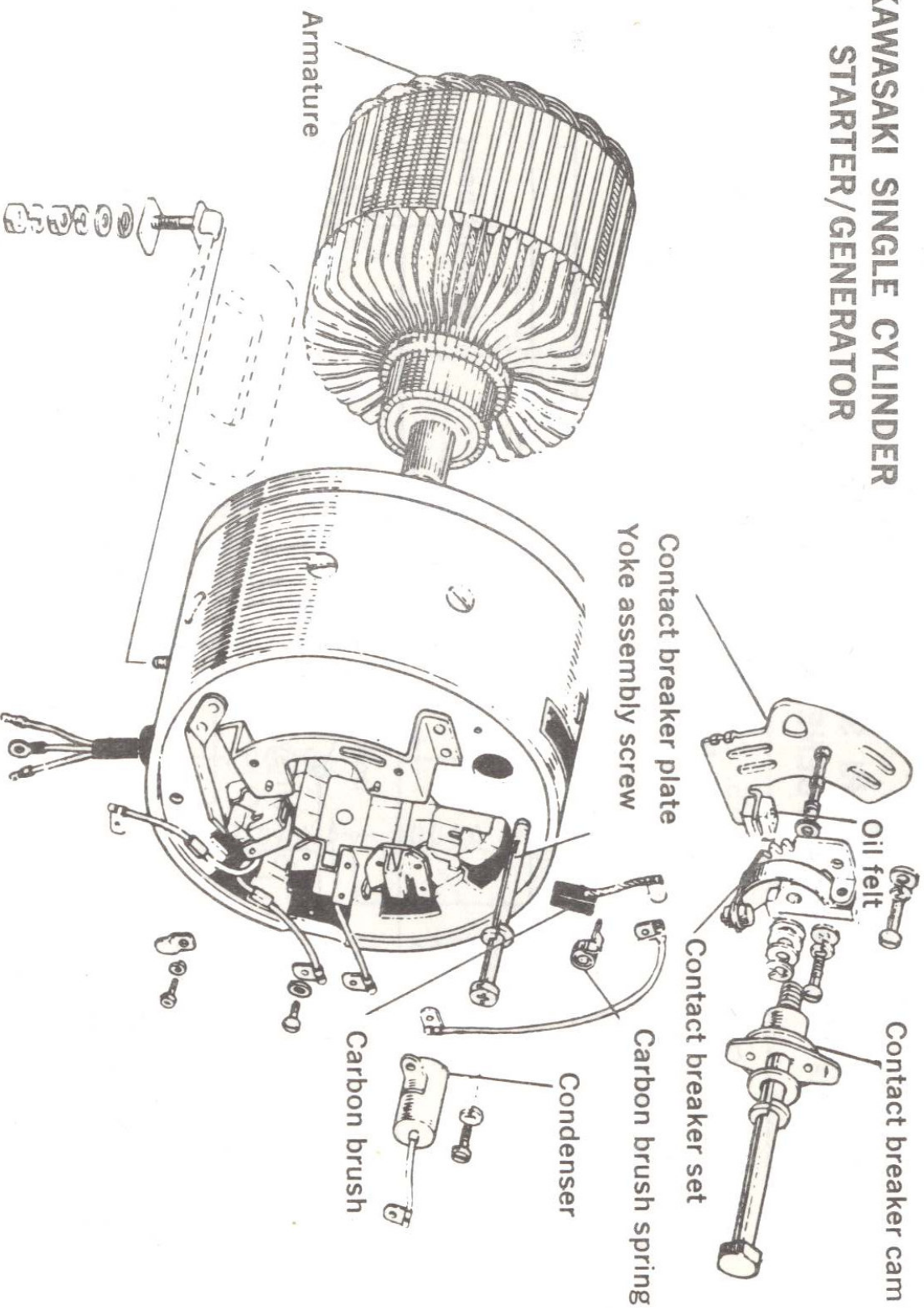


Some models have a combination

starter/generator instead of a magneto. **Figure 89** is an exploded view of this unit. The armature rotates with the engine crankshaft. Attached to the end of the armature shaft is the

breaker cam. The unit operates as a generator when the engine is running, and as a starting motor when the engine is stopped. Associated with the starter/generator is a cut-out relay,

KAWASAKI SINGLE CYLINDER STARTER/GENERATOR



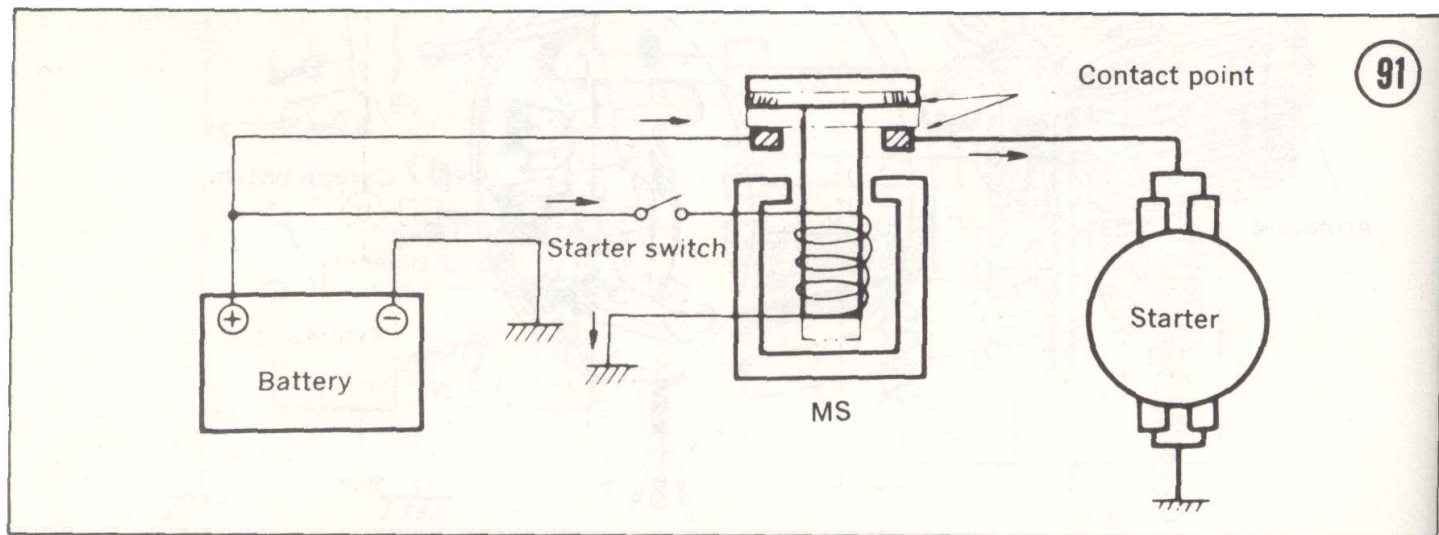
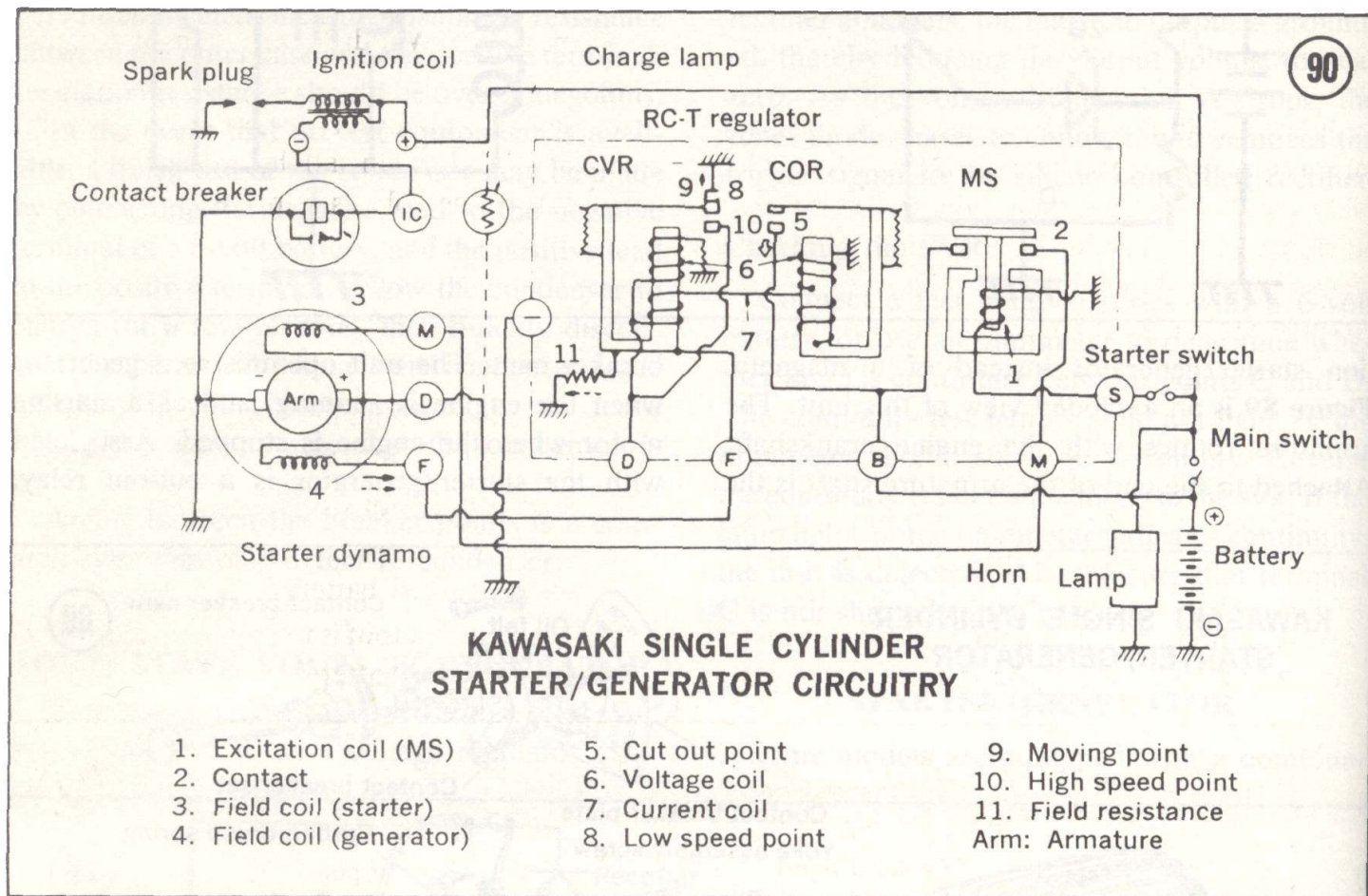
voltage regulator, and starter relay. **Figure 90** is a schematic diagram of the associated circuitry. Refer to this diagram for the following.

Starter Relay

The starter relay is enclosed within the voltage regulator unit. **Figure 91** illustrates the relay circuit. Pressing the starter switch energizes the relay coil and closes the relay contacts. Current then flows from the battery, through the relay contacts, and finally through the series field winding M of the starter/generator.

Cut-Out Relay

When the engine is off, or running at low speed, the battery must be disconnected from the generator to prevent it from discharging. The cut-out relay performs this function. As engine speed increases, output voltage of the generator increases to a value sufficient to charge the battery. When this occurs, a voltage sensing coil in the cut-out relay closes the relay contacts, permitting current to flow from the generator to the battery and external loads. As the engine slows down, generator output decreases, and current



generator.

Voltage Regulator

by controlling the field current in the generator.

Figure 92 illustrates the operation.

tain constant generator output.

ator output to decrease to almost zero. Voltage

regulation is then effected by cycling of contact (9) between the mid-position and contact (10).

Removal and Installation

To remove the starter/generator, proceed as follows.

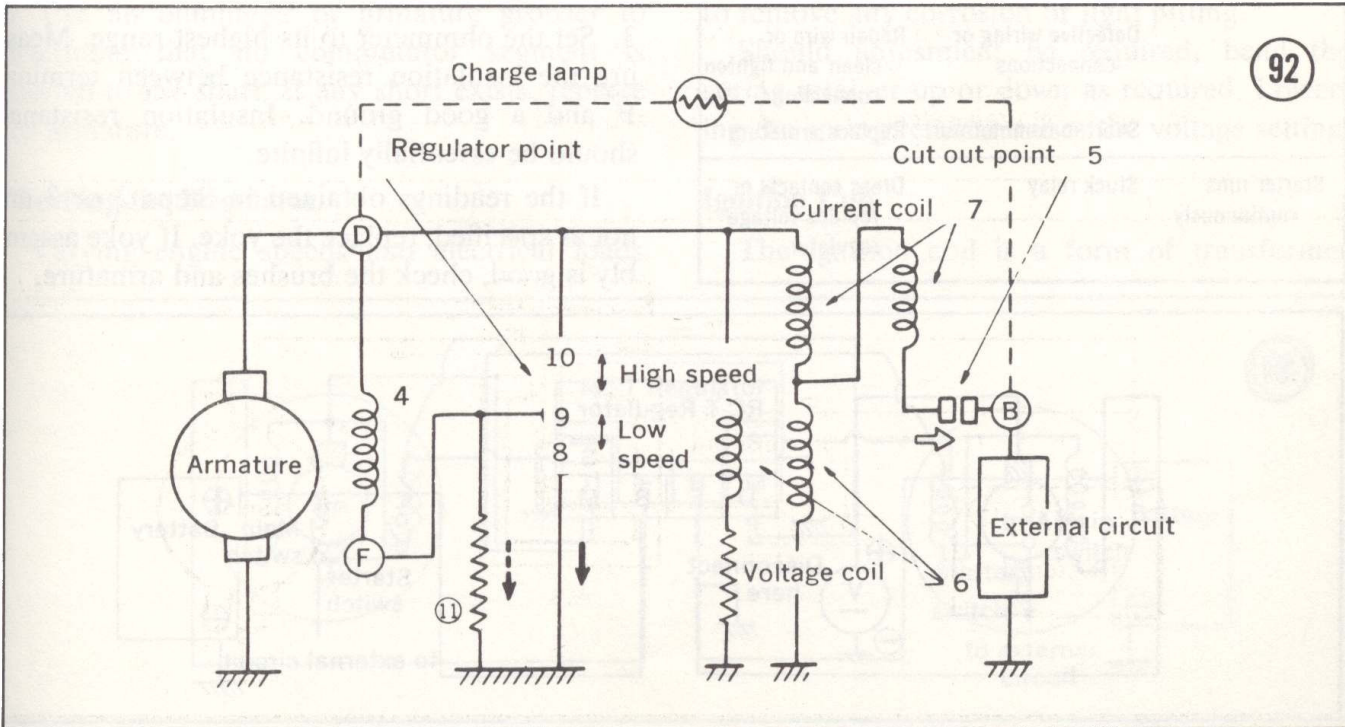
1. Remove the gearshift pedal.
2. Remove the left crankcase cover.
3. Remove the screws which secure the yoke assembly, then the yoke.
4. Remove the armature (**Figure 93**) with the armature puller yoke.
5. Remove the Woodruff key from the crankshaft.

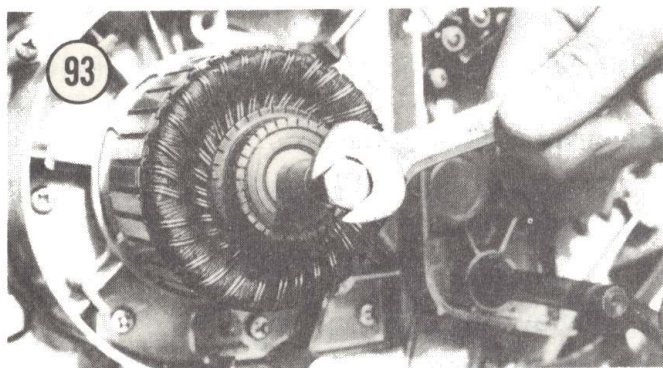
To install the starter/generator, reverse the removal procedure. Install the brushes and brush springs after the yoke is in place.

STARTER/GENERATOR TROUBLESHOOTING

Malfunctions within the starter/generator system can be divided into three main categories.

- Starter does not work properly.
- Generator output is too low, resulting in an undercharged battery.
- Generator output is too high, resulting in an overcharged battery.





Starter Troubleshooting

Table 22 lists symptoms, probable causes, and remedies for starter malfunctions.

Table 22 STARTER TROUBLESHOOTING

Symptom	Probable Cause	Remedy
Starter does not work	Low battery	Recharge battery
	Worn brushes	Replace brushes
	Internal short	Repair or replace defective component
	Relay inoperative	Replace voltage regulator
	Defective wiring or connections	Repair wire or clean and tighten
	Defective switch	Replace switch
Starter action is weak	Low battery	Recharge battery
	Pitted relay contacts	Clean contacts or replace voltage regulator
	Brushes worn	Replace brushes
	Defective wiring or connections	Repair wire or clean and tighten connections
	Short in commutator	Replace armature
Starter runs continuously	Stuck relay	Dress contacts or replace voltage regulator

Generator Troubleshooting

In the case of charging system malfunctions, it is necessary to determine whether the generator or the regulator is at fault. To determine which, refer to **Figure 94**, then proceed as follows.

1. Disconnect the wires from terminals D and F of the regulator.
2. Connect the wire which you removed from terminal F to a good ground. Connect an accurate voltmeter (0-20 VDC) between the wire removed from terminal D and ground.
3. Start the engine and run it at 2,200 rpm. If the voltmeter indicates more than 13 volts, it can be assumed that the generator is OK.

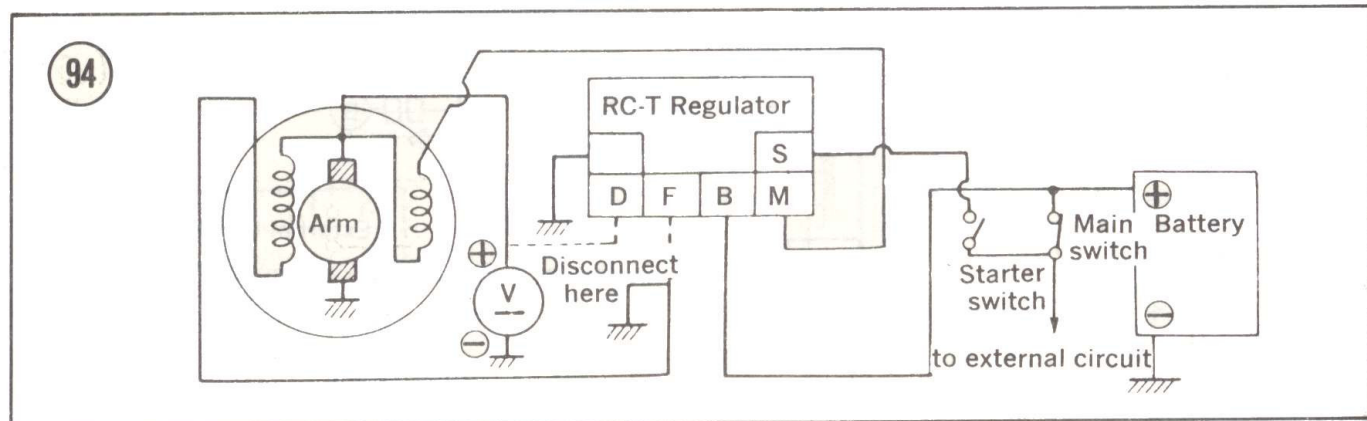
If the meter indications were not as specified, the starter/generator is faulty.

Checking the Yoke

Clean the yoke assembly of all foreign material, and remove it from the machine.

1. Use an ohmmeter to measure the insulation resistance between the positive brush and ground. If the meter indicates continuity, check for a short circuit at the brush holder or terminal D. Note that the negative brush holder is not insulated.
2. Measure the resistance between terminals F and D. Field coil resistance should be between 5 to 8 ohms.
3. Set the ohmmeter to its highest range. Measure the insulation resistance between terminal F and a good ground. Insulation resistance should be essentially infinite.

If the readings obtained in Steps 2 or 3 are not as specified, replace the yoke. If yoke assembly is good, check the brushes and armature.



Checking the Brushes

Poor brush condition is one of the most frequent causes of low generator output. Remove the brushes and examine them carefully. Each brush must contact the commutator with at least three quarters of its contact surface. If either brush is worn excessively, replace both brushes.

If the brushes and the commutator are rough, misalignment of the armature and crankshaft may be the cause. Check the tapered bore of the armature and smooth it if there are any burrs.

When you replace the brushes, be sure that the positive brush lead doesn't touch the brush holder or the edge of the breaker plate. Also be sure that the negative brush lead doesn't touch the positive brush spring.

Checking the Armature

1. Clean the commutator of oil, dust, and foreign material.
2. If the commutator is rough or covered with carbon dust, polish it with fine emery paper. If a light polishing does not clean up the surface, remove the armature and turn the commutator on a lathe. Do not reduce the commutator diameter by more than 0.08 inch (2 millimeters).
3. Undercut the mica segment between the commutator segments with a hacksaw blade to a depth of 0.02 to 0.04 inch (0.5 to 1.0 millimeters). Remove the dust between the segments.
4. Use an ohmmeter or armature growler to determine that no commutator segment is shorted to the shaft. If any short exists, replace the armature.

Checking the Regulator

Varying engine speeds and electrical loads

affect the output of the generator. The regulator controls the generator output, and also disconnects the battery from the generator whenever generator output voltage is less than that of the battery, thereby preventing battery discharge through the generator.

Disconnect the wire from terminal **B** at the regulator. Be careful that you don't allow this wire to become grounded. Connect the voltmeter between terminal **B** of the regulator and ground, as shown in **Figure 95**. Start the engine and run it at 2,500 rpm. The voltmeter should indicate 14.7 to 15.7 volts.

Adjusting the Voltage Regulator

CAUTION

Disconnect the battery before you remove the regulator cover. Do not make any adjustments with the battery in place.

Remove the regulator cover and adjust the regulator by bending the adjustment spring. Bending the spring downward raises the voltage setting. The voltage regulator can be identified by its two contact points.

The cut-out relay can be identified by a single set of contacts which are normally open. The relay rarely, if ever, needs adjustment. Usually all that is required is to dress the contacts lightly to remove any corrosion or light pitting.

Should adjustment be required, bend the spring retainer up or down as required. Lowering the spring retainer raises the voltage setting.

