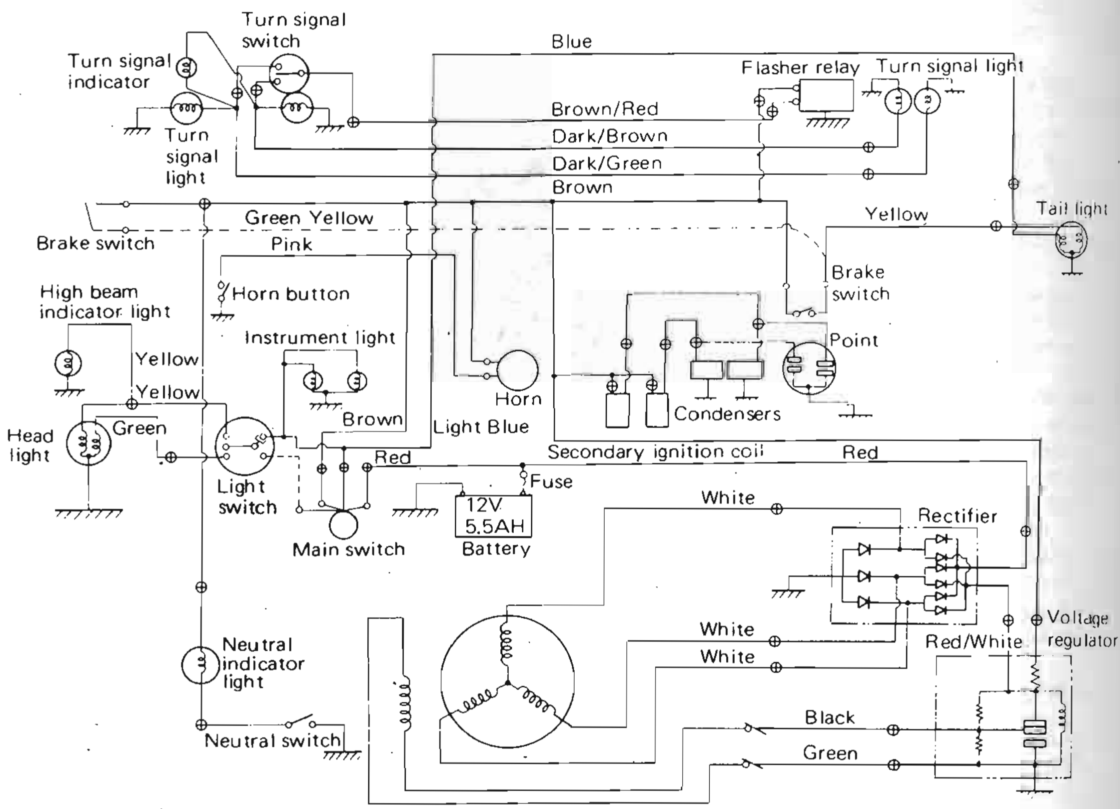
CHAPTER 5. ELECTRICAL

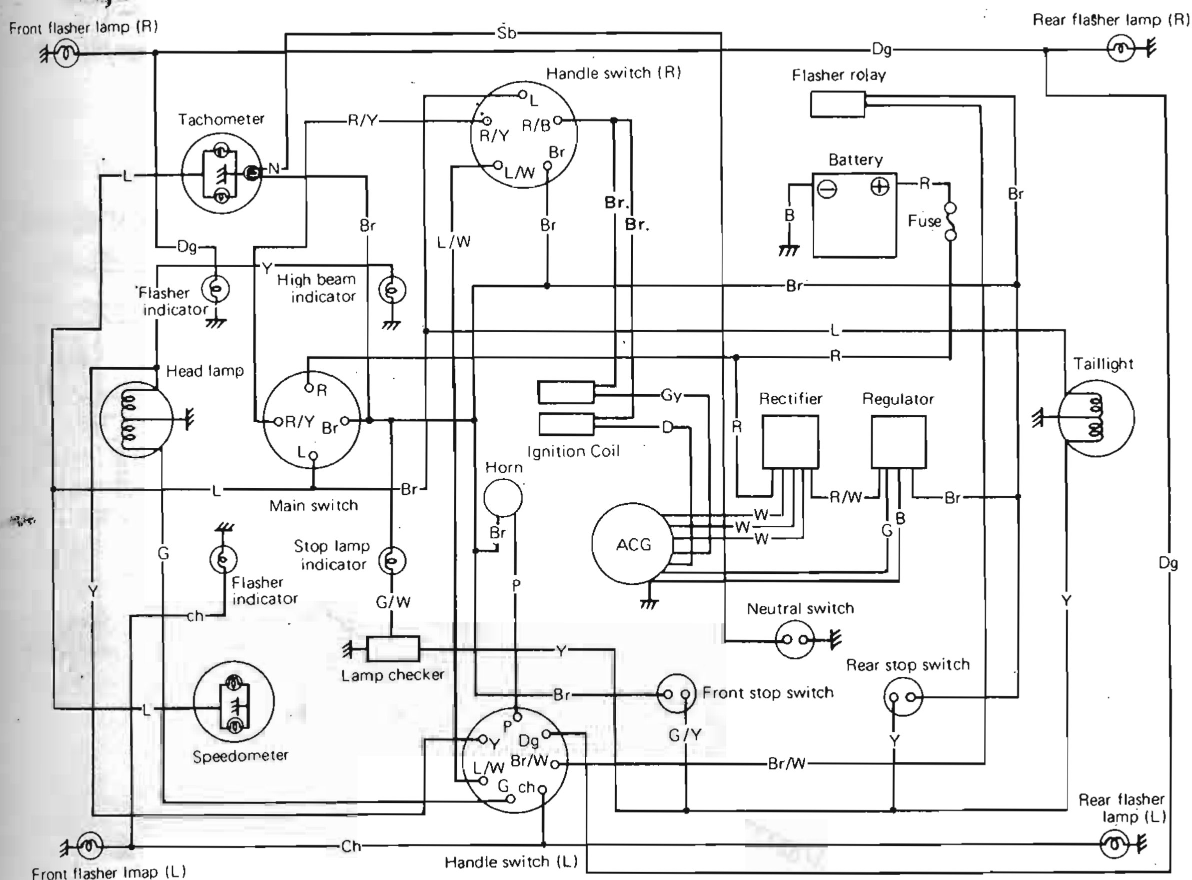
5–1 Charging System

The 250, 350 series electrical system use an alternator to generate voltage which is then rectified to direct current. These direct current voltage are controlled by a voltage regulator which is set to maintain a 12-15V DC constant.

When the engine is stopped, DC current to energize the lighting and ignition circuits is supplied by the BATTERY circuit. When the engine is running, excess voltage is shunted to the battery, if necessary, for recharging. If unneeded, the voltage regulator will decrease alternator current output.



DS7, R5C



RD250/A, RD350/A

Fig. 5-1-1

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

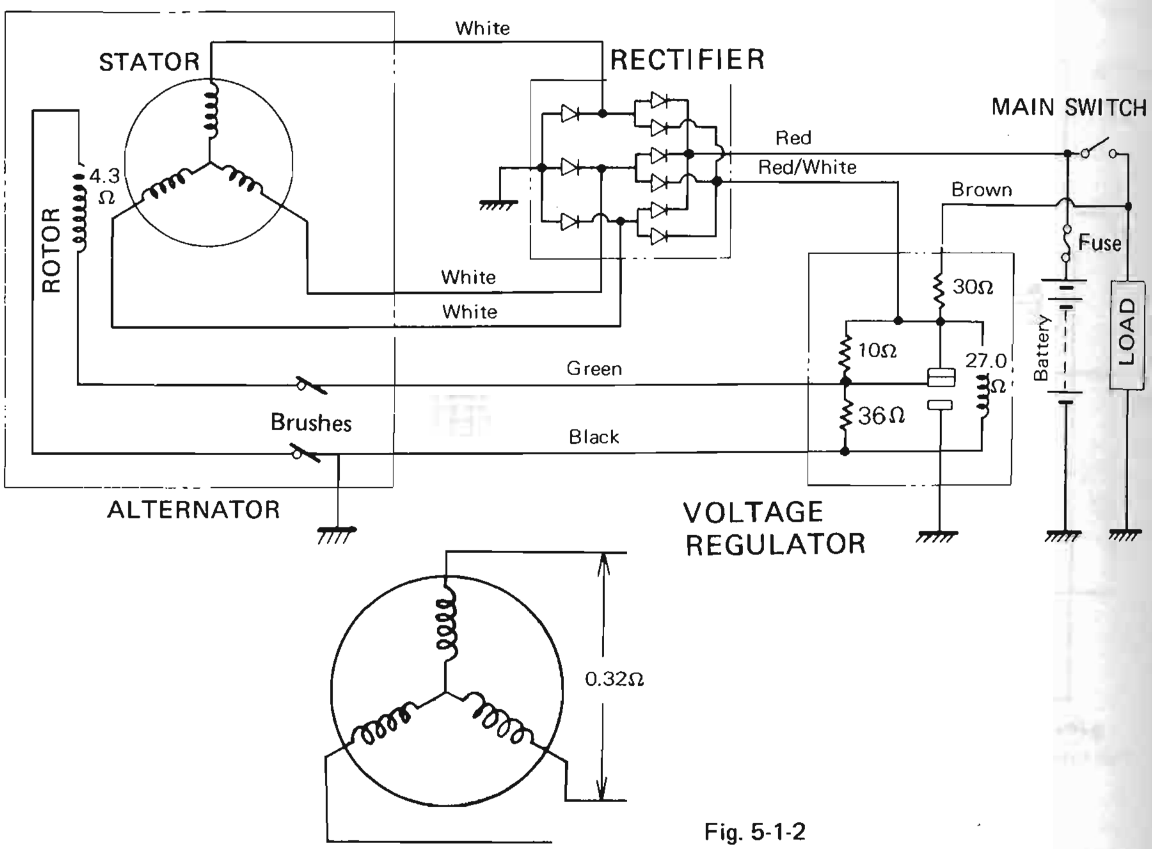
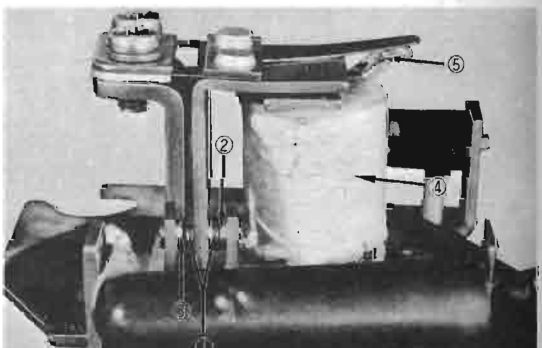


Fig. 5-1-2

1. Voltage Regulator

1) 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.
2) The regulator operates as a magnetic switch. As charging voltage rises, part of this voltage is routed through an electromagnet 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.



1. Central point arm
2. Right point (low rpm position)
3. Left point (high rpm position)
4. Electromagnet
5. Adjusting arm

Fig. 5-1-3

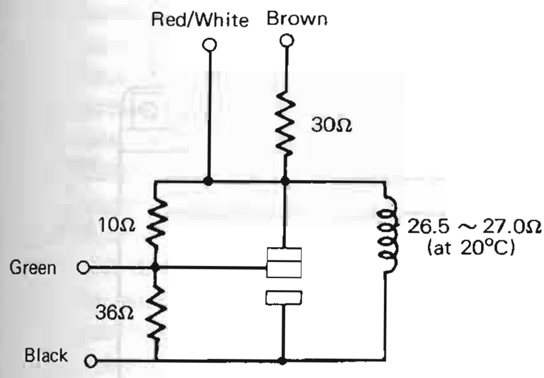


Fig. 5-1-4

3) Charging voltage output can be controlled at the regulator. Inside the housing is an arm that pushes against a flat spring steel plate. This is the adjusting arm.When adjusting arm is raised, output voltage will rise, and when arm is lowered, voltage will drop.

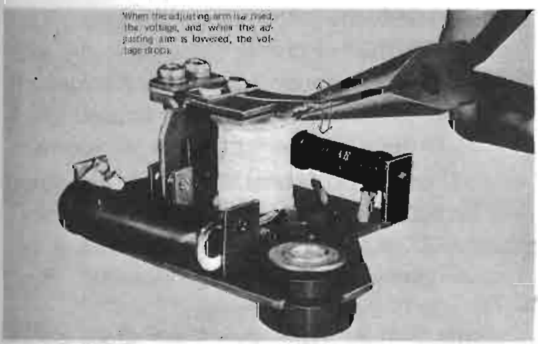


Fig. 5-1-5

4) Start the engine. Disconnect the rectifier red wire at the snap connector and hook up a voltmeter from the rectifier wire to ground. Accelerate the engine to 2,000 rpm. The voltmeter should read 14.5-15.5 volts DC. If it varies from this amount bend the adjusting arm up to raise the charging voltage or down to reduce output.

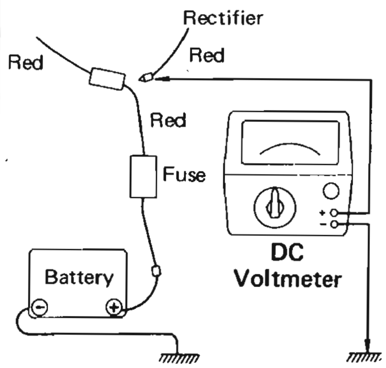


Fig. 5-1-6

2. Rectifier

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

3. Rotor

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 through 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 force). 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 ciruit in terms of voltage "flow". As soon as voltage is present in 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.

1) 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.
2) 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.
3) 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.
4) 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.

1) 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.
2) 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.
3) The stator assembly also holds the brushes for the rotor circuit.

5. Battery

1) Servicing a new battery

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

2) Battery maintenance

a. Periodic inspection can determine the condition of the battery housing and the condition of the internal parts. Check for cracks or holes in the housing. Check for broken plates, sulfation, low fluid level, or corroded terminals.

b. The battery housing is marked with a minimum and maximum fluid level. If any cell fluid level drops below the minimum level, fill with distilled water to correct height. Check once a month or more often in hot weather. Do not use tap water.

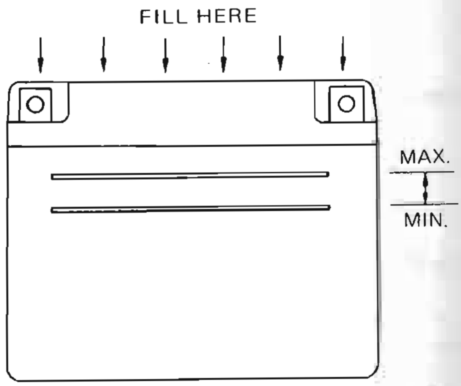


Fig. 5-1-7

3) Charging

a. Remove the battery and check the specific gravity of the battery fluid. A fully charged battery reads between 1.260~1.280. If the rating is less than 1.260, the battery needs charging.

b. Fill the battery to the proper level with distilled water. Leave the fill caps off until battery charging has finished. Use a battery charger that has a maximum output of 1 amp. The 250, 350 series battery use a 5.5 amp/hour battery. Do not exceed a one amp input as excessive heat would be generated.

NOTE

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

4) Troubleshooting

a. Excessive fluid evaporation from cells: Normal battery operation requires fluid to be added to the cells approximately once a month. If distilled water must be added every week or two, the battery is possibly being overcharged. Check voltage input from the alternator.

b. Low fluid level in one cell: If one cell continuously loses more fluid than others, check for a shorted cell. A shorted cell creates abnormal fluid evaporation. Check with a hydrometer for excessive difference in specific gravities between the cells.

c. Won't hold a charge:
First check the alternator output to eliminate the possibility of a low charging rate. Next, check for loose terminal con-

nections (creating high resistance), or a build-up of material in the bottom of the housing that could short the plates. Nothing can be done about loose terminals themselves except to replace the battery. Sediment at the bottom of the housing can sometimes be removed by flushing the battery out several times with distilled water if the cell is discharged, electrolyte if fully charged. Dry the battery off, and recharge for a few hours. If enough loose sediment is flushed out, the battery could hold a charge. If the battery still cannot hold a full charge, replace it.

d. Sulfation: Sulfation, in the form of a white, scaly material, gradually forms on the plates and at the bottom of the housing. It is created over a period of time as the sulfuric acid combines with the lead plates to produce lead sulfate (white particles of sulfation). It is a product of age and use. The battery usually needs to be replaced when sulfation reaches the point of shorting out the plates.

e. Make sure that the wires are hooked to the proper battery terminals. The red wire must be hooked to the "positive" terminal, the black lead must be hooked to the "negative" terminal. If the wires are reversed, the battery will quickly lose its charge. Very likely the battery will be destroyed if the reversed hook-up is left connected for any length of time.

5) Storage

a. Whether it is a new battery or one that has been in service, preparation for storage of either one is almost idential. When new, the battery is dry-charged (no electrolyte). Keep it away from moisture and heat. A stored dry-charged battery can last several months without losing a great deal if its charge.

b. A used battery should be filled to the maximum level with distilled water, given a complete charged and stored in a cool area (coldness slows the process of battery discharge). It should be given a booster charge every two months. When preparing to place a stored battery back into service, check for sufficient electrolyte and fully charge the battery.

6. Troubleshooting

Troubleshooting the electrical system of the R5 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) Min 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.

a. **It can break in two, stopping current flow. (Lose continuity)**

b. 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.

1) Charging voltage output

a-1 Start the engine.

a-2 Disconnect the rectifier red wire.
Hook up a voltmeter from the rectifier wire to ground.

a-3 Accelerate the engine to approximately 2,000 rpm and check the generated voltage. It must read between 14.0~15.0 volts DC.

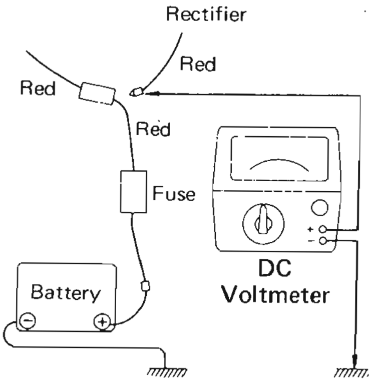


Fig. 5-1-8

a-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 adjusted to zero.

2) Broken wires

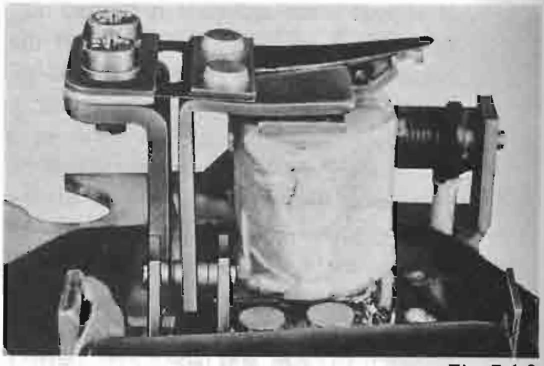
a. Check for obviously broken wires or separated connectors (especially multiple connectors). Pay particular attention to any parts that are subject to wear or might by subjected to vibration.

3) Regulator

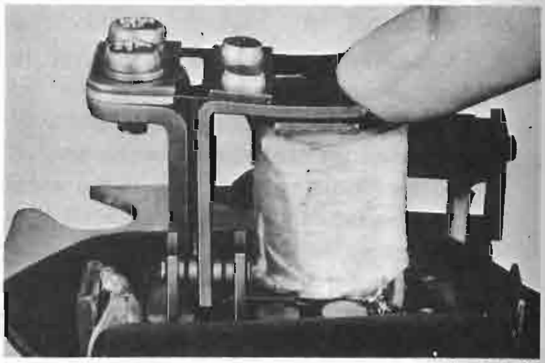
a. A defective regulator can cause abnormally low or high voltage output. Remove the regulator cover and examine all internal parts for signs of failure. All point surfaces should be reasonably clean. If they are very pitted, or if the central contact point has fused to a stationary point, then this is the troublespot. 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.

b. If visual inspection does not locate any troublesport 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, red/white, and brown wires at the connector.

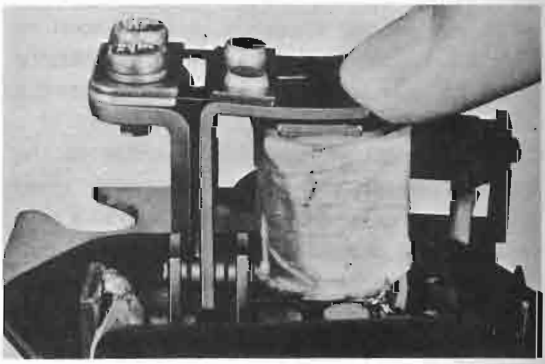
c. The following regulator resistance tests will refer to "1st position, 2nd position, and 3rd position". These refer to the center regulator point and its position between both outer points. 1st position is for voltage control at low engine rpm. 2nd point position is for voltage control at mid-rpm range. 3rd point position is for high rpm voltage control. This center point will be moved by hand to the proper position during testing procedures.



#1 Point Position **Fig. 5-1-9**
center point against right-hand point.



#2 Point Position **Fig. 5-1-10**
center point in the middle, not touch either stationary point.



#3 Point Position **Fig. 5-1-11**
center point against left-hand point.

d. Each of the following resistance test will give proper meter hook ups, position the regulator points should be in, and resistance specifications.

NOTE
All specifications have maximum and minimum tolerances of 2.5 ohms, except "zero" specifications, which must be less than 1 ohm maximum to be considered good.

e. For resistance test #1, hook the ohmmeter (0 x 1 ohms scale) to the black wire and the regulator base. This hook up must read zero ohms resistance. One or more ohms indicates a frayed or broken black wire.

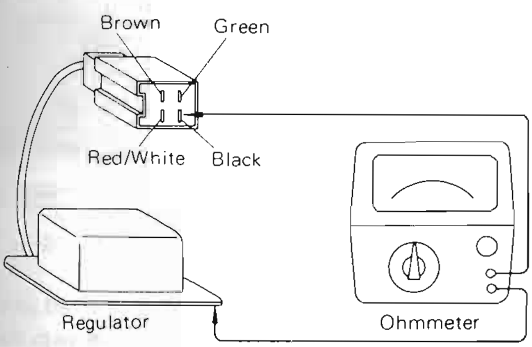


Fig. 5-1-12

f. For resistance test #2, remove the regulator cover and hook the two ohmmeter probes to the red/white wire and green wire.

#1	Point Position:	0 ohms
#2	Point Position:	9 ohms
#3	Point Position:	9 ohms

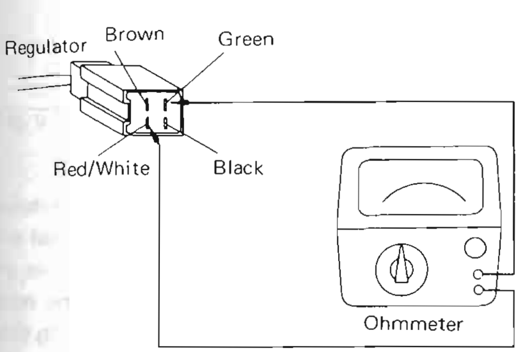


Fig. 5-1-13

g. For resistance test #3, hook the two ohmmeter probes to the red/white wire and black wire.

#1	Point Position:	27 ohms
#2	Point Position:	32 ohms
#3	Point Position:	9 ohms

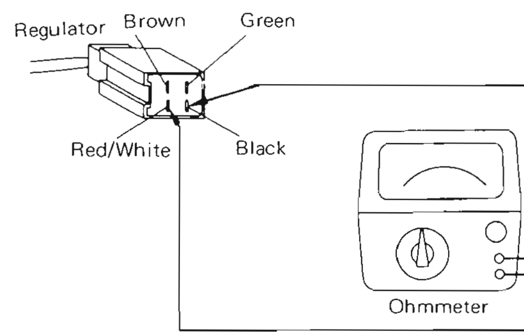


Fig. 5-1-14

h. For resistance test #4, hook the two ohmmeter probes to the brown wire and green wire.

#1	Point Position:	29 ohms
#2	Point Position:	37 ohms
#3	Point Position	37 ohms

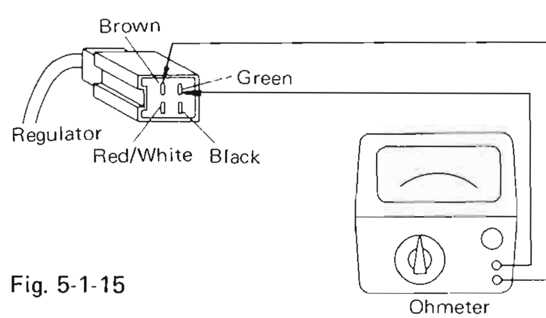


Fig. 5-1-15

i. For resistance test #5, hook the two ohmmeter probes to the brown wire and black wire.

#1	Point Position:	57 ohms
#2	Point Position:	62 ohms
#3	Point Position:	38 ohms

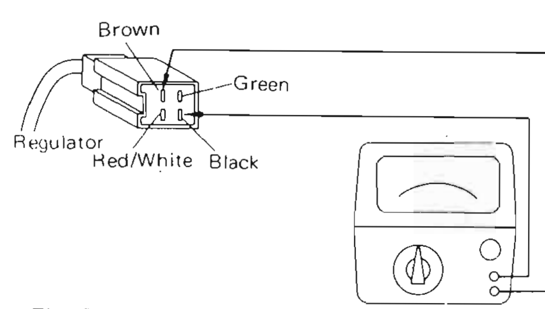


Fig. 5-1-16

j. For resistance test #6, hook the two ohmmeter probes to the green wire and black wire.

#1 Point Position:	27 ohms
#2 Point Position:	28 ohms
#3 Point Position:	0 ohms

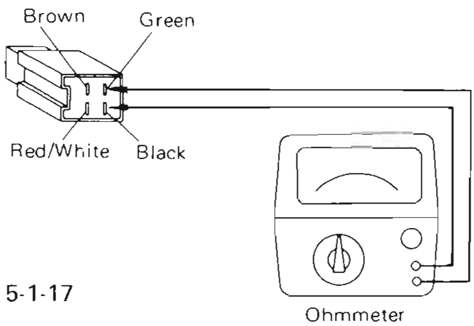


Fig. 5-1-17

k. 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 re-soldered), or burnt points that can be cleaned, 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.

4) Rectifier

a. 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.

b. The prongs are connected to three white wires (that hook up to the alernator wires), one black wire (to ground), one red wire (to battery and main switch) and one red/white wire (to regulator). Perform the following tests, using an ohmmeter (0~100Ω scale) to check the condition of the rectifier.

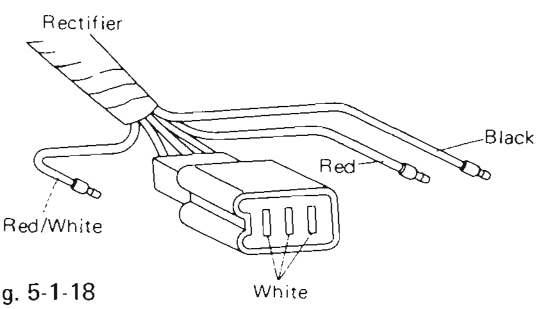


Fig. 5-1-18

c. Visually check all rectifier wires for breaks.

d. 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 (7-9Ω) reading one way and almost infinite resistance with the probes reversed.

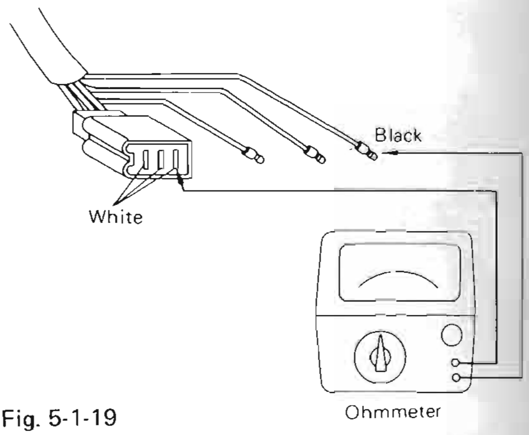


Fig. 5-1-19

e. 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 d.

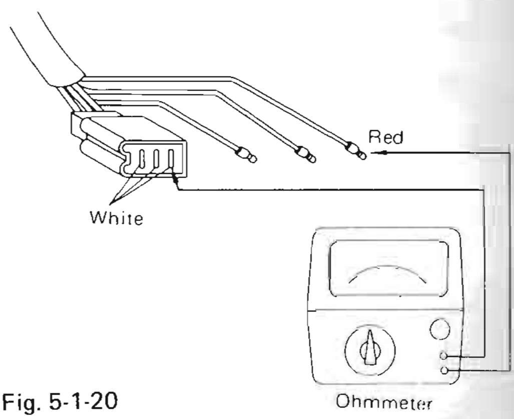


Fig. 5-1-20

f. Attach one meter probe to the white/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 indentical to those in e.

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

h. If resistance results in steps d, e and f show that current can flow both ways, or neither way, then one or more diodes have been damaged. Replace the unit.

5) Stator Windings

a. Trace the ACG wiring up to the multiple connector. Disconnect the connector and perform the following test to the three white wire ends at the multiple connector.

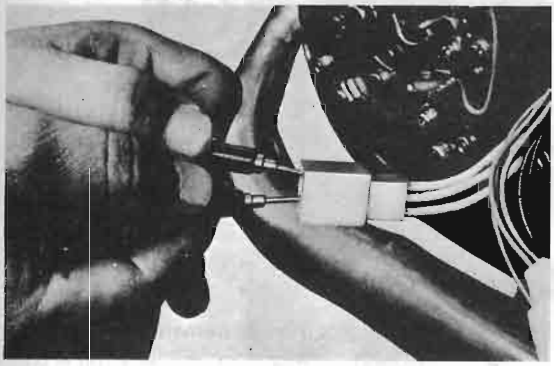


Fig. 5-1-21

b. All three white wires are interconnected in the stator windings. Use an ohmmeter to check resistance between any two white wires (three possible combinations). Each of the three measurements should shown 0.3~0.35Ω resistance.

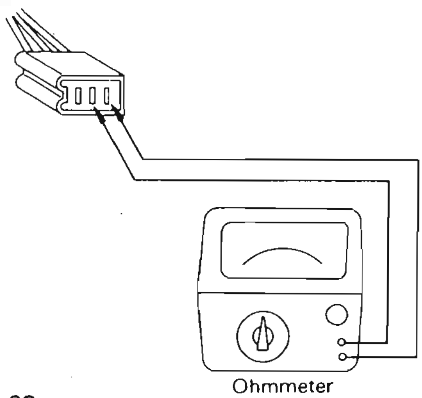


Fig. 5-1-22

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

d. If resistance values in steps b & c vary from those specified, then the stator windings are broken, shorted together, or shorted to the housing. Replace the entire stator assembly.

6) Carbon Brushes

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

b. Visually inspect the carbon brush holder and brushes for obvious brakage or wear. Standard brush length is 11.0 mm (0.433"), wear limit is 6.0 mm (0.236"). Also check for carbon dust on the brush that could cut down maximum possible output.

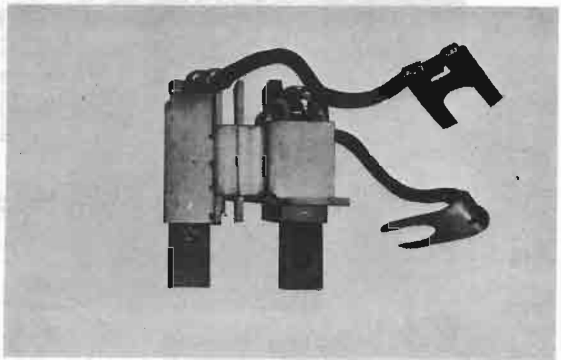


Fig. 5-1-23

c. If high resistance exists in either the green or black brush wire, it is frayed or broken. Repair or replace the entire wire (check wire to brush solder joint).

7) Rotor Windings

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

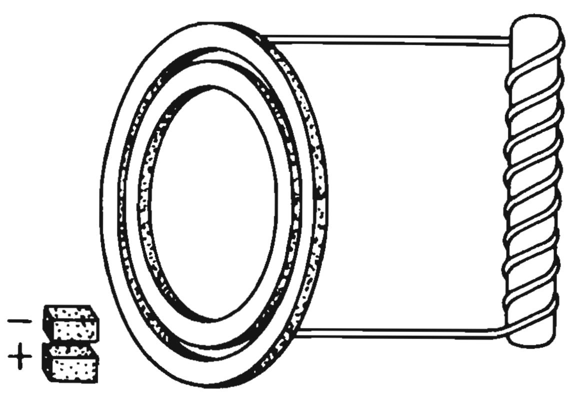


Fig. 5-1-24

b. Use an ohmmer (Ω x 1) to check resistance from one slip ring to another. Resistance must measure 4~4.5Ω. If more or less rotor will not work properly.

NOTE

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

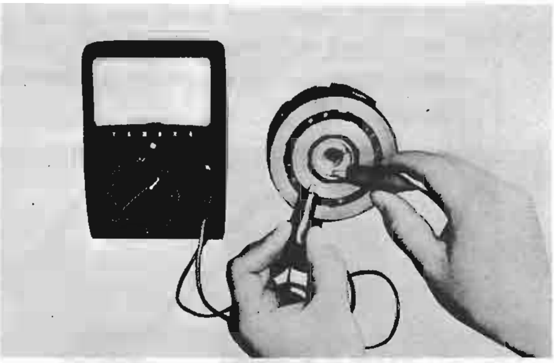


Fig. 5-1-25

c. Use an ohmmeter set to register at least kilo-ohms resistance. Measure insulation between each slip ring and the rotor core. This must show infinite resistance (more than 20 million ohms).

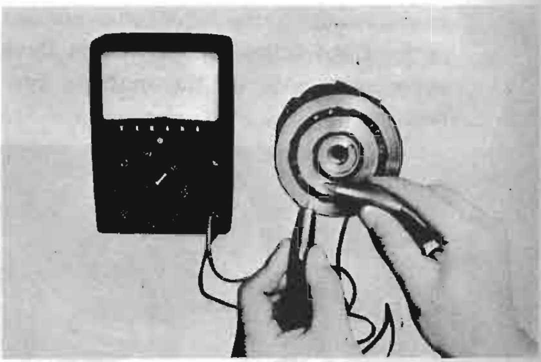


Fig. 5-1-26

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