SECTION 10-D
GENERATING SYSTEM

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SERVICE BULLETIN REFERENCE

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10-23 THE GENERATING SYSTEM

The generating system restores to the battery the energy used in cranking the engine. It also supplies current to carry the electrical load of the ignition, lights, signalling devices, and accessories, at operating speeds above 25 MPH up to the limit of the generator's capacity. At speeds below 25 MPH the output of generator is not sufficient to carry the electrical load of all units, therefore the battery supplies the additional current required.

The generating system consists of the generator (par. 10-24), generator regulator (par. 10-25), charge indicator, battery (par. 10-14), the wires and cables connecting these units, and the battery ground cable and ground through engine crankcase which completes the circuit. See figure 10-14.

The charge indicator indicates charging current going into the battery and the current leaving battery, except when cranking the engine or blowing the horn. The charge indicator does not indicate charging rate of generator since current supplied by generator to electrical units other than the battery and horns does not pass through the indicator.

10-24 DESCRIPTION OF GENERATOR

The generator is a two-brush, two-pole shunt wound unit which is capable of delivering 40 amperes when hot.

The maximum output of generator is controlled by the current regulator; however, the generator does not normally deliver the maximum output because the voltage regulator controls output in accordance with the requirements of the battery and the current consuming units in operating. See figure 10-12.

The generator pulley drives a fan which draws a draft of air through the generator to carry away the heat produced during operation. This ventilation permits the generator output to be increased to higher values than would be possible in a non-ventilated generator

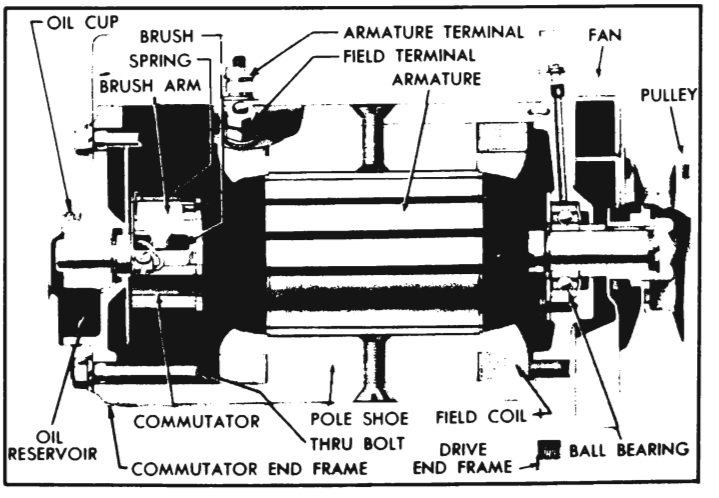

Figure 10-11—Generator, Sectional View—All Series

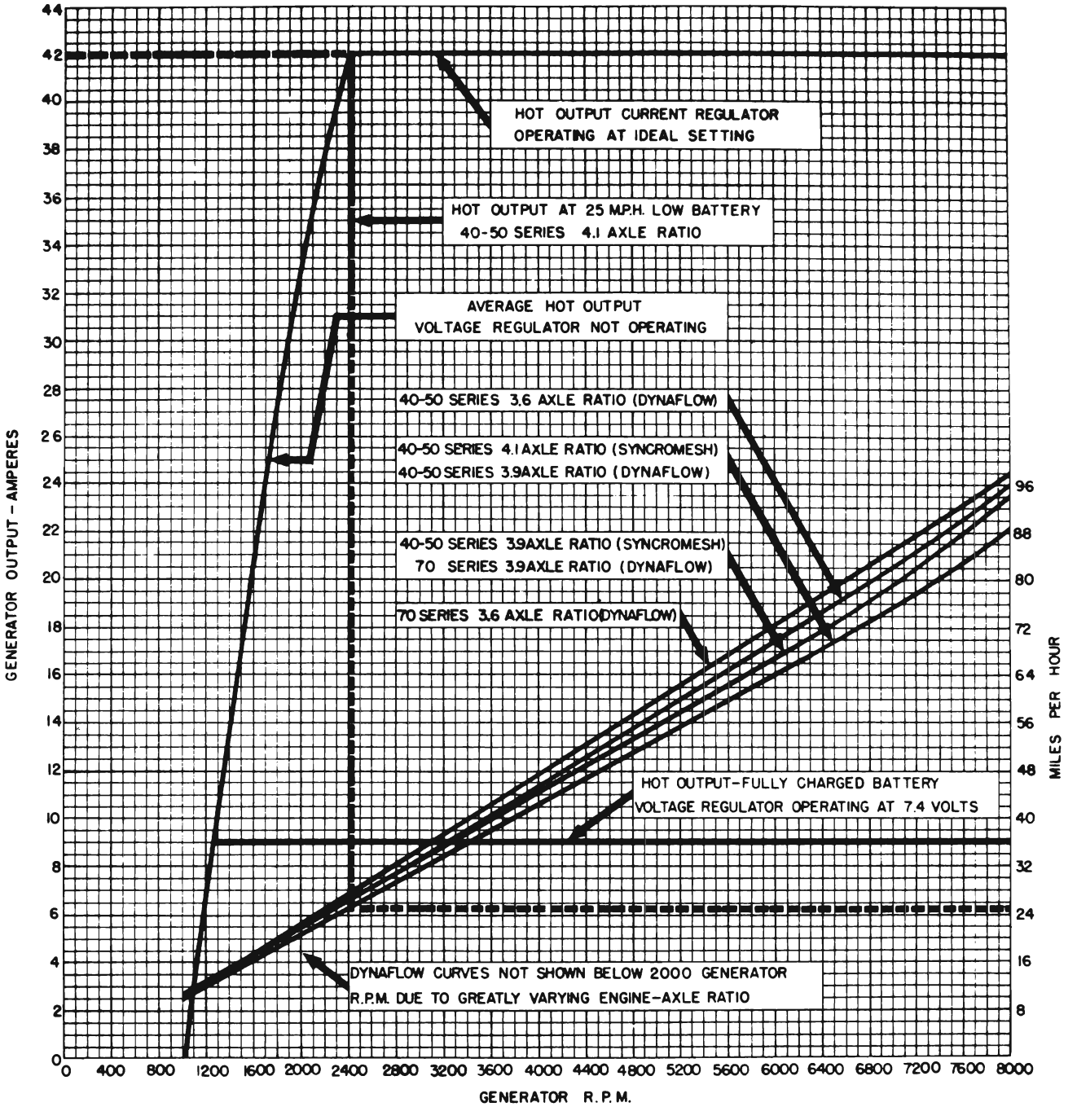

Figure 10-12—Generator Output Chart

of the same size.

The armature shaft is supported by an annular ball bearing in the drive end frame and a bronze bushing in the commutator end frame. The bearing and the bushing are provided with hinge cap oil cups for periodic application of a few drops of light engine oil. The two brushes are mounted on a brush plate attached to the commutator end frame and are held in contact with the commutator by spring loaded brush arms. One brush is grounded to the frame while the other brush is insulated from the frame and connected to the field coils and the armature terminal post ("A") on the field frame. The two field coils are held in place by two pole shoes which are attached to the field frame by large screws. See figure 10-11.

The generator is suspended on a bracket on left side of crankcase and is driven by the fan belt. The method of mounting permits generator to be moved in or out to adjust tension of fan belt.

The high output rating of the generator used on all series eliminates the need for special service generators except for certain police installations where unusual low speed performance is required. Delco-Remy has available through United Motors Service, a generator package suitable for this kind of installation.

10-25 DESCRIPTION OF GENERATOR REGULATOR

The generator regulator is mounted on the left front fender skirt and is cushioned by rubber to dampen the noise which is caused when the regulators operate. The regulator is grounded to the fender skirt through two of the attaching bolts, and to insure positive ground the base of regulator is also connected by a wire to the generator frame.

The generator regulator contains a cutout relay, current regulator, and voltage regulator, all mounted on one base and enclosed by a sheet metal cover. See figure 10-13. These three devices are magnetic switches whose functions and operations are as follows:

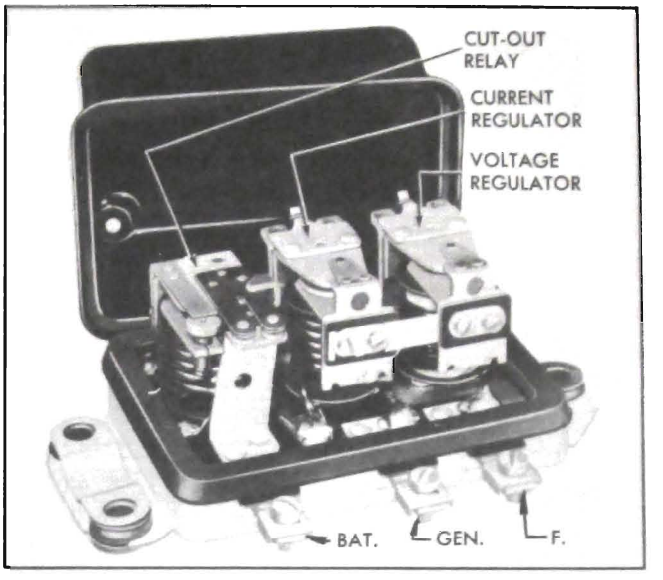

Figure 10-13—Generator Regulator

a. Cutout Relay

The cutout relay opens the circuit to prevent the battery from discharging to ground through the generator whenever the engine is stopped or generator is operating at such low speed that its voltage is less than voltage of battery. When the voltage of generator is slightly greater than battery voltage the relay closes the circuit so that generator can furnish current to the electrical system.

The cutout relay has a series or current winding of a few turns of heavy wire, and a shunt or voltage winding of many turns of fine wire, both assembled on the same core. The shunt winding is connected between generator armature and ground so that generator voltage is impressed upon it at all times. The series winding is connected so that all generator output current must pass through it. It is connected to a flat steel armature which has a pair of contact points through which current passes to the battery and other electrical units. The contact points are held open by armature spring tension when the unit is not operating. See figure 10-14.

When the generator begins to operate, voltage builds up and forces current through the shunt winding, thereby magnetizing the core. When the voltage reaches the value for which the relay is set, the magnetism is strong enough to overcome the armature spring tension and pull the armature toward the core, thereby closing the contact points. Generator current now flows through the series winding of relay in the right direction to add to the magnetism holding the points closed, and passes on to the battery and other electrical units in operation.

When the generator slows to engine idling speed, or stops, current begins to flow from the battery back through the generator, reversing the current flow through the series winding. This reduces the magnetism of the relay core to the extent that it can no longer hold the contact points closed against armature spring tension. The points are separated and the circuit broken between the generator and battery.

b. Current Regulator

The current regulator automatically controls the maximum output of the generator. When the current requirements of the electrical system are large and the battery is low, the current regulator operates to protect the generator from overload by limiting its output to a safe value.

The current regulator has one series winding of heavy wire through which the entire generator output flows at all times. This winding connects to the series winding in the cutout relay, described above. Above the winding core is an armature, with a pair of contact points which are held together by spring tension when the current regulator is not operating. When current regulator is not operating and the contact points are closed, the generator field circuit is directly grounded so that generator may produce maximum output, unless further controlled by the voltage regulator described below. See figure 10-14.

When the generator output increases to the

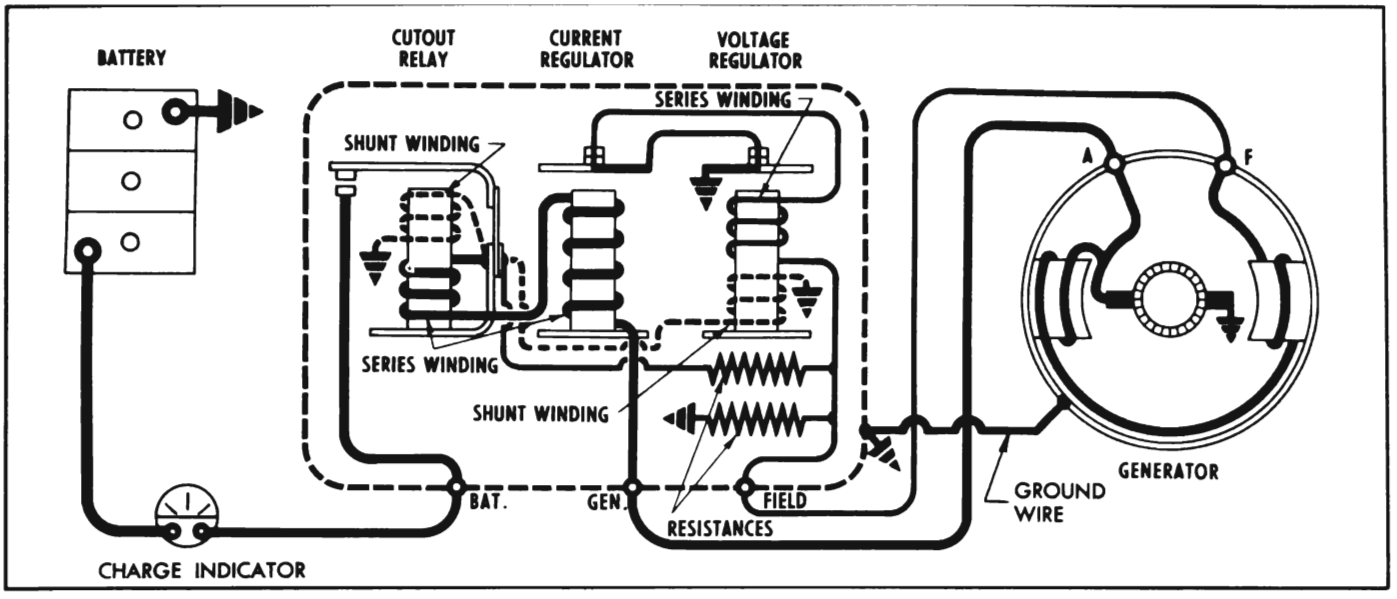

Figure 10-14—Generator Regulator in Generating Circuit

value for which the current regulator is set, the magnetism of the current winding is sufficient to overcome the armature spring tension. The armature is pulled toward the winding core so that the points are separated. The generator field circuit must then pass through a resistance, which reduces the flow through the field coils and thereby reduces the output of generator. This reduces the magnetic strength of the current winding so that spring tension again closes the contact points, directly grounding the generator field circuit and increasing generator output. This cycle is repeated 150 to 250 times a second, and the action limits the generator output to the value for which the regulator is set.

The current regulator has a bi-metal hinge on the armature for thermostatic temperature control. This automatically permits a somewhat higher generator output when the unit is cold, and causes the output to drop off as the temperature increases.

The current regulator operates only when the condition of battery and the load of current-consuming units in operation require maximum output of the generator. When current requirements are small, the voltage regulator controls generator output. Either the current regulator or the voltage regulator operates at any one time; both regulators never operate at the same time.

c. Voltage Regulator

The voltage regulator limits the voltage in the charging circuits to a safe value, thereby controlling the charging rate of the generator in accordance with the requirements of the battery and the current-consuming electrical units in operation. When the battery is low, the generator output is near maximum but as the battery comes up to charge, and other requirements are small, the voltage regulator operates to limit the voltage, thereby reducing the generator output. This protects the battery from overcharge and the electrical system from high voltage.

The voltage regulator consists of two windings assembled on the same core, an armature and a set of contact points, and a fixed resistance. The voltage winding consists of many turns of fine wire connected so that generator voltage is impressed on it at all times. The series winding, having a few turns of heavy wire, carries the generator field current directly to ground when the regulator contact points are closed. A contact point on the armature, which is located above the winding core, is held in contact with a stationary contact point by armature spring tension when the voltage regulator is not operating. See figure 10-14.

When the generator voltage reaches the value for which voltage regulator is set, the combined magnetic pull of the voltage and series windings is sufficient to overcome the armature spring tension, so that the armature is pulled toward the core and the contact points are separated. The instant the points separate, the field current flows to ground through the resistance. This reduces the current flow through the field coils and decreases generator voltage and output.

As soon as the field current stops flowing

through the series winding, the magnetic pull of this winding collapses. In addition, the reduced voltage in the circuit causes a weakening of the magnetic field of the voltage winding in the regulator. The resulting loss of magnetism permits the springs to pull the armature away from the core and close the contact points again, thereby directly grounding the generator field so that generator voltage and output increases.

This cycle is repeated 150 to 250 times a second, causing a vibrating action of the armature, and holds the voltage to a constant value. By maintaining a constant voltage, the voltage regulator continues to reduce the generator output as the battery comes up to charge. When the battery reaches a fully charged condition, the voltage regulator will have reduced the generator output to a relatively few amperes.

The voltage regulator has a bi-metal armature hinge for thermostatic temperature control. This automatically permits regulation to a higher voltage when the unit is cold, and a lower voltage when hot, because a high voltage is required to charge a cold battery.

As previously stated, the current and voltage regulators do not operate at the same time. When current requirements are large, the generator voltage is too low to cause voltage regulator to operate, therefore the current regulator operates to limit maximum output of generator. When current requirements are small, the generator voltage is increased to the value which causes voltage regulator to operate. The generator output is then reduced below the value required to operate the current regulator, consequently all control is then dependent on the operation of voltage regulator.

d. Resistances

The current and voltage regulator circuits use a common resistance which is inserted in the field circuit when either regulator operates.

A second resistance is connected between the regulator field terminal and the relay base, which places it in parallel with the generator field coils.

The sudden reduction in field current occurring when either the current or voltage regulator contact points open, is accompanied by a surge of induced voltage in the field coils as the strength of the magnetic fields change. These surges are partially dissipated by the two resistances, thus presenting excessive arcing at the contact points.

10-26 PERIODIC INSPECTION AND TEST OF GENERATOR—ON CAR

As a general rule, the generator should be inspected and tested every 5000 miles to determine its condition; however, the type of service in which some generators are used may make more frequent inspection advisable. High speed operation, excessive dust or dirt, high temperatures and operation of generator at or near full output most of the time are all factors which increase bearing, commutator and brush wear.

a. Inspection of Generator

The following inspection will disclose whether the generator is in proper condition for service or in need of removal for repairs.

1. Remove commutator cover band and inspect it for thrown solder. Thrown solder indicates that the generator has overheated, probably from excessive output. Since thrown solder results in loose or broken connections between armature windings and commutator riser bars, which usually causes burned commutator bars, the generator must be removed for repairs. (Par. 10-28).

2. Inspect commutator. If it is rough, worn, out of round, or has high mica between the bars it will require turning down and undercutting of the mica. Generator must be removed for this work.

3. Check condition of brushes; make sure they are not binding in holders and that they are resting on the commutator with sufficient tension to give good, firm contact. Brush leads and screws must be tight. If the brushes are worn down to one-half their original length, compared with new brushes, the generator must be removed for installation of new brushes. CAUTION: *When inspecting brushes do not pull them out of holders against spring tension by pulling on brush leads. This may loosen the leads in brushes, causing excessive resistance, heating and open circuits to develop. Do not snap brush arms down on brushes as this may chip or crack them.*

4. If commutator and brushes are in good condition but dirty, they can be cleaned without removal of generator. Clean off any grease with a cloth soaked with carbon tetrachloride or other non-inflammable solvent. While engine is running, polish commutator with a brush seating stone or with a strip of 2/0 sandpaper

placed over a wooden block having a smooth square end. *Never use emery cloth,* because it will cause arcing, burning and rapid wear of commutator and brushes. After cleaning commutator blow out all dust from generator.

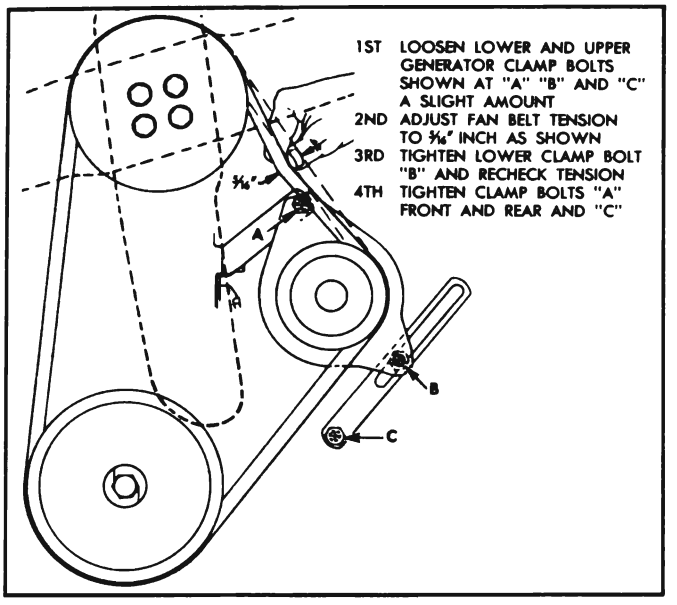

Figure 10-15—Fan Belt Adjustment

5. Check fan belt for condition and proper tension (fig. 10-15), and make certain that all generator mounting bracket and brace bolts are tight. A loose fan belt will permit belt slippage, resulting in rapid belt wear and low or erratic generator output. An excessively tight belt will cause rapid belt wear and rapid wear of generator and water pump bearings. NOTE: *If belt requires adjustment, first loosen belt so that pulley is free, then check pulley for tightness and check generator bearings for freeness of rotation and excessive side play. Tight or excessively worn bearings should be cleaned or replaced.*

6. Inspect and manually check all wiring connections at generator, regulator, charge indicator, and cranking motor solenoid switch to make certain that connections are clean and tight. Clean any loose connections before tightening, to insure good contact. Inspect wiring for broken insulation, broken strands, and loose terminals. Make any corrections necessary to eliminate excessive resistance.

b. Testing Generator Output and Generator Circuit Wiring

After the inspection given above it is advisable to test the generator for output and the circuit wiring for excessive resistance. *Before making the following tests make certain that battery specific gravity is not less than 1.250.*

1. Disconnect wire from generator regulator terminal marked "BAT" and connect an ammeter in series with this terminal and the disconnected wire.

2. Connect jumper wire between regulator terminal marked "F" and base plate of regulator so that current and voltage regulators cannot operate to control generator output.

3. Start engine and with all electrical units turned off slowly increase engine speed until ammeter registers 40 amperes, which should be reached at approximately 1250 RPM of engine when generator is HOT, or at slightly lower speed when generator is cold. CAUTION: *Do not exceed 1400 RPM of engine while "F" terminal is grounded.*

4. If 40 amperes cannot be obtained at approximately 1250 RPM of engine check fan belt for proper tension (fig. 10-15). If fan belt is not slipping the generator does not have proper output. Remove generator for bench test (par. 10-27) and make necessary corrections before attempting any adjustment of generator regulator.

5. Slowly increase engine speed until ammeter registers 20 amperes and note engine speed at this point, then stop the engine.

6. Disconnect ammeter and reconnect loose wire to "BAT" terminal of regulator. Leave jumper wire connected between "F" terminal and regulator base. Momentarily bridge between "F" and "GEN" terminals of regulator to polarize the generator.

7. Connect a voltmeter negative (−) lead to the battery positive (+) terminal and connect voltmeter positive (+) lead to the "A" terminal of generator.

8. Start engine and slowly open throttle until engine speed is the same as when 20 amperes was obtained in step 5. At this point note voltmeter reading.

9. The voltmeter indicates the voltage drop in the generator to battery wiring. If the reading is greater than .8 volt there is excessive resistance at some point in this circuit. The cause of high resistance must be located and eliminated to insure proper charging of the battery.

10. Disconnect voltmeter and remove jumper wire.

10-27 BENCH TEST OF GENERATOR

The following inspection and test of generator, after removal from car, may be used to determine the cause of unsatisfactory output before generator is disassembled.

1. Remove cover band and inspect condition of brushes and commutator as described in paragraph 10-26. If brushes and commutator are in satisfactory condition and the cause of trouble is not apparent proceed to the following steps.

2. Place piece of cardboard between commutator and grounded brush. Using test lamp and points, check for grounds with test points on "A" terminal and generator frame. If lamp lights, the generator is internally grounded. Locate the ground by insulating the other brush also, and checking the brush holders, armature, commutator and field separately.

3. If generator is not grounded, check the field for open circuits by placing one test lamp point on the "F" terminal and the other point on the brush holder to which the field is connected. If lamp does not light the field has open circuit. If the open circuit is due to a broken lead or bad connections, it can be repaired but if the open circuit is inside one of the field coils the coil must be replaced.

4. If the field is not open, check for a short circuit by connecting a 6-volt battery and an ammeter in series with the field coils. Proceed with care since a shorted field may draw excessive current which might damage the ammeter. An ammeter reading of 1.90 to 2.05 amperes indicates that field is satisfactory; a higher reading indicates a short circuit.

5. If the cause of trouble has not been located, disassemble generator for test of armature (par. 10-28).

6. If a shorted field is found be sure to check for burned contact points in the generator regulator as described in paragraph 10-29(b). A shorted field may permit an excessive field current which could burn the regulator points.

10-28 GENERATOR REPAIRS—ON BENCH

The generator brushes may be replaced without disassembling the generator, but all other internal repairs require disassembly.

If commutator has burned bars or is worn eccentric, new brushes will wear out very quickly if commutator is not trued up at time brushes are installed.

a. Replacement of Generator Brushes

When inspecting or replacing generator brushes, do not pull them out of their holders against spring tension by pulling on the brush leads. This may loosen the leads in the brushes, causing excessive resistance, heating, and open circuit to develop. Do not snap brush arms down on brushes as this may chip or crack them.

Make sure that brushes are free in the holders

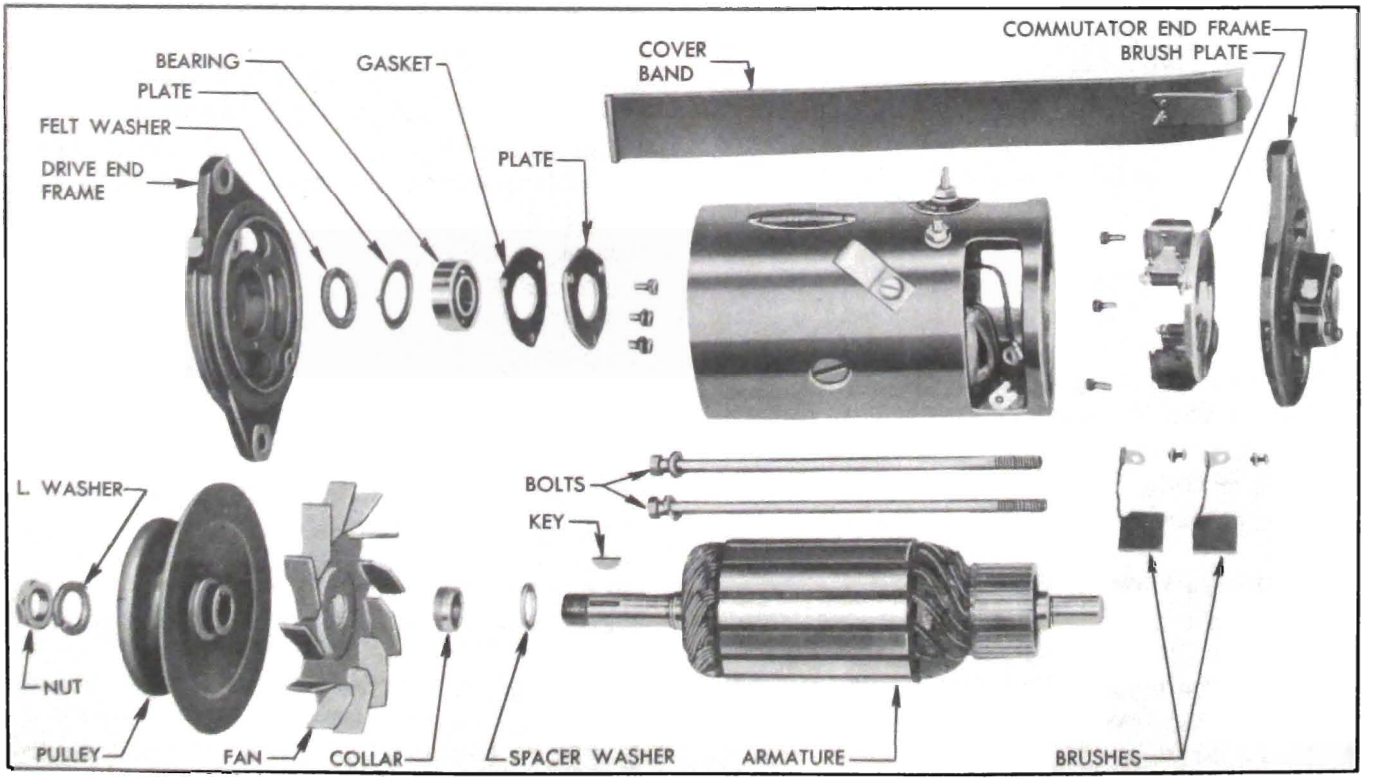

Figure 10-16—Generator Disassembled

and that springs have proper tension. Excessive tension will cause rapid brush and commutator wear, and low tension will cause arcing and burning of brushes and commutator. Hook a spring scale on end of brush arm and measure pull required to just lift arm off brush, pulling at right angle to brush arm. Tension should be 24 to 32 ounces, and may be adjusted by bending the brush spring as required. Be sure that spring tension has not been lost due to overheating.

New brushes must be seated to make good contact with armature, using a brush seating stone. This is a soft abrasive material which, when held against a revolving commutator, disintegrates so that particles are carried under the brushes and wear their contracting faces to the contour of the commutator in a few seconds. Blow all dust out of generator after the brushes are seated.

b. Disassembly, Cleaning and Inspection

When it is necessary to disassemble generator for any reason, make a complete clean up and test to make sure all parts are in satisfactory condition. See figure 10-16 for identification of parts.

1. Remove commutator cover band, disconnect leads at brushes and remove brushes.
2. Unscrew through bolts and remove the commutator end frame and field frame.
3. Hold armature in vise equipped with soft jaws, and avoid excessive tightening of vise. Remove pulley nut, lock washer, pulley, fan, key, collar, and drive end frame from armature shaft. Remove spacer washer.
4. Remove bearing retainer plate, gasket, bearing, plate and felt washer from drive end frame.
5. Thoroughly clean and inspect the ball bearing as described under Bearing Service (par. 1-11 and 1-12), and if satisfactory for use, pack it with high melting point ball bearing grease. Replace worn or rough bearing.
6. Remove dust cap from commutator end frame and clean out oil reservoir. Make sure that vent hole in dust cap is open. Install dust cap with new gasket.
7. Clean all other parts by wiping with clean cloths. The armature and field coils must not be cleaned in any degreasing compound since this might damage insulation so that a short or ground would subsequently develop.
8. If field coils are to be removed from frame, a pole shoe spreader and pole shoe screwdriver should be used to avoid distortion of frame. See figure 10-56.
9. Carefully inspect all parts for wear or damage and make necessary repairs, or replace unserviceable parts. Any soldering must be done with rosin flux; *never use acid flux on electrical connections.* If brush springs are distorted or show evidence of overheating, replace them.

c. Testing and Repairing Armature

Before making any repairs to the armature, test it for open, shorted or grounded circuits.

Open circuits in armature are usually obvious since the open circuited commutator bars are usually burned as a result of arcing as they pass under the brushes. If generator has overheated and thrown solder, the open circuit will be at connections to commutator riser bars. Repairs can be effected by resoldering leads to riser bars, using rosin flux.

Check armature for short circuits by placing it on a growler and slowly turning armature while holding a thin strip of steel (hacksaw blade) above armature core. The steel strip will vibrate when above the area of armature core in which any short circuited coils are located. Copper or brush dust in slots between commutator bars may cause shorts between bars which can be eliminated by cleaning out the slots. Shorts at cross-over of coils at the drive end can often be corrected by bending the wires slightly and reinsulating the exposed bare wire.

Test for grounds, using test lamp and points, by placing one test point on armature core and the other test point on commutator. If lamp lights, the armature is grounded. If grounds are at points where coils come out of slots in core, repairs can be made by placing insulating strips between core and coil which is grounded.

If armature is otherwise satisfactory but commutator is worn, burned, out of round, or has right high mica between bars, the commutator should be turned true in a lathe. After turning, undercut mica $\frac{1}{32}$", then carefully clean all dirt and copper dust out of slots. Lightly polish the commutator with 2/0 sandpaper to remove any slight burrs left by undercutting operation.

d. Assembly of Generator

Assemble generator by reversing disassembly procedure. If field coils were removed, use pole shoe spreader and pole shoe screwdriver to install them, to avoid distorting frame and to insure proper tightening of pole shoe screws. See figure 10-56.

10-29 TEST AND MINOR ADJUSTMENT OF GENERATOR REGULATOR—ON CAR

a. Methods of Testing—General Information

The generator regulator should be tested only when difficulty is experienced in keeping the battery charged, or when battery uses an excessive amount of water, which is usually caused by a high charging rate. Before testing the generator regulator make certain that the generator and circuit wiring are in good condition by performing the inspection and test given in paragraph 10-26.

Two methods of testing the operation and calibration of the three units in the generator regulator may be used:

(1) The FIXED RESISTANCE method (subpar. *c*, below) uses a fixed resistance in place of the car battery, therefore it eliminates the effect that battery condition may have on operation of the regulator units. All tests can be made without removing regulator cover, therefore proper regulator temperature can be maintained during tests. This method is recommended in preference to the second method (2) because it is more reliable and the tests can be made in less time.

(2) The VARIABLE RESISTANCE method (subpar. *d*, below) uses a variable resistance connected in series between the generator regulator and the battery. When testing the current regulator by this method the regulator cover must be removed to bridge across the voltage regulator contacts, consequently regulator temperature may vary and affect the accuracy of the test. Inaccurate results also may be obtained due to condition of the battery.

When using either method, the test voltmeter must be accurately calibrated as specified in subparagraph *b*, below.

IMPORTANT. Mechanical checks and adjustments, such as air gap and point opening, must be made with battery disconnected from regulator and preferably with regulator removed from car.

After any test or replacement of regulator, the car generator must be polarized after all wires are connected but *before engine is started.* Failure to polarize generator may result in severe damage to the equipment since reversed polarity causes vibration, arcing and burning of the relay contact points. The generator may be readily polarized by momentarily bridging between the "BAT" and "GEN" terminals of regulator to cause a surge of current through the generator.

Always make certain that rubber gasket is in proper position to seal regulator cover when installed. The gasket prevents entrance of dust, moisture, and oil vapors which might damage the regulator.

CAUTION: *When working on current regulator with engine running be very careful to keep hands and equipment clear of engine fan.*

b. Calibration of Test Voltmeter

The calibration of the test voltmeter should be frequently checked and should always be checked immediately following malhandling, sluggish movement of pointer, or when the meter has been dropped. If no commercial testing laboratory is available, voltmeter may be calibrated against a specially prepared storage battery as follows:

1. Select a satisfactory new 6-volt automotive storage battery and charge slowly (1 amp. per positive plate) until fully charged. Specific gravity of electrolyte should read between 1.275 and 1.290 in all cells. Allow battery to stand over night at approximately 80°F for stabilization of voltage. Battery terminal voltage will then be 6.4 volts. CAUTION: *Do not use battery for calibration immediately after charging because battery voltage will be abnormally high for several hours.*

2. Check the test voltmeter against prepared battery and note reading. If meter does not read 6.4 volts, calculate the difference. Assume that error will be the same between 7.2—7.7 volts and allow this difference when using voltmeter to test and adjust generator regulator. If voltmeter is found faulty it should be repaired at first opportunity.

The prepared calibrating battery also may be used to check an open circuit type battery testing meter by measuring the voltage of one cell, which will be 2.13 volts.

c. Fixed Resistance Test and Adjustment of Generator Regulator

The following procedure provides tests and adjustments for the cutout relay, voltage regulator, and current regulator in the order named. The test equipment described is the Allen Model E-302 Volt-Ampere Tester, which is the only approved combination instrument employing the fixed resistance method available at the present time. REGULATOR COVER MUST BE IN

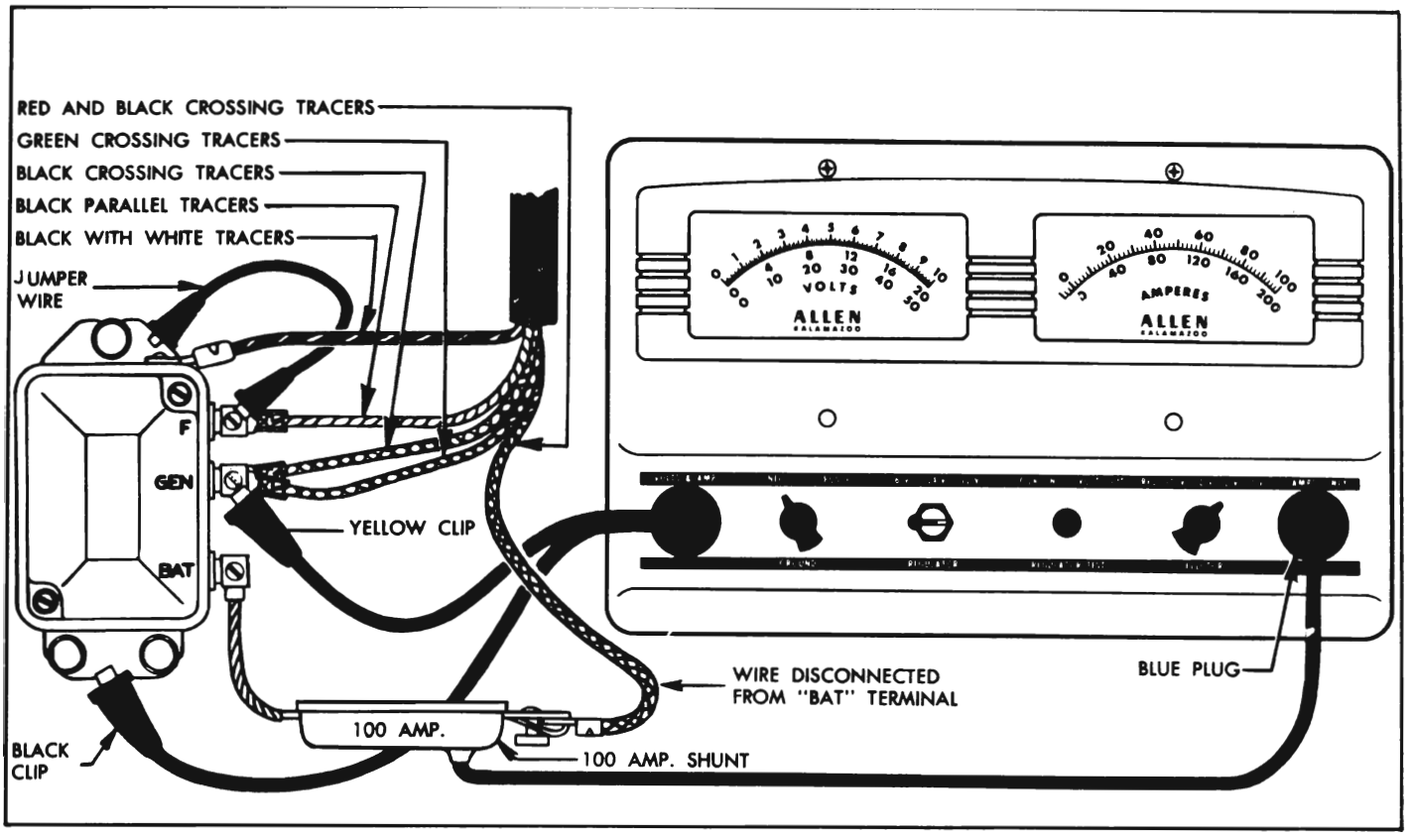

Figure 10-17—Cutout Relay Test Connections—Fixed Resistance Method

PLACE DURING ALL TESTS.

1. Connect a reliable tachometer to indicate engine speed.

2. Turn volt-ampere tester "SELECTOR" switch to "10V", turn "GROUND" switch to "NEG", and insert the BLUE plug of the 100 AMP. SHUNT into the "AMPS. ONLY" socket.

3. Disconnect wire from regulator terminal marked "BAT" and attach flexible lead of 100 AMP. SHUNT to the "BAT" terminal of regulator. Attach the disconnected battery wire to opposite end of the SHUNT. See figure 10-17.

4. Insert RED plug of voltmeter lead into "VOLTS & AMPS" socket of tester, connect YELLOW clip of lead to regulator terminal marked "GEN", and connect BLACK clip to ground on base plate of regulator. See figure 10-17.

5. Connect jumper wire between terminal marked "F" and ground on base of regulator so that voltage regulator cannot operate. This is advisable because an improperly adjusted voltage regulator may prevent the cutout relay from closing.

6. Start engine and warm it up until it is running on slow idle and adjust speed to 350 RPM. CAUTION: *Never run engine faster than 1400 RPM with "F" terminal grounded. A higher speed may cause damage to generator.*

7. Increase engine speed to 1250 RPM. Ammeter should read approximately 40 amperes. If it does not, fan belt is slipping or generator does not have proper output. These conditions must be corrected before further tests.

8. From slow idle slowly increase engine speed and note voltmeter reading at instant that cutout relay contacts close, indicated by movement of ammeter hand from zero. The voltmeter will read between 5.9 and 6.8 volts if closing voltage of relay is correctedly adjusted.

9. Gradually increase engine speed until generator is charging approximately 5 amperes. Slowly reduce speed until relay contacts open, indicated by ammeter hand returning to zero. Contacts should open on reverse or discharge current; if contacts open when ammeter shows charge it indicates a shorted relay winding requiring replacement of regulator. If ammeter does not return to zero after showing discharge current the relay contacts are sticking, requiring removal of regulator and adjustment of air gap, (par. 10-30).

10. If relay closing voltage is not between 5.9 and 6.8, remove regulator cover and adjust relay armature spring tension to obtain closing voltage of 6.4. Adjusting screw has a *left-hand thread,* therefore turning screw clockwise increases spring tension and closing voltage; turn-

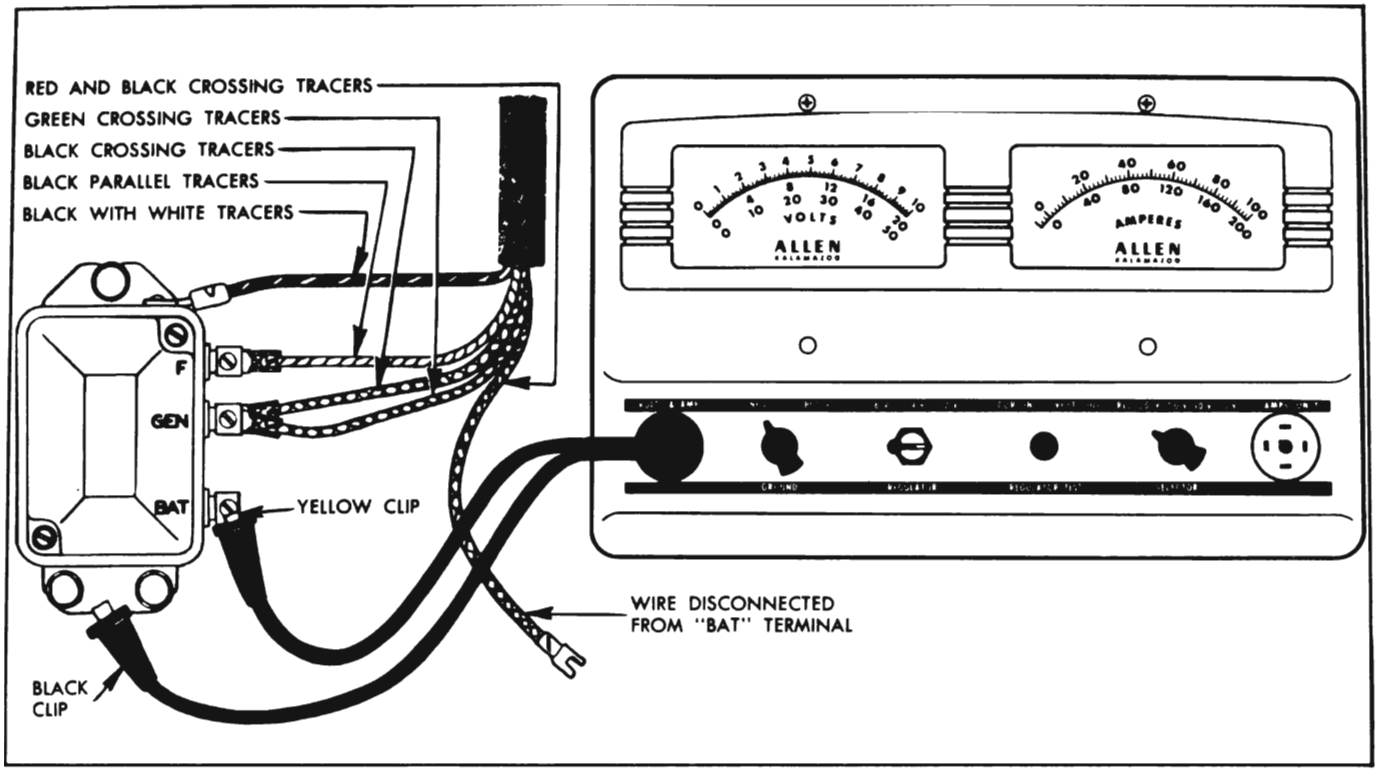

Figure 10-18—Voltage and Current Regulator Test Connections—Fixed Resistance Method

ing screw counterclockwise decreases closing voltage. See figure 10-19. *After adjustment, install cover and recheck closing voltage.*

CAUTION: *Never close relay contacts by hand with battery connected to regulator because this will cause a damaging high current flow through regulator units.*

11. After cutout relay closing voltage is correctly adjusted, shut off engine. Remove jumper wire from "F" terminal and disconnect 100 AMP. SHUNT from regulator, battery wire, and tester. Leave battery wire disconnected from regulator.

12. Turn "SELECTOR" switch to "REG" position, leave "GROUND" switch at "NEG" position, and turn "REGULATOR" switch to "6V" position. Connect YELLOW clip of voltmeter lead to regulator terminal marked "BAT" and leave BLACK clip connected to ground on base plate of regulator. See figure 10-18.

13. Start engine and increase speed to approximately 1500 RPM. Run engine for at least 15 minutes to permit the regulator to reach operating temperature.

CAUTION: *Since the voltage and current regulators are compensated for temperature, the following tests must be made with regulator at operating temperature to insure accurate results.*

14. Cycle the regulator by gradually reducing engine speed until cutout relay contacts open, then bring engine speed back to approximately 1500 RPM. The voltmeter reading will indicate the operating voltage, which will be between 7.2 and 7.7 if voltage regulator is properly adjusted. The ammeter will show a generator charging rate of 8 to 10 amperes. NOTE: *If no ammeter reading is obtained, check the 14 ampere fuse in tester.*

15. Immediately following the voltage regulator test, proceed to the following current regulator test while the regulator is still at operating temperature.

16. Increase engine speed to 2000 RPM, then depress the "REGULATOR TEST" button and note ammeter reading. Ammeter will read 40-46 amperes if current regulator is properly adjusted.

17. Abnormal fluctuation of voltmeter or ammeter pointer during above test of voltage or current regulator indicates an oxidized condition of regulator contact points which would cause high resistance in generator field circuit and reduce generator output. In this case make the following test for oxidized contact points.

(a) Reconnect the 100 AMP. SHUNT as shown in figure 10-17, but do not connect the jumper wire nor the voltmeter lead (yellow and black clips).

(b) Turn on headlights and set engine at

speed which produces approximately 5 amperes output.

(c) Ground the "F" terminal of regulator and note ammeter reading. If output increases more than 2 amperes when "F" terminal is grounded, contact points are oxidized and should be cleaned (par. 10-30).

18. If either the voltage or current regulator did not operate within specified limits, remove regulator cover and adjust armature spring tension as required. Turn adjusting screw clockwise to increase operating voltage or charging rate; turn counterclockwise to decrease operating voltage or charging rate. See figure 10-19. *The final setting must always be made by turning screw clockwise to increase voltage or charging rate—never by turning screw counterclockwise.*

Adjust voltage regulator to obtain operating voltage of 7.4. DO NOT EXCEED 7.7 VOLTS UNDER ANY CIRCUMSTANCE. Adjust current regulator to obtain charging rate of 42 amperes.

If adjusting screw is turned clockwise beyond normal range required for adjustment, the spring support may be bent so that it fails to return when pressure is relieved. If this happens, turn the screw counterclockwise until sufficient clearance exists between screw head and spring support, then bend spring support upward carefully until contact is made with screw head. Make final adjustment as described above.

19. After adjustment of either regulator unit, install cover and gasket, bring regulator up to operating temperature and recheck calibrations starting with step 13 above.

20. Upon completion of all tests and adjustments, disconnect tester and reconnect battery wire to "BAT" terminal of regulator. *Before starting engine,* momentarily bridge between the "BAT" and "GEN" terminals with a screwdriver to polarize the generator.

21. Set engine idle speed at 450 RPM, then disconnect tachometer.

d. Variable Resistance Test and Adjustment of Generator Regulator

The following procedure provides tests and adjustments of the cutout relay, voltage regulator, and current regulator in the order named. The required test equipment consists of a voltmeter, ammeter, and ¼ ohm variable resistance. In the tester illustrated in figures 10-20, 10-21, and 10-22, the variable resistance is internally connected in series with the ammeter, as required when the resistance is used. REGULATOR COVER MUST BE IN PLACE except when removal is specified.

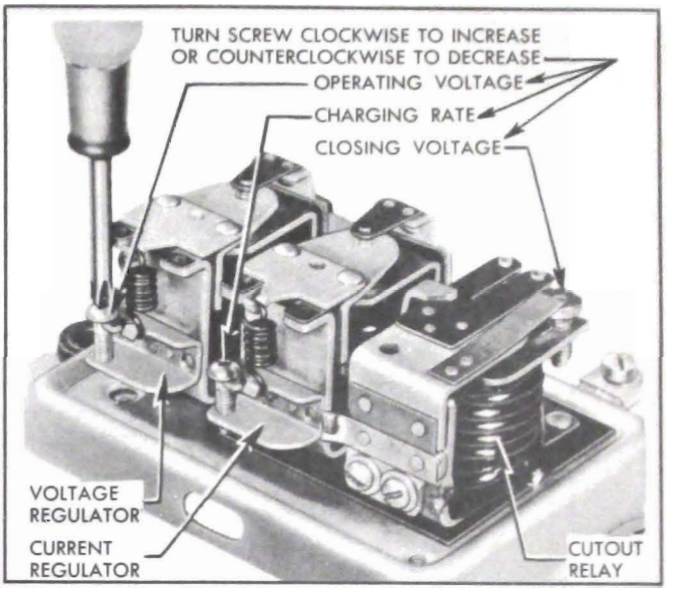

Figure 10-19—Generator Regulator Spring Tension Adjustments

1. Connect a reliable tachometer to indicate engine speed.

2. Disconnect wire from regulator terminal marked "BAT". Connect an ammeter and a ¼ ohm variable resistance in series between "BAT" terminal and the disconnected battery wire. Turn resistance to "out" position.

3. Connect voltmeter test leads to terminal marked "GEN" and to ground on base plate of regulator. See figure 10-20.

4. Connect jumper wire between terminal marked "F" and ground on base plate of regulator so that voltage regulator cannot operate. This is advisable because an improperly adjusted voltage regulator may prevent the cutout relay from closing.

5. Start engine and warm it up until it is running on slow idle and adjust speed to 350 RPM. CAUTION: *Never run engine faster than 1400 RPM with "F" terminal grounded. A higher speed may cause damage to generator.*

6. Increase engine speed to 1250 RPM. Ammeter should read approximately 40 amperes. If it does not, fan belt is slipping or generator does not have proper output. These conditions must be corrected before further tests.

7. From idle, slowly increase engine speed and note voltmeter reading at the instant that cutout relay contacts close, indicated by movement of ammeter hand from zero. The voltmeter will

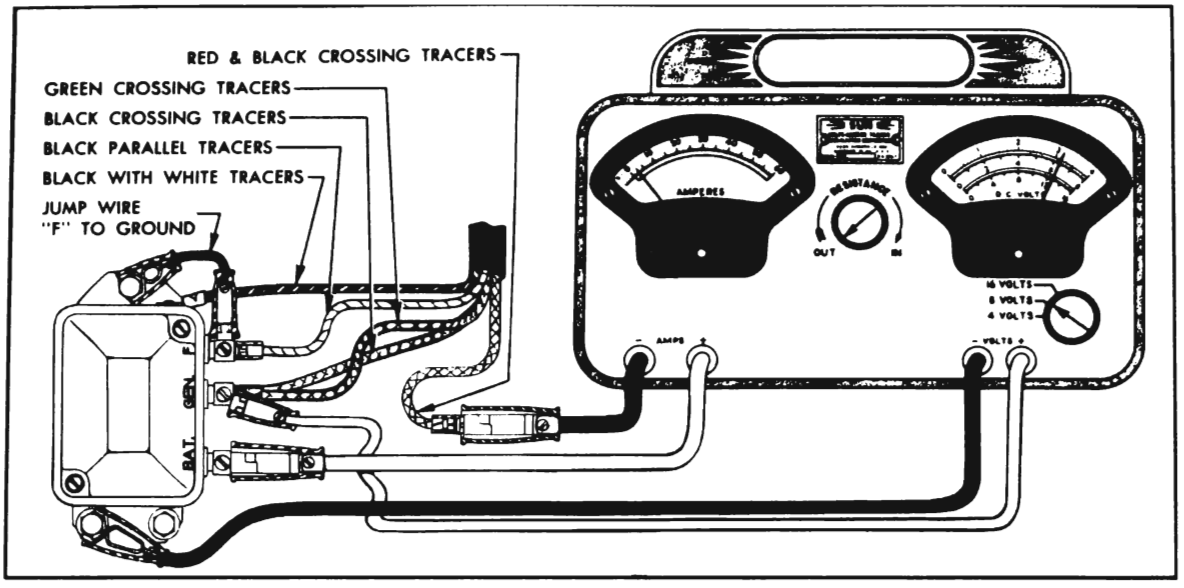

Figure 10-20—Cutout Relay Test Connection—Variable Resistance Method

read between 5.9 and 6.8 if closing voltage of relay is correctly adjusted.

8. Gradually increase engine speed until generator is charging approximately 5 amperes. Slowly reduce speed until relay contacts open, as indicated by ammeter hand returning to zero. Contacts should open on reverse or discharge current; if contacts open when ammeter shows charge it indicates a shorted relay winding requiring replacement of regulator. If ammeter does not return to zero after showing discharge current the relay contacts are sticking, requiring removal of regulator and adjustment of air gap (par. 10-30).

9. If relay closing voltage is not between 5.9 and 6.8, remove regulator cover and adjust relay armature spring tension to obtain closing voltage of 6.4. Adjusting screw has a *left-hand thread,* therefore turning screw clockwise increases spring tension and closing voltage; turning screw counterclockwise decreases closing voltage. See figure 10-19. *After adjustment, install cover and recheck closing voltage.*

CAUTION: *Never close relay contacts by hand with battery connected to regulator because this will cause a damaging high current flow through regulator units.*

10. After cutout relay closing voltage is correctly adjusted, shut off engine. Remove jumper wire from "F" terminal of regulator.

11. Change voltmeter test lead from "GEN" to "BAT" terminal of regulator, leaving other test lead connected to ground. See figure 10-21.

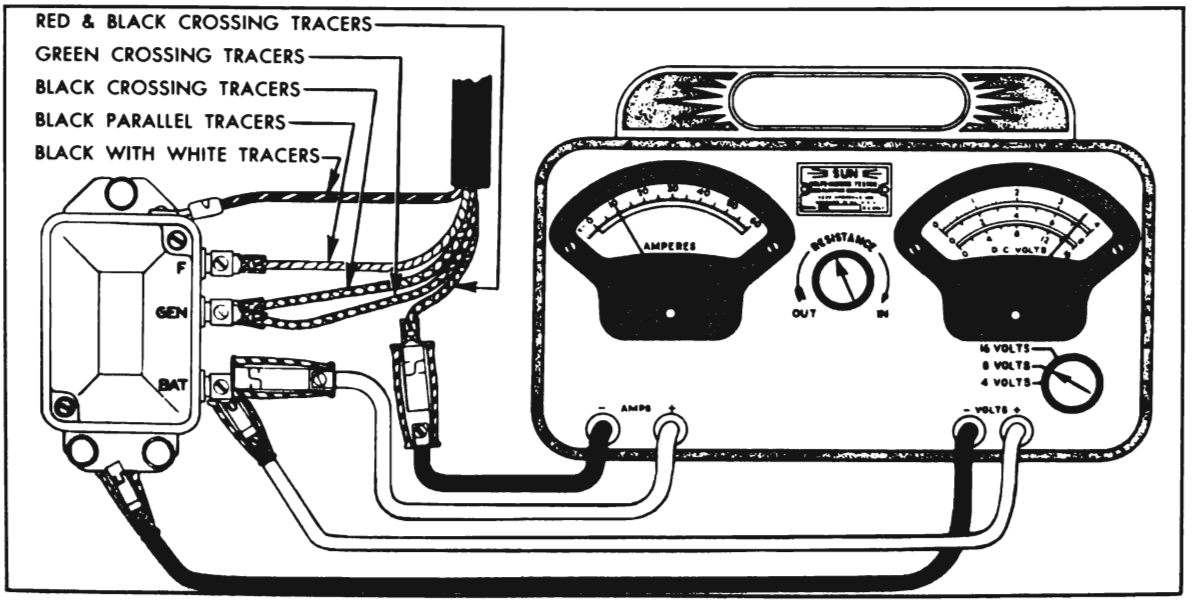

Figure 10-21—Voltage Regulator Test Connection—Variable Resistance Method

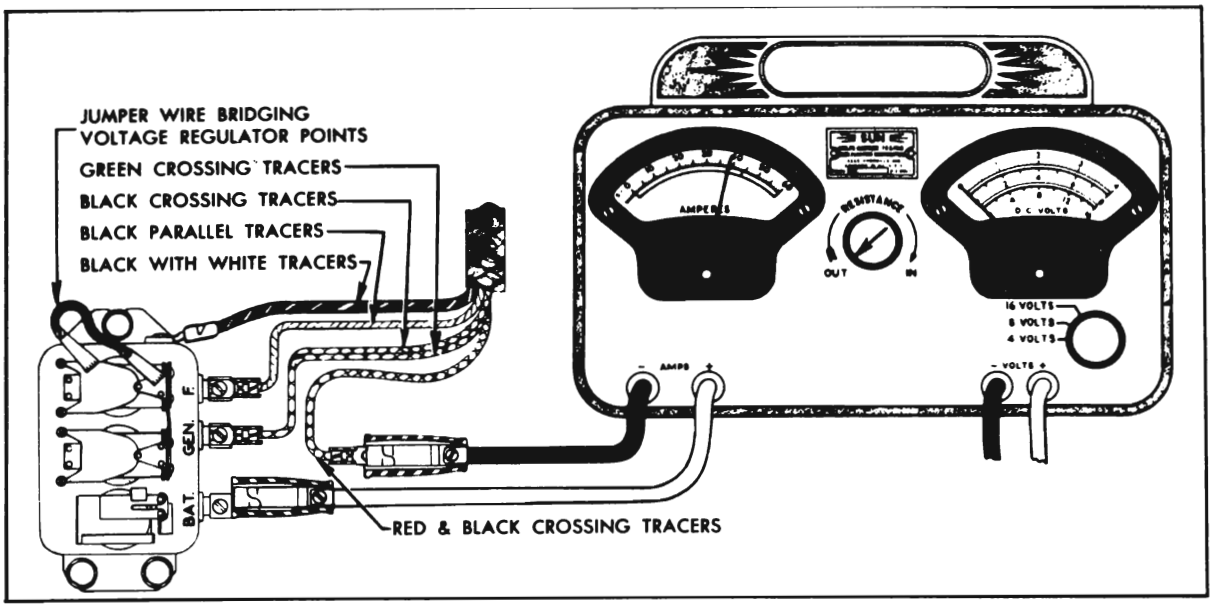

Figure 10-22—Current Regulator Test Connections—Variable Resistance Method

12. Start engine and increase speed to approximately 1500 RPM. Adjust resistance until ammeter reads 8 to 10 amperes. If less than 8 amperes is obtained, even with all resistance cut out, turn on car lights to permit increased generator output and adjust resistance to 8-10 amperes. Run at this setting for at least 15 minutes to permit the regulator to reach operating temperature.

CAUTION: *Since the voltage and current regulators are compensated for temperature, the following tests must be made with regulator at operating temperature to insure accurate results.*

13. Cycle the regulator by gradually reducing engine speed until cutout relay points open, then bring engine speed back to 1500 RPM and adjust resistance to give charging rate of 8-10 amperes. The voltmeter will read 7.2 to 7.7 volts if voltage regulator operating voltage is properly adjusted.

14. Immediately following the voltage regulator test, proceed to the following current regulator test while the regulator is still at operating temperature.

15. Stop engine, turn resistance to "out" position and disconnect voltmeter. Remove regulator cover and connect a jumper wire between upper contact and armature of voltage regulator. This will prevent voltage regulator from operating and reducing charging rate of generator. See figure 10-22.

16. Start engine and slowly increase speed until generator output remains constant, which should occur at approximately 2000 RPM of engine. The ammeter will register 40 to 46 amperes if current regulator is hot and correctly adjusted.

17. Abnormal fluctuation of voltmeter or ammeter pointer during above test of voltage or current regulator indicates an oxidized condition of regulator contact points, which would cause high resistance in generator field circuit and reduce generator output. In this case, make the following test for oxidized contact points.

(a) Remove jumper wire from voltage regulator contacts and make certain that the variable resistance is turned to "out" position.

(b) Turn on headlights and set engine at speed which produces approximately 5 amperes output.

(c) Ground the "F" terminal of regulator and note ammeter reading. If output increases more than 2 amperes when "F" terminal is grounded, contact points are oxidized and should be cleaned (par. 10-30).

18. If contact points are in satisfactory condition but either the voltage or current regulator did not operate within specified limits, adjust armature spring tension as required. Turn adjusting screw clockwise to increase operating voltage or charging rate; turn counterclockwise to decrease operating voltage or charging rate. See figure 10-19. *The final setting must always be made by turning screw clockwise to increase voltage or charging rate—never by turning screw counterclockwise.*

Adjust voltage regulator to obtain operating voltage of 7.4. DO NOT EXCEED 7.7 VOLTS UNDER ANY CIRCUMSTANCE. Adjust cur-

rent regulator to obtain charging rate of 42 amperes.

If adjusting screw is turned clockwise beyond normal range required for adjustment, the spring support may be bent so that it fails to return when pressure is relieved. If this happens, turn the screw counterclockwise until sufficient clearance exists between screw head and spring support, then bend spring support upward carefully until contact is made with screw head. Make final adjustment as described above.

19. After adjustment of either regulator unit, install cover and gasket, bring regulator up to operating temperature and recheck calibrations starting with step 12 above.

20. Upon completion of all tests and adjustments, disconnect regulator test equipment and reconnect battery wire to "BAT" terminal of regulator. *Before starting engine,* momentarily bridge between the "BAT" and "GEN" terminals with a screwdriver to polarize the generator.

21. Set engine idle speed at 450 RPM, then disconnect tachometer.

10-30 GENERATOR REGULATOR REPAIRS—ON BENCH

The contact points of a regulator will become oxidized and pitted after extended service and require cleaning. Contact points also may be burned because of faulty connections in the charging circuit, shorts or grounds in the generator field circuit, or installation of a radio bypass condenser on the "F" terminal of generator or regulator.

The majority of regulator troubles arise from dirty and oxidized contact points, which cause a reduced generator output. Cleaning of contact points, or replacements if badly burned, followed by adjustment of air gap and spring tension will correct faulty regulator operation in most cases. Cleaning of points and adjustment of regulator should not be attempted with unit on the car; remove regulator so that this work can be done properly.

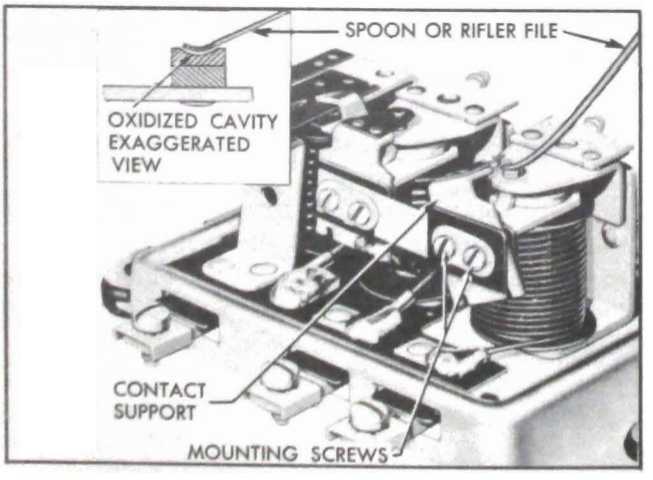

Figure 10-23—Cleaning Voltage Regulator Flat Contact Point

a. Cleaning Regulator Contact Points

Loosen the upper contact support mounting screws on voltage and current regulators and tilt support to one side so that each point can be cleaned separately without danger of bending The upper contact spring. Use a thin, fine-cut file on the crowned point on contact support, and use a spoon or riffler file to clean out the cavity which is usually formed in the flat contact point on the armature. See figure 10-23. A flat file will not clean out this cavity. File just enough to remove oxidation. *Never use emery cloth or sandpaper on contact points since particles of emery or sand left on points will cause them to arc and burn.*

After contact supports are returned to position, reset air gaps (subpar. *d,* below).

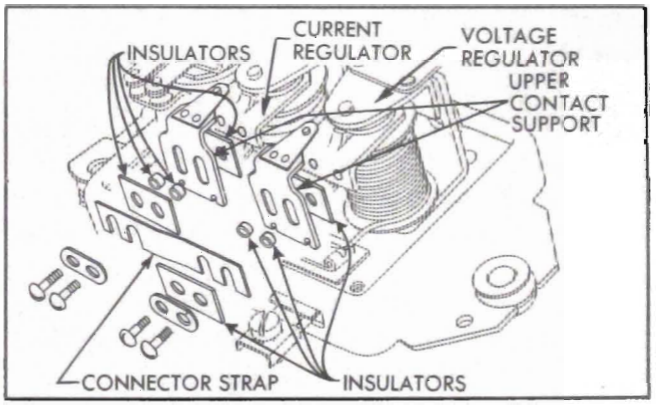

Figure 10-24—Relationship of Connector Strap, Insulators and Upper Contact Supports

b. Replacing Upper Contact Supports

If new upper contact supports are required or if supports have been removed, they should be installed as shown in figure 10-24. Note that the connector strap is connected to voltage regulator contact support but is insulated from the current regulator contact support. Note position of the flat and tubular insulators. After installation of contact supports, reset air gaps (subpar. *d,* below).

c. Adjustment of Cutout Relay

The cutout relay requires three checks and adjustment: Air gap, point opening and closing voltage.

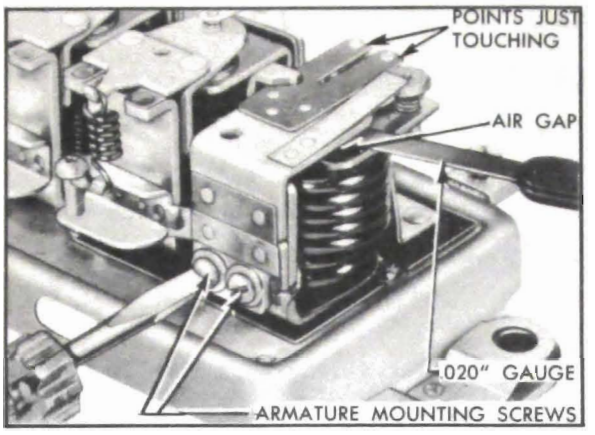

Figure 10-25—Adjustment of Cutout Relay Air Gap

1. Place finger on armature directly above core and move armature down until contact points just close. If both sets of points do not close simultaneously, bend spring fingers so that they do. *With points just closed,* measure air gap between armature and center of core; gap should be .020", measured with feeler gauge. Adjust air gap, if necessary, by loosening armature mounting screws and raising or lowering armature as required. Tighten screws securely and recheck air gap. See figure 10-25.

2. Check contact point opening with feeler gauges. Opening should be .020". Increase or decrease point opening, if necessary, by bending the upper armature stop. See figure 10-26.

3. Check and adjust closing voltage as described in paragraph 10-29, after installation of regulator on car, or while connected to a proper test generator and battery.

d. Adjustment of Voltage or Current Regulator

The voltage and current regulators require two checks and adjustment; air gap and voltage or current setting.

1. Push armature down to the core and slowly release it *until the contact points just touch,* then measure air gap between armature and center of core, using feeler gauge. Air gap should be .075".

2. Adjust air gap on each unit, if necessary, by loosening contact support mounting screws and raising or lowering support as required. Be sure points are lined up when tightening screws, then recheck gap after adjustment. See figure 10-27.

3. Check and adjust voltage and current settings as described in paragraph 10-29, after installation of regulator on car, or while connected to a proper test generator and battery.

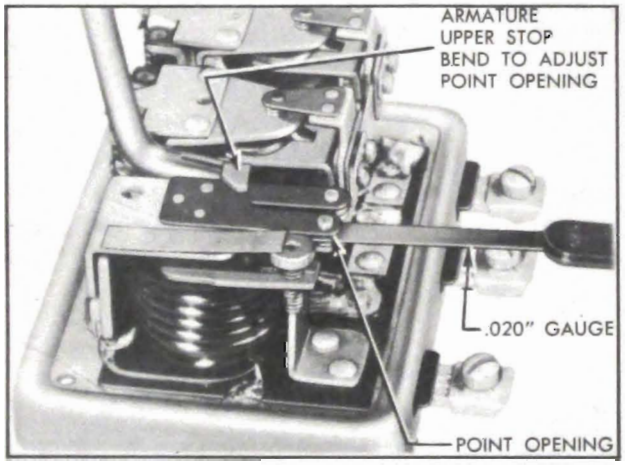

Figure 10-26—Adjustment of Cutout Relay Contact Point Opening

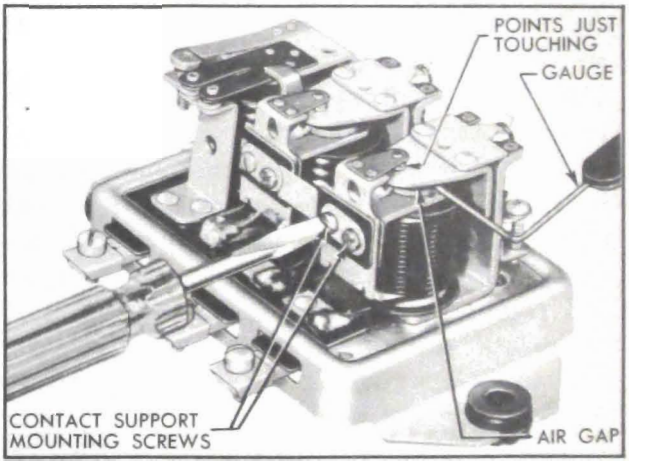

Figure 10-27—Adjustment of Voltage Regulator Air Gap