

Chapter 2 Charging System

Section 1 Battery

I . General Information

In the electric system, the battery has three functions. First of all, it is the energy source of starting engine and the car; Secondly, it acts as the voltage regulator of electric appliance system; Thirdly, when the load of electric appliance exceeds the output of generator, it can provide supplementary energy source for some time.

If the test result of the battery is good, but it is not satisfying during the use, it may result from the following factors:

1. The ancillary equipment keeps active.
2. The average traveling speed of the car keeps low for a long time.
3. The load of the electric appliance exceeds the output of generator, in particular while the additional equipment is added to the original configuration.
4. The charging system doesn't run well, e.g. resistance is too high, driving belt skids, the terminal post on the output end of the engine gets loose, generator or voltage regulator falls into malfunction.
5. The battery, including cable terminal post of it, has impurity on it, or it is not fastened, or the holding-down device of battery gets loose.
6. The electrical equipment has such mechanic problems as brittle failure or pinch-off of wire etc.

Visual Inspection

Check for obvious damage, such as cracking or breaking of shell and cover, which may cause the efflux of electrolyte. If such obvious damage exists, the battery should be replaced immediately. After the reason for such damage is found out, some modification should be made, if it is necessary. If the reason keeps unknown, further experiment shall be made to conduct further study.

Carrier and holding-down clamp

Before the battery is installed, the carrier and holding-down device should be cleaned. And they should be prevented from corrosion. The carrier should maintain a good status. Ensure that no other materials are on the carrier before the battery is installed. In order to prevent the battery from swinging in the carrier, the packing bolts should be reasonably tightened.

Sulfation

If the battery discharges for a long time, the lead sulfate will gradually become a kind of hard crystalline material, which doesn't tend to return to active material during the subsequent recharging. "Sulfation" just means such result and reaction process. This kind of battery can be recovered by means of slow charging. It can be recovered to the work level, however, its capacity is lower than before.

Solidification of electrolyte

The solidifying point of electrolyte is related to its specific density. The solidification may damage the battery, so it should be prevented from solidification by means of keeping full of charge. If the battery is frozen accidentally, it can't be charged before it warms up.

Maintenance of battery

1) Battery is a reliable component, but it needs regular maintenance. Keep the carrier of battery clean, prevent the terminal post from corrosion, and make the electrolyte level maximal. In addition, the liquid level of each unit should be basically equal.

2) Keep the cable plugging device of battery clean.

The cable plugging device, especially the positive terminal, is sure to become rusty. The rust on the fitting surface of conductor will hinder the circulation of electric current. It is usually because of the rust on the cable plugging device of battery that the engine can't be started, while the electromotor is activated. Regularly cleaning it and lubricating the plugging device may prevent them from corrosion.

II. In-Vehicle Maintenance ("jumping" start in case of emergency)

With assistant battery**Caution:**

Avoid pushing or pulling the car to start, which may cause the damage of exhaust gas purification system and/or other parts.

When the jumper cable is applied, carefully handle the assistant battery and the discharged battery. Avoid spark, and observe the following steps.

Warning:

※Any breach of the following conditions or steps may cause the following situations:

(1) Serious damage to person (especially the eyes) or materials, which result from the explosion of battery, combustion of acid liquor of battery and the electrified body.

(2) Damage to the electronic parts of car.

※Never place the battery in the place with electric spark, for the gas generated by battery is inflammable and explosive.

※Remove the jewelry, watch and other valuable goods, and wear protective glasses.

※Prevent the liquid of battery from directly touching eye, skin, fiber and varnish, because it is corrosive acid liquor. In case that it touches any parts, rinse them immediately.

※Take care that the metallic tools or jumper cable don't touch the positive terminal of battery (or the metals connecting with it) and other metals in the car, for it may cause short circuit.

※Keep the little children away from the battery.

1. Pull up the parking brake and put the gear shifter to the neutral position, switch off the igniter, lights and all other electric loads.

2. Connect one end of a jumper cable to the positive terminal of assistant battery, and the other end to the positive terminal of the discharged battery (jump-start the engine with 12v battery only).

3. Connect one end of the negative cable to the negative terminal of assistant battery, and the other end to the firm engine ground cable (e.g. in the exhaust manifold), which is at least 45cm(18in) away from the battery which starts the car.

Warning: avoid directly connecting the negative cable to the positive terminal of the

discharged battery.

4. Start the engine of the car preparing to jump-start, and switch off other electrical equipments. And then start the engine of the car with low-battery battery.
5. The step of disconnecting jumper cable must be exactly contrary to that of connecting. The first step is to disconnect the negative cable from the jump-started engine.

With charging equipment

Note: As to the jump-started engine with charging equipment, the applied equipment should be 12v, and the negative electrode should be connected to ground. Never adopt the 24v charging equipment, for use of such equipment may cause serious damage to the electrical system or electronic parts.

III. Off-Vehicle Maintenance

Removal and Installation

1. Disconnect the negative cable.
2. Disconnect the positive cable.
3. Remove the clamber nut and clamber.
4. Remove the battery.
5. When installing, the sequence is the reverse procedure of removal,
6. Tight the fixing nut of the battery cable according to the set torque.

Note: Check and ensure an enough distance between grounding cable and engine cover beside terminal post.

Tightening torque: 6~10N·m

Charging the battery which voltage decrease greatly or which is fully discharged.

1. Measure the voltage of battery terminal post with the prepared voltmeter. If the voltage is less than 10v, the charging current is very low. So there is a certain time before the battery can accept the several-milliampere current. Such a low current won't be detected by the amperometer used on the spot.
2. Put the battery charger in a high pre-set place.

3. With the polar protective circuits, some chargers won't charge until the lead is appropriately connected to the terminal post of the battery. The fully discharged battery has not enough voltage to activate the whole circuit. Even though the lead is correctly connected, the battery can't accept charging current. So this circuit should be bypassed according to the special regulations of the charger manufacturer so as to switch on the charger and charge the low-voltage battery.

4. The voltages and current values provided by battery charger differ from each other. With each voltage, the measurable charging current that can be accepted by battery needs the following time:

Voltage: A: over 16..... 4 hours
 B: 14-15.9..... 8 hours
 C: less than 13.9.....16 hours

After the above-mentioned charging time ends, if the charging current can't be detected yet, the battery should be replaced; if the charging current can be detected, the battery is good, which can be charged in the normal way.

5. Always remember that only when the fully discharged battery is charged to enough ampere hour (AH) can it be used again. According to experience, the charging ampere hours basically equals the nominal AH plus an additional 30% of it, which is usually used to charge the normal battery. For example, the required AH for the 45AH battery fully charged is $45 \times 1.3 = 58.5$. So, you are recommended to charge with a low ampere but for a long time. For example:

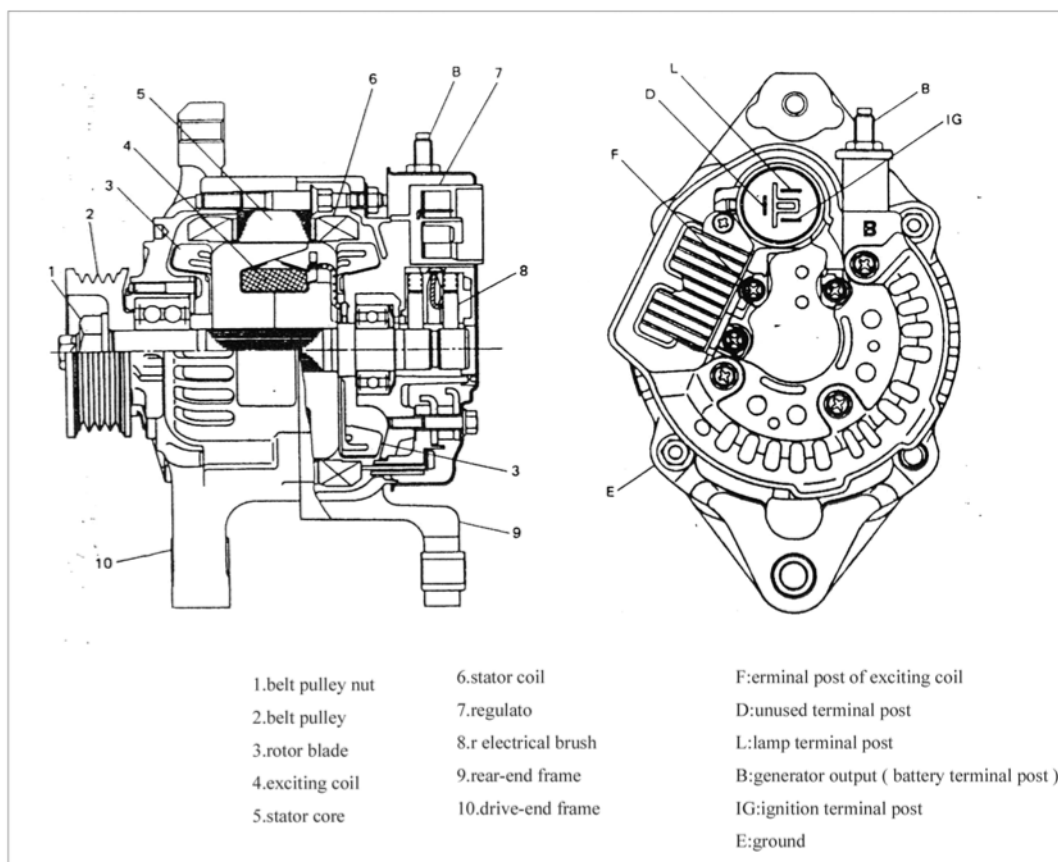
3 ampere $\times$ 20 hours..... 60AH or
 5 ampere $\times$ 12 hour..... 60AH etc.

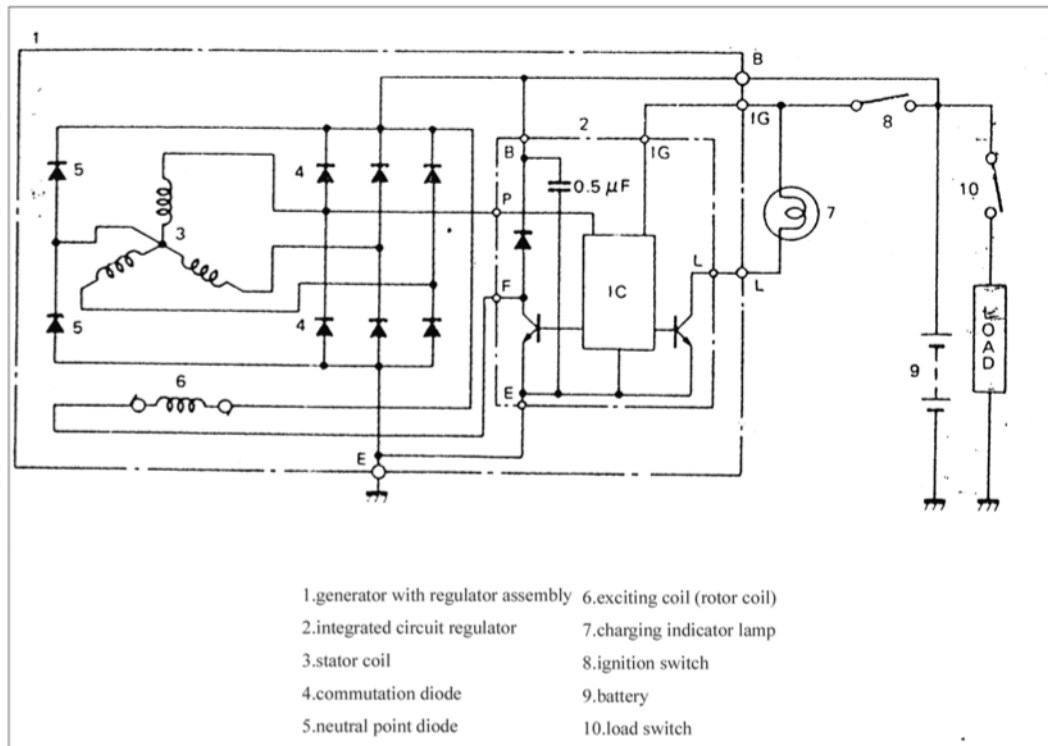
You are recommended to conduct load test to the battery recharged in this way so as to check its operational capability.

Section 2: Generator

I . General Information

The main charging coefficient is just the charging coefficient of the regulator of integrated circuit. The electric connection of its internal elements is shown in the following figure.





The characteristics of the generator are that a solid-state regulator is installed in it, and all the elements of the regulator are packed in a sealed case. The regulator, together with the brush carrier assembly, is installed in the slip ring and frame. The given voltage of generator can't be modified.

The generator rotor bearing contains enough grease, so it doesn't need regular lubricating. The two brushes make the current flow to the exciting coil in the rotor by means of two slip rings. Under normal circumstance, the brush will provide the long-term maintenance-free service.

The stator winding is installed in the laminated sheet iron strip that constitutes the frame of generator. The rectified current bridge connected to stator line set contains 6 diodes, which turns the alternating voltage in the stator into direct voltage on the output terminal post of generator. The neutral point diode is used to turn the wave of neutral point voltage into direct current so as to increase the output of generator.

The capacitor installed in the regulator assembly protects the diode from high voltage,

and restrains the radio noise.

II . Trouble Shooting

In order to avoid the damage to generator the following items should be observed:

Attention:

- ※Never mix up the polarity of IG terminal post and L terminal post.
- ※Avoid the short circuit between IG terminal post and L terminal post. The two terminal posts should be connected through charging indicator light.
- ※Loads should always be connected between IG coil and E terminal post .
- ※Please see section “Battery” for how to connect charger or assistant battery to the battery of the car.

The charging system is in malfunction when any of the following situations emerge:

1. The fault indicator lamp comes up.
2. Start slowly, which indicates that the battery is not sufficiently charged.
3. Too much electrolyte is ejected from vent opening, which indicates that the battery is overcharged.

The noise generator may result from the following factors: the head pulley gets loose; construction bolt gets loose; the bearing is worn out or has some foreign material in it; diode or stator doesn't work well.

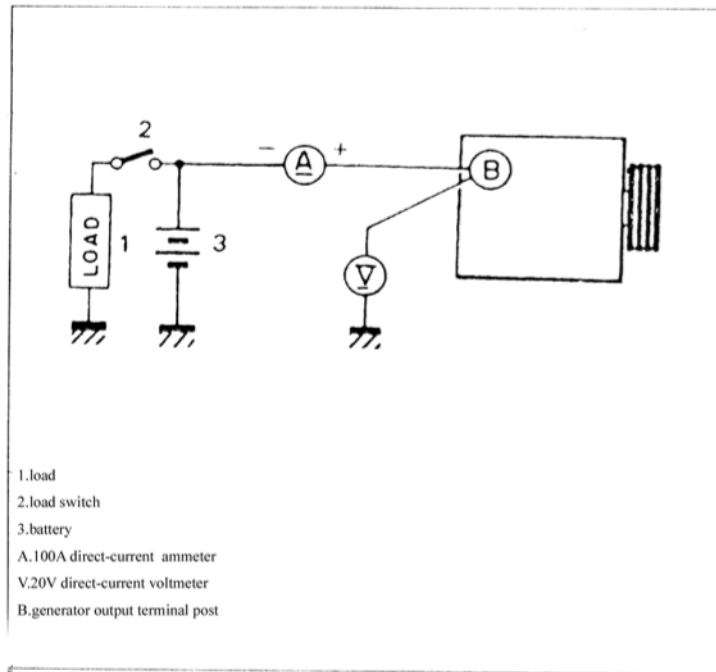
Fault indicator comes on

Symptom	Possible Reasons	Measures
While the ignition switch is switched on and the engine is stopped, the charging indicator light doesn't light up.	●The fuse snaps. ●Something wrong with indicator lamp in the cluster gauge. ●The connection gets loose. ●Something wrong with the regulator of integrated circuit.	Check the fuse. Check the cluster gauge. Tighten what is loose. Replace regulator of integrated circuit.
When the engine runs, the charging indicator light doesn't go out, and the battery needs frequent recharging.	●The driving belt is loose or worn out. ●The battery cable gets loose, rusty or worn out. ●Regulator of integrated circuit or generator doesn't work well. ●Bad connection	Adjust or replace the driving belt. Repair or replace driving belt. Repair or replace cable. Check charging system. Repair the connection.

Unchargable Battery

The slow starting may result from one or some of the following factors, even though the indicator light works normally. Operate according to the following steps using voltmeter and ampere meter.

1. Ensure that being uncharged is not due to keeping the accessory equipment working.
2. Check the driving belt for degree of tightness.
3. If you doubt whether the battery works well, please see section “battery” for further details.
4. Check the connection for fault. Check whether all the connections are firm and clean, and check the cranking motor and ignition grounding cable.
5. Connect the voltmeter and ampere meter according to the following chart.



Voltmeter

Be connected between terminal post B of generator and the earthing.

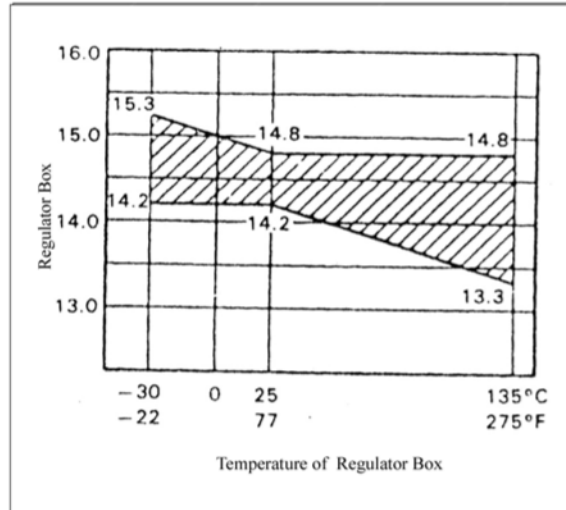
Ammeter

Be connected between terminal post B of generator and the positive terminal of battery.

6. Measure the voltage and current under each of the following circumstance.

Zero-load check

Make the engine run at idle speed to a speed of 2000r/min, and read the number in the gauge.



Note:

※Take into consideration that the voltage varies with the temperature of the regulator case.

※Before this test, the discharged battery must be fully charged.

Note: When the engine runs, never remove the terminal post of the battery, otherwise, the electronic parts may be damaged.

Standard current: 10A (max.)

Standard voltage: 14.2-14.8V in 25°C

Higher voltage

If the voltage is higher than the standard value, replace the regulator of integrated circuit.

Lower voltage

If the voltage is lower than the standard value, conduct the following check. Connect the F terminal post to the ground connection, start the engine, and then measure the voltage of B terminal post.

If the voltage goes up above the standard value, there is something wrong with the engine.

Loading check

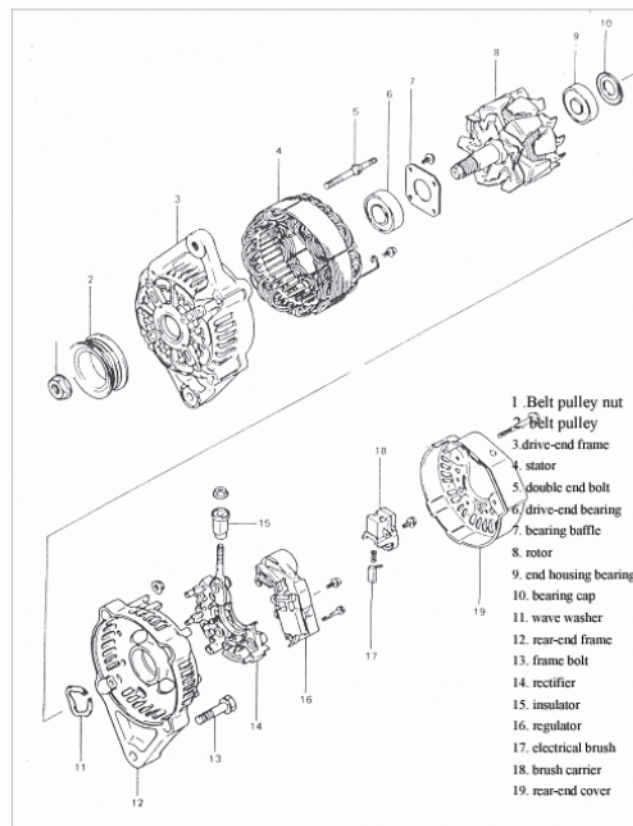
Make the engine run at a rotation speed of 2000r/min, and switch on the head lights and the fan of heater system. And then measure the current. If the current is lower

than 20A, repair or replace the generator.

Overcharged battery

1. Please see section “Battery” for ensuring the status of the battery.
2. The excessively effusion of electrolyte is the obvious indication of being overcharged. Then remove the generator to repair, and check the exciting coil winding for ground connection or short circuit. If any trouble exists, replace the rotor and check to ensure the output voltage is within the specified range.

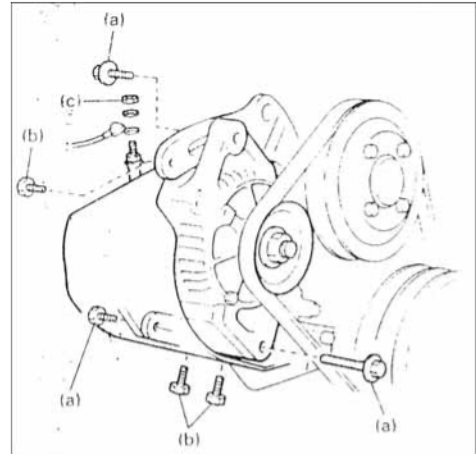
III. Overhaul



Removal and Installation

1. Remove negative cable from battery;
2. Disconnect the cable, which connects with terminal post B, and cable plugging device;
3. Remove the bolt of engine cover (upside);
4. Remove the adjusting bolt of driving belt of generator;

5. Remove the bolt of engine cover (downside), and then remove the cover;
6. Remove the construction bolt to take out the belt from the downside.
7. Install them in the step contrary to that of removal, and adjust the driving belt to the specified output tightness.



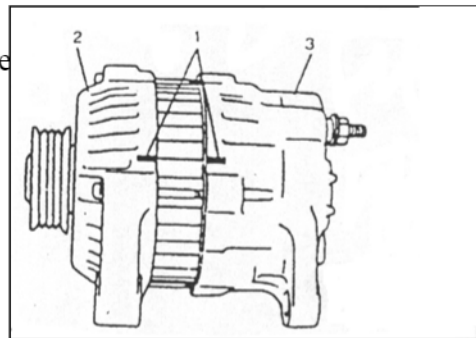
Tightening torque

- (a) : $18 \sim 28 \text{ N}\cdot\text{m}$
- (b) : $4 \sim 7 \text{ N}\cdot\text{m}$
- (c) : $6 \sim 10 \text{ N}\cdot\text{m}$

Disassembly

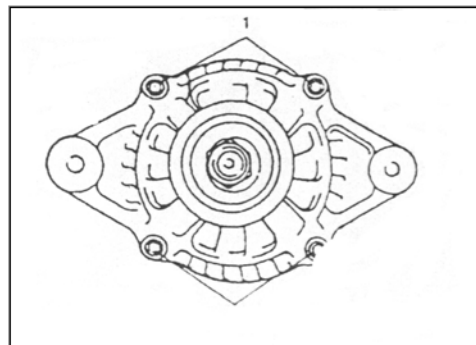
1. For convenience of installation, find out the alignment front cover and rear cover or make a fiducial mark.

- (1) Alignment index line
- (2) Front cover
- (3) Rear cover



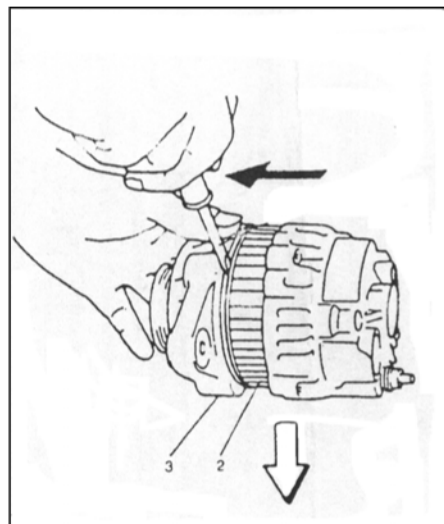
2. Remove the bolt in the front cover from generator.

1 Bolt



3. Insert a flat-head screwdriver or similar tool between stator core and front cover to divide the generator into two parts, front part and rear part.

- 1. Flat-head screwdriver
- 2. Stator core
- 3. Front cover

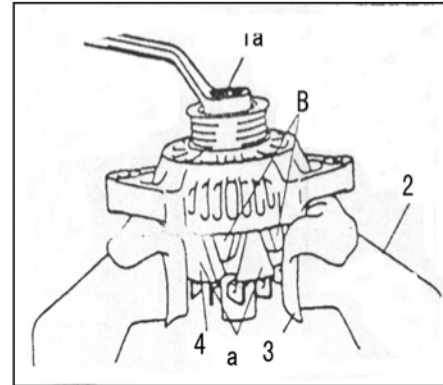


4. Loosen the belt pulley nut with clamp and remove the belt pulley.

Note:

When the clamp is used, a piece of clean cotton cloth should be laid between rotor and clamp to avoid the damage to rotor.

Always clamp the part “A” instead of part “B”, for the structural strength of part B doesn't suit firm clamping.



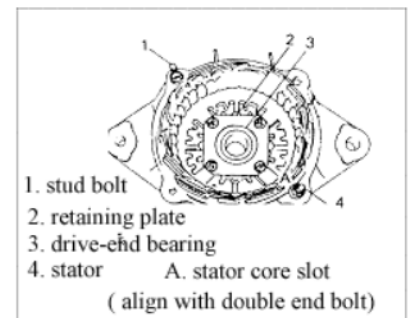
- 1a: Belt pulley nut 2: Clamp 3: Belt pulley bolt 4: Cotton cloth
5: Rotor

5. Remove the nut of B terminal post and isolator.

6. Remove 3 bolts and take off the rear cover.

7. Remove 3 bolts and pull out the brush carrier assembly.

8. Remove 3 bolts and pull out the regulator of integrated circuit.

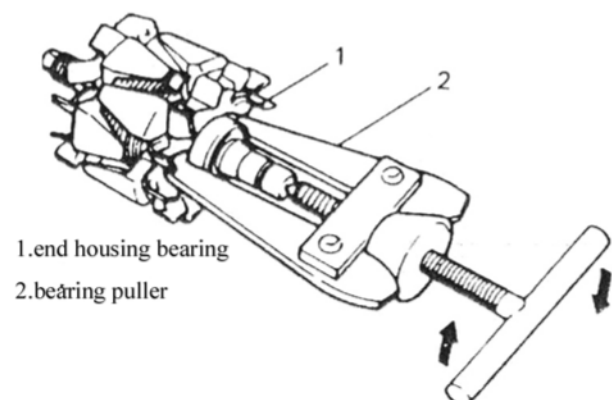


9. Remove 3 bolts and stretch the stator coil lead, and then take out the rectifier.

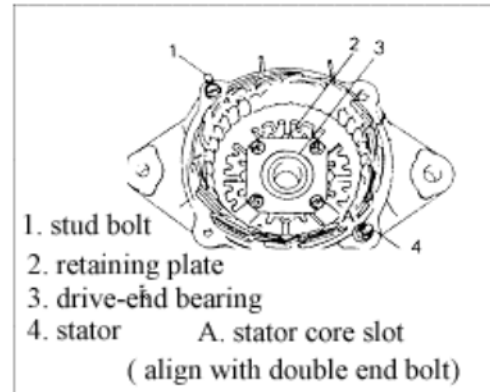
10. Remove the bolts and nuts in the rear frame, and then push out the rear frame with rotor.

11. Remove the end housing bearing with bearing puller.

Note: When the bearing puller is used, it is subject to careful operation to avoid deforming the cooling fan blade.



12. Remove 4 bolts and baffle and push out the bearing on the driving end.



13. If necessary, loosen stud bolts and pull out the stator.

Note: Heating the frame on the driving end may facilitate disassembling stator.

Assembling

Before disassembling, evaluate the faults. After that, find out the part subject to malfunction by means of careful check. Make available the parts for exchange use, and then assemble the generator in the step contrary to that of disassembling.

Note:

(1) When the stator coil is inserted into the frame on the driving end, the recess in the stator should be aligned with the stud bolts.

(2) When the brush carrier assembly is installed, the brush must be thoroughly disengaged from slip ring.

Note:

※When the rectifier is installed, check whether there is an enough big gap between stator conductor and cooling fan blade.

※Avoid over-tightening the insulator nuts of terminal post.

Tightening torque of stud bolt: 7~8.8N.m,

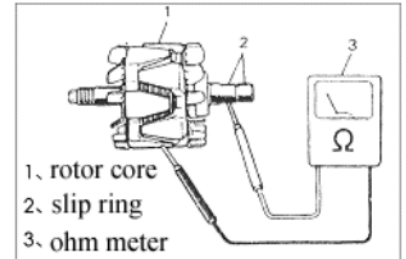
Tightening torque of frame bolt/nut and nut in the terminal post: 4~5N.m

Tightening torque of belt pulley nut: 95~130N.m

Check and Adjustment

Rotor ground

The slip ring and rotor core should be conductively closed, which should be checked by means of ohmmeter.



Open circuit

Connect the ohmmeter probe to the slip ring to check whether the exciting coil is current-carrying and its electric resistance value. If the value exceeds the specified one, replace the rotor.

The electric resistance value of exciting coil:

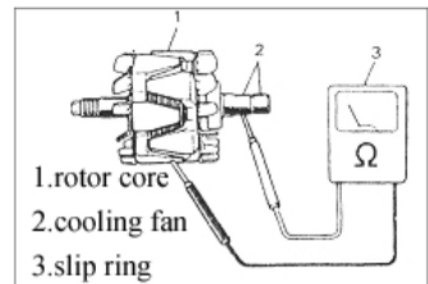
2.8-3.0Ω

Fan

The status of all the fan blades is good.

Bearing

Check whether it rotates stably using hand.



Bearing of drive shaft

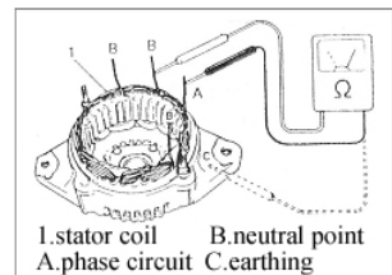
Before removing it, rotate it with hand to see whether it rotates stably.

Stator Ground

Check the stator coil and magnetic core for insulation with ohmmeter.

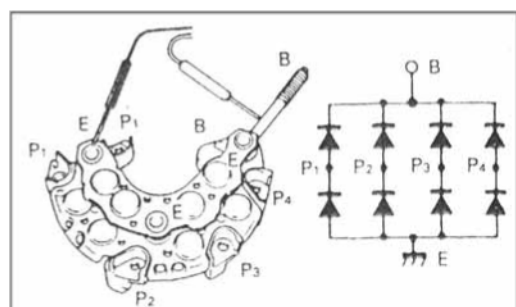
Open circuit

Check whether it is conductive between neutral point A and leg of circuit B.



Rectifier

With kΩohmmeter, check whether it is conduction between B terminal post and earth connection. Put one probe on B terminal post, and the other on the earth connection. And then



exchange the places of the two probes. Only one should be conductive, the other should be infinite. Otherwise, replace the rectifier assembly.

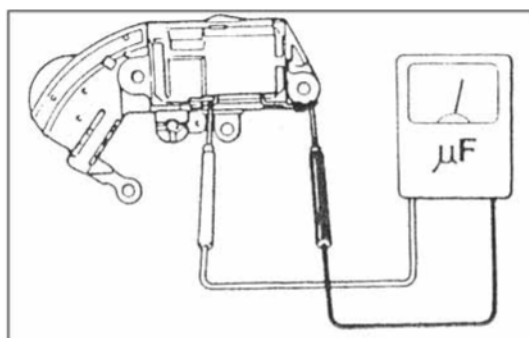
Note:

Never use a 500V megohmmeter to test the rectifier, because it may damage the diode of the rectifier.

Condenser

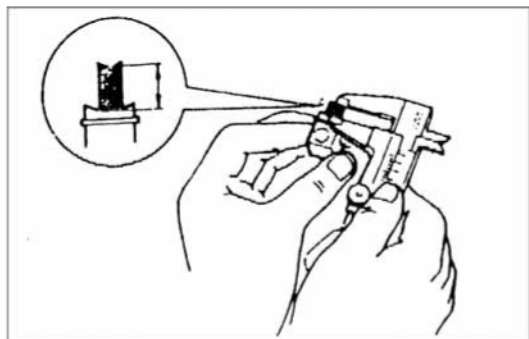
Use a capacitance measuring tester to check the capacitor state.

Condenser capacitance: $0.15\mu\text{F}$.



Brush

Refer to the chart to measure the length of the brush, and check its worn condition. If its length has reached the maintenance limit value, it should be replaced, together with the brush.



Maintenance limit value of brush length (min.): 4.5mm (0.18in)

IV. Technical Data of Generator

Rated voltage	12V
Maximal output	50A (thermal state 13.5V)
Maximal tolerable speed	18.000r/min
No-load speed	1110 r/min
Set voltage	14.2 to14.8V (5000 r/min)

	10A25℃ (77°F)
Tolerable ambient temperature	-30 to 90℃ -22 to 194°F
Polarity	Minus ground
Rotation direction	Clockwise, seeing from belt pulley