

## CRANKCASE/CRANKSHAFT

### Two-Piece Type:

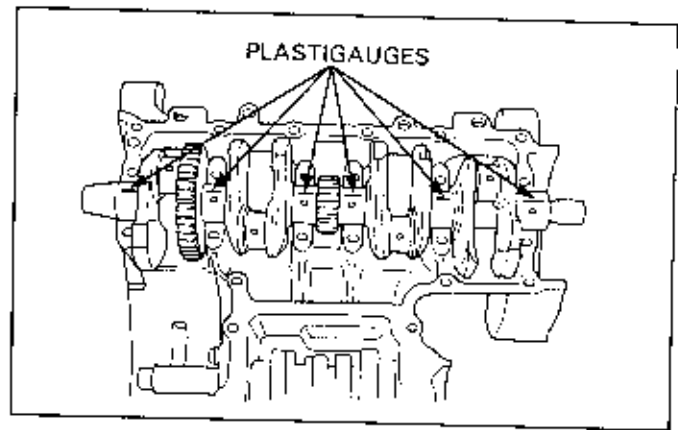
Wipe all oil from the bearing inserts and journals.

Reinstall the upper crankcase's main bearing inserts, then carefully lower the crankshaft in place.

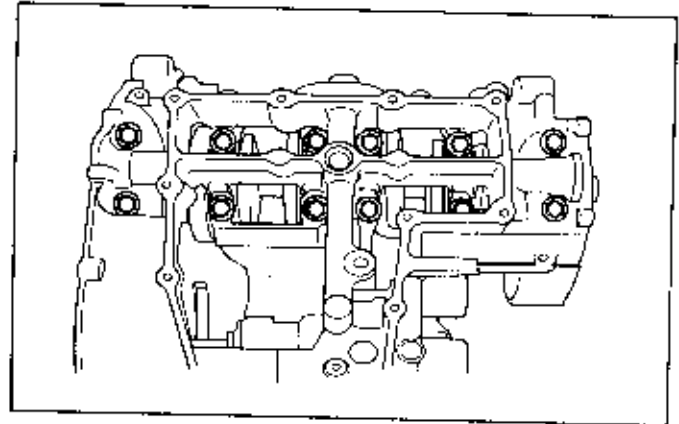
Put a piece of plastiguage on each journal.

### NOTE

- Do not put the plastiguage over the oil holes.
- Do not rotate the crankshaft during the inspection.

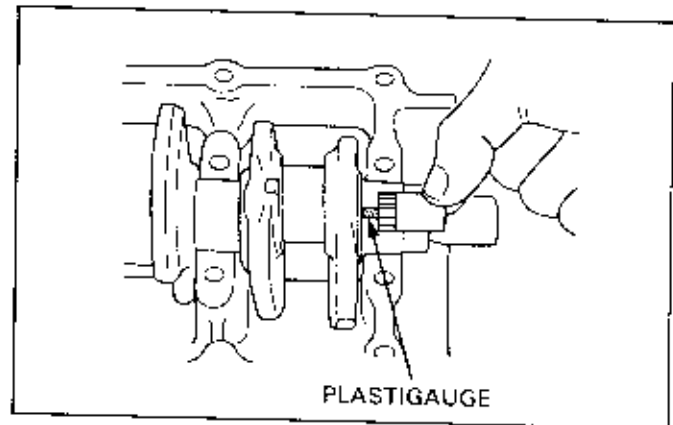


Install the main bearing inserts on the correct journals in the lower crankcase, then assemble and tighten the bolts evenly in 2 or 3 steps to the specified torque.



Remove the lower crankcase and measure the compressed plastiguage on each journal.

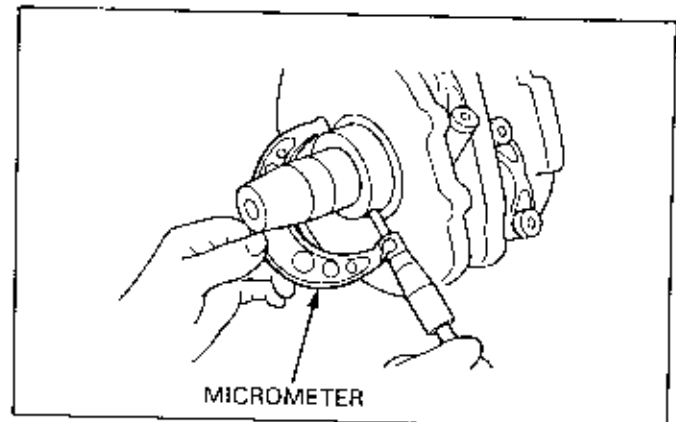
If the clearance is beyond the service limit, select the correct replacement bearings.



### One-piece Type

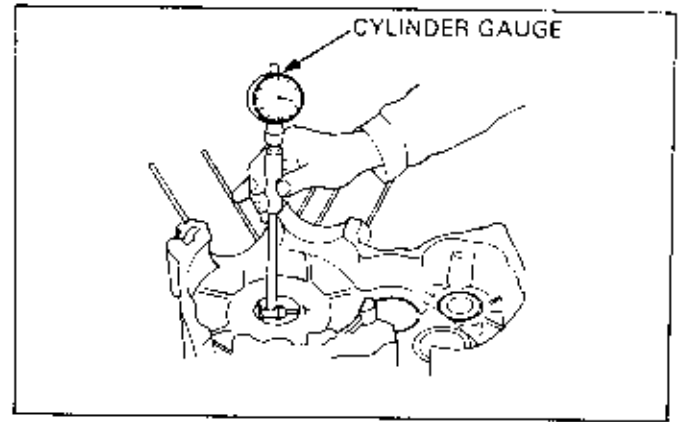
Wipe all oil from the bearing and the crankshaft journals.

Measure and record the crankshaft main journal O.D.



Measure and record the main bearing I.D.

Calculate the oil clearance by subtracting the journal O.D. from bearing I.D. Replace the bearing if the service limit is exceeded.



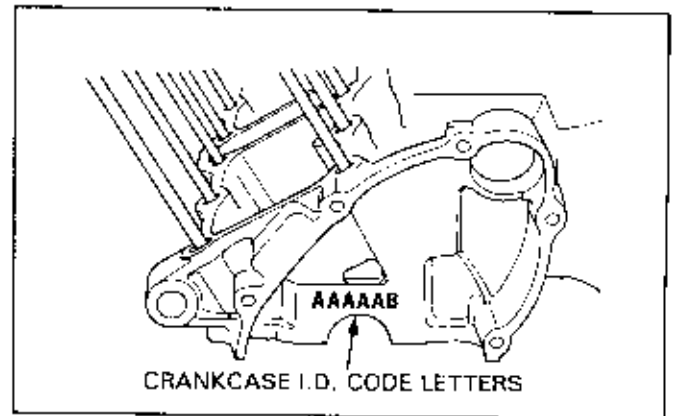
### MAIN BEARING SELECTION

#### Two-piece Type:

Record the crankcase I.D. code letters.

#### NOTE

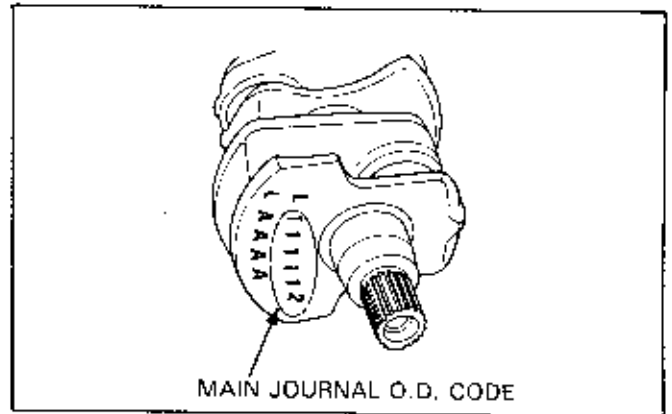
- Letters (A, B or C) on the upper crankcase are the codes for the main journal I.D.s from left to right.



Record the corresponding main journal O.D. code numbers (or measure the main journal O.D.).

#### NOTE

- Numbers (1, 2 or 3) on each crank weight are the codes for the main journal O.D.s from left to right.

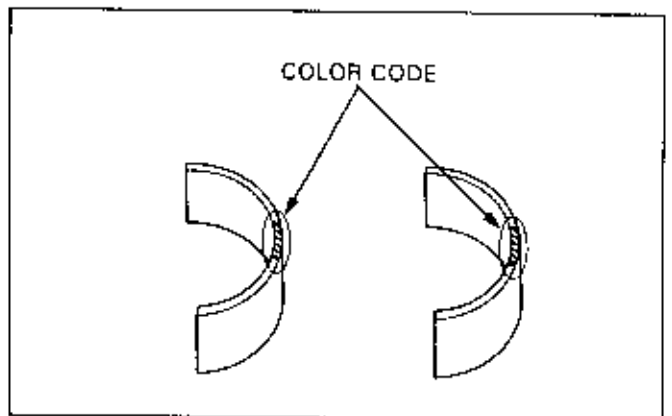


Cross reference the case and journal codes to determine the replacement bearing color code.

#### Example:

- I.D. code on the crankcase: A
- O.D. code on the crankshaft: 1
- Bearing color code: Pink

		CRANKCASE I.D. CODE		
		A	B	C
MAIN JOURNAL O.D. CODE	1	Pink	Yellow	Green
	2	Yellow	Green	Brown
	3	Green	Brown	Black



## CRANKCASE/CRANKSHAFT

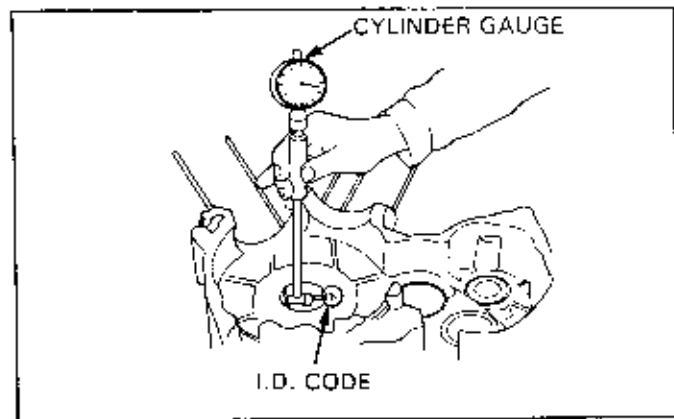
### One-piece Type

#### NOTE

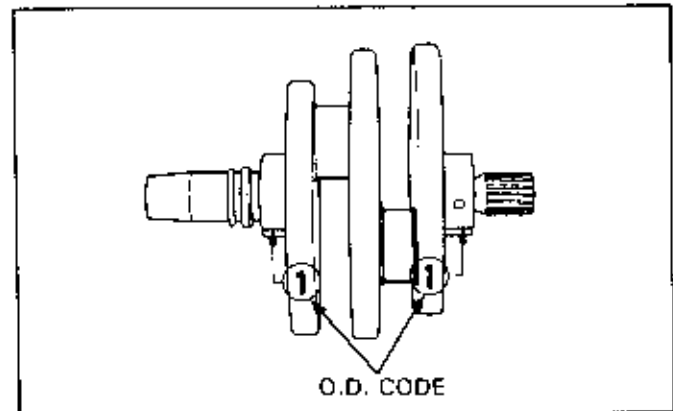
- Some bearings cannot be replaced. Refer to the Model Specific manual for complete information.

Press the old bearing out of the crankcase (page 11-7).

Record the I.D. code letter (A, B or C), or measure the crankcase I.D. after the bearing has been removed.



Record the main journal O.D. code number (1, 2 or 3).

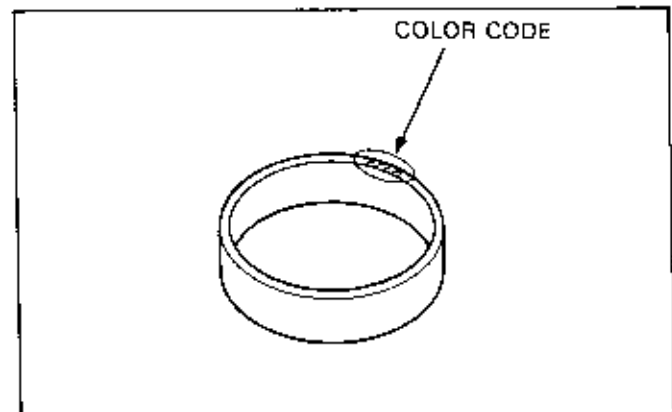


Cross-reference the case and journal codes to determine the replacement bearing color code.

#### Example:

I.D. code on the crankcase: A  
 O.D. code on the crankshaft: 1  
 Bearing code: Brown

		CRANKCASE I.D. CODE	
		A	B
MAIN JOURNAL O.D. CODE	1	Brown	Black
	2	Black	Blue

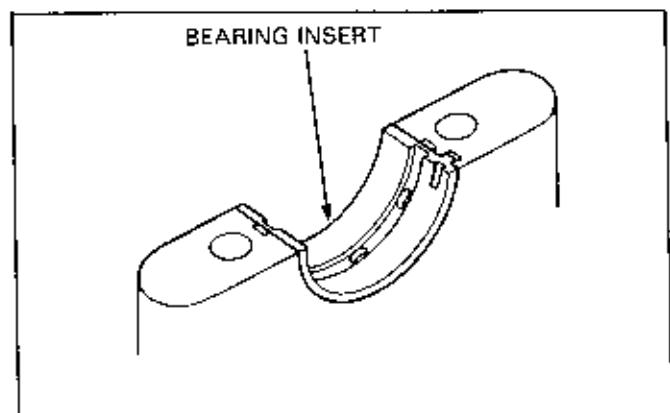


### REMOVAL

#### Two-piece Type

Carefully remove the bearing inserts from the crankcase.

Wipe all oil from the insert seating areas.

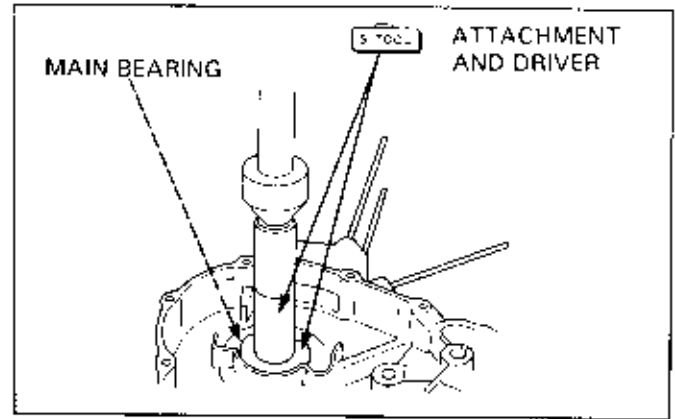


**One-piece Type:**

Press out the main bearing using the special tool and hydraulic press.

**CAUTION**

- When removing bearings, always use a hydraulic press and bearing removal tool to prevent crankcase damage.



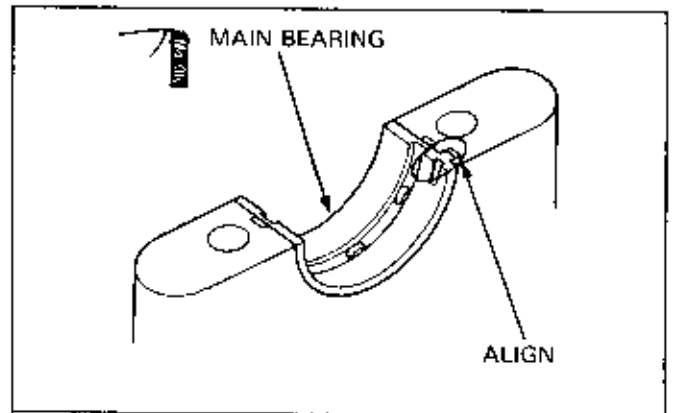
**MAIN BEARING INSTALLATION**

**Two-piece Type:**

Install the main bearings into the crankcase.

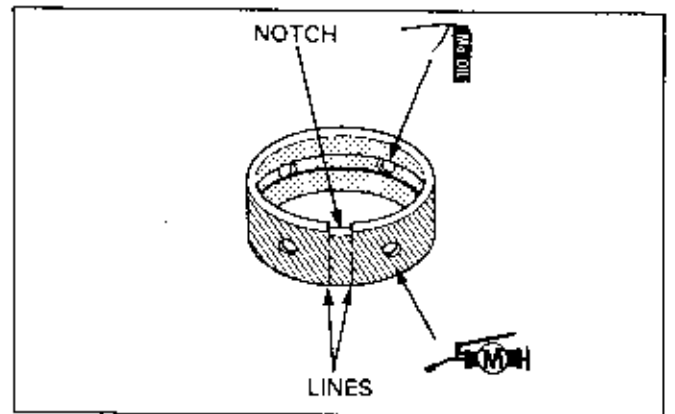
The bearing tabs should be aligned with the grooves in the case and caps.

Apply molybdenum disulfide solution to the upper and lower main bearings.



Mark a line perpendicular to the bearing surface from each edge of the notch as shown.

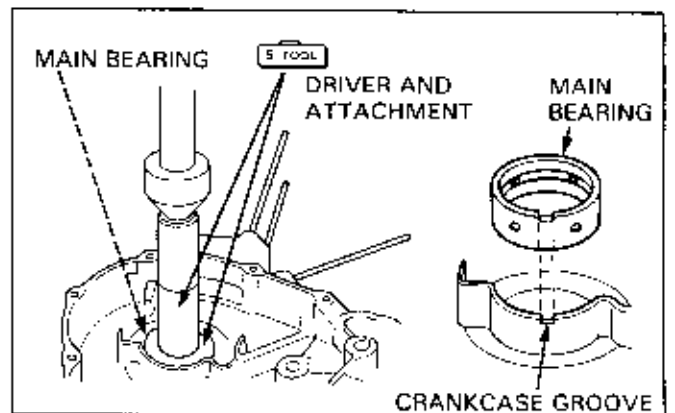
Apply molybdenum disulfide grease to the outer face of the bearing.



Place the bearing in the crankcase by aligning the two lines with the crankcase groove. Press it into place using a hydraulic press.

**CAUTION**

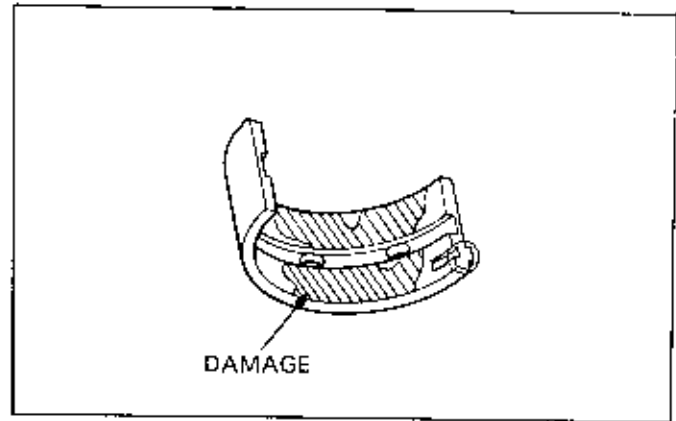
- Take care not to damage the inside surface of the new bearing during installation.



## CONNECTING ROD BEARINGS

### OIL CLEARANCE INSPECTION

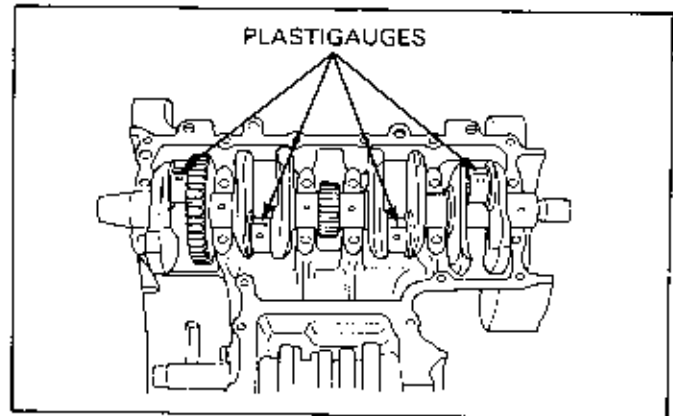
Check the bearing inserts for unusual wear or damage and replace as necessary.



Wipe all oil from the bearing inserts and crankpins. Put a piece of plastigauge on each crankpin.

#### NOTE

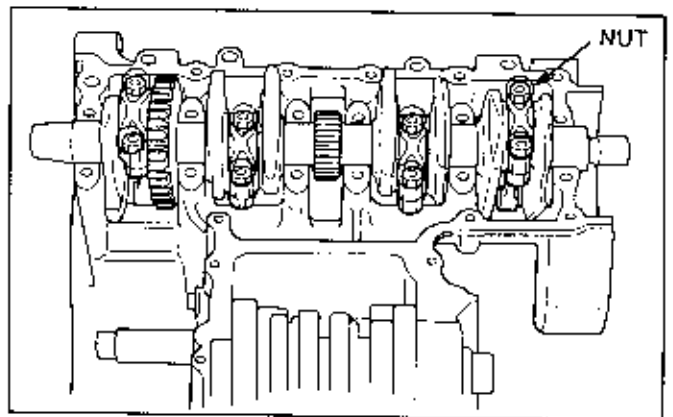
- Do not put the plastigauge over the oil hole in the crankpin.



Install the bearing caps and rods on the correct crankpins, and tighten them evenly.

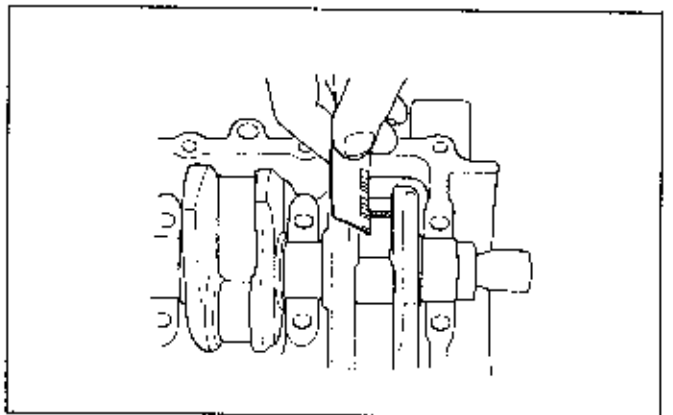
#### NOTE

- Do not rotate the crankshaft during inspection.



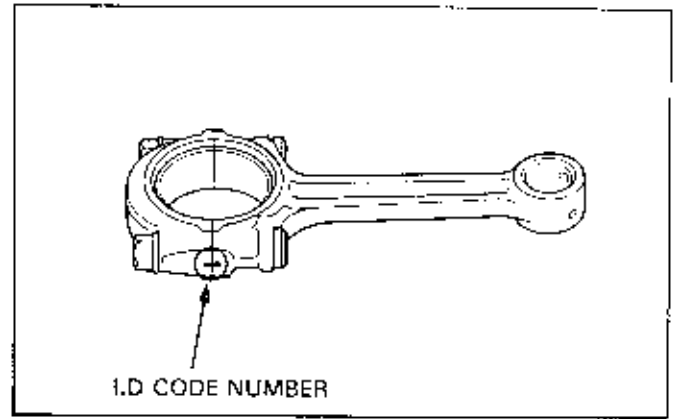
Remove the caps and measure the compressed plastigauge on each crankpin.

If the rod bearing clearance is beyond tolerance, select replacement bearings.

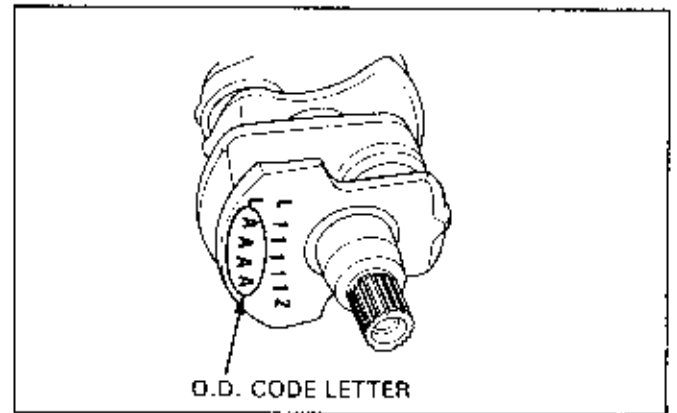


**4-STROKE  
BIG END BEARING SELECTION**

Record the corresponding rod I.D. code number (1, 2 or 3) or measure the I.D. with the bearing cap installed without bearing inserts.



Record the corresponding crankpin O.D. code letter (A, B or C) or measure the crankpin O.D.

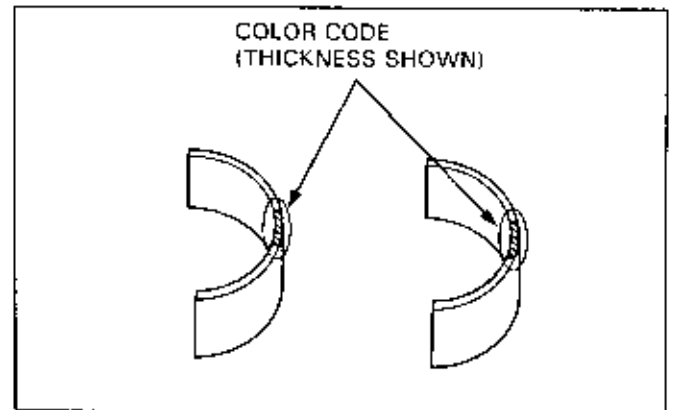


Cross-reference the crankpin and rod codes to determine the replacement bearing color.

**Example:**

- Crankpin code: A
- Connecting rod code: 1
- Bearing code: Pink

The pink code bearing should be selected.



		CRANKPIN I.D. CODE	
		A	B
CONNECTING ROD I.D. CODE	1	Pink	Yellow
	2	Yellow	Green

## CRANKCASE/CRANKSHAFT

### BEARING REPLACEMENT

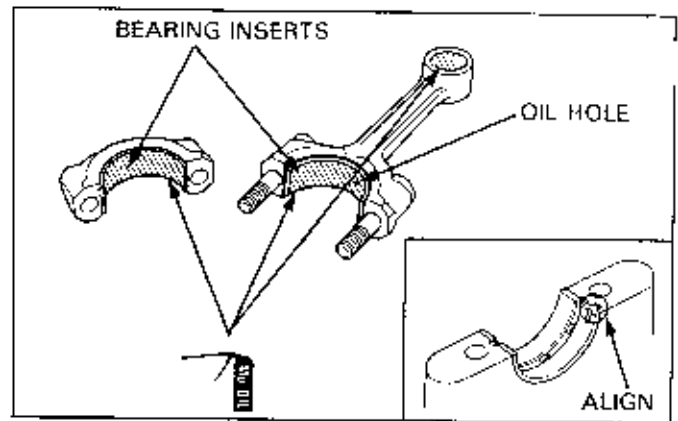
Remove the bearing inserts from the connecting rod and cap.

Wipe all oil from the connecting rod and the new bearing inserts.

Install the bearing inserts by aligning the tabs with the grooves in the connecting rod and cap.

#### NOTE

- The oil hole in the connecting rod should be aligned with the bearing insert oil hole.
- Apply molybdenum disulfide solution to the inside bearing surface for initial lubrication.



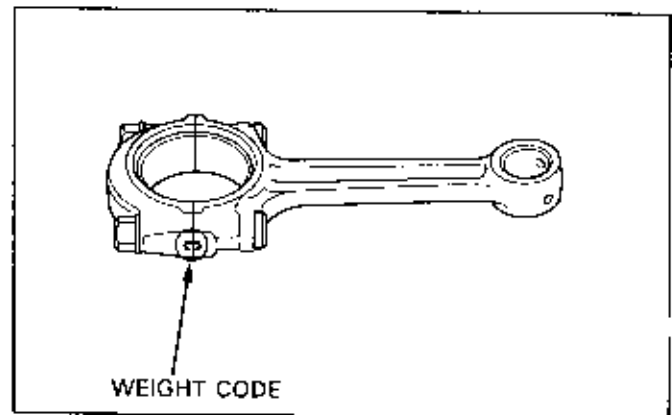
## CONNECTING ROD

### SELECTION

If a connecting rod requires replacement, you should select a rod with the same weight code (A, B or C) as the original.

#### NOTE

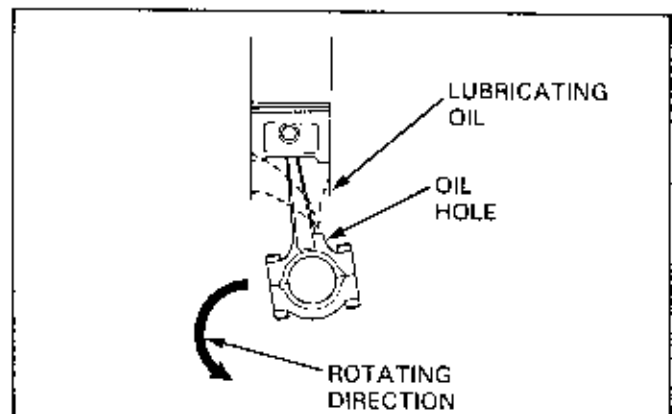
- An unbalanced connecting rod weight may cause abnormal engine vibration. If a rod with the same weight code is unavailable, use a replacement within one code letter of the original.



### INSTALLATION

Coat the inside bearing surfaces with molybdenum disulfide solution for initial lubrication, and reinstall them into the original positions and directions.

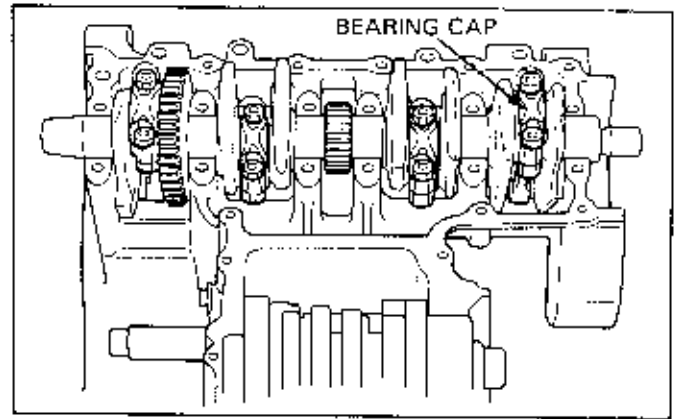
If the connecting rod has an oil hole, install the rod so that the hole is "behind" the crankshaft rotating direction as shown.



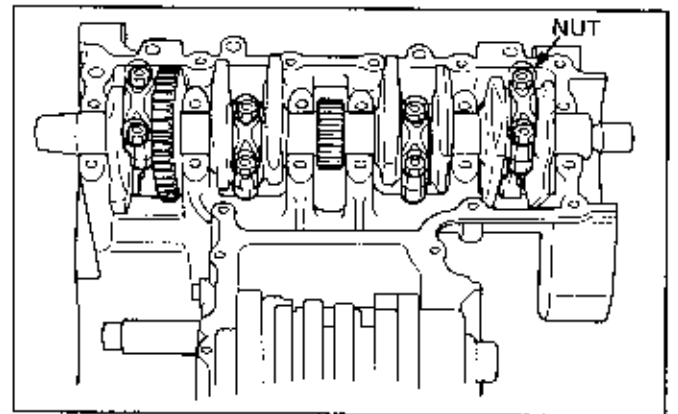
Install the bearing caps and connecting rods on the correct crankpins.

**NOTE**

- Install the connecting rods and bearing inserts in their original positions.
- Do not rotate the crankshaft and connecting rods during the plastigauge procedure.



Oil the threads of the connecting rod bolts and nuts so that the bolts will be tightened evenly. Tighten the nuts to the specified torque. After tightening, check that the connecting rods move freely without binding.



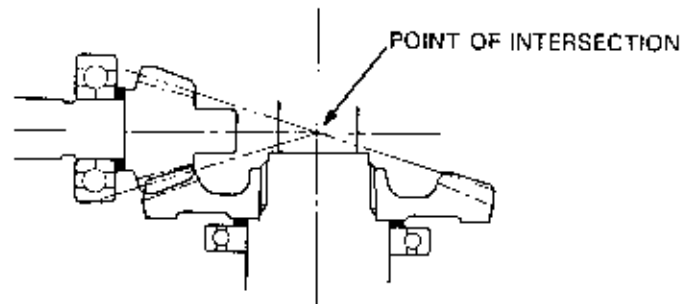


# 15. FINAL DRIVE/OUTPUT SHAFT

SERVICE INFORMATION	15-1	OUTPUT SHAFT	15-2
TROUBLESHOOTING	15-1	FINAL DRIVE	15-5
SYSTEM DESCRIPTION	15-2		

## SERVICE INFORMATION

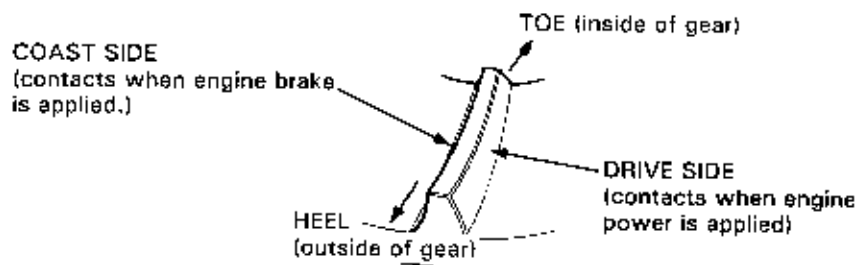
- Perform the gear contact pattern and backlash inspection and adjust the shim whenever you replace the bearings, gears or gear case. The extension lines from the gear engagement surfaces should intersect at one point.



- Check the ring gear-to-gear case cover stopper pin clearance on the final gear case. Adjust if it is out of specification.
- Replace the final drive shaft, side gear case output shaft, and the ring and pinion gears of the final gear case as a set.
- Protect the gear case with a shop towel while holding it in vise. Do not clamp it too tight as it could damage the gear case.
- When tightening the lock nut with a lock nut wrench, actual torque on the lock nut is greater than the reading by the length of the lock nut wrench.

Refer to the Medel Specific manual for specified torque. Do not overtighten the lock nut.

- Description of the tooth:



## TROUBLESHOOTING

### Excessive noise in final drive

- Worn or damaged ring gear and driven flange
- Damaged driven flange or wheel hub
- Worn or damaged pinion gear and/or pinion joint splines
- Excessive backlash between pinion and ring gears.
- Low oil level

### Excessive noise in side gear

- Worn or damaged output shaft and final drive shaft gears
- Worn or damaged side gear case bearing
- Incorrect adjustment shim

### Excessive rear wheel backlash

- Worn drive shaft splines
- Excessive backlash between ring gear and pinion gear
- Worn driven flange and ring gear splines
- Excessive play in final drive case bearings
- Worn drive shaft, universal joint and/or pinion joint splines
- Excessive play or worn universal joint bearing.

### Oil leak at final gear case

- Clogged breather hole
- Too much oil
- Faulty oil seal(s)

## FINAL DRIVE/OUTPUT SHAFT

### SYSTEM DESCRIPTION

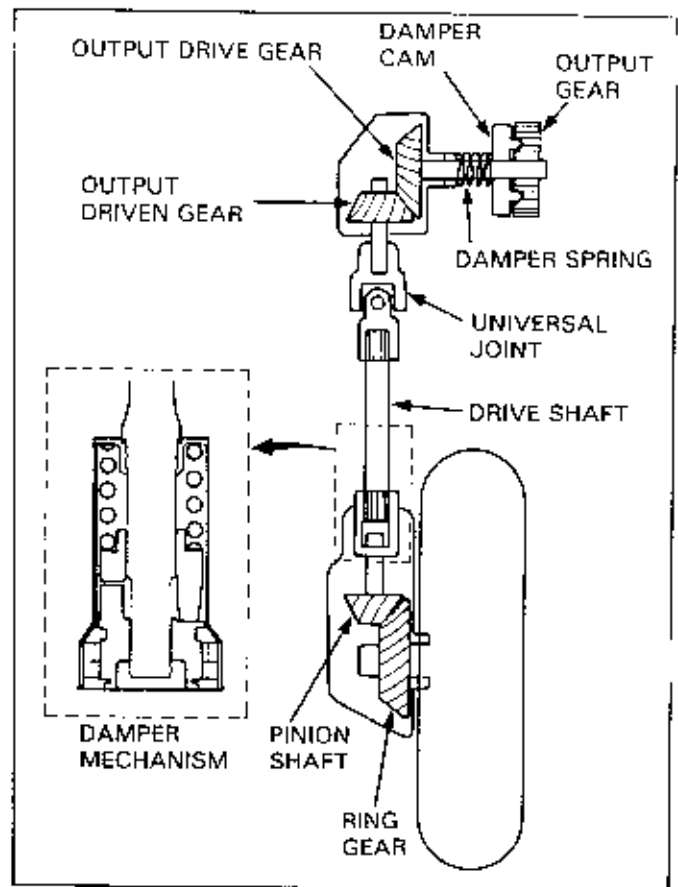
Power from the engine is transmitted to the rear wheel as follows:

Countershaft (or output drive shaft) → output driven shaft → drive shaft → pinion gear → ring gear → rear wheel.

To prevent harsh or jerky acceleration or deceleration a damper spring is placed in the drive line. The spring absorbs sudden applications of torque and provides smooth starts and stops.

The damper mechanism is attached to either the output gear case or drive shaft.

Unlike the drive chain, the system requires only periodic final gear oil change for maintenance.



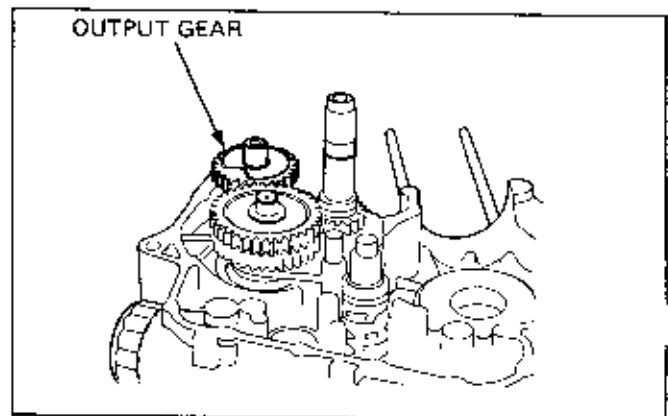
### OUTPUT SHAFT

#### REMOVAL

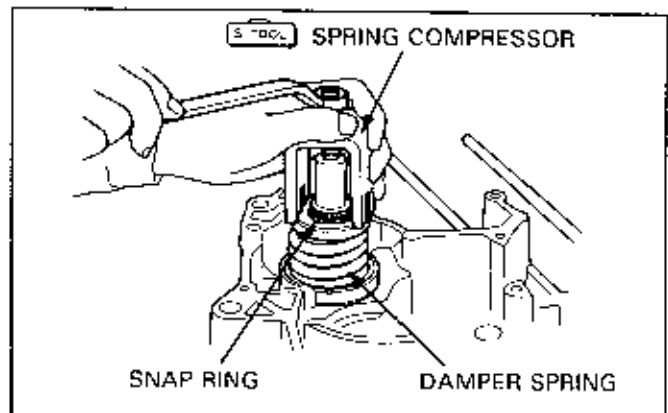
##### NOTE

- When a damper spring is installed to the output gear, remove the side gear case only after the damper spring has been removed. Follow the steps below.
- Refer to the Model Specific manual for output shaft removal.

Remove the output gear.



Using the damper spring compressor, compress the damper spring and remove the snap ring. Remove the damper spring compressor and then take out the damper cam and damper spring.



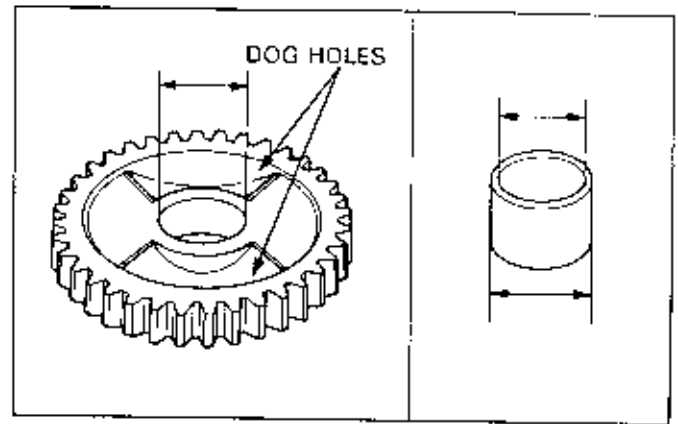
**INSPECTION**

Check the gear for damage or excessive wear, and the gear dog holes for damage; replace as necessary.

Measure the gear I.D.; replace if the service limit is exceeded.

Check the bushing for wear or damage.

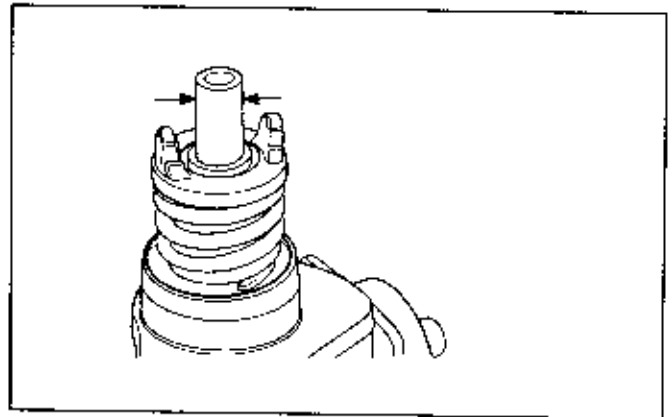
Measure the bushing I.D. and O.D.; replace if the service limit is exceeded.



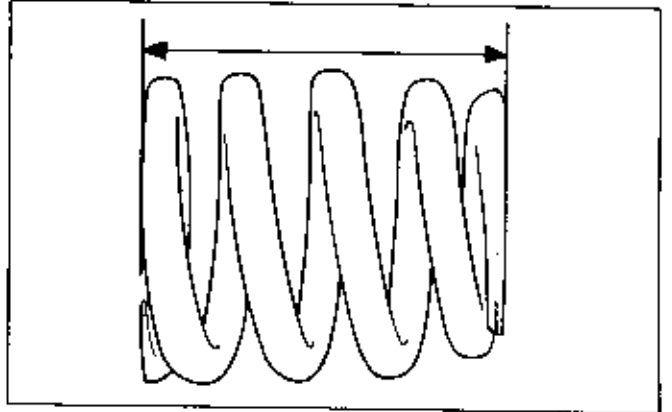
Calculate the gear-to-bushing clearance; replace the component if the service limit is exceeded.

Measure the O.D. of the countershaft or output drive shaft at the sliding area. Replace the shaft if the service limit is exceeded.

Calculate the shaft-to-bushing clearance. If the service limit is exceeded, determine if a new bushing would bring the clearance within tolerance. If so, replace the bushing. If the clearance still exceeds the service limit with new bushing, replace the shaft.



Measure the damper spring free length. Replace the spring if the free length exceeds the service limit.



**BACKLASH INSPECTION**

Clamp the output gear case in a vise that has soft jaws or use a shop towel.

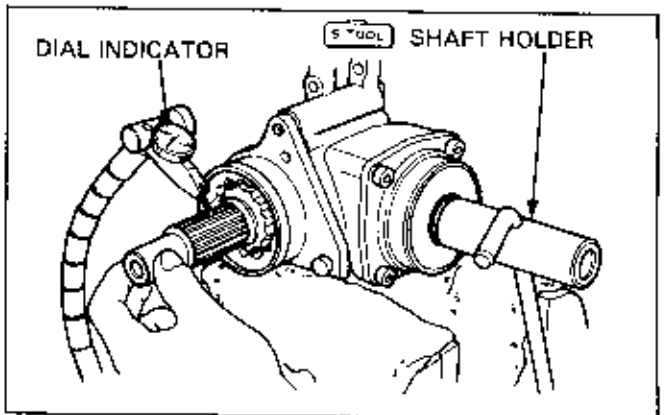
Set a horizontal type dial indicator on the countershaft or output drive shaft as shown.

Hold the driven gear with the shaft holder and rotate the countershaft or output drive shaft by hand until gear slack is taken up.

Turn the countershaft or output drive shaft back and forth to read the backlash.

Remove the dial indicator. Turn the countershaft or output drive shaft 120° and measure backlash. Repeat this procedure once more.

Compare the difference of the three measurements.

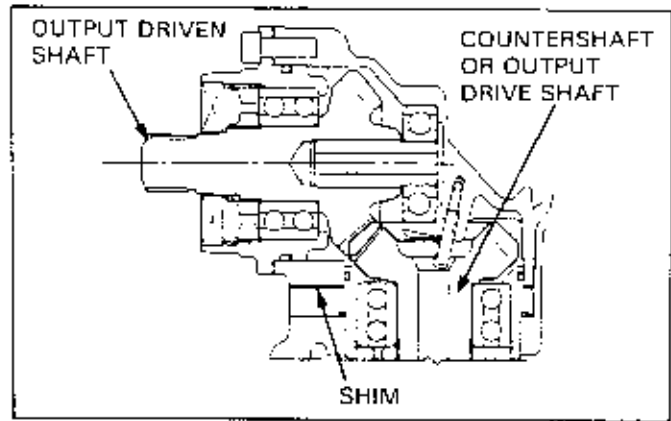


## FINAL DRIVE/OUTPUT SHAFT

If the difference in measurements exceeds the limit, it indicates that the bearing is not installed squarely. Inspect the bearings and reinstall if necessary.

If backlash is excessive, replace the countershaft or output drive shaft adjustment shim with a thinner one.

If the backlash is too small, replace the countershaft or output drive shaft shim with a thicker one.



### Gear tooth contact pattern check

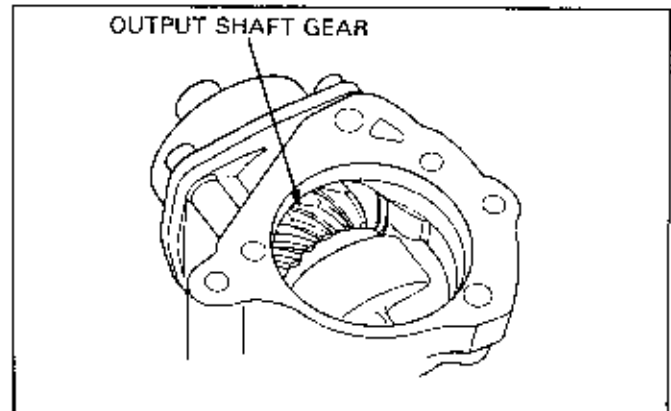
Remove the countershaft or output drive shaft from the side gear case.

Apply Prussian Blue to the output drive gear teeth.

Install the countershaft or output drive shaft and the shim.

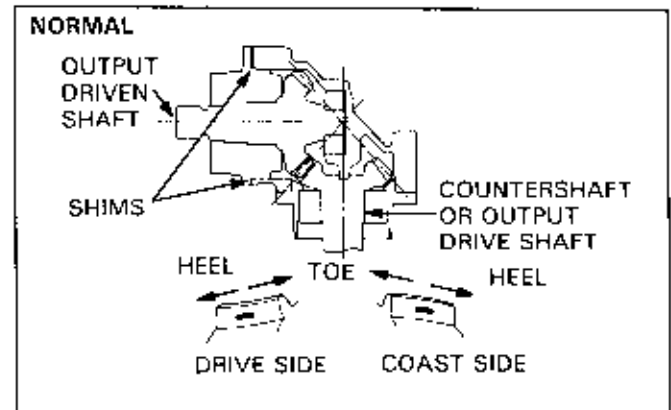
Rotate the drive shaft several times in the normal direction of rotation.

Remove the shaft and check the gear tooth contact pattern.

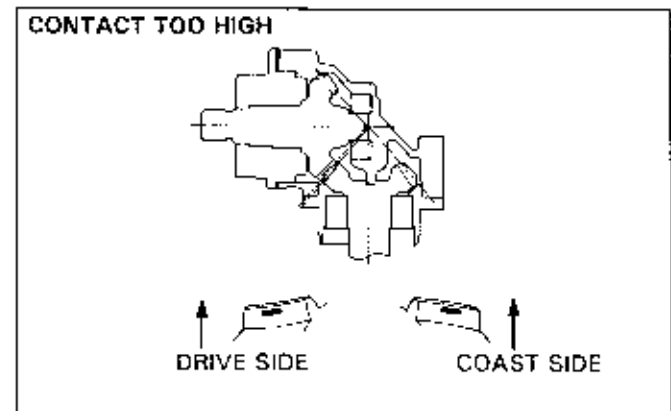


Contact is normal if Prussian Blue is transferred to the approximate center of each tooth and slightly to the side.

If the pattern is not correct, remove the output driven shaft and replace the shaft adjustment shim.

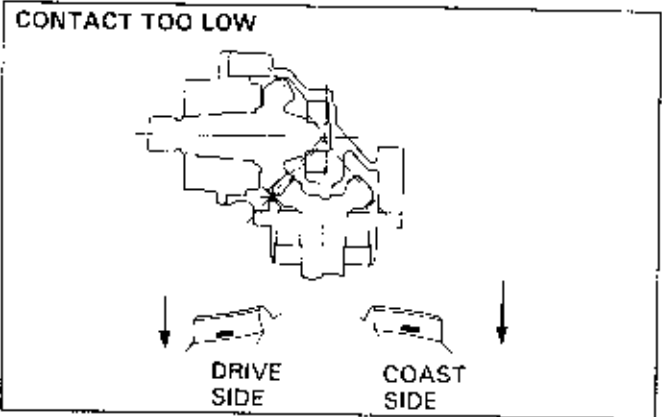


Replace the shim with a thinner one if the contact pattern is too high.



Replace the output shaft adjustment shim with a thicker one if the contact is too low.

Refer to the **Model Specific manual** for information of shim thickness.

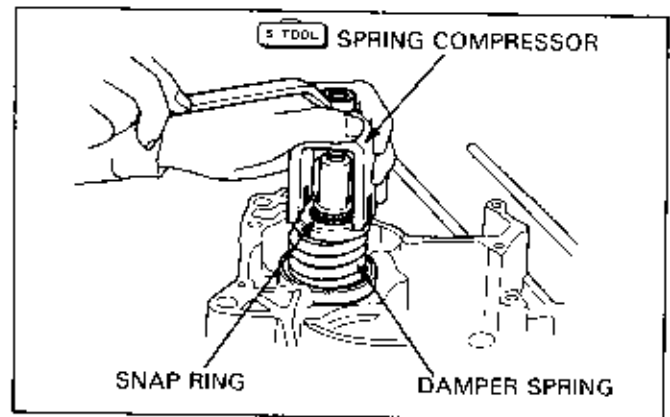


## INSTALLATION

Refer to the **Model Specific manual** for side gear case installation.

If the damper spring has been removed, install it according to the following procedure.

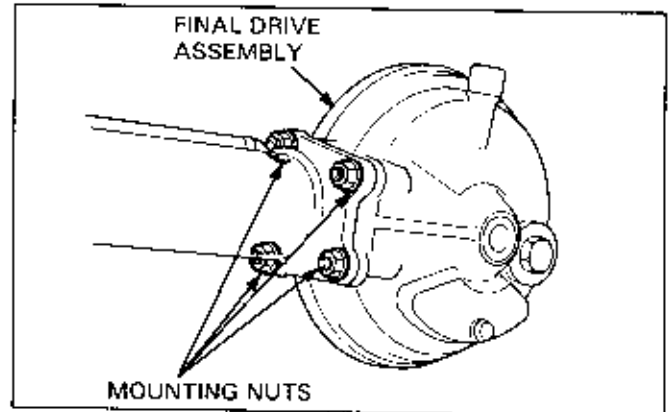
Place the damper spring and damper cam over the shaft. Install the damper spring compressor and compress the spring, then install the snap ring securely.



## FINAL DRIVE

### REMOVAL

Drain the final gear oil and remove the rear wheel. Remove the mounting nuts, and remove the final drive assembly.



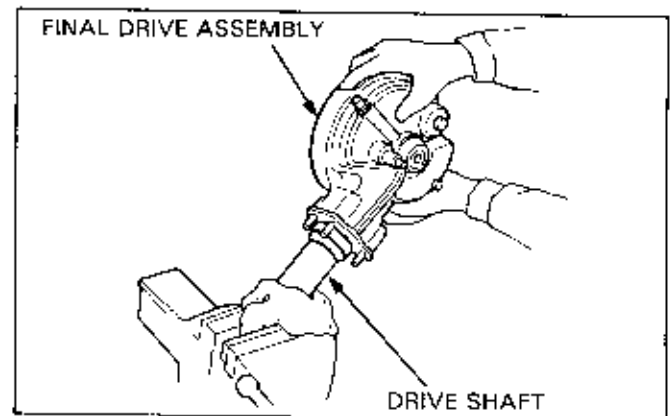
### DRIVE SHAFT REMOVAL

#### With Damper Case:

Hold the drive shaft in a vise with soft jaws and separate the final gear case from the drive shaft.

#### CAUTION

- Clamping the damper case section of the final drive assembly in a vise can damage it.

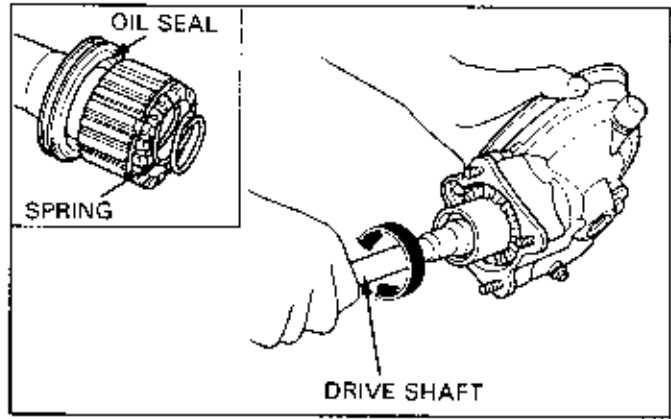


## FINAL DRIVE/OUTPUT SHAFT

### Without Damper Case:

Separate the drive shaft from the final gear case by gently turning the drive shaft and pulling.

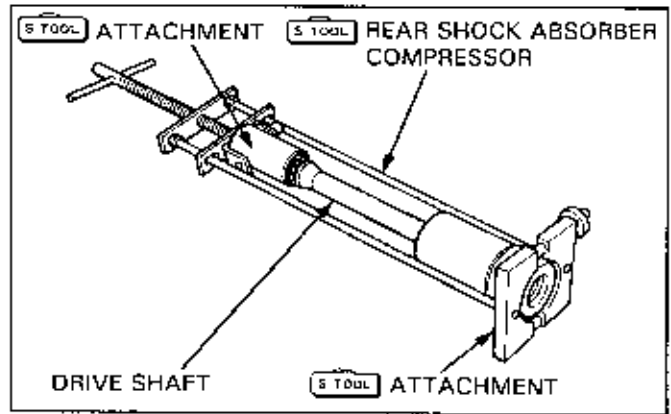
Remove the spring and oil seal.



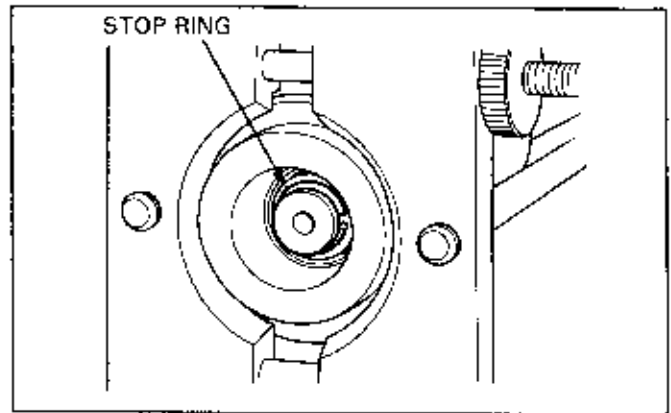
### DRIVE SHAFT/DAMPER DISASSEMBLY

Drain the oil from the damper case.

Set the drive shaft in the shock absorber compressor with the proper attachments.

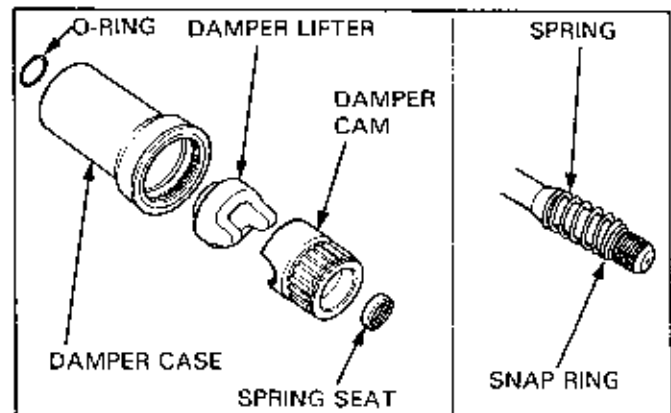


Compress the damper spring and remove the stop ring.  
Remove the tool.

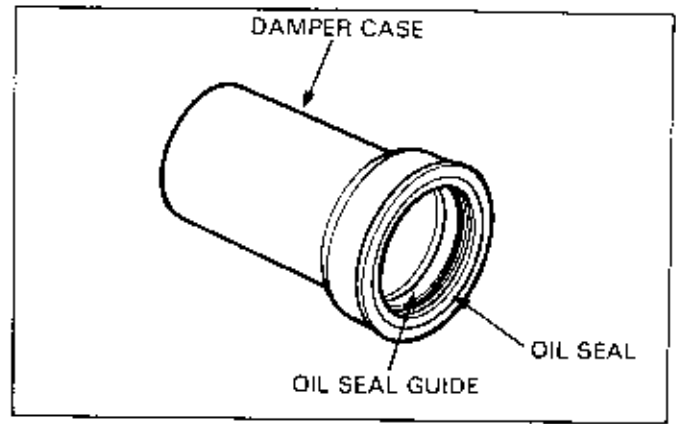


Remove the following:

- spring seat
- damper cam
- damper lifter
- damper case
- O-ring
- snap ring
- spring

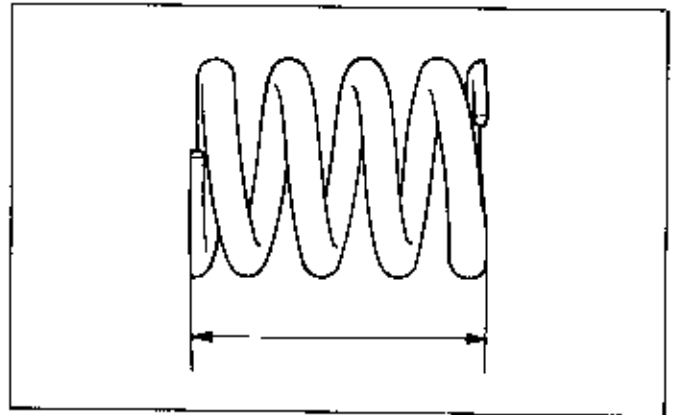


Remove the oil seal, oil seal guide and damper spring from the damper case.



### DRIVE SHAFT INSPECTION

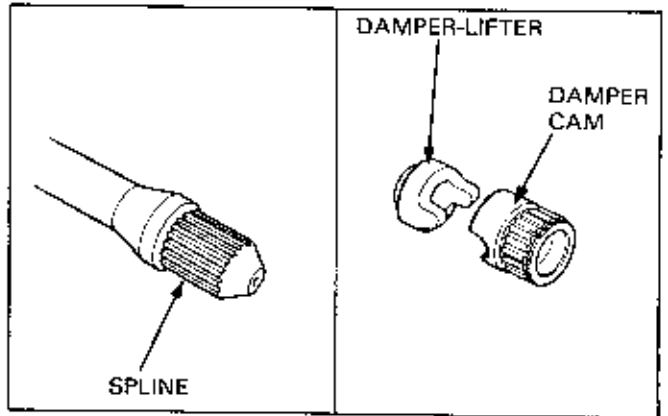
Measure the damper spring free length; replace the spring if the free length exceeds the service limit.



Check the splines of the drive shaft for damage or wear; replace as necessary.

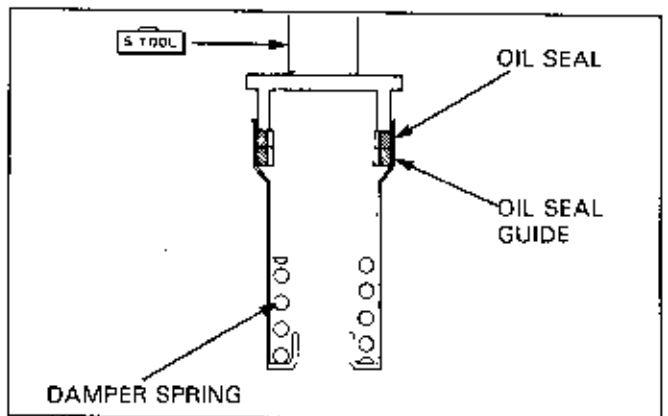
If the splines are damaged, check the universal joint splines also.

Check the damper cam and lifter for damage; replace as necessary.



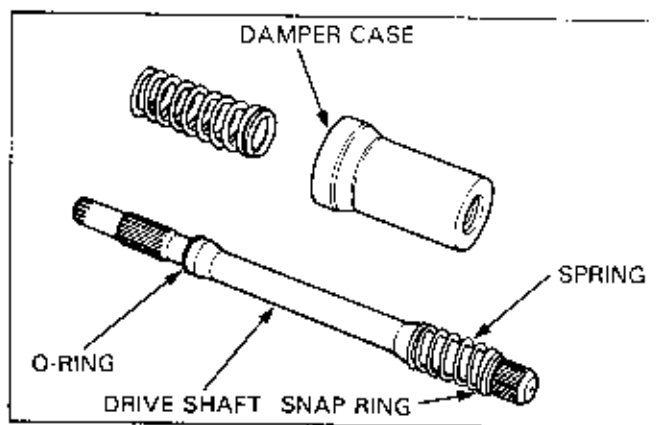
### DAMPER CASE ASSEMBLY

Install the spring in the damper case.  
Install the oil seal guide and a new oil seal using the special tool.

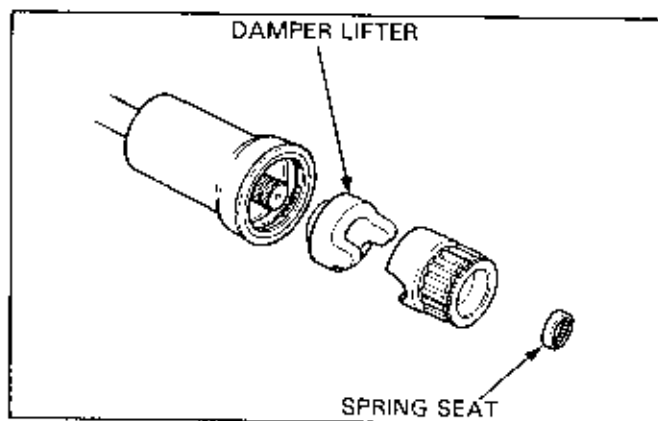


## FINAL DRIVE/OUTPUT SHAFT

Install a new O-ring onto the drive shaft.  
Install the spring and secure the snap ring.  
Insert the drive shaft into the damper case.



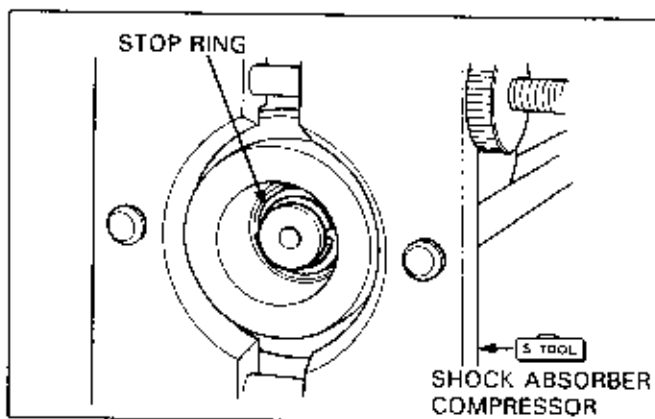
Install the damper lifter, damper cam and spring seat.



Set the drive shaft in the shock absorber compressor and compress the spring.

Set the stop ring securely into the groove on the drive shaft.

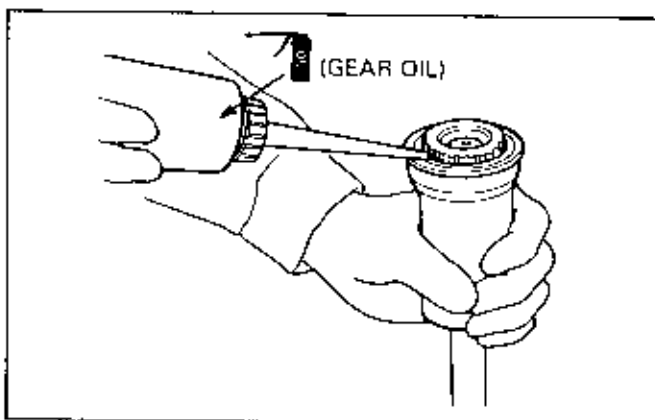
Remove the tools.



## DRIVE SHAFT INSTALLATION

**With Damper Case:**

Fill the damper case with the recommended type and amount of gear oil.



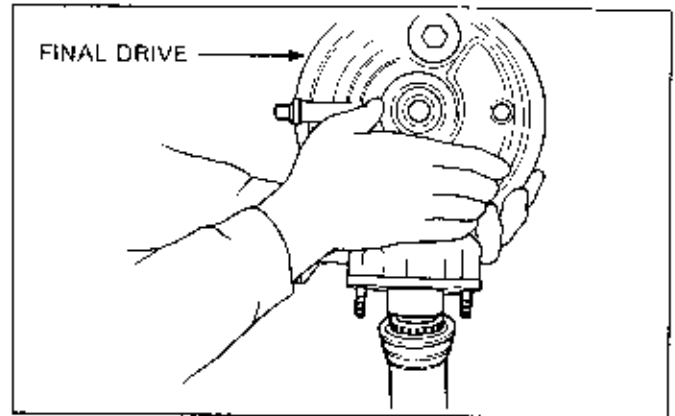


Hold the drive shaft upright to avoid spilling the damper case oil.

Carefully position the gear case on the shaft.

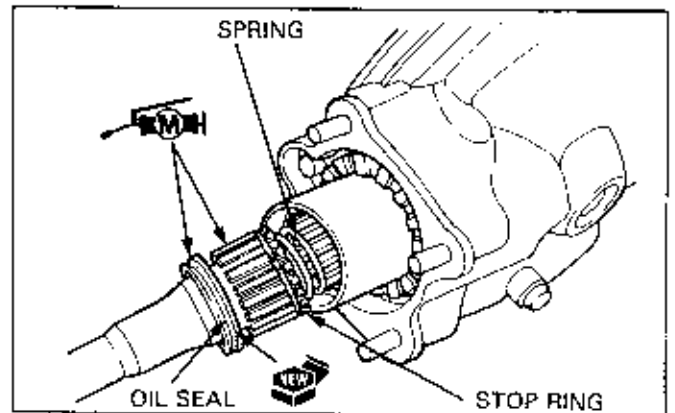
**CAUTION**

- Avoid damaging the damper case oil seal during assembly.



**Without Damper Case:**

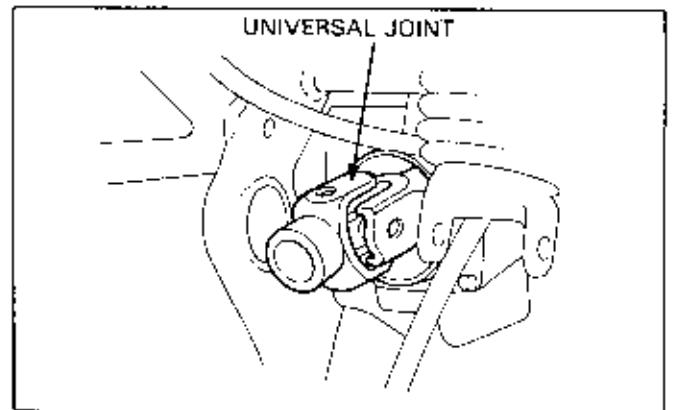
Install a new oil seal, stop ring and the spring. Then install the shaft on the final drive assembly.



**UNIVERSAL JOINT INSPECTION**

Remove the spring arm (see the Model Specific manual).

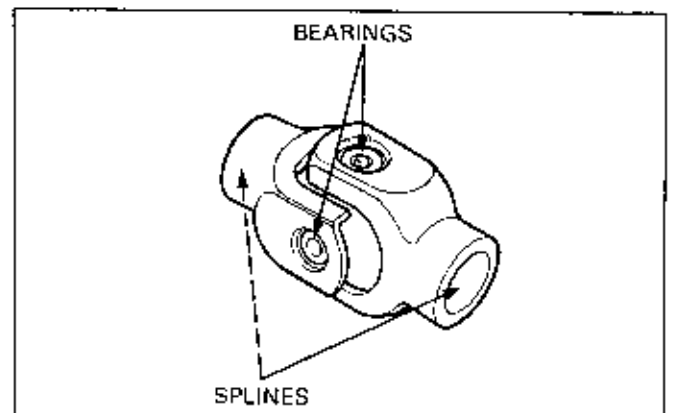
Remove the universal joint from the output shaft.



Check that the universal joint moves smoothly without binding or noise.

Check the splines for wear or damage and replace if necessary.

Install the universal joint on the output shaft, then install the swing arm.



# 16. WHEELS/TIRES

SERVICE INFORMATION	16-1	TIRE REMOVAL	16-11
TROUBLESHOOTING	16-1	TIRE INSTALLATION	16-14
WHEEL REMOVAL/INSTALLATION	16-2	WHEEL BALANCING	16-17
WHEEL BEARING REPLACEMENT	16-8	ATV WHEEL/TIRE	16-17
BASIC TIRE INFORMATION	16-9		

## SERVICE INFORMATION

- Support the motorcycle on its center stand and/or with a jack or other suitable support under the engine or frame when servicing the front wheel. Be certain that the motorcycle is secure before proceeding.
- In case the motorcycle, scooter or ATV is equipped with tubeless tires, valves, and wheel rims, use only tires marked "TUBELESS" and tubeless valves on rims marked "TUBELESS TIRE APPLICABLE." Never mount tires designed for use on automobiles.

### ⚠ WARNING

- Any attempt to mount passenger car tires on a motorcycle rim may cause the tire bead to separate from the rim with enough explosive force to cause serious injury or death.

## TROUBLESHOOTING

### Hard steering

- Steering head bearing adjustment nut too tight
- Faulty steering head bearings
- Damaged steering head bearings
- Insufficient tire pressure\*
- Faulty tire\*

### Front wheel wobbling

- Bent rim\*
- Worn front wheel bearings\*
- Faulty tire\*

### Steers to one side or does not track straight

- Unevenly adjusted right and left shock absorbers
- Bent fork
- Bent front axle: wheel installed incorrectly
- Faulty steering head bearing
- Bent frame
- Worn wheel bearing\*
- Worn swing arm pivot

### Wheel turns hard

- Misadjusted brake
- Faulty wheel bearing\*
- Faulty speedometer gear\*

\*These items are addressed in this section. All other items are addressed in the Front or Rear Suspension, or Brake Section.

# WHEEL REMOVAL/INSTALLATION

## FRONT WHEEL

### ⚠ WARNING

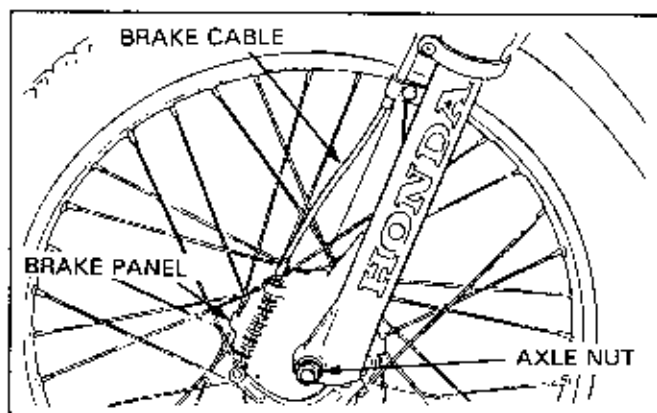
- Grease on the brake linings will reduce stopping power. Keep grease off the brake linings. Wipe excess grease off the cam and anchor pin.
  - Inhaled asbestos fibers have been found to cause respiratory disease and cancer. Never use an air hose or dry brush to clean brake assemblies. Use an OSHA-approved vacuum cleaner or alternate method approved by OSHA, designed to minimize the hazard caused by airborne asbestos fibers.
- Support the vehicle securely under the engine to raise the front wheel.
  - The speedometer cable and front brake cable must be disconnected.
  - On vehicles with hydraulic disc brakes, if the wheel cannot be removed with brake caliper(s) installed on the front fork(s), remove the wheel after the brake caliper has been removed with the caliper bracket attached.
  - After installing, check that the wheel turns smoothly and without play.

### AXLE NUT TYPE

#### Removal:

Remove the axle nut.

Pull the axle shaft from the fork legs while holding the wheel, then remove the wheel.



#### Installation

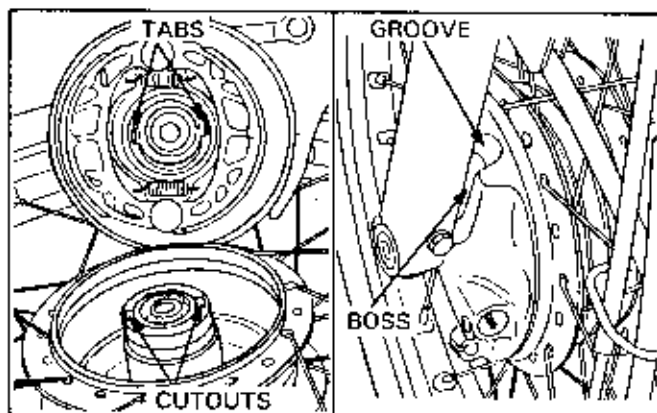
**Drum brake:** Align the speedometer gearbox retainer tabs with the cutouts and install the brake drum on the wheel hub.

Install the side collar.

Coat the axle shaft with a small amount of grease.

Place the wheel between the fork legs while aligning the boss of the fork leg with the groove of the brake panel. Insert the axle through the fork legs.

Turn the front wheel so that the speedometer gear retainer will engage properly with the wheel hub.

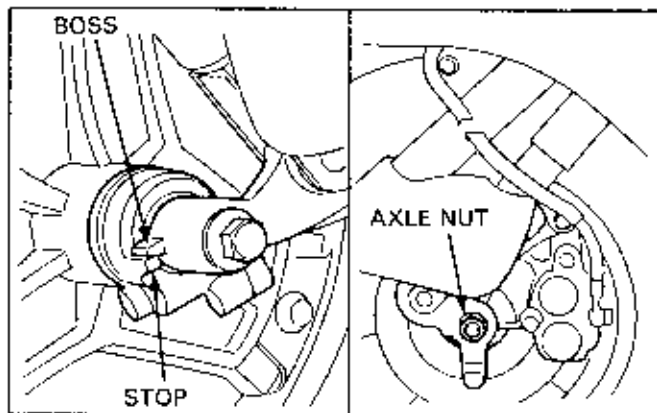


**Hydraulic disc brake:** Align the stop of the speedometer gearbox with the boss of the fork leg.

Set the wheel so that the brake disc is positioned between the brake pads. Use care not to damage the brake pads. Install the axle shaft.

Tighten the axle nut to the specified torque. (Refer to the Model Specific manual.)

Connect the cables.



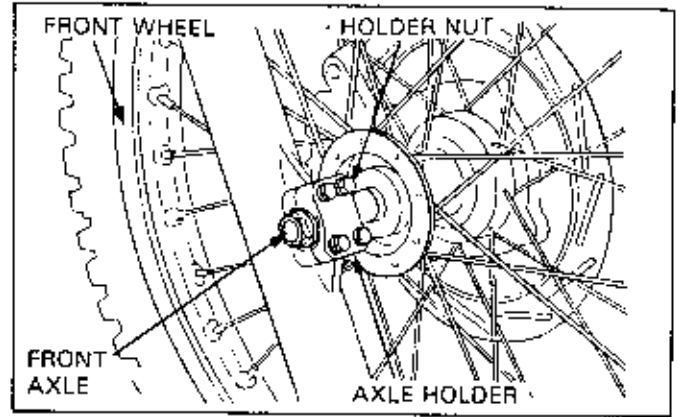
**SINGLE HOLDER TYPE**

**Removal:**

Loosen the axle shaft holder nuts.

Loosen the axle shaft while holding the wheel. Remove the axle shaft.

Remove the wheel.



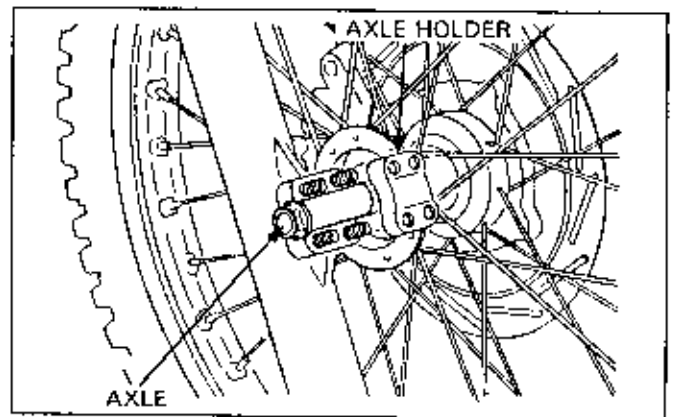
**Installation**

Hydraulic brake:

Place the front wheel between the fork legs while slipping the disc between the pads. Take care not to damage the pads. Set the wheel into the place and insert the axle shaft through the wheel.

Loosely install the axle holder with its UP mark toward up and tighten the axle shaft to the specified torque.

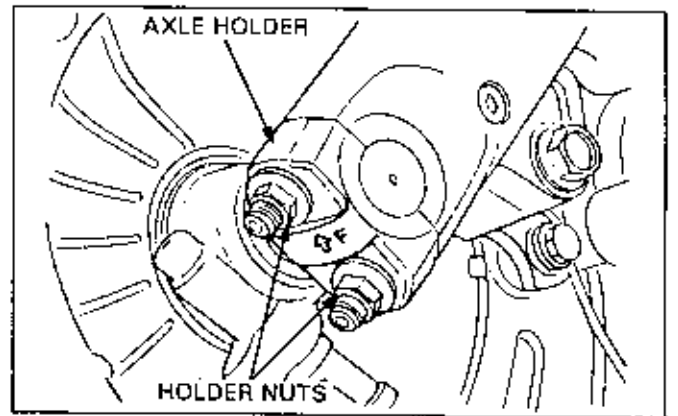
With the front brake applied, pump the front suspension up and down several times; then tighten the holder nuts to specified torque.



**NOTE**

- Holder nut should be tightened:  
 On vertically split type: upper first, then lower nut.  
 On horizontally split type: front first, then rear nut.

Reconnect the cables.



**DOUBLE HOLDER TYPE**

**Removal**

Remove both side holders and then remove the front wheel.

**Disassembly**

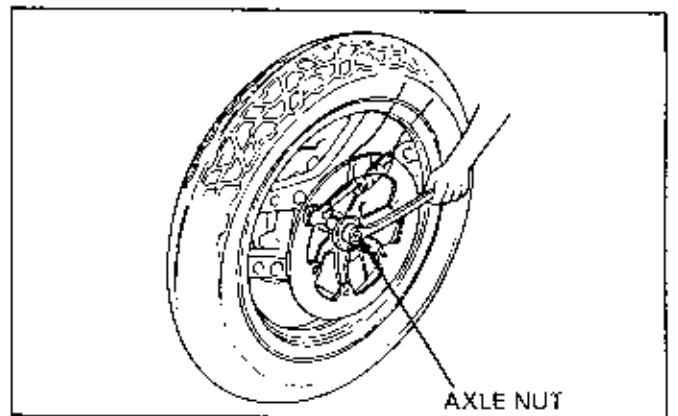
Remove the axle nut from the axle, then remove the axle shaft, collar and speedometer gear.

**Assembly**

Install the side collar and speedometer gear box onto the wheel hub.

Coat the axle shaft with small amount of grease and install the axle shaft.

Tighten the axle nut to the specified torque.



## WHEELS/TIRES

### Installation

Place the front wheel between the fork legs.

Set the brake disc between the brake pads carefully. Do not damage the pads.

Slowly lower the front of the vehicle until the fork legs are aligned with the axle.

Install the axle holders with the allow pointing forward and align the speedometer gear box boss with the fork leg stop.

Tighten the upper nuts or forward nuts first; then the lower or rear nuts.

Reconnect the cables.

### PINCH BOLT TYPE

#### Removal

Loosen the axle pinch bolts on the axle bolt side and remove the axle bolt.

Loosen the axle pinch bolts on the opposite side and remove the axle shaft while holding the wheel. Remove the front wheel.

#### Installation

Place the front wheel between the fork legs and work the brake disc between the pads. Be careful not to damage the pads.

Install the axle. Tighten the axle bolt to the specified torque. Align the speedometer gear box stop with the fork leg stop.

#### NOTE

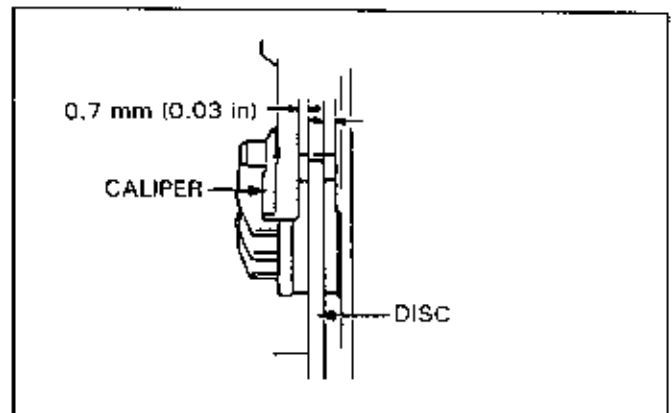
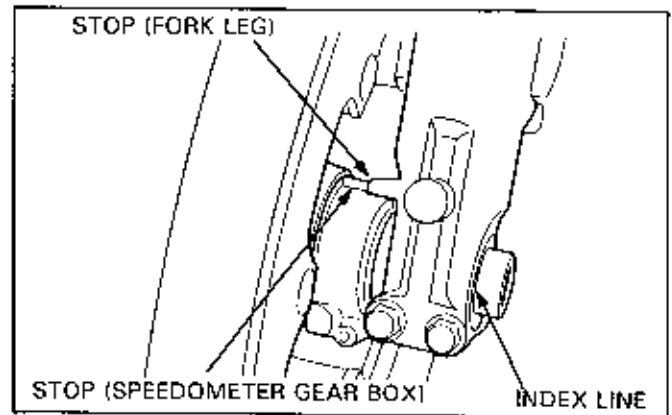
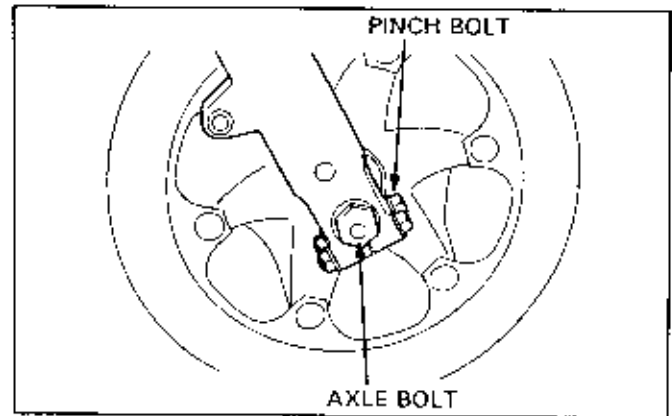
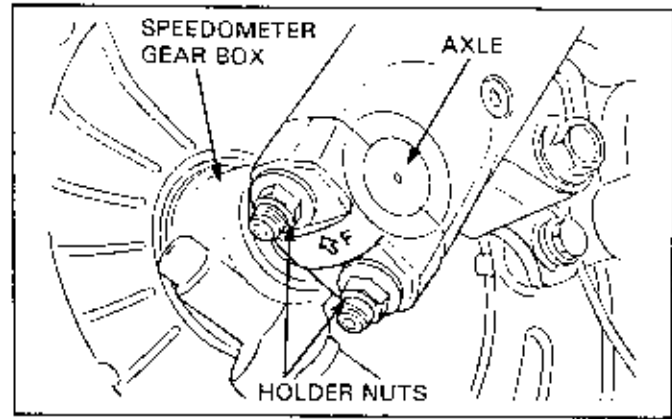
- Make sure that the index line on the axle aligns with the fork leg surface.

Tighten all the pinch bolts to the specified torque.

Refer to the Model Specific manual for the proper torque values.

Check the clearance between the brake disc and the caliper bracket on each side after installation. The clearance should be at least 0.7 mm (0.03 in).

If the clearance is not 0.7 mm (0.03 in) or more, loosen the holder nut or pinch bolt at the axle shaft side and adjust the clearance. Then tighten the holder nuts or pinch bolt to the specified torque.



## REAR WHEEL

**▲WARNING**

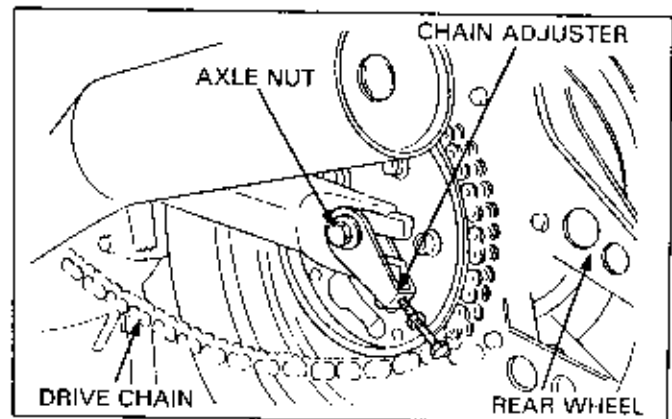
- Grease on the brake linings will reduce stopping power. Keep grease off the brake linings. Wipe excess grease off the cam and anchor pin.
- Inhaled asbestos fibers have been found to cause respiratory disease and cancer. Never use an air hose or dry brush to clean brake assemblies. Use an OSHA-approved vacuum cleaner or alternate method approved by OSHA, designed to minimize the hazard caused by airborne asbestos fibers.
- Support the vehicle securely with the rear wheel off the ground.
- Remove the muffler and/or other parts necessary to gain access to the wheel.
- For drum brakes, disconnect the brake rod or cable and brake torque rod from the brake panel.
- For hydraulic disc brakes, it may be necessary to remove the brake caliper. Refer to the Model Specific manual.
- Note the side collar position and direction so they can be installed properly.
- After installing, make sure that the rear wheel turns smoothly, without excessive free play.

## CHAIN DRIVEN TYPE

**Removal**

Loosen the axle nut and drive chain adjusters.

Move the rear wheel forward, and disengage the drive chain from the driven sprocket.

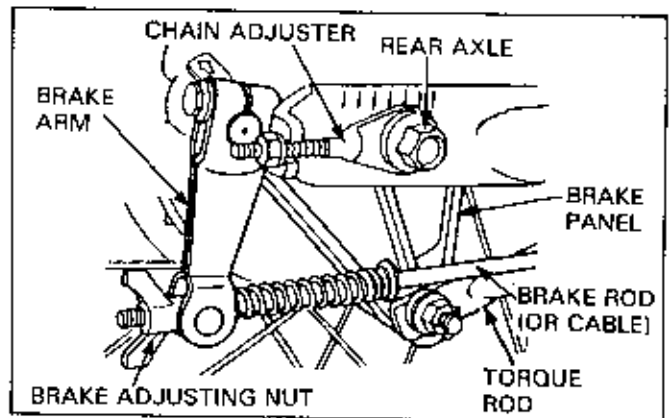


For mechanical drum brakes, remove the rear brake adjusting nut and depress the pedal to disconnect the brake rod (or cable) from the brake arm. If the brake panel is mounted with the brake torque rod, disconnect the torque rod from the brake panel by removing the torque rod mounting nut.

Remove the axle nut and rear axle.

For hydraulic disc brakes, move the caliper assembly away from the disc to avoid interference.

Remove the rear wheel.

**Installation**

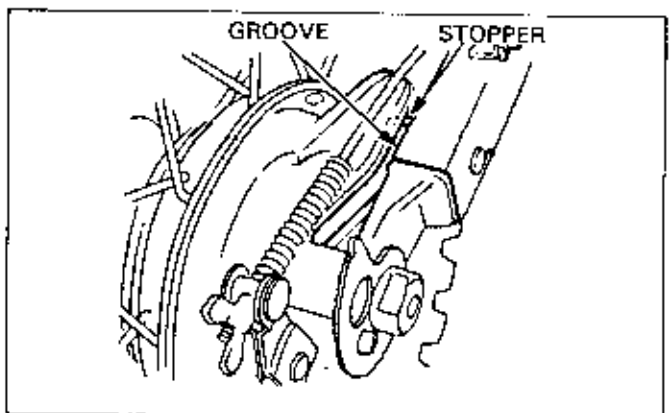
For drum brakes, install the brake panel and side collar on the wheel hub.

**NOTE**

- Note the proper direction of the axle side collar.

Place the rear wheel into the swingarm, while laying the drive chain between the sprocket and wheel hub.

In case that the swingarm on the brake panel is not mounted with the brake torque rod, insert the stopper on the swingarm into the groove of the brake panel when installing the wheel into the swingarm.



## WHEELS/TIRES

For hydraulic disc brakes, install the rear wheel by working the brake disc between the brake pads. Be careful not to damage the pads.

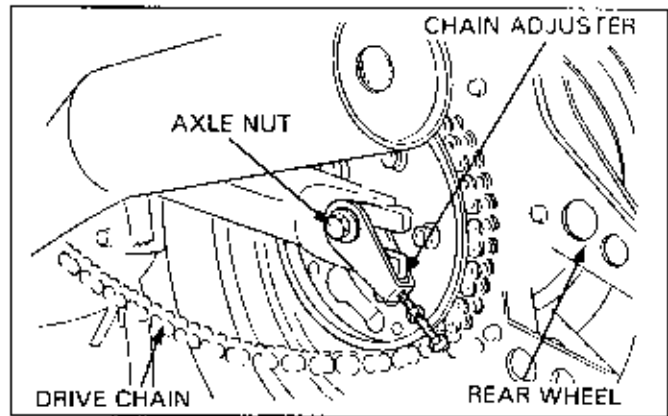
Set the rear wheel in the place. Install the rear axle with chain adjuster.

### NOTE

- Note the proper direction of the chain adjuster.

Install the chain adjuster and axle nut to the opposite side of the wheel.

Fit the drive chain over the driven sprocket.



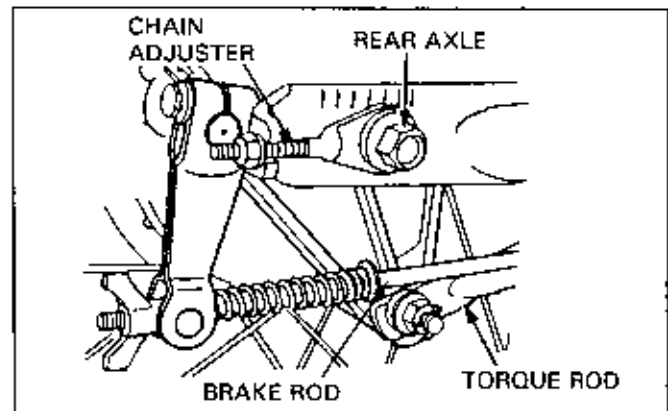
For mechanical drum brakes, connect the brake rod (or cable) to the brake arm and install the adjusting nut loosely. In case that the brake panel is mounted with brake torque rod, connect the torque rod to the brake panel and tighten the torque rod nut to the specified torque.

Adjust the drive chain slack.

Tighten the rear axle nut to the specified torque.

Secure the axle nut and torque rod nut with a new cotter pin if required.

For mechanical drum brakes, adjust the rear brake pedal free play.



## SHAFT DRIVEN TYPE

### Removal

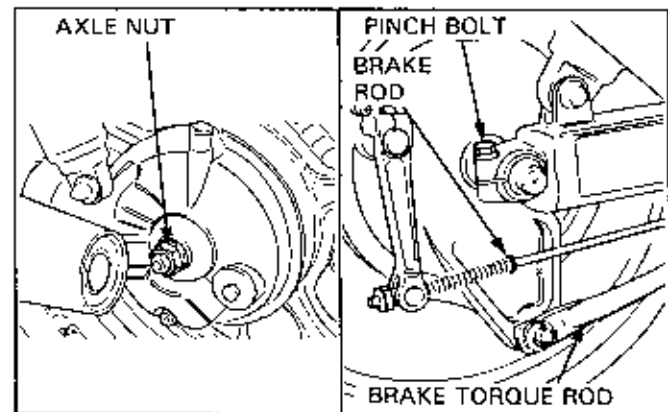
For drum brakes, disconnect the brake rod (or cable) and torque rod from the brake panel.

Remove the axle nut and loosen the axle pinch bolt.

Remove the rear axle.

For hydraulic disc brakes, move the caliper assembly away from the disc to avoid interference.

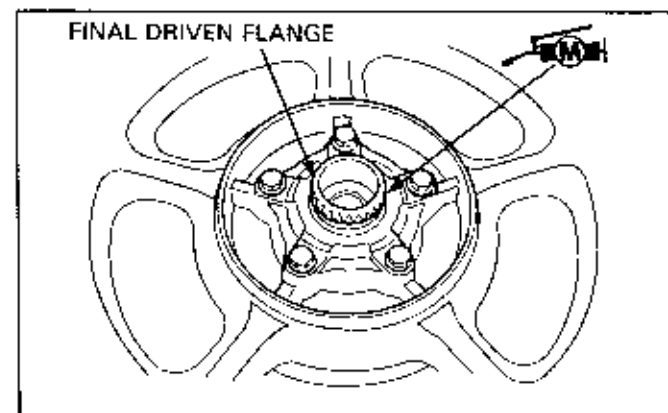
Remove the side collar and pull the rear wheel from the final drive gear. Remove the rear wheel.



### Installation

Coat the driven flange with molybdenum disulfide grease. Install the brake drum onto the wheel hub.

Place the rear wheel into the swing arm.



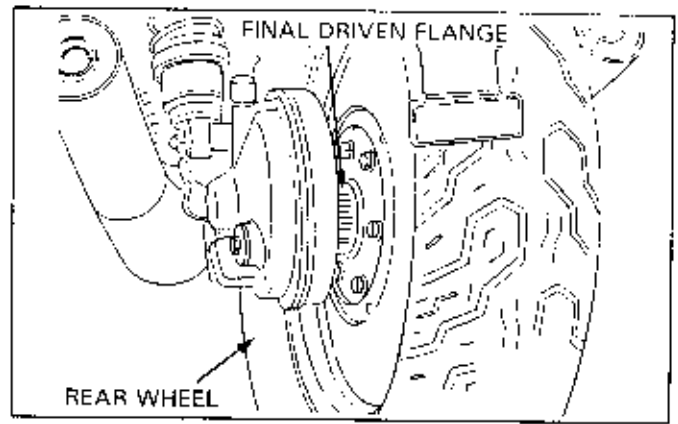
For the hydraulic disc brakes, work the brake disc between the brake pads. Be careful not to damage the pads.

Align the splines of the final driven flange with the splines of ring gear and push the rear wheel onto the final drive gear.

Install the side collar.

**NOTE**

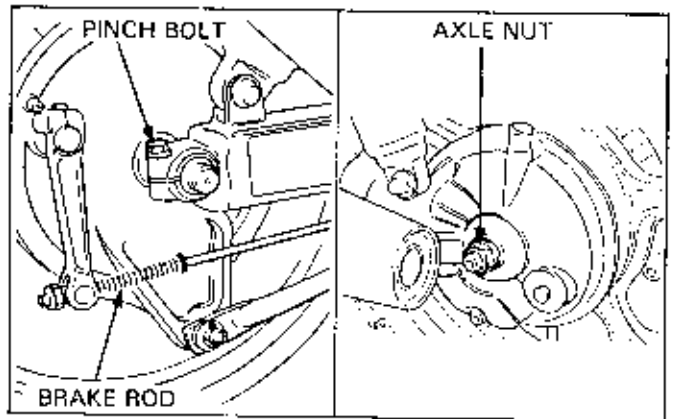
- Note the proper direction of the wheel side collar.



Set the rear wheel in place and install the axle. For mechanical drum brakes, connect the brake rod (or cable) to the brake arm and install the adjusting nut loosely. Connect the torque rod to the brake panel and tighten the torque rod nut to the specified torque.

Tighten the axle nut first then tighten the axle pinch bolt to the specified torque.

For mechanical drum brakes, adjust the rear brake pedal free play.



**UNIT SWING TYPE**

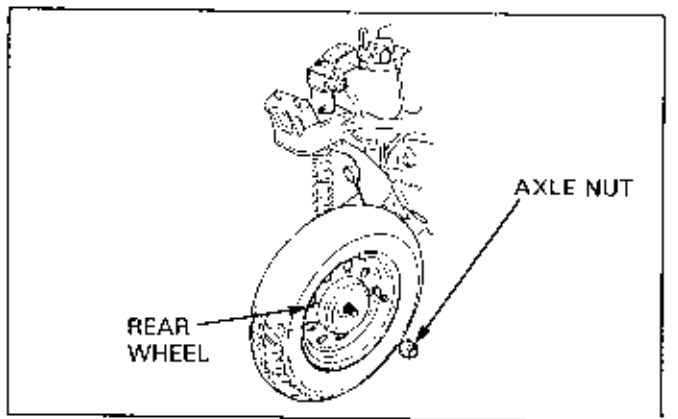
**Removal**

Remove the frame covers and exhaust muffler if necessary. Apply rear brake and loosen the axle nut.

**NOTE**

- If the rear axle spins with the axle nut, apply torque to the wrench allowing the scooter to tilt rearward and the rear wheel to contact the ground.

Remove the axle nut and rear wheel.



**Installation**

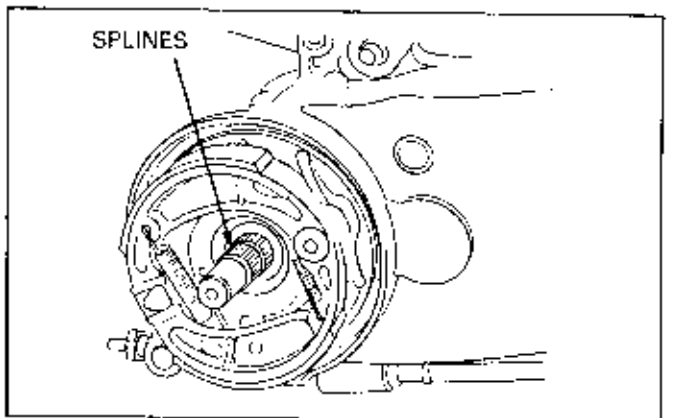
Install the rear wheel by aligning the splines of the wheel hub with the final drive shaft splines.

Apply the rear brake and tighten the rear axle nut to the specified torque.

**NOTE**

- If the rear axle spins with the axle nut, apply torque to the wrench allowing the scooter to tilt rearward and the rear wheel to contact the ground.

Install the removed parts.



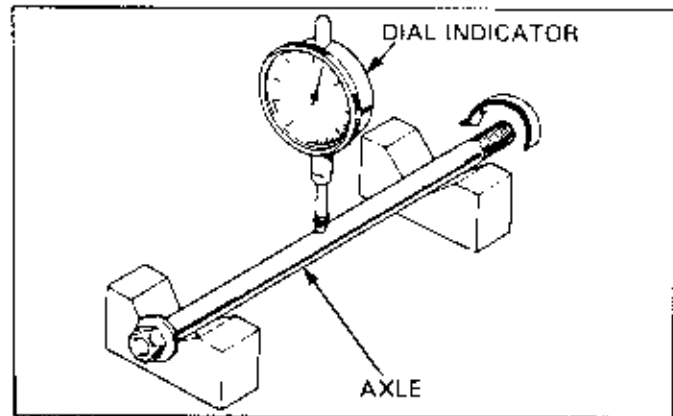


## WHEELS/TIRES

### AXLE INSPECTION

Set the axle in V-blocks, rotate the axle and measure the runout using a dial indicator.

The actual runout is 1/2 of the total indicator reading; replace if the service limit is exceeded. (Check the Model Specific manual for the actual service limit.)



### WHEEL BEARING REPLACEMENT

#### NOTE

- Disc brake type: Be sure to remove the brake discs before removing the wheel bearings.
- Refer to page 1-16 for the table of bearing remover/driver size.

#### REMOVAL

Remove the wheel.

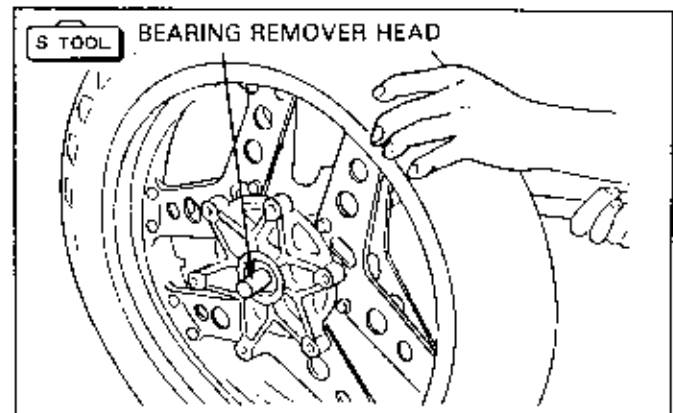
Remove the dust seal, side collar and brake drum and remove the speedometer gearbox retainer.

Rear wheel:

Chain drive type: Remove the driven sprocket.

Shaft drive type: Remove the driven flange.

Remove the right and left wheel bearings with the bearing remover shaft and remover head.



#### INSTALLATION

#### NOTE

- Right and left bearings have a specific installation order. Refer to the Model Specific manual for which bearing to install first.

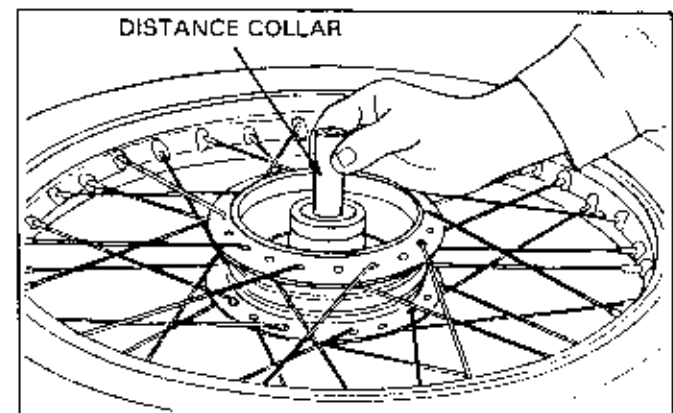
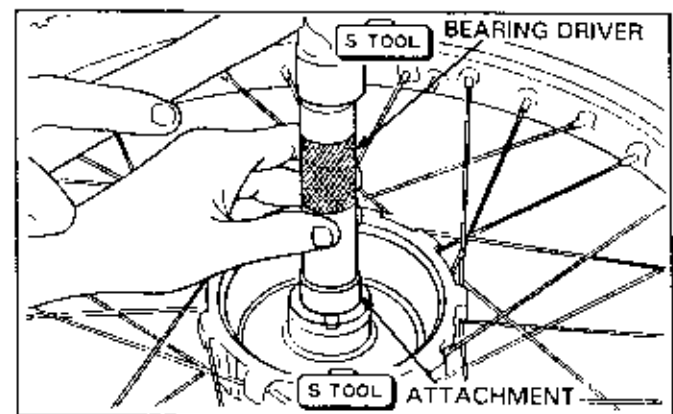
Drive in a new bearing.

Check the distance collar for its proper installation direction and install.

Install the other bearing.

#### NOTE

- Replace right and left bearings in pairs. Do not re-use old bearings.
- One side sealed type bearing: Install the bearing with its sealing face toward the outside.
- Both sides sealed type bearing: Install the bearing with its stamped size mark toward the outside.



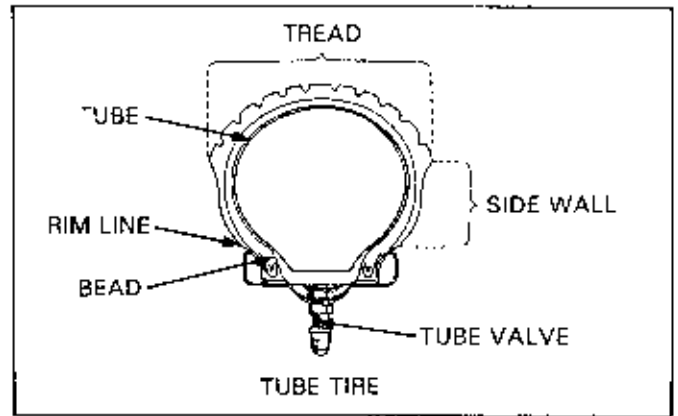
## BASIC TIRE INFORMATION

### CAUTION

- Be careful not to damage the rim area when using tire mounting tools.

### <TUBE-TIRE>

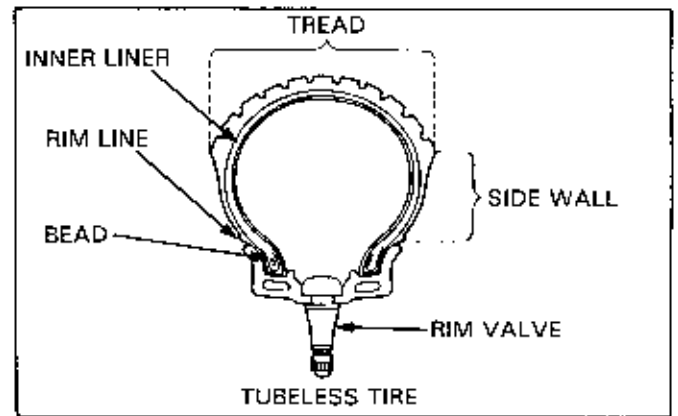
This type uses an air-filled tube within the tire's casing. Therefore, air in the tire leaks out instantly when a nail or other sharp objects penetrates the tire and tube.



### <TUBELESS TIRE>

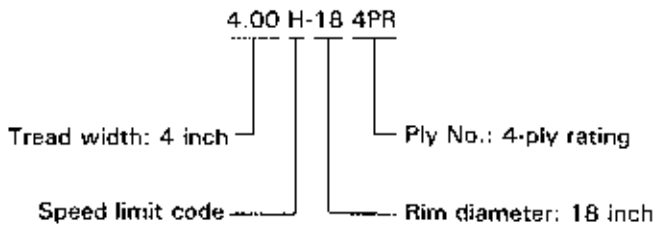
Tubeless tires have a rubber layer (inner liner), which prevents air from filtering through, glued to the inside. This acts in place of a tube. It also has a special bead area, which, together with the specialized rim, makes a tube unnecessary.

This inner liner is sufficient in thickness and does not stretch like a tube. Even when a nail penetrates the tire, the hole does not get any bigger. Instead, it closes around the nail, preventing air from leaking out.



### TIRE CODE

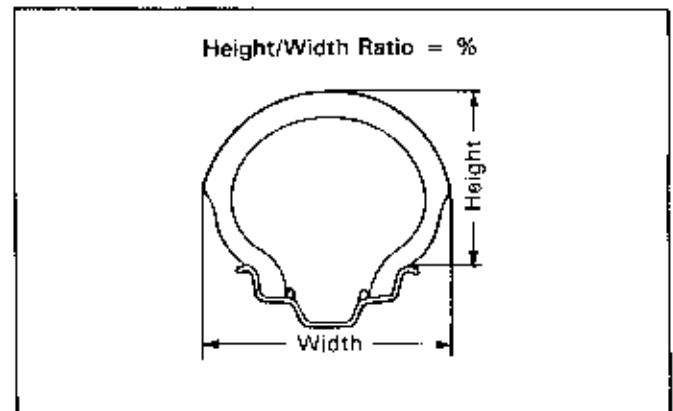
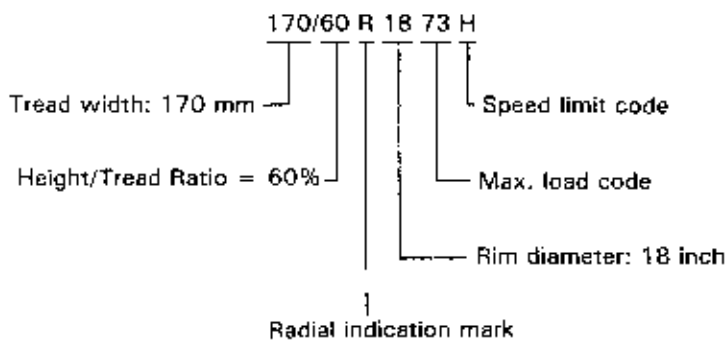
[Inch indication]



### Speed limit code:

- [J] ... 100 km/h max.
- [N] ... 140 km/h max.
- [P] ... 150 km/h max.
- [S] ... 180 km/h max.
- [H] ... 210 km/h max.
- [V] ... 210 km/h min.

[Metric indication]



## WHEELS/TIRES

### Tubeless tire

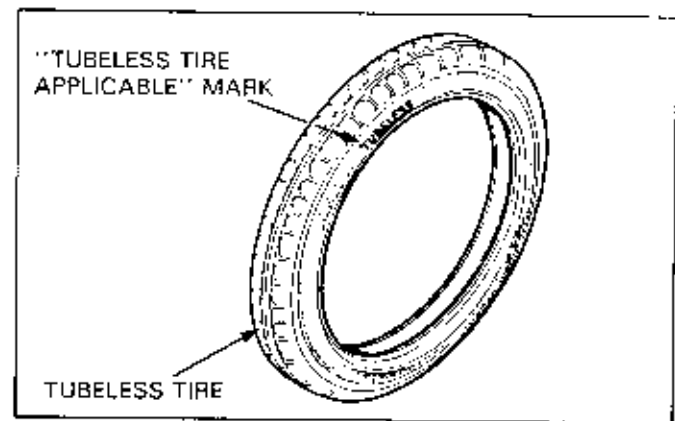
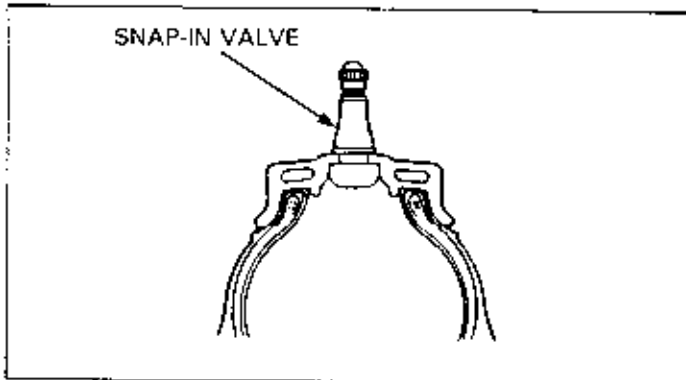
#### ⚠ WARNING

- Any attempt to mount passenger car tires on a motorcycle rim may cause the tire bead to separate from the rim with enough explosive force to cause serious injury or death.

Tubeless tires have "TUBELESS" stamped on their side walls. Tubeless tire rims have "TUBELESS TIRE APPLICABLE" stamped on them. Each rim valve has (Snap-in valve: TR412 or TR413) on it. The rim and tire mating areas and rim valves are different from tube-types in construction.

Replace the tire if it is punctured or its side wall is damaged.

Use care to protect the sealing surfaces when handling and storing tubeless tires and rims.



	Tubeless tire rim	Tube tire rim
Identification	<p>"TUBELESS TIRE APPLICABLE" stamped</p>	<p>"TUBELESS TIRE APPLICABLE" not stamped</p>
Rim valve hole diameter	11.5 mm	8.5 mm

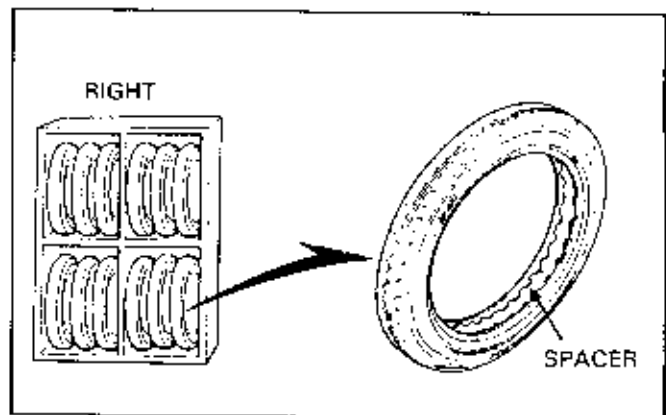
### Storage

Store tubeless tires upright with a spacer or thick paper placed between the tire beads.

If the bead-to-bead clearance is narrower than the rim width, it is difficult to install the tire onto the rim.

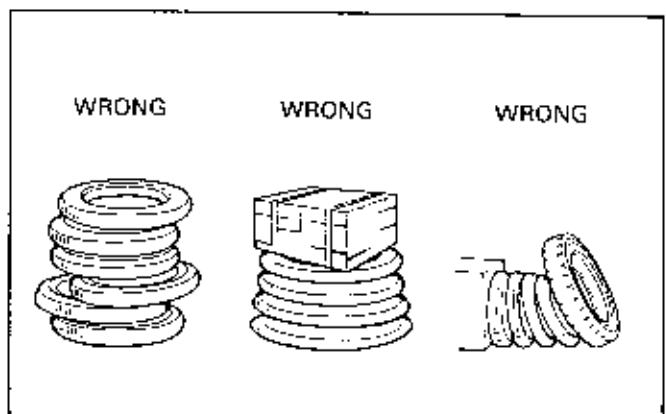
Do not stack or lean tires against each other.

To store the tire that is to be re-used, adjust the air pressure to 1/2 of the recommended pressure. Be sure that the valve cap is securely installed.



Do not store the tubeless tires or rims in these areas:

- Where the ozone is produced (near motor, battery charger)
- Hot area (near heater, steam pipe etc.)
- Where oil or grease is stored.
- In direct sunlight
- Wet or humid area



## TIRE REMOVAL

Refer to page 16-17 for ATV's wheel/tire servicing.  
Remove the wheel.

### NOTE

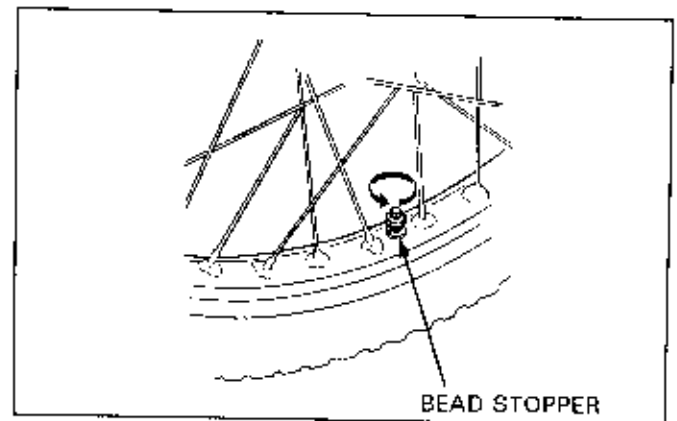
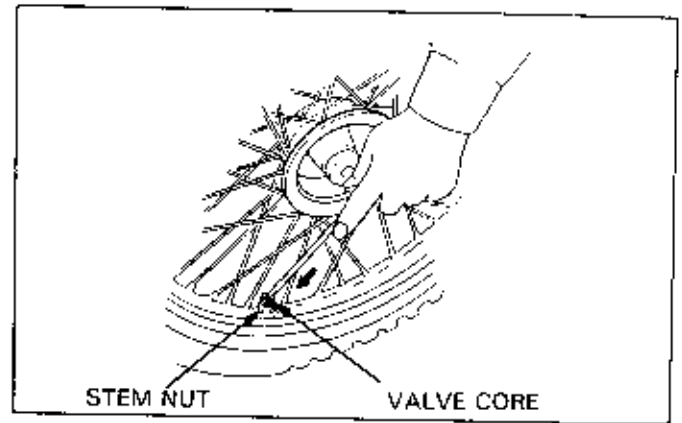
- **Single brake disc type:** To prevent damage to the disc, place the wheel on the level surface with the disc facing up.
- **Double brake disc type:** Remove one disc first, then place the wheel on the level surface with the other disc facing up.

Remove the valve cap and bleed air by pressing the valve core.

Remove the valve core after bleeding air completely.

Remove the valve stem nut and push the valve stem lightly.

If a bead stopper is installed, loosen the lock nut and push the bead stopper down.

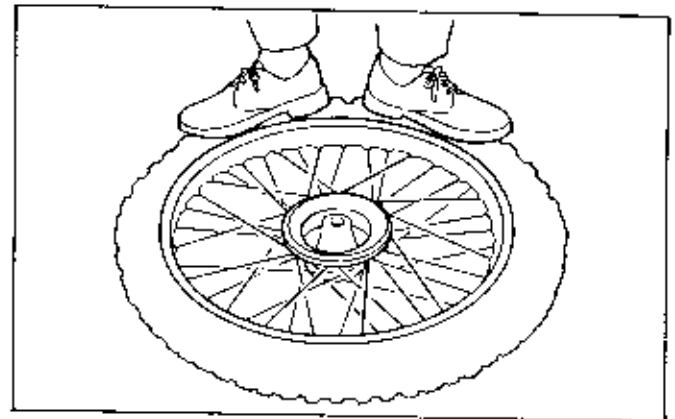


Collapse in the bead with a tire bead breaker.

If no tire bead breaker is available, step on the side wall to collapse the bead.

### NOTE

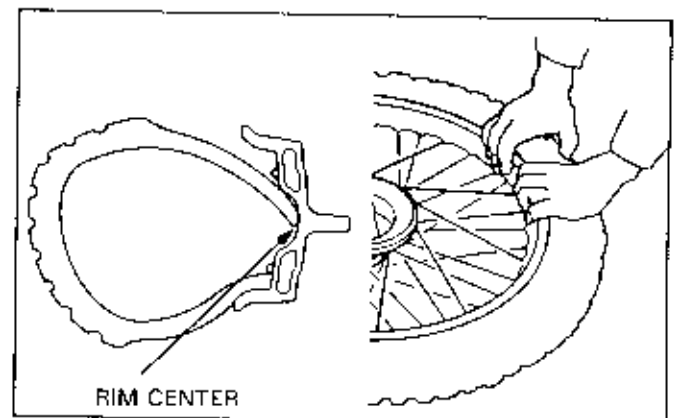
- Do not step on the rim.



Collapse the bead into the rim center and slide the tire out of position.

### NOTE

- Tire can be easily removed once the beads are collapsed completely.



## WHEELS/TIRES

Apply a mild detergent solution to the rim and tire mating surfaces.

Be sure that the bead is completely collapsed. In case of the tube type tire, insert the tire lever from the opposite side of the valve and raise the bead over the rim. On tubeless tires, insert the tire lever from the valve side and raise the bead over the rim.

Always use a rim protector when using tire levers.

### CAUTION

- To avoid damaging the rim when using the tire lever, always use rim protectors.

### NOTE

- Be sure to use motorcycle tire levers.
- Do not apply the mild detergent solution to the rim and tire mating surfaces of low pressure tire. Apply water only.

Insert another tire lever at 30–50 mm (1 to 2 in) from the first tire lever and remove the tire from the rim, little by little.

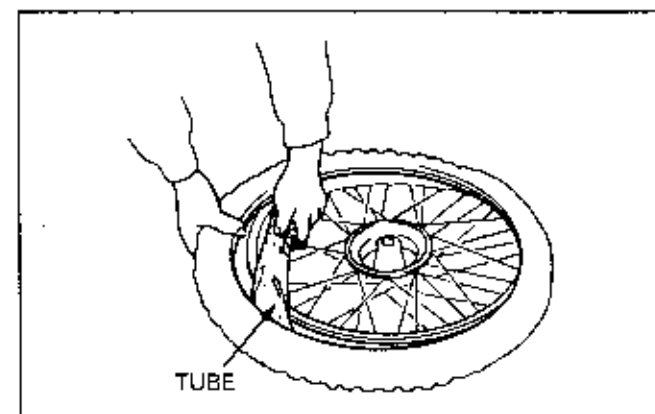
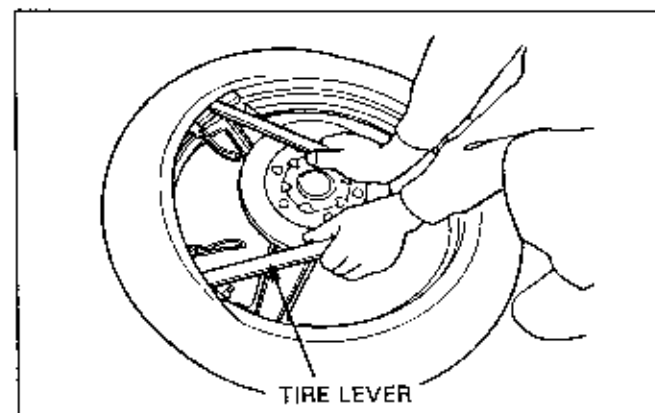
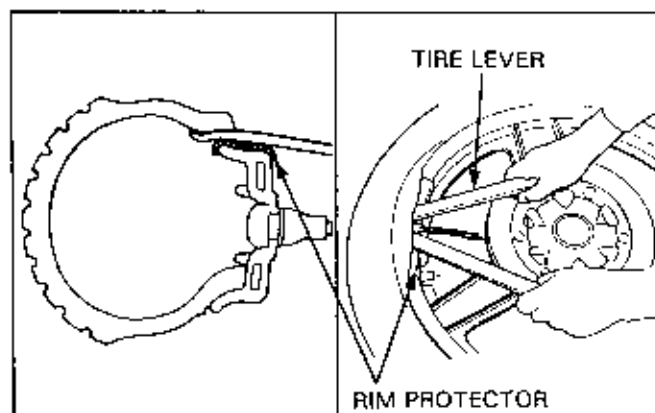
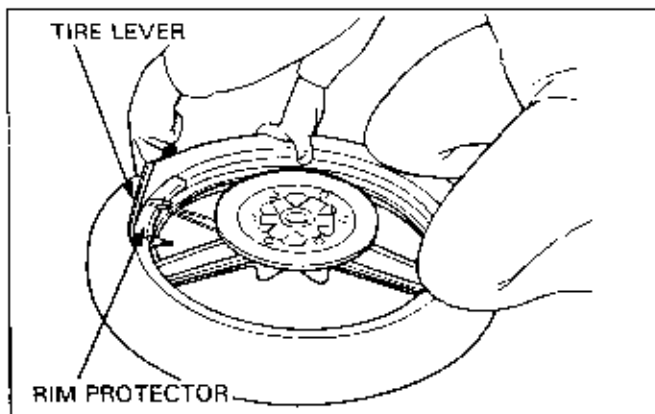
### NOTE

- Do not try to remove the bead too much at one time.
- Do not pry against or scratch the bead stopper area with the tire lever.

Repeat the above procedures until half of bead is removed. Then remove the remaining bead by hand.

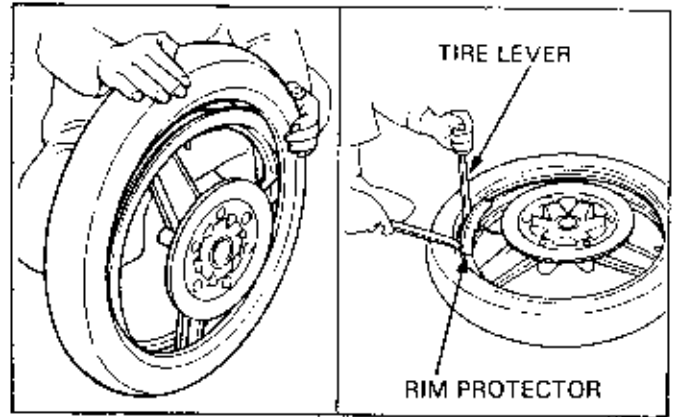
### Tube-type tire only

Press the valve into the tire completely and remove the tube from the tire.



Remove one side of bead using same procedures as the tubeless tire.

Remove the tire from the rim.



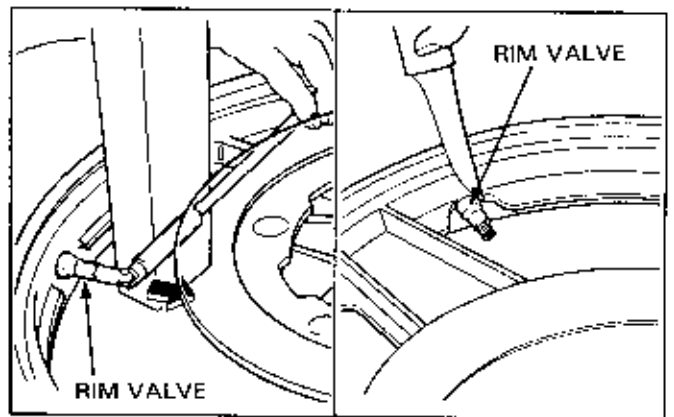
### RIM VALVE REPLACEMENT (TUBELESS TIRE ONLY)

Cut off the rim valve at its base.

Apply mild detergent solution to a replacement rim valve and insert it from inside of the rim.

#### NOTE

- Be sure to use the recommended rim valve.
- Do not damage the valve hole.
- Replace the rim valve whenever installing a tubeless tire.



### WHEEL CENTER ADJUSTMENT (SPOKE WHEEL ONLY)

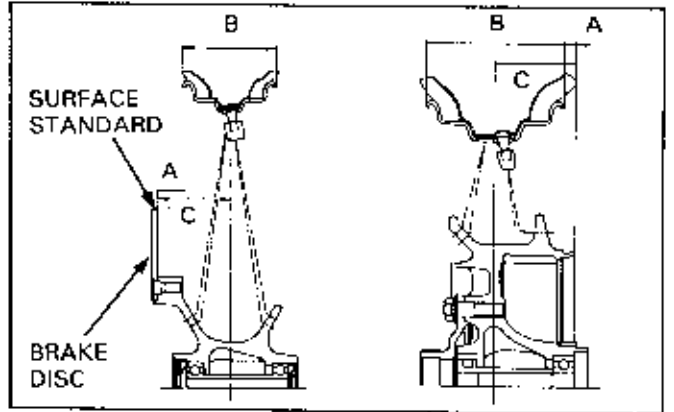
The wheel center adjustment is necessary when the spoke wheel has been rebuilt.

The distance indicated is as follows:

- A: Between the rim side and standard surface
- B: Rim width (measurement)
- C: Between the rim center and standard surface

#### NOTE

- Refer to the Model Specific manual for standard surface and specific values of C on each model.



Measure the distance B (rim width), and make the following calculations.

$$A = C - B/2$$

Example: (B: 76.2 mm, C: 56.5 mm)

$$A = 56.5 - 76.2/2 = 18.4$$

Adjust the rim position and distance A by tightening the spokes to specified torque in 2 or 3 progressive steps.

Inspect and adjust the wheel rim runout.

## TIRE INSTALLATION

Refer to page 16-17 for ATV's wheel tire servicing.

For a tube type tire, check the rim band and rim lock to be sure they are installed properly.

### WARNING

- Any attempt to mount passenger car tires on a motorcycle rim may cause the tire bead to separate from the rim with enough explosive force to cause serious injury or death.

### CAUTION

- Always change rims which have been bent or have cracks, as they may cause air leakage.
- Always change the rim if there are any flaws over 0.5 mm in depth and 1.0 mm in width on the surface touching the bead.

Check the tire for overall condition and use a mild detergent solution on the bead.

Use only water as a lubricant when removing or mounting tires.

Soap or other tire lubricants may leave a slippery residue that can cause the tire to shift on the rim.

### WARNING

- A tire that shifts on the rim may lead to a sudden loss of air pressure while riding and an accident could occur.

### NOTE

- Be sure to use motorcycle tire levers.
- Do not use the detergent solution on low pressure tires. Use water only.

If the tire has an light mark (yellow paint mark), install the tire with this mark aligned with the valve.

If the tire has an arrow mark, install the tire with the mark pointing in the direction of rotation.

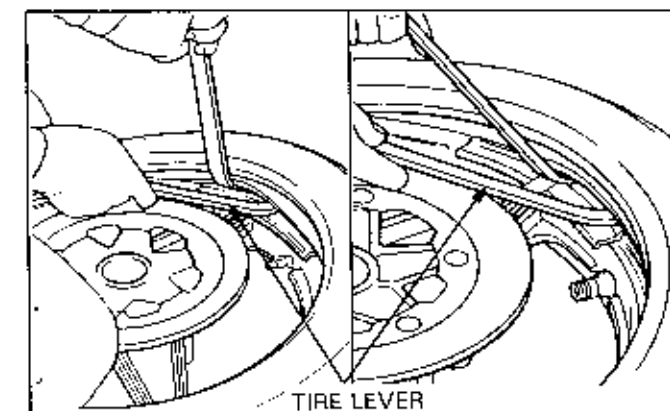
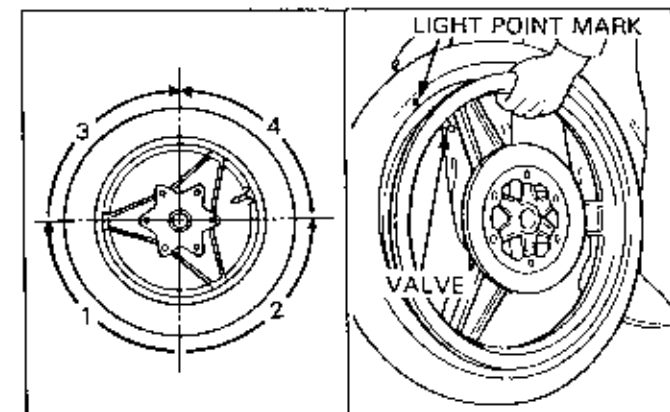
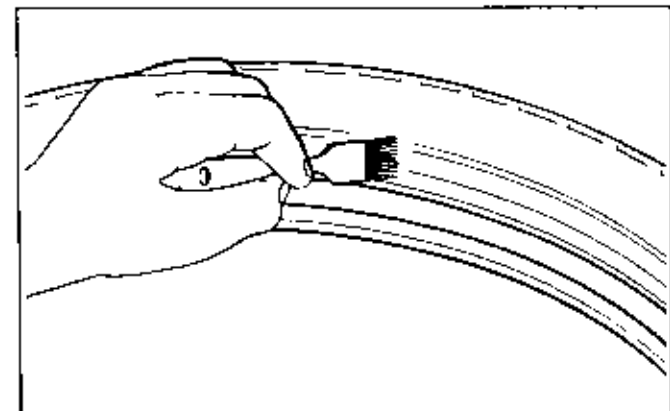
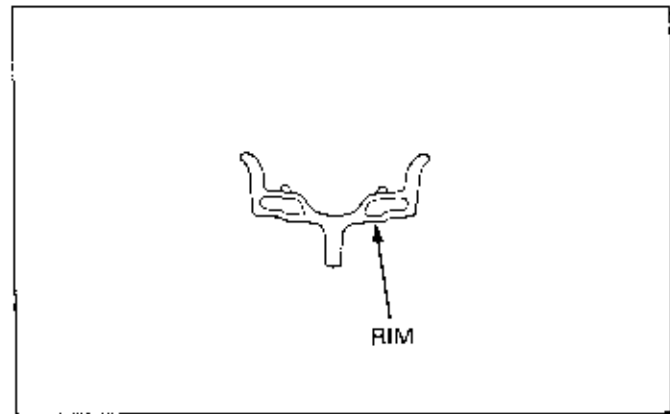
Stand the tire upright, hold it with one hand and, starting from the opposite side to the valve, install one side of the tire on the rim as much as you can by hand.

Be sure to assemble in the sequence shown.

Place the wheel on the level surface and install the remaining portion of the tire using two tire levers.

### NOTE

- For easy assembly, apply a mild detergent solution to the tire and rim mating surfaces.
- Do not use the detergent solution on the tire and rim mating surfaces of the low pressure tires. Use water only.



**Tube-type only**

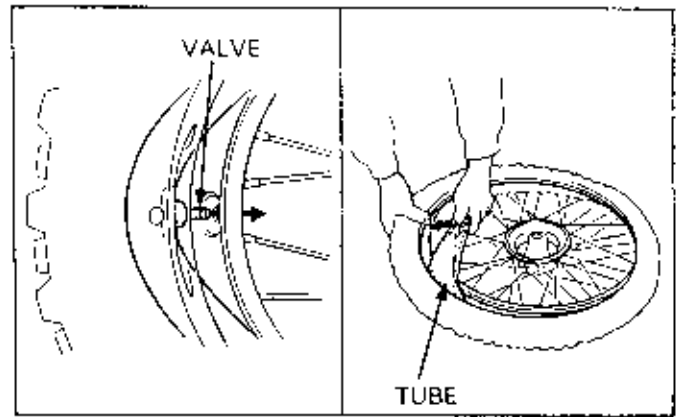
Inflate the tube with a small amount of air.

Push the tube into the tire.

Insert the valve through the valve hole and loosely install the nut.

Install the tube so that it is aligned with the concave portion of the rim center.

Be sure that the tube is not twisted and the valve stem is straight.



Install the other side of the bead while holding the assembled portion of the bead with your knee to prevent it from coming off.

**NOTE**

- Before using the levers, be sure that the bead on the opposite side is positioned in the center of the rim.

Install the bead a little at a time, using care not to damage the tube or wheel with the tire levers.

After 1/2 of the bead has been installed, insert the two tire levers at a distance of 30-40 mm (1 to 2 in) to install it. Repeat this procedure until 3/4 of the bead has been installed.

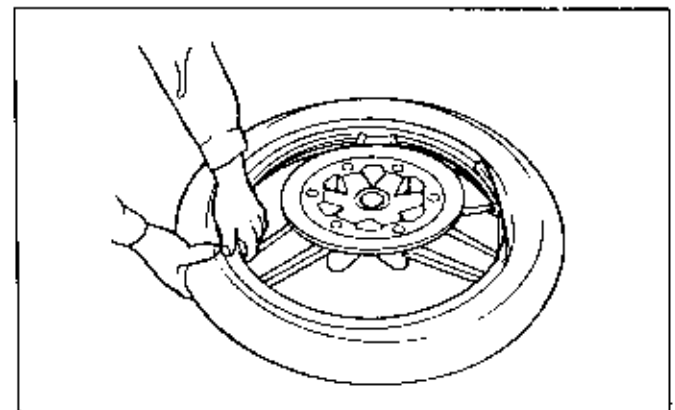
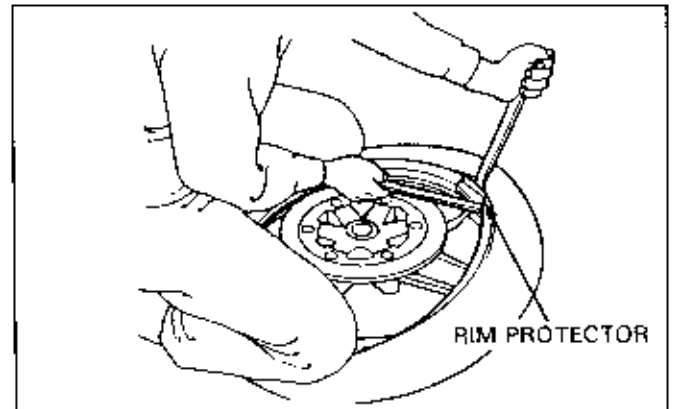
**NOTE**

- Hold one tire lever upright to remove the other lever.

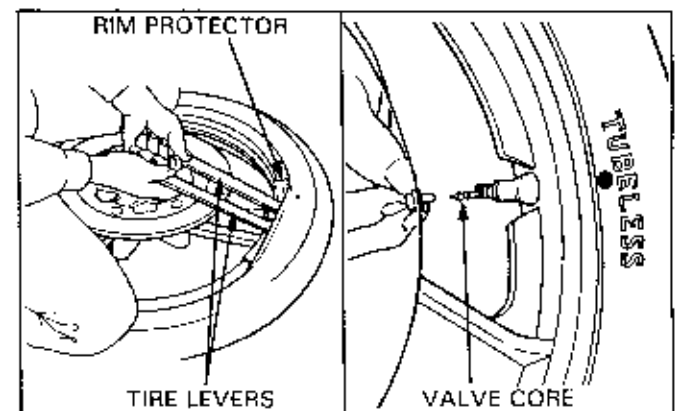
After 3/4 of the bead has been installed, check the bead on the opposite side. Be sure it is still in the center of the rim.

**NOTE**

- The last portion of the bead is more difficult to install. The rim and bead may be damaged if the bead on the opposite side of the point where you are working is not in the rim center.



When the remaining bead is only 50-60 mm (2 to 2.5 in), pull the two levers up and over.





## WHEELS/TIRES

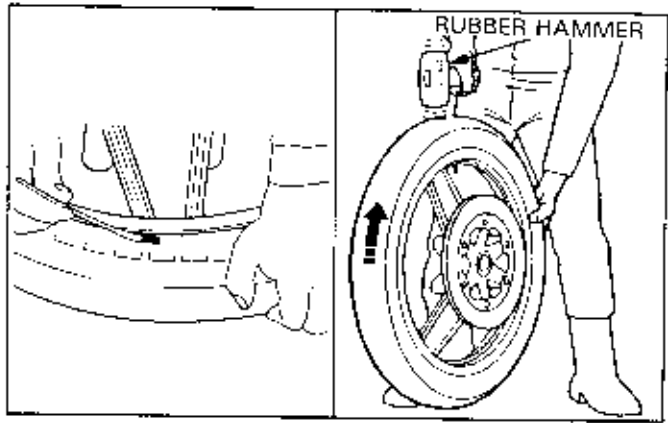
Apply a mild detergent solution to the bead again.

### ⚠ WARNING

- Use only water as a lubricant when removing or mounting tires.  
Soap or other tire lubricants may leave a slippery residue which can cause the tire to shift on the rim.

Tap on the tire tread surface with a rubber hammer so that the tire and rim fit evenly around the circumference.

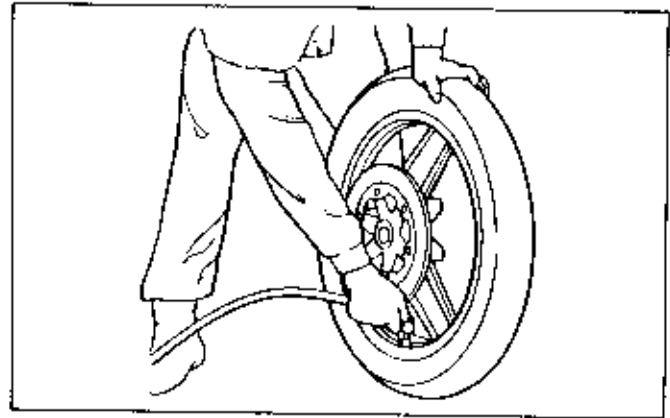
Be sure that the tire center and rim center are aligned.



Inflate the tire to 1.5 times the standard recommended pressure to seat the bead on the rim.

### ⚠ WARNING

- Use the tire pressures specified in the Model Specific manual or on the tire label. Overinflation may cause a tire to burst with sufficient force to result in serious injury or death.



### NOTE

- For tubeless tires, you may hear a loud sound as the bead seats onto the rim. This is normal.
- For tubeless tires, if air leaks out from between the rim and bead, let the wheel stand with the valve at the bottom and put air in while pushing down on the tire.

Check that the tire bead seats on the tire rim securely and the rim line of the tire is concentric with the rim.

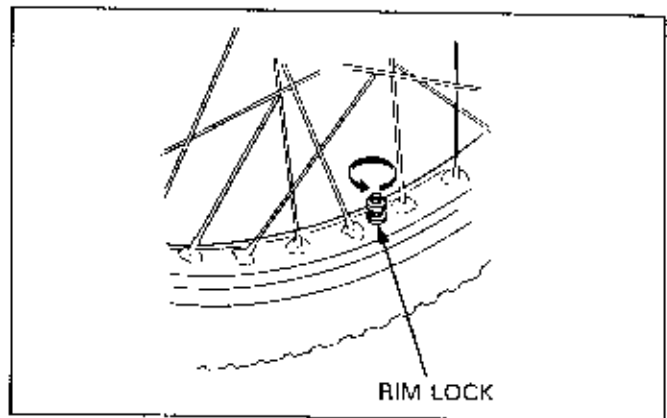
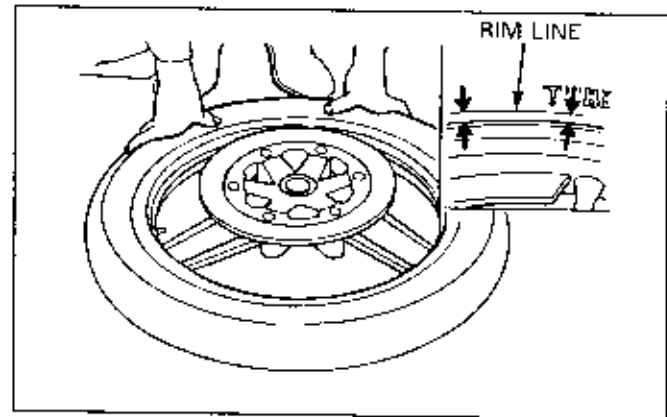
Adjust the tire pressure to the specified pressure.

Check the wheel balance.

Tighten the rim lock nut to specified torque if available.

On the tube type tire, tighten the valve stem nut.

Install the wheel.

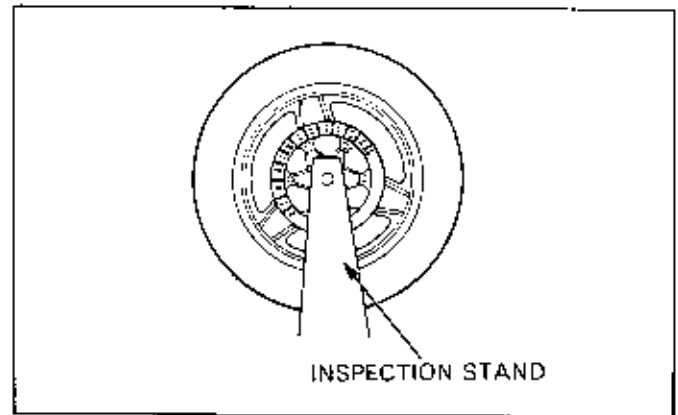


## WHEEL BALANCING

Refer to the Model Specific manual to verify whether or not the model being serviced requires wheel balancing. The manual will specify the type of weights required, if necessary.

### ⚠ WARNING

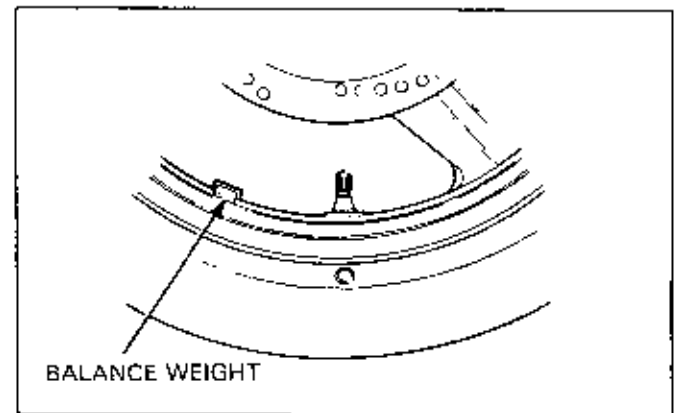
- Wheel balance directly affects the stability, handling and overall safety of the motorcycle. Carefully check balance before reinstalling the wheel.



Mount the wheel, tire and brake disc assembly in an inspection stand.

Spin the wheel, allow it to stop, and mark the lowest (heaviest) part of the wheel with chalk. Do this two or three times to verify the heaviest area. If the wheel is balanced, it will not stop consistently in the same position.

To balance the wheel, install wheel weights on the lightest side of the rim, the side opposite the chalk marks. Add just enough weight so the wheel will no longer stop in the same position when it is spun.



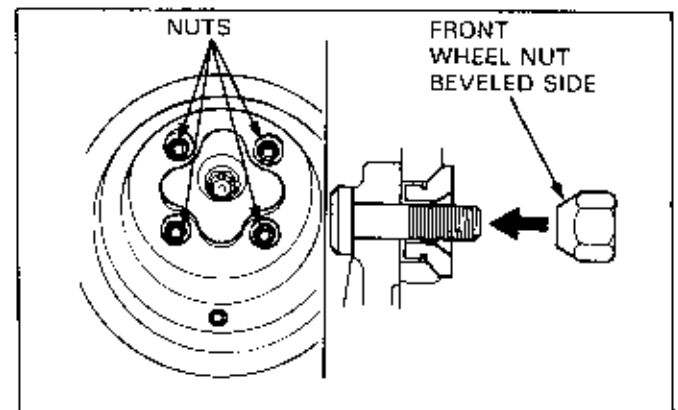
## ATV WHEEL/TIRE

### REMOVAL/INSTALLATION

Loosen the wheel nuts.

Raise the rear wheels off the ground with a jack or block under the engine.

Remove the wheel nuts and wheel.

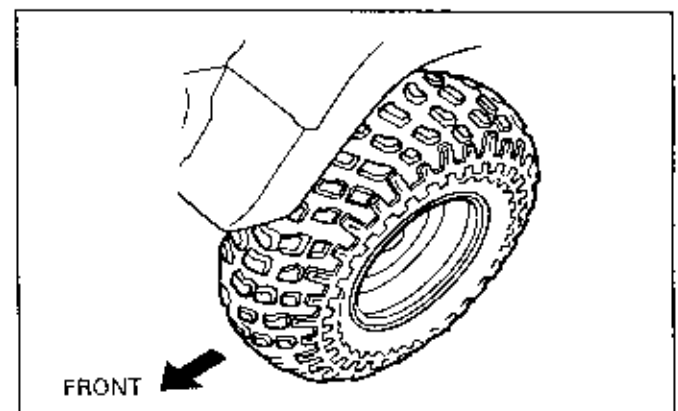


Install the wheel in its original position.

### NOTE

- Do not interchange the right and left tires. If the tire has arrow mark, install the wheel with the arrow mark pointing in the direction of rotation.

Install the wheel nuts with the beveled sides facing inward and tighten to the specified torque.



## WHEELS/TIRES

### TIRE REMOVAL (U.S.A. ONLY)

#### NOTE

- This service requires the Universal Bead Breaker (GN-AH-958-BB1) available in U.S.A. only.
- Remove and install tires from the rim side opposite the valve stem.

Remove the core from the valve stem.

A tire bead tool is required for tire removal.

Use a Coats 220 Tire Changer or equivalent to remove the tire from the rim. If a tire changer is not available, rim protectors and tire irons may be used.

#### CAUTION

- Take care to avoid damaging the bead seating area of the rim.

Install the proper size blade for the rim you are working on onto the breaker arm assembly.

#### CAUTION

- Use of an improper size tire tool may result in damage to the rim, tire, or tool.

Place the proper size adapter onto the threaded shaft and then put the wheel over the threaded shaft and adapter.

Lube the bead area with water, pressing down on the tire sidewall/bead area in several places to allow the water to run into and around the bead. Also lube the area where the breaker arm will contact the sidewall of the tire.

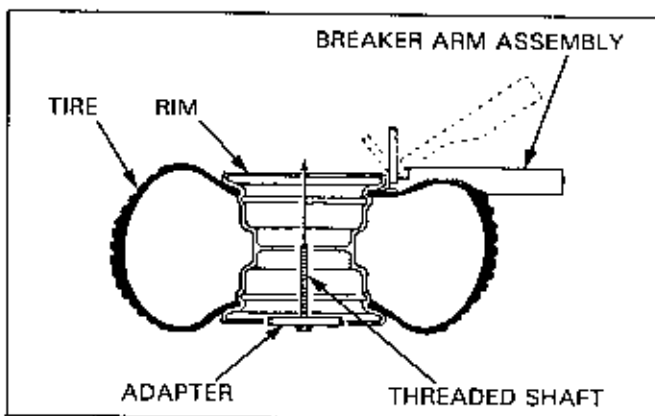
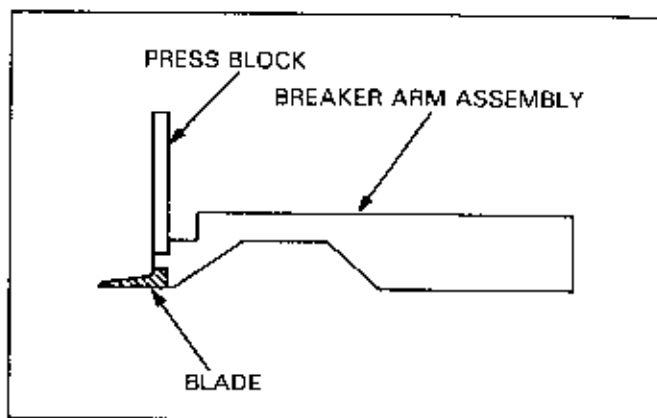
Use only water as a lubricant when removing or mounting tires.

Soap or other tire lubricants may leave a slippery residue that can cause the tire to shift on the rim.

#### WARNING

- A tire that shifts on the rim may lead to a sudden loss of air pressure while riding and an accident could occur.

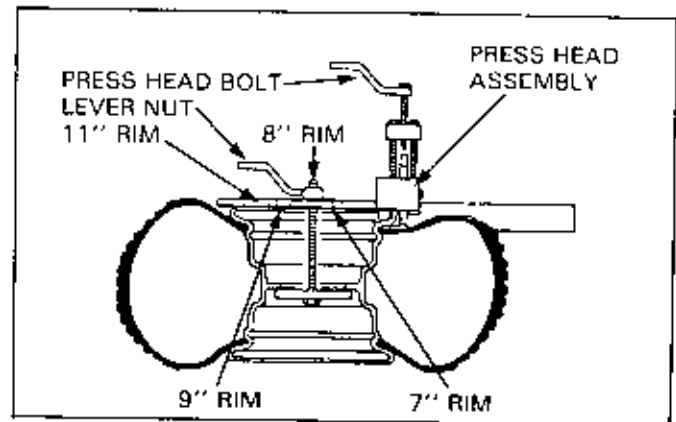
While holding the breaker arm assembly at an approximate 45° position, insert the blade of the breaker arm between the tire and rim. Push the breaker arm inward and downward until it is in the horizontal position with its press block in contact with the rim.



With the breaker arm in the horizontal position, place the breaker press head assembly over the breaker arm press block. Make sure the press head bolt is backed out all the way and then position the nylon buttons on the press head against the inside edge of the rim.

Insert the threaded shaft through the appropriate hole in the breaker press head assembly and then tighten the lever nut until both ends of the breaker press head assembly are in firm contact with the rim.

Tighten the press head bolt until the reference mark on the press block is aligned with the top edge of the press head.

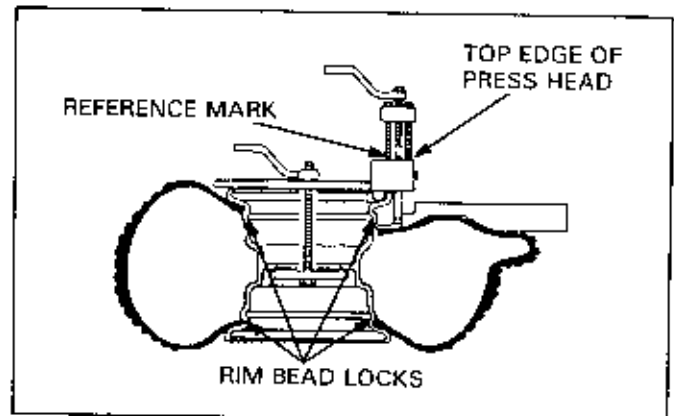


If the rest of the bead cannot be pushed down into the center of the rim by hand, loosen the press head bolt and the lever nut. Rotate the breaker arm assembly and breaker press head assembly 1/8 to 1/4 of the circumference of the rim. Tighten the lever nut and then tighten the press head bolt as described.

Repeat this procedure as necessary until the remainder of the bead can be pushed down into the center of the rim.

Assemble the Universal Bead Breaker on the other side of the wheel and break the bead following the same procedures.

Remove the tire from the rim using a tire changer machine or tire irons and rim protectors.

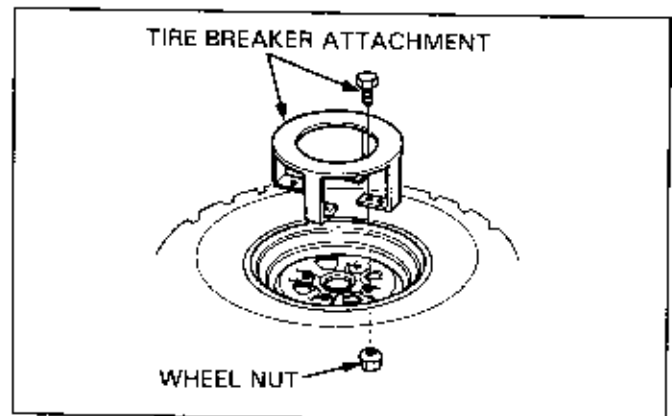


Remove tire from rim that has the smallest shoulder area to simplify removal.

### REMOVAL (EXCEPT U.S.A.)

#### NOTE

- Applying water, soapy water, oil, or other lubricants to the tire, rim or tire tool when removing the tire may cause the tire breaker arm to slip off the tire so that the bead cannot be broken.
- Follow the breaker manufacturer's instructions.

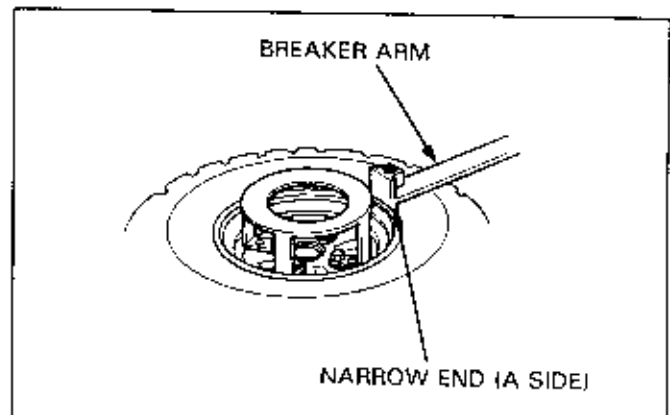


#### CAUTION

- Excessive lapping pressure may deform or damage the seat.
- Do not damage the bead seating area of the rim.

Install the tire breaker attachment on the rim with the wheel nuts and tighten the nuts securely.

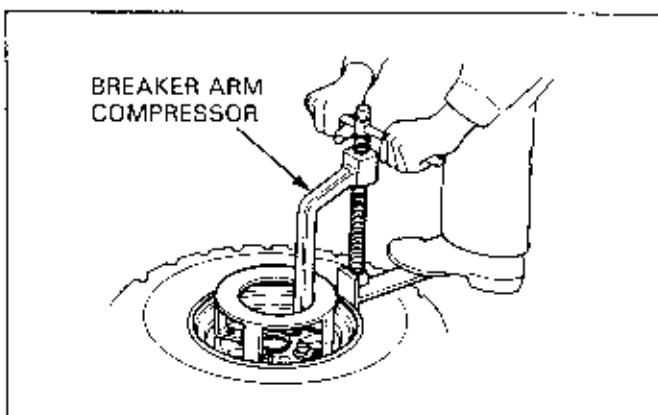
Insert the narrow end (A side) of the breaker arm between the tire and the rim.



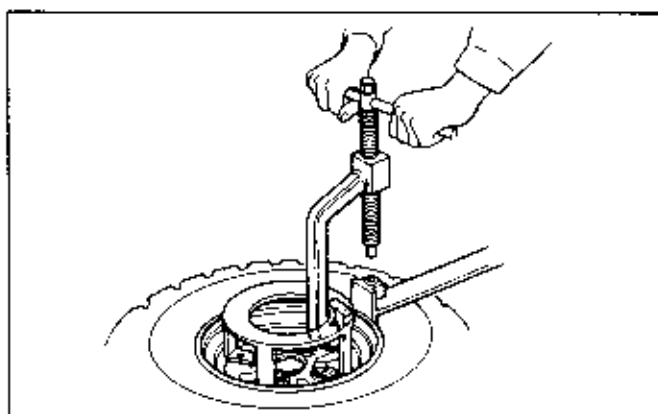
## WHEELS/TIRES

Position the breaker arm compressor on the tire breaker attachment as shown.

Keep the breaker arm horizontal and align the end of the compressor bolt with the breaker arm hole.



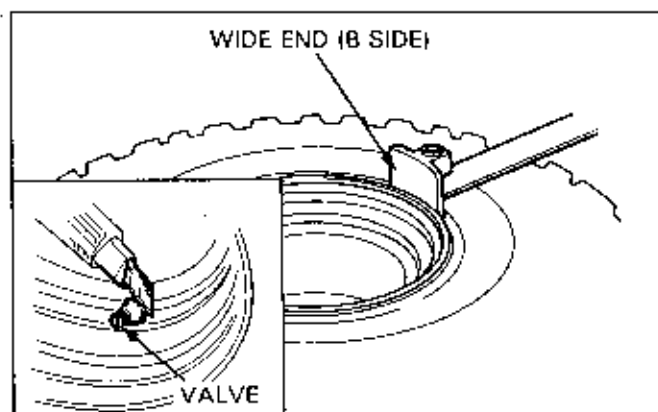
Screw in the breaker arm compressor bolt while pushing the breaker arm on the tire with your foot to break the bead from the rim.



### NOTE

- Do not break the bead all at once. Remove and reposition the compressor and arm 1/8 of the circumference of the rim. Tighten the compressor bolt. Break the bead by repeating this procedure 3–4 times.

If the bead breaking is difficult with the narrow end (A side) of the breaker arm, use the wide end (B side) of the arm and repeat the procedure in the previous step.



After removing the tire from the rim, cut the valve off at the bottom, being careful not to damage the rim.

### NOTE

- Be sure to replace the valve with a new one whenever the tire is removed from the rim.

## TIRE REPAIR

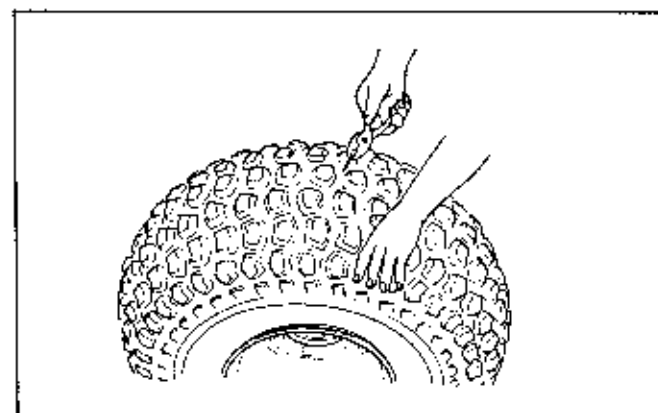
### NOTE

- Use the manufacturer's instructions for the tire repair kit you are using. If your kit does not have instructions, use the procedures provided here.

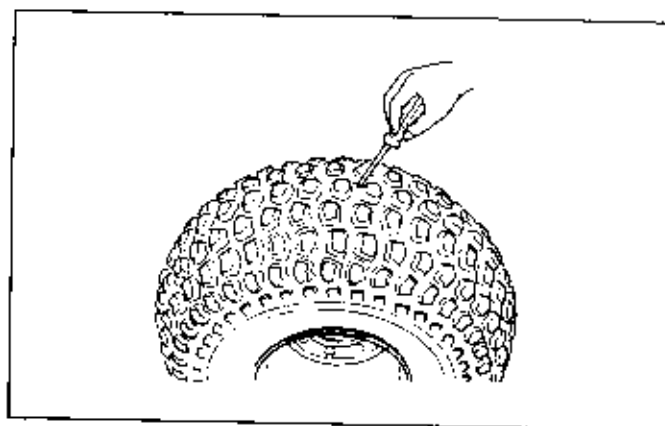
Check the tire for the puncturing objects. Chalk mark the punctured area and remove the object.

Inspect and measure the injury. Tire repairs for injuries larger than 15 mm (5/8 in) should be a section repair. Section repairs should be done by a professional tire repair shop.

If the injury is smaller than 15 mm (5/8 in), proceed with the repair as described here.



Install a rubber plug into the hole as follows:  
Apply cement to a plug inserting needle and work the needle into the hole to clean and lubricate it. Do this three times. Do not let the cement dry.



Insert and center a rubber plug through the eye of the inserting needle.

Apply cement to the rubber plug.

Push the inserting needle with plug into the hole until the plug is slightly above the tire. Twist the needle and remove it from the tire; the plug will stay in the tire.

#### NOTE

- Be careful not to push the plug all the way into the tire.

Trim the plug 6 mm (1/4 in) above the tire surface.

Repeat the above procedure if the puncture is large.

Do not use more than two plugs per hole.

Allow the repair to dry. Drying time will vary with air temperature. Refer to the tire repair kit manufacturer's recommendations.

Inflate the tire and test the seal by dabbing a small amount of cement around the plug. Escaping air will cause a bubble in the cement. If there is leakage, remove the tire (page 16-17) and apply a cold patch to the inside of the tire as described.

If a plug has been inserted, trim it even with the inner tire surface.

Temporarily place a rubber patch that is at least twice the size of the puncture over the injury. Make a mark around the patch, slightly larger than the patch itself.

Remove the patch.

Roughen the area marked inside the tire with a tire buffer or a wire brush. Clean the rubber dust from the buffed area.

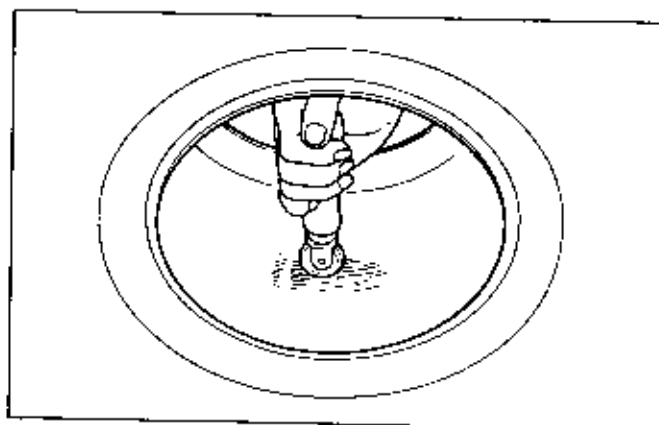
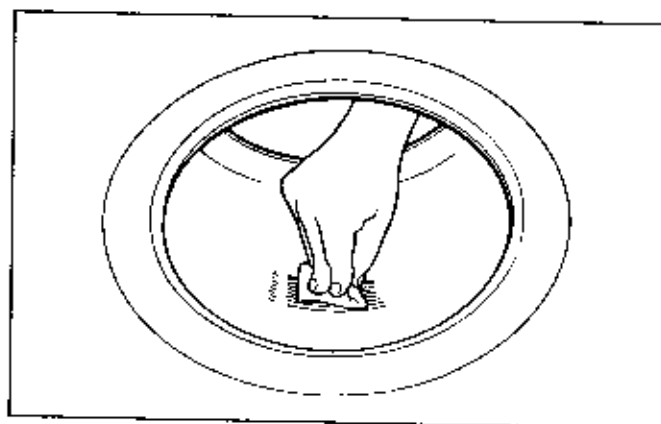
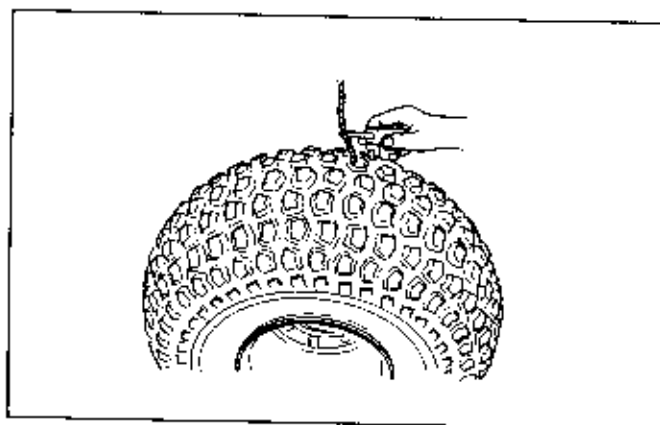
Apply cement over the area marked and allow it to dry.

Remove the lining from the patch and center it over the injury.

Press the patch against the injury using a special roller.

#### NOTE

- Allow cement to dry until tacky before applying patch.
- Do not touch the cement with dirty or greasy hands.



## WHEELS/TIRES

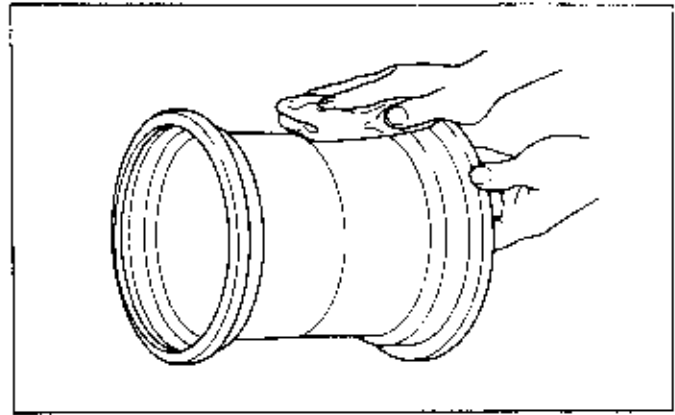
### ASSEMBLY

Clean the rim bead seat and flanges.  
Apply clean water to the rim flanges, bead seat and base.

Install the tire on the rim, where the rim shoulder width is the narrowest, to simplify installation.

#### ⚠ WARNING

- Use only water as a lubricant when mounting tires. Soap or other tire lubricants may leave a slippery residue that can cause the tire to shift on the rim resulting in a sudden loss of air pressure while riding.



Install the valve core in the valve stem.  
Install the tire and inflate it to seat the tire bead.

#### ⚠ WARNING

- The maximum pressure for seating the tire bead is indicated on the side wall. Do not inflate the tire beyond this pressure. The tire could burst with sufficient force to cause severe injury.

#### NOTE

- If the tire has arrow mark, install the tire with the mark pointing in the direction of rotation.
- Do not interchange the right and left tires.

Deflate the tire. Wait 1 hour and inflate the tire to the specified pressure.

Check for air leaks and install the valve cap.

The ATVs are equipped with tubeless tires, valves, and wheel rims. Use only tires marked "TUBELESS" and tubeless valves on rims marked "TUBELESS TIRE APPLICABLE." Never mount tires designed for use on automobiles on an original rim.

# 17. BRAKES

TROUBLESHOOTING	17-1	HYDRAULIC DISC BRAKES	17-8
BRAKE SYSTEM DESCRIPTIONS	17-2	MECHANICAL DRUM BRAKES	17-16

## TROUBLESHOOTING

### ⚠ WARNING

- Inhaled asbestos fibers have been found to cause respiratory disease and cancer. Never use an air hose or dry brush to clean brake assemblies. In the United States, use an OSHA-approved vacuum cleaner or alternate method approved by OSHA, designed to minimize the hazard caused by airborne asbestos fibers.

### HYDRAULIC DISC BRAKE

#### Brake lever/pedal soft or spongy

- Air bubbles in the hydraulic system
- Leaking hydraulic system
- Contaminated brake pad/disc
- Worn caliper piston seal
- Worn master cylinder piston seal
- Worn brake pad
- Contaminated caliper
- Caliper not sliding properly
- Worn brake pad/disc
- Low fluid level
- Clogged fluid passage
- Warped/deformed brake disc
- Sticking/worn caliper piston
- Sticking/worn master cylinder piston
- Worn brake disc
- Contaminated master cylinder
- Bent brake lever/pedal

#### Brake lever/pedal hard

- Clogged/restricted brake system
- Sticking/worn caliper piston
- Caliper not sliding properly
- Clogged/restricted fluid passage
- Worn caliper piston seal
- Sticking/worn master cylinder piston
- Bent brake lever/pedal

#### Brakes grab or pull to one side

- Contaminated brake pad/disc
- Misaligned wheel
- Clogged/restricted brake hose
- Warped/deformed brake disc
- Caliper not sliding properly
- Clogged/restricted brake hose joint

#### Brakes drag

- Contaminated brake pad/disc
- Misaligned wheel
- Worn brake pad/disc
- Warped/deformed brake disc
- Caliper not sliding properly

### MECHANICAL DRUM BRAKE

#### Poor brake performance

- Improperly adjusted brake
- Worn brake linings
- Worn brake drum
- Worn brake cam
- Improperly installed brake linings
- Brake cable sticking/needs lubrication
- Contaminated brake linings
- Contaminated brake drum
- Worn brake shoes at cam contact areas
- Improper engagement between brake arm and cam-shaft serrations

#### Brake lever hard or slow to return

- Worn/broken return spring
- Improperly adjusted brake
- Sticking brake drum due to contamination
- Worn brake shoes at cam contact areas
- Brake cable sticking/needs lubrication
- Worn brake cam
- Improperly installed brake linings

#### Brake squeaks

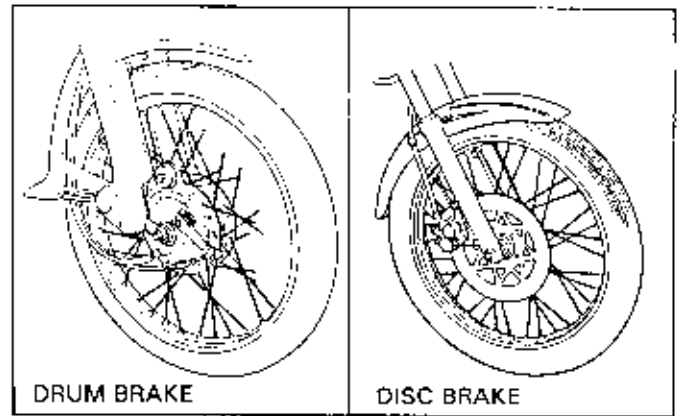
- Worn brake linings
- Worn brake drum
- Contaminated brake linings
- Contaminated brake drum



**BRAKE SYSTEM DESCRIPTIONS**

Braking systems on motorcycles, like virtually all braking systems, dissipate the vehicles kinetic energy by transforming it into heat energy-known as friction heat.

Two basic types of braking systems are used on Honda motorcycles and scooters; the drum-type and the disc type. Both the drum and the disc rotate together with the wheel. Each is slowed by the friction of either shoes or pads that press against them.

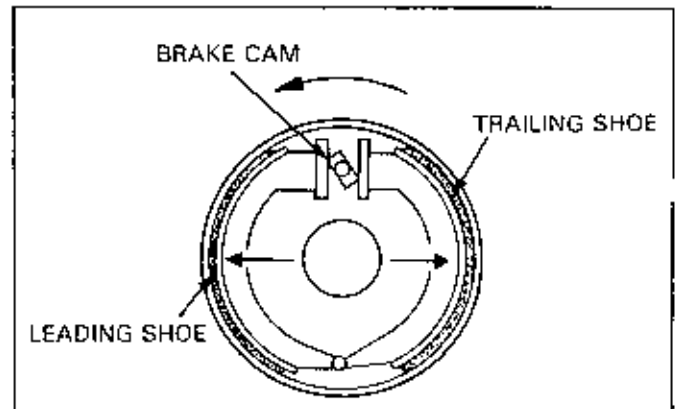


**MECHANICAL DRUM BRAKE**

**Single Leading Shoe Type  
(Or, Leading-Trailing Shoe Type)**

Force applied against the brake lever or pedal activates a cable or rod attached to the brake mechanism. A threaded adjuster on the end of the brake actuating cable or rod offers one of two adjustments to control the precise brake actuation point. The adjuster acts against a pivot on the end of the brake arm, which is clamped onto and turns a brake activating cam.

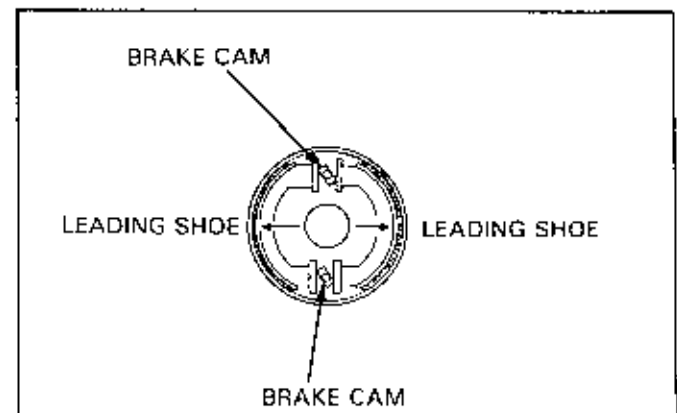
As shown in the illustration to the right, this cam transfers a rotating force from the outside of the drum, through the protective brake panel to the inside of the drum. Here the cam spreads one end of two crescent-shaped shoes. The other end of the shoes pivot against a common pin set into the brake panel. Both shoes press against the inside surface of the drum, creating friction and slowing the rotation of the wheel. The first shoe to act upon the drum beyond the cam, in relation to the rotating direction of the drum, is called the leading shoe. The second shoe, arcing out against the drum from the common pivot pin, is called the trailing shoe.



Due to its position within the system, the leading shoe creates more force against the drum than that which is applied to it. This increased force capability is called a self-energizing effect. In contrast, the trailing shoe, again, because of its position within the system based on the rotating direction of the drum, is pushed back by the rotating drum and creates less force than that which is applied to it.

**Dual Leading Shoe Type**

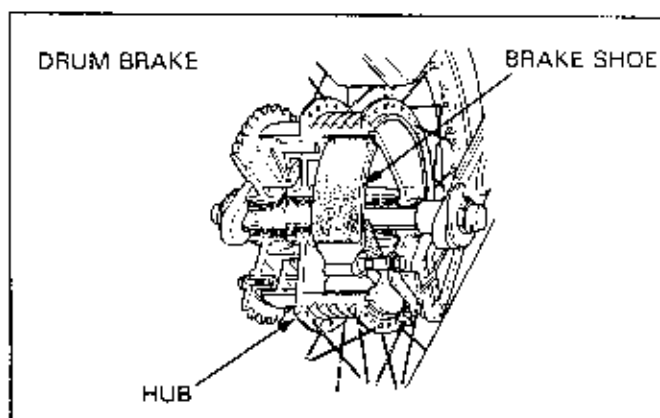
Dual leading shoe brakes differ from single leading shoe types in that they use two shoe-activating cams, each at opposite ends of the brake panel, to simultaneously press the shoes against the drum (see illustration at the right). Because both shoes are leading in relation to the rotating direction of the drum and therefore operate against the drum in same way, the effective braking force is noticeably greater than a similarly sized single leading shoe unit with an identical amount of actuating force applied to the brake lever or pedal.



It is vital for brake systems to quickly dissipate the heat that is generated by the friction of the braking action so their stopping force remains consistent. Since drum brakes contain almost all of the brake components within the wheel hub, it is important that these brake components be made of materials that conduct heat rapidly. It is just as important that the brake is of the proper size for the anticipated requirements of the vehicle.

In order to enhance heat conductivity while providing acceptable wear resistance on the inner surface of the brake drum, the drum itself is made of cast iron. The remainder of the drum/hub is made of aluminum alloy with cooling fins cast into the outer circumference; again for heat conductivity and dispersion, but also for reduced unsprung weight. To speed conductivity, the cast iron drum is captured within the aluminum hub and cannot be removed.

The drum thickness is relatively thin, which further aids heat conductivity, and must not be machined in a brake lathe. If the drum surface is severely damaged, the hub must be replaced.



## HYDRAULIC BRAKES

### Brake Fluid

The designations DOT 3 and DOT 4 specify the brake fluid's ability to withstand heat without boiling. The greater the number, the higher the boiling point. It is necessary for the brake fluid to have a high boiling point so that the fluid does not boil within the brake line due to the high temperature of the brake discs and components. Boiling brake fluid leads to a drastic loss of braking force due to the air bubbles that form within the brake lines.

Never mix DOT 3 and DOT 4 brake fluid within a system. It is important to add only the same DOT number and even the same brand of brake fluid when adding fluid. If you are unsure of the type within the system, drain the system and refill it with DOT 4; systems designed for DOT 3 can use DOT 4. But DOT 4 systems must never be filled with DOT 3. DOT 4 systems generate greater heat and thereby require the higher boiling point characteristic of DOT 4.

Avoid mixing different brands of brake fluid. Improper mixing such as this may lead to chemical decomposition and contamination.

It is also important to use only fresh brake fluid from a sealed container. Once a new container of brake fluid is opened, be sure to reseal it tightly and plan on discarding the fluid after six months. This is because brake fluid left in the container tends to absorb moisture from the air; it is hygroscopic. Moisture can form even within a sealed brake system because of this particular property. Moisture in the brake fluid contaminates the brake system and lowers the boiling point of the fluid. It also corrodes the brake cylinders and pistons, which eventually causes seal damage and leakage.

For this reason you should note the date on the container that it was first opened for later reference.

## BRAKES

Never reuse brake fluid due to the possibility of contamination from dust or moisture absorption.

If the brake fluid in a system shows any visual signs of contamination, it should be replaced — even if the recommended replacement interval has not passed.

You must be careful when handling brake fluid because it can quickly damage many painted or plastic surfaces on contact. In certain plastics, structural damage can occur if brake fluid penetrates the material's surface. The only general exception is the components of the brake system that are designed to be resistant to the effects of brake fluid. Brake fluid that is spilled on a motorcycle should be washed away with water immediately.

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.

### CAUTION

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

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

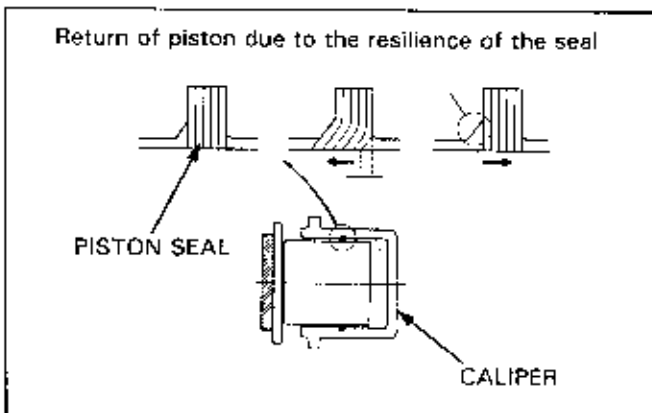
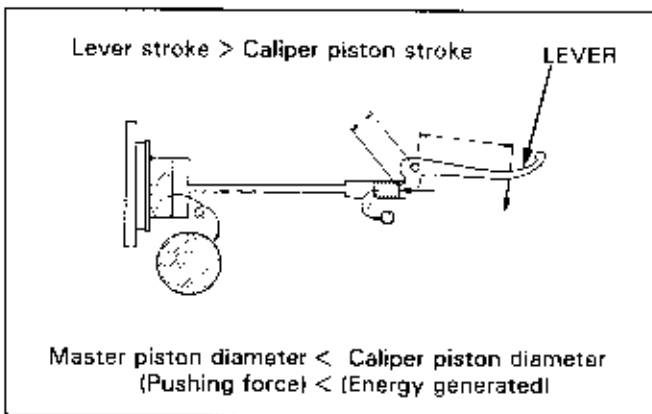
Pressure applied against the brake lever or pedal moves the piston within the master cylinder unit. Hydraulic fluid pressure is then transmitted through the brake line to the caliper where it presses against one or more caliper pistons.

Because hydraulic fluid cannot compress, the caliper piston(s) move at the same instant as does the master piston in the master cylinder.

The rise in hydraulic pressure that takes place between the master cylinder and the caliper because of the differences in the diameter of these parts is most significant. During development, these sizes are juggled to achieve best braking force and "feel". The leverage ratio offered by the design of the lever or pedal acting upon the master piston also helps to increase in force to be transmitted to the caliper pistons compared to the force initially applied.

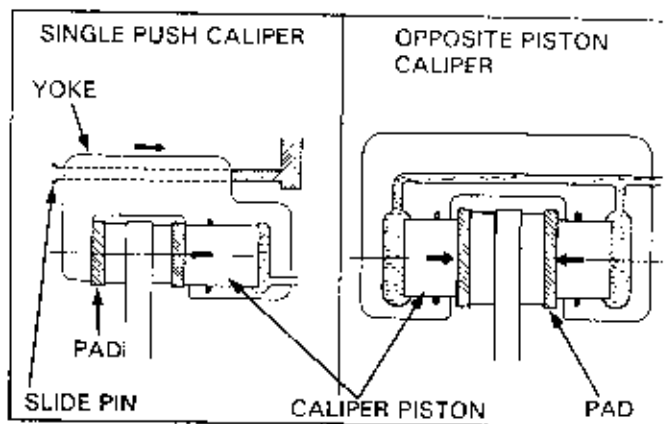
The caliper pistons are in direct contact with the back side of the brake pads. Anti-squeal shims are normally used between the piston and pad. As these pads press against opposite sides of the disc, the rotation of the wheel is slowed.

When the brake lever is released, hydraulic pressure decreases and the pads cease to press against the disc. Unlike drum brake systems where a spring retracts the shoes from the drum surface, on disc brake systems, the resilience of the caliper piston seals retracts the pads from the disc and automatically self-adjust for wear.



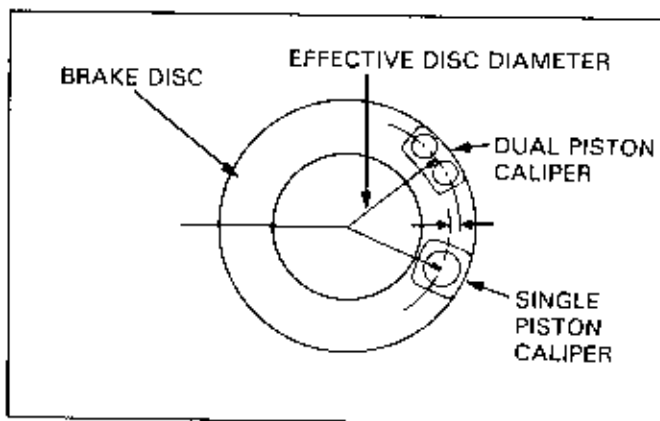
In single push type calipers, both pads press against the brake disc through a reaction of the sliding caliper yoke. Calipers of this type with single piston are more common on earlier Hondas. More current models use a single push type, but with dual pistons (both on the same side).

Opposite piston calipers are most often used for road racing motorcycles today. They do offer some improvement in performance, but at great increase in cost and complexity. In this type, pistons facing each other on opposite sides press the pads against the disc.

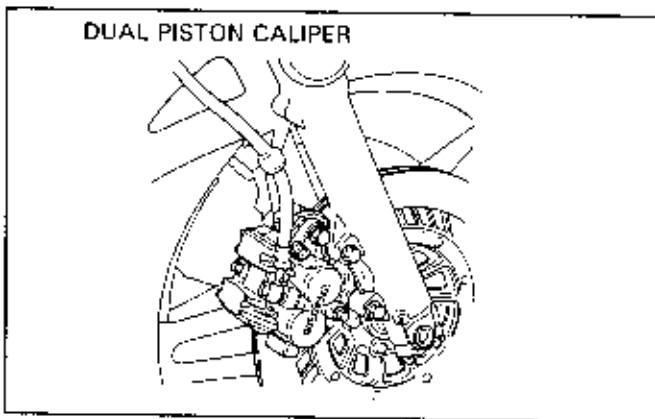


The amount of braking force available depends on the magnitude of force pressing the pads against the discs, the size of the contact area between the brake pads and discs, the distance between the center of the wheel and the center of the brake pads, and on the outside diameter of the tire.

Rectangular brake pads were introduced to increase the area of the pad against the disc. But it was found that these pads do not press against the disc uniformly, so the braking force is not as effective as it could be. Hence, the dual piston caliper was introduced so that a large braking force and uniform pressure against the brake pads is ensured. Some dual piston calipers have different piston sizes to further balance the braking force across the pad — the trailing piston being larger than the leading piston.



As previously touched on, increasing the area of contact between the brake pads and disc increases the braking force. This increased contact means increased heat energy. The increased heat energy requires greater capability for heat dissipation.



With the exception of in-board disc brakes and the GL1500 front brakes, all brake discs are exposed. To protect them from rust, the discs are made of stainless steel alloy.

Because the material the discs can be made of is limited, the discs can only be made so thin in order to reduce unsprung weight before thermal distortion of the disc becomes a problem.

As the temperature of the brake disc rises, the disc expands. Because the disc is bolted to the wheel, its expansion is limited and some degree of distortion occurs.

The VTR250, with its in-board front disc, uses a plain cast iron disc since rust is not a problem. The design of the GL1500 front brake with its covered discs and calipers, transfers much of its heat to the cast, hollow wheel.

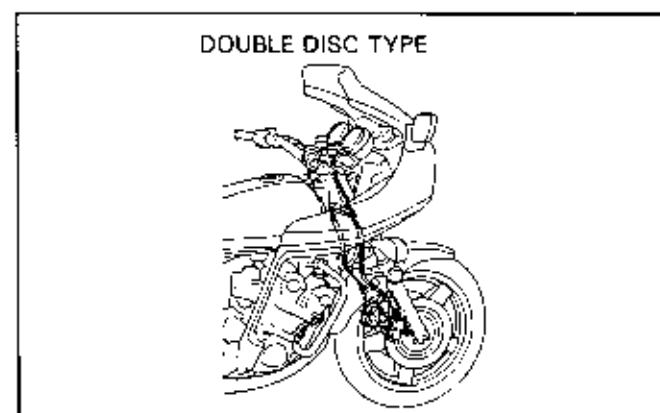
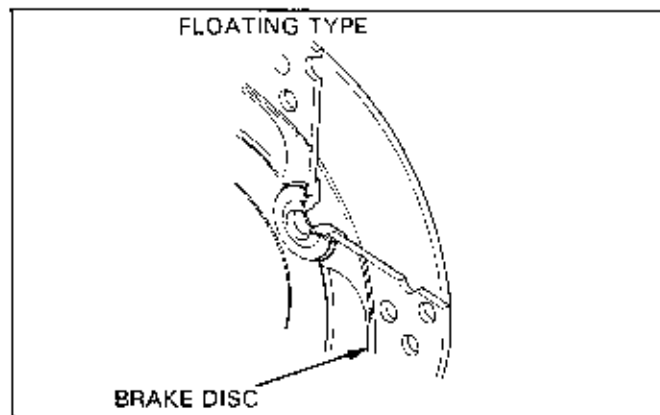
## BRAKES

To cope with the extreme heat typically generated in competition road racing, floating type discs have been developed. In this system, a floating disc is installed by means of spring washers and rivets or clevis pins with an aluminum carrier between the disc and the wheel. In this manner, deviations in radial directions are permitted, distortion is prevented and weight is reduced.

In addition to the design basics already stated, discs are commonly drilled or grooved to remove dust or dirt from the disc surface, thereby preventing what are known as sympathetic vibrations. Contrary to popular beliefs, holes drilled in the disc do not significantly aid cooling. These holes are perpendicular to the flow of air so little additional cooling occurs.

Among the many combinations of materials used to make brake pads are: wear resistant resin, metallic mixtures, and sintered metal. These materials are combined in brake pad manufacturing according to the design requirements of the particular application. Asbestos was dropped from use in pad manufacturing by Honda beginning around 1985-86.

Just as disc brakes are used where greater than typical drum brake stopping force is required, dual disc brakes (a disc on both sides of a single wheel) are used where an even greater braking capability or a smaller diameter front wheel is required.



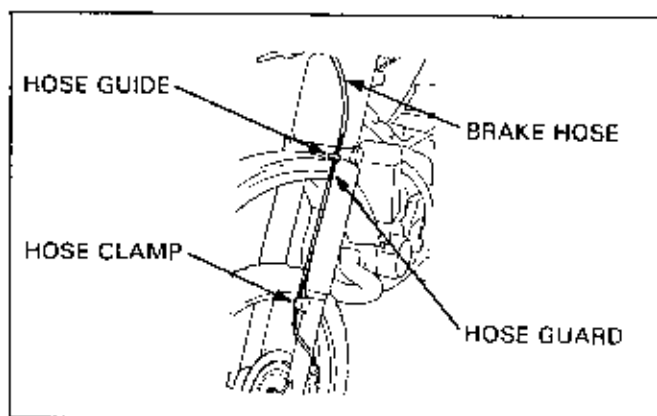
### GENERAL INFORMATION FOR SERVICE

- Do not allow dust, dirt, water or any foreign material to enter the system when refilling or replacing the brake fluid.
- To maintain proper sealing and initial fit, replace the parts specified for replacement at the time of service. Replace the required parts as a set, when specified, for the same reason.
- Clean the sliding surfaces of the brake pads and disc with brake cleaner. Replace the pads if they are contaminated with oil or grease, as this significantly reduces braking force.
- The brake calipers can be removed from the motorcycle and the pads can be replaced without disconnecting the hydraulic system.

- Bleed the hydraulic system if it has been disassembled or if the brake feels spongy.
- If brake pads or shoes have been overheated (glazed), they must be replaced. Overheating changes the composition of the friction material and merely wire brushing or sanding the friction surface cannot change this fact.
- Always replace hydraulic line/hose sealing washers with new ones when reassembling. These sealing washers are made of aluminum alloy for effective sealing and are distorted once they are used.

Use caution when handling and installing brake lines and hoses. When installing front brake lines, be sure that there is no possibility of damage or stress to the lines or hoses when the fork pivots fully in either direction or when the suspension compresses or extends. In the rear, allow proper clearance so that the lines or hoses do not rub against the tire, frame or swingarm, and so they are not caught between the coils of the spring when the suspension compresses.

All brake lines or hoses should be installed using the clamps provided. Each clamp should be positioned around the rubber hose guards to prevent any damage to the lines and hoses.

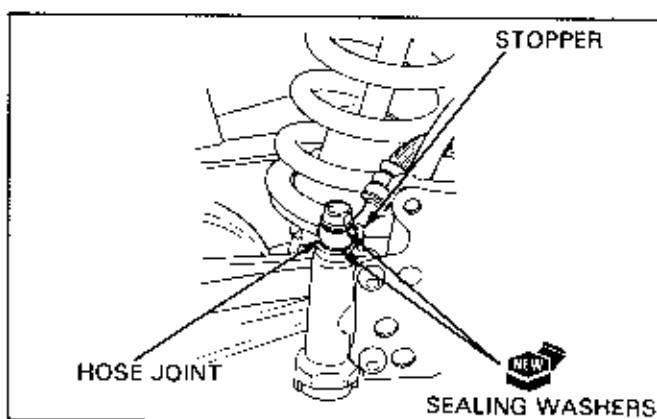


#### Eyelet-type line and hose joints:

Use new sealing washers whenever eyelet-type joints are reinstalled. Be sure the hose bolt fluid passage is free from clogging prior to installation.

Note the position of the stopper that aids in positioning the eyelet at the proper angle when installing the hose onto the master cylinder. If only one stopper is provided, press the hose end against the stopper while tightening the bolt. If two stoppers are provided, install the hose between the stoppers so that the hose will not move when the bolt is tightened.

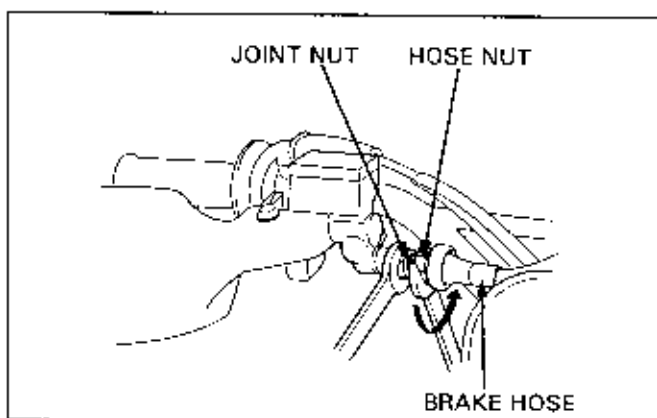
If the sealing washer includes a stopper with collapsible claws, be sure to note the direction these claws face so the new washer can be installed in the same position.



#### Hose Joints:

##### Removal

Remove the hose by loosening the joint nut while holding the hose nut stationary. This method prevents the hose from being twisted or kinked.

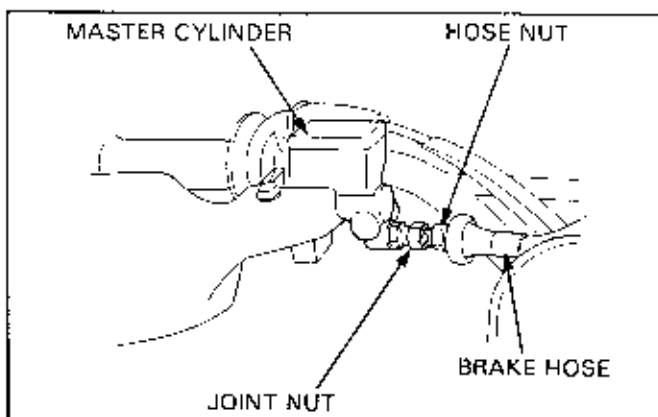


## BRAKES

### Installation

First install the hose joint onto the master cylinder with a new sealing washer and tighten it to the specified torque if it was removed.

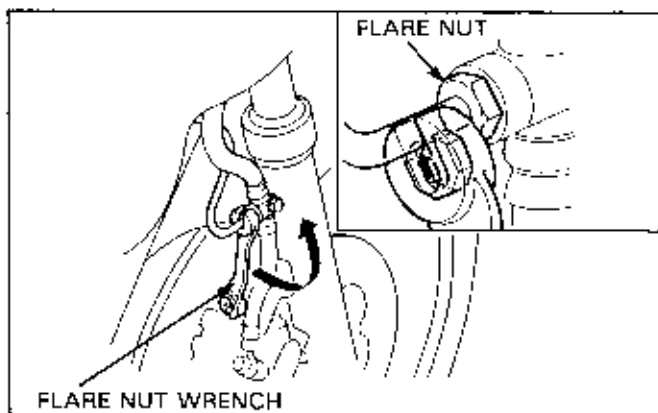
Then, while holding the hose nut, tighten the joint nut to the specified torque.



### Metal Brake Lines:

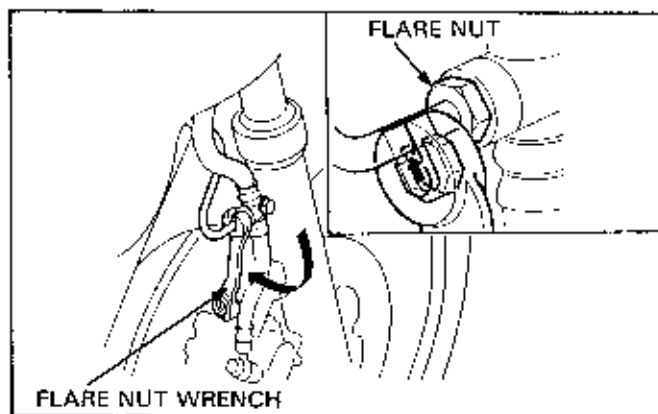
#### Removal

If the metal brake line is equipped with nuts as illustrated, always loosen the flare nuts first, using a flare nut wrench, so that the hose may be easily maneuvered. Remove the metal line using care not to bent it.



#### Installation

Always tighten brake line nuts first by hand. Then, confirm that the connections are free from play and tighten to the specified torque using a flare nut wrench.



## HYDRAULIC DISC BRAKES

### BRAKE 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.

#### CAUTION

- Spilling fluid on painted, plastic or rubber parts will damage them.

Remove the master cylinder cover and diaphragm.

Discard contaminated pads and clean a contaminated disc with a high quality brake degreasing agent.

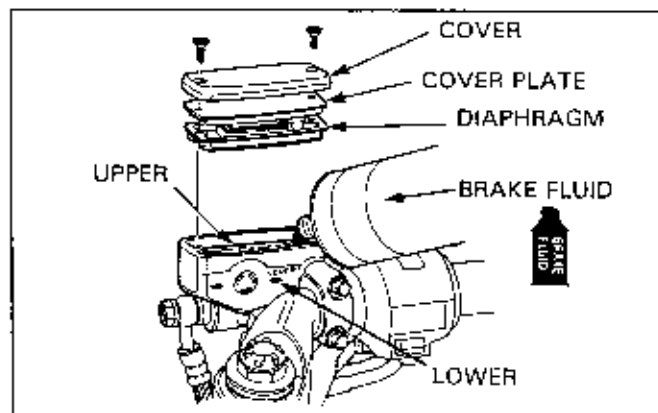
#### WARNING

- A contaminated brake disc or pad reduces stopping ability.

Refill with the same type of fluid.

#### WARNING

- Mixing incompatible fluids will impair braking efficiency.
- Foreign materials can clog the system, causing a reduction or complete loss of braking ability.



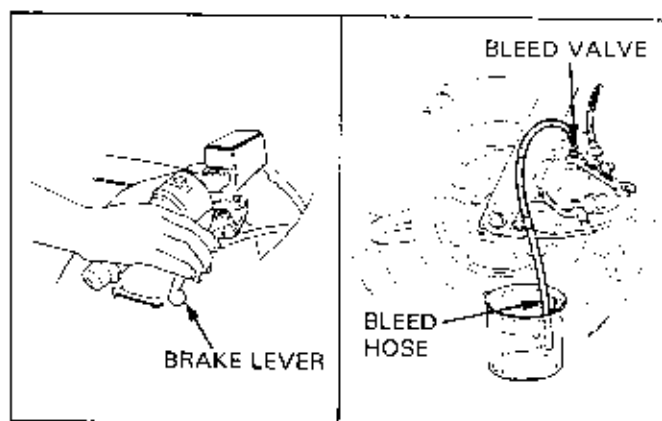
Connect a bleed hose to the bleed valve.

Loosen the caliper bleed valve and pump the brake lever or pedal. Stop operating the lever or pedal when fluid stops flowing out of the bleed valve.

Close the bleed valve and fill the master cylinder with the specified brake fluid. Refer to the Model Specific manual.

#### CAUTION

- Reusing drained fluids can impair braking efficiency.



Connect a commercially available Brake Bleeder to the bleed valve.

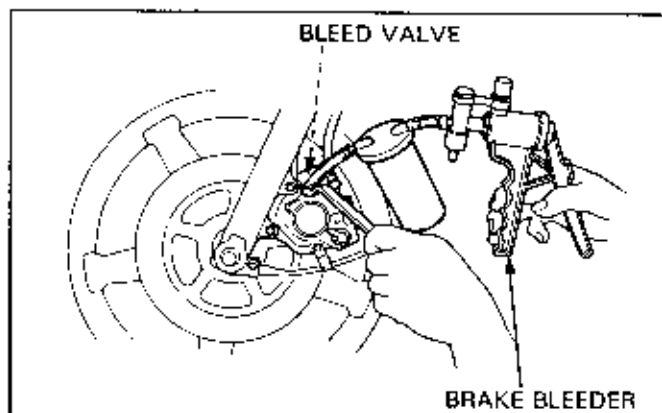
#### NOTE

- When using a brake bleeder, follow the manufacturer's operating instructions.

Pump the brake bleeder and loosen the bleed valve.

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

Repeat the above procedures until no air bubbles appear in the plastic hose.



#### NOTE

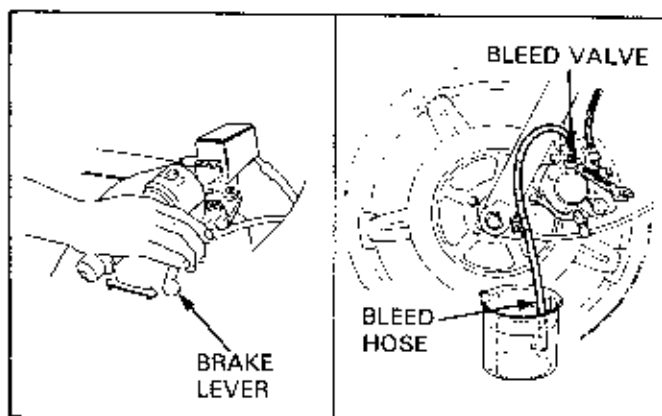
- Check the fluid level often while bleeding the brakes to prevent air from being pumped into the system.
- Use only specified brake fluid from a sealed container.
- If air is entering the bleeder from around the bleed valve threads, seal the threads with teflon tape.

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

Connect the transparent bleeder hose to the bleed valve and place the other end of the hose in a container.

Loosen the bleed valve 1/4 turn and pump the brake lever or pedal until there are no air bubbles in the bleed hose and lever or pedal resistance is felt.

After filling the system, close the bleed valve and inspect the system for air bubbles by operating the brake lever or pedal. If it feels spongy, bleed the system as follows.





## BRAKES

### AIR BLEEDING

1. Squeeze the brake lever, then open the bleed valve 1/4 turn and close the valve.

#### NOTE

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

2. Release the brake lever slowly and wait several seconds after it reaches the end of its travel.
3. Repeat the above steps 1 and 2 until bubbles cease to appear in the fluid at the end of the hose.

Tighten the bleed valve.

Be sure that the brake fluid is up to the upper level of the master cylinder and refill if necessary.

Reinstall the master cylinder cover.

### BRAKE PAD REPLACEMENT

#### Removal

There are two types of the brake pads;

Type A: pad pin is secured by the retainer plate.

Type B: pad pin is secured by the pad pin plug.

Type A: Loosen the pad pin retainer bolt.

Type B: Remove the pad pin plug and loosen the pad pin.

Refer to the Model Specific manual for the caliper removal/installation.

#### NOTE

- Remove the pads without removing the bracket from the caliper. If the pads cannot be removed, remove the bracket.

Push the piston all the way in to allow the installation of new brake pads.

Type A: Remove the pad pin retainer bolt and the pad pin retainer.

Before removing the pads, mark them so you can reinstall them in their original positions if they are to be reused, thereby assuring even disc pressure.

#### WARNING

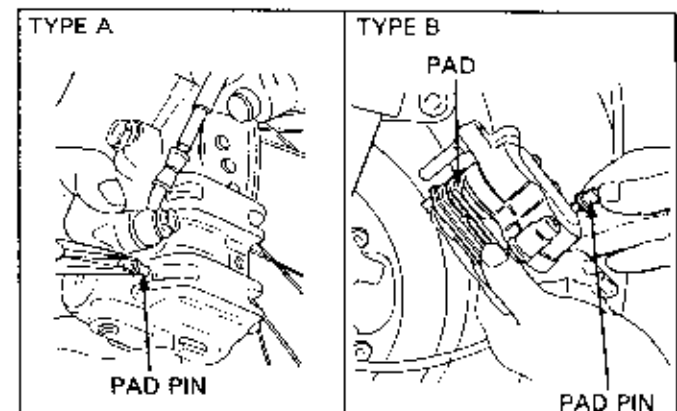
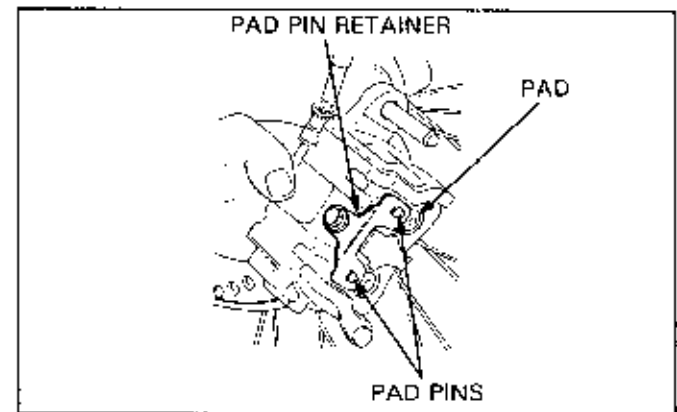
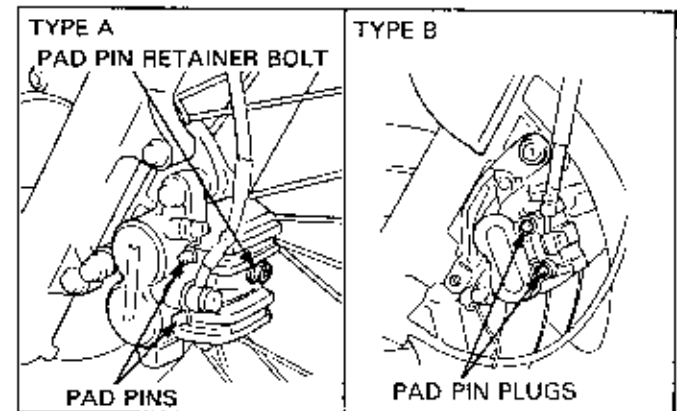
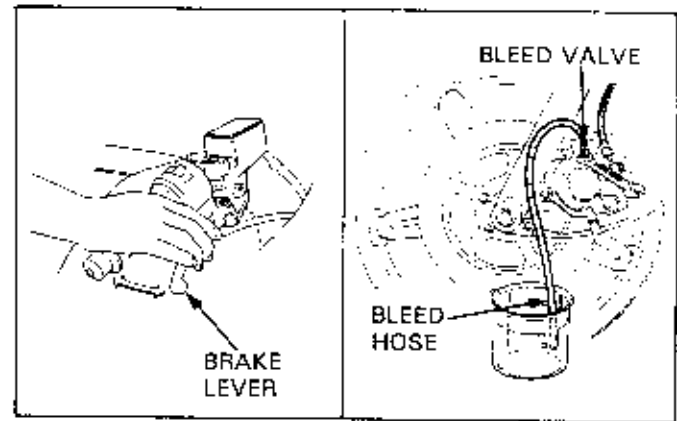
- Always reinstall the brake pads in their original positions to prevent loss of braking efficiency.

Type A: Pull out the pad pins and remove the pads.

Type B: Loosen the pad pins and remove the pins and pads.

#### NOTE

- Pad pins can be easily removed by pressing the pads in the caliper.
- Install the pad shim, if there is one, in the original position.

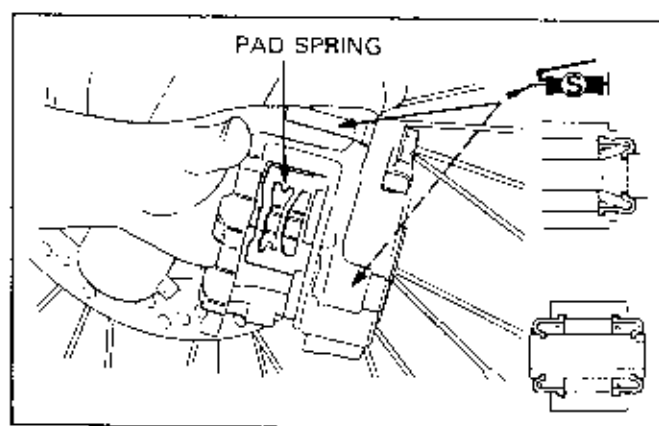


**Installation**

Press in the piston(s) to install the new pads.

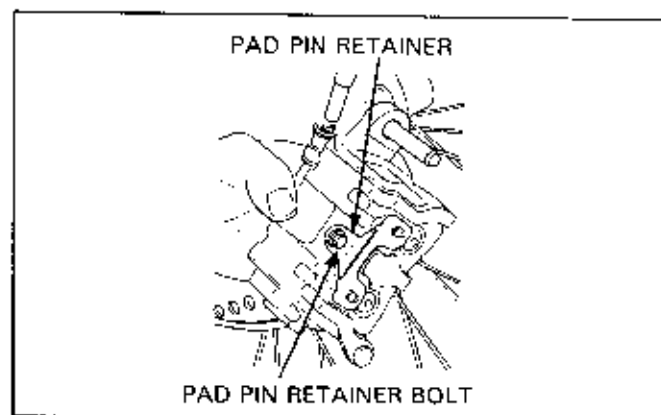
If the caliper and bracket are separate, apply silicone grease to the caliper pivot bolt boot, pin bolt, collar bore and insert the caliper into the bracket.

Set the boot lip in the pin bolt groove securely.



Install the new pad, align the holes in the pad and retainer and install the pad pin. Note the installation direction of the pad.

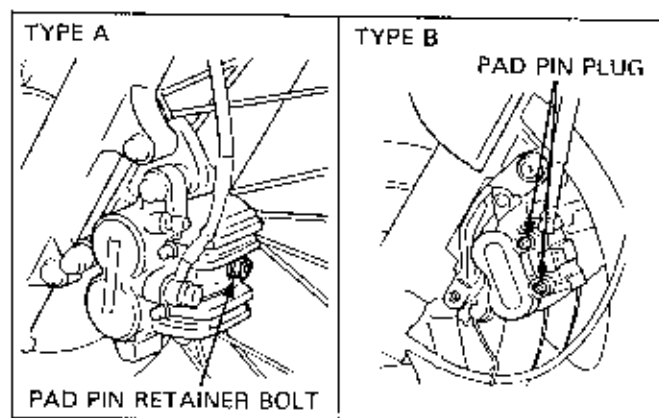
Type A: Install the retainer by aligning its hole with the pad pin groove and loosely tighten the bolt.



Install the caliper. (Refer to the Model Specific manual.)

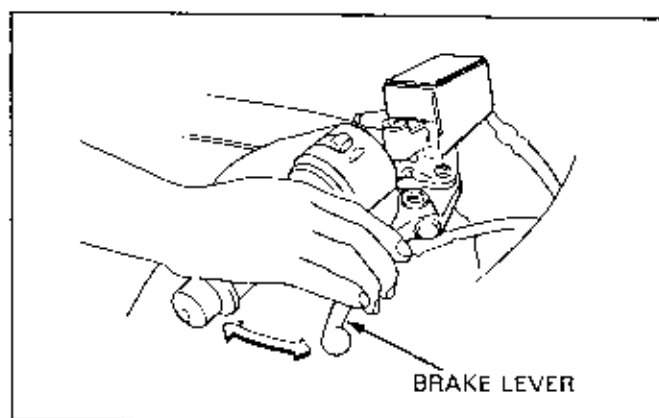
Type A: Tighten the pad pin retainer bolt to the specified torque.

Type B: Tighten the pad pin to the specified torque and install the pad pin plug.



Apply the brake lever to force the caliper piston out of the caliper.

Rotate the wheel by hand and check for the brake operation.



## BRAKES

### BRAKE CALIPER

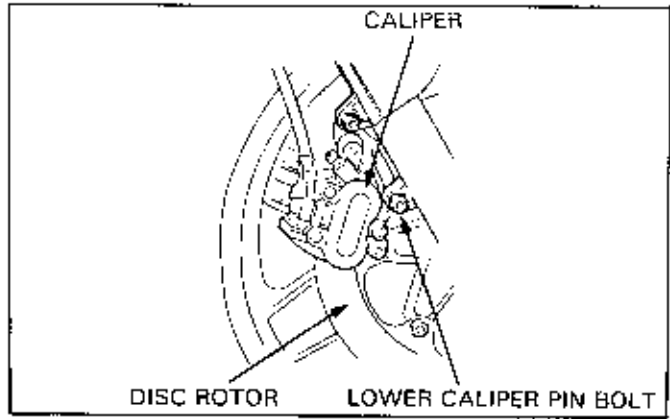
#### Removal

Refer to the Model Specific manual for the brake caliper removal/installation.

Pump the brake lever to force the caliper piston out of the caliper.

Place a clean container under the caliper and disconnect the brake hose from the caliper.

Clean the removed parts with fresh brake fluid. Avoid spilling brake fluid on painted surfaces.



#### CAUTION

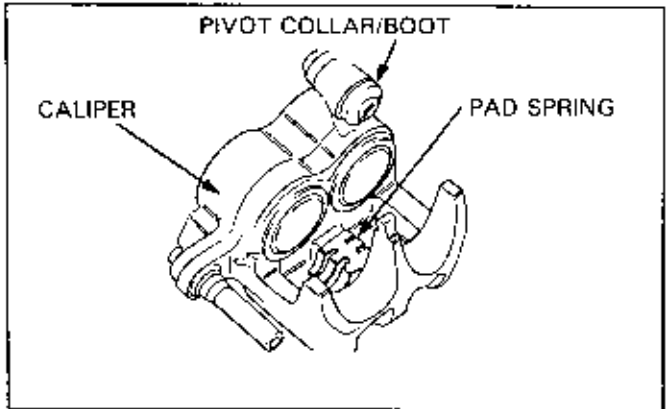
- Spilled brake fluid will damage painted, plastic or rubber parts.

Remove the brake caliper assembly and the pads from the caliper.

#### Disassembly

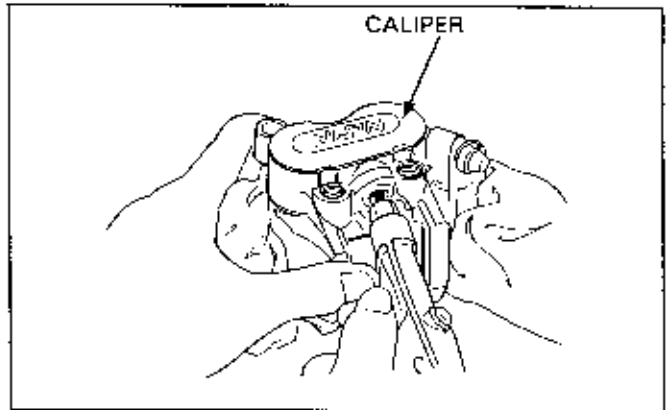
Remove the following:

- caliper bracket
- pad spring
- pivot collar
- boot



Remove the piston.

If necessary apply compressed air to the caliper fluid inlet to get the piston out. Place a shop rag under the caliper to cushion the piston when it is expelled. Use low pressure air in short spurts.

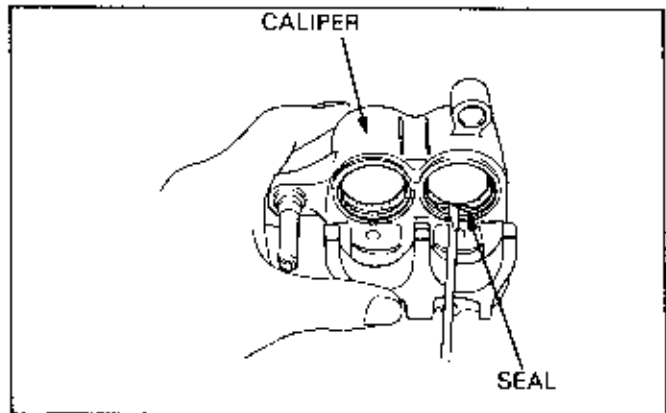


#### CAUTION

- Be careful not to damage the caliper cylinder bore when removing the seals.

Push the piston seal and dust seal in and remove them.

Clean the caliper, especially the brake piston seal grooves, with fresh brake fluid.



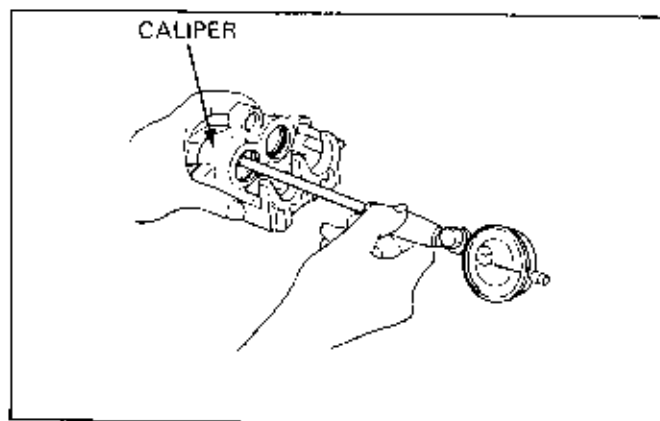
**Caliper cylinder inspection**

Check the caliper cylinder bore for scoring, scratches or other damage.

Measure the caliper cylinder I.D. in X and Y axis at several points.

Replace the caliper cylinder if the largest measurement is beyond the specified service limit.

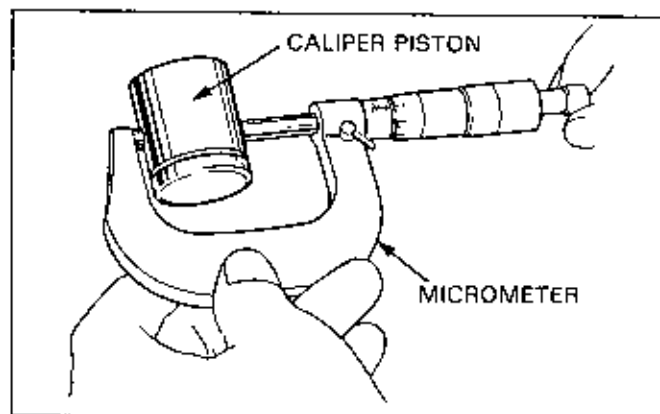
Refer to the Model Specific manual for the service limit.

**Caliper Piston Inspection**

Measure the caliper piston O.D. in X and Y axis at several points.

Replace the caliper piston if the smallest measurement is less than the specified service limit.

Refer to the Model Specific manual for the service limit.

**Assembly****NOTE**

- Make sure that each part is free from dust or dirt before reassembly.
- Replace the dust seals and piston seals as a set whenever they are removed.

Coat the new dust seals and piston seals with the recommended brake fluid and install them in the caliper cylinder grooves properly.

Coat the caliper piston with fresh brake fluid and install it in the caliper.

There are two types of caliper pistons; resin pistons mounted on light-weight motorcycles and metal pistons, on heavy-weight motorcycles. Note the installation direction as it is different according to the type of the piston.

**Resin piston:** Install with the concaved side away from the pad.

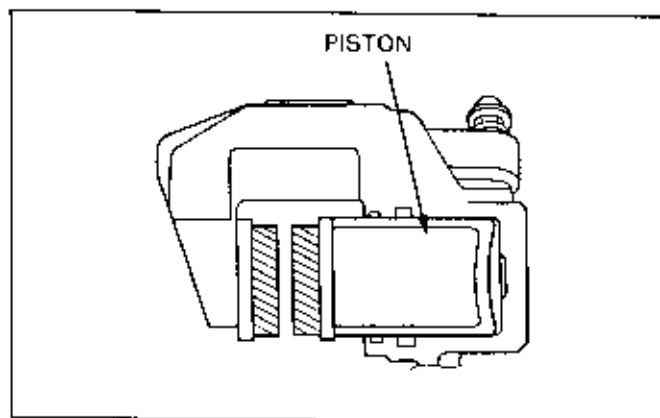
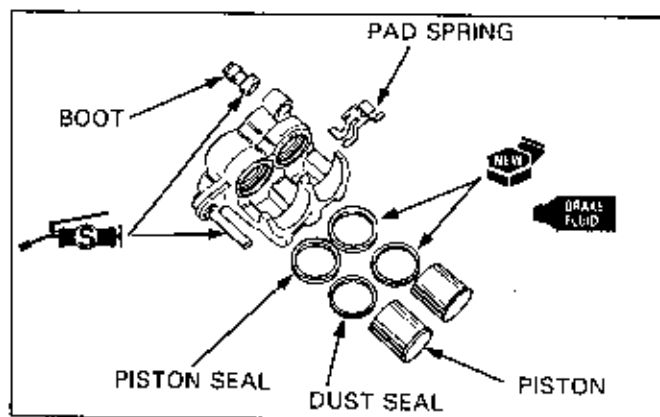
**Metal piston:** Install with the opening toward the pad.

Install the pad spring in the caliper.

Refer to the Model specific manual for the installation direction of the spring.

Install the pad (page 17-10).

Install the caliper. (Refer to the Model Specific manual.)



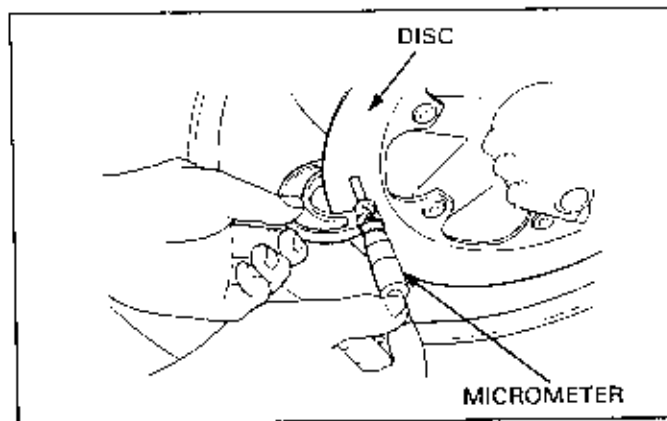
## BRAKES

### BRAKE DISC INSPECTION

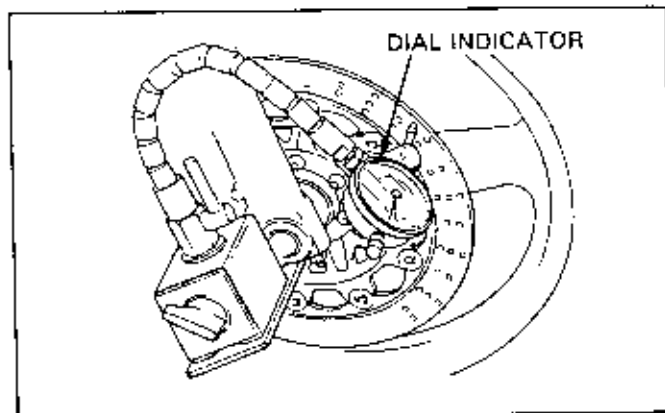
Visually inspect the discs for damage or cracks.

Measure the brake disc thickness at the several points and replace if the smallest measurement is less than the specified service limit.

Refer to the Model Specific manual for the service limit.  
Check the disc to see if the service limit is stamped on it.



Check the brake disc for warpage.  
Inspect the wheel bearings for excessive play. If the warpage exceeds the specification.  
Replace the brake disc if the wheel bearings are normal.



### MASTER CYLINDER

#### Disassembly

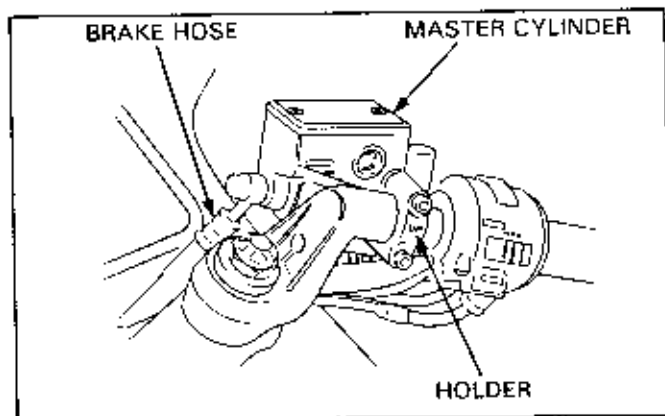
#### CAUTION

- Do not allow foreign materials to enter the master cylinder.

#### NOTE

- Replace the master piston, spring, cups and snap ring as a set whenever they are disassembled.

Disconnect the wire from the brake light switch.  
Drain the brake fluid (page 17-9).  
Remove the brake lever from the master cylinder.  
Disconnect the brake hose.  
Remove the master cylinder holder and the master cylinder.



Remove the rubber boot.

Remove the snap ring.

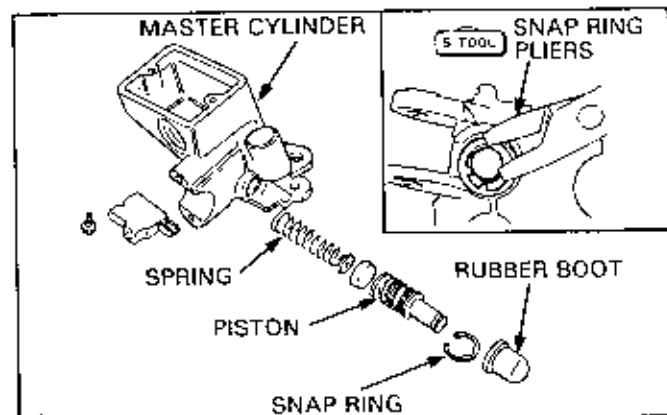


**SNAP RING PLIERS**

07914-3230001

Remove the piston and spring.

Clean the master cylinder with the recommended brake fluid.



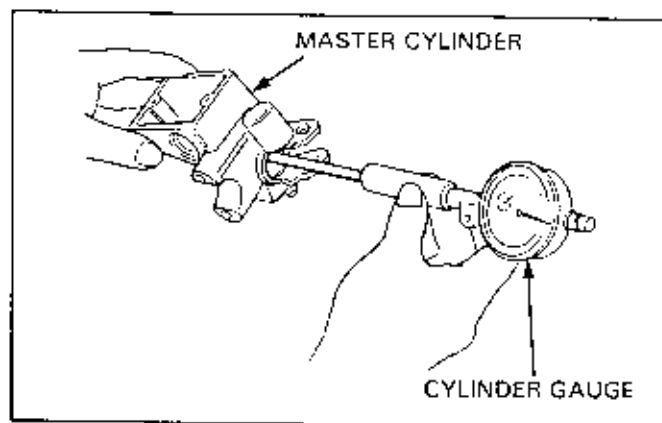
**Master Cylinder Inspection**

Check the master cylinder for scores, scratches or nicks and replace if necessary.

Measure the master cylinder I.D. in X and Y axis at several points.

Replace the master cylinder if the largest measurement is over the specified service limit.

Refer to the Model Specific manual for the service limit.



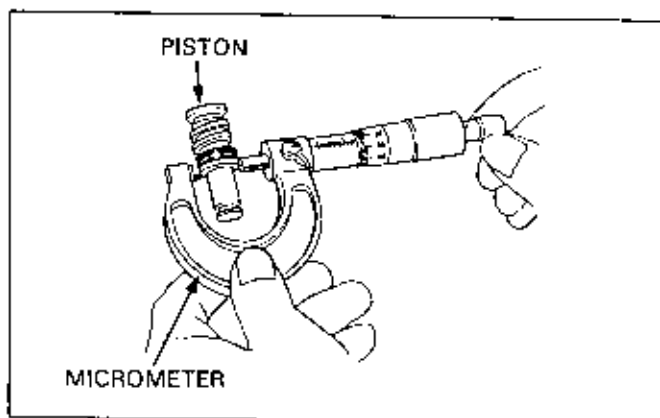
**Master Piston Inspection**

Measure the piston O.D. at the several points on the secondary cup side and replace it if the smallest measurement is less than the specified service limit.

Refer to the Model Specific manual for the service limit.

**NOTE**

- Replace the master cylinder, if it leaks with a new piston installed.



**Assembly**

**NOTE**

- Replace the piston, spring, cups and snap ring as a set.
- Be sure that each part is free from dust or dirt before reassembly.

Coat the piston cup with the fresh brake fluid and install it on the piston.

Install the spring with its larger diameter and toward the master cylinder.

Install the primary cup with its concaved side toward the inner side of the master cylinder.

Install the snap ring.

**S.T.O.C.**

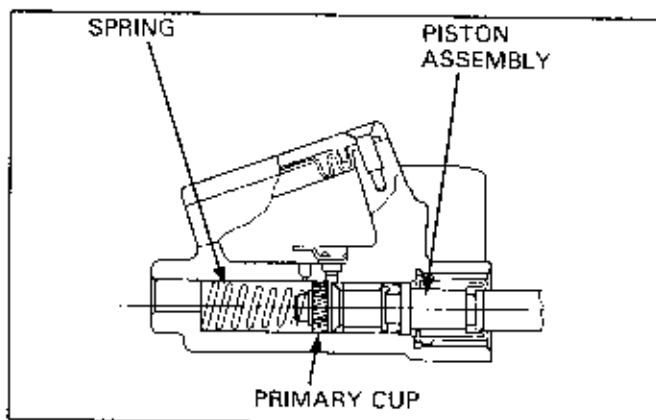
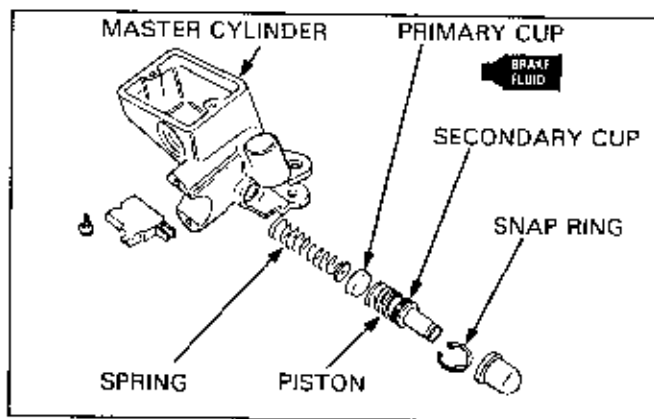
**SNAP RING PLIERS**

07914-3230001

**CAUTION**

- When installing the cups, do not allow the lips to turn inside out. (Refer to the drawing.)
- Note the installation direction of the snap ring.
- Be certain that the snap ring is seated firmly in the groove.

Install the rubber boot in the groove properly.



## BRAKES

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

Align the split between the holder and master cylinder with the punch mark on the handlebar.

Tighten the upper holder bolt to the specified torque first, then tighten the lower bolt to the same torque.

Install the brake lever and connect the wire to the brake light switch.

Connect the brake hose with two new sealing washers. Be careful not to twist the brake hose.

Tighten the brake hose bolt to the specified torque.

Make sure that the brake hose is routed properly.

Route all cables, hoses, and lines carefully to avoid kinking or pinching.

### CAUTION

- Improper routing may damage cables, hoses, and lines.

### WARNING

- Kinked or pinched brake cables, hoses, or lines may cause a loss of braking ability.

Fill the system with specified grade of fluid and bleed the air from the system (Refer to page 17-10).

## MECHANICAL DRUM BRAKES

Use an OSHA-approved vacuum cleaner or alternate method approved by OSHA, designed to minimize the hazard caused by airborne asbestos fibers.

### WARNING

- Inhaled asbestos fibers have been found to cause respiratory disease and cancer. Never use an air hose or dry brush to clean brake assemblies.
- Grease on the brake linings will reduce stopping ability.

Remove the wheel.

Remove the brake panel from the wheel hub.

### INSPECTION

#### Brake Drum I.D.

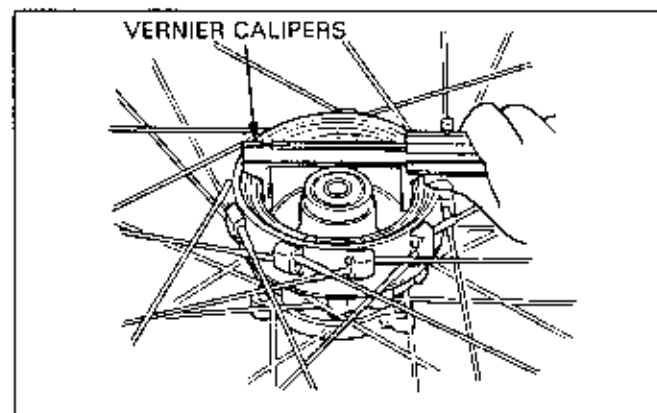
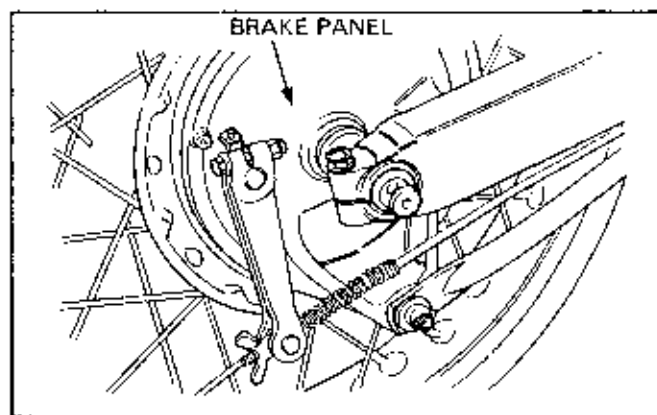
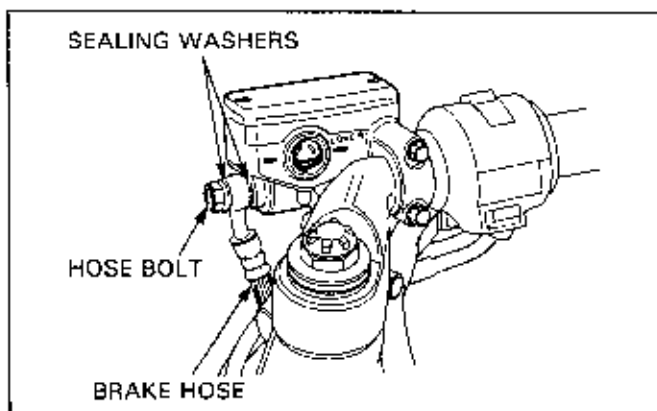
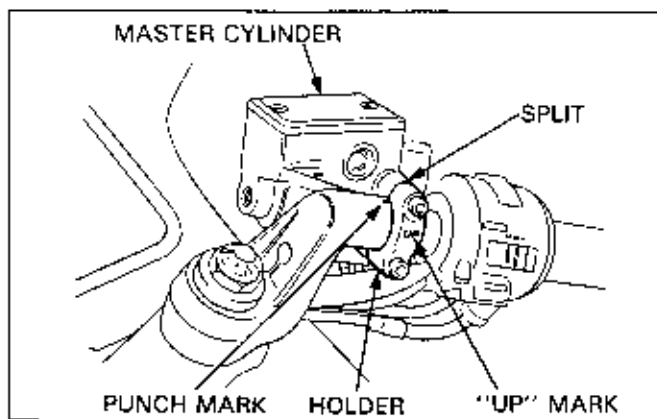
Check the brake drum for wear or damage. Replace the wheel hub if necessary.

Measure the brake drum I.D. at the lining surface in a several points and take the largest measurement.

Refer to the Model Specific manual for the service limit or refer to the wheel hub if the service limit is stamped on it.

### NOTE

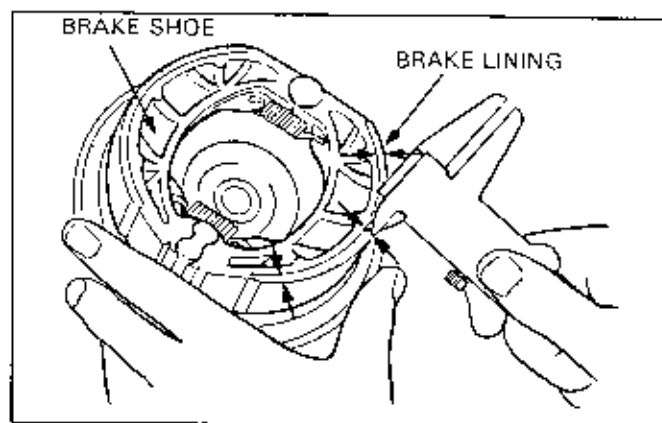
- If the brake drum is rusted, clean with # 120 emery paper.
- Be sure to use the inside vernier calipers to measure the brake drum I.D because the drum have a wear ridge.



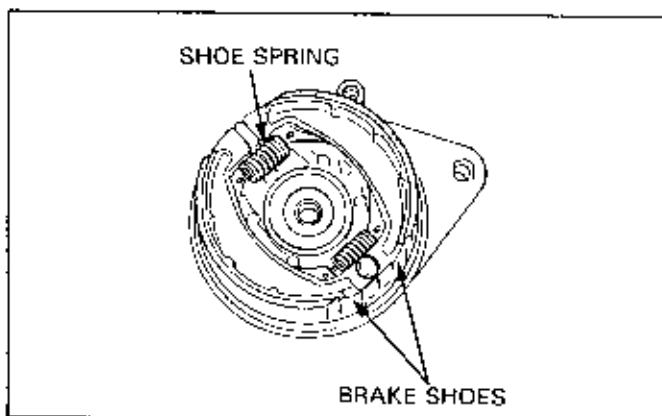
**Brake Lining Thickness**

Measure the brake lining thickness at 3 points (both ends and center).

Replace the brake shoes in pairs if the smallest measurement is less than the service limit or if they are contaminated with grease.

**DISASSEMBLY****NOTE**

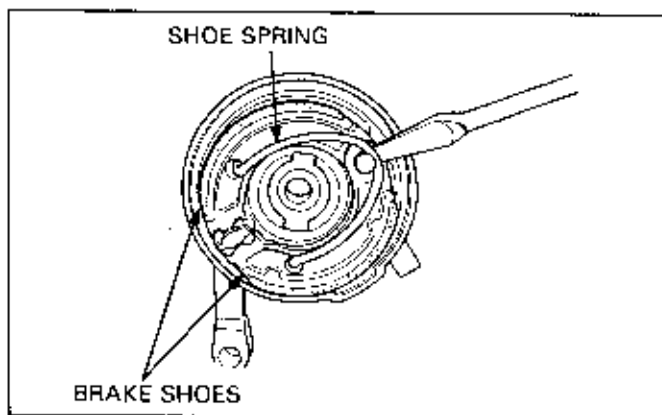
- Replace the brake shoes in pairs.
- When the brake shoes are reused, mark on the side of each brake shoe before disassembly so that they can be installed in their original positions.

**U-Spring Type**

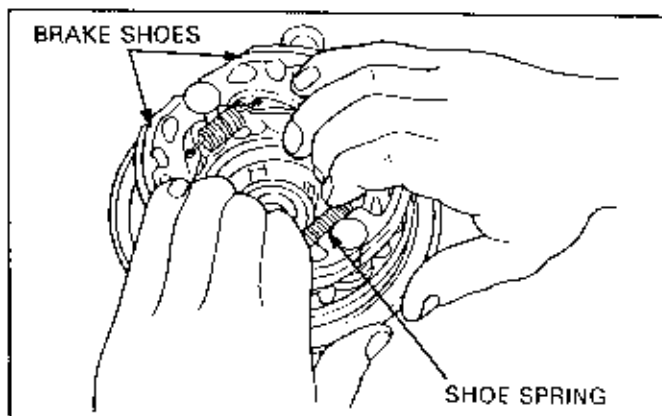
Move the brake arm and expand the brake shoes.

Remove the shoe spring from the anchor pin with a screwdriver.

Remove the brake shoes.

**Coil Spring Type**

Pull the brake shoes away from the anchors and remove the shoes.

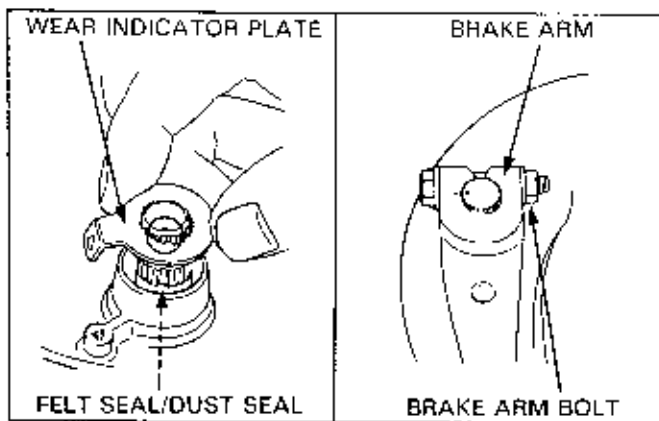




## BRAKES

Remove the following from the brake panel.

- brake arm
- wear indicator plate
- felt seal/dust seal
- brake cam



## ASSEMBLY

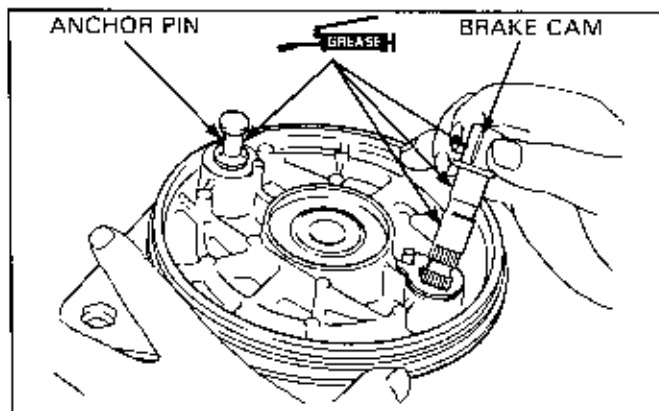
Apply a small amount of grease to the brake cam and anchor pin.

Install the brake cam in the brake panel.

Keep grease off the brake linings.  
Wipe excess grease off the cam and anchor pin.

### ▲WARNING

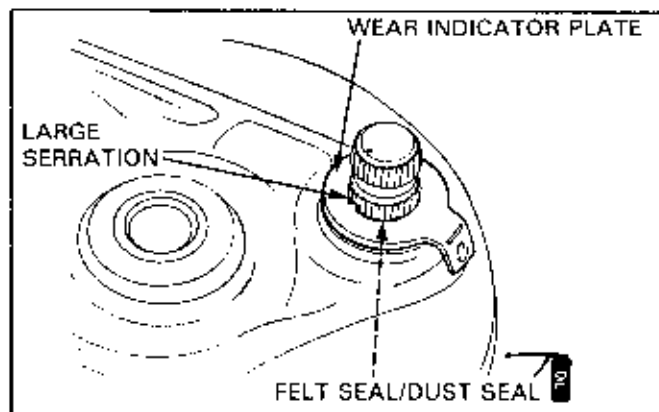
- Grease on the brake linings will reduce stopping ability and may cause brake failure.



Felt seal: Apply a small amount of engine oil to the felt and install the felt seal on the brake panel.

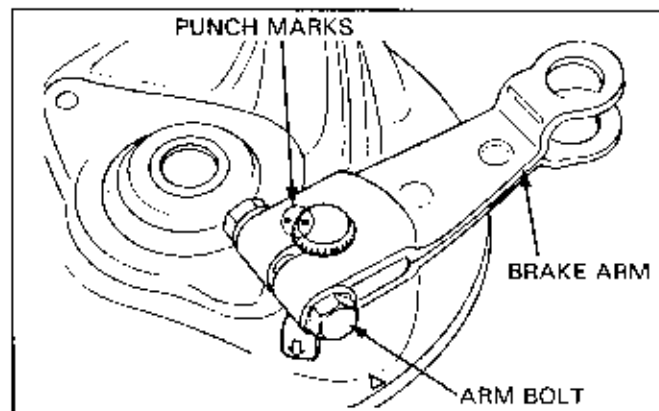
Dust seal: Apply a small amount of grease to the dust seal lip and install.

Install the wear indicator plate by aligning its large serration with the large serration of the brake cam.



Install the brake arm on the brake cam while aligning the punch marks.

Tighten the arm bolt and nut to the specified torque.



## NOTE

- Install the brake shoes according to the mark on the side of each brake shoe.

Keep grease off the brake linings.

If the brake drum and linings are contaminated with grease, clean the brake drum with brake cleaner and replace both brake shoes.

**⚠ WARNING**

- Grease on the brake linings will reduce stopping ability.

**Coil spring type:**

Install the shoe springs on the brake shoes.

Install a brake shoe on the brake panel, then install the other shoe with care that the shoe springs are in position.

**U-spring type:**

Install the brake shoes on the brake panel and expand the brake shoes by moving the brake arm.

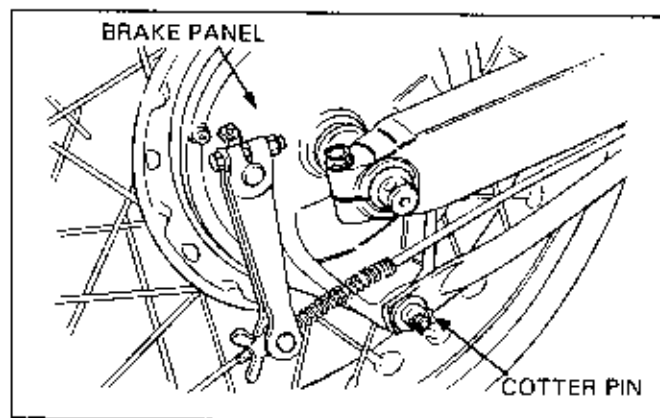
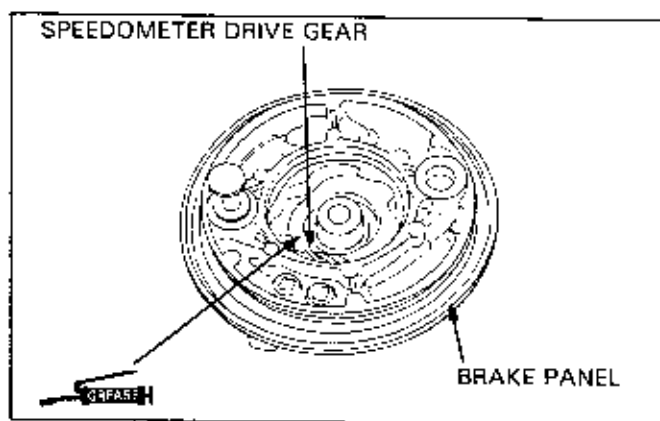
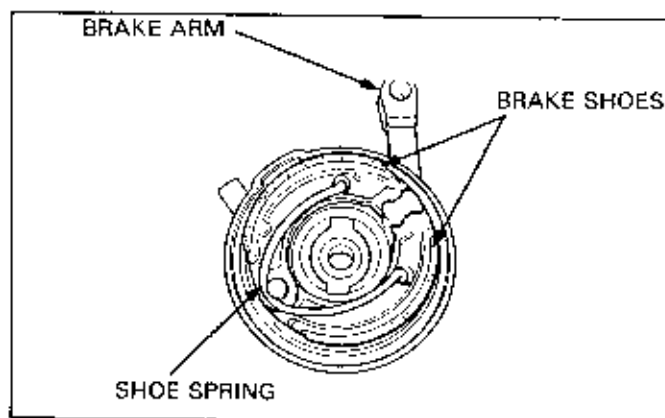
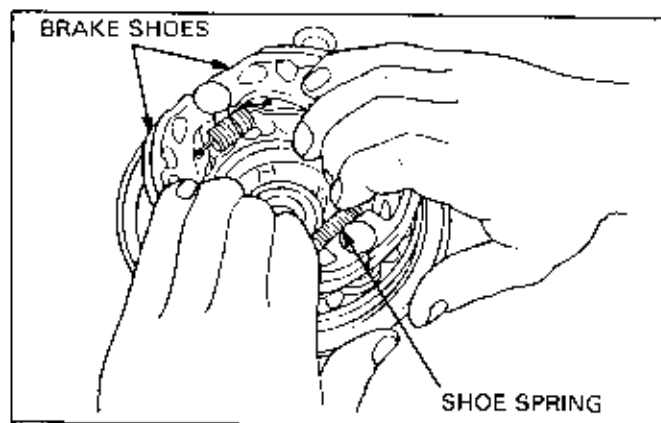
Install the shoe spring on the brake shoes and secure it on the anchor pin.

Install the brake panel on the wheel hub.

Install the wheel.

Front wheel: Check the Model Specific manual for the proper installation procedures.

Rear wheel: Check the Model Specific manual for the proper installation procedures.



# 18. FRONT SUSPENSION

SERVICE INFORMATION	18-1	FORK	18-5
TROUBLESHOOTING	18-1	HANDLEBAR(S)	18-11
SYSTEM DESCRIPTIONS	18-2	STEERING STEM	18-15

## SERVICE INFORMATION

### ⚠ WARNING

- Riding on damaged rims or spokes impairs safe operation of the vehicle.

- When servicing the front wheel, support the motorcycle securely with a jack or other support under the engine.
- Refer to the section 17 for brake system information.

## TROUBLESHOOTING

### Hard steering

- Steering head bearing adjustment nut too tight
- Faulty steering head bearings
- Damaged steering head bearings
- Insufficient tire pressure
- Faulty tire

### Soft suspension

- Weak fork springs
- Telescopic type:
- Insufficient fluid in fork
  - Low fluid level in fork
  - Faulty anti-dive system

### Steers to one side or does not track straight

- Unevenly adjusted right and left shock absorbers
- Bent fork
- Bent front axle; wheel installed incorrectly
- Faulty steering head bearings
- Bent frame
- Worn wheel bearing
- Worn swing arm pivot components.

### Hard suspension

- Bent fork components
  - Bent damper rod (bottom link type)
- Telescopic type:
- Incorrect fluid weight
  - Bent fork tubes
  - Clogged fluid passage

### Front wheel wobbling

- Bent rim
- Worn front wheel bearings
- Faulty tire

### Front suspension noisy

- Worn slider or guide bushings (bottom link type)
- Insufficient fluid in fork
- Loose fork fasteners
- Lack of grease in speedometer gearbox

### Wheel turns hard

- Brake misadjusted
- Faulty wheel bearing
- Faulty speedometer gear

### SYSTEM DESCRIPTIONS

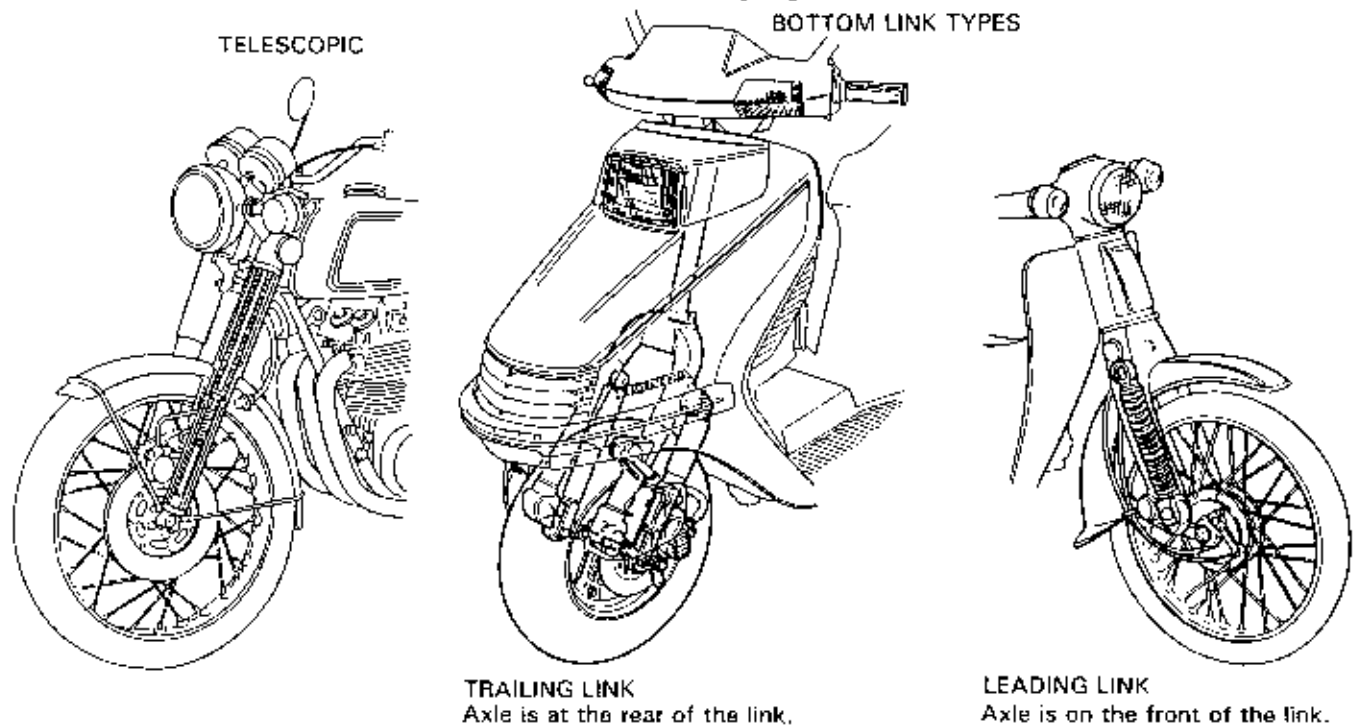
Telescopic and pivoting link-type front suspension systems are by far the most widely used types on motorcycles and scooters.

Telescopic front suspension systems are made up of a pair of upper fork tubes and lower fork sliders that telescope into one another. Within the set of tubes on either side is a spring and an oil damping system. Some systems utilize a cartridge damper within the fork sliders.

Basically, the oil controls the natural tendency of the spring to continue to rebound in ever decreasing amounts in both directions once acted upon by outside forces. Forcing the oil in each fork leg through a series of small holes, in effect, separates the rider/bike combination from both the unwanted characteristics of the spring and from height variations in the riding surface.

Pivoting link front suspension connects the axle to the fork by means of a pivoting link extending from the ends of the axle to the upper front portion of the fork. Between the pivot points on the fork and the axle are eyelets to which the spring/damper units are attached. The top of each 'shock absorber' is attached to the fork, up near the lower steering head bearing.

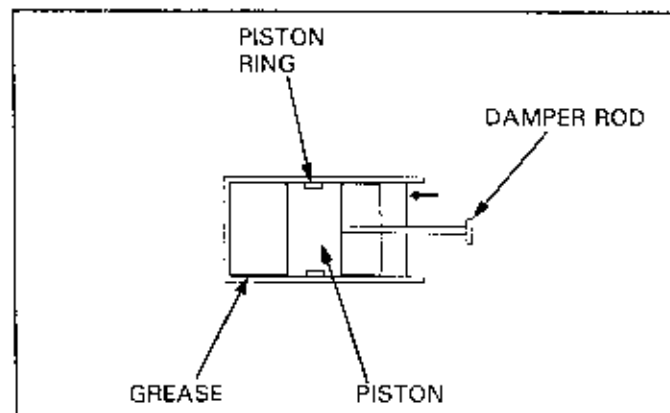
This design is divided into two basic categories. The trailing link design has the axle supported by links and 'shock absorbers' that 'trail' from the leading edge of the lower portion of the fork. Leading link type front suspension has the links pivoting toward the front and the 'shock absorbers' mounted to the leading edge of the fork.



### BASIC DAMPER OPERATION

#### Friction Damper Operating Principles

By far the simplest form of damper is the friction type. Instead of using oil to dampen the movement of the spring and suspension, the friction type uses only the friction of a single nonmetallic piston ring on the top of the damper rod pressing against the greased damper inner cylinder wall. This design is used primarily on only the smallest and simplest of vehicles.



**Oil Damper Operating Principles**

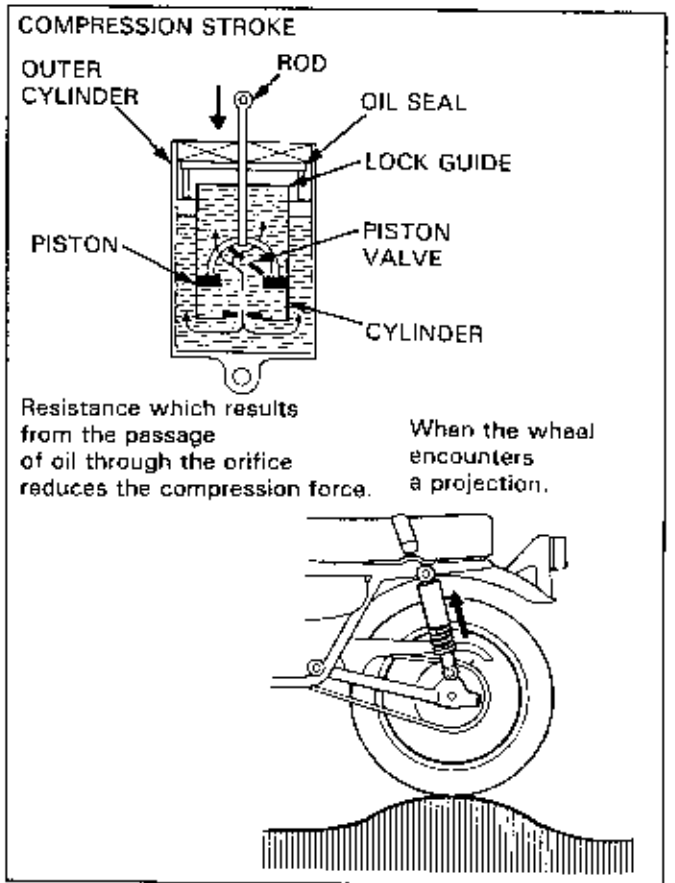
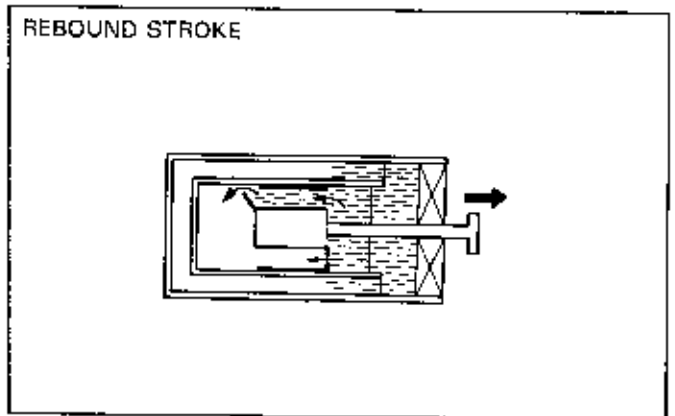
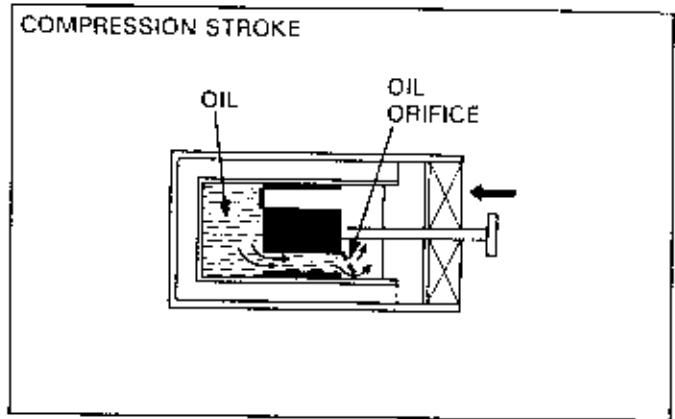
The primary function of suspension dampers is to control the natural rebound energy of the suspension springs so that traction and ride comfort is maintained.

An oil damper controls the spring action by forcing oil to flow through a specific set of holes in the damper piston as the combined spring/damper compresses or extends. The resistance of the movement of the damper piston created by the oil within the damper controls the force of the spring. By varying the path the oil is forced to take on the compression and rebound strokes, the desired damping rates can be achieved.

On the compression stroke, oil is forced through several large capacity damping orifices so that the wheel can respond quickly to terrain changes. Since the wheel is free to move quickly, the average ride height of the machine is not disturbed.

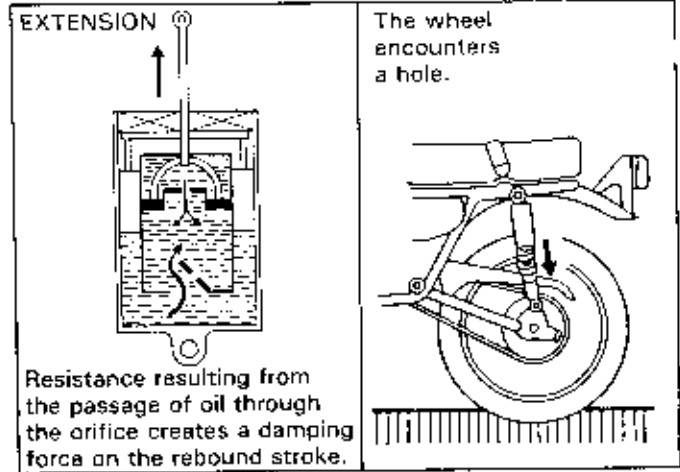
On the rebound stroke, the force of the compressed springs is slowed by forcing the damper oil through fewer and or smaller damping holes. The proper damping characteristics allow the suspension to extend quickly enough to meet the next bump, but not so quickly that the motorcycle bounces from one bump to the next.

In the illustration to the right the compression stroke within a double wall damper is described. As the damper body is forced up against the spring and damper piston, oil is forced through the piston valve with little resistance. The primary resistance to this compression is the damper spring. The oil that passes through the piston merely flows to the upper side of the piston. At the same time, some oil is also allowed to flow out of the cylinder bottom valve. The quantity of oil that flows out of the cylinder bottom valve is equivalent to the amount drawn into the top. The combined resistance to flow through each of these valves is the compression damping.



## FRONT SUSPENSION

The rebound stroke is illustrated in this drawing. Once the wheel has overcome the bump, the spring forces the damper rod to force the piston back through the damper. Here, oil flows with little resistance into the cylinder, but there is considerable resistance caused by damping valve in the piston.



### Telescopic Fork:

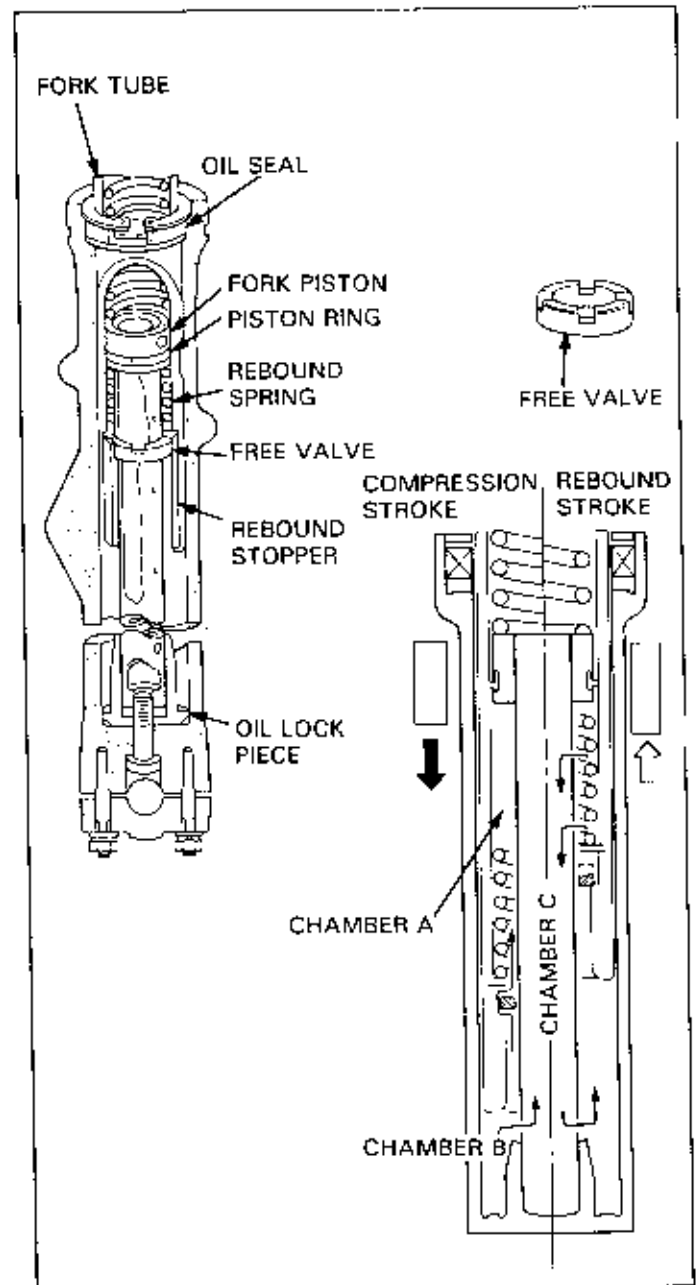
The telescopic fork serves as a skeletal member of the vehicle framework, a means for turning the vehicle and as the front suspension.

When the fork sliders move telescopically on the compression stroke, oil in Chamber B flows through the orifice in the fork tube into Chamber C, while the oil in Chamber B pushes past the free valve and up into Chamber A. The resistance in this oil flow absorbs shock on compression.

As the fork nears full compression, the tapered oil lock piece comes into play to hydraulically prevent the fork from bottoming.

On the rebound stroke, oil in Chamber A flows through the orifice in the top of the fork piston into Chamber C. Here the resulting resistance serves as a damping force and the tendency of the spring to rebound quickly is controlled.

The rebound spring absorbs the shock of the fork legs extending outward. Oil in Chamber C flows through the orifice in the bottom of the fork piston into Chamber B at this time.



**FORK****REMOVAL**

Remove the following:

- Handlebar(s).
- Front wheel.
- Front fender.
- Front brake caliper(s) and bracket(s).
- Fork brace.

Loosen the fork pinch bolts.

Pull each fork leg out of the fork bridges by twisting while pulling them down.

Press the air valve core to release air pressure from the fork.

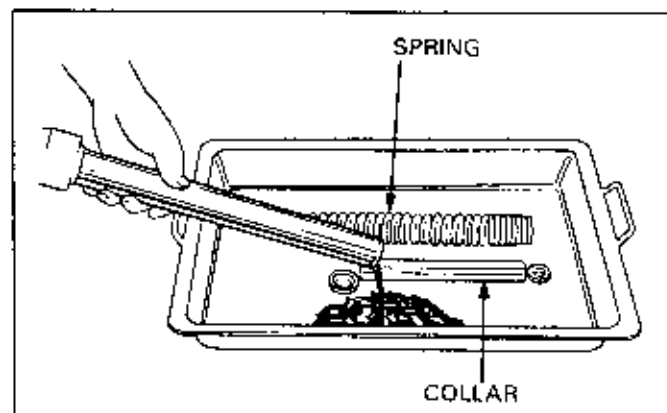
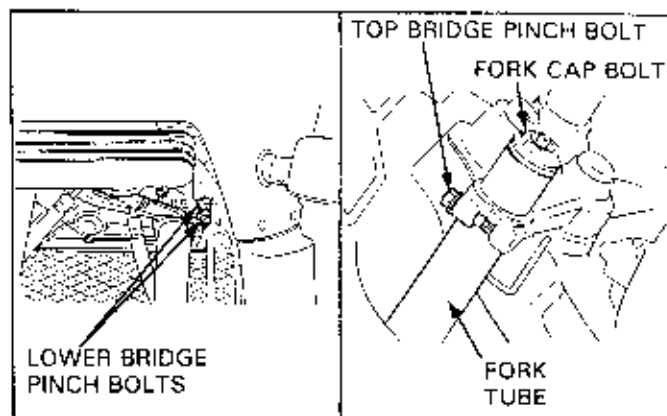
**NOTE**

If the fork legs are to be disassembled:

- Break the socket bolts in the bottom of the fork sliders loose, but do not unscrew them (oil will leak out).

To loosen the fork cap bolts:

- Because the clamping action of the pinch bolt(s) can distort the fork tubes slightly and prevent the caps from loosening, it is sometimes better to reposition the legs in the clamps so that the caps are 2 to 3 inches above the clamps, as shown in the first illustration on this page, prior to loosening them.

**DISASSEMBLY**

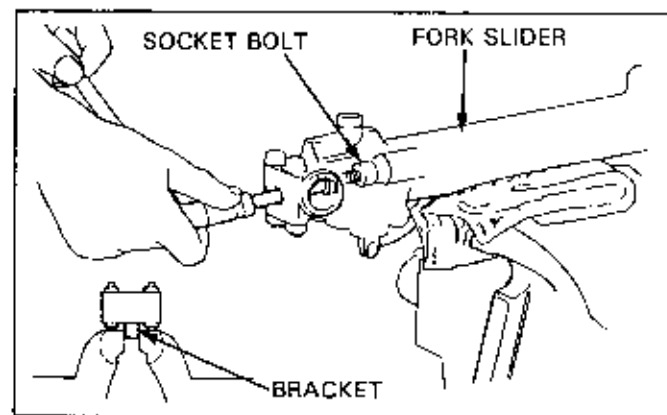
Remove the following:

- Fork boot (if used on the particular model)
- Fork cap bolt. (see note above)
- Spring seat.
- Collar.
- Fork spring.

Drain the fork oil by pumping the fork up and down several times.

Hold the fork slider in a vise with soft jaws or a shop towel.

Remove the socket bolt with a hex wrench.

**NOTE**

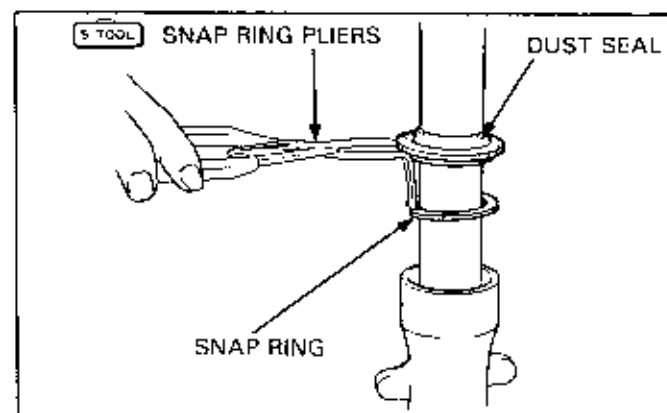
- Temporarily install the fork spring and fork cap bolt to loosen the socket bolt.

Remove dust seal, washer, and snap ring.

**5 TOOL**

**SNAP RING PLIERS**

**07914-3230001**



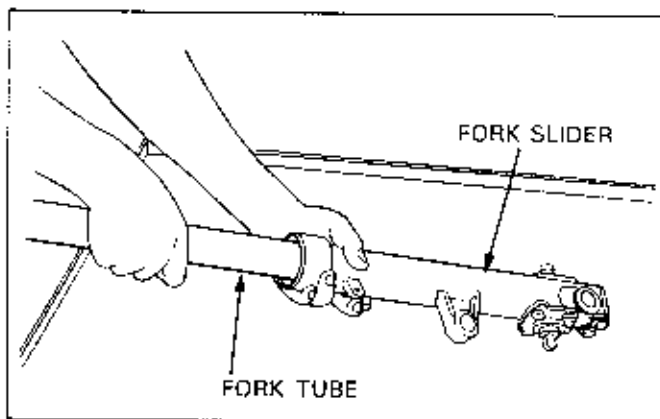
## FRONT SUSPENSION

Pull the fork tube out from the fork slider.

### NOTE

- If the type of fork being disassembled has a guide bushing installed, remove the fork tube as follows:

Pull the fork tube out until resistance from the slider bushing is felt. Then move it in and out, tapping the bushing tightly until the fork tube separates from the slider. The slider bushing will be forced out by the fork tube bushing.

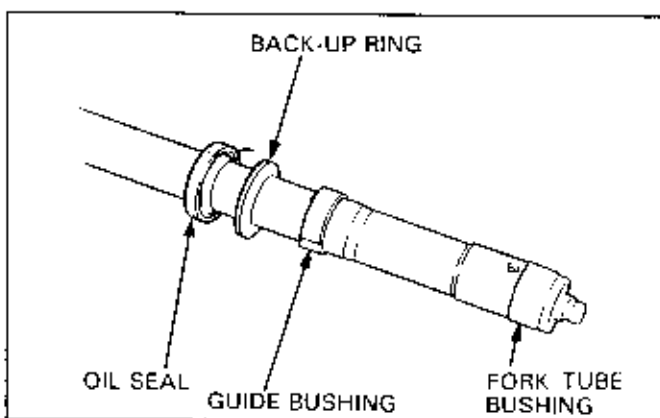


Remove the following:

- Oil seal.
- Back-up ring.
- Fork tube bushing.
- Guide bushing, if installed.
- Rebound spring, if possible.

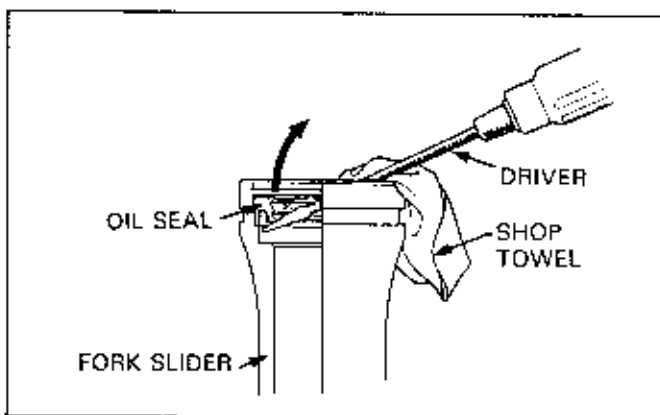
### NOTE

- Do not remove the fork tube bushings unless it is necessary to replace them with new ones.



### NOTE

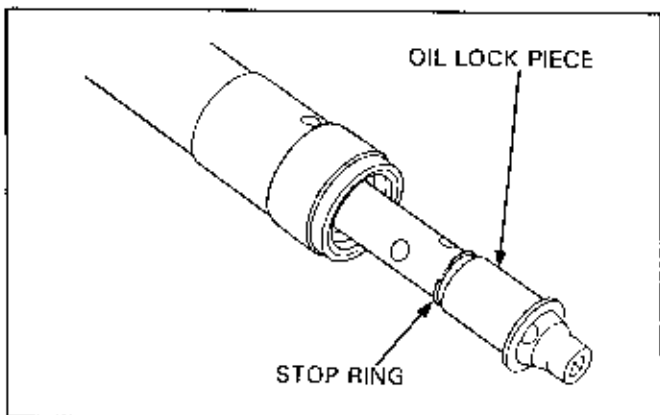
- On the fork type that has no guide bushing; the fork tube might come out of the fork slider and the oil seal may remain in the slider. Remove the oil seal with care not to damage the sliding surface of the slider.



Remove the following:

- Oil lock piece from the fork slider.
- Stop ring from the fork piston.

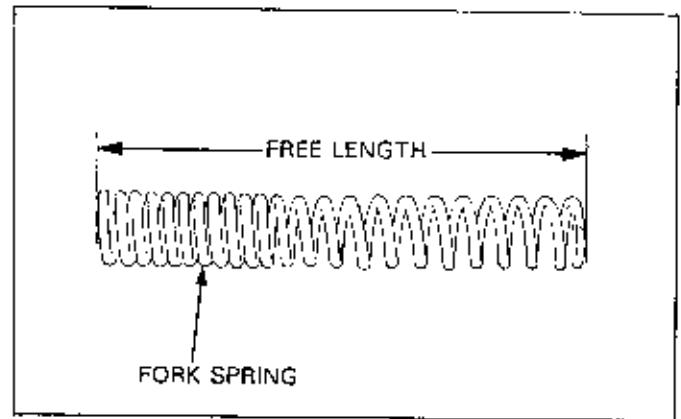
Clean all disassembled parts.





## INSPECTION

Measure the fork spring free length by placing the spring on a flat surface. Replace the spring if it is shorter than the service limit.

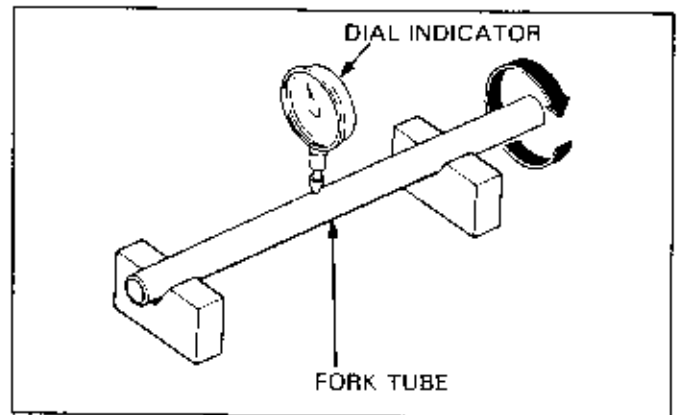


Set the fork tube in V-blocks and measure the fork tube runout by rotating it with a dial indicator mounted against it.

The actual runout is 1/2 of the total indicator reading, replace if the service limit is exceeded, or there are scratches or nicks that will allow fork oil to leak past the seals.

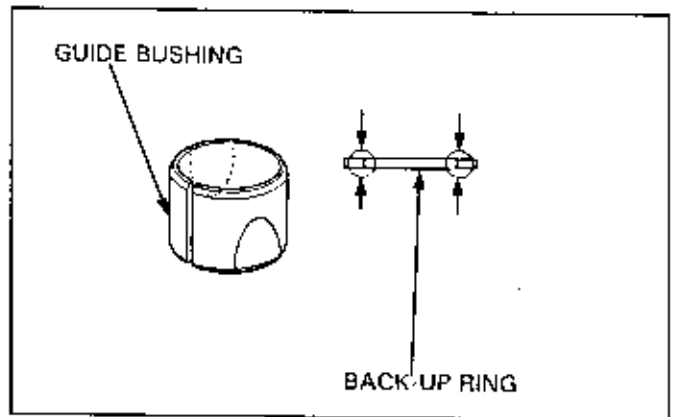
## NOTE

- Do not reuse the fork tube if it cannot be perfectly straightened with minimal effort.

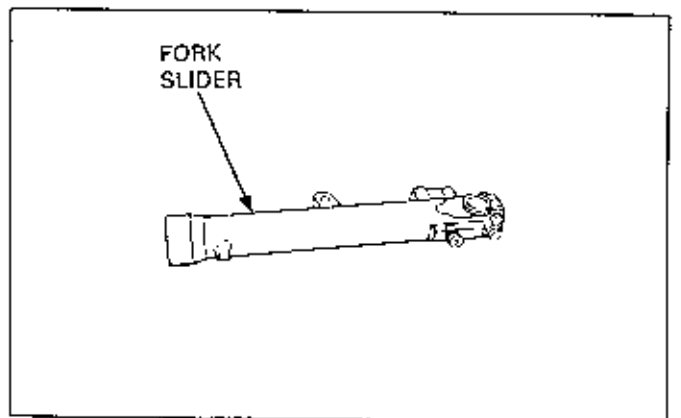


Visually inspect the slider and fork tube bushings. Replace the bushings if there is excessive scoring or scratching, or if the teflon is worn so that the copper surface appears on more than 3/4 of the entire surface.

Check the back-up ring: replace it if there is any distortion at the points shown.

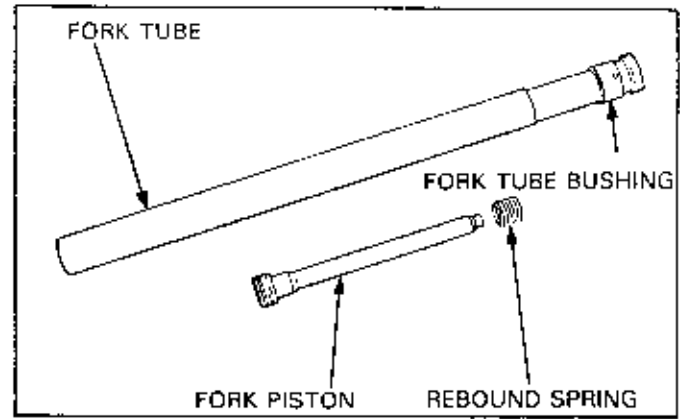


Check the fork sliders for internal scratches, dents that are visible from both the inside and outside, or abnormal wear. Replace if necessary.



## FRONT SUSPENSION

Check the fork piston and other components for damage, cracks, straightness or abnormal wear. Replace if necessary.

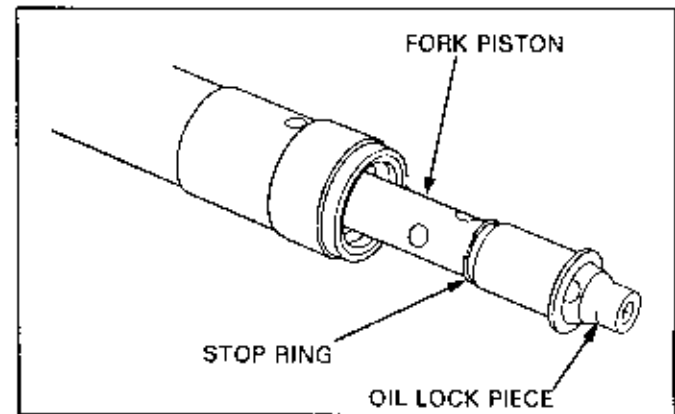


### ASSEMBLY

Insert the fork piston into the fork tube.

Install the following:

- stop ring onto the fork piston.
- rebound spring onto the fork piston (if the rebound spring has been removed).
- oil lock piece.



Replace the dust seal with a new one whenever it is removed.

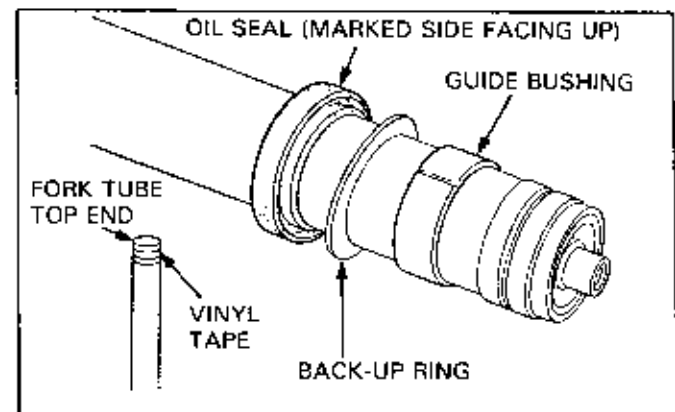
Insert the fork tube into the fork slider.

Install the back-up ring and a new oil seal.

Install the guide bushing if it has been removed.

### NOTE

- Inspect the fork tube sliding surfaces for damage, whenever the oil seal is replaced due to oil leaks.
- Wrap vinyl tape around the fork tube top end to avoid damaging the oil seal during the oil seal installation.
- Apply fork oil to the oil seal lip.
- Inspect the oil seal with the marked side facing up.

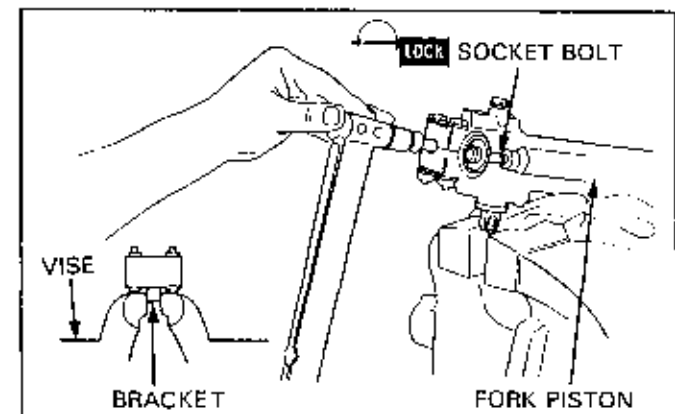


Place the fork slider in a vise, with soft jaws or a shop towel, by the brake bracket or caliper bracket as shown. Be careful not to distort the slider by clamping it in a vise incorrectly.

Apply a locking agent to the socket bolt and thread it into the piston. Tighten the bolt with a 6 mm hex wrench.

### NOTE

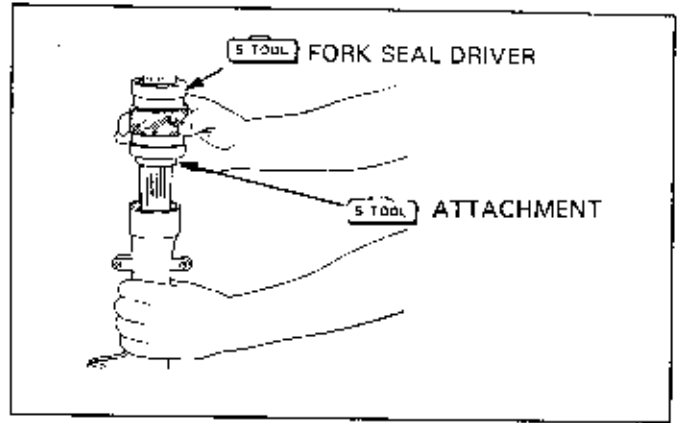
- Temporarily install the fork spring and fork cap bolt so that the piston is held in place when the socket bolt is tightened.



Place the slider bushing over the fork tube and rest it on the slider. Put the back-up ring and an old bushing or equivalent tool on top.

Drive the bushing into place with the seal driver and remove the old bushing or equivalent tool.

Coat a new oil seal with ATF and install it with the seal markings facing up. Drive the seal in with the seal driver.



Install the snap ring with its radiused edge facing down.

Seat the snap ring firmly in the groove.

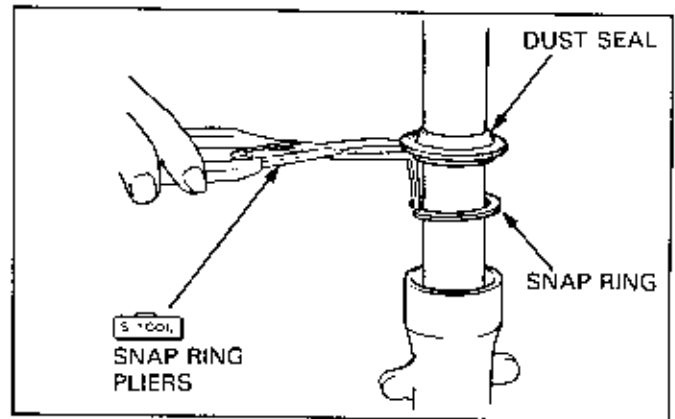
**WARNING**

- Failure to firmly seat the snap ring may cause the fork assembly to come apart unexpectedly and lead to a serious injury.

S TOOL

SNAP RING PLIERS

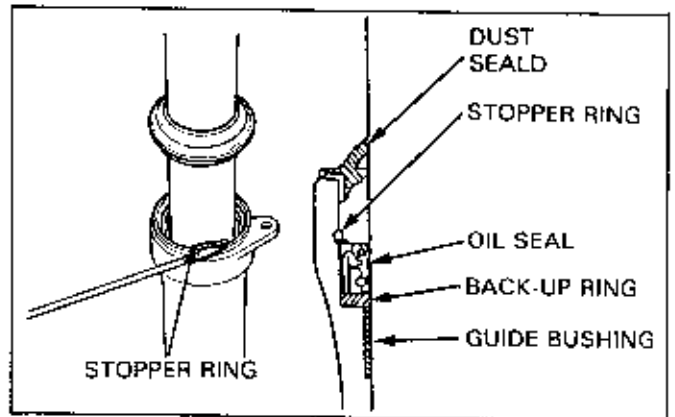
07914-3230001



**NOTE**

- In case of stopper ring, using a small screwdriver install the stopper ring into the groove taking care not to damage the fork tube.

Install the dust seal using the fork seal driver.

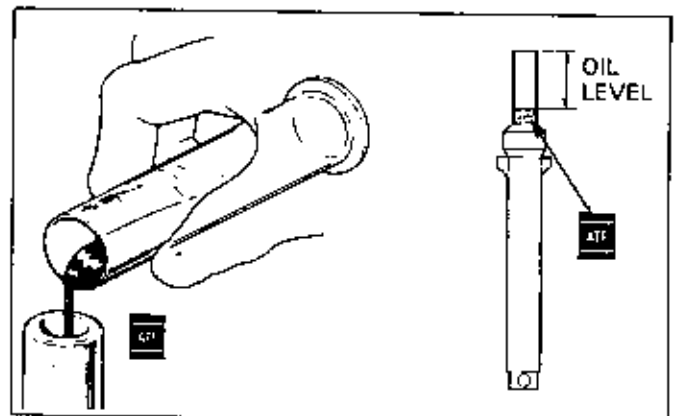


Pour the specified amount of ATF into the fork tube.

Pump the fork tube several times to remove trapped air from the lower portion of the tube.

Compress the fork leg fully and measure the oil level from the top of the tube.

Wipe the oil off of the spring thoroughly using a clean, lint free shop towel.



## FRONT SUSPENSION

Pull the fork tube up and insert the spring.

### NOTE

- Most fork springs are designed to be installed with a specific end toward the top and bottom.
- One end tapered; install the spring with the tapered end toward down. Both sides tapered; spring may be installed with either end down.
- If the coils on only one end are tapered, this end should be at the bottom. If the coils at both ends are tapered and the distance between each of the coils is the same (straight wound spring), either way is acceptable. However, a spring with the coils on both ends tapered and the coils are closer together at one end (progressive wound spring), the widely spaced coils should be at the bottom.

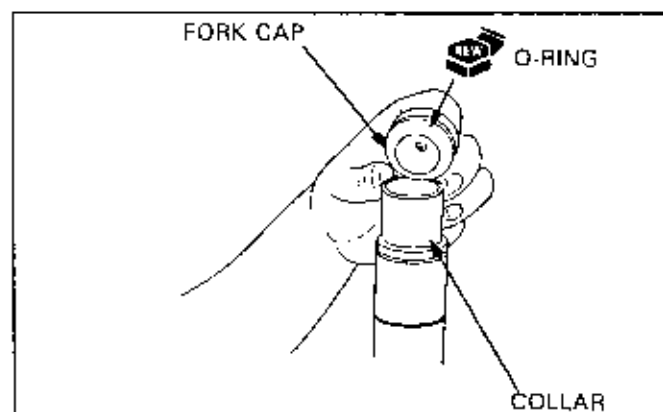
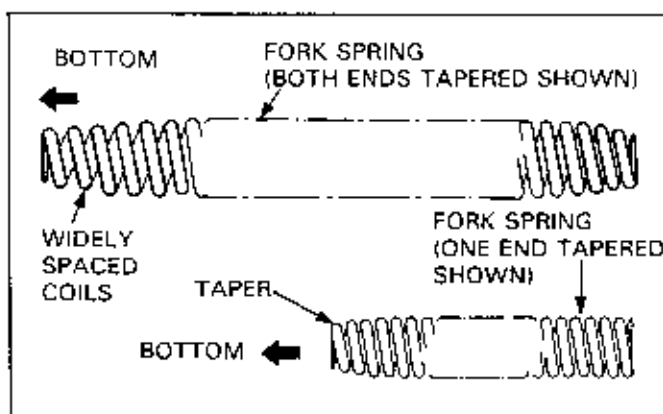
Reassemble the removed parts (spring, collar, etc.).

Install a new O-ring into the fork cap groove.

Screw the fork cap into the fork tube.

### NOTE

- Tighten the fork cap to the specified torque after installing into the fork bridges and tightening the stem side pinch bolts.



## INSTALLATION

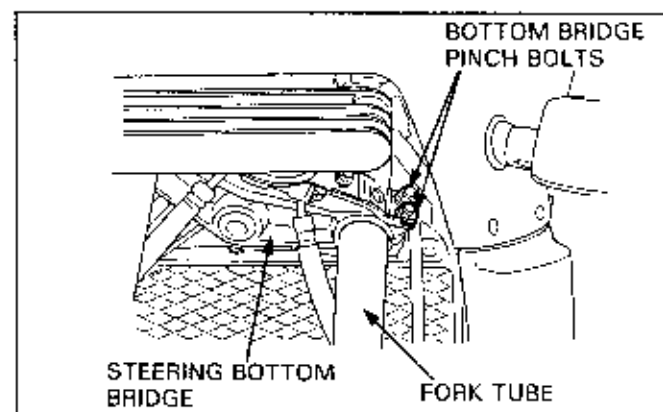
Install the fork boot (if the particular model uses one).

Install the fork legs through the fork bridges by twisting while pushing them upward.

Position the legs in the clamps as specified in the Model Specific manual.

### NOTE

- Make sure that the cables and wire harnesses are routed correctly.

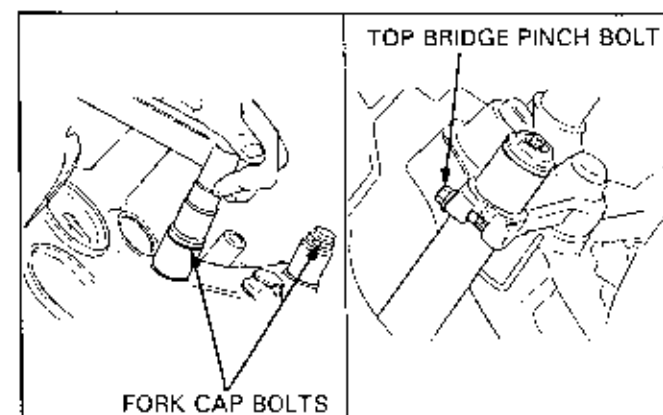


Tighten the fork bridge pinch bolts to the specified torque.

Tighten the fork caps to the specified torque.

Install the removed parts in the reverse order of removal (Refer to the Model Specific manual).

With the front brake applied, compress the fork up and down several times to check for proper fork operation.



**HANDLEBAR(S)****ONE-PIECE, TUBULAR TYPE****Removal**

Remove the following:

- Rear view mirror(s).
- Handlebar switches.
- Throttle cable.
- Brake and clutch lever brackets.

Prevent contaminants or any foreign material from entering the system when filling the reservoir.

**WARNING**

- Contaminants in the system may cause a reduction or loss of braking ability.

Avoid spilling the fluid on painted, plastic, or rubber parts. Place a rag over these parts whenever the system is serviced.

**CAUTION**

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

- Holder bolts.
- Handlebar upper holders.
- Handlebar.

**Installation**

Place the handlebar onto the lower holders, aligning the punch mark on the handlebar with the upper surface of the lower holders.

Install the upper holders with the punch marks facing forward.

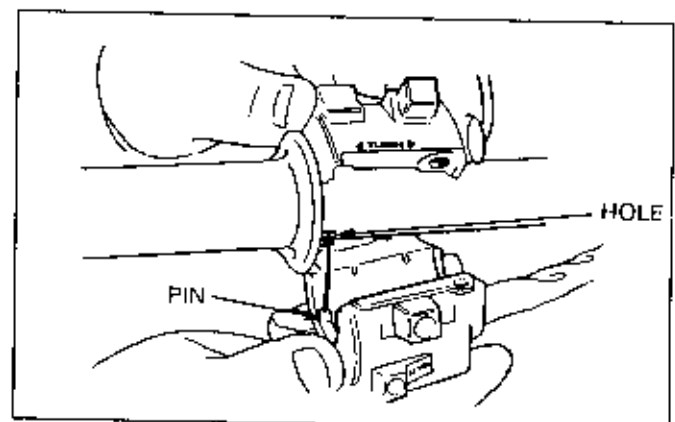
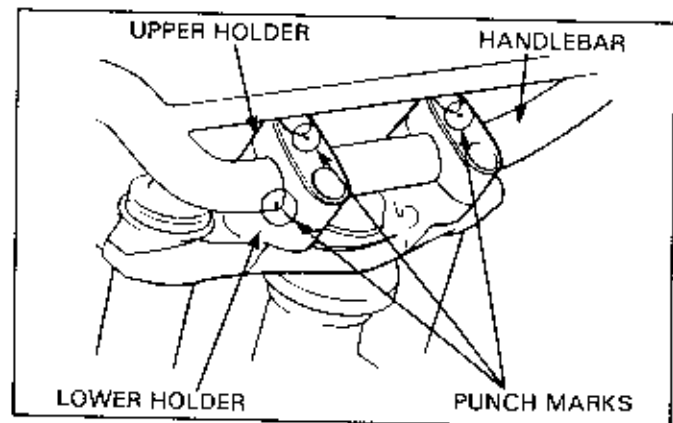
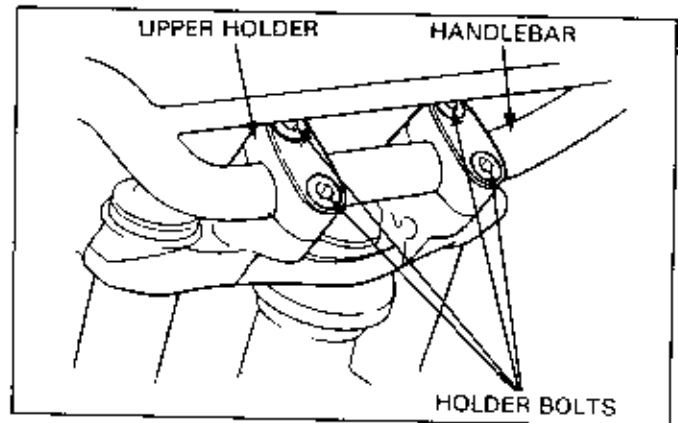
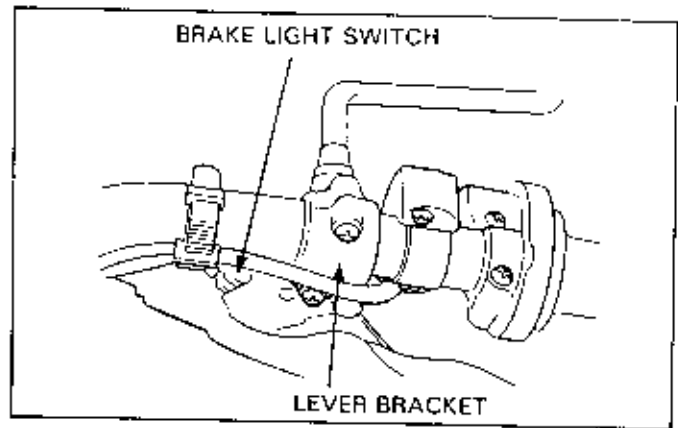
Tighten the front bolts first, then the rear, to the specified torque.

Refer to the Model Specific manual for the proper torque value.

Connect the choke cable to the choke lever.

Install the left handlebar switch, aligning the pin with the hole in the handlebar.

Tighten the forward screw first, then the rear screw.



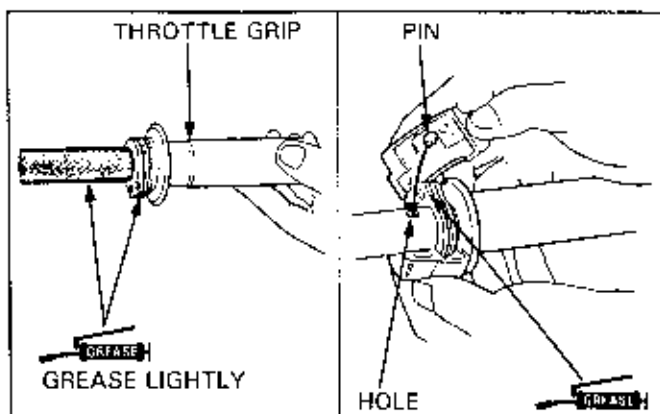
## FRONT SUSPENSION

Apply a light coating of grease to the throttle cable ends and throttle grip sliding surface.

Connect the throttle cable to the throttle grip and install the grip to the handlebar.

Install the right handlebar switch, aligning the pin with the hole in the handlebar.

Tighten the forward screw first, then the rear screw. Check that the throttle grip moves smoothly and adjust the throttle grip free play.

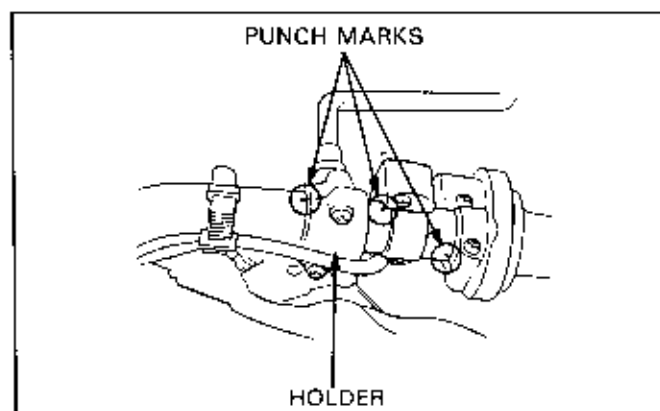


Install the brake lever and clutch lever brackets, aligning the punch marks with:

- cable type: slit in the bracket.
- hydraulic type: master cylinder and set the holder with the holder punch mark facing up.

Tighten the upper bolt first, then the lower bolts.

Route switch wires properly and secure them with bands.

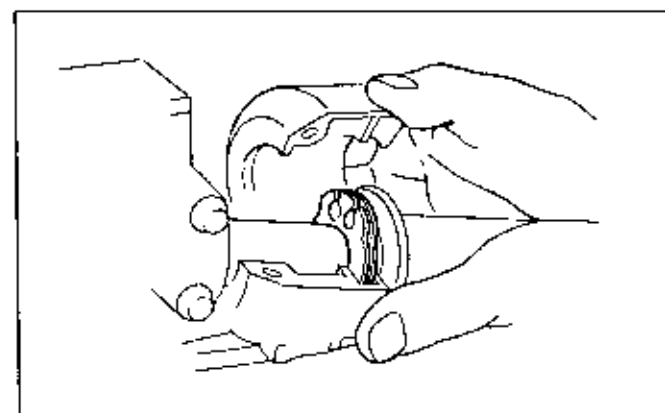


## TWO-PIECE, CLAMP-ON TYPE

### Removal

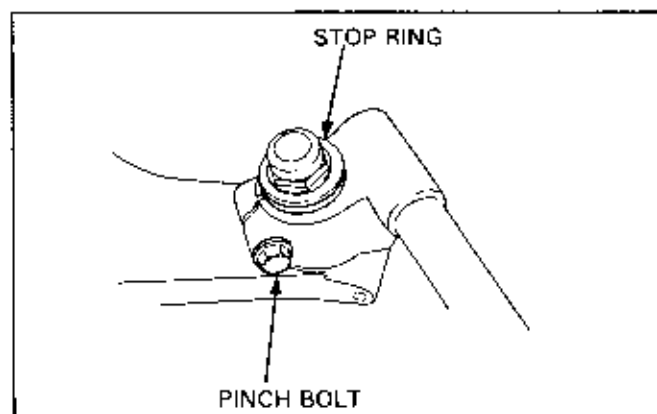
Remove the following:

- Both handlebar switches
- Throttle grip
- Master cylinder(s) or lever bracket(s)



Remove the stop ring.

Remove the pinch bolt and handlebar.



**Installation**

Install the handlebar by aligning the boss with the top bridge slot.

Install the stop ring into the groove of the fork tube.

Tighten the pinch bolts to the specified torque.

While turning the handlebar through its full range, check for smooth handlebar movement. Also check that there is no interference with cables or harnesses, especially throttle and brake cables, hoses, and lines.

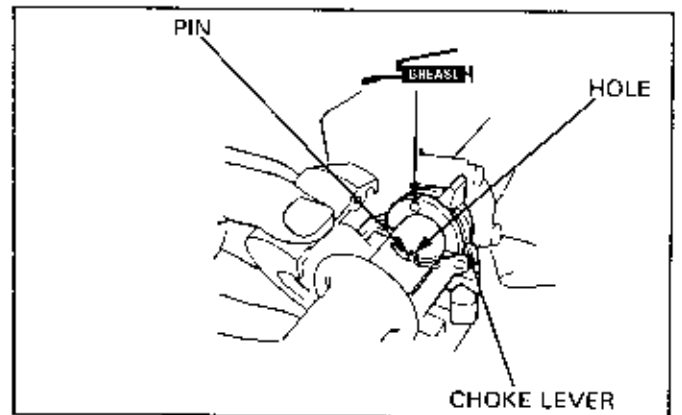
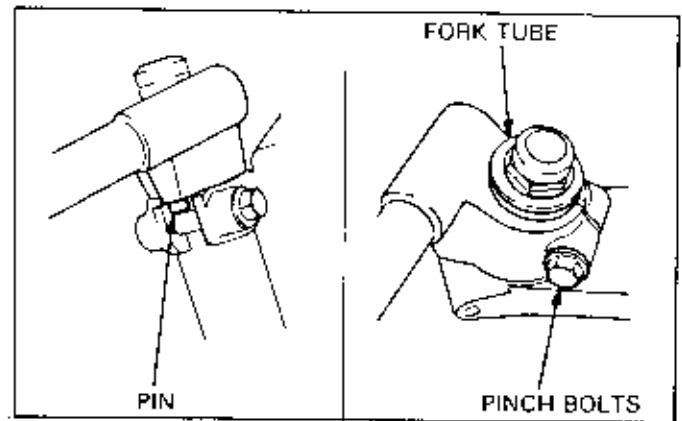
**WARNING**

- Handlebar interference can have an adverse effect on safe vehicle operation.

Connect the choke cable to the choke lever.

Install the left handlebar switch, aligning the pin with the hole in the handlebar.

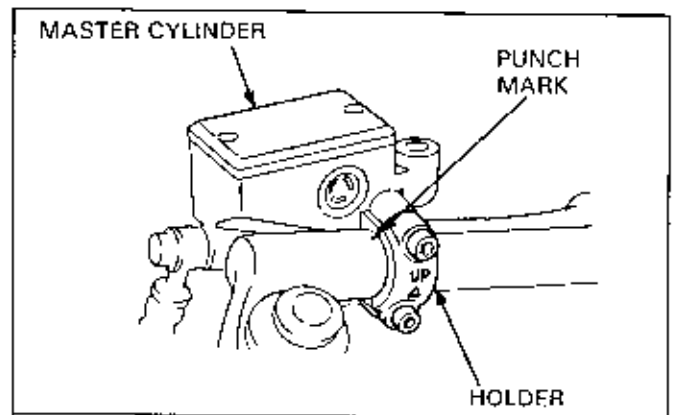
Tighten the forward screw first, then the rearward screw.



Install the brake lever and clutch lever brackets or both master cylinders by aligning the punch mark on the handlebar with the:

- On cable type: Slit of the lever bracket.
- On hydraulic type: Master cylinder and set the master cylinder holder with the "UP" mark facing up or punch mark facing forward or up.

Tighten the upper or forward bolt first, then tighten the lower or rearward bolt to same torque.



Apply grease to the cable ends and throttle grip sliding surface.

Connect the throttle cable to the grip and install the throttle grip.

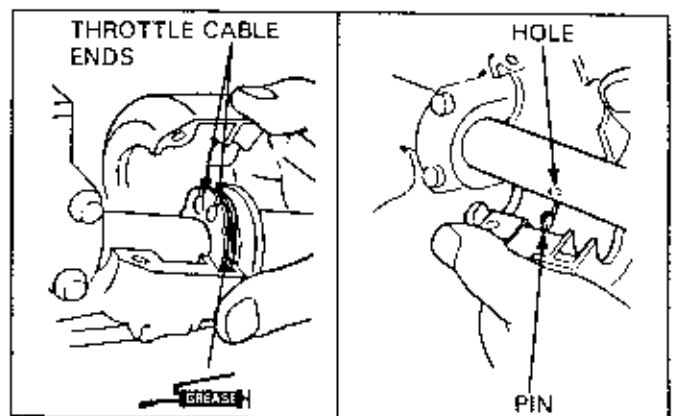
Set the right handlebar switch by aligning the pin with the hole of the handlebar.

Tighten the forward screw first, then the rearward screw.

Check that the throttle grip moves smoothly.

Route the wires properly and secure them with wire bands.

Adjust the throttle grip free play.



## FRONT SUSPENSION

### HANDLE GRIP INSTALLATION

If a choke lever is attached to handlebar, it must be installed onto the handlebar before you install the grip.

Apply Honda Bond A or Honda Hand Grip Cement (U.S.A. only) to the inside surfaces of the grips and to the clean surface of the left handlebar and throttle. Wait 3–6 minutes and install the grips. Rotate the grips for even application of the adhesive.

Apply sufficient but not excessive adhesive to the throttle. Excessive adhesive, forced into the interior bore of the drum, will restrict free drum movement on the handlebar.

Allow the adhesive to dry for at least an hour before using.

#### ⚠ WARNING

- Any restriction of the throttle can cause a loss of throttle control.

### HANDLEBAR WEIGHT REPLACEMENT

End-Type Weights:

Remove the mounting screw and weight.

Inner-Type Weights:

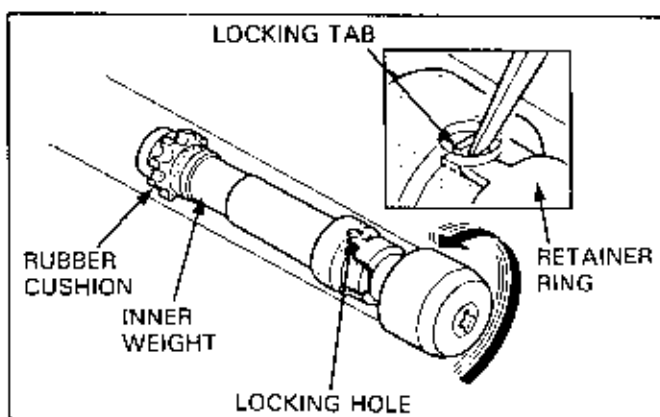
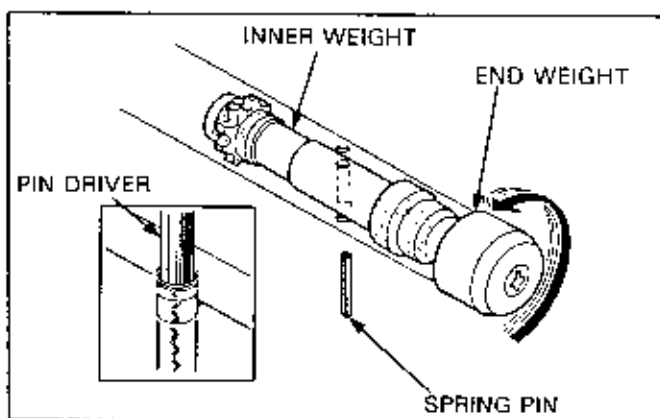
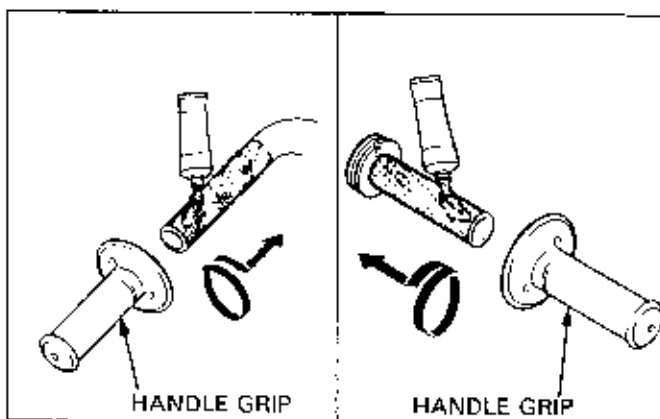
Remove the handlebar grip:

- Spring pin type:
  - Drive out the spring pin using a pin driver
- Retainer ring type:
  - Straighten the locking tab.

To remove, pull the weight while twisting it.

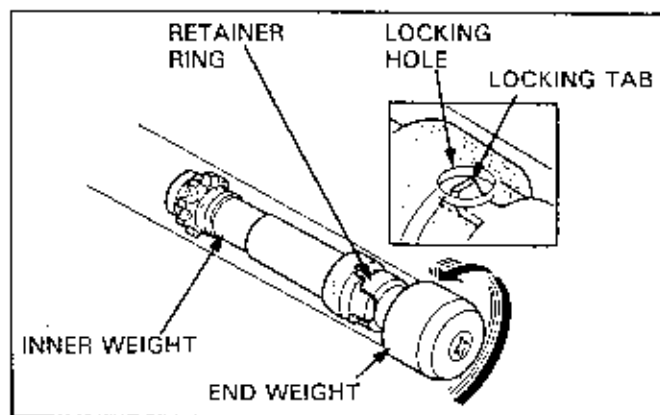
#### NOTE

- The inner weight is centered within the bar.



Install a new retainer ring to the inner weight and install the end weight, aligning the cutout.

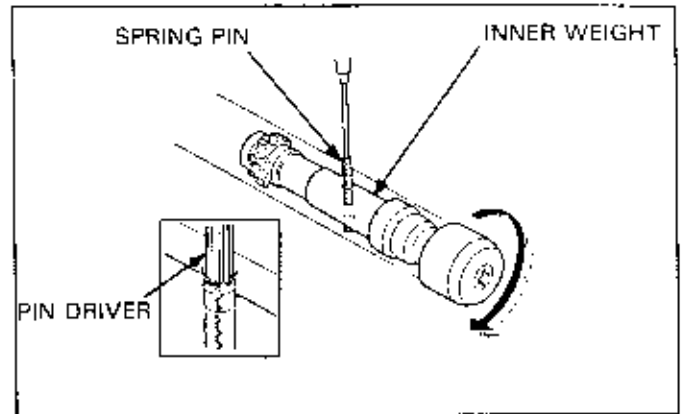
Insert the weight into the handlebar, and turn it to ensure that the locking tab aligns with the hole.





Insert the weight into the handlebar and align the spring pin holes by turning it.

Secure the weight with the spring pin using pin driver.



## STEERING STEM

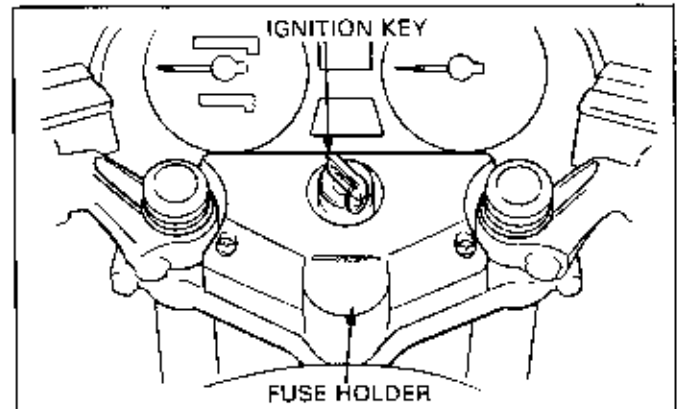
If the vehicle has been involved in a collision, the steering stem may be damaged.

### REMOVAL

Telescopic Type:  
Remove the handlebar.

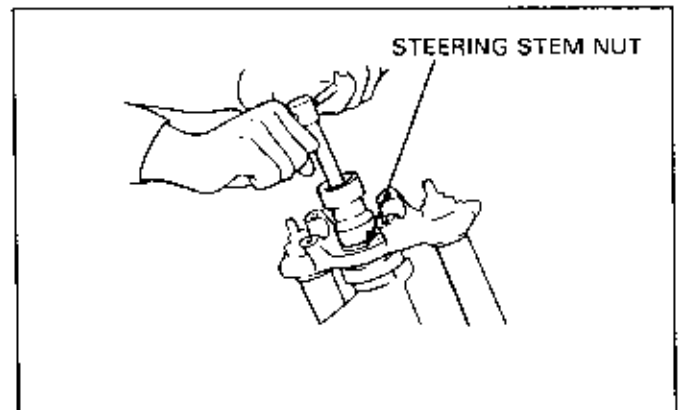
Remove the ignition switch and/or fuse holder if either are attached to the top fork bridge.

Refer to the Model Specific Manual for specific procedures.



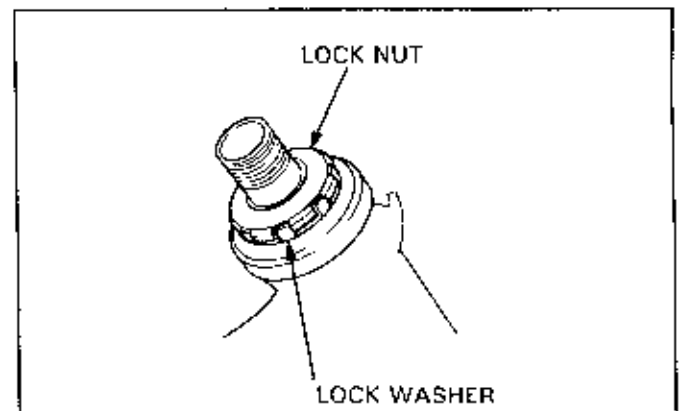
Remove the following:

- Stem nut and washer.
- Front wheel and fork.
- Fork top bridge.
- Horn and/or brake hose joint, if either are attached.



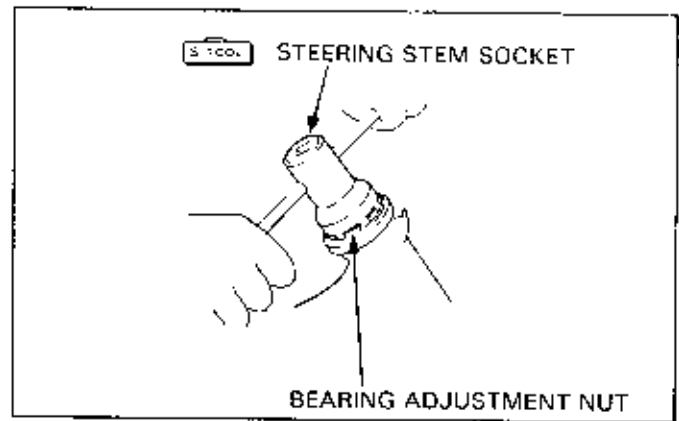
The lock washer tab must be bent down in order to remove the lock nut.

Remove the lock nut and lock washer.

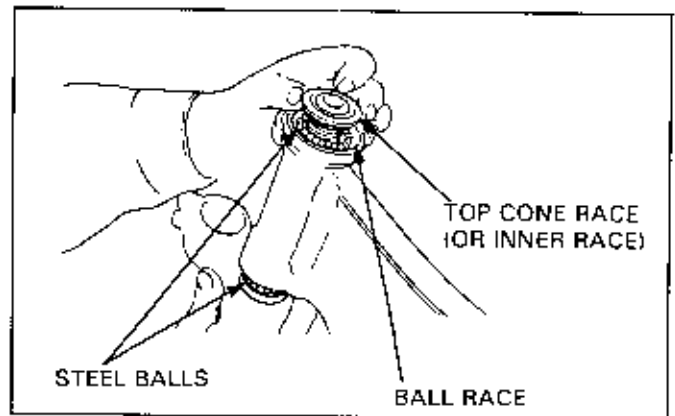


## FRONT SUSPENSION

Remove the bearing adjustment nut.



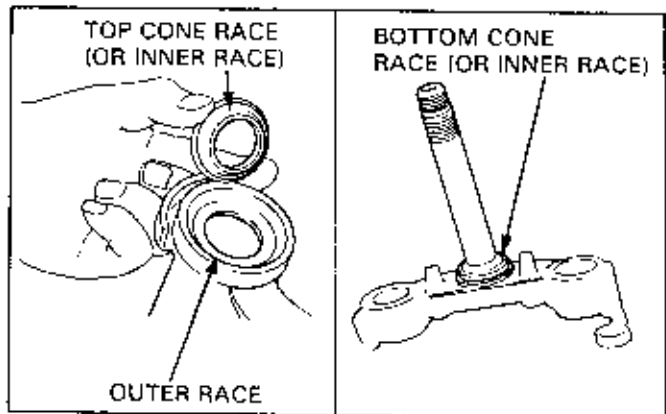
If the bearings are the loose-ball type, place a shop towel under the steering stem to catch the steel balls.



Remove the dust seal and top cone race, or inner race, while holding the steering stem with your other hand. Then remove the steering stem from the frame.

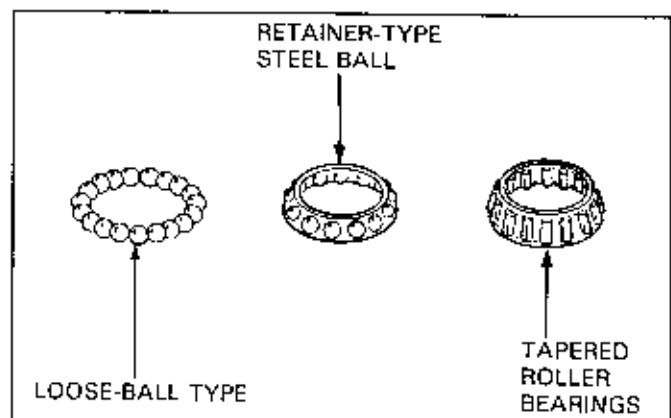
### NOTE

- Where loose balls are used, be sure you have the correct number of balls to ensure none have been lost.
- Tapered roller bearings or retained-ball type bearings should be removed from the steering stem after the stem has been removed from the frame.



### Inspection

Check all of the races and balls for damage or abnormal wear and replace as necessary.



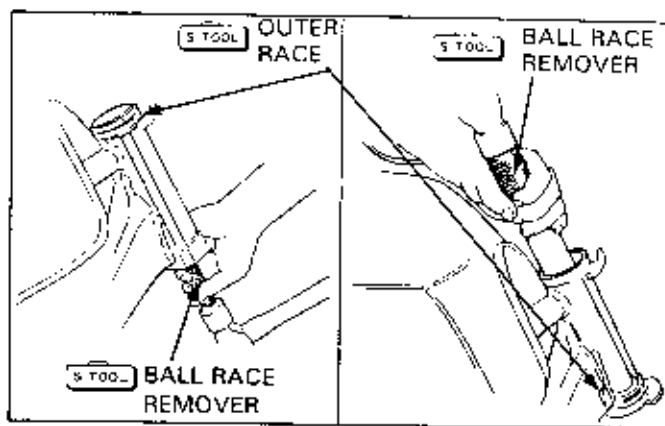
RACE REPLACEMENT

NOTE

- Bearings should be replaced as a set—inner and outer races.
- If the motorcycle has been involved in an accident, examine the area around the steering head for cracks.

Remove the races from the steering head using the ball race remover.

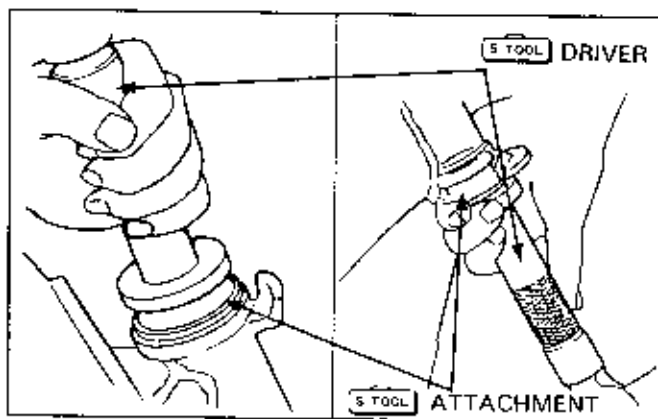
Refer to the Model Specific manual for specific tools.



Install new races into the steering head of the frame using the driver and attachment.

NOTE

- Drive the races in squarely, making sure that they are fully seated.

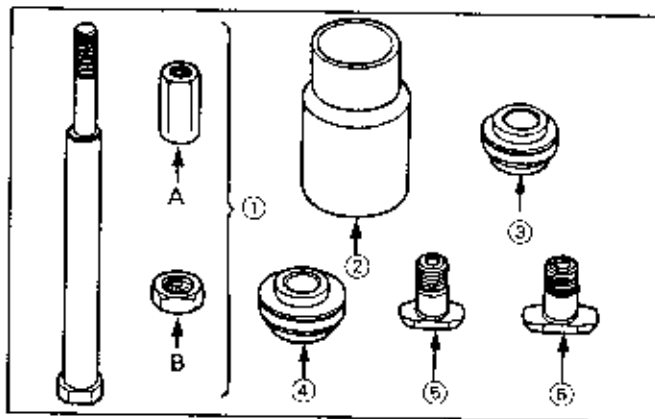


On aluminum frames: replace the races using the Ball Race Remover Set as described in the following procedure.



Ball race remover set (includes (1) thru. (6))

- |                         |               |
|-------------------------|---------------|
| (1) Driver shaft        | 07946-KM90001 |
| (2) Base                | 07946-KM90300 |
| (3) Attachment A, 47 mm | 07946-KM90600 |
| (4) Attachment B, 55 mm | 07946-KM90100 |
| (5) Remover A, 47 mm    | 07946-KM90200 |
| (6) Remover B, 55 mm    | 07946-KM90401 |
|                         | 07946-KM90500 |



Top Race Removal

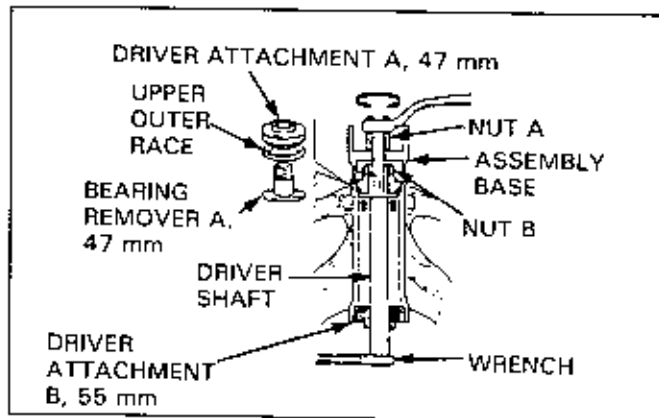
Install remover tool A into the steering head and place attachment A onto remover A and secure it with nut B.

Install attachment B onto the Driver shaft and install them through attachment A.

Install the base noting the proper installing direction and screw in nut A.

Set attachment B into the bottom of the steering head.

Hold the driver shaft with a wrench and tighten nut A to remove the upper race.



## FRONT SUSPENSION

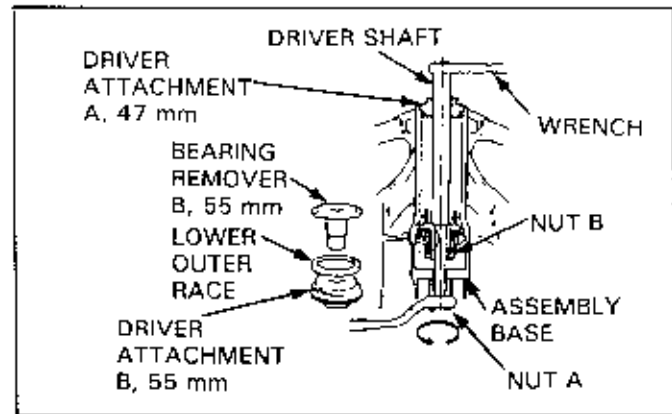
### Bottom Race Removal

Set remover B into the steering head, place attachment B onto remover B, and secure it with nut B.

Install attachment A onto the top of the steering head.

Install the remover shaft through attachments A and B and set the base with the big end toward the head pipe and screw in nut A.

Remove the bottom race in the same manner as the top race.



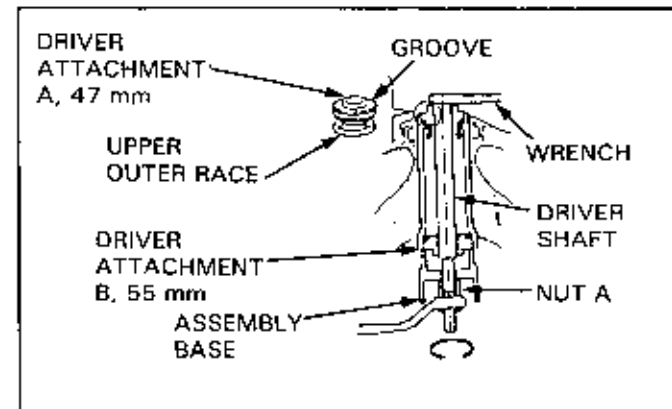
### Top Race Installation

Install a new top race and attachment A onto the top of the steering head.

Install the driver shaft, attachment and base with the small side of the base toward the steering head as shown.

Tighten nut A.

Hold the driver shaft to prevent the new race from turning, and install the top race by turning nut A gradually until the groove of attachment A aligns with the top end of the head pipe.

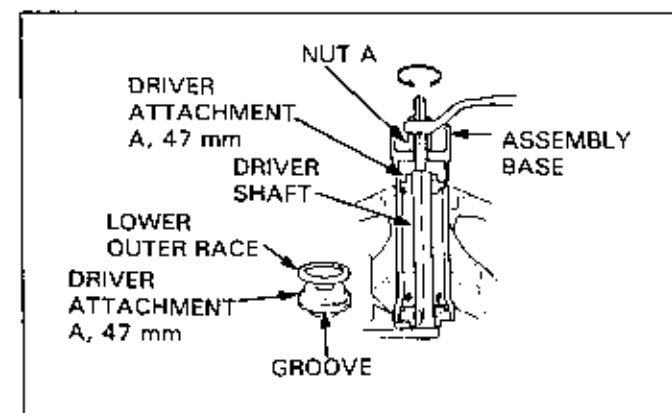


### Bottom Race Installation

Install a new bottom race and attachment B onto the driver shaft, and install them into the steering head.

Set attachment A and base on the top of the steering head and tighten nut A.

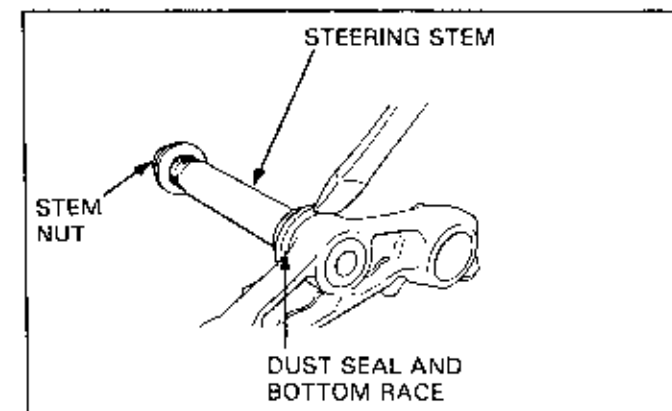
Hold the driver shaft securely and install the bottom race into the steering head by turning nut A gradually until the groove of the attachment aligns with the bottom of the steering head.



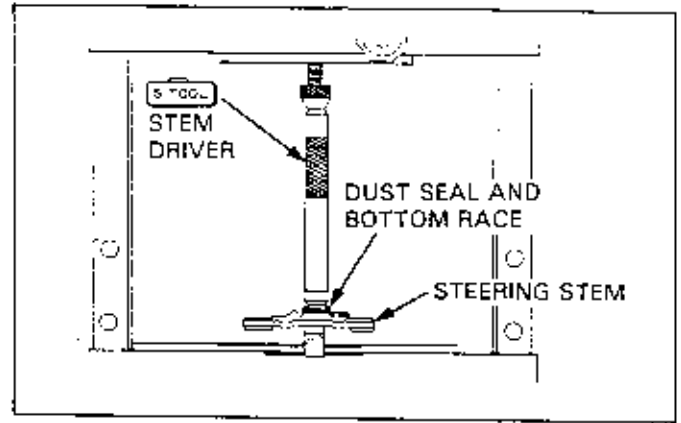
### Steering Stem Bottom Race Replacement

Temporarily install the steering stem nut onto the steering stem to prevent damage to the threads.

Remove the bottom race and dust seal using a drift, and discard them.



Install a new dust seal and bottom race onto the steering stem.  
Press in the bottom race using the steering stem driver and a hydraulic press.



### STEERING STEM INSTALLATION

#### Loose-Ball Type

Apply grease to the top and bottom cone races. Install the steel balls onto the top and bottom races making sure you have the correct amount.

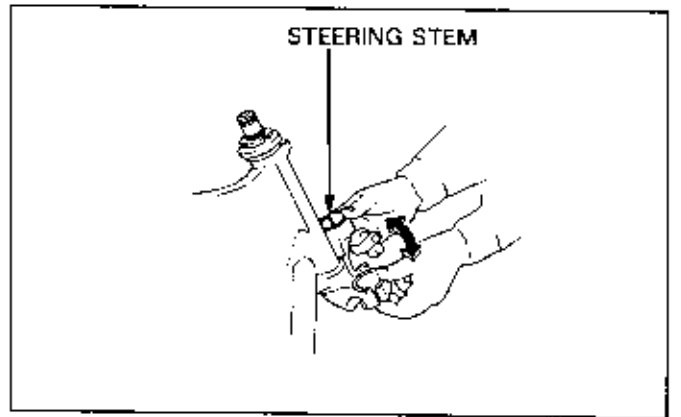
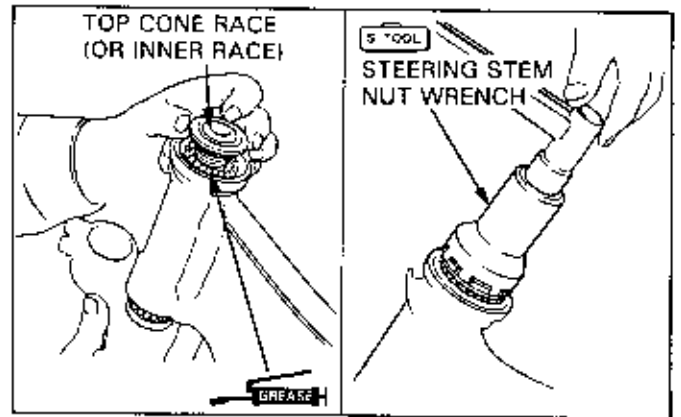
Insert the steering stem, taking care not to dislodge the steel balls from the grease.

Hold the steering stem in the place and install the top race and bearing adjustment nut.

Tighten the bearing adjustment nut to the proper torque: Refer to the Model Specific manual for this specification.

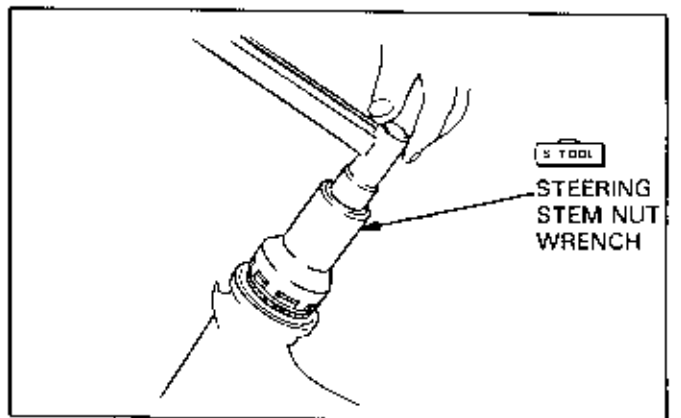
Move the steering stem right and left, lock-to-lock, several times to seat the bearings.

Make sure that the steering stem moves smoothly, without play or binding; then loosen the bearing adjuster nut.



Retighten the bearing adjustment nut to 15 N·m (1.5 kg-m, 10 ft-lb), then loosen the adjustment nut 1/8 turn.

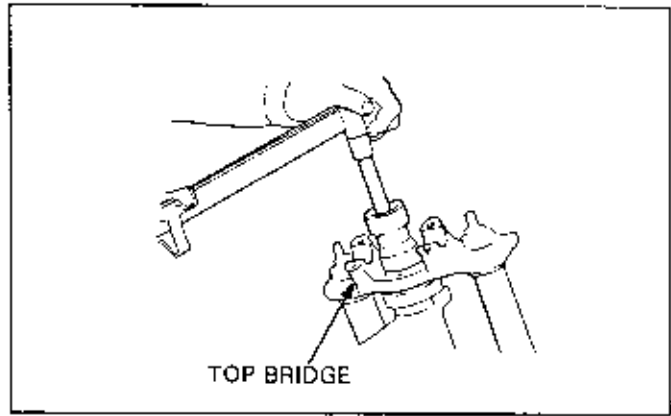
Recheck that the steering stem moves smoothly without play or binding.



## FRONT SUSPENSION

Reinstall the top bridge and fork legs temporarily.

Tighten the stem nut to the specified torque.

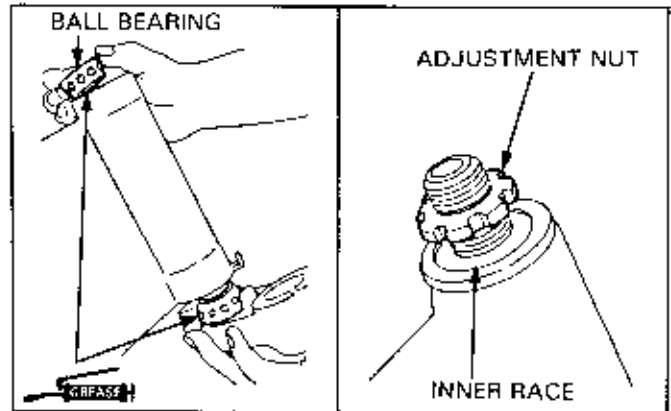


### Retainer-Type Ball Bearings

Apply grease to both the top and bottom bearings.

Place the lower bearing onto the steering stem with the retainer facing downward.

Insert the steering stem into the steering head and install the upper bearing into the steering head race.



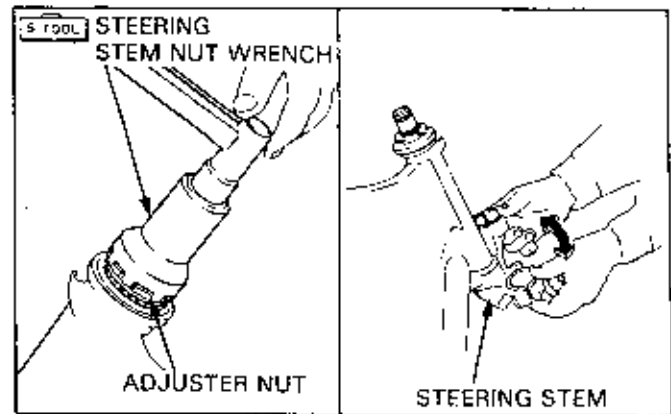
While holding the steering stem with one hand, install the top race and bearing adjustment nut onto the stem.

Tighten the bearing adjustment nut to 25 N·m (2.5 kg-m, 18 ft-lb).

Move the steering stem right and left, lock-to-lock, several times to seat the bearings.

Make sure that the steering stem moves smoothly, without play or binding; then loosen the nut.

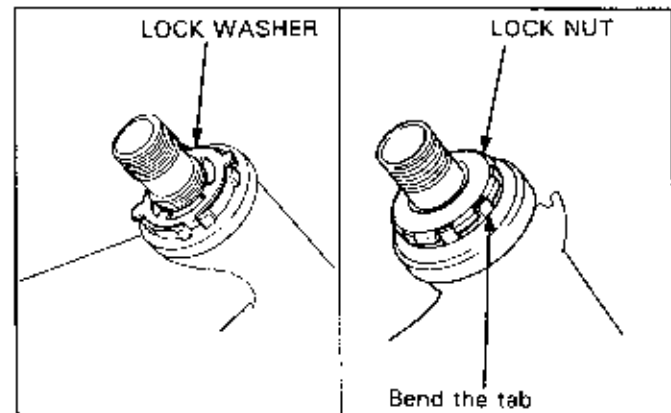
Retighten the adjuster nut to 25 N·m (2.5 kg-m, 18 ft-lb).



Install a new lock washer by aligning the tabs with the grooves in the adjustment nut.

Screw the lock nut all the way in with your fingers. Hold the bearing adjustment nut and further tighten the lock nut; enough to align the grooves with the tabs of the lock washer.

Bend the lock washer tabs up into the groove of the lock nut.

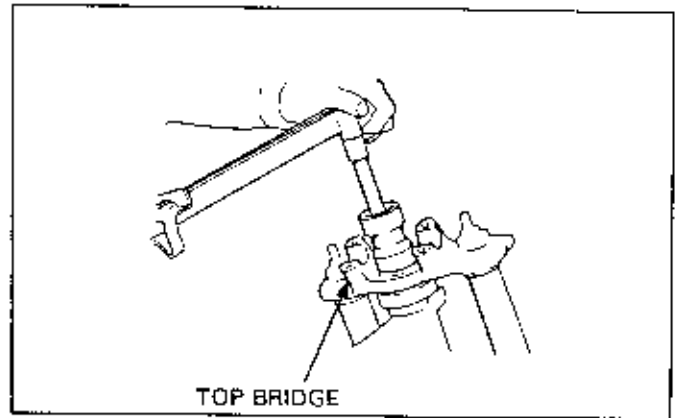


Install the top bridge and temporarily install the fork legs.

Tighten the stem nut to the specified torque.

Check the steering head bearing preload (page 18-22).

Reinstall the removed parts.

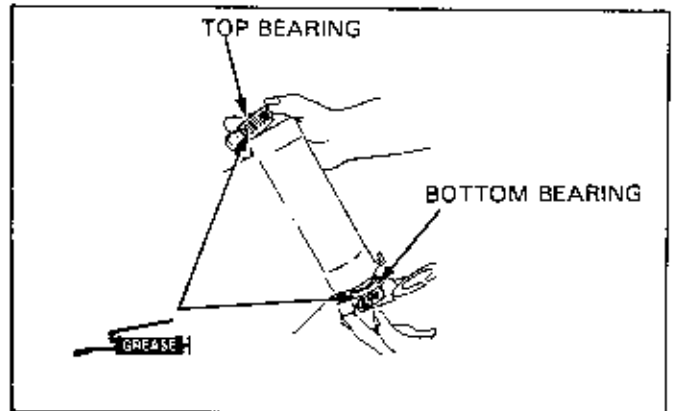


#### Tapered Roller Bearing Type

Apply grease to the top and bottom bearings.

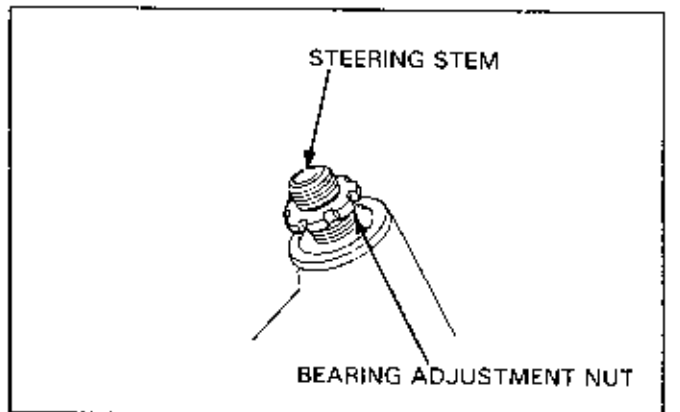
Install the bottom bearing onto the steering stem with the retainer toward the bottom.

Insert the steering stem into the steering head; then install the top bearing and dust seal (if a seal is used on the particular model).



Install bearing adjustment nut while holding the steering stem.

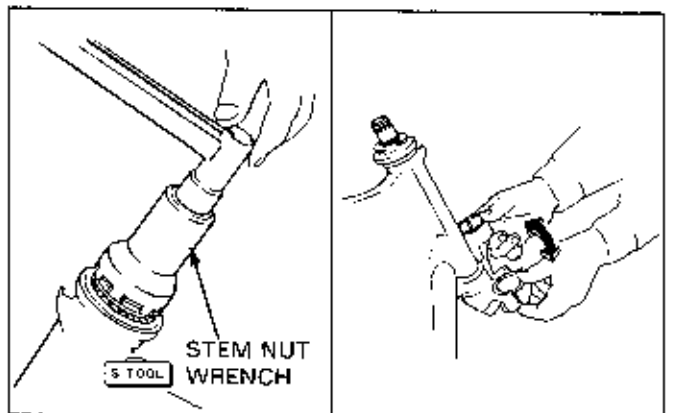
Tighten the adjustment nut to 11 N·m (1.1 kg-m, 8 ft-lb).



Move the steering stem right and left, lock-to-lock, several times to seat the bearings.

Make sure that the steering stem moves smoothly, without play or binding.

Retighten the adjustment nut to 11 N·m (1.1 kg-m, 8 ft-lb).



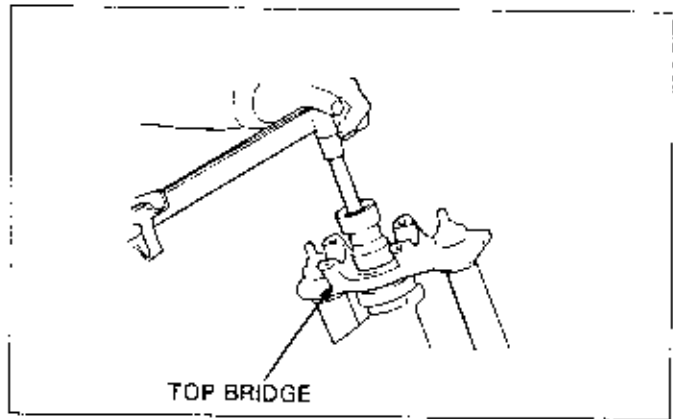
## FRONT SUSPENSION

Install the top bridge and temporarily install the fork legs.

Tighten the steering stem nut to the specified torque.

Check the steering head bearing preload.

Reinstall the remaining removed parts.



## STEERING HEAD BEARING PRELOAD MEASUREMENT

Steering head bearings (applicable to on-road models over 125 cc) that are too loose or too tight may cause handling problems.

After the steering stem and bearings have been reassembled, make sure that the steering head bearings are installed correctly by measuring the preload.

An average measurement is given here, refer to the Model Specific manual for the correct preload specification.

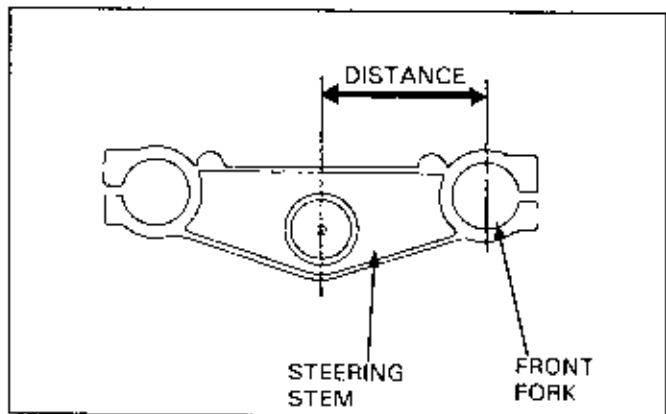
$$\text{Measurement (Reading on spring scale)} = \frac{\text{PRELOAD (kg-cm, in-lb)}}{\text{DISTANCE (between stem and fork tube centers)}} \\ \text{kg (lb)}$$

Example:

Distance: 7.5 cm (3.0 in)

Preload: 15 kg-cm (13.0 in-lb)

Measurement should be 2.0 kg (4.3 lb) in the spring scale.





**MEASUREMENT**

Place a jack or stand under the engine and raise the front wheel off the ground.

Set the steering stem in the straight ahead position.

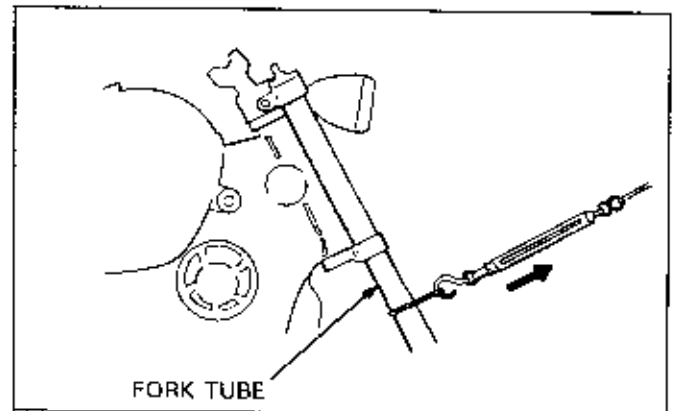
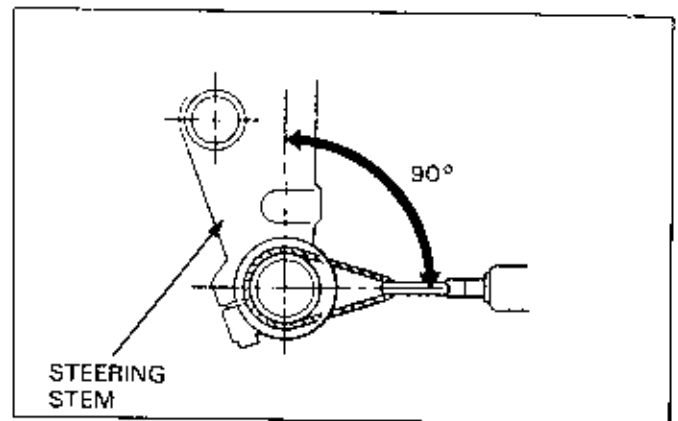
Hook the spring scale to the fork tube between the top and bottom bridges.

Pull the spring scale keeping the scale at a right angle to the steering stem.

Read the scale at the point where the steering stem just starts to move.

Compare this with the specification in the Model Specific manual.

Adjust as necessary.



# 19. REAR SUSPENSION

SERVICE INFORMATION	19-1	SHOCK ABSORBER	19-7
TROUBLESHOOTING	19-1	SWINGARM	19-11
SYSTEM DESCRIPTIONS	19-2	PRO-LINK SUSPENSION LINKAGE	19-11

## SERVICE INFORMATION

- Use only genuine Honda bolts and nuts on all suspension, swingarm, shock absorber and suspension linkage mounting locations.

### ⚠ WARNING

- The shock absorber contains nitrogen under high pressure. Do not allow fire or heat near the shock absorber.
- Before disposal of the shock absorber, release the nitrogen (see page 19-9).

## TROUBLESHOOTING

### Soft Suspension

- Weak spring(s)
- Oil leakage from damper unit
- Air or gas leakage
- Incorrect damper adjustment

### Hard Suspension

- Incorrectly mounted suspension components
- Incorrect damper adjustment
- Bent swingarm pivot
- Bent damper rod
- Damaged swingarm pivot bearing(s)
- Faulty suspension linkage
- Damaged linkage pivot bearings

## SYSTEM DESCRIPTIONS

Swingarm-type rear suspension systems provide a comfortable ride while offering good traction and wheel control capabilities. Using the front swingarm pivot as the fulcrum and mounting the rear axle at the trailing end of the swingarm allows the wheel to respond quickly to variations in the road or trail surface.

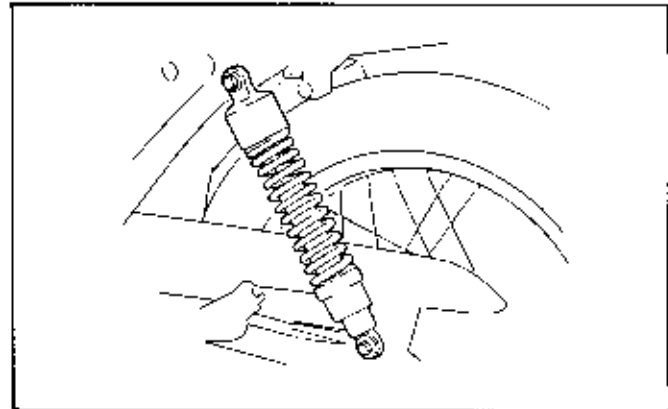
At present, almost all motorcycles have adopted this basic configuration for rear suspension. On some scooters, the entire engine and drive unit pivots as the "swingarm". This basic swingarm type rear suspension design can be broken down into a few categories, depending on the number of dampers used and the design of the swingarm.

### Conventional, Dual Spring/Damper Type

In the conventional type system, two spring/damper units support the rear of the frame from the rear section of the swingarm as illustrated here.

Today, this type of suspension is found primarily on small displacement motorcycles because of the simplicity of installation, the small number of components necessary and due to the systems basic economy. Up until around 1981, this dual spring/damper design was also used on most larger displacement motorcycles as well.

A rising rate type rear suspension is also possible on dual shock types if the shock angles are correctly positioned.

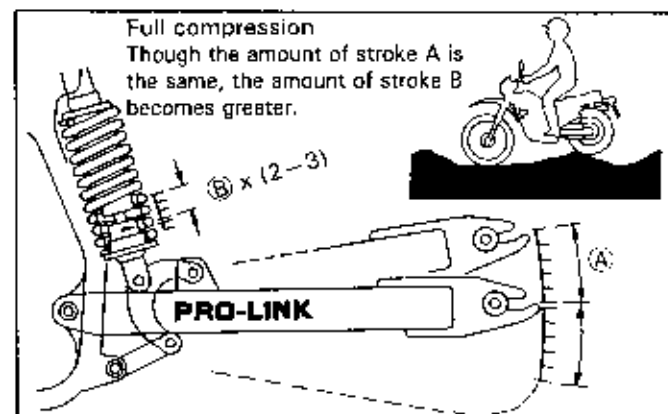
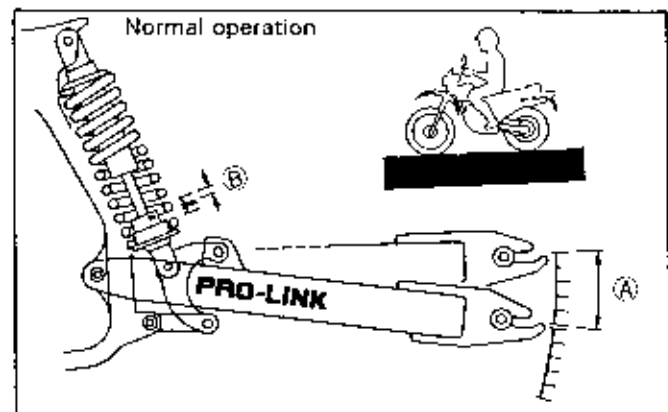


### Pro-Link, Progressive Link Type

Honda's Pro-Link suspension system is designed to provide both comfort and control without compromise. Its progressive action rising rate delivers an ideal proportion of springing and damping over a wide range of riding conditions. Initial rates are soft for supple response to small bumps and ripples. Should the riding surface become rougher, increasingly stiffer rates provide the control necessary to prevent bottoming and keep the rear wheel in contact with the surface.

The swingarm and damper unit of the Pro-Link type rear suspension are connected to the swingarm by a link. The damper unit travel in relation to the rear wheel movement can be changed relatively freely during the design stage in accordance with the combination of the cushion arm and cushion connecting rod that is selected.

As the axle stroke distance increases, the piston speed of the damper and shock absorbing force increase progressively. Therefore, this type of suspension is characteristically soft on initial travel so it absorbs small riding surface inconsistencies well, and provides progressively firmer resistance to prevent bottoming at full compression when a large bump is hit.

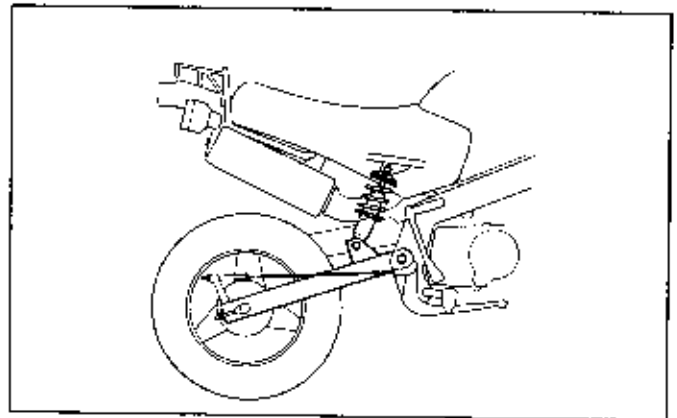


This arrangement offers a greater amount of suspension stroke compared to the amount the damper unit compresses and therefore greater control for improved suspension performance. It also enables the weight of the spring/damper unit to be centralized more compactly, nearer the center of the frame.

The Delta type Pro-Link is a further refinement which lowers the motorcycle's CG by a significant amount and reduces the weight of the cushion arm.

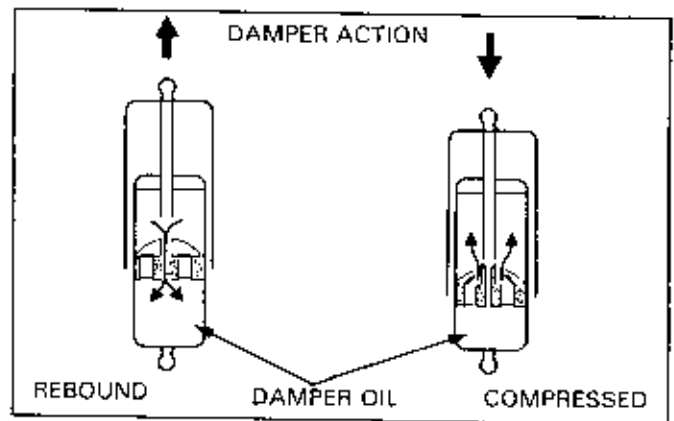
**Pro-Arm Type**

Honda's unique cantilever-type Pro-Arm is a stylish departure from the conventional forked-type swingarms. High rigidity and durability are achieved through the use of a massive box-section design and large diameter "axle". The "center pin" mounting allows easy wheel removal/installation and the design of the eccentric bearing carrier makes chain adjusting easy. Other benefits include minimal unsprung weight, added room for compact exhaust routing, slimmer overall machine shape, easier access for damper adjustments, and the simple design lends itself to ease of maintenance and cleaning.

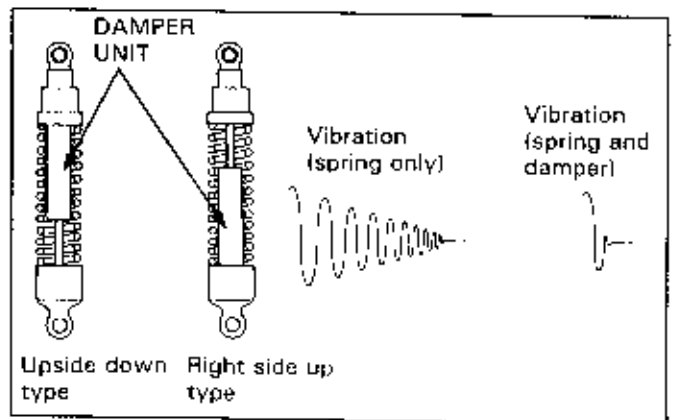


**Damper Design and Operation**

Riding comfort and proper rear wheel traction are provided by a combination spring/damper unit, and to some degree, by maintaining proper tire pressure. The damper absorbs some suspension compression force and controls the unwanted rebounding effects of the spring. Typically, comparatively little damping resistance is offered on the compression stroke as most of this (shock) is handled by the spring.



Oil dampers units are either the upside down type or the right side up type. Running the damper body upside down (with the shaft below and the body above) reduces unsprung weight.



## REAR SUSPENSION

In addition to the inverted and conventional damper body types, there are two basic damper designs, each named for the method used to create the damping action: the friction type and the oil damper type.

The friction type damper is comparatively simple in design and is used on only the most lightweight and economical models. This design uses only the friction of a nonmetallic piston against the greased, inside wall of the damper cylinder to counteract the natural rebounding action of the springs.

Many of the simplest and most lightweight motorcycles and scooters are equipped with single damping or single-effect type dampers. This design provides damping force only on the rebound stroke and relies on the compression resistance of the spring alone to absorb riding surface irregularities.

The most effective damper design is the double damping or double-effect type. In these, damping force is provided for both compression and rebound strokes.

Some damper designs include nitrogen gas within their bodies or within a reservoir to prevent the oil from foaming.

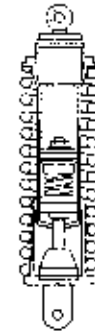
In emulsion type dampers the nitrogen is filled in the damper body.

Some of this type has a separator in the gas chamber by which gas is hard to be mixed with the oil.

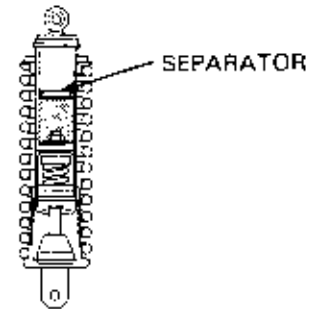
Decarbon design dampers keep the nitrogen gas separated from the oil by means of a free floating piston which acts as a diaphragm. This way the oil can pass through the damping orifices without interference from the gas bubbles.

Reservoir equipped dampers are a variation of the simplest Decarbon design. A more consistent oil temperature and therefore more consistent damping is provided due to an increased oil capacity; the shock body can be entirely filled with oil since the gas chamber is elsewhere. A rubber bladder is used within the reservoir to separate the nitrogen gas from the damper oil.

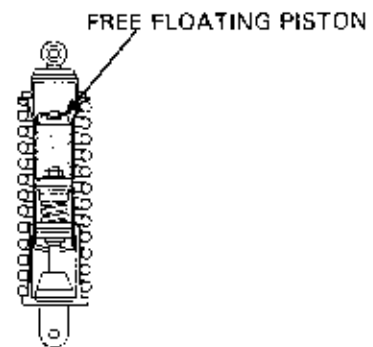
DOUBLE DAMPING (DOUBLE-EFFECT) TYPE



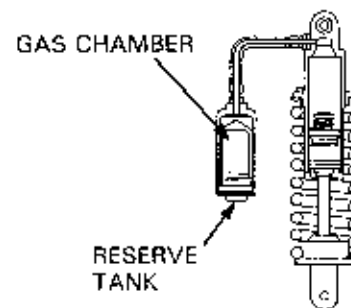
EMULSION TYPE



DECARBON TYPE



RESERVE-TANK TYPE

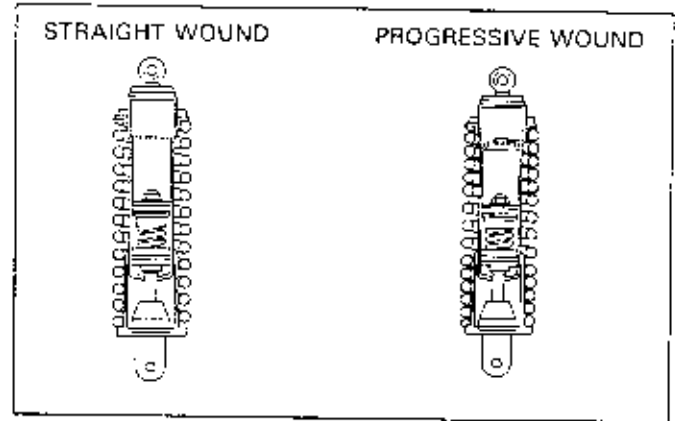


**Rear Damper Springs**

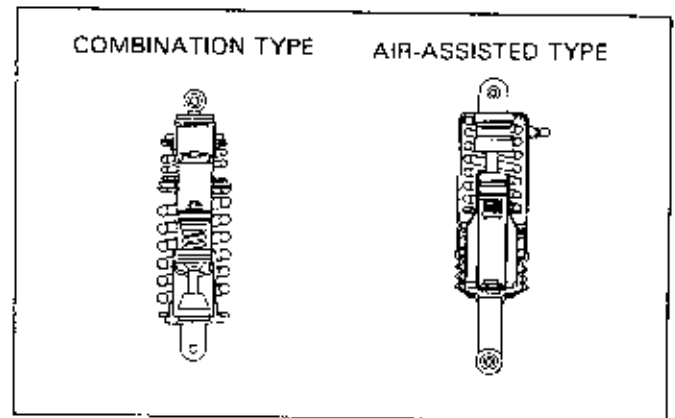
A variety of spring designs are used on motorcycles and scooters. Among these types are straight wound, progressive wound, wide pitch and narrow pitch, and even tapered spring wire types. Each provides different compressive force characteristics.

**NOTE**

- Unsprung weight is reduced slightly when the widely pitched (or spaced) spring coils are positioned toward the swingarm.



One means of achieving a progressive overall spring rate is to allow the spring rates of two or three different springs to "crossover" or combine their individual qualities by simply stacking the springs atop one another. This method is known as a combination type spring arrangement.



Another variation towards achieving a progressive spring action is to add an air-assist bladder to the spring/damper unit. On these types, air pressure is added up to a specified amount to compensate for increased load requirements rather than adjusting the preload on the spring.

The right "shock" on GL1500s is actually only an "air spring". It has no dampening properties aside from a very slight seal friction and is filled with only a very small amount of oil to lubricate its shaft and oil seal.

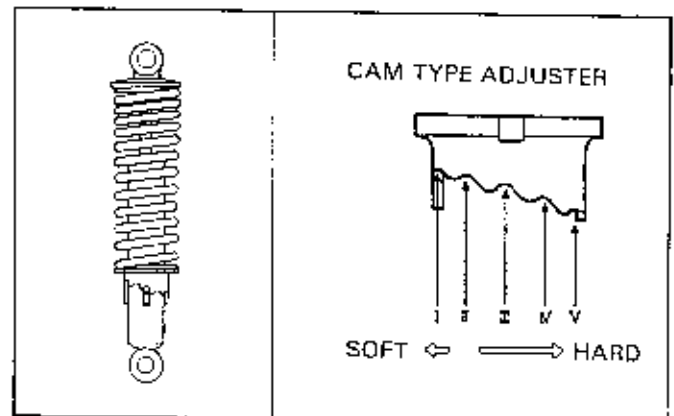
**Spring Preload Adjuster Designs**

The spring adjuster changes the coil spring length and the initial spring preload. There are several types of spring preload adjuster systems: pre-set type, mechanical type and both mechanical and hydraulic remote control types, all of which adjust the spring seat position.

The Pre-set category includes both the cam type preload adjuster and the near infinitely adjustable threaded, double locking nut type.

**Cam Type**

The cam type preload adjuster uses a collar with recessed steps that fits around the damper body. As each step is positioned against a stop or pair of stops built-in to the damper body, the spring preload can be adjusted to from three to five pre-set positions, to better suit vehicle load requirements.

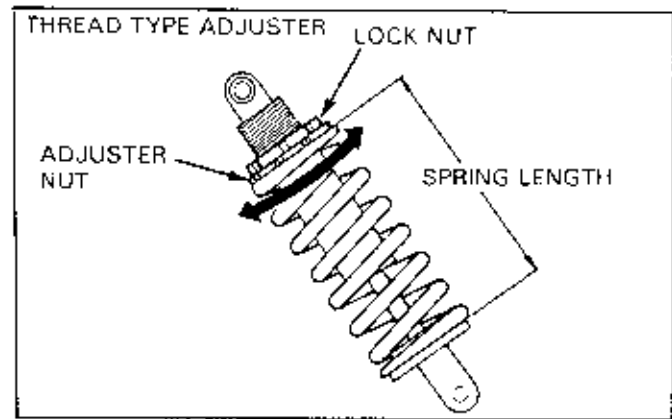


## REAR SUSPENSION

### Threaded Type

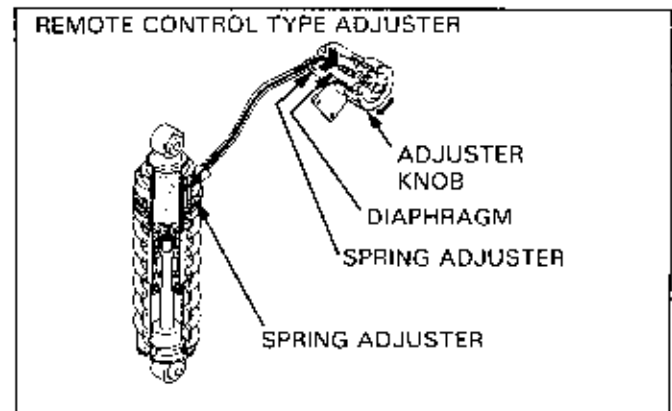
Spring preload is set by moving an adjuster nut to either compress or extend the height of the spring. Once the desired preload is established, a lock nut is tightened against the adjuster nut to prevent it from changing position. A minimum and maximum spring height (spring preload) is recommended for each model. These dimensions must be complied with.

Failure to comply with the minimum and maximum spring length specifications may result in the spring coil binding near full suspension compression or the spring perch retainers coming loose near full suspension extension.



### Remote Control Type

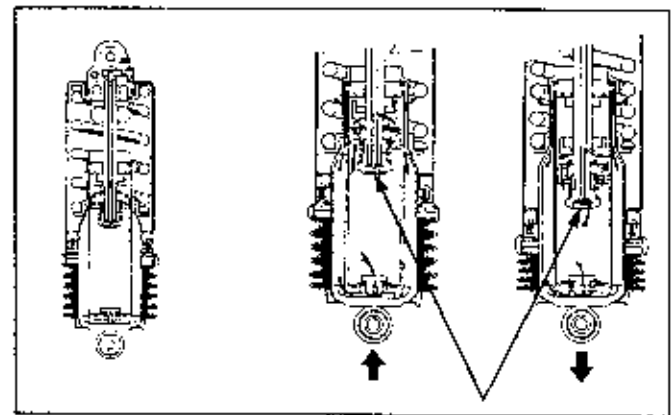
The remote type of spring preload adjuster uses hydraulic pressure to reposition the spring seat. An adjuster knob on a conveniently located control mechanism presses against a diaphragm, which in turn forces hydraulic fluid through a line to the damper unit. This hydraulic system, completely separate from the damping system, increases or decreases the height of the spring to achieve the desired preload.



### Damping adjuster

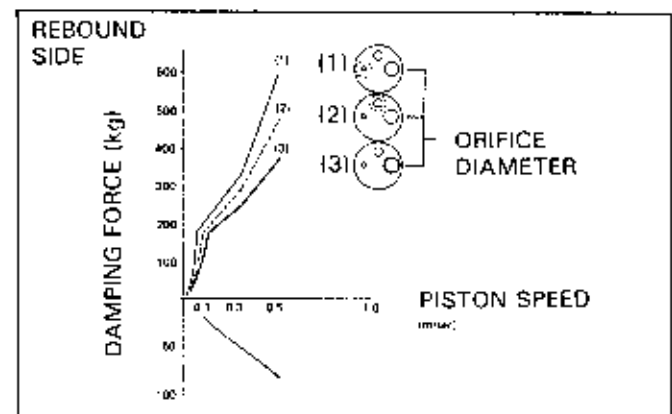
In oil damper units, a damping adjuster serves to control the oil flow by regulating the orifice diameter.

On certain types other than those shown in the drawings, the damping force is controlled by adjusting the pre-set load on the valve.



Decreasing the orifice diameter increases resistance and damper hardness.

Increasing the orifice diameter decreases resistance and damper hardness.



# SHOCK ABSORBER

## REMOVAL

Support the vehicle securely and raise the rear wheel off the ground.

Remove the mounting bolt(s) or nut(s); then remove the shock absorber.

## INSTALLATION

Install the shock absorber on the upper mount noting the proper installation direction.

Raise the rear wheel enough to allow installation of the lower mounts. Slip the mounts into position.

Tighten the upper and lower mounts to the specified torque.

On Pro-Link or Pro-Arm systems, refer to the Model Specific manual for shock absorber removal/installation procedures.

## DISASSEMBLY

### ⚠ WARNING

- Certain types of damper units are filled with high pressure nitrogen gas.
- Do not disassemble gas damper units.
- Be sure to release the gas from the damper unit before discarding it.
- To prevent loss of tension, do not compress the spring more than necessary to remove it.

Remove the shock absorber.

Compress the spring and remove the damper unit.

### Shock Absorber Compressor Use:

Install the shock absorber compressor on the rear shock absorber.

Certain types of shock absorber compressors require adapters when the attachment is installed, while others do not.

Refer to the Model Specific manual for the type of compressor.

Install the shock absorber compressor holder securely onto the coil spring end that is near the lock nut or stopper ring.

Turn the compressor handle and slowly compress the spring.

### Hydraulic Press Use:

Install the spring compressor attachment and compress the spring with the hydraulic press.

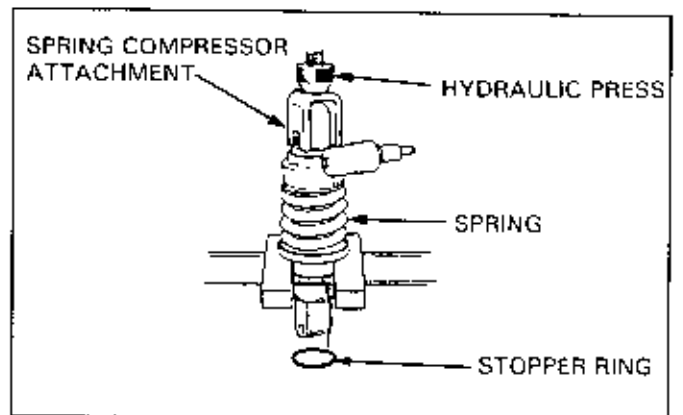
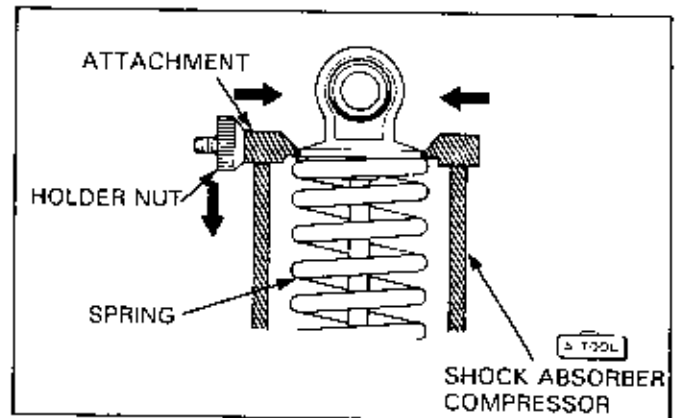
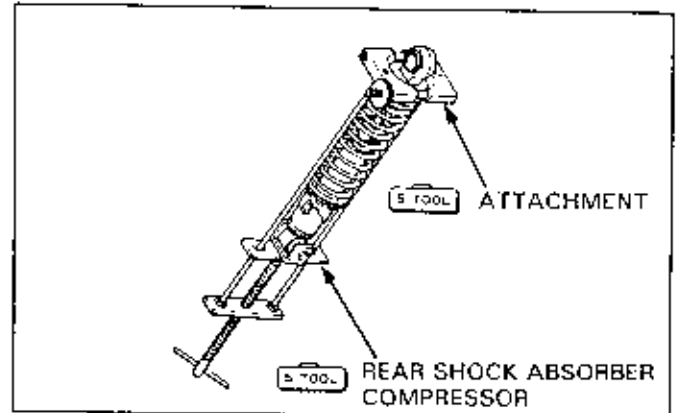
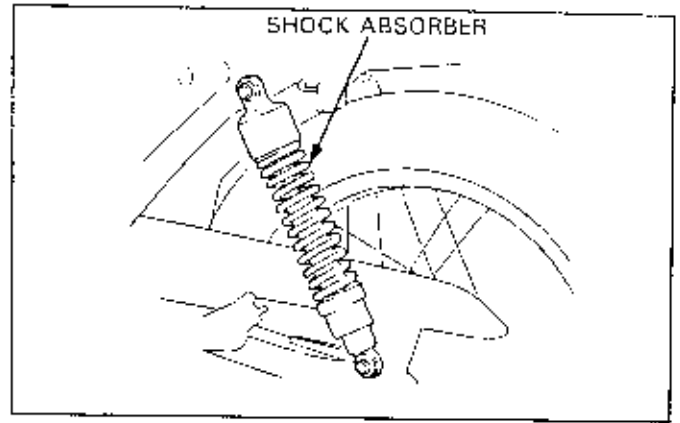
Always use a specified tool to compress the spring. Refer to Model Specific manual.

### ⚠ WARNING

- Use of a hydraulic press to compress the spring can lead to the spring or shock absorber flying out of the press and causing a serious injury.

Certain types of shock absorbers are mounted with a stopper ring while other types are mounted with a lock nut.

Refer to the Model Specific manual.

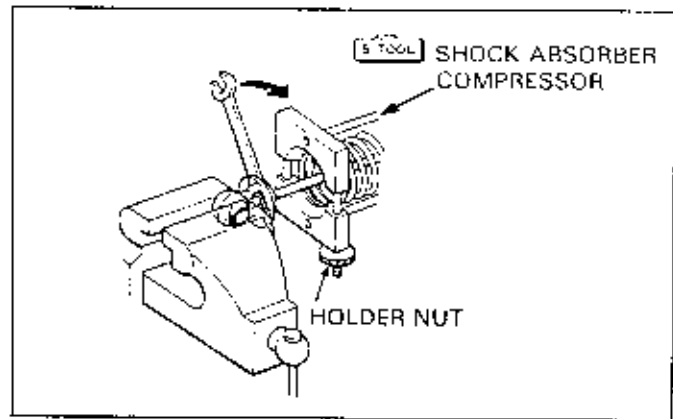




## REAR SUSPENSION

### Lock Nut Removal

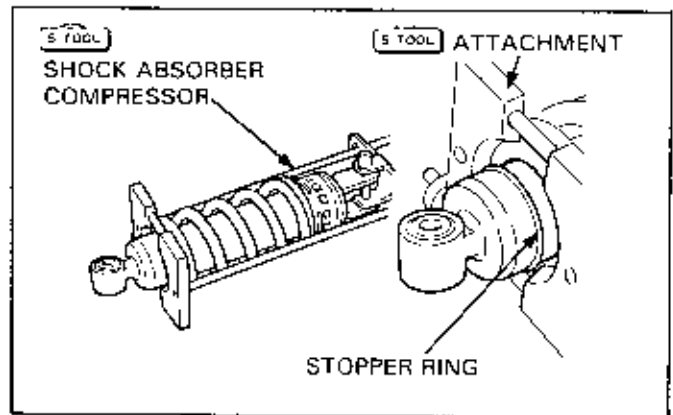
Compress the spring and loosen the lock nut, then remove the upper or lower joint and the spring.



### Stop Ring Removal

Compress the spring and remove the stopper ring.

Remove the spring.



## INSPECTION

### Spring

Place the spring on a level surface and measure the free length.

Replace the spring if it is deformed, cracked or its free length is shorter than the service limit.

### Damper Unit

Keep a gas-filled shock absorber away from fire or heat.

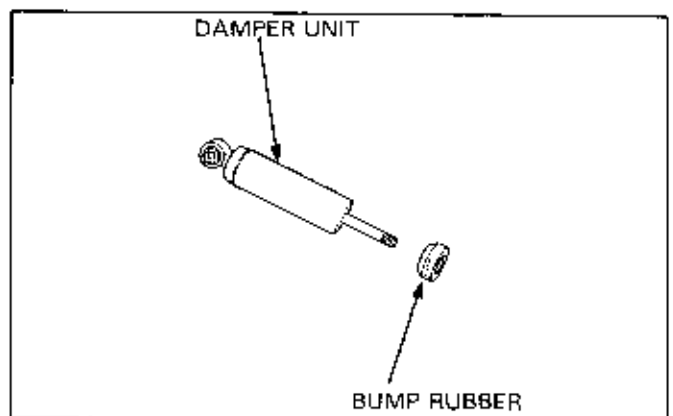
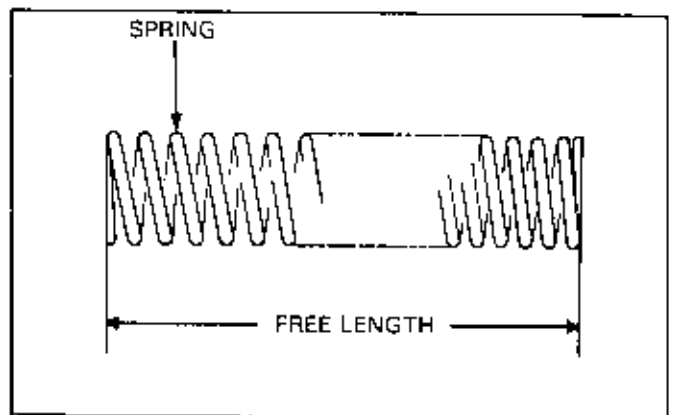
#### ⚠ WARNING

- Heating a gas-filled damper can lead to an explosive release of pressure which can cause a serious injury.
- Do not try to disassemble the damper unit if the disassembly procedure is not described in the Model Specific Manual. Disassembly can lead to a release of gas under high-pressure which can cause an injury.

Check the damper unit for deformation or oil leakage and replace if necessary.

Check the damper rod for straightness or stepped wear and replace if necessary.

Check the damper bump rubber for fatigue or damage and replace if necessary.



**Compression Force (Gas Filled Damper Only)**

Examine the damper rod and replace the damper unit if it is bent or scored.

Mark the damper rod at the specified compressed stroke (i.e., 10 mm/0.4 in) exposure from the damper body.

Place the damper rod on a scale and measure the force required to compress the damper until the mark is flush with the damper body.

Refer to the Model Specific manual for the compression force and the specified compressed stroke.

If the force required is less than service limit, gas is leaking.

Check the upper joint and collar for wear or damage and replace if necessary.

Check the rubber bushing for wear or damage and replace if necessary.

**NOTE**

- Apply specified grease to the sliding surfaces of the collar and bushing, and reinstall them.
- If a needle roller and spherical bearing are installed instead of the bushing and collar, refer to the Model Specific manual for their replacement.

**SHOCK ABSORBER DISPOSAL PROCEDURE**

Center punch the damper case to mark the drilling point. Refer to the Model Specific manual for the precise drilling point.

Wrap the damper unit inside a plastic bag.

Support the damper unit upright in a vise.

Through the open end of the bag, insert a drill motor with a sharp 2–3 mm (5/64–1/8 in) drill bit.

Use a sharp drill bit to minimize heat buildup.

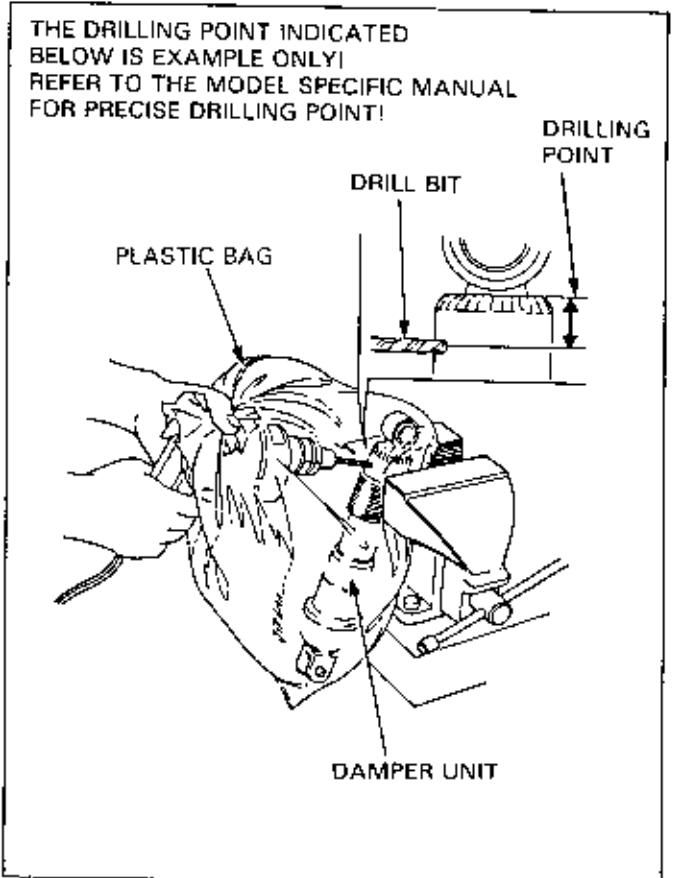
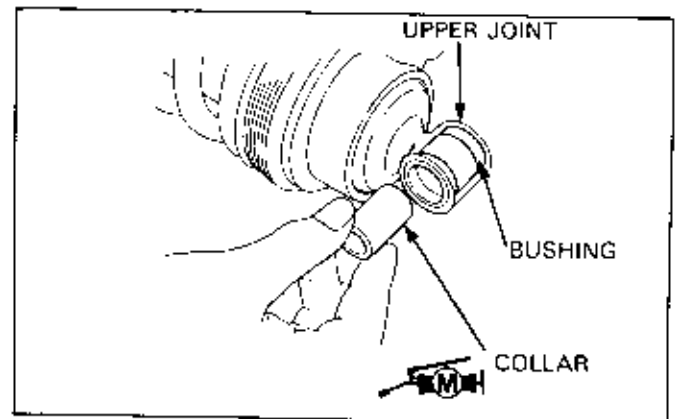
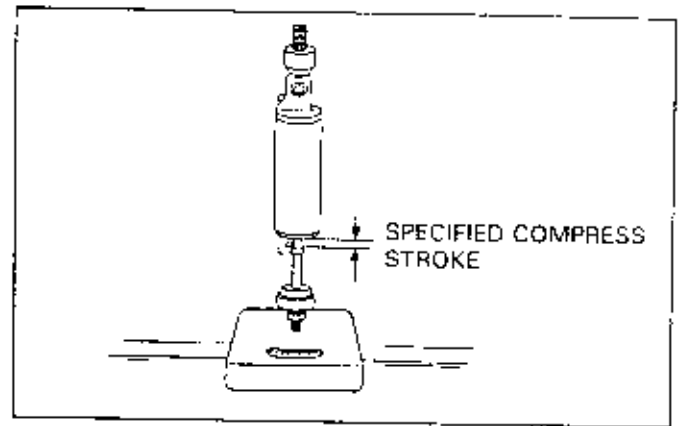
**⚠ WARNING**

- Using a dull drill bit allows a build-up of excessive heat and pressure inside the damper which may cause an explosion.
- The shock absorber contains nitrogen gas and oil under high pressure. Drilling farther into the damper case than specified can puncture the oil chamber. Oil escaping under high pressure may cause serious injury.
- Always wear eye protection to avoid getting metal shavings in your eyes when gas pressure is released.

**NOTE**

- The plastic bag is only intended to shield you from the escaping gas.

Hold the bag around the drill motor and briefly run the drill motor inside the bag; this will inflate the bag with air from the motor and help keep the bag from getting caught in the bit when you start.



## REAR SUSPENSION

On dampers with nitrogen gas filler valves, depress the valve core to release the nitrogen and then remove the valve from the shock absorber.

Point the valve away from you.

### ⚠ WARNING

- Always wear eye protection to avoid getting debris in your eyes.

## ASSEMBLY

Assemble the shock absorber in the reverse order of disassembly.

## NOTE

- If the shock absorber does not have the regular pitch spring, the spring should be installed in the correct position. Refer to the Model Specific manual for spring installation direction.

### Hydraulic Press Use:

Compress the spring until the stopper ring can be installed using a hydraulic press.

Refer to the Model Specific manual.

Install the stopper ring in the groove in the damper.

Be certain that the stopper ring is seated firmly in the groove.

### ⚠ WARNING

- Failure to firmly seat the snap ring may cause the shock assembly to come apart unexpectedly and lead to a serious injury.
- Compressing the spring more than necessary may cause a loss of spring tension.

Always use a Shock Absorber Spring Compressor to compress the spring on dampers with a rod screwed into the upper or lower joint.

### ⚠ WARNING

- Use of a hydraulic press to compress the spring can lead to the spring or shock absorber flying out of the press and causing a serious injury.

### Joint Installation:

Clean the lock nut threads before installing the lower joint.

Install the lock nut on the damper rod and tighten it by hand as full as it goes.

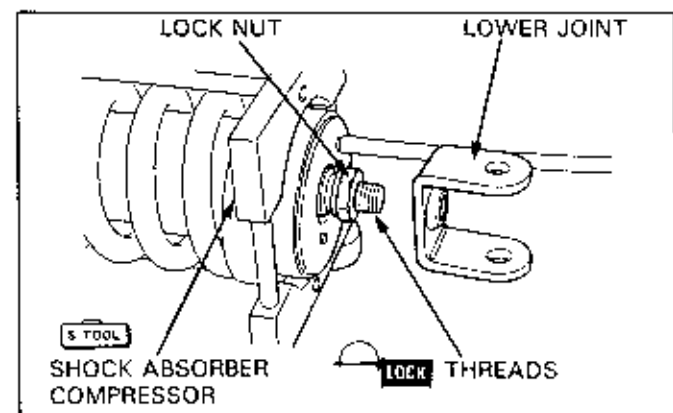
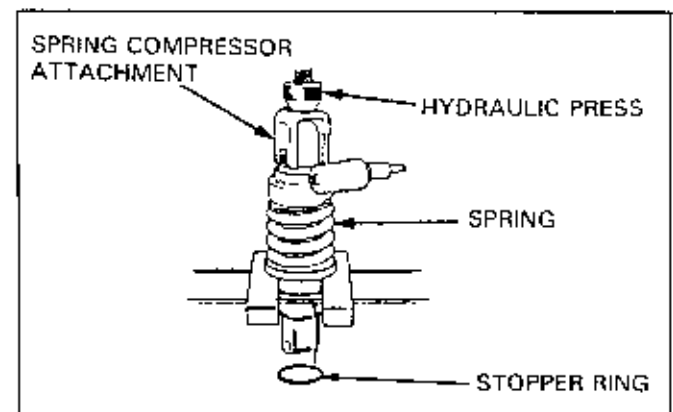
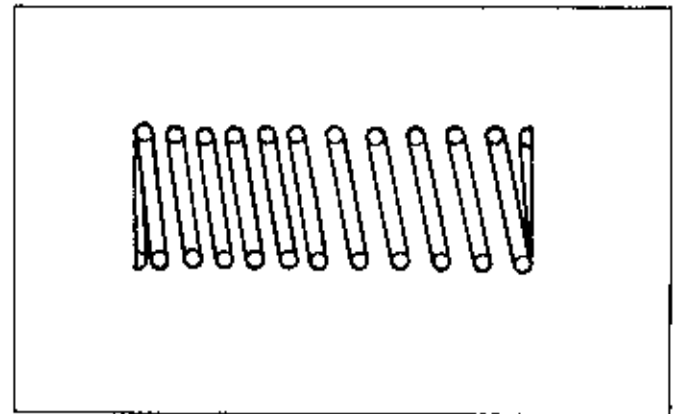
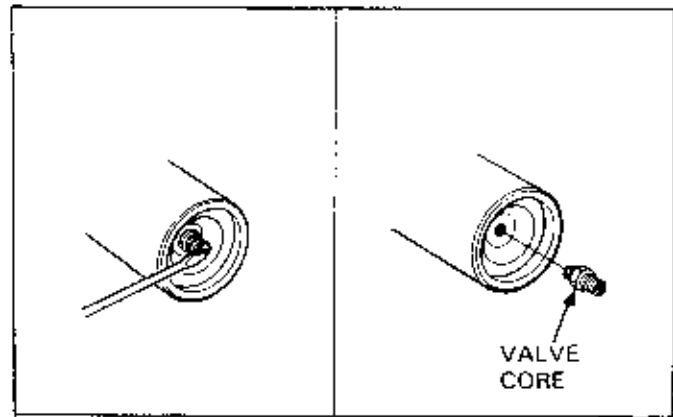
Apply a locking agent to the threads.

Install the lower joint on the damper unit.

Hold the lower joint and tighten the lock nut to the specified torque.

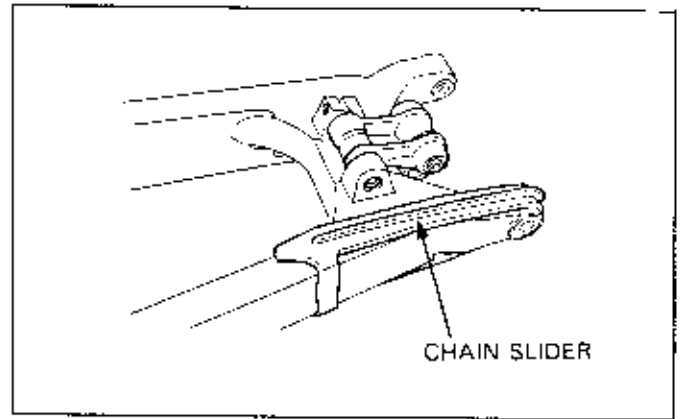
## CAUTION

- Loosening or removing a staked lock nut may cause the shock assembly to come apart unexpectedly and lead to a serious injury.



## SWINGARM

Refer to the Model Specific manual for each model for swingarm removal, disassembly, reassembly and installation.



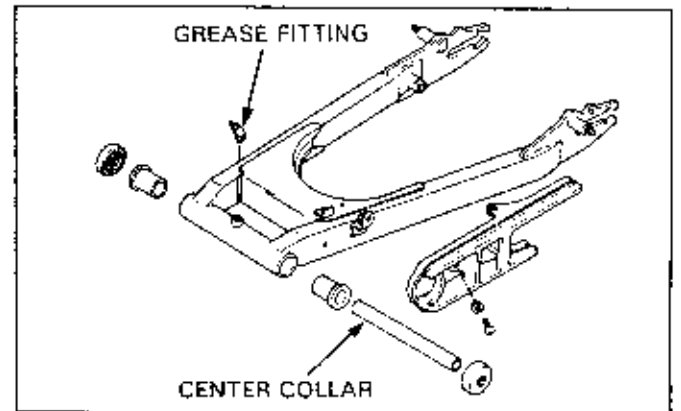
## INSPECTION

Remove the chain slider, chain guide and brake torque rod (if installed).

If the motorcycle is a shaft-drive type, remove the rubber boot.

Check the removed parts for wear or damage and replace if necessary.

Check the center collar/distance collar, if installed, for wear, scoring or scratches and replace if necessary.



## PRO-LINK SUSPENSION LINKAGE

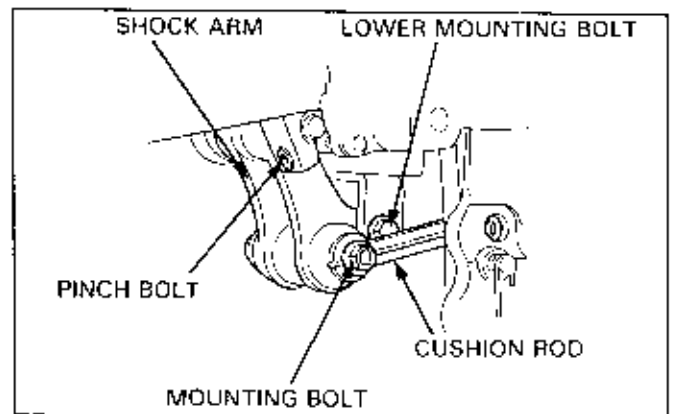
### NOTE

- Mark on the suspension linkage before disassembly. The cushion arm and connecting rod often have specific installation directions and they should be installed properly. They may interfere with the frame and/or change the vehicle height unless installed properly.

## REMOVAL

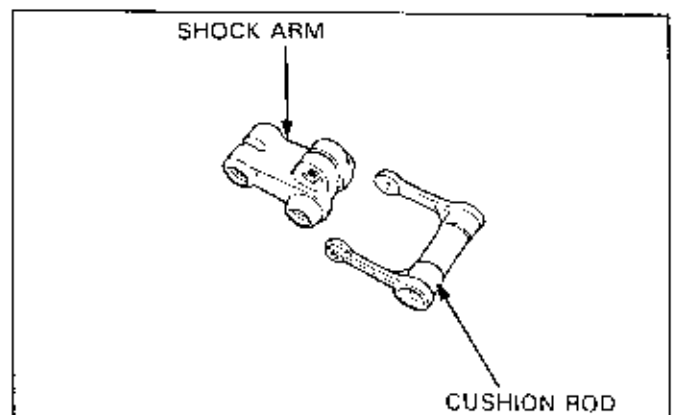
Remove the following:

- Rear wheel.
- Bolts from the frame side of the connecting rod.
- Rear shock absorber lower mounting bolts.
- Bolts from the swingarm side of the shock arm.



## INSPECTION

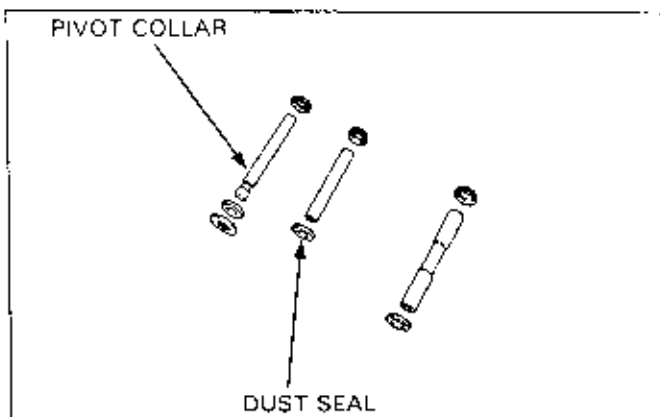
Check the shock arm and connecting rod for deformation, cracks or other damage and replace as necessary.



## REAR SUSPENSION

Check the pivot collars, dust seals, bushings and/or bearings for wear or damage and replace if necessary. Refer to the Model Specific manual for their replacement procedures.

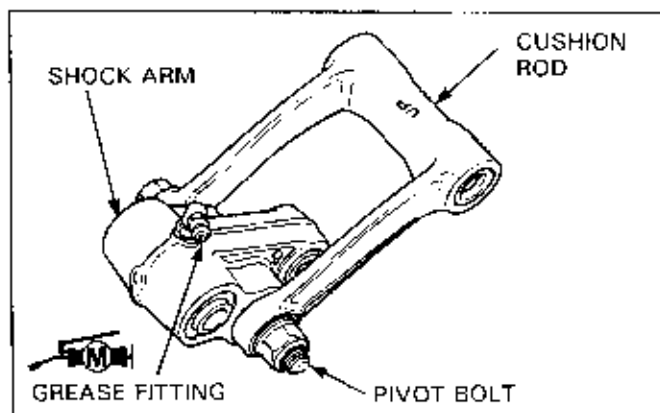
Refer to the Model Specific manual, if your motorcycle is equipped with needle roller or spherical bearings.



## INSTALLATION

Apply molybdenum disulfide grease to all pivot points. Pack the grease fittings (if installed) with grease. Reassemble the suspension linkage with care to the proper installation directions and loosely tighten the pivot bolts. Reinstall the suspension linkage assembly on to the frame and tighten each bolt to the specified torque.

Refer to the Model Specific manual for the proper torque specifications.



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## 20. FRAME/BODY PANEL

SERVICE INFORMATION	20-1	DESCRIPTION	20-2
TROUBLESHOOTING	20-1	INSPECTION	20-4

### SERVICE INFORMATION

- Although it is possible to weld some cracked frames and straighten some frames that are slightly bent it is best to replace the frame with a new one when it is damaged.
- Generally speaking, plastic body panels cannot be repaired and therefore must be replaced.
- It is possible that a front end collision will bend the steering head of the frame, but not the fork, wheel or even the axle.

### TROUBLESHOOTING

- Failure of the front suspension, steering or rear suspension may damage the frame enough to require replacement.
- Refer to the section 18 for front suspension and steering inspections.
- Refer to the section 19 for rear suspension inspection.

#### Abnormal engine vibration

- Cracked or damaged engine mounts
- Cracked, damaged or bent welded portions
- Bent or damaged frame
- Engine problems

#### Abnormal noise when riding (banging or cracking)

- Damaged or bent engine mounts
- Damaged welded points
- Damaged or bent frame

#### Steers to one side when under acceleration or deceleration

- Bent frame
- Bent fork
- Bent swingarm

## DESCRIPTION

Motorcycle, scooter and ATV frames serve as a skeleton to which all other components are attached. Various forms and intensities of vibration and stress act against the frame from both the engine and suspension when the vehicle is in use. These forces are a major factor in determining the final design of each frame.

The various frame designs can be classified into one of a few general categories. Certain types are chosen for particular models according to their engine displacement, the use the vehicle is designed for, serviceability, economic reasons, and even visual appeal.

The material used for a frame is chosen by similar means. Generally, aluminum frames are reserved exclusively for sport type, on-road motorcycles, usually of middle-to-large engine displacement. Virtually all other frames are made of steel. Aluminum alloys are lighter than steel of the same strength, but are bulkier and more expensive to produce.

A wide variety of tubing and pressed steel shapes as well as castings and forgings are combined to form the optimal framework for a particular model.

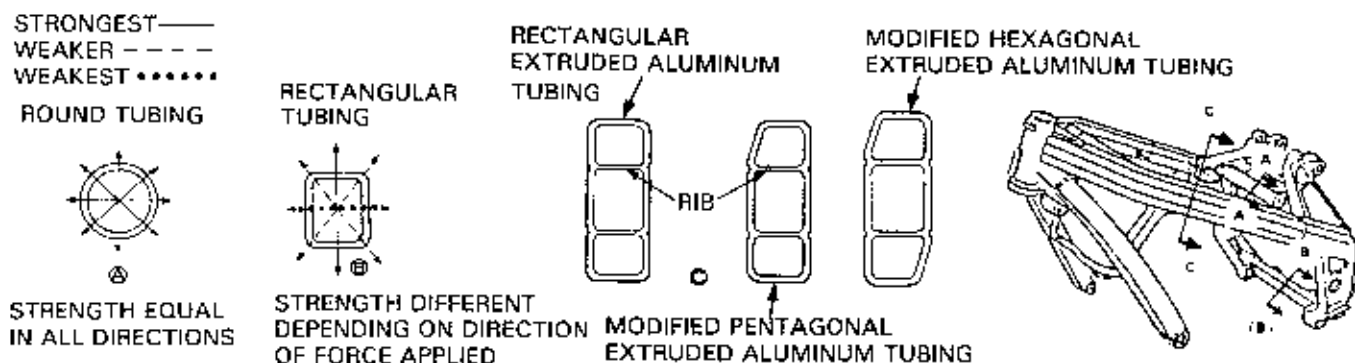
Many of the earliest Honda models used primarily a round steel tube frame. Later models up to 305 cc used a frame made mostly or entirely of pressed steel plate.

Some of today's frames are made almost entirely of round steel tubing of various sizes and thicknesses. Others are made up mainly of square steel tubing. Most aluminum frame members are some form of rectangular tubing, though a few pieces are square. The highest stressed rectangular aluminum members are often relatively complex extrusions designed to fulfill a specific set of requirements. Most aluminum and steel frames include some castings or pressed steel sections in order to form strong and compact tube joints, and for pivot or major attachment points.

Round tubing has the same strength in all directions. Square and rectangular tubing (as well as other variants) have different strength characteristics in different directions. When the maximum strength is required in a vertical direction and the strength in a horizontal direction is not as important, rectangular tubing with greater strength in the areas needed is chosen. At times a frame is lightened by changing the combination of the types of tubing.

Thinwall rectangular aluminum tubing is given a greater strength by adding an internal stiffening ribs and producing it in the form of an extrusion. Some models use a special modified pentagonal or hexagonal extruded aluminum tubing (with internal strengthening ribs) in order to improve the frame member's strength to weight ratio, its rigidity in one or more specific directions, and in some cases, to allow a more compact and unobstructed riding position.

The various material types, forms and dimensions used in frame design are linked directly to the experience gained from Honda's ongoing racing programs around the globe. As new knowledge is gained through competition, it is combined with input from non-competition testing and utilized in the construction of each new generation of production machine.



The frame also serves to absorb vibration from the engine and, to some degree, from the road surface. The difference in basic frame structure is determined according to the engine type and the type of use the machine is designed for.

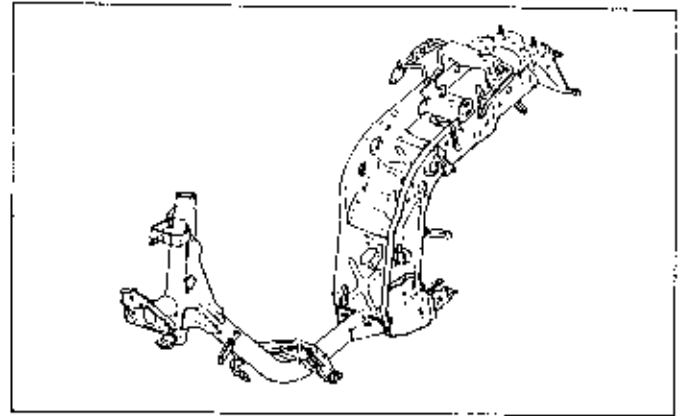
Two only slightly different frame designs may have significantly different vibration absorbing or generating characteristics which make one design correct and the other unsuitable, even with the same engine installed. Therefore, the particular frame structure a machine ends up with is chosen according to the engine type and by the specific use the machine is intended for, in order to prevent unpleasant vibration to the rider and premature fatigue to structural members.

Frames are classified as follows, according to differences in basic structure.

### BACK-BONE TYPE

This type of frame is made up of a combination of pressed steel plate and steel tubing.

This basic frame design is used mainly on scooters and some of Honda's early motorcycle designs. This type of construction allows added freedom in the overall design of the vehicle and relatively economical production.

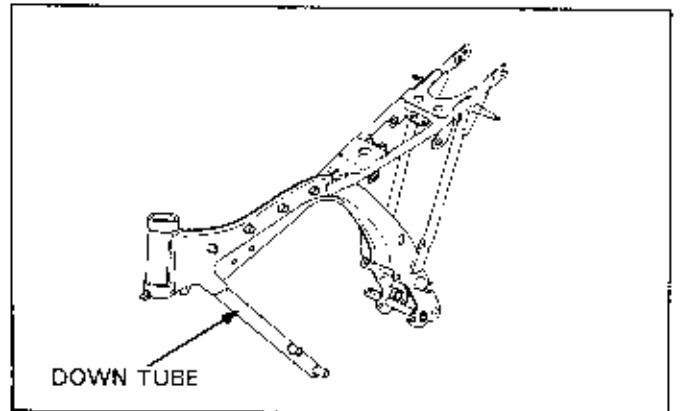


### DIAMOND FRAME

The lower section of the down tube is not connected with other frame tubes. The engine forms the final portion of the frame structure.

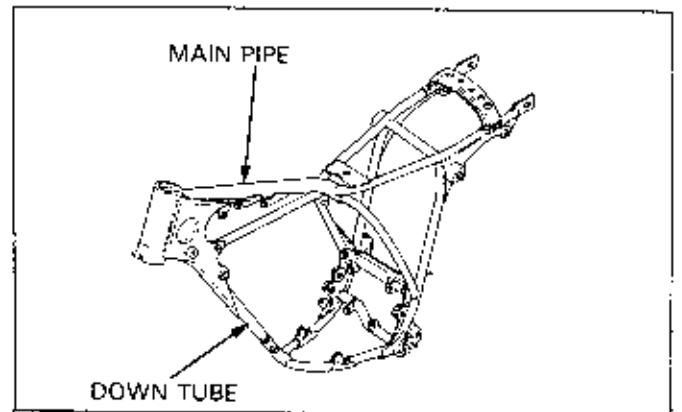
Mounting the engine generates the frame strength.

The diamond frame is used mainly on small and middle-size vehicles due to simplicity of the structure, light weight and excellent serviceability.



### SINGLE CRADLE FRAME

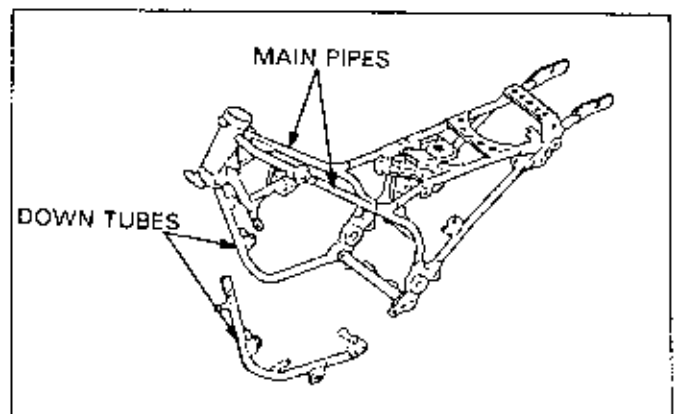
The single cradle frame has one down tube and one main pipe at the front of the engine. The frame structural material surrounds the engine. This frame is mainly applied to off-road vehicles, light weight, and middle-size on-road sport type vehicles due to light weight, greater strength and ease of serviceability.



### DOUBLE CRADLE FRAME

The double cradle design is similar to the above mentioned single cradle frame, but has two down tubes and main tubes, resulting in increased rigidity. A part of the down tube can be removed to facilitate engine removal on some models.

This frame is mainly used on large displacement on-road motorcycles.

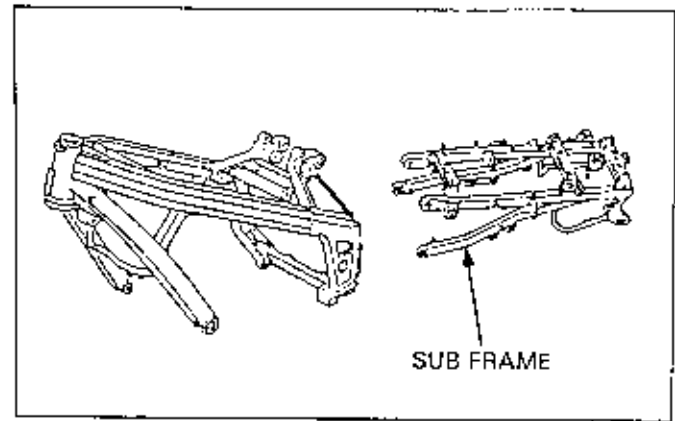




## FRAME/BODY PANELS

### ALUMINUM FRAME

The aluminum frame has a lighter weight than the steel frame. The use of rectangular and square cross-section tubing as a structural material provides a greater strength in the direction of stress. The sub frame can be removed to improve the service access on some models. This frame is mainly used on sport type on-road motorcycles.



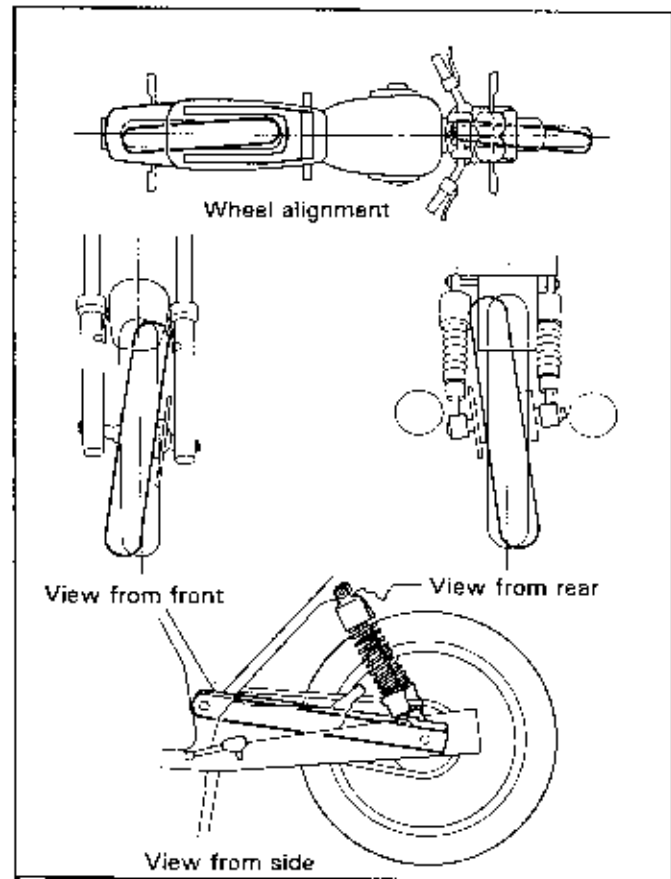
### INSPECTION

Visually check the frame for damage or bent tubes and components.

Straighten the handlebar and check the alignment between the front wheel and rear wheel.

If the rear wheel does not align with the front, check that the drive chain adjusters are adjusted correctly.

If the above rear wheel leans to either side when viewed from above, check whether the right or left arm is twisted or bent from the horizontal viewpoint of the arm section of the swingarm. In the same way, check the alignment of the rear shock absorber mounts (on dual shock models).

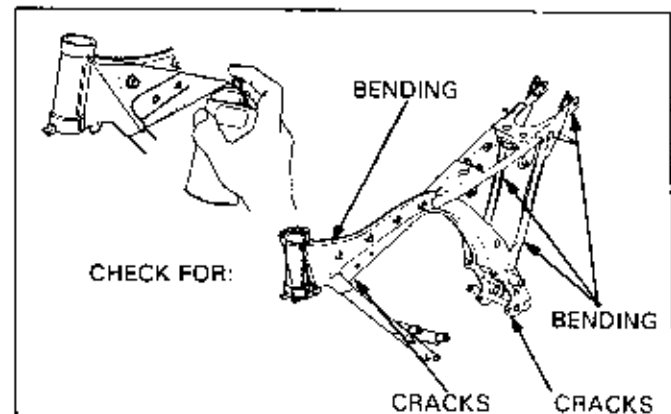


Apply penetrant to inspect the cracks.

#### NOTE

- Refer to the penetrant manufacturer's instruction manual for proper use and inspection procedure.

If cracks appear in the paint on the frame, inspect the area(s) more closely to find out if the frame material itself is cracked.



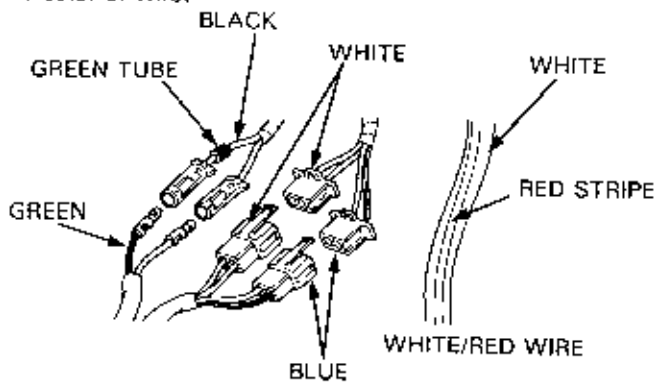
# 21. ELECTRICAL FUNDAMENTALS

SERVICE INFORMATION	21-1	BASIC ELECTRICAL DIAGNOSTIC METHODS	21-14
BASIC ELECTRONIC KNOWLEDGE	21-6		
ELECTRICAL SYMBOLS	21-13		

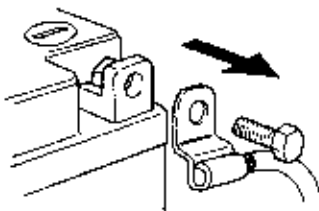
This chapter illustrates the safety precautions and the basic knowledge required for servicing electrical systems. Other chapters related to electrical systems do not contain the basic information presented in this chapter. Read this chapter thoroughly in order to understand the basic safety procedures and diagnostic methods before starting any servicing.

## SERVICE INFORMATION

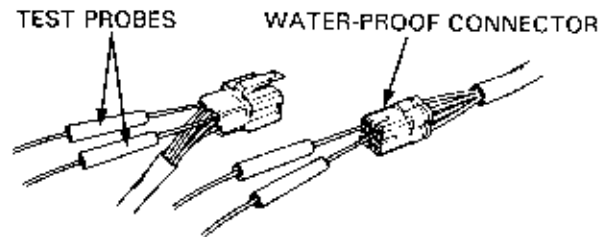
- Connect wires only with wires of the same color. However, in the few instances when wires with different colors are connected, there is always a colored band near the connector.
- Connect connectors with the same colored connectors.
- On wires with stripes, the stripe color is indicated after the color of wire.



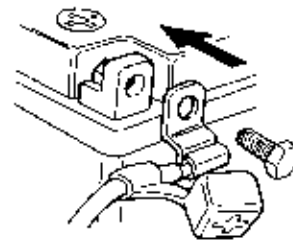
- Disconnect the negative cable of the battery before working on any electrical component.
- Do not let the tool contact the frame when disconnecting the cable.



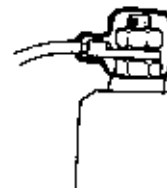
- When measuring voltage and resistance of wire terminals using testers; insert the probes from behind the connector. For water-proof connectors, insert the probes from the front to avoid opening the wire terminal.



- Connect the positive terminal first when connecting the battery.
- Coat terminals with clean grease after connection. Make sure the protective cover is secured on the terminal.



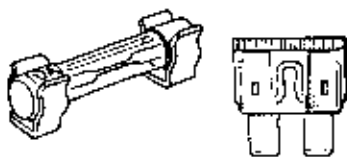
- After completing the job, check that all terminal protectors are placed correctly.



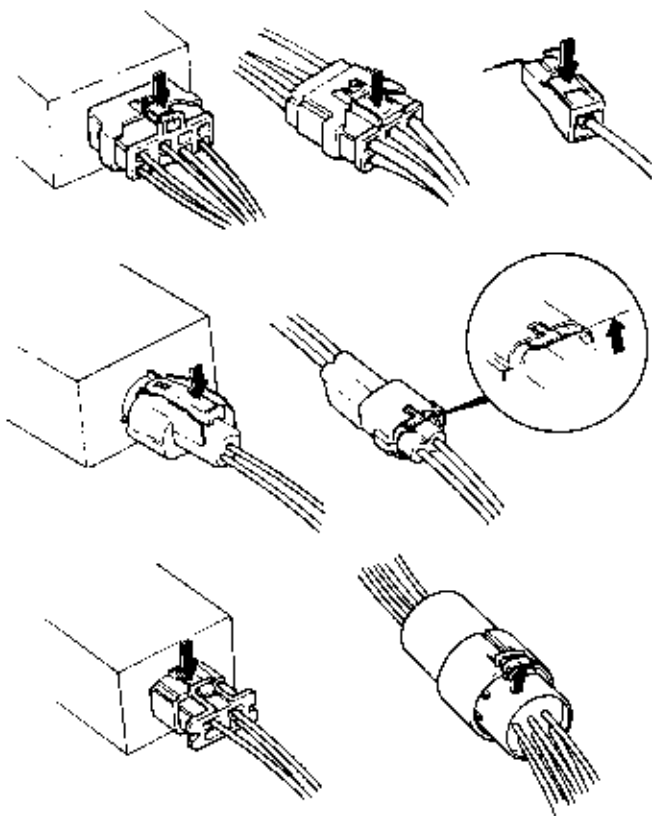
2

## ELECTRICAL FUNDAMENTALS

- If a fuse blows out, diagnose the cause and repair it. Replace the fuse with one of the correct rating.



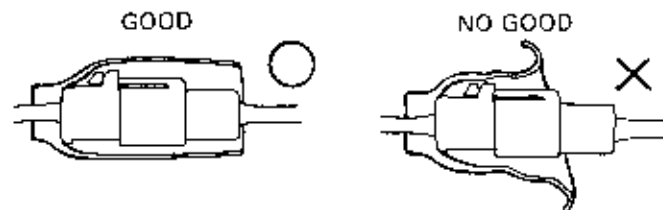
- Always separate the connectors with the ignition switch in the OFF position.
- Before separating the connector, check whether the connector is of the push-in type or pull-up type.
- For connectors with locks, push the connector in lightly then unlock the lock before disconnecting.



- When separating connectors, pull only on the connector housing. Do not pull on the wires.



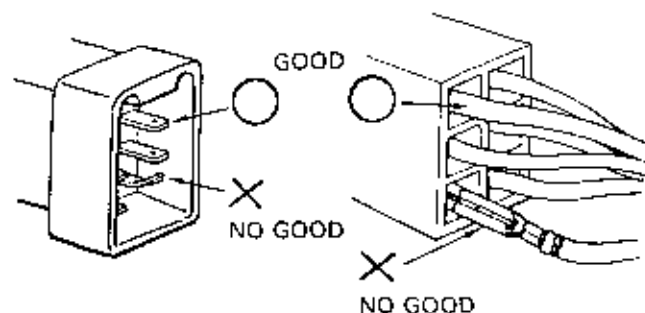
- Make sure protectors completely cover the connectors.



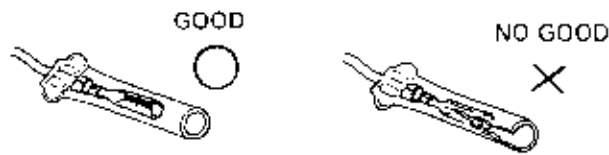
- Insert connectors all the way in.
- For connectors with locks, check that the lock is securely fastened.
- Make sure that the harnesses are secured to the motorcycle properly.



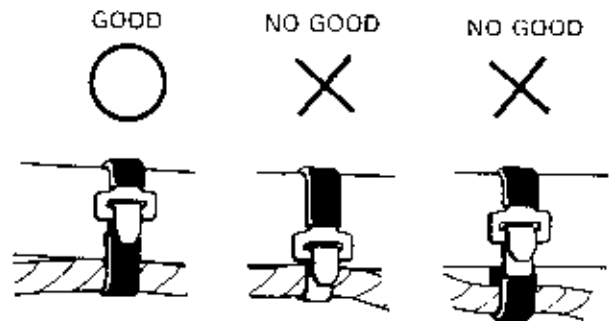
- Before connecting connectors, check that the pins are straight and that all the wire terminals are intact and tight.
- If a terminal is corroded, clean it thoroughly before connecting.



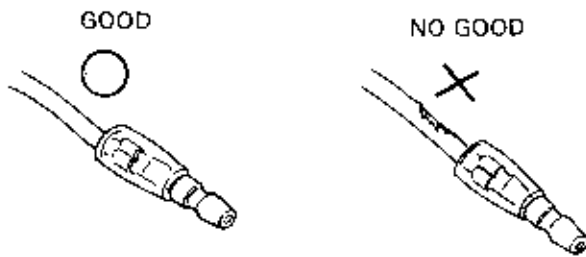
- Check for torn protective covers and oversized, loose fitting, female terminals before installation.



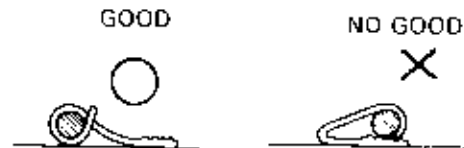
- Secure wires and wire harnesses to the frame with wire bands at the designated locations. Install the bands so that only the insulated surfaces contact the wires or wire harnesses.



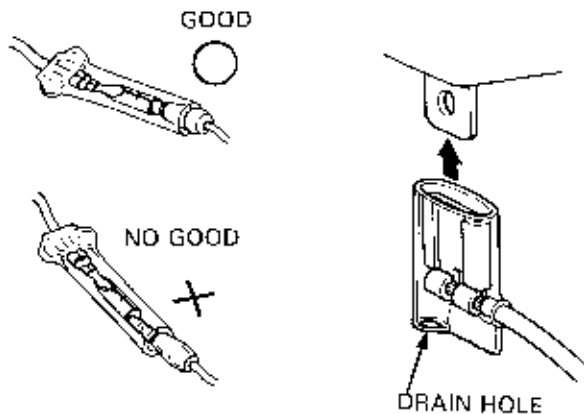
- Replace damaged wires with new ones.



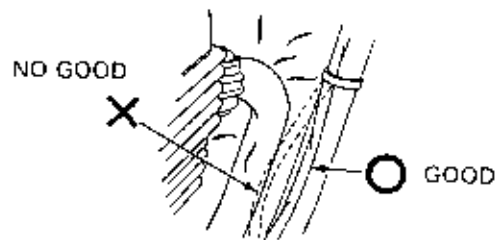
- Do not squeeze a wire against a weld or the end of its clamps.



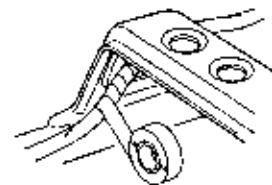
- When installing a connector, push it until it clicks into place.
- Check that connector protectors cover the terminals completely.
- Connectors with protectors facing up must have a drain hole.



- Check that harnesses cannot come in contact with hot parts after clamping.



- Protect wires and harnesses with at least two layers of electrical tape or with electrical harness tubes if they contact a sharp edge or corner.

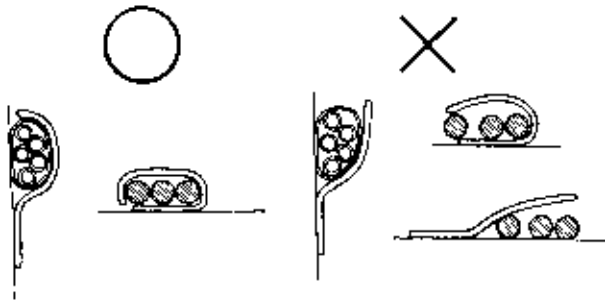


# ELECTRICAL FUNDAMENTALS

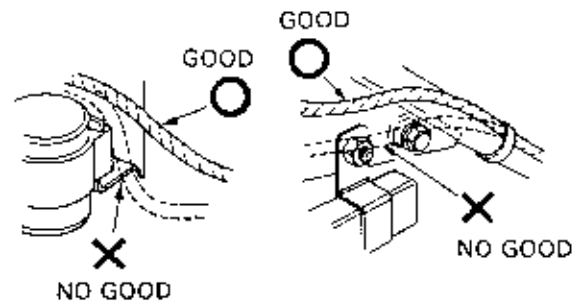
- Check that the wire harness is securely clamped at all locations.

GOOD

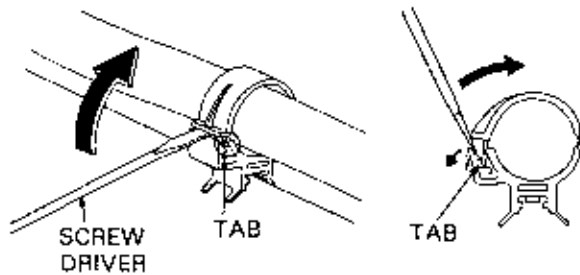
NO GOOD



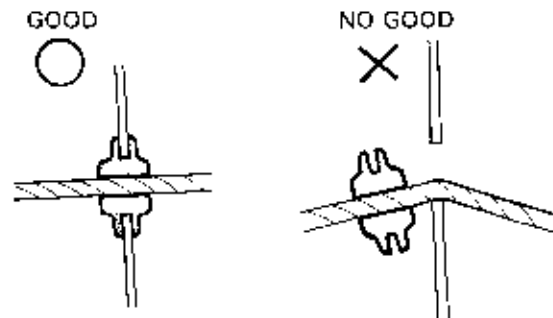
- Route wire harnesses to avoid sharp edges, corners or the projected ends of bolts and screws.



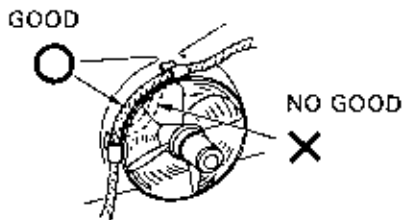
- To unlock wire harness or hose from a clip, use a screwdriver to open up the tab. When locking the clip, press firmly until it clicks. If the clip was removed from the frame, replace it with new one.



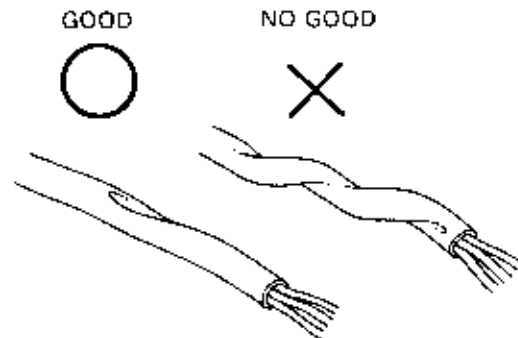
- Seat grommets in their holes properly.



- Check that the wire harness does not interfere with any moving or sliding parts after clamping.



- Do not bend or twist wire harnesses.

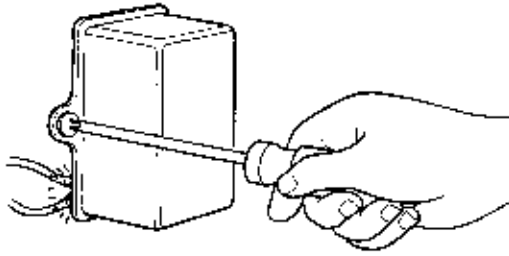


- Before using testers, read the instructions.

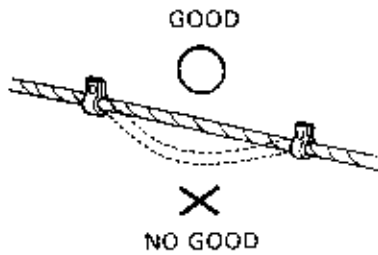
### CAUTION

- Do not drop parts containing semiconductors. Semiconductors are fragile and sensitive to shock. Dropping a semiconductor could damage or destroy it.

- Be careful not to pinch or trap wires or harnesses under items during installation.



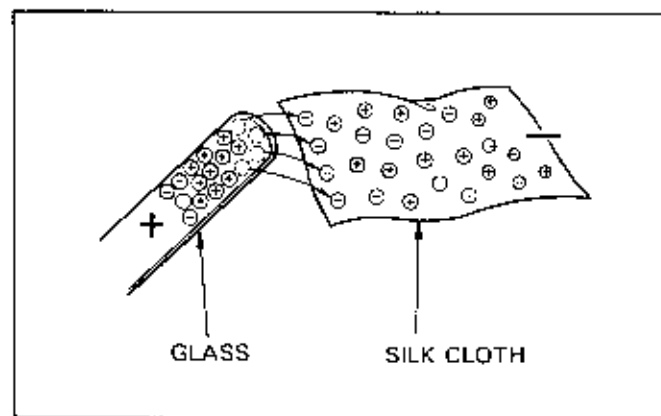
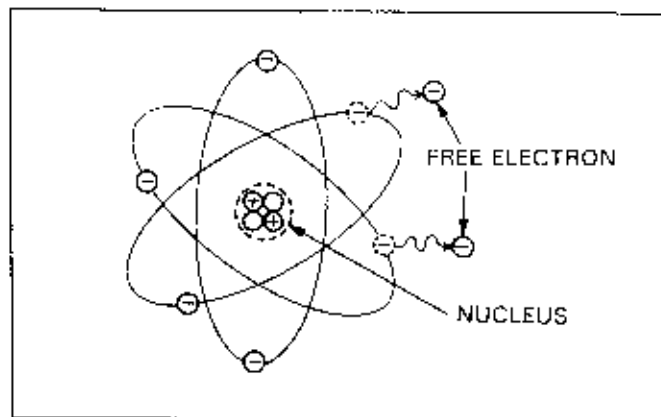
- Route wires and wire harness so that they are not too tight or loose when the handlebar is turned all the way to the right or left.
- Avoid routing wires and harnesses through sharp bends and around tight corners.
- Route harnesses so they are neither pulled taut nor have excessive slack.



## BASIC ELECTRONIC KNOWLEDGE

All matter, whether solid, liquid, or gas, are a collection of molecules, and each molecule is made up of atoms. Each atom consists of a nucleus, which is made up of protons and neutrons, and electrons which circle around the nucleus.

Electricity flows when these electrons freely move outward from their orbits. Some materials become conductors when there are a lot of free electrons and some become insulators when there are no free electrons. It is a well known fact that when a piece of glass is rubbed with silk cloth, it generates "Static Electricity" attracting a piece of paper towards it. This happens because the free electrons in glass move into the silk due to the heat generated by rubbing. As a result, the glass takes on a positive charge and the silk cloth takes on a negative charge.

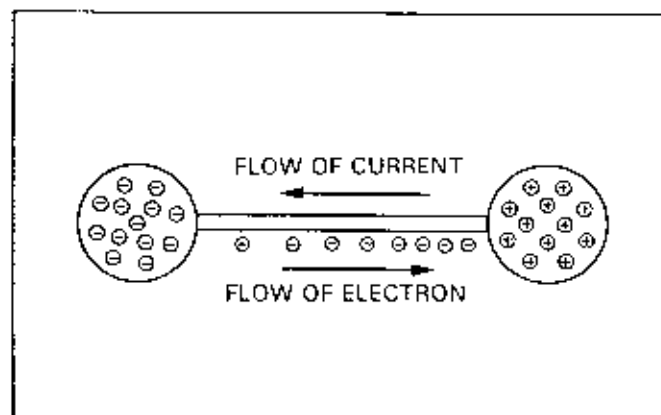


## CURRENT FLOW

When a positive charged material and a negative charged material are connected with a conductor, free electrons flow from negative charged to positive charged material. This flow of electrons is called "electricity". For a long time it was thought that electrical current flowed from the positive side of the source to the negative side. When it was discovered that electrons actually flow the other way it was too late to change existing publications on electricity. As a result, just for convenience, technical publications compromise by saying that electrical current flows from the positive to the negative side while electrons flow from the negative to the positive side.

It is convenient to think of the flow of electrical current as the flow of water.

The number of electrons passing any given point in a circuit in one second determines the current flowing through the circuit. The amount of current flow is measured in "Amperes (A)".



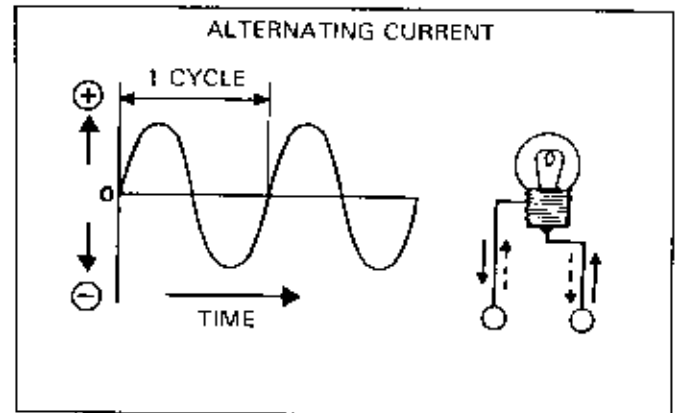
## ALTERNATING CURRENT AND DIRECT CURRENT

All electrical components are supplied with either alternating current or direct current, abbreviated as AC or DC respectively.

The fundamental characteristic of the two currents differ completely, and for the purpose of servicing, you need to have a good understanding of these differences.

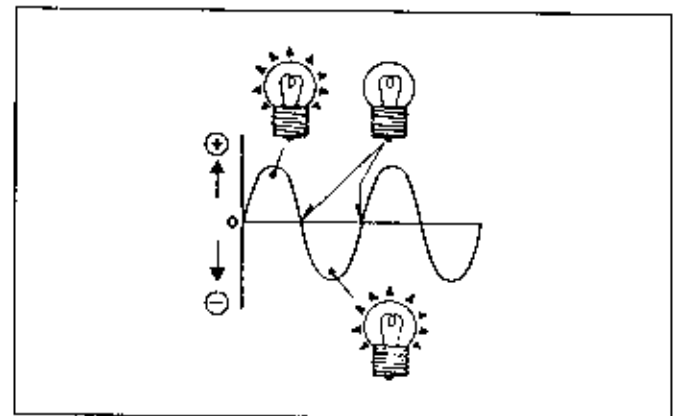
**Alternating-current**

Alternating current (AC) changes in voltage value and polarity with time. AC current flows in one direction until peak voltage is reached and then drops to zero volts. AC current then changes direction or polarity until peak voltage is achieved and again drops to zero and again changes polarity. From peak positive voltage to peak negative voltage and back again to peak positive voltage is known as a cycle.



In motorcycles, all electricity generated is AC. However, AC can be converted to direct current (DC) by rectification. The DC current is then supplied to components operating on DC. For example, some models use DC for their headlights and others use AC.

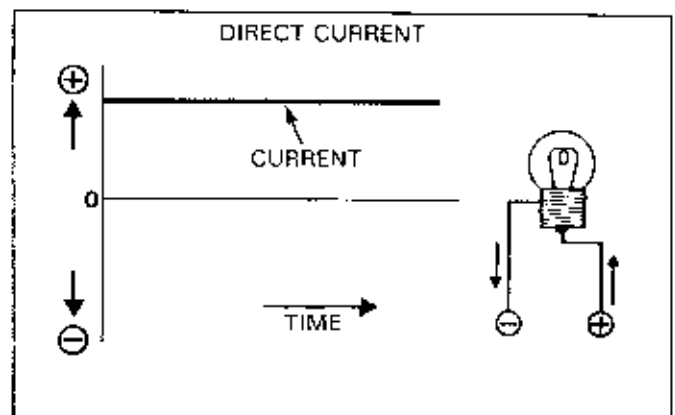
For headlights operating on AC, the lights turn off when the current flow is zero, and then go back on again as the polarity becomes reversed. This ON-OFF cycle is repeated at a high frequency (number of cycles in one second) and is not noticeable.

**Direct current**

Direct current is a current whose magnitude and direction remain constant. Its form is shown in the graph. Direct current is abbreviated as DC. Motorcycle batteries, and household batteries supply DC.

DC has the following characteristics as opposed to AC.

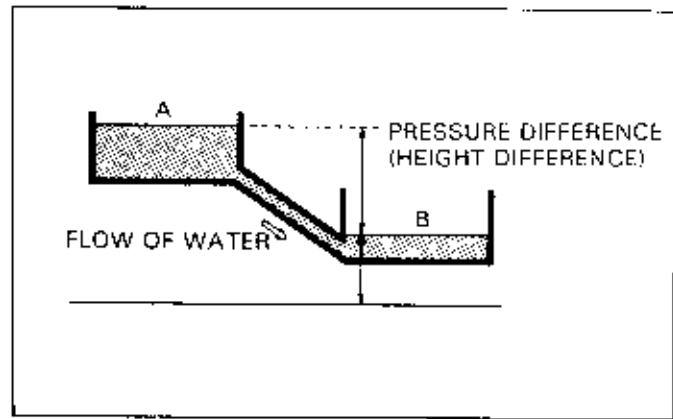
- DC can be stored in batteries and discharged when needed. (AC cannot be stored)
- DC is capable of a large current flow. (Good for starter motors)
- DC voltage cannot be stepped up or down. (AC can change its voltage by using a transformer)



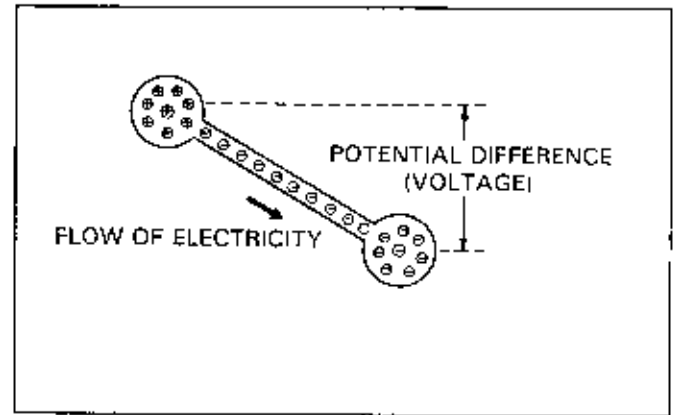


## VOLTAGE

As illustrated in the figure to the right, when two water tanks, A and B, are connected, water flows from tank A to tank B. This flow is the result of a pressure difference between the two tanks.

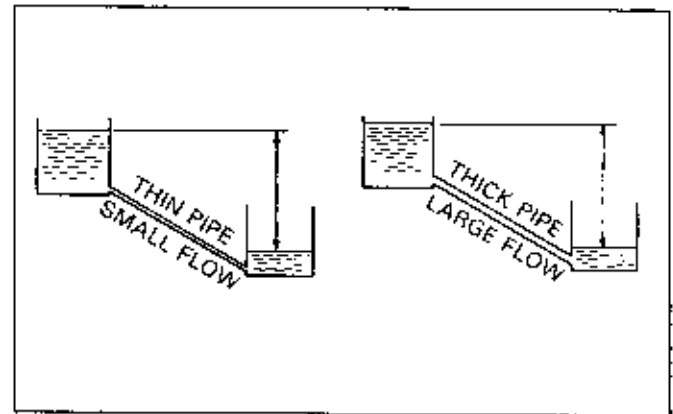


This same concept applies to electricity. The pressure difference, called the electrical potential difference, causes current to flow through a circuit. The pressure of the current is measured as voltage (V).

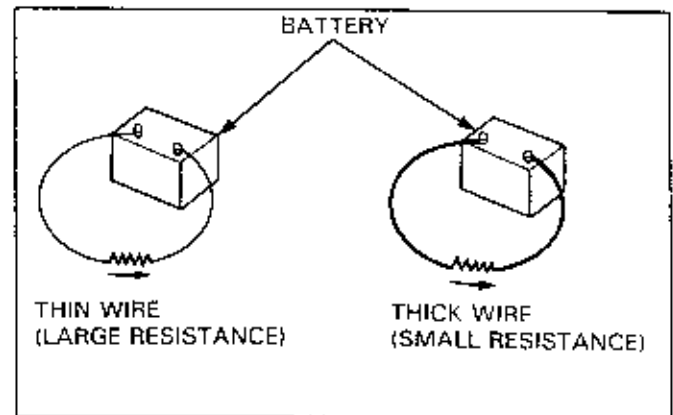


## RESISTANCE

As everyone knows, water flows through a larger pipe easier than a smaller pipe. This is because the smaller pipe provides greater resistance. Similarly, electrical current flows through a thicker wire (conductor) more easily than a thinner wire. The resistance limiting the flow of electricity through a wire is measured in Ohms ( $\Omega$ ).



Resistance increases as the size of wire become smaller and longer. This resistance value can be measured with an ohmmeter.

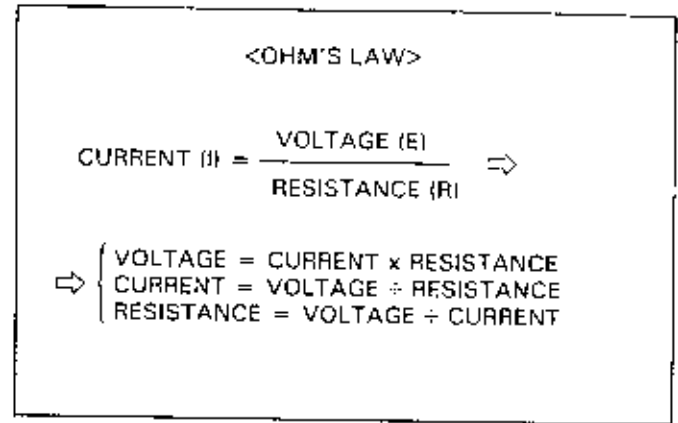


## OHM'S LAW

The amount of current flowing through a conductor in a closed circuit is proportional to the voltage applied to the conductor. The relationship between voltage and current flow and resistance is known as Ohm's law.

For example, if a 6  $\Omega$  resistor is connected to the + and - terminals of a 12 V battery, the current flowing through the resistor can be calculated by Ohm's law:

$$\text{Current} = \text{Voltage} \div \text{Resistance} = 12 \div 6 = 2 \text{ A}$$



## POWER

We use electricity to operate headlights or starter motors, or we convert it to heat.

The amount of work required to do these things is measured in Watts. Changing voltage (Volts) or the rate of current flow (Amperes) increases or decreases electrical power output (Watts).

The relationship is defined as:

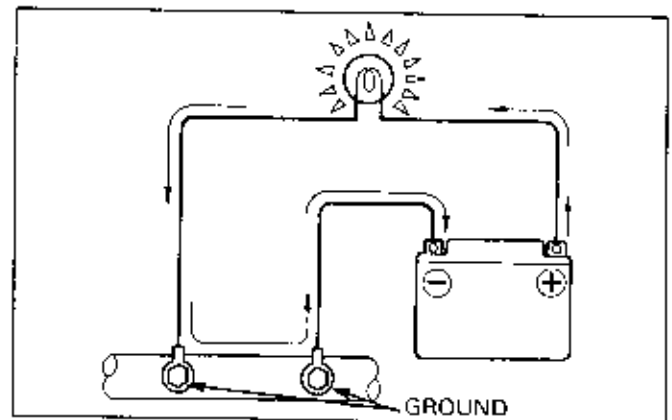
$$W = E \cdot I \text{ (Power} = \text{Voltage} \times \text{Current)}$$

## ELECTRICAL CIRCUIT

As shown in the right diagram, when a light bulb is connected to a battery, the current flows in the direction of the arrow and the light bulb turns on.

The path in which an electric current flows, is called a circuit. On Honda motorcycles, scooters and ATVs, the ground wire of an electrical circuit is connected to the engine or frame. Grounding the negative terminal is called a negative terminal ground type.

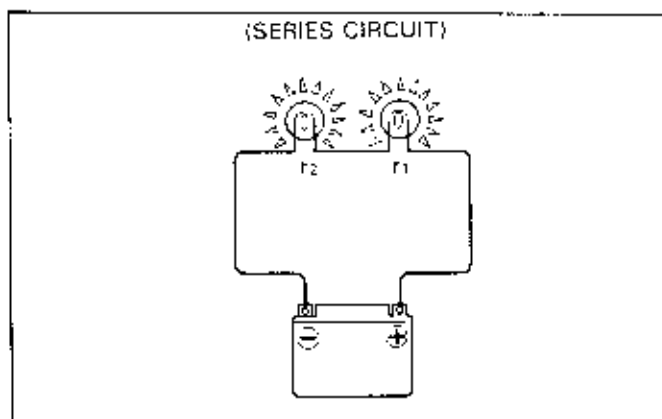
All Honda motorcycles, scooters and ATV share the negative ground circuit shown in the right diagram.



## ELECTRICAL FUNDAMENTALS

### Series circuit

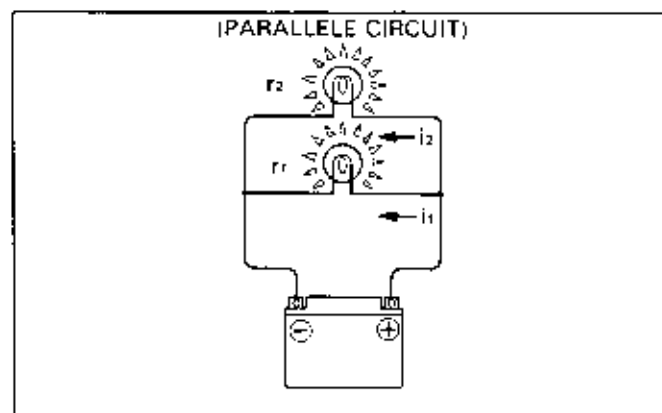
A series circuit is an electric circuit in which the current flows through one device into another, and then to ground. There is only one current path and the voltage is distributed by the loads. The total resistance ( $R$ ) can be found by simply adding all the resistances. eg.  $R = R1 + R2$



### Parallel circuit

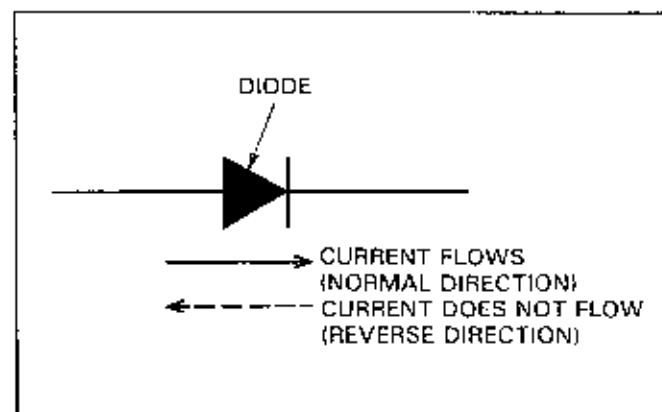
A parallel circuit is an electric circuit which has two current paths, one for the positive and one for negative. The devices are connected across the two paths. The voltage on each load is the same, but the current branches out to each load. the current flow to each load can be calculated as  $i1 = E \div r1$ ,  $i2 = E \div r2$ .

The total current ( $I$ ) is the sum of all current flowing to each load.



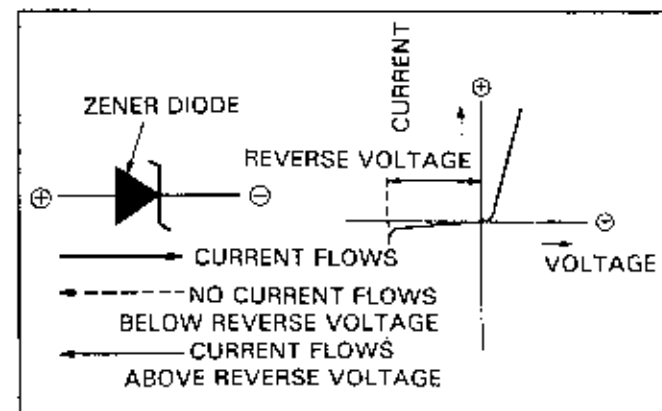
## DIODE

The diode allows current to flow in only one direction. When current is flowing, there is a slight voltage drop across the diode.



## ZENER DIODE

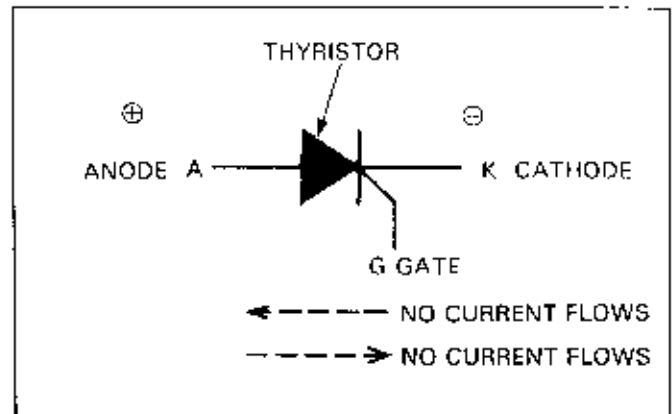
The zener diode allows current to flow in one direction similar to the diode above. When a certain reverse voltage is applied, current abruptly flows in the reverse direction. When the voltage is reduced below the reverse voltage, current flow in the reverse direction stops.



## THYRISTOR (SCR)

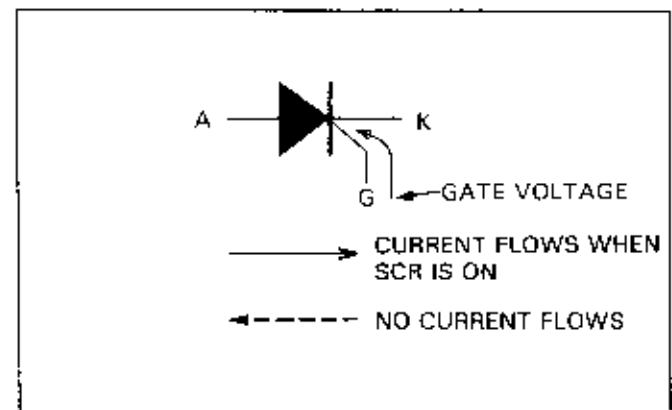
Thyristors have three terminals: anode, cathode, and gate. The current flowing from the anode to cathode is said to be in the positive direction.

Like diodes, thyristors do not flow current in the negative direction. Thyristors allow current to flow from anode to cathode only when the thyristor is turned on.



The thyristor is turned on when a certain amount of voltage is applied to the gate. This input to the gate is called gate voltage or trigger voltage.

Once the thyristor is turned on, there is no need to continuously apply voltage to the gate, and its characteristic becomes identical to a regular diode.



## SEMICONDUCTOR

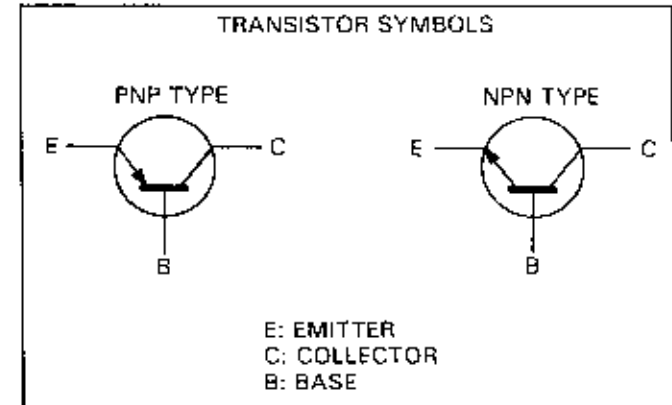
The electrical conductivity of semiconductors lies between that of conductors and insulators.

Before understanding how they work in circuits, you need to have a basic knowledge of its characteristics.

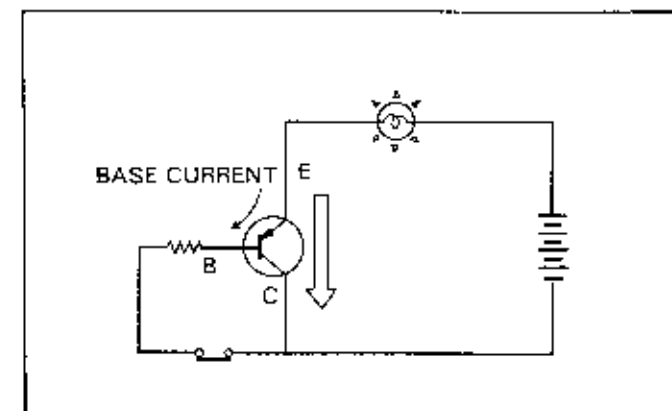
### Transistor

A transistor has three terminals; emitter (E), collector (C), and base (B).

There are two types of transistors: PNP and NPN type.



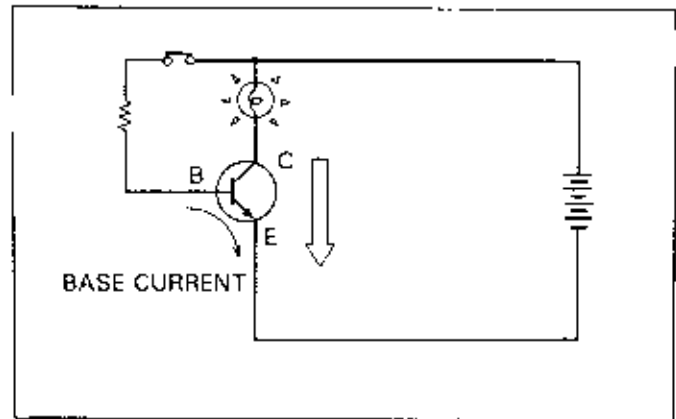
In PNP type transistors, when a positive voltage is applied to the emitter and negative voltage to the collector, almost no current flows from the collector to the emitter. If the emitter voltage is raised slightly higher than the base voltage and a small amount of current flows from the emitter to the base, a large amount of current flows from the emitter to the collector.



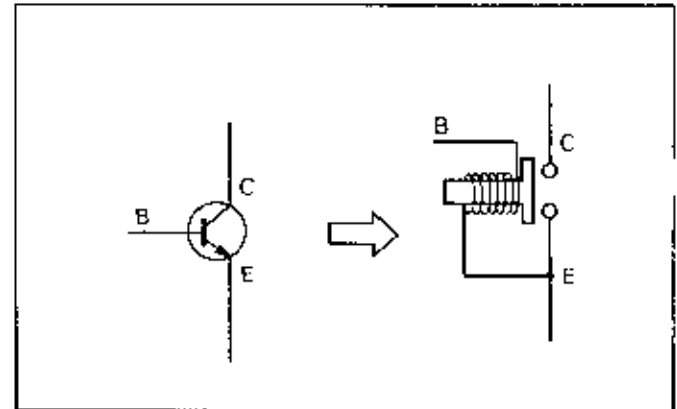
## ELECTRICAL FUNDAMENTALS

In the NPN type, almost no current flows when a positive voltage is applied to the collector and a negative voltage to the emitter. When a small current flows from the base to the emitter, a large current flows from the collector to the emitter.

In this way, the transistor resembles an amplifier in that the amount of collector to emitter current is controlled by the base current.



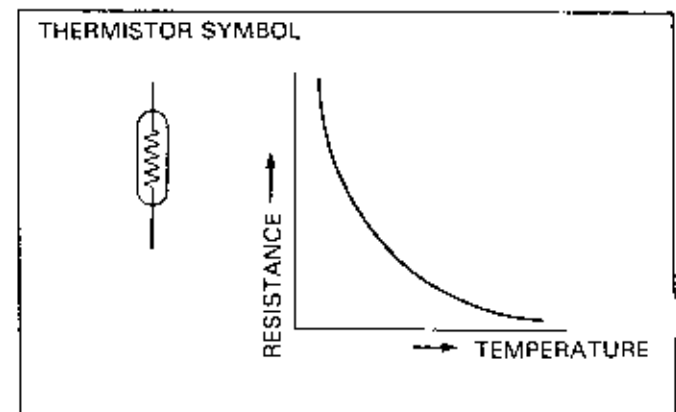
Transistors also resemble switching devices. The transistor is turned on, allowing collector to emitter current to flow when there is base current, and turn off when no base current exists.



### Thermistor

In general, the resistance value of most metals, including copper, increases as the temperature rises. In contrast, the resistance of a thermistor decreases as the temperature rises. When heat is applied to a substance, the activity of its molecules increases and prohibits the flow of free electrons. This increases the resistance.

For the thermistor, the number of free electrons increases as heat is applied. In this case, the activity of the molecules no longer obstructs the flow of electrons and the resistance decreases.



# ELECTRICAL SYMBOLS

The symbols below are the most common type of symbols used in electrical circuits.

Abbreviations used in switching devices are as follows:  
 NO (Normally Open): Switch is open at rest  
 NC (Normally Closed): Switch is closed at rest.

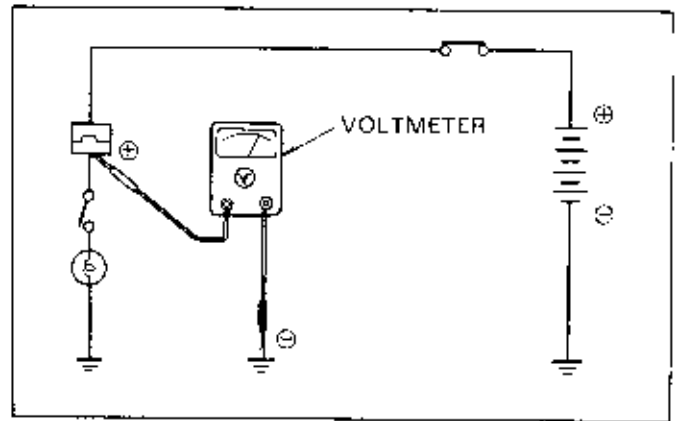
BATTERY	CONNECTION		MULTI-TESTER			MOTOR		
	Connected	No connection	Voltmeter	Ohmmeter	Ammeter			
<b>PUMP</b> 	<b>CONNECTOR</b> P = # of pin COLOR 		<b>CONNECTOR (Round type)</b> 	<b>CONNECTOR (Flat type)</b> 		<b>EYELET TERMINAL</b> 		
<b>IGNITION SWITCH (Circuit symbol)</b> 	<b>IGNITION SWITCH (Wiring symbol)</b> 		<b>SWITCH (Two terminal)</b> 		<b>SWITCH (Three terminal type)</b> 			
<b>FUSE</b> 	<b>RELAY (NO type)</b> 		<b>RELAY (NC type)</b> 		<b>LIGHT BULB</b> 			
<b>THREE PHASE ALTERNATOR</b> 	<b>SINGLE PHASE ALTERNATOR</b> 		<b>PULSE GENERATOR</b> 		<b>IGNITION COIL (Single type)</b> 			
<b>SPARK PLUG</b> 	<b>RESISTOR</b> 		<b>VARIABLE RESISTOR</b> 		<b>COIL</b> 	<b>SOLENOID</b> 	<b>LED</b> 	<b>CAPACITOR</b> 

# BASIC ELECTRICAL DIAGNOSTIC METHODS

## VOLTAGE MEASUREMENT

Measuring voltage is a fundamental method of checking circuit components. The measurement is conducted for the following reasons.

- ① To check if voltage exists. A test light could be used.
- ② To measure the actual voltage value. A voltmeter is used to determine if electrical component is operating normally.

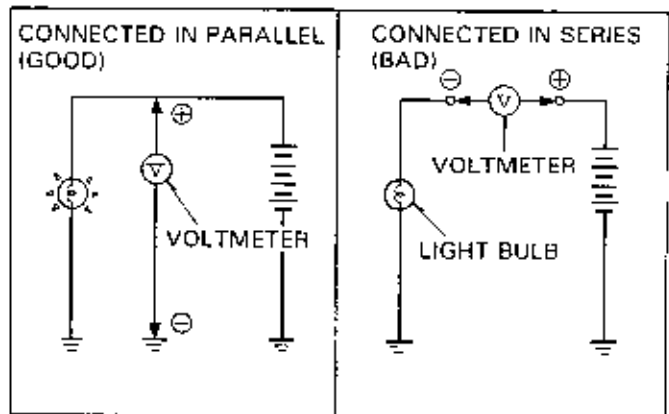


## HOW TO MEASURE VOLTAGE USING VOLTMETER

### NOTE

- Make sure the ground surface is clean and free of paint. Use a bolt attached directly to the frame.

Select a range that is one scale higher than the desired voltage value. Apply the red probe to the positive end and the black probe to the negative end of circuit. The diagram on the right shows that the voltmeter registers the voltage across the light bulb. Voltmeters are always connected in parallel, not in series.

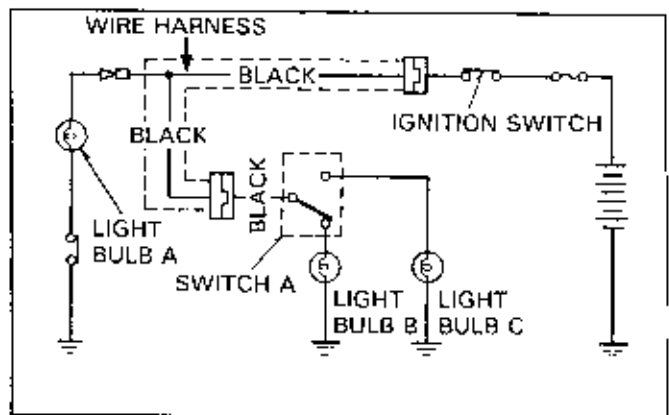


### Example 1

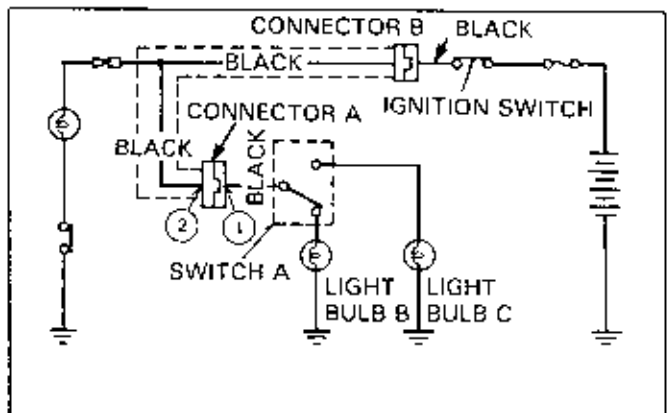
First study the circuit diagram.

If light bulbs B and C do not work, and A is OK, the malfunction is between the grounds at B and C and switch A.

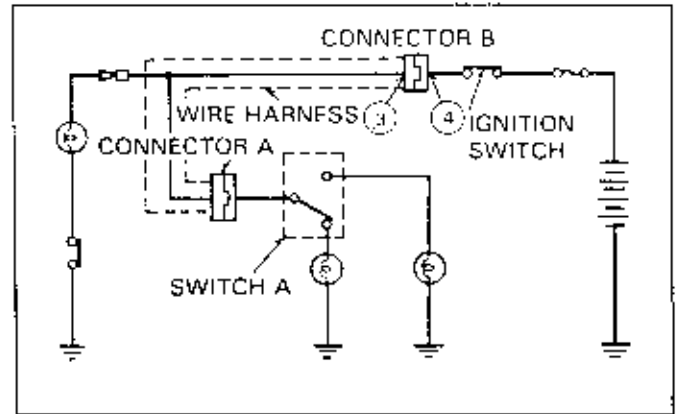
If light bulb A does not work also, the problem is between the grounds at A, B, and C and the ignition switch.



1. With the ignition switch ON and both light bulbs B and C do not work, check voltage at ①.
  2. If no voltage is measured at ①, check voltage at ② in case of false connection at connector A. If voltage exists at ② and not at ①, there is problem in the connection at connector A.
- If voltage registers at both ① and ②, switch A should be checked.



3. If voltage at ① and ② do not exist, check voltage at ③ and ④ in a similar manner.
- If there is no voltage at ③ and ④, check wiring between ignition switch and battery.
  - If there is voltage at ③ and ④, check for a broken wire or a short circuit in the wire harness. Exchange the wire harness with a new one if necessary.
  - If there is voltage at ④ and not at ③, then check for loose connector B.

**Example 2**

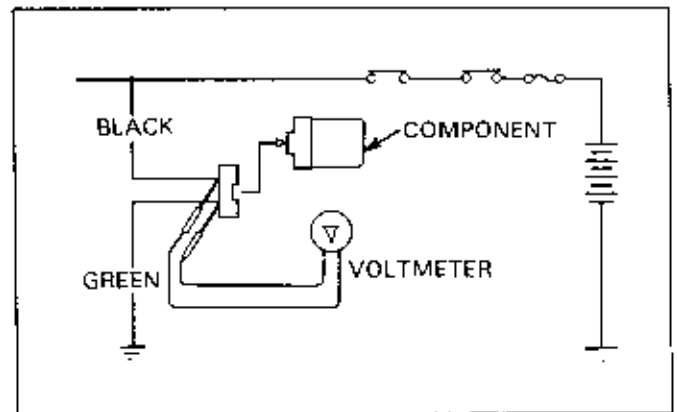
Sometimes it is easier to diagnose a component by measuring from its input terminals directly.

Here, the (+) probe goes to the positive input terminal and (-) probe goes to the ground wire of the component.

If no voltage is measured, there are two possible causes.

- ① No voltage at the positive input terminal.
- ② A loose ground wire.

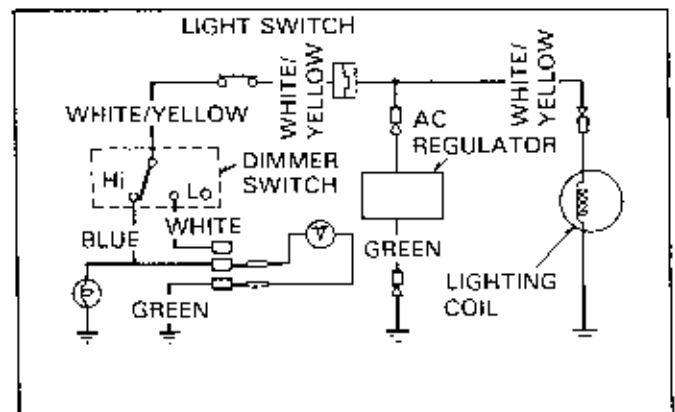
For ①, check for voltage between the input terminal leading to the battery and ground. For ②, check for continuity between the green wire terminal to ground.

**Example 3**

Voltage measurement is frequently used to check if a system is working correctly.

For instance, if a light bulb blows out frequently, it needs to be checked with an AC voltmeter to see if an excessive voltage is apparent.

In this case, measure the AC voltage of the light bulb terminals to see if it is within the specified voltage range.



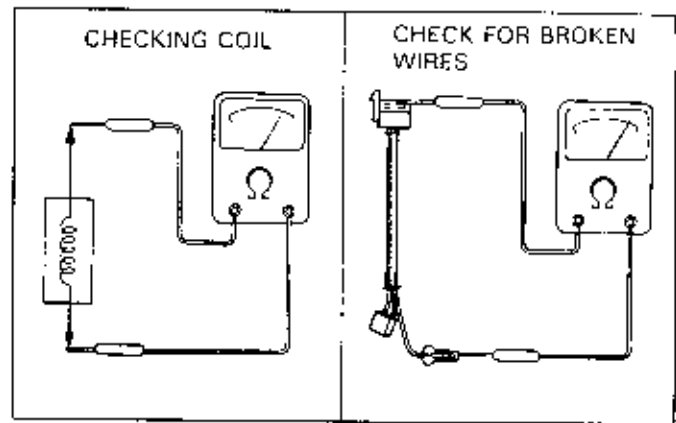


MEASURING RESISTANCE

Along with voltage, resistance is another basic parameter for diagnosing circuits and their components.

Resistance is measured for the following reasons.

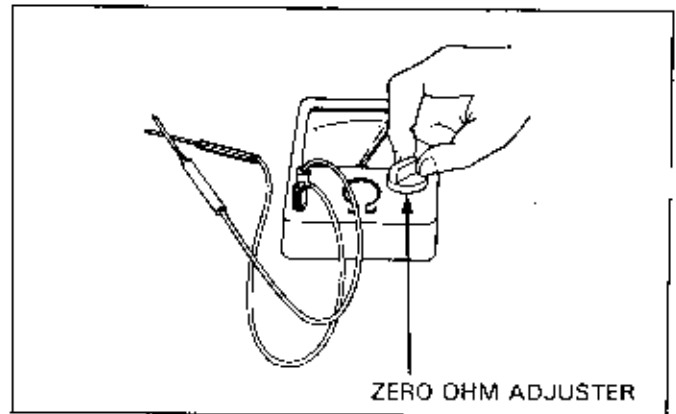
- ① To check if components are working properly.  
The resistance value of a coil (eg. ignition coil) indicates if it is normal or malfunctioning.
- ② To check for a broken wire.  
A continuity check indicates if a wire is intact or broken.



How to measure resistance using an ohmmeter.

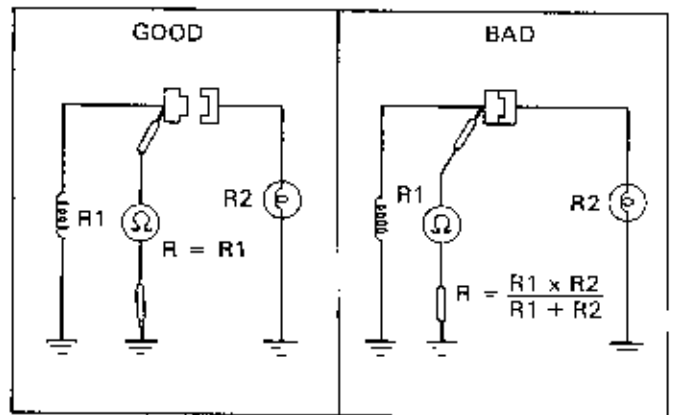
NOTE

- Proper zeroing of the ohmmeter is necessary to obtain correct measurements. Touch the two probes and adjust the ohmmeter so that it registers 0 (ohms symbol).

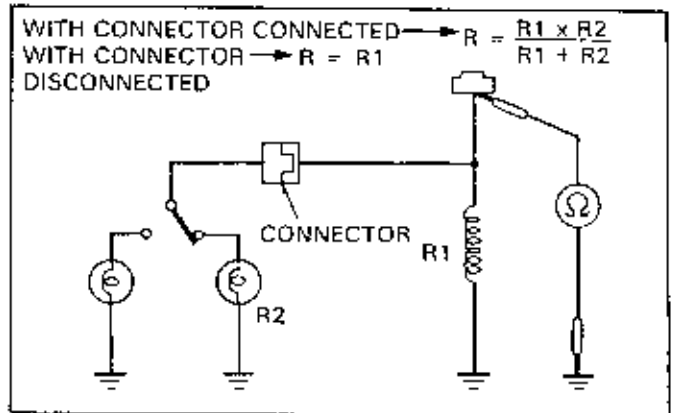


Since the polarity of terminals is not important, either probe may be applied to the terminal. However, since diodes allow current to flow in one direction only, the polarity is important.

Unlike when measuring voltage, it is necessary to disconnect the component from the circuit. If resistance is measured with the entire circuit connected, the ohmmeter will read a smaller value than the correct value.

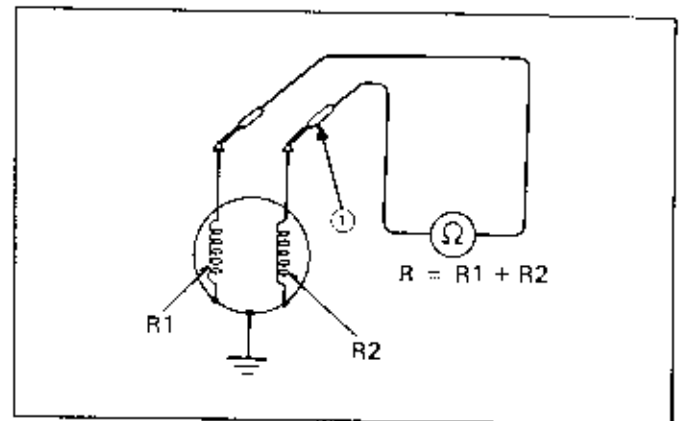


Similarly, if a circuit has branches, the connector leading to the specific branch needs to be disconnected in order to read correctly.



When the ohmmeter is connected in series, resistance values are large.

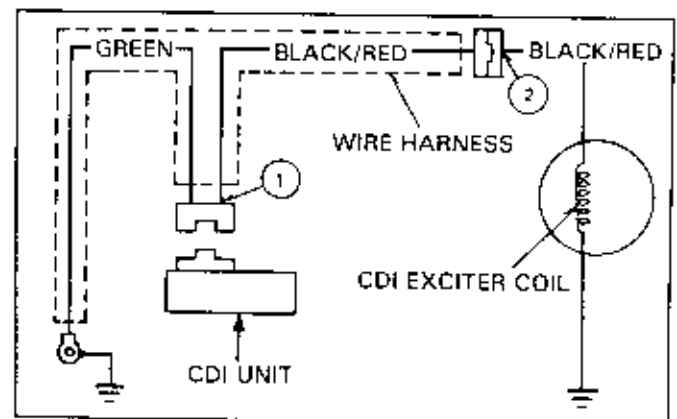
In the diagram, measure resistance  $R_1$  by moving the probe shown at ①, to a ground.



#### Example

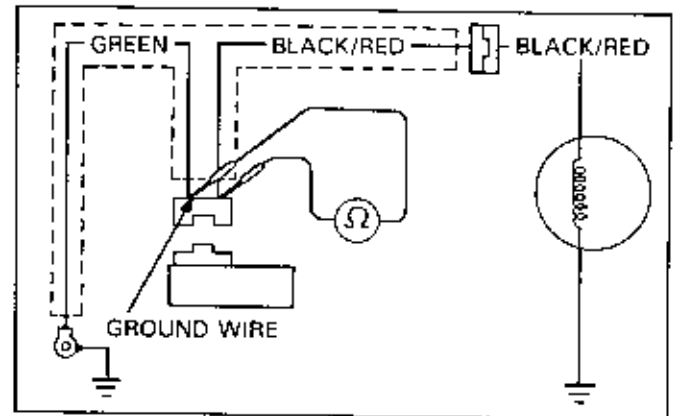
To check the CDI exciter coil, resistance can be measured at ① and ②. Measuring resistance at ①, automatically checks for a broken wire (black/red) and for a bad connection at the alternator connector. If the resistance is normal at ①, ② need not be checked.

If ② was checked first and correct resistance was measured, there is still a possibility of a broken wire and loose connection. That would require more investigation to locate the fault.



If, while measuring resistance at ①, the negative probe is placed on the ground wire (green), then the connection to ground is checked as well.

To check the operation of an exciter coil, place the probes as shown in the diagram. If the resistance is normal, then the exciter coil, the wire connected to the coil (black/red), and the ground wire (green) are all normal.



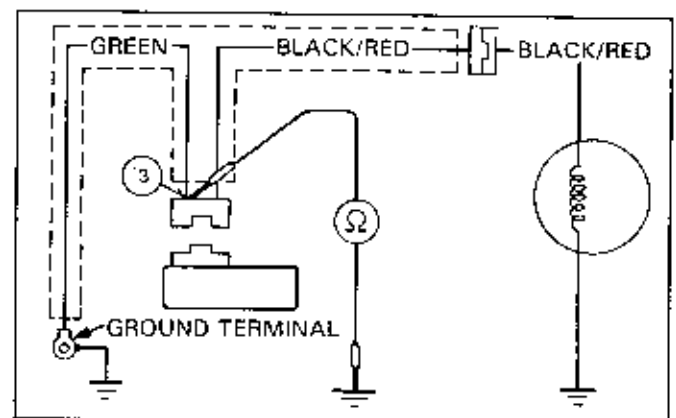
If the resistance is far off the standard value, check the following:

#### 1. Broken ground wire (green)

Place a probe at ③ and measure resistance.

If  $0\Omega$  is measured, then the green wire is properly grounded.

If  $\infty$  (infinity) is measured, then a broken wire (green) or loose connection at the ground terminal is suspect.

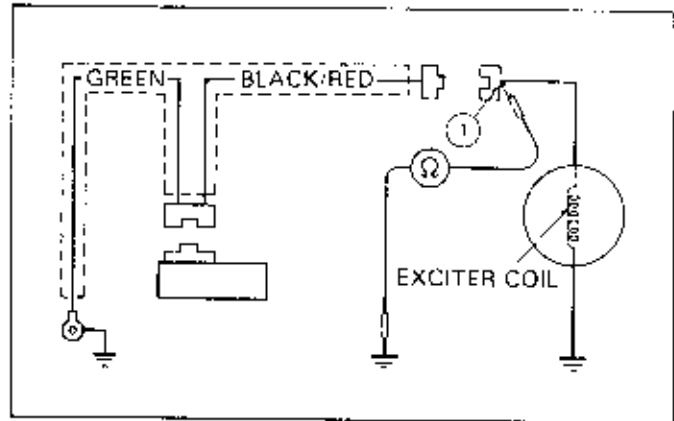


## ELECTRICAL FUNDAMENTALS

### 2. Faulty exciter coil

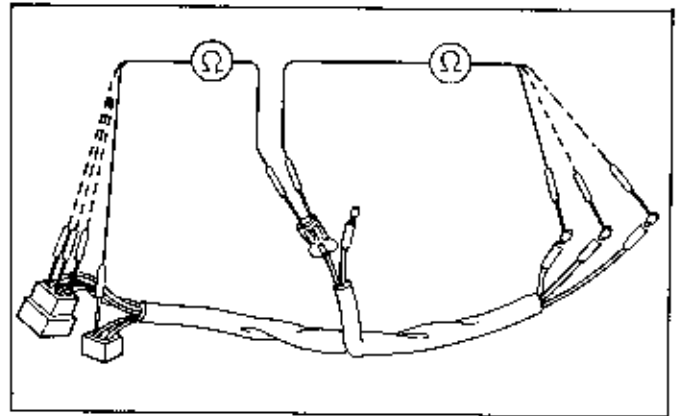
Disconnect the alternator connector, compare the resistance value at ② (measured on the previous page) and at ①.

- If the two values are not the same, a broken black/red wire or loose alternator connector is suspect.
- If both resistance values are the same, but not in the correct range, the exciter coil may be faulty.



### 3. Shorted wire or wire harness.

To see if the green or black/red wire is shorted, check the continuity between different colored wires. If you have continuity between other wires, replace the wire harness.



## MEASURING CURRENT

Current is not normally checked during motorcycle service procedures. Though it is used for testing components, current measurements are not used for checking continuity within circuits.

### How to measure current using ammeter

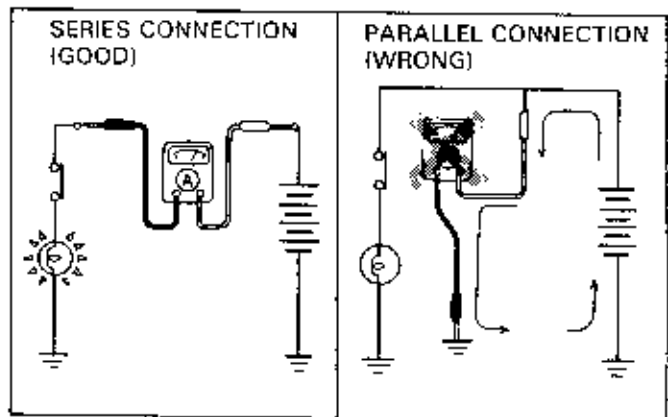
Ammeter is connected in series in the circuit and measures the current flowing through it.

Place the ⊕ (⊕ in circle symbol) red probe to the positive end of circuit and ⊖ (⊖ in circle symbol) black probe to the negative end.

Make sure the current flow does not exceed the maximum range selected.

### CAUTION

- Placing the ammeter in parallel, like a voltmeter, can damage the ammeter from a current overflow.
- Connecting the ammeter between the battery terminals will damage the ammeter.
- Turning on the starter motor while the ammeter is connected between the battery terminal and battery cable will damage the ammeter.



# 22. BATTERY/CHARGING/LIGHTING SYSTEM

SERVICE INFORMATION	22-1	CHARGING SYSTEM DESCRIPTIONS	22-12
TROUBLESHOOTING	22-2	CHARGING SYSTEM INSPECTION	22-19
BATTERY DESCRIPTIONS	22-4	REGULATOR/RECTIFIER INSPECTION	22-21
BATTERY REMOVAL/INSTALLATION	22-8	HEADLIGHT VOLTAGE INSPECTION	22-23
BATTERY TESTING/CHARGING	22-9	ALTERNATOR	22-26

## SERVICE INFORMATION

### ▲ WARNING

- The battery gives off explosive gases; keep sparks, flames, and cigarettes away. Provide adequate ventilation when charging or using the batteries in an enclosed space.
- The battery contains sulfuric acid (electrolyte). Contact with skin or eyes may cause severe burns. Wear protective clothing and a face shield.
  - If electrolyte gets on your skin, flush with water.
  - If electrolyte gets in your eyes, flush with water for at least 15 minutes and call a physician immediately.
- Electrolyte is poisonous. If swallowed, drink large quantities of water or milk and follow with milk of magnesia or vegetable oil and call a physician.
- KEEP OUT OF REACH OF CHILDREN.

Always turn off the ignition switch before disconnecting any electrical component.

### CAUTION

- Some electrical components may be damaged if terminals or connectors are connected or disconnected while the ignition is ON and current is present.

For extended storage, remove the battery, give it a full charge, and store it in a cool, dry place.

For a battery remaining in a stored motorcycle, disconnect the negative battery cable from the battery terminal.

### Conventional Battery:

- Use only distilled water in the battery.

### CAUTION

- Tap water will shorten the service life of the battery.

Immediately wash off any spilled electrolyte.

### CAUTION

- Avoid filling the battery above the UPPER LEVEL line to prevent an electrolyte overflow which could corrode the engine or nearby parts.

### Maintenance Free Battery:

### NOTE

- The maintenance free battery must be replaced when it reaches the end of its service life.

### CAUTION

- The battery caps should not be removed. Attempting to remove the sealing caps from the cells may damage the battery.

- Refer to section 21 for basic electrical service and safety steps.
- Refer to section 2 for battery fluid and specific gravity.
- This section explains the basic steps for diagnosis and service. Refer to the Model Specific manual for the location of specific components.

## BATTERIES/CHARGING/LIGHTING SYSTEM

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- Batteries can be damaged if overcharged or undercharged, or if left to discharge for long periods. These same conditions contribute to shortening the "life span" of the battery. Even under normal use, the performance of batteries deteriorates after 2–3 years.
- Battery voltage may recover after battery charging, but under heavy load, battery voltage will drop quickly and eventually die out. For this reason, the charging system is often suspected to be the problem. Battery overcharge often results from problems in the battery itself, which may appear to be an overcharge symptom. If one of the battery cells is shorted and battery voltage does not increase, the regulator supplies excess voltage to the battery. Under these conditions, the electrolyte level goes down quickly.
- Before troubleshooting the charging system, check for proper use and maintenance of the battery. Check if the battery is frequently under heavy load, such as having the headlight and taillight ON for long periods of time.
- The battery will self-discharge if allowed to stand idle for a long time. For this reason, charge the battery every two weeks to prevent sulfation from forming when the vehicle is not in use.
- Filling a new battery with electrolyte will produce some voltage, but in order to achieve its maximum performance, always charge the battery. Also, the battery life is lengthened when it is charged.
- When checking the charging system, always follow the steps in the troubleshooting flow chart.

## TROUBLESHOOTING

### BATTERY OVERCHARGING

On combined, lighting/charging coil systems, check the following areas. (A check is unnecessary for an independent lighting and charging system.)

- Headlight bulb rating (Wattage too low)
- Broken output wire
- Faulty headlight resistor (Open headlight circuit)
- Faulty lighting switch connection
- Broken regulator/rectifier ground wire or faulty connection

On a single phase, half-wave rectifier, check the following areas.

- Broken regulator/rectifier ground wire or faulty connection

On regulator/rectifiers with a battery voltage feedback circuit, check the following areas. (A check is unnecessary for a voltage feedback type.)

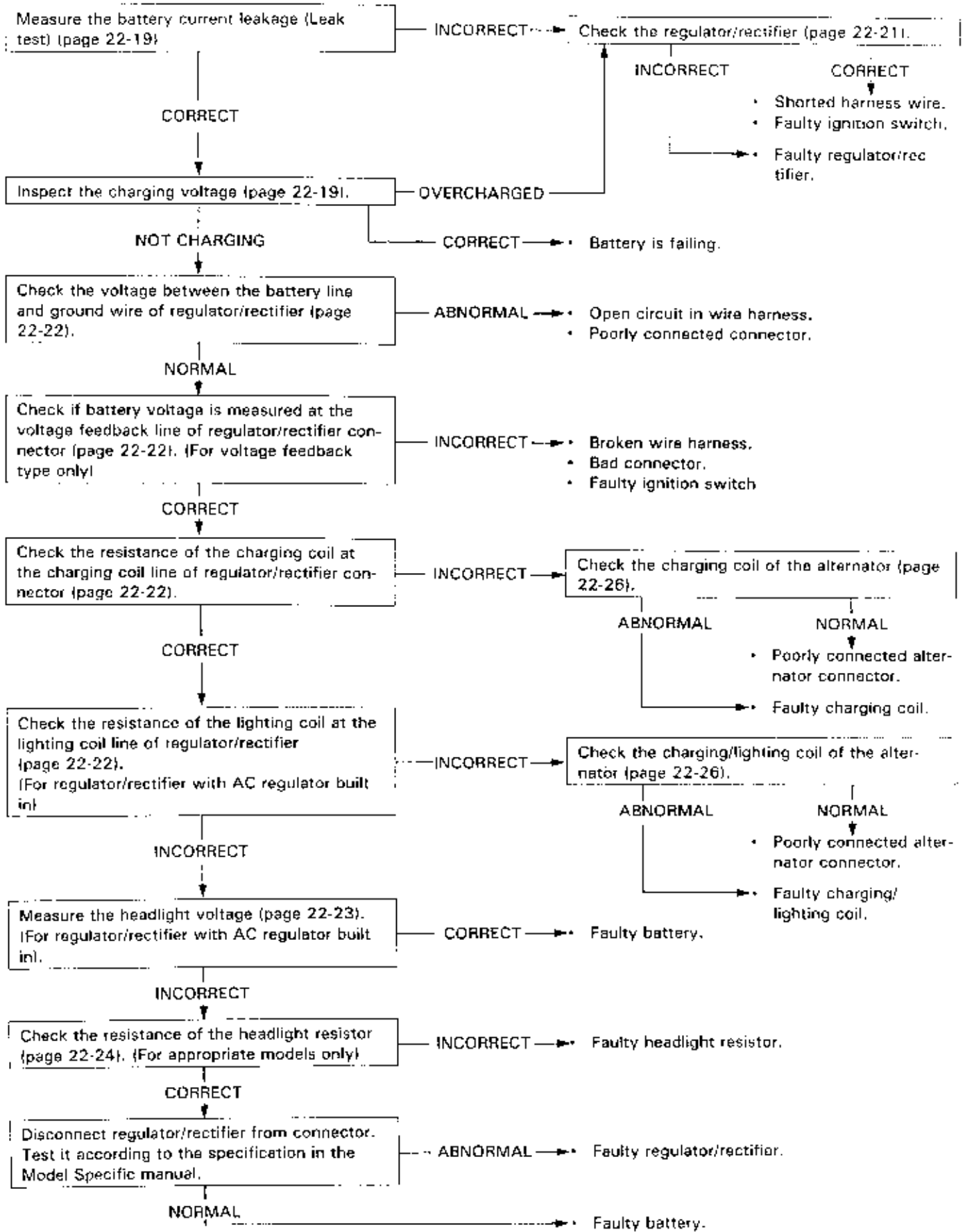
- Check if battery voltage is measured at voltage feedback line (black wire). If not, the problem may be a broken voltage feedback line.
- Check the voltage feedback line for a loose connection at the regulator/rectifier connector

On alternator with field coil, check the following areas.

- Continuity between field coil wire and ground.

If there are no problems in the above areas, replace the regulator/rectifier with a new one.

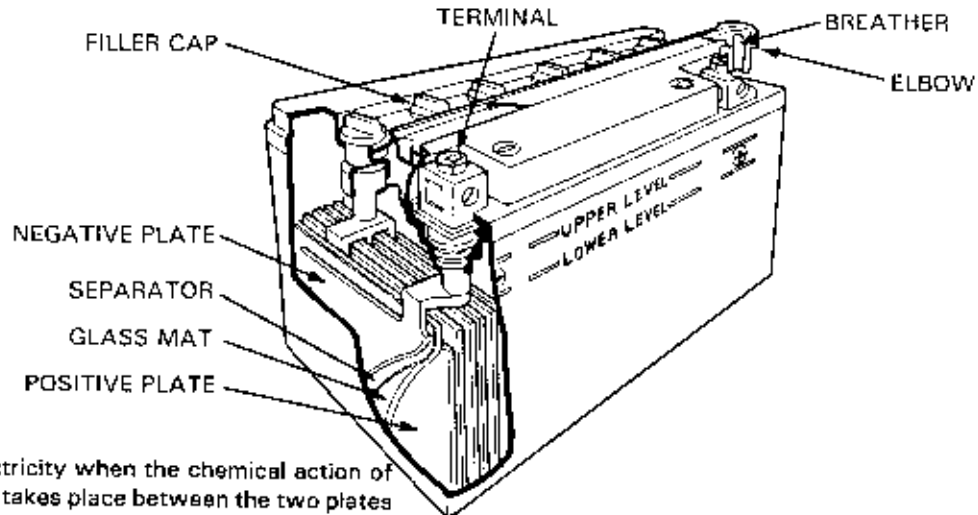
CHARGING SYSTEM



## BATTERY DESCRIPTIONS

There are two types of batteries used in Honda motorcycles, scooters and ATVs: the conventional battery and the Maintenance free battery.

### THE STRUCTURE OF A CONVENTIONAL BATTERY



#### Conventional Battery:

This battery conducts electricity when the chemical action of electrolyte (sulphuric acid) takes place between the two plates (lead peroxide and lead). The sulfate in the electrolyte combines with the plate materials, forming lead sulphate (battery discharge). By passing an electric current back into the battery, the plates revert to lead peroxide and lead (battery charge).

Since the specific gravity of the electrolyte (relative weight of sulphuric acid as compared with an equal volume of water) varies, the battery state of charge is determined by measuring the electrolyte's specific gravity.

#### ⚠ WARNING

- The battery gives off explosive gases; keep sparks, flames and cigarettes away. Provide adequate ventilation when charging or using the batteries in an enclosed space.
- The battery contains sulfuric acid (electrolyte). Contact with skin or eyes may cause severe burns. Wear protective clothing and a face shield.
  - If electrolyte gets on your skin, flush with water.
  - If electrolyte gets in your eyes, flush with water for at least 15 minutes and call a physician immediately.
- Electrolyte is poisonous. If swallowed, drink large quantities of water or milk and follow with milk of magnesia or vegetable oil and call a physician.
- KEEP OUT OF REACH OF CHILDREN.

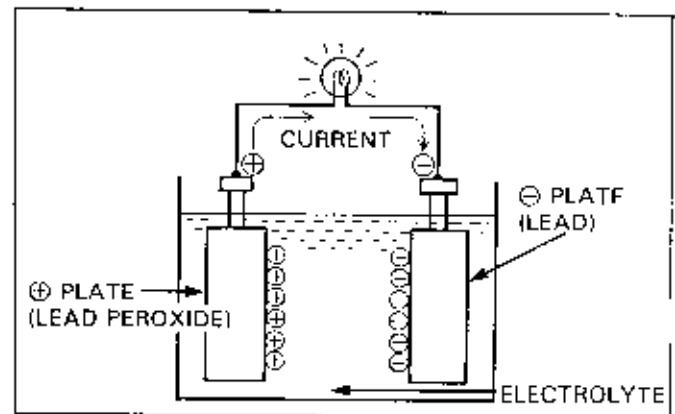
Use only distilled water in the battery.

#### CAUTION

- Tap water will shorten the service life of the battery.

#### CAUTION

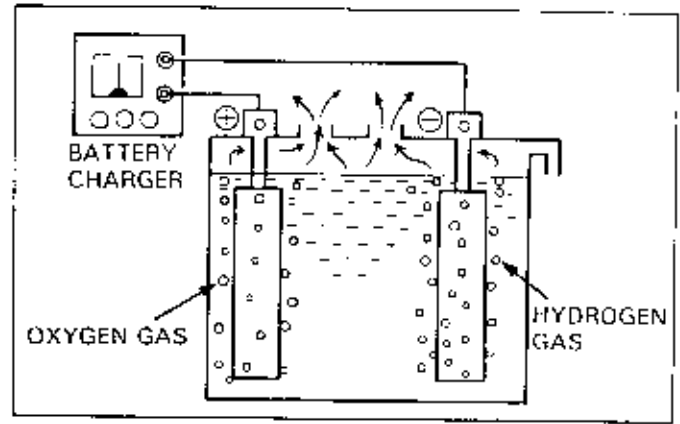
- Avoid filling the battery above the UPPER LEVEL line to prevent an electrolyte overflow which could corrode the engine or nearby parts.



When you charge the lead/acid battery, electrolysis breaks the water down into its components, hydrogen and oxygen. Because of the generation of these gases, you must remove the filler plugs while charging the battery.

The battery is equipped with a vent, usually routed overboard into tube, to rid it of the gases produced during normal use.

The battery is said to be overcharged when an excess current is supplied to the battery. When the battery is overcharged, volatile gas is emitted from the plates, and electrolyte temperature rises. This temperature rise causes more rapid loss of water from the battery electrolyte. This water loss and temperature rise will shorten the battery life. If left unchecked, water loss and high temperature will damage the battery beyond repair.



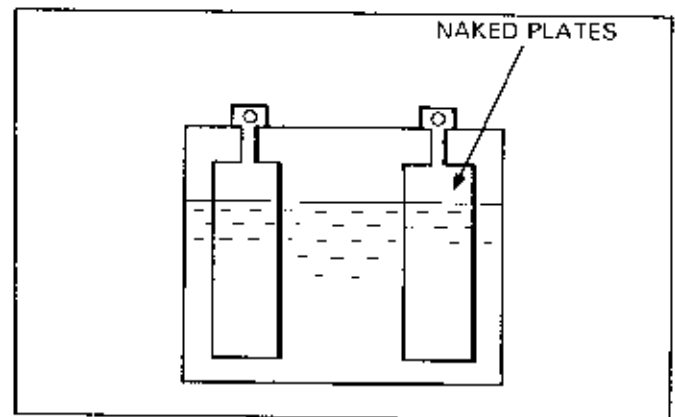
Because the motorcycle battery is constantly subjected to charging and discharging cycles, the water in the electrolyte is boiled off.

When the water is boiled off to the point where the plates become exposed, a white crystalline deposit forms. This process is called sulfation (lead sulfate).

The white crystalline lead sulfate, unlike the lead sulfate produced by discharging, is difficult to revert to lead peroxide and lead.

This causes damage to the battery and shortens the battery life. This can occur not only when the electrolyte level is low but also when the battery is discharged for long periods.

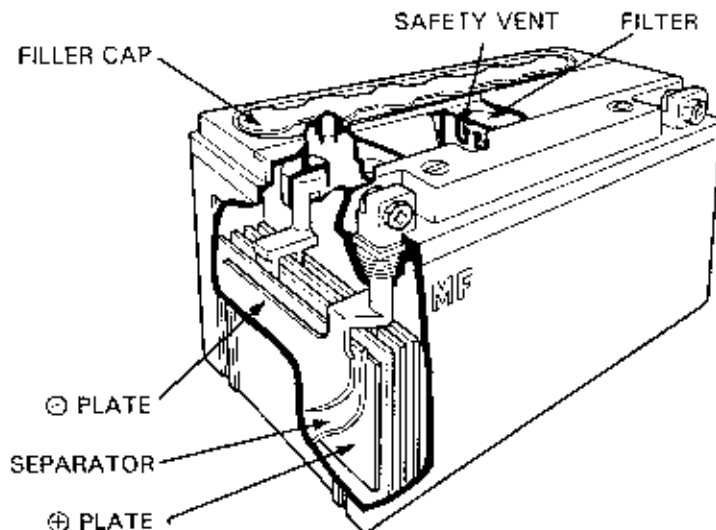
Remember that the electrolyte level goes down when the water in the battery evaporates. Always add distilled water, not electrolyte.





### MAINTENANCE-FREE BATTERY

The Maintenance-Free battery is a sealed battery that requires no electrolyte level inspection or periodic refilling.



Similar in design to the conventional battery, the MF battery produces hydrogen and oxygen gas. However, the plates are designed not to convert to lead completely. (This state of lead is called sponge lead.)

When the battery is overcharged and the positive plates produce oxygen gas, the negative plates are not completely converted to lead. There is no hydrogen gas produced.

The oxygen produced from the positive plate reacts with the active material (lead) on the negative plate, and produces water. Therefore, the water does not need to be added to MF batteries.

The MF batteries have safety valves designed to open up when excessive gas is produced. The safety valves close and seal the battery again when the internal pressure returns to normal. A ceramic filter is placed over the safety valves to prevent any internal ignition of the gases produced.

#### ⚠ WARNING

- Electrolyte is poisonous.
- Explosive gas can vent out from a battery when it is overcharged. For this reason, keep an open flame or lit cigarette away from a battery.

Use the electrolyte container designated for the specific battery.

#### CAUTION

- The MF battery life depends largely on the proper amount of electrolyte being added at the start of service.

#### NOTE

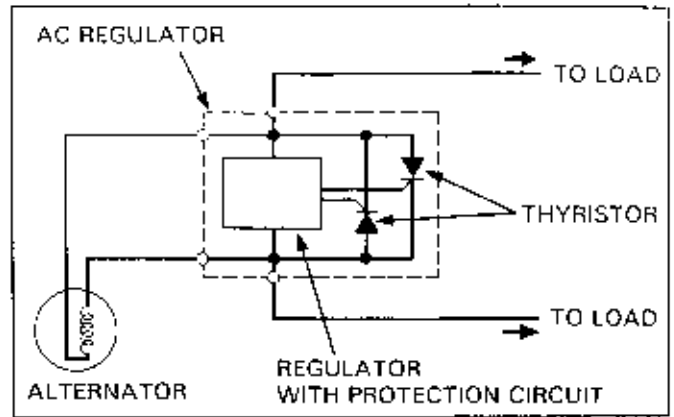
- Avoid interchanging conventional and MF batteries. They have different charging components.

#### CAUTION

- Removing the sealing caps from the cells may damage the battery.

MOTORCYCLES WITHOUT BATTERIES

Some motorcycles do not have batteries in their electrical systems. These models power electrical component with the electricity generated by the alternator, which is regulated by an AC regulator. For components using transistors which require DC current, a small rectifier (CD power unit) is used to rectify alternator signals to DC and feed DC current to these components.

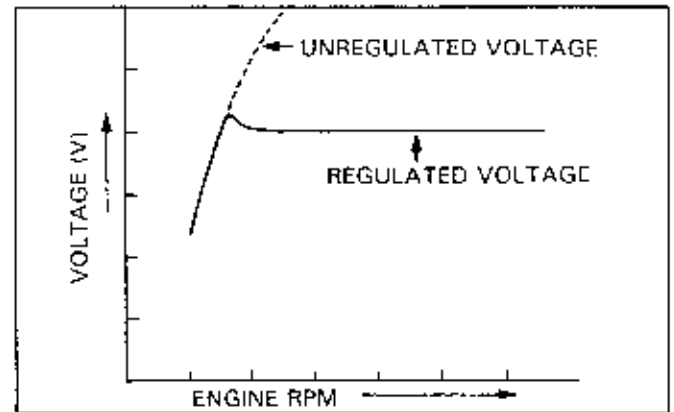


Voltage regulator

To provide a stable current without using a battery, a high power output alternator that feeds sufficient current at low engine rpm is utilized. If the alternator continues supplying current as the engine rpm increases, the excessive current may burn out light bulbs.

To prevent this, the AC regulator maintains the output voltage of the alternator in the specified range.

Some AC regulators have a protection circuit built into the alternator regulator circuit to prevent abrupt voltage increases on cold engine starts.



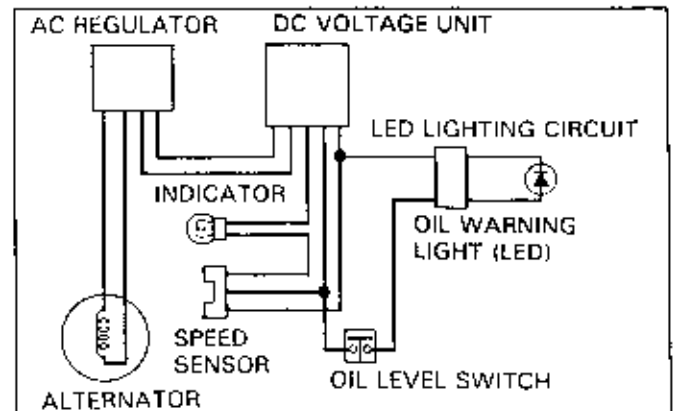
The current generated from the alternator flows directly to the loads at voltage levels lower than the regulated voltage value. As the engine rpm increases, the regulator detects the rise and directs current to thyristor, shorting the alternator output to ground. When the alternator voltage goes over the specified voltage, the regulator cuts off the excess voltage, maintaining a constant voltage output.

DC voltage unit

Although most electrical components receive AC current, there are systems such as the engine oil warning system which require DC current to operate their transistors and LEDs.

Therefore, a compact and light weight DC voltage unit regulates the AC current to these systems.

There are systems and components used specifically for AC: alternating flash turn signals, whose front and rear signals flash alternately, and AC horn which use electrical circuits and components designed for models without batteries.



## BATTERY REMOVAL/INSTALLATION

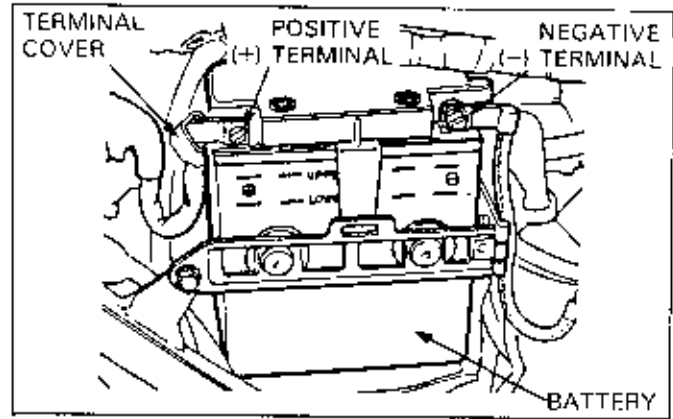
### REMOVAL

Turn off the ignition switch.

Remove the terminal cover and disconnect the negative (-) battery cable first, and then disconnect the positive (+) cable.

#### ⚠ WARNING

- Disconnecting the positive (+) cable first could cause an accidental direct short between the two terminals when the tool disconnecting the terminal contacts the frame. The spark could ignite or damage the battery.



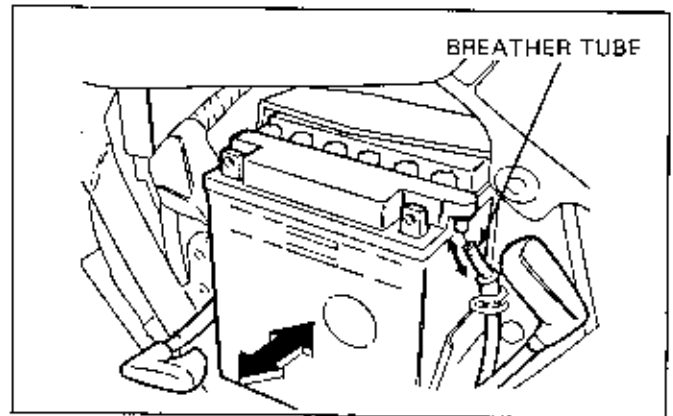
For conventional batteries, always disconnect the breather tube before removing battery.

#### NOTE

- Some electrolyte may remain in the breather tube.

#### ⚠ WARNING

- Keep electrolyte away from your eyes or skin while disconnecting the battery breather tube.

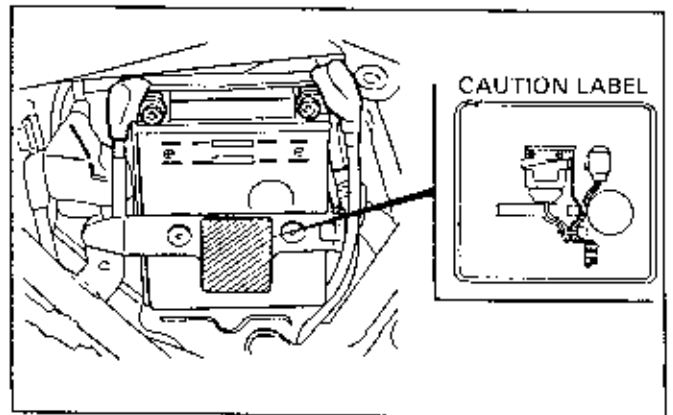


### INSTALLATION

Be sure to route the breather tube properly on conventional batteries.

#### ⚠ WARNING

- Take care to prevent spilling electrolyte from the breather tube because it can corrode components.
- Take care with the breather tube. Pay attention to the following points:
  - Connect the breather tube securely.
  - Follow the caution label and route the tube accordingly.
  - Avoid bending or squeezing the breather tube. Check that the breather tube has not been bent or squeezed by the surrounding components. Failure to replace a bent or squeezed breather tube may lead to a pressure buildup that can cause the battery to explode.



Place the battery into the frame.

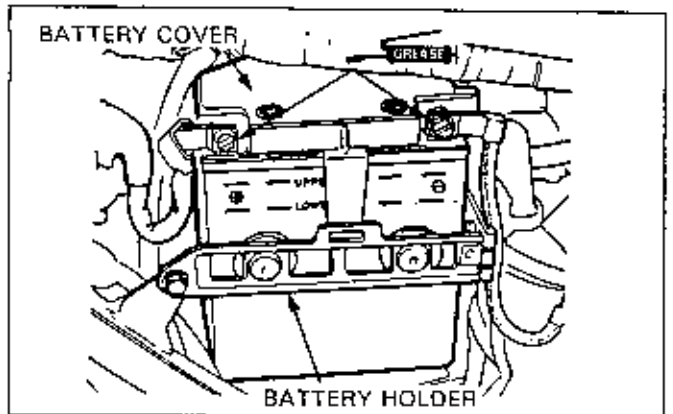
Secure the battery with the battery holder.

#### CAUTION

- Improper installation may cause vibrations which can damage the battery case.

To prevent shorting, always connect the positive (+) cable first.

After installing the battery, coat the terminals with clean grease to prevent corrosion.



## BATTERY TESTING/CHARGING

### BEFORE USING THE TESTER:

- Place the tester on a clean, flat and level surface.
- Be sure the work area is well ventilated, clear of flammable materials, and free from heat, humidity, water or dust.
- Always take the battery to the work bench/test area — continually moving of the tester or operation on an uneven surface may shorten its service life and reduce sensitivity over a period of time.

### NOTE

- Always clear the work area of flammable materials such as gasoline, brake fluid, electrolyte, or cloth towels when operating the tester, the heat generated by the tester may cause a fire.

### BATTERY TESTING

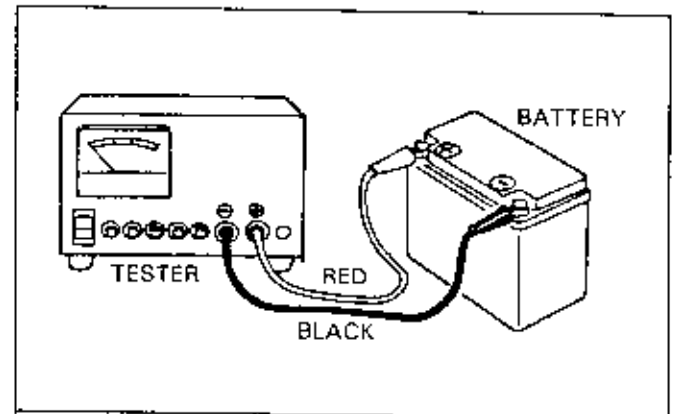
Use the following steps to remove the battery from the motorcycle:

- 1) Disconnect the negative (-) terminal lead.
- 2) Remove the battery holder.
- 3) Remove the battery cover (when applicable).
- 4) Disconnect the positive (+) terminal lead.
- 5) Remove the battery breather tube (when applicable).
- 6) Pull out the battery.
- 7) If necessary, clean the battery terminals.

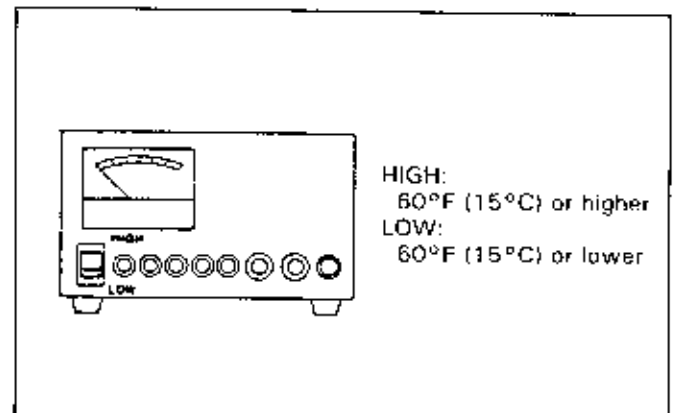
Securely connect the tester's positive (+) cable first — then connect the negative (-) cable.

### NOTE

- For accurate test results, be sure the tester's cables and clamps are in good working condition and that a secure connection can be made at the battery.



Set the temperature switch to "HIGH" or "LOW" depending on the ambient temperature.

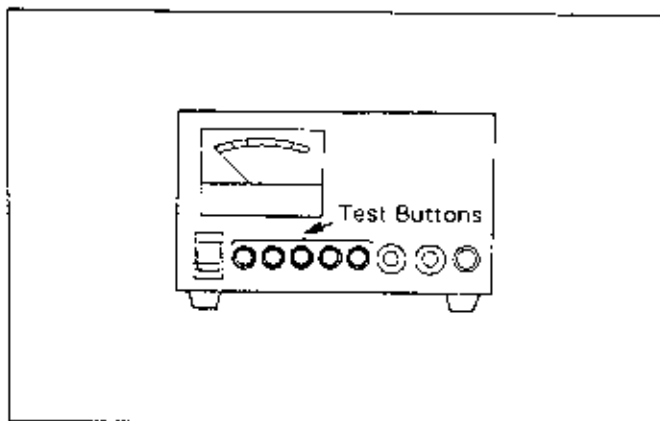


## BATTERIES/CHARGING/LIGHTING SYSTEM

Push in the appropriate test button for **three seconds** and read the condition of the battery on the meter.

### NOTE

- Be sure you've selected the correct test button that corresponds to the battery being tested — see the chart below. For the first check, **DO NOT** charge the battery before testing — test it in an "as is" condition.



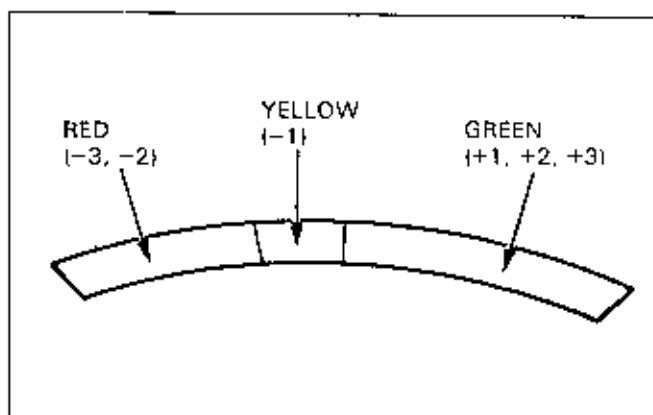
Capacity	-3 Ah	3.5 Ah-5 Ah		5.5 Ah-9 Ah	9.5 Ah-16 Ah		16.5 Ah-30 Ah
Type	YB25L-C-1-2 YB3L-A	TB4L-B YB4L-B-Ca YB5L-B YB5L-B-Ca	YT4L-12 YT4L-12B YT5L-12 YT5L-12B	12N9-4B-1 YB9(L)-B YB9-B-CA YB9A-A YTH9-12B	YB12A(L)-A YB12A-B YB9-B-Ca YB14L-A1 YB14A-A2	YB16B-A HYB16A-A YT12-12 YTH12-12B YTH14-12B	YB18(L)-A Y50-N18L-A

### CAUTION

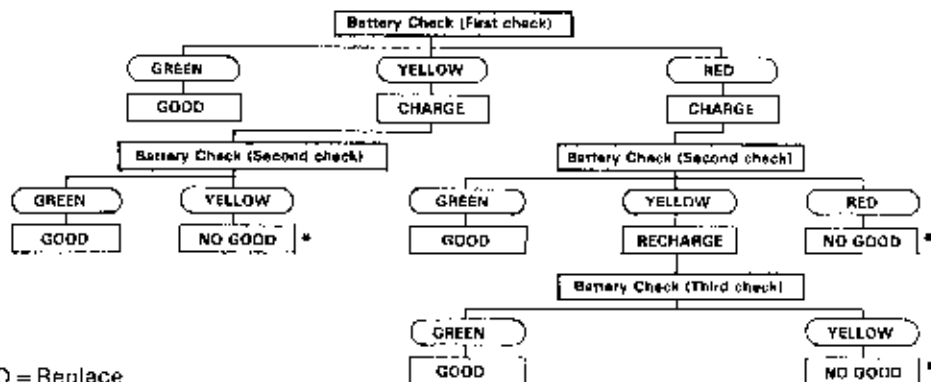
- To avoid damaging the tester, only test batteries with an amperage rating of less than 30 Ah.
- Tester damage can result from overheating when:
  - The test button is pushed in for more than three seconds.
  - The tester is used without being allowed to cool for at least one minute when testing more than one battery.
  - More than ten consecutive tests are performed without allowing at least a 30-minute cool-down period.

### NOTE

- The result of a test on the meter scale is relative to the amp. hour rating of the battery. **ANY BATTERY READING IN THE GREEN ZONE IS OK.** Batteries should only be charged if they register in the **YELLOW** or **RED** zone.



**EXAMPLE:** Gold Wing batteries (Y50-N18L-A, 18 AMP HOUR) using the 16.5-30 amp. hour setting may read in the **GREEN** zone, but close to the **YELLOW** (charge) zone. As long as the meter reads in the **GREEN** zone, the battery is OK.



\*NO GOOD = Replace

BATTERY CHARGING

Before Operating The Charger

- Be sure the area around the charger is well ventilated, clear of flammable materials, and free from heat, humidity, water and dust.
- Clean the battery terminals and position the battery as far away from the charger as the leads will permit.
- Do not place batteries below the charger — gases from the battery may corrode and damage the charger.
- Do not place batteries on top of the charger. Be sure the air vents are not blocked.

**WARNING**

- Always clear the work area of flammable materials such as gasoline, brake fluid, electrolyte, or cloth towels when operating the tester, or the heat generated by the tester may cause a fire.

1. Turn the Power Switch to the OFF position.
2. Set the Battery Amp. Hr. Selector Switch for the size of the battery being charged.
3. Set the Timer to the position indicated by the Honda Battery Tester; RED-3, RED-2, or YELLOW-1. If you are charging a new battery, set the switch to the NEW BATT position.
4. Attach the clamps to the battery terminals — RED to Positive, BLACK to Negative.

Connect the battery cables only when the Power Switch is OFF.

**WARNING**

- Connecting the cables with the Power Switch ON can produce a spark which could ignite or explode the battery.

5. Turn the Power Switch to the ON position.
6. When the timer reaches the "Trickle" position, the charging cycle is complete. Turn the Power Switch OFF and disconnect the clamps.

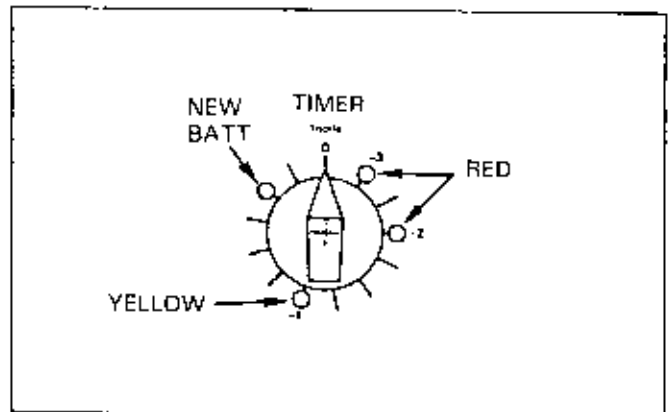
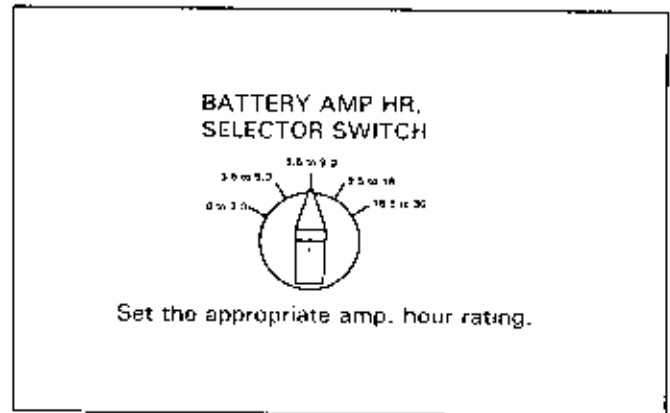
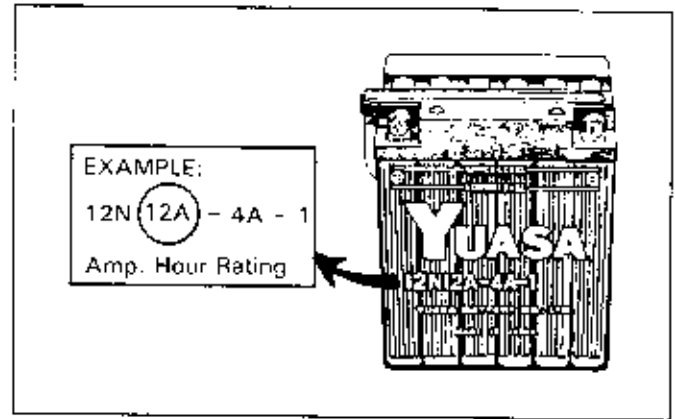
NOTE

- The charger will automatically switch to the Trickle mode after the set charging time has elapsed.

7. Retest the battery using the Honda Battery Tester and recharge if necessary using the above steps.

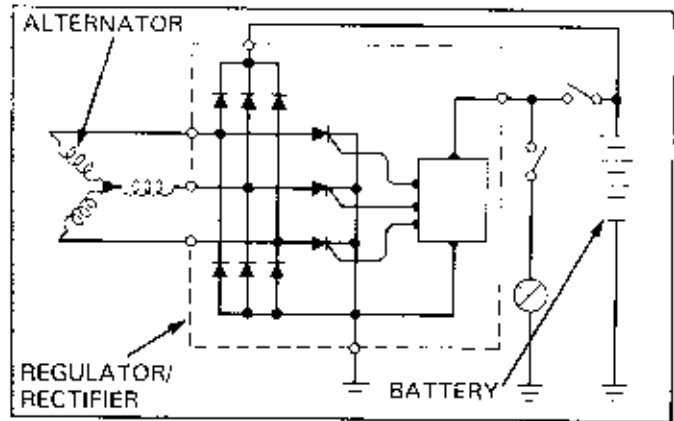
NOTE

- For accurate test results, let the battery cool for at least ten minutes or until gassing subsides after charging.



**CHARGING SYSTEM DESCRIPTION**

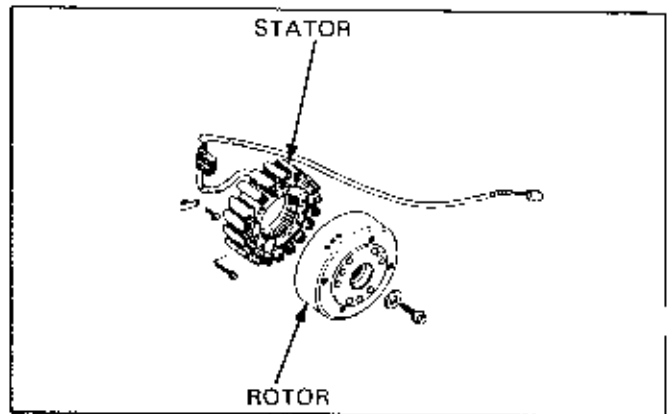
The charging system basically consists of the following components.



Component name	Function
Regulator/rectifier	<ul style="list-style-type: none"> <li>Regulates voltage so that it stays within the specified range.</li> <li>Converts alternating current (AC) to direct current (DC).</li> </ul>
Alternator	<ul style="list-style-type: none"> <li>A generator producing current (AC) and which is powered by engine revolution.</li> </ul>
Battery	<ul style="list-style-type: none"> <li>Stores regulated DC current.</li> </ul>

**ALTERNATOR TYPES**

The alternator consists of a rotor and a stator. The rotor consists of a flywheel made up of a series of magnets and is usually driven by the crankshaft. The stator consists of a series of soft iron poles around which are wound coils of wire. When the engine starts, the rotor rotates with the crankshaft. When the outer (or inner) core of the coil passes through the magnetic field, current is generated. This is called electromagnetic induction, and other systems such as the ignition and AC lighting systems generate power under the same principle. In addition, the rotor acts as a safety wheel on the crankshaft, smoothing out engine pulsations at low engine rpm.

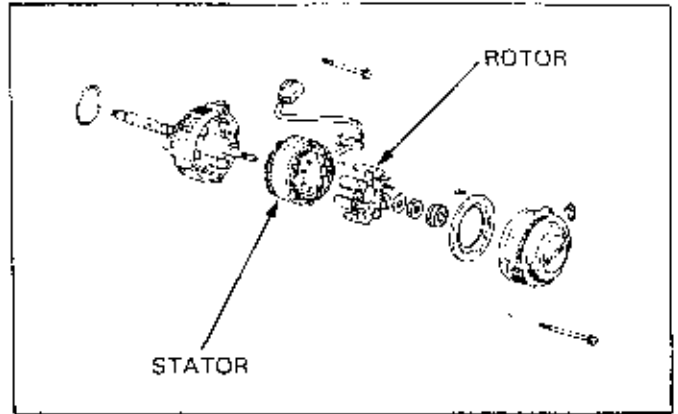


**Permanent Magnet Type**

This is the most common type of alternator with the stator placed inside the rotor. The permanent magnet is assembled on the inner walls of the rotor. In general, the stator consists of several coils producing power for the charging, ignition and lighting systems. Current for charging the battery is generated by the charging coil.

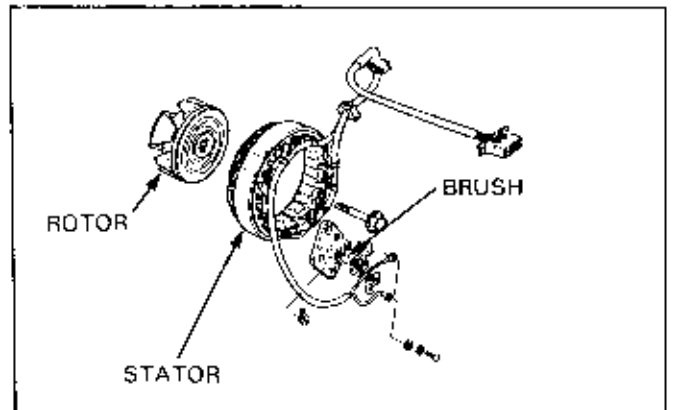
**Brushless Excited Field Coil Type**

The alternators previously mentioned are located within the engine. The alternator is exposed outside the engine because it is air cooled. In general, the rotor speed is multiplied by gears or chains connected to the crankshaft. This type is the most powerful among the triple phase alternators and is primarily used for power on large displacement motorcycles. Its structure differs fundamentally from the previous alternator in that it does not utilize a permanent magnet. Instead, the field coil magnetizes the rotor and generates power as the rotor passes the coil.



**Excited Field Coil Type With Brushes**

This type has a field coil placed inside the rotor. Current flows through the brushes to the field coil and electromagnetically induces the rotor. This generator has a strong magnetic force, large output, and is small and light weight.



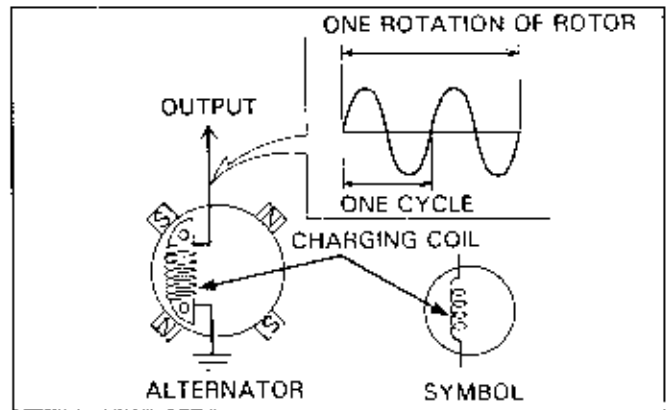
**ALTERNATOR FUNCTION**

**Single Phase Output Type**

Since this type uses only one charging coil, the output voltage is single phase AC wave. The output frequency varies depending on the number of magnets on the rotor.

The generator in the diagram on the right has two pairs of magnets, and its output has two cycles for every rotation of the rotor.

The single phase output type has a low output, and its small size is best suited for engines of small displacement and a small electrical load.





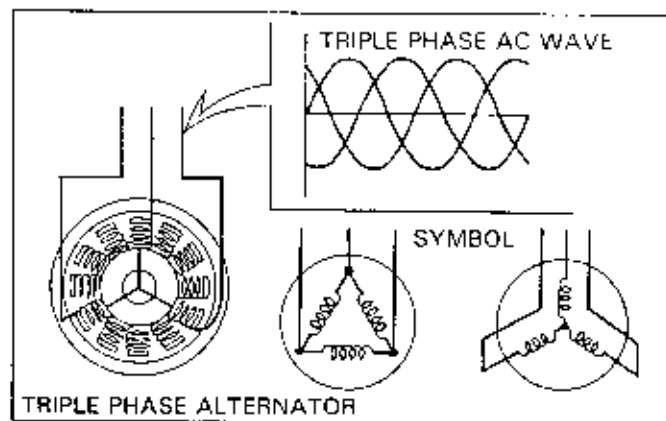
## BATTERIES/CHARGING/LIGHTING SYSTEM

### Triple Phase Output Type

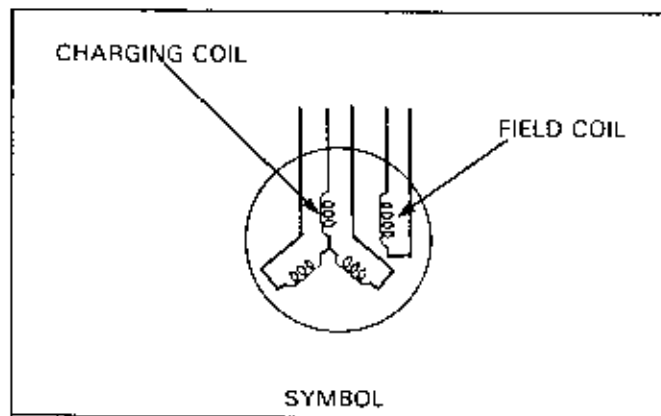
This type consists of three coils connected to each other, producing single phase alternating currents independently. The output of the alternator is three single phase AC wave forms where each is 120° out of phase with each other.

The symbol for this alternator has only three coils as in the diagram. The actual stator coil consists of several coils connected in series.

The triple phase output type is used in engines of medium to large displacement with large electrical loads. Depending on how the coils are connected, there are two symbols for this type. Servicing is the same for both types.



Most triple phase output types are used in electromagnetically induced type alternator, which has a permanent magnet on the rotor. The excited field coil type alternator feeds current to the field coil to magnetize the rotor which then acts like a permanent magnet. The symbol for this type has a field coil along with the charging coil.



## REGULATOR/RECTIFIER

The regulator/rectifier uses semiconductors such as thyristors which radiate heat in operation. Thus these components use printed circuit boards which are resined onto an aluminum case. The aluminum case has many fins for better heat dissipation.

As the engine revolutions increase, the output voltage of the alternator also increases. The function of the regulator/rectifier is to keep this AC output voltage within a certain range and to convert the AC output voltage to DC voltage — for powering various components and charging the battery.

### Type of Regulator/Rectifiers

Regulator/rectifiers are categorized as one of several types, based on its method of regulation and rectification. The chart below shows the different types of regulator/rectifiers.

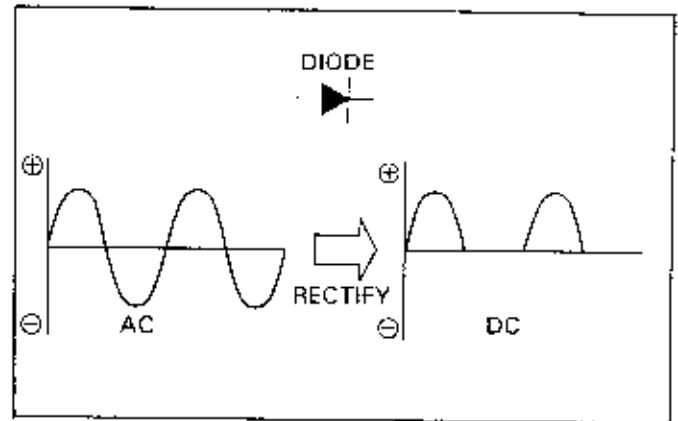
Input AC wave form	Rectification method	Voltage feedback method	Regulation method
Single phase	Half-wave rectification	Internal voltage feedback	SCR shorted
Triple phase	Full wave rectification	Battery voltage feedback	

Since the input wave form is the same as the output wave form of the alternator, refer to the alternator section for the types of input wave form.

**Single Phase, Half-Wave Rectifiers**

**(Diode rectification method)**

This method uses only a diode to convert alternating current to direct current. The diode allows current to flow in one direction only. Thus when a single phase AC waveform flows through the diode the negative voltage of the waveform is cut off and the positive voltage drops slightly. As a result, the output consist of the positive half cycles of the input waveform. Thus the signal is said to have been rectified; because only half cycles are utilized, this is called half-wave rectification.

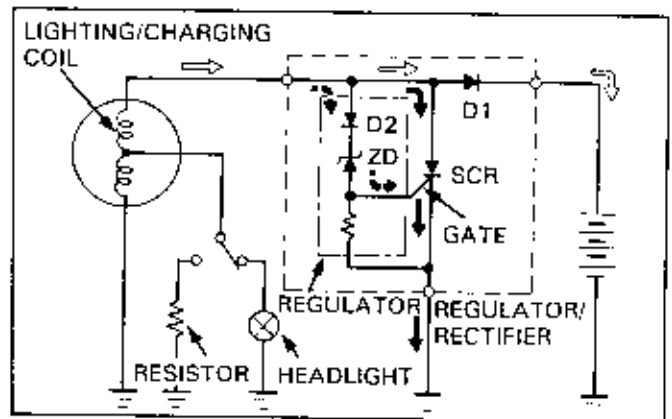


Single phase half wave rectification is used in models with small electrical loads.

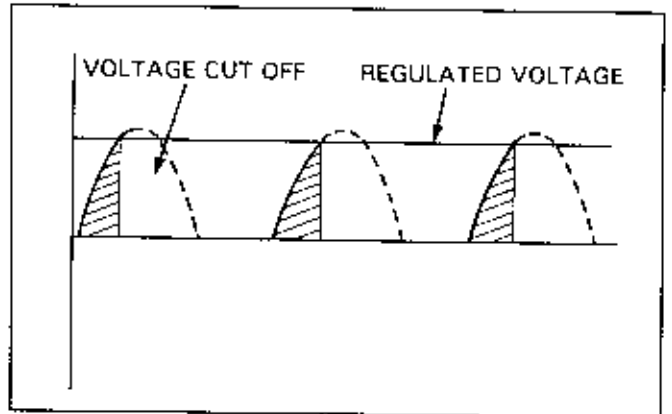
The single phase half wave rectifier utilizes two voltage feedback methods.

**(Internal voltage regulation method)**

The right circuit is the most basic regulator circuit. The signal from the charging coil is half-wave rectified through diode D1, which is inside the regulator/rectifier circuit, and is then fed to the battery. Voltage is regulated by the voltage regulation circuit and the SCR (thyristor).



As the engine rpm (rotation per minute) increases, the output of the alternator increases and that output is rectified by diode D2. This signal then goes to the zener diode (ZD). Current flows in the normal direction of the zener diode but does not flow in the reverse direction until a certain amount of voltage is applied in the reverse direction. Then this voltage is reached, the zener diode abruptly conducts current in the reverse direction. In this way, if the engine rpm increases and a certain voltage level is applied to the ZD, current is fed to the gate of SCR which then turns ON.



When the SCR turns ON, the output from the alternator is shorted to ground through SCR. For this reason, if the ground wires of the regulator/rectifier are broken or poorly connected, the battery becomes overcharged.

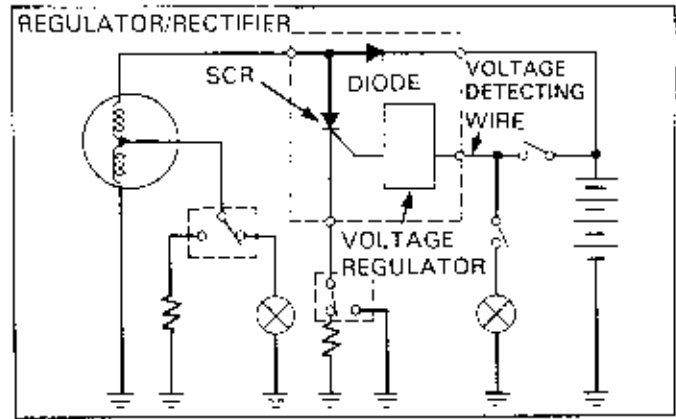
For alternators with the charging/lighting coil combined (charging and lighting systems power by the same coil), the headlight lighting system affects the performance of battery charging. Since the input of the lighting system is taken from the charging coil, if the load of the lighting coil is not stable, the charging of battery will be unstable. To prevent this from happening, when the headlight are off, the output from the charging coil is connected to a resistor equivalent to the impedance of the headlights.

It is clear from above that if the lighting output lines are broken or shorted, or if the switch has contact problems, the charging system is adversely affected.

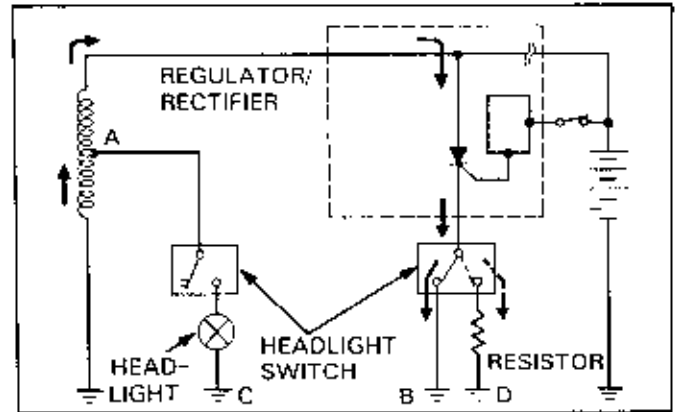
## BATTERIES/CHARGING/LIGHTING SYSTEM

### (Battery)

This method is similar to the method mentioned previously except that the voltage regulation is done after the signal is converted to DC at the input of the battery. Since this method regulates output voltage of alternator after it is rectified, its charging is precisely controlled.

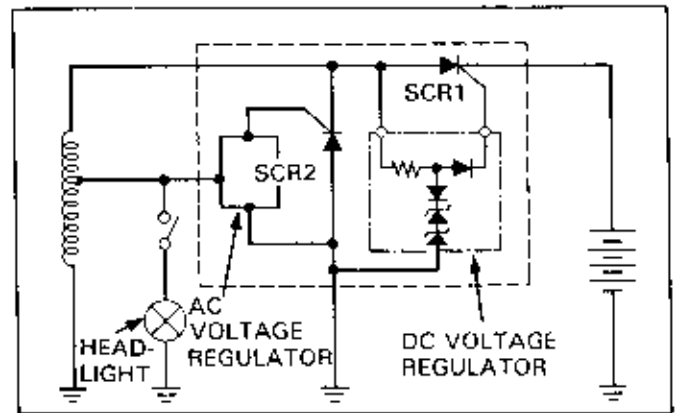


In order to regulate the current going to the headlight, there is sometimes a resistor connected to the ground wire of the regulator/rectifier through a switch. Since the charging coil powers the headlights as well, the headlight flickers and dims when the output of the charging coil is shorted to ground through the SCR. This happens because when the ground wire of the regulator/rectifier is connected to ground, the resistance AB becomes less than AC, thus less current is diverted to the headlight. In order to keep current flowing to the headlight steadily, a resistor, whose value is greater than resistance between AC, is placed between AD.



### (SCR switching regulation/AC regulator built in type)

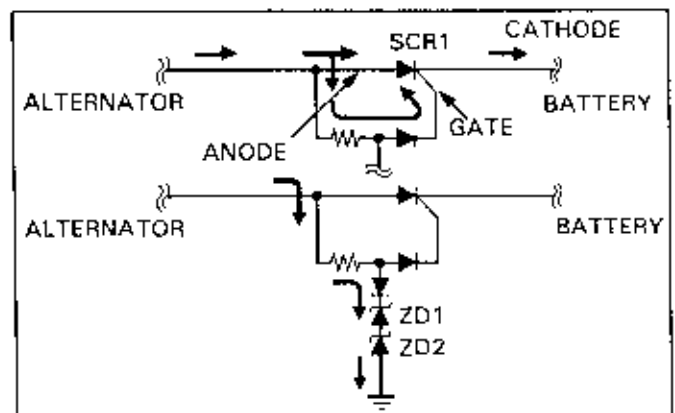
This type is used for models with small displacement engines. Unlike the type above, the SCR is used for switching and the ZD (zener diode) is used for voltage regulation.



The output of the alternator goes to the gate of SCR1 via the DC voltage regulator. When the voltage at the cathode of the SCR1 is less than the voltage at the gate, it is turned ON and thus SCR1 conducts current to the battery. When AC output of the alternator changes from the positive to negative, the gate voltage of SCR1 becomes zero, hence turning OFF the SCR1 and cutting off the negative signal to the battery.

The output voltage is regulated by the ZD1 and the ZD2 which turns ON (and shorts to ground) when the output voltage of the charging coil increases beyond a specified value.

The regulator may overcharge the battery if the ground wire is broken or if there are poor connections at the terminals.

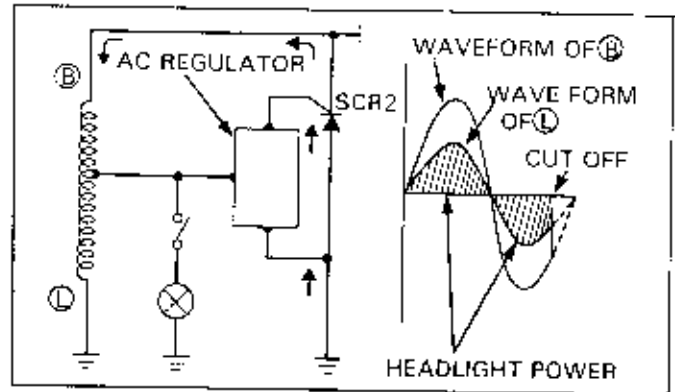


**AC regulator function:**

The AC regulator regulates the voltage to the headlight. Thus, no resistor is required. When the negative output of the charging coil reaches a certain voltage, the AC regulator feeds current to the gate of SCR2 and turns it ON. The SCR2 is shorted and a negative current to the coil regulates its output voltage.

Since the negative output voltage of the charging coil is not used for charging the battery, the AC regulator has no effect on charging the battery.

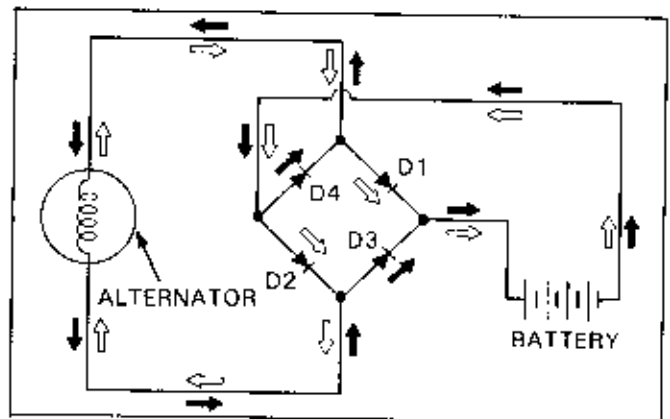
However, since when the negative output of the coil is cut off the headlight voltage is also cut off, the AC regulator regulates the output voltage to the headlight.



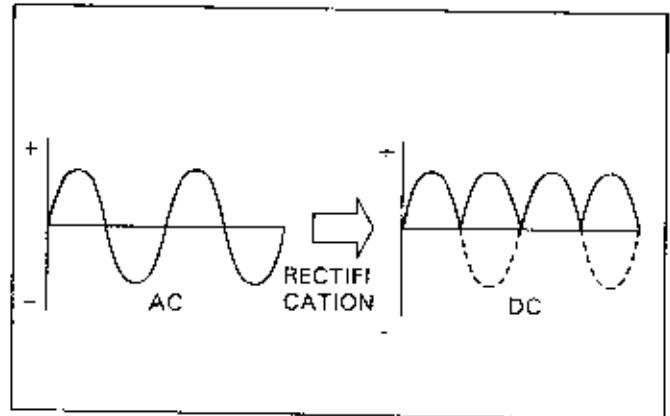
**Single Phase, Full-Wave Rectifiers**

This type is used on medium engine displacement models. Compared to the half-wave rectifier, the full-wave rectifier is more efficient in using the alternator output for charging the battery.

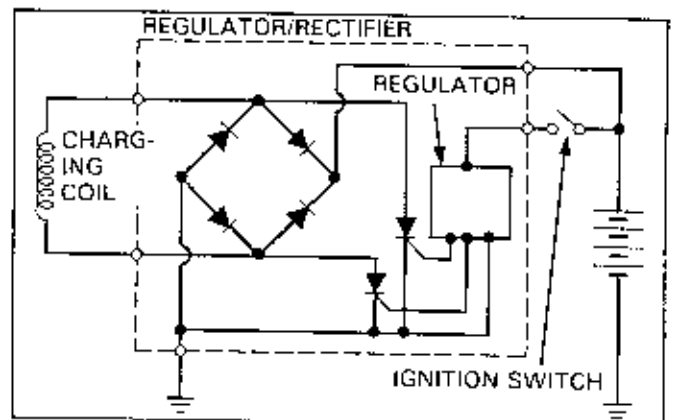
In order to convert the AC output of the alternator to DC, the diodes are arranged as in the right diagram, inside the regulator/rectifier. When the alternator is positive the current flows through D1 → battery → D2 → and when the alternator is negative the current flows through D3 → battery → D4 shown by the white arrow and black arrow respectively.



In this way, the AC output of the alternator is converted to a DC waveform. This circuit is called the full-wave rectifier and is distinguished from the half-wave rectifier.



Similar to the single phase half-wave rectifier, the full-wave rectifier has a battery voltage feedback method and internal voltage feedback method. The circuit at right uses the battery voltage feedback method.



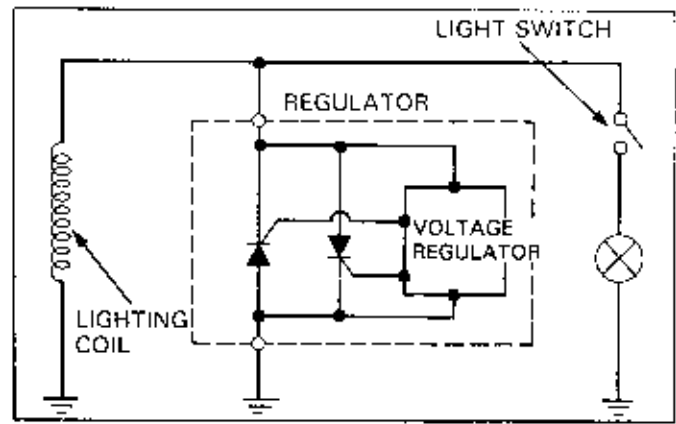
## BATTERIES/CHARGING/LIGHTING SYSTEM

### AC Regulator

Most medium engine displacement motorcycles have independent lighting and charging coils. For these models, the lighting coil has its own independent AC regulator. The regulator detects the AC voltage of the lighting coil inside the regulator/rectifier and shorts out all excessive output.

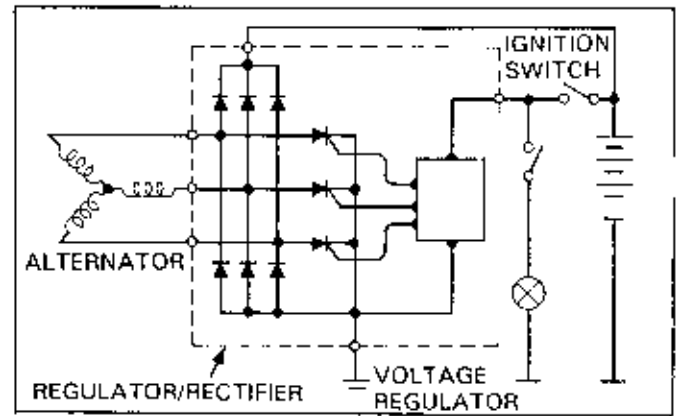
There are regulators which regulate both positive and negative outputs and ones which regulate negative output only.

Since these regulators have lighting and charging coils that operate independently, even if one of the coils does not work, the other is not affected.

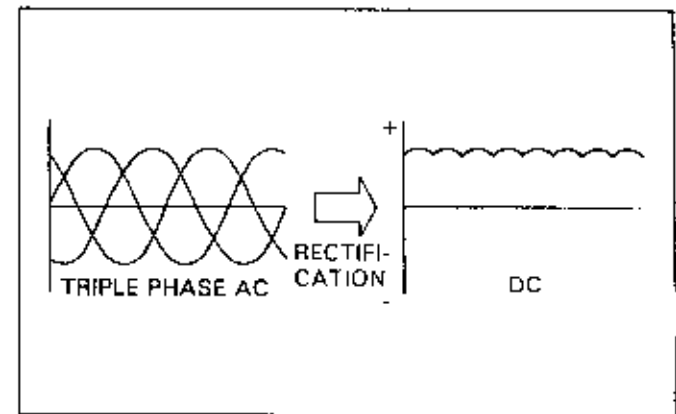


### Triple Phase Full-Wave Rectifier

This type is mainly used in medium and large engine displacement models. The rectifier is connected directly to the three phase alternator. This circuit has no lighting coil but instead, the battery feeds DC current to the lighting system.



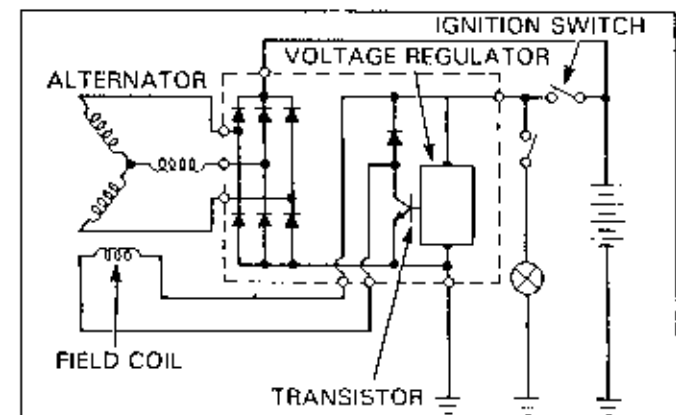
The rectified waveform of the triple phase AC output is more stable than the single phase AC type.



### Triple Phase Full-Wave Rectifiers With Field Coils

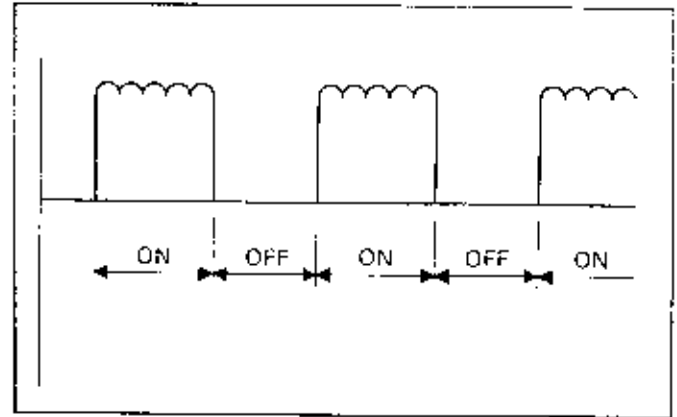
This type regulates the alternator output by the current flowing through the field coil. The regulator/rectifier has a voltage regulator for the field coil. The voltage regulator detects the voltage at the battery and feeds current to the base of transistor, turning it ON. When the transistor is ON, the battery feeds current through: ignition switch → field coil → transistor → ground. The field coil magnetizes the rotor, and the alternator generates power.

When the alternator reaches a certain voltage, the voltage regulator turns off the transistor and cuts off current to the field coil, hence the alternator stops generating power.



The voltage regulation is performed by a high frequency ON/OFF cycle of the alternator. When the DC voltage of the output waveform is measured by a voltmeter, a value smaller than the peak voltage is measured.

A broken wire in the field coil in this type of system will result in insufficient charging of alternator. If the ground wire of the field coil wire is shorted to ground (transistor shorted), the battery will be overcharged.



## CHARGING SYSTEM INSPECTION

### LEAK TEST

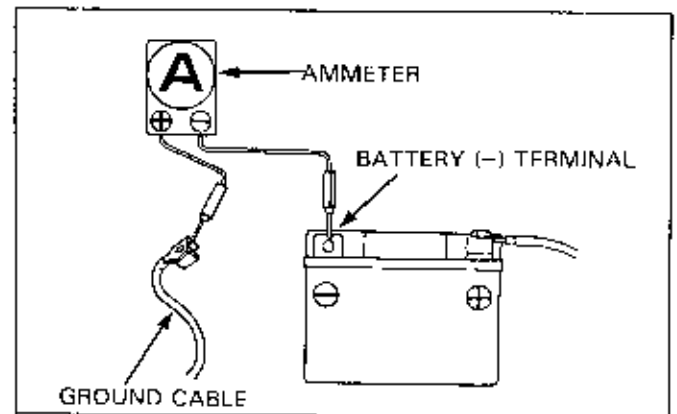
Turn off the ignition switch, and disconnect the ground (-) cable from the battery.

Connect an ammeter between negative (-) terminal and ground cable.

With the ignition switch off, measure the leakage current.

#### NOTE

- When measuring current using a tester, set it to a large range, and then bring it down the range to an appropriate level. Current flow larger than the range selected may blow out the fuse in the tester.
- While measuring current, do not turn the ignition on. A sudden surge of current may blow out the fuse in the tester.



If current leakage exceeds the standard value, a shorted circuit is likely to exist.

Locate the short by disconnecting connections one by one and measuring the current.

### CHARGING VOLTAGE INSPECTION

#### NOTE

- Be sure that the battery is fully charged before performing this test. The amount of current flow may change abruptly if not sufficiently charged.
  - For MF battery; use a battery whose voltage between its terminals is greater than 13.0 V.
  - For conventional battery, use battery whose specific gravity is greater than 1.27 (20°C/68 F).
- When the engine is started using the starter motor, a large amount of current may flow from the battery temporarily. Use the kick starter to start the engine for models equipped with both a starter motor and a kick starter.

## BATTERIES/CHARGING/LIGHTING SYSTEM

After warming up the engine, replace the battery with a fully charged battery.

Connect a multimeter between the battery terminals.

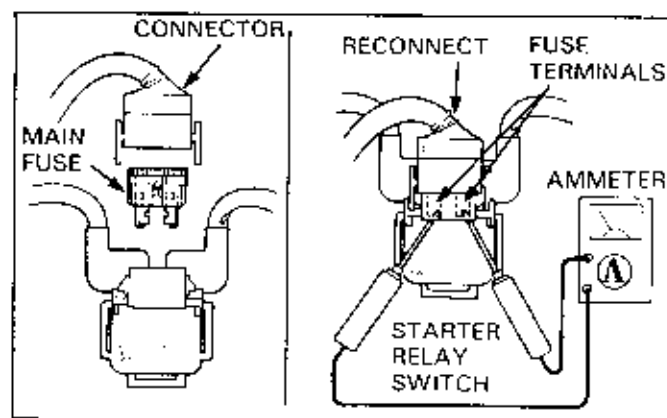
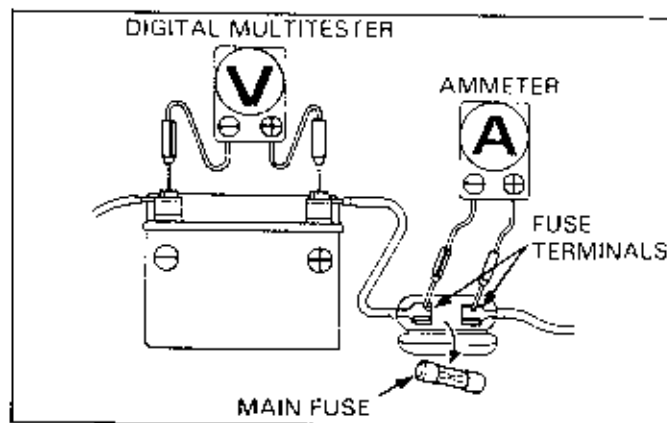


**DIGITAL MULTITESTER** 07411-0020000

Connect an ammeter between the terminals of the main fuse.

### NOTE

- If the probes are connected in reverse order, the registered current flow direction when charging and discharging the battery will be reversed as well. Refer to the Model Specific manual for proper connection of the multimeter.
- Use an ohmmeter that registers both positive and negative current flow. An ammeter which registers in only one direction will measure 0A for discharging.



### NOTE

- Be careful not to short any wires.
- Although the current could be measured when the ammeter is connected between the battery positive terminal and the positive  $\oplus$  cable, a sudden surge of current to the starter motor could damage the ammeter. Always use the kick starter to start the engine.
- Always turn the ignition off when conducting the test. Disconnecting the ammeter or wires when current is flowing may damage the ammeter.

For models with no tachometer, connect an engine tachometer.

Turn the headlight ON (Hi beam) and start the engine. Gradually increase the engine speed and measure the charging voltage at the specified rpm.

### NOTE

- If the charging current and voltage measurements are normal when the battery is replaced with a new battery, it is likely that the original battery's effective life span has passed.

For the following conditions, the problem is most likely related to the charging system. Follow the steps in the troubleshooting chart.

- ① Charging voltage fails to increase beyond battery terminal voltage and charging current is in the discharging direction.
- ② Both charging voltage and current greatly exceed the standard value.

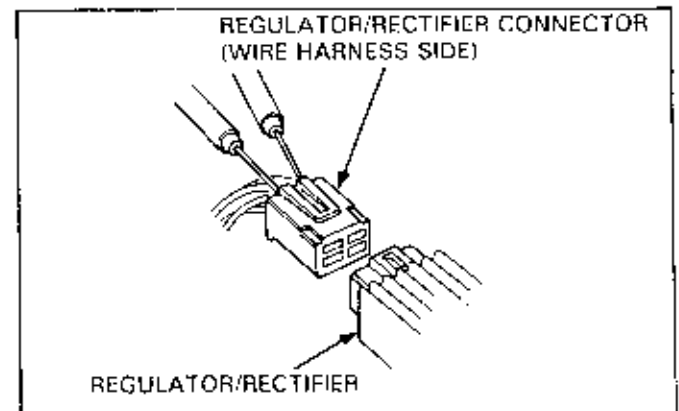
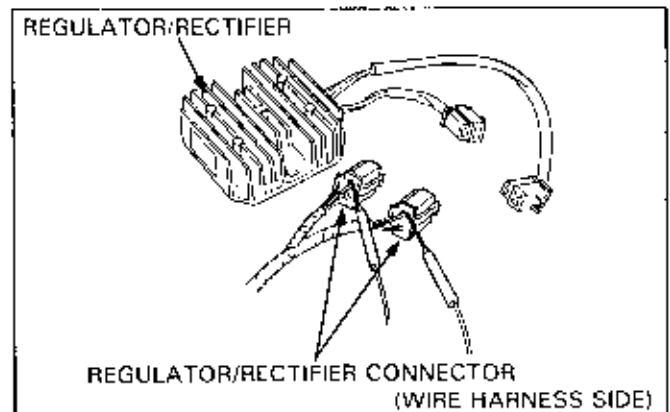
For conditions other than the ones mentioned above, the problem is most likely associated with an area other than the charging system, conduct the following inspection and follow the troubleshooting chart.

- ① Standard charging voltage/current is reached when the engine rpm exceeds the specified rpm.
  - Excessive electric load due to the use of light bulbs beyond the specified rating.
  - The replacement battery is old or underrated.
- ② Charging voltage normal but charging current abnormal
  - The replacement battery is old or underrated.
  - The battery used was undercharged or overcharged.
  - Blown out ammeter fuse.
  - Incorrect connection of ammeter.
- ③ Charging current normal but charging voltage abnormal
  - Blown out voltmeter fuse. (Check for faulty fuse by 0 Ω adjustment)

## REGULATOR/RECTIFIER INSPECTION

Service according to the troubleshooting chart. Since the regulator/rectifier is an electrical component using semiconductor devices, the component itself is not serviced. Instead, the connector on the regulator/rectifier is checked.

Inspect the regulator/rectifier at the terminals of each connector.



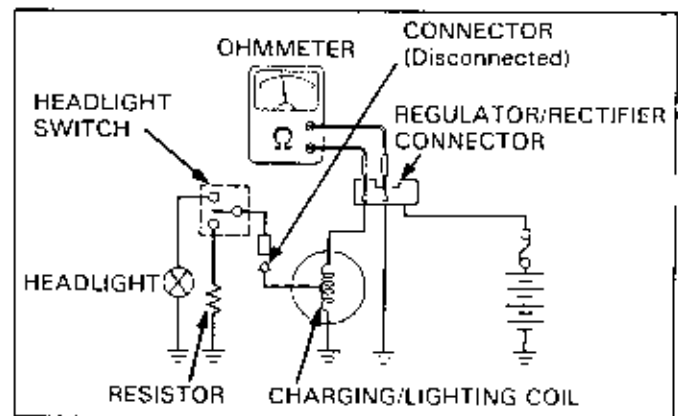


## BATTERIES/CHARGING/LIGHTING SYSTEM

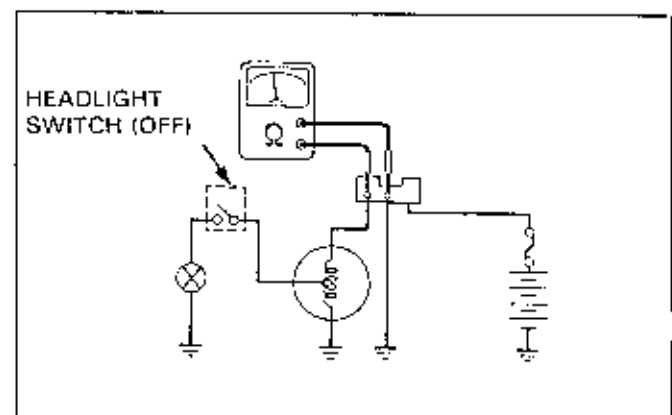
Items (wire colors)	Inspection
Battery wire (red/white or red)	Check that there is voltage between battery line (+) and ground line.
Ground wire (green)	Check continuity between ground and frame.
Voltage detection line (black) (external voltage detection type)	Check that there is battery voltage between voltage detection line (+) and ground wire when the ignition is ON.
Charging coil wire (refer to Model Specific manual)	Check that the resistance of the coil is within the specified range.
Charging/lighting coil wire (refer to Model Specific manual)	Check that the resistance of the coil is within the specified range. (Because the lighting system effects the resistance value, follow the steps below.)

For the charging/lighting coil (charging and lighting shared by a single coil), disconnect the output connector when measuring resistance. The headlight resistance will be included in the ohmmeter measurement if the connector is not disconnected. (If the headlight connector is connected, the measured resistance will be smaller, because the resistance of the headlight is connected in parallel.)

- For lighting systems whose headlight connector is connected to a resistor when the headlight is turned OFF, either disconnect the handlebar switch connector or disconnect the lighting output line of the alternator. (Refer to diagram at right.)



- For lighting systems that have a headlight ON and OFF switch, just turn off the headlight switch. (Refer to diagram at right.)

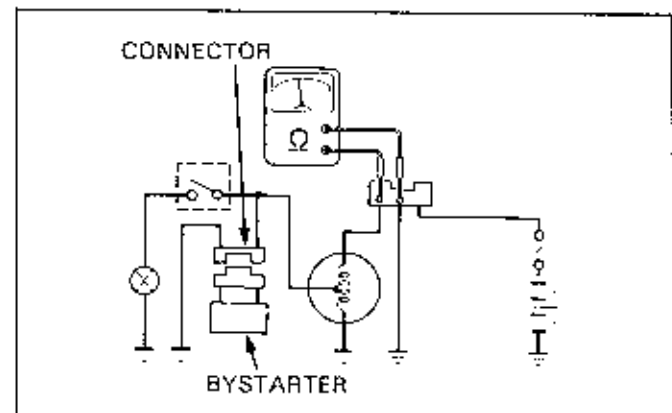


- Disconnect the auto-bystarter connector if applicable. (See diagram at right.)

If there is an abnormality in the diagnosis above, check the following:

- Battery wire → Broken wire harness (repair or replace)
- Ground wire → Broken wire harness (repair or replace)
- Charging coil wire (charging/lighting coil wire)
  - Check the charging coil (charging/lighting coil) of the alternator

If the resistance value of the alternator is normal (ie the resistance value measured by the above method is different from the alternator resistance), check for a broken or shorted wire harness between the regulator/rectifier and alternator or for poor connection at alternator connector.



## UNIT INSPECTION

Provided that all inspections on the wire harness side are normal and there are no loose connections at the regulator/rectifier connector, inspect the regulator/rectifier unit by measuring the resistance between the terminals. (Refer to Model Specific manual for specific data.)

### NOTE

- Resistance value will not be accurate if the probes touch your fingers.
- Use the following recommended multimeter.
- Using another manufacturer's equipment may not allow you to obtain the specified values. This is due to the characteristic of semiconductors, which have different resistance values depending on the applied voltage.

#### SPECIFIC MULTIMETER:

- 07411-0020000 (KOWA Digital type)
- KS-AHM-32-003 (KOWA Digital type; USA only)
- 07308-0020001 (SANWA Analogue type)
- TH-5H (KOWA Analogue type)

- Select the following range.

SANWA Tester:  $k\Omega$

KOWA Tester:  $\times 100 \Omega$

- An old, weak multimeter battery could cause inaccurate readings. Check the battery if the multimeter registers incorrectly.
- When using the Kowa multimeter, remember that all readings should be multiplied by 100.

Replace the regulator/rectifier unit if the resistance value between the terminals is abnormal.

## HEADLIGHT VOLTAGE INSPECTION

### Regulator/Rectifier With Built-in AC Regulator:

For a regulator/rectifier with a built-in AC regulator, measure the headlight lighting voltage.

### CAUTION

- Failure to measure the headlight voltage may lead to electrical damage of lighting components.

If the model is not equipped with a tachometer, connect an engine tachometer.

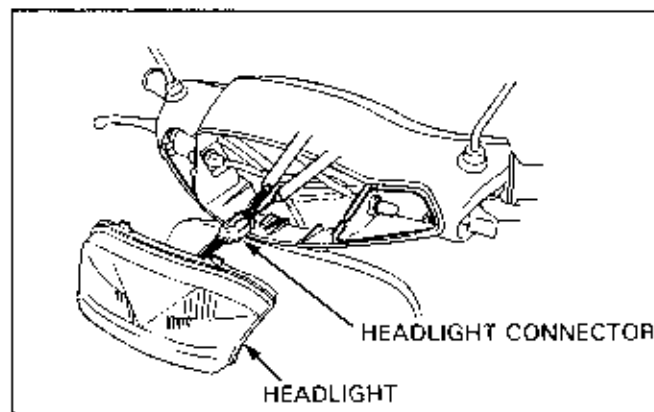
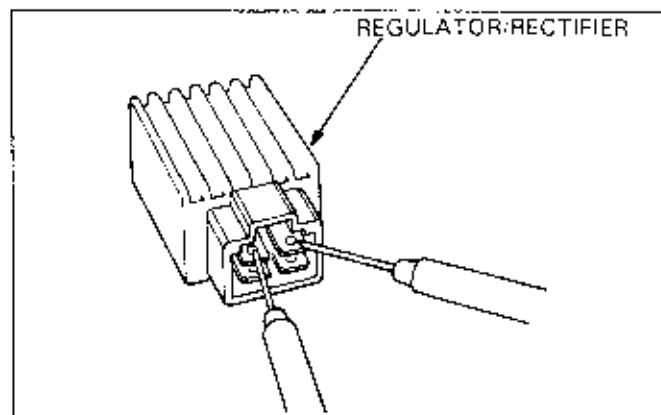
Remove the headlight and start the engine.

Turn the headlight on Hi-beam.

With the headlight wires still connected, measure the headlight lighting voltage between the terminals connected to blue (+) and green (-) wires.

Gradually increase the engine speed and read the voltage at the specified rpm.

Refer to Model Specific manual for service data.



## BATTERIES/CHARGING/LIGHTING SYSTEM

Select the AC range on your multimeter. (AC current flows to the headlight).

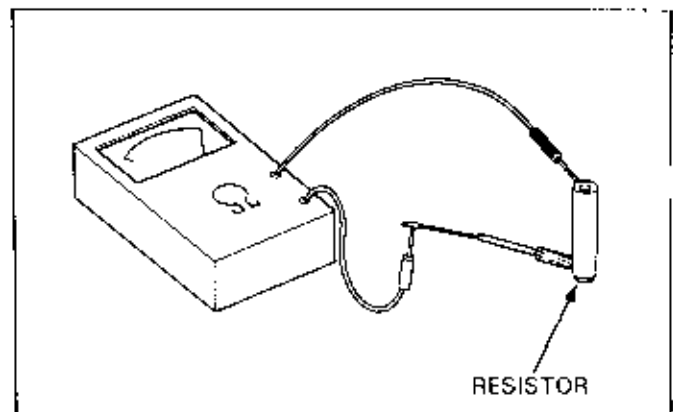
Use the specified multimeter. The measured headlight-regulated voltage may vary depending on the multimeter used because of the characteristics of the output waveform.

### SPECIFIC MULTIMETER:

- 07411-0020000 (KOWA Digital type)
- KS-AHM-32-003 (KOWA Digital type; USA only)
- 07308-0020001 (SANWA Analogue type)
- TH-5H (KOWA Analogue type)

### Resistor Inspection

For models with headlight resistor or an auto bystarter, measure the resistance of the resistor.



### AC Regulator Type:

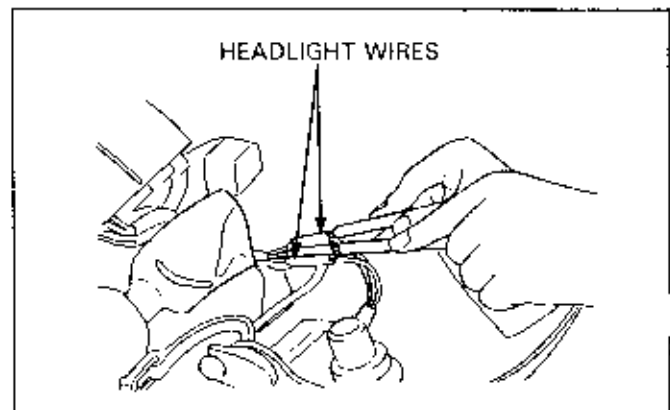
#### NOTE

- This section explains the inspection procedures for models which have an independent lighting coil powering the headlight system.
- For models with combined lighting and charging coil, refer to the regulator/rectifier inspection section.

For models not equipped with tachometer, connect engine tachometer.

Remove the headlight as shown, start the engine, and switch the headlight on Hi-beam.

With the headlight wires connected, measure the headlight lighting voltage between the blue (+) and green (-) wire terminals.



Increase the engine speed gradually and read the voltage at the specified engine rpm. Refer to the Model Specific manual for service data.

Select the AC range on your multimeter. (AC current flows to the headlight).

Use the specified multimeter. The measured headlight-regulated voltage may vary depending on the multimeter used because of the characteristics of the output waveform.

### SPECIFIC MULTIMETER:

- 07411-0020000 (KOWA Digital type)
- KS-AHM-32-003 (KOWA Digital type; USA only)
- 07308-0020001 (SANWA Analogue type)
- TH-5H (KOWA Analogue type)

- If the headlight lighting voltage is abnormally high, check the alternator connector and the alternator unit.
- If there is no headlight lighting voltage, check the following areas.
  - Loose or poor contact at a connection in the lighting circuit.
  - Continuity test for dimmer switch.
  - AC regulator.
  - Lighting coil in the alternator.

### AC REGULATOR INSPECTION

After checking that the connectors have no loose or poor connections, inspect the alternator unit by measuring the resistance between the terminals. (Refer to the Model Specific manual for service data.)

#### NOTE

- Resistance value will not be accurate if the probes touch your fingers.
- Use the following recommended multimeter.
- Using another manufacturer's equipment may not allow you to obtain the specified values. This is due to the characteristic of semiconductors, which have different resistance values depending on the applied voltage.

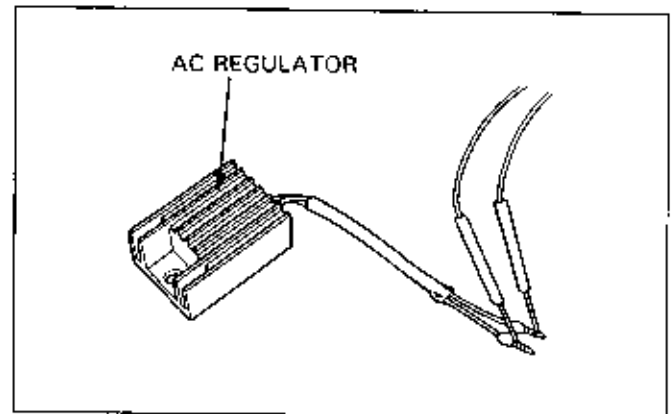
#### SPECIFIC MULTITESTER:

- 07411-0020000 (KOWA Digital type)
- KS-AHM-32-003 (KOWA Digital type; USA only)
- 07308-0020001 (SANWA Analogue type)
- TH-5H (KOWA Analogue type)

- Select the following range.

SANWA Tester:    k  $\Omega$   
 KOWA Tester:    x 100  $\Omega$

- An old, weak multimeter battery could cause inaccurate readings. Check the battery if the multimeter registers incorrectly.
- When using the Kowa multimeter, remember that all readings should be multiplied by 100.



If the resistance between the terminals is out of standard value, replace the regulator with a new one.

## ALTERNATOR

### CHARGING (CHARGING/LIGHTING) COIL INSPECTION

**NOTE**

- It is not necessary to remove the alternator from the engine.

Disconnect the alternator connector and check continuity between the wires.

(A) For single phase coils whose end is grounded, measure the resistance between output line and ground. (If the measured value is not correct, check the continuity between stator ground wire and ground, and between ground wire of alternator cover and ground.)

(B) For coils with two output lines, measure resistance between the two lines. Check that there is no continuity between engine ground and the output lines.

(C) For single phase, combined charging/lighting coils, measure the resistance at the charging output line and at lighting output line.

(D) For three phase coils, measure resistance between each output line, and check that there is no continuity between each output line and ground.

If the resistance values are much larger ( $\infty$ ) than the specified value, replace the stator.

If measurements are only slightly off the specified value, the stator may not need to be replaced.

Check other areas and decide if replacement is required.

### STATOR REMOVAL

Remove alternator cover. Watch for oil spilling out.

Hold the flywheel rotor with a holder and remove rotor bolt.

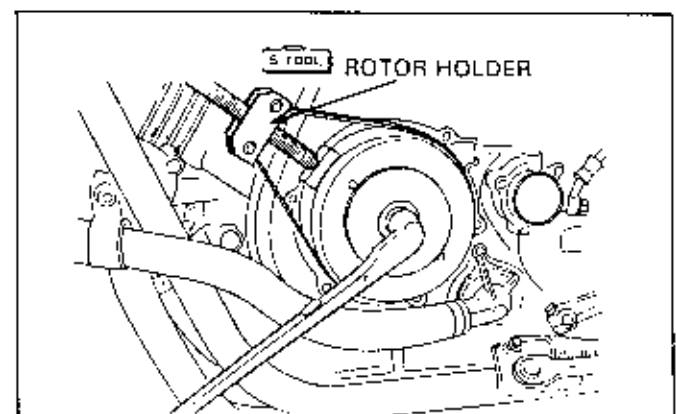
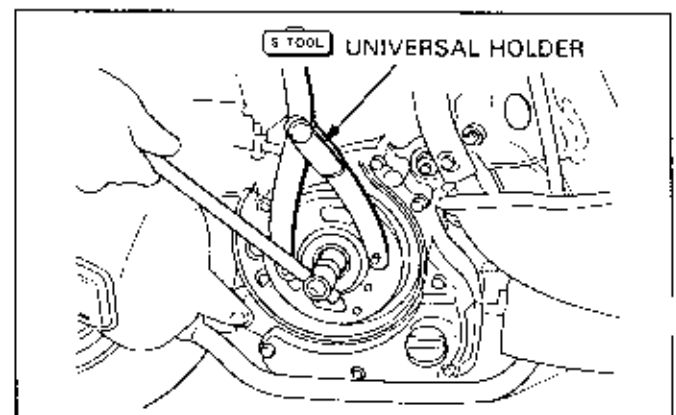
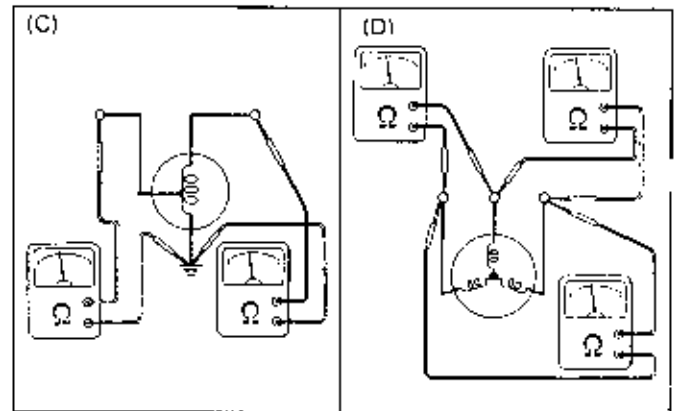
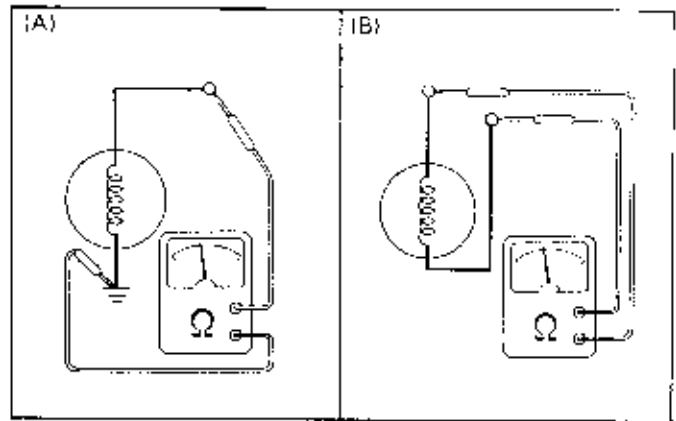
**3 TOOL**

**UNIVERSAL HOLDER**  
**ROTOR HOLDER**

**07725-0030000 or**  
**07725-0040000**

**CAUTION**

- Choose the correct holder. Using the wrong tool may damage components. Refer to the Model Specific manual for the correct holder.



Insert flywheel puller into the rotor and remove the rotor.

5 "00L

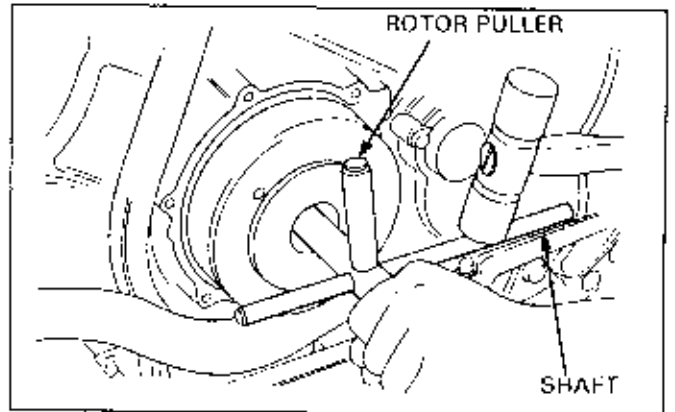
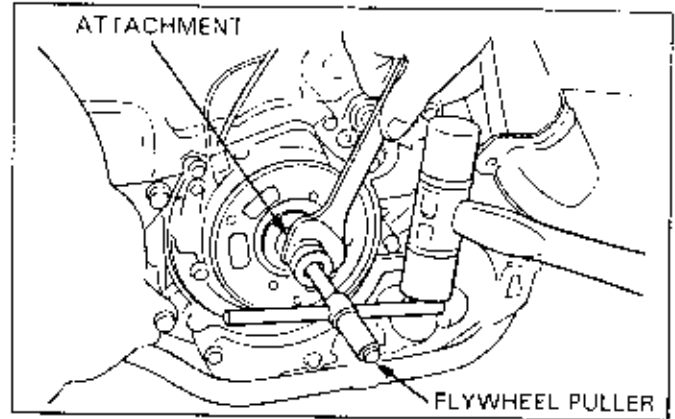
FLYWHEEL PULLER  
ROTOR PULLER

07733-0010000 or  
07733-0020001

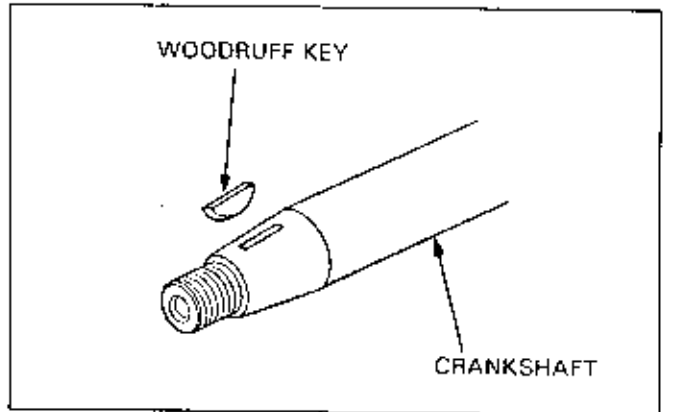
To remove the rotor, screw in the attachment, hold it securely with a wrench, and then screw in the puller shaft.

**CAUTION**

- Strong hammering on the puller shaft may damage the rotor.
- Always use a holder and a puller to remove the rotor. Do not try to remove the rotor by hammering directly on it. The crankshaft or components could be damaged.



Remove the woodruff key with care not to lose it.



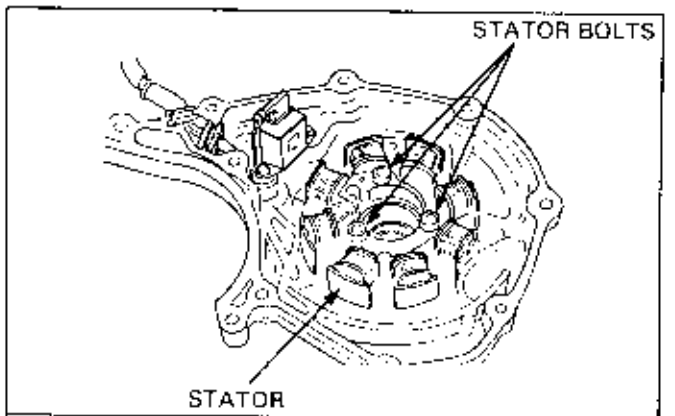
**STATOR REMOVAL**

Disconnect the alternator connector.

Remove the bolt or screw on the alternator cover or engine.

Remove the stator.

Stator bolts are often secured with locking agents. For this reason, use an impact driver.



## BATTERIES/CHARGING/LIGHTING SYSTEM

### STATOR INSTALLATION

Note the direction of stator, and install the stator on the crankcase.

Apply a locking agent to the bolt (or screw) threads and tighten it to the specified torque.

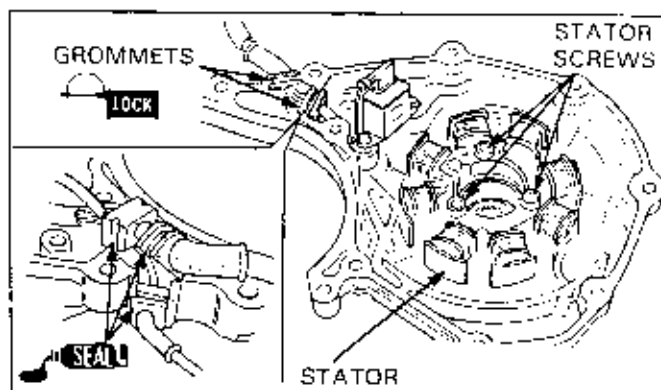
#### CAUTION

- If the stator bolt becomes loose, it may come into contact with the rotor and cause damage.

Route the stator wire correctly on the crankcase cover.

#### NOTE

- Route the stator wire so that it does not come into contact with the rotor.
- If there is a wire clamp or clip, secure the wire with it.
- Apply sealant to the grommet groove to prevent oil or water leakage.

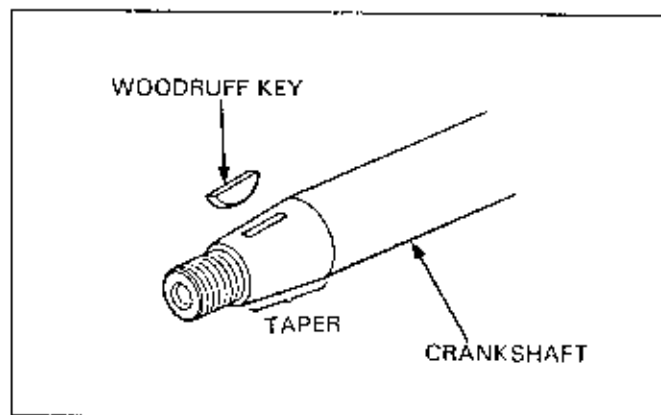


### ROTOR INSTALLATION

Clean the tapered portion of the crankshaft.

If the rotor is installed with dust or dirt on the taper, the taper will not make secure contact with the rotor and there will be excessive force on the woodruff key.

Insert the woodruff key into the key groove in the crankshaft.



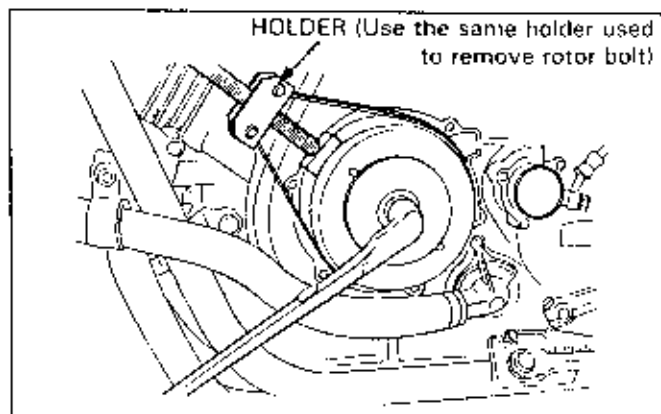
Set the rotor groove to the woodruff key and install the rotor on the crankshaft.

Tighten the rotor bolt (or nut) with your fingers.

#### CAUTION

- Before installing the rotor, check that no nuts or bolts are magnetically attached to the rotor. Installing the rotor with anything attached to it could damage the stator coil.

Hold the flywheel rotor with a holder and tighten the bolt (nut) to the specified torque.



Before bolting on the crankcase cover, check that the wires are not pinched.

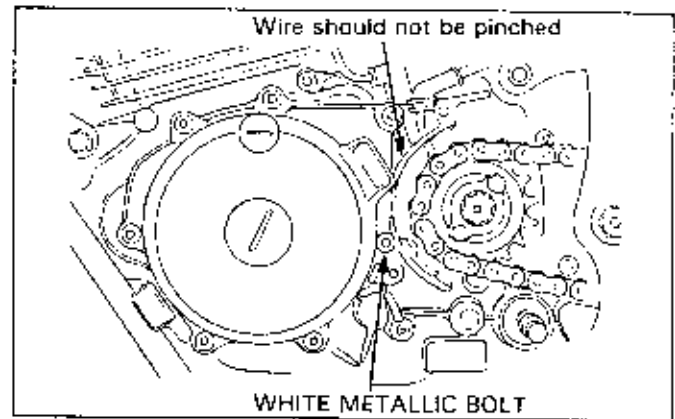
Install the crankcase cover onto the engine.

### CAUTION

- Use the crankcase (white metallic) ground bolt to ensure continuity between the engine and crankcase cover. (All other crankcase bolts are black.) The white bolt must be grounded properly to allow the electrical system to operate normally.

### NOTE

- For reassembly, install the white metallic bolt in the case hole with the unpainted seating surface.





# 23. IGNITION SYSTEMS

SERVICE INFORMATION	23-1	IGNITION TIMING	23-11
TROUBLESHOOTING	23-1	IGNITION COIL	23-12
SYSTEM DESCRIPTIONS	23-4	CDI SYSTEM	23-13
SPARK PLUG	23-9	TRANSISTORIZED IGNITION SYSTEM	23-16
SPARK TEST	23-10		

## SERVICE INFORMATION

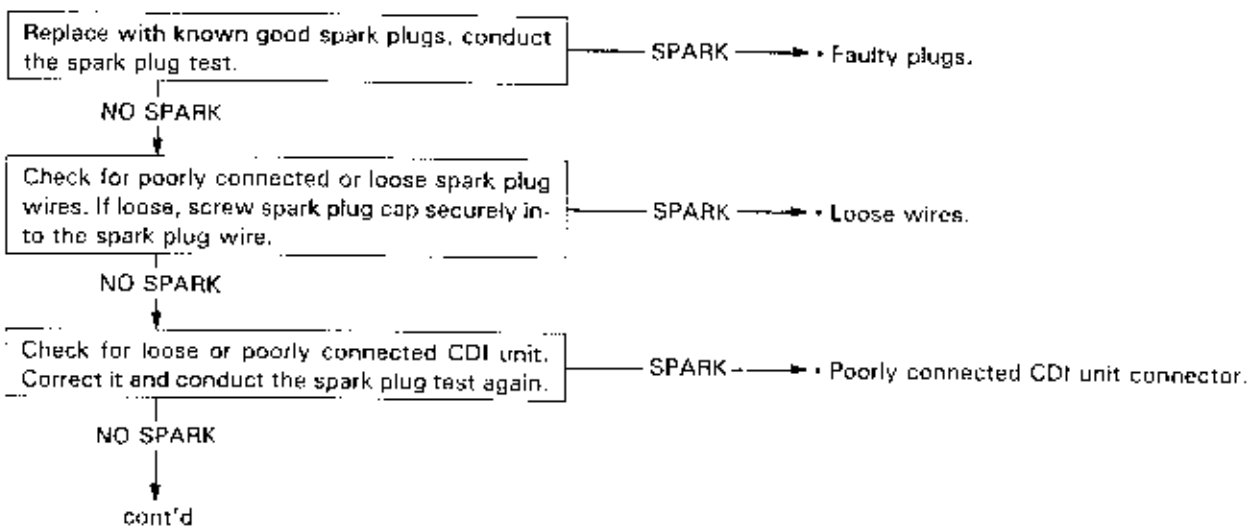
### GENERAL

- Follow the steps described in the troubleshooting flow chart when servicing the ignition system.
- The CDI unit and transistorized ignition system use an electrically controlled ignition timing system. No adjustments can be made to the ignition timing.
- For multi-cylinder engines, a rough diagnosis can be made by identifying the cylinder whose spark timing is incorrect.
- The CDI unit and the transistorized unit may be damaged if dropped. Also, if the connector is disconnected when current is flowing, the excessive voltage may damage the unit. Always turn off the ignition switch before servicing.
- A faulty ignition system is often related to poorly connected connectors. Check those connections before proceeding.
- For models with an electric starter, make sure the battery is adequately charged. Using the starter motor with a weak battery results in a slower engine cranking speed as well as a weak spark at the spark plugs.
- Use spark plugs of the correct heat range. Using spark plugs with an incorrect heat range can damage the engine. Refer to chapter 2 for servicing spark plugs.

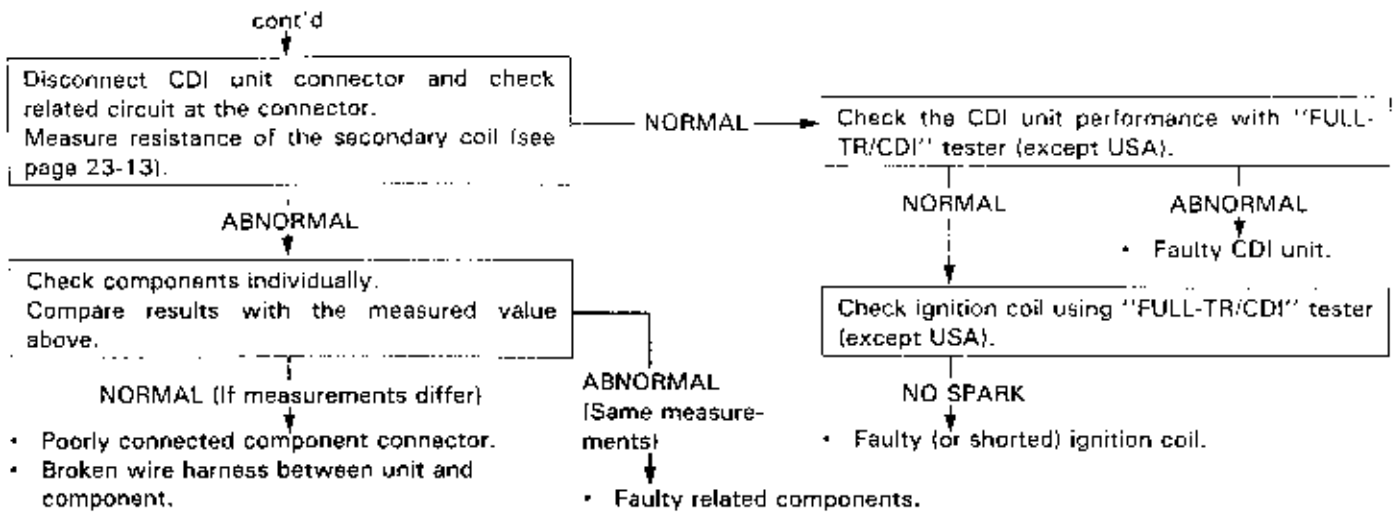
## TROUBLESHOOTING

The diagnostic steps presented here are general methods of troubleshooting the CDI and transistorized units. The steps and methods used in diagnosing may differ depending on each model. Refer to the Model Specific service manual for details concerning the ignition system.

### No spark at spark plugs. (CDI unit)

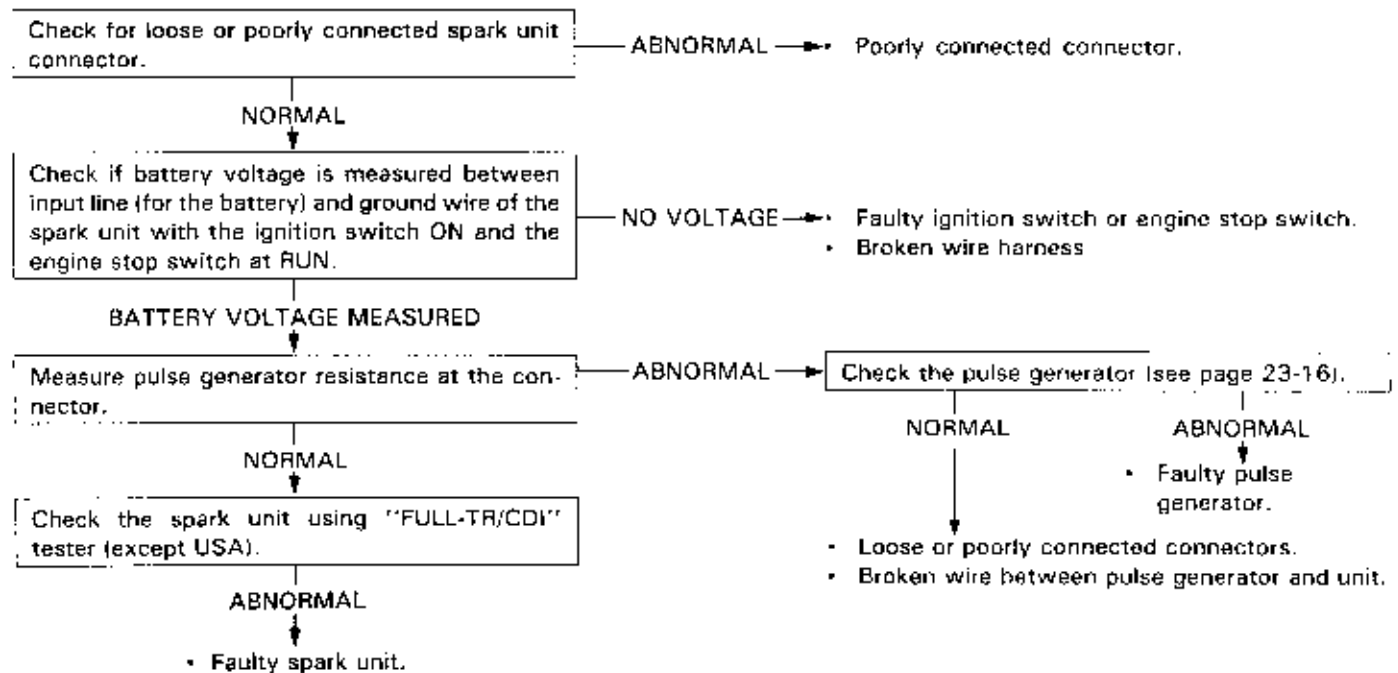


## IGNITION SYSTEMS



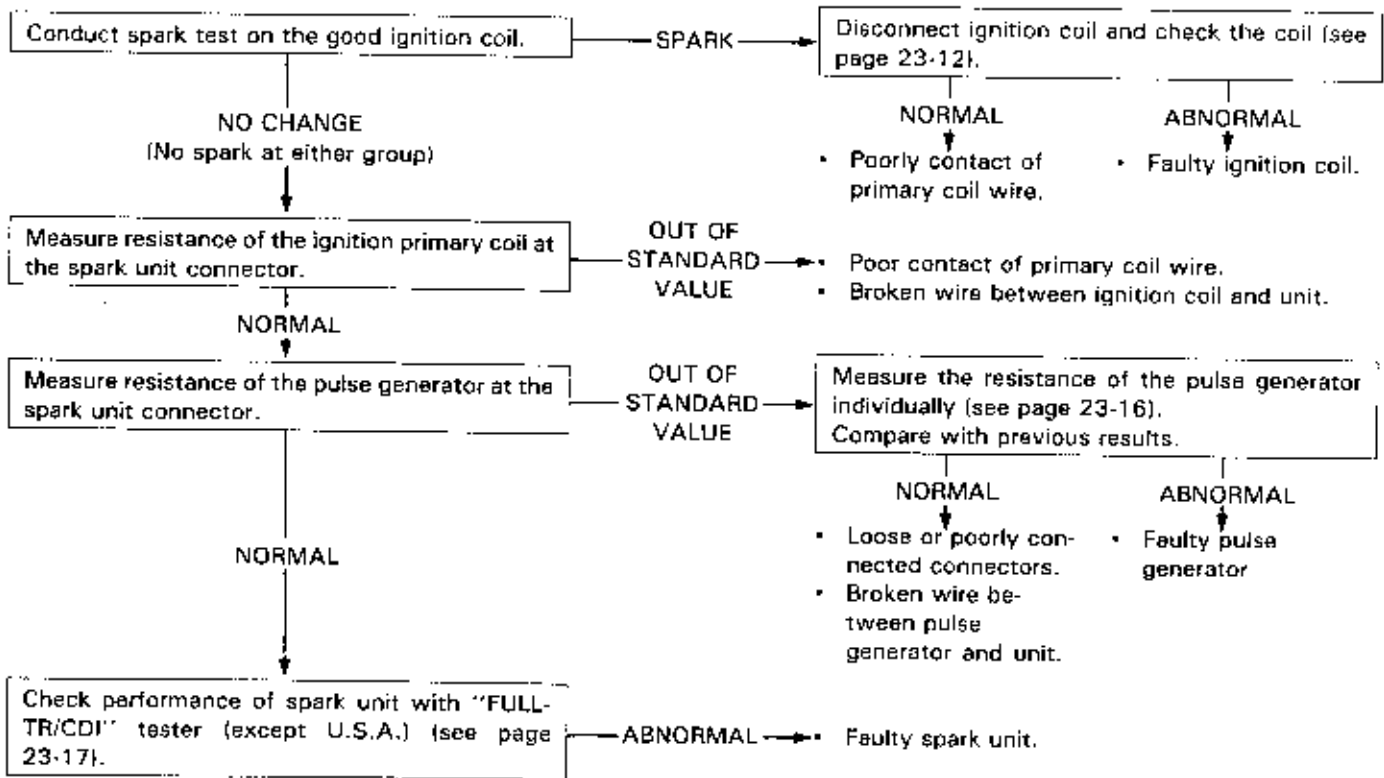
### No spark at all plugs. (Faulty Input system) <Transistorized ignition system>

If there is no spark at all plugs, the problem could be at the input of the ignition system (pulse generator, power supply circuit of the unit, spark unit).



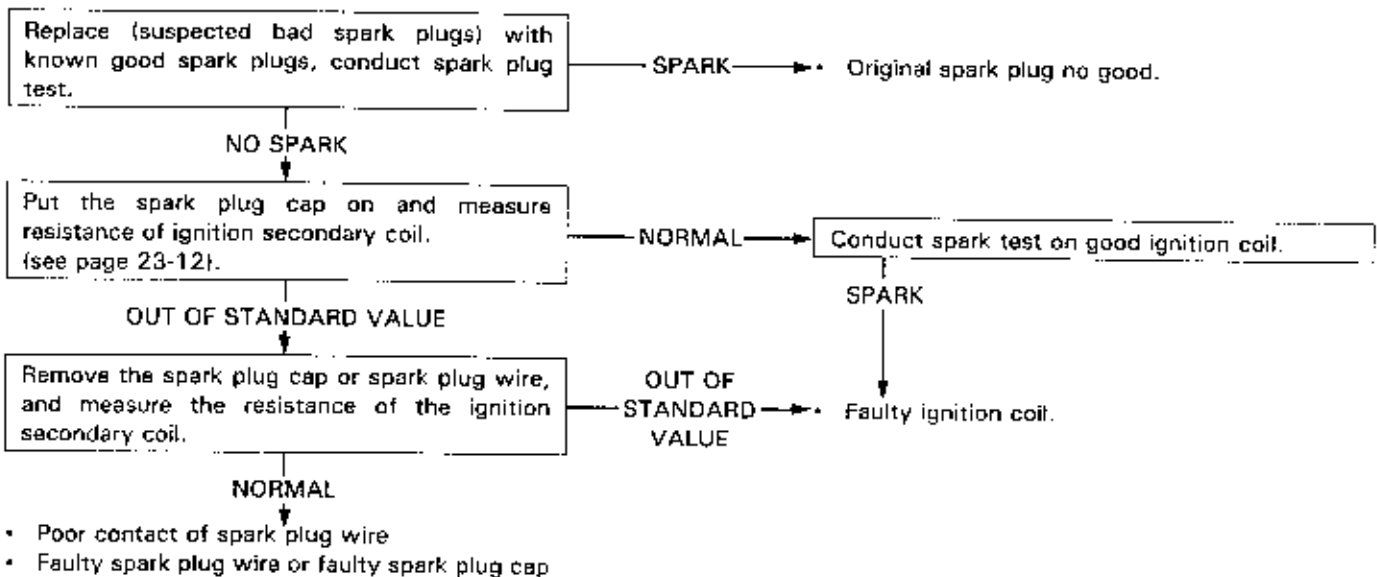
**No spark at either ignition group. <Multi-cylinder transistorized ignition system>**

- If there is no spark at either group, the problem is suspected in the primary coil side of the ignition system. (i.e. ignition coil, unit and ignition coil circuit.) However for models with several spark units where each fires its own group, faulty input components are suspected. Check input components described on the previous page.
- Ignition group is determined by the type of engine. Refer to Model Specific manual for details.



**No spark at one plug. (Trouble in secondary coil side) <Multi-cylinder transistorized ignition system>**

- For models with independent coils for each cylinder, the problem is suspected on the primary coil side. Refer to the above flow chart. (No spark at either ignition group)
- For double ignition coil (one coil igniting two spark plugs), faulty spark plug is most likely.



## SYSTEM DESCRIPTIONS

Most motorcycles use electrically controlled ignition systems. These ignition systems can be divided into two types, depending on how they operate.

Namely, there is the CDI and the transistorized type. Although their function is the same, the way they operate is different. In order to service these systems, one needs to understand their basic operation. Since both control their ignition-system components electrically, there is no mechanical wear, and periodic maintenance and adjustment is unnecessary.

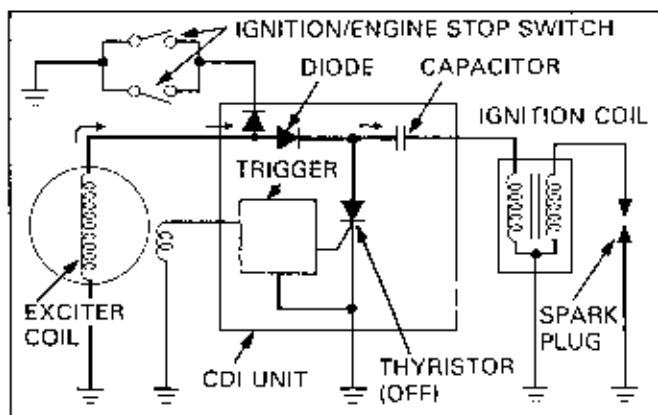
### CDI

The term CDI is an abbreviation for "Capacitive Discharge Ignition." The CDI produces quick and stable secondary voltage and is resistant to spark plug fouling. It is also designed to increase its secondary voltage as rpm increases. The CDI is used mainly on small engine displacement models.

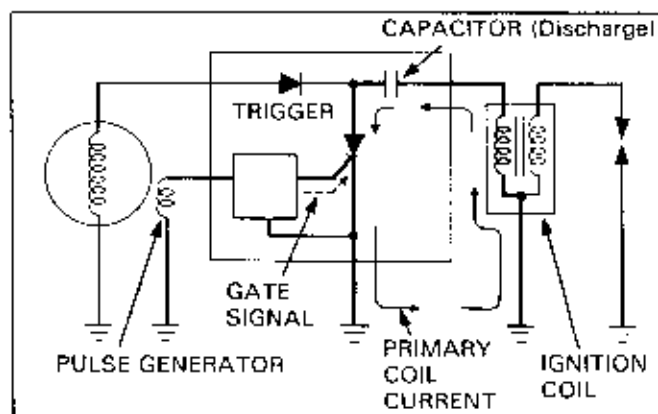
#### Operating Principles

As the alternator rotor turns, current is induced in the alternator (exciter coil). This current (AC) is fed to the CDI unit with a voltage of 100-400 volts. This AC current is half-wave rectified by a diode and is stored in the capacitor inside the CDI unit.

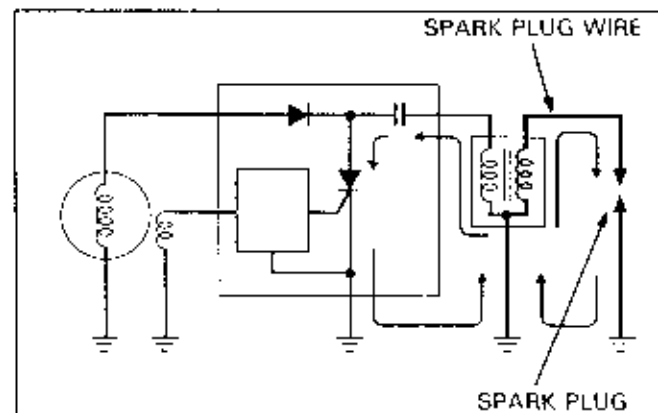
When the engine is turned off, the current induced by the exciter coil is shorted to ground, thus cutting off current to the capacitor and turning off the spark.



The capacitor cannot discharge until the SCR is turned ON. The SCR is turned ON as the pulse generator sends pulses to the trigger circuit which, in turn, feeds current to the gate of SCR.



When the SCR is turned ON, the capacitor discharges current to the ignition primary coil. A high voltage surge included in the secondary coil jumps the spark plug gap.

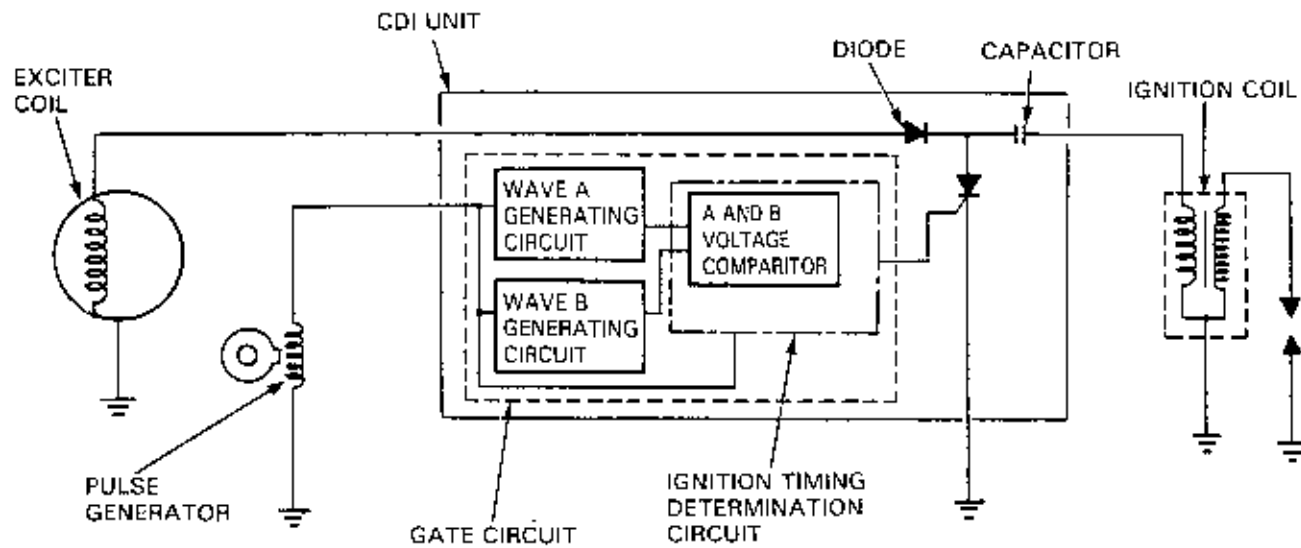


**Principle of Ignition Timing Advance**

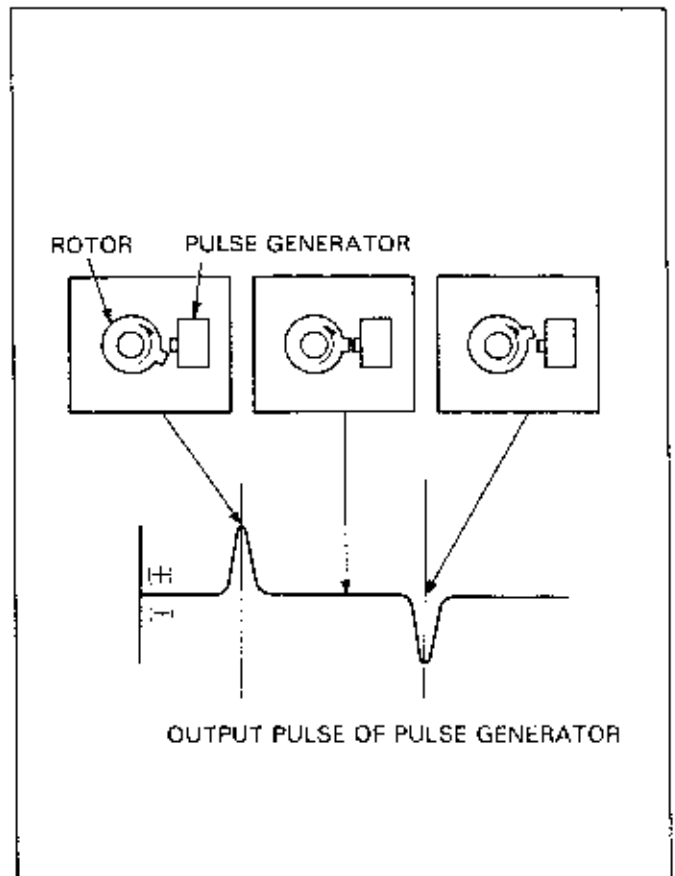
Another function of the electrically controlled ignition system is that the ignition timing advance (or retard) is controlled electrically. This system requires no mechanical advance and has no mechanical wear. The overall design eliminates periodic adjustments and maintenance.

This section explains the operating principles of the ignition timing advance. The ignition timing retard system operates under the same principles.

The trigger circuit consists of a wave A and wave B generating circuit which converts the output from the pulse generator to wave forms A and B, and an ignition timing selector circuit.



The pulse generator produces positive and negative voltage pulses when the rotor reluctor crosses the generator.



## IGNITION SYSTEMS

The output from the pulse generator is converted into basic waves A and B.

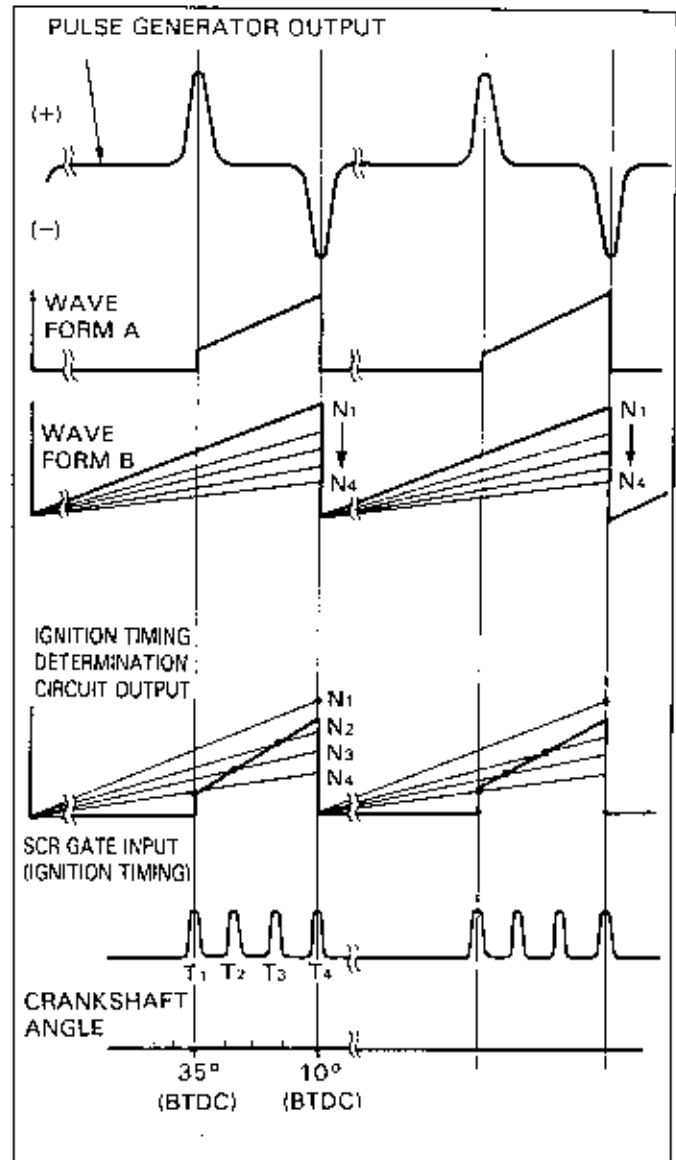
Basic wave A is unaffected by engine speed and remains constant.

Basic wave B changes its gradient as the engine speed increases as shown in the right graph.

The ignition timing determination circuit sends current to the gate of SCR when a negative voltage pulse from the pulse generator is input to the determination circuit or when the wave A becomes greater than wave B. The current to the gate of SCR turns on the SCR and ignites the spark.

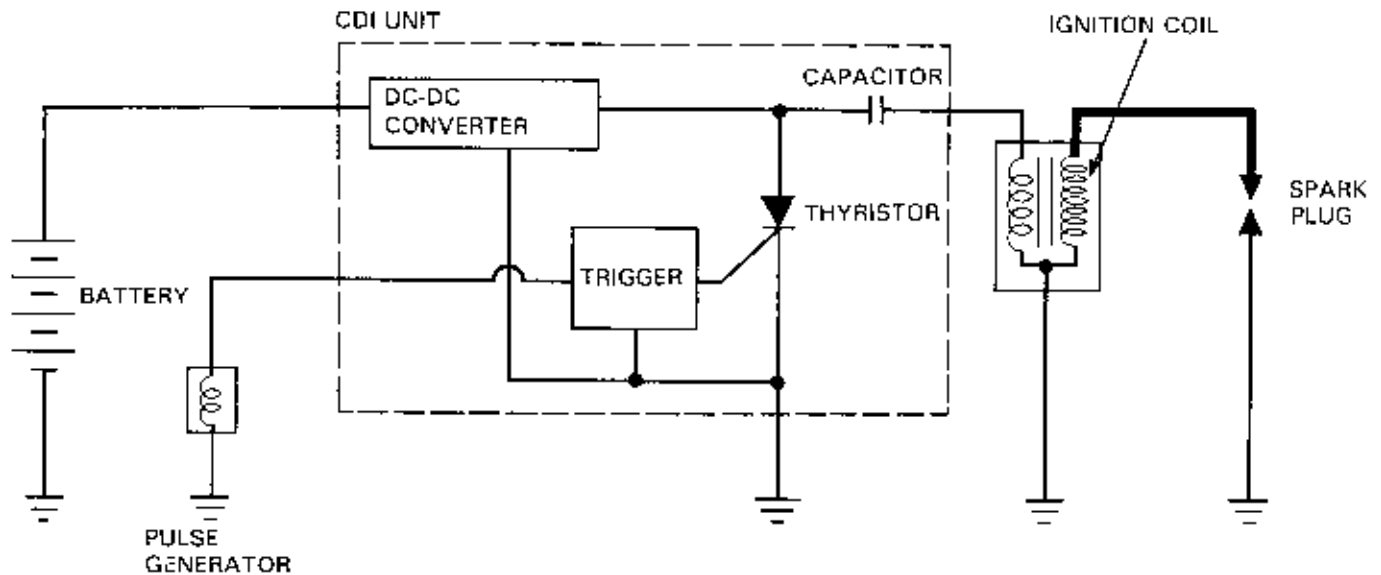
Since wave A remains constant and wave B changes its waveform, as the engine rotation increases, wave B becomes smaller than wave A. As the engine speed increases, the timing at which wave A becomes greater than wave B advances. When the engine speed increases above N4, ignition timing no longer advances because basic wave A is not inclined.

At N1, wave B is larger than wave A and thus ignition timing is determined by the negative voltage pulse from the pulse generator.



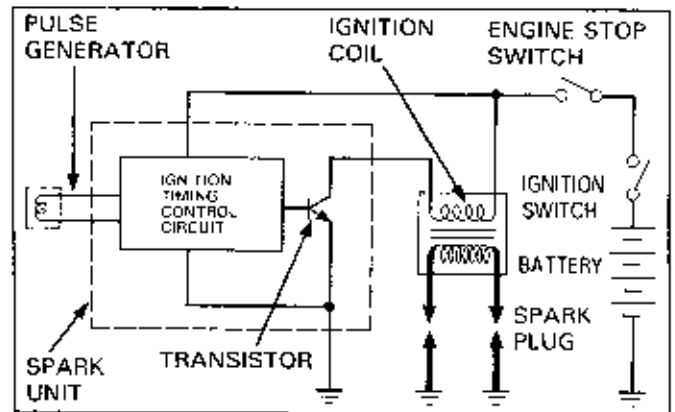
DC-CDI

The DC-CDI ignition system is basically a CDI system except that the battery is used for the source. The DC-CDI control unit includes a DC-DC converter which amplifies the battery voltage to about 220 V, which is then stored in the capacitor. Except for the DC-DC converter, the DC-CDI control unit is identical to the CDI unit. Compared to conventional exciter coil-powered CDI, the DC-CDI provides greater spark energy at low rpm since the power source is stable battery energy.



TRANSISTORIZED IGNITION SYSTEM

The transistorized ignition system also utilizes the battery, but its ignition operation works differently. Since the duration of time the spark plug fires is longer than that of the CDI, a larger ignition system is well suited for large displacement engines.

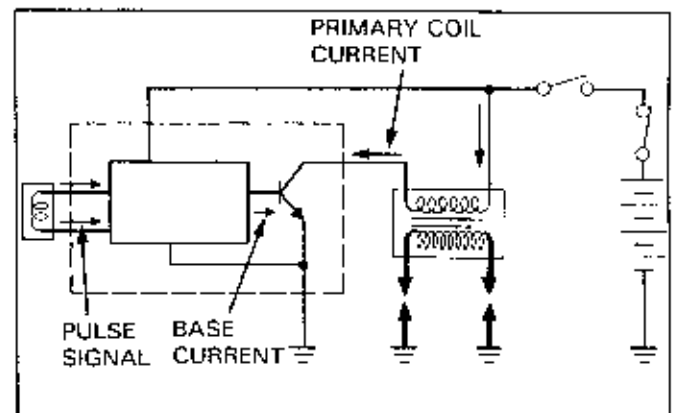


Operating Principles

The battery feeds current to the ignition primary coil via the ignition switch and engine stop switch when the transistor inside the spark unit is turned ON. This current is turned off when the transistor is OFF.

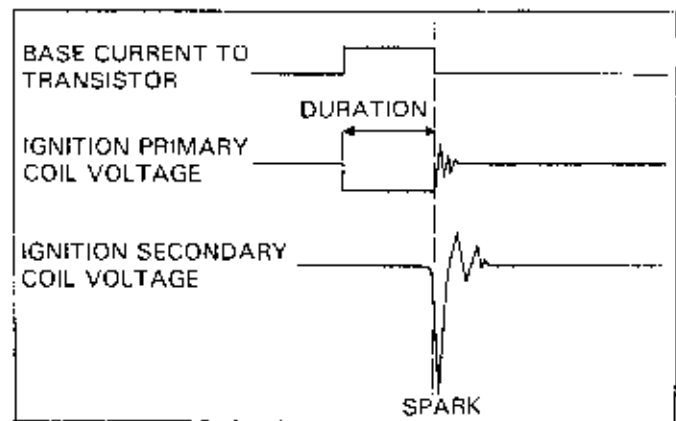
When the engine is turned on, the pulse signal from the pulse generator is fed to the ignition timing control circuit. The ignition timing control circuit determines the ignition timing based on the pulse signal and sends current to the base of transistor.

After current pulse flows through the primary coil, the transistor is turned OFF and current is cut off to the coil. At that moment, an induced voltage on the secondary coil ignites the spark plugs.



## IGNITION SYSTEMS

As the engine speed increases, the duration of current flow through the primary coil becomes shorter and thus the secondary coil voltage does not go high enough. For this reason, the ignition timing control circuit controls the duration of current flow through the ignition primary coil.



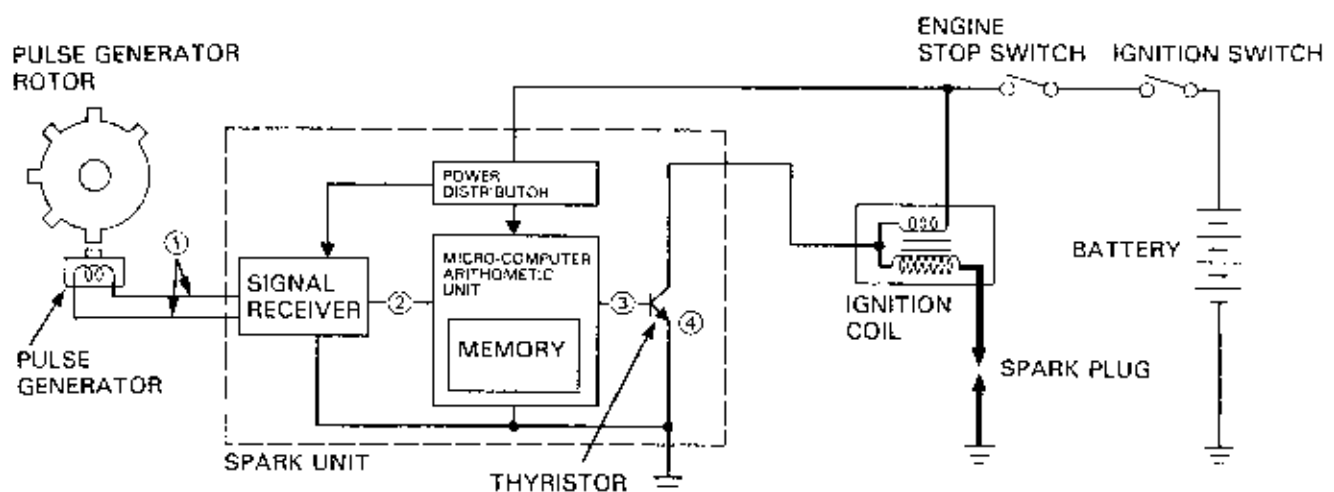
### DIGITALLY CONTROLLED TRANSISTORIZED IGNITION SYSTEM

This system digitally controls the ignition timing by a microcomputer inside the spark unit and calculates the ideal ignition timing at all engine speeds. It also has a fail-safe mechanism which cuts off power to the ignition coil in case the ignition timing becomes abnormal.

The control unit consists of a distributor, a signal receiver, which processes the pulse signals from the pulse generator, and a microcomputer which has a memory and an arithmetic unit.

The pulse generator rotor has reluctors which are irregularly spaced. When these reluctors move past the generator, pulses are fed to the spark unit. The number of reluctors and the angle between each reluctor differ depending on the number of cylinders and their arrangement. The circuit below is the ignition system of a 90° V-type 2 cylinder engine.

- ① As the engine starts, a pulse signal from the pulse generator is sent to the spark unit.
- ② The signal receiver converts the pulse signal to a digital signal and it is fed to the microcomputer.
- ③ As the microcomputer receives the digital signal, it processes signals containing information on the crankshaft angle and engine speed. The microcomputer then reads the information on ignition timing, which is based on the engine speed, from its memory, and determines the ignition timing. Then, the microcomputer sends current to the base.
- ④ As the current from the microcomputer flows to the base of transistor, the transistor is turned ON, and ignites the spark plug, identical to the transistorized ignition system.

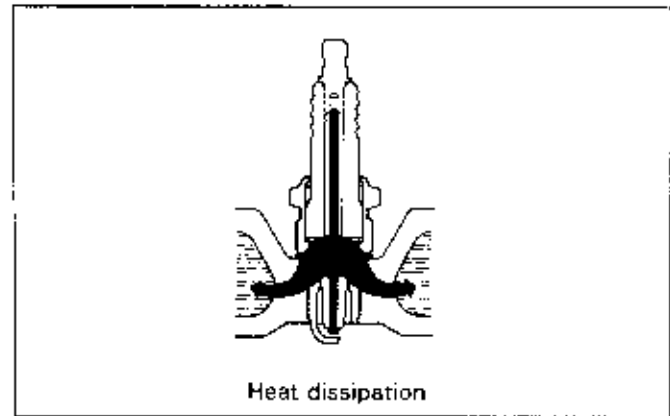




# SPARK PLUG

Due to the high voltage generated at the ignition coil, sparks jump across the center electrode and side electrode of the spark plug and ignite the fuel mixture in the combustion chamber.

Use spark plugs of the proper size and heat range appropriate for the engine, or the engine will not perform to its full potential and damage to the engine may occur.



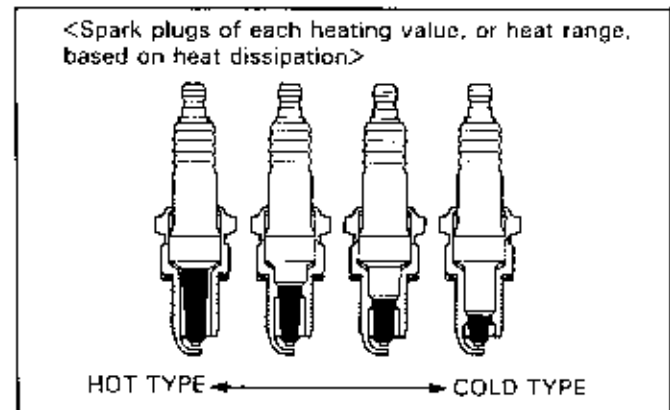
## Spark plug heat range

As the spark plug is constantly exposed to the engine combustion gas, it is necessary to dissipate heat in order to keep the spark plug at a certain temperature at which carbon deposits are burned off.

The capacity of dissipating the heat is called "heating value" or the heat range.

It is important to install the spark plug of the proper heating value, because the combustion gas temperature varies according to the engine type and driving conditions.

- Hot type ..... Heat is dissipated slowly.
- Cold type ..... Heat is dissipated quickly.
- Heating value is indicated by a number;
  - Smaller number ..... Hotter type
  - Larger number ..... Colder type

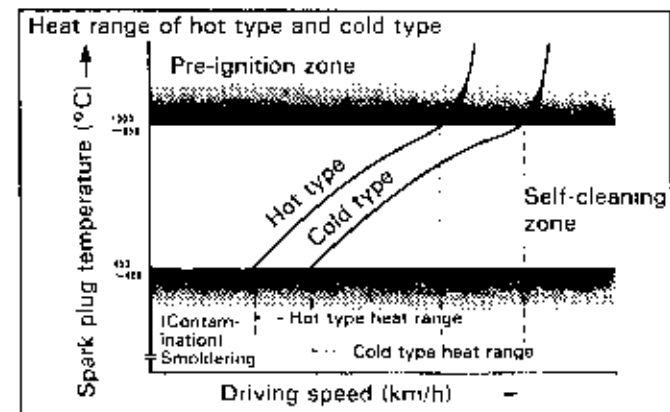


If an improper cold type spark plug is installed, the sparks do not jump across the electrodes as easily or it may contaminate the plug with oil/gasoline.

If an improper hot type is installed, it causes overheating or preignition and may result in melted electrodes and/or a hole in the piston.

Optional spark plugs are often listed for the Honda motorcycles.

Replace the plug with the optional one whenever the heating value of the original plug does not comply with the driving conditions.



There are several types of spark plugs, grouped according to the heating value, thread diameter and construction, as shown below.

## NGK plug

D	P	R	E	A-9
Thread dia.	Remark	Heating value	Thread length	Remark
A: 18 mm B: 14 mm C: 10 mm D: 12 mm	P: Porcelain projected type R: Resistor spark plug	4 (Hot type) 5 6 7 8 9 (Cold type)	E: 19 mm H: 12.7 mm	A, Z: Special type S: With cupped wick V: Narrow center electrode K: Side electrode Number indicates the plug gap. "9": 0.9 mm

## ND plug

X	24	E	P	U	-9
Thread dia.	Heating value	Thread length	Remark	Remark	Remark
M: 18 mm W: 14 mm X: 12 mm U: 10 mm	14 (Hot type) 15 20 22 24 27 (Cold type)	E: 19 mm F: 12.7 mm	P: Porcelain projected type L: Special plug R: Resistor spark plug S: Porcelain non-projected type U: With "U" groove in the side electrode	"9" indicates that the plug gap is 0.9 mm. If no number is listed, it usually indicates that the gap is 0.7 mm	

### SPARK TEST

Remove spark plugs from the cylinder head and connect spark plugs to the plug caps.

Ground the spark plug to the cylinder head and turn the ignition ON. Check if a good spark occurs while cranking the engine with the starter.

A high voltage spark will appear at the gap of the spark plug.

#### **⚠ WARNING**

- **Avoid touching the spark plug to prevent electric shock.**

For multi-cylinder engines, remove spark plug from each cylinder.

For some models with the CDI system, there is a circuit within the CDI unit designed to turn off the spark at low cranking speeds (below 200–500 rpm). In this case, leave the spark plug in the cylinder head and try the spark test with known good spark plug.

Some CDI units are designed to turn off the spark when the transmission is at neutral or reverse position.

If the plug fires, the spark plug is good.

Note that the plug is more difficult to fire in dense air than in normal atmospheric conditions.

Thus, even though spark occurs under normal atmospheric conditions, it may not occur in the compressed cylinder environment.

For this reason, you should check that the secondary coil has sufficient voltage by following the procedure that follows.

Attach a spark plug adaptor. Ground the black wire to the engine and conduct the spark plug test.

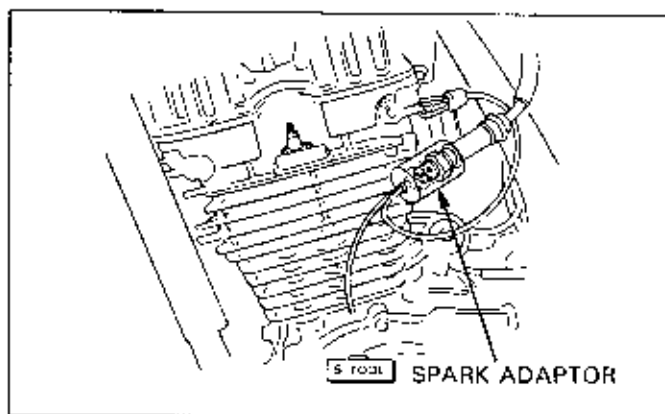
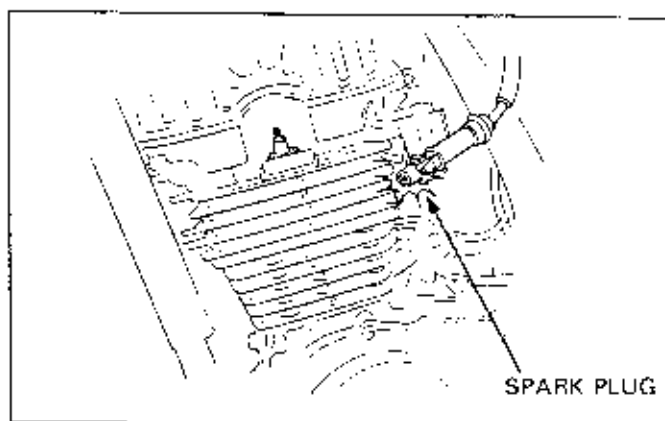
If there is a spark across the gap in the adaptor, the ignition coil is good.

#### **ⓘ Tool**

**SPARK ADAPTOR**

**07GGK-0010100**  
(Except USA)

If spark occurs across the spark plug gap, but no spark occurs with the adaptor on, the secondary coil voltage is insufficient.



## IGNITION TIMING

Warm up the engine.

Connect timing light to the spark plug wire.

For models with no tachometer, connect an engine tachometer.

### NOTE

- Read the instructions for timing light and engine tachometer before operating.

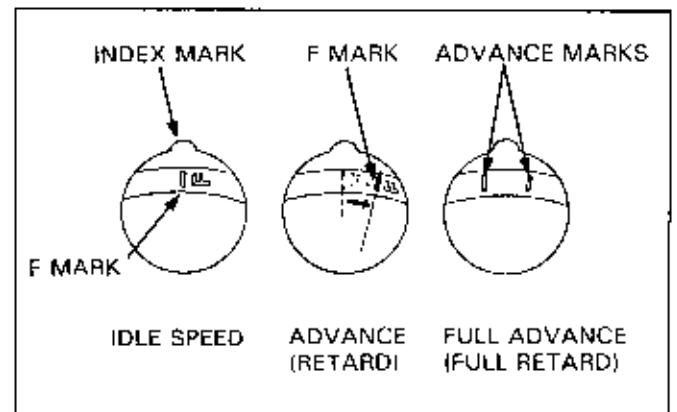
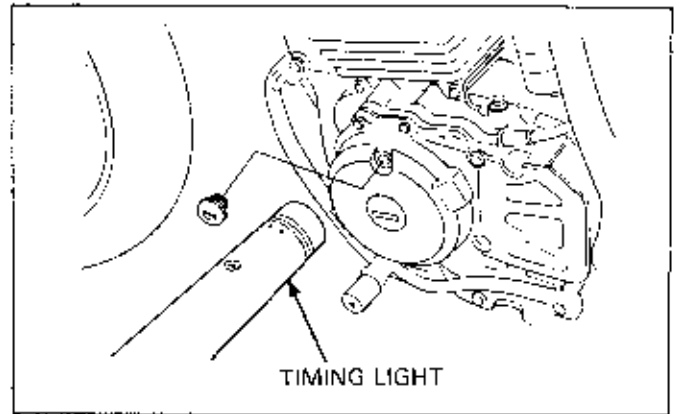
Remove the timing hole cap from the engine (Refer to the Model Specific manual for position of cap).

Start the engine and check if the following results are obtained.

- If the F mark on the rotor is aligned with the index mark on the case at the correct idling speed, then the timing is correct.
- Increase engine speed by rotating the stop screw on the carburetors.  
Check if the F mark begins to move when the engine speed reaches the advance (or retard) start rpm.  
However, this check cannot be done on models with a large ignition timing variation.
- At full advance/retard rpm, the ignition timing is correct if the index mark is between the two advance/retard marks.  
However, because models with large ignition timing variation cannot be checked this way, there are no advance/retard marks on the rotor for these models.

### NOTE

- For models with no advance (or retard) mark, check only the F mark position.

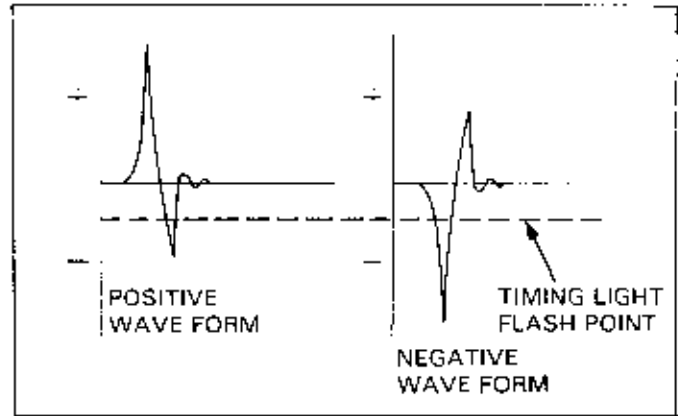


## IGNITION SYSTEMS

Depending on the kind of timing light used when checking the ignition timing, an abnormal advance timing could be observed.

This is because the spark plug wire being measured is not receiving a negative pulse. Most timing lights are designed to receive negative pulses.

If the spark plug wire being measured is receiving positive pulses, the input of the timing light will be receiving the alternated portion of the waveform. Thus, the timing light flickers.



Since the polarity of the waveform has no effect on the spark plug, connect the ignition primary coil wires to the opposite terminals. For double ignition coil types (a single coil firing two spark plugs), connect the timing light to the opposite wire of the same coil. The correct timing should then be observed.

## IGNITION COIL

### NOTE

- Since the resistance value of the primary coil is inherently very small, it is difficult to distinguish it from a shorted wire.
- Measure the coil resistance as a guideline for checking the coil. Check the performance of the coil with the "FULL-TR/CDI" tester (except U.S.A.).

### PRIMARY COIL INSPECTION

Measure the resistance between the two terminals of the ignition primary coil.

If the resistance value is within the specified range, the coil is good.

If resistance is  $\infty$  (infinite), replace the coil with a new one.

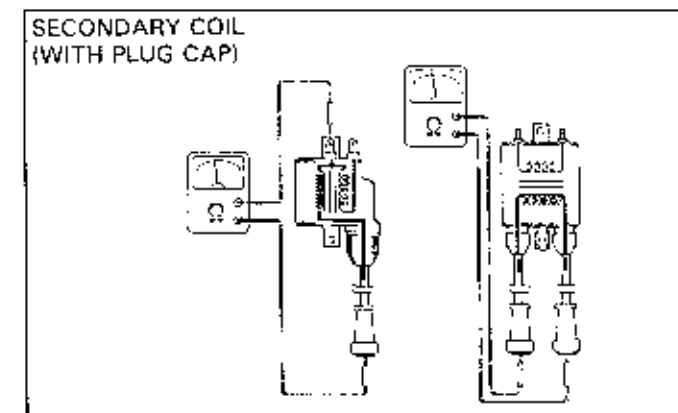
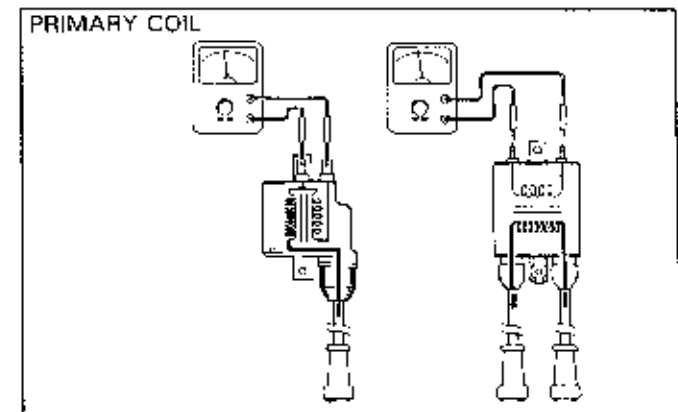
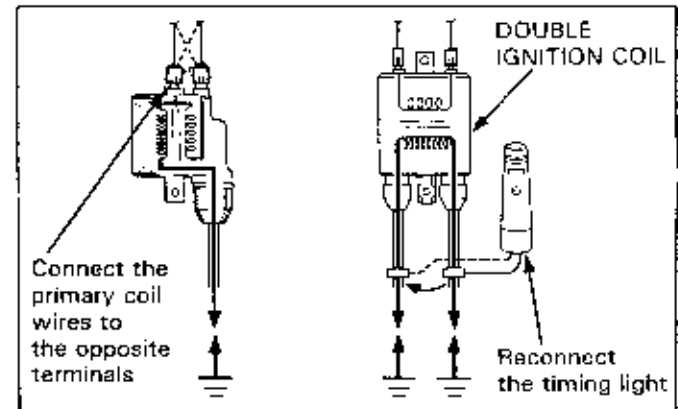
### SECONDARY COIL INSPECTION

With the spark plug cap on, measure the resistance between the primary coil terminal and the spark plug cap.

For double ignition coil, measure the resistance between the spark plug caps.

If the resistance value is within the specified range, then the coil is good.

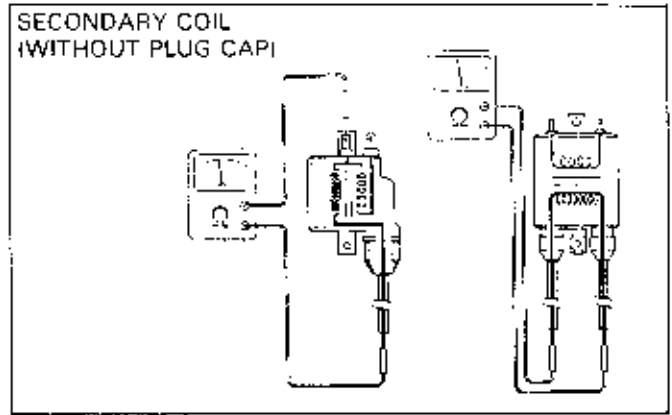
If the resistance is  $\infty$  (open wire), disconnect the spark plug cap and measure the secondary coil resistance.



Measure resistance between the primary coil terminal and spark plug wire.

For double ignition coil, measure the resistance between the spark plug wires.

If the resistance value is within the specified range, the coil is good.



### PERFORMANCE TEST (EXCEPT U.S.A.)

Test the spark performance of the ignition coil, using the Full-transistor/CDI tester.

Replace the coil if no spark occurs inside the spark adaptor.

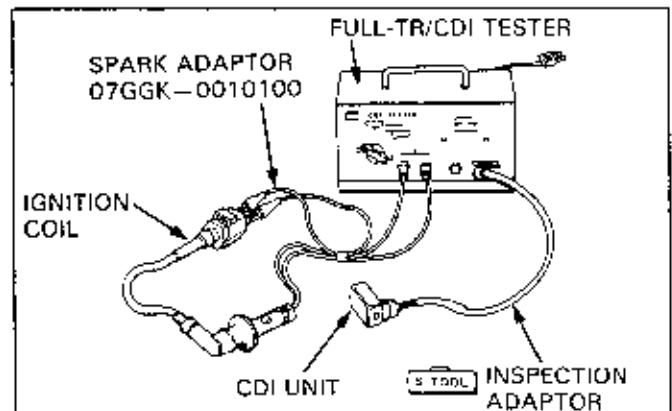
Read the instructions for the tester carefully and conduct the tests correctly.

The type of inspection adaptor used differs from model to model. Refer to the Model Specific manual for information on the type of adaptor required.

#### CAUTION

- The CDI unit or tester could be damaged if they were connected incorrectly.

Refer to the Model Specific manual for the connections of inspection adaptor (07508-0010400) whose wires are connected to the unit one by one.



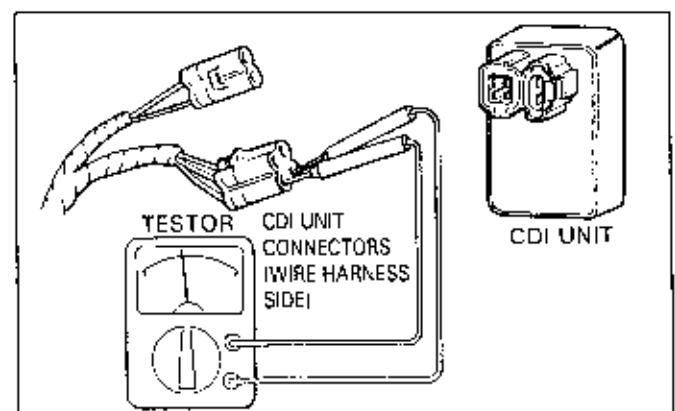
## CDI SYSTEM

### CIRCUIT INSPECTION

#### NOTE

- For diagnosing the ignition system, follow the steps in the troubleshooting flow chart.
- Refer to the Model Specific manual for service data, wiring diagrams, and wire colors.

Disconnect the connector from the CDI unit and diagnose the ignition related components by testing the connectors on the wire harness side.



## IGNITION SYSTEMS

### Checking items at the CDI unit connector

Checking item		Diagnosis
Ignition switch/Engine stop switch wire (excluding DC-CDI)		When the ignition switch is ON and engine stop switch at RUN, check for continuity between body ground and ignition switch wire.
Exciter coil wire (excluding DC-CDI)		Check if the specified resistance value is obtained between body ground and exciter coil wire.
Pulse generator wire		Check if the specified resistance value is obtained between body ground and pulse generator wire.
Ignition primary coil wire		Check if the specified resistance value is obtained between body ground and primary coil wire.
Neutral, reverse, change switch (for certain models only)		Check for continuity between ground and the wire corresponding to the transmission gear position.
Wire harness	Battery input line (only for DC-CDI)	When the ignition is ON and engine stop switch at RUN, check if battery voltage appear between battery input line and ground wire.
	Ground wire	Check for continuity between ground wire and body ground wire.

- If the above inspections are normal but the spark plug still does not fire, the problem could be related to the CDI unit or ignition coil. Check the CDI unit or ignition coil using the CDI/FULL-TR tester.
- If there is an abnormal circuit in the above inspection, check all items first and then check each component individually.

### PULSE GENERATOR INSPECTION

Disconnect pulse generator wire from the wire harness and measure resistance of coil between the two wire terminals.

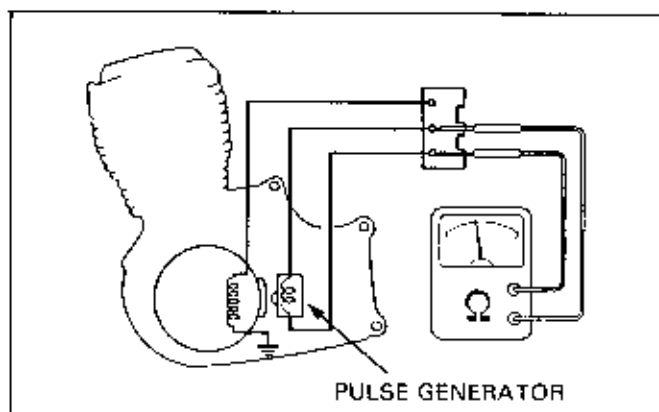
If the resistance value is within the specified range, the pulse generator is good.

If the resistance is far off the specified range, replace the pulse generator.

#### NOTE

- If the resistance value is slightly off the standard value, it may not necessarily have any effect on its function. In this case, check all of the related components for trouble in other areas.

For removal and replacement of pulse generator, refer to the Model Specific manual.



**EXCITER COIL INSPECTION**

Disconnect the alternator from the wire harness and measure the exciter coil resistance.

For engine ground type, measure the resistance between the exciter coil output line and body ground.

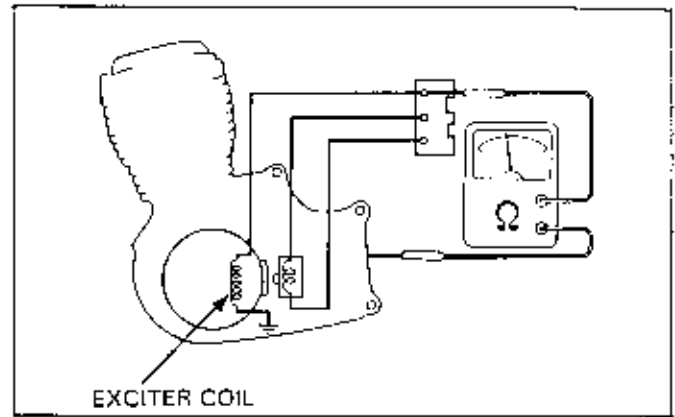
For exciter coil with ground wire, measure the resistance between the exciter coil output line and ground wire.

If the resistance value is within the specified range, the exciter coil is good.

If the resistance value is far off the specified value, replace the stator with a new one.

**NOTE**

- If the resistance value is only slightly off the standard value, it may not necessarily have any effect on its function. In this case, check all of the related components for trouble in other areas.



**CDI UNIT PERFORMANCE TEST (EXCEPT U.S.A.)**

The CDI unit is checked by the Full transistor/CDI tester.

Follow the tester manufacturer's instructions.

Refer to the Model Specific manual for the type of inspection adaptor required.

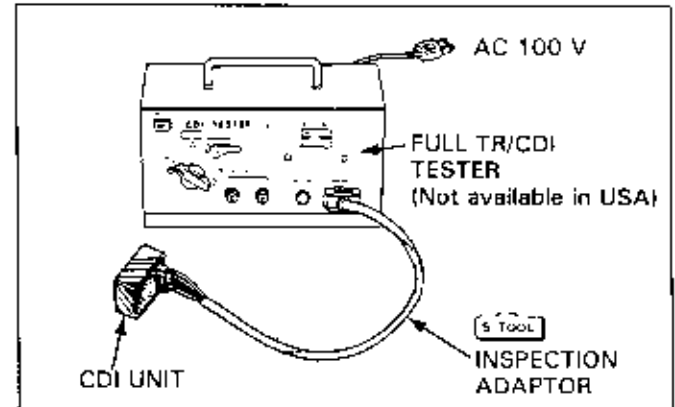
**CAUTION**

- Improper connections could damage the CDI unit or tester.

For inspection adaptor, refer to the Model Specific manual.

Switch	Good condition	Bad condition
OFF	No spark	---
P	No spark	---
EXT	No spark	Spark
ON1	Spark	No spark
ON2	Spark	No spark

If there are any 'Bad' symptoms in the checks above, replace the CDI unit.



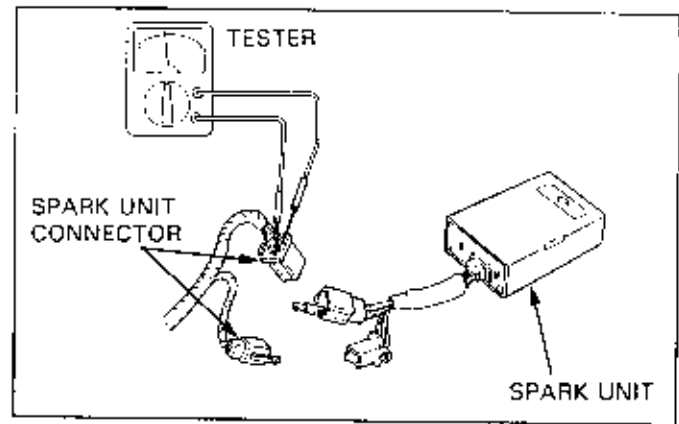
# TRANSISTORIZED IGNITION SYSTEM

## CIRCUIT INSPECTION

**NOTE**

- Follow the steps in the troubleshooting flow chart for servicing.
- Refer to the Model Specific manual for service data, wiring diagrams, and wire colors.

Disconnect the connector from the spark unit and conduct these tests at the connector.



**Spark unit connector inspection item**

Inspection item	Diagnosis
Power source input line	Check if there is battery voltage between the power source input line and the ground line when the ignition switch is "ON" and engine stop switch is at "RUN".
Pulse generator coil	Check if the resistance value between the wires is in the specified range.
Ignition primary coil	Check if the resistance value between the coil wire and body ground or ground wire is in the specified range.
Ground wire	Check for continuity between the ground wire and body ground.

- If the above diagnosis reveals no abnormality, but the spark plug still will not fire, the ignition coil or spark unit could be faulty. Check the spark unit or ignition coil using a CDI/Full transistor tester.
- If the above diagnosis indicates a faulty circuit, check all circuits, then check each of the components individually.

## PULSE GENERATOR INSPECTION

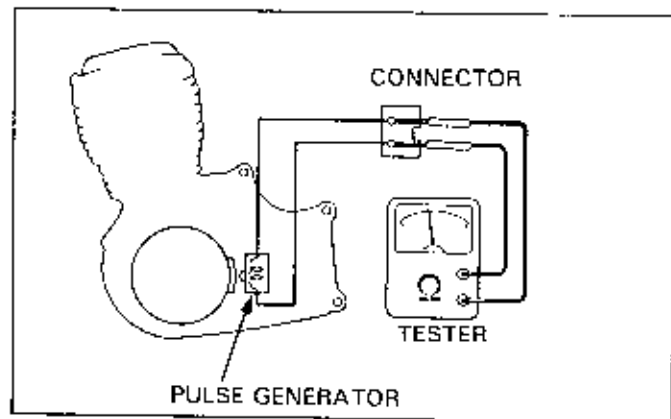
Disconnect the pulse generator from the wire harness and measure the resistance between the wire terminals.

The pulse generator is good if the resistance value is within the specified range.

Replace the pulse generator if the value is far off the specified range.

**NOTE**

- If the resistance value is only slightly off the standard value, it may not necessarily have any effect on its function. In this case, check all related components for trouble in other areas.



Refer to the Model Specific manual for removal and replacement of pulse generator.



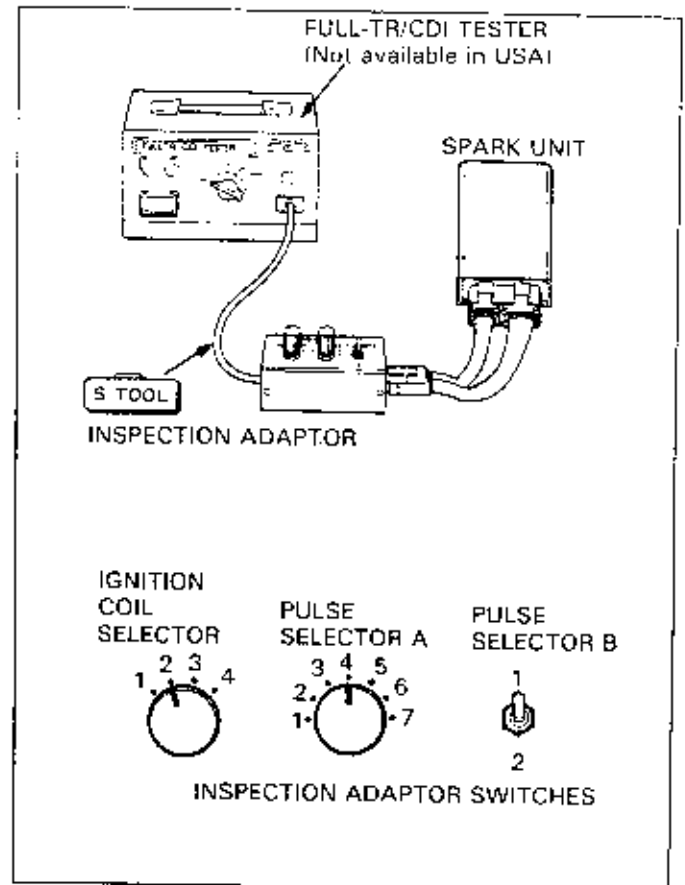
**SPARK UNIT PERFORMANCE TEST  
(EXCEPT U.S.A.)**

Use the "Full-TR/CDI" tester to test spark unit performance. Follow the tester manufacturer's instruction. Refer to the Model Specific manual for the type of inspection adaptor required.

**CAUTION**

- Improper connections could damage the CDI unit or tester.

Switch	Good condition	Bad condition
OFF	No spark	—
P	No spark	—
EXT	No spark	Spark
ON1	Spark	No spark
ON2	Spark	No spark



For digital-controlled spark unit, use spark adaptor (07508-0013600).

Select the proper position for the selector switch before testing.

Selector	Item
IG Coil Selector	Number of ignition coil
P. Selector A	Pulse signal No. (Refer to Model Specific manual for switch position)
P. Selector B	Firing interval (No. of cylinder) "1": 2, 4 cylinders "2": 3, 6 cylinders

# 24. ELECTRIC STARTER/STARTER CLUTCH

SERVICE INFORMATION	24-1	CLUTCH SWITCH DIODE INSPECTION	24-8
TROUBLESHOOTING	24-1	STARTER CLUTCH INSPECTION	24-8
STARTER MOTOR	24-3	STARTER PINION INSPECTION	24-9
STARTER RELAY SWITCH	24-6		

## SERVICE INFORMATION

### ⚠ WARNING

- Always turn the ignition switch OFF before servicing the starter motor. The motor could suddenly start, causing serious injury.

- Refer to the Model Specific manual for removal and installation of the starter motor.
- A weak battery may be unable to turn the starter motor quickly enough, or, supply adequate ignition current.
- If the current is kept flowing through the starter motor to turn it while the engine will not be cranking, the starter motor may be damaged.
- For models with a centrifugal clutch, incorrect adjustment of the brake light switch could prevent the starter motor from operating.

## TROUBLESHOOTING

### Starter motor turns slowly.

- Low specific gravity in battery (or Dead battery).
- Poorly connected battery terminal cable.
- Poorly connected starter motor cable.
- Faulty starter motor.
- Poorly connected battery ground cable.

### Starter motor turns, but engine does not turn.

- Starter motor is running backwards.
  - Brushes assembled improperly.
  - Case assembled improperly.
  - Terminals connected improperly.
- Faulty starter clutch.
- Damaged or faulty starter pinion.
- Damaged idler gear or reduction gear.
- Broken starter motor drive chain.
- Faulty starter clutch.

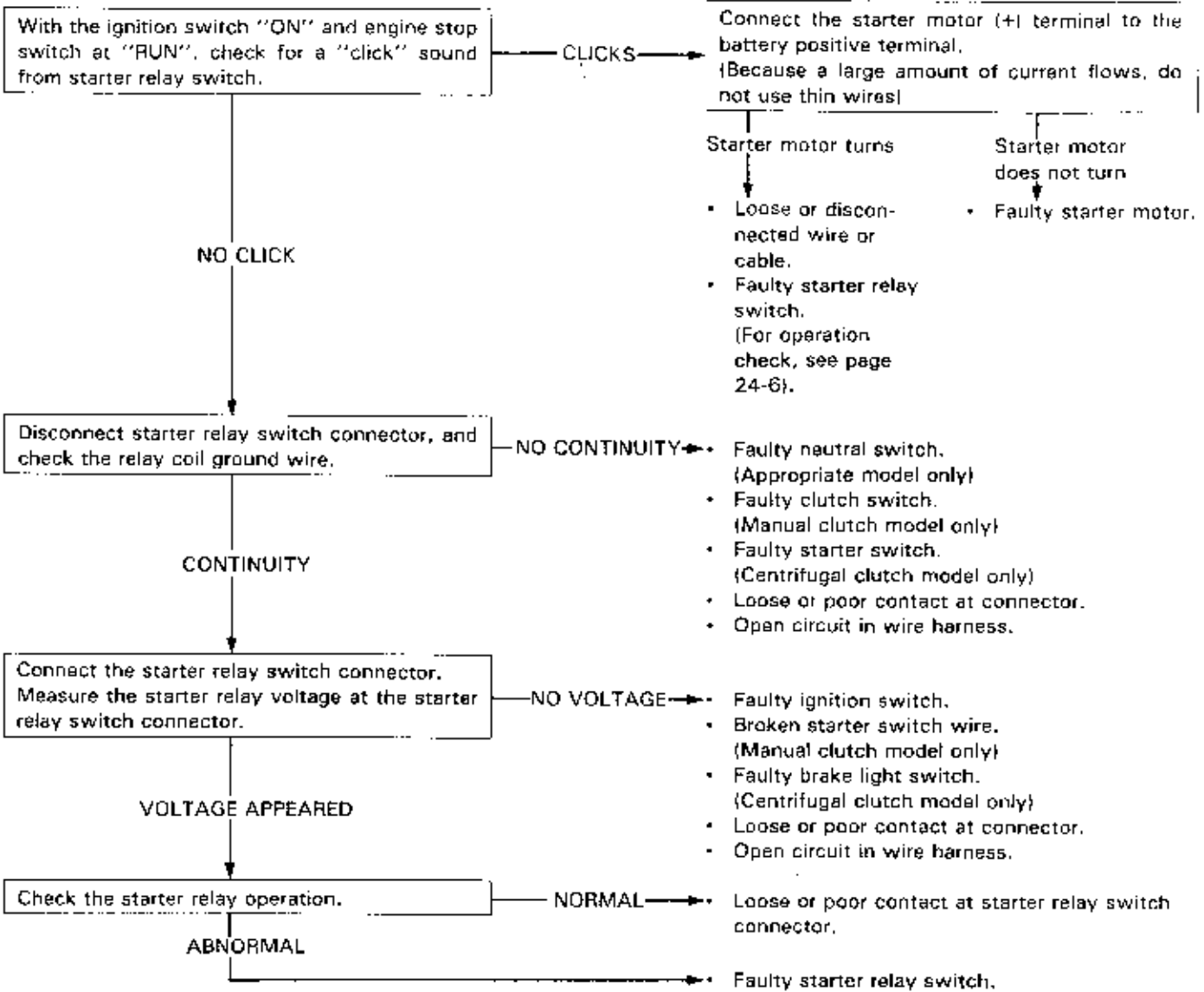
### Starter motor relay "clicks", but engine does not turn over.

- Crankshaft does not turn due to engine problems.
- Excessive reduction gear friction.
- Faulty starter pinion engagement.

# ELECTRIC STARTER/STARTER CLUTCH

## Starter motor will not turn.

- Check for a blown out main or sub fuse before servicing.
- For models with a centrifugal clutch, check that the brake light switch is correctly adjusted.



## STARTER MOTOR

### DISASSEMBLY

Before disassembling the starter motor mark the position of the case and cover so the starter can be assembled correctly later.

Remove the starter motor case screws and remove the cover.

### NOTE

- For models with shims between the armature and cover, record the location and number of shims.
- Record the order so the parts can be installed correctly later.

### INSPECTION

Check for continuity of the starter motor case.

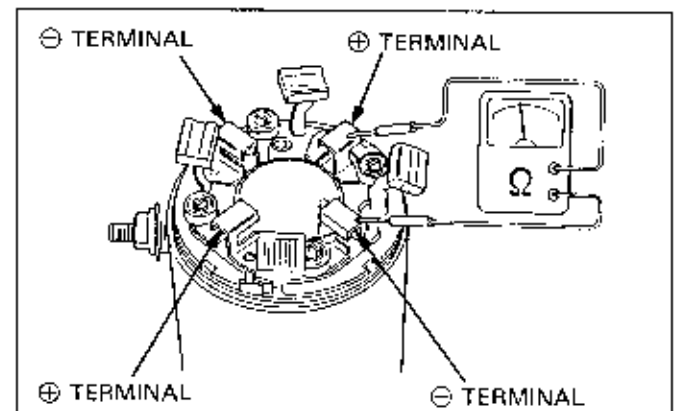
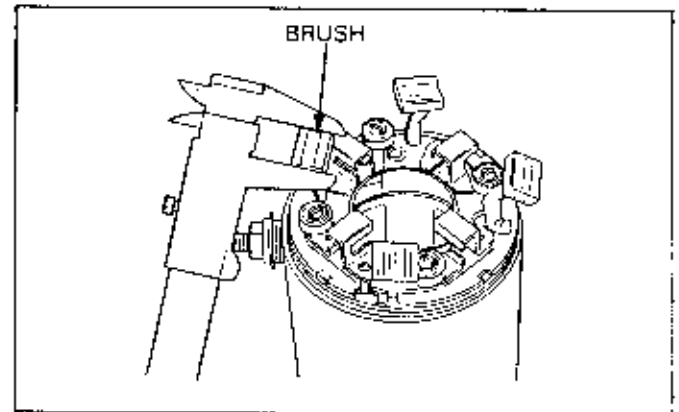
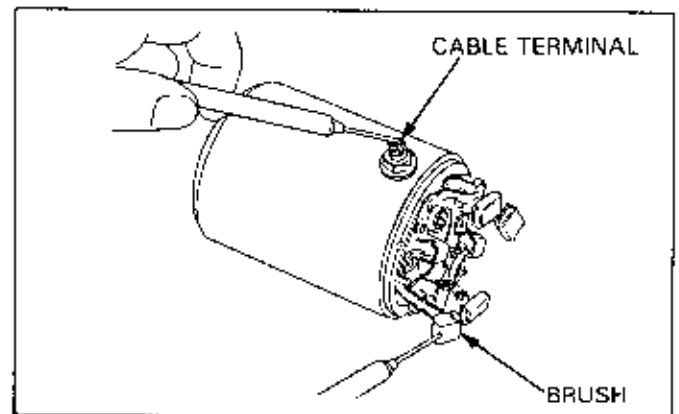
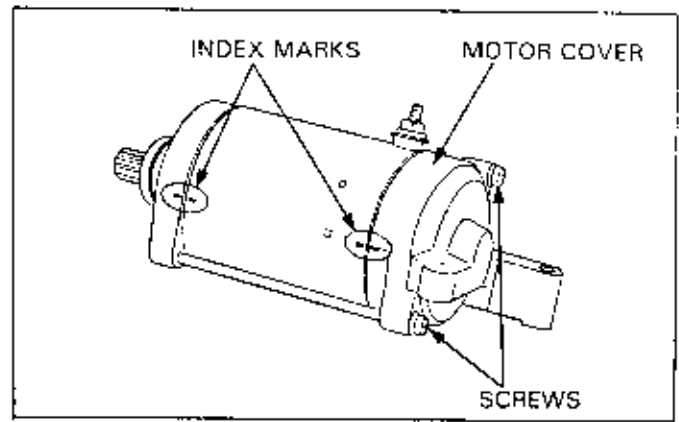
- Between cable terminal and case: normal if no continuity.
- Between cable terminal and brush (black wire): normal if there is continuity.

If abnormal, replace with a new one.

Measure the brush length.

Replace the brush if it is worn beyond the service limit.

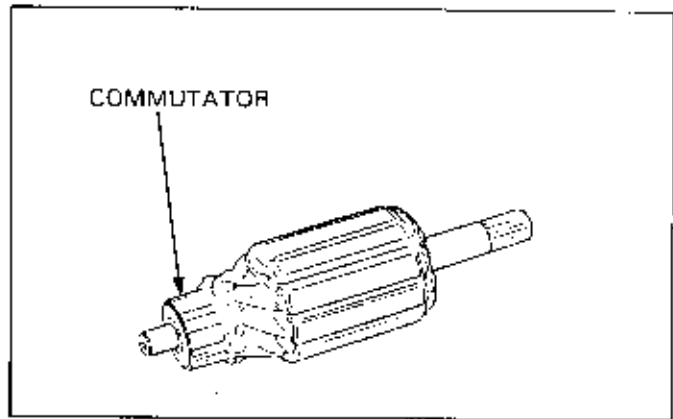
Check for continuity between  $\oplus$  and  $\ominus$  terminals of the brush



## ELECTRIC STARTER/STARTER CLUTCH

Check the commutator for:

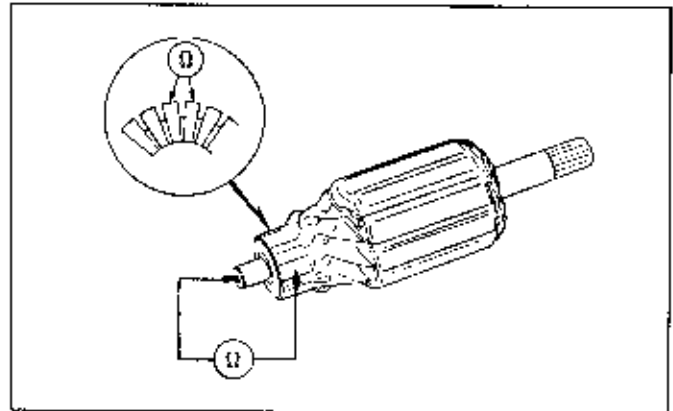
- Damage or abnormal wear. → Replace with a new one.
- Discoloration of the commutator bar.
  - Replace with a new one.
- Metallic debris between commutator bars.
  - Clean it off.



Check for continuity between pairs of commutator bars.

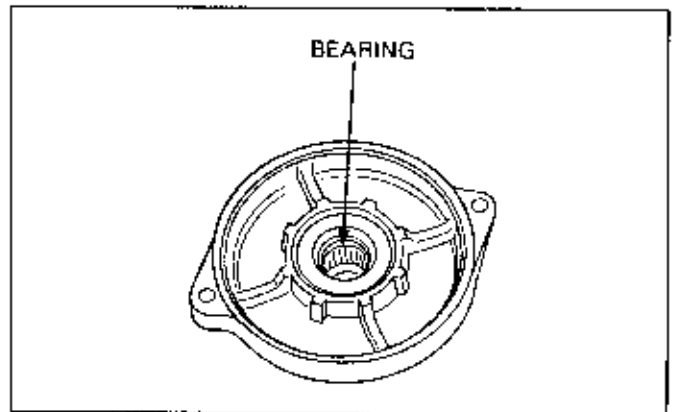
Make a continuity check between individual commutator bars and the armature shaft.

There should be no continuity.



Check the bearings. (For applicable models only)

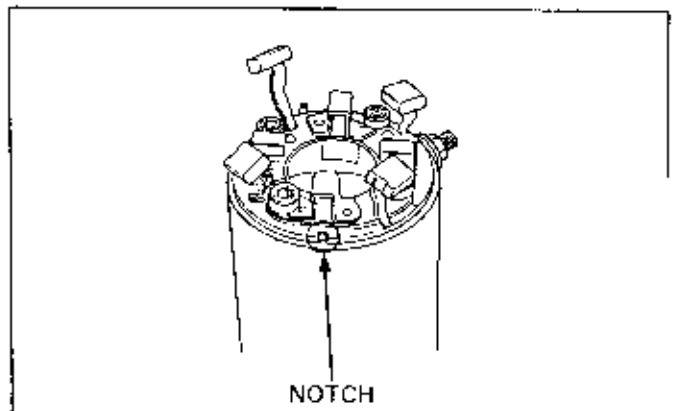
- Do not rotate smoothly. → Replace with a new one.
- Loose bearing. → Replace with a new one.



## ASSEMBLY

Align the case notch with the brush holder pin and install the case.

Place the O-ring (seal ring) on the case. (For applicable models only)



Carefully insert the brushes into the brush holder.

**CAUTION**

- The sliding surfaces of the brushes can be damaged if they are not installed properly.

Apply grease to both ends of the armature shaft.

Push and hold the brush inside the brush holder, and insert the armature through the brush holder.

When inserting the armature into the case, hold the armature tightly to keep the magnet from pulling the armature against the case.

**CAUTION**

- The coil may be damaged if the magnet pulls the armature against the case.

Insert the shims in the correct order to the armature shaft. (For applicable models only)

Insert the O-ring. (For applicable models only)

Align the mark (that you made earlier) and install the cover.

**CAUTION**

- When installing the cover, take care to prevent damaging the oil seal lip with the shaft.

Tighten the cover screws.

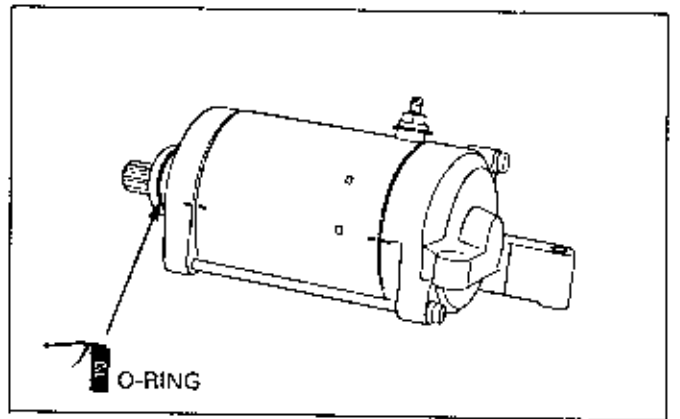
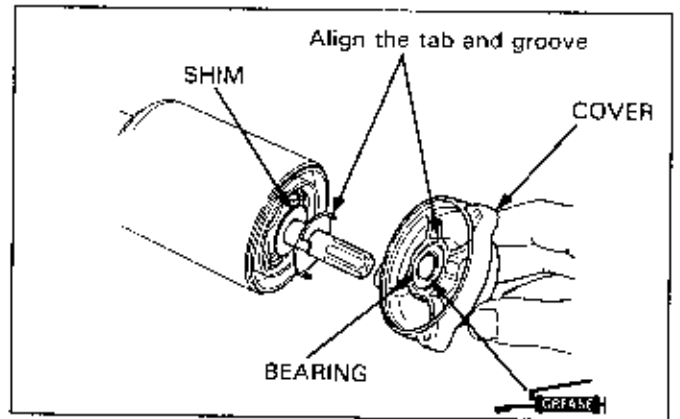
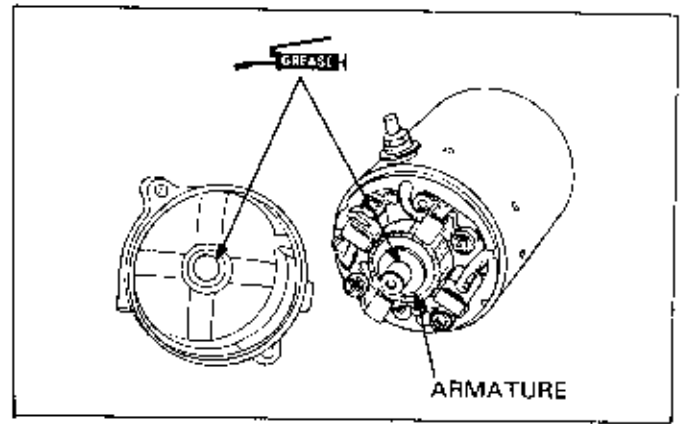
For starter motors that are mounted within a motor mount hole, check for a damaged O-ring.

In order to prevent damage, grease the O-ring.

Refer to the Model Specific manual for installation.

**CAUTION**

- Overtightening the cable terminal nuts may cause the terminals to turn inside the starter motor, resulting in serious damage to the inner connectors.



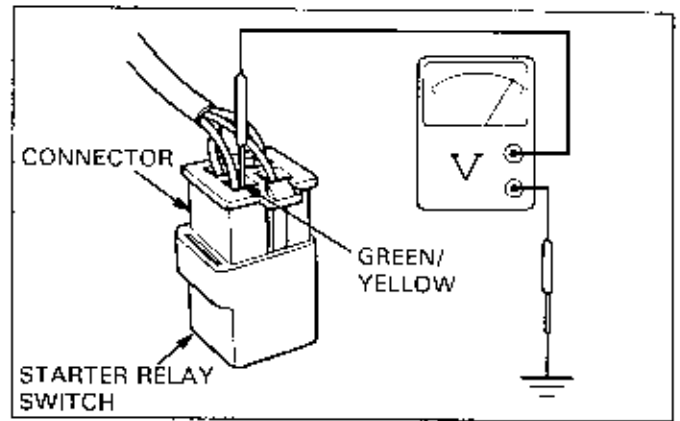
◀Circuit B▶

Measure the voltage between the green/yellow wire and ground at the starter relay switch connector.

If battery voltage is measured when the front or rear brake are applied, it is normal.

NOTE

- If the brake light adjustment is incorrect, no voltage will appear when the brake is ON.

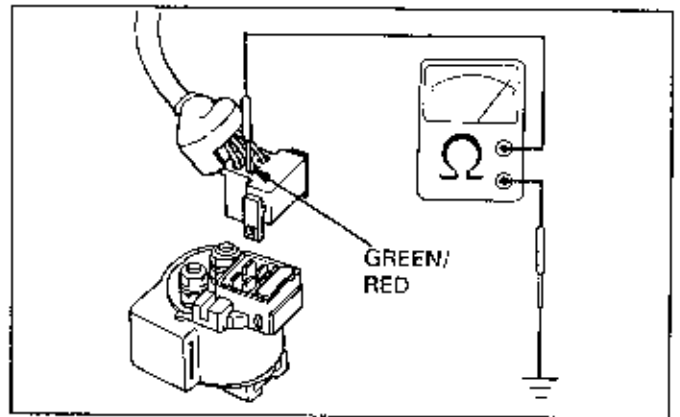


Starter relay switch ground line

◀Circuit A▶

Disconnect the connector from the starter relay switch and check for continuity between the ground wire (green/red) and ground.

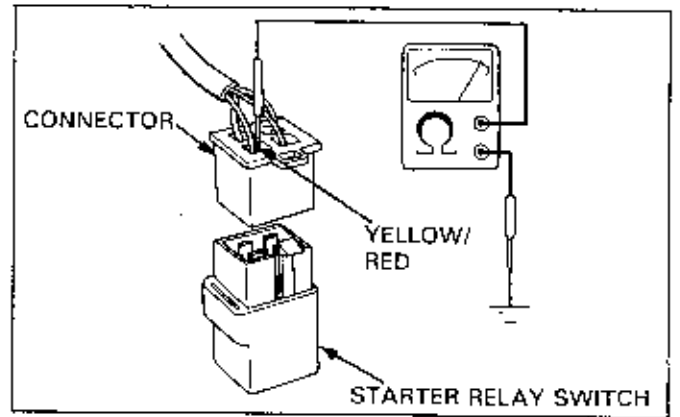
If there is continuity when the transmission is in neutral or when the clutch is disengaged, the ground circuit is normal. (In neutral, there is a slight resistance due to the diode.)



◀Circuit B▶

Disconnect the connector from the starter relay and check for continuity between the ground wire (yellow/red) and ground.

If there is continuity only when the starter switch is pressed, the ground circuit is normal.



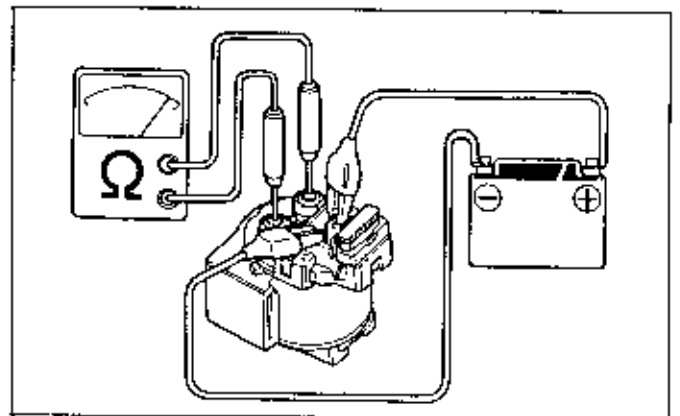
OPERATION CHECK

Apply battery voltage between the two relay coil terminals. Check for continuity between B (battery) and M (rotor) terminals.

◀Circuit A▶

Apply battery voltage between yellow/red and green/red terminals.

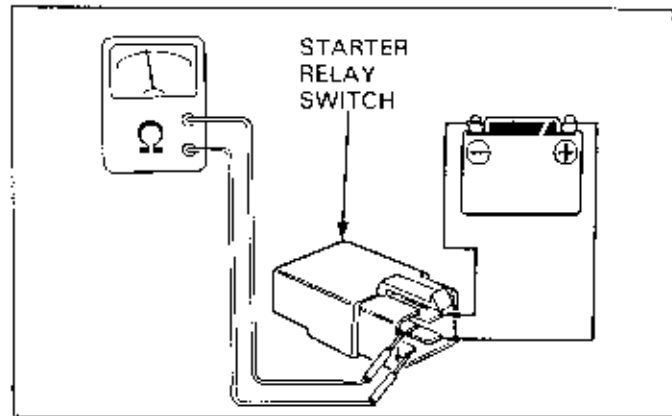
If there is continuity between B and M terminals, it is normal.



## ELECTRIC STARTER/STARTER CLUTCH

### «Circuit B»

When battery voltage is applied between the starter relay green/yellow wire and yellow/red terminals, there should be continuity between the red and red/white terminals. The terminals are distinguished by the corresponding wire color of the wire harness connector.



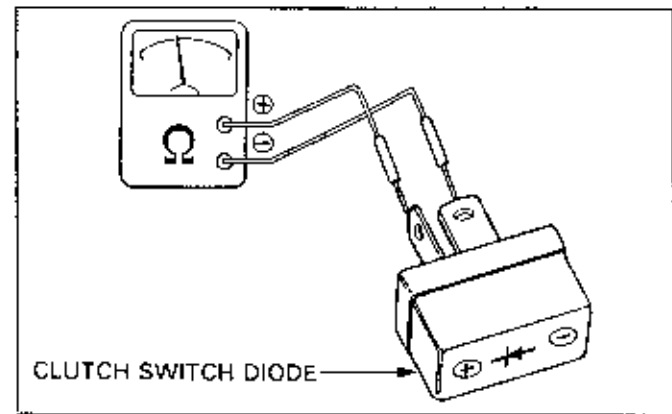
## CLUTCH SWITCH DIODE INSPECTION

The purpose of the clutch switch diode is to prevent reverse current flow from the neutral indicator to the clutch switch.

- Faulty diode. → Neutral indicator turns ON when clutch is disengaged.
- Loose connections at diode terminal.
  - Starter motor does not turn when transmission is in neutral.

Check for continuity between diode terminals. When there is continuity, a small resistance value is measured.

- If there is continuity in one direction, the clutch switch diode is good.

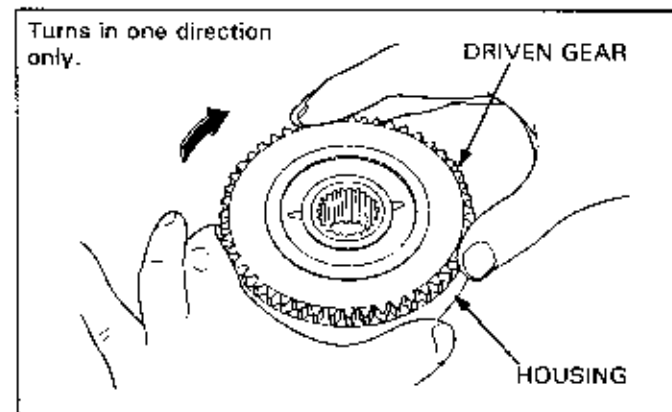


## STARTER CLUTCH INSPECTION

Refer to Model Specific manual for starter clutch removal and installation.

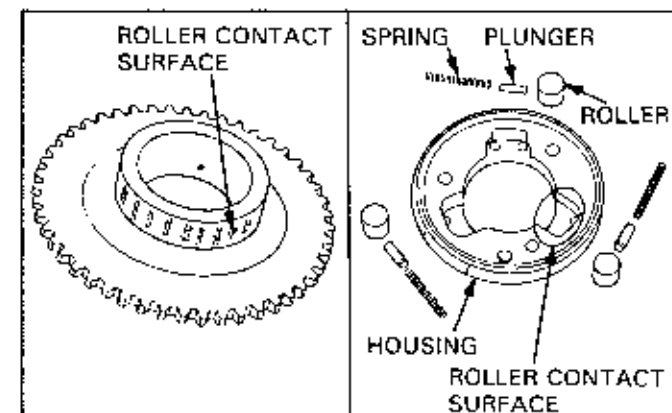
Install the driven gear into the housing. With all parts assembled, check the starter clutch.

- Check that the gear, or sprocket, turns smoothly in one direction and locks up in the other direction.



### Disassemble the housing.

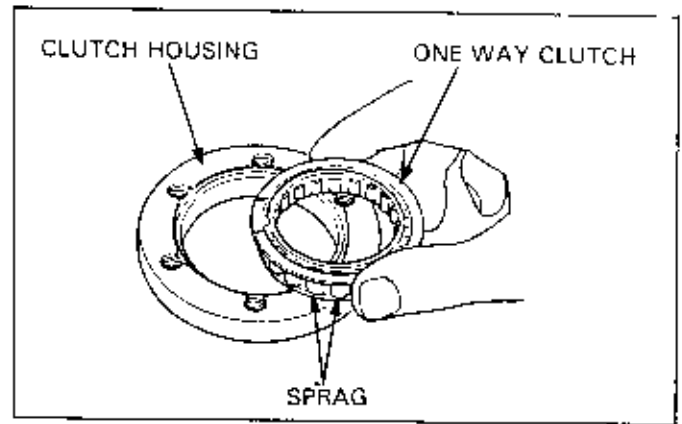
- Check the roller contact surface of the gear, or sprocket, for damage. → Replace with a new one.
- Check the roller contact surface of the housing for damage. → Replace with a new one.
- Damage to roller. → Replace with a new one.
- Deformation or damage to the spring. → Replace with a new one.





For one-way sprag clutch, check each sprag, clutch housing, and all inner portion contact surfaces.

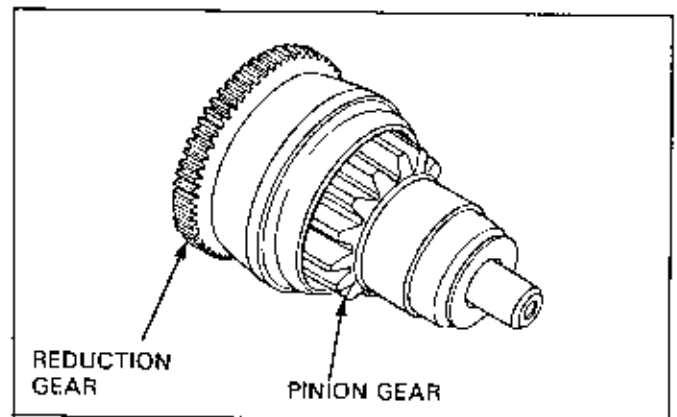
- Abnormal wear or damage to sprag.  
→ Replace with a new one.
- Irregular movement of the sprag.  
→ Replace with a new one.
- Damage to the clutch housing or inner portion contact surface. → Replace with a new one.



### STARTER PINION INSPECTION

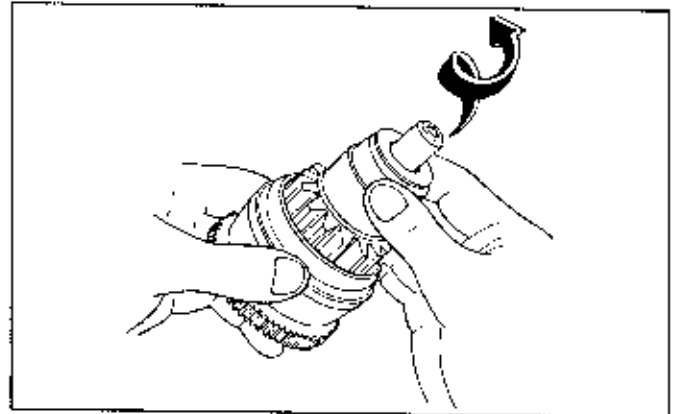
Refer to the Model Specific manual for starter pinion removal and installation.

- Wear or damage to the pinion, reduction gears  
→ Replace with a new one.
- Worn journals. → Replace with a new one.



Check if the pinion gear moves smoothly along the axis.

- Pinion gear does not move smoothly.  
→ Replace with a new one.



# 25. LIGHTS/METERS/SWITCHES

SERVICE INFORMATION	25-1	LOW FUEL INDICATOR	25-8
OIL PRESSURE WARNING LIGHT (4-STROKE ENGINE)	25-2	FUEL PUMP	25-9
OIL LEVEL INDICATOR (2-STROKE ENGINE)	25-2	HEADLIGHT BULB	25-11
FAN MOTOR SWITCH	25-4	SWITCHES	25-12
COOLANT TEMPERATURE GAUGE	25-5	TURN SIGNAL LIGHTS	25-16
FUEL GAUGE	25-7	HORN	25-17

## SERVICE INFORMATION

### ⚠ WARNING

- Halogen headlight bulbs become very hot while the headlight is ON, and remain hot for a while after they are turned OFF. Be sure to let them cool down before servicing.

Use a flame and heated water/coolant mixture for the thermo sensor inspection.

### ⚠ WARNING

- Keep all flammable materials away from the flame. Wear protective clothing, gloves and eye protection.

- Refer to the section 21 for the general service rules.
- This section covers the general inspection/service procedures of the lights, meters and switches. Refer to the Model Specific manual for the location and arrangement of components on the model being serviced.
- Note the followings when replacing the halogen headlight bulb.
  - Wear clean gloves while replacing the bulb. Do not put finger prints on the headlight bulb, as they may create hot spots on the bulb and cause it to break.
  - If you touch the bulb with your bare hands, clean it with a cloth moistened with alcohol to prevent its early failure.
  - Be sure to install the dust cover after replacing the bulb.
- A continuity test can be made with the switches installed on the motorcycle.
- Check the battery condition before performing any inspection that requires proper battery voltage.
- There are two types of lighting systems; AC lighting that takes power from the alternator coil, and DC lighting that takes power from the battery. On DC lighting systems, the headlight comes on without starting the engine. On AC lighting systems, the headlight comes on when the engine is running. (Refer to section 21).

## OIL PRESSURE WARNING LIGHT (4 stroke engine)

### THEORY

When the oil pressure is below the specifications, the oil pressure switch senses it and the oil pressure warning light comes on. It should be OFF while the engine is running.

### INSPECTION

- Oil pressure warning light does not come on with the ignition switch turned ON.

1. Disconnect the oil pressure switch wire and turn the ignition switch ON. Check for battery voltage between the wire and ground.

No voltage

Voltage

- Oil pressure switch faulty.

2. Check for the voltage between the black/brown terminal of the instruments and ground.

No voltage

Voltage

- Ignition switch faulty.
- Sub fuse blown.

- Broken wire between the warning light and oil pressure switch.
- Bulb blown.

- Oil pressure warning light stays on while the engine is running.

1. Check the engine oil level.

Specified oil level

Low oil level

- Oil insufficient.

2. Disconnect the oil pressure switch wire and turn the ignition switch ON.

Indicator lights

Indicator does not light

- Shorted blue/red wire between the warning light and pressure switch.

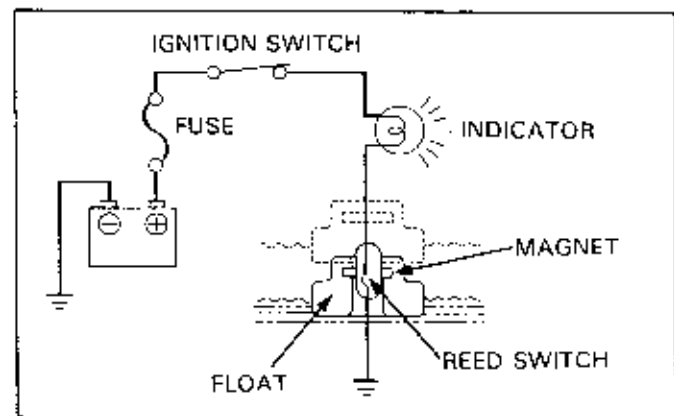
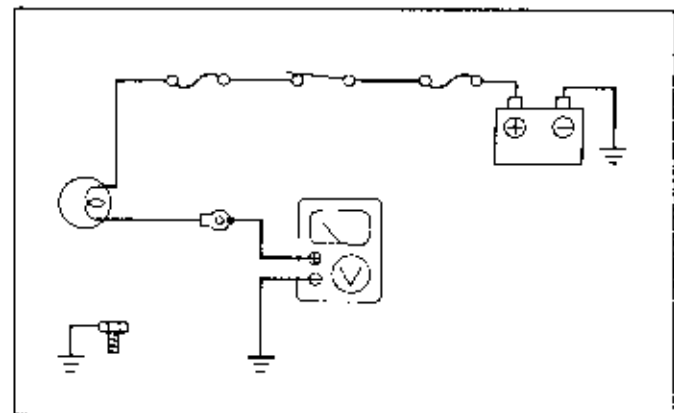
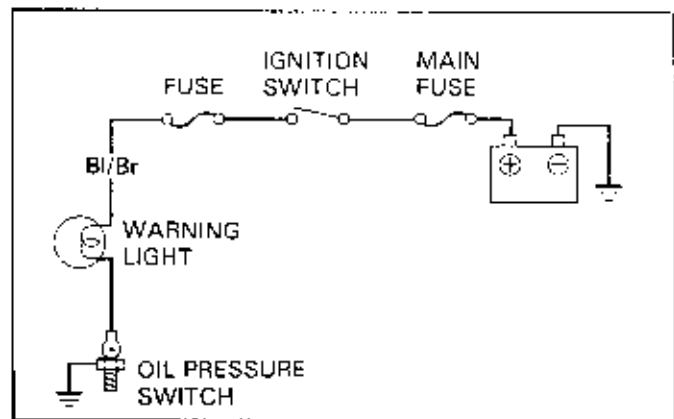
- Faulty oil pressure switch.
- Low oil pressure. (see section 3)

## OIL LEVEL INDICATOR (2 stroke engine)

### THEORY

The oil level switch float in the oil tank moves up and down in accordance with the volume of oil in the tank. When the oil level is low, the float also goes down and the reed switch (oil level switch) is closed by the magnetic force of the float.

When the ignition switch is turned ON, current flows through the reed switch and the oil level indicator comes on.



INSPECTION

- Oil level indicator comes on when the oil in the tank reaches a specified level.

1. Disconnect the wires from the oil level switch and turn the ignition switch ON.

Indicator lights

Indicator does not light

- Shorted wire between the indicator and oil level switch.
- Faulty oil level switch.

- Oil level indicator does not come on with no or low oil level in the tank.

1. Disconnect the wires from the oil level switch and connect a jumper wire between the wire terminals. Turn the ignition switch ON and check the indicator.

Indicator does not come on

Indicator comes on

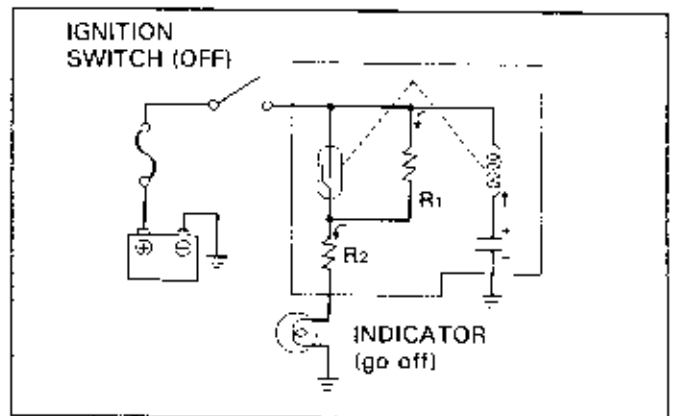
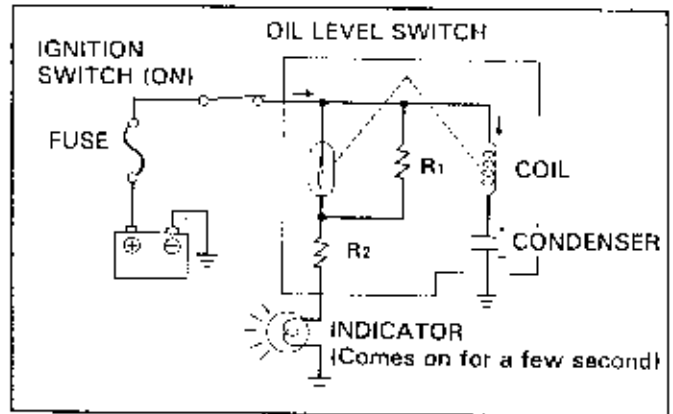
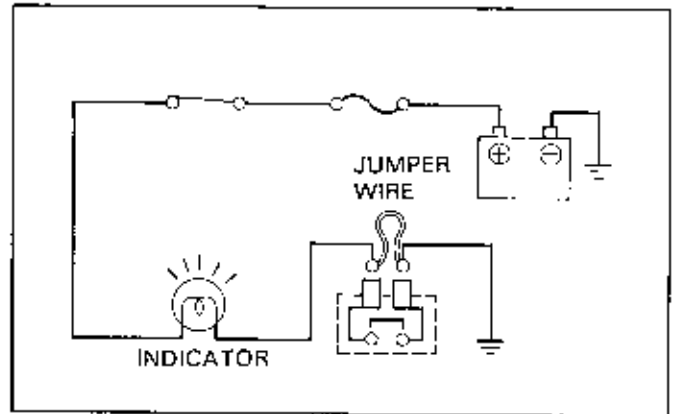
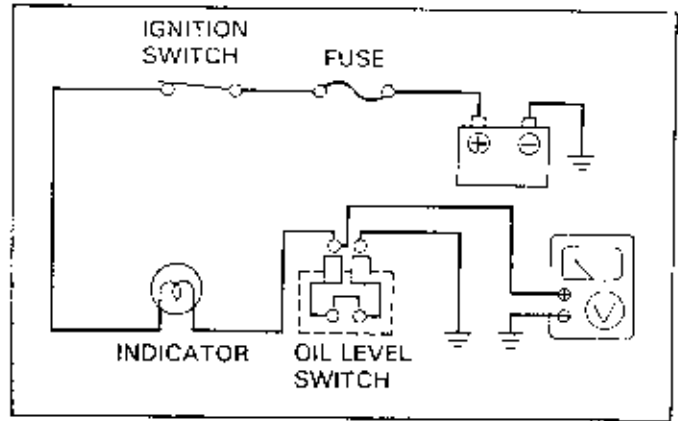
- Faulty oil level switch.
- Poor wire connection.

2. Disconnect the wires from the oil level switch and check for voltage between the wire and ground.

No voltage

Voltage

- Broken wire between the oil level indicator and level switch.
- Blown bulb.
- Faulty oil level switch.
- Poor oil level switch wire connection.



TIMER TYPE THEORY

A timer type indicator has a bulb check function so as to check the oil level indicator for proper operation.

When the ignition switch is turned ON, current flows through the exciter coil to the condenser, generates the electromagnetic force at the exciter coil and closes the reed switch. Current flows from the reed switch through the resistor R<sub>2</sub> to the oil level indicator and turns it on. When the condenser is fully charged, current flows through the exciter coil to the condenser decreases and, consequently, electromagnetic force at the coil decreases, the reed switch opens and the oil level indicator turns off.

When the ignition switch is turned OFF, current stored in the condenser flows through the exciter coil and through resistors R<sub>1</sub> and R<sub>2</sub> to the oil level indicator. The oil level indicator does not come on this time.

TIMER TYPE INDICATOR INSPECTION

- Oil level indicator comes on when the oil in the tank reaches a specified level.
  - Faulty oil level switch.
  - Shorted wire harness.
- Oil level indicator does not come on with no oil or low oil level in the tank.

1. Disconnect the oil level switch connector and connect a jumper wire to the power supply wire (black or black/brown) terminal and the indicator wire (green/red) terminal to short. Turn the ignition switch ON and check the oil level indicator.

Indicator does not come on

Indicator comes on

- Faulty oil level switch.
- Poor connection of the connector.

2. Disconnect the oil level switch connector and check for voltage between the power supply wire (black or black/brown) and ground.

Voltage

No voltage

- Broken power supply wire.
- Faulty sub fuse.
- Faulty ignition switch.
- Poor connection of the sub fuse connector.

3. Connect the jumper wire to the power supply wire and oil level indicator wire to short and check for voltage between the indicator wire and ground.

Voltage

No voltage

- Blown bulb.
- Faulty ground.
- Broken indicator wire.

FAN MOTOR SWITCH

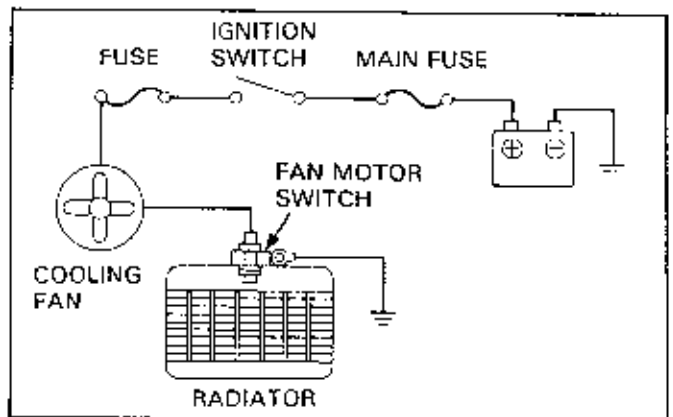
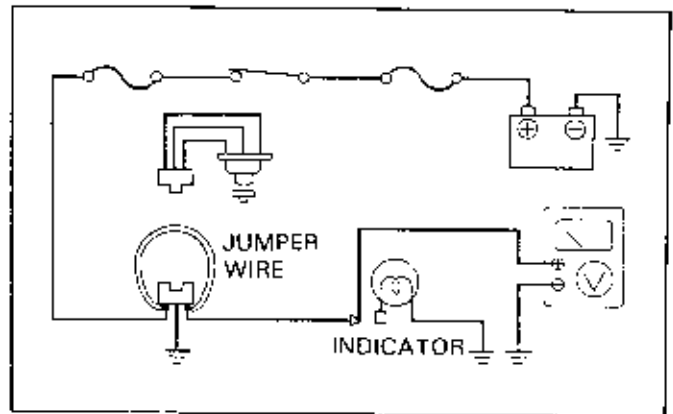
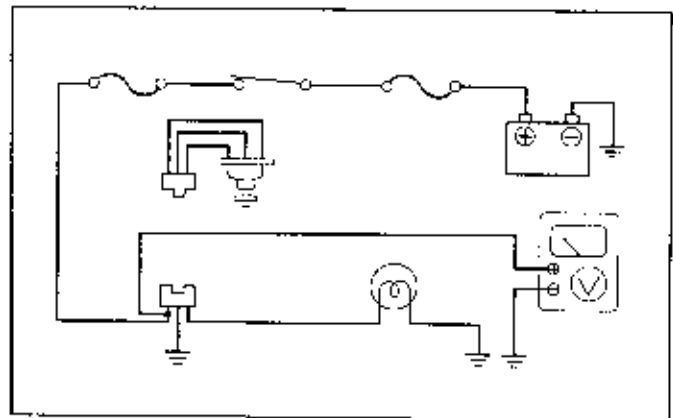
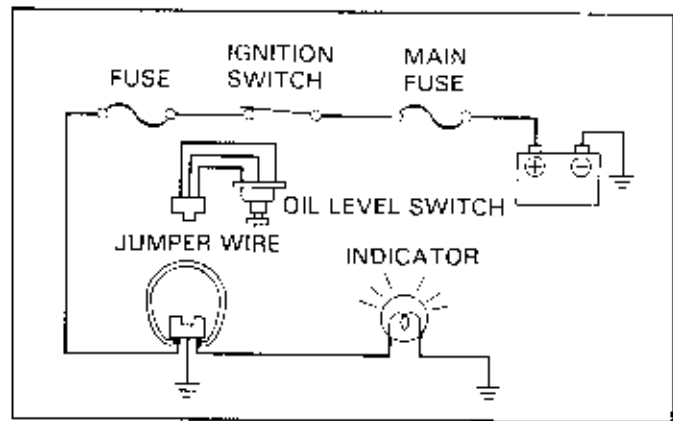
NOTE

- The fan motor may continue to run, even when the ignition switch is turned OFF. However, this does not necessarily indicate trouble.

When the coolant temperature increases to above the specification, the fan motor switch turns on to operate the fan motor. When the coolant temperature is below the specification, it turns off to stop the fan motor.

NOTE

- Check the coolant level and bleed air from the cooling system if the coolant is apt to overheat. (see page 5-6 for coolant replacement and air bleeding.)



**INSPECTION**

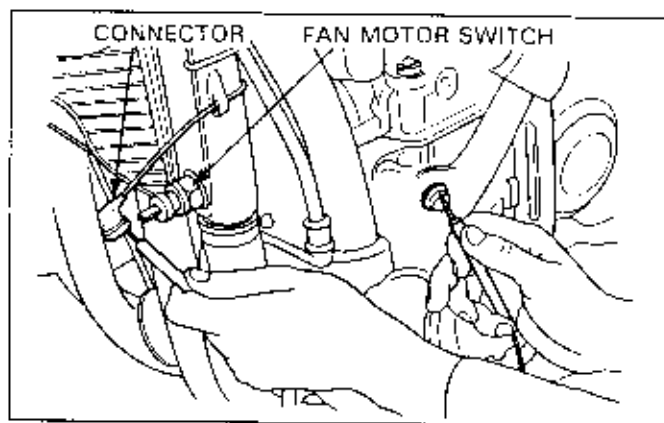
- Fan motor does not stop.

1. Turn the ignition switch OFF, disconnect the connector from the fan motor switch and turn the ignition switch ON again.

Motor does not stop

Motor stops

- Shorted wire between the fan motor and switch.
- Faulty fan motor switch.



- Fan motor does not start.

1. Disconnect the connector from the fan motor switch and ground the connector to the body with a jumper wire. Turn the ignition switch ON and check the fan motor.

Motor does not start

Motor starts

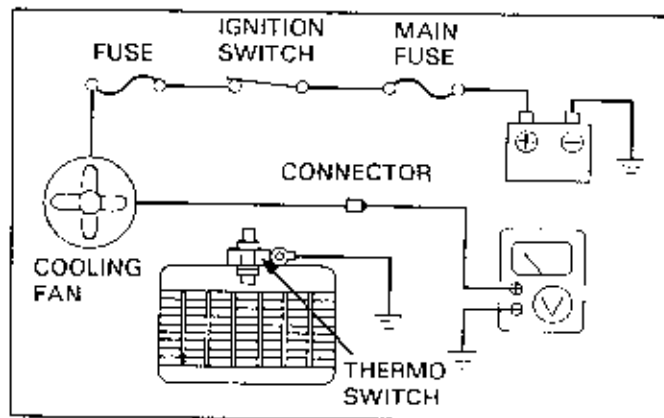
- Faulty fan motor switch.
- Poor connection of the fan motor switch connector.

2. Check for the battery voltage between the fan motor switch connector and ground.

No battery voltage

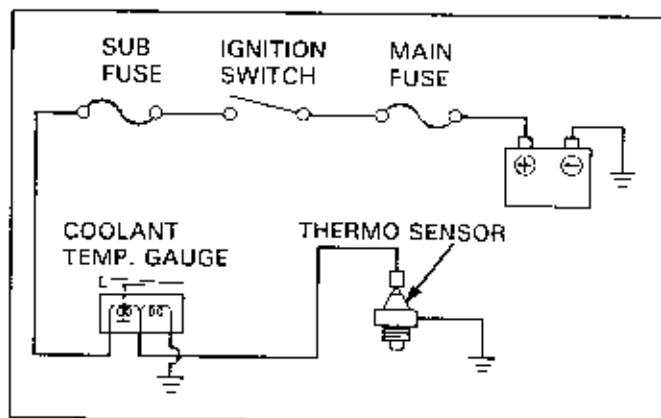
Battery voltage

- Broken wire harness
- Blown sub fuse.
- Faulty ignition switch
- Poor connection of the connector (between the ignition switch and fuse box).
- Faulty fan motor.



**COOLANT TEMPERATURE GAUGE**

The thermo sensor changes the amperage of the current that flows to the coolant temperature gauge in accordance with the change in coolant temperature and moves the temperature gauge needle.



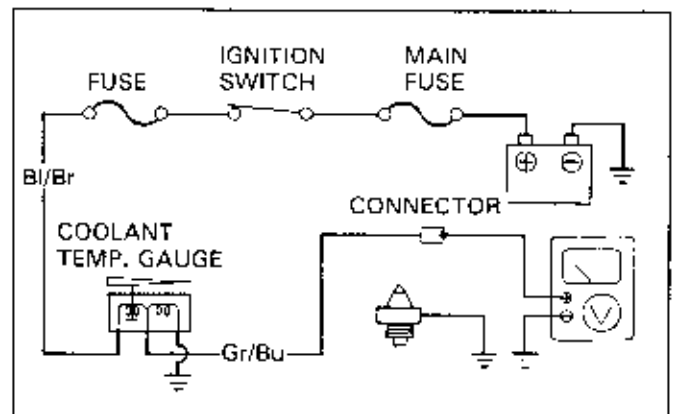
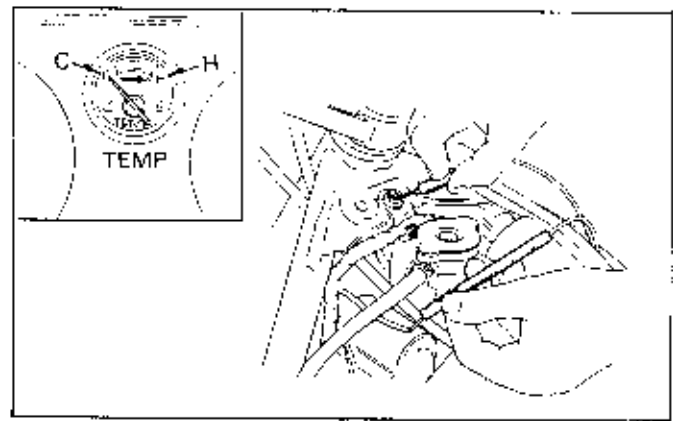
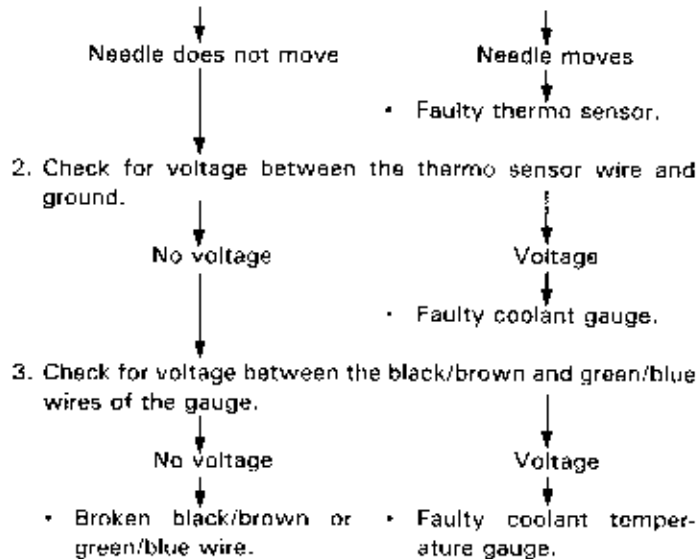
## LIGHTS/METERS/SWITCHES

### INSPECTION

1. Disconnect the wire from the thermo sensor.  
Ground the thermo sensor wire with a jumper wire.  
Turn the ignition switch ON and check the coolant gauge.  
Disconnect the thermo sensor wire from the ground immediately if the gauge needle moves fully to H.

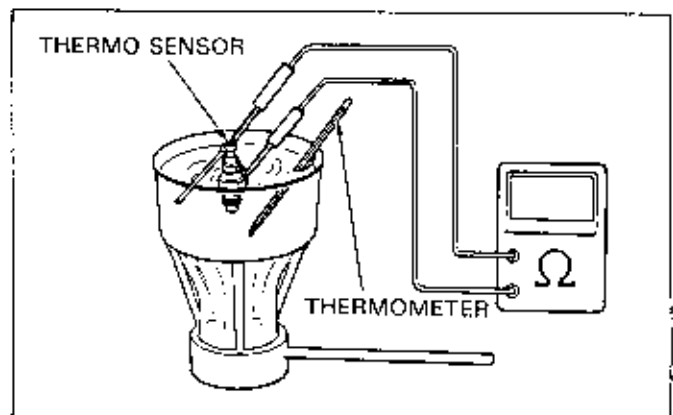
#### CAUTION

- Immediately disconnect the wire from the ground when the needle moves to H (hot) to prevent damage to the gauge.



### THERMO SENSOR INSPECTION

- Drain the coolant (see page 5-6).  
Disconnect the wire from the thermo sensor.  
Remove the thermo sensor.  
Suspend the thermo sensor in a pan of coolant (50-50 mixture) over a burner and measure the resistance through the sensor as the coolant heats up.



#### WARNING

- Keep flammable materials away from the burner.
- Wear insulated gloves and eye protection.

#### NOTE

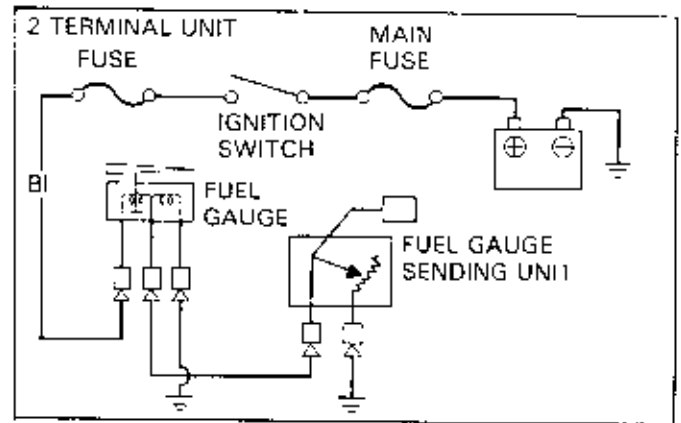
- Soak the thermo sensor in coolant up to its threads with at least 40 mm (1.57 in) from the bottom of the pan to the bottom of the sensor.
- Keep temperature constant for 3 minutes before testing. A sudden change of temperature will result in incorrect readings. Do not let the thermometer or thermo sensor touch the pan.
- Apply sealant to the threads on the thermo sensor prior to installation.

## FUEL GAUGE

Fuel unit resistance changes in accordance with the float in the fuel unit moving up and down. The fuel gauge needle is moved by the change of amperage that flows through the fuel gauge.

There are two types of fuel gauges: The "Return type" where the needle returns to "Empty" when the ignition switch is turned OFF, and "Stop type" where the needle stays in position when the ignition switch is turned OFF.

Check the fuel gauge if its needle does not move.



## INSPECTION

1. If the fuel unit connector has 2 terminals, short the gauge terminals with a jumper wire.

If the unit connector has 3 terminals, short the gauge side yellow/white terminal and green terminal with a jumper wire.

Turn the ignition switch ON and check the gauge needle.

Needle does not move

Needle moves

- Check the fuel unit.

2. Check for continuity between the unit and fuel gauge.

Continuity

No continuity

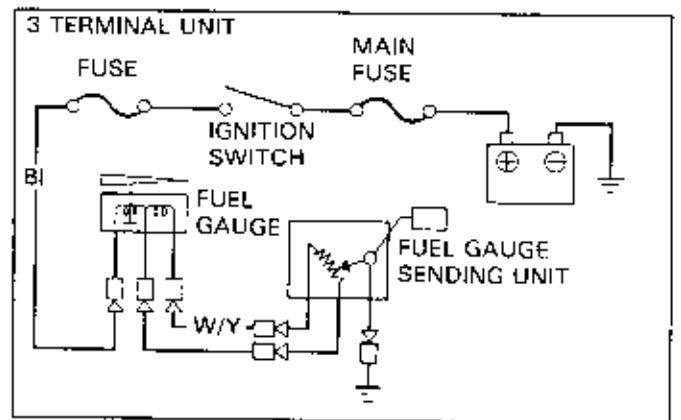
- Broken wire between the unit and gauge.

3. Check for voltage at the black or black/brown (positive power line) and ground wires of the fuel gauge.

No voltage

Voltage

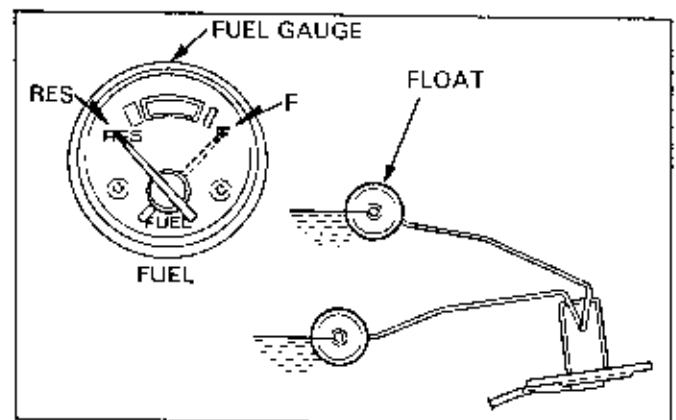
- Broken positive power line.
- Faulty fuel gauge.



## FUEL UNIT INSPECTION

Refer to the Model Specific manual for the fuel unit removal/installation.

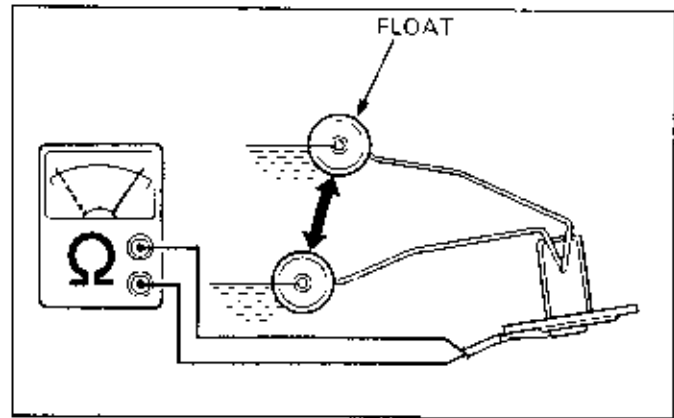
1. Connect the fuel unit connector.  
Turn the ignition switch ON.  
Move the float up and down to be sure that the fuel gauge needle moves to "F" and "RES".  
If the needle does not move, go to the step 2.





2. Measure the resistance between the connector terminals with the float in up and down positions.

If the resistance is normal, check the fuel gauge.  
If the resistance is not normal, replace the fuel unit.

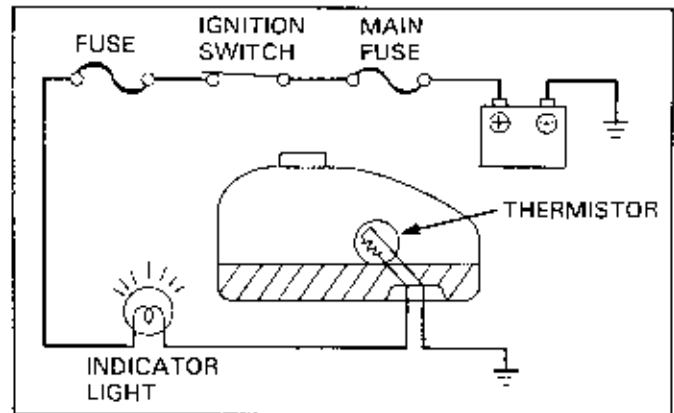


## LOW FUEL INDICATOR

A thermistor is built into the fuel level sensor in the fuel tank and the fuel warning light turns on due to the thermistor's self radiation of heat.

When the thermistor is in the gasoline, radiation of heat increases and the self heating action is reduced. As the resistance increases and the current does not flow at this time, the fuel warning light does not turn on.

When the thermistor is out of gasoline, i.e. fuel level is low, radiation of heat decreases and the self heating increases. As the resistance is low at this time, current flows and the low fuel indicator turns on.



## INSPECTION

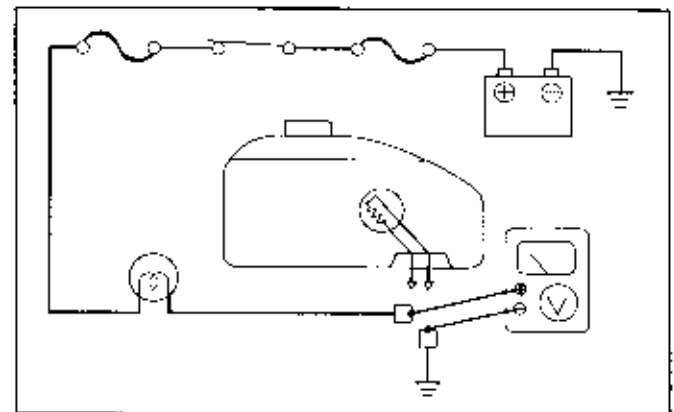
If the low fuel indicator does not go off, check as noted below. Check for battery voltage between the fuel level sensor connector terminals.

Battery voltage

- Faulty fuel level sensor.
- Poor connection of the connector.

No battery voltage

- Shorted wire between the indicator light and sensor.
- Faulty ground.



If the fuel warning light does not turn on, check as noted below.

1. Check for battery voltage between the fuel level sensor connector terminals.

No battery voltage

Battery voltage

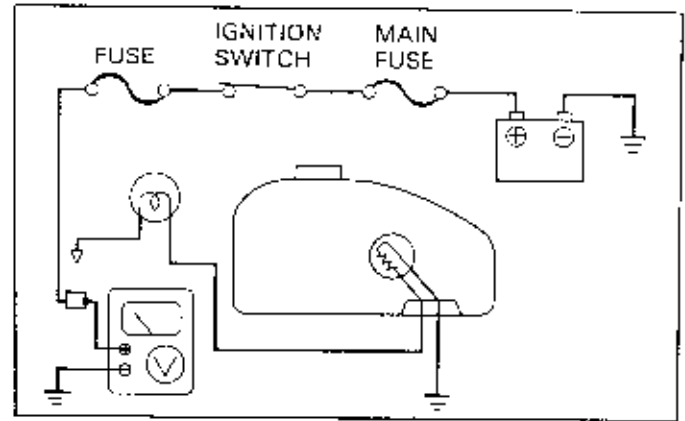
- Faulty fuel level sensor.
- Poor connection of the connector.

2. Check for battery voltage between the battery side of the wire from the indicator light and ground.

No battery voltage

Battery voltage

- Faulty sub fuse.
- Faulty ignition switch.
- Poor connection of the fuse holder connector.
- Blown bulb.
- Broken wire between the warning light and sensor.
- Faulty ground.



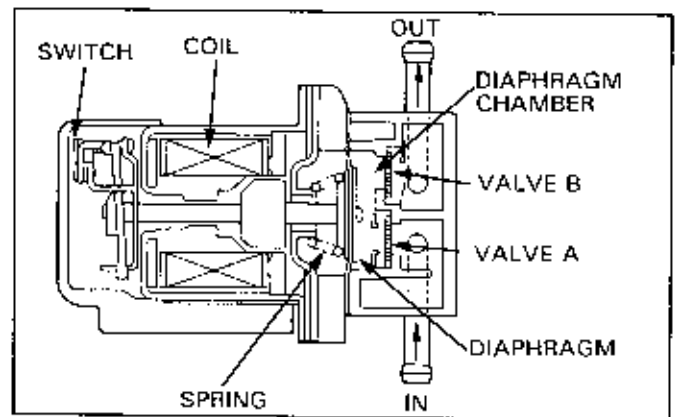
## FUEL PUMP

### DESCRIPTION

Certain models are equipped with a low pressure electromagnetic fuel pump to send the fuel to the carburetor.

When the engine is started, the switch is turned on by the function of the fuel cut-off relay (refer to the description of fuel cut-off relay), which generates the electromagnetic force at the coil and moves the plunger and diaphragm up. The valve A is then opened by the vacuum and the fuel flows to the diaphragm chamber. The plunger pushes the switch up and turns it off. As the electromagnetic force at the coil goes out this time, the plunger and diaphragm are returned by the spring and the fuel in the diaphragm chamber is sent to the carburetor through the valve B.

Certain types of this fuel pump have the fuel cut-off relay built in.



FUEL CUT-OFF RELAY

With the ignition switch ON, current flows to the transistor and thyrister but it does not flow to the fuel pump. To fill the carburetor float chamber with fuel when the ignition switch is turned ON, certain types of the fuel cut-off relay have a timer function that sends current to the fuel pump for a few seconds.

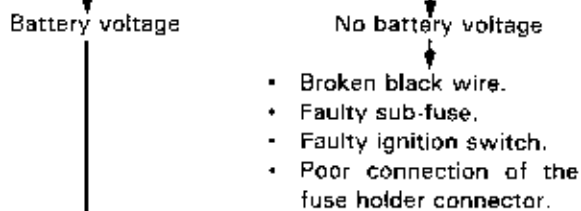
While the engine is running, pulses are transmitted from the spark unit to the ignition primary circuit and, when it is transmitted to the transistor, current flows from the transistor to the thyrister to turn it ON. The battery current flows to the fuel pump this way.

As the fuel cut-off relay is controlled by the ignition primary circuit, the relay does not operate unless the ignition primary circuit operates properly.

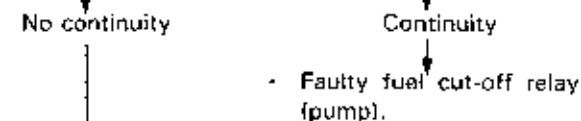
INSPECTION

Turn the ignition switch ON and perform the following inspections.

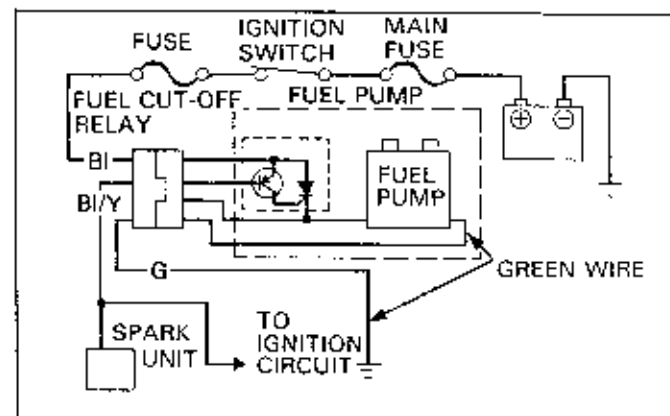
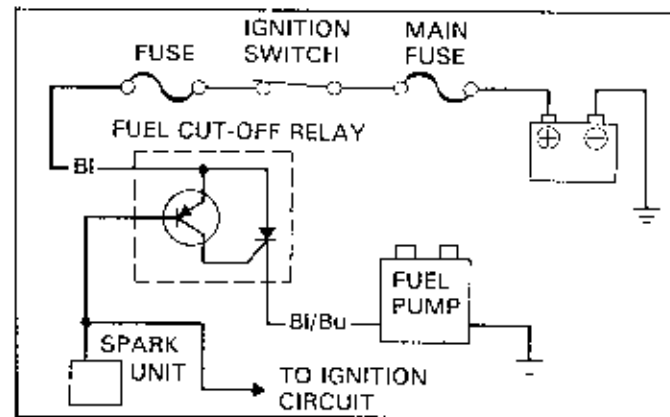
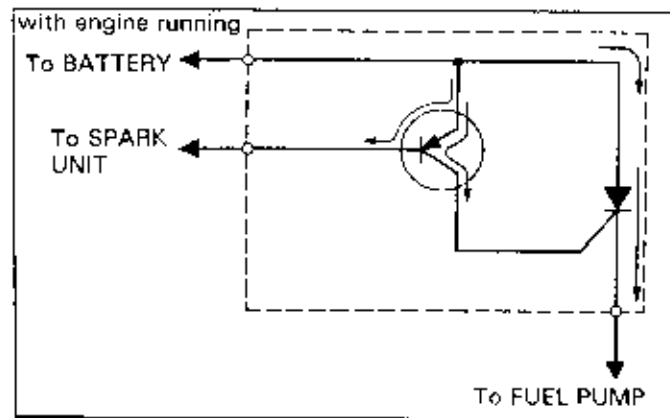
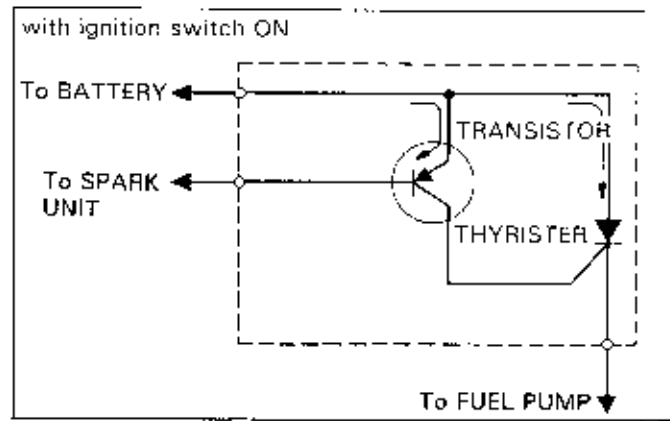
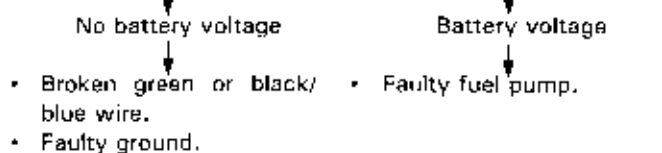
1. Check for battery voltage between the black wire (+) of the fuel cut-off relay connector (pump connector if the relay is built in the pump) and ground (-).



2. Check for continuity between the black/blue wire of the relay connector and ground (or black/yellow wire and green wire of the pump connector, if the relay is built into the pump).



3. Short the black and black/blue wires of the relay connector with a jumper wire and check for battery voltage between the black/blue (+) wire and green wire of the pump connector.



**DISCHARGE VOLUME INSPECTION**

Turn the ignition switch OFF.

Disconnect the fuel pump-to-carburetor tube from the carburetor and place the tube end in a beaker.

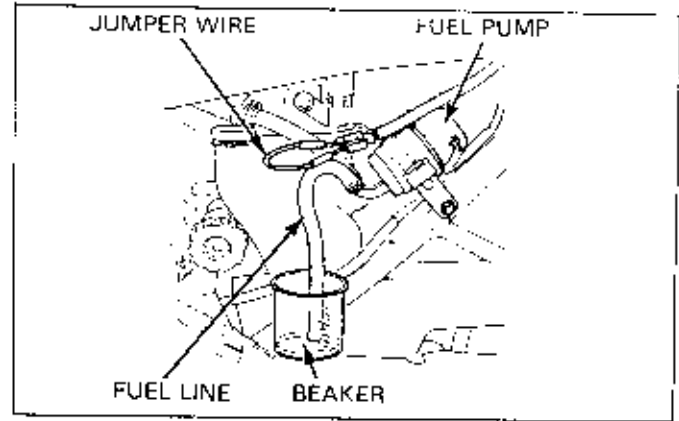
**NOTE**

- If it is hard to reconnect the tube to the carburetor, disconnect it from the fuel pump and connect the other tube to the pump (gasoline discharge port).

Refer to step 3 of INSPECTION and short the relay connectors. If the relay is built into the pump, short the black and black/yellow wires.

Turn the ignition switch ON for 5 seconds and drain the pump.

Multiply the drained fuel by 12. It should be as specified in the Model Specific manual.

**HEADLIGHT BULB**

Before replacing the bulb, be sure to check the switches for loose connection of the connectors.

**WARNING**

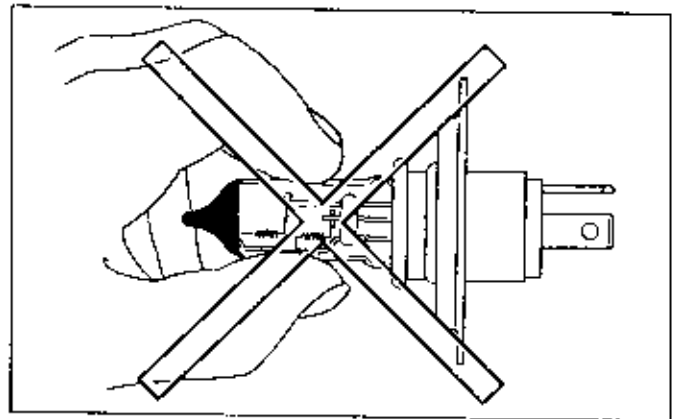
- Halogen headlight bulbs become very hot while the headlight is ON, and remain hot for a while after they are turned OFF. Be sure to turn the ignition switch OFF and let the bulb cool down before replacement.

If you touch the bulb with your bare hands, clean it with a cloth moistened with denatured alcohol to prevent early bulb failure.

**CAUTION**

- Avoid touching Halogen headlight bulbs. Finger prints can create hot spots that cause a bulb to break.

Be sure to install the dust cover after replacing the bulb.



## SWITCHES

### INSPECTION

Disconnect the connector that is nearest to the switch that you are to inspect and check for continuity between the switch side terminals of the connector.

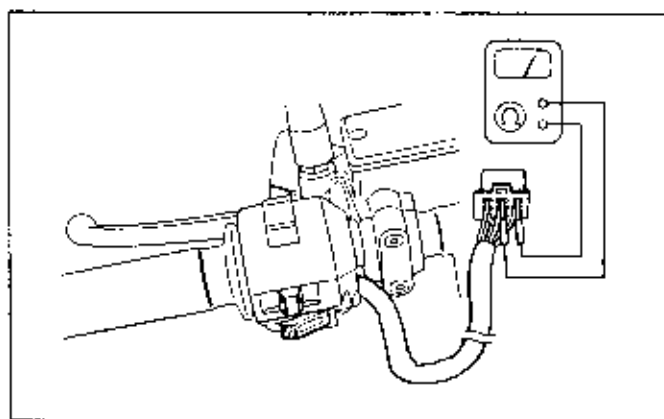
There should be continuity between the  $\bigcirc - \dots - \bigcirc$  positions on the continuity chart. (Refer to the Model Specific manual for the continuity chart.)

Example: Turn signal switch

Wire color	Orange	Gray	Blue
Switch position			
L	$\bigcirc - \dots - \bigcirc$	$\bigcirc - \dots - \bigcirc$	
N			
R		$\bigcirc - \dots - \bigcirc$	$\bigcirc - \dots - \bigcirc$

With the turn signal switch in N (neutral), there should be no continuity between the wires.

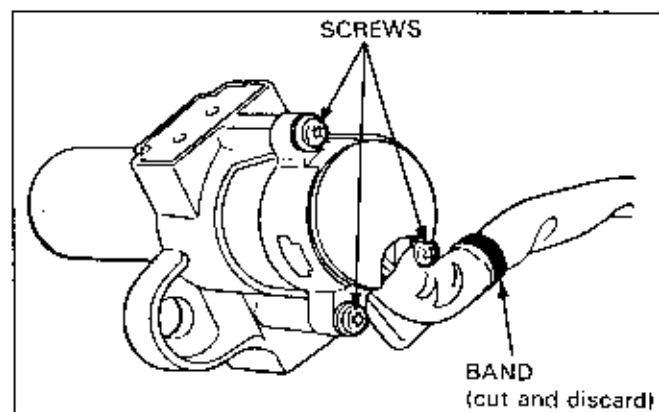
With the switch in L (left), there should be continuity between the orange and gray wires and with the switch in R (right), there should be continuity between the blue and gray wires.



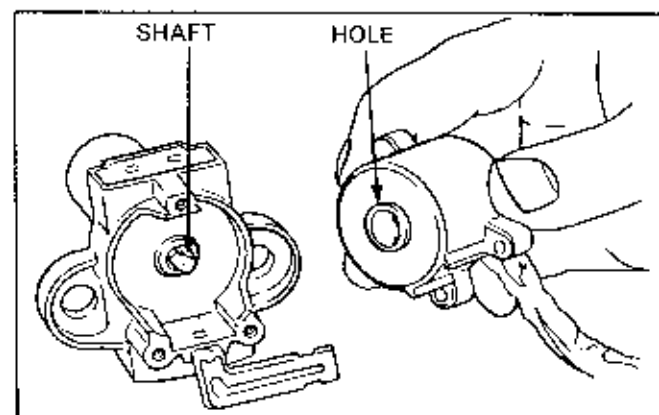
### CONTACT BASE REPLACEMENT

When the contact base is mounted with screws;  
Remove the ignition switch.

Remove the band and three screws, then remove the switch from the switch cylinder.

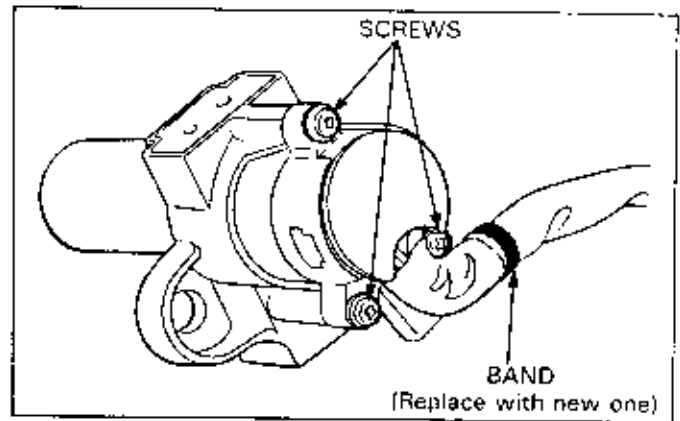


Reassemble the switch and cylinder with the cylinder shaft aligned with the hole in the switch.



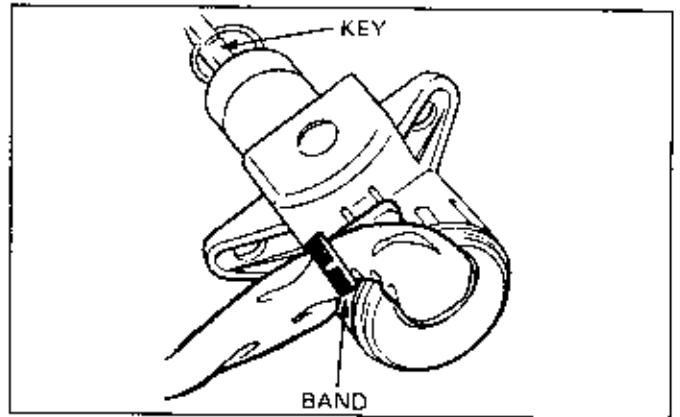
Tighten the contact base with the three screws.

Clamp the wires with a wire band and cut off the excess portion of the band. Check the ignition switch.



When the contact base is secured with tabs; Remove the ignition switch and band.

Insert the ignition switch key and turn it to the position between ON and OFF.

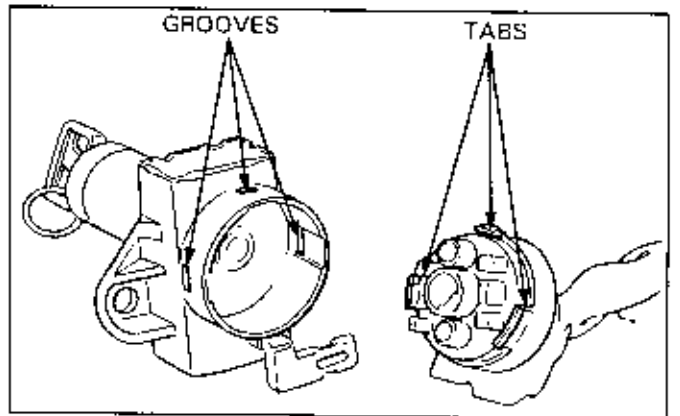


Push the contact base tabs in with a screwdriver so that they are out of the slots in the ignition switch body, and remove the contact base.

Insert the contact base on the ignition switch body with its tabs aligned with the slots in the ignition switch body.

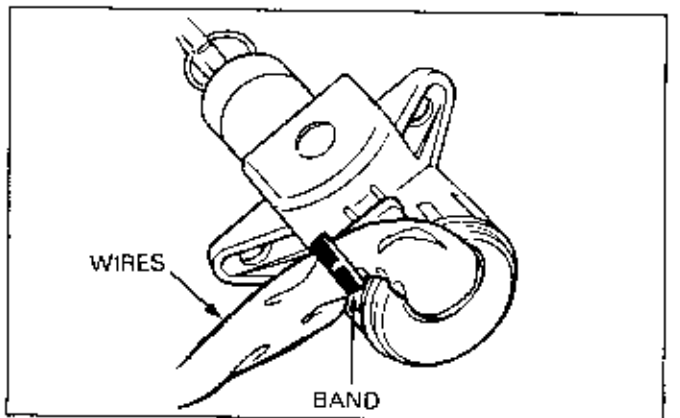
**NOTE**

- Be sure that the ignition switch key is in the position between ON and OFF before attempting to remove the contact base.



Clamp the wires with a wire band and cut off the excess portion of the band.

Check the ignition switch.



## LIGHTS/METERS/SWITCHES

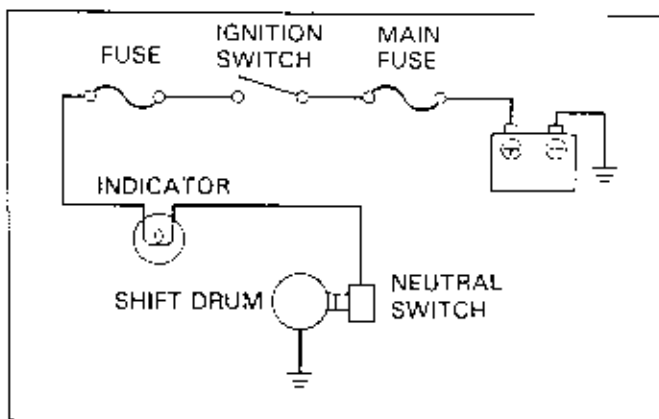
### NEUTRAL SWITCH

When the ignition switch is ON and the transmission is in neutral, the neutral switch turns the indicator on.

Some models are equipped with a change switch and/or over drive switch.

The change switch detects the gear position by the position of the shift drum and sends a signal to the gear position indicator/CDI unit.

The overdrive switch turns the overdrive indicator on when the transmission is in OD (overdrive) position.



### INSPECTION

#### Neutral Indicator does not go off;

Disconnect the light green/red wire from the neutral switch and turn the ignition switch ON.

Indicator does not light

- Faulty neutral switch

Indicator lights

- Broken light green/red wire

#### Neutral indicator does not come on;

Disconnect the light green/red wire from the neutral switch and turn the ignition switch ON.

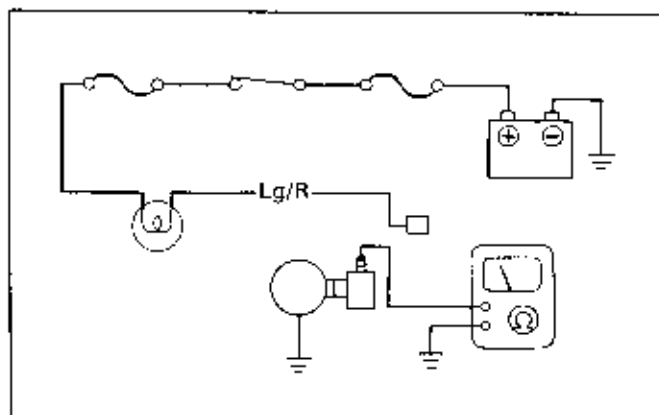
Check for battery voltage between the light green/red wire and ground.

Battery voltage

- Faulty neutral switch.

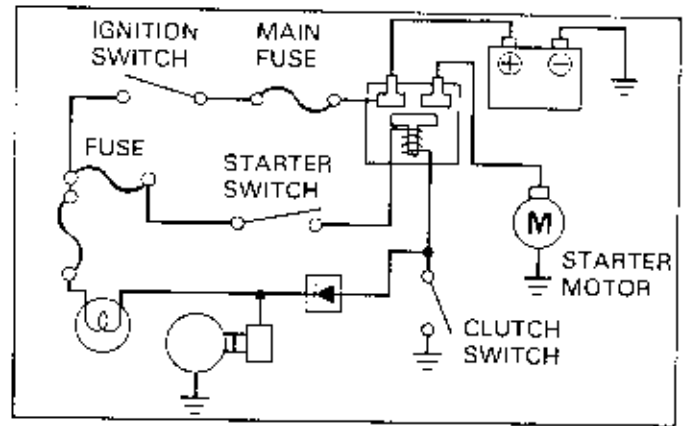
No battery voltage

- Broken light green/red wire between the indicator and neutral switch.
- Blown bulb.
- Blown sub fuse.
- Poor connection of the fuse connector.



## CLUTCH SWITCH

The clutch switch prevents the starter motor from rotating while the engine is running and the transmission is in positions other than neutral.



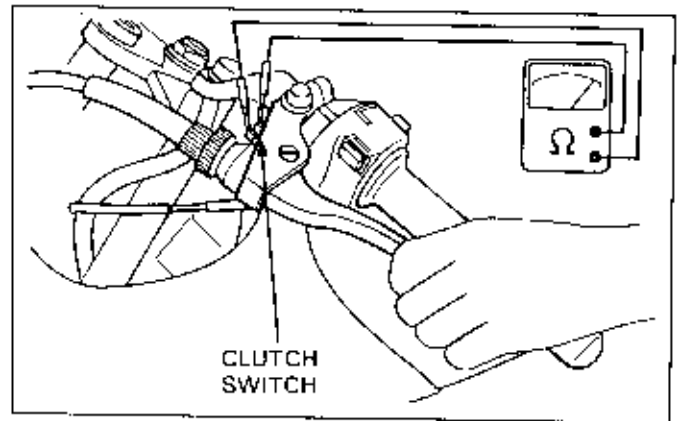
### INSPECTION

Check the starter system if the starter motor rotates with the transmission in positions other than neutral. The starter motor should be operated with the clutch lever squeezed and not be operated with the lever released. If the system is normal, check the following.

Disconnect the wire from the clutch switch and check for continuity between the clutch switch terminals while operating the clutch lever.

When the clutch lever is pulled in:  
There should be continuity between the terminals.

When the clutch lever is released:  
There should be no continuity between the terminals.



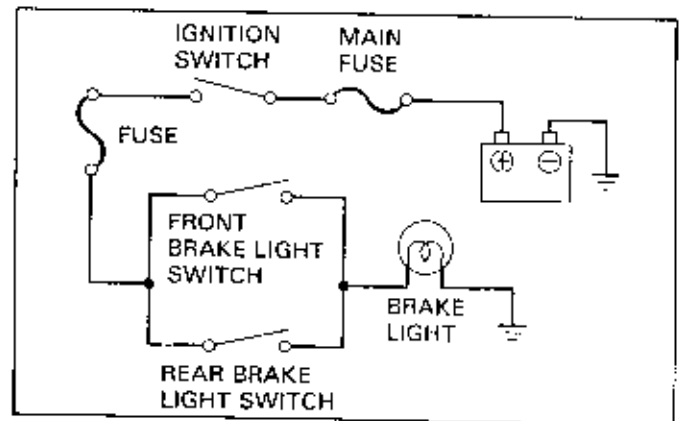
If the clutch switch is normal, check the following.

- Check for shorted wire between the starter relay switch and the clutch switch.
- Check the neutral switch.

## BRAKE LIGHT SWITCH

The brake light comes on when the brake lever (or pedal) is applied.

Starter motor equipped scooters: To prevent the accidental start up of the scooter, current does not flow to the starter motor unless the brake lever (or pedal) is applied.

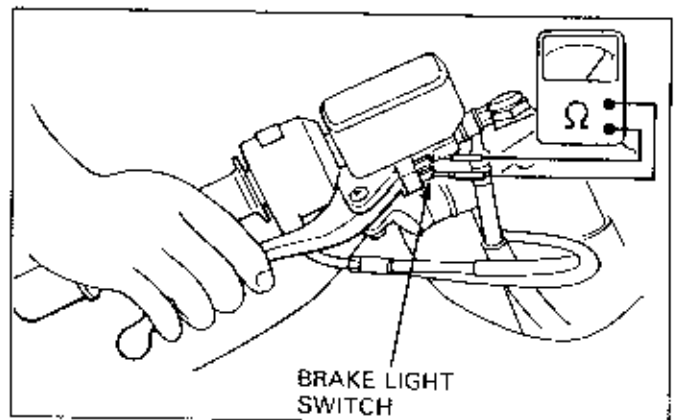


### INSPECTION

Brake light does not come on;

1. Check for the following.

- Burned bulb.
- Poor connection of the brake light switch connector.





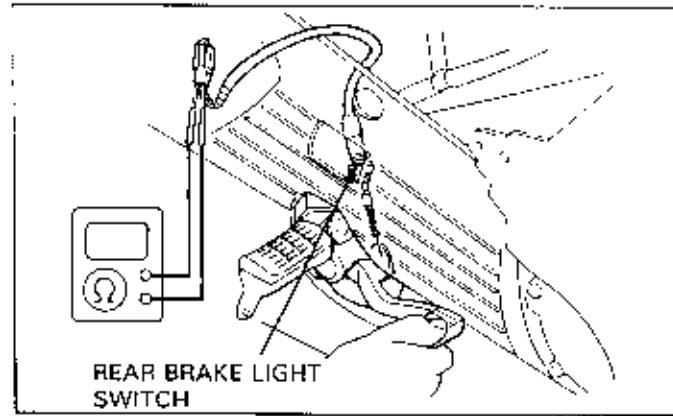
## LIGHTS/METERS/SWITCHES

2. If normal, disconnect the brake light switch connector and check for continuity between the terminals while operating the brake lever (or pedal).

When the brake lever (or pedal) is depressed:  
There should be continuity between the terminals.  
When the brake lever (or pedal) is released:  
There should be no continuity between the terminals.

3. If the brake light switch is normal, check for the following.

- Burned sub fuse.
- Ignition switch.
- Poor connection of the fuse connector.
- Broken wire between the sub fuse and brake light switch.
- Broken wire between the brake light switch and brake light.



## TURN SIGNAL LIGHTS

If the turn signal light does not blink, check the following.

- Is the battery normal?
- Is the bulb burned out?
- Is the bulb of the specified wattage?
- Is the fuse burned out?
- Are the ignition switch and turn signal switch normal?
- Is the connector properly connected?

If normal, check as noted below.

- When the turn signal relay has 2 terminals:

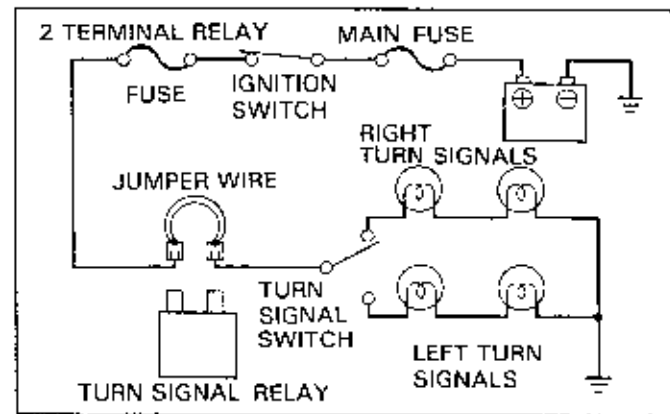
Disconnect the connector from the relay and short the connector with a jumper wire. Turn the ignition switch ON and check the turn signal light by turning the switch ON.

Light does not come on

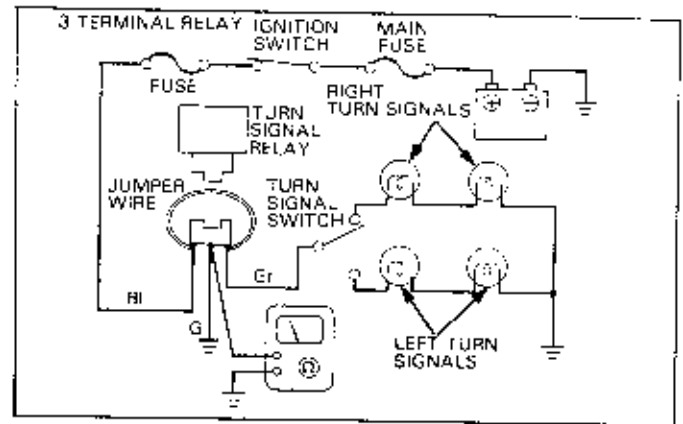
- Broken wire harness.

Light comes on

- Faulty turn signal relay.
- Poor connection of the connector.



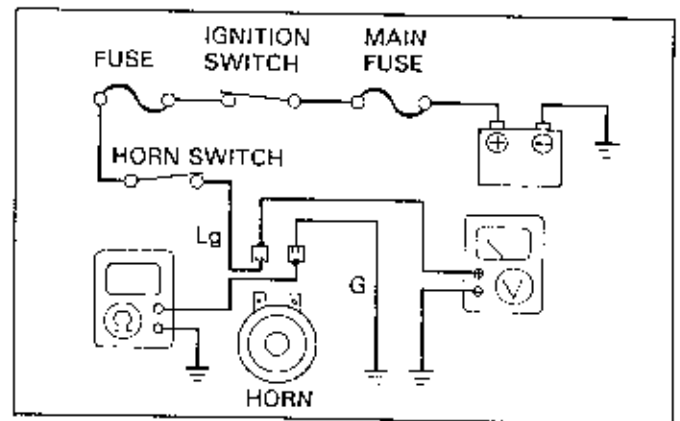
- When the turn signal relay has 3 terminals;
  1. Short the black and gray terminals of the turn signal relay connector with a jumper wire. Turn the ignition switch ON and check the turn signal light by turning the switch ON.
    - ↓
    - Light comes on
      - ↓
      - 2. Check for continuity between the green terminal of the relay connector and ground.
        - ↓
        - Continuity
          - Faulty turn signal relay.
          - Poor connection of the connector.
        - ↓
        - No continuity
          - Broken ground wire.
      - ↓
      - Light does not come on
        - Broken wire harness.
    - 2. Check for continuity between the green terminal of the relay connector and ground.
      - ↓
      - Continuity
        - Faulty turn signal relay.
        - Poor connection of the connector.
      - ↓
      - No continuity
        - Broken ground wire.



## HORN

### Horn does not sound:

1. Check the ignition switch and horn switch. If normal, check the following.
2. Disconnect the wire from the horn. Turn the ignition switch ON, press the horn switch (or start the engine and press the horn switch if your motorcycle is battery-less type) and check for voltage between the light green wire and ground.
  - ↓
  - Voltage
    - ↓
    - 3. Check for continuity between the green wire and ground.
      - ↓
      - Continuity
        - Faulty horn.
      - ↓
      - No continuity
        - Broken green wire.
        - Faulty ground.
    - ↓
    - No voltage
      - Broken light green wire.
      - Faulty sub fuse.

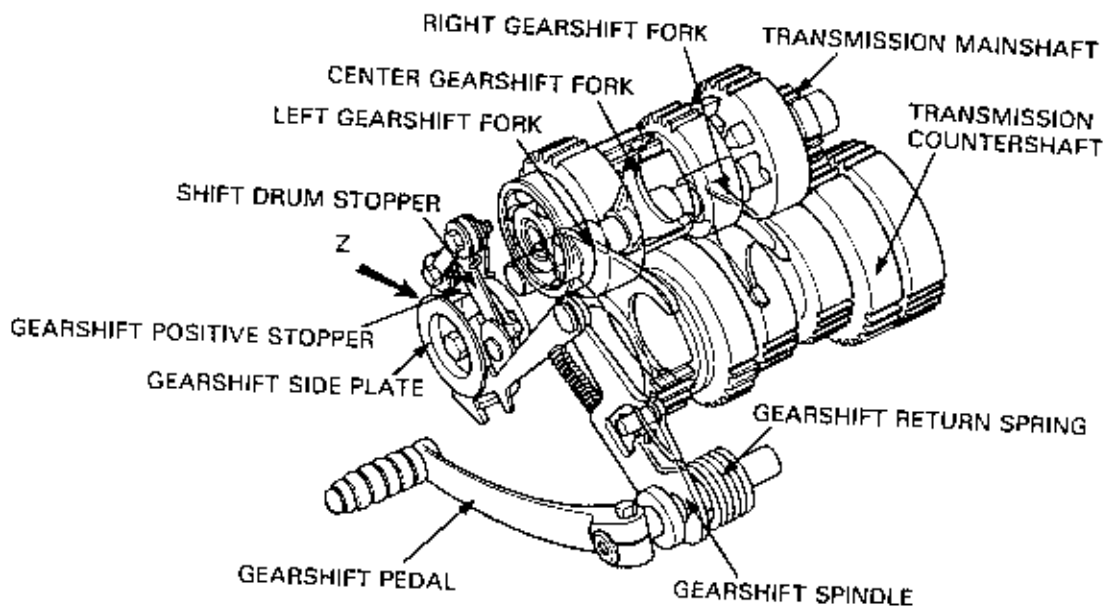
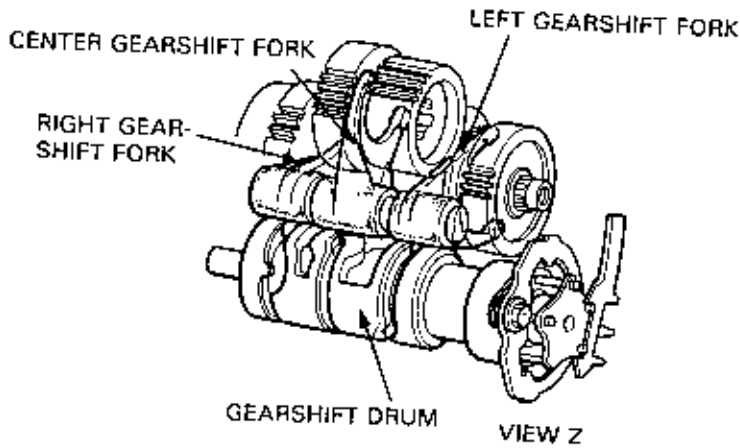


# SYSTEM DESCRIPTION

## GEARSHIFT MECHANISM

### CONVENTIONAL TYPE

The gearshift mechanism consists of three gearshift forks, a gearshift drum, a gearshift arm, a shift drum stopper and a gearshift positive stopper. When the gearshift pedal is depressed the gearshift spindle rotates, causing the gearshift arm to rotate the shift drum. When the shift drum rotates, the shift forks move sideways due to the cam action of the groove cut in the shift drum body.



## PLANETARY GEAR TYPE

**OPERATION:**

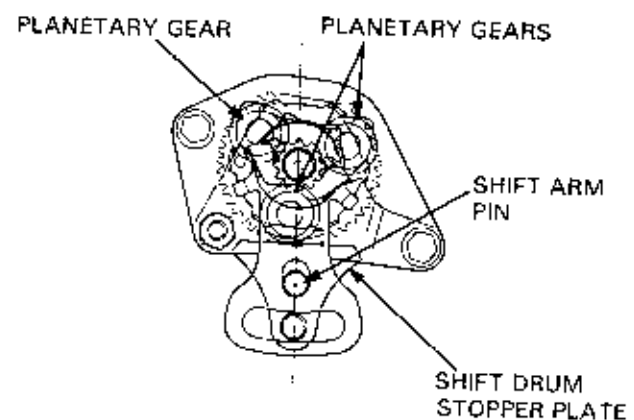
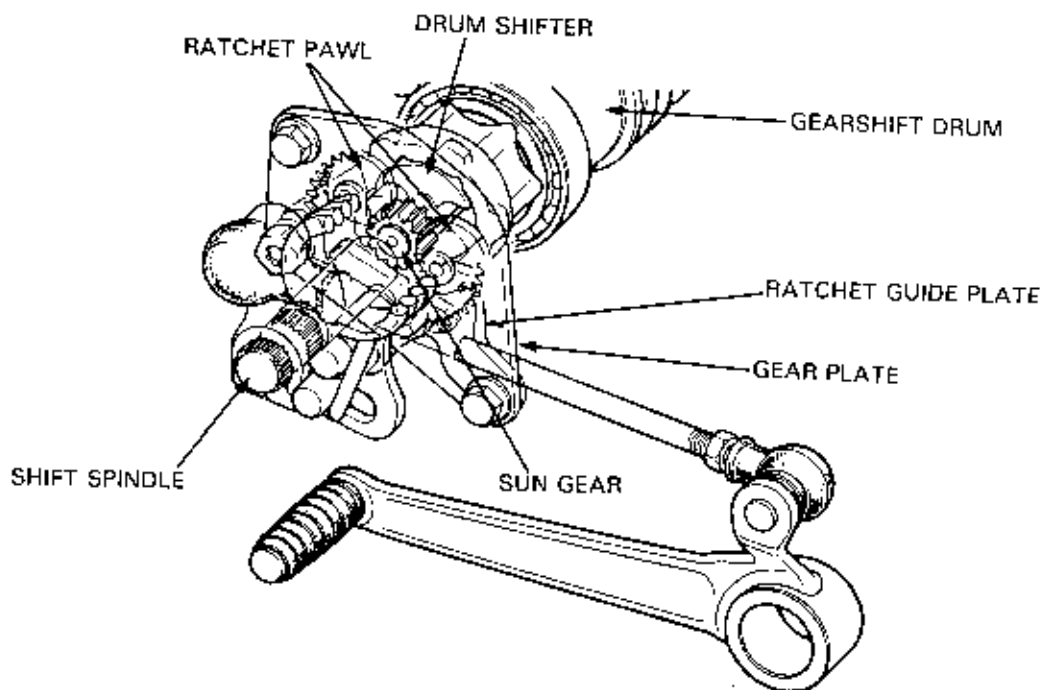
This system is comprised of a shift spindle assembly, guide plates, drum shifter, and two stopper assemblies.

The shift spindle assembly is comprised of the shift spindle, and the three planetary gears.

The shift spindle assembly, plus the guide plates, transmit the gear shifter movement to the sun gear on the drum shifter. As the drum shifter turns, one of its pawls will engage a detent in the shift drum, turning the drum.

Turning the drum causes the shift forks to move by the same cam action as with the conventional type shift mechanism.

The two stopper assemblies locate the shift drum at the proper gear and neutral positions.

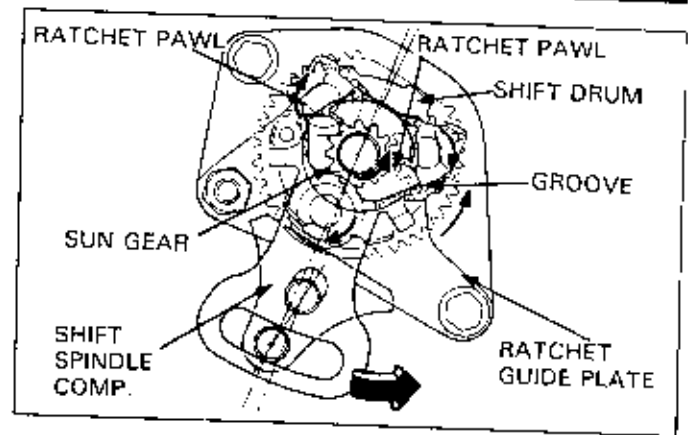


## TRANSMISSION

### Shift Start

Pushing down on the shift pedal turns the spindle counterclockwise. Because the gear plate is fixed, the planetary gears turn clockwise, turning the drum shifter counterclockwise.

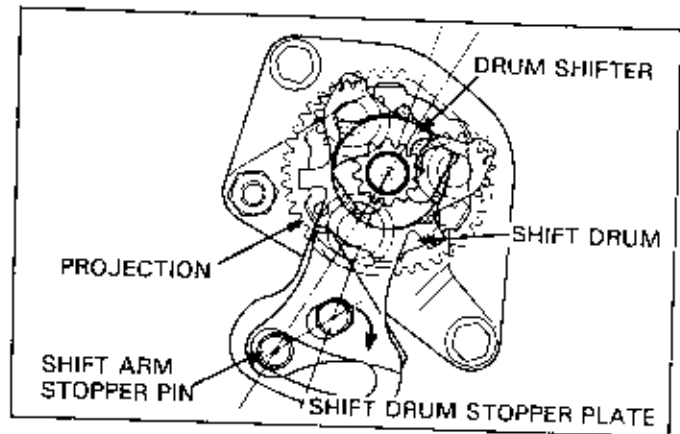
As the drum shifter turns counterclockwise, the right pawl engages the detent in the shift drum, while the left pawl is pushed out of the way into the shifter by the guide plate. With the pawl engaged, the drum shifter turns the shift drum, moving the shift forks into place.



### Shift Finish

To prevent the drum from rotating too far, a shift drum stopper plate is used. The shift drum stopper plate rotates on an eccentric pivot moved by the spindle assembly.

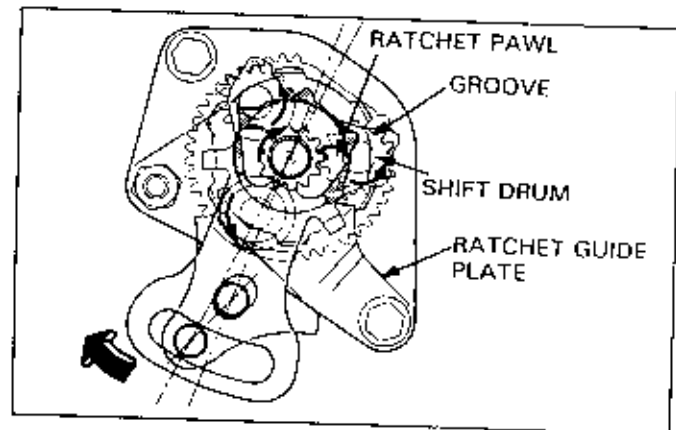
As the spindle reaches the end of its travel, one leg of the stopper plate is moved up to contact a positive stop on the shift drum. At the same time the spindle assembly is prevented from moving too far by the shift arm stopper pin.



### Shift Return

When the shift pedal is released, the shift return spring brings the spindle assembly back to the centered position.

At this time, the drum shifter rotates and the ratchet feature allows the right pawl to disengage from the shift drum. As the drum shifter rotates, the drum stopper arm prevents the shift drum from moving.



**CONSTANT MESH TRANSMISSION**

The constant mesh transmission consists of the following components:

- The mainshaft, with its fixed and sliding gears.
- The countershaft, with its fixed and sliding gears.
- The shift forks.
- The shift drum.

Power is transmitted through the clutch to the mainshaft.

From the mainshaft, power may be transmitted through several gear sets to the countershaft.

M1 through M5 are the gears on the mainshaft and C1 through C5 are the countershaft gears.

The gear sets are comprised of opposing gears, one gear on each shaft.

The illustration on the right shows the gear sets, pairing the mainshaft number with the countershaft number (M1/C1, M2/C2, etc.).

Selection of the proper gear set is done by moving a sliding gear into contact with the gear set desired.

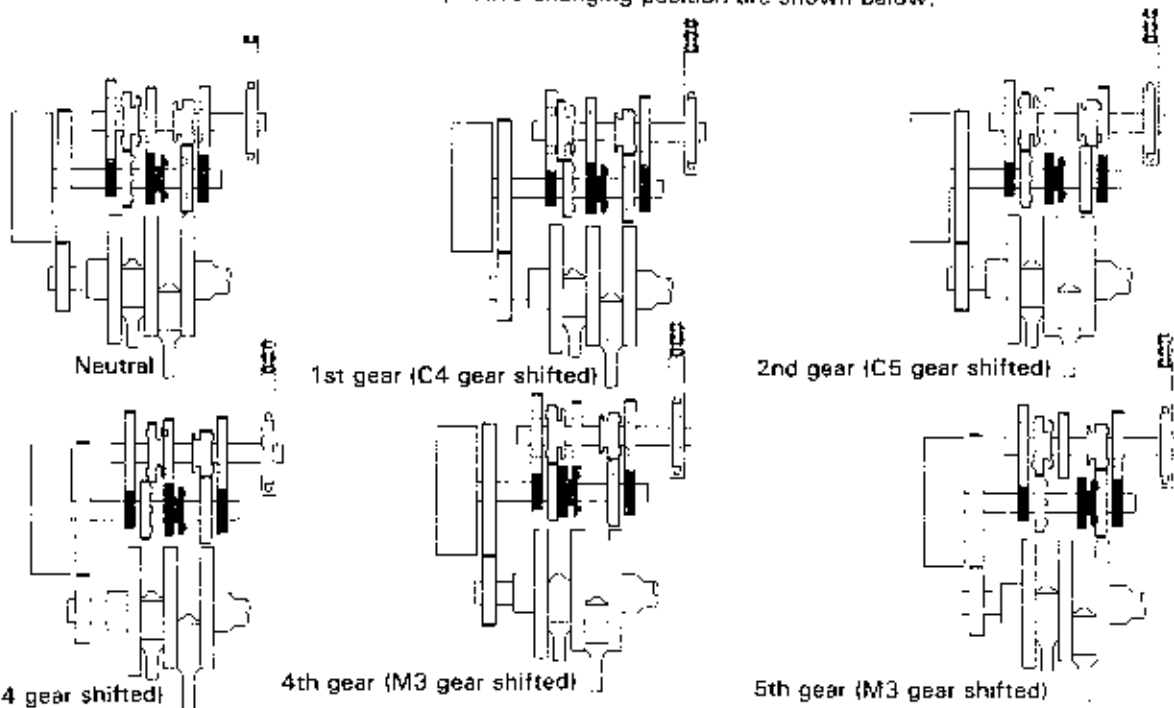
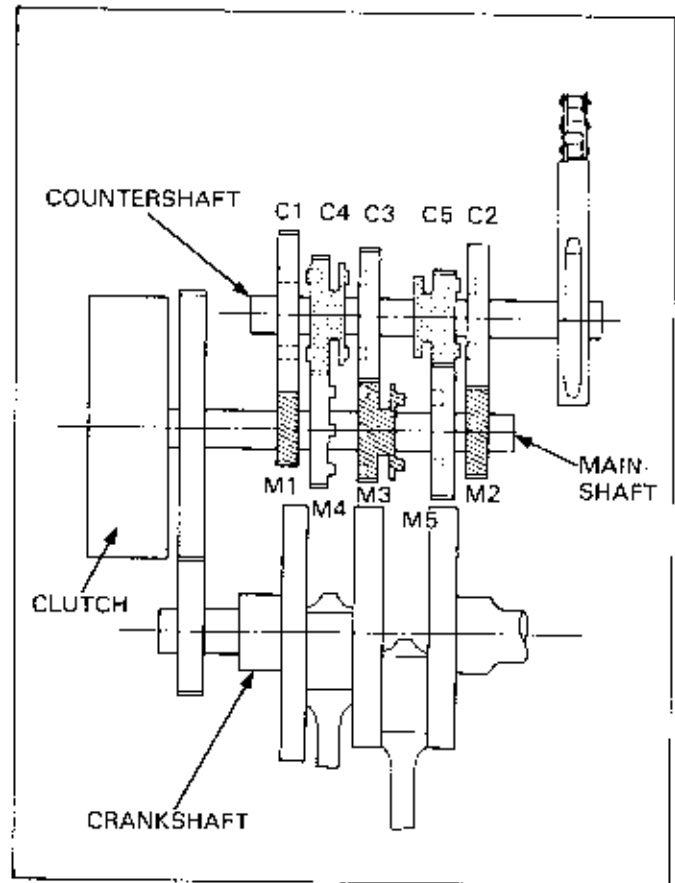
Connection of the sliding gear and the gear set is done using dogs and dog holes on the sides of the gears.

In the illustration, gears M3, C4, and C5 are the sliding gears.

The sliding gears are moved by shift forks which ride on the shift drum. Cam grooves cut in the shift drum move the shift forks as the drum rotates.

Rotation of the shift drum is done by working the gearshift pedal.

The relative positions of the transmission at the respective changing position are shown below.

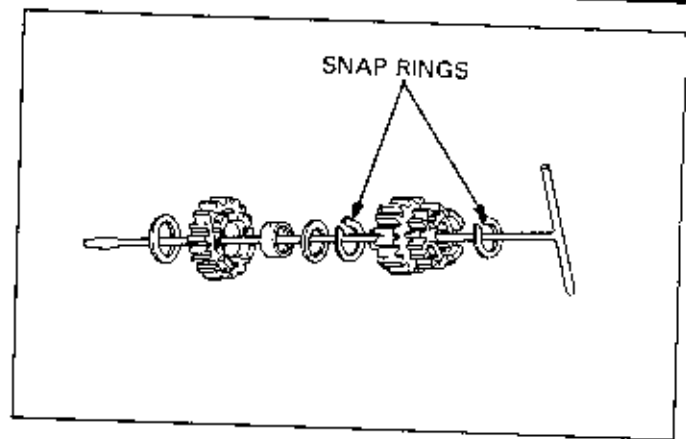


## TRANSMISSION

### TRANSMISSION DISASSEMBLY

#### NOTE

- Keep track of the disassembled parts (gears, bushings, washers, and snap rings) by stacking them on a tool or slipping them onto a piece of wire.
- Do not expand the snap ring more than necessary for removal. To remove a snap ring, expand the snap ring and pull it off using the gear behind it.

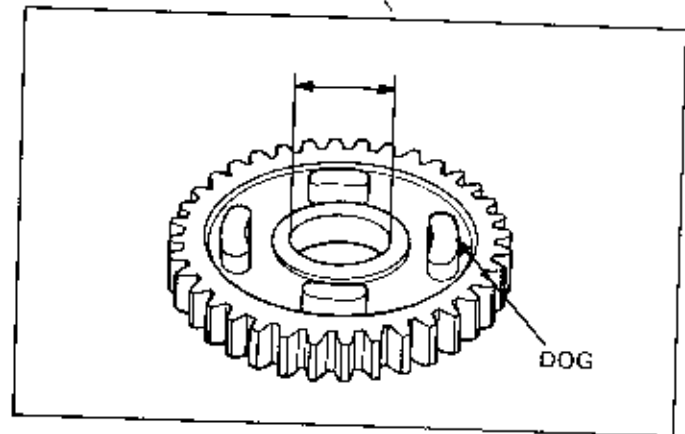


### TRANSMISSION INSPECTION

#### Check the following:

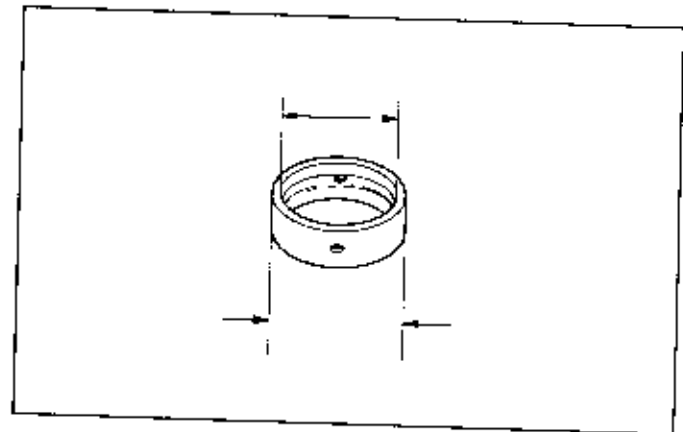
##### Gears:

- Teeth—for damage or excessive wear.
- Dogs and dog holes—for damage or excessive wear.
- Measure the gear I.D. (except splined holes and holes with needle bearings).



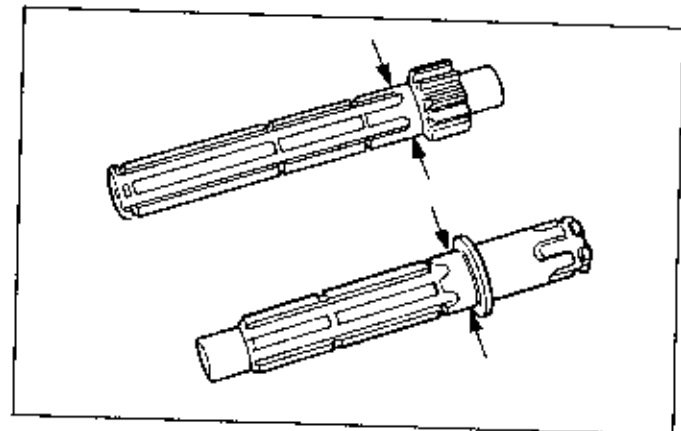
##### Bushings:

- For wear or damage.
- Measure the I.D. and O.D.
- Calculate the gear-to-bushing and bushing-to-shaft clearances.



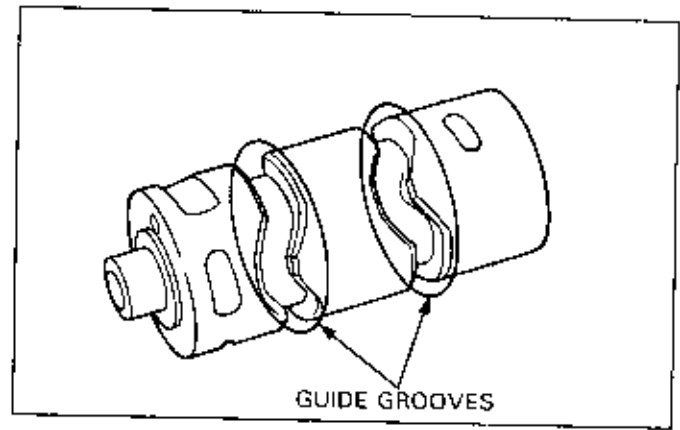
##### Mainshaft, Countershaft

- Spline groove and sliding surface for abnormal wear or damage.
- Measure O.D. at the gear sliding areas.
- Calculate the gear-to-shaft and shaft-to-bushing clearances.



**Shift Drum**

- The guide groove for abnormal wear or damage.
- The bearing for excessive play or damage (if required).

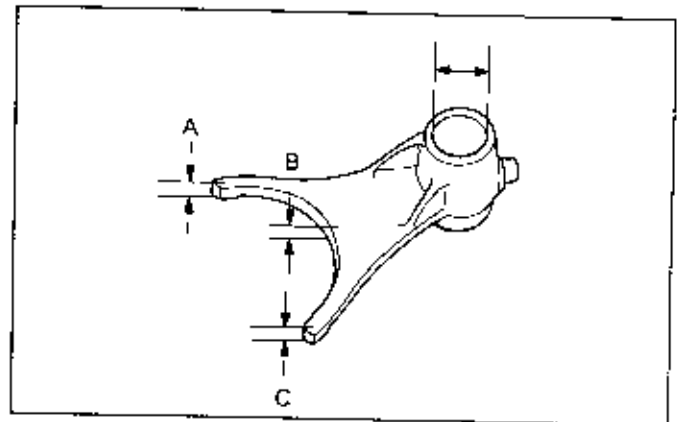


**Shift Fork**

- For deformation or abnormal wear.
- Measure the fork claw thickness.
- Measure the I.D. of the shift fork.

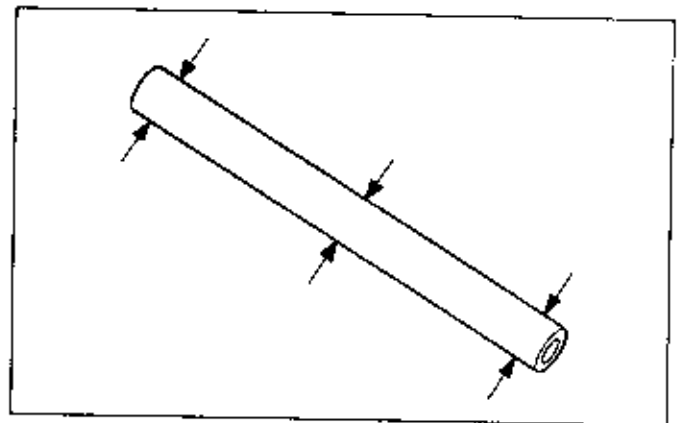
**NOTE**

- Some fork claws are measured at A and C (claw ends). Others are measured at B (the center).



**Shift Fork Shaft**

- For damage and straightness.
- Measure the O.D. at the shift fork areas.



**TRANSMISSION ASSEMBLY**

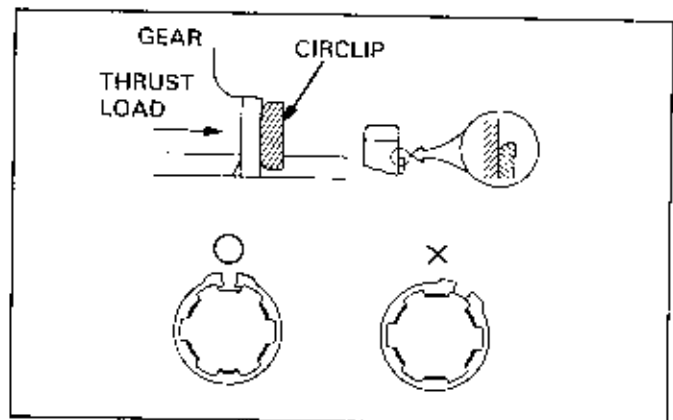
Clean all parts in solvent.

Apply molybdenum disulfide grease to all sliding surfaces of the mainshaft, countershaft and bushings to ensure initial lubrication.

Reassemble all parts into their original positions.

**NOTE**

- Always install the thrust washers with the chamfered (rolled) edge facing away from the thrust load.
- After installing a snap ring, slightly open the ring and rotate it in its groove to be sure it is fully seated.
- Do not use worn snap rings which could easily spin in the groove. It would be too loose to properly seat in the groove. Align the gap in the snap ring with the groove of the spline.

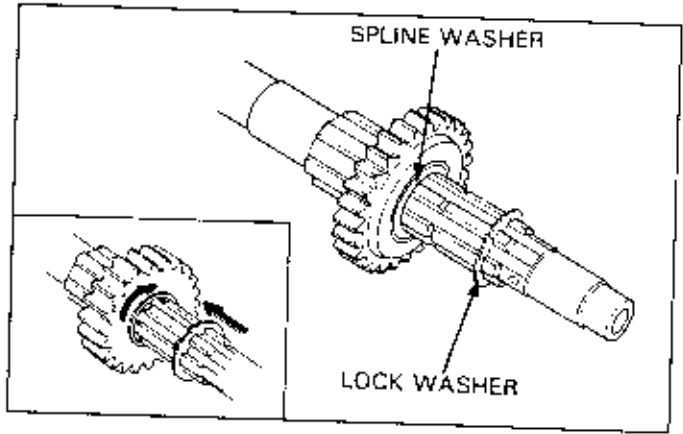




# TRANSMISSION

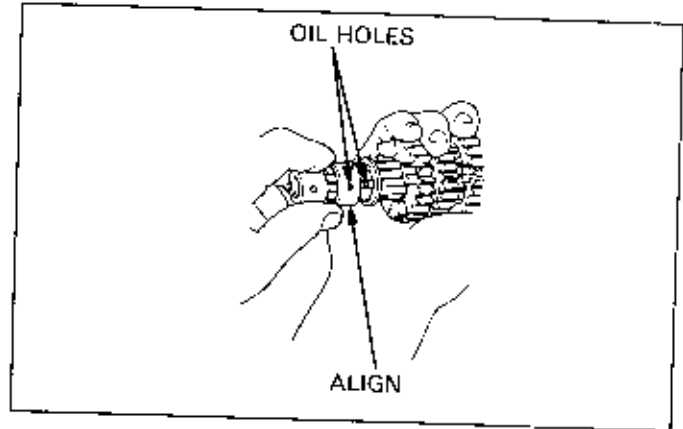
## NOTE

- Install the lock washer by aligning its tabs with the grooves of the spline washer.
- Do not forget to install the thrust washer at the end of the mainshaft and countershaft.



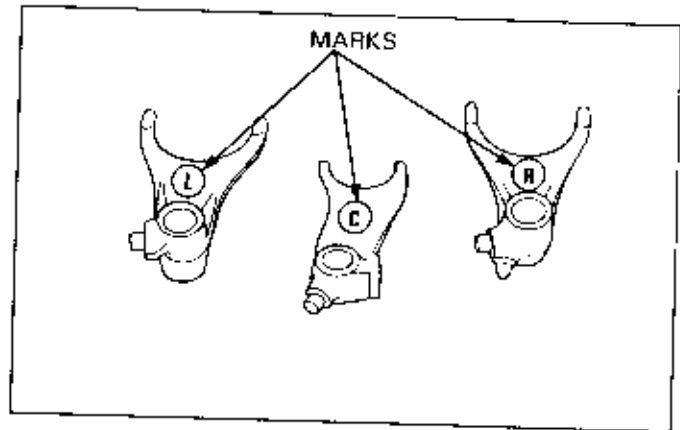
## NOTE

- Align oil hole in the bushing or gear with shaft oil hole.



Install the shift forks in the correct positions according to the location mark on each fork.

- "L" mark: Left side of the crankcase
- "C" mark: Center of the crankcase
- "R" mark: Right side of the crankcase



Turn the mainshaft or countershaft to ensure that the gears turn smoothly after reassembly.

Lubricate gears with clean (recommended) engine oil while turning the shaft.

