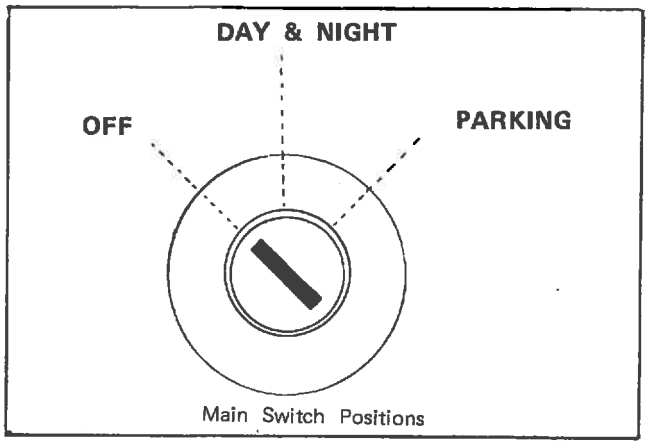
B) Main Switch

1) Main Switch

The XS650 uses a three position switch that directs current from the battery (or alternator) to the various lighting and ignition circuits.



Main Switch Positions

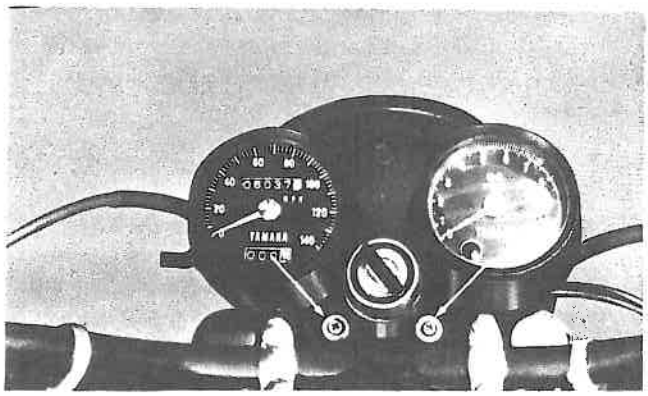
1st position: Prevents current from flowing to any circuit.

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.

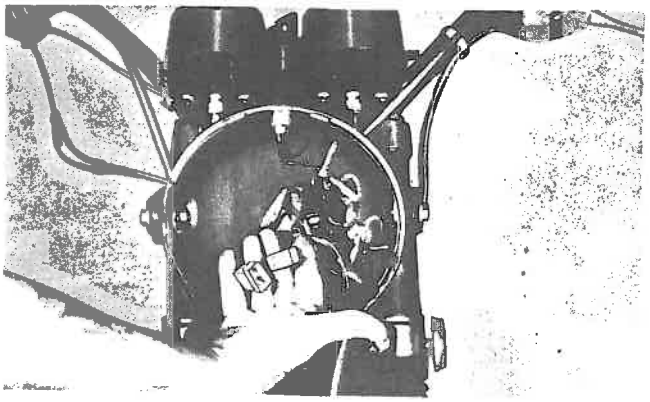
3rd position: Only the parking light is activated.

2) Location and Replacement

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



b) 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.

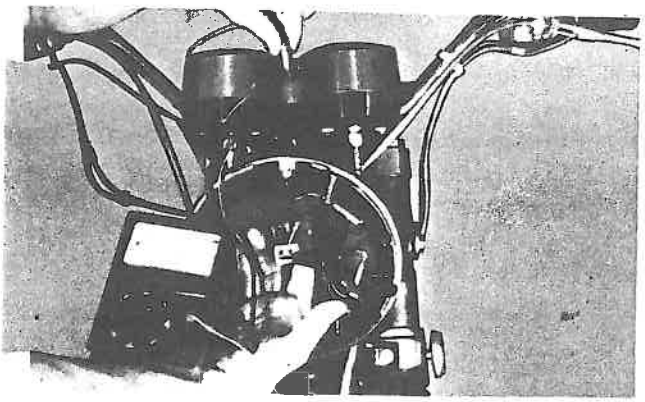


3) Troubleshooting

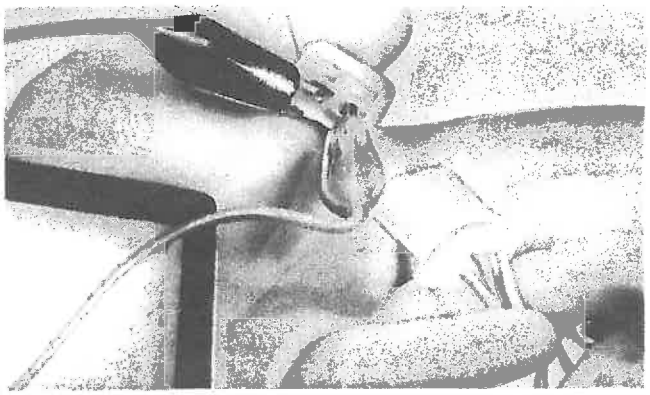
a) If voltage from the battery (or alternator) reaches the main switch (through the red wire), but the same voltage does not pass through the switch, then it should be checked.

b) 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.

c) 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.



d) 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.

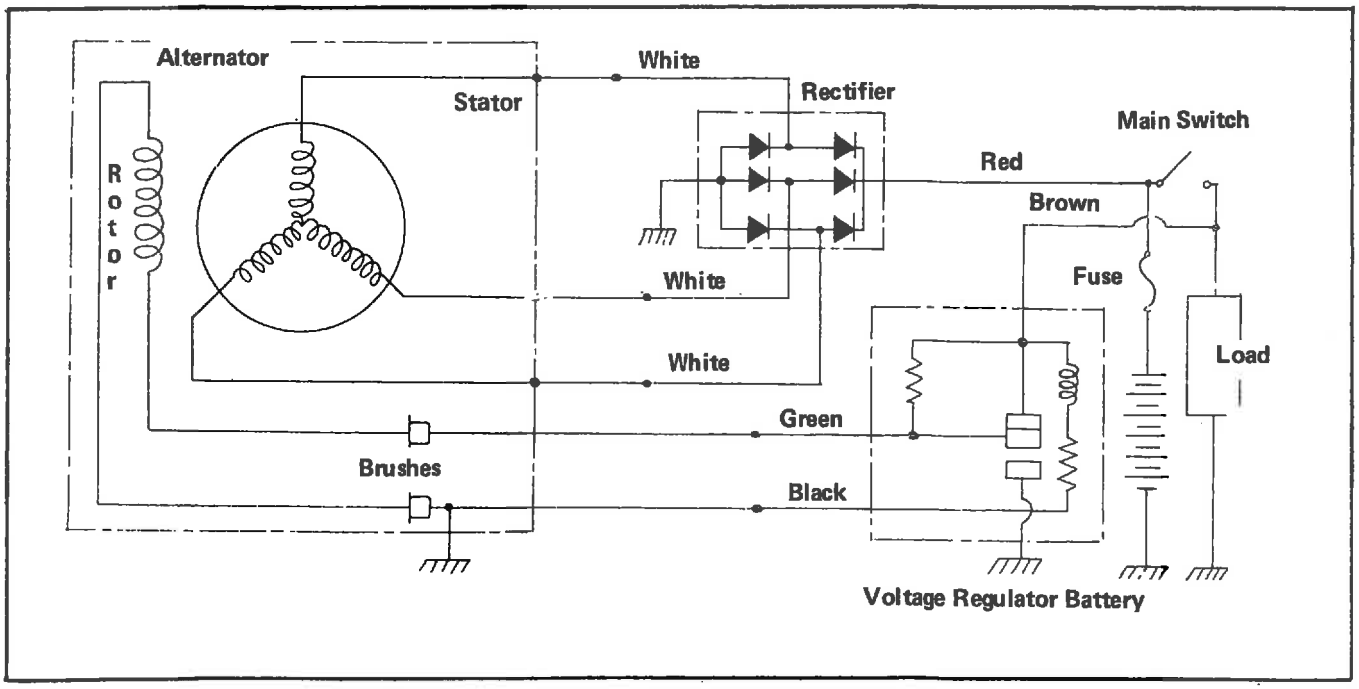


e) Turn the switch to the "Parking" position and touch the probe to the blue wire end. Continuity must exist.

f) If any of the previous tests reveal 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 internally and must be replaced.

C) Charging Circuit

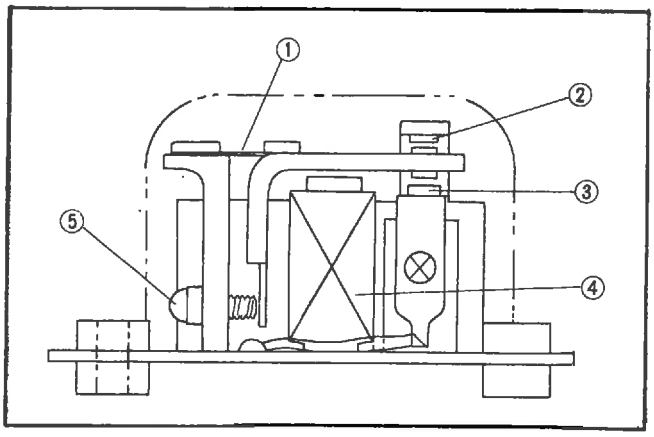
This circuit consists of the battery (to first provide voltage to the rotor field windings) regulator, ACG (alternating current generator), rectifier, and main switch.

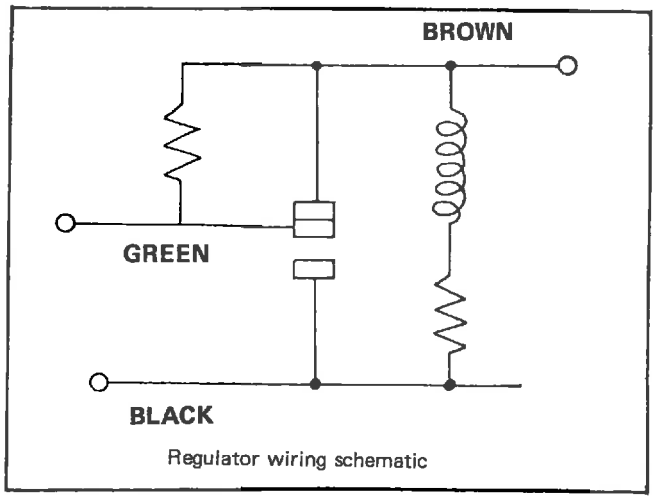


1) Regulator

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.

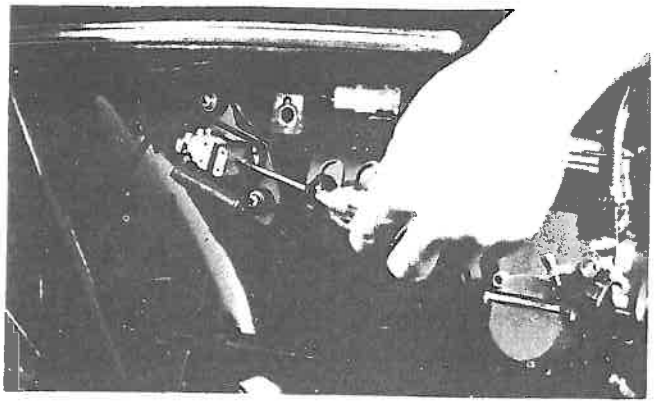




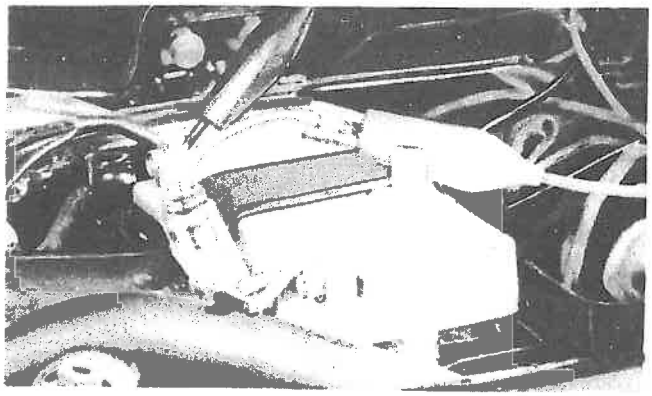
Regulator wiring schematic

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.

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.



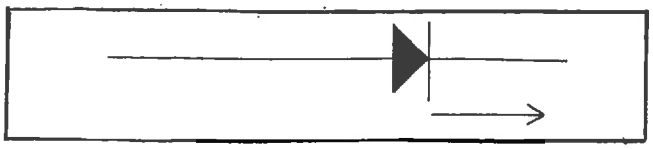
d) Start the engine. Disconnect the fuse box wire leading to the battery and hook up a voltmeter from the fuse box to ground. Accelerate the engine to 2,500 rpm. The voltmeter should read 14.5~15 volts DC. If it varies from this amount twist the adjusting screw in to raise the charging voltage or out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



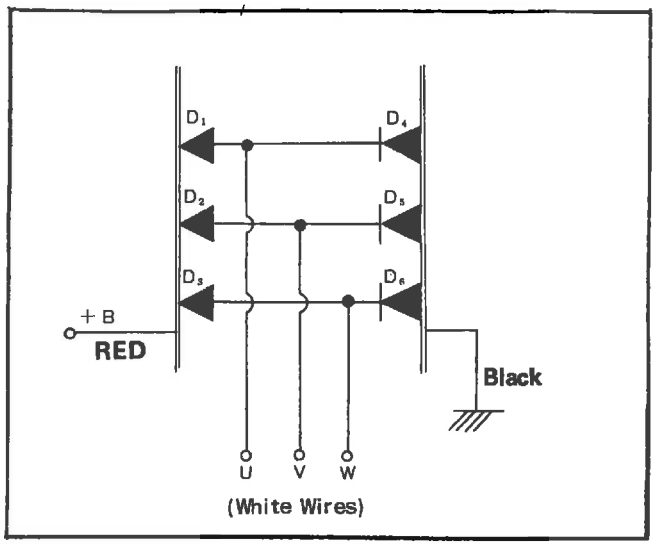
No load voltage test hook up.

2) Rectifier

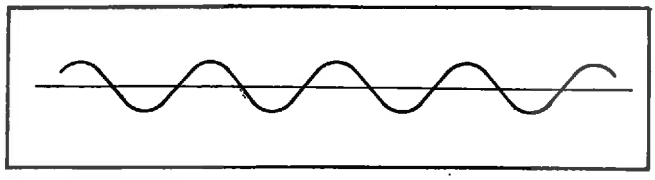
a) The XS650 unit is a full wave rectifier which changes alternating currect (AC) generated by the alternator to direct current (DC) by passing the AC through six sillicon diodes. The diodes permit only one-way current flow. DC is sent to the battery and main switch.



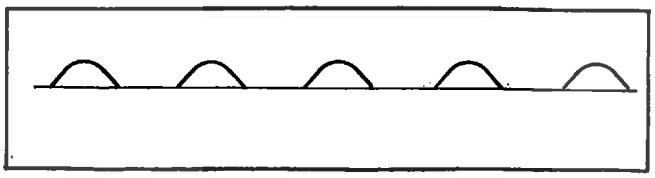
b) This symbol indicates a one-way diode. Current flows in the direction the sign is pointing.



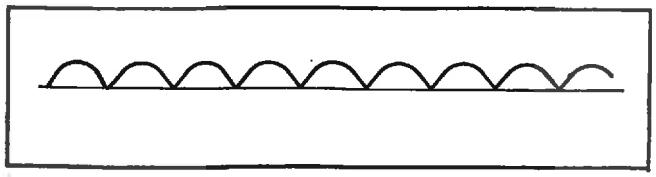
c) Schematic representation of the three phase, fullwave rectifier in the XS650 generating circuit.



d) Wave form of standard alternating current.



e) Wave form of alternating current after rectification by one diode (now direct current)



f) Wave form of AC after full wave rectification.

3) Rotor (Alternating Current Generator)

The rotor of the ACG (Alternating Current Generator-alternator) 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 Negative to Positive. 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 good 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.

4) 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.

5) Troubleshooting

Troubleshooting the electrical system 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 ohms 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 TESTS CAN BE COMPLETED WITH THE PARTS STILL ATTACHED TO THE MACHINE. THERE SHOULD BE NO NECESSITY TO REMOVE ANYTHING EXCEPT INSPECTION COVERS OR MISCELLANEOUS ITEMS TO GET TO THE PART.

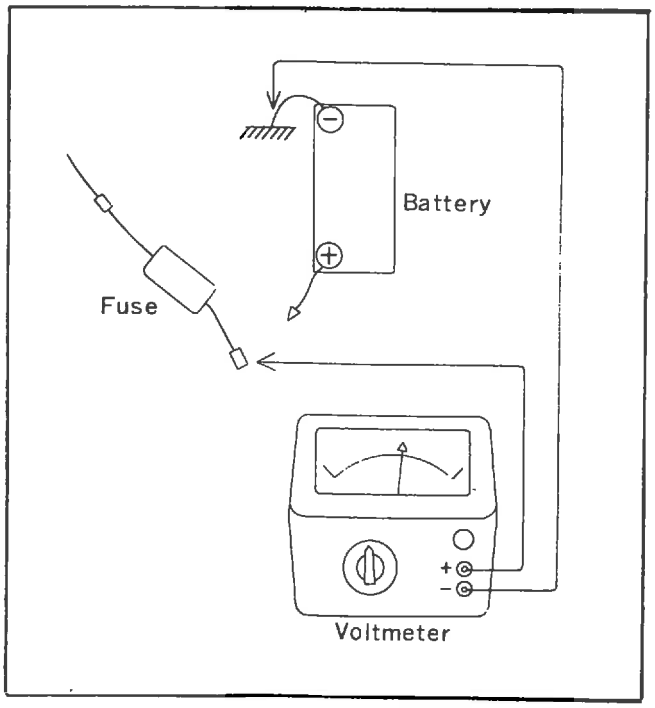
a) Charging voltage output

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 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.

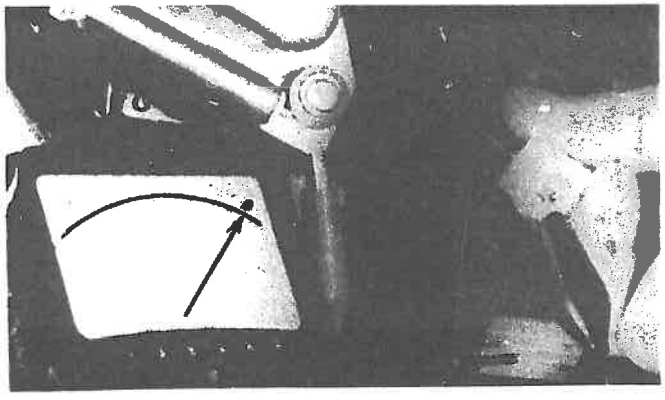
c) **Regulator**

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 fused 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.

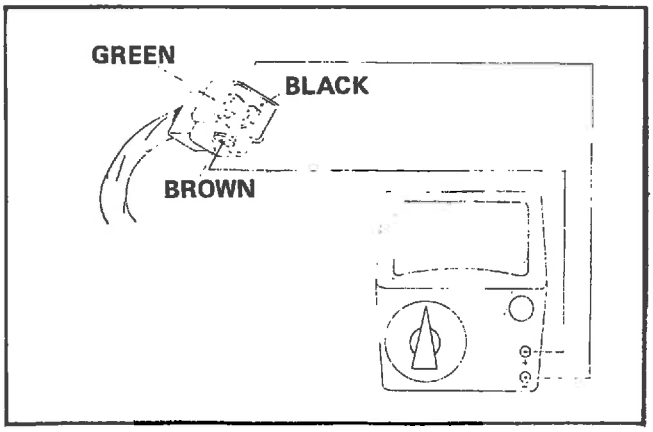
2) If visual inspection does not locate any trouble spot then check for proper resistance through all regulator circuits. This is done by separating the regulator multiple connector and measuring resistance through the green, black, and brown wires at the multiple connector.

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 ohms resistance. Several ohms resistance indicates a frayed or broken black wire.

NOTE: Voltage output will be excessively high if this black wire is broken anywhere between the regulator and the stator.

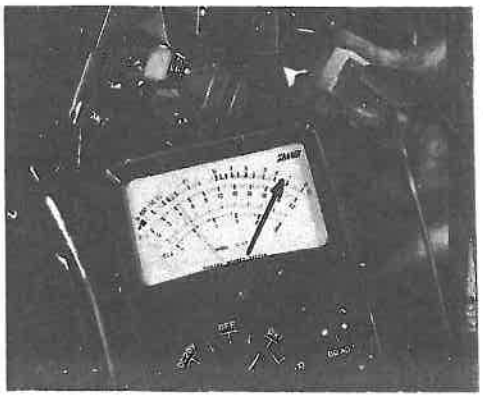


4) Hook one meter probe to the brown wire and the other probe to the green wire.

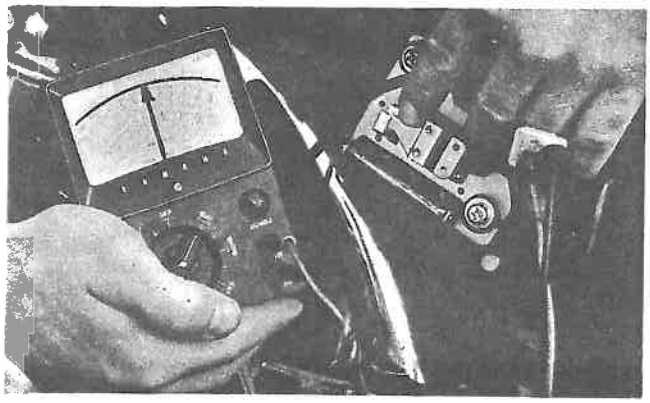


5) Remove the regulator cover.

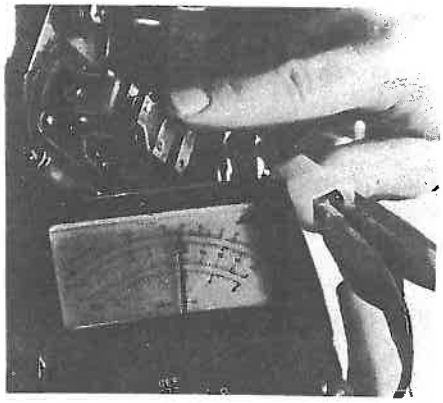
6) With the central contact point held against the top point by the spring (as in the low rpm position), the meter should show no resistance at all (two ohms resistance is too much). If high resistance exists, one of the wires is broken, a soldered joint has separated, or the points are burned. The unit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



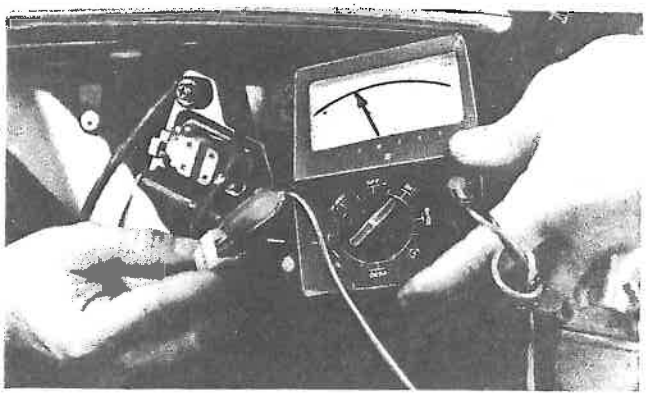
7) Maintain the same meter hook-up as step four. Push the central point arm until the point is positioned mid-way between the top and bottom points. The meter must read 9~10Ω resistance. If the observed resistance varies from this figure, the 10Ω regulator resistor has failed; either internally or at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

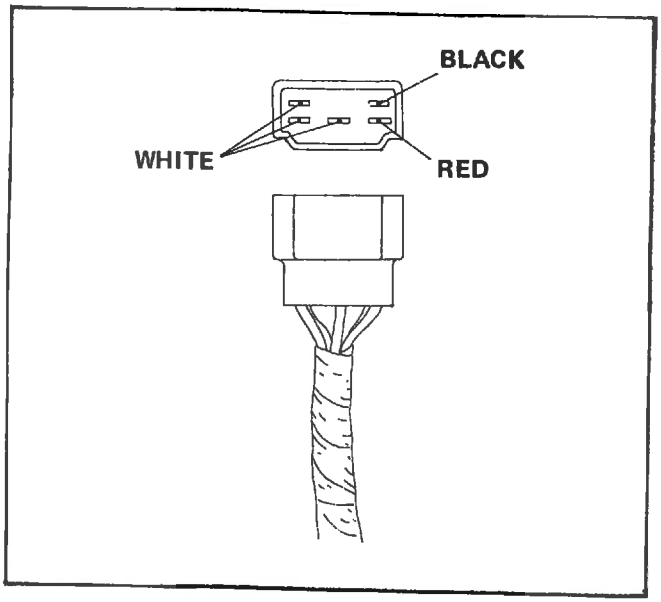


10) A correctly operating regulator will give the resistance values as listed in each test. If the measured values differ, and the variation cannot be blamed on a broken or disconnected wire (that can be resoldered), replace the regulator unit. If a complete regulator resistance test shows all circuits 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.

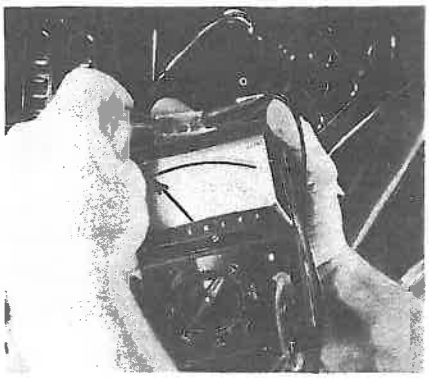
2) The prongs are connected to three white wires (that hook up to the alternator wires), one black wire (to ground) and one red wire (to battery and main switch). Perform the following tests, using an ohmmeter (0~1000Ω scale) to check the condition of the rectifier.



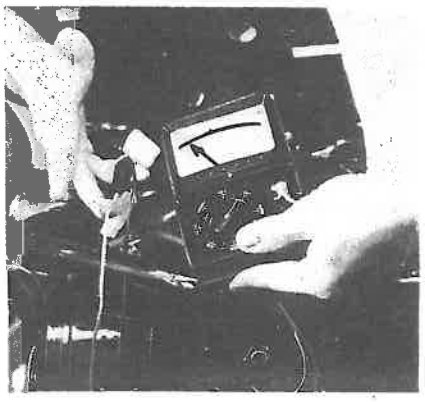
3) Visually check all rectifier wires for breaks.

NOTE: The black rectifier lead, which starts at the rectifier and passes through the main wiring loom, is grounded to one of the secondary ignition coil bolts. If this black wire breaks, voltage output will increase radically. Remember this point when troubleshooting.

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 (75~150) 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).

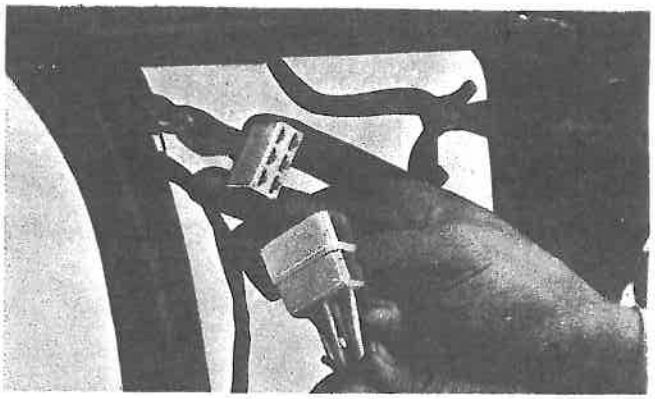


6) All rectifier wires directly attached to the diodes are fully insulated. If any are broken, replace the unit.

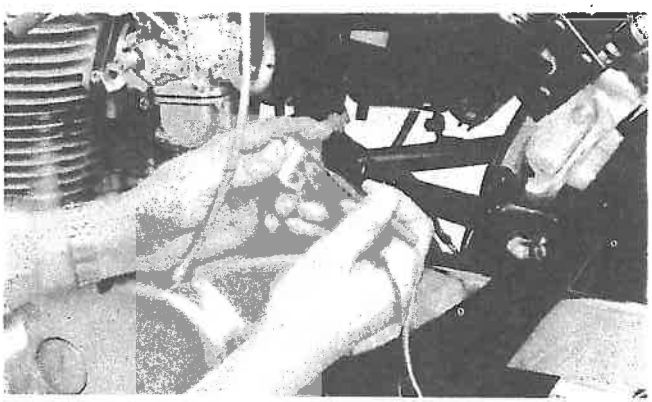
7) If resistance results of steps 4) and 5) show that current can flow both ways, or neither way, then one or more diodes have been damaged. Replace the unit.

e) Stator Winding

1) 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).



2) 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.



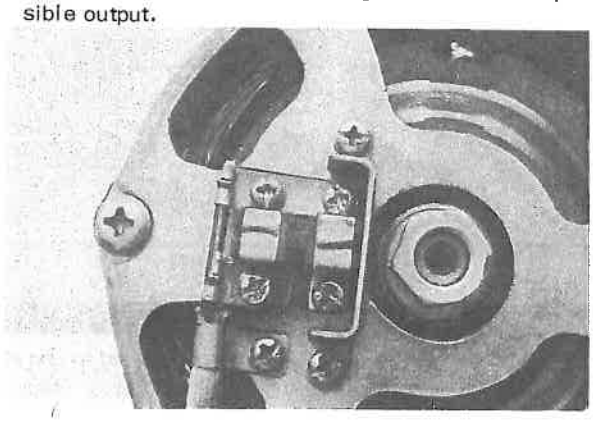
3) Set the ohmmeter scale to read at least in kilo-ohms. Clamp the ohmmeter probe to the stator housing and touch each white wire with the other probe. There should be infinite resistance.

4) 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.

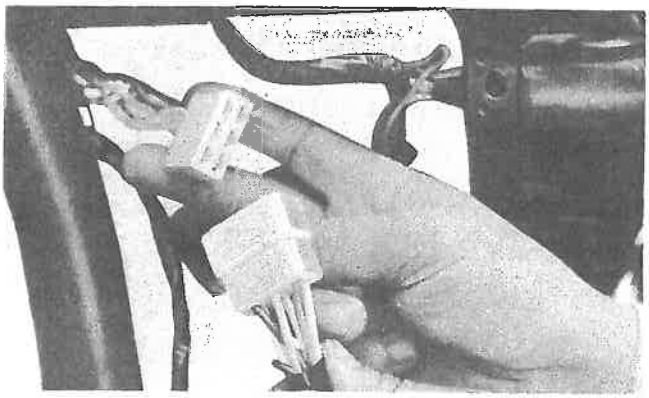
f) Carbon Brushes

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

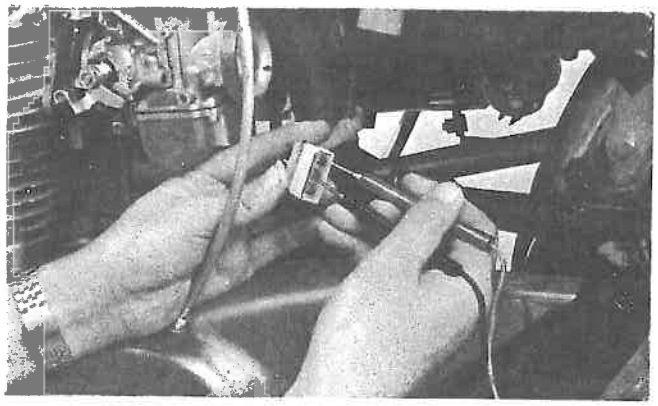
2) Visually inspect the carbon brush holder and brushes for obvious breakage or wear. Standard brush length is 14.5 mm (.572"). Wear limit is 7.0 mm(.276"). Also check for carbon dust that could 'short out' the insulated brush, thereby cutting down maximum possible output.



3) 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.



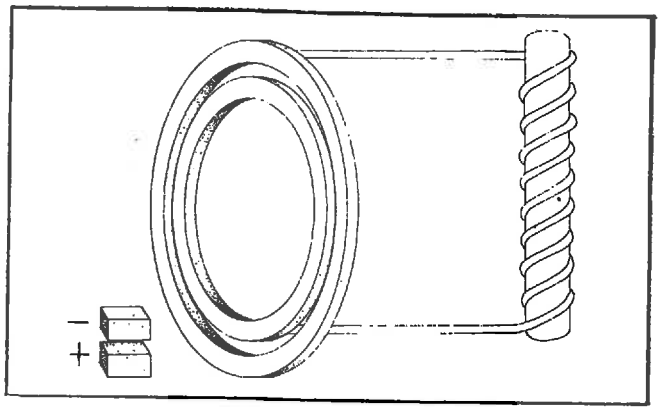
4) Check wiring resistance from the multiple connector to the carbon brush first through the green wire and then the black wire. There must be zero resistance.



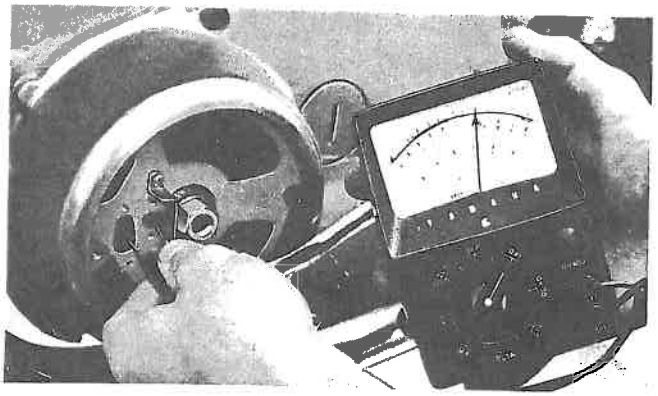
5) If high resistance exists in either wire, it is frayed or broken. Repair or replace the entire wire.

g) Rotor Windings

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

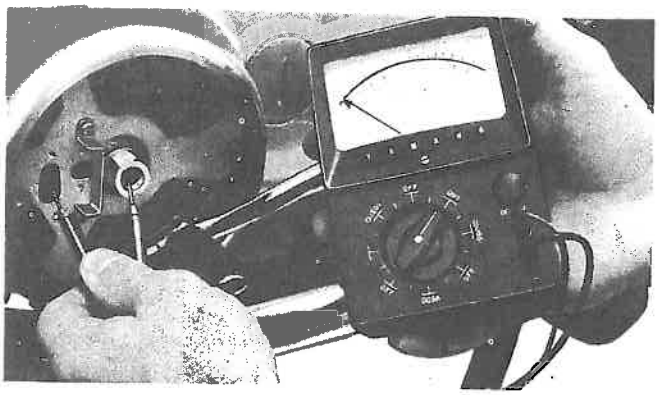


2) Use an ohmmeter (Ω x 1) to check resistance from one slip ring to another. Resistance should measure 5~7Ω.



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

3) 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.



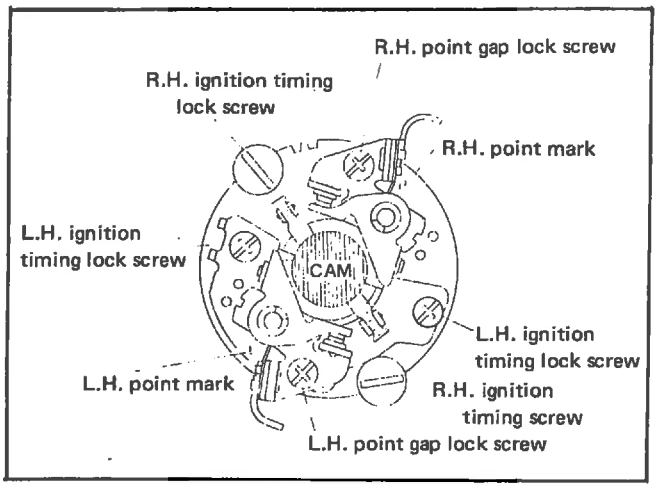
4) If resistance measurements differ greatly from those specified, the winding is either broken, shorted to itself, or shorted to the core. Replace it.

D) 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.

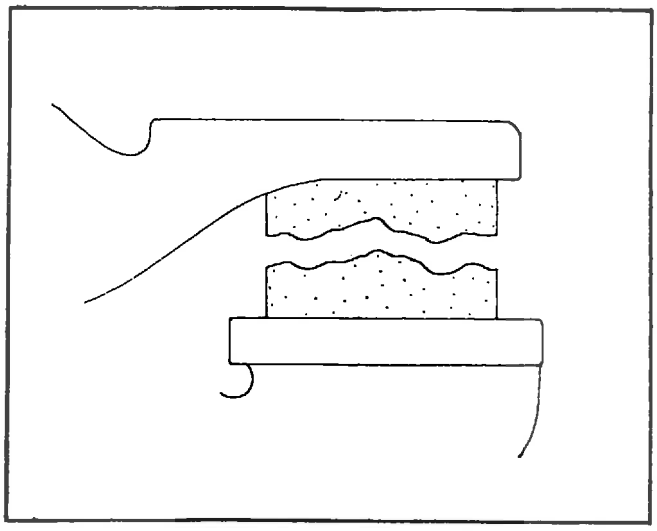
The points act as circuit breakers for the ignition system. A point cam spins counterclockwise in the center of the ignition unit. A lobe on the cam controls the opening and closing of the points.

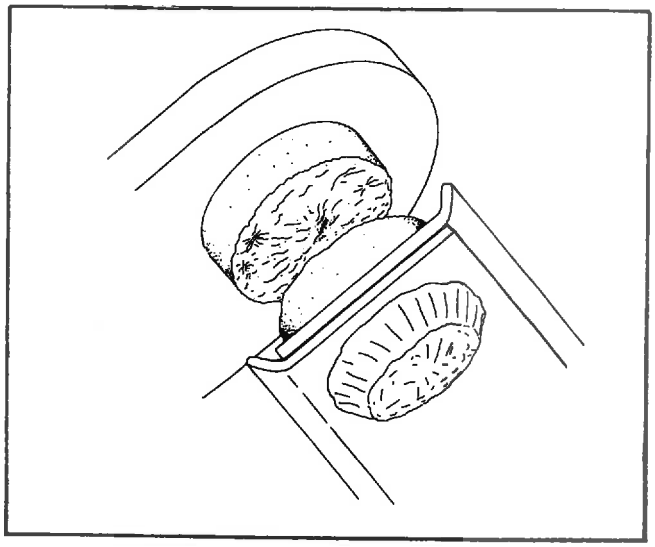
When the points are closed, current flows to the primary coil (which begins to build a magnetic field). At a precisely calculated point of crankshaft rotation, the cam forces the points apart, which stops current flow to the primary winding in the ignition coil. High voltage is then generated in the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





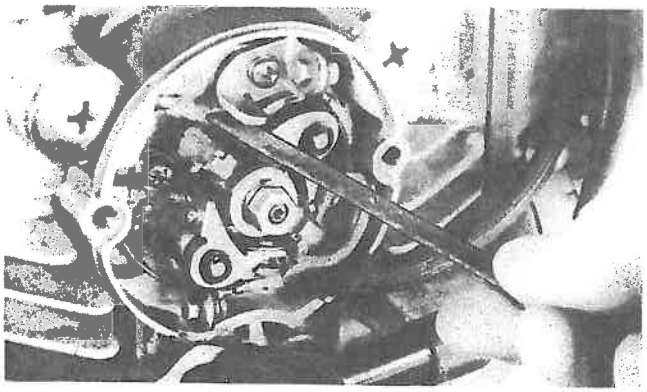
b) Oil may gradually seep past the seal and coat the points or wiring. This will burn onto the points creating an insulating film. It must be cleaned off with ignition cleaning solvent.

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.)

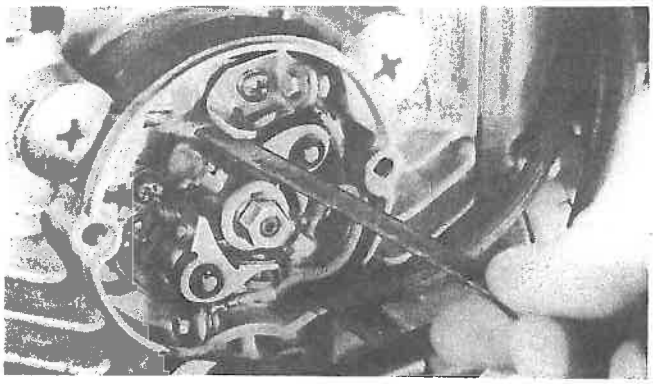
d) If a point return spring becomes weak or broken, the pivoting point will bounce. Timing will become erratic and ignition firing will be uneven. Measure spring tension by attaching a scale (measured in grams) to the pivoting point. It should take 700~800 g to cause the points to separate. (Use a point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

2) Repair

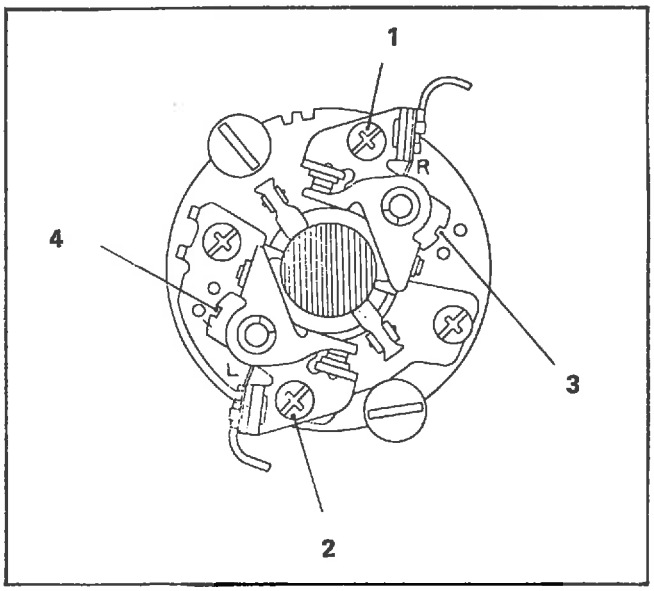
a) Point gap on each set of points must be set at .3~.4 mm (.012"~.016"). Constant electrical arcs across the points cause some metal to burn away, changing point gap. Clean and regap the points every 2,000 miles. Check timing after re-gapping.



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 laquer 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 .4mm (0.16") 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.

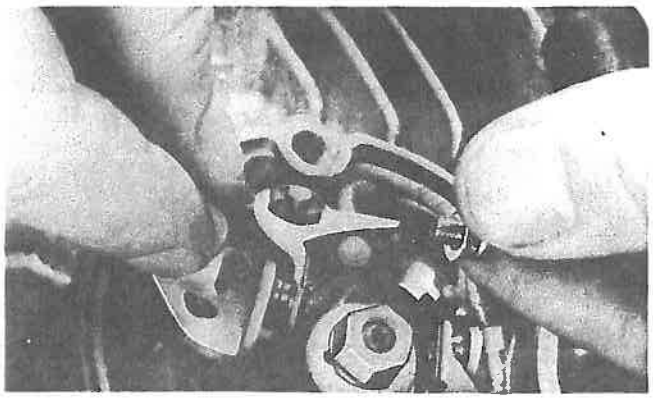


d) Next, rotate the camshaft until the second set of points opens to its widest point. Then perform the same steps as described in the previous paragraph.

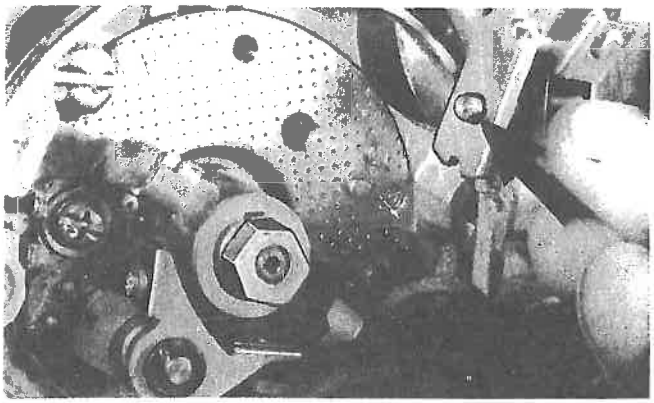
NOTE:
Add a few drops of light-weight oil onto the felt rubbing pad after each point adjustment to lubricate the point cam surface. Do not overoil.

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.

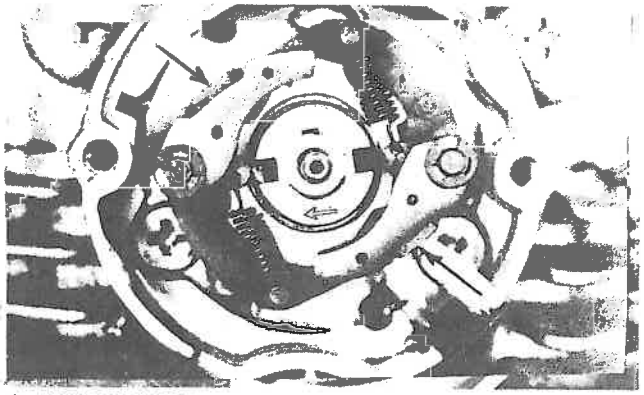


b) Locate the new set of points into position by slipping the point assembly locating pin into the appropriate locating hole in the base plate.

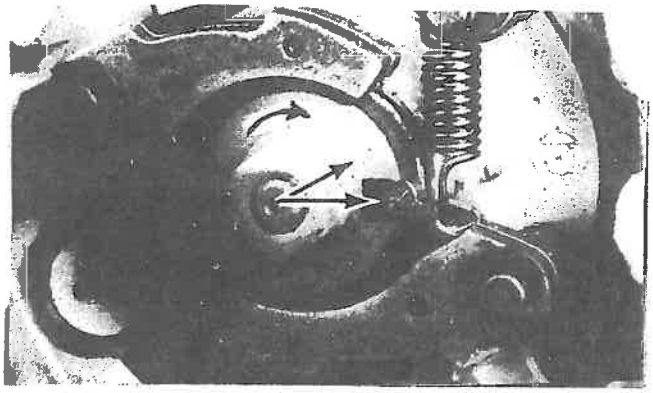


c) Insert and tighten the point lock screw. Finish this replacement by attaching the point wire to the stationary point and re-gapping the new point assembly.

E) Advance Assembly



Advance arm stops



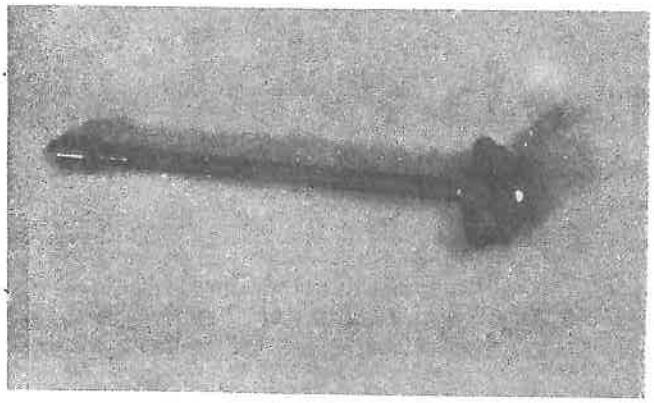
Proper assembly procedure (direction arrow)

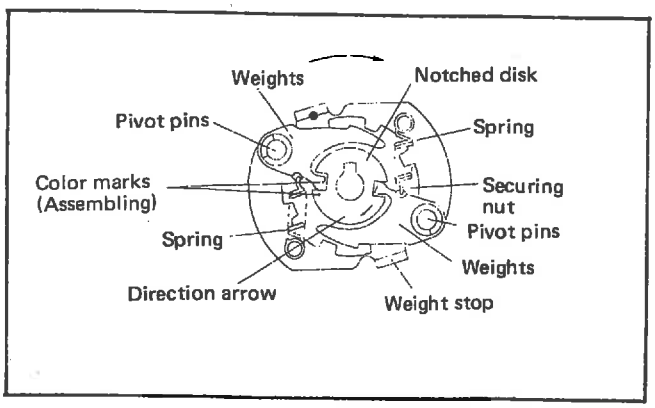
1) The governor rod is threaded at one end and a notched disk is attached to it by a nut. Around this disk is the advance unit which mounts directly to the end of the camshaft (a ring nut holds it in place).

   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.

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.

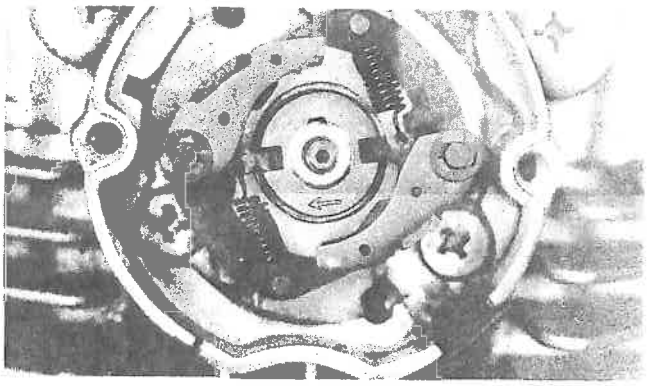
3) The advance unit mechanically changes ignition firing from 13–17° BTDC at low rpm to 40° BTDC at high rpm (full advance). The ignition point cam is attached to one end of a rod that travels completely through the center of the camshaft. The rod is connected squarely to the camshaft. The point cam opens and closes the points. The other rod end provides a mounting point for the advance unit.





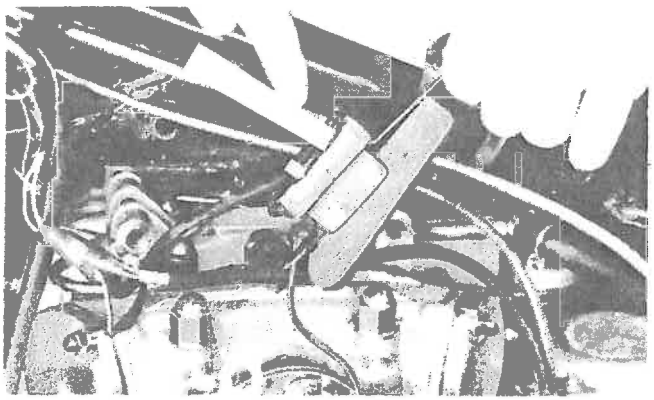
4) If a return spring is broken, the ignition timing will advance too quickly. This condition causes poor performance and excessive engine heat.

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. •

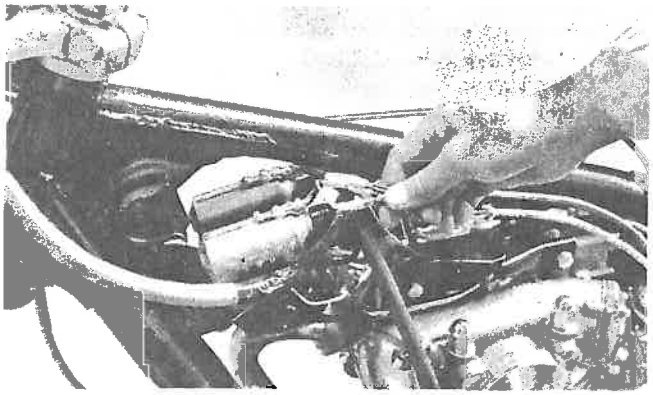


F) Condenser

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.

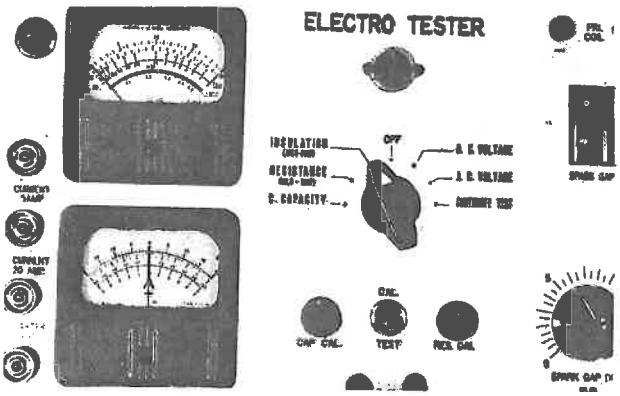


2) The condensers serve as a storage device to decrease arcing across the ignition points. Should one fail there could be either no spark or severe point pitting due to arcing. In the event of severe arcing there is also the possibility that the strength of the ignition spark may be decreased.

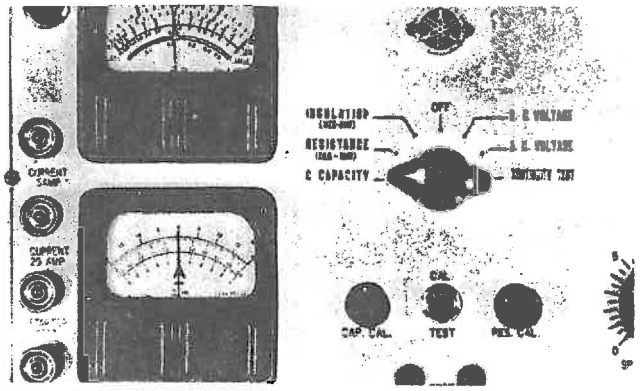


3) To test the condition of either condenser, pull the male/female connection apart.

4) Hook an ohmmeter or your electro tester 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.

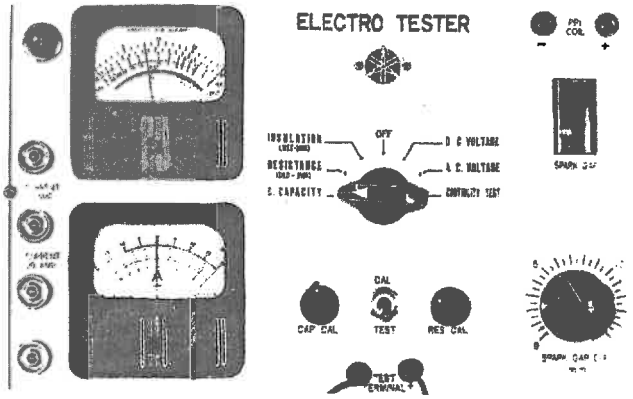


5) Next, hook up an electrotester to the condenser. (Leads in the same position). Turn the main function switch to "Capacitance" and the calibration switch to "Cal".



6) Turn the "Cap. Cal." knob until the meter needle is mid-range (in the black) on the red meter section for "Capacitance".

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.

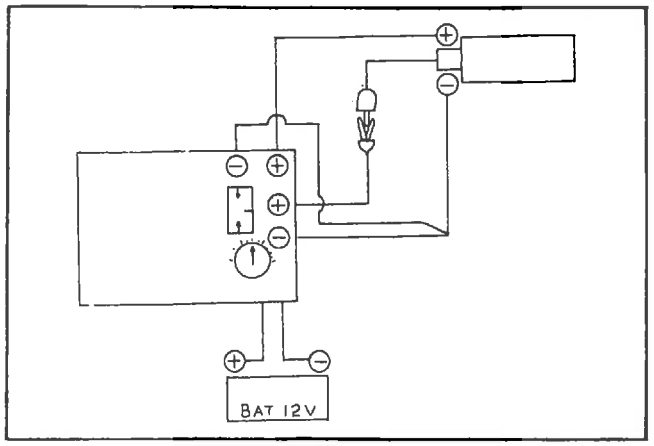


G) Ignition Coil

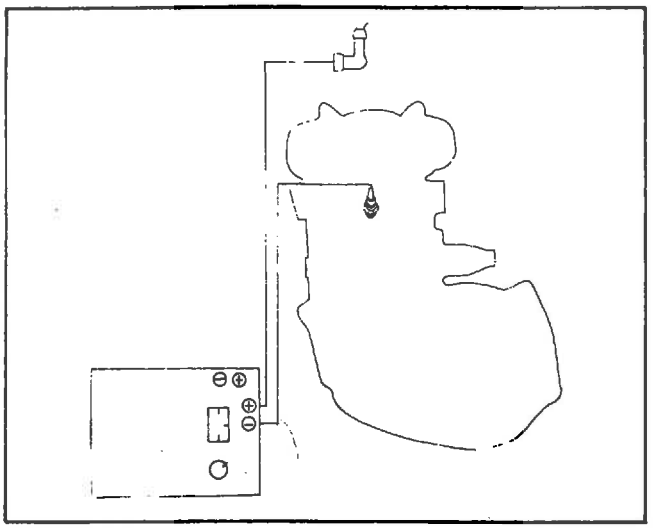
1) Location
The ignition coils are mounted to a bracket directly in back of the steering head. They can not be removed until the gas tank is removed.

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 shown below 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 **shown below for setting up.** Close the point gap on the Electrotester to zero. Turn the ignition on and start the machine. Rev the machine to 2~3,000 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 smooth again. Point gap should be at least 7 mm.



H) Spark Plug

1) Standard spark plug is an NGK B-8E which is a 14 mm, 3/4" reach, fairly cold plug.

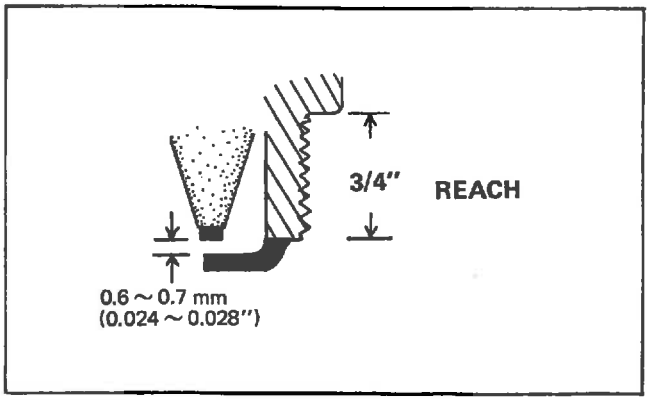
2) Under normal conditions the spark plug should show no deposits on the porcelain insulator around the positive electrode. The porcelain should be a light-to-medium tan color. After 2,000~4,000 miles fuel deposits will begin to build up on the plug. Fuel deposits are easily cleaned off but as this is the period for a tune-up it is advisable to replace the spark plug.

3) If one or both plugs are wet, black, and/or heavily sooted, this is an indication that temperatures within the combustion chamber are too low. Check with the rider as to his habits. The plug is designed to give best performance during moderate to medium-high speed cruising.

4) If one or both plugs are white, blistered, and/or the electrode has melted away, this is an indication of excessive combustion chamber temperature.

5) Under normal circumstances it is best to tune carburetion to achieve a correct spark plug reading. However, if the situation is only slightly incorrect then one step hotter (B-7E) or colder (B-9E) spark plug can be installed. If the machine is being driven under extremely adverse conditions it may be necessary to change carburetion, timing, and one or more heat ranges in the plug.

6) Servicing
Clean the electrodes of carbon and adjust the electrode gap to 0.6~0.7 mm (0.024"~0.028"). Be sure to use the specified plug, B-8E, when replacing.

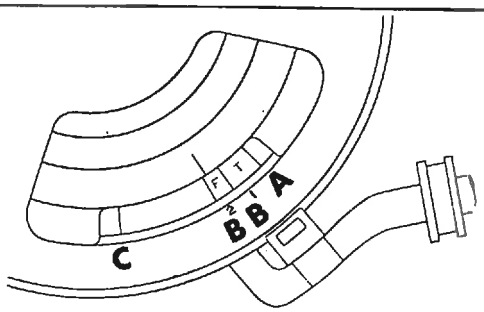


I) Setting Ignition Timing

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 by 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, is 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).



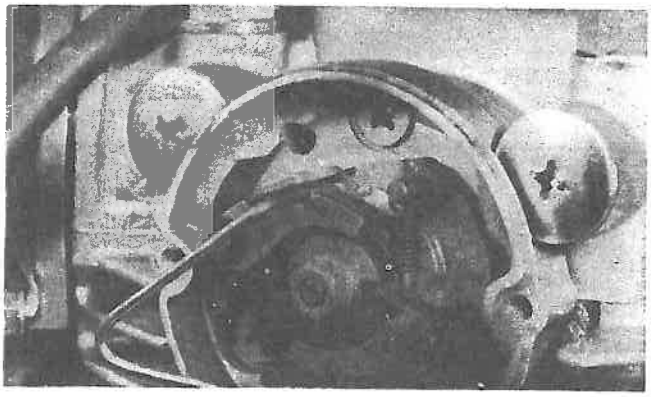
A-Top Dead Center
B^1 & B^2—Ignition Fire Marks
C-Mark for "Fully Advanced" Ignition Timing

3) The fourth timing mark indicates 40° before TDC, the fully advanced ignition position.

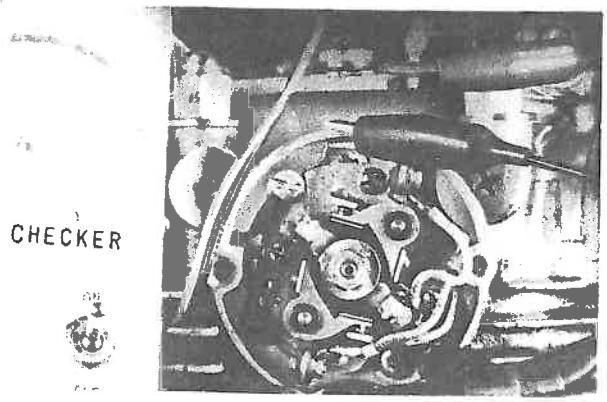
NOTE:
Each point gap should be checked first, and adjusted, if necessary. Then proceed with the timing adjustment.

4) Remove the alternator inspection plate, ignition points cover, and ignition advance unit cover.

5) Securely anchor the igniton advance weights into the "fully retarded" position (weights held inward).

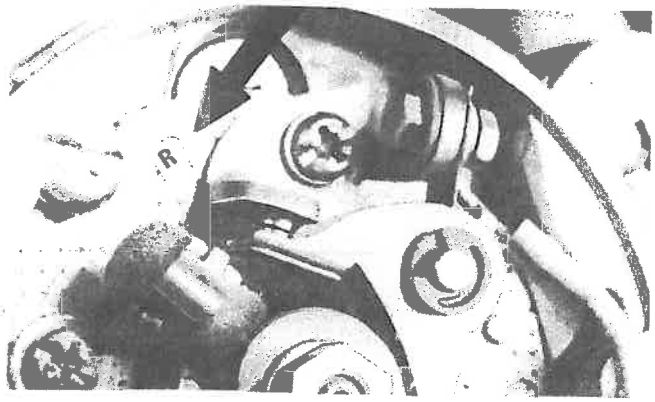


6) Check the point checker for full scale deflection (Infinity to Zero resistance), then hook the black lead to a good ground; the red lead to the grey point wire (right cylinder).



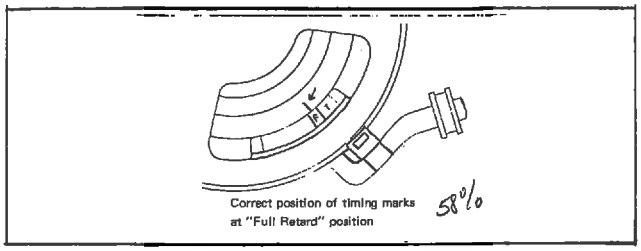
CAUTION
Ignition timing for each cylinder is set separately. However, it is absolutely necessary that the right cylinder points are timed BEFORE the left cylinder points. The right cylinder points are mounted directly to the ignition point base plate. The left cylinder points, however, mount on a separate plate that is in turn mounted to the 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.



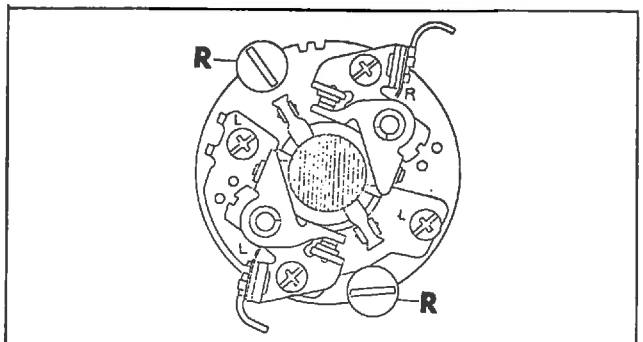
8) Rotate the crankshaft in the direction of running rotation (counterclockwise when viewed from the left side) until the right-hand set of points just start to open, as indicated by the point checker.

9) Check the rotor timing mark position. If the righthand 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

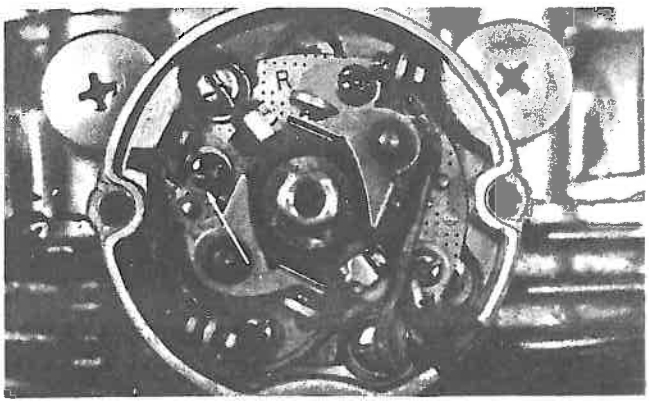
10) With the timing marks lined up correctly, loosen both base plate lock screws. Pivot the entire plate until the right cylinder points just start to open, (as indicated by the point checker).

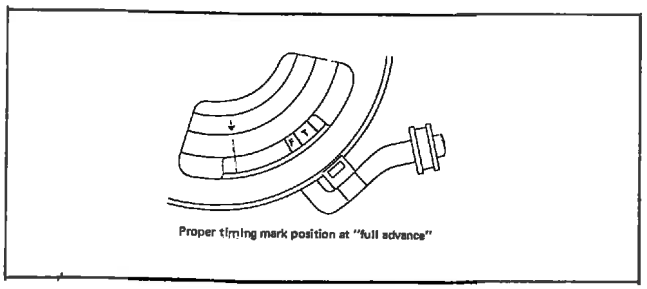


Base plate set screws

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.





Proper timing mark position at "full advance"

13) As the XS650 will normally be ridden at an average speed above 3,000 rpm, ignition timing must also be checked at the "fully advanced" position. In fact, it can also be set at this position. To check:

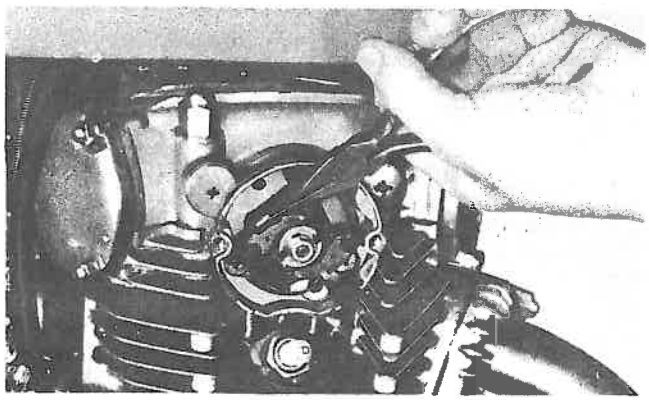
a) Wedge the ignition advance weights fully open. Repeat steps #8 and #9. The points should just start to open when the rotor timing mark is within 1mm (.040") of the stator full advance mark.

b) The above check can also be made with the engine running. Hook up the Electro Tester dual timing light to both spark plugs. Start the engine. At idle to about 1,500 rpm the unit should remain retarded. From approximately 1,500 rpm to about 3,000 rpm the unit should advance. At approximately 3,000 rpm, the unit should show full advance and both cylinders should be firing within 1mm (.040") of the full advance stator mark. Continue to check ignition operation to rpm redline, if desired.

NOTE: The "b" method allows you to check your work and the actual operation of the ignition.

14) If the ignition does not show complete advance, or too much, the advance mechanism must be checked. Check for proper assembly and spring tension. In addition, check the advance weight stoppers. Total advance should be 40° ± 2°. If this is not the case, and the springs, etc., check out, replace the governor assembly.

NOTE: It is possible to change the amount of advance by bending the weight stoppers. Remove the governor assembly and heat it prior to bending the stoppers as they may fracture if cold. Do not over-heat as this may make the stoppers lose their rigidity, causing them to bend during operation. Bending the stoppers out, away from the weights, increases the amount of advance. Normal advance amount is approximately 27°. It should not be necessary to bend the stoppers more than 0.7mm (.030") in either direction. More than that may weaken them.



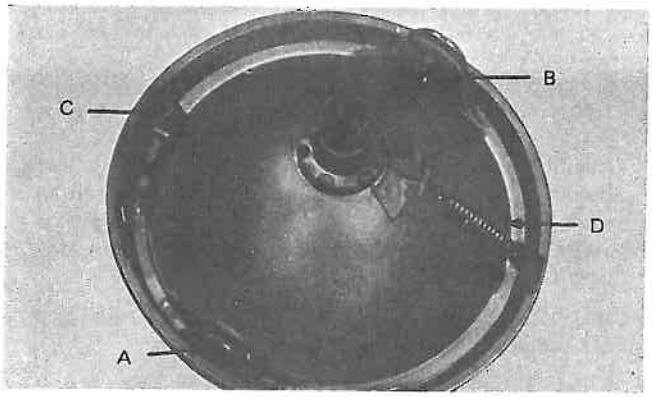
15) Finally, it is a good idea to re-check your results, especially in the case where the engine has not been running correctly.

J) Lighting Circuit

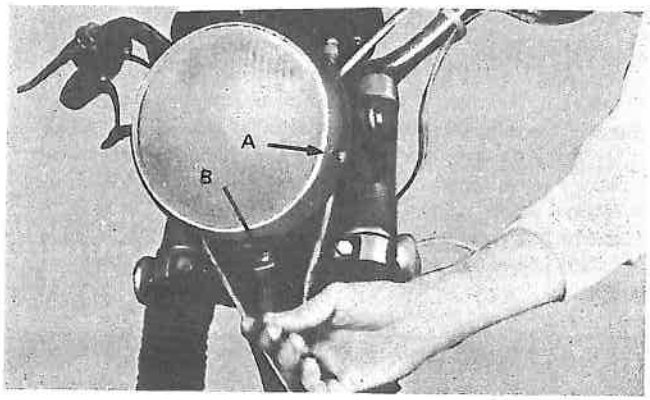
1) Headlight

a) The headlight is a semi-sealed unit with a non-replaceable filament. If the headlight burns out, replace the entire headlight bulb unit.

b) 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".



c) Adjustment:
Screw "A" controls side-to-side headlight movement. Screw it in or out until the headlight beam is centered. (See below)

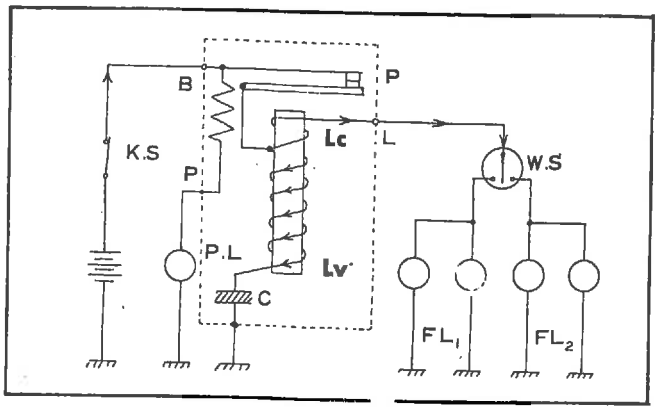


d) Headlight up and down movement is controlled by bolt "B". Loosen this bolt and tilt the headlight into position, then retighten the bolt.

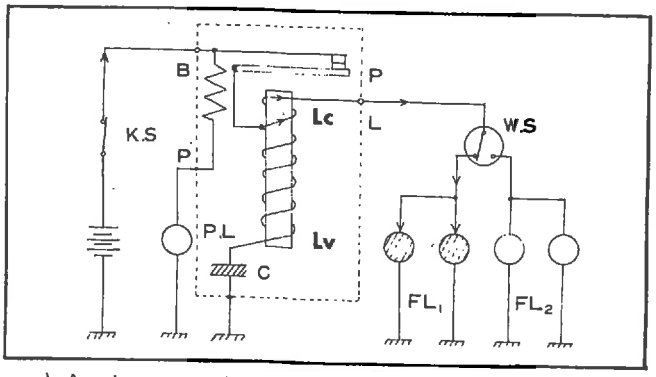
NOTE: Occasionally, the headlight bolts "C" will require loosening first.

2) Turn Signals

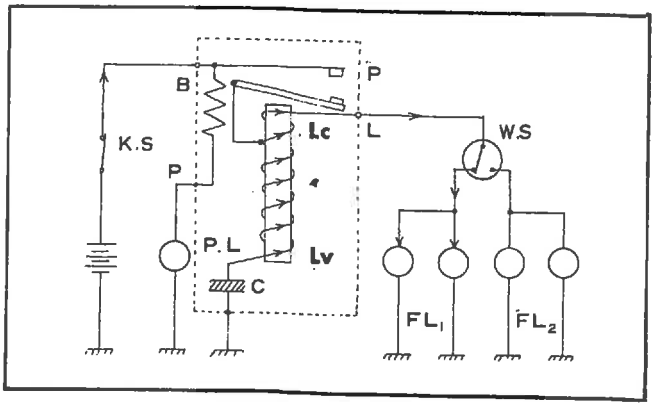
a) Voltage flows from battery to the relay condenser. The condenser becomes fully charged (including wire to flasher switch) and all voltage flow stops in the relay.



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



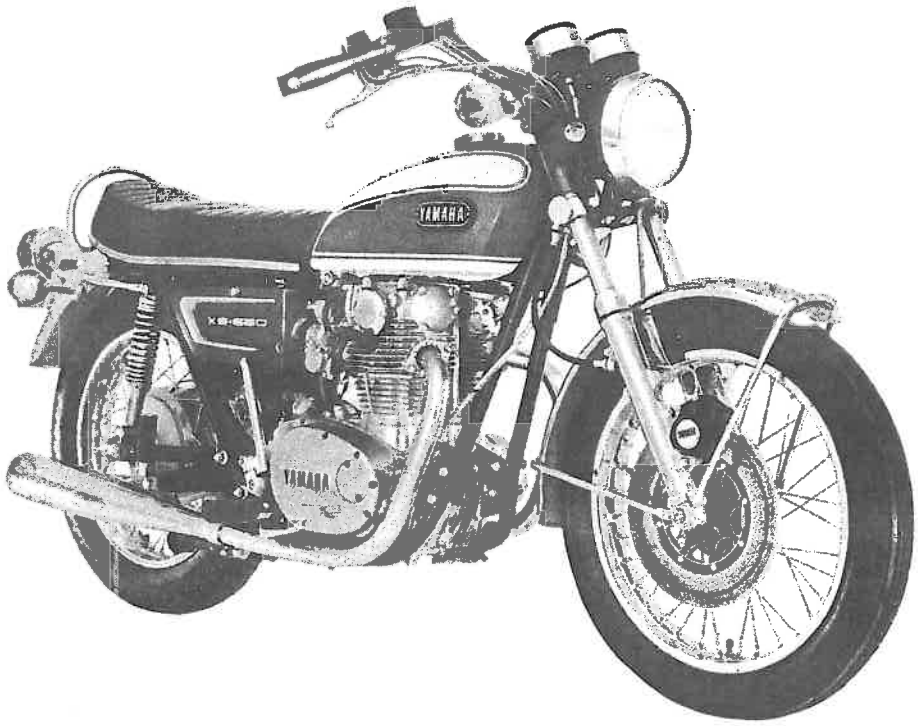
c) At the same time that voltage lights the flasher, the "Lc" winding around the metal core creates an electro-magnet that pulls the contact points apart. Voltage flow stops and the flasher lights go out. Magnetism to hold the points apart is momentarily maintained because the stored electrical charge in the condenser discharges back through "Lv" and "Lc" windings. The stored condenser amperage, however, is not sufficient to light the flasher lights (due to their being a high resistance load), so both flasher lights do not light again.



YAMAHA

XS2–TX650

SUPPLEMENTARY INFORMATION

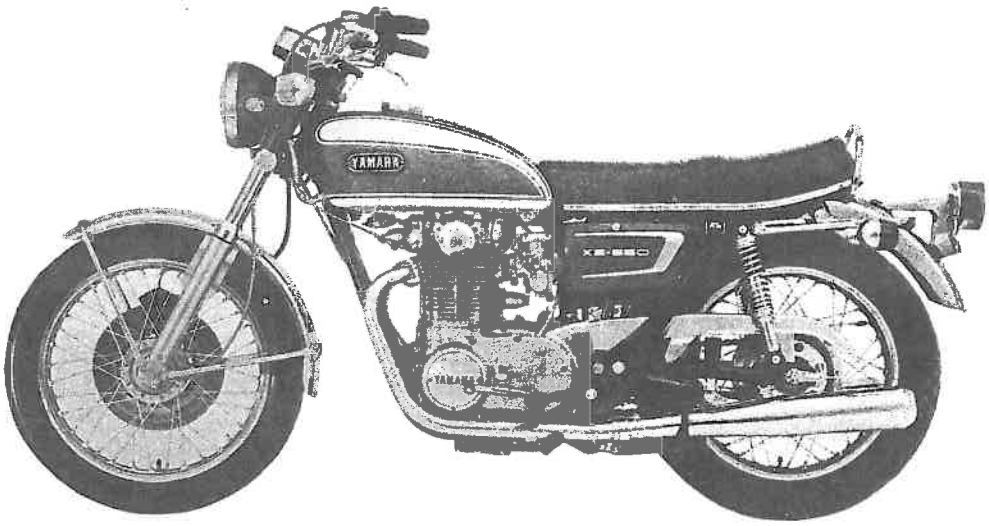


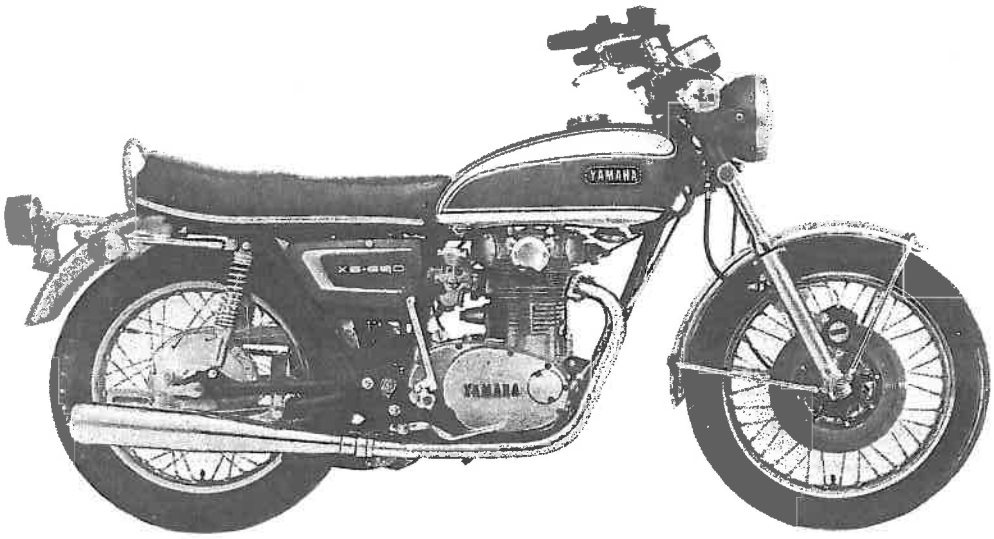
FOREWORD

Yamaha's XS2 is an improved version of the XS1 and equipped with additional components - electric starter and front wheel disc brake.

This XS2 Supplementary Information describes the construction of the electric starter and the disc brake and the procedures for inspection and maintenance.

PROFILE VIEWS





Dimensions.		
Overall Length	85.6 in. (2175 mm)	
Overall Width	35.6 in. (905 mm)	
Overall Height	45.9 in. (1165 mm)	
Wheelbase	55.5 in. (1410 mm)	
Min. Ground Clearance	5.9 in. (150 mm)	
Weight (net)	427 lbs. (194 Kg)	
Performance:		
Max. Speed	115 + mph	
Fuel Consumption (on paved level road)	82.5 mpg at 37 mph (35 km/l at 60 km/h)	
Climbing Ability	26 degrees	
Minimum Turning Radius	98.4 in (2500 mm)	
Braking Distance	46 ft. at 31 mph (14 m at 50 km/h)	
Engine:		
Type	Twin cylinder Air-cooled 4 stroke W/S.O.H.C.	
Lubrication System	Pressure lubricated, wet sump.	
Bore and Stroke	2.953x2.913 in. (75x74 mm)	
Displacement	39.85 cu. in. (653 cc)	
Compression Ratio	8.7 : 1	
Maximum Power	53 BHP/7000 rpm	
Maximum Torque	40.1 ft-lbs/6000 rpm (5.5 kg-m/6000 rpm)	
Oil Sump Capacity	2.6 qts. (2.5 l)	
Valve Clearance	Cold IN: 0.15 mm (0.006 in.) EX: 0.30 mm (0.012 in.)	
Idle Speed	1000 ~ 1200 rpm	
Carburetor:		
Type	BS38x2	
Needle Jet	4JN19-4th Stage	
Pilot Fuel Jet	42.5	
Air Filter	Dry paper filter	
Clutch:		
Type	Wet, multi-disc. (6 friction + 5 metal plates.)	
Primary Drive: Type:	Spur gear (straight cut)	
Reduction Ratio (gear and total)	72/27 (2.667)	
Transmission: Type:	Constant mesh, five speed, wide-ratio	
Oil	SAE 20W/40	
1st	32/13 = 2.461 (5.904)	Internal engine ration (Pri. x Trans.) Multiply by drive chain ration for overall gearing
2nd	27/17 = 1.588 (4.235)	
3rd	26/20 = 1.300 (3.466)	
4th	23/21 = 1.095 (2.920)	
5th	22/23 = 0.956 (2.550)	
Secondary Reduction System:		
Type	Single Row chain	
Secondary Reduction Ratio:	34/17 = 2.0	

Chassis:		
Fuel Tank Capacity		3.7 U.S. gals. (14.0 ℓ) (3.7 gals. — TX650)
Caster		63°
Trail		3.9 in (101 mm)
Front Tire		
Size		3.50 - 19 - 4PR
Fork Oil Quantity (each)		135cc(4.6 oz.)
Rear Tire		
Size		4.00 - 18 - 4PR
Front Brake Type		Hydraulic Disc Brake
Rear Brake Type		Internal expansion, single leading shoe
Generator		
Type		Alternator
Model		LD115
Manufacturer		HITACHI
Ignition System		
Spark Plug	Manufacturer	N.G.K.
	Heat Range	B-8ES
Battery		
Model		(12N12-4A-1) x 1
Manufacturer		G. S.
Capacity		12V. 12 AH.
Dimension		5.36 x 2.36 x 5.16 ins. (134 mm. x 59 mm. x 129 mm.)
Lighting System		
Headlight		12V, 50W/40W
Tailight		12V/8W
Stoplight		12V/23W
Neutral Light		12V/3W
Flasher Indicator Light		12V/3W
Flasher Light		12V/27W
High Beam Indicator		12V/2W
Speedometer Light		12V/3W
Tachometer Light		12V/3W

NOTE: TX650 SPECIFICATIONS IDENTICAL TO XS2 UNLESS OTHERWISE NOTED.

SEE ALSO XS1/XS1B SPECIFICATIONS.

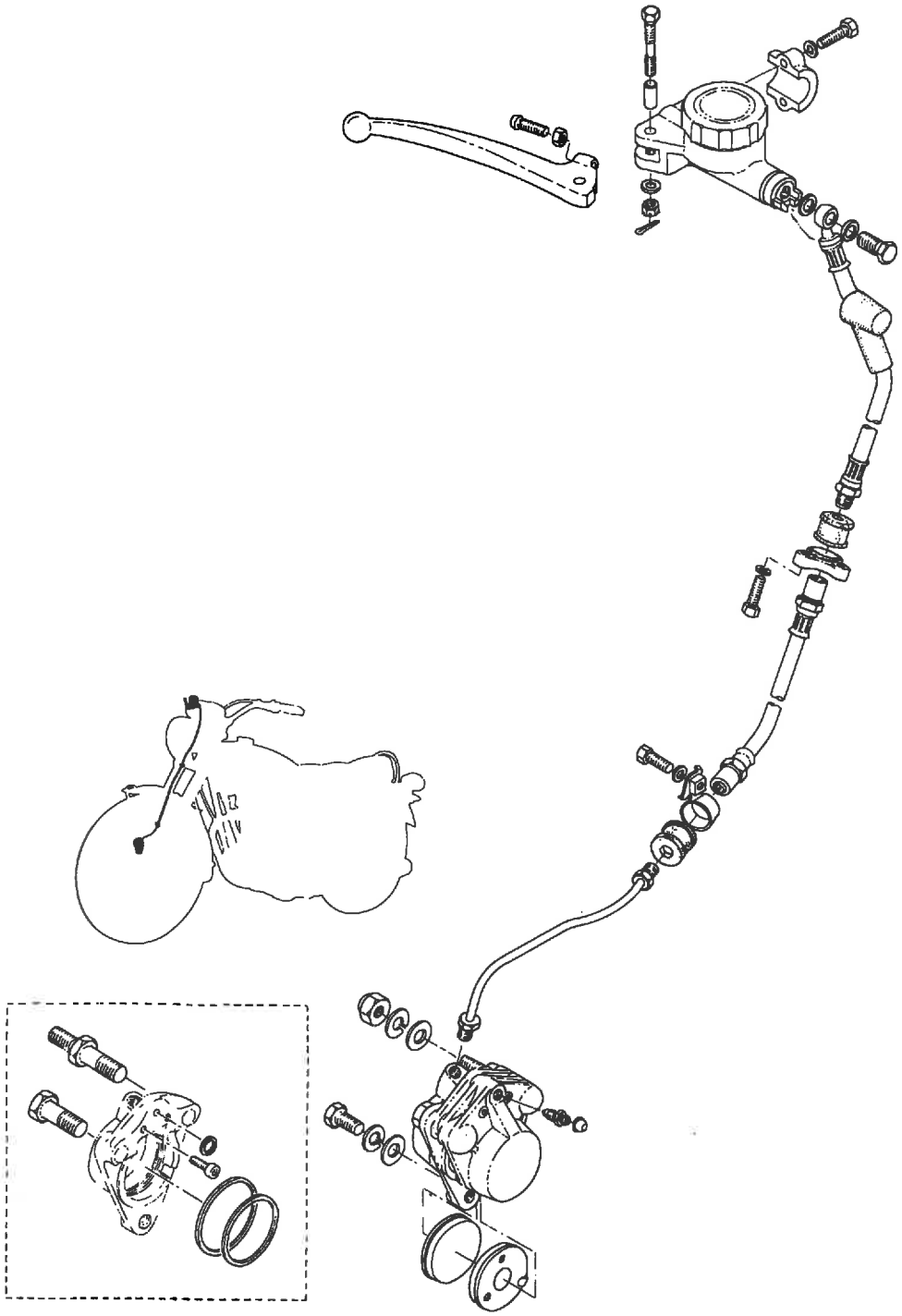
DISC BRAKE

(See page 165 for TX650A)

1. Construction

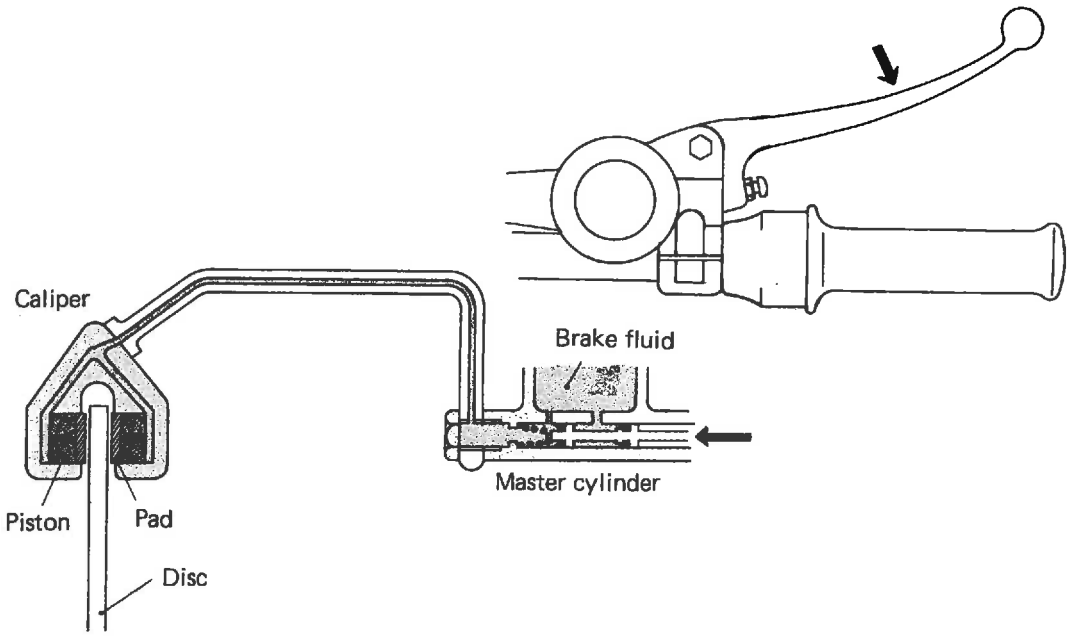
Construction

A fixed-caliper type disc brake, in which the two flat shoes grip the rotating disc, is in use. The right part of the handlebar has a brake lever and a master cylinder. The calipers are installed on the front fork, while the brake disc is mounted on the front hub. The master cylinder is connected to the calipers by a brake hose and pipe.



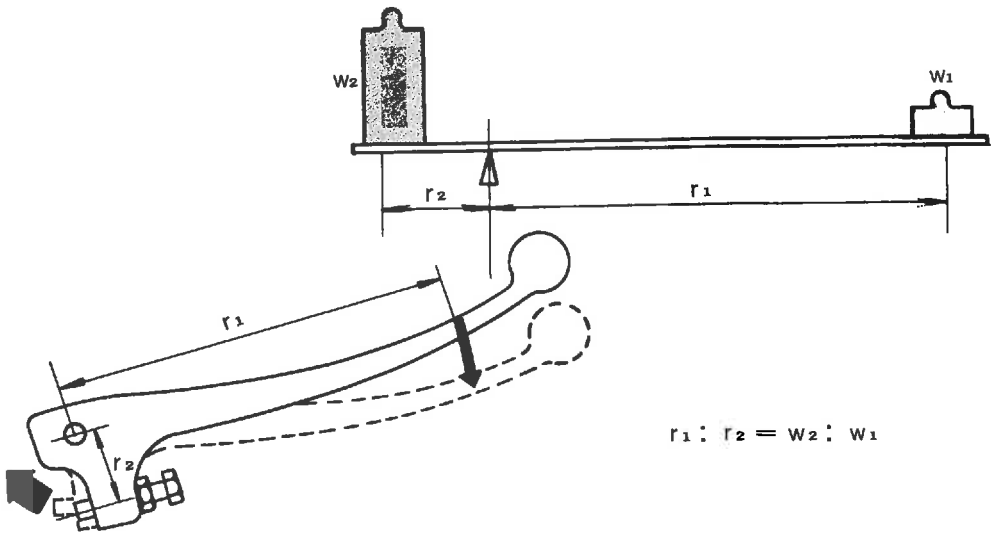
Operation

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.



Brake Lever

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

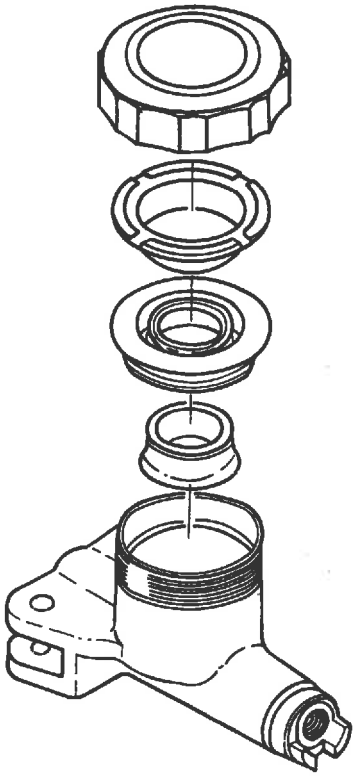


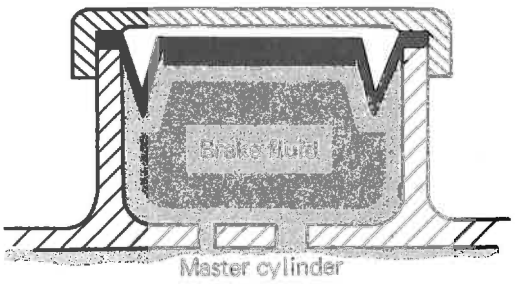
Master Cylinder

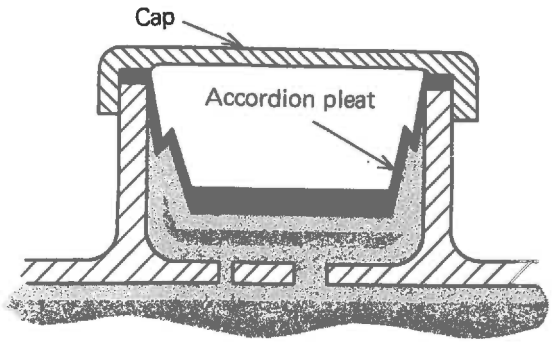
The master cylinder piston is linked to the brake lever. When the brake lever is squeezed, the piston forces the brake fluid through the hose and pipe to the calipers.

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 30cc). 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.

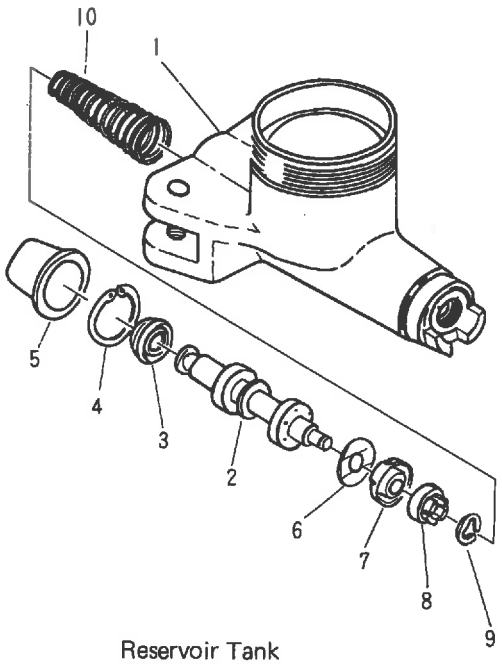






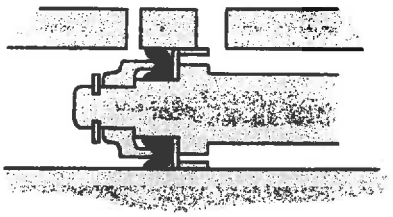
Piston

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.

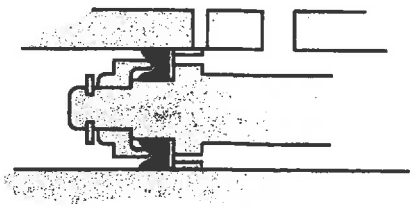


1. Body Master cylinder
2. Piston
3. Cup
4. Circlip
5. Dust boot
6. Spacer
7. Cup
8. Retainer
9. Clip
10. Spring

Reservoir Tank



When the brake lever in squeezed



Brake hose and pipe

The brake hose and pipe carry hydraulic pressure to the calipers.

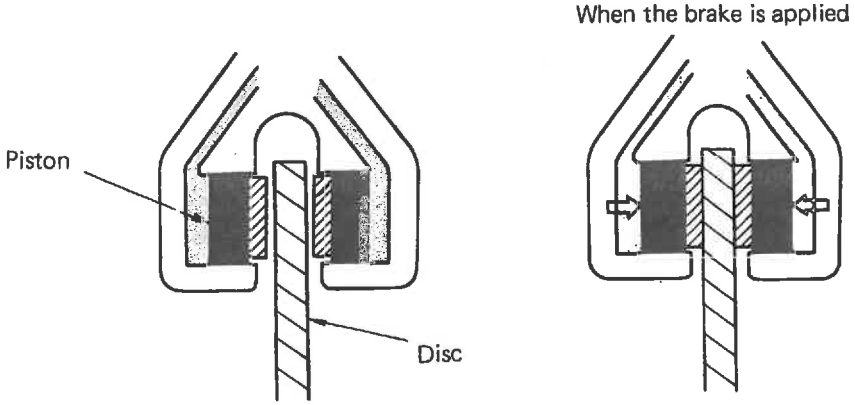
The brake hose is flexible and capable of withstanding a hydraulic pressure of 350 kg/cm² in conforming to SAEJ–1401.

The brake pipe is made of doubled steel tubing. For better corrosion resistance it is plated with zinc.

Calipers

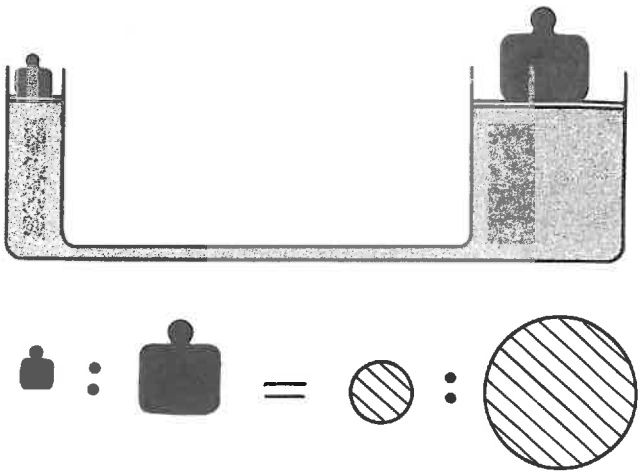
The hydraulic pressure carried to the calipers forces the caliper pistons out; by which action the pads are pushed out to grip the revolving disc.

When the brake is applied



Piston

The caliper pistons are forced against the brake pads by hydraulic pressure. The force created is about nine times the force applied to the master hydraulic cylinder piston. Combined with the mechanical advantage of the brake hand lever, the total force applied to the brake disc is approximately 36 times the force applied to the brake hand lever.

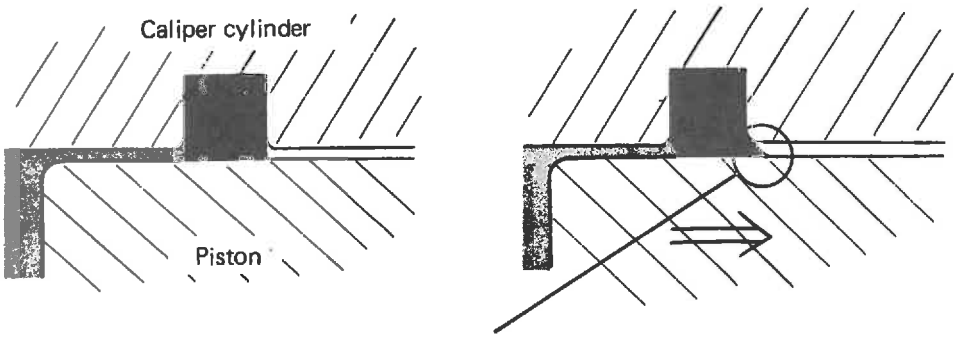


The applied force is proportional to the area ratio.

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 0.3 mm.)



The friction between piston seal and piston and elasticity of the seal cause the piston to return to its home position.

Pads

The pads are forced against the revolving disc by the caliper cylinder pistons to grip the disc. They are composed of resin mold asbestos.

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 ass'y.

Disc

The stainless steel disk is held to the front wheel hub, and it is gripped by the pads located on each side of the disc.

Brake Fluid

The brake fluid is compressed in the master cylinder, and the 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 property is excellent.

Note that the disk brake fluid must be of genuine quality, because the fluid temperature tends to rise as compared with the drum brake.
Suggested brake fluid specifications: DOT 3 or 4.

NOTE: Do not mix brake fluids with different brand names. Some brake fluids are not compatible with others.

2. Disassembly

The tire and bearings can be disassembled without removing the brake disc. Do not attempt to remove the brake disc unnecessarily.
Tools and Parts required for Disassembly:

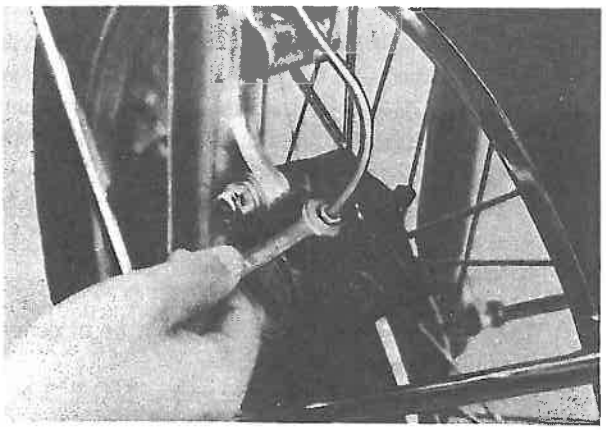
General service tools
Hexagon wrench, 5mm
Grip pliers
Air compressor
Rags
Torque wrench

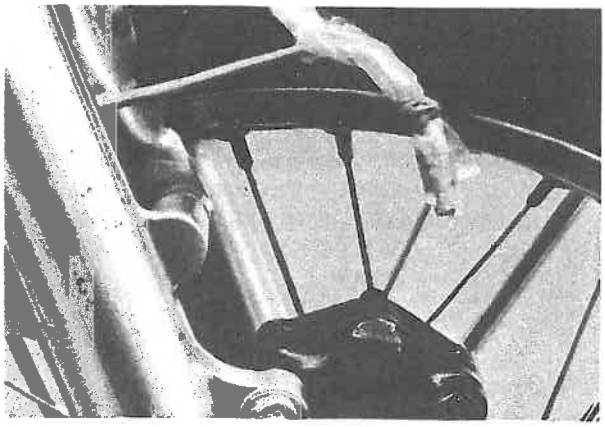
Caliper

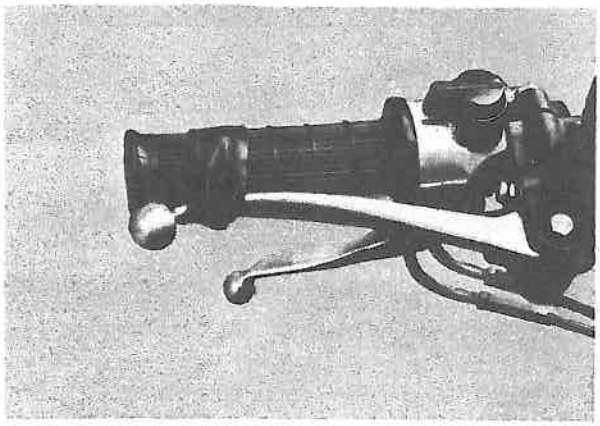
Removing the Caliper

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

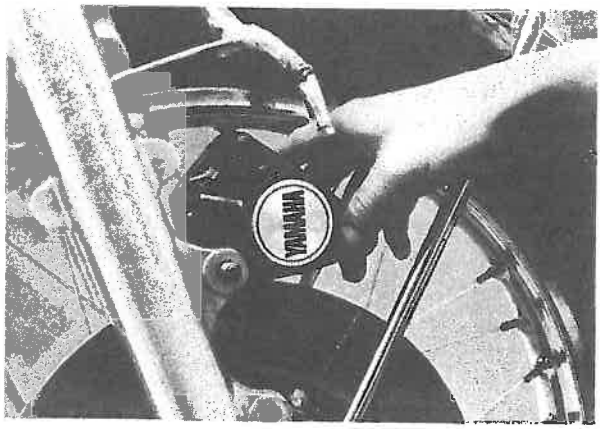
Note
It is advisable to keep the brake lever squeezed, because this brake lever position prevents the fluid from leaking out of the reservoir. Place a heavy rubber band around the lever and handlebar grip.





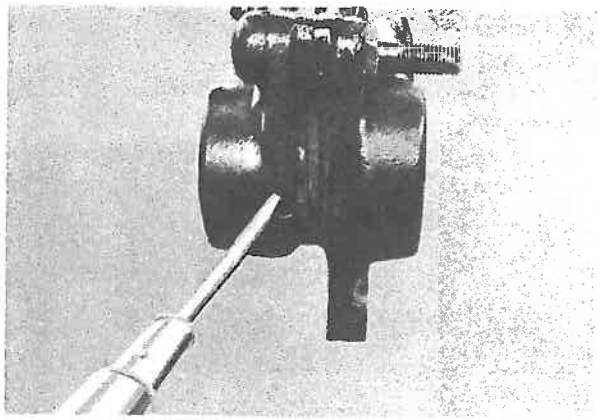


2. Remove the caliper mounting bolts and nuts.
3. Rotate the caliper ass'y upward, and remove it.



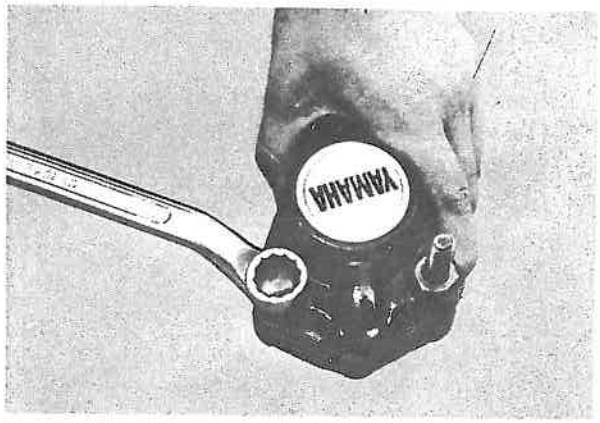
Removing the Pads

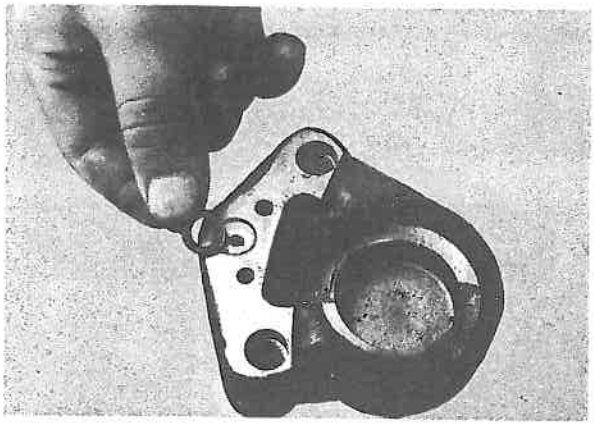
4. Remove the pads from their seats.



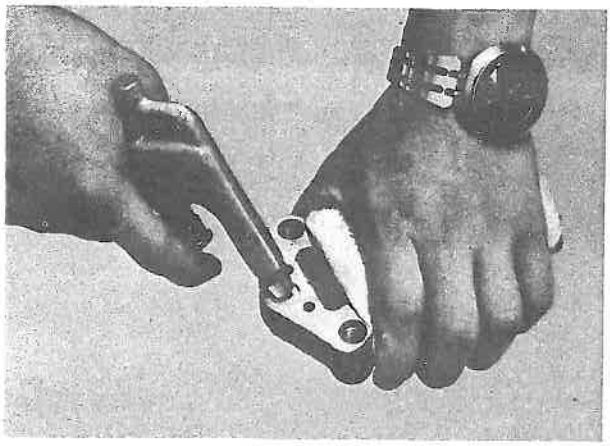
Removing the caliper Pistons and Seals:

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 screw driver.

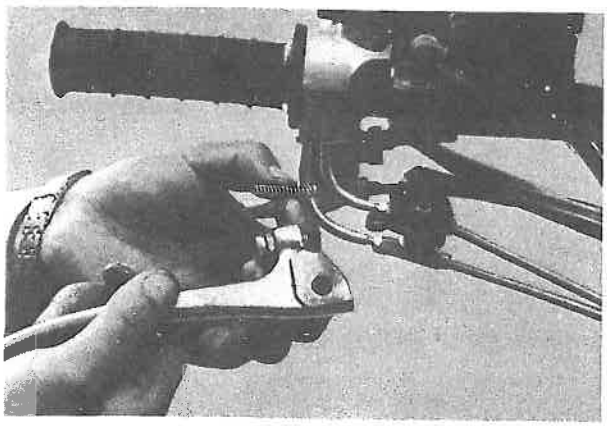


8. Remove the piston seal and dust seal from the caliper body.
   The foregoing applies to both pistons.

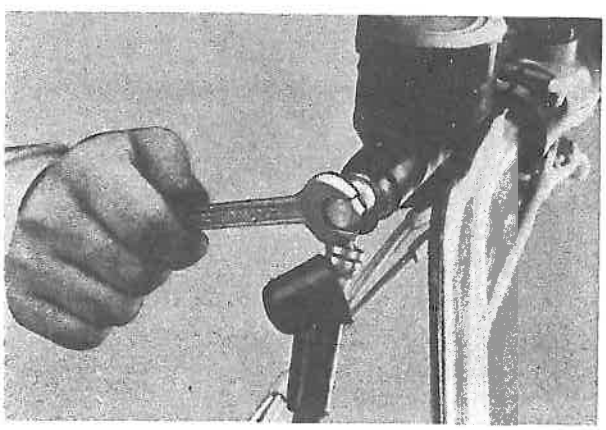
Note:
The removed parts should be kept free from gasoline, kerosene, engine oil, etc. If any oil attaches to a seal, it will swell up or deteriorate.

Master Cylinder

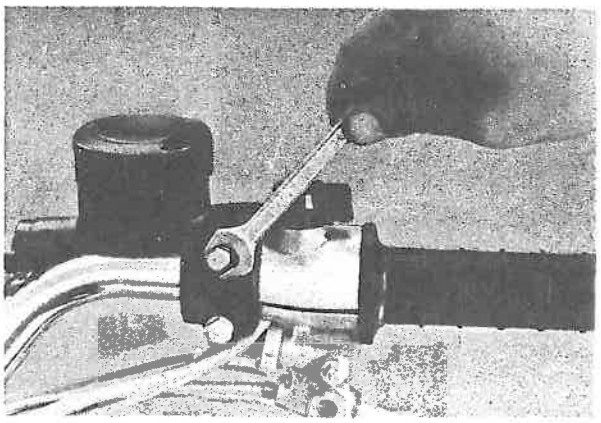
1. Remove the stop switch and brake lever.
   (Take care not to misplace the brake lever return spring.)



2. Remove the brake hose.

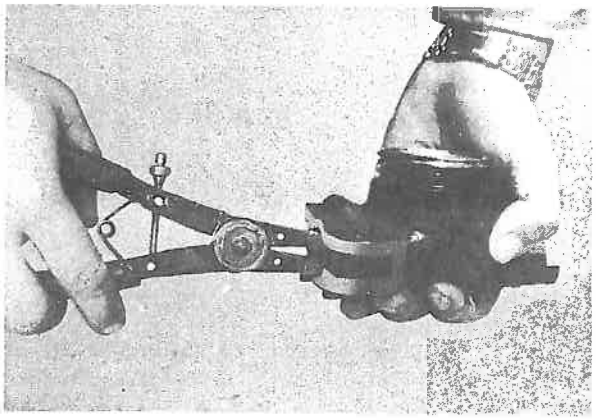


3. Remove the two master cylinder mounting bolts, and remove the master cylinder from the handlebar.
4. Remove the reservoir tank cap, and remove the diaphragm.
5. Drain the brake fluid from the reservoir tank.

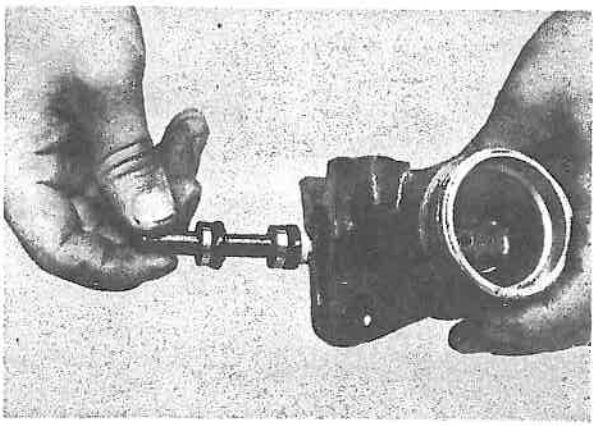


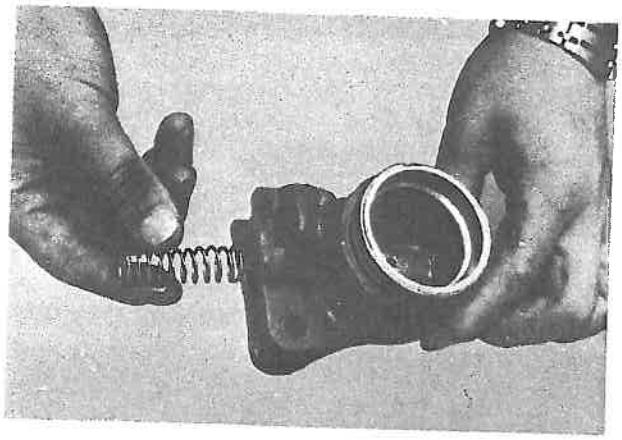
6. Remove the master cylinder boot.

7. Remove the snap ring with clip pliers.

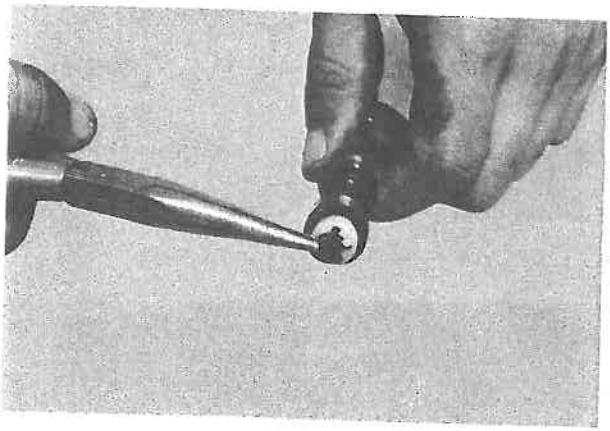


8. Remove the piston. (Note that a spring remains in the master cylinder.)

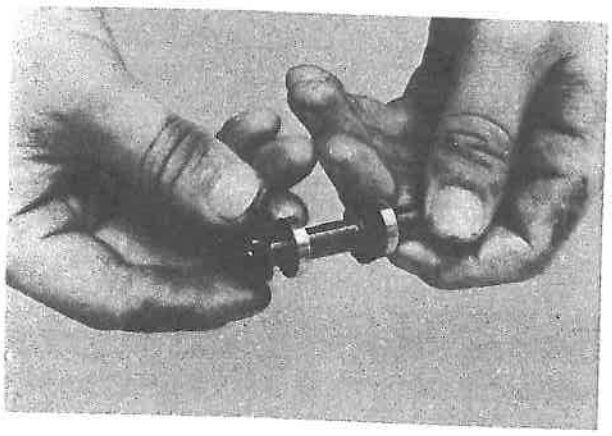




9. Remove the E clip, and remove the cylinder cup retainer.



10. Remove the cylinder cup.



3 . Inspection

Measuring Instruments required for Inspection

Dial gauge
Dial gauge adapter
Micrometer 0-25 mm
Vernier calipers 150mm

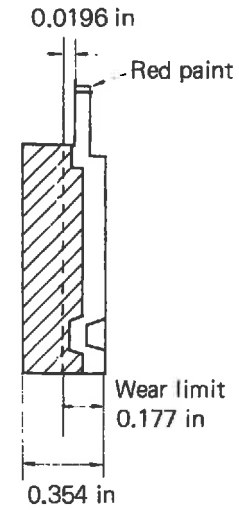
Pistons

Pistons

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

Pads

If any pad is found excessively worn, replace it.
Min allow pad thickness: 0.5 mm (0.0196'')



DISC PAD

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.

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 in fresh, new, brake fluid.
3) Whether it shows wear or not, 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 fo use, whether they are in good condition or net.

Conical Spring

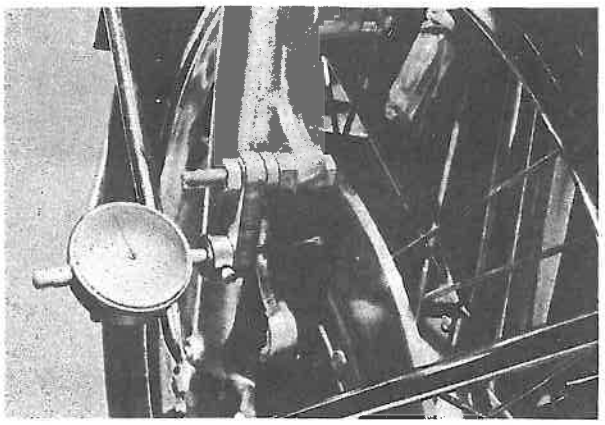
1) Check the spring for breakage and wear.

Brake Hose and Brake Pipe

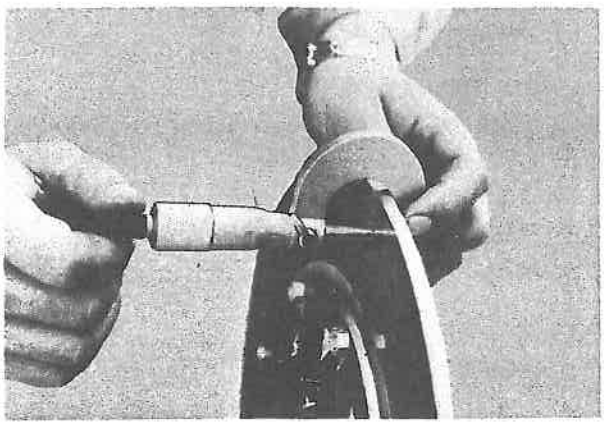
1) Check them for leakage and damage.
2) Replace the brake hose every four years of use, whether it appears to be in good condition or not.

Disc

1) Check the disc ass'y for run-out.
   If the disc shows a deflection of 0.15 mm or more, check the disk itself and the bearings.



2) If the disc has excessive wear or damage, replace it.
   Min allow disc thickness: 6.5mm



4. Assembly and Adjustment

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 avoided, because it causes rubber parts to swell. The same can be said of alcohol. Any rubber dipped in alcohol will swell.)
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 ones. All other parts should be washed with fresh, clean, new brake fluid. In addition, the lines, ports, passages, etc., should be thoroughly flushed with clean, new brake fluid.

Calipers

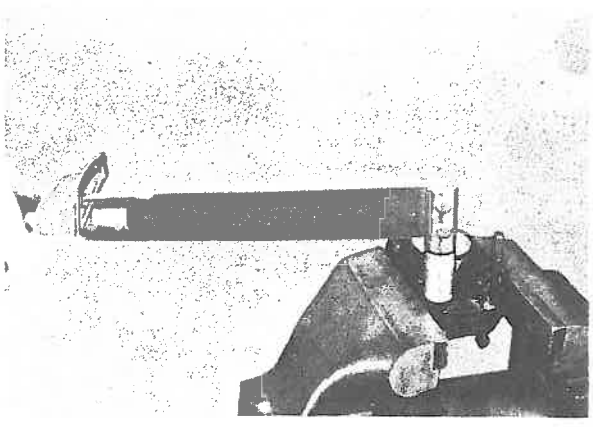
Piston Installation

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



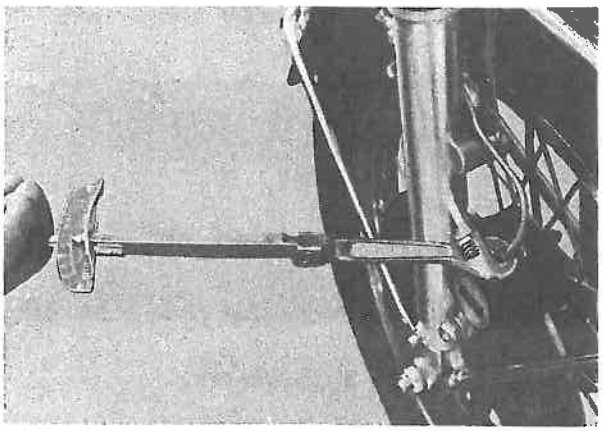
7) They are very important parts viewed from operational safety, and therefore, the removed bridge bolts should always be replaced. Be sure they are tightened with correct torque.
   Tightening torque: 750 - 950 kg-cm

Pad Installation

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

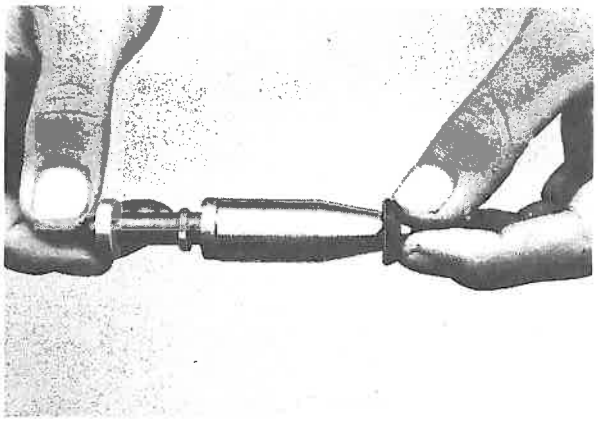
10) To install the calipers on the front fork, reverse the procedures for removal.
    Tightening torque: 400-500 kg-cm
11) Install the brake pipe.
    Tightening torque: 130-180 kg-cm

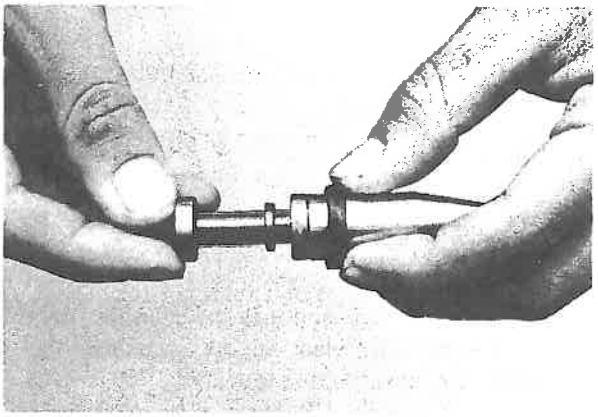


Master Cylinder

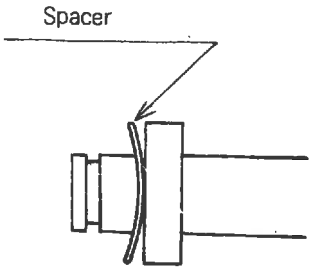
Installing the Cylinder Cup

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

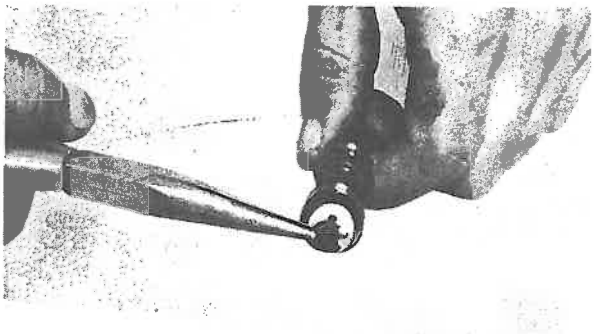




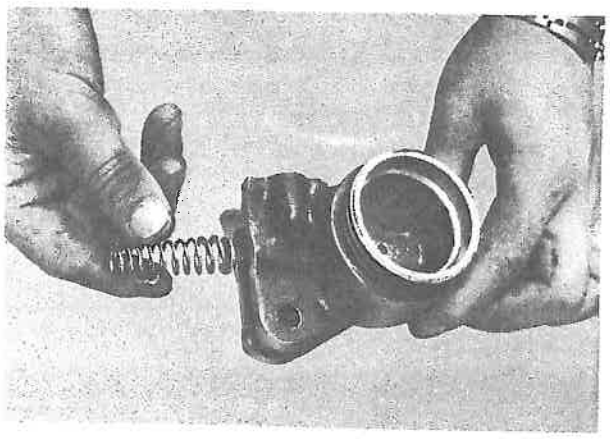
2) Install the spacer. Be sure that the spacer is positioned correctly.



3) Install the cup, retainer and E clip.



4) Insert the spring into the master cylinder body.



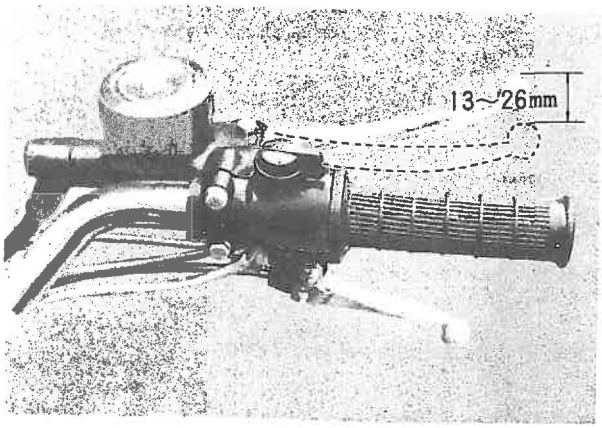
Installing the Piston

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.

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



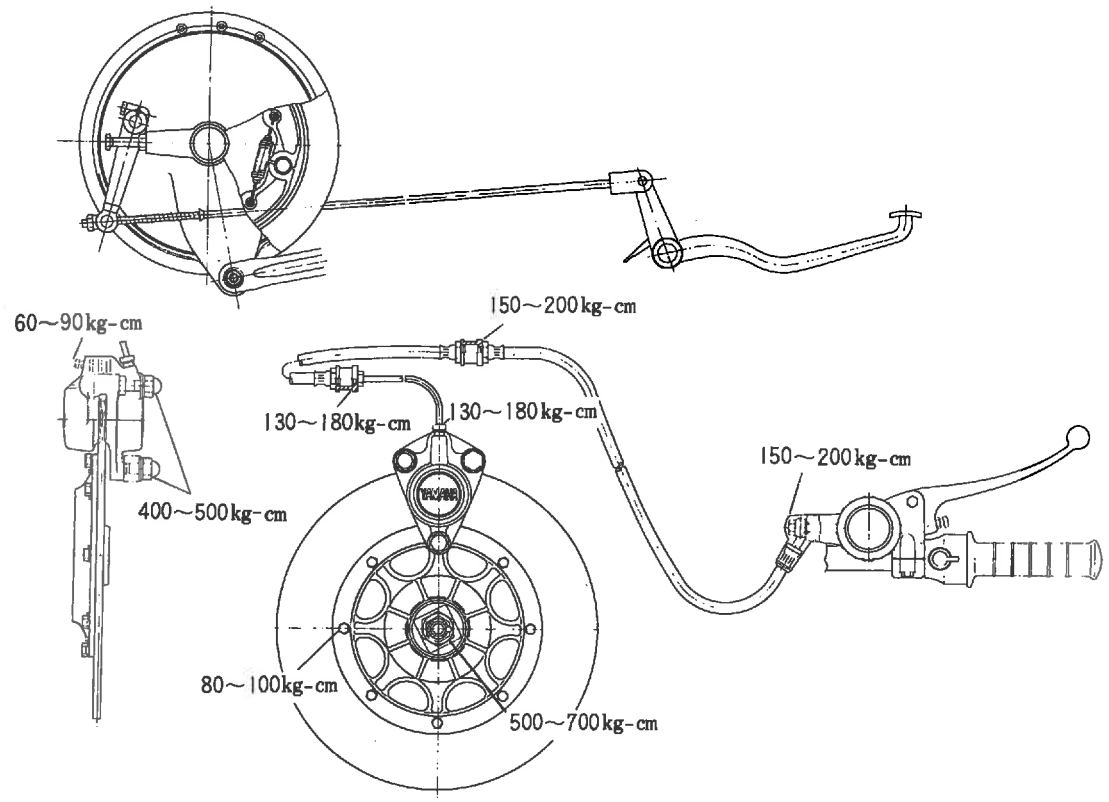
10) Fasten the brake hose to the master cylinder with the union bolt.

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

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

Brake Hose and Brake Pipe

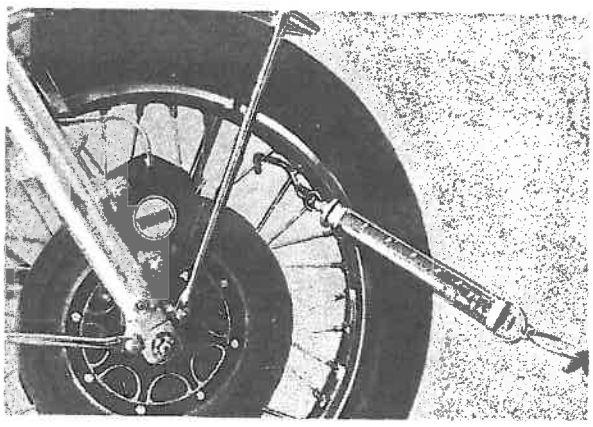
The brake hose and brake pipe fittings should be fastened with the following torque.



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: 80~100kg-cm
2) The deflection of the disc ass'y should be within the specified value. (0.15mm)
3) The disc trailing torque should be within the specified amount after it is assembled.
   Torque: 2~4 kg 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 can be neglected. A slight drag will not result in serious trouble, and will not develop into a worse condition.

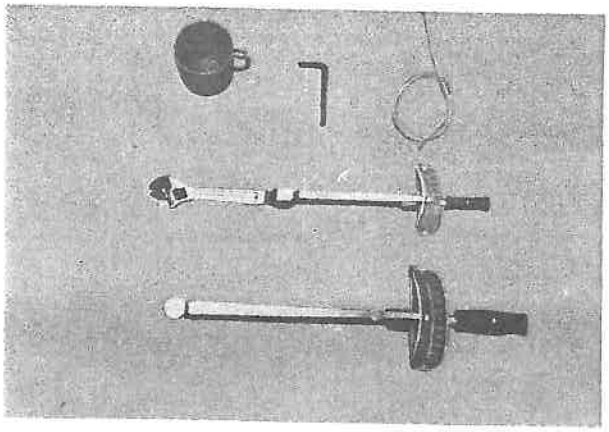


Air Bleeding

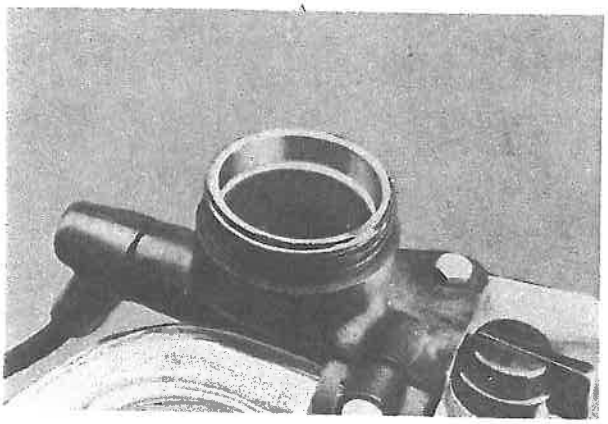
When any parts relating to the brake fluid are reinstalled, be sure that each metal fastener is fully tightened and then bleed the air.

Tools and Parts

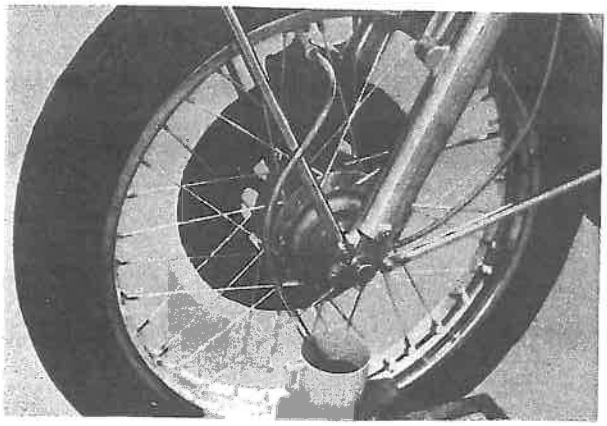
Wrench
Torque wrench
Vinyl tube Inside dia 4mm
Brake fluid (SAE grade #J1703B)
Brake fluid receiving vessel
Rags



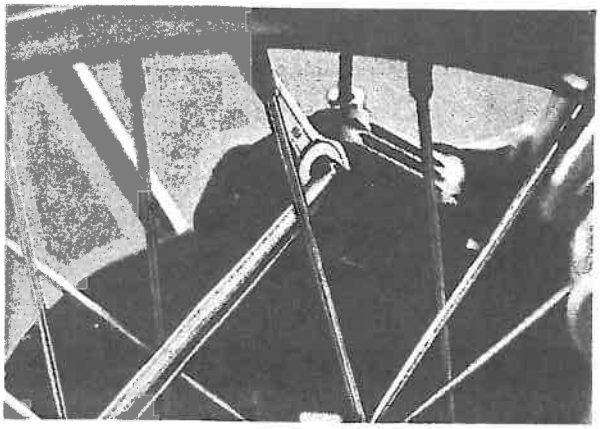
1) Fill with brake fluid so that the reservoir level reaches the specified line.
2) Install the diaphragm to prevent the brake fluid from escaping.



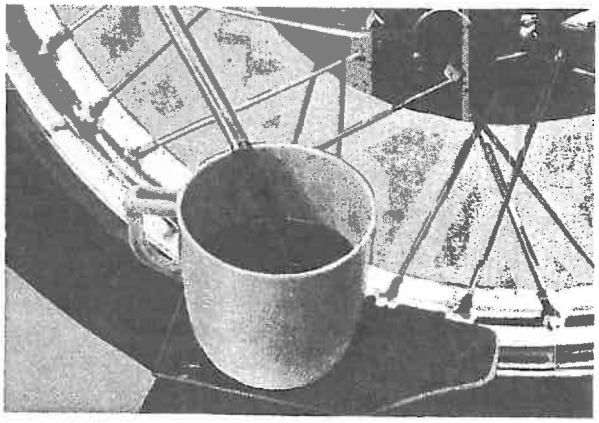
3) Connect the vinyl tube to the caliper bleed screw tightly so that no brake fluid will leak out.



4) Place the brake fluid receiving vessel 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 handle bar grip.



Note:
When bleeding the air, do not operate the brake lever quickly. Otherwise, the air will turn into fine 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

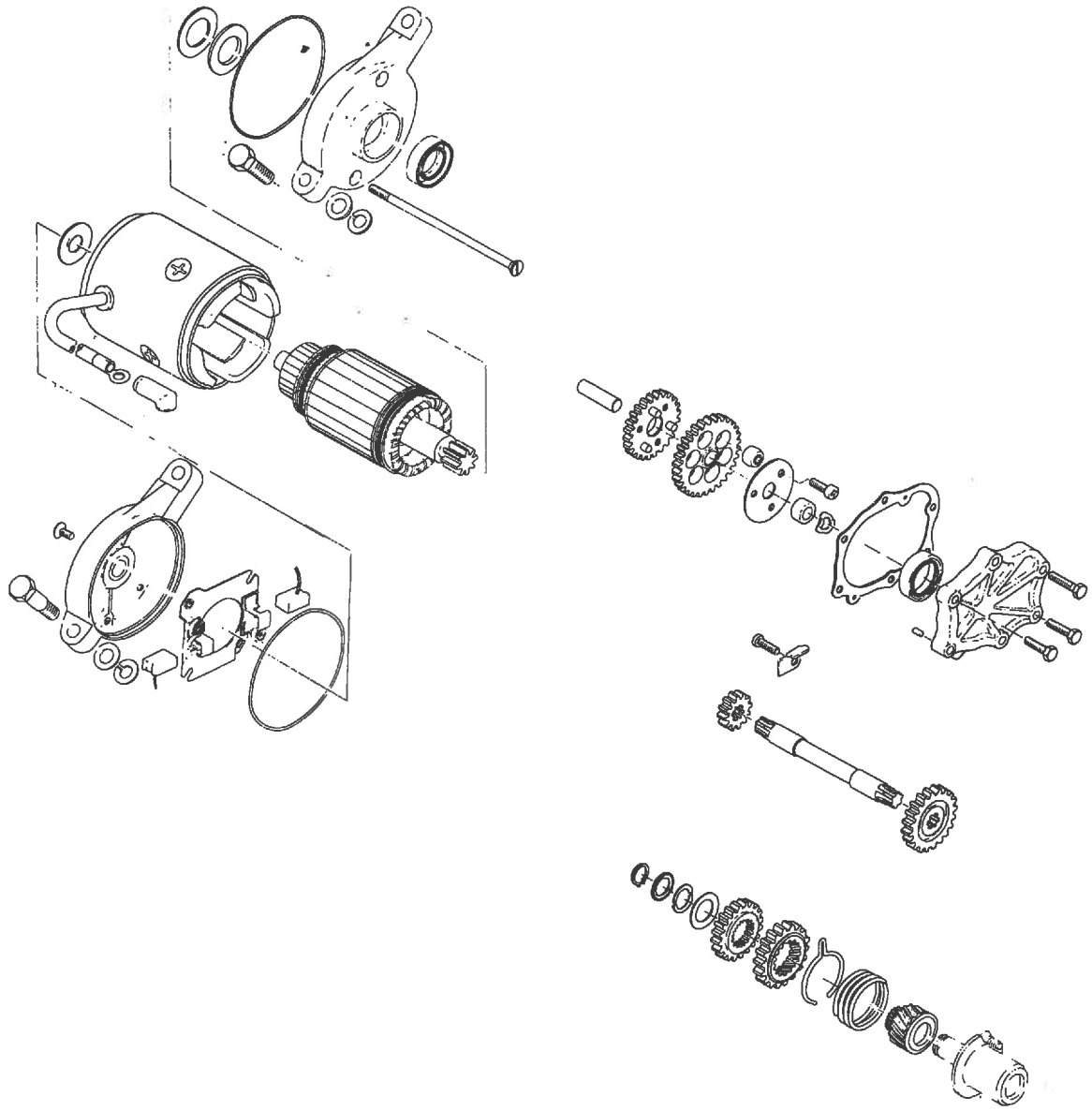
8) Refill with brake fluid so that the level will again reach the specified line.

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. Specifications

1. Brake lever ratio	3.77
2. Caliper area ratio of master cylinder	9.15
3. Total lever ratio	34.5
4. Braking torque	3.45 F
(F denotes gripping force)	
5. At a reduced speed of 0.8 G	
a. Required braking torque	54.0 kg-m
b. Required gripping force	15.7 kg
c. Generated oil pressure	30.8 kg/cm^2
d. Pressure on lining surface	32.0 kg/cm^2
6. Dragging resistance of pad	13.5 kg-cm
7. Lining	
Material	Resin mold
Dimension	47.0ϕ x 5.3^t
Effective thickness	4.3^t
Wear coefficient	0.40
8. Brake hose	
Dimension	10.5ϕ x 3.1ϕ
Allowable compression	350 kg/cm^2 or more
9. Brake pipe	
Dimension	4.70ϕ x 0.7^t
Allowable compression	350 kg/cm^2
10. Disc	
Outside diameter	298ϕ
Effective friction radius	124.7
Thickness	7
Material	13-14 Cr stainless
Heat treatment	High frequency hardening
Master cylinder	
Inner diameter (bore)	15.875 ϕ
Stroke	16 mm
Reservoir capacity	31.5 cc
Material	LP cast AC2B
Type	Rockied type tightly sealed reservoir
Caliper	
Inner diameter	48.1
Material	FCD40
Type	Two opposing piston type
Others	Automatic clearance adjusting device for wear

ELECTRIC STARTER

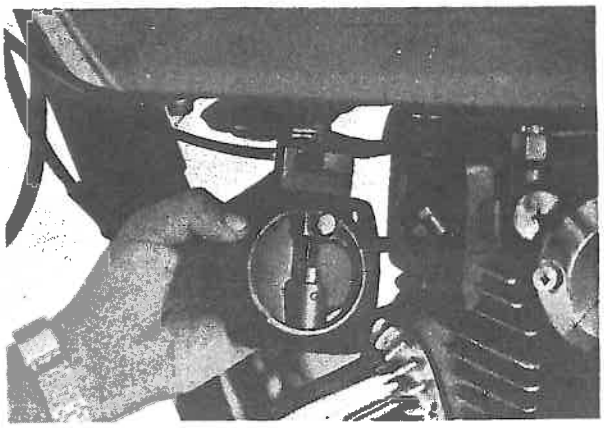


Construction

The starter motor is located under the crankcase.
An idler gear is attached to the shaft. Torque from the motor, during operation, is transmitted through the idler gear and the three reduction gears to the splined gear (gear 4). The gear works in the same manner as the splined kick gear, moving out to engage with the gear mounted on the outer half of the right half crankshaft. In this fashion, torque from the starter motor is transmitted to the crankshaft. As the engine starts, gear 4 is automatically disengaged from the crankshaft. The starter motor itself is a series-winding, 12 volt D.C. motor which draws 150 amps or less initially. 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

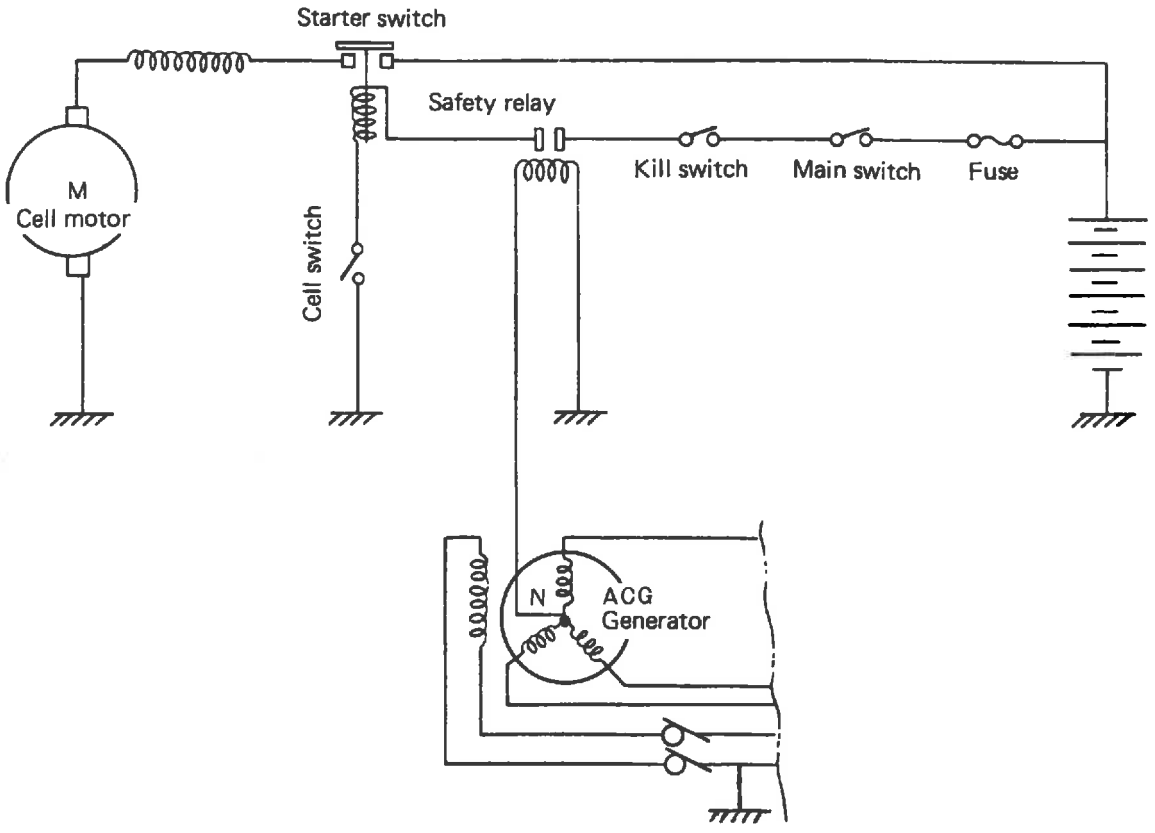
1) As the cell switch closes, current flow is created in the starter motor solenoid's windings and the solenoid closes.



2) 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.

3) As the engine starts, the ACG begins to generate voltage. As voltage rises to 4V (±0.5V) 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.

4) Finally, the engine runs fully on both cylinders.



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	
ARMATURE	Resistance	0.055 ohms (20°C)	No Grounded core
COMMUTATOR	Diameter	33 ϕ std	
	Wear limit	32 ϕ	
	Mica undercut	0.5~0.8 mm	
	Undercut limit	0.2 mm	
	Max. allow runout	±0.15 mm	Out of roundness
BRUSH SPRING		800 gr pressure std.	(+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	6.5V	
	Cut out Voltage	4.0V	
	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:		35 A 12 V (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)		

Disassembly

Starter motor

1. Drain the engine oil.

2. Remove the four motor mounting bolts. (8 mm)

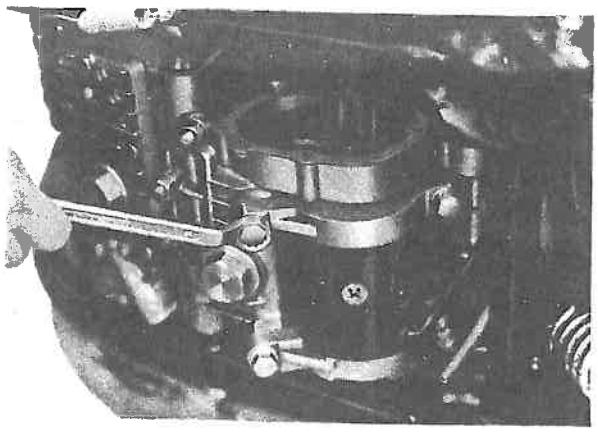
Note:

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.

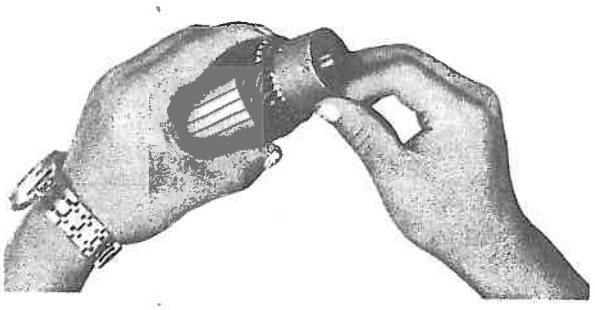


Servicing and troubleshooting

Armature

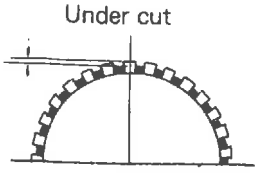
1. If the commutator surface is dirty, clean with #600 grit sandpaper as shown in the drawing at the right.

After sanding, wash thoroughly with electrical contact cleaner and dry with high-pressure air stream.



2. The mica insulation between commutator segments should be 0.5~0.8mm below the segment level.

If not, undercut to proper limits with appropriately shaped tool. (A hacksaw blade can be ground to fit).

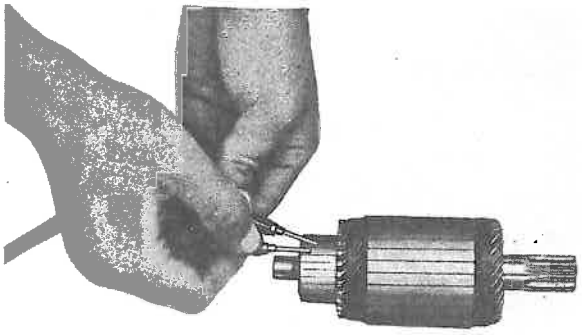


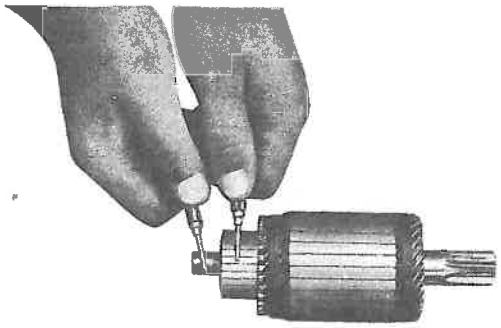
3. Each commutator segment should show zero ohms resistance to the others and at least three million ohms resistance to the core. If there is less than [illegible] ohms resistance to the core, or one of the segments is open, replace the armature.

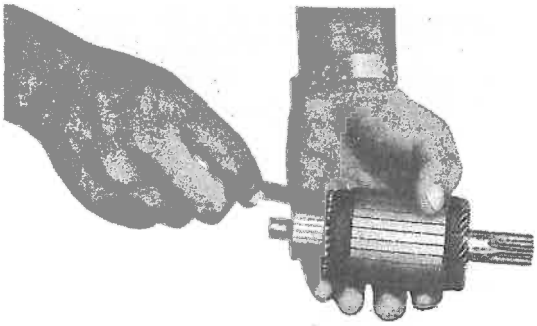
   In addition, the armature can be placed on a "growler" (testing device) and checked magnetically for internal shorts. Follow manufacturer's test recommendations.
4. If the armature shows signs of having been in contact with the yoke windings check the front and rear cover bearings.
   Replace as necessary.

5. 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.







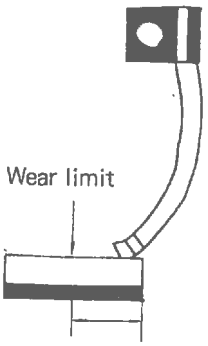
Carbon brushes

1. Check brush length and replace if at or near limits.

2. Check brush spring pressure. Replace if over/under specs.

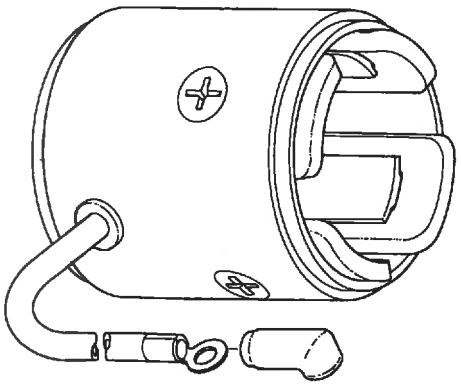
NOTE:
Spring pressure is measured with a nominal length brush installed. Lift until spring starts to lift off brush and note reading on scale. (Nominal: 800gr.)

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



Yoke

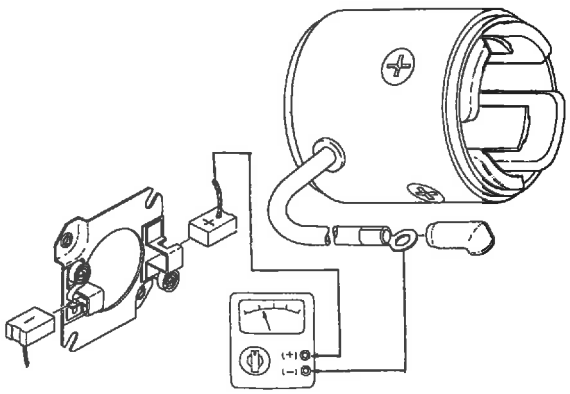
1. If the yoke area is dirty, clean with clean solvent and dry with high-pressure air.



2. Yoke coil resistance is 0.05 ohms.
   If coil resistance is more than 0.055 ohms or less than 0.045 ohms, replace it.

   If the yoke shows leakage to ground (resistance is less than 0.1 million ohms) replace it. (20° C)

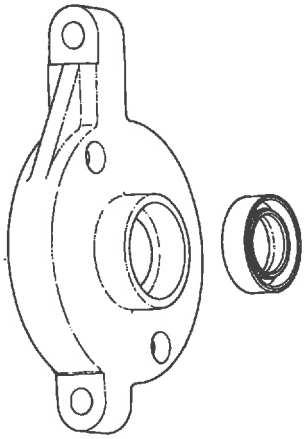
NOTE:
Immediately after cleaning, the yoke may show some insulation leakage. Wait for it to thoroughly dry before checking or reinstalling.



Covers

1. 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)



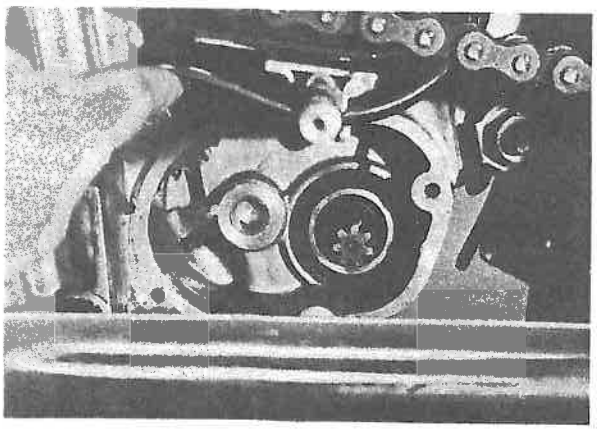
2. Clean the bearings thoroughly, lightly oil each and check for hard spots during rotation, cracked or broken balls and/or races, etc.
   Replace as necessary.

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

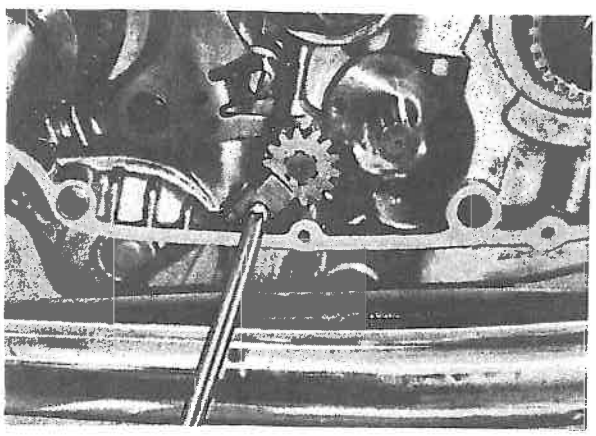
Starter reduction gears

NOTE:
Additional disassembly details can be found in the Engine Section.

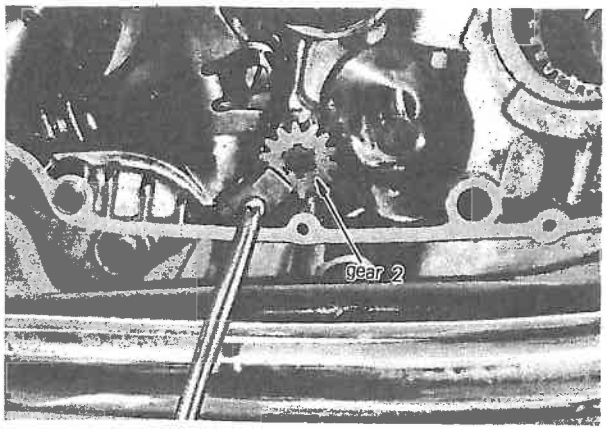
1. Drain the engine oil.
2. Remove the left crankcase cover.
3. Remove the gear train cover.
4. Remove the idler gear.



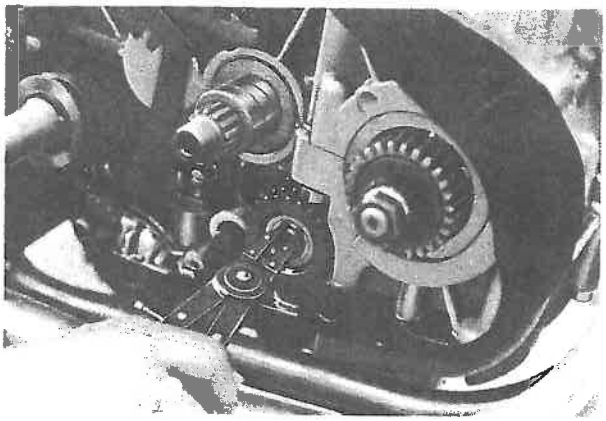
5. Remove the right crankcase cover.
6. Remove the clutch.
7. Remove the stopper plate mounting bolt and plate.



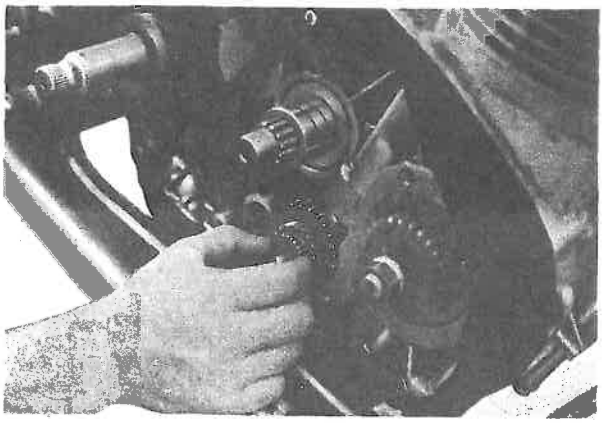
8. Remove the gear "2".



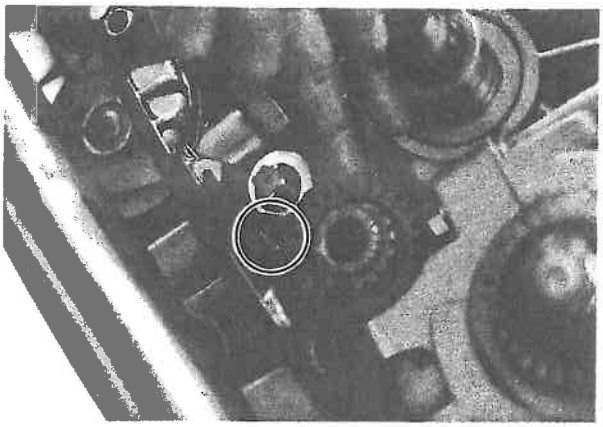
9. Remove the circlip.



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



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, galling, etc. Replace as necessary.

NOTE ON REASSEMBLY:

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