FOREWORD

This service manual has been designed to furnish all dealer and service personnel with specific information concerning this machine, including disassembly and assembly procedures, inspection and analysis of worn parts, and subsequent repair or adjustment procedures.

The manual should be thoroughly read. This will provide full familiarity with the design of this machine and all correct repair procedures.

Because Yamaha engineers are constantly searching for new and more efficient engine advancements, it is possible that some of this information may be modified in the future. Any change in design, adjustments or repair procedures will be immediately forwarded to all Authorized Yamaha Dealers through Service and/or Parts News Bulletins.

YAMAHA MOTOR CO., LTD.
Engineering & Service Department

INDEX

GENERAL 1

ADJUSTMENTS 2

ENGINE SECTION 3

FUEL SYSTEM 4

CHASSIS 5

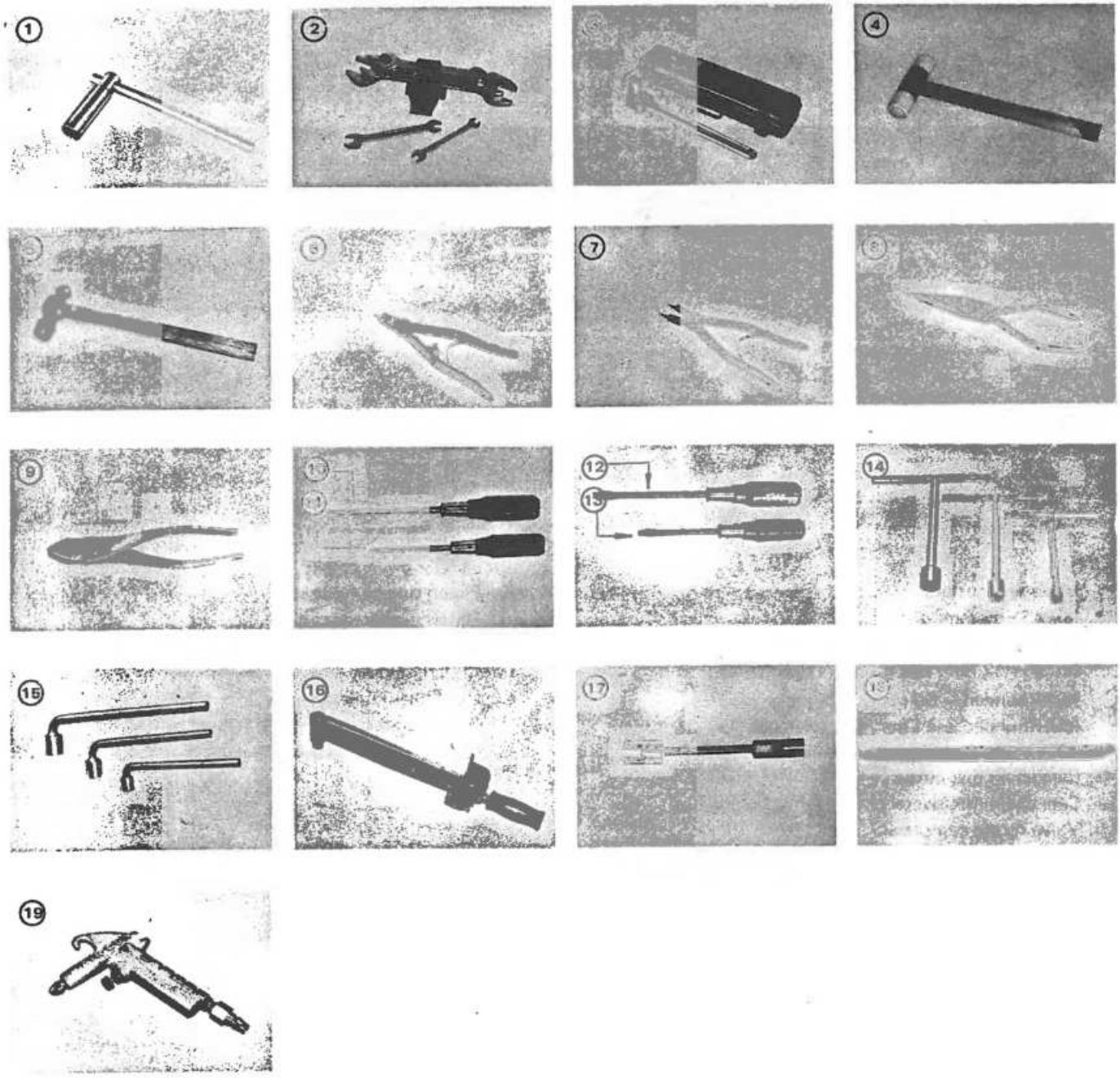
ELECTRICAL 6

TROUBLESHOOTING 7

1-4. SERVICE TOOLS

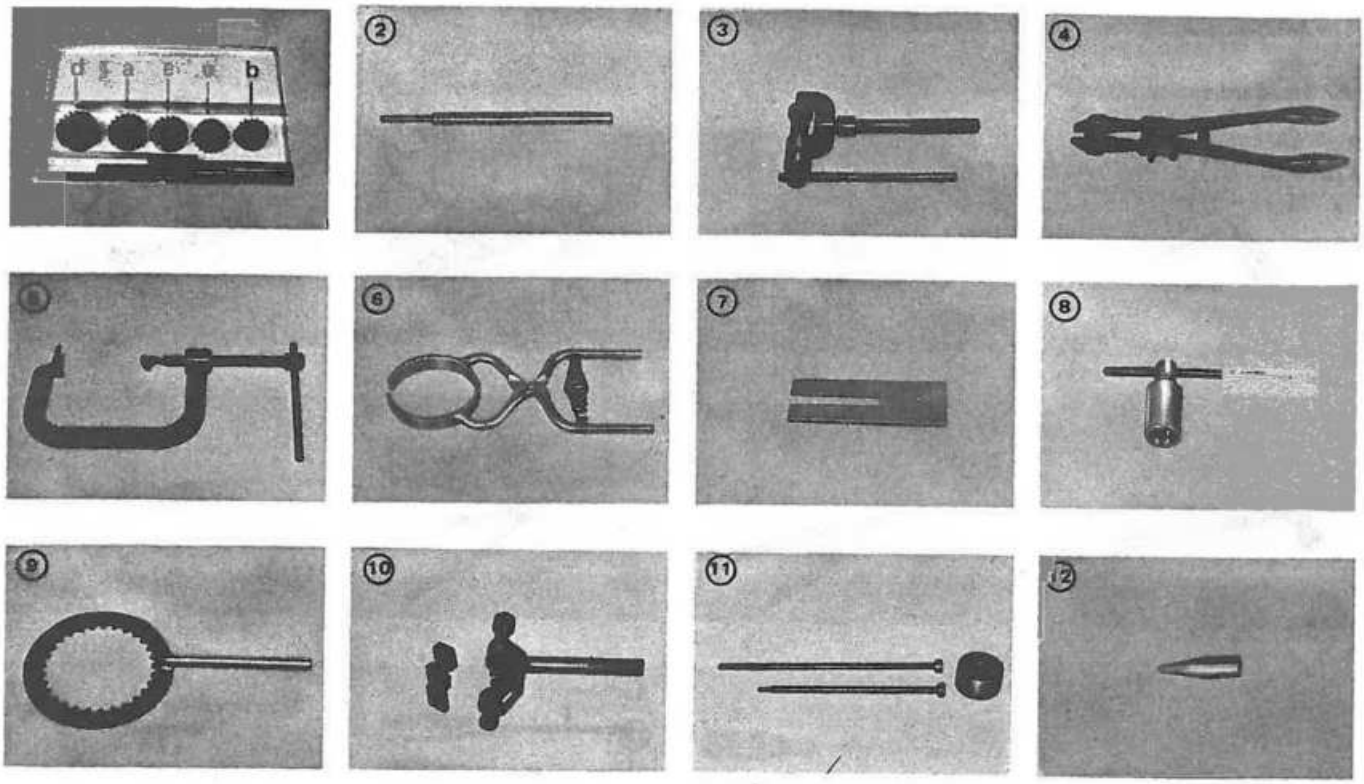
The following additional tools are required to service the YAMAHA XS650B.

A. Standard tools



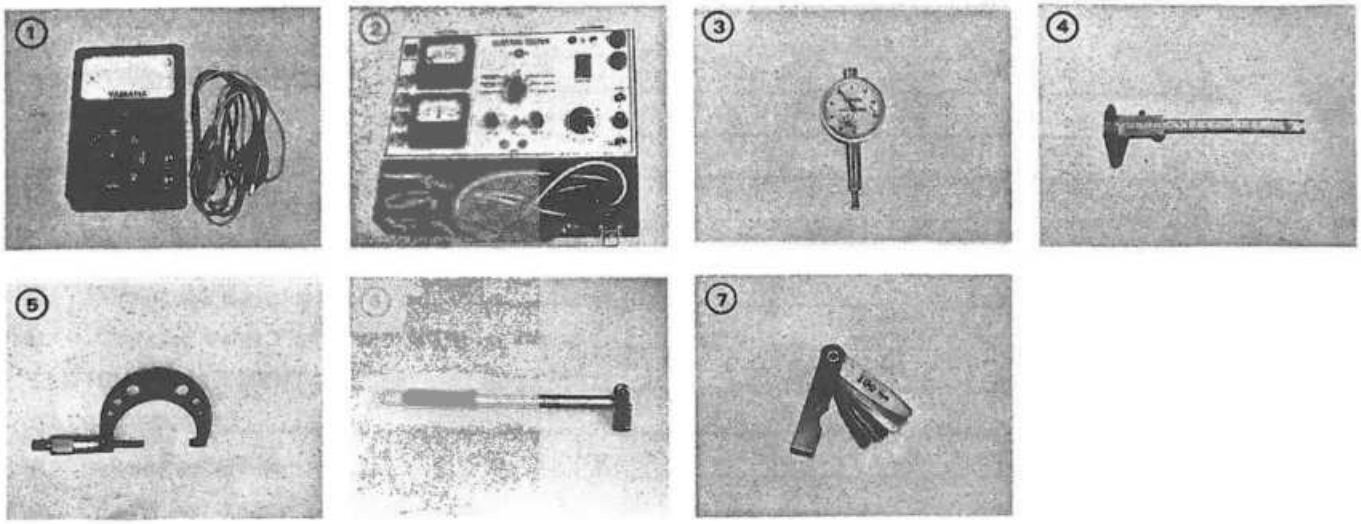
1. Plug wrench
2. Open-end wrenches
3. Socket wrenches
4. Soft-faced hammer
5. Steel hammer
6. Clip pliers (ST type)
7. Clip pliers (RT type)
8. Needle nose pliers
9. Combination pliers
10. Phillips-head screwdriver (Large)
11. Phillips-head screwdriver (Medium)
12. Slot-head screwdriver (Large)
13. Slot-head screwdriver (Medium)
14. T-type socket wrenches
15. L-type socket wrenches
16. Torque wrench
17. Nipple wrench
18. Iron levers
19. Air gun

D. Special tools



1. Valve seat cutters
   (a) 45 - 40 mm. dia. (intake)
   (b) 45 - 34 mm. dia. (exhaust)
   (c) 65 - 42 mm. dia. (intake/exhaust)
   (d) Rounded – 50 mm. dia. (intake)
   (e) Rounded – 44 mm. dia. (exhaust)
2. Valve guide installation/removal guide
3. Cam chain link cutter
4. Cam chain link riveter
5. Valve spring compressor
6. Piston ring compressors
7. Piston support plates
8. Rotor puller
9. Clutch holding tool
10. Drive chain link cutter
11. Rocker arm/Balancer shaft puller
12. Master cylinder seal installing tool

B. Measuring instruments



1. Pocket tester
2. YAMAHA electrotester
3. Dial gauge
4. Vernier Cariper
5. Micro Meter
6. Cylinder gauge
7. Feeler gauge

C. Miscellaneous tools



1. YAMAHA 4-stroke oil (or Motor oil 10W/30)
2. Oil jug
3. YAMAHA bond (No. 1)
4. Oiler
5. YAMAHA bond (No. 4)
6. Parts tray
7. Brake fluid
8. Overhauling stand
9. Bearing grease
10. Rags
11. Cotter pin
12. Vinyl tube (4mm)
13. Spring balance

CHAPTER 2. ADJUSTMENTS

2-1. VALVE ADJUSTMENT 18
A. Valve Adjustment 18
B. Setting Ignition Timing 18
2-2. CAM CHAIN ADJUSTMENT 21
A. Chain Tensioner 21
B. Timing the Camshaft 22
C. Checking Valve Timing with a Degree Wheel 23
2-3. CLUTCH ADJUSTMENT 24
2-4. CARBURETOR 25
A. Idle-speed Adjustment 25
B. Fuel Level Adjustment 25
2-5. SHIFT ADJUSTMENT 26
2-6. REAR BRAKE AND STOP SWITCH ADJUSTMENT 26
A. Rear Stoplight Switch Adjustment 27
2-7. SERVICE CHECKS/ADJUSTMENTS 27
A. Cylinder Compression Check 27
B. Changing or Adding Engine/Transmission Oil 28

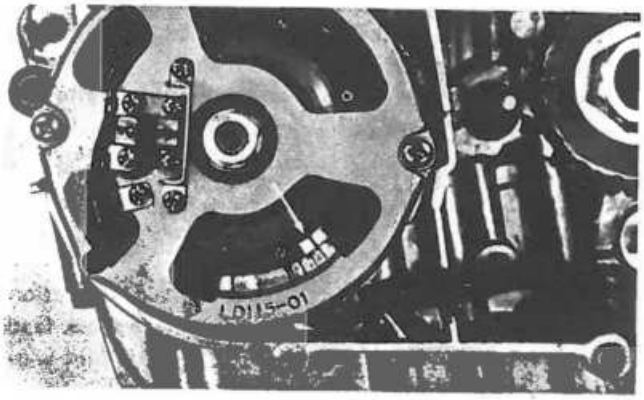
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CHAPTER 2. ADJUSTMENTS

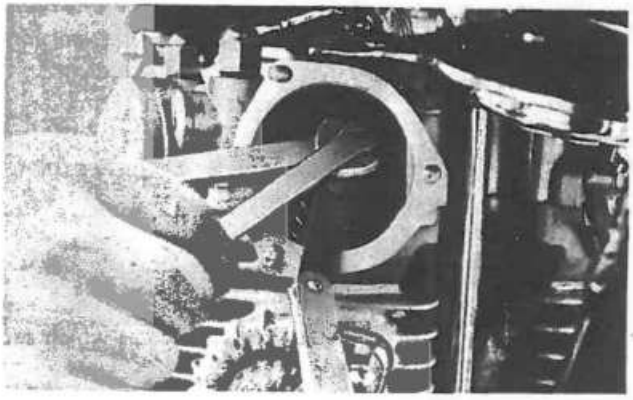
2-1. Valve Adjustment

A. Valve Adjustment

Improper valve clearance causes poor engine performance and possible engine damage. If there is too little clearance, the valve is held partially open. This permits blowby past the valve and a drop in compression. If there is too much clearance there will be excessive engine noise and the valve will not open fully which will create partial blockage of airflow at the port.



1. Remove all four tappet covers and the alternator cover.
2. Next, align the "T" mark on the stator with the timing mark on the rotor. This places the pistons at top dead center. One of the cylinders is now at the top of its compression stroke. The cylinder that is on the compression stroke has both valves shut. This can be noted by observing which cylinder has clearance at both valve adjustors.



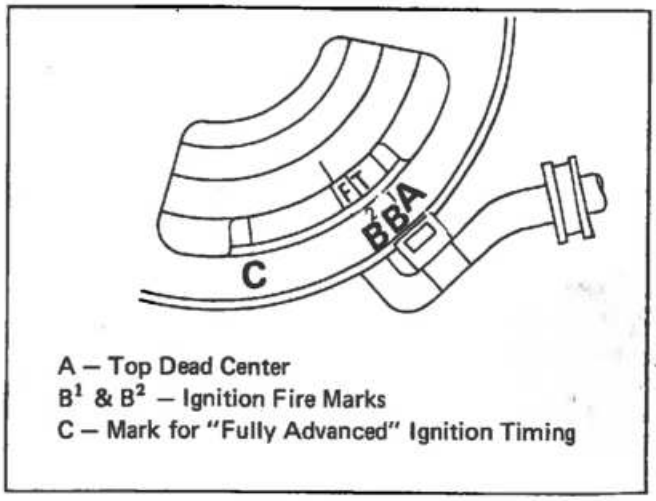
3. Use a feeler gauge to determine the existing clearance. The exhaust valve clearance should measure 0.004 in. (0.10 mm.); the intake clearance should measure 0.002 in. (0.05 mm.). (engine cold)
4. Loosen the lock nut and use the valve adjusting tool found in the Special Tool kit. Turn the adjustor in or out to obtain the correct clearance. Hold the adjustor solid to prevent it from moving and thoroughly tighten the lock nut. Recheck the clearance after tightening.
5. Rotate the crankshaft one complete revolution and once again line up the rotor and stator marks. The valve train of the other cylinder is now in position for adjustment.

Caution:
ADJUST VALVE CLEARANCE ONLY WHEN THE ENGINE IS COLD.

B. Setting Ignition Timing

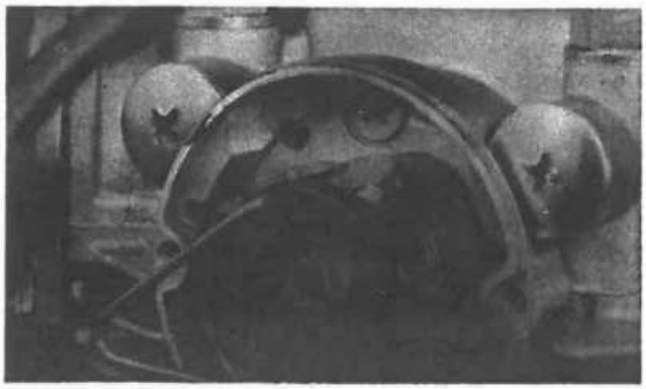
Caution:
In order to obtain accurate ignition timing, in relation to piston position, the cam chain must first be adjusted.

1. Ignition timing is checked observing the position of the timing marks on the rotor in relation to the timing marks on the stator.
2. The rotor has one timing mark. The stator has four timing marks. The first mark is identified by the letter "T". This means the piston is at "Top Dead Center". The next two marks, identified by the letter "F" stamped between them, are the point of proper ignition timing when fully retarded (engine stopped or idling). When setting ignition timing, set it so both cylinders fire between the marks (both ignition advance weights completely closed).



A – Top Dead Center
B^1 & B^2 – Ignition Fire Marks
C – Mark for "Fully Advanced" Ignition Timing

3. The fourth timing mark indicates 38° before TDC, the fully advanced ignition position.

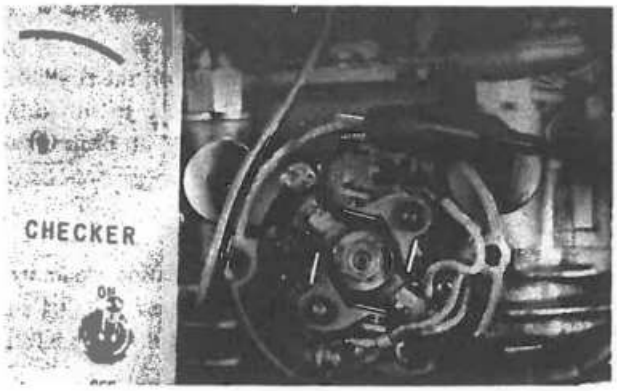


Note:

Each point gap should be checked first, and adjusted, if necessary. Then proceed with the timing adjustment.

4. Remove the alternator inspection plate, ignition points cover, and ignition advance unit cover.
5. Securely anchor the ignition advance weights into the "fully retarded" position (weights held inward).

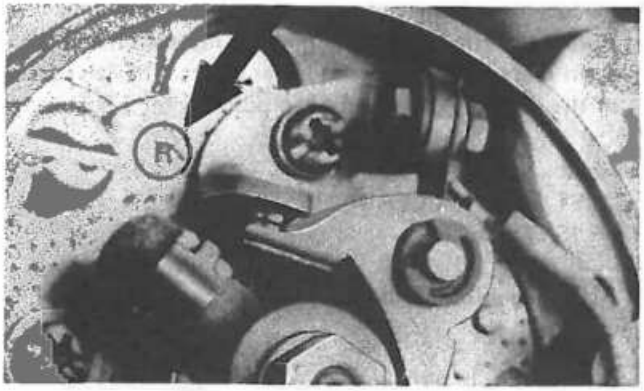
6. Check the point checker for full scale deflection (Infinity to Zero resistance), then hook the black lead to a good ground; the red lead to the grey point wire (right cylinder).



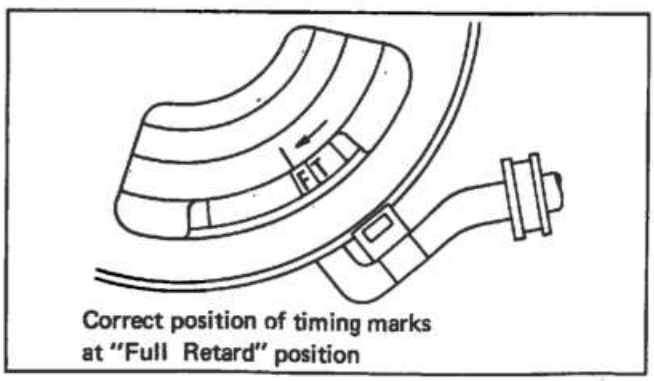
Caution:

Ignition timing for each cylinder is set separately. However, it is absolutely necessary that the right cylinder points are timed before the left cylinder points. The right cylinder points are mounted directly to the ignition point base plate. The left cylinder points, however, mount on a separate plate that is in turn mounted to the large ignition base plate. If the left cylinder points are timed first, they will shift out of position when the base plate is pivoted to time the right cylinder points.

7. The letter "L" (for left cylinder) is stamped next to one set of points, the letter "R" (for right cylinder) is stamped next to the other set. This indicates which set of point fires which cylinder.

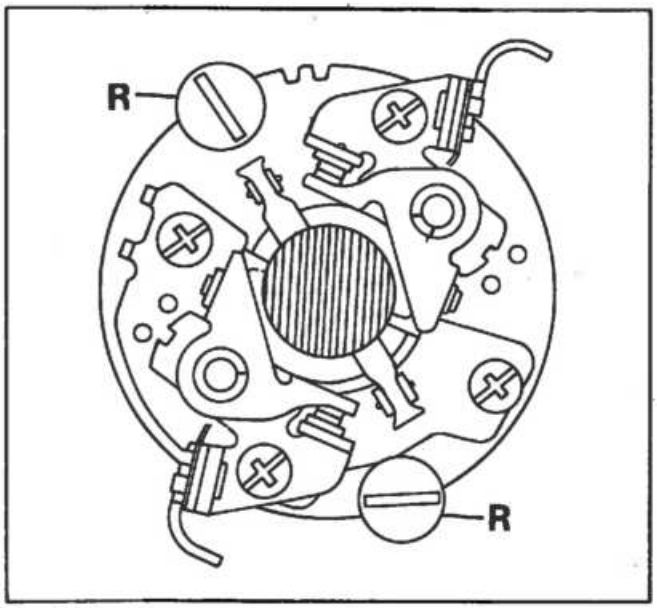


8. Rotate the crankshaft in the direction of running rotation (counterclockwise when viewed from the left side) until the right hand set of points just start to open, as indicated by the point checker.
9. Check the rotor timing mark position. If the right-hand points are timed correctly, the rotor mark will line up exactly between the two "F" stamped timing marks on the stator. If these marks do not line up, a corrective adjustment must be made to the points.



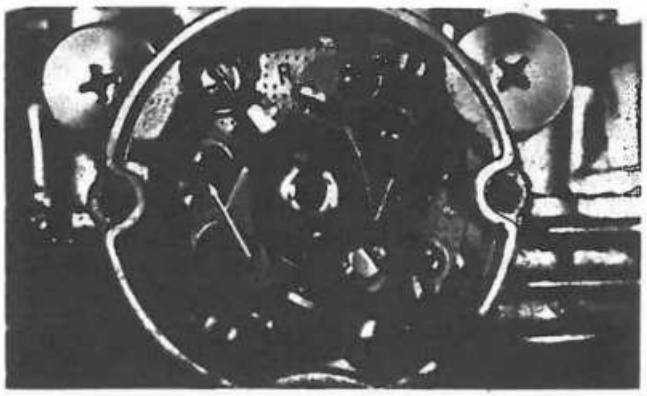
Correct position of timing marks at "Full Retard" position

10. With the timing marks lined up correctly, loosen both base plate lock screws. Pivot the entire plate until the right cylinder points just start to open, (as indicated by the point checker).

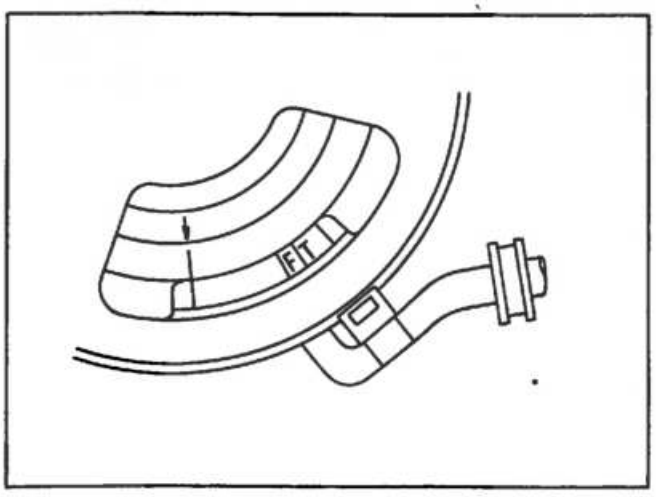


Base plate set screws

11. Tighten down both lock screws and check the timing again to make sure the base plate has not moved.
12. To set left cylinder timing, repeat steps 6 thru 10, except to switch the point checker probe from the grey wire to the orange wire. The left cylinder points are held in place on the base plate by two different lock screws. Loosen both lock screws as shown in the accompanying figure and make the necessary adjustments.

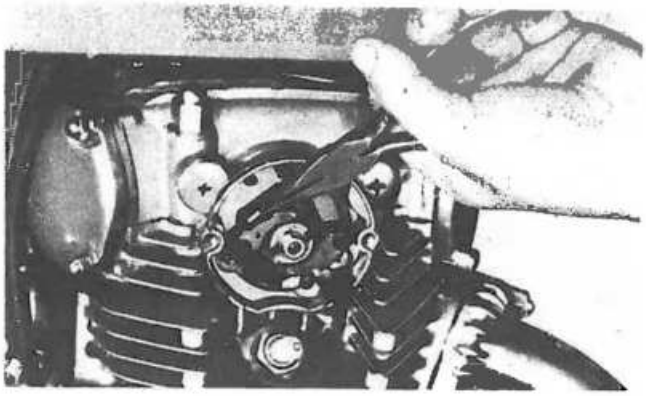


13. Ignition timing of both cylinders must be checked at the "fully advanced" position. Wedge both ignition advance weights fully open. With the point checker hooked up to the orange wire, rotate the crankshaft. The left-hand points must now open when the rotor mark lines up with the stator full advance mark. (A tolerance of 3 mm. is allowed in either direction of the stator mark.) Switch the point checker lead to the right-hand cylinder and re-check.



Proper timing mark position at "full advance"

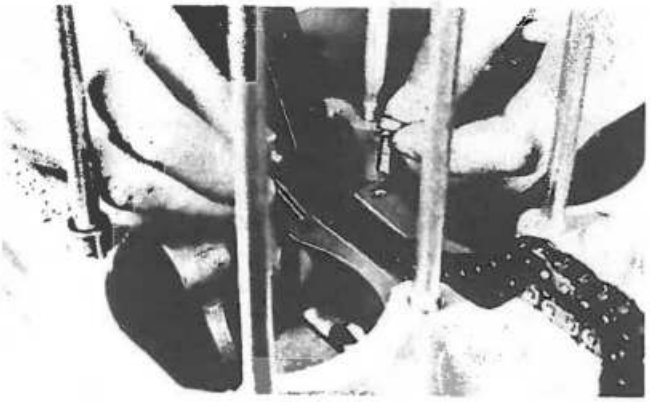
14. If both cylinders are timed correctly at "fully retarded" position, but the timing marks do not line up at the "fully advanced" position (within tolerances), make an adjustment at the ignition advance weight stoppers. Bend them in to slightly lessen the amount of ignition advance, bend them out to increase the amount of advance.
15. Finally, it is a good idea to re-check your results, especially in the case where the engine has not been running correctly.

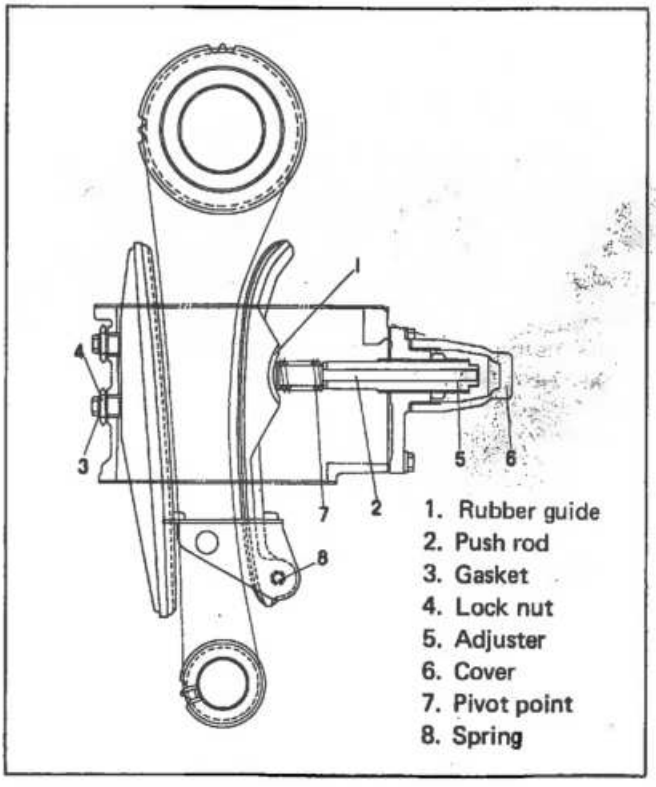


2-2. CAM CHAIN ADJUSTMENT

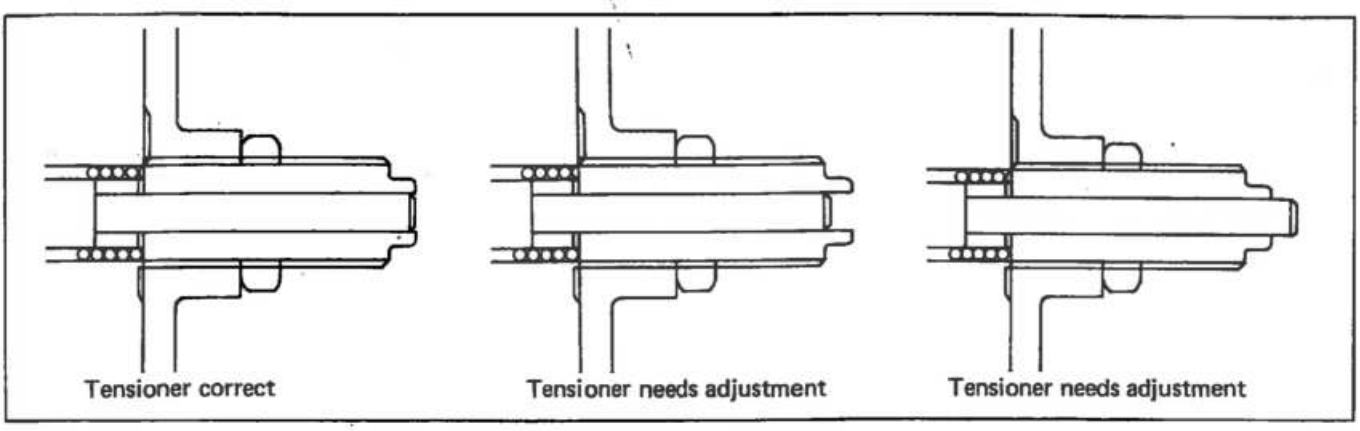
A. Chain Tensioner

1. The chain tensioner consists of a steel and rubber guide that is held against the cam chain by a spring and a locked in-place push rod. This slider takes up any free play in the chain. In addition, a rubber dampener solidly mounted to the tensioner arm, just below the tensioner base, helps to guide the cam chain. Because of gradual chain wear, an adjustment is required periodically.
2. Four 6 mm. bolts hold the tensioner housing in place. Remove these and pull the unit out of the cylinder.
3. Reverse this procedure to install the unit. During installation, install a new gasket coated on both sides with Yamaha Bond #4.
4. Rotate crankshaft in a counterclockwise direction (viewed from the left side of the engine) to place all slack in the area of the chain tensioner.
5. Remove the metal case protective cover.
6. Loosen the tensioner lock nut.
7. Use a 22 mm. wrench to turn the adjustor in until the push rod (inside adjuster) is flush with the end of the adjustor.



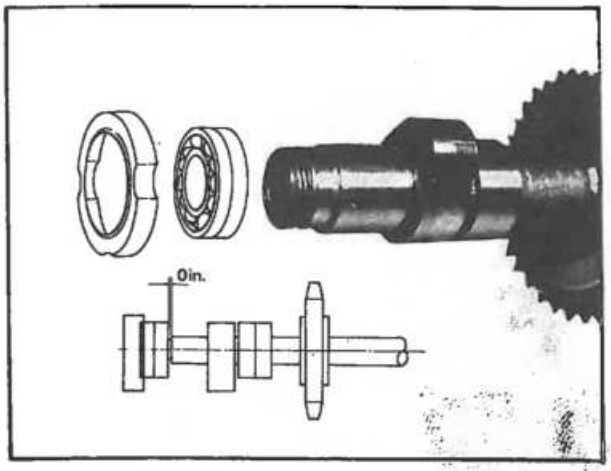


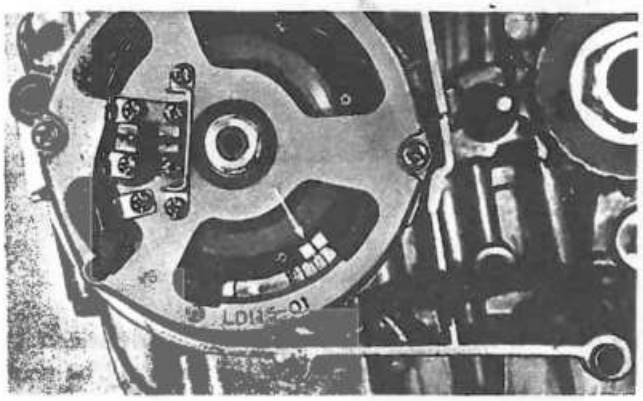
8. Tighten the lock nut and install the cover.
   Check this adjustment every 2,000 miles.



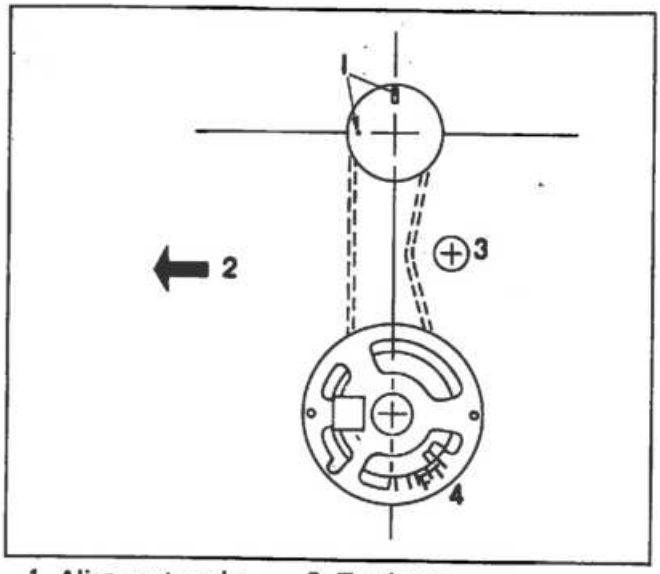
B. Timing the Camshaft

1. Slide all cam bearings in toward the center of the camshaft as far as possible. Place the camshaft into position with the camshaft threaded end on the right-hand side. Holding both cam bearings in toward the cam sprocket, move the cam back and forth until the cam chain driven sprocket is aligned with the crankshaft drive sprocket. This can be determined by observing the position of each cam bearing in its bearing boss. Both bearings must be positioned at equal distance in the cam bearing bosses.





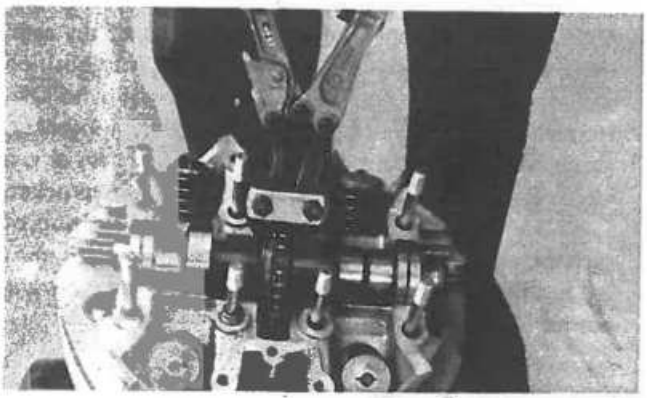
2. Next, rotate the pistons to TDC, as verified by lining up the rotor timing mark with the "T" (top) mark on the stator.
   If the stator has been removed, use the "dowel pin" process described in the Valve Timing section carefully equalizing the "dead point" of piston travel by turning the crankshaft forward and backward a few degrees at TDC. Make sure the piston is at the top of its compression stroke first. Otherwise, an opening valve may catch the dowel pin.



1. Alignment marks
2. Front
3. Tensioner
4. "T" mark lined up

3. There is a groove in the left side of the cam sprocket. Position this groove so that it lines up with the sprocket centers. This can be checked. The punch mark on the camshaft sprocket must be parallel with the head gasket surface. Lay a straight edge across the head surface and check the punch mark.
4. Reconnect the cam chain. The chain tensioner has been loosened during disassembly. Therefore, the cam chain will have excessive slack. To avoid incorrect timing, the cam chain should be installed with no slack in the cam chain on the front portion (opposite side from the tensioner). Any slack on the back chain portion can be taken up with the tensioner.
5. Join the chain together by installing and riveting a new chain link. Always use a new link each time the chain is reconnected. (Use a chain riveter, not a hammer and punch, to mushroom the rivet ends). The Parts Book lists the replacement link to use.

Important:
Make the proper chain tension adjustment.



C. Checking Valve Timing with a Degree Wheel

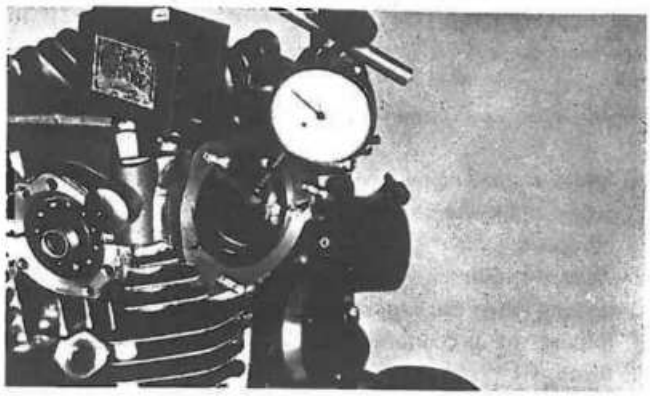
If the camshaft is not timed to open the valves in correct relation to crankshaft rotation, performance will be poor and engine misfire can occur.

1. Important. Make sure the cam chain tensioner has been properly adjusted.
2. Adjust all valves to correct clearances. (0.006" intake, 0.012" exhaust engine COLD.)
3. Remove the left-hand case cover and stator. Mount the degree wheel (found in Special Tool Kit) to the rotor lock bolt.

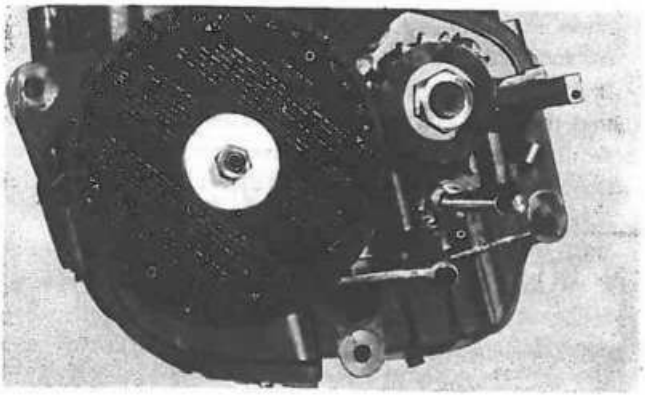
4. Remove a spark plug and a place wooden dowel pin in the hole. Rotate the engine in a counterclockwise direction (from left side) and find Top Dead Center on the compression stroke (valves are both closed) by watching the piston rise and fall as indicated by dowel pin position.
   Mount a pointer at the degree wheel so that it points to "O" on the wheel with the engine at TDC.
5. Mount the dial indicator over an intake valve tappet adjustor.
6. Rotate the crankshaft in a counter-clockwise direction (from left side). Watch the mounted dial indicator. Note when all clearance is taken up and the valve just starts to open.
7. Check the pointer position (in degrees on the wheel). The dial indicator should show the valve open 47° before top dead center after all valve tappet clearance has been taken up. Remember, "O" on the degree wheel is at Top Dead Center. The intake valve must close 67° after bottom dead center; a total of 294°.
8. If the valve starts to open 37° or 57° before top dead center, the camshaft sprocket is one tooth off in its alignment with the crankshaft sprocket. The cam chain must be loosened and the camshaft rotated to its correct position.

Note:

Valve timing is off by approximately 10° for every tooth the camshaft sprocket is misaligned.







2-3. CLUTCH ADJUSTMENT

If the clutch lever lash is too small, the clutch tends to slip during engagement. If too large, it tends to drag. This causes fast wear to friction plates and results in poor gear shifting.

To adjust the clutch, proceed as follows:

1. Remove the adjusting screw cap, and loosen the adjusting screw lock nut.
2. Screw in the clutch cable adjusting screw (on the clutch lever holder) until tight, and screw in the clutch adjusting screw until it contacts the push rod. (If the clutch adjusting screw is further screwed in, the clutch springs will be contracted, and the clutch adjusting screw will also become tight.) Back out the clutch adjusting screw 1/4 turn.
3. Tighten the clutch adjusting screw lock nut.
4. Finally, adjust the play of clutch lever holder by turning the clutch cable adjusting screw.

Amount of play: 0.8 - 1.1 in. (20 - 30 mm.)

2-4. CARBURETOR

A. Idle-speed adjustment

1. Reduce the engine speed by turning the throttle stop screw clockwise so that the engine runs at lowest possible speed.
2. Turn the pilot air screw to the right or left, and stop turning when the engine begins to run faster.
3. Repeat the procedures of 1. and 2. above two or three times.
4. Turn the throttle stop screw so that the engine runs at specified idling speed.

B. Fuel Level Adjustment

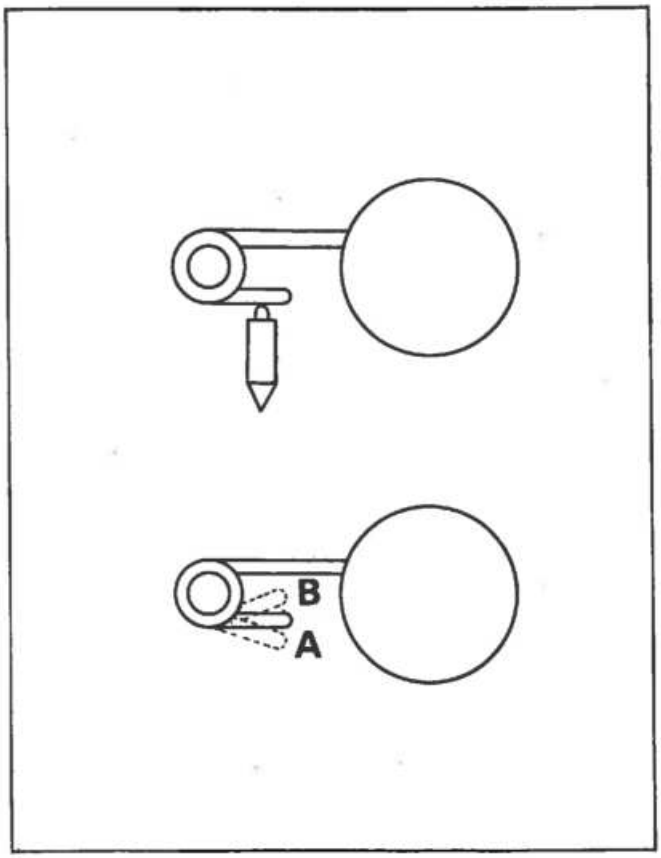
The fuel level is the distance from the center of main bore to the fuel surface. But in actual fuel level adjustment, it is the distance from the sealing surface of float chamber to the bottom of float.

To adjust the fuel level, proceed as follows:

1. Remove the mixing chamber top, together with the slide.
2. Remove the float chamber, and clean the float valve of dust. If it is worn excessively, replace.
   Remove the float chamber gasket, and invert the mixing chamber. Push up the float once with your finger, and lower it slowly. Using a vernier caliper, measure the distance from the sealing surface of mixing chamber to the bottom (top in this case) of the float the moment that the float arm lightly contacts the end of float valve. As illustrated below, bending the float arm in the direction of "A" lowers the fuel level; bending in the opposite direction "B" raises the fuel level.
   Butterfly valve synchronization: Both butterfly valves must be adjusted to open and close simultaneously. Fully close the throttle grip so that both butterfly valve actuator mechanisms rest against their throttle stop screws. Slowly twist the throttle grip and note whether both butterfly valves start to open at the same time. If this does not occur simultaneously, use the cable adjustor to lengthen or shorten one cable until correct action is achieved. In addition, with the throttle fully closed, both throttle cables should have approximately 1 mm. free play before both butterfly valves start to lift simultaneously.

Note:

Idle speeds on both carburetors MUST BE SET before synchronizing butterfly operation.



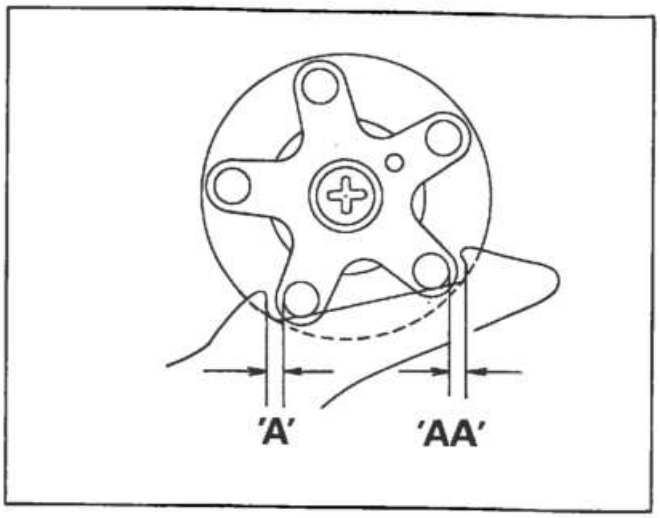
2-5. SHIFT ADJUSTMENT

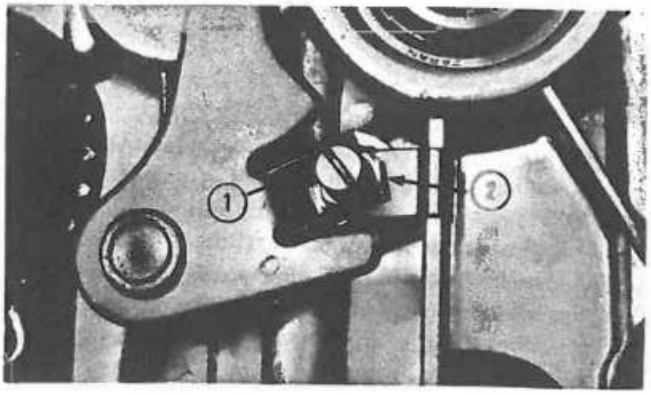
1. If shifting adjustment is correct, distances "A" and "AA" will be equal (see this page). If these are not equal, loosen the screw lock nut ② and rotate the eccentric screw ① until "A" and "AA" become equal. Retighten the lock nut and bend up the tab.

Note:

Make this adjustment in second, third, or fourth gear.

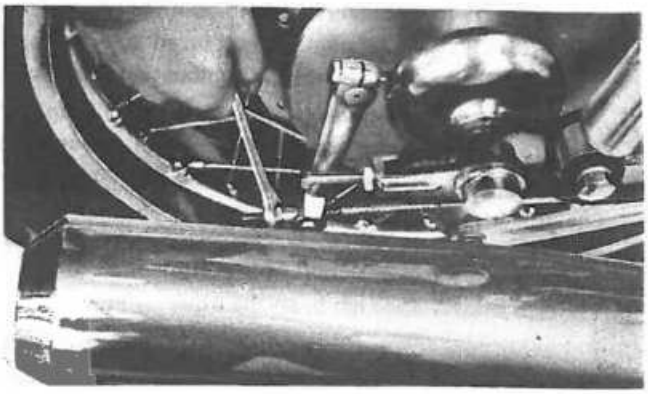
After adjustment, shift gears into a different position, and make sure that the above gaps are equal, then straighten the lock washer.





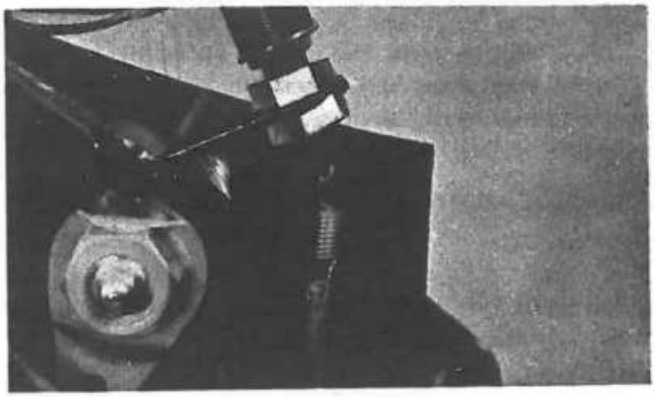
2-6. REAR BRAKE AND STOPSWITCH ADJUSTMENT

Rear brake adjustment should be checked any time the rear wheel is removed or the drive chain is adjusted.



A. Rear Stoplight Switch Adjustment

1. The rear brake stoplight switch mounts to the frame just behind the right-hand case cover. A thin rod connects the switch to the brake pedal.
2. To make an adjustment, loosen one lock nut and spin the other nut. To raise the switch, loosen the bottom nut. To lower the switch, loosen the top nut.
3. Check rear stoplight switch adjustment whenever the rear brake is adjusted or the rear wheel is moved.



2-7. SERVICE CHECKS/ADJUSTMENTS

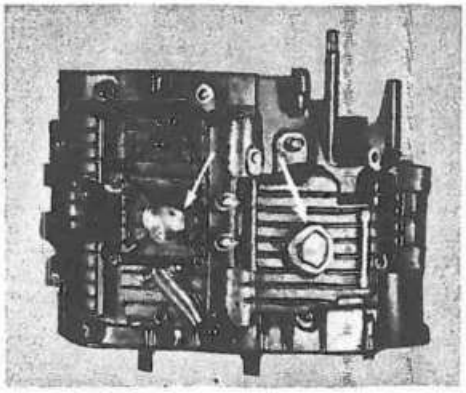
A. Cylinder Compression Check

1. Low cylinder compression means the combustion area is not sealing correctly. A leak exists at one of the following points: past one of the valves; out a defective gasket through a warped head; down past the rings.
2. Remove both spark plugs and screw the compression gauge adaptor tightly into either spark plug hole.
3. Twist the throttle grip FULLY OPEN and kick the engine over several times.
4. With 5 or 6 full kicks the gauge should register 10.5 kg/cm^2 (145 lbs/in^2), but it could measure as low as 9.5 kg/cm^2 (130 lbs/in^2) and still be considered adequate. If compression reads lower than 9.5 kg/cm^2 (130 lbs/in^2), then a failure has occurred to one of the parts directly associated with the combustion chamber.
5. If cylinder compression reads more than 10.5 kg/cm^2 (145 lbs/in^2), then carbon has built up on the combustion chamber or piston crown, reducing combustion chamber volume. This in turn creates a higher compression ratio. This situation must be corrected by decarbonizing or excessive heat will develop.
6. Perform steps 3. through 5. on the other cylinder.

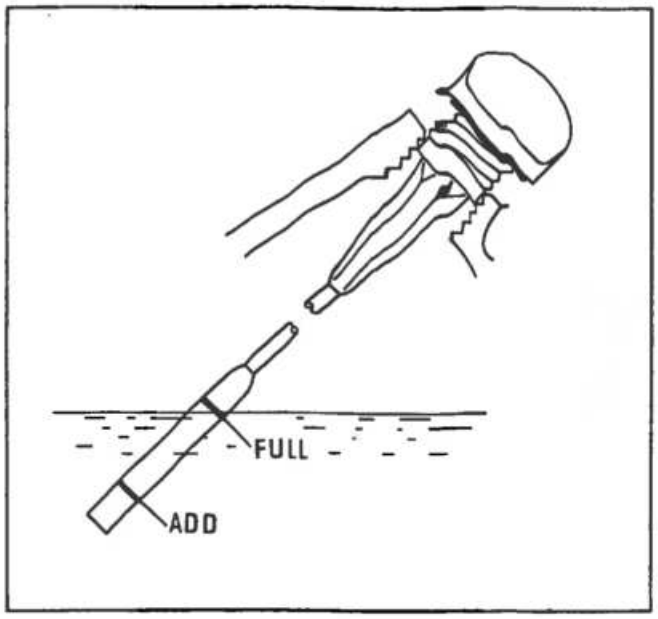


B. Changing or Adding Engine/Transmission Oil

1. Engine and transmission oil is contained in a single reservoir in the bottom engine case.
2. Remove both oil drain plugs on the bottom of the engine. Immediately reinstall and tighten both plugs after the compartments have drained.



3. Remove the oil dip stick and add oil. If making a complete oil change, add 2-3/4 litres (5.8 pints). Actual capacity is 3 litres but 1/4 litres of oil cannot be immediately drained from all passages.
4. If oil is merely being added, use the dip stick to measure existing oil level. Then add sufficient oil to bring the oil up to its proper level, as indicated by the mark on the dip stick.
5. Finally, let the engine run for several minutes. Stop and let set for one minute, and recheck oil level. Check level with machine on mainstand and level.



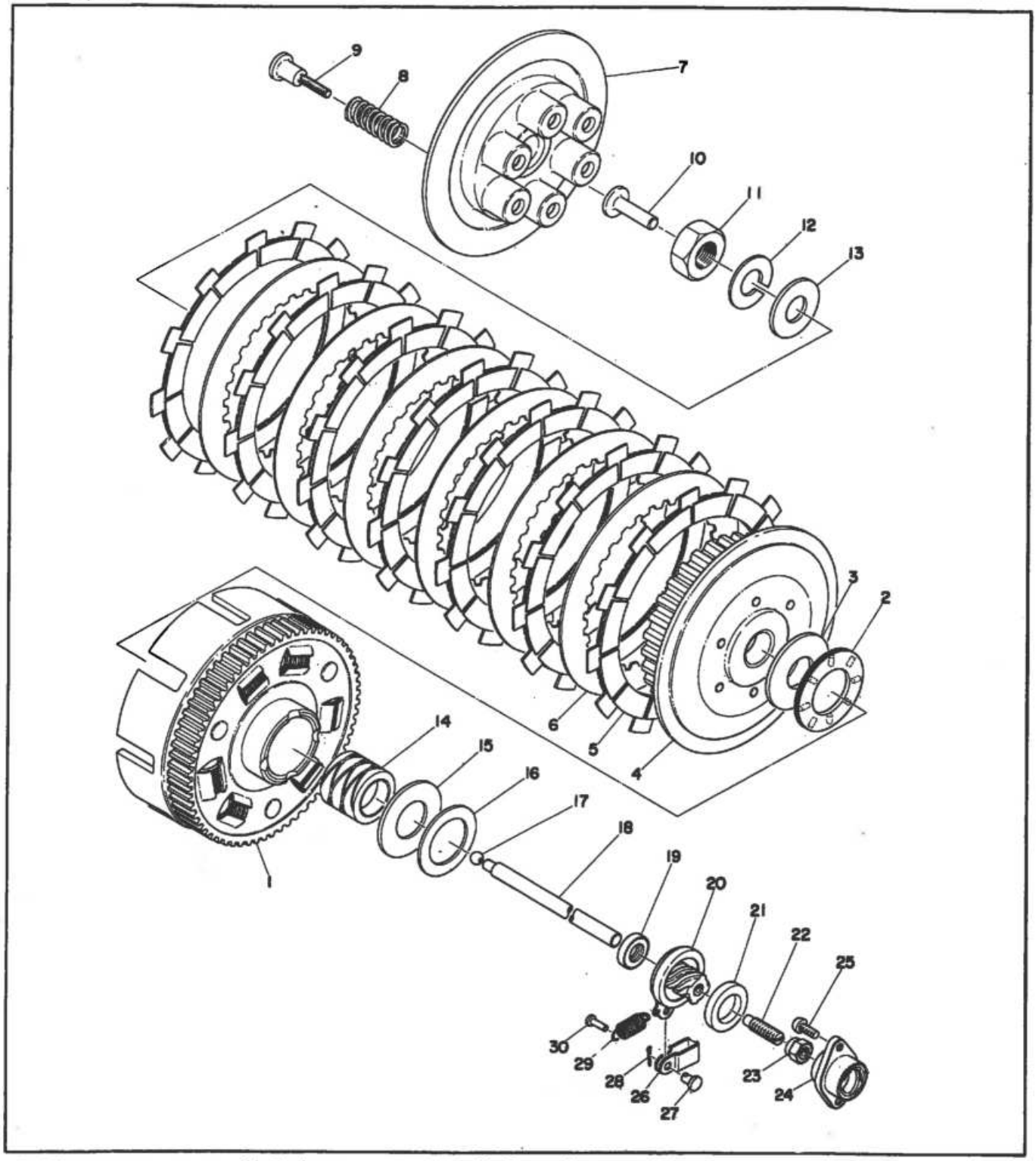
CHAPTER 3. ENGINE SECTION

3-1. CLUTCH 29
A. Clutch Removal 30
B. Checking 31
C. Note on Assembly 32
3-2. KICK AXLE ASSEMBLY 33
A. Removal 34
B. Checking 34
C. Installing 34
3-3. CHANGE SHAFT ASSEMBLY 35
A. Removal 35
B. Checking 35
3-4. LUBRICATION 36
A. Oil Lubrication System 36
B. Removal and Installation 39
C. Oil Filter 40
D. Oil Filter Servicing 40
E. Starter Motor 41
F. Starter Reduction Gears 41
G. Servicing and Troubleshooting 41
3-5. REMOVING ENGINE FROM FRAME 42
A. Removing Engine from Frame 42
B. Engine Disassembly Notes 46
C. Alternator Case Cover 47
D. Cylinder Head Cover (Disassembly) 48
3-6. CYLINDER HEAD 51
A. Removal of Parts 51
B. Cylinder Head 52
3-7. CYLINDER & PISTON ASSEMBLY 65
A. Removing the Oil Line Fitting 65
B. Cylinder Wear and Repair Procedures 65
C. Piston 66
D. Piston Removal 67
E. Piston Wear 67
F. Piston Clearance 68
G. Cleaning Piston Ring Grooves 68
H. Piston Ring Removal and Installation 69
I. Piston Ring Description 69
J. Piston Ring (Standard and Oversize) Identification Code 70
K. Piston Ring Wear 71
L. Piston Pin and Bearing 72
M. Piston Installation 72
N. Cylinder Installation 73

3

3-8. CRANKCASES 74
A. Separating Crankcases 74
3-9. TRANSMISSION 76
A. Transmission Removal 77
B. Shift Drum Assembly 77
C. Crankshaft 82
D. Crankshaft Installation (Including Cam Chain) 83
E. Oil Strainer in Bottom Case 84
F. Replacing Cylinder Mounting Studs 84

3-1. CLUTCH

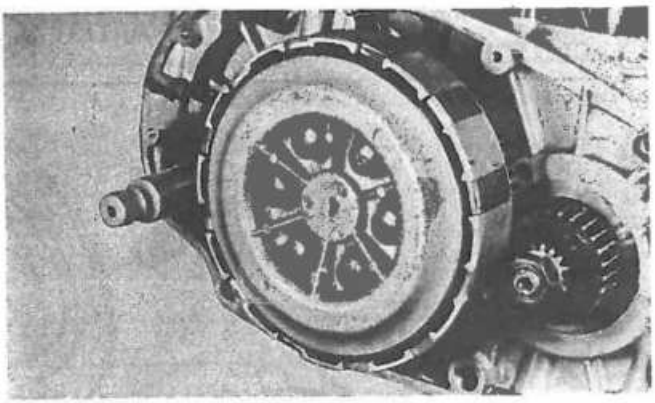


1. Driven gear comp.
2. Bearing
3. Thrust plate 2
4. Clutch boss
5. Friction plate 1
6. Clutch plate
7. Pressure plate
8. Clutch spring
9. Spring screw
10. Push rod 1
11. Lock nut
12. Spring washer
13. Plain washer
14. Spacer
15. Thrust plate 2
16. Washer
17. Ball
18. Push rod 2
19. Oil seal
20. Push lever ass'y
21. Dust seal
22. Adjusting screw
23. Adjusting nut
24. Push screw housing
25. Panhead screw
26. Joint
27. Pin
28. Cotter pin
29. Return spring
30. Spring hook

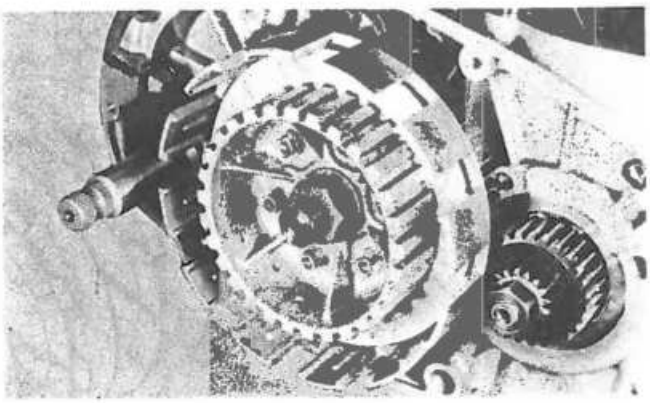
A. Clutch Removal

1. Remove all six clutch spring screws and pull off the pressure plate.

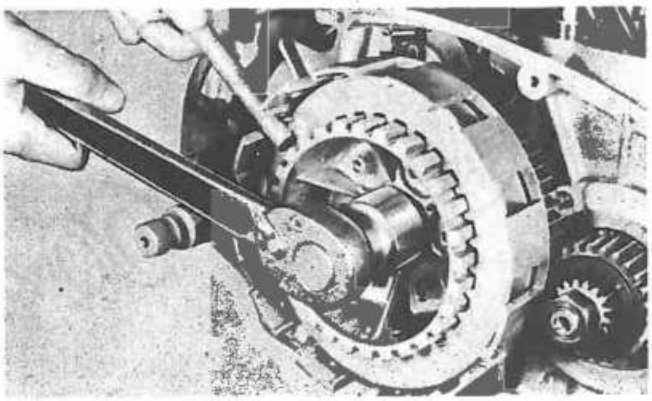
Note:
Loosen the screws in stages using a cross pattern.



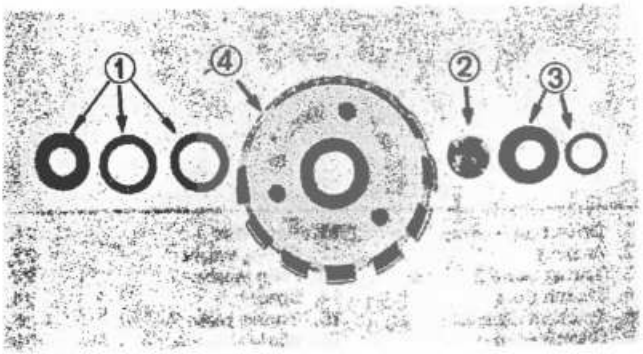
2. Pull out the push crown, the ball directly behind the push crown, and the push rod behind the ball.
The push rod is easily removed from the other end of the main shaft.



3. Hold the clutch unit with the holding tool (found in the Special Tool kit), and unscrew the clutch boss lock nut.



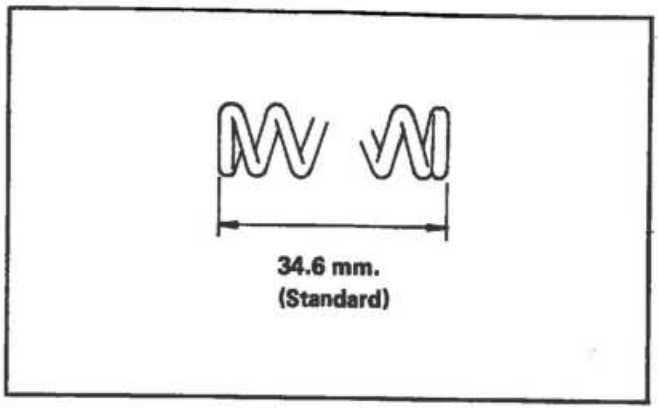
4. Slide out the clutch boss and clutch plates. Behind the boss are two thrust washers with a flat thrust bearing in between. Remove these parts.
5. The clutch housing is now free. After pulling the housing off, slide off the clutch bushing spacer and thrust washer(s) behind the spacer.



1. Thrust bearing and washers (between clutch boss and housing)
2. Spacer
3. Washers (right against axle bearing)
4. Clutch housing

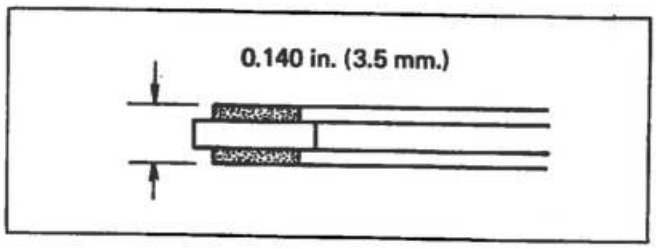
B. Checking

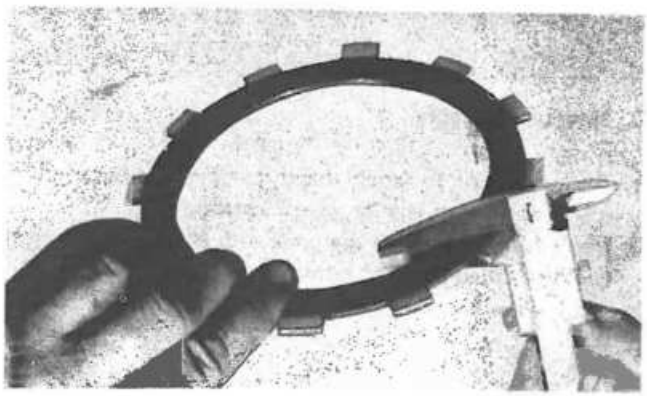
1. Clutch Spring Wear
   a) Measure the spring free length with vernier calipers. If standard length has shortened by 1 mm. (0.04") or more, replace the spring.





2. Friction Plate Wear
   a) Standard thickness is 0.140 in. (3.5 mm.). If wear has decreased the thickness to 0.122 in. (3.1 mm.) replace the plate (measure at two or three points).





3. Clutch Plate Wear
   a) These plates must be flat. Lay each one on a surface plate and check both inner and outer edges for signs of "dishing" (a bow in the plate surface). Replace the plate if warpage exists.
   b) Run a feeler gauge around the inner and outer edges. Replace any plate that is warped sufficiently to permit a 0.008 in. (0.2 mm.) feeler gauge to slide under either edge.

4. Push Rod
   a) Roll the push rod over a surface plate. If the rod is bent, or if deep grooves have been worn in the rod, replace it.
5. Clutch Installation
   a) Reverse the clutch removal sequence. Tighten the clutch boss lock nut to 13 kg/m (93 ft/lbs).

Caution:

Be sure the two flat thrust washers and one flat thrust bearing are installed behind the clutch boss. Also, grease the flat thrust bearing and thrust washer closest to the clutch housing to prevent these parts from sliding forward, out of position, during clutch boss installation.

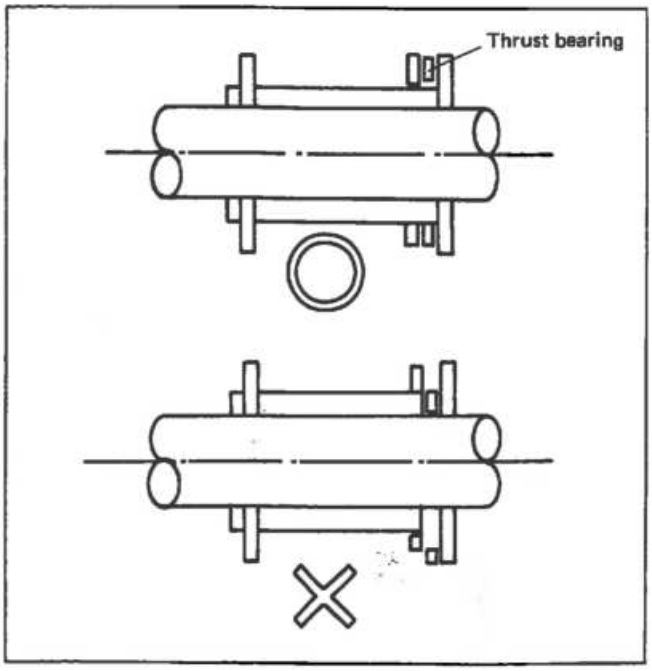
   b) When installing the clutch spring bolts, screw them in until they bottom fully (approximately 5 ft/lbs.– 0.8 kg/m torque).

Important Note:

When installing the six friction plates (between the metal clutch plates), install two fiber-backed plates, then both aluminum-backed plates, and finally the remaining two fiber-backed friction plates, with the appropriate clutch plates between each friction plate.

C. Note on Assembly

1. Take care not to pinch the thrust bearing between spacer and thrust washer. (See illustration)
2. Don't forget to install the push rod. Make sure the steel ball is installed between push rods A and B.



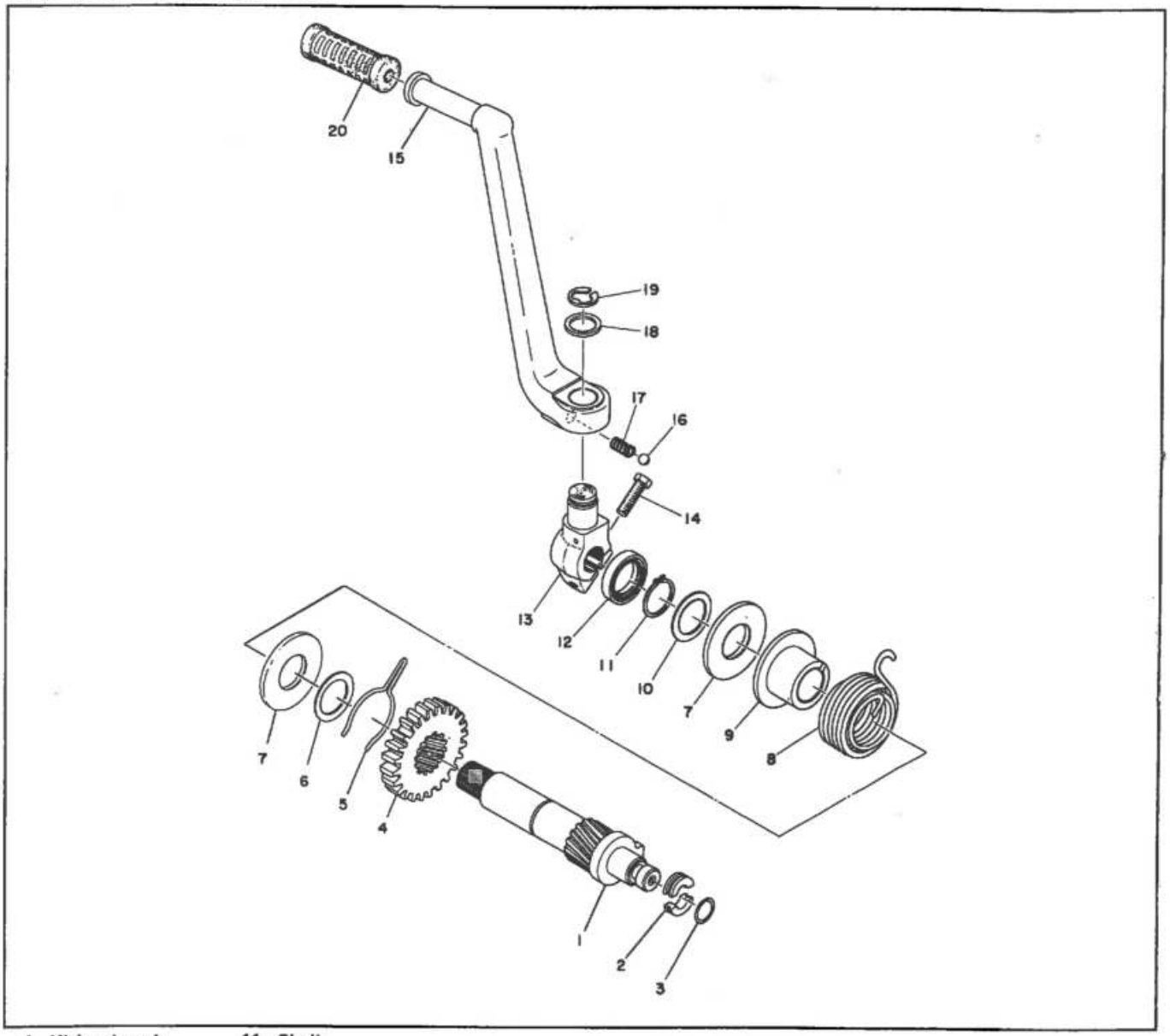
a) The primary drive gear (and pump drive gear in front of it) is held to the crankshaft by a nut and lock washer. Remove the nut and washer and slide the primary drive gears off. Use a gear puller if the primary drive gear does not come off easily. A square-shaped key fits into a crankshaft keyway to prevent the drive gear from spinning.

b) To install the primary drive gear, slide it onto the crankshaft. Next, line up the keyways in the gear and the shaft and insert the square-shaped key. Install and tighten the lock nut to 12 kg/m (85 ft/lbs.).

Caution:

If the primary drive gear and primary driven gear teeth do not match up fully (if there is visible tooth overlay to one side), check the possibility of incorrect clutch installation.

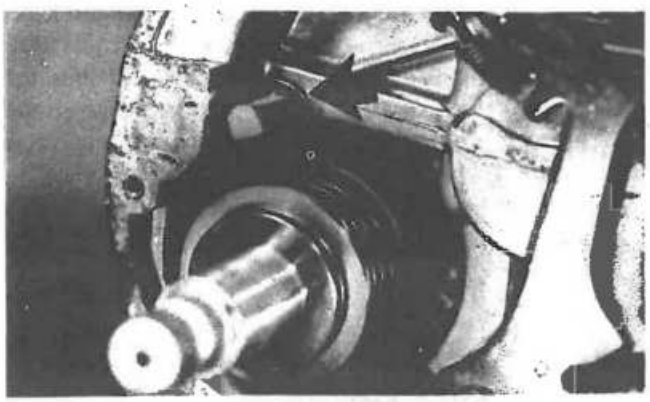
3-2. KICK AXLE ASSEMBLY



1. Kick axle ass'y
2. Holder
3. Clip
4. Kick gear
5. Kick clip
6. Shim
7. Spacer
8. Kick spring
9. Spring guide
10. Shim
11. Circlip
12. Oil seal
13. Kick crank boss
14. Bolt
15. Kick crank
16. Ball
17. Boss stopper spring
18. Washer
19. Circlip
20. Kick lever cover

A. Removal

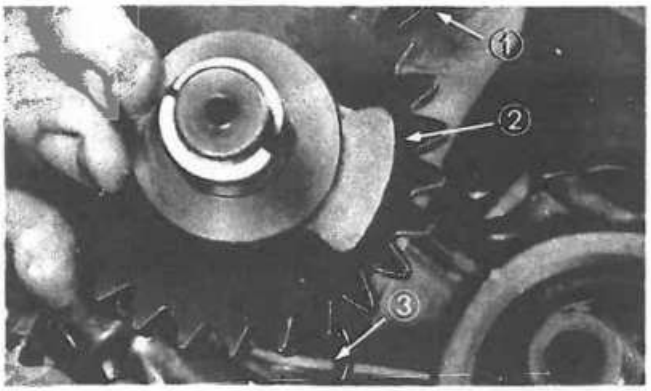
Slip the bent spring end off its anchor point and pull the kick starter assembly out of the case.



Anchor point of kick spring

B. Checking

1. Kick clip
   The kick clip is fitted to the kick gear and slides in the slit. A tight or loose fitting may result in trouble. Using a balance as illustrated, measure the friction of kick clip with kick gear. If too loose, twist the kick clip so that friction increases or replace the kick clip.
   the kick clip.
2. Kick gear
   Check the kick gear for wear or scratches on teeth, particularly in the chamfered area.



1. Kick clip
2. Kick stopper
3. Return spring

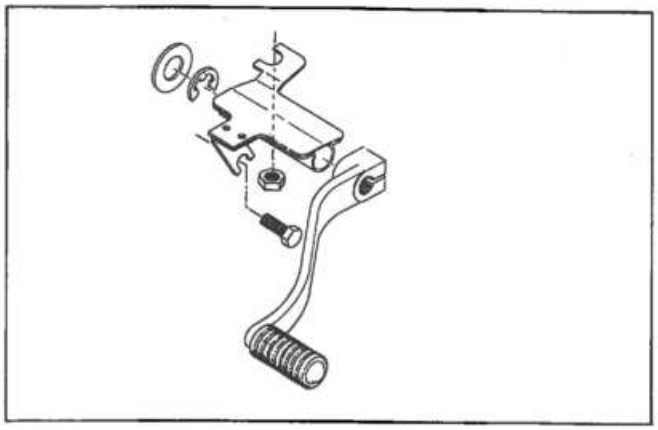
C. Installing

To install the kick assembly, partially insert the assembly until the return spring (#3) can be slipped over its anchor point, then rotate the kick clip (#1) until it slips into the appropriate recessed area in the case. Attach the kick lever and rotate the kick axle 1/2—3/4 revolution in a counter-clockwise direction. Push the axle in. The kick stopper (#2) will slip into its recessed area in the case. The kick starter is now pre-loaded to achieve positive kick return.

3-3. CHANGE SHAFT ASSEMBLY

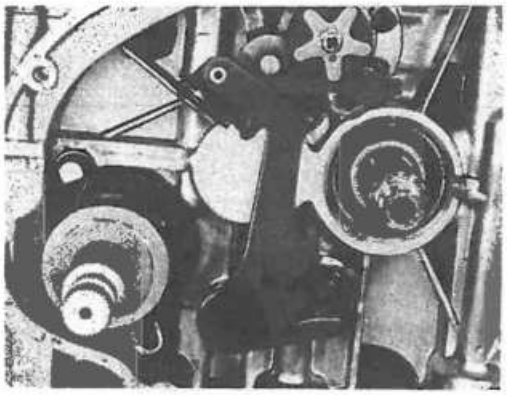
A. Removal

1. Remove the case cover (L), change lever and footrest.
2. Remove the 8–mm. nut locking the chain guide, and remove the clamp for lead wire coming from the generator, then remove the chain guide.
3. Remove the E clip and thrust washer.



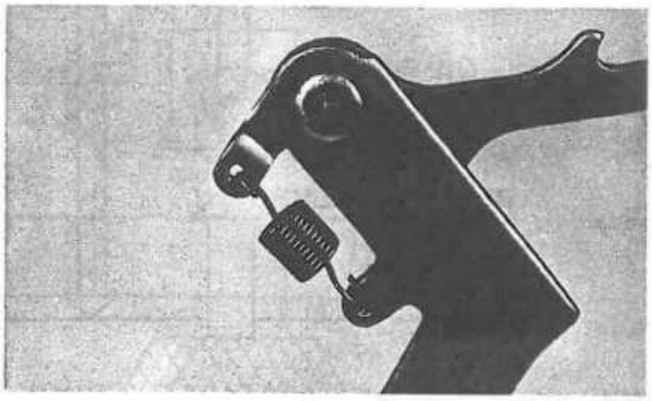
B. Checking

1. Check the lever return spring and shaft return spring for stretches and cracks.

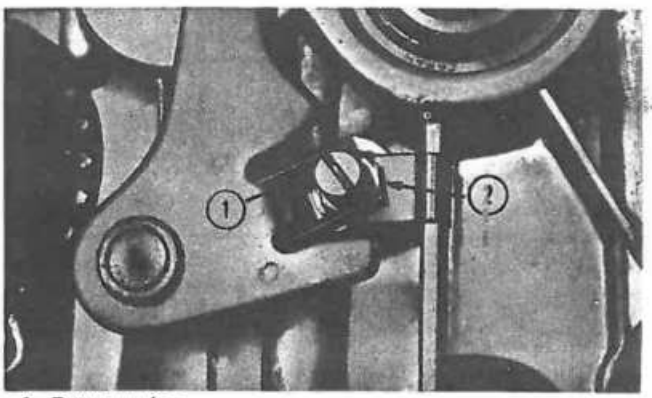


shift shaft unit in position

2. Check the rivet (located between changer levers 1 and 2) for tightness and wear.

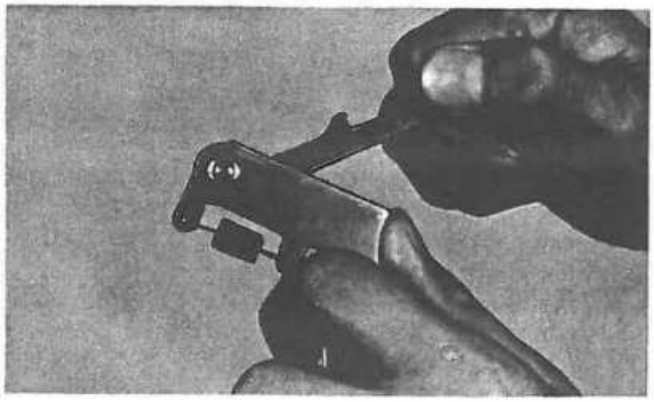


3. Check the tightness of adjusting screw lock nut.



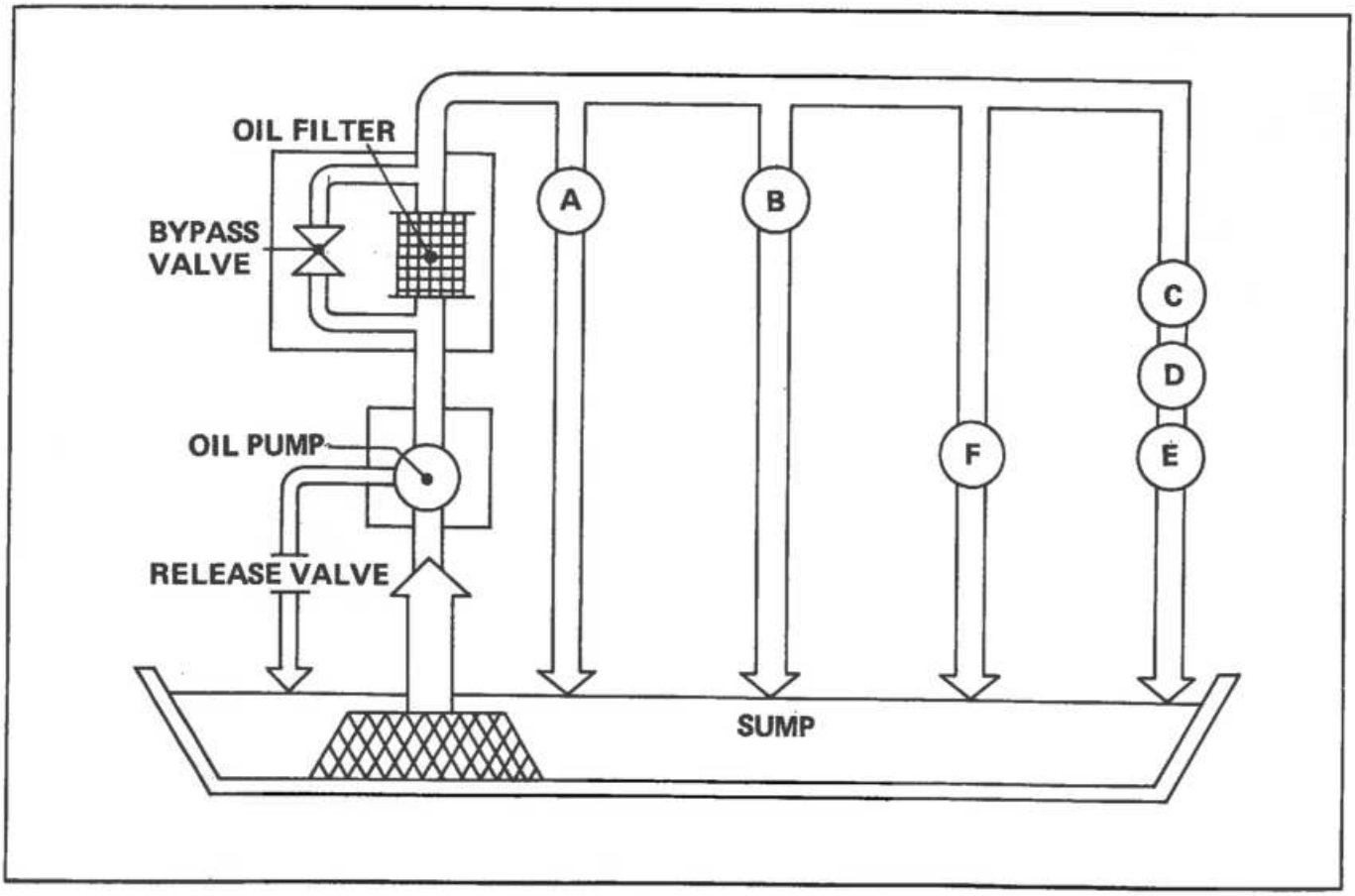
1. Return spring
2. Lock nut

4. Check the cam stopper spring for stretches. Check the spring hook for breakage. Check the rivet for excessive wear and deformation. Replace as required.

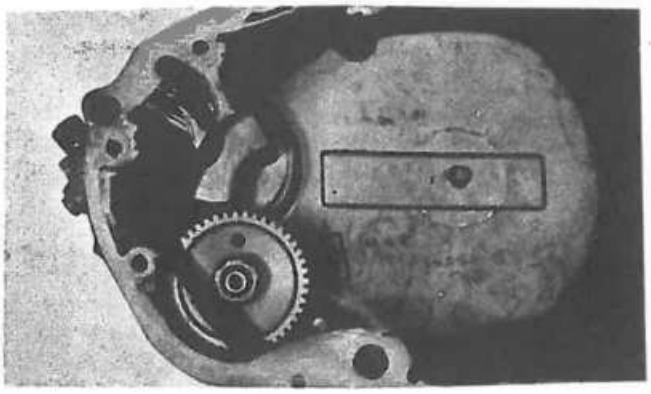


3-4. LUBRICATION

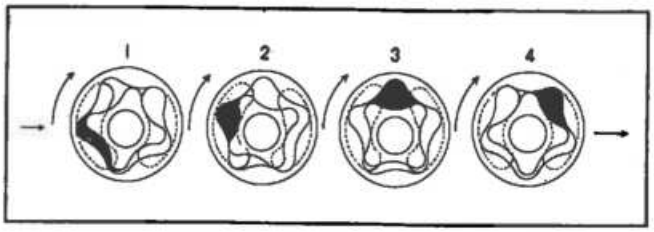
A. Oil Lubrication System

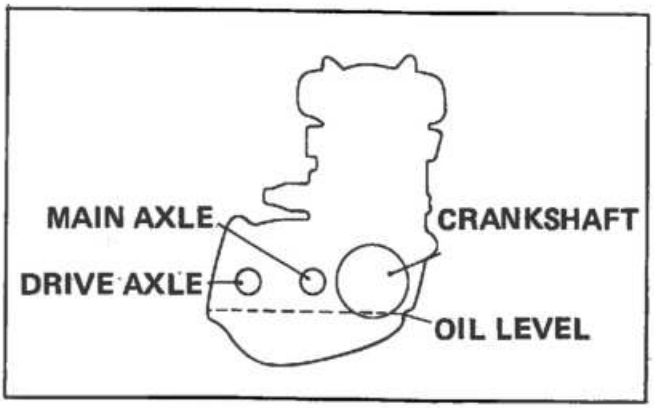


1. This machine has a "wet sump", pressure feed oiling system. Oil is stored in the crankcase. Oil passes through a wire screen filter in the bottom of the crankcase to the trochoid oil pump (rotary type rather than plunger type). Because of pump design, oil pump pressure pulses are so frequent as to provide constant, unfluctuating oil pressure to all vital parts.
2. Oil from the pump is pushed through a fine wire mesh filter into oil passages in the cases and delivered under pressure to the following parts:
   (a) Crankshaft main bearings
   (b) Connecting rod big end bearings
   (c) Transmission main axle
   (d) Clutch bearing
   (e) Shift fork guide bar
   (f) Rocker arms
3. The following parts are lubricated by "oil splash".
   (a) Crankshaft
   (b) Connecting rod small end bearings
   (c) Cam chain
   (d) Piston and cylinder walls
   (e) Primary drive and driven gears
4. The oil pump fits into a cavity at the inner front portion of the right-hand case cover (behind the tachometer drive unit).

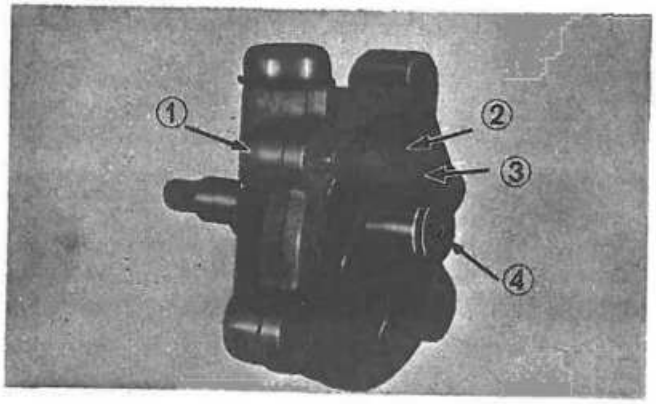


5. Steps 1 through 4 (below) show how the oil chamber first increases in size as it sucks in oil (intake passage shown in dotted outline), and then pushes the oil out the outlet passage (also shown in dotted outline). Because the rotor is equipped with four tips, there are always four stages of pumping strokes occurring, supplying a constant pressure.



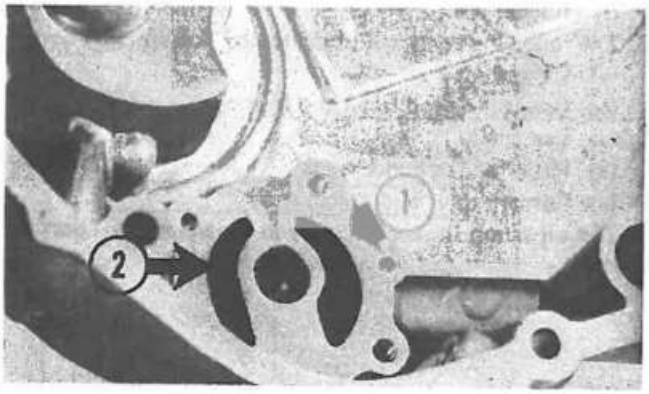


6. The oil pump is fitted with a bypass valve (check ball and spring) that permits the oil from the pump to be redirected back to the oil reservoir in case of excessive pressure in the delivery passages.
7. Pictured right is the pump after it has been removed from the cavity. The cover is constructed of aluminum and all other pump parts are made of steel.



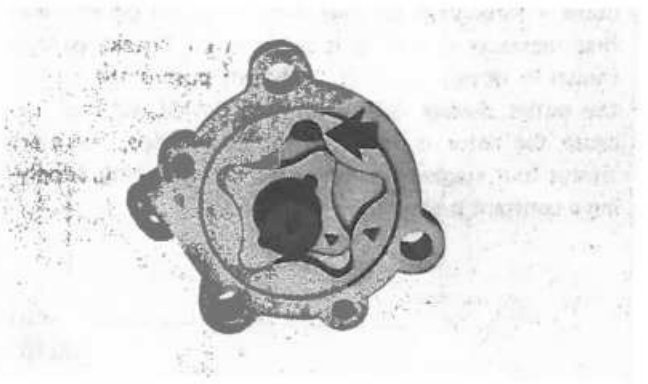
1. Aluminum Cover
2. Outer rotor
3. Inner rotor
4. Shaft

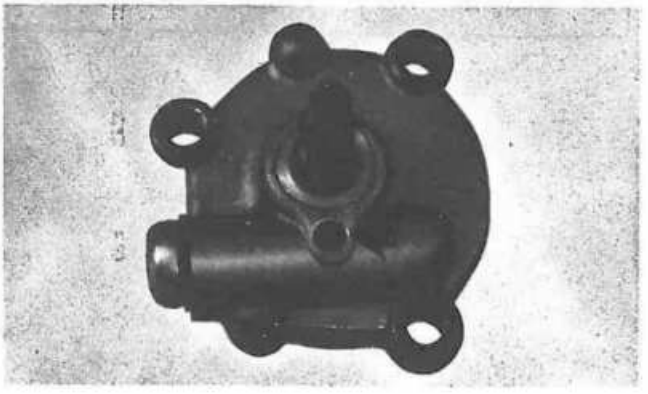
8. The shaft (#4), spins in the cover (#1). A four-pointed inner rotor (#3) is turned by the shaft. The outer rotor (#2) has five rounded notches. As the inner rotor spins, it turns the outer rotor (just like two gears intermeshed). The inner and outer rotor spin at different speeds thereby creating a changing gap between them. The gap is the oil chamber.
9. This picture shows the intake cavity 1 and the outlet cavity 2. Oil flows through the intake passage, into the pump. The oil pump forces it out, through the oil filter, into the oil delivery passages.



Oil inlet and outlet holes
(pump removed)

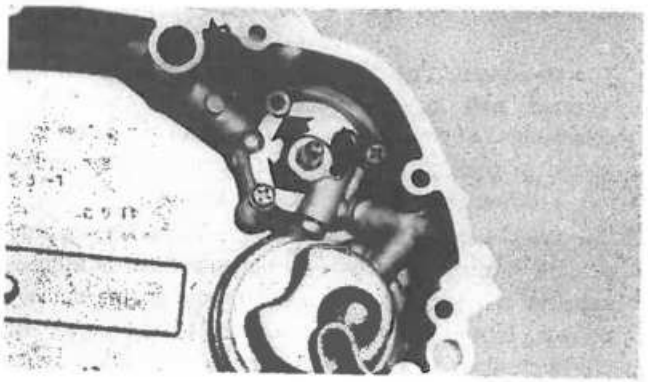
10) The cover has a drilled hole that leads to a pressure relief check ball. If too much pressure develops the check ball valve releases oil back into the crankcase (2).





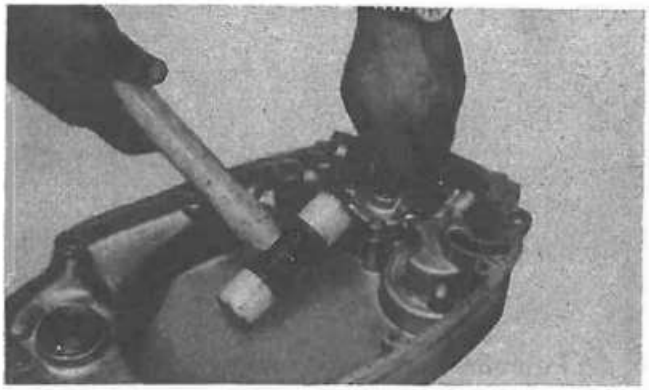
B. Removal and Installation

1. The oil pump driven gear slips off the shaft after the tachometer drive gear has been removed. The key in the shaft must also be removed.
2. Remove the three Phillips-head retaining screws.

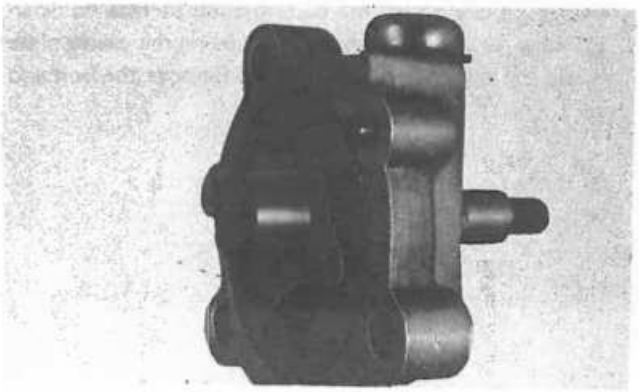


Removing oil pump set screws

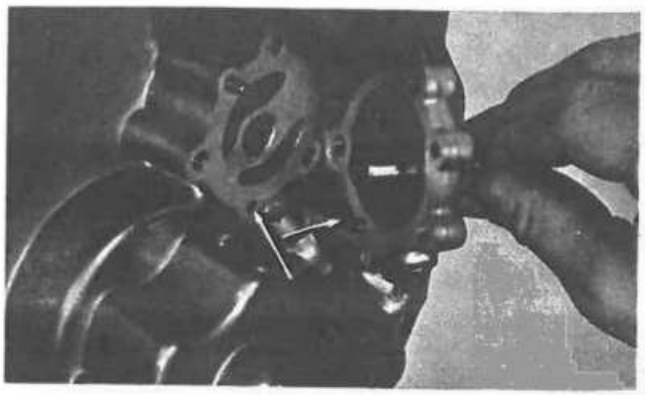
3. Pull up on the pump shaft while tapping on the pump until the unit comes loose.
4. Lift out the inner and outer rotors if they do not come out as a unit.



5. Installation of the oil pump is basically a reversal of the removal procedure. Install the shaft, inner rotor, and outer rotor into the pump cavity in the case cover (be sure the notch in inner rotor lines up with the pin in the shaft).

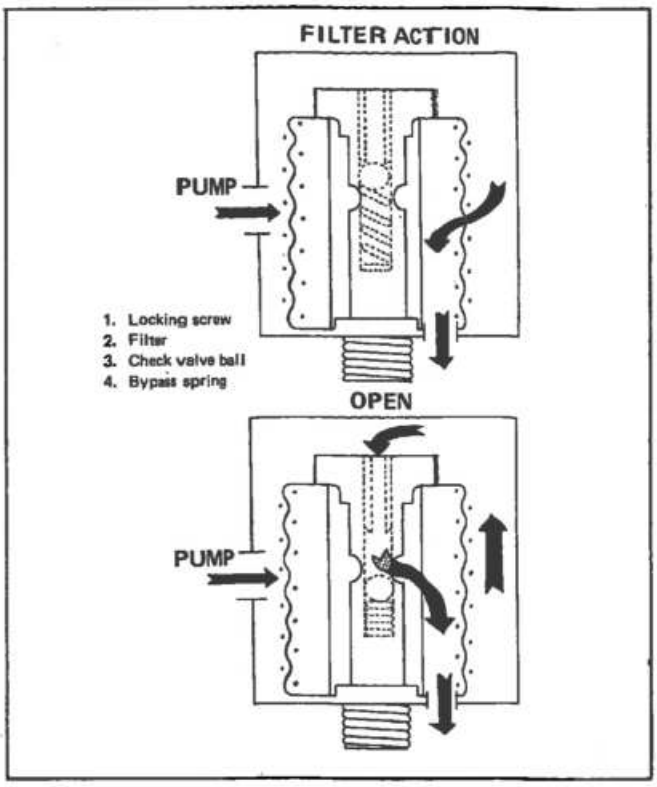


6. Slip the cover into place, using the locating pin to position the unit.



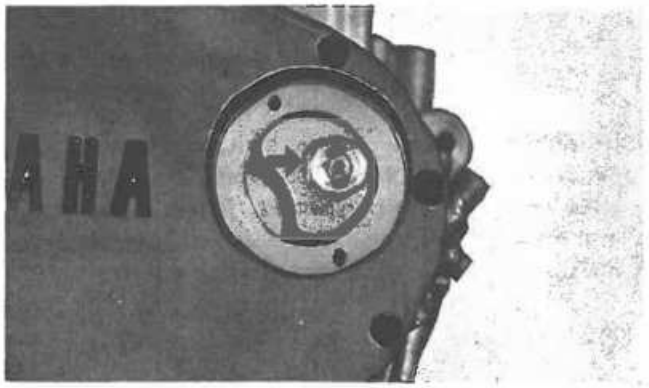
C. Oil Filter

1. The stationary type oil filter, which is bolted into a recessed well in the outer right hand cover, is constructed of fine mesh wire. Oil from the pump is forced in through the outer surface of the filter and into a drilled passage leading to the engine.
2. The filter is equipped with a bypass. If the filter is plugged, oil is forced through a spring-loaded ball type check valve in the locking bolt and into the engine delivery passage. In this manner, oil delivery to the engine will not be stopped by a clogged filter.



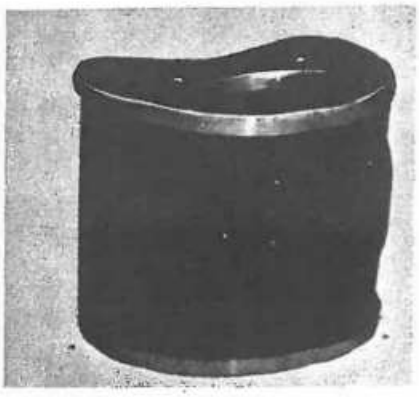
D. Oil Filter Servicing

1. The oil filter cavity in the right-hand case cover is covered by a plate held in place by two Allen screws. A circular groove cut in the plate mating surface holds an "O" ring for sealing purposes. Removing the cavity plate reveals the oil filter retaining bolt. Remove the bolt and slip the filter out.



Filter securing bolt removal

2. With the filter out of the machine, check rippled outer surface for trapped particles. Thoroughly clean the filter with solvent and high pressure air. Also, after the filter has been removed from the machine, clean out the oil filter cavity in the case cover.
3. Installation is accomplished by reversing the above procedure. Do not overly tighten the filter securing bolt or the filter could collapse. Also, check the cover O-ring and replace it if it is damaged.



Dirty oil filter

E. Starter Motor

1. Drain the engine oil
2. Remove the four motor mounting bolts. (8 mm.)

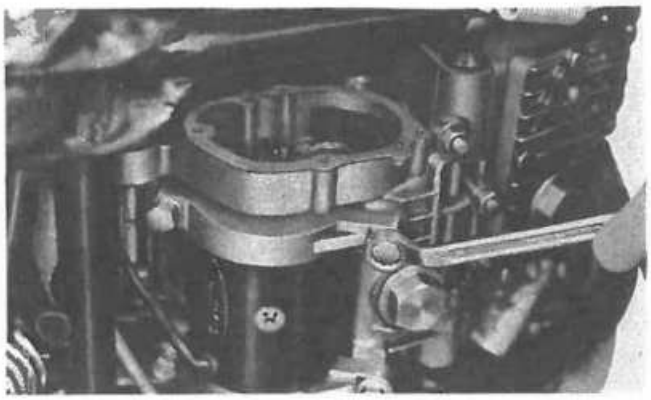
Note:

To ease removal, the machine should be placed on a lift or tilted towards the left.

3. To remove the motor, pull straight back from its mounting location.

Note on Reassembly:

Make sure the gear shaft properly engages the reduction gear. Torque the 8 mm. securing bolts evenly, in gradual stages, to a setting of 2.0 kg/m. Refill the sump with 84.5 oz. (2500 cc.) of SAE "SD" (MS) motor oil.

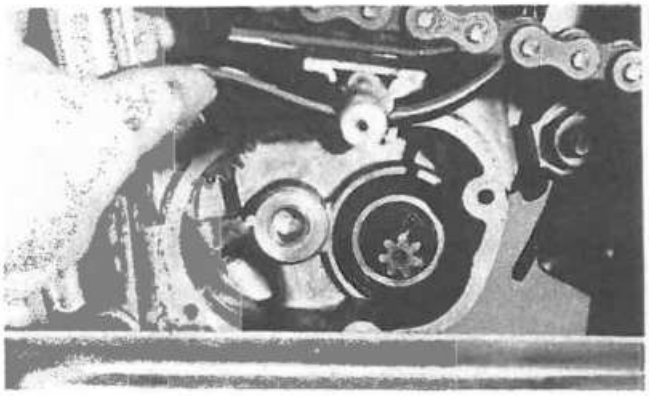


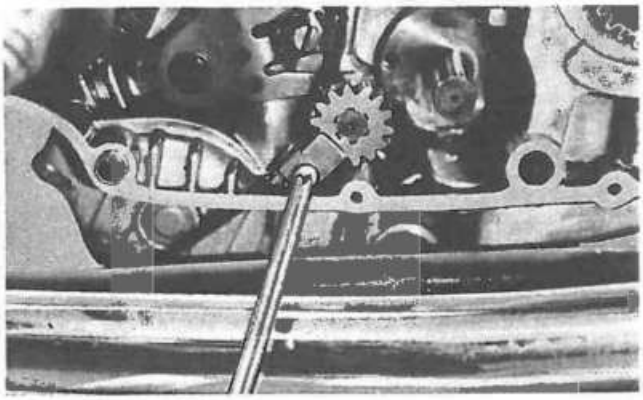
F. Starter reduction gears

Note:

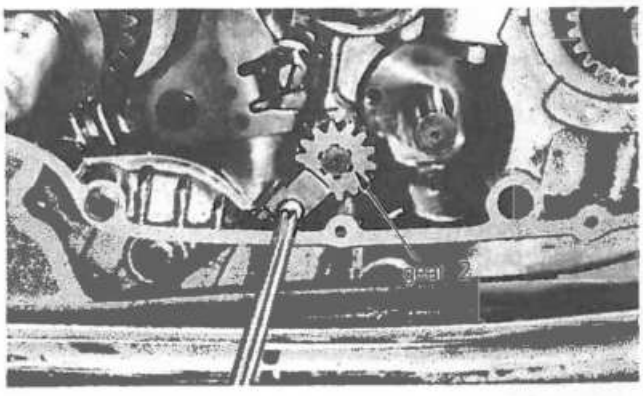
Additional disassembly details can be found in the Engine Section.

1. Drain the engine oil.
2. Remove the left crankcase cover
3. Remove the gear train cover.
4. Remove the idler gear.
5. Remove the right crankcase cover.
6. Remove the clutch.
7. Remove the stopper plate mounting bolt and plate.
8. Remove the "gear 2".
9. Remove the circlip.
10. Remove the "gear 3" and "gear 4".
    Remove the starter wheel.

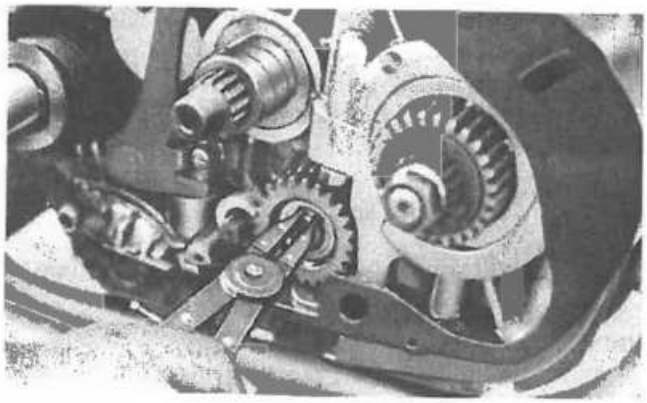




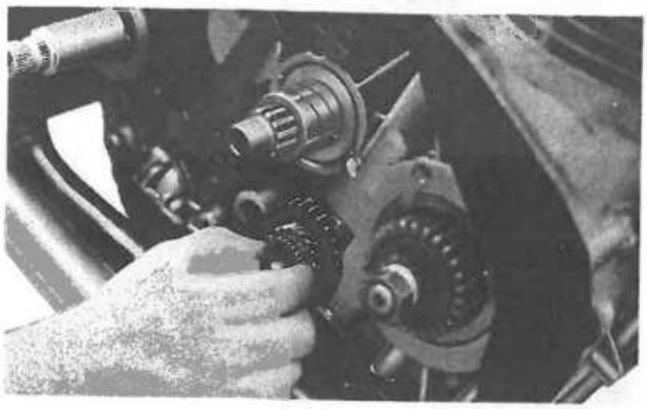
11. Remove the "gear 2".



12. Remove the circlip.



13. Remove the gears "3" and "4". Remove the starter wheel.

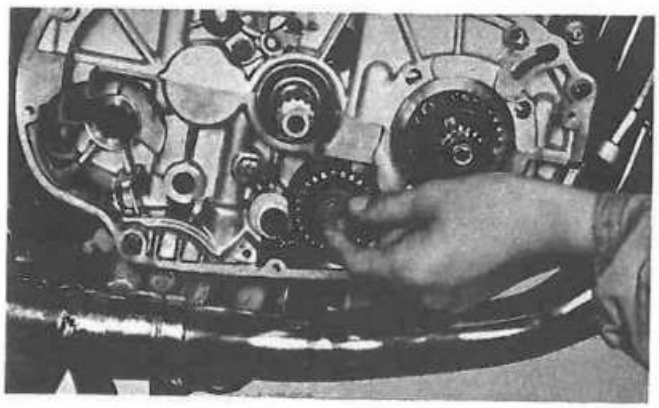


G. Servicing and troubleshooting

1. Gear "4" receives the most use. Check it thoroughly for signs of wear.
   Replace as necessary.
2. Check the return spring for fatigue. It should provide for positive return.
   Replace as necessary.
3. Check the remaining gears for chipped teeth, gauling etc.
   Replace as necessary.

Note on Reaseembly:

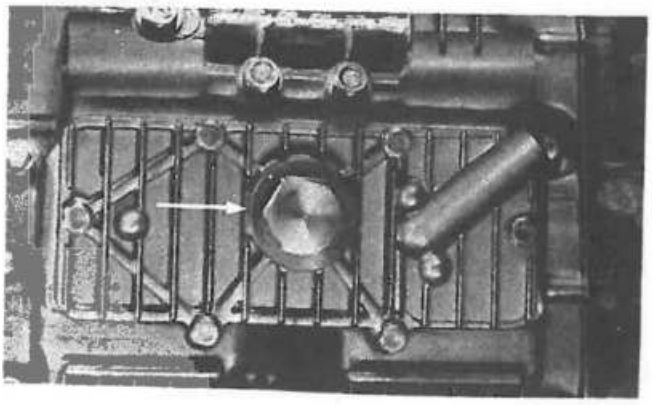
During reassembly, make sure the starter clip is firmly fitted in the crankcase groove.



3-5. REMOVING ENGINE FROM FRAME

A. Removing Engine from Frame

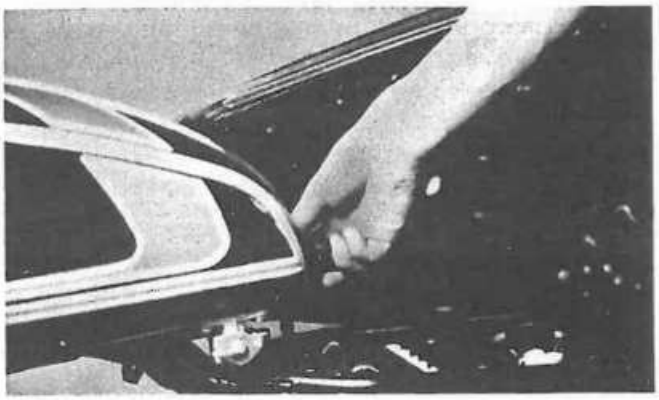
1. Drain the oil. Two drain plugs in the bottom of the crankcase must be removed to entirely drain both the engine and the transmission.



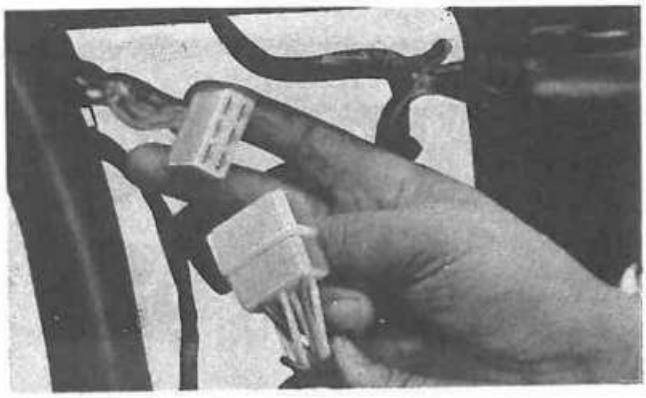
2. Shut off both fuel petcocks and disconnect the fuel lines and crossover tube. Lift the seat.
   Lift the rear of the tank to clear the mounting bushing from the anchor pin, then slide the tank back to free it from the front tank mounts.



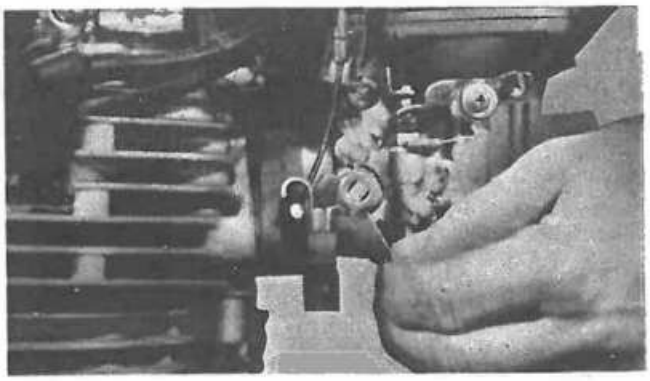
3. Remove both frame side covers.



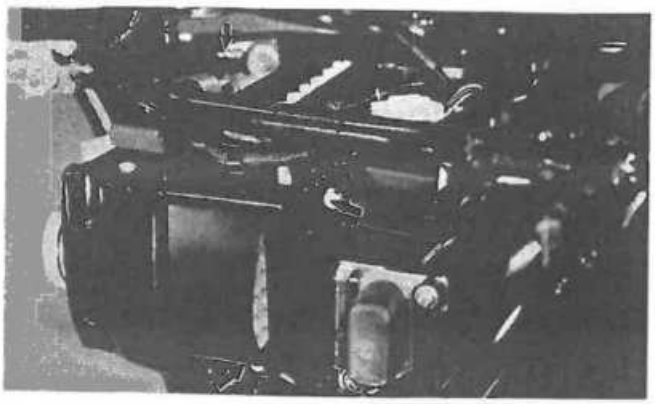
4. Disconnect the alternator wire loom at the multiple connector. It is located just behind the air filter housing.



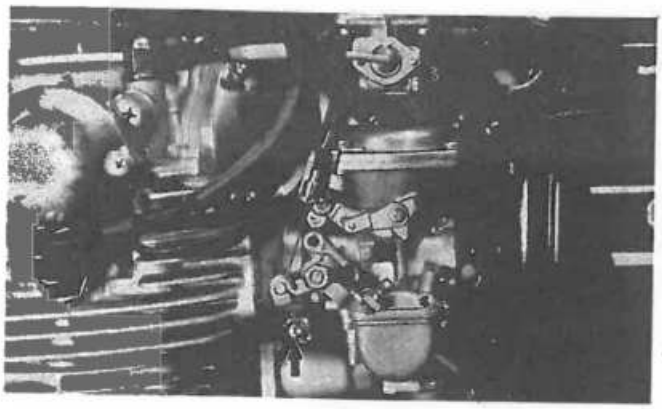
5. Remove the throttle cable from each carburetor.



6. Disconnect the air cleaner mounting bolts: one on top, under the seat, one on the side cover.

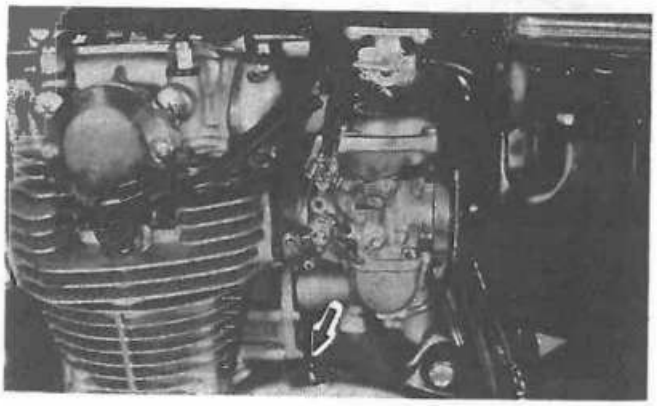


7. Disconnect the fuel balance tube (#2) between the carburetor float bowls. Pay strict attention to the linkage between the carburetor starter levers so that it is not damaged during removal. Loosen screw #1 and remove the left carburetor (with air cleaner attached). Repeat this procedure for the right carburetor.

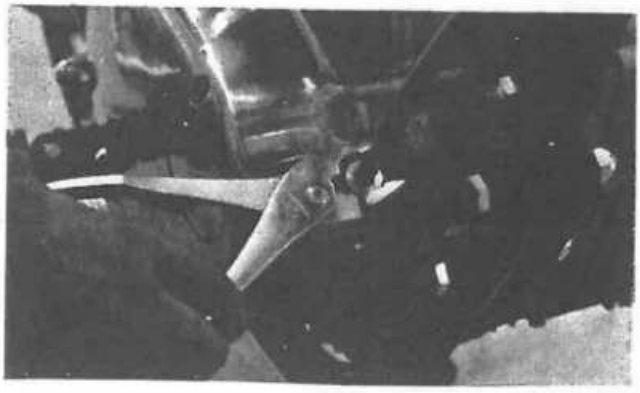


#1 Carb. Tightening Screw
#2 Fuel Balance Tube

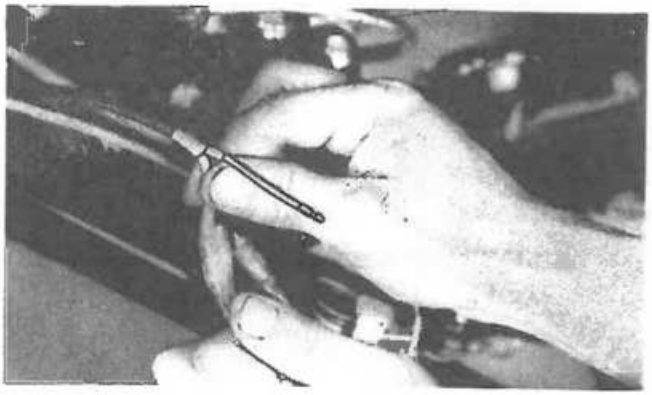
8. Disconnect the engine breather tube which is located above and between the carburetors.
9. Remove the neutral light lead on top of the engine.



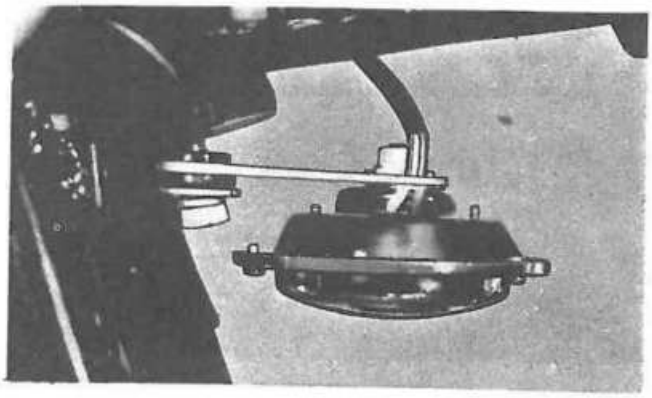
10. Remove both spark plug high tension leads.
11. Remove the tachometer cable from the engine right front side.



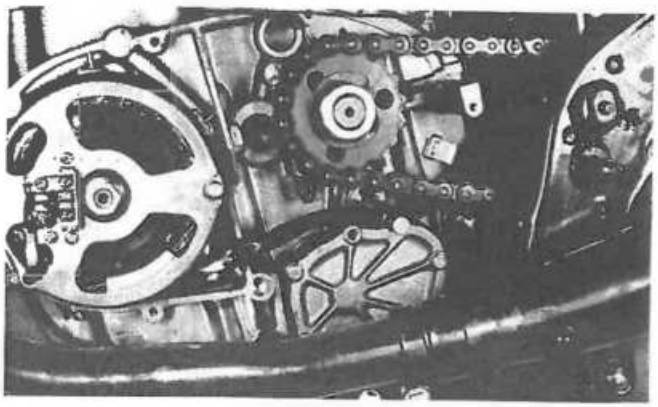
12. Disconnect the point wires at the condenser and ignition switch multiple connectors. (under tank)



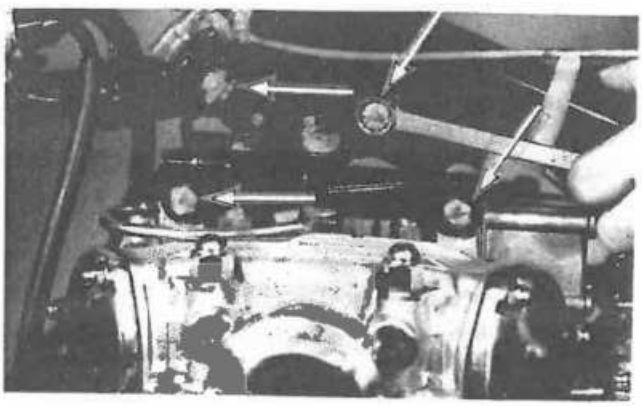
13. Remove the horn. It is located directly behind the steering head and below the secondary ignition coil. When removing this part, take off the horn and bracket as a unit.



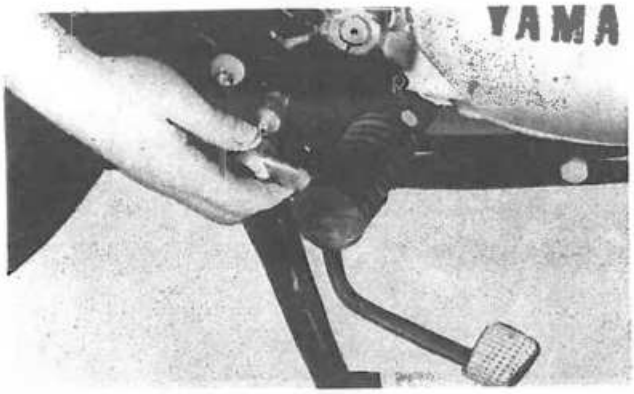
14. Remove the left-hand engine case cover. This eases drive chain removal and installation.



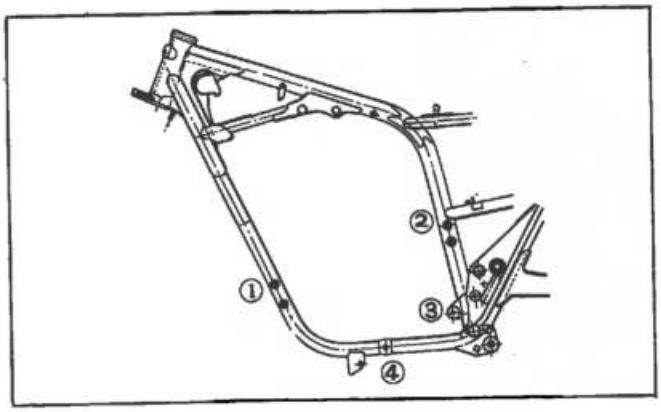
15. Remove the drive chain.
16. Remove the left-foot peg.
17. Remove both exhaust pipe assemblies.
18. Remove the top center engine mounting brackets. Remove them in the manner shown in this picture as reassembly is easier and faster than if the bracket is removed in individual pieces.



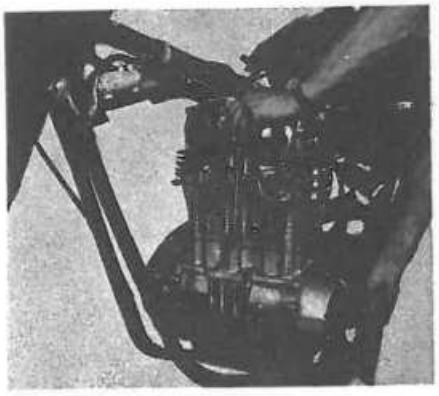
19. Remove the brake pedal to provide access to the lower rear engine mounting bolt.



20. Remove all other engine mounting bolts and brackets in order of the number sequence as shown in the picture. Remove the bottom center bolt last.



21. Remove the engine. Lift it out the left hand side.



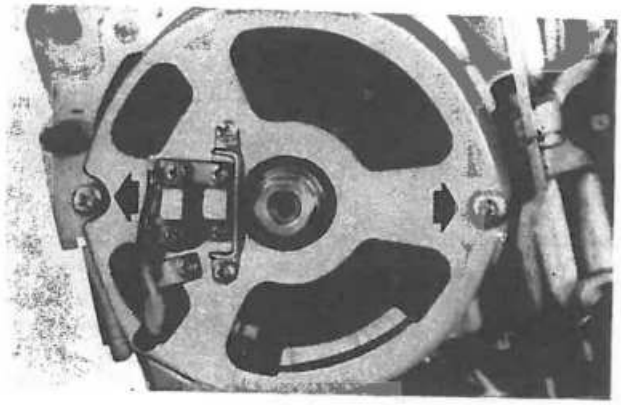
B. Engine Disassembly Notes:

1. Keep all parts in separate sections to aid in reassembly.
2. All gaskets, cotter pins, O-rings, and circlips, if damaged or worn, should be replaced.
3. Always use proper tools (as listed in the Tools Section) and proper repair techniques. A set of metric Allen wrenches must be available due to the use of Allen head screws.
4. Clean all parts with solvent, and if any part has a drilled oil passage, blow the passage out with compressed air.

5. Tighten all nuts and bolts in proper rotation (in cases such as head nuts or case bolts) beginning with the larger bolts (if any) and then going back over and tightening the smaller bolts in the proper sequence.
6. Always check the torque specifications section for correct torque, and use a torque wrench.
7. After completing each section check to make sure every procedure has been done properly and completely to avoid having to go back and do it again.
8. Occasionally, after several hours operation on a rebuilt engine, oil leaks will develop. This is caused by gasket compression. Re-torque all cylinder holding bolts should this occur.

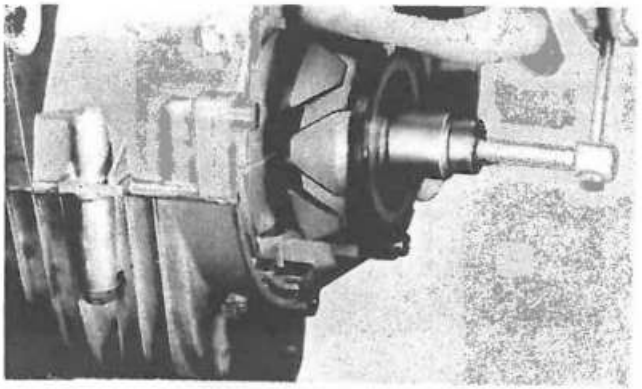
C. Alternator Case Cover

1. Stator Removal and Installation
   a) The stator is held in place by two bolts. Remove the bolts and slide off the stator assembly. Take care that the wiring loom does not catch on any corners.
   b) Reverse these steps to install.

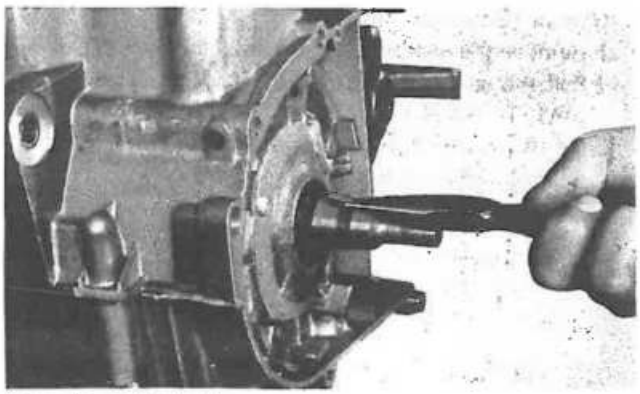


Two screws holding stator in place

2. Rotor Removal and Installation
   a) Remove the rotor securing nut and lock washer. Mount the rotor pulling tool (found in Special Tool Kit) onto the rotor and pull the rotor off.



   b) Immediately after pulling the rotor, remove the rotor shaft key so that it cannot be lost.
   c) Installation: Slide the key into the keyway, lubricate the shaft taper with a light grease, line up the key slot on the rotor with the key and push the rotor on. Always lube the end of the shaft for future disassembly. disassembly.



Removing rotor shaft key

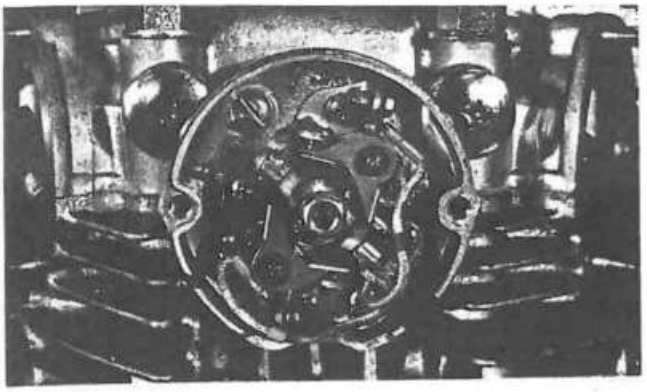
D. Cylinder Head Cover (Disassembly)

Removal and disassembly of the cylinder head cover requires the removal of the engine from the frame.
The cylinder head cover consists of:

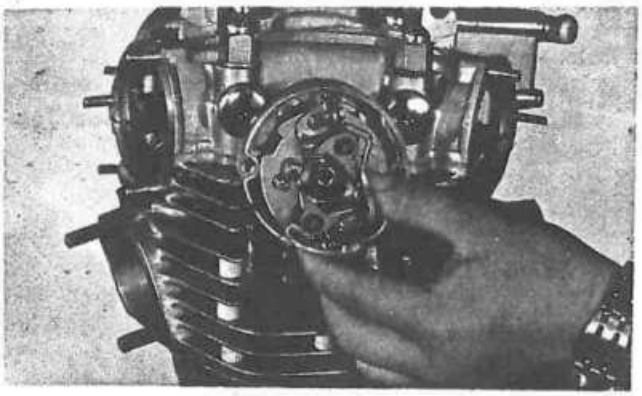
1. Oil delivery line (connected to cover at top)
2. Rocker covers (4)
3. Rocker shaft hole covers (4)
4. Rocker shaft
5. Rocker arm
6. Cylinder head cover sleeves and O-rings.

In addition, the cylinder head cover helps to support:

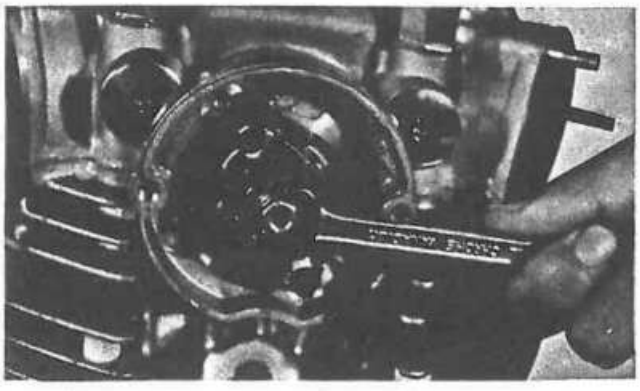
1. Ignition point assembly
2. Governor unit (centrifugal ignition advance unit)



1. Oil Delivery Line Removal
   The oil delivery line is located at the front of the engine between the cylinders. Disconnect it at the crankcase and at the head where it is held in place by two banjo bolts.
2. Ignition Breaker Point Removal
   a) Although the ignition system has a dual point arrangement they are, in effect, mounted on a single backing plate. The points can be removed as a unit.



   b) The point assembly backing plate is held in place by two slotted-head screws. Remove the screws and the plate assembly will slip off.
   c) Remove the three Phillips screws anchoring the point housing. The housing can now be tapped loose and removed.

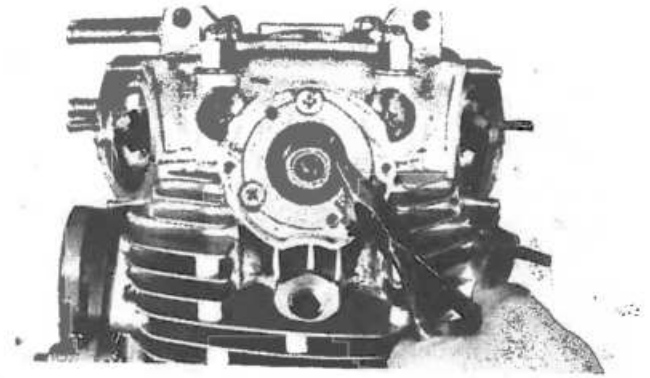


3. Advance (Governor) Unit
   a) Remove the lock nut (1) and notched plate (2).
   b) Pull the advance rod out the left camshaft side (point side). To aid in future assembly, it is best to reassemble the notched plate, lock washer, and lock nut onto the rod and set it aside.

c) Use a punch and hammer to loosen the ring nut that secures the entire ignition advance unit. As this ring nut is loosened, slide the advance unit out; otherwise the ring nut will bind up.



d) Remove the advance unit locating pin.

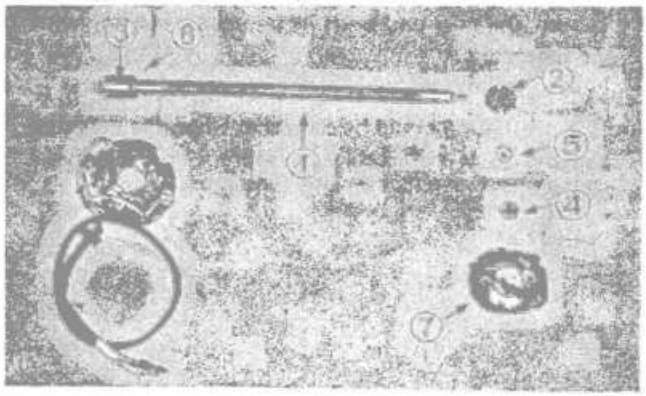


e) Finally, remove the advance unit housing which is held in place by three Phillips-head screws. The housing might need a light tap to break it loose from gasket adhesion. Use a soft-head hammer.

4. Governor (Advance) Rod Unit

a) Description:

The entire unit consists of the advance rod, a notched ignition advance disk, an ignition point cam, two locating pins, and a lock washer and nut for each end.

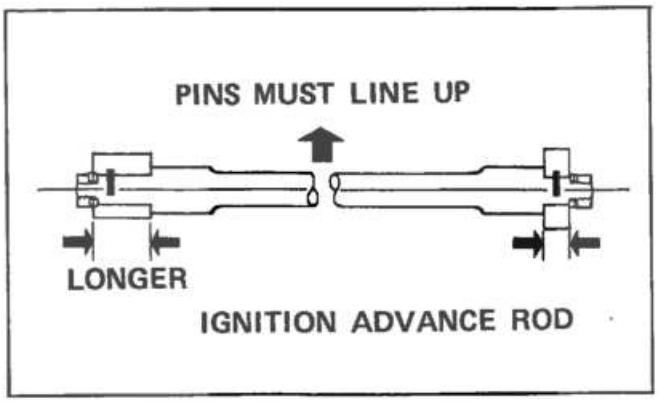


b) Disassembly procedure:

(1) The notched disk, lock washer, and lock nut have already been removed. The point cam can be removed next. It is held by a lock washer and nut. Remove these pieces and slip the point cam off. A spacing washer behind the cam should also be removed, if one is present.



(2) Two locating pins are pressed into drilled holes in the rod. Normally there is no need to remove them. However, if one should come out, it must be pressed back into its hole so that it lines up with the other locating pin.



c) Assembly procedure:

(1) Both ends of the advance rod appear to be identical. However, one machined end is longer than the other. The point cam slips onto the longer end. The advance disk fits over the shorter end. The point cam and its spacing washer both have locating grooves that must line up with the locating pin. This prevents improper assembling.

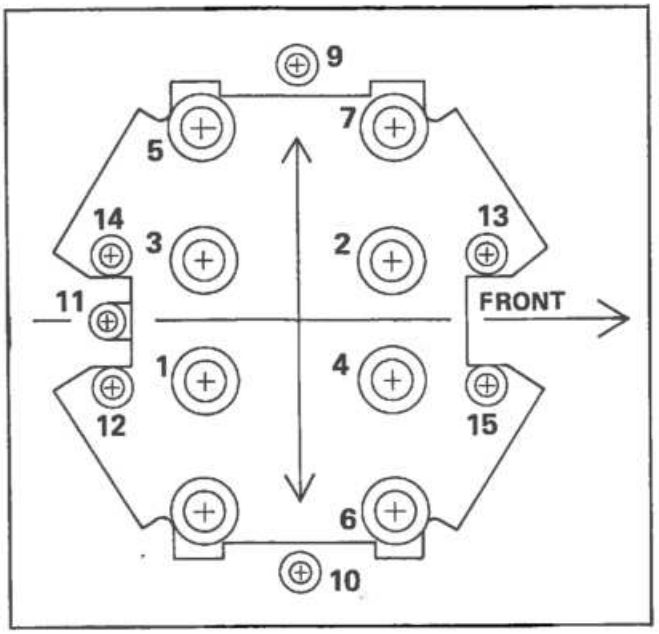
5. Cylinder Head Cover Removal

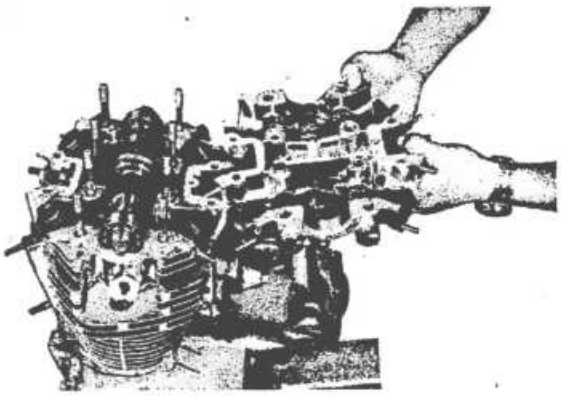
a) Remove all four tappet covers. Then remove the eight head cover retaining nuts and four retaining bolts. Remove the cover. Tap around the edges with a rubber hammer to free the cover if necessary. Never use a metal-head hammer.

Caution:

Loosen the nuts and bolts in sequence, starting with the inner nuts.

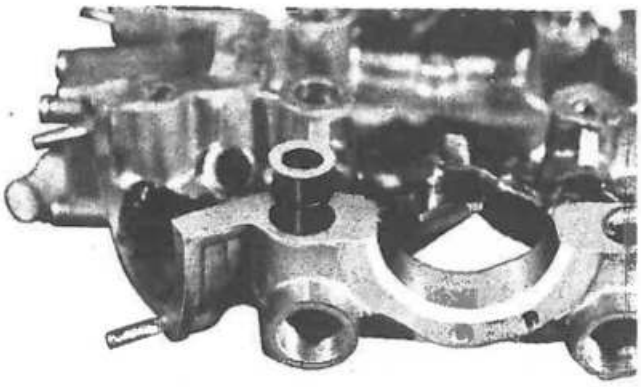
Lips of sealing washers (indicated by numerals, 1, 5, 6 and 8 in the figure) could be caught in when the cylinder head moves up. It is advisable, therefore, to remove these washers before loosening nuts, 1, 2, 3 and 4.





3-6. CYLINDER HEAD

A. Removal of Parts



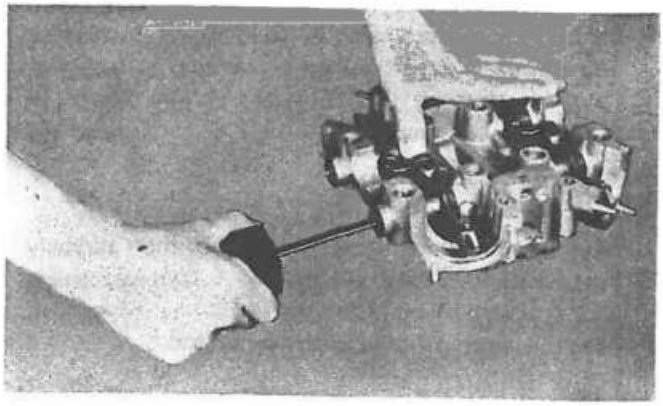
Rocker Arm and Rocker Shaft Removal

1. First, remove all four rocker shaft covers. Then remove the shouldered sleeves and O-rings (see picture). Insert a 6 mm. screw into the tapped shaft, and withdraw the rocker shaft. It should slide out easily. Lift the rocker arm out of the head cover. Repeat this procedure for each rocker assembly.

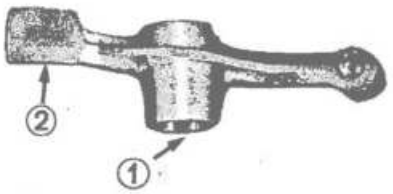
Note:

Keep each mating rocker arm and shaft assembly separated. Reinstall them as a unit.

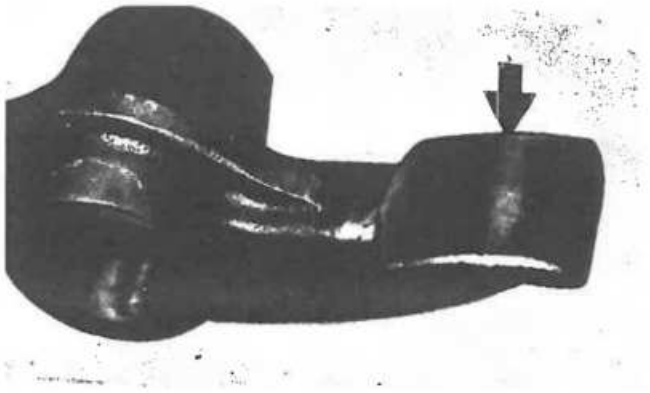
2. Reinstall the shafts using the 6 mm. screw. That way, the threaded hole will be properly positioned for future disassembly; without the hole and screw it is very difficult to remove the shaft.



3. Rocker Arm and Rocker Shaft Wear
   a) The rocker arm usually wears at two spots: ① at the rocker shaft hole where it rubs against the rocker shaft, and ② at the cam lobe contacting surface.

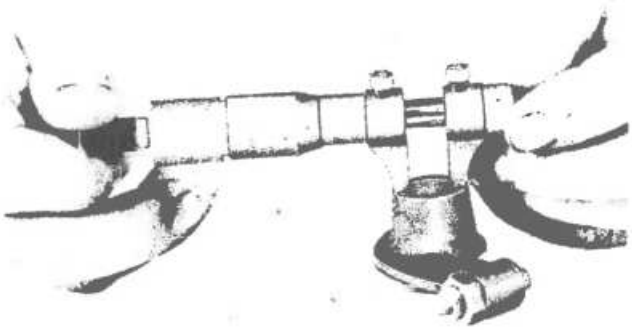


   b) Check the cam lobe contacting surface of the rocker arm for grooves in the surface, for deep and obvious scratches, flaking of the hardened surface, or a blue discoloration of the metal (obvious evidence of too much heat). Check the mating cam lobes in the same manner.



c) If any grooves are readily apparent, replace the rocker arm. Do not try to repair the surface by cleaning with an oil stone or emery cloth as this will change the curvature of the follower and thereby the rate of valve opening.

d) Measure the rocker shaft hole in the rocker arm. Standard size is 0.59 in. (15.01 mm.)



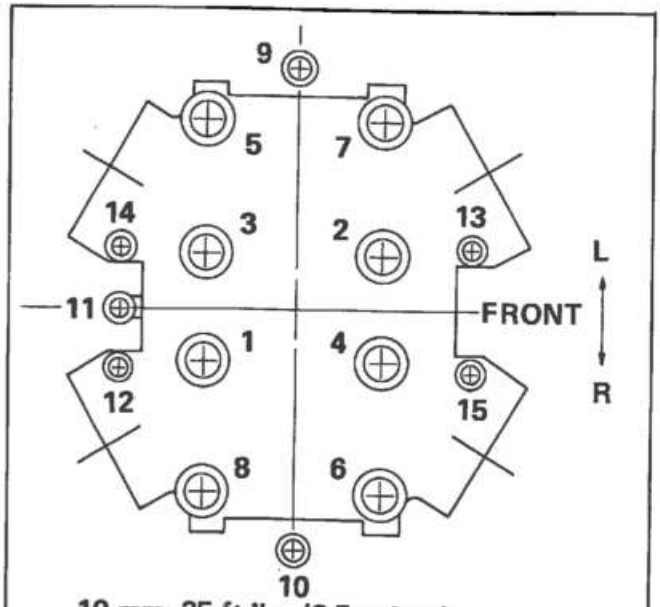
e) Rocker shaft diameter measures 0.59 in. (14.98 mm.) when new. The shaft has been hardened and it should not wear excessively. If a groove has developed in its surface that can be felt, or if it shows a blue discoloration, then the shaft should be replaced and the lubrication system (pump and passages) checked.



f) Standard clearance between the rocker shaft and hole should be 0.002 in. (0.05 mm.). If measurement shows more than 0.004 in. (0.10 mm.) clearance, replace either or both parts as necessary.

B. Cylinder Head

1. Assembling the Cylinder Head Cover
   a) All head cover components can be installed in the head cover in reverse order of removal, beginning with rocker arms and rocker shafts. Be sure to coat all surfaces with oil as the parts are reassembled.
   b) All rocker arms are idential and all rocker shafts are identical, which make them interchangeable. However, try to keep the arms and shafts together as four individual sets (one arm and one shaft to a set) and to reinstall them in the head cover in their original location. Also, when installing the rocker shafts, see that the drilled and tapped end points outward to facilitate future disassembly. Complete this phase of assembly by installing the shaft hole covers.
2. Installing the Cylinder Head Cover and Attached Parts
   a) Coat the head and cover mating surfaces with a non-hardening sealant (Yamaha Bond #4) and slip the head cover into position on the head. Install all head cover retaining nuts and retaining bolts and thread them down until lightly seated. USE A TORQUE WRENCH to tighten these nuts and bolts to the proper torque setting, and in proper torque sequence. Tightening torque for 10 mm. studs is 25 ft-lbs. (3.5 m-kgs.), for 8 mm. it is 14 ft-lbs. (2.0 m-kgs.), and for 6 mm. it is 7 ft-lbs. (1.0 m-kg.).



10 mm. 25 ft-lbs. (3.5 m-kgs.)
8 mm. 14 ft-lbs. (2.0 m-kgs.)
6 mm. 7 ft-lbs. (1 m-kg.)

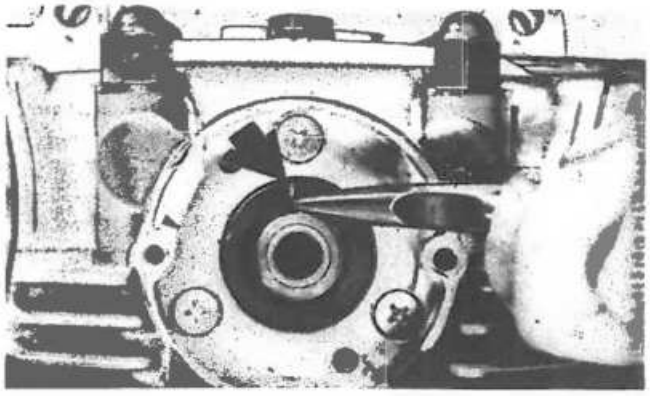
TIGHTENING SEQUENCE

Caution:

If the stud threads are not lubricated prior to cylinder head cover assembly, it is possible to shear a stud when tightening cover nuts. Therefore, apply a liberal coating of 30 weight oil to all threads first, and then torque the head cover down.

b) Install the ignition points housing and the centrifugal advance housing. These housings are identical and can only fit on the machine one way.

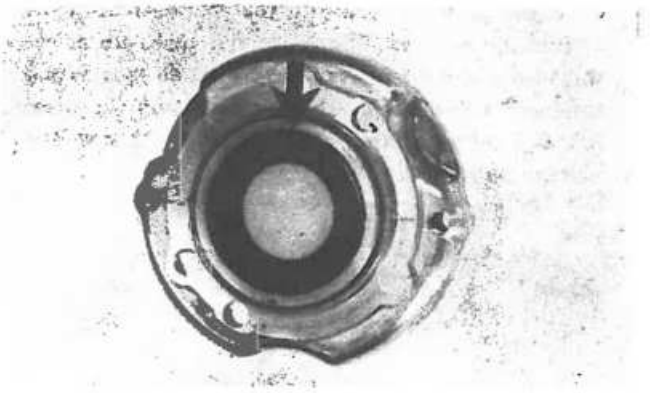
c) Install the centrifugal advance unit locating pin.



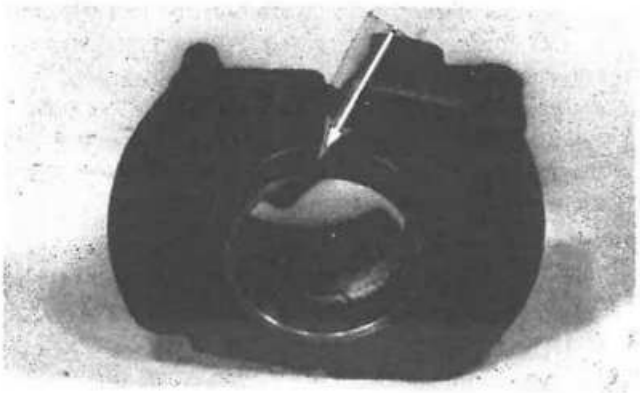
d) If necessary, insert a new gasket between the housing and head covers. Also, if any oil residue is found on the ignition points, then the rubber seal may be leaking. Check the seal for grooves, creases, or any deformity that would permit oil to leak past. If found, replace the seal.

Note:

Grease the seal lip before installing the housing.



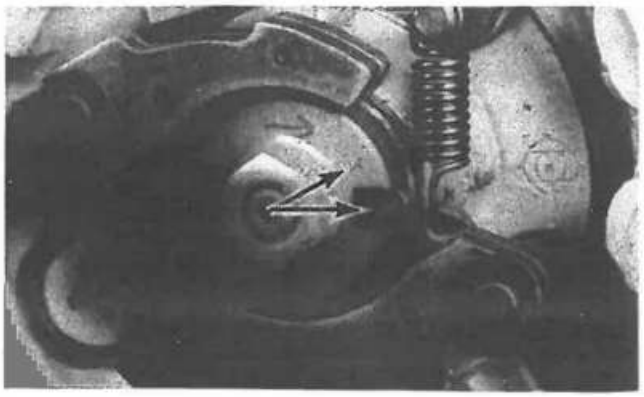
e) Mount the governor (centrifugal advance) unit in its housing. It can only fit one way as there is a notch in the back of the unit that must line up with the locating pin. Next, screw the ring nut onto the camshaft end until tight and then use a punch and hammer to completely tighten the ring nut.



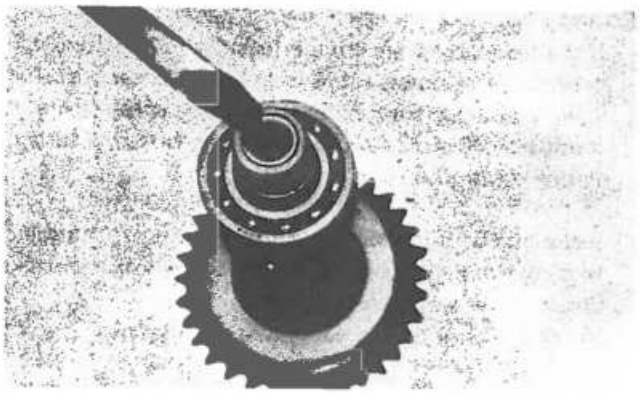
f) Place the disk into position and engage the centrifugal weight arms into the proper disk slots.

Caution:

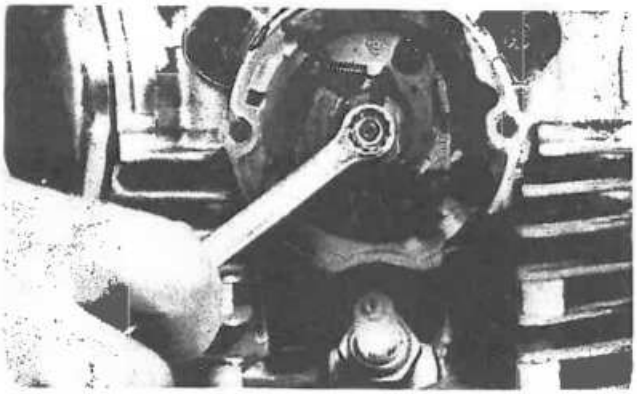
Make sure the disk face with the arrow showing direction of rotation faces outward. Also, there is a color mark on it. This arm must fit into the disk slot identified by a color mark right next to it. If either of these steps is performed incorrectly, operation of the advance unit will be impaired.



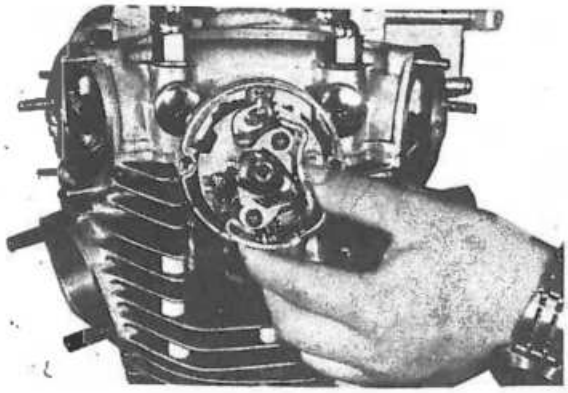
g) Before inserting the governor rod, both supportive needle bearings (located inside each end of the camshaft) should be lubricated with a light-weight grease. These bearings support the point cam rod and every time this unit is taken apart these bearings should be greased.



h) Slide the governor rod into the camshaft from the ignition points side. A locating pin sticks up at the threaded end of the governor rod. Install the rod and rotate it until this locating pin slips into the inner notch in the governor unit disk: Next install and tighten the lock nut.

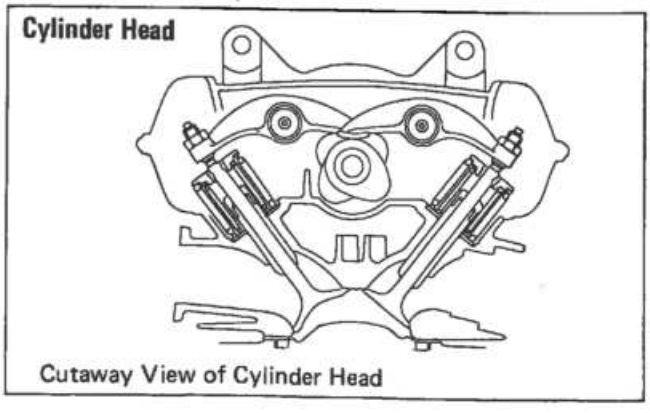


i) Install the ignition point assembly. Do this by expanding the two sets of points and slipping the assembly over the point cam. The point assembly is designed to fit only one way. Position the right cylinder points (stamped "R" on the plate just below the points) at the top of the housing. Install and tighten both securing screws.



j) Make sure the point wire rubber grommet is in good shape and installed correctly, then secure the point housing cover in place.

k) Install the oil delivery line. (After the engine has run sufficiently to warm up to operating temperature, check for oil leaks at this point if necessary.)

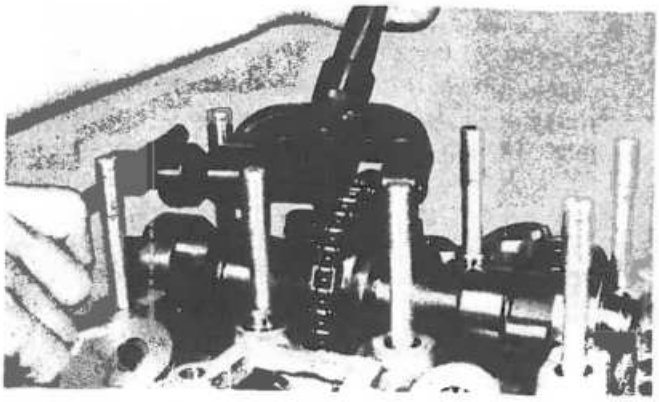


Cutaway View of Cylinder Head

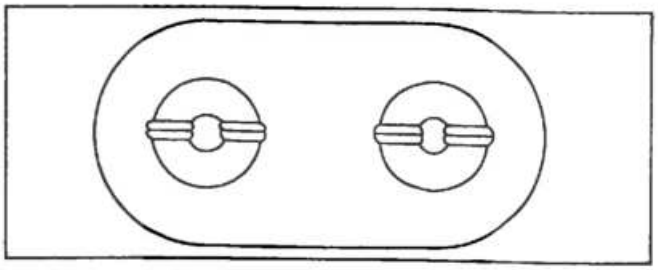
3. Cam Chain Removal

a) The single row cam drive chain connects the camshaft to the crankshaft. The chain is "endless" in that there is no master link to disassemble it, other than the link riveted at the factory when the chain was first installed.

b) A chain breaker (in Special Tool kit) must be used to remove a selected link. Place a rag around the sprocket to prevent metal chips from falling into the engine.

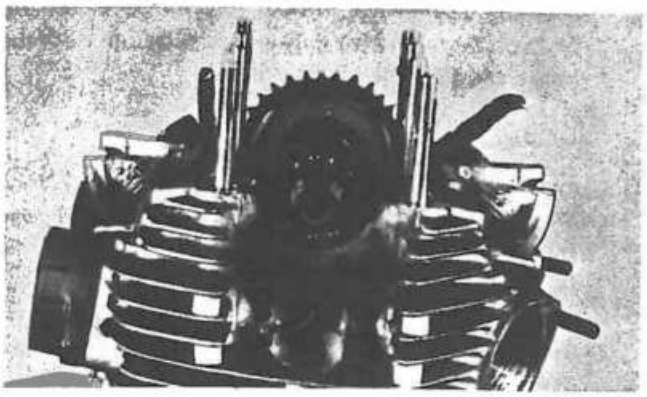


c) Separate the chain link that was originally riveted at the factory. The rivet heads on this link have punch marks and slots across the heads.



Caution:

d) Attach a wire to a chain link on each side of the link to be separated. Do this before separating the chain to prevent the chain from dropping into the crankcase. After separating the chain anchor both retaining wires to prevent the chain from dropping down.



(1) Remove the chain, clean it in solvent, then examine for wear.

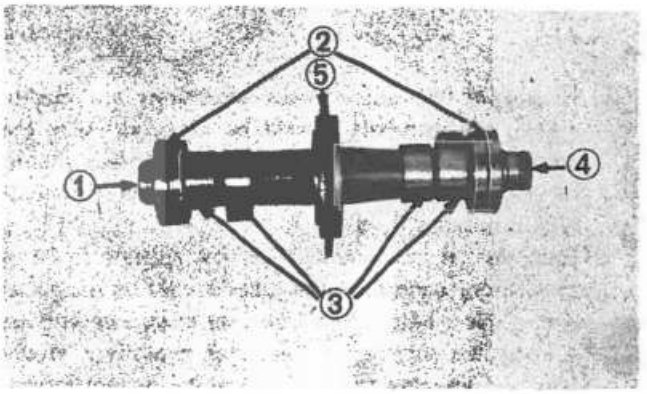
(2) If the engine is not to be disassembled, pull a length of wire through with the chain during removal in order to provide a means of reinstalling the chain after cleaning and checking.
It is also a good idea to have a mechanic's mechanical claw on hand to help feed the chain around the guide bars on the lower drive sprocket during reassembly.

Note:

Checking Cam Chain Wear:
Check the cam chain using the same methods as when the secondary drive chain is checked.

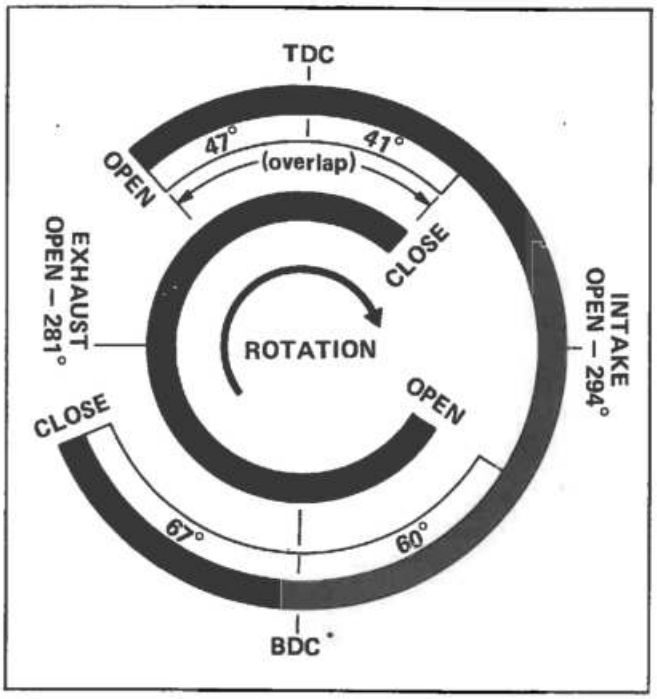
4. Camshaft

a) The XS650B engine uses a single overhead camshaft. All four cam lobes (2 intake and 2 exhaust) are located on one shaft. The cam lobes have been specially tempered to resist wear. The camshaft is connected to the crankshaft by a single row endless chain. Sprocket ratio is 2.1, which turns the camshaft at half crankshaft rpm. The camshaft is supported on top of the cylinder head by four single row ball bearings at each end.

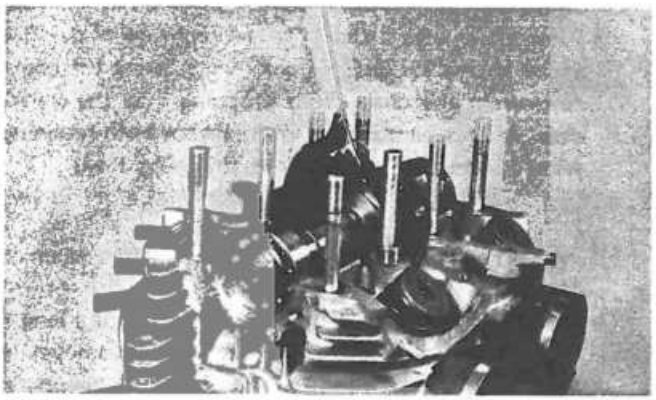


1. Needle bearing
2. Single row ball bearings (4)
3. Cam lobes
4. Governor mounting threads
5. Camshaft sprocket (34 teeth)

b) The ignition points fit against, but do not mount directly to, the left end of the camshaft. The camshaft right end is threaded and the ignition governor (centrifugal advance) unit mounts directly to this end. The shaft is hollow and the governor rod slips through this passage to link the governor unit with the ignition points unit. Each end of this drilled passage is fitted with a needle bearing to support the rod and a small labyrinth seal to prevent governor rod lubricating oil from leaking into both units; especially the ignition points unit.



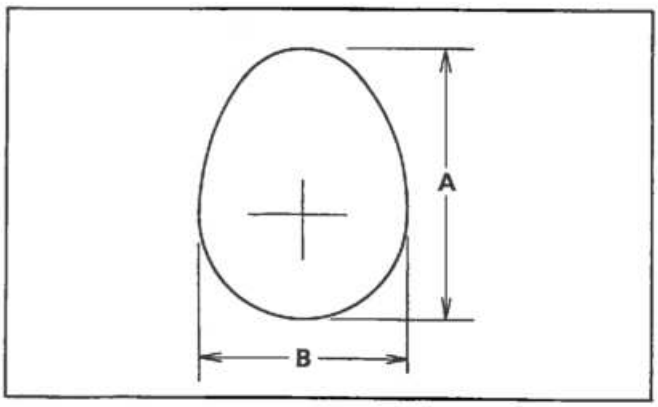
c) The intake valve open 47° before top dead center and closes 67° after bottom dead center, which means the intake valve is held open 294°. The exhaust valve opens 60° before bottom dead center and closes 41° after top dead center. It remains open for a duration of 281°. At one point during cam rotation, both the intake and the exhaust valve closes.



5. Camshaft Removal
   a) With the camshaft drive chain removed (or held away by safety wire), the camshaft can be lifted out of the head.
6. Camshaft Wear
   a) The cam lobe metal surface may have a blue discoloration due to excessive friction. The metal surface could also start to flake off or become pitted. This is due to poor lubrication, incorrect clearances (from poor adjustment or valve bounce), or due to normal wear.

	Cam Lift (A)		Base Circle Diameter (B)	
	Standard Value	Wear Limit	Standard Value	Wear Limit
Intake	39.99 ± 0.05	39.88	32.24 ± 0.05	32.02
Exhaust	40.03 ± 0.05	39.88	32.30 ± 0.05	32.15

b) If any of the above wear conditions are readily visible, the camshaft should be replaced. Also, the corresponding rocker arm contacting surface should be checked for similar wear and replaced if obvious wear is noted.
c) Even though the cam lobe surface appears to be in satisfactory condition, the lobes should be measured with a micrometer. Cam lobe wear can occur without scarring the surface. If this wear exceeds a predetermined amount, valve timing and lift are affected. Replace the camshaft if wear exceeds the limits listed.



d) All camshaft bearings should be removed, cleaned, dried, and the races visually checked for pits, rust spots or chatter marks where the balls have dragged. If any of these conditions exists the bearing(s) should be replaced.

Note:

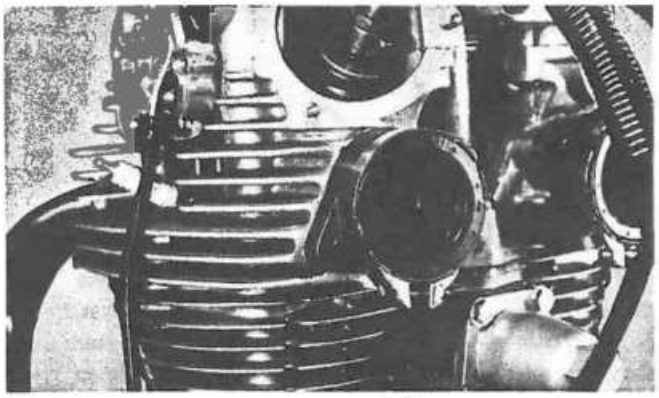
Lubricate the bearings immediately after examining them to prevent rust formation.

7. Carburetor Manifold Removal

The rubber manifolds are secured to the head by two Allen-head screws each. Remove the screws and the manifolds.

8. Cylinder Head Removal

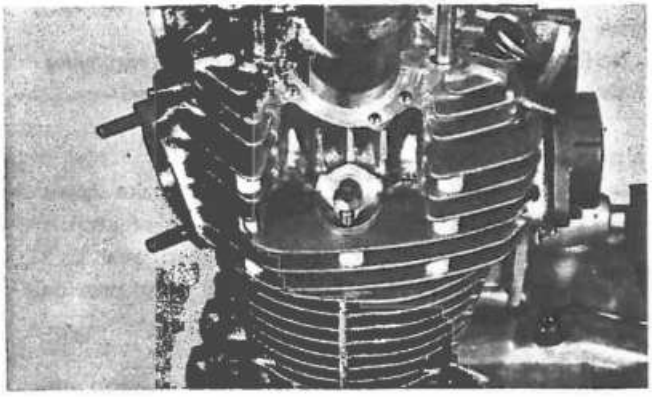
a) The head is now held in place by two hex-head screws (#1) beneath each spark plug hole and one 6 mm. screw (#2) which is located between the intake manifolds. Remove the bolts and slide the cylinder head up over the studs. While performing this operation, hold the safety wires to the cam chain so it does not fall into the crankcase.

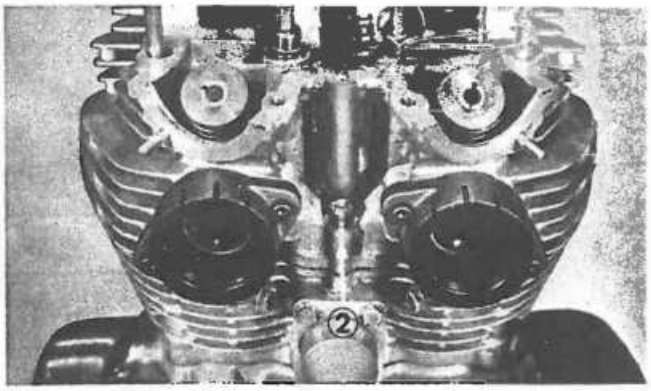


9. Cylinder Head Wear

a) There must be no head warpage. Clean the head thoroughly with solvent, dry it, and lay it on a machined surface plate. If warpage is extreme, the head will rock back and forth. Check for lesser warpage by running a 0.001" – 0.002" feeler gauge under the head mating surface. If the gauge slips in between the head and the surface plate anywhere around the perimeter, then the head must be re-surfaced.

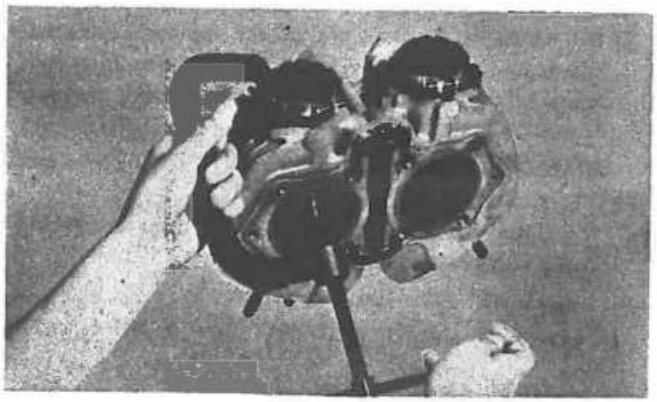
b) Place a sheet of #400 grit emery paper on the surface plate and slide the head mating surface across this paper in a figure 8 pattern to remove any measureable warpage. If more than 0.0025" needs to be removed, the head should be taken to a machine shop for milling.





10. Valve Removal

a) A valve spring compressor is available in the Special Tool kit. Compress the valve spring and then remove both keepers. Remove the compressor and lift off the collar and springs.



Note:

The keepers might be partially stuck in the collar. Use a rubber hammer to tap the edge of the collar a few times to loosen the keepers.

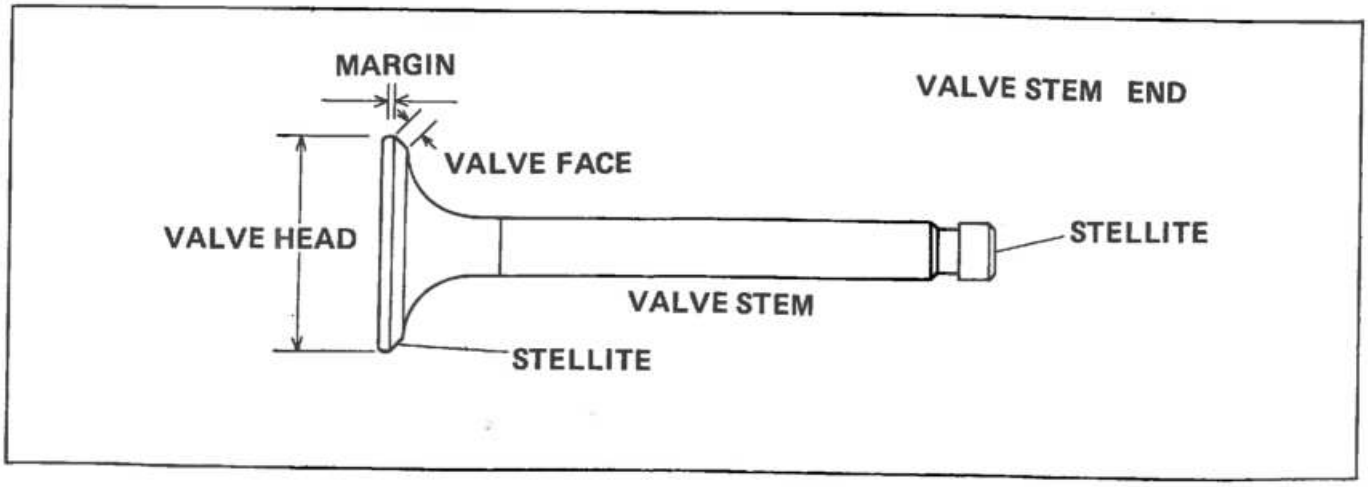
b) Pull the valve out. If the stem tip or keeper groove edges are slightly expanded, causing difficult removal, do not force the valve out as the valve guide inner diameter might be damaged. First, use a fine file to remove any lip that exists on the stem and then remove the valve.

Note:

Be sure to remove the valve stem seal before removing the valve. Otherwise the seal could be damaged.

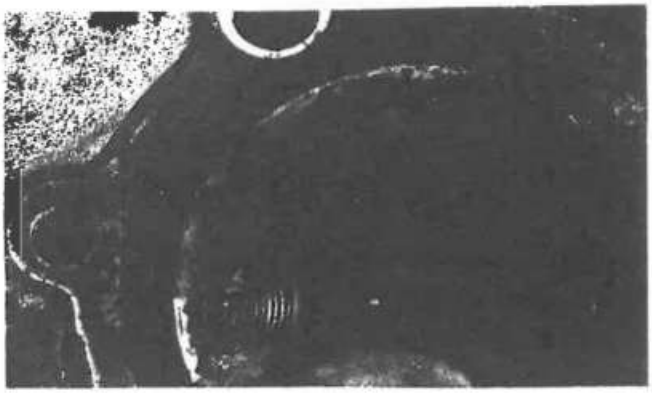
11. Valve Description

The head is equipped with four valves; two intake valves and two exhaust. The stem tip and valve face of each is plated with Stellite (hardened metal) to keep wear at a minimum. The intake valve diameters are larger to provide less restriction for the incoming fuel/air charge.



12. Decarbonization of the Head and Components

Carbon deposits build up in the combustion chambers, on the valves, and in the exhaust ports. Thoroughly clean all parts with a blunt scraper, then wash in solvent and dry with compressed air. The parts can then be examined and measured for wear.



Combustion chamber carbon deposits

13. Valve Wear

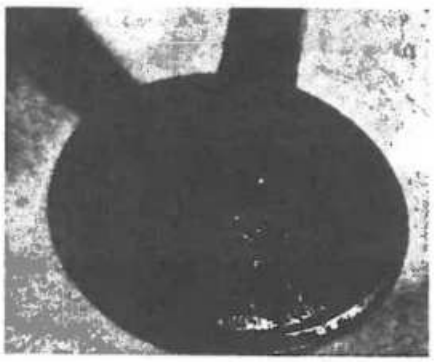
a) Check the valve stem tip for an indentation caused by the adjustor constantly striking the tip. If this indentation is 0.015 in. – 0.020 in. (0.4 – 0.5 mm.) deep, or more, then regrind the tip surface flat. Remove only the material necessary, no more. Use a commercial valve grinder with the appropriate adaptor mounted on it to grind the tip.

b) Valve stem wear must be measured and then combined with valve guide measurements to arrive at a stem-to-guide clearance. This clearance must be within the tolerances shown below. If it exceeds the maximum limit then replace either or both parts as required.

c) The valve should also be checked for a bent stem. Roll the stem along the edge of a surface plate and visually check for stem warpage. Replace the valve if any warpage exists.

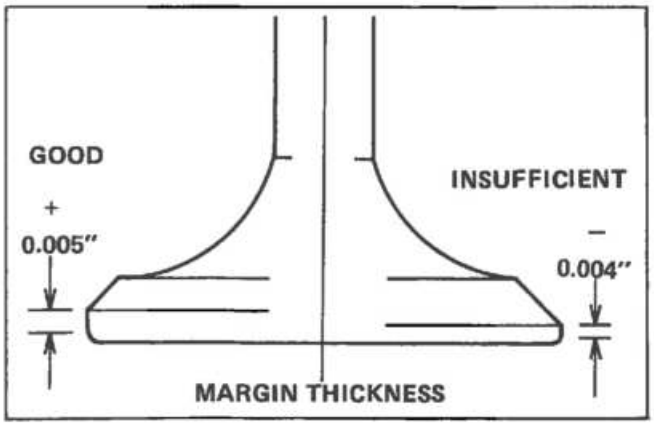
Note:

When checking the stem for warpage, be sure all carbon has been cleaned off.
Otherwise, an accurate check cannot be made.



Valve carbon deposits

d) Check the valve for pits, carbon deposits, warpage (including the entire head), and actual chips broken off the margin. If warpage exists or if the surface is chipped, replace the valve. If it is just pitted and/or carboned up, lap it to the valve seat. If it does not clean up by lapping then use a mechanical grinder to resurface the valve face. After grinding, check valve margin thickness. If it has been reduced to a sharp edge because of grinding, the valve should be replaced as this thin edged margin can readily heat up and cause pre-ignition.

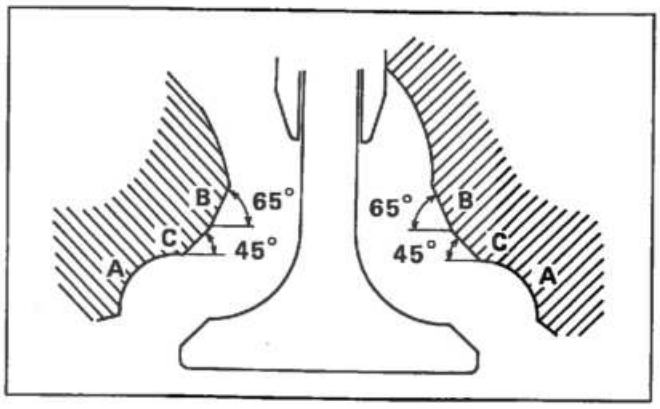


e) Check the stem for scratches. These occur when carbon collects in the valve guide and then hardens. As the stem continually rubs against this hard carbon, scratches are worn in the stem. Replace the valve if deep scratches are found.

	Original Clearance	Replacement Clearance
Intake	0.020 – 0.044 mm.	0.100 mm.
Exhaust	0.035 – 0.059 mm.	0.120 mm.

14. Grinding the Valve Seat

a) The valve seat is subject to severe wear similar to the valve face. Whenever the valve face is resurfaced, the valve seat should also be resurfaced at a 45° angle. In addition, if a new valve guide has been installed (without any valve repair), the valve seat should be checked to guarantee complete sealing between the valve face and seat.



Caution:

If the valve seat is obviously pitted or worn, it should be cleaned with a valve seat cutter. Use the 45° cutter, and when twisting the cutter, keep an an even downward pressure to prevent chatter marks.

If cutting section 'A' of the intake valve seat, use cutter 8R (radius cutter). If cutting section 'A' of the exhaust valve seat, use cutter 8R (also radiused).

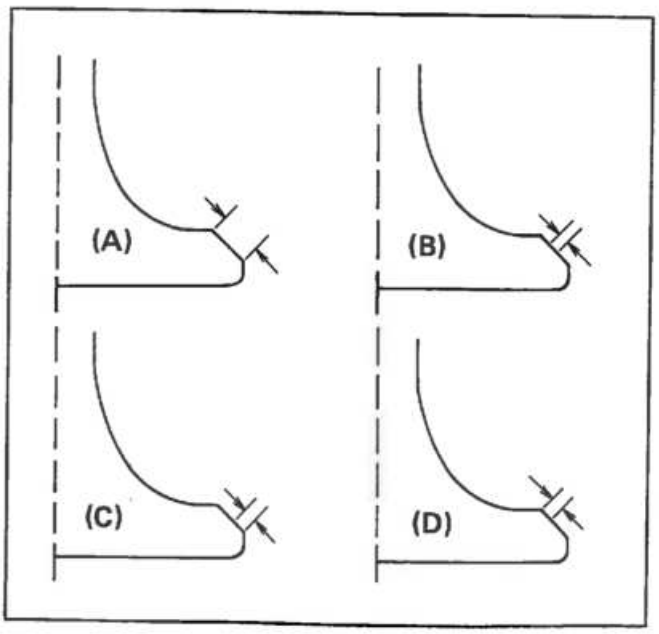
If cutting section 'B', use the 65° cutter.

If cutting section 'C', use the 45° cutter.

b) Measure valve seat width. Apply mechanic's bluing dye (such as Dykem) to the valve face, apply a very small amount of fine grinding compound around the surface of the valve seat, insert the valve into position, and spin the valve quickly back and forth. Lift the valve, clean off all grinding compound, and check valve seat width. The valve seat will have removed the blueing wherever it contacted the valve face.
Measure the seat width with vernier calipers. It should measure approximately 0.05 in. (1.3 mm.). Also, the seat should be uniform in contact area. If valve seat width varies, or if pits still exist, then continue to cut with the 45° cutter. Remove just enough material to achieve a satisfactory seat.

	Standard Width	Wear Limit
Seat Width	0.051 in. (1.3 mm.)	0.078 in. (2.0 mm.)

c) If the valve seat is uniform around the perimeter of the valve face, but is too wide or not centered on the valve face, it must be altered. Use either the "R" (radius), 45°, or 65° cutters to correct the improper seat location in the manner described below:



(A) If the valve face shows that the valve seat is centered on the valve face, but too wide, then lightly use both the "R" and the 65° cutters to reduce the seat width to 0.05 in. (1.3 mm.).

(B) If the seat shows to be in the middle of the valve face, but too narrow, use the 45° cutter until the width equals 0.05 in. (1.3 mm.).

(C) If the seat is too narrow, and right up near the valve margin, then first use the "R" cutter and then the 45° cutter to get the correct seat width.

(D) If the seat is too narrow and down near to bottom edge of the valve face, then first use the 65° cutter and then the 45° cutter.

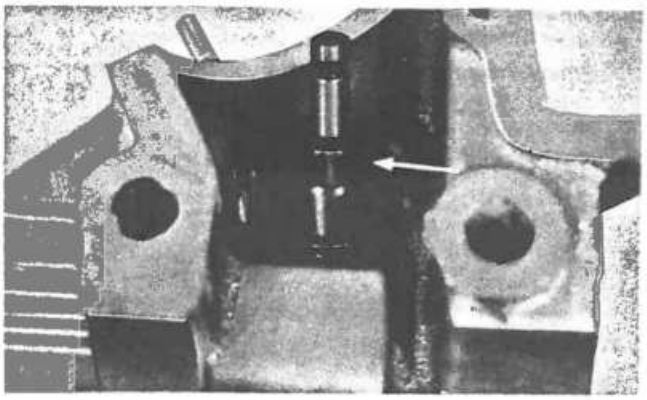
15. Lapping the Valve/Valve Seat Assembly
    a) The valve-valve seat assembly should be lapped if, (1) neither the seat nor the valve face are severely worn, or: (2) if the valve face and valve seat have been resurfaced and now require a final light grinding operation for perfect sealing.
    b) Apply a small amount of coarse lapping compound to the valve face. Insert the valve into the head. Rotate the valve until there is a burnished spot all the way around the valve face. Clean off the coarse compound, then follow the same procedure with fine compound. Continue lapping until the valve face shows a complete and smooth surface all the way around. Clean off all compound material. Apply bluing dye to the valve face and rotate the valve face for full seat contact which is indicated by a shiny surface all around the valve face where the bluing has been rubbed away.

    Note:

    The valve can most easily be rotated if a section of flexible rubber hose of 5/16" ID is slipped over the valve stem and spun.

16. Valve Leakage Check
    a) After all work has been performed on the valve and valve seat, and all head parts have been assembled, check for proper valve seat sealing by pouring solvent into each of the intake ports, then the exhaust ports. There should be no leakage by the seat. If this fluid leaks, disassemble the valve assembly and continue to lap with fine compound. Clean all parts thoroughly, reassemble and check again with solvent. Repeat this procedure as often as necessary to obtain a satisfactory seal.

17. Valve Stem Seal
    a) This seal slips down over the valve stem to prevent excessive amounts of oil from passing down the stem and into the combustion chamber. If this seal is cracked, split, or hardened, replace it.

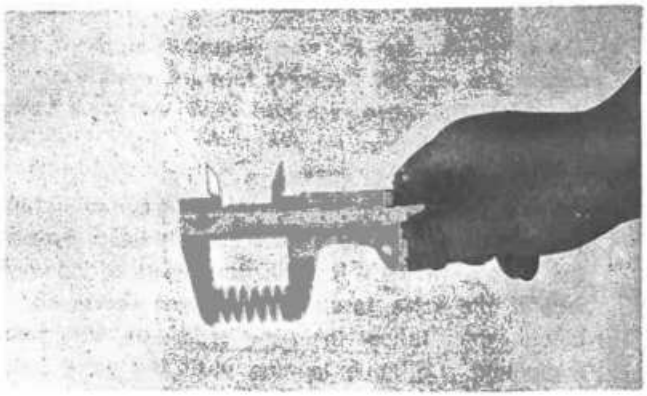


18. Valve Spring
    a) The 650 series engine use two springs of different size to prevent valve float or surging.
    The chart below shows the basic value characteristics.

	OUTER	INNER
Diameter of Wire	4.5 mm.	2.9 mm.
Direction of Winding	Right Hand	Left Hand
Total Windings	6.0	7.25
Free Length	41.8 mm.	41.0 mm.
Installed Length (Valve Closed)	37 mm.	35 mm.
Installed Pressure	20.1 kgs. (44 lbs.)	9.7 kgs. (20 lbs.)
* Compressed Length (Valve Open)	27.8 mm.	25.8 mm.
Compressed Pressure	60.0 kgs. (132 lbs.)	25 kgs. (55 lbs.)

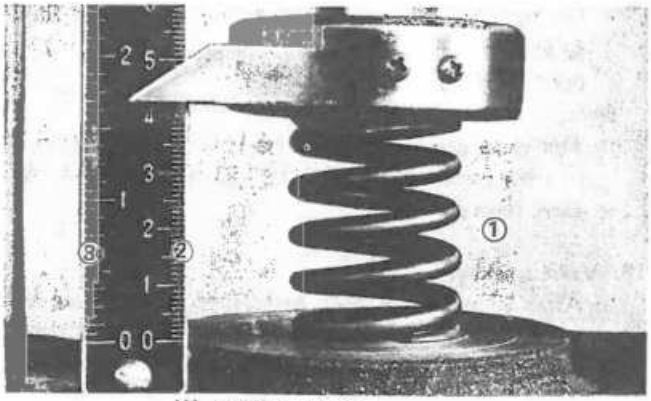
* Measured without collar
All measurements ± three percent.

b) Even though the spring is constructed of durable spring steel, it gradually loses some of its tension. This is evidenced one way by a gradual shortening free length. Use a vernier caliper to measure spring free length. If the free length of any spring has reduced more than 0.080 in. (2 mm.) from its specification, replace it.



c) Another symptom of a fatigued spring is insufficient spring pressure when compressed. This can be checked using a valve spring compression rate gauge.

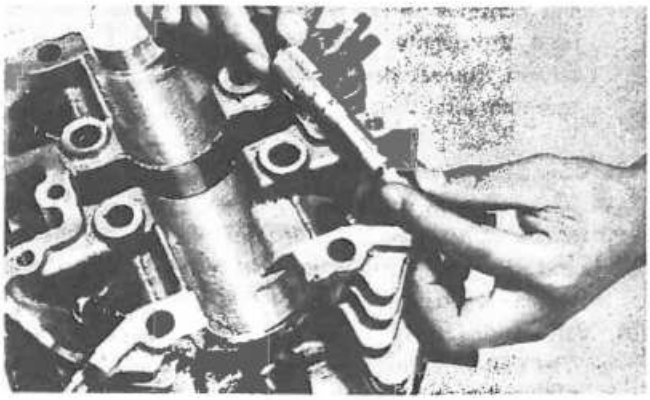
Test each spring individually. Place it in the gauge and compress the spring first to the specified compressed length with the valve closed (all spring specifications can be found in previous section, Valve Spring) then to the length with the valve open. Note the poundage indicated on the scale at each setting. This procedure must be performed on the outer springs, then the inner springs.



(1) Individual spring
(2) Length measuring scale
(3) Pounds pressure scale

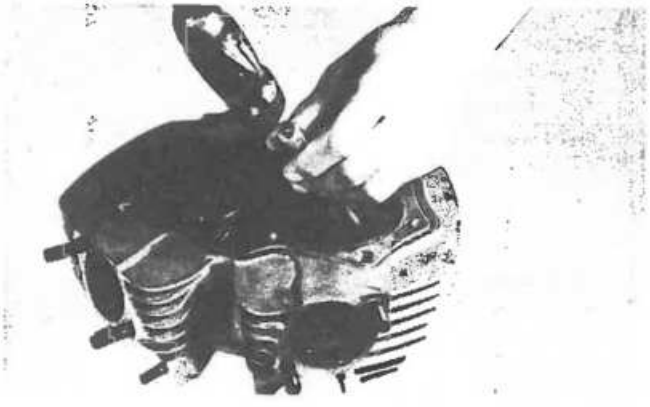
19. Valve Guide

a) The inside diameter must be measured with a ball gauge. Measure at each end and in the center of the drilled passage. Compare this measurement, using the largest measurement of these spots, with factory specifications listed in Valve Description. If this measurement exceeds the maximum tolerance, replace the guide.



b) The valve guide is replaceable. It is held in the head by an interference fit of approximately 0.0015" (0.04mm). To ease guide removal and reinstallation, and to maintain the correct interference fit, heat the head to 200 ~ 400° Farenheit. If possible, use an oven to avoid any possibility of head warpage due to uneven heating.

c) Use the appropriate shouldered drift (Special Tools Kit) to drive the old guide out and the new guide in.



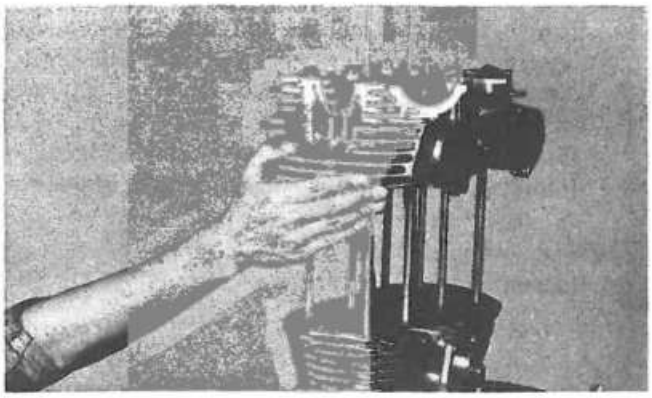
CAUTION:
The valve guides which are sold as spare parts are oversizes, and therefore, when replacing a valve guide, the valve guide hole in the cylinder head must be bored by a reamer.

After fitting the valve guide into the cylinder head, be sure to grind the valve seat, and perform valve lapping.
The valve must be replaced by a new one.

	Reamer outside diameter	Bushing outside diameter
1st oversize	15.1 $^{+0.015}_{+0.007}$ mm.	15.1 $^{+0.063}_{+0.045}$ mm.
	0.5952 $^{+0.00059}_{+0.00027}$ in.	0.5952 $^{+0.00247}_{+0.00177}$ in.
2nd oversize	15.2 $^{+0.015}_{+0.007}$ mm.	15.2 $^{+0.063}_{+0.045}$ mm.
	0.5992 $^{+0.00059}_{+0.00027}$ in.	0.5992 $^{+0.00247}_{+0.00177}$ in.

20. Installing the Head
    a) A new head gasket must be installed. The gasket can correctly fit only one way. Slip the cylinder head over the studs and onto the cylinder.
    b) While performing this step, push the cam chain safety wires up through the slot in the head and pull the cam chain up. Install and tighten both retaining bolts and the one 6 mm. screw.

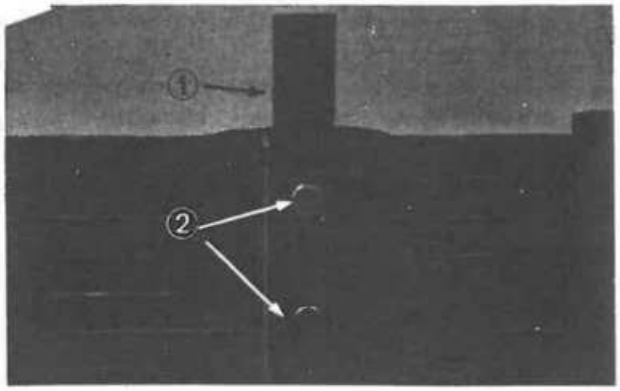
    Note:
    After completing this phase, plug the spark plug holes to prevent anything from dropping into the cylinder.



Cam Chain Vibration Dampener (Opposite the tensioner)

a) This rubber dampener (1) prevents the cam chain from bowing out because of chain weight and engine rpm. It is located in the hollow cavity between the cylinders and to the front, opposite the tensioner. It receives little abuse from the chain and should last indefinitely. However if the cam chain loosens sufficiently to rub hard against the rubber dampener, it could wear out. It is held in place by two bolts (2) at the front of the cylinder. Remove these two bolts and lift the dampener out.

b) After completing the cam chain adjustment, recheck the rotor timing mark and cam sprocket timing groove positions to guarantee that they did not rotate out of position during chain installation.

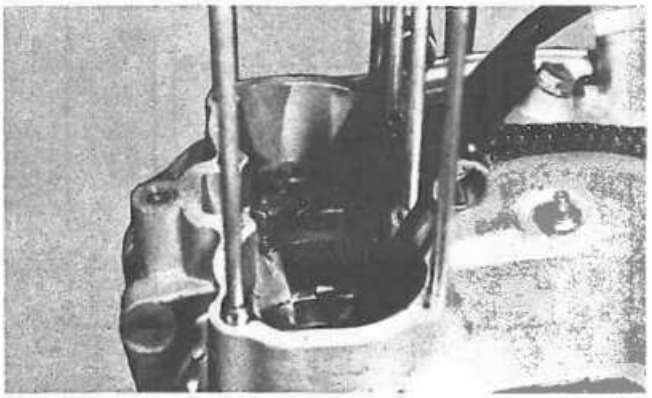


(1) Dampener
(2) Set screw

Cam Chain Vibration Dampener (in engine case)

a) The rubber faced dampener supports the cam chain, helping to keep it running straight between the camshaft sprocket and crankshaft sprocket.

b) The entire unit mounts in the top engine case half; in the center cavity between the two pistons. Remove the four securing screws and (after the cylinders are removed) the unit can be removed.
Check for tearing or excessive wear.
c) Note the position of the two slotted screws, these have a tapered shoulder for proper location in the cases, during reassembly replace as shown.



21. Chain Tensioner

a) The chain tensioner consists of a steel based rubber that is held against the cam chain by a spring and a locked in-place push rod. This slider takes up any free play in the chain. In addition, a rubber dampener solidly mounted to the tensioner arm, just below the steel wheel, helps to guide the cam chain. Because of gradual chain wear, an adjustment is required periodically.

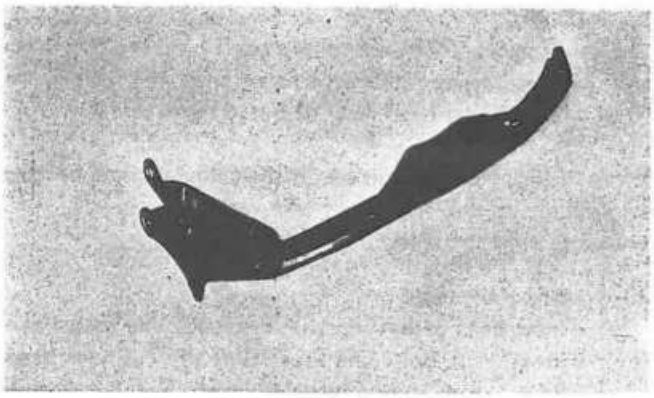
b) Four 6 mm. bolts hold the tensioner housing in place. Remove these and pull the unit out of the cylinder.

c) Reverse this procedure to install the unit. During installation, install a new gasket coated on both sides with Yamaha Bond #4.

d) Rotate crankshaft in a counterclockwise direction (from the left side of the engine) to place all slack in the area of the chain tensioner.

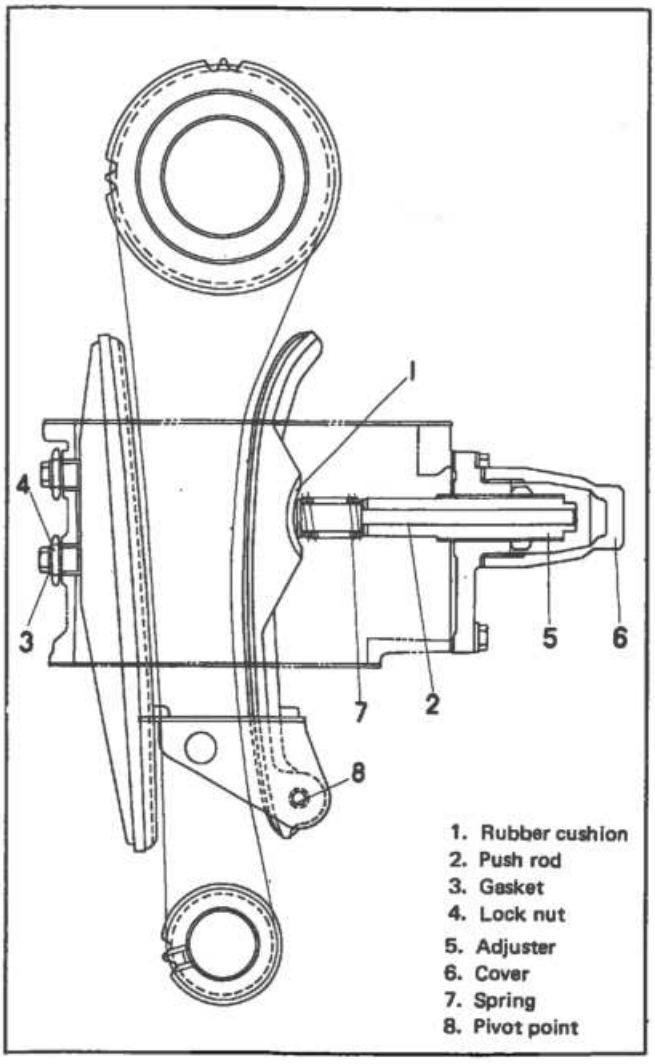
e) Remove the cast metal protective cover.

f) Loosen the tensioner lock nut.



g) Use a 22 mm. wrench to turn the adjuster in until the push rod (inside adjuster) is flush with the end of the adjuster.

h) Tighten the rock nut and install the cover. Check this adjustment every 2,000 miles. (3,000 kms.)

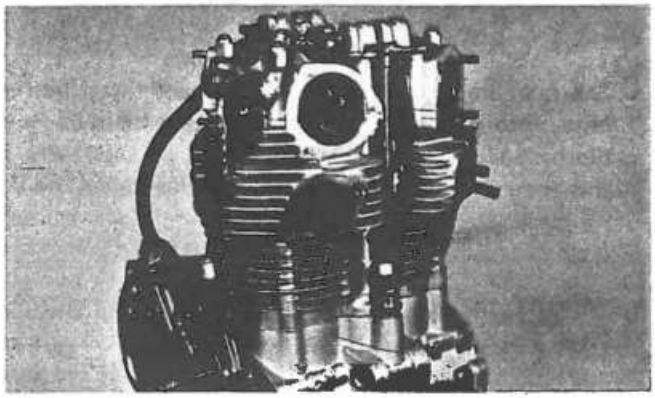


3-7. CYLINDER & PISTON ASSEMBLY

The cylinder is constructed of aluminum with cast iron sleeves. It has a cavity down the center of the cylinder that serves two purposes. First, it provides a channel for the cam chain to run in between the camshaft and the crankshaft. Secondly, it provides a space for air circulation that aids in cooling both cylinders.

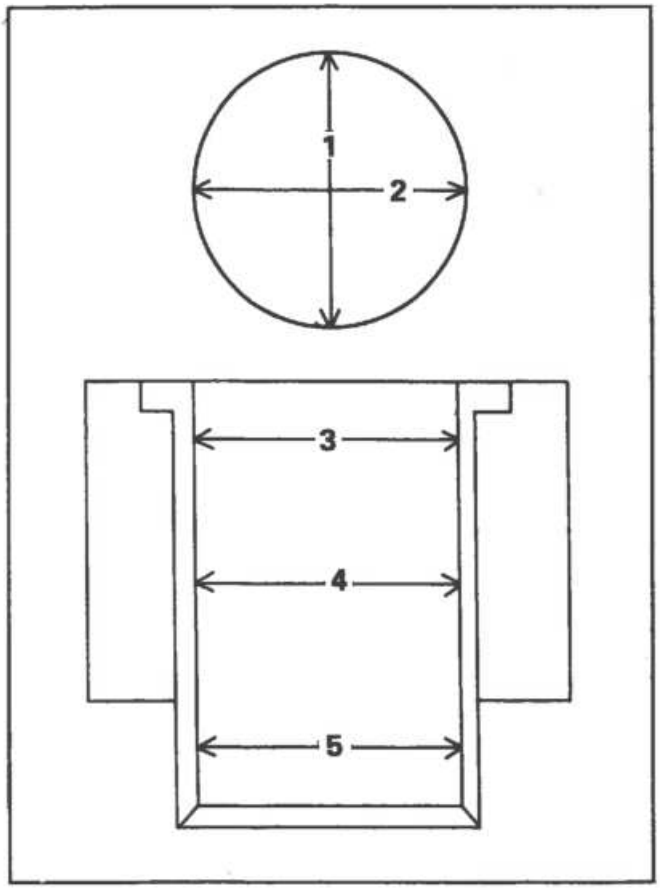
A. Removing the Oil Line Fitting

With the head cover and cylinder head removed, remove the oil line fitting at the front base of the cylinder. The cylinder is now free to be lifted off. The cylinder might have to be tapped a few times with a rubber hammer to break the base gasket adhesion. As the cylinder is lifted for removal, place shop rags in the crankcase opening beneath both pistons to keep any contamination or parts (such as circlips) from dropping into the crankcase.

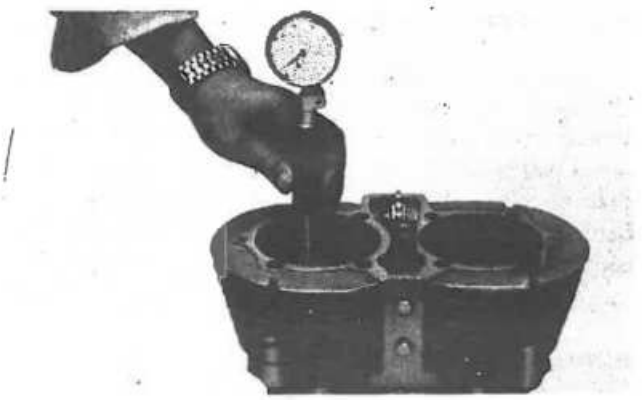


B. Cylinder Wear and Repair Procedures

1. Constant friction between the bore and piston, plus microscopic particles of contamination that enter through the intake, cause a gradual wear of the bore. This wear can be detected by measuring various points in the bore and comparing these measurements against standard specifications.
2. This drawing shows the places to take bore measurements with a cylinder measuring gauge (tool available through Yamaha International).



3. Subtract the bottom bore measurement from the top bore measurement. The difference between these two dimensions is called the "cylinder taper". Check to see if the amount of taper is still within specified limits.



	Standard	Wear Limit
Cylinder Bore (mm.)	75.0	75.1
Cylinder Tape (mm.)	0.005	0.05

4. The bore might be lightly damaged with scratches or nicks. Run a hone through the bore a few times to see if the bore cleans up. If these scratches are too severe, a hone cannot remove them, and a cylinder rebore would be necessary. (Pistons are available in four oversizes: 0.25 mm., 0.50 mm., 0.75 mm. and 1.0 mm.)

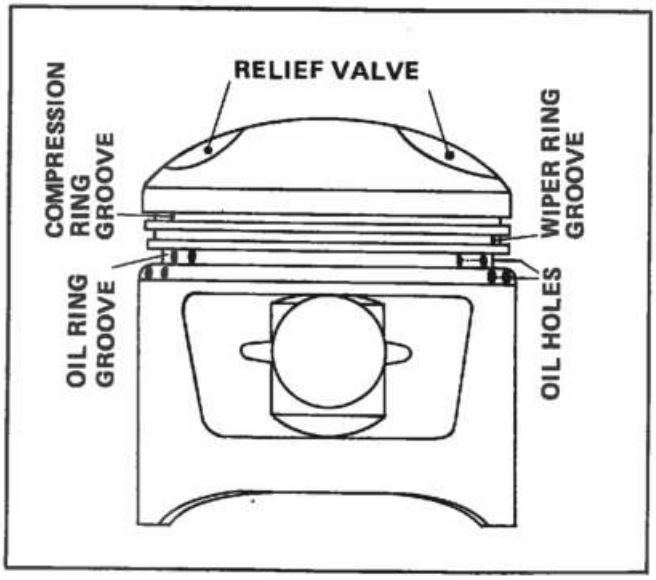
Note:

The hone should be used in a low rpm. drill and the hone should be moved through the entire bore at an even speed. This should result in a "crosshatch" pattern which aids ring seating.

C. Piston

The piston crown is domed. It also has two relief areas for valve head clearance during engine operation. The relief areas are unequal in size since the intake valve is larger than the exhaust valve. An arrow is stamped on the crown to indicate piston position for installation. The piston should be installed with the arrow pointing forward.

Oil drain holes have been drilled in the oil scraper ring groove and in the piston wall just beneath the bottom groove. This provides an escape path for oil scraped off the cylinder wall. It also provides a path for lubrication of the piston pin and bearing.



D. Piston Removal

1. Remove the outer circlip from each piston. Support the piston by hand and push out the piston pin using a soft drift (do not use a hammer). Lift the piston off and set it to one side with the piston pin and needle bearing.



2. Each piston must be marked as to which cylinder it came from to ensure identical match-up during re-installation. Lightly scribe an "L" inside the left piston skirt and an "R" inside the right piston skirt.

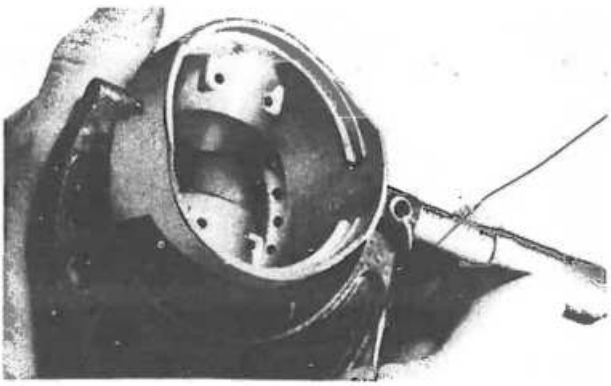


E. Piston Wear

1. First, check the piston for cracked or broken sections, including the crown, ring lands, and skirt. Also check the piston crown for possible metal disintegration due to excessive heat in the combustion chamber.
2. If severe score marks are found on the skirt, this can be attributed to insufficient lubrication sometime during engine operation or improper clearance. If these marks can be removed with fine emery cloth the piston can be used again.
3. All of the above wear conditions may require piston replacement (except as noted). If a defective piston is reinstalled, the engine will not perform satisfactorily and premature engine failure may occur.
4. Check for additional wear by measuring piston diameter 0.75 in. (20 mm.) from the bottom of the skirt and at right angles to the piston pin holes. Piston standard size is 2.95 ins. (75 mm.).
5. Standard piston wear usually does not exceed 0.2 mm. This measurement is important when determining piston-to-cylinder clearance.



Piston size mark



Measuring maximum piston diameter

F. Piston Clearance

1. Piston-to-bore clearance is the difference between minimum cylinder bore measurement and maximum piston diameter. Standard clearance is 0.0020 in. – 0.0022 in. (0.050 – 0.055 mm.). If measurements prove that the clearance equals 0.10 mm. or more, it is excessive, and one of two corrective measures must be taken to bring the clearance back within tolerances.
2. If cylinder taper is within tolerances, and if the cylinder can be cleaned up by honing, then obtain a larger size standard piston that is large enough to obtain the correct clearance.
3. Bore and hone out the cylinder to the size of a first oversize piston, plus the correct clearance.
4. How to Calculate Standard Size Piston-to-Cylinder Clearance from Stamped Numbers
   Nominal piston standard size is 75 mm. The number stamped on the piston crown is the actual size. (The 74 is dropped.)

Example:

0.956 on crown really means 74.954 mm. piston diameter, or 0.046 mm. undersize.
Cylinder standard bore size is marked in large numbers on the very bottom of the cylinder. It equals 75 mm. plus the amount marked.

Example:

0.007 marked on cylinder really means 75.007 mm. cylinder bore, or 0.007 mm oversize.
If the above piston is used with this cylinder, total clearance would be 0.0021 in. (0.053 mm.).

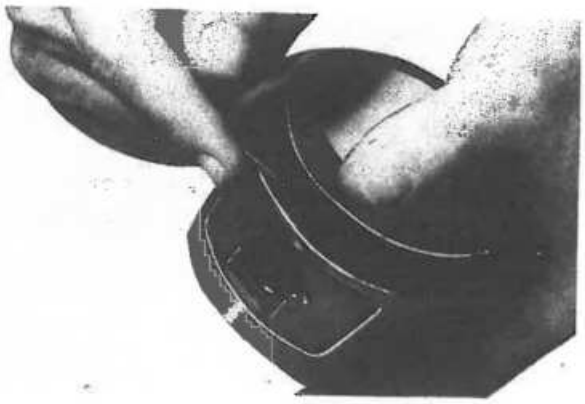
Example:

75.007 mm. (Cylinder)
–74.954 mm. (Piston)

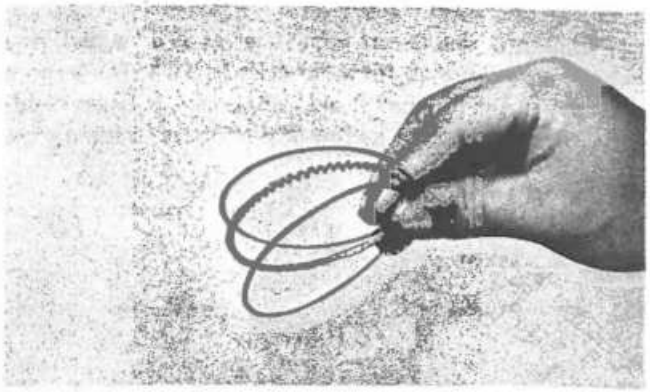
0.053 mm. (Clearance)

G. Cleaning Piston Ring Grooves

1. Carbon and varnish gradually build up in the ring grooves. Remove the rings and use the blunt end of a discarded ring to clean all carbon from the grooves. The oil ring (bottom) should not require this procedure. Check to make sure the oil relief holes are not blocked.



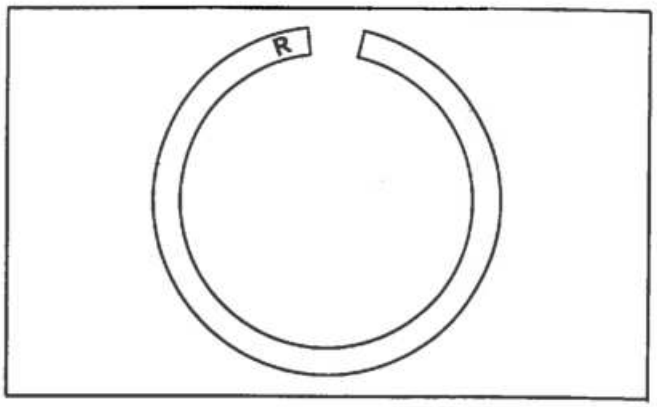
H. Piston Ring Removal and Installation



The piston is equipped with three rings. Remove them in sequence, starting with the top ring. Installation of these rings is basically a reversal of the above process, except for the bottom (oil control) ring.

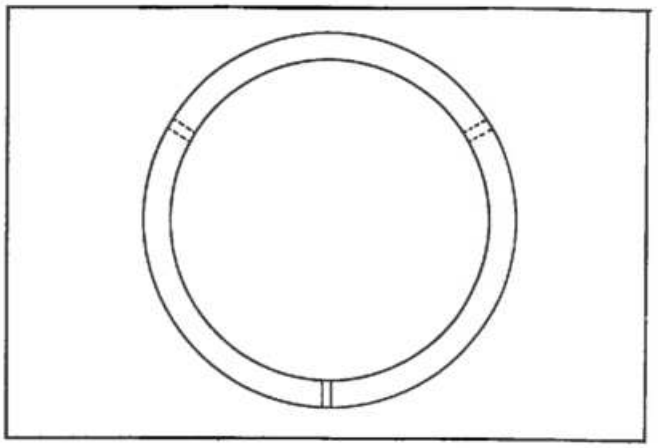
1. Oil control Ring Installation (Installed first):
   The oil control ring consists of three separate parts, two identical rails and one expanding spacer. First, slip the spacer over the piston, and into the bottom groove. Neither rail has a particular top side. So install one rail into the bottom part of the groove and then position the last rail, either side up, into the top part of the groove. Finally, position the three end gaps approximately 120° from each other.

2. Middle and Top Ring Installation:
   Install the middle ring and top ring. Each ring is stamped with an "R" on one side that must face up toward the piston crown when installed.



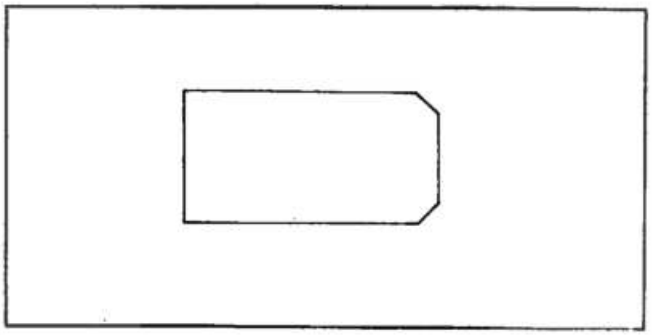
3. Spacing of All Ring End Gaps:
   All ring end gaps must be off-set from one another to prevent the leakage of compression and oil.
   Stagger their positions evenly around the perimeter of the piston.

Note:
The oil control ring has three gaps. Use the top rail's gap to judge where the compression and wiper ring gaps should be aligned.

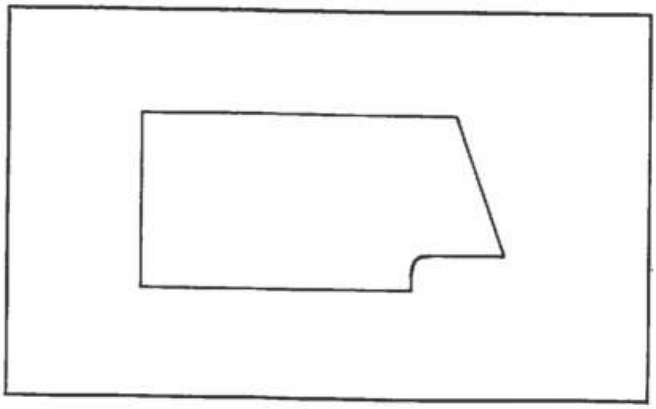


I. Piston Ring Description

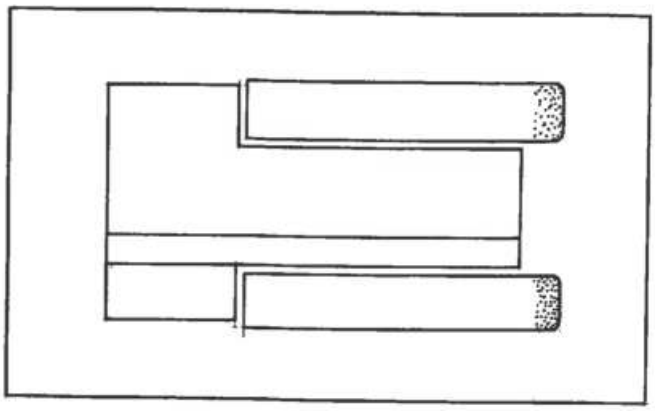
1. Top ring:
   This is the compression ring. It must provide efficient sealing and must be able to withstand the greatest amount of heat. The outer edge is chrome-plated for wear and heat resistance. Both outer edges of this ring are beveled (see the drawing of ring cross-sectional view) to provide a good compression sealing edge.



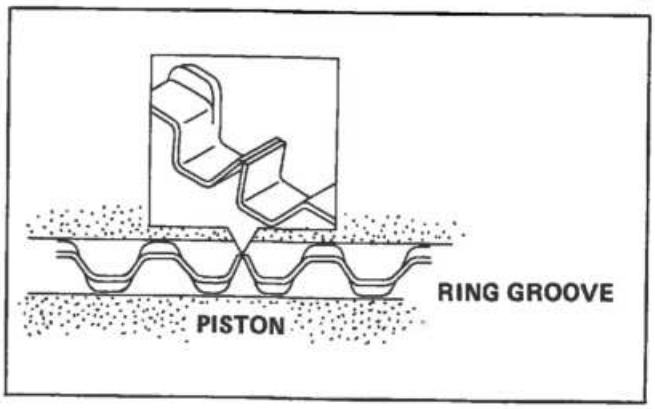
2. Middle ring:
This second ring is cast iron. It serves as a "wiper" ring to scrape excess oil from the cylinder wall. The bottom of the ring is notched to aid this process. It flexes slightly, which provides a narrow and effective scraping edge.



3. Bottom ring:
This ring's purpose is to trap and remove oil from the cylinder wall. The ring consists of three separate components: top and bottom spring steel rails, and a stainless steel wave type expanding spacer. Oil is trapped between the two rails and is forced out the holes drilled in the piston ring groove. The rail outer edge is chrome-plated to resist wear.



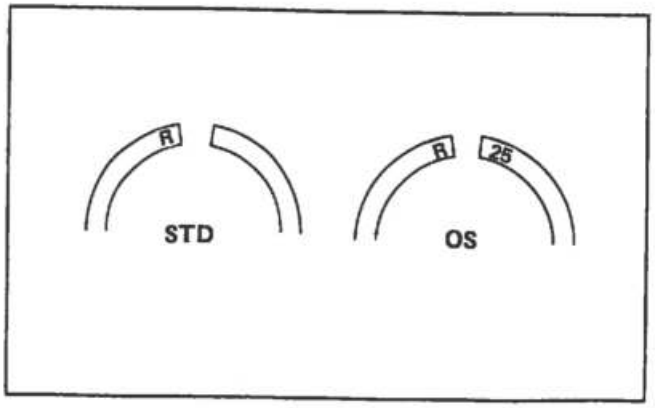
4. The expander spacer, because of its design, pushes both rails against the ring groove sides. In addition, the spacer is equipped with a projecting inner lip that pushes both rails out, creating an excellent oil trapping action.



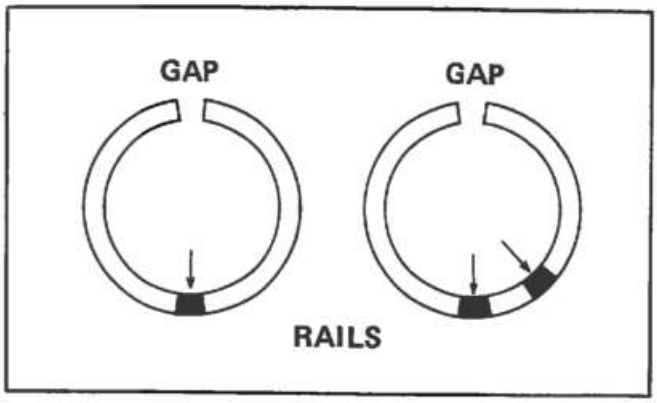
J Piston Ring (standard and oversize) Identification Code

1. The oversize top and middle ring sizes are stamped on top of the ring.

SIZE (mm.)		MARK
Standard		None
Oversize	1st	25
	2nd	50
	3rd	75
	4th	100



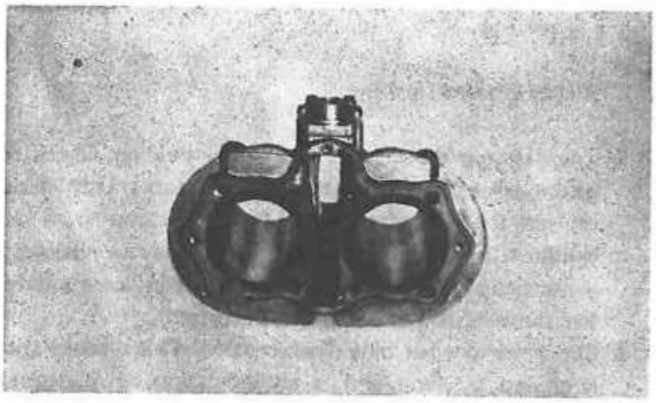
2. All three pieces of the bottom ring (oil control) are color-coded to identify sizes. The color marks are painted on the ring, 180° opposite the end gap (see below).



SIZE		COLOR	
Standard		Blue	(1 mark)
Oversize 1st	25 (0.25 mm.)	Blue	(2 marks)
2nd	50 (0.50 mm.)	Red	(1 mark)
3rd	75 (0.75 mm.)	Red	(2 marks)
4th	100 (1.0 mm.)	Yellow	(1 mark)

K. Piston Ring Wear

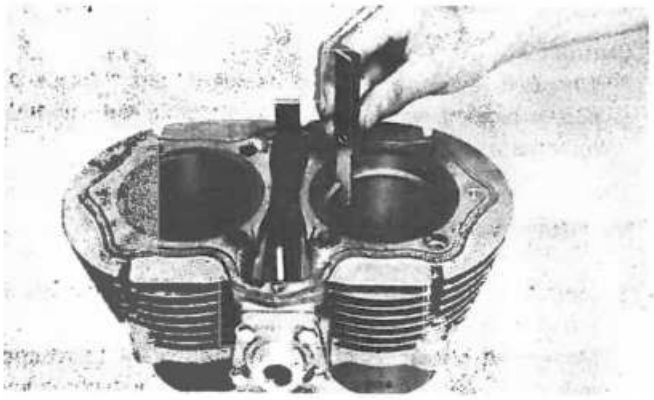
1. All three rings experience the same type of wear. Any check applied to one ring can be used to also test the others.
2. Before checking for wear, clean all carbon from the ring surface. This insures an accurate wear check.
3. Check for gaps between the ring contacting edge and the cylinder wall. Push the ring into the bore (with an inverted piston to make sure it is not cocked). Slip a piece of white paper beneath the cylinder bore (for visual contrast) and check the outer perimeter for visible gaps between the ring and the cylinder wall.



4. With the ring still positioned in the bore, check and gap clearance with a feeler gauge. Standard specifications and maximum wear limits are listed below.

Note:

The end gap on the expander spacer of the oil control ring is unmeasurable. If the oil control ring rail(s) show excessive gap all three components should be replaced.



	Standard Gap (mm.)	Wear Limit
Compression Ring	0.2 – 0.4	0.8
Wiper Ring	0.2 – 0.4	0.8
Oil Control (Rails)	0.3 – 0.6	1.0

5. Piston ring/ring groove fit must have correct clearance. If the piston and ring have already been used in the engine, the ring must be removed, the ring groove cleaned of carbon, and then the ring should be reinstalled. Use a feeler gauge to measure the gap between the ring and the land. The standard tolerance is 0.0016 in. (0.04 mm.) to 0.0032 in. (0.08 mm.). The wear limit is 0.006 in. (0.15 mm.).



6. **Note:** There must be no side gap clearance at all on the oil control ring. If any clearance exists, the expander spacer has become fatigued. Replace the ring.
7. If any of the previous three wear checks prove any of the rings to be worn beyond acceptable tolerances, replace the entire set.

Caution:

Whether the rings are new or used, they must always be checked for correct ring end gap clearances. This applies to all three piston rings.



L. Piston Pin and Bearing

1. The piston pin oscillates in a needle bearing. Check the piston pin surface for needle bearing marks. If any exist, replace the pin and needle bearing. However, a dull finish at the center section of the pin may be noticed. It is normal operating wear and does not indicate a defective pin (unless this dull surface is pitted).
2. Check the pin for blue discoloration. This discoloration is caused by heat and is an indication of inadequate lubrication. The pin should be replaced and the lubrication system checked.

Caution:

Whenever the piston pin is replaced, also replace the needle bearing and check the connecting rod small end for wear which might require rod replacement.

M. Piston Installation

1. Lubricate the needle bearings with oil prior to piston installation.
2. Mount the piston (rings installed) onto the connecting rods. Be sure the arrow stamped on the piston crown points forward. Also make sure that the left piston (already marked during removal) is fitted to the left-hand connecting rod. This guarantees that all previous clearances remain unchanged unless new parts are installed or cylinder work is done.

Note:

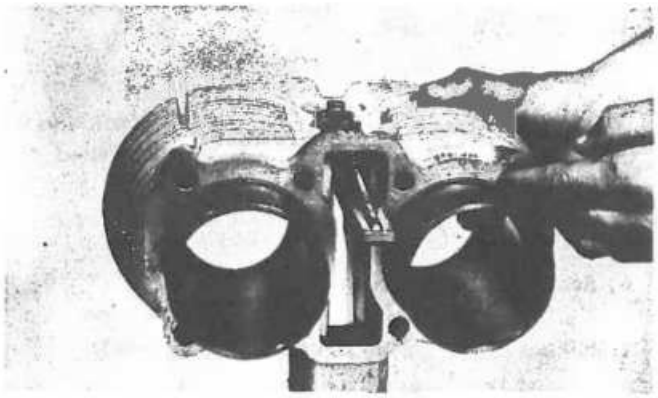
The piston pin should be a thumb-press fit into the piston. After the pin has been installed, lock it in place with two new circlips. Never use old circlips.

N. Cylinder Installation

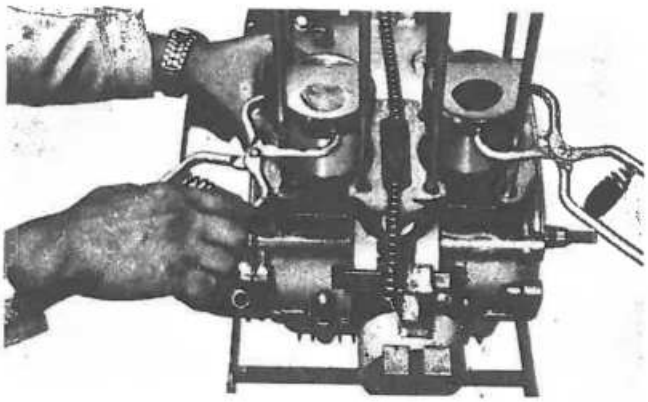
1. Make sure the crankcase and cylinder bottom matching surface are clean, then install a new base gasket.



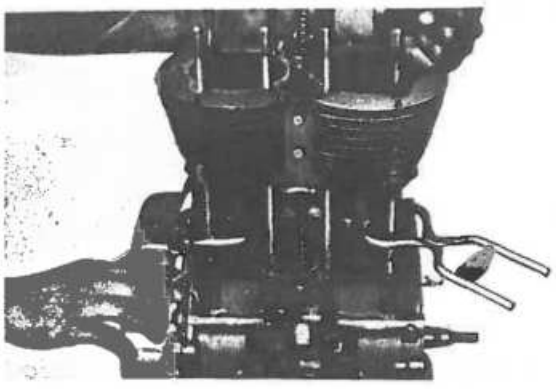
2. Check to see that the cylinder base O-rings are in place. Replace as necessary to avoid oil leakage.



3. Slip a piston support plate (found in Special Tool Kit) under each piston skirt. This prevents the pistons from being pushed down during cylinder installation. Place a rag under each base special tool to protect the new gasket.



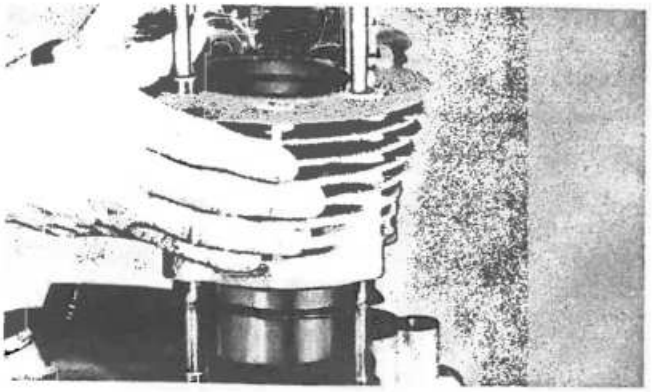
4. Lubricate the piston wrist pin bearing, and rings. Position and tighten the ring compressors (found in Special Tool Kit) so the rings can slip up into the cylinder without catching on the bottom of the cylinder. Lubricate both bores. Slip the cylinder down over the studs until it slips over the pistons and rests on the ring compressors.



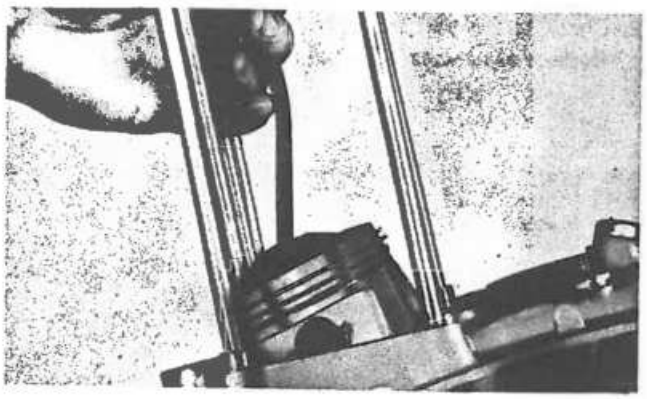
5. Rotate the crankshaft so that the pistons slide up into the bores. Remove the ring compressors and piston bases, then push the cylinder down until it butts against the crankcase.

Note:

All parts should be well lubricated during assembly. When a newly rebuilt engine is started for the first time the oil supply passages will be empty and there will be a short period when no oil is delivered to various parts. It is a good idea to kick the engine over several times prior to starting to fill these passages.



3-8. CRANKCASES

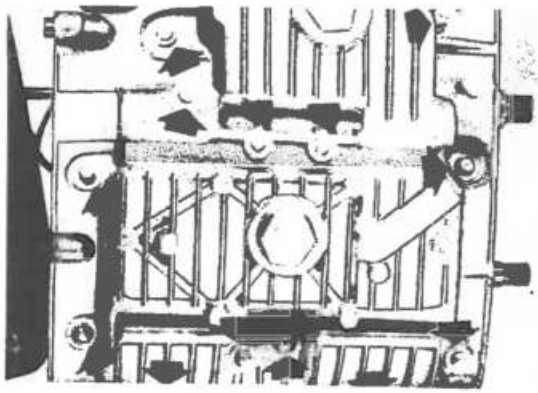


The 650 series unit construction crankcase contains the transmission, crankshaft, oil sump, and associated parts such as oil strainer (in crankcase sump), etc.

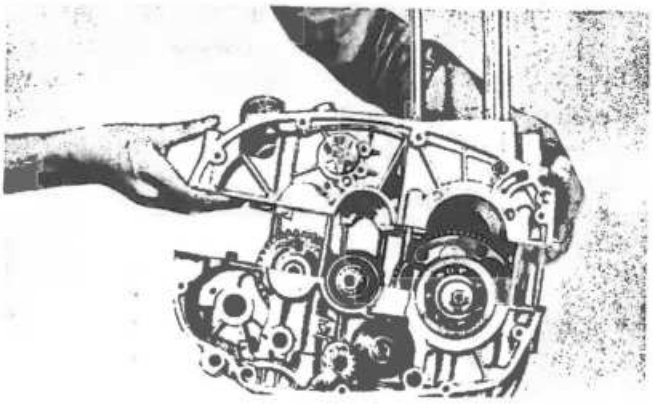
A. Separating Crankcases

1. Pull out the cam chain (if not already removed).

2. Loosen and remove all case securing bolts located on the bottom of the case plus the case bolts around the dip stick on top. Start with #18 and loosen each bolt to #1. Loosen each bolt ¼ turn at a time to avoid case warpage. Start with #18 and loosen each bolt to #1. (Numbers are stamped on the case next to each nut.

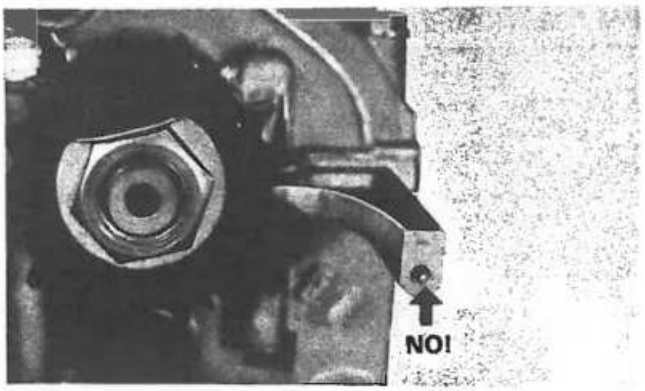


3. Separate the cases by lifting the top case. It might be necessary to tap the top case loose with a rubber hammer.

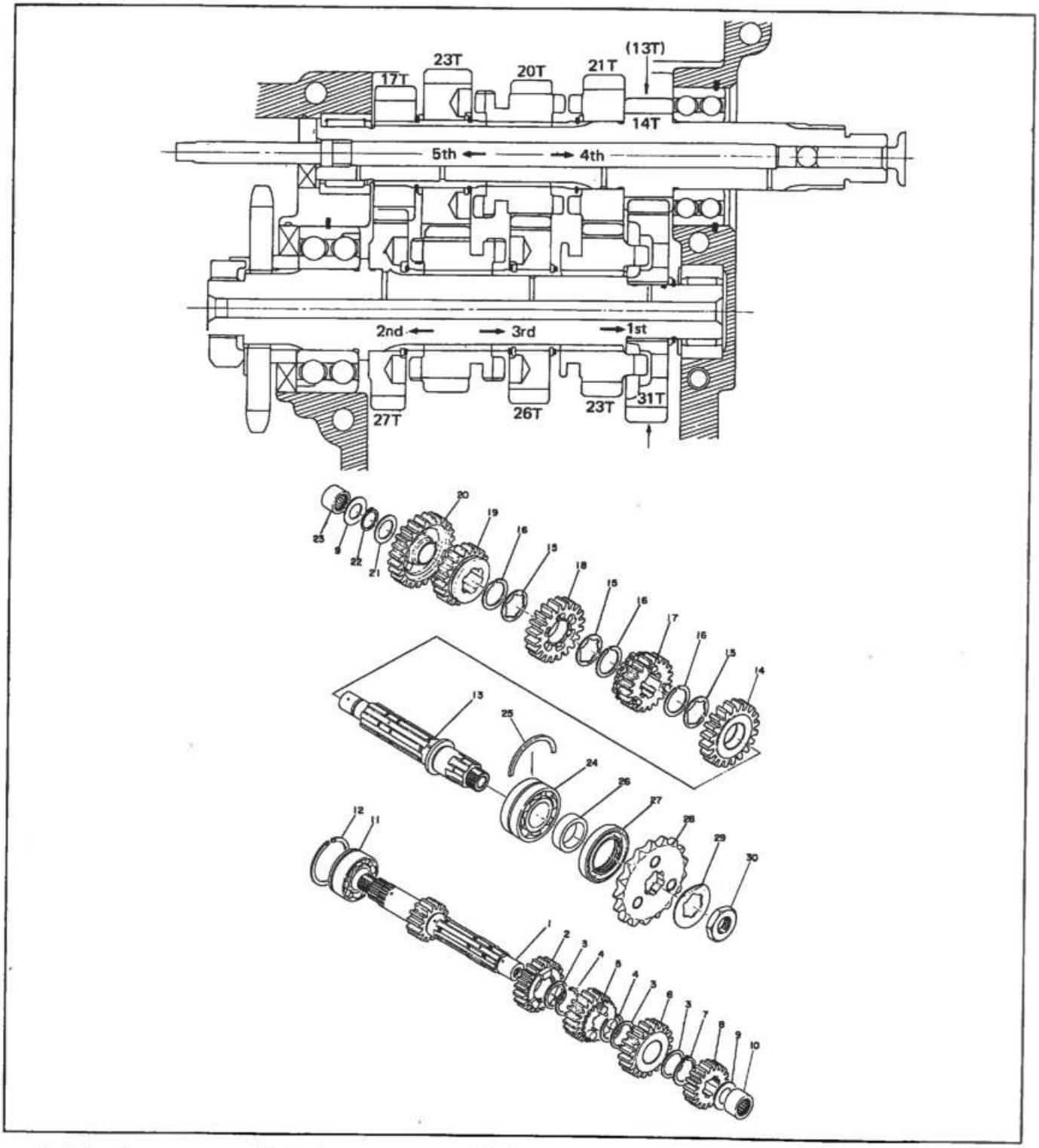


Caution:

Do not hammer on the case cover mounting flange; it could easily break off.



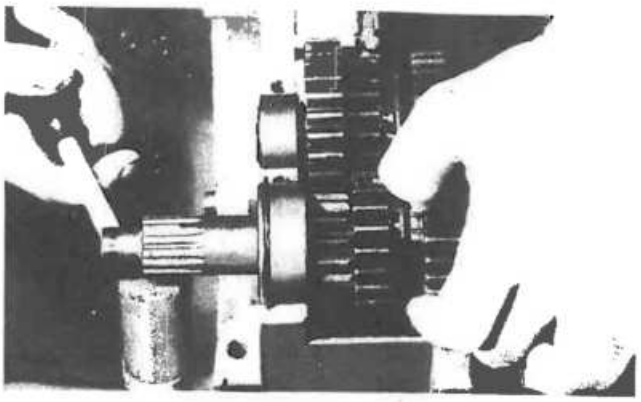
3-9. TRANSMISSION



1. Main axle
2. 4th pinion gear
3. Gear hold washer 5
4. Circlip
5. 3rd pinion gear
6. 5th pinion gear
7. Circlip
8. 2nd pinion gear
9. Drive axle shim
10. Bearing
11. Bearing
12. Circlip
13. Drive axle
14. 2nd wheel gear
15. Gear hold washer 3
16. Circlip
17. 5th wheel gear
18. 3rd wheel gear
19. 4th wheel gear
20. 1st wheel gear
21. Gear hold washer
22. Circlip
23. Bearing
24. Bearing
25. Circlip
26. Distance collar
27. Oil seal
28. Drive sprocket
29. Lock washer
30. Lock nut

A. Transmission Removal

1. Tap lightly with a rubber hammer to loosen the transmission, then lift it out.

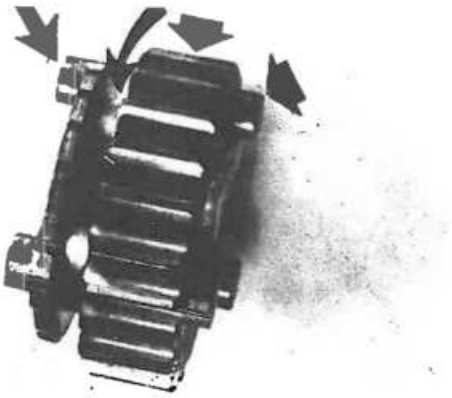


2. Check the gears for chipped teeth.
   Check engagement dogs and slots for rounded edges. Check the sliding gear fork grooves for a blue discoloration. If any of the above mentioned conditions are obviously noticeable, replace the gear(s).

Note:

Especially in the case of damaged engagement dogs, check the mating gear for damage or excessive wear. It is sometimes necessary to replace the parts as a set.

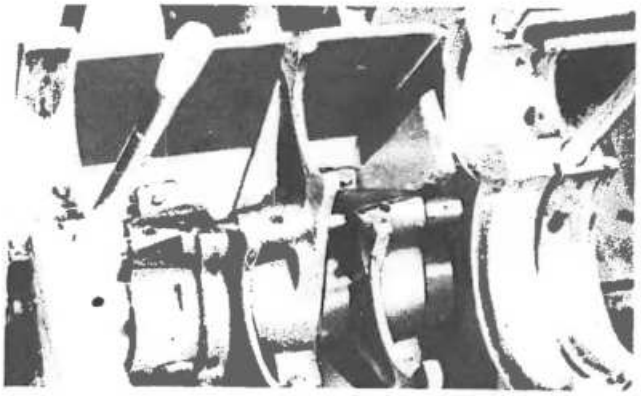
If any circlip has been removed several times, it should be replaced by a new one.



Gear wear points

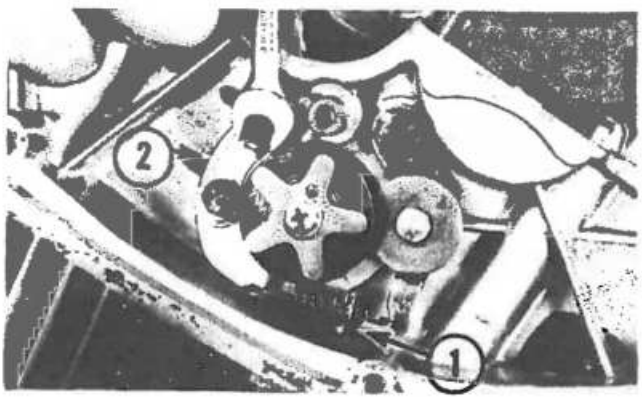
B. Shift Drum Assembly

1. By turning the shift cam with the shift fork, check to see whether the shift fork moves smoothly or not.
   If not, check the guide bar for bends, or check the shift cam groove for scratches.



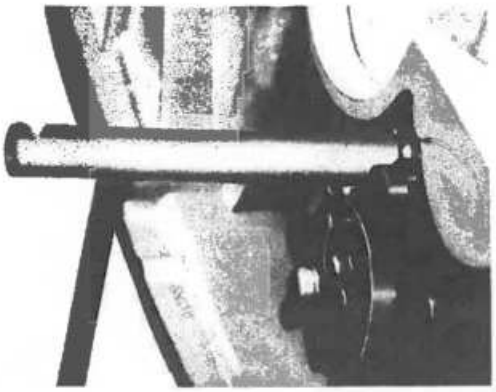
Shift forks and drum in position

On the exterior section of the right-hand case is the shift drum stopper. Release the stopper spring (#1) and remove the stopper unit. Bend the lock tabs down on the locating plate bolts and remove the plate (#2).

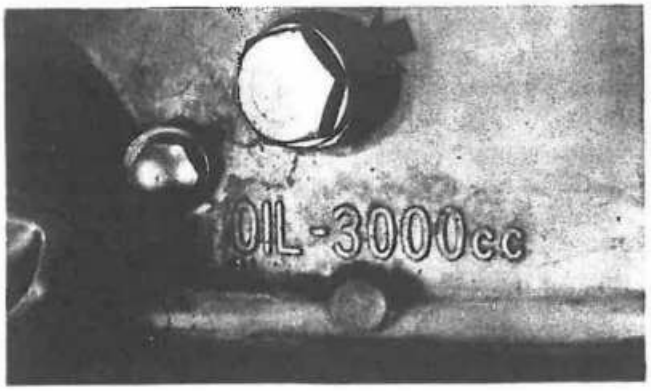


a) Fork Guide Bar Removal and Installation
The fork guide bar is held in place by the shift drum stopper plate. With the plate removed, the bar can be pulled out.

Caution:
Note that the stopper plate has a locking tab to secure the two bolts holding the plate in place. During reassembly, always make sure the locking tabs are bent up firmly around the securing bolt heads.

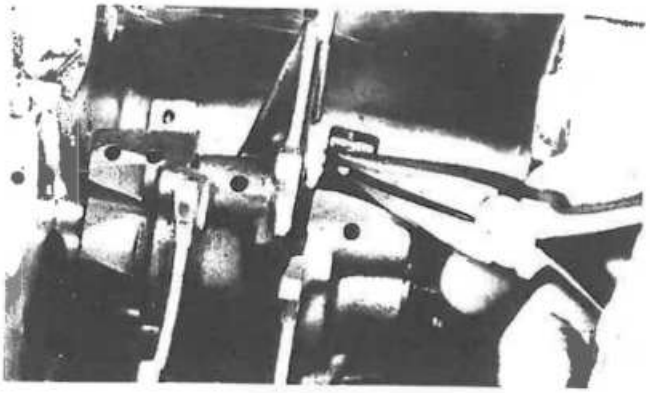


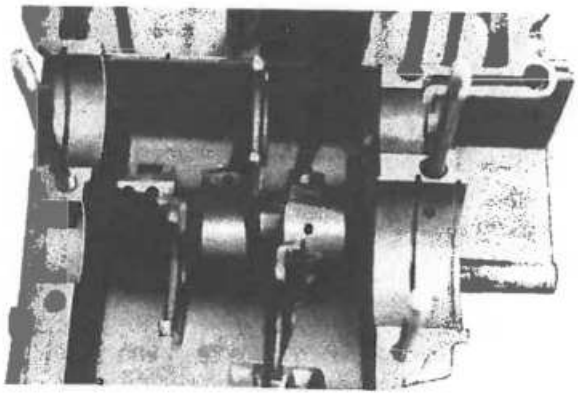
2. Check the guide bar for alignment. Roll it over a surface plate and check for bends. If it is bent, replace it.
3. Shift Drum Removal
Remove the neutral detent unit.



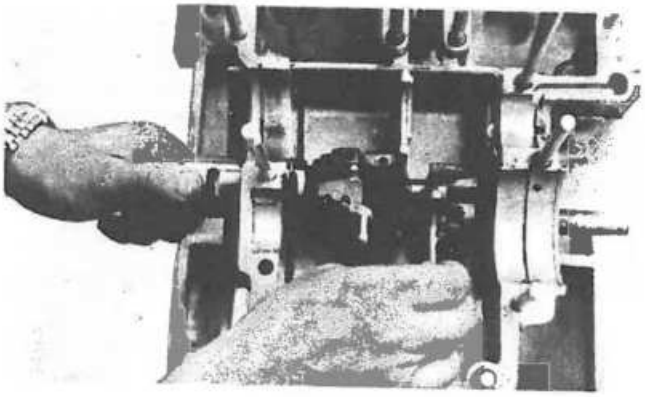


4. A cam follower pin mounted in each fork is held in place by cotter pin and cam follower roller.

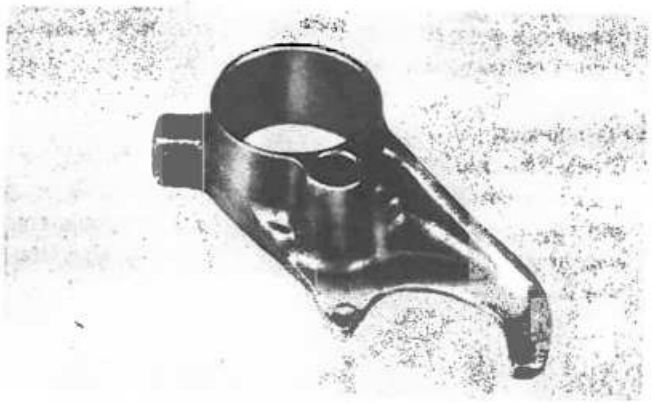




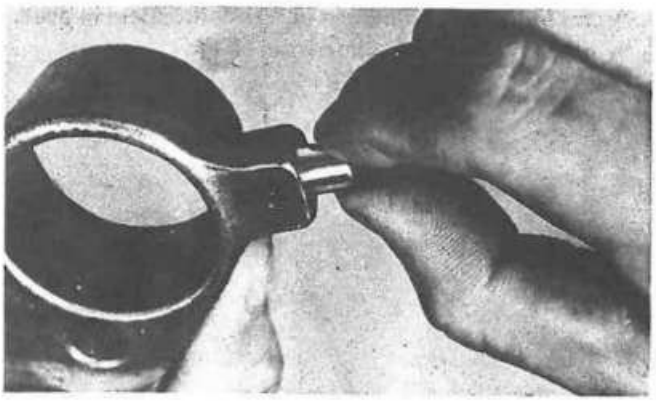
5. Pull out the shift drum and remove all three shift forks from the case. Take care, when removing the shift drum to catch all three cam follower rollers that rest in the grooves in the drum.



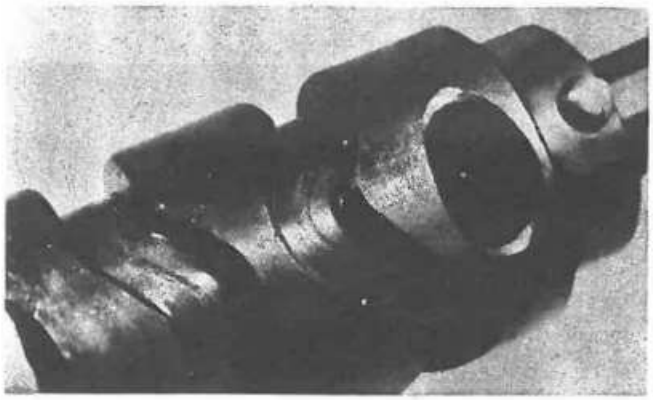
6. Checking the shift fork
   a) Check the ends of fork for seizure (due to friction), scratches and twists. If faulty, replace the fork.



b) Insert the cam follower pin into the hole in shift fork, and check the wear of hole by moving the pin.
If the gap between the pin and hole measures more than 0.039 in. (1 mm.), replace both pin and fork.

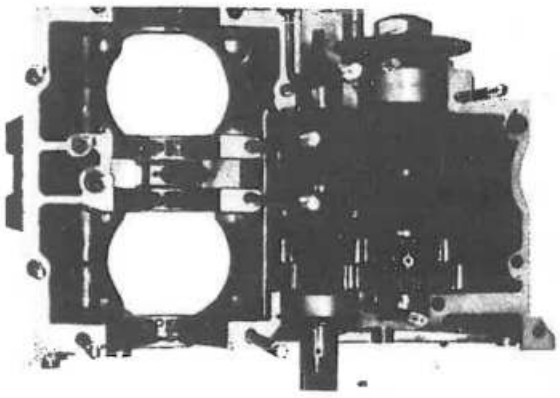


7. Checking the shift cam
If the shift cam groove is worn excessively or scratched, the cam follower pin does not move smoothly, thus impairing gear shifting. If the pin does not move due to scratches in the shift cam groove, replace the shift cam.
8. Shift Drum and Shift Fork Installation:
Installation of this unit is a reversal of the previous steps. Be sure to lubricate the shift drum and forks before installation. When installing the cam follower pin, always use new cotter pins. After bending the cotter pins, make sure the bent pin ends do not drag. Check for smooth fork movement on the shift drum after assembly.
9. When installing the cam follower pins, the one located in the center should be installed first.

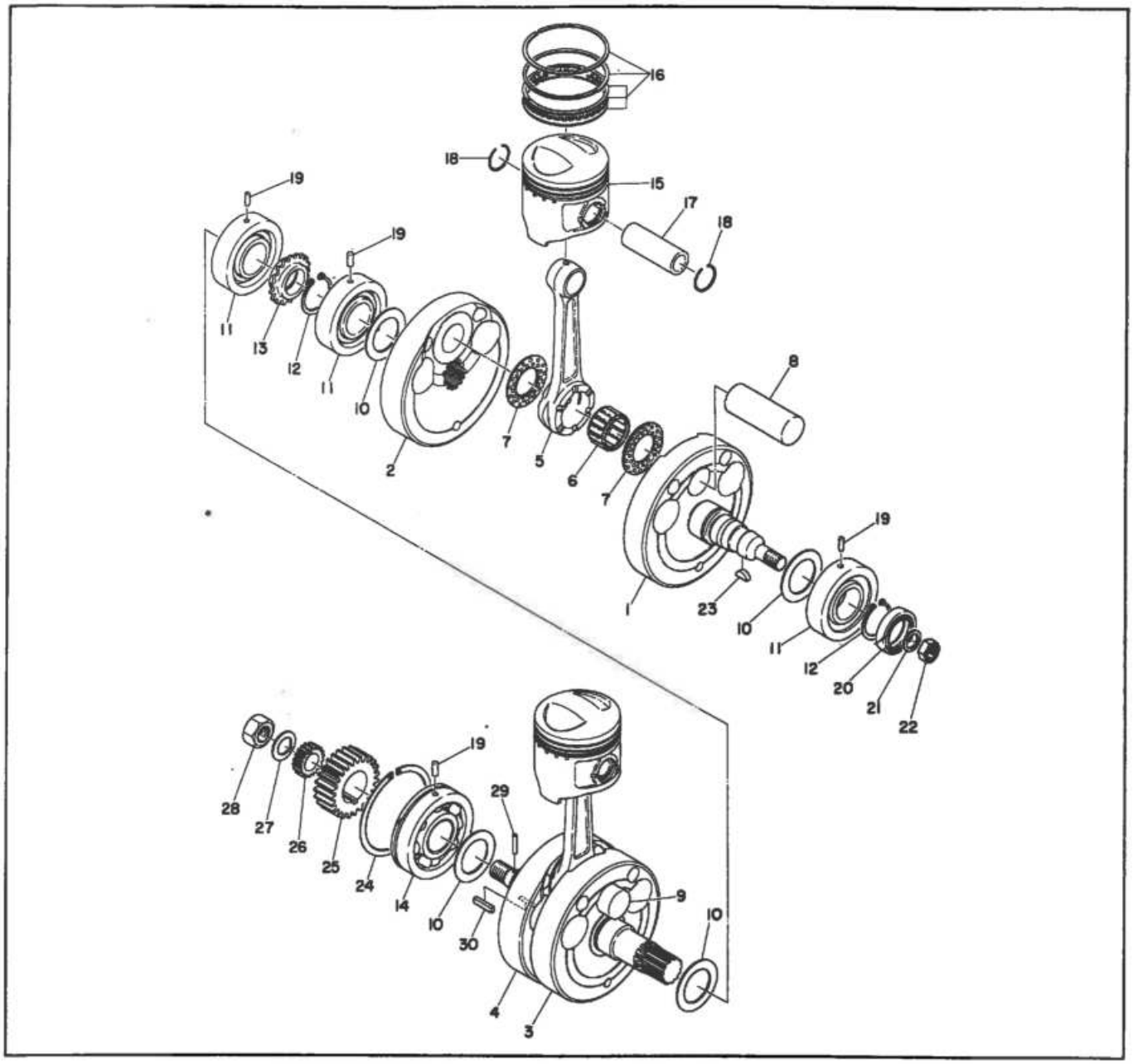


10. Pay particular attention to the direction and order of fork installation. Fifth gear wheel shift fork has a clearance notch machined into one side to allow clearance for the neutral light button. Fourth gear wheel shift fork is also notched on one side to provide clearance for the neutral position stopper. If these shift forks are incorrectly installed, the neutral stopper and neutral light button will not fit into position.
11. Installation
With both shafts assembled, including all bearings and seals, fit the transmission into the TOP CASE. This permits the shift forks to slip over the sliding gears easily. Be sure both transmission shaft circlips are fitted to the bearings and the circlips have been positioned in the circlip grooves.

Note:
Transmission installation is easier if the shift drum is rotated to the neutral position.



Very Important
Check for smooth and complete shifting through all gears after installing the shift drum, shift fork, guide bar, and transmission. At the same time check for complete engagement of all engaging dogs into the appropriate gear slots.



1. Crank 1 (left)
2. Crank 1 (right)
3. Crank 2 (left)
4. Crank 2 (right)
5. Connecting rod
6. Con-rod big end bearing
7. Crank pin washer
8. Crank pin
9. Crank pin
10. Crank shim
11. Bearing
12. Circlip
13. Cam chain sprocket
14. Bearing
15. Piston
16. Piston ring set
17. Piston pin
18. Piston pin clip
19. Dowel pin
20. Oil seal
21. Spring washer
22. Crank shaft nut 2
23. Woodruff key
24. Circlip
25. Primary drive gear
26. Drive gear
27. Spring washer
28. Crank shaft nut 1
29. Dowel pin
30. Woodruff key

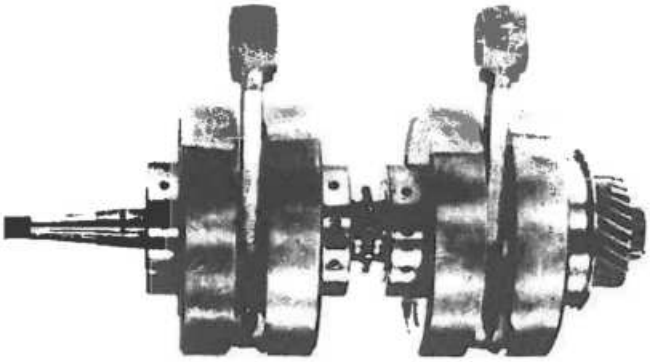
Note:

Unless the roller main bearings are to be replaced, do not remove them from the crankshaft as the aluminum roller cage can be damaged. The crankshaft can be disassembled with bearings in place; just remove the outer race to provide pressing clearance.

If removing the bearings, use a guillotine type bearing puller.

C. Crankshaft

The crankshaft is built up of pressed together parts. It has four full circle crank wheels. The entire unit runs in four main bearings, three rollers and one ball bearing (the ball bearing is the outer right-hand bearing). The rods run parallel (360° crank) on needle bearings over hollow center crank pins. The left and right crank halves are pressed together with the cam chain drive sprocket between the halves.



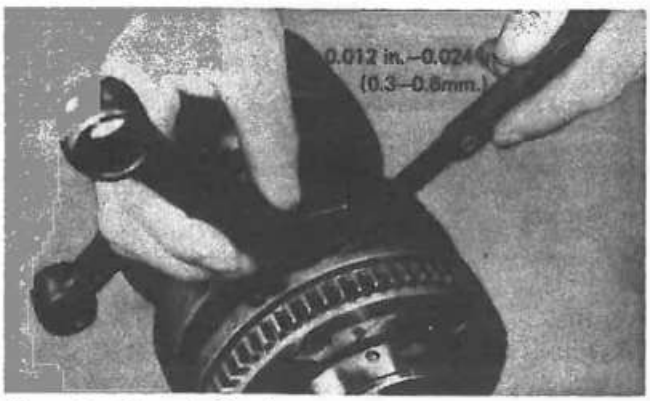
Completely assembled crankshaft

1. Crankshaft removal:
   Tap the crankshaft with a rubber hammer to loosen it, then lift it out.
2. Crankshaft main bearing wear
   Though the crankshaft main bearings are heavy duty and will withstand much abuse, they should still be checked for wear.
3. Clean the bearing in solvent and dry it with air. Visually inspect all friction surfaces for obvious pits, scratches, chatter marks, or rust. Any of these bearing conditions that are bad enough to be readily seen should be sufficient cause for bearing replacement.
4. Measure connecting rod axial looseness at the small end to determine the amount of wear in the big end (crank pin and big end bearing). Hold the big end stable to prevent it from sliding, then rock the small end.
   Maximum Allowable Tolerance: 2 mm. Small End Play



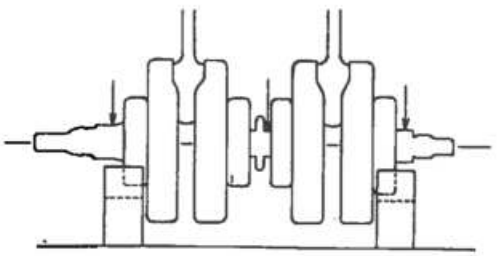
Checking for big end wear

5. If small end side play exceeds 2 mm., disassemble the crankshaft and check the connecting rod, crank pin, and needle bearing for wear. Replace worn parts and recheck small end play. It should measure no more than 1.0 mm. with new parts.
6. Check for correct connecting rod big end side play. Slide the big end to one side and insert a feeler gauge between the crankwheel and rod big end. It should measure between 0.012 in. (0.3 mm.) and 0.024 in. (0.6 mm.). If it exceeds 0.26 in. (0.65 mm.), the connecting rod big end should be closely checked for excessive wear. In addition, total crankshaft width should be measured.



Measuring big end side clearance

7. Check the crankshaft unit for excessive run out. Mount the crankshaft in V-blocks and check for run out using a dial indicator. Run out at all measurement points should not exceed 0.0012 in. (0.03 mm.)



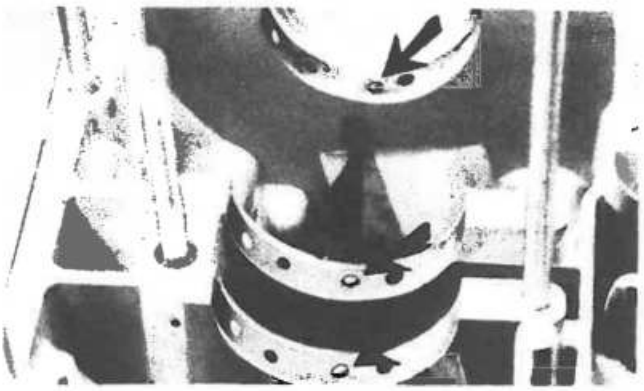
0.0012 in. (0.03 mm.).

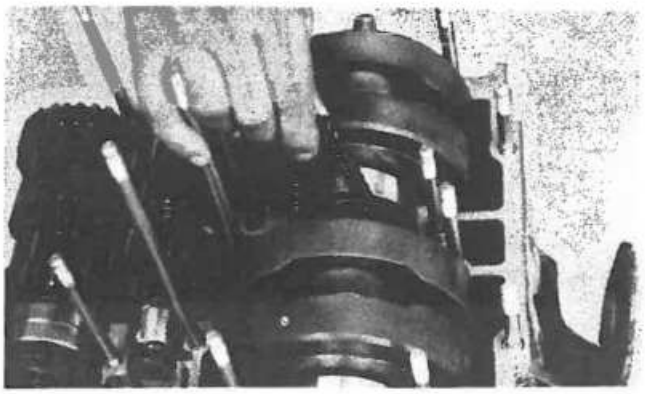
D. Crankshaft Installation (including cam chain)

Note:

Prior to crankshaft installation, make sure the left-hand crank seal is mounted on the crankshaft, teflon lip facing out.

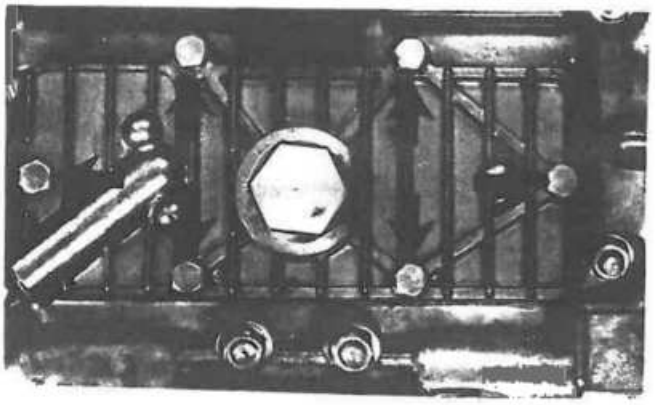
1. Lubricate all crank bearings, then install the crankshaft into the top case. Make sure that each main bearing outer race fits in place over its locating pin in the case. DO NOT STRIKE THE CRANKSHAFT OR MAIN BEARINGS WITH A HAMMER TO SEAT THE CRANKSHAFT but rather fit each bearing over each locating pin and push the crankshaft into position by hand. Each bearing outer race has a punch mark, and lining this mark up with the crankcase mating surface helps the bearing race to fit in the locating pin.
2. Fit the chain over the crankshaft cam sprocket so that it drops into the center slot. Attach safety wire to each end of the cam chain and tie it off to prevent the chain from dropping back into the cases during further engine assembly.





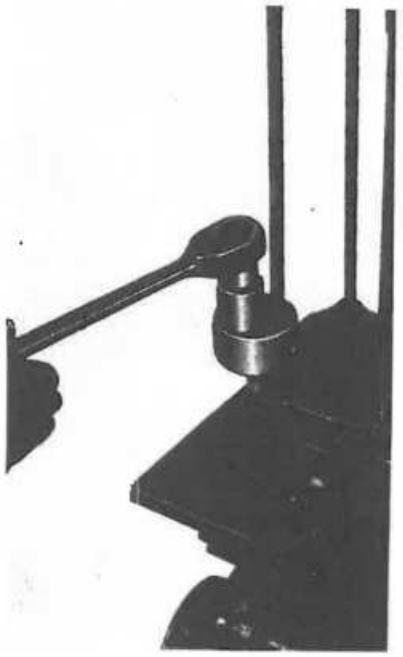
E. Oil Strainer in Bottom Case

1. A wire mesh oil strainer mounts on a removable plate at the bottom of the lower engine case. The strainer can be removed for cleaning. The oil strainer mounting plate is held to the case by six bolts. When the plate is removed the gasket surfaces must be thoroughly cleaned. A new gasket must be used when the plate is installed back on the lower case. Apply Yamaha bond #5 to both gasket surfaces prior to reassembly.

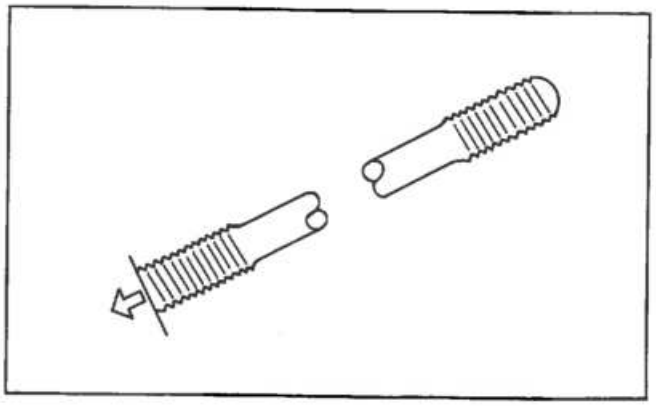


F. Replacing Cylinder Mounting Studs

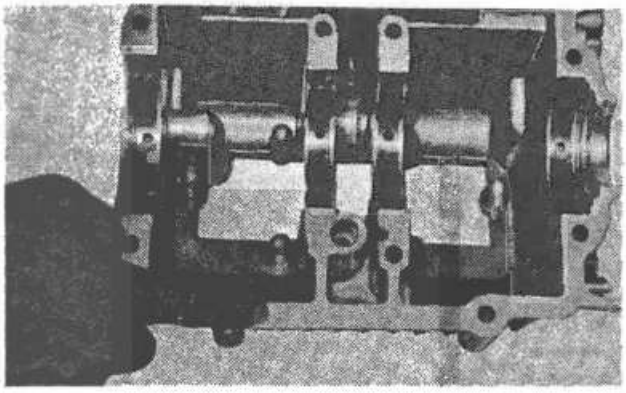
1. The studs are replaceable. They can be removed with a standard stud puller.



2. If a cylinder stud must be replaced, be sure the flat stud is screwed into the case.

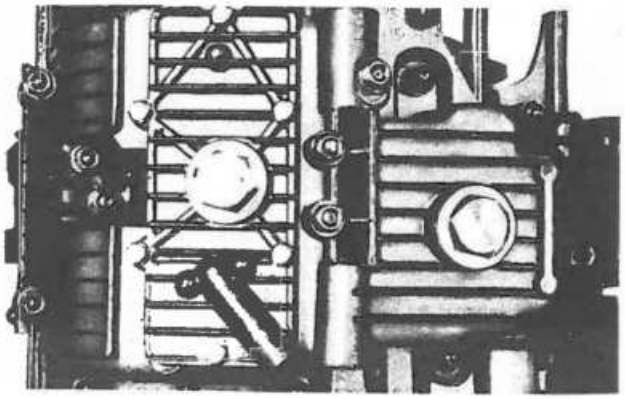


Assembling top and bottom cases:
The shifting mechanism, transmission, and crankshaft have already been installed in the top case. Make sure both case gasket surfaces are clean, then apply Yamaha Bond #4 (non-drying, rubber base sealer) to the gasket surfaces. Slide the cases together.



3. Complete the crankcase assembly by installing and tightening all crankcase securing nuts and bolts to 14 ft/lbs. (2 kg/m.), following the tightening sequence numbers stamped on the case next to each nut. (1 through 18 tighten in 3 gradual stages.)





CHAPTER 4. FUEL SYSTEM

4-1. PETCOCK 86
A. Removal and Installation 86
B. Cleaning 86
4-2. CARBURETOR 86
A. Method of Operation 88
B. Starter System 90
C. Float System 91
D. Idle Circuit 93
E. Mid and High Speed System 94
F. Disassembly and Assembly Procedure 95
G. Adjustments 97

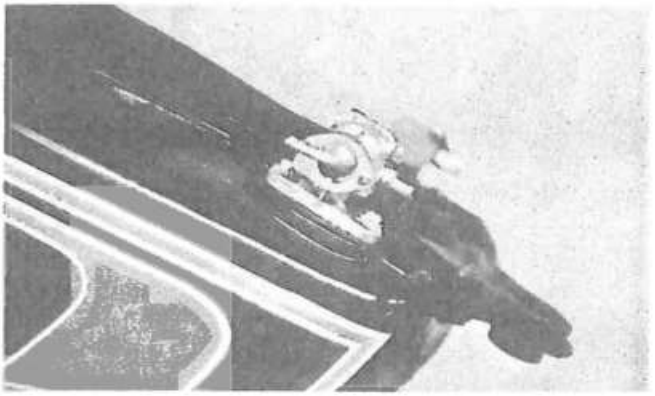
4

The fuel system consists of fuel tank, (petcock with integral filter), fuel delivery lines, and two constant vacuum carburetors. Each section of the fuel system should be checked for possible incorrect operation. Trace for fuel flow from the tank, through the petcock, and through the carburetor. Also check for possible air restrictions or leaks.

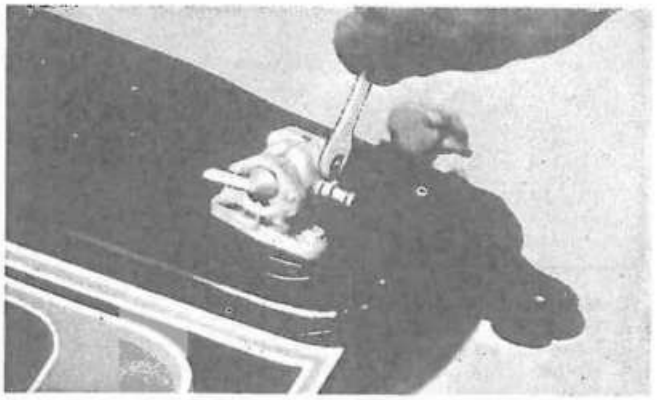
4-1. PETCOCK

A. Removal and Installation

1. The two petcocks are bolted to the rear underside of the fuel tank. Remove the two screws holding each petcock.



2. A neoprene O-ring fitted into a groove in the petcock mating surface seals the petcock to the fuel tank. Check the condition of this O-ring and replace it if it is broken, flattened, or chipped.
3. Petcock installation is accomplished by fitting the O-ring in position and securing the petcock with the two screws.

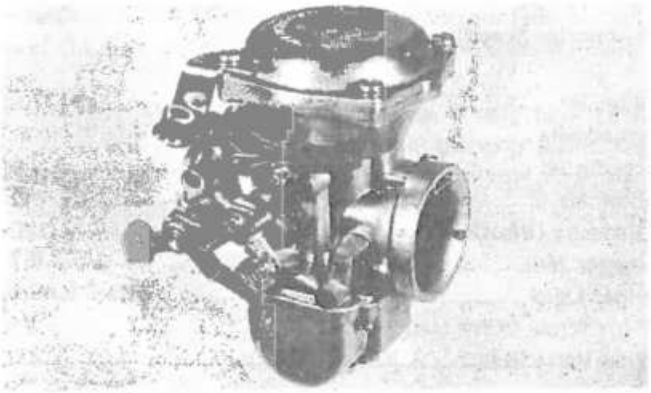


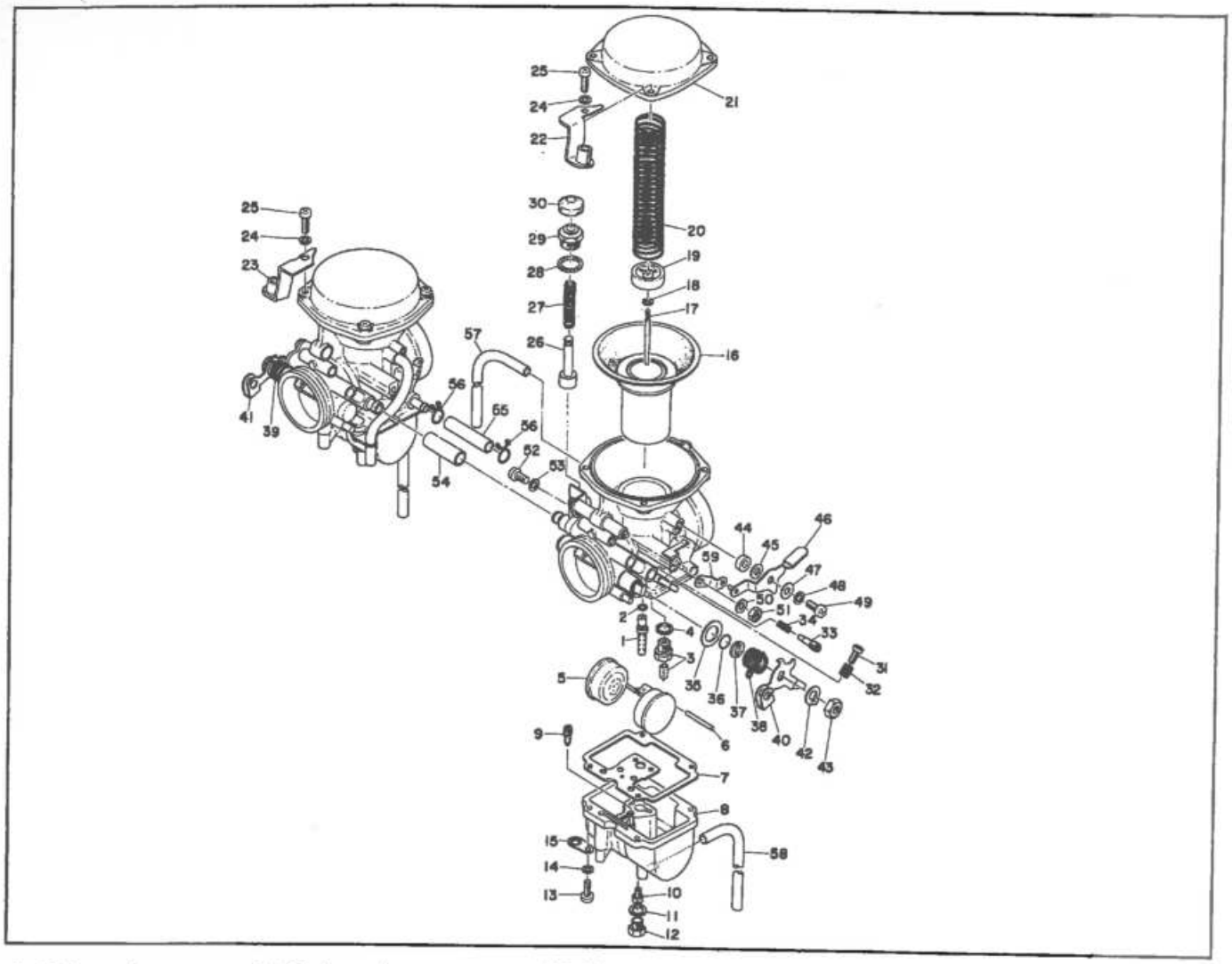
B. Cleaning

1. Sediment from the fuel tank (including water) can collect in the petcock chamber. A bolt beneath the fuel outlet can be removed to drain the petcock chamber. Larger obstructions can be removed by removing the screw-held plate at the opposite side of the fuel outlet.

4-2. CARBURETOR

The XS650B is equipped with two "constant vacuum" carburetors (design is similar in operation to the SU type carburetor) mounted on rubber intake manifolds. Air flow through the venturi is controlled by a throttle slide (vacuum piston). The slide is lifted and lowered by engine vacuum rather than a cable directly linked to the throttle grip.





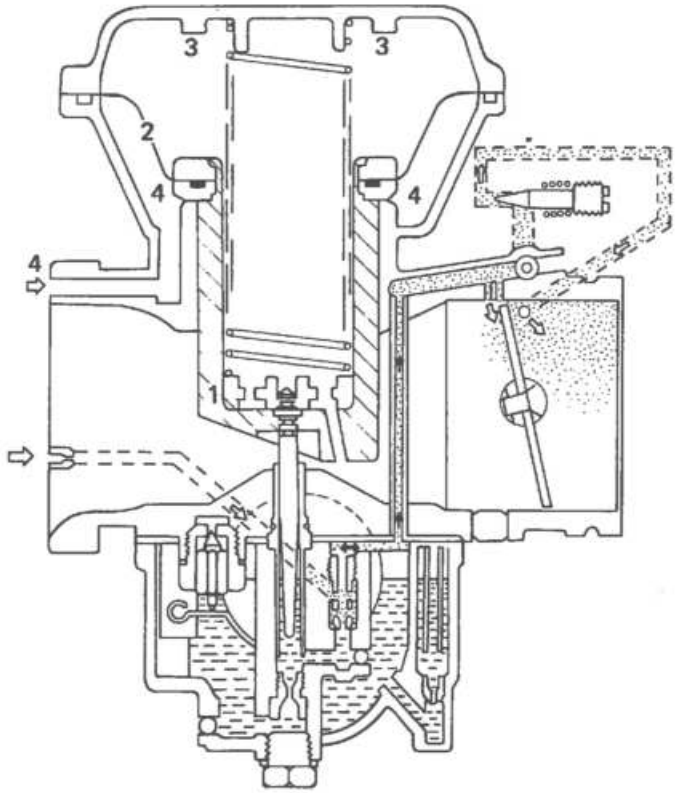
1. Main nozzle
2. O-ring
3. Valve seat ass'y
4. Washer
5. Float
6. Float pin
7. Float chamber packing
8. Float chamber body
9. Pilot jet
10. Main jet
11. Washer
12. Plug screw
13. Panhead screw
14. Spring washer
15. Plate
16. Diaphragm ass'y
17. Needle
18. Clip
19. Set needle plate
20. Diaphragm spring
21. Diaphragm cover
22. Throttle bracket ass'y (left)
23. Throttle bracket ass'y (right)
24. Spring washer
25. Panhead screw
26. Starter plunger
27. Plunger spring
28. Washer
29. Plunger cap
30. Plunger cap cover
31. Throttle stop screw
32. Throttle stop spring
33. Pilot screw
34. Pilot screw spring
35. Washer
36. Seal
37. Spring collar
38. Throttle spring (left)
39. Throttle spring (right)
40. Throttle lever (left)
41. Throttle lever (right)
42. Washer
43. Nut
44. Ring
45. Washer
46. Lever ass'y
47. Washer
48. Spring washer
49. Panhead screw
50. Washer
51. Nut
52. Panhead screw
53. Spring washer
54. Starter connecting pipe
55. Pipe
56. Clip
57. Pipe
58. Pipe
59. Lever

Carburetor Specifications

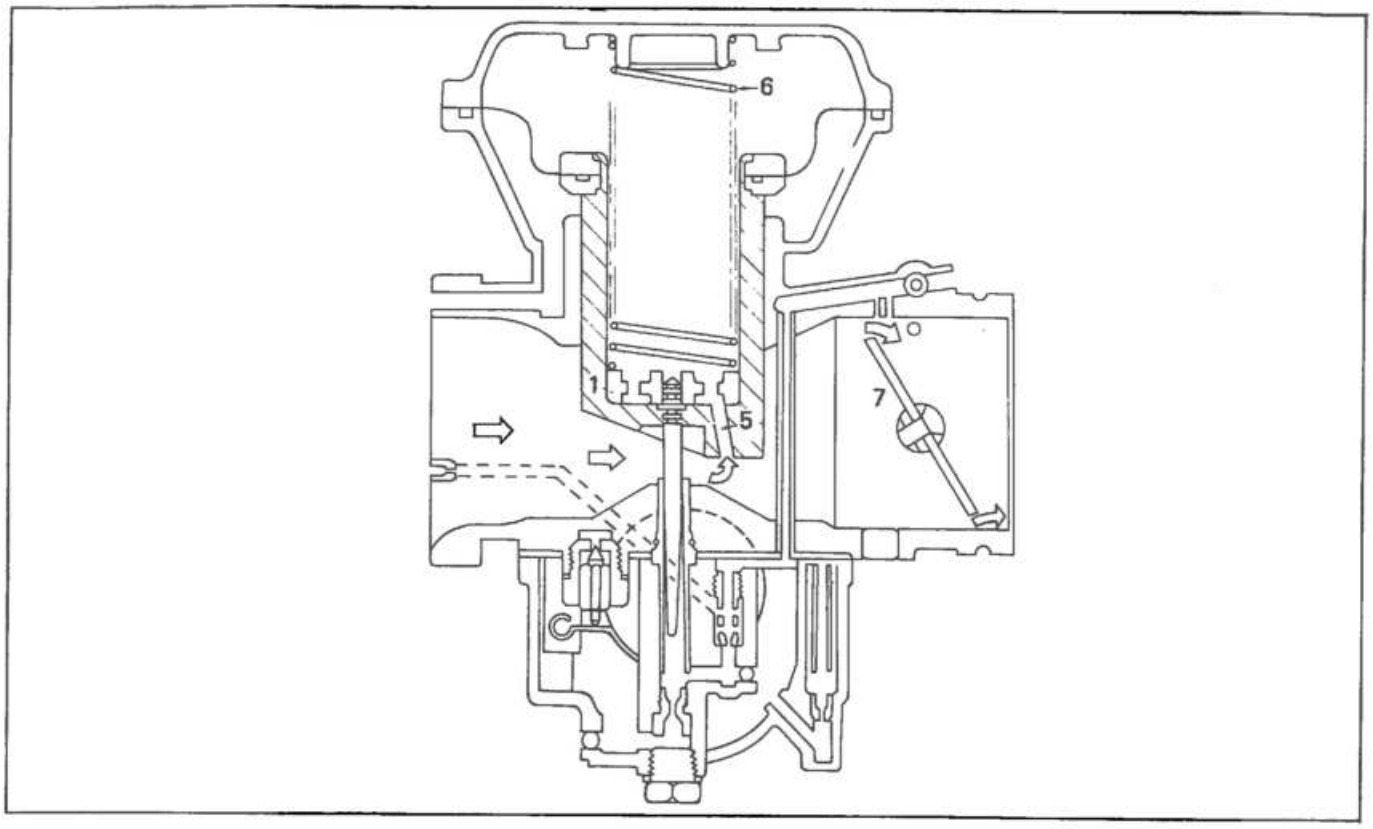
Main Jet	#127.5
Jet Needle	4N08-4th stage.
Needle Jet	Z-6
Pilot Jet	#45
Butterfly (throttle) valve	120
Starter Jet	0.7
Float Level	24 ± 2.5 mm.
Pilot Screw (turns out)	3/4
Fuel Valve Seat	2.5

A. Method of Operation

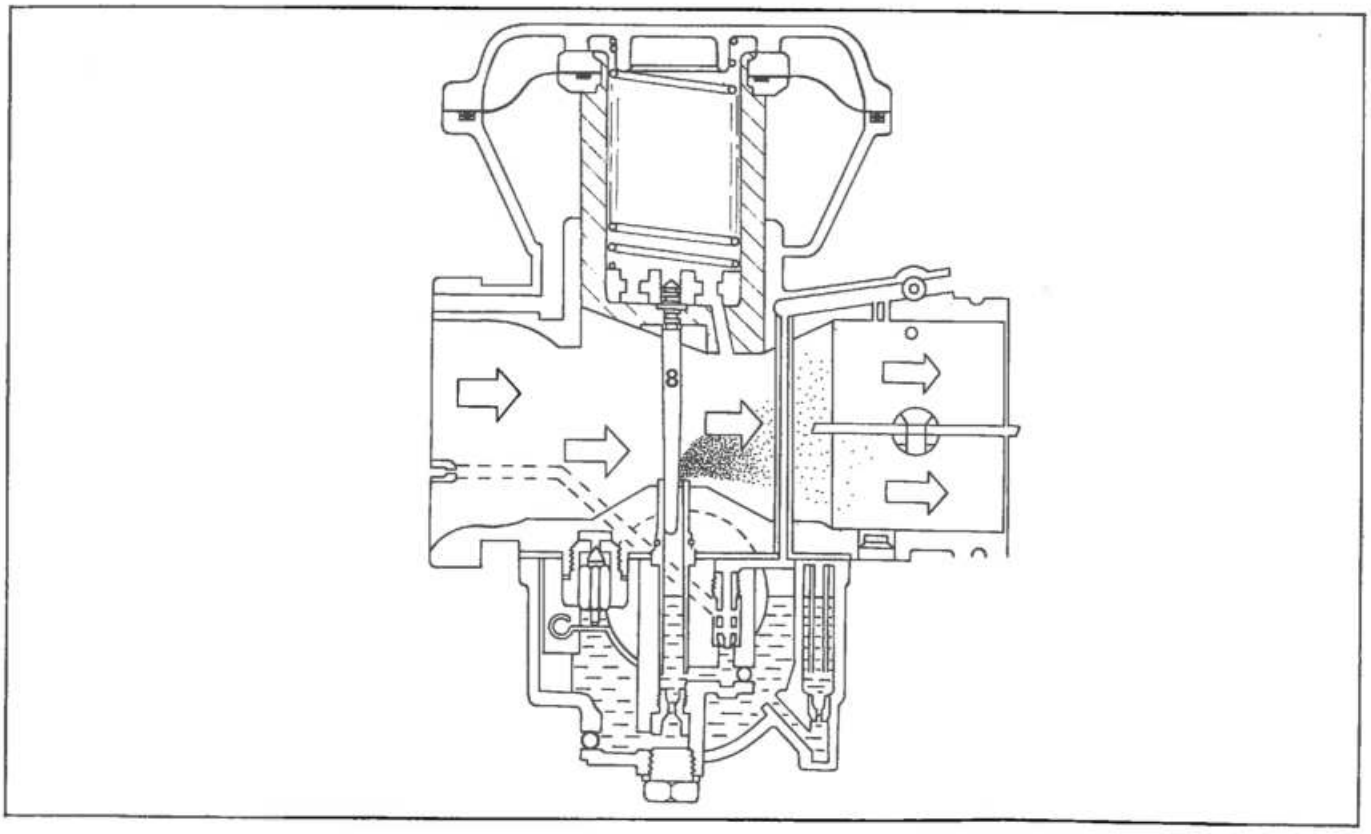
1. Vacuum piston actuation:
   The vacuum piston (#1) is lifted by engine vacuum. A flexible rubber diaphragm (#2) is attached to the piston top and to the piston top and to the housing. This diaphragm divides the top part of the carburetor into a vacuum chamber (#3) above the diaphragm, and an atmospheric pressure chamber (#4) below the diaphragm.



2. Atmospheric air pressure (approximately 15 lbs/in^2) passes through the air passage and occupies the space below the diaphragm. A drilled hole in the vacuum piston (#5) provides an unobstructed path up to the vacuum chamber. As air is pulled past the vacuum piston by engine vacuum — creating a low pressure area at this point — the piston hole permits this low pressure to fill the vacuum chamber. Unequal air pressure exists on either side of the diaphragm.
   Atmospheric pressure pushes up on the diaphragm, lifting the vacuum piston (#1) as well. The diaphragm (and piston) continues to lift until the vacuum piston return spring (#6) and the low air pressure match the pushing atmospheric pressure below.
3. Air speed through the venturi, which controls the amount of low pressure in the vacuum chamber, is controlled by a butterfly valve (#7). A cable connects the throttle grip directly to this butterfly valve. Twisting the grip opens the batterfly valve.

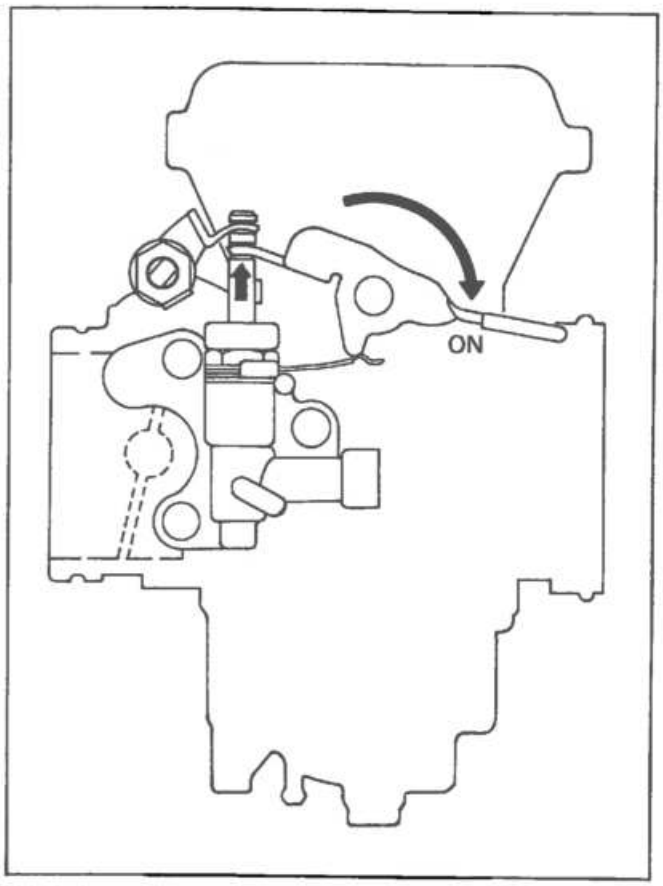


4. As the butterfly valve opens, engine vacuum sucks air through the venturi at a greater speed. Faster air speed causes a greater air pressure drop. This dropping pressure immediately occupies the vacuum chamber, lifting the vacuum piston higher. The vacuum piston will continue to lift as the butterfly is opened further.
5. When the vacuum piston lifts it also lifts the jet needle (#8) below. This permits additional fuel to flow up the fuel outlet nozzle and to the engine in the standard method.

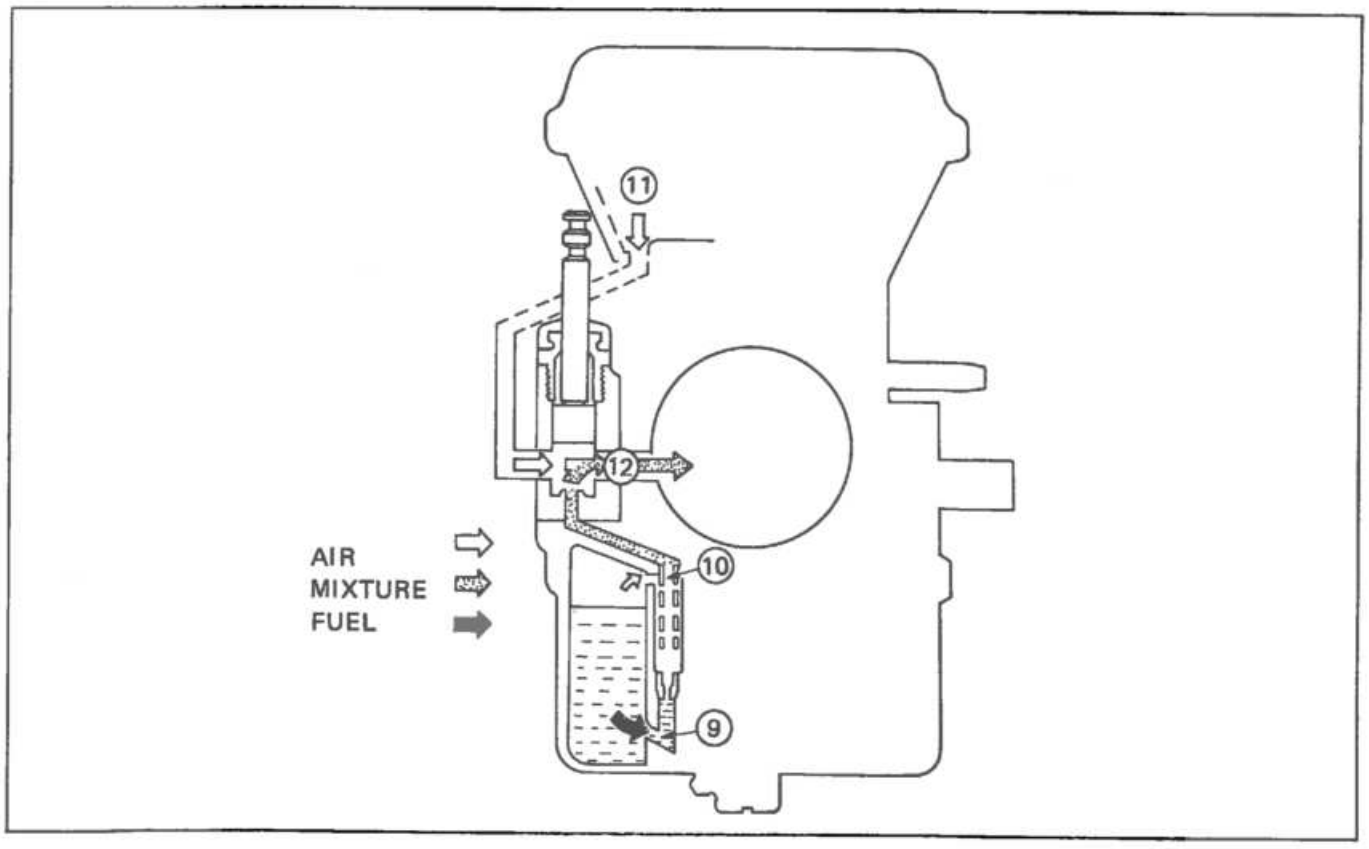


B. Starter System

1. This system is identical to the starter system used on all our two-stroke Yamahas. It consists of a separate fuel/air circuit that enriches the fuel/air mixture for easier starting. The starter housing, however, can be removed from the main carburetor body.
   When the starter lever is pushed down, a rich starting mixture ratio of approximately 9:1 enters the engine.
2. Fuel for this starter system comes from the float bowl, through a drilled passage through the starter jet (#9). The fuel continues up through a mixing chamber (#10) where air begins to mix with the fuel. Air for the starter system is drawn down through a passage (#11) from the atmospheric chamber below the diaphragm.

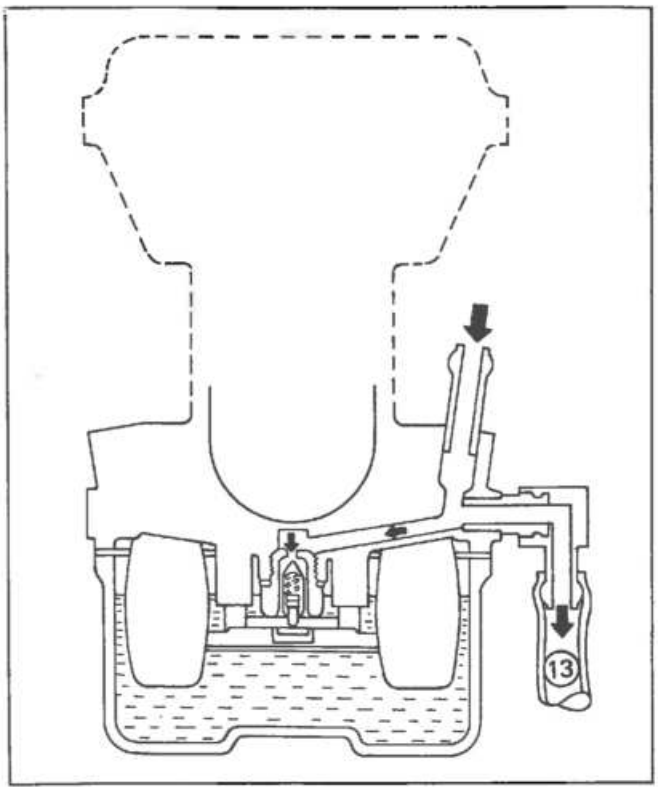


3. The fuel and air meet and mix at the starter plunger chamber and are sucked out through the outlet passage (#12) into the venturi.

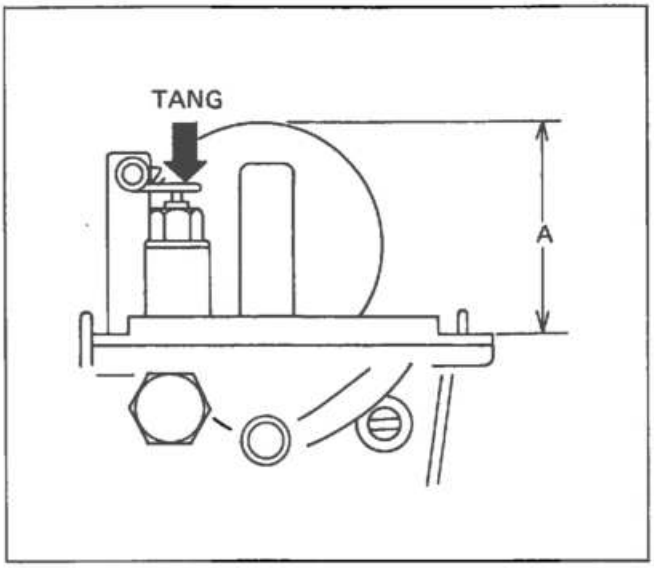


C. Float System

1. Proper fuel level is maintained in the float bowl via the standard method. Two interconnected floats pivot when the level of fuel rises until float/fuel level is high enough to force the inlet valve firmly against its seat. This shuts off the fuel supply from the gas tank.
2. An interconnecting fuel equalizer tube (#13) between both carburetors permits fuel to flow between them.



3. Gas flows from the tank, through both petcocks, and then to each carburetor. If fuel should cease to flow from one petcock, due to any sort of stoppage, fuel will still continue to flow to both carburetors through the equalizer tube. This eliminates the danger of one cylinder running lean due to lack of fuel.
4. Float level adjustment
   The float level may change because of a worn needle valve or a bent float arm. If the fuel level rises above a specified level, the air/fuel mixture becomes rich. If the fuel level drops, the mixture becomes lean.



5. Remove the float chamber body and float bowl gasket. Invert the mixing chamber body. Slowly lower the float with your fingers until the float just contacts the top of the float needle, do not compress the spring in the float needle.
6. Measure height "A" from the top of the float chamber gasket seat (gasket removed).
   Standard measurement: 0.98 in.±0.098 in.(25±2.5mm.)
7. Bend the tang (which contacts the float needle) so that a correct measurement is obtained.

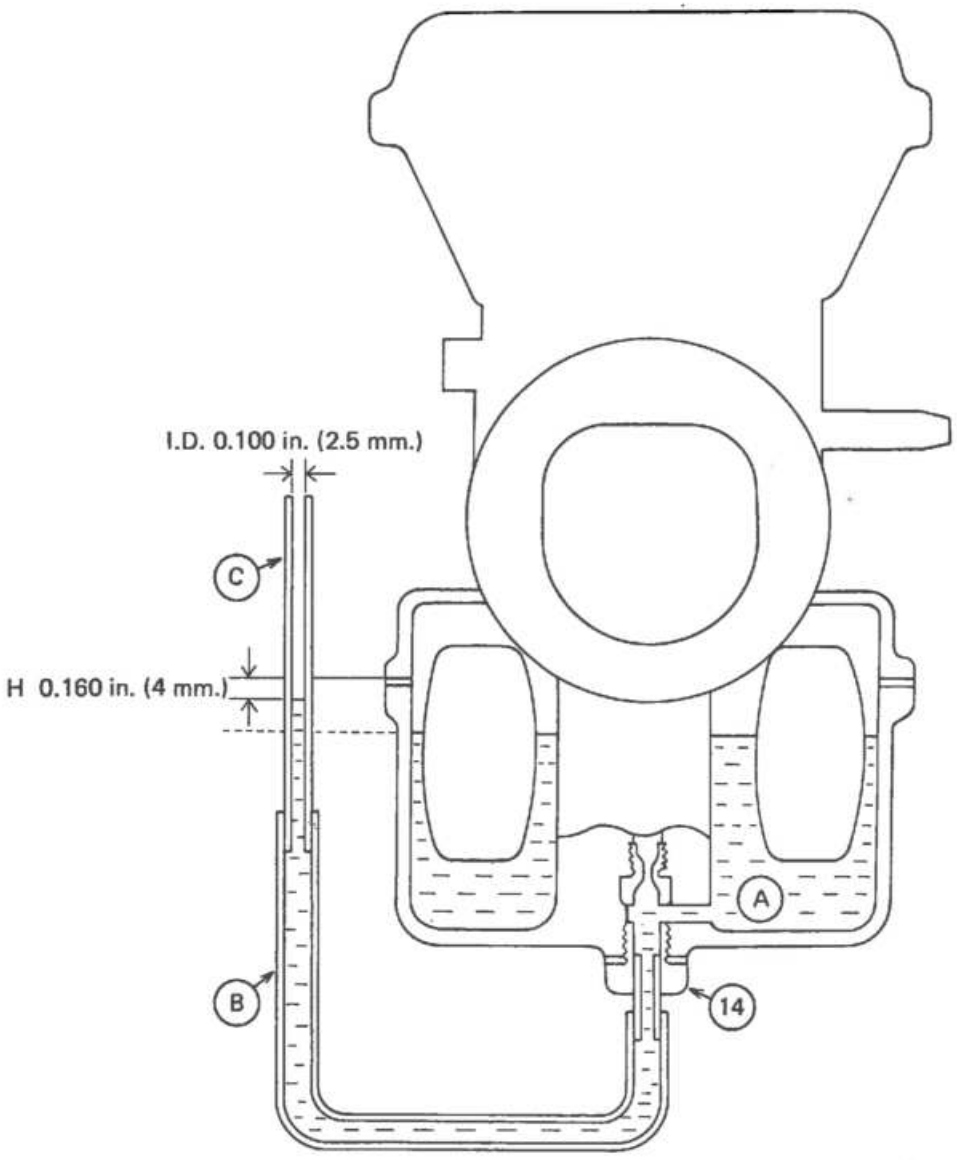
Caution:

Both floats must be identical in height. If they are not, carefully bend the interconnecting bar between both floats until they have identical heights.

8. Carburetor fuel level can also be checked without removing the float bowl. Construct a special tool using a spare main jet cover nut (#14), rubber tubing (B), and a short length of clear plastic tubing (C). It MUST have an inside diameter of 0.100 in. (2.5 mm.).
9. After constructing and installing the special tool, hold the clear tubing to the float bowl gasket surface on the main body (see drawing). The fuel level in the tubing must be 0.160 in. (4 mm.) below the main body gasket surface (can be checked with the engine stopped).

Note:

The carburetor must be positioned straight up (not tilted to one side, forward, or backward) to obtain an accurate reading. Also, if the clear tubing inside diameter is other than 0.100 in. (2.5 mm.), the fuel level shown will not be accurate.

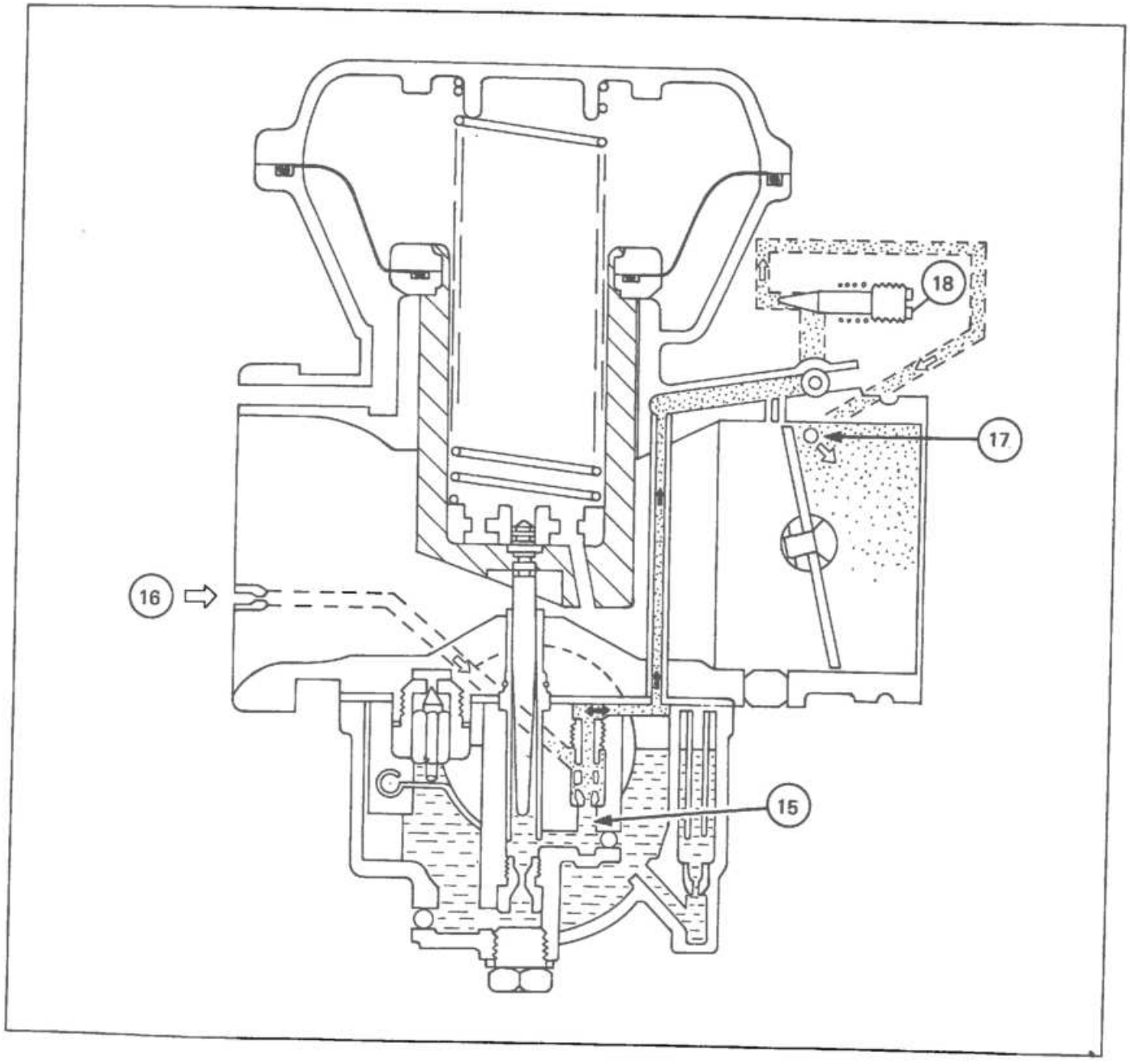


14. Adaptor A. Fuel B. Flexible tubing C. Clear plastic tubing

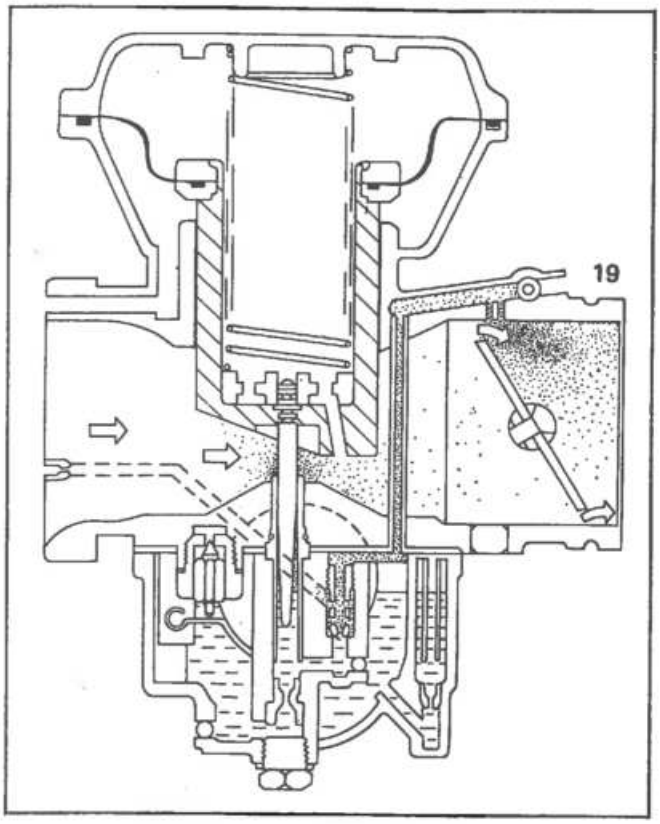
D. Idle Circuit

1. At idling rpm., air pressure in the venturi is not sufficiently low enough to draw fuel flow up through the needle jet nozzle. Fuel travels up through the main jet to the pilot jet (#15). At the same time air passes through the pilot air jet (#16) down through a drilled passage to the pilot jet, where it mixes with the fuel. This mixture passes up through a drilled passage to the pilot outlet (#17) at the upper edge of the venturi, just in front of the butterfuly. The amount of fuel/air mixture to the engine is controlled by the pilot screw (#18).

2. To increase engine rpm. the butterfly valve is opened further. The top edge of the butterfly uncovers first one bypass outlet (#19) (next page) and then a second bypass outlet. This permits more fuel to progressively enter the venturi and to mix with the additional air that begins to flow past the partially opened butterfly valve. In addition, fuel still flows out the pilot outlet.



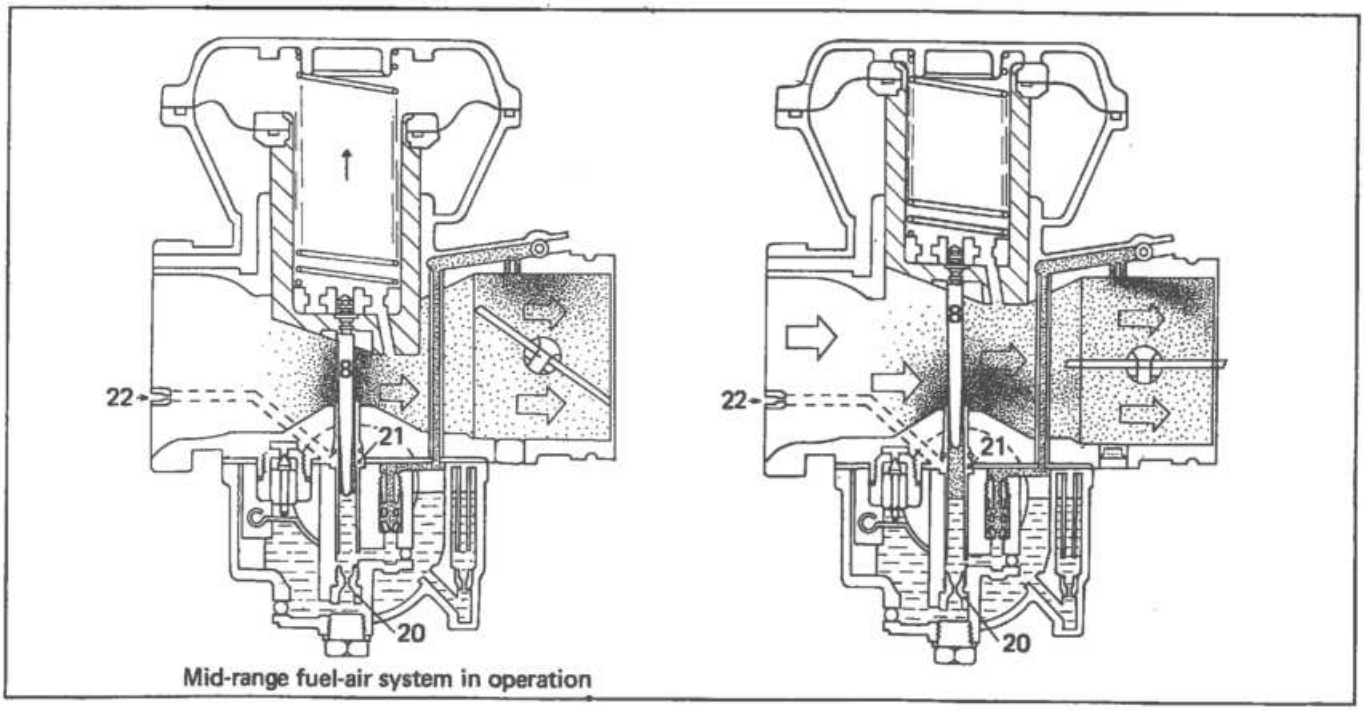
3. Fuel quantity through body bypass outlets is controlled by the diameter of the drilled passages. Both bypass outlets are drilled from the venturi straight into the pilot fuel/air mixture delivery passage.



E. Mid and High Speed System

1. Fuel flow for mid-range and high speed operation comes through the main jet (#20), through the needle jet (#21), and around the jet needle (#8) into the venturi. As engine rpm. increases, venturi vacuum also increases (the butterfly valve is opened further). This causes the vacuum piston to lift, which in turn lifts the tapered jet needle. More fuel flows past the needle and to the engine..

2. Air enters the primary air jet (#22) and travels down a drilled passage to the needle jet. It mixes with the fuel at this point. Final air/fuel mixing is accomplished when this primary air/fuel mixture enters the venturi and mixes with the air passing through.



Mid-range fuel-air system in operation

F. Disassembly and Assembly Procedure (for replacement or cleaning)

1. The vacuum chamber cover on top is held in place by four screws. Remove these screws and lift off the chamber cover.

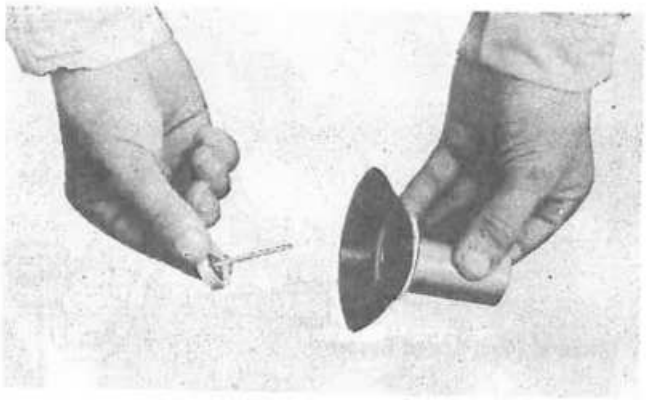
Note:

When installing the set screws, be sure to correctly position the throttle cable anchor bracket.

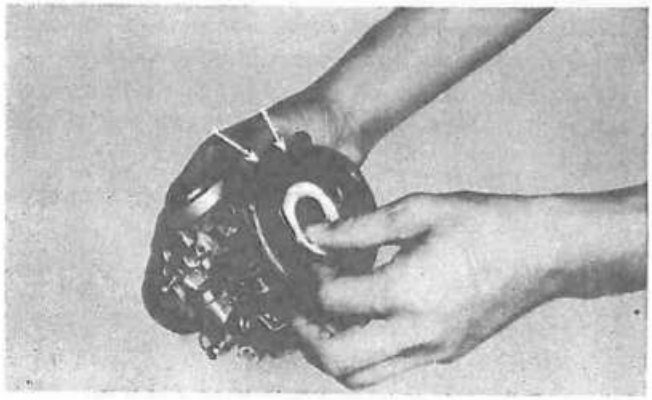


Removing cover securing screws

2. Once the cover has been removed, the spring, jet needle retainer, jet needle, and vacuum piston can be removed.

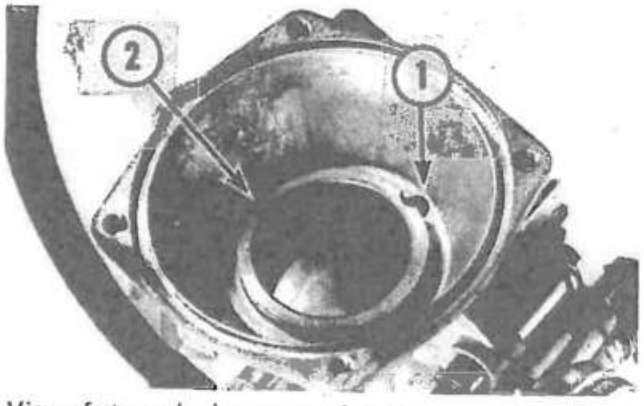


3. Installation of the vacuum piston is accomplished by inserting it into the carburetor body and lining up the small projection on the outer edge of the rubber diaphragm with the corresponding notch in the outer edge of the carburetor top mating surface.



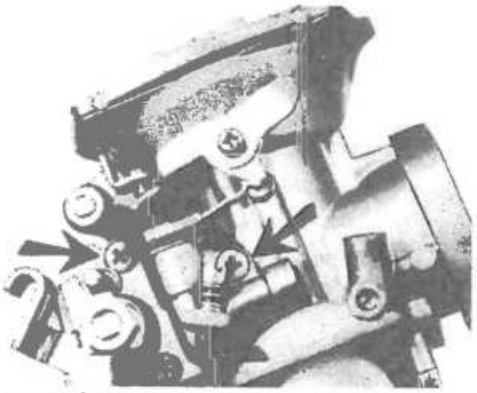
Vacuum piston and associated parts

4. With the top removed, the inlet passage (#1) and air passage to the starter jet (#2) are visible.



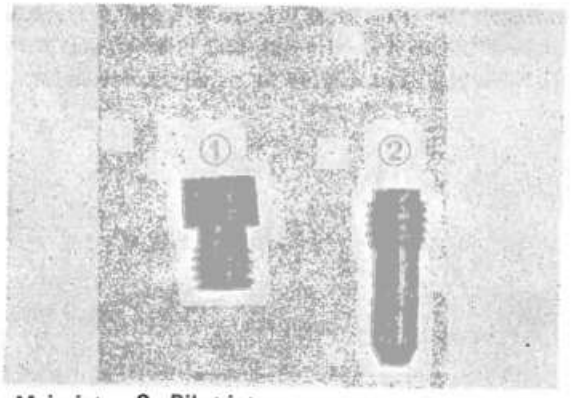
View of atmospheric pressure chamber

5. The starter jet housing mounts to the left side of the carburetor. It is held by three screws. A gasket fits between the starter jet housing and main housing.

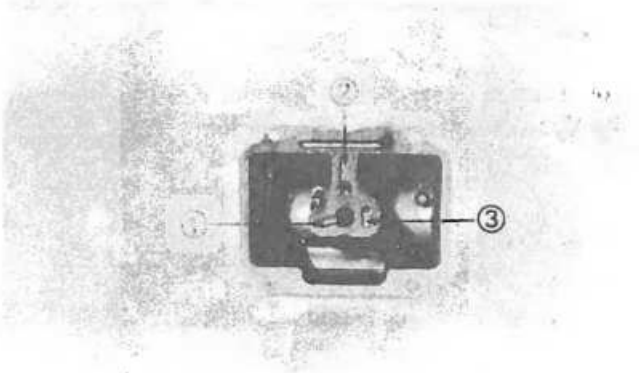


Starter housing securing screws

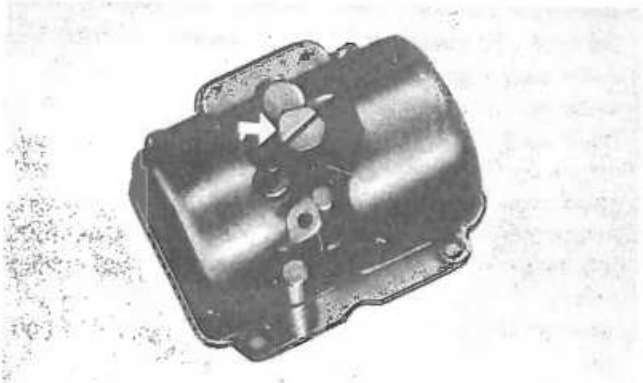
6. The float bowl mounts to the bottom of the main housing. Remove the four retaining screw and then remove the float bowl.
7. Both the pilot jet and the main jet are screwed into orifices in the float bowl. The pilot jet is removed from the inside, the main jet is removed from the bottom, after first removing the cover screw.



1. Main jet 2. Pilot jet

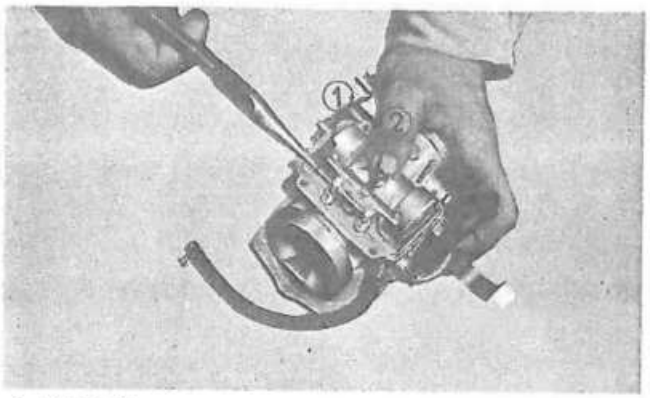


1. Primary air passage to needle jet 3. Pilot jet
2. Pilot air passage to pilot jet



Main jet cover

8. Turn the carburetor upside down, pull out the float pivot pin, and remove the float.

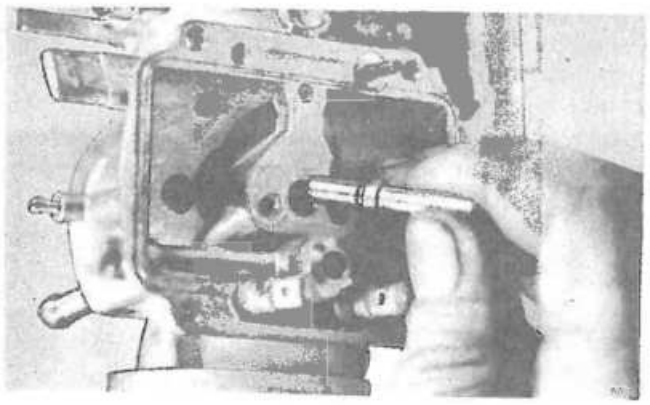


1. Pivot pin
2. Float level adjustment tang

Caution:

Directly beneath the float adjustment tang is the float valve. Remove this part immediately to prevent its loss.

9. The needle jet fits into the main housing from the bottom. If removal is required, pull it down and out by hand. Reverse this procedure to install the needle jet.



G. Adjustments

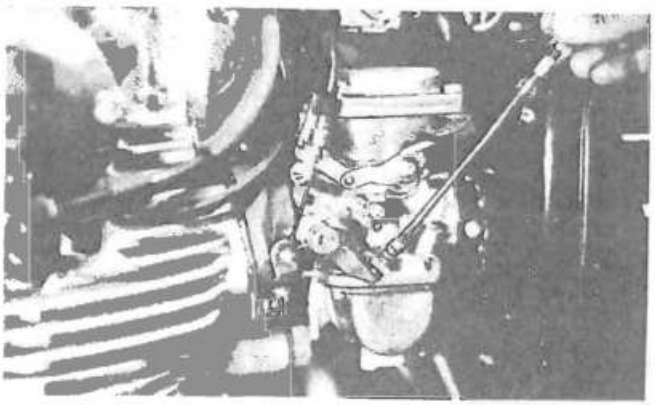
1. Idle mixture: turn the idle mixture screw in until it is lightly seated, then back it out 3/4 turn.



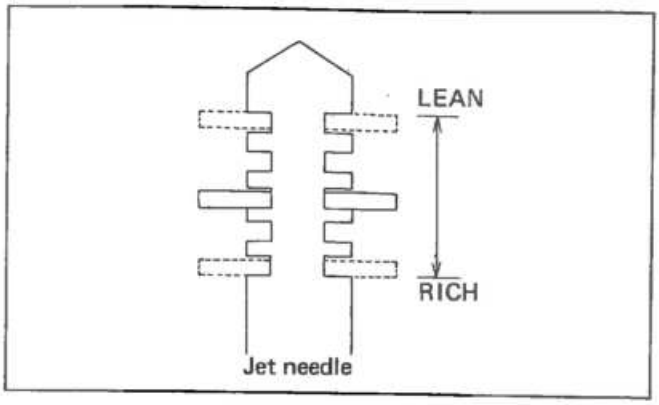
1. Pilot mixture adjusting screw
2. Idle speed adjusting screw

2. Idle speed:

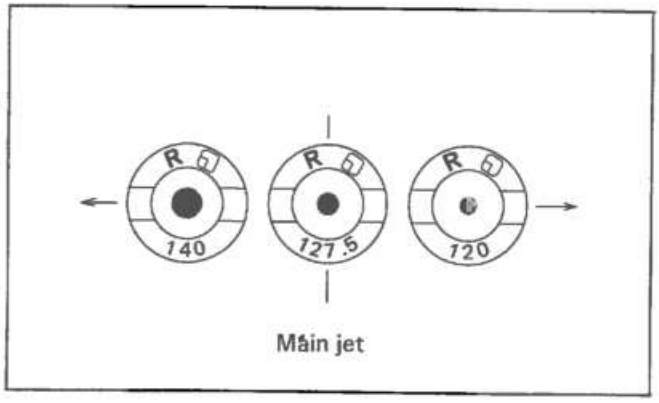
Set both idle screws so the engine idles fast. Pull off one spark plug high tension lead. Back out the idle speed screw on the running cylinder until the engine dies. Hook up the spark plug lead, start the engine, and pull off the opposite spark plug lead. Slowly back off the idle speed screw of the running cylinder until the engine dies. Attach the loose spark lead and start the engine. Both cylinders should be idling at the same speed, pulling evently. If engine rpm. is too high, back off both idle speed screws an even amount until idle is 900 ~ 1,000 rpm.



3. Jet needle (mid-range):
Mid-range fuel supply is controlled by the position of the needle in the needle jet. The needle clip comes standard in the 4th groove from the top (4th stage). To lean out the mid-range mixture, move the clip one groove higher (dropping the needle). To enrich the mixture, place the clip one groove lower (raising the needle).

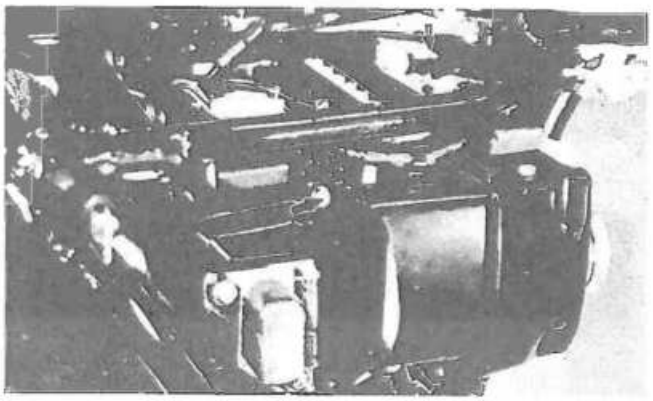


4. Main jet (high speed):
The carburetor comes equipped with a #130 main jet. Install a one step larger main jet (#140) to enrich the high speed mixture. Install a one step smaller main jet (#120) to lean out the mixture.

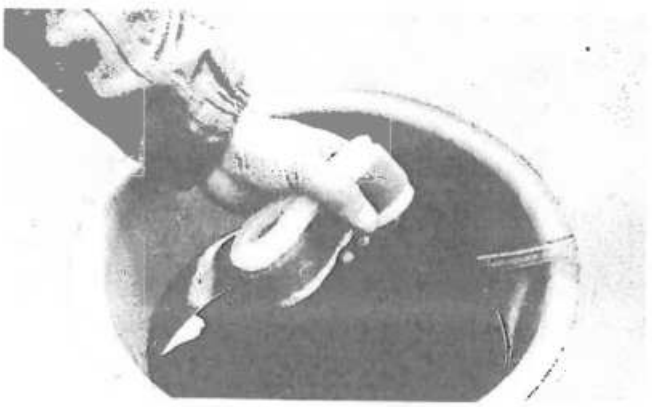


H. Air filter

1. Disconnect the air cleaner mounting bolts: one on top, under the seat, one on the side cover.



2. The element is made of foam rubber damp with oil. The removed element should be washed in a detergent. Then apply motor oil (10W-30 or equivalent) to the element, and squeeze it lightly.



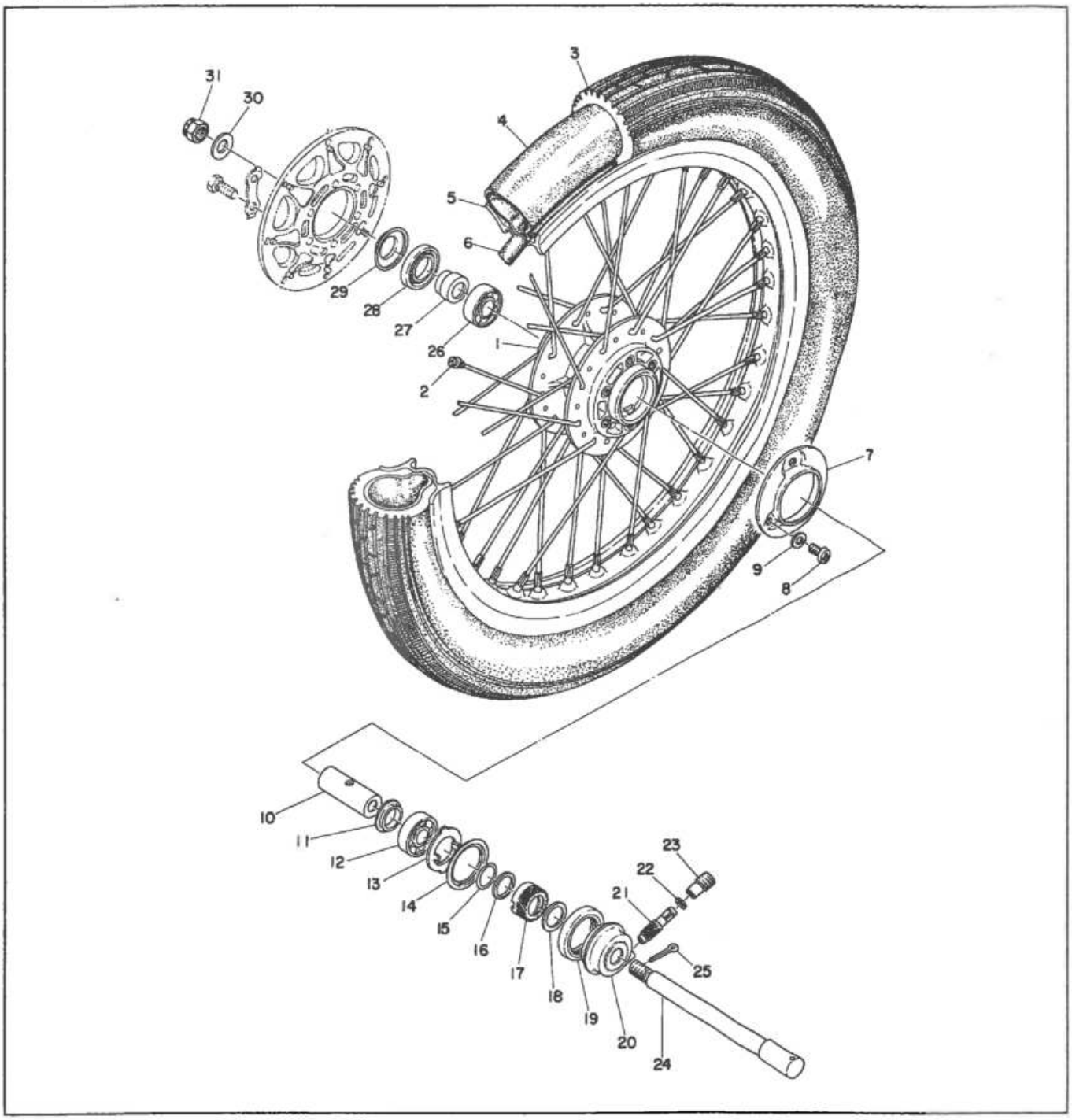
CHAPTER 5. CHASSIS

5-1. FRONT WHEEL 99
A. Removal 100
B. Disc Brake Operation 100
5-2. DISASSEMBLY 103
A. Caliper 103
B. Master Cylinder 104
5-3. INSPECTION 107
A. Measuring Instruments Required for Inspection 107
B. Pistons 107
C. Master Cylinder 108
D. Brake Hose and Brake Pipe 108
E. Disc 108
5-4. ASSEMBLY AND ADJUSTMENT 109
A. Cleaning 109
B. Calipers 109
C. Master Cylinder 110
D. Brake Hose and Brake Pipe 112
E. Disc 112
F. Air Bleeding 113
5-5. WHEELS 115
A. Tire and Tube Removal and Installation 115
B. Rim and Spokes 115
C. Seals and Bearings 116
5-6. REPLACING WHEEL BEARINGS 117
5-7. FRONT FORKS 118
A. Outer Fork Leg Removal 119
B. Oil Seal Replacement 120
C. Inspection 120
D. Assembly 121
5-8. STEERING HEAD 121
A. Removal 121
B. Inspection 123
C. Installation 123
5-9. SWING ARM 126
A. Inspection 126
B. Lubrication 126
C. Removal 126
5-10. REAR SUSPENSION 127
5-11. REAR WHEEL 128
A. Removal 128
B. Disassembly and Assembly 130
C. Rear Wheel Sprocket 131

5

5-12. DRIVE CHAIN 132
A. Removal and Installation 132
B. Wear 132
C. Maintenance 133
D. Adjustment 133
E. Removal and Installation (XS650) 134
5-13. BRAKE SHOES 135
5-14. BRAKE DRUM 136

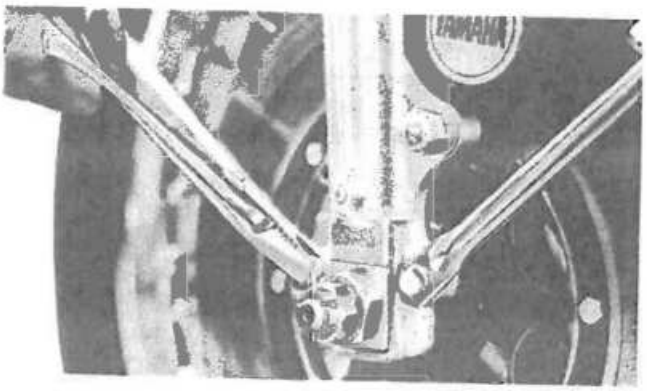
5-1. FRONT WHEEL



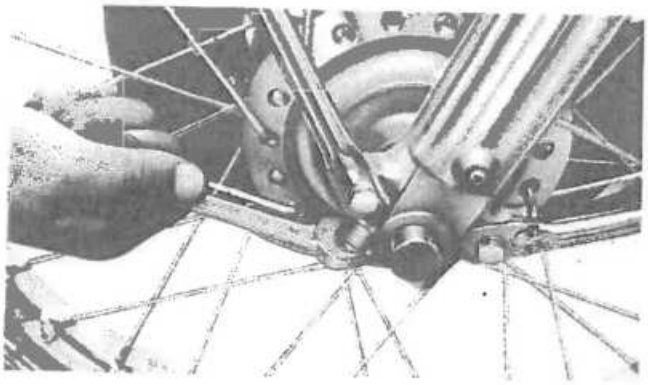
1. Front hub
2. Spoke set
3. Front tire
4. Tube
5. Rim
6. Rim band
7. Housing cover
8. Panhead screw
9. Spring washer
10. Bearing spacer
11. Spacer flange
12. Bearing
13. Meter clutch
14. Clutch meter
15. Stop ring
16. Thrust washer 2
17. Drive gear
18. Thrust washer 1
19. Oil seal
20. Gear unit housing
21. Meter gear
22. Washer
23. Bushing
24. Wheel shaft
25. Cotter pin
26. Bearing
27. Shaft collar
28. Oil seal

A. Removal

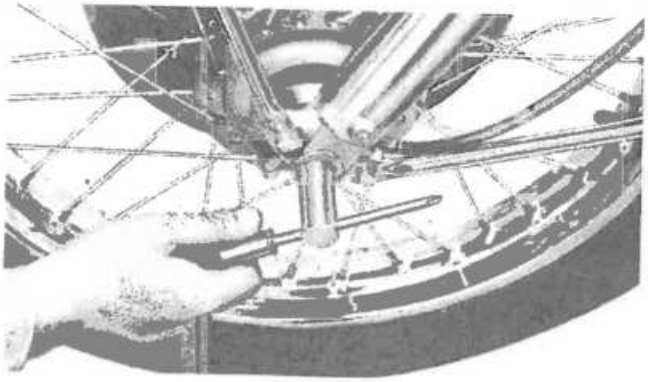
1. Remove the cotter pin.
2. Remove the front wheel shaft nut.



3. Loosen the wheel shaft lock nuts.

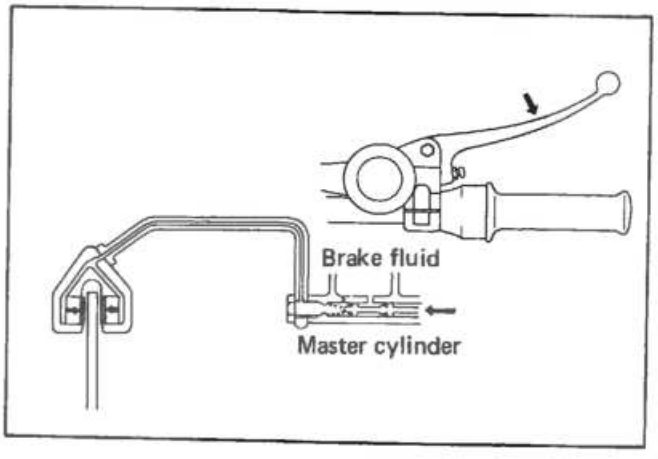


4. Remove the front axle by simultaneously twisting and pulling out on the axle.
5. Raise the front of the machine off the ground, remove the wheel assembly.

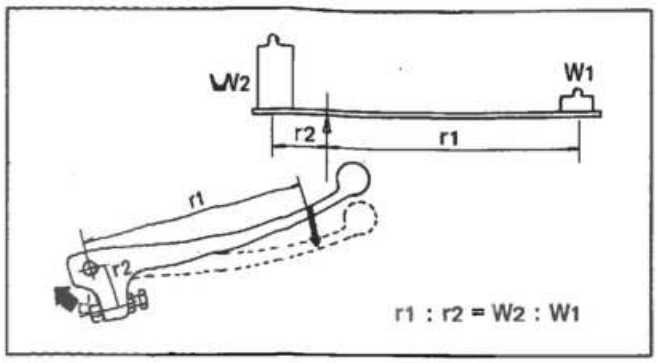


B. Disc Brake Operation

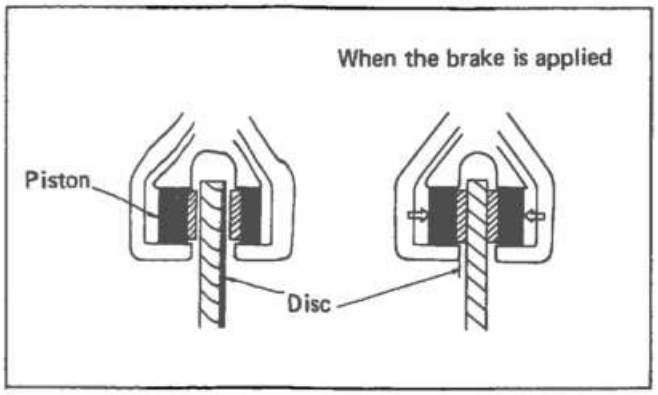
When the front brake lever is squeezed, it forces the master cylinder piston to move. As the piston cup moves past the compensating port, it traps the brake fluid in the cylinder. Pressure rises rapidly, and the fluid is forced through the brake hose to the caliper cylinders. The brake fluid forced into the caliper cylinders pushes against the pistons in the cylinders, and the pads (or "pucks") located on each side of the disc are forced against the disc. The friction between the pads and revolving disc then provides the braking action. As the brake lever is released, both brake lever and pistons are forced back to their respective original positions by the force of return springs.



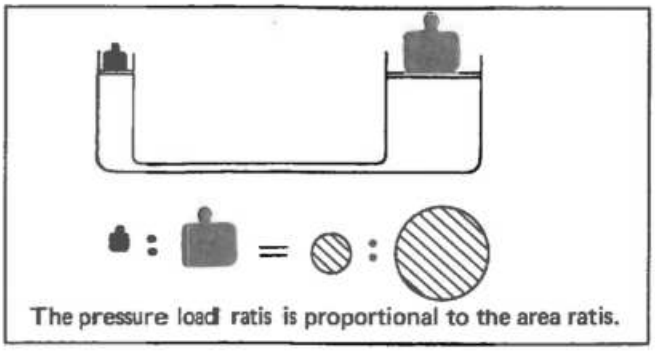
1. Brake lever
When the brake lever is squeezed, it produces a push, at the master cylinder piston about four times greater than the force applied to the brake lever.



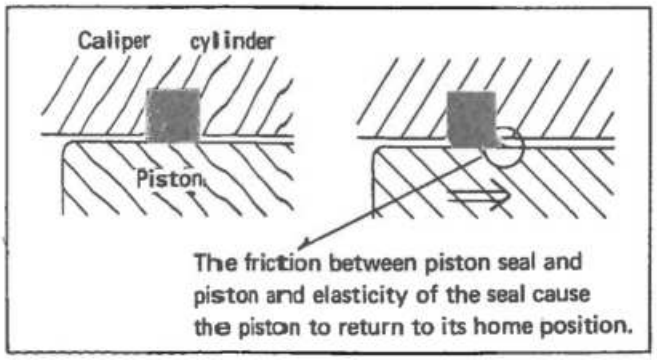
2. Brake hose and pipe
The brake hose and pipe carry hydraulic pressure to the calipers.
The brake hose is flexible and capable of withstanding a hydraulic pressure of 350 kg/cm^2 in conforming to SAEJ-1401.
The brake pipe is made of double steel tubing. For better corrosion resistance it is plated with zinc.
3. Calipers
The hydraulic pressure carried to the calipers forces the caliper pistons out; by which action the pads are pushed out to grip the revolving disc.



4. Piston
The caliper pistons are forced against the pads by hydraulic pressure which is about nine times greater than the pressure produced in the master cylinder. This is because the caliper cylinder piston surface area is much larger than the master cylinder piston surface area.

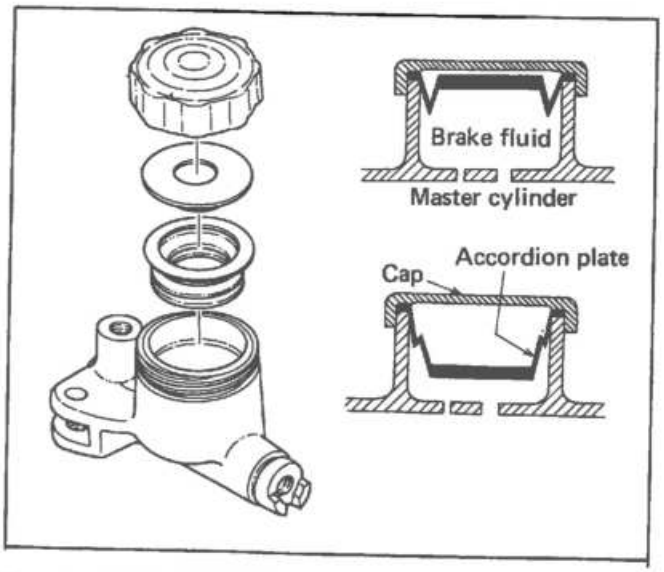


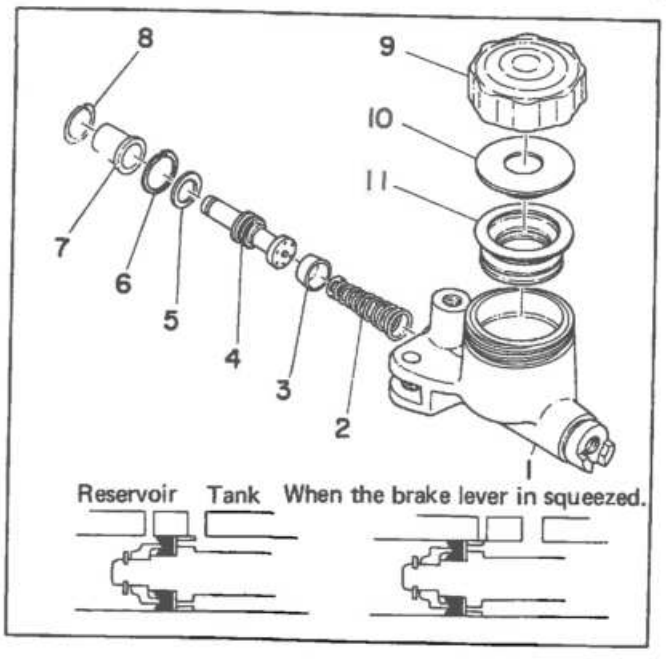
5. Seals
Each caliper cylinder has a piston seal (to maintain good sealing between the piston and the caliper cylinder wall) and a dust seal (to prevent dirt and water from entering the cylinder).
The piston seal is designed to move the piston back to its home position by making use of its tortional moment after the brake lever is released. The tortional moment is produced by the frictional force and elasticity of the piston seal. The piston seal also serves as an automatic adjuster of the clearance between the disc and the pad. (The clearance between the disc and the pad is normally 0.1 to 013 mm.)



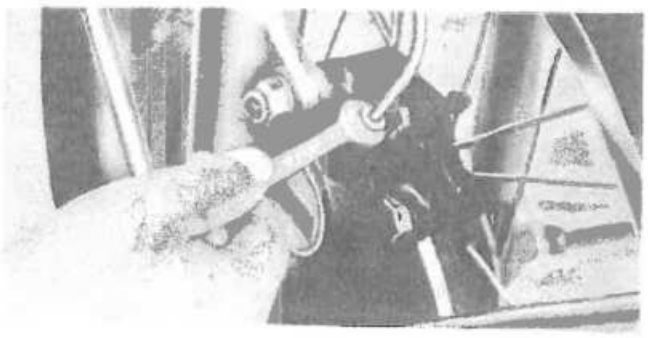
6. Pads
   The pads are forced against the revolving disc by the caliper cylinder pistons to grip the disc. They are composed of resin mold asbestor.
7. Bleed screw
   Air in the hydraulic line impairs hydraulic action. To expel air out of the caliper cylinder, a bleed screw is provided on the caliper assembly.
8. Disc
   The stainless steel disc is held to the front wheel hub and it is gripped by the pads located on each side of the disc.
9. Brake fluid
   The brake fluid is compressed in the master cylinder, and hydraulic pressure thus produced is carried to the caliper cylinder pistons. In this sense, the brake fluid plays a very important role.
   The brake fluid must meet the following requirements:
   1. Proper viscosity and liquidity can be maintained at working temperatures.
   2. Good stability is maintained. (That is the fluid will not separate, change in viscosity, and/or precipitate.)
   3. Boiling point is high. (No vapor lock will result.)
   4. It will not deteriorate rubber.
   5. Water resisting proparty is excellent.

   Note that the disc brake fluid must be of genuine quality, because the fluid temperature tends to rise as compared with the drum brake.
   Suggested brake fluid specifications: SAE J1703B.
10. Master cylinder
    The master cylinder piston is linked to the brake lever. When the brake lever is squeezed, the piston forces the brake fluid through the hose and pipe to the calipers.
11. Reservoir tank
    As wear on the brake pads increases, the amount of brake fluid must be increased to maintain proper hydraulic pressure. The reservoir tank supplies this brake fluid. (tank capacity is approximately 30 cc.) To prevent air from entering the brake line when the brake fluid level lowers, especially on a rough road or in an inclined position, a compensating diaphragm is provided for the reservoir tank.
12. Piston
    The master cylinder piston has two cups; one maintains good sealing between the cup and the cylinder wall of the master cylinder, and the other prevents the brake fluid from leaking out from the cylinder to the brake lever side. The return spring forces the brake lever to its home position, when the lever is released.





5-2. DISASSEMBLY



The tire and bearings can be disassembled without removing the brake disc. Do not remove the brake disc unnecessarily.

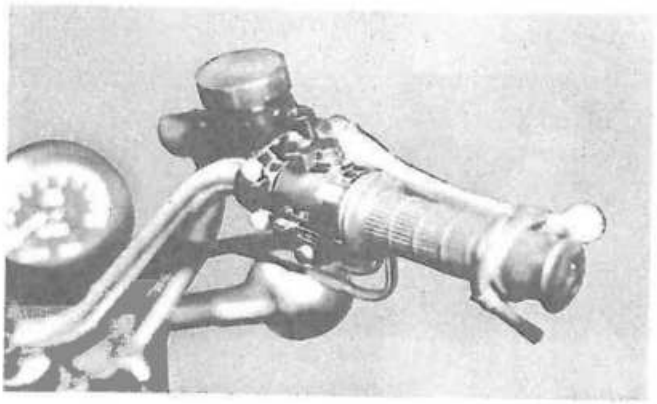
Tools and Parts required for Disassembly.
- General service tools
- Hexagon wrench, 5 mm.
- Grip pliers
- Air compressor
- Rags
- Torque wrench

A. Caliper



1. Removing the Caliper
   Remove the brake pipe from the caliper assembly.
   Put the removed brake pipe in a clean vinyl bag so that it can be kept free from dust and dirt.

Note:
It is advisable to keep the brake lever squeezed, because this brake lever position prevents the fluid from leaking out of the reservoir. Place a heavy rubber band around the lever and handlebar grip.

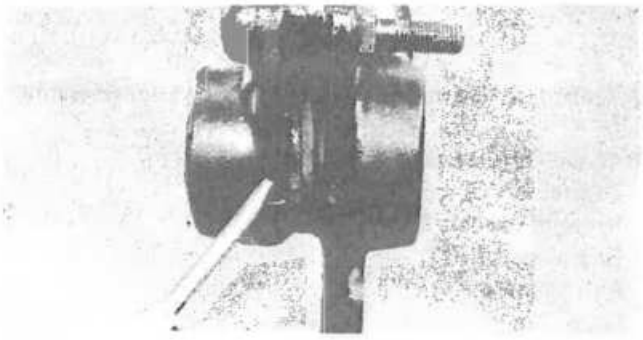




2. Remove the caliper mounting bolts and nuts.
3. Rotate the caliper assembly upward, and remove it.

Removing the Pads

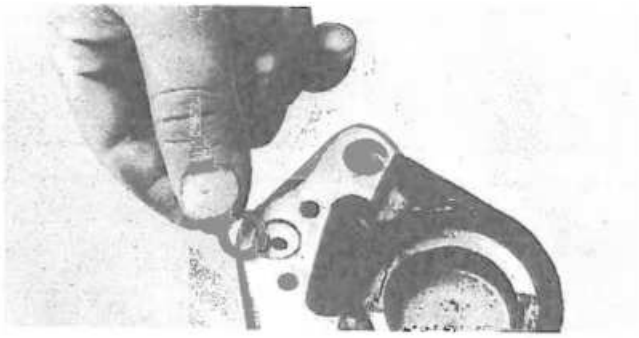
4. Remove the pads from their seats.



Removing the caliper pistons and seals:

5. Remove the two bridge bolts and two hexagon bolts.
6. Remove the caliper seal.



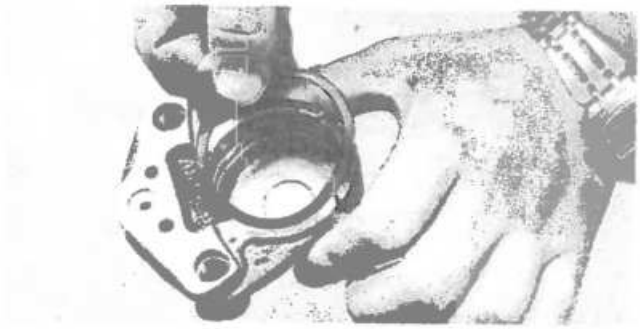


7. Force the piston from the caliper cylinder by feeding compressed air into the cylinder through the fluid inlet. Never attempt to push the pistons with a screwdriver.



8. Remove the piston seal and dust seal from the caliper body.
   The foregoing applies to both pistons.

Note:
The removed parts should be kept free from gasoline, kerosene, engine oil, etc. If any oil attaches to a seal, it will swell up or deteriorate.

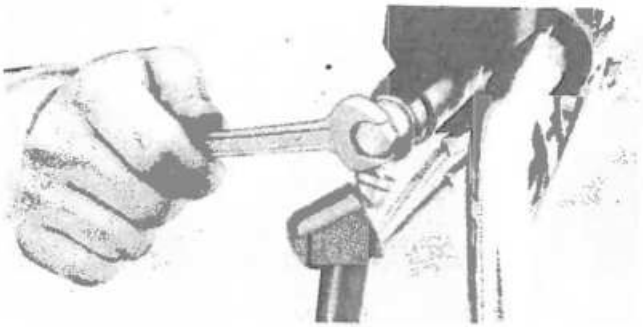


B. Master Cylinder

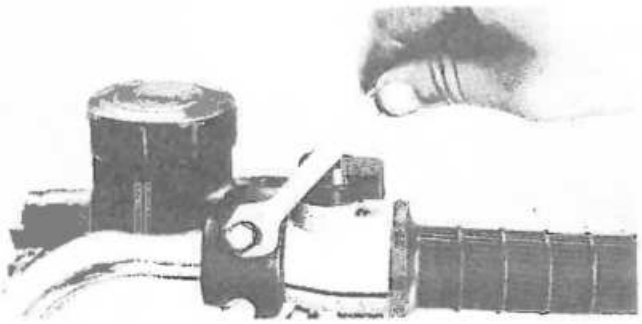
1. Remove the brake lever.
   (Take care not to misplace the brake lever return spring.)



2. Remove the brake hose.



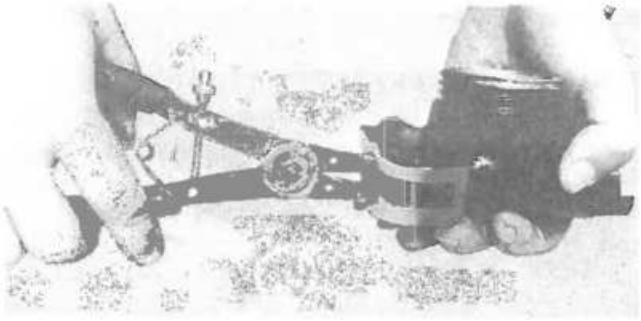
3. Remove the two master cylinder mounting bolts, and remove the master cylinder from the handlebar.
4. Remove the reservoir tank cap, and remove the diaphragm.
5. Drain the brake fluid from the reservoir tank.



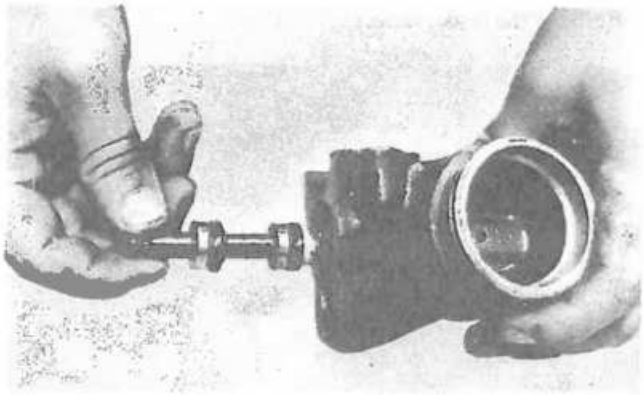
6. Remove the master cylinder boot.

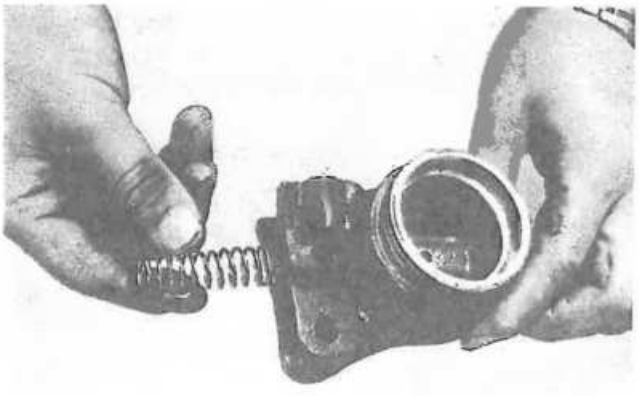


7. Remove the snap ring with clip pliers.



8. Remove the piston. (Note that a spring remains in the master cylinder.)

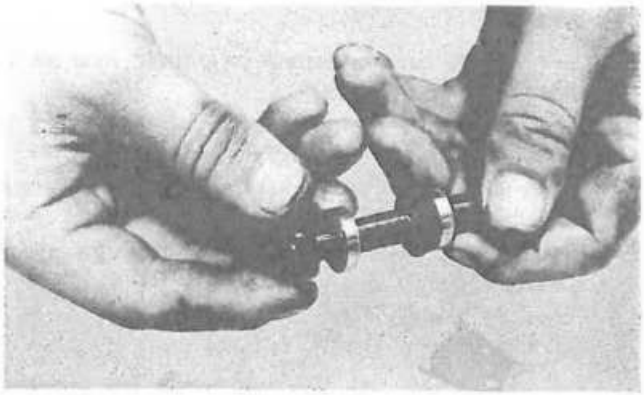




9. Remove the E clip, and remove the cylinder cup retainer.



10. Remove the cylinder cup.



5-3. INSPECTION

A. Measuring Instruments Required for Inspection

Dial gauge
Dial gauge adapter
Micrometer 0.25 mm.
Vernier calipers 150 mm.

B. Pistons

Pistons

If any piston is found scratched or worn, replace it.

Pads

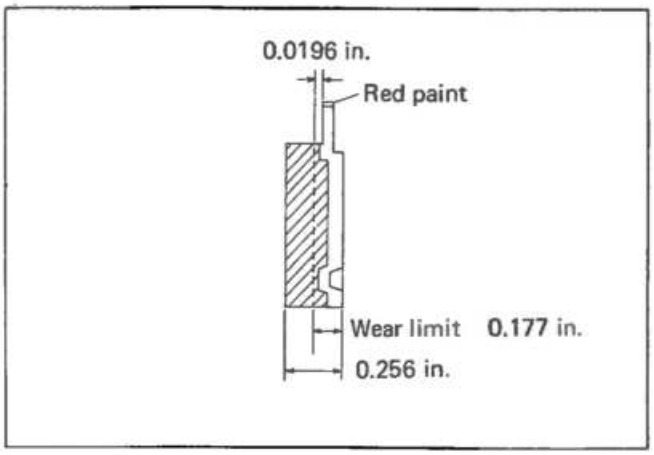
If any pad is found excessively worn, replace it.
Min allowable pad thickness: 0.5 mm.

Piston seal and dust seal

If any seal is found damaged, replace it.
It is advisable to replace the seals every two years of use, whether they appear damaged or not.

Bridge bolt

Replace the bridge bolts each time they are removed for disassembly, whether damaged or not.



C. Master Cylinder

Master cylinder body

1. If the master cylinder has any streak or grooved wear on its wall, replace it.
2. If the outlet end has any scratch or dent, replace it.
3. Check the compensating port for clogging.
4. Check for any foreign matter inside the cylinder and the reservoir tank.

Piston

1. If the piston has any streak or grooved wear, replace it.
2. If the piston has any rust, replace it.

Cylinder cups

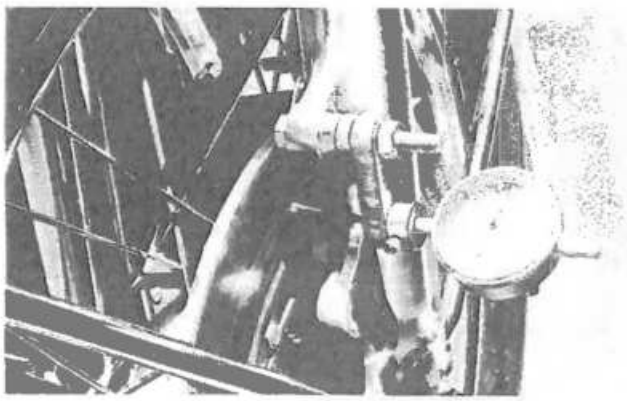
1. If any cylinder cup has a streak or grooved wear on its contacting surface, replace it.
2. If any cylinder cup is found to be swollen, replace it together with the other seal and rubber parts.
   Thoroughly wash all areas which are exposed to brake fluid with new brake fluid.
3. Whether or not it shows wear, replace the cylinder cup every two years of use.

Reservoir diaphragm and master cylinder boot

1. Check the flange and accordion pleats for damage, cracks and aging.
2. Check for swelling. (If swollen, take the same steps as in the case of the cylinder cup.)
3. Replace both every two years of use, whether they are in good condition or not.

Conical spring

1. Check the spring for breakage and wear.

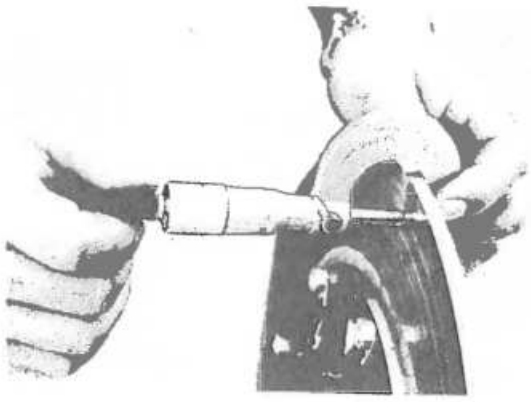


D. Brake Hose and Brake Pipe

1. Check them for leakage and damage.
2. Replace the brake hose every four years of use, whether or not it appears to be in good condition.

E. Disc

1. Check the disc assembly for run-out.
   If the disc shows a deflection of 0.15 mm. or more, check the disc itself and the bearings.
2. If the disc has excessive wear or damage, replace it.
   Min. allowable disc thickness: 6.5 mm.



5-4. Assembly and Adjustment

A. Cleaning

All the removed parts should be washed in the following manner before they are installed.

1. A new brake fluid should be used as a cleaning detergent.
   (The use of any mineral oil should be avoided, because it causes rubber parts to swell. The same can be said of alcohl. Any rubber dipped in alcohol may swell up.)
2. If an oil of any other kind (such as mineral oil) is mixed in the system by mistake, the piston cups and seals should be replaced with new one. All other parts should be washed with fresh, clean, new brake fluid. In addition, the lines, ports, passages, etc., should be thoroughly flushed with a clean, new brake fluid.

B. Calipers

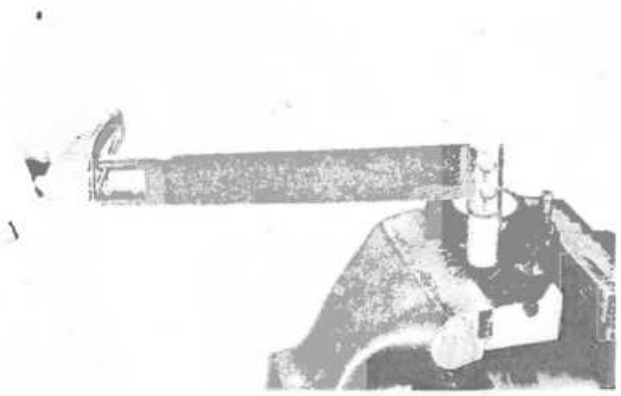
Piston installation

1. Install the piston seal and dust seal in their seats in the caliper cylinder.
2. Coat the caliper cylinder walls and piston with new brake fluid.
3. Insert the piston into the caliper cylinder with your hand.
   In inserting the piston, special care should be taken so that the piston goes into the cylinder smoothly.



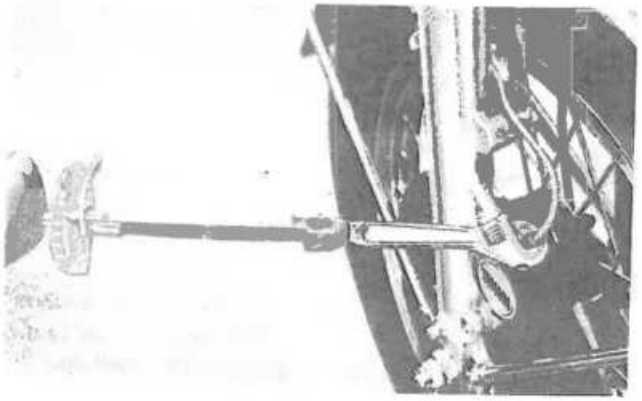
Assembling the outer and inner calipers.

4. Install the caliper seal in their seat.
5. Put together the outer and inner calipers.
   (Make sure that no dust or dirt is attached to the mating surfaces.)
6. The two bridge bolts must be replaced with new ones.
   Tighten the two hexagon bolts. (The bridge bolts should be tightened later.)
   Tightening torque: 60 ~ 100 kg-cm.
7. They are very important parts viewed from operational safety, and therefore, the removed bridge bolts should always be replaced. Be sure they are tightened with correct torque.
   Tightening torque: 750 ~ 950 kg-cm.
8. Install the pads in their seats.
9. When replacing the pads alone, it is necessary to push back the piston so that new pads can easily be installed. (When the piston is pushed back, and the compensating port is open, the brake fluid level in the reservoir tank will rise steeply. Loosen the bleed screw in necessary, and bleed off the excess brake fluid.



Installing the calipers

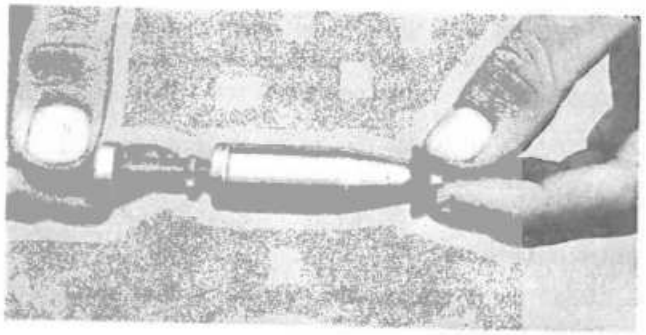
10. To install the calipers on the front fork, reverse the procedures for removal.
    Tightening torque: 400 ~ 500 kg-cm.
11. Install the brake pipe.
    Tightening torque: 130 ~ 180 kg-cm

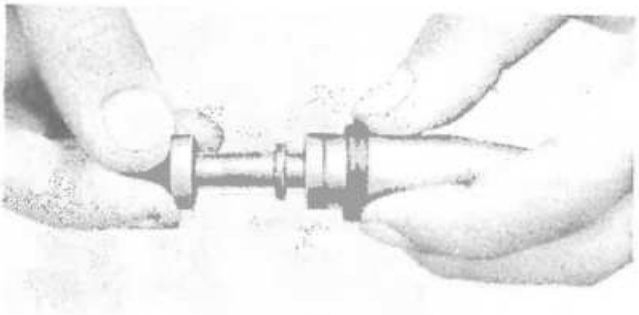


C. Master Cylinder

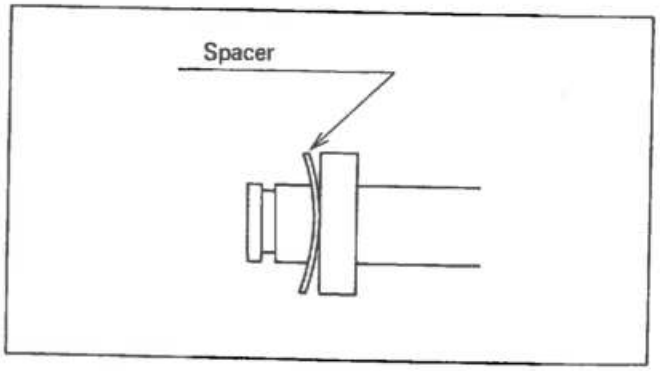
Installing the cylinder cup

1. Dip the cup in a new brake fluid, and install it.
   Take care not to scratch the cup and the piston. (Use the jigs.)

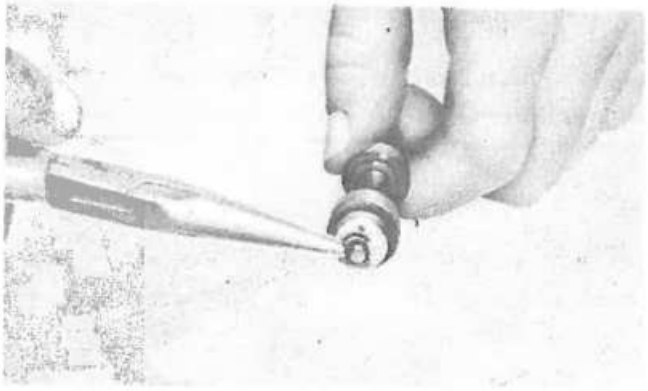




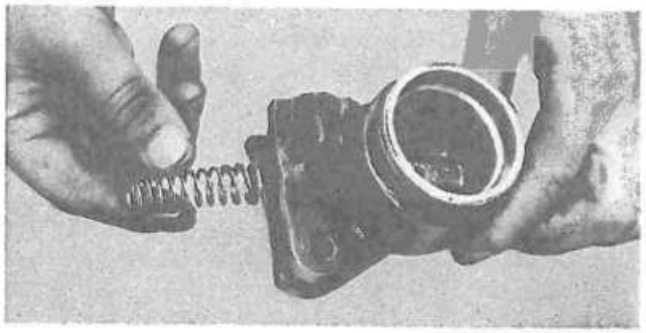
2. Install the spacer. Be sure that the spacer is positioned correctly.



3. Install the cup, retainer and E clip.



4. Insert the spring into the master cylinder body.



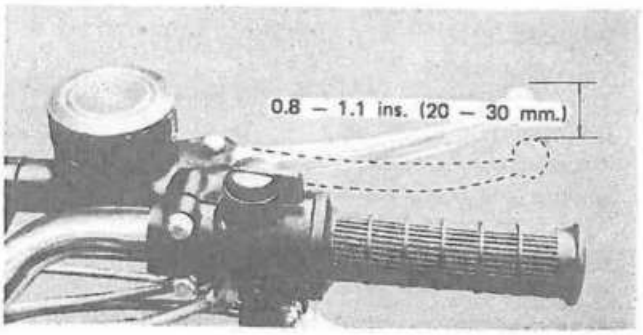
Installing the piston

5. Check the piston surfaces and cup surfaces for scratches, and then, insert the piston into the cylinder.
   Avoid forcing the piston into the cylinder; otherwise, the cylinder wall will be scratched, thus allowing the brake fluid to leak past.
6. Install the snap ring.
7. Install the boot in the master cylinder groove and the piston groove, respectively.

Installing the master cylinder on the handlebar.

8. Install the master cylinder on the handlebar.
9. Adjust the clearance between the piston and the push rod.

Brake Lever Free Play: 0.8 ~ 1.1 ins. (20 ~ 30 mm.)



Note:
Fully tighten the adjusting screw lock nut so that it will not become loose.

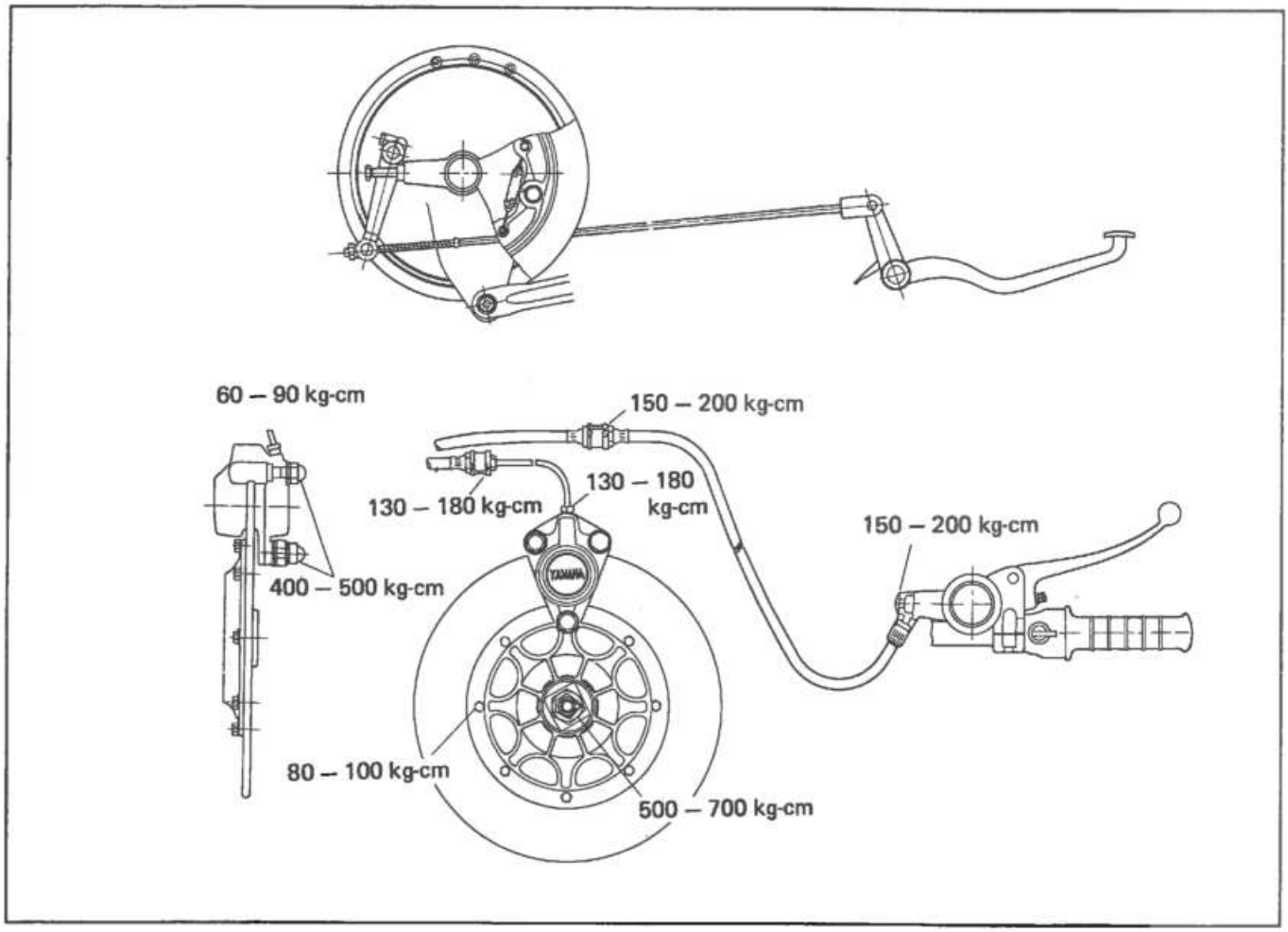
10. Fasten the brake hose to the master cylinder with the union bolt.

Note:
If the gasket is found scratched, it should be replaced.

11. Feed approximately 30 cc. of brake fluid into the reservoir tank prior to bleeding.

D. Brake Hose and Brake Pipe

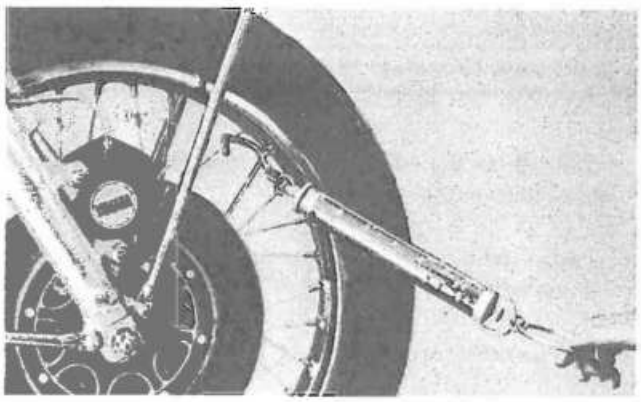
The brake hose and brake pipe fittings should be fastened with the following torque.



E. Disc

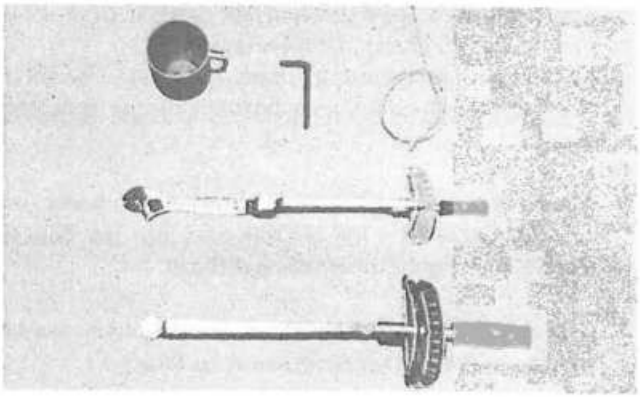
1. The disc mounting bolts should be tightened gradually and in pattern with correct torque. The lock tabs should be properly positioned and bent tightly over the bolt heads.
   Tightening torque: 80 ~ 100 kg-cm.
2. The deflection of the disc assembly should be within the specified value. (0.15 mm.)
3. The disc trailing torque should be within the specified amount after it is assembled.
   Torque: 2~4 m-kgs. when assembled as shown in the figure on the right.
   If the value exceeds this limit, check the disc run out.

* On the disc brake, a slight drag is normal.



F. Air Bleeding

When any parts relating to the brake fluid are reinstalled, be sure that each metal fastner is fully tightened and then bleed the air.



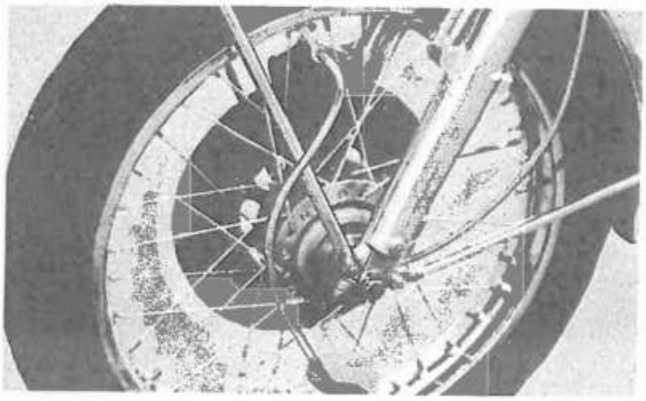
Tools and parts

Wrench
Torque wrench
Vinyl tube inside diameter 4 mm.
Brake fluid (SAE grade #J1703B)
Clean container
Rags

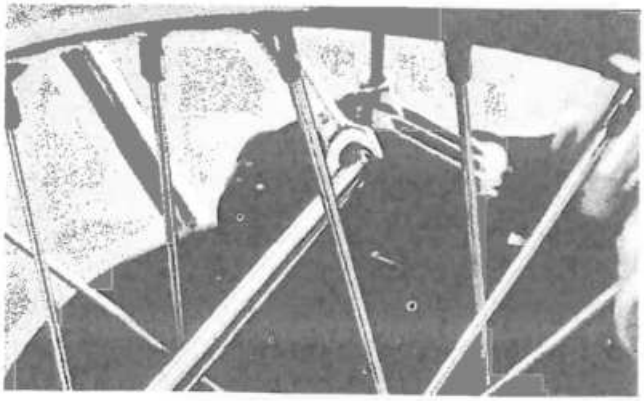
1. Fill with brake fluid so that the reservoir level reaches the specified line.
2. Install the diaphragm to trap the brake fluid.



3. Connect the vinyl tube to the caliper bleed screw tightely so that no brake fluid will leak out.



4. Place the clean container at the end of the vinyl tube.



5. Apply the brake lever slowly a few times. With the brake lever squeezed, loosen the bleed screw.
6. As fluid and air escape, the lever will close. Tighten the bleed screw before the lever bottoms on the handlebar grip.

Note:

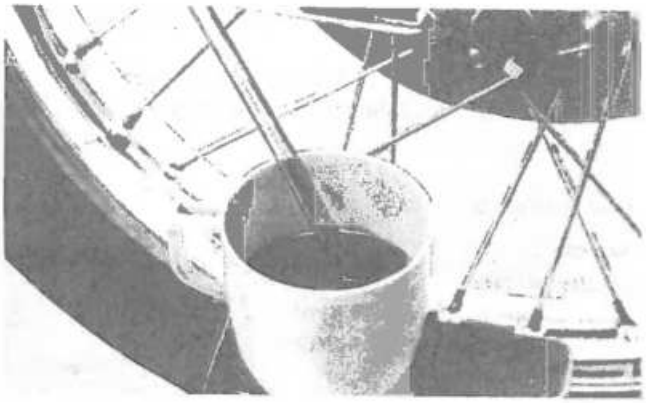
When bleeding the air, do not operate the brake lever quickly. Otherwise, the air will turn into the bubbles, thereby making the air bleeding difficult.

7. Repeat the procedures in 5) ~ 6) above until air bubbles will completely disappear in the vinyl tube.

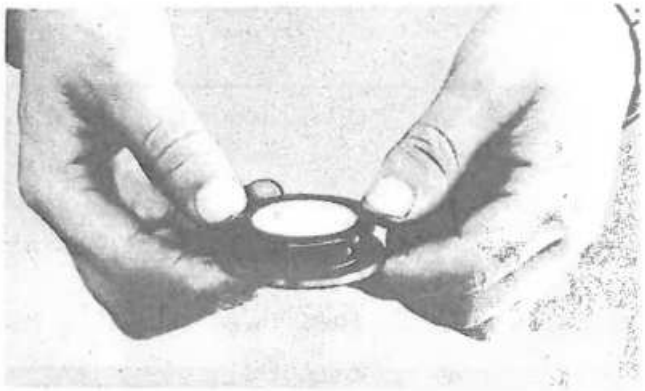
Note:

Bleed screw tightening torque: 60 ~ 90 kg-cm.

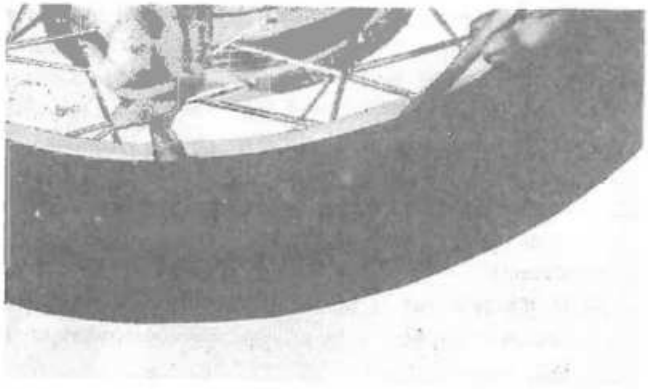
8. Refill with brake fluid so that the level will again reach the specified line.
9. The reservoir tank is of complete airtight design.
   When the pads become worn, the brake fluid level will lower, but the diaphragm will automatically adjust the brake fluid level by shifting its position.
   Therefore, when the reservoir tank is filled with the brake fluid, the diaphragm must be reset to its original position.





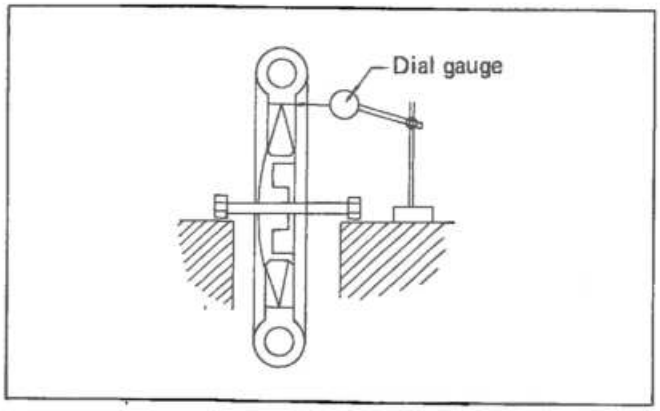


5-5. WHEELS



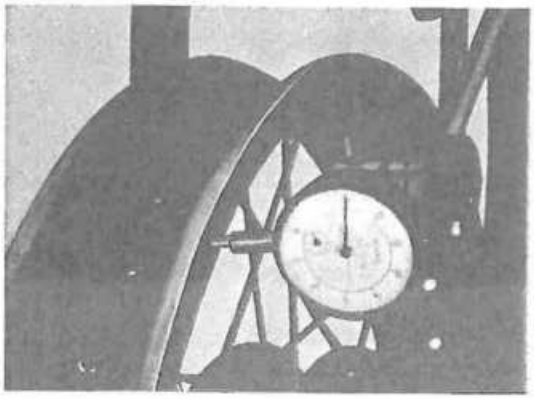
A. Tire and tube removal and installation

1. Whether it is the front tire to be changed, the procedure of tire and tube removal is identical. The explanation that follows is the proper method for both wheels.
2. Remove the valve cap, valve stem, and valve stem lock nut. Use two tire irons (with rounded edges) and begin to work the tire bead over the edge of the rim, starting opposite the tube stem. Take care to avoid pinching the tube. After one bead of the tire has been completely worked off the rim, slip the tube out. Be very careful not to damage the stem as it is pushed back out of the rim hole.
3. If the tire is to be completely removed, then work the tire off the same rim edge.
4. Installing the tire can be accomplished by reversing the disassembly procedure. The only difference in procedure would be to inflate the tube momentarily before both tire edges have been completely slipped onto the rim. This removes any creases that might exist. After the tire has been completely slipped onto the rim, check to make sure that the stem is squarely in the center of the hole in the rim. Then inflate the tube to 40 + psi several times. Check for leaks, and set at prescribed pressure.

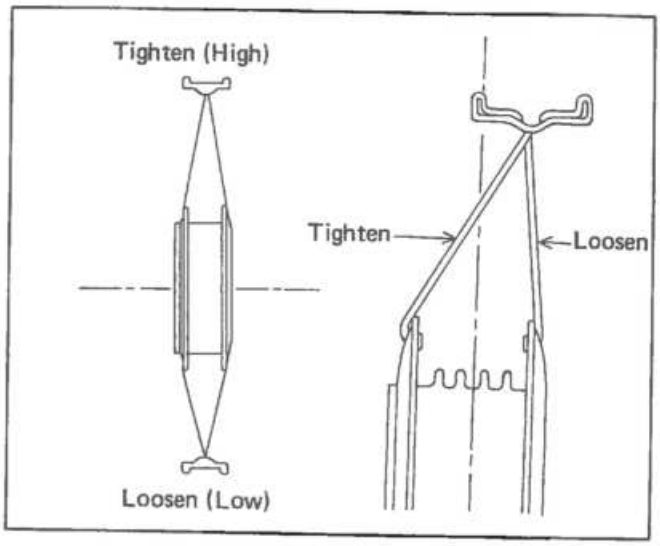


B. Rim and Spokes

1. A rim can develop warpage. It is due to (1) running the wheel into an object and bending the outer rim, or (2) one or more spokes loosening.

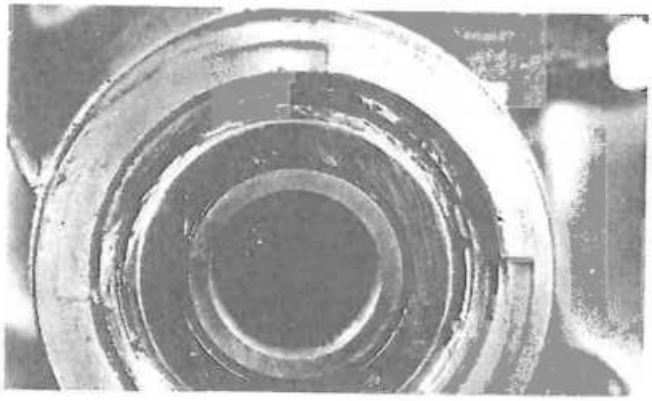


2. Check for warpage by mounting the wheel on a stand (or, if the wheel is attached to a motorcycle, it can be blocked up and held in place). Use some device to measure or detect movement then slowly spin the wheel and note the amount of rim "run-out". It should not exceed 1/16".
3. If all the spokes are tight, and the rim shows no obvious signs of damage, and yet run out is still excessive, do the following:
   a) If the run out is up and down, loosen the spokes opposite the high spot and tighten the spokes at the high spot.
   b) If the run out is sideways, loosen the spokes at the high spot, and tighten the spokes opposite the high spot.



C. Seals and Bearings

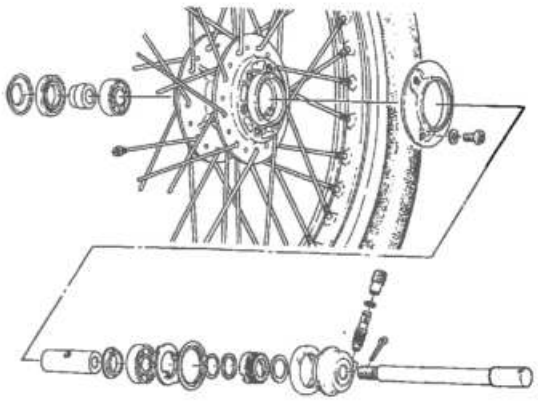
1. Wheel hub seals should be replaced every time they are pried out during repair, or if broken, cracked, or damaged in any way.
2. Check for smooth wheel bearing rotation. Dirt, rust spots, or any irregular surfaces will cause the bearing to hang up (will not spin smoothly). Remove the bearing, clean it, and check again. If the bearing still does not spin freely, replace it.



Note on Bearing Installation:

Be sure to grease the bearing before installation, using a quality bearing grease. In addition, during installation, protect the bearing to prevent dirt or contamination of any sort from entering the bearing.

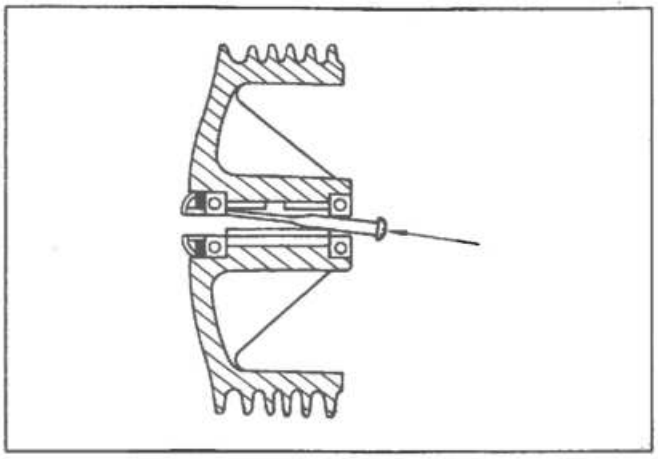
3. The wheel hub houses both bearings, a spacer between the bearings, an outer seal, and a metal cap outside the seal. Removal of the outer bearings requires that the seal be pried out.



5-6. REPLACING WHEEL BEARINGS

If the bearings allow play in the wheel hub or if wheel does not turn smoothly, replace the bearings as follows:

1. First Clean the outside of the wheel hub.
2. Drive the bearing out by pushing the spacer aside (the spacer "floats" between the bearings) and tapping around the perimeter of the bearing inner race with a soft metal drift pin and hammer. Both bearings can be removed in this manner.
3. To install the wheel bearing, reverse the above sequence. Be sure to grease the bearing before installation. Use a socket that matches the outside race of the bearing as a tool to drive in the bearing.



Installation

1. Lightly grease the lips of the front wheel oil seals and gear teeth of the speedometer drive and driven gears.

   USE LIGHT-WEIGHT LITHIUM SOAP BASE GREASE.

2. Position the oblong projection on the speedometer housing within the slot provided on the inside of the lower left fork leg.



After replacing wheel and axle, tighten axle nut FIRST and install a new cotter pin.

Note:

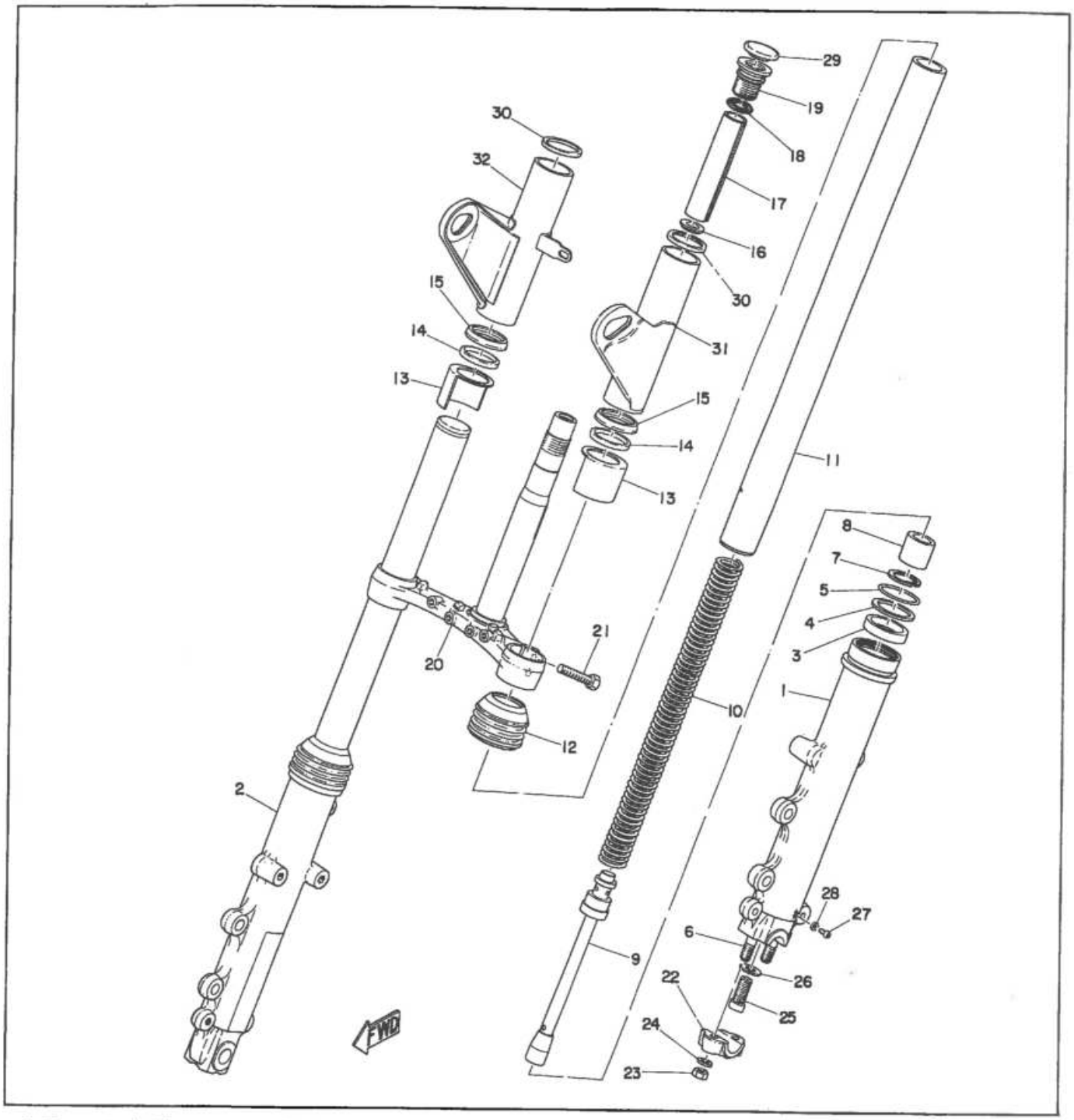
Align the groove of the spacer and the surface of the holder.

Axle nut torque:	900 – 1,100 in-lbs. (10 – 12 m-kgs.)

Then tighten the axle holder nuts.

Holder nut torque:	175 in-lbs. (2.0 m-kgs.)

5-7. FRONT FORKS



1. Outer tube (left)
2. Outer tube (right)
3. Oil seal
4. Oil seal washer
5. Oil seal clip
6. Bolt
7. Circlip
8. Piston
9. Cylinder comp.
10. Spring
11. Inner tube
12. Dust seal
13. Outer cover
14. Packing
15. Cover under guide
16. Spring upper seat
17. Spacer
18. O-ring
19. Cap bolt
20. Under bracket comp.
21. Bolt
22. Axle holder
23. Nut
24. Spring washer
25. Bolt
26. Packing
27. Drain plug
28. Packing
29. Cap
30. Cover upper guide
31. Upper cover (left)
32. Upper cover (right)

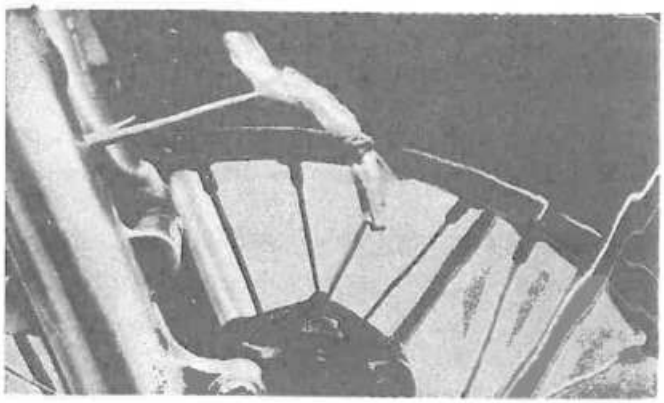
A. Outer Fork Leg Removal

Note:

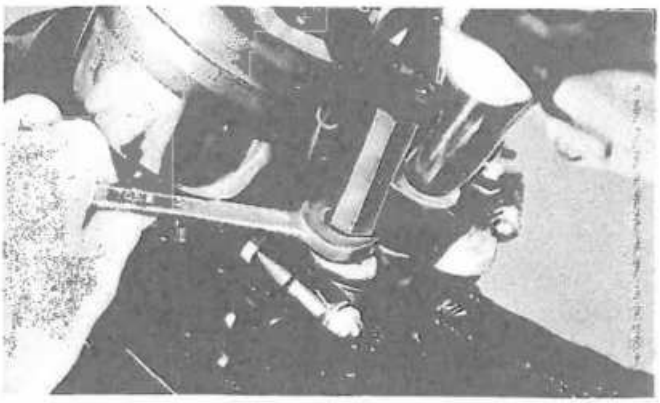
Remove the front wheel and front fender before starting this procedure.

When remove the right outer fork leg, brake hose must be removed at the top of the caliper.

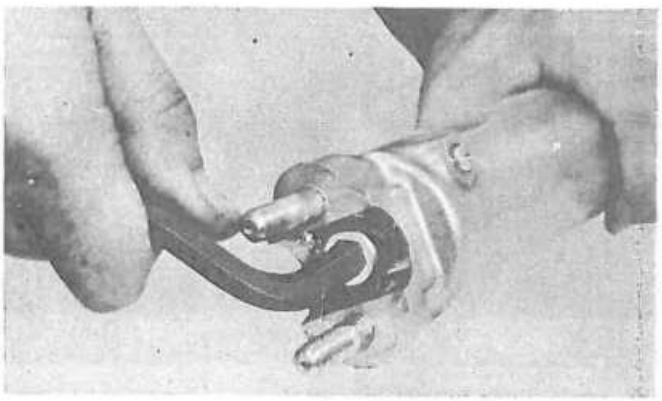
1. Remove the front fork leg from the chassis and drain the oil



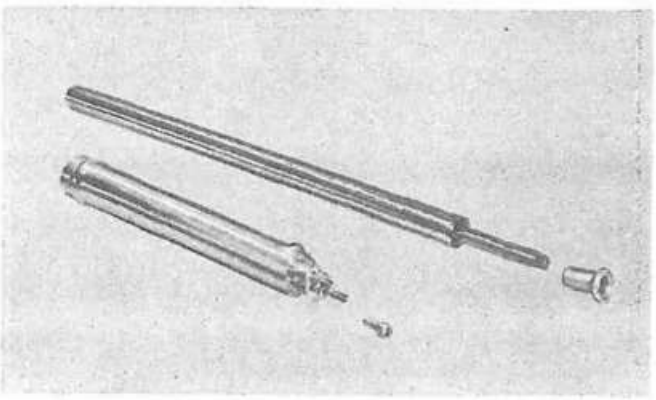
2. Remove the caps and drain the oil from both fork tubes.



3. Remove the special bolt from bottom of outer tubes.



4. Remove inner tube and damper assembly from outer tube.



B. Oil seal replacement

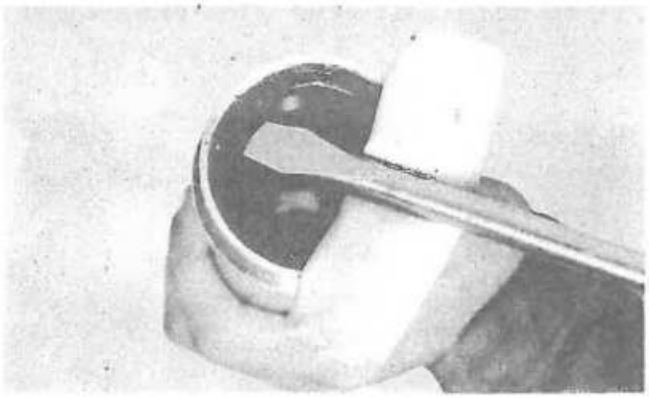
1. Remove the oil seal clip and washer.

Note:

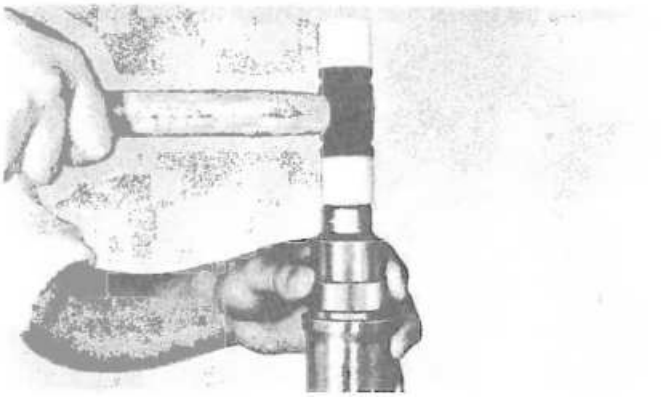
The oil seal that is pressed into the top of the outer tube should be replaced whenever the forks are disassembled



2. Carefully pry out old seal without damaging fork tube.



3. Insert new seal with "open" side down using large socket and soft hammer



C. Inspection

Inspect the inner tube for bends or scratches. If the bend is slight, it can be corrected with a press. It is recommended however, to replace the tube.

D. Assembly

1. When assembling the front fork, reverse the order of disassembly.
2. Installing the front forks.
   a) Bring up the front fork to the correct position and partially tighten the underbracket mounting bolt.
   b) Pour specified amount of oil into the inner tube through the upper end opening. Use 10W/30 "SE" motor oil.

Note:
Specialty type fork oils of quality manufacture may be used.

Fork oil capacity:	60 oz. (175 cc.) per side

c) Install the inner tube caps.

Inner tube cap torque:	900 in-lbs. (10 m-kgs.)

d) Tighten all pinch bolts.

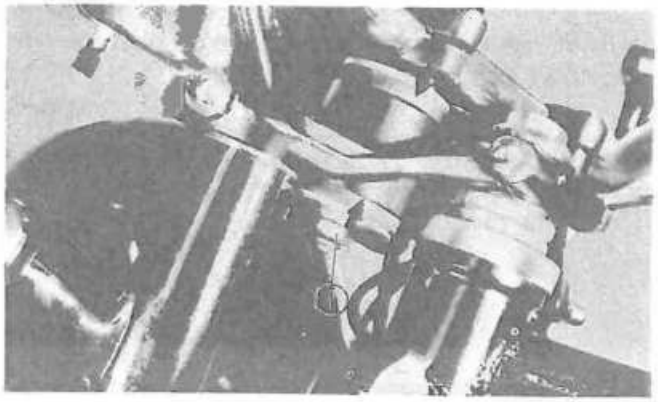
Pinch bolt torque:	70 – 100 in-lbs. (0.8 – 1.2 m-kgs.)

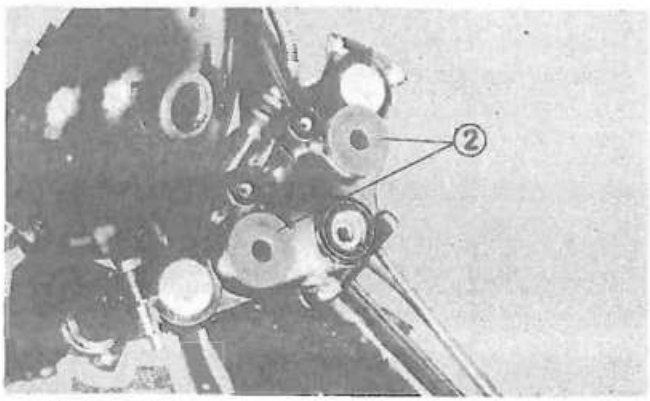
5-8. STEERING HEAD

A. Removal

Note:
The following procedures can be performed with the entire fork unit still attached.

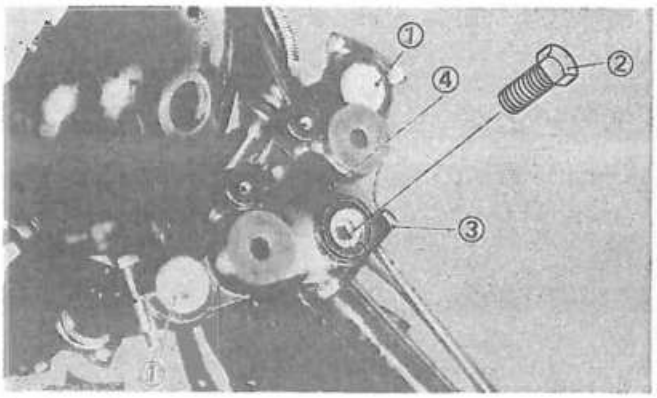
1. The handlebar holders are rubber mounted in the top handle crown. Remove the handlebar holder retaining nuts (1), then pull out the holders and rubber cushions (2).





Rubber cushion

2. Loosen the handle crown lock bolt and unscrew the steering stem nut. Remove the front fork bolts. The handle crown can now be removed.



1. Front fork bolt
2. Steering stem nut
3. Lock bolt
4. Handle crown

3. Remove steering ring nut with steering nut wrench.

Caution:

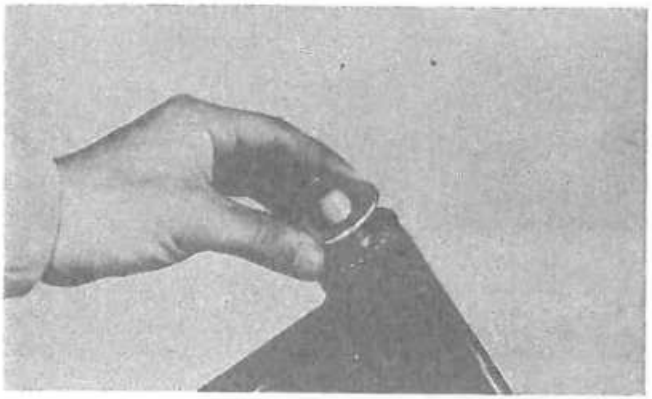
Support ''under bracket'' with one hand to hold the bracket up into the headstock so that the loose bearings will not fall out.

4. While still supporting the "under bracket", carefully lift off the upper bearing cover.



5. Lift off the top bearing race and remove all of the ball bearings from the upper bearing assembly.

Ball quantity/size: 22 3/16 ins.

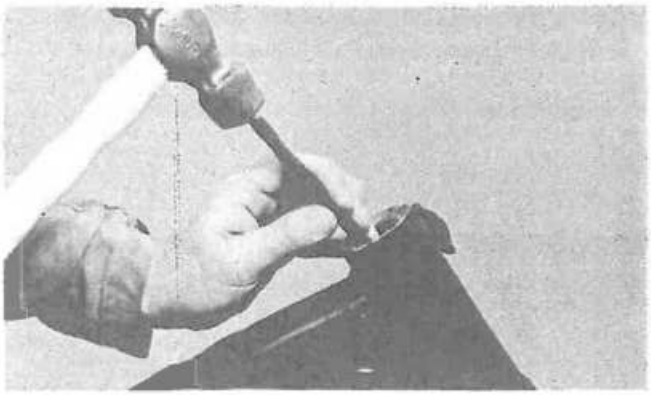


6. Remove bracket while being very careful not to lose any bearings from the lower assembly.

Ball quantity/Size: 19 1/4 ins.



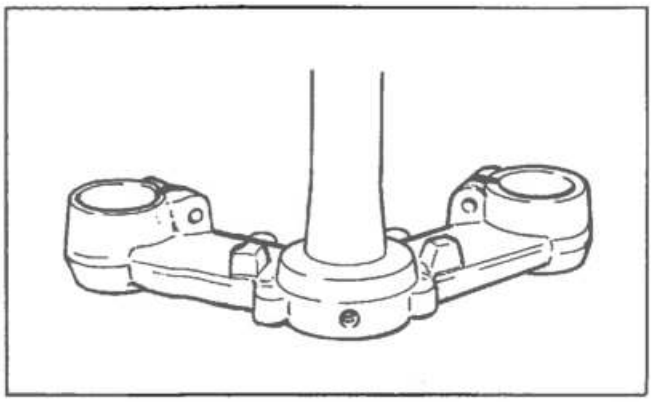
7. Remove races from head pipe using drift punch and hammer as sshown Work the race out gradually by tapping lightly around its complate diameter.



8. Remove the bearing race from the lower bracket by tapping around its diameter with a drift punch and hammer.

Note:

Remove dust seal

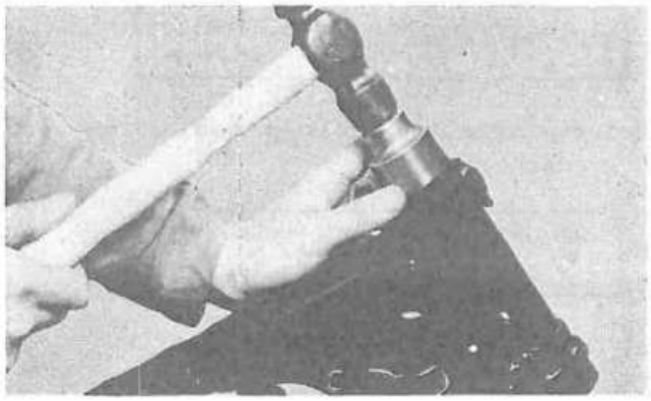


B. Inspection

1. Examine all the balls for pits or partial flatness. If any one is found defective, the entire set (including both races) should be replaced. If either race is pitted, shows rust spots, or is damaged in any way, replace both races and all balls.
   Examine dust seal under lowest race and replace if damaged.

C. Installation

1. If pressed in races have been removed, tap in new races.



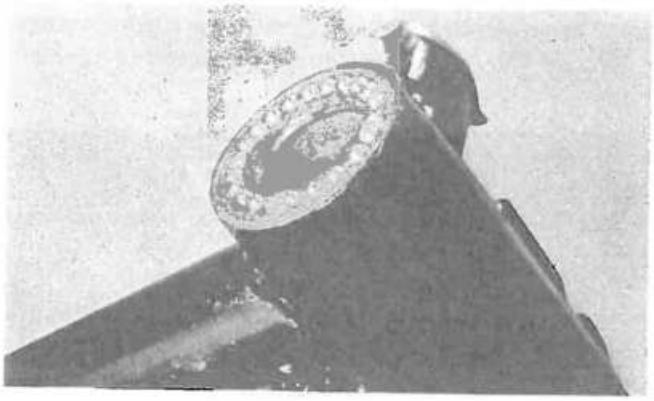
2. Grease the lower ball race of the bottom assembly and arrange the balls around it. Then apply more grease.



3. Grease the lower ball race of the upper assembly and arrange the balls around it. Then apply more grease and set the top race into place.

Note:

Use medium-weight wheel bearing grease of quality manufacturer-preferably waterproof.



4. Carefully slip the underbracket stem up into the steering head. Hold the top bearing assembly in place so the stem does not knock any balls out of position.
5. Set the upper bearing cover on and install the ring nut. Tighten the ring nut so that all freeplay is taken up, but so the bracket can still pivot freely from lock to lock. Recheck for free play after the entire fork unit has been installed. (Refer to Section 2-4, G for adjustment procedure.)
6. Install the fork tubes into the underbracket to ease headlight body installation.
7. Install the headlight-body and stays onto the fork tubes with all rubber and steel spacing washers properly in place.
8. Install the upper fork bracket. Tighten steering fitting bolt then tighten stem pinch bolt. Torque to specification.

Steering fitting bolt:	
Stem pinch bolt:	140 – 200 lbs. (1.6 – 2.4 m-kgs.)

9. Tighten upper fork tube pinch bolts and torque to specification.

Upper fork tube pinch bolt torque:
70 – 100 in-lbs. (0.8 – 1.2 m-kgs.)

Note:

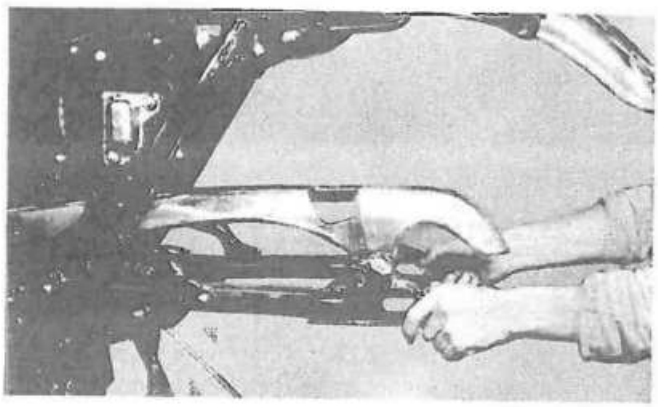
Make certain that tops of fork tubes are adjusted to the same level. If necessary, loosen underbracket pinch bolts and adjust.

10. Install handlebars and torque to specification.

Handlebars mounting bolt torque:
100 – 160 in-lbs. (1.1 – 1.8 m-kgs.)

11. Reconnect all electrical wiring and check operation.
12. Install headlight and check operation.
13. Install front wheel.
14. Reconnect speedometer and tachometer cables.
15. Reconnect clutch, front brake and throttle cables and check operation.

5-9. SWING ARM



A. Swing arm inspection

1. With rear wheel and shock absorbers removed, grasp the ends of the arm and move from right to left to check for freeplay.

Swing arm freeplay: 0.04 in. (1.0 mm.)

2. If freeplay is excessive, remove swing arm and replace swing arm bushing.

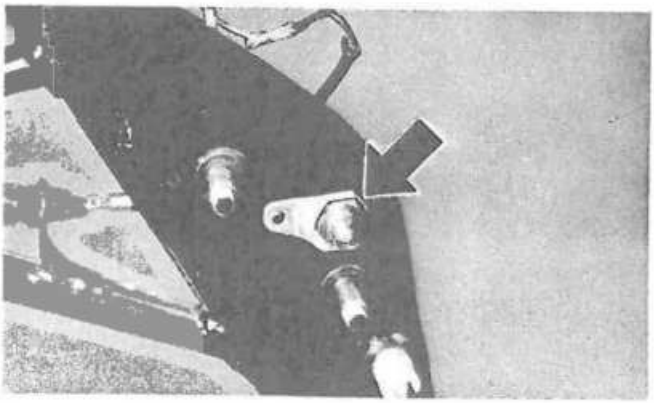
B. Swing arm lubrication

1. Apply grease to grease fitting on top of pivot with low pressure hand operated gun. Apply until fresh grease appears at both ends of pivot shaft.

Recommended lubricant: Smooth chassis lube grease

2. Wipe off excess grease.

C. Swing arm removal

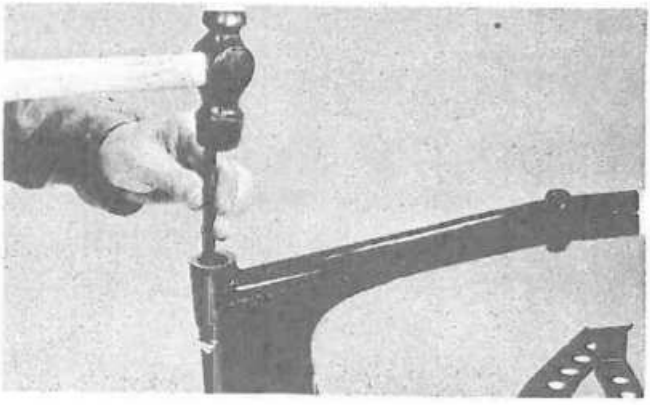


1. Remove nut on swing arm pivot bolt and tap out bolt with a long aluminum or brass rod.

Note:

Carefully remove the arm while noting the location of spacing washers and shims.

Pivot bolt torque:	862 – 955 in-lbs. (10 – 11 m-kgs.)



2. Tap out old bushing from each side of pivot using the long rod.
3. Install new bushings using a press.

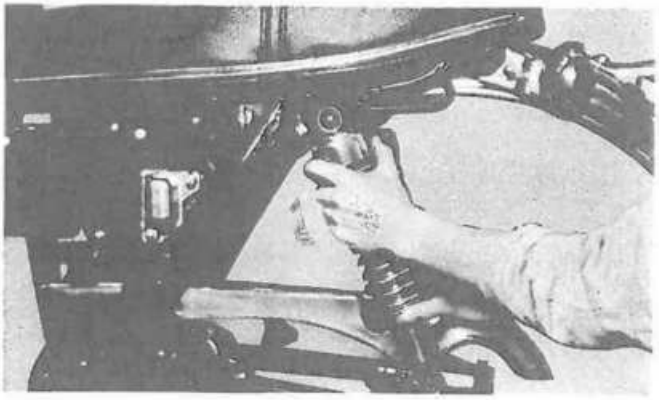
Note:

If tapping on bushing, bushing may be broken.

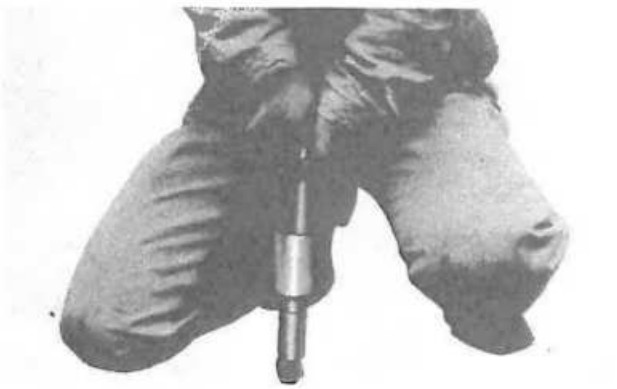
5-10. REAR SUSPENSION

Rear Suspension

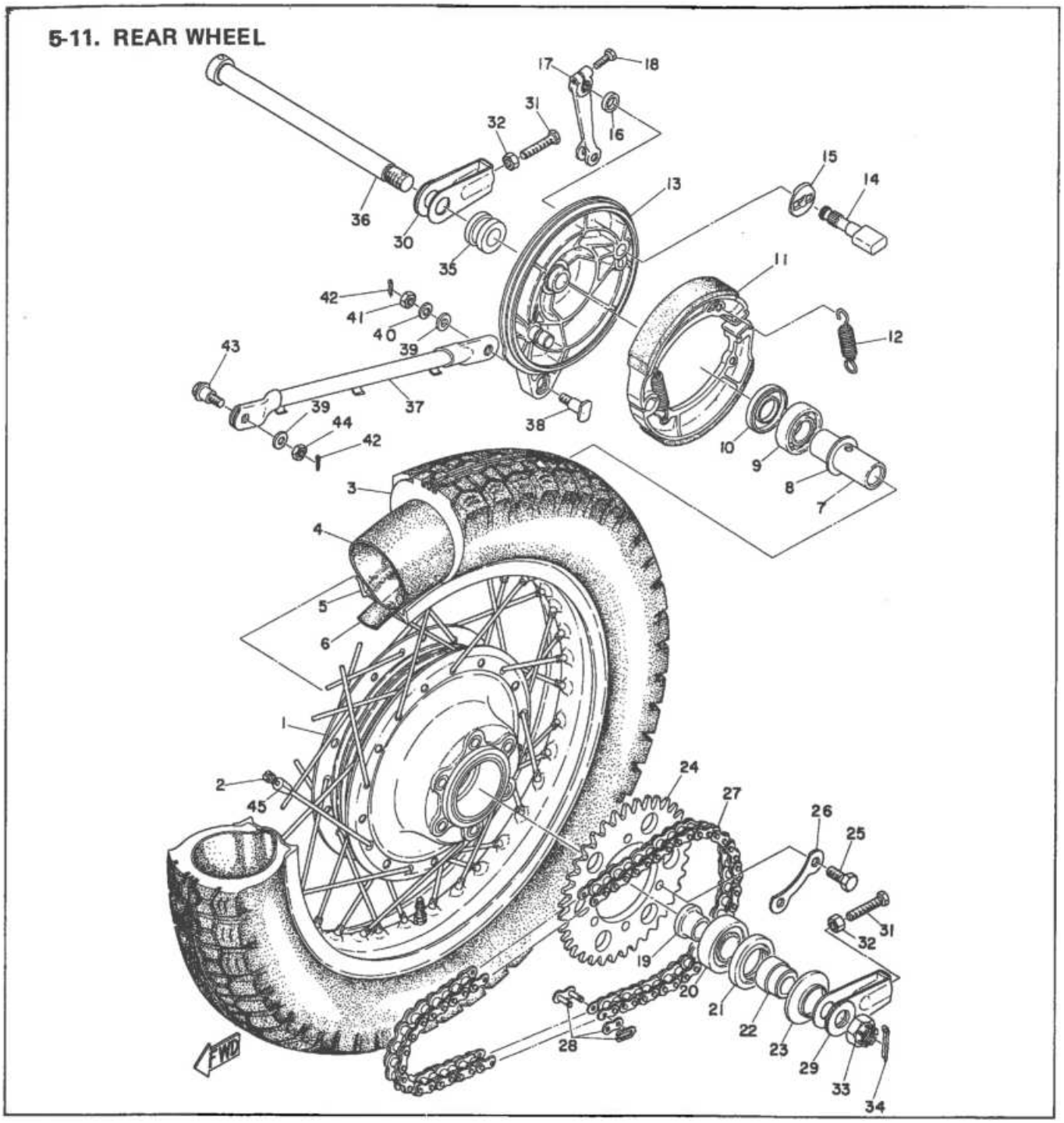
1. Removing Both Mounting Bolts.
   Remove both mounting bolts and pull the suspension unit out of the frame and swing arm mounts.



2. Wear
   A unit that has lost its suspension qualities will compress quite easily and rebound quickly. To test the effectiveness of the unit, compress it as far as possible and then immediately take all weight off the shock. A suspension unit that is working properly will rebound quickly half-way and then slowly expand the second half. A defective shock will rebound to its fullest length without hesitation.



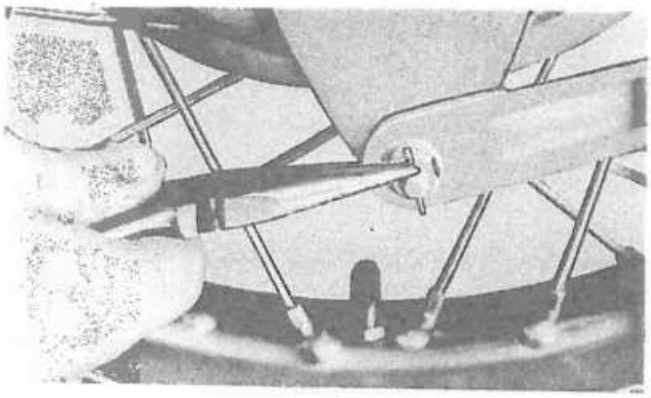
5-11. REAR WHEEL

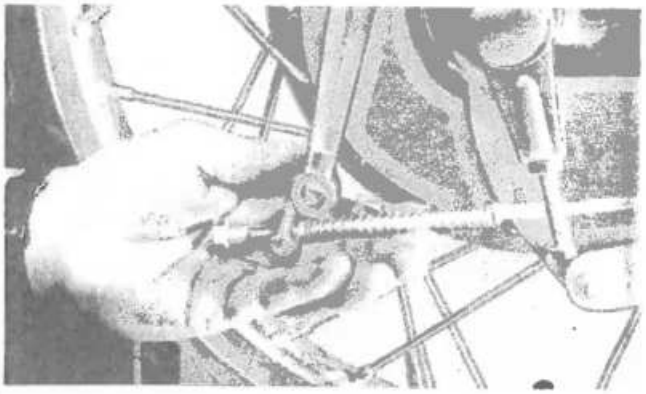


1. Rear hub
2. Spoke set
3. Rear tire
4. Tube
5. Rim
6. Rim band
7. Bearing spacer
8. Spacer flange
9. Bearing
10. Oil seal
11. Brake shoe comp.
12. Return spring
13. Brake shoe plate
14. Cam shaft
15. Cam shaft shim
16. Cam shaft seal
17. Cam shaft lever
18. Bolt
19. Collar
20. Bearing
21. Oil seal
22. Shaft collar
23. Dust cover
24. Sprocket wheel gear
25. Fitting bolt
26. Lock washer
27. Chain
28. Chain joint
29. Chain puller (left)
30. Chain puller (right)
31. Chain puller bolt
32. Nut
33. Shaft nut
34. Cotter pin
35. Wheel shaft collar
36. Wheel shaft
37. Tension bar
38. Tension bar bolt 2
39. Plain washer
40. Spring washer
41. Nut
42. Cotter pin
43. Tension bar bolt 1
44. Nut
45. Wheel balancer

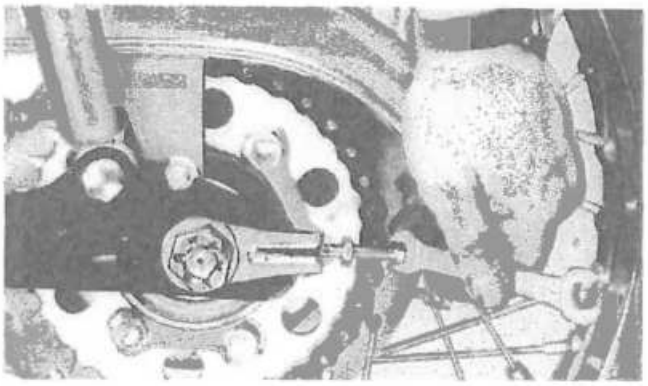
A. Removal

1. Disconnect the tension bar and the brake rod from the rear shoe plate. Pay strict attention to the presence and location of the tension bar lock washer and cotter key. These are safety parts and must be included during assembly.

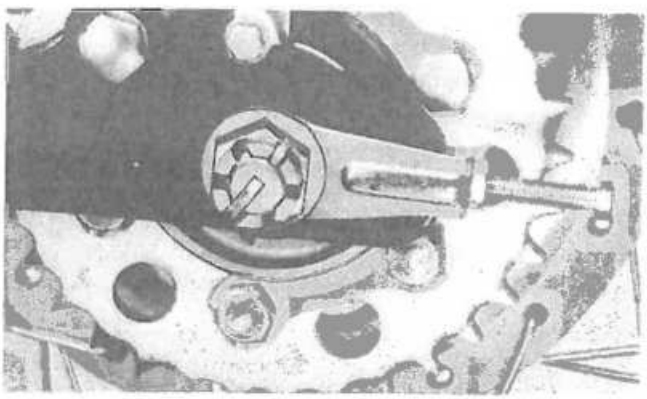




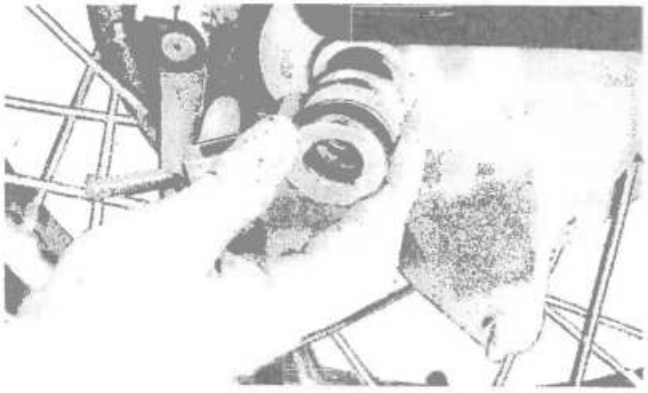
2. Loosen the chain tension adjusting nuts and bolts on both right and left sides.



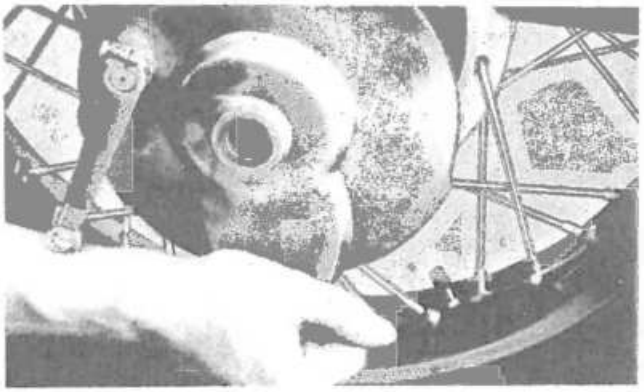
3. Remove the rear axle cotter pin.
4. Remove the rear axle securing nut.



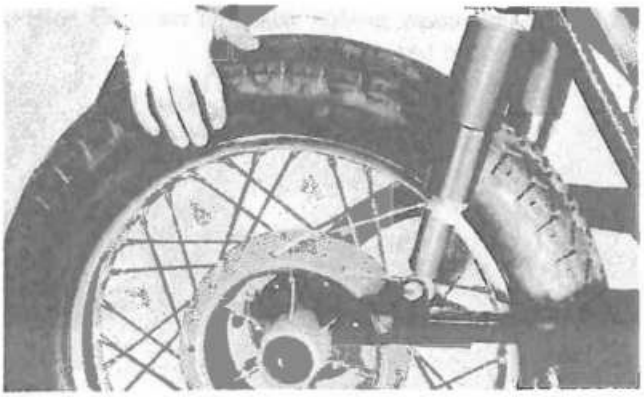
5. Remove the right-hand chain adjustor and distance collar.



6. Remove the rear brake plate.

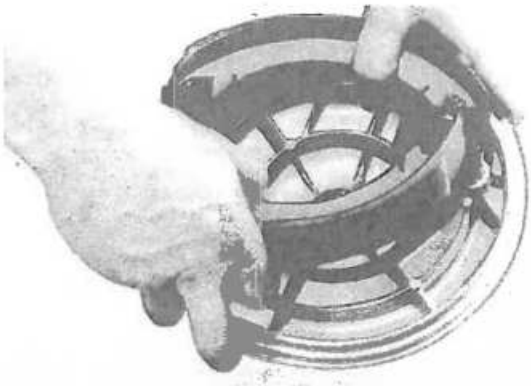


7. Lean the machine to the left and remove the rear wheel assembly.



B. Disassembly and assembly

1. Both sides of the single leading shoe unit are mounted on the brake plate. To remove the shoes, pull them out and away from the anchor pin and brake actuating cam.



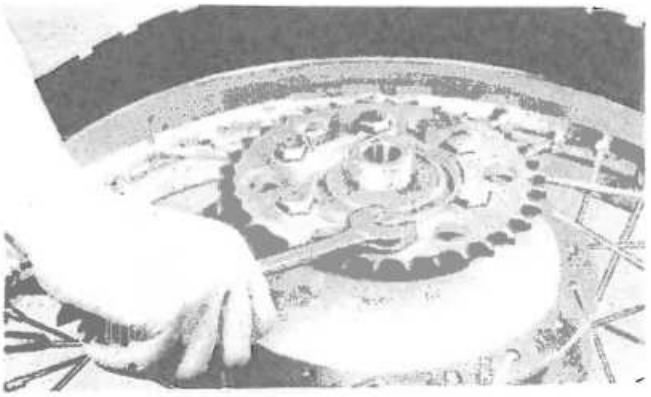
2. Both wheel bearings are mounted in the hub. Their removal can be completed by following the removal procedures explained just previously in the "Seals and Bearings" section, except that the rear wheel has two seals, located one outside each bearing.

C. Rear wheel sprocket

1. Bend the lock washer ears flat.

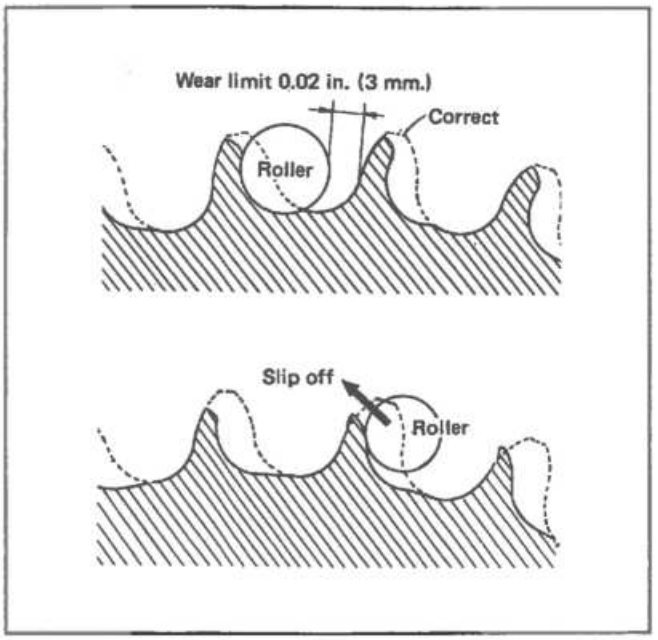


2. Remove the sprocket mounting bolts. Check the lock washer and bolt for damage. If the lock washer is not bent over the hexagon bolt head, or is broken, or the bolt is loose, the sprocket can come loose.



Note on installation:
Be sure that all lock tabs are not cracked or broken and that they are all bent up against the bolts.

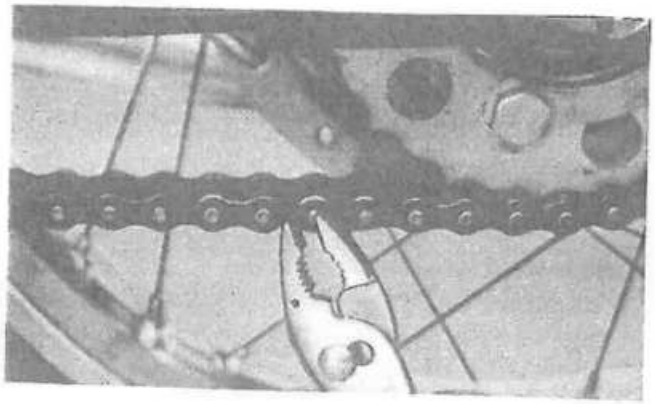
3. Constant friction and force from the chain creates wear on the sprocket teeth. If wear has progressed to the extent shown in this illustration, replace the sprocket.



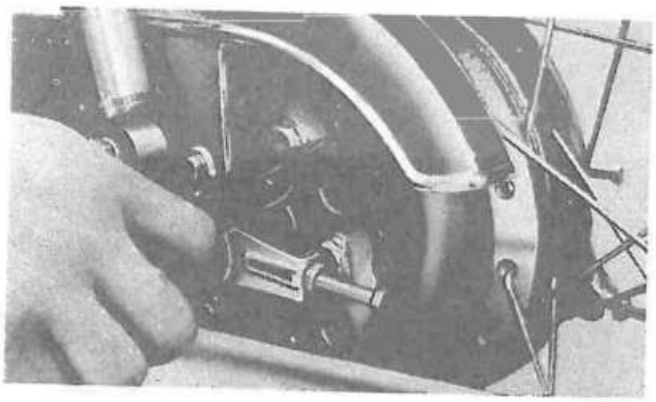
5-12. DRIVE CHAIN

A. Removal and installation

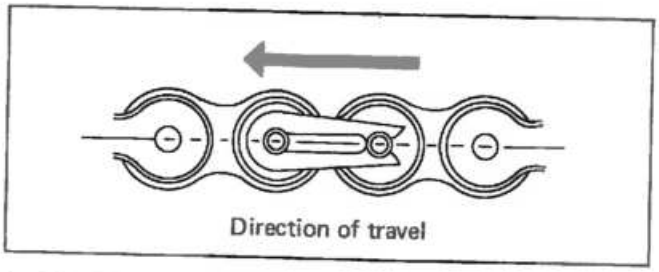
1. Rotate the rear wheel unit the master link is on the sprocket then pry off the master link clip and pull out the master link.



2. To aid in installation lay the chain free ends over the rear wheel sprocket. This holds both chain ends solidly to permit master link insertion. Complete the installation by installing the master link clip.

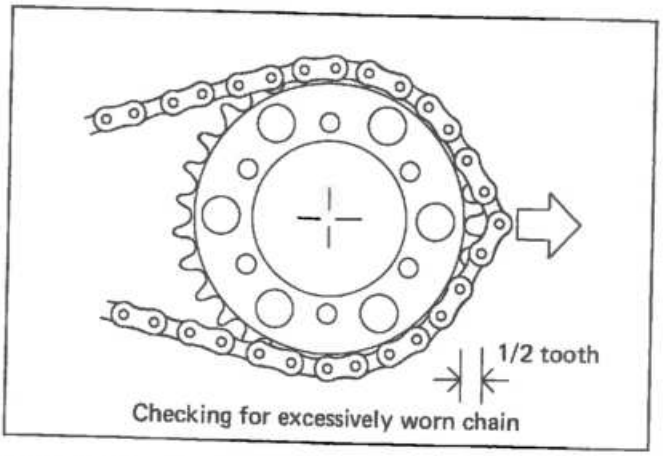


3. Whenever installing the chain, always install the master link retaining clip so that the rounded closed end faces the direction of travel.

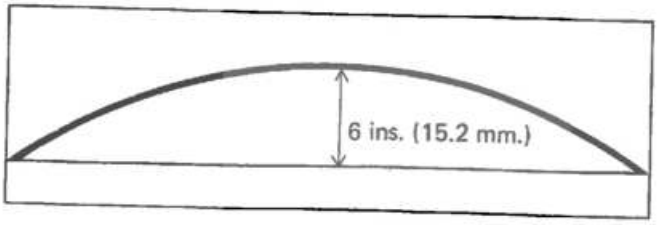


B. Wear

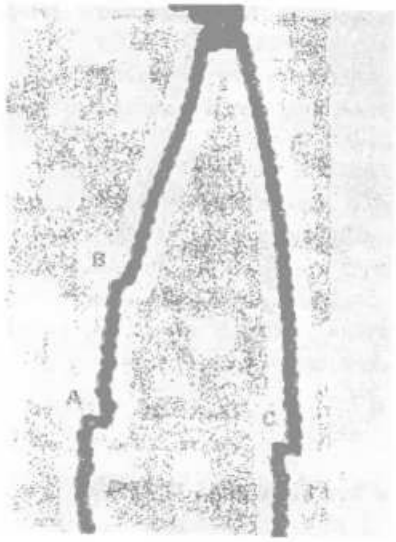
1. With the chain still on the motorcycle, lift the chain away from the rear wheel sprocket. A chain is defective if it can be pulled away from the sprocket more than half the length of a link.



Checking for excessively worn chain



2. Check the chain for binding caused by dirt or rust. Hang the chain straight down and check all links for indications of binding (A, B & C in the picture). If soaking in a strong solvent does not remove the binding situation then replace the chain.

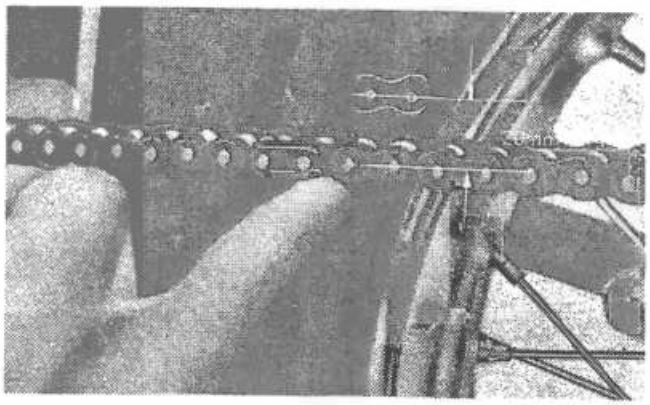


C. Maintenance

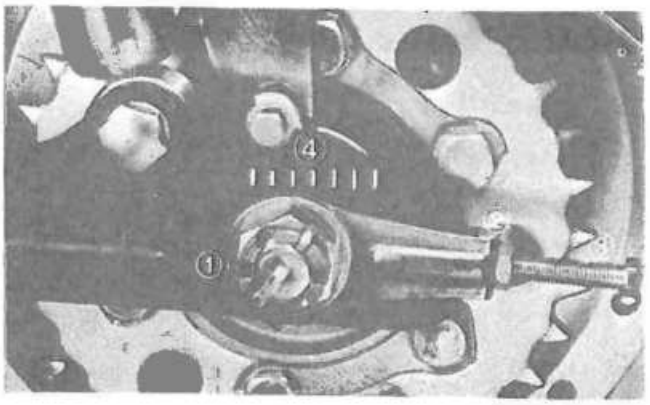
1. Lubrication-there are several pressure can lubricants available. Use a rag to wipe off any accumulation of dirt, then spray a liberal amount of lubricant on the chain at least every 200 miles (300 km.).
2. Cleaning the chain has to be periodically removed from the machine and soaked in cleaning solvent. Drain and dry the chain. Immediately after the chain has dried completely, lubricate to prevent any rust from forming.

D. Adjustment

1. Proper drive chain up and down free play with the rider in position and both wheels on the ground should equal 0.75 in. (20 mm.) when measured at the center of the lower section of chain. Follow these steps to obtain the correct free play:



2. Remove the cotter pin and loosen the rear wheel nut (1).
3. Loosen the chain adjusting bolt lock nut (2) on each side.
4. Rotate both adjusting bolts (3) to obtain the correct free play, and at the same time make sure that both ends of the axle are positioned evenly. This can be done by matching the marks on the sides of the swing arm (4) just above and to the rear of the rear wheel nuts.



1. Lock nut
2. Adjustor lock nut
3. Adjustor
4. Alignment marks

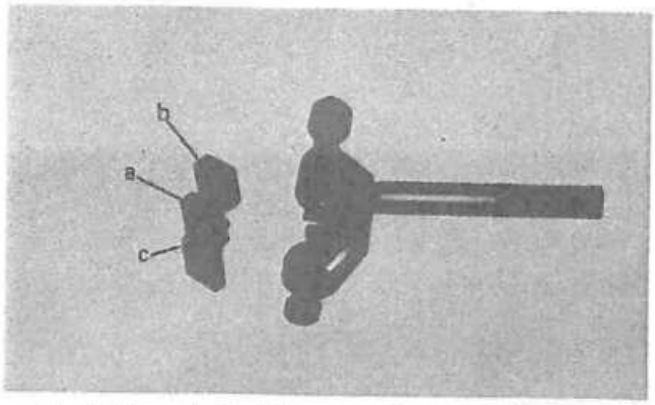
5. After completing the adjustment, retighten all lock nuts.
6. Finally, check for correct brake pedal and stoplight operation as they could have changed due to the chain adjustment.

A worn chain causes wear to both sprockets. If either sprocket is excessively worn, it can cause a new chain to wear out prematurely. Strict attention should be paid to the condition of all three components if any one is replaced. Possibly two or all three components might require replacement if wear is excessive.

E. Removal and installation (TX650)

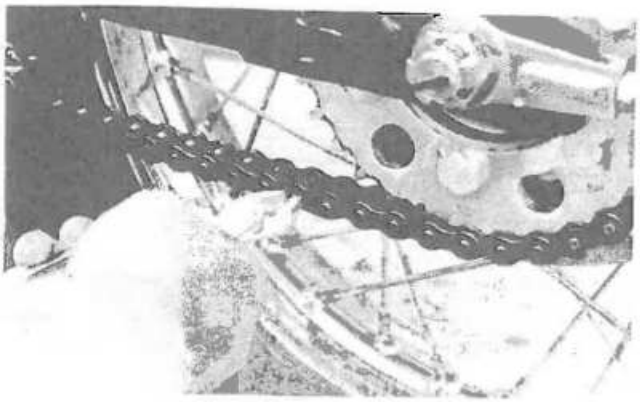
On the SX650B, the drive chain joint plate is press-fitted. To remove or to install, a special tool is required.

1. Removal
   a) The chain cutter is required.

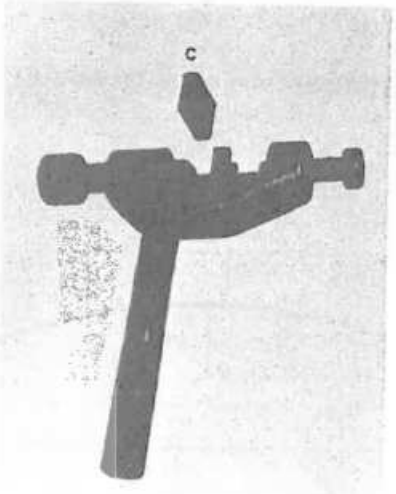


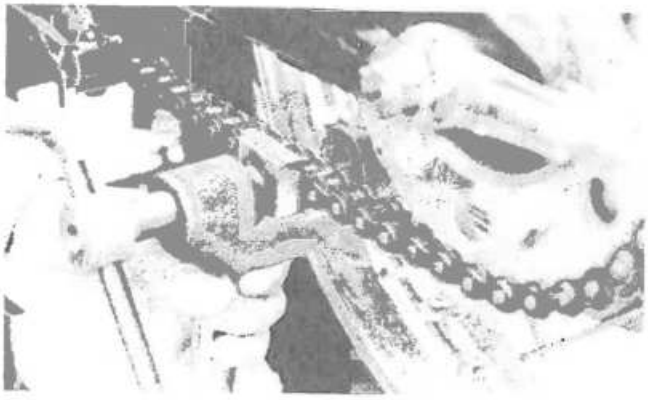
a. Press fitting adaptor (1)
b. Press fitting adaptor (2)
c. Press removing adaptor

b) Bring the master link clip slightly before the sprocket wheel, and remove the clip.

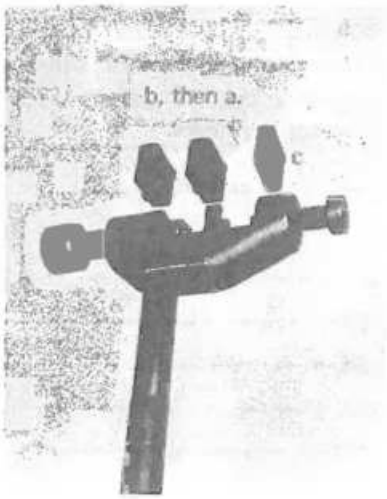


c) Set the chain cutter on the chain, and remove the chain joint plate.
Then, cut the chain.

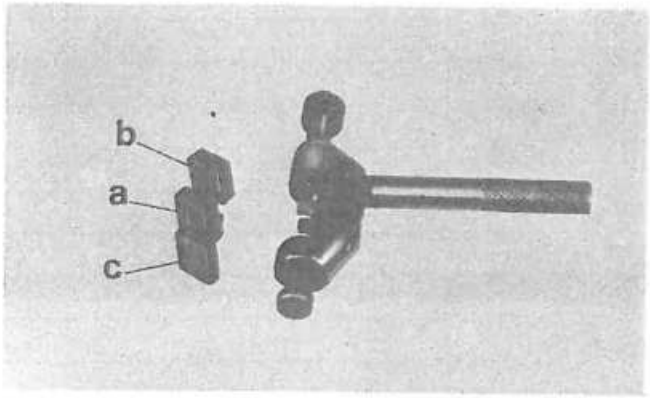




2. Installation
   a) Attach the adaptor (for press-fitting) to the chain cutter.



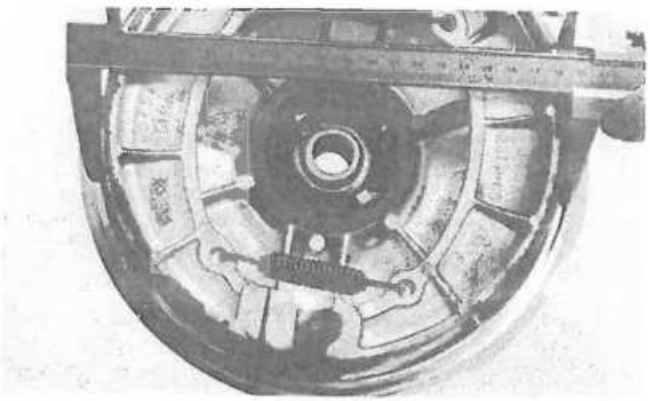
   b) Connect the chain on the sprocket wheel.
   Next, turn the sprocket wheel so the joint is positioned slightly before the sprocket wheel.
   Attach a new chain joint plate, and press-fit the joint plate in position using the special tool (the chain cutter fitted with the adopter for press-fitting).



a. Press fitting adaptor (1) c. Press removing adaptor
b. Press fitting adaptor (2)

5-13. BRAKE SHOES

1) Use a vernier caliper to measure the outside diameter of the installed brake shoes and individual shoe linings. If either measurement proves any part of the brake unit to be excessively worn, replace both shoes with a new set.

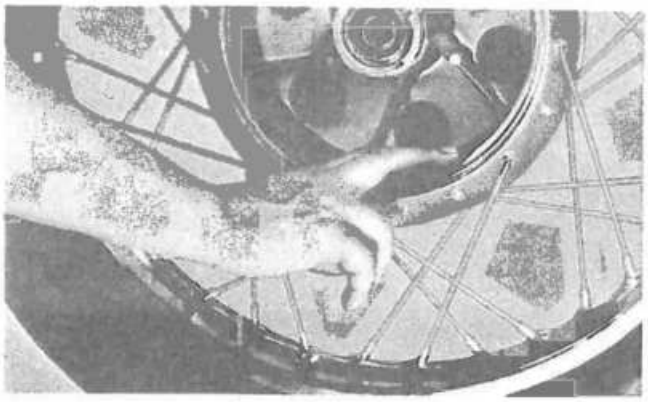


2) Check for brake shoe high spots that cause uneven contact with the brake drum. Remove these high spots with a file or emery cloth.
3) Friction heat can glaze the brake shoe surface. This causes less than maximum stopping efficiency. Use a file or rough emery cloth to evenly rough up the surface.

	STD.	Wear Limit
Shoe Outside Diameter	6.772" (172 mm.)	6.612" (168 mm.)
Lining Thickness	160" (4 mm.)	.080" (2 mm.)

5-14. BRAKE DRUM

1) Grease on the brake drum causes improper braking performance. Thoroughly clean the surface with a rag soaked in solvent.
2) Any ridges or glazing that might exist on the brake drum surface can impair the operation. Use emery cloth to lightly sand out any ridges.

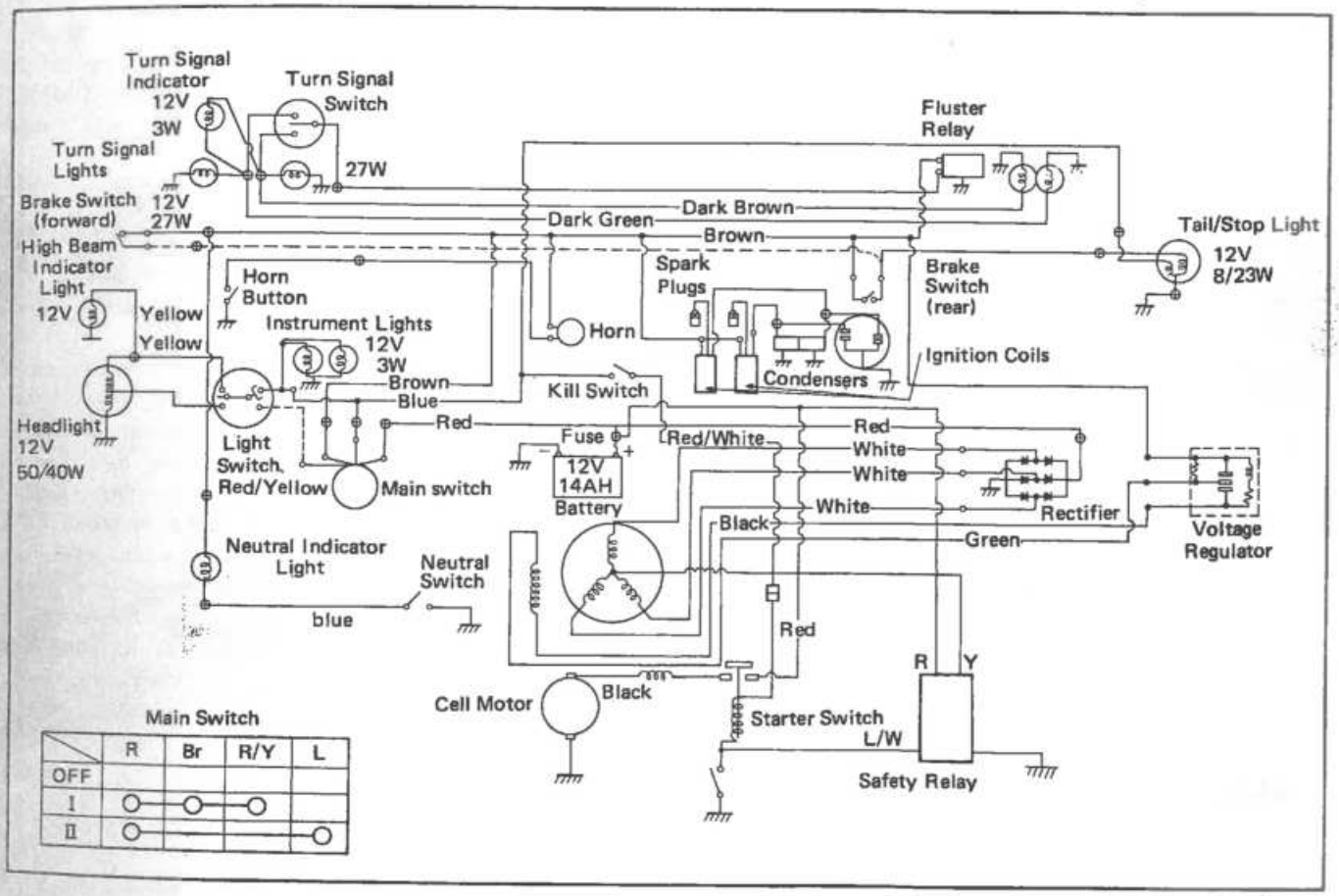


CHAPTER 6. ELECTRICAL

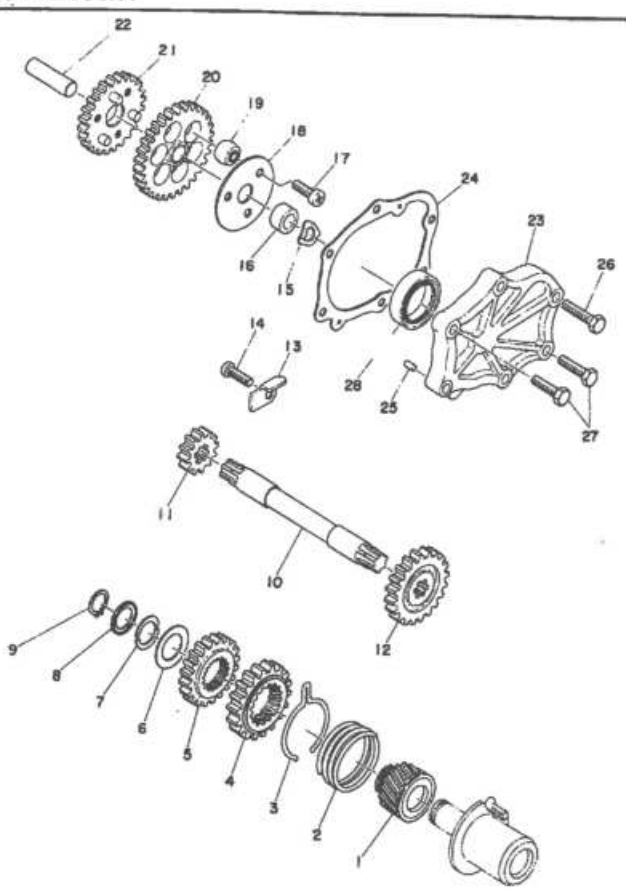
6-1. ELECTRIC STARTER 137
A. Construction 139
B. Specifications 139
C. Disassembly 141
D. Servicing and Troubleshooting 141
6-2. REGULATOR 147
6-3. RECTIFIER 148
6-4. ROTOR (ALTERNATING CURRENT GENERATOR) 149
6-5. STATOR (ALTERNATING CURRENT GENERATOR) 149
6-6. TROUBLESHOOTING 149
A. Charging Voltage Output 150
B. Broken Wires 150
C. Regulator 150
D. Rectifier 152
E. Ignition Breaker Points 154
F. Advance Assembly 156
G. Condenser 158
H. Ignition Coil 159
6-7. SPARK PLUG 160
A. How to "read" Spark Plug (Condition) 160
B. Inspection 161
6-8. MAIN SWITCH 161
A. Main Switch 161
B. Location and Replacement 161
C. Troubleshooting 162
6-9. LIGHTING CIRCUIT 163
A. Headlight 163
B. Turn Signals 163
6-10. BATTERY 164
A. Servicing a New Battery 164
B. Battery Maintenance 164
C. Charging 165
D. Trouble Shooting 165
E. Storage 166

The XS650B electrical system uses an alternator to generate voltage which is then rectified to direct current. This direct current voltage is controlled by a voltage regulator which is set to maintain a 14 ~ 15V DC constant.

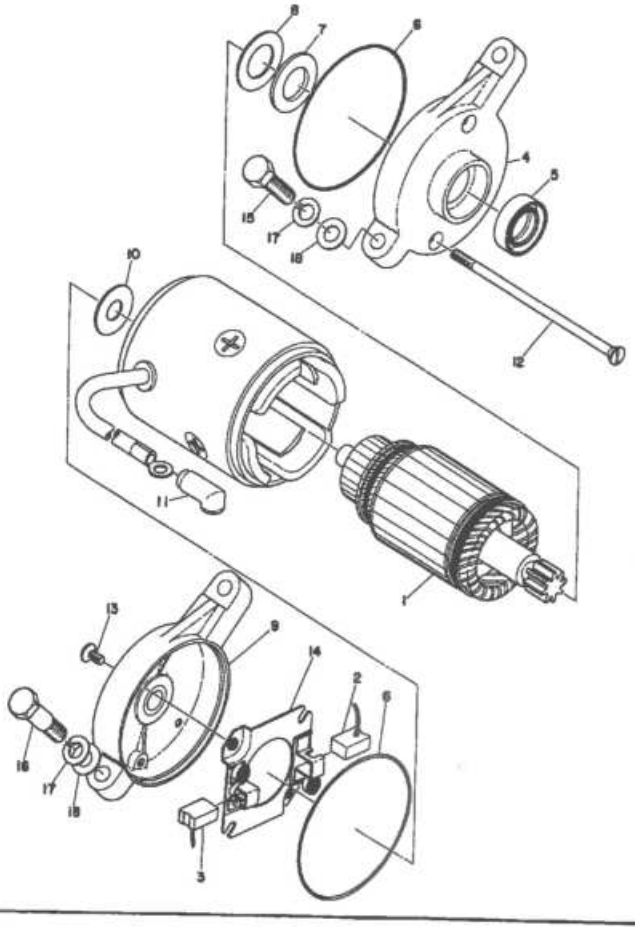
When the engine is stopped, a direct current to energize the lighting and ignition circuits is supplied by the battery, when running, it is supplied by the alternator/rectifier/regulator circuit. Excess voltage is shunted to the battery, if necessary, for recharging. If unneeded, the voltage regulator will decrease alternator output.



6-1. ELECTRIC STARTER

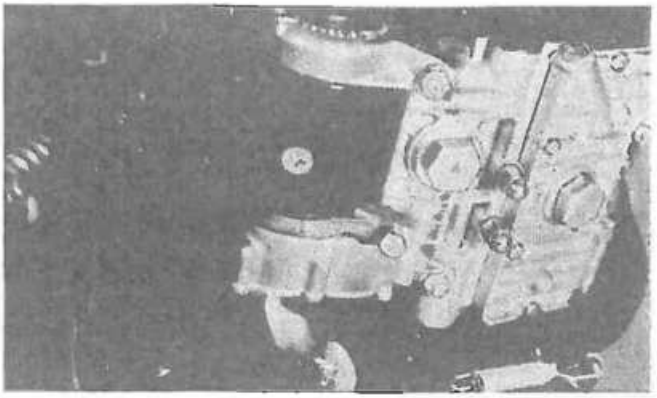


1. Starter wheel
2. Return spring
3. Starter clip
4. Gear 4
5. Gear 3
6. Washer
7. Clip
8. Clip holder
9. Circlip
10. Shaft 2
11. Gear 2
12. Gear 1
13. Stopper plate
14. Panhead screw
15. Wave washer
16. Collar 1
17. Panhead screw
18. Idle gear plate
19. Absorber
20. Idle gear 1
21. Idle gear 2
22. Shaft 1
23. Gear train cover
24. Gear train cover gasket
25. Dowel pin
26. Bolt
27. Bolt
28. Oil seal



1. Armature
2. Brush 1
3. Brush 2
4. Electric motor cover 1
5. Oil seal
6. O-ring
7. Special washer
8. Thrust washer 1
9. Electric motor cover 2
10. Thrust washer 2
11. Cap
12. Special screw
13. Flat head screw
14. Brush holder
15. Reamer bolt
16. Bolt
17. Spring washer
18. Plain washer

A. Construction

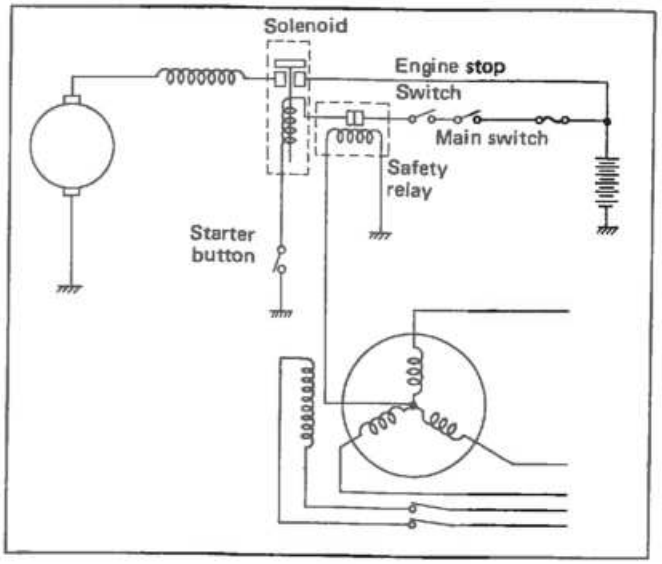


The starter motor is located under the crankcase. An idler gear is attached to the shaft. Torque from the motor, during operation, is transmitted from the idler gear, through the three reduction gears to the splined engagement gear (gear 4). The engagement gear works in the same manner as a splined kick gear, moving out to engage the gear mounted on the outer half of the right-hand crankshaft half. In this fashion, torque from the starter motor is transmitted to the crankshaft. As the engine starts, gear 4 is automatically disengaged.

The starter motor itself is a series-winding, 12 volt D.C. motor which draws 150 amps or less initially. (When the decompression lever is squeezed, at 20°C.)

A safety relay is incorporated within the starting circuit to automatically open the circuit when the engine fires. This provides for immediate disengagement of the starter motor gear train and, in addition, prevents the starter motor from over-revolving through a no-load condition as gear 4 disengages.

Operation



The electric starter switch closes. This creats current flow in the starter motor solenoid's windings and the solenoid closes.

When the solenoid (starting motor switch) closes, a direct circuit from the battery to ground through the motor circuit is created. Resistance is extremely low in this circuit and, consequently, a heavy current flow passes through the motor to ground, causing the motor to turn. As the engine starts, the ACG begins to generate voltage. As voltage rises to 4 V (±0.5 V) the safety relay opens. This opens the circuit to the cell switch which in turn opens the circuit to the solenoid. With no current flow in the solenoid windings, the solenoid arm return spring opens the heavy duty circuit between the battery and starter motor. The starter motor stops turning and the splined engagement gear (gear 4) returns to the "rest" position.

B. Specifications

Note:

The following specifications should be referred to while disassembly and troubleshooting (explained in following chapters) is taking place.

COMPONENT	ITEM	MAINTENANCE STANDARDS	REMARKS
Motor			
FIELDS	Resistance	0.05 ohms (20°C)	
BRUSH	W x T x L	16 x 7 x 11 mm.	
	Limit length	4.5 mm.	
AMATURE	Resistance	0.055 ohms (20°C)	No Grounded core
COMMUTATOR	Diameter, New	33ϕ	
	Wear limit	32ϕ	
	Mica undercut	0.5 – 0.8 mm.	
	Undercut limit	0.2 mm.	
	Max. allow runout	±0.15 mm.	
BRUSH SPRING	Pressure, std.	800 gr.	(+10%, -25%)
STARTER SWITCH	Yoke gap	—	(solenoid)
	Core gap	1.5 – 1.88 mm.	
	Point gap	0.88 – 1.11 mm.	
	Magnet windings	3.5 ohms (20°C)	
	Cut in Voltage	6.5 V	
	Cut out Voltage	4.0 V	
	Coil circuit	4A Draw. (20°C)	
SAFETY SWITCH	Yoke gap	0.2 mm.	
	Core gap	0.5 – 0.6 mm.	
	Point gap	0 mm.	
	Cut-out Voltage	2.5 V or less	
MISCELLANEOUS ELECTRICAL			
STARTER MOTOR DRAW:	35A 12V (20°C)		No load
FEATURE STANDARDS:			
LOAD:	8.3V 100A 3800 r.p.m.		
CONSTRAINT:	4V 300A or less		
NOMINAL ENGINE R.P.M.:	300 r.p.m. at 75A or less (When the decompression lever is squeezed, at 20°C)		

C. Disassembly

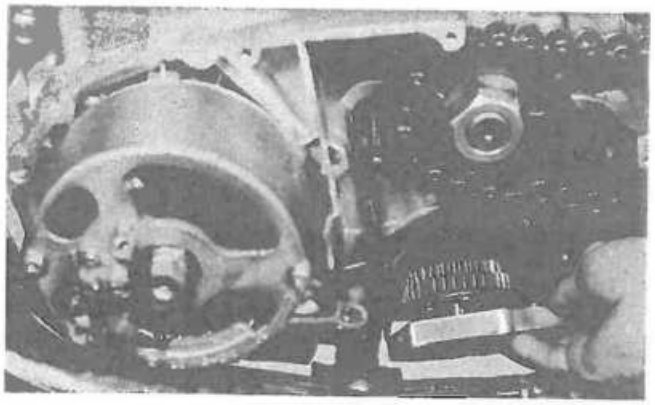
Starter Motor

1. Drain the engine oil.
2. Remove the four motor mounting bolts (8 mm.).

Note:

To ease removal, the machine should be placed on a lift or tilted towards the left.

3. Remove the motor. Pull straight back from its mounting location.



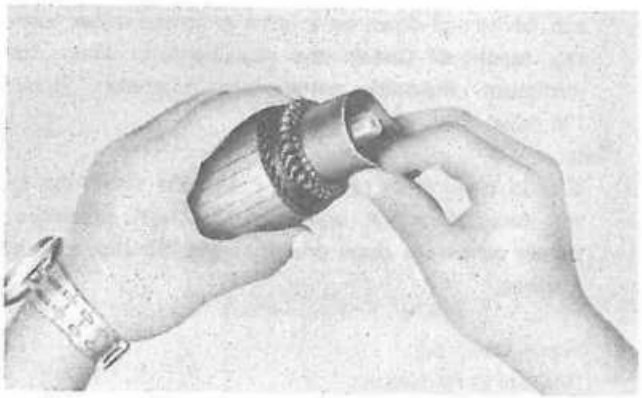
Note on reassembly:

Make sure the gear shaft properly engages the reduction gear. Torque the 8 mm. securing bolts evenly, in gradual stages, to a setting of 2.0 kg/m. Refill the sump with 2500 cc. of SAE "SD" (MS) motor oil.

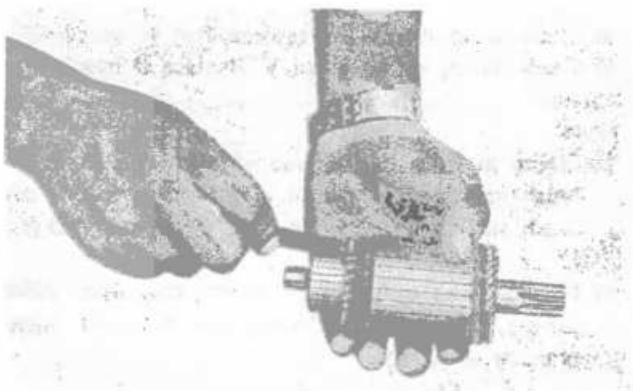
D. Servicing and Troubleshooting

1. Armature

a) If the commulator surface is dirty, clean with #600 grit sandpaper as shown in the drawing below. After sanding, wash thoroughly with electrical contact cleaner and dry with high-pressure air steam.

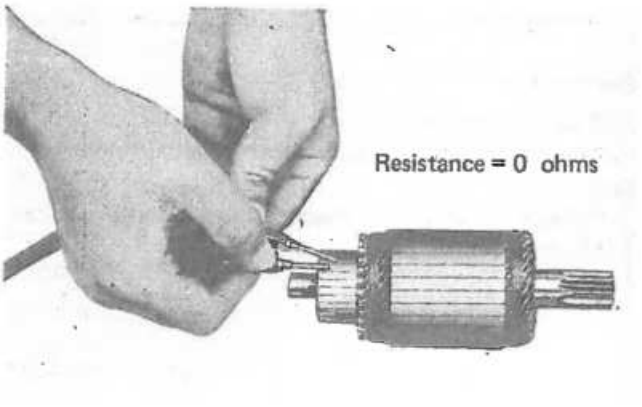


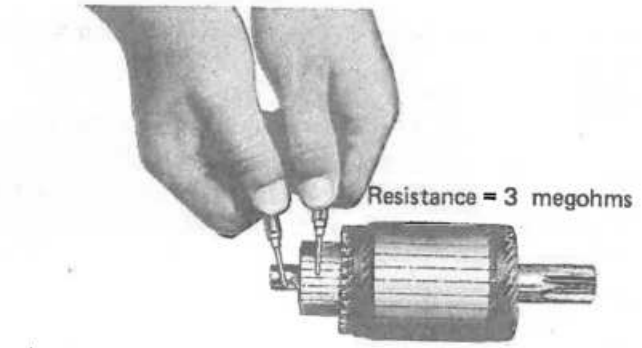
b) The mica insulation between commutator segments should be 0.5 ~ 0.8 mm. below the segment level. If not, scrape to proper limits with appropriately shaped tool. (A hacksaw blade can be ground to fit).



c) Each commutator segment should show zero ohm resistance to the others and at least three million ohms resistance to the core. If there is less than 00 ohms resistance to the core, or one of the segments is open, replace the armature.

In addition, the armature can be placed on a "growler" (testing device) and checked magnetically for internal shorts. Follow manufacturer's test recommendations.





d) If the commutator surface shows heavy scoring, it can be turned down on a lathe or commutator turning machine. Check the specification chart for minimum allowable commutator diameter. Recut the mica after.

Note:

Should turning be required, check the condition of the cover bearings, armature electrical properties starter amperage draw and rpm and, finally, carbon brushes.

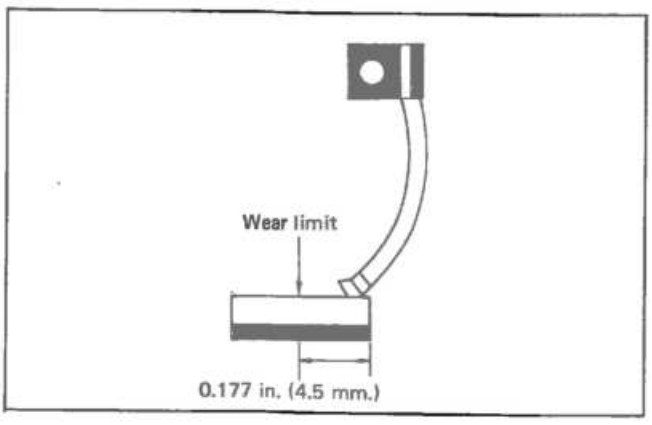
Cover bearings.
Replace as necessary.

2. Carbon brushes
   a) Check brush length and replace if at or near limits.
   b) Check brush spring pressure. Replace if over/under specs.

Note:

Spring pressure is measured with a nominal length brush installed. Lift until spring starts to lift off brush and note reading on scale. (Nominal: 800 gr.)

c) Clean the brush holders thoroughly. Use clean solvent, a soft-bristled brush, and dry with high-pressure air stream.

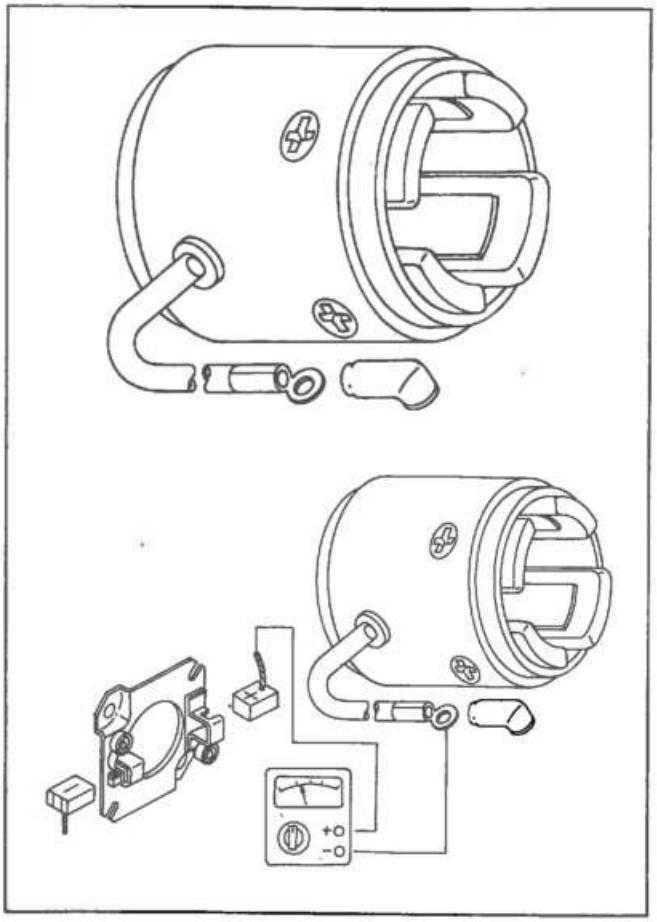


3. Yoke

a) If the yoke area is dirty, clean with solvent and dry with high-pressure air.

b) Yoke coil resistance is 0.05 ohm.
If coil resistance is more than 0.055 ohm or less than 0.045 ohm, replace it.
If the yoke shows leakage to ground (resistance is less than 0.1 million ohms) replace it. (20°C)

Note:
Immediately after cleaning, the yoke may show some insulation leakage. Wait for it to thoroughly dry before checking or reinstalling.



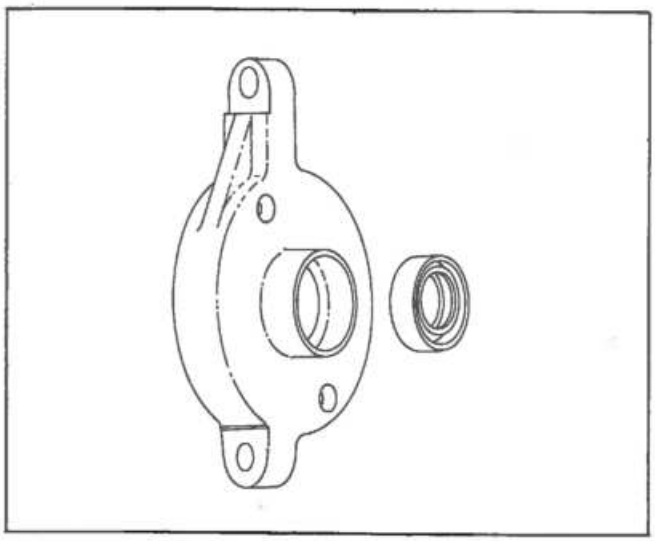
4. Covers

a) Check oil seals for hardening, cracking, worn lips. Replace as necessary.

Note:
During reassembly, pre-lube the lips of all seals with "white" grease. (lithium soap base grease)

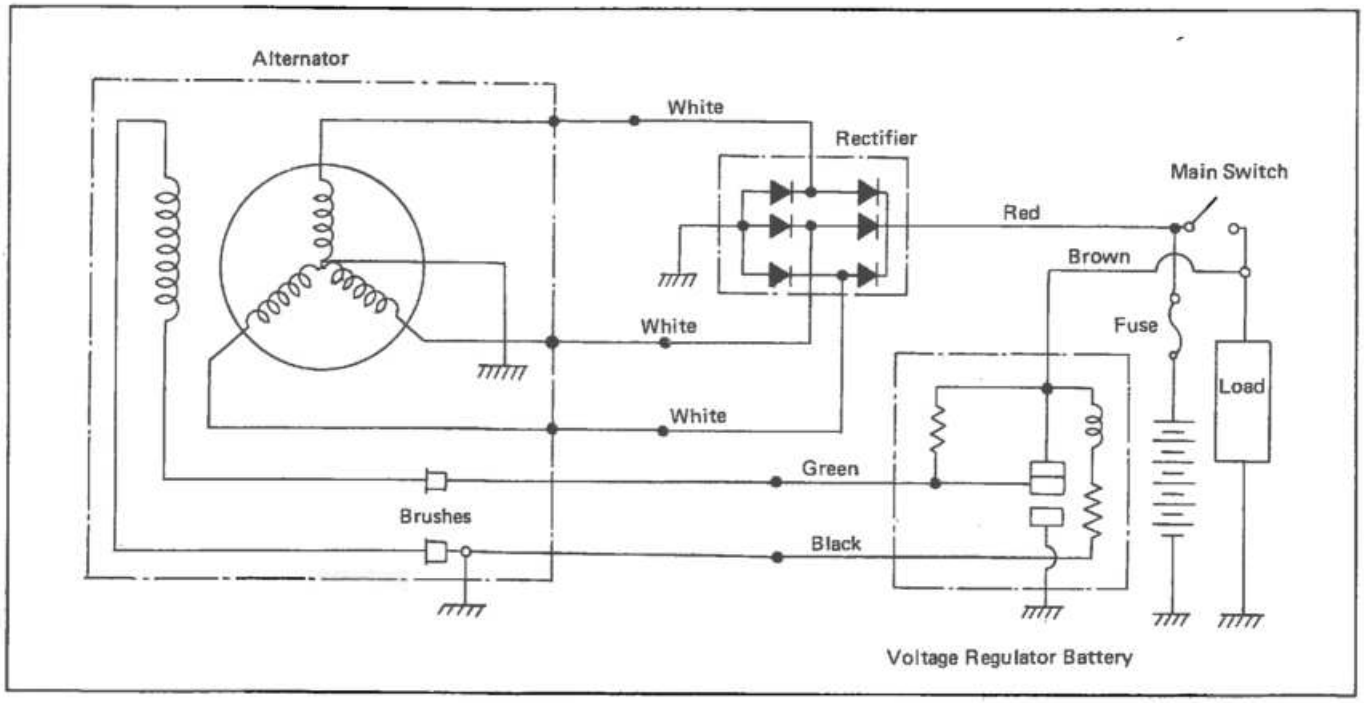
b) Clean the bearings thoroughly, lightly oil each and check for hard spots during rotation, cracked or broken balls and/or races, etc.
Replace as necessary.

Note:
During reassembly, all non-sealed bearings should be given a light coating of 20 W. or 30 W. "SD" (MS) motor oil.



5. Charging Circuit

This circuit consists of the battery to first provide voltage to the rotor field windings, regulator, ACG (alternating current generator), rectifier, and main switch.



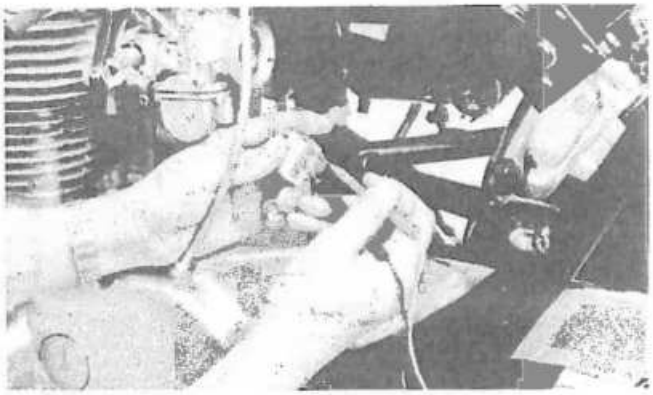
6. Alternator

Stator Winding

a) Trace the ACG wiring up to the multiple connector. Disconnect the connector and perform the following test to the three white wire ends at the multiple connector (there are a total of six wire ends in the connector).



b) All three white wires are interconnected in the stator windings. Use an ohmmeter to check resistance between any two white wires (three possible combinations). Each of the three measurements should show 0.8 ~ 1.0Ω resistance.



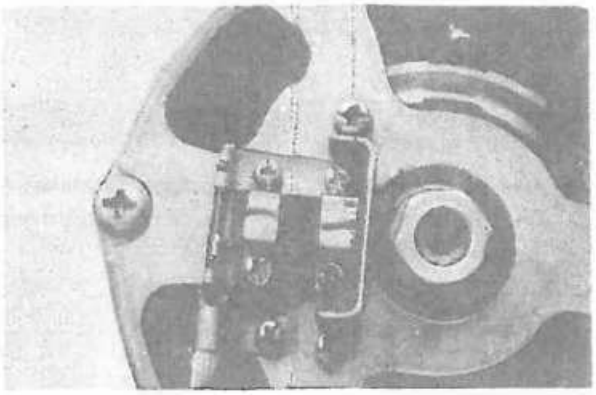
c) Set the ohmmeter scale to read at least in kilo-ohms. Clamp the ohmmeter probe to the stator housing and touch each white wire with the other probe. There should be infinite resistance.

d) If resistance values in steps two & three vary from those specified, then the stator windings are broken, shorted together, or shorted to the housing. Replace the entire unit.

7. Carbon brushes

a) If the carbon brushes do not function correctly, electricity cannot pass to the rotor field windings. This reduces alternator output.

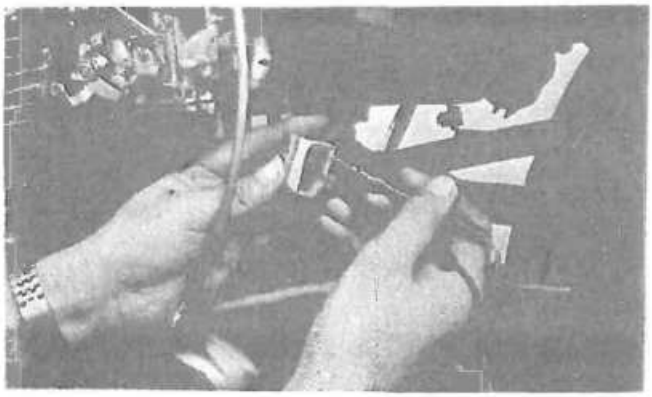
b) Visually inspect the carbon brush holder and brushes for obvious breakage or wear. Standard brush length is 0.571 in. (14.5 mm.). Wear limit is 0.276 in. (7.0 mm.)



c) Both carbon brush wires (black and green) are located in the same wiring loop as the three white stator wires. They share the same multiple connector which has already been disconnected.



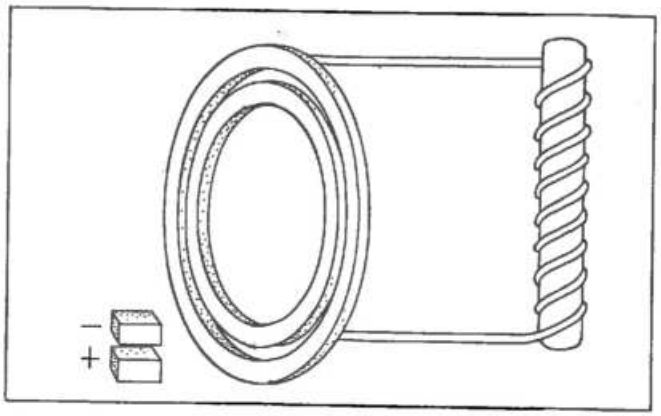
d) Check wiring resistance from the multiple connector to the carbon brush first through the green wire and then the black wire. There must be zero resistance.



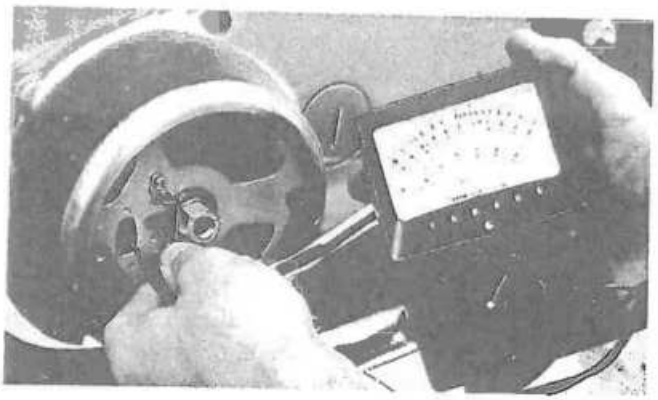
e) If high resistance exists in either wire, it is frayed or broken. Repair or replace the entire wire.

8. Rotor Windings

a) The field windings are one continuous coil of wire, each end attached to an insulated slip ring.



b) Use an ohmmeter (Ω x 1) to check resistance from one slip ring to another. Resistance should measure 5 ~ 7Ω.



Note:

Both slip rings must be clean or an inaccurate reading will result.

c) Use an ohmmeter set to register at least kilo-ohms resistance. Measure insulation between each slip ring and the rotor core. This must show infinite resistance.

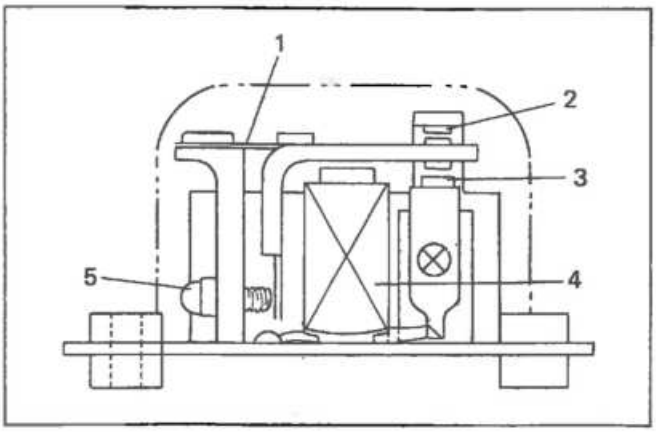


d) If resistance measurements differ greatly from those specified, the winding is either broken, shorted to itself, or shorted to the core. Replace it.

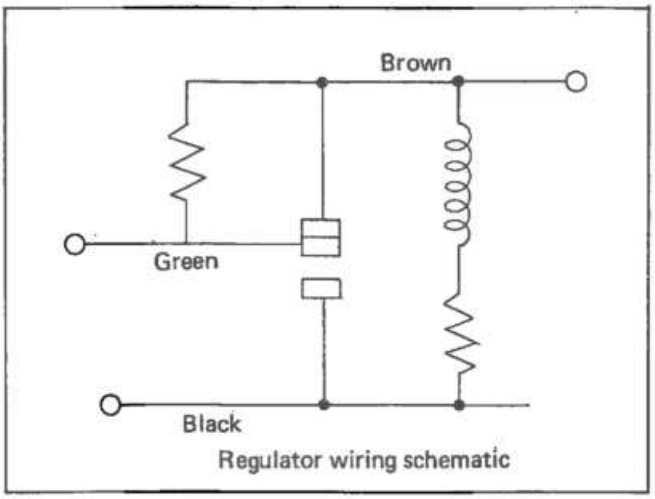
6-2. REGULATOR

This circuit consists of the battery to first provide voltage to the rotor field windings, regulator, ACG (alternating current generator), rectifier and main switch.

a) The regulator's function is to pass a controlled amount of voltage to the rotor windings which create a magnetic field that produces charging voltage in the stator.

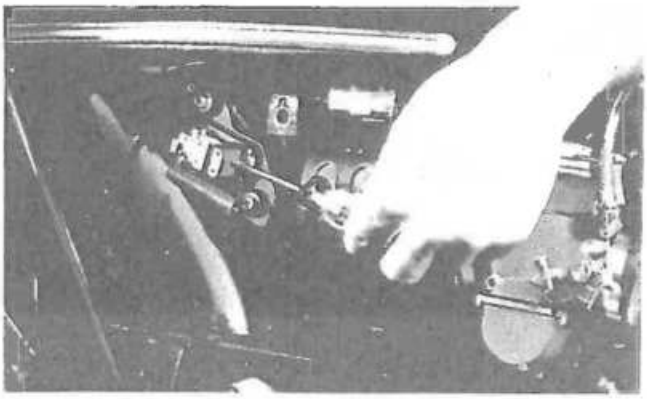


b) The regulator operates as a magnetic switch. As charging voltage rises, part of this voltage is routed through an electro-magnet in the regulator. Rising voltage creates greater regulator magnetism, which in turn pulls the central contact point through different positions. Different resistors are switched into the circuit as this central contact point moves. These resistors cut down the amount of voltage passing, to the rotor windings, which reduces the charging voltage output.

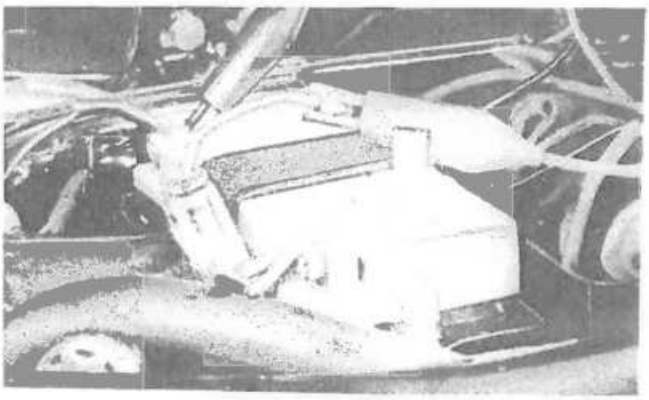


Regulator wiring schematic

c) Charging voltage output can be controlled at the regulator. Inside the housing is a screw that pushes against a flat spring steel plate. This is the adjusting screw.



d) Start the engine. Disconnect the fuse box wire leading to the battery and hook up a voltmeter from the fuse box to ground. Accelerate the engine to 2,500 rpm. The voltmeter should read 14.5 ~ 15 volts DC. If it varies from this amount, twist the adjusting screw in to raise the charging voltage or out to reduce the voltage.



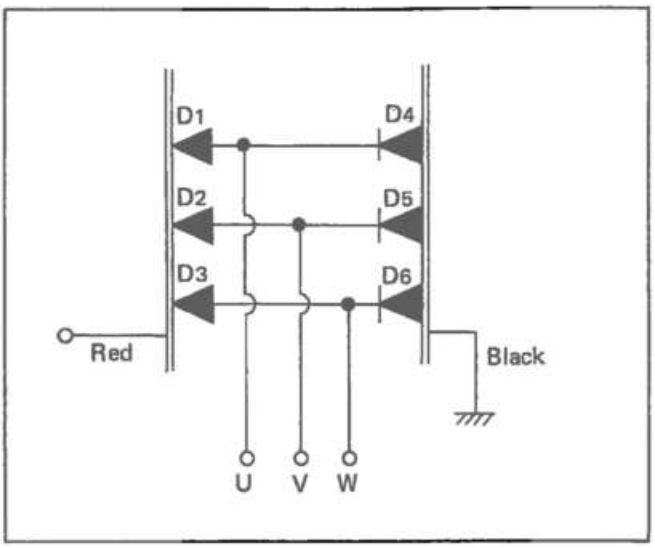
6-3. RECTIFIER

a) This unit is a full wave rectifier which changes alternating current generated by the alternator to DC current by passing this AC current through six silicon diodes. The diodes permit only one-way electrical flow. The DC current is sent to the battery and main switch.

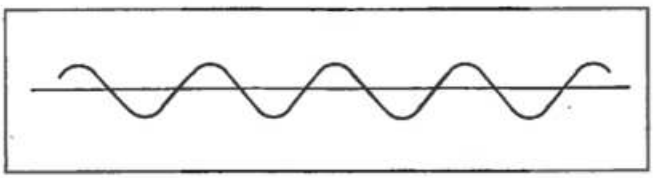
b) This sign indicates a one-way diode. Current flows in the direction the sign is pointing.



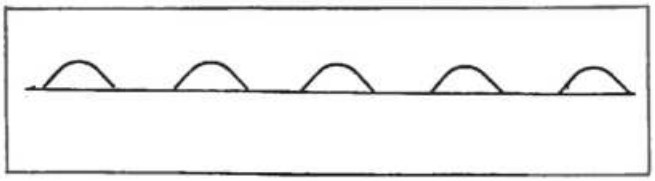
c) Schematic representation of the three phase, fullwave rectifier in the XS1-B generating circuit.



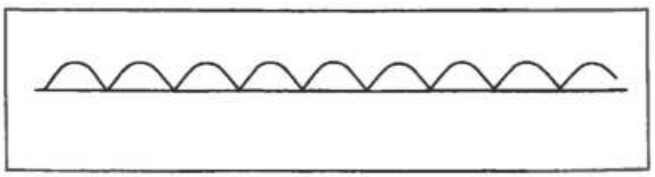
d) Wave form of standard alternating current.



e) Wave form of direct current after rectification by one diode (or half-wave rectifier).



f) Wave form of direct current after full wave rectification.



6-4. ROTOR (ALTERNATING CURRENT GENERATOR)

The rotor of the ACG. (Alternating Current Generator) is the source for the magnetic field which induces current flow in the stator windings. Current for the rotor windings comes from the voltage regulator and is supplied either by the battery (when the machine is not running) or by the stator windings themselves.

Note:

In order to make the explanation easier remember that current flows as a result of voltage (electromotive attraction). Current flows from Positive to Negative. Voltage does not "flow" but is instantly present when a circuit is closed. However, we shall discuss the operation of this circuit in terms of voltage "flow". As soon as voltage is present on a circuit, and there is a complete path for current to flow, it will. The amount of current flow is dependent upon the amount of voltage present to act upon the electrons and the amount of resistance present to oppose electron flow.

a) When the ignition switch is turned on, voltage flows from the battery, through the closed contacts in the voltage regulator, bypassing the dropping resistors in the voltage regulator.
b) From the voltage regulator, voltage passes through the positive brush, to the single rotor winding. If the winding is intact, and the negative brush has been electrical contact, current will begin to flow through the rotor winding.
c) When this current flows, it creates a magnetic field around the wire it flows in. Wind this wire into a tightly concentrated coil and the magnetism will become quite intense. The rotor has now become an electromagnet.
d) The rotor is attached directly to the crankshaft. When the crankshaft revolves, the magnetic field surrounding the rotor windings (due to current flow through the windings) rotates also. The brushes and slip ring on the rotor are necessary in order to maintain electrical contact and current flow during this rotation.

6-5. STATOR (ALTERNATING CURRENT GENERATOR)

The stator consists of three windings of wire surrounding the rotor assembly. It is within the stator windings that current is generated for recharging the battery and running the various electrical circuits on the machine.

a) When the magnetic field surrounding the rotor winding begins to spin, its lines of magnetic flux (force) intersect the windings within the stator. As this takes place, current is generated within the stator windings.
b) This current flow is in the form of alternating current. It is transmitted on the three (white) stator winding wires to the rectifier where it is changed to direct current by the diodes of the rectifier.
c) The stator assembly also holds the brushes for the rotor circuit.

6-6. TROUBLESHOOTING

Troubleshooting the electrical system of the XS650B is relatively simple if a few basic facts are kept in mind.
First, the entire electrical system is composed of the following assemblies.

1. Rotor
2. Stator
3. Rectifier
4. Voltage regulator
5. Turn signal relay
6. Ignition points/condensors
7. Ignition coils
8. Spark plugs
9. Main switch
10. Battery/fuse
11. Accessory switch
12. Light bulbs
13. Wiring loom
14. Horn

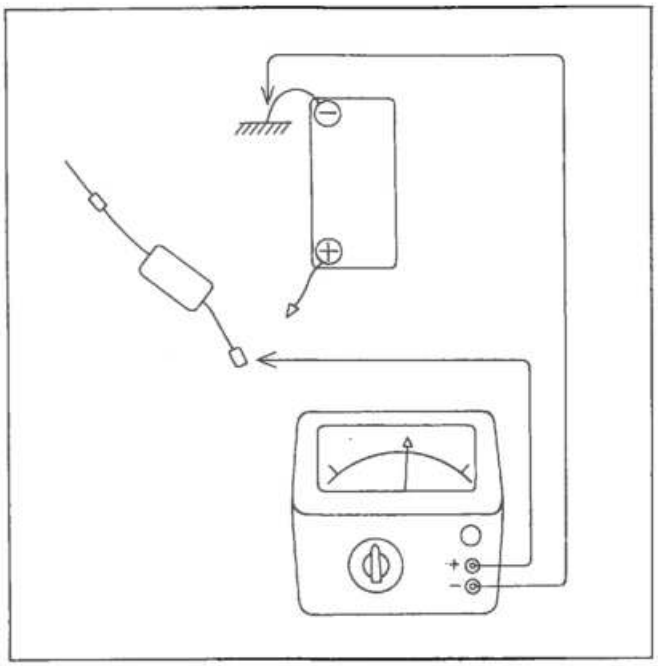
In the majority of instances where a failure occurs the assembly is replaced. This includes lights, switches, coils plugs, relays, points, condenser and, in most cases, horn. Second; in the assemblies, remember that they are made out of wire and only two things can go wrong with a piece of wire:

1. It can break in two stopping current flow. (Lose continuity)
2. Its insulation can be lost causing it to short circuit with ground or another wire. This can be a direct short with zero ohm between or "insulation leakage" with as much as two million ohms between.

Our troubleshooting list defines the steps taken to search for these two possibilities.

Note:

All these test can be completed with the parts still attached to the machine. It is not necessary to remove anything except inspection covers or miscellaneous items to get to the part.



A. Charging Voltage Output

1. Start the engine.
2. Disconnect the red wire at the fuse box. Hook up a voltmeter from the regulator side of the fuse box to ground.
3. Accelerate the engine to approximately 2,500 rpm. and check the generated voltage. It must read between 14.5 ~ 15 V (DC).
4. If voltage output is off, (and not correctable by regulator adjustment), then each part of the charging circuit must be checked to locate the defective part. Perform these checks in the sequence listed below.

Caution:

Before each resistance test, be sure that the ohmmeter dial has been set at the correct position and needle adjusted to zero.

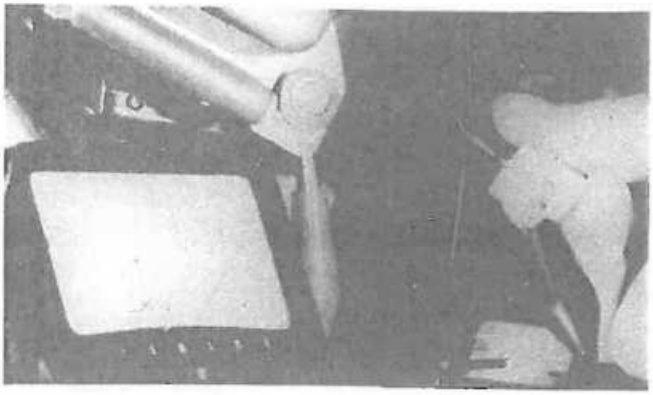
B. Broken wires

1. Check for obviously broken wires or separated connectors (especially multiple connectors). Pay particular attention to any parts that are subject to wear or might be subjected to vibration.

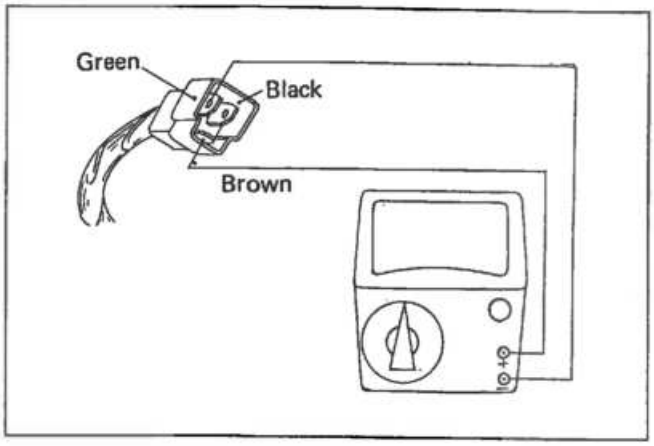
C. Regulator

1. A defective regulator can cause abnormally low or high voltage output. Remove the regulator cover and examine all internal parts for signs of failure. All point surfaces should be reasonably clean. If they are very pitted, or if the central contact point has fuse to a stationary point, then this is the trouble spot. Clean the points if possible. If this does not help, replace the regulator. Also, if any wire is broken, and cannot be soldered back in place, replace the regulator.
2. If visual inspection does not locate any trouble spot then check for proper resistance through all regulator circuits. This is done by separating the regulator multiple connector and measuring resistance through the green, black, and brown wires at the multiple connector.

3. Hook up an ohmmeter (0 ~ 20 ohms), one probe attached to the black wire and one probe to the regulator base. It must read zero ohm resistance. Several ohms resistance indicates a frayed or broken black wire.

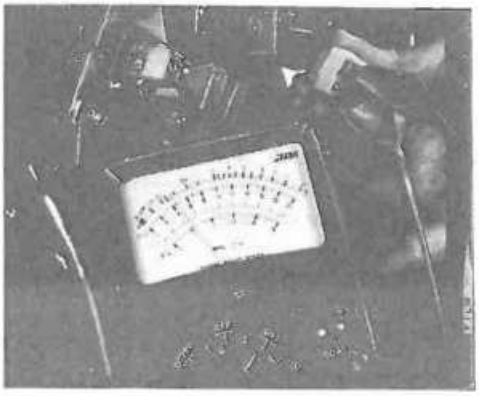


4. Hook one meter probe to the brown wire and the other probe to the green wire.

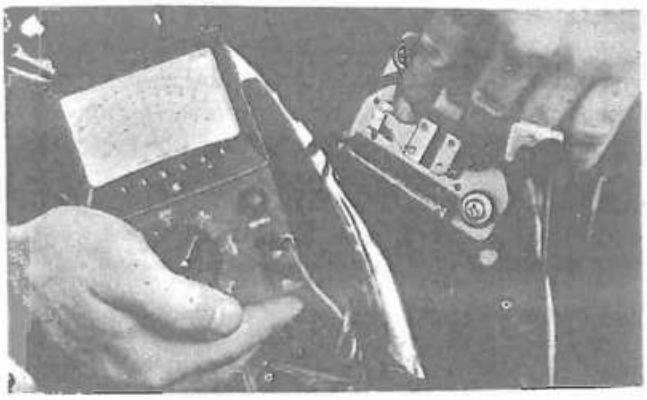


5. Remove the regulator cover.

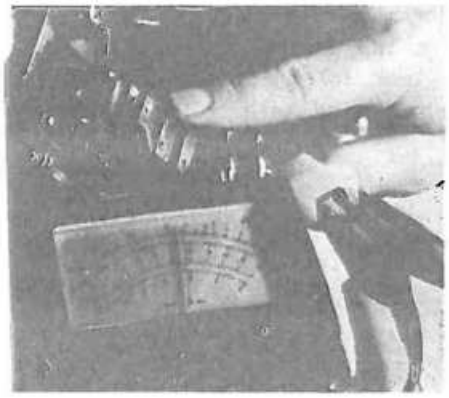
6. With the central contact point held against the top point by the spring (as in the low rpm. position), the meter should show no resistance at all (two ohms resistance is too much). If high resistance exists, one of the wires is broken, a soldered joint has separated, or the points are burned. The unit usually requires replacement if the problem cannot be cured by cleaning the points.



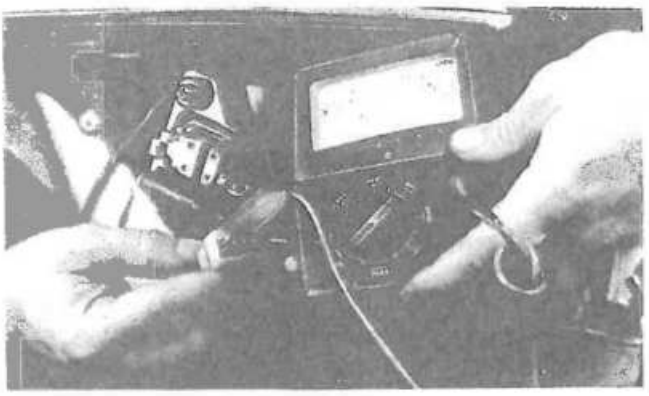
7. Maintain the same meter hook-up as step four.
Push the central point arm until the point is positioned mid-way between the top and bottom points. The meter must read 9 ~ 10Ω resistance. If the observed resistance varies from this figure, the 10Ω regulator resistor has failed; either internally or at its solder points.



8. Maintain the same meter hook-up as step four. Push the central point down until it contacts the bottom point. The meter must show a 7 ~ 8Ω resistance value. Check the condition of both contact points as burnt points can cause an improper reading.



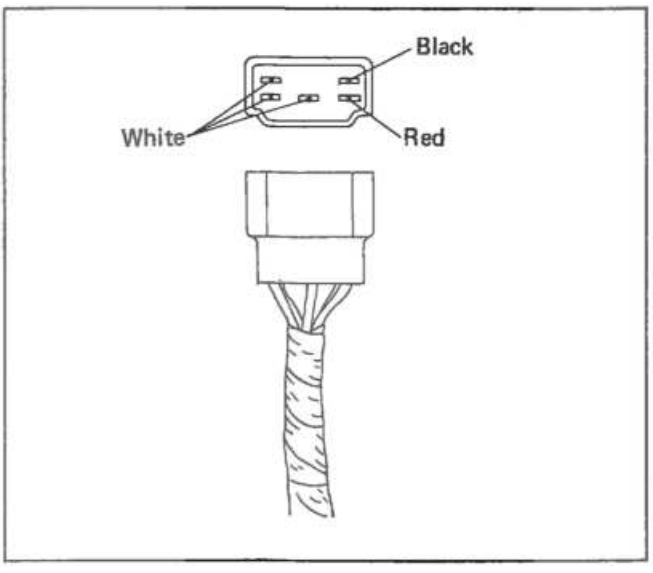
9. At the multiple connector, hook the ohmmeter to the black and brown wires. Permit the central point to spring up against the top point and measure the resistance. It must measure 36 ~ 38Ω resistance.



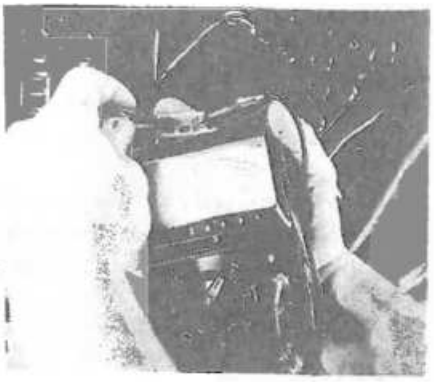
10. A correctly operating regulator will give the resistance values as listed in each test. If the measured values differ and the variation cannot be blamed on a broken or disconnected wire (that can be resoldered), replace the regulator unit. If a complete regulator resistance test shows all circuits to have correct resistance, the regulator is probably not the cause of improper voltage output. The next charging circuit component must be checked.

D. Rectifier

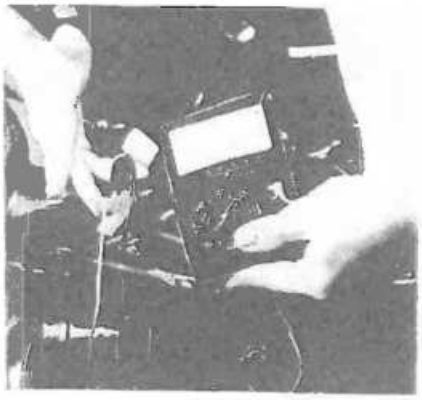
1. Check the rectifier for proper one-way electrical flow through the diodes. Trace the rectifier wiring back to its multiple connector and disconnect it. Inside the connector are five metal prongs.
2. The prongs are connected to three white wires (that hook up to the alternator wires), one black wire (to ground) and one red wire (to battery and main switch). Perform the following tests, using an ohmmeter (0 ~ 1000Ω scale) to check the condition of the rectifier.
3. Visually check all rectifier wires for breaks.



4. Clamp the black probe to the black wire and touch the other positive test lead to each white wire in the connector. Next, reverse the position of the meter probes and again touch each of the white wires. For these diodes to be good the meter must show a small resistance (75 ~ 150Ω) reading one way and almost infinite resistance with the probes reversed.



5. Attach one meter probe to the red wire and again touch each white lead with the other probe. Reverse the probes and again touch each white lead. The resistance readings must be identical to those in 4.



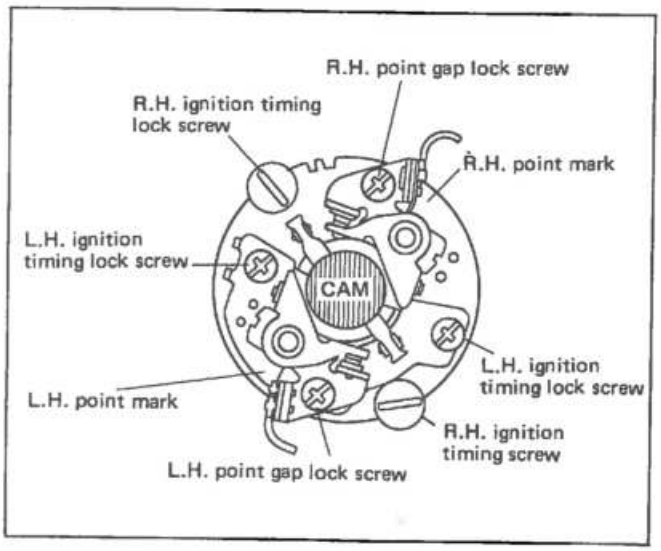
6. All rectifier wires directly attached to the diodes are fully insulated. If any are broken, replace the unit.
7. If resistance results of steps 4. and 5. show that current can flow both ways, or neither way, then one or more diodes have been damaged. Replace the unit.

E. Ignition breaker points

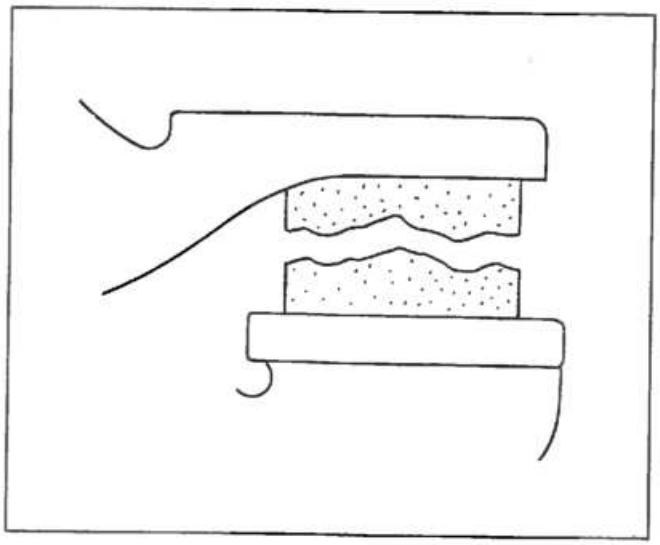
This unit is equipped with two independent sets of ignition points; one for each cylinder. They are both located in a single housing mounted on the left end of the camshaft.

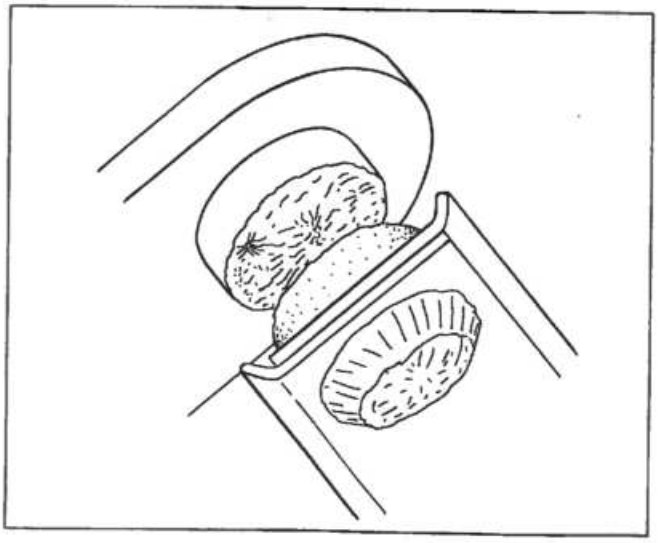
The points act as circuit breakers for the ignition system. A point cam spins counterclockwise in the center of the ignition unit. A lobe on the cam controls the opening and closing of the points.

When the points are closed, current flows to the primary coil (which begins to build a magnetic field). At a precisely calculated point of crankshaft rotation, the cam forces the points apart, which stops current flow to the primary winding in the ignition coil. High voltage is then generated in the coil's secondary winding and causes a spark to jump the plug electrodes.



1. Wear
   a) The points gradually become burnt and pitted. This is normal wear. However, metal from one point might transfer to the other. If this metal build-up cannot be cleaned off with a point file, the points should be replaced.

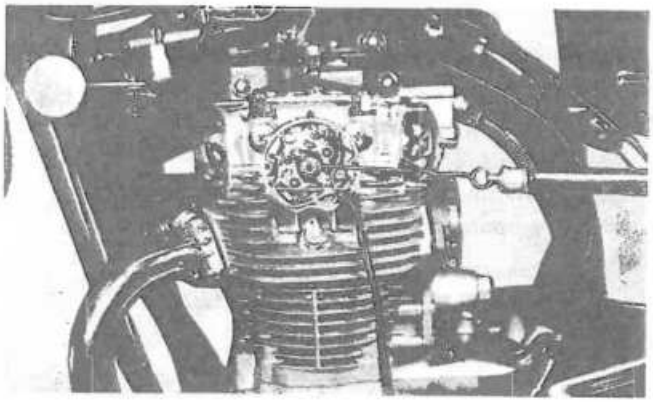




b) Oil may gradually seep past the seal and coat the points or wiring. This will burn onto the points creating an insulating film. It must be cleaned off with ignition cleaning solvent.

c) The fiber cam follower mounted on the pivoting point arm rubs against the cam. Eventually this block wears down which results in a reduction of the point gap and retarded timing of that cylinder. The remedy is to regap the points and check the timing (timing should be checked any time the points are re-gapped.)

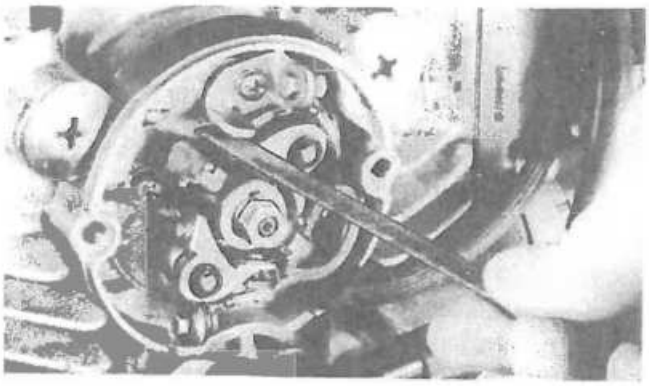
d) If a point return spring becomes weak or broken, the pivoting point will bounce. Timing will become erratic and ignition firing will be uneven. Measure spring tension by attaching a scale (measured in grams) to the pivoting point. It should take 700 ~ 800 g. to cause the points to separate. (Use a point checker to measure the separation electrically).



2. Repair

a) Point gap on each set of points must be set at 0.012 in. – 0.018 in. (3 – 45 mm.). Constant electrical arcs across the points cause some metal to burn away, changing point gap. Clean and regap the points every 2,000 miles. Check timing after re-gapping.

b) To clean the points, run a point file between the points until the grey deposits and pits have been removed. Spray the points with ignition point cleaner or lacquer thinner, then snap the points shut on a white business card (or paper of hard texture) and repeatedly pull the card through until no more carbon or metal particles come off on the card. (The card may be dipped in lacquer thinner or other cleaner to facilitate this procedure.)

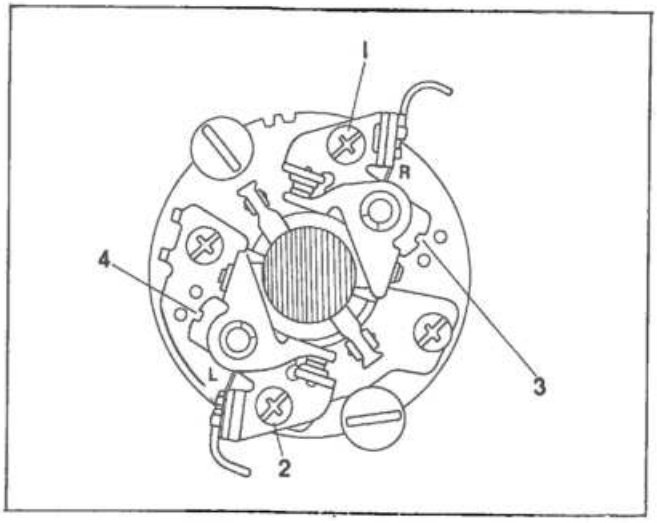


c) To gap the points, first rotate the engine until the ignition cam opens the points to their widest position. Slip a 0.4 mm. feeler gauge into the gap. It must be a tight slip fit. If an adjustment is necessary, loosen the point lock screw (1 or 2) as shown in the accompanying drawing, insert a screwdriver into the adjustment slots (3 or 4), and open or close the points until the feeler gauge indicates the correct gap. Retighten the lock screw and recheck the gap.

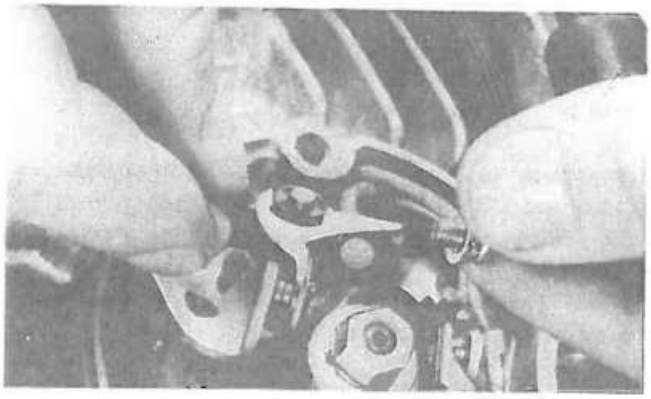
d) Next, rotate the camshaft until the second set of points opens to its widest point. Then perform the same steps as described in the previous paragraph.

Note:

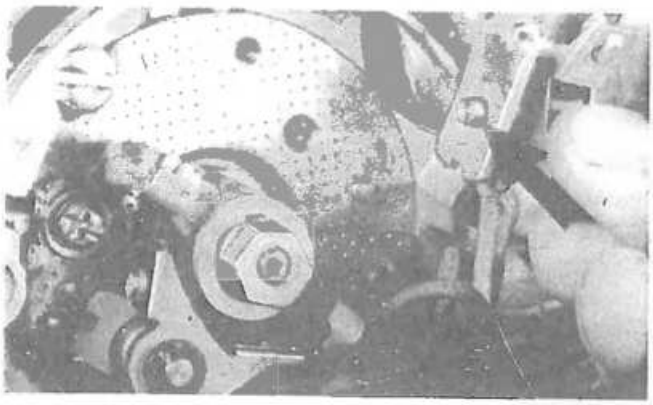
Add a few drops of light-weight oil onto the felt rubbing pad after each point adjustment to lubricate the point cam surface. Do not over oil.



3. Replacement
   a) Unscrew the point wire securing screw. Completely remove the point lock screw. Lift the entire point assembly up off the point base plate.

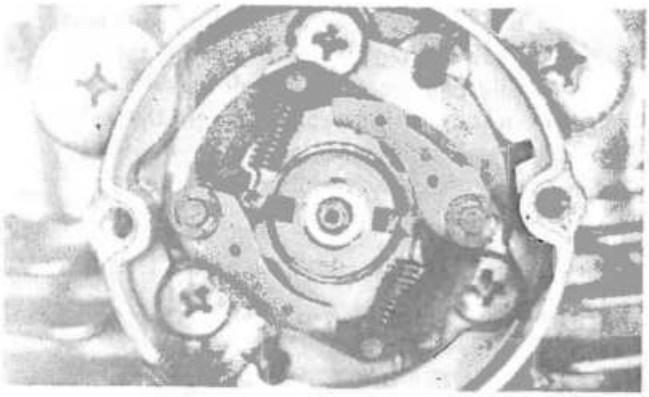


   b) Locate the new set of points into position by slipping the point assembly locating pin into the appropriate locating hole in the base plate.
   c) Insert and tighten the point lock screw. Finish this replacement by attaching the point wire to the stationary point and re-gapping the new point assembly.

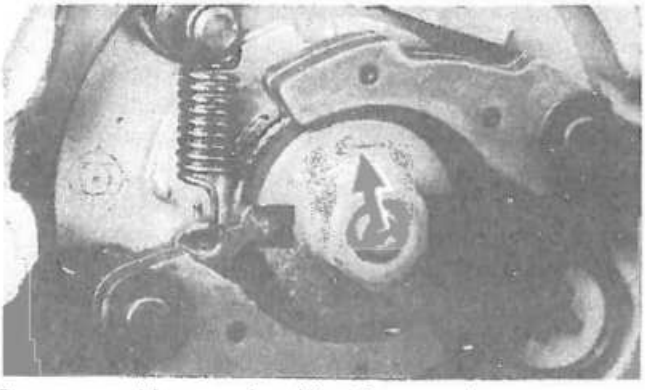


F. Advance assembly

1. The governor rod is threaded at one end and a notched disk is attached to it by a nut. Around this disk is the advance unit which mounts directly to the end of the camshaft (a ring nut holds it in place).
   Two centrifugal weights pivot on pins. Each weight has a small extension that fits into the disk notch. As engine rpm. increases, both weights begin to swing out on their pivot pins due to centrifugal force acting on the rotating unit. The weights continue to swing outward as rpm's increase until the weights are stopped by fixed stopper pins. As these weights pivot, the extensions in the disk notches cause the disk to rotate. Since the disk is directly attached to the point cam rod, the ignition point cam also rotates, which causes ignition timing to advance.

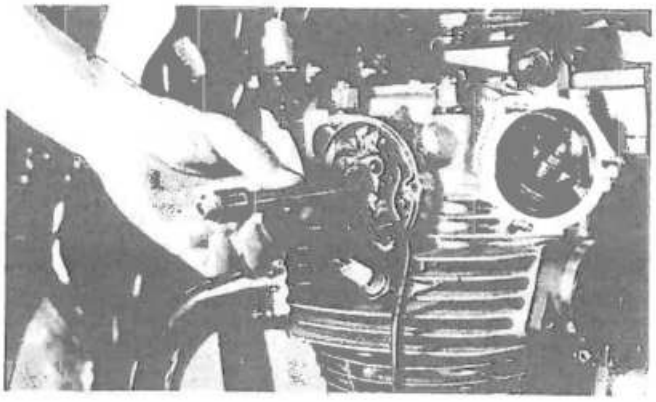


Advance arm stops

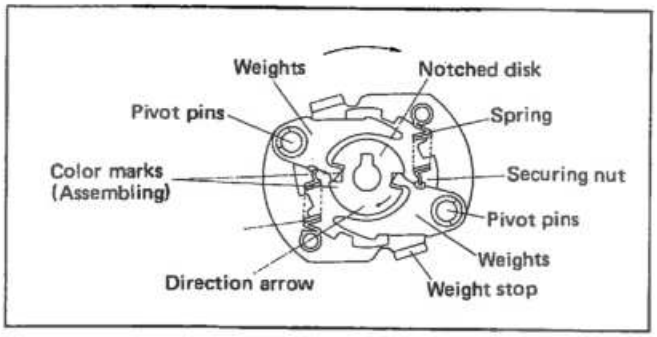


Proper assembly procedure (direction arrow)

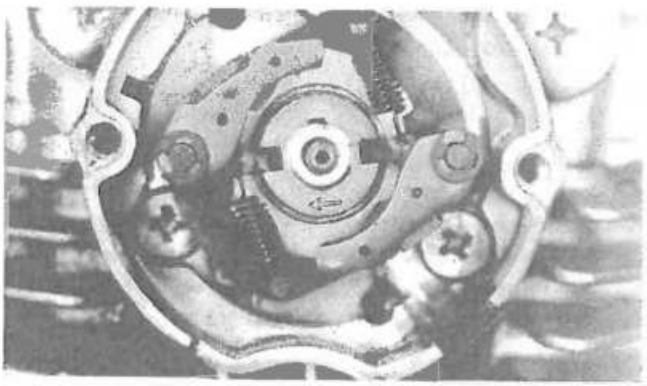
2. Both weights must pivot smoothly or ignition advance will not occur at the proper rpm., nor will it advance to its fullest extent. On occasion, light-weight grease must be applied to the weight pivot pins.



3. The advance unit mechanically changes ignition firing from 10° BTDC at low rpm. to 38° BTDC at high rpm. (full advance). The ignition point cam is attached to one end of a rod that travels completely through the center of the camshaft. The rod is bolted squarely to the camshaft. The point cam opens and closes the points. The other rod end provides a mounting point for the advance unit.



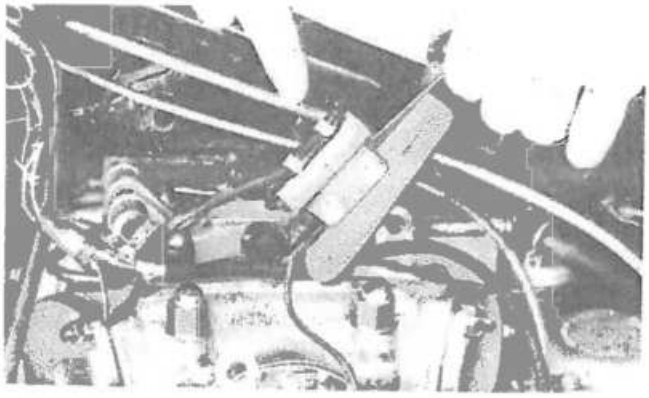
4. If a return spring is broken, the ignition timing will advance too quickly. This condition causes poor performance and excessive engine heat.



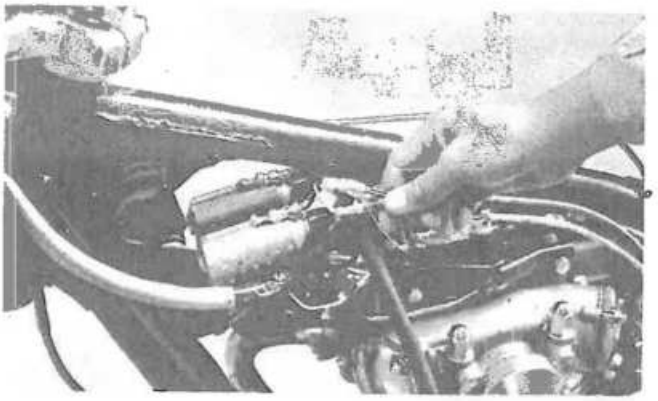
5. If the notched disk has been installed incorrectly, timing will be advanced too early. A groove in the mounting hole that fits over a pin in the rod, plus the color marks that have been matched up, prevents the disk from being installed 180° off. However, the direction of rotation arrow must face outward or the disk will be installed incorrectly.

G. Condenser

1. The ignition condensers are located on the left-hand side of the top engine mounting bracket. The two condensers are mounted as a single assembly and must be replaced as a set in the event of failure.

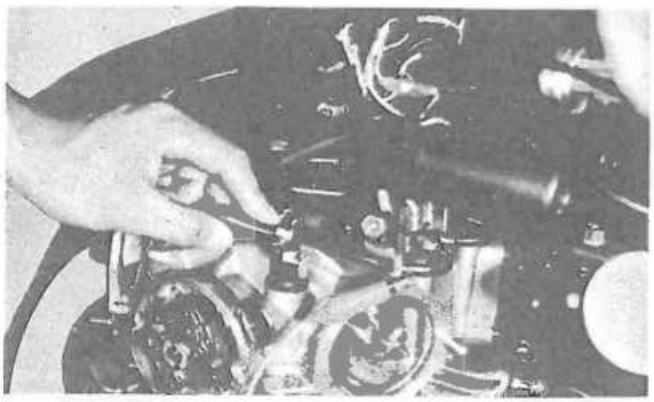


2. The condensers serve as a storage device to decrease arcing across the ignition points. Should one fail there could be either no spark or severe point pitting due to arcing. In the vent of severe arcing there is also the possibility that the strength of the ignition spark may be decreased.

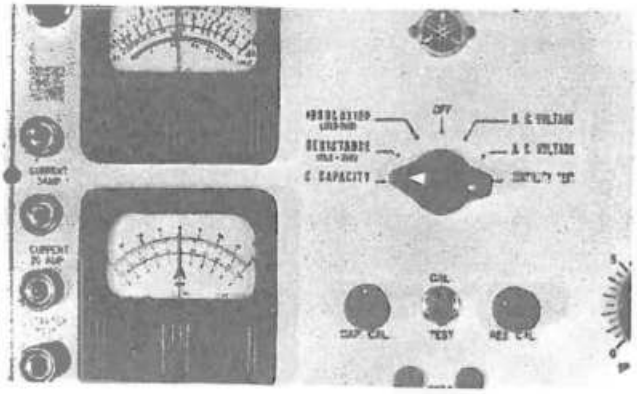


3. To test the condition of either condenser, pull the male/female connection apart.

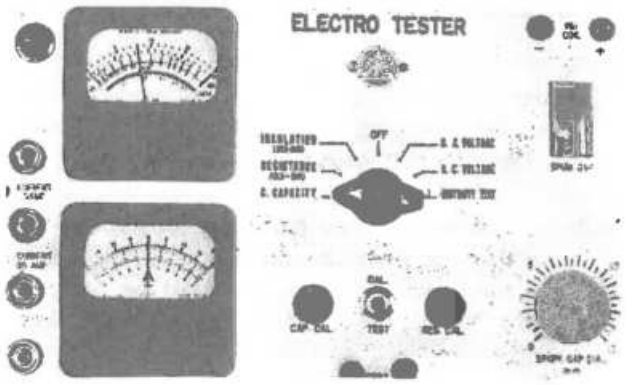
4. Hook an ohmmeter to the condenser. Black (Neg) lead to the condenser case, Red (Pos) lead to the wire running from the center of the condenser. There will be a momentary flow of current and then the condenser should show at least 5+ million ohms resistance between the positive terminal and ground.



5. Next, hook up an electrotester to the condenser. (leads in the same position). Turn the main function switch to "Capacity" and the calibration switch to "Cal.".

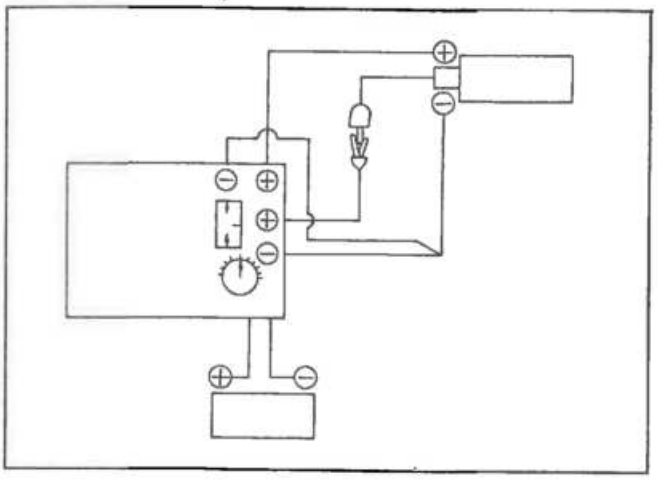


6. Turn the "Cap. Cal." knob until the meter needle is mid-range (in the black) on the red meter section for "Capacity".
7. Turn the Calibration switch to "Test". The needle should stay in approximately the same position. If it moves very far into the red, replace the condenser assembly.

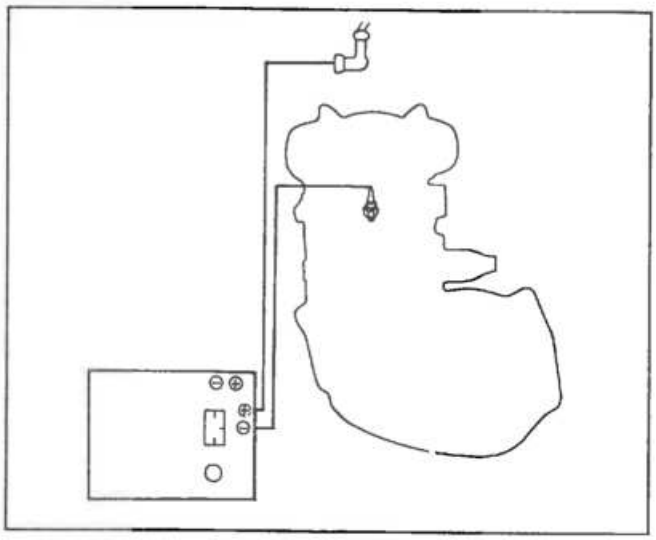


H. Ignition coil

1. Location
   The ignition coils are mounted to a bracket directly in back of the steering head. They can not be removed until the gas tank is removed.
2. The ignition coils can be checked on the machine. It is not necessary to remove either the coil or the gas tank unless the coil is defective and needs replacing.
3. Static Test:
   Follow the diagram at the right to check the coil. Leave the ignition key off and block the points open with a piece of paper. The coil should show at least 8 mm. spark gap. (Instructions for setting up the Electrotester can be found on the Electrotester cover.)



4. Dynamic Test:
   Follow the diagram at the right for setting up. Close the point gap on the Electrotester to zero. Turn the ignition on and start the machine. Rev. the machine to 2000 ~ 3000 rpm. (or the rpm. you wish to test at) and begin opening the tester's point gap. When the engine begins to misfire, close the point gap until it runs smoothly again. Point gap should be at least 7 mm.



6-7. SPARK PLUG

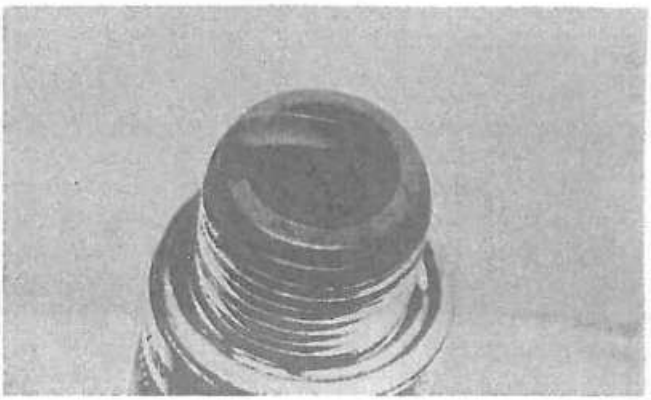
The life of a spark plug and its discoloring vary according to the habits of the rider. At each periodic inspection, replace burned or fouled plugs with suitable ones determined by the color and condition of the bad plugs.
One machine may be ridden only in urban areas at low speeds, whereas another may be ridden for hours at high speeds, so confirm what the present plugs indicate by asking the rider how long and how fast he rides, and recommend a hot, standard or cold plug type accordingly.
It is actually economical to install new plugs often since it will tend to keep the engine in good condition and prevent excessive fuel consumption.

A. How to "read" spark plug (condition)

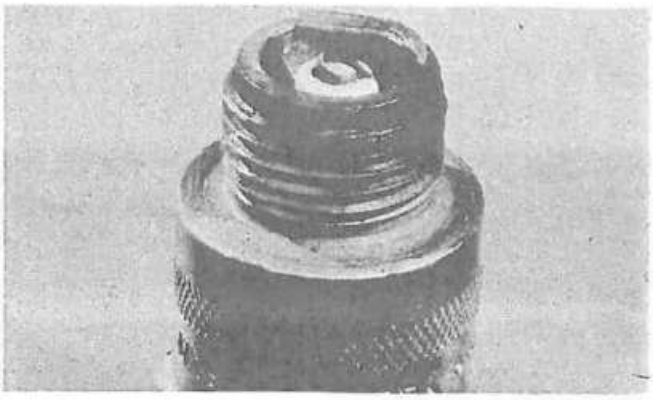
1. Best . . . . . When the porcelain around the center electrode is a light tan color.



2. If the electrodes and porcelain are black and somewhat oily, replace the plug with a hotter-type for low speed riding.



3. If the porcelain is burned white and/or the electrodes are partially burned away, replace the plug with a colder-type for high speed riding.

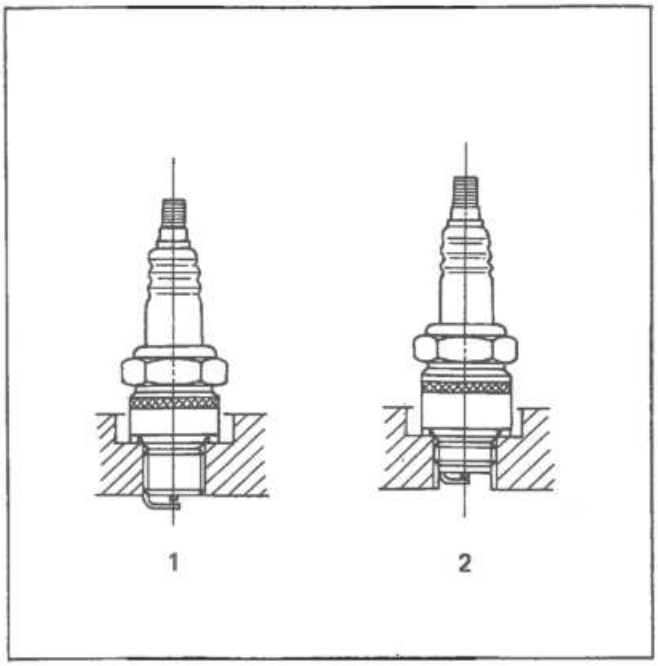


B. Inspection

Instruct the rider to:

1. Inspect and clean the spark plug at least once per month or every 500 ~ 1000 kms.
2. Clean the electrodes of carbon and adjust the electrode gap.
3. Be sure to use the proper reach plug as replacement to avoid overheating, fouling or piston damage.

	Model
Spark Plug Type	B-8ES
Spark Plug Gap	0.020 – 0.024 in. (0.5 – 0.6 mm.)



1. Proper reach 2. Insufficient reach

6-8. MAIN SWITCH

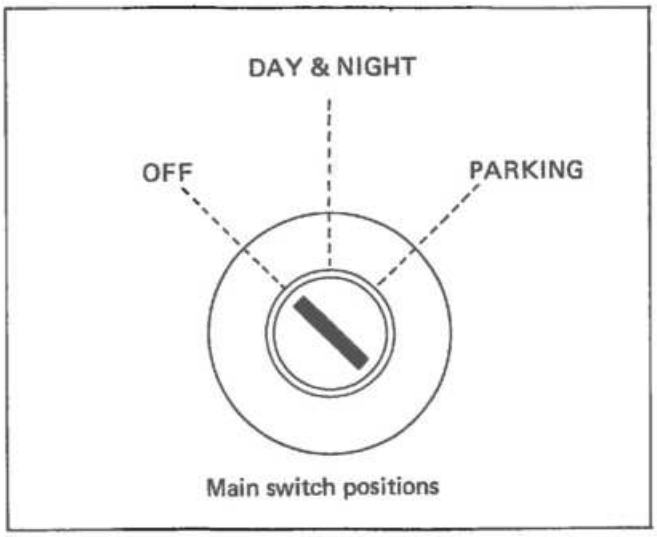
A. Main switch

The XS650B use a three position switch that directs current from the battery (or alternator) to the various lighting and ignition circuits.

1st position: Prevents current from flowing to any circuit.

2nd position: Supplies current to all day and night circuits, including (1) horn, (2) ignition coils, (3) front and rear stop switches, (4) turn signal switches, (5) all indicator lights, (6) and headlight/taillight switches.

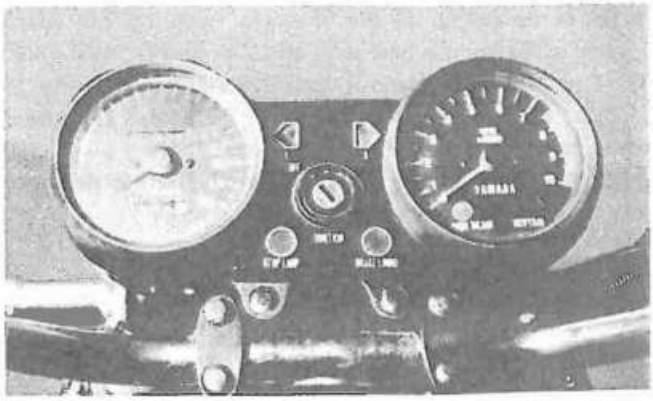
3rd position: Only the parking light is activated.



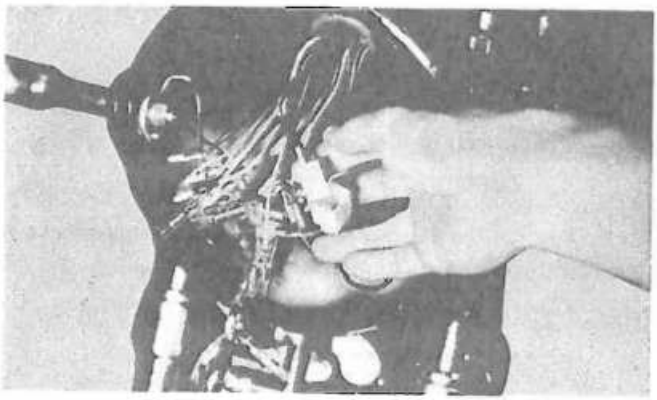
Main switch positions

B. Location and replacement

1. The switch is mounted on the tachometer/speedometer bracket. Remove both Phillips-head screws.



2. Remove the headlight. Two Phillips-head screws at the bottom of the shell hold it in place. Reach inside the headlight shell and disconnect the main switch multiple connector. The main switch can now be removed from the machine.



C. Troubleshooting

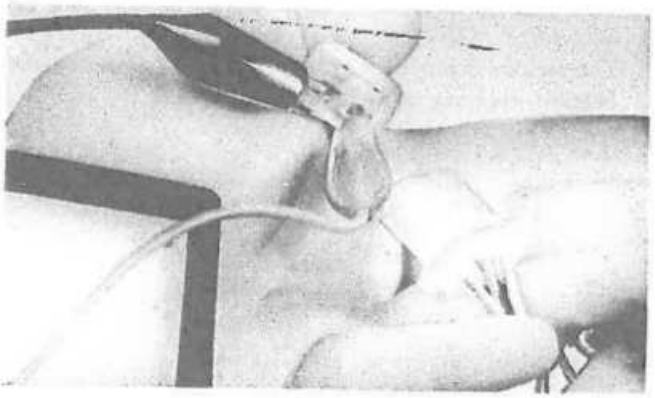
1. If voltage from the battery (or alternator) reaches the main switch (through the red wire), but, the same voltage does not pass through the switch, then it should be checked.
2. Use a pocket tester or electro-tester with the meter set to register continuity (Ohms x 1). The switch does not have to be removed from the machine but its multiple connector in the headlight must be disconnected. Make all continuity checks at this main switch multiple connector.

3. Four wires hook into the multiple connector, red, blue, brown, and red/yellow. Hook one lead of the tester to the red wire and use the other as a probe. First, check that there is no continuity between the red wire and the switch housing.



4. Turn the switch to the "Day-Night" position, Probe with the unattached meter lead. Touch the brown wire end and then the red/yellow wire end.
Continuity must exist.

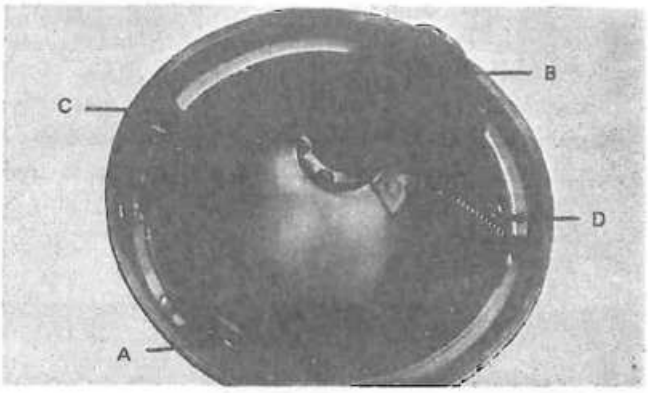
5. Turn the switch to the "Parking" position and touch the probe to the blue wire end. Continuity must exist.
6. If any of the previous tests reveals no continuity to exist check all main switch wires. If these wires appear to be in satisfactory condition (not broken or shorted to the frame), then the main switch itself is defective and must be replaced.



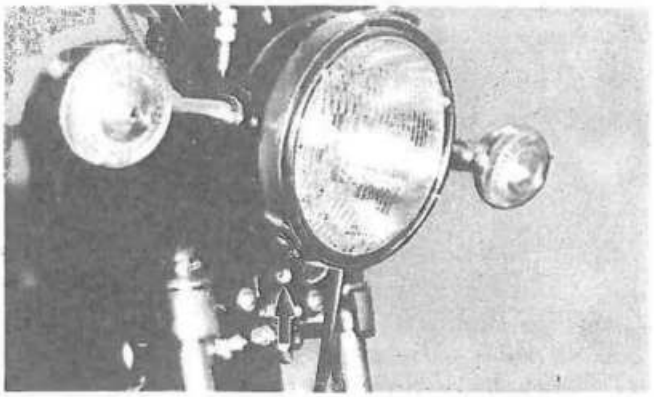
6-9. LIGHTING CIRCUIT

A. Headlight

1. The headlight is a semi-sealed unit with a non-replaceable filament. If the headlight burns out, replace the entire headlight bulb unit.
2. Replacement:
   Remove screws "A", "B" and "C" ("C" is the side adjustment screw). Unhook spring "D" and pull the defective unit out of its shell. Slip a new unit into position and install parts "A", "B", "C" and "D".

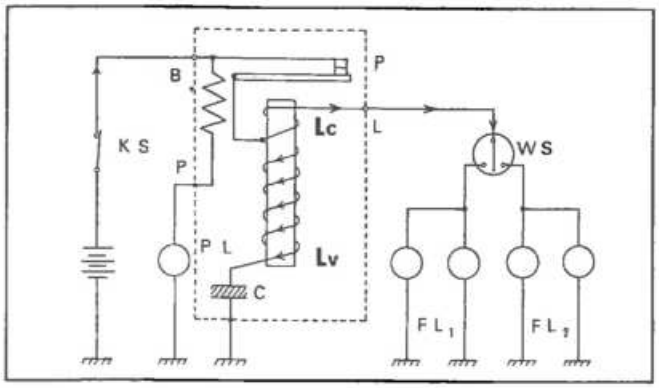


3. Adjustment:
   Screw "A" controls side-to-side headlight movement. Screw it in or out until the headlight beam is centered.
4. Headlight up and down movement is controlled by bolt "B". Loosen this bolt and tilt the headlight into position, then retighten the bolt.

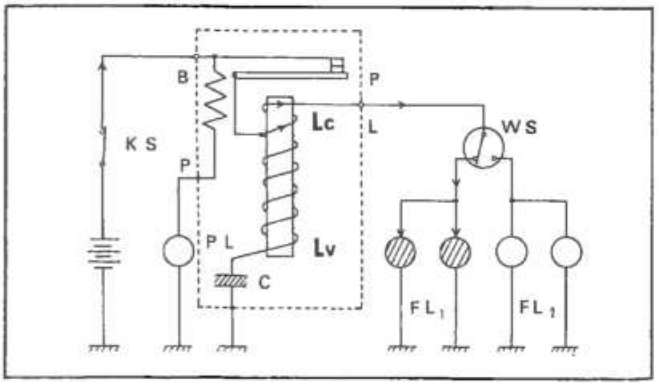


B. Turn signals

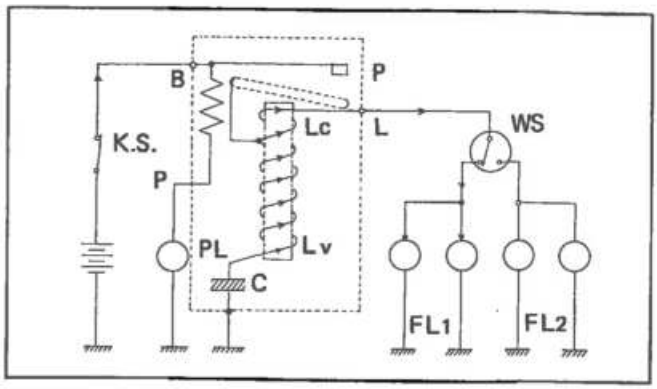
1. Voltage flows from battery to the relay condenser. The condenser becomes fully charged (including wire to flasher switch) and all voltage flow stops in the relay.



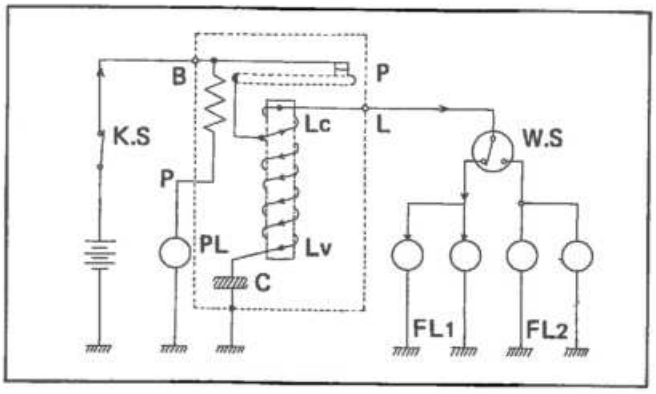
2. When the realy switch is activated, voltage flows from the battery through the "Lc" winding and causes the flasher to light.



3. At the same time that voltage lights the flasher, the "Lc" winding around the metal core creates an electro-magnet that pulls the contact points apart. Voltage flow stops and the flasher lights go out. Magnetism to hold the points apart is momentarily maintained because the stored electrical charge in the condenser discharges back through "Lv" and "Lc" winding. The stored condenser amperage, however, is no sufficient to light the flasher lights (due to their being a high resistance load), so both flasher lights do not light again.



As soon as the condenser becomes sufficiently discharged, magnetism ceases and the point spring pulls one point into the other. Voltage once again flows to the flasher lights, causing them to light. At the same time some voltage charges the condenser. The process continues to repeat itself until the switch is turned off.



4. Improper Operation
   a) No flasher action at all:
      Check for a broken or shorted wire in the turn signal circuit.
   b) Too slow or too fast flasher action:
      A burned out flasher bulb will slow the flasher action. Check the condition of all flasher bulbs. If flashing action is too slow, and all bulbs are good, the flasher relay (condenser inside) is defective. Replace the relay.

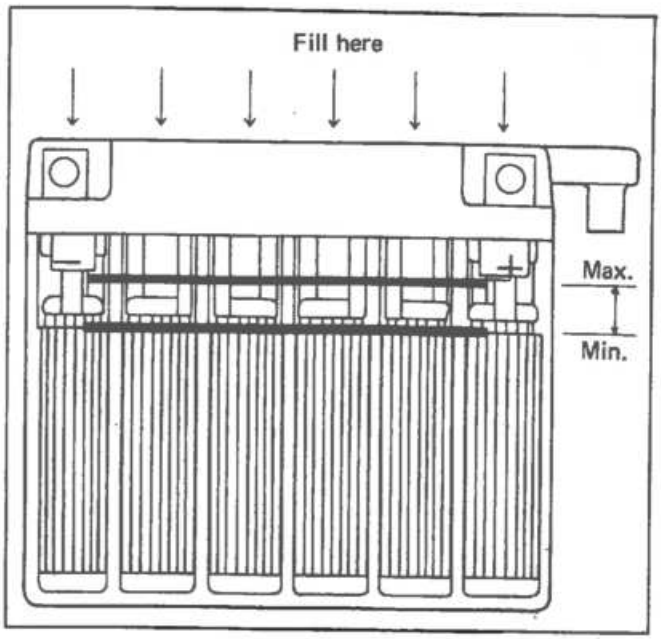
6-10. BATTERY

A. Servicing a new battery

1. Check the housing for cracks or other damage. Fill the battery with electrolyte and let set for an hour. This allows the acid to soak into the plates. With the caps off, hook up a trickle charger to the battery and charge it at 1 amp/hour rate or less. Check the specific gravity. A fully charged battery should have a rating of 1.260 ~ 1.280. If the electrolyte has dropped below minimum level after charging, add electrolyte (rating of 1.260 ~ 1.280).

B. Battery maintenance

1. Periodic inspection can determine the condition of the battery housing and the condition of the internal parts. Check for cracks or holes in the housing. Check for broken plates, sulfation, low fluid level and corroded terminals.
2. The battery housing is marked with a minimum and maximum fluid level. If any cell fluid level drops below the minimum level, fill with distilled water to correct height. Check once a month or more often in hot weather. Do not use tap water.



C. Charging

1. Remove the battery and check the specific gravity of the battery fluid. A fully charged battery reads between 1.260 ~ 1.280. If the rating is less than 1.260, the battery needs charging.
2. Fill the battery to the proper level with distilled water. Leave the fill caps off until battery charging has finished. Use a battery charger that has a maximum output of 1 amp. The XS650 battery uses a 12 amp/hour battery. DO NOT exceed a one amp input as excessive heat may be generated within the battery.

Note:

Battery fluid level sometimes drops during charging. Refill if necessary, using distilled water.

D. Troubleshooting

1. Excessive fluid evaporation from cells: Normal battery operation requires fluid to be added to the cells approximately once a month. If distilled water must be added every week or two, the battery is possibly being overcharged. Check voltage input from the alternator.
2. Low fluid level in one cell: If one cell continuously loses more fluid than others, check for a shorted cell. A shorted cell creates abnormal fluid evaporation. Check with a hydrometer for excessive difference in specific gravities between the cells.
3. Won't hold a charge:
   1) First check the alternator output to eliminate the possibility of a low charging rate. Next, check for loose terminal connections (creating high resistance), or a build up of material in the bottom of the housing that could short the plates. Nothing can be done about loose terminals themselves except to replace the battery.
      Sediment at the bottom of the housing can sometimes be removed by flushing the battery out several times with distilled water if the cell is discharge; flush with electrolyte if fully charged. Dry the battery off and recharge for a few hours. If enough loose sediment is flushed out, the battery could hold a charge. If the battery still cannot hold a full charge, replace it.

4. Sulfation: Sulfation, in the form of a white, scaly material, gradually forms on the plates and at the bottom of the housing. It is created over a period of time as the sulfuric acid combines with the lead plates to produce lead sulfate (white particles of sulfation). It is a product of age and use. The battery usually needs to be replaced when sulfation reaches the point of shorting out the plates.
5. Make sure that the wires are hooked to the proper battery terminals. The red wire must be hooked to the "positive" terminal, the black lead must be hooked to the "negative" terminal. If the wires are reversed, the battery will quickly loose its charge. Very likely the battery will be destroyed if the reversed hook-up is left connected for any length of time.

E. Storage

1. Whether it is a new battery or one that has been in service, preparation for storage of either one is almost identical. When new, the battery is dry charged (no electrolyte). Keep it away from moisture and heat. A stored dry-charged battery can last several months without losing a great deal of its charge.
2. A used battery should be filled to the maximum level with distilled water, given a complete charge and stored in a cool area (coldness slows the process of battery discharge). It should be given a booster charge every two months. When preparing to place a stored battery back into service, check for sufficient electrolyte and fully charge the battery.

CHAPTER 7. TOUBLESHOOTING

7-1. NO START OR DIFFICULT TO START 167
A. Ignition System 167
B. Fuel System 167
C. Compression-Cylinder Compression Measure Shows Low Pressure 167
7-2. POOR IDLE AND/OR LOW SPEED PERFORMANCE 168
A. Ignition System 168
B. Fuel System 168
C. Compression System 168
7-3. POOR MID-RANGE AND HIGH SPEED PERFORMANCE 168
A. Ignition System 168
B. Oil System 169
C. Too Much Blue Exhaust Smoke 169

Millimeters to Inches 170
Inches to Millimeters 170
Conversion Table 171
Torque Specifications 171
CIRCUIT DIAGRAM 172

7

CHAPTER 7. TROUBLESHOOTING

7-1. No Start or Difficult to Start

A. Ignition System

Possible Cause	Inspection and Repair
1. Carbon-fouled or worn out spark plug.	Clean plug (if possible) and gap to .6 – .7 mm.
2. Gap incorrect or bridged.	
3. Contact breaker point burned up or worn out.	Clean or change points.
4. Point gap incorrect.	Set point gap (.3 – .4mm.)
5. Ignition timing out of adjustment.	Set ignition timing.
6. Ignition coil no good.	Use electro-tester to measure primary and secondary winding resistance. Also make a standard coil test.
7. Condenser shorted out.	Use electro-tester to check capacity and insulation.
8. Brown or red ignition wires broken or shorted.	Turn on main switch. Hit horn and stoplight. No operation means possible broken wire.
9. Main switch no good.	Check main switch.
10. Blown fuse.	Replace.
11. Battery discharged or defective.	Check specific gravity of each cell with hydrometer.

B. Fuel System

Possible Cause	Inspection and Repair
1. No gas.	Disconnect fuel line at carburetor, turn fuel petcock on check for fuel flow.
2. Tank cap vent hole plugged.	
3. Petcock defective.	
4. Fuel line plugged.	
5. Carburetor not level,	
6. Carb equalizer tube has hole or loose connection.	

C. Cylinder Compression Measurement Shows Low Pressure

Possible Cause	Inspection and Repair
1. Lack of tappet clearance: valve held open.	Adjust tappet.
2. Valve timing incorrect.	Camshaft improperly installed or cam chain loose.
3. Cylinder head gasket broken.	Check for combustion gases blowing out past gasket.
4. Valve seat defective.	See valve seat section.
5. Piston ring(s) defective.	Too much smoke while riding motorcycle. Especially blue smoke indicating oil burning. See individual wear sections for inspection methods.
6. Cylinder tapered or out of round.	
7. Valve guide(s) worn out.	
8. Guide seals bad.	

7-2. Poor Idle and/or Low Speed Performance

A. Ignition System

Possible Cause	Inspection and Repair
1. Spark plug fouled or incorrect gap.	Clean and gap, or replace if necessary.
2. Contact points bad.	Clean and gap, or replace if necessary.
3. Incorrect ignition timing.	Reset timing.
4. Weak spark.	Check ignition coil and condenser.
5. Partially discharged or defective battery.	Weak horn and lights-check fluid level; recharge.

B. Fuel System

Possible Cause	Inspection and Repair
1. Tank cap vent plugged.	Clean or repair as necessary.
2. Fuel petcock plugged.	
3. Carburetor slow speed system inoperative.	
4. Pilot screw out of adjustment or plugged.	
5. Carburetor float level incorrect.	
6. Starter levers on.	
7. Air leak.	Manifold equalizer tube cracked, or rubber carburetor manifold cracked.
8. Carburetor not level.	
9. Equalizer tube has hole or loose connection.	

C. Compression System

Possible Cause	Inspection and Repair
1. Incorrect tappet clearance.	
2. Valve timing (camshaft) incorrect.	
3. Valve seat leak age.	
4. Valve guide worn.	

7-3. Poor Mid-Range and High Speed Performance

A. Ignition System

Possible Cause	Inspection and Repair
1. Spark plug incorrect.	Clean and gap to 6–7mm. or change plug if necessary.
2. Advance (or spring) defective.	Advance not able to turn, governor weight not pivoting. Check for correct "retard" to "full advance" position.
3. Ignition timing off.	
4. Points set too close.	Re-gap to 0.3 – 0.45 mm.

B. Oil System

Possible Cause	Inspection and Repair
1. Oil level too low.	Check and refill.
2. Oil too thin.	Improper weight or too contaminated-change oil.
3. Oil pump defective.	Loosen oil delivery line to head and check for oil flow.
4. Oil passage(s) plugged.	Disassemble engine. Squint solvent on oil through passages.

C. Too Much Blue Exhaust Smoke

1. Too much engine oil.	Check oil level and drain some if necessary.
2. Breather plugged up.	Check and clean if necessary.
3. Cylinder and/or piston rings worn.	Make necessary measurements and replace as necessary.
4. Worn valve guide.	Make necessary measurements and replace as necessary.
5. Cracked valve guide seals.	Make necessary inspection and replace as necessary.

Millimeters to Inches

	0	.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0		.0039	.0079	.0118	.0157	.0197	.0236	.0276	.0315	.0354
1	.0394	.0433	.0472	.0512	.0551	.0591	.0630	.0669	.0709	.0748
2	.0787	.0827	.0866	.0906	.0945	.0984	.1024	.1063	.1102	.1142
3	.1181	.1200	.1260	.1299	.1339	.1378	.1417	.1457	.1496	.1535
4	.1575	.1614	.1654	.1693	.1732	.1772	.1811	.1850	.1890	.1929
5	.1969	.2000	.2047	.2087	.2126	.2165	.2205	.2244	.2283	.2323
6	.2362	.2402	.2441	.2480	.2520	.2559	.2598	.2638	.2677	.2717
7	.2756	.2795	.2835	.2874	.2913	.2953	.2992	.3031	.3071	.3110
8	.3150	.3189	.3228	.3268	.3307	.3346	.3386	.3425	.3465	.3504
9	.3543	.3583	.3622	.3661	.3701	.3740	.3780	.3819	.3858	.3898
10	.3937	.3976	.4016	.4055	.4094	.4134	.4173	.4213	.4252	.4291

.01mm = .0004 .03mm = .0012 .05mm = .0020 .07mm = .0028 .09mm = .0035
.02mm = .0008 .04mm = .0016 .06mm = .0024 .08mm = .0031 .10mm = .0039

Inches to Millimeters

	0	.1	0.2	0.3	0.4	.05	.06	.07	.08	.09
0		.254	.508	.762	1.016	1.270	1.524	1.778	2.032	2.286
1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
2	5.080	5.334	5.588	5.842	6.096	6.350	6.604	6.858	7.112	7.366
3	7.620	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146
10	25.400	25.654	25.908	26.162	26.416	26.670	26.924	27.178	27.432	27.686

.001" = .0254mm .003" = .0762mm .005" = .1270mm .007" = .1778mm .009" = .2286mm
.002" = .0508mm .004" = .1016mm .006" = .1524mm .008" = .2032mm .010" = .254mm

CONVERSION TABLE

LENGTHS

Multiply	By	To Obtain	Multiply	By	To Obtain
Millimeters (mm)	0.03937	Inches	Kilometers (km)	.6214	Miles
Inches (in)	25.4	Millimeters	Miles (mi)	1.609	Kilometers
Centimeters (cm)	.3937	Inches	Meters (m)	3.281	Feet
Inches (in)	2.54	Centimeters	Feet (ft)	.3048	Meters

WEIGHTS

Kilograms (kg)	2.205	Pounds	Grams (g)	.03527	Ounces
Pounds (lbs)	.4536	Kilograms	Ounces (oz)	28.25	Grams

VOLUMES

Cubic centimeters (cc)	.06102	Cubic inches	Imperial gallons	277.274	cu.in.
Cubic inches (cu.in.)	16.387	cc.	Liters (l)	1.057	Quarts
Liters (l)	.264	Gallons	Quarts (qt)	.946	Liters
Gallons (gal)	3.785	Liters	Cubic centimeters (cc)	.0339	Fluid ounces
U.S. gallons	1.2	Imperial-gals.	Fluid ounces (fl. oz)	29.57	cc.
Imperial gallons	4.537	Liters			

OTHERS

Metric horsepower (ps)	1.014	bhp	Foot-pounds (ft-lbs)	.1383	kg-m
Brake horsepower (bhp)	.9859	ps.	Kilometers per liter (km/l)	2.352	mpg
Kilogram-meter (kg-m)	7.234	Foot-pounds	Miles per gallon (mpg)	.4252	km;l
Kilograms/sq.cm (kg/cm^2)	14.22	Pounds/sq.in. (lbs/in^2 or psi)			
Centigrade (C°)	(C° x 9/5) + 32	Fahrenheit (F°)			

TORQUE SPECIFICATIONS

Stud size	kg-m	In-lbs*
6mm.	1.0	90
7	1.5	135
8	2.0	180
10	3.2–4.0	300–350
12	4.0–4.6	350–400
14	4.6–5.2	400–450
17	5.87–7.0	500–600

* Ft-lbs = In-lbs divided by 12.

XS650B WIRING DIAGRAM

