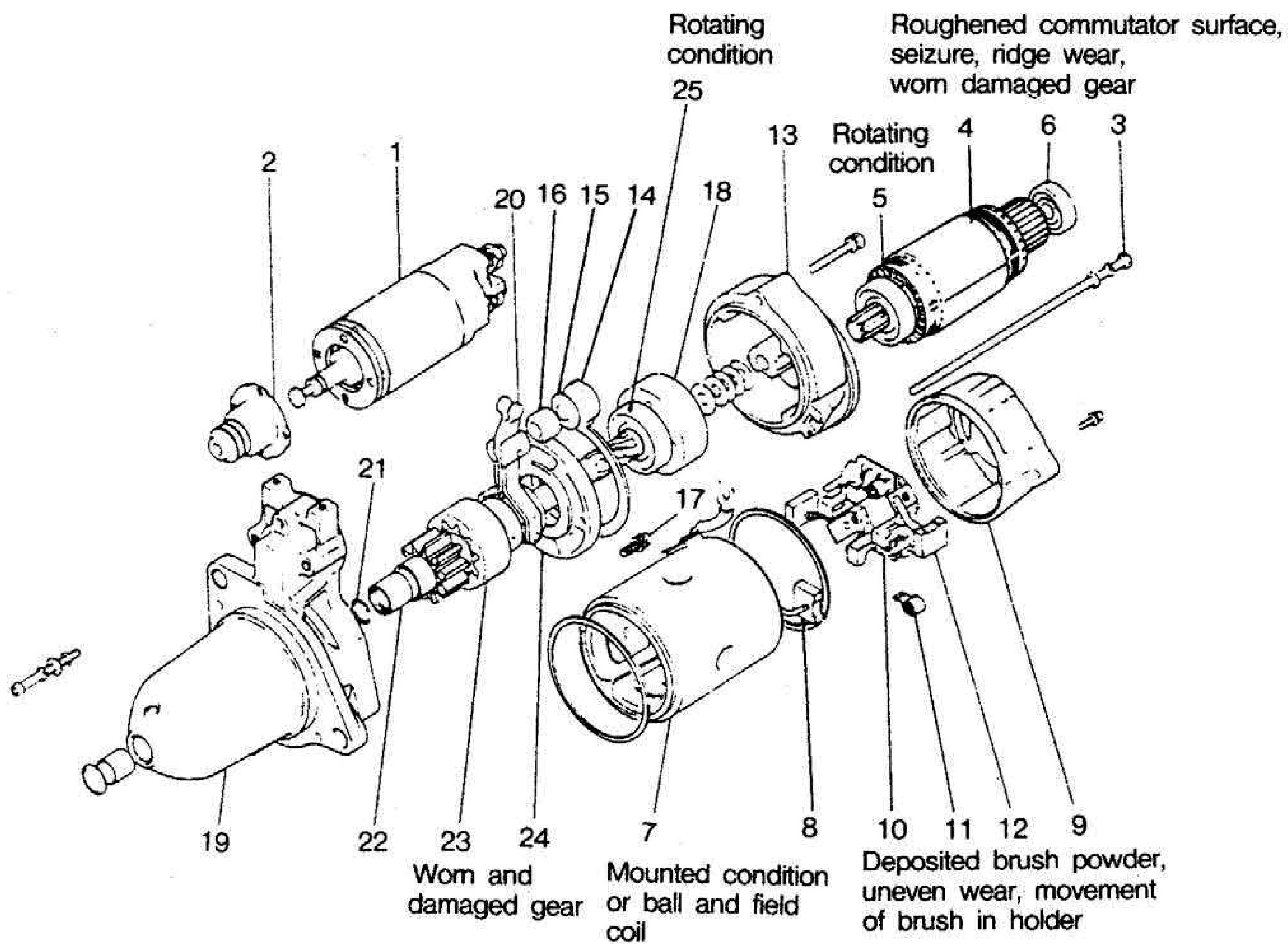


12-1 STARTER

(1) Disassembly



- | | | |
|-----------------|-------------------|-----------------------|
| 1 Magnet switch | 10 Brush holder | 18 Gear shaft |
| 2 Cover set | 11 Brush spring | 19 Front bracket |
| 3 Through bolt | 12 Brush(-) | 20 Lever |
| 4 Armature | 13 Center bracket | 21 Ring |
| 5 Bearing | 14 Packing | 22 Pinion stopper |
| 6 Bearing | 15 Holder | 23 Overrunning clutch |
| 7 Yoke assembly | 16 Spacer | 24 Gear bracket |
| 8 Brush(+) | 17 Screw | 25 Bearing |
| 9 Rear bracket | | |

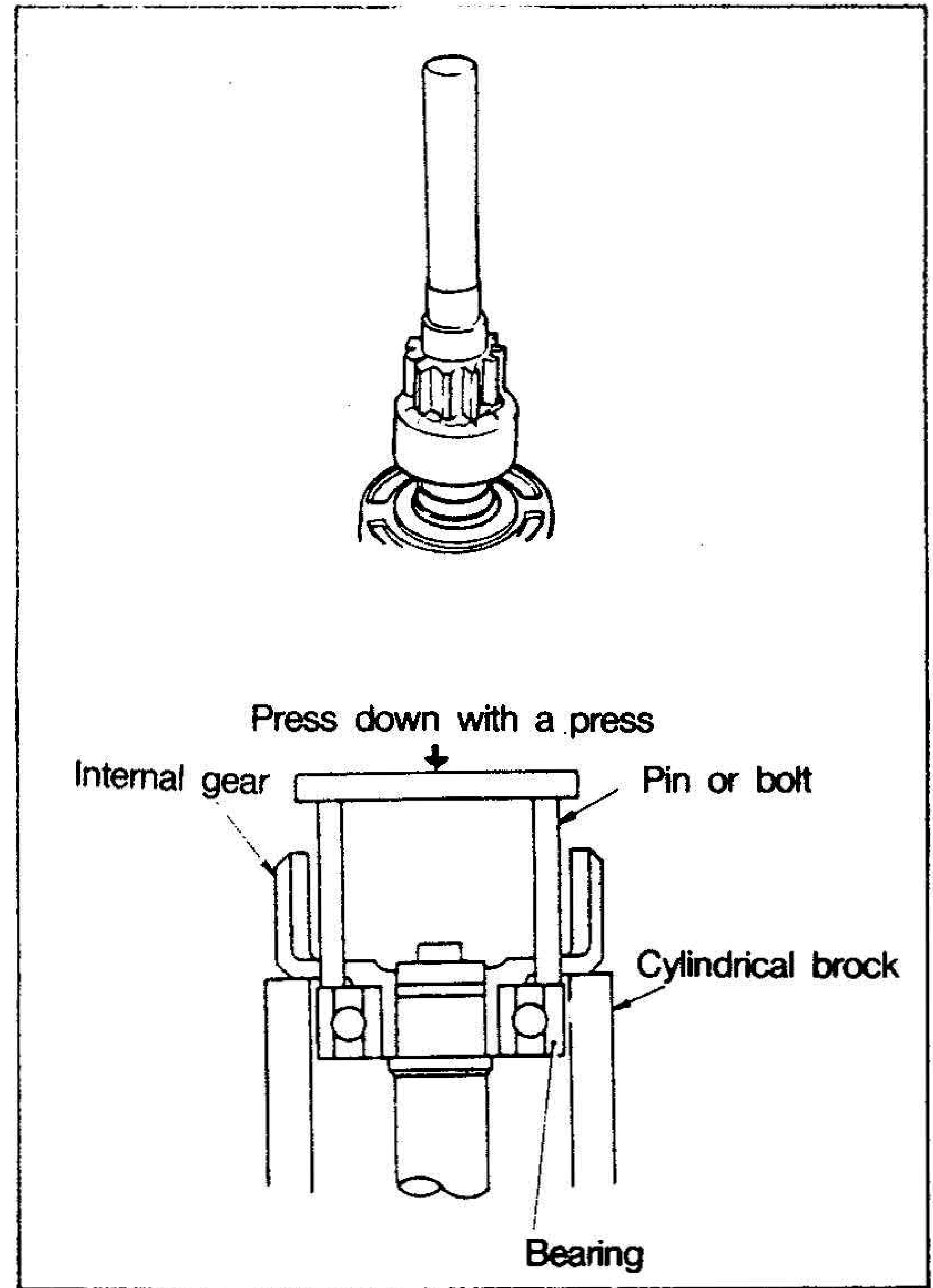
NOTE : 1. Do not remove the bearings located on each end of the armature unless defective.

2. To prevent misassembly, carefully confirm the assembly sequence and directions beforehand.

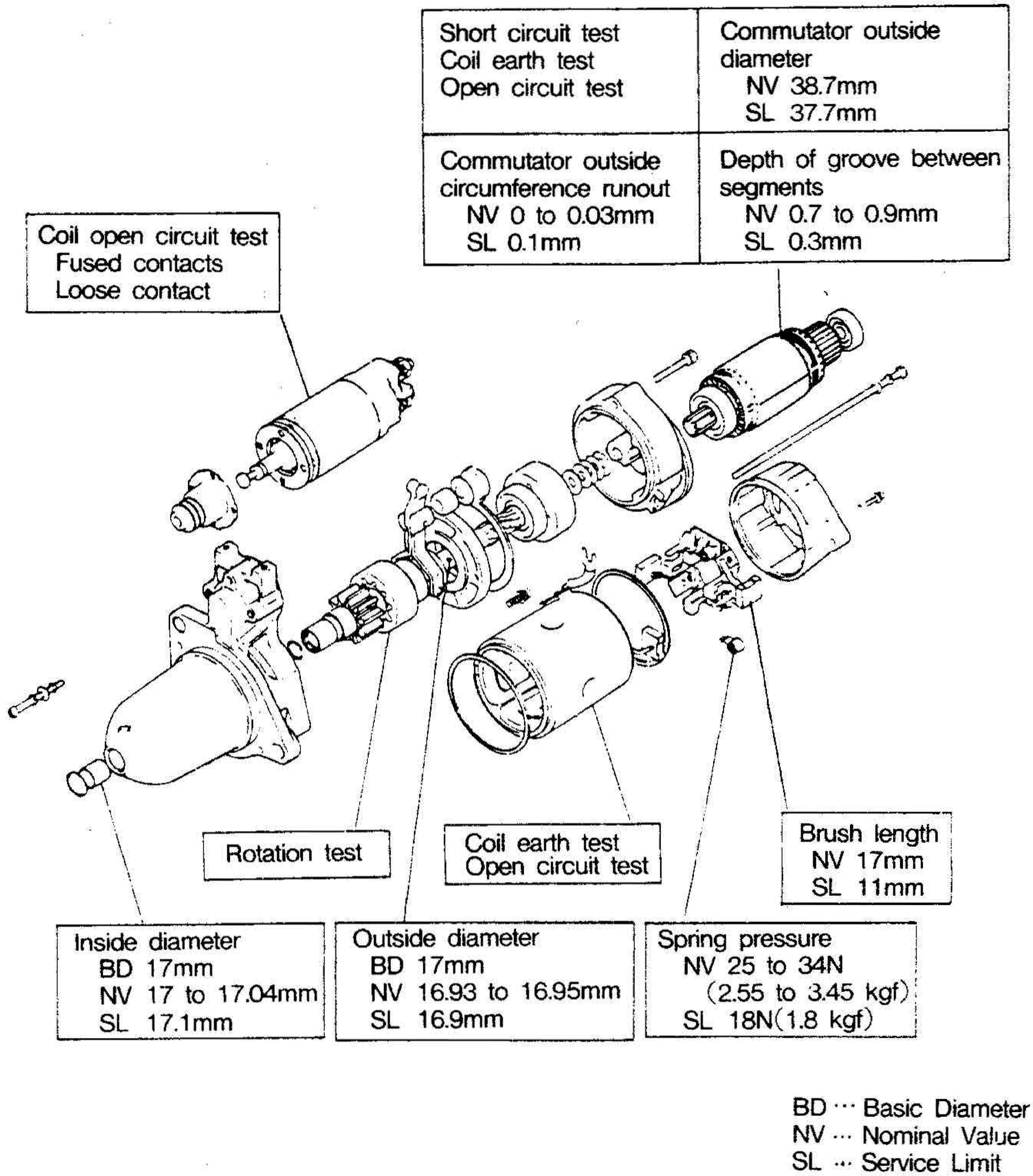
- (1) Hold a pipe-like tool on the pinion stopper and strike it with a hammer until the pinion stopper is loosened from the ring.

NOTE : If the pinion stopper cannot be removed, grind away the burr of the ring groove in the gear shaft.

- (2) If the bearing 25 of the gear shaft is defective, put a pin or bolt in each of the four holes(6mm in diameter) in the internal gear and press down the bearing out of position with a press.



(2) Inspection



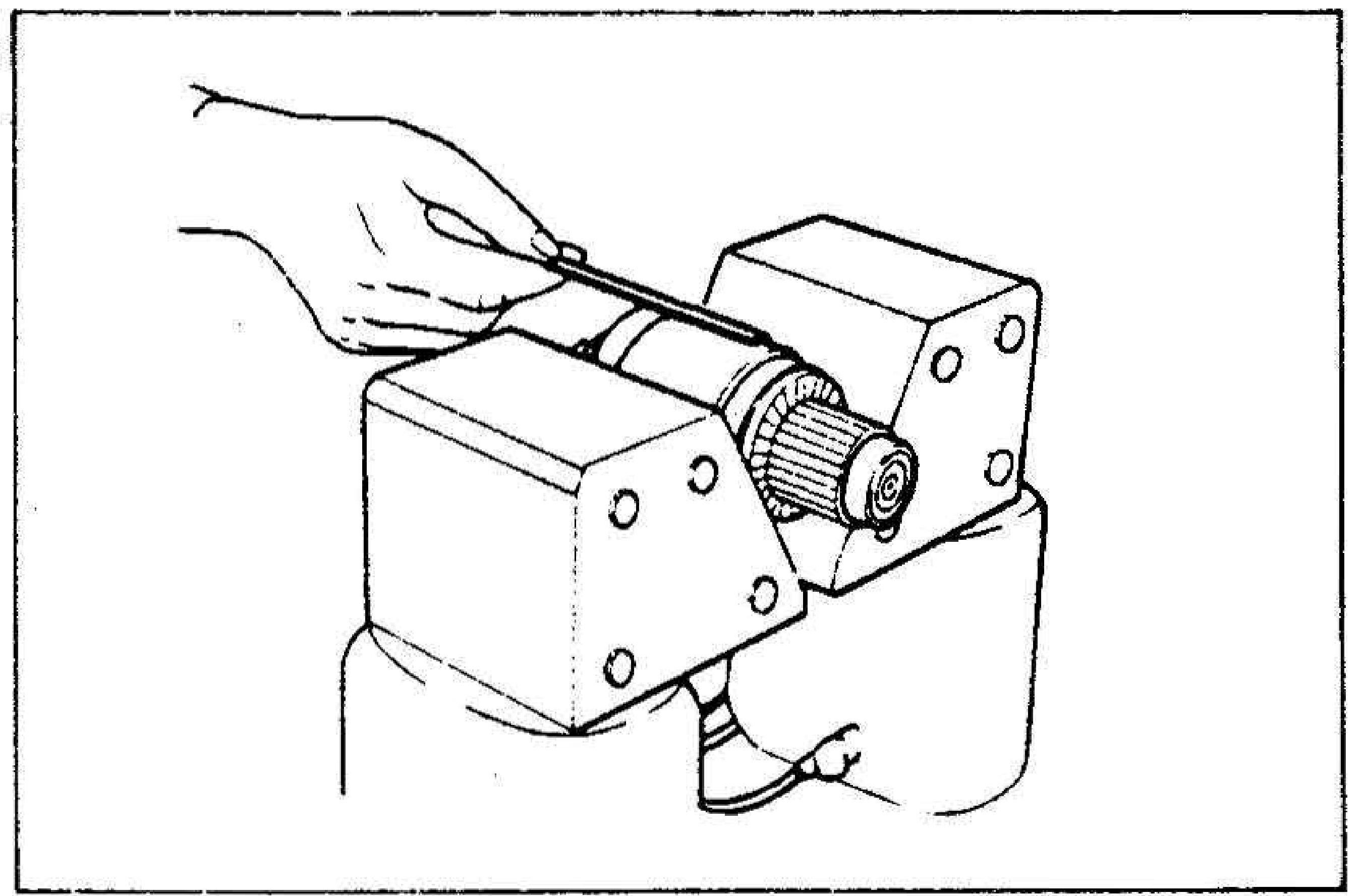
(a) Armature

1) Coil short circuit test

Place the armature on a growler tester.

Hold a piece of iron in parallel with the armature and slowly turn the armature by hand.

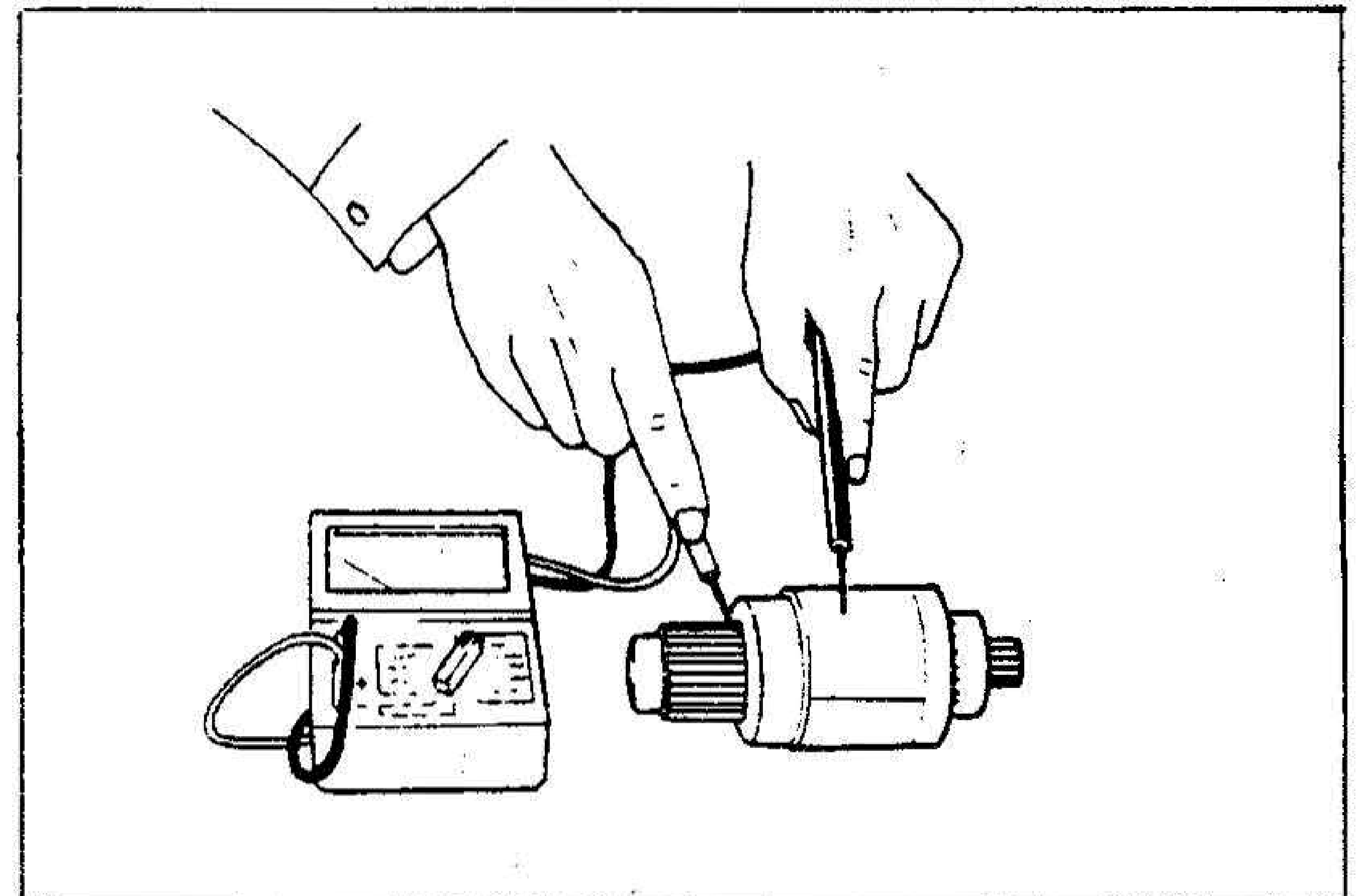
If the iron piece is attracted or vibrates, it means that there is a short circuit. Replace the armature.



2) Coil earth test

Check to ensure that there is no continuity between the commutator and core.

If there is a continuity, it means that the coil is earthed. Replace the armature.

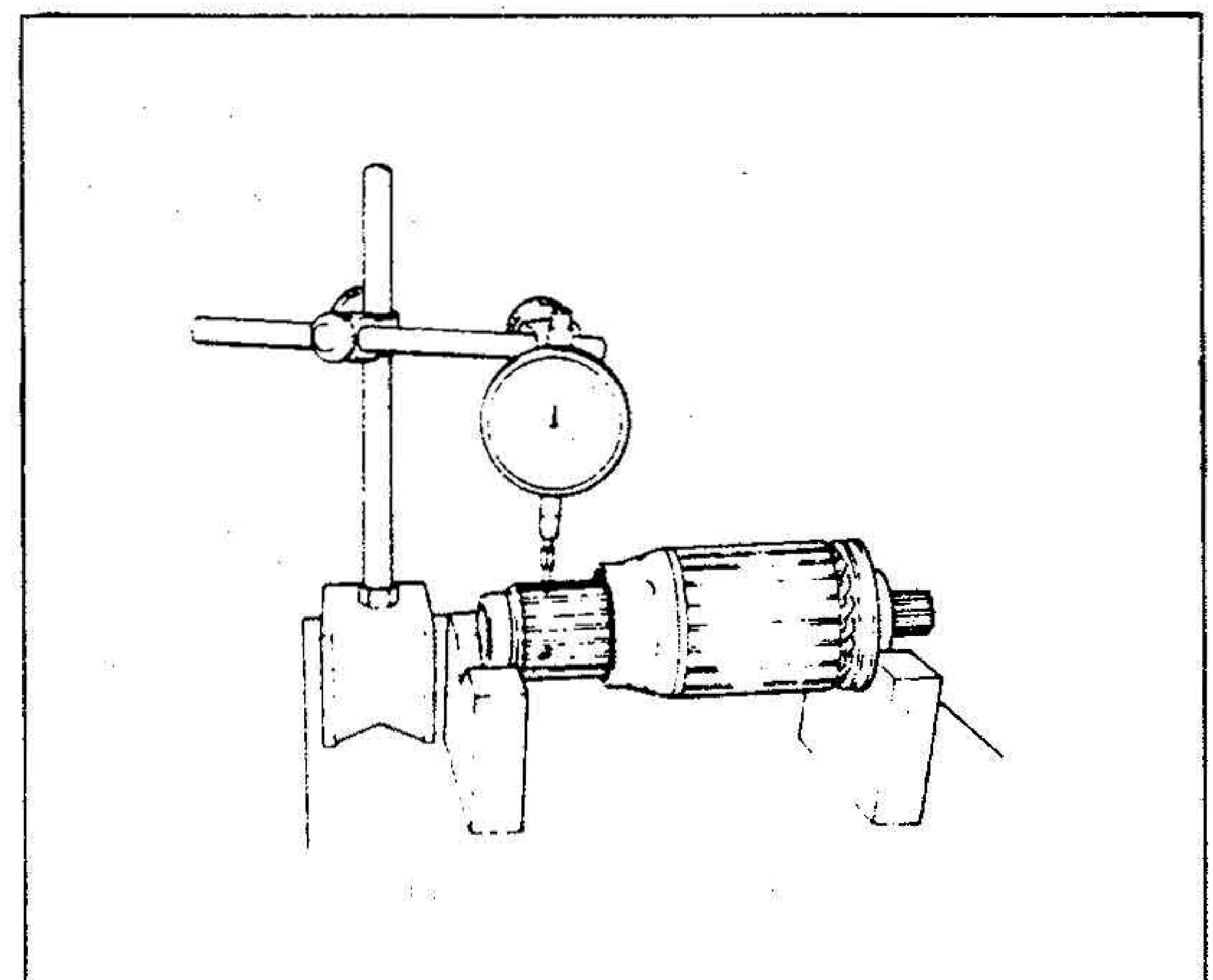


3) Inspection of commutator

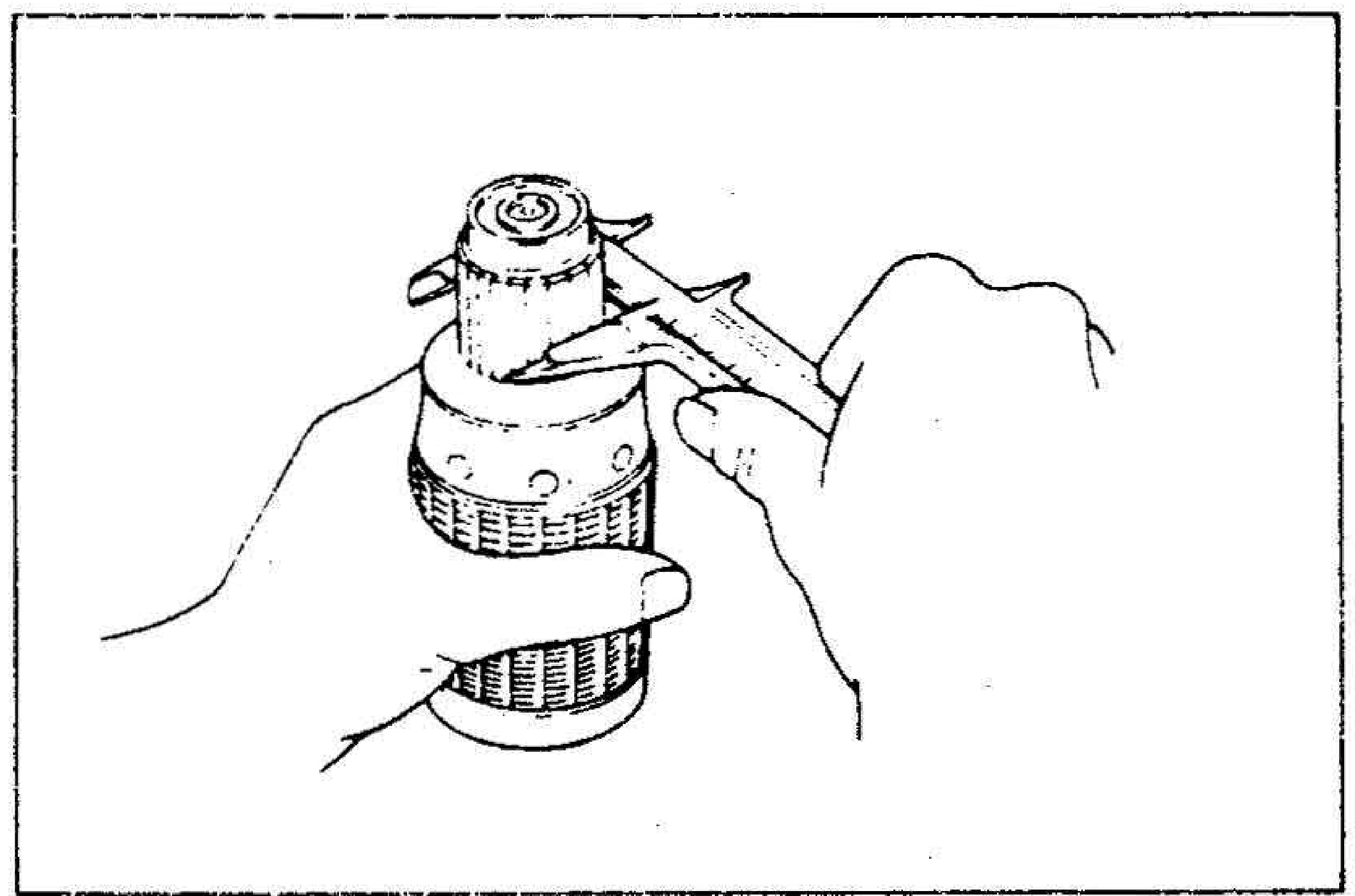
a) Measure the runout of the commutator with a dial gauge.

If the runout is in excess of the repair limit, correct, while making sure that the service limit of the outside diameter is not exceeded.

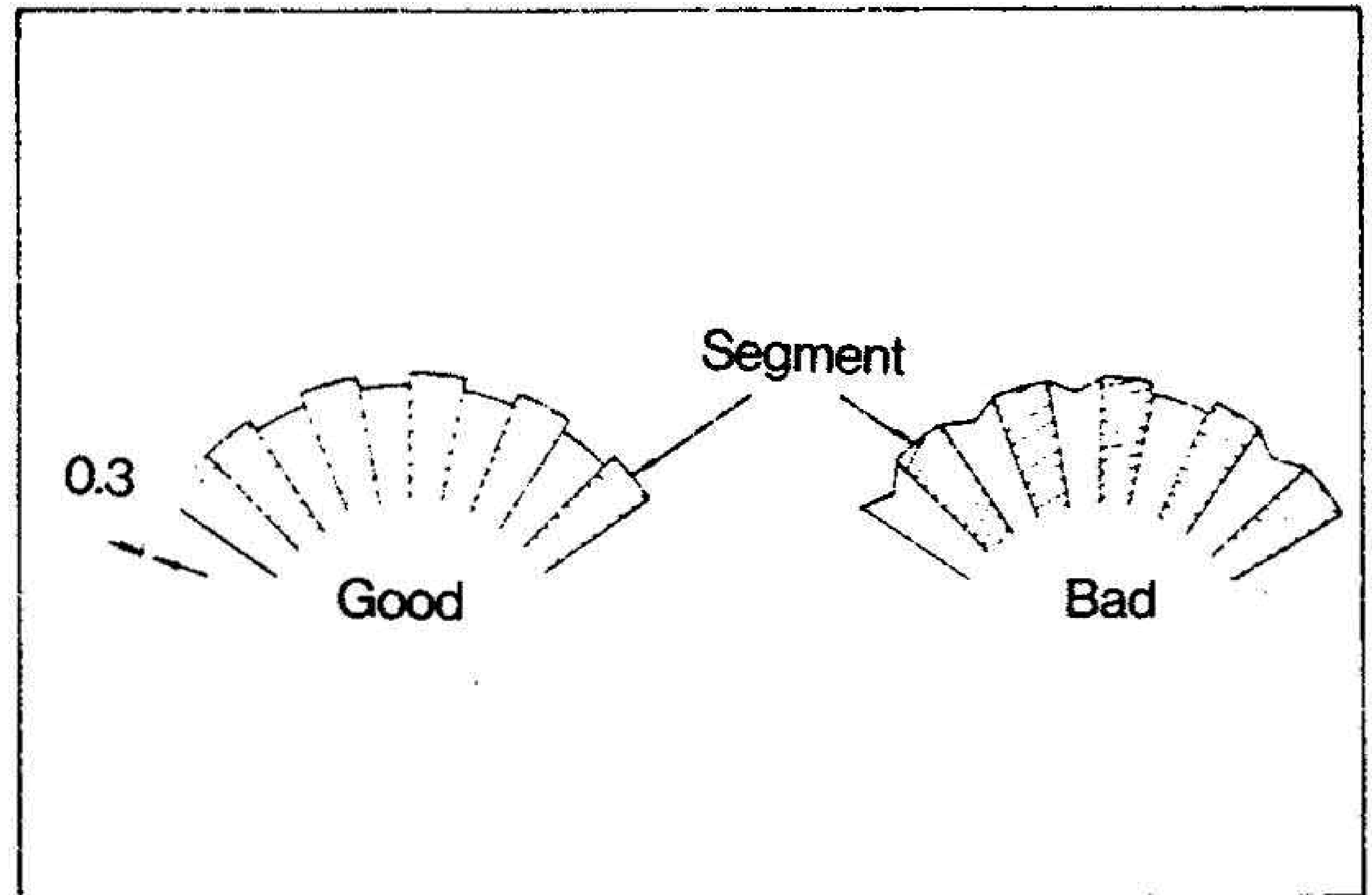
If the commutator surface is rough or shows ridge wear, correct with sandpaper (No. 300 to 500).



b) Measure the outside diameter of the commutator. If the outside diameter is less than the service limit, replace the armature.



c) Measure the depth of groove between segments. If the depth is less than the repair limit, correct.

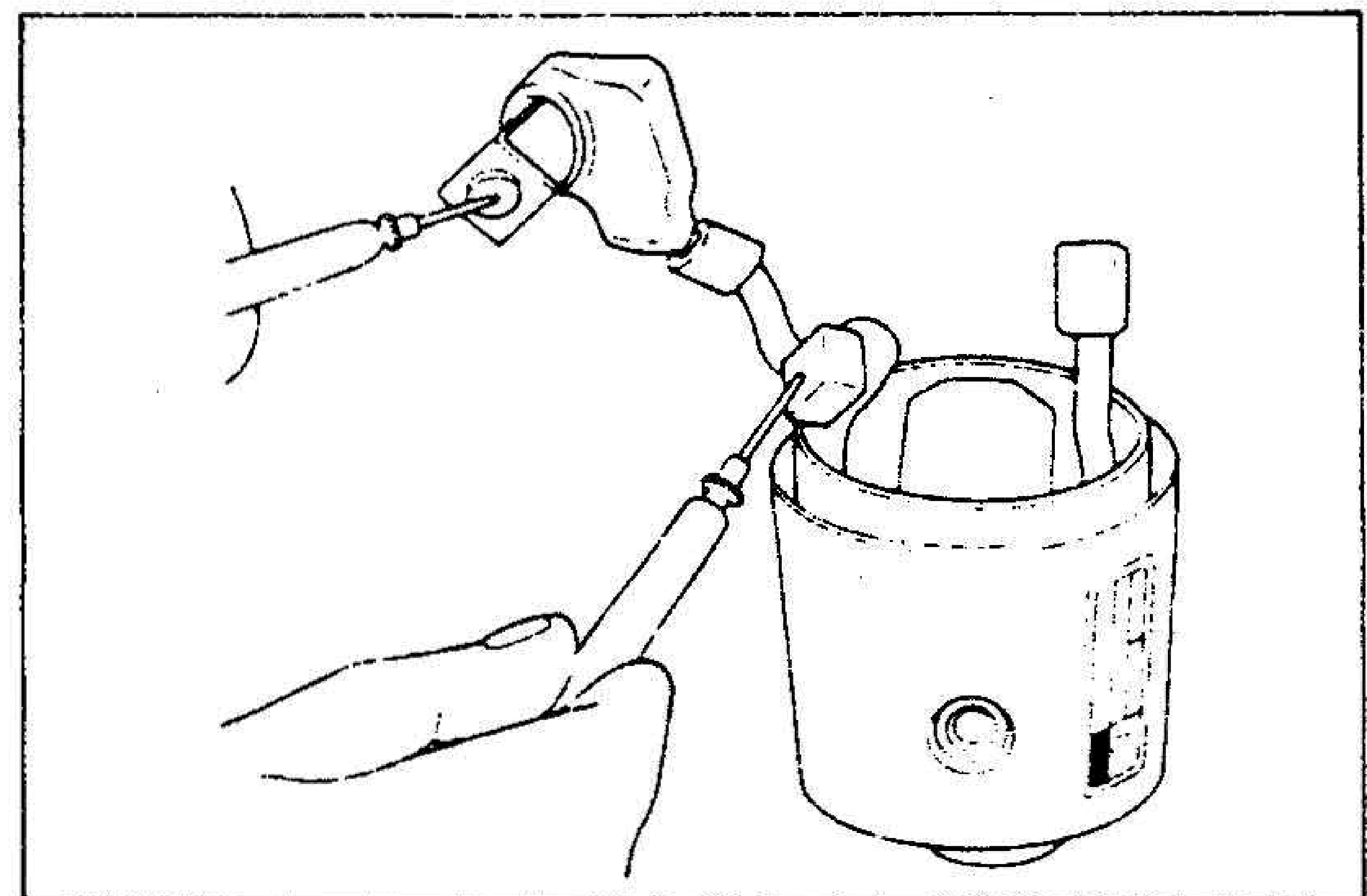


Field coil

1) Coil open circuit test

Check to ensure that there is continuity between the terminal lead and brush(+).

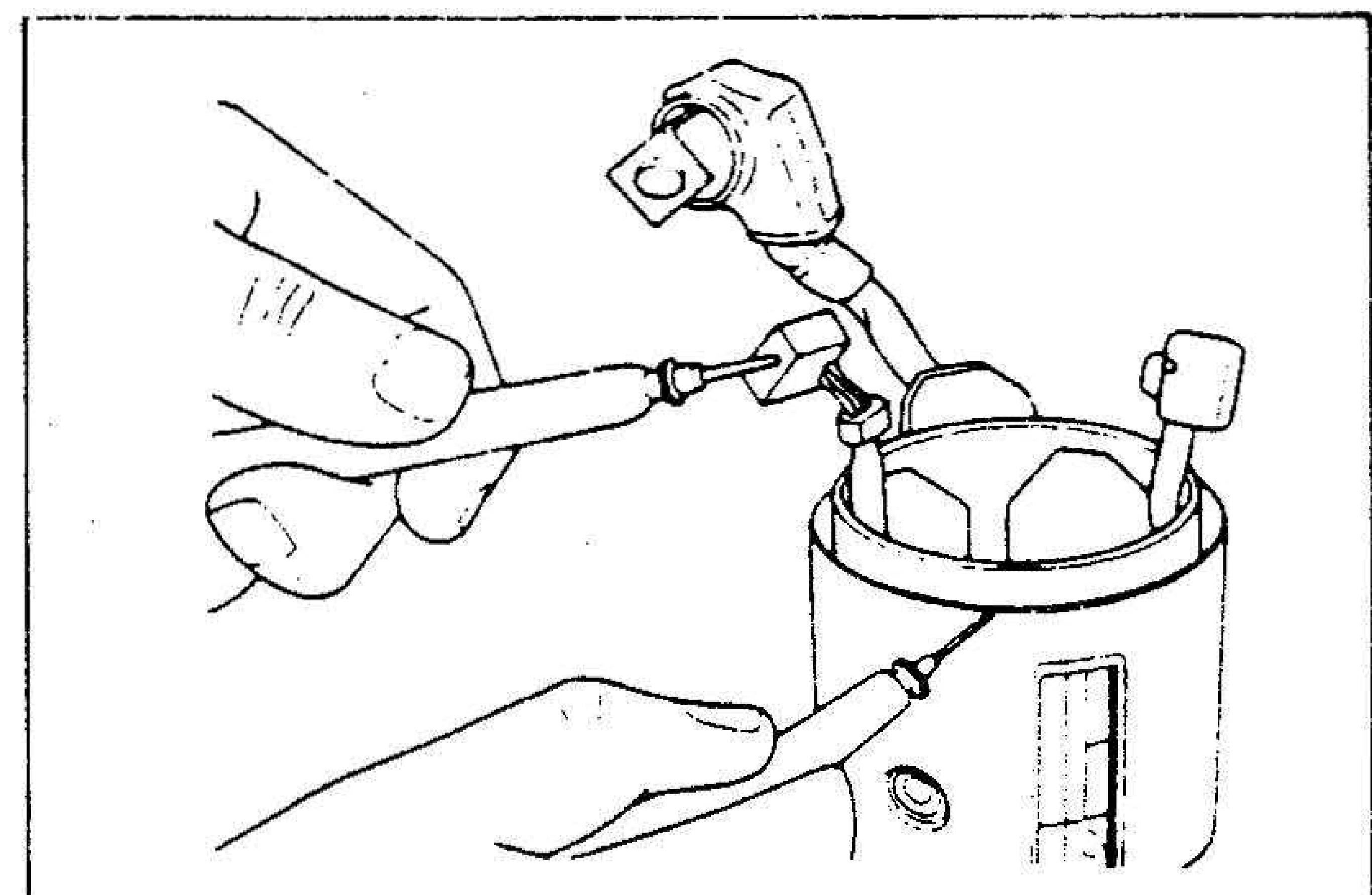
If there is no continuity, it means that there is an open circuit. Replace the yoke assembly.



2) Coil earth test

Check to ensure that there is no continuity between the yoke and brush(+).

If there is a continuity, the coil is earthed. Check for poor insulation. If correction is impossible, replace the yoke assembly.

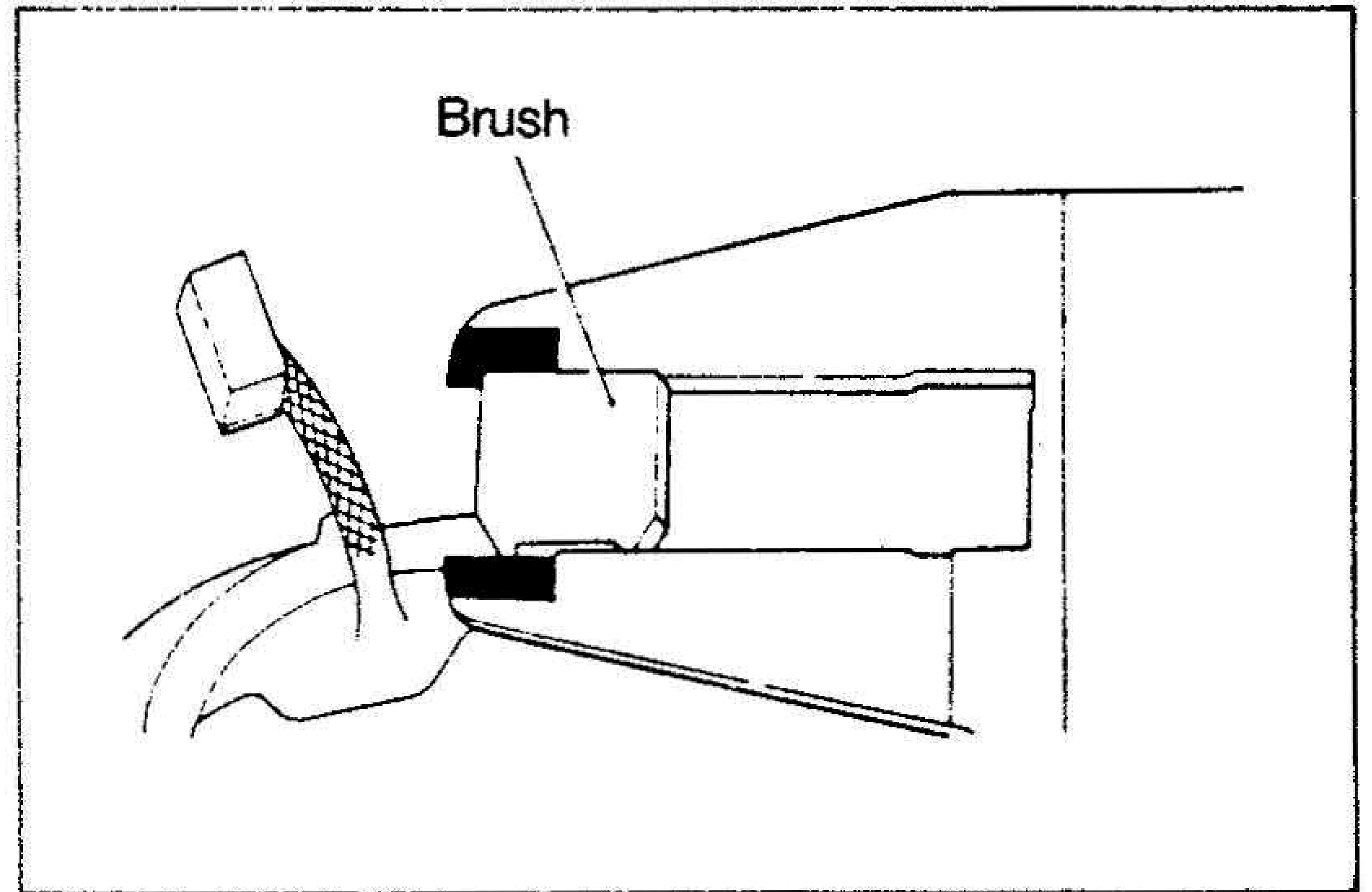


(c) Brush and brush holder

1) Wear of brush

Measure the length of brush. If the length is less than the service limit, replace the brush.

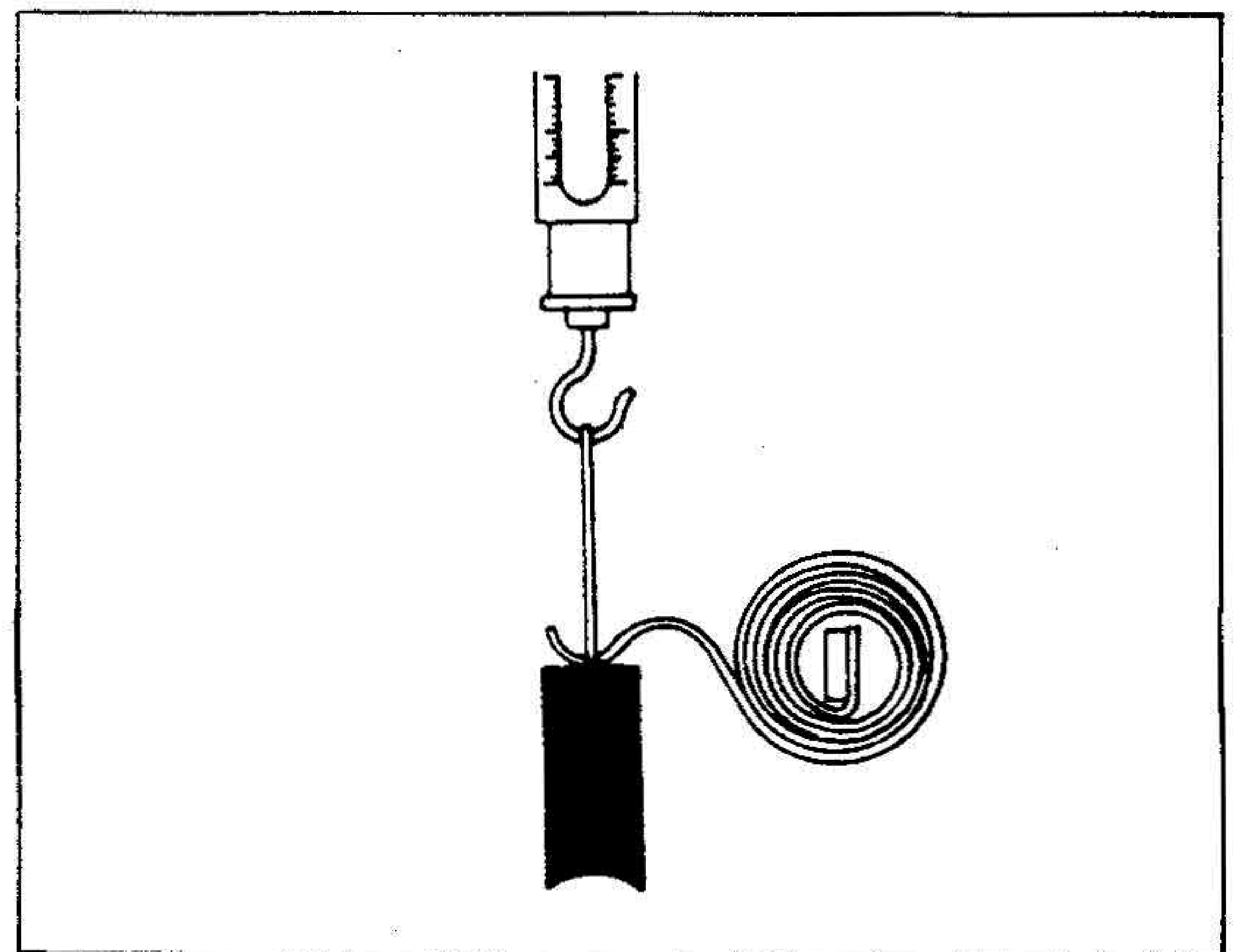
If the brush is unevenly worn or has a rough contacting surface, correct with sandpaper (No. 300 to 500).



2) Brush spring pressure

Measure the installed load of brush spring. Using a new brush, read the load at the moment the spring leaves the brush.

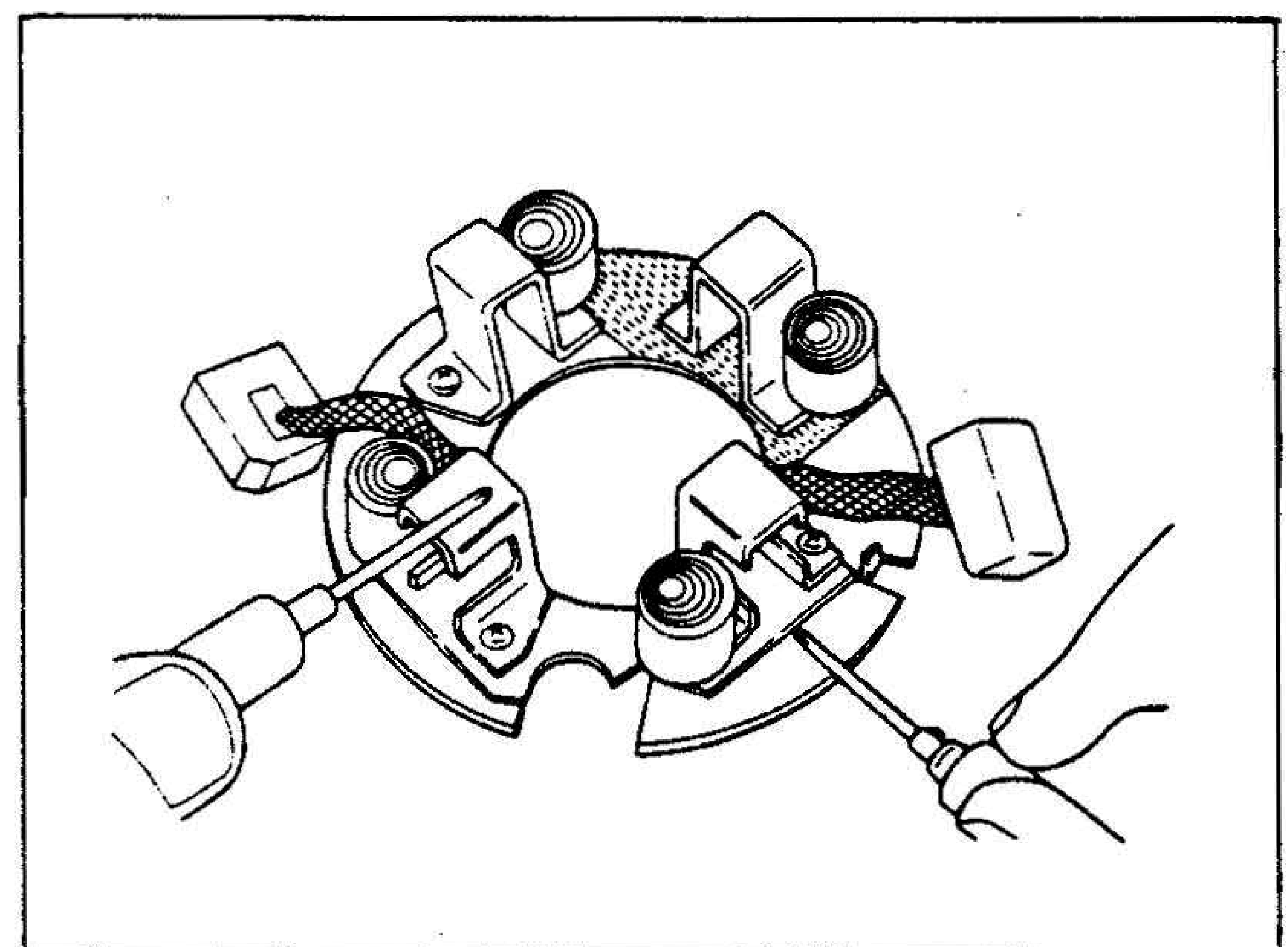
If the spring pressure is less than the service limit, replace the spring.



3) Brush holder insulation test

Check to ensure that there is no continuity between the (+) side brush holder and (-) side holder plate.

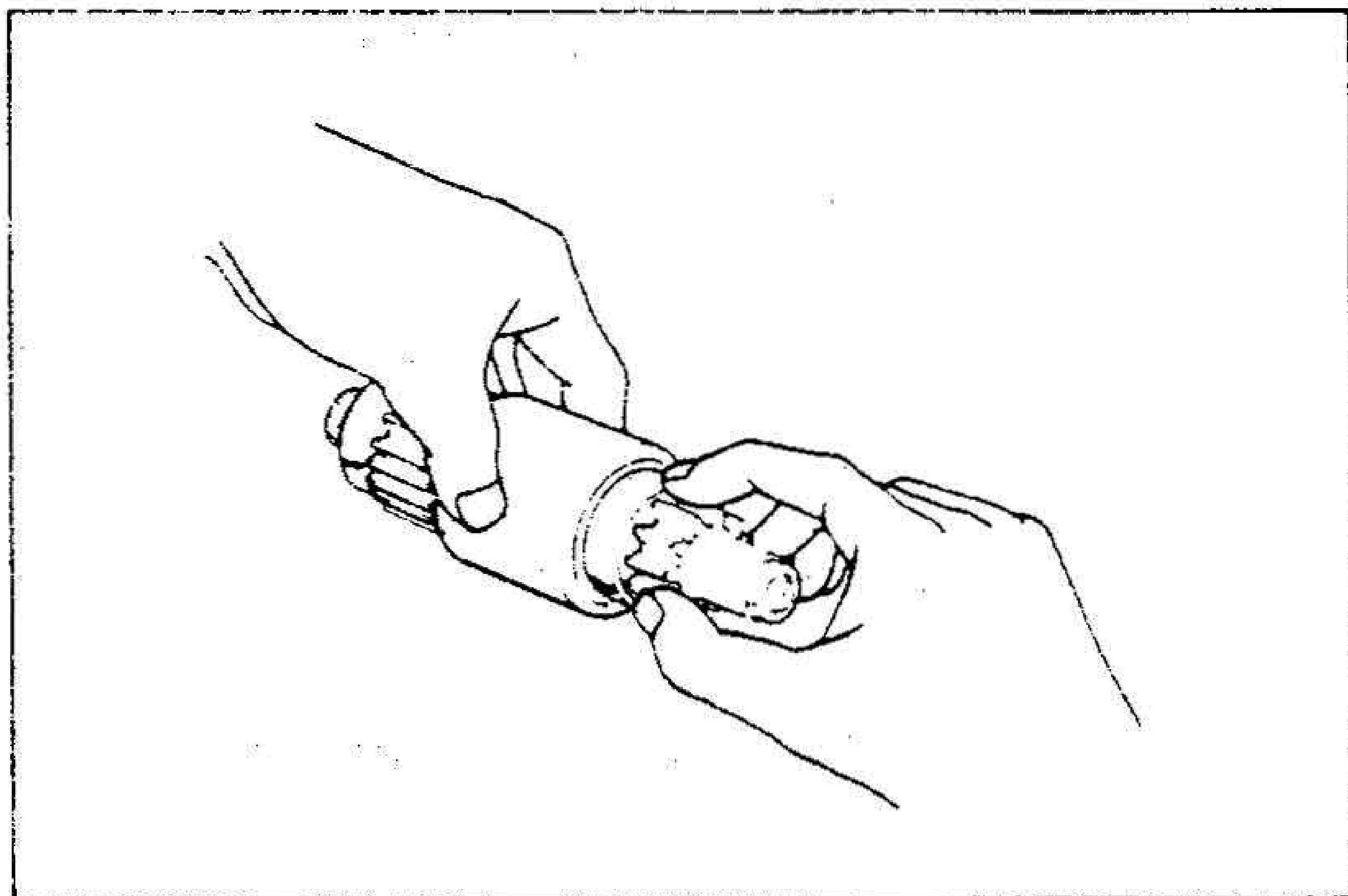
If there is a continuity, replace the brush holder.



(d) Overrunning clutch

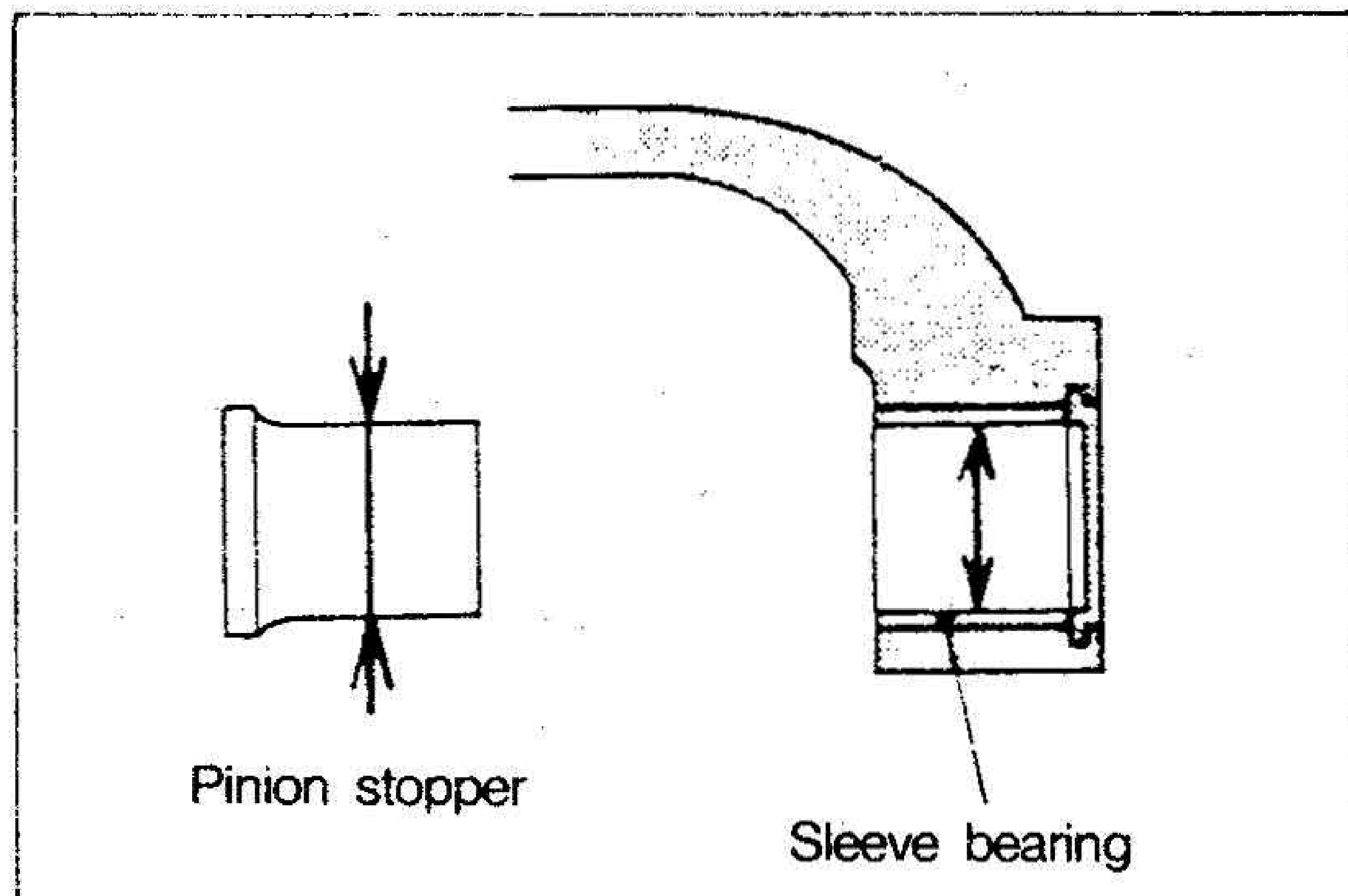
Check to ensure that the pinion rotates smoothly when turned in the drive direction (clockwise) and locks when turned in the opposite direction (counterclockwise).

If the pinion does not rotate properly, replace the overrunning clutch.



(e) Measure the outside diameter of gear shaft and the inside diameter of sleeve bearing in the front bracket.

If the readings are the service limits, replace.



(f) Magnet switch

Perform the following continuity tests. If defective, replace the magnet switch.

1) Coil open circuit test

Check to see that there is continuity between S and M terminals (resistance value 1Ω or less) and between the S terminals and earth (resistance value 2Ω or less).

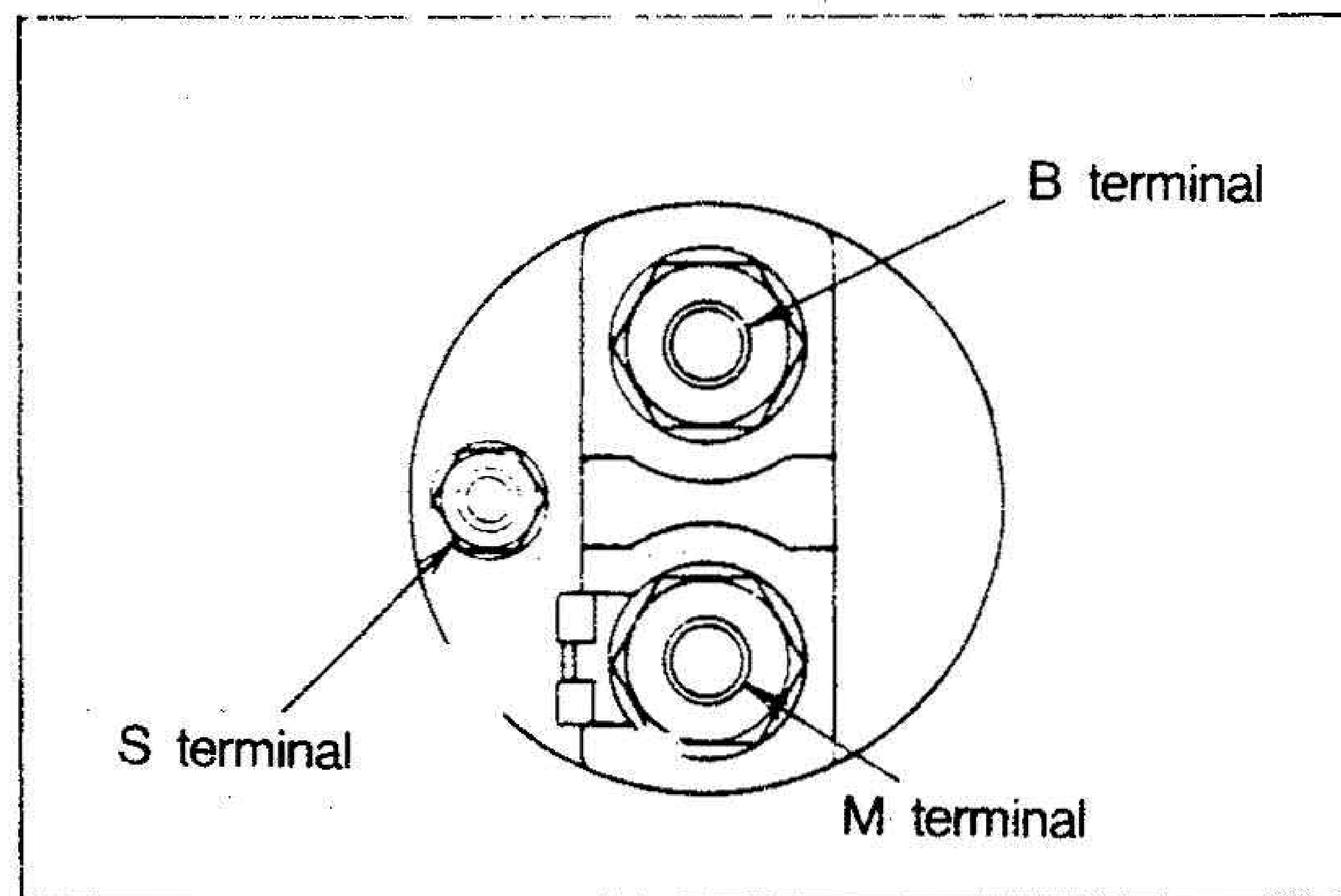
2) Melted contact check

Check to see that there is no continuity between B and M terminals.

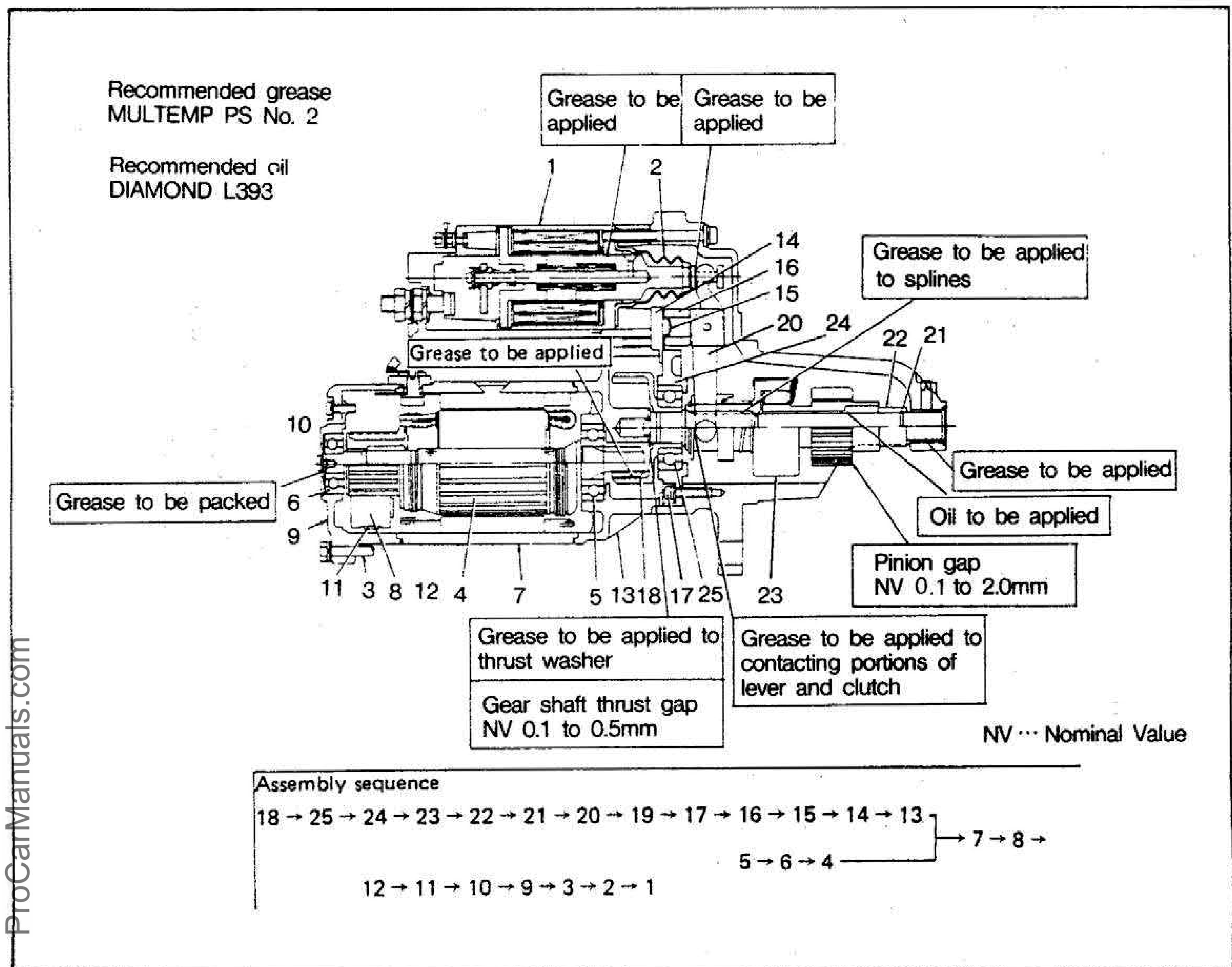
3) Loose contact check

Check to see that there is a little voltage drop across the contacts.

If there is a large voltage drop, the contacts are defective.



(3) Reassembly



NOTE : 1. When the lever is installed, pay attention to its installing direction.

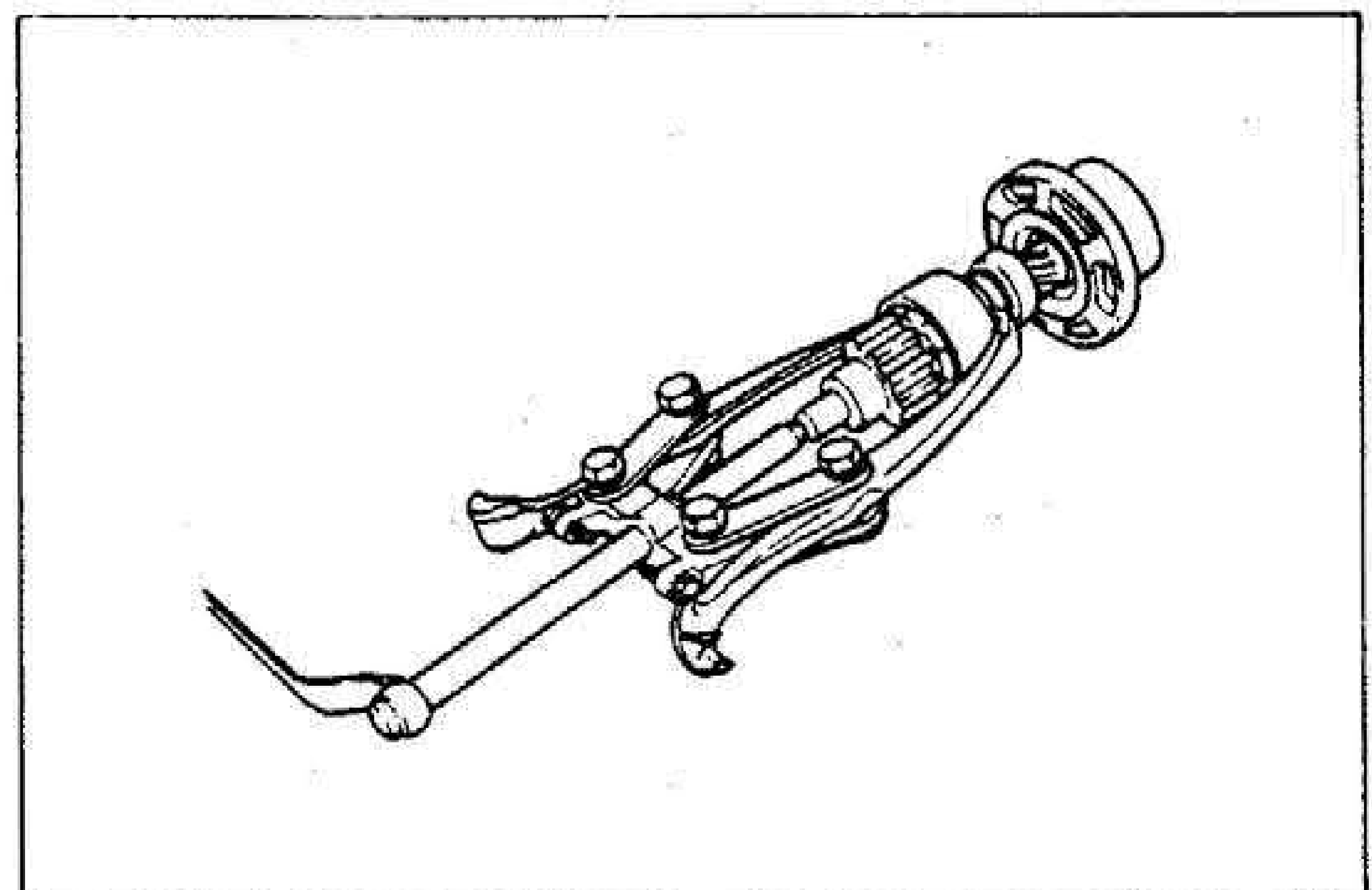
2. The yoke assembly and center bracket have a positioning notch and projection.

3. The armature thrust gap is a no-adjustment type.

(a) Install the following parts on the gear shaft 18.

- 25 Bearing
- 24 Gear bracket
- 23 Overrunning clutch
- 22 Pinion stopper
- 21 Ring

For installation of the pinion stopper and ring, install the pinion stopper, secure the ring in the ring groove



of the gear shaft, and then secure both by drawing the overrunning clutch tightly against them.

- (b) Choose adjusting washers to make sure that the thrust gap of the gear shaft falls within the nominal value, and install the packing 14, bearings 5 and 6 put together as an assembly, armature 4 and center bracket 13.

To measure the thrust gap, temporarily assemble the center bracket and determine the gap on the basis of a difference in the dimension A. Thickness of adjusting washers 0.2mm and 1.0mm

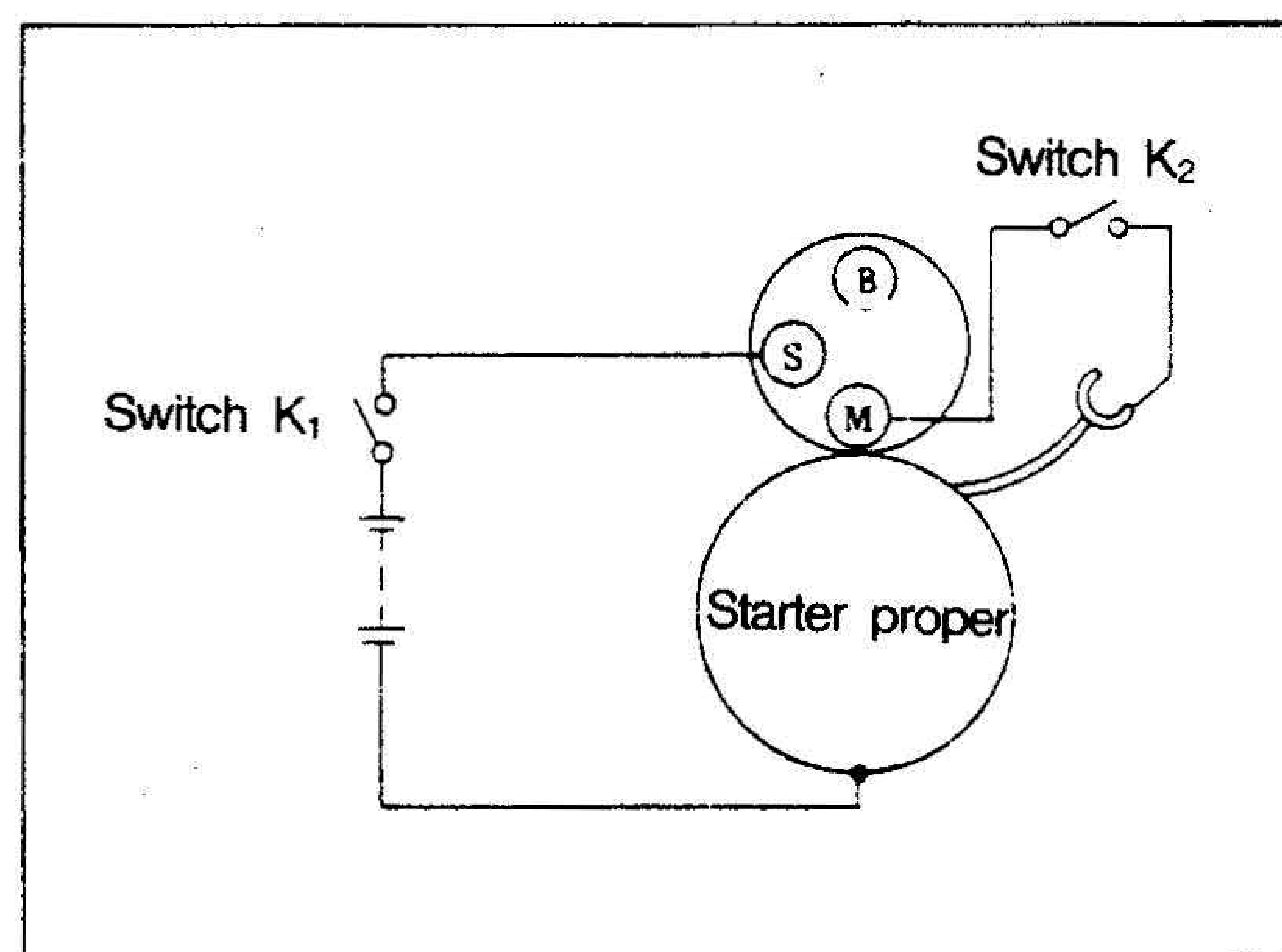
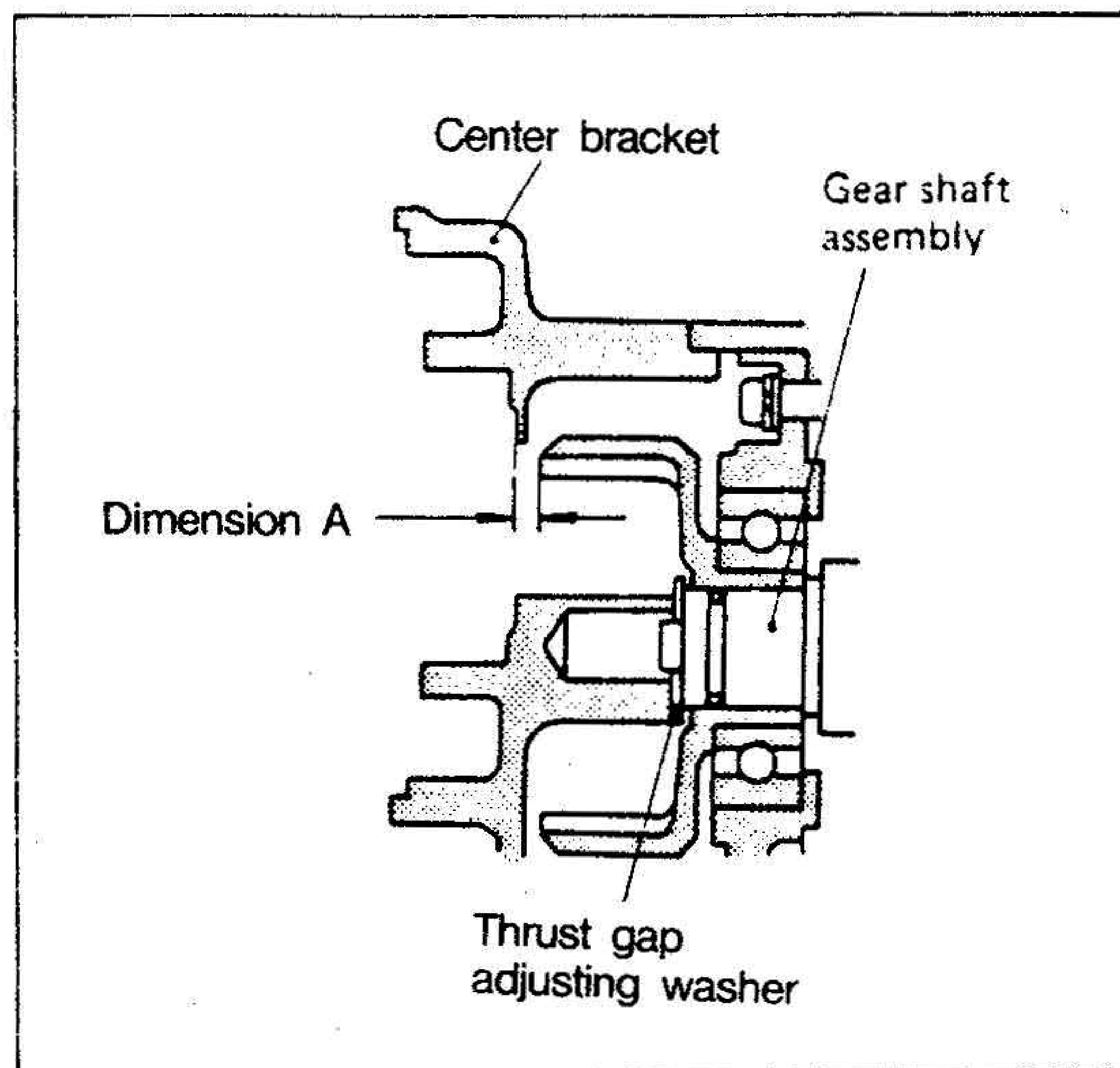
NOTE : If the thrust gap is measured with the packing installed, an accurate reading cannot be taken because of the elasticity of the packing.

- (c) Install the cover set 2 and magnet switch 1.

Measure the pinion gap and add or remove washers on the magnet switch assembly mounting surface so that the gap will conform to the nominal value.

To measure the pinion gap, make connections as shown in illustration at right.

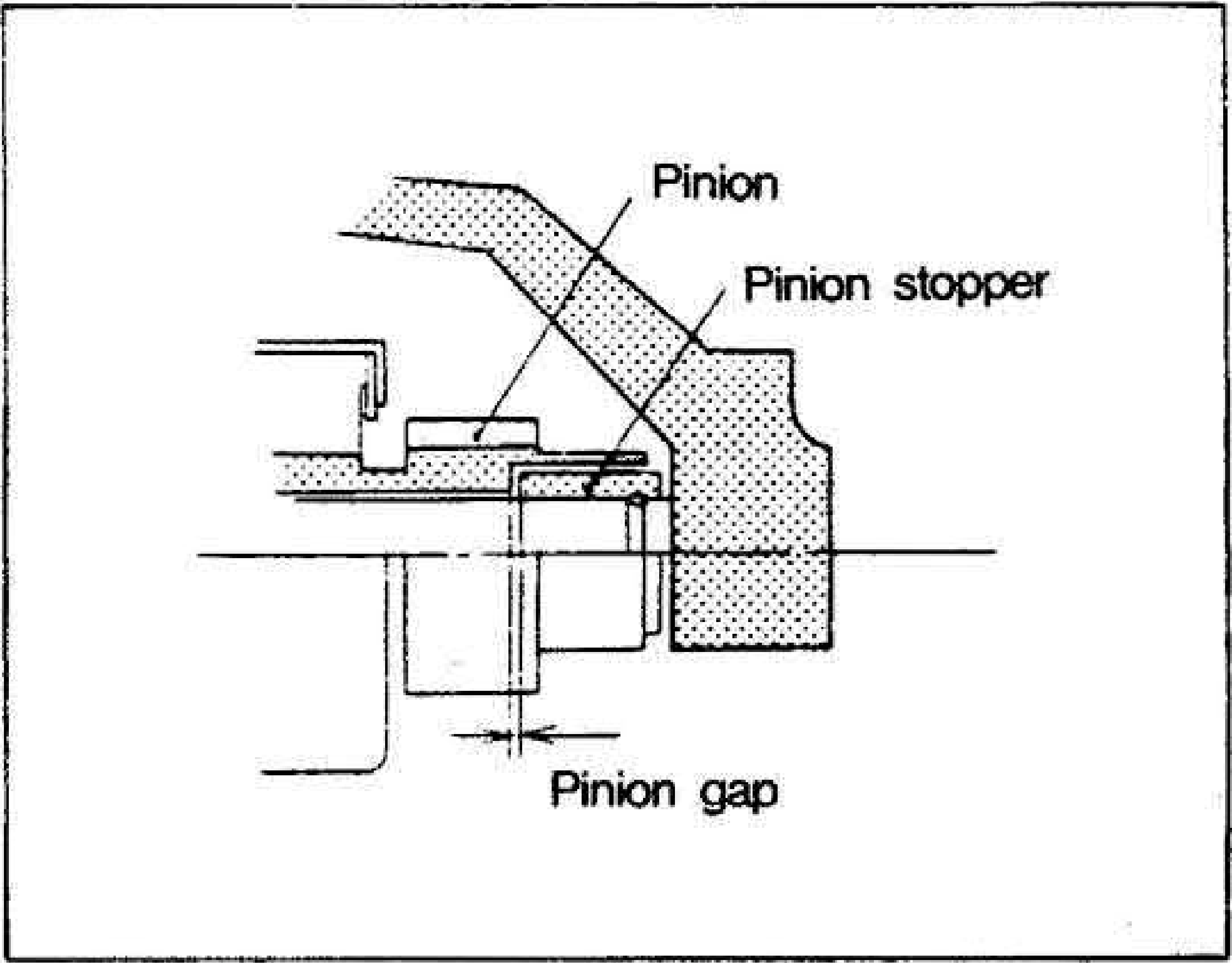
Close the switches K_1 and K_2 . If the



pinion comes out rotating, open the switch K_2 to stop rotation of the pinion.

In this condition, lightly push the pinion toward the armature, and the amount the pinion is moved in the axial direction is the pinion gap.

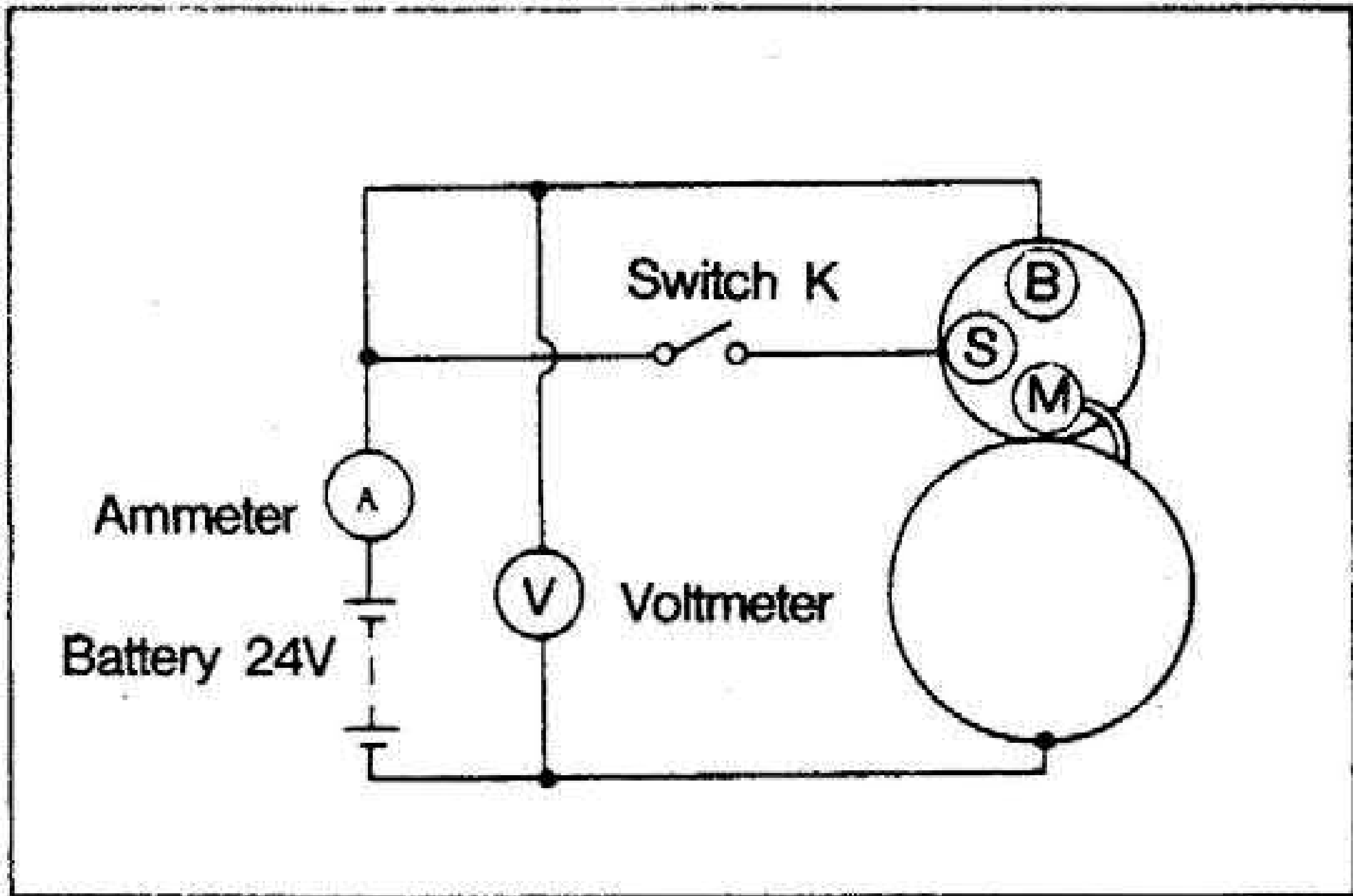
NOTE : 1. Do not close the switch K_2 for more than 30 seconds. If the switch is closed for a longer period, heat damage to the coil and lead could result.



2. The pinion is pushed by a spring in the direction that it moves out. Even if it is pushed back by hand, the pinion will return when released.

4) Test

No-load characteristics	Voltage	23V
	Current	110A or less
	Rotating speed	3100rpm or more
Bound characteristics	Voltage	8V
	Current	1400A or less
	Torque	98N(10kgf) or more
Magnet switch operating voltage		16V or less



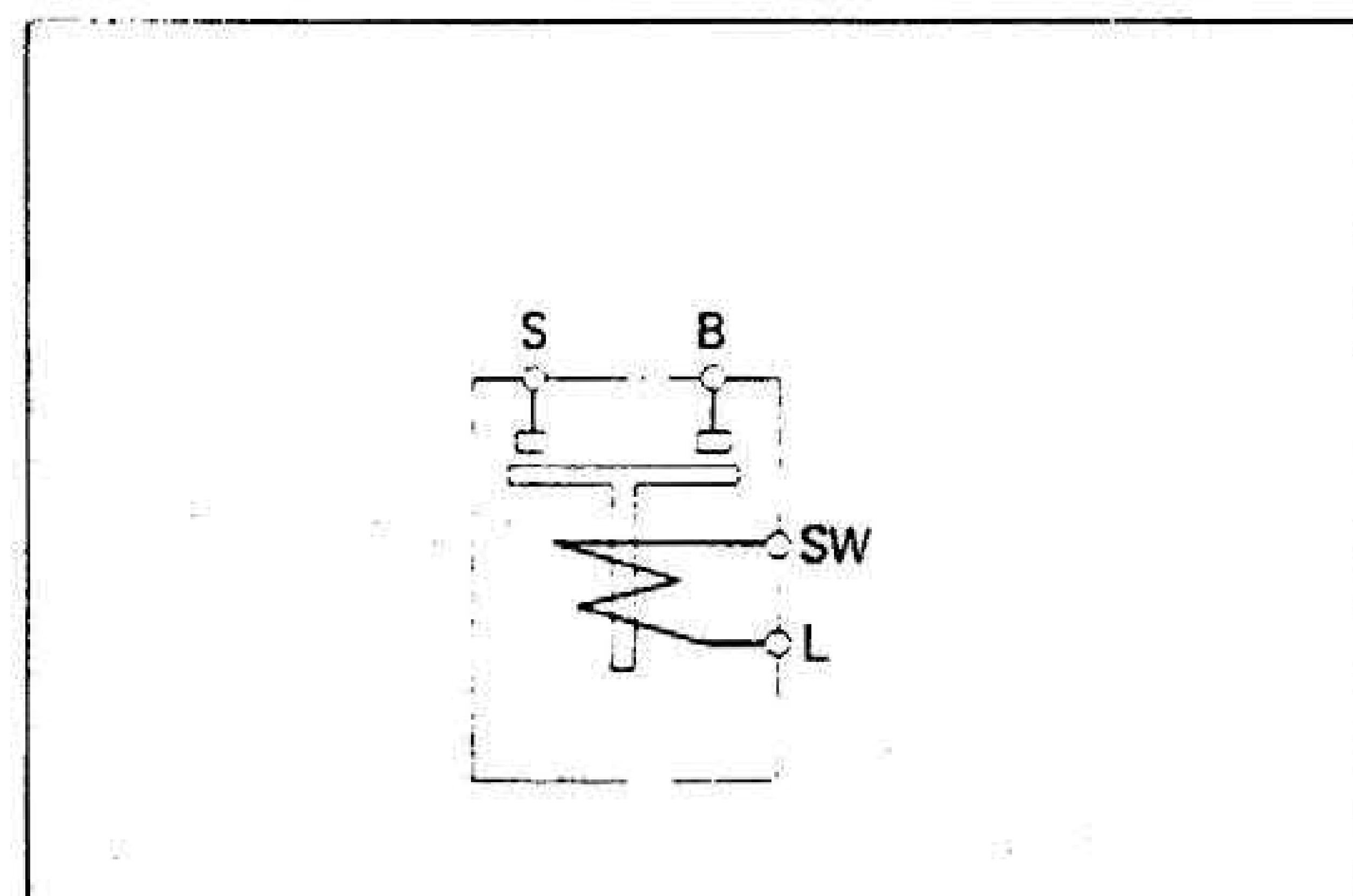
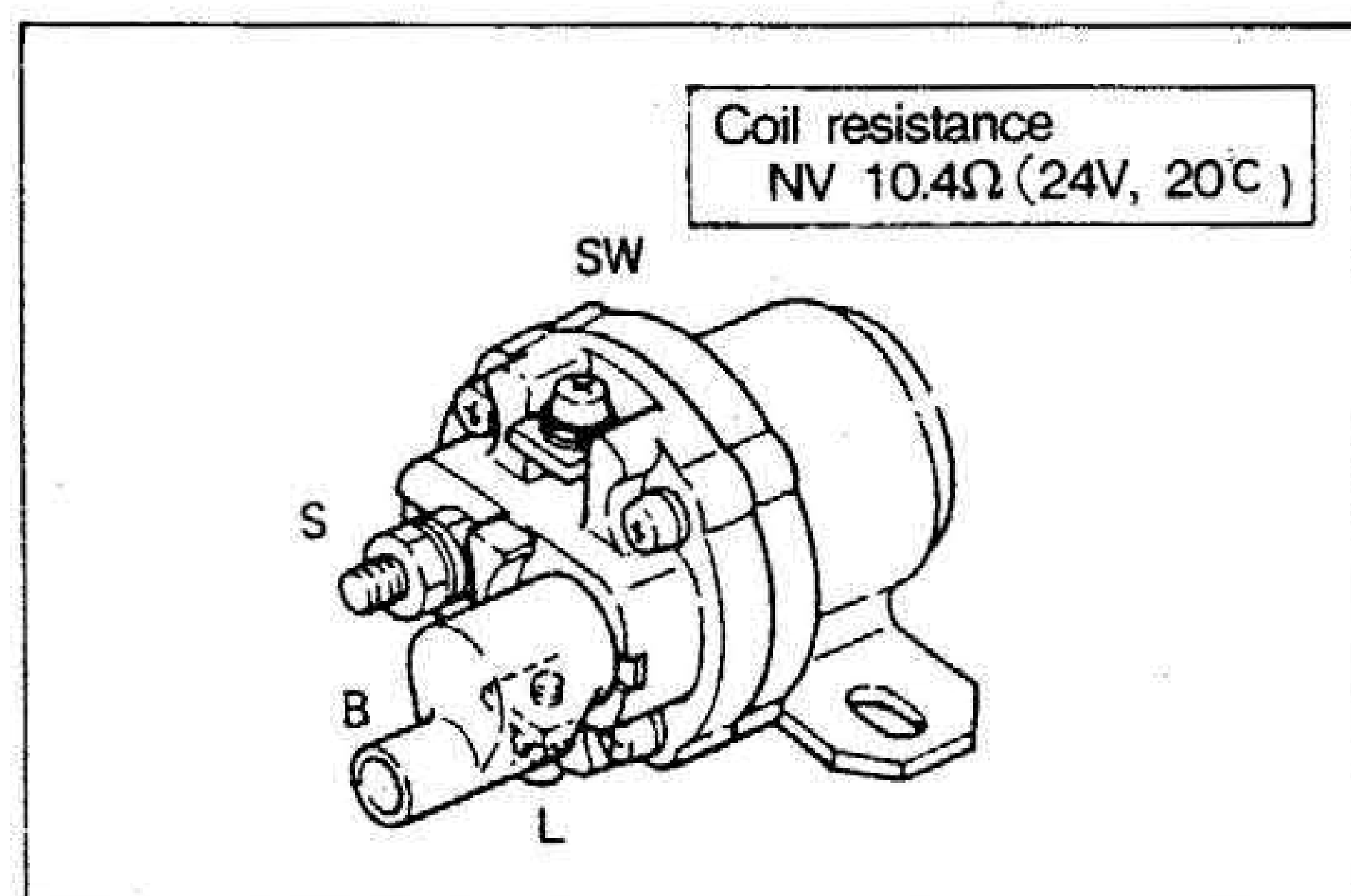
Large current flows but rotating speed is low. (No torque)	(1) Sleeve bearing and ball bearing short of oil or contaminated (2) Armature and yoke pole portion rubbing (3) Armature coil and yoke field coil earthed (4) Armature coil short-circuited
Large current flows but no rotation occurs.	(1) Magnet switch earthed (2) Armature coil and yoke field coil earthed (3) Sleeve bearing and ball bearing seized
No current flows and no rotation occurs.	(1) Open circuit in armature coil and yoke field coil (2) Open circuit in brush (3) Commutator contaminated or in loose contact due to high mica, etc.
Small current flows and rotating speed is low.	Contacting portions of yoke field coil in loose contact
Large current flows and rotating speed is high.	Short circuit in yoke field coil

NOTE : 1. Use as thick wires as possible for wiring and tighten all terminals firmly.

2. Since the starter has a built-in reduction gear, it produces high rotating sound at no load.
3. If the starter is operated for a long period, the battery will run down and the rotating speed will fall. Operate the starter for 10 to 15 seconds and stop it for 10 to 15 seconds, and thereafter repeat this sequence.

12-2 STARTER RELAY

- (1) Check for continuity between the "SW" and "L" terminals and check to ensure that the coil resistance is up to specification.
- (2) Check to ensure that when the battery voltage(24V) is applied across the "SW" and "L" terminals, there is continuity between the "B" and "S" terminals.

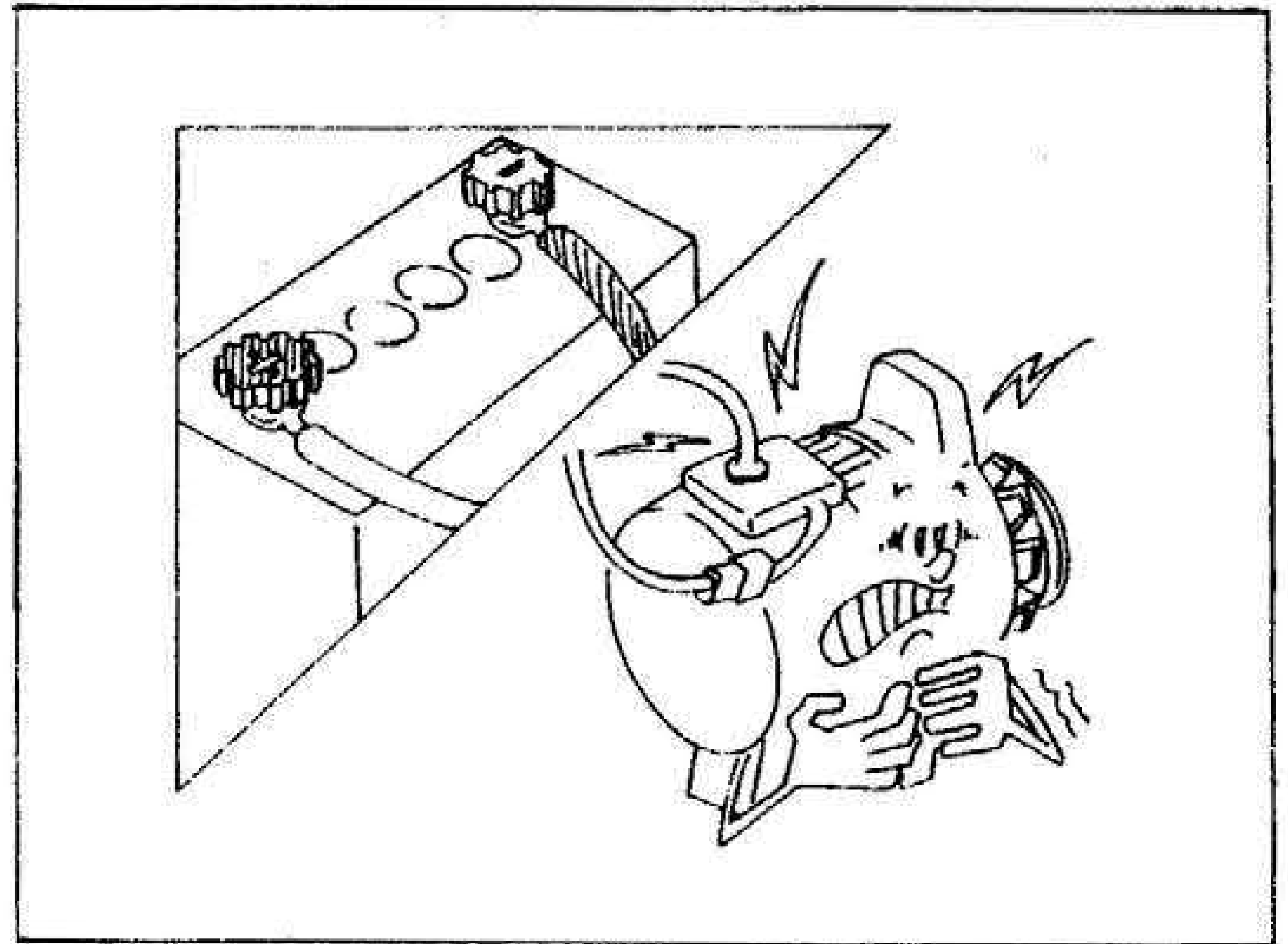


12-3 ALTERNATOR

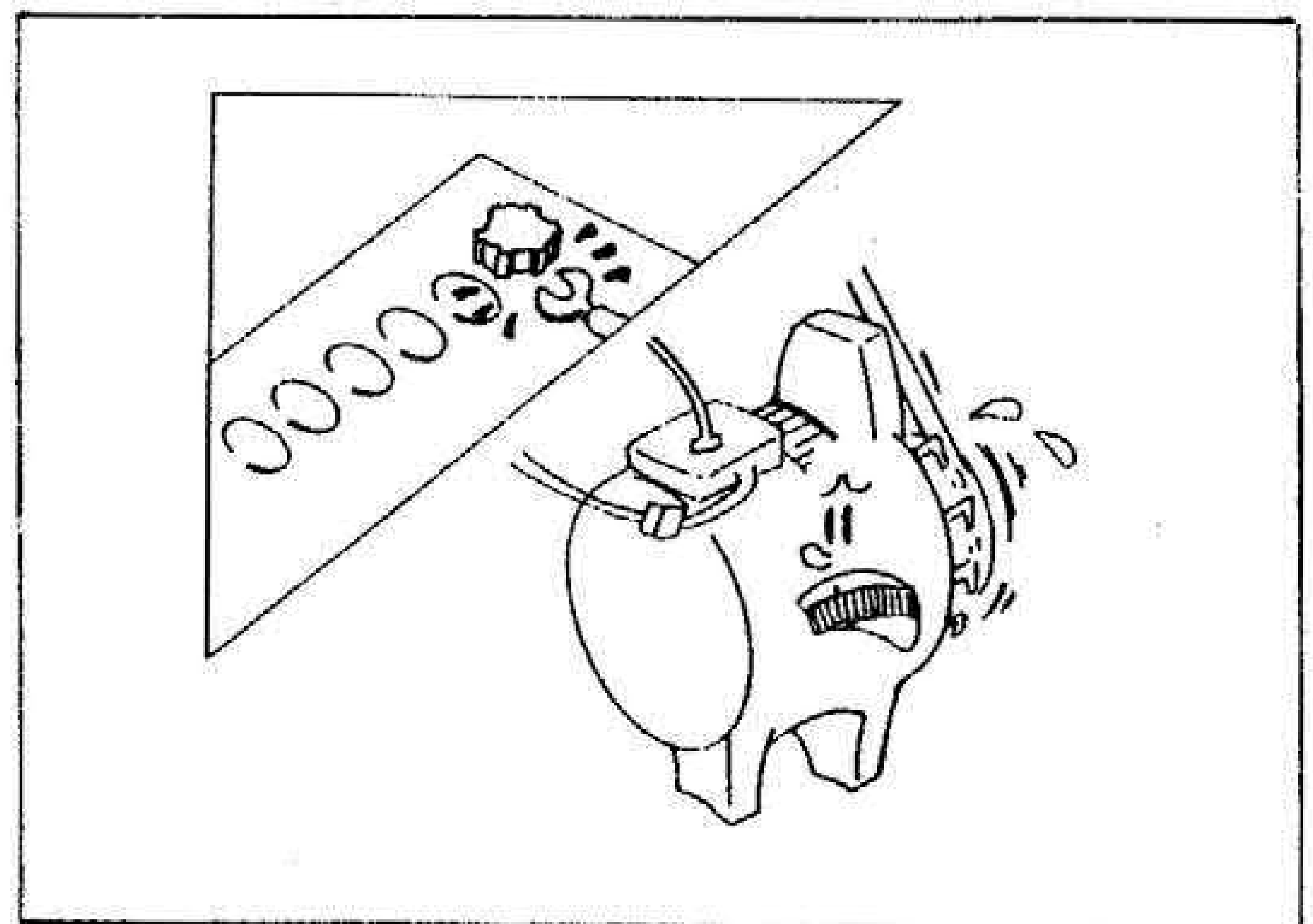
12-3-1 Alternator Handling Precautions

When servicing the alternator, pay attention to the following.

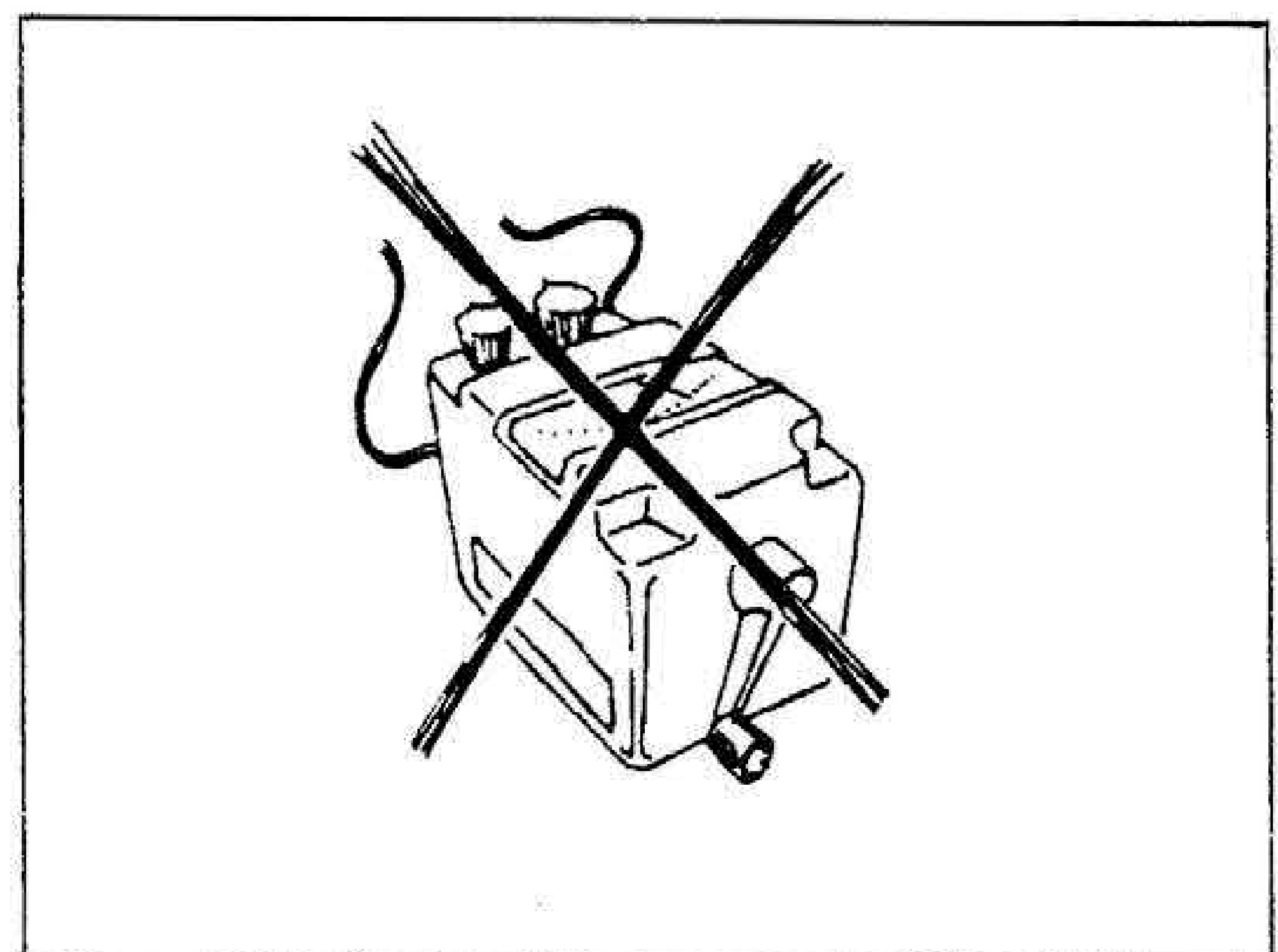
- (1) If the polarity of the battery is reversed when connections are made, large current will flow from the battery to the alternator, causing damage to the diode and the IC regulator.



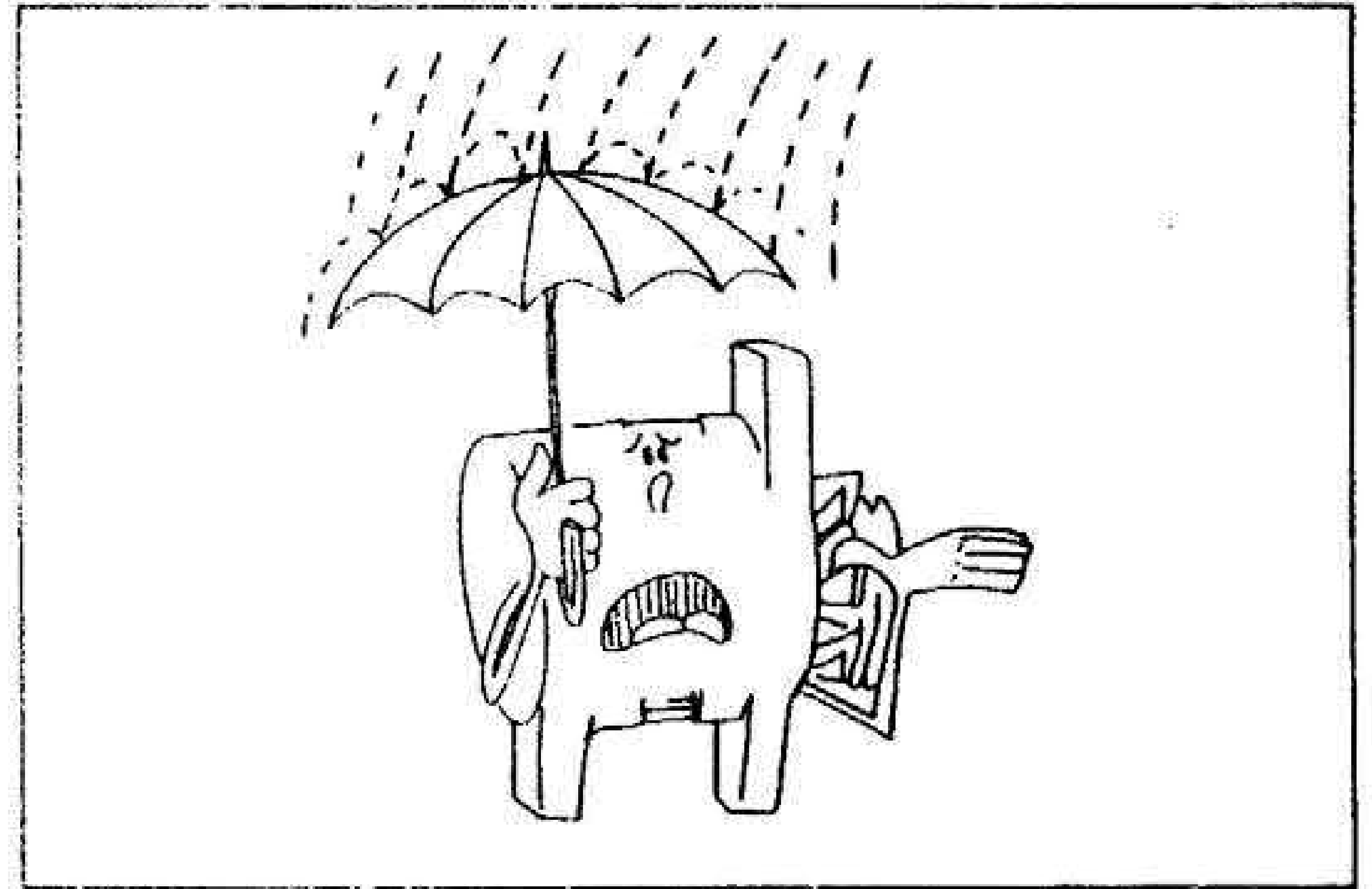
- (2) Do not disconnect the battery terminal connections while the engine is running. Otherwise, a surge voltage will be generated, causing deterioration of the diode and the regulator.



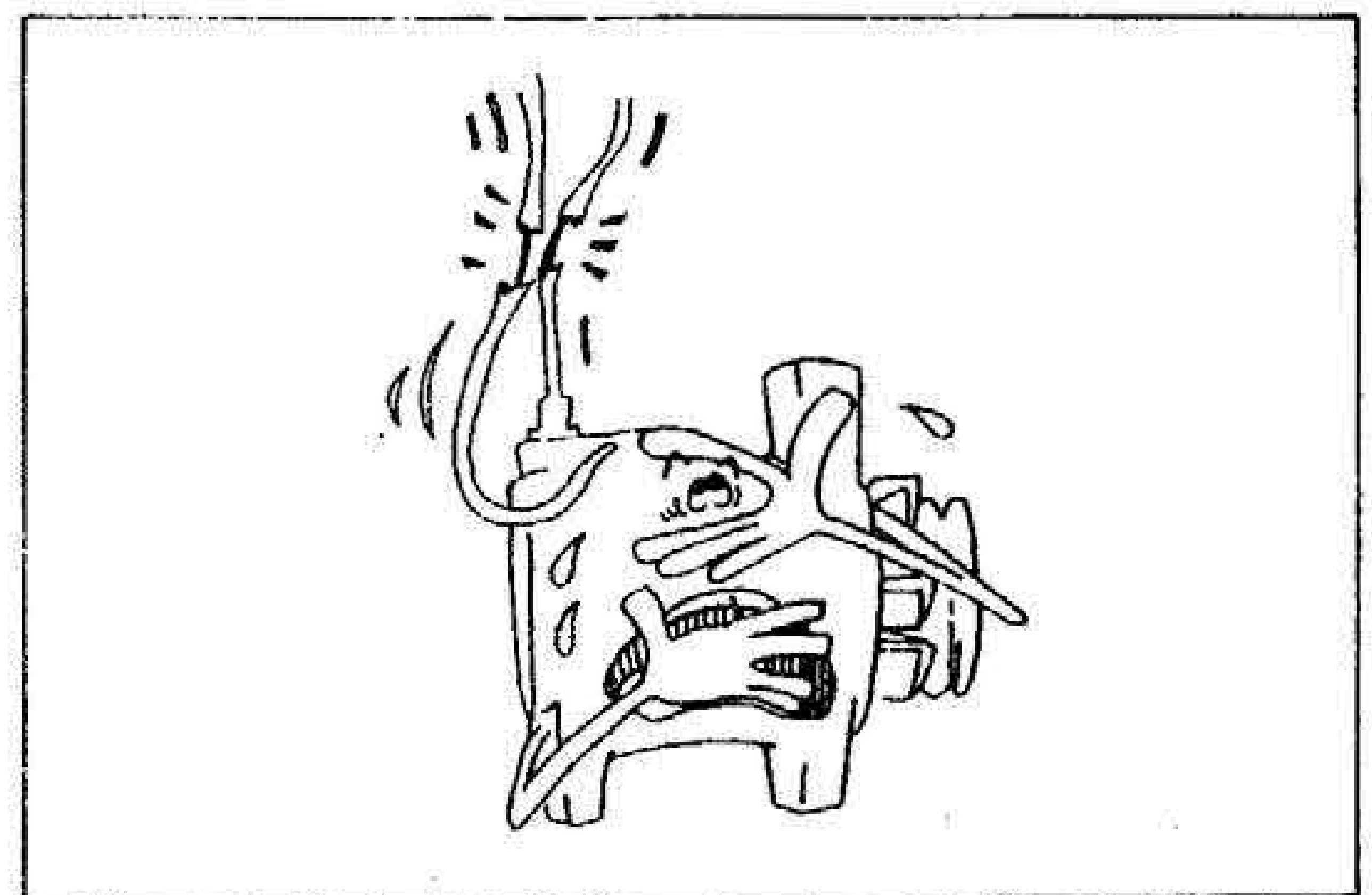
- (3) Do not use a high voltage tester such as megger to test the alternator as it could cause damage to the diode and the regulator.



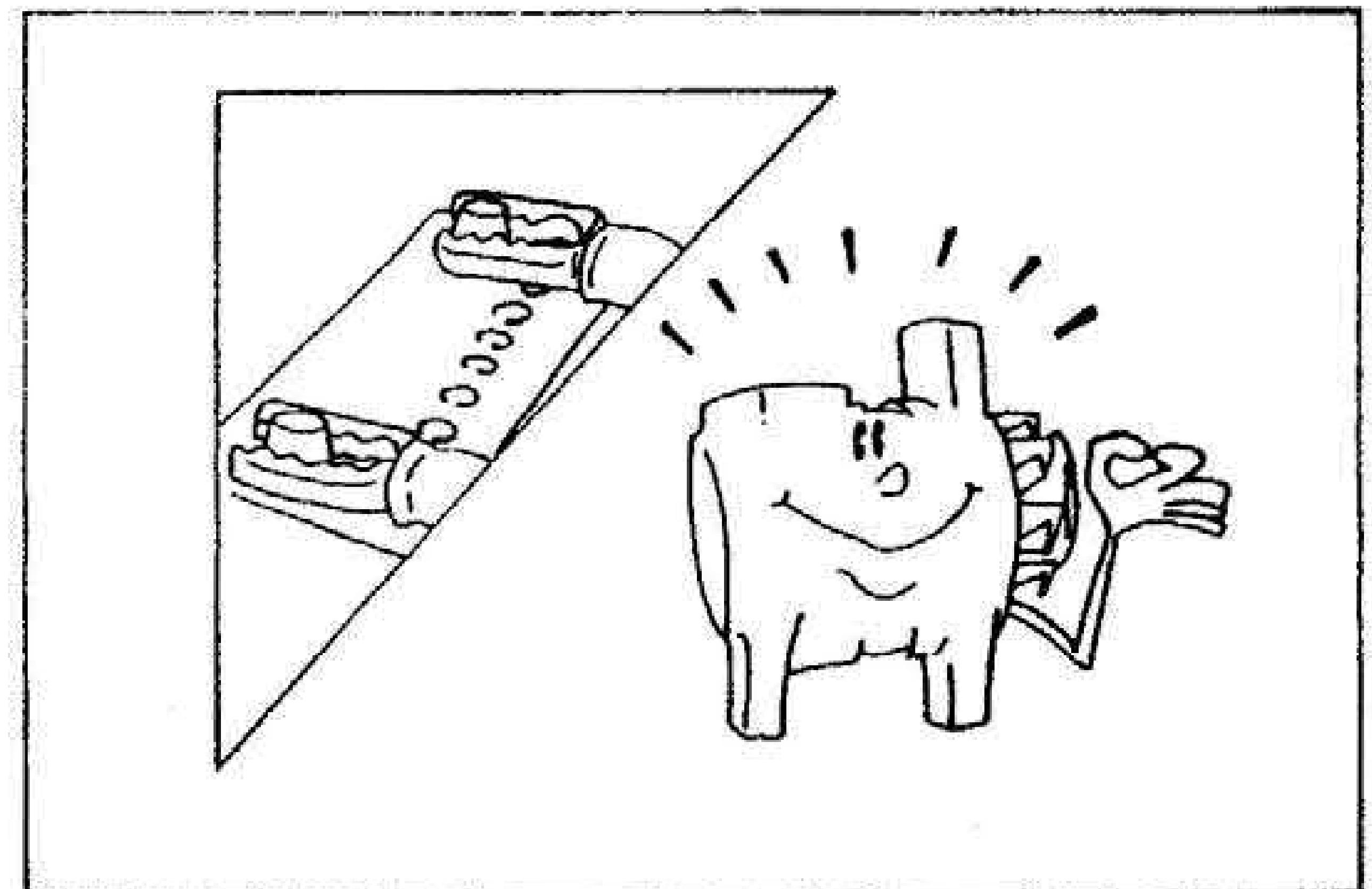
- (4) When a steam cleaner is used, take care to prevent direct exposure of the alternator to the steam.



- (5) Operation of the alternator with the terminals shorted will result in damage to the diodes.

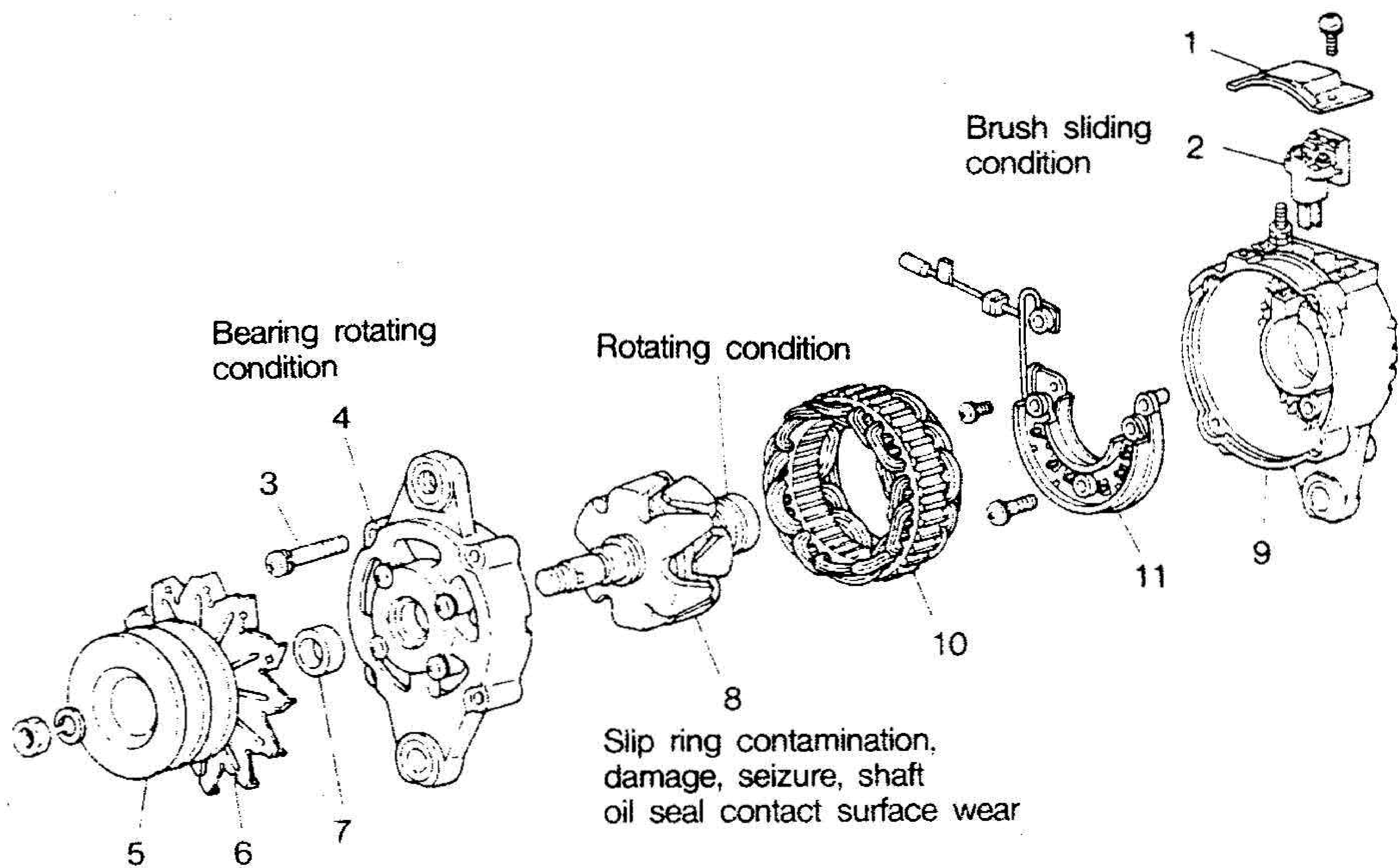


- (6) When the battery is to be quick-charged with a quick charger, be sure to disconnect the battery terminal connections beforehand. Otherwise, the diode and the regulator would be damaged.



12-3-2 40A Alternator

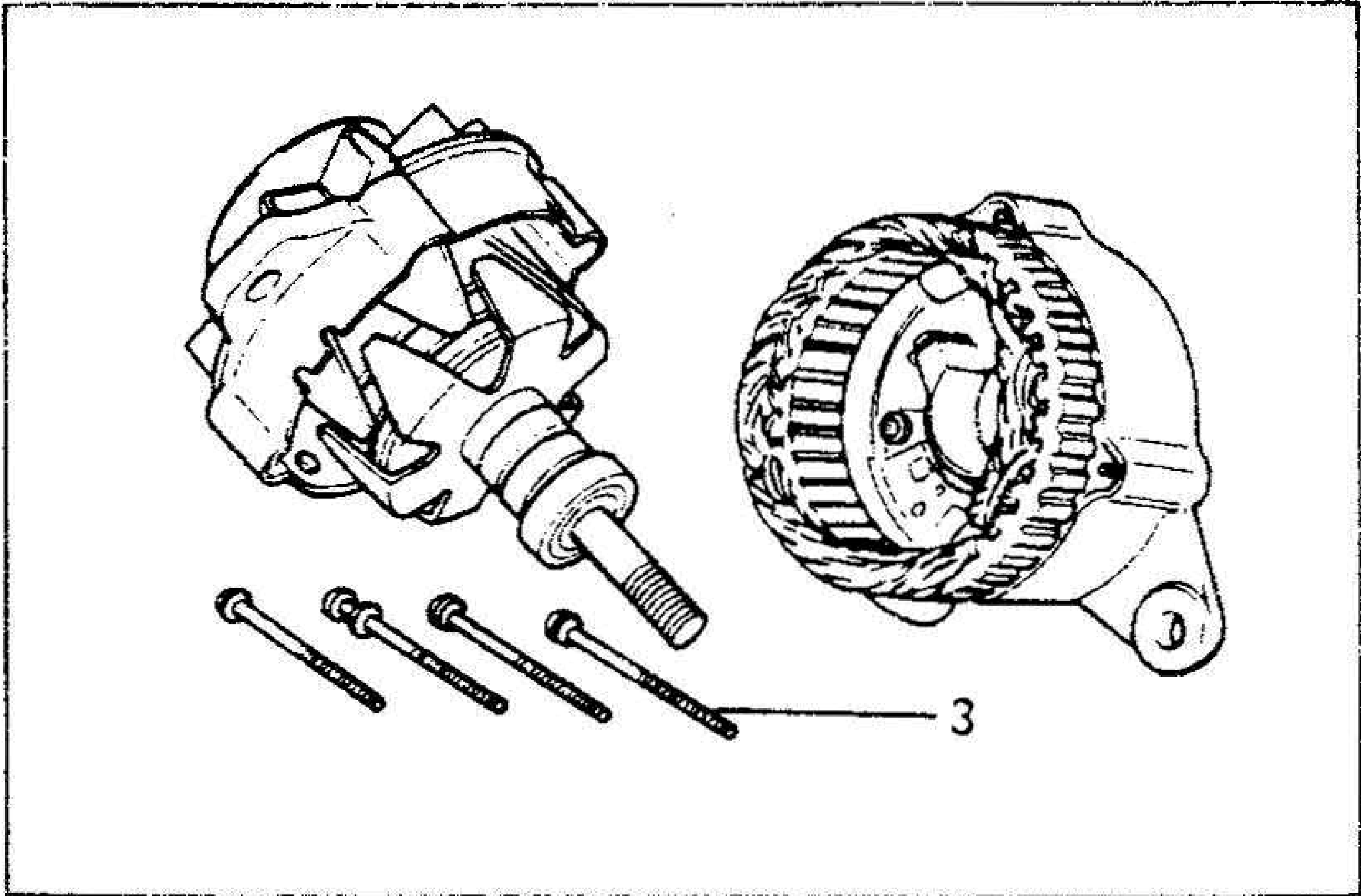
(1) Disassembly



- | | | |
|----------------------|----------|----------------|
| 1 Cover | 5 Pulley | 9 Rear bracket |
| 2 Regulator assembly | 6 Fan | 10 Stator |
| 3 Through bolt | 7 Spacer | 11 Rectifier |
| 4 Front bracket | 8 Rotor | |

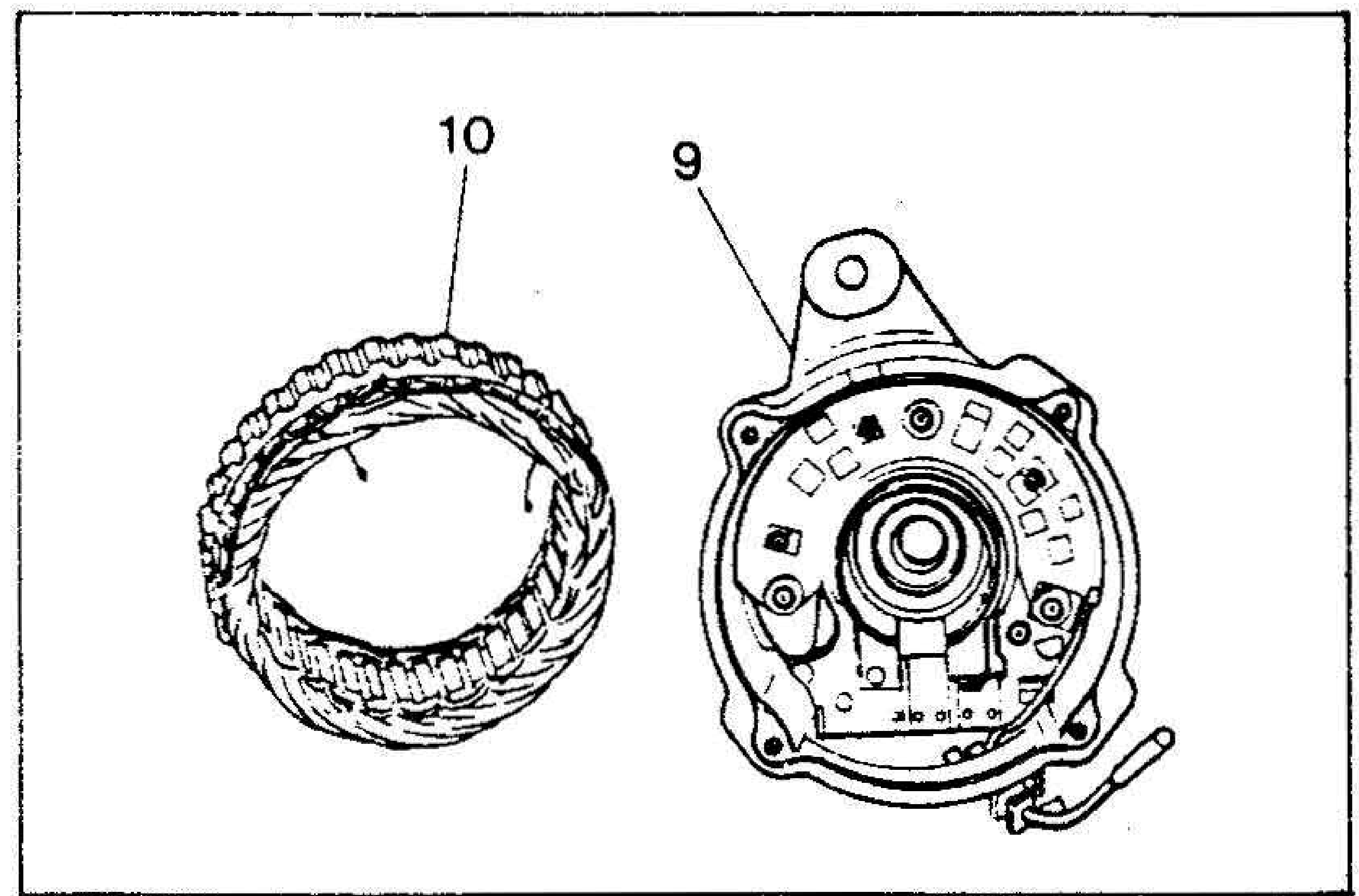
- NOTE : 1. If disassembly is continued without removing the regulator assembly, the brush will be damaged when removing the rotor.
2. Do not remove the oil seal unless it is defective.

(a) Remove the through bolt 3 and separate the assembly into the front bracket and the rear bracket as illustrated.



- (b) Unsolder the stator coil leads and remove the stator 10 from the rear bracket 9.

NOTE : When unsoldering, operate the soldering iron quickly (within 5 seconds or so).



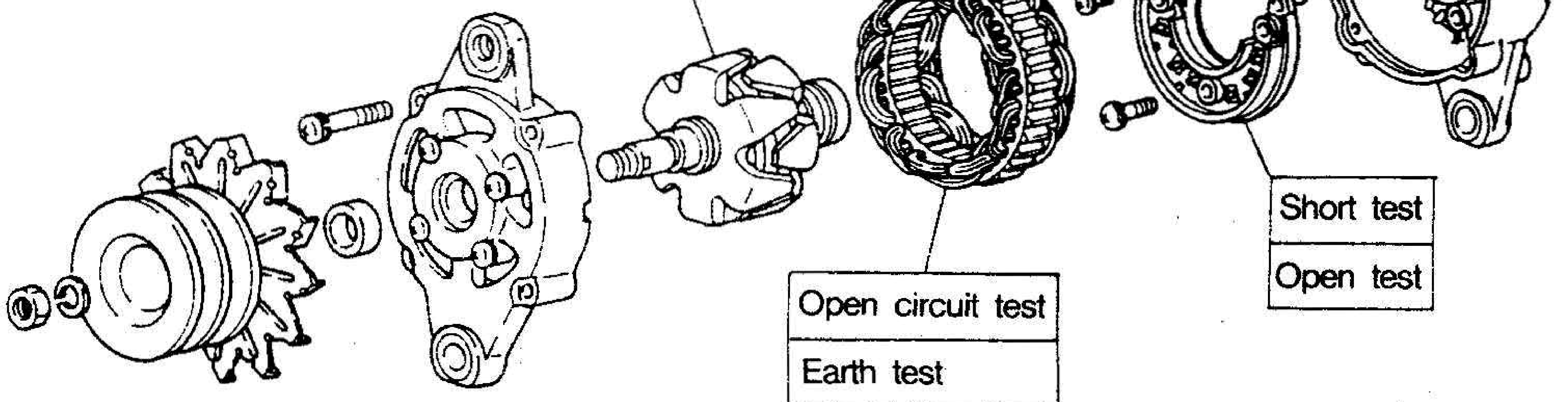
(2) Inspection

NV ... Nominal Value
SL ... Service Limit

Earth test	
Slip ring O.D.	Field coil resistance
NV 41mm	NV 10Ω
SL 40.4mm	

Brush length
NV 23mm
SL 8mm

Brush spring pressure
NV 3.7N(380 gf)
SL 2N(200 gf)



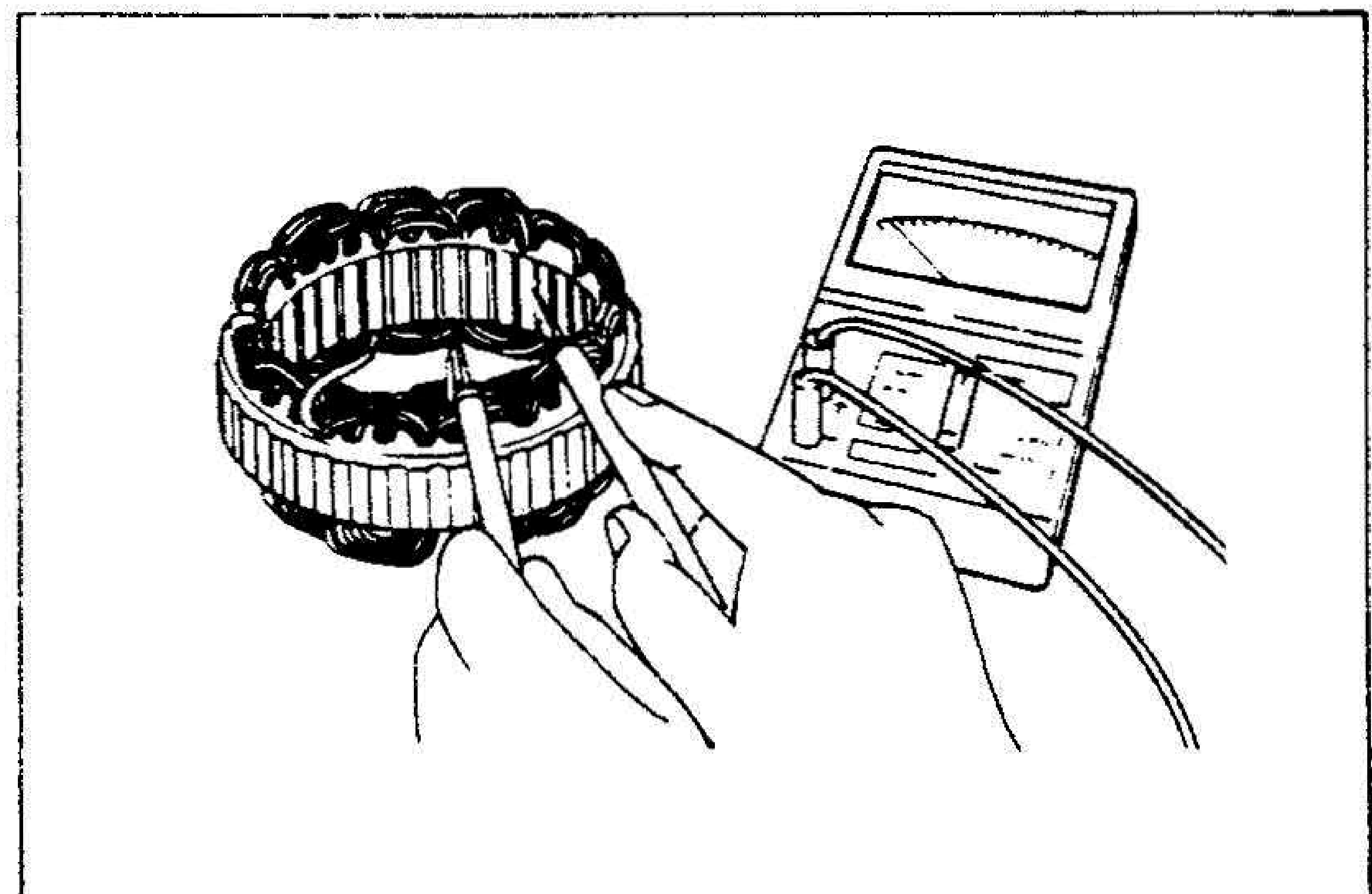
(a) Stator

- 1) Check that there is continuity between stator leads.

If not, replace the stator as leads are broken.

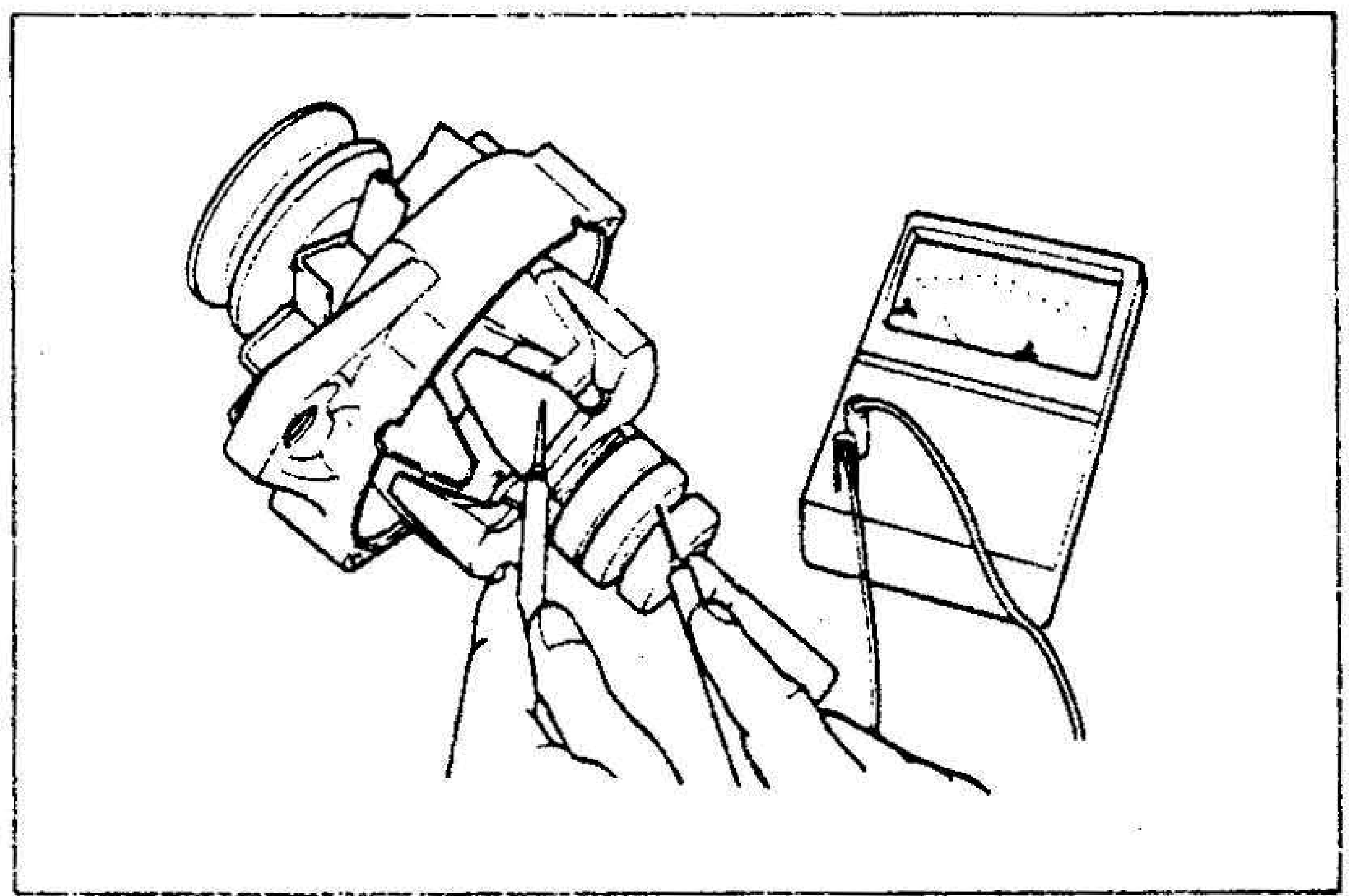
- 2) Check that there is no continuity between the stator leads and core.

If there is continuity, replace the stator as it is earthed.

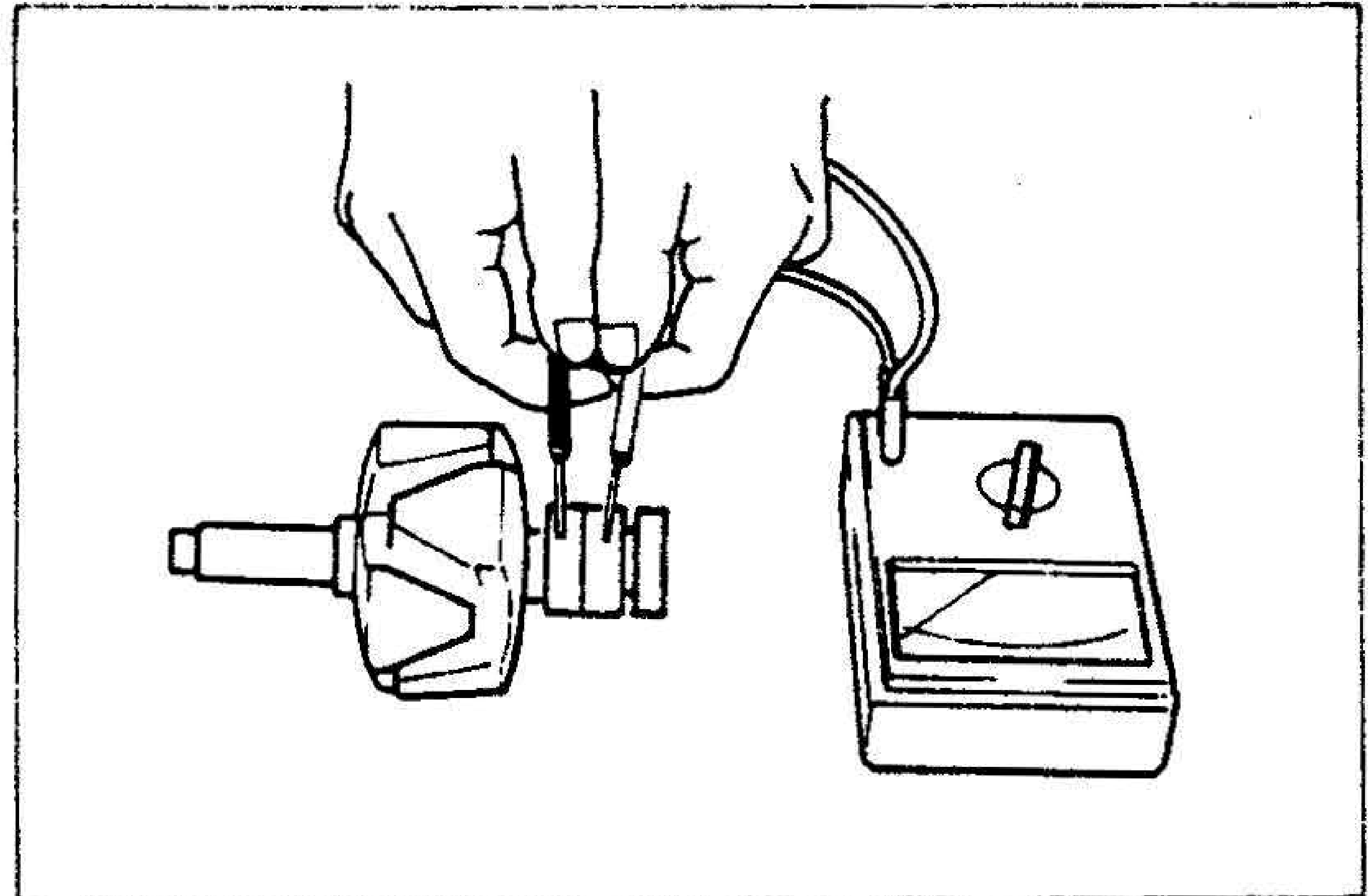


(b) Rotor

- 1) Check that there is no continuity between the slip ring and the core. If there is continuity, replace the rotor.

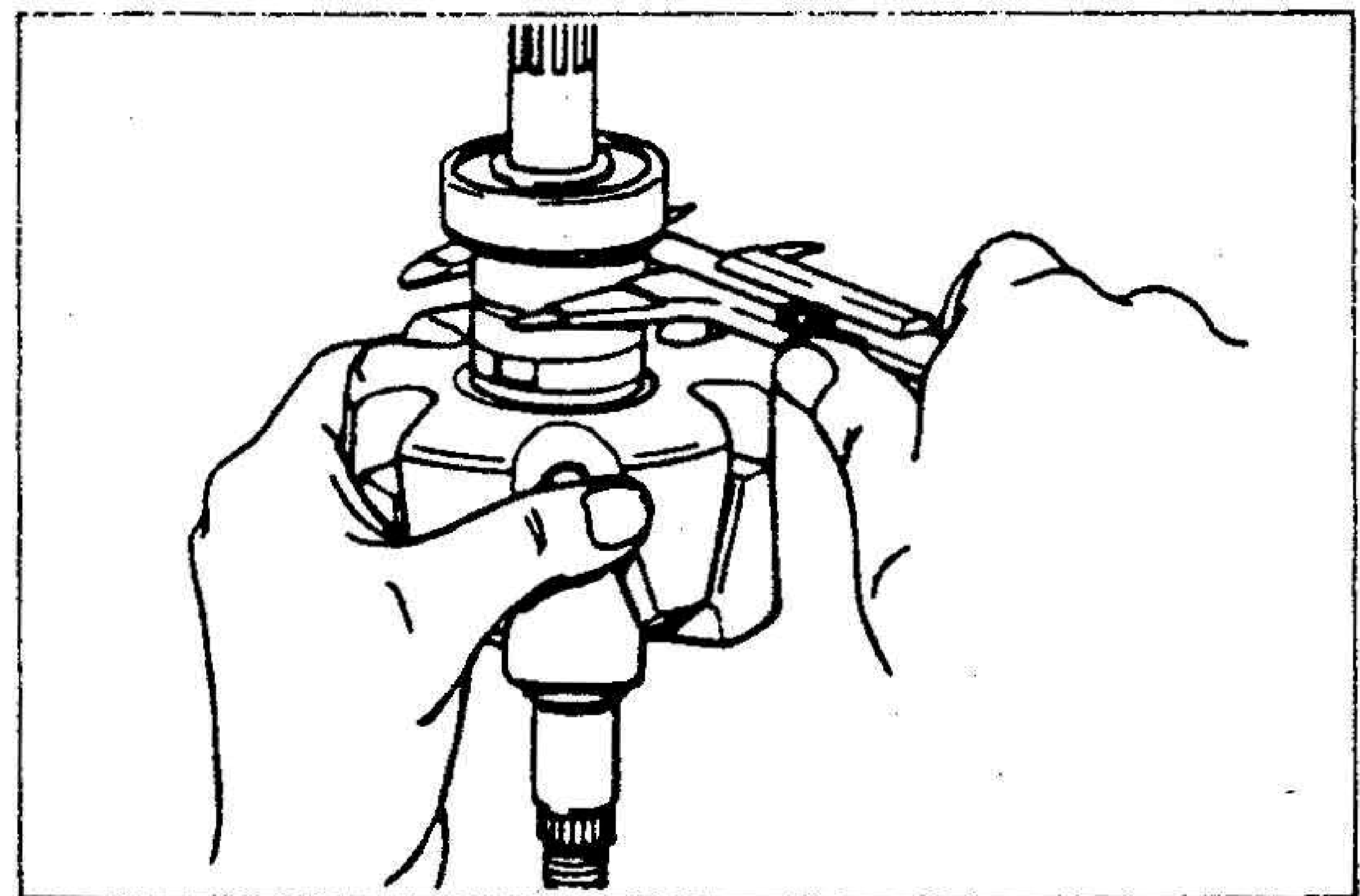


- 2) Measure the resistance between the slip rings. Replace the rotor if the resistance is not as specified.



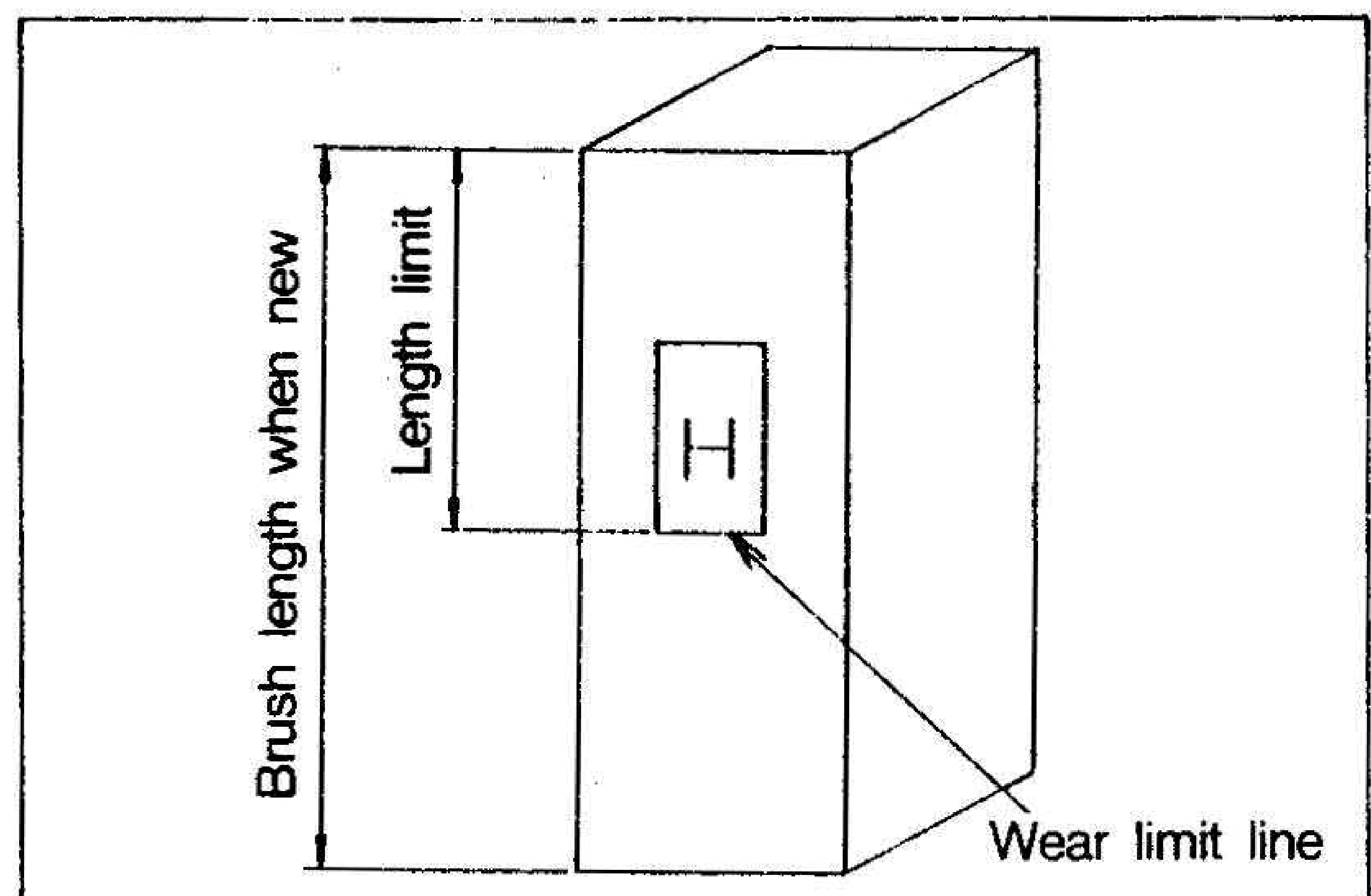
- 3) If the slip ring has rough surface or unevenly worn surface, correct with sandpaper or lathe.

Do not correct beyond the service limit of the slip ring O.D.



(c) Brush

- 1) Replace the brush if it is worn beyond the wear limit.

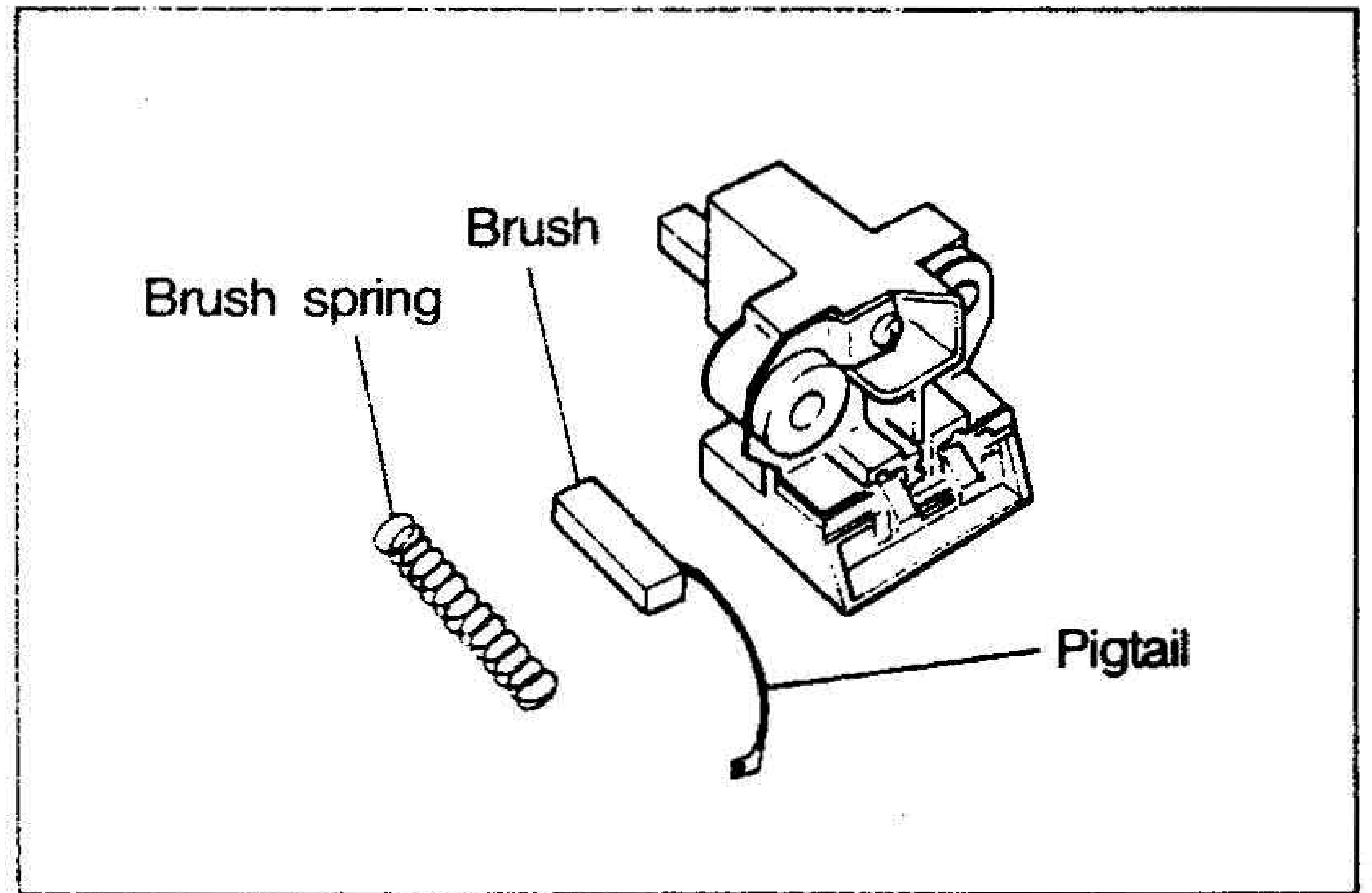


- 2) When a brush has been replaced, push in the new brush and measure the brush spring pressure.

If the spring pressure is lower than the service limit, replace the brush spring.

- 3) Replacement of brush and brush spring.

The brush and brush spring can be removed by unsoldering the pigtail.



Diode

For each diode, check the resistance between the diode leads and the heat sink.

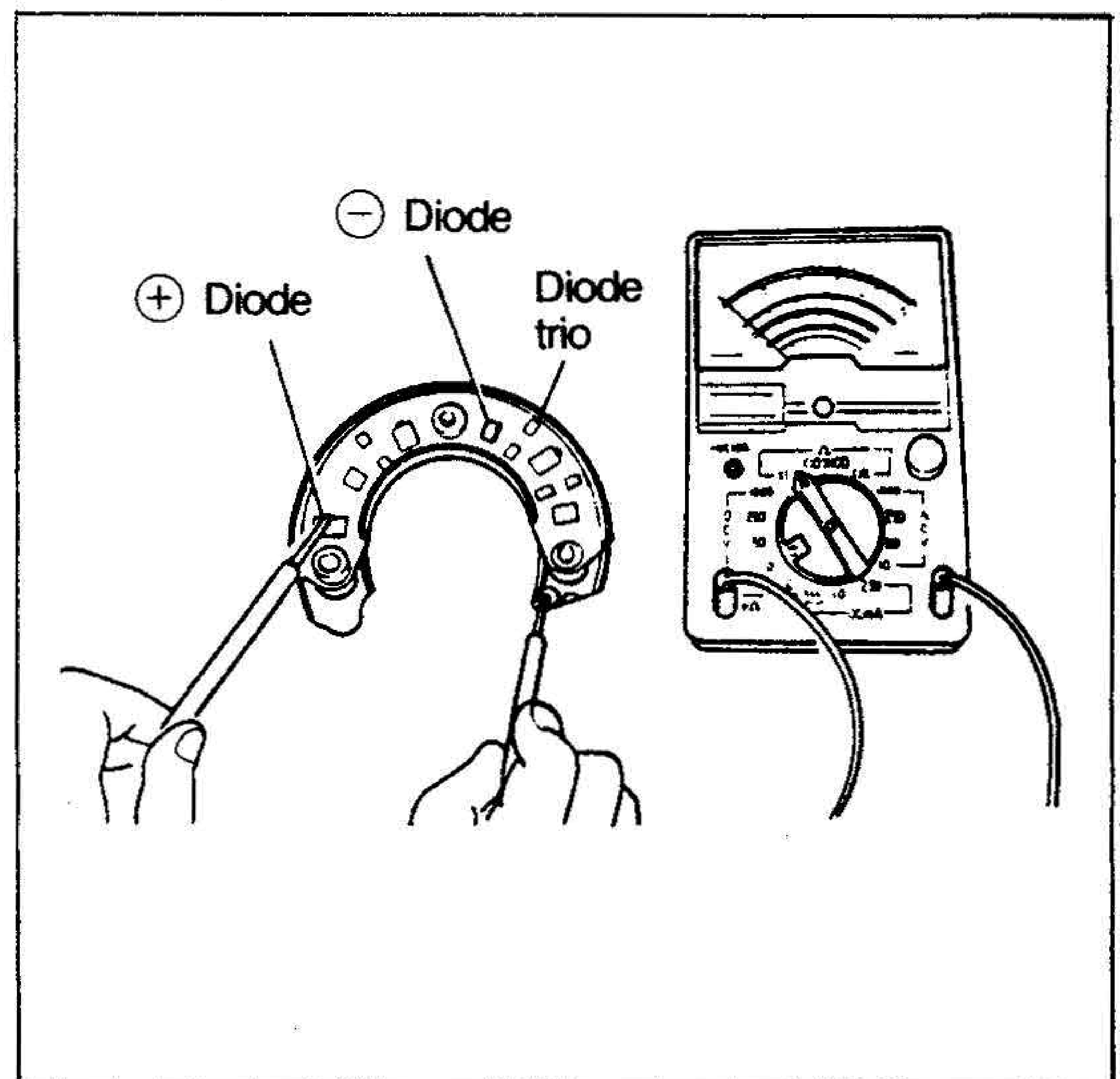
Check the resistance in two manners, namely connecting the positive (+) tester lead to the diode or connecting the negative(−) lead to the diode.

The diode is open if the resistance is infinite in both cases.

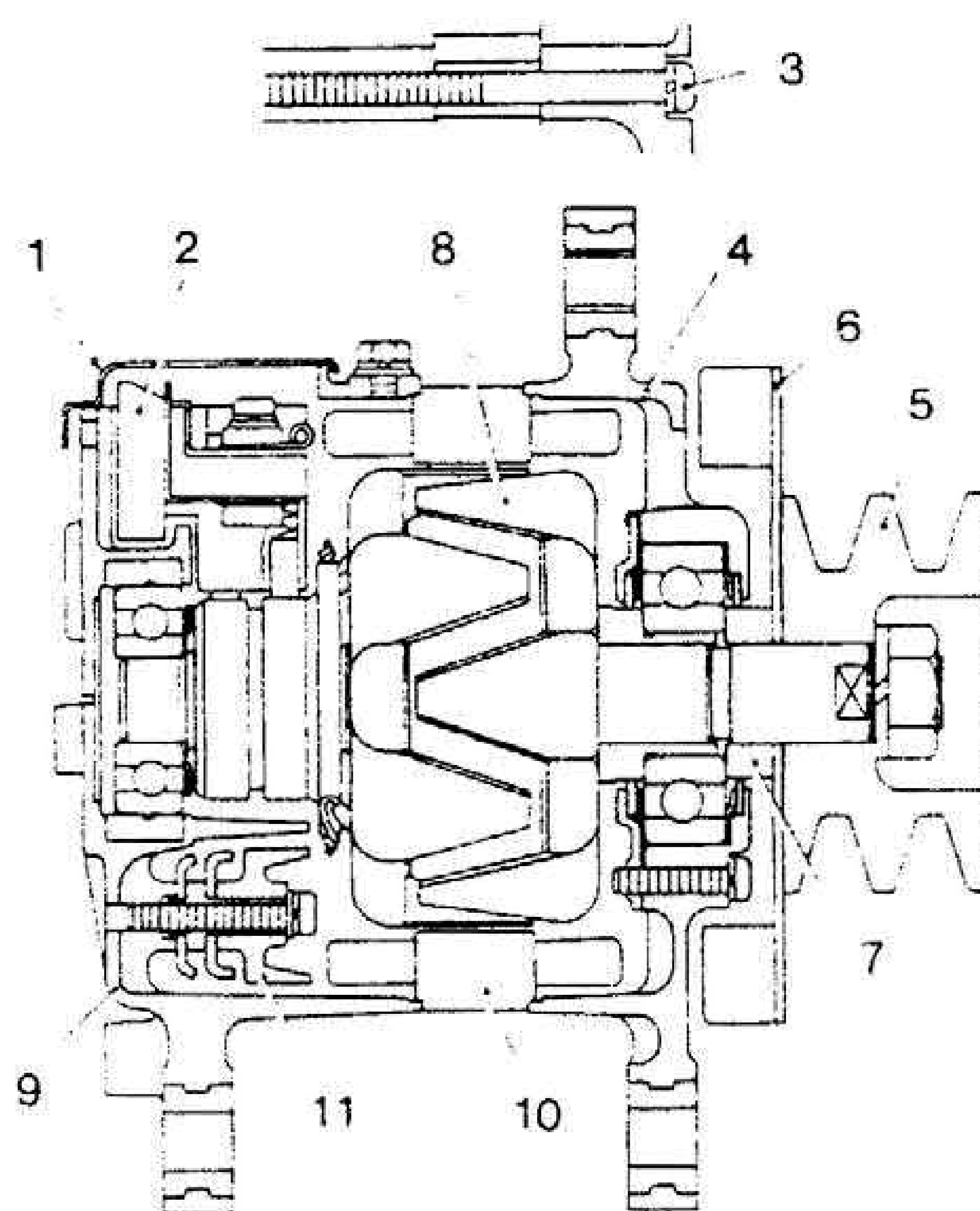
The diode is shorted if the resistance is nearly 0 in both cases.

Replace the rectifier if the diode is open or shorted.

As for the diode trio, check resistance between diode trio leads.



(3) Reassembly



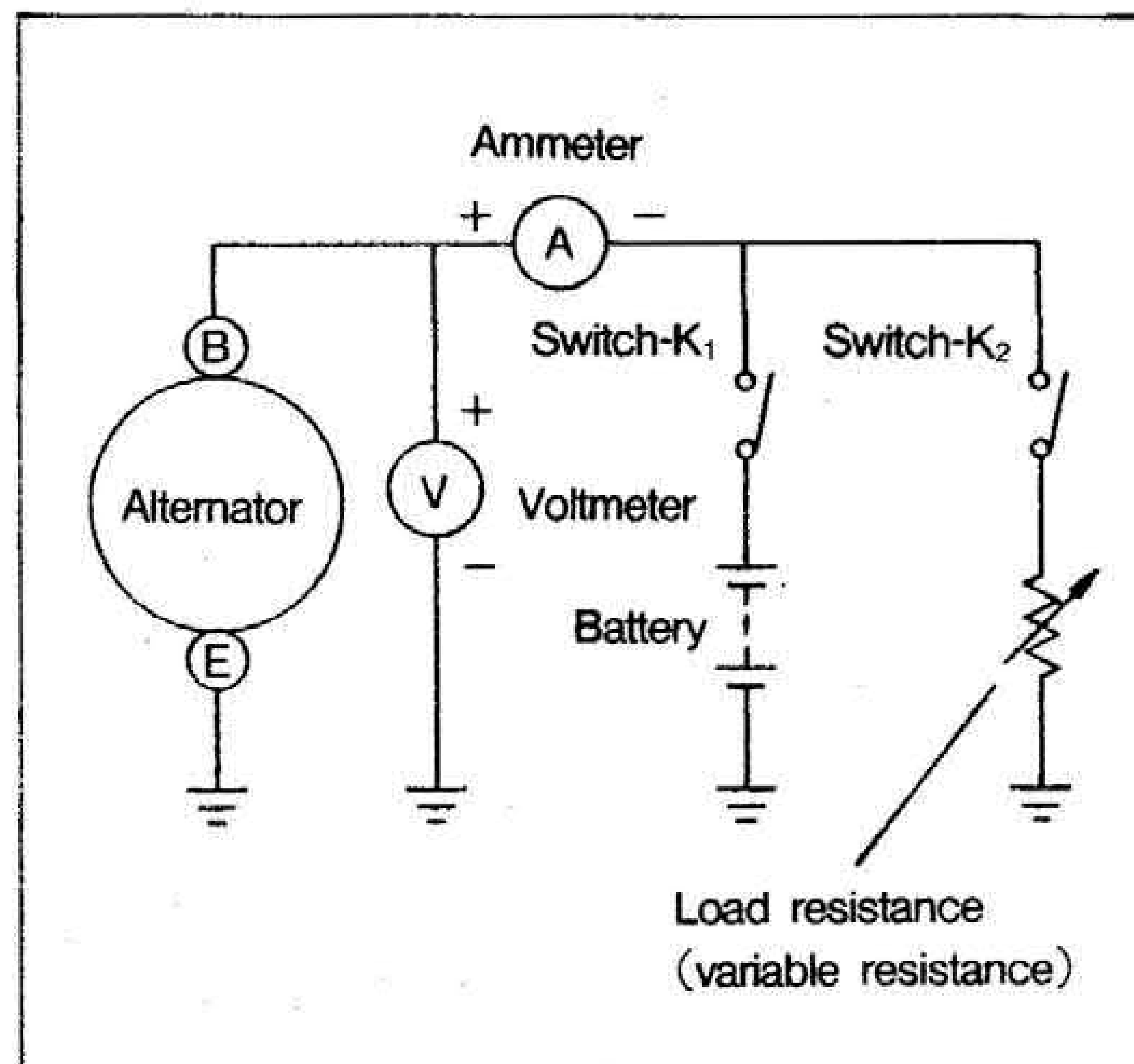
- NOTE : 1. When inserting the shaft through the oil seal, apply vinyl tape around the splined section of the shaft to prevent the oil seal lip from being damaged by the splined section.
2. When inserting the oil seal into the rear bracket, work uniformly on the outer circumference of the oil seal to prevent local shock or heavy shock.

(4) Test

(a) Performance test(on test bench)

Characteristics under load

Characteristics when loaded	Model		40A
	Terminal voltage		27V
	Current	When cold	26A or more
		When hot	22A or more
	Rotating speed		1500rpm
	Terminal voltage		27V
	Current	When cold	37A or more
		When hot	33A or more
	Rotating speed		2500rpm



With the load resistance set at maximum(almost no load current flowing), close switches K₁ and K₂. While increasing the alternator speed gradually, decrease the load resistance and measure the specified terminal voltage and the current value at specified speed.

If the measurement reading is less than the specified level, check each section of the alternator.

(b) Performance test(as mounted to engine)

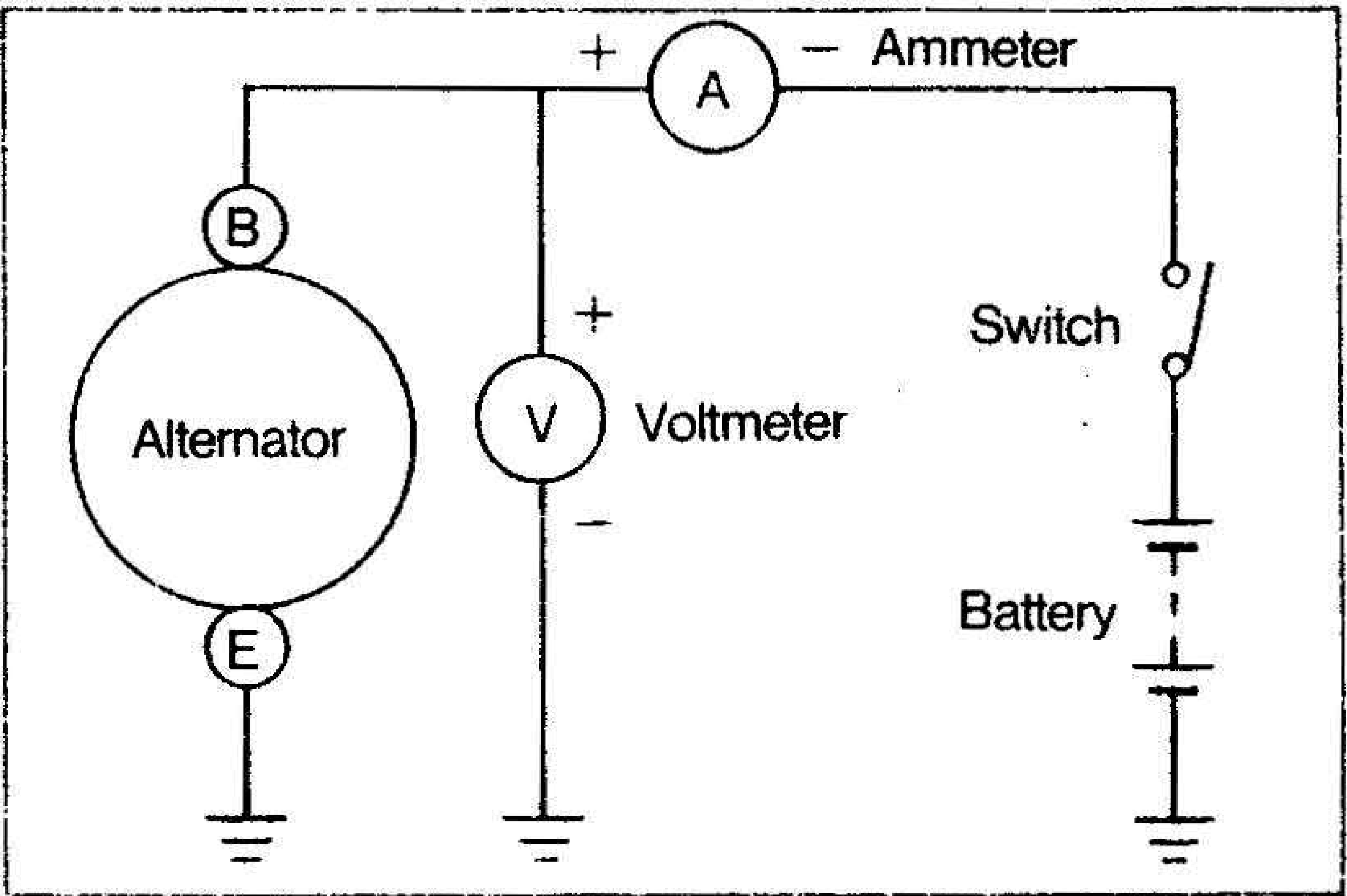
1) Provide a switch between the battery and the alternator "B" terminal. With the switch turned off, connect an ammeter(60A class) and a voltmeter.

2) Turn on the switch to check that the voltmeter indicates the battery voltage.

3) Start up the engine and immediately turn on all lamp switches. Then, increase the engine speed and read the maximum current value as soon as the alternator speed reaches 5000rpm.

4) If the current reading is 70% or more of the nominal output, the alternator may be safely regarded as good.

NOTE : The on-vehicle inspection is a simple way of inspection and the test bench inspection is necessary for more accurate results.

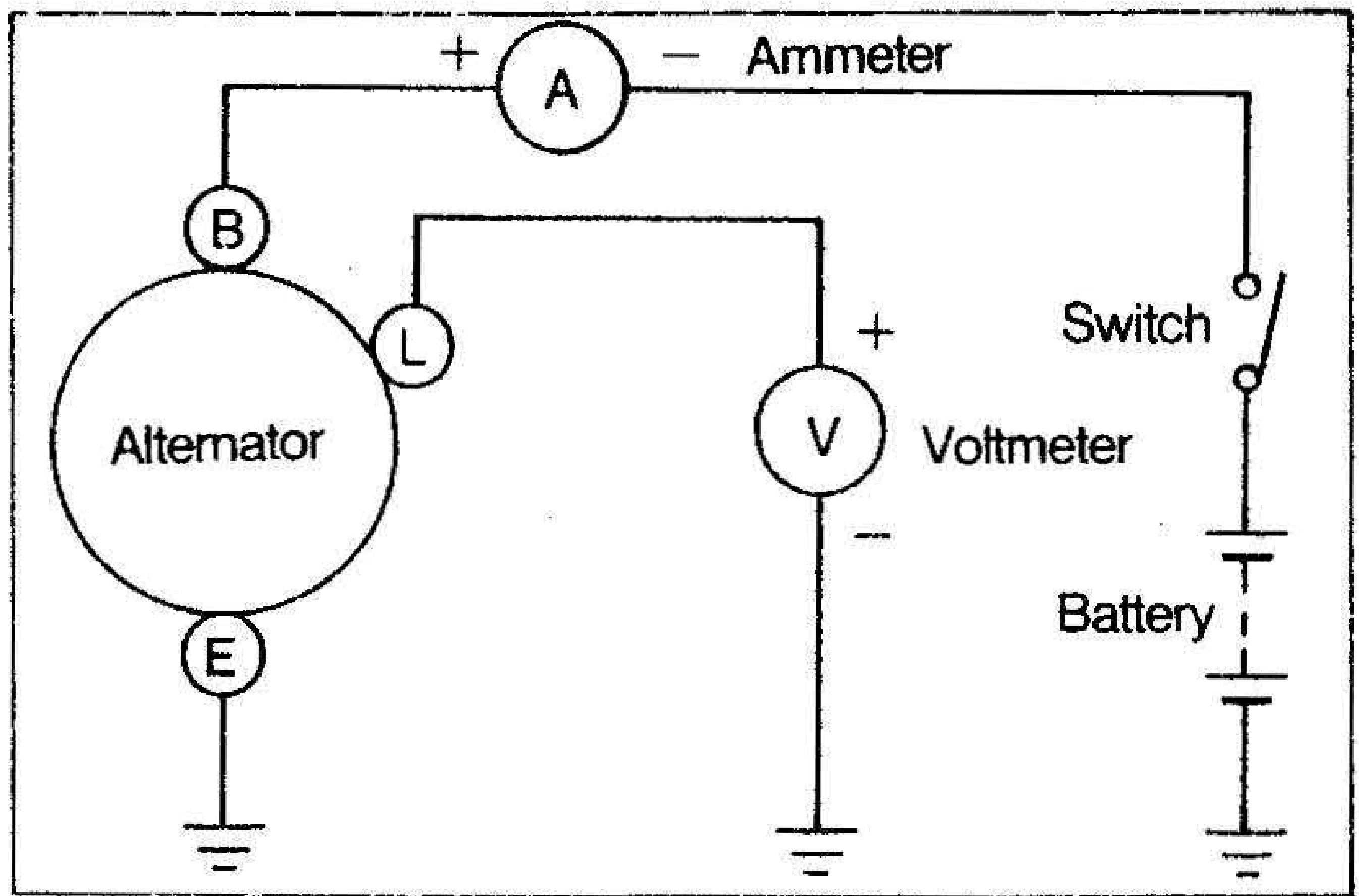


(c) IC regulator regulated voltage inspection(on test bench)

IC regulator regulated voltage

	Measured between
28 to 29V	terminals L and E
	at 5000rpm, load
	5A or less

Use a fully charged battery. Close the switch and gradually increase the alternator speed to 5000rpm. Check that the current value at this speed is 5A or less. The regulator is good if the regulated voltage un-

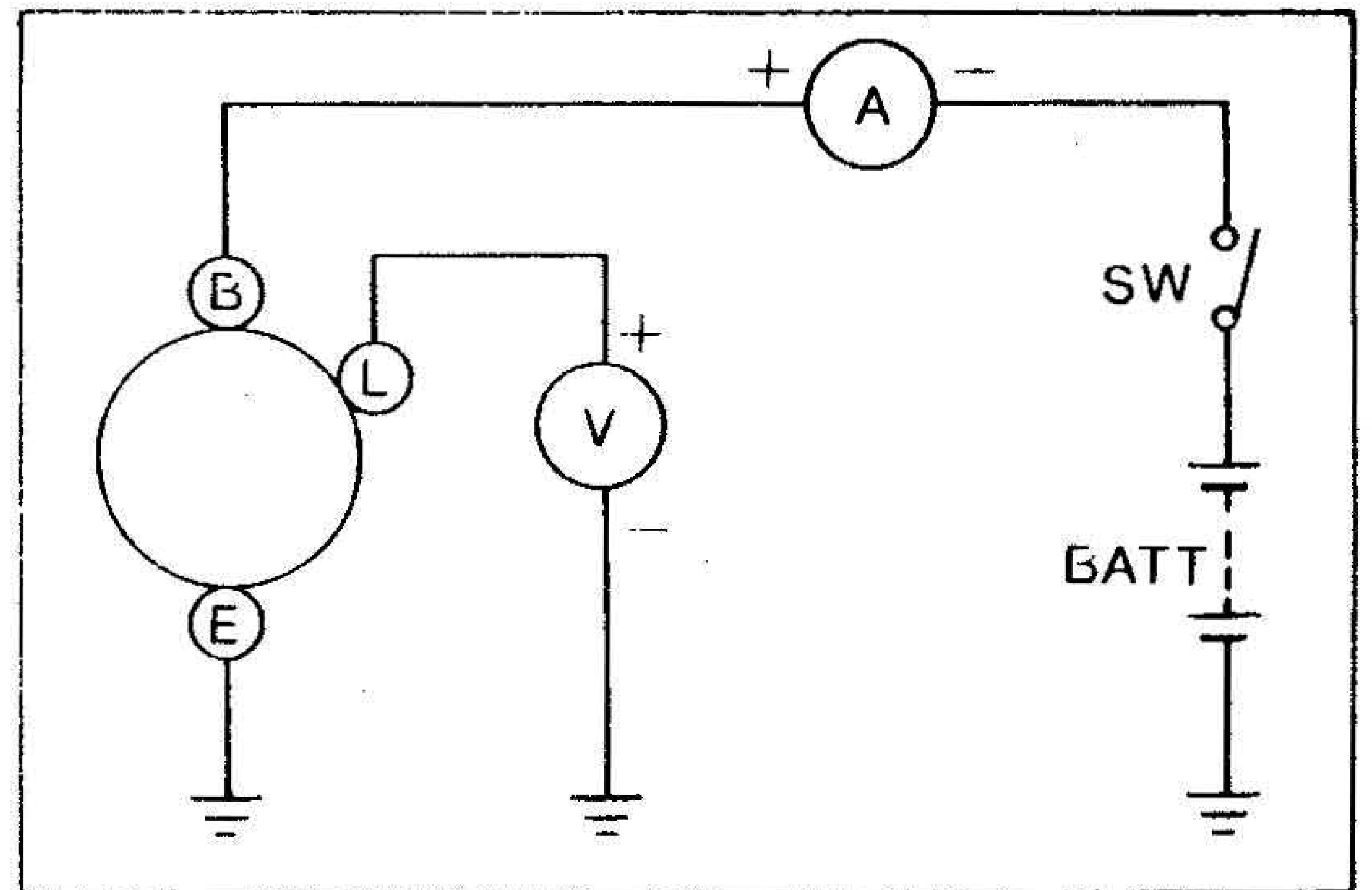


der this condition is as specified.

If not, replace the regulator assembly as the regulated voltage is not readjustable.

(d) IC regulator regulated voltage inspection(as mounted to engine)

- 1) Connect a voltmeter and an ammeter and provide a switch.
- 2) The regulator is normal if the voltmeter reads 0 when the switch is closed. If the voltmeter pointer deflects, the alternator or wiring is defective.
- 3) With the ammeter terminal shorted to prevent flow of the starter current through it, start up the engine.



- 4) Increase the engine speed to approximately 2000rpm and read the regulator voltage value if the charge current is 5A or less.

If the charge current is 5A or more, continue charging for some time or replace with a fully charged battery. It is also acceptable to connect a 1/4 resistor(25W) in series to the battery to limit the charge current.

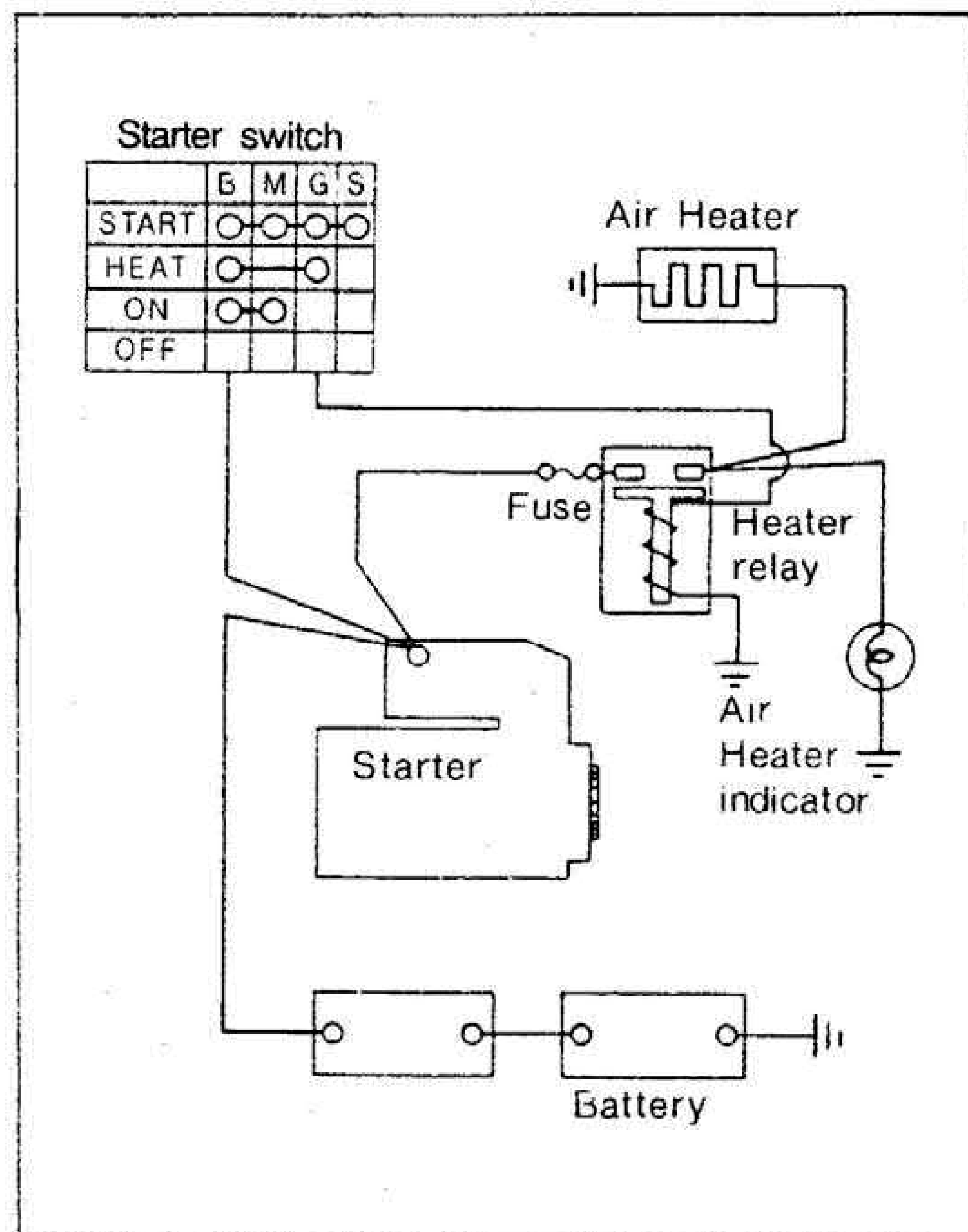
- 5) It is good if the regulator voltage is as specified.

If not, replace the regulator assembly as the regulator voltage is not readjustable.

12-4 AIR HEATER

Standard Limits

Indicator resistance	12.2Ω
Heater relay resistance	10.4Ω
Air heater resistance	0.23 to 0.27Ω
Time required for indicator to be red hot	40 to 60 sec.



The heater relay is provided with a fuse of the air heater circuit. Check the fuse and replace if burned out, after determining the cause of the burn-out.

For replacement, be sure to use a fuse of the amperage(91A) marked on the burned out fuse.

