SECTION EE

ENGINE ELECTRICAL SYSTEM

CONTENTS

BATTERY

WARNING:
Never touch positive and negative terminals at the same time with bare hands. This could result in injury.

CHECKING ELECTROLYTE LEVEL

Remove six vent plugs and check for electrolyte level in each cell.

If necessary, pour distilled water.

CHECKING SPECIFIC GRAVITY

Specific gravity of battery electrolyte is tested by a hydrometer. If the state of charge of battery is below 70%, battery must be recharged or battery-electrolyte concentration adjusted.

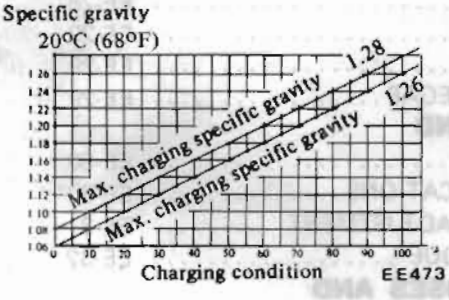


Fig. EE-1 Charging Condition

The gravity of electrolyte changes 0.0007 for every 1°C (1.8°F) temperature. Converted specific gravity at 20°C (68°F) can then be made by using the following formula:

$$S_{20} = St + 0.0007 (t - 20)$$

Where,

St: Specific gravity of electrolyte at t°C

S_{20}: Specific gravity of electrolyte corrected at 20°C (68°F)

t: Electrolyte temperature

For example: A hydrometer reading of 1.260 at 30°C (86°F) would be 1.267 corrected to 20°C (68°F), indicating fully charged battery. On the other hand, a hydrometer reading of 1.220 at −10°C (14°F) would be 1.199 corrected to 20°C (68°F), indicating a partially charged battery.

The state of charge of battery can be determined by the following table if the specific gravity of electrolyte is known. Before checking, be sure that cells are filled to correct level.

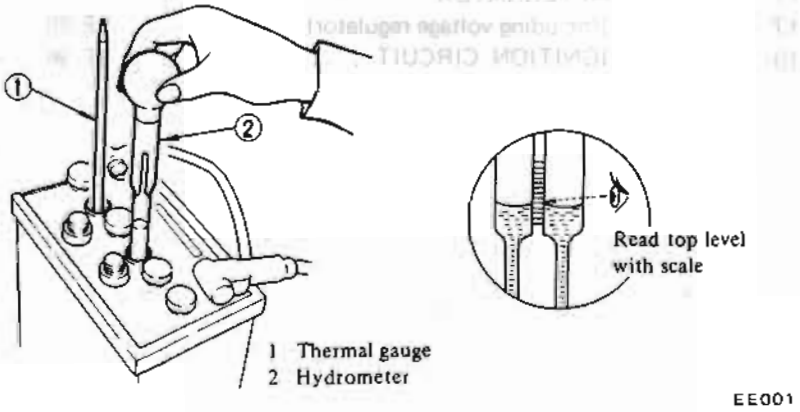


Fig. EE-2 Checking Specific Gravity

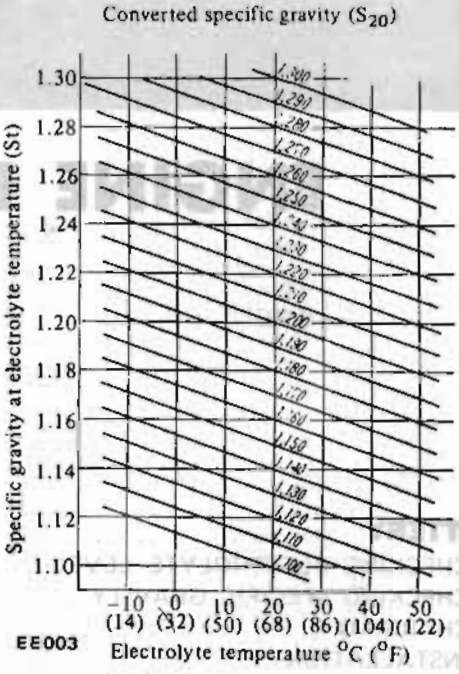


Fig. EE-3 Conversion of Specific Gravity

BATTERY FREEZING

Battery electrolyte freezing point varies with acid concentration or its specific gravity. A battery with an insufficient charge will freeze at lower temperatures. If specific gravity of a battery falls below 1.1, this is an indication that battery is completely discharged and will freeze readily when temperatures fall below freezing.

Note: Use extreme caution to avoid freezing battery since freezing will generally ruin the battery.

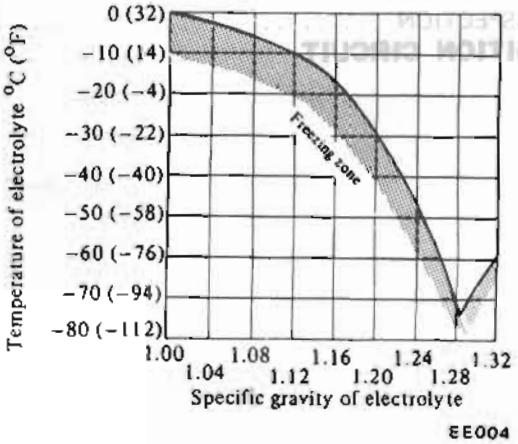


Fig. EE-4 Freezing Point of Electrolyte

CHARGING

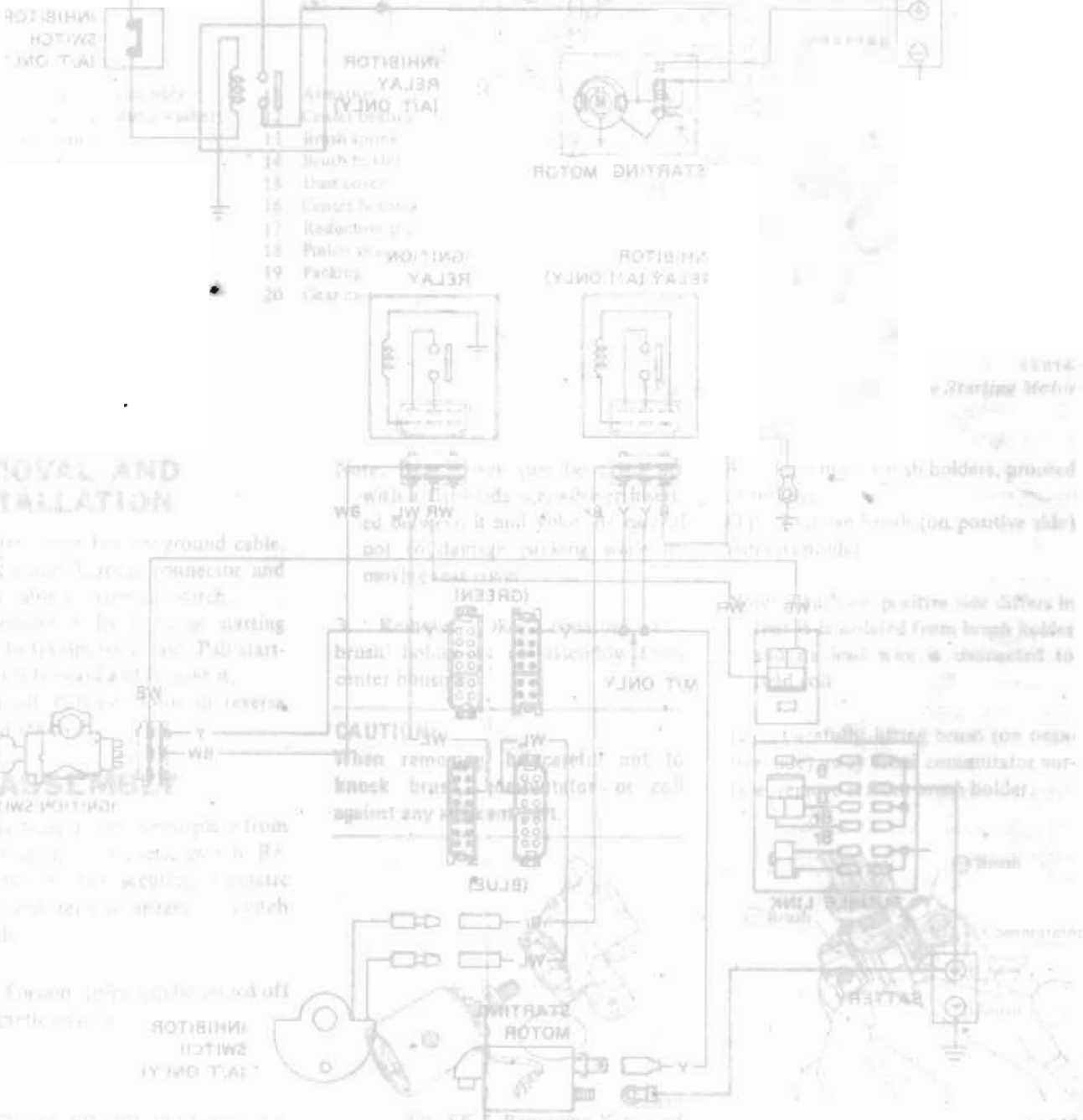
If electrolyte level is satisfactory, battery must be charged when electrolyte gravity reading falls below 1.20 or 1.22 (N70Z). If battery on car is quick-charged to bring it up to full charge, the operation should be carried out with negative cable removed.

Prior to charging, corroded terminals should be cleaned with a brush and common baking-soda solution. In addition, the following items should be observed while battery is being charged.

1. Be sure that electrolyte level is above top of each plate.
2. Keep removed plugs in a safe place.
3. Do not allow electrolyte temperature to go over 45°C (113°F).
4. After charging, check to be certain that specific gravity does not exceed maximum charging specific gravity at 20°C (68°F). Correction can be made by adding distilled water into cells as necessary.
5. Keep battery away from open flame while it is being charged.
6. After all vent plugs have been tightened, clean all sprayed electrolyte off upper face of battery.

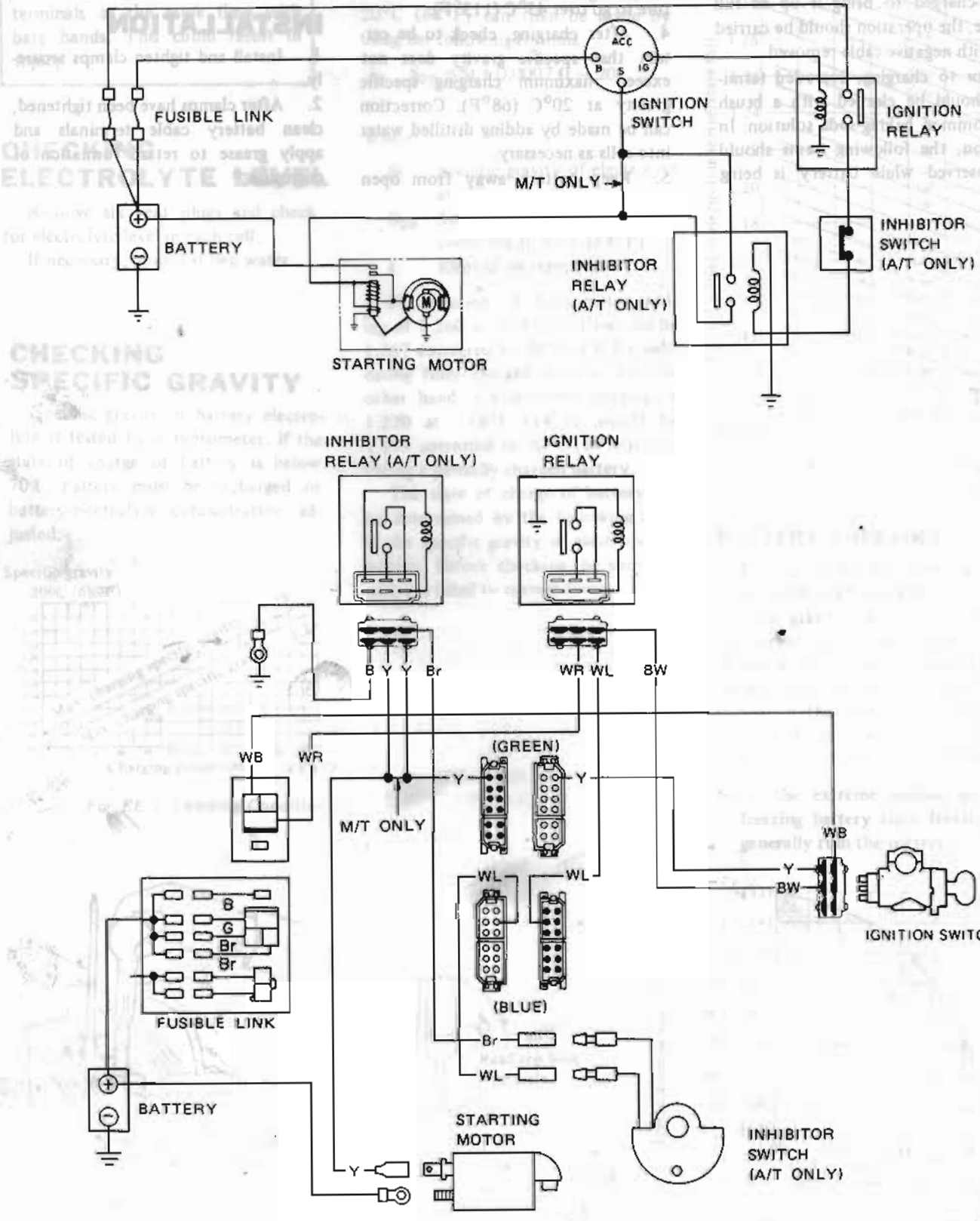
INSTALLATION

1. Install and tighten clamps securely.
2. After clamps have been tightened, clean battery cable terminals and apply grease to retard formation of corrosion.



STARTING MOTOR

STARTING CIRCUIT

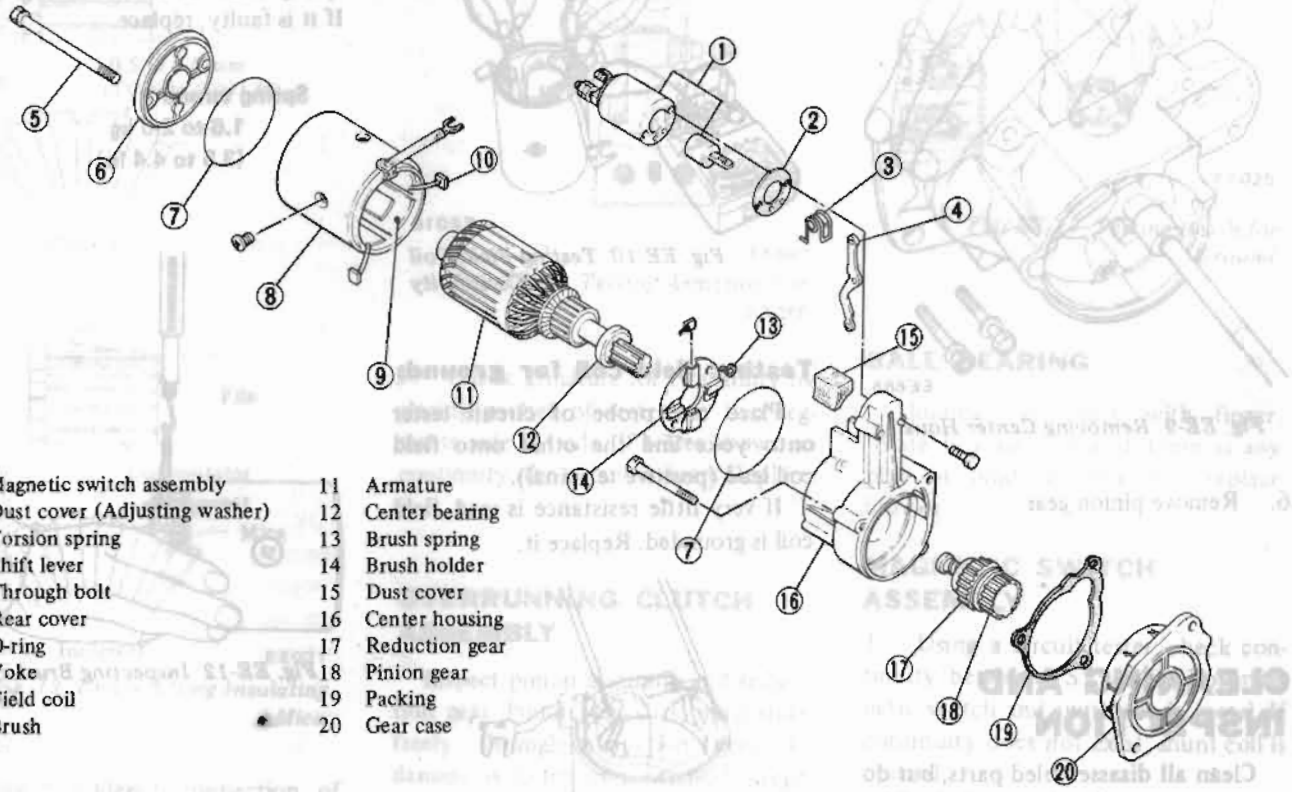


EE755

Fig. EE-5 Circuit Diagram of Starting System

CONSTRUCTION

Reduction gear type



1	Magnetic switch assembly	11	Armature
2	Dust cover (Adjusting washer)	12	Center bearing
3	Torsion spring	13	Brush spring
4	Shift lever	14	Brush holder
5	Through bolt	15	Dust cover
6	Rear cover	16	Center housing
7	O-ring	17	Reduction gear
8	Yoke	18	Pinion gear
9	Field coil	19	Packing
10	Brush	20	Gear case

EE614

Fig. EE-6 Reduction Gear Type Starting Motor

REMOVAL AND INSTALLATION

1. Disconnect battery ground cable. Disconnect harness connector and battery cable at magnetic switch.
2. Remove bolts securing starting motor to transmission case. Pull starting motor forward and remove it.
3. Install starting motor in reverse order of removal.

DISASSEMBLY

1. Disconnect connecting plate from "M" terminal of magnetic switch. Remove two screws securing magnetic switch and remove magnetic switch assembly.

Note: Torsion spring can be pulled off magnetic switch.

2. Remove through bolts and rear cover.

Note: Rear cover can be pried off with a flat-blade screwdriver inserted between it and yoke. Be careful not to damage packing while removing rear cover.

3. Remove yoke, armature and brush holder as an assembly from center housing.

CAUTION:
When removing, be careful not to knock brush, commutator or coil against any adjacent part.

EE615

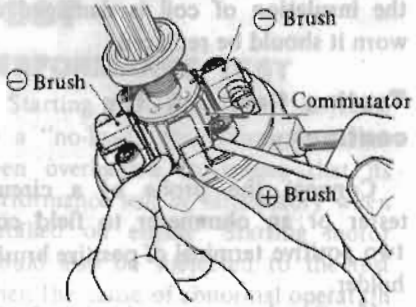
Fig. EE-7 Removing Yoke and Armature Assembly

4. To remove brush holders, proceed as follows:

(1) Remove brush (on positive side) from its holder.

Note: Brush on positive side differs in that it is isolated from brush holder and its lead wire is connected to field coil.

(2) Carefully lifting brush (on negative side) away from commutator surface, remove it from brush holder.



EE616

Fig. EE-8 Removing Brush

5. Remove bolts securing center housing to gear case, and detach center housing.

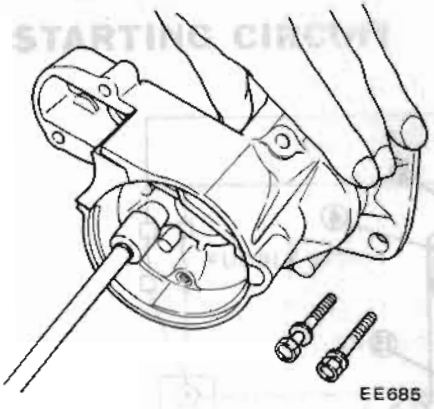


Fig. EE-9 Removing Center Housing

6. Remove pinion gear.

CLEANING AND INSPECTION

Clean all disassembled parts, but do not use grease dissolving solvents for cleaning overrunning clutch, armature assembly, magnetic switch assembly and field coils since such a solvent would dissolve grease packed in clutch mechanism and would damage coils or other insulators.

Check them for excessive damage or wear, and replace if necessary.

TERMINAL

Check terminal for damage and wear, and replace magnetic switch assembly if necessary.

FIELD COIL

Check field coil for insulation. If the insulation of coil is damaged or worn it should be replaced.

Testing field coil for continuity:

Connect the probe of a circuit tester or an ohmmeter to field coil two positive terminal of positive brush holder.

If tester shows no conduction, field coil is open. Replace it.

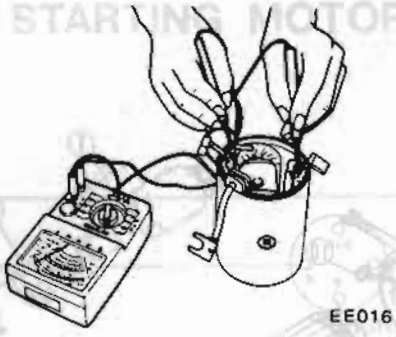


Fig. EE-10 Testing Field Coil for Continuity

Testing field coil for ground:

Place one probe of circuit tester onto yoke and the other onto field coil lead (positive terminal).

If very little resistance is read, field coil is grounded. Replace it.

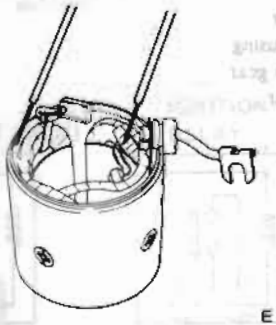


Fig. EE-11 Testing Field Coil for Ground

BRUSHES AND BRUSH LEAD WIRE

Check the surface condition of brush contact and wear of brush. If a loose contact is found it should be replaced.

If brush is worn so that its length is less than specified value, replace.

Minimum length of bursh:
11 mm (0.43 in)

Check the connection of lead clip and lead wire.

Check brush holders and spring clip to see if they are not deformed or bent, and will properly hold brushes against the commutator.

If brushes or brush holders are dirty, they should be cleaned.

BRUSH SPRING TENSION

Check brush spring tension by a spring scale as shown in Fig. EE-12. If it is faulty, replace.

Spring tension:
1.6 to 2.0 kg
(3.5 to 4.4 lb)

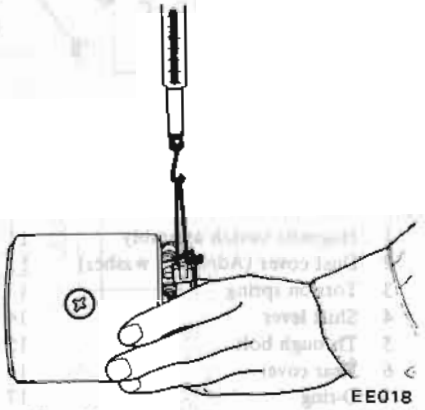


Fig. EE-12 Inspecting Brush Spring Tension

ARMATURE ASSEMBLY

Check external appearance of armature and commutator.

1. Inspect commutator. If the surface of commutator is rough, it must be sanded lightly with a No. 500 sand paper. If the depth of insulating mica is less than 0.2 mm (0.008 in) from commutator surface, insulating mica should also be undercut so that its depth is 0.5 to 0.8 mm (0.020 to 0.031 in).

The wear limit of commutator diameter is 1 mm (0.04 in). If the diameter of commutator is less than specified value, replace armature assembly.

Diameter limit:
29 mm (1.14 in)

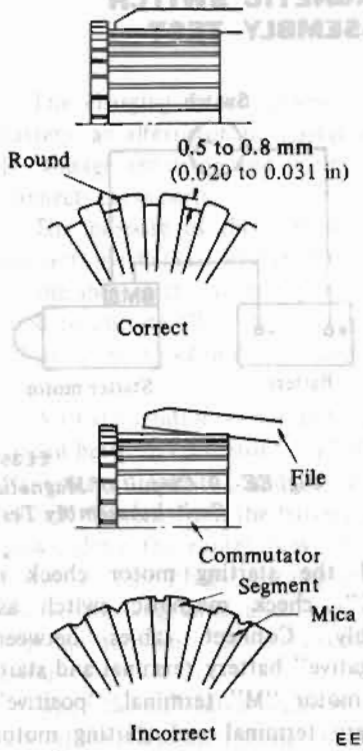


Fig. EE-13 Undercutting Insulating Mica

2. Inspect soldered connection of armature lead and commutator. If loose connection is found, solder it using resin flux.
3. Armature test for ground

Using a circuit tester, place one test probe onto armature core or shaft and other onto each commutator bar.

If tester shows continuity, armature is grounded and must be replaced.

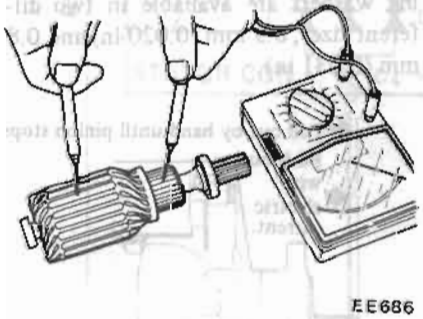


Fig. EE-14 Testing Armature for Ground

4. Check armature for short by placing it on armature tester (growler) with a piece of iron over armature core, rotating armature. If the plate vibrates, armature is shorted. Replace it.

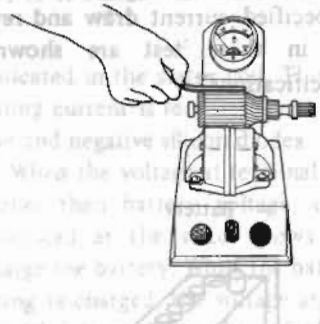


Fig. EE-15 Testing Armature for Short

5. Check armature for continuity by placing probes of tester on two segments side by side. If tester shows no continuity, the circuit is open. Replace it.

OVERRUNNING CLUTCH ASSEMBLY

Inspect pinion assembly and reduction gear. Pinion gear shaft must slide freely through reduction gear. If damage is found or resistance except normal resistance due to spring is felt when sliding, it must be repaired. Inspect pinion teeth. If excessive rubbing is found on teeth, replace. Flywheel ring gear also must be inspected.

Fig. EE-16 Pinion and Reduction Gear Overrunning Clutch

BRUSH HOLDER TEST FOR GROUND

Using a circuit tester, place one test probe onto negative side of brush holder and another onto positive side. If tester shows continuity, brush holder is shorted to ground. Replace brush holder.

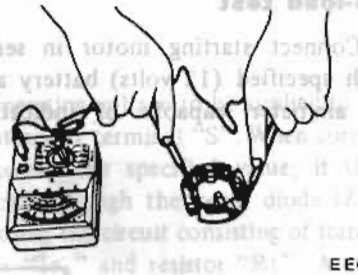


Fig. EE-17 Testing Brush for Ground

BALL BEARING

Holding outer race with finger, rotate bearing to see if there is any play or bind. If necessary, replace bearing.

MAGNETIC SWITCH ASSEMBLY

1. Using a circuit tester, check continuity between "S" terminal of magnetic switch and switch body metal. If continuity does not exist, shunt coil is opened.

Replace switch assembly.

2. In the same manner as above, check continuity between terminals "S" and "M". If continuity does not exist, series coil is opened.

Replace switch assembly.

ASSEMBLY

Reassemble starting motor in reverse sequence of disassembly.

When assembling, be sure to apply grease to gear case and rear cover bearing metal, and apply oil lightly to pinion.

TEST

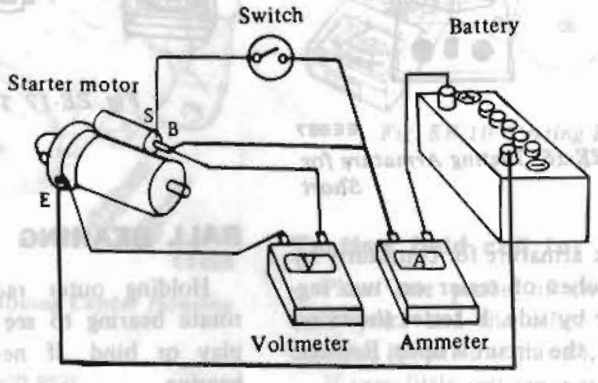
PERFORMANCE TEST

Starting motor should be subjected to a "no-load" test whenever it has been overhauled to ensure that its performance will be satisfactory when installed on engine. Starting motor should also be subjected to the test when the cause of abnormal operation is to be determined. A brief outline of the test is given below.

No-load test

Connect starting motor in series with specified (12 volts) battery and an ammeter capable of indicating 1,000 amperes.

Specified current draw and revolution in these test are shown in "Specifications".



EE738

Fig. EE-18 No-load Testing

DIAGNOSES OF TEST

1. Low speed with no-load and high current draw may result from the following:

(1) Tight, dirty or worn bearings.

(2) Bent armature shaft or loosened field probe.

(3) Shorted armature;

Check armature further.

(4) A grounded armature or field;

a. Remove input terminal.

b. Raise two negative side brushes from commutator.

c. Using a circuit tester, place one probe onto input terminal and the other onto yoke.

d. If tester indicates continuity, raise the other two brushes and check field and armature separately to determine whether field or armature is grounded.

2. Failure to operate with high current draw may be caused by the following:

(1) A grounded or open field coil:

Inspect the connection and trace circuit by a circuit tester.

(2) Armature coil does not operate:

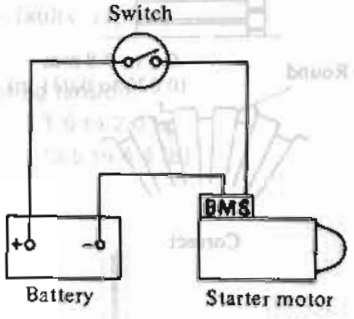
Inspect commutator for excessive burning. In this case, arc may occur on damaged commutator when motor is operated with no-load.

(3) Burned out commutator bar:

Weak brush spring tension, broken brush spring, rubber bush, thrust out of mica in commutator or a loose contact between brush and commutator would cause commutator bar to burn.

3. Low current draw and low no-load speed would cause high internal resistance due to loose connections, damaged leads, dirty commutator and causes listed on item 2-(3).

MAGNETIC SWITCH ASSEMBLY TEST



EE351

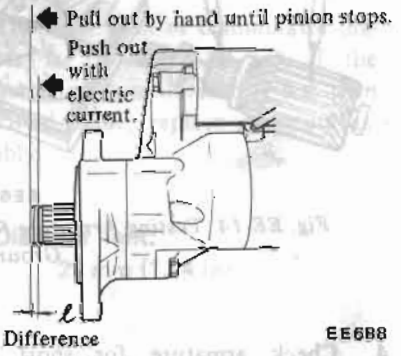
Fig. EE-19 Circuit of Magnetic Switch Assembly Test

If the starting motor check is "OK", check magnetic switch assembly. Connect cables between "negative" battery terminal and starting motor "M" terminal, "positive" battery terminal and starting motor "S" terminal connecting a switch in series as shown above.

With the switch on compare difference in height of pinion when it is pushed out with magnetic switch energized and when it is pulled out by hand until its stopper touches reduction gear.

Difference "ℓ":
0.3 to 1.5 mm
(0.012 to 0.059 in)

If necessary, adjust it by changing or adding adjusting washer(s). Adjusting washers are available in two different sizes, 0.5 mm (0.020 in) and 0.8 mm (0.031 in).



EE688

Fig. EE-20 Measuring Difference "ℓ"

CHARGING CIRCUIT

The charging circuit consists of a battery, an alternator incorporating an IC voltage regulator and wiring that connects these parts.

The purpose of this system is to convert mechanical energy from the engine into electrical energy which is used to operate all electrically operated units and to keep the battery fully charged.

With the ignition switch in ON, the circuit between transistor "Tr_1" of the IC voltage regulator and ground is closed. Current from the battery then flows along the route shown by the arrow in Fig. EE-21, turning on the charge warning lamp and flowing on through terminal "L" to excite the rotor.

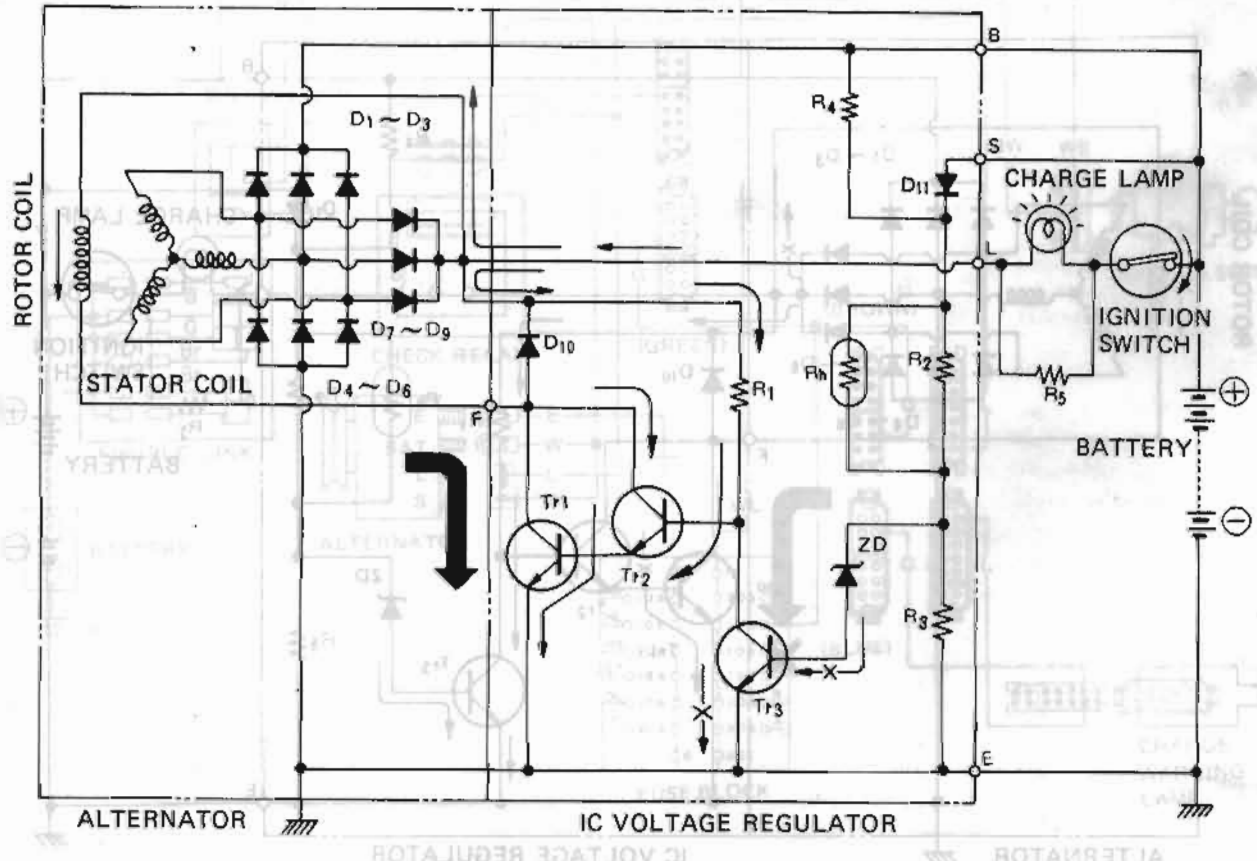
When the alternator begins to operate, three-phase alternating current is indicated in the stator coil. This alternating current is rectified by the positive and negative silicon diodes.

When the voltage at terminal "B" is higher than battery voltage, current produced at the stator flows to recharge the battery. While the battery is being re-charged, the voltage at terminal "L" is equal to that of terminal "B". At this point, there is no voltage differential on either side of the charge warning lamp, which causes the charge warning lamp to turn off. In other words, current does not flow from the battery to terminal "L". Accordingly, current flow through the rotor as shown in Fig. EE-22, is taken over by current produced at the stator. The circuit between terminal "F" and "Tr_1" is then closed. See Fig. EE-22.

The IC voltage regulator monitors generating voltage to be applied to the battery at terminal "S". When current exceeds the specified value, it then flows through the zener diode (ZD), closing the circuit consisting of transistor "Tr_3" and resistor "R1". At this point, current neither flows through transistor "Tr_1" to ground nor to the rotor, thereby reducing the voltage generated at the stator. See Fig. EE-23.

When voltage generated at terminal "S" is reduced to the specified value, transistor allows current to flow through the rotor, increasing the generating voltage.

In this manner, output voltage from the alternator does not rise above the specified value by the ON-OFF operation of the rotor coil through the IC voltage regulator.



EE760

Fig. EE-21 Simplified Charging Circuit (Initial excitation current)

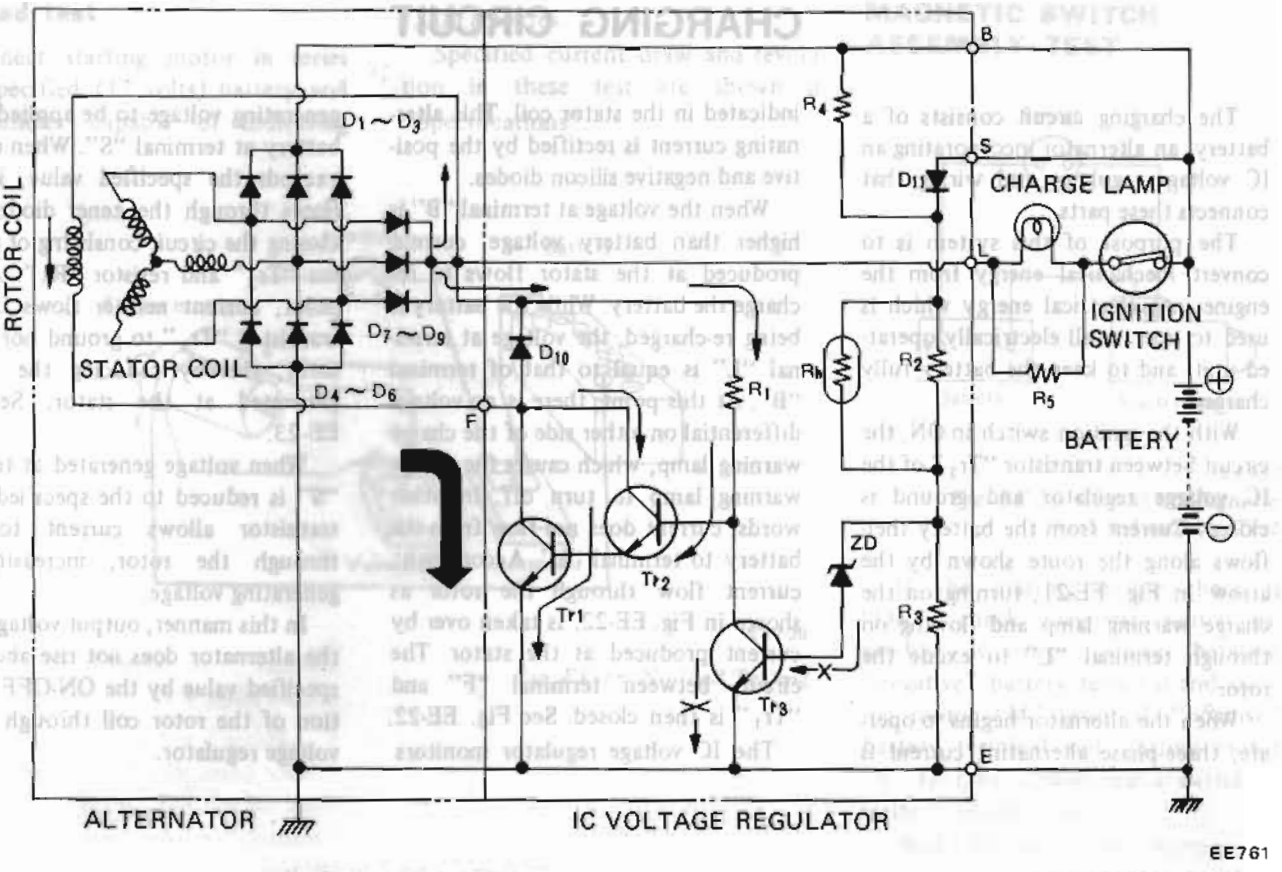


Fig. EE-22 Simplified Charging Circuit (when battery voltage is lower than regulating voltage)

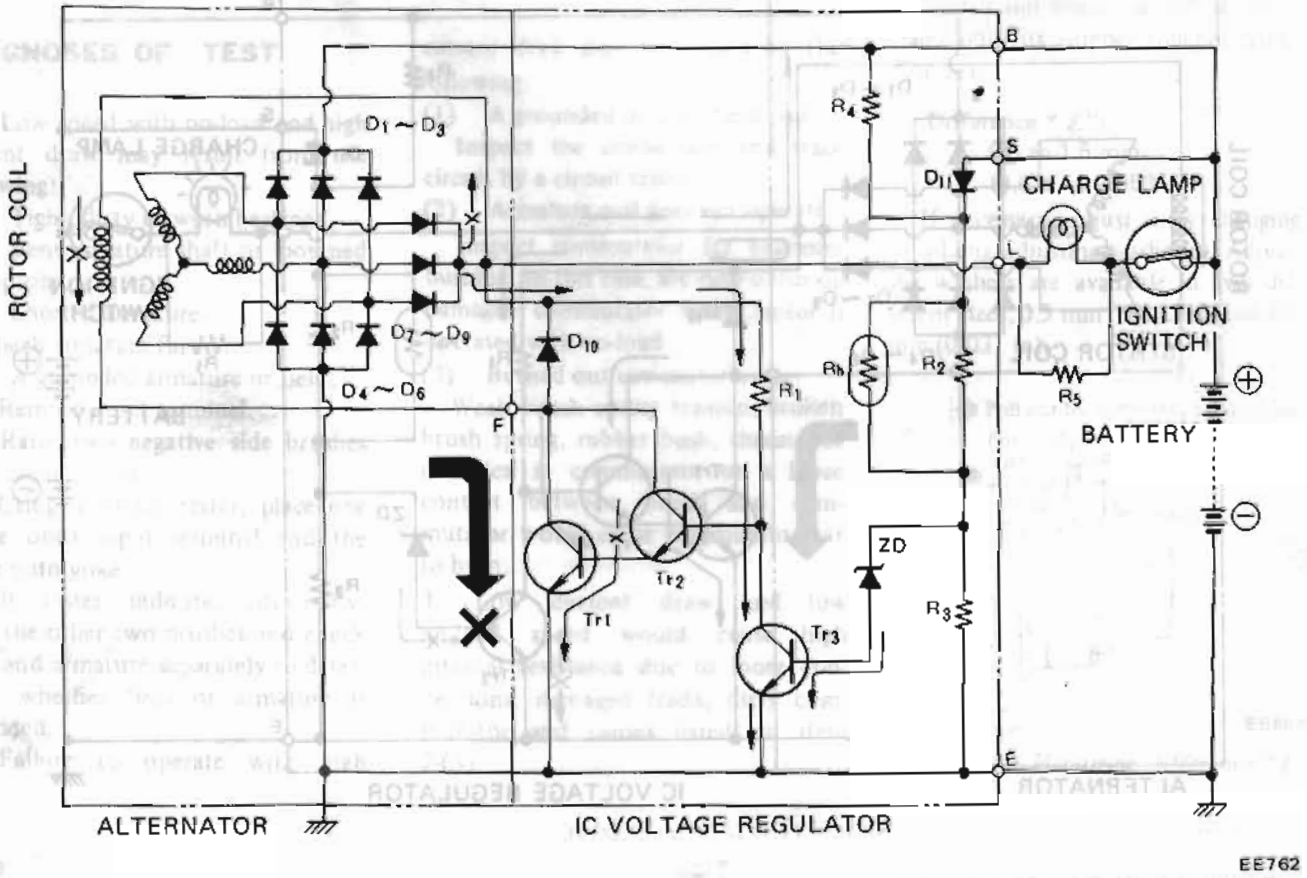
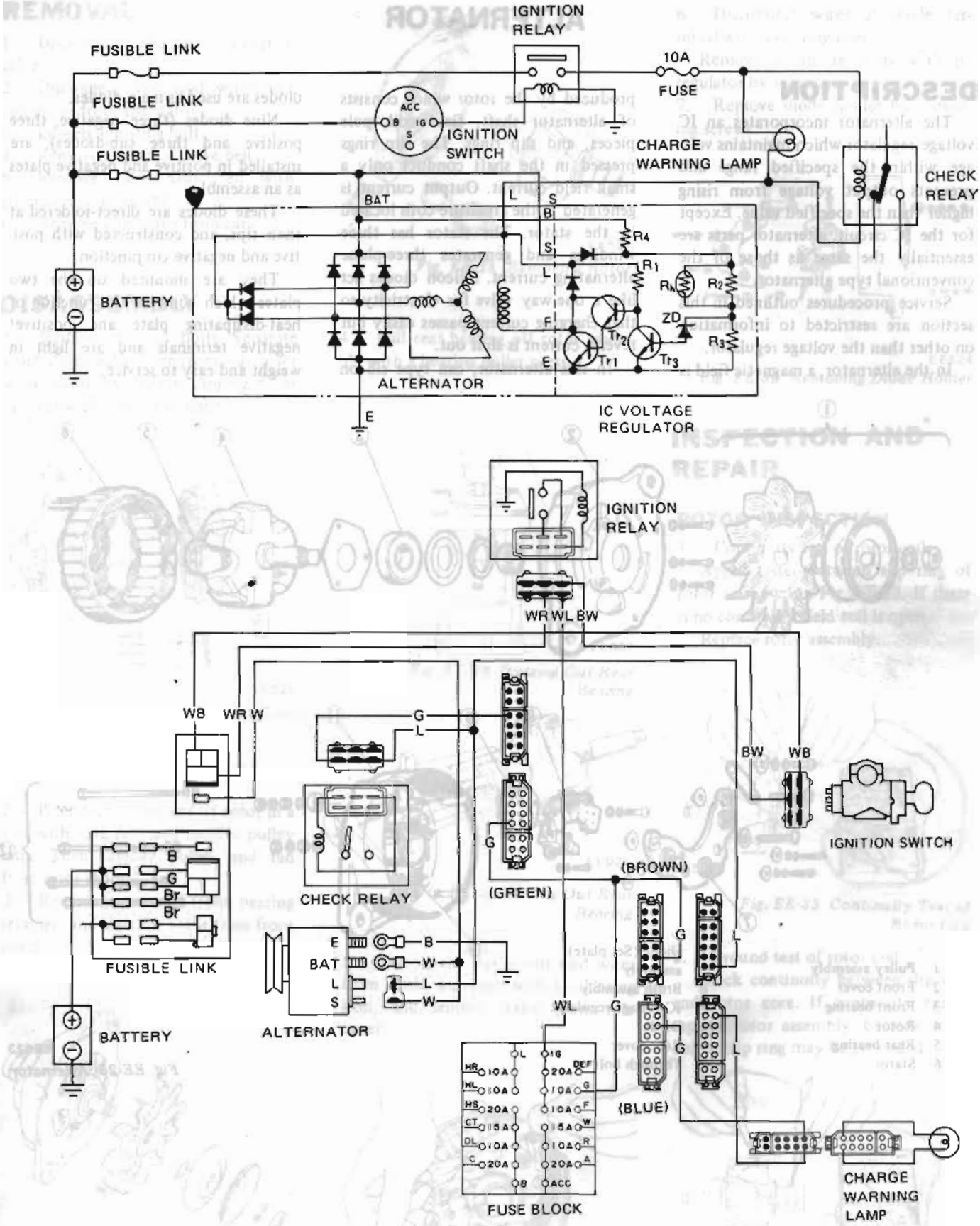


Fig. EE-23 Simplified Charging Circuit (when battery voltage is higher than regulating voltage)



EE756

Fig. EE-24 Circuit Diagram of Charging System

ALTERNATOR

DESCRIPTION

The alternator incorporates an IC voltage regulator which maintains voltage within the specified range and prevents output voltage from rising higher than the specified value. Except for the IC circuit, alternator parts are essentially the same as those of the conventional type alternator.

Service procedures outlined in this section are restricted to information on other than the voltage regulator.

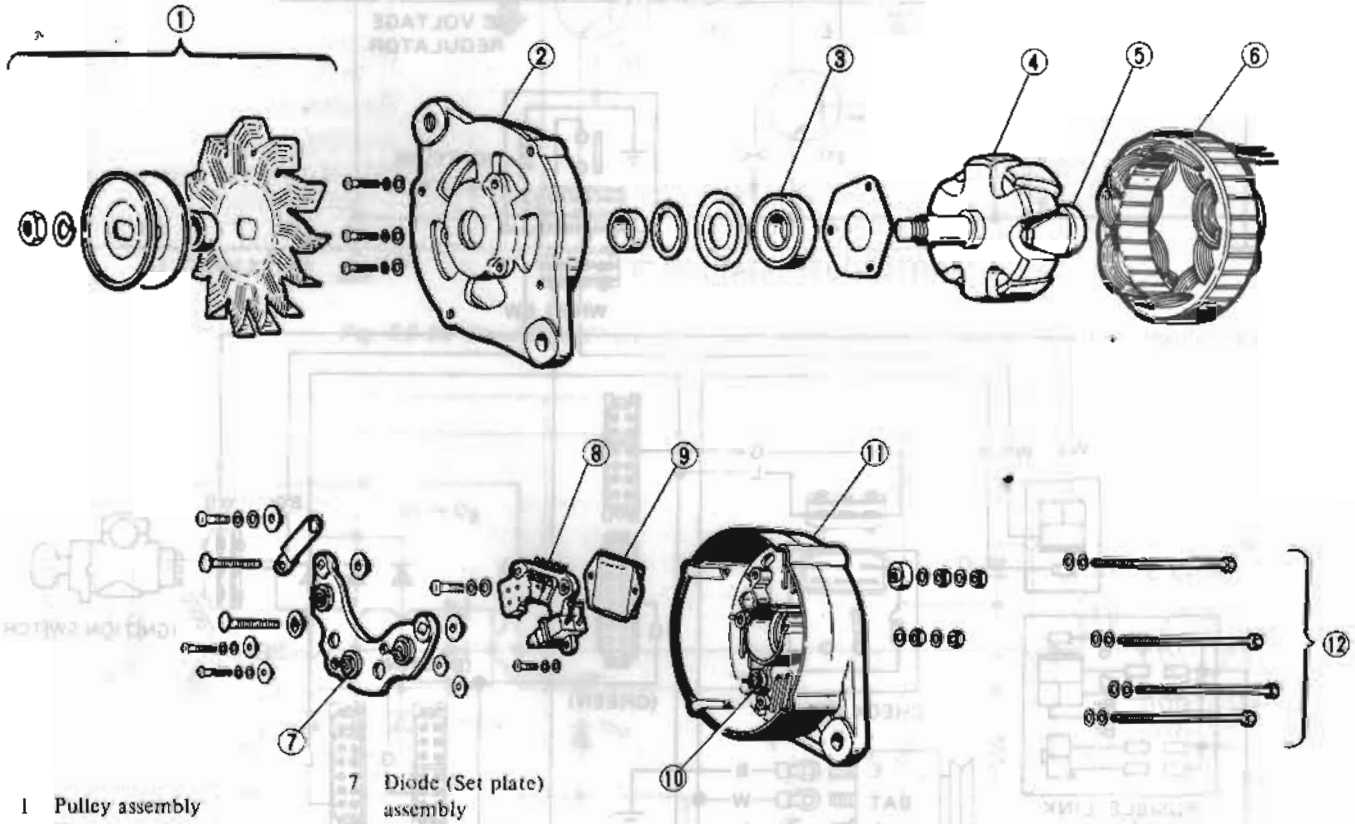
In the alternator, a magnetic field is produced by the rotor which consists of alternator shaft, field coil, pole pieces, and slip rings. The slip rings pressed in the shaft conduct only a small field current. Output current is generated in the armature coils located in the stator. The stator has three windings and generates three-phase alternating current. Silicon diodes act like a one-way valve for electricity so that charging current passes easily but reverse current is shut out.

In this alternator, can type silicon diodes are used as main diodes.

Nine diodes (three negative, three positive and three sub-diodes), are installed in positive and negative plates as an assembly.

These diodes are direct-soldered at their tips, and constructed with positive and negative conjunction.

They are mounted on the two plates which combine the function of heat-dissipating plate and positive/negative terminals and are light in weight and easy to service.



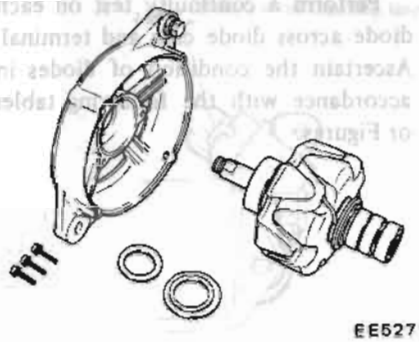
1 Pulley assembly
2 Front cover
3 Front bearing
4 Rotor
5 Rear bearing
6 Stator
7 Diode (Set plate) assembly
8 Brush assembly
9 IC voltage regulator
10 Diode
11 Rear cover
12 Through bolt

EE623

Fig. EE-25 Alternator

REMOVAL

1. Disconnect battery negative cable.
2. Disconnect two lead wires and connector from alternator.
3. Loosen adjusting bolt.
4. Remove alternator drive belt.
5. Remove parts associated with alternator from engine.
6. Remove alternator from car.

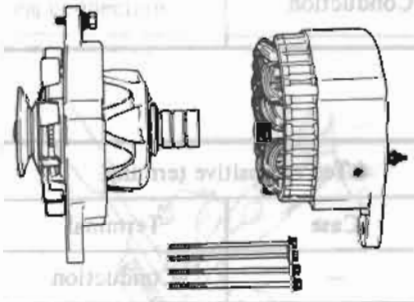


EE527

Fig. EE-28 Removing Rotor

DISASSEMBLY

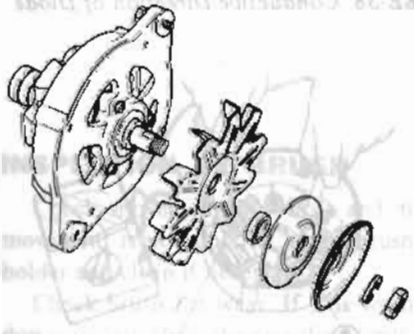
1. Remove through bolts. Separate front cover with rotor from rear cover with stator by lightly tapping front bracket with a wooden mallet.



EE525

Fig. EE-26 Separating Front Cover

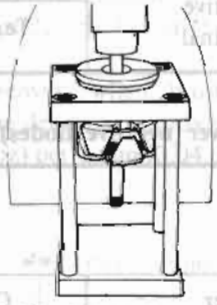
2. Place rear cover side of rotor in a vise with soft jaw, and remove pulley nuts. Then remove pulley and fan from rotor shaft.
3. Remove setscrews from bearing retainer, and separate rotor from front cover.



EE526

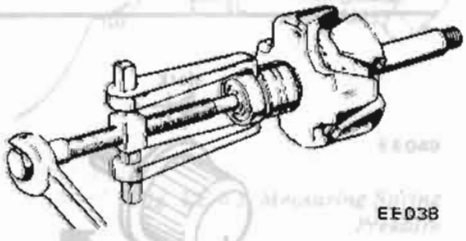
Fig. EE-27. Removing Pulley and Fan

4. Pull rear bearing off rotor assembly with a bearing puller press.



EE037

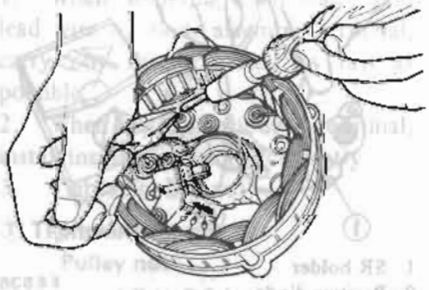
Fig. EE-29 Pressing Out Rear Bearing



EE038

Fig. EE-30 Pulling Out Rear Bearing

5. Disconnect stator coil lead wires from diode terminals with a soldering iron, and remove stator from rear cover.



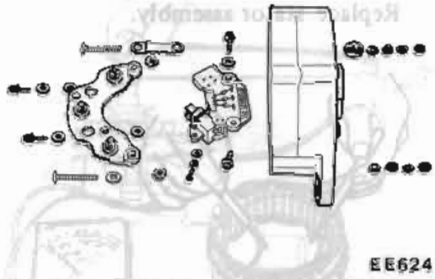
EE623

Fig. EE-31 Removing Stator Coil

6. Disconnect wires at diode terminal with soldering iron.

Remove brush assembly with IC regulator by loosening screws.

7. Remove diode holder by loosening screws.



EE624

Fig. EE-32 Removing Diode Holder

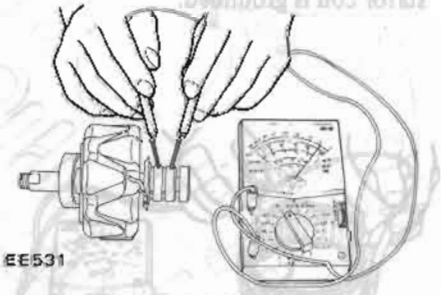
INSPECTION AND REPAIR

ROTOR INSPECTION

1. Continuity test of rotor coil

Apply tester between slip ring of rotor as shown in Fig. EE-33. If there is no continuity field coil is open.

Replace rotor assembly.

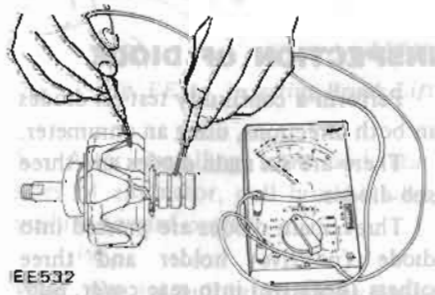


EE531

Fig. EE-33 Continuity Test of Rotor Coil

2. Ground test of rotor coil

Check continuity between slip ring and rotor core. If continuity exists, replace rotor assembly, because rotor coil or slip ring may be grounded.



EE532

Fig. EE-34 Testing Rotor Coil for Ground

INSPECTION OF STATOR

1. Continuity test

Stator is normal when there is continuity between individual stator coil terminals. When there is no continuity between individual terminals, cable is broken.

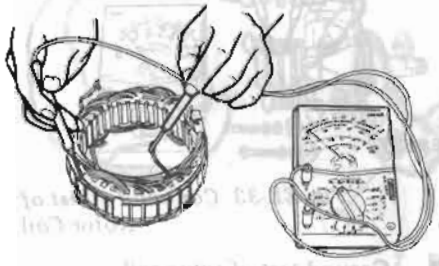
Replace stator assembly.

EE533

Fig. EE-35 Testing Stator for Continuity

2. Ground test

If each lead wire of stator coil (including neutral wire) is not conductive with stator core, condition is satisfactory. If there is continuity, stator coil is grounded.



EE534

Fig. EE-36 Testing Stator for Ground

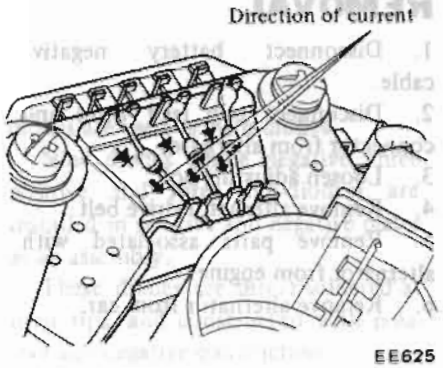
INSPECTION OF DIODE

Perform a continuity test on diodes in both directions, using an ohmmeter.

There are six main diodes and three sub-diodes.

Three main diodes are pressed into diode (positive) holder and three others (negative) into rear cover. Sub-diodes are soldered onto brush assembly.

Perform a continuity test on each diode across diode case and terminal. Ascertain the condition of diodes in accordance with the following tables or Figures.



EE625

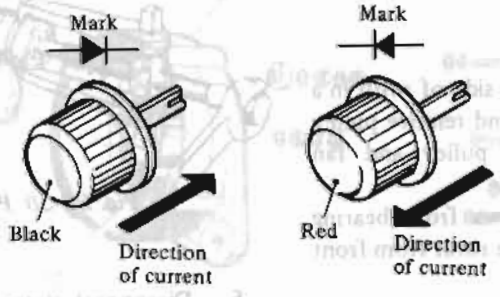
Fig. EE-37 Sub-diode

- **Diode holder (positive diodes)**

		Tester positive terminal	
		Case	Terminal
Tester negative terminal	Case	–	Nonconduction
	Terminal	Conduction	–

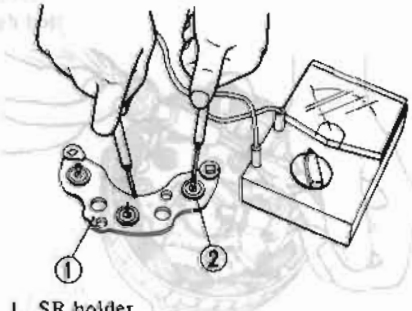
- **Rear cover (negative diodes)**

		Tester positive terminal	
		Case	Terminal
Tester negative terminal	Case	–	Conduction
	Terminal	Nonconduction	–



EE535

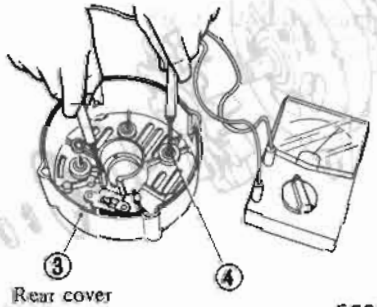
Fig. EE-38 Conductive Direction of Diode



1 SR holder
2 Positive diode

EE536

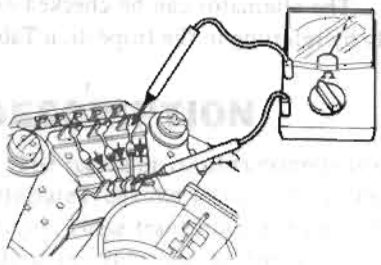
Fig. EE-39 Inspecting Positive Diode



3 Rear cover
4 Negative diode

EE537

Fig. EE-40 Inspecting Negative Diode



EE626

Fig. EE-41 Inspecting Sub-diode

CAUTION:
If it is necessary to remove sub-diode, pinch diode lead wire with a pair of pliers to prevent heat transfer from soldering iron to diode when unsoldering connection.

EE627

Fig. EE-42 Removing Sub-diode

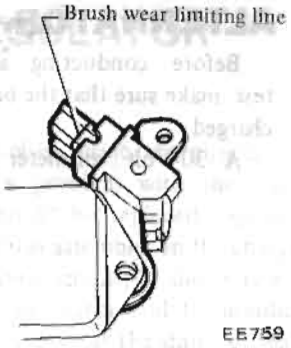
If current flows in both positive and negative directions, diode is short-circuited. If current flows in one direction only as shown in Figs. EE-37 and EE-38, diode is in good condition. Replace diodes if faulty.

INSPECTION OF BRUSH

Check movement of brush and if movement is not smooth, check brush holder and clean if necessary.

Check brush for wear. If it is worn down to less than the specified limit, replace brush assembly.

Check brush pig tail and, if damaged, replace.



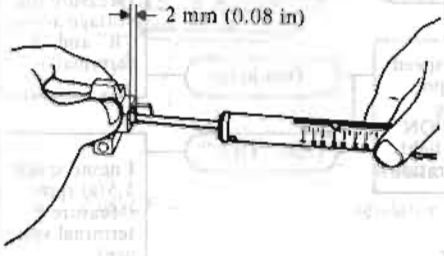
EE759

Fig. EE-43 Brush Wear Limit

SPRING PRESSURE TEST

With brush projected approximately 2 mm (0.08 in) from brush holder, measure brush spring pressure by the use of a spring balance. Normally, the rated pressure of a new brush spring is 255 to 345 gr (8.99 to 12.17 oz).

Moreover, when brush is worn, pressure decreases approximately 20 gr (0.71 oz) per 1 mm (0.04 in) wear.



EE049

Fig. EE-44 Measuring Spring Pressure

ASSEMBLY

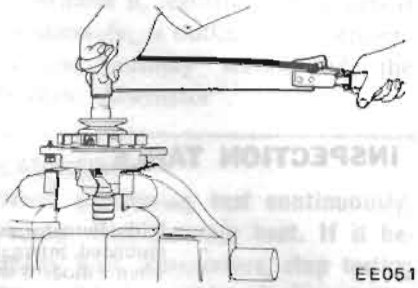
Assemble alternator in the reverse sequence of disassembly, noting the following:

1. When soldering each stator coil lead wire to diode assembly terminal, carry out the operation as fast as possible.
2. When installing diode A terminal, install insulating bushing correctly.
3. Tighten pulley nut.

Ⓣ Tightening torque:
Pulley nut
4.5 to 6.0 kg-m
(33 to 43 ft-lb)

When pulley is tightened, make sure that deflection of V-groove is proper.

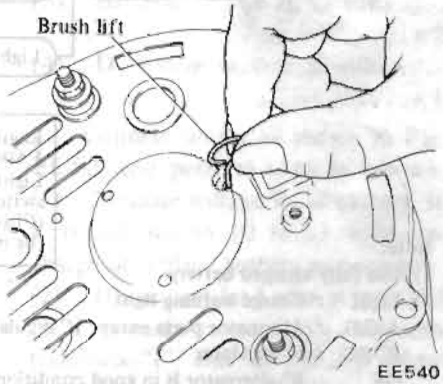
V-groove deflection:
0.3 mm (0.012 in)



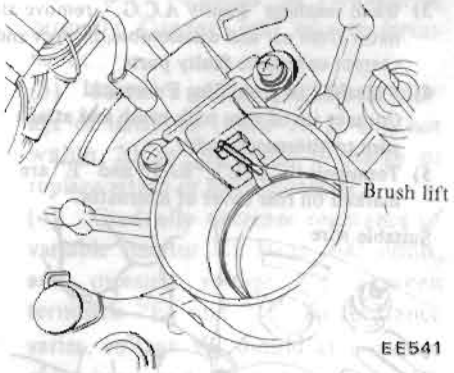
EE051

Fig. EE-45 Tightening Pulley Nut

4. Before installing front and rear sides of alternator, push rear cover brush up with fingers and retain brush, as shown in Fig. EE-46, by inserting brush lift into brush lift hole from outside.



EE540



EE541

Fig. EE-46 Inserting Brush Lift

5. After installing front and rear sides of alternator, pull brush lift by pushing toward center.

Note: Do not pull brush lift by pushing toward outside of cover as it will damage slip ring sliding surface.

6. Tighten through bolts.

Ⓣ **Tightening torque:**
Through bolts
35 to 40 kg-cm
(30 to 35 in-lb)

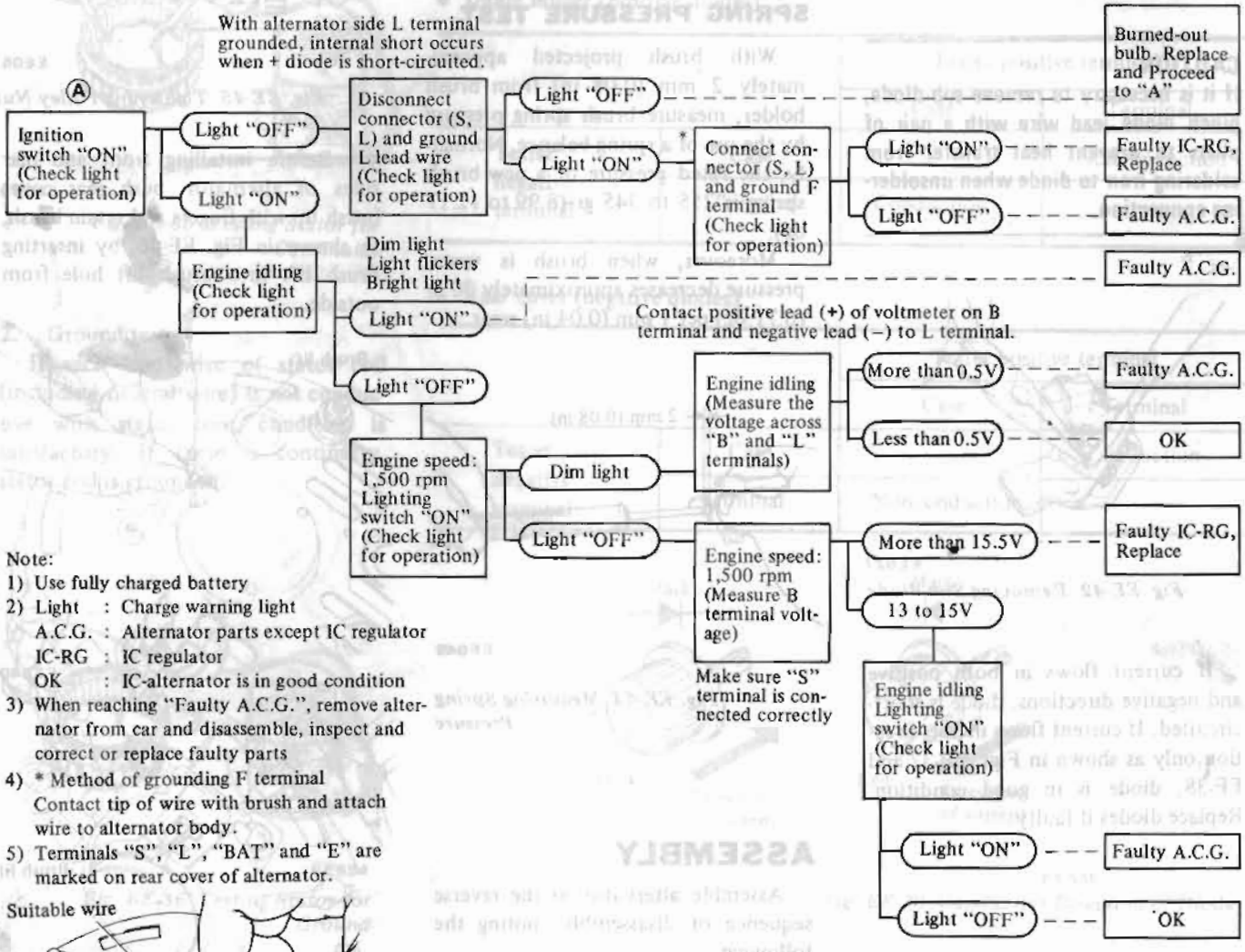
ALTERNATOR TEST

Before conducting an alternator test, make sure that the battery is fully charged.

A 30-Volt voltmeter and suitable test probes are necessary for the test.

The alternator can be checked easily by referring to the Inspection Table.

INSPECTION TABLE



Note:
1) Use fully charged battery
2) Light : Charge warning light
   A.C.G. : Alternator parts except IC regulator
   IC-RG : IC regulator
   OK : IC-alternator is in good condition
3) When reaching "Faulty A.C.G.", remove alternator from car and disassemble, inspect and correct or replace faulty parts
4) * Method of grounding F terminal
   Contact tip of wire with brush and attach wire to alternator body.
5) Terminals "S", "L", "BAT" and "E" are marked on rear cover of alternator.

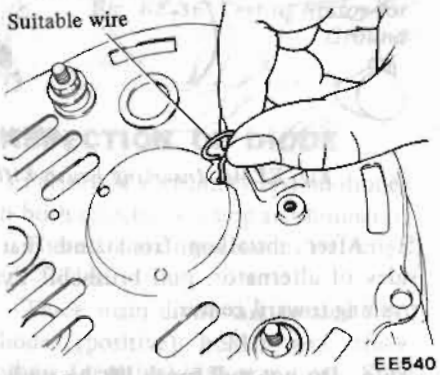
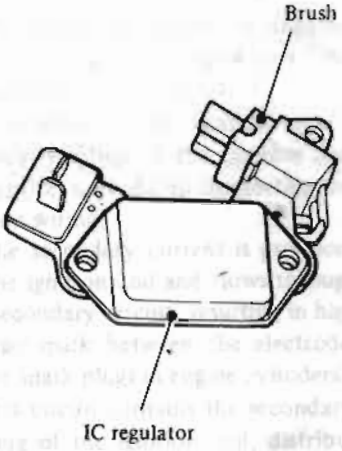


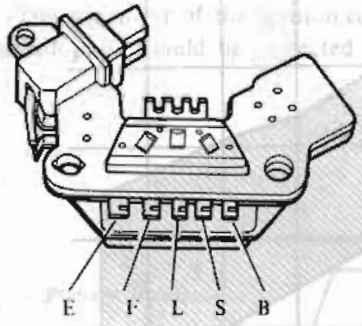
Fig. EE-47 Grounding F Terminal

REGULATOR

DESCRIPTION

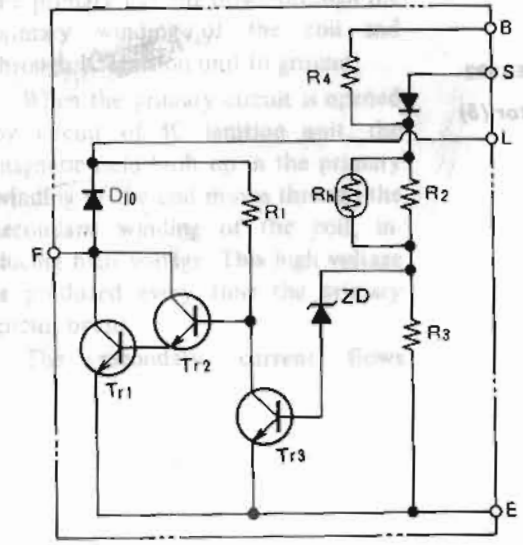
The regulator consists essentially of integrated circuits incorporating transistors. These transistors interrupt and admit current flow to the alternator rotor coil, thus maintaining its output voltage at a constant value. Unlike in a mechanical type regulator, an electronic relay employing transistors is utilized. These transistors are enclosed in a very compact, sealed case. The electronic relay is soldered to the brush assembly inside the alternator. Should any problem with the relay arise, it should be replaced together with the brush assembly. In the charge warning lamp circuit, a diode is attached to the stator coil to monitor generating voltage at the stator so that when the monitored voltage and charging voltage are equal during re-charging, the charge warning lamp is turned off. Accordingly, a charge warning relay is not employed in this circuit.





EE698

Fig. EE-48 IC Voltage Regulator



B.S.L.E.F. .. Terminal
R ..... Resistor
Rh..... Thermistor
Tr ..... Transistor
ZD ..... Zener diode

EE766

Fig. EE-49 Circuit of Regulator

INSPECTION

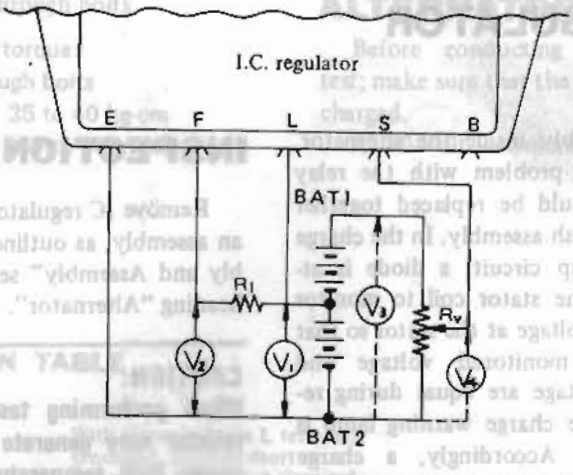
Remove IC regulator and brushes as an assembly, as outlined in "Disassembly and Assembly" section under the heading "Alternator".

CAUTION:
When performing test continuously, resistor may generate heat. If it becomes high temperature, stop testing for a while to avoid burning.

1. The following test equipment and accessories are required.

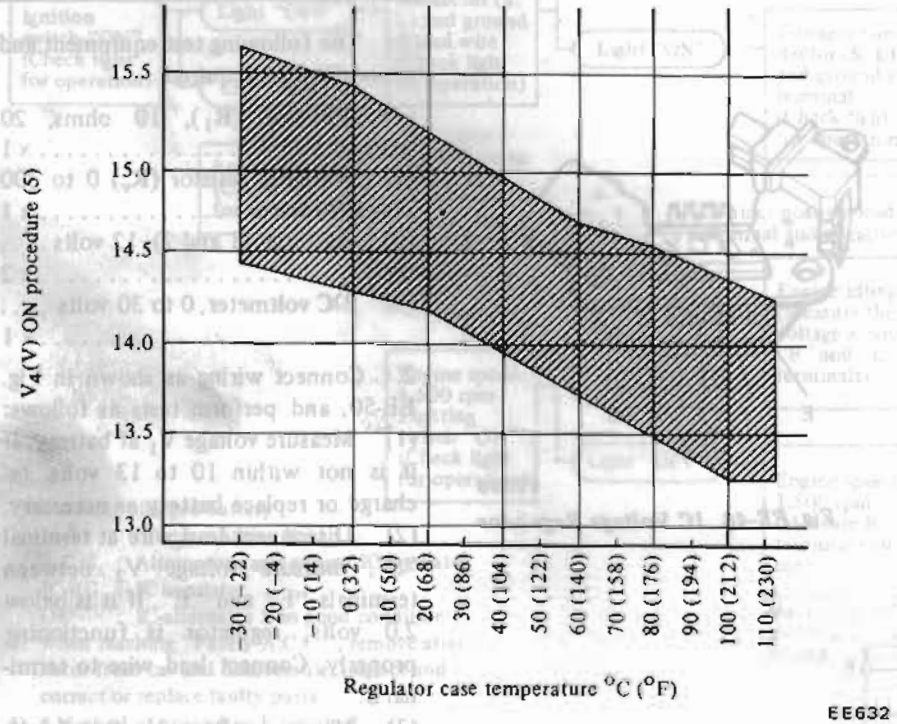
(1) Resistor (R_1), 10 ohms, 20 watts ..... x 1
(2) Variable resistor (R_v) 0 to 300 ohms, 20 watts ..... x 1
(3) Batteries (1 and 2), 12 volts ..... x 2
(4) DC voltmeter, 0 to 30 volts ..... x 1

2. Connect wiring as shown in Fig. EE-50, and perform tests as follows:
(1) Measure voltage V_1 at battery. If it is not within 10 to 13 volts, re-charge or replace battery as necessary.
(2) Disconnect lead wire at terminal "S", measure voltage V_2 between terminals "F" and "E". If it is below 2.0 volts, regulator is functioning properly. Connect lead wire to terminal S.
(3) Measure voltage V_3 (total voltage of batteries 1 and 2). If it is not within 20 to 26 volts, re-charge or replace either or both batteries.
(4) Gradually decrease resistance of variable resistor Rv from 300 ohms, and measure voltage V_2 between terminals "E" and "F". As resistance varies, voltage V_2 should at a certain point increase to as high as voltage V_1 which is measured in Step (1). If there is such a variation, the regulator is functioning properly. Hold variable resistor Rv at the same voltage as V_1. If there is no voltage variation, regulator is out of order and must be replaced.



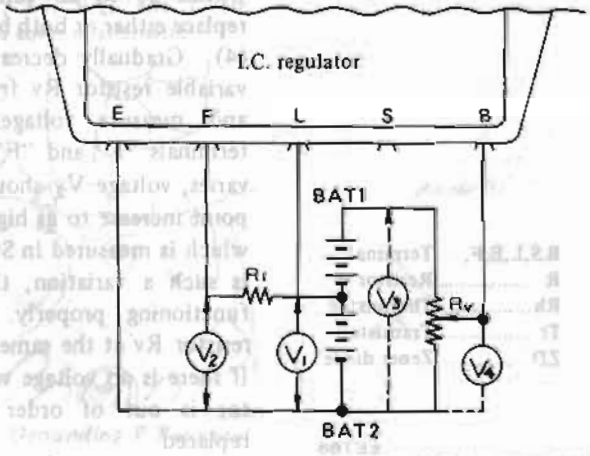
EE631

Fig. EE-50 Testing Regulator (1)



EE632

Fig. EE-51 Testing Regulator (5)



EE633

Fig. EE-52 Testing Regulator (6)

(5) Measure voltage V_4 between center tap of variable resistor Rv and terminal "E".

With Rv resistance set at a value obtained in step (4) above, measure voltage V_4 to see if it is within specified range indicated in Fig. EE-51. If it is not, regulator is not functioning properly. Replace.

(6) Reconnect wiring as shown in Fig. EE-52, and repeat steps (4) and (5). If voltage V_4 is 0.5 to 2.0 volts higher than that in step (5), regulator is functioning properly. If it is not, replace.

IGNITION CIRCUIT

DESCRIPTION

The ignition circuit consists of ignition switch, IC ignition unit, distributor, wiring, spark plugs and battery.

The distributor is of the pick-up type and is equipped with a pick-up coil which electrically detects the ignition timing signal in place of the circuit breaker of the conventional distributor. The IC ignition unit is a new addition, which generates the signal required for the make and break of the primary current for the ignition coil.

The primary current is supplied by the battery or alternator and flows through the primary circuit.

It consists of the ignition switch, primary winding of the ignition coil, IC ignition unit and all connecting low tension wiring.

The secondary current is produced by the ignition coil and flows through the secondary circuit, resulting in high voltage spark between the electrodes of the spark plugs in engine cylinders.

This circuit contains the secondary winding of the ignition coil, distributor high tension cables to coil and spark plugs, distributor rotor and cap.

When the ignition switch is turned on and the distributor reluctor rotates, the primary current flows through the primary winding of the coil and through IC ignition unit to ground.

When the primary circuit is opened by circuit of IC ignition unit, the magnetic field built up in the primary winding of the coil moves through the secondary winding of the coil, inducing high voltage. This high voltage is produced every time the primary circuit opens.

The secondary current flows through the high tension cable to the distributor cap, then the rotor distributes the current to one of the spark plug terminals in the distributor cap.

Then the spark occurs while the secondary current jumps the gap between the insulated electrode and the ground side electrode of the spark plug. This process is repeated for each power stroke of the engine.

The spark plug should be inspected, cleaned and regapped at tune up. Spark plugs should also be replaced periodically as specified in the "Maintenance Schedule".

The remainder of the ignition component parts should be inspected for only their operation, tightness of electrical terminals, and wiring condition.

Apply grease (NLGI consistency No. 1 containing MoS_2 or equivalent) to distributor rotor shaft as required.

WARNING:
When current is flowing, never touch with bare hand high tension cables or any other parts with high voltage. If parts are moist, touching them could cause an electric shock, even if they are insulated. Always wear dry, well-insulated gloves or wrap affected parts with dry cloth before handling.

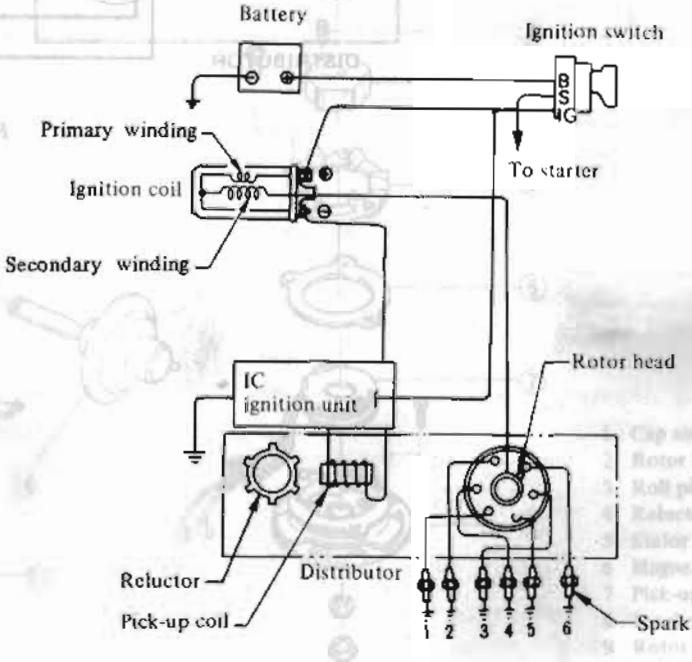


Fig. EE-53 Ignition System Circuit Diagram

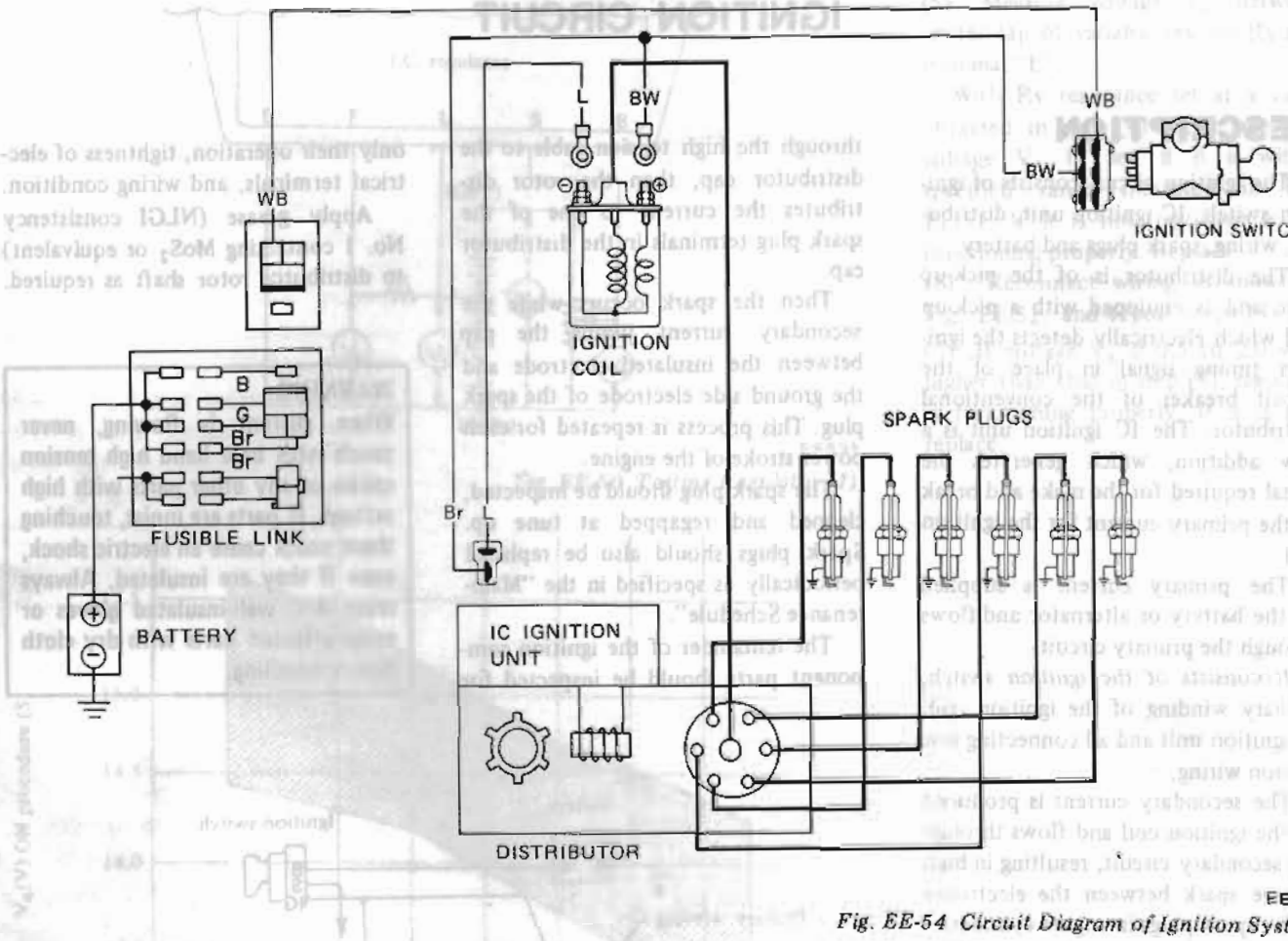


Fig. EE-54 Circuit Diagram of Ignition System

DISTRIBUTOR

CONSTRUCTION

In the conventional distributor the ignition timing is detected by the cam and breaker arm, while in this distributor it is detected by the reluctor on the shaft and the pick-up coil provided in place of the breaker. The amount of magnetic flux passing through the pick-up coil is changed when the reluctor rotates, and then the electrical signal is generated in the pick-up coil.

This electric signal is conducted into the IC ignition unit, which makes and breaks the primary current running through the ignition coil and generates high voltage in the secondary winding.

The centrifugal and vacuum advance mechanisms employ the conventional mechanical type.

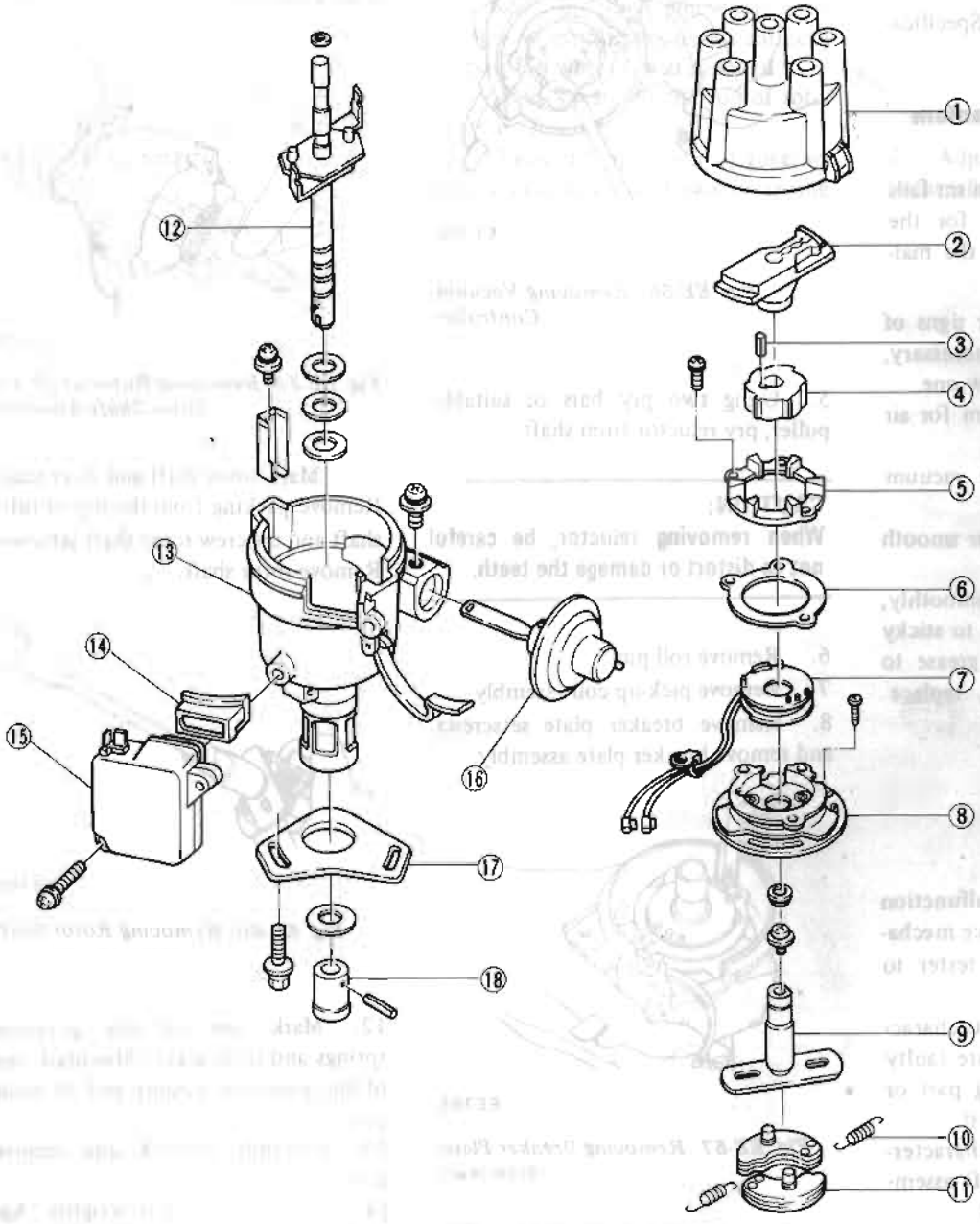


Fig. EE-55 Distributor

CHECKING AND ADJUSTMENT

CAP AND ROTOR HEAD

Cap and rotor head should be inspected periodically as specified in the "Maintenance Schedule". Remove cap and clean all dust and carbon deposits from cap and rotor from time to time. If cap is cracked or is leaking, replace with a new one.

ADVANCE MECHANISMS

Specifications

Refer to Service Data and Specifications for distributor.

Vacuum advance mechanism mechanical parts

If vacuum advance mechanism fails to operate properly, check for the following items and correct the malfunction as required.

1. Check vacuum inlet for signs of leakage at its connection. If necessary, retighten or replace with a new one.
2. Check vacuum diaphragm for air leak.

If leak is found, replace vacuum controller assembly.

3. Inspect breaker plate for smooth moving.

If plate does not move smoothly, this condition could be due to sticky steel balls or pivot. Apply grease to steel balls or, if necessary, replace breaker plate as an assembly.

Centrifugal advance mechanical parts

When cause of engine malfunction is traced to centrifugal advance mechanical parts, use distributor tester to check its characteristics.

If nothing is wrong with its characteristics, conceivable causes are faulty or abnormal wear of driving part or others. So do not disassemble it.

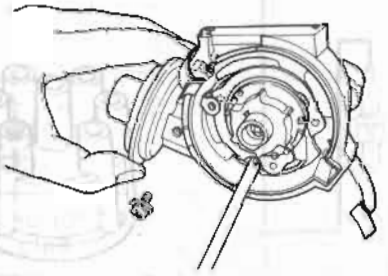
In the event of improper characteristics, check closely rotor shaft assembly, governor weight and shaft.

If any of the above parts are malfunctioning, replace the parts.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLY

1. Take off cap and remove rotor head.
2. Remove IC ignition unit. Refer to IC Ignition Unit for removal and installation.
3. Remove stator and magnet by removing stator securing screws.
4. Remove vacuum controller by removing securing screws.



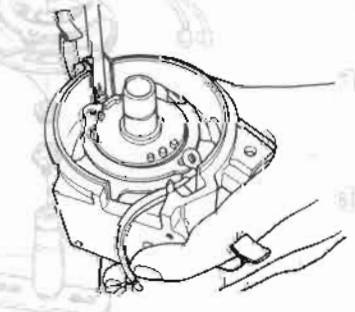
EE702

Fig. EE-56 Removing Vacuum Controller

5. Using two pry bars or suitable puller, pry reluctor from shaft.

CAUTION:
When removing reluctor, be careful not to distort or damage the teeth.

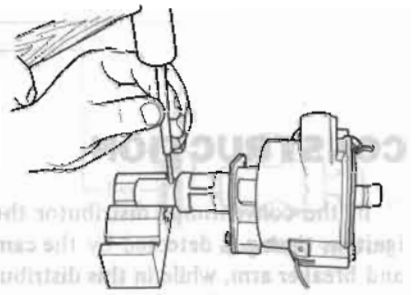
6. Remove roll pin.
7. Remove pick-up coil assembly.
8. Remove breaker plate setscrews and remove breaker plate assembly.



EE703

Fig. EE-57 Removing Breaker Plate Setscrews

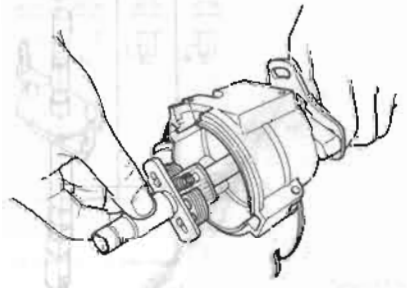
9. Punch knock pin out and remove pinion.



EE704

Fig. EE-58 Removing Knock Pin

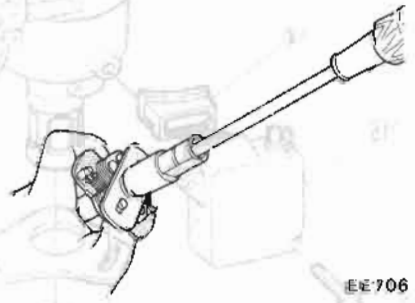
10. Remove rotor shaft and drive shaft assembly.



EE705

Fig. EE-59 Removing Rotor Shaft and Drive Shaft Assembly

11. Mark rotor shaft and drive shaft. Remove packing from the top of rotor shaft and unscrew rotor shaft setscrew. Remove rotor shaft.



EE706

Fig. EE-60 Removing Rotor Shaft

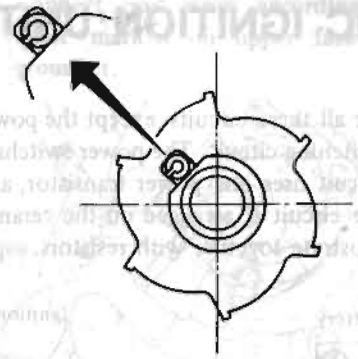
12. Mark one of the governor springs and its bracket. Also mark one of the governor weights and its pivot pins.
13. Carefully unhook and remove governor springs.
14. Remove governor weights. Apply grease to governor weights, after disassembling.

ASSEMBLY

To assemble, reverse the order of disassembly. Carefully observe the following instructions.

CAUTION:
Before installing IC ignition unit, make sure mating surfaces of IC ignition unit and distributor are clean and free from dust, sand and moisture.

1. Align match marks so that parts are assembled to their original positions.
2. Ensure that reluctor is properly oriented when installing on shaft. Always drive in roll pin with its slit toward the outer end of shaft. See Fig. EE-61. Be sure to use a new roll pin.

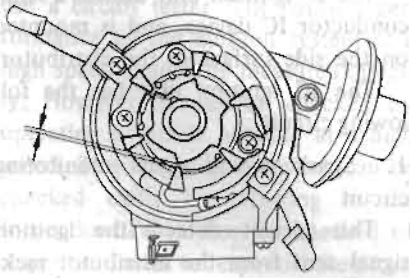


EE707

Fig. EE-61 Driving in Roll Pin

3. When installing pinion on shaft, be sure to install pinion gear correctly to position where it was installed.
4. Apply grease to the top of rotor shaft as required.
5. Check the operation of governor before installing distributor on engine.
6. Properly center stator and reluctor before tightening.

Standard air gap:
0.3 to 0.5 mm
(0.012 to 0.020 in)



EE701

Fig. EE-62 Air Gap

7. Adjust ignition timing after distributor is installed on engine.

IC IGNITION UNIT

DESCRIPTION

The IC ignition unit utilizes a semiconductor IC device, and is mounted on the side surface of the distributor.

The IC ignition unit has the following circuits:

1. Spark timing signal monitoring circuit

This circuit detects the ignition signal sent from the distributor pick-up coil, and amplifies the signal.

2. Lock-preventing circuit

This circuit cuts off the ignition coil primary current when the ignition switch is ON and the engine is stationary.

If the ignition coil primary current is allowed to flow under such conditions, excessive current will be drawn because of low internal resistance of the ignition coil.

This can result in an abnormal temperature rise in the ignition coil or discharged battery. These malfunctions can be prevented by this lock-preventing circuit.

3. Duty control circuit

This circuit controls the ratio of the ignition coil primary current ON-OFF time periods, in one cycle of ignition operation.

This is equivalent to the dwell angle of the conventional point type distributor. In order to provide high-performance spark firing over a wide-range of driving speeds, this duty can be controlled by the source voltage and the ambient temperature, as well as by the engine rpm.

4. Power switching circuit

This circuit is used to make or break directly the primary circuit current of the ignition coil.

5. Current limiting circuit

This circuit controls the current value so that excessive current will not flow through the power switching circuit.

To ensure efficient operation of the IC ignition unit, these five circuits are manufactured in one assembly, as shown in Fig. EE-63.

The semi-conductor IC is utilized for all these circuits, except the power switching circuit. The power switching circuit uses one power transistor, and the circuit is arranged on the ceramic substrate together with resistors, capacitors and diodes.

Each component part of this unit is highly reliable, however, should any part be found faulty, the entire assembly must be replaced.

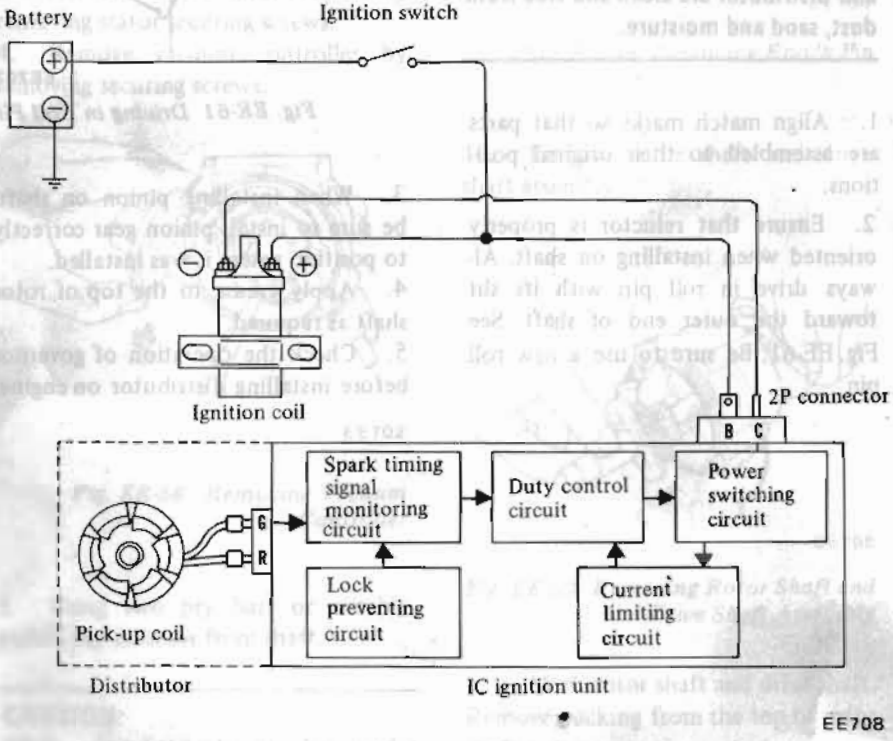


Fig. EE-63 IC Ignition Unit Circuit Diagram

REMOVAL AND INSTALLATION

1. Disconnect battery ground cable.
2. Take off distributor cap and remove rotor head.
3. Disconnect harness connector.
4. Remove IC ignition unit securing screws.

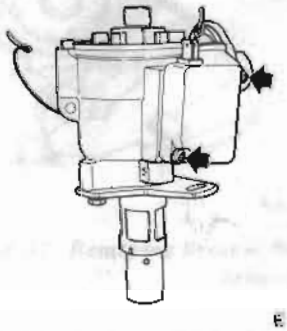


Fig. EE-64 Removing IC Ignition Unit

5. Disconnect pick-up coil wire from IC ignition unit.

Note: Holding connector with needle nose pliers as shown in Fig. EE-65, disconnect pick-up coil terminal. Be careful not to pull lead wire.

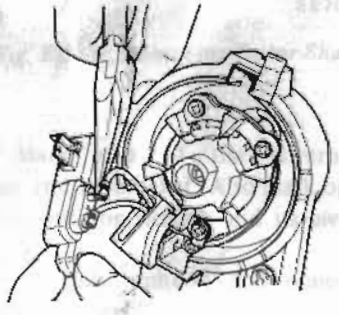


Fig. EE-65 Disconnecting Pick-up Coil Terminal

6. Install IC ignition unit in the reverse order of removal.

CAUTION:
Before installing IC ignition unit, make sure mating surfaces of IC ignition unit and distributor are clean and free from dust, sand and moisture.

Note:
a. When connecting lead wires to unit, insert lead wire terminal with fingers as shown in Fig. EE-66.
b. Connect lead wires according to color marked on upper face of grommet.

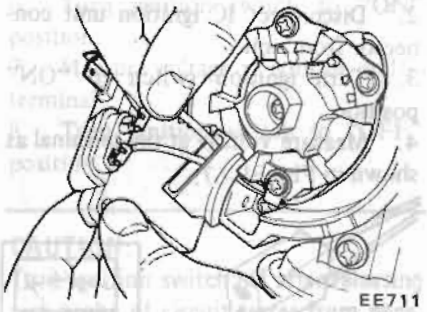


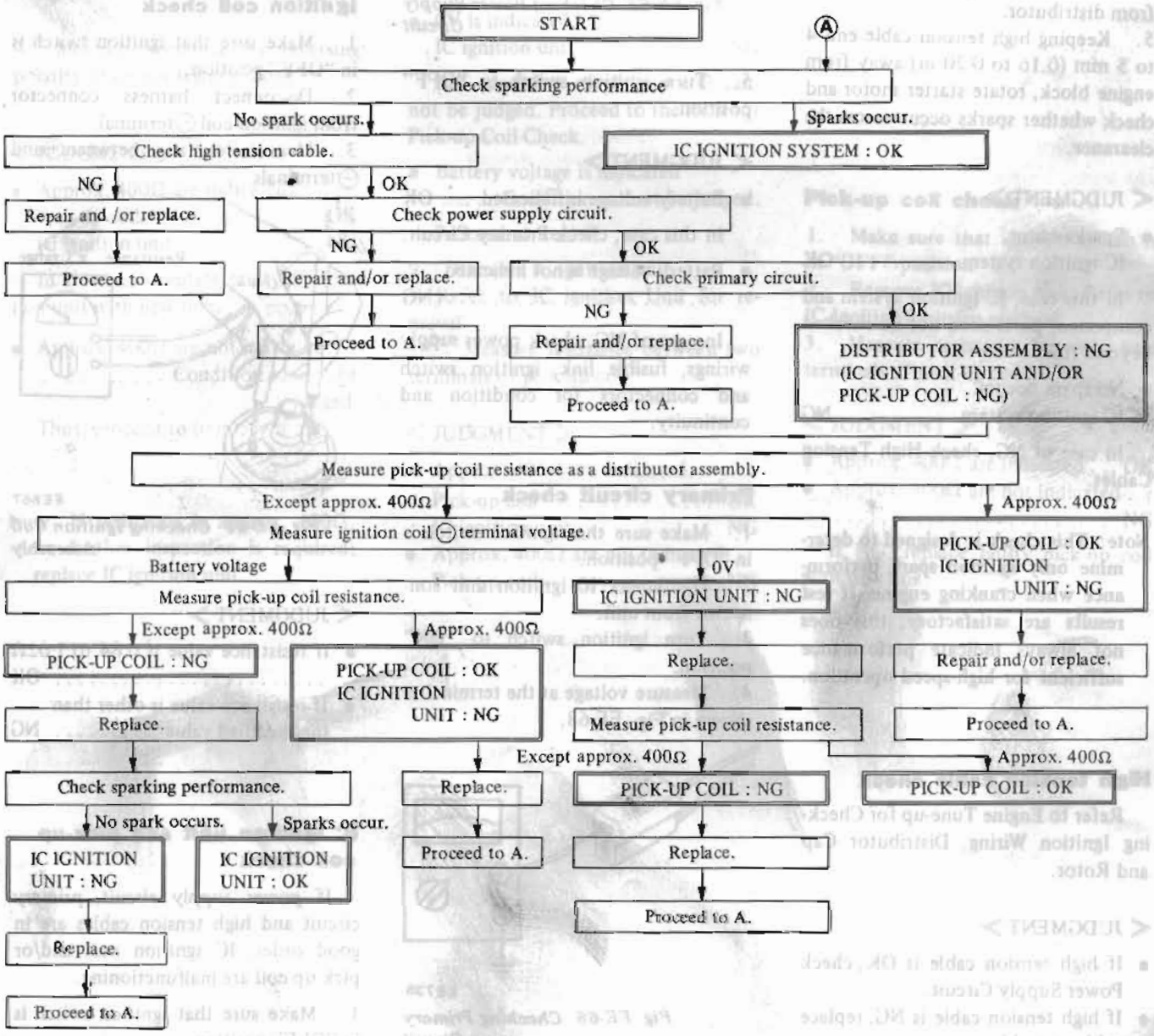
Fig. EE-66 Connecting Pick-up Coil Terminal

CHECKING IC IGNITION SYSTEM

DESCRIPTION

To check the IC ignition system, use a circuit tester. The ignition performance of the ignition system at a high speed cannot be measured directly. However, it can be checked by operating a vehicle actually at a high speed. The IC ignition system can be checked easily by referring to the Inspection Table. For the method of inspection, refer to respective items.

INSPECTION TABLE



CHECKING PROCEDURE

Sparking performance check

1. Turn ignition switch to "OFF" position.
2. Disconnect EFI fusible link connector.

CAUTION:
Before disconnecting EFI fusible link connector, ensure that ignition switch is in "OFF" position.

3. Disconnect cold start valve harness connector.
4. Disconnect high tension cable from distributor.
5. Keeping high tension cable end 4 to 5 mm (0.16 to 0.20 in) away from engine block, rotate starter motor and check whether sparks occur across the clearance.

≪ JUDGMENT ≫

- Sparks occur.
  IC ignition system ..... OK

  In this case, IC ignition system and component parts need not be checked beyond this.
- No spark occurs.
  IC ignition system ..... NG

  In case of NG, check High Tension Cables.

Note: **This check is designed to determine only ignition spark performance when cranking engine. If test results are satisfactory, this does not always indicate performance sufficient for high-speed operation.**

High tension cable check

Refer to Engine Tune-up for Checking Ignition Wiring, Distributor Cap and Rotor.

≪ JUDGMENT ≫

- If high tension cable is OK, check Power Supply Circuit.
- If high tension cable is NG, replace cable assembly.

Power supply circuit check

1. Make sure that ignition switch is in "OFF" position.
2. Disconnect IC ignition unit connector from unit.
3. Turn ignition switch to "ON" position.
4. Measure voltage at the terminal as shown in Fig. EE-67.

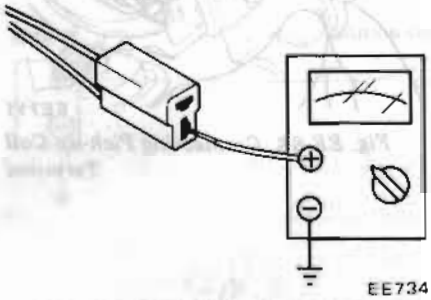


Fig. EE-67 Checking Power Supply Circuit

5. Turn ignition switch to "OFF" position.

≪ JUDGMENT ≫

- Battery voltage is indicated .. OK

  In this case, check Primary Circuit.
- Battery voltage is not indicated
  ..... NG

  In case of NG, check power supply wirings, fusible link, ignition switch and connectors for condition and continuity.

Primary circuit check

1. Make sure that ignition switch is in "OFF" position.
2. Disconnect IC ignition unit connector from unit.
3. Turn ignition switch to "ON" position.
4. Measure voltage at the terminal as shown in Fig. EE-68.

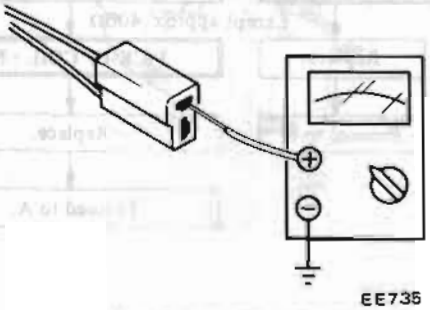


Fig. EE-68 Checking Primary Circuit

5. Turn ignition switch to "OFF" position.

≪ JUDGMENT ≫

- Battery voltage is indicated .. OK

  In this case, proceed to the step for IC Ignition Unit and Pick-up Coil Check.
- Battery voltage is not indicated
  ..... NG

If NG, check condition and continuity of primary circuit wirings and connectors. If results of these inspections are satisfactory, check Ignition Coil.

Ignition coil check

1. Make sure that ignition switch is in "OFF" position.
2. Disconnect harness connector from ignition coil ⊖terminal.
3. Measure resistance between⊕and ⊖terminals.

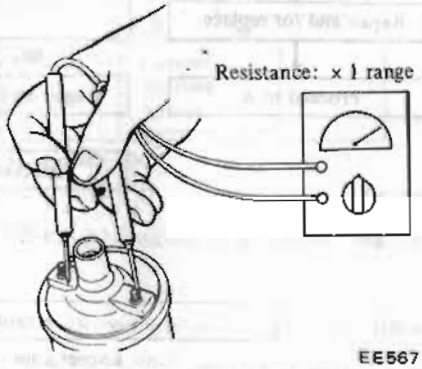


Fig. EE-69 Checking Ignition Coil Assembly

≪ JUDGMENT ≫

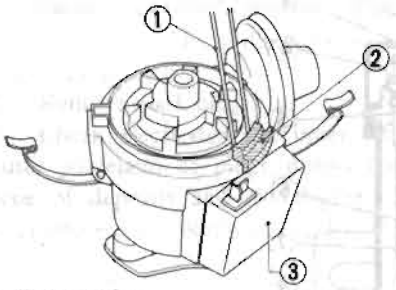
- If resistance value is 0.84 to 1.02Ω
  ..... OK
- If resistance value is other than the specified value ..... NG

IC ignition unit and pick-up coil check

If power supply circuit, primary circuit and high tension cables are in good order, IC ignition unit and/or pick-up coil are malfunctioning.

1. Make sure that ignition switch is in "OFF" position.

2. Remove distributor cap and rotor.
3. Measure resistance between two terminals of pick-up coil as a distributor assembly with a circuit tester.



1 Tester probes
2 Grommet
3 IC ignition unit EE736

Fig. EE-70 Measuring Pick-up Coil Resistance

4. Measure resistance by reversing polarity of circuit tester probes.

≪ JUDGMENT ≫

- Approx. 400Ω are indicated.
  Pick-up coil . . . . . OK
  IC ignition unit . . . . . NG

In this case, replace faulty IC ignition unit with new one.

- Approx. 400Ω are not indicated
  . . . . . Condition cannot be judged.

Thus, proceed to item 5.

Note: If resistance is approx. 400Ω, no further inspection is required; replace IC ignition unit.

5. Make sure 2-pin IC ignition unit connector is securely connected to unit.
6. Turn ignition switch to "ON" position.
7. Measure voltage at ignition coil ⊖ terminal.
8. Turn ignition switch to "OFF" position.

CAUTION:
Turn ignition switch off after releasing test probe of circuit tester from negative terminal of ignition coil. Failure to do this could result in damage to circuit tester.

≪ JUDGMENT ≫

- 0V is indicated.
  IC ignition unit . . . . . NG

But condition of pick-up coil cannot be judged. Proceed to the item for Pick-up Coil Check.

- Battery voltage is indicated
  . . . . . Condition cannot be judged.

Proceed to item 9.

9. Remove IC ignition unit.
Refer to IC ignition Unit for removal.
10. Measure resistance between two terminals of pick-up coil.

≪ JUDGMENT ≫

- Approx. 400Ω are indicated.
  Pick-up coil . . . . . OK
  IC ignition unit . . . . . NG
- Approx. 400Ω are not indicated.
  Pick-up coil . . . . . NG

Condition of IC ignition unit cannot be judged. Proceed to item 11.
11. Replace faulty pick-up coil with new one.
12. Install original IC ignition unit.
13. Check sparking performance.

≪ JUDGMENT ≫

- Sparks occur.
  IC ignition system (IC ignition unit) . . . . . OK
- No spark occurs.
  IC ignition unit . . . . . NG

If NG, replace faulty IC ignition unit with new one.

Pick-up coil check

1. Make sure that ignition switch is in "OFF" position
2. Remove IC ignition unit. Refer to IC Ignition Unit for removal.
3. Measure resistance between two terminals of pick-up coil.

≪ JUDGMENT ≫

- Approx. 400Ω are indicated . . OK
- Approx. 400Ω are not indicated
  . . . . . NG

If NG, replace faulty pick-up coil with new one.

IGNITION COIL

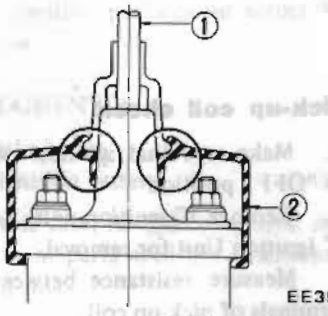
The ignition coil is an oil-filled type. The ignition coil case is filled with oil which has good insulating and heat-radiating characteristics.

The ignition coil has a greater ratio between the primary and secondary windings to step up battery voltage to high voltage. This causes stronger sparks to jump the spark plug gap.

The cap is made of alkyd resin which offers high resistance to electric arc and increased insulation.

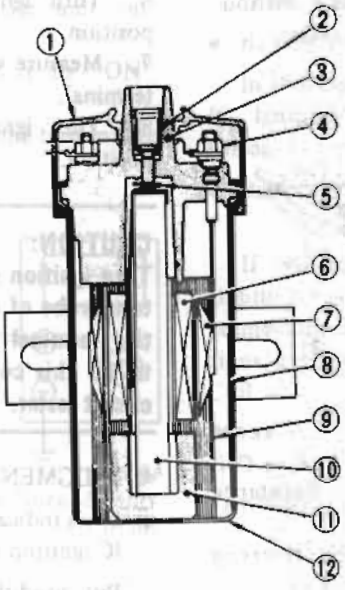
When high tension cable is installed to ignition coil, there should be no clearance between their caps.

Note: Do not disconnect high tension cables from spark plugs during engine running.



1 High tension cable
2 Rubber cap

Fig. EE-71 Correct Installation of High Tension Cable



1 Rubber cap for ignition coil
2 Secondary terminal
3 Cap
4 Primary terminal
5 Spring
6 Secondary winding
7 Primary winding
8 Side core
9 Insulator
10 Center core
11 Segment
12 Case

Fig. EE-72 Ignition Coil

SPARK PLUG

INSPECTION

1. Disconnect high tension cables from spark plugs by pulling on boot, not on cable itself.
2. Remove spark plugs.
3. Check electrodes and inner and outer porcelains of plugs, noting the type of deposits and the degree of electrode erosion. Refer to Fig. EE-73.

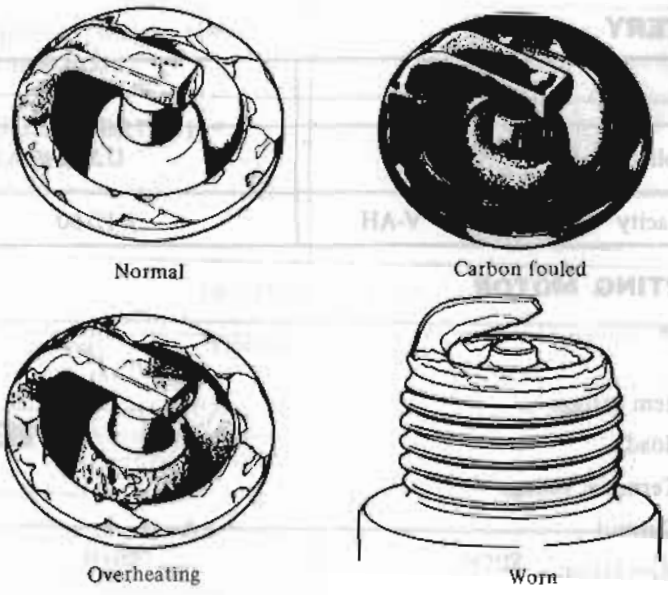


Fig. EE-73 Spark Plug

Normal: Brown to grayish-tan deposits and slight electrode wear indicate correct spark plug heat range.

Carbon fouled: Dry fluffy carbon deposits on the insulator and electrode are mostly caused by slow speed driving in city, weak ignition, too rich fuel mixture, dirty air cleaner, etc.
It is advisable to replace with plugs having hotter heat range.

Oil fouled: Wet black deposits show excessive oil entrance into combustion chamber through worn rings and pistons or excessive clearance between valve guides and stems. If the same condition remains after repair, use a hotter plug.

Overheating: White or light gray insulator with black or gray brown spots and bluish burnt electrodes indicate engine overheating. Moreover, the appearance results from incorrect ignition timing, loose spark plugs, low fuel pump pressure, wrong selection of fuel, a hotter range plug, etc.
It is advisable to replace with plugs having colder heat range.

4. After cleaning, dress electrodes with a small fine file to flatten the surfaces of both center and side electrodes in parallel. Set spark plug gap to specification.
5. Install spark plugs and torque each plug.
6. Connect spark plug wires.

CLEANING AND REGAP

Clean spark plugs in a sand blast type cleaner. Avoid excessive blasting. Clean and remove carbon or oxide deposits, but do not wear away porcelain. If deposits are too stubborn, discard plugs.

After cleaning spark plugs, renew firing surface of electrodes with file mentioned above. Then check spark plug gap with wire feeler gauge. All spark plugs new or used should have the gap checked and reset by bending ground electrode.

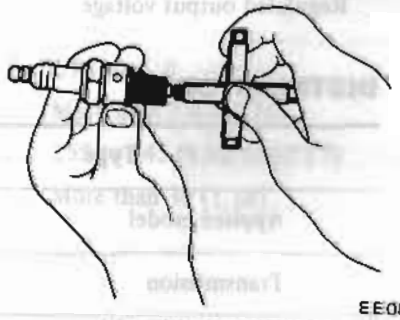


Fig. EE-74 Setting Spark Plug Gap

SERVICE DATA AND SPECIFICATIONS

GENERAL SPECIFICATIONS

BATTERY

Type		N50Z	N70Z
Applied model		U.S.A.	Canada U.S.A. (Optional)
Capacity	V-AH	12-60	12-70

STARTING MOTOR

Type			S114-254B Reduction gear type
System voltage		V	12
No load			
Terminal voltage		V	12
Current		A	Less than 100
Revolution		rpm	More than 4,300

ALTERNATOR

Type			LR160-42B
Nominal rating		V-A	12-60
Ground polarity			Negative
Minimum revolution under no load (When 14 volt is applied)		rpm	Less than 1,000
Hot output current		A/rpm	60/5,000
Pulley ratio			2.09
Regulated output voltage		V	14.4 to 15.0

DISTRIBUTOR

Type	D6K8-02	D6K8-03	D6K8-05	D6K8-06	D6K8-07
Applied model	Non-California models		California models		Canada
Transmission	M/T	A/T	M/T	A/T	M/T, A/T
Firing order	1-5-3-6-2-4				
Rotating direction	Counterclockwise				

IGNITION COIL

Type		CIT-30	STC-30
Primary voltage	V	12	
Spark gap	mm (in)	More than 7 (0.28)	

SPARK PLUG

Type	Standard	B6ES-11, BR6ES-11* L45W-11	BR6ES-11
	Hot	B5ES-11, BR5ES-11* L46W-11	BR5ES-11
	Cold	B7ES-11, BR7ES-11* L44W-11	BR7ES-11
Applied model		U.S.A.	Canada
Size (screw dia. x reach) mm (in)		14 x 19 (0.55 x 0.75)	

*Option

INSPECTION AND ADJUSTMENT

BATTERY

Type	N50Z	N70Z
Full charging specific gravity	1.26	1.28

STARTING MOTOR

Type		S114-254B
Outer diameter of commutator	mm (in)	More than 29 (1.14)
Minimum length of brush	mm (in)	11 (0.43)
Brush spring tension	kg (lb)	1.6 to 2.0 (3.5 to 4.4)
Difference "ℓ" in height of pinion	mm (in)	0.3 to 1.5 (0.012 to 0.059)

ALTERNATOR

Type		LR160-42B
Minimum length of brush	mm (in)	More than 7.0 (0.276)
Brush spring pressure	gr (oz)	255 to 345 (8.99 to 12.17)
Slip ring outer diameter	mm (in)	More than 30 (1.18)

DISTRIBUTOR

Type		D6K8-02	D6K8-03	D6K8-05	D6K8-06	D6K8-07
Air gap	mm (in)	0.3 to 0.5 (0.012 to 0.020)				
Cap insulation resistance	MΩ	More than 50				
Rotor head insulation resistance	MΩ	More than 50				
Cap carbon point length	mm (in)	10 (0.39)				
Vacuum advance [Distributor degree/ distributor mmHg (inHg)]		0/150 (5.91) 9/295 (11.61)	0/150 (5.91) 5/250 (9.84)	0/110 (4.33) 10/290 (11.42)	0/150 (5.91) 7.5/270 (10.63)	0/150 (5.91) 9/295 (11.61)
Centrifugal advance [Distributor degree/distributor rpm]		0/600 8.5/1,250	0/600 8.5/1,250	0/600 8.5/1,250	0/600 8.5/1,250	0/600 8.5/1,250

IGNITION COIL

Type	CIT-30	STC-30
Primary resistance at 20°C (68°F) Ω	0.84 to 1.02	
Secondary resistance at 20°C (68°F) kΩ	8.2 to 12.4	

SPARK PLUG

Type	B6ES-11, L45W-11 B5ES-11, L46W-11 B7ES-11, L44W-11	BR6ES-11 BR5ES-11 BR7ES-11
Plug gap mm (in)	1.0 to 1.1 (0.039 to 0.043)	1.0 to 1.1 (0.039 to 0.043)

TIGHTENING TORQUE

Magnetic switch terminal	kg-cm (in-lb)	115 to 160 (100 to 139)
Magnetic switch attaching bolts	kg-cm (in-lb)	38 to 51 (33 to 44)
Starting motor		
Gear case attaching bolts	kg-cm (in-lb)	64 to 85 (56 to 74)
Pulley nut	kg-m (ft-lb)	4.5 to 6.0 (33 to 43)
Alternator through bolts	kg-cm (in-lb)	35 to 40 (30 to 35)
Spark plug	kg-m (ft-lb)	1.5 to 2.5 (11 to 18)

TROUBLE DIAGNOSES AND CORRECTIONS

I. BATTERY

Battery is not charged correctly.

1. Correctly adjust belt tension of alternator.
2. Complete connections in charging system.
3. Securely connect battery terminals.

Lighting load test.

1. Make sure that electrolyte level is correct.
2. Crank engine for three seconds (with ignition system open).
3. Turn on headlight (low beam) for one minute, and then measure specific gravity of each cell of battery.

Specific gravity of each cell is less than 1.200 (N50Z) or 1.220 (N70Z).

1. When specific gravity can not be raised above 1.200 (N50Z) or 1.220 (N70Z) by charging, the battery is run-down.

Specific gravity of some cells is above 1.200 (N50Z) or 1.220 (N70Z), but others show lower specific gravity.

Specific gravity of each cell is above 1.200 (N50Z) or 1.220 (N70Z).

Unbalance is within 0.05.

1. Discharged battery. Charge it and repeat lighting load test.

Unbalance of specific gravity between cells exceeds 0.05.

1. Battery is run-down.

Unbalance is within 0.05.

1. Battery is satisfactory.

Unbalance of specific gravity between cells exceeds 0.05.

1. Battery is run-down.

II. STARTING MOTOR

Condition	Probable cause	Corrective action
Starting motor will not operate.	Discharged battery.	Charge or replace battery.
	Damaged solenoid switch.	Repair or replace solenoid switch.
	Loose connections of terminal.	Clean and tighten terminal.
	Damaged field coil.	Replace yoke.
	Damaged brushes.	Replace brushes.
	Damaged bearing.	Replace bearing.
	Damaged armature.	Replace armature.
Noisy starting motor.	Loose securing bolt.	Tighten.
	Worn pinion gear.	Replace.
	Poor lubrication.	Add oil.
	Worn commutator.	Replace.
	Worn brushes.	Replace.
Starting motor cranks slowly.	Discharged battery.	Charge.
	Loose connection of terminal.	Clean and tighten.
	Worn brushes.	Replace.
	Locked brushes.	Inspect brush spring tension or repair brush holder.
	Loose connections of terminal.	Clean and tighten terminal.
	Damaged field coil.	Replace yoke.
	Damaged brushes.	Replace brushes.
	Damaged bearing.	Replace bearing.
	Damaged armature.	Replace armature.
Starting motor cranks slowly.	Dirty or worn commutator.	Clean and repair.
	Armature rubs field coil.	Repalce assembly.
	Damaged solenoid switch.	Repair or replace.
Starting motor operates but does not crank engine.	Worn pinion.	Replace.
	Locked pinion guide.	Repair.
	Worn ring gear.	Replace.
Starting motor will not disengage even if ignition switch is turned off.	Damaged solenoid switch.	Repair or replace.
	Damaged gear teeth.	Replace damaged gear.

III. ALTERNATOR (Including voltage regulator)

Condition	Probable cause	Corrective action
No output	Sticking brushes.	Correct or replace brushes and brush springs.
	Dirty brushes and slip rings.	Clean.
	Loose connections or broken leads.	Retighten or solder connections. Replace leads if necessary.
	Open stator winding.	Repair or replace stator.
	Open rotor winding.	Replace rotor.
	Open diodes.	Replace.
	Shorted diodes.	Replace.
	Shorted rotor.	Replace rotor.
	Shorted stator.	Replace.
	Ground "BAT" terminal.	Replace insulator.
	Broken fan belt.	Replace.
Excessive output.	Voltage regulator breakdown.	Check regulator operation and replace as required.
	Poor connection of alternator "S" terminal.	Correct.
	Open diode.	Replace.
Low output.	Loose or worn fan belt.	Retighten or replace.
	Sticking brushes.	Correct or replace brushes and springs if necessary.
	Low brush spring tension.	Replace brush springs.
	Voltage regulator breakdown.	Check regulator operation and replace as required.
	Dirty slip rings.	Clean.
	Partial short, ground, or open in stator winding.	Replace stator.
	Partially shorted or grounded rotor winding.	Replace rotor.
	Open or damaged diode.	Replace diode.
Noisy alternator.	Loose mounting.	Retighten bolts.
	Loose drive pulley.	Retighten.
	Broken ball bearing.	Replace.
	Improperly seated brushes.	Seat correctly.

IV. IGNITION CIRCUIT

1. When engine does not start.

If there is no problem in fuel system, ignition system should be checked. This can be easily done by detaching a high tension cable from distributor, starting engine and observing condition of spark that occurs between high tension cable and engine block. After checking this, repair as necessary.

Note: Turn ignition switch to "OFF" position. And disconnect cold start valve harness connector and EFI fusible link connector.
Then, observe the condition of sparks while starter motor is in operation.

Condition	Location	Probable cause	Corrective action
No spark at all	Distributor	Breakage of lead-wire on low tension side.	Repair.
		Poor insulation of cap and rotor head.	Replace.
		Open pick-up coil.	Replace.
		Improper air gap.	Adjust.
	Ignition coil	Wire breakage or short circuit of coil.	Replace with new one.
	High tension cable	Wire coming off.	Repair.
		Faulty insulation.	Replace.
	IC ignition unit	Faulty IC ignition unit.	Replace.
		Breakage of circuit.	Replace.
		Detached connection.	Repair.
Spark length More than 6 mm (0.24 in)	Spark plugs	Spark plug gap too wide.	Correct or replace.
		Too much carbon.	Clean or replace.
		Broken neck of insulator.	Replace.
		Expiration of plug life.	Replace.
	Distributor	Improper air gap.	Adjust.
	IC ignition unit	Faulty IC ignition unit.	Replace.
		Breakage of circuit.	Replace.
		Detached connection.	Repair.

2. Engine rotates but does not run smoothly.

This may be caused by the ignition system or other engine conditions not related to ignition system. Therefore, first a complete inspection of ignition system should be carried out.

Condition	Location	Probable cause	Corrective action
Engine misses.	Distributor	Foreign matter on reluctor or stator.	Clean.
		Improper air gap.	Correct.
		Leak of electricity at cap and rotor head.	Repair or replace.
		Breakage of pick-up coil lead wire.	Replace.
		Worn or shaky breaker plate.	Replace assembly.
		Worn or shaky distributor driving shaft.	Replace assembly.
	Ignition coil	Layer short circuit or inferior quality coil.	Replace with good one.
	High tension cable	Deterioration of insulation with consequent leak of electricity.	Replace.
	Spark plugs	Fouled.	Clean.
		Leak of electricity at upper porcelain insulator.	Repair or replace.
		Spark plug gap too narrow.	Correct or replace.
	IC ignition unit	Faulty IC ignition unit.	Replace.
		Breakage of circuit.	Replace.
		Detached connection.	Repair.
Engine causes knocking very often.	Distributor	Improper ignition timing (too advanced).	Correct.
		Coming off or breakage of governor spring.	Correct or replace.
		Worn pin or hole of governor.	Replace.
	Spark plugs	Burnt too much.	Replace.
Engine does not deliver enough power.	Distributor	Improper ignition timing (too retarded).	Correct.
		Improper functioning governor.	Replace assembly.
		Foreign particles stuck in air gap.	Clean.
	Spark plugs	Fouled.	Clean.