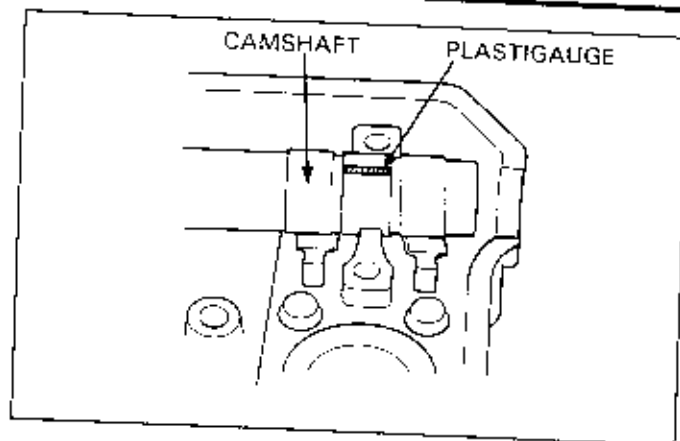


CYLINDER HEAD

If a dial indicator cannot be used, measure the oil clearances using plastigauge:

Clean off any oil from the camshaft journals.

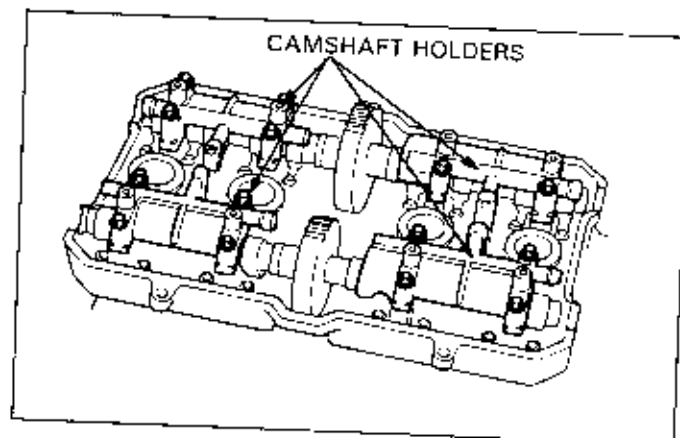
Put the camshaft in the cylinder head and place a strip of plastigauge on top of each camshaft journal.



Install the camshaft holders and tighten the mounting bolts to the specified torque. (Refer to the Model Specific manual for the correct torque specification)

NOTE

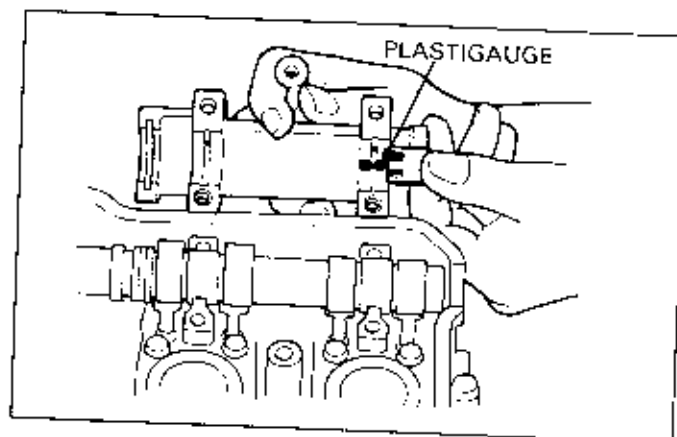
- Do not rotate the camshaft during inspection.



Remove the camshaft holders and measure the width of each plastigauge. The widest thickness determines the oil clearance.

When the service limits are exceeded, replace the camshaft and recheck the oil clearance.

Replace the cylinder head and camshaft holders if the clearance still exceeds service limits.



ROCKER ARM, ROCKER ARM SHAFT

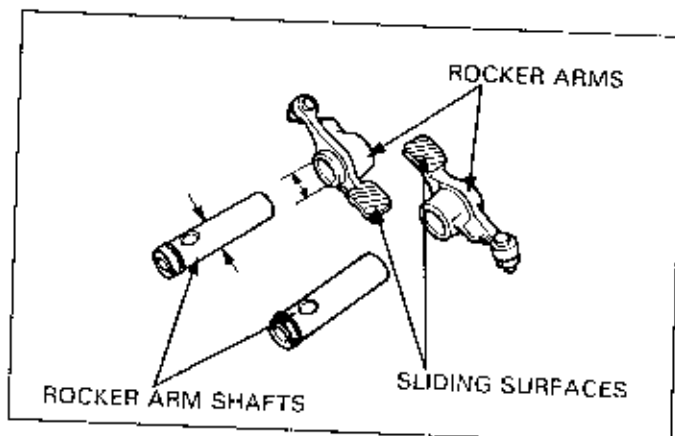
Inspect the sliding surface of the rocker arms for wear or damage where they contact the camshaft, or for clogged oil holes.

Measure the I.D. of each rocker arm.

Measure each rocker arm and shaft O.D.

Inspect the shaft for wear or damage and calculate the shaft to rocker arm clearance.

Replace the rocker arm and/or shaft if the measurements exceed the service limits.



CYLINDER HEAD INSPECTION

SOLVENT TEST

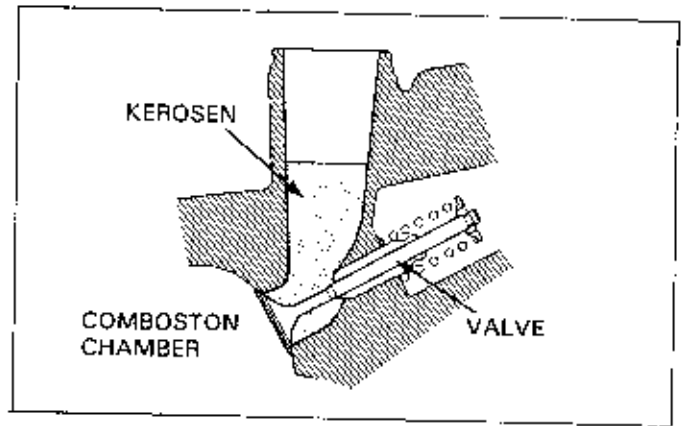
Remove the cylinder head.

Be sure that the valve is installed on the cylinder head and place the cylinder head with the intake port toward up. Pour the kerosine from the intake port into the cylinder head. Wait for a few minutes, then check the combustion chamber side valve area for kerosine leakage.

With the exhaust port toward up, pour the kerosine from the exhaust port into the cylinder head, wait for a few minutes, and check for kerosine leakage.

If kerosine leaks from around the valve, it indicates faulty sealing of the valve seat. Remove the valve from the cylinder head and check the following.

- Valve seat for damage (page 9-11)
- Valve seat contact face (page 9-11)
- Valve stem for bend or damage (page 9-8)



WARPAGE INSPECTION

Remove carbon deposits from the combustion chamber and clean off the head gasket surfaces.

NOTE

- Gaskets will come off easier if soaked in high flash-point cleaning solvent.

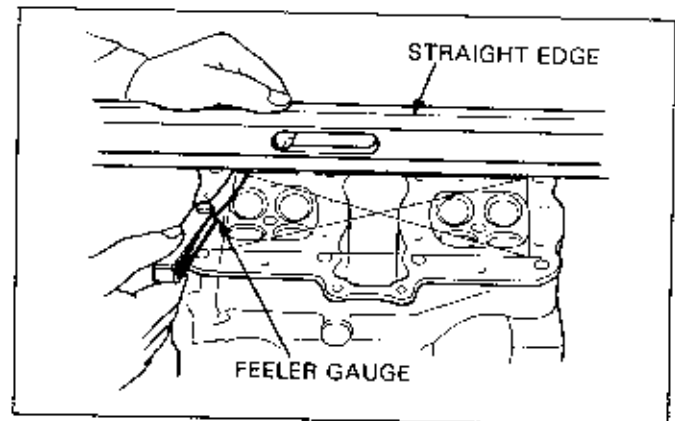
CAUTION

- Avoid damaging the gasket and valve seat surfaces.

Check the spark plug hole and valve areas for cracks.

Check the cylinder head for warpage with a straight edge and feeler gauge.

Repair or replace the cylinder head if warpage exceeds the service limit. (Refer to the Model Specific manual)



CYLINDER HEAD

CYLINDER HEAD DISASSEMBLY

Remove the cylinder head according to the Model Specific manual.

Remove the valve cotters with the valve spring compressor.

TOOL:

VALVE SPRING COMPRESSOR 07757-0010000 and
ATTACHMENT
(as necessary)

CAUTION

- Compressing the valve springs more than necessary will cause loss of valve spring tension.

Remove the valve spring compressor, then remove the retainers, valve springs and valves.

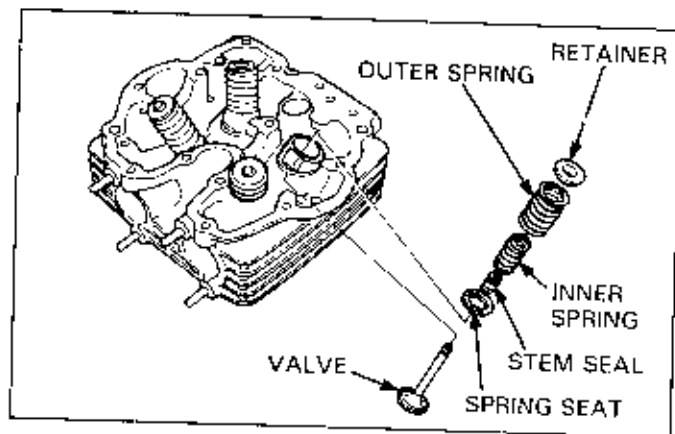
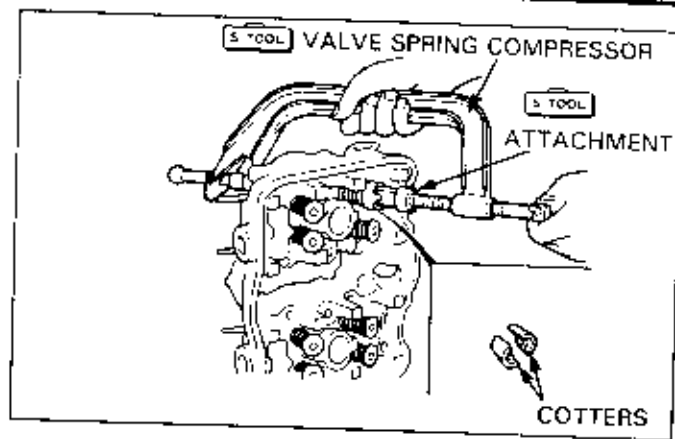
NOTE

- Mark the valves so they can be replaced in their original positions for installation later.

Remove and discard the stem seal if necessary.

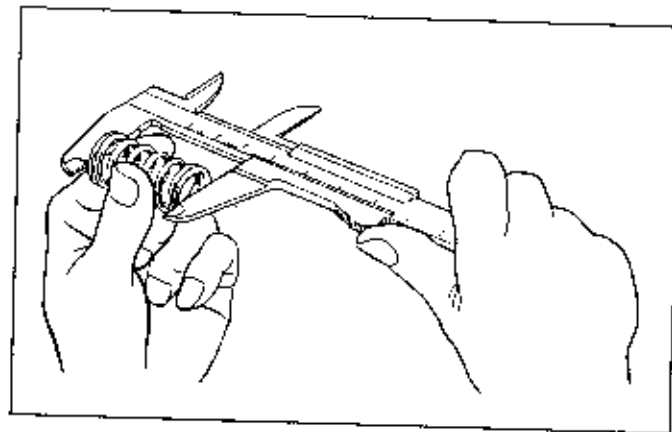
NOTE

- Do not reuse the removed stem seal.



VALVE SPRINGS

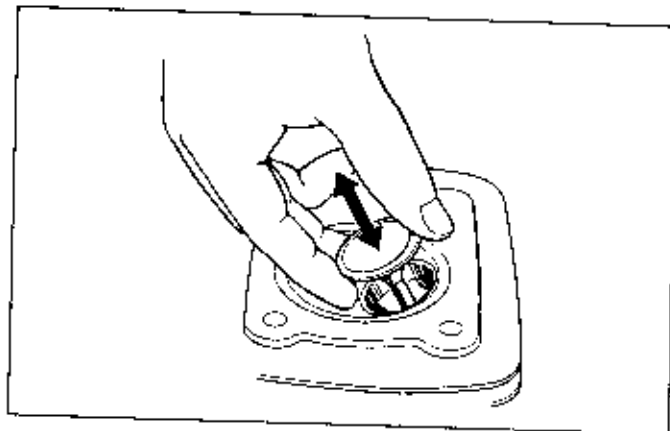
Measure the free length of the inner and outer valve springs.



VALVES

Inspect each valve for bending, burning, scratches or abnormal wear.

Insert the valves in their original positions in the cylinder head. Check that each valve moves up and down smoothly, without binding.



Measure and record the valve stem O.D. in three places along the valve guide sliding area.

Replace the valve with a new one if the service limit is exceeded.

VALVE GUIDES

INSPECTION

Insert the valve guide reamer from the combustion chamber side and ream the guide to remove any carbon build-up before measuring the guide.

NOTE

- Take care not to tilt or lean the reamer in the guide while reaming. Otherwise, the valve is installed slanted, that causes oil leaks from the stem seal and improper valve seat contact and results in the valve seat refacing not able to be performed.
- Rotate the reamer clockwise, never counterclockwise when inserting and removing.

Measure and record each valve guide I.D. using a ball gauge or inside micrometer.

STEM-TO-GUIDE CLEARANCE

When using a dial indicator:

Measure the guide-to-stem clearance with a dial indicator while rocking the stem in the direction of normal thrust (wobble method).

REPLACEMENT

NOTE

- Refinish the valve seats whenever the valve guides are replaced to prevent uneven seating.

Flanged Guides:

Chill the valve guides in the freezer section of a refrigerator for about an hour.

Heat the cylinder head to 130°C–140°C (275°F–290°F). Do not heat the cylinder head beyond 150°C (300°F). Use temperature indicator sticks, available from welding supply stores, to be sure the cylinder head is heated to the proper temperature.

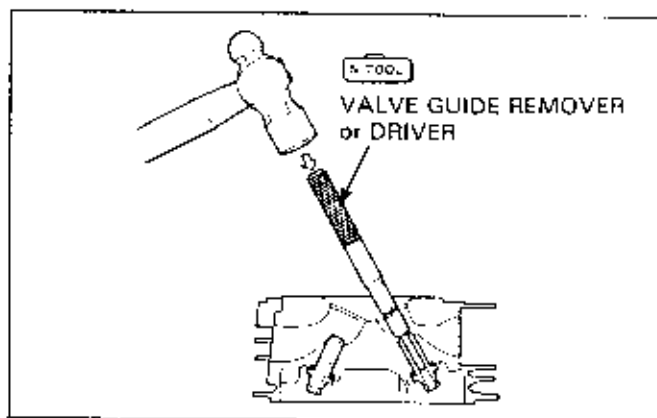
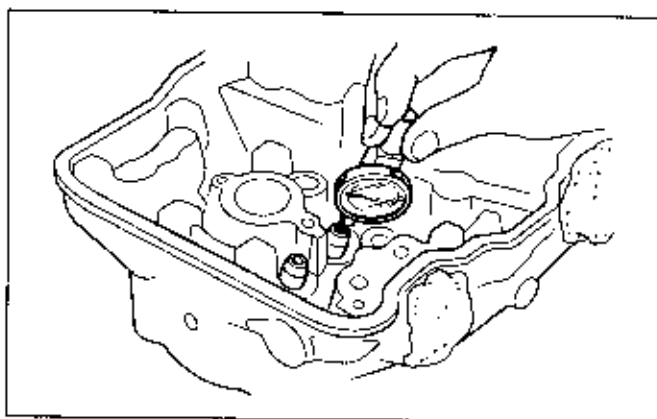
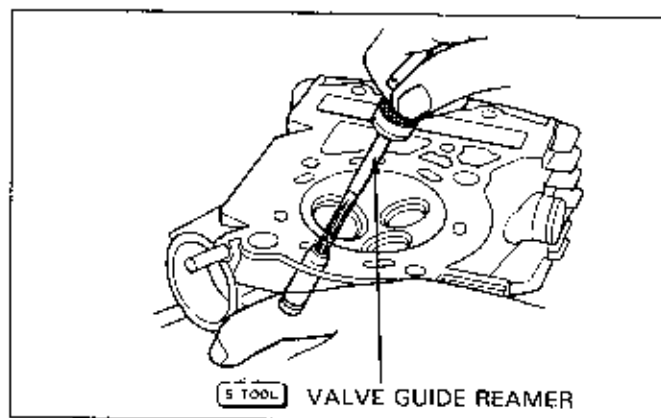
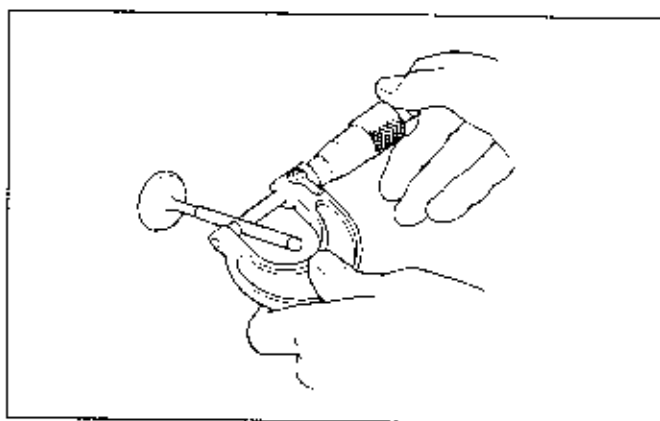
CAUTION

- Using a torch to heat the cylinder head may cause warping.

WARNING

- Wear insulated gloves to avoid burns when handling the heated cylinder head.

Support the cylinder head and drive the old guides out of the combustion chamber side of the cylinder head.



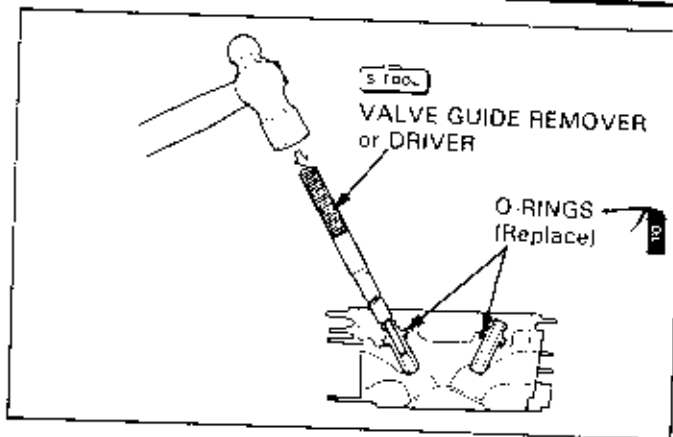
CYLINDER HEAD

CAUTION

- Avoid damaging the head when driving the valve guide out.

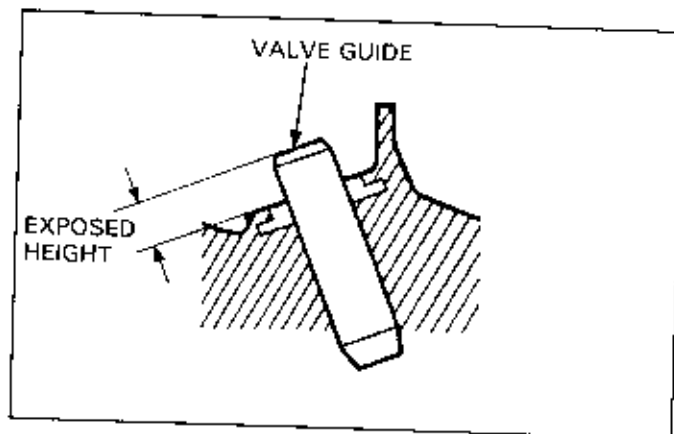
Apply oil to a new O-ring and install it onto a new valve guide. Drive the new guide in from the camshaft side of the cylinder head while the cylinder head is still heated.

Let the cylinder head cool to room temperature, then ream the new valve guides.



Flangeless Type Guides:

Measure and record the exposed height of the valve guide using a pair of vernier calipers.



Chill the valve guides in the freezer section of a refrigerator for about an hour.

Heat the cylinder head to 130°C–140°C (275°F–290°F). Do not heat the cylinder head beyond 150°C (300°F). Use temperature indicator sticks, available from welding supply stores, to be sure the cylinder head is heated to the proper temperature.

CAUTION

- Using a torch to heat the cylinder head may cause warping.

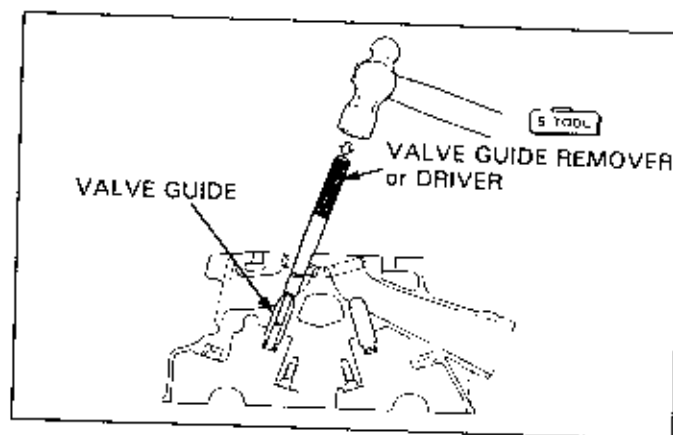
WARNING

- To avoid burns, wear insulated gloves when handling the heated cylinder head.

Support the cylinder head and drive the old guides out of the combustion chamber side of the cylinder.

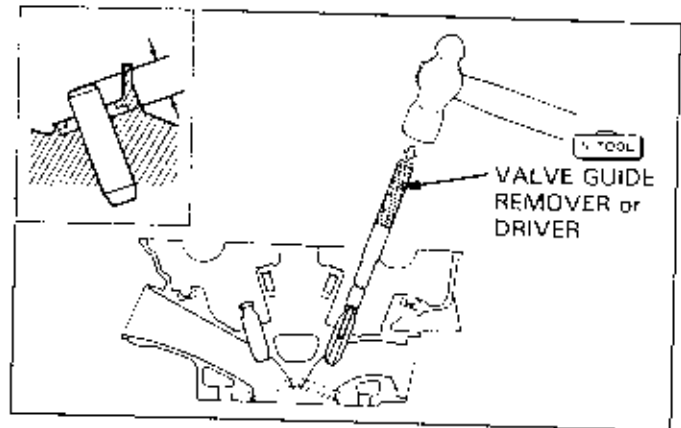
CAUTION

- Avoid damaging the head when driving the valve guide out.



While the cylinder head is still heated, drive a new valve guide in from valve spring side until the exposed height is the same as was measured for the old guide.

Let the cylinder head cool to room temperature and ream the new valve guide.



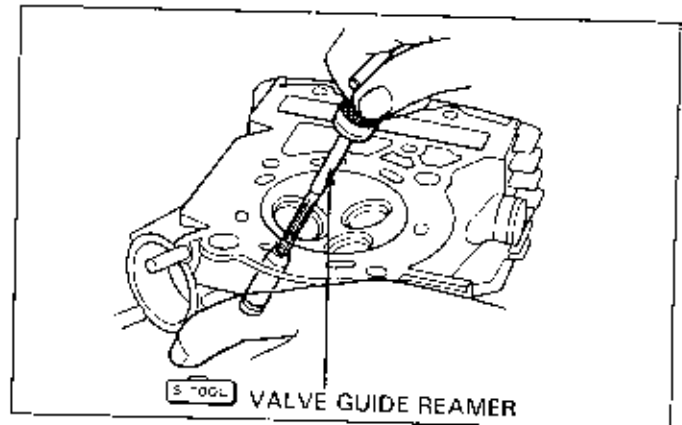
VALVE GUIDE REAMING

When reaming new valve guides, insert the valve guide reamer from the combustion chamber side.

NOTE

- Take care not to tilt or lean the reamer in the guide while reaming. Otherwise, the valve is installed slanted, that causes oil leaks from the stem seal and improper valve seat contact and results in the valve seat refacing not able to be performed.
- Use cutting oil on the reamer during this operation.
- Rotate the reamer clockwise, never counterclockwise when inserting and removing.

Reface the valve seats and clean the cylinder head thoroughly to remove any metal particles.



VALVE SEATS

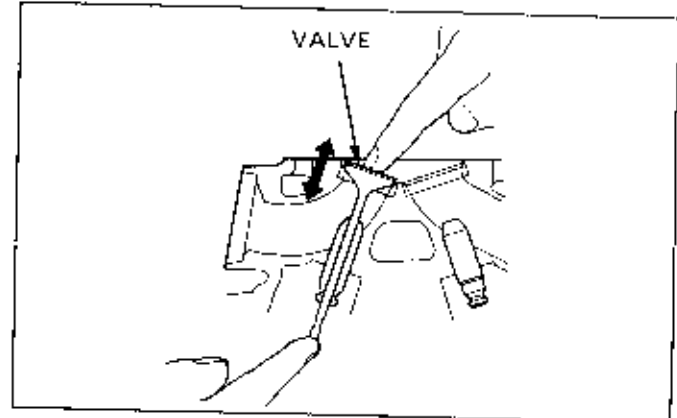
INSPECTION

Clean all intake and exhaust valves thoroughly to remove carbon deposits.

Apply a light coating of Prussian Blue to each valve face.

NOTE

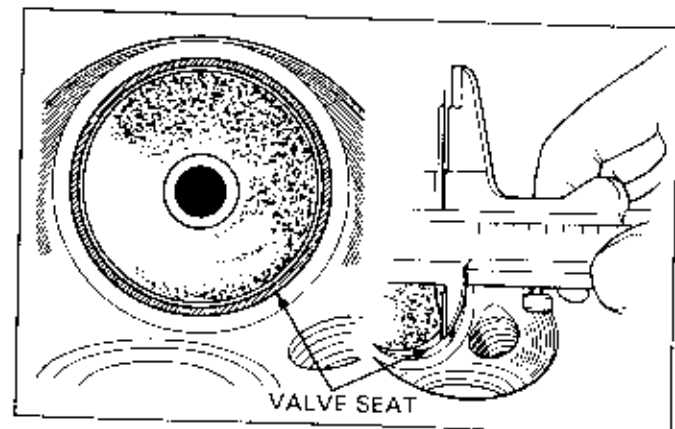
- Tap the valve against the valve seat several times with your finger, without rotating the valve, to check for proper valve seat contact.



Remove the valve and inspect the valve seat face. The valve seat contact should be within the specified width and evenly all around the circumference. If the valve seat width is not within specification, reface the valve seat (page 9-12).

NOTE

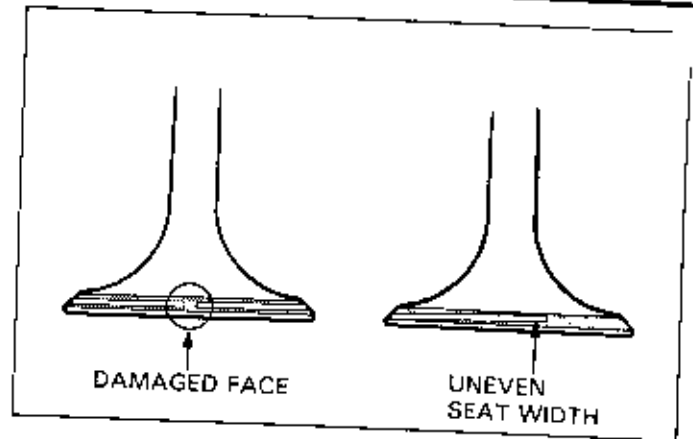
- Most valve faces and stem tips are coated with a thin layer of stellite so they cannot be ground. If a valve face or stem tip is rough, worn unevenly, or contacts the seat improperly, the valve must be replaced.



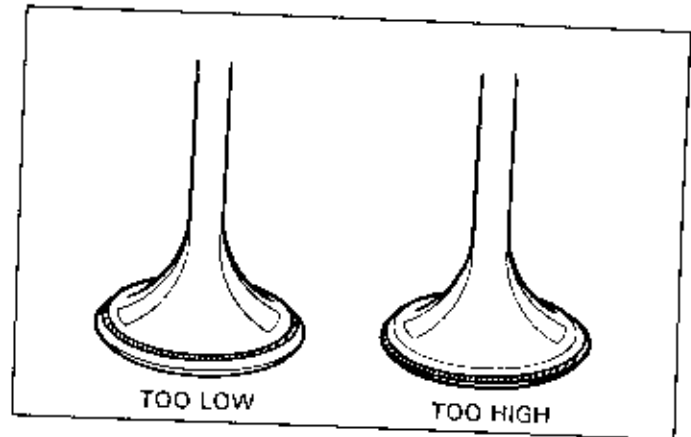
CYLINDER HEAD

Inspect the valve seat face for:

- Uneven seat width:
 - Bent or collapsed valve stem;
Replace the valve and reface the valve seat.
- Damaged face:
 - Replace the valve and reface the valve seat.



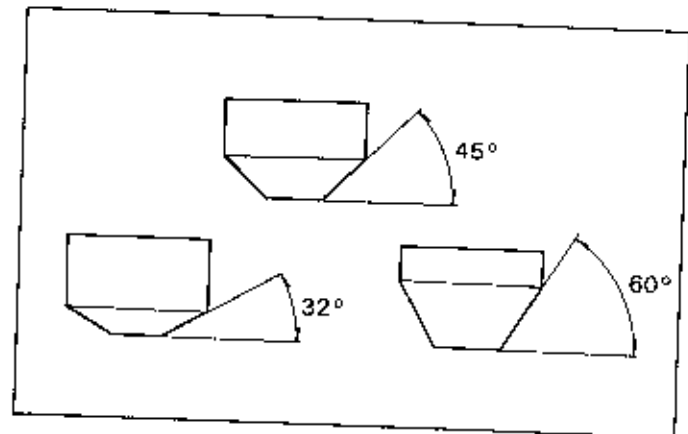
- Contact area (too high or too low area).
 - Reface the valve seat.



VALVE SEAT REFACING

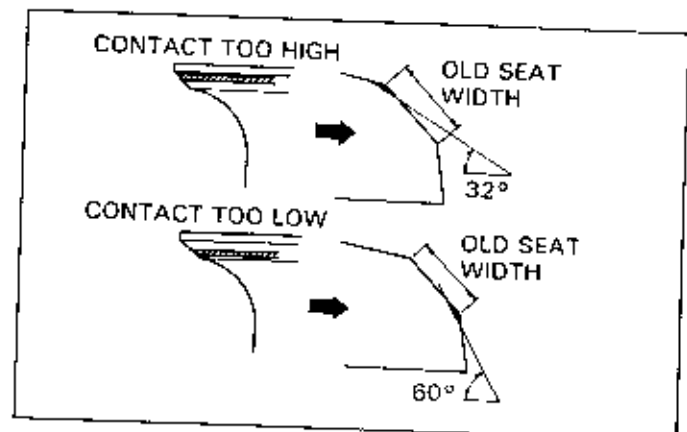
NOTE

- Follow the refacer manufacturer's operating instructions.
- Reface the valve seat whenever the valve guide has been replaced.
- Be careful not to grind the seat more than necessary.

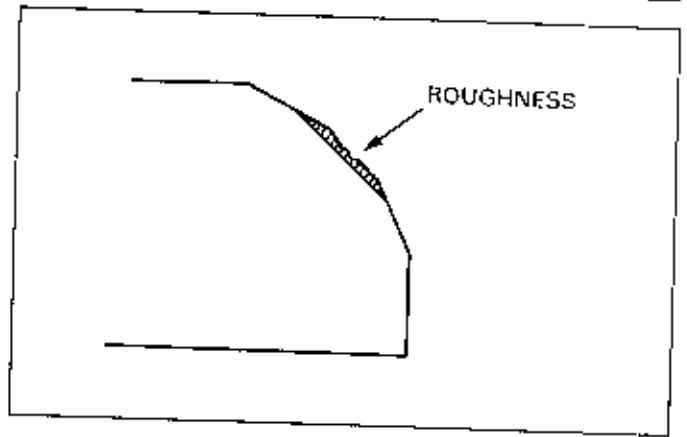


If the contact area is too high on the valve, the seat must be lowered using a 32 degree flat cutter.

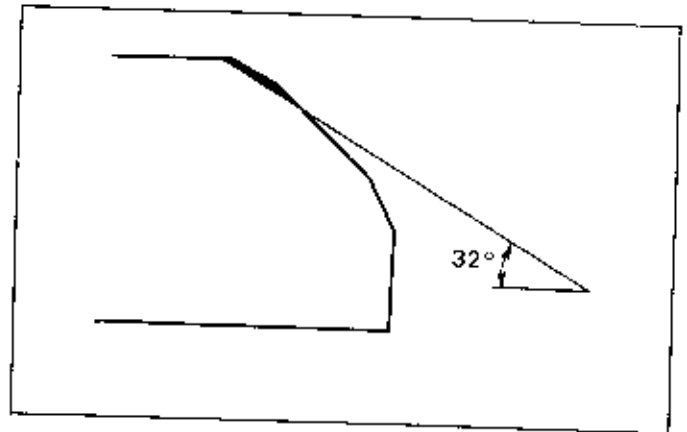
If the contact area is too low on the valve, the seat must be raised using a 60 degree inner cutter. Refinish the seat to specifications, using a 45 degree finish cutter.



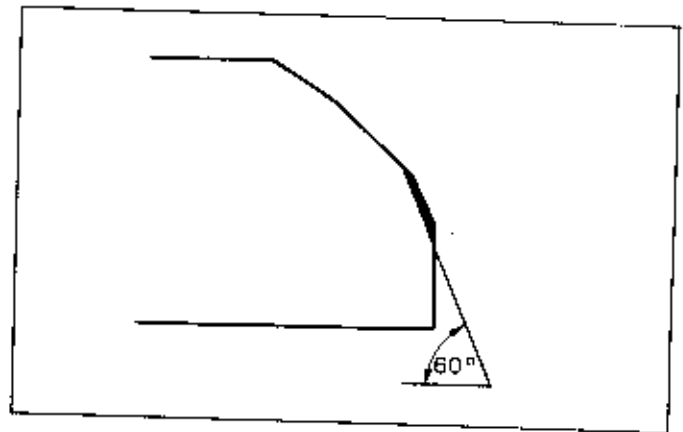
Using a 45 degree cutter, remove any roughness or irregularities from the seat.



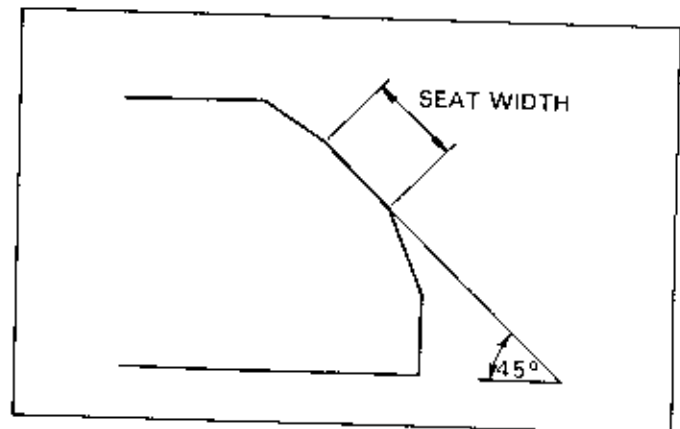
Using a 32 degree cutter, remove 1/4 of the existing valve seat material.



Using a 60 degree cutter, remove the bottom 1/4 of the old seat.



Using a 45 degree cutter, cut the seat to the proper width.



CYLINDER HEAD

After cutting the seat, apply lapping compound to the valve face, and lap the valve using light pressure.

CAUTION

- Excessive lapping pressure may deform or damage the seat.
- Change the angle of lapping tool frequently to prevent uneven seat wear.
- Lapping compound can cause damage if it enters between the valve stem and guide.

After lapping, wash any residual compound off the cylinder head and valve.

NOTE

- Lapping has no effect on long-term durability or performance. It only ensures that the valve and valve seat will pass a solvent test.

Recheck the seat contact after lapping.

CYLINDER HEAD ASSEMBLY

Install new stem seals.

NOTE

- Replace the stem seals with new ones whenever a stem seal is removed.

Lubricate each valve stem with molybdenum disulfide grease and insert the valve into the valve guide.

CAUTION

- Turning a valve too fast can damage the stem seals.

Install the spring seats, valve springs and retainers.

NOTE

- For valve spring with varying pitch, install the valve springs with the narrow pitch end facing down.

Compress the valve springs with the valve spring compressor and install the valve cotters.

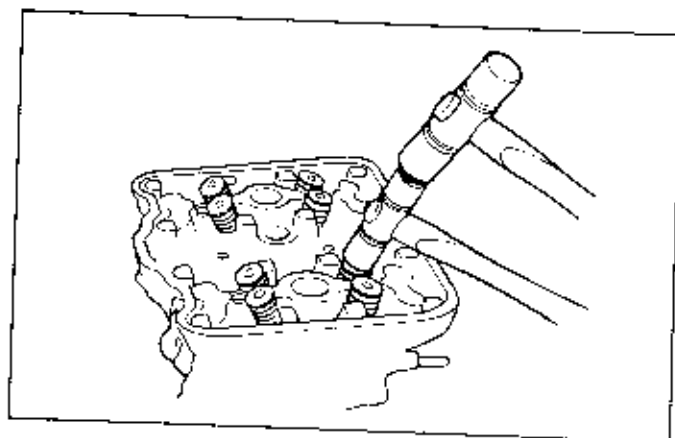
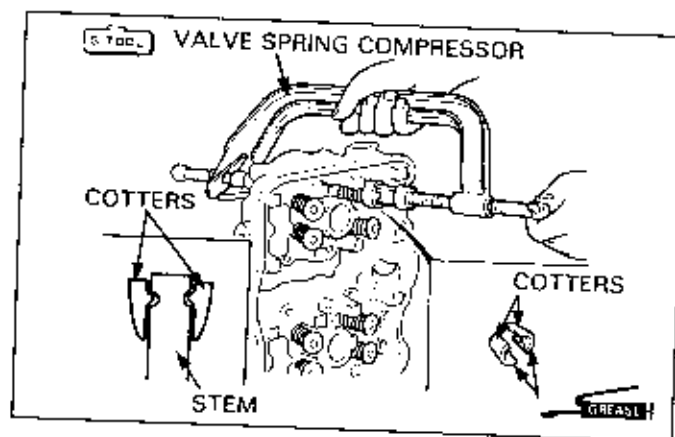
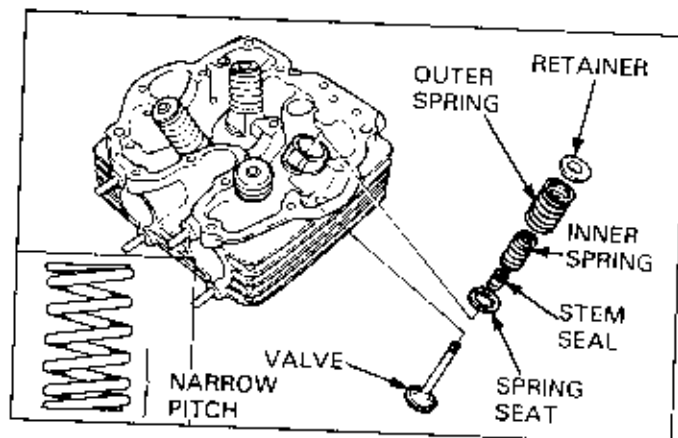
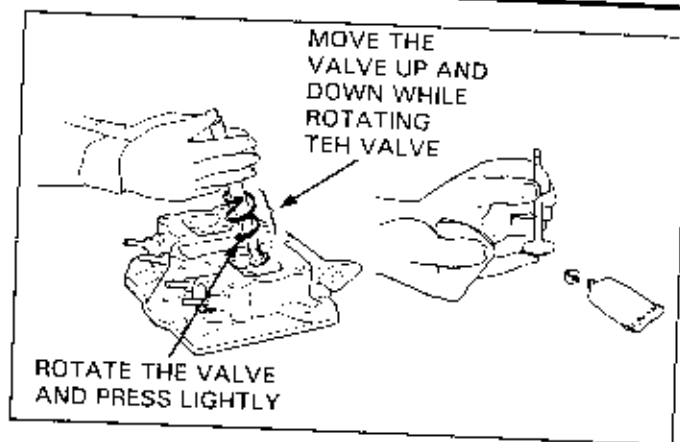
CAUTION

- Compressing the valve spring more than necessary when installing the valve cotters may cause loss of valve spring tension.

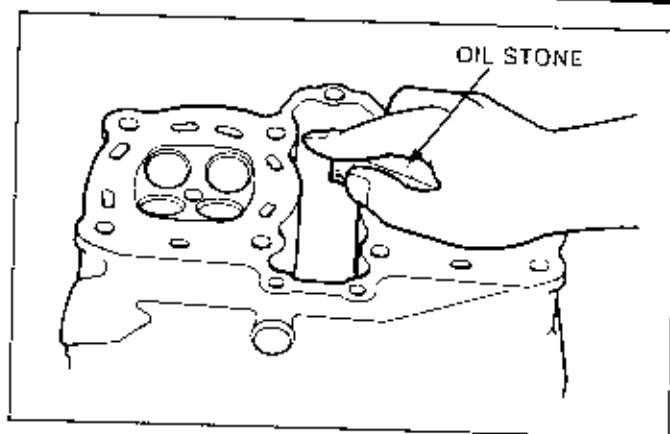
NOTE

- To ease installation of the cotters, grease them first.

Tap the valve stems gently with a soft hammer to firmly seat the cotters.

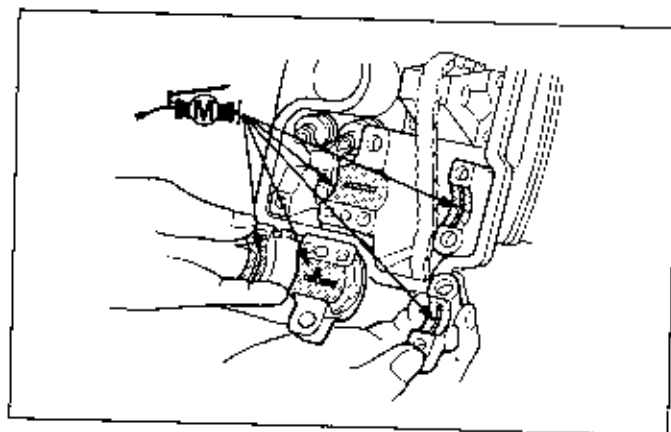


Clean any gasket material from the cylinder mating surface.
Reface the mating surface using oil stone, if necessary.

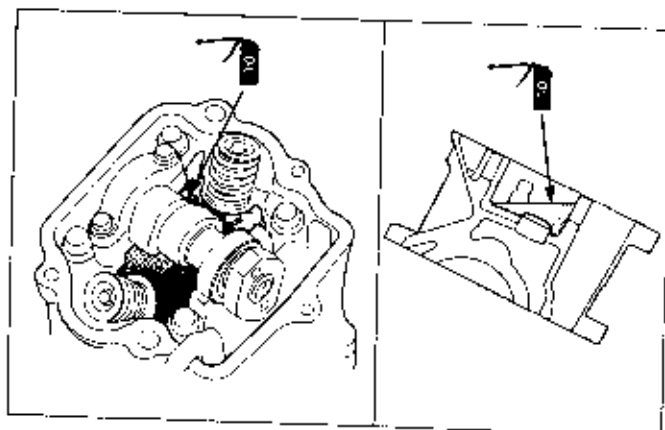


INITIAL CAMSHAFT LUBRICATION

Apply molybdenum disulfide grease to the camshaft journal surfaces in the cylinder head.



Fill the oil pockets in the head with the recommended oil.



10. CYLINDER/PISTON

SERVICE INFORMATION	10-1	CYLINDER	10-5
TROUBLESHOOTING	10-1	PISTON/PISTON RING	10-6
SYSTEM DESCRIPTION	10-2	CYLINDER INSTALLATION	10-10

SERVICE INFORMATION

- Be careful not to damage the mating surfaces by using a screwdriver when disassembling the cylinder. Do not strike the cylinder too hard during disassembly, even with a rubber or plastic mallet, to prevent the possibility of damage to the cylinder fins.
- Take care not to damage the cylinder wall and piston.
- With multi-cylinder engines store the pistons, piston rings and piston pins in the same order they were installed so they can be reinstalled in the original positions.

TROUBLESHOOTING

Four stroke engines: If performance is poor at low speeds, check for white smoke in the crankcase breather tube. If the tube is smoky, check for a seized piston ring.

NOTE

- Refer to section 3 for cylinder compression and leak-down test procedures.

1

Compression too low, hard starting or poor performance at low speed

- Leaking cylinder head gasket
- Loose spark plug
- Worn, stuck or broken piston rings
- Worn or damaged cylinder and piston

Compression too high, overheating or knocking

- Excessive carbon build-up in cylinder head or on top of piston

Excessive smoke

- Worn cylinder, piston, or piston rings
- Improper installation of piston rings
- Scored or scratched piston or cylinder wall

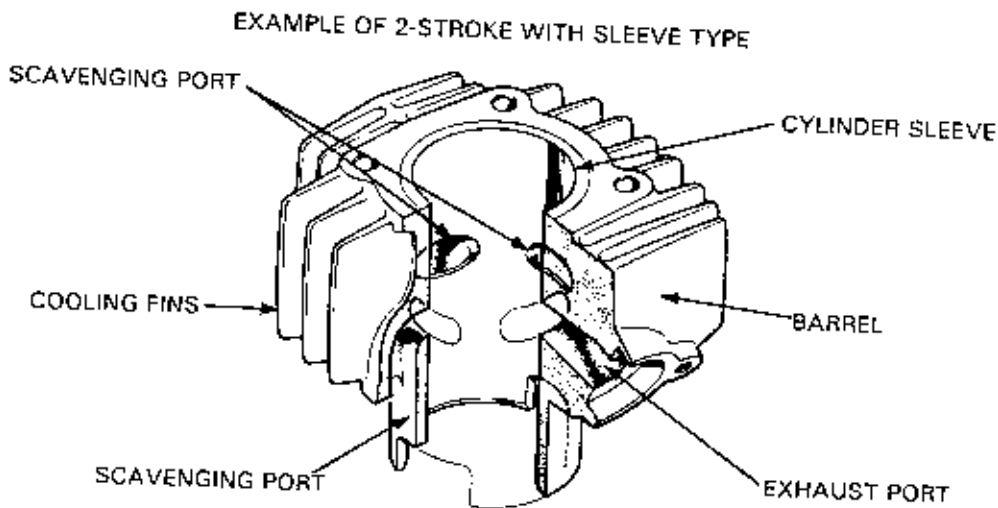
Abnormal noise (piston)

- Worn cylinder and piston
- Worn piston pin or piston pin hole
- Worn connecting rod small end bearing

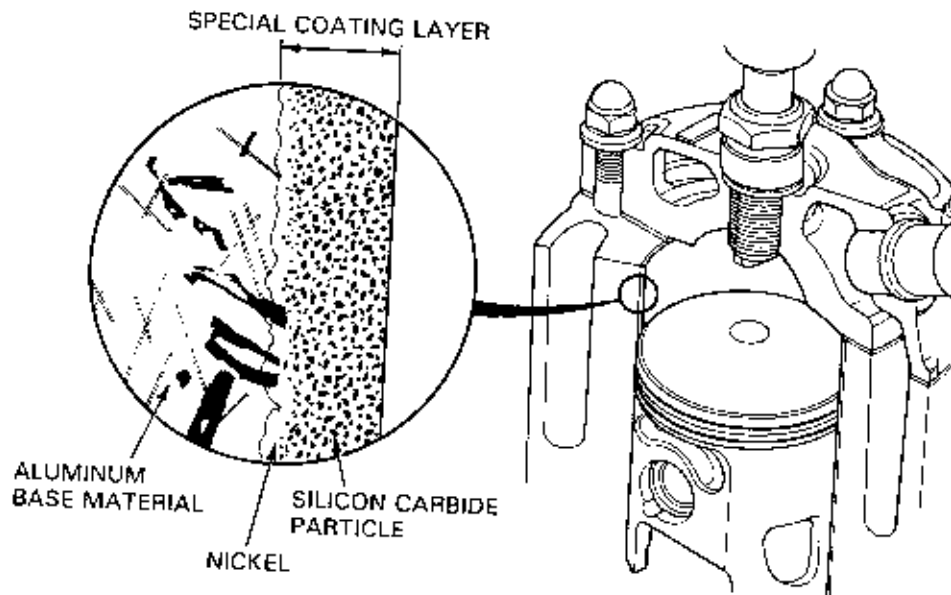
SYSTEM DESCRIPTION

CYLINDER

As the cylinders are affected by combustion heat and pressure, they are made of a one-piece aluminum or steel casting with considerable strength and cooling abilities. Air-cooled engines are provided with cooling fins and liquid-cooled engines are provided with a water jacket; necessary to cool the engine. With a 4-stroke engine, the cylinder wall has a cylindrical shape. With the 2-stroke engine, however, the exhaust or scavenging ports are open and the characteristics of the engine depend on the shape, location and size of the ports. These ports are the key parts of a 2-stroke engine. Because the piston rings and piston skirts move against the cylinder walls, a material with high wear resistance is required. For the aluminum cast cylinder, a steel cylinder sleeve is pressed into the part that directly contacts the piston and rings. In some 2-stroke engines, the cylinder walls are plated with special hard metal (nickel-silicon carbide coating) having considerable cooling ability, seizure and wear resistance which is much lighter than the sleeve type. With the sleeve type, the cylinder wall is honed for a finish. Fine grooves are made in the surface to collect and spread the oil on the cylinder wall to lubricate the piston. With the plated type, neither modification of the cylinder wall nor reboring is possible. If the cylinder wall is flawed, the cylinder must be replaced.



EXAMPLE OF 2-STROKE ENGINE PROCESSED WITH NICKEL-SILICON CARBIDE (Nikasil®)



PISTON

The piston moves at high speed in the cylinder, and is exposed to the extreme temperature of combustion. Pistons are therefore made of a specially forged light alloy type aluminum, which is not only lightweight but also less susceptible to thermal expansion.

The piston itself is a high temperature part, being cooled only by the release of heat to the cylinder through the inhaled air/fuel mixture and the piston ring. The piston head is therefore fabricated to have a somewhat smaller outer diameter than the skirt, due to the high temperature exposure and large thermal expansion. With a 2-stroke engine, the cylinder is distorted and the clearance with the piston tends to partially decrease, as there are two different parts with unequal thermal expansion in the cylinder: a part cooled by the air/fuel mixture around the piston, such as the scavenging port, and a part exposed to the extreme heat near the exhaust port. To resolve this problem the piston head of the 2-stroke engine is oval and designed to have appropriate clearance during driving.

At the small end of the connecting rod of the 2-stroke engine, a needle bearing is used. For the 4-stroke engine, however, a plain bearing is used at this point.

The reciprocating motion of the piston is converted into a rotational motion of the crankshaft through the connecting rod. To smooth the motion conversion, the pin hole of the piston is slightly offset against the center shaft of the crankshaft.

If the piston is assembled in an incorrect direction, the piston strikes the cylinder wall due to reversed offset, causing rapid wear or seizure.

To assemble the offset correctly, the assembly must be done by following the marks indicating the piston head assembly direction.

PISTON RING

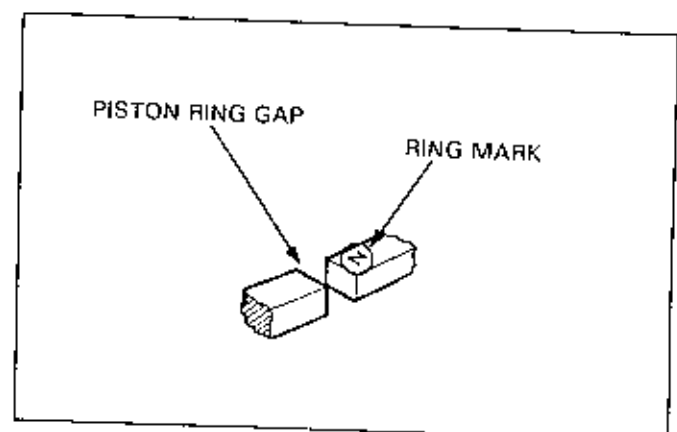
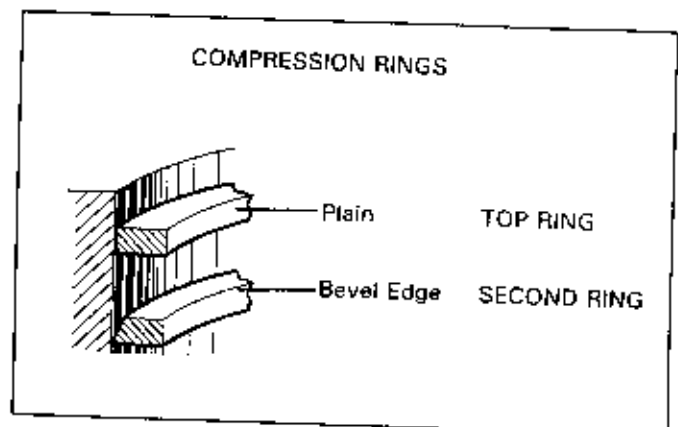
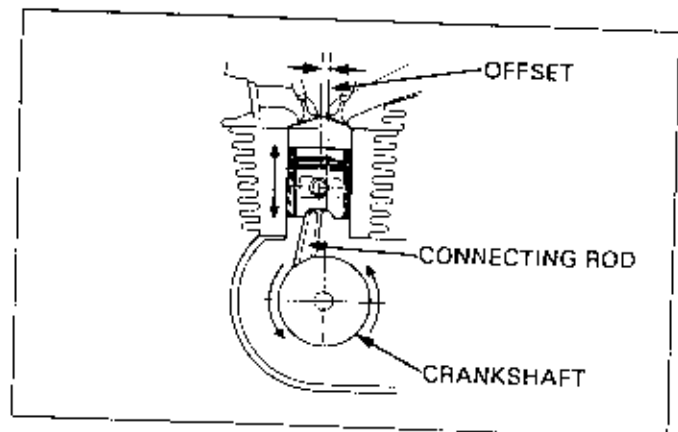
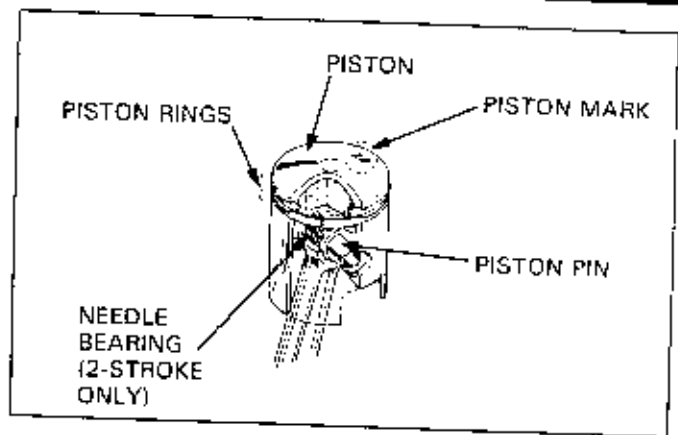
4-STROKE

The piston rings are inserted within the grooves in the piston. Rings are made of a material with considerable wear resistance, as the piston rings move at high speed with the piston while being pressed against the cylinder wall by their own tension.

The ring arrangement for the 4-stroke engine is with two compression rings sealing the combustion gas and a pair of oil rings removing the oil from the cylinder wall.

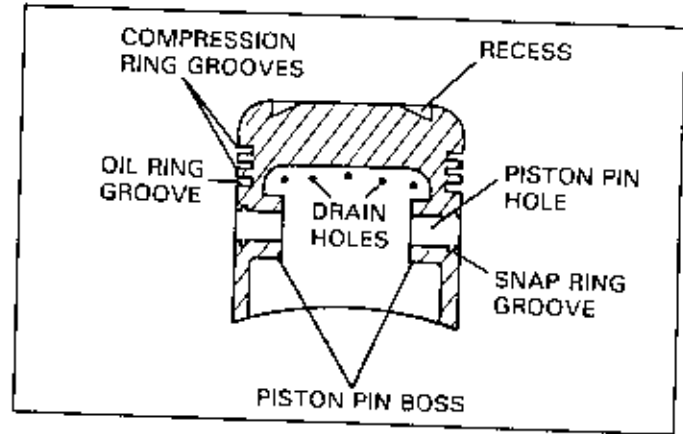
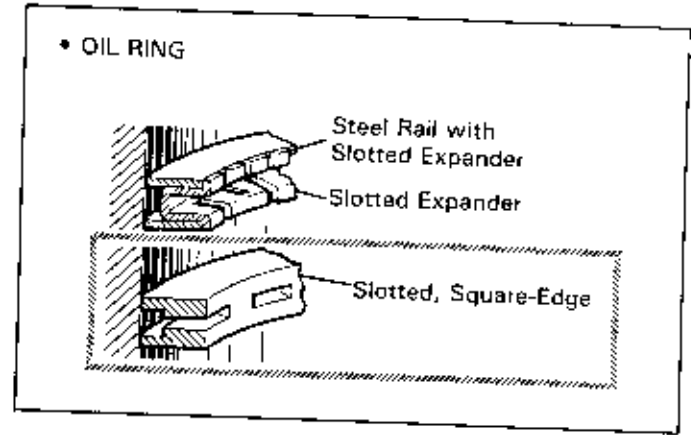
Although the two compression rings are similar in appearance, they are different in detail. Therefore, when removed, their installation position must be noted and marked before starting to prevent incorrect reassembly. If identification is difficult, the difference in shapes should be remembered; the top ring is usually plain and the second ring has a beveled edge. Most of the top rings are chrome plated on their sliding surface in order to increase wear resistance. A few second rings are, however, also plated.

Piston rings for 4-stroke engines and also for 2-stroke engines have identification marks near the end gap of the top and second rings. These ring marks must face upwards on the piston when assembling.



CYLINDER/PISTON

The oil ring is needed to remove oil from the cylinder wall and return the residue from the hole of the oil ring groove. If the oil ring fails, oil flows into the combustion chamber and burns, causing smoke. The oil ring is either of a split type arranged with two side rails and a slotted expander, or an integral type with a slotted square edge.

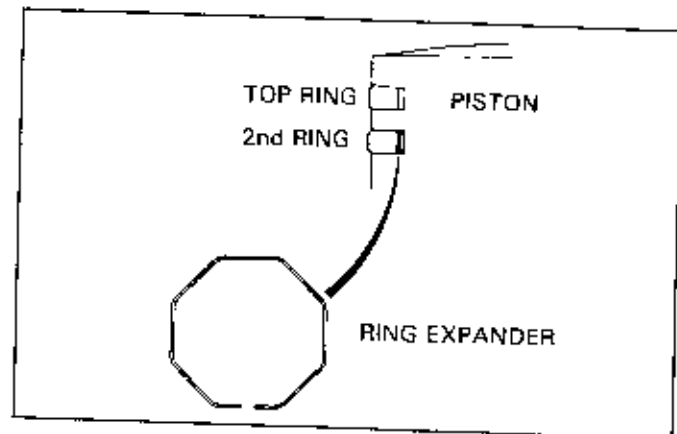
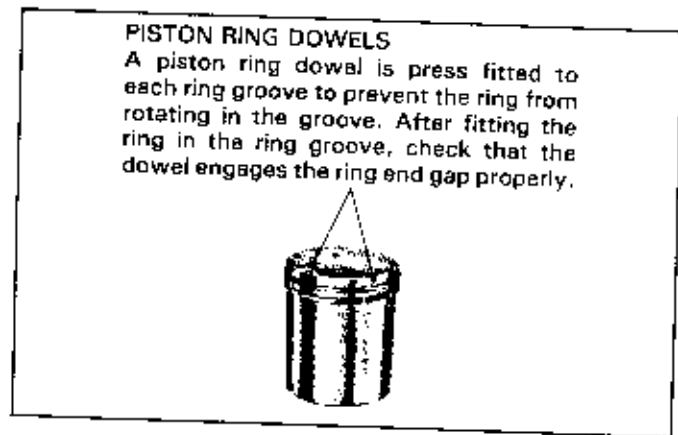


2-STROKE

As the 2-stroke engine has a different lubrication system, it is arranged with only the top and second rings and without an oil ring. As the 2-stroke engine has a cylinder wall with a port, a piston ring dowel is added to the ring groove of the piston, to prevent the rings from moving and hooking an edge in a port, causing breakage. The piston rings of the 2-stroke engine must therefore be assembled by aligning the end gaps to the dowels.

The design and shape of piston rings for 2-stroke engines are different than that of 4-stroke engines. A taper is provided over the entire cross section in 2-stroke ring design. This is because; with the 2-stroke engine burning engine oil, carbon tends to adhere to the ring groove. If not remedied, the ring sticks to the groove, causing to lose tension and resulting in decreased compression. The ring and the ring groove therefore have a tapered form to remove the carbon in the ring groove when the ring is compressed during engine movement. The rings of this type are called keystone rings.

Some 2-stroke piston rings are provided with an expansion ring inserted between the inside of the second ring and the piston. The tension of the expansion ring absorbs the impact generated when the piston contacts the cylinder wall, with a resultant decrease in engine noise.



CYLINDER

WARPAGE INSPECTION

Remove the cylinder (see Model Specific manual).

Carefully remove any adhering gasket material from the cylinder/head mating surface. Do not scratch the surface.

Check the cylinder for warpage by placing a straight edge and a feeler gauge across the stud holes. Replace the cylinder if the service limit is exceeded.

NOTE

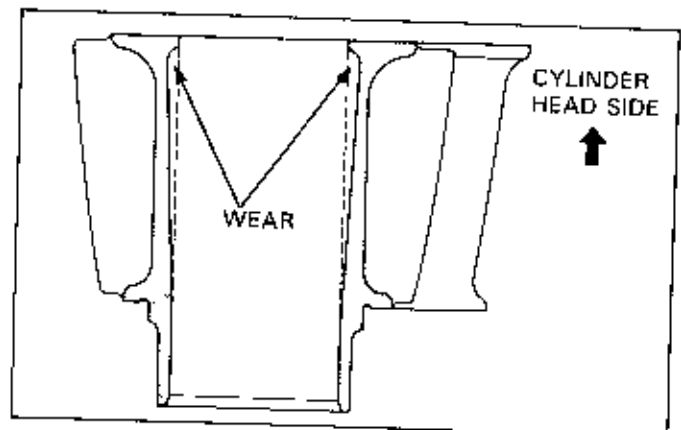
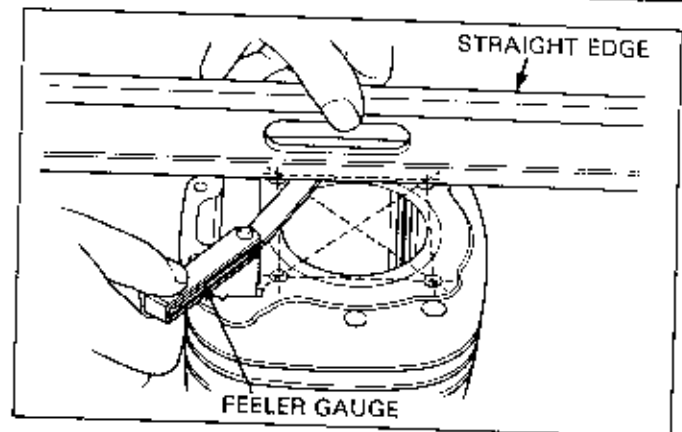
- Any clearance between the cylinder and head due to damage or warpage will result in compression leaks and reduced performance.

WEAR INSPECTION

Inspect the cylinder wall for scratches and wear.

NOTE

- Inspect the area near T.D.C. (Top Dead Center) carefully. This area is especially subject to wear due to the possibility of borderline lubrication from heat and top ring compression.

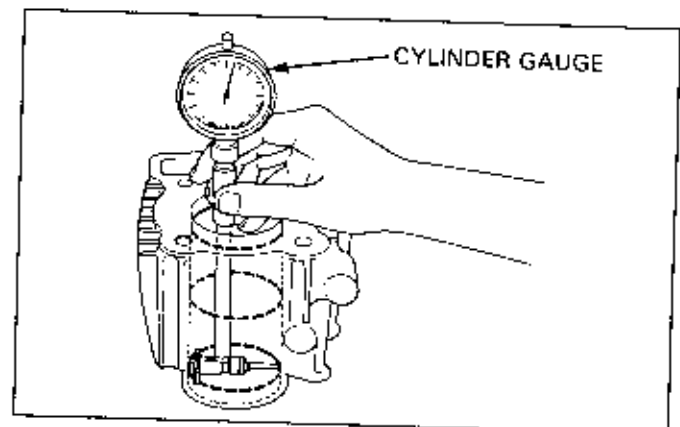


Measure and record the cylinder I.D. at three levels in both an X and Y axis.

Take the maximum reading to determine the cylinder wear.

NOTE

- Two-stroke engines: avoid the intake and exhaust ports when measuring.



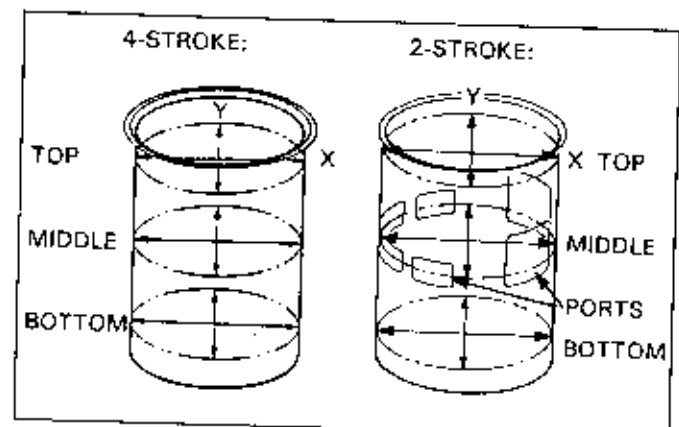
Measure the piston O.D. (see page 10-7).

Calculate the piston-to-cylinder clearance. Take the maximum reading to determine the clearance.

Calculate the cylinder for taper at three levels in an X and Y axis. Take the maximum reading to determine the taper.

Calculate the cylinder for out-of-round at three levels in an X and Y axis. Take the maximum reading to determine the out-of-round.

If any of the cylinder measurements exceed the service limits and oversized pistons are available, rebore to next smallest size possible and install the proper pistons. Otherwise, replace the cylinder.



CYLINDER/PISTON

PISTON/PISTON RING

REMOVAL

NOTE

- Place a clean shop towel over the crankcase to prevent the possibility of the clip falling into the crankcase.

Remove the piston pin clip using a pair of pliers. Press the piston pin out of the piston.

2-stroke engines:

Remove the needle bearing from the small end of the connecting rod.

NOTE

- Do not damage or scratch the piston.
- Do not apply side force to the connecting rod.
- Do not let the clip fall into the crankcase.
- Mark and store the pistons and piston pins so that they can be reinstalled in their original positions.

INSPECTION

Clean carbon deposits from the piston.

NOTE

- Clean carbon deposits from the piston ring grooves with a ring that will be discarded. Never use the wire brush; it will scratch the groove.

Inspect the piston rings for movement by pressing the rings. The rings should be able to move in its groove without catching.

Spread each piston ring and remove it by lifting it up at a point just opposite the gap.

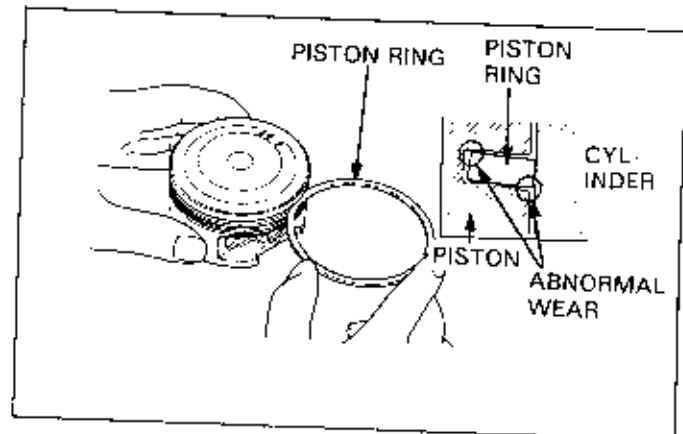
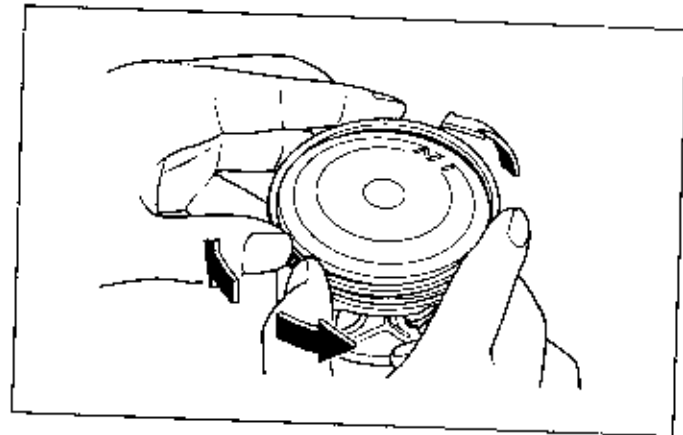
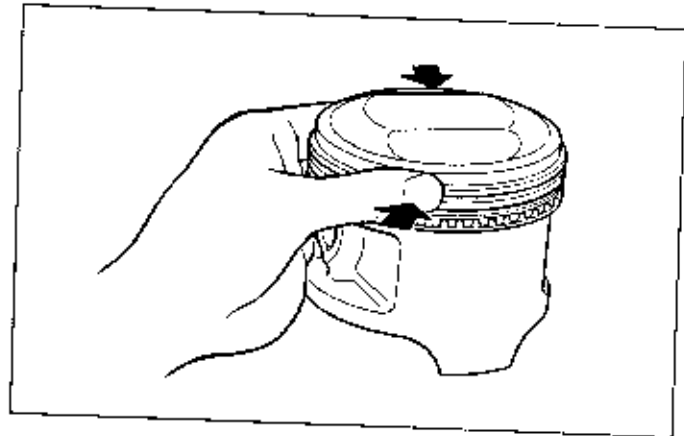
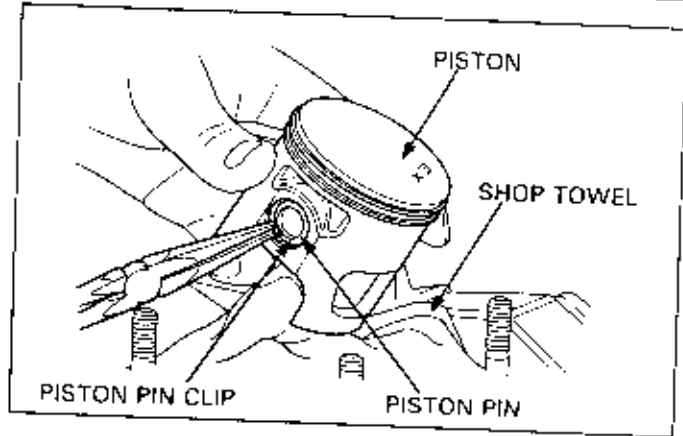
CAUTION

- Do not damage the piston ring by spreading the ends too far.

Some 2-stroke engines: Remove the expander from the second ring groove.

Inspect the piston:

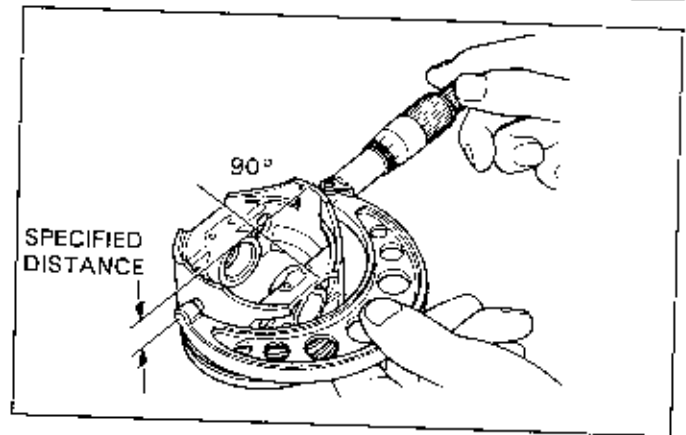
- Sliding surface for scratches or wear. Remove any small surface scratches using #600-#800 sandpaper. If there is deep scratches, replace the piston.
- Piston ring grooves- for excessive wear. Replace the piston as necessary.
- 4-stroke engines: Oil pass holes in the oil ring groove- for clogs. Clean the oil holes with compressed air.



Measure and record the piston O.D. 90° to the piston pin bore and at the point specified in the Model Specific manual, near the bottom of the piston skirt.

Replace the piston if the service limit is exceeded.

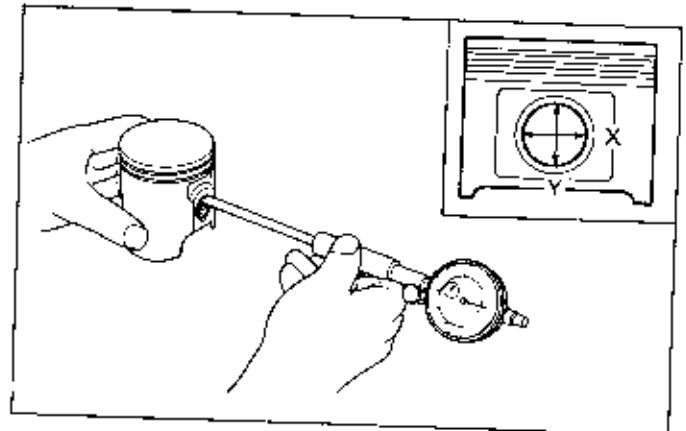
Calculate the piston-to-cylinder clearance (see page 10-5).



NOTE

- Always replace piston rings as a set.

Measure the piston pin bore I.D. in an X and Y axis. Take the maximum reading to determine the I.D. Replace the piston if the I.D. is over the service limit.



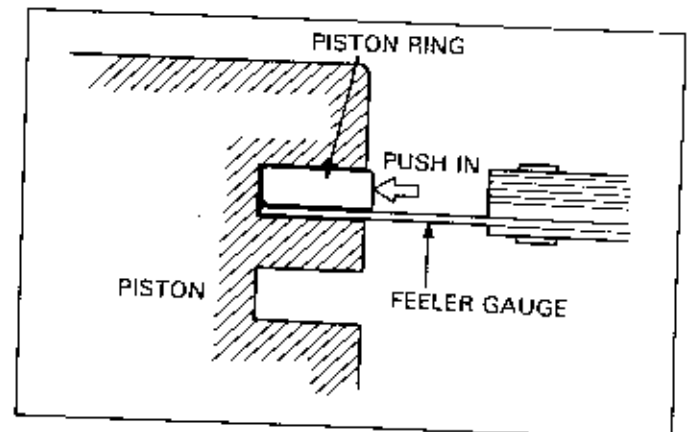
Inspect the piston rings, and replace them if they are worn.

NOTE

- Always replace piston rings as a set.

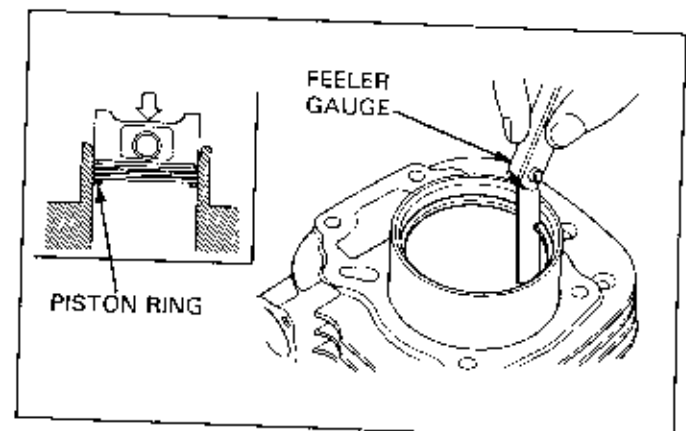
Reinstall the piston rings (see page 10-8) into the piston grooves.

Push in the ring until the outer surface of the piston ring is nearly flush with the piston and measure the clearance using a feeler gauge. Replace the piston ring if the service limit is exceeded.



Insert the piston ring into the bottom of the cylinder squarely, using the piston as shown.

Measure the end gap using a feeler gauge. Replace the ring if the service limit is exceeded.



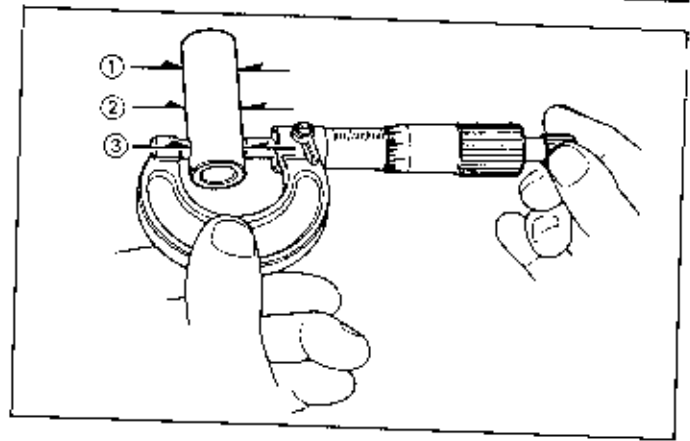
CYLINDER/PISTON

PISTON PIN INSPECTION

Measure the piston pin O.D. at three points.

Replace the piston pin if the service limit is exceeded.

Calculate the piston pin-to-pin bore clearance by subtracting the piston pin O.D. from the pin bore I.D.



SMALL END BEARING SURFACE INSPECTION

2-stroke Engines:

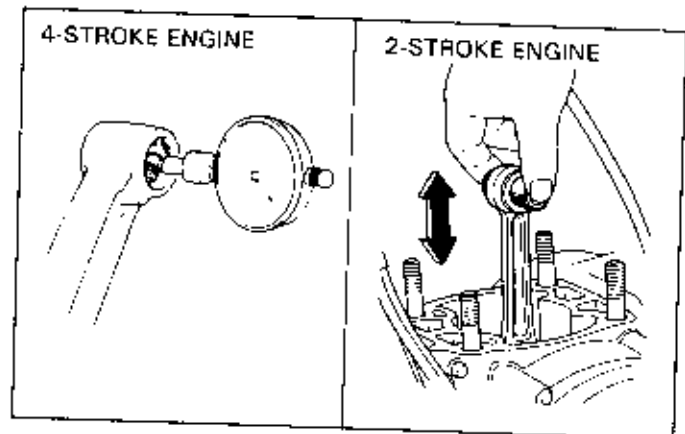
Install the needle bearing and piston pin in the connecting rod small end and check for excessive play.

If the piston pin I.D. is over the service limit, the crankshaft must be replaced. Measure the I.D. of the connecting rod small end.

4-stroke Engines:

Measure the I.D. of the connecting rod small end.

Replace the connecting rod or crankshaft assembly if the service limit is exceeded.



PISTON/PISTON RING INSTALLATION

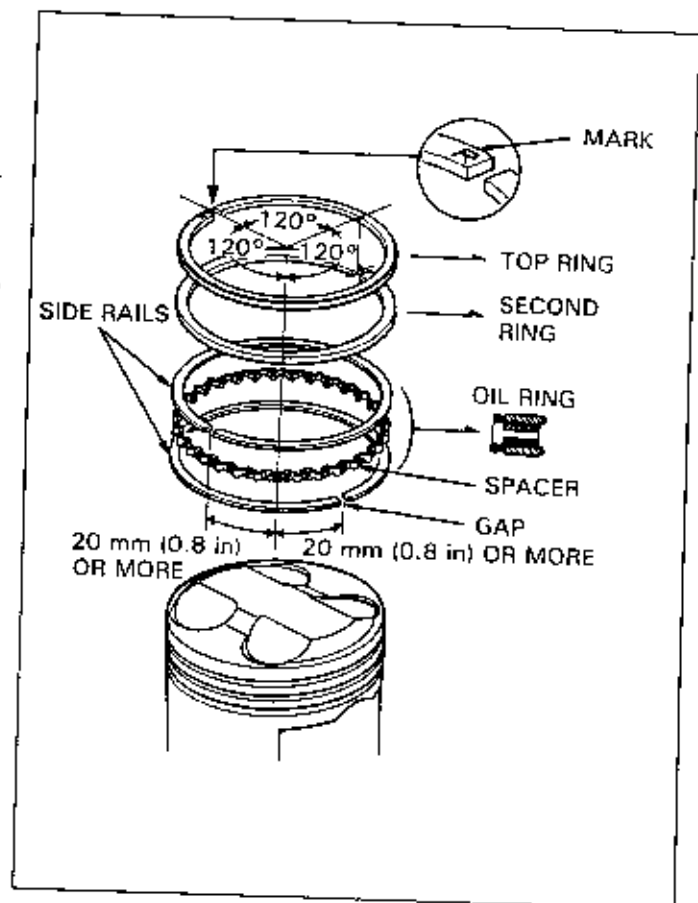
4-stroke Engines:

Clean the piston heads, ring lands and skirts.

Carefully install the piston rings onto the piston with the markings facing up.

NOTE

- Be careful not to damage the piston and rings during assembly.
- Do not confuse the top and second rings: The top ring is chrome-coated and the second ring is not coated (black).
- After installing the rings they should rotate freely, without sticking.
- Space the ring end gaps 120 degrees apart.
- Space the side rail gaps 40 mm (1.6 in) or more apart as shown.



2-stroke Engines:

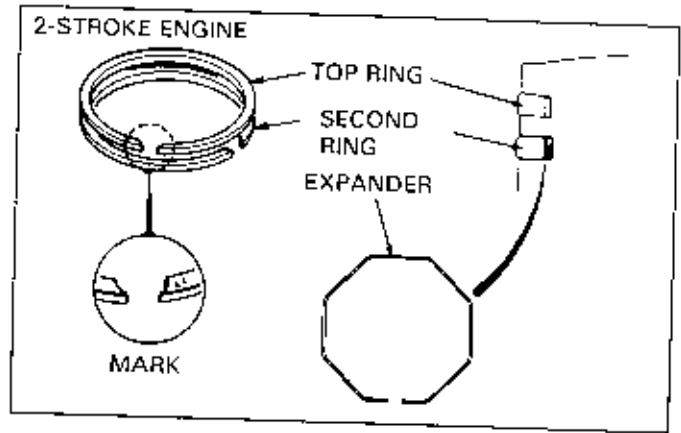
Clean the piston ring grooves.

Lubricate the piston rings and ring grooves with clean 2-stroke oil.

Install the piston rings on the piston with the marks facing up.

NOTE

- Do not confuse the top and second rings. Be sure to install them in the proper grooves.
- Some 2-stroke engines use an expander ring behind the second ring.

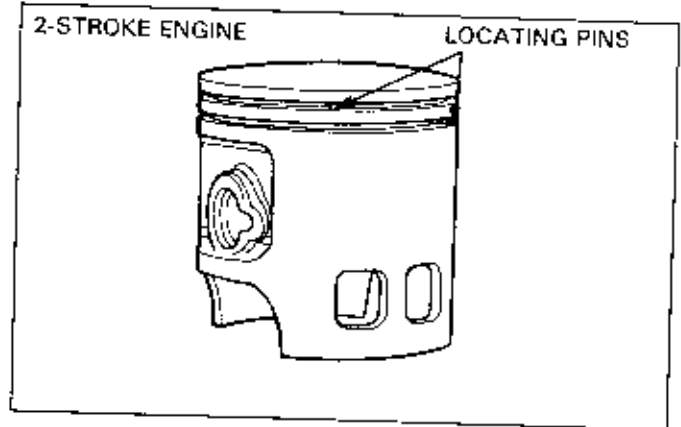


In 2-stroke engines, the piston has locating pins that hold the piston rings away from the intake and exhaust ports.

Align the piston ring end gaps with the locating pins.

Check the fit of each ring in its groove by pressing the ring into the groove. Make sure that it is flush with the piston at several points around the ring.

If the ring rides on the locating pin, it is damaged during assembly.



PISTON INSTALLATION

Coat the needle bearing (2-stroke engine only) and piston pin with the recommended oil.

Lubricate the piston pin.

4-STROKE ENGINE: Molybdenum solution

2-STROKE ENGINE: Recommended engine oil

NOTE

- Place a clean shop towel over the crankcase to prevent the clip from falling into the crankcase.

Install the needle bearing into the connecting rod.

Install the piston and insert the piston pin.

NOTE

- The mark that is stamped on the piston head should be facing the correct direction.
 "IN" MARK: TO INTAKE SIDE
 "EX" or "Δ" MARK: TO EXHAUST SIDE

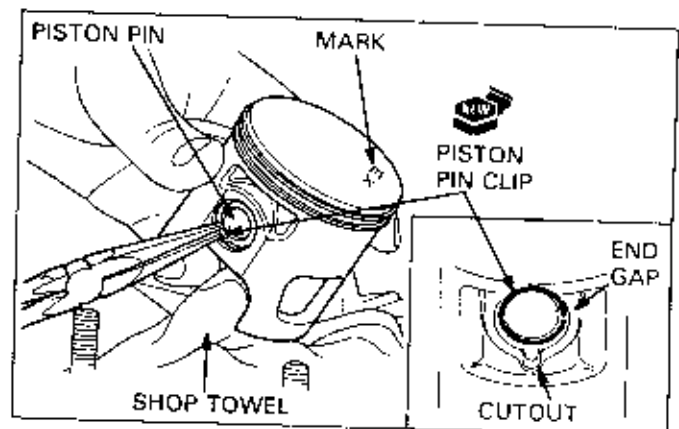
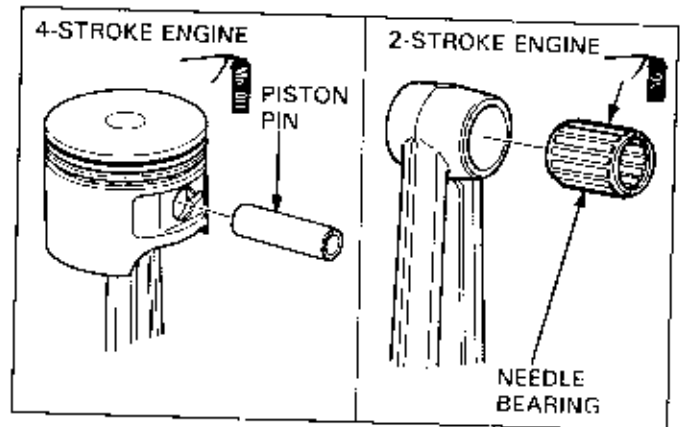
Install new piston pin clips.

CAUTION

- Always use new piston pin clips. Reinstalling used piston pin clips may lead to serious engine damage.

NOTE

- Take care not to drop the piston pin clip into the crankcase.
- Set the piston pin clip in the groove properly.
- Do not align the clip's end gap with the piston cutout.



CYLINDER INSTALLATION

Make sure that the piston ring end gap is correct.
Install a new cylinder gasket and dowel pins.

Coat the cylinder wall with clean engine oil and install the cylinder.

NOTE

- Route the cam chain through the cylinder.
- Be careful not to damage the piston rings.

Single cylinder:

Install the cylinder over the piston while compressing the piston rings by hand.

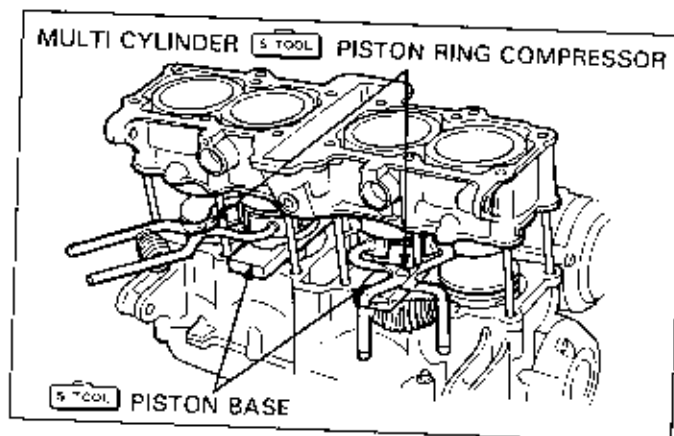
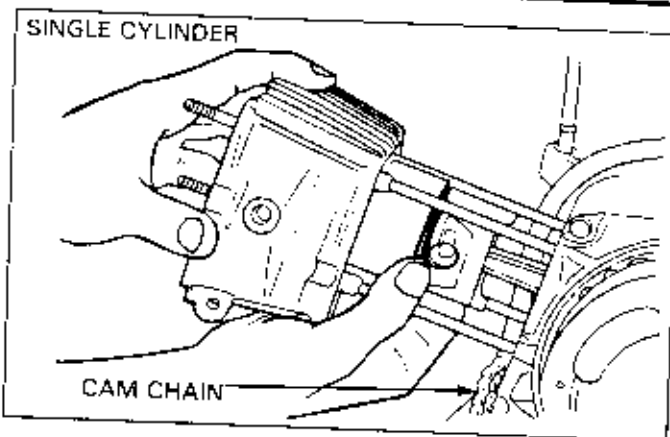
Multi cylinder:

Position the piston at T.D.C. and install two piston bases to hold the 2/3 pistons.

Compress the rings with the piston ring compressor and install the cylinder.

Parallel four cylinders:

First install #2/3, then #1/4.



11. CLUTCH

SERVICE INFORMATION	11-1	CLUTCH INSPECTION	11-10
TROUBLESHOOTING	11-1	HYDRAULIC CLUTCH SYSTEM	
SYSTEM DESCRIPTIONS	11-2	SERVICE	11-27

SERVICE INFORMATION

- Clutch maintenance can be done with the engine in the frame.
- Refer to the Model Specific manual for removal/installation of the crankcase cover and specific clutch maintenance.
- Engine oil viscosity and level have an effect on clutch disengagement. When the clutch does not disengage or the vehicle creeps with clutch disengaged, inspect the engine oil level before servicing the clutch system.
- On wet centrifugal clutches, the clutch will not engage properly if the engine oil contains additives such as molybdenum disulfide. Oils with a molybdenum disulfide additive tend to reduce clutch friction.

TROUBLESHOOTING

1

Clutch lever too high

- Damaged, kinked or dirty clutch cable
- Damaged clutch lifter mechanism
- Faulty clutch lifter plate bearing
- Sticking clutch slave cylinder piston
- Clogged hydraulic system

Clutch will not disengage or motorcycle creeps with clutch disengaged

- Too much clutch lever free play
- Warped plate
- Loose clutch lock nut
- Oil level too high, improper oil viscosity or oil additive used
- Air in hydraulic system
- Low fluid level
- Hydraulic system leaking or clogged

Clutch slips

- Clutch lifter sticking
- Worn clutch discs
- Weak clutch springs
- No clutch lever free play
- Hydraulic system clogged

SYSTEM DESCRIPTIONS

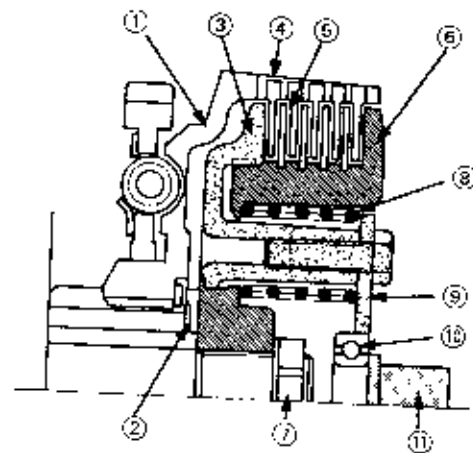
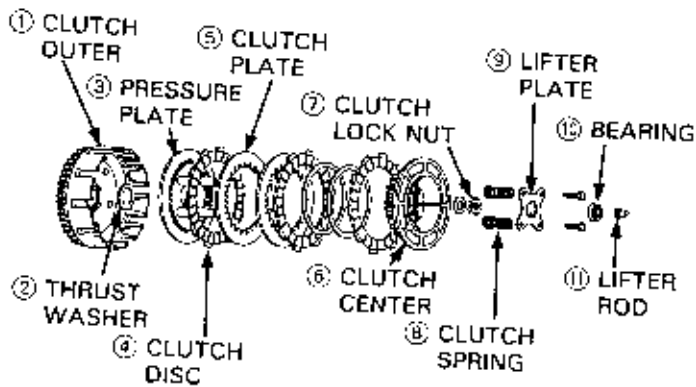
The clutch system is to disconnect/connect the power of the crankshaft. Most clutches are placed between the primary reduction and transmission. With some models, however, they are attached directly to the crankshaft. The actuation of the clutch can be roughly divided into two types: the manual clutch controlled by the rider and the centrifugal clutch performing connection/disconnection of the power according to engine rotation.

The clutch controls the transmission of power by frictional force. When the clutch is completely disengaged, power cannot be transmitted to the rear wheel. When the vehicle is started, the clutch gradually increases its frictional force and smoothly transmits power to the rear wheel. When the clutch is completely engaged, the power of the crankshaft will be directly transmitted to the rear wheel.

If the clutch is partially released with the engine at high rpm, the reduction in friction force caused by heat or wear in the clutch causes the clutch to slip even when completely engaged. As a result, power transmission is lost.

WET MULTIPLATE MANUAL CLUTCH (TYPE A: OUTER PUSH TYPE)

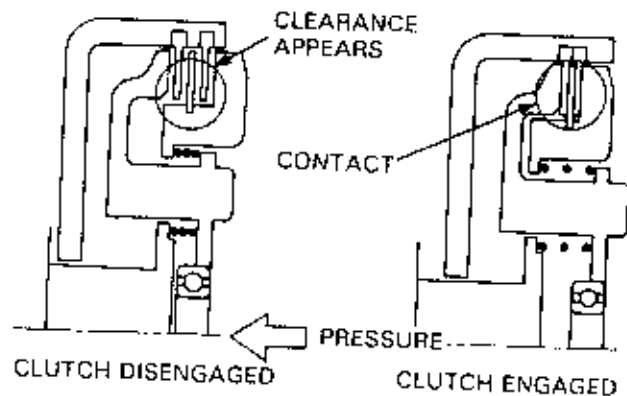
This is the most conventional clutch type used on motorcycles. The primary drive gear of the crankshaft drives the primary driven gear integrated in the clutch outer. The clutch disc and the clutch outer rotate with the crankshaft, as the claws of the outer circumference of the clutch disc are engaged with the grooves of the clutch outer. The mainshaft of the transmission and the clutch center are however fixed with a lock nut. Furthermore, the clutch center and the clutch plate are engaged with the spline. Thus, the clutch plates rotate with the rear wheel through the transmission.



When the clutch lever is pulled in, the clutch lifter mechanism presses the pressure plate through the lifter plate, resulting in a gap between the disc and the plate. The power of the crankshaft is now not transferred to the rear wheel.

When operating the transmission gears and gradually releasing the clutch lever, the pressure plate begins to press the disc and plate by the tension of the spring, and the discs and the plates begin to transmit power by sliding contact. At this time, the vehicle will start to move.

When the clutch lever is completely released, the discs and plates are completely caught between the pressure plate and the clutch center, and no longer mutually slip. The power of the crankshaft is thus completely transmitted to the rear wheel.



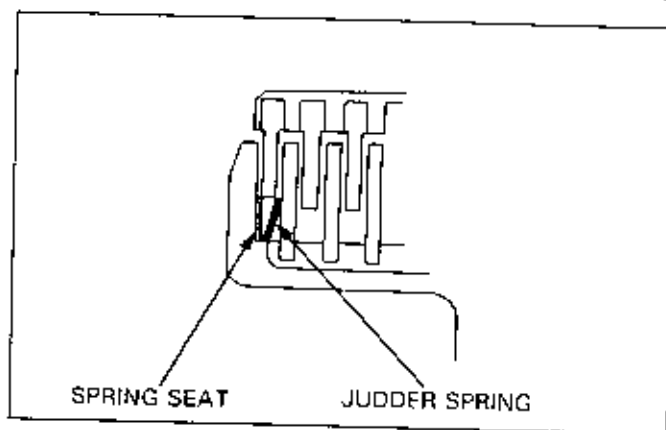
Judder Spring Purpose

When the clutch lever is released to engage the clutch, the clutch discs and plates sometimes engage intermittently causing judder or vibration to some degree.

To lessen this symptom, some models are equipped with a judder spring.

The clutch discs and plates are pressed by the judder spring tension and each disc and plate engages smoothly.

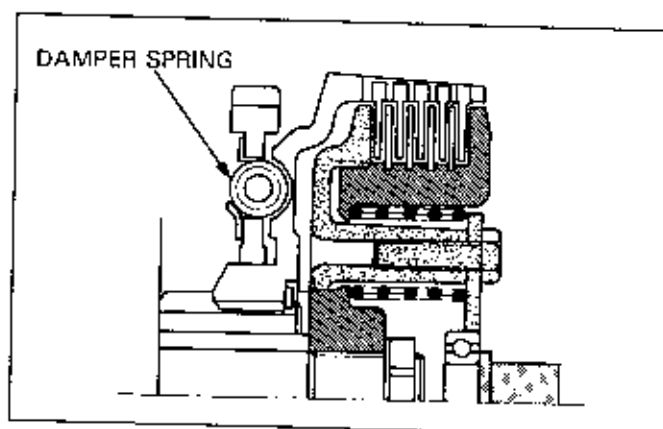
A judder spring is not installed on motorcycles on which the judder is not bothersome.

**Damper Spring Purpose**

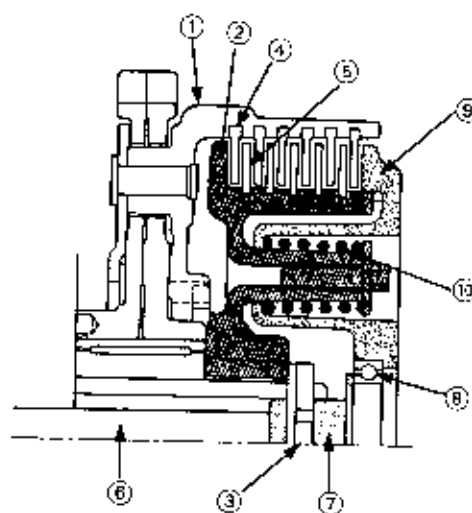
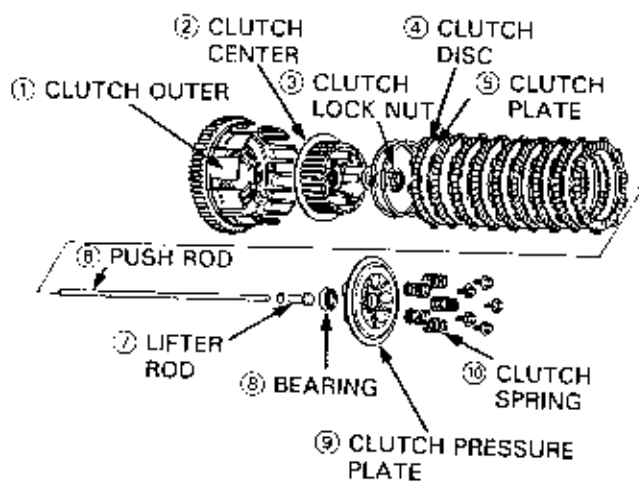
When the engine is running, the combustion pressure that the piston receives is applied to the crankshaft intermittently and the clutch outer primary driven gear receives the striking force from every piston stroke.

Due to the pulsing nature of the power input, a damper spring is installed between the clutch outer and primary driven gear, close to the crankshaft.

The damper springs absorb the impact of the power pulses so they are not transmitted through the rest of the drive line. The drive train is thus protected from unnecessary damage and overall vibration is reduced.

**TYPE B (INNER PUSH TYPE)**

The clutch lifter mechanism of this type is equipped on the opposite side of the clutch, and is different from the type A. The push rod is installed through the mainshaft and presses the clutch pressure plate located outside of the clutch outward to disengage the clutch. All but the above characteristic are the same as type A.

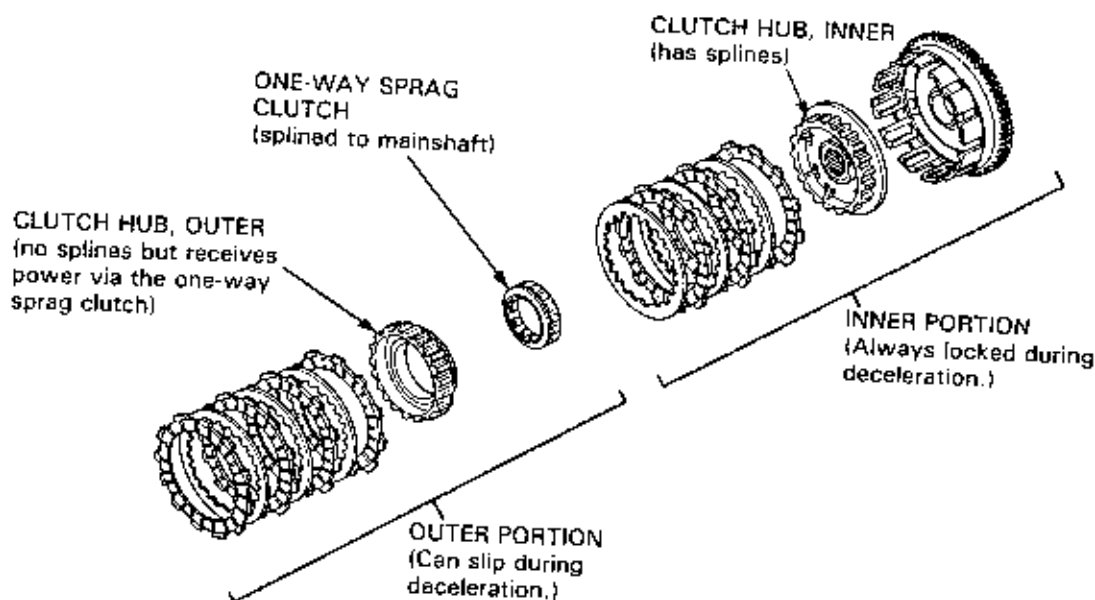


Power transmission and operating principle are the same as type A (see page 11-2).

CLUTCH

ONE-WAY CLUTCH SYSTEM (TYPE C: INNER PUSH TYPE WITH BACK TORQUE LIMITER MECHANISM)

On rapid downshifting from high RPM, the compression braking forces created by the engine can exceed the rear wheel's traction; the engine becomes a rear wheel brake. This can cause momentary lockup of the rear wheel — until the compression braking force drops below the level necessary to make the rear tire break traction. If multiple downshifts are made, the result will be a much longer loss of traction. The one-way clutch system has been specifically designed to prevent this loss of traction.



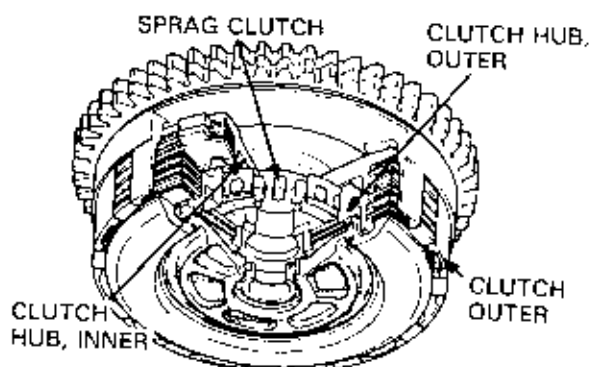
The major difference between this system and a conventional clutch is a two-piece clutch hub, inner and outer. In addition, the outer portion of the clutch hub, that which controls the majority of the clutch plates and discs, is driven by a special one-way sprag clutch.

The inner portion of the clutch hub is splined to the transmission's mainshaft as is normal. But it only controls about two-fifths of the clutch plates and discs. This portion of the clutch transmits power and deceleration forces in the usual manner.

The outer portion of the clutch hub is not splined to the transmission's mainshaft. It controls about three-fifths of the clutch plates and discs. This portion transmits power when the sprag clutch is locked up, such as during normal acceleration, cruising, and deceleration. But it will slip during high RPM deceleration.

OPERATION:

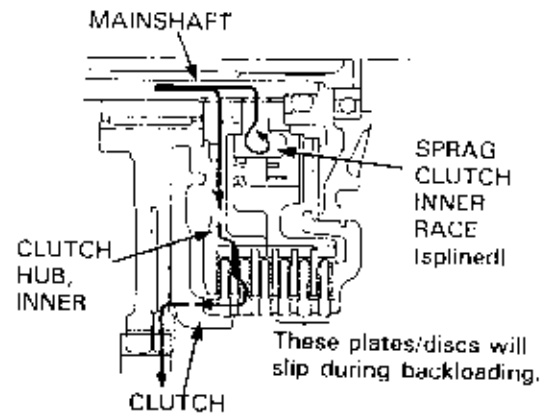
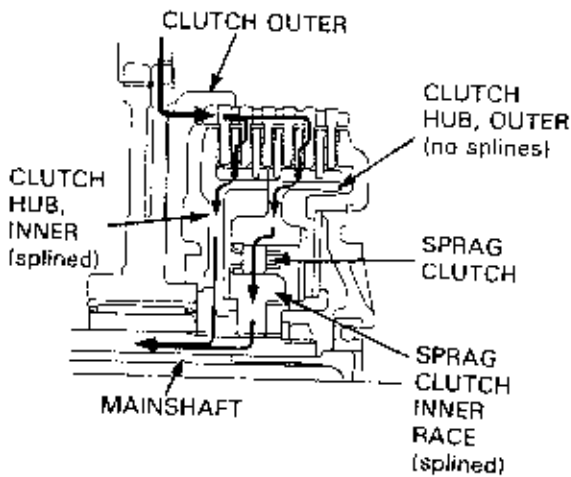
When the transmission is downshifted from high RPM, it causes a backloading at the clutch because of the forces generated by the engine's compression braking effect. If these forces approach that which will cause the rear wheel to lock up, the one-way clutch will disengage the outer portion and allow the inner portion to slip. It will do this to a degree that allows the rear wheel to maintain traction while maintaining the highest effect of engine braking. So rather than being a harsh ON or OFF mechanism, the one-way clutch determines the correct amount of slip for each situation, all the while maintaining maximum possible engine braking effect.



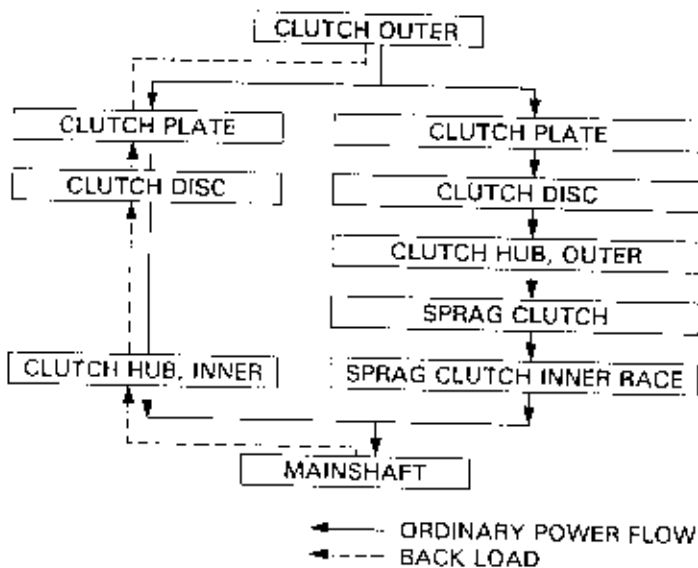
• OPERATION

During acceleration, cruising and normal deceleration, power is transmitted through the clutch in the normal manner: Clutch outer → plate → disc → sprag clutch → mainshaft.

When there is a backloading on the clutch caused by the rear wheel nearing lock up, the sprag clutch will slip just enough to prevent the wheel from locking without losing the benefit of maximum engine compression braking.



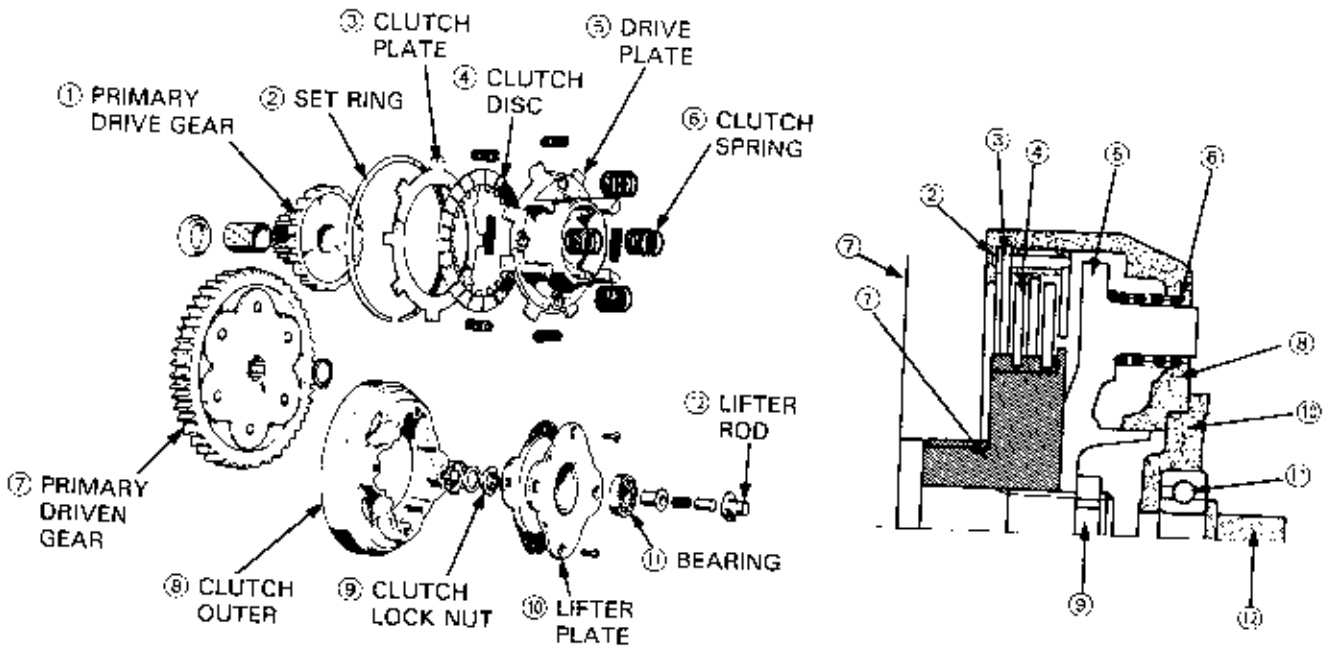
• POWER FLOW DIAGRAM



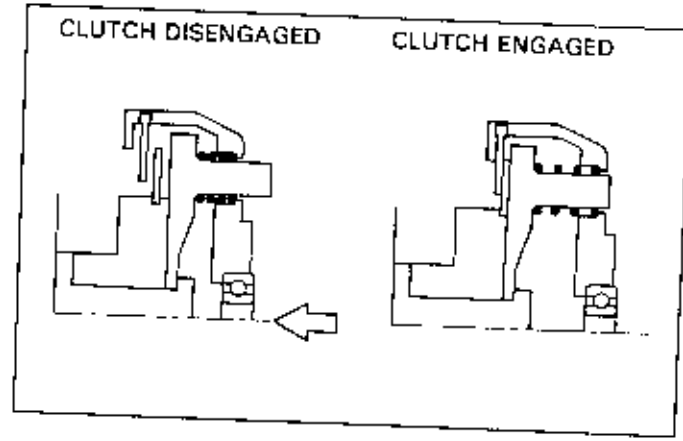
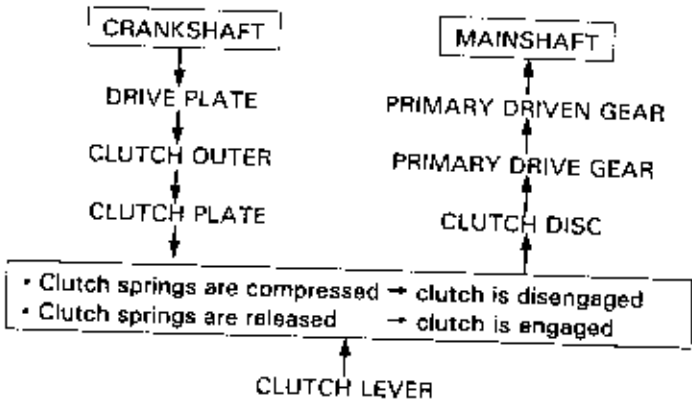
CLUTCH

TYPE D (CRANKSHAFT MOUNTED)

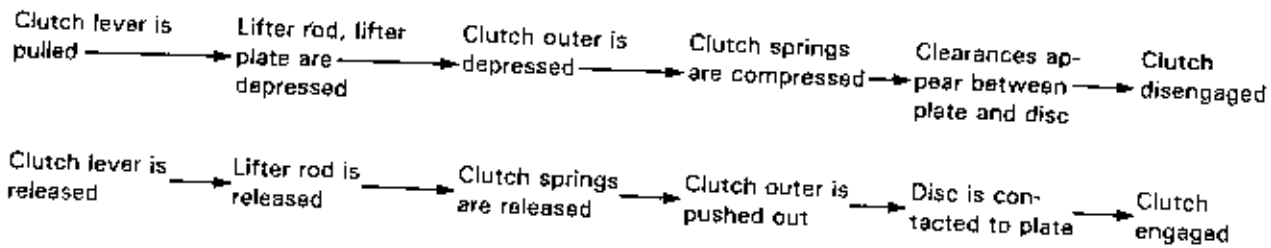
- Clutch outer is on the crankshaft



Power Flow Diagram



OPERATION:



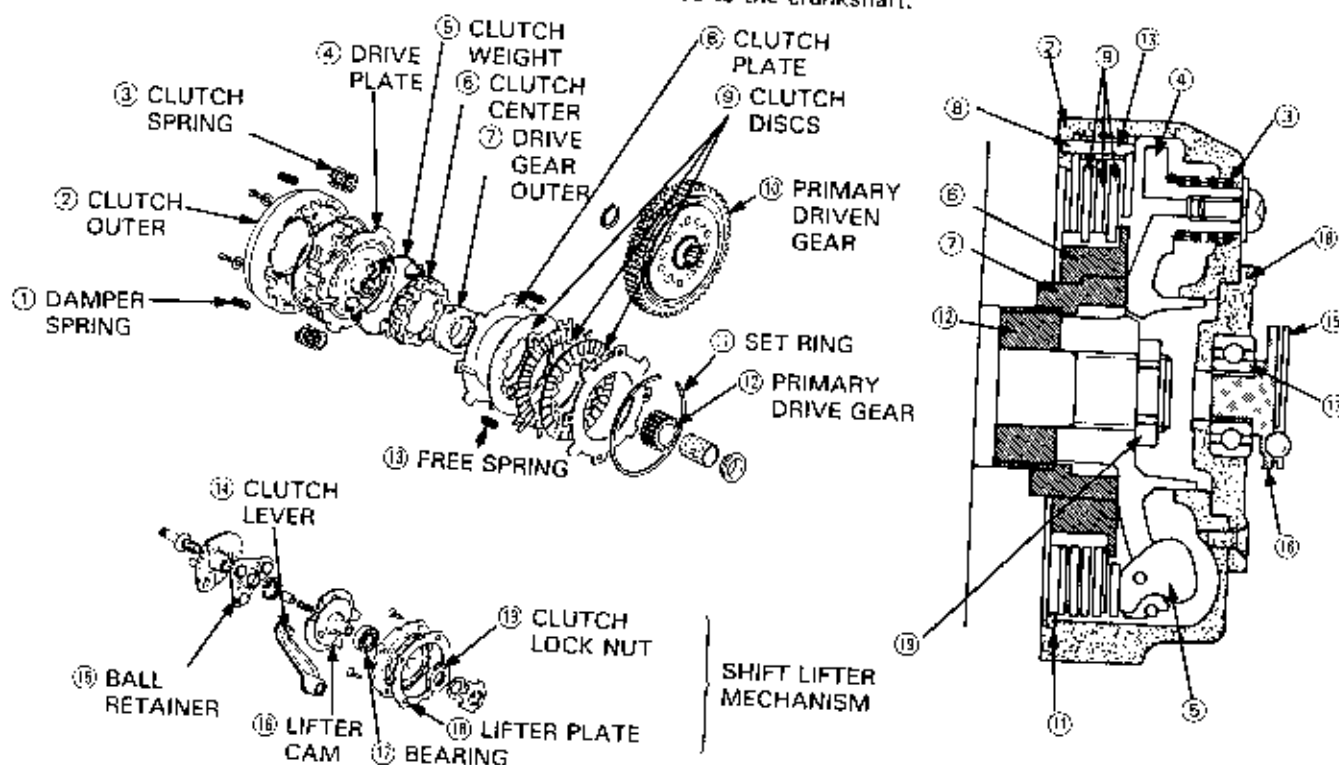
WET MULTIPLATE CENTRIFUGAL CLUTCH

The centrifugal clutch achieves a connection/disconnection of the clutch by the centrifugal force applied on the clutch rotated by the crankshaft. With this mechanism, the vehicle will not start when idling, because the centrifugal force is less and the clutch is disengaged. However, as the rotation of the engine increases, the clutch will be engaged and the vehicle can be moved without manual operation of the clutch.

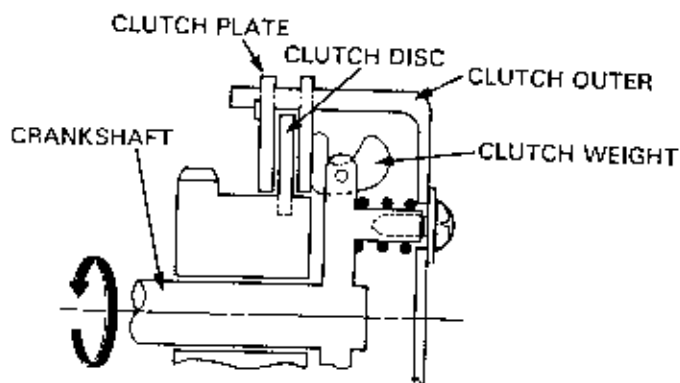
When the centrifugal clutch is combined with the transmission, it will be provided with an independent mechanism, to disengage the clutch by the motion of the pedal when operating the gear shift. This is to disengage the clutch temporarily when changing gears, and to eliminate the pressure applied on the toothed surface of the gear transmission to enable the gear to slide smoothly, resulting in an easier shift.

TYPE A: SHIFT CLUTCH COMBINED

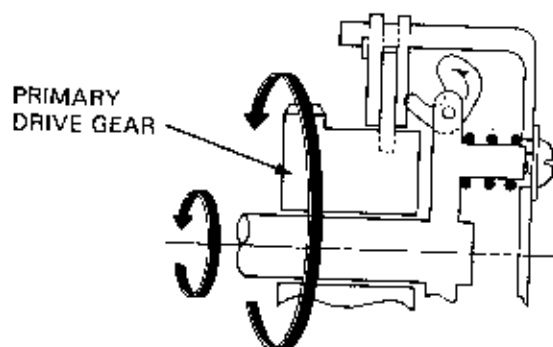
The centrifugal and shift clutches are combined to be mounted to the crankshaft.



At low engine speeds, the centrifugal force applied on the clutch weight is less. The weight does not work, and a gap exists between the clutch plates and discs. The clutch is disengaged.

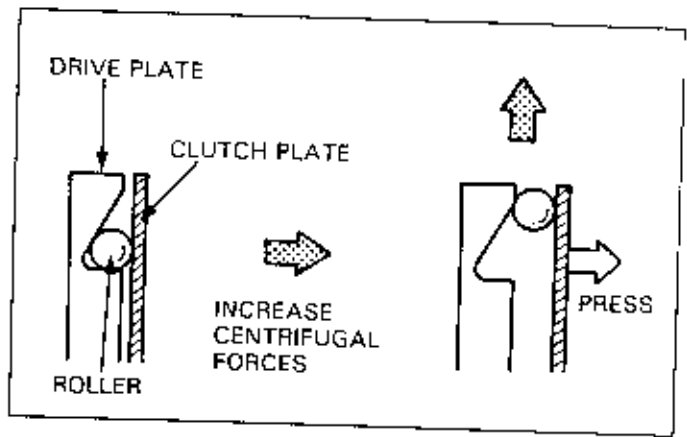


When the engine speed is increased, the centrifugal force applied to the clutch weight increases. The weight moves outwards and presses the clutch plate. The plates and the discs therefore closely join and the power of the crankshaft will be transmitted to the primary drive gear.



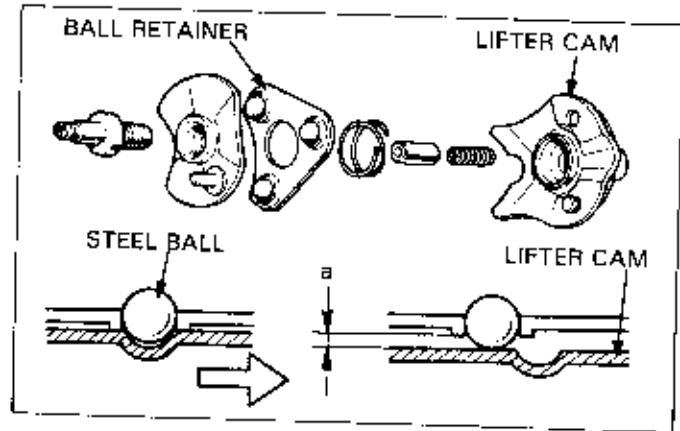
CLUTCH

In some cases, a roller is used instead of a clutch weight between the drive plate and the clutch plate. In this type, centrifugal force shifts the roller to the outside of the drive plate, causing the pressure on the clutch plate to engage the clutch.

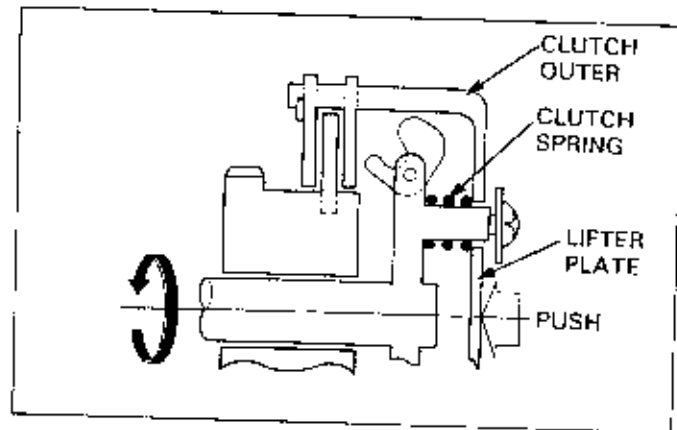


GEAR SHIFT LIFTER

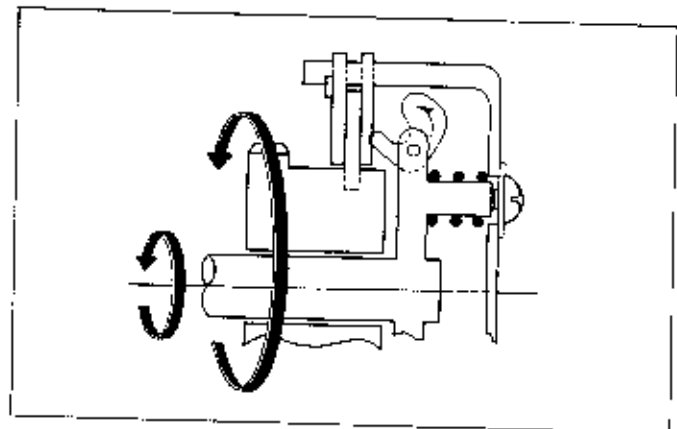
When the shift pedal is operated, the rotation of the gear shift spindle rotates the lifter cam through the clutch lever. When the lifter cam is rotated, the ball positions of the ball retainer and the lifter cam are dislocated, causing the lifter cam to lift for the distance shown in the figure (a) and the pressure plate is pressed.



When the pressure plate is pressed, the clutch outer contracts the spring and the whole clutch outer is pushed inwards. At this time, even though the clutch weight is closely joined to the disc and plate, a gap will exist between the disc and plate from the motion of the clutch outer, and the clutch is then disengaged.

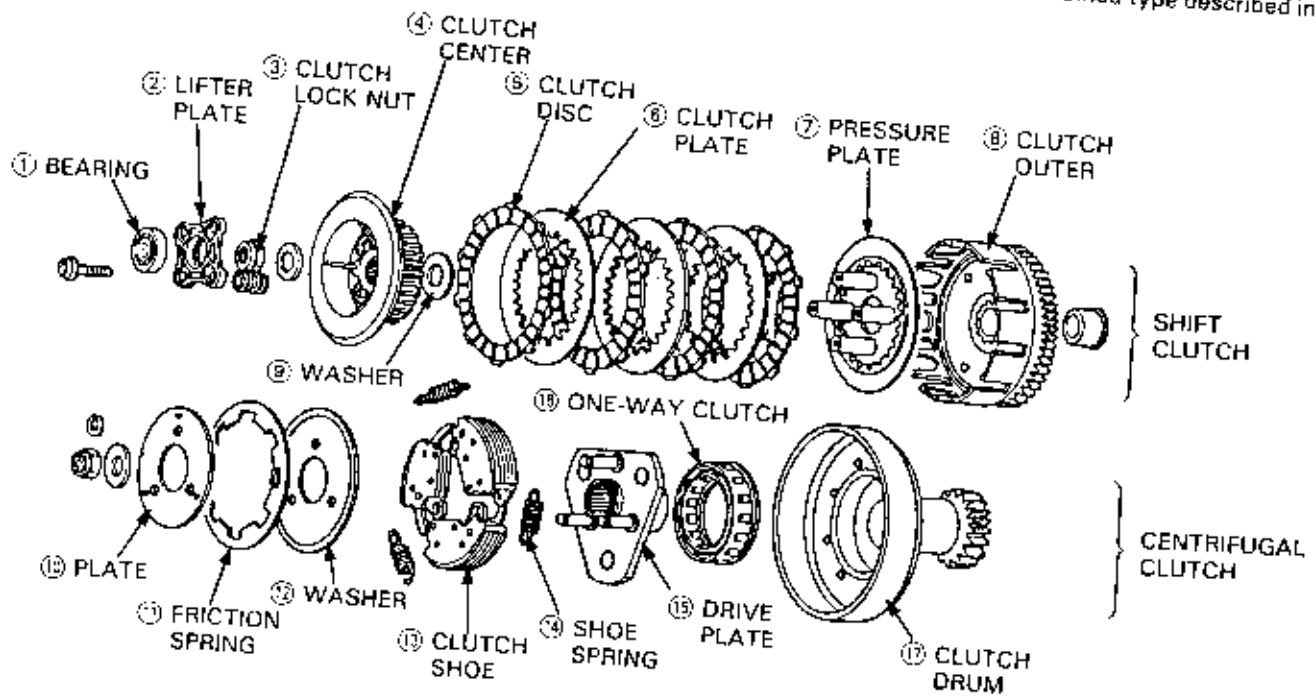


As the pedal is released after completion of shifting gears, the lifter cam returns to its original position. When the clutch outer returns to its original position by the tension of the clutch spring, the disc and the plate closely join again, and the clutch is then engaged.



TYPE B: SEPARATED SHIFT CLUTCH

The centrifugal clutch and the shift clutch are separate in this type, increasing the clutch capacity in comparison with the combined type described on previous pages. Differing from the type mentioned in the previous section, the centrifugal clutch has a mechanism whereby the clutch shoe attached to the crankshaft is expanded outwards by centrifugal force, and the shoe is pressed against the inner surface of the clutch drum, allowing power transmission. This is a similar mechanism to a drum brake. The shift clutch is attached to the mainshaft as with a manual clutch. The work of engaging/disengaging is also the same as with the manual clutch. The gear shift lifter mechanism is the same as that of the combined type described in the previous section.



OPERATION PRINCIPALS

- Centrifugal operation; refer to belt automatic transmission.
- Lifter mechanism of change system; refer to wet multiplate centrifugal clutch (Type A).
- Clutch mechanism of change system; refer to wet multiplate centrifugal clutch (Type A).

CLUTCH

CLUTCH INSPECTION

CLUTCH LIFTER DISASSEMBLY/INSPECTION

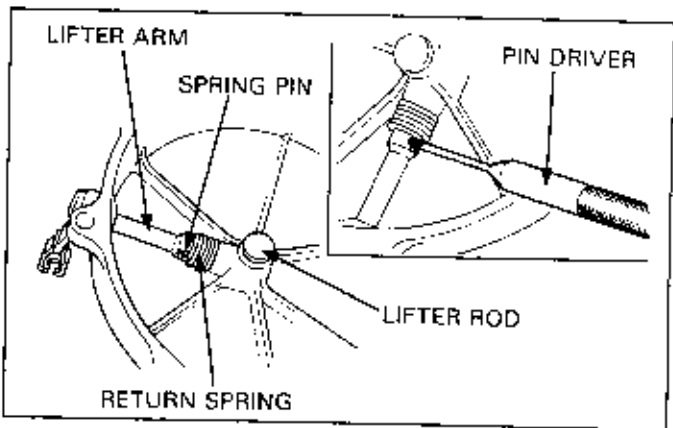
(Type A and a part of Type B)

Remove the crankcase cover (Refer to Model Specific manual).

Remove the lifter rod and return spring.

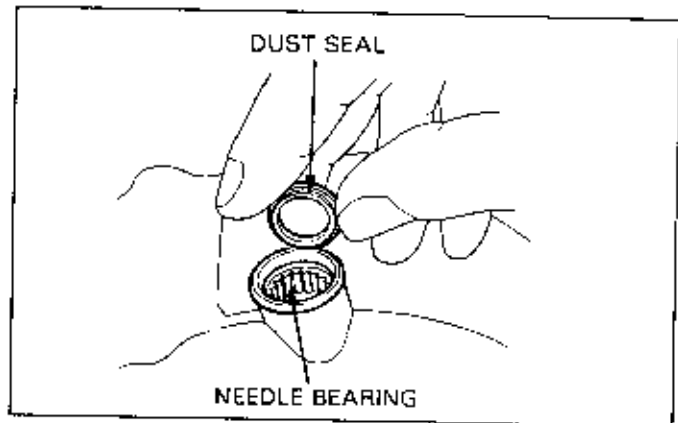
If a spring pin is used, drive out the pin using a pin driver.

Remove the lifter shaft from the crankcase cover.



Check following:

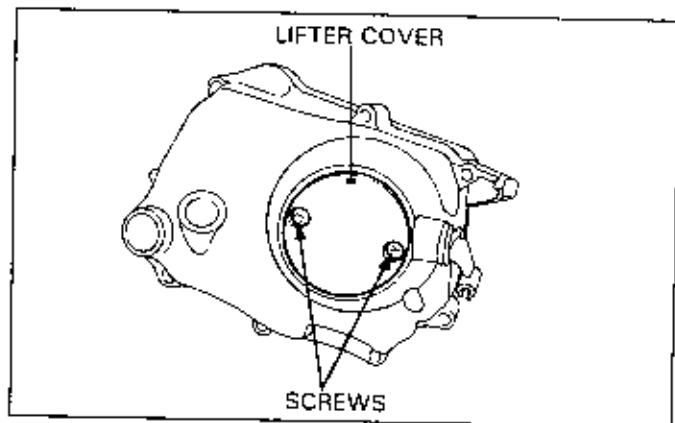
- lifter rod for bending
- needle bearing for play or damage
- dust seal for damage
- return spring for damage or weakness



(Type D)

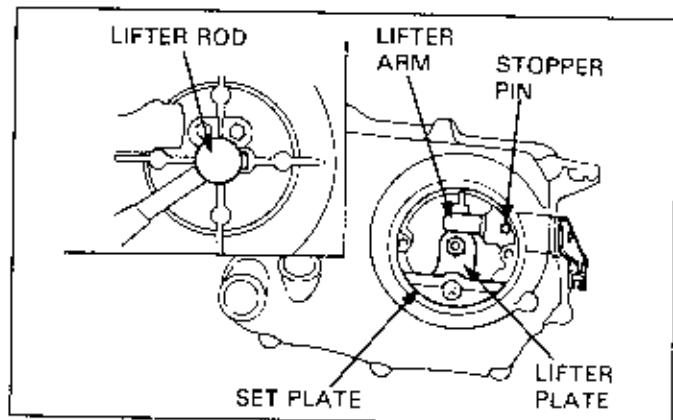
Remove the right crankcase cover (see the Model Specific manual).

Remove the screws and lifter cover.



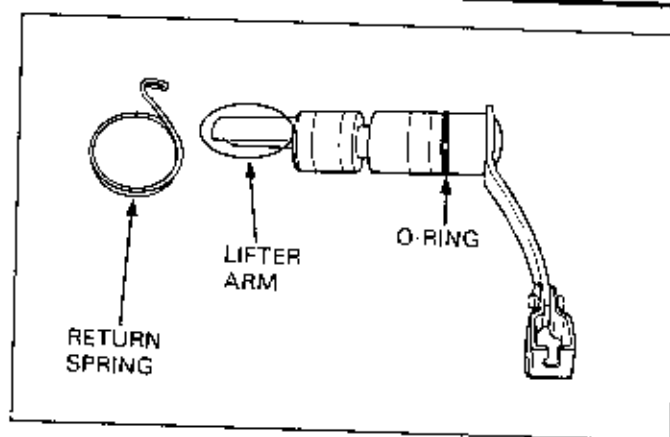
Remove the following:

- Stopper pin and lifter arm
- Screw and set plate
- Lifter plate and lifter rod



Check the following:

- Lifter arm, for straightness
- Return spring for weakness
- O-ring, for damage
- Sliding surface of the lifter arm, for abnormal wear or damage.



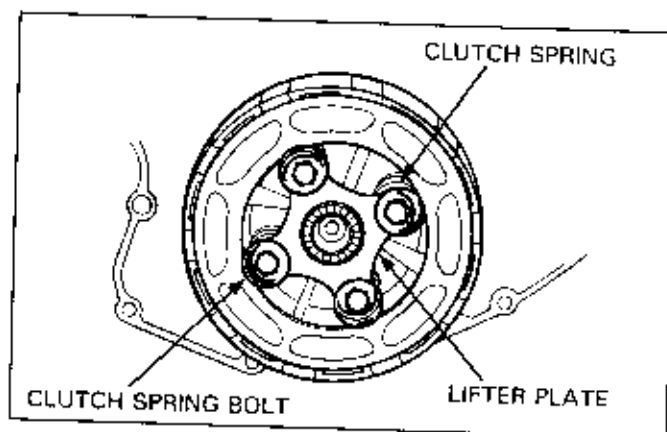
CLUTCH REMOVAL/DISASSEMBLY

(Type A)

Loosen the clutch spring bolts in a crisscross pattern in 2 or 3 steps.

Remove the clutch spring bolts, lifter plate and clutch springs.

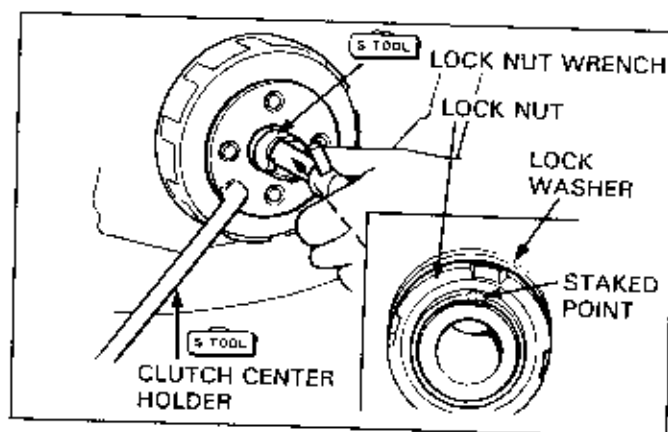
If the clutch is secured with a staked lock nut, unstake the nut.



Remove the lock nut and lock washer using a special tool.

If a snap ring is used:

Remove the snap ring and clutch assembly.



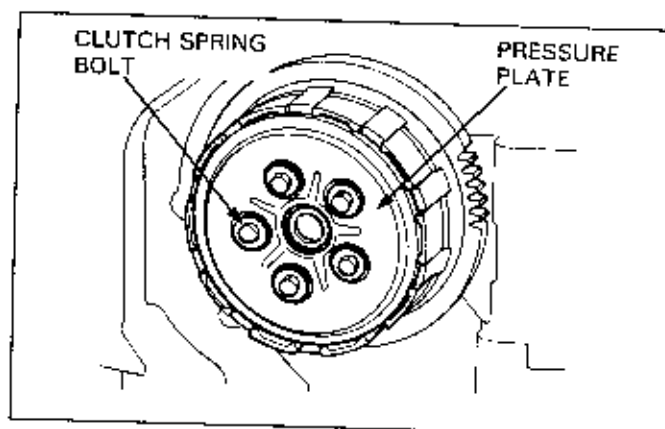
(Type B)

Loosen the clutch spring bolts in a crisscross pattern in 2 or 3 steps.

Remove the clutch spring bolts, pressure plate and clutch springs.

NOTE

- Hydraulic Clutches: To protect the clutch system from air contamination slowly squeeze the clutch lever immediately after removing the pressure plate, then tie the lever to the handlebar grip.



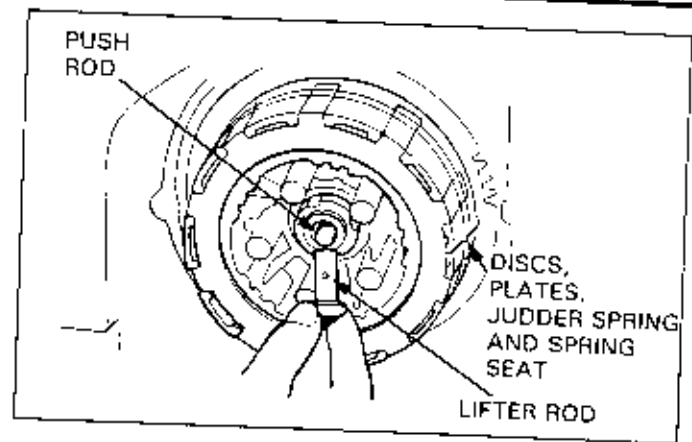
CLUTCH

Remove the lifter rod, push rod, discs and clutch plates.

NOTE

- Some models have a steel ball between the lifter and push rods.

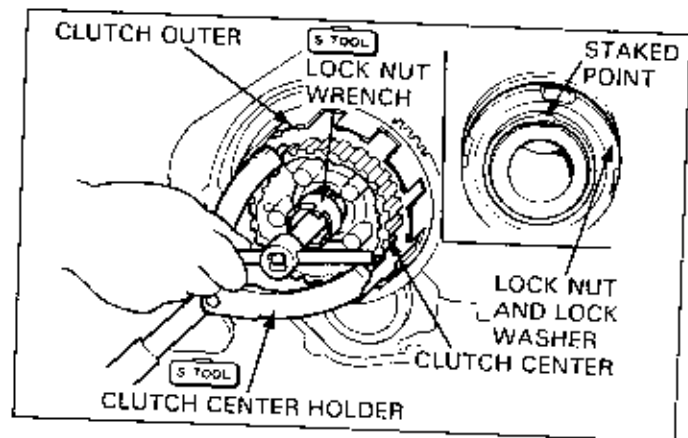
Remove judder spring and spring seat if they are installed.



If the lock nut is staked to the mainshaft, unstake the lock nut and remove it.

Remove the lock washer.

Remove the clutch center and clutch outer.



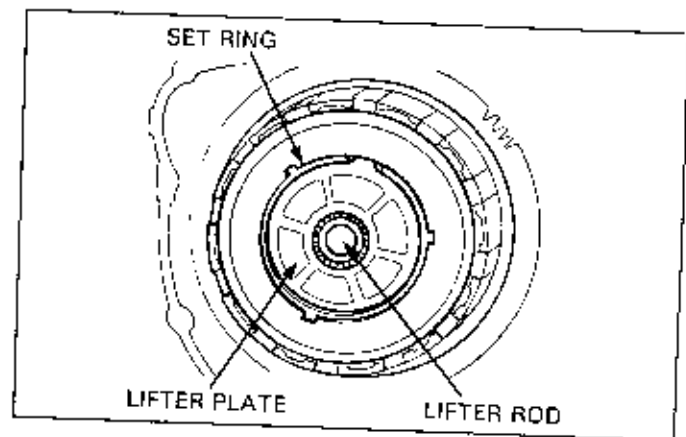
(Type C)

Remove the set ring, lifter plate, lifter rod and bearing.

Slowly squeeze the clutch lever immediately after removing the clutch lifter plate, then tie the lever to the handlebar.

CAUTION

- Ambient air can contaminate and may damage the clutch system.

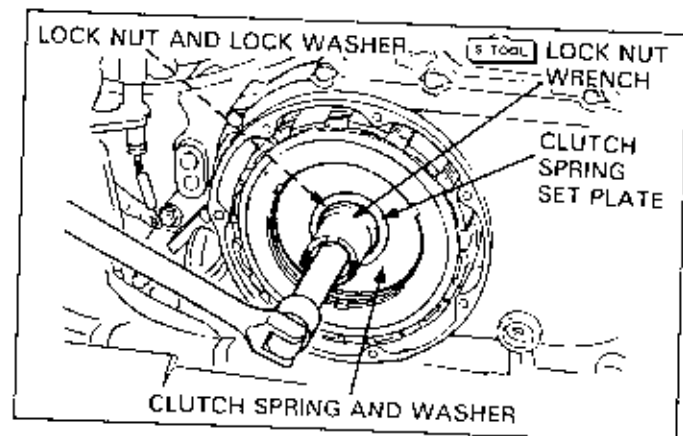


Shift the transmission into top gear and apply the rear brake. Remove the lock nut.

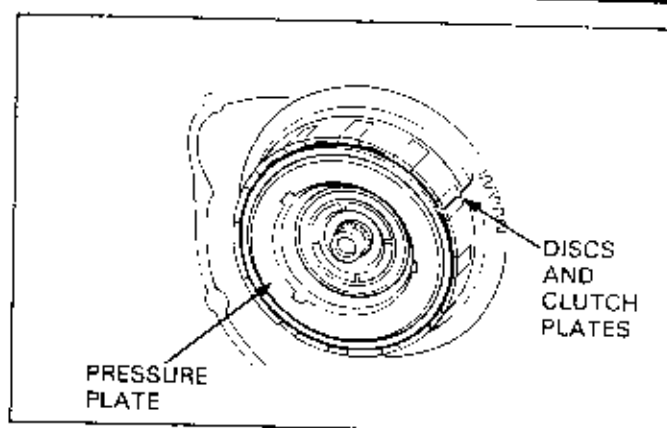
NOTE

- If the engine is not in the frame, shift the transmission into top gear and hold the drive sprocket using the universal holder (07725--0030000).

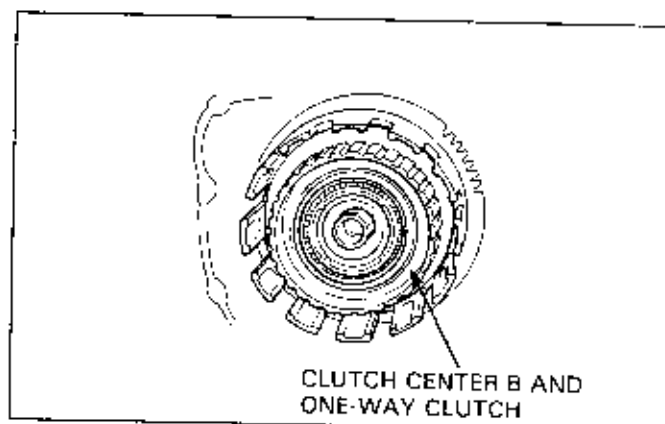
Remove the lock washer, clutch spring set plate, clutch spring and washers.



Remove the clutch pressure plate, clutch plates and discs.

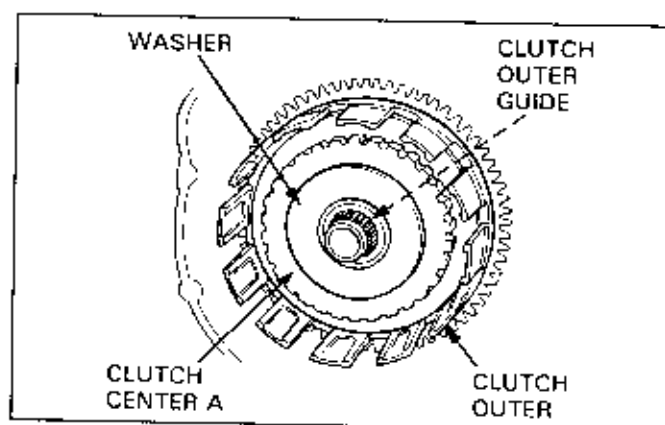


Remove clutch center B and the one-way clutch as an assembly.



Remove clutch center A, the washer and the clutch outer.

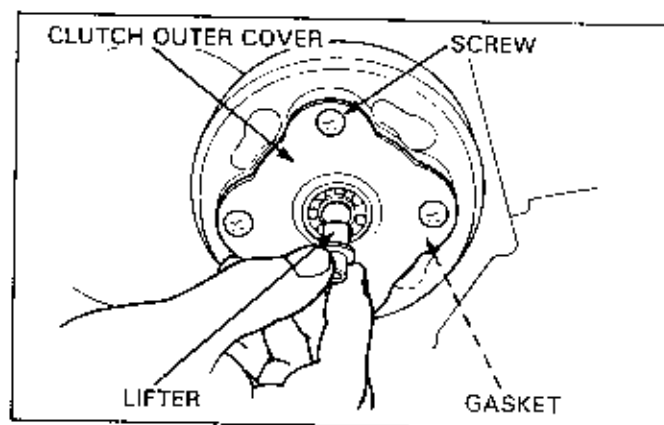
Remove the clutch outer guide.



(Type D)

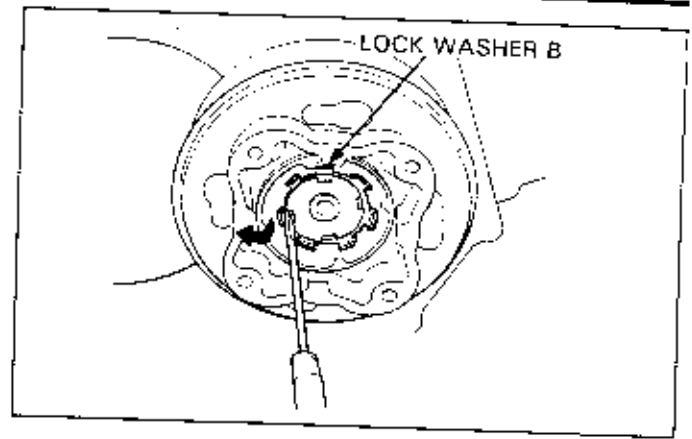
Remove the lifter, spring and oil through guide.

Remove the screws, clutch outer cover and gasket.



CLUTCH

Straighten the lock washer tab.



Hold the clutch outer using the clutch outer holder.

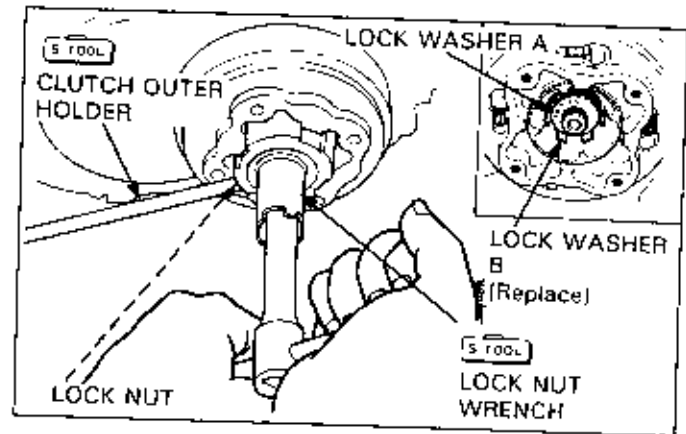
Remove the lock nut using the lock nut wrench.

Remove lock washers A and B; discard washer B.

NOTE

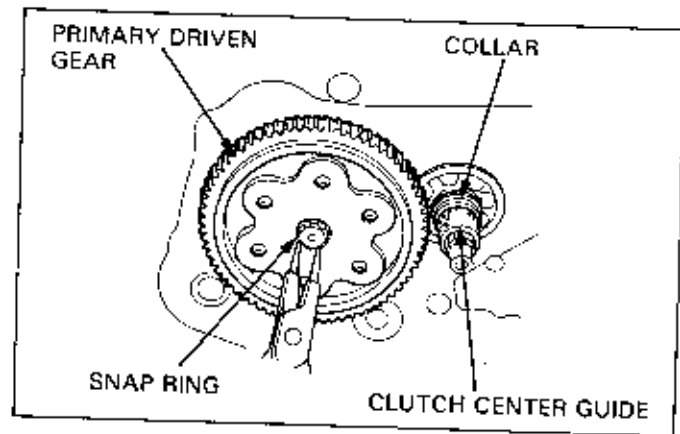
- Replace lock washer B whenever it is removed.

Remove the clutch assembly from the crankshaft.

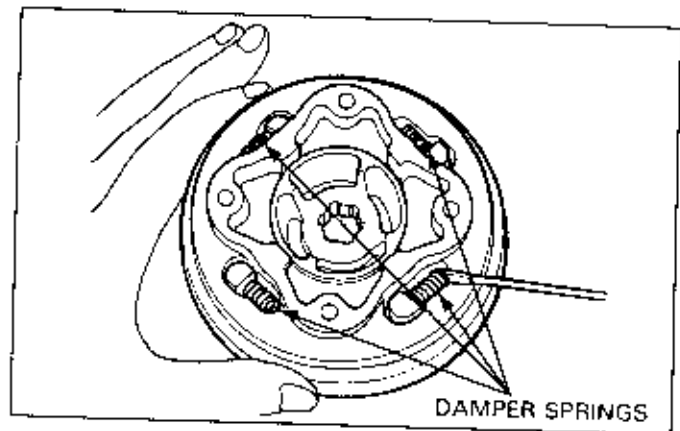


Remove the snap ring and primary driven gear from the mainshaft.

Remove the clutch center guide and collar from the crankshaft.



Remove the damper springs from the clutch outer.

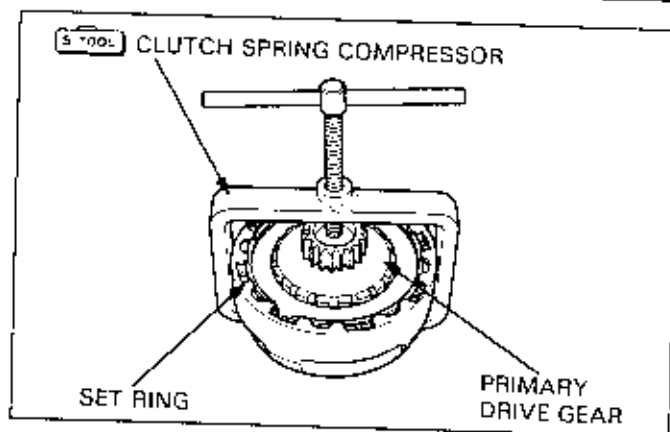


Install the primary drive gear onto the clutch assembly and compress the clutch springs using the clutch spring compressor, then remove the set ring.

S TOOL

CLUTCH SPRING COMPRESSOR 07960-0110000

Loosen and remove the tool, then disassemble the clutch.

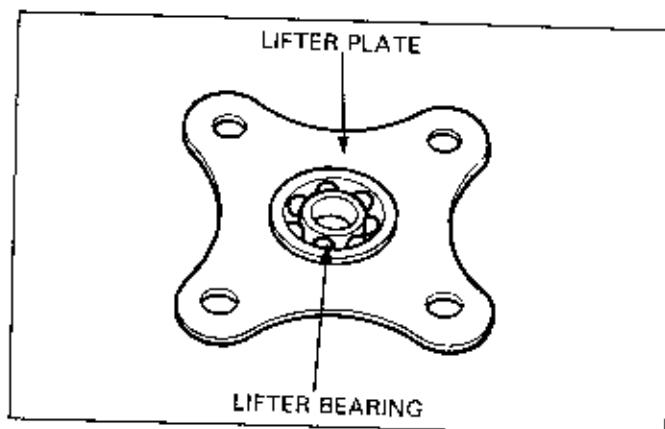


CLUTCH INSPECTION

Lifter Plate Bearing (Type A, B, C, and D)

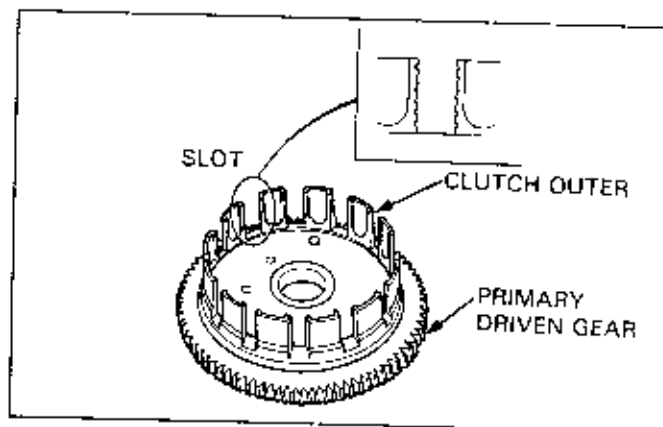
The lifter plate bearing inner race is loaded by the lifter rod when the clutch is disengaged. Inner bearing race damage affects the clutch operation.

Turn the bearing inner race with your finger, and check that the bearing turns smoothly and quietly without play. Also check that the outer race fits tightly in the lifter plate.



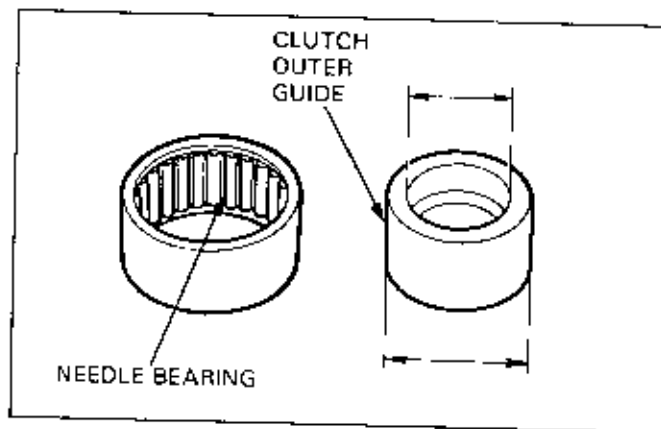
Clutch Outer (Types A, B, C and D)

- Check the primary driven gear teeth for wear or damage, replace as necessary.
- Check the slots of the clutch outer for nicks, damage or wear from the clutch discs; replace as necessary.



Clutch Outer Guide, Needle Bearing (Types A, B and C)

- Measure the I.D. and/or O.D. of the clutch outer guide. Replace if the service limits are exceeded.
- Check the needle bearing for damage or excessive wear; replace if necessary.



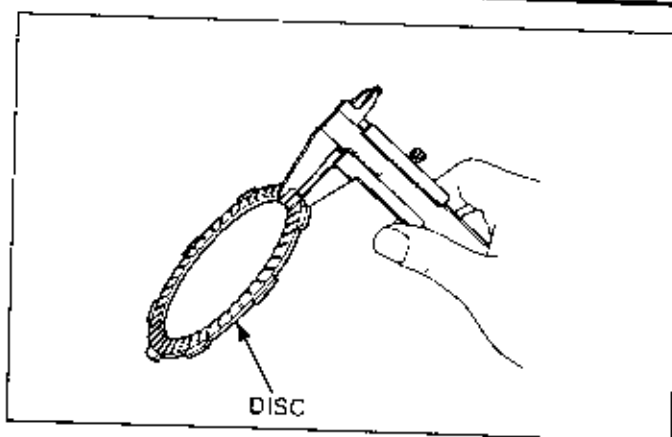
CLUTCH

Clutch Disc (Types A, B, C and D)

- Check the clutch discs for scoring or discoloration; replace as necessary.
- Measure the disc thickness and replace the discs if the service limit is exceeded.

NOTE

- Replace the clutch discs and plates as a set.

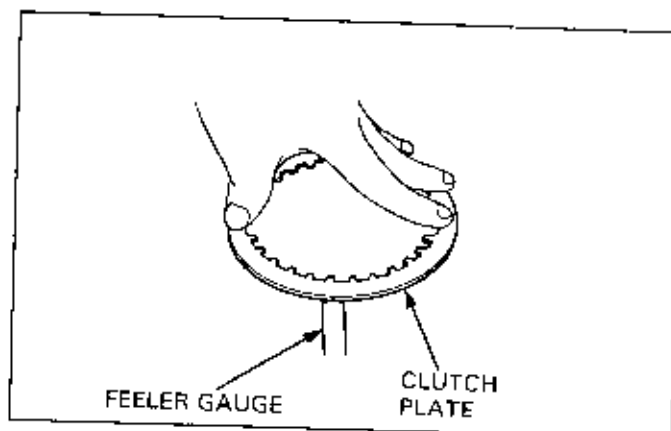


Clutch plate (Types A, B, C and D)

- Check the clutch plates for warpage or discoloration; replace if necessary.
- Check for plate warpage on a surface plate using a feeler gauge; replace if the service limit is exceeded.

NOTE

- Warped clutch plates prevent the clutch from disengaging properly.

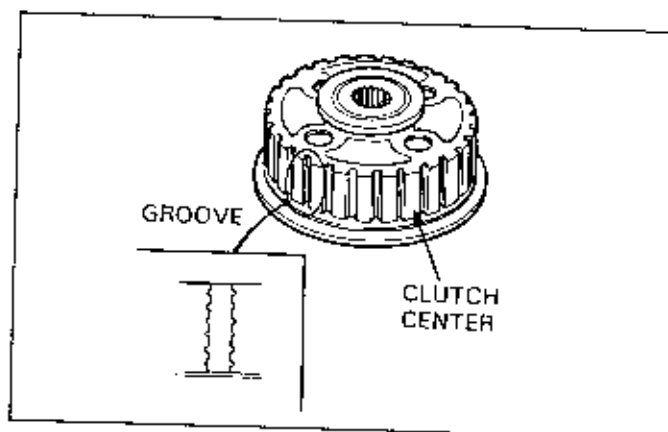


Clutch Center

Check the clutch center for nicks, grooves or abnormal wear from the clutch plates; replace as necessary.

NOTE

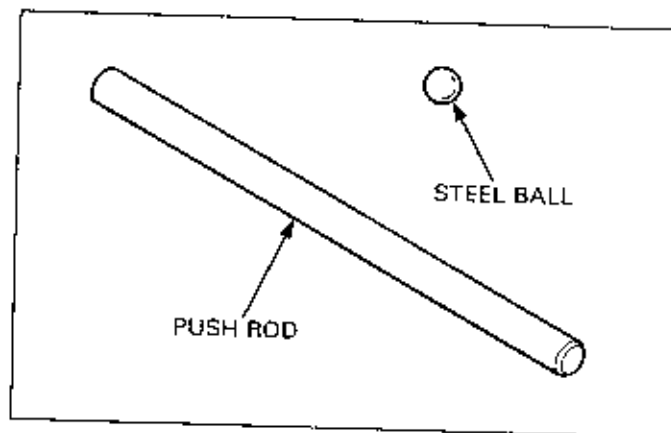
- A damaged clutch center causes engine noise.



Lifter Push Rod (Types B and C)

Check the push rod for trueness or damage; replace if necessary.

If there is a steel ball between the lifter rod and push rod, check the ball for wear or damage; replace as necessary.

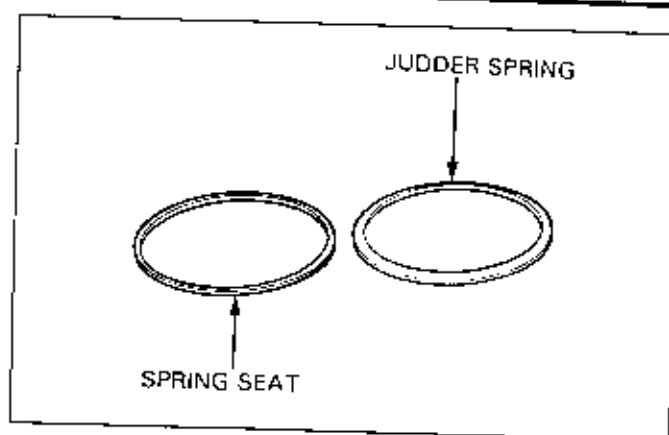


Judder Spring, Spring Seat**(Types A and B)**

Check the judder spring and spring seat for deformation, warpage or damage; replace as necessary.

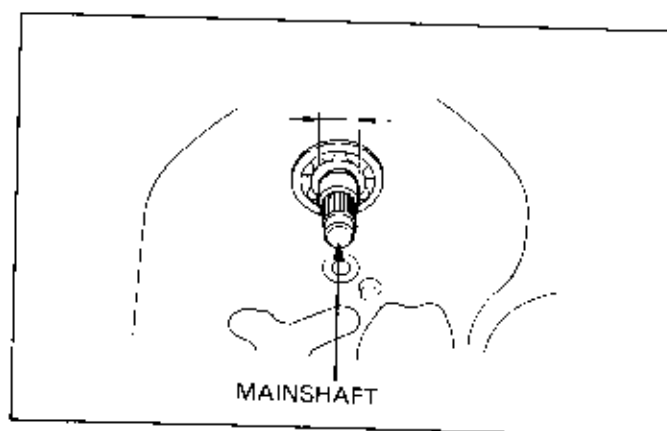
A damaged or warped spring seat will cause the judder spring to be pressed unevenly.

A damaged judder spring also causes the weak contact between the discs and plates or uneven disc/plate contact.

**Mainshaft****(Types A, B and C)**

Measure the mainshaft O.D. at the sliding surface, if the clutch outer guide slides on the mainshaft.

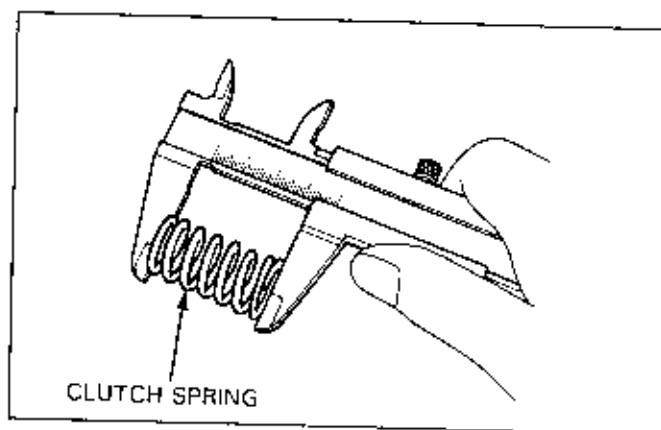
Replace the mainshaft if the service limit is exceeded.

**Clutch Spring****(Types A, B and D)**

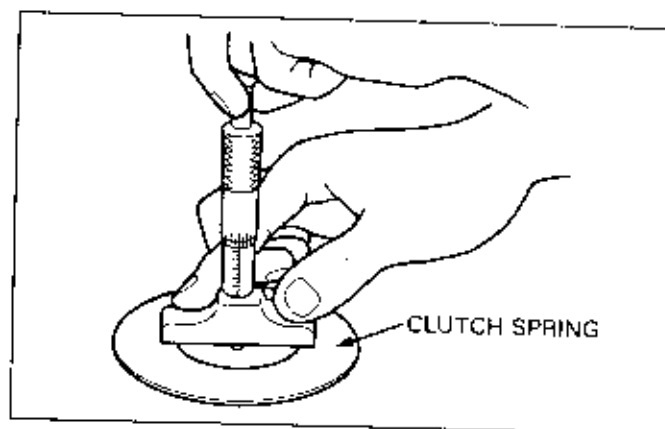
Measure the clutch spring free length; replace the springs if the measurement is not within the service limit.

NOTE

- If the vehicle has been used for a long time, the clutch spring free length will be shorter, because the clutch springs are compressed while the clutch is disengaged.
- Replace the clutch springs as a set so that the discs contact evenly with the clutch plates.

**Clutch Spring****(Type C)**

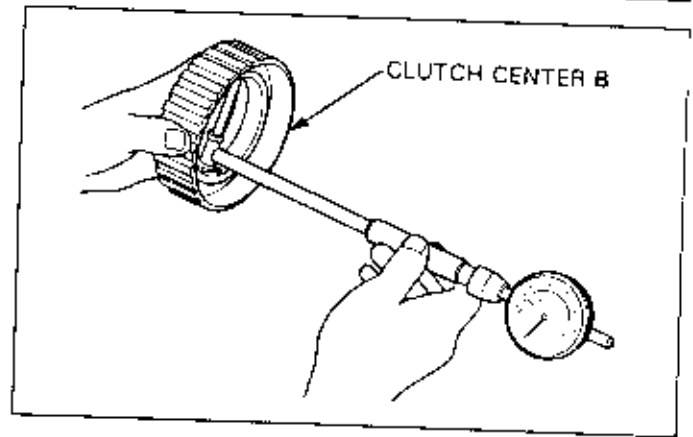
Measure the free height of the clutch spring; replace the spring if the measurement is lower than service limit.



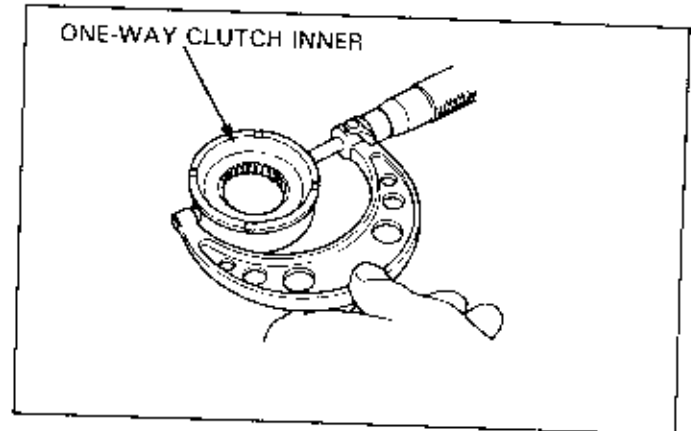
CLUTCH

One-Way Clutch (Type C)

- Check the inside surface of clutch center B for abnormal wear or damage; replace as necessary.
- Measure the I.D. of clutch center B. Replace if the service limit is exceeded.



- Check the outside surface of the one-way clutch inner for abnormal wear; replace if necessary.
- Measure the O.D. of the one-way clutch inner. Replace if the service limit is exceeded.

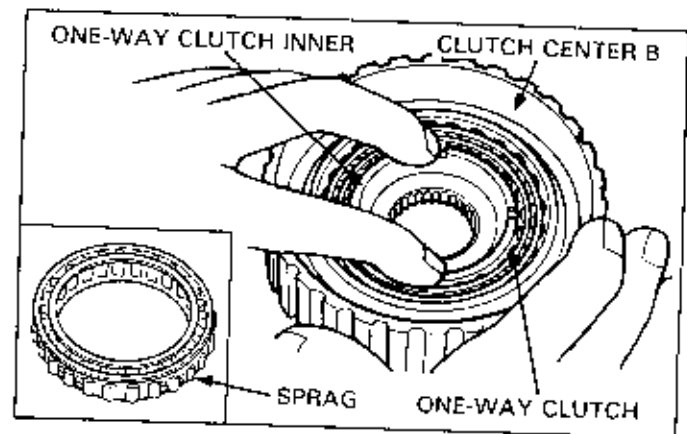


- Check the sprag for damage or excessive wear; replace if necessary.

Reassemble the one-way clutch as follows:

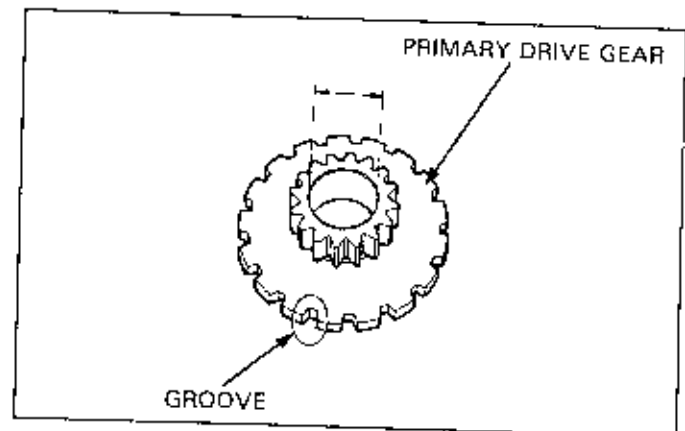
- Install the sprag into the clutch center B, with the flanged side facing up.
- Install the clutch inner into the sprag by turning it in the specified direction with the groove facing up.

Hold the clutch inner and turn clutch center B as shown and check that the clutch center turns in the specified direction but not in the opposite direction. Replace the one-way clutch if the clutch center turns in both directions.



Primary Drive Gear (Type D)

- Check the drive gear grooves for nicks or wear caused by the clutch plates; replace as necessary.
- Measure the I.D. of the primary drive gear. Replace if the service limit is exceeded.

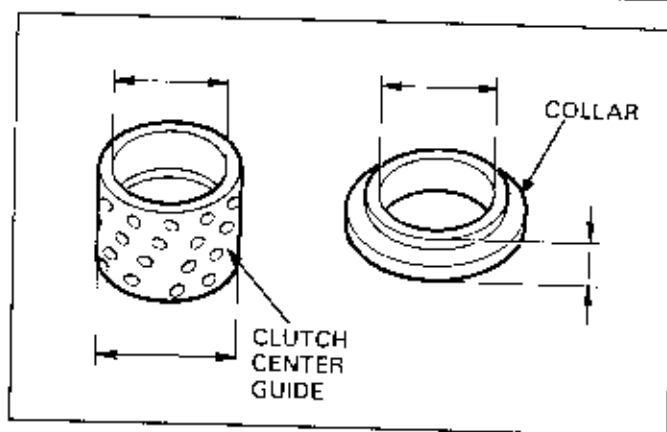


Clutch Center Guide, Collar (Type D)

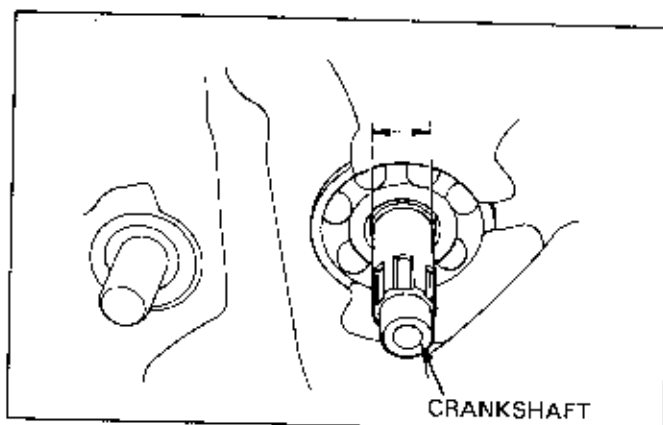
- Measure the I.D. and/or O.D. of the clutch center guide at the sliding surface.

Replace the guide if the service limit is exceeded.

- Measure the I.D. and/or height of the collar; replace if the service limit is exceeded.

**Crankshaft (Type D)**

Measure the O.D. of the crankshaft at the clutch center guide sliding surface, replace if the service limit is exceeded.

**CLUTCH REASSEMBLY****(Type A)**

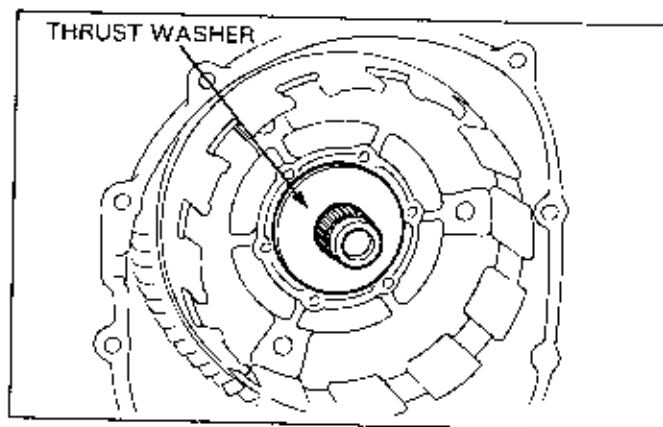
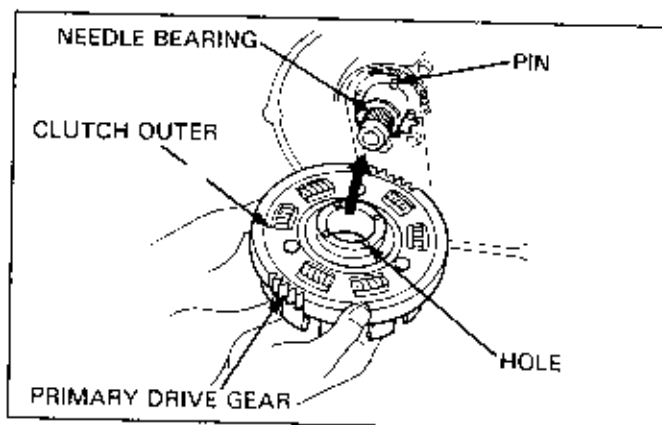
Install the needle bearing or clutch outer guide onto the mainshaft.

Install the clutch outer onto the mainshaft.

NOTE

- If the pump drive sprocket is installed on the mainshaft, align the holes of the clutch outer with the pins on the oil pump drive sprocket.
- If the primary drive gear is the anti-backlash type, install the clutch outer onto the mainshaft while moving the drive sub gear to align the two gear teeth using a screwdriver. Take care not to damage the gear teeth.

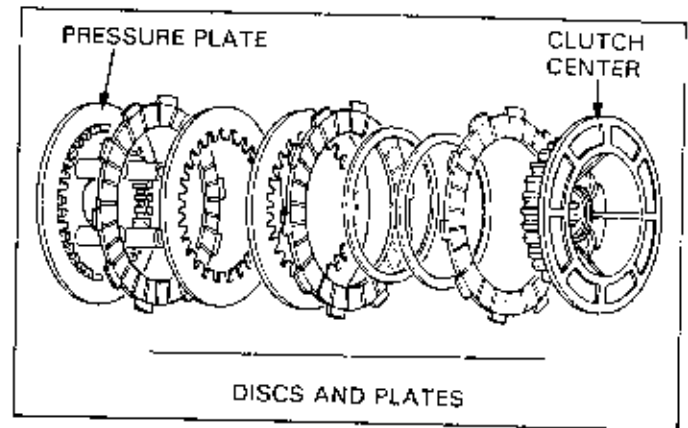
Install the thrust washer (if used).



CLUTCH

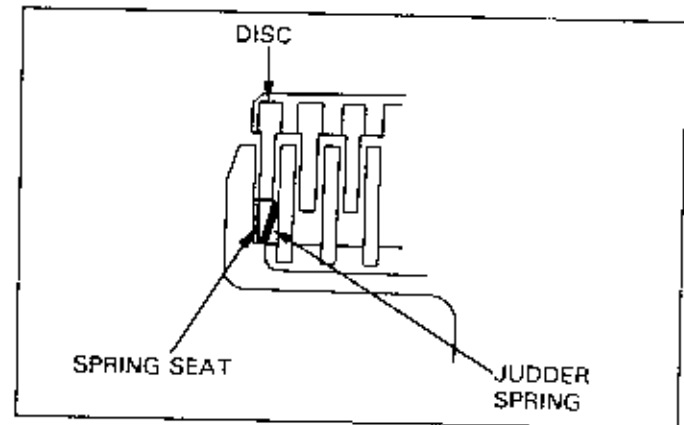
Coat the clutch discs and plates with clean oil.

Install the pressure plate, discs, plates and clutch center onto the mainshaft in the order shown. If a judder spring is used, install the judder spring and spring seat as shown below.

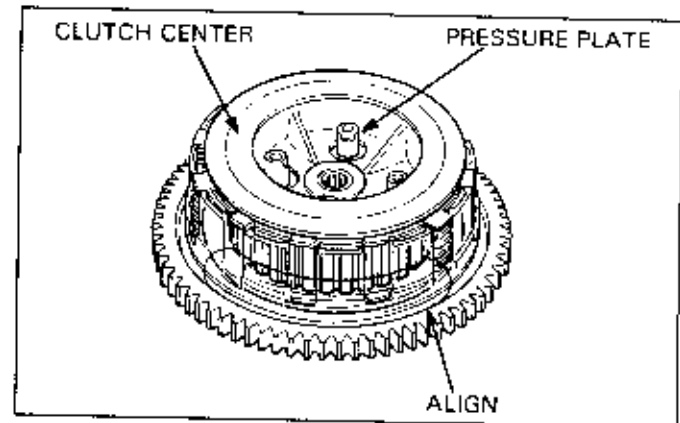


NOTE

- The disc that is installed against the judder spring has a larger I.D. than the other discs.
- If the splines of the clutch center cannot be aligned with the mainshaft splines while installing, change the transmission into any gear position and turn the rear wheel to ease installation.



Make sure that the clutch center is installed completely; the grooves of the clutch center must align with the tabs of the pressure plates.



If the clutch is secured with a lock nut;

Install the lock washer onto the mainshaft with the "OUTSIDE" mark facing outside.

If there is no mark, install the lock washer with the convex side facing out.

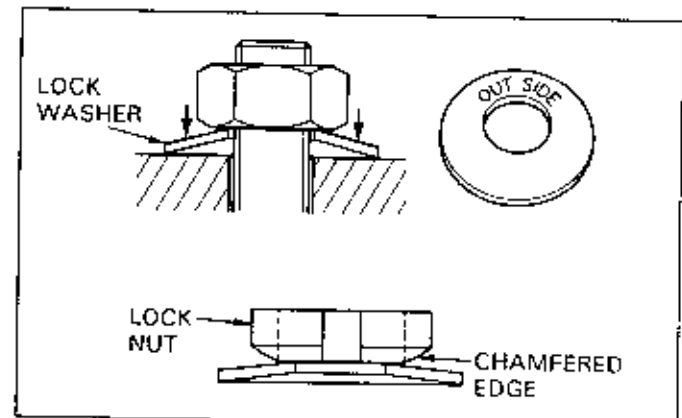
Install the lock nut and tighten it to the specified torque.

NOTE

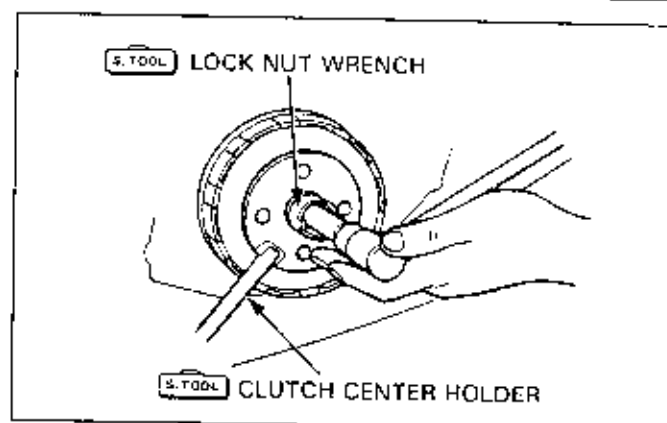
- Use a new lock nut if the lock nut was staked.
- Face the chamfered side of the lock nut inward if the lock nut is chamfered.

• If a snap ring is used:

Set the snap ring into the groove in the mainshaft with the chamfered side inward. Turn the snap ring to be sure that it is seated in the groove.



Tighten the lock nut to specified torques using a special tool.

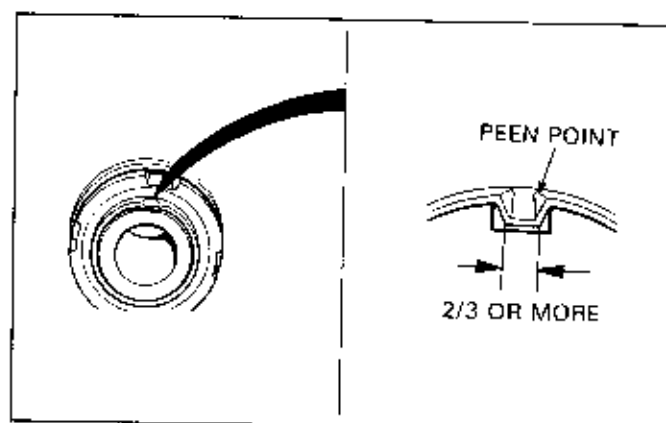


Where a staked lock nut is used:

Stake the nut to the mainshaft.

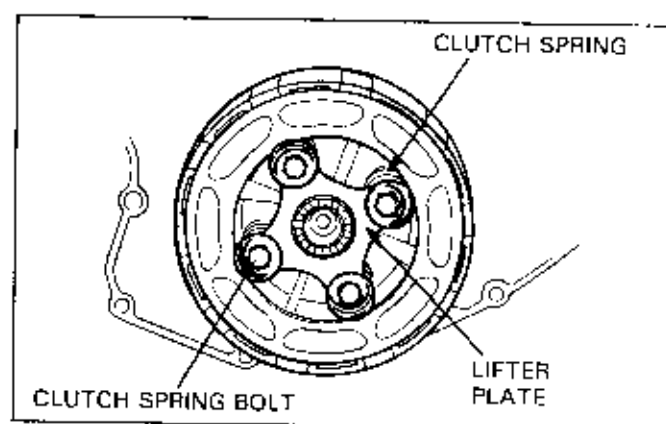
NOTE

- Replace staked-type lock nut, if the old staked area of the nut aligns with the groove of the shaft after tightening the nut to specified torque.
- Be careful not to damage the shaft when staking the lock nut.
- Make sure that the peen point covers at least 2/3 of the width of the mainshaft groove.



Set the bearing in the lifter plate, then install the clutch springs and the lifter plate.

Install the clutch spring bolts and tighten them in a crisscross pattern in 2 or 3 steps.



(Type B)

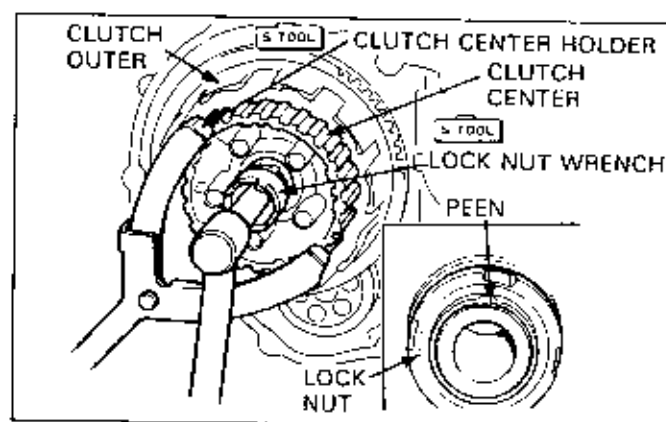
Install the clutch outer guide, needle bearing and clutch outer (see page 11-19).

Install the clutch center.

Install the lock washer and lock nut (see page 11-20).

Tighten the lock nut using the special tool to hold the clutch center.

Stake the lock nut if necessary.



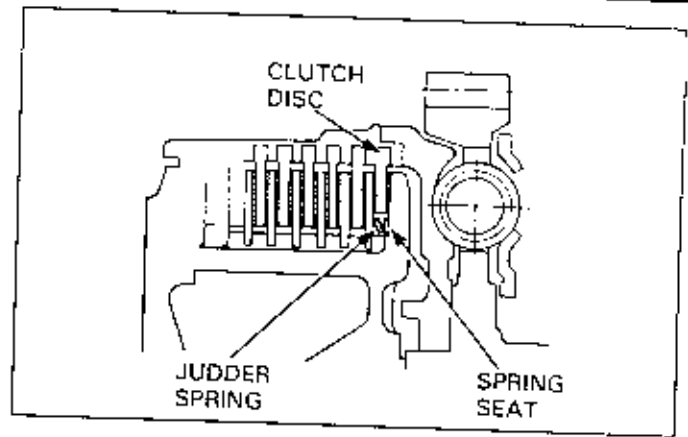
CLUTCH

Coat the clutch plates and discs with clean engine oil.

Install the judder spring seat and spring, discs and clutch plates.

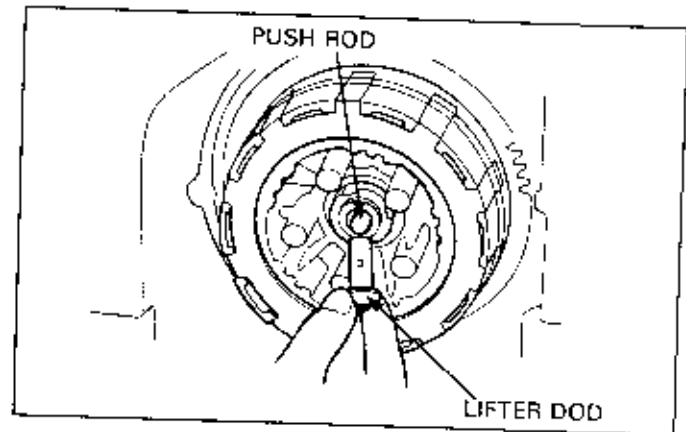
NOTE

- The judder spring and spring seat should be installed as shown.
- The disc that is installed against the judder spring has a larger I.D. than the other discs.



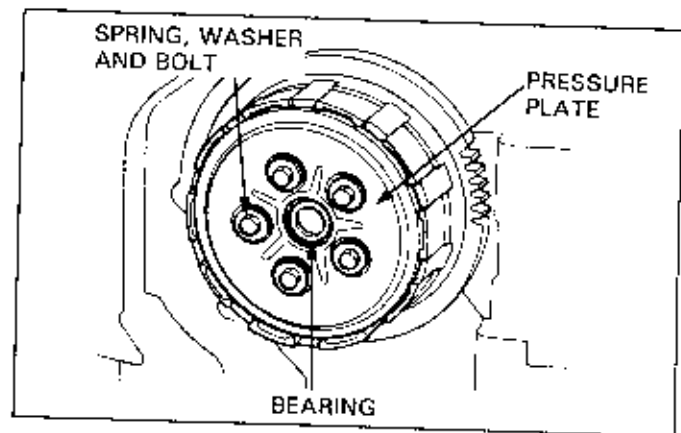
Coat the push rod with grease and install it into the mainshaft.

Install the lifter rod (and steel ball, if removed).



Install the bearing in the lifter plate, then install the clutch springs, pressure plate, washer(s) and clutch spring bolts.

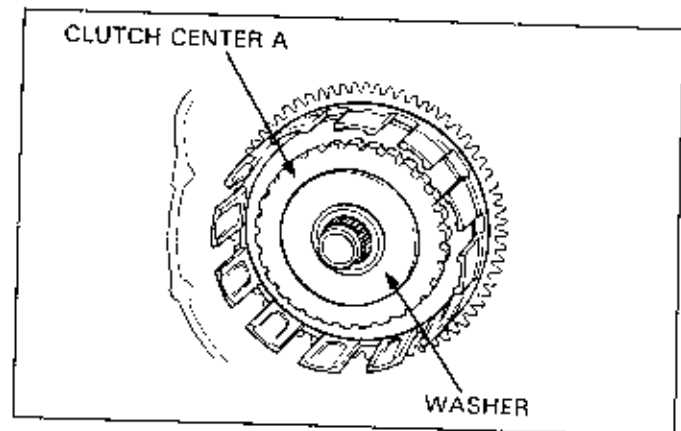
Tighten the clutch spring bolts.



(Type C)

Install the clutch outer guide, needle bearing and clutch outer (see page 11-19).

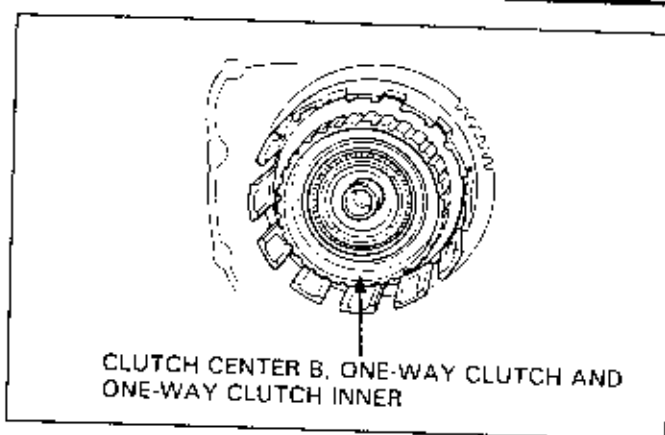
Install clutch center A and the washer.



Install the clutch center B, the one-way clutch and one-way clutch inner as an assembly onto the clutch outer.

NOTE

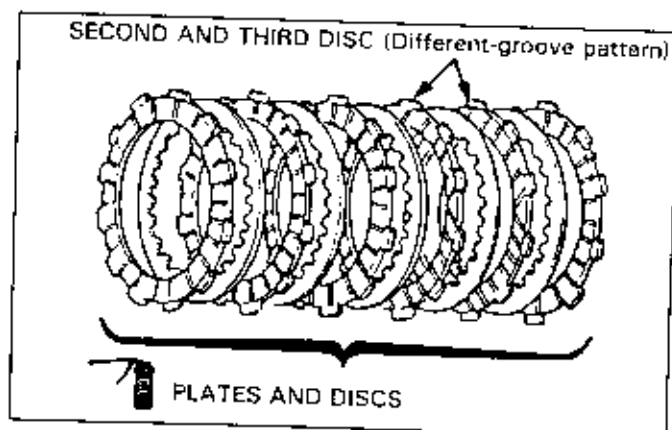
- See page 11-18 for one-way clutch assembly.
- Make sure that the one-way clutch is installed correctly by turning clutch center B. The clutch center should turn in the specified direction freely and should not turn in the opposite direction.



Coat the clutch plates and discs with clean engine oil and install them in the clutch outer and on the clutch center.

NOTE

- Two discs have different groove patterns than the other discs. Install these two in the SECOND and THIRD disc positions (from the mainshaft).
- Do not move clutch center B after installing the discs and clutch plates.

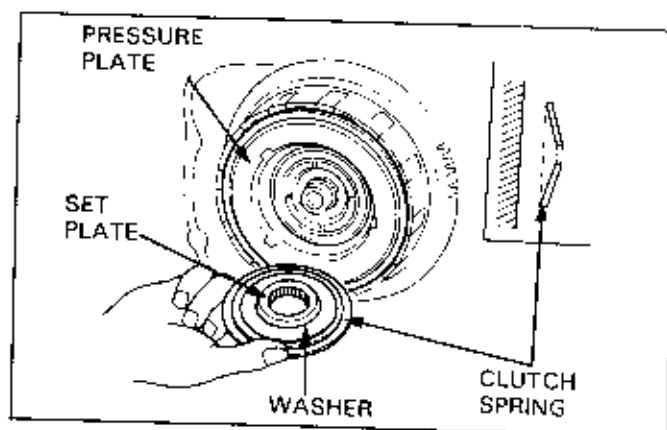


Install the pressure plate.

Install the washers, clutch spring and set plate.

NOTE

- Install the clutch spring with concave side toward the inside.

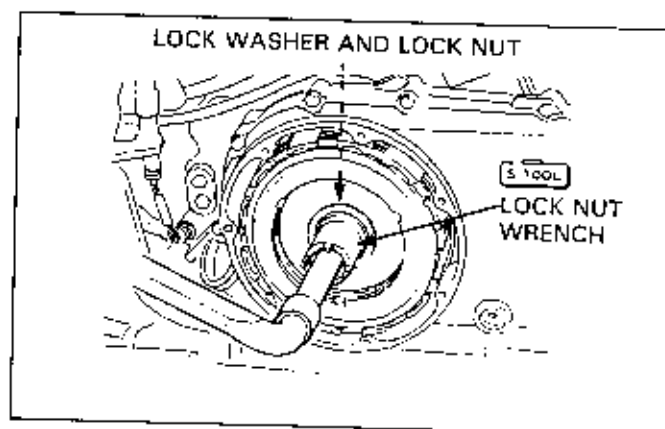


Install the lock washer and lock nut (see page 11-20).

Put the transmission in top gear and apply the rear brake. Then tighten the lock nut to the specified torque.

NOTE

- If the engine is not in the frame, shift the transmission into top gear, hold the drive sprocket with the universal holder, and tighten the lock nut.



CLUTCH

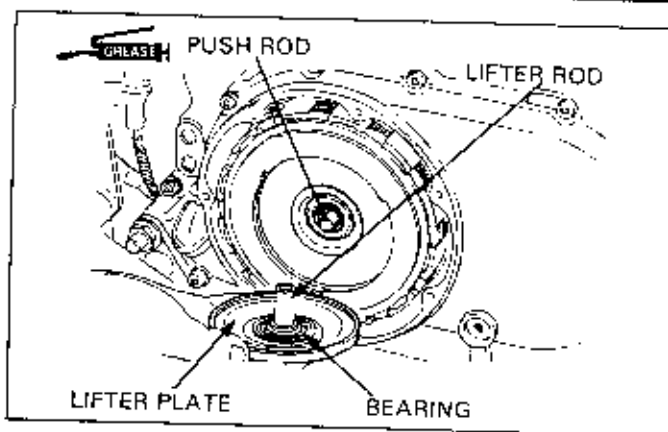
Coat the push rod with grease and install it in the mainshaft.

Install the lifter rod.

Untie the clutch lever from the handlebar.

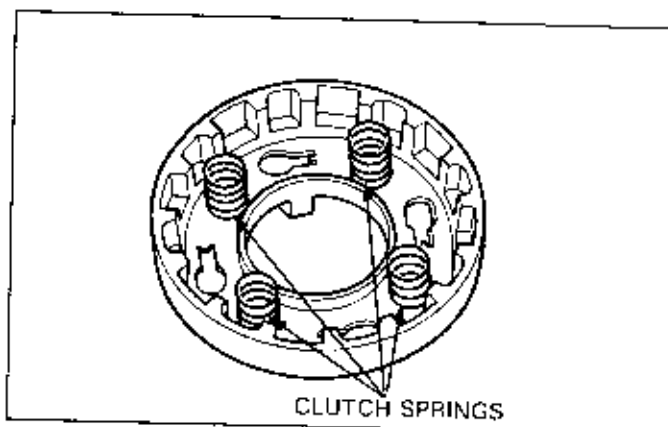
Install the bearing onto the lifter plate.

Install the lifter plate and secure it with the set ring.



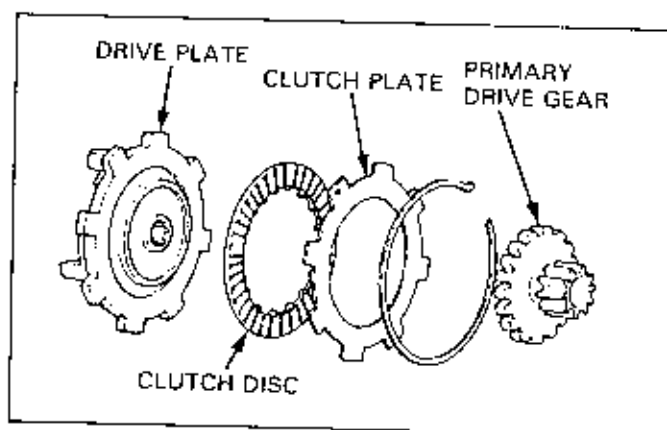
[Type D]

Install the clutch springs on the clutch outer.



Assemble the drive plate in the clutch outer.

Install the clutch disc, clutch plate and primary drive gear.

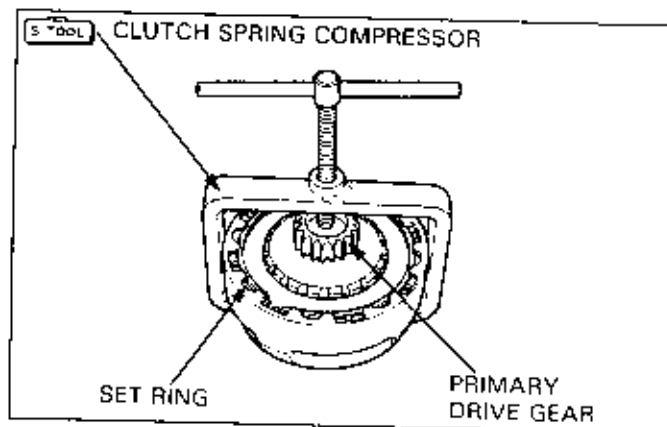


Compress the clutch springs with the clutch spring compressor, then install the set spring in the groove of the clutch outer.

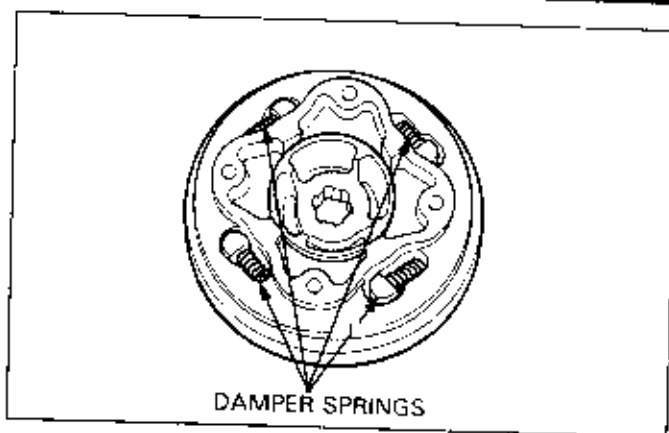
Remove the tool.

[S TOOL]

CLUTCH SPRING COMPRESSOR 07960-0110000

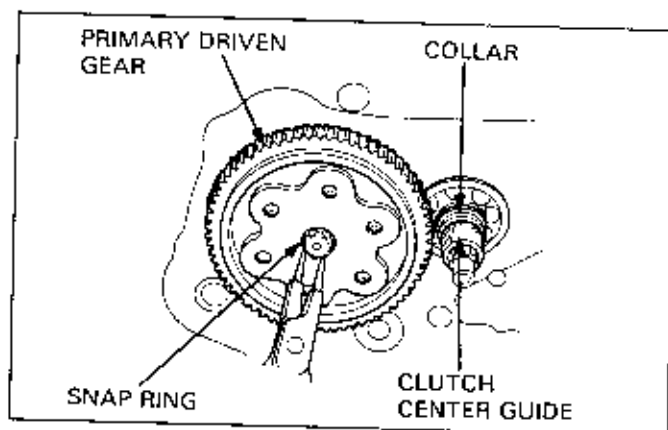


Install the clutch damper springs.



Install the collar and clutch center guide onto the crankshaft.

Install the primary driven gear onto the mainshaft and secure it with a snap ring.



Install the clutch assembly onto the crankshaft.

Install a new lock washer B [tongued washer] onto the mainshaft.

NOTE

- Replace lock washer B with new one whenever it is removed.

Install lock washer A with the "OUTSIDE" mark facing outside. If there is no mark, install the lock washer with the convex side toward the outside.

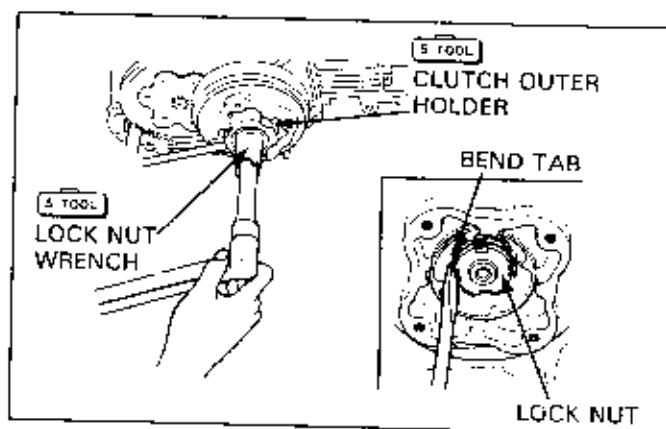
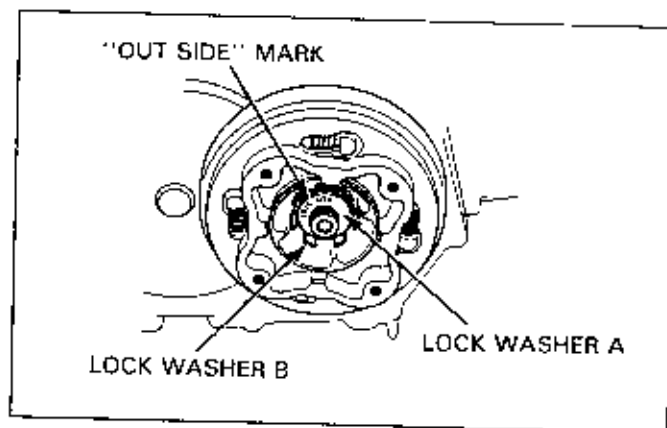
Install the lock nut with the chamfered edge toward the inside.

Hold the clutch outer using a special holder tool and tighten the lock nut to the specified torque.

Bend the tab of lock washer B up into the lock nut groove.

NOTE

- If the tab and groove aren't aligned, turn the lock nut in the tightening direction to align; do not loosen the nut to set the locking tab.

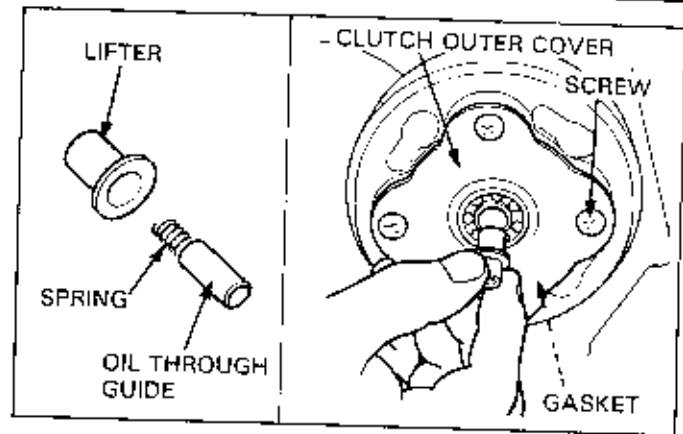


CLUTCH

Install a new gasket onto the clutch outer.

Install the clutch outer cover and tighten the mounting screws.

Install the lifter, spring and oil through guide onto the clutch assembly.



CLUTCH LIFTER REASSEMBLY

(Type A and a part of type B)

Coat the lifter arm and dust seal with grease.

Install the lifter arm and return spring.

Drive in a new spring pin using a pin driver until the pin does not interfere with the lifter arm.

Reset the return spring in the place.

Install the lifter rod into the cutout in the lifter arm.

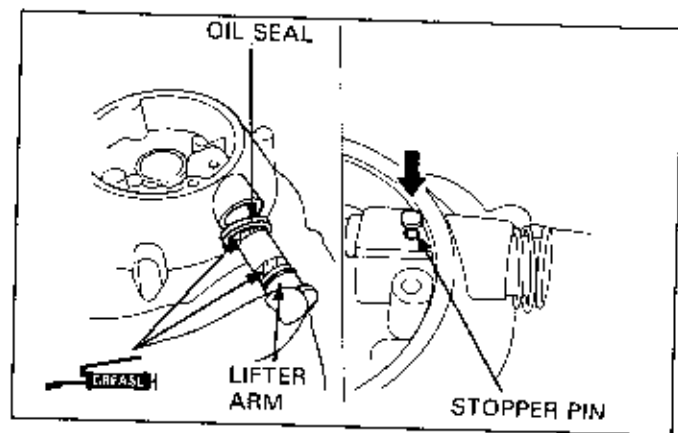
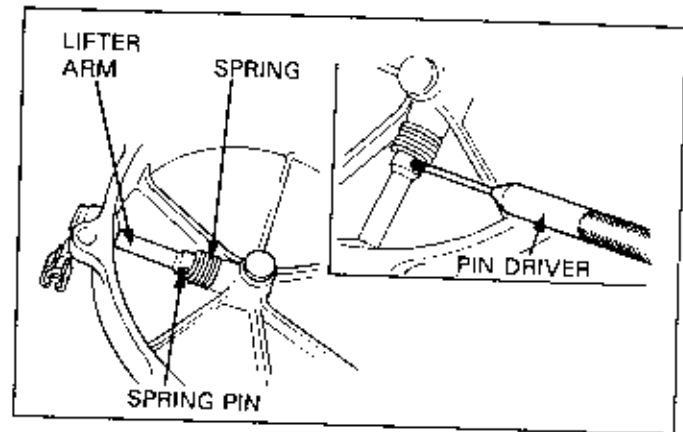
Install the crankcase cover (see the Model Specific manual).

(Type D)

Coat the lifter arm with grease.

Replace the O-ring with new one, and install the return spring and lifter arm in the crankcase cover.

Install the stopper pin into the pin hole on the crankcase cover.

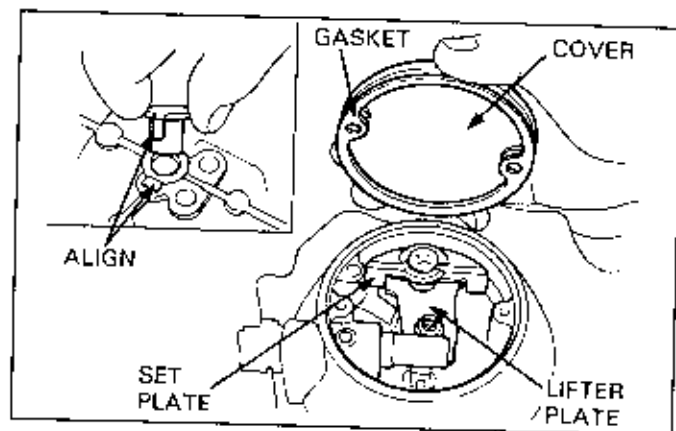


Install the lifter plate and set plate, then tighten the screw.

Install the lifter rod by aligning the boss of the lifter rod with the groove in the crankcase cover.

Install a new gasket and the clutch lifter cover. Tighten the screws.

Install the crankcase cover (see the Model Specific manual).



HYDRAULIC CLUTCH SYSTEM SERVICE

FLUID REPLACEMENT

Before removing the reservoir cover, turn the handlebar until the reservoir is level.

Place a rag over painted, plastic or rubber parts whenever the system is serviced.

Remove the reservoir cover, diaphragm cover and diaphragm.

CAUTION

- Spilled fluid will damage painted, plastic or rubber parts.

Connect a bleed hose to the bleed valve.

Loosen the bleed valve and pump the clutch lever.

Stop operating the lever when no fluid flows out of the bleed valve.

Refill with the same type of fluid from an unopened container.

Do not allow foreign material to enter the system when refilling the reservoir.

WARNING

- Using the wrong fluid will cause loss of braking efficiency.
- Contaminated fluid can clog the system, causing a loss of braking ability.

Connect the brake bleeder to the bleed valve.

Pump the brake bleeder and loosen the bleed valve.

Add clutch fluid when the fluid level in the master cylinder reservoir is low.

Repeat above procedure until air bubbles do not appear in the bleed hose.

NOTE

- Be sure the fluid reservoir is parallel to the ground before removing the cover and diaphragm.
- If air enters the bleeder from around the bleed valve threads, seal the threads with teflon tape.

If the brake bleeder is not available, perform the following procedure.

Connect a bleed hose to the bleed valve.

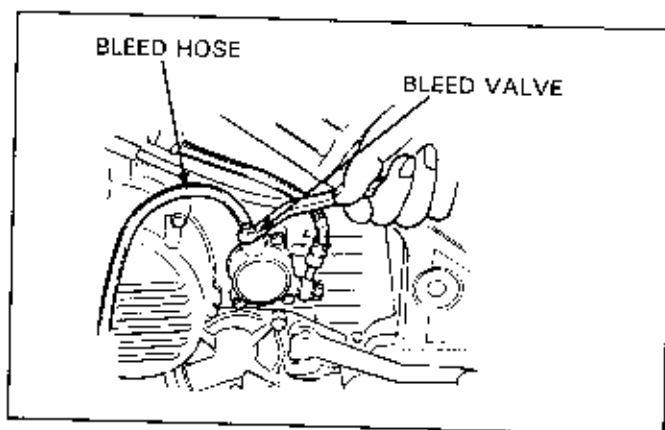
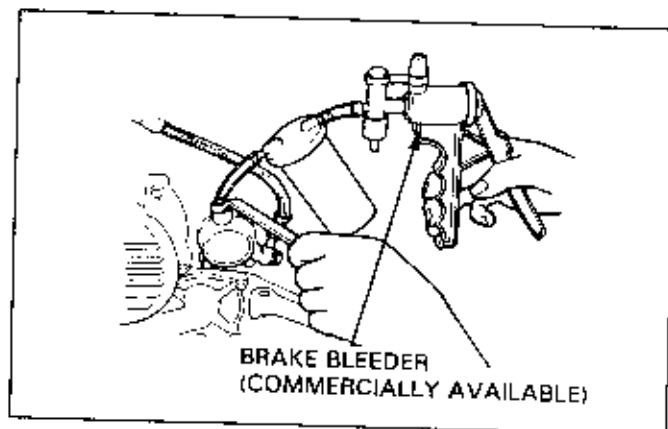
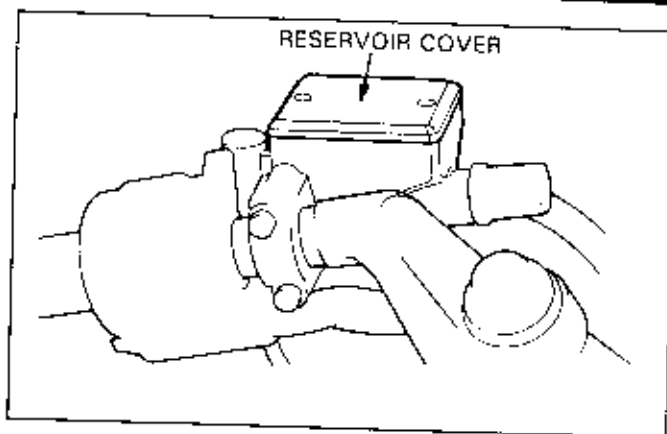
Loosen the slave cylinder bleed valve and pump the clutch lever.

Stop operating the lever when no fluid flows out of the bleed valve.

Close the bleed valve. Fill the reservoir, and install the diaphragm.

Pump up the system pressure with the lever until there are no air bubbles in the fluid flowing out of the reservoir small hole and lever resistance is felt.

Then bleed the system.



CLUTCH

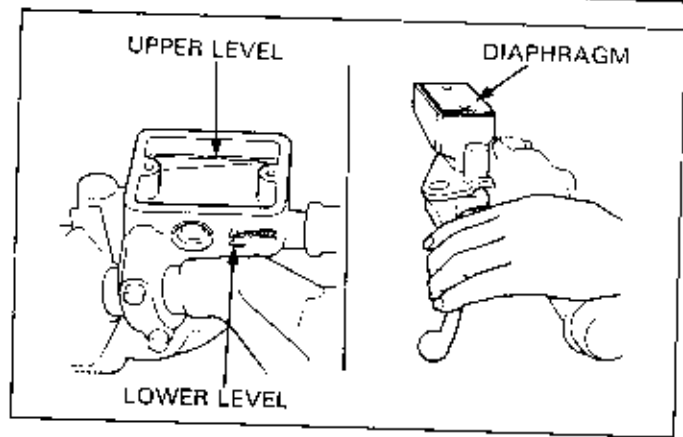
AIR BLEEDING

1) Squeeze the clutch lever, open the bleed valve 1/2 turn then close the valve.

NOTE

- Do not release the clutch lever until the bleed valve has been closed.
- Check the fluid level often while bleeding the system to prevent air from being pumped into the system.

2) Release the clutch lever slowly and wait several seconds after it is fully released, before repeating the procedure.

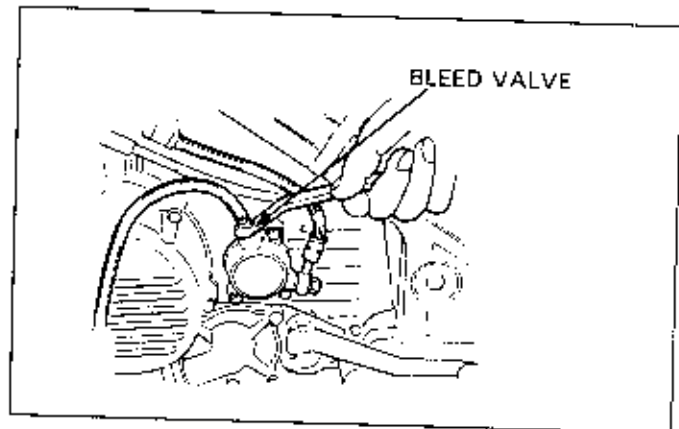


Repeat the above procedures until air bubbles no longer appear at the end of the hose.

Tighten the bleed valve to the specified torque.

Fill the clutch fluid reservoir to the upper level.

Install the diaphragm, diaphragm cover and reservoir cover.



CLUTCH MASTER CYLINDER

Removal/Disassembly

Place a rag over painted, plastic or rubber parts whenever the system is serviced.

CAUTION

- Spilled fluid will damage painted, plastic, or rubber parts.

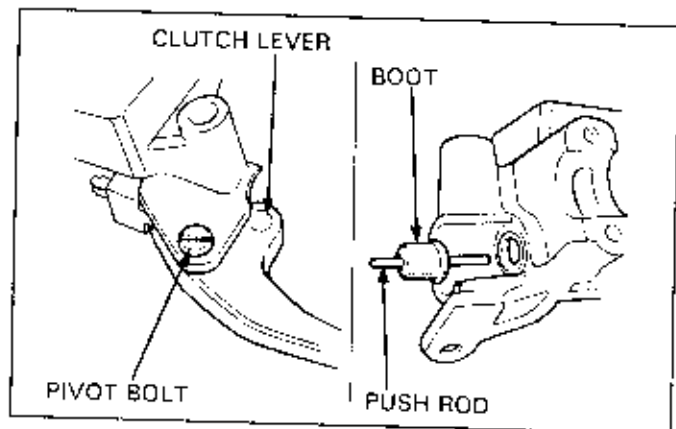
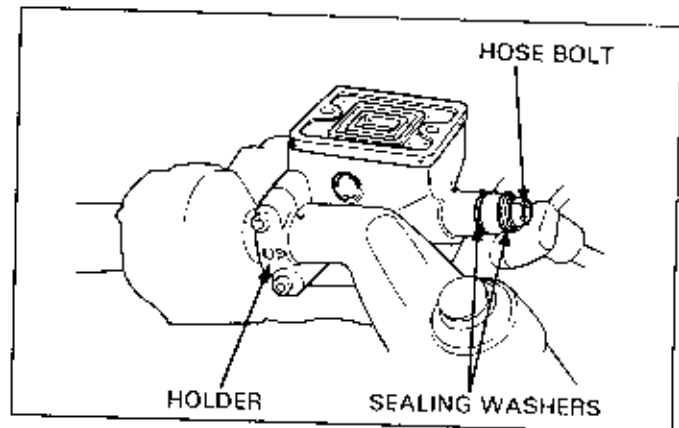
Disconnect the clutch switch wires, and remove the clutch hose bolt and two sealing washers.

Cover the end of the hose with a clean rag to prevent contamination of the system. Then secure the hose to the handlebar.

Remove the holder bolts and holder, then remove the master cylinder from the handlebar.

Remove the clutch lever pivot bolt, nut and clutch lever.

Remove the push rod and boot.

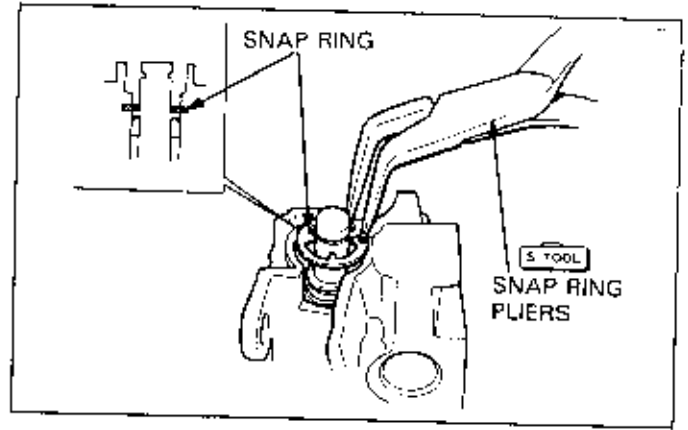


Remove the snap ring from the master cylinder.

5 TOOL

SNAP RING PRIERS

07914-3230001 or equivalent tool commercially available

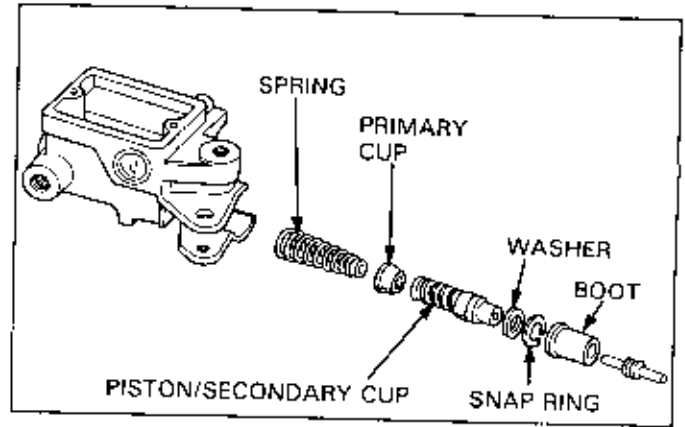


Remove the washer, piston/secondary cup, primary cup and spring from the master cylinder body.

Replace the master piston components as a set.

CAUTION

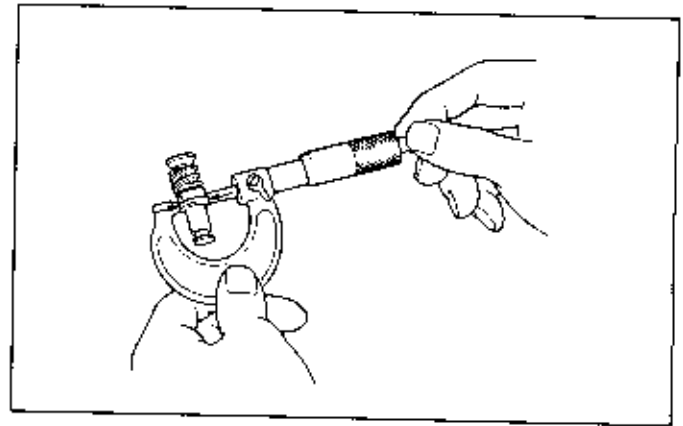
- Replacing individual master piston components can cause clutch system failure.



Inspection

Check the primary cup and secondary cup for wear, damage or deterioration and replace as necessary.

Measure the master piston O.D., replace if the service limit is exceeded.

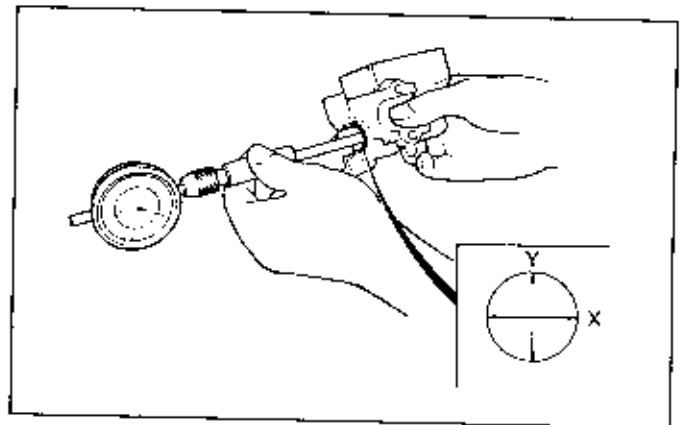


Check the master cylinder for scores or nicks and replace as necessary.

Measure the master cylinder I.D. in X and Y directions; replace if the service limit is exceeded.

NOTE

- Replace the piston, spring and cups as a set.



CLUTCH

Assembly/Installation

Clean all parts thoroughly.

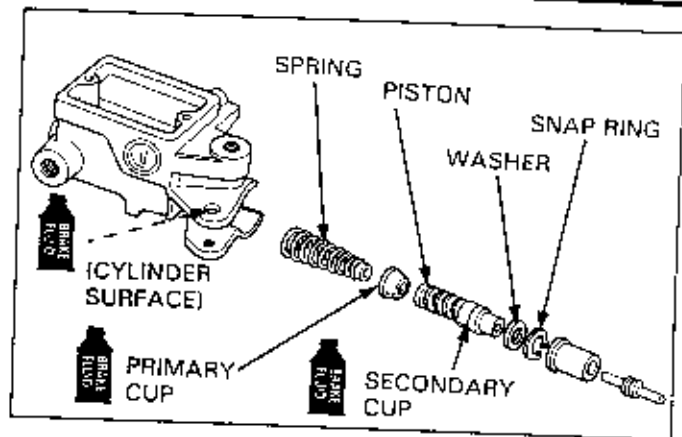
Coat the primary and secondary cups with clean brake fluid before assembly.

Install the spring in the master cylinder with the small end out.

Install the primary cup and piston/secondary cup.

CAUTION

- Allowing the lips to turn inside out when installing the cups will result in brake system failure.

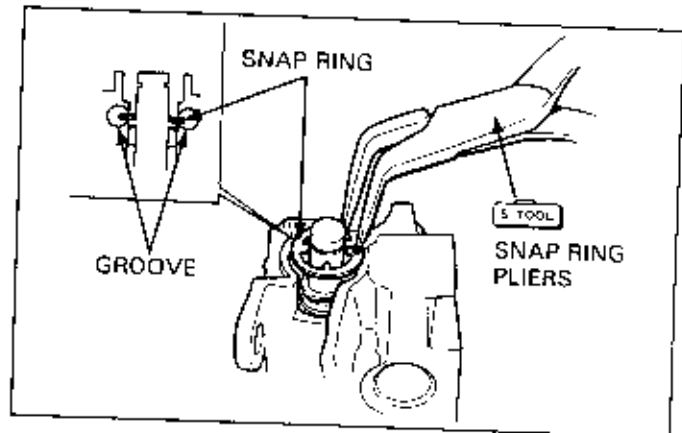


Install the washer and snap ring making sure the snap ring is seated firmly in the groove.

S TOOL

SNAP RING PLIERS

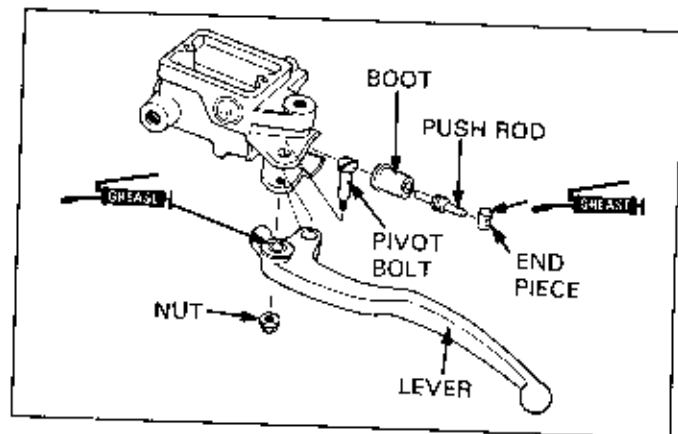
07914-3230001 or
equivalent tool
commercially available



Install the boot and push rod.

Set the push rod end piece into the clutch lever hole. Then install the lever with the end piece over the push rod.

Screw in the pivot bolt making sure that the lever moves smoothly, then tighten the pivot nut securely.



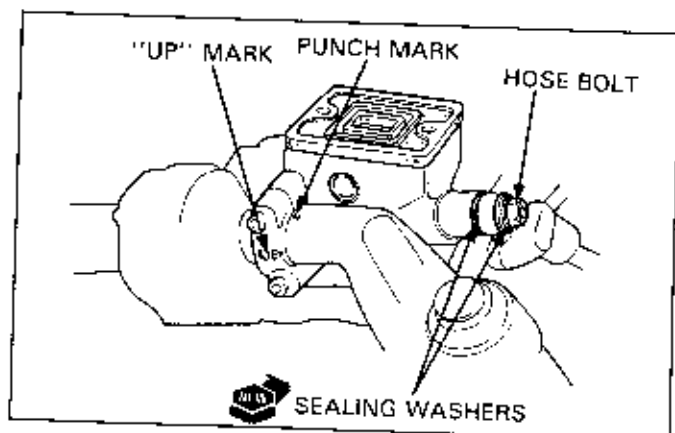
Place the master cylinder on the handlebar and install the holder with the "UP" mark facing up.

Align the end of the holder with the handlebar punch mark.

Tighten the upper holder mounting bolt first, then tighten the lower bolt.

Install the clutch hose with the bolt and two new sealing washers.

Connect the clutch switch wires to the switch terminals.
Fill the reservoir and bleed the clutch system (page 11-28).



CLUTCH SLAVE CYLINDER

Place a rag over painted, plastic or rubber parts whenever the system is serviced.

CAUTION

- Spilled fluid will damage painted, plastic, or rubber parts.

Remove the slave cylinder mounting bolts and then remove the slave cylinder from the crankcase.

NOTE

- Do not disconnect the clutch hose until the piston has been removed.

Inspect the piston seals for signs of leakage.

Disassemble the slave cylinder and replace the piston seal as required.

Place a clean pan under the slave cylinder to catch the draining fluid and squeeze the clutch lever slowly to push out the piston.

Drain the clutch fluid. Temporarily install the slave cylinder then disconnect the clutch hose.

Remove the spring from the piston.

Check the piston and cylinder for scoring or scratches.

Remove the oil seal and piston seal from the piston and discard them.

The seals must be replaced with new ones whenever they have been removed.

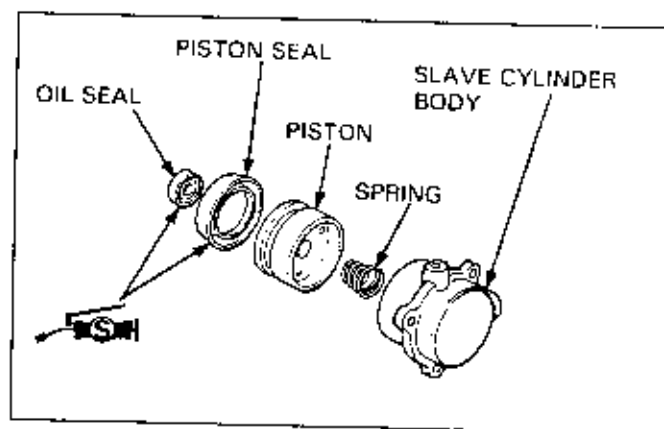
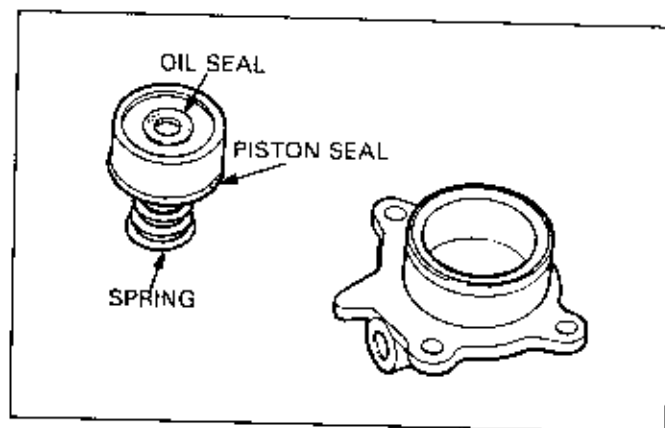
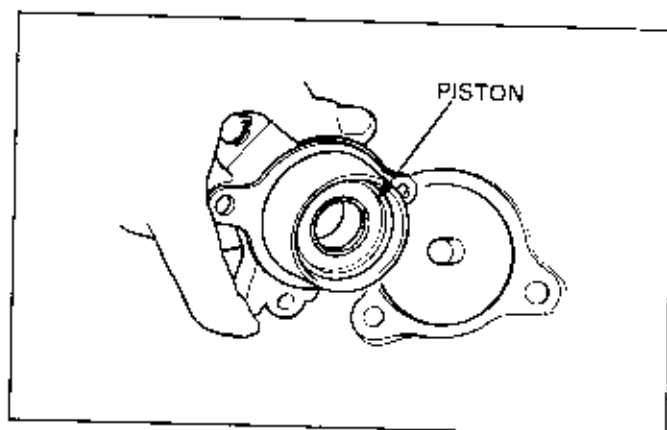
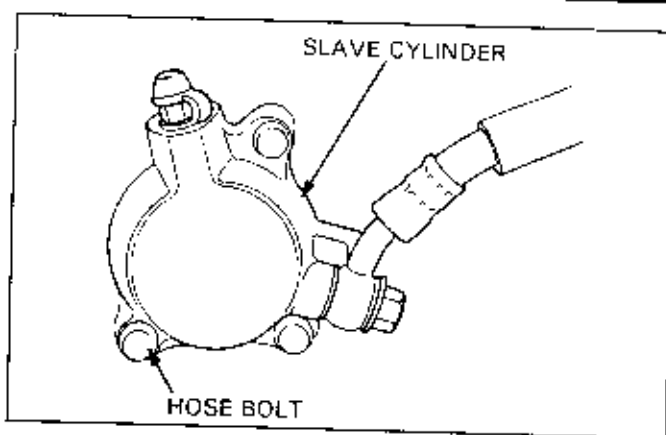
Assembly

Assemble the slave cylinder in the reverse order of disassembly.

Apply a medium grade of hi-temperature silicone grease or brake fluid to the new piston seal and oil seal.

Carefully seat the piston seal in the piston groove. Install the oil seal. Place the piston in the cylinder with the seal end facing out.

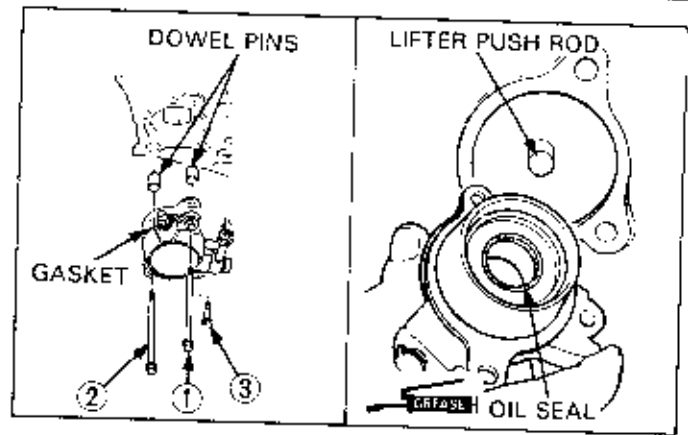
Install the spring in the cylinder with small end toward the piston.



CLUTCH

Make sure that the clutch lifter push rod is installed properly.

Install the dowel pins and a new gasket onto the slave cylinder and install the cylinder by aligning the push rod with the oil seal hole.



Tighten the mounting bolts to the specified torque.

NOTE

- Some models have dowel bolts instead of dowel pins to secure the slave cylinder positions.
- Note the location of the dowel bolts or dowel pins for positioning the slave cylinder.
- Tighten the bolts in 2 or 3 steps in a crisscross pattern starting from the dowel bolt or the dowel pin bolt.

Connect the clutch hose with the hose bolt and two new sealing washers, then tighten the hose bolt to the specified torque.

Fill the clutch fluid reservoir and bleed the clutch system (page 11-28).

