SERVICE MANUAL

MODEL
L14, L16 & L18 SERIES
ENGINES

NISSAN

NISSAN MOTOR CO., LTD.
TOKYO, JAPAN

SECTION EE

ENGINE ELECTRICAL SYSTEM

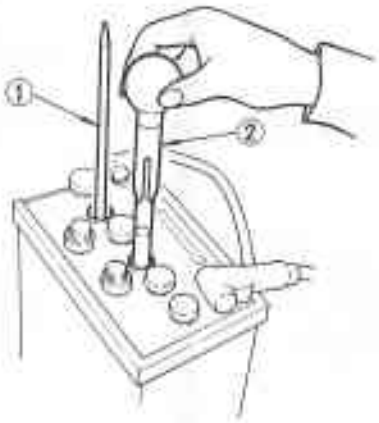
EE

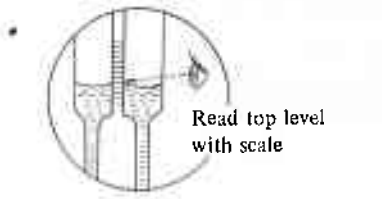
BATTERY

CONTENTS

REMOVAL

1. Disconnect negative and positive terminals.
2. Remove nuts from battery clamps; take out clamps.
3. Remove battery.





1 Thermal gauge
2 Hydrometer

EE001

Fig. EE-1 Checking specific gravity

CHECKING ELECTROLYTE LEVEL

Battery comes into two types; self-filling and conventional. To check the level, remove one vent plug and see if the float is raised to the correct level (self-filling type).

If it is below the specified level, raise to correct level by pouring distilled water into the battery case.

On standard type, remove six vent plugs and check for electrolyte level in each cell.

If necessary, pour distilled water.

CHECKING SPECIFIC GRAVITY

Specific gravity of battery electrolyte is tested by a hydrometer. If the state of charge of battery is 60% full, or specific-gravity reading is below 1.20 [as corrected at 20°C (68°F)], battery must be recharged or battery-electrolyte concentration adjusted.

Add or subtract gravity points according to whether the electrolyte temperature is above or bellow 20°C (68°F) standard.

The gravity of electrolyte changes 0.0007 for every 1°C (1.8°F) temperature. A correction can then be made by using the following formula:

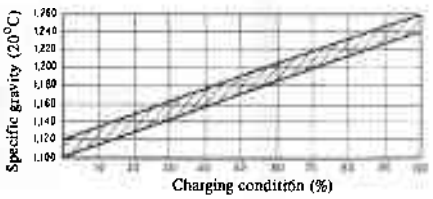
$$St + 0.0007 (t - 20)$$

Where

- St: Specific gravity of electrolyte at t°C
- S20: Specific gravity of electrolyte corrected at 20°C (68°F)
- t: Electrolyte temperature

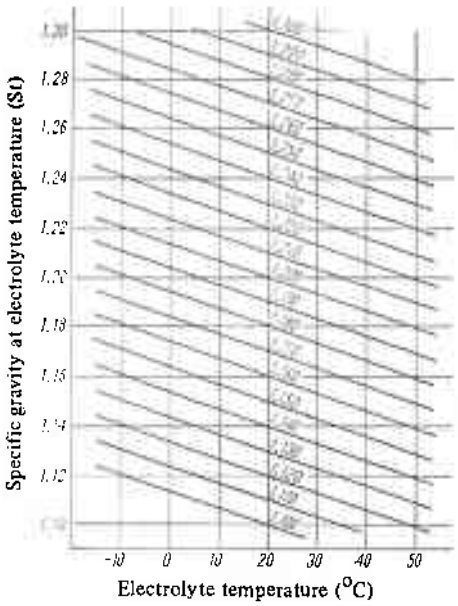
For example: A hydrometer reading of 1.260 at 30°C (86°F) would be 1.267 corrected to 20°C (68°F), indicating fully charged battery. On the other hand, a hydrometer reading of 1.220 at −10°C (14°F) would be 1.199 corrected to 20°C (68°F), indicating a partially charged battery.

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



EE002

Fig. EE-2 Charging condition



EE003

Fig. EE-3 Specific gravity at electrolyte temperature

Battery freezing

Temperatures at which battery electrolyte freezes vary with acid concentration or its specific gravity. A battery with a insufficient state of charge will freeze at lower temperatures. If specific gravity of a battery falls below 1.1, the indication is that the battery is completely discharged and will freeze readily when temperatures fall below freezing.

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

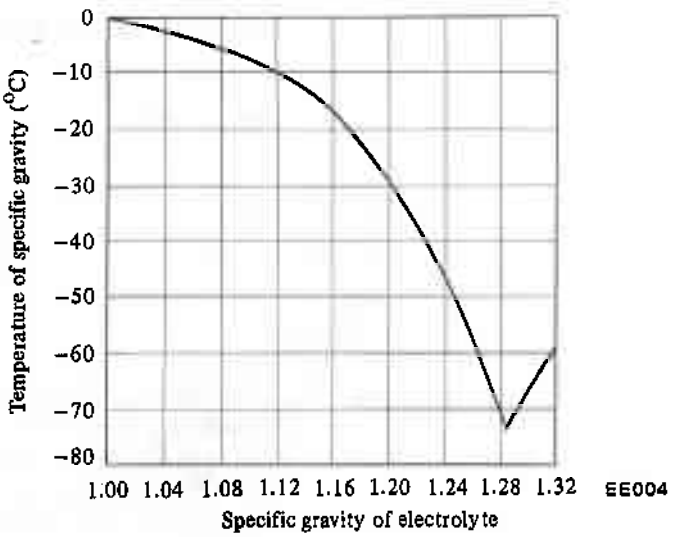


Fig. EE-4 Freezing point of electrolyte

CHARGING

Battery must be recharged when electrolyte-gravity reading falls below 1.20 with electrolyte level being satisfactory. If battery is quick-charged to bring it up to full charge, the operation should be carried out with negative terminal removed.

Prior to charging, corroded terminals should be cleaned with a brush and common baking-soda solution. In addition, the following items should be observed during recharging battery:

1. Be sure that electrolyte level is above top of each plate.
2. Keep removed plugs in a safe location.
3. Do not allow electrolyte temperature to go over 45°C (113°F).
4. After recharging, check to be certain that specific gravity does not exceed 1.260 [at 20°C (68°F)]. Correction can be made by adding distilled water into cells as necessary.
5. Keep battery away from open flame while it is being recharged.
6. After all vent plugs have been tightened, clean all spraying of electrolyte off upper face of battery.

INSTALLATION

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

STARTING MOTOR

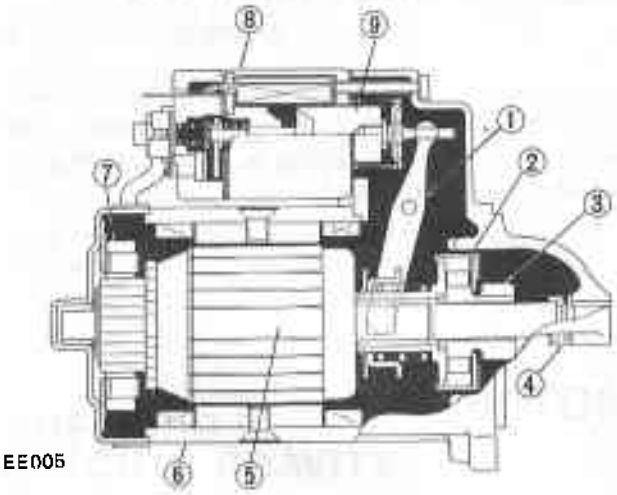
CONTENTS

SPECIFICATIONS

	L14, L16 and L18 engine
Type	HITACHI S114-103P
Voltage	12 volts
Output	1.0 KW
Starting current (voltage)	Less than 480 amps. (6 volts)
No load current (voltage)	Less than 60 amps. (12 volts)
No load starter revolution	More than 7,000 rpm
Shift type of pinion gear	Magnetic shift
Number of teeth on pinion gear	9
Number of teeth on ring gear	120
Weight kg (lb)	5.1 (10.42)

DESCRIPTION

The function of the starting system, consisting of the battery, ignition switch, starting motor and solenoid, is to crank the engine. The electrical energy is supplied from the battery, the solenoid completes the circuit to operate the starting motor, and then the motor carries out the actual cranking of the engine.



1 Shift lever
2 Over-running clutch
3 Pinion
4 Pinion stopper
5 Armature
6 Yoke
7 Brush
8 Magnetic switch Ass'y
9 Plunger

Fig. EE-5 Sectional view of starting motor

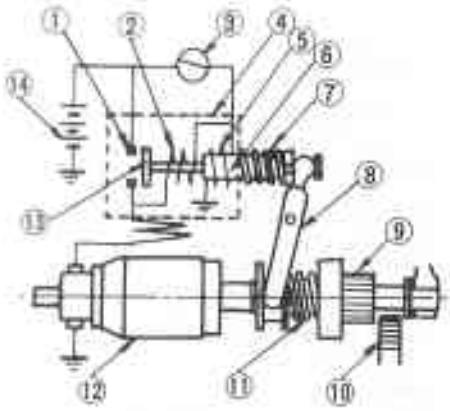
OPERATION

When the ignition switch is turned fully clockwise to the START position, battery current flows through "series" and "shunt" coils of the solenoid, magnetizing the solenoid. The plunger is pulled into the solenoid so that it operates the shift lever to move the drive pinion into the flywheel ring gear. Then the solenoid switch contacts close after the drive pinion is partially engaged with the ring gear.

Closing of the solenoid switch contacts causes the motor to crank the engine and also cut out the "series" coil of the solenoid, the magnetic pull of the "shunt" coil being sufficient to hold the pinion in mesh after the shifting has been performed.

After the engine starts running, the driver releases the ignition key and it automatically returns to the ON position.

This breaks the solenoid circuit so that reverse current flows through the series coil, and the magnetic field builds up in the direction in which the plunger moves back. As this happens, the resultant force of the magnetic fields in the shunt coil and the series coil becomes zero. The return spring then actuates the shift lever to pull the plunger, which allows to open the solenoid switch contacts. Consequently, the starting motor stops.

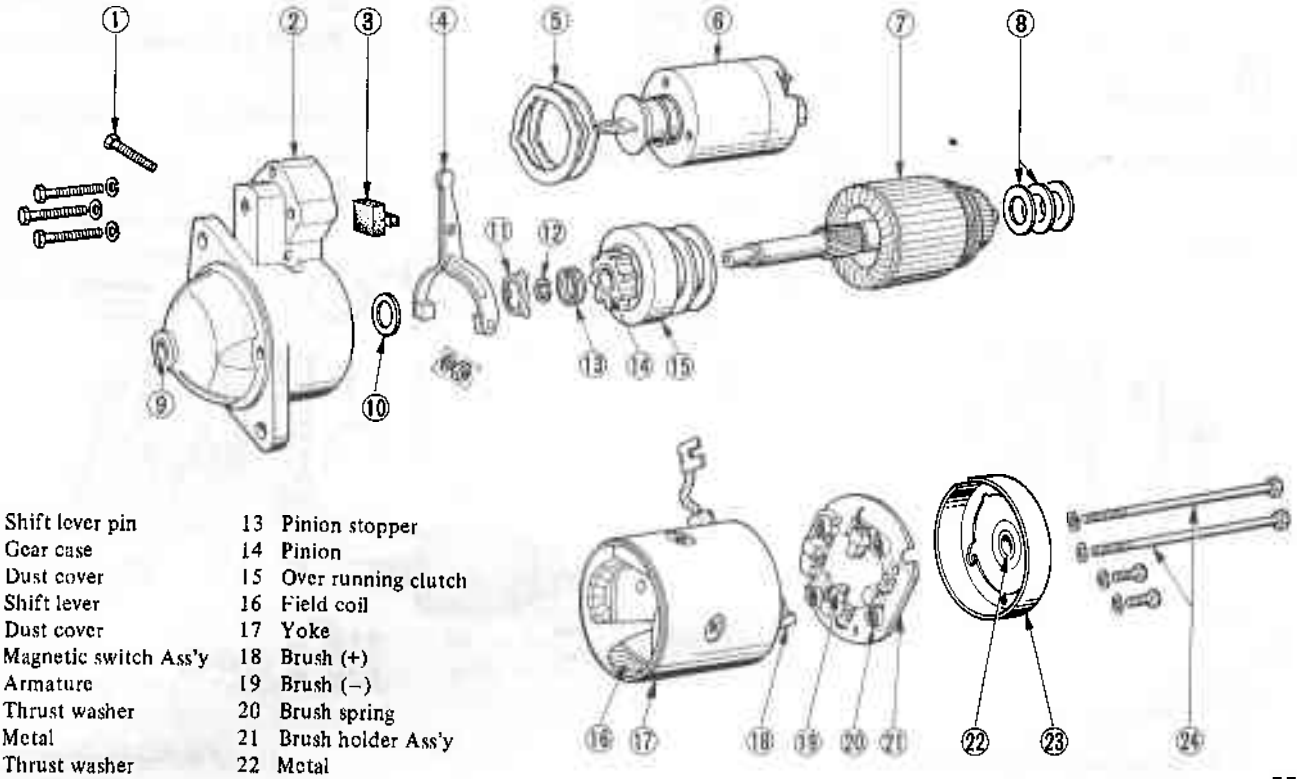


1 Stationary contact
2 Series coil
3 Ignition switch
4 Solenoid
5 Shunt coil
6 Plunger
7 Return spring
8 Shift lever
9 Drive pinion
10 Ring gear
11 Pinion sleeve spring
12 Armature
13 Movable contactor
14 Battery

Fig. EE-6 Starting motor circuit

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, into or out of mesh with the ring gear teeth. The over-running clutch is designed to transmit driving torque from the motor armature to the ring gear, but permit the pinion to over-run the armature after the engine has started.

CONSTRUCTION



EE007

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

Fig. EE-7 Exploded view of starting motor

REMOVAL

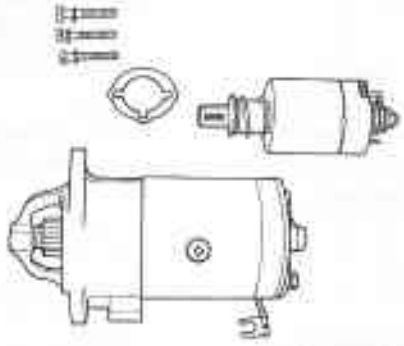
1. Disconnect battery ground cable.

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

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

DISASSEMBLY

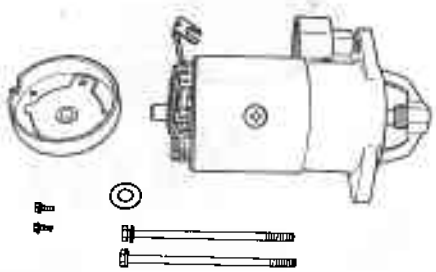
1. Loose nut securing connecting plate to magnetic switch "M" terminal. Remove three screws securing magnetic switch and remove magnetic switch assembly.



EE008

Fig. EE-8 Removing magnetic switch assembly

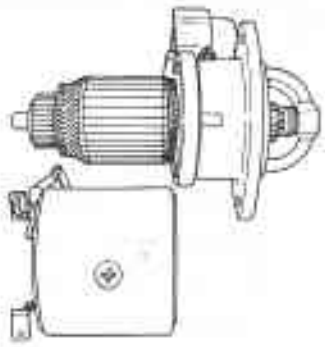
2. Remove two through bolts and brush cover assembly.



EE009

Fig. EE-9 Removing brush cover

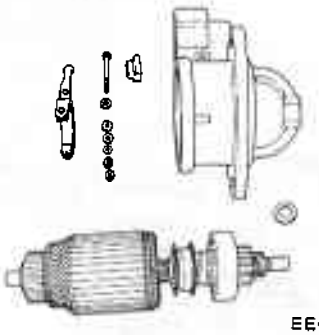
3. Remove yoke assembly by hitting lightly with a wooden hammer.



EE010

Fig. EE-10 Removing yoke assembly

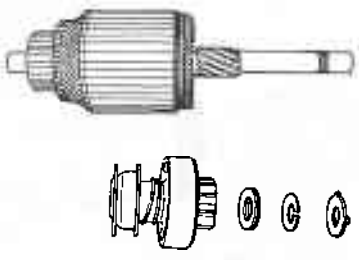
4. Withdraw armature assembly and shift lever.



EE011

Fig. EE-11 Removing armature assembly and shift lever

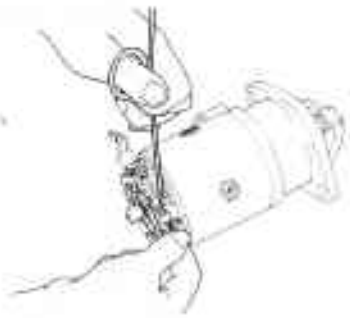
5. Remove pinion stop ring located at the end of armature shaft. To remove stop ring, first push stop ring to clutch side and then, after removing snap ring, remove stop ring with over-running clutch. Withdraw over-running clutch assembly from armature shaft.



EE012

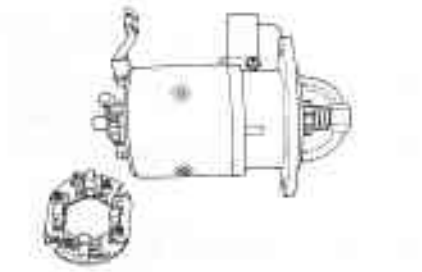
Fig. EE-12 Removing over-running clutch assembly

6. Unsolder brushes, using a soldering-iron and remove each brush.



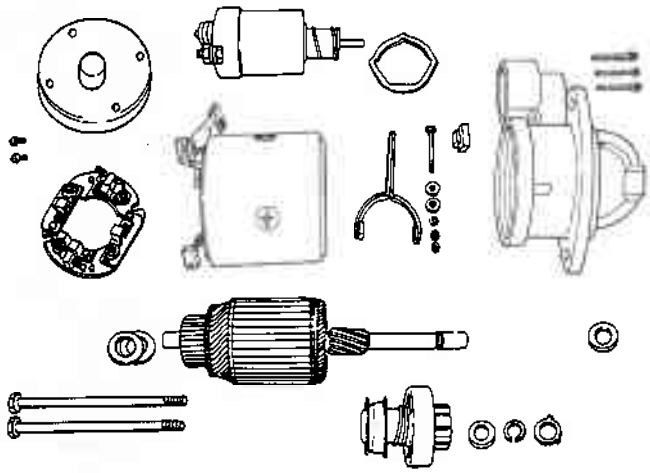
EE013

Fig. EE-13 Removing brush



EE014

Fig. EE-14 Removing brush holder



EE015

Fig. EE-15 Disassembly

CLEANING AND INSPECTION

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

Check them for excessive damage or wear, and they should be replaced if necessary.

Terminal

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

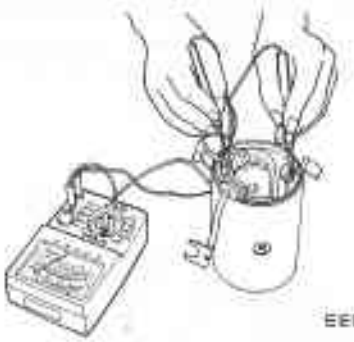
Field coil

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

Testing field coil for continuity:

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

If tester shows no conduction field circuit or coil is open.



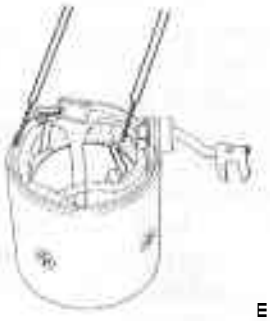
EE016

Fig. EE-16 Testing field coil for continuity

Testing field coil for ground:

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

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



EE017

Fig. EE-17 Testing field coil for ground

Field coil tester for short:

Unsolder the connecting portion of each coil and proceed to the same mentioned above.

If a defective coil is found, it should be replaced.

Brushes and brush lead wire

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

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

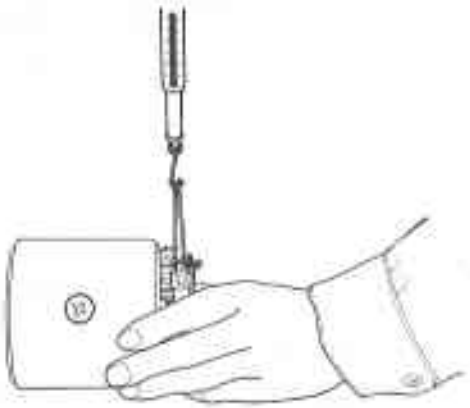
Check the connection of lead clip and lead wire.

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

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

Brush spring tension

Check brush spring tension by a spring scale as shown in Figure EE-18. The reading should be 1.6 kg (3.53 lbs). Replace spring if tension is lower than 1.4 kg (3.09 lbs).



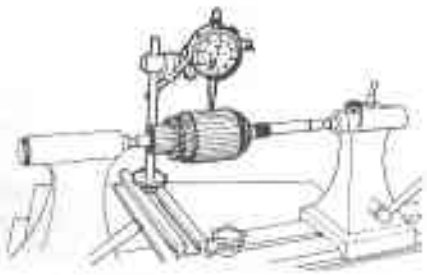
EE018

Fig. EE-18 Inspecting brush spring tension

Armature assembly

Check external appearance of armature and commutator.

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



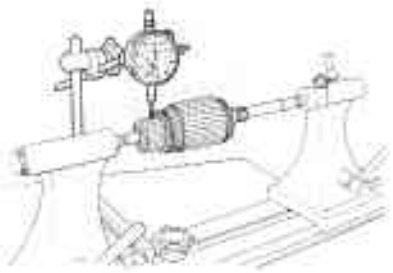
EE019

Fig. EE-19 Inspecting armature shaft for bend

2. Inspect commutator. If the surface of commutator is rough, it must be sanded lightly with a No. 500 emery paper. Commutator must be checked also for out-of-round. If the out-of-round is more than 0.2 mm (0.0079 in), or the depth of insulating mica is less than 0.2 mm (0.0079 in) from commutator surface. Commutator (armature) should be turned in a lathe, so that the out-of-round is less than 0.05 mm (0.0020 in). Insulating mica should also be undercut so that the depth of it 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 beyond repair, replace.

Note: It is recommended to replace commutator as an assembly if worn or damaged.



EE020

Fig. EE-20 Inspecting commutator

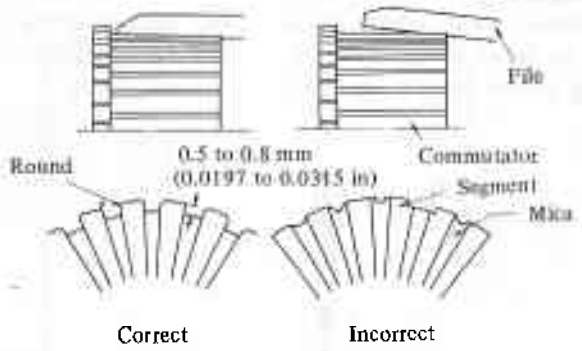


Fig. EE-21 Undercutting insulating mica

3. Inspect soldered connection of armature lead and commutator. If loose connection is found, solder it using rosin flux.

4. Armature test for ground

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

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

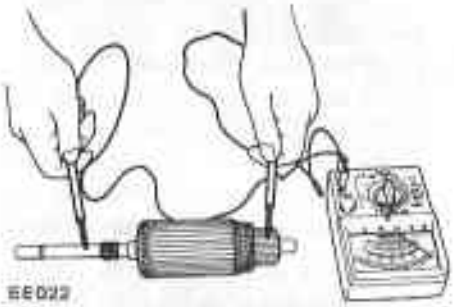


Fig. EE-22 Testing armature for ground

5. Check armature for short by placing on armature tester (glora) and with a piece of iron over armature core, rotate armature. If the plate vibrates, armature is shorted.

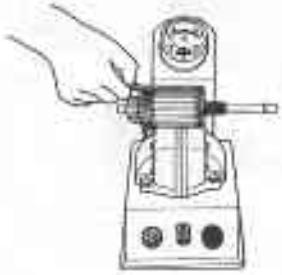


Fig. EE-23 Testing armature for short

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

Over-running clutch assembly

Inspect pinion assembly and screw sleeve. Screw sleeve must slide freely along armature shaft splines. If damages are found or resistance would be felt when sliding, it must be repaired. Inspect pinion teeth. If excessive rubbing would be found on teeth, it should be replaced. Flywheel ring gear also must be inspected.

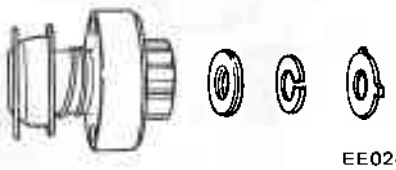


Fig. EE-24 Over-running clutch assembly

Brush holder test for ground

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

Fig. EE-25 Testing brush for ground

Pinion case bearing metal

Inspect bearing metal for wear or side play. If the clearance between bearing metal and armature shaft is more than 0.2 mm (0.0079 in), replace metal. Press in a new bearing and adjust the clearance 0.03 to 0.10 mm (0.0012 to 0.0039 in). Bearing metal should be so pressed in that the end of the bearing metal would be equal to gear case end plane.

Magnetic switch assembly

Inspect magnetic switch contacts. If a rough welding be found on the contact, it should be repaired.

ASSEMBLY

Reassemble starting motor in reverse sequence of disassembly.

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

TEST

Performance test

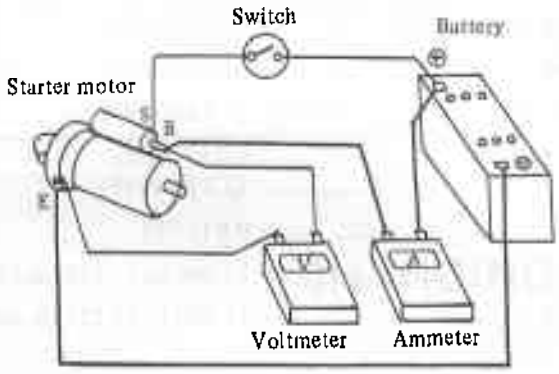
Starter motor should be subjected to a "no-load" test whenever it has been overhauled to ensure that its performance will be satisfactory when installed to engine. Starter motor

should also be subjected to the test when the cause of abnormal operation is to be determined. A brief outline of the test is given below.

No-load test

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

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



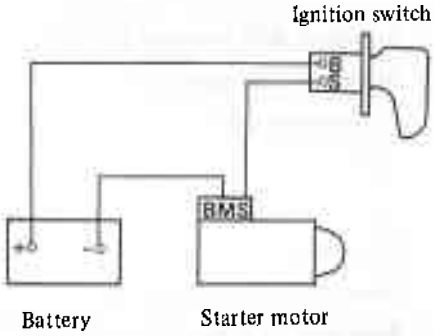
EE026

Fig. EE-26 No-load testing

Diagnosis of test

1. Low speed with no-load and high current draw may result from the following causes.
(1) Tight, dirty or worn bearings.
(2) Bent armature shaft or loosened field probe.
(3) Shorted armature;
Check armature further.
(4) A ground armature or field;
a. Remove input terminal.
b. Raise two negative side brushes from commutator.
c. Using a circuit tester, place one probe onto input terminal and the other onto yoke.
d. If tester indicates 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 the following items.
(1) A grounded or open field coil:
Inspect the connection and trace circuit by a circuit tester.
(2) Armature coil does not operate:
Inspect commutator for excessive burning. In this case, arc may occur on defective commutator, when motor is operated with no-load.
(3) Burned out commutator bar:
Weak brush spring tension, broken brush spring, rubber bush, thrust out of mica in commutator or a loose contact between brush and commutator would cause to burn commutator bar.
3. Low current draw and low no-load speed would cause high internal resistance due to loose connections, defective leads, dirty commutator and causes listed on item 2-(3).

Magnetic switch assembly test

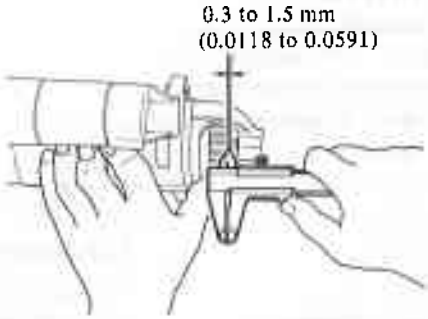


EE027

Fig. EE-27 Circuit of magnetic switch assembly test

If the starting motor check is "OK," check magnetic switch assembly. Connect cables between "negative" battery terminal and starting motor "M" terminal, "positive" battery terminal and starting motor "S" terminal connecting ignition switch in series as shown in Figure EE-27.

With ignition switch on, measure the gap "ℓ" between pinion front edge and pinion stopper.



EE028

Fig. EE-28 Measuring gap "ℓ"

SERVICE DATA

≪ S114-103P ≫

Armature shaft diameter (pinion side)	mm (in)	10.950 to 10.968 (0.4311 to 0.4318)
Armature shaft diameter (rear end)	mm (in)	11.450 to 11.468 (0.4508 to 0.4515)
Amendment limit of shaft diameter	mm (in)	0.1 (0.0039)
Amendment limit of shaft bent	mm (in)	0.08 (0.0031)
Clearance between shaft and bush	mm (in)	0.03 to 0.1 (0.0012 to 0.0039)
Amendment limit of dittoed clearance	mm (in)	0.2 (0.0079)
Outer diameter of commutator	mm (in)	35.0 (1.3780)
Wear limit of commutator diameter	mm (in)	2.0 (0.0787)
Brush length	mm (in)	18.5 (0.7283)
Wear limit of dittoed length	mm (in)	6.0 (0.2362)
(remaining brush should be more than)	mm (in)	12.5 (0.4921)
Brush spring tension	kg (lb)	0.8 (1.76)
Front bracket metal inner diameter	mm (in)	11.000 to 11.018 (0.4331 to 0.4338)
Rear cover metal inner diameter	mm (in)	11.500 to 11.521 (0.4528 to 0.4536)

TROUBLE DIAGNOSES AND CORRECTIONS

Condition	Probable cause	Corrective action
Starting motor will not operate.	Discharged battery.	Charge or replace battery.
	Defective solenoid switch.	Repair or replace solenoid switch.
	Loosen connections of terminal.	Clean and tighten terminal.
	Defective brushes.	Replace brushes.
	Defective starting motor.	Remove starting motor and make test.
Noisy starting motor.	Loose securing bolt.	Tighten bolt.
	Worn pinion gear.	Replace pinion gear.
	Poor lubrication.	Fill in oil.
	Worn commutator.	Disassemble motor.
	Worn brushes.	Replace brushes.
Starting motor cranks slowly.	Discharged battery.	Charge or replace battery.
	Loose connection of terminal.	Clean and tighten terminal.
	Worn brushes.	Replace brushes.
	Locked brushes.	Inspect brush spring tension or repair brush holder.

Condition	Probable cause	Corrective action
Starting motor cranks slowly.	Dirty or worn commutator. Armature rubs field coil. Defective solenoid switch.	Clean and repair. Replace assembly. Repair or replace switch.
Starting motor operates but does not crank engine.	Worn pinion. Locked pinion guide. Worn ring gear.	Replace pinion. Repair pinion guide. Replace ring gear.
Starting motor will not disengage even ignition switch is turned off.	Defective solenoid switch. Defective gear teeth.	Repair or replace solenoid switch. 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.

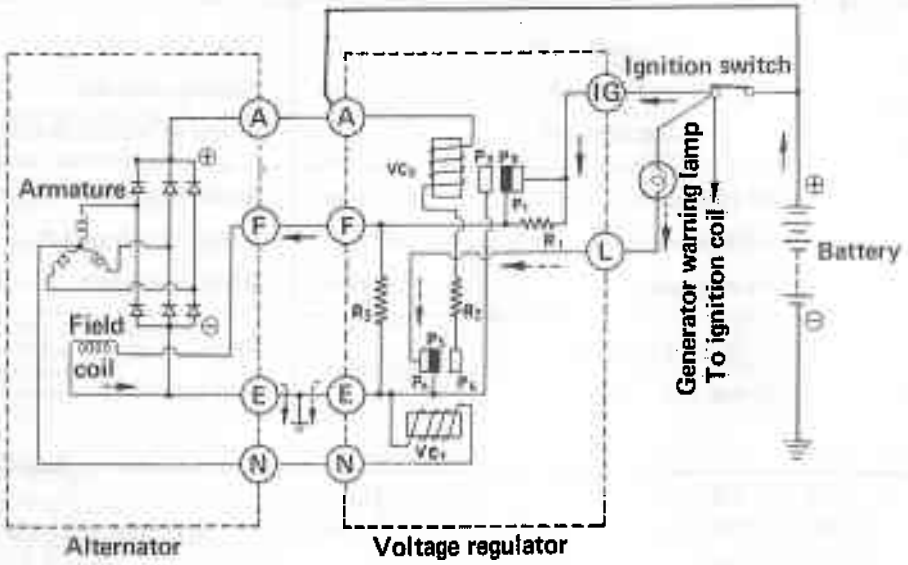
When the ignition switch is set to "ON," current flows from the battery to ground through the ignition switch, voltage regulator IG terminal, primary side contact point "P1," movable contact point "P2," voltage regulator "F" terminal, alternator "F" terminal, field coil and alternator "E" terminal, as shown in Figure EE-29 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-30 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.

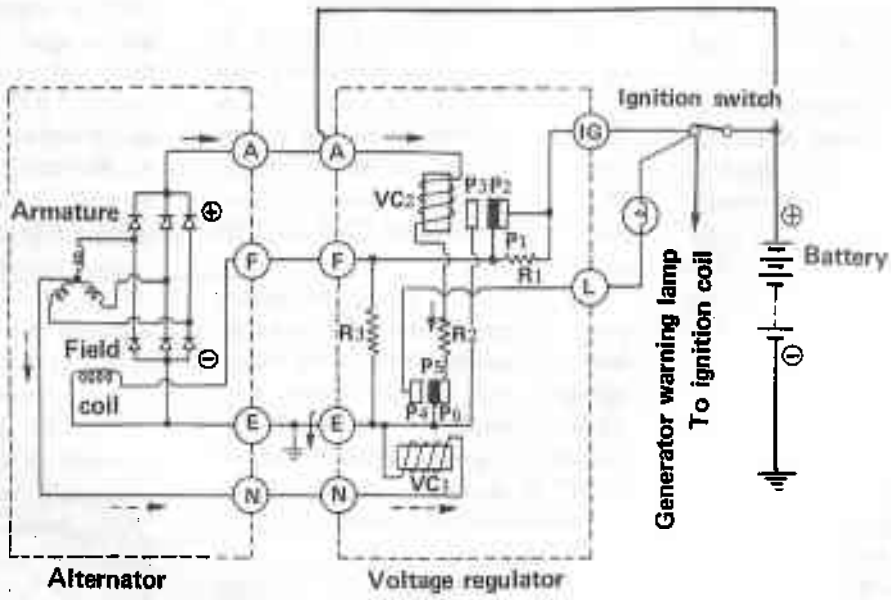
When the alternator speed is increased or the voltage starts to rise excessively, the movable contact point "P2" is separated from the primary side contact "P1" by the magnetic force of coil "VC2." Therefore, registor "R1" is applied into the field circuit and output voltage is decreased. As the output 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.



EE029

Fig. EE-29 Charging circuit (I)



EE030

Fig. EE-30 Charging circuit (II)

ALTERNATOR

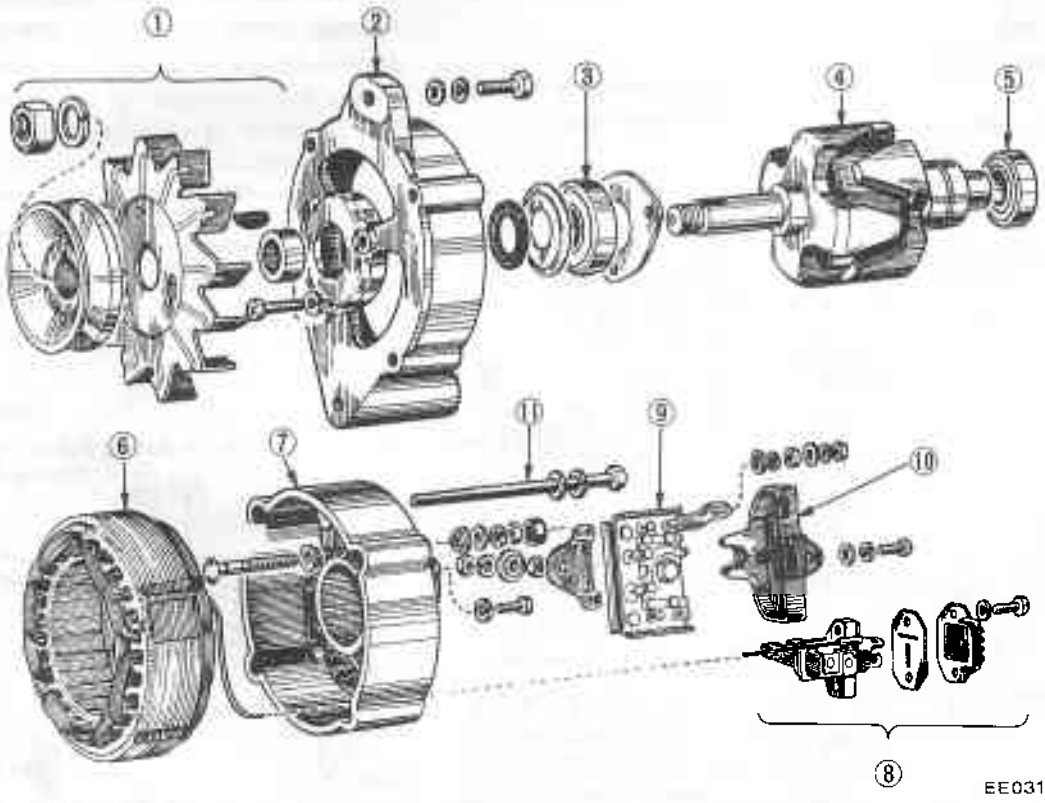
CONTENTS

DESCRIPTION

Alternator	Applied vehicle
LT135-13	510 all models
LT150-05	610 all models

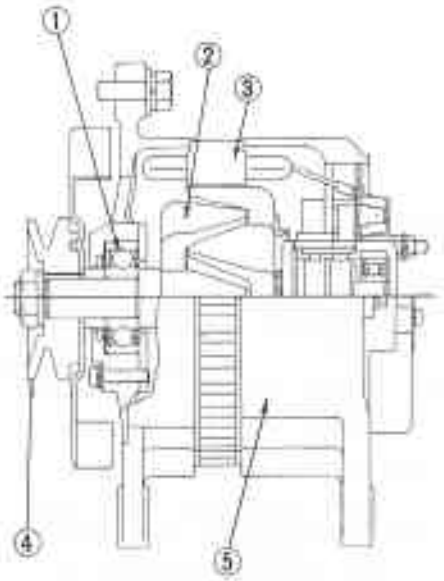
In the alternator, a magnetic field is produced by the rotor which consists of alternator shaft, field coil, pole pieces, and slip rings. The slip rings pressed in the shaft conduct only a small field current. Output current is generated in the armature coils located in the stator. The stator has three 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 silicone 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 Rear bearing
6 Stator
7 Rear cover
8 Brush assembly
9 Diode set plate assembly
10 Diode cover
11 Through bolts

Fig. EE-31 Exploded view of alternator



1 Front bearing
2 Rotor
3 Stator
4 Pulley
5 Front cover
6 Encased diode

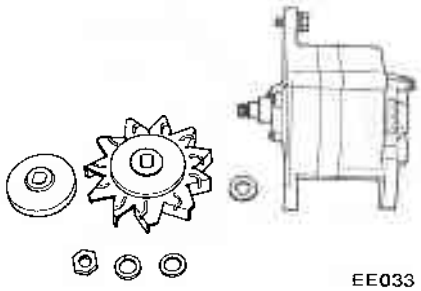
Fig. EE-32 Sectional view of alternator

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 pulley nut, pulley rim, fan and spacer.

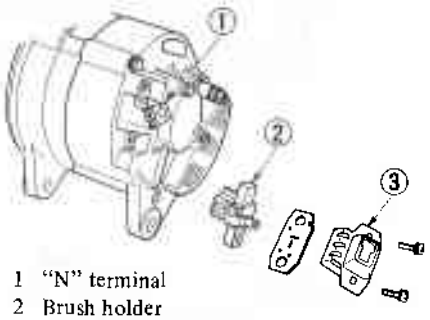


EE033

Fig. EE-33 Removing pulley and fan

2. 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.

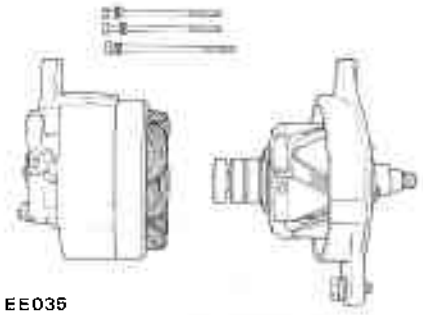


1 "N" terminal
2 Brush holder
3 Brush holder cover

EE034

Fig. EE-34 Removing brush

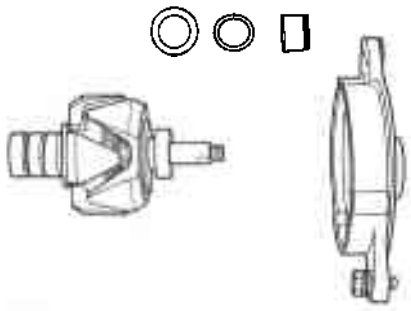
3. Loosen and remove through bolts. Separate front cover with rotor from rear cover with stator by lightly tapping front bracket with a wooden mallet.



EE035

Fig. EE-35 Separating front cover with rotor from rear cover

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



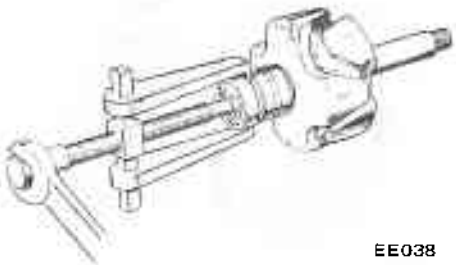
EE036

Fig. EE-36 Removing rotor

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

EE037

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



EE038

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

6. Remove diode cover fixing screw, and remove diode cover. Disconnect three stator coil lead wires from diode terminal with a soldering iron.
7. Remove A terminal nut and diode installation nut, and remove diode assembly.

EE039

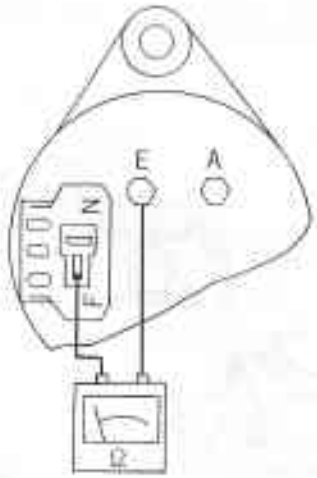
Fig. EE—39 Removing diode assembly

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



EE040

Fig. EE-40 Inspecting alternator

Rotor inspection

1. Conduction test of rotor coil

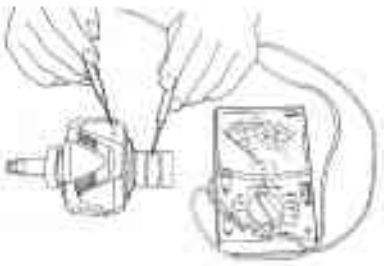
Apply tester between slip rings of rotor as shown in Figure EE-41. If there is no conduction, discontinuity of field coil may exist. When resistance is approximately 4.4Ω at normal ambient temperature, condition is satisfactory.

EE041

Fig. EE-41 Conduction test of rotor coil

2. Ground test of rotor coil

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



EE042

Fig. EE-42 Testing rotor coil for ground

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.

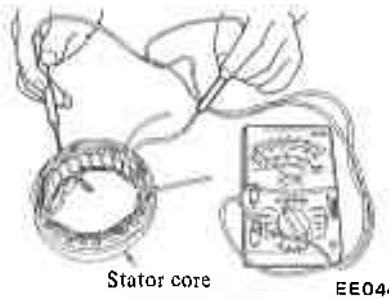
Replace with stator assembly.

EE043

Fig. 43 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.

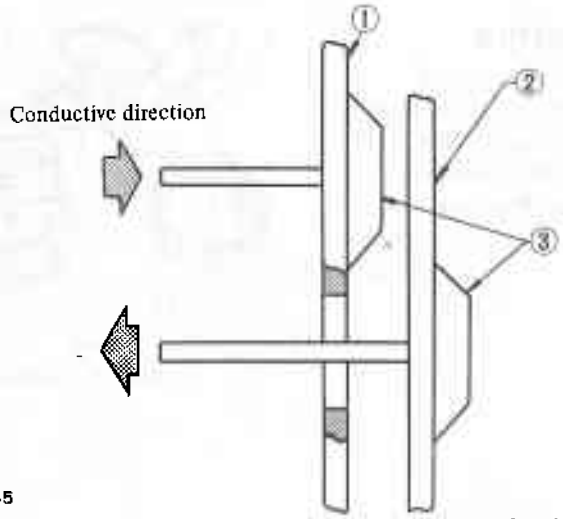


EE044

Fig. EE-44 Testing stator for ground

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 and plate.

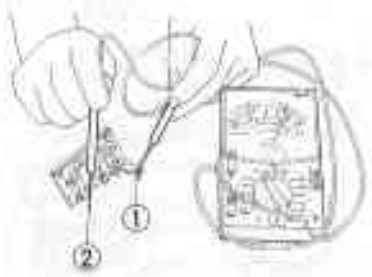


1 (+) plate
2 (−) plate
3 Diode

Fig. EE-45 Conductive direction of 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 below table.)

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.



1 (+) plate
2 Terminal

Fig. EE-46 Inspecting positive diode

Test probe of a circuit tester		Conduction
⊖	⊕	
terminal	⊕ plate	X
⊕ plate	terminal	—
terminal	⊖ plate	—
⊖ plate	terminal	X
⊖ plate	⊕ plate	X
⊕ plate	⊖ plate	—

Fig. EE-48 Inspecting diodes

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.

1 (−) plate
2 Terminal

Fig. EE-47 Inspecting negative diode

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.

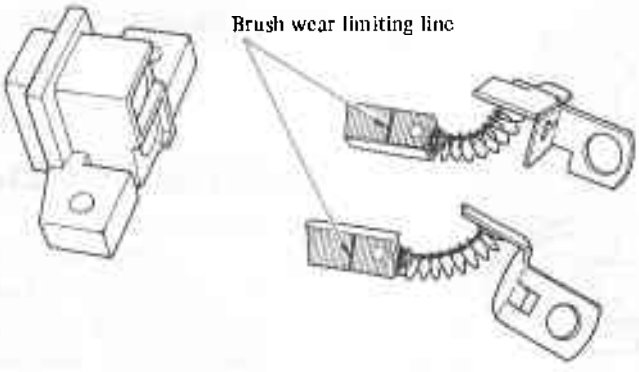


Fig. EE-49 Brush wear limit

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 g (9.0 to 12.2 oz).

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

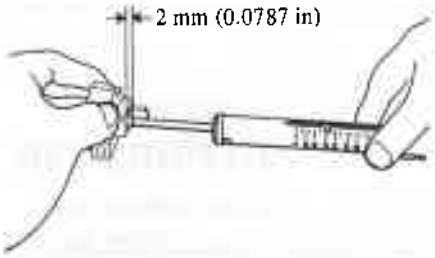
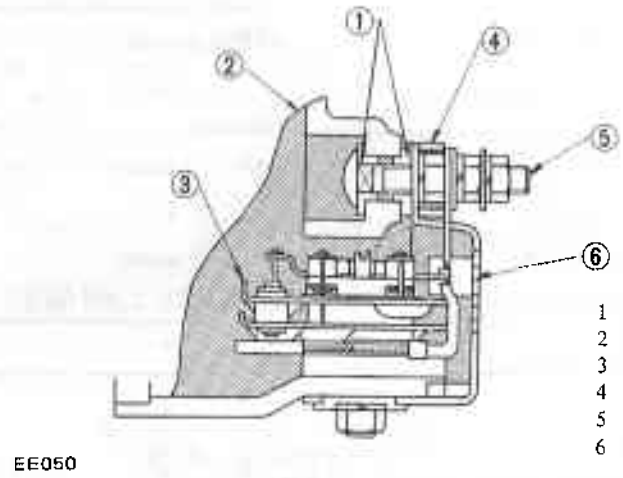


Fig. EE-50 Measuring spring pressure

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.



1 Insulating bush
2 Rear cover
3 Diode assembly
4 Insulating tube
5 A terminal bolt
6 Diode cover

Fig. EE-51 Sectional view of diode and A terminal

3. Tighten pulley nut with tightening torque of 350 to 400 kg-cm (301 to 344 in-lb). When pulley is tightened, make sure that deflection of V-groove is less than 0.3 mm (0.0118 in).

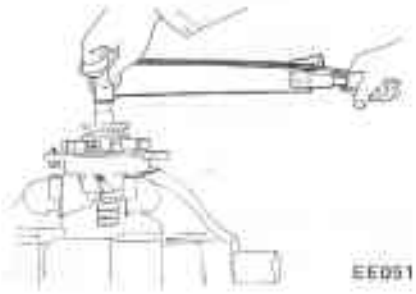


Fig. EE-52 Tightening pulley nut

ALTERNATOR TEST

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

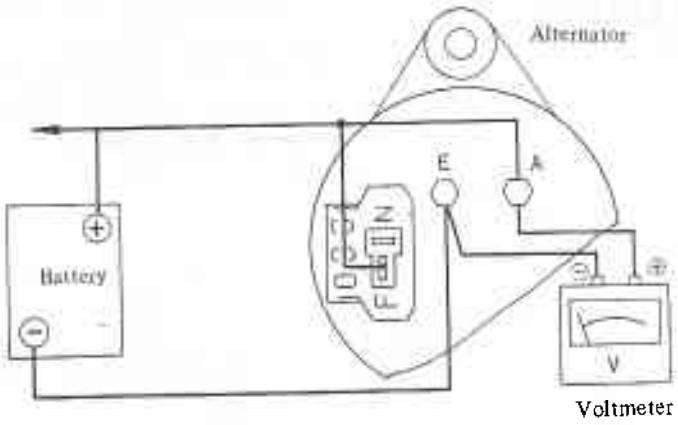
To conduct a test, it is necessary to use a 30-volt voltmeter and suitable test probes.

Set up a test circuit as shown in Figure EE-53 and test alternator in the manner indicated in the flow chart 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 approx. 1,100 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.



EE052

Fig. EE-53 Testing alternator

Notes:

a. **Do not run engine at the speed of more than 1,100 rpm while test is being conducted on alternator.**

b. **Do not race engine.**

SPECIFICATIONS AND SERVICE DATA

Specifications

Item \ Model	LT135-13	LT150-05
Applicable to	510 all models	610 all models
Maker	HITACHI	←
Nominal rating	12V-35A	12V-50A
Ground polarity	Negative	←
Revolution	1,000 to 13,500 rpm	←
Minimum revolution under no load	Less than 1,000 rpm	←
Output current	28A (14V, 2,500 rpm)	37.5A (14V, 2,500 rpm)
Pulley ratio	2.25	←

Service data

≪ LT135-13, 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 dia.	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.

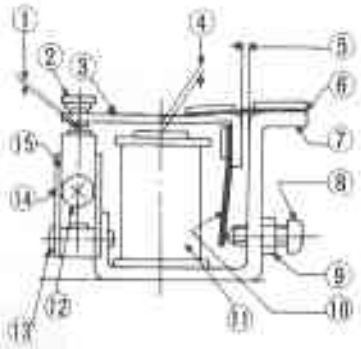
When the upper contacts are closed, ignition warning lamp goes on.

Regulator model	Applied vehicle	Applied alternator
TL1Z-57	510 all models	LT135-13
TL1Z-58	610 all models	LT150-05

EE053

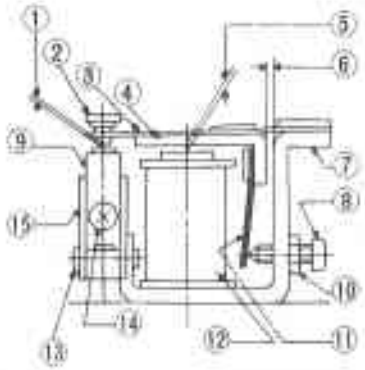
Fig. EE-54 View of removing cover

As for the construction, the voltage regulator is very similar to the charge relay as shown in Figure EE-55.



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

(a) Construction of voltage regulator



EE054

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

(b) Construction of charge relay

Fig. EE-55 Structural view

MEASUREMENT OF REGULATOR 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 ohms) 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 (0.25Ω) 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.

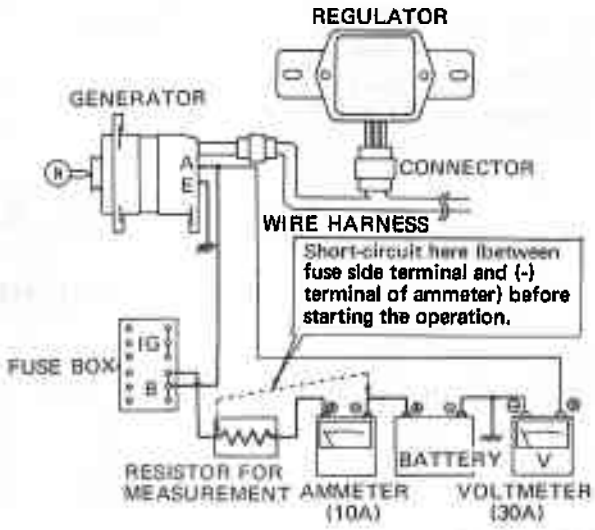
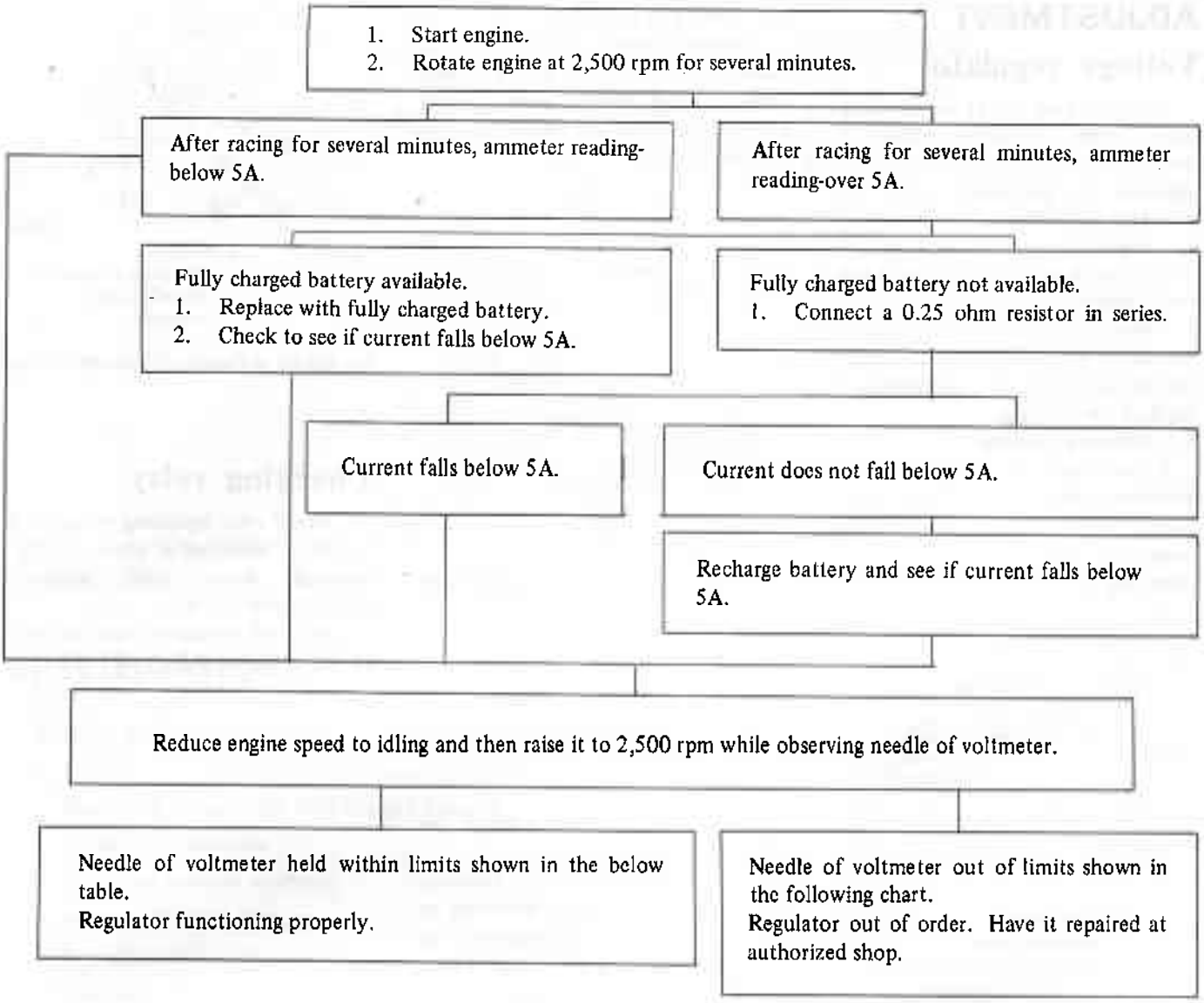


Fig. EE-56 Measuring regulator voltage with regulator on vehicle

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



Regulator model TL1Z-57 and TL1Z-58 (HITACHI)

Temperature °C (°F)	Voltage V
−10 (14)	14.75 to 15.25
0 (32)	14.60 to 15.10
10 (50)	14.45 to 14.95
20 (68)	14.30 to 14.80
30 (86)	14.15 to 14.65
40 (104)	14.00 to 14.50

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 approx. 0.3 V 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 in the left hand side.

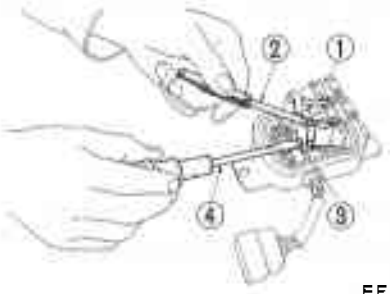
ADJUSTMENT

Voltage regulator

As the result of above measurement, when regulating voltage is deviated from rated value, adjust regulator in accordance with the 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 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-57.)



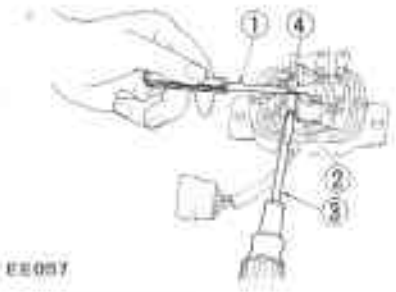
EE056

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

Fig. EE-57 Adjusting core gap

4. Adjusting 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-58.)



EE057

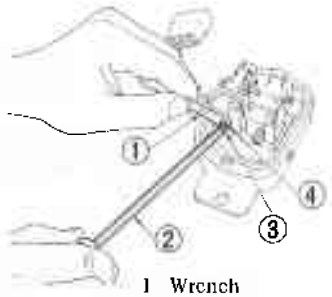
1 Thickness gauge
2 3 mm (0.1181 in) dia. screw
3 Crosshead screwdriver
4 Upper contact

Fig. EE-58 Adjusting point gap

5. Adjusting voltage

Adjust regulating voltage as follows:

Loosen lock nut securing adjusting screw. Turn this screw clockwise to increase, or counterclockwise to decrease, regulating voltage. (See Figure EE-59.)



EE058

1 Wrench
2 Crosshead screwdriver
3 Adjusting screw
4 Lock nut

Fig. EE-59 Adjusting regulating voltage

Charging relay

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

Use a DC voltmeter, and set up a circuit as shown in Figure EE-60.

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 5.2 Volt

(Pilot lamp remains lit)
1. Check fan belt tension.
2. If correct, remove regulator and adjust as necessary.

Over 5.2 Volt

(Pilot lamp remains lit)
Pilot lamp relay coil or contact points out of order.
Replace regulator.

Over 5.2 Volt

(Pilot lamp does not lit)
Pilot lamp relay assembly is in good condition.

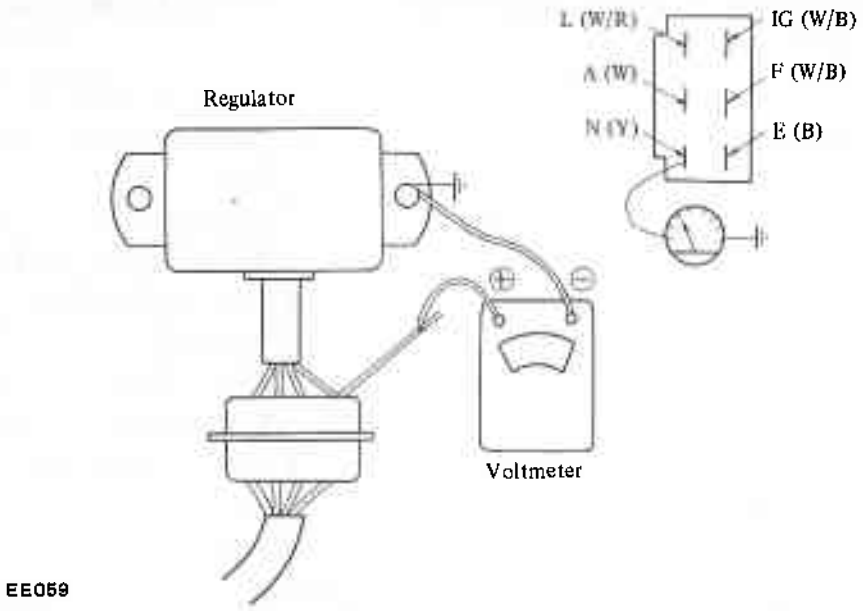


Fig. EE-60 Testing charging relay

SPECIFICATIONS AND SERVICE DATA

Voltage regulator		
Model		TL1Z-57, TL1Z-58
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 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. During cranking, electrical 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 low voltage current is supplied by the battery or alternator and flows through the primary circuit. It consists of the ignition switch, resistor, primary winding of the ignition coil, distributor contact points, condenser and all connecting low tension wiring.

The high voltage current is produced by the ignition coil and flows through the secondary circuit, resulting in high voltage spark between the electrodes of the spark plugs in engine cylinders. This circuit contains the secondary winding of the ignition coil, coil to distributor high tension cables, distributor rotor and cap.

When the ignition switch is turned on and the distributor contact points are closed, the primary current flows through the primary winding of the coil and through the contact points to ground. This flowing produces a magnetic field around the coil winding and then electrical energy in the coil.

When the contact points are opened by the revolving distributor cam, the magnetic field built up in the primary winding of the coil moves through the secondary winding of the coil inducing high voltage. The high voltage is produced every time the contact points open. The high voltage current flows through the high tension cable to the distributor cap. Then the rotor distributes the current to one of the spark plug terminals in the distributor cap.

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

The distributor contact points and spark plugs require periodic service. That is, the breaker points should be inspected, cleaned and regapped 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 remainder of the ignition component parts should be inspected for only their operation, tightness of electrical terminals, and wiring condition.

The ignition circuit is shown below:

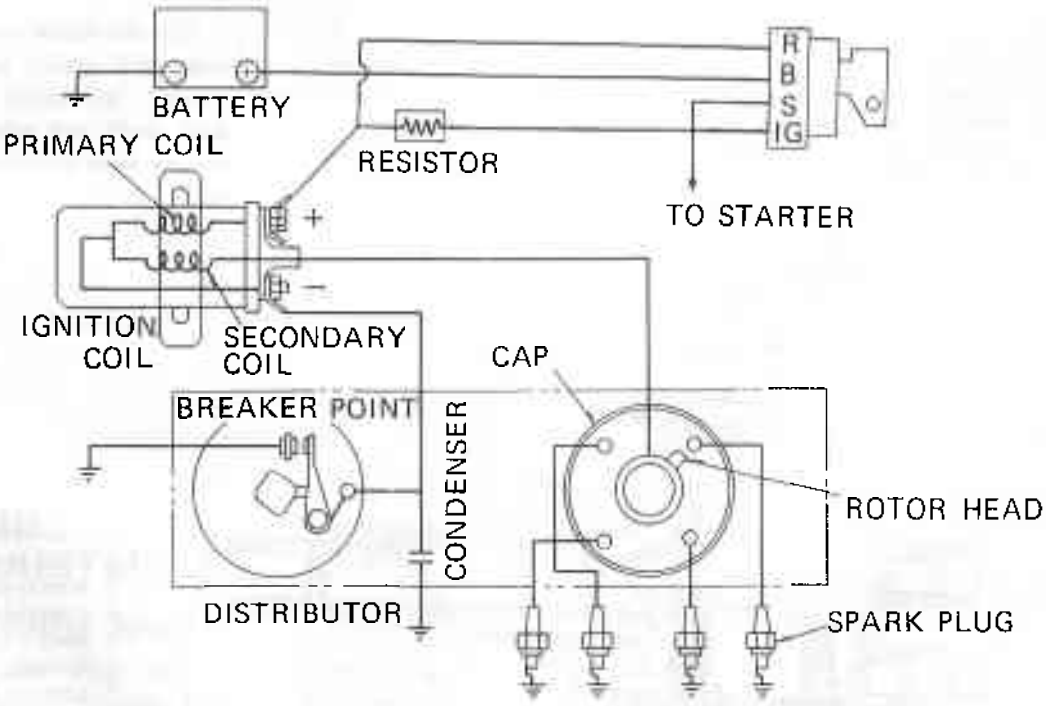


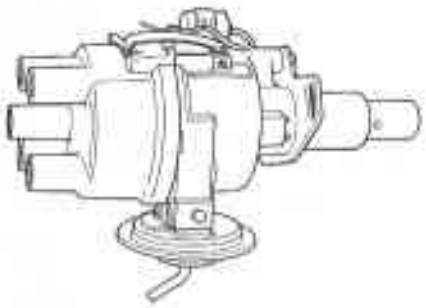
Fig. EE-61 Ignition system circuit diagram

DISTRIBUTOR

CONTENTS

CONSTRUCTION

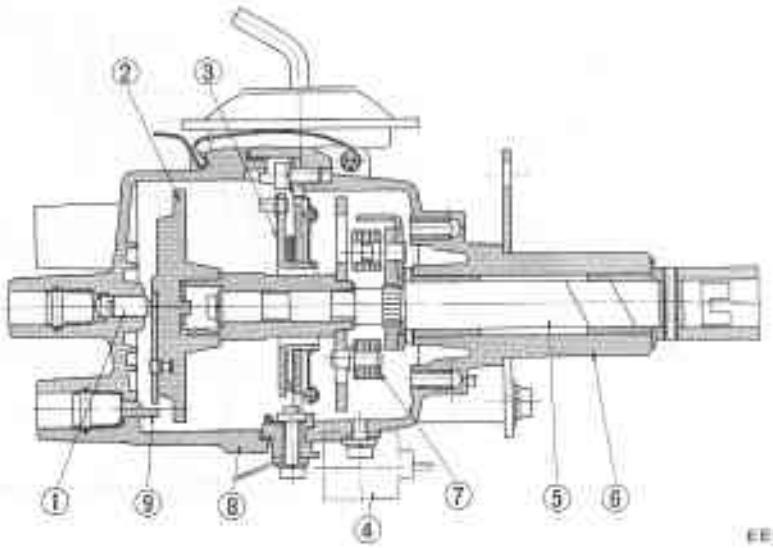
Distributor model	Applied engine
D411-58K	L16 & L18 (with single carb.)
D409-54K	L16 & L18 (with twin carb.) Use a fuel of 95 octane number.
D411-63	L14



EE061

Fig. EE-62 External view of distributor

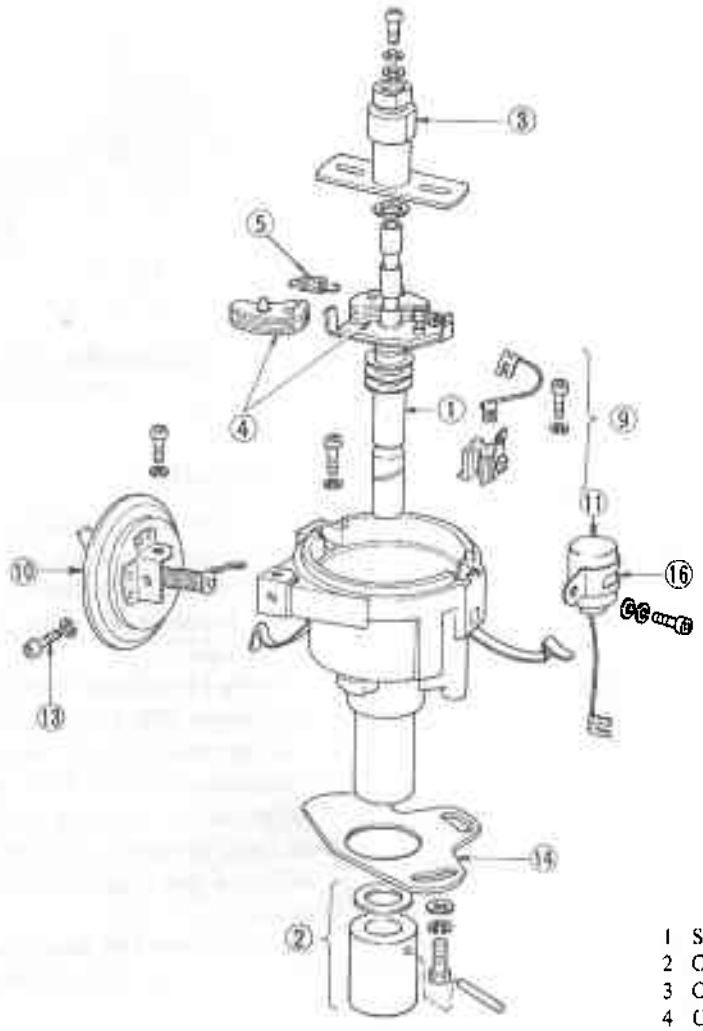
The distributor consists of breaker plate with contact points, centrifugal advance mechanism, vacuum unit, drive shaft, and rotor. Figure EE-63 and 64 show an sectional view of the unit.



EE062

1 Center carbon
2 Rotor head
3 Breaker plate (Contact)
4 Condenser
5 Shaft
6 Housing
7 Governor weight
8 Cap
9 Side plug

Fig. EE-63 Construction



EE063

1 Shaft assembly
2 Collar set assembly
3 Cam assembly
4 Governor weight assembly
5 Governor spring
6 Rotor head assembly
7 Breaker assembly
8 Contact set
9 Terminal assembly
10 Vacuum control assembly
11 Condensor assembly
12 Distributor cap assembly
13 Carbon point assembly
14 Fixing plate

Fig. EE-64 Components of distributor

CHECKING AND ADJUSTMENT

Cap and rotor head

Cap and rotor head 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.

Point

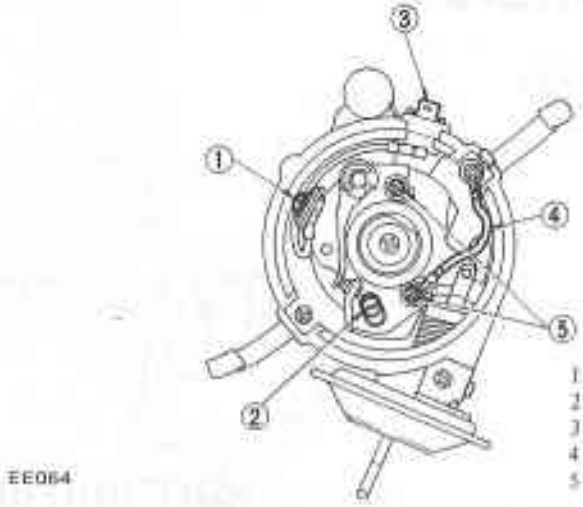
Standard point gap is 0.45 to 0.55 mm (0.0177 to 0.0217 in). In case size is off the standard, adjustment is made by loosening point screws. Gap gauge is required for adjustment.

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

When point surface is rough, take off any irregularities with fine sand paper of No. 500 or 600 or with 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:



1 Screw
2 Adjuster
3 Primary lead terminal
4 Earth lead wire
5 Set screw

Fig. EE-65 Breaker

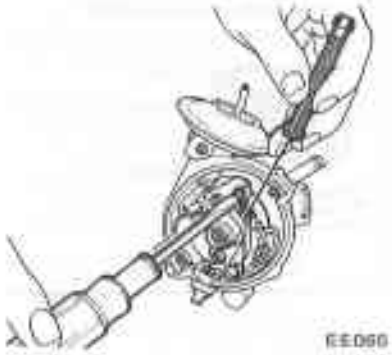


Fig. EE-66 Measuring point gap

First turn out set screws 1 to 1.5 turns at contact arm and primary lead wire connection just for enough to pull out primary lead terminal.

Referring to Figure EE-65, unscrew two contact set fixing screws and remove lead wire.

While holding contact arm by fingers, pull out contact set toward you by raising it slightly. Contact point and arm can then be removed together.

Install new contact point and arm assembly in reverse sequence of removal. Coat cam heel and cam shaft head with a light coating of grease.

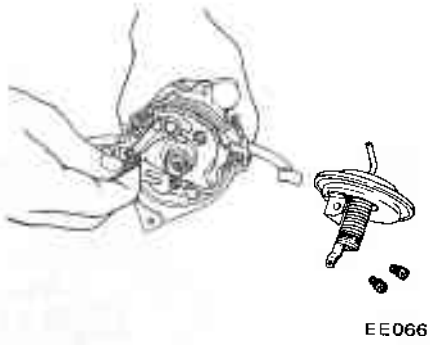


Fig. EE-67 Disassembling contact arm and contact point

Condenser

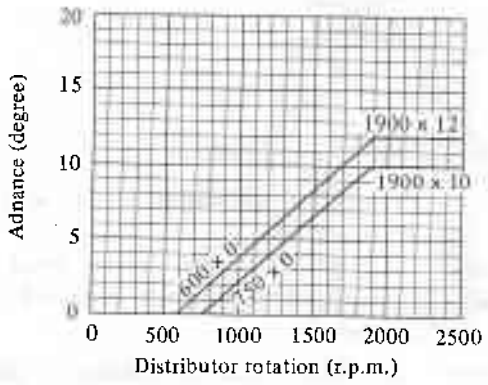
Satisfactory performance of condenser depends on capacity and degree of insulation, requiring attention to be sure that terminals are clean and set screws are tight.

Checking of condenser is made by a capacity tester. This can also be 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.

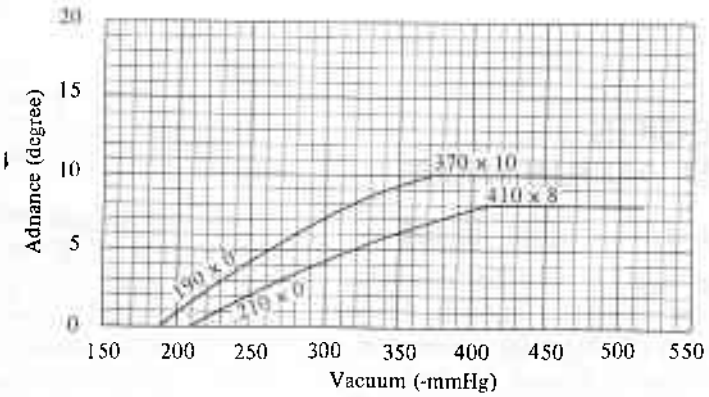
If needle shows any steady reading or if it registers zero, the likelihood is that transformer is out of order, calling for replacement.

Advance mechanisms

≪ Performances ≫



Centrifugal advance



Vacuum advance

EE067

Fig. EE-68 Performance curve for L16 & L18 with single carb.

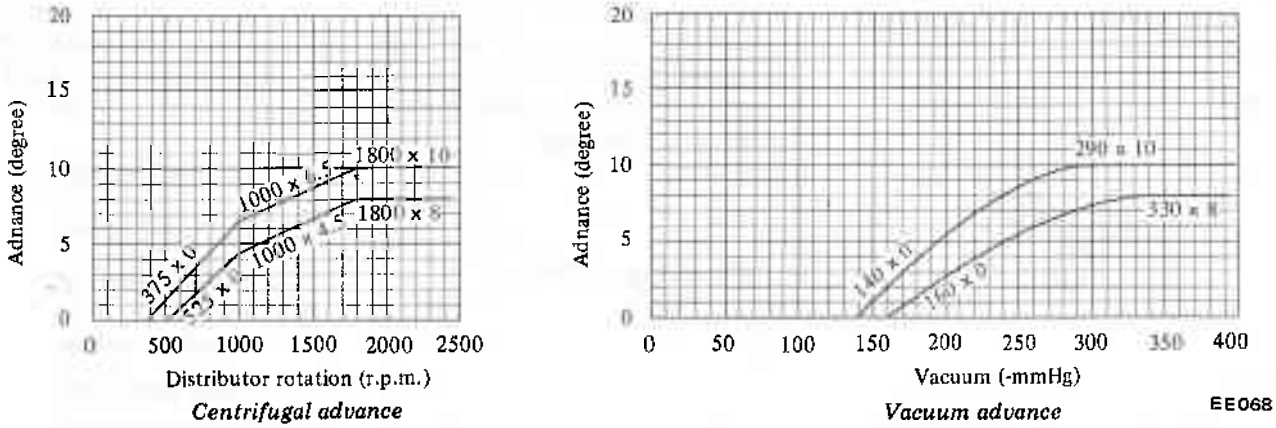


Fig. EE-69 Performance curve for L16 & L18 with twin carb.

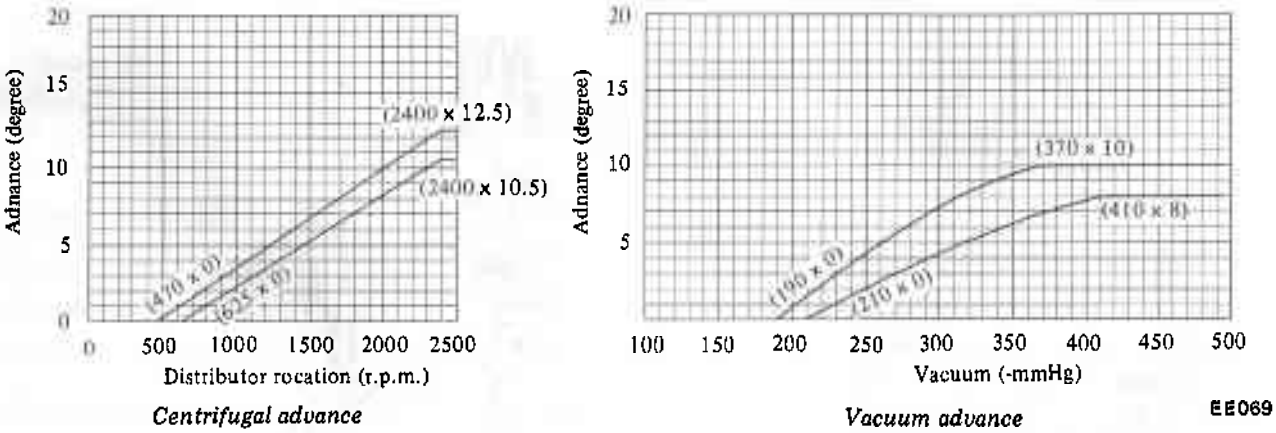


Fig. EE-70 Performance curve for L14 engine

≪Vacuum advance mechanism mechanical parts ≫

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 mechanical parts ≫

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 or 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

To disassemble, follow the below procedure.

1. Take off cap and disconnect rotor head.
2. Remove vacuum controller.

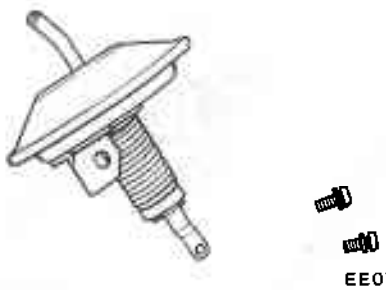
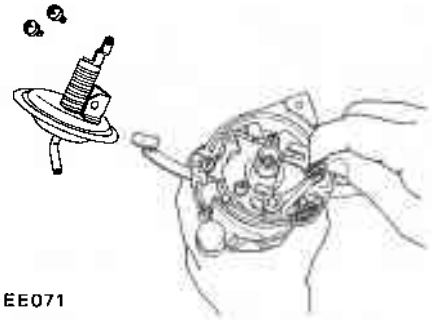


Fig. EE-71 Disassembling vacuum controller

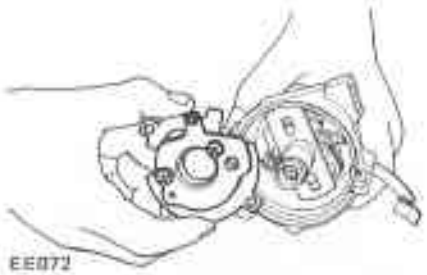
3. Remove contact breaker.

Refer to Page EE-29, when contact set is removed.



EE071

Fig. EE-72 Removing contact set

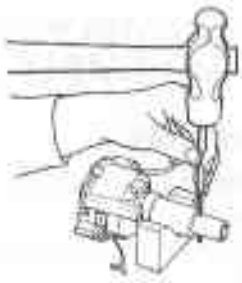


EE072

Fig. EE-73 Removing contact breaker

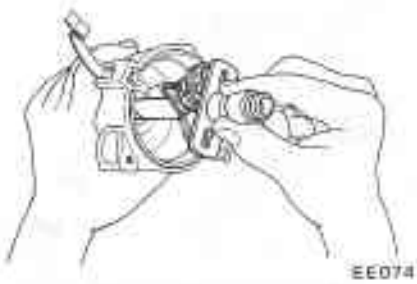
4. When contact breaker is disassembled, be careful not to lose steel balls between breaker spring and breaker plate.

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



EE073

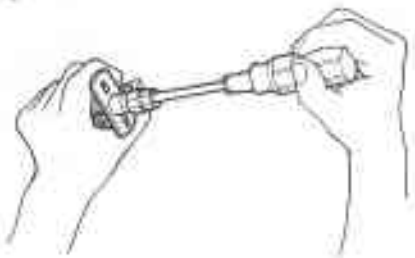
Fig. EE-74 Removing knock pin



EE074

Fig. EE-75 Removing rotation parts

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

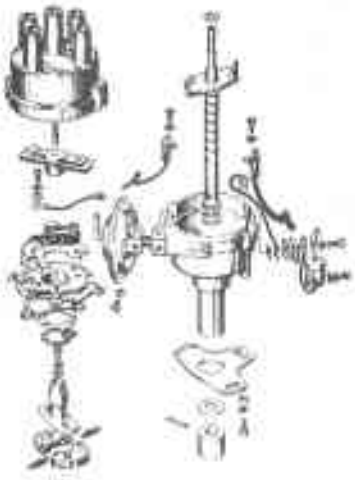


EE075

Fig. EE-76 Removing cam

7. When governor weight and spring are disconnected, be careful not to stretch or deform governor spring.

After disassembling, apply grease to governor weights.

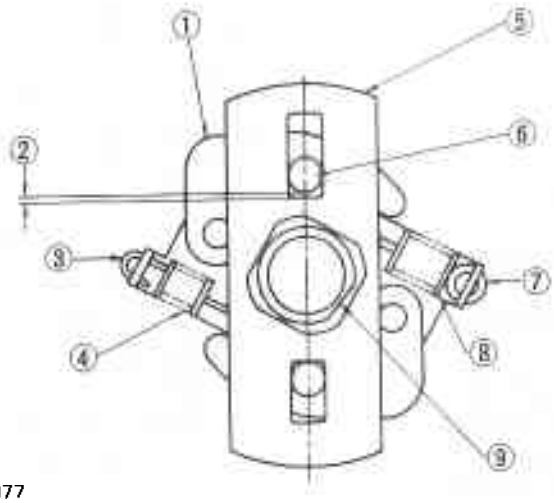


EE076

Fig. EE-77 Exploded view

Assembly

Assembly can be made in reverse sequence of disassembly. Refer to Figure EE-78 for replacement and reassembly of governor spring and cam.



EE077

1 Governor weight
2 Clearance for start and end of advancing angle
3 Rectangular hook
4 Governor spring (B)
5 Cam plate
6 Weight pin
7 Circular hook
8 Governor spring (A)
9 Rotor positioning tip

Fig. EE-78 Setting governor spring and cam

SPECIFICATIONS AND SERVICE DATA

Distributor type	D411-58K	D409-54K	D411-63
Make	HITACHI	←	←
Applied engine	L16 & L18 (with single carb.)	L16 & L18 (with twin carb.)	L L14
Firing order	1-3-4-2	←	←
Rotating direction	Counter-clockwise	←	←
Ignition timing (B.T.D.C.)	10°/600	14°/650	8°/600
Dwell angle (degree)	49° to 55°	←	←
Condenser capacity (μF)	0.22 to 0.44	←	←

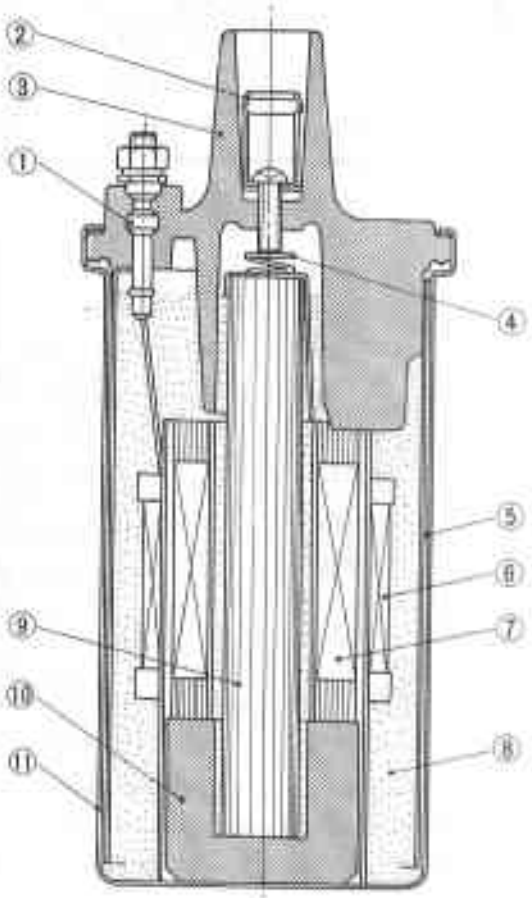
≪ All distributors ≫

Point gap	mm (in)	0.45 to 0.55 (0.0177 to 0.0217)
Point pressure	kg (lb)	0.50 to 0.65 (1.10 to 1.43)
Shaft diameter (lower part)	mm (in)	12.430 to 12.440 (0.4894 to 0.4898)
Housing inner diameter	mm (in)	12.450 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)
Repair limit of clearance	mm (in)	0.08 (0.0031)
Shaft diameter (upper part)	mm (in)	$8\frac{-0.005}{-0.014}(0.3150\frac{-0.0002}{-0.0006})$
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 (0.1969 to 0.1976)
Clearance between pivot and hole	mm (in)	0.01 to 0.046 (0.0004 to 0.0018)

IGNITION COIL

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.



EE078

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

Fig. EE-79 Construction

SPECIFICATIONS

Make and type		HITACHI (6R-200)
Primary voltage	V	12
Spark gap	mm (in)	More than 7 (0.2756)
Primary resistance at 20° (68°F)	Ω	1.5 to 1.7
Secondary resistance at 20° (68°F)	KΩ	9.5 to 11.6
Resistor	Ω	1.6

SPARK PLUG

CONTENTS

DESCRIPTION

The spark plugs are of the resister type, having 14 mm (0.551 in) threads and 0.8 to 0.9 mm (0.031 to 0.035 in) gap. The inspection and cleaning should be made every 10,000 km (6,000 miles), and replacement should be carried out every 20,000 km (12,000 miles).

Note: All spark plugs installed on an engine, must be of the same brand and number of heat range.

INSPECTION

1. Remove spark plug wire by pulling on boot, not on wire itself.
2. Remove spark plugs.
3. Check electrodes and inner and outer porcelains of plugs, noting the type of deposits and the degree of electrode erosion. Refer to Figure EE-80.

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

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

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

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

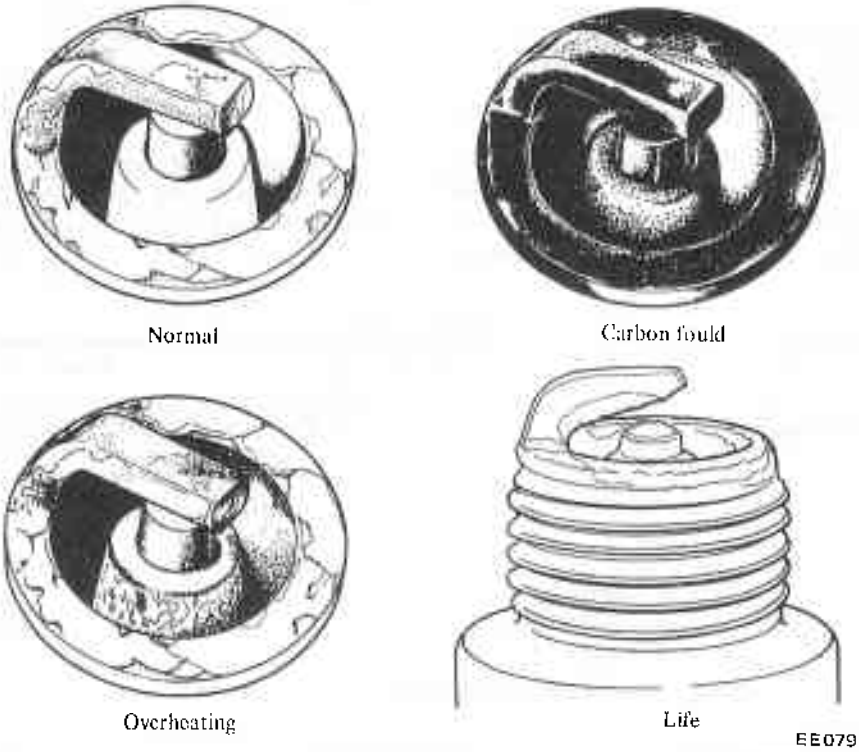


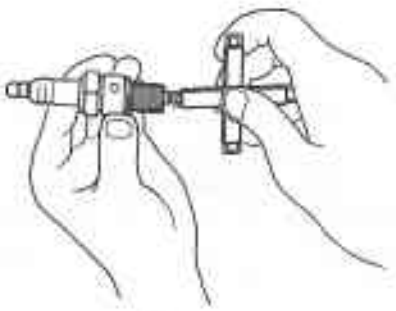
Fig. EE-80 Spark plug

4. After cleaning, dress electrodes with a small fine file to flatten the surfaces of both center and side electrodes in parallel. Set spark plug gap to specification.
5. Install spark plugs and torque each plug to 1.5 to 2.0 kg-m (11 to 15 ft-lb).
6. Connect spark plug wires.

CLEANING AND REGAP

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

After cleaning spark plugs, renew firing surface of electrodes with file mentioned above. Then gap spark plugs to 0.8 to 0.9 mm (0.030 to 0.035 in) using a round wire feeler gauge. All spark plugs new or used should have the gap checked and reset by bending ground electrode.



EE080

Fig. EE-81 Setting spark plug gap

SERVICE DATA AND SPECIFICATIONS

Item \ Make	NGK	
Model	BP-5ES	BP-6ES
Applied engine	L14, L16 and L18 (with single carb.)	L16 and L18 (with twin carb.)
Size (screw dia. x reach) mm (in)	14 x 19 (0.55 x 0.75)	←
Plug gap mm (in)	0.8 to 0.9 (0.031 to 0.035)	←
Tightening torque kg-m (ft-lb)	1.5 to 2.5 (11.0 to 15.0)	←

TROUBLE DIAGNOSES AND CORRECTIONS

1. When engine does not start

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

Spark length	Trouble location	Causes	Remedies
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 cable	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.
		Point burnt too much.	Replace.
Less than 6 mm (0.2362 in)	Spark plugs	Electrode gap too wide.	Correct or replace.
		Too much carbon.	Clean or replace.
		Broken neck of insulator.	Replace.
		Expiry of plug life.	Replace.

2. When engine rotates but does not run smoothly.

In this case, there are many causes resulting from the ignition system and other engine conditions not related to ignition. Therefore, first complete inspection of ignition system should be carried out.

Troubles	Trouble location	Causes	Remedies
Engine misses	Distributor	Dirty point.	Clean.
		Improper point gap.	Correct.
		Leak of electricity of cap and rotor head.	Repair or replace.
		Defective insulation of condenser.	Replace.
		Defective arm.	Oil shaft.
		Defective spring of arm.	Replace assembly.
		Breakage of lead wire.	Replace.
		Worn out or shaky breaker plate.	Replace assembly.
		Worn out or shaky distributor shaft.	Replace assembly.
	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.	Clean.
		Leak of electricity at upper porcelain insulater.	Repair or replace.
Engine causes knocking very often	Distributor	Improper and advance timing.	Correct the fitting.
		Coming off or breakage of governor spring.	Correct or replace.
		A pin or a hole of governor portion worn out.	Replace.
	Spark plugs	Burnt too much.	Replace.
Engine does not give enough power	Distributor	Improper and retarded timing.	Correct the fitting.
		Defective function of governor.	Replace assembly.
		Dirty point.	Clean.
		Point gap too narrow.	Correct.
	Spark plugs	Dirty.	Clean.