ENGINE ELECTRICAL

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GENERAL DESCRIPTION

The 1954 Cadillac has a 12 volt ignition system consisting of the battery, ignition switch, ignition coil, distributor, spark plugs, and wiring.

The 12 volt, 9 plate battery has a capacity of 55 ampere hours, and is used on all series cars, except the 86 Commercial. The 86 Commercial battery has 11 plates and a capacity of 70 ampere hours. The battery is mounted in the lower right rear corner of the engine compartment, near the cowl. The negative battery terminal is grounded to the frame on all series.

An oil insulated induction coil is mounted on top of the intake manifold behind the carburetor. The interrupted low tension current from the battery produces a high voltage in the secondary circuit of the coil. A resistor is connected with the ignition

ENGINE ELECTRICAL

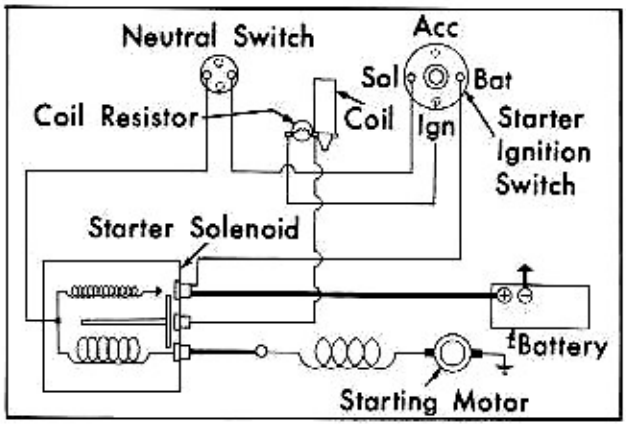

Fig. 11-1 Starting Circuit Diagram

coil primary circuit to avoid burning the breaker points. This resistor reduces the voltage to the coil and breaker points to approximately 9 volts under normal running conditions. In order to insure adequate ignition voltage during the engine cranking period, the resistor is shunted through the starter solenoid circuit, and full available battery voltage is supplied to the ignition coil during this period. Fig. 11-1.

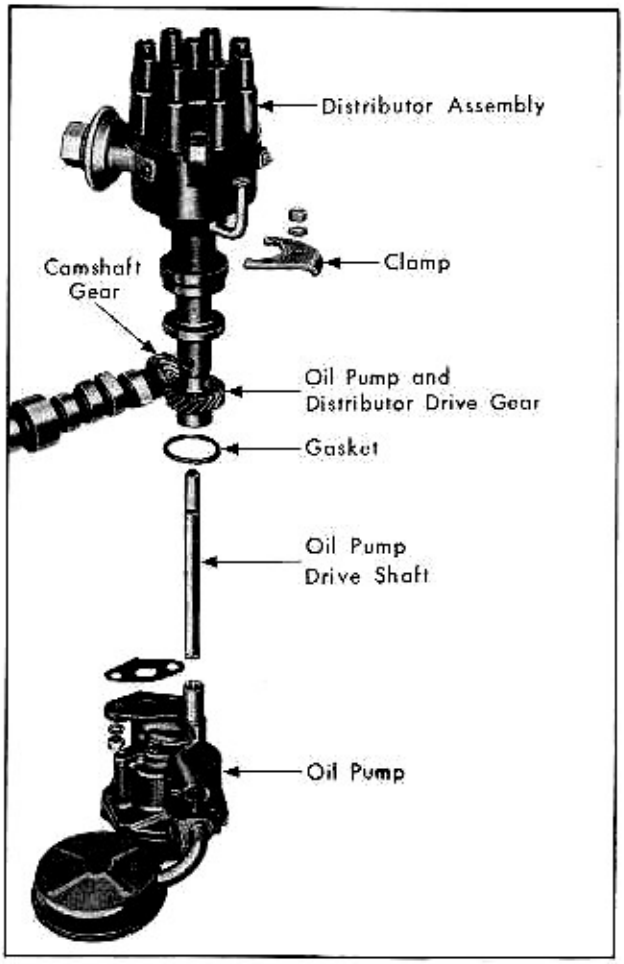

Fig. 11-2 Distributor and Oil Pump Drive Mechanism

The distributor directs the high voltage current in the proper sequence to the spark plugs which ignite the fuel - air mixture in the cylinders.

The distributor, mounted at the rear of the engine, is fully automatic in operation, and is driven by a steel drive gear which is driven by the camshaft drive gear, Fig. 11-2. An outside oiler is provided for lubrication (10W oil) of the distributor. The distributor cam rotates in a counterclockwise direction when viewed from above, and the firing order is 1-8-4-3-6-5-7-2. To eliminate the need for radio noise suppressors on the spark plugs, the distributor rotor has a built-in suppressor.

A single contact point set is used with an eight lobe breaker cam on the distributor shaft. The circuit breaker plate bearing is a bushing located at the center of the plate. Spark advance is controlled by centrifugal weights and by vacuum from the carburetor throttle body. Therefore, ignition timing is controlled by both engine speed and engine load.

Timing marks are located on the harmonic balancer at the front of the crankshaft. These marks, lettered "A" and "C", are located on the balancer so that the piston in number one cylinder is at top dead center when the "C" mark is in line with the pointer on the engine front cover. The "A" line will then be five crankshaft degrees ahead of the "C" line.

The 1954 generator, located on the front of the right exhaust manifold, has an output of 30 amperes at approximately 30 miles per hour. The generator regulator is made up of three separate units: a cut-out relay, a current regulator, and a voltage regulator; all of which are mounted in one complete assembly on the front of the right radiator support baffle.

The cut-out relay makes the connection between the generator and battery when the generator voltage becomes sufficient to close the contact points. When generator voltage becomes less than battery voltage (slow speeds or at idle), opposing magnetic fields are set up in the cut-out relay windings, causing the points to open.

When generator output reaches the value for which the voltage regulator is set, the magnetic field produced by the voltage regulator windings opens the contact points, thus directing the generator field current through a resistance to ground. As soon as the points open, the voltage regulator magnetic field is reduced enough to allow the points to close again by spring tension. This cycle repeats itself from 60 to 70 times per second.

When current from the "A" terminal of the generator reaches the value for which the current regulator is set, magnetism opens those points, sending the generator field current through a resistance to ground. This, in turn, weakens the generator output and the cycle repeats itself from 150 to 250 times per second. Either the voltage regulator or the current regulator operates at any one time - the two do not operate at the same time.

Spring tensions in the individual units of the generator regulator are adjusted by means of screw type adjusters which afford a simple, accurate regulator armature adjustment.

The 12 volt starter motor for 1954 has a spiral splined drive shaft for smoother meshing of gears. The gear ratio between the starter and the flywheel has been increased to lessen the load on the battery when the starter is engaged.

The new four pole four field starter motor drives the flywheel ring through an over-running clutch mechanism. This type of drive is so constructed that the starter pinion, which is solenoid-shifted, must be in mesh with the flywheel before electrical contact with the starter can be made. The starting motor and solenoid are mounted on the lower flywheel housing at the right side of the engine. The starter motor is operated by a combination starter-ignition switch, which energizes a solenoid mounted on the starter housing.

SERVICE INFORMATION

(1) Filling the Battery

The battery should be inspected every 2000 miles during the winter and every 1,000 miles, or every month, during warm weather to make sure that the electrolyte is kept at the proper level. Only distilled water kept in a glass, rubber, or porcelain lined container should be used to replace liquid lost through evaporation. The water level should always be maintained to the bottom of the split ring well.

(2) Battery Electrolyte Tests

The electrolyte (battery solution) can be tested with a hydrometer. The specific gravity registered by the hydrometer should be 1.260-1.280 at 80°F when the battery is fully charged. A gravity reading of 1.150 or below indicates that the battery is entirely discharged. Temperature affects the resistance of the electrolyte; for this reason, a cold battery requires a much higher charging voltage than a warm battery.

Whenever a reading under 1.250 at 80°F is due to a temporary abnormal demand for current due to excessive use of lights or starter, the charging rate should be sufficient to bring the battery up to a fully charged condition again. If the electrolyte tests below 1.200 at 80°F, the battery should be recharged from an outside source.

(3) Causes of Low Battery Conditions

Common causes of low battery conditions other than that due to a defective battery are listed below, and should be investigated when it is indicated that the car has a consistently low battery.

1. Excessive use of accessories with the engine idling or not running.

2. Leaving the car with the lights on or the doors open.

3. Improper installation of accessories.

4. Generator belt loose. Tighten belt.

5. Incorrect regulator settings must be corrected and set preferably toward high limit, as explained in Notes 26, 27, and 28.

6. Self-discharge resulting from a dirty battery case.

7. The battery cable and ground strap must be connected tightly and free of corrosion.

8. If generator output is low it may be checked and corrected as explained in Note 16.

9. A partial ground in the positive side of battery circuit. With clock disconnected and all switches in "OFF" position, a milliammeter or voltmeter connected in series between the positive post and the battery cable should indicate zero.

(4) Visual Inspection

1. Inspect positive (insulated) cable and negative ground strap for corrosion or damage.

2. Inspect metal carrier and hold down clamps for corrosion. If corrosion exists, it will be necessary to remove clamp and battery from car and pour warm water over corroded areas in order to loosen the copper sulphate that has been deposited, so that it can be brushed off and flushed away.

3. The battery posts and terminals should be in-

spected for corrosion. If corroded, wipe off the posts and terminals with a cloth dampened with household ammonia, or a saturated solution of water and baking soda. These alkaline solutions will neutralize any acid on parts being cleaned. Felt washers, soaked with engine oil, should be installed under each terminal to retard corrosion. These should be oiled at each lubrication.

CAUTION: Care should be taken to keep cleaning solution out of battery cells, otherwise, the electrolyte will become prematurely weakened.

4. Examine the battery for cracks in case, raised cells, and also tightness in carrier.

(5) Battery Tests

a. Battery Capacity Test

This high rate discharge test is made to determine the discharge capacity of the battery as compared with its original specifications and ratings.

NOTE: This test can be done only when the battery is in a charged condition. (1.250, or above). If reading is below 1.250, the battery should be slow charged until fully charged, in order to secure proper test results.

1. Turn control knob of Battery Starter Tester to "OFF" position.

2. Zero the ammeter pointer to eliminate instrument errors.

3. Turn voltmeter selector to 15 volt position.

4. Connect positive leads of Ammeter-Voltmeter tester to positive terminal of battery, and negative leads of tester to negative terminal of battery, Fig. 11-3.

5. Turn ampere control knob in clockwise direction until test ammeter reads 180 amps for all series except 86, which is 210 amps, (three times ampere-hour rating of battery).

CAUTION: Do not turn handle in counter-clockwise direction, as this will connect ammeter across battery, causing a direct short.

6. With test ammeter at 180 (or 210) amps for 15 seconds, the voltmeter should read 9.6 volts or more, which will indicate satisfactory discharge capacity.

7. Turn ampere control knob to "OFF" position before disconnecting clips.

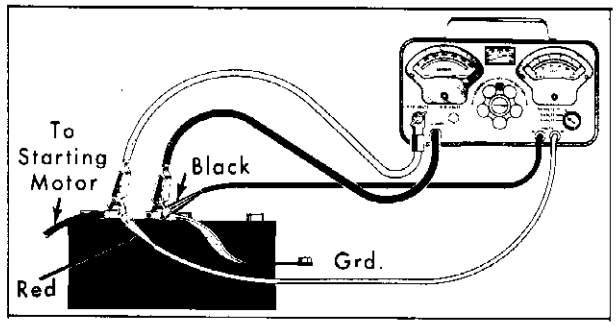

Fig. 11-3 Battery Capacity Test

b. Test Charging Battery

If voltage in above test was below 9.6 volts, the battery should be test charged to determine whether the battery can be satisfactorily charged. This can be done with a fast charger by means of the following three minute test:

1. Make certain the master switch on the charger is off, and the voltage switch in the 12-volt position.

2. Connect charger to battery.

3. Switch on the charger, turn the timer knob past 5 minutes to cock the timer, and then turn it back exactly to three minutes.

4. Set the charging rate at 40-45 amperes. When battery is cold (below 60°F) continue high rate test charge for 10-15 minutes to warm battery.

5. Charge battery for 3 minutes, then check individual cell voltages.

6. If any single cell varies more than .1 volt from the other, the battery should be replaced.

7. Check total battery voltage. This should be less than 15.5 volts and if so, the battery can be fast charged.

8. If the reading is above 15.5 volts, the battery is sulphated and should be cycled and slow-charged until the specific gravity reaches its peak. When specific gravity remains constant after testing battery at one hour intervals for three hours, the battery is at its highest state of charge.

9. Perform the battery capacity test again to obtain an accurate indication of the battery's condition. Replace battery if capacity test does not comply with specifications.

(6) Care of Batteries Not in Use

Batteries in cars in storage or batteries kept in

parts stock for sale require special care to prevent plate sulphation or other deterioration due to inactivity.

Before a battery is stored or stocked, an inspection should be made to see that it is filled to the proper level and that it is fully charged (1.250 - 1.280).

Batteries in storage should be checked every two weeks and recharged at least every 30 days, or whenever the specific gravity is below 1.240.

(7) Battery Removal and Installation

a. Removal

1. Remove flexible heater duct.

2. Disconnect battery cables.

3. Remove two wing nuts and hold-down clamp.

4. Remove battery by using a battery carrying strap on the terminals, lifting it at an angle. Make certain this operation is done carefully to prevent damage to the terminals.

b. Installation

1. Install battery by reversing above procedure.

NOTE: Care should be taken to tighten the wing nuts just enough to prevent vibration of the battery. Avoid over-tightening the nuts, which would cause damage to the battery case.

(8) Starter Circuit Resistance Tests

a. Battery Cable and Starter Switch Test— Insulated Circuit Test

This test measures the resistance of the cables and switches that feed the starter motor. The heavy current used by the starter motor will produce a voltage drop in the wiring which can be measured as an indication of this resistance. Proceed as follows:

1. Using the Battery-Starter Tester, turn the voltmeter selector switch to 15 volt scale.

2. Remove high tension wire from coil center terminal so the engine will not start.

3. Connect solenoid starter "clicker" switch and test leads as shown in Fig. 11-4.

4. Connect positive voltmeter lead to the center of the positive battery post, on which the insulated

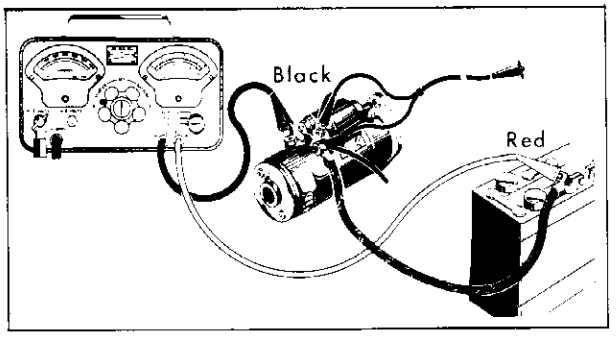

Fig. 11-4 Battery Cable to Starter Test

battery cable is connected. Connect negative voltmeter lead to the starting motor terminal.

5. Close solenoid starter "clicker" switch, and turn voltmeter to 5-volt scale while cranking. Observe reading, and turn meter back to 15-volt scale.

6. The voltmeter should drop .2 of a volt or less while the engine is being cranked. If the voltage drop is more than .2 of a volt it is an indication that the cables or connections are dirty or corroded, or that the solenoid switch is defective.

7. If voltage drop across the entire insulated side of the battery starter circuit exceeds the specified .2 volt, test the individual parts of the insulated circuit for excessive resistance. Maximum voltage drop for each should not exceed the following specifications:

a. Battery to Solenoid Switch	.1 Volt
b. Across Solenoid Switch	.1 Volt
c. Solenoid Switch to Starter Terminal.	Zero

b. Ground Circuit Test

1. Turn voltmeter selector switch of Battery-Starter Tester to 5 volt position.

2. Connect test leads as shown. Fig. 11-5.

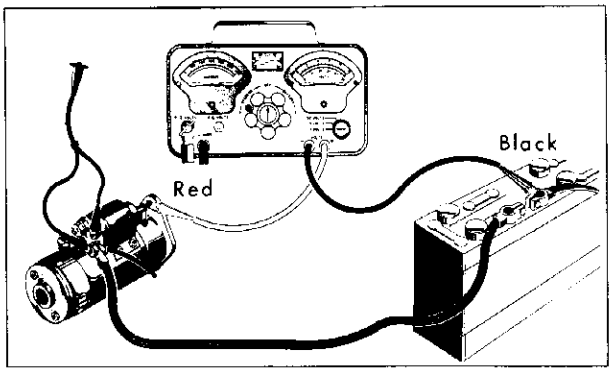

Fig. 11-5 Ground Circuit Test

3. Connect starter solenoid "clicker" switch.

4. Connect negative voltmeter lead to clean spot at the center of the negative battery post, and not to the cable clamp.

5. Connect positive voltmeter lead to the starter mounting bolt.

6. With the starter cranking the engine, the voltage drop should not exceed .1 volt. A reading of more than .1 volt is usually an indication of resistance due to loose, dirty, or corroded connections.

(9) Amperage Draw Test on Starter Motor

This test determines how much current is drawn from the battery in cranking the engine. Proceed as follows:

1. Turn Battery Starter Tester control knob to "OFF" position.

2. Turn voltmeter knob to 15 volt position.

3. Connect test leads as shown in Fig. 11-6.

4. Connect solenoid "clicker" switch from battery to starter solenoid.

5. Disconnect high tension coil lead and close starting motor "clicker" switch to crank engine. Note the exact reading on voltmeter.

6. Open starter motor switch. Turn Battery Tester control knob clockwise until the voltmeter reads exactly as in Step No. 5.

CAUTION: Do not turn handle in counterclockwise direction, as this will connect ammeter directly across battery causing a direct short.

7. Read test ammeter for starting motor amperage draw. This should be approximately 130 to 165 amps. If amperage draw is higher than specified, various conditions within the starter could cause the trouble, such as: The armature touching the field coils, a grounded field coil, worn starter bushings, bent armature shaft, etc.

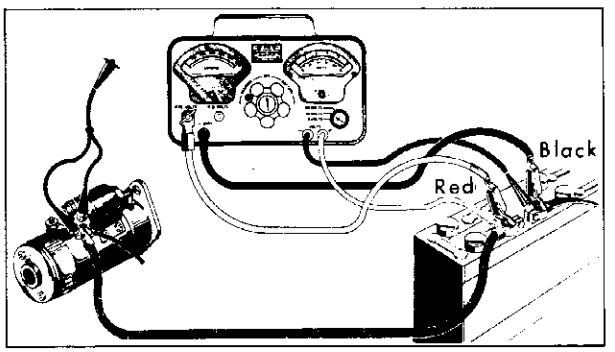

Fig. 11-6 Amperage Draw Test

(10) Inspection and Adjustment of Distributor Contact Points

a. Inspection

Remove distributor cap from the distributor and inspect the contact points for pitting, oxidation, misalignment, or an oily surface.

Pitted or oxidized points should be replaced, and misaligned points should be properly aligned and set. Contact points with an oily surface should be inspected for pitted or oxidized condition, and the source of oil located and corrected. If the points are worn evenly and show a uniform gray surface, they do not need attention, providing the point gap is within limits.

b. Adjustment

1. Loosen contact point support hold-down screw.

2. Set distributor shaft so contact arm rubbing block rests on one lobe of distributor cam.

3. Turn eccentric screw until gap between contact points measures .016" (new and used points).

4. Tighten hold-down screw and recheck gap.

The cam or dwell angle of distributor is 26 - 33 degrees. Dwell angle should not be used as the absolute setting for contact point gap. A feeler gauge or preferably a dial indicator is the only accurate method of measuring point gap.

Whenever the points are cleaned, adjusted, or replaced, the distributor cam wick, breaker plate bushing and felt, and pivot pin should be lubricated with 1 or 2 drops of No. 10-W oil. Lubricate distributor cam lobes with a slight amount of "M31-Lubrico" to reduce rubbing block wear.

(11) Distributor Test Information

For Service Stations equipped with distributor testing machines, the information on 1954 service distributors is furnished below:

Maximum vacuum advance is 13^{O}-14.5^{O} at 16"-17" Hg. Vacuum advance starts at 6.5 to 9.0" Hg.

Centrifugal Advance

Engine Speed R.P.M.	Engine Degrees Spark Advance	Distr. Speed R.P.M.	Spark Advance Distr.
800	0	400	0
1200	3-6.5	600	1-3.25
1600	9-13	800	4.5-6.5
1900	14-18	950	7-9
2400	16-20	1200	8-10
3200	19-23	1600	9.5-11.5
4000	22.5-26.5	2000	11.25-13.25

Vacuum-Inches of Mercury	Vacuum Advance Distributor Degrees	Engine Degrees
6-1/2	0	0
10	1-1/2 - 4-1/2	3-9
12	5-1/2 - 8-3/4	11-17
14	9 - 12-1/4	18-24
16	11-3/9 - 14-1/2	24-29
17	Min. 13	Min. 26

The 1954 series distributor advance mechanism is designed to give maximum fuel economy and performance. The effect of this design is represented in the above chart. Fig. 11-7.

If tests indicate an improperly operating advance mechanism, disassemble the distributor, as outlined in Note No. 12, and repair or replace worn or defective parts.

Reassemble distributor, as outlined in Note No. 13, and measure the contact arm spring pressure. This spring pressure should be 19-23 oz. To adjust spring tension, bend spring until required tension is obtained. Adjust contact points, as outlined in Note 10b. The gap measurement should be .016".

(12) Removal and Disassembly of Distributor

a. Removal

1. Remove distributor cap from distributor.

2. Disconnect vacuum pipe at vacuum control. Fig. 11-8.

3. Disconnect primary lead at distributor.

4. Turn the engine to top dead center for number one cylinder ("C" on harmonic balancer). The rotor will now point to number one insert in distributor cap, toward rear of engine.

5. Remove distributor hold down nut and clamp.

6. Lift the distributor out of the engine.

NOTE: The distributor rotor will turn slightly as the drive gear becomes disengaged from the teeth of the camshaft gear. Scribe a line on the edge of the distributor cup, directly below the tip of the rotor. This will assure proper engagement of drive gear teeth with camshaft teeth to retain correct timing when reinstalling distributor.

b. Disassembly

1. Remove rotor from end of distributor shaft. Fig. 11-8.

2. Remove ground wire screw at breaker plate, and two screws holding vacuum advance to distributor housing, and remove vacuum advance mechanism.

3. Remove primary insulator from housing.

4. Remove three screws holding breaker plate to distributor housing.

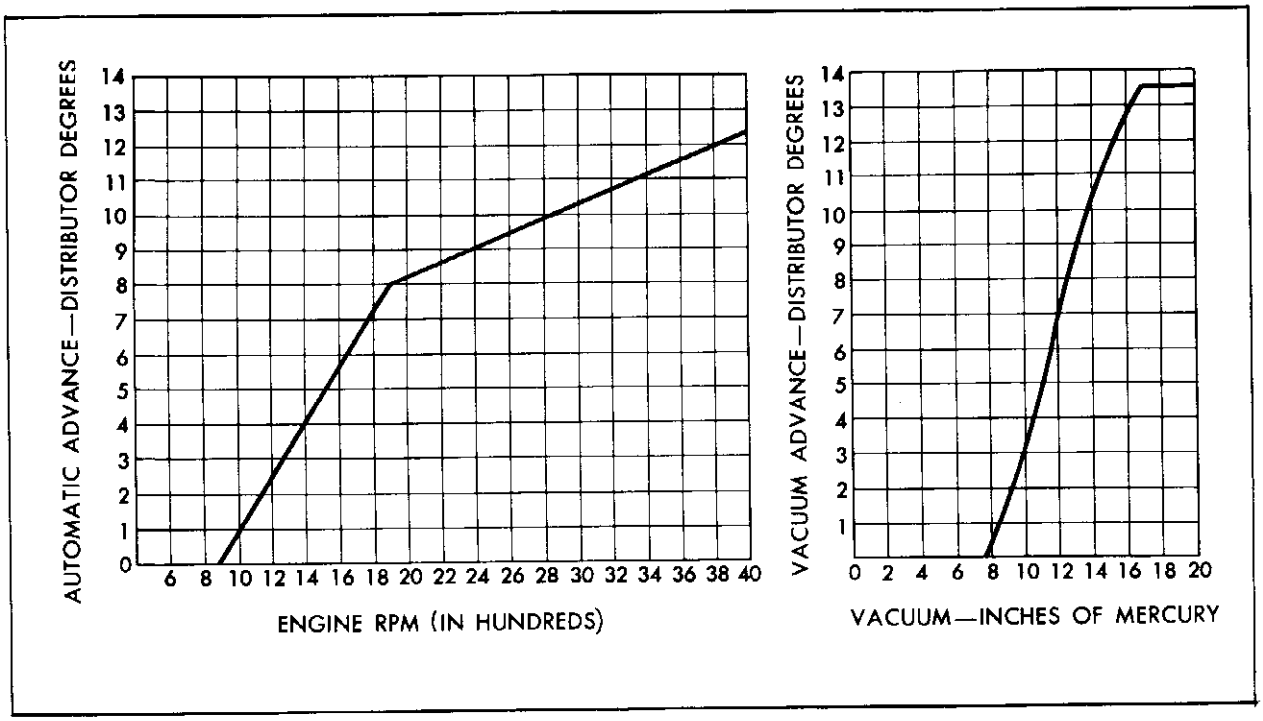

Fig. 11-7 Distributor Advance Curves

NOTE: Two of these screws hold the distributor cap retaining clips in position.

5. Lift breaker plate contact point and condenser assembly out of distributor housing.

6. Remove contact point support hold-down screw.

7. Remove contact points.

8. Disassemble contact arm spring, primary jumper wire, and condenser lead wire from contact point support fibre insulator.

9. Remove condenser hold-down screw and condenser from breaker plate. Inspect bushing in breaker plate for wear.

NOTE: The breaker plate assembly is serviced as a complete assembly. No attempt should be made to disassemble this unit.

10. Bend down ends of counterweight hold-down plate lock washers, and remove nuts and lock washers.

11. Remove both governor weight springs and remove governor hold-down plate.

12. Remove both governor weights.

13. Remove "O" ring seal from shaft housing.

NOTE: No attempt should be made to remove the distributor shaft from housing, as this is serviced as an assembly.

(13) Assembly and Installation of Distributor

a. Assembly

To assemble the distributor, reverse the disassembly procedure as outlined above, being sure to install new governor weight hold-down plate lock washers. Bend tangs of these washers up around nuts.

b. Installation

1. Install rubber "O" ring seal below distributor housing mounting flange.

2. Install distributor, starting with rotor pointing toward rear and slightly to right of engine.

NOTE: If the engine has been cranked, remove number one spark plug. Crank the engine until number one piston is in firing position, and timing mark "C" lines up with pointer on engine front cover, engage distributor drive gear with oil pump drive shaft so that rotor is above mark scribed on edge of cup in removal.

3. Install distributor hold-down clamp and nut.

4. Connect distributor primary lead.

5. Install distributor cap.

6. Fill distributor oiler tube with 10-W oil.

7. Set timing (Note 14).

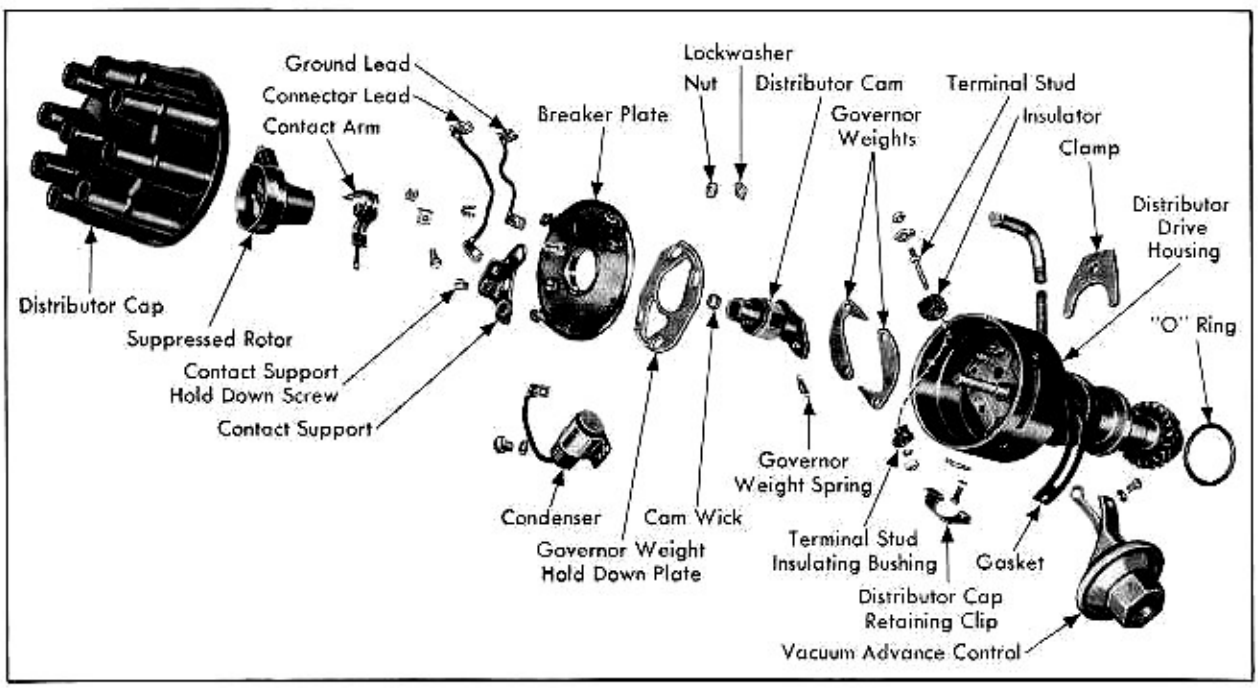

Fig. 11-8 Distributor Disassembled

8. Connect vacuum advance pipe at vacuum control unit.

(14) Setting Timing

1. Adjust distributor clamp nut to allow the distributor to be turned without excessive looseness.

2. Disconnect carburetor vacuum advance pipe at distributor and plug end of pipe with tape. (This is important, as carburetor trouble can affect the timing adjustments). Fig. 11-9.

3. Insert an adapter pin alongside No. 1 wire in distributor cap, if spark plug connectors are not available.

4. Connect a suitable timing light to adapter or connector.

NOTE: Make sure that timing marks and timing pointer are clean. Then draw a chalk line half way between "A" and "C" lines on the harmonic balancer.

5. Start engine and warm to operating temperature. Engine idle speed should be 400 R.P.M. Observe timing light flashes on harmonic balancer in relation to pointer, and rotate distributor so that light flashes as pointer and the chalk line on the harmonic balancer are opposite each other. The chalk line is 2-1/2 degrees before top dead center, Fig. 11-9.

NOTE: In localities where gasoline of the required octane rating is not available, the ignition timing may be retarded toward the "C" line on harmonic balancer to eliminate "PING".

6. Insert an adapter pin alongside No. 6 wire and note the chalk line with relation to the pointer when light flashes. If the chalk line shows up before or after the pointer, set the distributor to divide the variance.

NOTE: If this variance is excessive, the distributor and its alignment should be rechecked.

7. Tighten clamp nut to 15 to 18 ft. lbs. and recheck timing to make sure that it did not change.

8. Remove tape from distributor pipe, and connect pipe.

NOTE: If timing advances with engine idling, it is a fair indication that the throttle valves are open. Carburetor cleaning and adjustment is then necessary.

(15) Generator Charging Circuit Precautions

The following precautions are extremely important in avoiding trouble in the charging circuit. Fig. 11-10. Everyone who does any electrical work whatever should be thoroughly familiar with them.

The battery should always be disconnected before any wires at the generator or at the voltage

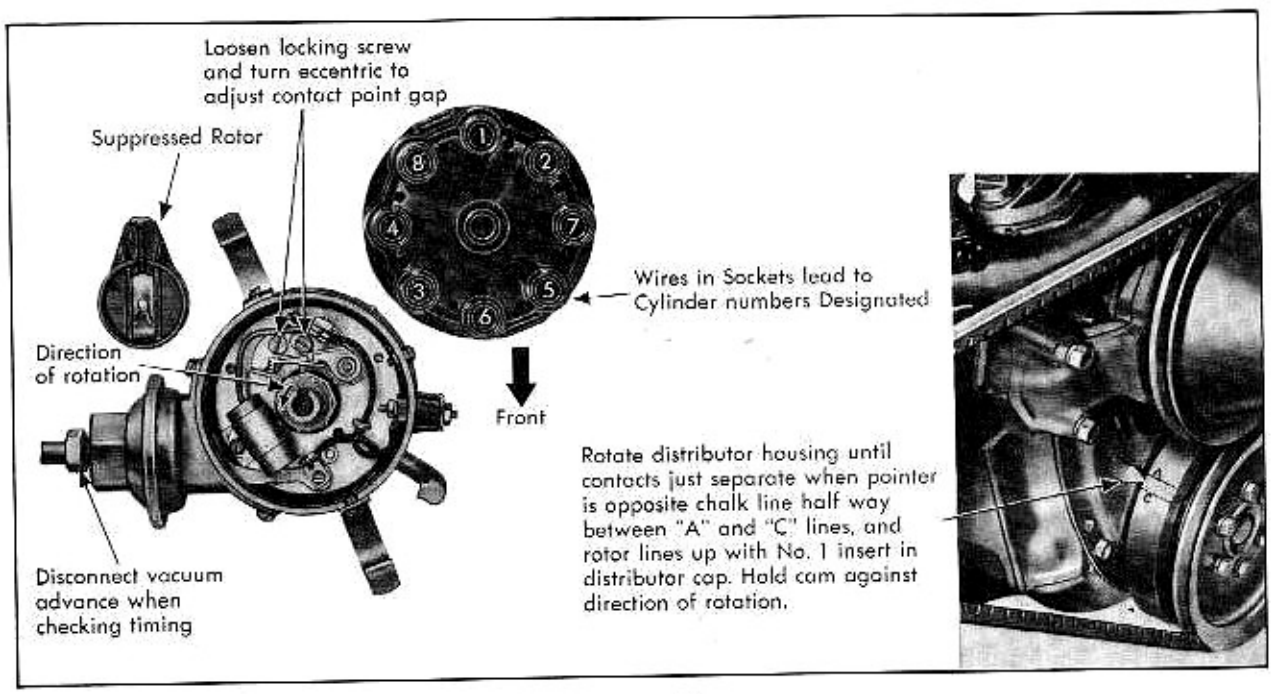

Fig. 11-9 Ignition Adjustments

regulator are removed. This is necessary to prevent the possibility of loose connections being grounded in such a way as to reverse the generator polarity - a condition which will cause arcing, fluttering and burning of the cut-out relay points.

A further precaution to assure correct generator polarity after connecting the battery, generator, and regulator is to connect a jumper lead momentarily between the "Gen" and "Bat" regulator terminals before starting the engine. The momentary surge of battery current will polarize the generator correctly.

When installing a radio noise suppression condenser on a generator, be sure it is connected to the generator armature terminal. Under no circumstances should it be connected to the field terminal, as this would result in rapid oxidation of the regulator contact points. Never run or test the generator on an open circuit for more than a few seconds as both the generator and regulator may be damaged.

(16) Generator Tests

a. Output Test

1. Disconnect lead from battery terminal of the regulator.

2. Connect ammeter leads of Volt-Ampere Tester as shown in Fig. 11-11.

3. Be sure knob on Volt-Ampere Tester is in "DIRECT" position.

4. Temporarily ground the generator field, with the jumper lead.

5. Start the engine and gradually increase its speed until the ammeter indicates at least 25% (38 amperes) above rated generator output of 30 amperes. This will indicate that the generator is in good condition. If the generator does not produce its rated maximum output in the above test the generator should be checked further to determine the cause of low output.

b. Visual Inspection

Check For:

1. Sticking or worn brushes.

2. Burned insulation or thrown solder.

3. Dirty, burned, or glazed commutator.

4. Frayed, worn or slipping fan belt.

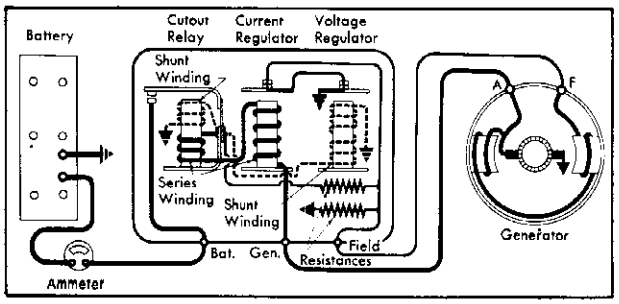

Fig. 11-10 Generator Charging Circuit

c. Testing for Ground in Generator

1. Remove the generator from the car.

2. Raise ground brush from commutator and insulate it from commutator with a piece of cardboard.

3. Connect the Armature Tester to a 110 volt supply outlet.

4. Using test points, check for ground from main brush lead on "A" terminal to generator frame.

5. If a ground is indicated in above tests, raise and insulate both brushes and check in turn, the insulated brush holder, armature commutator, and fields to locate the ground.

d. Checking for Open Circuit or Shorts

1. If no ground is indicated in above test, check field coils for open circuit.

2. Remove armature from generator and check between adjacent bars with test points. An open circuit in the armature windings will be indicated if the bulb on the tester does not light.

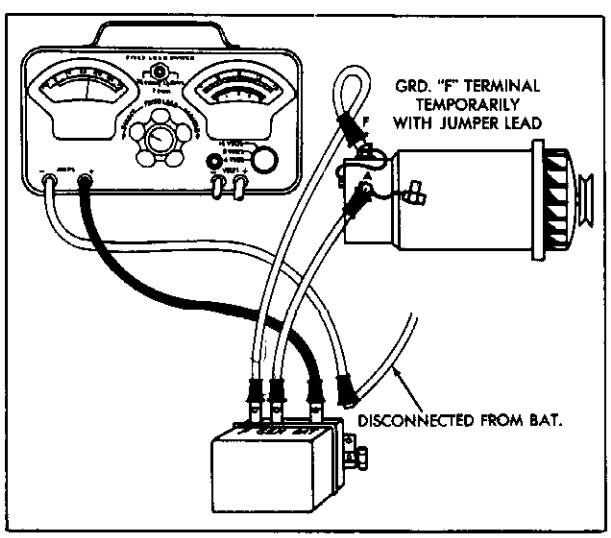

Fig. 11-11 Generator Output Test

3. Test armature for short circuit using the "growler" on the tester. A short circuit will cause a short strip of steel, such as a hack-saw blade, held over the armature core to vibrate.

(17) Generator Circuit Resistance Tests

Excessive resistance in the charging circuit will cut down current to the battery and increase generator voltage. It is important, therefore, to determine the voltage drop through the charging circuit.

a. Insulated Side of Charging Circuit

1. With control knob in "DIRECT" position, set voltmeter selector switch of the Volt-Ampere Tester to 4 volt position.

2. Temporarily ground the generator field terminal, with jumper wire.

3. Connect test leads as shown in Fig. 11-12.

4. Start engine and adjust speed so that the generator charges exactly 20 amperes without lights, radio, heater, or other accessories operating. The voltmeter should not read more than .8 volt, from the armature terminal of the generator to the positive terminal of the battery.

If voltmeter reading exceeds .8 volt, it indicates excessive resistance in the circuit.

With charging rate at exactly 20 amperes, place voltmeter leads across each part of the circuit in turn. The readings should not exceed the following values:

a. From armature terminal of generator to armature terminal of regulator	.15 volts
b. From armature terminal of regulator to battery terminal of regulator	.20 volts
c. Average voltage drop across test ammeter and leads	.25 or less
d. From end of disconnected battery wire to ungrounded post of battery	.20 volts
Total	.80 volts or less

b. Ground Side of Charging Circuit

1. Be sure the control knob is in "DIRECT" position.

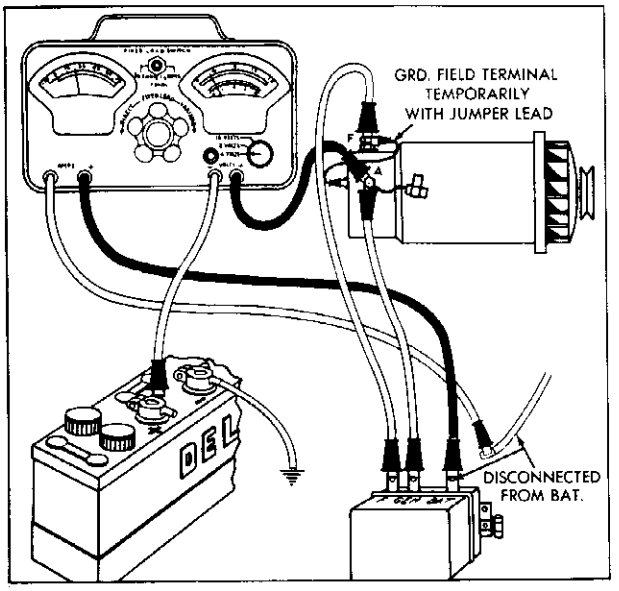

Fig. 11-12 Generator Circuit Resistance Test-Insulated Side

2. Connect ammeter and jumper lead, as shown in Fig. 11-13, and leave voltmeter selector switch in 4 volt position.

3. Connect the voltmeter from the grounded battery terminal to the ground on the generator end frame.

4. With an ammeter reading of 20 amperes, the voltmeter should not exceed .1 volt.

c. Regulator to Ground

1. Remove jumper lead from the generator field circuit.

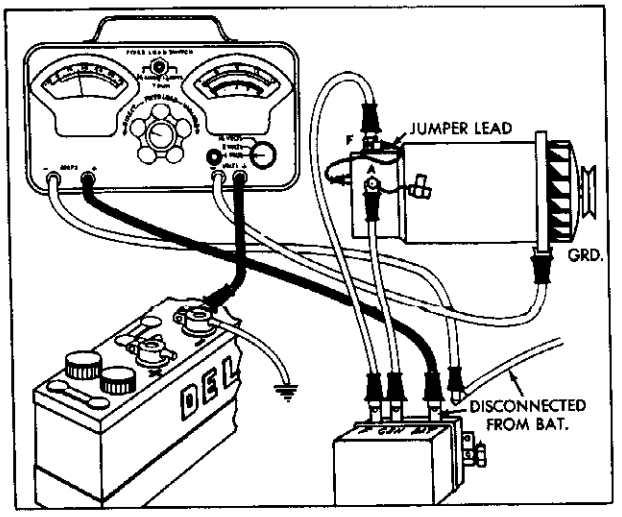

Fig. 11-13 Generator Circuit Ground Test—Grounded Side

2. Be sure control knob is in "DIRECT" position.

3. Connect ammeter as shown in Fig. 11-14.

4. Connect the voltmeter from the generator ground to base of regulator assembly. Be sure voltmeter switch is in 4 volt position.

5. Slowly increase engine speed from idle to 1,500 R.P.M. while observing the voltmeter. Voltmeter reading should be less than .1 volt if regulator ground circuit is satisfactory.

NOTE: Increase engine speed momentarily to see if the generator charges after the jumper lead is removed. If the generator charges with the jumper lead on, but will not charge after the jumper lead is removed, the most common causes are: Cutout relay set too high, voltage regulator set below closing voltage of the cutout relay, or a defective field circuit in the regulator.

(18) Removal of Generator

1. Disconnect battery.

2. Disconnect wires from generator.

3. Remove two generator mounting bolts and nuts, adjusting screw, and generator belt.

4. Remove generator from engine.

(19) Disassembly of Generator

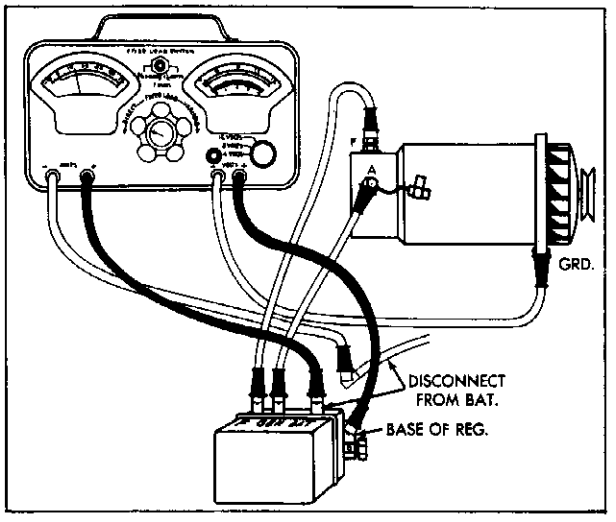

Fig. 11-14 Regulator Ground Test

1. Place generator in a bench vise, using vise as a holding fixture only, using care not to damage frame.

2. Remove two through bolts and end frame.

3. Remove drive end frame and armature assembly from generator frame.

4. Inspect brush holders in frame to see that they are not loose and that they are properly aligned.

5. Inspect Durex bearing in commutator end frame for wear. If bearing is worn excessively, replace commutator end frame.

6. Remove generator pulley, attaching nut, and lock washer.

7. Remove generator pulley, using vise as holding fixture for armature.

8. Remove key from shaft and slide outside spacer washer off the shaft.

9. Remove drive end frame with bearing and bearing retainer plate from armature shaft.

10. Remove bearing retainer plate screws, retainer plate, and gasket from drive end frame.

11. Remove bearing from drive end frame.

12. Slide inside spacer washer from armature shaft.

13. Remove field and armature terminal nuts, and push terminal studs through frame.

14. Remove two large screws which hold pole pieces and field coils to generator frame.

15. Remove pole pieces and field coils as an assembly from the generator frame.

(20) Assembly of Generator

1. Install pole pieces in field coils and install this assembly in generator frame, being sure field terminal lead is near the hole in frame for lead terminal stud.

2. Install two screws which hold pole pieces and field coils to frame, and tighten.

3. Install field terminal stud through insulator in generator frame.

4. Install armature lead and terminal stud through insulator in generator frame.

5. Install narrow spacer washer on armature shaft.

6. Pack drive end bearing with chassis grease and install in drive end frame.

7. Install bearing retainer plate and gasket on drive end frame and install screws.

8. Install drive end frame assembly on shaft and slide on thick spacer washer.

9. Install key in keyway of armature shaft and install generator ventilating fan and pulley.

10. Install lock washer and nut on end of armature shaft and tighten to 70 ft. lbs. torque.

11. Install armature and drive end frame assembly in generator frame, holding brushes out to clear commutator.

12. Position generator frame dowel pin with hole in drive end frame.

13. Inspect brushes to see that they are seated correctly.

14. Install commutator end frame on generator frame, aligning dowel pin with hole.

15. Install and tighten two through bolts.

(21) Installation of Generator

1. Install generator on right exhaust manifold bracket and loosely install two mounting screws and generator adjusting strap clamp screw.

2. Install generator belt

3. Connect field and armature wires.

4. Connect battery.

5. Momentarily connect a jumper lead on regulator, across "Gen" and "Bat" terminals before starting engine, to assure correct polarity.

(22) Accessory Ground Circuit Test

The headlights and accessories are usually grounded to the body or sheet metal of the car. If there is not a good ground circuit between the car body and the engine, there will be a voltage drop from the car body to the engine when the lights and accessories are turned on. This condition will result in light flare-up or could cause reverse generator polarity.

NOTE: This test must be made with engine off.

1. Turn the voltmeter selector switch to the 4 volt position.

2. Connect one voltmeter lead to ground on the car body and the other lead to ground on the engine.

3. Turn on all lights and accessories, then note the voltmeter reading. This should not exceed .1 volt.

4. If the voltmeter reading exceeds .1 volt, test the voltage drop at the ground strap connection between the engine and car body.

(23) Primary Wiring Insulation Test

This test, using a megohm tester, is used to detect intermittent short circuits. The megohm test applies approximately 500 volts to the circuit and will show intermittent and "damp weather" shorts that cannot be found by other methods.

1. Disconnect the positive battery cable from its battery post.

2. Turn off all switches, and close all doors to prevent operation of courtesy lights from door switches.

3. Turn the tester master switch "ON".

4. Connect the condenser tester leads together and turn switch to megohm position. Adjust meter to "SET LINE" with regulator.

5. Touch battery cable to its battery post to wind clock or disconnect clock for safety.

6. Connect condenser leads as shown in Fig. 11-15. Meter should read in Blue Meg band if insulation in primary circuit is normal.

7. If tester reads out of the blue band after disconnecting the clock, the short in the primary

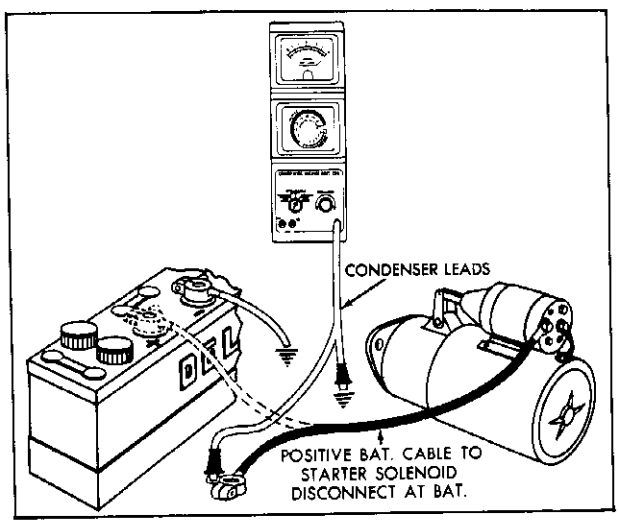

Fig. 11-15 Primary Wiring Test

wiring circuit may be located by disconnecting the battery wire at each of the following units in turn:

Stop Light Switch
Courtesy Light Switches
Horn Relay and Wire
Starter Switch
Light Switch
Ignition Switch
Regulator
Spotlight Switch
Heater Switch
Condenser - Generator

(24) Regulator Tests

In analyzing complaints of generator operation, any of several basic conditions may be found.

a. Fully Charged Battery and Low Charging Rate

This indicates normal generator-regulator operation. Regulator settings may be checked as outlined in Notes 26, 27 and 28.

b. Fully Charged Battery and a High Charging Rate

This indicates that the voltage regulator is not reducing the generator output as it should. A high charging rate to a fully charged battery will use excessive water, damage the battery, and the accompanying high voltage is very injurious to all electrical units.

This operating condition may result from:

1. Improper voltage regulator setting.

2. Defective voltage regulator unit.

3. Grounded generator field circuit (in either generator, regulator, or wiring).

4. Poor ground connection at regulator.

5. High temperature which reduces the resistance of the battery to charge so that it will accept a high charging rate, even though the voltage regulator setting is normal.

If the trouble is not due to high temperature, determine the cause of trouble by disconnecting the lead from the regulator "F" terminal with the generator operating at medium speed. If the output remains high, the generator field is grounded either in the generator or in the wiring harness. If the output drops off, the regulator is at fault and it should be checked for a high voltage setting or grounds.

c. Low Battery and High Charging Rate

This is normal generator-regulator action. Regulator setting may be checked as outlined in Notes 26, 27, and 28.

d. Low Battery and Low or No Charging Rate

This condition may be due to:

1. Loose connections, frayed or damaged wires.

2. Defective battery.

3. High circuit resistance.

4. Low regulator setting.

5. Oxidized regulator contact points.

6. Defects within the generator.

If the condition is not caused by loose connections, frayed or damaged wires, and the system voltage is still low, momentarily ground the "F" terminal of the regulator with the generator operating at a medium speed.

If output increases, check the regulator for oxidized contact points or a low voltage setting, either of which would prevent the generator from producing rated output.

Make the following test to check for oxidized contact points:

1. Insert an ammeter at the "BAT" terminal of the regulator and turn control knob of Volts Ampere Tester to "DIRECT" position.

2. Turn on headlights and operate engine at a speed which will produce 5 ampere output.

3. Ground the "F" terminal momentarily with jumper lead. Fig. 11-16.

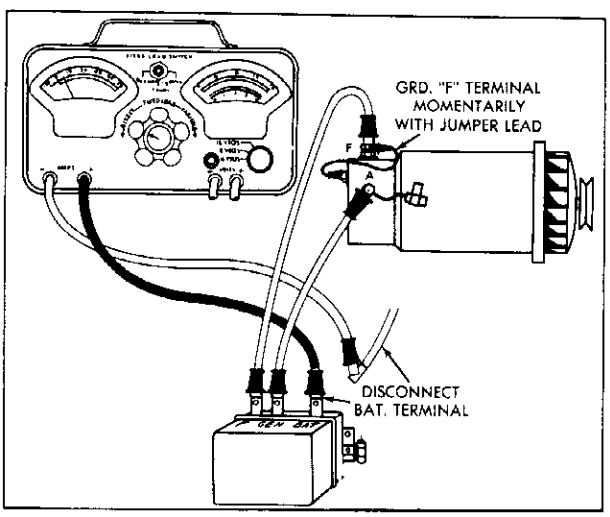

Fig. 11-16 Testing for Oxidized Points

4. If output increases more than 2 amperes, oxidized points are indicated and both voltage and current regulator points should be cleaned.

5. If output remains low, test the generator.

6. If no output at all is obtained from the generator, make sure cut-out relay is operating, since it may be failing to close, due to an open circuit in the core winding.

e. Burned Resistors, Windings, or Contacts

These result from open circuit operation or high resistance in the charging circuit. Where burned resistors, windings, or contacts are found, always check car wiring before installing a new regulator. Otherwise, the new regulator may also fail in the same way.

f. Burned Relay Contact Points

This is due to reversed generator polarity. Generator polarity must be corrected after any checks of the regulator or generator, or after disconnecting and reconnecting leads.

(25) Cleaning Contact Points

The contact points of a regulator will not operate indefinitely without some attention. It has been found that a great majority of all regulator trouble can be eliminated by a simple cleaning of the contact points, plus some possible readjustments. The flat points should be cleaned with a spoon or riffler file. A flat file cannot be used successfully to clean the flat contact points, since it will not touch the center of the flat point where point wear is most apt to occur. On negative grounded regulators which have the flat contact points on the regulator armatures, loosen the contact bracket mounting screws so that the brackets can be tilted to one side. Never use emery cloth or sandpaper to clean the contact points.

(26) Voltage Regulator Adjustments

The voltage control unit of the regulator limits charging system voltage to the value for which the unit is adjusted. This test should be made at normal operating temperature.

1. Make certain jumper wire is removed from field terminal of generator.

2. Switch voltmeter to 16 volt scale and rezero the pointer to the set line while pressing the chrome button.

3. Connect a 1/4 ohm resistor to the regulator

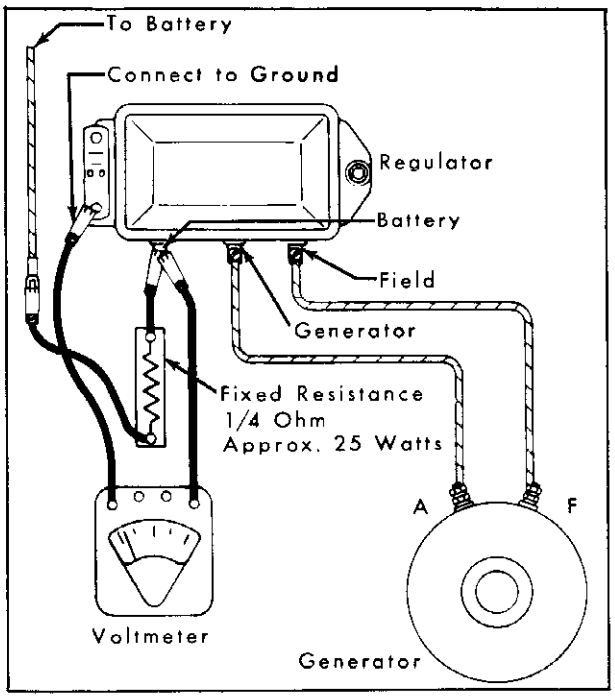

Fig. 11-17 Voltage Regulator Adjustment

"BAT" terminal and to the loose insulated wire connector as indicated in Fig. 11-17. No polarity precautions are required.

4. Connect voltmeter across charging circuit, putting red clip on regulator "BAT" terminal and black clip on ground.

NOTE: Since the voltage drop tests have been made, making certain regulator is properly grounded, the black clip can be connected to the regulator base, generator frame, or the negative battery clamp.

5. Start engine and run at 1500 R.P.M. to normalize temperature of voltage regulator unit.

NOTE: The regulator cover must be in place during this procedure. If the system has started out cold, a warm-up period of 15 minutes, with the voltage regulator operating, would be necessary. Be certain all lights and accessories are "OFF".

6. The next step is to cycle the regulator. This is done by slowing the engine down briefly. Move the red voltmeter clip to the "GEN" terminal and reduce engine speed until generator voltage drops to 4 volts. Then move voltmeter clip back to "BAT" terminal.

7. Slowly increase engine speed to 1500 R.P.M. and note voltmeter reading. The reading should be between 13.8 and 14.8 volts.

8. Slow engine to idle.

9. If voltage is other than specified, remove the cover and check air gap with points just barely touching. This should be .075" and may be adjusted by loosening the armature screws and moving the armature either up or down as required. The point gap, with armature down, should not exceed .012".

10. Check that generator voltage is down to 4 volts and run engine back up to 1500 R.P.M. Take another reading.

NOTE: A difference in readings may be evident with the cover off. Allow for this difference when adjusting the voltage.

11. Turn adjusting screw clockwise to raise voltage to 14.5 volts. If setting is above 14.5 volts, loosen screw until voltage is below 14.5 and make final adjustment by increasing the voltage to 14.5. Recheck voltage setting after cover is installed.

(27) Cut-Out Relay Adjustments

The cut-out relay has two functions: to close the charging circuit when the generator potential is higher than that of the battery, in order to maintain the charge of the battery; and to open the charging circuit when the generator potential is lower than the battery, to prevent discharge of the battery through the generator.

To determine the closing voltage of the relay, test as outlined below:

1. Turn the control knob of Volt-Ampere Tester to "DIRECT" position.

2. Turn voltmeter selector switch to 16 volt position.

3. Connect test ammeter and voltmeter leads as shown in Fig. 11-18.

4. Start engine and slowly increase engine speed, noting voltage at which cut-out relay points close. When the relay points close, the voltmeter needle flickers and the ammeter starts to register.

5. The cut-out relay points should close between 11.8 and 13.6 volts at operating temperature with cover on.

If closing voltage is outside these limits, the cover should be removed and the air gap, between the cut-out armature and center of core should be checked and adjusted to .020". The air gap may be adjusted by loosening the two screws on the back of relay and raising or lowering the armature as necessary. Make sure that both points on the armature close simultaneously. If they do not, bend spring fingers so they do. Adjust the closing voltage by turning adjusting screw clockwise (left hand threads) to increase closing voltage and counterclockwise to decrease closing voltage. Adjust to 12.8 volts.

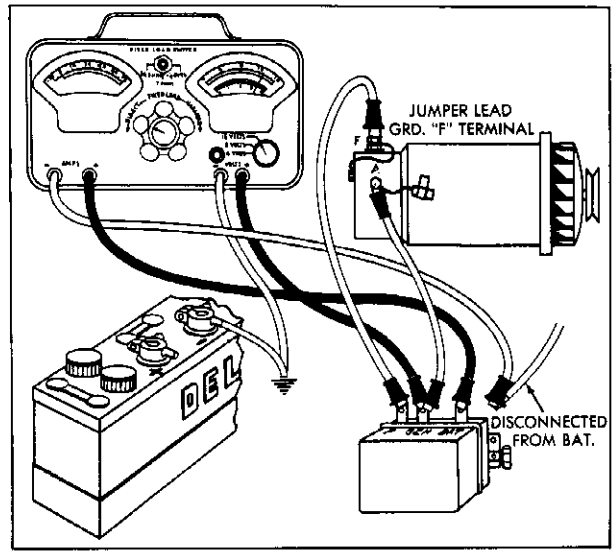

Fig. 11-18 Cut-Out Relay Adjustment

(28) Current Regulator Adjustments

The current regulator limits the flow of current from the generator. Too low a current setting will prevent the generator from carrying the ignition, accessory, and battery charging loads, while too high a setting will overload and burn out the generator armature.

1. Be sure the jumper lead is removed from the generator field circuit.

2. Connect the Volts-Ampere Tester with control knob locked in "FIXED LOAD" position, as shown in Fig. 11-19 (Voltmeter leads not used).

3. Be sure the "FIXED LOAD" switch of the tester is in the 1-1/2 ohm position.

4. Start engine and adjust speed to approximately 1500 R.P.M.

5. With the cover in place and the regulator at operating temperature, turn the control knob of the tester to "VARIABLE" position, and adjust the control knob to obtain the highest possible reading on ammeter (27-33 amps).

6. If regulator setting is other than specified above, the cover should be removed and the points inspected for burning or pitting.

7. Adjust the air gap between core and armature to .075" with points just touching.

8. Contact point opening with armature down should be .012" minimum.

9. Turn adjusting screw clockwise to increase current or counter-clockwise to decrease the current setting. Make final adjustment by increasing current setting. Adjust to 30 amperes, and recheck with cover in place.

(29) Secondary Efficiency Test

This test provides an over-all indication of the performance of the entire ignition system.

1. Turn coil tester selector switch to secondary efficiency position.

2. Connect Tachometer leads, as shown in Fig. 11-20.

3. Start engine and set speed at 1000 R.P.M.

4. Ground red (positive) lead of Coil Tester.

5. Connect the black lead to each spark plug in turn, and note the reading on the secondary efficiency scale of the Coil Test Meter.

6. Readings should be in the good band and even at all plugs.

Secondary efficiency test indications are as follows:

a. Reverse meter reading (off scale to left with leads connected as in Steps 4 and 5) indicates-coil of wrong polarity; primary wires reversed at coil; or battery connected backwards.

b. Uneven reading at plugs indicates defective spark plug wires or connections, corroded distributor cap towers, uneven spark plug gaps, or a "COCKED" distributor cap.

c. Unusually high readings at two or more plugs indicates a cracked distributor cap or insulation breakdown between spark plug wires.

d. Low reading at all plugs indicates excessive resistance in either the primary or secondary circuit, or a weak coil.

e. If the reading is unusually low at one or two plugs, remove the wire from the plug and again note the reading. If the reading improves with the wires removed, the plug is shorted out.

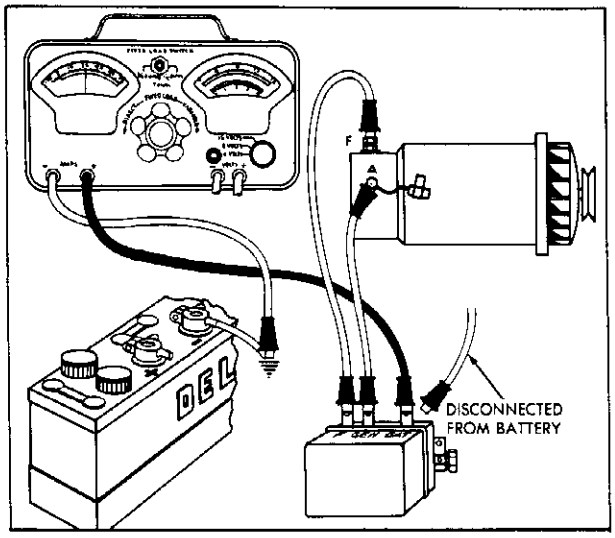

Fig. 11-19 Current Regulator Adjustment

(30) Cleaning and Setting Spark Plugs

Type 46-5 spark plugs are used on 1954 engines, and should be cleaned with an AC Model "A" or "K" spark plug cleaner. The condition of the cleaning compound is important. It must be dry, because, if moist, the compound may pack in the space between the insulator tip and shell, allowing only the tip of the plug to be cleaned. Also, the compound must be sharp to do a good cleaning job. After prolonged use, the particles of compound lose their sharp cutting edges and will not clean properly.

With the spark plug in the cleaner and the air blast turned on, press the cleaner hood down, rocking the plug, if the model "A" cleaner is being used. Raise the cleaner hood to the air blast position for a few seconds. Rotate the plug in its adapter and repeat the operations until the entire insulator is clean (white). It should be noted here that some spark plugs may have fused deposits on the lower insulator tips that are difficult, if not impossible, to remove. Make sure that all cleaning compound is removed from the plug.

The correct spark plug gap for 1954 engines is

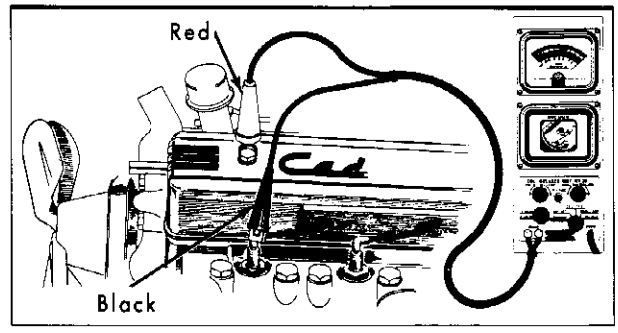

Fig. 11-20 Secondary Efficiency Test

.035". The gap should be checked only with a round wire gage, and should be adjusted by bending the side electrode only. Never bend the center electrode. The plugs should be tightened in the engines to 20-25 ft. lbs. torque.

The type 46-5 spark plug is used as original equipment on all 1954 Cadillacs to satisfy the majority of owners who largely drive at lower speeds on shorter runs. For owners who drive at higher speeds on longer runs, the cooler 44-5 type plug is recommended. When replacing spark plugs, note the condition of the electrodes. If they appear to be excessively burned or blistered, a cooler plug should be used. If the plugs have sooty carbon deposits, a hotter plug should be used. Under no circumstances, however, should a type 48 plug be used in a 1954 engine.

(31) Ignition Primary Circuit Resistance Test

Excessive voltage drop in the primary circuit will lessen the secondary output of ignition coil, resulting in hard starting and poor performance.

1. Turn the voltmeter selector switch of the Volts-Ampere Tester to the 4 volt position.

2. Connect test leads as shown in Fig. 11-21.

3. Remove distributor cap and close breaker points by rotating engine a fraction of a revolution at a time with the cranking motor.

4. Be sure all lights and accessories are turned off.

5. Turn ignition switch "ON". Voltmeter should read not more than .1 volt.

6. Test ignition switch by turning it off and on several times. Voltmeter should read the same each time switch is turned on.

7. Test all wires for tightness. Move them about and note any change in meter reading.

8. Remove voltmeter leads and place them across the primary wire from the coil to the distributor as shown by dotted leads in Fig. 11-21. Voltmeter should read less than .1 volt.

NOTE: If voltmeter reading exceeds the specified maximum, isolate the point of high resistance by placing the test leads across each connection and wire in turn. The reading across a connection should be zero. The reading across any one wire should be proportionate to its length as compared to the length and allowable voltage drop of the entire circuit.

(32) Ignition Coil Tests

The coil in the ignition circuit of an engine acts as a transformer by stepping up the battery voltage to a voltage sufficiently high to jump the rotor gap in the distributor and the spark plug gap while under compression. The common causes of coil failure are as follows:

1. High resistance due to corroded connections or broken wires.

2. Short circuits or breakdown of insulation between turns of the coils and grounds.

3. Breakdown of insulation between the windings and the core or case.

a. Reading the Coil Tester Meter

The OHM scale is to be used for measuring the resistance from zero Ohms to 100,000 Ohms.

To measure the resistance of a unit, connect the positive primary and the ground lead clips together. Turn the switch to the "DWELL-OHM" position.

Adjust the Dwell-Ohm Regulator until the meter reads on the set line. Disconnect the leads. Connect the unit in which resistance is being measured, in series with the test leads. The meter will then indicate the amount of resistance in the unit.

The "OHMS" scale is read from right to left from 0 to 100,000 Ohms. From 0 to the first graduation indicates 100 Ohms. 5C indicates 500 Ohms, IM indicates 1,000 Ohms, 100M indicates 100,000 Ohms.

b. Calibrating the Coil Tester

To assure an accurate test of the ignition coil,

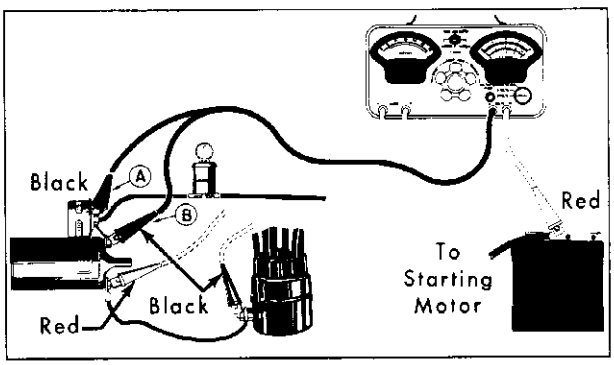

Fig. 11-21 Ignition Primary Circuit Resistance Test

the battery in the tester must be charged to at least 1.250 specific gravity. The calibration of the Coil Test Unit will vary slightly with long periods of use due to normal wear of the point rubbing block in the breaker assembly. The calibration should be checked and adjusted, if necessary, at least twice each year.

IMPORTANT: This procedure outlines the proper method of testing the calibration of the Coil Test Unit. The calibration of the Unit should be checked at least twice a year and more often if in continuous use.

1. Zero meter to left side of scale, using adjustment on face of meter.

2. Connect blue ground and red primary leads together as shown in Fig. 11-22.

3. Turn master switch "ON".

4. Turn switch of the Coil Tester Unit to "DWELL-OHM" position, and use dwell-OHM regulator to adjust meter needle to set line.

5. Disconnect leads and connect the primary leads (red and black) together.

6. Meter now reads the dwell of the Coil Breaker Unit. It should be 6, plus or minus 1/2 division. If meter does not read within these limits, remove cover from Coil Breaker Unit and adjust Tester distributor points, with breaker running, until proper reading is obtained.

7. Disconnect test leads and proceed with coil tests.

c. Coil Heat On or Off the Vehicle

Before testing any coil it should be brought to operating temperature. If the coil is on a vehicle which has been operated for a sufficient period of time to bring the coil to normal operating temperature, the coil does not need additional heating before testing. If, however, the coil is not up to temperature, the coil must be heated with the Coil Heater.

1. Disconnect primary ignition lead at the distributor and remove the high tension lead from the coil tower.

2. Insert adapter lead in coil tower and connect coil tester leads as shown in Fig. 11-23.

NOTE: Primary lead may be connected directly to coil primary terminal as shown or through the ballast resistor on a 12 volt coil.

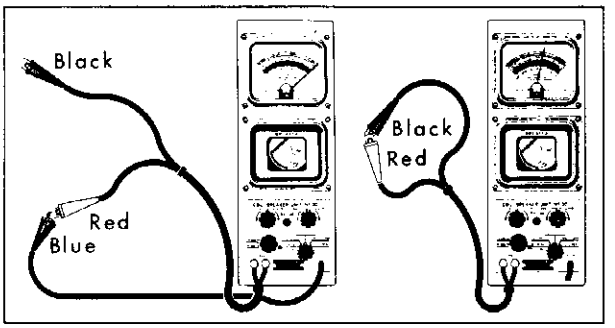

Fig. 11-22 Calibrating Coil Tester

3. Turn Master switch "ON".

4. Turn Voltage Selector Switch to 12 volt position.

5. Turn Selector Switch of the Coil Tester to "COIL HEAT" position.

6. Heat Coil 6 minutes only.

CAUTION: Do not touch leads while tester is in "Coil Heat" position. Turn selector switch to secondary efficiency position before removing clips.

d. Coil Secondary Continuity Test on Vehicle

This test is made to determine the condition of the secondary windings of the coil. A high reading will indicate an open or high resistance secondary, while a low reading will indicate a shorted winding. This test, in addition to the Coil Capacity Test, is necessary for a thorough test of the coil condition.

1. Disconnect distributor primary wire.

2. Turn Master switch "ON".

3. Turn the switch of the Coil Tester Unit to "DWELL-OHM" position.

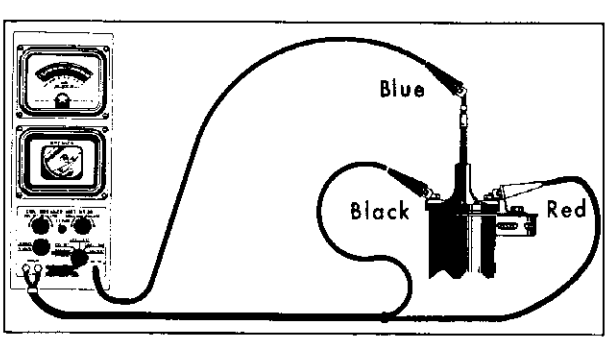

Fig. 11-23 Heating Coil

4. Connect leads as shown in Fig. 11-24.

5. The meter should read LESS than 20,000 OHMS resistance. A reading of more than 20,000 OHMS indicates a BAD coil.

e. Coil Capacity Test

This test determines whether or not the coil is satisfactory for vehicle operation when used in conjunction with the Coil Secondary Continuity Test.

1. Turn the Voltage Selector Switch of the Coil Tester to 12 volt position.

2. Disconnect the distributor primary lead (and Tach Dwell lead if used), preferably at the coil as shown in Fig. 11-25.

3. Turn on ignition switch.

4. Remove high tension lead from coil.

5. Connect tester leads as shown in solid lines, Fig. 11-25 to include ballast resistor in test circuit.

6. Turn switch of Coil Tester Unit to "Coil Set" position, and adjust Coil Set Regulator until meter reads at set point 8.

7. Turn switch to "Coil Test" position. The coil meter should be steady in the GOOD band.

NOTE: If coil tests BAD, reconnect positive tester lead as shown by dotted lines in Fig. 11-25 and readjust Coil Set Regulator until meter reads at set point 8, then retest Coil.

If the Coil now tests Good, check Ballast Resistor and resistor connections.

Ballast Resistor value:

1.40 to 1.65 Ohms.

8. Turn Tester Switch to "Secondary Efficiency" position.

(33) Condenser Tests

a. Preliminary Steps

The condenser has two important functions: First, it aids in the collapse of the primary field: Second, it prevents arcing and pitting of the breaker points.

The condenser should be tested for:

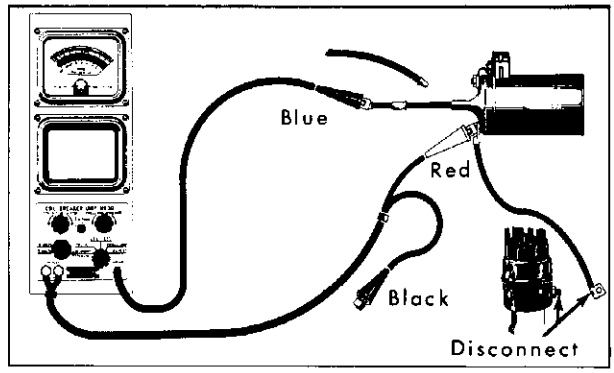

Fig. 11-24 Coil Secondary Test

1. Series resistance.

2. Correct capacity.

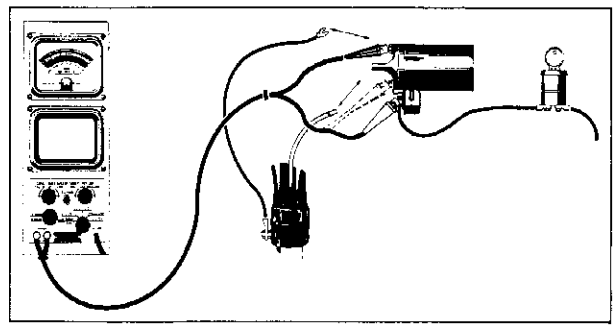

Fig. 11-25 Coil Capacity Test

3. Maximum insulation breakdown resistance.

These factors are tested on the Condenser Tester with one hook-up, by turning the Selector Switch to the proper position. First, however, the meter

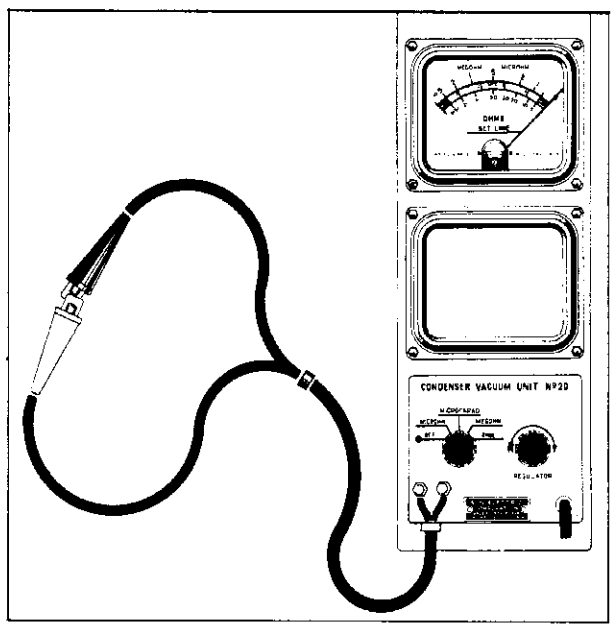

Fig. 11-26 Calibrating Condenser Test Meter

should be calibrated:

1. Connect the Condenser Tester wire clips together, Fig. 11-26.

2. Turn Master switch "ON".

3. Turn switch of the Condenser Tester Unit to "Microhm" position and allow unit to warm up.

4. Turn regulator knob until meter reads on set line.

5. Leave in "Microhm" position and proceed with Condenser Tests.

b. Condenser Tests

Microhm (series resistance) Tests

1. After calibrating tester, leave switch in "Microhm" position and connect test leads as shown in Fig. 11-27.

2. Meter should read in blue microhm bar at right of scale.

3. If reading is not in blue bar, move grounded lead of Condenser Tester to the body of the condenser. If reading improves, condenser is poorly grounded.

4. Move condenser pigtail lead about. If a deflection of the meter is noted, lead is making poor contact; condenser should be replaced.

Microfarad (capacity) Test

1. Turn switch to "Microfarad" position.

2. Read Microfarad capacity on center scale of meter.

3. Capacity should be .18 to .23 MFD.

Megohm (insulation) Test

1. Turn switch to "Megohm" position.

2. The meter should read in the blue, megohm bar at left of scale.

3. If the meter reads to the right of the blue bar, condenser insulation is leaking.

NOTE: When testing condenser off the vehicle connect one condenser test lead to the insulated condenser terminal and the other test lead to ground on condenser body. Always discharge condenser after testing.

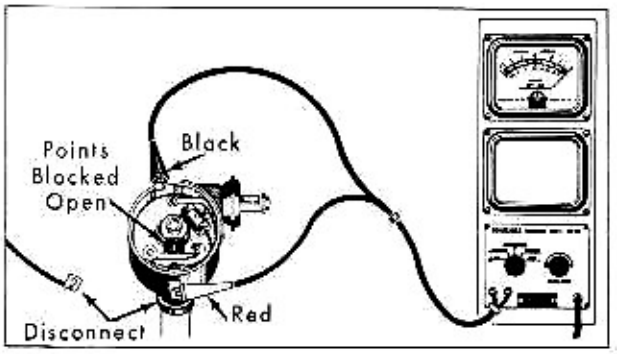

Fig. 11-27 Condenser Tests

(34) Starter Pinion Adjustment

1. Remove starter from car.

2. Press on clutch as shown in Fig. 11-28, and take up movement.

3. Check the clearance between the starter pinion and pinion stop with a feeler gage. The clearance should be .010" to .140", when in cranking position.

4. If clearance is incorrect, adjust pinion by loosening the plunger linkage screw and changing the position of the serrated linkage as required.

(35) Starting Motor Circuit

The starting motor is engaged when the ignition key is turned to the extreme right position, by means of a solenoid, Fig. 11-29, mounted on the starter housing. The solenoid first engages the starter pinion with the flywheel gear and then closes the main switch so that battery current is delivered to the cranking motor.

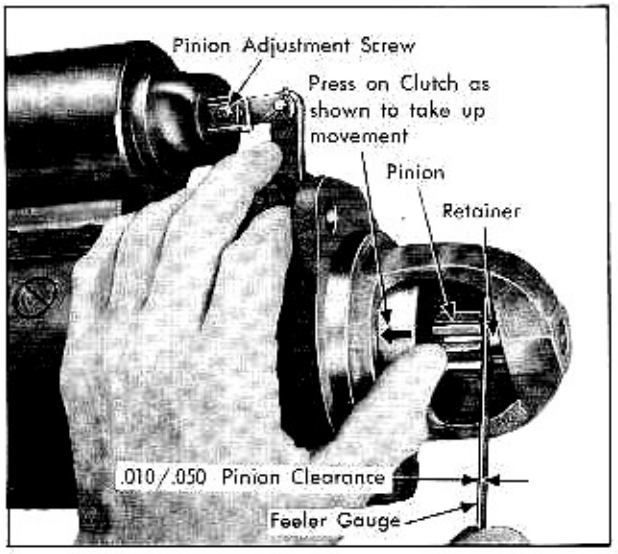

Fig. 11-28 Starter Pinion Adjustment

The solenoid is drawn into the engaged position by the pull-in coil, and held in position by the hold-in coil, while the ignition key is held in the extreme right position, Fig. 11-29. The contact bar at the end of the solenoid completes a direct circuit between the battery and the starter motor, energizing the starting motor.

The current consumption of the solenoid switch should be 72-76 amperes at 10.0 volts for both windings, and 18-20 amperes at 10 volts for the hold-in winding alone.

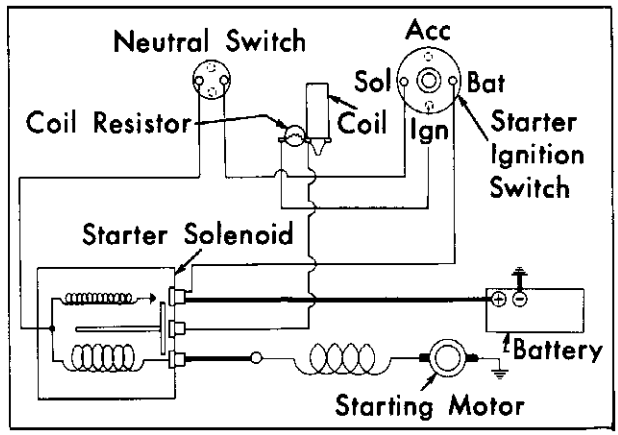

Fig. 11-29 Starting Circuit

(36) Normal Cranking Motor Maintenance

Lubrication -- Whenever the cranking motor is disassembled for repair or service, place a few drops of light engine oil on the oilless bushings in the end bearings. Avoid excessive lubrication, since this might cause lubricant to be forced out onto the commutator where it would gum and cause poor commutation with a resulting inferior cranking motor performance. Never oil commutator.

Inspection -- Since there are no inspection windows in the extruded frame, the commutator end frame should be removed periodically and the brushes and commutator inspected. If the commutator is dirty, it may be cleaned with No. 00 sandpaper. NEVER USE EMERY CLOTH TO CLEAN COMMUTATOR. If the commutator is rough, out-of-round, or has high mica it should be turned down on a lathe and the mica undercut. Worn brushes should be replaced.

(37) Checking Inoperative Cranking Motor

If the cranking motor does not develop rated torque and cranks the engine slowly or not at all, check the battery, battery terminals and connections, the ground cable, and the battery-to-cranking motor cable. Corroded, frayed, or broken cables should be replaced, and loose or dirty connections corrected.

The overrunning clutch should withstand 50 to 60 foot pounds torque without slipping. The pinion should turn freely and smoothly in the overrunning direction. The solenoid switch contacts should be checked for burned condition, and the contact disc and terminal studs replaced if necessary.

If the above are all in order, inspect the brushes and commutator. The brushes should form a good contact with the commutator and have the correct spring tension. If there are burned bars in the commutator, it may indicate open circuited armature coils which prevent proper cranking. Inspect the soldered connections at the commutator riser bars, and resolder these connections and turn down the commutator as necessary.

Tight or dirty bearings will reduce armature speed or prevent the armature from turning. A worn bearing, bent shaft, or loose pole shoe will allow the armature to drag, causing slow speed or failure of the armature to rotate. Check for these conditions. If the brushes, bearings, commutator, switch, etc., appear in good condition, the battery and external circuit all right, and the cranking motor still does not operate correctly, remove the cranking motor for Bench Check as to NO-LOAD and TORQUE tests.

(38) Starter Motor Tests

1. NO-LOAD TEST -- Connect the cranking motor in series with a battery of the specified voltage and an ammeter capable of indicating several hundred amperes. If an R.P.M. Indicator is available, read the armature R.P.M. also. Test should indicate 95 amperes at 10.1 volts at approximately 3500 R.P.M.

2. TORQUE TEST -- Torque testing equipment, if available, may be used to determine if the motor will develop rated torque. A high current-carrying variable resistance should be connected into the circuit so the specified voltage at the cranking motor may be obtained since a small variation in the voltage will produce a marked difference in the torque developed. The lock torque developed is 11 lbs. ft. at 460 amperes at 5.2 volts.

(39) Interpretation of No-Load and Torque Tests

1. Low free speed and high current draw with low torque:

a. Tight, dirty or worn bearings, bent shaft or loose pole shoe screws.

b. Grounded armature or field. Check further by isolating various parts of the motor and checking with a test lamp to determine location of ground.

NOTE: The end of the shunt field coil must be disconnected from ground before checking for grounded armature or field.

c. Shorted armature. Check on growler.

2. Failure to operate with high current draw:

a. Direct ground in switch, terminal or fields.

b. Frozen shaft bearings.

3. Failure to operate with no current draw:

a. Open field circuit. Inspect internal connections and trace circuit with a test lamp. (See note concerning shunt field in 1b).

b. Open armature coils. Inspect commutator for badly burned bars.

c. Broken or weak brush springs, worn brushes, high mica on the commutator, or other causes which would prevent contact between the brushes and the commutator.

4. Low no-load speed with low torque and low current draw:

a. An open field winding. Check with a test lamp to determine "open" location. (See note concerning shunt field in 1b.)

b. High internal resistance due to poor connections, defective leads, dirty commutator, and causes listed under 3c above.

5. High free speed with low developed torque and high current draw indicates shorted fields.

(40) Removal and Disassembly of Starting Motor

At regular intervals, the cranking motor should be disassembled for cleaning and inspection of all parts. The overrunning clutch, armature and fields should not be cleaned in any degreasing tank, or with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism and would damage the insulation in the armature and field coils. It is suggested that parts be cleaned with oleum spirits and a brush. All worn parts should be replaced and the commutator turned down in a lathe if necessary. The rubber boot covering the solenoid plunger should be replaced if the old one has deteriorated enough to permit moisture and dirt to enter solenoid. OIL OR GREASE IS VERY DETRIMENTAL TO THIS BOOT.

a. Removal

1. Disconnect battery cable at starter solenoid.

2. Disconnect starter button and coil feed wires at solenoid terminals.

3. Remove two starter mounting bolts at flywheel housing. Pull starter forward and remove from car.

b. Disassembly

1. Remove solenoid.

a. Remove nut and lockwasher connecting switch to motor terminal.

b. Remove cotter key and pin from plunger linkage.

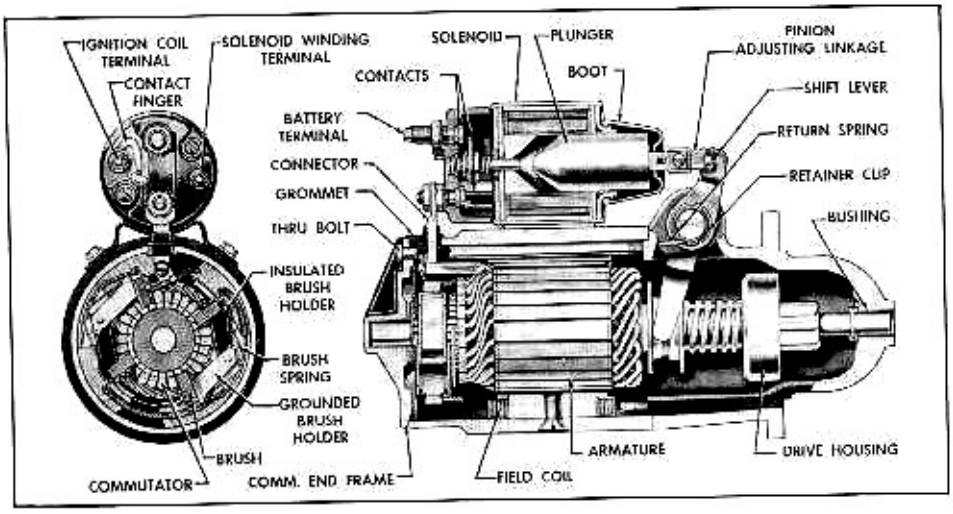

Fig. 11-30 Starter Cross Section

c. Remove four switch attaching screws, and take off solenoid switch.

2. Remove three bolts and remove commutator end frame and field frame assembly, Fig. 11-30.

3. Remove large retainer clip, then unhook shift lever spring and remove.

4. Remove small retainer clip and remove upper shift lever shaft.

5. Remove armature with clutch and lower shift lever from housing. Also remove thrust collar.

6. Remove clutch from armature by first sliding thrust collar off end of armature shaft, Fig. 11-31.

7. Slide a standard 1/2" pipe coupling or other metal cylinder of suitable size onto shaft, so end of coupling or cylinder butts against edge of retainer, Fig. 11-32. Tap end of coupling with hammer, driving retainer towards armature and off snap ring.

8. Remove snap ring from groove in shaft, using pliers or other suitable tool. Replace snap ring if distorted.

9. Slide retainer and clutch from armature shaft.

10. Disassemble brush holders from field frame.

a. Remove screws attaching leads and brushes to the holders.

b. By hand, press down on the flat spring so that center of spring clears the retaining slot. Slide off the brush spring and two brush holders as a group.

c. Repeat procedure for remaining set of brush holders.

(41) Assembly and Installation of Starter Motor

The assembly and installation of the starter motor is the reverse of the procedure described above, with the exception of the following procedure for replacing clutch on armature shaft.

a. Lubricate drive end of armature shaft with grade 20 oil.

b. Slide clutch assembly onto armature shaft with pinion outward.

c. Slide retainer onto shaft with cupped surface facing end of shaft.

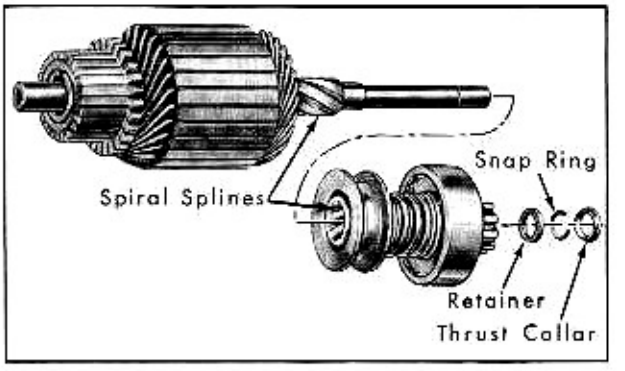

Fig. 11-31 Starter Armature Assembly - Exploded

d. Stand armature on end of wood surface with commutator down. Position snap ring on upper end of shaft and hold in place with a block of wood. Hit wood block a blow with hammer, forcing snap ring over end of shaft. Slide snap ring down into groove by hand, Fig. 11-33.

e. Assemble thrust collar on shaft with shoulder next to snap ring.

f. Place armature on work bench and position retainer and thrust collar next to snap ring. Then using two pair of pliers at same time (one pair on

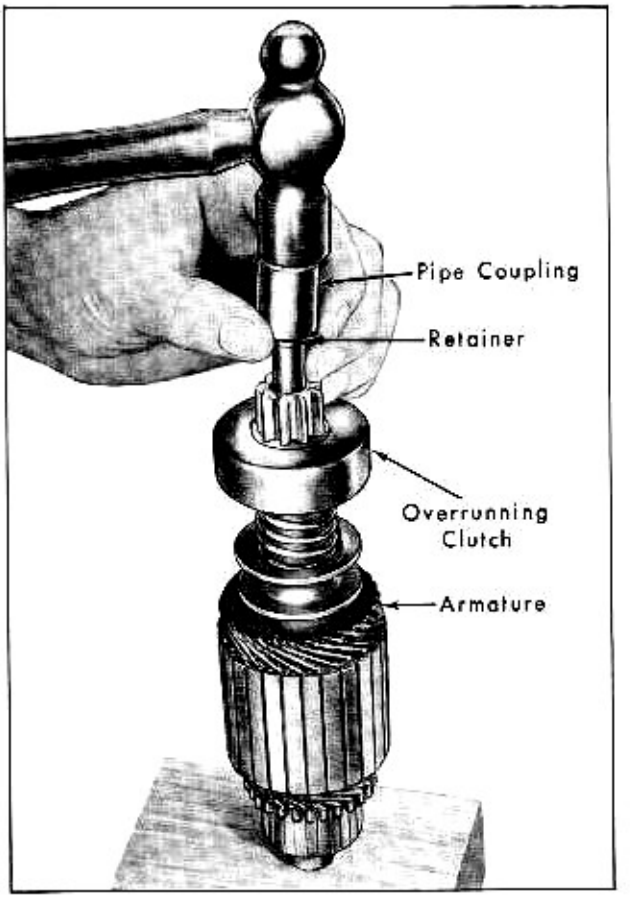

Fig. 11-32 Driving Retainer Off Snap Ring

either side of shaft), grip retainer and thrust collar and squeeze until snap ring is forced into retainer, Fig. 11-34.

(42) Engine Tests

Engine tests, includes the inspection, testing, and adjustments of the various components of the engine and engine accessories. These various tests have been covered in detail in this section and only a reference to the note number will be made.

1. Inspect and test the battery. This includes visual inspection, electrolyte test, capacity test, and test charging battery, Notes 1-7.

2. Inspect and test the starting system. This includes visual inspection of connections, starter circuit resistance tests, and amperage draw test on the starter motor, Notes 8 and 9.

3. Inspect, test and adjust the distributor as explained in Notes 10 and 11.

4. Make certain engine idle R.P.M. is correctly adjusted - 400 R.P.M. in "Drive".

5. Inspect and test the performance of the generator. This includes observing generator charging circuit precautions, visual inspection, output tests, testing for ground in generator, and resistance tests, Notes 15-17.

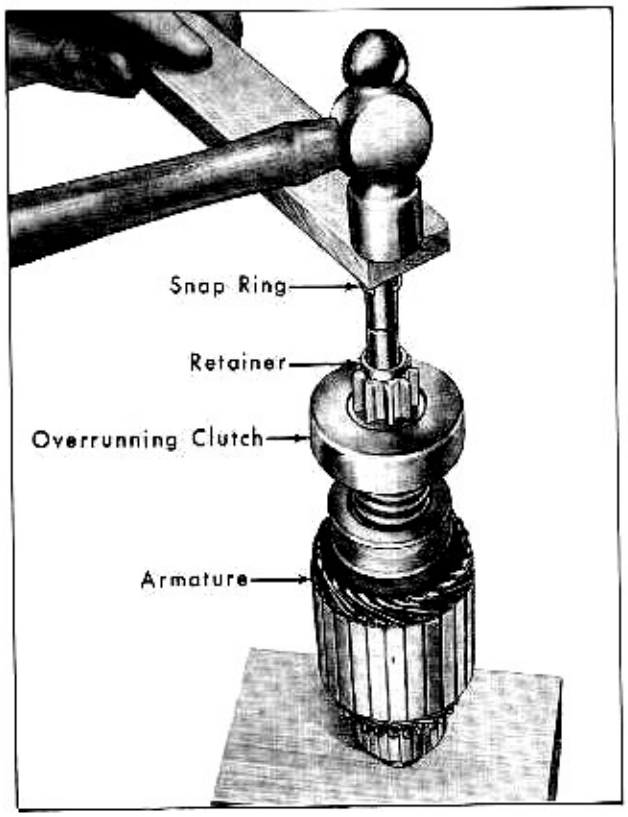

Fig. 11-33 Installing Snap Ring on Shaft

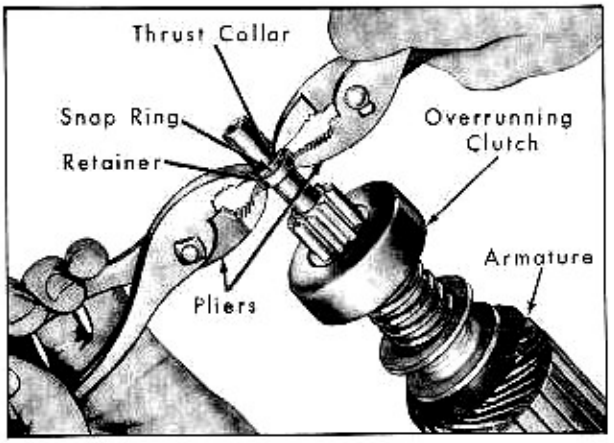

Fig. 11-34 Installing Snap Ring Into Retainer

6. Test regulator for proper performance as explained in Notes 24-28.

7. Test spark timing, Note 14.

8. To provide an indication of the over-all performance of the entire ignition system, make the secondary efficiency test, Note 29.

9. The fuel system should be inspected thoroughly. Clean all fuel lines, strainers and flexible lines. The fuel filter strainer must be replaced if plugged.

10. Clean and service carburetor air cleaner, Section 2, Note 10.

11. In cases where carburetor is not functioning properly, it should be overhauled, Section 12.

12. Test fuel pump for proper pressure, volume, and inches of vacuum, Section 12.

13. Clean and set spark plugs, Note 30.

14. Test the ignition primary circuit for excessive voltage drop which would lessen the secondary output of the ignition coil, resulting in hard starting and poor performance, Note 31.

15. Test the coil continuity and capacity for proper performance, Note 32.

16. Test all condensers for series resistance, capacity, and insulation, Note 33.

17. Check all water hoses and tighten clamps.

18. Tighten cylinder heads - 65 to 70 ft. lbs.

19. Tighten manifolds - 25 to 30 ft. lbs.

20. Adjust generator belt to proper tension.

ENGINE ELECTRICAL

SPECIFICATIONS

Subject and Remarks	All Series
IGNITION	
Coil, amperes draw, engine running	1.25A
Coil, Delco-Remy type number	1115082
Distributor, Delco-Remy Type No.	1110844
Distributor advance - engine degrees	
Centrifugal advance	$24^{o} \pm 2^{o}$
Vacuum advance	$27.5^{o} \pm 1.5^{o}$
Dwell angle range	26^{o}-33^{o}
New and used point gap	.016"
Tension of contact arm spring	19-23 oz.
Timing mark, ahead of center	$2\text{-}1/2^{o}$
Spark plugs --	
A.C. type number	46-5
Gap	.035"
Thread	14MM
Ignition switch --	
Delco-Remy type number	1116470
Firing order	1, 8, 4, 3, 6, 5, 7, 2
Cond. Capacity in Microfarads	.18-.23
GENERATOR	
Delco-Remy type number	1102002
Armature --	
Commutator out of round, not over	.002"
End play in bearing, not over	.005"
Car speed at min. peak charging rate	25.5 MPH
Delco-Remy type number	1102002
Generator ventilation	Forced Air
Ratio of armature RPM to engine RPM	2.15-1
Brush spring tension	24-32 oz.
GENERATOR TEST SPECIFICATIONS	
Output, cold --	
Cut-in Engine RPM	535
Amperes	0
Volts	12.8
Given Speed, Engine RPM	1000
Amperes	30
Volts	14.0
GENERATOR REGULATOR	
Delco-Remy type number	1118826
Current regulator --	
Air gap (between armature and center of core)	.075"
*Current setting, in amperes	
Range	27 - 33
Adjust to	30
Cut-out relay --	
Air gap	.020"
Contact point opening	.020"
*Contacts close at volts	11.8-13.6
Adjust to	12.8
Voltage regulator --	
Air gap	.075"
Voltage setting --	
*Closed circuit in volts	
Range	14 - 15
Adjust to	14.5
STARTING MOTOR	
Delco-Remy type number	1107622
Armature --	
Commutator out-of-round, not over	.005"
Bearings --	
Commutator end	Oilless Bushing
No center bearing	
Drive end	Oilless Bushing
Lock amperage	460
Lock torque, in ft. lbs	11.5
Lock voltage	5.2
Gear ratio	19.5-1
No load RPM	6500
Amperage	75
Volts	10.3
Brush spring tension	30-40

*At operating temperature after 15 minutes running with 8 to 10 amps. current flow through regulator.

Subject and Remarks	All Series
BATTERY	
Capacity, ampere hours	
54-62, 60S, 75	55
54-86 Comm'l.	70
Delco-Remy type number	
54-62, 60S, 75	3EM60-W
54-86 Comm'l.	3EM70-W
Plates, number of	
54-62, 60S, 75	9
54-86 Comm'l.	11
Terminal grounded	Negative

ENGINE ELECTRICAL

TORQUE TIGHTNESS

Application	Size	Ft. Lbs. Min.	Ft. Lbs. Max.
Distributor clamp nut	5/16-24	15	18
Generator bracket to exhaust manifold nut	3/8-24	25	30
Generator to adjusting link	5/16-24	15	18
Generator mounting	5/16-24	12	15
Generator terminal nut	No. 12-24	12	15 In. Lbs.
Ignition coil mounting screw	5/16-18	15	18
Regulator mounting screws	1/4-20	2	3
Spark plugs	14 mm	20	25
Starter mounting	7/16-14	45	50
Starter solenoid terminal nut	8-32	15	18 In. Lbs.

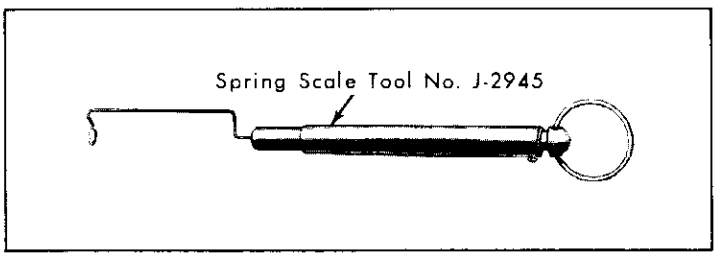

Fig. 11-35 Special Tools

OTHER NOTES AND REFERENCES

ENGINE ELECTRICAL

OTHER NOTES AND REFERENCES