SERVICE MANUAL

MODEL
L20A, L24 SERIES
ENGINE

NISSAN

NISSAN MOTOR CO., LTD.
TOKYO, JAPAN

SECTION EE

ENGINE ELECTRICAL SYSTEM

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STARTING CIRCUIT

The electrical system is a 12 Volt system. This section is subdivided into the following subsections for electrical parts which are required for engine operation.

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

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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 until the engine starts running by its own power. 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.

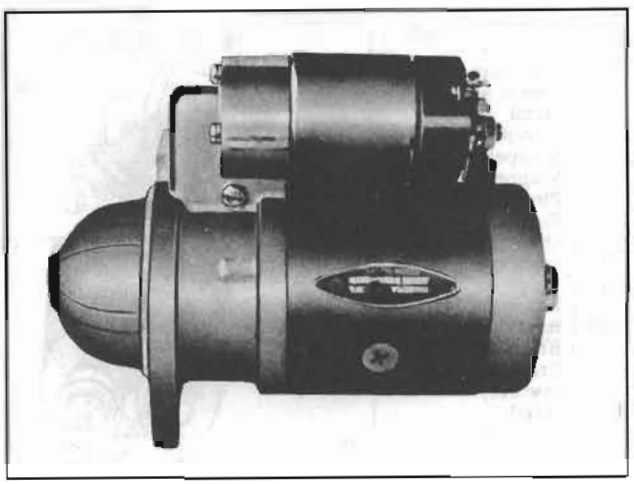


Fig. EE-1 External view

REMOVAL

1. Disconnect the battery ground cable.

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

2. Remove two bolts used to secure the starting motor on the clutch housing. Pull the starter assembly forward and remove the starting motor.

DISASSEMBLY

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

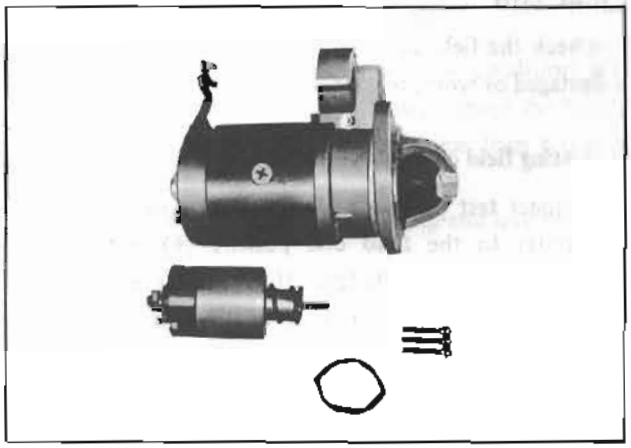


Fig. EE-4 Removing magnetic switch assembly

2. Remove two through bolts and brush cover assembly.

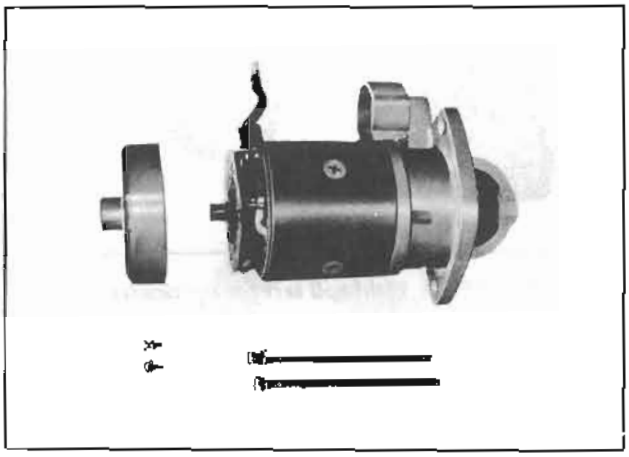


Fig. EE-5 Removing the brush cover

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

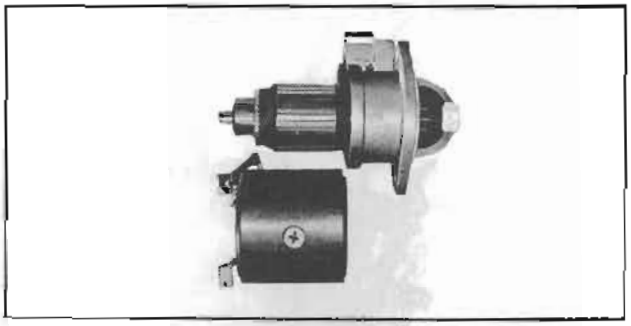


Fig. EE-6 Removing the yoke assembly

4. Withdraw the armature assembly and shift lever.

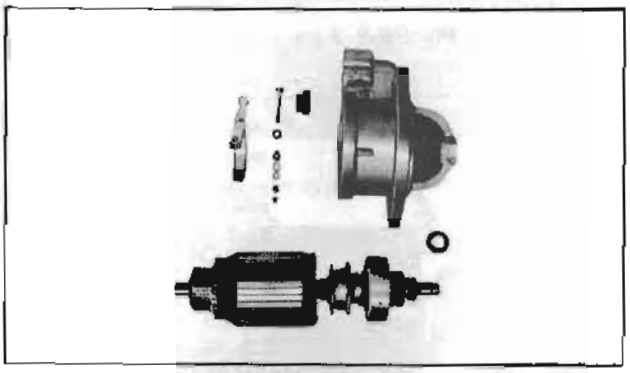


Fig. EE-7 Removing the armature assembly and shift lever

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

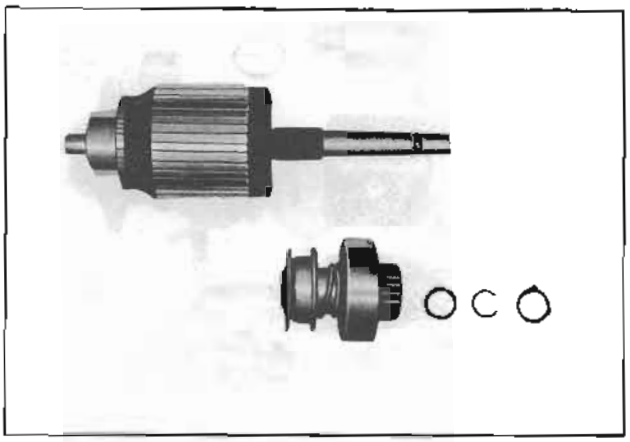


Fig. EE-8 Removal of the over-running clutch assembly

6. Unsolder the brushes with a soldering-iron and remove the brushes.

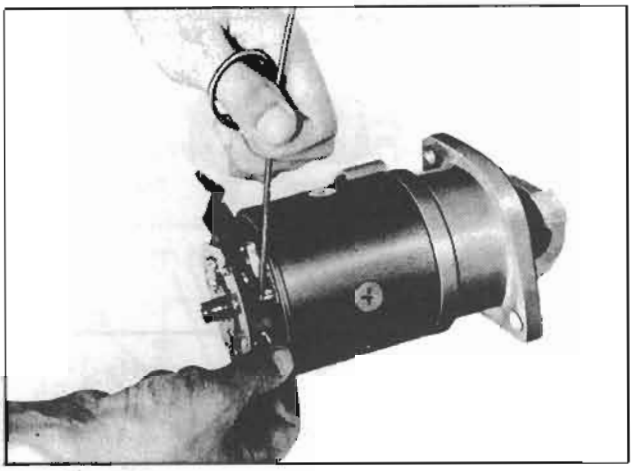


Fig. EE-9 Removing brush

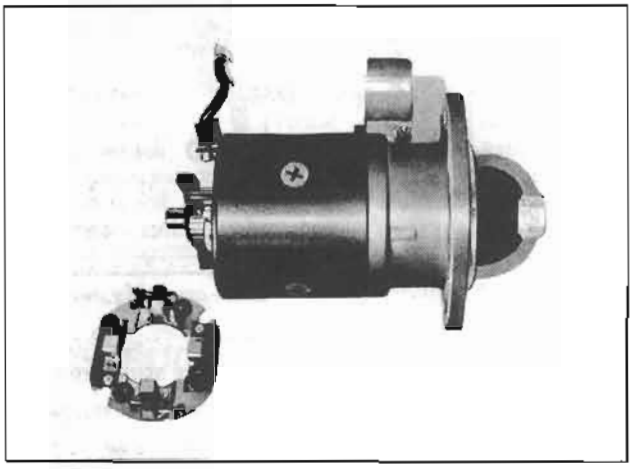


Fig. EE-10 Removing brush holder

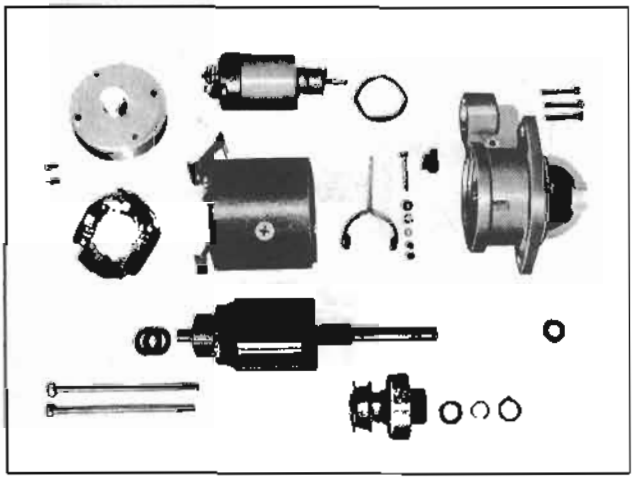


Fig. EE-11 Disassembly

CLEANING AND INSPECTION

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

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

Terminal

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

Field coil

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

Testing field coil for continuity:

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

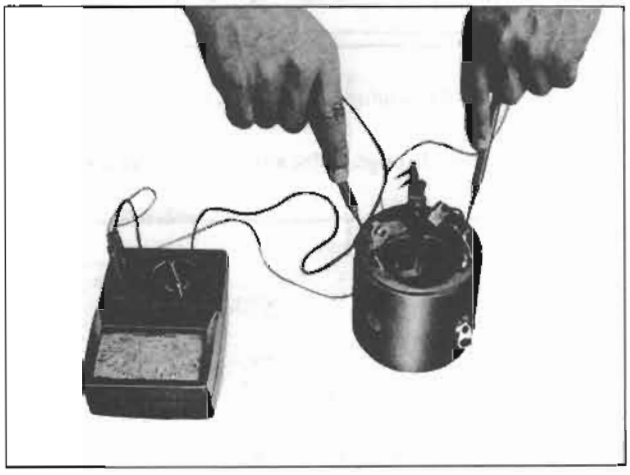


Fig. EE-12 Field coil test for continuity

Testing field coil for ground:

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

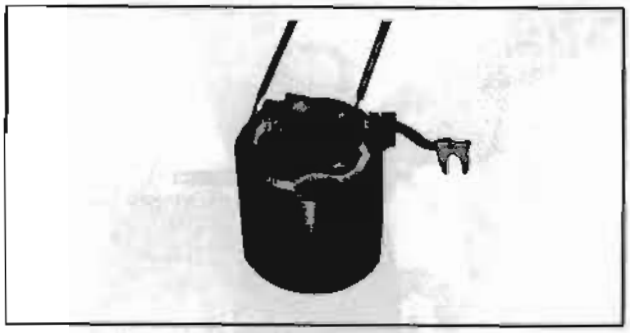


Fig. EE-13 Field coils test for ground

Field coil test for short-circuit

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

When the coil is defective, replace the coil.

Brushes and brush lead wire

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

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

Check the connection of the 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 the commutator.

If the brushes or brush holders are dirty, clean.

Brush spring tension

Measure the brush spring tension by the use of a spring scale as shown in Figure EE-14. The reading should be 0.8 kg (1.76 lb). Replace the spring if the tension is lower than 0.7 kg (1.54 lb).

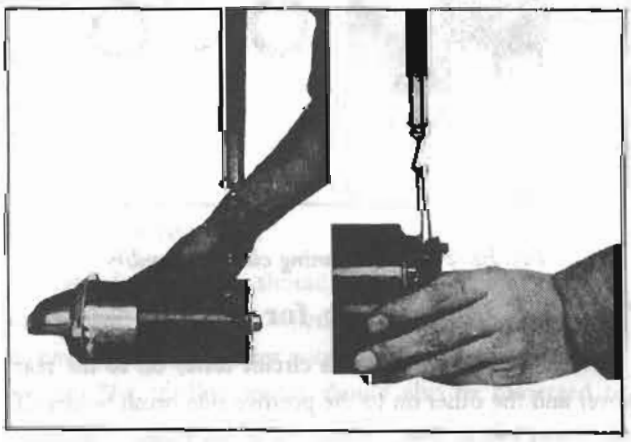


Fig. EE-14 Inspection of brush spring tension

Armature assembly

Check external appearance of the armature and the commutator.

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

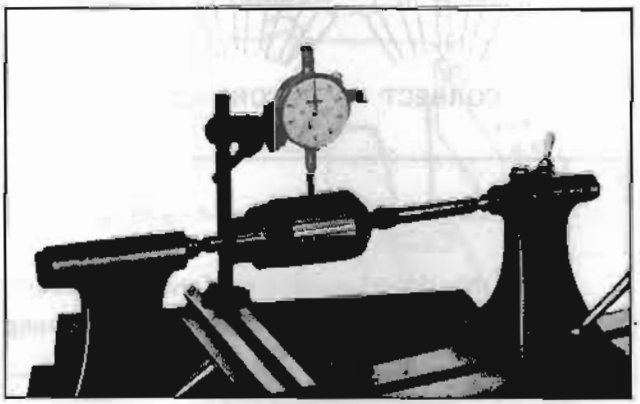


Fig. EE-15 Inspection of armature shaft for bend

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

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

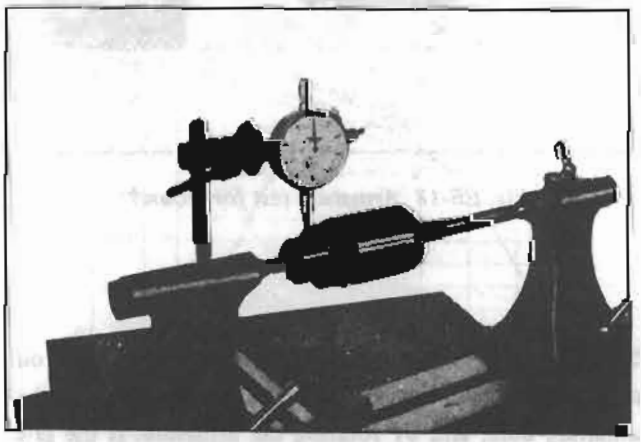


Fig. EE-16 Inspection of commutator

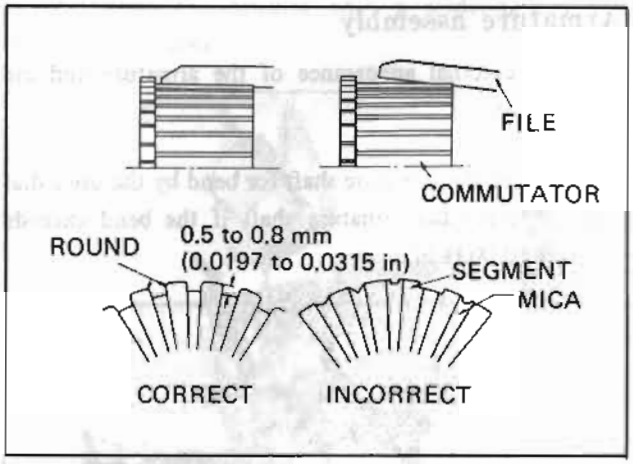


Fig. EE-17 Undercutting insulating mica

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

4. Testing armature for ground

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

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

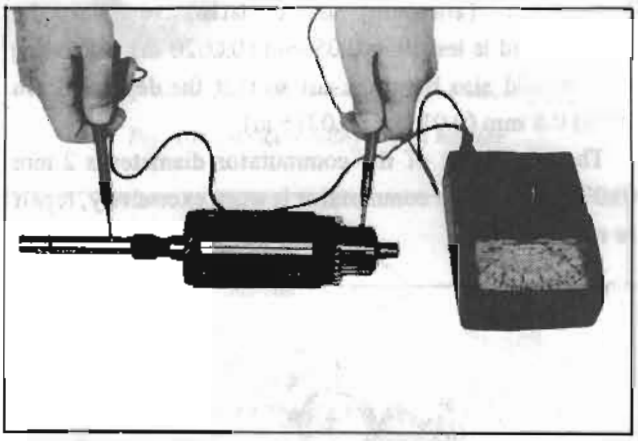


Fig. EE-18 Armature test for ground

5. Check the armature for short-citcuit by placing it on an armature tester placing a hack-saw blade over the armature core, and by rotating the armature. If the saw blade vibrates, armature is short-circuited.

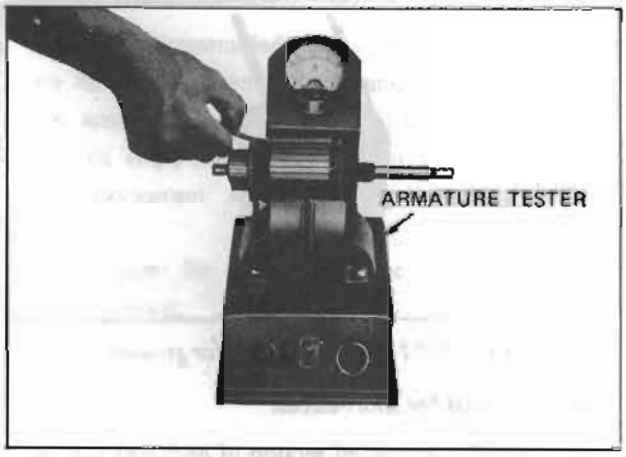


Fig. EE-19 Armature test for shaft

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

Over-running clutch assembly

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

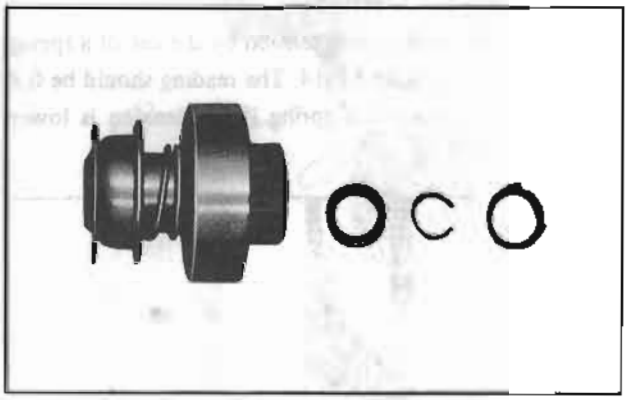


Fig. EE-20 Over-running clutch assembly

Testing brush holder for ground

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

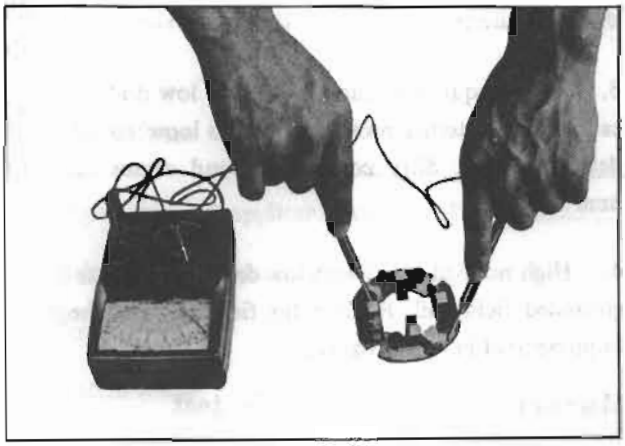


Fig. EE-21 Brush holder test for ground

Pinion case bearing metal

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

Magnetic switch assembly

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

REASSEMBLY

Reassemble the starting motor in reverse sequence of disassembly.

When assembling, be sure to fill the rear case with grease and apply oil to the rear cover bearing metal and pinion slightly.

TEST

Performance test

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

Specified current draw and revolution in these test are shown in "specification"

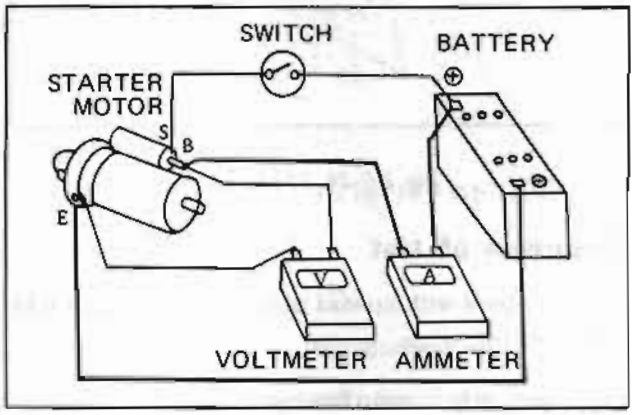


Fig. EE-22 No-load test

Torque test

Torque testing equipment should be used to measure the torque the motor will develop. A high current carrying variable resistance should be connected to the circuit so that the specified voltage at the 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 Figures EE-23 and EE-24.

≪ Characteristic curve ≫

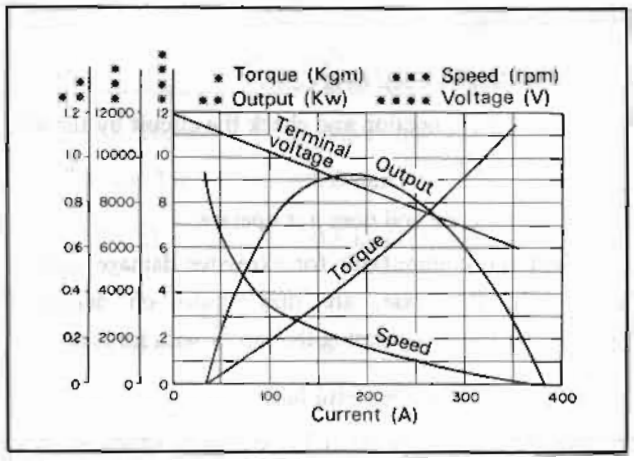


Fig. EE-23 S114-121

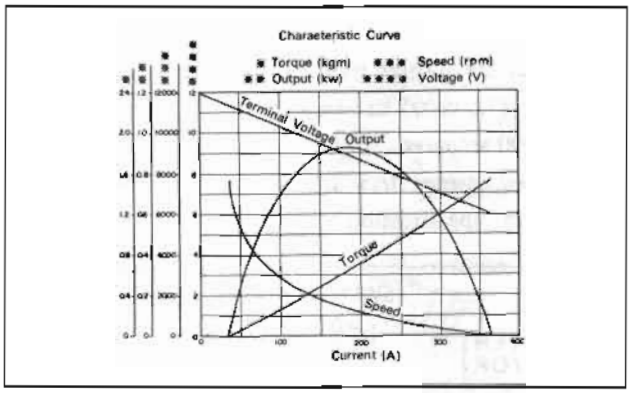


Fig. EE-24 S114-122

Diagnoses of test

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

(1) Tight, dirty or worn bearings

(2) Bent armature shaft or loosen field probe

(3) Shorted armature;

Check armature further.

(4) Grounded armature or field;

Remove copper connector. Remove negative side brush and insulate it from the commutator before inspection. Using a circuit tester, place one probe on the insulated terminal and the other on the rear cover. If the tester indicates conduction, remove other two brushes and check field and armature separately to determine whether the field is grounded or armature.

2. Failure to operate with high current draw may result from followings.

(1) Grounded or open field coil:

Inspect the connection and check the circuit by the use of a circuit tester.

(2) The armature coil does not operate:

Inspect the commutator for excessive damage due to burning. In this case, arc may occur on defective commutator during operating the motor with no-load.

(3) Burned out commutator bar:

Weak brush spring tension, broken brush spring, rubber brush, thrust out of mica in the commutator or a loose contact brush and commutator would cause burning of the 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 the field coil and check for improvement in performance.

Magnetic switch assembly test

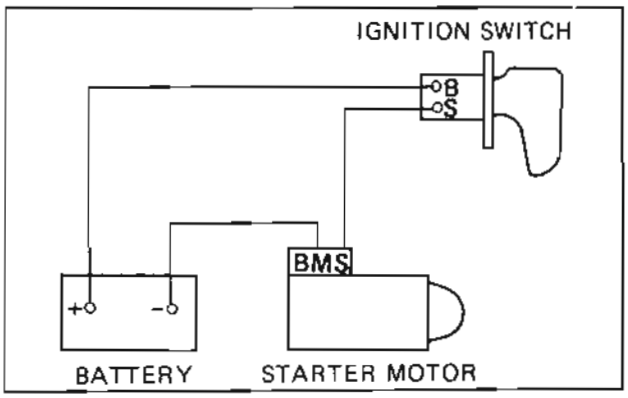


Fig. EE-25 Circuit of magnetic switch assembly test

When the starting motor is checked completely, check the magnetic switch assembly. Connect jumper cables between the "negative" battery terminal and the starting motor "M" terminal, the "positive" battery terminal and the starting motor "S" terminal connecting ignition switch in series as shown in Figure EE-25.

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

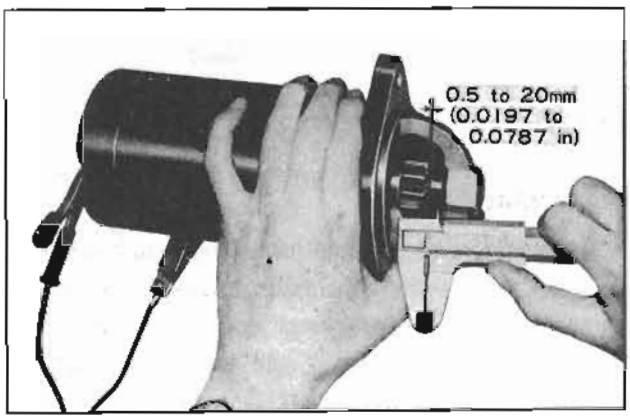


Fig. EE-26 Measurement of gap "ℓ"

SPECIFICATIONS AND SERVICE DATA

Specifications

Engine to which applicable (car model)	L24 (S30, G130)	L20A (H130)
Make and type	HITACHI S114-122	HITACHI S114-121
Nominal output	1.0 kw	1.0 kw
System voltage	12V	12V
Weight	6.0 kg (13.2 lb)	5.3 kg (11.7 lb)
No load		
Terminal voltage	12V	12V
Current	less than 60A	less than 60A
Revolution	more than 5,000 rpm	more than 7,000 rpm
Load		
Terminal voltage	6V	6V
Current	less than 460A	less than 460A
Torque	more than 1.4 kg-m (10.1 ft-lb)	more than 1.15 kg-m (8.3 ft-lb)
Pinion drive out voltage	less than 8V	less than 8V
Magnetic switch		
Series coil resistance	0.31Ω	0.31Ω
Shunt coil resistance	0.93Ω	0.93Ω

Service data

Brush length	18.5 mm (0.7283 in)	18.5 mm (0.7283 in)
Wear limit	6.0 mm (0.2362 in)	6.0 mm (0.2362 in)
Brush spring tension	0.8 kg (1.76 lb)	0.8 kg (1.76 lb)
Commutator		
Outer diameter	35.0 mm (1.378 in)	35.0 mm (1.378 in)
Wear limit	2.0 mm (0.0787 in)	2.0 mm (0.0787 in)
Taper limit	0.4 mm (0.0157 in)	0.4 mm (0.0157 in)
Depth of mica	0.5 to 0.8 mm (0.0197 to 0.0315 in)	0.5 to 0.8 mm (0.0197 to 0.0315 in)

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

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 the terminal.
	Defective brush	Replace the brush.
	Defective starting motor	Dismount the starting motor and conduct testing.
Noisy starting motor.	Loose securing bolt	Retighten the bolt.
	Worn pinion gear	Replace the pinion gear.
	Poor lubrication	Lubricate.
	Worn commutator	Overhaul.
	Worn brush	Replace the brush.
Starting motor cranks slowly.	Discharged battery	Charge or replace the battery.
	Loose terminal connection	Clean and retighten the terminal.
	Worn brush	Replace the brush.
	Locked brush	Check the 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 the engine.	Worn pinion Locked pinion guide Worn ring gear	Replace the pinion. Repair the pinion guide. Replace the ring gear.
Starting motor does not disengage when the ignition switch is turned off.	Defective solenoid switch Defective gear teeth	Repair or replace the solenoid switch. Replace the defective gear.

CHARGING CIRCUIT

The charging circuit includes 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-27 by fall line arrow marks. Then the rotor in the alternator is exited. 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. (Figure EE-27).

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 by the dotted line arrow marks. Then, the coil "VC1" is excited, and the movable contact point "P5" comes in to 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 incrased 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 in to 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 in to contact once again, and the alternator voltage increases. Thus, the rapid vibration of the movable contact point "P2", or applying and removing the registance in the alternator field circuit maintains an alternator output voltage to 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 finally. 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 to constant.

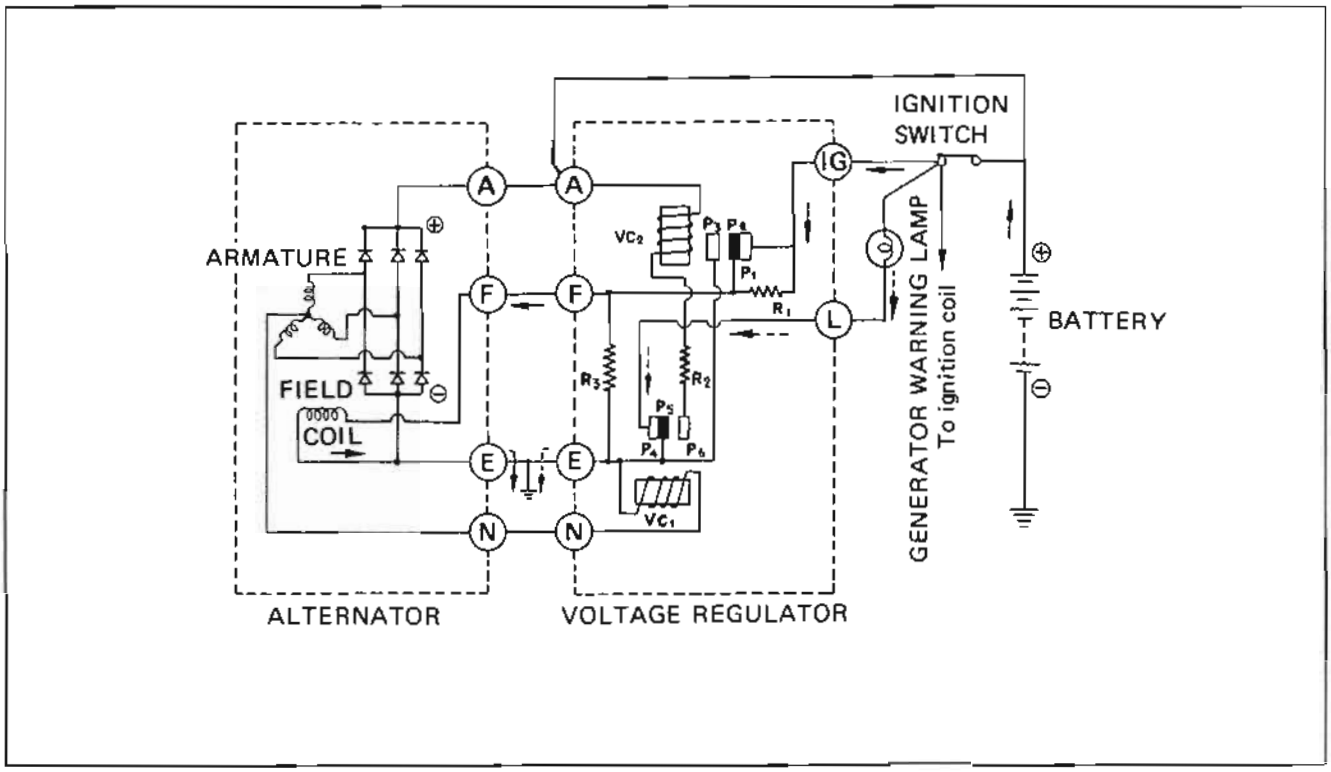


Fig. EE-27 Charging circuit (I)

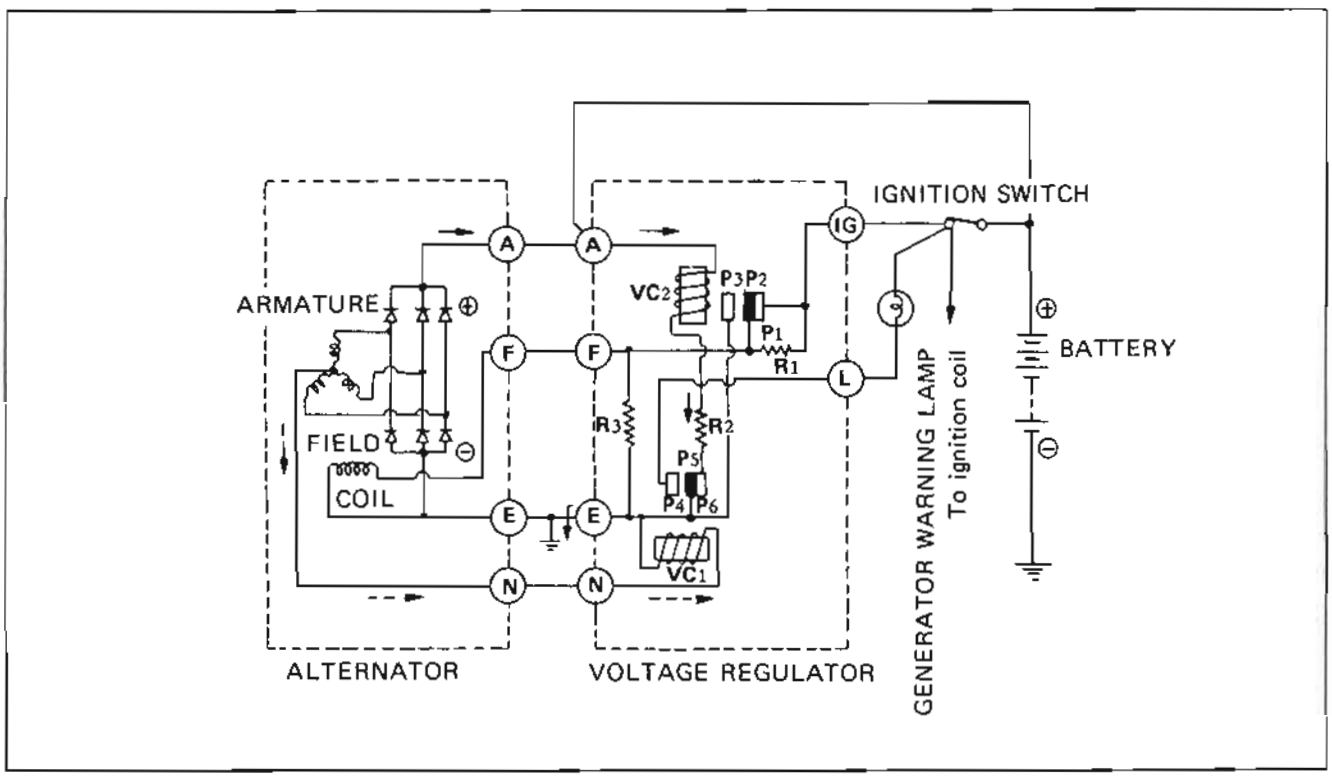


Fig. EE-28 Charging circuit (II)

ALTERNATOR

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DESCRIPTION

The alternator differs from the DC generator, wherein, the alternator turns the magnetic pole and fixes the armature. 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 are used (three negatives and three positives), and three each diodes are installed in positive and negative heat sinks. Voltage control system is basically same as that of the D.C. system.

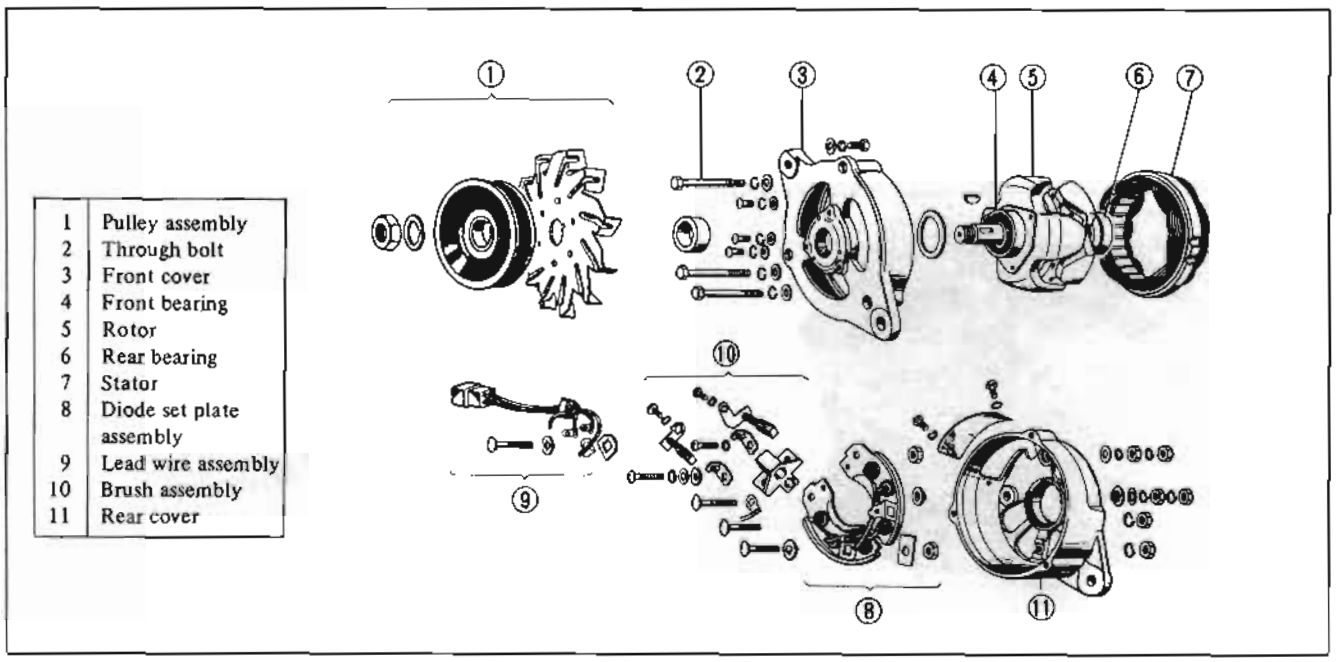


Fig. EE-29 Exploded view of alternator

REMOVAL

1. Disconnect the negative battery terminal.

2. Disconnect two lead wires from the generator and connector.

3. Loosen the adjusting bolt.

4. Remove the generator drive belt.

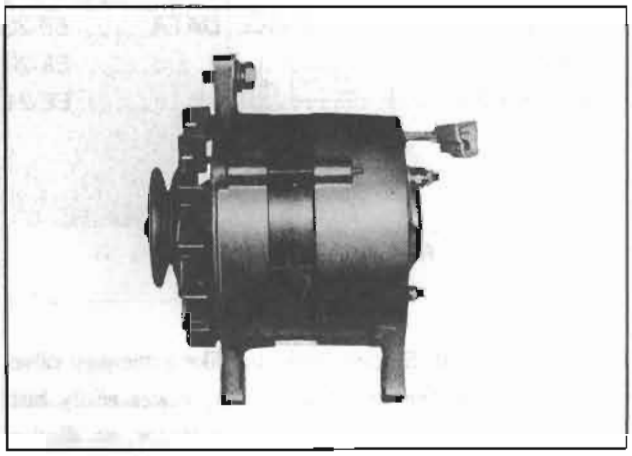


Fig. EE-30 External view

5. Remove the generator installation.

6. Dismount the generator from the vehicle.

DISASSEMBLY

1. Unscrew the through bolts.

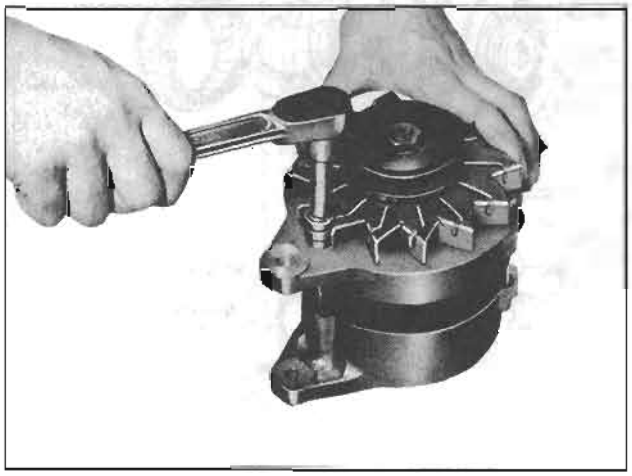


Fig. EE-31 Removal of through bolt

2. Separate the diode end housing from the drive end housing assembly by tapping the front bracket lightly with a wooden mallet.

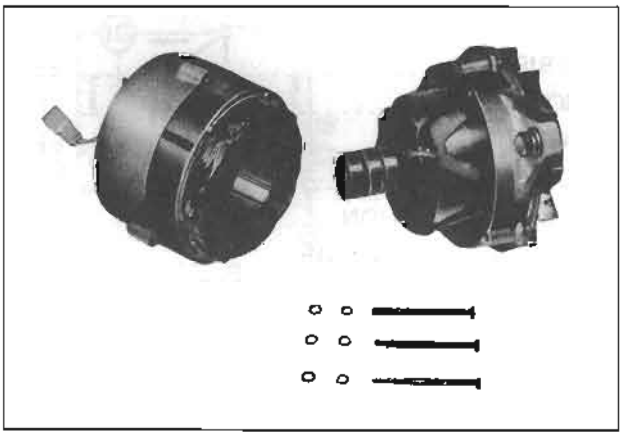


Fig. EE-32 Drive end housing and diode end housing separated

3. Secure the rotor of the drive end housing assembly in a vise carefully so that the rotor is not damaged.

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

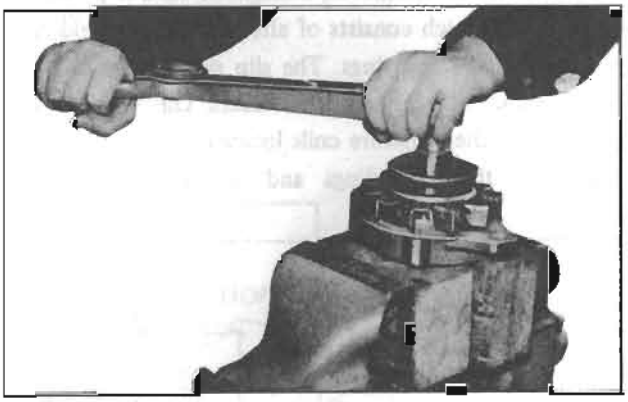


Fig. EE-33 Disassembling the rotor

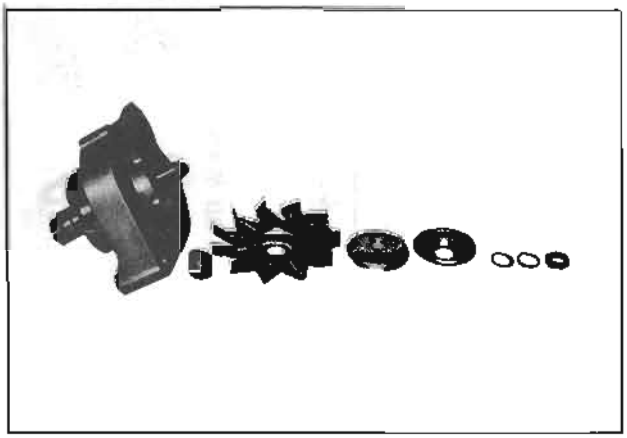


Fig. EE-34 Removal of pulley

4. Remove the rotor from the drive end housing assembly by tapping the drive end housing lightly with a mallet.

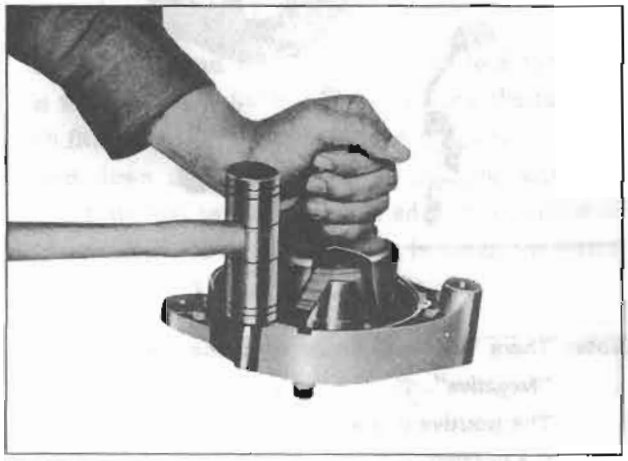


Fig. EE-35 Removal of rotor

5. Remove the bearing retainer by unscrewing three set screws and remove the bearing with a press.



Fig. EE-36 Removal of bearing retainer

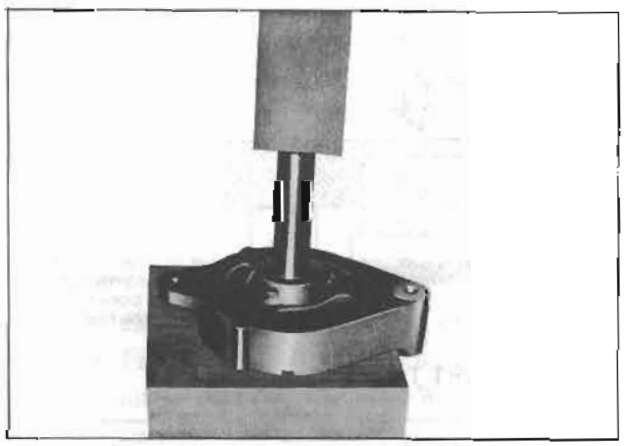


Fig. EE-37 Pulling out of bearing

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

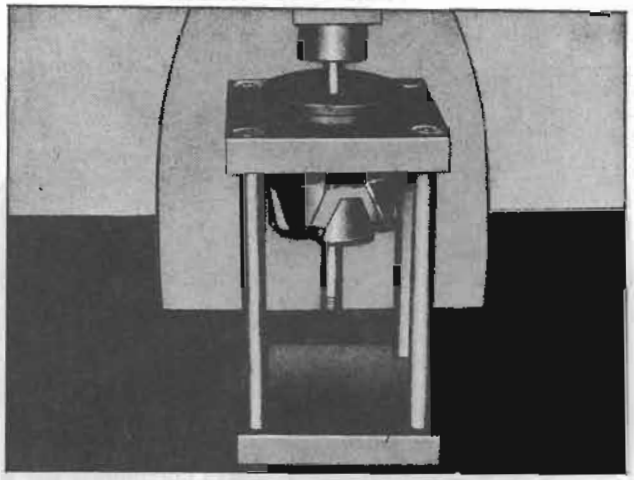


Fig. EE-38 Pulling out of rear bearing (I)

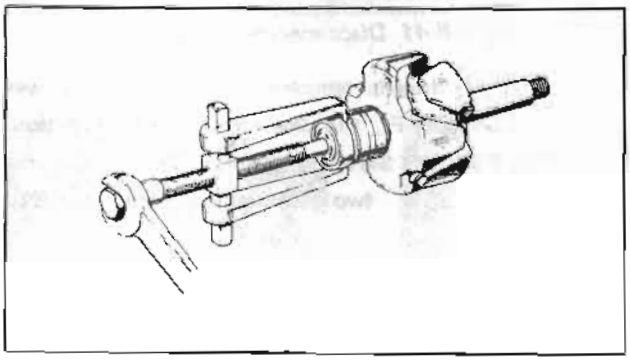


Fig. EE-39 Pulling out of rear bearing (II)

7. Disconnect the negative three diodes from three coil lead wires and each lead wire between diodes by unsoldering with a soldering iron, and separate the stator from the diode end housing assembly.

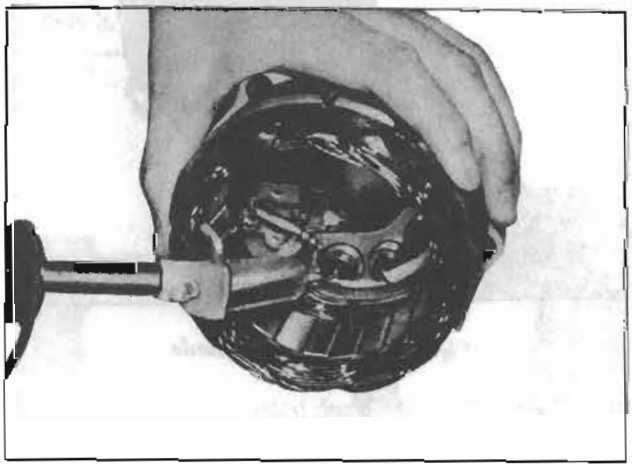


Fig. EE-40 Removing stator

8. Remove the brush cover by unscrewing each set screw.

Unsolder and disconnect "N" terminal lead wire. The diode end and the stator can be separated.

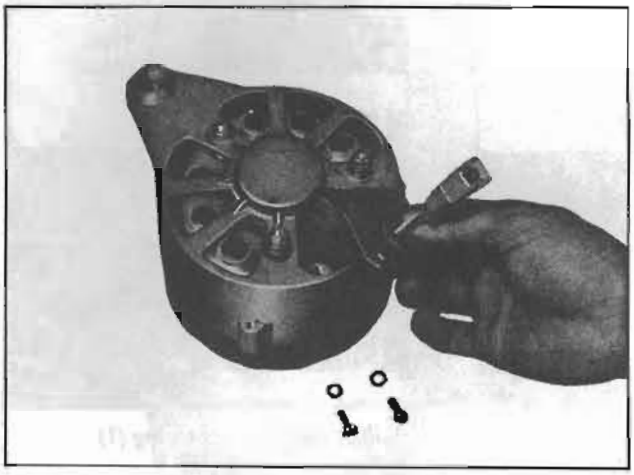


Fig. EE-41 Disconnecting N terminal

Note: When the internal temperature of a diode rises over 150°C (300°F), the diode will lose its function. Therefore, use the electric iron, 100W to 200W, for approximately two seconds at the soldered portions.

9. Remove the heat sink and the brush holder from the rear cover by unscrewing each set screw. Be careful not to lose small parts such as screws, washers and bushings.

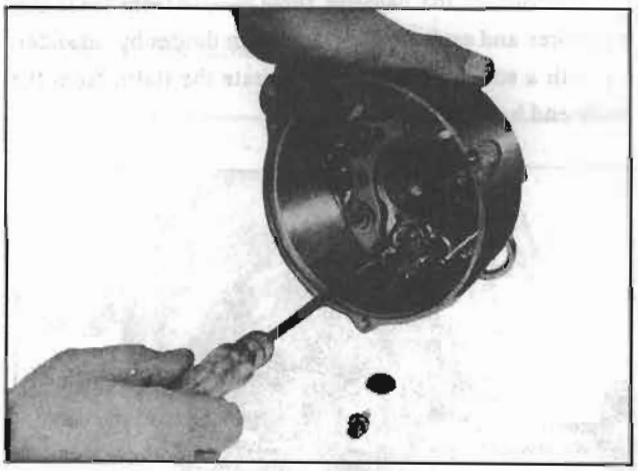


Fig. EE-42 Remvoing diode

10. Disassembling the brush holer

Unsolder lead wire F (white · black), and the brush holder wires (negative and positive) with a soldering iron.

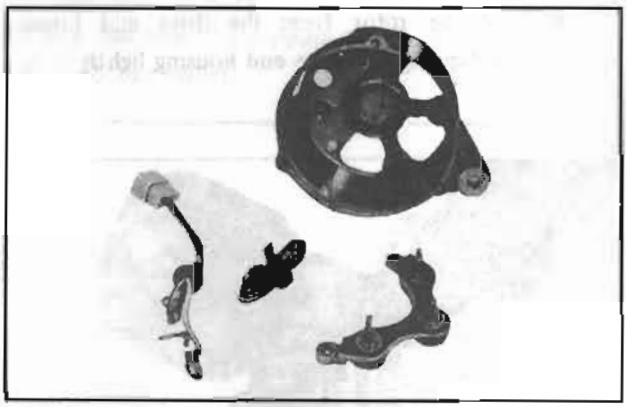


Fig. EE-43 LT140-53

Note: There are two kinds of diode, "Positive" and "Negative".

The positive diode is marked with "red figure" on the bottom of the diode and the negative diode is marked with "black figure" in the same manner as shown in Figure EE-44.

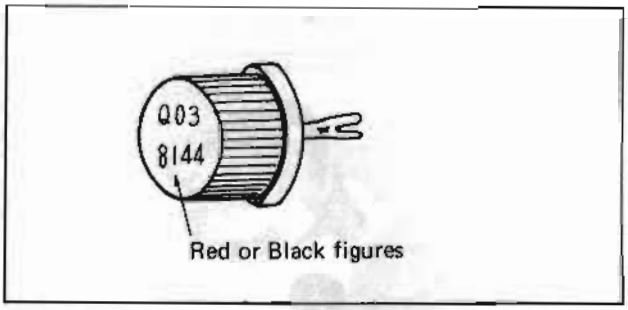


Fig. EE-44 Diode identification

DIODE REMOVAL

To remove a diode, use a suitable tool to support the heat sink, and remove the diode by the use of an arbor press as shown in Figure EE-45.

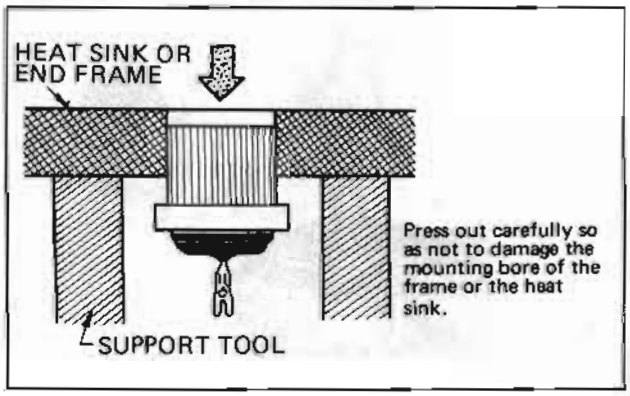


Fig. EE-45 Removal of the diode

Note: Do not strike the diode, as the shock may damage the other diodes.

DIODE INSTALLATION

Support the head sink with a suitable tool and then press the diode into the heat sinks by using the tool Ⓐ which fits over the outer diode edge (A portion).

Press down the diode completely into the mounting bore of C portion toward the lower edge of B portion of the diode. Replaced diode should not be taken out with a force smaller than 15 kg (33 lb).

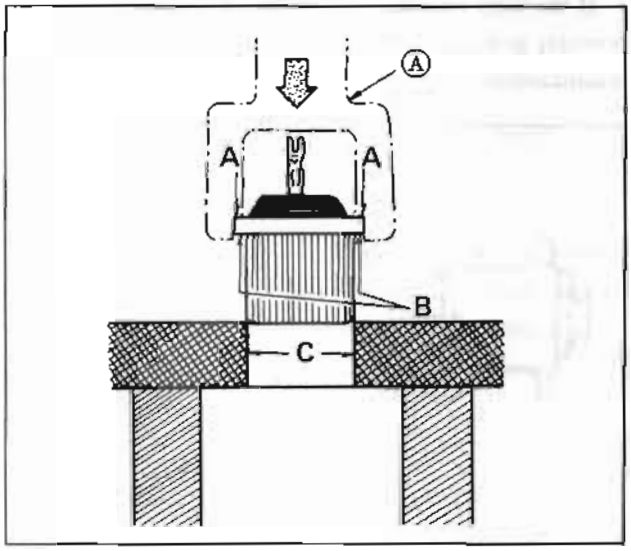


Fig. EE-46 Installation of the diode

INSPECTION AND REPAIR

Remove the alternator from the vehicle and apply the tester between the lead wire F (black-white color) and the lead wire E (black color). When the resistance is approximately 5 to 6Ω, the condition is satisfactory.

Rotor inspection

1. Conduction test of field coil

Apply the tester between the slip rings of rotor as shown in Figure EE-51. If there is no conduction, the disconnection of field coil may exist. When the resistance is approximately 4.47Ω at normal ambient temperature, the condition is satisfactory.

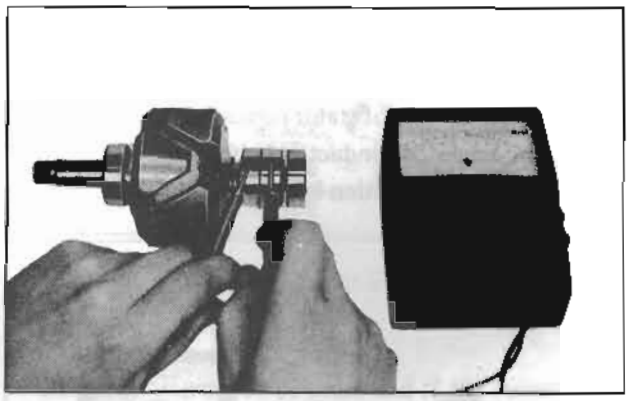


Fig. EE-47 Conduction test of field coil

2. Ground test of field coil

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

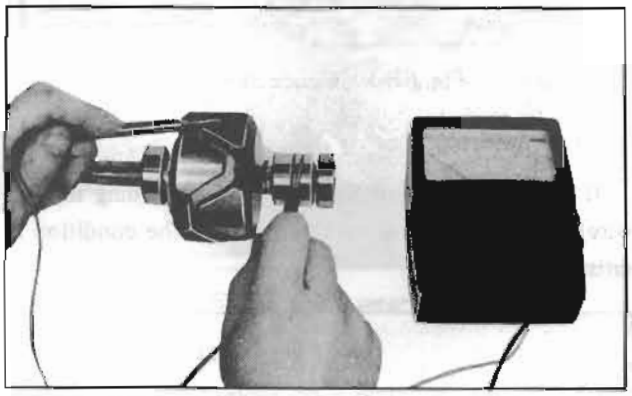


Fig. EE-48 Ground test of field coil

3. Inspection of rotor eccentricity

Check the eccentricity of rotor as shown in Figure EE-49, with a dial gauge.

Repair or replace if the eccentricity is over 0.10 mm (0.0039 in).

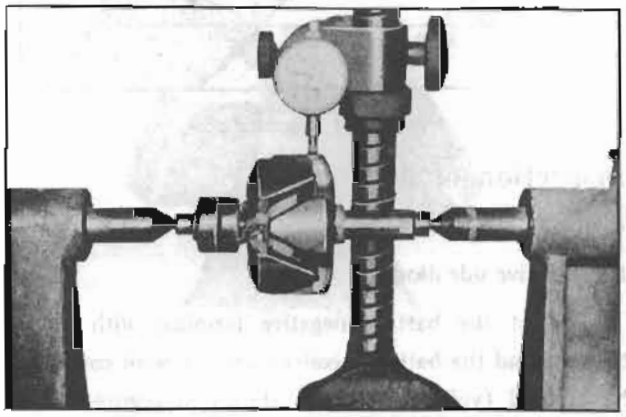


Fig. EE-49 Inspection of rotor eccentricity

Inspection of stator

1. Conduction test

If the neutral wire of stator connected to the lead wire N (yellow color) is conductive with each lead wire of armature coil, the condition is satisfactory.

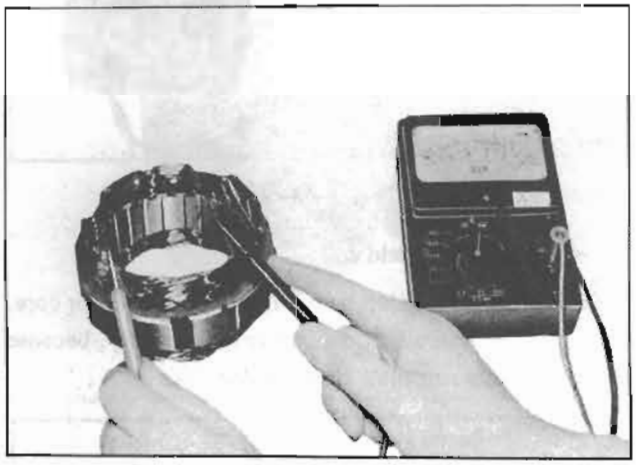


Fig. EE-50 Conduction test

2. Ground test

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

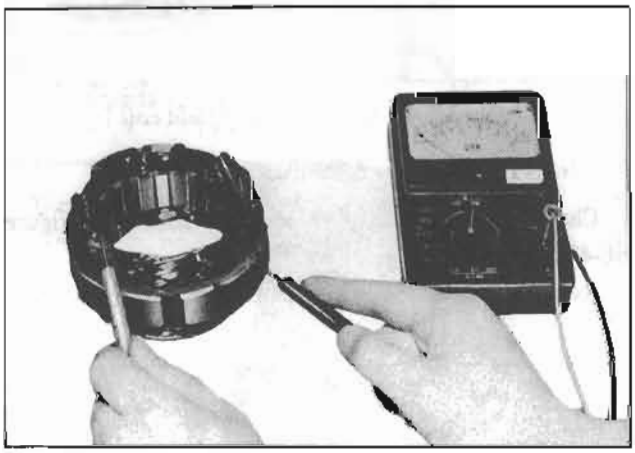


Fig. EE-51 Ground test

Inspection of diode

(Using lamp and battery)

1. Positive side diode

Connect the battery negative terminal with the A terminal and the battery positive terminal with connector N terminal (yellow color) as shown in Figure EE-52. Lamp in the circuit will light.

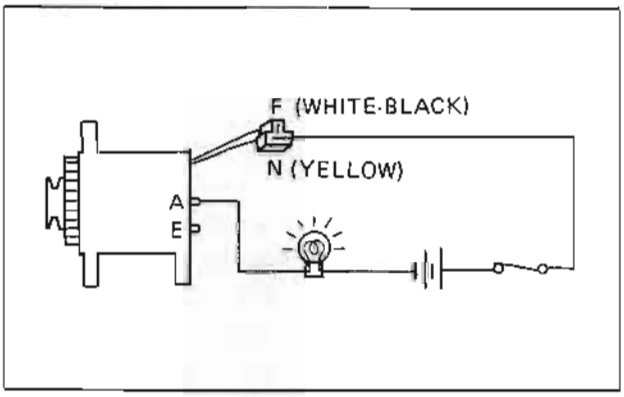


Fig. EE-52 Inspection of positive side diode

If the lamp does not light when the connection is made reversely as shown in Figure EE-53, the positive side diode is satisfactory.

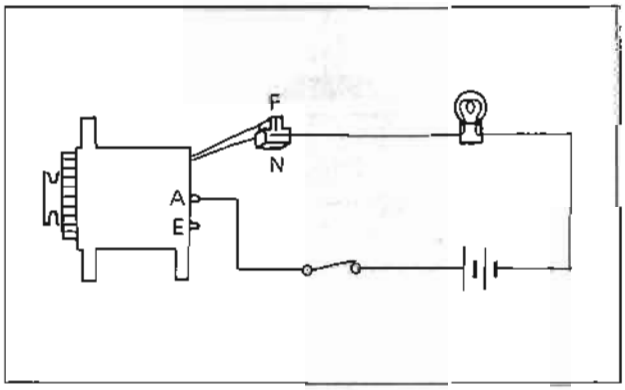


Fig. EE-53 Inspection of positive side diode

2. Negative side diode

Connect the battery negative terminal with connector N terminal (yellow color) and the battery positive terminal with E terminal as shown in Figure EE-54. Lamp in the circuit will light.

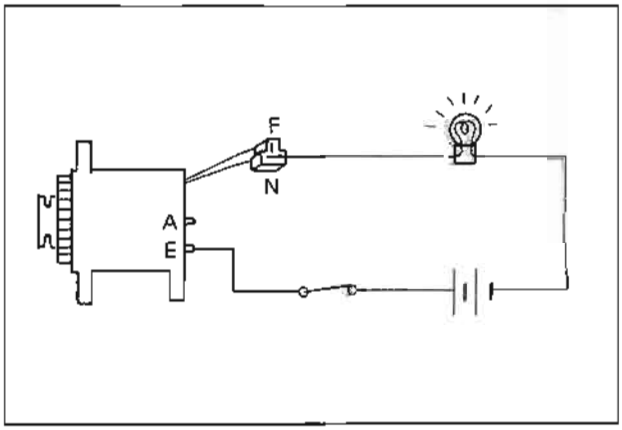


Fig. EE-54 Inspection of negative side diode

If the lamp does not light when the connection is made reversely as shown in Figure EE-55, the negative side diode is satisfactory.

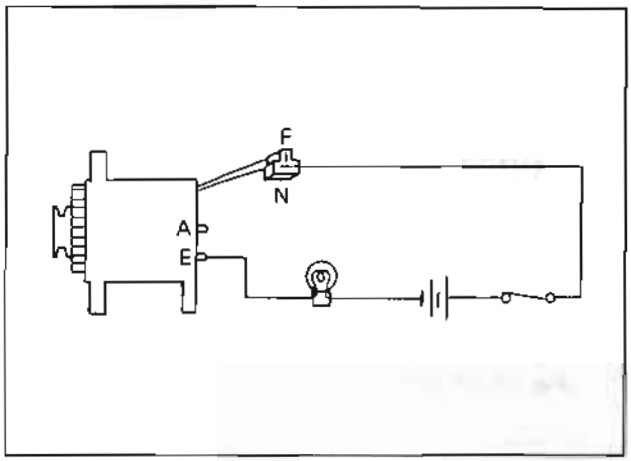


Fig. EE-55 Inspection of negative side diode

Inspection of diode with tester

There are two kinds of diodes as shown in Figure EE-56. Each diode can be discriminated its polarity by the color of the printed figures on each diode as shown below.

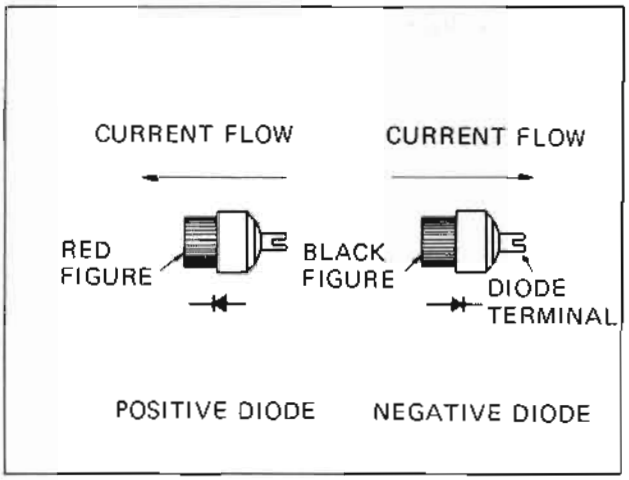


Fig. EE-56 Diode

Check diode resistance, using a tester, in a current flow direction and a reverse direction.

When one side shows low resistance and the other shows high resistance, the diode is satisfactory.

If both sides are low, there will be a short circuit and if both sides are high, there will be a open circuit. In both cases, replace diode.

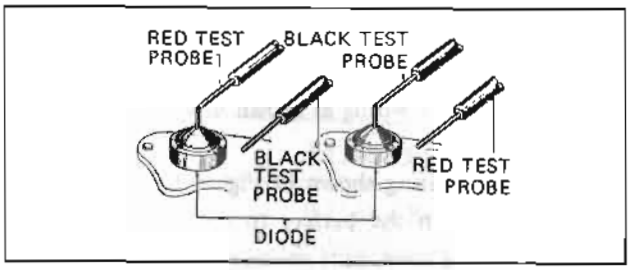


Fig. EE-57 Diode test

Inspection of brush

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

If brush worn more than 7 mm (0.2755 in), replace the brush with new one.

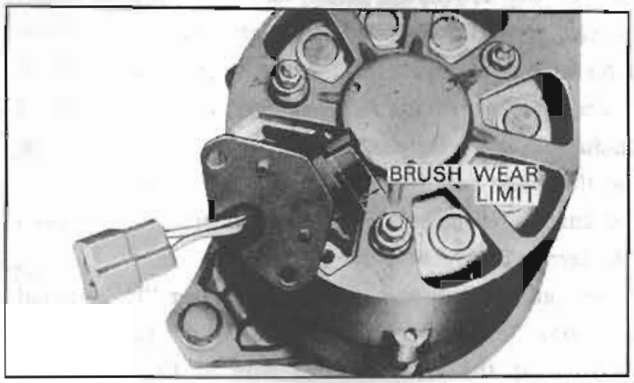


Fig. EE-58 Brush wear limit

Spring pressure test

Place a suitable block on a platform scale and press down brush holder with brush and spring on the block until brush sinks in the holder to 1 mm (0.0394 in) height from the holder. The reading subtracted the block weight shows the spring pressure. The spring pressure should be 0.35 kg (0.77 lb). If the pressure is less than 0.2 kg (0.44 lb), replace it.

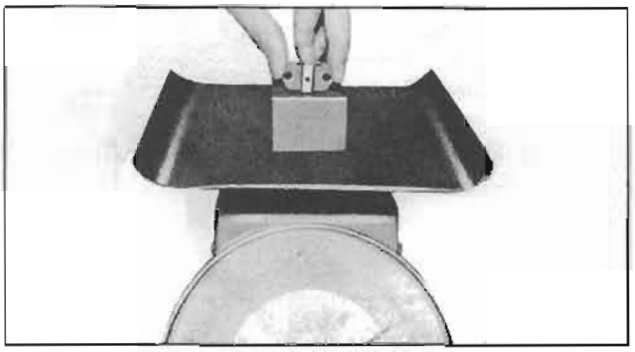


Fig. EE-59 Spring pressure test

Inspection of out put

For output inspection, remove the alternator from the vehicle and connect wiring as shown in Figure EE-60 and drive it with motor.

Through the wiring shown in Figure EE-60 magnetic current flows from the battery to the field coil of the alternator. In this state, raise revolution of the alternator gradually up to the speed where there is no reverse flow (approximately 2A) to the field coil and read the revolution. Correct revolution is approximately 1,000 rpm without load.

Next, increase load resistance to the maximum so as to reduce load current to the minimum, and turn off the switch. Raise the load current slowly to increase revolution of the alternator. Make sure that output current increase as revolution of the alternator increases. If there is no large difference from the specification, it is correct.

Disregarding whether the battery is over-charged or discharged, when the charging current is small, first, check the alternator and the relay for the performance. Inspect the charging current by inserting an ammeter between "A" terminal of relay and the battery.

Disconnect wire between the alternator "F" terminal and relay "F" terminal at the relay "F" terminal and short-circuit the removed lead wire at the relay "A" terminal. If the charging current highly increases, the relay is in disorder.

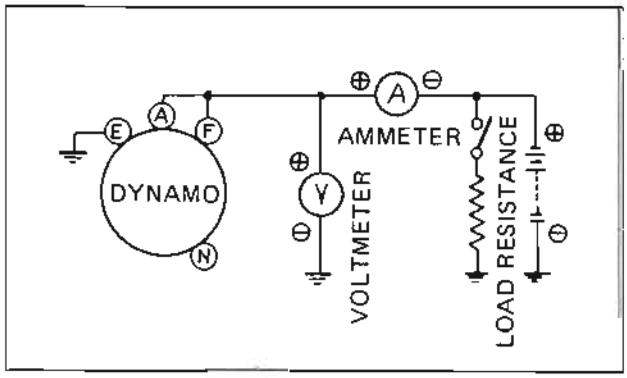


Fig. EE-60 Circuit for the output inspection

Note: Use the battery charged in full up to the normal capacity.

REASSEMBLY

Assemble the generator in reverse sequence of disassembly. Always make sure that the polarity of alternator diode is aligned correctly. Refer to Figure EE-60 Diode.

SPECIFICATIONS AND SERVICE DATA

Specifications

Engine to which applicable	L24	L20A
Make and Type	HITACHI LT145-35	HITACHI LT140-53
Nominal output	12V - 45A	12V - 40A
Pole	Negative ground	Negative ground
Revolution	10,000 to 13,500 rpm	10,000 to 13,500 rpm
No-load minimum revolution	Less than 1,000 rpm	Less than 1,000 rpm
Output current	More than 34A (14V 2,500 rpm) More than 45A (14V 5,000 rpm)	More than 30A (14V 2,500 rpm) More than 40A (14V 5,000 rpm)
Weight	5.1 kg (11.2 lb)	5.0 kg (11.0 lb)
Applied regulator	TL1Z-37	TL1Z-37

Service data

Type	LT145-35	LT140-53
Stator coil resistance per phase	0.09 Ω [20°C (68°F)]	0.11 Ω [20°C (68°F)]
Rotor coil resistance	4.1 Ω	4.1 Ω
Standard brush spring pressure	0.3 kg (0.7 lb)	0.3 kg (0.7 lb)
Standard brush height	14.5 mm (0.571 in)	14.5 mm (0.571 in)
Wear limit of brush	7 mm (0.276 in)	7 mm (0.276 in)
Standard front shaft size	15 mm dia. (0.591 in dia.)	15 mm dia. (0.591 in dia.)
Standard rear shaft size	12 mm dia. (0.472 in dia.)	12 mm dia. (0.472 in dia.)

REGULATOR

CONTENTS

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MEASUREMENT OF REGULATING VOLTAGE EE-22
ADJUSTMENT EE-23
Voltage regulator EE-23
Charge relay EE-24
Precautions for adjustment EE-25
SPECIFICATIONS AND SERVICE DATA EE-25
TROUBLE DIAGNOSES AND CORRECTIONS EE-26

DESCRIPTION

The regulator, consisting of a voltage regulator and charge relay, features;

(1) Compact and light

(2) Adjustment can be made easily because adjust screw is used for voltage adjustment.

(3) Installation of the stationary contact is improved and gap adjustment is thereby eased.

(4) The coil is secured on the base by means of caulking, the yoke and armature are installed by means of welding, and thus, the construction has been simplified.

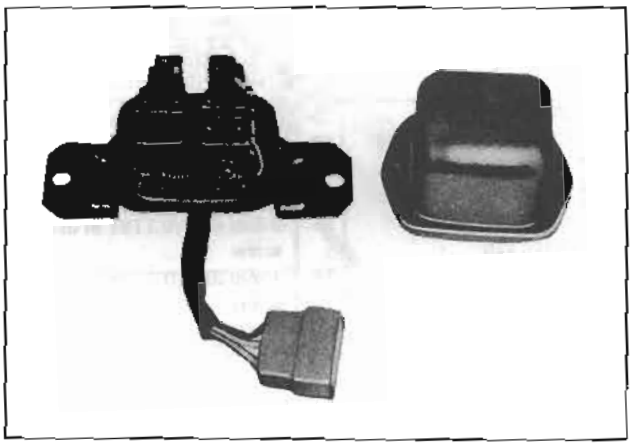
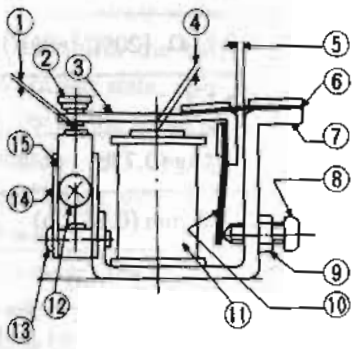


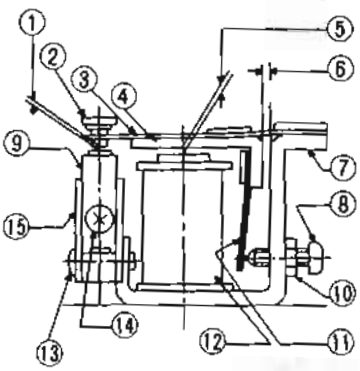
Fig. EE-61 Remove the cover view

As for the construction, the voltage regulator is very similar to the charge relay as shown in Figure EE-62.



1	Point gap	10	Adjust spring
2	Lower contact	11	Coil
3	Aramture	12	3 mm dia. (0.1181 in dia.) screw
4	Core gap		
5	Yoke gap	13	4 mm dia. (0.1575 in dia.) screw
6	Connecting spring		
7	Yoke	14	Contact set
8	Adjusting screw	15	Upper contact
9	Lock nut		

(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	3 mm dia. (0.1181 in dia.) screw
6	Yoke gap		
7	Yoke	14	4 mm dia. (0.1575 in dia.) screw
8	Adjusting screw		
		15	Contact set

(b) Construction of charge relay

Fig. EE-62 Structural view

MEASUREMENT OF REGULATING VOLTAGE

Regulating voltage is measured with the regulator combined with the specified generator. Theoretical measurement differs from that made actually on the vehicle. The methods are described as follows:

1. Theoretical method

Prepare a DC voltmeter, DC ammeter, techometer, battery, and resistor (0.25 Ω), and form a circuit as shown in Figure EE-63.

(1) Operate the generator under the rated speed (5,000 rpm).

(2) Read the indication on the voltmeter. The pointer indicates the regulating voltage.

(3) At the same time, make sure that the current is less than 5 amperes.

Note: Be sure to measure regulating voltage when the generator speed has reached the rated speed. The rated voltage (regulating voltage) varies depending on the ambient temperature. When measuring voltage, measure ambient temperature and calibrate appropriately.

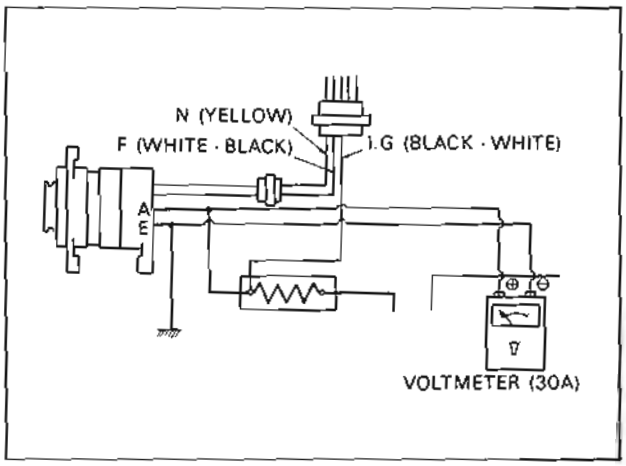


Fig. EE-63 Theoretical regulating voltage measuring circuits

2. Measuring regulating voltage of regulator mounted on a vehicle

(1) Use the same equipment as for the theoretical method, and connect them as shown in Figure EE-64. Install the regulator perpendicularly by facing the connector downward in this case, also.

(2) Make sure that all electrical loads (such as head lamps, air conditioner, radio, etc.) on the vehicle have been interrupted.

(3) Before starting the operation, be sure to short-circuit the line between fuse side terminal of the resistor for voltage measurement and (−) terminal of the ammeter. Pointer of the ammeter may deflect rapidly and reversely due to discharge current flowing from the battery resulting damaged ammeter. (See Figure EE-64.)

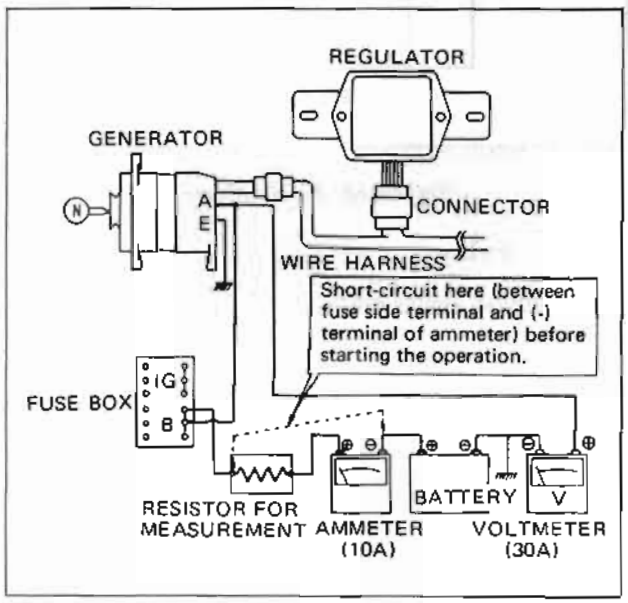


Fig. EE-64 Regulating voltage measuring circuit with regulator mounted on the vehicles

(4) Raise the engine speed gradually, and measure voltage when the engine speed reaches the rated level. The measured voltage is the regulating voltage when the regulator is mounted on the vehicle.

Note: **a. Do not race the engine when starting but operate under idling speed.**

b. Raise the engine speed gradually from idling to the rated normal speed, and measure voltage.

c. When two to three minutes are elapsed after starting the regulator operation, voltage rises approximately 0.3V from the normal voltage due to the self-heating. Thus, be sure to measure voltage within one minute after starting the operation. When measurement cannot be made within one minute, cease the operation once and measure again after cooling the regulator.

ADJUSTMENT

Voltage regulator

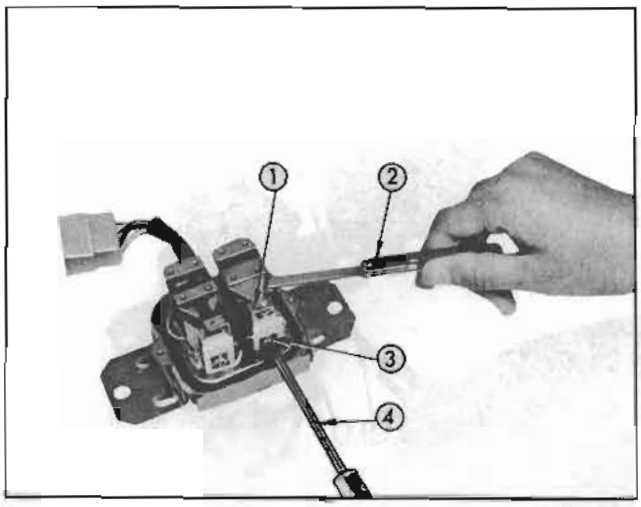
As the result of above measurement, when the regulating voltage is deviated from the rated value, adjust the regulator in accordance with the following instructions.

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

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

3. Adjusting core gap

Loosen the screw [4 mm diameter (0.1575 in diameter)] which is used to secure the contact set on the yoke, and move the contact upward or downward properly. (See Figure EE-65.)

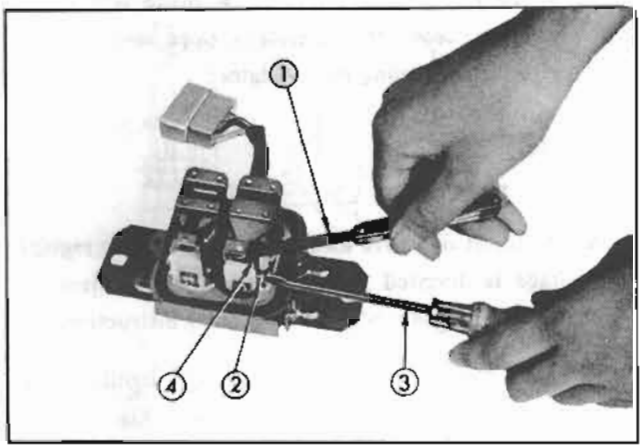


1	Contact set	3	4 mm dia. (0.1575 in dia.) screw
2	Thickness gauge	4	Cross-head screwdriver

Fig. EE-65 Adjusting core gap

4. Adjusting point gap

Loosen the screw [3 mm diameter (0.1181 in diameter)] used to secure the u per contact, and move the upper contact upward or downward adequately. (See Figure EE-66.)

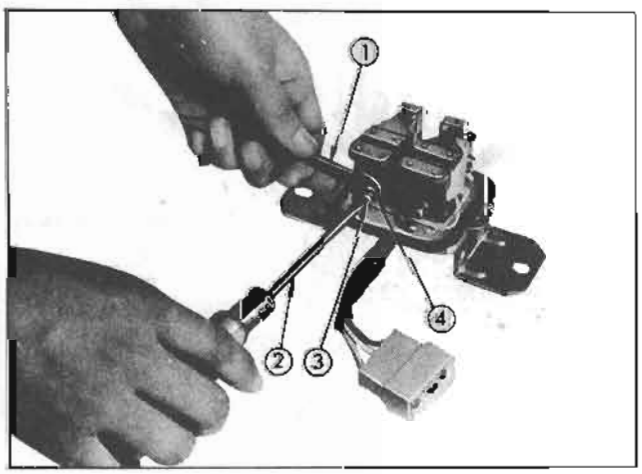


1	Thickness gauge	3	Cross-head screwdriver
2	3 mm dia. (0.1181 in dia.) screw	4	Upper contact

Fig. EE-66 Adjusting point gap

5. Adjusting voltage

Adjust regulating voltage with the adjusting screw. When increasing voltage, loosen the lock nut (used to secure the adjusting screw) and screw the adjusting screw. When decreasing, unscrew the adjusting screw. (See Figure EE-67.)



1	Spanner	3	Adjusting screw
2	Cross-head screwdriver	4	Lock nut

Fig. EE-67 Adjusting regulating voltage

Note: Upon completion of the regulating voltage adjustment, retighten the lock nut and securely set the adjusting screw stationarily.

Under the normal (satisfactory) condition, difference between the lower contact operating voltage and upper contact operating voltage rises 0 to approximately 0.5V as shown in Figure EE-68.

Reduce the core gap when the difference exceeds 0.5V, and increase when the difference is less than 0V.

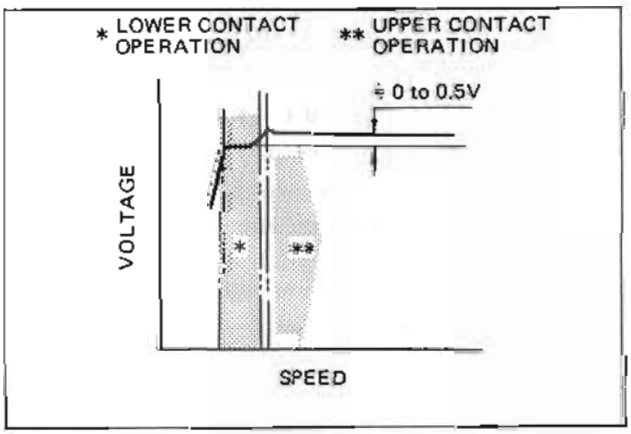


Fig. EE-68 Jump voltage

Charge relay

The normal charge relay operating voltage is 8 to 10V at the generator "A" terminal. However, it operates at 4 to 5V because one half of the "A" terminal voltage ("N" terminal voltage) is applied to the charge relay voltage coil.

It is difficult to measure this operating voltage with the regulator mounted on the vehicle.

Prepare a battery, voltmeter and variable resistor, and measure operating voltage after dismounting the regulator. Figure EE-69 shows the measuring circuit.

Set the variable resistor to "MAX" position, apply current (turn on the switch), and reduce resistance gradually. When resistance is reduced to a certain level, the charge lamp goes out. This level indicates the charge relay operating voltage.

Set the variable resistor to "MAX" position, apply current (turn on the switch), and reduce resistance gradually. When resistance is reduced to a certain level, the charge lamp goes out. This level indicates the charge relay operating voltage. The rated value is 4 to 5 volts. When deviated, readjust. The adjustment is carried out in the same manner as the voltage regulator.

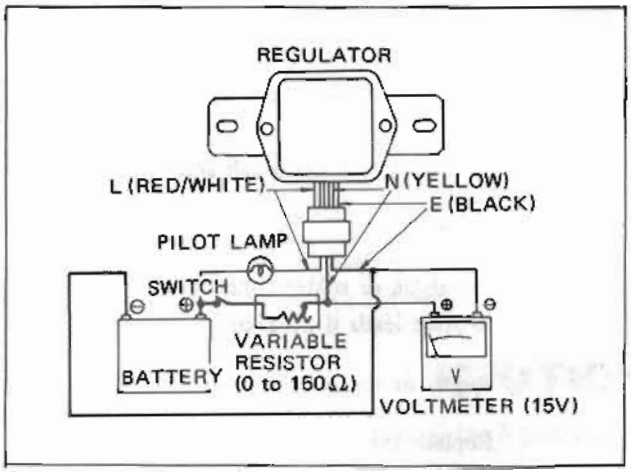


Fig. EE-69 Charge relay operating voltage measuring circuit

Precautions for adjustment

1. Upon completion of the adjustment, reinstall the cover and make sure that the regulator operates correctly.

2. When the cover is removed or adjusting screw is adjusted while adjusting voltage, be sure to disconnect the regulator once, and reconnect when measuring actually. The battery circuit may be short-circuited.

SPECIFICATIONS AND SERVICE DATA

Voltage regulator

Model	TL1Z-37
Regulating voltage (with fully charged battery and connected faced downward)	* 14.3 to 15.3 V [at 20°C (68°F)]
Voltage coil resistance	10.5 Ω [at 20°C (68°F)]
Rotor coil inserting resistance	10 Ω
Voltage coil series resistance	25 Ω
Smoothing resistance	40 Ω
Core gap	0.6 to 1.0 mm (0.0236 to 0.0394 in)
Point gap	0.3 to 0.4 mm (0.0118 to 0.0157 in)

Charge relay

Release voltage	8 to 10 V at "A" terminal
Voltage coil resistance	37.8 Ω [at 20°C (68°F)]
Core gap	0.8 to 1.0 mm (0.0315 to 0.0394 in)
Point gap	0.4 to 0.6 mm (0.0157 to 0.0236 in)

*Standard temperature gradient: -0.015 V/°C

TROUBLE DIAGNOSES AND CORRECTIONS

Troubles	Possible causes	Corrective action
No output	Sticking brushes	Correct or replace brush and brush spring.
	Dirty brushes and slip rings	Clean.
	Loose connections or broken leads	Retighten or solder connection. Replace leads if necessary.
	Open stator winding	Repair or replace the stator.
	Open rotor winding	Replace the rotor.
	Open diodes	Replace the diodes.
	Shorted rotor	Replace the rotor.
	Shorted stator	Repair or replace the stator.
	Grounded "BAT" terminal	Replace the insulator.
	Broken fan belt	Replace the belt.
Excessive output	Broken neutral wire (color of wire is white.)	Replace the wire.
	Defective voltage regulator	Check the regulator operation and repair or replace as required.
	Poor grounding of the alternator and voltage regulator "E" terminal	Retighten the terminal connection.
	Broken ground wire (color of wire is black.)	Replace the wire.
Low output	Loose or worn fan belt	Retighten or replace the belt.
	Sticking brushes	Correct or replae brushes and spring if necessary.
	Low brush spring tension	Replace the brush spring.
	Defective voltage regulator	Check the regulator operation and repair or replace as required.
	Dirty slip rings	Clean.
	Partial short, ground, or open in stator winding	Replace the stator.
	Partially shorted or grounded rotor winding	Replace the rotor.

	Open or defective diode	Replace the diode
Noisy alternator	Loose mounting	Retighten the mounting bolts.
	Loose drive pulley	Retighten the pulley correctly.
	Defective ball bearing	Replace the bearing.
	Improperly seated brushes	Seat brushes correctly.

IGNITION CIRCUIT

The ignition circuit includes the distributor, ignition coil, ignition switch, spark plugs, high tension cable and the battery.

DISTRIBUTOR

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Distributor model	Applied engine
D612-52	L24 (with Emission Control)
D606-52	L24 (with Single and Twin carb.) L20A (Premium Gas)
D609-56	L20A (Regular Gas)

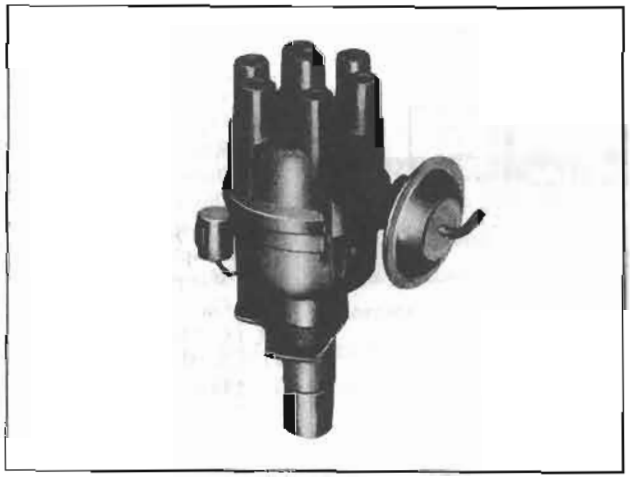


Fig. EE-70 D612-52

CONSTRUCTION AND OPERATION

Figure EE-71 shows ignition system of gasoline engine. The distributor consists of high tension voltage part, switch off part, centrifugal advancing angle part, vacuum advance mechanical part and driving part.

Figure EE-72 shows the construction.

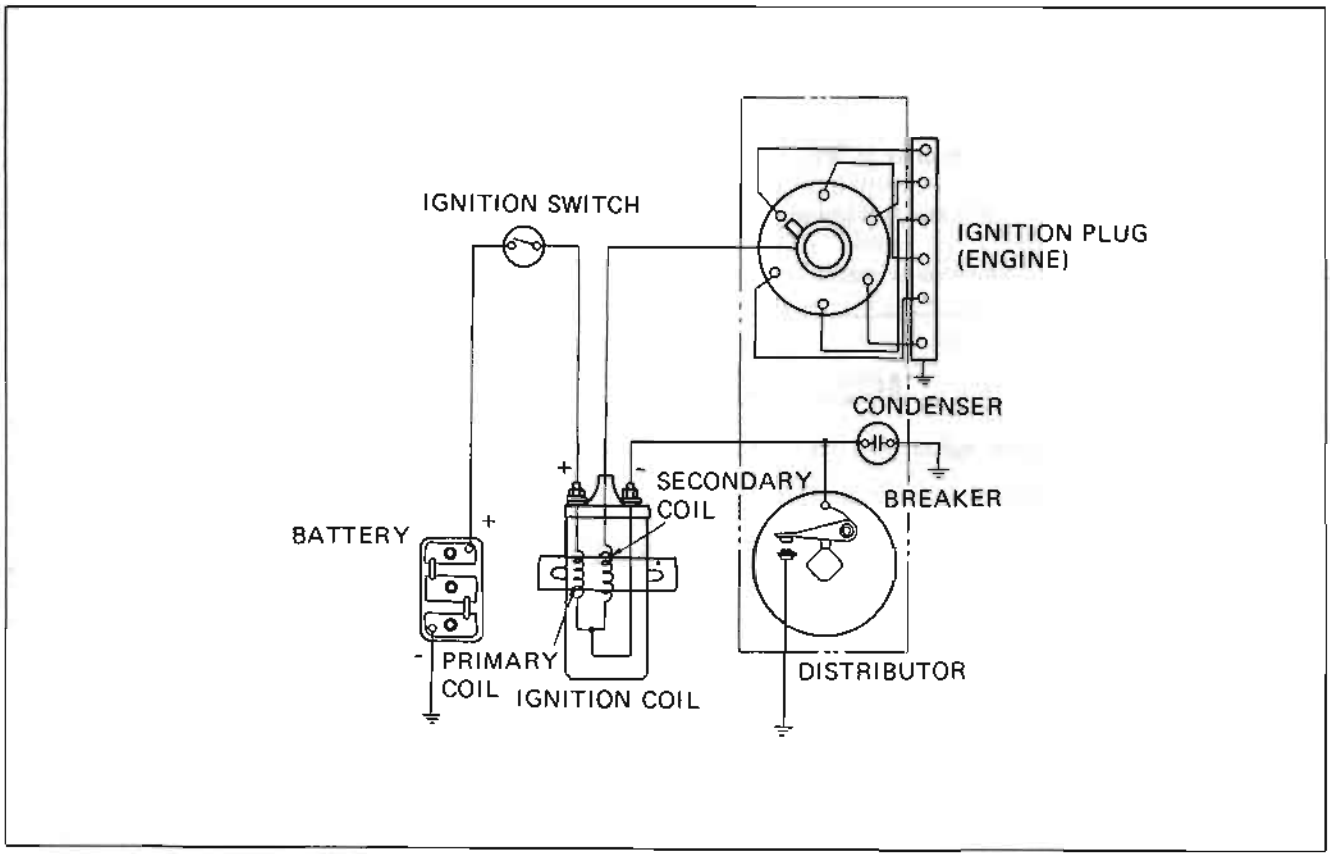
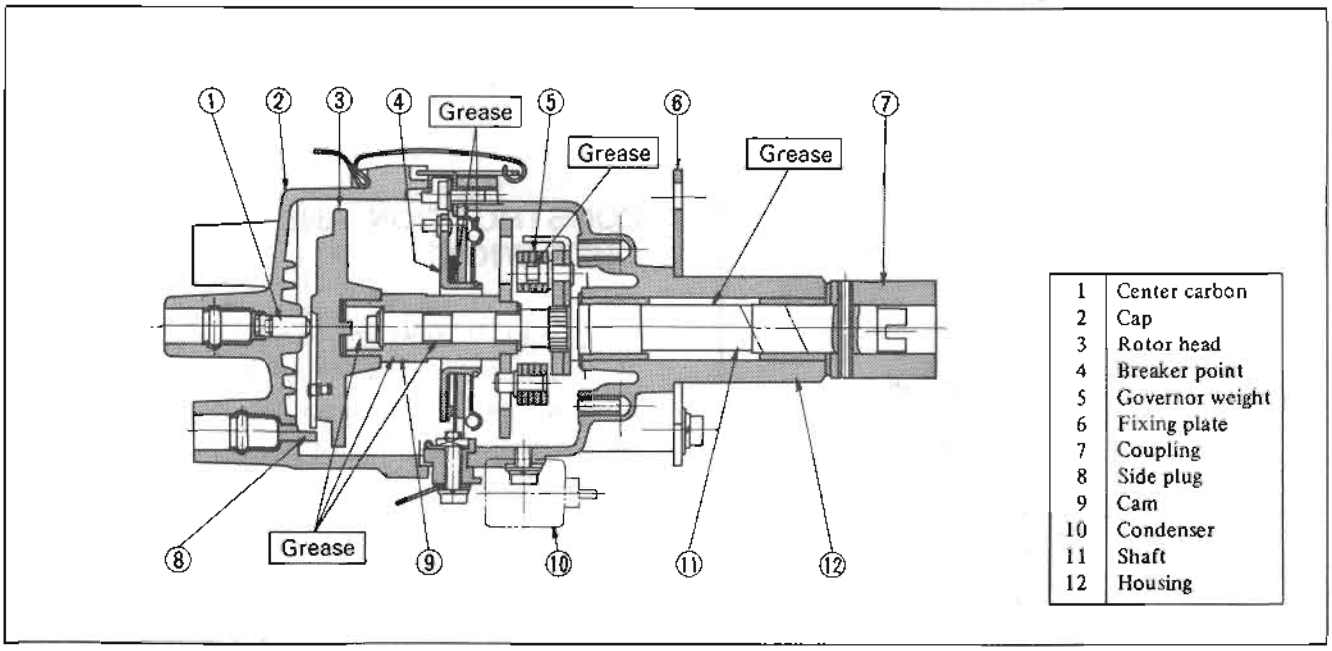


Fig. EE-71 Ignition system circuit diagram



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-72 Structure

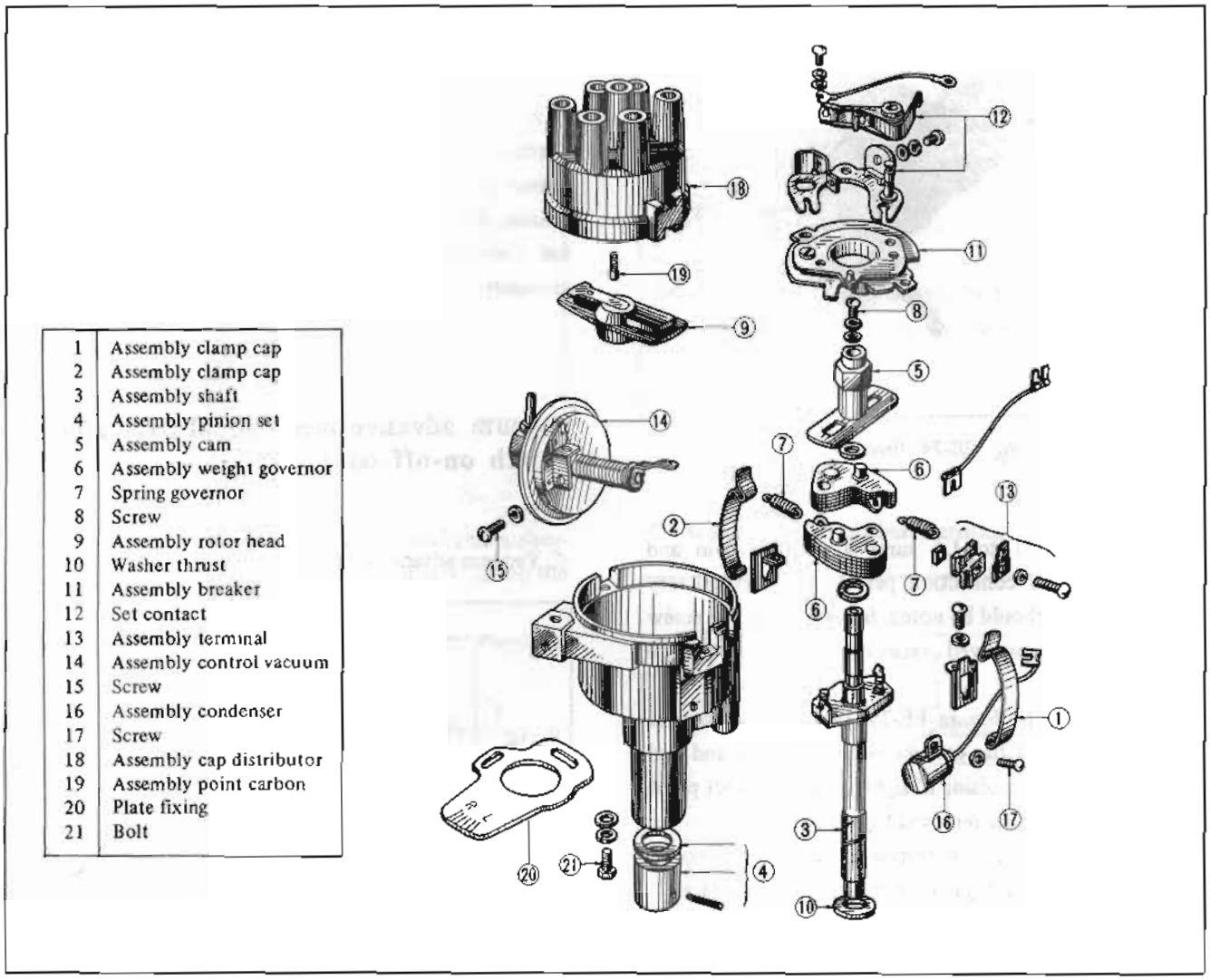


Fig. EE-73 Components of distributor

CHECKING AND ADJUSTMENT

Cap and rotor head

Cap and rotor head must always be kept clean to maintain good insulation durability since high tension voltage from ignition coil is imposed on them. Sometimes, inside of the cap and rotor head is covered with fine carbon particles and dust. Cleaning with gasoline is required once a month. Whenever crack or trace of leakage is found on the cap, replace with a new one.

Point

Standard point gap is 0.45 to 0.55 mm (0.0177 to 0.0217 in). When the gap is off the standard, adjust by loosening point screws. Gap gauge is required for adjustment. However, without gap gauge, it may be adjusted by holding down the contact arm the stopper of which is 0.5 mm (0.0197 in) thick.

As for those with tungsten point, point gap must be checked at every 4,000 km (2,500 miles) run.

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

At this time, grease both arm pivot receiver and surface of cam. When point is worn remarkablly, replace with a new one. At the same time, replace the contact arm and contact point, also. Details for replacement are described in the forthcoming sub section.

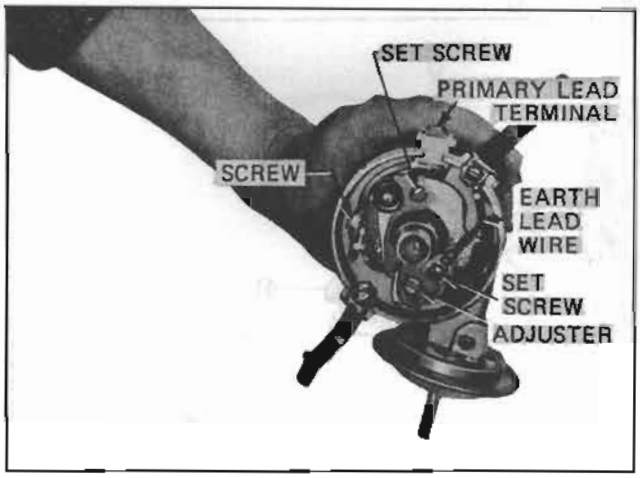


Fig. EE-74 Breaker

First unscrew 1 to 1.5 turns at contact arm and primary lead wire connection part to pull out primary lead terminal. It should be noted, however, that the screw should not be unscrewed excessively. Refer to Figure EE-75.

As shown in the Figure EE-75, take off the stopper from stem bar, hold the contact point by fingers and pull it out toward you by raising it slightly. Both contact point and contact arm can be removed together.

Set new contact set in reverse sequence of removal. Slightly grease both arm pivot receiver and cam surface.

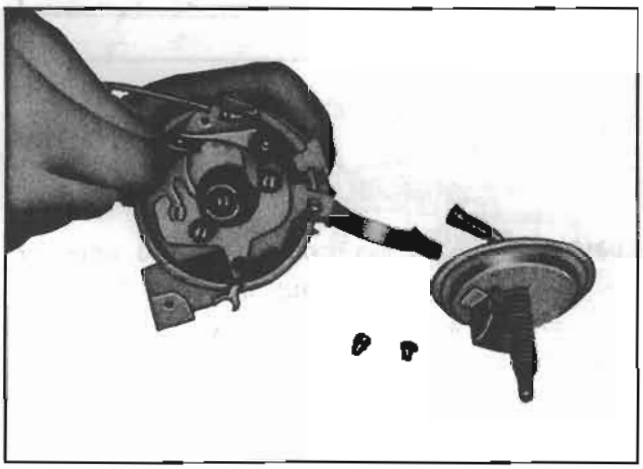


Fig. EE-75 Disassembling the contact arm and contact point

Condenser

Performance of condenser depends on the setting and insulating condition. Thus, periodical checking is required to maintain the outlet of lead wire clean and to prevent set screw from loosening. Checking the condenser is checked by the use of a capacity meter. It may be also checked by the use of a tester by adjusting its range to measure large resistance value. When the condenser is normal, the tester pointer swings largely and rapidly, and moves gradually back to the infinite side. When the pointer does not stay still or it points Zero in resistance, the transformer is out of order, and replacement is necessary.

Vacuum advance mechanical part and switch on-off part

≪ Vacuum advance characteristic ≫

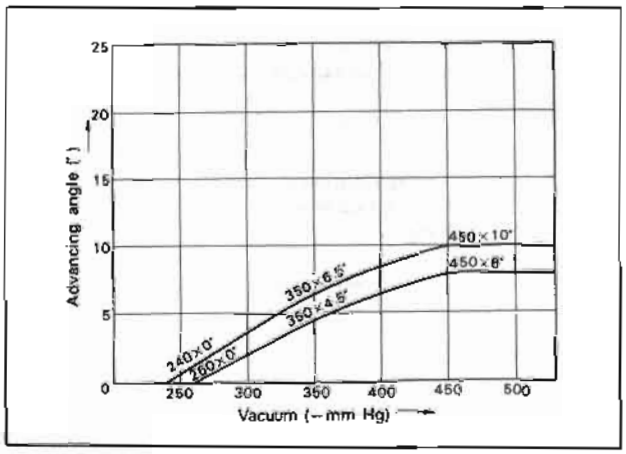


Fig. EE-76 D612-52

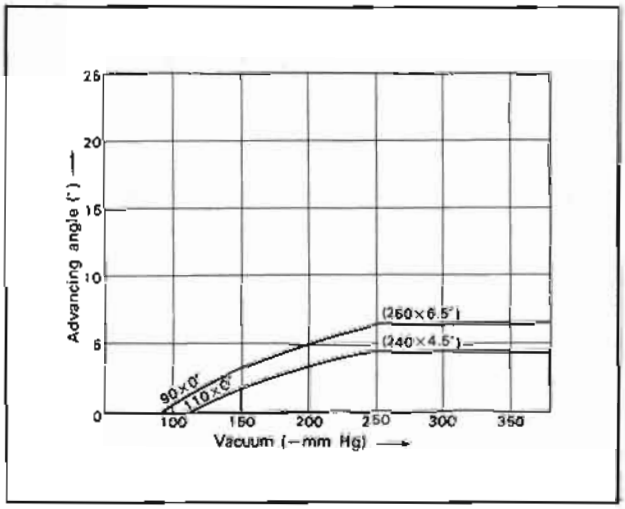


Fig. EE-77 D606-52

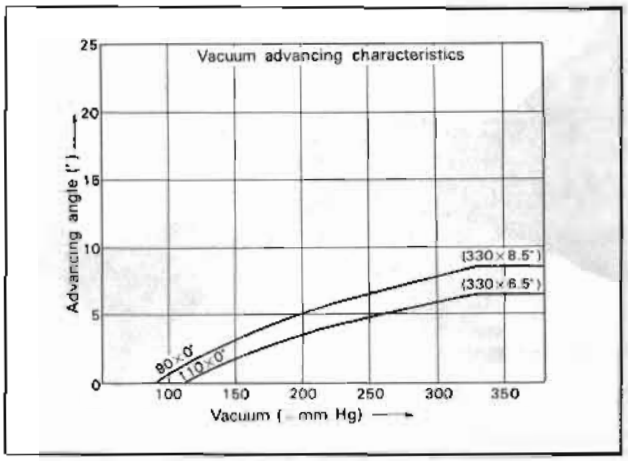


Fig. EE-78 D609-56

Make sure that the vacuum advance mechanism operates correctly with the operation indicator attached to the vacuum advance mechanism.

The following causes are considered for improper operation.

1. Leakage of air due to incomplete fastening of vacuum inlet

2. Leakage due to defective diaphragm

3. Stationary side and moving side of the breaker plate are sticked.

Solution for 1. is to make complete fastening and 2. is to replace it with a new one. Solution for 3. is as follows:

(1) The moving side of the breaker plate is supported by three steel balls at upper and lower sides.
Make sure that these balls work smoothly.

(2) The moving side of the breaker plate is rotated with the stationary side pivot receiver.
Make sure that this pivot receiver operates correctly
When assemblin, be sure to apply three steel balls to the upper and lower sides and to grease them.

Centrifugal advance mechanical part

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

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

Do not disassemble it. When characteristics are improper, remove the switch on-off part and check cam assembly, governor weight, shaft and governor spring, and other relative parts carefully.

When reassembling the centrifugal advance mechanical part, be sure to check advance characteristics by the use of a distributor tester.

≪ Centrifugal advance characteristics ≫

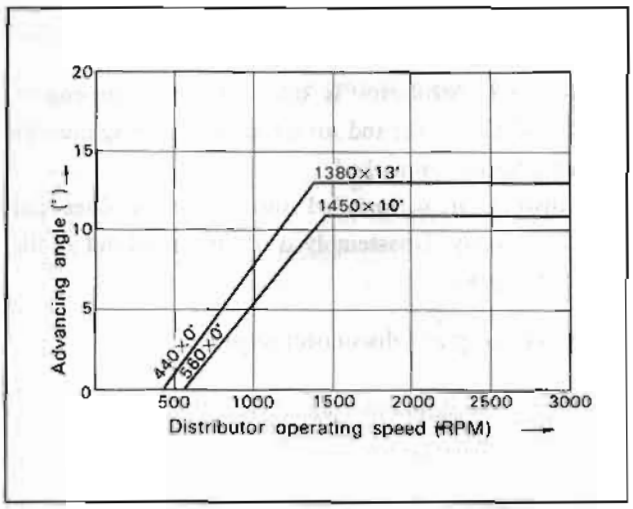


Fig. EE-79 D612-52

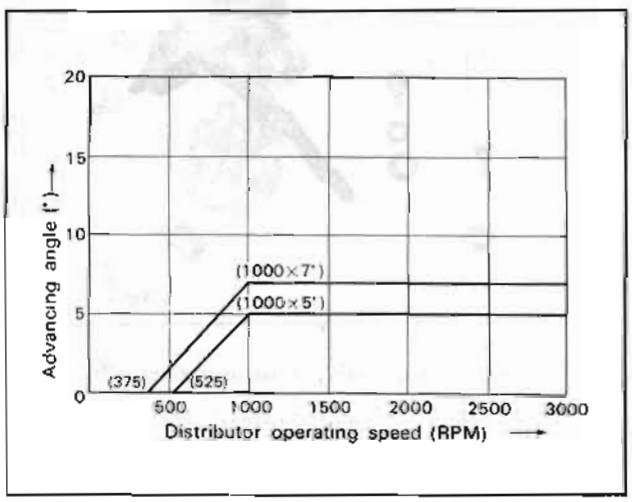


Fig. EE-80 D606-52

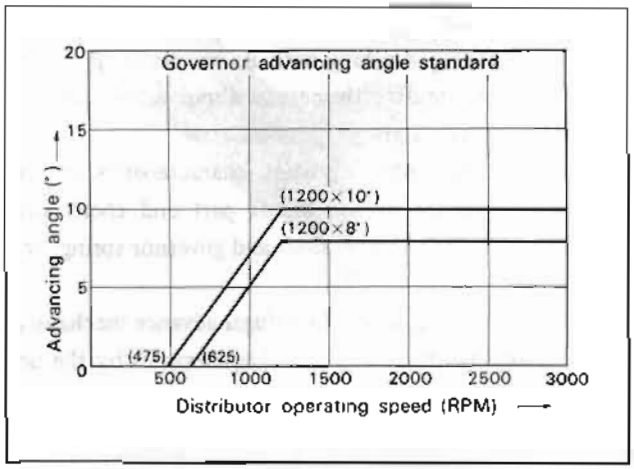


Fig. EE-81 D609-56

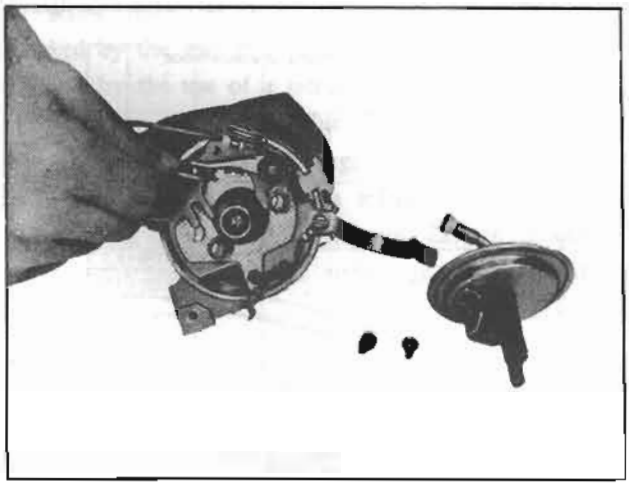


Fig. EE-83 Removal of contact set

DISASSEMBLY AND REASSEMBLY

Disassembly

When the distributor is disconnected from engine, position of distributor and rotor head for housing must be well remembered or marked.

If distributor is installed incorrectly, it does not operate correctly. Disassembly is to be carried out in the following sequence.

1. Remove cap and disconnect rotor head.

2. Remove vacuum controller.

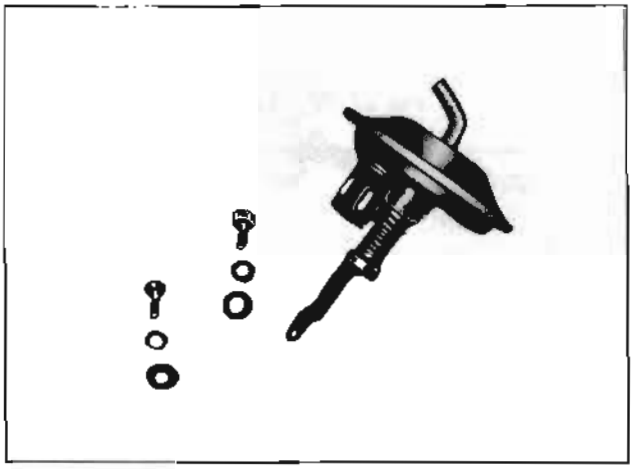


Fig. EE-82 Disassembly of vacuum controller

3. Remove contact breaker.

Refer to page EE-34 when disconnecting the contact set.

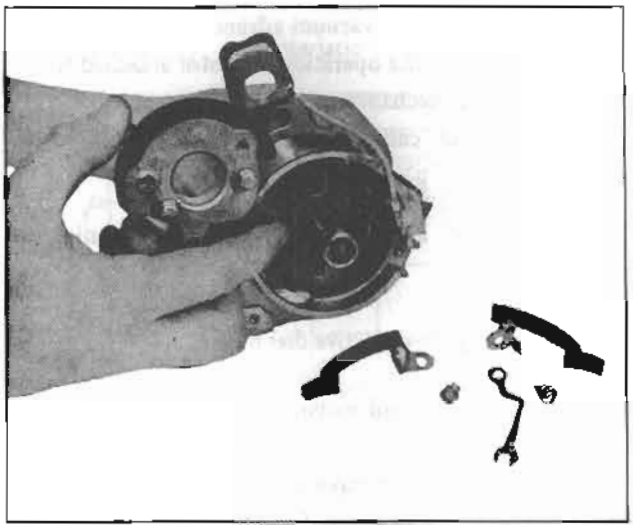


Fig. EE-84 Removal of contact breaker

4. When contact breaker is disassembled, remove the clip to disconnect breaker plate (fixed) by depressing the moving breaker plate downward.

Be careful not to lose steel balls applied between breaker spring and breaker plate as well as those between breaker plates.

5. Pull the knock pin and disconnect the gear to remove the whole rotary unit. However, before removing, put counter marks on the gear and shaft or remember the relationship between the coupling and setting groove of the cam rotor head.

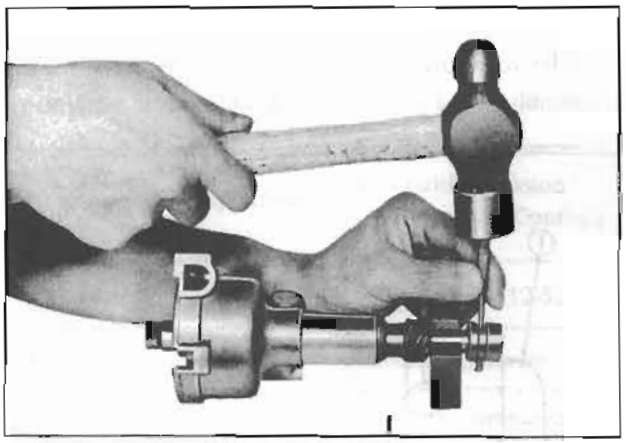


Fig. EE-85 Removal of knock pin

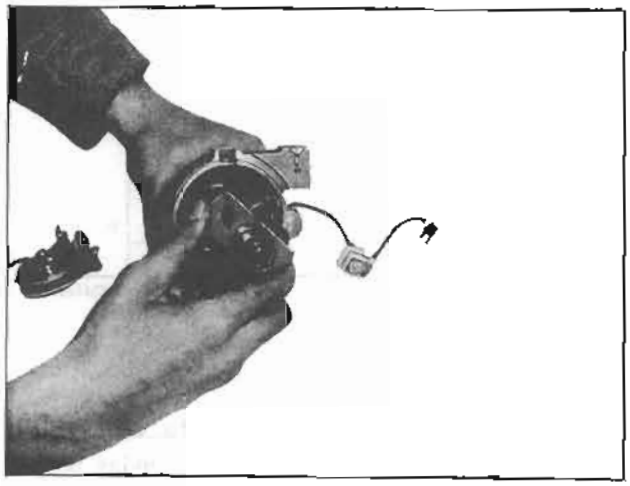


Fig. EE-86 Removal of rotation part

6. When the cam is disconnected, remove the set screw first, since the shaft head is fastened by the screw to hold the cam down. Be sure to put counter marks on the cam and shaft or remember the relationship with ignition timing.

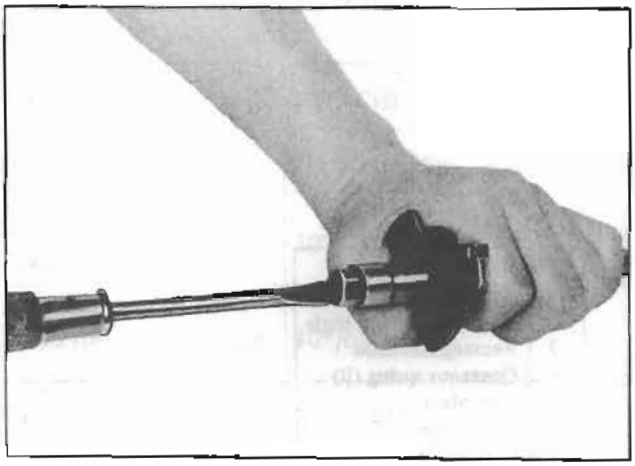


Fig. EE-87 Removal of cam

7. When disconnecting the governor spring from the governor weight, be careful not to stretch or deform the governor spring. When disassembly is completed, apply grease to the weight pivot.

8. Figure EE-90 shows the exploded view.

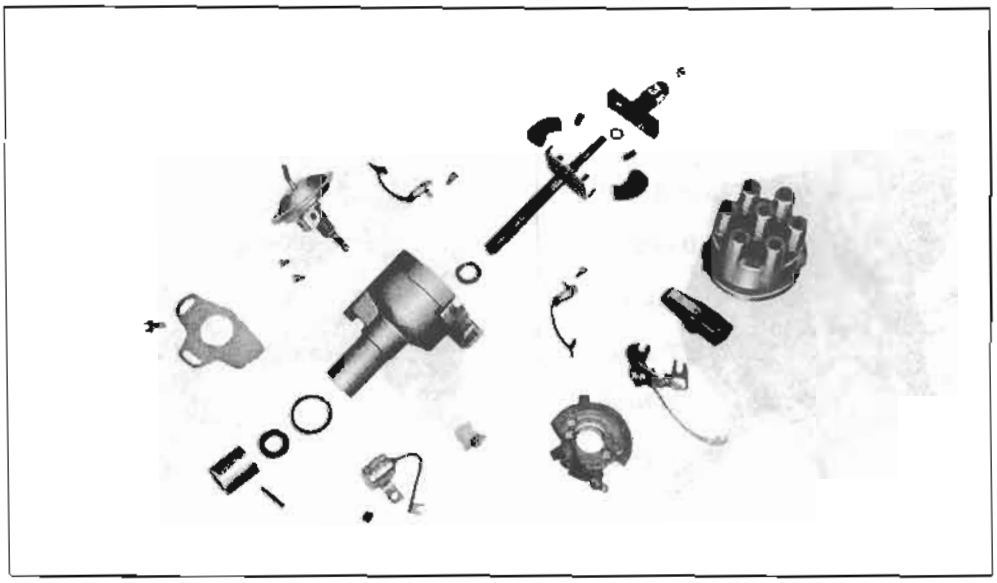


Fig. EE-88 Exploded view (D410-58, D409-54)

Reassembly

The distributor is reassembled in reverse sequence of disassembly.

Refer to Figure EE-91 at the time of replacement and reassembly of the governor spring and cam.

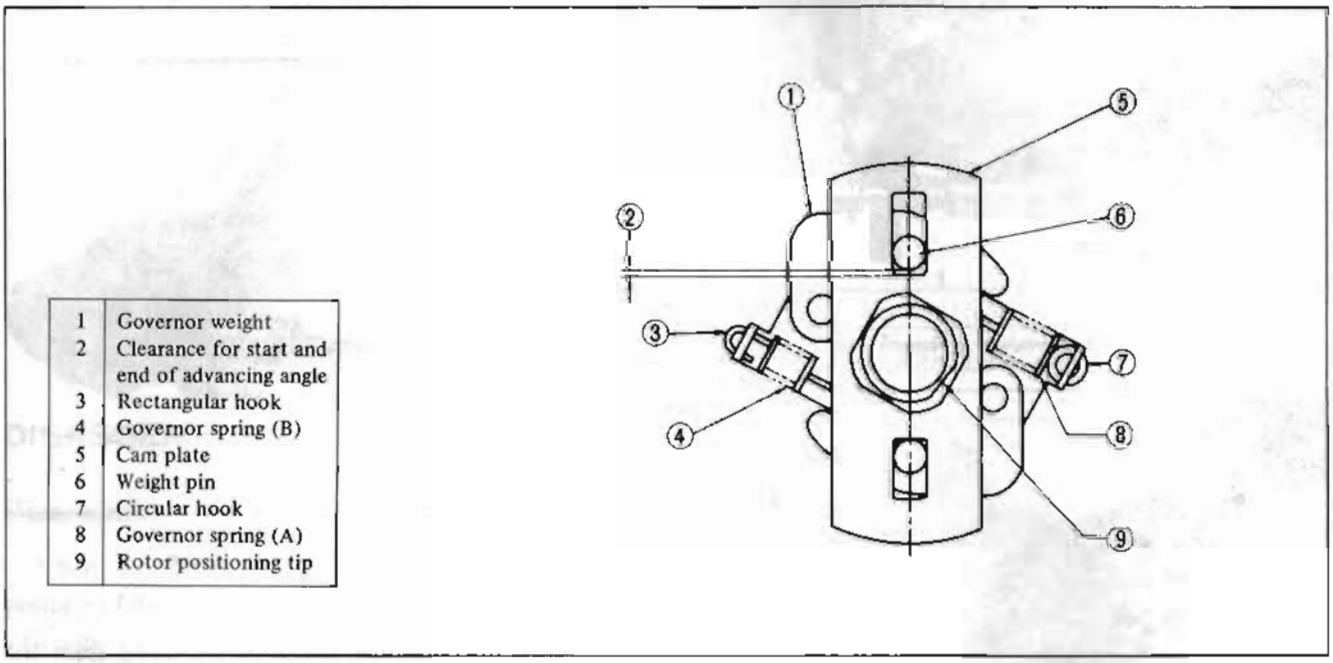


Fig. EE-89 Setting of governor spring and cam

At the time of assembly, rotor head positioning tip at cam is to be set to governor spring circular hook side. Then weight pin for governor spring (A) with circular hook comes in long rectangular hole. It leaves clearance at the start and end of advancing. Meanwhile, weight pin on opposite side comes in short rectangular hole. It does not leave clearance either at the start and end of advancing.

When assembly is completed, set it to engine after checking advance characteristic and confirming performance. Be sure to make adjustment of ignition timing after this.

Adjustment must be made to let off the distributor point at degree position of upper dead point of first cylinder compression of engine.

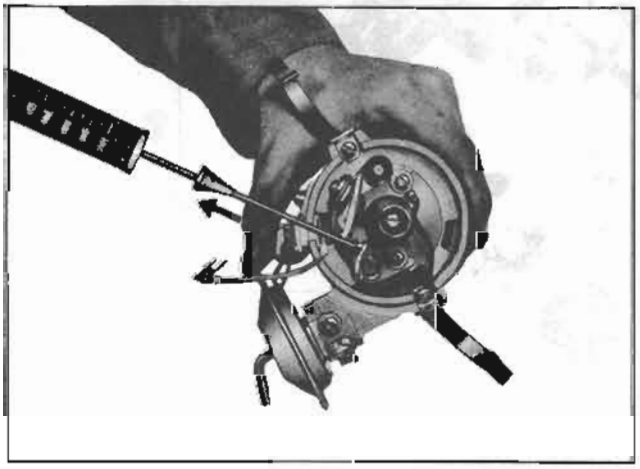


Fig. EE-90 Point pressure test

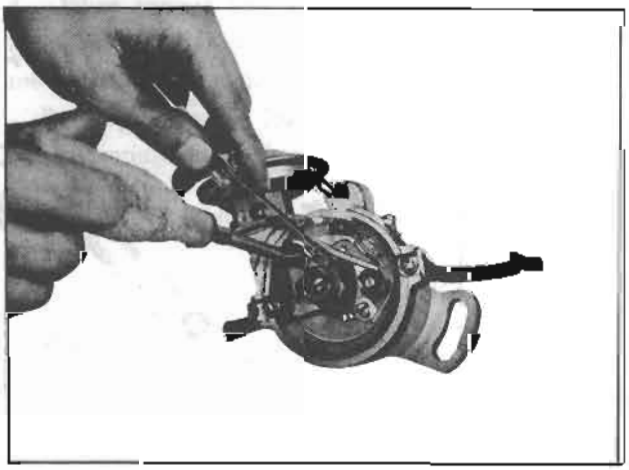


Fig. EE-91 Point gap measure

SPECIFICATIONS AND SERVICE DATA

Specifications

Engine to which applicable			L24 (with Emission Control)	L24 (with Single and Twin carb.) L20A (Premium Gas)		L20A (Regular Gas)
Make and type			HITACHI D612-52	HITACHI D606-52		HITACHI D609-56
Firing order			Counterclockwise	Counterclockwise		Counterclockwise
Ignition timing (B.T.D.C.)	Manual T/M		5°/750 rpm	L24 Twin 17°/650 rpm	L24 Single L20A 17° 550 rpm	10°/550 rpm
	Automatic T/M (at "N" range)			17°/700 rpm	17°650 rpm	10°/650 rpm
Dwell angle			35° to 41°	35° to 41°		35° to 41°
Advance characteristics	Centrifugal	Start	500 rpm	450 rpm		550 rpm
		Maximum	12°/1,415 rpm	6°/1,000 rpm		9°/1,200 rpm
	Vacuum	Start	250 mm/Hg (9.84 in/Hg)	100 mm/Hg (3.94 in/Hg)		100 mm/Hg (3.94 in/Hg)
		Maximum	9°/450 mm/Hg (17.7 in/Hg)	5.5°/245 mm/Hg (9.6 in/Hg)		7.5°/330 mm/Hg (13.0 in/Hg)
Weight			1.0 kg (2.2 lb)	1.0 kg (2.2 lb)		1.0 kg (2.2 lb)

Service data

All distributors

Point gap ..... 0.45 to 0.55 mm (0.0177 to 0.0217 in)

Point pressure ..... 0.50 to 0.65 kg (1.1 to 1.4 lb)

Condenser capacity ..... 0.20 to 0.24 μ F

Condenser isolate resistance ..... 5 M Ω

Cap isolate resistance ..... 50 M Ω

Rotor head isolate resistance ..... 50 M Ω

Cap carbon point ..... 12 mm (0.472 in)

Shaft diameter (lower part) ..... $12.45\ \frac{-0.010}{-0.020}$ mm ($0.4902\ \frac{-0.0004}{-0.0008}$ in)

Housing inner diameter ..... $12.45\ \frac{+0.018}{0}$ mm ($0.4902\ \frac{+0.0007}{0}$ in)

Clearance between shaft and housing	0.010 to 0.038 mm (0.0004 to 0.0015 in)
Amendment limit of clearance	0.08 mm (0.0031 in)
Shaft diameter (upper part)	$8\ ^{-0.005}_{-0.014}$ mm ($0.3150\ ^{-0.0002}_{-0.0006}$ in)
Cam inner diameter	$8\ ^{+0.015}_{0}$ mm ($0.3150\ ^{+0.0006}_{0}$ in)
Clearance between shaft and cam	0.005 to 0.029 mm (0.0002 to 0.0011 in)
Weight pivot diameter	$5\ ^{-0.010}_{-0.028}$ mm ($0.1969\ ^{-0.0004}_{-0.0010}$ in)
Weight hole diameter	$5\ ^{-0.018}_{0}$ mm ($0.1969\ ^{+0.0007}_{0}$ in)
Clearance between pivot and hole	0.01 to 0.046 mm (0.0004 to 0.0018 in)

IGNITION COIL

CONTENTS

DESCRIPTION EE-36
SPECIFICATION EE-37

DESCRIPTION

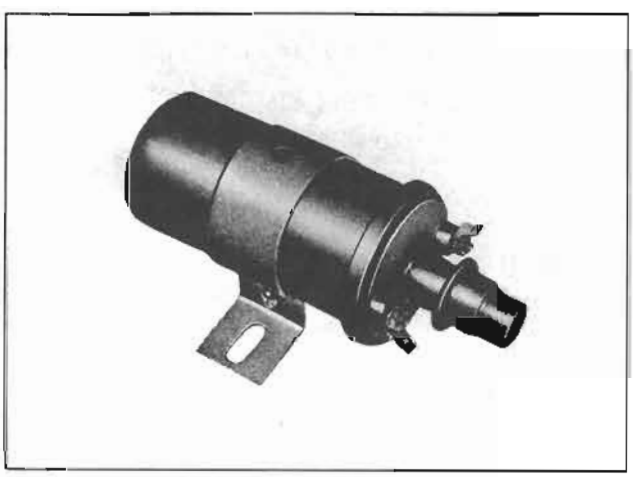
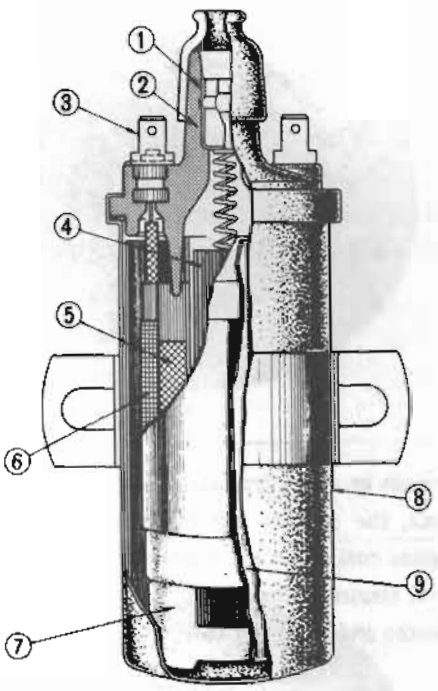


Fig. EE-92 HPS-13E

The ignition coil is a pitch type coil. The coil is equipped with resistor for improved spark performance at high revolution. The number of turns in primary winding results in a higher inductance in this winding, which makes it possible for this coil to provide a higher secondary voltage output throughout the speed range.

For optimum starting performance, the resistor is by-passed during cranking, thereby connecting the ignition coil directly to battery. This provides full battery voltage available at coil and thus keeps ignition voltage as high as possible during cranking. The resistor is by-passed automatically through the ignition and starting switch when switch is in the "start" position.



1	Primary terminal	6	Primary coil
2	Cap	7	Insulator
3	Secondary terminal	8	Case
4	Inside iron core	9	Outside iron core
5	Secondary coil		

Fig. EE-93 Construction

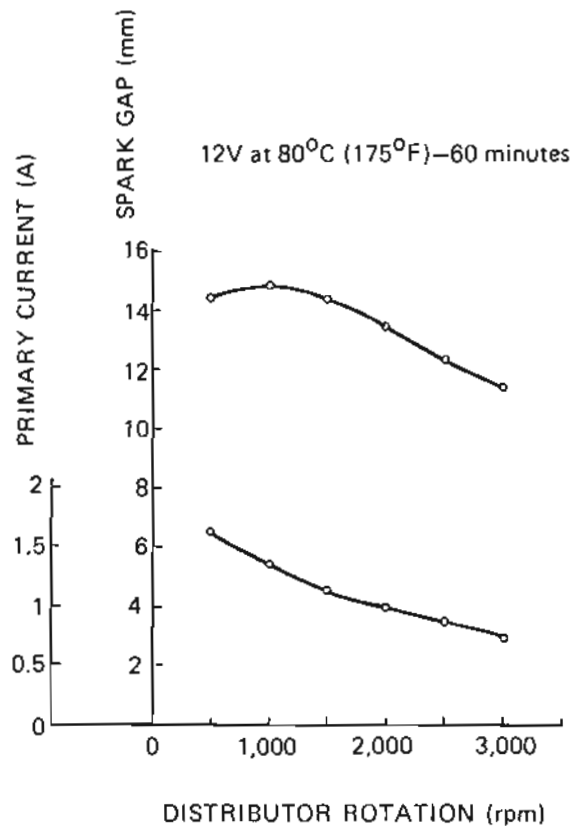


Fig. EE-94 C6R-200, HP5-13E characteristic curve

SPECIFICATION

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

SPARK PLUGS

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TROUBLE DIAGNOSES AND CORRECTIONS EE-40

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. Faulty 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 hard pull, 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.

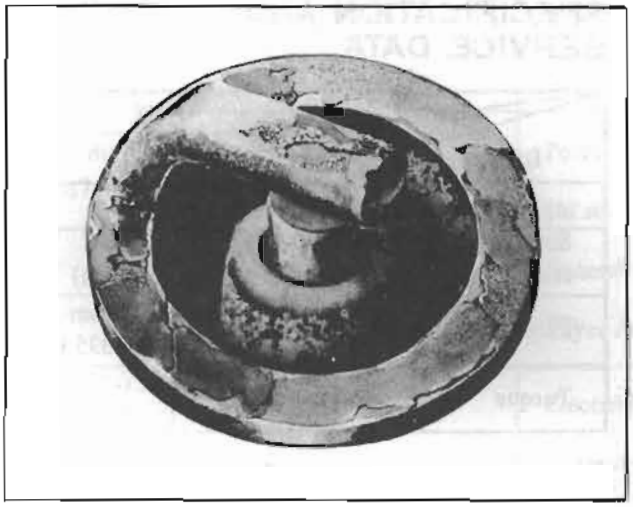


Fig. EE-95 Normal

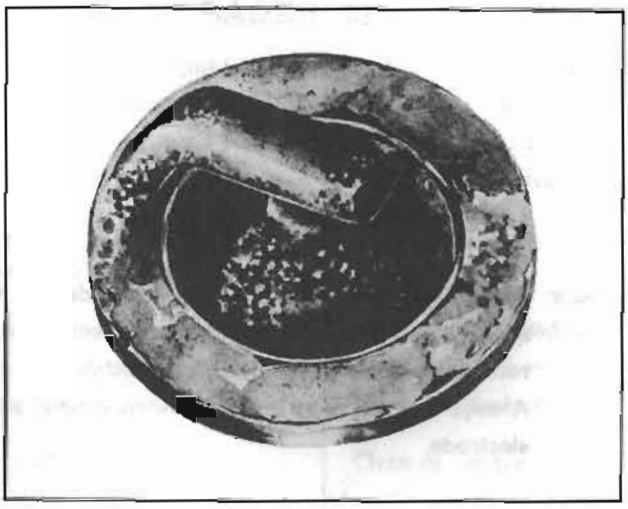


Fig. EE-98 Overheating (II)

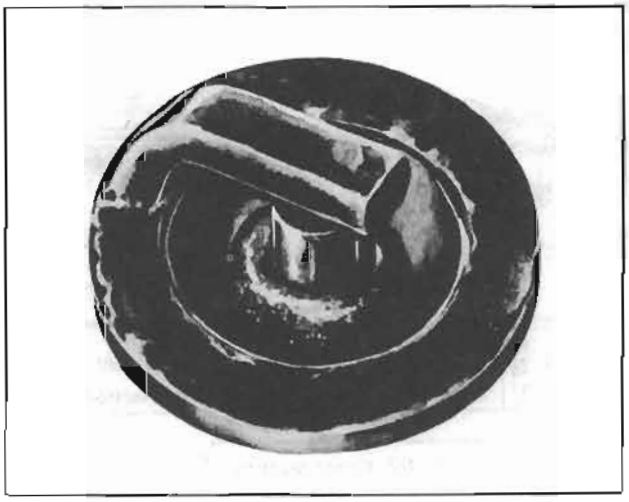


Fig. EE-96 Wet



Fig. EE-99 Overheating (III)



Fig. EE-97 Overheating (I)

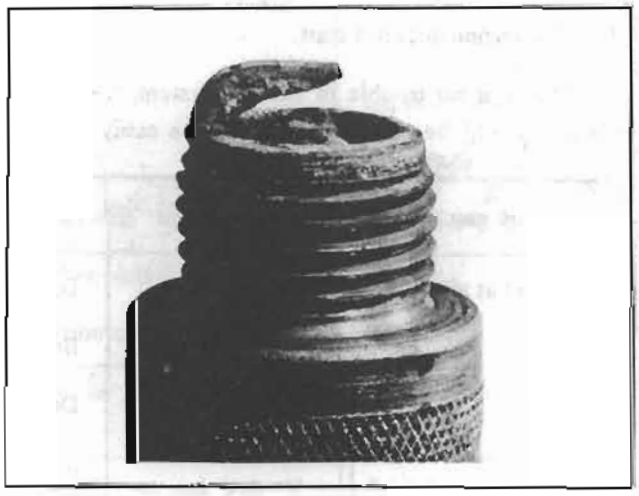


Fig. EE-100 Life

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.**

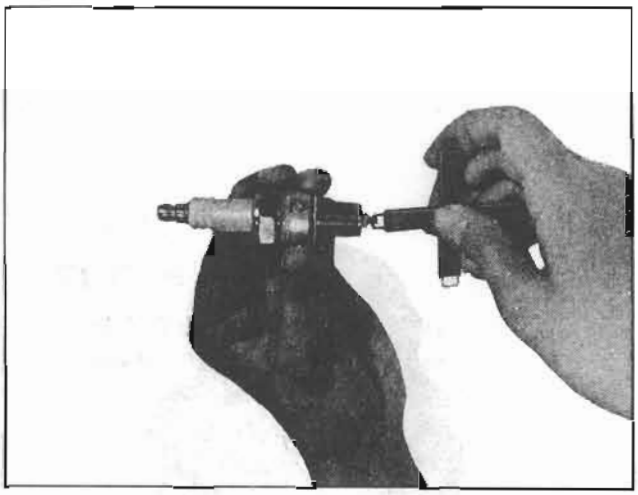
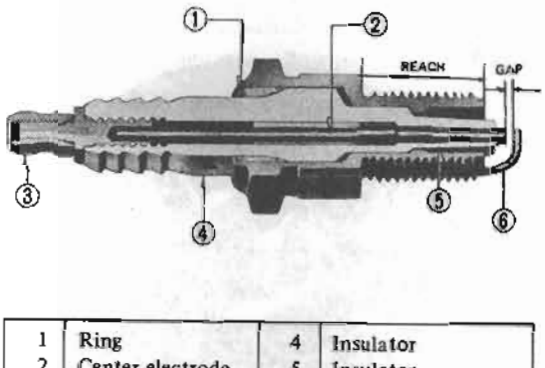


Fig. EE-101 Measuring spark plug gap

SPECIFICATION AND SERVICE DATA

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



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

Fig. EE-102 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 cylinder block. 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 with good one.
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 may 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	Correct.
		Improper point gap	Correct.
		Leak of electricity of cap and rotor head	Clean or replace.
		Defective insulation of condenser	Replace.
		Defective insulation of lead wire of condenser	Correct.
		Defective arm	Oil the shaft.
		Defective arm spring	Correct or replace.
		Near-breakage of lead wire	Correct.
		Worn or shaky breaker plate	Correct.
		Worn or shaky distributor shaft.	Correct.
	Ignition coil	Layer short-circuit or use of inferior quality	Replace with good one.
	High tension code	Deterioration of insulation and leak of electricity	Replace.

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

SERVICE JOURNAL OR BULLETIN REFERENCE

DATE	JOURNAL or BULLETIN No.	PAGE No.	SUBJECT