

SECTION 10

CHARGING SYSTEM

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10-1. ALTERNATOR

GENERAL DESCRIPTION

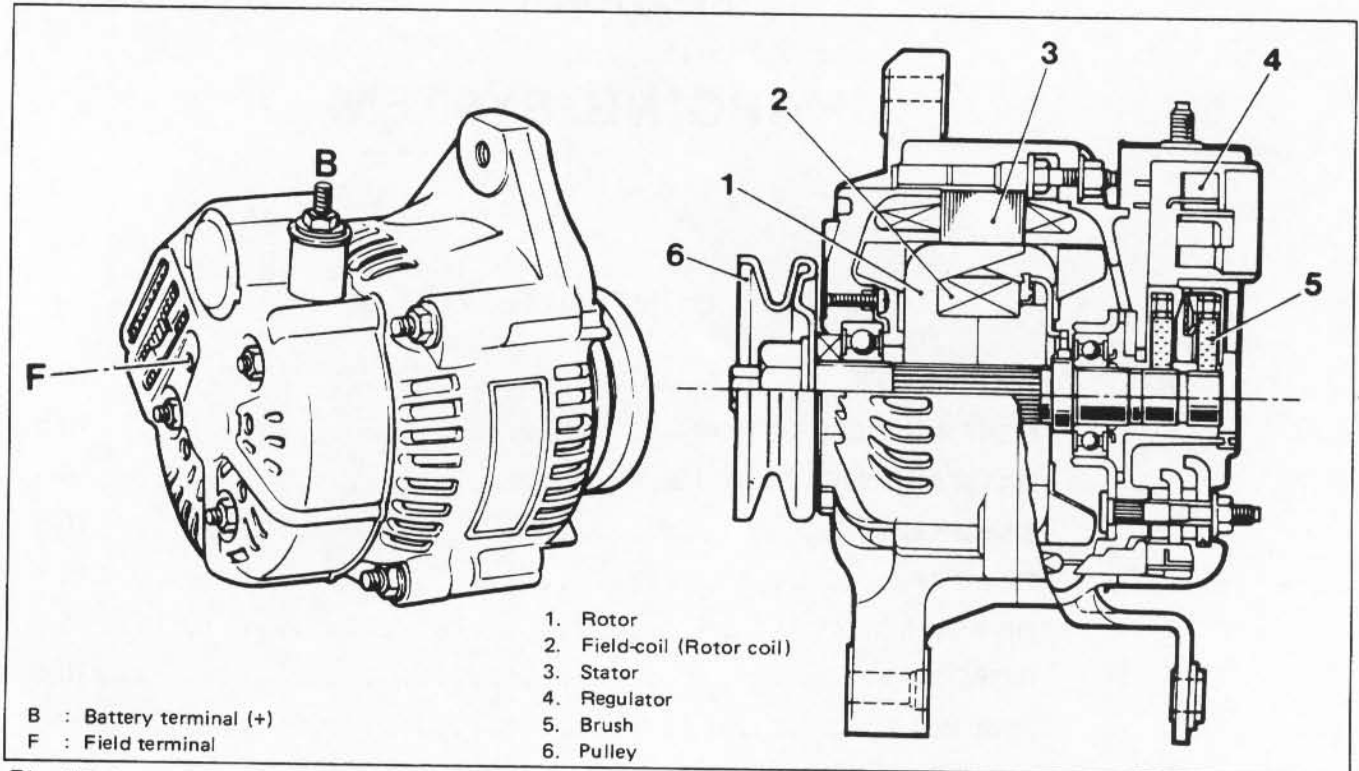


Fig. 10-1

The basic charging system is the IC integral regulator charging system. The internal components are connected electrically as shown below.

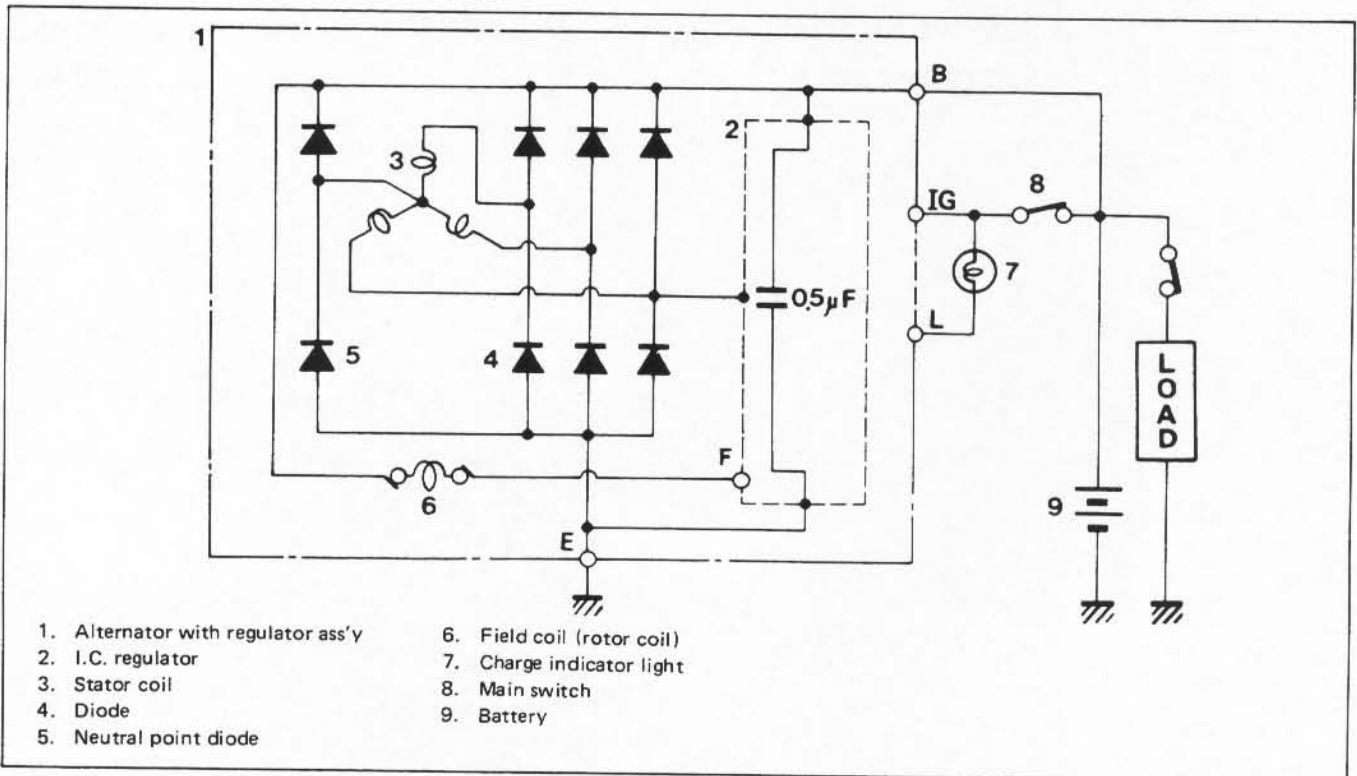


Fig. 10-2

The alternator features a solid state regulator that is mounted inside the alternator. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The regulator voltage setting cannot be adjusted.

The alternator rotor bearings contain enough grease to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long period of attention-free service.

The stator windings are assembled on the inside of a laminated core that forms part of the alternator frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator A.C. voltages to a D.C. voltage which appears at the generator output terminal.

The neutral diodes serve to convert the voltage fluctuation at the neutral point to direct current for increasing the alternator output.

A condenser mounted in the end frame protects the diodes from high voltages and suppresses radio noise.

DATA AND SPECIFICATION

Nominal operating voltage	12 volts
Max. alternator output	45A
Polarity	Negative ground
No-load alternator speed	1,110 rpm (r/min)
Regulated voltage	14.5 ± 0.3 V
Direction of rotation	Clockwise as viewed from pulley side
Maximum permissible alternator speed	15,000 rpm (r/min)
Working temperature range	-30 ~ 90° C (-22 ~ 194° F)
Rectification	Full wave rectification

Noisy Alternator

Noise from the alternator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode, or defective stator.

DIAGNOSIS

A charging circuit wiring diagram for alternator connection is shown above. To avoid damage, always follow these precautions:

- 1) Do not mistake the polarities of IG terminal and L terminal.
- 2) Do not create short circuit between IG and L terminals. Always connect these terminals through a lamp.
- 3) Do not connect any load between L and E.

Trouble in the charging system will show up as one or more of the following conditions:

- a. Faulty indicator lamp operation.
- b. An undercharged battery as evidenced by slow cranking or indicator clear with red dot.
- c. An overcharged battery as evidenced by excessive spewing of electrolyte from the vents.

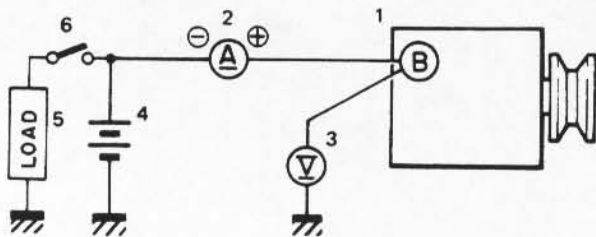
A. Faulty Indicator Lamp Operation

Problem	Possible cause	Correction
Charge light does not light with ignition ON and engine off	Fuse blown Light burned out Wiring connection loose IC regulator faulty	Check fuse Replace light Tighten loose connections Replace IC regulator
Charge light does not go out with engine running (battery requires frequent re-charging)	Drive belt loose or worn Battery cables loose, corroded or worn IC regulator or alternator faulty Wiring faulty	Adjust or replace drive belt Repair or replace cables Check charging system Repair wiring

B. Undercharged Battery

This condition, as shown by slow cranking or indicator clear with red dot, can be caused by one or more of the following conditions even though the indicator lamp may be operating normally. The following procedures also apply to cars with a voltmeter.

- 1) Insure that the undercharged condition has not been caused by accessories left on for extended period.
- 2) Check drive belt for proper tension.
- 3) If a battery defect is suspected, refer to latter part of this section, p. 10-10 ~ p. 10-13.
- 4) Inspect wiring for defects. Check all connections for tightness and cleanliness, including slip connectors at alternator and bulkhead, and battery cable connections at battery, starter and ignition ground cable.
- 5) Connect voltmeter and ammeter as shown in the diagram below.



1. Generator
2. Ammeter
3. Volt meter
4. Battery
5. Load
6. Switch

Fig. 10-3

a. Voltmeter

Set between alternator (B) terminal and ground.

b. Ammeter

Set between alternator (B) terminal and battery (+) terminal.

6) Current and voltage measurements

a. No-load check

Run engine from idling up to 2,000 r/min (rpm) and read meters.

Standard current	10 A maximum
Standard voltage	14.2 – 14.8 V (at 25° C, 77° F)

NOTE:

Consideration should be taken that the voltage will vary somewhat with regulator case temperature.

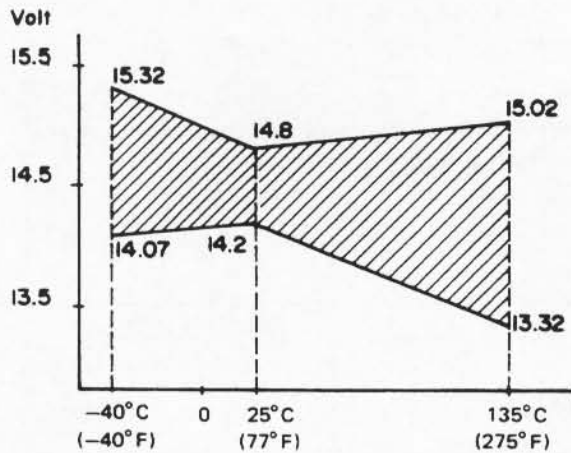


Fig. 10-4

If voltage is higher than standard value, replace IC regulator.

If voltage is below standard value, check IC regulator and alternator as follows:

Ground F terminal and start engine. Then measure voltage at B terminal.

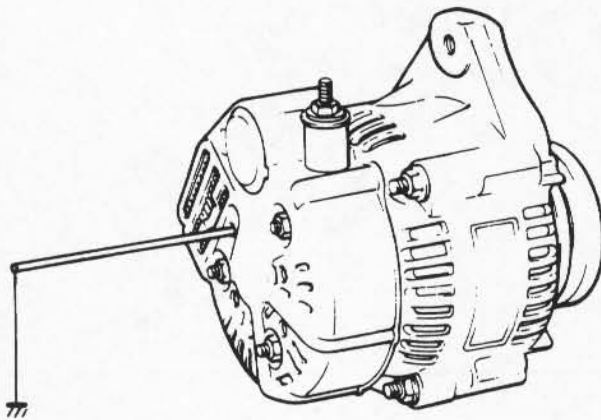


Fig. 10-5 Grounding terminal "F"

If voltage is above standard value, replace IC regulator.

If voltage is below standard value, check alternator.

b. Load check

Run engine at 2,000 r/min (rpm) and turn on headlamps and heater motor.

Measure current and if less than 20A, repair alternator.

C. Overcharged Battery

1) To determine battery condition, refer to latter part of this section, p. 10-10 ~ P. 10-13.

2) If an obvious overcharge condition exists as evidenced by excessive spewing of electrolyte, proceed to DISASSEMBLY under ALTERNATOR SERVICE on p. 10-6 and check field windings for grounds and shorts. If defective, replace rotor.

ALTERNATOR SERVICE

REMOVAL

- 1) Remove battery (-) terminal.
- 2) Disconnect alternator lead wires (coupler & white lead wire).
- 3) Unclamp brake pipe from pipe clamp on radiator under cover and remove radiator under cover.
- 4) Remove alternator mounting bolts and alternator drive belt adjusting bolt.
- 5) Take down alternator.

DISASSEMBLY

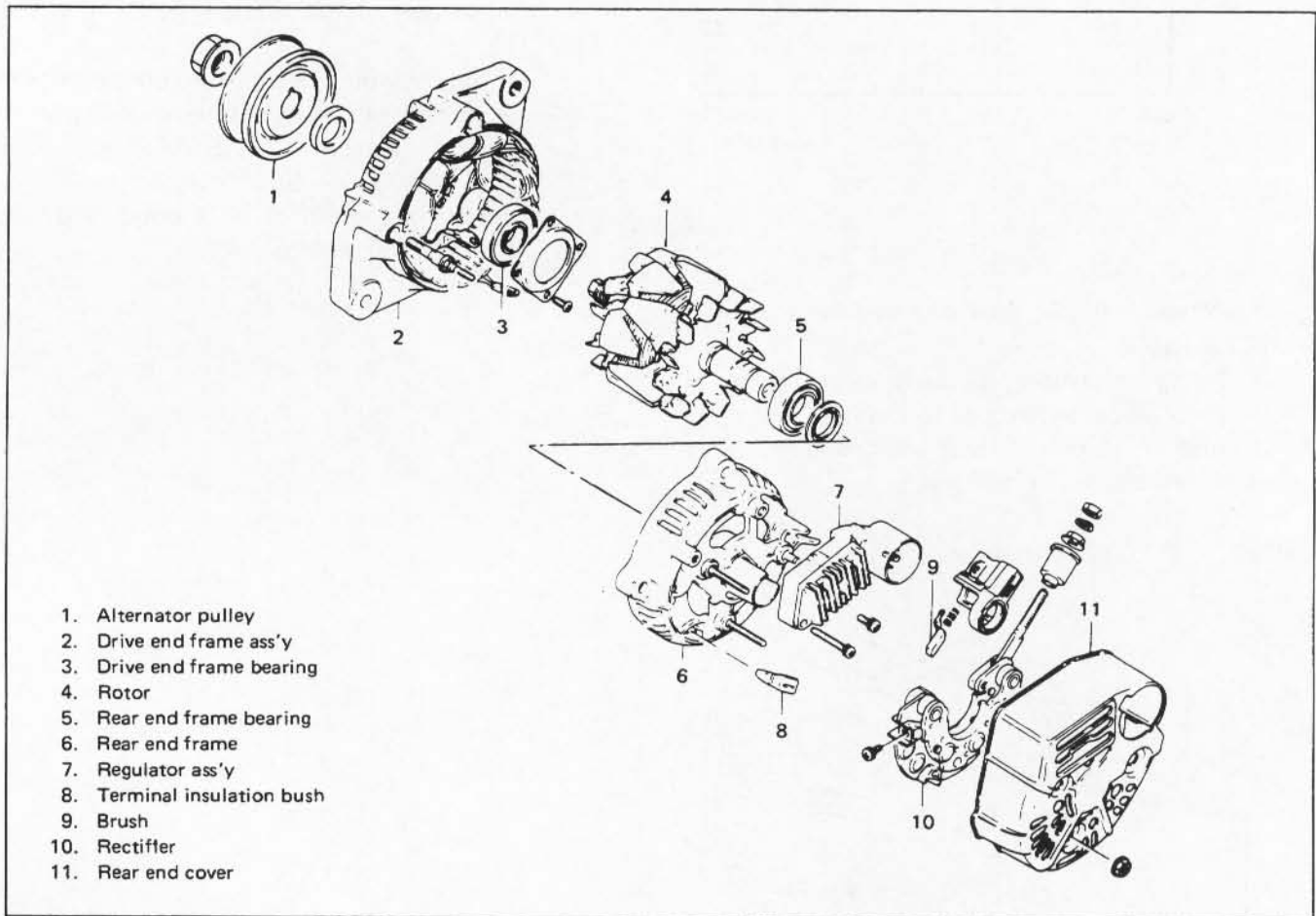
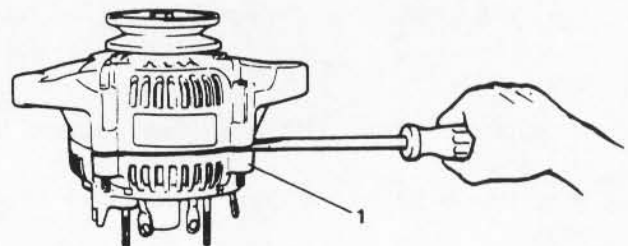


Fig. 10-6

- 1) Remove nut and take off B terminal insulator bushing.
- 2) Remove 3 nuts and take off rear end cover.
- 3) Remove 2 regulator mounting screws and 3 brush holder screws and take off regulator and brush holder.
- 4) Remove 4 stator coil terminal screws.
- 5) Remove rectifier holder together with I.C. regulator.
- 6) Remove 4 nuts and take off rear end frame.



1. Rear end frame

Fig. 10-7

7) Loosen alternator pulley nut and take off pulley.

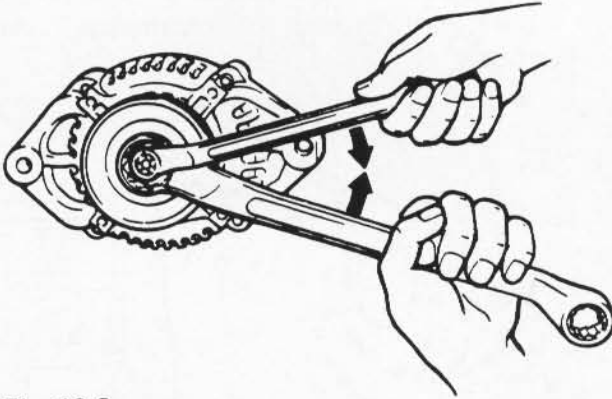


Fig. 10-8

10) When removing rear bearing, use bearing puller.

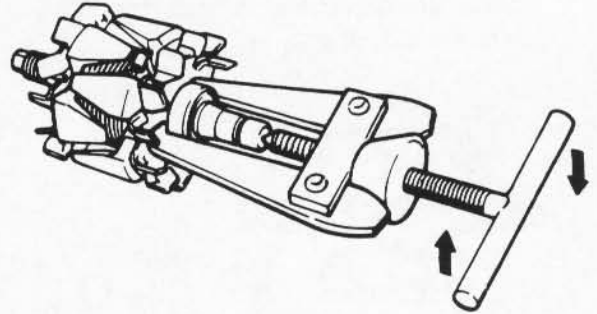


Fig. 10-11

8) Remove rotor from drive end frame.

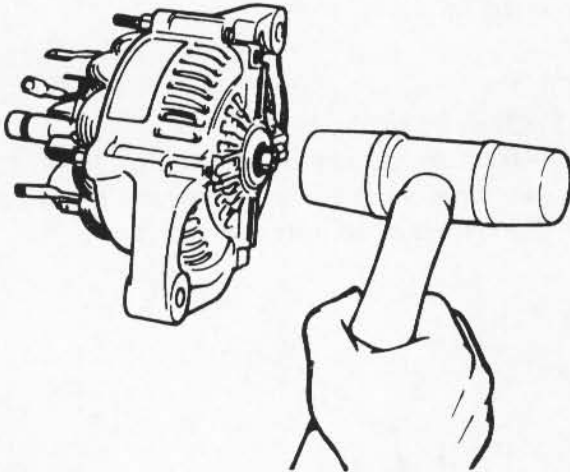
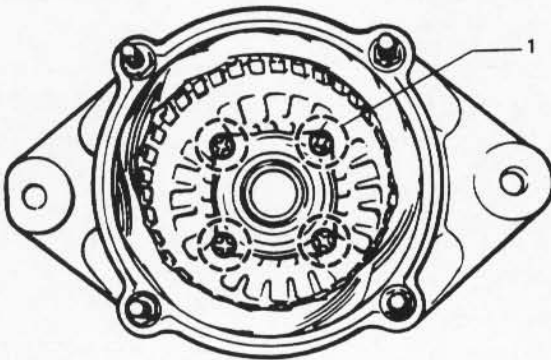


Fig. 10-9

9) When removing front end bearing, remove 4 4-mm bearing retainer screws.



1. Bearing retainer fitting screw

Fig. 10-10

INSPECTION

Rotor

- 1) Check rotor for no open circuits
Using an ohmmeter, check for continuity between slip rings.

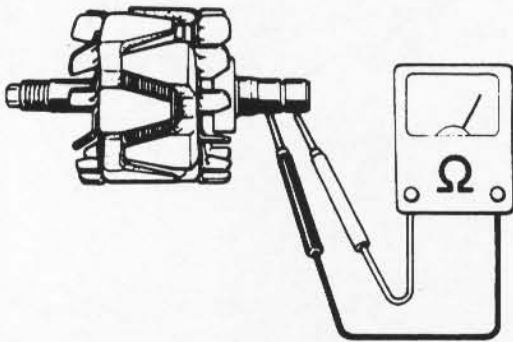


Fig. 10-12

Standard resistance	2.8 – 3.0 Ω
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If there is no continuity, replace rotor.

- 2) Check rotor for no grounds.
Using an ohmmeter, check that there is no continuity between slip ring and rotor.
If there is continuity, replace rotor.

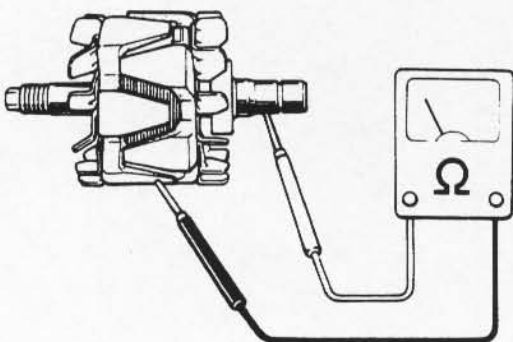


Fig. 10-13

- 3) Inspect slip rings
Check slip rings for roughness or scoring. If rough or scored, replace rotor.

Stator

- 1) Check stator for no open circuits
Using an ohmmeter, check all leads for continuity. If there is no continuity, replace stator.

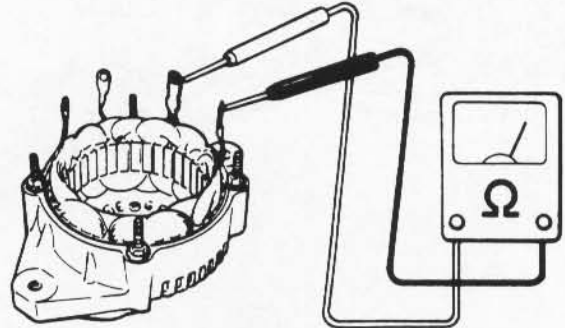


Fig. 10-14

- 2) Check stator for no grounds
Using an ohmmeter, check that there is no continuity between coil leads and stator core.
If there is continuity, replace rotor.

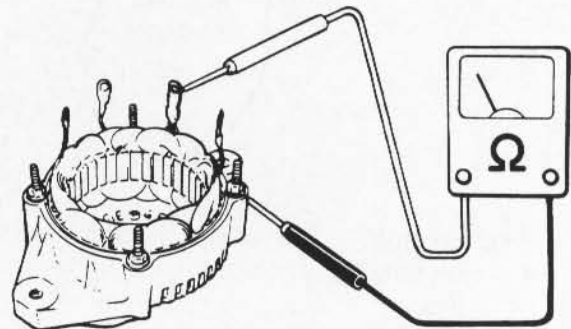


Fig. 10-15

Brush and Brush holder

Check each brush for wear by measuring its length as shown. If brush is found worn down to service limit, replace brush with holder.

Brush length	Standard	Service limit
	11 mm (0.43 in)	5 mm (0.20 in)

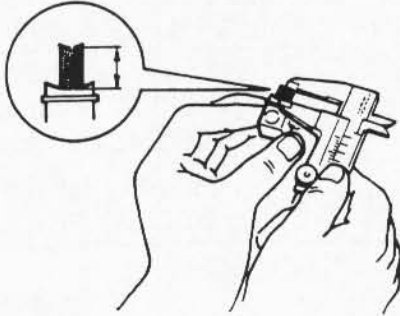


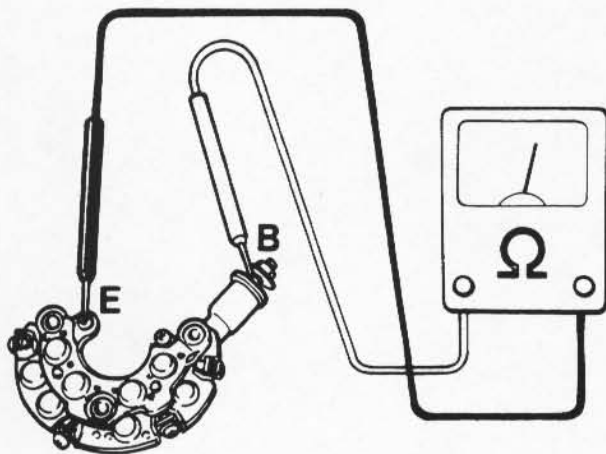
Fig. 10-16

Rectifier

Using an ohmmeter, check continuity between "B" terminal and ground.

Put one tester lead to terminal "B" and the other lead to ground; then swap two leads. Of two tester indications, one should be about 10 ohms, meaning continuity, and the other should be infinity (non continuity).

If not, replace rectifier assembly.



B : Battery terminal
E : Earth

Fig. 10-17

Condenser

Check condenser capacity in regulator.

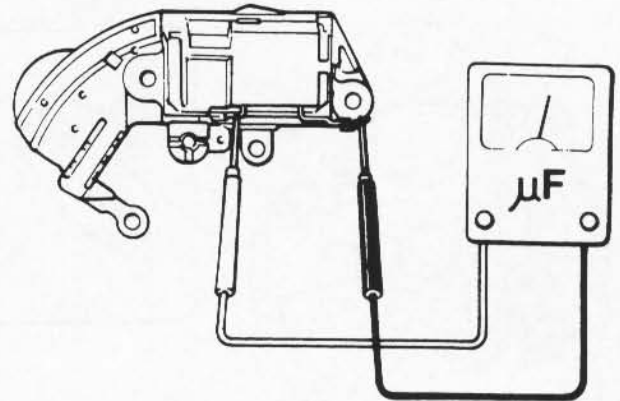


Fig. 10-18

Condenser capacity	0.5 μ F
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ASSEMBLY

Reverse disassembly procedure, using care on following points.

- 1) Use a press when forcing bearing into rotor shaft or drive end frame.

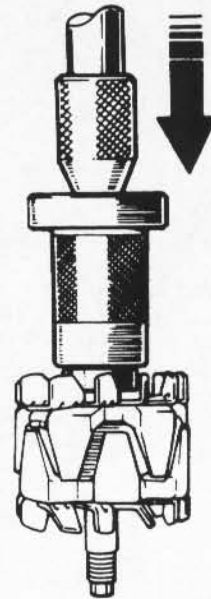
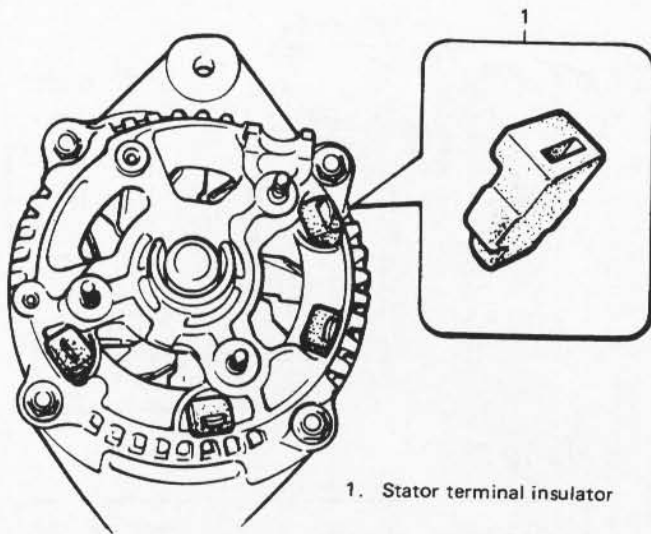


Fig. 10-19

- 2) Alternator pulley tightening torque.

Tightening torque		
50 – 65 N·m	5.0 – 6.5 kg·m	37 – 47 lb-ft

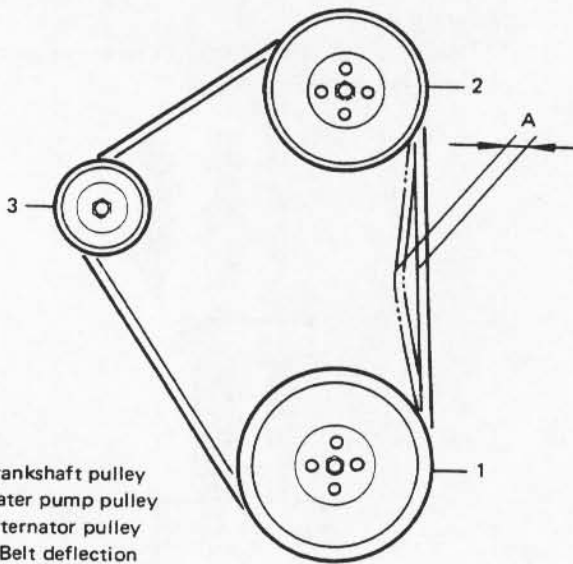
3) Make sure to assemble stator terminal insulator properly.



1. Stator terminal insulator

Fig. 10-20

4) Alternator V belt tension.



- 1. Crankshaft pulley
- 2. Water pump pulley
- 3. Alternator pulley
- A : Belt deflection

Fig. 10-21

Drive belt deflection (Under 10 kg thumb pressure)	6 – 9 mm (0.24 – 0.35 in)
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10-2. BATTERY

GENERAL DESCRIPTION

The battery mounted in each vehicle is one of the following three types, dependin on specification.

Model	NS40S [NX100-S6] [NX100-S6(S)]
Rated capacity	30AH [45AH] , 12 Volts
Electrolyte	2.2 liters [3.1 liters] (4.65/3.87 US/Imp. pt) [6.55/5.46 US/Imp. pt.]
Electrolyte S.G.	1.280 when fully charged at 20°C (68°F)

NOTE:

Clamp brake pipe with pipe clamp on radiator under cover after installing radiator under cover.

CARE OF THE BATTERY

The following information is basic in nature and is nothing new; it is merely a reiteration of what every Service shop personnel knows about the automotive storage battery. The information is intended to serve as a reminder to the reader, with a hope that he will, in turn, remind each final user of the important basic facts about the battery whenever opportunity permits him to engage in a conversation with the final user in the shop or out of the shop.

1) The battery is a very reliable component, but needs periodical attentions.

Keep the battery container clean; prevent rust formation on the terminal posts; keep the electrolyte up to the upper level uniformly in all cells; and try to keep the battery fully charged at all times.

2) Preserve the capacity of the battery.

There is a limit to the ability of the battery to hold electricity is store. This limit is called "capacity."

There are several ways for the battery to lower its capacity:

a. Loss of electrolyte, or fall in electrolyte level.

When this happens, the battery cannot hold so much electricity as it originally could. Handle the battery with care when you take it down. Barring the loss of electrolyte by careless spilling or otherwise, the electrolyte level goes down gradually in the battery at work because the water content of it evaporates. Periodically refill distilled water to each cell, as necessary, so that the electrolyte is always up to the specified level. Never allow its surface to fall so much as to expose the cell plates.

b. Overcharging the battery in place or off the machine.

In recharging the battery off the machine, caution must be exercised so as not to overcharge it. Overcharging gives rise to several complexities. For one thing, it heats up the battery to deform the battery container to result in a destroyed battery. Overcharging could occur in a battery in place if the voltage regulator is maladjusted to allow the alternator (or the dynamo in other machines) to develop too high an output voltage. For another thing, "gassing" occurs in a battery being overcharged to result in a loss of water content. One of the most serious consequences of overcharging is the swelling of positive-plate grids, causing the grids to crumble and the plates to buckle.

c. Undercharging the battery in place.

Regulator malfunctioning is usually the cause of the battery remaining in a state of charge far below its capacity. This condition is very undesirable in freezing weather, for the electrolyte in such a battery can easily freeze up to result in a destroyed battery. Moreover, an undercharged battery is an easy prey to a greater evil-sulfation.

d. Sulfation

Let us recall the electrochemical reactions that take place in the battery during charging and discharging. As the battery gives out its energy (discharging), the active materials in its cell plates are converted into lead sulfate. During recharging, this lead sulfate is reconverted into active material. If the battery is allowed to stand for a long period in discharged condition, the lead sulfate becomes converted into a hard, crystalline substance, which will not easily turn back to the active material again during the subsequent recharging. "Sulfation" means the result as well as the process of that reaction. Such a battery can be revived by very slow charging and may be restored to usable condition but it is a damaged battery and its capacity is lower than before.

3) Keep the battery cable connections clean.

The cable connections, particularly at the positive (+) terminal post, tend to become corroded. The product of corrosion, or rust, on the mating faces of conductors resists the flow of current. The inability of the starter motor to crank the engine is often due to the rust formation in the battery cable connection. Clean the terminals and fittings periodically to ensure good metal-to-metal contact, and grease the connections after each cleaning to protect them against rusting.

4) Be always in the know as to the state of charge of the battery.

The simplest way to tell the state of charge is to carry out a hydrometer test. The hydrometer is an inexpensive instrument for measuring the specific gravity (S.G.) of the battery electrolyte. Why measure the S.G.? Because the S.G. of the electrolyte is indicative of the state of charge.

The direct method of checking the battery for state of charge is to carry out a high rate discharge test, which involves a special precise voltmeter, an expensive instrument used generally in the service shops but not recommendable to the user of the machine.

At 20°C of battery temperature (electrolyte temperature):

The battery is in **FULLY CHARGED STATE** if the electrolyte S.G. is 1.280.

The battery is in **HALF CHARGED STATE** if the S.G. is 1.220.

The battery is in **NEARLY DISCHARGED STATE** if the S.G. is 1.150 and is in danger of freezing.

What if the battery temperatures not 20°C (68°F)? Since the S.G. varies with temperature, you have to correct your S.G. reading (taken with your hydrometer) to the value at 20°C, and apply the corrected S.G. value to the three-point guide stated above. This manner of correction needs a chart showing the relation between S.G. and temperature. There is a simpler way: refer to the graph given below, which tells you the state of charge for a range of S.G. value and a range of temperature.

How to use the temperature-corrected state-of-charge graph.

Suppose your S.G. reading is 1.28 and the battery temperature is -5°C (23°F). Locate the intersection of the -5°C line and the 1.28 S.G. line. The intersection is "A". It is in the zone for **CHARGED STATE**. How much is the battery charged? To find out the answer, draw a line parallel to the zone demarcation line, extending it to the right, and see where this line crosses the percentage scale. In the present example, the line crosses at, say, 85% point. The battery is 85% fully charged.

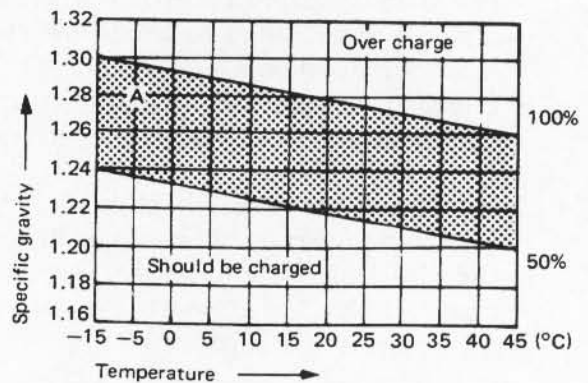


Fig. 10-22

REMOVE AND REPLACE

When handling a battery, the following safety precautions should be followed:

- 1) Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.
- 2) Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantity of water and cleaned immediately. To remove or replace a battery, always disconnect the negative cable first, then the positive cable.

BATTERY CABLES

Connect battery cables as shown in the figure below and make sure to properly tighten all terminals.

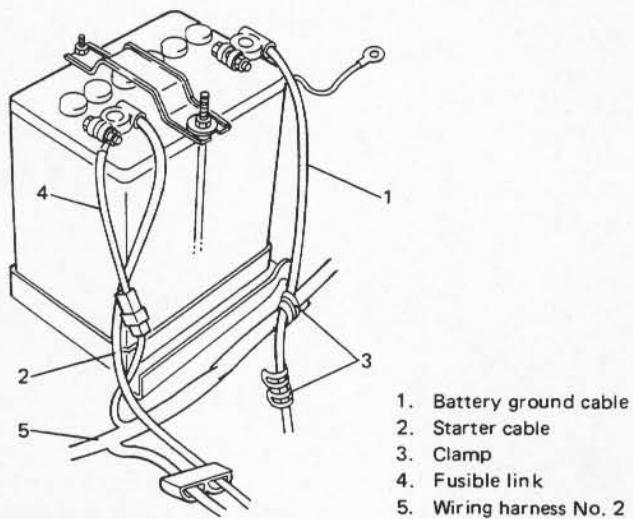


Fig. 10-23