# SERVICE MANUAL

MODEL
L20A, L24 SERIES
ENGINES



NISSAN

NISSAN MOTOR CO., LTD.
TOKYO, JAPAN

## SECTION EE

# ENGINE ELECTRICAL SYSTEM

# STARTING CIRCUIT

The electrical system is a 12-Volt system. This section is divided into the following subsections:

1. Starting motor 2. Alternator 3. Regulator 4. Ignition coil 5. Spark plugs

Information for body electrical system, such as the lighting circuit, instrument, windshield wipers, etc. are described in section BE.

# STARTING MOTOR

## CONTENTS



## DESCRIPTION

The starting system permits the engine being cranked by setting the ignition switch to "start." While the ignition switch is set to "start," the starting motor continues operation. Current to the starting motor is interrupted and the motor is disengaged by setting the ignition switch to "ON." This starting motor is a compound motor, and is equipped with an enclosed over-running clutch. The solenoid switch is built in the yoke.

**Note: Make sure to set ignition switch to "ON" position as soon as engine starts lest starter pinion should be damaged.**

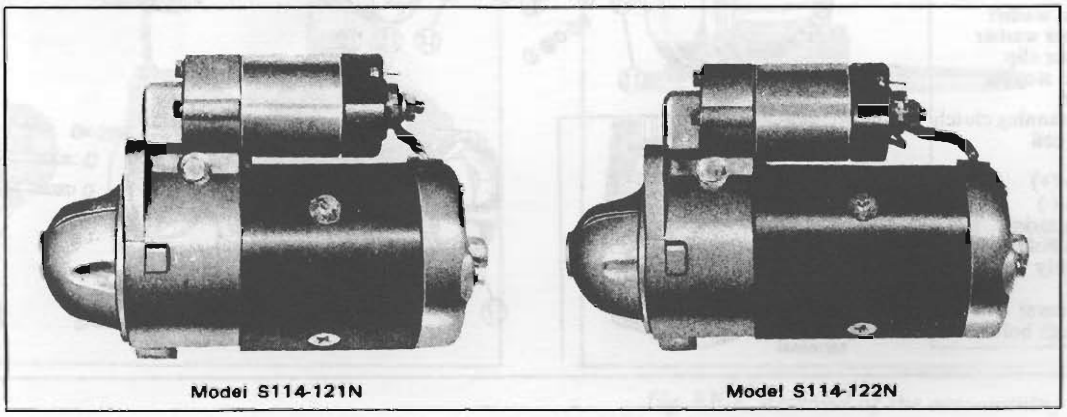
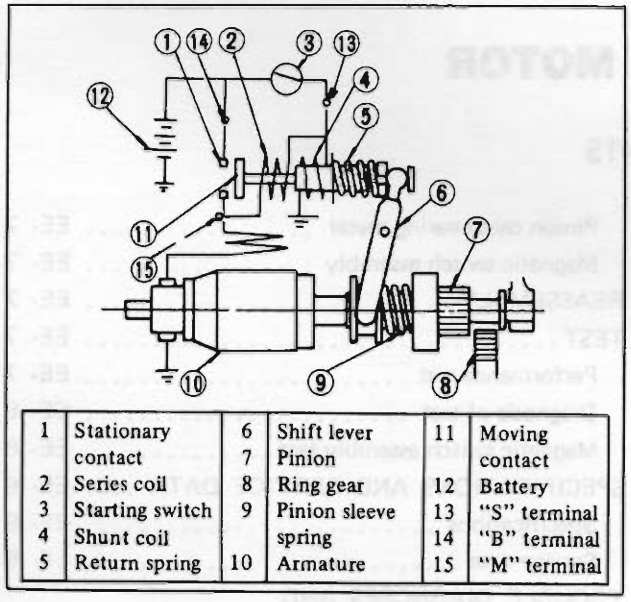



*Fig. EE-1 External view*

## OPERATION

When the ignition switch is set to "start," current flows through the "series" and "shunt" coils of the solenoid and the solenoid is excited. The plunger is pulled into the solenoid so that it operates the shift lever to engage the drive pinion with flywheel ring gear, and the solenoid switch is closed.



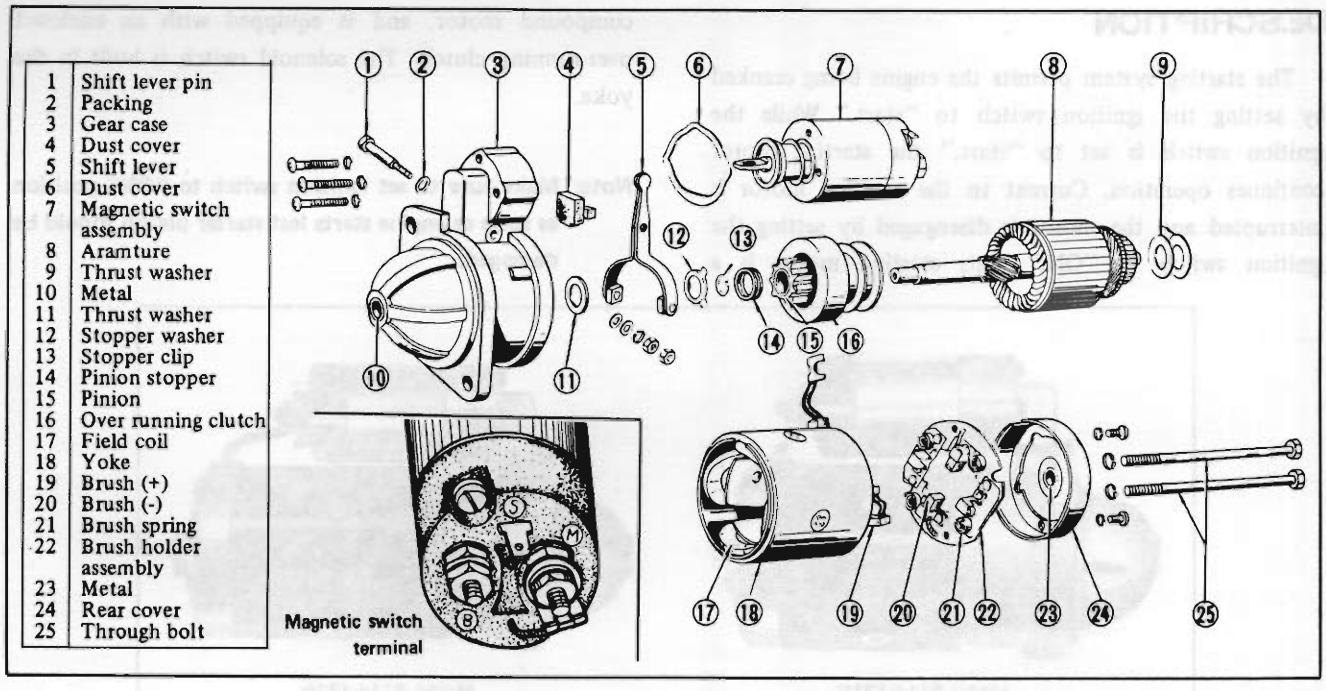
| | | | | | |
|---|---|---|---|---|---|
| 1 | Stationary contact | 6 | Shift lever | 11 | Moving contact |
| 2 | Series coil | 7 | Pinion | 12 | Battery |
| 3 | Starting switch | 8 | Ring gear | 13 | "S" terminal |
| 4 | Shunt coil | 9 | Pinion sleeve spring | 14 | "B" terminal |
| 5 | Return spring | 10 | Armature | 15 | "M" terminal |

*Fig. EE-2 Starting motor circuit*

When the contacts (stationary and movable) are closed, the motor operates to crank the engine, and the "series" coil of the solenoid is cut out. The magnetic force of the "shunt" coil is sufficient to hold the pinion in mesh after shifting the system.

When the engine is operated, and the ignition switch is set to "ON," the "series" coil demagnetizes the "shunt" coil, and the return spring actuates the plunger to return to the original position. Consequently, the motor stops. More positive meshing and demeshing of the pinion and the ring gear teeth are secured by means of the over-running clutch. The over-running clutch employs a shift lever to slide the pinion along the armature shaft so as to engage or disengage with the ring gear teeth. The over-running clutch is designed to transmit driving torque from the motor armature to the ring gear, and to permit the pinion over-running the armature when the engine is started.

## CONSTRUCTION




| | |
|---|---|
| 1 | Shift lever pin |
| 2 | Packing |
| 3 | Gear case |
| 4 | Dust cover |
| 5 | Shift lever |
| 6 | Dust cover |
| 7 | Magnetic switch assembly |
| 8 | Aramture |
| 9 | Thrust washer |
| 10 | Metal |
| 11 | Thrust washer |
| 12 | Stopper washer |
| 13 | Stopper clip |
| 14 | Pinion stopper |
| 15 | Pinion |
| 16 | Over running clutch |
| 17 | Field coil |
| 18 | Yoke |
| 19 | Brush (+) |
| 20 | Brush (-) |
| 21 | Brush spring |
| 22 | Brush holder assembly |
| 23 | Metal |
| 24 | Rear cover |
| 25 | Through bolt |

*Fig. EE-3 Components of starting motor*

## REMOVAL

1. Disconnect battery ground cable.

Disconnect black wire with yellow tracer from magnetic switch terminal, and black battery cable from battery terminal.

2. Remove two bolts used to secure starting motor on gear case. Pull starter assembly forward and remove starting motor.

## DISASSEMBLY

1. Loosen nut used to secure connecting plate to magnetic switch "M" terminal. Remove three screws used to secure magnetic switch, and remove the magnetic switch assembly.

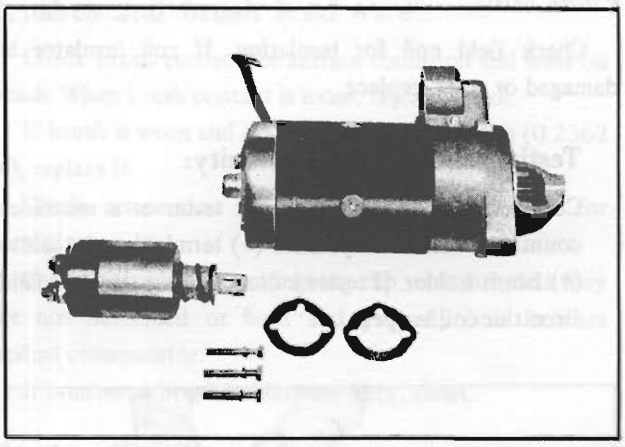


*Fig. EE-4 Removing magnetic switch assembly*

2. Remove two through bolts and brush cover assembly.

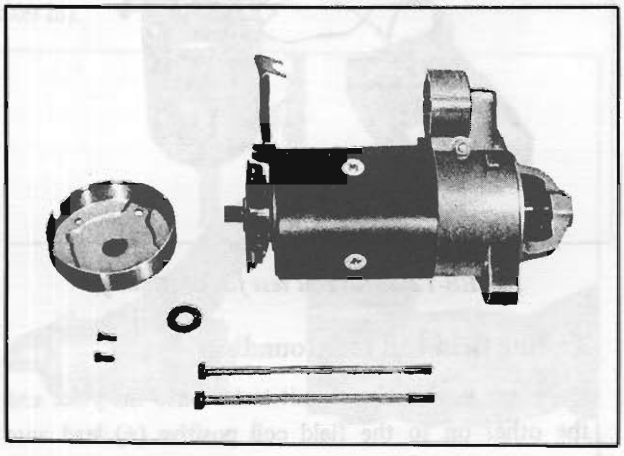


*Fig. EE-5 Removing the rear cover*

3. Remove yoke assembly by lightly tapping with a wooden mallet.

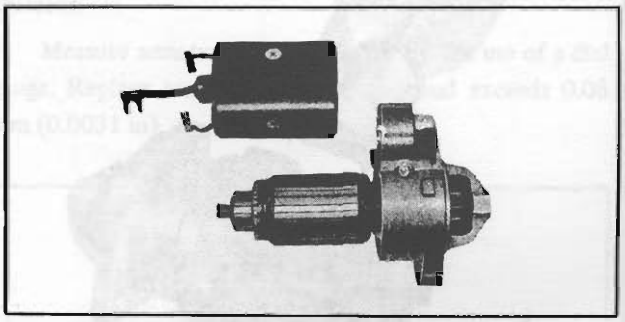


*Fig. EE-6 Removing the yoke assembly*

4. Withdraw the armature assembly and shift lever.

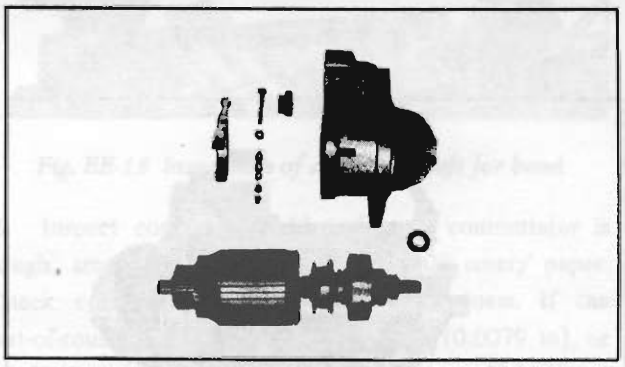


*Fig. EE-7 Removing the armature assembly and shift lever*

5. Remove pinion stop ring from armature shaft end. To remove stop ring, first, push stop ring to clutch side and after removing snap ring, remove the stop ring together with over-running clutch. Withdraw over-running clutch assembly from armature shaft.

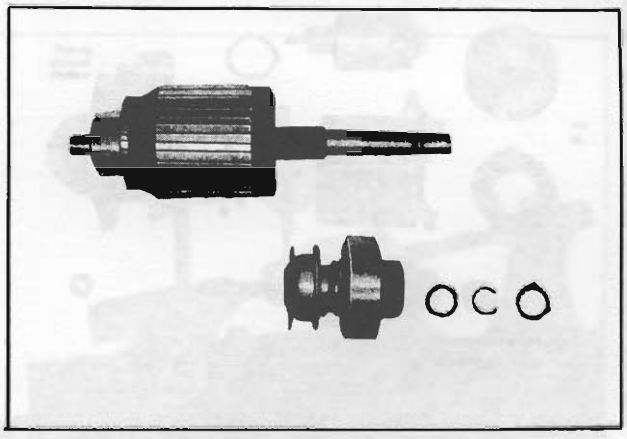


*Fig. EE-8 Removal of the over-running clutch assembly*

6. Remove brush springs and then brushes.

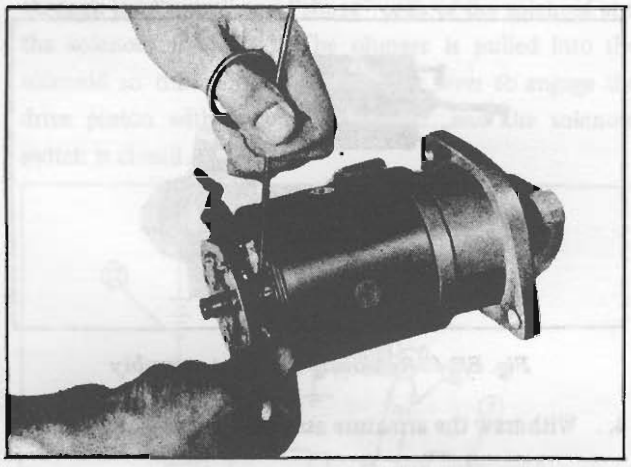


*Fig. EE-9 Removing brush*

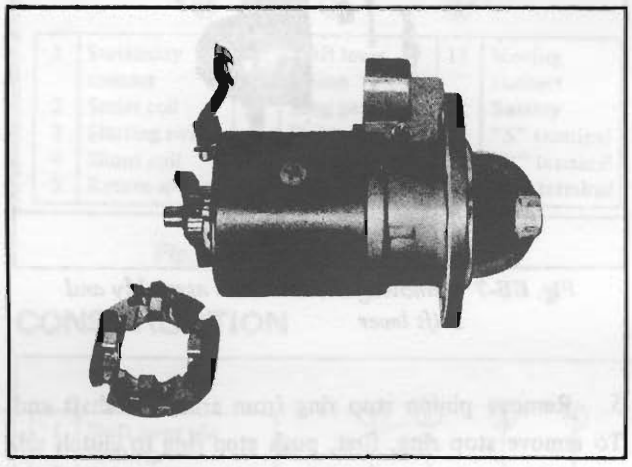


*Fig. EE-10 Removing brush holder*

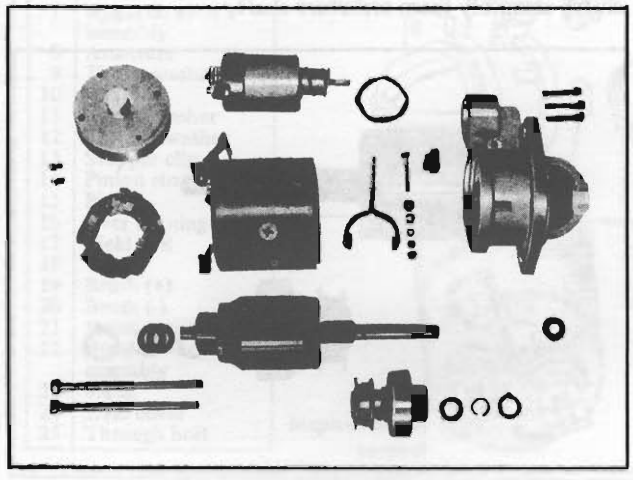


*Fig. EE-11 Disassembly*

## CLEANING AND INSPECTION

Clean all disassembled parts. Be careful not to use grease dissolving solvent for cleaning of over-running clutch, armature assembly, magnetic switch assembly and field coils since solvent dissolves grease packed in clutch mechanism and damages coils or other insulators.

Check them for damage or excessive wear. Replace them as required.

### Terminal

Check terminal for damage and wear, and replace if necessary.

### Field coil

Check field coil for insulation. If coil insulator is damaged or worn, replace.

#### Testing field coil for continuity:

Connect test probe of a circuit tester or a resistance counter to field coil positive (+) terminal and positive (+) brush holder. If tester indicates no continuity, field circuit or coil is open.

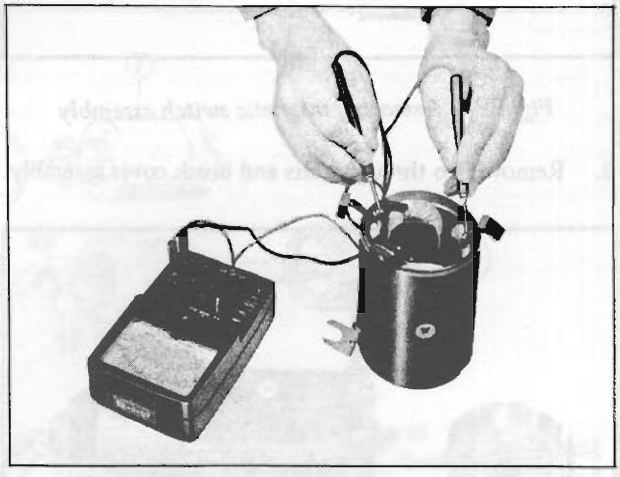


*Fig. EE-12 Field coil test for continuity*

#### Testing field coil for grounding:

Place one probe of a circuit tester onto the yoke and the other on to the field coil positive (+) lead wire terminal. If resistance is read, the field coils are grounded.

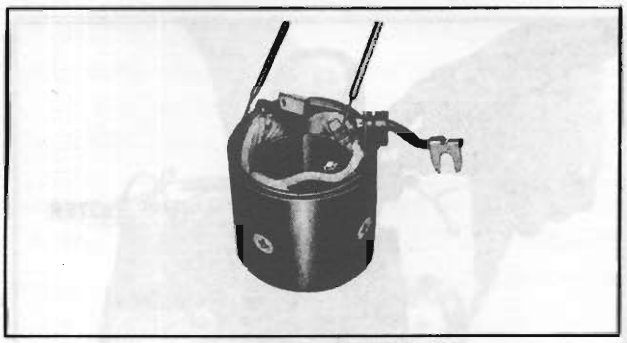


*Fig. EE-13 Field coil test for grounding*

### Field coil test for short-circuit

Unsolder connected section of each coil and check circuit with a tester in the same manner as described above.

When coil is defective, replace coil.

## Brushes and brush lead wire

Check brush contact for surface condition and wear on brush. When brush contact is loose, replace brush.

If brush is worn and height is less than 6.0 mm (0.2362 in), replace it.

Check connection of lead clip and lead wire for conditions:

Check brush holders and spring clip to ensure that they are not deformed or bent and properly hold brushes against commutator.

If brushes or brush holders are dirty, clean.

## Brush spring tension

Measure brush spring tension by the use of a spring scale as shown in Figure EE-14. The reading should be 1.6 kg (3.52 lb). Replace spring if tension is lower than 1.4 kg (3.09 lb).

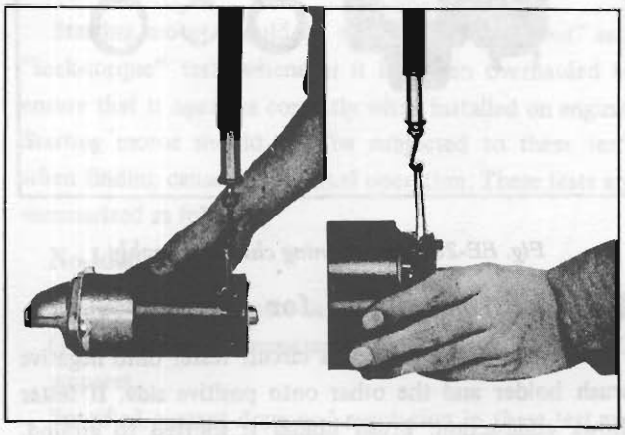


*Fig. EE-14 Inspection of brush spring tension*

## Armature assembly

Check external appearance of armature and commutator.

1. Measure armature shaft for bend by the use of a dial gauge. Replace armature shaft if the bend exceeds 0.08 mm (0.0031 in).

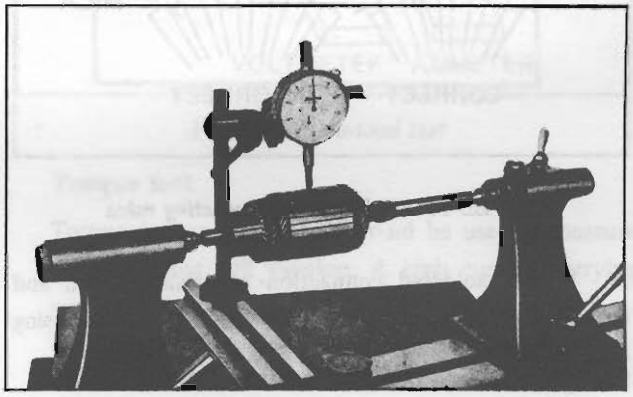


*Fig. EE-15 Inspection of armature shaft for bend*

2. Inspect commutator. If surface of commutator is rough, smooth it lightly with a No. 500 emery paper. Check commutator also for out-of-roundness. If the out-of-roundness is more than 0.2 mm (0.0079 in), or insulating mica depth is less than 0.2 mm (0.0079 in) from commutator surface, turn commutator (armature) in a lathe, so that out-of-roundness is less than 0.05 mm (0.0020 in). Insulating mica should also be under-cut so that depth is from 0.5 to 0.8 mm (0.0197 to 0.0315 in).

The wear limit of commutator diameter is 2 mm (0.0787 in). If commutator is worn excessively, repair or replace it.

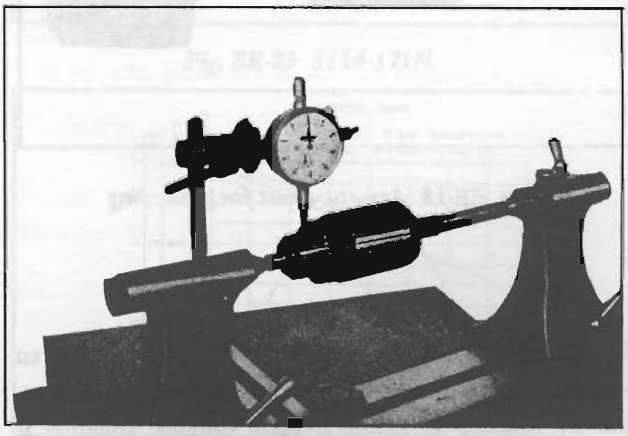


*Fig. EE-16 Inspection of commutator*

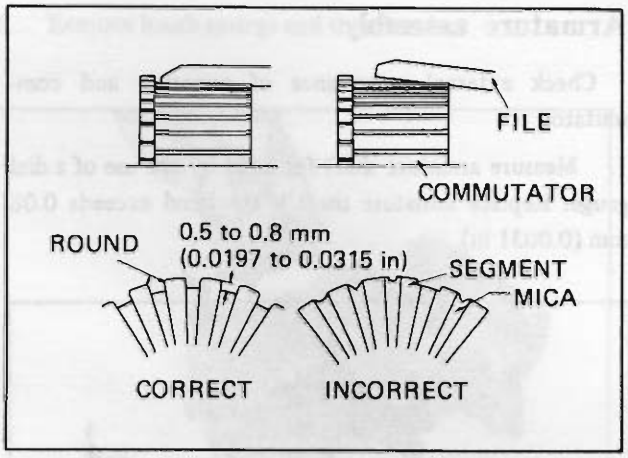



*Fig. EE-17 Undercutting insulating mica*

3. Inspect soldered connection of armature lead and commutator. If loose connection is found, resolder (using rosin flux).

4. Testing armature for grounding

Place one test probe of a circuit tester, on to armature shaft and the other on to each commutator bar.

If tester shows continuity, armature is grounded. Replace armature with a new one.

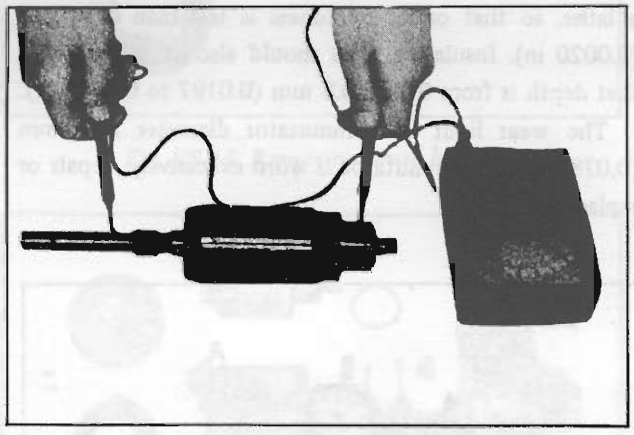


*Fig. EE-18 Armature test for grounding*

5. Check armature for short-circuit by placing it on an armature tester placing an iron plate over armature core, and by rotating armature. If plate vibrates, armature is short-circuited.

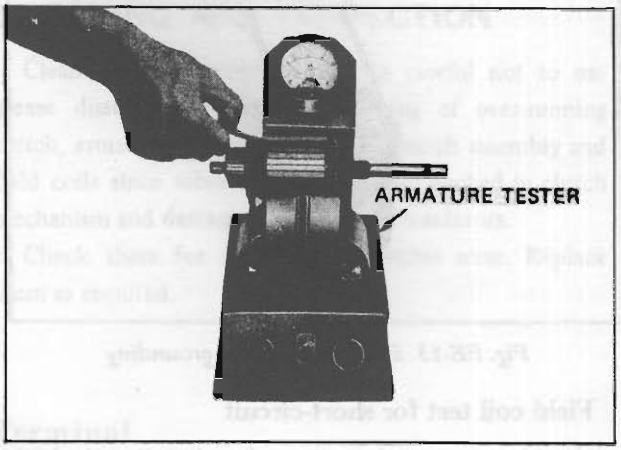



*Fig. EE-19 Armature test for shaft*

6. Check armature for continuity by placing probes of a tester on two segments side by side. If tester shows no conduction, circuit is open.

## Over-running clutch assembly

Inspect pinion assembly and sleeve. Sleeve must slide freely along armature shaft spline. If damages are found or there is a resistance while sliding, replace. Inspect pinion teeth for excessive wear, and replace as required. Check flywheel ring gear also for damage and wear.

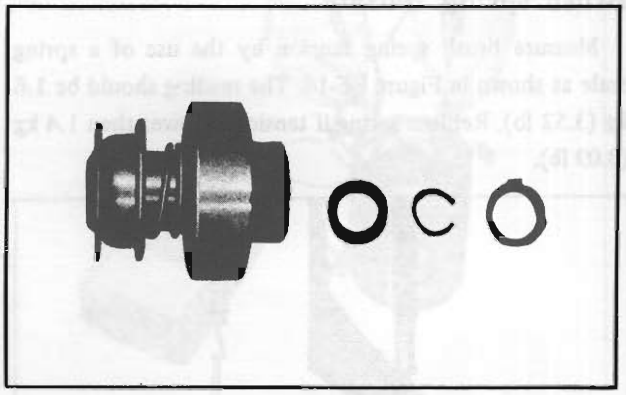


*Fig. EE-20 Over-running clutch assembly*

## Testing brush holder for ground

Place one test probe of a circuit tester onto negative brush holder and the other onto positive side. If tester shows conduction, brush holder is shorted to ground. Replace insulator or brush holder.

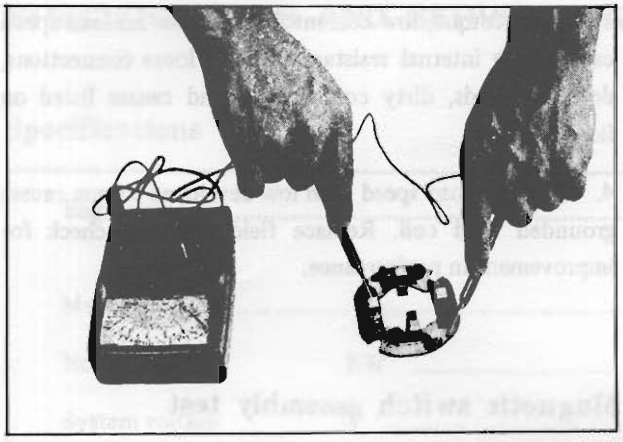


*Fig. EE-21 Brush holder test for grounding*

## Pinion case bearing metal

Inspect bearing metal for wear and side play. If clearance between bearing metal and armature shaft is more than 0.2 mm (0.0079 in), replace metal. Install a new bearing and adjust clearance to 0.03 to 0.10 mm (0.0012 to 0.0039 in). Install bearing metal so that end of bearing metal is flush with gear case end plate.

## Magnetic switch assembly

Inspect magnetic switch contacts. If contact surface is rough, replace.

# REASSEMBLY

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 to pinion sparingly.

# TEST

## Performance test

Starting motor should be subjected to "no-load" and "lock-torque" tests whenever it has been overhauled to ensure that it operates correctly when installed on engine. Starting motor should also be subjected to these tests when finding cause of abnormal operation. These tests are summarized as follows.

### No-load test

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

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

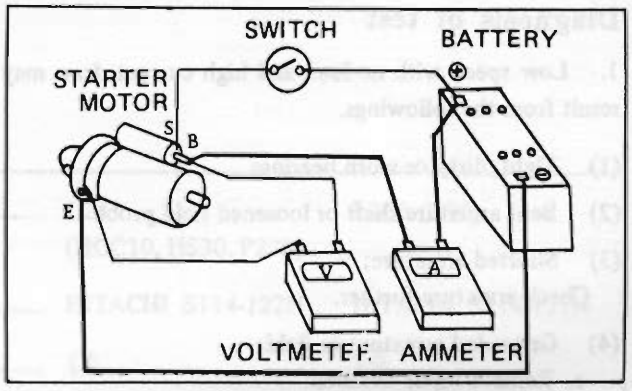



*Fig. EE-22 No-load test*

### Torque test

Torque testing equipment should be used to measure torque motor will develop. A high current carrying variable resistance should be connected to circuit so that specified voltage at starting motor may be obtained, since a small variation in the voltage will produce a marked difference in the torque development.

Specified power, voltage and torque are shown in Figure EE-23 and EE-24.

≪ Characteristic curves ≫

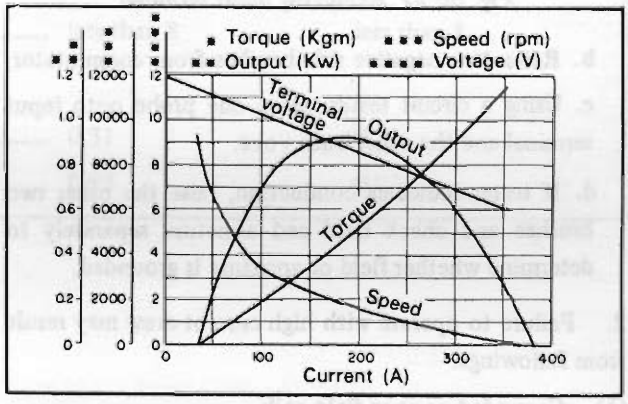



*Fig. EE-23 S114-121N*

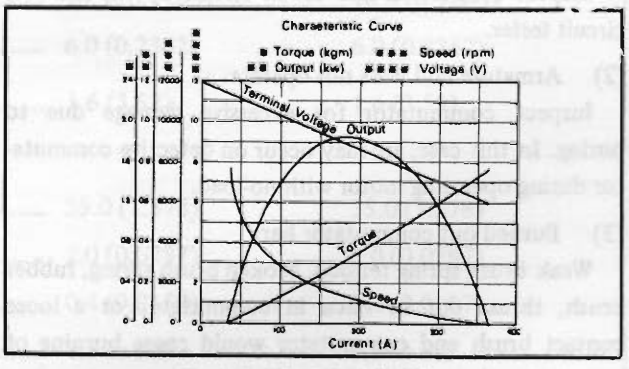



*Fig. EE-24 S114-122N*

## Diagnosis of test

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

(1) Tight, dirty or worn bearings

(2) Bent armature shaft or loosened field probe

(3) Shorted armature;
Check armature further.

(4) Grounded armature or field;
a. Remove input terminal.

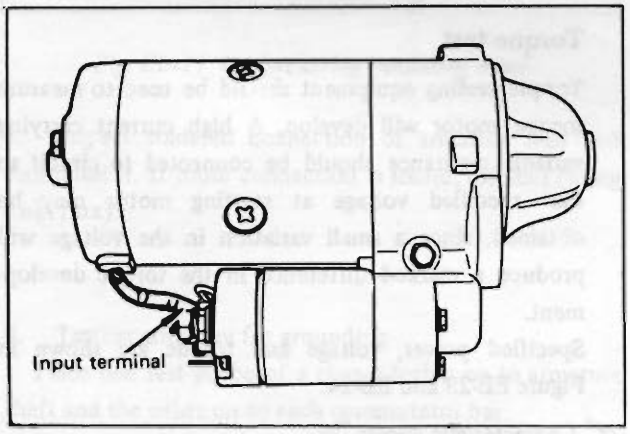



*Fig. EE-25 Removing input terminal*

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 conduction, 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 result from followings.

(1) Grounded or open field coil:
Inspect connection and check circuit by the use of a circuit tester.

(2) Armature coil does not operate:
Inspect commutator for excessive damage due to buring. In this case, arc may occur on defective commutator during operating motor with no-load.

(3) Burned out commutator bar:
Weak brush spring tension, broken brush spring, rubber brush, thrust out of mica in commutator or a loose contact brush and commutator would cause burning of commutator bar.

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

4. High no-load speed with low developed torque causes grounded field coil. Replace field coil and check for improvement in performance.

## Magnetic switch assembly test

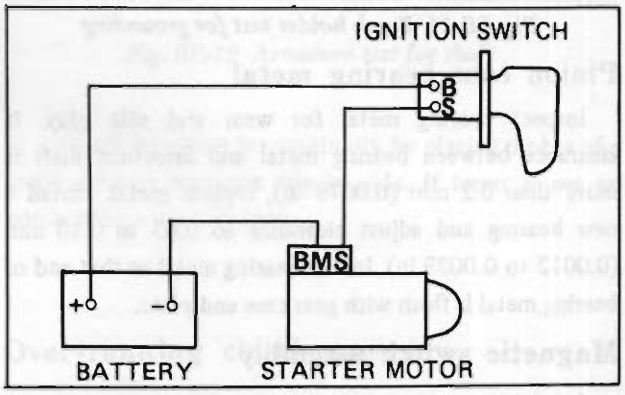



*Fig. EE-26 Circuit of magnetic switch assembly test*

When starting motor is checked completely, check magnetic switch assembly. Connect jumper cables between "negative" battery terminal and starting motor "M" terminal, "positive" battery terminal and starting motor "S" terminal connecting ignition switch in series as shown in Figure EE-26.

With ignition switch on, measure gap "$\ell$" between pinion front edge and pinion stopper, and adjust by changing length of magnetic switch shaft if necessary.

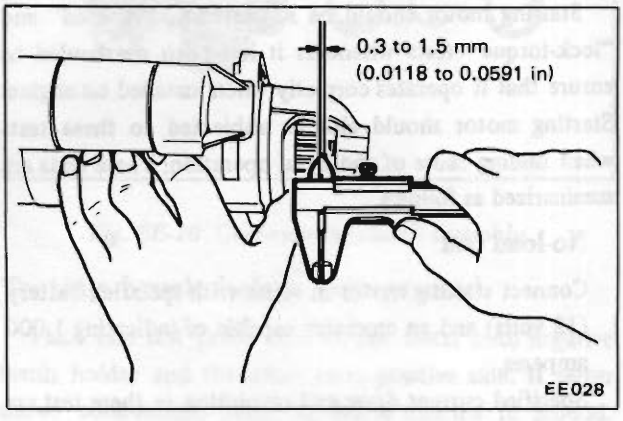



*Fig. EE-27 Measurement of gap "$\ell$"*

## SPECIFICATIONS AND SERVICE DATA

### Specifications

| | | | | |
|---|---|---|---|---|
| Engine model | | | L24 (HGC10, HS30, P230) | L20A (230) |
| Make and type | | | HITACHI S114-122N | HITACHI S114-121N |
| Nominal output | KW | | 1.0 | 1.0 |
| System voltage | V | | 12 | 12 |
| Weight | kg (lb) | | 6.0 (13.2) | 5.3 (11.7) |
| No load | | | | |
| Terminal voltage | V | | 12 | 12 |
| Current | A | | less than 60 | less than 60 |
| Revolution | rpm | | more than 5,000 | more than 7,000 |
| Load | | | | |
| Terminal voltage | V | | 6 | 6 |
| Current | A | | less than 460 | less than 460 |
| Torque | kg-m (ft-lb) | | more than 1.4 (10.1) | more than 1.15 (8.3) |
| Pinion drive out voltage | V | | less than 8 | less than 8 |
| Magnetic switch | | | | |
| Series coil resistance | Ω | | 0.31 | 0.31 |
| Shunt coil resistance | Ω | | 0.93 | 0.93 |

### Service data

| | | | | |
|---|---|---|---|---|
| Brush length | mm (in) | | 18.5 (0.7283) | 18.5 (0.7283) |
| Wear limit | mm (in) | | 6.0 (0.2362) | 6.0 (0.2362) |
| Brush spring tension | kg (lb) | | 1.6 (3.52) | 1.6 (3.52) |
| Commutator | | | | |
| Outer diameter | mm (in) | | 35.0 (1.378) | 35.0 (1.378) |
| Wear limit | mm (in) | | 2.0 (0.0787) | 2.0 (0.0787) |
| Taper limit | mm (in) | | 0.4 (0.0157) | 0.4 (0.0157) |
| Depth of mica | mm (in) | | 0.5 to 0.8 (0.0197 to 0.0315) | 0.5 to 0.8 (0.0197 to 0.0315) |

| | | | |
|---|---|---|---|
| Wear limit | mm (in) | 0.2 (0.0079) | 0.2 (0.0079) |
| Clearance between armature shaft and bushing | mm (in) | 0.03 to 0.1 (0.0012 to 0.0040) | 0.03 to 0.1 (0.0012 to 0.0040) |
| Wear limit | mm (in) | 0.2 (0.0079) | 0.2 (0.0079) |
| Armature shaft diameter | | | |
| Pinion side | mm (in) | 11.0 (0.433) | 11.0 (0.433) |
| Rear end | mm (in) | 11.5 (0.453) | 11.5 (0.453) |
| Wear limit | mm (in) | 0.1 (0.0039) | 0.1 (0.0039) |
| Bend limit | mm (in) | 0.08 (0.0031) | 0.08 (0.0031) |

## TROUBLE DIAGNOSES AND CORRECTIONS

| Troubles | Possible causes | Corrective action |
|---|---|---|
| Starting motor does not operate. | Discharged battery | Charge or replace the battery. |
| | Defective solenoid switch | Repair or replace the solenoid switch. |
| | Loose terminal connection | Clean and retighten terminal. |
| | Defective brush | Replace brush. |
| | Defective starting motor | Dismount starting motor and conduct testing. |
| Noisy starting motor. | Loose securing bolt | Retighten bolt. |
| | Worn pinion gear | Replace pinion gear. |
| | Poor lubrication | Lubricate. |
| | Worn commutator | Overhaul. |
| | Worn brush | Replace brush. |
| Starting motor cranks slowly. | Discharged battery | Charge or replace battery. |
| | Loose terminal connection | Clean and retighten terminal. |
| | Worn brush | Replace brush. |
| | Locked brush | Check brush spring for tension or brush holder, and repair or replace as required. |
| | Dirty or worn commutator | Clean and repair. |
| | The armature rubs the field coil. | Overhaul. |

| | | |
|---|---|---|
| | Defective solenoid switch | Repair or replace the switch. |
| Starting motor operates but does not crank engine. | Worn pinion | Replace pinion. |
| | Locked pinion guide | Repair pinion guide. |
| | Worn ring gear | Replace ring gear. |
| Starting motor does not disengage when ignition switch is turned off. | Defective solenoid switch | Repair or replace solenoid switch. |
| | Defective gear teeth | Replace defective gear. |

## CHARGING CIRCUIT

The charging circuit consists of the battery, alternator, regulator and necessary wiring to connect 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.

When the ignition switch is set to "on," current flows from the battery to ground through the ignition switch, voltage regulator IG terminal, primary side contact point "P1," movable contact point "P2," voltage regulator "F" terminal, alternator "F" terminal, field coil and alternator "E" terminal, as shown in Figure EE-28 by full line arrow marks. Then the rotor in the alternator is excited. On the other hand, current flows from the battery to ground through the ignition switch, warning lamp, voltage regulator "L" terminal, lamp side contact point "P4," movable contact point "P5," and voltage regulator "E" terminal, as shown by dotted line arrow marks. Then, the warning lamp lights.

When the alternator begins to operate, three-phase alternating current is induced in the armature. This alternating current is rectified by the positive and negative silicon diodes. The rectified direct current output reaches the alternator "A" and "E" terminals.

On the other hand, the neutral point voltage reaches "N" and "E" terminals (nearly a half of the output voltage), and current flows from voltage regulator "N" terminal to "E" terminal or ground through the coil "VC1" as shown in Figure EE-29 by the dotted line arrow marks. Then, the coil "VC1" is excited, and the movable contact point "P5" comes into contact with voltage winding side contact point "P6." This action causes to turn off the warning lamp and complete the voltage winding circuit, as shown by the full line arrow marks.

When the alternator speed is increased or the voltage starts to rise excessively, the movable contact point "P2" is separated from the primary side contact "P1" by the magnetic force of coil "VC2." Therefore, register "R1" is applied into the field circuit and output voltage is decreased. As the output voltage is decreased, the movable contact point "P2" and primary side contact "P1" comes into contact once again, and the alternator voltage increases. Thus, the rapid vibration of the movable contact point "P2," maintains an alternator output voltage constant.

When the alternator speed is further increased or the voltage starts to rise excessively, the movable contact point "P2" comes into contact with secondary side contact point "P3." Then, the field current is shut off and alternator output voltage is decreased immediately. This action causes to separate movable contact "P2" from secondary contact "P3." Thus, the rapid vibration of the movable contact point "P2" or breaking and completing the field circuit maintains an alternator output voltage constant.

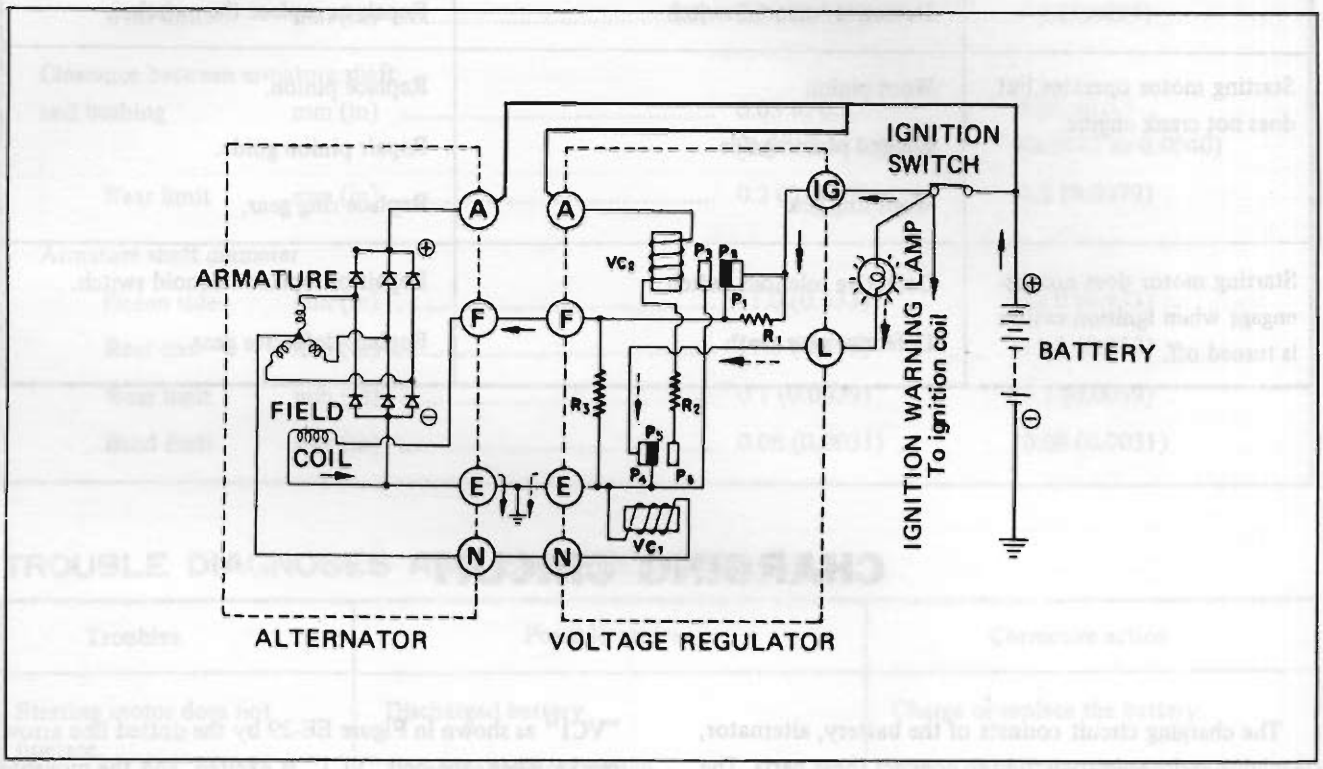



*Fig. EE-28 Charging circuit (I)*

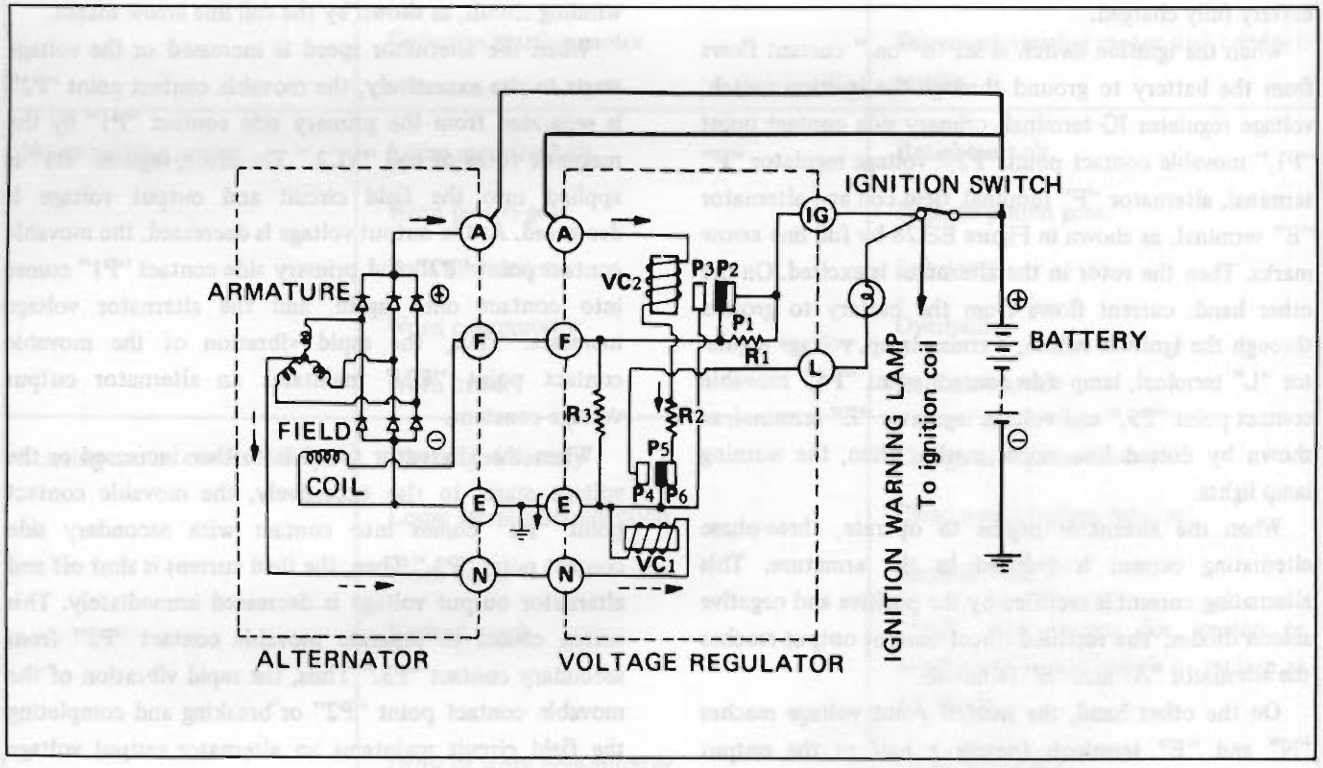



*Fig. EE-29 Charging circuit (II)*

# ALTERNATOR

## CONTENTS

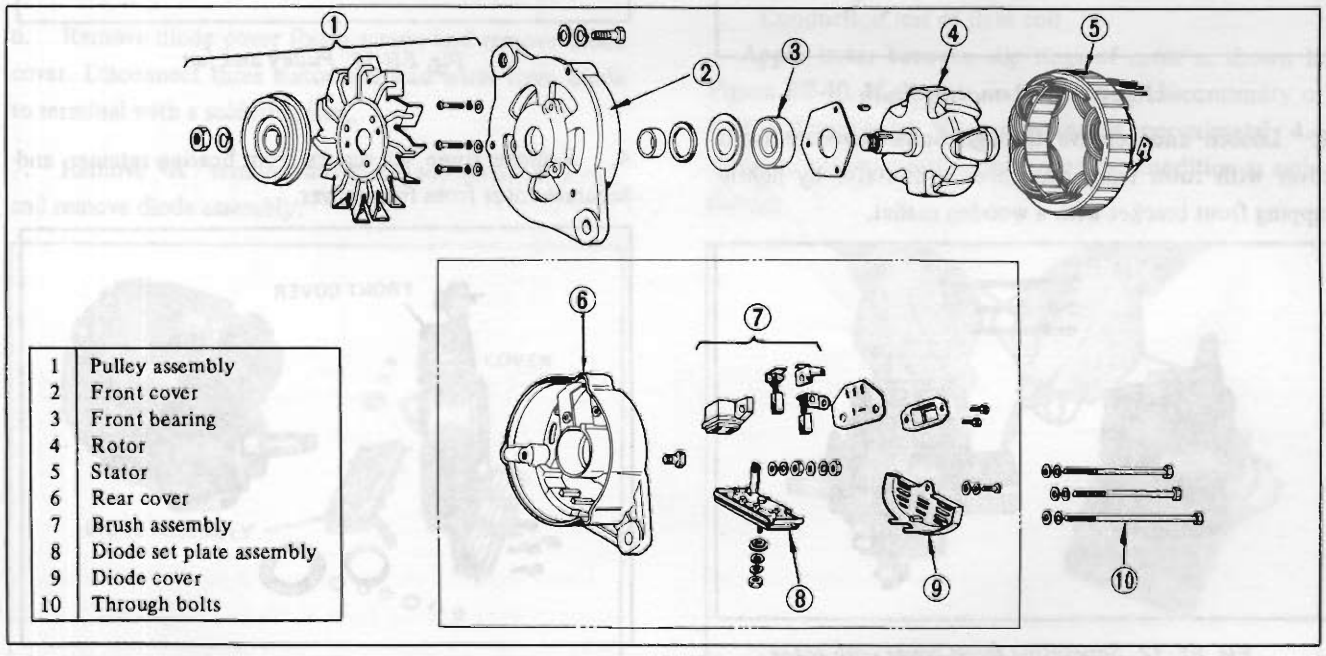


## DESCRIPTION

| Alternator model | Engine model |
|---|---|
| LT150-05 | L20A, L24 engine |

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

Pack-type silicon diodes are used in this alternator. 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 | Stator |
| 6 | Rear cover |
| 7 | Brush assembly |
| 8 | Diode set plate assembly |
| 9 | Diode cover |
| 10 | Through bolts |

*Fig. EE-30 Exploded view of alternator*

## REMOVAL

1. Disconnect negative battery terminal.
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 vehicle.

## DISASSEMBLY

1. Remove brush holder fixing screws, and remove brush holder cover. Remove brush holder forward, and remove brushes together with brush holder.

**Note: Do not disconnect "N" terminal from stator coil lead wire.**

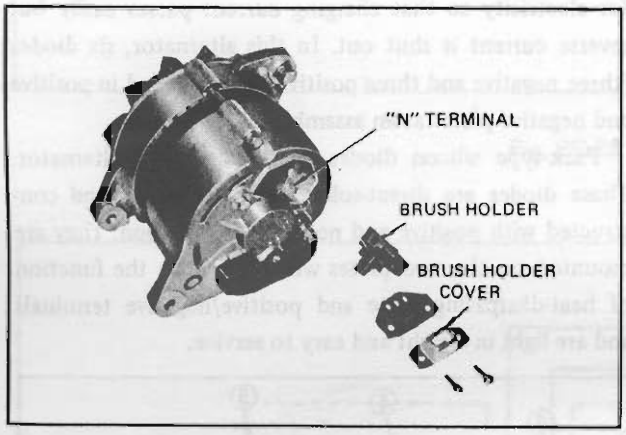



*Fig. EE-31 Removing brush*

2. Loosen and remove through bolts. Separate front cover with rotor from rear cover with stator by lightly tapping front bracket with a wooden mallet.

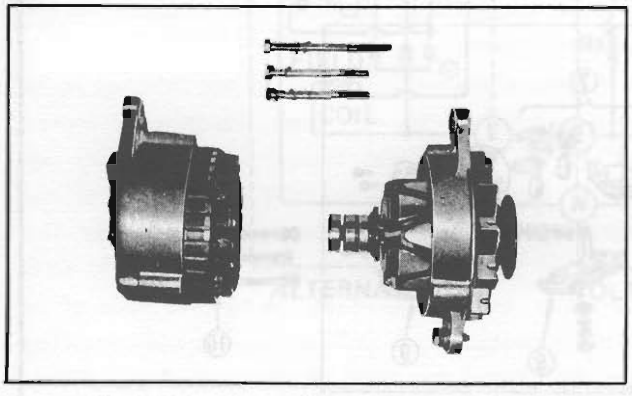


*Fig. EE-32 Separating front cover with rotor from rear cover*

3. Remove pulley nut, pulley rim, fan and spacer.

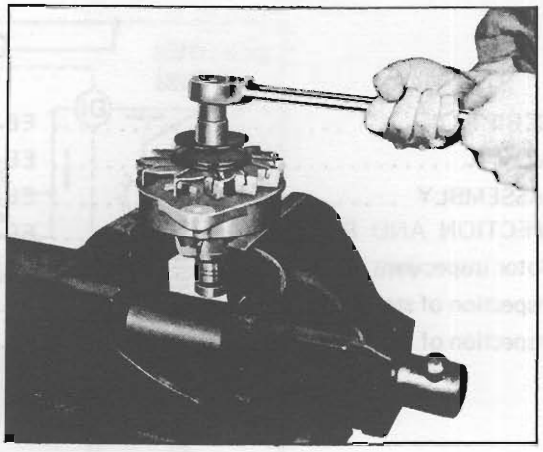


*Fig. EE-33 Removing pulley and fan*

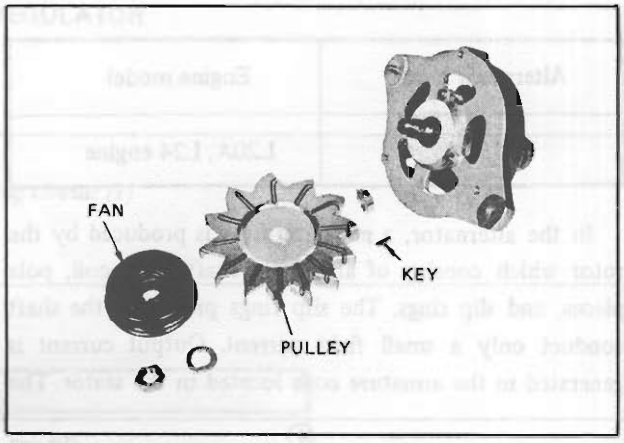



*Fig. EE-34 Pulley and fan*

4. Remove three set screws from bearing retainer, and separate rotor from front cover.

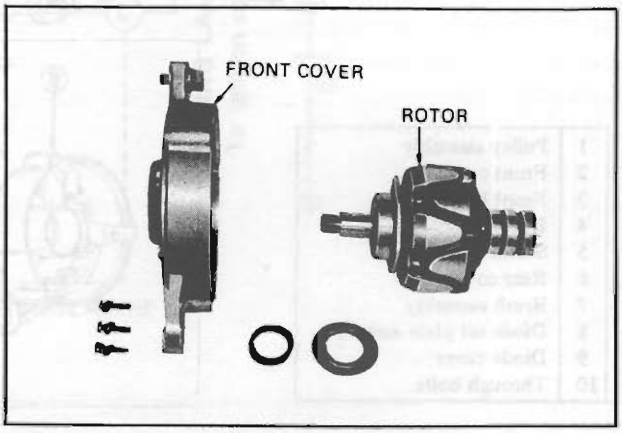



*Fig. EE-35 Removing rotor*

5. Pull out rear bearing from rotor assembly with a press or bearing puller.

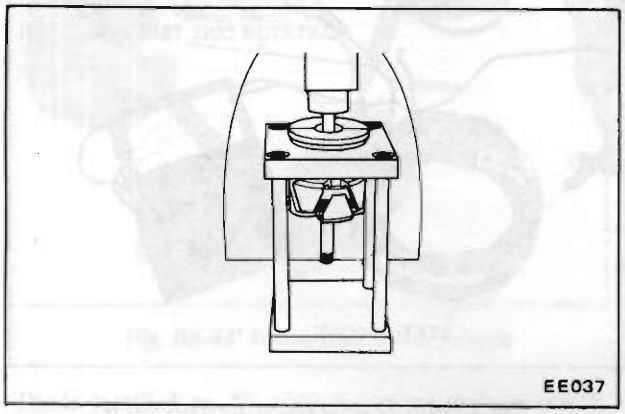



*Fig. EE-36 Pulling out of rear bearing (I)*

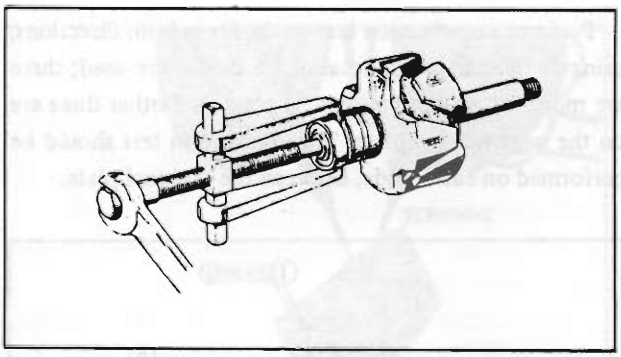


*Fig. EE-37 Pulling out of rear bearing (II)*

6. Remove diode cover fixing screw, and remove diode cover. Disconnect three stator coil lead wires from diode to terminal with a soldering iron.

7. Remove "A" terminal nut and diode installation nut, and remove diode assembly.

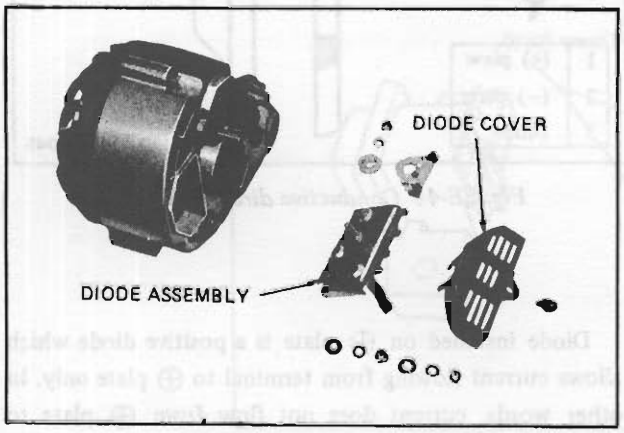



*Fig. EE-38 Removing diode assembly*

**Note: Use care in handling diode assembly to prevent an undue stress on it.**

## INSPECTION AND REPAIR

Remove alternator from vehicle and apply tester between lead wire "F" (white with black tracer) and lead wire "E" (black color).

When the resistance is approximately 5 ohms, the condition of brush and field coil is satisfactory. When no conduction exists in brush, field coil, or when resistance differs remarkably between those parts, disassemble and inspect.

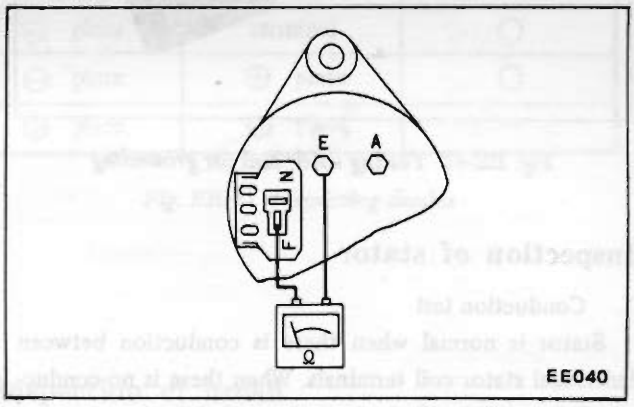



*Fig. EE-39 Inspecting alternator*

### Rotor inspection

1. Conduction test of field coil

Apply tester between slip rings of rotor as shown in Figure EE-40. If there is no conduction, discontinuity of field coil may exist. When resistance is approximately 4.4 ohms at normal ambient temperature, condition is satisfactory.

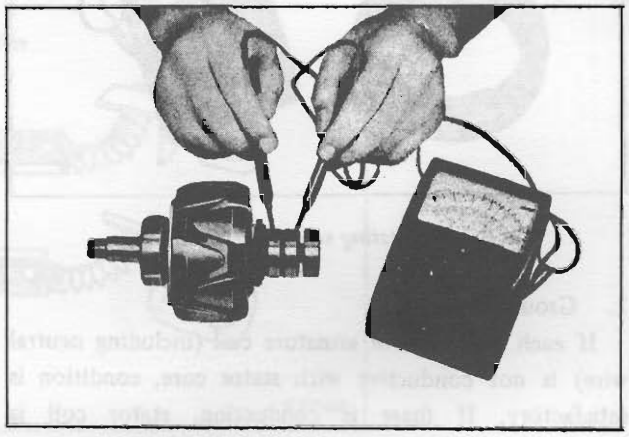


*Fig. EE-40 Conduction test of rotor coil*

2. Ground test of field coil

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

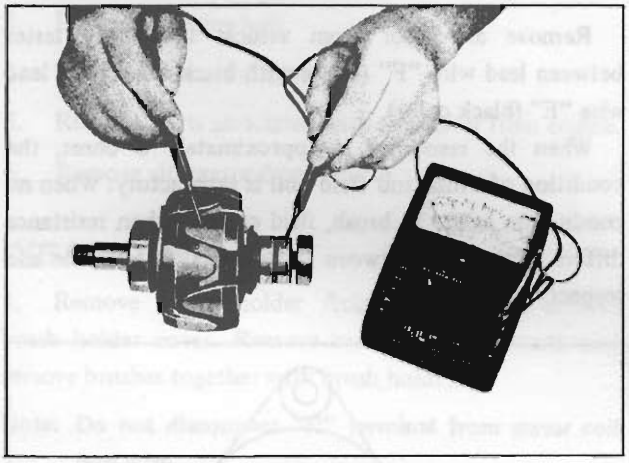


*Fig. EE-41 Testing rotor coil for grounding*

## Inspection of stator

1. Conduction test

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

Replace with stator assembly.

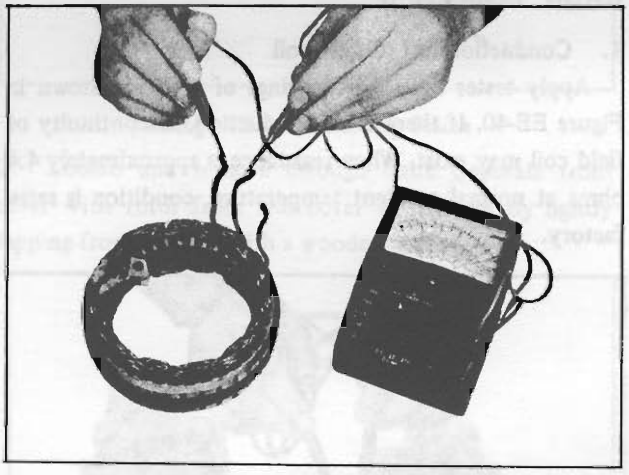


*Fig. EE-42 Testing stator for conduction*

2. Ground test

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

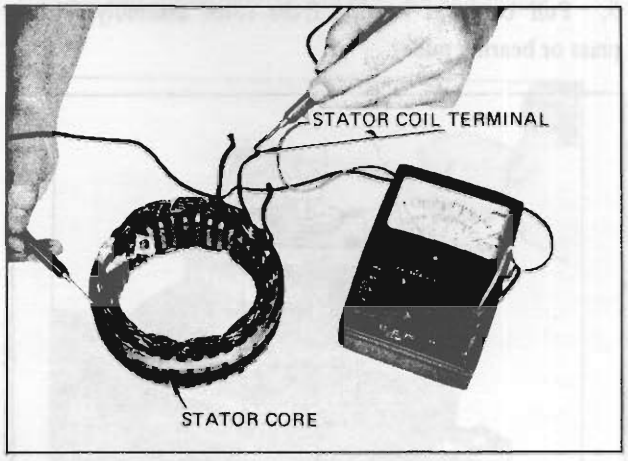



*Fig. EE-43 Testing stator for grounding*

## Inspection of diode

Perform a conduction test on diodes in both directions, using an ohmmeter. A total of six diodes are used; three are mounted on the positive ⊕ plate, and other three are on the negative ⊖ plate. The conduction test should be performed on each diode, between the terminal plate.

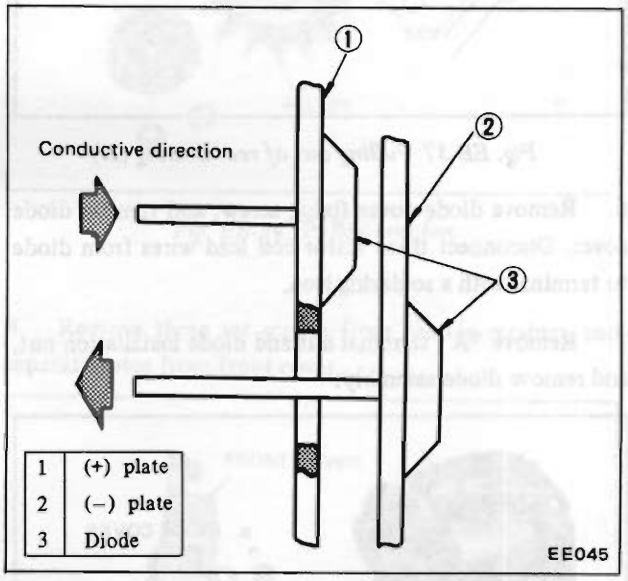



*Fig. EE-44 Conductive direction of diode*

Diode installed on ⊕ plate is a positive diode which allows current flowing from terminal to ⊕ plate only. In other words, current does not flow from ⊕ plate to terminal.

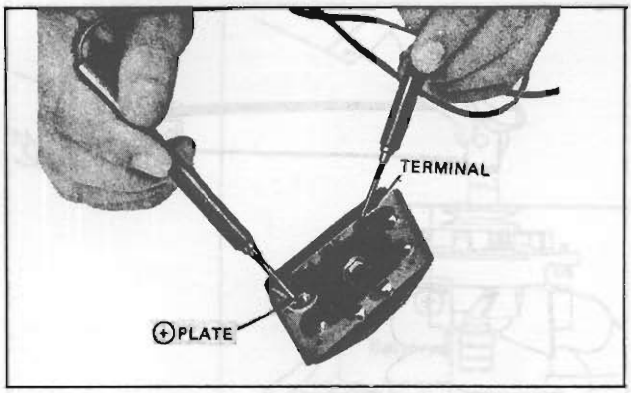



*Fig. EE-45 Inspecting positive diode*

Diode installed on ⊖ plate is a negative diode which allows current flowing from ⊖ plate to terminal only. In other words, current does not flow from terminal to ⊖ plate.

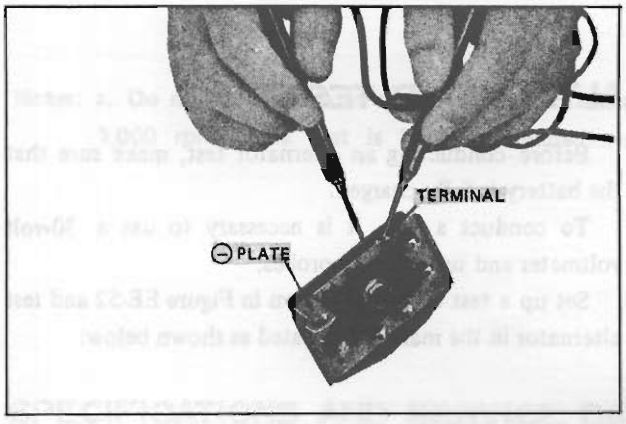



*Fig. EE-46 Inspecting negative diode*

If current flows toward both positive and negative directions, diode is short-circuited. If current flows in the same direction only, diode is in good condition. These diodes are unserviceable. If there is a defective diode, replace all diodes (six diodes) as an assembly. (See Fig. EE-47.)

| Test probe of a circuit tester | | Conduction |
|---|---|---|
| ⊖ | ⊕ | |
| terminal | ⊕ plate | ○ |
| ⊕ plate | terminal | – |
| terminal | ⊖ plate | – |
| ⊖ plate | terminal | ○ |
| ⊖ plate | ⊕ plate | ○ |
| ⊕ plate | ⊖ plate | – |

*Fig. EE-47 Inspecting diodes*

## Inspection of brush

Check movement of brush and if movement is unsmooth, check brush holder and clean it.

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

Check brush pig tail and, if found defective, replace.

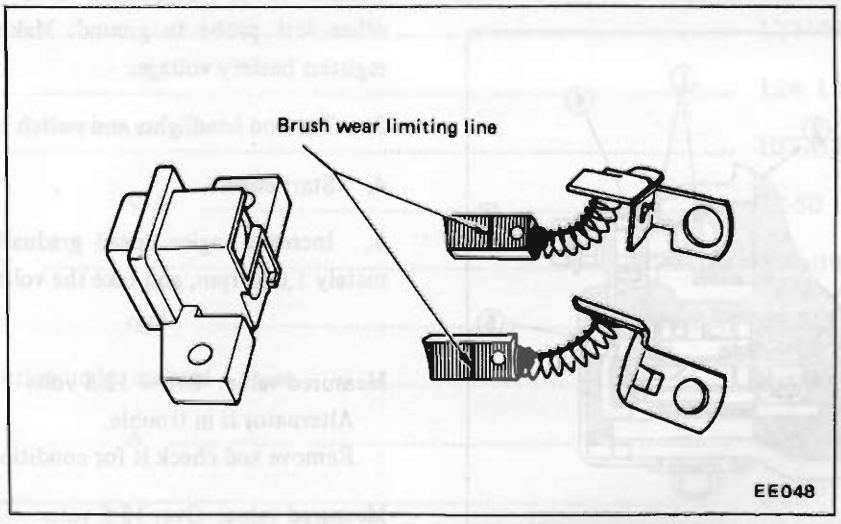



*Fig. EE-48 Brush wear limit*

### Spring pressure test

With brush projected approximately 2 mm (0.0787 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 (9.0 to 12.2 oz).

Moreover, when brush is worn, pressure decreases approximately 20 gr (0.7 oz) per 1 mm (0.0394 in) wear.

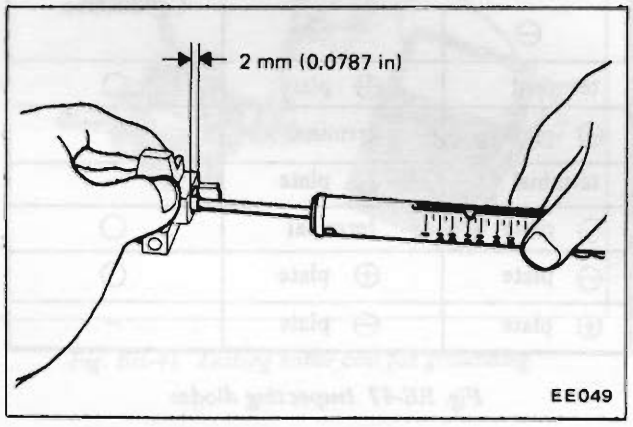



*Fig. EE-49 Measuring spring pressure*

## REASSEMBLY

Reassemble alternator in the reverse sequence of disassembly noting following matters:

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 bush and insulating tube correctly.

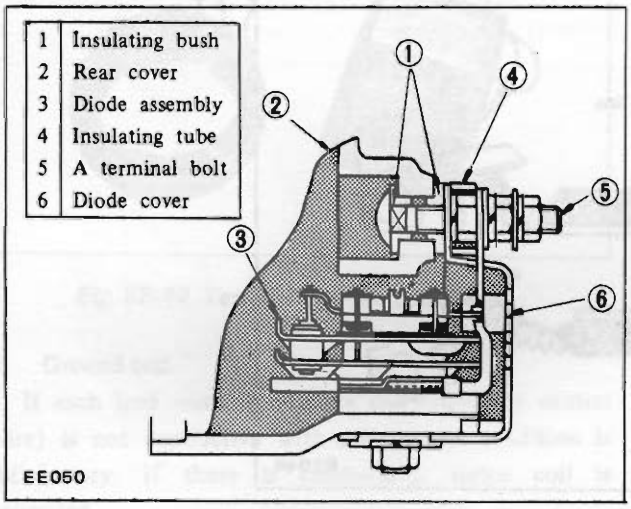



*Fig. EE-50 Sectional view of diode and "A" terminal*

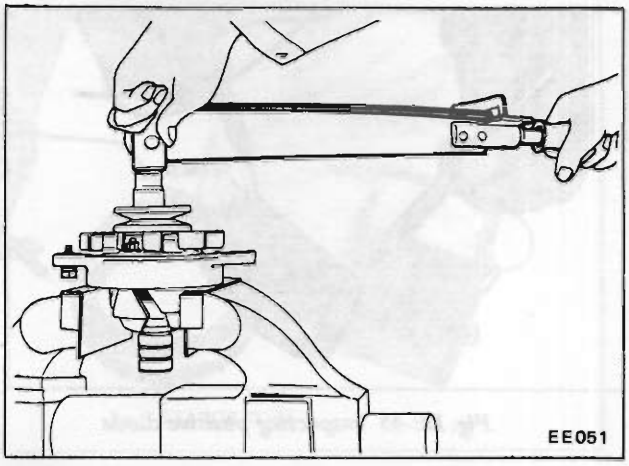



*Fig. EE-51 Tightening pulley nut*

## ALTERNATOR TEST

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

To conduct a test, it is necessary to use a 30-volt voltmeter and suitable test probes.

Set up a test circuit as shown in Figure EE-52 and test alternator in the manner indicated as shown below:

1. Disconnect connectors at alternator.

2. Connect one test probe from voltmeter positive terminal to "N" terminal or "BAT" terminal. Connect the other test probe to ground. Make sure that voltmeter registers battery voltage.

3. Turn on headlights and switch to Main Beam.

4. Start engine.

5. Increase engine speed gradually until it is approximately 1,000 rpm, and take the voltmeter reading.

Measured value: Below 12.5 volts
Alternator is in trouble.
Remove and check it for condition.

Measured value: Over 12.5 volts
Alternator is in good condition.

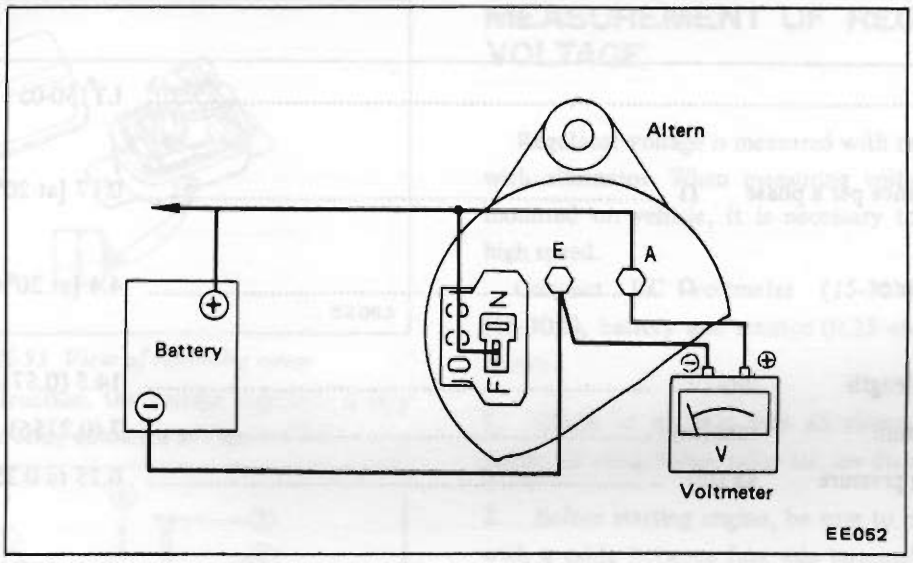



*Fig. EE-52 Testing alternator*

**Notes: a. Do not run engine at the speed of more than 1,000 rpm while test is being conducted on alternator.**
**b. Do not race engine.**

## SPECIFICATIONS AND SERVICE DATA

### Specifications

| | | |
|---|---|---|
| Model | | LT150-05 |
| Applicable to | | L24, L20 engine |
| Maker | | HITACHI |
| Nominal rating | V-A | 12-50 |
| Ground polarity | | Negative |
| Revolution | rpm | 1,000 to 13,500 |
| Minimum revolution under no load | rpm | less than 1,000 |
| Output current | A | 37.5 (14V, 2,500 rpm) |
| Pulley ratio | | 2.25 |

## Service data

| | | |
|---|---|---|
| Model | | LT150-05 |
| Stator coil | | |
| Resistance per a phase | Ω | 0.17 [at 20°C (68°F)] |
| Rotor coil | | |
| Resistance | Ω | 4.4 [at 20°C (68°F)] |
| Brush | | |
| Brush length | mm (in) | 14.5 (0.571) |
| Wear limit | mm (in) | 7 (0.2756) |
| Spring pressure | kg (lb) | 0.25 to 0.35 (0.55 to 0.77) |
| Slip ring | | |
| Outer diameter | mm (in) | 31 (1.220) |
| Reduction limit | mm (in) | 1 (0.0394) |
| Repair accuracy | mm (in) | 0.05 (0.0197) |

# REGULATOR

## CONTENTS



## DESCRIPTION

The regulator consists basically of a voltage regulator and a charge relay. The voltage regulator has two sets of contact points, a lower set and upper set, to control alternator voltage.

An armature plate placed between the two sets of contacts, moves upward or downward or vibrates. The lower contacts, when closed, complete the field circuit direct to ground; and the upper contacts, when closed, complete the field circuit to ground through a resistance (field coil), and produces alternator output.

The charge relay is similar in construction to the voltage regulator.

When the upper contacts are losed, ignition warning lamp goes on.

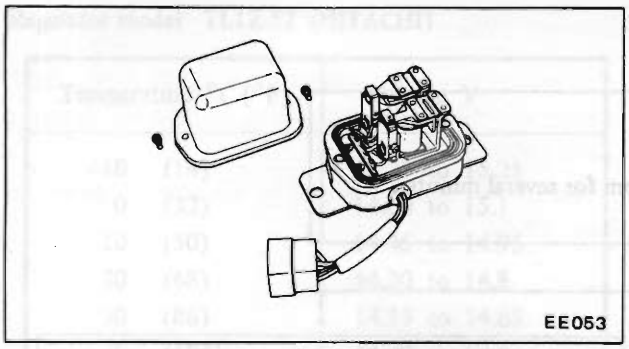
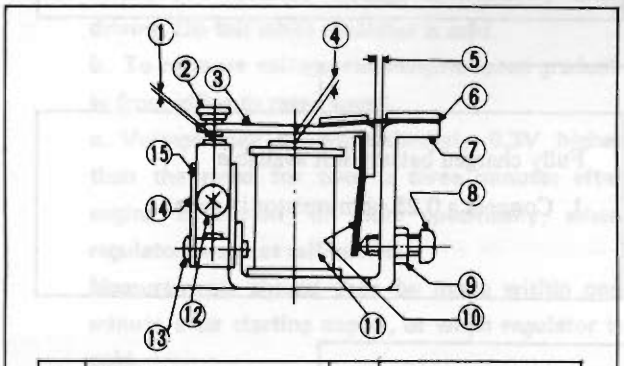


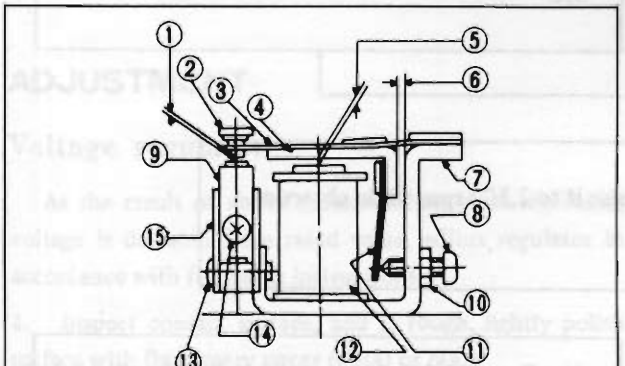

*Fig. EE-53 View of removing cover*

As for the construction, the voltage regulator is very similar to the charge relay as shown in Figure EE-54.



| | | | |
|---|---|---|---|
| 1 | Point gap | 9 | Lock nut |
| 2 | Lower contact | 10 | Adjust spring |
| 3 | Armature | 11 | Coil |
| 4 | Core gap | 12 | Screw (3 mm dia.) |
| 5 | Yoke gap | 13 | Screw (4 mm dia.) |
| 6 | Connecting spring | 14 | Contact set |
| 7 | Yoke | 15 | Upper contact |
| 8 | Adjusting screw | | |

*(a) Construction of voltage regulator*



| | | | |
|---|---|---|---|
| 1 | Point gap | 9 | Voltage regulator contact |
| 2 | Charge relay contact | 10 | Lock nut |
| 3 | Connecting spring | 11 | Adjust spring |
| 4 | Armature | 12 | Coil |
| 5 | Core gap | 13 | Screw (3 mm dia.) |
| 6 | Yoke gap | 14 | Screw (4 mm dia.) |
| 7 | Yoke | 15 | Contact set |
| 8 | Adjusting screw | | |

*(b) Construction of charge relay*

*Fig. EE-54 Structural view*

## MEASUREMENT OF REGULATING VOLTAGE

Regulator voltage is measured with regulator assembled with alternator. When measuring voltage with regulator mounted on vehicle, it is necessary to rotate engine at high speed.

Connect DC voltmeter (15-30V), DC ammeter (15-30A), battery and resistor (0.25 ohm) with cables as shown.

1. Check to be sure that all electrical loads such as lamps, air conditioner, radio etc. are disconnected.

2. Before starting engine, be sure to make short circuit with a cable between fuse side terminal of resistor (0.25 ohm) and negative side terminal of ammeter. Failure to follow this caution causes needle of ammeter to swing violently and reversely, resulting in a damaged ammeter.

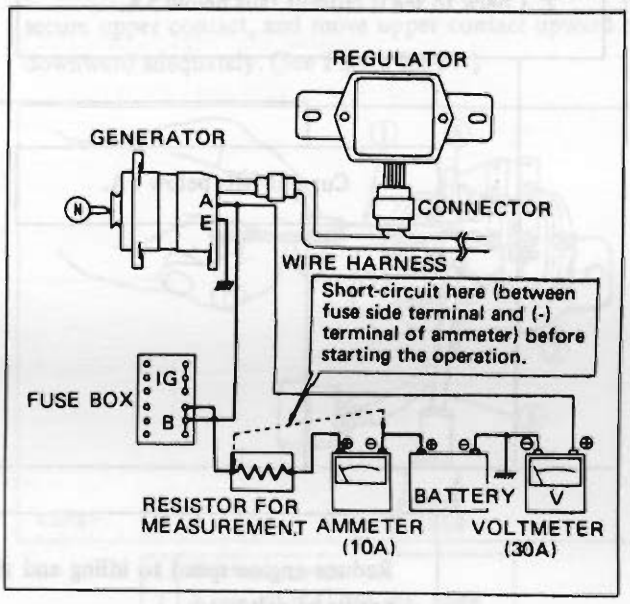



*Fig. EE-55 Measuring regulator voltage with regulator on vehicle*

3. Refer to following chart to determine if regulator and relative parts are in good condition:

1. Start engine.
2. Rotate engine at 2,500 rpm for several minutes.

After racing for several minutes, ammeter reading below 5A

After racing for several minutes, ammeter reading over 5A

Fully charged battery available

1. Replace with fully charged battery.
2. Check to see if current falls below 5A.

Fully charged battery not available

1. Connect a 0.25 ohm resistor in series.

Current falls below 5A.

Current does not fall below 5A.

Recharge battery and see if current falls below 5A.

Reduce engine speed to idling and then raise it to 2,500 rpm while observing needle of voltmeter.

Needle of voltmeter held within limits shown in following chart.
Regulator functioning properly.

Needle of voltmeter out of limits shown in following chart.
Regulator out of order. Have it repaired at authorized shop.

Regulator model TL1Z-57 (HITACHI)

| Temperature °C (°F) | Voltage V |
|---|---|
| −10 (14) | 14.75 to 15.25 |
| 0 (32) | 14.60 to 15.1 |
| 10 (50) | 14.45 to 14.95 |
| 20 (68) | 14.30 to 14.8 |
| 30 (86) | 14.15 to 14.65 |
| 40 (104) | 14.00 to 14.5 |

**Notes: a. Do not measure voltage immediately after driving. Do this while regulator is cold.**

**b. To measure voltage, raise engine speed gradually from idling to rated speed.**

**c. Voltage may be approximately 0.3V higher than the rated for two to three minutes after engine is started, or more specifically, when regulator becomes self-heated.**

**Measurements should then be made within one minute after starting engine, or when regulator is cold.**

**d. The regulator is of a temperature-compensating type. Before measuring voltage, be sure to measure surrounding temperature and correct measurements according to the table.**

## ADJUSTMENT

### Voltage regulator

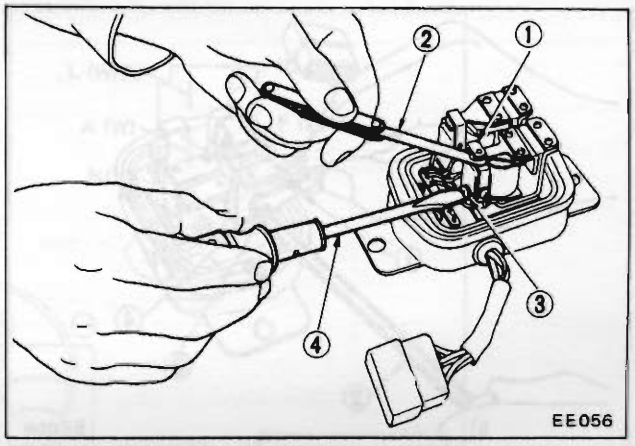
As the result of above measurement, when regulating voltage is deviated from rated value, adjust regulator in accordance with following instructions.

1. Inspect contact surface, and if rough, lightly polish surface with fine emery paper (#500 or 600).

2. Measure each gap, and adjust if necessary. Adjust core gap and point gap in that order. No adjustment is required for yoke gap.

3. Adjusting core gap

Loosen the screw [4 mm (0.1575 in) diameter] which is used to secure contact set on yoke, and move contact upward or downward properly. (See Figure EE-56.)

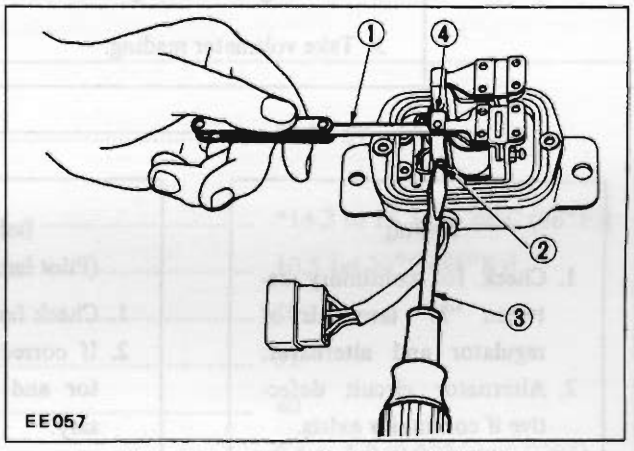



| | |
|---|---|
| 1 | Contact set |
| 2 | Thickness gauge |
| 3 | 4mm (0.1575 in) dia. screw |
| 4 | Crosshead screwdriver |

*Fig. EE-56 Adjusting core gap*

4. Ajusting point gap

Loosen screw [3 mm (0.1181 in) diameter] used to secure upper contact, and move upper contact upward or downward adequately. (See Figure EE-57.)

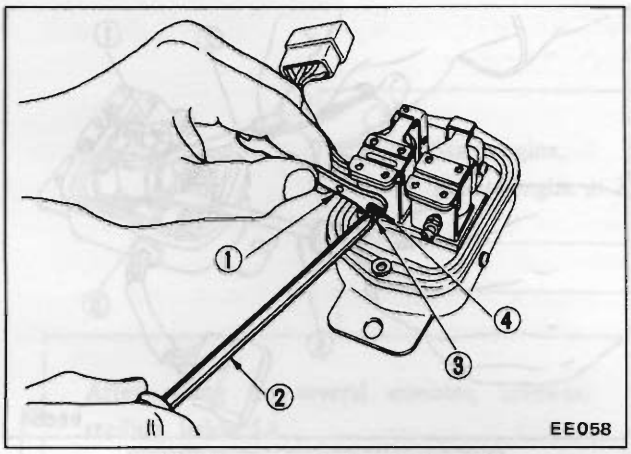



| | |
|---|---|
| 1 | Thickness gauge |
| 2 | 3 mm (0.1181 in) dia. screw |
| 3 | Crosshead screwdriver |
| 4 | Upper contact |

*Fig. EE-57 Adjsuting point gap*

5. Adjusting regulating voltage

Loosen lock nut securing adjusting screw. Turn this screw clockwise to increase, or counterclockwise to decrease, regulating voltage. (See Figure EE-58.)




| | |
|---|---|
| 1 | Wrench |
| 2 | Crosshead screwdriver |
| 3 | Adjusting screw |
| 4 | Lock nut |

*Fig. EE-58 Adjusting regulating voltage*

## Charge relay

Normal relay operating voltage is 8 to 10V as measured at alternator "A" terminal. Relay itself, however, operates at 4 to 5V.

Use DC voltmeter, and set up a circuit as shown in Figure EE-59.

1. Connect positive terminal of voltmeter to regulator lead connector "N" terminal with negative terminal grounded.
2. Start engine and keep it idle.
3. Take voltmeter reading.

**0 Volt**

1. Check for continuity between "N" terminals of regulator and alternator.
2. Alternator circuit defective if continuity exists.

**Below 5.2V**
(Pilot lamp remains lit.)

1. Check fan belt tension.
2. If correct, remove regulator and adjust as necessary.

**Over 5.2V**
(Pilot lamp remains lit.)

Pilot lamp relay coil or contact points out of order.
Replace regulator.

**Over 5.2V**
(Pilot lamp does not lit.)

Pilot lamp relay assembly is in good condition.

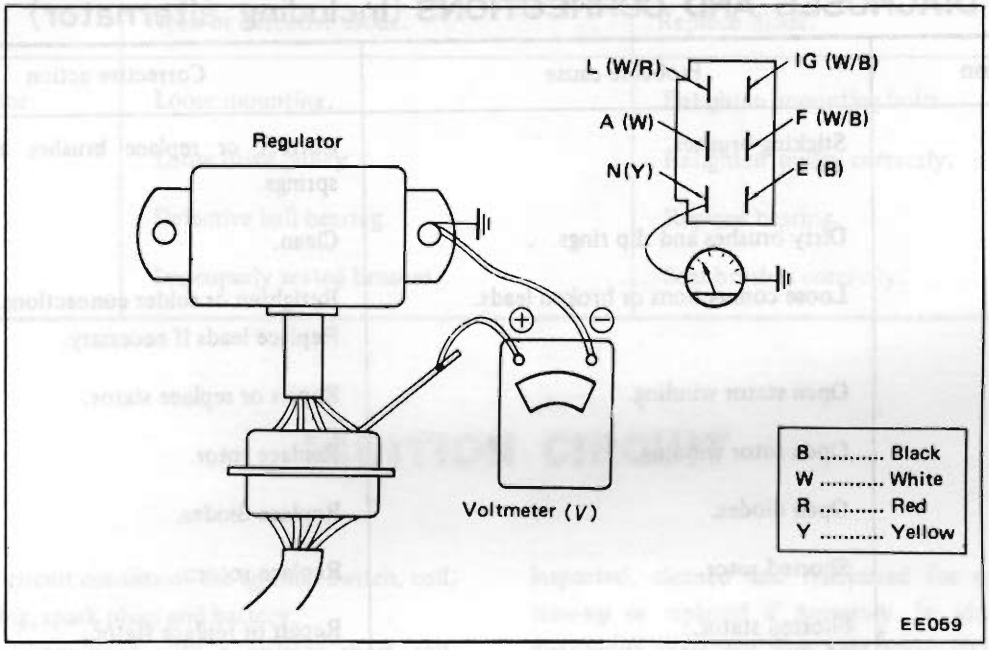



*Fig. EE-59 Testing charging relay*

## SPECIFICATIONS AND SERVICE DATA

| | | |
|---|---|---|
| **Voltage regulator** | | |
| Model | | TL1Z-57 |
| Regulating voltage (with fully charged battery) | V | *14.3 to 15.3 [at 20°C (68°F)] |
| Voltage coil resistance | Ω | 10.5 [at 20°C (68°F)] |
| Rotor coil inserting resistance | Ω | 10 |
| Voltage coil series resistance | Ω | 31 |
| Smoothing resistance | Ω | 40 |
| Core gap | mm (in) | 0.6 to 1.0 (0.0236 to 0.0394) |
| Point gap | mm (in) | 0.3 to 0.4 (0.0118 to 0.0157) |
| **Charge relay** | | |
| Release voltage | V | 4.2 to 5.2 at "N" terminal |
| Voltage coil resistance | Ω | 37.8 [at 20°C (68°F)] |
| Core gap | mm (in) | 0.8 to 1.0 (0.0315 to 0.0394) |
| Point gap | mm (in) | 0.4 to 0.6 (0.0157 to 0.0236) |

* Standard temperature gradient: –0.015V/°C

## TROUBLE DIAGNOSES AND CORRECTIONS (Including alternator)

| 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 diodes. |
| | Shorted rotor. | Replace rotor. |
| | Shorted stator. | Repair or replace stator. |
| | Grounded "BAT" terminal. | Replace insulator. |
| | Broken fan belt. | Replace belt. |
| Excessive output. | Broken neutral wire (color of wire is white.). | Replace wire. |
| | Defective voltage regulator. | Check regulator operation and repair or replace as required. |
| | Poor grounding of alternator and voltage regulator "E" terminal. | Retighten terminal connection. |
| | Broken ground wire (color of wire is black.). | Replace wire. |
| Low output. | Loose or worn fan belt. | Retighten or replace belt. |
| | Sticking brushes. | Correct or replace brushes and springs if necessary. |
| | Low brush spring tension. | Replace the brush springs. |
| | Defective voltage regulator. | Check regulator operation and repair or 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 defective diode. | Replace diode. |
| Noisy alternator | Loose mounting. | Retighten mounting bolts. |
| | Loose drive pulley. | Retighten pulley correctly. |
| | Defective ball bearing. | Replace bearing. |
| | Improperly seated brushes. | Seat brushes correctly. |

# IGNITION CIRCUIT

The ignition circuit consists of the ignition switch, coil, distributor, wiring, spark plugs and battery.

The circuit is equipped with a resistor short coil. During cranking engine, electric current bypasses the resistor, thereby connecting the ignition coil directly to battery. This provides full battery voltage available at coil and keeps ignition voltage as high as possible.

The distributor contact points and spark plugs require periodic service. That is, the breaker points should be inspected, cleaned and readjusted for specified gap at tune-up or replaced if necessary. In addition, lubricate distributor shaft and cam heel every 10,000 km (6,000 miles). Spark plugs should be removed, inspected and maintained to obtain good firing.

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

The ignition circuit is as shown below:

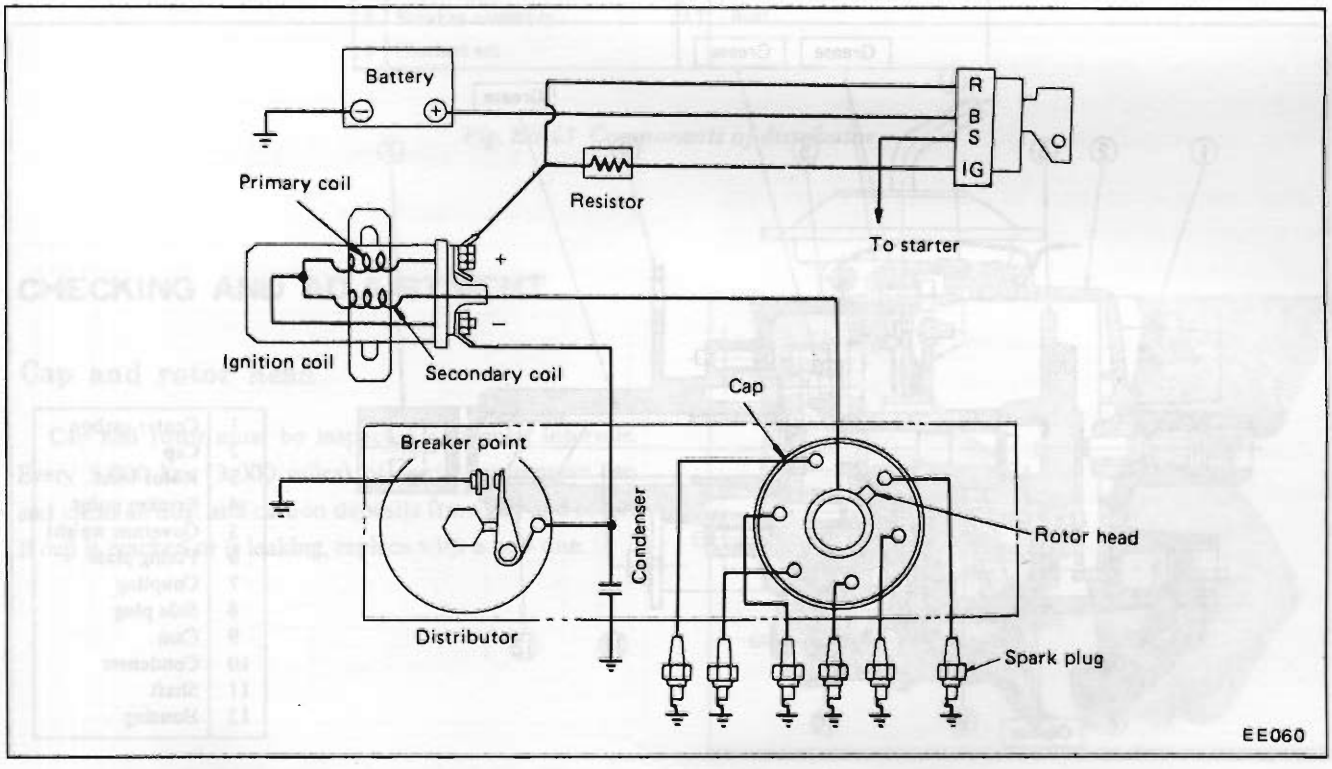



*Fig. EE-60 Ignition system circuit diagram*

# DISTRIBUTOR

## CONTENTS



| Distributor model | Applied engine |
|---|---|
| D606-52 | L24 (with single and twin carb.) |
| D609-56 | L20 engine |

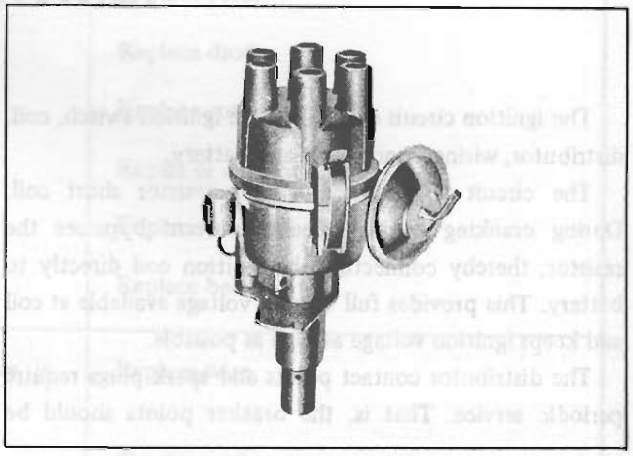
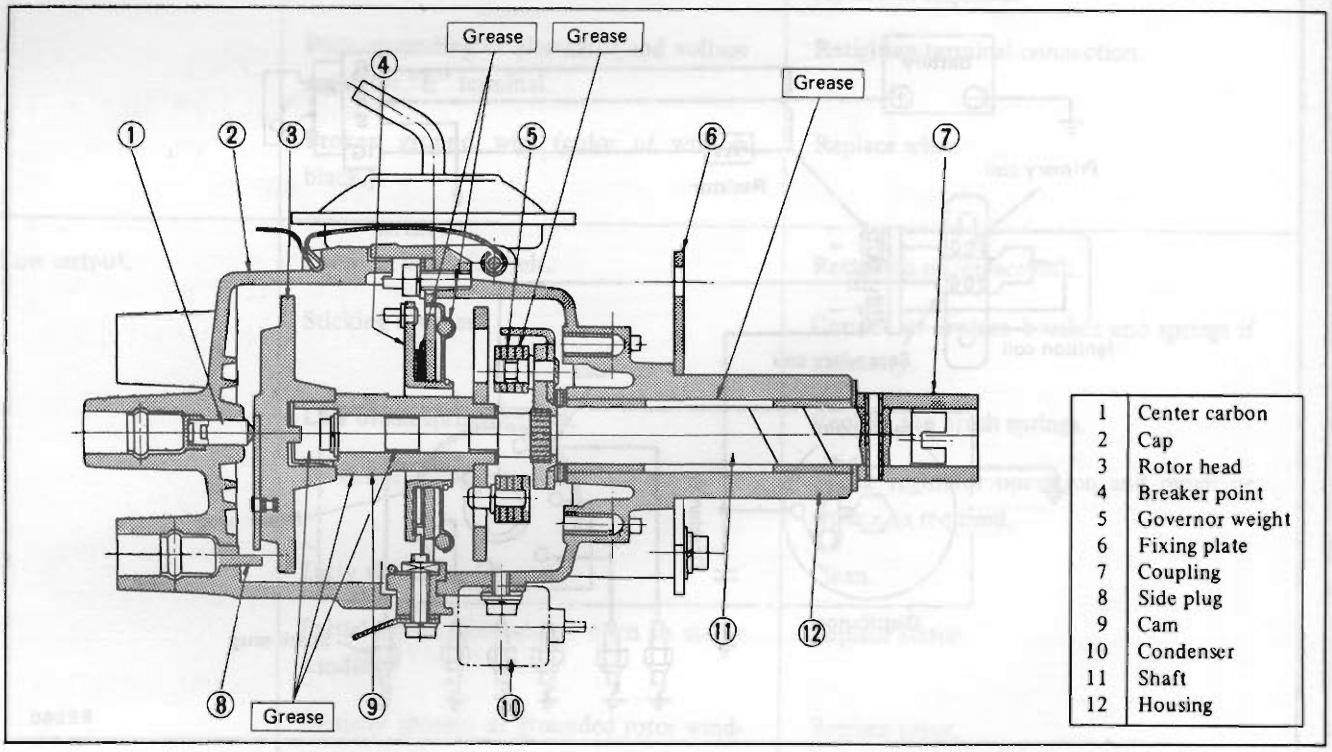


*Fig. EE-61 D612-53*

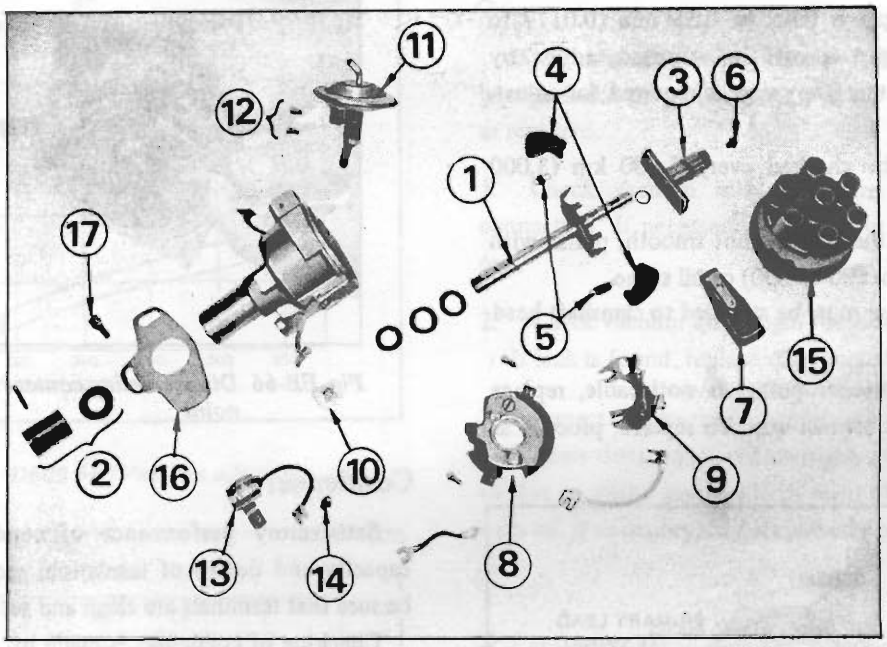
## CONSTRUCTION AND OPERATION

Figure EE-62 shows a distributor removed off the engine. It consists of breaker plate with contact points, centrifugal advance mechanism, vacuum unit, drive shaft and rotor.




| | |
|---|---|
| 1 | Center carbon |
| 2 | Cap |
| 3 | Rotor head |
| 4 | Breaker point |
| 5 | Governor weight |
| 6 | Fixing plate |
| 7 | Coupling |
| 8 | Side plug |
| 9 | Cam |
| 10 | Condenser |
| 11 | Shaft |
| 12 | Housing |

*Fig. EE-62 Structure*




| | | | |
|---|---|---|---|
| 1 | Shaft assembly | 10 | Terminal assembly |
| 2 | Collar set assembly | 11 | Vacuum control assembly |
| 3 | Cam assembly | 12 | Screw |
| 4 | Governor weight assembly | 13 | Condenser |
| 5 | Governor spring | 14 | Screw |
| 6 | Screw | 15 | Distributor cap assembly |
| 7 | Rotor head assembly | 16 | Fixing plate |
| 8 | Breaker assembly | 17 | Bolt |
| 9 | Contact set | | |

*Fig. EE-63 Components of distributor*

## CHECKING AND ADJUSTMENT

### Cap and rotor head

Cap and rotor must be inspected at regular intervals. Every 5,000 km (3,000 miles) of operation, remove cap and clean all dust and carbon deposits from cap and rotor. If cap is cracked or is leaking, replace with a new one.

*Fig. EE-64 Removing rotor head*

## Point

Standard point gap is 0.45 to 0.55 mm (0.0177 to 0.0217 in). When gap is off the standard, adjust by loosening point screws. Gap gauge is required for adjustment.

Point gap must be checked every 5,000 km (3,000 miles) of operation.

When surface of the point is not smooth, polish with fine emery paper (No. 500 or 600) or oil stone.

At this time, grease must be supplied to camshaft head and cam heel.

When wear on breaker points is noticeable, replace points together with contact arm. To replace, proceed as follows:

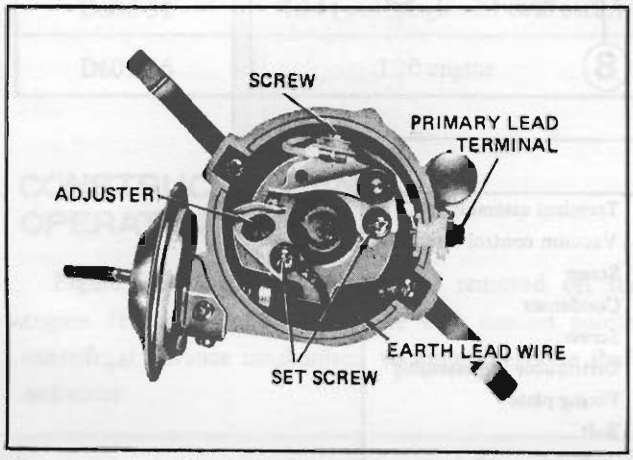



*Fig. EE-65 Breaker*

First loosen set screws 1 to 1.5 turns at contact arm and primary lead wire connection just far enough to permit removal of primary lead terminal, Figure EE-66.

Referring to Figure EE-66 in the right hand side, unscrew two contact arm set screws to remove lead wire.

While holding contact arm assembly by fingers, pull out contact arm by raising it slightly.

Contact set can then be removed together. Install new contact set in reverse sequence of removal. Coat cam heel and camshaft head with a light coating of grease.

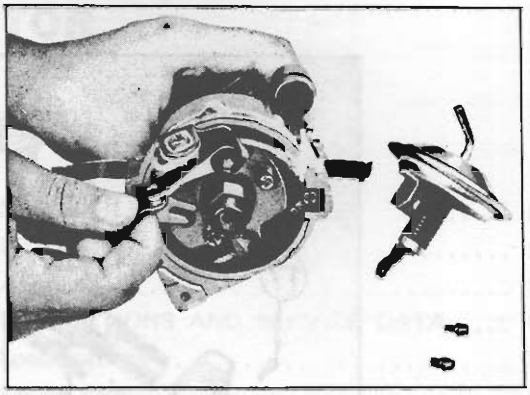


*Fig. EE-66 Disassembling contact arm and contact point*

## Condenser

Satisfactory performance of condenser depends on capacity and degree of insulation, requiring attention to be sure that terminals are clean and set screws are tight.

Checking of condenser is made by a circuit tester with its range set to "high" resistance" reading. When needle of tester swings violently and then moves back to infinite gradually, it is an indication that condenser is in good condition.

If needle shows any steady reading, or if it registers zero, the likelihood is that transformer is out of order, calling for replacement.

## Vacuum and centrifugal advance part

≪Advance characteristics≫

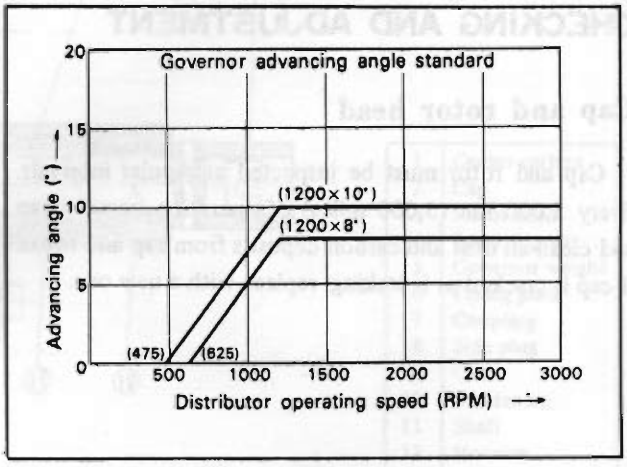



*Fig. EE-67 D609-56 (Centrifugal advance)*

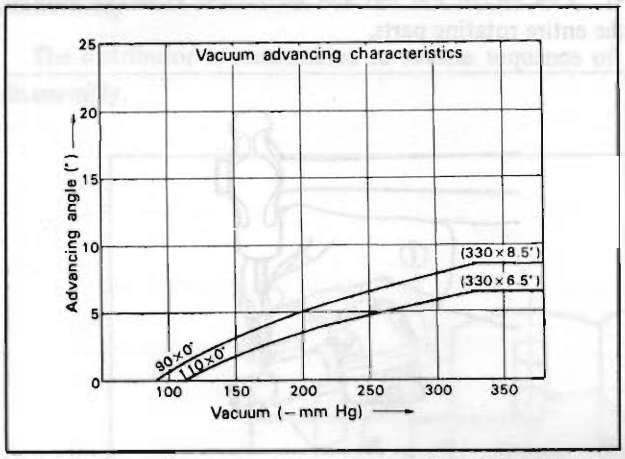



*Fig. EE-68 D609-56 (Vacuum advance)*

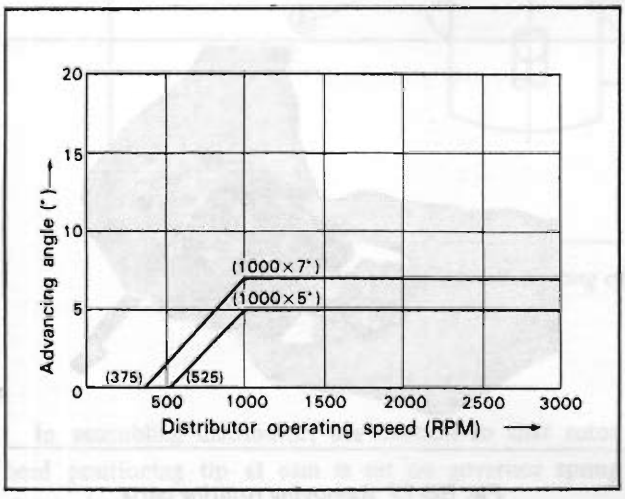



*Fig. EE-69 D606-52 (Centrifugal advance)*

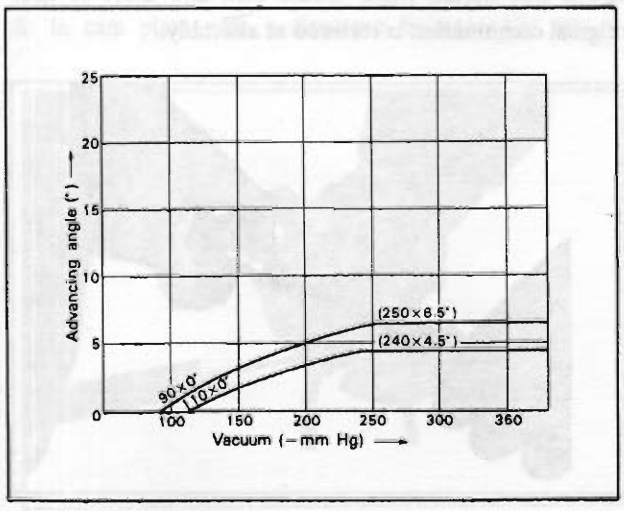



*Fig. EE-70 D606-52 (Vacuum advance)*

≪ Vacuum advance part ≫

If vacuum advance mechanism fails to operate properly, check for the following items and correct the trouble 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 diaphragm with a new one.

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 mechanism ≫

When cause of engine trouble is traced to centrifugal advance mechanical part, use distributor tester to check its characteristic.

When nothing is wrong with its characteristic, conceivable causes are defectiveness of abnormal wearing-out of driving part or others.

So do not disassemble it. In case of improper characteristic, take off switch on-off part and check closely cam assembly, governor weight, shaft and governor spring, etc.

In case centrifugal advance mechanical part is reassembled, be sure to check advance characteristic by distributor tester.

## DISASSEMBLY AND ASSEMBLY

### Disassembly

Disassembly can be made in the following order.

1. Take off cap and disconnect rotor head.

2. Remove vacuum controller.

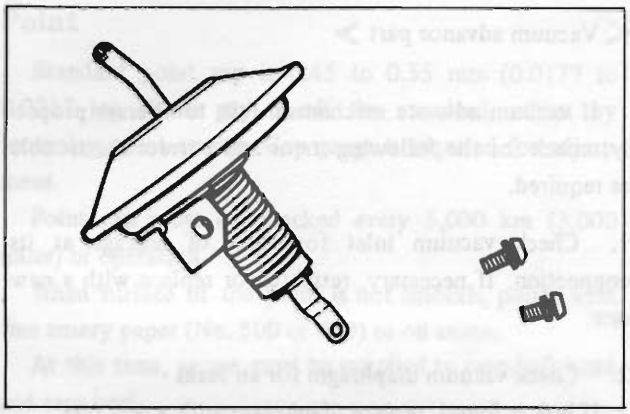


*Fig. EE-71 Disassembling vacuum controller*

3. Remove contact breaker.
Refer to page EE-72 when contact set is removed.

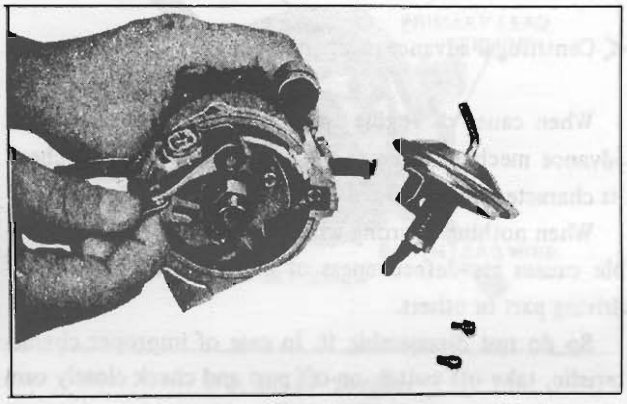


*Fig. EE-72 Removing contact set*

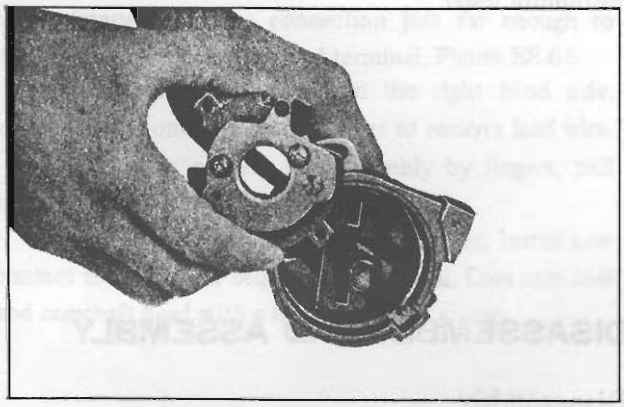


*Fig. EE-73 Removing contact breaker*

4. When contact breaker is disassembled, be careful not to lose steel balls between breaker spring and breaker plate.

5. Pull knock pin out and disconnect collar to remove the entire rotating parts.

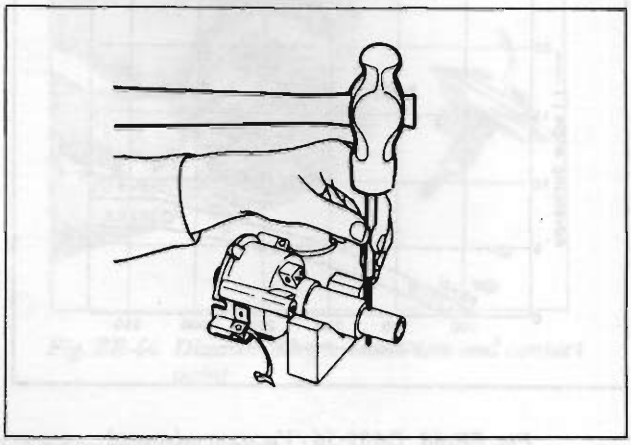


*Fig. EE-74 Removing knock pin*

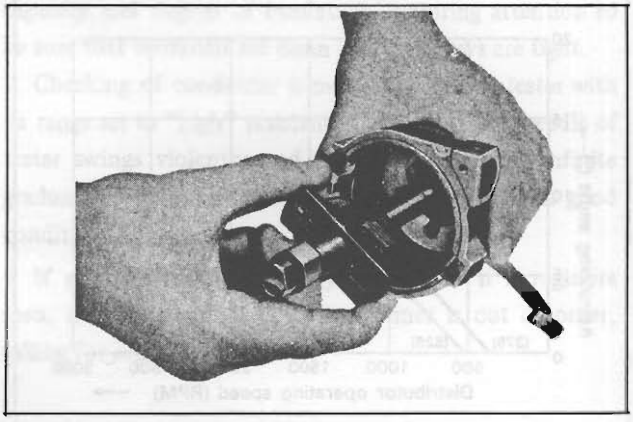


*Fig. EE-75 Removing rotating parts*

6. When cam is to be removed, first remove set screw since shaft head is fastened with the screw to hold cam down. Put match mark across cam and shaft so that original combination is restored at assembly.

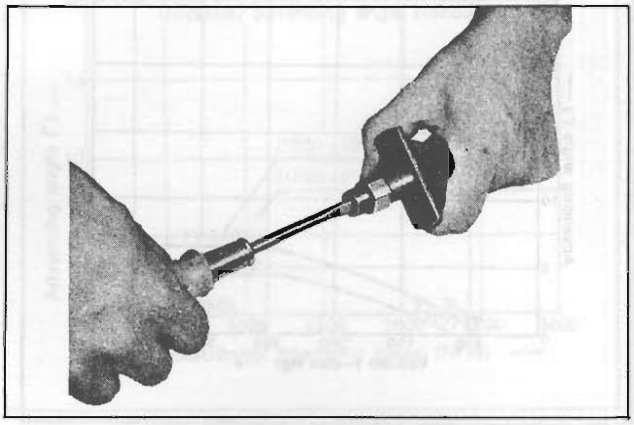


*Fig. EE-76 Removing cam*

## Assembly

The distributor is reassembled in reverse sequence of disassembly.

Refer to Figure EE-79 for replacement and reassembly of governor spring and cam.

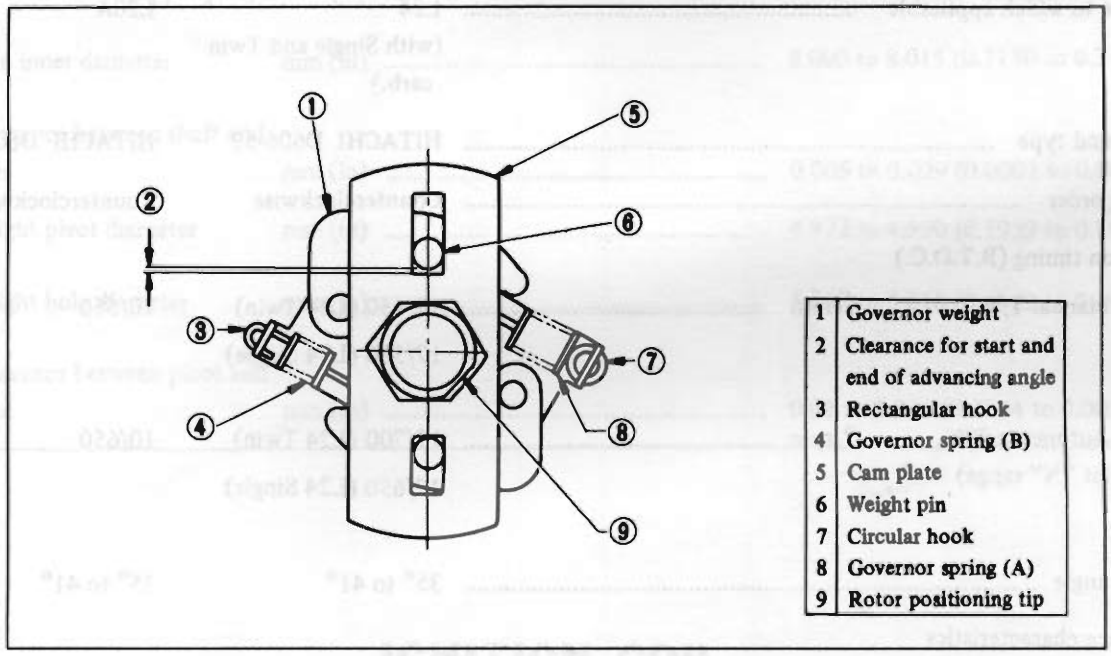



*Fig. EE-77 Setting of governor spring and cam*

In assembling distributor, use caution so that rotor head positioning tip at cam is set on governor spring circular hook side.

Then weight pin for governor spring A with circular hook comes in long rectangular hole.

Also check to be sure that weight pin on spring A is in slit in cam plate with a clearance between the two at beginning and end of governor operation.

Meanwhile, weight pin on opposite side comes in short rectangular hole. It does not leave clearance either at the start and end of advancing.

After assembly, check operation of governor before installing it on engine. Ignition timing should be tested with unit mounted on engine.

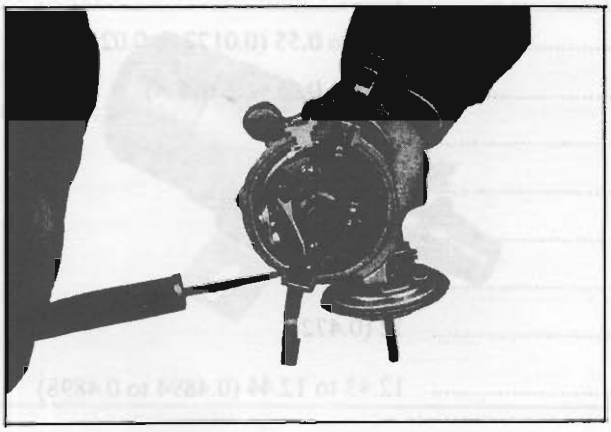


*Fig. EE-78 Testing point pressure*

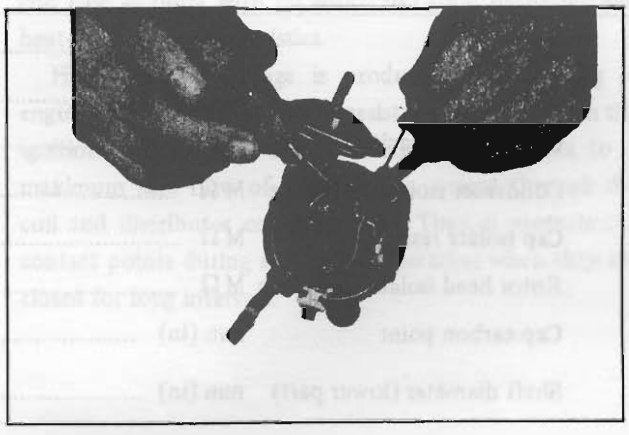


*Fig. EE-79 Measuring point gap*

## SPECIFICATIONS AND SERVICE DATA

### Specifications

| | | | |
|---|---|---|---|
| Engine to which applicable | | L24 (with Single and Twin carb.) | L20A |
| Make and type | | HITACHI D606-52 | HITACHI D609-56 |
| Firing order | | Counterclockwise | Counterclockwise |
| Ignition timing (B.T.D.C.) | | | |
| Manual T/M | °/rpm | 17/650 (L24 Twin)<br>17/550 (L24 Single) | 10/550 |
| Automatic T/M (at "N" range) | °/rpm | 17/700 (L24 Twin)<br>17/650 (L24 Single) | 10/650 |
| Dwell angle | | 35° to 41° | 35° to 41° |
| Advance characteristics | | | |
| Centrifugal | | | |
| Start | rpm | 450 | 550 |
| Maximum | °/rpm | 6/1,000 | 9/1,200 |
| Vacuum | | | |
| Start | mmHg (inHg) | 100 (3.94) | 100 (3.94) |
| Maximum | °/mmHg (inHg) | 5.5/245 (9.6) | 7.5/330 (13.0) |
| Weight | kg (lb) | 1.0 (2.2) | 1.0 (2.2) |

### Service data

| | | |
|---|---|---|
| Point gap | mm (in) | 0.45 to 0.55 (0.0177 to 0.0217) |
| Point pressure | kg (lb) | 0.50 to 0.65 (1.1 to 1.4) |
| Condenser capacity | μF | 0.20 to 0.24 |
| Condenser isolate resistance | MΩ | 5 |
| Cap isolate resistance | MΩ | 50 |
| Rotor head isolate resistance | MΩ | 50 |
| Cap carbon point | mm (in) | 12 (0.472) |
| Shaft diameter (lower part) | mm (in) | 12.43 to 12.44 (0.4894 to 0.4898) |
| Housing inner diameter | mm (in) | 12.45 to 12.468 (0.4902 to 0.4909) |

| | | |
|---|---|---|
| Clearance between shaft and housing | mm (in) | 0.010 to 0.038 (0.0004 to 0.0015) |
| Amendment limit of clearance | mm (in) | 0.08 (0.0031) |
| Shaft diameter (upper part) | mm (in) | 7.986 to 7.995 (0.3144 to 0.3148) |
| Cam inner diameter | mm (in) | 8.000 to 8.015 (0.3150 to 0.3156) |
| Clearance between shaft and cam | mm (in) | 0.005 to 0.029 (0.0002 to 0.0011) |
| Weight pivot diameter | mm (in) | 4.972 to 4.990 (0.1959 to 0.1965) |
| Weight hole diameter | mm (in) | 5.000 to 5.018 (0.1962 to 0.1969) |
| Clearance between pivot and hole | mm (in) | 0.01 to 0.046 (0.0004 to 0.0018) |

# IGNITION COIL

## CONTENTS



## DESCRIPTION

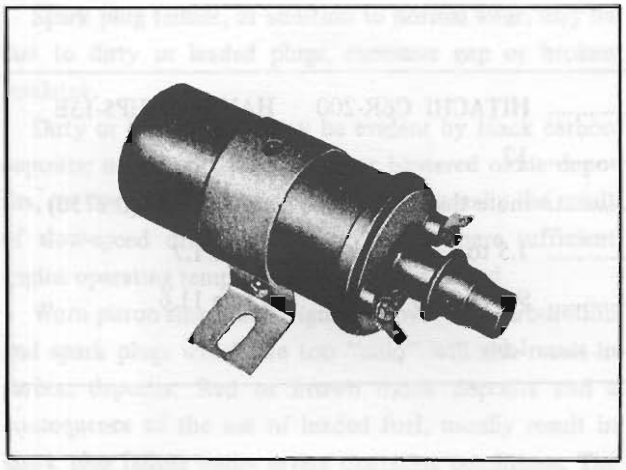
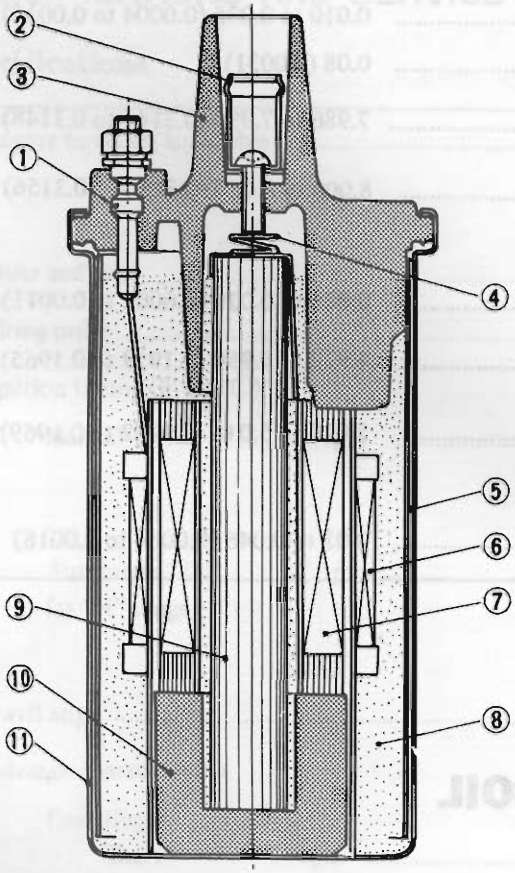


*Fig. EE-80 HP5-13E*

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

High sparking voltage is produced from starting to engine high revolution by the resistor which is used in the ignition coil circuit. The internal resistor limits to a maximum safe flow of the primary current through the coil and distributor contact points. Thus, it protects the contact points during slow speed operation when they are closed for long intervals.




| | | | |
|---|---|---|---|
| 1 | Primary terminal | 7 | Secondary coil |
| 2 | Secondary terminal | 8 | Insulator oil |
| 3 | Cap | 9 | Center core |
| 4 | Spring | 10 | Segment |
| 5 | Side core | 11 | Case |
| 6 | Primary coil | | |

*Fig. EE-81 Construction*

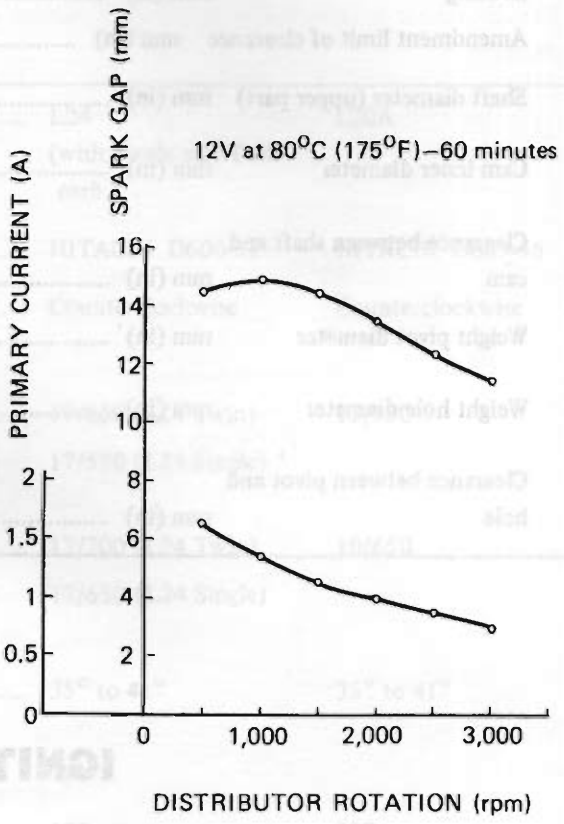



*Fig. EE-82 C6R-200, HP5-13E characteristic curve*

## SPECIFICATION

| | | | |
|---|---|---|---|
| Make and Type | | HITACHI C6R-200 | HANSHIN HP5-13E |
| Primary voltage | V | 12 | 12 |
| Spark gap | mm (in) | more than 7 (0.2756) | more than 7 (0.2756) |
| Primary resistance at 20°C (68°F) | Ω | 1.5 to 1.7 | 1.5 to 1.7 |
| Secondary resistance at 20°C (68°F) | KΩ | 9.5 to 11.6 | 9.5 to 11.6 |
| Resistor | Ω | 1.6 | 1.6 |

# SPARK PLUGS

## CONTENTS



## PERIODICAL SERVICES

Plugs should be removed for cleaning, inspection and regapping periodically (actual time depending on operating conditions).

## INSPECTION

Spark plug life is affected to a large extent by operating conditions and plug life varies consequently. In order to secure peak performance, spark plugs should be checked, cleaned and regapped every 12 months or 20,000 km (12,000 miles).

Worn or dirty plugs will give satisfactory operation at idling speed, but under high speed operation, they frequently fail. The fault of plugs are evident in a number of ways such as increased fuel consumption, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear, may be due to dirty or leaded plugs, excessive gap or broken insulator.

Dirty or leaded plugs may be evident by black carbon deposits, or red, brown, yellow or blistered oxide deposits, on the plugs. The black deposits are usually the result of slow-speed driving and short runs where sufficient engine operating temperature is seldom reached.

Worn piston rings, faulty ignition, over-rich carburetion and spark plugs which are too "cold" will also result in carbon deposits. Red or brown oxide deposits and a consequence of the use of leaded fuel, usually result in spark plug failure under severe operating conditions. The oxides have no adverse effect on plug operation as long as they remain in a powdery state. But, under high speed or heavy load, the powder oxide deposits melt and form a heavy glaze coating on the insulator which, when hot, acts as a good electrical conductor, allowing current to follow the deposits and short out the plug.

Excessive gap wear on plugs of low mileage, usually indicates the engine is operating at high speeds or loads that are consistently greater than normal or that a plug which is too "hot" is being used. In addition, electrode wear may be the result of plug overheating, caused by combustion gases leaking through the threads and gasket, due to insufficient compression of the spark plug gasket, dirt under the gasket seat. Too "lean" carburetion will also result in excessive electrode wear.

Broken insulators are usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but soon oil or moisture will penetrate the fracture. The fracture is usually just below the crimped part of shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. In fairly rare instances, this type of break may result from the plug operating too "hot" such as encountered in sustained periods of high-speed operation or under extremely heavy loads. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the ground side electrode. Spark plugs with broken insulators should always be replaced.

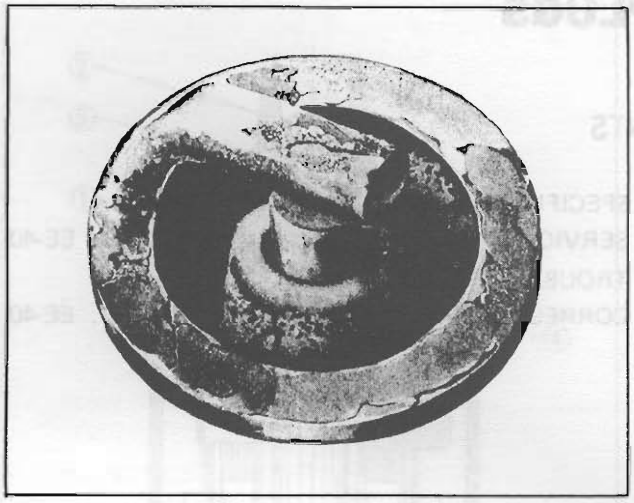


*Fig. EE-83 Normal*

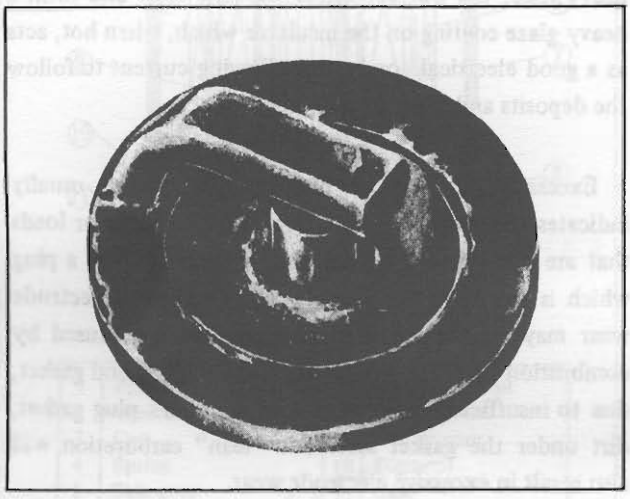


*Fig. EE-84 Wet*

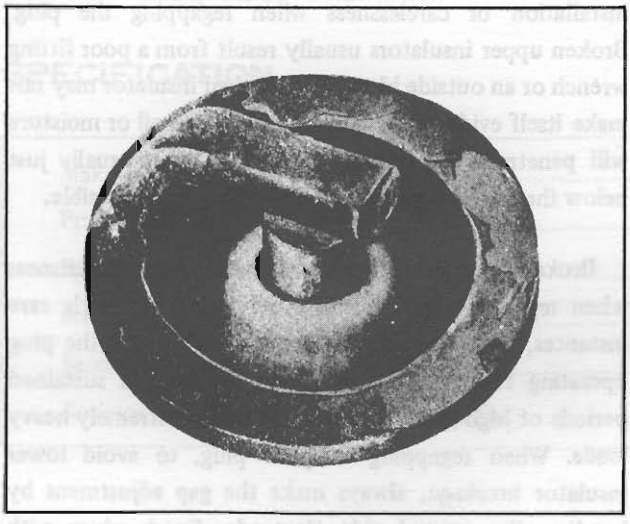


*Fig. EE-85 Overheating (I)*

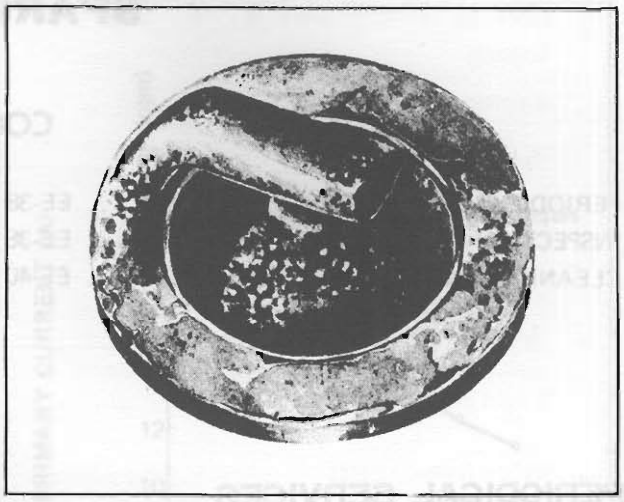


*Fig. EE-86 Overheating (II)*

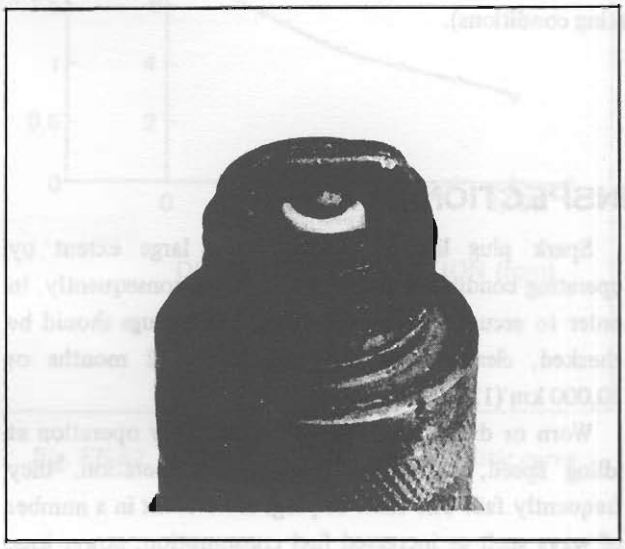


*Fig. EE-87 Overheating (III)*

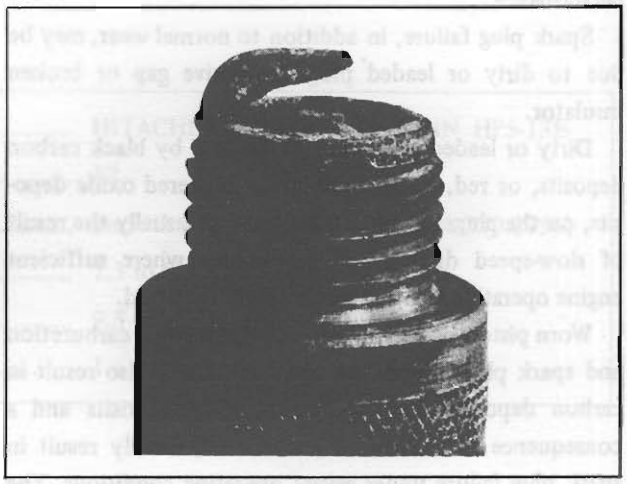


*Fig. EE-88 Life*

## CLEANING AND REGAP

Clean spark plugs thoroughly using an abrasive-type cleaner. All spark plugs must be of the same make and number or heat range. Use a round feeler gauge to adjust the spark plug gaps.

**Note: Before adjusting gap, file center electrode falt. In adjusting spark plug gap, never bend center electrode which extends through porcelain center. Always make adjustments by bending ground side electrode.**

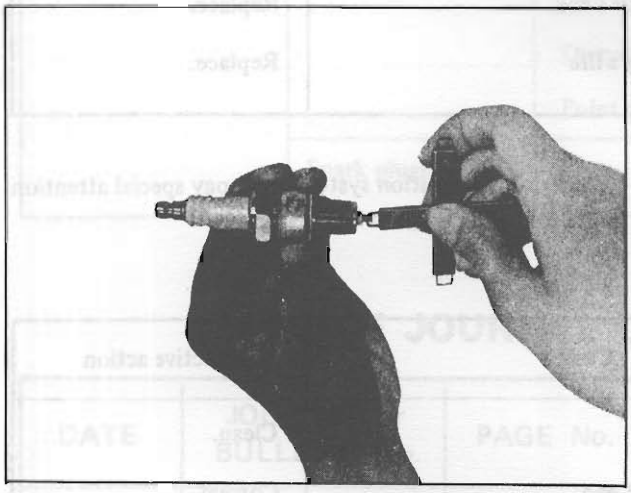
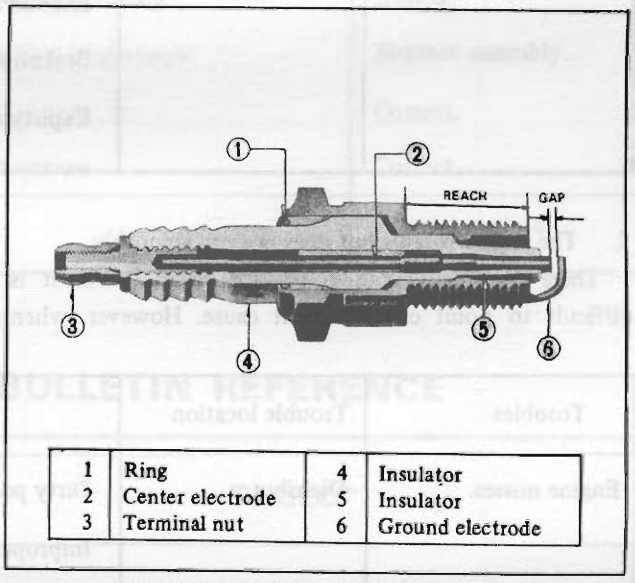


*Fig. EE-89 Measuring spark plug gap*

## SPECIFICATION AND SERVICE DATA

| Item \ Make | NGK |
|---|---|
| Model | BP-5ES (230 only)<br>BP-6ES |
| Applied engine | L20A, L24 |
| Size (screw diameter x reach) mm (in) | 14 x 19<br>(0.55 x 0.75) |
| Plug gap mm (in) | 0.8 to 0.9<br>(0.031 to 0.035) |
| Torque kg-m (ft-lb) | 1.5 to 2.0<br>(11.0 to 15.0) |




| | | | |
|---|---|---|---|
| 1 | Ring | 4 | Insulator |
| 2 | Center electrode | 5 | Insulator |
| 3 | Terminal nut | 6 | Ground electrode |

*Fig. EE-90 Cross section of spark plug*

## TROUBLE DIAGNOSES AND CORRECTIONS

1. The engine does not start.

If there is no trouble in the fuel system, the ignition system should be checked. This can be easily done by detaching the high tension cord from spark plugs, start the engine by the starting motor and observe the condition of the sparks that occur between the high tension cord and spark plug terminal. After checking this, use the proper countermeasures.

| Spark gap | Trouble location | Causes | Corrective action |
|---|---|---|---|
| No sparks at all | Distributor | Defective insulation of condenser | Replace. |
| | | Breakage of lead-wire on low tension side | Repair. |
| | | Defective insulation of cap and rotor head | Replace. |
| | | Point does not open or close. | Repair. |
| | Ignition coil | Wire breakage or short circuit of coil | Replace with new one. |

| | | | |
|---|---|---|---|
| | High tension code | Wire coming off | Repair. |
| | | Defective insulation | Replace. |
| 1 to 2 mm (0.0394 to 0.0787 in) or irregular | Distributor | Point gap too wide | Correct. |
| | | Oil sticking on point | Clean. |
| | | Excessively burnt point | Replace. |
| | | Layer short-circuit | Replace assembly. |
| Less than 6 mm (0.2362 in) | Spark plugs | Electrode gap too wide | Correct or replace. |
| | | Excessively accumulated carbon | Clean or replace. |
| | | Broken insulator neck | Replace. |
| | | Expirty of plug's life | Replace. |

2. The engine rotates but does not run smoothly.

There are many causes for this trouble, and it is difficult to point out the right cause. However, when considering the ignition system only, pay special attention to the following points.

| Troubles | Trouble location | Causes | Corrective action |
|---|---|---|---|
| Engine misses. | Distributor | Dirty point | Clean. |
| | | Improper point gap | Correct. |
| | | Leak of electricity of cap and rotor head | Replace. |
| | | Defective insulation of condenser | Replace. |
| | | Defective insulation of lead wire of condenser | Replace. |
| | | Defective arm | Oil the shaft. |
| | | Defective spring of arm spring. | Replace assembly. |
| | | Near-breakage of lead wire | Replace. |
| | | Worn or shaky breaker plate | Replace assembly. |
| | | Worn or shaky distributor shaft. | Replace assembly. |
| | Ignition coil | Layer short-circuit or use of inferior quality | Replace assembly. |
| | High tension code | Deterioration of insulation and leak of electricity | Replace. |

| | | | |
|---|---|---|---|
| | Spark plugs | Dirty | Clean or replace. |
| | | Electricity leaks at the upper porcelain insulator | Replace assembly. |
| Engine causes knocking very often. | Distributor | Improper advance timing | Adjust. |
| | | Come off or breakage of governor spring | Correct or replace. |
| | | Worn out pin or hole of governor portion | Replace. |
| | Spark plugs | Excessively burnt spark plug | Clean or replace. |
| Engine does not provide enough power | Distributor | Improper or retarded timing | Adjust. |
| | | Defective function of governor | Replace assembly. |
| | | Dirty point | Correct. |
| | | Point gap too narrow | Correct. |
| | Spark plugs | Dirty | Clean or replace. |

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