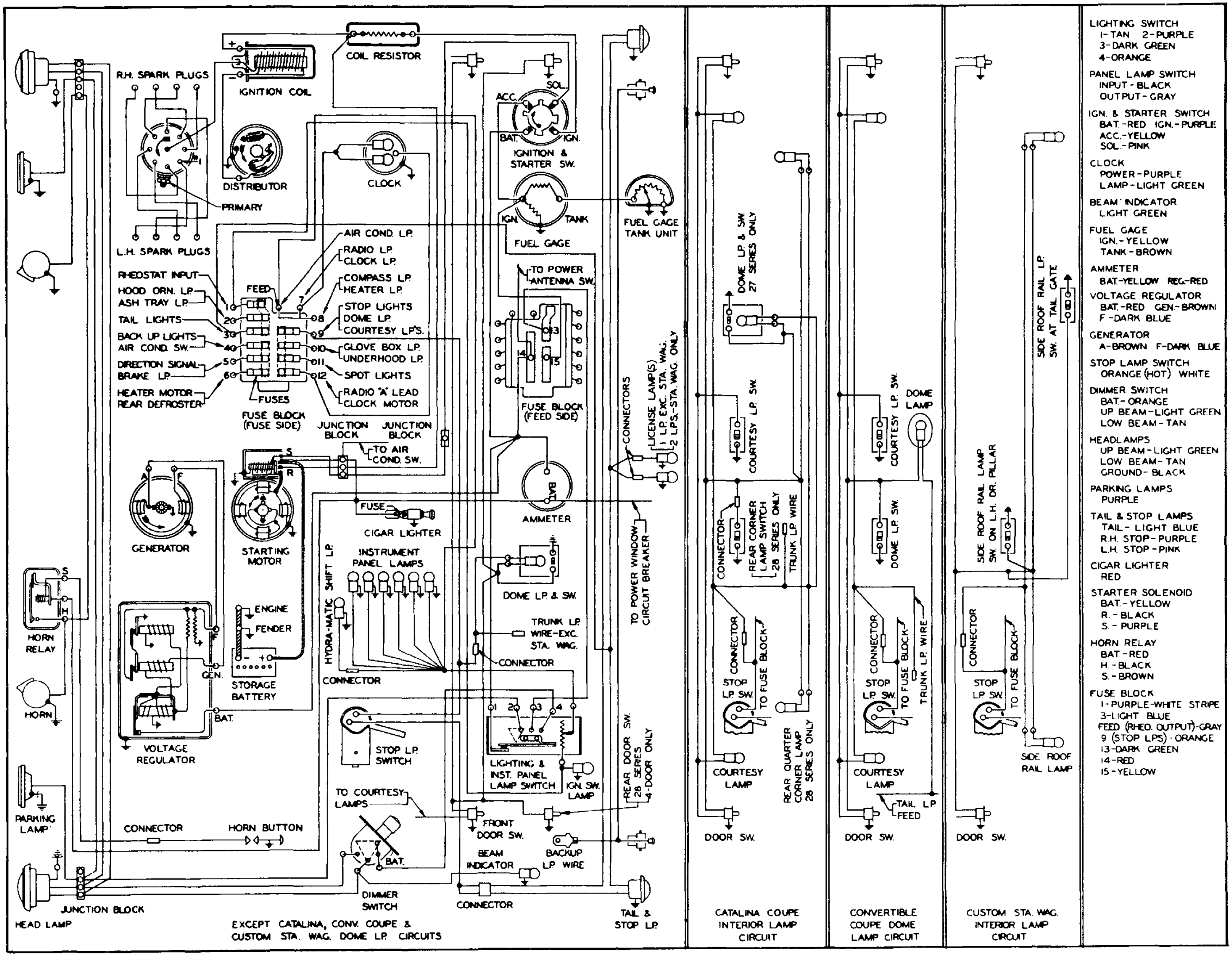


Fig. 12-1 Schematic Wiring Diagram

ELECTRICAL AND INSTRUMENTS

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

THE 12-VOLT SYSTEM

Notable advantages of the 12-volt system are better ignition performance, increased wattage output of the generator, and increased cranking speeds. Although the 12-volt electrical system in itself is new, the individual units that make up the system are similar in appearance to earlier 6-volt equipment.

The higher voltage of the 12-volt system should continually be kept in mind when working on 12-volt equipment. Accidental short circuits that may not damage similar 6-volt units will be more apt to damage 12-volt units. Arcs that occur around the battery, since they are larger, will be more apt to ignite any gas escaping from the battery. In addition, tools involved in accidental short circuits may be severely damaged.

The complete wiring diagram (less accessories) for all models is shown schematically in Figure 12-1. To simplify the job of localizing electrical difficulties, it is convenient to subdivide the complete electrical system as follows:

1. Charging Circuit.
2. Starting Circuit.
3. Ignition Circuit.
4. Lighting Circuit.

These subdivisions will be followed in covering the electrical equipment used.

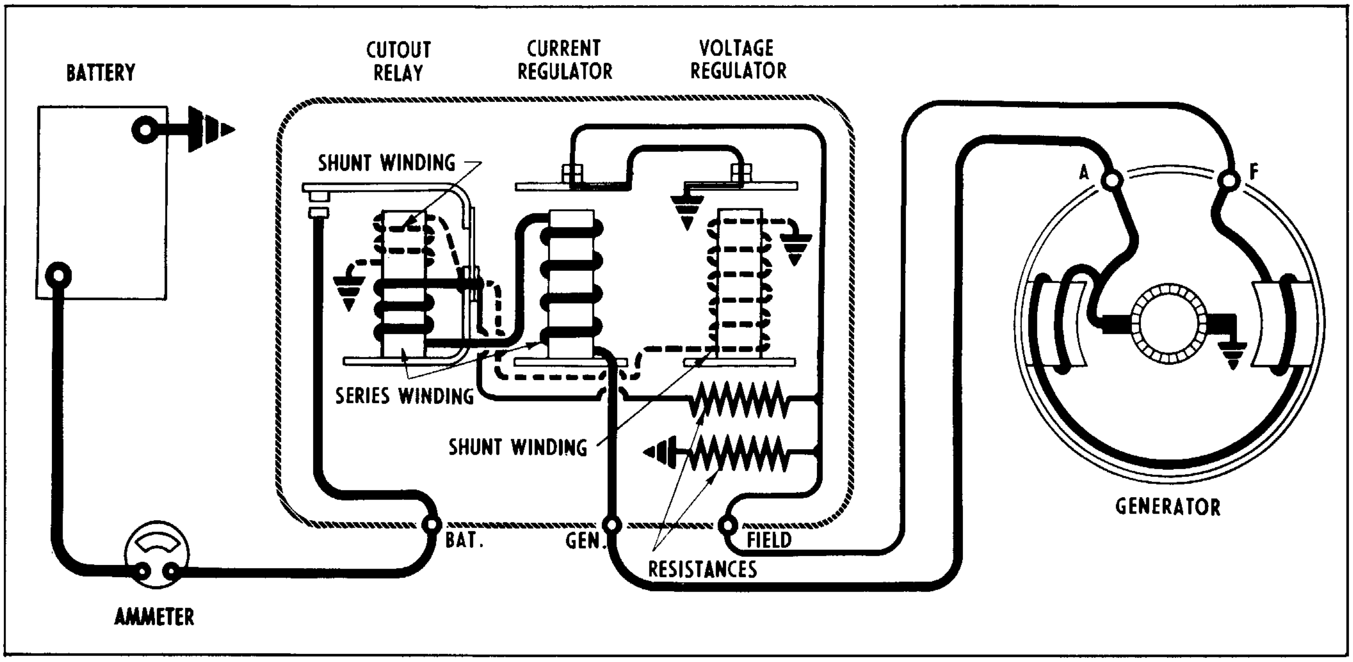


Fig. 12-2 Charging Circuit

CHARGING CIRCUIT DESCRIPTION

The charging circuit includes the battery, generator, regulator, and ammeter. The simplified wiring diagram shown in Fig. 12-2 illustrates this circuit.

BATTERY

All models are equipped with 12-volt Delco batteries. The standard installation is a Delco Model 2SM50, 9 plate, 50 ampere-hour battery (Fig. 12-3).

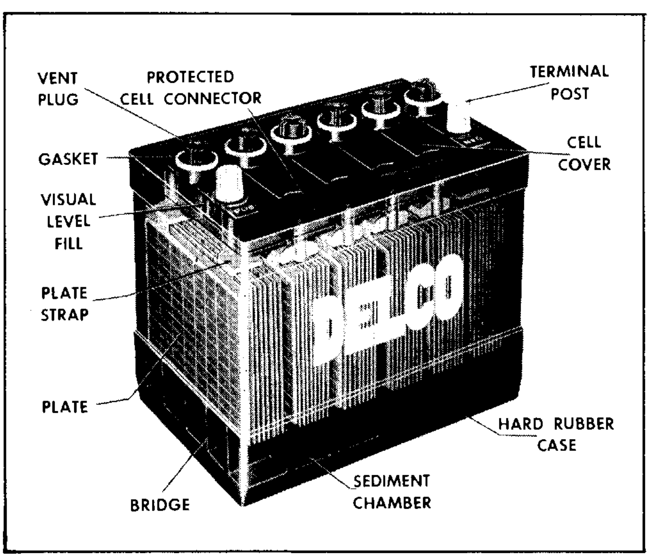


Fig. 12-3 Twelve Volt Battery

The optional heavy-duty installation is a Delco Model 3SM70, 11 plate, 70 ampere-hour battery. Both of these batteries have a specific gravity of 1.260-1.280 at full charge at 80° F. The battery date code is located on the second cell cover from the positive post end of the battery. This date code should always be included in product information reports or correspondence about batteries.

Both model batteries are equipped with "Visual Level" cell covers to facilitate checking electrolyte level and to lessen the possibility of overfilling the battery. These covers have a long, circular, tapered vent well with two small vertical slots diametrically opposite. Viewed from above, with the battery vent plugs removed, the lower end of the vent well appears as a ring with small portions of the circumference missing. As water is added to the cell, the surface of the rising liquid contacts the slotted lower end of the vent well causing a distortion of the reflecting surface of the liquid which is very noticeable. Thus, the lower end of the vent well serves as a reference point in determining proper electrolyte level. The cell is properly filled when the surface of the electrolyte touches the bottom of the vent well. If some overfilling occurs, the amount can be estimated readily by the height of liquid in the vent well itself.

A metal hold-down placed over the top of the battery when mounted in the car is attached to two bolts which fasten it to the battery support.

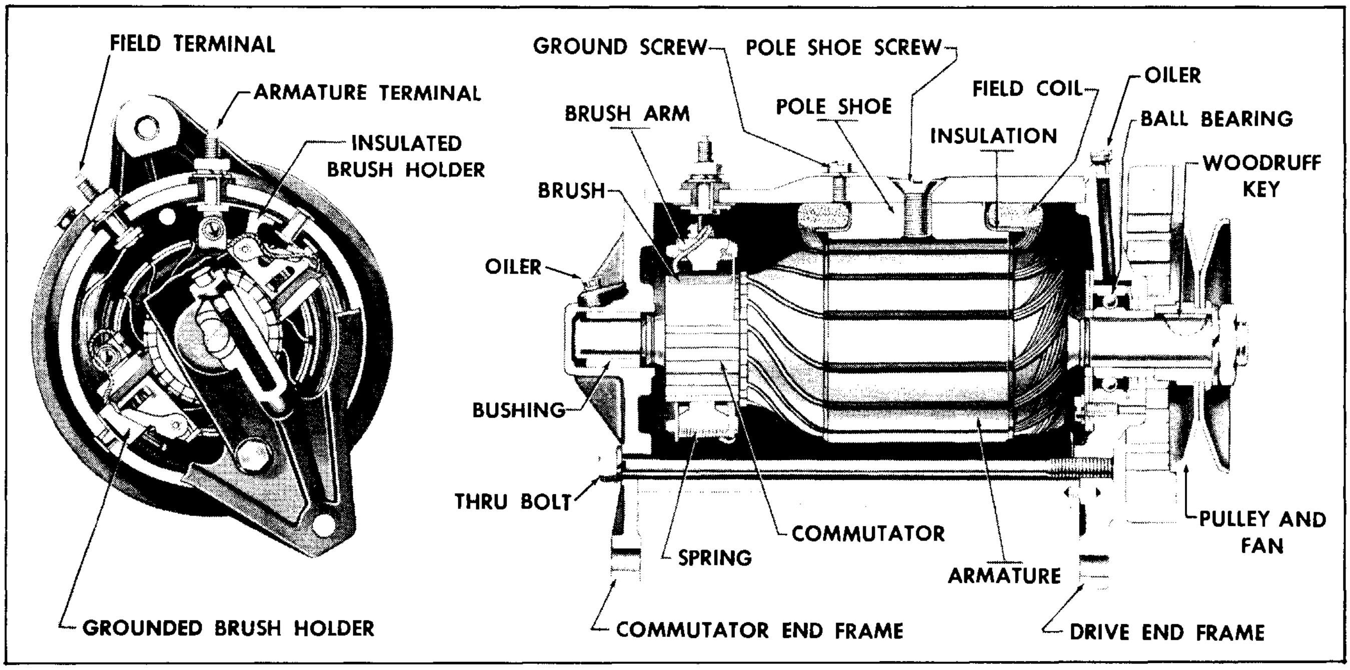


Fig. 12-4 Standard Generator—Cross Section

GENERATOR

Delco-Remy 12-volt, two-brush, shunt generators (Fig. 12-4) are used. The armature in each of these generators is supported by a ball bearing in the drive end frame and by a porous bronze bushing in the commutator end frame. The generator is cooled by a fan mounted on the drive end. Generator output is controlled by a current and voltage regulator.

The standard installation uses a 12-volt, 25-ampere generator. The optional heavy-duty installation and models with air conditioning use a 12-volt, 35-ampere generator. (Early production heavy duty generator is 30 ampere output.)

REGULATOR

A Delco-Remy three-unit, 12-volt regulator (Fig. 12-5) is used on all car models. The regulator is designed for use with a negative grounded battery and a shunt type generator. The regulator contains a cut-out relay, a voltage regulator unit, and a current regulator unit.

CUT-OUT RELAY—The purpose of the cut-out relay is to close and open the charging circuit between the generator and battery. When the generator voltage reaches the value for which the cut-out relay is adjusted, the contact points close and current flows from the generator toward the battery. When generator voltage falls below battery voltage, the contact points open to prevent battery discharge through the generator while the engine is idling or stopped.

VOLTAGE REGULATOR—The purpose of the voltage regulator unit is to limit the system voltage to a safe maximum. Vibrating contacts of the voltage regulator limit voltage by intermittently inserting resistance in the generator field circuit as required. With system voltage properly limited, electrical accessories are protected and the battery is not subjected to excessive overcharging.

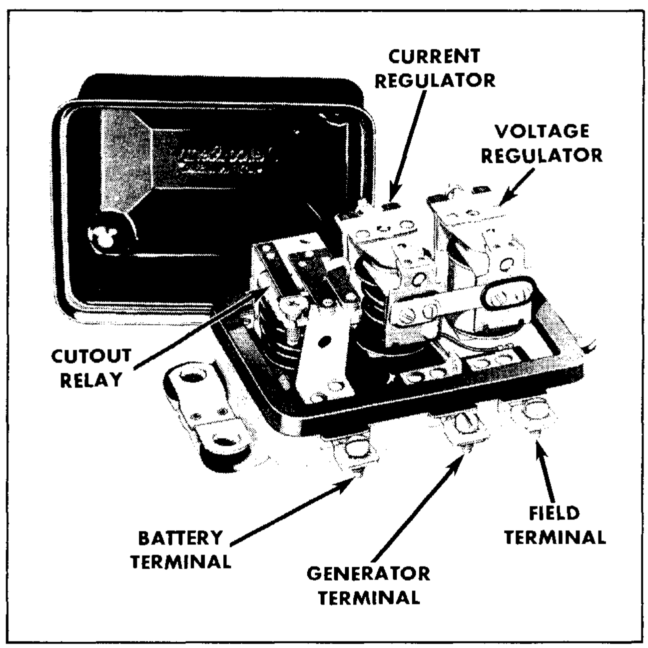


Fig. 12-5 Voltage and Current Regulator

CURRENT REGULATOR—The purpose of the current regulator unit is to prevent overheating of the generator armature by limiting generator output. Vibrating contacts of the current regulator limit current output by intermittently inserting resistance in the generator field circuit as required.

AMMETER

The ammeter is connected in the charging circuit and indicates whether current is flowing into or out of the battery. While the ammeter indicates whether or not the battery is being charged, it is not intended to indicate the amount and no attempt should be made to interpret the ammeter reading in amperes.

Due to the vibrating action of the contact points in the current and voltage regulator units, the ammeter needle may oscillate under certain operating conditions. Unless the regulator has oxidized contact points (see CHECK FOR OXIDIZED REGULATOR CONTACT POINTS, page 12-8) this oscillation does not indicate any regulator trouble and *it must not be used alone as a basis for replacing the regulator.*

GROUND STRAP—DASH TO ENGINE

The dash to engine ground strap is used only on cars equipped with radio.

CHARGING CIRCUIT— PERIODIC SERVICE

BATTERY

Liquid level in the battery should be checked every 2,000 miles or once a month. In extremely hot weather, the checking should be more frequent. If the liquid level is found to be low, water should be added to each cell *until the liquid level rises to the bottom of the vent well. DO NOT OVERFILL!* Distilled water, or water passed through a "demineralizer", should be used for this purpose in order to eliminate the possibility of harmful impurities being added to the electrolyte. Many common impurities will greatly shorten battery life.

The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the battery hold-down bolts should be kept properly tightened. Particular care should be taken to see that the tops of 12-volt batteries are kept clean of acid film and dirt because of the high voltage between the battery terminals. For best results when cleaning batteries, wash first with a dilute ammonia or soda solution to neutralize any acid present and then flush off with clean water. Care must be taken to keep vent plugs tight so that the neutralizing solution does not enter the cell. The hold-down bolts should be kept tight enough to prevent the battery from shaking around in its holder so as not to damage the battery case, but they should not be tightened to the point where the battery case will be placed under a severe strain.

To insure good contact, the battery cables should be tight on the battery posts. The battery ground cable must always be connected to the battery support as well as the engine to insure a good ground circuit through the fender skirt to the regulator. If the battery posts or cable terminals are corroded, the cables should be disconnected and the terminals and clamps cleaned separately with a soda solution and a wire brush. After cleaning apply a thin coating of petrolatum on the posts and cable clamps to help retard corrosion.

GENERATOR

The hinge cap oilers of the generator should be filled with light engine oil once at each vehicle lubrication period. However, if the oil reservoir in the commutator end frame should become exhausted through failure to add oil at each vehicle lubrication period, the oil cup should be filled *three times consecutively,* allowing time between fillings for the oil to saturate the wick. The hinge cap oiler on the drive end frame, however, never should be filled more than once at each lubrication period. CAUTION: Do not fill oil cups with engine running.

Periodic servicing of the generator should include an inspection of the commutator and brushes for cleanliness and wear. If the commutator is dirty it should be cleaned as outlined under GENERATOR, page 12-13. If the brushes are worn down to less than half their original length, they should be replaced.

REGULATOR

Normally, periodic service of the regulator is not required. However, it may occasionally be necessary to clean the regulator contact points as outlined under REGULATOR INSPECTION AND ADJUSTMENT, page 12-14.

CHARGING CIRCUIT—CHECKS AND ADJUSTMENTS ON CAR

WIRING

Excessive voltage drop in the charging circuit tends to keep the battery in an undercharged condition. To check for excessive voltage drop (resulting from loose connections or other high resistance) in the charging circuit, make connections as shown in **Fig.** 12-6 and proceed as follows:

1. Ground the "F" terminal of the regulator.

2. Turn off all accessories and operate the generator at a speed which will produce a charge rate of 20 amperes.

3. Measure the voltage drop at V_1, V_2 and V_3. Readings V_1 plus V_2 should not exceed 0.5 volt. Reading V_3 should not exceed 0.3 volt. If the voltage drop exceeds these limits, excessive resistance is indicated in the circuit checked.

4. Remove the ground lead at the "F" terminal of the regulator and, with the engine stopped, turn on the full lighting and accessory load (approximately 20 amperes). Measure the voltage drop at V_4. If this voltage drop exceeds 0.1 volt, excessive resistance is indicated in this portion of the charging circuit.

If excessive resistance is found, check the wiring for defects, and replace if necessary. Clean and tighten all connections.

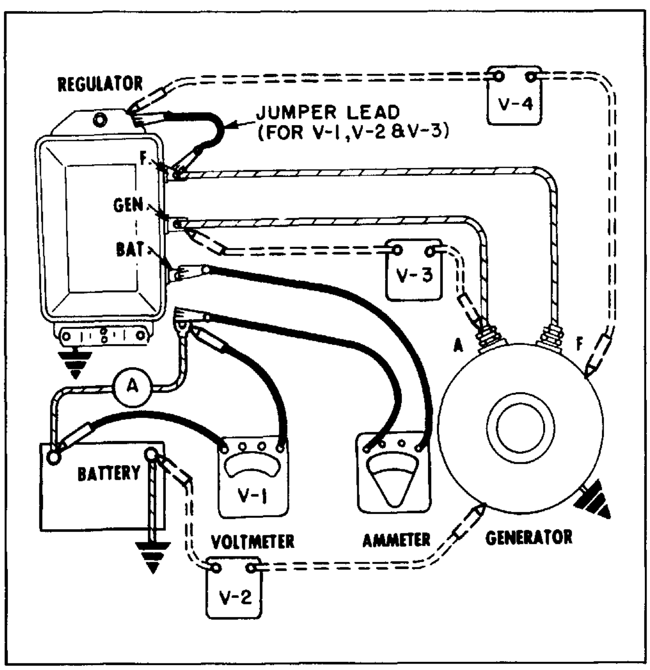


Fig. 12-6 Testing for Voltage Drops in Charging Circuit

BATTERY

Measure the specific gravity of the electrolyte in each battery cell. Correct the specific gravity readings for temperature. (When electrolyte temperature is above 80 degrees F, add 4 points (.004) to the reading for each 10 degrees above 80 degrees **F**. When the electrolyte temperature is below 80 degrees **F**, subtract 4 points for each 10 degrees below 80 degrees **F**.). If the specific gravity is less than 1.215, @ 80° **F**, recharge the battery. If the specific gravity is above 1.215 but the variation between cells is more than 25 points (.025), it is an indication of shorted cells, acid loss or a worn-out battery, and the unit should be removed from the car for further checking to determine whether or not it should be replaced.

When the specific gravity of each cell is above 1.215 and variation between cells is less than 25 points, the battery may be checked under load. This can be done by briefly applying a heavy electrical load to the battery by means of a carbon pile or other suitable equipment and measuring the terminal voltage of the battery. The load in amperes should equal three times the ampere-hour rating of the battery. (Example: For 2SM50 battery, load equals $3 \times 50 = 150$ amps.) Terminal voltage under this load should be not less than 9.0 volts. If test equipment for loading the battery is not available, the cranking motor may be used as a load. (CAUTION: Disconnect distributor to coil primary wire when using the cranking motor as a load. This prevents the engine from firing.) When using the cranking motor for this test, the terminal voltage of the battery should be not less than 9.0 volts. If the terminal voltage is less than 9.0 volts during either of these checks, the battery should be removed from service for further checking to determine whether or not it should be replaced. CAUTION: Do not operate the cranking motor for more than 30 seconds at a time.

REGULATOR

Four regulator electrical checks can be made on the car—the settings of the cutout relay, voltage regulator, and current regulator, and a check for oxidized regulator contact points. Mechanical checks and adjustments requiring removal of the regulator from the car are discussed under REGULATOR INSPECTION AND ADJUSTMENT, page 12-13.

The regulator cover must be in place and the regulator must be at operating temperature when the electrical settings are checked. For best results, the electrical checks should be made in the following order.

1. Voltage regulator setting.

2. Cut-out relay closing voltage.
3. Current regulator setting.
4. Check for oxidized contact points.

The procedure required for making each of these checks follows: NOTE: If special testing equipment is used, follow the manufacturer's instructions.

VOLTAGE REGULATOR—TEST AND ADJUST

Methods for checking and adjusting the voltage regulator setting are discussed in the the following paragraphs. However, it is seldom necessary to check and adjust the voltage regulator setting as long as (1) the battery remains satisfactorily charged without excessive use of water and (2) there is no evidence of damage to lights or other voltage-sensitive equipment.

To check the voltage regulator setting, proceed as follows:

1. Connect a ¼-ohm fixed resistor (approximately 25 watts capacity) into the charging circuit at the "BAT" terminal of the regulator and connect a voltmeter from the "BAT" terminal to ground (Fig. 12-7).

2. Operate the engine at 1600 r.p.m. for at least 15 minutes, with ¼-ohm resistor in circuit and regulator cover in place, to bring the regulator to operating temperature.

3. Place a thermometer near the regulator so that the bulb of the thermometer will be about ¼" from the cover.

4. Cycle the generator by stopping the engine, restarting, and returning to 1600 engine r.p.m.

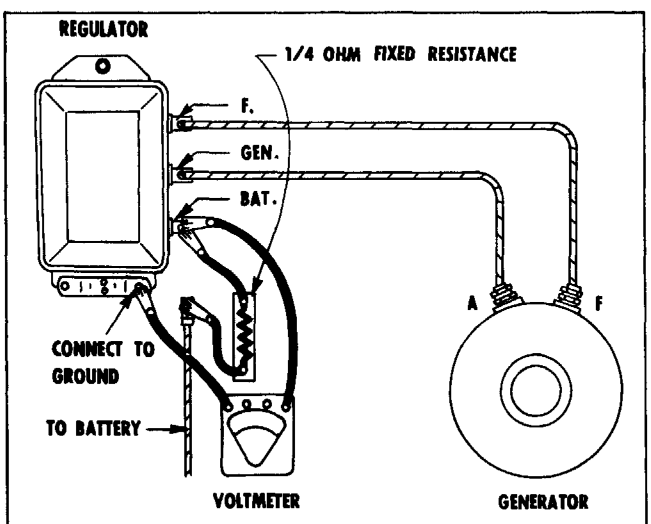


Fig. 12-7 Connections for Testing Voltage Regulator

VOLTAGE CORRECTION FACTORS FOR REGULATOR SETTINGS AT DIFFERENT REGULATOR AMBIENT TEMPERATURES

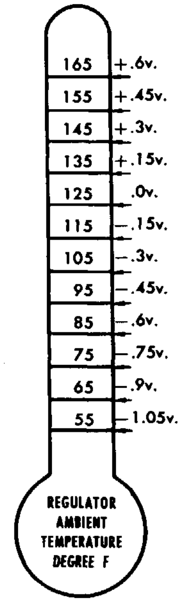
Correction can be made for ambient temperature by adding .15 volt to the operating voltage regulator setting for every 10 degrees that the ambient temperature is above 125 degrees. For every 10 degrees the ambient temperature is below 125 degrees, .15 volt must be subtracted from the operating regulator setting.

EXAMPLE NO. 1

Operating Voltage Setting	14.2 V
Regulator Ambient Temperature	165° F
Correction Factor	+.6 V
"Corrected" Voltage Regulator Setting*	14.8 V

EXAMPLE NO. 2

Operating Voltage Setting	14.6 V
Regulator Ambient Temperature	105° F
Correction Factor	−.3 V
"Corrected" Voltage Regulator Setting*	14.3 V



*Note—Corrected voltage regulator setting should be within the normal range, 13.8 to 14.8 volts.

Fig. 12-8 Voltage Regulator Temperature Correction Chart

5. Note the voltmeter reading and regulator ambient temperature (temperature of air about ¼" from regulator). The voltmeter reading found represents the voltage regulator setting *at the ambient temperature noted. The setting will be different at other temperatures.* Regulator specifications are based on

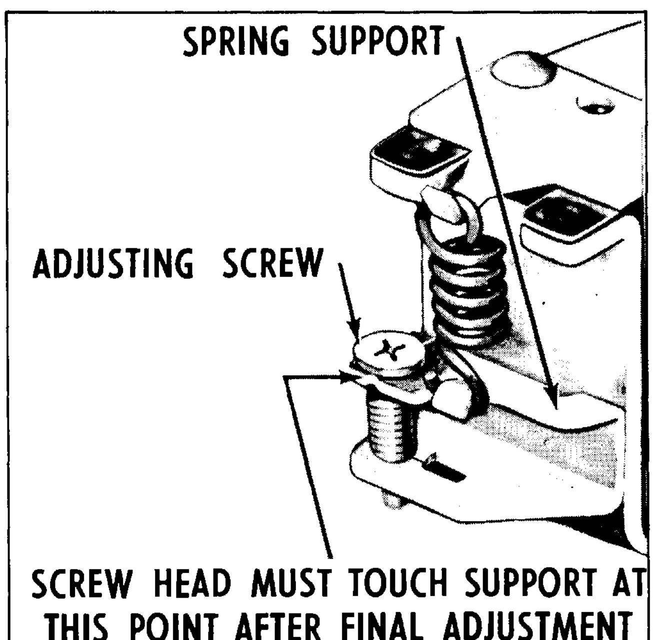


Fig. 12-9 Proper Relationship of Spring Support and Adjusting Screw

checks made at an ambient temperature of 125°F. If the temperature is above 125°F, the regulator will limit voltage to a higher value or if below 125°F, the same regulator will limit voltage to a lower value. A voltage correction factor must therefore be applied to the voltage reading before it can be compared with specifications on page 12-46.

Correcting the Voltage Regulator Setting for Regulator Ambient Temperature—Figure 12-8 shows the voltage correction factor to be applied to the voltage setting at different ambient temperatures. To obtain the "corrected" voltage regulator setting, note the correction factor in Figure 12-8 that corresponds most nearly with the regulator ambient temperature noted in Step 5, and apply it to the voltage reading observed in Step 4. (See examples shown in Figure 12-8.)

When the "corrected" voltage regulator setting falls *within* the normal range given in the specifications and the battery condition has been *satisfactory, the voltage regulator setting should not be disturbed.*

When the "corrected" voltage regulator setting falls *inside or outside* the normal range given in the specifications but battery condition has been *unsatisfactory, tailor the voltage regulator setting* as follows:

TAILORING THE VOLTAGE REGULATOR SETTING

NOTE: The desired voltage regulator setting is that which keeps the battery in a satisfactory state of charge without causing excessive water usage (as evidenced by water consumption exceeding one ounce per cell each 1000 miles). In order to obtain the desired setting, tailor the voltage regulator setting.

a. When the battery uses too much water and the "corrected" voltage setting is above the normal range, lower the "corrected" setting to 14.3 volts and check for an improved condition over a reasonable service period. When the battery uses too much water and the "corrected" voltage setting is *within* the normal range, lower the setting 0.1 or 0.2 volt and check for an improved condition over a reasonable service period. Repeat until the battery remains charged with a minimum use of water.

b. When the battery is consistently undercharged and the "corrected" voltage setting is *below* the normal range, increase the "corrected" setting to 13.8-14.5 volts and check for an improved condition over a reasonable service period. When the battery is consistently undercharged and the "corrected" voltage setting is *within* the normal range, increase the setting 0.1 volt and check for an improved condition over a reasonable service period. Repeat until the battery remains charged with a minimum use of water. NOTE: Avoid "corrected" settings above 14.8 volts as these may cause damage to lights and other voltage-sensitive equipment.

It rarely will be found necessary to use a voltage regulator setting outside the normal range in order to correct battery conditions. Batteries which do not respond to voltage regulator settings within the normal range usually will be found to be (1) batteries used in cars that are operated consistently at low speeds or in heavy traffic, or (2) batteries that have abnormal charging characteristics.

(1) When a car is operated consistently at low speeds or in heavy traffic the battery may remain undercharged even with a voltage regulator setting of 14.8 volts. Under these operating conditions, generator output and charging time may be insufficient to offset electrical loads on the battery. Periodic recharging of the battery from an outside source or replacement of the original generator with a special generator will be required in these cases.

(2) Batteries suspected of having abnormal charging characteristics should be removed for a complete check. If the checks outlined under BATTERY CHARGING, page 12-9, indicate that the battery is still serviceable, a voltage regulator setting outside the normal range may be adopted provided it does not cause damage to lights or other voltage-sensitive equipment or cause the battery to use water.

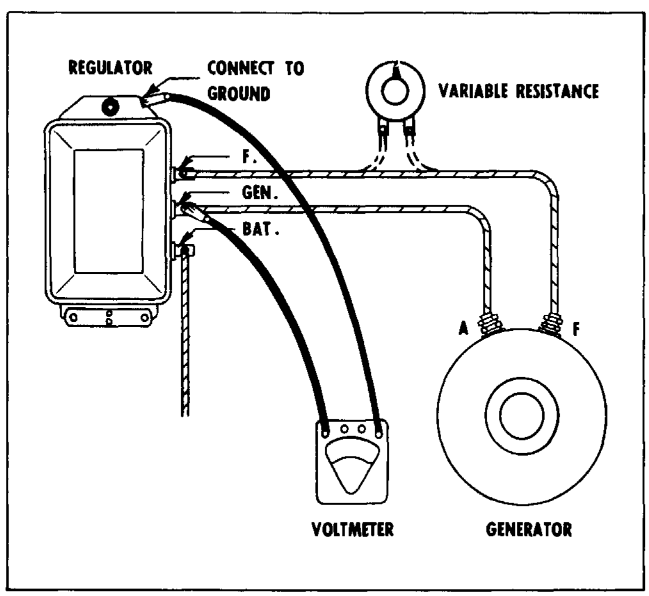


Fig. 12-10 Connections for Checking Closing Voltage

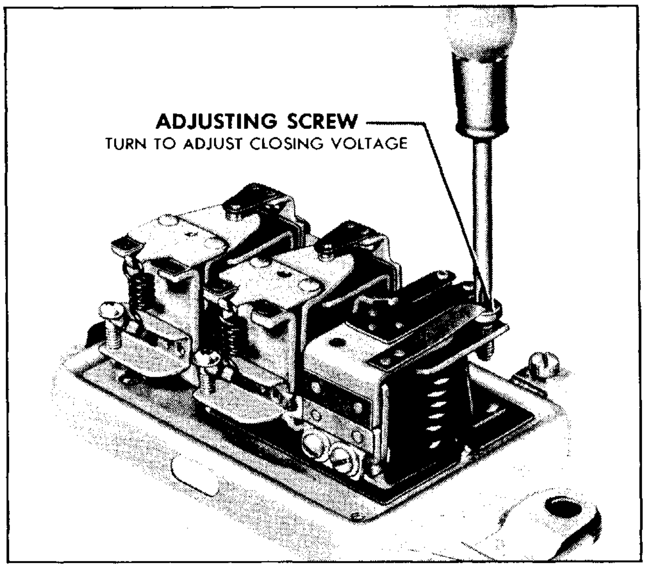


Fig. 12-11 Adjusting Closing Voltage

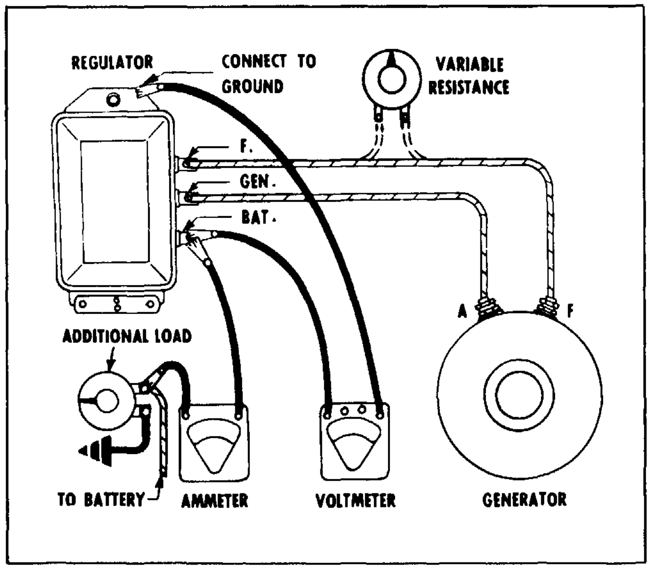


Fig. 12-12 Connections for Checking Current Regulator

On new cars or on other applications where no battery history is available, any "corrected" voltage regulator setting found within the normal range may be considered satisfactory unless local conditions or subsequent battery performance indicate the need for tailoring the voltage regulator setting.

When the need for changing the voltage regulator setting has been established, proceed as follows: Remove the regulator cover and turn adjusting screw clockwise to raise the setting, counterclockwise to lower the setting. Before taking the new reading after each adjustment, replace the regulator cover as quickly as possible and cycle the generator. CAUTION: Final adjustment should always be made by increasing spring tension to assure contact between the screw head and spring support (Fig. 12-9). Sometimes the spring support does not follow the screw head as spring tension is decreased, and it will be necessary to bend the spring support up to insure contact between the screw head and spring support. Failure of the voltage regulator unit to "hold" its setting usually results from (1) setting or checking the voltage regulator at other than operating temperature, and (2) the screw head not touching the spring support after final adjustment is completed.

CUT-OUT RELAY CLOSING VOLTAGE—TEST AND ADJUST

NOTE: It is seldom necessary to check the closing voltage of the cutout relay as long as the relay functions to close and open the charging circuit. Any setting that falls within the specified range is satisfactory as long as the setting is at least 0.5 volt below the voltage regulator setting.

1. Connect a voltmeter between the regulator "GEN" terminal and ground (Fig. 12-10).

2. Check cut-out relay closing voltage by *either* of the following methods.

a. Slowly increase generator speed and note the voltage at which the relay closes. Decrease generator speed and make sure the cut-out relay contact points open.

b. Connect a 25-ohm, 25-watt variable resistor in the field circuit. Operate the generator at medium speed at maximum resistance (with all the resistance of the variable resistor turned in the circuit). Slowly decrease (turn out) the resistance, and note the voltage at which the contact points close. Slowly increase the resistance and make sure that the contact points open.

3. Adjust the closing voltage by turning the adjusting screw (Fig. 12-11). Turn the screw clockwise to increase the setting and counterclockwise to decrease the setting.

CURRENT REGULATOR—TEST AND ADJUST

It is seldom necessary to check the setting of the current regulator unless the generator armature shows signs of overheating. Any setting that falls within the specified range is satisfactory.

1. Connect an ammeter into the charging circuit

and connect voltmeter from "BAT" to ground (Fig. 12-12).

2. Turn on all accessory load (lights, radio, etc.) and connect any additional load such as carbon pile or bank of lights across the battery to drop system voltage to 12.5-13 volts.

3. Operate the generator at 1600 engine r.p.m. for at least 15 minutes to establish operating temperature. The regulator cover must be in place.

4. Cycle the generator and note the current regulator setting (see step 4 under VOLTAGE REGULATOR–TEST AND ADJUST for cycling procedure).

5. Adjust the current setting in the same manner as that used for adjusting the voltage regulator setting.

CHECK FOR OXIDIZED REGULATOR CONTACT POINTS

1. Turn on the headlights.

2. Operate the generator at a speed which will produce a charge rate of 5 amperes.

3. Ground the "F" terminal of the regulator.

4. If generator output increases more than 2 amperes, oxidized regulator contact points are indicated and the regulator should be removed from the car and the contact points should be cleaned as outlined under REGULATOR INSPECTION AND ADJUSTMENT, Page 12–13.

CHARGING CIRCUIT— MINOR REPAIRS

BATTERY CABLE REPLACEMENT

When replacing battery ground cable be sure to connect the cable to the battery support as well as to the engine. This is necessary to insure a good ground circuit through the battery support and fender skirt to the regulator.

The battery-to-starter cable is difficult to remove at the starting motor solenoid. For this reason the cable should be removed and replaced as an assembly with the starting motor as outlined on pages 12–18 and 12–21 respectively.

BATTERY SUPPORT REPLACEMENT

When replacing the battery support, it is very important that the outer edges of the battery bear firmly and evenly against the support. To provide even support, install shims as necessary between the corners of the support and the support bracket.

BATTERY CHARGING

Batteries removed from the car for charging should be charged continuously at a low rate until fully charged. Batteries may be safely slow-charged at a rate in amperes equal to 7% of the battery's ampere-hour capacity. Example: 7% of 50 A.H.=3.5 amperes. This is called the "normal" charge rate. The battery is fully charged when specific gravity readings taken at hourly intervals with battery on charge show no increase during three consecutive readings. Although the slow-charge method is recommended for charging all batteries, discharged batteries in otherwise good condition may be given a "boost" with a fast charger if time does not permit complete slow-charging. When using a quick charger, it must be remembered that the battery is only receiving a *partial* charge and that the battery electrolyte temperature must not be allowed to exceed 120° F. If the battery heats excessively, quick charging must be discontinued. NOTE: Do not load-test batteries having specific gravity readings less than 1.215 @ 80° F. Batteries removed from the car for further checking in order to determine whether or not the unit should be replaced, first should be brought to a fully-charged condition by slow-charging. Badly sulfated batteries may require a continuous slow charge for 48 hours or more before a rise in gravity reading occurs. If the specific gravity reading of any cell fails to reach 1.250 (corrected to 80° F) or if there is a variation of more than 25 points between cells after thorough slow charging, replace the battery. If the specific gravity of each cell is 1.250 or more and variation between cells is less than 25 points the battery may be given a high-rate discharge test as follows:

HIGH-RATE DISCHARGE TEST

Place an ampere load equal to three times the ampere-hour rating (Example: 3×50 A.H. = 150 amperes) across the battery and measure the terminal voltage. If terminal voltage is less than 9.0 volts under load, replace the battery. (If no equipment is available for placing a high-rate discharge load across the battery, measure the open circuit voltage of each cell with an open circuit cell tester. If the open circuit cell voltages vary more than .05 volt, replace the battery).

GENERATOR REMOVAL

1. Disconnect field and output wires from generator.

2. Remove adjusting strap screw and remove fan belt from generator pulley.

3. Remove generator from mounting bracket.

GENERATOR DISASSEMBLY

1. Place generator in bench vise; use vise as holding fixture only and be careful not to distort generator frame: NOTE: Check brush spring tension before disassembling generator to determine if spring is weak or brush holder is gummy (Fig. 12-14). Proper spring tension is approximately 28 ounces.

2. Remove two through bolts and remove commutator end frame assembly (Fig. 12-13).

3. Remove brushes.

4. Remove drive end frame assembly, with armature and pulley, from generator frame.

5. Remove drive pulley. A fan belt held tightly in the pulley groove will aid in holding the armature while removing the nut.

6. Remove drive pulley and key from armature shaft.

7. Remove spacer collar from armature shaft and then slide drive end frame from armature shaft. Bearing-assembly-spacer-inside washer will remain on armature shaft and may be lifted off after removing end frame from armature.

8. Remove bearing retainer plate and gasket from end frame.

9. Push ball bearing out of end frame and put in a clean place where grit or dirt will not enter.

10. Remove bearing felt washer and bearing felt from drive end frame.

CLEANING AND INSPECTION OF GENERATOR

1. With the generator completely disassembled, wash all metal parts except the armature and fields in cleaning solvent. Fields and armature must never be cleaned with any degreasing solvents since this may damage the insulation. NOTE: Armature and field coils may be cleaned by brushing with oleum spirits.

2. After it has been given a thorough cleaning in solvent, inspect generator ball bearing for roughness, scored races, and deformed balls.

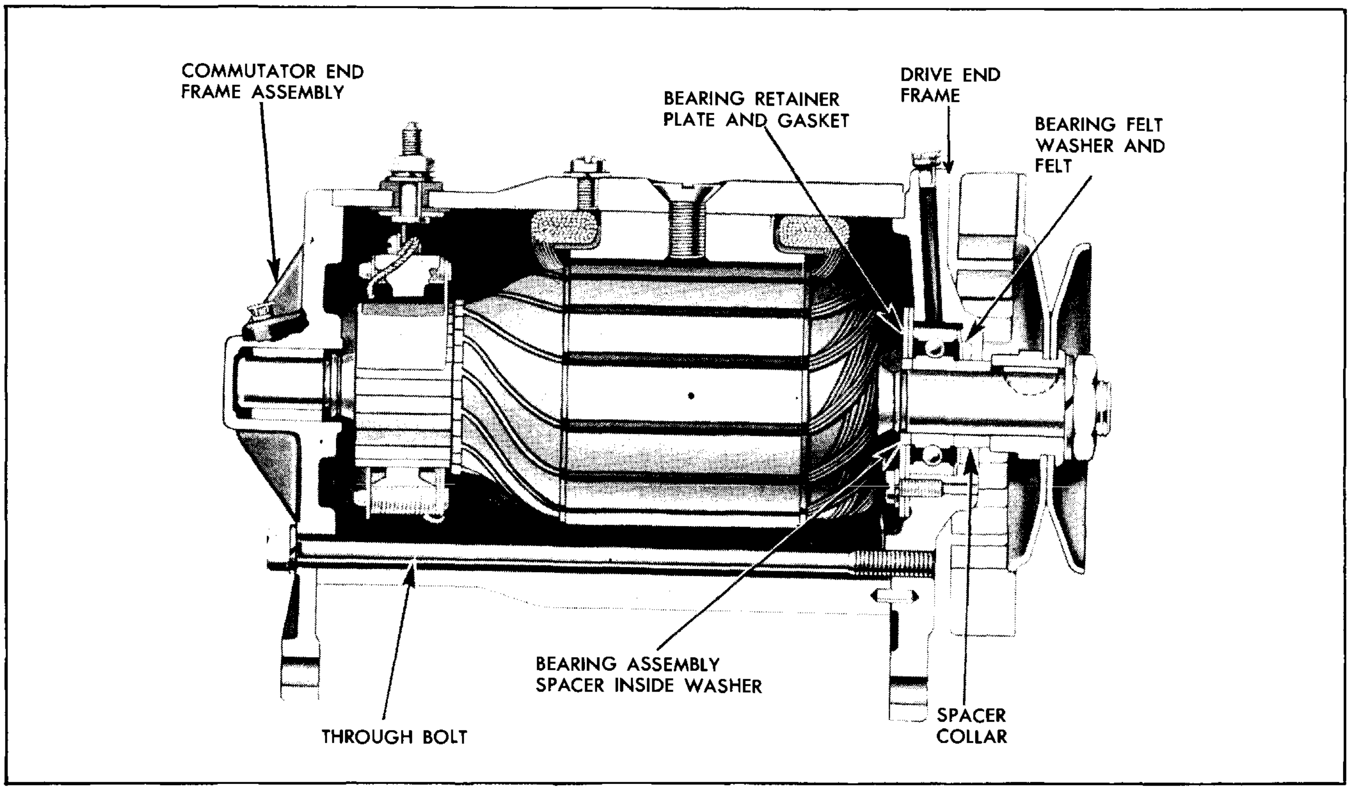


Fig. 12-13 Standard Generator—Cross Section

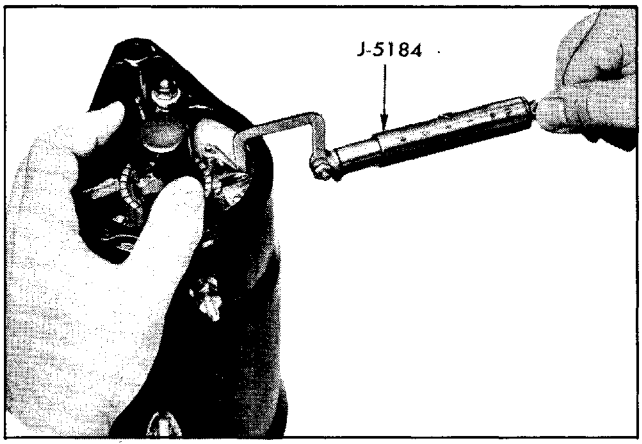


Fig. 12-14 Checking Brush Spring Tension

3. Check brush holders to see that they are not deformed or bent so as to interfere with holding brushes properly against commutator.

4. Check fit of armature shaft in bushing in commutator end frame. If bushing is excessively worn it should be replaced.

5. Inspect armature commutator; if rough it must be turned down and insulation undercut. Inspect solder at points where armature wires fasten to ends of commutator riser bars to make sure solder is in place so as to assure a good connection.

6. If test equipment is available:

a. Check armature for shorts by placing on growler and with hack saw blade over armature core, rotate armature (Fig. 12-15). If saw blade vibrates, armature or cummutator is shorted. Recheck after cleaning between the commutator bars and if saw blade still vibrates, armature is shorted and must be replaced.

b. Check armature for open circuit by making bar-to-bar check as shown in Fig. 12-16. Inconsistent variation in readings indicates an open armature.

c. Using a 110-volt test lamp, place one lead on armature core and other on commutator. If lamp lights, armature is grounded and must be replaced (Fig. 12-17).

d. Using a 110-volt test lamp, place one lead on field terminal on generator frame and the other lead on armature terminal (Fig. 12-18). If lamp does not light, the field coils are open and must be replaced (unless a loose connection is found which can be soldered).

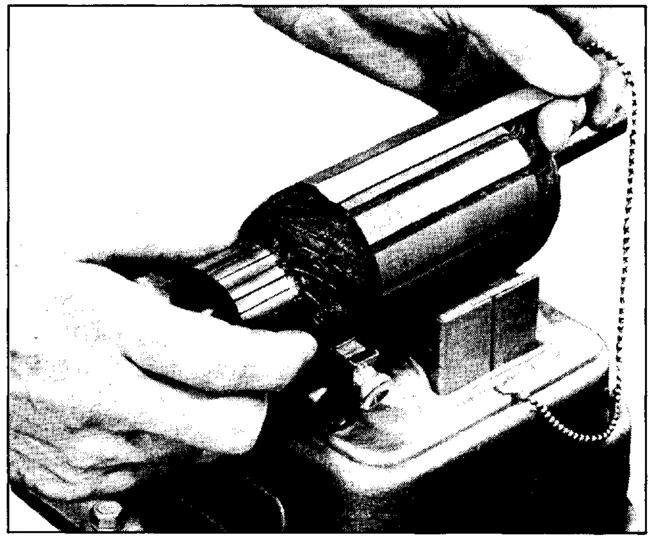


Fig. 12-15 Testing Armature for Shorts

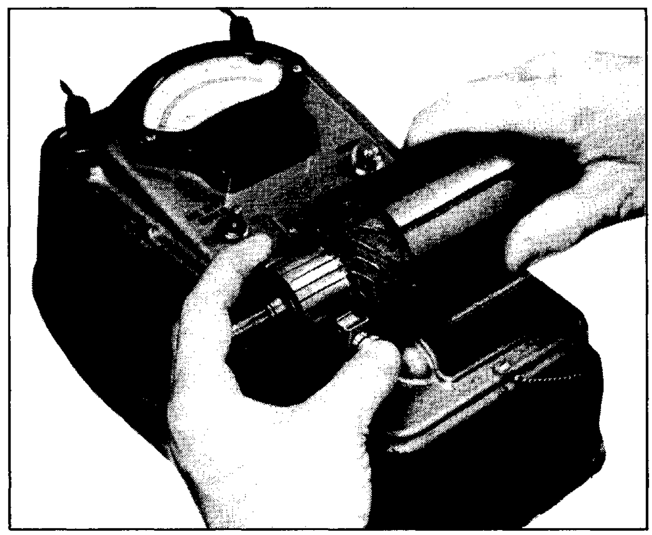


Fig. 12-16 Bar-to-Bar Test for Open Armature

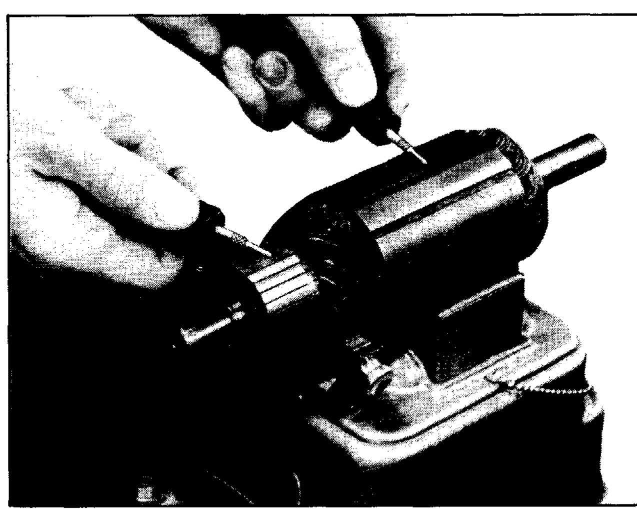


Fig. 12-17 Testing Armature for Ground

Fig. 12-18 Testing Field Coils for Open Circuit

e. Using a 110-volt test lamp, place one lead on ground (touch to generator frame) and other lead on field terminal on generator frame (be sure free end of field wire is not touching ground and field terminal insulation is not broken) (Fig. 12-19). If lamp lights, the field coils are grounded. If ground in field coils cannot be located or repaired, coils must be replaced.

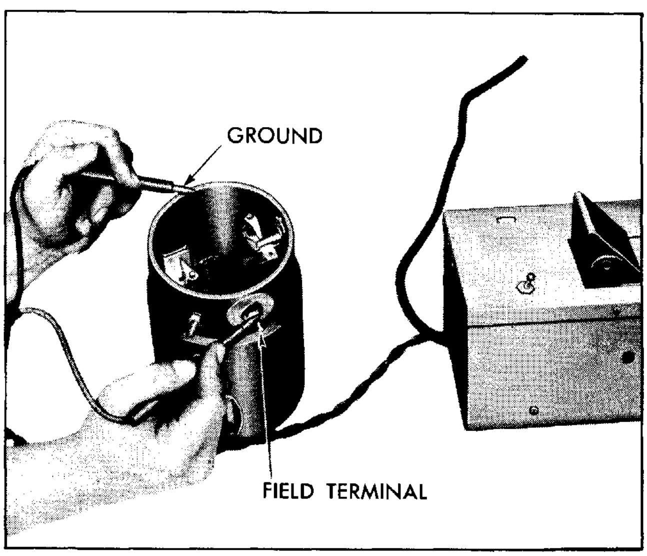


Fig. 12-19 Testing Field Coils for Ground

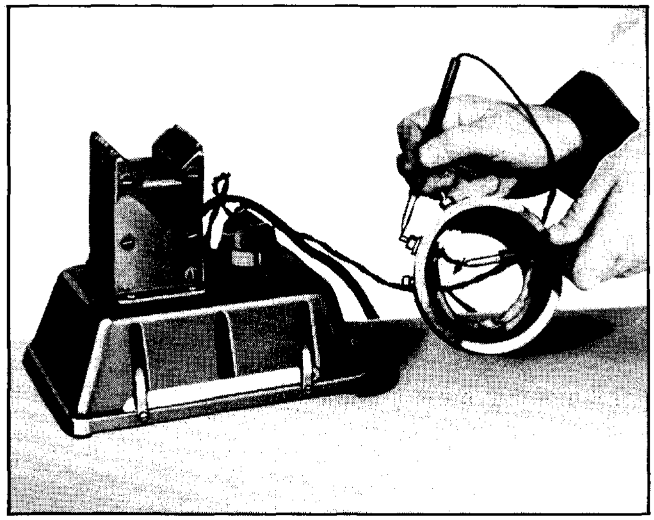


Fig. 12-20 Testing Brush Lead to Output Terminal for Open Circuit (Heavy Duty Only)

f. This test applies only to heavy-duty generators with brushes mounted on commutator end frame. Using a 110-volt test lamp, place one lead on generator positive (or output) terminal on generator frame, and place other lead on the end of wire to generator positive terminal which was removed from brush when generator was disassembled (Fig. 12-20). If lamp does not light, wire is open circuited and must be replaced.

g. Using a 110-volt test lamp, place one lead on generator positive (or output) terminal on generator frame, and place other lead on ground (touch to generator frame) (Fig. 12-21). (Be sure loose end of terminal lead is not touching ground.) If lamp lights, positive terminal insulation through generator frame is broken down and must be replaced.

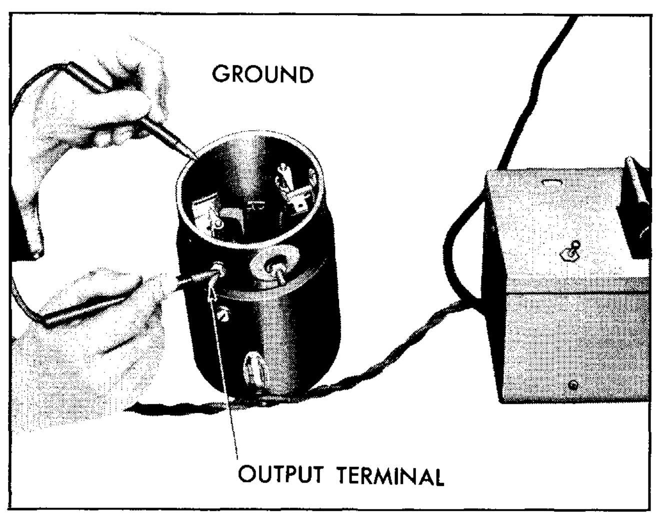


Fig. 12-21 Testing Positive Terminal for Ground

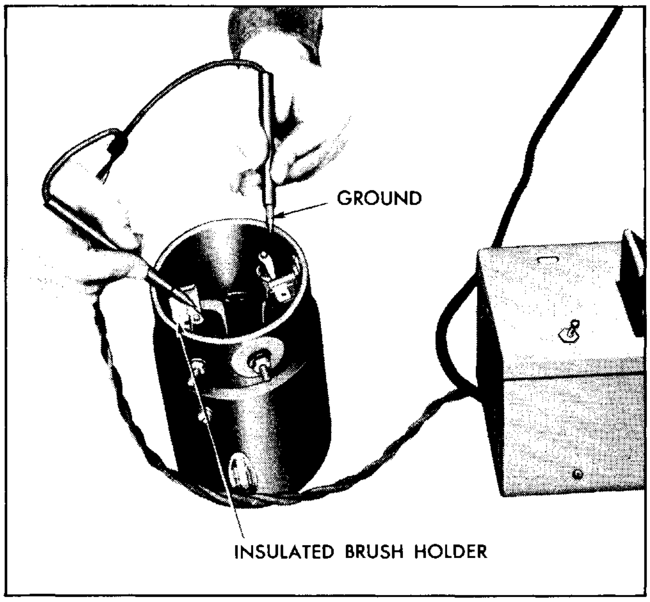


Fig. 12-22 Testing Positive Brush Holder for Ground

h. Using a 110-volt test lamp, place one lead on the positive or insulated brush holder and the other lead on ground. If lamp lights the brush holder is grounded due to defective insulation at the frame (Fig. 12-22).

GENERATOR REPAIR

LOOSE ELECTRICAL CONNECTIONS

When an open soldered connection is found during inspection, it may be resoldered provided rosin flux is used for soldering. CAUTION: *Acid flux must never be used on electrical connections.*

TURNING COMMUTATOR

When inspection shows commutator roughness, it should be cleaned as follows:

1. Turn down commutator in a lathe until it is thoroughly cleaned. CAUTION: *Do not cut beyond section previously turned.*

2. Undercut insulation between commutator bars 1/32". This undercut must be the full width of insulation and flat at the bottom; a triangular groove will not be satisfactory. After undercutting, the slots should be cleaned out carefully to remove any dirt and copper dust.

3. Sand the commutator lightly with No. 00 sandpaper to remove any slight burrs left from undercutting.

4. Recheck armature on growler for short circuits.

ASSEMBLY OF GENERATOR

1. Repack ball bearing with a good grade of ball bearing grease working the grease well into the bearing.

2. Install felt washer and then steel washer in drive end frame.

3. Install ball bearing in drive end frame and then position gasket and bearing retainer on frame and install three retaining screws.

4. Place steel washer on drive end of armature shaft and then slip drive end frame assembly onto armature shaft.

5. Install spacer washer on armature shaft and slide it down into place in end frame against bearing inner race.

6. Position drive pulley key in armature shaft and install drive pulley on shaft.

7. Install drive pulley lockwasher and nut and tighten.

8. Place armature and end frame assembly in field frame, aligning dowel pins with holes.

9. Install commutator end frame on field frame, aligning dowel pins with holes.

10. Install and tighten two generator through-bolts.

11. Install new brushes in brush holders by pulling back on brush arm and inserting brush in each holder making sure that chamfered end of brush seats correctly on commutator. Brushes will be seated, if necessary after installing generator in car.

12. Connect brush and field leads to brushes.

13. Fill reservoirs with engine oil. In order to completely fill the oil reservoir at the commutator end, it will be necessary to make three consecutive fillings, allowing time between fillings for oil to saturate the wick.

GENERATOR INSTALLATION

1. Place generator in position on mounting bracket and install bracket bolts. Tighten snugly.

2. Place fan belt over generator drive pulley and fasten adjusting strap screw to generator, but do not tighten brace bolt.

3. Force generator away from engine until fan belt has ¼" deflection when forced downward from normal position with a force of about 8 lbs. (5 lbs. with Air Conditioning) applied midway between the generator and fan. Tighten adjusting strap screw with generator in this position and tighten bracket bolts securely.

4. Connect positive generator lead and field lead to terminals on generator frame. CAUTION: *On radio equipped cars do not connect radio by-pass condenser to generator field terminal. It should be connected to generator output (A) terminal.*

5. Polarize the generator by momentarily touching a jumper wire to the "BAT" and "GEN" terminals on regulator.

6. Start engine. If brushes squeak, seat them by placing brush seating paste on the commutator. The soft abrasive material of the paste will be carried under the brushes and wear the brush faces to the commutator contour in a few seconds.

REGULATOR REMOVAL

While electrical adjustments are made with the regulator on the car as outlined under CHECKS AND ADJUSTMENTS ON CAR, Page 12–5, it is necessary to remove the regulator for cleaning contact points and adjusting air gaps on the three regulator units.

To remove the regulator it is merely necessary to disconnect the leads from the regulator and remove the regulator to fender skirt mounting screws.

REGULATOR INSPECTION AND ADJUSTMENT (REMOVED FROM CAR)

CONTACT POINTS

The regulator contact points will not operate indefinitely without some attention. It has been found that a great majority of all regulator troubles can be corrected by a simple cleaning of contact points plus possibly some readjustment.

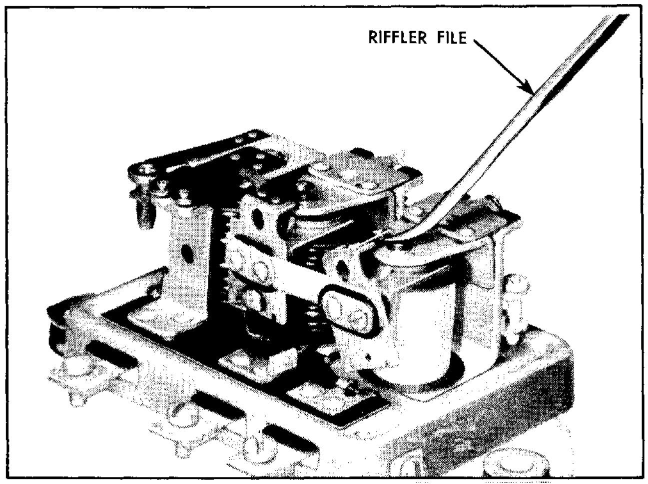


Fig. 12-23 Cleaning Regulator Contact Points

To clean the contact points, loosen the upper contact bracket mounting screws so that the bracket can be tilted to one side as shown in Fig. 12-23. (For greater accessibility in cleaning, the contact support brackets may be removed.) Great care should be exercised to reinstall them as shown in Fig. 12-24, checking to make sure that the connector strap between the voltage and current regulators is insulated from the voltage regulator contact mounting screws and is connected to the current regulator contact mounting screws.

The large flat contact point, located on the armature of both current and voltage regulator units, always develops a slight cavity and will require the most attention. It is not necessary to have a flat surface on this contact point, but a riffler file should be used to remove all oxides so that pure metal is exposed (Fig. 12-23).

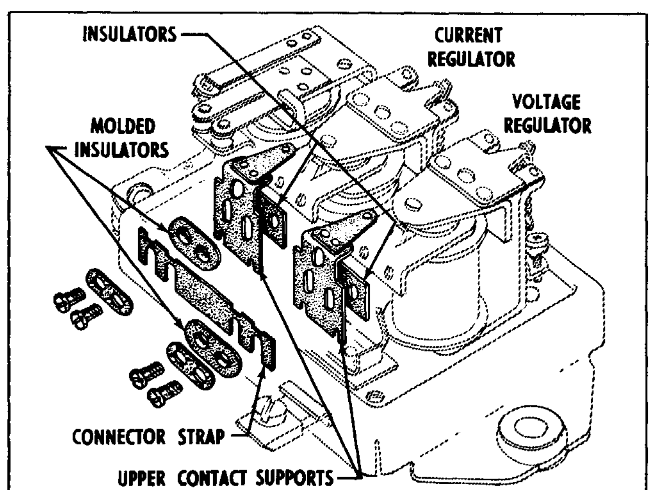


Fig. 12-24 Regulator Contact Mounting

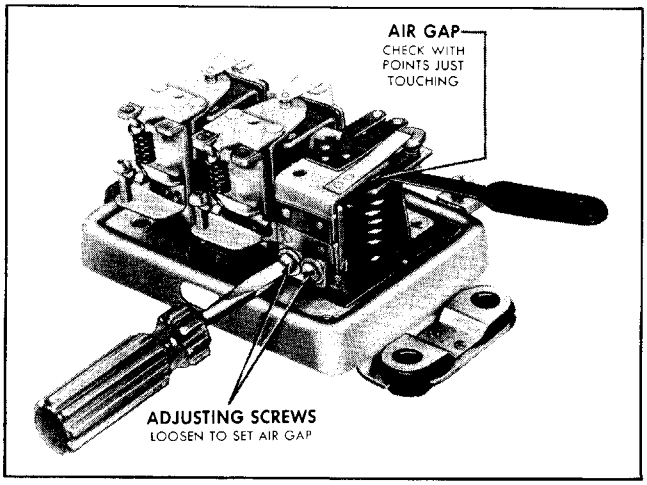


Fig. 12-25 Adjusting Cutout Relay Air Gap

The small soft-alloy contact point, located on the upper contact support of current and voltage regulator units, does not oxidize. This contact point may be cleaned with crocus cloth, or other fine abrasive material, followed by a *thorough* wash with clean carbon tetrachloride to remove any foreign material remaining on the contact surface. CAUTION: Do not file contact points excessively. Never use sandpaper or emery cloth.

CUT-OUT RELAY INSPECTION AND GAP ADJUSTMENT

1. Place fingers on armature directly above core and move armature directly down until points just close and then measure air gap between armature and center of core. Air gap should be .020".

Check to see that both points close simultaneously; if not, bend spring finger so that they do. To adjust air gap, loosen two screws at back of relay and raise or lower armature as required. Tighten screws securely after adjustment (Fig. 12-25).

2. Check point opening and adjust to .020" by bending upper armature stop (Fig. 12-26).

VOLTAGE REGULATOR INSPECTION AND GAP ADJUSTMENT

Push armature down to core and release it until contact points just touch and then measure air gap between armature and center of core. Air gap should be .075".

Adjust gap by loosening contact mounting screws and raising or lowering contact brackets as required (Fig. 12-27). Check to see that points are lined up and tighten screws after adjustment.

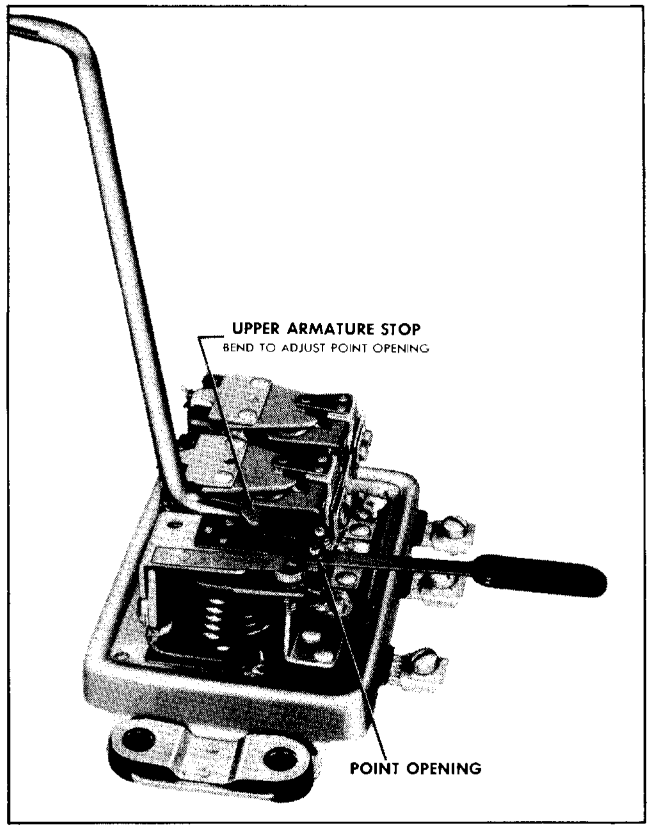


Fig. 12-26 Adjusting Cutout Relay Point Opening

CURRENT REGULATOR INSPECTION AND GAP ADJUSTMENT

Check and adjust current regulator air gap in exactly the same manner as voltage regulator (Fig. 12-27). Air gap should be .075".

Be sure rubber gasket is in place on regulator base before installing regulator cover.

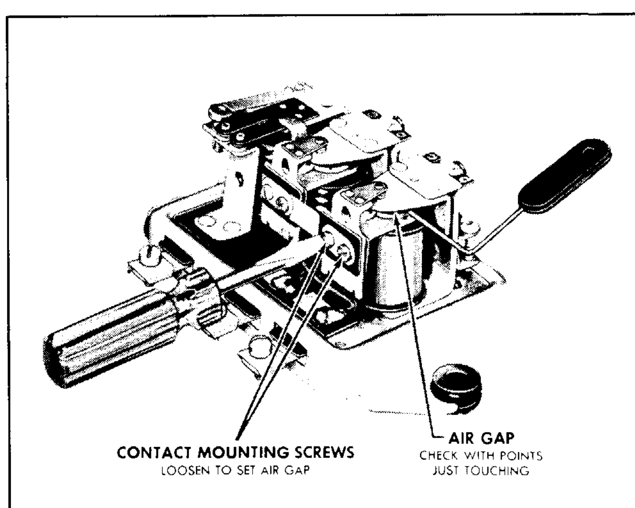


Fig. 12-27 Adjusting Voltage Regulator Air Gap

INSTALLATION OF REGULATOR

1. Install regulator and tighten mounting screws. CAUTION: Do not tighten the mounting screws excessively as this will destroy the cushioning effect of rubber grommets in the mounting.

2. Attach "BAT", "GEN", and "FIELD" leads to regulator and polarize generator by momentarily touching a jumper wire to the "BAT" and "GEN" terminals on the regulator before starting the engine.

3. Check and adjust the electrical settings of the regulator on the car as outlined under CHECKS AND ADJUSTMENTS ON CAR, page 12-5.

CHARGING CIRCUIT TROUBLE DIAGNOSIS

BATTERY

1. Measure the specific gravity of the electrolyte. If it is below 1.215 (corrected to 80° F) recharge with a slow rate charger. If variation between cells exceeds 25 points (.025), remove the battery from service for further checking.

2. Measure the terminal voltage of the battery during cranking. Disconnect distributor to coil primary wire during this check to prevent engine firing. If the terminal voltage is less than 9.0 volts, remove the battery from service for further checking.

3. If the battery remains undercharged, check for loose generator belt, defective generator, high resistance in the charging circuit, oxidized regulator contact points, or a low voltage setting. (See CHECKS AND ADJUSTMENTS ON CAR.)

4. If the battery uses too much water, lower the voltage regulator setting. (See CHECKS AND ADJUSTMENTS ON CAR.)

GENERATOR

1. Check belt tension and adjust as required.

2. Inspect commutator and, if dirty, clean by holding No. 00 sandpaper or a cleaning stone against it while generator is operating at idle speed. CAUTION: Do not use emery cloth for cleaning armature.

3. With the engine operating at medium speed, momentarily ground the "F" terminal of the generator. Generator output should increase. If it doesn't, make a complete check of the generator.

4. If output is high and is not affected by grounding the "F" terminal of the generator, disconnect the lead from the "F" terminal of the generator. Generator output should fall off. If it does not, remove the generator and check it for a grounded field.

GENERATOR BRUSH NOISE

Generator brush noises can usually be eliminated by seating the brushes with the generator on the car. While brush seating compound will frequently provide satisfactory seating, the use of a brush seating stone as follows has been found to provide a more positive cure:

1. Start engine and run until it reaches normal operating temperature. (Brush noise may be more pronounced when generator is hot.)

2. Determine engine speed at which brush noise is loudest.

3. While running engine at speed where noise is loudest, very carefully stone commutator until noise disappears.

4. In rare instances, stoning may not eliminate the noise. In this case, remove the armature from the generator, turn down the commutator and undercut the mica as outlined on page 12-13. When reassembling generator, install new brushes.

REGULATOR

Measure the voltage between the "BAT" terminal of the regulator and ground at (1) idle speed, and (2) medium engine speed. The voltage should be higher at a medium engine speed than it is at idle speed. If it is not and the generator passes its tests above, make a complete check of the regulator. If it is, the voltage regulator setting still may require adjustments as discussed under points 3 and 4 of "BATTERY" if the battery remains undercharged or uses too much water.

STARTING CIRCUIT DESCRIPTION

The starting circuit includes the starting motor, solenoid, and battery. (For a complete discussion of the battery see CHARGING CIRCUIT DESCRIPTION.) The starting motor (Fig. 12-28) is a 12-volt extruded frame type unit. A metal connector bar connects the fields directly to the solenoid terminal, eliminating the conventional motor terminal and connector strap. A rubber grommet assembled in the frame around the bar insulates the bar from ground and also prevents dirt, water, and oil from entering the motor. The motor has four pole shoes and a compound field—three field coils connected in series from the connector bar to the insulated brushes, and one shunt coil connected from the connector bar to ground. An overrunning clutch type of drive is used to engage the starting motor pinion with the flywheel. The overrunning action of the clutch protects the motor armature from excessive speed when the engine fires. A solenoid switch mounted on the motor frame operates the overrunning clutch drive by means of a linkage to the shift lever. When the control switch is closed manually, the solenoid is energized, shifting the starting motor pinion into mesh with the flywheel. The main contacts of the solenoid are then closed so that battery current is delivered to the starting motor. The solenoid plunger is protected from dirt, water, and oil by a rubber boot.

The armature shaft and clutch have mating spiral splines which prevent transmission of full cranking power until the clutch pinion is fully engaged in the flywheel ring gear. A pinion stop, consisting of a snap ring and retainer, and a thrust collar assembled on the armature shaft, takes all the end thrust.

Brush arm supports are attached directly to the extruded section of the field frame. One ground brush and one insulated brush are pivoted from the same brush holder support; thus only two brush holder supports are required. A single ribbon type spring applies tension to each pair of brushes.

A drain in the bottom of the drive housing prevents the accumulation of mud and water in the housing.

The starting motor used on cars with power steering is slightly different in that the solenoid has been moved rearward to provide clearance at the steering gear.

PERIODIC SERVICE

No periodic lubrication of the starting motor or solenoid is required. The motor and brushes cannot be inspected without disassembling the unit so no service is required on the motor or solenoid between overhaul periods.

CHECKS AND ADJUSTMENTS ON CAR

Although the starting motor cannot be checked against specifications on the car, a check can be made for excessive resistance in the cranking circuit. To check for excessive resistance in the cranking circuit, measure:

(1) The voltage drop, during cranking, between the insulated battery post and the "BATTERY" terminal of the solenoid.

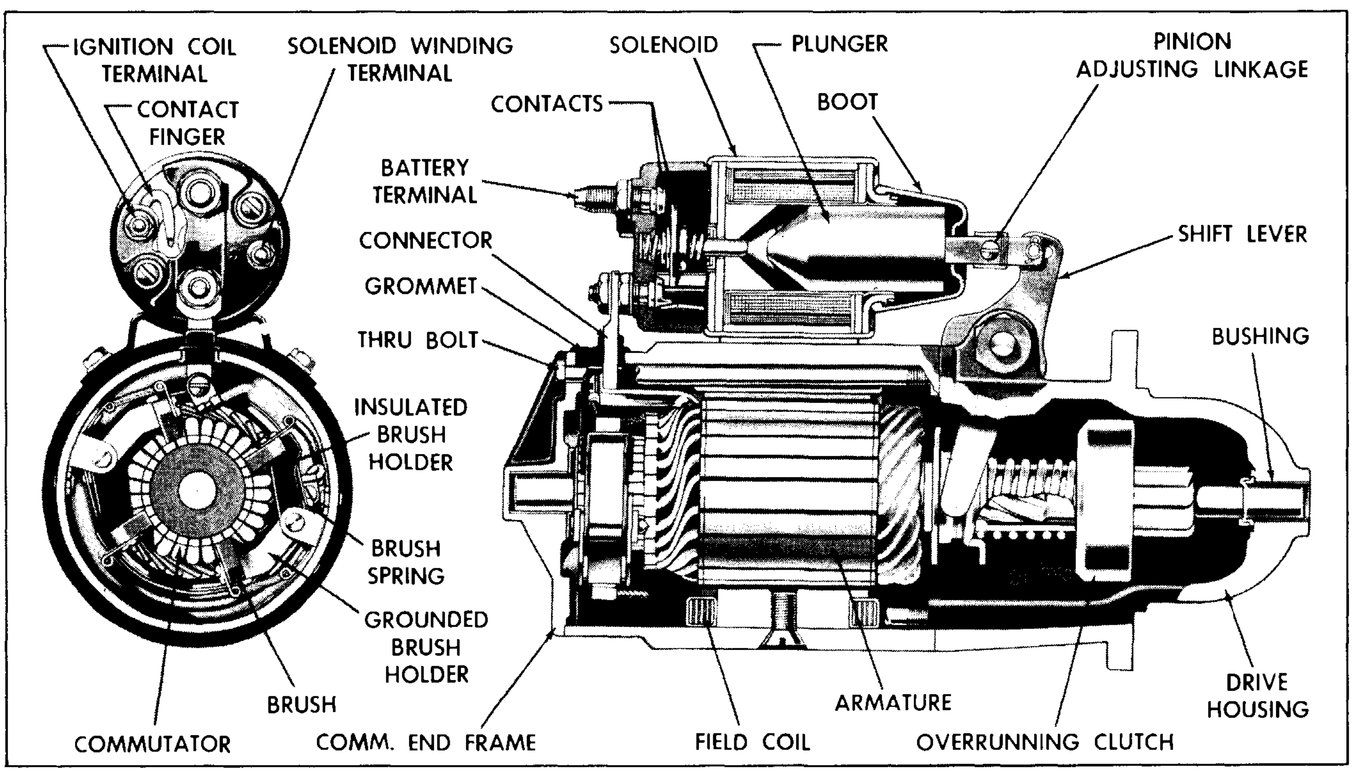


Fig. 12-28 Starting Motor and Solenoid—Cross Section (Without Power Steering)

(2) The voltage drop, during cranking, between the "BATTERY" terminal of the solenoid and the "MOTOR" terminal of the solenoid.

(3) The voltage drop, during cranking, between the grounded battery post and the starting motor frame.

CAUTION: To prevent the engine from firing during the above checks, disconnect the primary lead to the distributor, either at the distributor or at the coil.

If the voltage drop for any one of the above three checks exceeds 0.2 volt, excessive resistance is indicated in that portion of the cranking circuit being checked. Locate and eliminate the cause for any excessive voltage drop in these circuits in order to obtain maximum efficiency of the cranking system.

When the solenoid fails to pull in, the trouble may be due to excessive voltage drop in the solenoid control circuit. To check for this condition, close the starting switch and measure the voltage drop between the "BATTERY" terminal of the solenoid and the "SWITCH" terminal of the solenoid. Excessive resistance in the solenoid control circuit is indicated and should be corrected if this voltage drop exceeds 3.5 volts.

If the voltage drop does not exceed 3.5 volts and the solenoid does not pull in, measure the voltage available at the "SWITCH" terminal of the solenoid. If the solenoid does not feel warm, it should pull in whenever the voltage available at the "SWITCH" terminal is 7.7 volts or more (when the solenoid feels warm, it will require a somewhat higher voltage to pull in).

STARTING MOTOR REMOVAL

NOTE: Due to the difficulty in removing wires from the solenoid and the cable clamp on the solenoid, the starting motor and cables should be removed together. This will also aid in proper reassembly of cables to the solenoid and the cable clamp since they can be assembled before the starting motor is installed.

1. Disconnect battery to starting motor cable from battery post.

2. Remove rubber cover from junction block on left fender skirt by pulling straight off.

3. Disconnect junction block to solenoid wires from junction block noting which terminal each wire is removed from.

4. Remove battery cable from clip on junction block.

5. Raise front of car and place car stand under front suspension.

6. Remove engine side apron from below starting motor.

7. Pull battery cable and solenoid wire loom down so they hang free of surrounding parts.

8. Remove starting motor mounting screws and remove starting motor with cable and solenoid wire loom.

9. Remove wires from solenoid and cable from clamp on solenoid bracket.

STARTING MOTOR DISASSEMBLY

1. Remove pin connecting solenoid link to shift lever.

2. Remove through bolts.

3. Remove commutator end frame, field frame assembly and armature assembly from drive housing.

4. Remove overrunning clutch from armature shaft as follows:

a. Slide thrust collar (Fig. 12-29) off end of armature shaft.

b. Slide a standard half inch pipe coupling or other metal cylinder of suitable size (an old pinion of suitable size can be used if available) onto shaft so end of coupling or cylinder butts against edge of retainer (Fig. 12-30). Tap end of coupling with hammer, driving retainer towards armature and off snap ring.

c. Remove snap ring from groove in shaft using pliers or other suitable tool. If snap ring is too badly distorted during removal it may be necessary to use a new one when reassembling clutch.

d. Slide retainer and clutch from armature shaft.

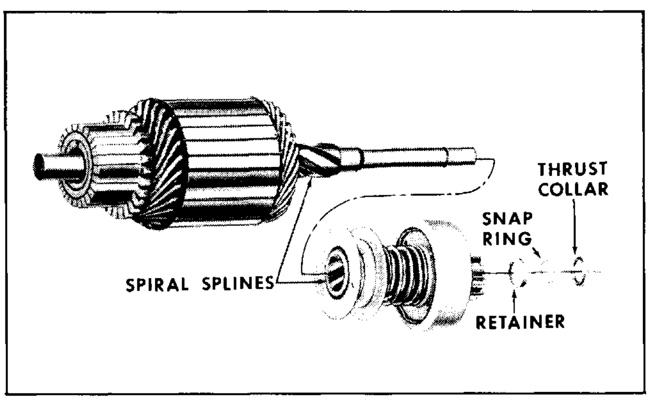


Fig. 12-29 Armature and Overrunning Clutch Assembly—Exploded

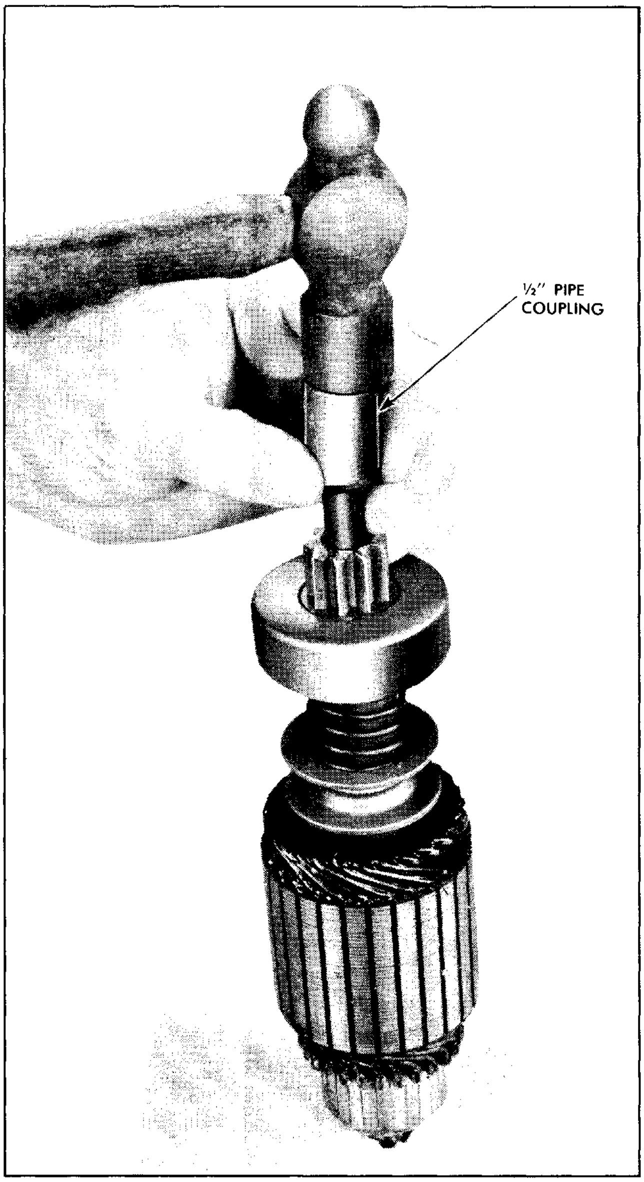


Fig. 12-30 Driving Retainer Off Snap Ring

CLEANING, INSPECTION AND TESTING OF STARTING MOTOR

1. Clean all starting motor parts, but *do not use grease dissolving solvents for cleaning the overrunning clutch, armature, and field coils* since such a solvent would dissolve the grease packed in the clutch mechanism and would damage armature and field coil insulation.

2. Test overrunning clutch action. The pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked, or excessively worn. Replace assembly if necessary.

3. Check brush holders to see that they are not deformed or bent, but will properly hold brushes against the commutator.

4. Check fit of armature shaft in bushing of drive housing. Shaft should fit snugly in the bushing. If the bushing is worn, it should be replaced.

5. Inspect armature commutator. If commutator is rough or out of round, it should be turned down and undercut. Inspect the points where the armature conductors join the commutator bars to make sure that it is a good firm connection. A burned commutator bar is usually evidence of a poor connection.

6. If test equipment is available,

a. Check the armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated (Fig. 12-15). If saw blade vibrates, armature is shorted. Recheck after cleaning between the commutator bars. If saw blade still vibrates, replace the armature.

b. Using a 110-volt test lamp, place one lead on the armature core or shaft and the other on the commutator (Fig. 12-17). If the lamp lights, the armature is grounded and must be replaced.

c. Using a 110-volt test lamp, place one lead on each end of the three field coils connected in series (Fig. 12-31). If the lamp does not light, the field coils are open and will require repair or replacement.

Fig. 12-31 Testing Field Coils for Open Circuit

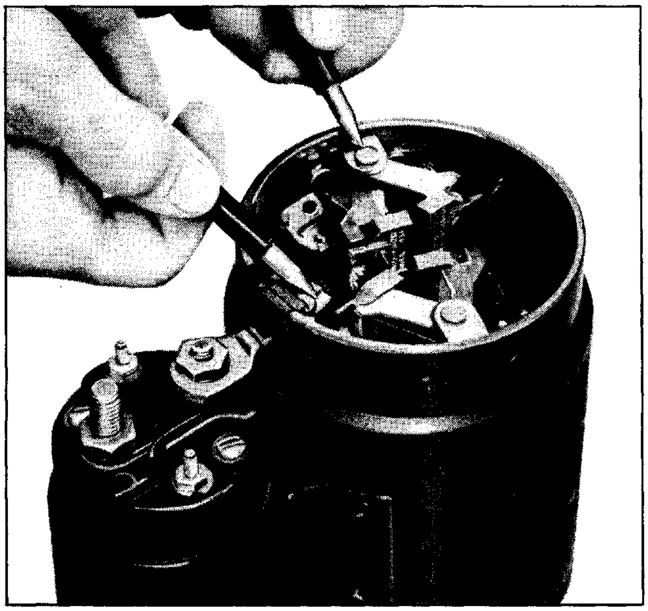


Fig. 12-32 Testing Field Coils for Ground

d. Using a 110-volt test lamp, place one lead on the connector bar and the other on the field frame (Fig. 12-32). Disconnect the shunt coil ground before this check is made. If the lamp lights, the field coils are grounded and the defective coils will require repair or replacement.

e. Using a 110-volt test lamp, place one lead on each end of the shunt coil (Fig. 12-33). Disconnect the shunt coil ground before this check is made. If the lamp does not light, the shunt coil is open and will require replacement.

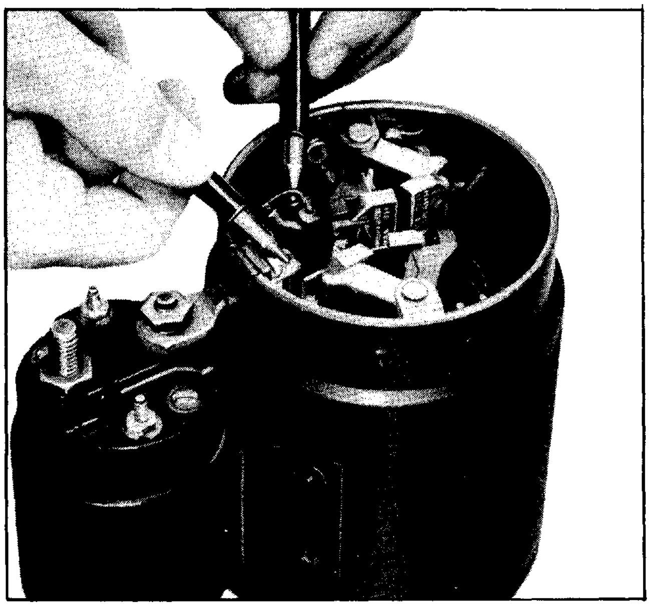


Fig. 12-33 Testing Shunt Coil for Open Circuit

f. Check the current draw of the solenoid windings. To check the current draw of the hold-in winding, connect a variable source of voltage (in series with an ammeter) to the switch terminal of the solenoid and ground. To check the current draw of both windings, ground the solenoid motor terminal, and connect a source of voltage (in series with an ammeter) to the switch terminal of the solenoid and ground.

CAUTION: Either of the above checks must be completed in a minimum length of time to prevent heating of the solenoid windings. Heating will cause the current draw readings to be below the specifications which are based on a temperature of 80° F. (See SPECIFICATIONS, Page 12-46.)

ASSEMBLY OF STARTING MOTOR

1. Assemble overruning clutch to armature shaft as follows:

a. Lubricate drive end of armature shaft with light engine oil.

b. Slide clutch assembly onto armature shaft with pinion outward (Fig. 12-29).

c. Slide retainer onto shaft with cupped surface facing end of shaft (Fig. 12-29).

d. Stand armature on end on 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 (Fig. 12-34).

e. Assemble thrust collar on shaft with shoulder next to snap ring (Fig. 12-29).

f. Place armature flat on work bench, and position retainer and thrust collar next to snap ring. Then, using two pairs of pliers at same time (one pair on either side of shaft), grip retainer and thrust collar and squeeze until retainer is forced over snap ring (Fig. 12-35).

2. Place 4 or 5 drops of light engine oil in drive housing bushing. Make sure thrust collar is in place against snap ring and retainer and slide armature and clutch assembly into place in drive housing, engaging shift lever with clutch.

3. Position field frame over armature, against drive housing using care to prevent damage to brushes.

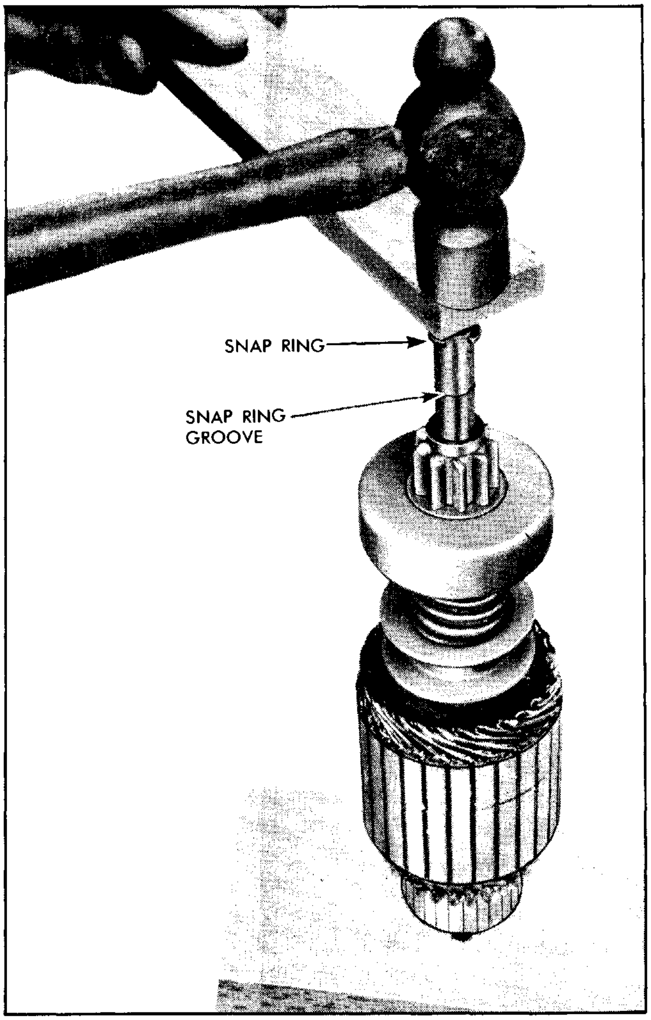


Fig. 12-34 Forcing Snap Ring Onto Armature Shaft

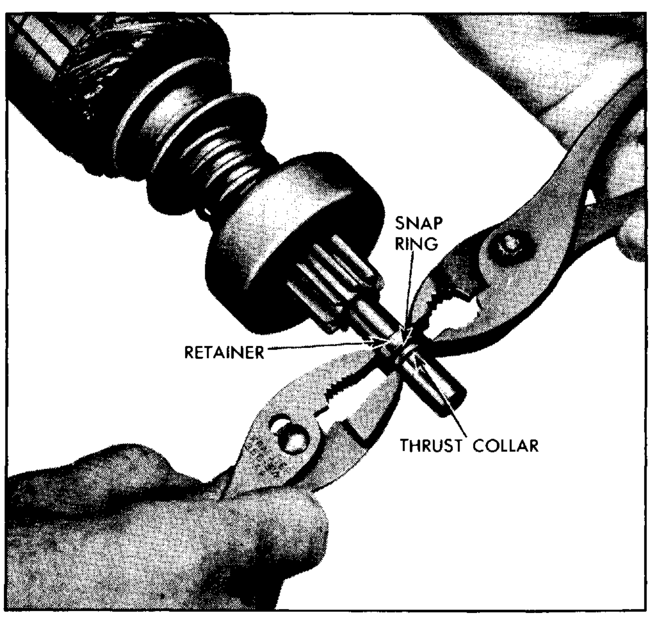


Fig. 12-35 Forcing Retainer Over Snap Ring

4. Place 4 or 5 drops of light engine oil in bushing in commutator end frame. Place leather thrust washer on armature shaft and slide commutator end frame onto shaft.

5. Install through bolts and tighten securely.

6. Assemble solenoid link to shift lever and install pin and cotter pin.

7. Adjust pinion clearance as follows:

Connect a voltage source of approximately 4 volts (two battery cells in series) between the solenoid switch terminal and ground. CAUTION: *Do not connect the voltage source to the ignition coil terminal of the solenoid. Do not use a 12-volt battery instead of the 4 volts specified as this will cause the motor to operate. As a further precaution to prevent motoring, connect a heavy jumper lead from the solenoid motor terminal to ground.* Push the solenoid plunger into the solenoid by hand. Once in, battery current will hold it in place. Push the pinion back as far as possible to take up any movement, and check the clearance between the end of the pinion and the pinion stop with a feeler gauge (Fig. 12-36). Clearance should be .010"-.140". Adjust pinion clearance by loosening the screw in the plunger linkage and shortening or lengthening the linkage as required. Retighten the screw securely when adjustment is correct. NOTE: Pinion clearance should be checked any time the starting motor is disassembled or the solenoid is replaced. Improper clearance will cause the buttons on the shift lever yoke to rub on the collar during cranking.

8. Test the free speed of the starting motor. To make this test, connect a battery in series with an ammeter to the starting motor terminal and ground. Use an r.p.m. indicator to determine the speed reached by the starting motor (see SPECIFICATIONS, page 12-46). Failure of the starting motor to perform according to specifications may be due to tight or dirty bearings, or high resistance connections.

STARTING MOTOR INSTALLATION

1. Connect battery cable and solenoid wires to solenoid and bend clamp over cable as shown in Fig. 12-37. NOTE: Connect yellow wire to battery cable terminal of solenoid, black wire to terminal marked "R" and purple wire to terminal marked "S".

2. Install starting motor on engine and tighten mounting screws securely.

3. Push cables up where they can be reached from above car, then lower car.

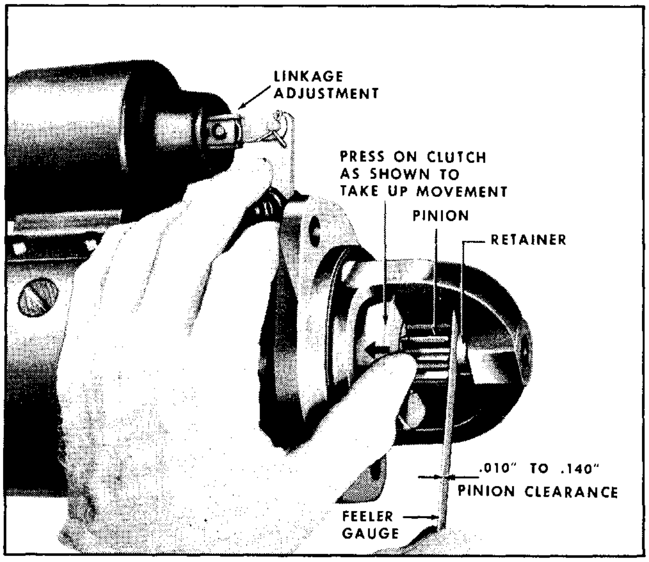


Fig. 12-36 Measuring Pinion Clearance

4. Route solenoid-to-junction-block wire loom around cable guide on cover of power brake unit (if so equipped), beneath steering column and connect wires to junction block. Connect wires to terminals which have matching wires on opposite side. Replace rubber cover on junction block by pressing firmly onto terminal studs.

5. Route battery cable around cable guide on cover of power brake unit (if so equipped), beneath steering column and through clamp on fender skirt junction block. Bend clamp over cable securely and connect cable to battery post.

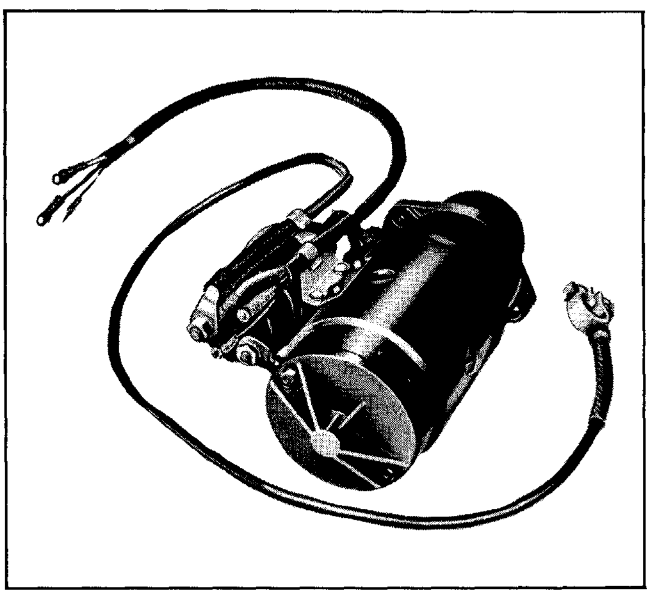


Fig. 12-37 Proper Assembly of Wires and Cable to Solenoid

STARTING MOTOR CIRCUIT TROUBLE DIAGNOSIS

STARTING MOTOR AND SOLENOID

CAUTION: Specific gravity of battery must be 1.215 or higher before making the following tests.

1. If the solenoid does not pull in, measure the voltage between the switch "S" terminal of the solenoid and ground with the starting switch closed. (CAUTION: If the solenoid feels warm, allow to cool before checking.) If the voltage is less than 7.7 volts, check for excessive resistance in the solenoid control circuit. If the voltage exceeds 7.7 volts, remove the starting motor and check (1) solenoid current draw, (2) starting motor pinion clearance, and (3) freedom of shift lever linkage.

2. If the solenoid "chatters" but does not hold in, check the solenoid for an open "hold-in" winding. *Whenever it is necessary to replace a starting motor solenoid, always adjust starting motor pinion clearance.*

3. If motor engages but does not crank or cranks slowly, check for excessive resistance in the external cranking circuit or within the starting motor.

IGNITION CIRCUIT DESCRIPTION

The ignition circuit (Fig. 12-38) includes the distributor, ignition coil, ignition resistor, ignition switch, spark plugs, battery, and the resistance type secondary cables. (For a complete discussion of the battery, see CHARGING CIRCUIT DESCRIPTION, page 12-2.)

DISTRIBUTOR

The distributor is designed for the ultimate in synchronism accuracy. Double bearing construction is used for the distributor drive shaft (Fig. 12-39). The lower babbitt bearing receives automatic lubrication from the crankcase and the upper bearing is supplied by a wick type oiler. A center bearing type of vacuum advance breaker plate assembly (Fig. 12-40 and 12-41) is used in this distributor. The vacuum advance breaker plate assembly consists of a movable breaker plate, a support plate, and a lubricating felt between the two plates. These parts are held together by means of retainer washers on a hub and a bearing washer, spiral stabilizing spring, and retainer on the stabilizing spring post. The movable breaker plate is supported by three molded buttons which ride on the support plate.

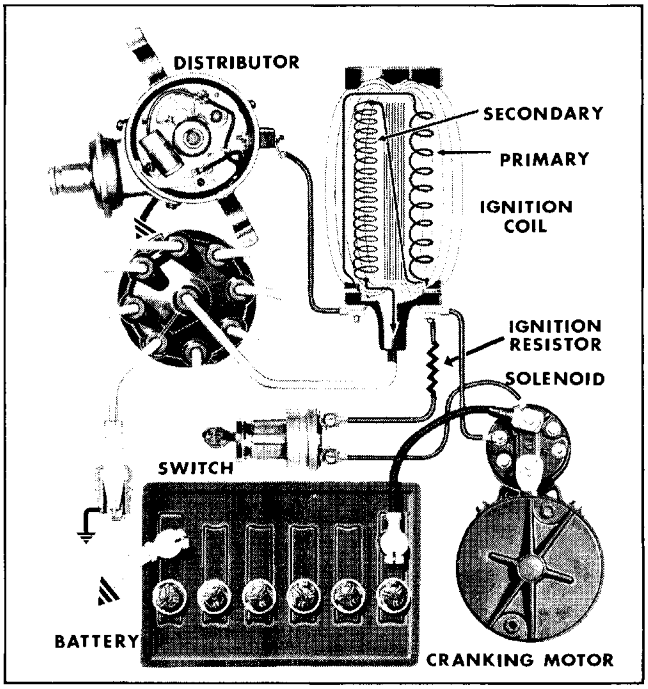


Fig. 12-38 Ignition Circuit—Schematic

A vacuum control unit is mounted on the outside of the distributor housing. The vacuum control unit consists of an enclosed spring-loaded diaphragm linked mechanically to the movable breaker plate inside the distributor. The air tight side of the diaphragm is connected to the intake manifold side of the carburetor. Under part throttle operation the intake manifold vacuum is sufficient to actuate the diaphragm and cause the movable breaker plate to move, thus advancing the spark and increasing fuel economy.

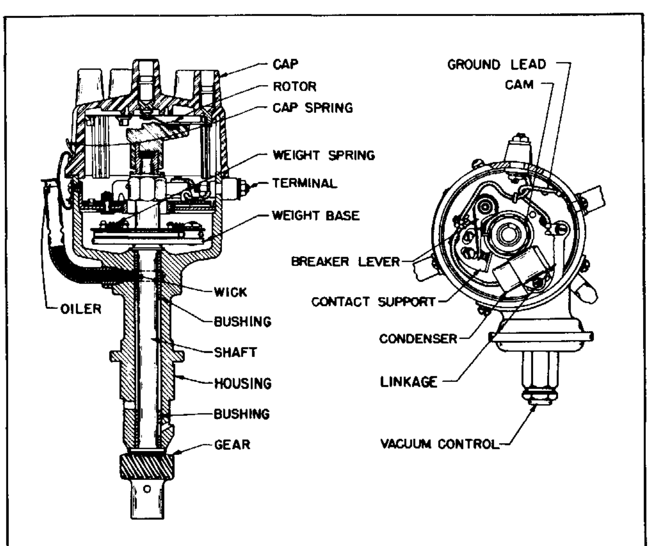


Fig. 12-39 Distributor Construction

During acceleration or when the engine is pulling heavily, the vacuum is not sufficient to actuate the diaphragm and the moveable breaker plate is held in the retarded position by a calibrated return spring which bears against the vacuum diaphragm.

The centrifugal advance mechanism consists of an automatic cam actuated by two centrifugal weights controlled by springs. As the speed of the distributor shaft increases with engine speed, the weights are thrown outward against the pull of the springs. This advances the cam causing the contact points to open earlier and thus advancing the spark.

IGNITION COIL AND IGNITION RESISTOR

The ignition coil is an oil-filled, hermetically-sealed unit designed specifically for use with an external resistor in the 12-volt system. The improved ignition performance of the 12-volt system is largely the result of this new design. The external resistor, connected in series with the primary circuit between the battery and coil, increases coil efficiency by dissipating nearly half the heat which otherwise would be generated within the coil itself. The resistor is wound with wire which changes resistance only slightly with temperature. This characteristic prevents excessive primary current at low temperatures and thus reduces the tendency for the contact points to oxidize in cold weather. The resistance of the resistor is 1.40-1.65 ohms.

To obtain greatly improved starting performance at low temperatures, the resistor is by-passed during cranking, thereby connecting the ignition coil directly to the battery. This makes full battery voltage available to the coil and thus keeps ignition voltage as high as possible during cranking. The by-passing of the resistor during cranking is accomplished by the use of a "finger" within the solenoid (Fig. 12-28) connected to the ignition coil. As the solenoid contacts close, the solenoid finger is connected to the battery. CAUTION: Since the ignition primary circuit is supplied through the solenoid during cranking, the engine will kick over any time it is cranked, even though the ignition switch is off. To prevent this from happening and possibly causing serious injury, always disconnect the ignition primary wire from the coil or distributor before making underhood tests which require cranking the engine.

SECONDARY IGNITION CABLES

All ignition cables in the secondary or high tension system (coil to distributor and distributor to plugs) is neoprene jacketed. This cable is resistant to the

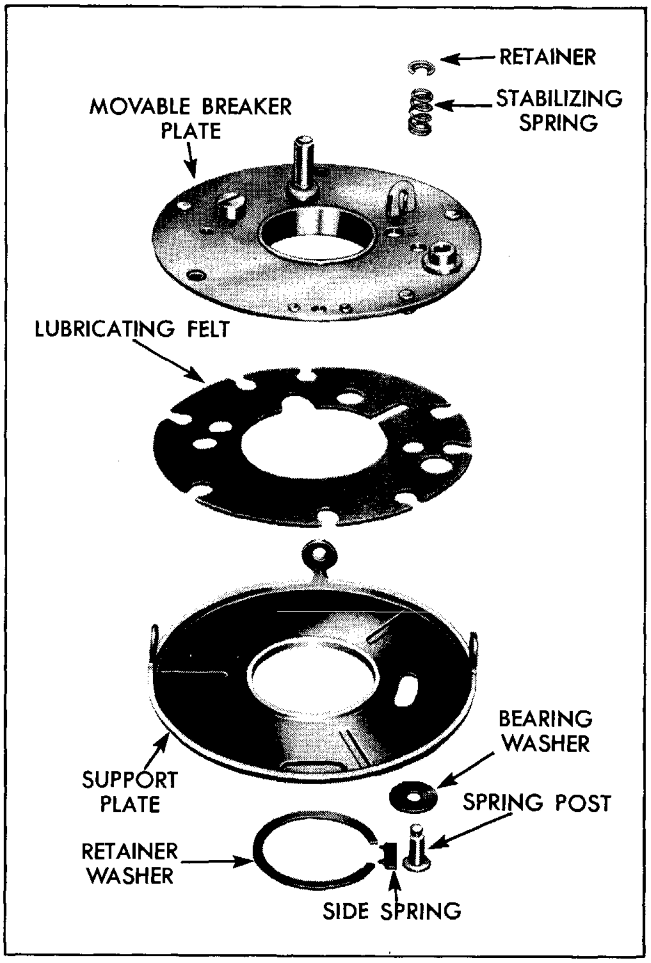


Fig. 12-40 Vacuum Advance Breaker Plate Assembly—Exploded

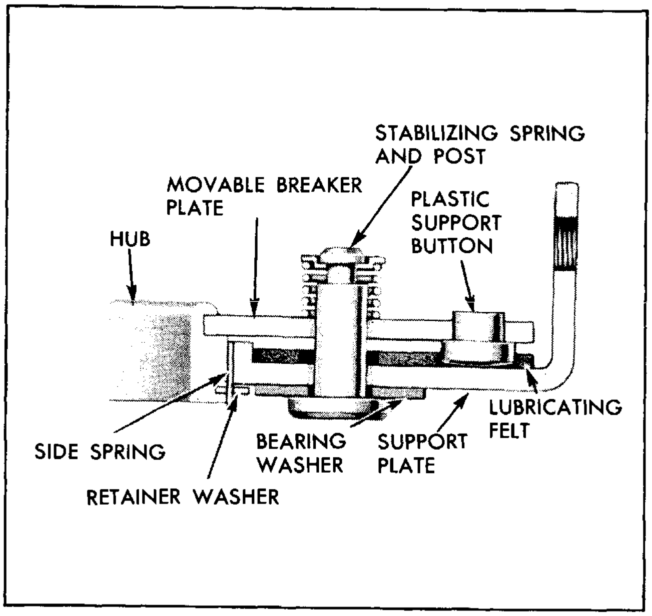


Fig. 12-41 Vacuum Advance Breaker Plate Assembly—Cross Section

action of oil, grease, battery acid and road salt, and also offers resistance to corona breakdown. Ignition cables have a multiple, cloth thread core impregnated with a graphite solution to give the correct conductivity. These cables give proper resistance for suppression of radio and television interference.

No external suppressors should be used on the ignition system on car radio installation.

IGNITION AND STARTING SWITCH

The ignition and starting switch is key-operated to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

SPARK PLUGS

AC type 44-5 spark plugs are used. This type was chosen for the normal or average service for which the engine was designed.

Normal or average service is assumed to be a mixture of idling, slow speed, and high speed operation with some of each making up the daily total driving. Occasional or intermittent high speed driving is essential to good spark plug performance as it provides increased and sustained combustion heat that burns away any excess deposits of carbon or oxide that may have accumulated from frequent idling or continual stop-and-go or slow-speed driving.

Spark plugs in Pontiac engines are protected by an insulating nipple made of special heat resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent "flash-over", with resulting missing of the engine, even though a film is allowed to accumulate on the exposed portion of the plug porcelains. *IMPORTANT: Do not mistake "Corona" discharge for "flash-over" or a shorted insulator. Corona is a steady blue light appearing around the insulator, just above the shell crimp. It is the visible evidence of a high tension field, and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.*

All AC Spark Plugs have a type number on the insulator which designates the thread size as well as relative position of the plug in the "Heat Range." Type numbers starting with "4" are 14 mm. thread size.

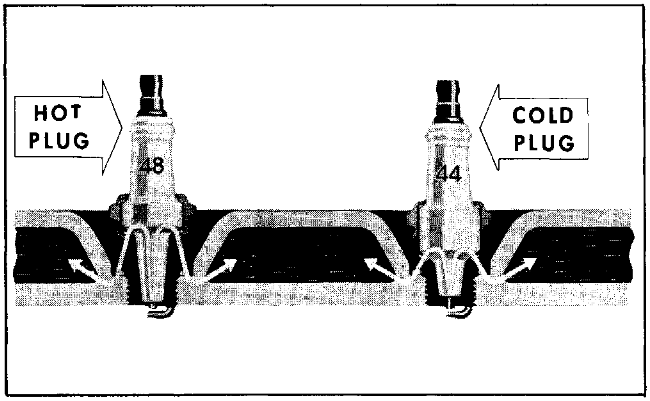


Fig. 12-42 Spark Plug Heat Range

The last digit of the type number indicates the "Heat Range" position of the plug in the AC Heat Range System (Fig. 12-42). Read these numbers as you would a thermometer—the higher the last digit, the "hotter" the plug will operate in the engine; the lower the last digit, the "cooler" the plug.

Thus a Type 48, which is a 14 mm. spark plug, has a higher number last-digit (8) than Type 44 (with last-digit 4) in the same 14 mm. thread size, and so is the "hotter" running plug. A plug number 44-5 would fall in a heat range half way between the 44 and 45.

PERIODIC SERVICE

The distributor and spark plugs are the only ignition system components that require periodic service. The remainder of the ignition system requires only periodic inspection to check operation of the units, tightness of the electrical connections, and condition of the wiring. When checking the coil, test with a reputable tester.

DISTRIBUTOR

The distributor requires lubrication at 2,000 and 10,000-mile intervals in accordance with the instructions in the GENERAL LUBRICATION SECTION. In addition it requires periodic inspection of cap and rotor, wiring, and point condition, and a check for correct spark timing. This should be done at each tune-up and at least every spring and fall.

SPARK PLUGS

Periodically (the actual time depending on operating conditions) the plugs should be removed for cleaning, inspection and regapping as outlined on page 12–26.

ADJUSTMENTS ON CAR

IGNITION TIMING

Correct timing of the spark, with relation to engine piston position, is made in the shop by use of a power timing light and timing marks on the harmonic balancer (Fig. 12-43).

At the time the spark is adjusted, the general appearance of the breaker points should be observed. If a smudge line appears on the point support and breaker plate just beneath the points, burned points (from oil or crankcase vapor between the points) are very probable. Points which have gone several thousand miles will have a rough surface, but this does not mean the points are worn out. The roughness between points matches so that a large contact area is maintained and the points will continue to provide satisfactory service. If dirt or scale are present the points should be cleaned with a few strokes of a clean, fine-cut, contact file. Do not attempt to remove all roughness or dress the point surfaces down smooth. Never use emery cloth or sandpaper to clean points. If points are burned or badly pitted they should be replaced and the cause of this condition found and corrected. If this is not done the new points will also burn and pit in a short time.

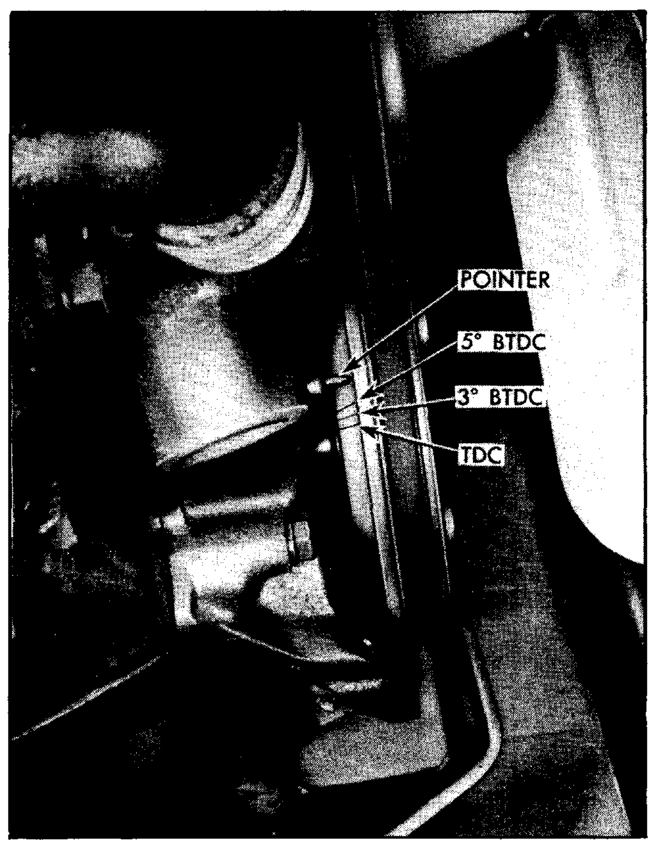


Fig. 12-43 Timing Marks and Pointer

Adjust ignition timing as follows:

1. Adjust breaker point gap as outlined in step 7 under ASSEMBLY OF DISTRIBUTOR, page 12-29.

2. Loosen distributor clamp screw and rotate distributor until power timing light shows that pointer is at 5° BTDC mark on harmonic balancer (see SPECIFICATIONS, page 12-46). Tighten distributor clamp screw to 12-15 lb ft. torque.

MINOR REPAIRS

SPARK PLUGS—INSPECT, CLEAN AND ADJUST

When checking the condition of removed spark plugs, there are five principal points to observe:

1. Dirty—The lower end of the spark plug insulator becomes coated under operation with an oxide deposit. This deposit is a conductor of electricity (especially when heated), and when ocurring in sufficient quantity, will cause missing. The deposit may occur at various mileages depending on operating conditions and is usually brown in color, although sometimes it is yellow or white. Plugs with this oxide coating on the lower end are not defective and replacing them is needless. Fouled and dirty or oxide coated plugs can be thoroughly cleaned without injuring the insulator by use of the AC model "A" Spark Plug Cleaner and Indicator (Fig. 12-44) or similar equipment.

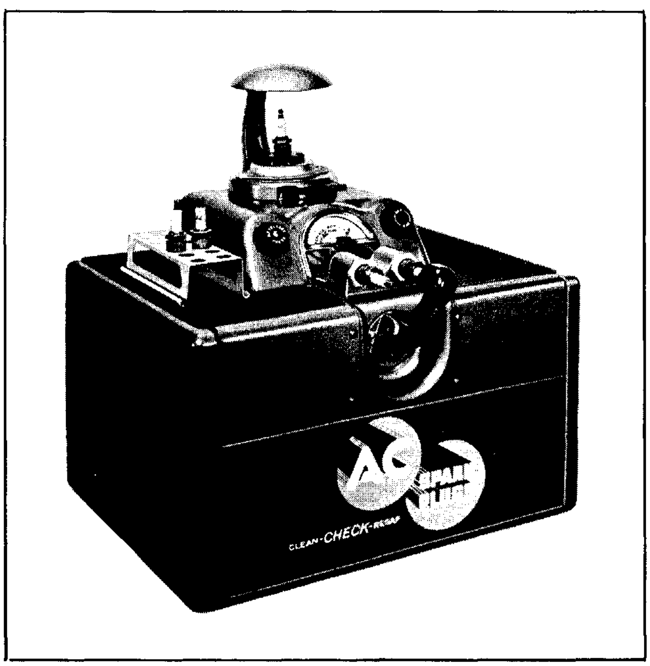


Fig. 12-44 Spark Plug Cleaner and Indicator

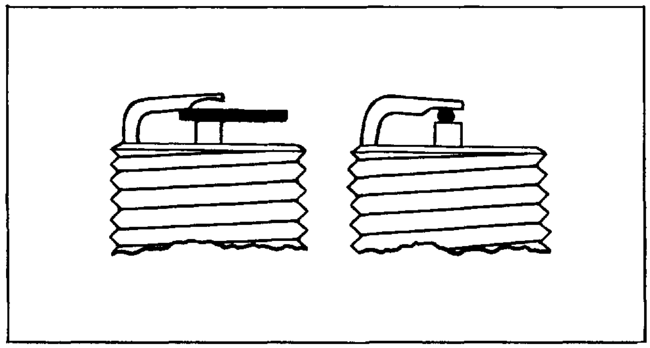


Fig. 12-45 Flat Feeler Versus Round Wire Gauge For Measuring Spark Plug Gap

Spark plugs should be cleaned following the instructions furnished with the cleaner. After cleaning, file the center electrode flat (to reduce the voltage required to fire the plug) and set the gap to .033"-.038" using a round wire gauge (Fig. 12-45). Test the spark plugs following the instructions furnished with the Model "A" Spark Plug Cleaner and Indicator or similar unit before installing them in engine.

2. Worn-Out—Normal wear, electrodes consumed from long service. Replace plugs.

3. Wide Gap—Resulting from normal wear or rapid wear, requiring regapping of electrodes. When adjusting gap always make adjustment on the outer electrode, never on the center one, as this will break or crack the insulator. It is good practice to use new gaskets under the plugs when reinstalling them in the engine. Spark plugs should be tightened to not more than 25 lb. ft. torque. If a plug is installed in a location where a torque wrench cannot be used, turn the plug finger tight on a new gasket then tighten ¾ of a turn with a wrench.

4. Broken Insulator—Breakage of the upper end by mechanical damage such as careless use of wrenches, or cracked insulator tips due to the plug having operated too hot. Replace plug.

5. Damaged Shell—Threads stretched or broken, or shell cracked due to mishandling or excessive tightening. Replace plug.

IGNITION AND STARTER SWITCH ASSEMBLY—REMOVE AND REPLACE

1. Remove positive cable from battery to protect against short circuit.

2. Remove ignition switch ferrule by unscrewing with special spanner J-5893 (Fig. 12-46).

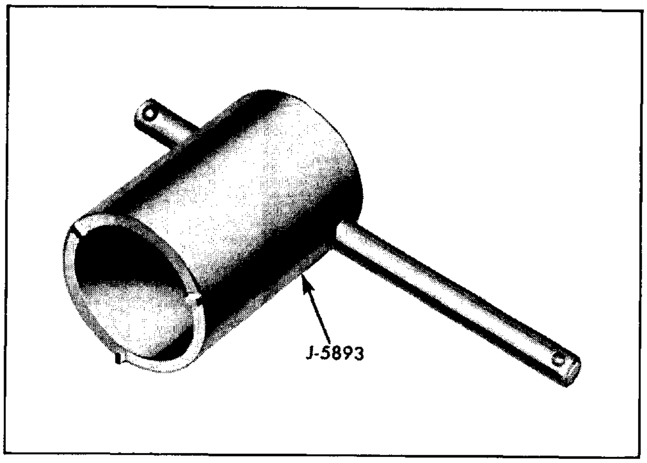


Fig. 12-46 Ignition Switch Ferrule Spanner

3. Remove ignition switch lamp housing brace screw from bottom flange of instrument panel.

4. Remove switch from back of instrument panel and disconnect wires.

5. Replace switch by reversing above steps.

IGNITION SWITCH LOCK CYLINDER—REMOVE AND REPLACE

1. Place ignition key in lock and depress lock plunger by inserting small pin through hole in lock cap.

2. While holding plunger in, turn key approximately 20° counterclockwise to release lock cylinder and remove cylinder from switch.

3. To install lock cylinder, insert key in cylinder. Then, with key and cylinder turned about 20° counterclockwise, insert cylinder in lock and rotate clockwise to lock in place.

FREEING UP STICKING IGNITION LOCK

Occasionally an ignition lock may stick, making it difficult to insert key and turn lock. In such case blow a very small quantity of powdered graphite into the lock key hole and operate lock several times to free up.

DISTRIBUTOR REMOVAL

1. Disconnect distributor-to-coil primary wire.
2. Remove distributor cap.
3. Crank engine so rotor is in position to fire No. 1 cylinder and timing mark on harmonic balancer is indexed with pointer.
4. Remove vacuum line from distributor.
5. Remove distributor clamping screw and hold-down clamp.
6. Remove distributor and distributor to block gasket. It will be noted that the rotor will rotate as the distributor is pulled out of the block. Note the relationship of the rotor and the distributor housing after removal so that the rotor can be set in the same position when the distributor is being installed. NOTE: Always set distributor in upright position so oil from distributor shaft will not run out onto breaker plate and points.
7. If distributor cap requires removal for purpose of cleaning and inspection, mark position on cap tower for lead to No. 1 cylinder. This will aid in rapid re-installation of leads on cap in right order.

DISTRIBUTOR DISASSEMBLY

Before disassembling distributor it is advisable to place the distributor in a distributor testing machine or synchroscope and, after adjusting point gap, test the distributor for variation of dwell and correct centrifugal and vacuum advance (see SPECIFICATIONS, page 12-46). This test will give valuable information on distributor condition and indicate parts replacement which may be necessary. Check area on breaker plate just beneath breaker points. A smudgy line indicates that oil or crankcase vapors have been present between points. Disassemble distributor as follows.

1. Remove vacuum link to breaker plate screw, vacuum control attaching screws, and remove linkage and vacuum control assembly.

2. Remove screws holding support plate and breaker plate to distributor housing, and remove breaker plate assembly from distributor.

3. Remove breaker points and condenser.

4. If centrifugal advance mechanism requires attention, remove distributor cam, centrifugal advance weights and springs from distributor weight base.

CLEANING AND INSPECTION OF DISTRIBUTOR

When inspecting the distributor parts keep in mind the results of the pre-disassembly test on the distributor tester as this will indicate certain parts which probably are defective. Before inspection, clean all parts in cleaning solvent except cap, rotor, condenser, breaker plate assembly and vacuum control unit. Degreasing compounds may damage insulation of the parts listed, or, in the case of the breaker plate assembly, will saturate the felt between the plates and impair its lubricating ability.

SERVICING BREAKER PLATE ASSEMBLY

The movable breaker plate and support plate are not serviced separately. It is necessary to replace the breaker plate assembly if either part becomes seriously damaged or worn. However, this assembly requires very little maintenance other than lubrication at regular intervals.

Disassembly of the breaker plate assembly should be attempted only when removed from the distributor. Otherwise parts will drop into the distributor bowl when the stabilizing spring post assembly is released, necessitating removal and disassembly of the entire distributor. To disassemble the breaker plate assembly, release the C-shaped spring retainer and the spiral stabilizing spring from the post (Fig 12-40). The stabilizing post and bearing washer can then be removed from the support plate. Remove the retainer washer from the center bearing and separate the movable breaker plate from the support plate. (Take care that the small side spring is not dislodged from its recess in the edge of the center hole in the support plate. This spring helps to prevent any side play in the breaker plate assembly and also contributes to the over-all tension of the assembly.) Reassembly is the reverse of disassembly.

After reassembly of the breaker plate assembly, two checks are required. The stabilizing spring tension (Fig. 12-47) is measured with the breaker plate assembly right side up in a horizontal position. Apply spring scale J-5184 or a similar type at the stabilizing spring post, and note the force required to start vertical movement of the post. This force should be not less than 18 ounces or more than 24 ounces. If necessary, the stabilizing spring force can be increased by carefully stretching the spring or replacing it.

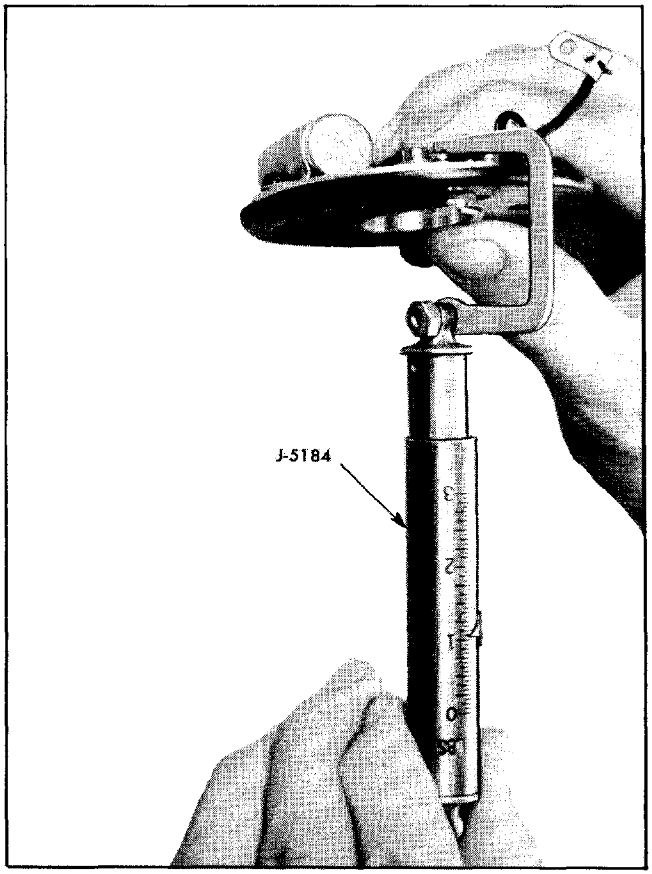


Fig. 12-47 Measuring Stabilizina Spring Tension

It is also necessary to check the friction between the plates. With the breaker plate assembly right side up in the horizontal position, rotate the breaker plate to the fully retarded position. Measure the force required to rotate the breaker plate from the fully retarded position (measure at the bearing to which the vacuum control unit is normally connected, Fig. 12-48). The pull required to rotate the breaker plate should not exceed 15 ounces. Readings in excess of 15 ounces may be caused by insufficient lubrication, cupped or distorted upper or lower plate, or dirt between the plates.

When the breaker plate assembly is reinstalled in the distributor, care must be taken when attaching the vacuum control linkage. The linkage must be fitted to the connector bearing on the breaker plate so that there is no upward or downward thrust on the plate when the vacuum control operates. Also check the clearance of the linkage through full travel to be sure that the condenser lead does not interfere with the operation of the assembly.

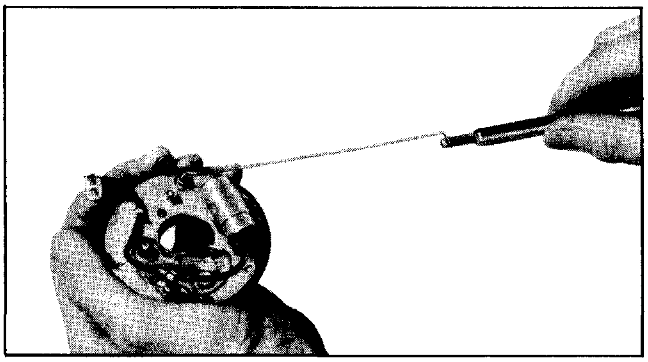


Fig. 12-48 Measuring Breaker Plate Friction

ASSEMBLY OF DISTRIBUTOR

1. Coat surface of shaft running in bushing with light engine oil and insert distributor shaft and weight base in housing. Make sure washer is in place under weight base.

2. Install two washers and distributor drive gear on distributor shaft against housing and insert and peen over retaining pin.

3. Install advance weights and springs. Wipe surfaces of advance parts with a rag moistened with light engine oil to prevent rusting. Place one drop of light engine oil on each weight pivot pin.

4. Install breaker cam. Saturate felt in cam with light engine oil but do not oil beyond what felt will readily absorb.

5. Install vacuum advance breaker plate assembly in distributor.

6. Install vacuum control assembly on distributor. Check to see that vacuum control linkage is fitted to connector bearing on breaker plate so there is no upward or downward thrust on plate when vacuum control is operated.

7. Replace breaker points and condenser. When replacing breaker points, particular care should be given to:

   a. Assembly of breaker point support.

   b. Assembly of breaker lever and breaker spring.

   c. Breaker point alignment.

   d. Breaker point opening.

   e. Breaker lever spring tension.

The slotted hole in the point support should fit snugly around the base of the breaker lever pivot post. Do not spring the slot any more than is necessary to slip the breaker point support over the base of the post (Fig. 12-49).

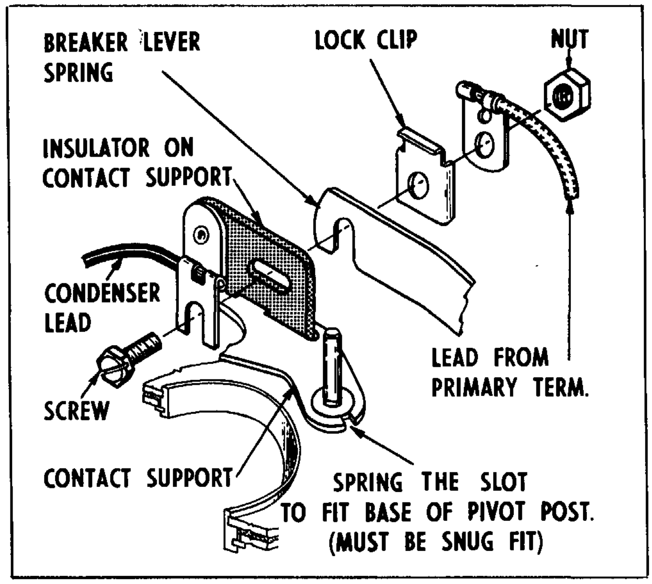


Fig. 12-49 Correct Assembly of Breaker Lever and Spring

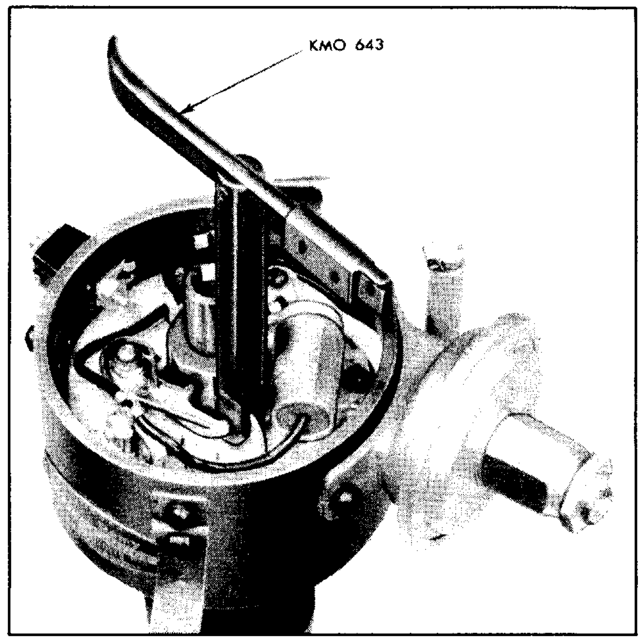


Fig. 12-50 Bending Contact Support to Align Points

It is important that the breaker lever spring be correctly assembled to the breaker point support. The correct assembly is shown in Fig. 12-49.

After assembling the breaker lever, check and adjust point alignment. Use contact aligning tool KMO 643 as shown in Fig. 12-50 to align the two contact surfaces.

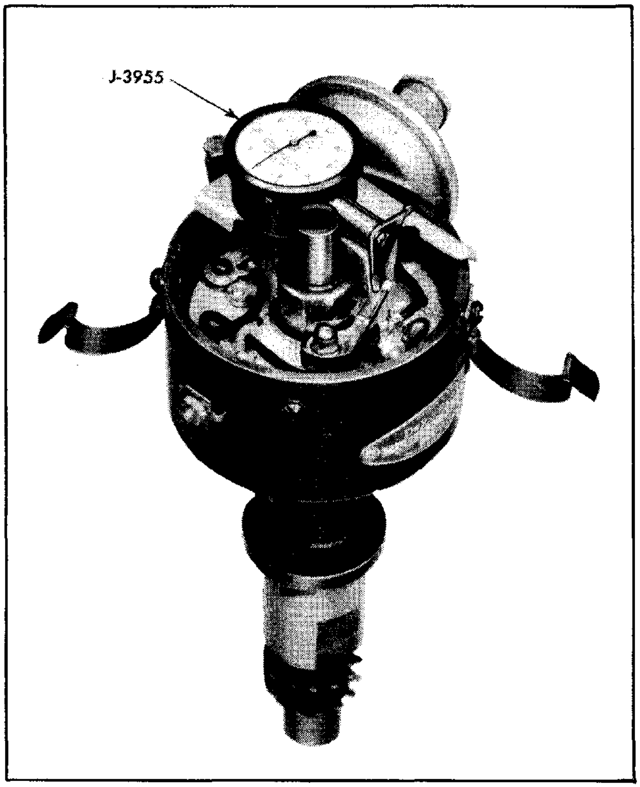


Fig. 12-51 Checking Point Opening with Dial Indicator

Use a dial indicator such as J-3955 or feeler gauge to properly adjust the breaker point opening (Fig. 12-51). (See SPECIFICATIONS, page 12-46.) Although a feeler gauge is satisfactory for measuring the point opening on a new set of contact points, it will give a false adjustment if used to adjust the point opening on a used set of contact points.

Probably the most important item to check when installing a new set of breaker points is the breaker lever spring tension. This is checked with a spring scale such as J-5184 hooked immediately behind the breaker lever contact (Fig. 12-52 and 12-53). Spring tension required to open the contact points should be 19-23 ounces when the scale is hooked in the position shown. For ease in adjustment of the spring tension on new sets of points, the breaker lever as received will produce a tension exceeding that specified. To adjust the spring tension on a new set of contact points, use a pair of pliers to decrease spring tension as shown in Fig. 12-54. *If spring tension exceeds that specified, tilting of the breaker plate assembly and improper operation of the vacuum advance mechanism may result.*

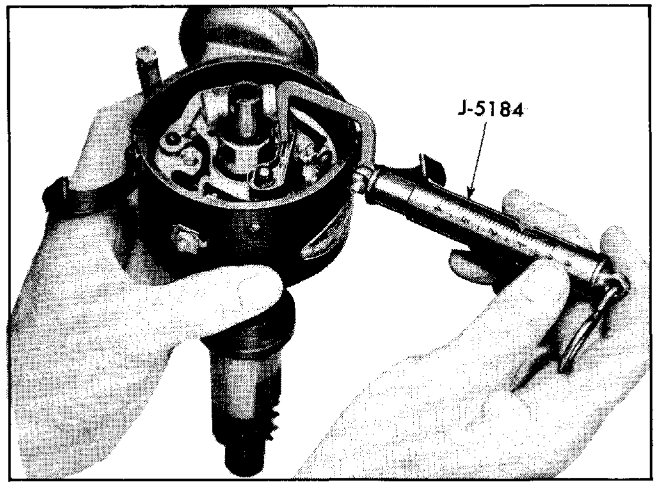


Fig. 12-52 Measuring Breaker Lever Spring Tension

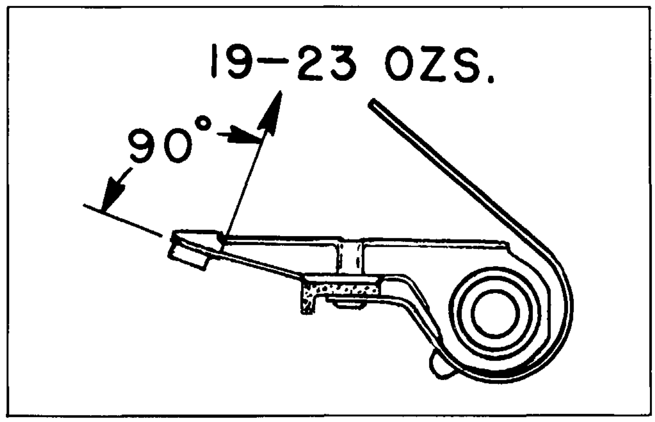


Fig. 12-53 Position for Hooking Spring Scale

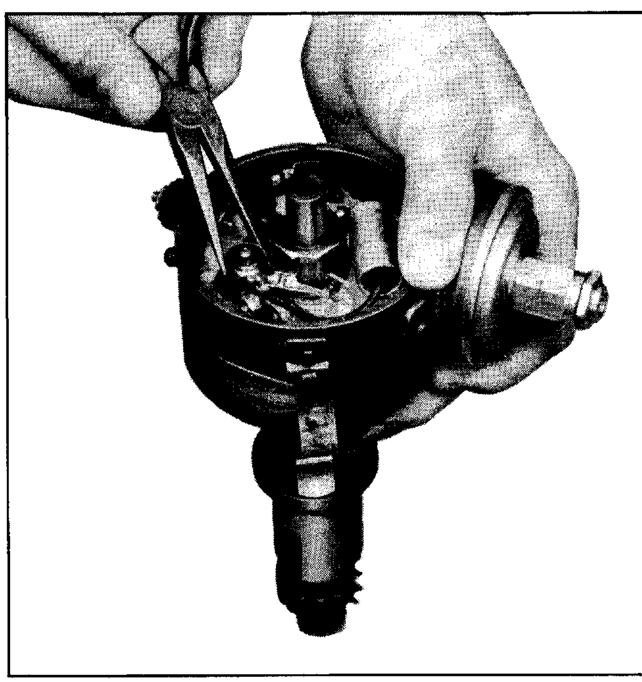


Fig. 12-54 Reducing Spring Tension

After checking and adjusting breaker point opening to specifications, check the cam angle or dwell with a contact angle meter. If the cam angle is less than the specified minimum, check for defective or misaligned contact points or worn distributor cam lobes. The variation in cam angle readings between idle speed and 1750 engine RPM should not exceed 3°. Excessive variation in this speed range indicates wear in the distributor. NOTE: Cam angle readings taken at speeds above 1750 engine RPM may prove unreliable on some cam angle meters.

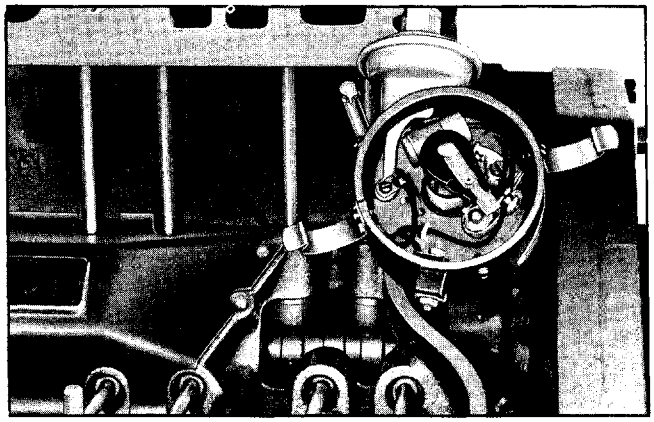


Fig. 12-55 Relationship of Distributor Housing and Rotor in Firing Position for No. 1 Cylinder

DISTRIBUTOR INSTALLATION

1. Check to see that engine is at firing position for No. 1 cylinder (No. 1 piston at top of compression stroke) and timing mark on harmonic balancer is indexed with pointer.

2. Position new distributor to block gasket on block.

3. Install distributor in block so that vacuum diaphragm faces the right side of the engine and rotor points toward contact in cap for No. 1 cylinder. Before installing distributor, index rotor with housing as noted when distributor was removed. This will simplify indexing the distributor shaft and gear with the oil pump drive shaft and the drive gear on the camshaft. Distributor and rotor will be positioned as shown in Fig. 12-55 when properly installed with No. 1 piston in firing position.

4. Replace distributor clamp leaving screw loose enough to allow distributor to be turned for adjustment.

5. Attach vacuum line to distributor.

6. Install spark plug wires in distributor cap. Place wire for No. 1 cylinder in tower shown in Fig. 12-56 (marked on old cap during disassembly) then install remaining wires counterclockwise around the cap according to the firing order (1-8-4-3-6-5-7-2).

When installing new wires, they should be located in wire supports as shown in Fig. 12-57.

7. Attach distributor to coil primary wire.

8. Adjust point gap as outlined in step 7 under ASSEMBLY OF DISTRIBUTOR, page 12-29.

9. Replace distributor cap and adjust timing as outlined on page 12-25.

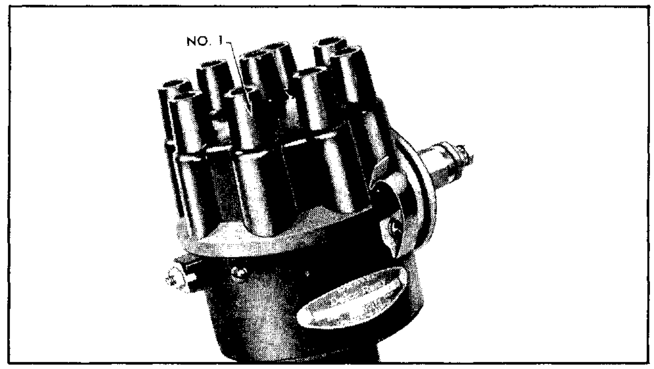


Fig. 12-56 Location of No. 1 Spark Plug Cable Terminal

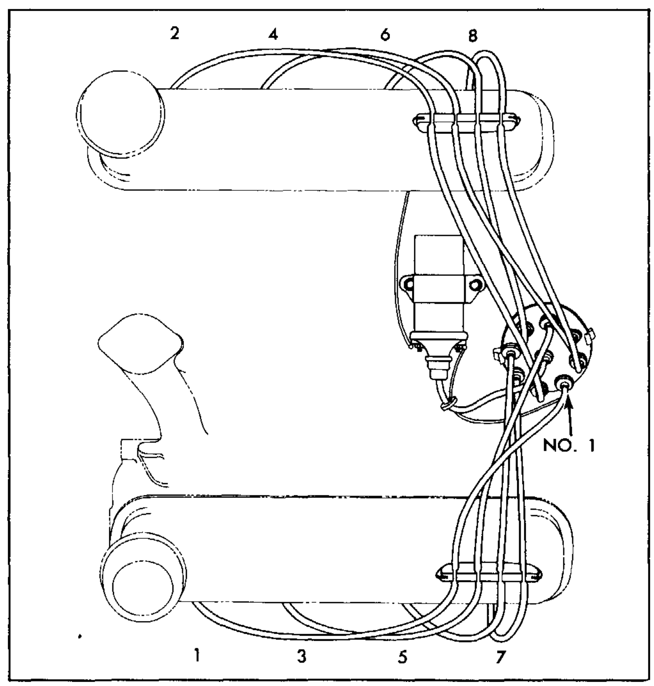


Fig. 12-57 Arrangement of Spark Plug Wires in Wire Support

IGNITION SYSTEM TROUBLE DIAGNOSIS

NOTE: See page 00-8 for information concerning detonation.

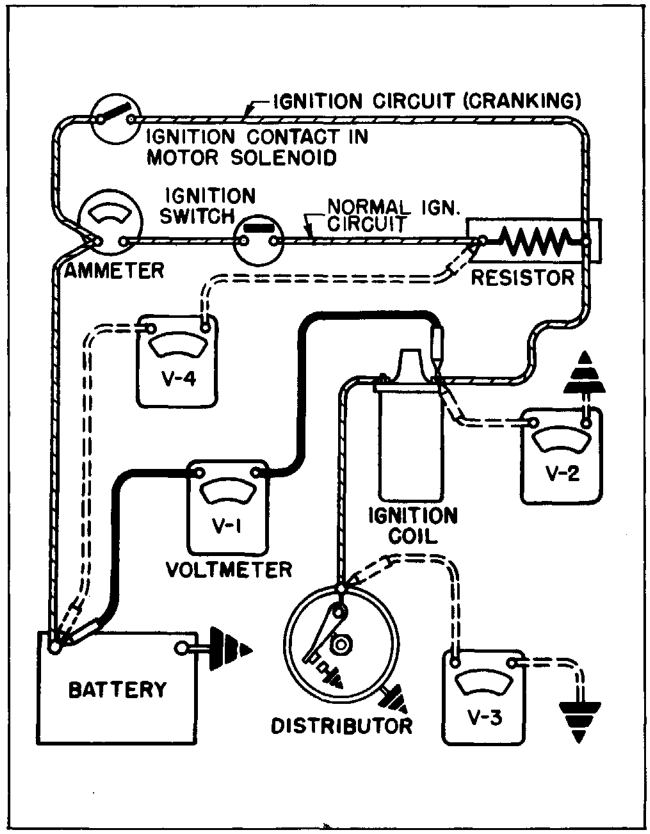


Fig. 12-58 Connections for Checking Ignition Circuit Voltage

QUICK CHECKS

If the engine does not run, the ignition system may be at fault if:

1. There is no spark, during cranking, when a spark plug wire is held ¼ inch from the engine.

2. The engine starts but immediately stops when the ignition switch is released from the "START" position.

If these checks indicate trouble in the ignition system, follow the procedure outlined below. This procedure may also be helpful in locating trouble in the ignition system if the car runs but not satisfactorily.

DIAGNOSIS PROCEDURE

If the checks outlined above indicate that the ignition system is at fault, the following checks may be made to help locate the difficulty. All checks are to be made with the lights and accessories off and in the sequence shown. Voltage readings referred to are indicated on Fig. 12-58. (If the engine starts but immediately stops when the starting switch is released from the "START" position, the first 4 of the following checks may be omitted.)

OPERATION	SPECIFICATION	POSSIBLE TROUBLE
Check all connections in Primary and Secondary circuit.		
Remove secondary coil lead from distributor cap. Hold ¼ inch from engine while cranking, and observe if spark occurs.		Distributor Cap. Rotor. Spark Plug Wiring.
Check Voltage V_1 while cranking.	1 Volt Max.	Open circuit from battery side of coil to solenoid switch. Solenoid switch not closing ignition circuit. Ground in circuit from coil terminal to solenoid switch. Ground in coil.
Check Voltage V_2 ignition switch "On", points open.	Normal Battery Voltage	Low Battery. Points not open. Ground in circuit from coil to distributor. Ground in distributor. Ground in coil. Ground in circuit from coil to solenoid switch or to resistor.

DIAGNOSIS PROCEDURE—CONT.

OPERATION	SPECIFICATION	POSSIBLE TROUBLE
Check Voltage V_2 ignition switch "On", points closed.	5 to 7 Volts	*If over 7 volts check following:* Contacts not closed. Loose connection in distributor. Distributor not grounded to engine. Faulty contacts. Loose connection between coil and distributor. Resistor out of circuit due to shorted or incorrect wiring. Solenoid switch contacts stay closed. Resistor has too little resistance. Coil primary is open.
Check Voltage V_3 ignition switch "On", points closed.	0.2 Volts Max.	Contacts not closed. Loose connection in distributor. Distributor not grounded to engine. Faulty contacts—if faulty, recheck voltage V_2, ignition switch on, points closed.
Check Voltage V_4 ignition switch "On", points closed.	0.7 Volts Max.	Loose connection from resistor through ignition switch circuit to battery.

If these checks fail to find cause of trouble —remove distributor, coil, and resistor from engine and check to specifications. Also check wiring harness.

SERVICE CRAFTSMAN NEWS REFERENCE

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LIGHTING, HORN, AND ACCESSORY POWER CIRCUITS—

GENERAL DESCRIPTION

FUSES AND CIRCUIT BREAKER

Fuses for all circuits are located in one fuse block. The fuse block is located in the inside of the dash, above and to the left of the steering column. The circuits supplied by each fuse are shown in the wiring diagram (Fig. 12-1) and on the fuse block (Fig. 12-59). The stop lights are fed from the same fuse as the dome and courtesy lamps. Thus, if the fuse blows, it will immediately be indicated by the fact that the dome lamp does not light.

All fuses in the fuse block are 7 ½ ampere capacity except the 4 ampere fuse for instrument panel lamp rheostat. A spare 7 ½ ampere fuse is located in a clip at the bottom of the fuse block.

The headlamp, parking lamp, and tail lamp circuits are protected by a circuit breaker on the main lighting switch. The breaker is set to remain closed as long as the current flow does not exceed 22 amperes. If excessive current should flow, the circuit breaker will become heated causing the points to separate. It is calibrated so that a current of 30 amperes for a period of ½ minute to 3 minutes will cause the circuit breaker to open.

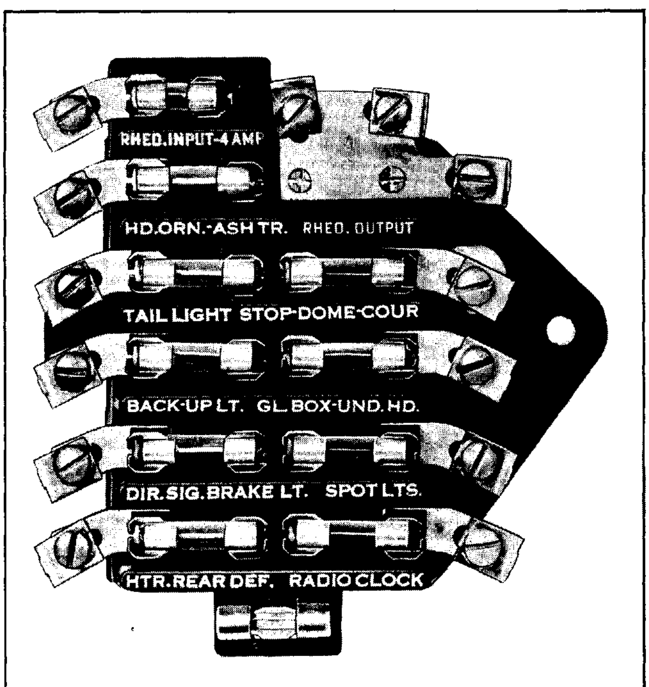


Fig. 12-59 Fuse Block

Separate fuses are used for the electric antenna and air conditioner on cars so equipped. The electric antenna circuit uses a 14 ampere fuse mounted in a line holder above the fuse block. The air conditioner uses a 30 ampere fuse mounted in a line holder either on the defroster core housing or, if the car is not equipped with a defroster, on the front of the dash where the defroster would be.

A circuit breaker is used in the electric window lift circuit. It is located inside the left cowl, above the kick pad.

LIGHTING

Lighting is controlled by two switches. First, the instrument panel main lighting switch which has two "on" positions or notches, the first for parking, tail and license lamps, and the extreme out position for the headlamps, tail, and license lamps. Rotating the lighting switch knob operates a rheostat for dimming the instrument panel lamps; with the rheostat in the extreme position the instrument panel lamps are completely off. Second, the headlamp beam switch (foot operated) which determines if the headlamp country (bright) beam or traffic (dim) beam is on when the main lighting switch is pulled out. A red indicator lamp on the speedometer shows when the headlamp country beam is on. NOTE: Advise owner to always see that the red indicator light is out, indicating that the traffic beam is on, when meeting cars.

Parking lamps on cars with direction signals use a two filament bulb, the same as that used for the tail and stop lamp. Cars without direction signals use single filament bulbs in parking lamps.

Headlamps are of sealed beam construction so that the light source, reflector, lens, and lens gasket are all assembled in one sealed unit. When the filament burns out or the lens is cracked or broken, the entire unit is readily replaceable with a new unit.

The filaments used in twelve volt headlamps are very fragile. These headlamp units must be handled carefully, therefore, to prevent breakage.

HORNS

The two horns used on the car are designed to give a blended tone when operated together. Each of these horns uses a magnetically actuated diaphragm to develop a resonating air column in the horn projector.

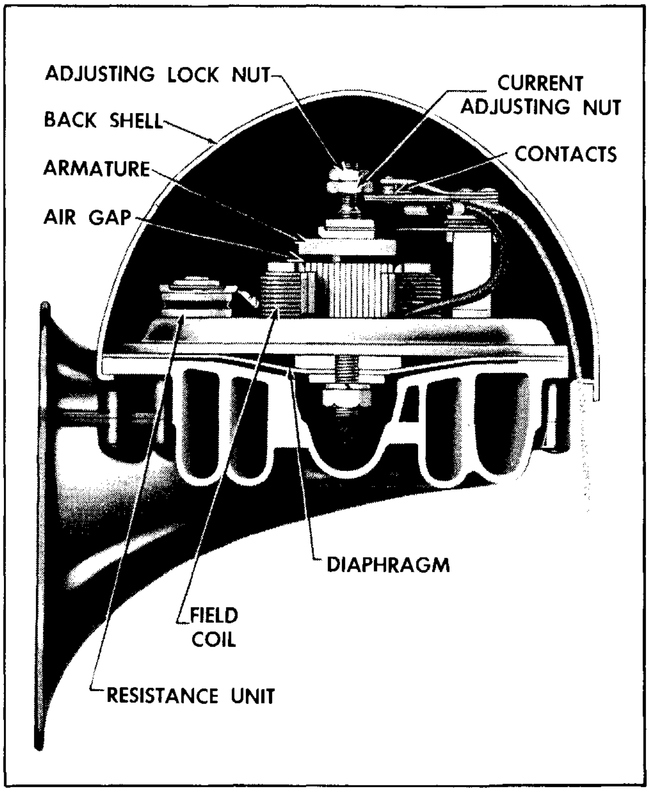


Fig. 12-60 Cross Section of Horn

The power plant of these horns (Fig. 12-60) consists of a field coil, a laminated pole piece, an armature linked to a diaphragm, and a set of contacts in series with the field coil. Current flows from the battery through the field coil and contact points to ground whenever the horn circuit is completed through the relay. Current flow through the winding produces a magnetic field around the pole piece which attracts the armature toward the pole. Since the diaphragm is connected to the armature, movement of the armature causes similar movement of the diaphragm. The normally-closed contacts are opened as the armature moves toward the pole. When the current flow is interrupted in this manner and the field coil no longer produces a magnetic field around the pole piece which attracts the armature, the armature returns to its original position due to the "spring-back" of the diaphragm and the contacts re-close. This cycle is repeated many times per second resulting in a rapid vibration of the diaphragm. A resistance unit of several ohms is connected across the contact points to reduce arcing and burning of the contacts.

A relay is used in the horn circuit because of the high current required to operate horns. The relay reduces the length of heavy gauge wire required and makes a more direct connection between the horns and the battery. Consequently, higher voltage is available at the horns and better performance is obtained by eliminating the voltage drop which otherwise would be in the horn button wiring circuit.

CIGAR LIGHTER

The lighter assembly is composed of the following parts:

Socket assembly	Heating element
Clamping shell	Fuse
Knob assembly	Panel ferrule

A special fuse of the thermal type is used in the lighter for protection of the knob, heating element, and other parts of the assembly. This unit depends basically on temperature rather than current for blowing of the fuse.

The lighter releases automatically (usual time for release is 10 to 14 seconds) which means that if the plug assembly for some reason is held in by the operator's hand a sufficient length of time (60 to 90 seconds) the fuse will blow. This may in some cases account for a blown fuse where none of the other parts of the lighter are defective.

If temperature of the element shows indications of incorrect timing (too hot or too cold), the socket assembly containing the bi-metal hold-in fingers must be replaced.

The lighter has a safety feature in the form of two retaining fingers which prevent the knob and element assembly from falling out or popping out of the socket onto the floor. If these fingers do not keep the knob and element assembly from falling out onto floor the socket assembly should be replaced.

ADJUSTMENTS ON CAR

AIMING HEADLAMPS

Various types of headlamp brightness and aiming testers are available; however, it is only necessary to have a light colored headlamp screen approximately 4 feet high by 8 feet wide (a white wall will do but a movable screen is best) perferably equipped with black movable tapes to mark the lines shown in Fig. 12-61. To aim headlights using screen proceed as follows:

1. Place screen on level floor 25 feet from front of car.

2. Rock car sideways so as to insure car is in a rest position to give normal headlamp height above floor.

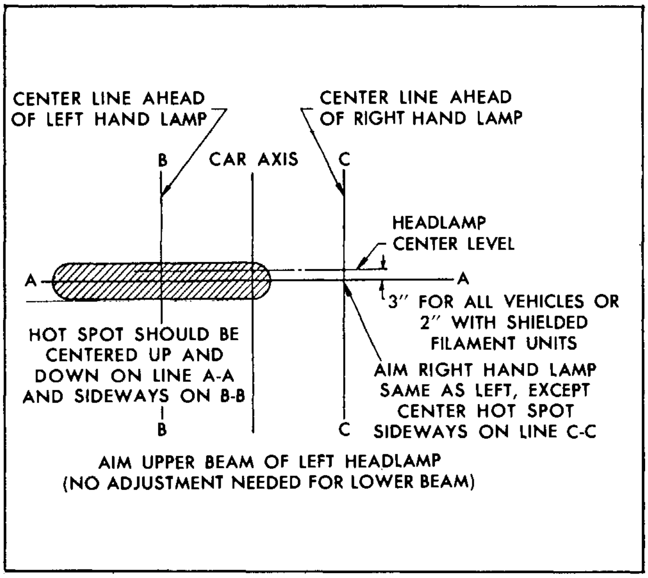


Fig. 12-61 Headlamp Aiming Chart

3. Locate headlamp center level line (Fig.12-62) at the same height as lamp centers above ground. If floor that car and screen are resting on is not level, headlamp center level line cannot be located by measuring from ground at screen. In this case line should be located by cutting two sticks of length equal to the headlamp center to floor distance and placing these sticks vertically with one end resting on floor at the front and rear fender; sight by eye, locating a point on the screen in line with the tops of the sticks; this is the position of the center level line (Fig. 12-62).

4. Locate vertical car axis line on screen (Fig. 12-61) by looking through rear car window and locating a point on screen lining up with hood ornament and center of rear window.

5. Locate and mark lines BB and CC (Fig. 12-61) the same distance either side of car axis line as headlamp centers are on either side of car center line.

6. Locate and mark line AA as follows (Fig. 12-61).

When aiming headlamps having unshielded filaments mark line AA three inches below headlamp center level line. When aiming headlamps having shielded filaments (type 5400) mark line AA two inches below headlamp center level line. (Shielded filament headlamps (type 5400) can be identified by an inverted cup shape shield over and in front of the filament. The shield is visible through the lens of the sealed beam unit. Only the unshielded type is used in production, but the shielded type is available for service in those areas where they are legal.)

NOTE: If local state regulations prescribe a setting other than described above, such regulations should be followed in locating line AA and subsequent aiming of headlamps as outlined in step 7.

7. With headlamp door removed, lights turned on country beam, and cover over right headlamp, adjust left headlamp horizontal and vertical adjusting screws (Fig. 12-63) to bring center of beam hot spot on intersection of lines AA and BB as shown by shaded area on Fig. 12-61.

8. Repeat Step 7 for right headlamp.

9. Reinstall headlamps doors and lock in place with door screws.

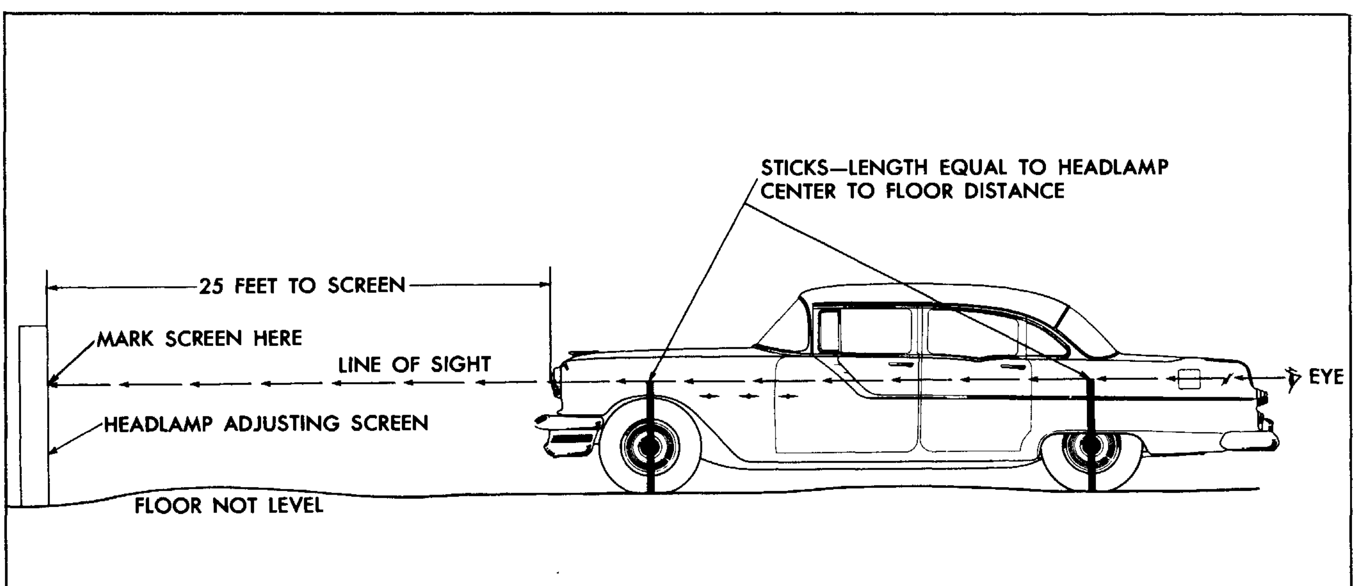


Fig. 12-62 Locating Headlamp Center Level on Screen

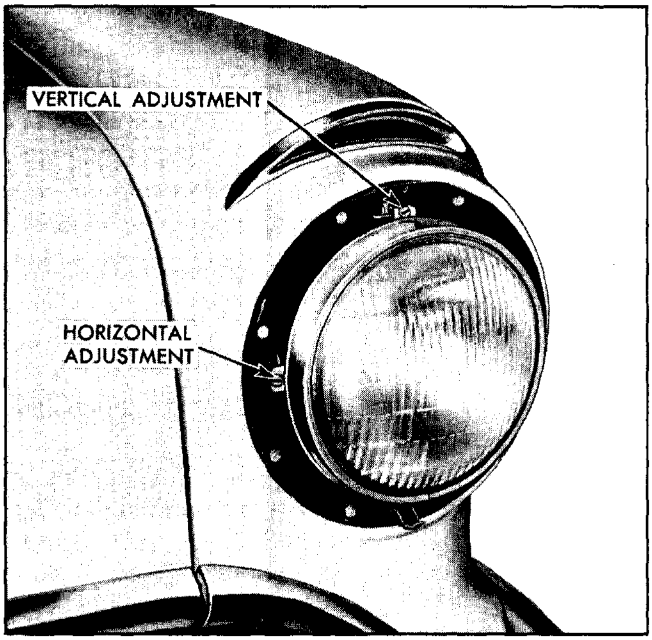


Fig. 12-63 Headlamp Aiming Screws

MINOR REPAIRS

HEADLAMP SEALED BEAM UNIT—REMOVE AND REPLACE

1. Remove headlamp door screw and headlamp door.

2. Remove three screws (or the spring on late models) holding sealed beam unit retaining ring in place and remove retaining ring and sealed beam unit from mounting.

3. Pull connector from rear of beam unit and on late units separate sealed beam unit from retaining ring and mounting ring.

4. Assemble new sealed beam unit into mounting ring and retaining ring and plug sealed beam unit into connector.

5. Install beam unit and retaining ring.

6. Check headlamp aiming and readjust if necessary.

7. If headlamp door rubber seal is defective, remove seal and cement new seal securely to door.

8. Check to see that headlamp door retaining spring is located exactly at the top and replace door and retaining screw.

LIGHTING SWITCH—REMOVE AND REPLACE

1. Remove one battery cable from battery post.

2. Pull switch knob to headlight "on" position, push latch button on top of switch assembly and pull out switch knob assembly.

3. Unscrew bushing from switch assembly.

4. Remove screw which fastens switch steady rest bracket to bottom of instrument panel and remove switch and bracket assembly.

5. Remove leads from light switch one at a time and connect to new switch.

6. Transfer steady rest bracket to new switch.

7. Position new switch in instrument panel, and start bushing through ferrule into switch assembly. Then install steady rest bracket to instrument panel screw and tighten securely. Tighten bushing securely.

8. Insert knob assembly into switch assembly until end of rod engages catch.

9. Install cable on battery post.

CIGAR LIGHTER PARTS—REMOVE AND REPLACE

FUSE

1. Turn wire connector at rear of lighter base slightly to disengage it and then pull it to rear off lighter base assembly.

2. Fuse may now be unscrewed from lighter base assembly.

3. Screw on new lighter fuse.

4. Reconnect connector to lighter base.

ELEMENT

Remove knob and metal knob flange from element assembly and install knob and flange on new heating element assembly.

LIGHTER SOCKET OR WELL

1. Remove wire connector from rear of lighter socket.

2. Unscrew clamping shell from lighter socket and remove socket from instrument panel.

3. To install, reverse above procedure, seeing that clamping shell is turned up ONLY FINGER TIGHT on lighter socket.

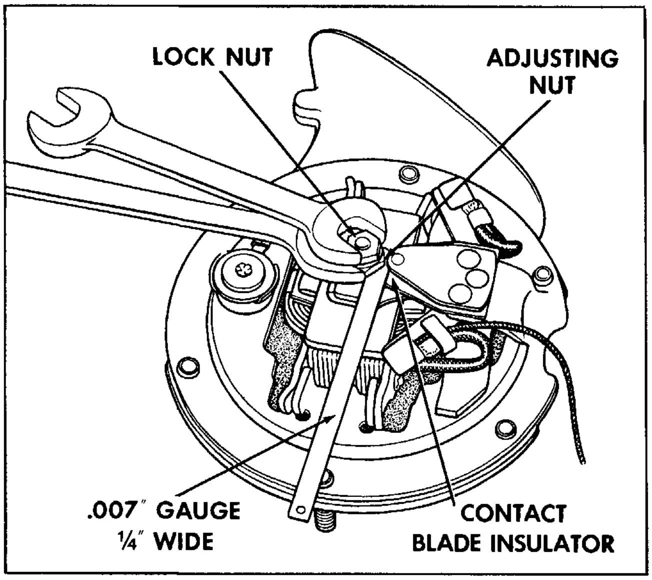


Fig. 12-64—Making Current Adjustment

INSPECTION AND ADJUSTMENT OF HORN

INSPECTION

Remove the back shell and carefully check the horn for loose or broken leads and connections. Inspect the air gap to make certain it is free of foreign material such as burrs, steel shavings, etc. If no cause for failure is found, check the current adjustment.

CURRENT ADJUSTMENT

To check the current adjustment, measure the current draw of the horn while the horn is operating. The low note horn (identified by an "L" on the edge of the casting) should have a current draw of 8.5-10.5 amperes at 11.5 volts. The high note horn (identified by an "H" on the edge of the casting) should have a current draw of 7.5-9.5 amperes at 11.5 volts. To change the current adjustment, disconnect the battery, loosen the lock nut on the armature stud at the center of the horn, and rotate the current adjusting nut counterclockwise to increase the current or clockwise to decrease the current. This adjustment is very sensitive and the adjusting nut should be moved only 1/10 of a turn at a time and locked in position before operating the horn to recheck the current adjustment. Adjust the current to the specified value.

An alternate method of adjusting the horn is as follows: Insert a .007" feeler gauge (not more than ¼ inch wide) between the adjusting nut and the contact blade insulator (Fig. 12-64). Do not allow the gauge to touch the contact points. Connect the horn to a 12-volt battery and turn the adjusting nut to a position where the horn will just operate. Lock the adjusting nut in position and check the horn performance with the feeler gauge removed.

HORN RELAY—CHECK AND ADJUST

Three checks and adjustments are required on the horn relay: air gap, point opening, and closing voltage. The air gap and contact point opening checks and adjustments should be made with the battery disconnected.

AIR GAP

The air gap should not normally require adjustment unless the relay has been misadjusted. Check the air gap (see SPECIFICATIONS, page 12–46) with the points barely touching and adjust if necessary by bending the lower point support (Fig. 12-65).

POINT OPENING

Check the contact point opening (see SPECIFI-

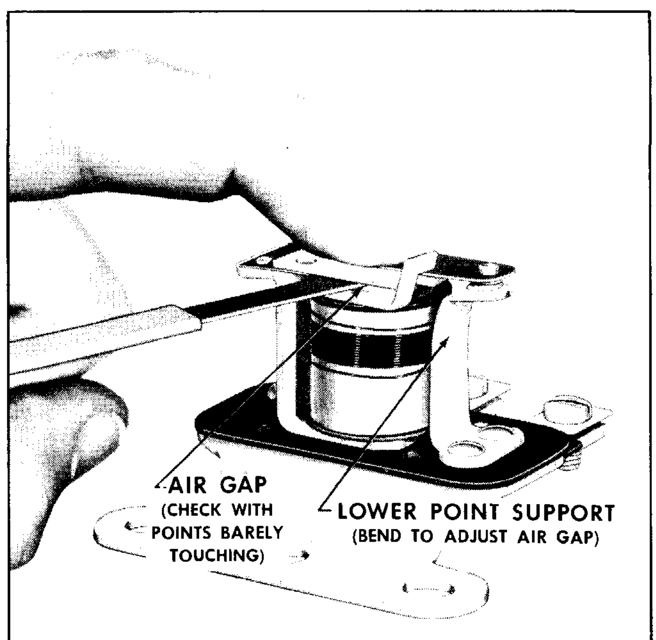


Fig. 12-65 Adjusting Air Gap

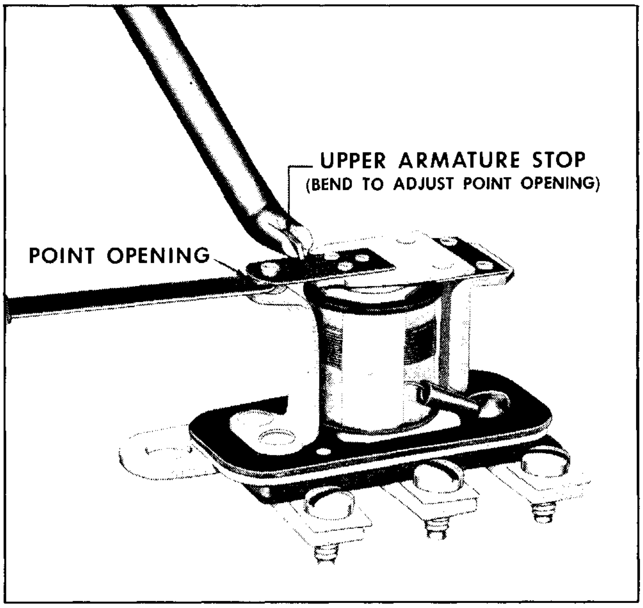


Fig. 12-66 Adjusting Contact Point Opening

CATIONS, page 12–46) and adjust by bending the upper armature stop (Fig. 12-66).

CLOSING VOLTAGE

To check the relay closing voltage, connect a variable resistance or potentiometer of sufficient value (not less than 10 ohms) in series with the "B" terminal, connect a voltmeter to the "S" and "B" terminals, and ground the "S" terminal as shown in Fig. 12-67. Slowly decrease the amount of resistance in order to check the relay closing voltage (see SPECIFICATIONS, page 12–46). Adjust the closing voltage by bending the armature spring post (Fig. 12-68). Bend down to increase the closing voltage and bend up to decrease the closing voltage. NOTE: The horn relay terminals do not carry any markings but relationship of the terminals is as shown in Fig. 12-67.

LIGHTING AND ACCESSORY POWER CIRCUITS— TROUBLE DIAGNOSIS AND TESTING

Troubles in the lighting and accessory power circuits are caused by loose connections, open or shorted wiring, or blown fuses. In each case trouble diagnosis requires following through the circuit until the source of difficulty is found. To aid in making an orderly point-to-point check, refer to the schematic wiring diagram (Fig. 12-1).

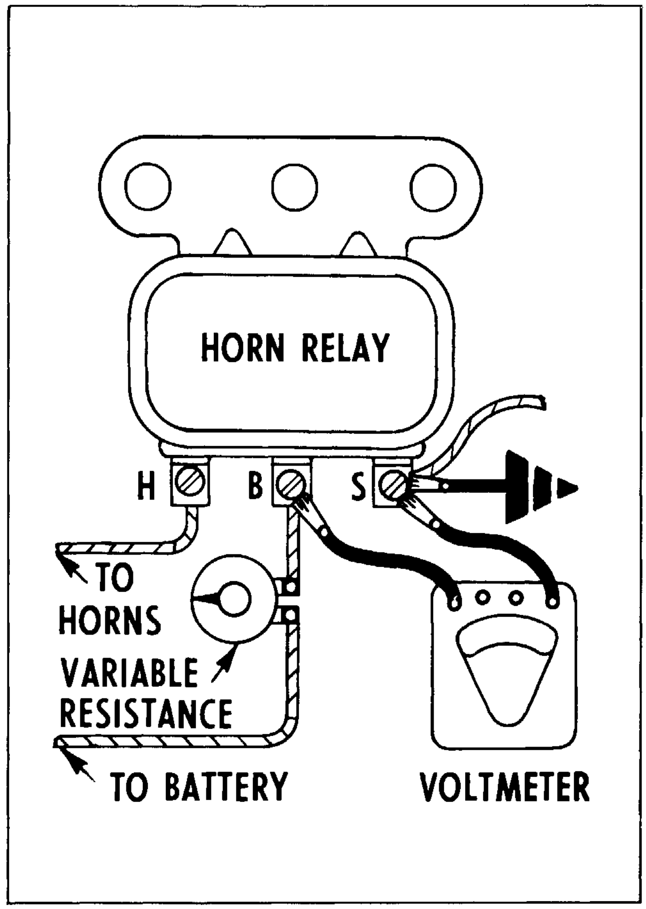


Fig. 12-67 Checking Relay Closing Voltage

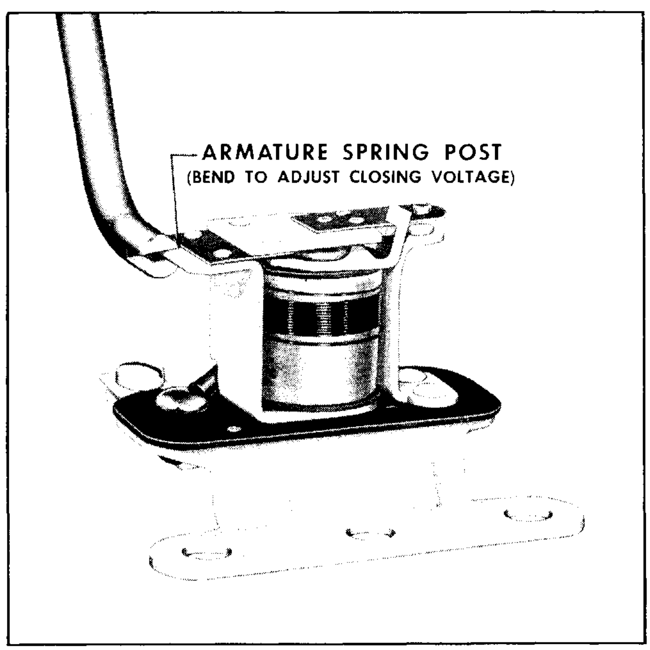


Fig. 12-68 Adjusting Relay Closing Voltage

HORN CIRCUIT—TROUBLE DIAGNOSIS

HORNS WILL NOT OPERATE

CAUSE	REMEDY
Loose connections in circuit.	Check and tighten connections.
Defective horn switch.	Remove button or ring and replace defective parts.
Defective horn relay.	Check and adjust (page 12–38) or replace.
Defects within horn.	To locate the trouble, connect a jumper lead to the "H" and "B" terminals of the relay (Fig. 12-67). If the horn blows, the trouble is in the relay, horn button, or wiring. (To determine whether the relay, horn button, or wiring is at fault, ground the "S" terminal of the relay. If the horn blows, the horn button or wiring is at fault.) If the horn does not blow and the wiring between the battery and relay is not defective, connect a voltmeter between the horn terminal and the horn mounting nut. Again connect the jumper lead to the "H" and "B" terminals of the relay and note the voltmeter reading. If no voltmeter reading is obtained, the wiring between the relay and horn is open or the horn is not grounded. If the voltmeter reading is less than 7.0 volts, the trouble is due to high resistance connections in the wiring or a faulty horn. If the voltmeter reading is above 7.0 volts, the trouble is due to a faulty horn which should be removed for a bench check.

POOR TONE

CAUSE	REMEDY
Low available voltage at horn.	Check battery and charging circuit.
Defects within horn.	Although the horn should blow at any voltage above 7.0 volts, a weak or poor tone may occur at operating voltages below 11.25 volts. If the horn has a weak or poor tone at an operating voltage of 11.25 volts or higher, remove the horn for inspection and adjustment (page 12–38).

HORNS OPERATE INTERMITTENTLY

CAUSE	REMEDY
Loose or intermittent connections in horn relay or horn circuit.	Check and tighten connections.
Defective horn switch.	Remove button or ring and replace defective parts.
Defective relay.	Check and adjust relay (page 12–38).
Defects within horn.	Inspect and adjust horn (page 12–38).

INSTRUMENTS— GENERAL DESCRIPTION

Instruments consist of a fuel gauge, temperature gauge (thermo-gauge), charge indicator, oil pressure gauge, and speedometer. Authorized service on the instruments can be obtained through branches of United Motors Service Division and AC Service Stations. However, a knowledge of instrument circuit checks must be had to determine if operating difficulties lie in the instrument itself or in its allied circuit.

FUEL GAUGE

An electric fuel gauge is used on all models. The fuel gauge indicates the quantity of gasoline in the tank only when the ignition is turned on. When the ignition is turned off or to start the pointer drops back beyond the empty mark. The letters "E" and "F" on the fuel gauge are used to point out direction of indicator travel only. Gauge readings are made from the three dots on the gauge face. The left hand dot indicates empty, the center dot half-full and the right hand dot full. The dash unit of this instrument consists principally of two coils spaced 90° apart, with an armature and pointer assembly mounted at the intersection of the coil axis (Fig. 12-69). Silicone liquid in the armature bearing prevents vibration of the pointer on rough roads. The left coil is connected directly across the battery (through the ignition switch) and the right coil connected to the battery and a resistance which is the fuel tank rheostat in the fuel gauge. The resistance allows more current to flow through the right hand coil as the tank fills up, causing the right hand coil to balance the constant magnetism of the left hand coil, bringing the pointer and armature assembly to rest somewhere between the two coils, the exact position depending on the relative magnetic strength between the two coils.

The fuel gauge tank unit consists of a float, with linkage connecting to a movable contact arm and a rheostat. As the float rises, due to filling the tank, the contact arm moves over the rheostat cutting in resistance and allowing more current to flow through the right-hand ("full") coil of the panel unit.

THERMO-GAUGE

The mechanical thermo-gauge consists of an indicating unit connected by a small tubing to a bulb filled with a heat expanding liquid. The bulb end is exposed to engine coolant so that increased engine heat causes the contained liquid to expand. Expansion causes pressure on bourdon (partially flattened and curved) tube which has one end fastened to the indicating unit frame and the other end to the pointer. As the free end of the bourdon tube moves outward, the pointer indicates the degrees of heat on the dial.

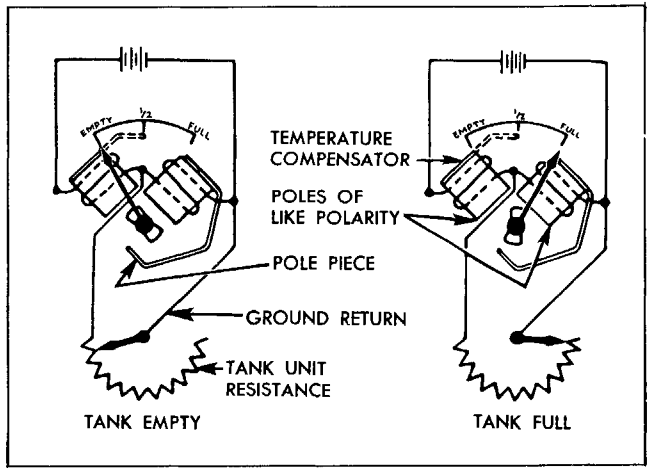


Fig. 12-69 Gasoline Gauge Diagram

CHARGE INDICATOR

The charge indicator (sometimes referred to as ammeter) consists of a frame to which is attached a permanent magnet. The frame also supports an armature and pointer assembly. When no current flows through the charge indicator, the magnet holds the pointer armature and pointer so it indicates 0. When current passes in either direction through the indicator the resulting magnetic field attracts the armature opposing the effect of the permanent magnet and giving a reading proportional to the current flow. NOTE: The charge indicator is marked "DIS" on one side of "O" and "CHG" on the other since it only indicates flow of current and does not show how much current is flowing. No attempt should be made to interpret the reading in amperes current flow.

OIL PRESSURE GAUGE

The oil pressure gauge indicates the pressure in the engine's full pressure lubrication system. The gauge is read in the same manner as the fuel gauge with the dots indicating "0", "40" and "80" respectively. The gauge shows the oil pump is working, but does not indicate how much oil there is in the crankcase. At average driving speeds the gauge should read approximately "40". When oil gauge reads approximately "40" at average driving speed, it may read near the "0" mark at hot idle.

The oil pressure gauge consists of a dial, frame and mechanism assembly. Oil pressure is transmitted through a small oil line to the threaded frame socket and into a bourdon (partially flattened curved) tube which has one end fastened to the frame. The free closed end of the bourdon tube is connected to the gauge pointer by a linkage. Oil pressure has a tendency to straighten the bourdon tube causing its free end to move outward in proportion to the pressure. This, by means of the linkage moves the pointer to give an indication of pounds per square inch pressure on the dial.

SPEEDOMETER

The speedometer incorporates a speed indicating mechanism and an odometer to record total mileage. A flexible cable, which enters the speedometer driven gear in the transmission on one end and the speedometer head at the other, rotates both mechanisms whenever the transmission main shaft, propeller shaft and wheels rotate. The speed indicating portion of the speedometer operates on the magnetic principle.

In the speedometer head is a permanent magnet which rotates at the same speed as the cable. This magnet exerts a pull on a speed cup causing it to move in direct ratio to the revolving magnet speed. A speed disc is attached to the speed cup spindle to indicate speed on the speedometer dial. A finely calibrated hair spring (also part of the speed cup assembly) opposes the magnetic pull on the speed cup so the pointer indicates true speed; it also pulls the cup and pointer to zero when the car stops. The odometer is driven by a series of gears from a worm gear cut on the magnet shaft. The odometer discs are so geared that as any one disc finishes a complete revolution, the next disc to the left is turned one-tenth of a revolution.

PERIODIC SERVICE

No periodic service or lubrication of instruments (except for the speedometer cable) is required. In fact it must never be attempted on the panel instruments as it will interfere with their satisfactory operation. Never attempt to lubricate the fuel gauge tank unit; adequate lubrication of this unit is provided by splash of the gasoline.

In some cases the speedometer cable becomes noisy or the speed indicator wavers or jerks. This may be due to a dry cable which should be lubricated using special AC speedometer grease as outlined in the General Lubrication Section. When the cable is removed for lubrication, it should be checked for kinks.

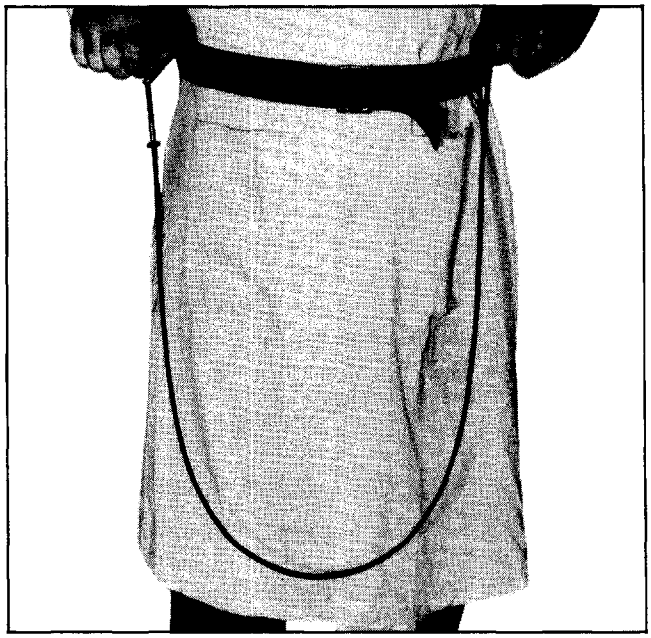


Fig. 12-70 Testing Speedometer Cable for Kinks

To do this, take the two ends of the cable (after removing it from casing) one end in each hand, and with the hands about a foot apart (Fig. 12-70) slowly turn the cable. If it is kinked, the loop will "flop"; in such a case replace the cable.

MINOR REPAIRS

SPEEDOMETER—REMOVE AND REPLACE

1. Disconnect speedometer cable, note position of five lamp sockets by wire color and remove five lamp sockets from back of speedometer assembly. Remove lamp socket wire harness from clip on left-hand side of speedometer assembly.

2. Remove three screws from face of speedometer assembly (two on bottom, one on top).

3. Remove speedometer assembly by tipping top out of instrument panel, then lifting out.

4. To remove speedometer head, remove the three screws which fasten it to the back of the speedometer assembly.

5. Assemble and install speedometer by reversing above steps.

CHARGE INDICATOR-THERMO-GAUGE CLUSTER—REMOVE AND REPLACE

NOTE: Follow instructions on page 12-45 for diagnosis and testing before condemning instrument panel unit.

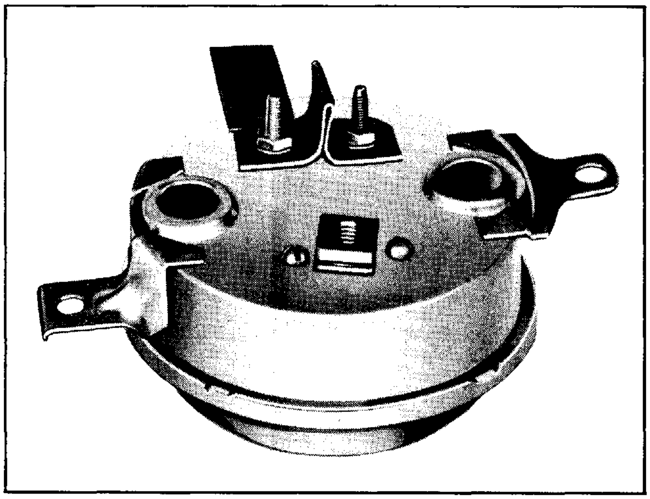


Fig. 12-71 Crimps Which Fasten Instrument Cluster Bezel to Body

1. If thermo-gauge is to be replaced, drain radiator so coolant will not be lost when thermo-gauge bulb is removed from intake manifold.

2. Disconnect positive cable from battery post.

3. Remove nuts and washers from two studs which fasten cluster to back of instrument panel.

4. Pull cluster out from rear of instrument panel. NOTE: If charge indicator is to be replaced, it will not be necessary to remove thermo-gauge bulb from engine.

5. Remove leads from charge indicator.

6. Remove and replace defective gauge. To replace individual gauge, straighten out the crimps which retain the bezel to the body of the cluster (Fig. 12-71). The front of the cluster can then be removed to gain access for replacing individual gauge. NOTE: If thermo-gauge assembly is being replaced, route the new capillary tube the same as the one which was removed and install the grommet in the hole where it passes through the dash.

7. Replace cluster in instrument panel by reversing steps 1-5. When connecting leads to ammeter, be sure to connect yellow lead to terminal marked "BAT" and red lead to unmarked terminal.

FUEL-OIL PRESSURE GAUGE CLUSTER—REMOVE AND REPLACE

NOTE: Follow instructions on page 12–45 for diagnosis and testing before condemning instrument panel unit.

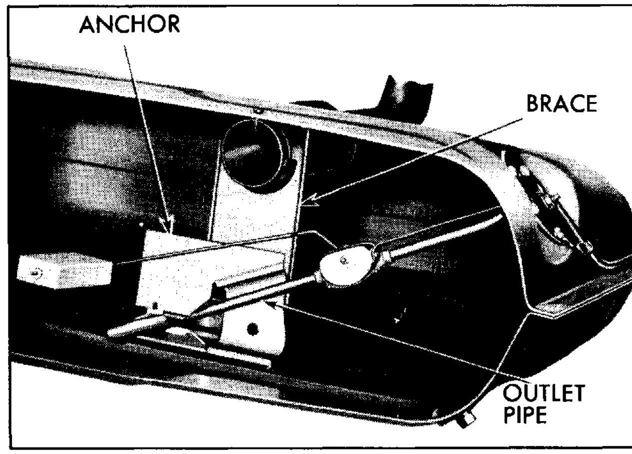


Fig. 12-72 Fuel Gauge Tank Unit Installed in Tank

1. Disconnect one cable from battery post.

2. Disconnect oil pressure gauge line from gauge.

3. Remove nut and washer from stud which retains cluster to back of instrument panel on left side. Open glove compartment door and remove screw which retains right side of cluster.

4. Remove leads from fuel gauge terminals, marking carefully to identify which terminals leads were removed from.

5. Remove and replace defective gauge. To replace individual gauge, straighten out the crimps which retain the bezel to the body of the cluster. The front of the cluster can then be removed to gain access for replacing individual gauge.

FUEL GAUGE TANK UNIT—REMOVE AND REPLACE

NOTE: Before removing tank unit be sure it is actually defective; see testing section, page 12–45.

1. Clean away any dirt that has collected around tank unit and tank unit terminal so it will not enter tank and also because dirt, particularly if calcium chloride, causes an electrical leak that will cause error in gauge reading.

2. Disconnect lead from terminal on tank unit, disconnect fuel line, remove five screws holding unit to tank and remove unit from tank.

3. Install new tank unit as follows, first checking for float arm freedom of movement by raising it to various positions and seeing if it will always fall to "empty" position.

a. Install the unit straight into the tank until the flange is about one and one-half inches above the tank.

b. At this point force the lower end of the unit down against the bottom of the tank and to the right against the baffle.

c. Push the unit straight in against the tank, engaging the horizontal portion of the outlet pipe in the anchor as shown is Fig. 12-72. Install attaching screws and tighten securely. (If unit is not engaged in anchor, the mounting flange will be held away from the tank on the left side.) NOTE: Always check the fuel indication of panel unit after replacing tank unit. If four to five gallons of gasoline are required before the pointer begins to move, the outlet pipe is not properly positioned in the anchor.

4. Securely install wire to terminal on tank unit and see that boot on wire connection is properly installed so as to seal connection.

5. Reconnect fuel pipe.

SPEEDOMETER CABLE—REMOVE AND REPLACE

1. Disconnect speedometer cable casing from speedometer case and transmission.

2. Slide old cable from upper end of casing, or if broken from both ends of casing.

3. Take a short piece of speedometer cable with a tip to fit the speedometer and insert it in the speedometer socket. Spin the short cable between the fingers in the direction that higher speed is indicated on the speedometer dial and note if there is any tendency to bind. If binding is noted, there is trouble inside the head and the speedometer should be repaired.

4. Inspect cable casing, especially at transmission end, for sharp bends and breaks. If breaks are noted, replace casing.

5. Spread a thin, even coating of special AC Speedometer Cable Grease over the lower two-thirds of new cable. Do not over-grease.

6. Insert cable into upper end of casing, lower end first.

7. Seat upper cable tip in speedometer and tighten casing connector to speedometer case as tightly as possible with fingers. NOTE: Insufficient tightening of connector will result in connector loosening, causing speedometer indicator to waiver.

8. See that there are no sharp bends in casing.

9. Connect lower end of casing to transmission and tighten with pliers making sure lower cable tip seats properly in speedometer driven gear.

INSTRUMENTS—TROUBLE DIAGNOSIS AND TESTING

GASOLINE GAUGE DOES NOT SHOW "FULL" WITH FULL TANK

CAUSE	REMEDY
Gauge improperly positioned in anchor.	Remove gauge and install properly (page 12-43).

GASOLINE GAUGE DOES NOT REGISTER WITH IGNITION ON

CAUSE	REMEDY
Break in line between instrument panel unit and ignition switch.	Check line and connections to switch and panel unit.
Defective panel unit.	Check (see page 12-45) and replace.

GASOLINE GAUGE SHOWS FULL UNDER ALL CONDITIONS

CAUSE	REMEDY
Break in line between tank and instrument panel unit.	Check (see page 12-45) and repair.
Defective tank unit.	Check (sse page 12-45) and replace.
Tank unit improperly grounded.	Remove paint under tank unit mounting screws and tighten screws. Ground tank to chassis and check gauge operation.

INSTRUMENTS—TROUBLE DIAGNOSIS AND TESTING—CONT.

GASOLINE GAUGE SHOWS EMPTY UNDER ALL CONDITIONS

CAUSE	REMEDY
Lead to tank unit grounded.	Make necessary repair.
Defective tank unit.	Check (see below) and replace.
Defective panel unit.	Check (see below) and replace.

THERMO-GAUGE SHOWS INCORRECT TEMPERATURE

CAUSE	REMEDY
Defective unit.	Immerse bulb end in water of known temperature. Replace gauge if it reads incorrectly.

SPEEDOMETER NOISE AND/OR INDICATOR OSCILLATING

CAUSE	REMEDY
Cable dry.	Lubricate according to page 0–4.
Casing contacts other metal parts.	Re-route cable so it is clear of all other metal parts.
Kinked cable.	Replace cable. Re-route casing so that bends have no less than 6″ radius.
Defective speedometer head.	Replace or have repaired at authorized service station.
Casing connector loose on speedometer case.	Tighten connector.

TESTING FUEL GAUGE TANK AND INSTRUMENT PANEL UNITS

In order to isolate trouble in the fuel tank or instrument panel unit, use either an extra tank unit, which is known to be good, or an AC Gas Gauge Tester AC No. 1516000 which can be procured from AC Service Stations. CAUTION: In process of testing fuel gauge panel unit NEVER place full battery current on terminal to which wire to tank unit is normally attached. To do so will burn out resistance coil in tank unit even though the terminal is touched only momentarily.

To test, remove lead to tank unit from instrument panel unit and then use one of the following methods:

TESTING WITH EXTRA TANK UNIT

1. Attach a wire lead from the terminal on the extra tank unit to the tank unit terminal on the panel unit and connect a second wire from body of extra tank unit to car chassis.

2. Turn on ignition and move float on extra tank unit to full and empty positions. If panel unit indicates corresponding reading, it is satisfactory and trouble is in tank unit or wire lead from panel unit to tank unit.

3. Check wiring to tank unit by disconnecting lead from tank unit in car and connecting to test unit. With test unit grounded to chassis move float to full and empty positions and see that instrument panel unit reads correctly. Incorrect reading indicates defect in wiring.

4. Check tank unit by removing from tank, reconnecting the lead and operating unit in same manner as the test unit (tank unit must be grounded while testing). If instrument panel shows correct reading trouble was caused by poor connection of lead to tank unit or poor ground. If instrument panel does not give correct reading, install a new tank unit.

TESTING WITH AC TESTER

1. Remove lead to tank unit from instrument panel unit. Attach red wire of AC tester to the tank unit terminal on panel unit and ground the tester by connecting the black wire to a good ground.

2. Turn on ignition switch and move lever on tester through its full travel. If panel unit reads "empty" and "full", it is satisfactory and trouble is in tank unit or possibly wire lead from instrument panel unit to tank unit.

3. Check wiring to tank by disconnecting lead from tank unit in car and connecting to AC tester. Ground tester and move lever on tester through its full travel. If instrument panel unit shows "empty" and "full", tank unit is probably defective and should be checked as in step 4 above.

SPECIFICATIONS

DISTRIBUTOR

Model		1110828
Rotation (viewed from top)		counterclockwise
Ignition timing		5°BTDC
Point Opening		.016″
Cam Angle		26°–33°
Breaker Lever Tension		19–23 oz.
Condenser Capacity		.18–.23
Centrifugal Advance	ENGINE R.P.M.	ENGINE DEGREES
Start	500	0–2
Intermediate	2400	21–25
Intermediate	2800	24–28
Maximum	3400	28–32
Vacuum Control Model		1116080
Vacuum Advance		
Inches of Mercury to start advance		4–6
Inches of Mercury for full advance		12.5–13.5
Maximum Advance (engine degrees)		14–18

HORN RELAY

Model Number	1116781
Air Gap	.014″
Point Opening	.027″
Closing Voltage	5.0–9.5 Volts

REGULATOR (STANDARD)

Model Number	1118945
Cutout Relay Air Gap	.020″
Cutout Relay Point Opening	.020″
Cutout Relay Closing Voltage	11.8–13.5 volts
Voltage Regulator Air Gap	.075″
Voltage Regulator Setting	13.8–14.8 volts
Current Regulator Air Gap	.075″
Current Regulator Setting	23–27 amperes

REGULATOR (HEAVY DUTY 35 AMPERE)

Model Number	1118956 or 1118967
Cutout Relay Air Gap	.020″
Cutout Relay Point Opening	.020″
Cutout Relay Closing Voltage	11.8–13.5 volts
Voltage Regulator Air Gap	.075″
Voltage Regulator Setting	13.8–14.8 volts
Current Regulator Air Gap	.075″
Current Regulator Setting	32–38 amps.

REGULATOR (HEAVY DUTY 30 AMPERE)

Model Number	1118826
Cutout Relay Air Gap	.020″
Cutout Relay Point Opening	.020″
Cutout Relay Closing Voltage	11.8–13.5 volts
Voltage Regulator Air Gap	.075″
Voltage Regulator Setting	13.8–14.8 volts
Current Regulator Air Gap	.075″
Current Regulator Setting	27–33 amperes

GENERATOR (STANDARD)

Model Number	1100304
Brush Tension	28 oz.
Cold Output	25 amperes at 14.0 volts, 2780 R.P.M.
Field Current Draw	1.5–1.62 amperes at 12 volts

GENERATOR (HEAVY DUTY 35 AMPERE)

Model Number	1105944
Brush Tension	28 oz.
Cold Output	35 amps., 14 volts at 2150 RPM
Field Current (amps. at 12V. at 80°F.)	1.54–1.67

GENERATOR (HEAVY DUTY 35 AMPERE)

Model Number	1102039 and 1102027
Brush Tension	28 oz.
Cold Output	35 amps., 14 volts at 2350 RPM
Field Current (amps. at 12V. at 80°F.)	1.64–1.82

GENERATOR (HEAVY DUTY 30 AMPERE)

Model Number	1102018
Brush Tension	28 oz.
Cold Output	30 amperes at 14.0 volts, 2150 R.P.M.
Field Current Draw	1.48–1.62 amperes at 12 volts

STARTING MOTOR

Model Number	
With standard steering	1107631
With power steering	1107632
Brush Tension	35 oz. min.

STARTING MOTOR—(Cont.)

Free Speed	
Volts	10.1
Amperes	95 Max.
R.P.M.	3500 Min.

SOLENOID

Model Number	1119760 and 1119761
Hold-in Winding	18–20 Amperes at 10 volts
Both Windings	72–76 Amperes at 10 volts

BATTERY (STANDARD)

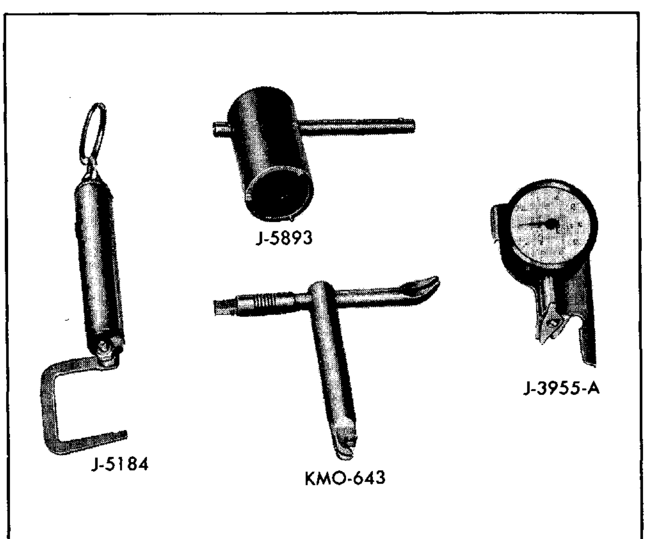
Model Number	2SM50
Number of Plates	9
20 Hr. Rating	50 Amp. Hrs.
Total Minutes at 150 amps. at 0°F.	3.7
Voltage After 5 sec. at 150 amps. at 0°F.	8.4

BATTERY (HEAVY DUTY)

Model Number	3SM70
Number of Plates	11
20 Hr. Rating	70 Amp. Hrs.
Total Minutes at 150 amps. at 0° F.	5.8
Voltage After 5 sec. at 150 amps. at 0°F.	9.0

HIGH TENSION WIRE RESISTANCE

Spark Plug Wires	
1, 3, 4	6563–13125
2	7563–15125
5, 6, 8	5375–10750
7	4813–9625
Coil to Distributor Wire	1813–3625



SPECIAL TOOLS

J-3955-A	Distributor Point Opening Indicator
J-5184	Armature Brush Tension Checking Scale
J-5893	Ignition Switch Spanner Wrench
KMO-643	Distributor Point Aligner