DAIHATSU

F300

CHARGING SYSTEM

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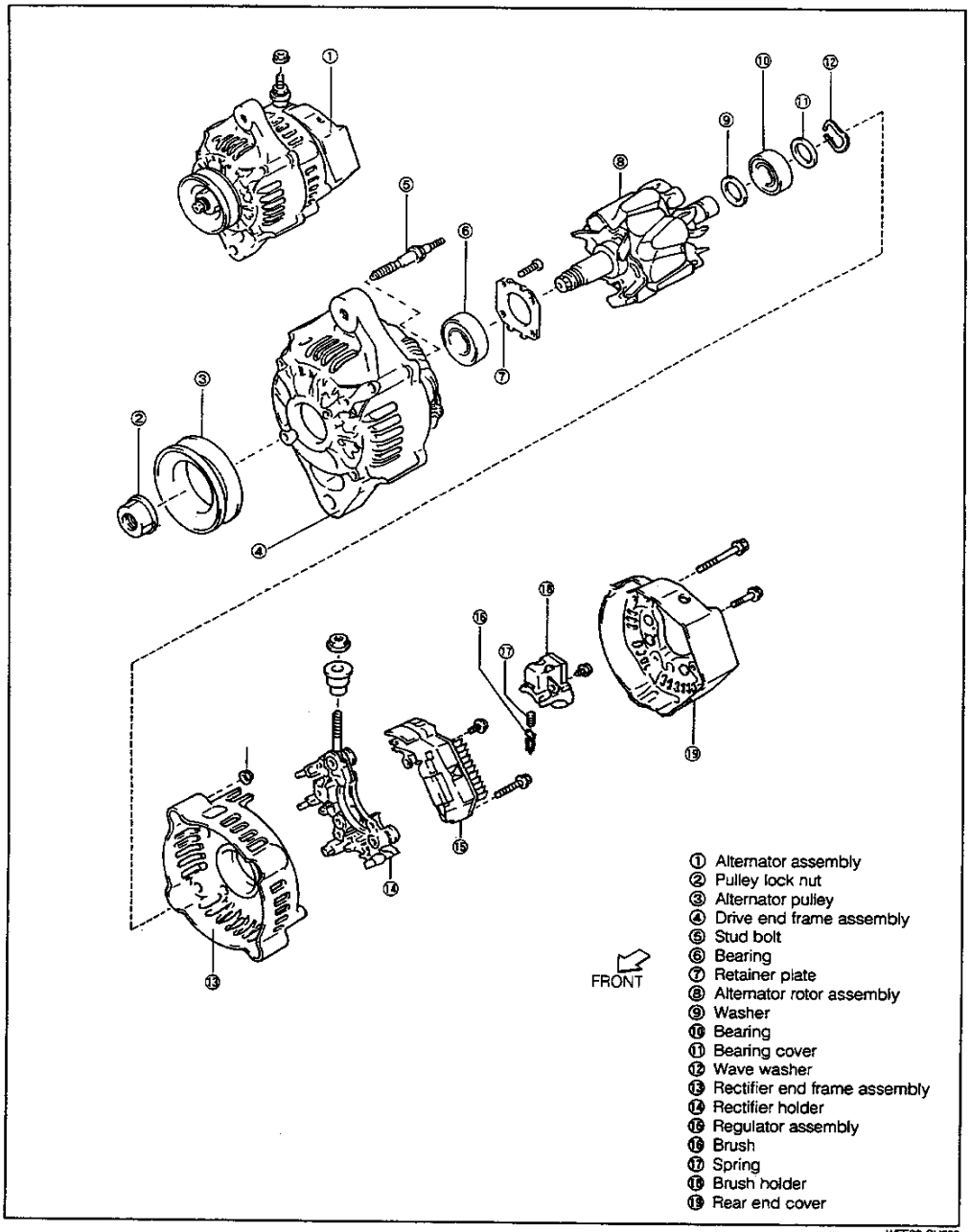
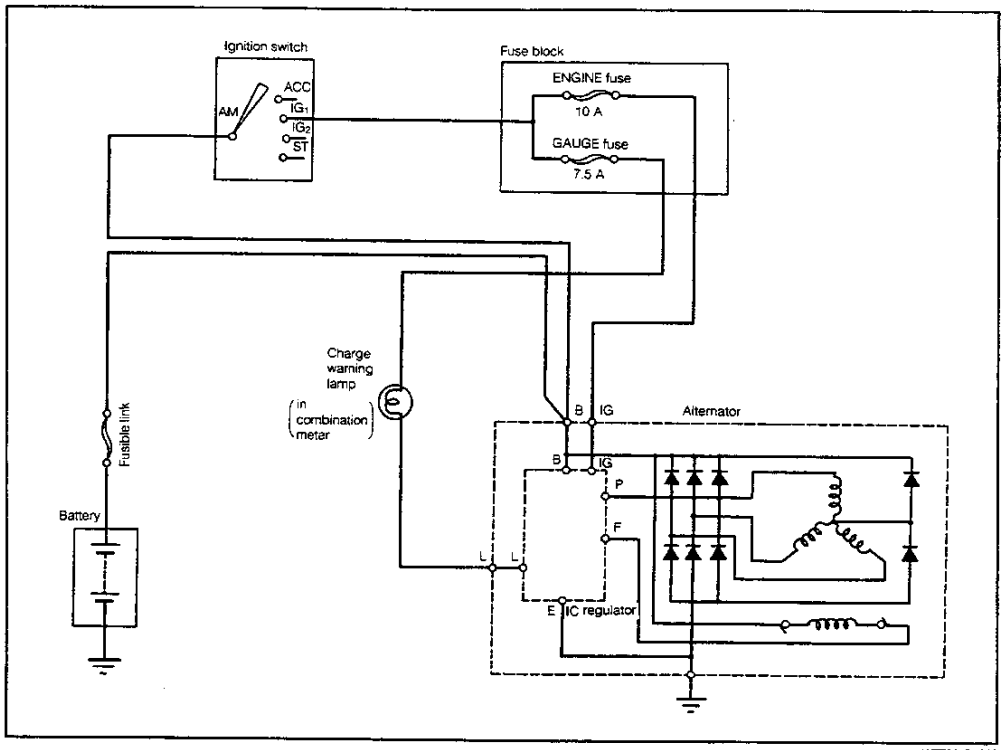
WFE90-CH001

1. COMPONENTS



WFE90-CH002

2. CHARGING SYSTEM CIRCUIT



WFE90-CH003

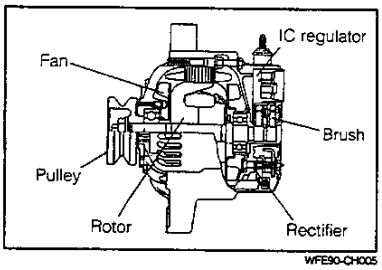
3. TROUBLE SHOOTING

Problem	Possible causes	Remedies
Charge warning lamp will not glow even if ignition switch is turned ON.	Fuse blown	Check gauge fuse.
	Lamp bulb burnt	Replace bulb.
	Poor connection of wiring	Repair poor connection of wiring.
	Open wire	Repair or replace.
	IC regulator faulty	Replace regulator assembly.
Charge warning lamp will not go out even if engine has started.	Drive belt loose or worn	Adjust or replace.
	Battery cables loose, corroded or worn	Repair or replace cables.
	Fuse blown	Check gauge fuse.
	Fusible link blown	Replace fusible link.
	IC regulator or alternator faulty	Check charging system.
	Wiring faulty	Repair or replace.

WFE90-CH004

4. DESCRIPTION

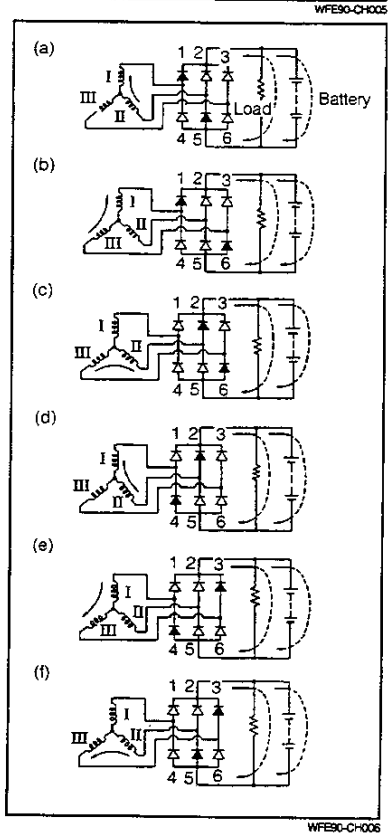
The charging device consists of an alternator and a regulator. The alternator produces alternating current (AC), which is converted to direct current (DC) by a rectifier.
The battery supplies power for operating the starter as well as power required while the engine is stopped.
The alternator recharges the battery so as to maintain it in an operational state at all times. The alternator also furnishes power for the electric equipment.



WFE90-CH005

Electricity is produced when a magnet is moved in the vicinity of a coil. When the magnet is getting close to the coil, voltage is produced in one direction. However, when the magnet is leaving the coil, the direction of the voltage changes. This type of current is generally called alternating current, for the direction of the current is alternating.
The main purpose of a generator for motor vehicles is to charge the battery. Hence, a generator which produces alternating current is not suited for this purpose. It is, therefore, necessary to convert alternating current to direct current. As semiconductor technology has advanced, today it has become possible to convert alternating current to direct current at a low cost. Consequently, alternators (AC generators) have been commonly used. The following are advantages of alternators compared with DC generators.
(1) Compact design, light weight and remarkable vibration-resistant characteristics
(2) Capable of withstanding high-speed rotation, quick acceleration and deceleration.
(3) Being endurable under severe environment prevailing with dirt, dust and moisture, etc.
(4) Having a fewer number of consuming parts and being easy to repair

The alternator has three pairs of stator coils and rotor (coil) and produces three-phase current. The alternator employs six rectifiers, which performs three-phase full-wave rectification. The generated voltage (electromotive force) is in proportion to the strength of the magnetic field (magnet). This means that the voltage is proportional to the current of the rotor coil and to the rotation speed, i.e. the moving speed of the magnet.
The generated voltage varies as the engine revolution speed of the vehicle changes. It is, therefore, necessary to regulate the voltage so that the battery can be charged. For this purpose, the current of the rotor coil is regulated, thereby producing a regulated generator voltage. To achieve this operation, a regulator has been employed.
The regulator is of an IC (integrated circuit) type and it is built inside the alternator itself.



WFE90-CH006

The electromotive force generated in a coil is generally expressed by the following formula.

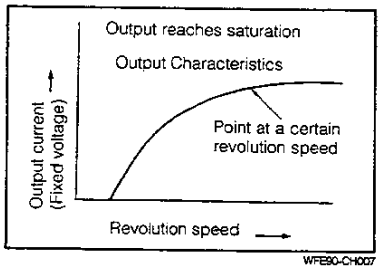
$$e = -N\cdot\frac{d\phi}{dt}$$

where,

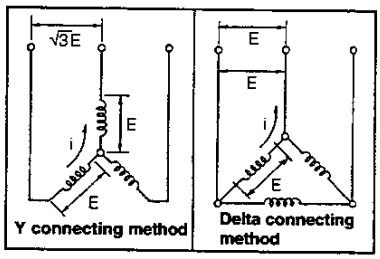
e : Induced electromotive force in coil (V)
N : Number of turns of wire in coil
$\frac{d\phi}{dt}$: Rate of change in magnetic flux (ϕ) per unit time
– : This means voltage is generated in such a direction that the change in magnetic flux is prevented.

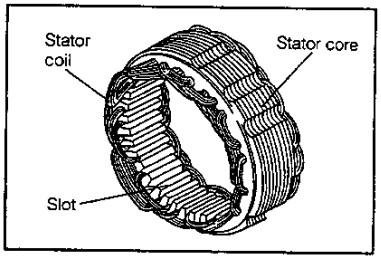
The magnetic flux increases in proportion to the current of the rotor coil. However, as the magnetic flux is reaching a saturation point, the increase of the magnetic flux is no longer proportional to the current.

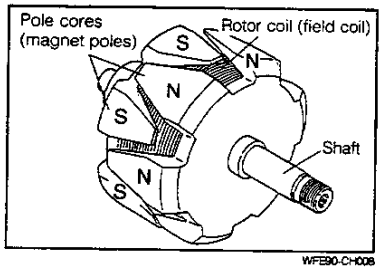
The output of the alternator increases as the rotation ($\frac{d\phi}{dt}$) increases, eventually reaching a saturation point.
This saturation is believed to be caused by the decline of the rate of change ($\frac{d\phi}{dt}$) i.e. the rate of change in magnetic flux (ϕ) per unit time when the magnetic flux of the rotor is applied to the stator coil.
Besides the controlling by the magnetic flux and rotation speed described above, the output is restricted by the electric resistance of the stator coil. This resistance, mainly attributable to the induction reactance of ac current, increases as the frequency (rotation speed) rises.



The alternator is so designed that its electromotive force is generated at the stator coil. Therefore, the alternator features easy cooling and virtually trouble-free operation.
To connect the three pairs of stator coils, a "Y" connecting method is employed. Although this Y connecting method is inferior to a Delta-type connecting method in the maximum output current, the Y connecting method has a greater electromotive force at lower speeds. Moreover, the Y connecting method has an advantage of use of the neutral point. For these reasons, the Y connecting method has been widely used on small capacities less than 1 kW.
The stator assembly is made up of a laminated iron frame. This construction has been adopted so as to hold the stator coil and allow the magnetic flux from the rotor to pass through the coil easily (improvement of permeability).
The installation of an iron core in the coil increases the self inductance. This causes an increase of the inductive reactance in the case of AC current, resulting in reduced electromotive force. However, in the case of comparatively-low frequencies, the installation of iron core has more favorable effects in increasing the electromotive force which is attained by improved permeability, even counteracting the aforesaid disadvantage. For this reason, the iron core is generally employed. The purpose of slots provided at the core is to retain the wound stator coil. These slots also serve as magnetic flux passages which have been so designed that the rotor magnetic flux intersects the stator coil effectively.

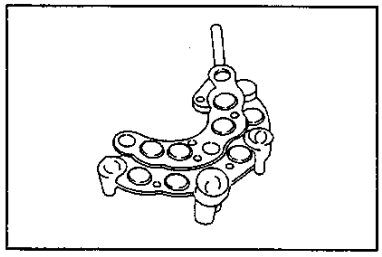


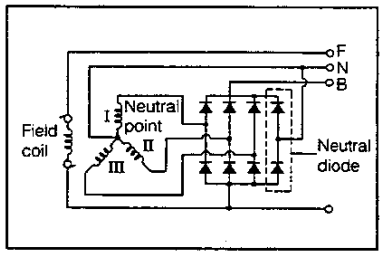


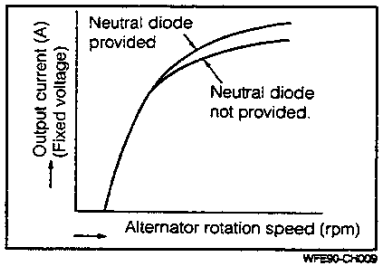


CHARGING SYSTEM

Theoretically speaking, six pieces of diodes are sufficient for full-wave rectification. However, the latest alternators have employed two more diodes for the purpose of utilizing the electromotive force at the neutral point. As a result, the latest alternator can produce a greater output current than the conventional alternators.



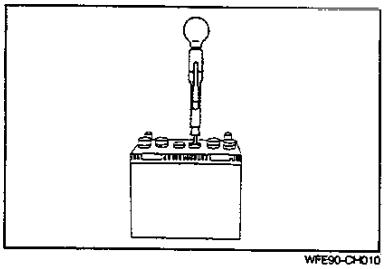




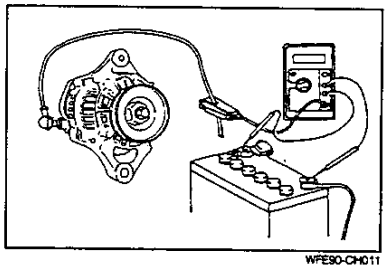
WFE90-CH009

5. IN-VEHICLE INSPECTION

(1) Prior to the in-vehicle inspection, be sure to perform the following checks.
- ① Specific gravity of battery electrolyte
- ② Installation of battery terminals
- ③ Tension of V-belt
- ④ Fuse
- ⑤ Wiring harness
- ⑥ Abnormal noise emitted from alternator while engine is rotating

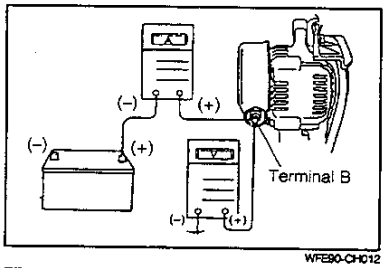

WFE90-CH010

(2) Output test under unloaded state
- ① Ensure that all switches are turned OFF so that no unnecessary electric load may be applied.
  - Headlamps
  - Heater blower
  - Radio
  - Rear defogger
  - Room lamp, etc.


WFE90-CH011

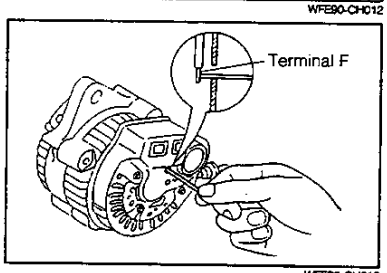
- ② Raise the engine revolution speed gradually to 2000 rpm. Measure the current and voltage at 2000 rpm.
  Specifications: Not to exceed to 10 A
  14.2 - 14.8 V

NOTE:
Immediately after the engine starting, the current may jump to 10 A or more momentarily. This is not an abnormal phenomenon.



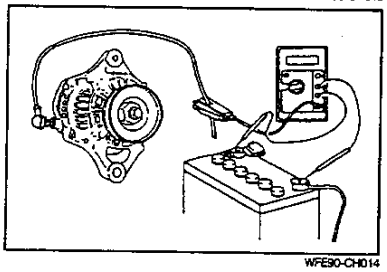
WFE90-CH012

If the voltage reading is less than the standard voltage, ground the terminal F as indicated in the right figure. Proceed to start the engine.
If the voltage reading becomes greater than the standard voltage under this setting, replace the IC regulator.
If the voltage reading is still less than the standard voltage under this setting, check the alternator.



WFE90-CH013

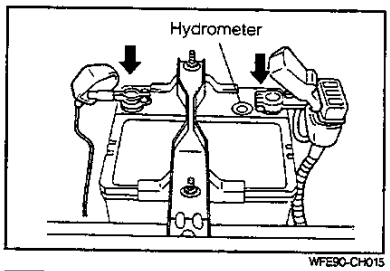
(3) Output test under loaded state
- ① To apply electric load, perform the following operation.
  a. Set the headlamps to the upper-beam position.
  b. Set the heater blower to the "High" position.
- ② Measure the output current of the alternator at the engine speed of 2000 rpm.
  Specified Value: 30 A or more


WFE90-CH014

NOTE:
When the battery is fully charged, the measured current may be below the specified value. This is not an abnormal phenomenon. At this time, increase the electric load, for example, by turning ON the rear defogger. Then, check to see if the output current rises or not.

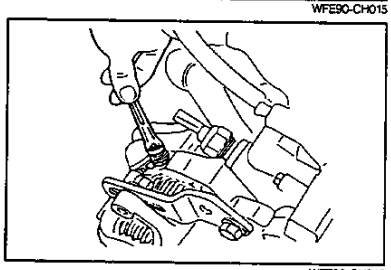
6. REMOVAL

(1) Disconnect the ground cable terminal from the negative (–) terminal of the battery.

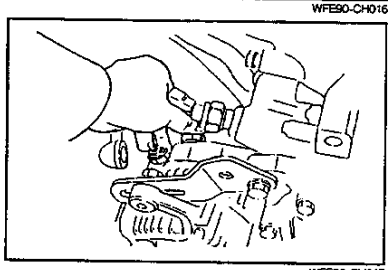


WFE90-CH015

(2) Disconnection of wires from alternator
① Remove the nut and wire from the alternator.


WFE90-CH016

② Disconnect the connector from the alternator.


WFE90-CH017

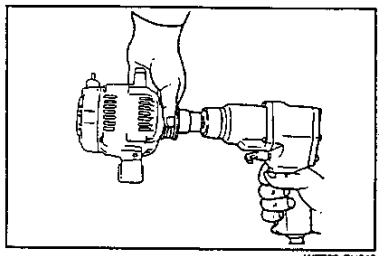
(3) Removal of alternator drive belt
Loosen the alternator attaching bolts. Remove the drive belt.

(4) Removal of alternator
① Remove the alternator attaching bolts.
② Remove the alternator from the engine compartment.

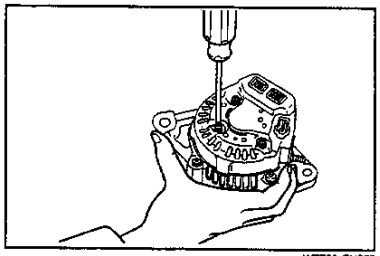
WFE90-CH018

7. DISASSEMBLY

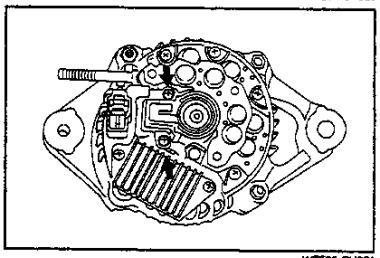
(1) Remove the alternator pulley lock nut by means of an impact wrench.
NOTE:
Be sure to use an impact wrench having a hexagonal hole.


WFE90-CH019

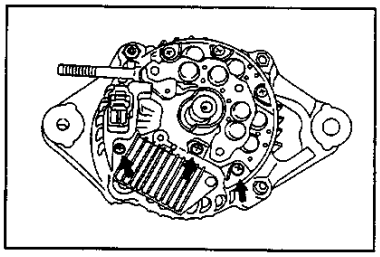
(2) Removal of rear end cover
① Remove the nut and terminal insulator.
② Remove the three screws.
③ Remove the rear end cover.

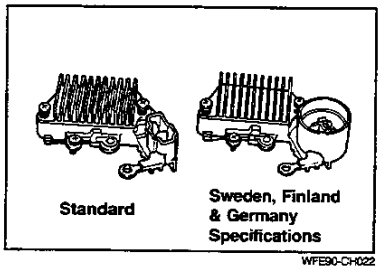

WFE90-CH020

(3) Remove the brush holder.


WFE90-CH021

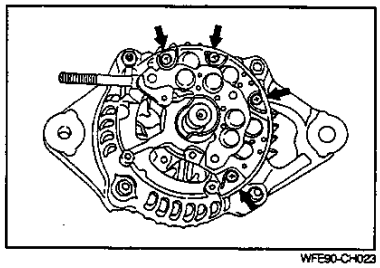
(4) Remove the regulator assembly.



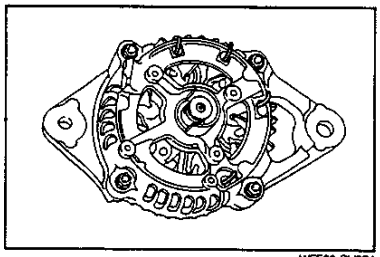


WFE90-CH022

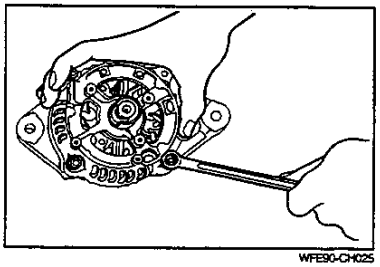
(5) Removal of rectifier holder
① Remove the attaching screws.


WFE90-CH023

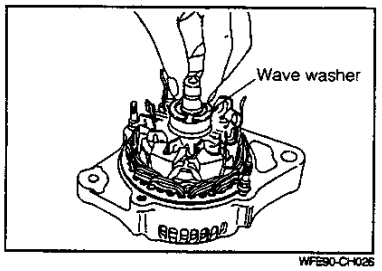
② Straighten the stator wire.
③ Remove the rectifier holder.


WFE90-CH024

(6) Remove the rectifier end frame from the drive end frame by removing the two nuts and bolts.
NOTE:
- **Be very careful not to damage the stator wire.**
- **If any difficulty is encountered in the removal, lightly tap the shaft with a plastic hammer to facilitate the removal.**


WFE90-CH025

(7) Remove the rotor from the drive end frame assembly.



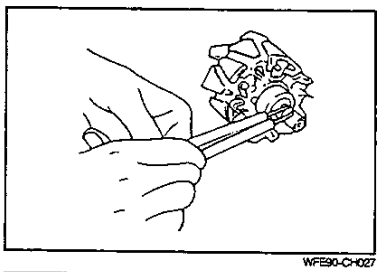
WFE90-CH026

8. INSPECTION

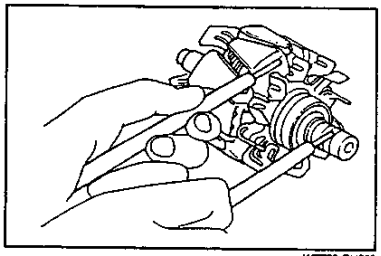
(1) Rotor

① Inspection of rotor for open circuit
Using an ohmmeter, check to see if specified resistance exists between the rotor slip rings.
Standard Resistance: 2.9 ± 0.2 Ω

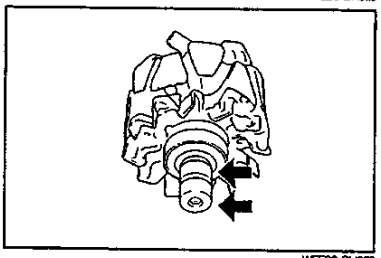
If no specified resistance exists, replace the rotor.


WFE90-CH027

② Inspection of rotor for ground
Ensure that no continuity exists between the rotor slip rings and the rotor core.
If continuity exists, replace the rotor.

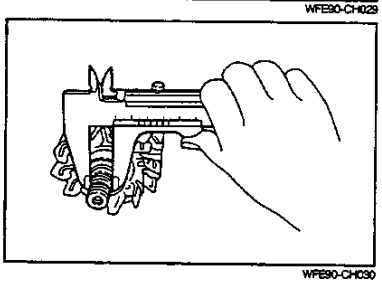

WFE90-CH028

③ Inspection of slip rings
a. Check to see if the slip ring surface exhibits roughness, abnormal wear and/or burning.
Replace the rotor, if necessary.


WFE90-CH029

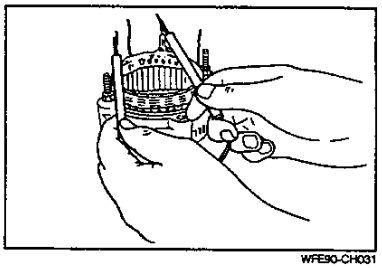
b. Measure the outer diameter of the slip ring, using vernier calipers.
Standard diameter: 14.4 mm
Minimum diameter: 14 mm

If the slip ring diameter is less than the minimum diameter, replace the rotor assembly.

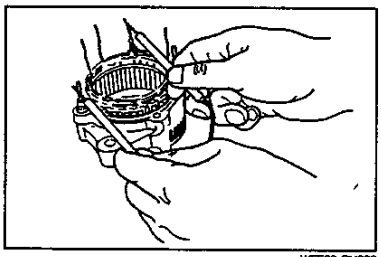

WFE90-CH030

(2) Stator

① Inspection of stator for open circuit
Using an ohmmeter, check to see if any open circuit of the stator coil is present between the leads.
If no continuity exists, replace the end frame assembly.
Specified Resistance: About 0.2 Ω


WFE90-CH031

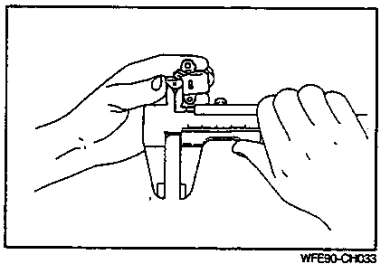
② Inspection of stator for short circuit
Using an ohmmeter, check to see if any short circuit of the stator coil is present between the coil lead and the drive end frame.
If continuity exists, replace the drive end frame assembly.


WFE90-CH032

(3) Brush and Brush Holder

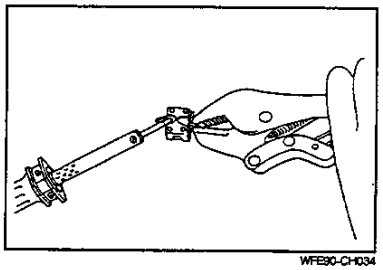
① Measurement of exposed brush length
Measure the exposed brush length, using a scale.
Standard exposed length: 10.5 mm
Minimum exposed length: 1.5 mm

If the exposed length is less than the minimum requirement, replace the brushes.


WFE90-CH033

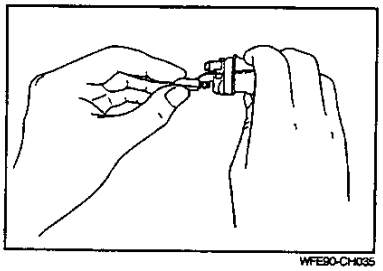
② Replacement of brushes (If necessary)
a. Remove the brush and spring from the brush holder by melting the solder by means of a soldering iron.

NOTE:
- **Prior to the operation, remove the painting film at the solder surface with a knife or the like.**
- **For this operation, it is advisable to use a soldering iron with a capacity of about 40 W.**

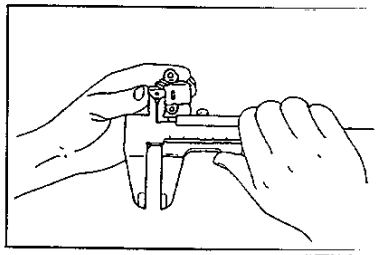

WFE90-CH034

b. Install the brush cord in the brush holder with the spring fitted in place.

NOTE:
Using a knife, etc., remove the soldered section of the brush holder to form a flat surface until the bare metal is exposed.

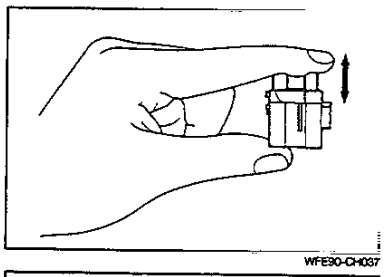

WFE90-CH035

c. Solder the brush cord in the brush holder in such a way that the exposed length of the brush meets the specification.
Standard exposed length: 10.5 mm

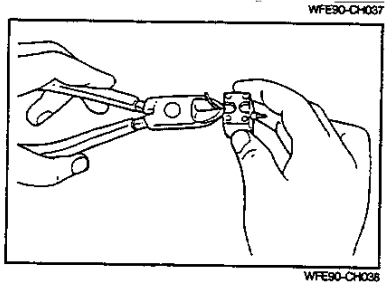


NOTE:
- Prior to the operation, let solder flow onto the forward end of the brush wire.
- To facilitate soldering:
  Route the wire through the holder hole and adjust the exposed length of the brush to the specification. Bend the wire at its forward end on which solder has been applied in the preceding step. Then, solder the wire to the holder.

d. Ensure that the brush moves freely in the brush holder.



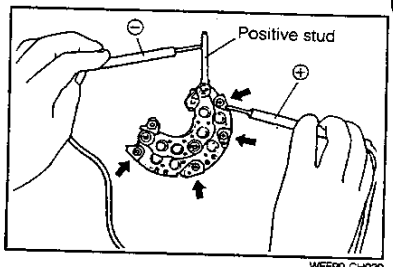
e. Cut off any excess remaining wire and apply an insulation paint.



(4) Rectifier

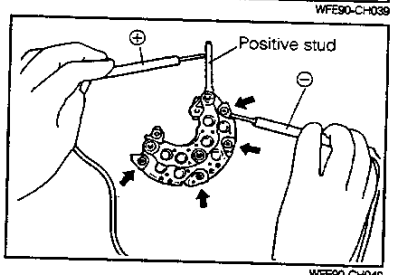
① Inspection of rectifier at positive ⊕ side

a. While using an ohmmeter, connect one tester probe to the positive stud. Also, connect the other probe to each of the rectifier terminals.



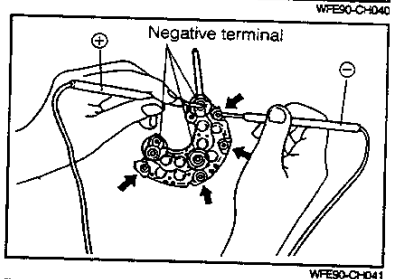
b. Repeat the same steps described in a. above with the polarity of the tester probes reversed this time.

c. Ensure that continuity exists either in the step a. or in the step b. and no continuity exists at the other test.
If not, replace the rectifier holder.



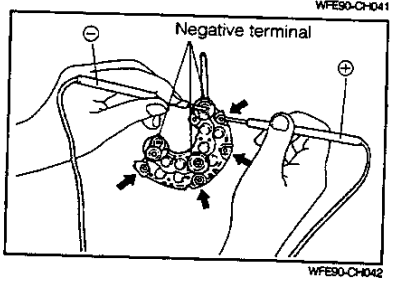
② Inspection of rectifier at negative ⊖ side

a. While using an ohmmeter, connect one tester probe to each rectifier negative terminal. Also, connect the other probe to each rectifier terminal.



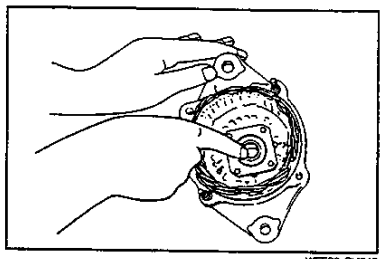
b. Repeat the same steps described in a. above with the polarity of the tester probes reversed this time.

c. Ensure that continuity exists either in the step a. or in the step b. and no continuity exists at the other test.
If not, replace the rectifier holder.

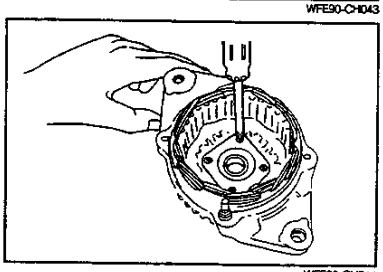


(5) Bearings

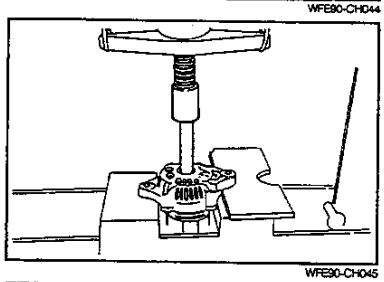
① Inspection of front bearing
Ensure that the bearing turns smoothly.
Replace the bearing, if necessary.


WFE90-CH043

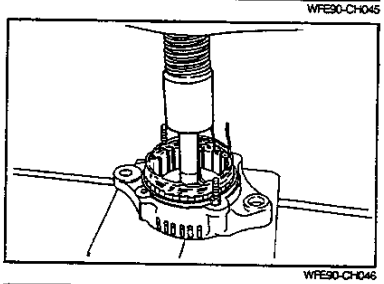
② Replacement of front bearing (If necessary)
a. Remove the four screws and retainer plate.


WFE90-CH044

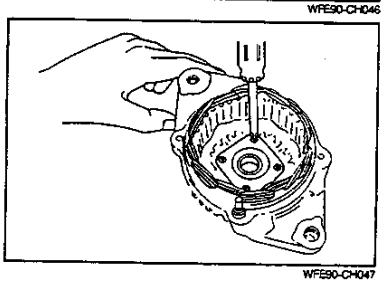
b. Remove the front bearing from the drive end frame, using a socket wrench in conjunction with a press.


WFE90-CH045

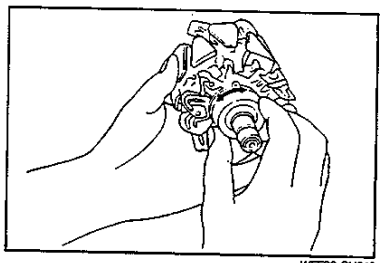
c. Press the new front bearing into the drive end frame, using suitable socket wrench.


WFE90-CH046

d. Attach the retainer plate to the drive end frame with the four screws.

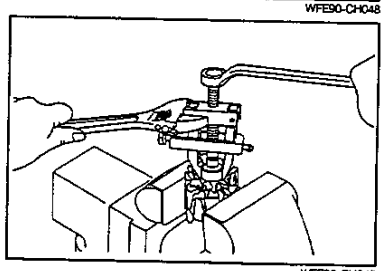

WFE90-CH047

③ Inspection of rear bearing
Ensure that the bearing turns smoothly.
Replace the bearing, if necessary.

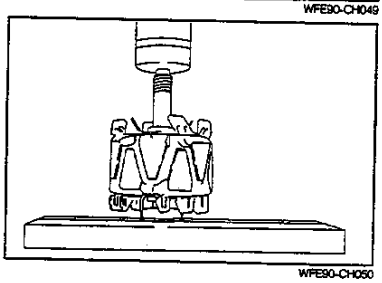

WFE90-CH048

④ Replacement of rear bearing (if necessary)
a. Remove the rear bearing and bearing cover from the rotor, using the armature bearing puller.

NOTE:
Be very careful not to damage the fan during the removal.

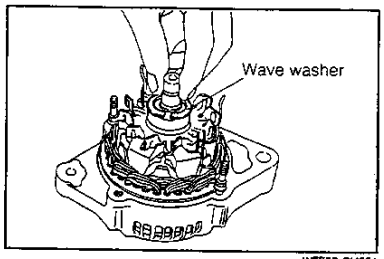

WFE90-CH049

b. Press a new rear bearing with spacer, using a hydraulic press.
c. Press a new bearing cover, using a suitable steel pipe.


WFE90-CH050

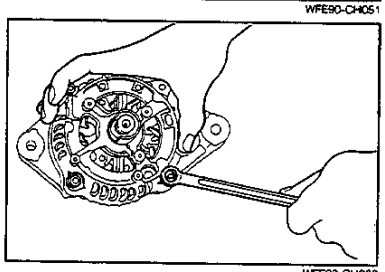
9. ASSEMBLY

(1) Install the rotor into the drive end frame assembly.

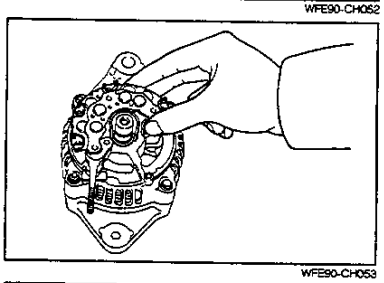


WFE90-CH051

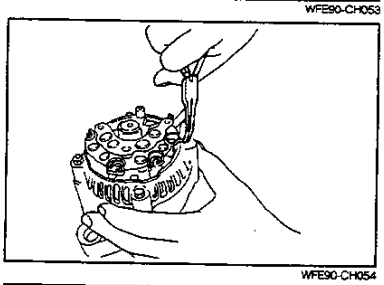
(2) Installation of rectifier end frame on drive end frame.
Install the rectifier end frame on the drive end frame with the two bolts and two nuts.
NOTE:
- **Be very careful not to damage the stator wire during the installation.**
- **If some resistance is encountered during the insertion, lightly tap the frame with a plastic hammer.**


WFE90-CH052

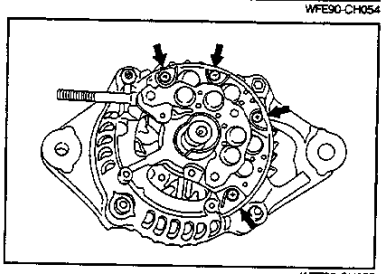
(3) Installation of rectifier holder, regulator assembly and brush holder.
① Attach the rectifier holder to the end frame with the stator wires passed through the aperture of the rectifier holder.


WFE90-CH053

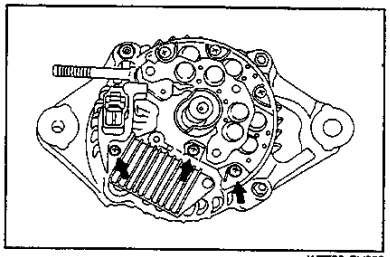
② Wind the stator wire around the installing section of the rectifier attaching screws.


WFE90-CH054

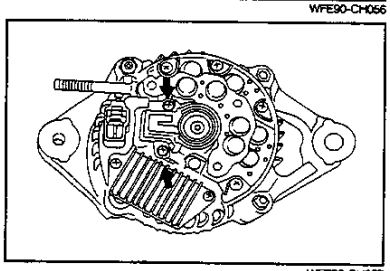
③ Secure the four attaching screws.


WFE90-CH055

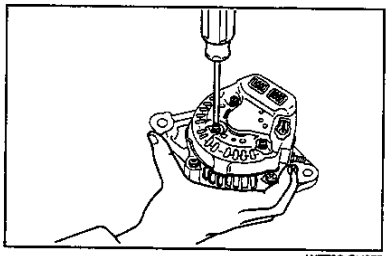
(4) Install the regulator assembly with the three attaching screws.


WFE90-CH056

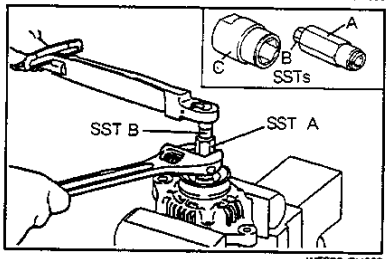
(5) Install the brush holder in such a way that a gap of at least 1 mm (0.04 inch) is provided between the brush holder and the regulator assembly. Secure the brush holder with the two screws.


WFE90-CH057

(6) Installation of rear cover
   ① Install the rear end cover with the three attaching screws.
   ② Install the terminal insulator and tighten it with the nut.


WFE90-CH058

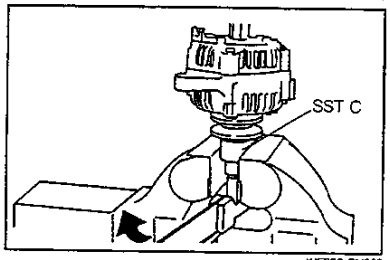
(7) Attach the pulley to the alternator shaft.
(8) Tighten the SST B to the specified torque. Secure the the SST B to the alternator shaft.
   SSTs: 09820-87201-000
   Specified Torque: 39 N·m (4 kgf-m)



WFE90-CH059

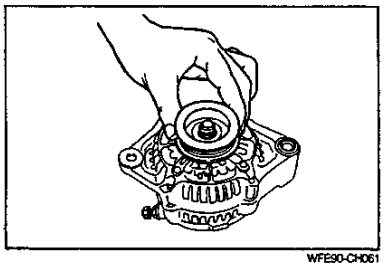
(9) Clamp the SST C in a vise. Tighten the nut by turning the SST B.
   Specified Torque: 110 N·m (11.25 kgf-m)

(10) Remove the SSTs A and B.



WFE90-CH060

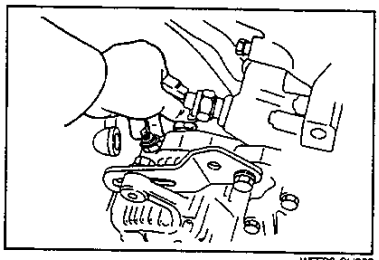
(11) Ensure that the rotor turns smoothly.



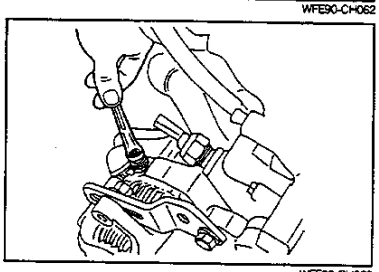
WFE90-CH061

10. INSTALLATION

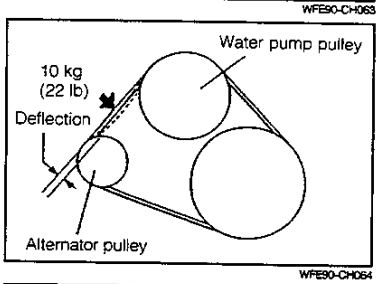
(1) Temporarily install the alternator on the engine with the two attaching bolts.
(2) Connection of wire to alternator
① Connect the connectors to the alternator.


WFE90-CH062

② Install the wire and nut to the alternator.

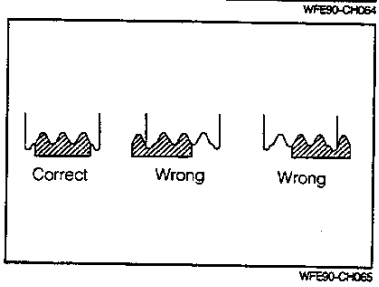

WFE90-CH063

(3) Installation of alternator drive belt
① Install the alternator drive belt properly.
NOTE:
Make sure that the alternator drive belt is properly engaged in the grooves of each pulley.



WFE90-CH064

② Tension adjustment of drive belt
Adjust the belt tension in such a way that the deflection of the drive belt meets the specification when you push the midpoint of the drive belt between he alternator pulley and the water pump pulley by applying a force of 98 N (10 kgf).
Specified Belt Deflection
New belt: V belt: 5.0 - 7.0 mm
V-ribbed belt: 4.0 - 5.0 mm
Used belt: V belt: 6.0 - 8.0 mm
V-ribbed belt: 5.0 - 6.0 mm



WFE90-CH065

NOTE:
- "New belt" refers to a belt with has been used less than 5 minutes on a running engine.
- "Used belt" refers to a belt which has been used on a running engine 5 minutes or more.
- If belt replaced with new one, run the engine for about 5 minutes and then recheck the tension.

(4) Reconnect the ground cable terminal to the negative (–) terminal of the battery.

WFE90-CH066