ENGINE ELECTRICAL SYSTEM

DESCRIPTION

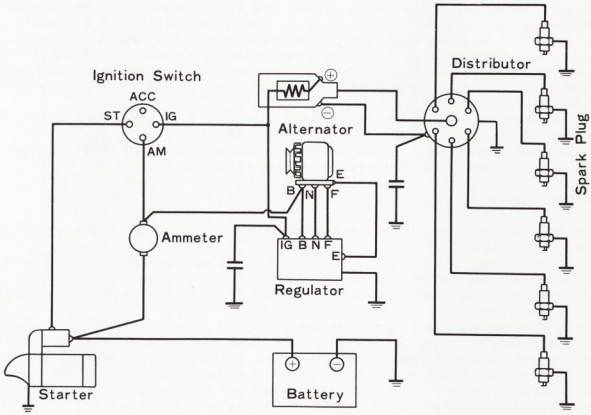


Fig.7-1 Wiring Diagram of Engine Electrical System G0329

The wiring diagram of the engine electrical system is as shown in figure 7-1, and is equipped with a 12 volt electrical system.
The electrical system for this engine consists of four systems: Starting, Charging, Ignition, and Battery.

Starting System:

The starter, having the magnetic switch, is activated by turning the ignition key.
The starter has the following characteristics. The output is large, and is sealed type to prevent entry of dirt, and dust.
The starter clutch is very small, and the armature does not over-run. The operation of the starter clutch, and the magnetic switch enables to accomplish a smooth, and trouble-free gear meshing.
The use of mold commutator has increased the durability of the commutator against the centrifugal force.
Also the use of molds for the magnetic switch terminals, and the contact plate have extremely reduced the possibility of having short circuiting, and poor insulation.
The armature brake is designed to apply when the starter clutch returns completely to its original position.

Charging System:

The charging system consists of the alternator, and the regulator, and this alternator comprises three major parts; the stator, rotor, and the rectifiers. Alternating current from the alternator is converted into a direct current by the rectifier. The rectifier has a very high resistance to the flow of electrical current in one direction, but a very low resistance in the other direction. The high resistance prevents the current from flowing from the battery to the alternator. Such rectifiers provide rectification throughout the operating range of the alternator.
The regulator acts in limiting the alternator voltage to a pre-set value by controlling the rotor coil current.
No current control is required for such alternator since the current output is controlled by the self-limiting characteristics of the alternator.

Ignition System:

The ignition system produces, and delivers high voltage surges to the spark plugs at timed intervals.
Each high voltage surge produces a spark at the spark plug gap, to which it is delivered, igniting the mixture of air and fuel in the combustion chamber.
If it functiones improperly, it immediately will affect the engine performance, and fuel consumption.
The distributor equipped on this engine, designed especially for high speed operation, utilizes two sets of breaker points. The points are mounted opposite to each other, and are designed so that when one breaker set opens, the other set closes. The dual breaker sets are installed in parallel circuit with the cam which is provided with three cam lobes, and not six, therefore the engine can operate at much higher speeds and still produce a uniform sparks.

Battery:

The battery equipped on this car is compact, and the output is large. The inside of the battery is easily visible as the case is of a plastic material.

TROUBLE SHOOTING

Symptoms & Probable Causes	Remedies
Starter	
1. Starter does not turn or slow cranking of engine	
a. Poor contact of ignition switch points	Replace ignition switch
b. Poor connection of ignition switch conjunction socket	Repair conjunction socket
c. Poor connection of magnetic switch "50" terminal	Repair conjunction terminal
d. Open wiring between ignition switch and magnetic switch "50" terminal	Repair or replace wiring
e. Poor connection of battery ground cable	Clean and tighten

Symptoms & Probable Causes	Remedies
f. Poor connection of battery terminal/s	Clean and tighten
g. Weak battery	Recharge or replace
h. Burnt or poor contact of magnetic switch contact plate	Replace magnetic switch
i. Open magnetic switch pull-in coil circuit	Replace magnetic switch
j. Open magnetic switch holding coil circuit	Replace magnetic switch
k. Poor contact of brushes	Dress commutator, and brushes
l. Burnt commutator	Lathe cut the commutator
m. Commutator mica too high	Under cut the mica
n. Shorted or grounded field coil	Replace field coil
o. Shorted or grounded armature	Replace armature
p. Poor tension of brush spring/s	Replace spring/s
q. Poor soldering of starter field coil to brush	Solder field coil lead
r. Worn bushing/s	Replace bushing/s
2. Starter turns, but pinion does not mesh with ring gear	
a. Worn starter clutch pinion gear	Replace starter clutch
b. Defective starter clutch (over running clutch)	Replace starter clutch
c. Weak starter clutch retracting spring	Replace starter clutch
d. Poor movement of starter clutch on armature shaft	Clean and correct
e. Worn bushing/s	Replace bushing/s
f. Incorrect magnetic switch plunger travel	Adjust magnetic switch plunger stud
g. Missing pinion drive lever set pin	Replace and correct
h. Worn flywheel ring gear	Replace ring gear
3. Starter keeps running	
a. Melted magnetic switch contact plate	Replace magnetic switch
b. Shorted magnetic switch coil	Replace magnetic switch
c. Ignition switch returns poorly	Replace ignition switch
Alternator, Regulator & Batter	
1. Battery discharges	
a. Loose or worn "V" belt	Adjust or replace "V" belt
b. Shorted or opened alternator stator coil	Replace stator
c. Opened alternator rotor coil	Replace rotor
d. Poor contact of brushes, and slip rings	Clean or replace

Symptoms & Probable Causes	Remedies
e. Defective alternator rectifier/s	Replace rectifier/s
f. Regulator out of adjustment	Adjust regulator
g. Burnt or poor contact of regulator points	Dress points or replace regulator
h. Lack or insufficient electrolyte of battery	Replenish or replace
i. Shorted battery plates	Replace battery
j. Poor connection of battery terminal/s	Clean and tighten
k. Open or poor connection iwring between ingition switch and regulator "IG" terminal	Repair or replace wiring
l. Open or poor connection wiring between alternator "F" terminal and regulator "F"	Repair or replace wiring
m. Excessive current draw	Check excessive current draw (remove item/s if installed)
2. Battery overcharges	
a. Poor connection of regulator "E" terminal	Clean and repair
b. Opened voltage regulator coil	Replace regulator
c. Melted regulator points	Replace regulator
d. Regulator out of adjustment	Adjust regulator
e. Opened voltage relay coil	Replace regulator
3. Ammeter needle vibrates	
a. Loose or worn "V" belt	Adjust or replace "V" belt
b. Poor connection of wiring terminals	Clean and tighten
c. Burned or melted regulator points	Replace regulator
4. Noisy alternator	
a. Defective bearing/s	Replace bearings
b. Defective rectifier/s	Replace rectifier/s
c. Grounded or shorted stator coil	Replace stator coil

Ignition System

1. Starter turns but engine will not start	
a. Weak battery	Recharge battery
b. Excessive moisture on high tension lead/s or spark plug/s	Remove moisture and dry

Symptoms & Probable Causes	Remedies
c. Cracked or leaky distributor cap or rotor	Replace cap or rotor
d. Broken wire in primary circuit	Repair or replace wire
e. Burnt or improperly adjusted breaker points	Adjust or replace points
f. Defective condenser	Replace condenser
2. Hard starting	
a. Weak battery	Recharge battery
b. Defective spark plug/s	Replace spark plug/s
c. Defective breaker points	Replace breaker points
d. Loose connection in primary circuit	Tighten or repair
e. Defective condenser	Replace condenser
f. Defective ignition coil	Replace ignition coil
g. Cracked or leaky distributor cap or rotor	Replace cap or rotor
3. Engine misses	
a. Dirty or defective spark plug/s	Clean, adjust or replace spark plug/s
b. Loose high tension lead/s or defective insulation	Tighten, repair or replace high tension lead/s
c. Cracked distributor cap	Replace cap
d. Improper breaker points adjustment	Adjust breaker points
e. Incorrect ignition timing interval	Adjust ignition timing interval

STARTER

Specification

Voltage	12 volts
Maximum output power	0.8 KW
Actuating time	30 seconds
Direction of revolution	Clockwise as seen from pinion side
Number of poles	Four
Armature brake	Mechanical brake
No-load characteristics:	
Voltage	at 11 volts
Amperage	Less than 50 amperes
Revolution	More than 3,000 rpm
With load characteristics:	
Voltage	at 9.5 volts
Amperage	Less than 230 amperes
Revolution	More than 800 rpm
Torque	at 0.7 m-kg (5.1 ft-lb)
Locked characteristics:	
Voltage	at 7.7 volts
Amperage	Less than 380 amperes
	More than 1.0 m-kg (7.2 ft-lb)

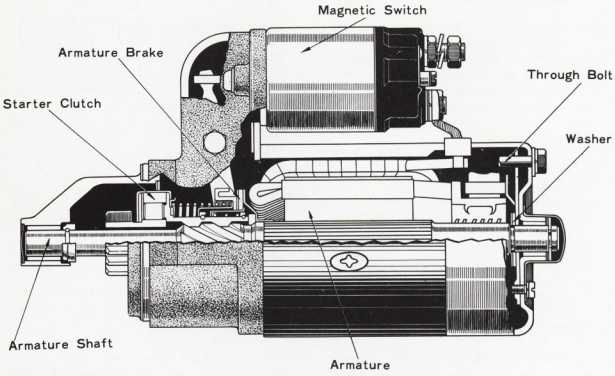


Fig.7-2 Cross Sectional View of Starter Y5208

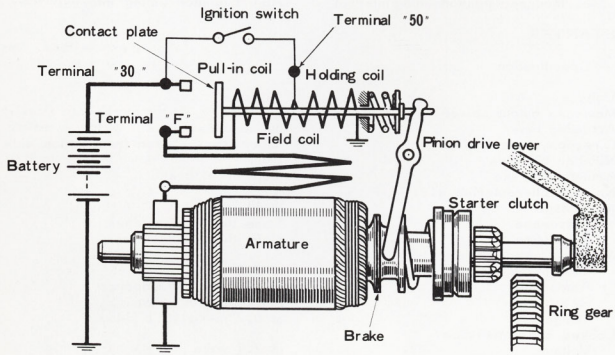


Fig.7-3 Starter Circuit X3717

Removal

1. Disconnect the battery to starter cable from the battery terminal. To remove the starter cable, unhook the service lid clips, and remove the right side service lid upper panel.
   Next, unlock the service lid lower panel lock, and open the service lid lower.

2. Disconnect the choke wire (1) from each carburetor.

3. Unscrew the two bolts, and remove the air intake connector No.1 (2).

4. Remove all the air funnels, then remove the air intake connector No.2 (3).

5. Disconnect the fuel hoses (4) from the carburetors No.3 (5).

6. Disconnect the accelerator connecting rod (6) from the accelerator link arm (7).

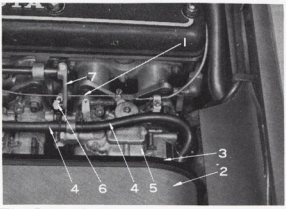


Fig.7-4 Carburetor Removal V1228

7. Take care, and remove the carburetor No.3 from the intake manifold.
   Do not touch the adjusting screws on the carburetor when removing the carburetor.

8. Disconnect the battery to starter cable, and the other wires from the starter.

9. Remove the starter toward the engine compartment.

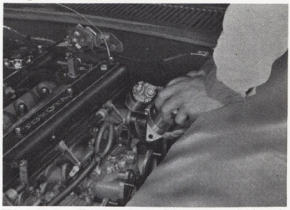


Fig.7-5 Removing Starter V1229

Disassembly

1. Disconnect the field coil lead wire from the magnetic switch terminal.

2. Remove the magnetic switch.

3. Remove the bearing cover, then remove the lock plate, and the washers.

4. Loosen and remove the through bolts, then remove the commutator end frame.

5. Withdraw the brushes from the brush holder, and remove the brush holder.

6. Tap the starter yoke with a mallet lightly, and separate the yoke from the starter drive housing.

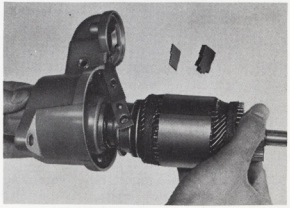
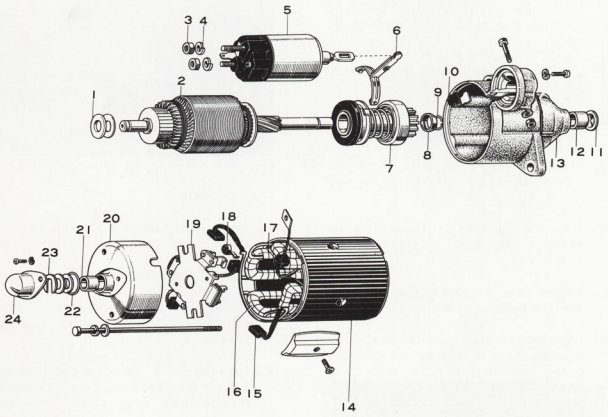


Fig.7-6 Removing Armature W8627



1. Washer
2. Armature
3. Nut
4. Lock washer
5. Magnetic switch
6. Pinion drive lever
7. Starter clutch
8. Pinion stop collar
9. Snap ring
10. Rubber plate
11. Bearing cover
12. Bushing
13. Starter drive housing
14. Starter yoke
15. Brush
16. Field coil
17. Rubber bushing
18. Brush spring
19. Brush holder
20. Commutator end frame
21. Bushing
22. Rubber ring
23. Lock plate
24. Bearing cover

Fig.7-7 Starter Components Y5209

7. Loosen and remove the drive lever set pin, and remove the plate and the rubber plate.

8. Remove the pinion drive lever and the starter armature.

9. Remove the snap ring retaining the pinion stop collar to the end of the armature shaft.
   To remove the snap ring, make a tool similar to the one as illustrated in the following illustration, with a suitable size pipe to remove the pinion stop collar towards the starter clutch side first, then remove the snap ring.

10. Remove the pinion stop collar, and slide out the starter clutch from the armature shaft.

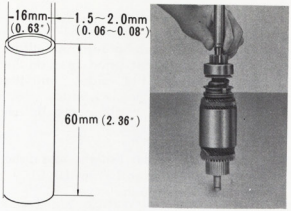


Fig.7-8 Removing Snap Ring W0818 X3718

Inspection & Repair

Armature

1. Inspect the clearance between the armature shaft, and the bushings. The clearance should be 0.005 to 0.1 mm (0.0002 ~ 0.0039"). The limit is 0.2 mm (0.008"). If the limit exceeds, replace the armature or the bushing/s.

2. Check the commutator for roughness, burnt or scored surface, and if necessary, dress or cut with a lathe just enough to remove stock to clean the surface, and remove the roughness. If the diameter of the commutator is out-of-round more than 0.3 mm (0.012"), cut the commutator on a lathe. The out-of-round should not exceed 0.05 mm (0.002").

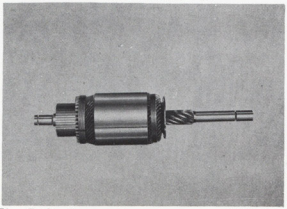


Fig.7-9 Inspection of Commutator W0819

The diameter serviceable limit is 36.8 mm (1.449"), and if the limit exceeds, replace the armature.

3. Check the mica depth, and file off the mica if the depth is less than 0.2 mm (0.008"). The proper depth should be 0.5 to 0.8 mm (0.02 ~ 0.03").

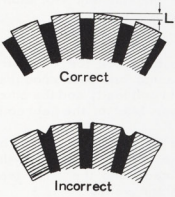


Fig.7-10 Commutator Mica Depth X3719

4. Check the commutator for ground by placing one test prod lead on the commutator segment, and the other lead on the armature core or shaft. If the test lamp lights, the commutator is grounded. Replace the armature.

5. Check the armature for short circuit by placing the armature on a growler, and hold a hacksaw blade over the armature core while rotating the armature.

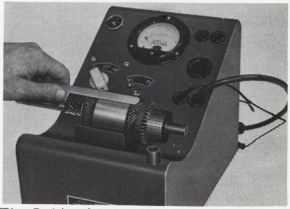


Fig.7-11 Armature Core Short Circuit Test V2187

If the hacksaw blade vibrates, the armature core is shorted. Replace the armature.

6. Check the armature coil for open circuit by placing the armature on a growler, and connect the two segments with the test prod leads. Replace the armature if the reading shows inconsistent vibration.

Field coil

1. Check the field coil for open circuit by placing one test prod lead on the field coil lead, and the other on the other lead of the field coil.

2. Check the field coil for ground by placing one test prod lead on the field coil lead, and the other lead on the starter yoke.
If the tester needle moves, the field coil has a ground circuit.

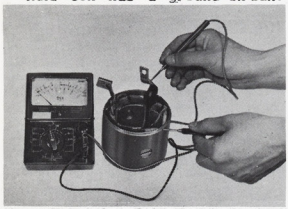


Fig.7-12 Testing Field Coil V2190 for Ground

Starter clutch

1. Check the pinion teeth for wear, score, and chips.
If defective, replace the starter clutch assembly.

2. Check the starter clutch for damage, binding in reverse motion, and also for looseness.
If necessary, replace the starter clutch assembly.

Brush & Brush holder

1. Check the brush holder insulation.
Connect one test prod lead on the brush holder (+) side, and the other lead on the (-) side.
If necessary, replace the brush holder.

2. Check the brush length, and if the length is less than 13 mm (0.51"), replace the brush.

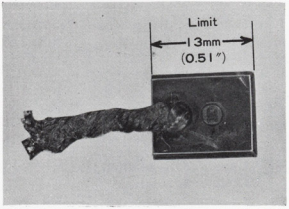


Fig.7-13 Brush Length W0821

3. Check the brush spring tension with a pull scale.
The reading of the tension should be made with the spring just off the brush.
The brush spring tension should be 1,200 grams (2.6 lb), and the limit is 600 grams (1.3 lb).

Magnetic switch

1. Test the pull-in coil motion of the magnetic switch. Connect the test

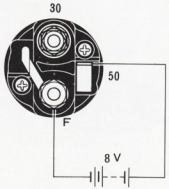


Fig.7-14 Pull-in Coil Test X5786

lead as illustration in figure 7-14. The magnetic switch should pull in the plunger strongly with 8 volts.

2. With the magnetic switch in pull-in condition, connect the battery negative lead to the magnetic switch body.
Next, disconnect the test lead of the battery negative lead from the "F" terminal, and the plunger must be pulled in and held in this position.

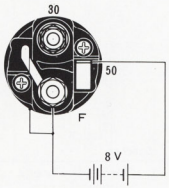


Fig.7-15 Holding Coil Test X5787

3. Check the plunger return test by connecting the battery negative lead to the "F" terminal, and the positive lead to the magnetic switch body. After pushing in the plunger with the hand, and releasing the hand, the plunger should return with 12 volts. This indicates that the magnetic switch is satisfactory.

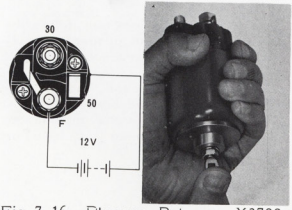


Fig.7-16 Plunger Return Test X3722 W8635

Assembly

Follow the disassembly procedures in the reverse order.

1. Before assembly, all rotating or sliding parts should be lubricated with engine oil or multipurpose grease as shown in the following illustration.
Multipurpose grease indicated by "A".
Engine oil indicated by "B".

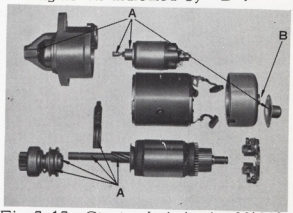


Fig.7-17 Starter Lubrication V1230

2. Assemble the starter clutch onto the armature shaft, then install the pinion stop collar, and the snap ring.
Lock the pinion stop collar in place by punching at two places.

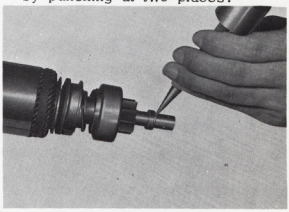


Fig.7-18 Punching Stop Collar V1136

3. When assembling the pinion drive lever to the drive ring of the starter clutch, position the drive ring stopper as shown in figure 7-19.

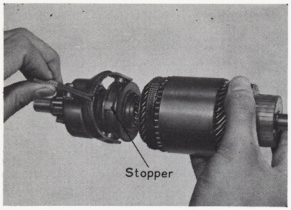


Fig.7-19 Assembling Pinion W8642 Drive Lever

4. After assembly, check the thrust clearance between the commutator end frame, and the lock plate at the end of the armature shaft. The thrust clearance should be 0.05 ~ 0.35 mm (0.002 ~ 0.013"), and the limit is 0.8 mm (0.03"). If necessary, adjust the thrust clearance with the washer.

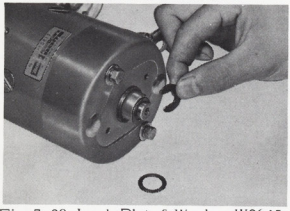


Fig.7-20 Lock Plate & Washer W8645

5. After assembly, check the clearance between the starter clutch pinion, and the pinion stop collar. The clearance should be 2 ~ 4 mm (0.08 ~ 0.16"), when the starter is operated under no load. If the clearance is not within this value, remove the magnetic switch, and adjust the length of the magnetic switch moving stud.

Performance Test

The following tests should be performed after assembling the starter.

Use a fully charged battery (45 ampere-hour battery) for the test.

1. No-load test.
   To perform a no-load test, connect the test lead as shown in figure 7-21.
   The starter should rotate smoothly at a constant speed of over 3,000 rpm at 11 volts with a current draw of 50 amperes or less.

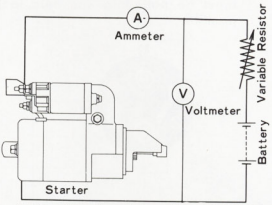


Fig.7-21 Testing Circuit G0330

2. Load test
   To perform a load test, follow the instructions, and procedures outlined in the instruction manual of the tester.
   The starter should operate under the load of 0.7 m-kg (5.1 ft-lb) at 9.5 volts with a current draw of less than 230 amperes at 800 rpm or more.

3. Lock test
   To perform a lock test, follow the instructions, and procedures outlined in the instruction manual of the tester.
   The armature locked, and the current draw should be less than 380 amperes at 7.7 volts producing a torque of 1.4 m-kg (10 ft-lb) or more.

Installation

To install, follow the removal procedures in the reverse order.
Adjust the carburetors. For detail adjustment, and procedures refer to Engine Tune-Up section.

ALTERNATOR & REGULATOR

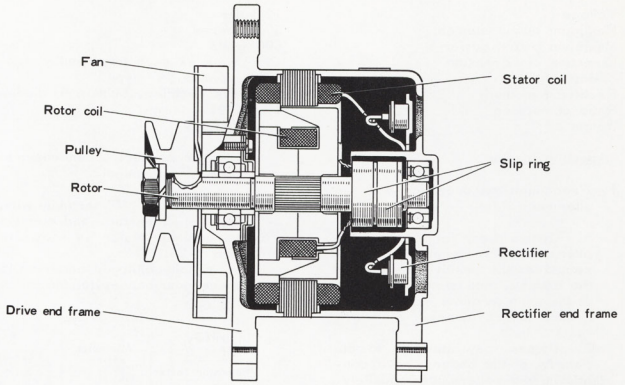


Fig.7-22 Cross Sectional View of Alternator Y5118

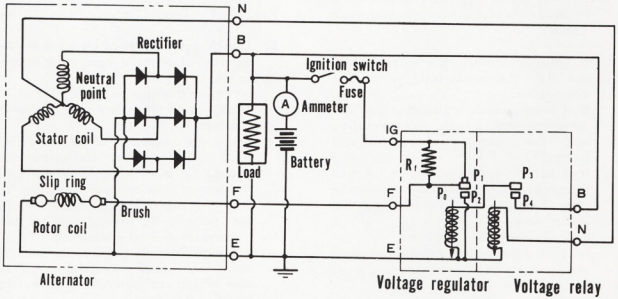


Fig.7-23 Alternator Generating Circuit X4368

Specification

Voltage	12 volts
Maximum output current	50 amperes
Maximum output power	600 watts
Direction of revolution	Clockwise as seen from pulley
Stator coil	Three-phase "Y" type
Rectifying method	All-wave rectifier, built in six diodes
Ratio of rotation	1 to 1.21
Weight	5 kg (11 lbs)

Inspection in Car

1. Precaution on operation with the alternator.

   a. Always keep in mind that the alternator "B" terminal is connected to the positive terminal of the battery, and also that voltage at the "F" terminal exists as the ignition switch closes.

   b. Always pay attention to the polarity of the battery, not to connect it to the alternator oppositely. If connected oppositely, large current flows from the battery to the alternator, and damages the rectifier, and sometimes the flasher unit will burn.

   c. For quick charging, make sure to disconnect the battery to starter cable.

   d. Never rotate the engine with the "B" terminal lead wire disconnected.
   If disconnected, voltage at the "N" terminal increases abnormally, and the voltage relay coil will burn.
   If it is necessary to open the "B" terminal, disconnect the connector plug for the "F" terminal at the same time.

   e. For adjustment of the regulator, make sure to disconnect the connector plug.
   If connected, the points may short, and may be damaged.

   f. Never connect a condenser to the "F" terminal.

2. Disconnect the "B" terminal wire from the alternator, and connect the regulator tester as shown in figure 7-24.
   Use a fully charged battery (45 ampere-hour battery)for the check.

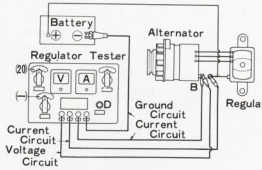


Fig.7-24 Test Circuit G0333

3. Check the voltage of alternator regulator at normal operating temperature.
   Increase the engine revolution gradually until the engine revolution reaches 2,000 rpm.
   Read the voltage, which should be 13.5 ~ 14.5 volts, and amperage should be less than 10 amperes.
   A current flow considerably higher than that specified above, indicates the battery is discharged or the battery plates are shorted.
   If the voltmeter needle vibrates, it indicates that the regulator points are rough or improper connection of "F" terminal.
   If the voltmeter indicates more than

that specified baove, it is the indication of the following symptoms.

a. Voltage regulator high speed point gap is too wide.

b. Improper contact of the voltage regulator high speed points.

b. Improper contact of the voltage regulator high speed points.

c. Voltage regulator or voltage relay coil opened.

d. Improper connection of regulator "N" or "B" terminal.

e. Voltage regulator low speed point pressure is too strong.

4. Load test.
   Make the test connection as shown in figure 7-24.
   Increase the engine revolution gradually until the engine revolution reaches 2,000 rpm.
   Close the switch "D" of the tester, then check the reading on the ammeter.
   The ammeter should indicate more than 37 amperes, and the voltage should be 13.5 ~ 14.5 volts.
   Do not close the switch "D" too long.
   If the current flow is extremely lower than the specified amperage, shorted or opened.

5. Stop the engine, and disconnect the connector plug.
   Check the resistance between the regulator "IG" and "F" terminals with a circuit tester.
   There should be no resistance.

6. Check the resistance between the alternator "F" and "E" terminals with a circuit tester.
   The specified resistance should be 6 ~ 9 ohms.
   If there is little or no resistance, the rotor coil is shorted.
   If the resistance is considerably higher than that specified above, the rotor coil or brushes, and the slip rings have a high resistance or are opened.

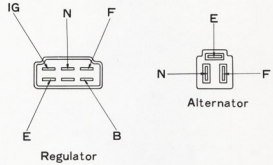


Fig.7-25 Regulator & Alternator Connector Plug X6097

Alternator

Removal

1. Disconnect the battery to ground cable from the battery terminal. To disconnect the cable, refer to starter removal paragraph 1.

2. Disconnect the "B" terminal wire, and the connector plug from the alternator.

3. Loosen the fan belt adjusting bar bolt, and disengage the "V" belt.

4. Remove the radiator lower shroud.

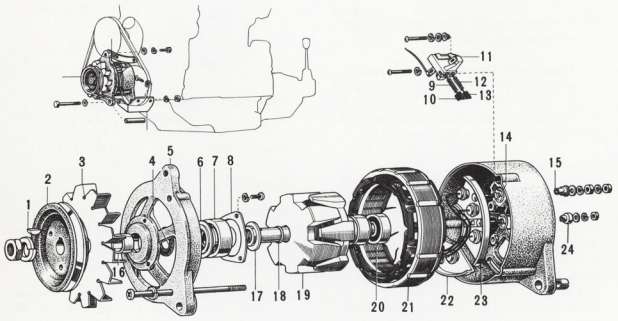
5. Remove the alternator retaining through bolt, and remove the alternator from the lower position.

Disassembly

1. Remove the three through bolts.

2. Separate the drive end frame, and the rotor from the rectifier end frame and the stator.

3. Remove the pulley retaining nut and washer, then remove the pulley and fan.



1. Key
2. Alternator pulley
3. Alternator fan
4. Felt ring
5. Drive end frame
6. Felt ring cover
7. Bearing
8. Bearing retainer
9. Brush spring
10. Brush
11. Brush holder
12. Brush spring
13. Brush
14. Insulator washer
15. Terminal insulator
16. Space collar
17. Spacer
18. Snap ring
19. Alternator rotor
20. Bearing
21. Alternator stator
22. Holder w/rectifier (-)
23. Holder w/rectifier (+)
24. Terminal insulator

Fig. 7-26 Alternator Components Y5211

4. Remove the rotor from the drive end frame with a press.

5. Remove the rear bearing from the rotor shaft with the Injection Pump Spline Shaft Puller 09286-46011.

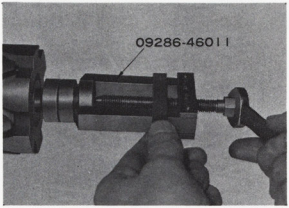


Fig.7-27 Removing Rear Bearing V1139

6. Unscrew the retaining screws, and remove the bearing retainer, front bearing, felt ring cover and the felt ring from the drive end frame.

7. Remove the rectifier holder retaining nuts, and the "B" terminal nut, and insulator, then separate the stator, brush holder, and the rectifier holder from the rectifier end frame.

8. Disconnect the stator coil "N" terminal from the brush holder, and remove the brush holder from the rectifier holder, if necessary.

Inspection & Repair

Bearing

Check the bearings for scores, roughness, abnormal noises or damage. If necessary, replace them.

Rotor

1. Check the rotor coil for open or short circuit.

Make the connection as shown in figure 7-28.
The coil resistance should be 3.5 ohms. If it is little or no resistance the rotor coil or the slip rings indicate a short, and if considerably higher than that specified above, it indicates an opened coil or connection defect.
If the test shows that the rotor coil is shorted or opened, and the slip rings are faulty, the rotor assembly should be replaced.

Fig.7-28 Testing Rotor Coil V2196 for Open and Short Circuits

2. Connect the tester from the slip rings to the rotor or rotor shaft, and check the insulation between them.
If necessary, replace the rotor assembly.

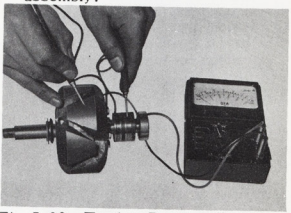


Fig.7-29 Testing Rotor Coil V2197 for Ground

Note:
If the rotor coil lead wire/s, and the slip ring/s is loose, the play between the rotor core, and the shaft must be thoroughly checked, and if necessary, replace.

Stator

1. Check the stator coil for insulation.
Connect the tester between the stator coil lead, and the stator core.
If the tester needle moves, the coil insulation is defective. Replace the stator assembly.

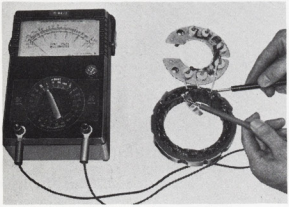


Fig.7-30 Testing Stator Coil for Insulation V1142

2. Check the stator coil for open circuit.
Disconnect the rectifiers from the stator coil lead quickly with a soldering iron.
Check the four leads of the stator coil for conductance between them.

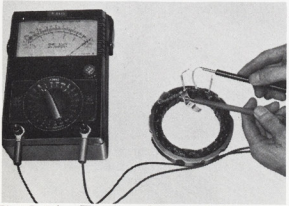


Fig.7-31 Testing Stator Coil for Open Circuit V1145

If necessary, replace the stator coil assembly.

Brush & Brush holder

1. Check the brushes for cracks, and wear.
If the brush is worn beyond 8 mm (0.31"), replace the brushes.
The specified length is 13 mm or 0.51".

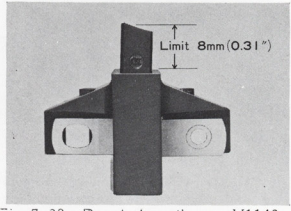


Fig.7-32 Brush Length V1143

2. If the brush is replaced, install the brush spring onto the brush lead and solder the brush lead to keep the protruded brush length to 13 mm (0.51").
The brush should slide smoothly.

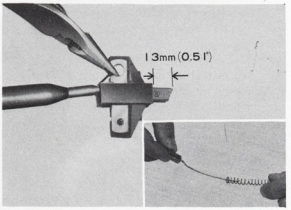


Fig.7-33 Replacing Brush V0216 V0217

Rectifier

Good or defective rectifier is classified by resistance value between the rectifier holder, and the rectifier lead.

1. Rectifier open test

a. Rectifier holder positive side. Connect the tester (+) lead on the rectifier holder, and (-) lead on the rectifier lead as shown in figure 7-34.
Good rectifier will indicate no resistance, and if it indicates a high resistance, the rectifier is opened. If necessary, it should be replaced as a set.

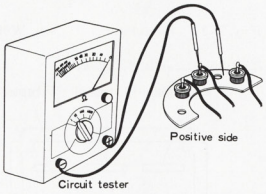


Fig.7-34 Rectifier Open Test X5803

b. Rectifier holder negative side. Connect the tester (-) lead on the rectifier holder, and (+) lead on the rectifier lead.
Good rectifier will indicate no resistance, and if it indicates high resistance, the rectifier is opened. If necessary, the rectifier should be replaced as a set.

Assembly

To assemble, follow the disassembly procedures in the reverse order.

1 Before assembly, the front, and the rear bearings should be lubricated with multipurpose grease.

2. When assembling the drive end frame, install the felt ring covers (1), and (2) with the locking portion side facing the felt rings (3), and (4).

3. When installing the drive end frame onto the rotor use the Transmission Oil Plug 09325-12010.

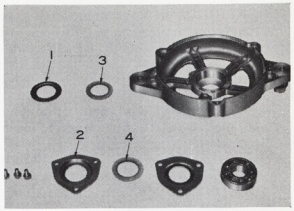


Fig.7-35 Drive End Frame Assembly V1149

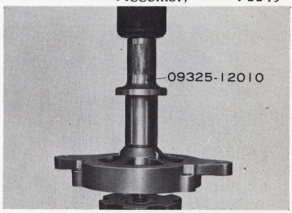


Fig.7-36 Installing Drive End Frame V1150

4. To assemble the stator, and the rectifier end frame with the brush holder onto the rotor, press the brushes against the brush spring tension into the brush holder, then insert a wire through the access hole in the rectifier end frame, and also into the hole provided in the brush holder to keep them in their positions.

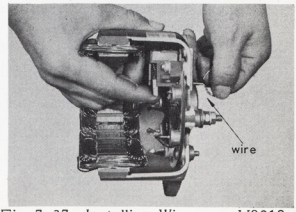


Fig.7-37 Installing Wire V0218

After assembling completely, remove the wire from the rectifier end frame, and the brush holder.

Output Test

Perform the output test in accordance with the circuit shown in the following illustration.
Use a fully charged battery (45 ampere-hour battery) for the test.

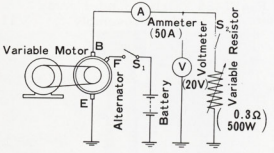


Fig.7-38 Output Test Circuit Y5120

1. Turn on the switch "S1" only, then increase the alternator revolution gradually with a variable motor until the voltage reading reaches 13.5 volts.
   Read the revolution of the alternator which should be 950 - 1,150 rpm.

2. Turn on the switch "S1", and "S2" further holding the output voltage at 13.5 volts, and the amperage at 43 ~ 51 with a variable resistor.
   Read the revolution of the alternator which should be 2,500 rpm.

Installation

Follow the removal procedures in the reverse order.
The "V" belt specified tension is 8 to 10 mm (0.31 ~ 0.40") when depressed at midway of the "V" belt with 10 kg (22 lb) pressure.

REGULATOR

Fig.7-39 Regulator W9678

Regulator Circuit Test

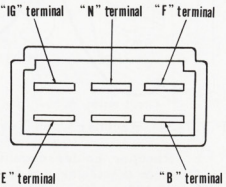


Fig.7-40 Regulator Wiring Harness Connection Plug G0334

1. Connect the circuit tester between the "IG", and "F" terminals.
   The resistance should be zero.
   If the resistance exceeds zero, the voltage regulator low speed point is defective.
   Press the armature of voltage regulator, and check the resistance.
   The specified resistance is 2.8 ohms.
   If the resistance is considerably higher than that specified above, the control resistor is defective.

2. Connect the circuit tester between the "N", and "E" terminals.
   The specified resistance is 23 ohms.

If the resistance is considerably higher or lower than that specified above, the voltage relay coil is defective.

3. Connect the circuit tester between the "B", and "E" terminals.
   There should be no conductance, If any conductance is present, the voltage relay points are melted.

Testing & Adjustment

Always use a fully charged battery of 12 volts, 45 ampere-hour rating. Final adjustment of the regulator should performed with the regulator at normal operating temperature.

1. Voltage relay
   Make the test connection as shown in figure 7-41.
   Turn on the switch "S", and operate the variable motor, and increase the alternator revolution gradually, and read the voltage at the time when the ammeter needle moves.
   This cut-in voltage should be 4.5 to 5.8 volts. To adjust, bend the relay adjusting arm.

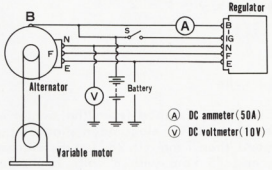


Fig.7-41 Voltage Relay Test Circuit G0348

2. Voltage regulator
   Make the test connection as shown in figure 7-42.
   Turn on the switch "S", and check the voltage, and amperage by varying the alternator revolution gradually, and read the amperage at the time when the ammeter needle registers maximum.
   Increase the revolution, and read the voltage at the time when the ammeter needle registers one-half of maximum amperage reading. Also increase the revolution until it reaches 3,000 rpm, then read the voltage.
   The voltage should be within 13.8 to 14.8 volts.
   To adjust, bend the regulator adjusting arm.

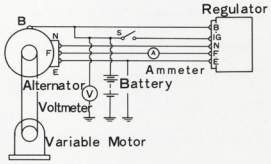


Fig.7-42 Voltage Regulator X4370 Test Circuit

IGNITION SYSTEM

Ignition System Specification:

Distributor	
Condenser capacity	0.135 ~ 0.165 micro-farad
Breaker point pressure	510 ~ 690 grams (18 ~ 24 oz)
Breaker point gap	0.4 ~ 0.5 mm (0.016 ~ 0.020")
Cam dwell angle	41°
Octane selector advance (degree of crankshaft)	One complete turn is about 4.6° One graduation is about 10.4°
Vacuum advance begins	At 30 ~ 50 mm Hg (1.18 ~ 1.97 in Hg)
Timing advances 1.3 ~ 3.7°	At 60 mm Hg (2.36 in Hg)
Timing advances 5.9 ~ 7.9°	At 120 mm Hg (4.72 in Hg)
Timing advances 9.0 ~ 11°	At 190 mm Hg (7.48 in Hg)
Governor advances begins	At 500 ~ 650 rpm
Timing advances 3 ~ 5°	At 860 rpm
Timing advance 8 ~ 10°	At 2,100 rpm
Firing order	1 - 5 - 3 - 6 - 2 - 4
Ignition Coil	
Primary voltage	12 volts
Secondary voltage	Sparking distance from the center to three negative electrodes should jump more than 7 mm (0.28") at distributor speed 75 rpm with 8 volts applied. Sparking distance from center to three negative electrodes should jump more than 6 mm (0.24") at distributor speed 2,500 rpm with 12 volts applied.
Primary resistance (includes primary resistor)	2.55 ~ 3.15 ohms
Secondary resistance	9.000 ohms
Spark plug	NGK BP7E

DISTRIBUTOR

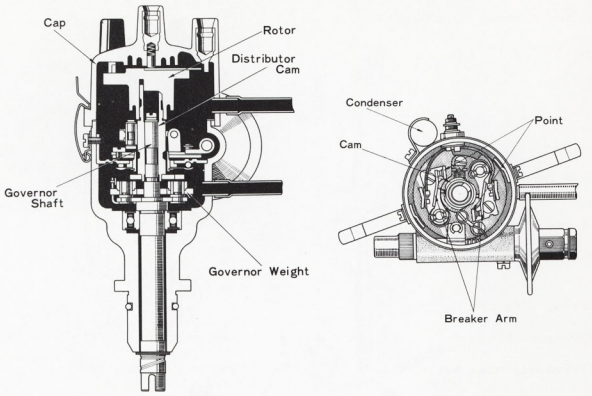


Fig.7-43 Distributor Cross Sectional View G0338, G0339

Removal

1. Disconnect the high tension wires from the spark plugs, and the ignition coil.

2. Disconnect the primary wire, and the vacuum advance line at the distributor.

3. Pull out the tubes from the tube clips, and then remove the distributor cap.

4. Scribe a mark on the distributor housing, and the cylinder block indicating the position of the distributor housing in the cylinder block, and scribe another mark on the distributor housing indicating the position of the rotor.
These marks can be used as guides when installing the distributor in a correct timing position of the engine.

Caution:
Do not rotate the crankshaft while the distributor is removed.

Disassembly

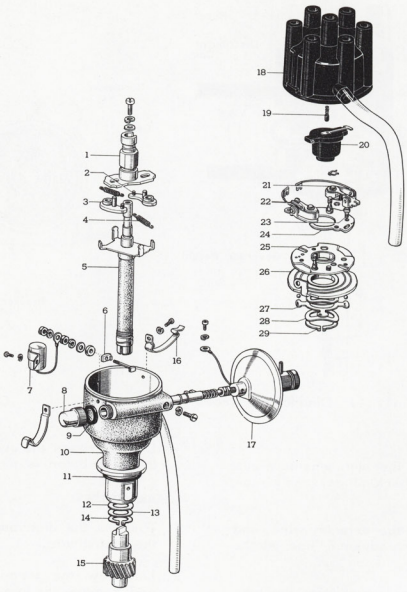
1. Pull out the distributor rotor from the distributor.

2. Unscrew the terminal bolt nuts, and remove the lock washers, insulator, and the condenser.

3. Remove the snap rings, and the securing screw, then lift the breaker point sets.

4. Disconnect the vacuum advancer lead wire, and remove the screws securing the breaker shift plate, then remove it.

5. Remove the terminal bolt, and the insulator.



1. Distributor cam
2. Governor weight
3. Governor weight
4. Governor spring
5. Governor shaft & plate
6. Terminal insulator
7. Condenser
8. Adjuster cap
9. Seal washer
10. Distributor housing
11. "O" ring
12. Washer
13. Washer
14. Snap ring
15. Distributor gear
16. Spring clip
17. Vacuum advancer
18. Distributor cap
19. Center carbon piece
20. Distributor rotor
21. Breaker point set "A"
22. Breaker point set "B"
23. Screw
24. Shift plate
25. Breaker plate
26. Stationary plate
27. Set spring
28. Washer
29. Snap ring

Fig.7-44 Distributor Components Y5212

6. Remove the snap washer that secures the diaphragm link to the moveable breaker plate.

7. Remove the octane selector adjust cap.
   Remove the vacuum advancer retaining screw, and slide the advancer out of the distributor.

8. Remove the spring clips, and lift the breaker plate, and the stationary plate out of the distributor.

9. Remove the rubber cap, and unscrew the distributor cam retaining screw in the cam, and lift the cam from the distributor shaft.

10. Mark one of the governor spring and its bracket.
    Also mark one of the governor weight, and its pivot pin.

11. Carefully unhook, and remove the governor springs, then remove the governor weights.

12. Remove the snap ring, and washer at the end of the distributor shaft.

13. Pull out the distributor shaft from the housing.

Inspection & Repair

Wash all the parts with the exception of the vacuum advancer, condenser and the cap in cleaning solvent.
Inspect the parts for excessive wear or damage, and replace as required.

1. Check the distributor cap for cracks, carbon tracks, and burnt or corroded terminals, and also the wear of the center carbon piece.
   Carbon protrusion is 10 mm or 0.39", and the limit is 7 mm or 0.27".

2. Inspect the rotor for damage or deterioration.

3. Inspect the breaker points for burnt or pitted condition, and if necessary, clean with a point file.
   Never use emery clotch or sandpaper to clean the points since particles will embed, and rapid burning will result.

4. Inspect the distributor shaft for bend which should not exceed 0.05 mm (0.002").

5. Inspect the governor weight for binding with the pivot pin.

6. Inspect the distiributor cam lobes for scoring, and sign of wear. If any lobe is scored or worn, replace the cam.

7. Check the operating resistance between the breaker plate, and the stationary plate with a tension scale.
   The resistance should not exceed 530 grams (18.7 oz).

Assembly

Follow the disassembly procedures in the reverse order.

1. It is recommended that cam lubricating felt block, breaker points, and the condenser should be replaced at the time of assembly.

2. Lubricate the following portions upon assembling.

   a. Coat the governor weight pivot pins, and governor spring hooking portions slightly with gear lubricant.

   b. Coat the sliding surface of the breaker plate with the stationary plate, and the governor linkage, and pack in the cam with distributor lubricant.

   c. Coat the cam lubricating felt block with silicone grease.

3. Install the felt block onto the break-

er shift plate as shown in the illustration.

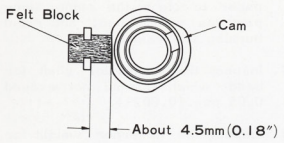


Fig.7-45 Felt Block & Cam G0341

4. Check and adjust the breaker point gap with a feeler gauge.
   Rotate the distributor shaft until the breaker arm rubbing block is at the top of the cam.
   The specified breaker point gap is 0.45 mm (0.018").

5. Check the breaker arm point contact pressure with a pull-scale by pulling at right angle with the breaker arm point.
   Read the pull-scale just when the point opens.
   The pressure should be 510 to 690 grams (18 ~ 24 oz). If the reading is low, replace the breaker points assembly.

Testing

1. Install the distributor onto a distributor tester, and check the cam dwell angle.
   The dwell angle should be 41°.
   The adjustment can be made by adjusting the breaker point gap.
   If the gap is wide, the angle will be small, and if the gap is narrow, the angle will be large.

2. Adjustment of ignition timing intervals.

   a. Install the distributor on a distributor tester, then disconnect the breaker arm lead wires from the terminal bolt.

   Connect a test lamp between the battery positive terminal, and the breaker arm lead wire, and connect another test lamp in the same manner, and also connect other test lead to the battery negative terminal, and the distributor housing.

   b. Rotate the distributor shaft slowly, and check the test lamp just when the lamps to out.
   From the point of one test lamp goes out, to another one goes out point is the ignition timing interval.
   The intervals should be 60°, and adjust if necessary.

   c. To adjust, loosen the screws securing the breaker shift plate to the breaker plate, and move the breaker shift plate with a screwdriver.
   After adjustment, recheck the ignition intervals in the same manner.

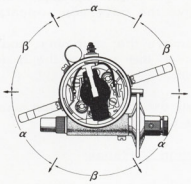


Fig.7-46 Distributor Ignition Intervals G0342

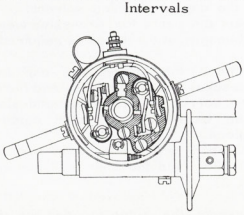


Fig.7-47 Distributor Adjustment G0346

d. Connect the breaker arm lead wires to the terminal bolt.

3. Check the advance characteristics.

a. Centrifugal advancer.
Operate the distributor in the direction of the rotation, and adjust the speed to the initial rpm setting listed in the characteristics graph.
Move the protrusion scale so that one of the flashes aligns with the zero degree mark.
Slowly increase the rpm to setting specified for the first advance reading listed in the graph.
If the correct advance is not indicated at this rpm, replace the governor springs.
Check the advance at all rpm settings listed in the graph.
Operate the distributor both for higher and lower rpm ranges.

b. Vacuum advancer.
Connect the tester vacuum line to the fitting on the vacuum advancer.
Check the advance at the first vacuum setting in the graph.

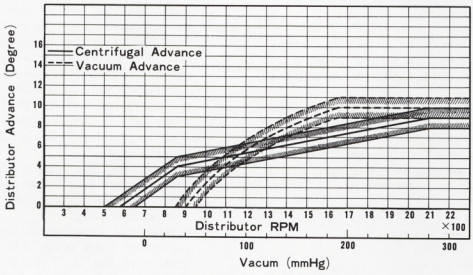


Fig.7-48 Characteristics Graph G0343

Installation

1. If the crankshaft has not been rotated, position the distributor into the distributor driven gear sleeve with the rotor aligned with the mark previously scribed on the distributor housing, and the marks on the distributor housing, and the cylinder block.
Install the distributor clamp, and install the cap.

2. If the crankshaft was rotated while the distributor was removed from the engine, it will be necessary to time the engine.

a. Rotate the crankshaft until No.1 piston is at T.D.C. after compression stroke.
Align the B.T.D.C. 15 graduation on the crankshaft damper with the timing mark on the timing chain cover.

b. Pull out the distributor driven gear, and sleeve from the cylinder block, and align the driven gear as shown in figure 7-49.

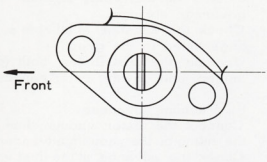


Fig. 7-49 Distributor Driven G0344
Gear Alignment

c. Remove the distributor cap, and set the octane selector at normal position.

d. Position the distributor rotor as illustrated in figure 7-50.
Next, install the distributor into the driven gear sleeve.
Make sure that the driven gear shaft properly engages the distributor shaft.
Rotate the distributor housing slightly until the breaker point starts opening.

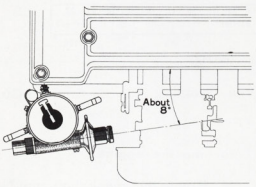


Fig. 7-50 Distributor G0345
Installation

e. Install the distributor clamp, and tighten the retaining bolts.
Install the distributor cap.

3. Connect the vacuum line, primary wire, and the secondary high tension wires.

4. Run the engine at 700 ~ 800 rpm and using a timing light, check if the timing mark aligns with the 15° graduation on the crankshaft damper.
Loosen the clamp retaining bolts slightly, and adjust the ignition timing as necessary.

NOTE:
The ignition timing intervals can be adjusted after the distributor is installed onto the engine.
To check, connect a timing light onto the No. 1 cylinder spark plug, and rotate the crankshaft until No. 1 piston is at B.T.D.C. 15 graduation after compression stroke. The timing light should flash at this point.
Disconnect the timing light cord from the No. 1 cylinder spark plug, then connect it to the No. 6 cylinder spark plug.
Rotate the crankshaft further one complete turn from this position, and align the B.T.D.C. 15 graduation on the crankshaft damper with the timing mark on the timing chain cover.
At this time, the timing light should flash. If the light does not flash at this point, the ignition timing interval is incorrect.
Adjust the intervals by referring to adjustment of ignition timing intervals, paragraph c.

IGNITION COIL & HIGH TENSION WIRES

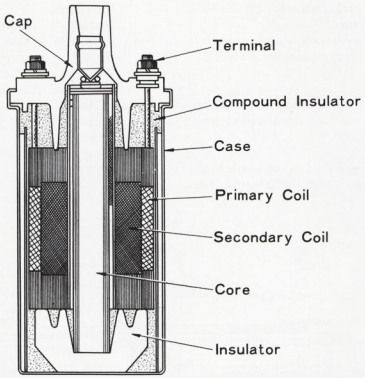


Fig.7-51 Ignition Coil Cross Sectional View G0194

This engine is equipped with an ignition coil built-in with a primary resistor, and the coil excels in building up higher secondary voltage to give sufficient sparks during high speed operations.

The high tension wires are of internal resistance type which filter out the high frequency electrical impluses that are the source of ignition noise interference.

Inspection

Caution:

a. Before testing the coil, always heat the coil to normal operating temperature (80°C or 176°F).

b. When checking the resistance of the high tension wires or setting the ignition timing, do not puncture the wires with a test prod.
The test prod may cause a separation in the conductor.

c. When removing the high tension wires from the spark plugs, hold the wire end, and pull straight out carefully.

d. Never try to alter the length of the high tension wires.

e. Do not make a sharp bend of the high tension wires.

f. Install the high tension wire firmly so that vibration of the wire may be prevented.

g. Install the high tension wire so as to avoid contact between the wire, and the metal surface.

1. Check the primary resistance with a coil tester.
The resistance should be 2.55 to 3.15 ohms (including the primary resistor).

2. Check the secondary resistance with a coil tester.
   The resistance should be 8,400 to 9,200 ohms.
   If there is any broken circuit within the coil, the resistance will be larger.

3. Clean and inspect the high tension wires for cracked insulation, and loose terminals.

4. Check the resistance of each high tension wire, and it should not exceed

5. To perform a spark test, this test should be made after installing on the car.
   Install a terminal adapter in the terminal of the wire to be checked.
   Run the engine at idle speed, and disconnect the high tension wire from the spark plug.
   Hold the adapter approximately 7 mm (0.28") from the cylinder head.
   The spark should jump the gap regularly.

SPARK PLUG

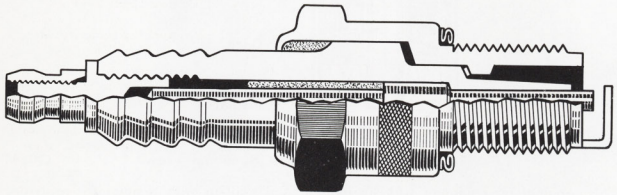


Fig.7-52 Spark Plug X6105

Spark plug life is governed to a large extent by the operating conditions, and plug life varies accordingly.
Worn or dirty plugs may give satisfactory operation at idling speed, but under high speed operating conditions these frequently fail.
Faulty plugs are evident in a number of ways such as wasting gas, power loss, loss of speed, hard starting, and general poor engine performance.
Dirty or leaded plugs may be evident by black carbon deposits on the plugs. The black deposits are usually the result of incorrect carburetor adjustment, slow speed driving, and short runs where sufficient engine operating temperature is seldom reached.

Inspection & Adjustment

Clean the spark plugs thoroughly using a sand-blast cleaner.
Do not prolong the use of the abrasive blast as it will erode the insulation.
If the porcelains are badly glazed or blistered, the spark plugs should be replaced.
All spark plugs must be of the same make, and the number or heat range.

Use a wire gauge to adjust the spark plug gaps to 0.7 ~ 0.8 mm (0.027 to 0.031").
Always make the adjustment by bending the ground electrode.
Before adjusting the gap, file the center electrode flat.

BATTERY

Removal

1. Open the engine hood, and unhook the service lid clips, and remove the service lid upper right panel. Next, unhook the service lid lower panel lock, and open the service lid lower panel.
   Unhook the service lid hinge rear side, then slide the service lid lower panel rearward, and remove the lid.

2. Disconnect the battery to starter cable, and the battery to ground cable from the battery terminals.

3. Remove the battery hold-down clamp, then remove the battery.

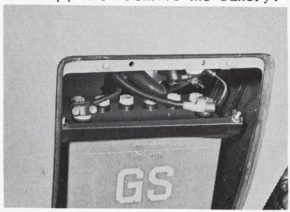


Fig.7-53 Battery Removal V1229

Inspection & Adjustment

1. Check the electrolyte level of each cell.
   If necessary, add sufficient electrolyte to the level line.
   Always use distilled water to replenish the battery.

2. Check the specific gravity of the electrolyte with a hydrometer. If the specific gravity reading is below 1.200, and the difference between each cell is more than 0.025, the battery should be recharged.
   Electrolyte specific gravity of a fully charged battery should be 1.250 ~ 1.270 at 20°C (68°F).
   The specific gravity of acid solution to be used as electrolyte, varies according to its temperatures.
   It is necessary before adjusting the specific gravity that it is converted according to standard temperature reading of 20°C (68°F).
   For conversion of temperature pertaining to acid specific gravity, the following equation should be used.

$$S20 = ST + 0.0007 (t - 20)$$

S20 ... Specific gravity at 20° C
ST.... Specific gravity at t° C
t ..... Temp. of electrolyte (°C)
0.0007. Temp. coefficient

Electrolyte specific gravity at 20° C (68° F)

1.260 is 100% fully charged state
1.210 is 75% fully charged state
1.160 is 50% fully charged state
1.110 is 25% fully charged state
1.060 is fully discharged state

Charging

Before placing the battery on the charger, clean the battery terminals, check the electrolyte level, and replenish with distilled water as necessary.
Remove all the filler caps while charging, and do not allow the battery electrolyte temperature to rise 45° C (113°F).
Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if frame or sparks are bought near the vent openings of the battery.
The sulphuric acide in the battery electrolyte can cause a serious burn if spilled on the skin or spattered in the eyes. It should be flushed away with large quantity of clear water.
For quick charging, make sure to disconnect the battery to starter cable. If not, the rectifier of the alternator will be damaged.