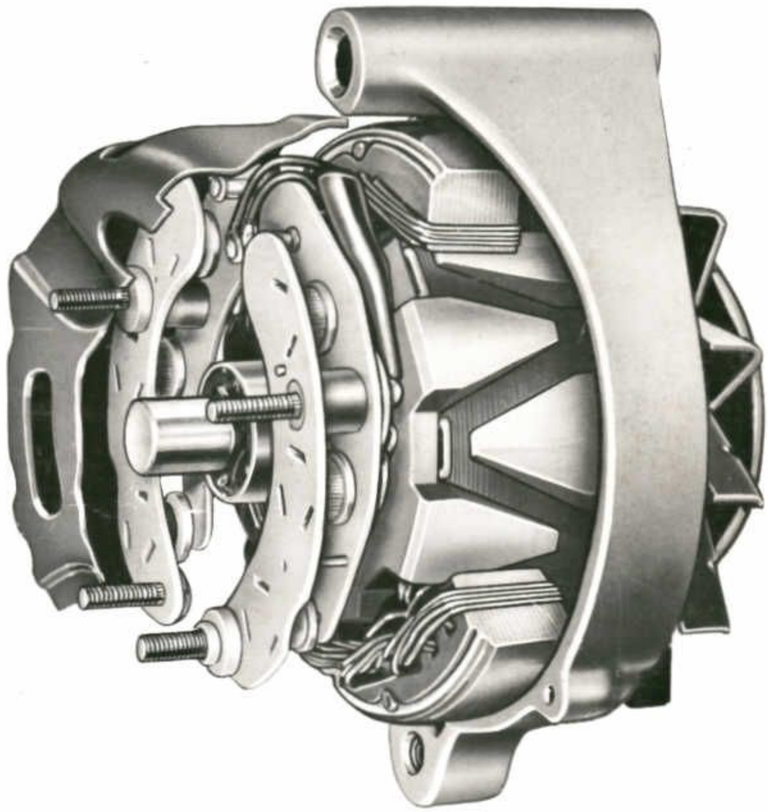
Autolite ALTERNATOR



SERVICE and TESTING PROCEDURES

Foreword

The general purpose of this manual is to provide a single source to which service technicians may refer for factory-recommended Autolite alternator service procedures. It also provides complete test procedures for all designs of Autolite alternator charging systems; plus, typical test procedures for equipment produced by other manufacturers.

Other important purposes for this manual include its usefulness . . .

- as a reference book for students who attend an Autolite-Ford Field Service Clinic covering A.C. Charging Systems.

- as additional charging system reference data for AUTO TECH enrollees and graduates.

A Table of Contents and List of Illustrations follows. We suggest that you read these preliminary guides to the organization of materials in the manual.

The procedures, descriptive data, and specifications pertaining to the Autolite-Ford design of alternator which are contained in this manual were in effect at the time this publication was approved for printing. The Autolite-Ford Parts Division of Ford Motor Company reserves the right to alter its product line, change specifications, or change design at any time without incurring obligation. The Autolite-Ford Parts Division, in covering service procedures pertaining to other manufacturers' products, used printed materials prepared by these manufacturers as authoritative references for said procedures. Accordingly, no responsibility is assumed for the data which is published herein or for any product or procedural changes which are made by these manufacturers at any time.

NATIONAL SERVICE DEPARTMENT

AUTOLITE-FORD PARTS DIVISION

Ford Motor Company

Ford Number AUD-7525-B1

PRICE $2.00

Table of Contents

AND . . .

AUTOLITE TECHNICAL SERVICE INSTITUTE

presents...

The last six pages of this manual describe AUTO TECH – WHAT IT IS . . . HOW IT WORKS . . . WHAT IT PROVIDES. We encourage you to read about this low-cost correspondence training program which carries a money-back guarantee. A registration form is included for your convenience.

List of Illustrations

This numerically arranged list of illustrations is meant to be a "quick index" feature. It will be most useful after the instructional content of the manual has been absorbed to the point where a picture reference is meaningful.

The centered column headings group the illustrations under the sections or major subdivisions of the manual.

Introduction

The order in which the materials in this manual are arranged is meant to familiarize you in a step-by-step manner with an automotive alternator charging system.

- First . . . we introduce you to the subject with a typical picture of an alternator charging system; and then, point out the approximate location of each component in the engine compartment.
- Next . . . we familiarize you with the part names and relative position of each part in an alternator assembly and regulator assembly.
- Then . . . we provide you with those details of component design which might be of importance to a service technician on the job.

With this background information, it is felt that the section of the manual covering "Operating Principles" will have more meaning. (We encourage you to study this portion of the manual. Even though a technician can successfully service an alternator and its regulator without a background in operational theory, knowing *how* and *why* these parts perform as they do can measurably improve your potential as an effective diagnostician.)

The theory which is included in this manual under "Principles of Operation" makes no attempt to fully cover basic subjects such as induced voltage, inductive reactance, wave rectification, etc. An effort has been made, however, to handle the applicable portions of these subjects in a manner which will minimize the need for additional background research on the part of the reader.

The concluding sections of the manual cover diagnosis, testing, overhaul and adjustment procedures, and specifications. (In the section dealing with test procedures, instructions are provided for the Chrysler, Delco, Leece-Neville, Motorola, Prestolite, and Autolite alternator charging systems.)

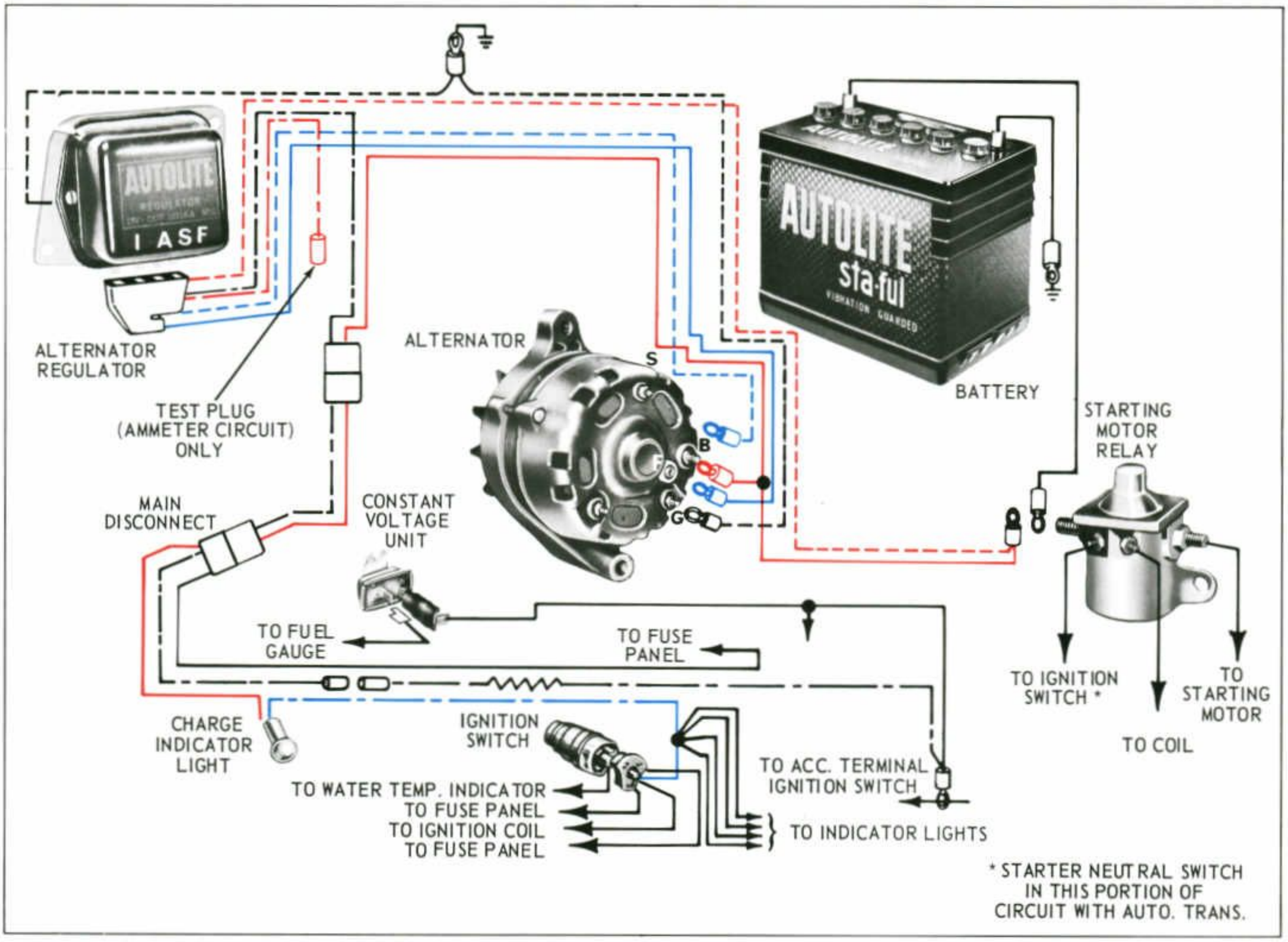


FIGURE 1. APPROXIMATE LOCATION OF ALTERNATOR CHARGING SYSTEM COMPONENTS — FORD MOTOR COMPANY CARS

The Alternator Charging System

Figure 1, on the preceding page, is a pictorial diagram of an automotive charging system which incorporates an alternator and alternator regulator. It illustrates the relative position of these parts in the engine compartment of a Ford passenger car. It also illustrates each of the components involved in completing a typical charging system circuit.

The picture is provided as an introductory piece to familiarize you with part names and point out that a complex of wires links each component into a total circuit. If you are not already acquainted with an alternator charging system, we suggest that you study the illustration. The general information it offers will help you to better understand the parts and circuit data covered on the text pages which follow.

Component Parts of the Alternator and Regulator

The Autolite alternator has been produced in two basic designs . . . we shall identify them as "1963-64" and "1964-66" designs. Figure 2 illustrates an assembly which is typical of each.

The primary differences between the two units shown are described in the coverage which follows for the major components of these alternators. As with the introductory piece of art, the purpose for this illustration, at this point in the text, is familiarization. Again, if necessary, we suggest that you study the picture until you feel that you are familiar with component part names and their relative positions. Then, proceed to the information given for the components themselves.

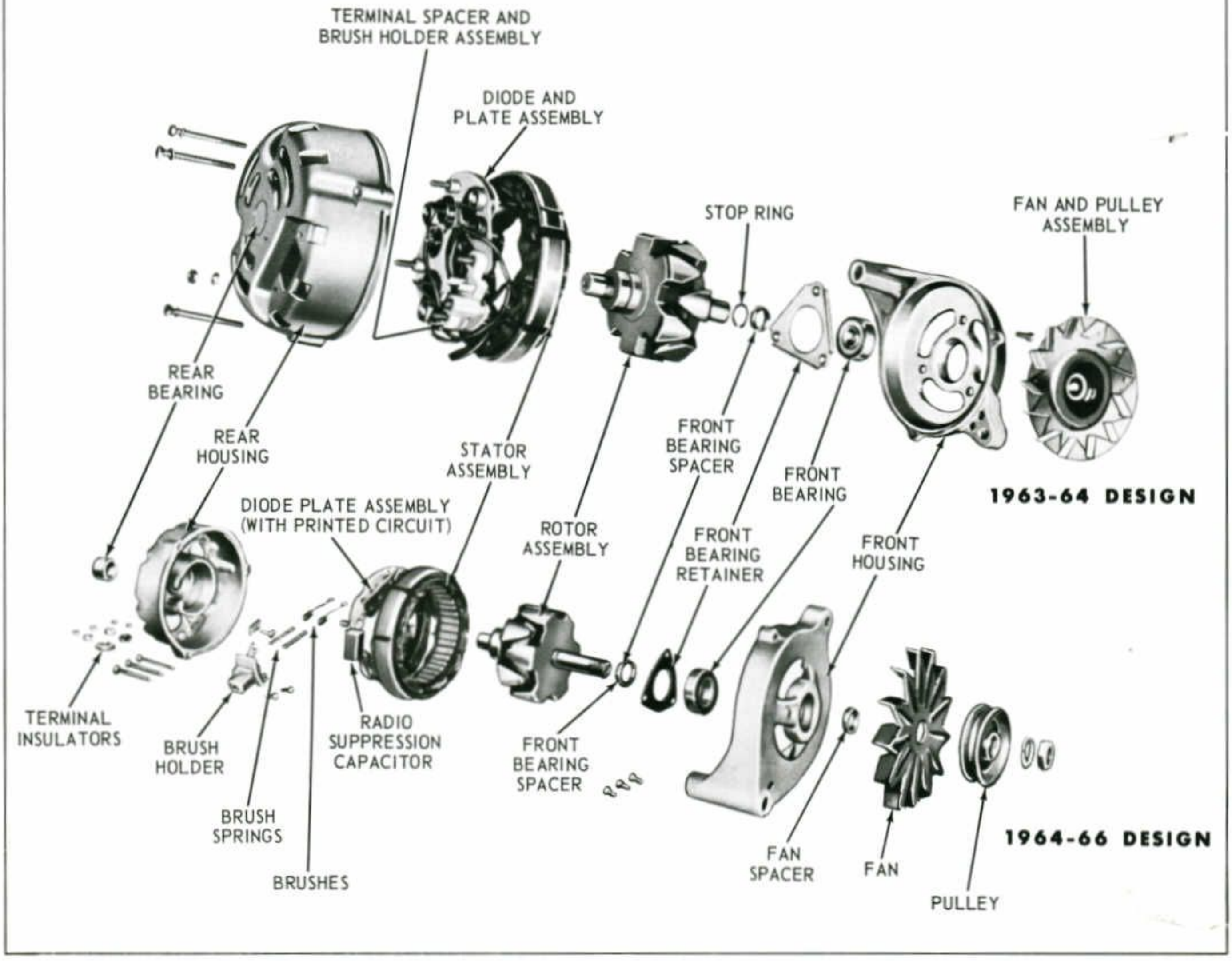


FIGURE 2. TYPICAL ALTERNATOR ASSEMBLY DESIGNS — EXPLODED VIEWS

Parts Description

Alternator Components

FRONT HOUSING, FAN AND PULLEY

A die-cast aluminum front housing is used on all Autolite alternators to meet design requirements for a lightweight, non-magnetic material. This casting incorporates the bosses used to attach the assembly to its mounting bracket. It also provides the supporting surface for the rotor shaft front bearing.

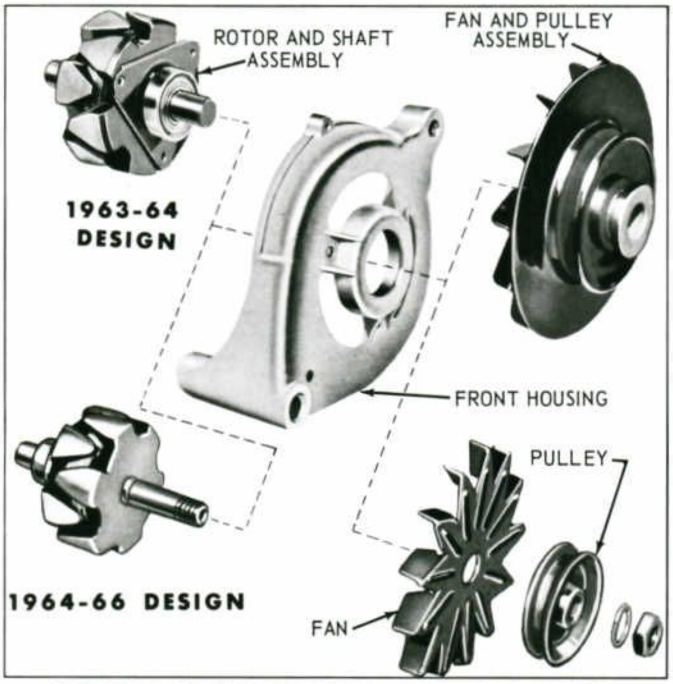


FIGURE 3. FRONT HOUSING, FAN, AND PULLEY

Two types of fan and pulley arrangements have been used since the introduction of the Autolite alternator. The earlier production units employed an integral fan and pulley assembly which was pressed onto the rotor shaft. Later units are equipped with a separate fan and pulley which are attached with a nut and lockwasher to the rotor shaft. This shaft is threaded at its forward end. (See Figure 3.) (Procedures covering removal and installation of each type of fan and pulley will be covered later in the manual.)

REAR HOUSING AND TERMINAL LOCATIONS

The alternator rear housing — an aluminum die casting — supports the rotor shaft rear bearing and provides mounting bosses for the rectifier assembly. It also provides the openings needed for cooling and making electrical connections.

Figure 4 illustrates typical rear housing designs and identifies the terminal attaching locations for each.

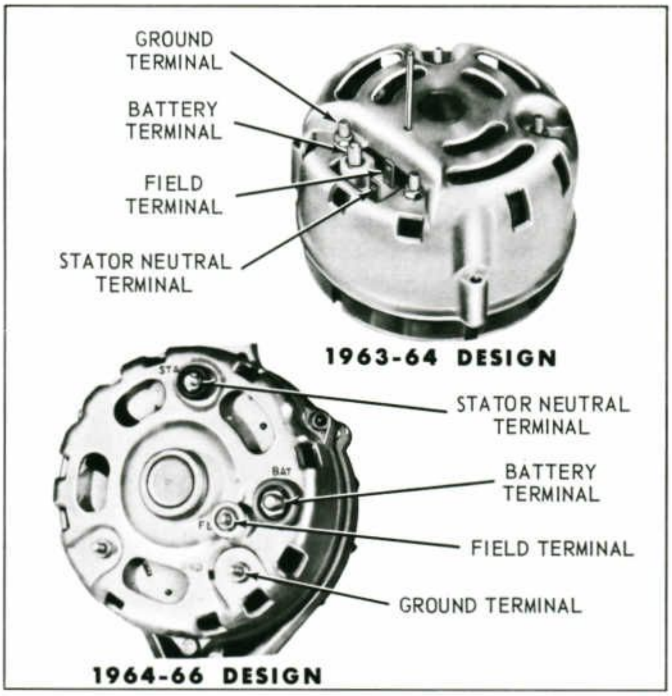


FIGURE 4. REAR HOUSING AND TERMINAL LOCATIONS

STATOR CORE AND COIL ASSEMBLY

Core Design

A number of steel stampings are riveted together to form the core of the stator. The inner surface of this core contains 36 equally spaced, vertical slots which accommodate the stator core coil windings. (See Figure 5.)

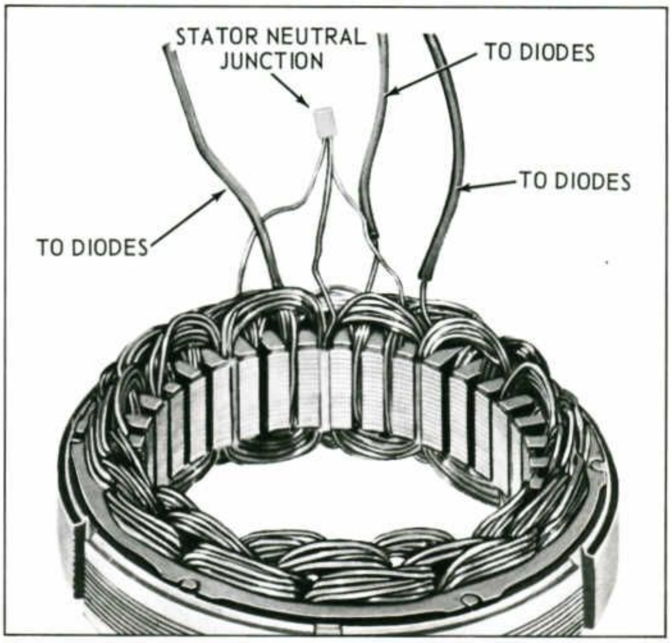


FIGURE 5. STATOR CORE AND COIL ASSEMBLY

Coil Windings

A "neutral junction" is formed by attaching one end of each of three coil wires together in a soldered junction. (A lead wire to the regulator "S" terminal is also attached at this junction.) The opposite ends of each wire are attached to one of three sets of positive and negative diodes located in the diode plates which are positioned forward of the stator core.

Between their terminating points, the coil wires are woven through the vertical slots in the core. Each wire is passed over and under the core in a three-layer winding and is inserted in every third slot. The completed windings result in an alternating arrangement of layers of the first, second, and third wires in the 36 core slots. (See Figure 6.)

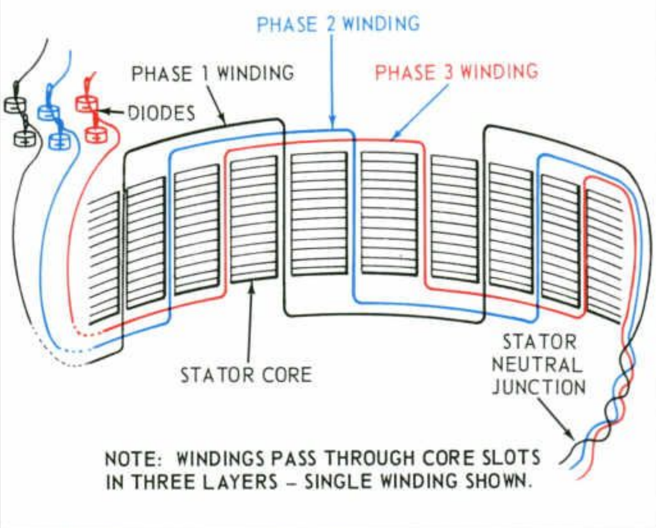


FIGURE 6. 3-PHASE STATOR WINDING

ROTOR CORE AND COIL ASSEMBLY

The rotor core and coil assembly includes:

- A rotor shaft.
- Two slip rings.
- Two rotor halves.
- An iron core and coil assembly.

Figure 7 shows these components in disassembled and assembled form.

The rotor shaft is supported at each end by bearings. The front bearing (ball-type) is pressed onto the rotor shaft and the rear bearing (needle-type) is pressed into the rear housing. The slip rings and coil and core assembly are press-fitted to the shaft with a rotor half enveloping each end of the core.

The rotor core and coil assembly turns inside the stator core and coil assembly. (A very narrow air gap exists between these two assemblies. This design clearance permits maximum magnetic power.)

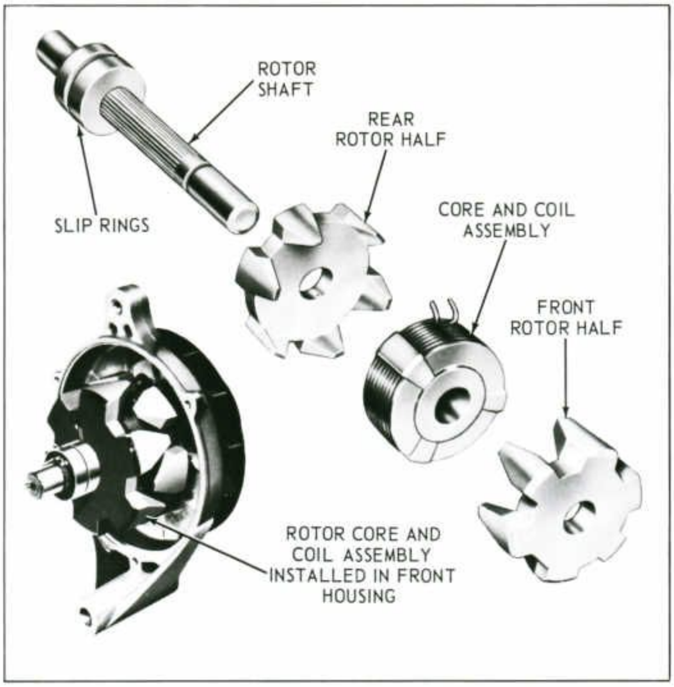


FIGURE 7. ROTOR CORE AND COIL ASSEMBLY

BRUSHES AND HOLDERS

The brushes and holders used in the 1963-64 and 1964-66 designs of alternators differ considerably from each other. In the original units, a torsional-type spring retains the fork-shaped brush holders to a plastic terminal spacer. This spacer, as shown in Figure 8, has cast-in neutral and field terminal blades and attaching provisions to secure the spacer and brush holder assembly to the negative heat sink plate.

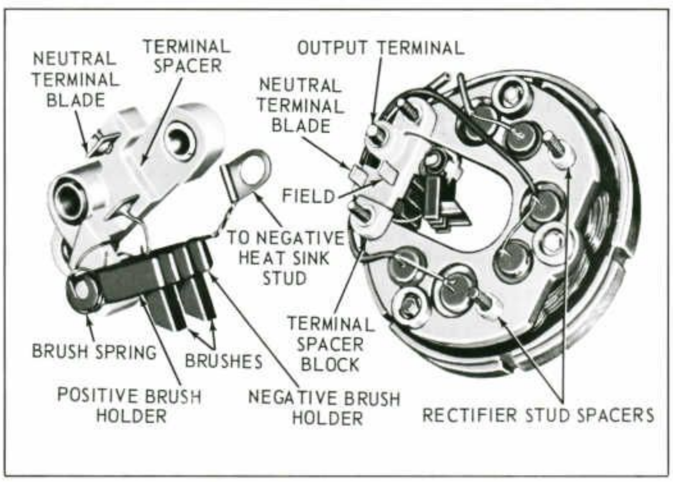


FIGURE 8. BRUSHES AND HOLDER — 1963-64 DESIGN

In the 1964-66 design of alternator, the brush holder is installed inside a boss in the rear housing casting. Figure 9 illustrates the brush and holder assembly and the manner in which it is installed.

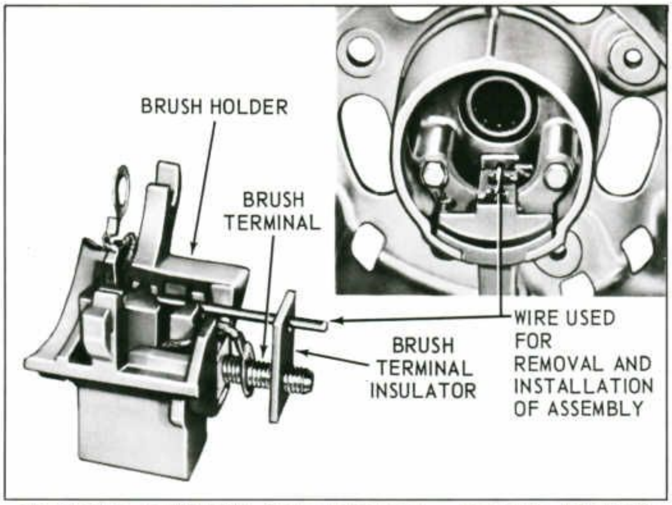


FIGURE 9. BRUSHES AND HOLDER — 1964-66 DESIGN

In both types of brush installation, the positive and negative brush ride the surface of their mating slip ring under spring pressure and transmit field current through its circuit to ground.

RECTIFIER ASSEMBLIES

The two basic designs of alternator being covered in this manual each employ a different design of rectifier assembly.

As shown in Figure 10, the 1963-64 rectifier assemblies included two steel diode plates (heat sinks), each containing three diodes. The three coil wires leading from the stator core and coil assembly are attached to a diode in the outer plate, as well as to the nearest diode in the inner plate. (It will be noticed that each plate and the diodes it holds are of opposite polarity. The significance of this relationship will be explained later under "Operating Principles.")

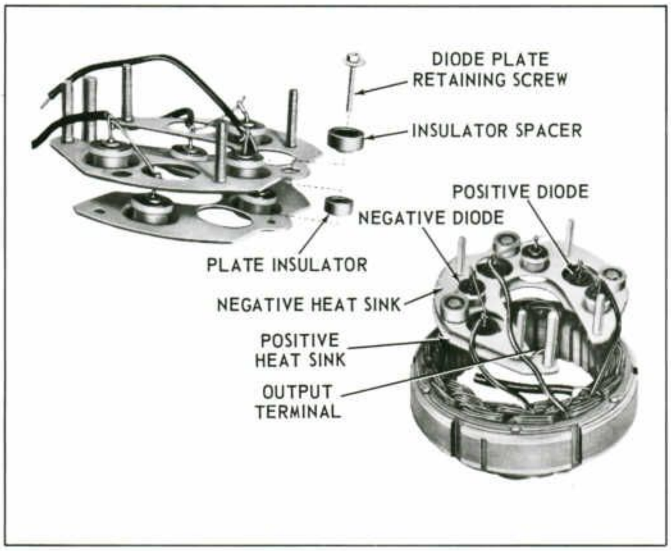


FIGURE 10. RECTIFIER ASSEMBLY—1963-64 DESIGN

Structurally, the diodes are soldered to their respective plates and the two plates are joined using three insulating spacers. The inner plate (positive sink) also contains the alternator output terminal.

The complete assembly is attached to the rear housing by means of the four mounting studs in the outer plate.

The 1964-66 rectifier assemblies, as illustrated in Figure 11, use a printed circuit board. The arc-shaped positive and negative diode plate and diode assemblies are attached to the rear of this circuit board. Insulated spacers and roll pins maintain the necessary separation between the board and plates.

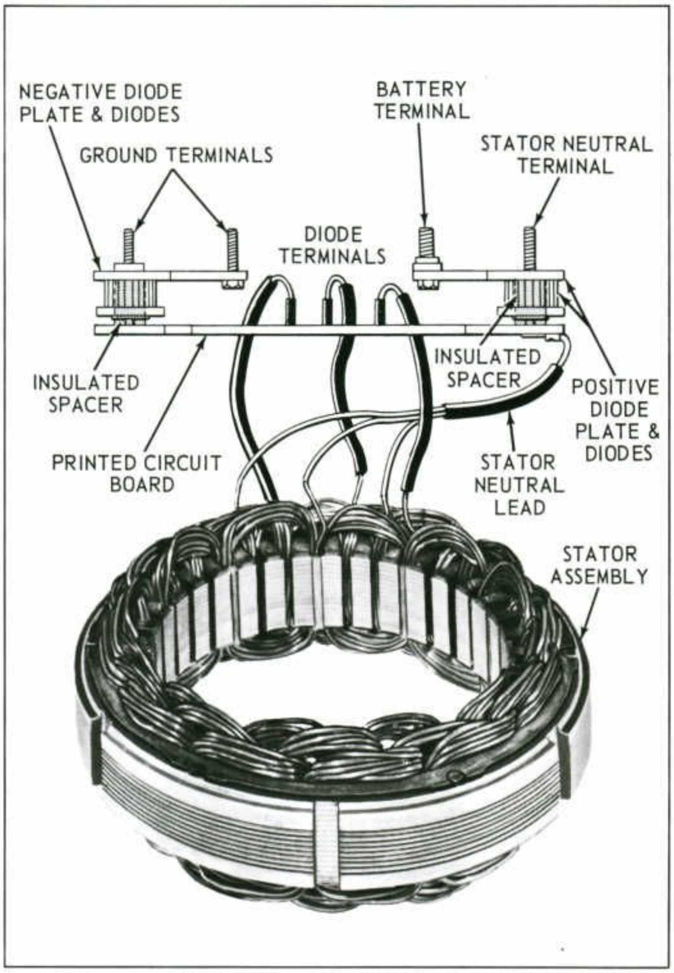


FIGURE 11. RECTIFIER ASSEMBLY—1964-66 DESIGN

With this design, the three stator winding leads are attached to integral terminals on the back of the circuit board instead of directly to a pair of diodes. The stator neutral lead contains a "C"-type terminal connector which is attached to the insulated stator neutral terminal post.

Attachment of the stator and rectifier assembly to the rear housing is accomplished in a manner similar to the early design.

Alternator Regulator Designs

An alternator has a self-limiting characteristic which controls current flow in the charging circuit. It does not, however, control voltage or incorporate relay provisions in the field circuit. Thus, an alternator regulator is included in an alternator charging circuit.

Figure 12 illustrates four typical units which have been or are now in the Autolite line . . . three with provisions for mechanical adjustments and one with transistorized controls. (Only voltage limitation can be adjusted in a transistorized regulator. The field relay is a separate unit in the charging circuit.) The illustration denotes the chronological sequence in which the various designs were introduced.

The principal difference in the mechanical regulators shown in Views A, B, and C is the geometry of the field relay contact post arm and the adjustment procedures related to each. (The details of these differences are covered in the "Overhaul and Adjustments" section of this manual.)

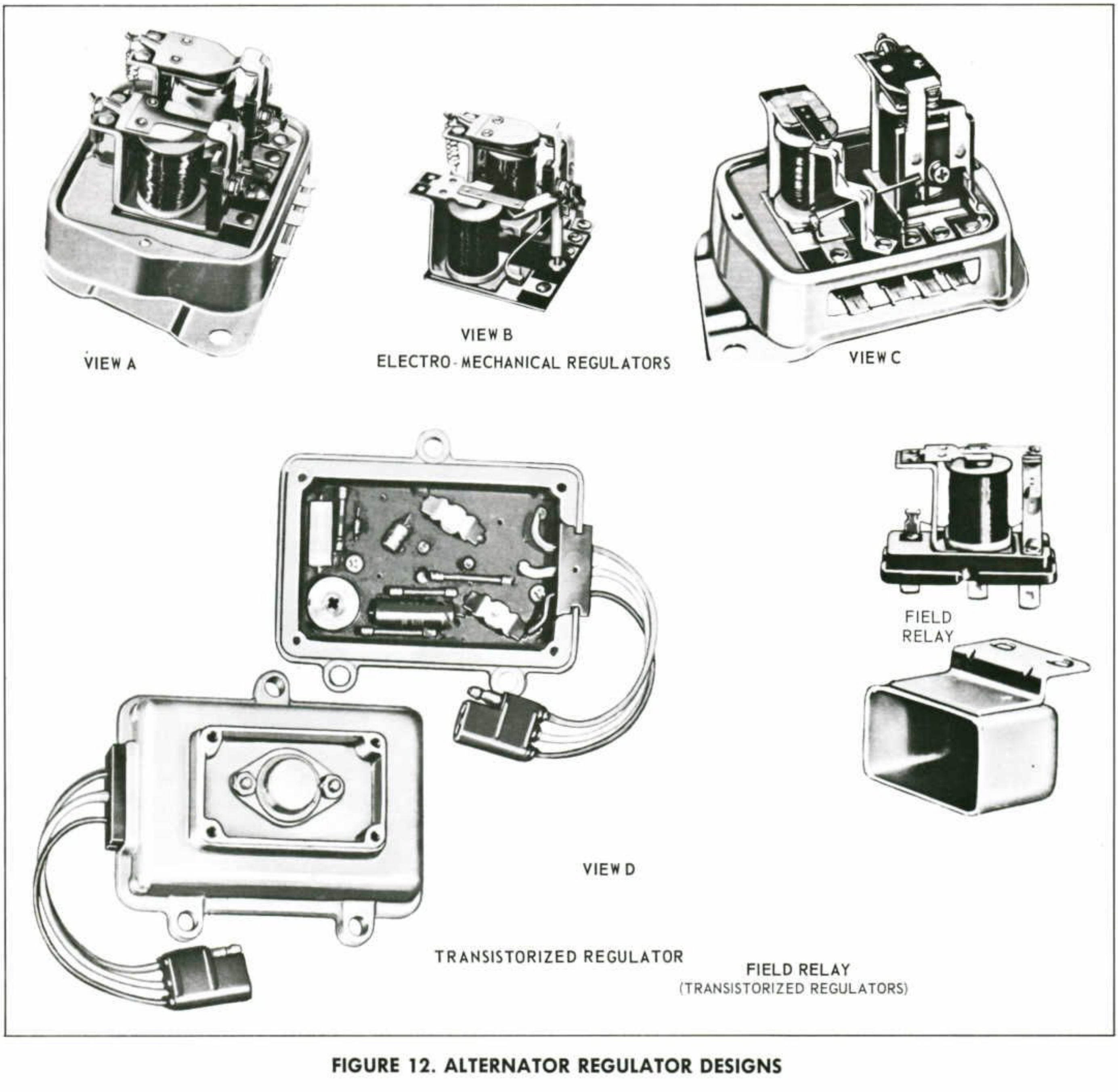


FIGURE 12. ALTERNATOR REGULATOR DESIGNS

Principles of Operation

Introduction

As indicated in the Foreword to this Manual, the information covered under "Principles of Operation" is included for those who wish to supplement their technical understanding of A.C. systems with that portion of electrical theory which most directly applies to alternators. Although we encourage you to study this material, you may skip to Page 21 without omitting any of the information needed by a technician to properly service an alternator and its regulator.

Reading the Circuit Diagrams

Beginning with Figure 15, we use circuit diagrams to illustrate certain current flow conditions at a given instant. You will notice that the component parts of the circuit are photographic reproductions of the actual parts. Standard symbols for the internal circuits of these parts are superimposed on the reproduction. The external portions of the circuit are also standard symbols for wiring connections between terminal locations.

Purpose of an Alternator

The purpose of the alternator is to produce electrical energy. This energy is used to maintain the proper state of charge in the battery and supply current to all electrically powered equipment in the car. It performs this function by converting the mechanical energy derived from its moving parts into electricity.

REMEMBER . . .

The BATTERY is the source of electrical current for the car when the ignition switch is in other than the "OFF" position and the engine is not running.

The ALTERNATOR becomes the electrical power source when the engine is running.

Under operating conditions, a belt driven pulley is turning the alternator rotor assembly inside the motionless stator core and coil assembly. The slip rings, which are pressed onto the rear portion of the rotor shaft, are connected with the rotor coil winding. A brush holder assembly, retains the two trailing-type brushes which are spring loaded in the holder so that they will maintain a desirable contact with the slip rings throughout the service life of the brushes.

Figure 13 simulates the physical relationship between the rotor and stator assemblies. Study this illustration – taking particular notice of the following:

- Three separate series of coils are wound on the stator core. These windings are arranged in three layers in each stator core slot with their installed positions occupying a staggered relationship to each other.
- When the winding process is completed, a loose end for each coil remains. These ends are directed through a printed circuit board to a pair of diodes – one is positive; the other is negative.
- The diodes are installed in arc-shaped metal plates which serve as conductors by transmitting current from the diode to a terminal. The positive diode plate assembly includes the battery and stator terminals . . . the negative plate assembly includes the ground and field terminals. (The stator and field terminals use the plates as supports. They are completely insulated against these plates.)

In the illustration, we are showing a simulated end view of a rotor assembly. Thus, you can see the tips of one set of magnetic fingers and the wide leading edges of the other set of fingers. (Keep in mind that these fingers envelop the current-carrying rotor coil.)

Notice that the centerlines of the fingers align with the centers of the slots in the stator. (In actual operation, this, of course, would be only a momentary condition. Keep in mind that the rotor is turning inside the stator at a speed approximately two to three times greater than engine r.p.m.) The purpose for mentioning this alignment factor is merely to point out that each of the sets of six rotor fingers occupy matching positions in relation to the adjacent stator. Thus, whatever one set of fingers is doing at a given instant, the remaining five sets are doing exactly the same thing at the same time.

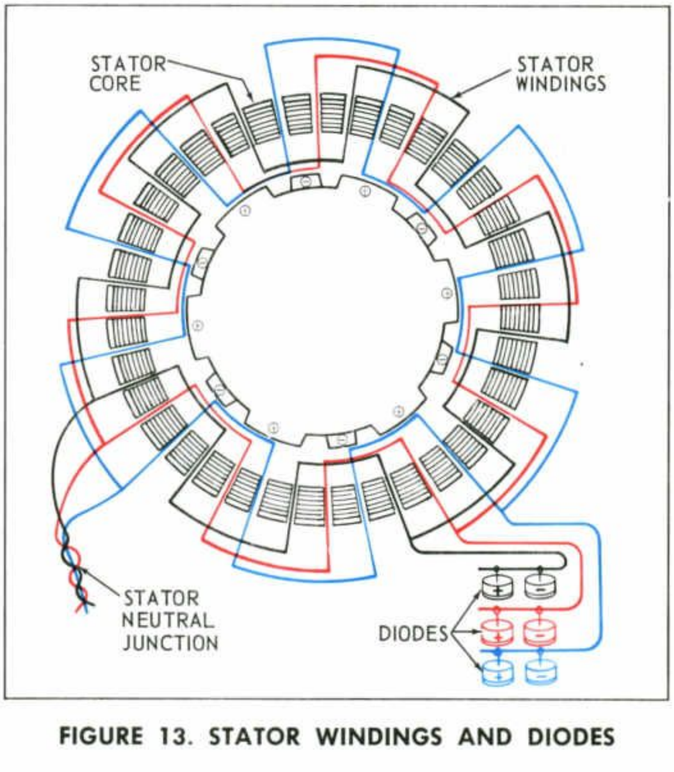


FIGURE 13. STATOR WINDINGS AND DIODES

You will also notice in Figure 13 that there is no visible circuit connection between the rotor and stator assemblies. We've already mentioned that there is a circuit continuity between these two major components; but we haven't indicated how this occurs.

The technical name for the means by which this gap in the circuit is bridged is ELECTRO-MAGNETIC INDUCTION. In effect, this means that an electromagnetic force is transferring energy from one part of the circuit to the other. The fact that this transfer is taking place indicates that certain design requirements have been met:

- The portion of the circuit in the rotor core and coil assembly includes a current-carrying conductor. This conductor, as evidenced by the fact that it carries a current, is obviously in the form of a complete circuit; and, when this current is flowing, provides a magnetic field around the windings.
- The core, around which the coil is wound, although it is not a permanent magnet, will be considered to be a magnetized component for purposes of illustration.
- The belt-driven rotor shaft, by rotating the rotor core and coil assembly inside the stator assembly, is creating relative motion between these two portions of a total circuit.

Thus, we have a conductor which forms a complete circuit, a magnetic field, and motion . . . the design requirements for electro-magnetic induction. Now, examine Figure 14, a representative rotor assembly cutaway, as we review how these design requirements for electro-magnetic induction are met in an alternator:

- ***THE CONDUCTOR WHICH FORMS A COMPLETE CIRCUIT***
- Notice that the coil leads from the core and coil assembly each terminate at one of the two slip rings on the rotor shaft (A separate brush contacts the surface of each of these slip rings.) One provides for input from the battery; the other, a ground path or return circuit to the battery . . . A COMPLETE CIRCUIT.

- ***THE PROVISIONS FOR CREATING A MAGNETIC FIELD***
- The core and coil portion of the assembly shown is an electro-magnet. The rotor pole finger halves are positioned at each end of the core and coil. These integral pole fingers, which are 30° out of point-to-point alignment, extend upward and over the coil windings to form alternately north and south polarity fingers. (Notice that a design gap exists between each finger.)

When current is introduced into the rotor coil, the strength of its inherent magnetic field as a straight conductor is greatly multiplied. The core further intensifies the strength of the magnetic field; and, by the design of the assembly, concentrates the field in the rotor fingers.

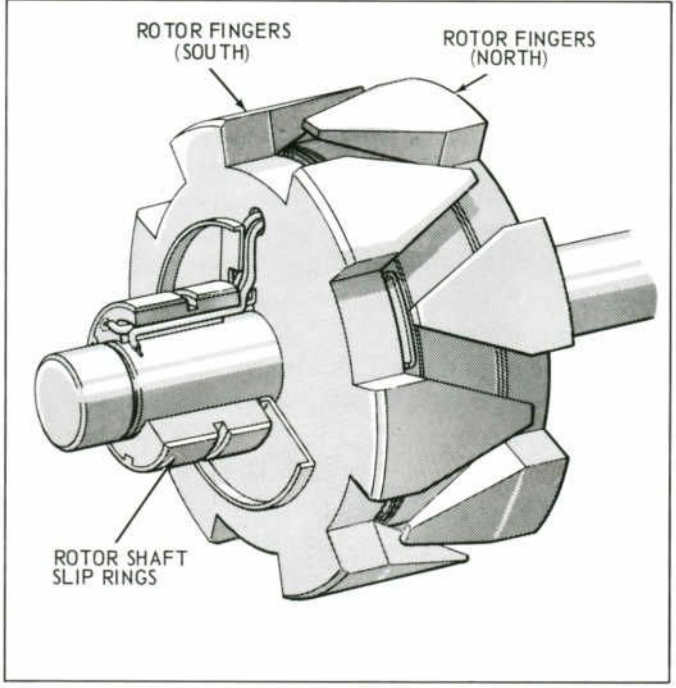


FIGURE 14. ROTOR CORE AND COIL CONSTRUCTION

- ***THE PRESENCE OF RELATIVE MOTION AND ITS EFFECT***

An assembly of the type shown in the illustration is belt driven in a clockwise rotation. As a result of this rotation, the magnetic fields concentrated in the alternately north and south rotor fingers are moving past the stator windings. Thus, between the rotor finger gaps mentioned previously, the stator windings are exposed to a build-up and falling-off of positive and negative magnetic force. This, in effect, results in the production of alternating current in the stator windings.

We have now described the mechanics involved in transferring the magnetic and mechanical energy in the rotor assembly to the stator windings. The next step is to trace this action a little further with the aid of a series of wiring schematics—through the complete circuit. (Ford Motor Company charging systems are used as typical examples. The starter-neutral switch required on cars equipped with an automatic transmission is not shown.)

Energizing the Field (Indicator Light Circuit)

Figure 15 illustrates two basic paths current will follow in a charging system equipped with a charge indicator light. Following the arrows, View A traces the current as it flows in sequence from the battery, to the starter relay, ignition switch, indicator light, regulator, and alternator rotor assembly; then, back through the ground side of the circuit to the battery. Several points to notice in the schematic include:

- The starter relay plunger position (open) indicates that the ignition switch is in the "ACC" or "IGN" position.
- The current is passing through the indicator light as well as through the parallel 15 ohm resistor.
- The current passes through the I terminal of the regulator and closed upper contact points in the voltage limiter. (The resistors provide alternate paths in the regulator.) Current then flows to the regulator F terminal.

This circuit involves a relatively small amount of current. It is enough, however, to energize the stator and develop sufficient voltage at the neutral junction, when the engine starts, to close the field relay. (In supplying battery current to the rotor coil in the manner described, the possibility of insufficient voltage to energize the alternator is overcome.)

Figure 15, View B illustrates the path followed by the current when the stator windings are being energized sufficiently by the field to produce a normal output. When this takes place the field relay contact points close allowing current to flow from the battery terminal of the starter relay through the battery terminal (A) of the regulator instead of through the ignition switch and indicator light. The balance of the path through the regulator is the same if voltage has not built up to the point where the regulation has started.

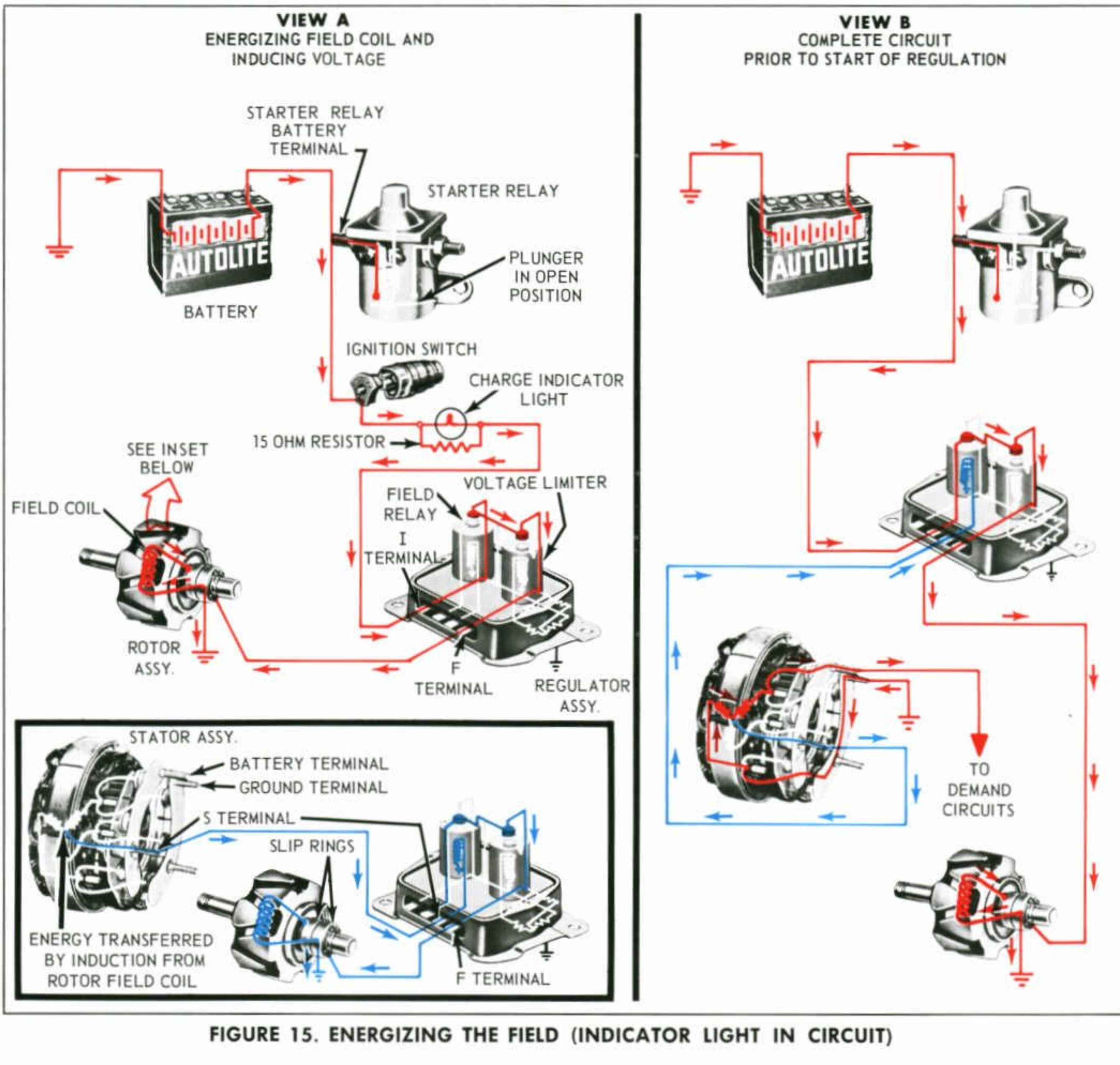


FIGURE 15. ENERGIZING THE FIELD (INDICATOR LIGHT IN CIRCUIT)

Energizing the Field (Ammeter in Circuit)

If a charging circuit is equipped with an ammeter instead of an indicator light, the hook-up is a little different. The field relay is connected with the ignition switch through the regulator stator (S) terminal. Thus, when the ignition switch is turned on, full battery current flows through the ammeter and stator terminal of the regulator to the field relay and the points close. This completes a path for battery current to pass to the upper set of voltage limiter points; then, it continues through the field terminal of the regulator to the alternator field coil. (With the exception of 1963-64 designs, the alternator stator neutral lead and the I terminal on the regulator are not used in a circuit equipped with an ammeter.)

Figure 16 illustrates the circuit when the rotor field coil is being energized and shows the circuit as it would appear when voltage limitation is not required.

As soon as alternator output voltage reaches its specified rating, the rgulator will start to vibrate and take over control of alternator output.

When the ignition key is in the START position, there is no current flowing through the field relay coil. Thus, the poir:ts are open, and no battery current can

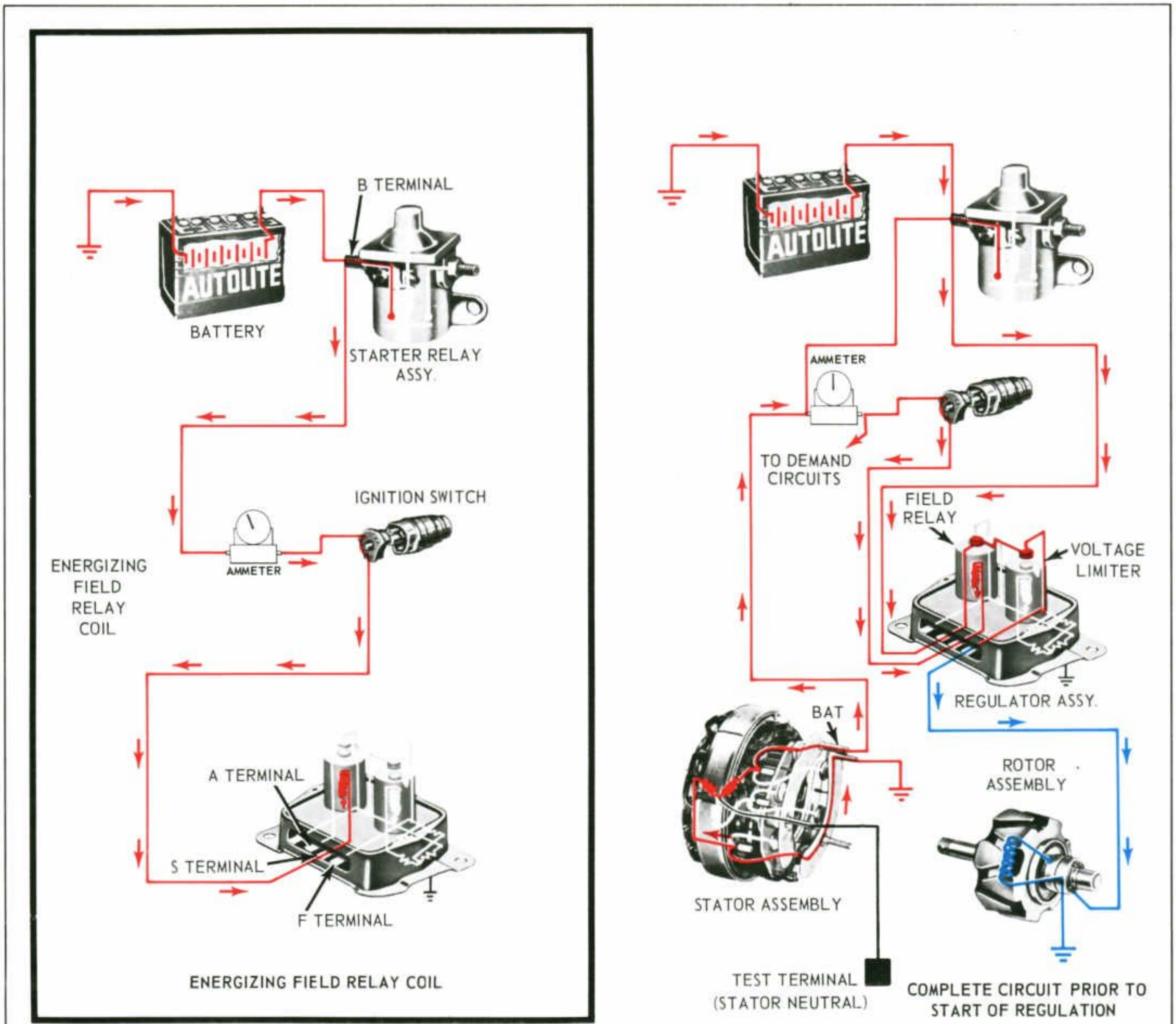


FIGURE 16. ENERGIZING FIELD—AMMETER IN CIRCUIT

flow through the alternator field. The system remains inoperative until the switch is returned to the ON position.)

3-Phase Alternator Current

Up to this point, we have developed that portion of the charging circuit which is involved in the energizing of the field. We know that magnetic energy is passing through the rotor coil assembly, and that this current is being transferred through the electro-magnetized rotor fingers to the stator windings. In circuits which incorporate an indicator light, we have shown the path followed by the rotor-induced current as it flows from the stator neutral junction to the stator terminal of the alternator and from there to the stator terminal of the regulator where it energizes the field relay.

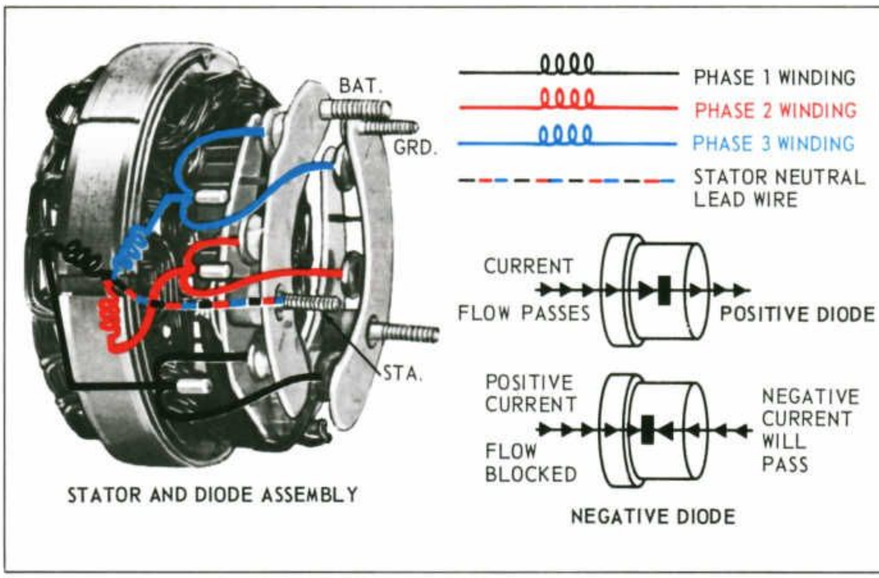


FIGURE 17. INTERNAL ALTERNATOR CIRCUIT

We are now ready to describe the paths current will follow in the alternator as negative and positive fingers turn past the triple-wound, three-phase windings in the stator. (Refer to Figure 17.)

First, study the symbol located in the center of the stator and diode assembly. It shows three coils joined together to form what is known as a "wye" winding. Each of these coils represents one of the three windings which is wound through the stator slots. For convenience and ease of identification, we have named and numbered them . . . Phase 1, Phase 2, and Phase 3. As a further identification aid, we have color-coded these windings and their related parts in the alternator – black, blue, and red – in the phase sequence just indicated.

Notice that each winding leads to a separate terminal and then branches-off to two diodes – one is positive; the other is negative. The positive diode, as the symbol indicates, will pass positive current only. The negative diode, on the other hand, passes only negative current. (Remember that the rotor fingers are producing alternately positive and negative current pressures as they pass the windings in the stator.) In effect, they are producing alternating current. However, the battery and other electrical components in the car require direct current. Thus, with a negative ground circuit, the insulated side would obviously be positive and require a positive D.C. input. Accordingly, the diode serves as a form of electrical check valve which will pass the required positive portion of the current produced in the stator and by-pass the negative portion.

Diodes

Controlling current flow in this manner is a function known as "rectification"–the active device, as previously stated, is the diode.

The actual "rectifying" component of the diode is a very small metallic disc, or square wafer, of pure silicon, treated with a controlled impurity. (See Figure 18.) The manner in which the metallic disc is installed in the diode assembly determines whether the diode is negative or positive. (Inverting the disc in a positive diode would make it a negative assembly.) This disc is only .008" to .010" thick and approximately one-eighth of an inch square (depending upon current rating).

CAUTION . . .

We repeat that the chemical composition of the positive silicon wafer or disc is such that it passes

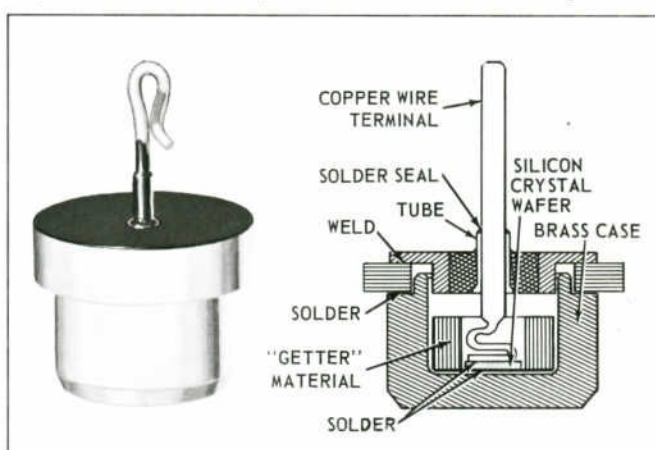


FIGURE 18. DIODE CONSTRUCTION

only positive current. Thus, if battery polarity is reversed, full battery voltage will impress excessive current on the positive diodes causing their destruction. This damage can also extend to the wiring harness.

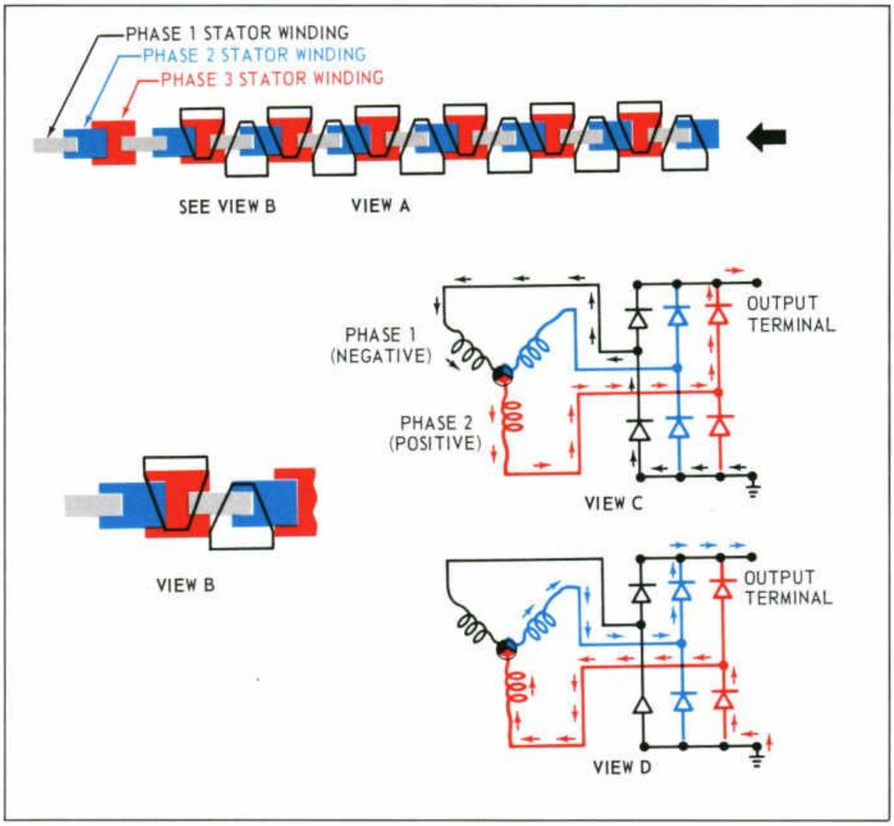


FIGURE 19. CURRENT FLOW IN THE ALTERNATOR

Analyzing the Phases

Refer now to Figure 19, View A. In this illustration we have a pictorial representation of stator windings laid out in flat form. We are also showing a succession of positive and negative rotor fingers passing over the windings. There are several important points which should be noted . . .

- Each rotor finger is overlapping three windings. (When the leading edge of a finger is at the design gap between each finger, the overlap would involve only two windings.)
- Each north and each south finger holds the same proximity relationship with the stator as each other north and south finger.

Let's examine the significance of these observations. First, because the relationship between the six sets of rotor fingers and their adjacent stator windings is the same, we will need to consider just one set to determine what all sets are doing at a given instant. This being so, examine the position of the first two fingers, as shown in Figure 19, View B.

- The north finger is inducing a comparatively high voltage into the RED or Phase 3 winding, as evidenced by the relative amount of exposure of the winding to that finger. The south finger in the set, at this same instant, is inducing its strongest force into the BLACK or Phase 1 winding.
- Current flow will respond to these two electromotive forces, and it will move from negative to positive.

Figure 19, View C, illustrates the effect of these forces when the fingers are positioned as shown in View B. When they progress, as a pair, to the next windings in sequence, the BLUE (Phase 2) winding will be positive and the RED (Phase 3) winding will be negative. Figure 19, View D, traces current flow under these conditions.

Now, before applying the operating principles data we have covered so far to regulation of the circuit, let's review the highlights . . .

1. An alternator has two component circuits – one, the field circuit, is being fed current from a power source – the other is found in the stator windings and terminal components.
2. The transfer of energy between the two circuits is effected by induction as the moving north and south rotor fingers alternately pass the stator windings. (The design gap between fingers collapses the magnetic field for each winding as rotation continues. This means that the magnetic fields build and collapse in typical alternating current cycles even though the phases overlap.)
3. The voltage induced by the field applies its current-driving force to the pair of stator windings being most strongly energized. Accordingly, it pushes current from negative to positive out to the diodes.
4. The diodes pass positive current to the alternator output terminal. The negative diodes pass negative current returning through the ground circuit. (Each type of diode blocks current of opposite polarity.)

(With this information as backup, let's give some detailed consideration to regulation of voltage in the charging system.

Voltage Regulator

The amount of voltage delivered by an alternator must be regulated to protect the charging circuit. Circumstances or preference will determine whether this is accomplished with a vibrating type electro-mechanical regulator or with a "transistorized" unit which incorporates transistors, diodes, and resistors in an arrangement which accomplishes the same end.

ELECTRO-MECHANICAL REGULATOR

Remember, an Autolite alternator regulator differs from a generator regulator. It includes a FIELD RELAY and a two-stage VOLTAGE LIMITER. It *does not* have a current limiter. (An alternator is said to be "self-limiting" in its production of current. This is true, because the frequency of current flowing in the stator windings increases in proportion to any increase in the speed of the rotor, while a similar proportion applies to the inductive reactance set up in the unit. As rotor r.p.m. increases . . . voltage, current, and reactance also increase. Design is such, however, that these contrary forces – current output and reactance – prevent an excessive output.)

We have already covered the purpose and operating principle of the field relay in our description of the way in which an alternator is energized. Voltage limiting action will occur under two general conditions:

- When high field current is required.
- When low field current is required.

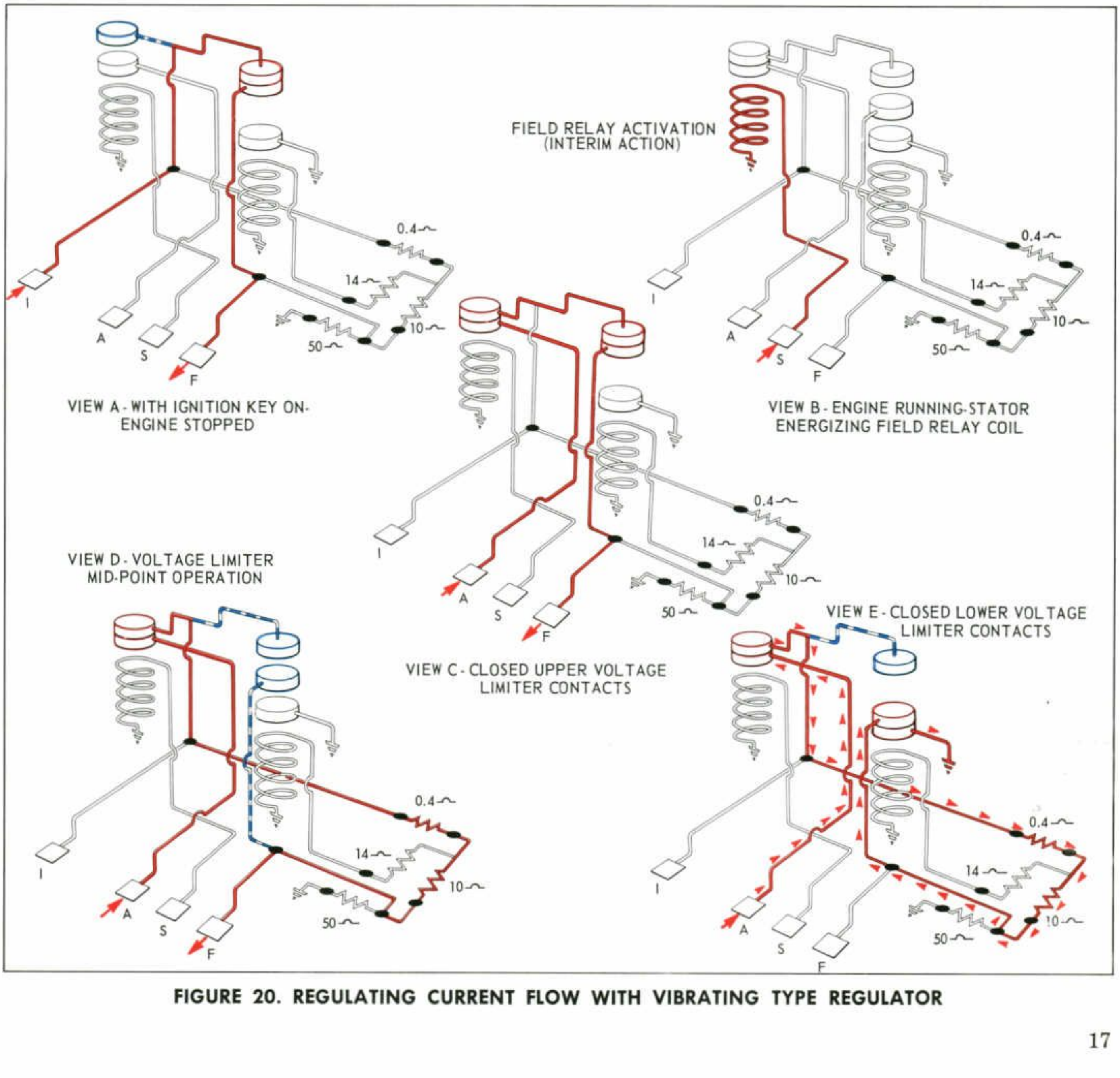


FIGURE 20. REGULATING CURRENT FLOW WITH VIBRATING TYPE REGULATOR

The following chart indicates the reaction of the contact points under each condition of regulation:

RELATIVE FIELD CURRENT REQUIREMENT	CONTACT POINT POSITION	AFFECT ON CIRCUIT
HIGH	FLUCTUATING BETWEEN CLOSED UPPER POINTS AND MID-POSITION	UPPER POINTS CLOSED—Full System Voltage Applied to Rotor Field for Maximum Current. POINTS AT MID-POSITION – Field current flows through resistors where it is reduced.
LOW	FLUCTUATING BETWEEN CLOSED LOWER POINTS AND MID-POSITION	LOWER POINTS CLOSED—No field current flows. Both ends of circuit are grounded. POINTS AT MID-POSITION—Same as above.

Figure 20 illustrates circuit flow patterns when the points are in each of the positions specified in the chart. (Keep in mind that the armature fluctuates between the contact positions with a frequency which is related to alternator r.p.m. and the amount of electrical load.)

Other components of the regulator circuit which warrant your attention include . . .

- ***AN ABSORBING RESISTOR –***

A 50-ohm resistor is connected across the rotor field coil to act as a dampening device for electrical surges in the field circuit. Surges in the field coils would otherwise be transmitted by transformer action to the stator coils where diode damage could occur. This resistor is called an absorbing resistor.

- ***A BALLAST RESISTOR –***

Voltage limiter operation is partially stabilized by the resistor connected in series with the limiter coil. When the coil is cold, the copper wire has a lower resistance and, therefore, would permit more current to flow. The increased coil current would, in turn, produce a stronger magnetic field, thus reducing the limiting voltage of the regulator. This effect is reduced by the increased voltage drop across the resistor. This 14 ohm resistor is called a ballast resistor.

- ***A MAGNETIC SHUNT –***

A magnetic shunt made of carpenter metal also helps to stabilize the operation of the limiter. The shunt is located at the top of the limiter coil and is, in effect, a magnetic short circuit between the coil core and the yoke. At low temperatures, the shunt has good magnetic conductivity, and reduces the effectiveness of the limiter magnetic field. When the regulator temperature becomes stabilized, the shunt becomes less conductive, and the magnetic field acts more effectively on the limiter armature.

Desirable State of Charge

Desirable battery state of charge results when the limiter voltage is adjusted to the battery temperature. When the ambient temperature is slow, the bi-metal used for the hinge of the voltage limiter increases the effort required to open the limiter contacts. The voltage impressed on the limiter coil will increase to provide the required stronger field. Thus, when ambient temperature is low and the battery is cold, the limited voltage is higher; when the battery is hot, the limited voltage is reduced.

IMPORTANT SERVICE NOTE

As indicated previously, the voltage limiter is both temperature corrected and compensated. This is a feature which requires particular attention on the part of the service technician.

IT IS IMPOSSIBLE TO PROPERLY TEST AND ADJUST A REGULATOR UNTIL NORMAL OPERATING TEMPERATURES ARE REACHED AND THE EXACT AMBIENT TEMPERATURE IS KNOWN. REFER TO SPECIFICATIONS FOR DETAILS.

TRANSISTORIZED REGULATOR

Refer to Figure 21, and study the part names and arrangement of the circuit.

In a typical regulatory cycle, beginning with battery voltage at the demand level, current will flow to the demand. This charging current will cause a gradual rise in battery terminal voltage until the point is reached where the zener diode breaks down. When the zener does break down, it redirects the path of conduction from the power transistor to the drive transistor, stopping the feed of power into the field.

The inductive nature of the field resists the abrupt change experienced when the power transistor is shut off. As a result, flux build-up is great enough to maintain current flow in the same direction as it flowed under power. The decay diode provides the electrical path for this portion of the cycle.

As the magnitude of the flux gradually decreases, battery terminal voltage begins to fall off. At a given point, the drop will be sufficient to inactivate the zener diode and drive transistor. When this occurs, the power transistor goes into operation to begin a new cycle.

Charging voltage requirements of the battery vary with temperature – less voltage is required as temperature increases. Thus, a 140-ohm resistor is included in the circuit to provide effective temperature compensation. This resistor changes the zener conduction point to satisfy ambient temperature conditions. A 40-ohm variable resistor also acts on the zener to give an approximate 3-volts range in the span between high-low voltage regulation and provide control over its operating point at a given temperature.

The capacitor and resistors related to it are in a feed back network. The 56-ohm resistor and capac aid in heat control by faster "ON-OFF" response.

The functions of the remaining circuit components are as follows:

- Bias Diode – allows operation up to 200°F.
- 100-ohm Resistor – supplies base bias for the power transistor.
- 47-ohm Resistor – driver transistor bias circuit.

The switching action between transistors is referred to as "flip-flop." The fequency range is approximately 90 to 7000 cycles per second.

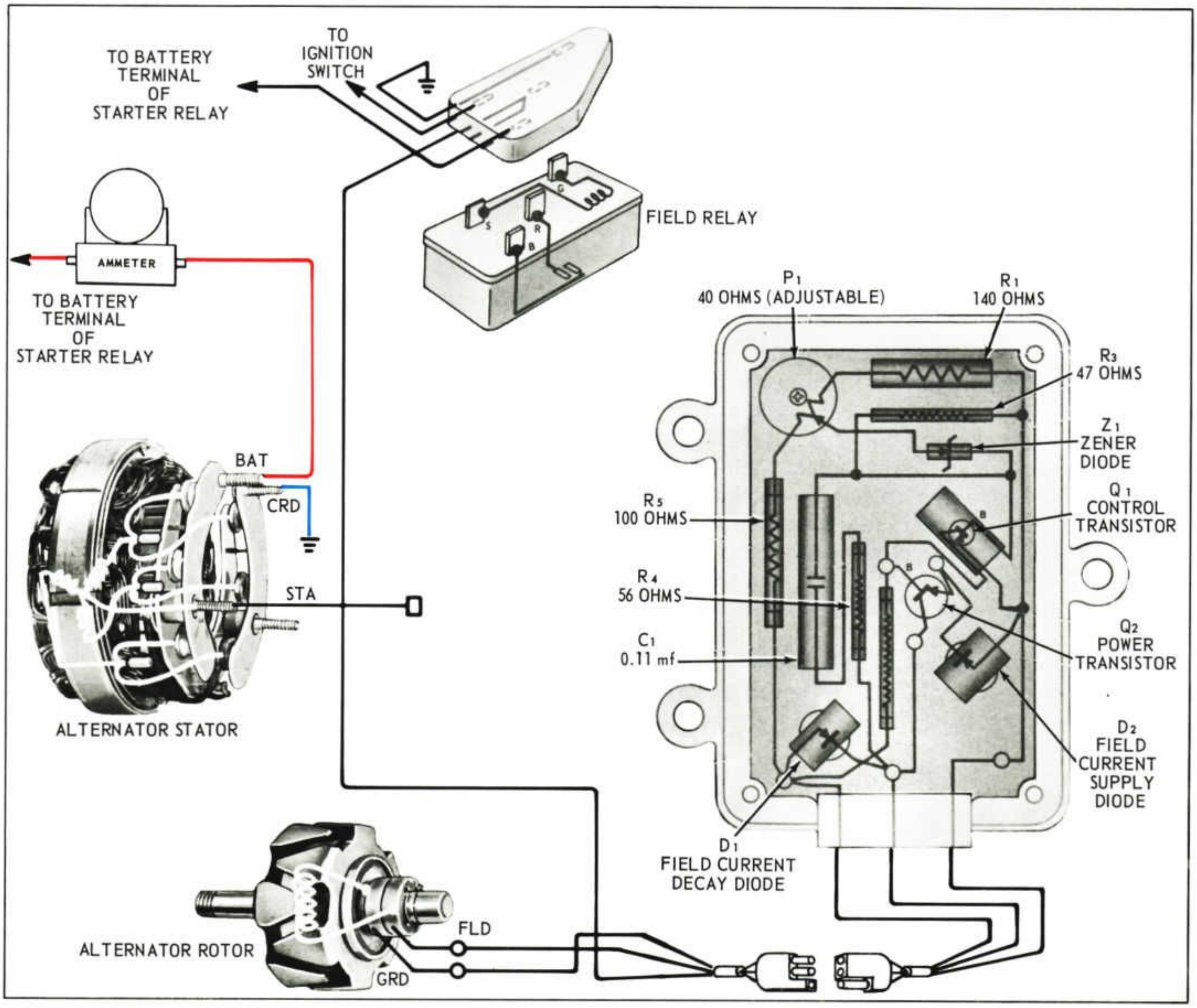


FIGURE 21. REGULATING CURRENT FLOW WITH TRANSISTORIZED REGULATOR

Trouble Shooting and Testing Procedures

Trouble shooting the charging system may involve any one or more of the components in the system . . . the alternator, the alternator regulator, the battery, the charge indicator light or ammeter, and the wiring which connects these components into a circuit.

The chart on Page 6 is furnished as a guide for categorizing troubles and suggesting their probable causes and remedies. Before studying this chart, however, we suggest that you give consideration to the general comments which precede it.

General Comments about Trouble Shooting

Battery discharge is not always due to charging system defects. Excessive use of lights and accessories while the engine is either off or running at low idle; corroded battery cables and connectors; low water level in the battery; or prolonged disuse of the battery, which would permit self-discharge . . . these are all possible reasons which should be considered when a battery is run down or low in charge.

Charging system troubles such as low alternator output, no alternator output (indicated by the indicator light being on or the indicator gauge showing discharge while the engine is running), or alternator output voltage too high, require testing of both the alternator and the alternator regulator.

Alternator regulator failures are usually not recognized except by the direct effect on the alternator output and, of course, eventual battery discharge. As the regulator is the control valve for the alternator, it acts to protect the battery by preventing excessive voltage output. Discharge of the battery to ground through the alternator is prevented by the diodes of the alternator which permit current flow in one direction (to the battery) only. Proper adjustment of the two units in a mechanical alternator regulator (field relay and voltage limiter), is very important. (The transistorized regulator has just one adjustment.)

Battery Testing

Determining the condition of the battery is a logical starting point for trouble shooting what appears to be a charging system problem. In making this determination, a visual inspection and/or instrument checks are necessary. Thus, suggested procedures are included at this point in the manual. BE SURE THE BATTERY IS IN GOOD CONDITION AND MEETS SPECIFICATIONS FOR STATE-OF-CHARGE.

VISUAL INSPECTION

A visual inspection cannot be expected to effectively substitute for an instrument check when diagnosing a battery problem or evaluating its condition. An inspection will, however, uncover tell-tale clues which can direct the service technician toward the selection of instrumentation which will most efficiently test a battery under a given set of conditions.

Where there is an indication that there is a need for further service, it is advisable that the technician check the installation date. (Length of service could be a factor—it would certainly be an aid in determining whether trouble is premature or the result of normal degeneration.)

The standard practice of battery manufacturers is to provide a predetermined location for this date . . . it may be the top surface of the negative battery post . . . a date-coding ring is the stamping tool used for marking . . . or a special surface area may be set aside for date-coding.

This code is also approaching industry standardization:

1. The letters "A" through "M" (excluding the letter "I" identify the months of the year in chronological order.
2. The numerals "0" through "9" identify the terminal digit of the year.

Accordingly, the code "A3" would signify that a given battery was placed in service in JANUARY of 1963.

The following are items which may be visually checked for symptoms of trouble in-the-making:

- The condition of the battery case and its 1-piece cover or individual cell covers.
- The top surface of the cover for acid accumulation.
- The color and odor of the electrolyte in the battery.
- A gassing condition when the charging circuit is operating.
- The condition and size of cables.
- Corrosive deposits.
- All surfaces of the battery for any indications of abuse.
- Missing vent plugs.
- The level of the battery's electrolyte.

Now, let's consider the items suggested as visual inspection check points in a little greater detail.

Condition of Case and Cover

1. Check for cracks or buckling which could result from one of the following:
   a. Excessive tightening of hold-down attachments.
   b. Hold-down attachments too loose, causing vibra-

tion damage.
   c. Excessive temperatures.
      (1) In the engine compartment
      (2) Internally, due to a high charging rate
   d. Buckled plates as a result of the battery standing in an under-charged condition for long periods of time.
   e. Excessive loads (As a reminder . . . never use the starting motor to propel the vehicle.)
   f. Clogged vent caps which prevent expansion of the hydrogen and oxygen gases during charge.
   g. Freezing of the electrolyte. (A battery with ¾ state of charge is in no danger of freezing.)
2. Check the cell covers; they could be raised as a result of operating an under-charged battery over a long period of time – then subjecting it to prolonged over-charging.
3. Again, check the cell case and cover, one or both could be broken as a result of an open flame or spark being brought too close to a "gassing" battery.

Evidence of Acid on Cover

If acid deposits are noted on the cover, it is quite possible that leakage, spill-over, or gassing due to a high charging rate is a contributing cause. (A voltmeter check will determine whether leakage is taking place.) If these conditions are not serviced, they can result in an increase in the rate of self-discharge.

Color and Odor of the Electrolyte

Separately or in combination, discoloration of normally clear electrolyte and/or the presence of an odor similar to that of "rotten eggs" suggests one or more of the following:
1. The existence of an excessively high charging rate.
2. The adverse affects of deep cycling.
3. The presence of impurities in the electrolyte solution.
4. An aged battery which is approaching the end of its useful life.

Signs of Abuse

Surface indications of abuse to the battery are a clue to the cause of some troubles. Check for the following:
1. Battery posts which have been damaged as a result of:
   a. Hammering.
   b. Flashing tools or wires across the terminals.
   c. Stretching short cables on applications that require longer lengths.
   d. Improper cable removing techniques.
   e. Improper connections of booster or charging equipment.
2. Sealing compounds which have been damaged as a result of:
   a. Excessive probing with pointed testing devices which have not been followed-up with repair.
   b. Placing copper objects on the top of the battery.

Electrolyte Level

Battery capacity is reduced in direct proportion to the amount of active plate material which is exposed to the air. If inspection reveals a low supply, pure water should be added to restore its level to ¼″ to ½″ above the top of the plates. (Most batteries have a level indicator near the base of the filler opening. If such an indicator is provided, it should be used.)

Water consumption at a rate up to two ounces per cell per 1000 miles of driving is considered to be acceptable. The need to add water in excess of this amount suggests the need to check and adjust the voltage limiter. (A running record of mileage and water consumption will aid in determining the adequacy of voltage limiter operation.)

Condition and Size of Cables

The condition and size of cables is important. The high current requirements of the starting system demand a minimum of voltage loss through the cables. To guard against difficulty in this respect . . .
1. Cable clamps should be inspected for:
   a. Excessive corrosion deposits
   b. Acid erosion of clamp or bolt and nut
   c. Loose clamp to battery post connections
2. The size of the cable used should be noted and compared to manufacturer's recommendations.
   a. A number 4 gauge is recommended for 12-volt applications.
   b. A number 0 or a number 1 gauge is recommended for 6-volt applications.
   c. Special applications may require heavier gauge cables than those recommended.
   d. Any separated wire strands will require that the remaining strands carry the same current load as a new cable.
   e. Periodic cleaning helps lengthen service life.

INSTRUMENT TESTS

There are numerous test instruments on the market which measure battery condition and state-of-charge with varying degrees of reliability. We shall cover several, beginning with the established hydrometer test.

Hydrometer Test

The basic equipment needed to perform a hydrometer test is a syringe-type hydrometer and a dairy-type, mercury-in-glass thermometer which has a scale reading up to 125°F. and a pick-up tube immersion requirement of not more than 1 inch. The float in the basic design of hydrometer covers an approximate specific

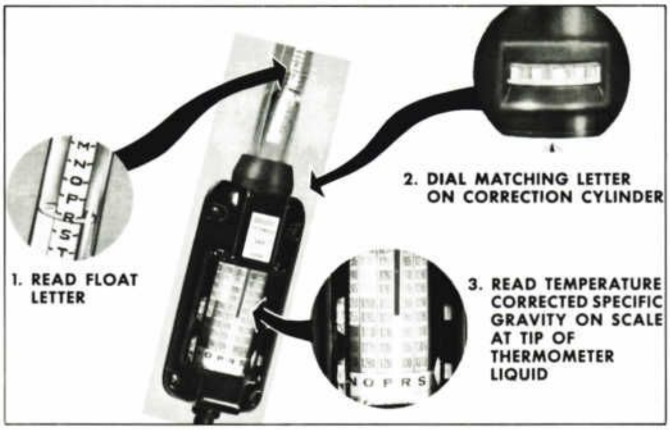


FIGURE 22. BATTERY HYDROMETER TEST

gravity range from 1.100 to 1.300 gravity points. (This point rating is based on the relative weight of equal volumes of water and sulphuric acid with water having a rating of 1.000 gravity point and pure acid having a rating of 1.835 gravity points.)

The majority of hydrometers now on the market combine the basic hydrometer and thermometer. The Autolite Climate-Eye unit shown in Figure 22 is one of these combination hydrometers. To further simplify obtaining a temperature corrected reading, the float is letter-coded instead of designating the gravity points. This letter code is then dialed with a thumb wheel on the back of the hydrometer and a corrected reading may be observed directly through an unbreakable, lucite, magnifying lens. This reading is superimposed on a colored background which tells at a glance whether the state of charge of the battery is good or fair . . . or whether recharging is necessary. Read the column diectly to the right of the thermometer tip.

TEST PROCEDURE

The procedure and service tips which follow apply to a hydrometer test made with a Climate-Eye Hydrometer. (If another type of hydrometer is used, it will be necessary to handle the temperature correction step in accord with provisions the device incorporates for this necessary alteration of the basic float reading.)

1. Raise hood and put fender cover in place.
2. Remove all vent plugs.
   a. Visually check vent openings.
   b. If a plugged vent is suspected, blow out with compressed air.
3. Make sure the electrolyte level is high enough to withdraw proper amount of acid into hydrometer barrel.
   a. Take no readings immediately after adding water.
   b. Water must be thoroughly mixed with underlying electrolyte, by charging, before hydrometer readings are reliable.
4. Insert hydrometer pick-up tube into cell with bulb squeezed tightly by thumb pressure.
5. Slowly release thumb pressure until bulb is fully expanded and float is suspended freely in the barrel.
   a. Always hold barrel level to prevent float from binding or sticking to sides.
      (1) Wash barrel and float assembly periodically with soap and water.
      (2) While disassembled, inspect float assembly for leaks.
   b. Float assembly should not touch top or bottom stoppers of barrel.
6. Raise hydrometer or lower eye level to read float scale at the electrolyte level.
   (Hydrometer floats are calibrated at 80°F.)
7. Note the letter on the float scale which is intersected by the upper surface of the electrolyte in the hydrometer barrel.
8. Using the thumb wheel on the back side of the hydrometer, dial the matching letter on the correction cylinder. (The red thermometer column will be adjacent to the letter you have just dialed.)
9. Record the specific gravity reading which aligns with the tip (bottom) of the thermometer column.
10. Repeat this procedure (Steps 3 through 9) for each cell in the battery.

TEST CONCLUSIONS

1. If all cells are even at 1.215 or above, the state of charge is probably good.
   WHAT TO DO . . .
   To confirm that the state of charge is satisfactory, make a capacity test; and, if okay, check the voltage limiter setting and the balance of the electrical system for short circuits or excessive voltage losses.)
   (CAPACITY TEST PROCEDURES ARE COVERED UNDER "VARIABLE LOAD TEST" IN THIS SECTION OF THE MANUAL.)
2. If all cells are even, but less than 1.215, the state of charge is doubtful.
   WHAT TO DO . . .
   Recharge according to manufacturer's recommendations and retest.
3. If the difference between cells is less than 50 points (.050), the battery is probably serviceable.
   WHAT TO DO . . .
   Recharge according to manufacturer's recommendations and retest.
4. If the specific gravity between any two cells is more than 50 points (.050), the battery is not satisfactory for service and is probably defective.
   WHAT TO DO . . .
   Recommended replacement to avoid unexpected failure.

NOTE: Each manufacturer recommends a high rate charge schedule for the batteries in his product line. Autolite recommends the following . . .

Specific Gravity Reading	Charge Rate Amperes	Battery Capacity – Amp. Hours			
		45	55	70	80
		High Rate Charging Time			
1.125* to 1.150	35	65 min.	80 min.	100 min.	115 min.
1.150 to 1.175	35	50 min.	65 min.	80 min.	95 min.
1.175 to 1.200	35	40 min.	50 min.	60 min.	70 min.
1.200 to 1.225	35	30 min.	35 min.	45 min.	50 min.
1.225 to 1.250	5	NOTE: Charge at low rate only until specific gravity reaches 1.250 at 80° F.			

*If specific gravity is below 1.125, use indicated high rate, then follow with low rate of charge (5 amperes) until specific gravity reaches 1.250 at 80° F.

Variable Load Test

The purpose of a variable load test is to determine whether or not a battery is capable of meeting the specified demands of the starting motor. The demand conditions are duplicated with the test instrument.

(It is important to note that a variable load test is also referred to as a CAPACITY TEST or HIGH RATE DISCHARGE TEST.)

In the test instrument shown in Figure 23, the ammeter scale reads straight amperes (0-500 amps.) and ampere-hours (3 times amps.) in the upper and lower segments respectively. The voltmeter scale highlights the acceptable minimum voltages under load of 4.8 for a 6-volt battery and 9.6 for a 12-volt battery.

Among the safety precautions to be observed when using a variable load tester, the following are of particular importance:

1. The load limit should not be maintained for more than 15 seconds.
2. The battery should not be load tested if the electrolyte temperature is below 60°F.

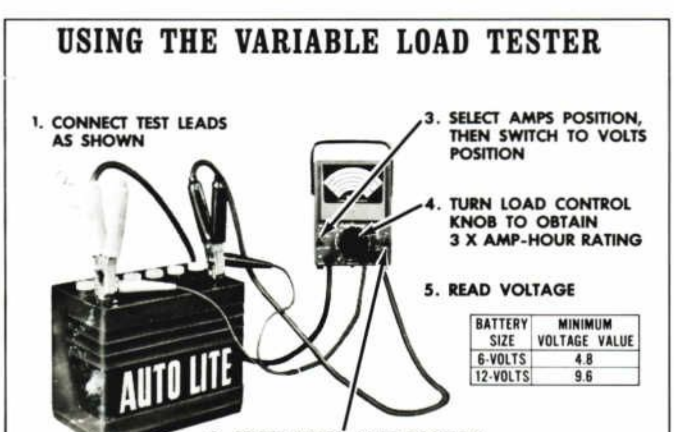


FIGURE 23. BATTERY VARIABLE LOAD TEST

3. The battery should not be load tested if the specific gravity of the electrolyte is below 1.225. (The tropical mixture, where 1.225 is a full-charge gravity reading is an exception.)

   In the absence of test equipment, cranking the engine for 15 seconds, and then, checking the terminal voltage with a voltmeter for conformity to the specified minimums is a suggested substitute.

TEST PROCEDURE

1. Raise hood and put fender cover in place.
2. Add water, if necessary, to bring electrolyte to proper level.
3. Check to make sure that the load control knob is "off" or all the way to the left.
4. Connect tester leads to the battery posts.
   a. Positive to positive and negative to negative.
   b. Large leads are for the ammeter and small leads are for the voltmeter.

      CAUTION

      Variable load test equipment of the type we are describing is designed to read amperage across the battery terminals. DO NOT ATTEMPT TO USE OTHER THAN A HEAVY-DUTY AMMETER FOR THIS KIND OF TEST INSTALLATION. THE HIGH CURRENT INVOLVED WILL BURN-UP AN UNDER-CAPACITY TESTER.
5. Set test selector switch to VOLTS-AMPS position and VOLTS-AMPS selector switch to AMPS position.
6. Turn load control knob to the right until the meter corresponds to the specified ampere-hour rating of the battery.

   NOTE 1 – If specified rating is not available, use a 60-ampere-hour rate for 12-volt batteries or a 100 ampere-hour rate for 6-volt batteries.

   NOTE 2 – Do not exceed 15 seconds for tests.

7. Set volts-amps selector switch to volts position and read voltmeter.

TEST CONCLUSIONS

1. If the terminal voltage is 9.6 volts or more for a 12-volt battery, or 4.8 volts or more for a 6-volt battery, the battery has a good output capacity and will accept a normal charge.
2. If battery construction will allow, the voltage of each cell may be measured separately while subjected to the same load as previously discussed.
   a. If cell voltage is below 1.5 volts or –
   b. If there is a variation of .15 volt or more between cells – the battery should be placed on a charger and subjected to a 3-minute charge test.
3. If the terminal voltage is below 9.6 volts for a 12-volt battery or 4.8 volts for a 6-volt battery, the battery should not be condemned until is has been placed on a charger, subjected to a 3-minute charge test, recharged, and re-tested for capacity. (A battery charger with an adjustable charging rate and an ammeter that reads 40 amps and 75 amps is best suited for this particular test.)

Specialized Instrument Tests

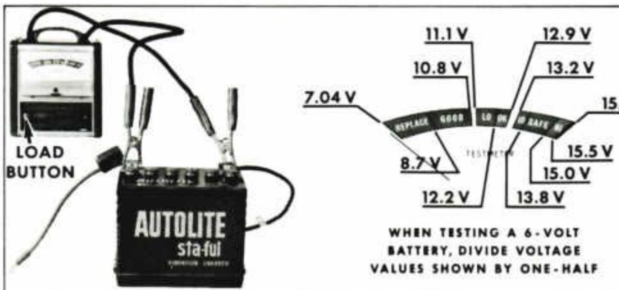
New test instruments – many with multi-purpose designs—are being made available to service technicians to help them diagnose battery problems quickly and accurately. The device we shall describe below is one of these new instruments.

PRINCIPLES OF OPERATION

This specialized test instrument may be used on any battery regardless of construction design features. It incorporates no moving parts, other than the relay contacts used to automatically select the proper voltage and polarity. The tester is a special adaptation of a calibrated voltmeter which is connected internally to a "fixed" resistor. The descriptive word "fixed" could be misleading as the resistance value of the resistor changes with temperature variation. Heat dissipation is accomplished by imbedding the resistors in sand. The actual current flow through the resistor is determined by the size (capacity) of the battery – accuracy of this tester has been verified by Autolite Engineering.

Batteries of 70 ampere-hour capacity were accurately tested and it is believed that the same high degree of accuracy could be expected on a battery with an 80 ampere hour rating.

The basic principle of operation, therefore, lies in voltage stabilization. Whenever the button is depressed, it must be held until the needle remains stationary. In other words, a voltage reading is taken whenever the amperage potential of the battery and its related heat characteristics match the designed resistance (heat absorption characteristics) of the instrument. No



TEST BATTERY'S	TESTMETER READINGS			
"CONDITION" (BUTTON DEPRESSED)	GREEN	GREEN	RED	RED
"CHARGE" (BUTTON RELEASED)	GREEN	RED	RED	GREEN
TEST RESULTS	GOOD AND CHARGED	GOOD BUT NEEDS RECHARGE	RETEST AFTER 20 MIN. FAST CHARGE	REPLACE

FIGURE 24. SPECIALIZED BATTERY TESTER

reading is attempted until the imbedded resistors have reached their heat saturation point.

MULTI-PURPOSE TESTER

This test device is advertised as having many applications . . .

- Determining battery's condition and state of charge
- Testing battery cables
- Testing electrical systems for shorts and leaks
- All other voltmeter applications such as checking the voltage drops in the starting and charging system circuits

In this manual, we shall cover the first application only.

TEST PROCEDURE FOR BATTERY'S CONDITION AND CHARGE

1. Raise hood and put fender cover in place.
2. Connect positive tester lead to battery positive post and negative tester lead to battery negative post.
   a. Twist tester clips to insure good contact.
   b. Make sure vehicle's lights and electrical accessories are "off."
      (1) Any reading indicates proper hook-up.
      (2) If no reading, fast charge battery for 20 minutes before attempting any tests.
3. Press load button and hold until tester needle remains stationary – then read "battery's condition."
4. Release load button and read "battery's charge" only after needle remains stationary.

TEST CONCLUSIONS

1. The chart in Figure 24 shows the combinations of conditions which the test meter will indicate and the conclusions to be drawn.
2. A slow charge is required to bring a battery to a full state of charge. Thus, the "recharge" called for in the second column of the chart permits a 20-minute fast charge for testing.
3. Any "chattering" sound indicates a discharged battery or poor cable connections.
4. Remember to hold load button as long as necessary.

TROUBLE SHOOTING CHART

BASIC TYPES OF TROUBLE	PROBABLE CAUSES	SERVICE PROCEDURE
BATTERY LOW IN CHARGE HEADLIGHTS DIM AT IDLE NOTE: A history of recurring discharge of the battery, which cannot be explained, suggests the need for checking and testing the complete charging system.	ALTERNATOR DRIVE BELT	ADJUST OR REPLACE BELT, AS REQUIRED.
	BATTERY CABLES, CHARGING SYSTEM WIRING	CLEAN BATTERY CABLES AND TERMINALS. TIGHTEN LOOSE CONNECTION. REPAIR OR REPLACE, AS REQUIRED.
	ELECTROLYTE (SPECIFIC GRAVITY)	TEST EACH CELL AND EVALUATE CONDITION: • All readings even at 1.215 or above – Battery O.K. • All readings even, but less than 1.215 – Recharge and retest. • High-Low variation between cells less than 50 gravity points – Recharge and retest. • High-Low variation between cells exceeds 50 gravity points – Replace battery.
	BATTERY (CAPACITY)	TEST CAPACITY AND EVALUATE CONDITION: • Minimum voltage 9.6 for 12-volt battery or 4.6 for 6-volt battery. (Both values under specified test load conditions.) • If capacity is under minimum specifications, perform 3-minute charge test. If below maximum (15.5 volts for 12-volt battery or 7.75 for 6-volt battery at 40 and 75 amps. charge rate, respectively) battery is O.K. – Recharge. If above maximum, battery is sulfated. Slow charge at 1 amp./positive plate. Replace battery if it doesn't respond to slow charge.
INDICATOR LIGHT STAYS ON. AMMETER REGISTERS CONSTANT DISCHARGE. BATTERY WILL NOT HOLD CHARGE. ALTERNATOR OUTPUT LOW. NO ALTERNATOR OUTPUT.	BROKEN, LOOSE, OR SLIPPING DRIVE BELT	ADJUST OR REPLACE, AS REQUIRED.
	BATTERY CABLES, CHARGING SYSTEM WIRING	CLEAN BATTERY CABLES AND TERMINALS. TIGHTEN LOOSE CONNECTIONS. REPAIR OR REPLACE, AS REQUIRED.
	BATTERY SPECIFIC GRAVITY	IF UNSATISFACTORY, REPLACE BATTERY.
	ALTERNATOR OUTPUT ①	IF SATISFACTORY, TEST ALTERNATOR REGULATOR. ADJUST OR REPLACE. ①
		IF LOW, PERFORM CHARGING CIRCUIT RESISTANCE TESTS. IF RESISTANCE IS WITHIN SPECIFICATIONS, BENCH TEST ALTERNATOR. ①
		IF NONE, TEST BATTERY TO FIELD WIRING. ① IF WIRING IS SATISFACTORY, BENCH TEST ALTERNATOR. ①

NOTES:

① To test alternator output, install ammeter in series between the battery cable and battery post. Add 2 amps. to reading to cover standard ignition system draw and 6 amps. to cover draw in a transistorized system.

NOTES: (Continued)

② Test both the voltage limiter and field relay. In transistorized regulatory systems, the field relay is a sealed unit. Refer to Page 32 for the recommended testing procedure. If regulator adjustments are found to be correct, check the following wires:

- From the accessory terminal of the ignition switch through the charge indicator light and 15-ohm resistor to the regulator "I" terminal.
- From the "S" terminal of the regulator to the "S" terminal of the alternator.

Repair or replace these wires, as necessary.

③ An output of 2 to 5 amps. less than specifications indicates an open diode. A reading approximately 10 amps. low indicates a shorted diode.

④ To check battery to field wiring, install a field rheostat between battery positive terminal and alternator field terminal; then, perform regular output test. A good reading indicates that the wire from the battery terminal of the starter relay to the field terminal of the alternator is defective. If there was no output reading, bench test alternator and repair or replace parts, as required.

BASIC TYPES OF TROUBLE	PROBABLE CAUSES	SERVICE PROCEDURE
LIGHTS AND FUSES FAIL PREMATURELY SHORT BATTERY LIFE BATTERY USES EXCESSIVE WATER BURNING OF DISTRIBUTOR POINTS BURNING OF RESISTOR WIRE COIL DAMAGE HIGH CHARGING RATE	CHARGING SYSTEM WIRING, INCLUDING REGULATOR GROUND WIRE.	TIGHTEN LOOSE CONNECTIONS. REPAIR OR REPLACE WIRING, AS REQUIRED.
	VOLTAGE LIMITER CONTACT POINTS	REPLACE REGULATOR IF POINTS ARE BURNED.
	VOLTAGE LIMITER SETTING	IF WITHIN SPECIFICATIONS, RESET TO LOW END OF CLEARANCE RANGE.
		IF TOO HIGH, AND POINTS ARE NOT BURNED, ADJUST TO SPECIFICATIONS.
ALTERNATOR NOISE	ALTERNATOR DRIVE BELT (SQUEALING NOISE)	ADJUST OR REPLACE BELT, AS REQUIRED. (AN APPLICATION OF BELT DRESSING MAY ELIMINATE NOISE CAUSED BY MINOR SURFACE IRREGULARITIES.)
NOTE: Water pump noise is sometimes confused with alternator noise. A sound detecting device, such as a stethoscope, will eliminate indecision in this respect.	ALTERNATOR BEARING (SQUEALING NOISE)	REPLACE BEARING IF FOUND TO BE OUT-OF-ROUND, WORN, OR CAUSING SHAFT SCORING.
	ALTERNATOR DIODE (WHINING NOISE)	TEST ALTERNATOR OUTPUT. (A SHORTED DIODE CAUSES A MAGNETIC WHINE AND A LOSS OF APPROXIMATELY 10 AMPS. OF OUTPUT.) TEST DIODES AND REPLACE, AS REQUIRED. (REPLACING RECTIFIER ASSEMBLY MAY BE MOST FEASIBLE FIX.)
INDICATOR GAUGE FLUCTUATES OR INDICATOR LIGHT FLICKERS	REGULATOR CONTACTS	CHECK FOR OXIDIZED OR DIRTY REGULATOR CONTACTS. REPLACE REGULATOR, IF NECESSARY.
	CHARGING SYSTEM WIRING	TIGHTEN LOOSE CONNECTIONS. REPAIR OR REPLACE WIRING, AS REQUIRED.
	BRUSHES	CHECK FOR TIGHTNESS AND WEAR. REPLACE, IF NECESSARY.

Charging System Testing Procedures

The test procedures provided in this section cover AUTOLITE, CHRYSLER, DELCO, PRESTOLITE, LEECE-NEVILLE, and MOTOROLA systems in the order named. AUTOLITE procedures include illustrations for each test hook-up. (Basic test instruments—voltmeter, ammeter, carbon pile, etc.—are shown.) The balance of systems are covered with a schematic and step-by-step procedures.

THE AUTOLITE SYSTEM

Safety Precautions

As a preface to instructions for testing an A.C. charging system, we emphasize the importance of observing the safety precautions which follow. They apply in general to all alternator systems, but are worded, in this instance, to apply specifically to AUTOLITE.

FIGURE 25. SAFETY PRECAUTIONS

1. Disconnect battery ground cable before removing plug connector at alternator.
2. Alternator output terminal "hot" at all times.
3. Never reconnect battery ground cable until all wiring harness connections have been made.
4. Always place pry bar against rear of front housing. (Autolite only.)
5. Never attempt to polarize the alternator.
6. Observe polarity when installing a battery in the vehicle.
7. Connect booster battery in parallel. Negative to negative and positive to positive.
8. Disconnect battery ground cable before connecting a charger to the battery.
9. Never operate alternator with rotor coil energized unless it is connected to an external load.
10. Always use a recommended diode tester to check diodes.

SERVICE NOTE:
Although it has not been substantiated by evidence acceptable to Autolite Engineering, alternators have been reported to be damaged when arc welding was performed on the frame without disconnecting both battery cables. Pending further information, it may be advisable to disconnect the cables.

Output Test

PRELIMINARY INFORMATION

Several test equipment manufacturers merchandise a type of battery post adaptor switch which may be used when making charging system tests. Although the designs vary, they each provide for direct connection of a test ammeter. This eliminates the necessity for disconnecting the regular charging circuit wiring.

Because these adaptors are frequently used, we have illustrated the test hook-up for checking alternator output with and without a typical device installed. (It is important to remember that an adaptor "hides" approximately 5 amperes of output current from the ammeter. It is also important that no switches be closed when testing with an adaptor. Door-operated switches are often overlooked. A closed switch would affect the amount of field current draw.)

TEST PROCEDURE (Without Battery Post Adaptor)

Refer to Figure 26.

1. Disconnect the battery ground cable.
2. Connect an engine tachometer.
3. Remove the alternator lead wire from the battery terminal of the starter relay. Attach one lead of an ammeter to the battery terminal of the starter relay. Attach the other lead of the ammeter to the alternator lead wire that was removed from the battery relay terminal.
4. Disconnect the regulator connector from the regulator and install a jumper wire across the "A+" and "F" terminals of the connector. (Spade connectors on the jumper will be required for most applications.)
5. Install a carbon pile rheostat across the battery terminals.
6. Connect a voltmeter lead to the alternator lead wire that was removed from the battery relay terminal and other voltmeter lead to ground.
7. Following the manufacturer's specifications, reconnect the battery ground cable, start the engine and slowly accelerate while applying the required load with the rheostat to attain the prescribed voltage. DO NOT EXCEED THE MAXIMUM R.P.M. INDICATED BY THE MANUFACTURER.
8. Compare the amperage reading on the ammeter with the rated output for the alternator being tested. If no output current is noted during the period of acceleration and load application, stop the test immediately.

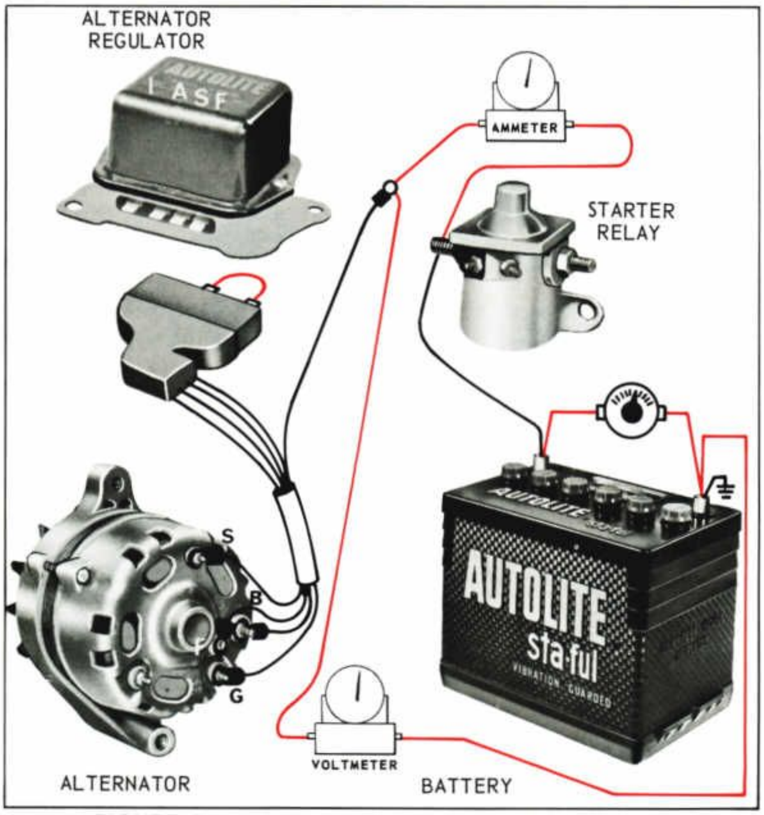


FIGURE 26. ALTERNATOR OUTPUT TEST HOOK-UP
(Without Adaptor)

TEST PROCEDURE

(With Battery Post Adaptor)

Refer to Figure 27.

1. Disconnect both battery cables.
2. Connect an engine tachometer.
3. Place the adaptor over the battery positive post.
4. Attach the positive battery cable to post provided on the adaptor.
5. Attach the test ammeter leads to the terminals provided on the adaptor.
6. Attach a positive voltmeter lead to the adaptor and the negative lead to a clean ground connection.
7. Install a jumper wire with spade terminals between the A + and F terminals of the regulator connector plug.
8. Connect a carbon pile rheostat across the battery.
9. Connect the previously removed battery ground cable; then, close the adaptor switch.
10. Start the engine; then, open the adaptor switch.
11. Slowly accelerate the engine while adding load with the rheostat until the manufacturer's specified voltage is reached. (DO NOT EXCEED SPECIFIED MAXIMUM R.P.M.)
12. With the engine running and ammeter leads attached to the adaptor, the ammeter will register the amount of current flowing into the battery. Compare this reading with the rated output for the type and size of alternator being tested. Stop the test if no amperage is produced during acceleration and load application.

EXAMPLE OF TEST SPECIFICATIONS

An Autolite alternator has a specified voltage rating of 15.0 volts. The maximum hot engine r.p.m. allowed to attain this voltage under load is 2900 r.p.m. Within these limits, specified output should be attained. (If a special battery post adapter is used in conjunction with making this test, output will read approximately 5 amps below specifications because current used by the ignition system, gauge system, and field coil does not pass through the ammeter. The specification must also be modified by adding 9 amps to the current reading if a transistorized ignition system is involved.)

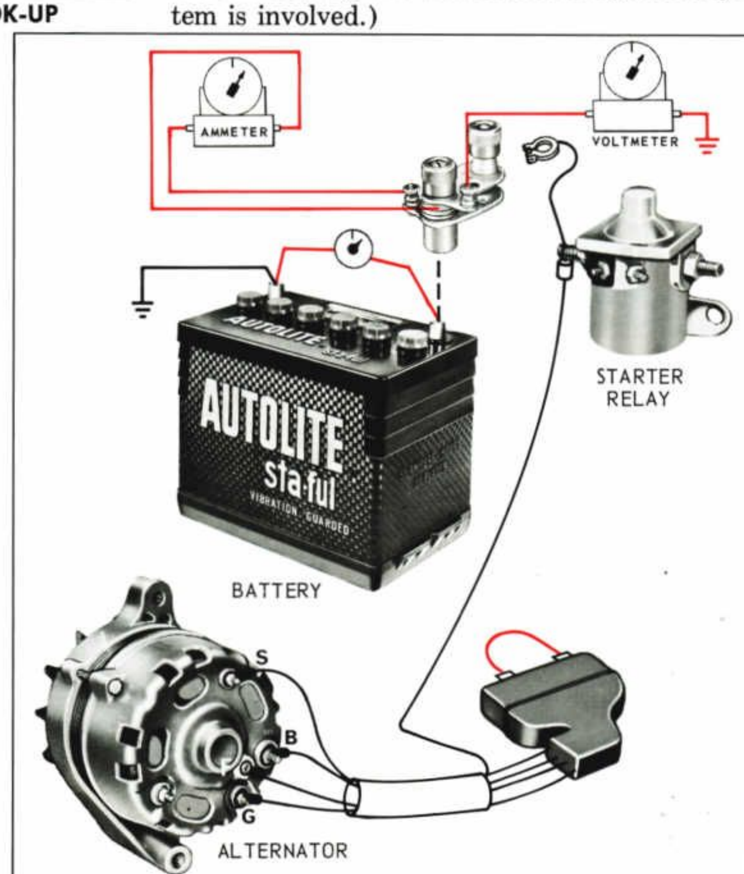


FIGURE 27. ALTERNATOR OUTPUT TEST HOOK-UP
(With Adaptor)

TEST CONCLUSIONS

1. If the alternator output (amperes) meets or exceeds the specified minimum, make the alternator neutral voltage test. An output less than specified is an indication of a poor connection of a broken wire in the wiring harness or connector plug, or a faulty alternator. Test the harness; if all connections are good, remove the alternator for repairs. Any test indicating alternator malfunction should be followed by circuit resistance tests to determine whether the circuit is faulty or if the alternator should be removed from the vehicle for bench testing and repair.
2. An output of 2 to 5 amperes less than specifications usually is an indication of an open diode. A slipping drive belt can also cause this condition. When the output is approximately 10 amperes less than specification, a shorted diode is usually the cause.

Testing Notes

- A shorted positive diode often causes alternate flashing of the oil pressure warning light and the charge indicator light with the ignition switch off.
- Feedback from the charge indicator light circuit to accessory terminal of the ignition switch causes this peculiar effect by activating the fuel and temperature gauge system.
- When the contacts in the constant voltage regulator on the instrument cluster close, the oil pressure light becomes dim and the charge indicator light becomes bright.
- When the constant voltage contacts open, the oil pressure light becomes bright and the charge indicator light becomes dim.
- A shorted positive diode also causes battery discharge through the field circuit due to the closed field relay contacts.

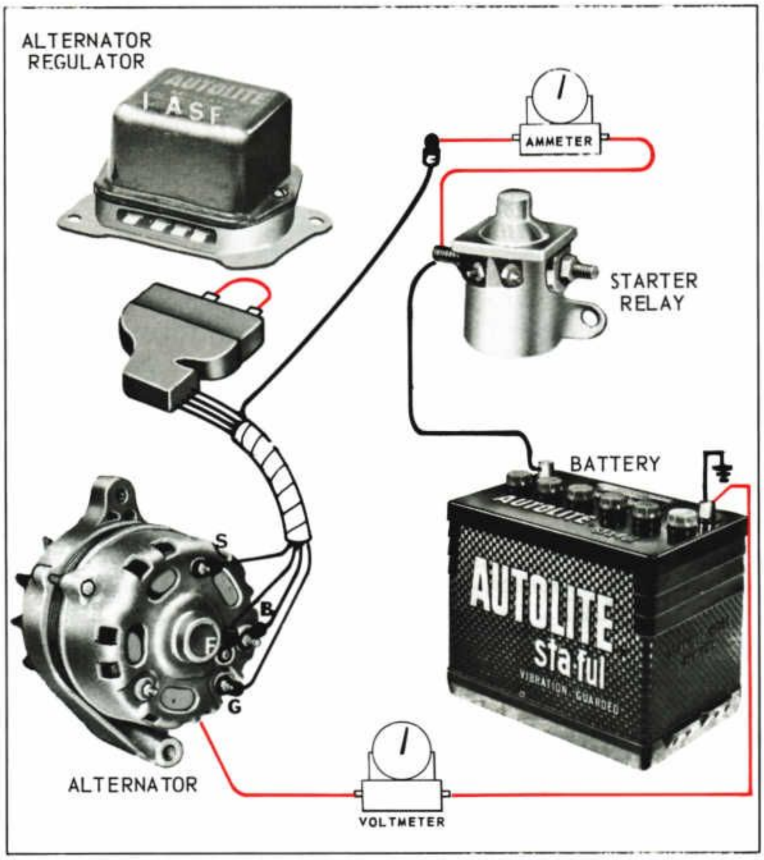


FIGURE 29. GROUND CIRCUIT RESISTANCE TEST

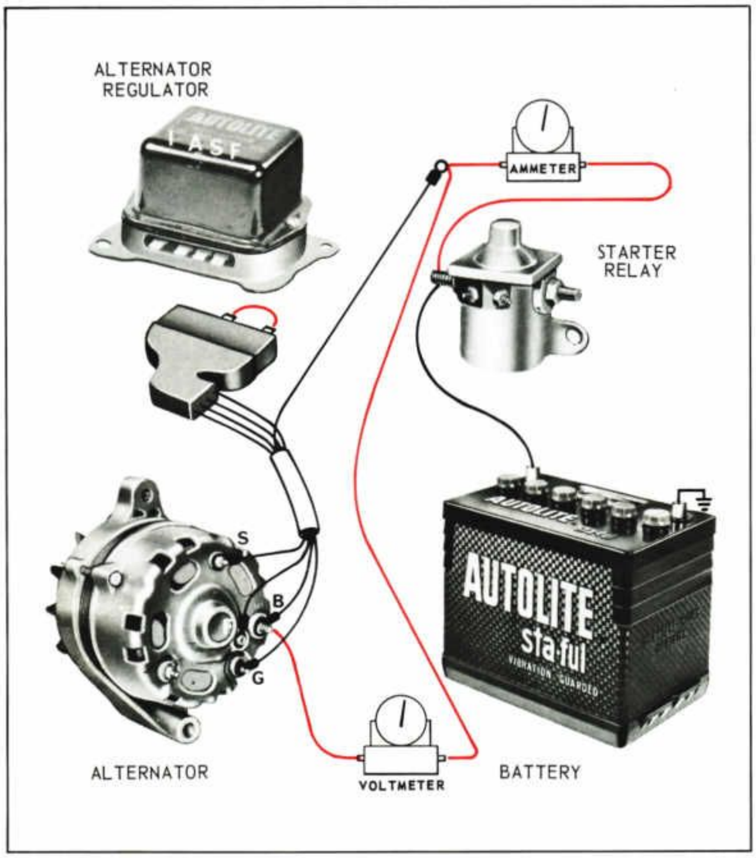


FIGURE 28. INSULATED CIRCUIT RESISTANCE TEST

Circuit Resistance Tests

Higher than normal voltage drops (losses) can be caused by excessive resistance in the charging circuit (alternator to battery to alternator). This can cause an undercharged battery condition. Two tests are necessary to determine the condition of the circuit:

- Insulated Side – Refer to Figure 28.
- Ground Side – Refer to Figure 29.

Both tests require a constant current flow of 20 amperes, indicated on the test ammeter, and a voltage loss or drop measurement of each circuit.

TEST PROCEDURE

1. Disconnect the battery ground cable.
2. Connect an engine tachometer.
3. Remove the alternator lead wire from the battery terminal of the starter relay. Attach one lead of an ammeter to the battery terminal of the starter relay. Attach the other ammeter lead to the end of the alternator lead wire that was removed from the battery relay terminal.
4. Install a voltmeter lead to the alternator output terminal. Install the other voltmeter lead to the alternator lead wire that was removed from the relay for the insulated circuit resistance test.
5. Install a voltmeter lead to the alternator ground terminal or frame and the other voltmeter lead to the battery negative terminal for a ground circuit resistance test.
6. Install a jumper wire with spade terminals across the regulator connector plug A+ and F terminals.
7. Reconnect the battery ground cable, start the engine, and accelerate it until a reading of 20 amps is obtained.

TEST CONCLUSIONS

1. Excessive resistance in the insulated side of the charging circuit is indicated when the voltmeter exceeds 0.3 volt on vehicles equipped with a charge indicator lamp, or 0.7 volt on vehicles with an ammeter.
2. Excessive resistance in the alternator to battery ground circuit is indicated when the voltmeter reading exceeds 0.3 volt.

The majority of higher than normal resistance problems can be traced to improper or corroded connections.

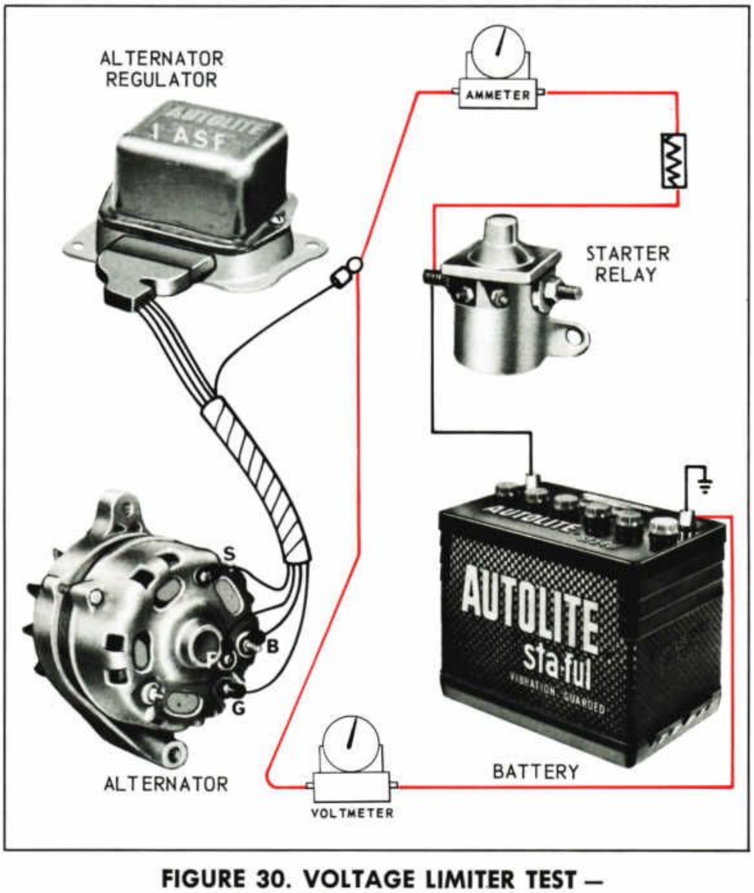


FIGURE 30. VOLTAGE LIMITER TEST — MECHANICAL REGULATOR

Voltage Limiter Test (Mechanical Regulators Only)

Voltage limiter tests are essential when battery water usage or state of charge are the causes of trouble. A double-contact regulator operates over slightly wider voltage limits than the common single-contact limiter and requires a different test procedure.

Upper stage operation occurs at moderate engine speeds or when the amperage load is relatively high. Lower stage operation occurs at the higher engine speeds with relatively light electrical loads.

Voltage limiter calibration tests must be made with the regulator cover and gasket in place.

The regulator temperature must be normalized before making the voltage limiter tests. If the vehicle has not been driven far enough for the engine temperatures to be normalized, turn off all electrical accessories and operate the engine with the hood closed until the desired temperature is reached.

TEST PROCEDURE

Refer to Figure 30.

NOTE: Only lower stage regulation needs to be tested to check for proper calibration.

1. Disconnect the battery ground cable.
2. Connect an engine tachometer.
3. Remove the alternator lead wire from the battery terminal of the starter relay. With a ¼ ohm resistor in series with an ammeter, connect one end of the ammeter to the battery terminal of the starter relay. Attach the other ammeter lead to the alternator lead wire which was removed from the battery terminal on the starter relay.
4. Connect a voltmeter lead to the alternator lead wire which was removed from the battery terminal of the starter relay. Connect the other voltmeter lead to the negative terminal of the battery.
5. Position a thermometer on the regulator cover with the back of the dial approximately one-inch from the cover.

   Refer to manufacturer's specifications for regulator temperature correction factors.
6. Reconnect the battery ground cable. Start the engine and make sure all accessories are off.

7. Operate engine at 1500 r.p.m. for 5 minutes. If ammeter indicates more than 10 amps., top engine and recharge the battery.

With a ¼ ohm resistor installed in series between ammeter and battery, the ammeter should read approximately 2 amps. It is important to cycle the regulator at this time; stop the engine, restart the engine and increase speed to 1500 r.p.m.

Allow the battery to normalize for about a minute, then read the voltmeter and the thermometer. If the regulated voltage is not within specifications bend the lower spring hanger downward to increase or upward to decrease voltage.

Field Relay Tests (Mechanical Regulators Only)

A 150 ohm rheostat and a voltmeter are used to check the voltage required to close the field relay. This test is normally made with the voltage regulator on the bench. Use a 6-volt battery if a rheostat of less than 100 ohm capacity is used.

TEST PROCEDURE

Refer to Figure 31.

1. Disconnect the regulator connector plug and remove the regulator cover.
2. Connect the 150 ohm rheostat to the positive battery post, and to the "S" terminal of the regulator.
3. Connect the voltmeter positive lead to the "S" terminal of the regulator, and the negative lead to the regulator base.
4. If the test is performed on the bench, connect a ground wire from the regulator base to the negative terminal of the battery.
5. Place the rheostat in the full counterclockwise (maximum resistance) position. Slowly rotate the rheostat clockwise from the maximum resistance position until the field relay contacts close.
6. Observe the voltmeter reading at the moment the relay closes.

TEST CONCLUSIONS

The relay closing voltage should agree with manufacturer's specifications. The lower spring hanger may be adjusted downward to increase or upward to decrease closing voltage requirements.

(Transistorized Regulators Only)

Basic test equipment for checking a transistorized alternator regulator includes a 12-volt test lamp, a voltmeter and a field rheostat of not less than 50 ohms. (A potentiometer may be substituted for the field rheostat.) Figure 32 illustrates these devices installed in a test circuit.

TEST PROCEDURE

1. Disconnect the relay connector plug and remove the relay cover.
2. Install a voltmeter between the relay "S" terminal and battery negative post, a fully loaded 50-150 ohm field rheostat or potentiometer between the relay "S" terminal and battery positive post, and a 12-volt test lamp between the relay "R" terminal and battery ground.
3. Complete a circuit between the battery and relay by installing jumpers between the relay "G" terminal and battery ground and between the relay "B" terminal and battery positive post.
4. Gradually rotate the field load control knob to decrease the load in the circuit. Continue this action until the test lamp glows.
5. At the instant the test lamp first goes on, note the voltmeter reading. THIS IS THE RELAY CLOSING VOLTAGE.

TEST CONCLUSIONS

The relay closing voltage should agree with manufacturer specifications. If not, it should be replaced.

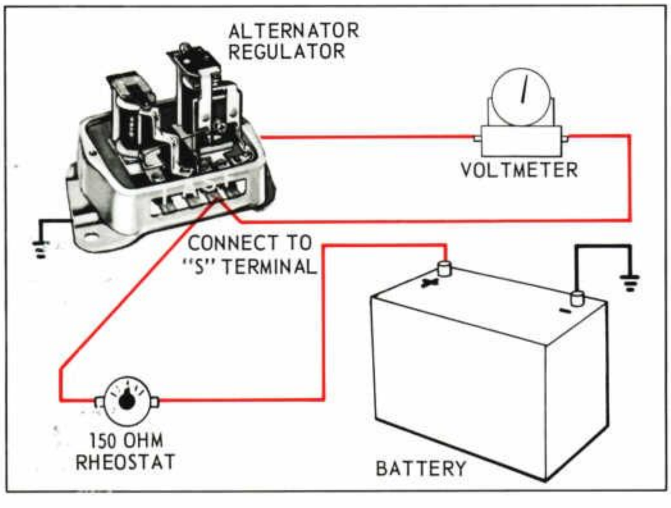


FIGURE 31. FIELD RELAY TEST — MECHANICAL REGULATORS

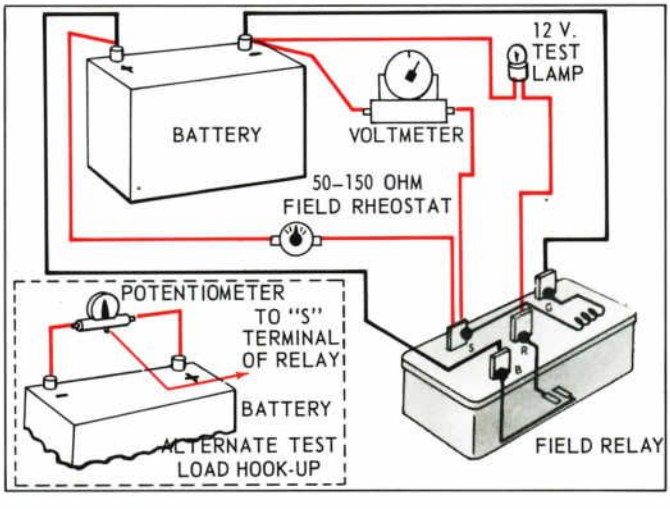


FIGURE 32. FIELD RELAY TEST—TRANSISTORIZED REGULATORS

Neutral Voltage Test

Refer to Figure 33.

1. Be sure that all lights and electrical accessories are turned off.
2. Remove the connector plug from the regulator. Remove the regulator cover, and install the connector plug.
3. Start the engine and operate at idle speed.
4. Connect the negative voltmeter test clip to the regulator base.
5. Connect the positive voltmeter test clip to a small screwdriver and touch the screwdriver to the center rivet at the front of the regulator. Use care to touch only the rivet or associated terminal; avoid contact with the screw heads and terminals nearby.

SERVICE NOTE:

The reader's attention is directed to the alternate hook-up shown in the illustration with the neutral (tester) terminal provided in the harness.

6. If the unit is operating properly, the voltmeter will indicate 6 volts minimum and the field relay will be closed.

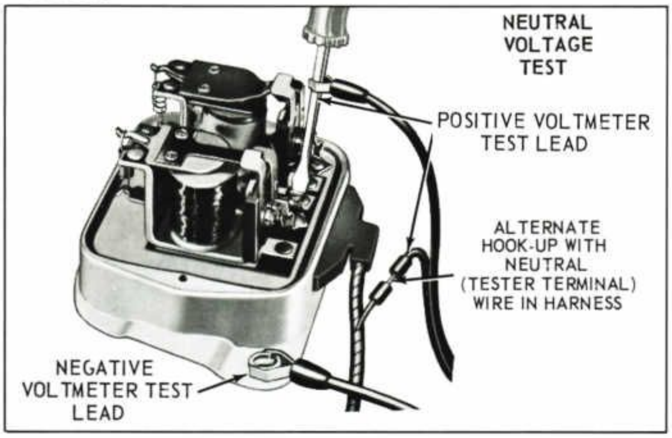


FIGURE 33. NEUTRAL VOLTAGE TEST

TEST CONCLUSIONS

1. If the voltage is over 6 volts, but the relay does not close, check the relay adjustments or replace the regulator.
2. If the field relay does not close, and less than 6 volts is indicated, check the 15-ohm resistor wire (hooked in parallel with the indicator light bulb) and the wiring harness and connector plugs for an open or faulty connection.
3. Low voltage can also be caused by low output from the alternator which would have been discovered during the output test.

Bench Tests

Diodes

1. With the stator and diode and plate assembly removed from the rear housing, connect the test clip

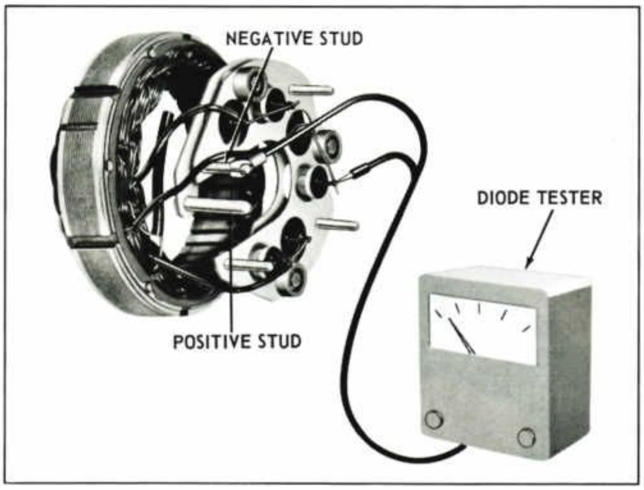


FIGURE 34. BENCH TESTING DIODES

from the diode tester to the negative stud. Agitate the connections gently while testing the diodes to locate intermittent conditions. (See Figure 34.)

2. Touch the test prod to each of the three stator wires that connect the positive and negative diodes together. Generally, the meter reading should be the same for all three diodes. A low reading will usually indicate a faulty soldered connection at one of the diode terminals.
3. Move the test clip to the positive stud and repeat the test, as outlined in the preceding steps.

STATOR

Shorted turns within any coil, and coil-to-coil shorts will usually burn or discolor the insulation on the affected turns or coils.

COIL TEST

The purpose of the coil test is to locate shorted coils and faulty neutral junction splices. In effect, the test hook-up results in a high current "ohmmeter" which is sensitive to slight changes in coil resistance.

Procedure

1. With the stator assembly disconnected from the diode and plate assembly, connect the voltmeter test clips to the coil wire directly. A separate carbon pile rheostat, in series with an ammeter, and a 12-volt battery comprises the basic circuit.
2. Adjust the carbon pile to produce 20 amperes of current flow and read the voltmeter. Refer to the application specification in the specifications section of this manual.
3. If the voltage is too high, check the splice and repair. Test the stator when the repairs are complete. If voltage is still too high, replace the stator. If the voltage is too low, a section of the coil is shorted and the stator must be replaced.

Ground Test

The stator must be disconnected from the diode and

FIGURE 35. STATOR WINDING GROUND TEST

plate assemblies when this test is made. Faulty or damaged insulation between the coil wires and the stator core can cause grounded stator coils.

Procedure (Continuity Test Lamp)

1. Insert the plug into a 115 volt A.C. outlet. Use a 7 to 15-watt bulb.
2. Touch one test prod to a bare metal surface of the stator core, and the other prod to a bare stator lead wire. The test lamp should not light. (See Figure 35.)
3. Replace the stator assembly if even the slightest glow is seen in the test lamp.

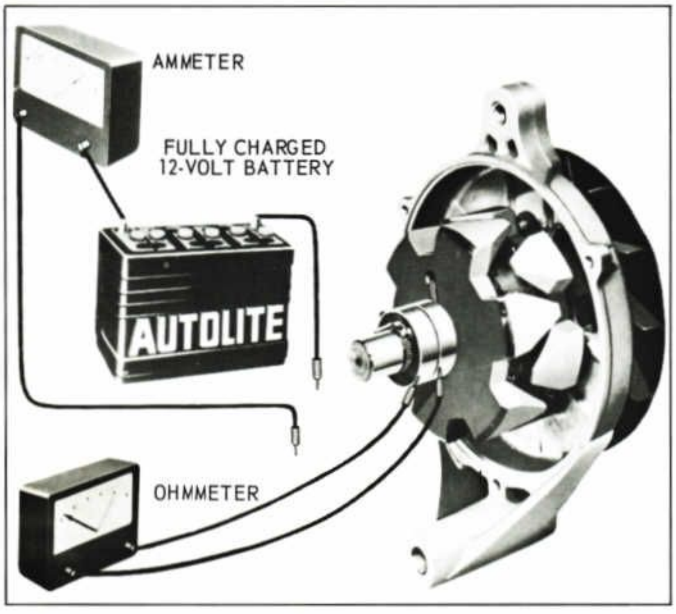


FIGURE 36. ROTOR COIL RESISTANCE TEST

ROTOR CORE TEST

Insulation will flake off a badly burned rotor coil. Replace a rotor having a discolored or burned coil.

Do not attempt to measure coil resistance through the brushes of an assembled alternator. The brushes add resistance. (See Figure 36.)

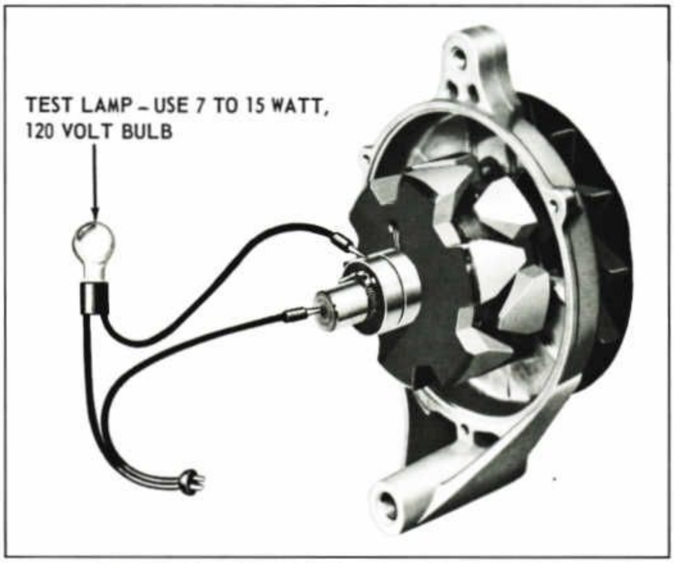
Procedure

1. Use either an ohmmeter or an ammeter to check rotor coil resistance. A fully charged 12-volt battery must be used. Ammeter readings could vary if the battery voltage is not precisely 12-volts.
2. Inspect the soldered connection at the slip ring terminals. Repair, if necessary, and check the coil.
3. Replace the rotor assembly if the coil fails the prescribed test.

Ground Test

Grounded rotor coils are caused by defective coil or lead wire insulation which allows wire contact to some metal part of the rotor. Damaged regulator voltage limiter contacts usually result from the increased field currrent flow.

A relatively high voltage is used in this test to detect slight leakage before actual failure occurs. Use care to avoid electrical shock from bodily contact with the test prods during use. Remove the plug from the outlet when the tester is not in use.



FGURE 37. ROTOR COIL GROUND TEST

1. Insert plug into a 115-volt A.C. outlet. Use a 7- to 15-watt bulb. (See Figure 37.)
2. Touch one test prod to a bare metal surface of the rotor shaft, and the other to the slip rings. The test lamp should not light.
3. Replace the rotor assembly if even the slightest glow is seen in the test lamp.

OTHER ALTERNATOR CHARGING SYSTEMS

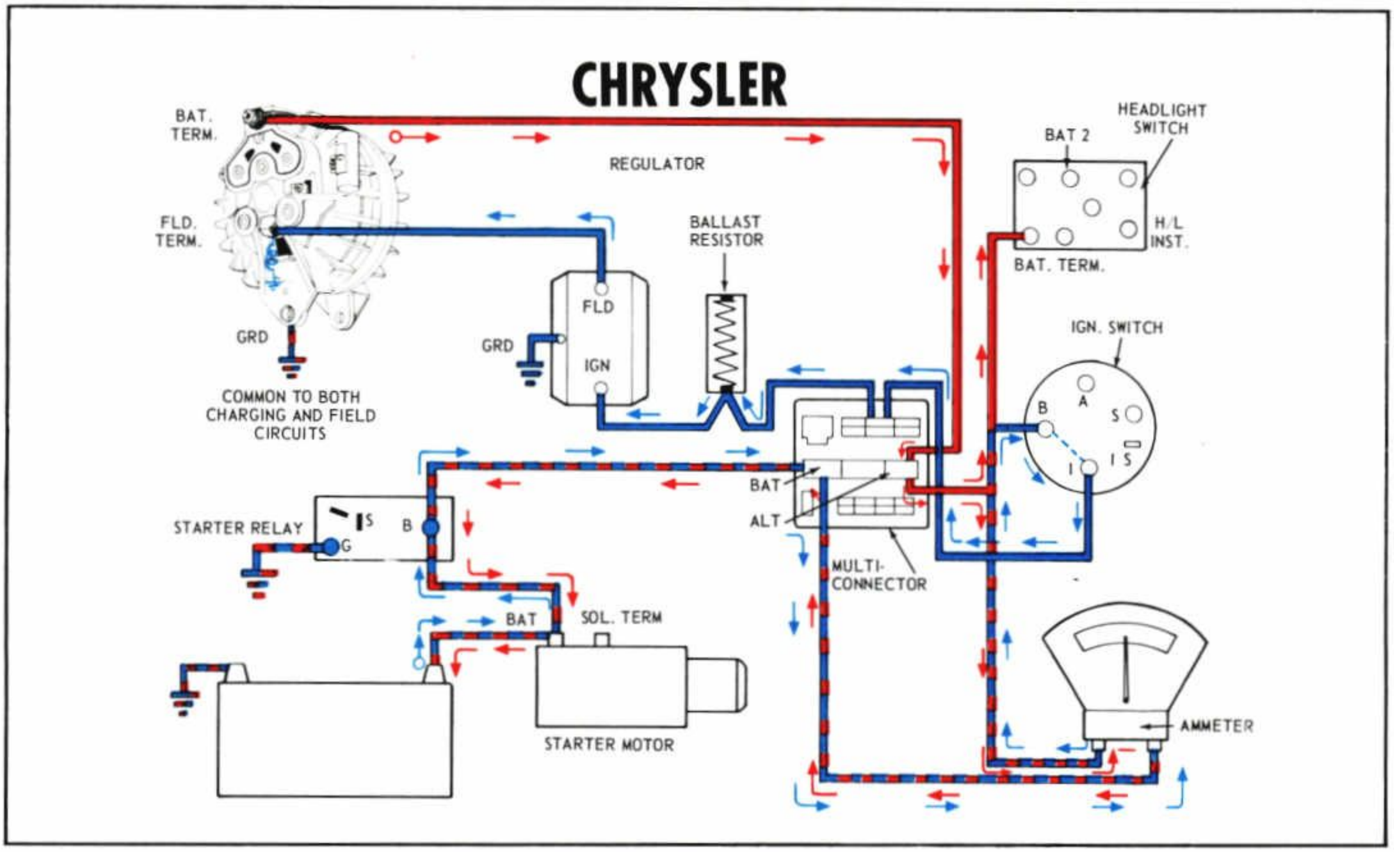


FIGURE 38. CHRYSLER ALTERNATOR CHARGING CIRCUIT

TEST SEQUENCE

Be sure field circuit resistance and charging circuit resistance are within specifications before making further system tests.

SERVICE NOTE:

As a safety precaution, remove the vehicle ground cable before connecting instrument leads.

Field Circuit Resistance Test

1. Disconnect either end of the ignition ballast resistor.
2. Turn ignition switch ON.
3. Connect positive voltmeter lead to the battery positive post and negative lead to the regulator "field" terminal.
4. Read lowest voltage scale. Drop should not exceed 0.3 volt.

Charging Circuit Resistance Test

1. Disconnect the charging circuit wire from the alternator battery terminal.
2. Connect an ammeter in series between the alternator battery terminal and the disconnected battery wire.
3. Connect positive voltmeter lead to the battery wire at ammeter connection and negative voltmeter lead to the positive battery post.
4. Disconnect the field leads from both alternator and regulator field terminals. Connect a jumper lead from alternator battery terminal to alternator field terminal. NOTE: Observe ammeter reading before the ignition is turned on and before engine is started.
5. Test ammeter now registers FIELD CURRENT DRAW. A reading of less than 2.4 amperes indicates high resistance inside the alternator. A reading of more than 2.8 amperes indicates shorted field coils.
6. If the field current draw is within specifications proceed with a charging circuit resistance test. Start engine and adjust R.P.M. until a reading of 10 amperes is obtained on the test ammeter. Voltage drops should not exceed 0.3 volt.

Current Output Test

1. Leave ammeter in series as in preceding resistance tests.
2. Move voltmeter negative lead to a good ground.
3. Connect a carbon pile rheostat across the battery. Be sure the rheostat is in the "off" or "open" position.
4. Leave jumper wire between alternator "bat" and "fld" terminals.
5. Adjust engine speed to EXACTLY 1250 R.P.M.

6. Adjust carbon pile rheostat to obtain EXACTLY 15 volts and read ammeter. Turn rheostat "off" immediately after taking ammeter reading. Compare to manufacturer's specifications.

Voltage Regulator Tests

1. Leave ammeter and voltmeter connected as in output test.
2. Remove the jumper wire and reconnect field wire to the alternator and regulator field terminals. Make sure that ignition switch is off to prevent an accidental ground which will cause regulator and field circuit damage.
3. Remove the carbon pile rheostat.
4. Start engine and adjust speed to 1250 R.P.M. and turn on lights and/or accessories to obtain a 15 ampere output. Operate engine at this speed and load until temperature is normalized.
5. Note voltage reading and compare to specification. (This is upper contact regulation.)
6. Increase engine speed to 2200 R.P.M.
7. Turn off all lights and accessories and observe the voltmeter and ammeter. Voltage should increase a minimum of 0.2 volt but not more than 0.7 volts. Ammeter should not register more than 5 amperes.
8. Adjust regulator by increasing or decreasing voltage regulator spring tension as required to obtain the desired specification.

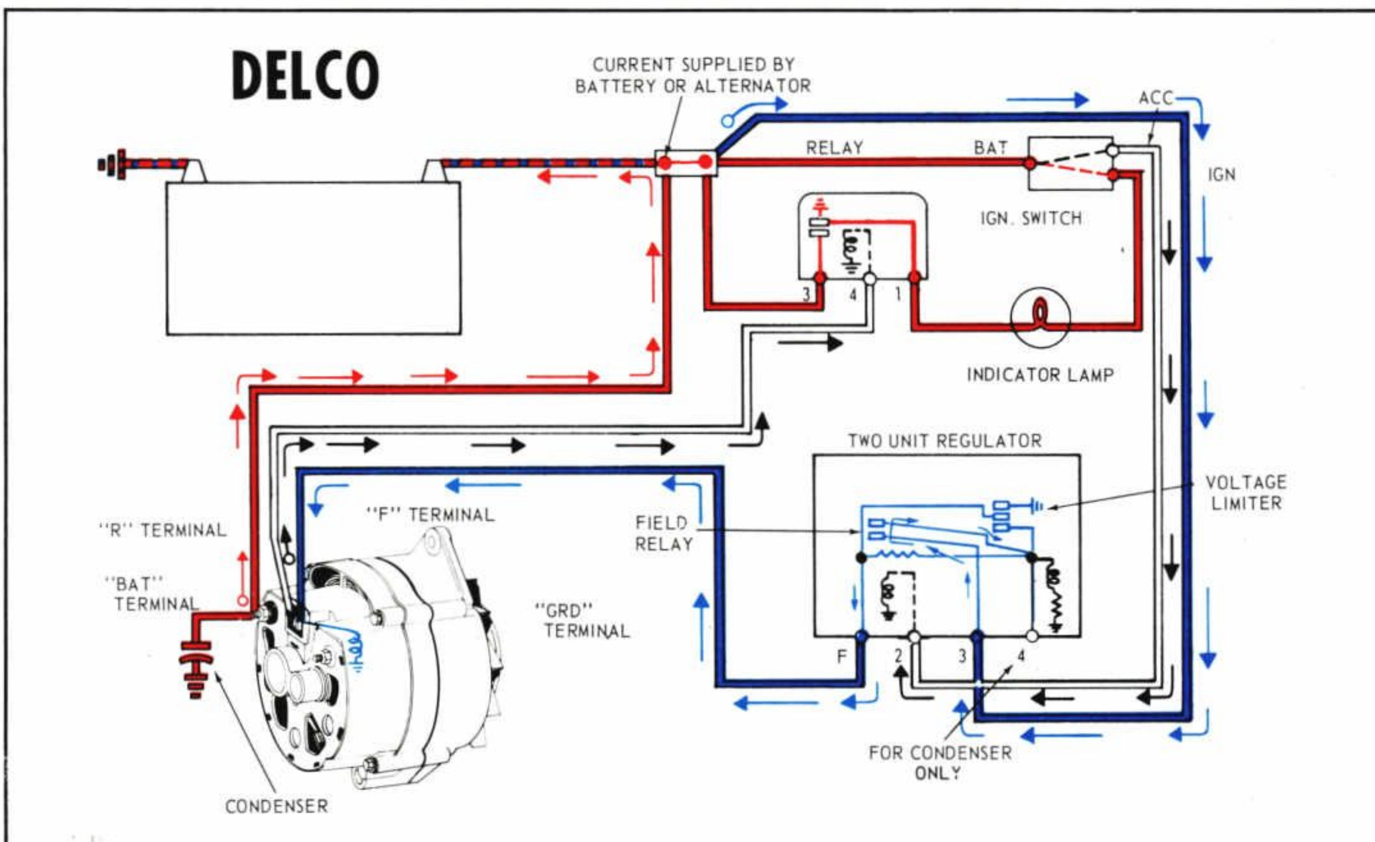


FIGURE 39. DELCO ALTERNATOR CHARGING CIRCUIT

SERVICE NOTES:

Trouble in the charging circuit will usually be indicated by one or more of the following conditions:

1. Faulty indicator lamp operation.
2. Undercharged battery–evidenced by slow cranking.
3. Overcharged battery – evidenced by excessive water usage.

Before making any electrical checks, visually inspect all connections to make sure that they are clean and tight. Avoid accidental contact with the units when removing or replacing the regulator cover.

CAUTION: Remove the vehicle ground cable before connecting instrument leads.

INDICATOR LAMP RELAY TEST

If the lamp fails to light when the ignition switch is closed, check for a burned out bulb. (No. 57 – 12 volt, 2 candle power.) If the lamp does not go out with the ignition switch opened, check for a shorted diode in the alternator. If the lamp fails to go out with the alternator in operation, the fault may be in the relay or in the alternator itself. To determine which, make the following checks:

1. Connect a voltmeter from the alternator "R" terminal to ground. (Adapter wire is necessary.)
2. Operate the engine at moderate speed, and observe the voltmeter reading.
3. If the voltmeter reading is 5 volts or more, and the lamp fails to go out, the indicator lamp relay is defective and must be replaced.
4. If the voltmeter reading is less than 5 volts, alternator trouble is indicated.

ALTERNATOR OUTPUT TEST

1. Connect ammeter in series between alternator "Bat" terminal and "Bat" terminal wire.
2. Connect voltmeter from alternator "Bat" terminal to ground.
3. Remove regulator "F" terminal lead wire and attach this disconnected wire (with a jumper) to the regulator "V" terminal.
4. Load vehicle battery with carbon pile rheostat to limit voltage to recommended specifications.
5. Start engine and adjust speed to specified R.P.M. Ammeter should read rated output.
6. If rated output cannot be reached, remove alternator from vehicle for complete bench testing.

VOLTAGE LIMITER TESTS (2-UNIT CONTROL)

The air gap adjustment is critical to obtain the required differences in voltage setting between the upper and lower sets of contacts. The initial setting is only approximate and is made by the "feeler gauge" method. Final adjustment is whatever is required to obtain the specified differences.

1. Connect an ammeter and a ¼ ohm resistor (25 watt rating) in series between the alternator "Bat" terminal and the disconnected "Bat" lead wire.
2. Connect a variable resistor (25 ohm, 25 watt capacity) in series between the regulator "F" terminal and the disconnected field lead wire. Turn to "No Resistance" position.
3. Disconnect regulator "V" terminal lead and connect a jumper lead from the regultor "V" terminal to the alternator "Bat" terminal.
4. Connect a voltmeter from regulator "V" terminal to ground.
5. Operate engine at 1500 R.P.M. for 15 minutes – leave cover on regulator and turn off all accessories and lights. Finally, cycle the alternator, as follows:
   a. Turn variable field resistor to full resistance position.
   b. Disconnect – then reconnect the jumper lead at the regulator "V" terminal.
   c. Return variable field resistor to the no-resistance position.

CAUTION: Do not disconnect the jumper lead when field resistor is in the "no resistance" position.

6. Increase engine speed to 2500 R.P.M. Compare voltage reading to specification. Voltage limiter is now operating on its upper contacts. If it will not operate on the upper contacts, battery should be at least partially recharged before proceeding.
7. Turn spring-hanger adjusting screw to obtain the specified voltage setting. Always turn screw clockwise to make final setting.
8. Recycle the alternator – as explained in Step 5, above.
9. Operate engine at 2500 R.P.M. and note voltage setting; readjust, if necessary.
10. To check lower contact regulation, slowly increase the resistance of the variable resistor while the engine is operating at 2500 R.P.M. Note voltage reading and compare to specification.
    a. If lower contacts do not operate, load battery with carbon pile or turn vehicle headlights on.
    b. The use of earphones connected across the regulator "F" and "SW" terminals is often used to determine which set of points are in operation. A visual observation is less desirable as the removal of the cover affects the temperature stabilization.
11. A difference in voltage of upper and lower contact operation is increased by increasing the armature air gap and decreased by decreasing the armature air gap.
12. If air gap adjustment is made, it is necessary to recheck the voltage setting of both sets of contacts.

FIELD RELAY TESTS

1. Connect a variable resistor (50-75 ohm) in series between the regulator "SW" terminal and detached lead wire.
2. Connect voltmeter from regulator "SW" terminal to ground.
3. Turn resistor to "open" or full resistance position.
4. Turn ignition switch "on". If oil pressure switch is used, place jumper temporarily across terminals.
5. Slowly decrease resistance and note closing voltage of the relay.
6. Adjust to specification by bending the heel iron (armature hinge support.)

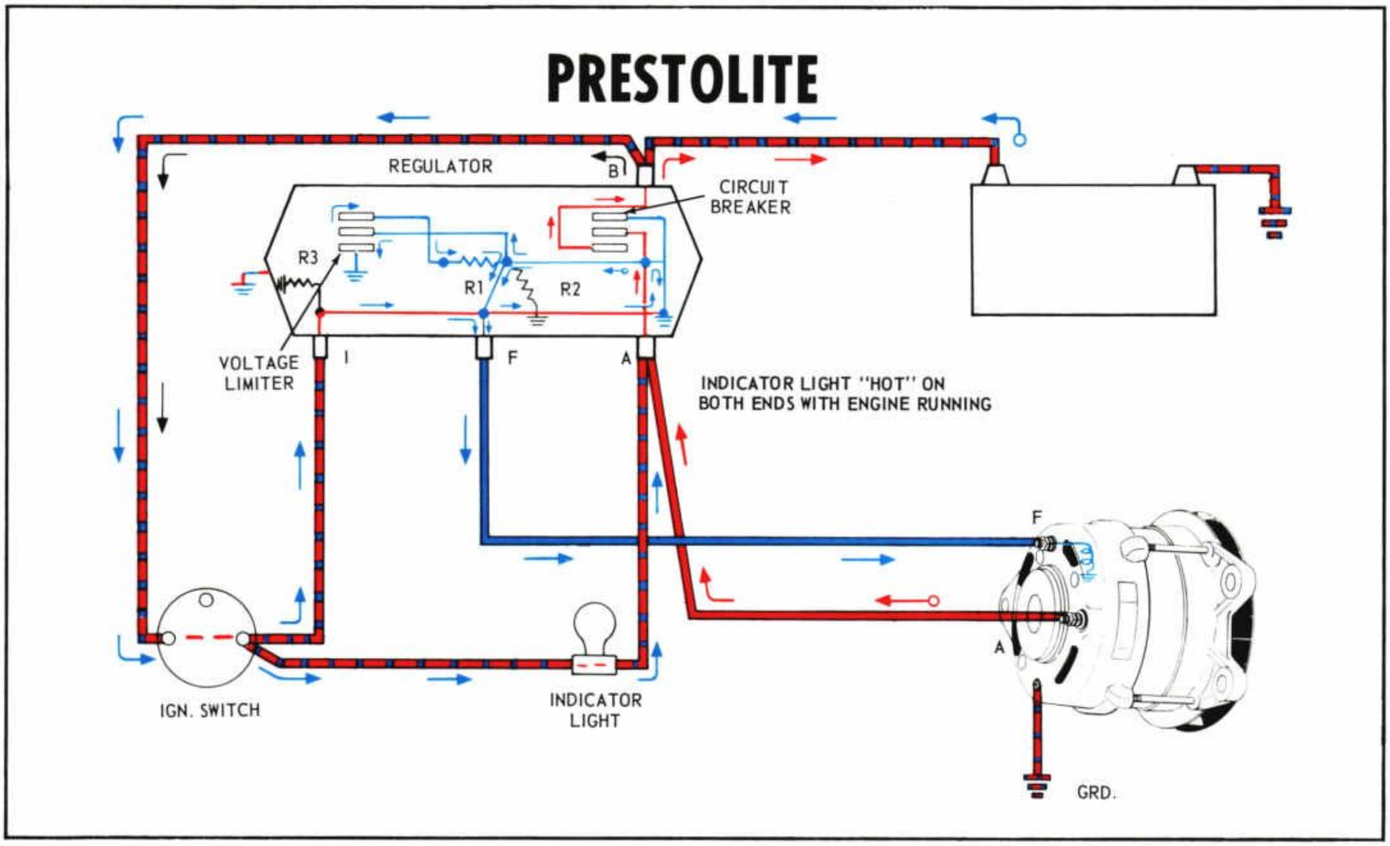


FIGURE 40. PRESTOLITE ALTERNATOR CHARGING SYSTEM

OPERATIONAL CIRCUIT BREAKER TEST

SERVICE NOTES:

Most alternator manufacturers no longer make use of the circuit breaker because of the one-way action of the diodes. For background purposes, the following information is included:

This alternator regulator consists of a voltage-regulator and a circuit breaker and can be identified by four terminals marked I, F, A, and B. No current regulator is required because the alternator is inherently self-limiting.

The cicuit breaker unit has a built-in polarity sensing feature which acts as a safety device to isolate the alternator output terminal from battery potential when the system is not in operation. This eliminates damage to the alternator, wiring harness and components of the charging system if a battery was accidentally installed with incorrect ground polarity.

The circuit breaker is a dual contact unit with the upper stationary and upper movable contacts closed in the "at rest" position. The circuit breaker winding has a tap at approximately 1/3 of the winding distance from one end. This tap is connected to the regulator "I" terminal. When the ignition switch is turned on, the winding is energized at the tap and from this point, there are two paths for current to flow. One path through each portion of the winding. This differential establishes two magnetic fields; one opposing the other and the upper contacts remain closed.

The alternator rotor winding is energized through a portion of the C.B. winding to the circuit breaker upper contacts and through the regulator upper contacts to the regulator field terminal and to the alternator rotor winding. As alternator voltage increases and is applied to the regulator "A" terminal and to the circuit breaker upper contacts, it opposes the voltage in this portion of the winding to the tap; thereby, reducing current flow, and in turn reduces the magnetic field. The current flow in the winding connected between the tap and regulator ground remains undisturbed and its magnetic field overcomes the reduced bucking field from the other portion of the winding. The current breaker armature pulls down to connect the battery and alternator together. The circuit breaker will not connect the alternator and battery together if battery should be accidentally connected with reverse polarity.

1. Turn on the ignition switch – charge indicator lamp should light.
2. Start engine, light should go out.
3. Stop engine, and with ignition switch off, charge indicator lamp should not be lighted.

If trouble is indicated, check the battery, wiring and all connections, ignition switch, light bulb, and alternator output.

If an ammeter is used with this regulator, in place of the charge indicator light, the ammeter should not indicate discharge when the ignition switch and all accessory switches are in the "off" position.

OUTPUT TEST

SERVICE NOTE:

As a safety precaution, remove vehicle ground cable before connecting instrument leads.

1. Disconnect "A", "F", and "B" leads from regulator and attach these three leads together. Place a test ammeter in series, between this multiple connection and the alternator "A" terminal.
2. Connect a carbon pile rheostat across the battery.
3. Connect a voltmeter from alternator "A" terminal to ground.
4. Start engine and adjust engine speed to 1750 R.P.M.
5. Adjust carbon pile rheostat to obtain a voltage reading of 14.2 volts. Ammeter should now read rated output; ±2 amps.
   a. A reading of 5 amperes less than specifications indicates an open diode.
   b. If alternator output will not exceed 10 amps and "growl" or "hum" is audible, a shorted diode is indicated.

VOLTAGE LIMITER TEST

THE REGULATOR IS THE LAST ITEM TO BE TESTED.

The regulator is usually not the troublemaker. If all of the other items listed above are checked and irregularities corrected, the regulator, or circuit breaker unit, will usually need no adjustment.

The first part of this test checks the operating voltage of the regulator when operating on the upper contacts. Use a fully charged battery.

1. Start engine and adjust speed to obtain approximately 1800 alternator R.P.M. Turn on lights and accessories to obtain a 10 to 12 ampere charge rate. Operate the system at this speed and load for 15 minutes to normalize the temperature. (This regulator is temperature compensated.)
2. Cycle the system by stopping and restarting the engine, then note the voltmeter reading. If seriously out of adjustment, a rough setting may be made. The final setting is not made until the "spread" between operation on the upper contact is established. This value is determined in the next part of the test which checks voltage when the regulator is operating on the lower grounding contact.
3. Test connections remain the same as for the previous part of the test. Increase engine speed to obtain 3500 alternator R.P.M. minimum, and turn off all lights and accessories. Voltage should increase and amperage should decrease. The "spread" in voltage should be as indicated by the manufacturer. The battery must be fully charged to make this test for "spread" between operating on upper contacts and operating on lower contacts. Check the spread using a 12 to 15 ampere load while the alternator is operating at 3500 R.P.M. minimum. Switch the load on and off and wait 15 seconds, then again read the voltmeter. The difference between the two readings is the "spread". A 1/4 ohm resistor may be used in the charging circuit to check operation on lower grounding contacts. The final regulator reading may now be made after cycling the system; adjust if necessary. Use 12 to 15 ampere load.

   The use of a 2000 ohm radio headphone is recommended while checking the spread. Connect the headphone from the regulator field terminal to ground. (USE CARE NOT TO ACCIDENTALLY GROUND THE FIELD TERMINAL TO AVOID DAMAGE TO THE REGULATOR CONTACT REED AND WIRING.) While operating on the upper contacts, the frequency will be rather slow compared to the much faster frequency of point operation on the lower grounding contact. During certain conditions of engine speed and load, the regulator armature is in the float position with neither the upper nor lower set of contacts operating. The regulator armature float may occur at approximately 2400 alternator R.P.M., depending upon the regulator setting and regulator operating temperature, along with state of charge of battery. (Headphone will detect this condition.)
4. With a cold regulator and a fully charged battery, turn on headlights for one minute to remove surface charge before operating the engine. If on generator-regulator test bench – remove surface charge from battery with a carbon pile.
5. If the "spread" is greater or less than specified, remove the regulator cover and adjust by loosening the stationary contact support screw and moving the support up or down. (A small amount of up or down movement will usually make quite a change in spread.) Raising the stationary support will increase the voltage "spread".
6. Replace the cover and reduce the alternator speed to approximately 1800 R.P.M. and repeat the first part of the test with the regulator operating on the upper contact. If the voltage setting is not within specifications, remove the cover and adjust by bending the lower spring hanger. (Use insulated spring hanger bending tool.) Replace the cover and cycle after each trial adjustment to obtain accurate readings. AFTER REPLACING COVER, BE SURE TO RUN AT LEAST 3 MINUTES BEFORE

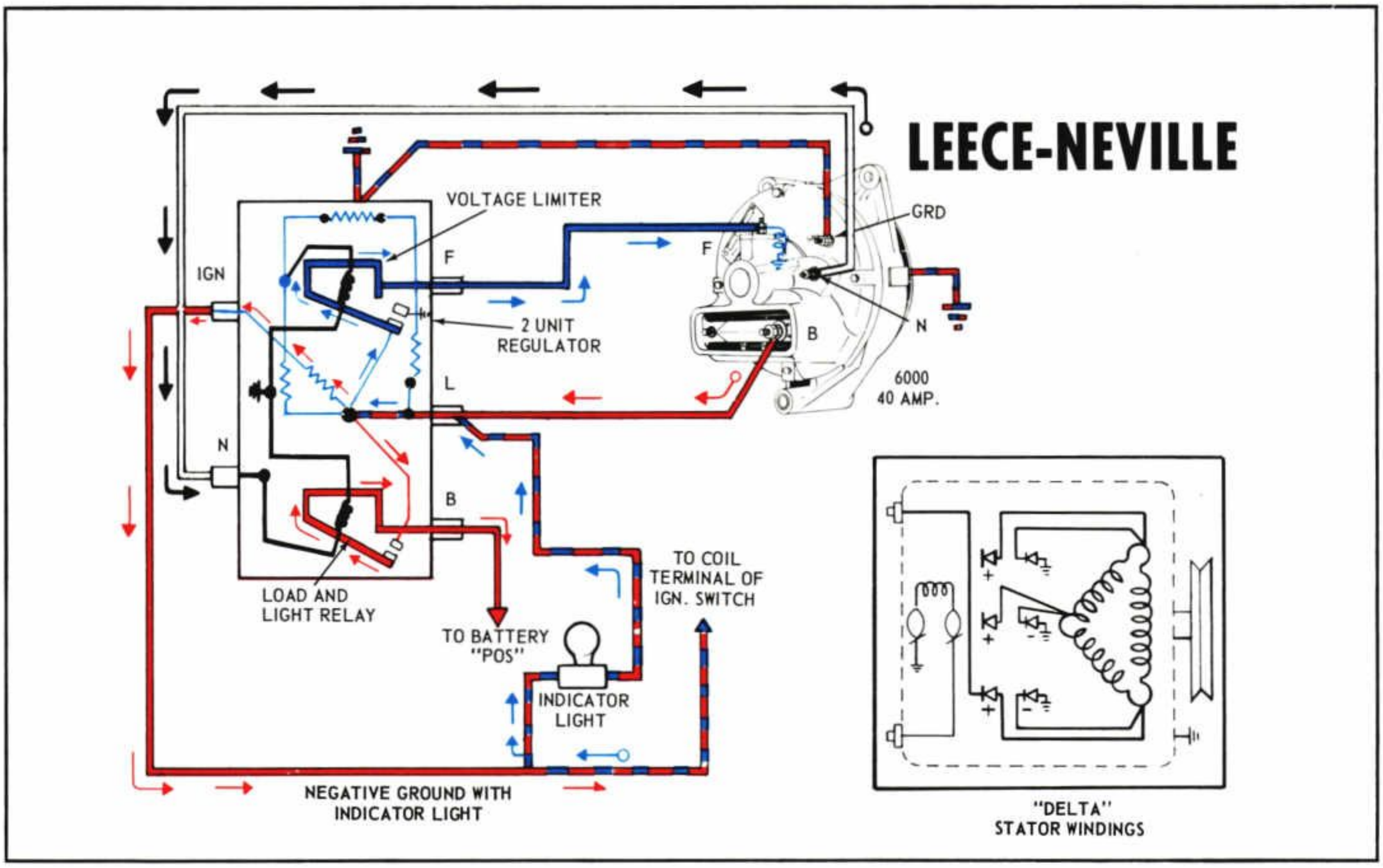


FIGURE 41. LEECE-NEVILLE ALTERNATOR CHARGING SYSTEM

The above illustration provides a line drawing of the "Delta" stator winding as an example of an alternator using this type of diode to stator hook-up.

SERVICE NOTE:

As a safety precaution, disconnect the vehicle ground strap before connecting instrument leads.

1. Remove "F" lead from alternator.
2. Attach jumper lead from alternator "B" to "F" terminals.
3. Attach an ammeter in series between alternator "B" terminal and vehicle battery.
4. Start engine, slowly raise R.P.M. and note ammeter reading.
   a. High rate of charge indicates satisfactory operation.
   b. Low or no rate of charge indicates alternator must be removed from vehicle for further tests.

CAUTION: BE ESPECIALLY CAREFUL NOT TO CONNECT THE JUMPER LEAD FROM "F" TERMINAL TO GROUND OR FROM "F" TERMINAL TO "G" TERMINAL ON THE ALTERNATOR. SUCH A CONNECTION WILL RESULT IN BURNED OUT JUMPERS, OR FUSED REGULATOR CONTACTS.

REGULATORS WITHOUT "N" TERMINAL

MEASURING POINT	RESISTANCE (OHMS)	REMARKS
B to G	Open	L.R. Open
B to G	0	L.R. Closed
B to Base	Open	L.R. Open
G to Base	16	L.R. Open
F to G	0	V.R. Outer Contacts Closed
F to G	15	V.R. Armature Floating
F to G	8	V.R. Inner Contacts Closed
F to Base	16	V.R. Outer Contacts Closed
G to Base	16	V.R. Outer Contacts Closed
IGN to Base	50	V.R. Outer Contacts Closed
IGN to F	70	V.R. Outer Contacts Closed
IGN to F	80	V.R. Armature Floating
IGN to F	50	V.R. Inner Contacts Closed
IGN to G	70	V.R. Outer Contacts Closed
IGN to G	70	V.R. Armature Floating
IGN to G	60	V.R. Inner Contacts Closed

REGULATORS WITH "N" TERMINAL

MEASURING POINT	RESISTANCE (OHMS)	REMARKS
B to L	Open	L.R. Open
B to L	0	L.R. Closed
B to Base	Open	L.R. Open

REGULATORS WITH "N" TERMINAL (Cont'd.)

MEASURING POINT	RESISTANCE (OHMS)	REMARKS
L to Base	16	L.R. Open
F to L	0	V.R. Outer Contacts Closed
F to L	15.5	V.R. Armature Floating
F to L	8	V.R. Inner Contacts Closed
F to Base	16.5	V.R. Outer Contacts Closed
L to Base	16.5	V.R. Outer Contacts Closed
IGN to Base	42	V.R. Outer Contacts Closed
IGN to F	26	V.R. Outer Contacts Closed
IGN to F	42	V.R. Armature Floating
IGN to F	34	V.R. Inner Contacts Closed
IGN to L	26	V.R. Outer Contacts Closed
IGN to L	26	V.R. Armature Floating
IGN to L	26	V.R. Inner Contacts Closed
NEUT. to Base	8.2	L.R. Open
NEUT. to IGN	50	L.R. Open
NEUT. to B	Open	L.R. Open

RESISTANCE TESTS

1. Attach an ohmmeter between the regulator terminals. The values should not vary more than 5% of the values tabulated in the accompanying resistance charts.
2. All other circuit resistance tests may be conducted as described previously by connecting a voltmeter in parallel (across) any portion of the suspected circuit.

FIELD AND LAMP RELAY TEST

SERVICE NOTE:

This alternator uses a regulator consisting of two elements; a voltage limiter and a relay. The relay element is used as a field relay on regulators numbered 3628RA and 3629RA, and as a load relay on numbers 3630RA and 3631RA. This multipurpose relay also serves as a lamp relay. When used as a load relay element, it serves the same function as the reverse current relay in the conventional D.C. system.

1. Connect a 12-volt battery to regulator "N" terminal and to the regulator ground. (Base)
2. Insert a variable resistor in series between the regulator "N" terminal and one lead of the battery.
3. Connect a voltmeter from the regulator "N" terminal to ground.
4. Begin with full resistance and slowly decrease the resistance until the relay points close (1.9 to 2.4 volts).
5. Adjust spring tension to obtain the specified setting.

LOAD RELAY TEST

This test is used when the regulator is not equipped with an "N" terminal. They are numbered 3532RA and 3533RA.

1. Connect a 12-volt battery to regular "IGN" terminal and to the regulator ground. (Base)
2. Insert a variable resistor in series with one lead of the battery.
3. Connect a voltmeter from regulator "IGN" terminal to ground.
4. Begin with full resistance and slowly decrease the resistance until the relay points close (1.9 to 2.4 volts).
5. Adjust spring tension to obtain the specified setting.

VOLTAGE LIMITER TEST

1. Connect a voltmeter from regulator "B" terminal to ground.
2. Connect an ammeter in series between the regulator "B" terminal and the vehicle battery (3631RA). In series between the alternator "B" terminal and the vehicle battery. (3629RA)
3. Insert a variable resistor between regulator "B" terminal and the battery ground.
4. Connect a pair of earphones (not less than 1,000 ohms) to the regulator "F" and "G" terminals.
5. Close the battery and "IGN" switch.

NOTE 1: Before setting each voltage, the alternator speed must be reduced to zero and the ignition switch turned off momentarily.

6. Raise the alternator speed slowly and listen for the vibration which will indicate the START OF REGULATION on the outer contacts (top contacts). This vibration should start when the voltage is 14.1 to 14.5 volts. To increase voltage, bend the lower arm of the spring bracket down. To decrease the voltage, bend the lower arm up. Refer to Note No. 1.
7. Slowly increase the alternator RPM past the START OF REGULATION until the vibration ceases and the voltage reaches its maximum value. This will occur immediately before the armature starts to vibrate on the inner (bottom) set of contacts. This maximum voltage (14.8) is known as the TRANSFER VOLTAGE. The transfer voltage is obtained by varying the spring tension as in Step 4. Refer to Note No. 1.
8. Again increase the alternator speed slowly past the TRANSFER VOLTAGE until the armature vibrates on the inner (bottom) contacts. At this point the voltage should be 14.1 to 14.5 volts. This voltage is called the REGULATOR OPERATING VOLTAGE. The regulator operating voltage is obtained by adjusting the core gap. Increase the gap to increase the voltage. Decrease the gap to decrease the voltage. This is done by loosening the contact block locking screw. Raise or lower contact block, as required.

NOTE 2: In making any electrical setting it is not necessary to reset the CONTACT gaps.

CURRENT LIMITER TESTS (IF SO EQUIPPED)

1. Raise the alternator speed to 2,000 R.P.M. Close the resistance load. The Current Limiter contact

should vibrate and limit the line current. For correct setting refer to manufacturer's specifications.

2. To increase the current setting, increase the spring tension by bending the lower arm of the spring bracket down. To decrease bend the lower arm up.

FINAL VOLTAGE SETTING (COVER ON)

The following check should be made to insure proper regulation under severe shock loadings, temperature changes and speed variations encountered in service.

1. Allow the regulator to operate long enough to bring it up to the operating temperature.
2. With the alternator operating at approximately 2,000 R.P.M. and a resistance load of approximately 25 amperes, shock the regulator by opening and closing the resistance load switch several times.
3. Remove the resistance load, stop the alternator, and momentarily turn-off the ignition switch. With only battery load connected, again bring the alternator speed up to approximately 2,000 R.P.M. and check the voltage. The OPERATING VOLTAGE should be 13.6 to 14.0 volts. If this voltage is not maintained, vary the armature spring tension to obtain the specified voltage.

SERVICE NOTE:

Lower contact regulation immediately after transfer, must not be more than .2 volt lower and .1 volt higher than start of regulation.

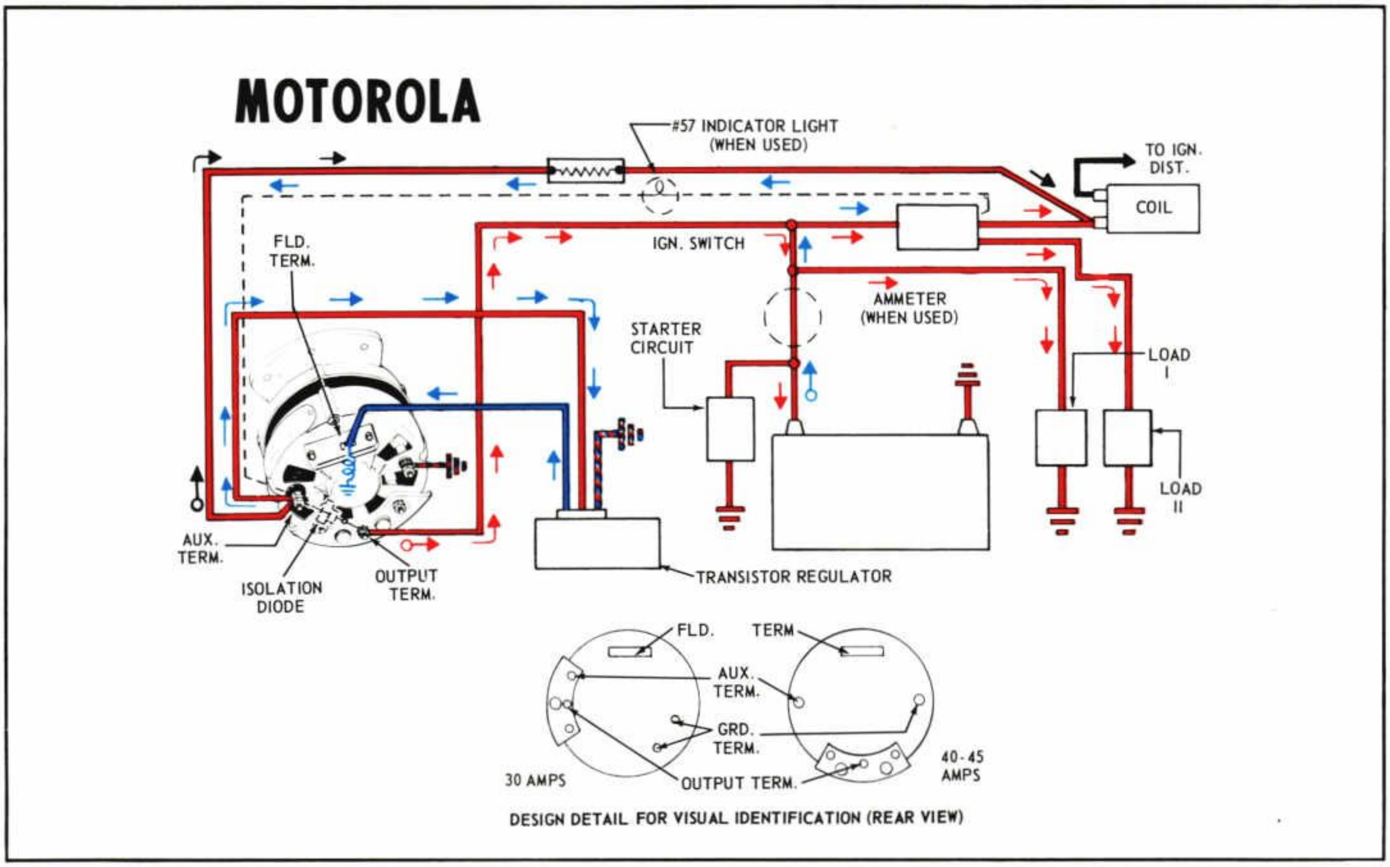


FIGURE 42. MOTOROLA ALTERNATOR CHARGING SYSTEM

SERVICE NOTES:

1. The alternator and regulator may be tested "In Vehicle" or in a "Bench Test" set up.
2. The Motorola all electronic voltage regulator is a factory sealed unit. It has no moving parts, therefore, requires no adjustment.
3. As a safety precaution, remove vehicle ground cable before connecting instrument leads.

ISOLATION DIODE TEST

If it is suspected that the battery is being discharged with the ignition switch and all accessories OFF, the cause could be a shorted isolation diode.

Make certain that the regulator is connected to the alternator; then measure the voltage appearing at the auxiliary terminal. With ignition switch and all accessories OFF, the voltage at the auxiliary terminal should read 0 VOLT. If voltage is shown, it indicates excessive leakage through the isolation diode and that the diode must be replaced.

FIELD CIRCUIT TESTS

With Key On – Engine Not Running

With voltmeter positive lead attached to auxiliary terminal and negative lead attached to ground, the correct voltage at auxiliary terminal is approximately 1.5 volts. If voltage at auxiliary terminal is higher than 2 volts, field circuit is defective – check brushes. If voltage reads 0 volts at auxiliary terminal, check 75 ohm resistor and associated circuit. If this voltage is not correct, make a Field Draw Test.

With Engine Running

Correct voltage at auxiliary terminal is 15.4 volts and at output terminal is 14.4 volts. If voltage at auxiliary terminal is 15.4 volts while at output terminal it is 12 volts (battery voltage) the isolation diode is open.

Field Draw

This test also evaluates complete field circuit. It is conducted with the ignition switch in the "OFF' position. In this instance, it is independent of voltage regulator. Circuit is through brushes, slip-rings, field coil to ground. With ammeter in series between output and field terminals and field wire disconnected, current should be 2 to 2.5 amps. If less than this, check brushes and slip rings. IT IS DESIRABLE TO USE A FIELD RHEOSTAT IN SERIES FOR PROTECTION OF THE AMMETER. IF FIELD IS SHORTED, EXCESSIVE CURRENT FLOW THROUGH THE AMMETER COULD RESULT IN POSSIBLE DAMAGE TO THE METER.

This test isolates defect to either the alternator or regulator if made under the following conditions:

1. Field plug is disconnected.
2. Regulator plug is disconnected.
3. Auxiliary terminal is shorted to field terminal.
4. Engine is running at idle.

If voltage at auxiliary terminal rises to 15-16 volts now, when it did not with regulator connected, then defect is in regulator and it should be replaced. If voltage does not rise at auxiliary terminal, defect is in alternator stator or rectifier diodes, if field circuit checked out properly. For defects in stator or diodes, remove alternator.

BATTERY CHARGING CIRCUIT TEST

This test checks the condition of the battery charging and negative ground return circuit. The test should be performed with a fully charged battery in good condition so that the current output can be completely controlled with the external load (carbon pile). Battery connections should be cleaned and tightened prior to test.

1. Connect an ammeter in series with the alternator output terminal and output cable.
2. Connect a carbon pile load across the battery.
3. Start engine and adjust engine speed and carbon pile load for 10 amperes of alternator output current.
4. With engine speed and carbon pile adjusted to 10 amperes of output current, measure the charging circuit voltage drop from negative side of ammeter to positive battery terminal. The voltage drop must not exceed .3 volts.

   If the voltage drop exceeds .3 volts, check all wiring and connections in charging circuit. A voltage drop test across each connection will locate the faulty connection. Clean and tighten all connections and repeat test.
5. With the alternator current output adjusted to 10 amperes, measure the voltage drop of the battery ground return circuit. Connect voltmeter from alternator ground terminal "G" to negative (–) battery terminal. Voltage drop must not exceed .15 volt. If voltage drop exceeds .15 volt, check battery ground cable connections at engine and/or grounding straps between body and engine (if any). Make certain alternator is well grounded through its mounting bracket to engine.

   If the foregoing tests did not localize the faulty component and the alternator system is not functioning properly, remove alternator from car for further testing.

PRE-INSTALLATION TEST

SERVICE NOTE:

As a precautionary measure, the following "Pre-Installation Test" will help to assure the technician that the alternator has been assembled correctly after unit has been disassembled.

After alternator assembly has been completed, install brush assembly and make the following insulation test to make certain that the positive diode assembly is properly insulated, as follows:

1. Connect a test lamp (12 volt DC only) to auxiliary terminal and ground terminal.
2. Then, reverse test lamp probes.

Test lamp should light in one direction but not in the other direction.

Overhaul Procedures

The materials in this section of the manual have been separated into the two design categories established earlier . . . "1963-64" and "1964-66." Removal procedures – and then, installation procedures are provided for each category. Next, step-by-step disassembly, cleaning and inspection, and assembly procedures are provided for 1963-64 designs in the sequence listed. The sequence is then repeated for 1964-66 designs.

Removal

1963-64 DESIGN

1. Disconnect the battery ground cable and raise car on hoist.
2. Remove the alternator shield, if applicable.
3. Remove the nut and washer from the alternator output and ground terminal studs. Pull the wiring harness plug connector from the alternator.
4. Loosen the alternator to mounting bracket and the adjusting arm bolts. Remove the drive belts.
5. Remove the attaching parts and the alternator.

1964-66 DESIGN

1. Disconnect the battery ground cable, then raise the car on a hoist.
2. Loosen the alternator mounting bolts and remove the adjustment arm to alternator bolt.
3. Disengage the alternator mounting bolt, disconnect the alternator wiring harness and remove the alternator.

Installation

1963-64 DESIGN

1. Position the alternator and attaching parts on the engine and install screws finger-tight.
2. Install and adjust the belts, tightening all mounting bolts.
   W[illegible] adjusting the drive belt tension, always [illegible] pry bar against the rear of the front hous-[illegible]ver pry against the stator section of the alter[illegible]tor.
3. Install the wiring harness plug connector and tighten the nuts.

1964-66 DESIGN

1. Attach th[illegible] [illegible]lternator wiring harness. (See Figure 43.) Position the alternator to the engine, and install the alternator mounting bolt finger tight.
2. Install the adjustment arm to alternator bolt.
3. Adjust the belt tension. Apply pressure on the alternator front housing only, when tightening the belt. Tighten the adjusting arm bolts and the mounting bolt.
4. Lower the car and connect the battery ground cable.

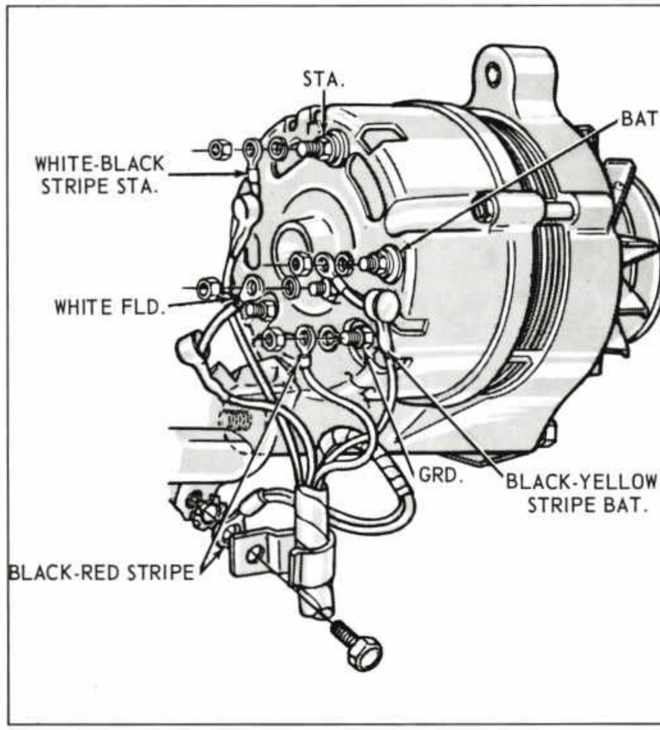


FIGURE 43. TERMINAL CONNECTIONS (1964-66 ALTERNATOR)

The alternator is polarized every time the ignition switch is turned to the ON position. Therefore, attempting to polarize the alternator is a waste of time and will damage the voltage regulator and wiring harness. Never attempt to polarize the alternator.

Disassembly

1963-64 DESIGN

1. Scribe mark both the front and rear housing to assure proper alignment when the parts are again to be assembled.
2. Use a small screwdriver to raise the brushes; use a ventilation hold on the rear surface of the housing for accessibility. Hold the brushes in the retracted position by installing a short length of 1/8 to 1/32 inch diameter brazing rod, or similar stiff wire, through the hole in the bracket provided for the purpose. (See Figure 44.)
3. Remove the screws attaching the rear housing to the front housing. Separate the stator core from the front housing. Use a screwdriver in one of the six core slots for stubborn cases. Guide the stator past

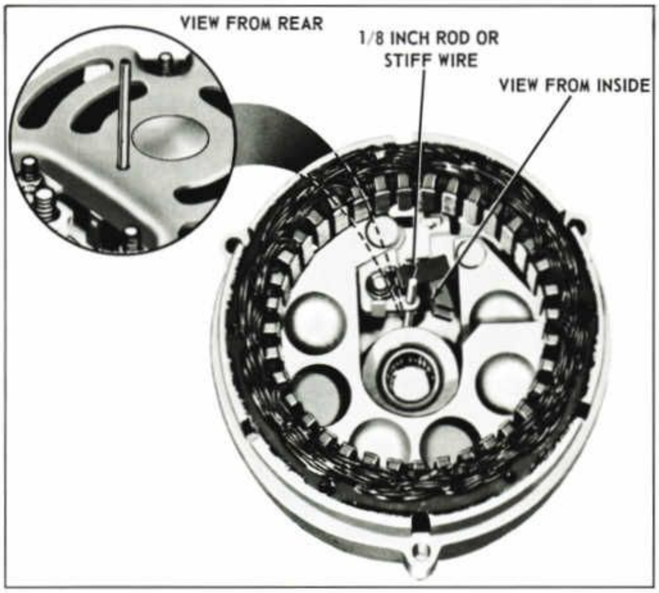


FIGURE 44. REMOVING STATOR CORE AND COIL ASSEMBLY FROM HOUSING.

the rotor core, keeping the brushes clear of the greasy rotor shaft.

4. Remove the four nuts and lockwashers from the studs protruding through the rear housing.
5. Separate the stator core from the rear housing. Use a screwdriver in one of the six core slots for stubborn cases.
6. Push the diode plate studs through the holes in the rear housing and remove the housing.
7. Remove the two spacer sleeves from the diode plate studs. (See Figure 45.)

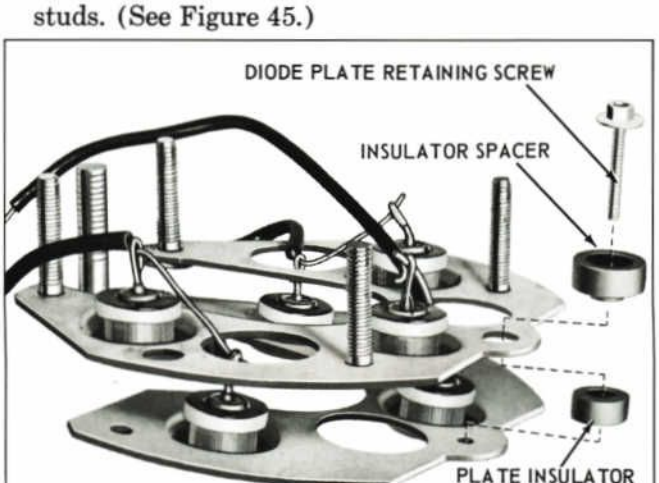


FIGURE 45. REMOVING SPACER SLEEVES AND DIODE PLATE STUDS

8. If the rear bearing requires replacement, position the rear housing in an arbor press.
9. Use appropriate stock, or bearing removal tool.
10. Support the rear housing at the area directly below the bearing boss to prevent breakage or distortion of the housing.
11. Press the bearing from the rear housing.
12. If the components of the rectifier assembly are to be serviced, remove the stator wires from the diode lead wires. Unsolder the stator lead wire from the diode. Open the hook and remove the stator wire from the hook. Use a long-nose pliers, between the hook and diode, to conduct heat away from the diode. Excess heat can destroy a diode. (See Figure 46.)

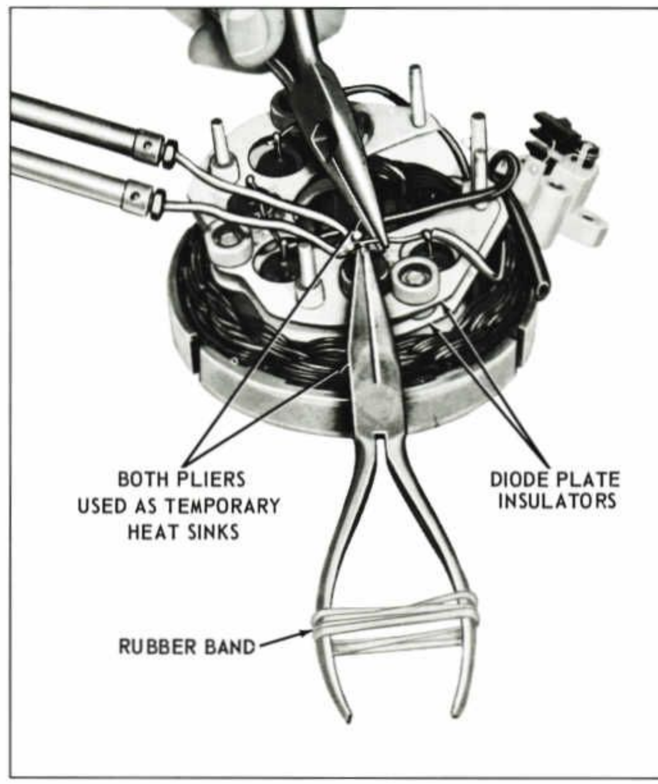


FIGURE 46. DISCONNECTING STATOR AND DIODE LEAD WIRES

(If only the positive diode plate is to be replaced, only the positive plate diodes need be disconnected. All diodes must be disconnected when the negative (upper) plate is to be replaced.)

13. Remove the screws and insulators attaching the positive plate to the negative plate.
14. Slide the terminal spacer off the studs.
15. If the terminal spacer or stator assembly is to be replaced, unsolder the neutral wire from the blade terminal at this time.
    a. Slide both brushes out of the brush holders.
    b. Use pliers to straighten the locking tabs to permit removal of the terminal blade with the brush attached. (See Figure 47 on the next page.)
    c. Use a small screwdriver to unhook the spring from each brush holder. Slide the spring eye off

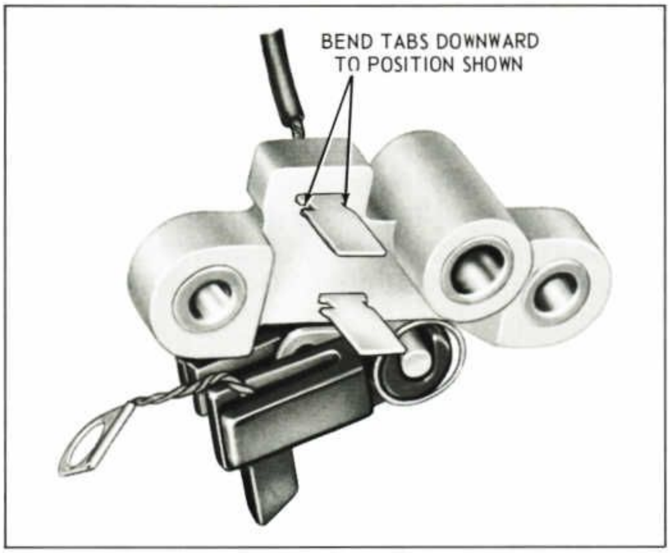


FIGURE 47. REMOVING TERMINAL SPACER AND BRUSH HOLDER ASSEMBLY

one of the holders, and remove it from the assembly.

d. Slide the brush holders off the terminal spacer. Unsolder the flexible stator wire from the blade terminal; then, remove the terminal spacer.

16. To remove the pulley from the rotor shaft, it is necessary that a special pully remover tool be used. Figure 48 illustrates a typical tool of this type.
17. A special tool is also needed to remove the front bearing and related parts. The procedure is as follows:

a. Remove the three bearing retainer attaching screws.

b. Slide the front housing off the bearing.

c. Position the bearing retainer against the rotor core, and the puller to the bearing outer race. Remove and discard the bearing. (See Figure 49.)

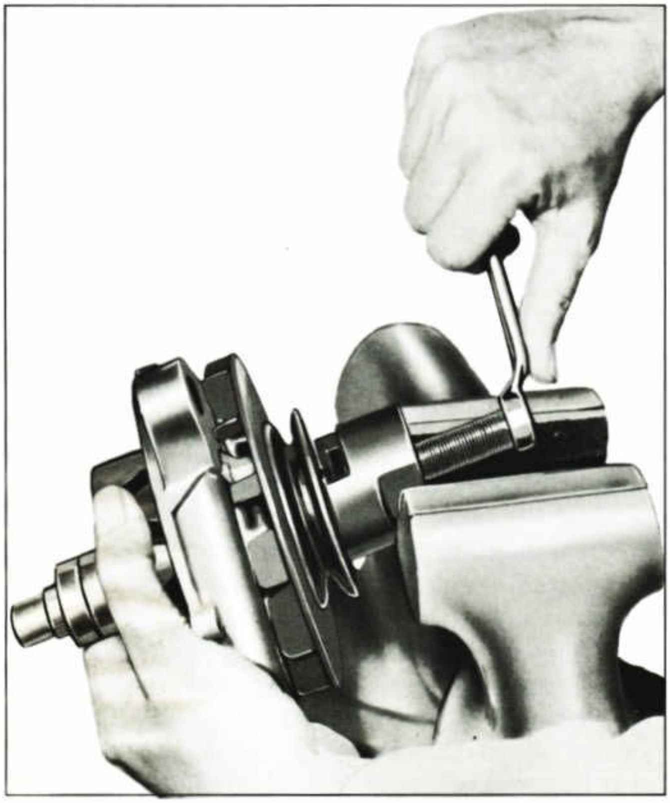


FIGURE 48. REMOVING ALTERNATOR PULLEY

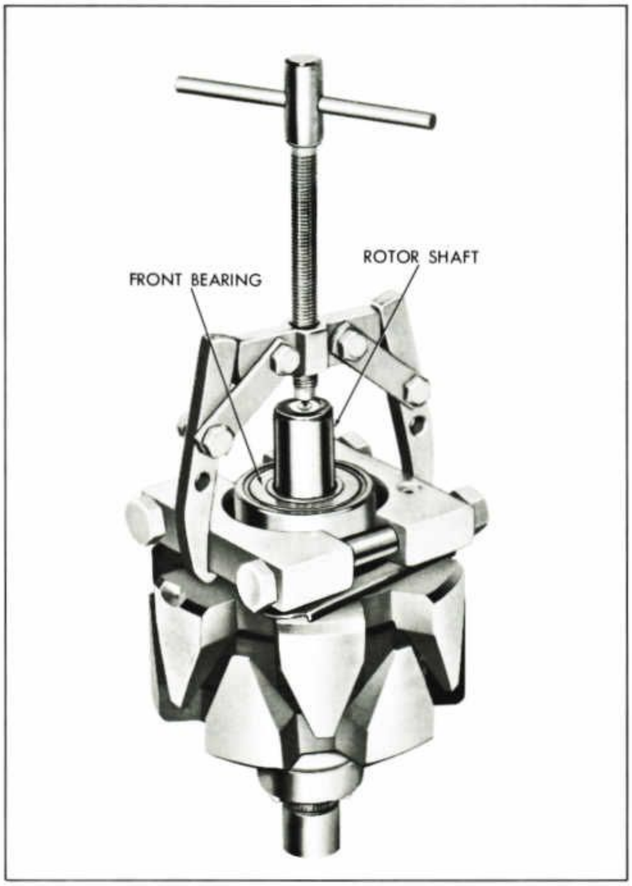


FIGURE 49. REMOVING FRONT BEARING

d. Remove the bearing retainer. Slide the stop off the shaft.

e. Remove the stop ring from the groove.

Cleaning and Inspection

1963-64 DESIGN

1. Inspect the bearing cavity in the front housing for corrosion and pitting. Use a new bearing to test the size of the bore for a slip fit.
2. Check the front housing for cracks, particularly near the threaded mounting ear, at the ribs which support the bearing pocket.
3. Examine the stator coils for discoloration or flaking of the wire insulation. Check for loose coils, loose slot insulation, and for a loose connection at the neutral junction.

4. Check the front bearing for damaged seals, rough spots when turned, or excessive play.
5. Inspect the rear bearing for contamination of the grease by abrasive substances or water. Do not add grease to the bearing; replace the bearing when grease is lost or contaminated.
6. Examine the rear bearing surface of the rotor shaft for roughness.
7. Inspect the rotor coil solder connections at the slip ring terminals. Inspect the coil for discoloration or flaking of the wire insulation.
8. Examine the slip rings for broken terminals, loose attachment to insulator, nicks or surface roughness.
9. Examine the pulley belt grooves for nicks or distortion. Check the fan for bent blades. Inspect the hub for a rusty or corroded bore at the shaft contact area, stripped puller threads, and for bent or cracked pulling flange.
10. Check the brushes for chipped edges, frayed or stiff pigtail lead wires, and proper retention in brush holder arm. Check the brush holder arms for freedom of movement and for spring tension. Examine the spring for damage or distortion.
11. Apply light pressure to the diode terminal wires and to the stator lead wires which connect them together, as a check for cracked wires. Sometimes these cracks are not visible to the naked eye but can be discovered by an attempt to move the wires.

Assembly

1963-64 DESIGN

1. Position the ball bearing in the cavity in the front housing.
2. Position the bearing retainer to the front housing.
3. Install the three hex head bearing retainer screws.
4. Install a new stop ring onto the rotor shaft and into the groove. Do not open the stop ring with pliers or other installation tool.
5. Slide the bearing stop onto the shaft and against the stop ring.
6. Position the rotor assembly in an arbor press with the flat surface at the rear end of the shaft against a flat and true surface of the press. (See Figure 50.)
7. Position a ¾ inch I.D. steel pipe, or a suitable tool between the bearing inner race and the press ram. Press the bearing onto the shaft and against the stop.
8. Position the front housing assembly (with bearing installed) to the rotor shaft.
9. Position the rotor and front housing assembly in an arbor press with the flat surface at the rear end of the shaft against a flat and true surface of the press.

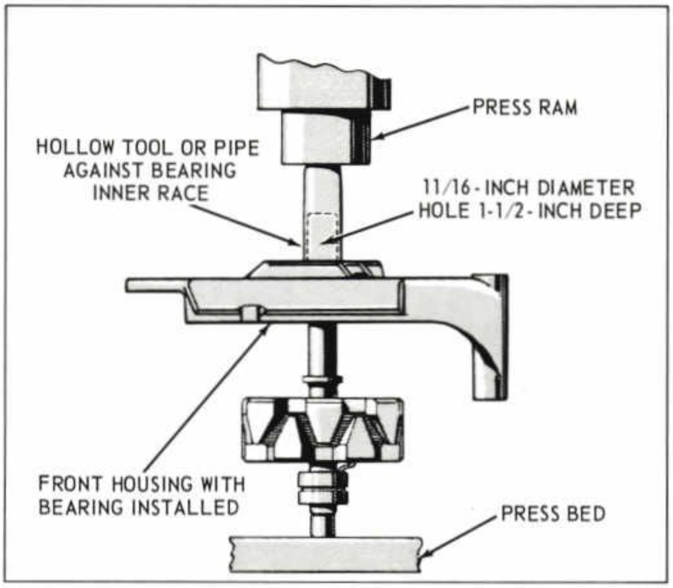


FIGURE 50. INSTALLING FRONT BEARING

(See Figure 51.)

10. Position the pulley squarely against the rotor shaft and bring the press ram into contact with the flange. A pulley which has been removed and installed several times may have to be replaced because of the increased bore diameter. A pulley is not suitable for re-use when more than ¼ of the shaft length will enter the bore of the pulley with light pressure.
11. Press the pulley onto the shaft until the hub just

FIGURE 51. INSTALLING ALTERNATOR PULLEY

touches the inner race of the front bearing.

12. Position both brush holders to the terminal spacer and install the spring.
13. Insert the terminal blade of the brush lead into the slot in terminal spacer. The brush pigtail should extend toward the brush holder. The locking tabs must be visible beyond the outside of the spacer.
14. Lift the inside brush holder and install the brush to the holder.
15. Install the outside brush to the brush holder.
16. Position the positive and negative plate and diode assemblies.
17. Position an insulator spacer between the plates and loosely install a washer-head screw, and a cupped insulator to the negative plate. Loosely install the two remaining insulator spacers, screws, and cupped insulators.
18. Align the terminal spacer with the three diode plate studs. Install the outside brush eyelet terminal to the negative plate stud. The crimped edge of eyelet must fit over the edge of the diode plate. Position the terminal spacer against the negative diode plate.
19. Tighten the three washer-head screws.
20. Form the brush pigtail wires into loops and bend the wires away from each other toward the front and rear, as a precaution against a short circuit.
21. Use fine sandpaper to brighten all wires to be soldered. Tin all wires with rosin core solder. Never use acid core solder for electrical connections.
22. Place a ¼ inch thick wood or fiber block (used as a temporary spacer on top of the stator assembly. Position the diode and plate assembly on the block and adjust the lead wires as shown in Figure 52.

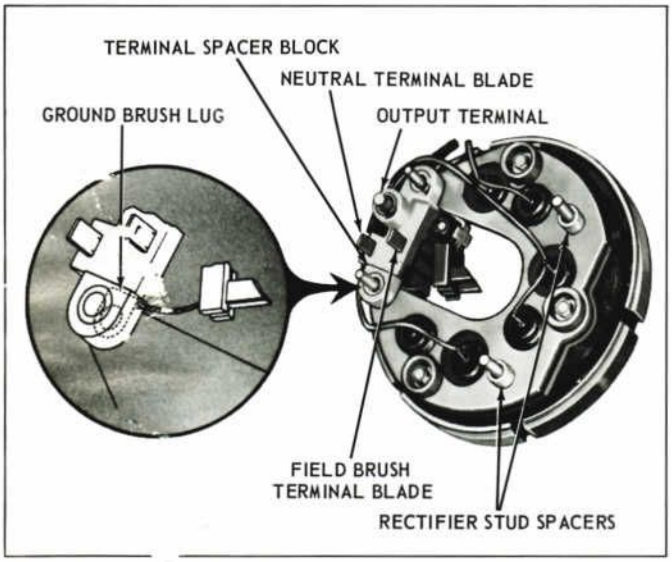


FIGURE 52. INSTALLING TERMINAL BLOCK SPACER

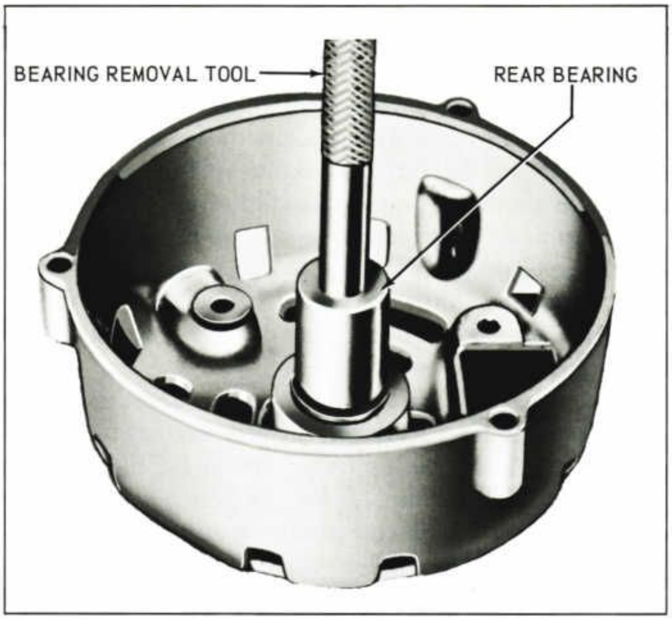


FIGURE 53. INSTALLING REAR BEARING

23. Insert the neutral wire (wire with taped splice) into the hole in the blade terminal of the spacer. Solder the wire to the terminal.
24. Select the longest stator wire (approximately 6½ inches long). Insert the tinned wire into the hooks on the two diodes located between the lower mounting studs. Use gentle round bends; sharp bends may break. Close the hooks onto the wire. Solder the wires to the hooks. Clip off excess wire.
25. Select the next longest stator wire and connect it to the diodes located on the right side. Solder the wire to the hooks according to the prescribed method.
26. Connect the remaining stator wire to the diodes on the left side. Solder the wire to the hooks.
27. Position the wires close to the diode and plate assembly to provide clearance for the rear housing.
28. Place the rear housing on a flat surface in the arbor press. (See Figure 53.)
29. Position the bearing and installation tool square to the rear housing. The installation tool must be cleaned before use. Use a flat washer on the installation tool, or flat stock approximately 1½″ square between the press ram and the bearing.
30. Press the bearing into the housing until the top surface of the bearing is flush with the top surface of boss.
31. Install a spacer on both of the lower diode plate mounting studs.
32. Position the rear housing to the stator and diode plate assembly; align the diode plate mounting studs and the brush holder retracting rod to the proper holes in the rear housing.

33. Install a lockwasher and nut to each of the diode plate mounting studs.
34. Raise the brush holders and insert a length of 1/8 to 3/32 inch diameter brazing rod, or other stiff wire, to retain the holders in the retracted position.
35. Clean the rear bearing end of the rotor shaft before assembly. Align the scribe marks made on both the front and rear housings prior to disassembly. Install the rear housing to the front housing, using care to prevent damage to the brushes by the slip rings. Keep the stator pressed tightly against the rear housing to prevent damage to the wires.
36. Seat the machined portion of the stator core into the step in the front and rear housing.
37. Install the three hex-head screws and tighten them evenly. Remove the brush retracting rod.

Disassembly

1964-66 DESIGN

1. Place a scribe mark on both the front and rear alternator housings to facilitate alignment during reassembly. Refer to Figure 54 for guidance during the disassembly procedure.
2. Remove the three housing through bolts; then, separate the front and rear sub-assemblies.
3. Remove all attaching parts from the rear housing, and slide the housing off the stator and diode plate assembly.
4. Remove the brush holder attaching screws. Then, remove the holder, brushes, brush springs, insulator, and terminal.
5. If the rear bearing is to be replaced, press it from the rear housing. Be sure to support the housing on its inner boss while performing this operation.
6. If a diode plate assembly is to be replaced, unsolder the stator leads from the printed circuit board terminals. Then, separate the stator from the diode plate assembly. Use a 100 watt soldering iron to perform this operation.
7. Remove the drive pulley nut, lockwasher, pulley, fan, fan spacer, rotor, and rotor stop. Refer to Figure 55. (A special tool, similar to that shown in the illustration, is needed to remove the pulley nut.)

FIGURE 55. ALTERNATOR DRIVE PULLEY REMOVAL

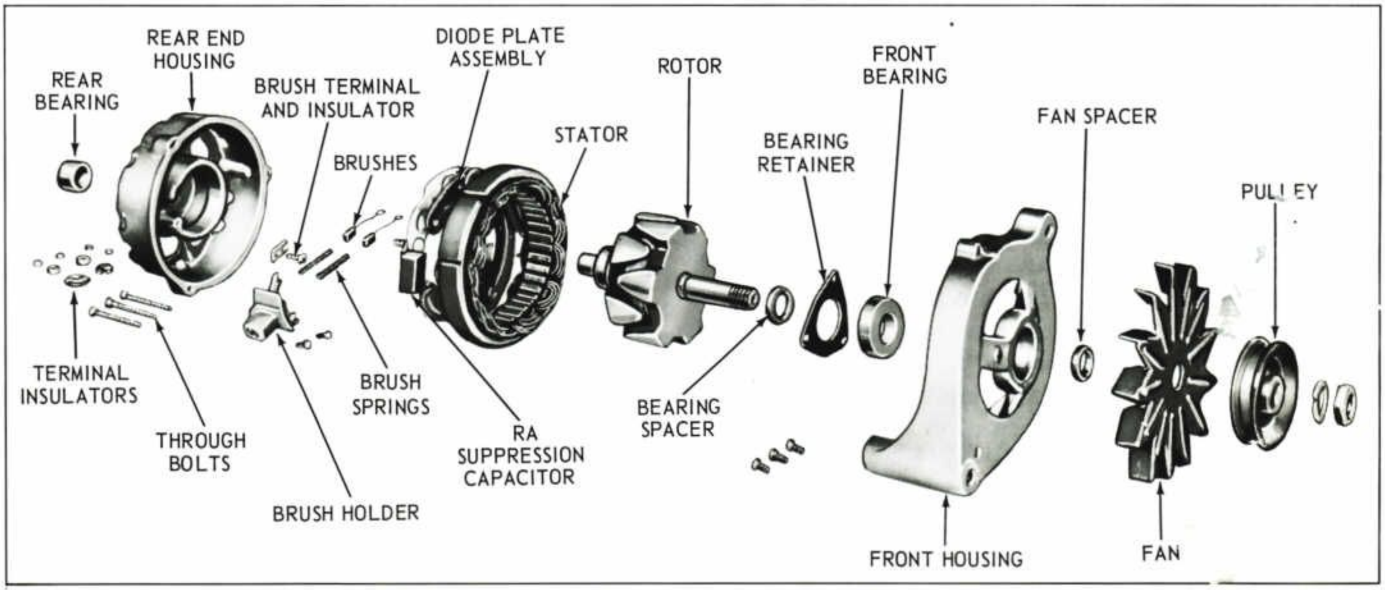


FIGURE 54. 1964-66 ALTERNATOR (EXPLODED VIEW)

8. Remove the three screws which secure the front end bearing retainer and remove the retainer.
9. If the bearing is to be replaced because it is damaged or has lost its lubricant, press it out of the front housing. (Support the housing close to the bearing boss.)

Cleaning and Inspection

1964-66 DESIGN

1. Follow the general instructions provided previously for earlier Autolite designs when cleaning and inspecting alternator components.
2. If slip rings are turned-down to remove nicks and scratches, do not exceed the minimum diameter of 1.22 inches. If the rings are badly damaged, the complete rotor assembly should be replaced.
3. The diode plate assembly is serviced as a unit. If, however, circuit board replacement is preferred, this component is available as a separate service part.

Assembly

1964-66 DESIGN

1. Press the front end bearing into the bearing boss, and install the bearing retainer.
2. If the stop-ring on the rotor drive shaft was damaged, install a new stop-ring. Push the new ring on the shaft and into the groove. Do not open the ring with snap ring pliers as permanent damage will result.
3. Position the rotor stop on the drive shaft with the recessed side against the stop-ring.
4. Position the front end housing, fan spacer, fan, pulley and lock washer on the drive shaft, and install the retaining nut to specified torque.
5. If the rear end housing bearing was removed, support the housing on the inner boss and press in a new bearing flush with the outer end surface.
6. Connect the stator wire to its terminal screw on the positive diode plate. Solder stator wires back onto the rectifier terminals. (Polarity is not important but solder each wire to the nearest terminal with the center wire on the center terminal.) Maintain a spacing of approximately one inch between the circuit board and stator core. Position the radio noise suppression capacitor in the rectifier (if used). Install insulating spacers over the studs on the positive diode plate. The thinnest spacer is located at the noise capacitor. Bend any surplus length of stator wire sideways to prevent interference with the rotor poles during operation.
7. Install the stator and rectifier assembly in the rear housing. Observe terminal locations and insulator colors to be sure that the installation is being properly made.
8. Install the brush springs into the brush holder. Then, install the brushes with their brush pigtail wires (flat end of brush) toward the spring. (See Figure 56.) Locate the pigtail wires in the slots provided for this purpose. Insert a two-inch-long "brush retracting wire" (paper clip) into the hole located on the outside of the rear housing, between the field terminal and the bearing boss. Depress the insulated brush; push the brush retracting wire over the top of the brush and into the hole in the partition between the brushes. Depress the grounded brush and push the retracting wire over the top of the brush to hold it in the retracted position.
9. Before assembling the alternator front and rear sections, inspect the stator leads for proper position. They must clear the rotor then wipe the rear bearing surface of the rotor shaft to insure a clean, dry surface. Be sure that the stator core is properly seated into both housings. Tighten the through bolts evenly by tightening each a little at a time in sequence until all are tight.
10. Remove brush retracting wire and reseal the hole. CAUTION: Damage to the wiring and regulator can occur if the retracting wire is not removed from the alternator.

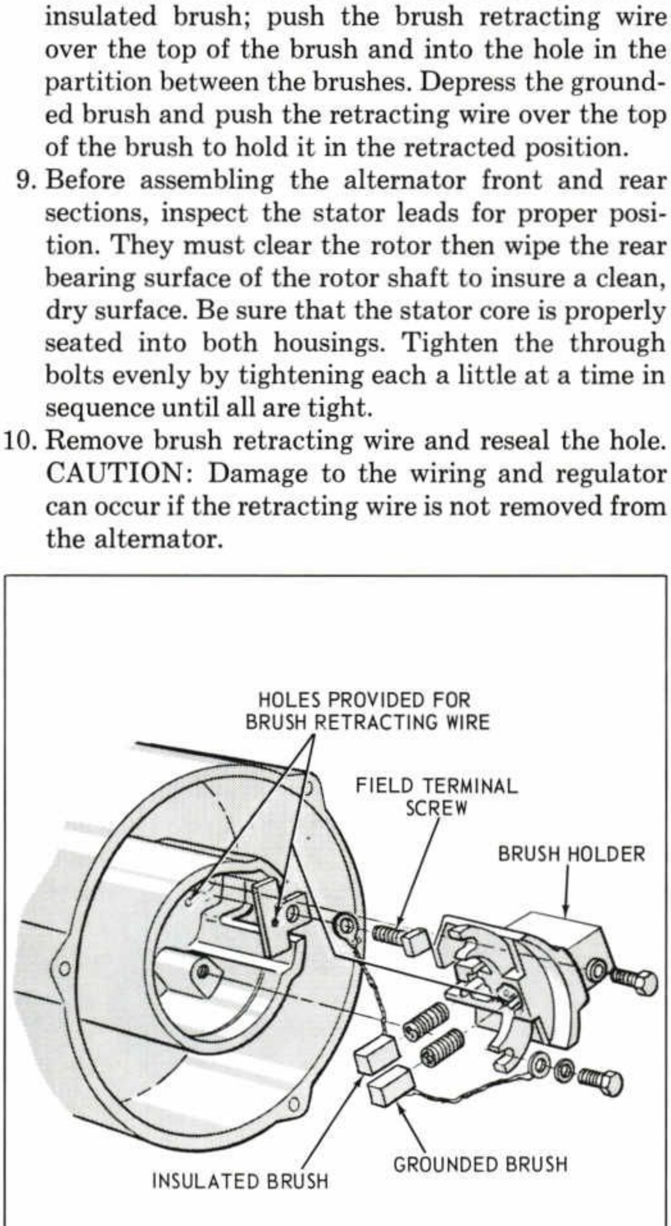


FIGURE 56. BRUSH HOLDER INSTALLATION

Specifications

IDENTIFICATION			ORIGINAL EQUIPMENT		REPLACEMENT PARTS		APPLICATION DATA
MAKE	MODEL YEAR	ENGINE (C.I.D.)	FORD PART NUMBER 10300 (PREFIX & SUFFIX SHOWN)	ALTERNATOR OUTPUT RATING (AMPS.)	AUTOLITE ALTERNATOR SERVICE PART NO.	AUTOLITE ALTERNATOR PULLEY SERVICE PART NO.	REFER TO NOTE NUMBERS BELOW; THEN SEE PG. 54
BRONCO	1966	170	C6DF-A	38	GL-51	GP-468	1
			C6TF-J	45	GL-51	GP-467	2
			C6TF-F	55	GL-52	GP-467	2
COMET	1965	200	C5DF-A	38	GL-51	GP-468	1
		289	C5DF-A	38	GL-51	GP-467	1
			C5DF-A	38	GL-51	GP-467	3
			C5DF-B	38	GL-52	GP-464	4
	1966	200	C6DF-A	38	GL-51	GP-468	1
			C6AF-B	42	GL-51	GP-468	2, 5, 6
			C6AF-G	55	GL-52	GP-464	2, 4, 7, 8
		289	C6DF-A	38	GL-51	GP-468	1
			C6DF-B	38	GL-51	GP-464	9
			C6AF-B	42	GL-51	GP-468	2, 6
			C6AF-C	42	GL-51	GP-464	10
			C6AF-F	55	GL-52	GP-468	3
			C6AF-G	55	GL-52	GP-464	2, 10, 12
		390	C6TF-A	38	GL-51	GP-467	1
			C6DF-B	38	GL-51	GP-464	9
			C6AF-A	42	GL-51	GP-467	2, 6
			C6AF-C	42	GL-51	GP-464	10
			C6AF-G	55	GL-52	GP-464	2, 4, 8, 10
			C6TF-F	55	GL-52	GP-467	3
FAIRLANE	1964	170	C3TF-AF	42	GL-46	GP-401	1
		200	C3TF-AF	42	GL-46	GP-401	1
		260	C3OF-E	42	GL-34	GP-388	1
		289	C3OF-E	42	GL-34	GP-388	1
	1965	200	C5DF-A	38	GL-51	GP-417	1
			C5TF-A	45	GL-51	GP-416	2
			C5AF-J	53	–	–	14
			C5AF-F	55	GL-52	GP-419	2
		289	C5DF-A	38	GL-51	GP-417	1, 3
			C5DF-B	38	GL-51	GP-417	4
			C5AF-D	42	GL-51	GP-418	15
			C5TF-A	45	GL-51	GP-416	2
			C5AF-H	53	–	–	14
			C5AF-F	55	GL-52	GP-419	2
	1966	200	C6DF-A	38	GL-51	GP-468	1
			C6DF-B	38	GL-51	GP-464	16
			C6AF-B	42	GL-51	GP-468	2, 5, 6, 17
			C6AF-C	42	GL-51	GP-464	10, 18, 19
			C5AF-J	53	–	–	14
			C6AF-G	55	GL-52	GP-464	2,4,7, 10, 19, 20

IDENTIFICATION			ORIGINAL EQUIPMENT		REPLACEMENT PARTS		APPLICATION DATA
MAKE	MODEL YEAR	ENGINE (C.I.D.)	FORD PART NUMBER 10300 (PREFIX & SUFFIX SHOWN)	ALTER-NATOR OUTPUT RATING (AMPS.)	AUTOLITE ALTERNATOR SERVICE PART NO.	AUTOLITE ALTERNATOR PULLEY SERVICE PART NO.	REFER TO NOTE NUMBERS BELOW; THEN SEE PG. 54
FAIRLANE (Cont.)	1966 (Cont.)	289	C6DF-A	38	GL-51	GP-468	1
			C6DF-B	38	GL-51	GP-464	9, 21
			C6AF-B	42	GL-51	GP-468	2, 6, 17
			C6AF-C	42	GL-51	GP-464	10, 22
			C6AF-G	55	GL-52	GP-464	2, 4, 8, 10, 20, 23
			C6AF-F	55	GL-52	GP-468	3
		390	C6TF-A	38	GL-51	GP-467	1
			C6TF-B	38	GL-51	GP-464	9, 21
			C6AF-A	42	GL-51	GP-467	2, 6, 17
			C6AF-C	42	GL-51	GP-464	10, 23
			C5AF-H	53	–	–	14
			C6AF-G	55	GL-55	GP-464	2, 4, 8, 10, 20, 23
			C6TF-F	55	GL-55	GP-467	3
FALCON	1965	170	C5DF-A	38	GL-51	GP-467	1
		200	C5DF-A	38	GL-51	GP-467	1
		289	C5DF-A	38	GL-51	GP-467	1, 4
			C5DF-B	38	GL-52	GP-468	3
	1966	170	C6DF-A	38	GL-51	GP-468	1
			C6DF-B	38	GL-51	GP-464	16
			C6GF-A	45	GL-51	GP-468	2, 6
			C6GF-B	45	GL-51	GP-464	23
			C6AF-G	55	GL-52	GP-464	2, 4, 8, 21
		200	C6DF-A	38	GL-51	GP-468	1
			C6DF-B	38	GL-51	GP-464	16
			C6GF-A	45	GL-51	GP-468	2, 6
			C6GF-B	45	GL-51	GP-464	23
			C6AF-G	55	GL-51	GP-464	2, 4, 8, 21
		289	C6DF-A	38	GL-51	GP-468	1
			C6DF-B	38	GL-51	GP-464	9, 21
			C6GF-A	45	GL-51	GP-468	2, 6
			C6GF-B	45	GL-51	GP-464	10, 22
			C6AF-G	55	GL-52	GP-464	2, 4, 8, 10, 23
			C6AF-F	55	GL-52	GP-468	3
FORD	1963	223	C3SF-A	40	GL-4	GP-390	2
		260	C3SF-A	40	GL-4	GP-391	2
		390	C3SF-A	40	GL-4	GP-398	2
	1964	223	C4AF-A	42	GL-42	GP-429	1
		289	C3OF-E	42	GL-34	GP-388	1
		352	C3OF-E	42	GL-34	GP-388	1
		390	C3OF-E	42	GL-34	GP-388	1, 24
			C4SF-A	42	GL-35	GP-387	3
		427	C3MF-A	40	GL-23	GP-351	2
	1965	240	C5AF-A	42	GL-51	GP-467	1, 25
			C5AF-C	42	GL-51	GP-464	16

IDENTIFICATION			ORIGINAL EQUIPMENT		REPLACEMENT PARTS		APPLICATION DATA
MAKE	MODEL YEAR	ENGINE (C.I.D.)	FORD PART NUMBER 10300 (PREFIX & SUFFIX SHOWN)	ALTERNATOR OUTPUT RATING (AMPS.)	AUTOLITE ALTERNATOR SERVICE PART NO.	AUTOLITE ALTERNATOR PULLEY SERVICE PART NO.	REFER TO NOTE NUMBERS BELOW; THEN SEE PG. 54
FORD (cont.)	1965 (cont.)	240 (cont.)	C5AF-F	55	GL-52	GP-464	2, 4
			C5AF-G	55	GL-52	GP-468	3
			C5AF-J	53	–	–	2, 14
		289	C5AF-B	42	GL-51	GP-468	1, 25
			C5AF-C	42	GL-51	GP-464	16
			C5AF-H	53	–	–	14
			C5AF-F	55	GL-52	GP-464	2, 4
			C5AF-G	55	GL-52	GP-468	3
			C5TF-K	60	–	GP-471	2, 14
		352	C5AF-A	42	GL-51	GP-467	1, 25
			C5AF-C	42	GL-51	GP-464	26
			C5AF-E	42	GL-51	GP-472	16
			C5AF-H	53	–	–	14
			C5AF-F	55	GL-52	GP-464	2
			C5TF-E	55	GL-52	GP-472	4
			C5TF-F	55	GL-52	GP-467	3
			C5TF-K	60	–	GP-471	2, 14
		390	C5AF-A	42	GL-51	GP-467	1, 25
			C5AF-C	42	GL-51	GP-464	24
			C5AF-E	42	GL-51	GP-472	16
			C5AF-H	53	–	–	2, 14
			C5AF-F	55	GL-52	GP-464	2
			C5TF-E	55	GL-52	GP-472	4
			C5TF-F	55	GL-52	GP-467	3
			C5TF-K	60	–	GP-471	2, 14
		427	C5AF-D	42	GL-51	GP-465	1
	1966	240	C6AF-A	42	GL-51	GP-467	1
			C6AF-C	42	GL-51	GP-464	9, 16
			C5AF-H	53	–	–	2, 14
			C6AF-G	55	GL-52	GP-464	2, 3, 22, 27
			C5AF-F	55	GL-52	GP-468	25
		289	C6AF-A	42	GL-51	GP-467	2
			C6AF-B	42	GL-51	GP-468	1
			C6AF-C	42	GL-51	GP-464	16, 26
			C5AF-H	53	–	–	2, 14
			C6AF-G	55	GL-52	GP-464	2, 4, 10, 11
			C6AF-F	55	GL-52	GP-468	4, 19
			C5TF-K	60	–	GP-471	2, 14
		352	C6AF-A	42	GL-51	GP-467	1
			C6AF-C	42	GL-51	GP-464	13, 27
			C5AF-H	53	–	–	2, 14
			C6AF-G	55	GL-52	GP-464	2, 4, 10, 22, 27
			C6TF-F	55	GL-52	GP-468	3, 19
			C5TF-K	60	–	GP-471	2, 14
		390	C6AF-A	42	GL-51	GP-467	1
			C6AF-B	42	GL-51	GP-468	2
			C6AF-C	42	GL-51	GP-464	13, 27
			C5AF-H	53	–	–	2, 14
			C6AF-G	55	GL-52	GP-464	2, 4, 10, 22, 27
			C6TF-F	55	GL-52	GP-468	3, 19

IDENTIFICATION			ORIGINAL EQUIPMENT		REPLACEMENT PARTS		APPLICATION DATA
MAKE	MODEL YEAR	ENGINE (C.I.D.)	FORD PART NUMBER 10300 (PREFIX & SUFFIX SHOWN)	ALTERNATOR OUTPUT RATING (AMPS.)	AUTOLITE ALTERNATOR SERVICE PART NO.	AUTOLITE ALTERNATOR PULLEY SERVICE PART NO.	REFER TO NOTE NUMBERS BELOW; THEN SEE PG. 54
FORD (cont.)	1966 (cont.)	390	C5TF-K	60	–	GP-471	2, 14
		427	C6AF-D	42	GL-51	GP-465	15
		428	C6AF-A	42	GL-51	GP-467	1
			C6AF-B	42	GL-51	GP-468	2
			C6AF-C	42	GL-51	GP-464	13, 27
			C6AF-F	42	GL-52	GP-468	4, 19
			C5AF-H	53	–	–	2, 14
			C6AF-G	55	GL-52	GP-464	2, 4, 10, 22, 27
			C6TF-F	55	GL-52	GP-468	3, 19
			C5TF-K	60	–	GP-471	2, 14
LINCOLN	1963	430	C3SF-B	40	GL-5	GP-346	13
	1964	430	C3SF-B	40	GL-5	GP-346	1
			C3SF-D	42	GL-40	GP-352	13
			C4VF-A	52	GL-41	GP-352	4
	1965	430	C5AF-E	42	GL-51	GP-421	1
			C5TF-E	55	GL-52	GP-421	28
	1966	462	C6AF-G	55	GL-52	GP-464	1
			C6VF-A	60	GL-63	GP-464	29
MERCURY	1963	390	C3SF-C	30	GL-6	GP-347	1
		406	C3MF-A	40	GL-23	GP-351	1
	1964	390	C3SF-A	40	GL-4	GP-347	1
		427	C4MF-B	42	GL-39	GP-389	1
	1965	390	C5AF-A	42	GL-51	GP-416	1
			C5AF-E	42	GL-51	GP-421	4
			C5AF-H	53	–	–	2, 14
			C5AF-F	55	GL-52	GP-419	2
			C5TF-E	55	GL-52	GP-421	2, 4
			C5TF-K	60	–	–	2, 14
		427	C5AF-D	42	GL-51	GP-413	1
			C5TF-K	60	–	–	2, 14
	1966	390	C6AF-A	42	GL-51	GP-467	1
			C6AF-C	42	GL-51	GP-464	26
			C5AF-H	53	–	–	2, 14
			C6AF-G	55	GL-52	GP-464	2, 4
			C6TF-F	55	GL-52	GP-467	3
			C5TF-K	60	–	GP-471	2, 14
		410	C6AF-A	42	GL-51	GP-467	1
			C6AF-C	42	GL-51	GP-464	26
			C5AF-H	53	–	–	2, 14
			C6AF-G	55	GL-52	GP-464	2, 4
			C6TF-F	55	GL-52	GP-467	3
			C5TF-K	60	–	–	2, 14
		428	C6AF-A	42	GL-51	GP-467	1
			C6AF-C	42	GL-51	GP-464	26, 30
			C5AF-H	53	–	–	2, 14
			C6AF-G	55	GL-52	GP-464	2, 4
			C6TF-F	55	GL-52	GP-467	3
			C5TF-K	60	–	–	2, 14

IDENTIFICATION			ORIGINAL EQUIPMENT		REPLACEMENT PARTS		APPLICATION DATA
MAKE	MODEL YEAR	ENGINE (C.I.D.)	FORD PART NUMBER 10300 (PREFIX & SUFFIX SHOWN)	ALTERNATOR OUTPUT RATING (AMPS.)	AUTOLITE ALTERNATOR SERVICE PART NO.	AUTOLITE ALTERNATOR PULLEY SERVICE PART NO.	REFER TO NOTE NUMBERS BELOW; THEN SEE PG. 54
MUSTANG	1965	200	C5DF-A	38	GL-51	GP-467	1
		289	C5DF-A	38	GL-51	GP-467	1, 3
			C5DF-B	38	GL-51	GP-464	—
			C5AF-D	42	GL-51	GP-465	4
		390	C5AF-A	42	GL-51	GP-467	1
			C5TF-A	42	GL-51	GP-467	29
			C5TF-F	55	GL-52	GP-467	2, 29
	1966	200	C6DF-A	38	GL-51	GP-468	1
			C6AF-B	42	GL-51	GP-468	2, 6
		289	C6DF-A	38	GL-51	GP 468	1
			C6DF-B	38	GL-51	GP-464	9, 21
			C6AF-B	42	GL-51	GP-468	2, 6
			C6AF-C	42	GL-51	GP-464	10
			C6AF-D	42	GL-51	GP-465	15
THUNDERBIRD	1963	390	C3SF-C	30	GL-6	GP-347	1
			C3SF-A	40	GL-4	GP-347	2
			C3SF-B	40	GL-5	GP-346	3
	1964	390	C3SF-A	40	GL-4	GP-387	1, 13
			C3SF-B	40	GL-5	GP-346	3
			C4SF-A	42	GL-35	GP-347	2, 13
			C4SF-B	52	GL-36	GP-347	2, 3
	1965	390	C5AF-A	42	GL-51	GP-416	1
			C5TF-A	45	GL-51	GP-416	2
			C5TF-F	52	GL-52	GP-416	—
	1966	390	C6AF-A	42	GL-51	GP-467	1
			C6GF-B	42	GL-51	GP-464	31
			C6TF-J	45	GL-51	GP-467	3
		428	C6AF-A	42	GL-51	GP-467	1
			C6GF-B	42	GL-51	GP-464	31
			C6TF-J	45	GL-51	GP-467	3, 13
			C6TF-F	55	GL-52	GP-467	28

NOTES:

1. Standard
2. Option
3. Air Conditioning and Power Steering
4. Air Conditioning without Power Steering
5. Automatic Transmission
6. Trailer Package
7. Optional – Automatic Transmission
8. Optional – Trailer Package
9. Thermactor without Power Steering
10. Optional – Thermactor without Power Steering
11. Economy – without Power Steering
12. Optional – Air Conditioning without Power Steering
13. Transistorized Ignition
14. Leece-Neville
15. High Performance
16. Economy – Air Conditioning
17. Police and Taxi
18. Economy – Automatic Transmission
19. Optional – Economy Air Conditioning & Power Steering
20. Optional – Police and Taxi
21. Economy – Air Conditioning without Power Steering
22. Optional – Economy – without Power Steering
23. Optional – Economy – Air Conditioning
24. Standard or Police Interceptor
25. Economy – Air Conditioning and Power Steering
26. Thermactor
27. Optional – Thermactor without Air Conditioning
28. Air Conditioning and Transistorized Ignition
29. Air Conditioning and/or Transistorized Ignition
30. Standard Police
31. Thermactor without Air Conditioning

AUTOLITE BROAD COVERAGE ABC

ALTERNATORS

FOR FORD MOTOR COMPANY PASSENGER CARS

MAKE	MODEL YEAR	APPLICATION DATA	ORIGINAL EQUIPMENT ALTERNATOR	O.E. OUTPUT	ABC ALTERNATOR	MOUNTING KIT	PULLEY AND FAN KIT
COMET	1965	With Air Conditioning	C5DF-10300A	38	GL-58	GY-812	*
			C5DF-10300B	38	GL-59	GY-812	*
FAIRLANE	1964	6 Cyl.	C3TF-10300AF	42	GL-58	GY-812	GP-475
		8 Cyl.	C3OF-10300E	42	GL-58	GY-812	GP-475
	1965	All 6 & 8 Cyl.	C5DF-10300A	38	GL-58	GY-812	*
		8 Cyl. W/AC	C5DF-10300B	38	GL-59	GY-812	*
		All 6 & 8 Cy.	C5AF-10300F	55	GL-59	GY-812	*
FALCON	1965	All 6 & 8 Cyl.	C5DF-10300A	38	GL-58	GY-812	*
		8 Cyl. W/AC	C5DF-10300B	38	GL-59	GY-812	*
FORD	1963	8 Cyl. 406 & 427 C.I.D.	C3MF-10300A	40	GL-58	GY-812	GP-480
		8 Cyl. 406 C.I.D.	C3SF-10300A	40	GL-58	GY-812	GP-480
	1964	6 Cyl.	C4AF-10300A	42	GL-58	GY-812	GP-476
		6 Cyl.	C3OF-10300E	42	GL-58	GY-812	GP-476
		All 8 Cyl. Exc. 427 C.I.D.	C3OF-10300E	42	GL-58	GY-812	GP-475
		8 Cyl. 427 C.I.D.	C3MF-10300A	40	GL-58	GY-812	GP-480
	1965	6 Cyl.	C5AF-10300A	42	GL-58	GY-812	*
		8 Cyl. 289 C.I.D.	C5AF-10300B	42	GL-58	GY-812	*
		8 Cyl. 352 & 390 C.I.D.	C5AF-10300A	42	GL-58	GY-812	*
		6 Cyl. 289 C.I.D. W/AC	C5AF-10300C	42	GL-59	GY-812	*
		8 Cyl. 352 & 390 C.I.D. W/AC	C5AF-10300E	42	GL-59	GY-812	*
		8 Cyl. 427 C.I.D.	C5AF-10300D	42	GL-58	GY-812	*
		All W/AC	C5AF-10300F	55	GL-59	GY-812	*
		6 & 8 Cyl. 289 C.I.D. W/AC & PS	C5AF-10300G	55	GL-59	GY-812	*
		8 Cyl. 352 & 390 C.I.D. W/AC	C5TF-10300E	55	GL-59	GY-812	*
		8 Cyl. 352 & 390 C.I.D. W/AC & PS	C5TF-10300F	55	GL-59	GY-812	*
LINCOLN	1963-64		C3SF-10300B	40	GL-58	GY-812	GP-476
	1964		C3SF-10300D	42	GL-58	GY-812	GP-476
		With Air Conditioning	C4VF-10300A	52	GL-59	GY-812	GP-476
	1965		C5AF-10300E	42	GL-58	GY-812	*
		With Air Conditioning	C5TF-10300E	52	GL-59	GY-812	*
MERCURY	1963	390 C.I.D.	C3SF-10300C	30	GL-58	GY-812	GP-477
		390 C.I.D.	C3SF-10300A	40	GL-58	GY-812	GP-477
		390 C.I.D. W/AC	C3SF-10300B	40	GL-59	GY-812	GP-476
		406 & 427 C.I.D.	C3MF-10300A	40	GL-58	GY-812	GP-480
	1964	390 C.I.D.	C3SF-10300A	40	GL-58	GY-812	GP-477
		390 C.I.D. W/AC	C4TF-10300A	42	GL-59	GY-812	GP-475
		390 C.I.D. W/AC & PS	C4SF-10300A	42	GL-59	GY-812	GP-477
		427 C.I.D.	C4MF-10300B	40	GL-58	GY-812	GP-480
	1965	390 C.I.D.	C5AF-10300C	42	GL-58	GY-812	*
		390 C.I.D. W/AC	C5AF-10300E	42	GL-59	GY-812	*
		390 C.I.D. W/AC & PS	C5AF-10300A	42	GL-59	GY-812	*
		390 C.I.D.	C5AF-10300F	55	GL-59	GY-812	*
		390 C.I.D. W/AC	C5TF-10300E	55	GL-59	GY-812	*
		390 C.I.D. W/AC & PS	C5TF-10300F	55	GL-59	GY-812	*
		427 C.I.D.	C5AF-10300D	42	GL-58	GY-812	*
MUSTANG	1965	6 Cyl. 200 C.I.D.	C5DF-10300A	38	GL-58	GY-812	*
		8 Cyl. 289 C.I.D.	C5DF-10300A	38	GL-58	GY-812	*
		8 Cyl. 289 C.I.D. W/AC	C5DF-10300B	38	GL-59	GY-812	*
		8 Cyl. 289 C.I.D.	C5AF-10300D	42	GL-58	GY-812	*
THUNDERBIRD	1963		C3SF-10300C	30	GL-58	GY-812	GP-477
	1963-64		C3SF-10300A	40	GL-58	GY-812	GP-477
		With Air Conditioning	C3SF-10300B	40	GL-59	GY-812	GP-476
	1964		C4SF-10300A	42	GL-58	GY-812	GP-477
		With Air Conditioning	C4SF-10300B	52	GL-59	GY-812	GP-477
	1965		C5AF-10300A	42	GL-58	GY-812	*
			C5TF-10300A	45	GL-58	GY-812	*
		Trans. Ign. & AC	C5TF-10300F	52	GL-59	GY-812	*

*Transfer Pulley and Fan from O.E. Alternator.

NOTE: Service replacements for the following Pulley.

ALTERNATOR

MODEL YEAR	RATED OUTPUT AMPS. @ 15V.	RATED OUTPUT WATTS @ 15V.	VEHICLE APPLICATION	ALTERNATOR DESIGN	ENGINE R.P.M. AT RATED OUTPUT COLD	ENGINE R.P.M. AT RATED OUTPUT HOT	ENGINE R.P.M. AT CUT-IN	COLOR CODING	FIELD CURRENT @ 12V.
1963	30	450	Mercury, Thunderbird	Ford	3400 [1]	6500 [1]	900 [1]	--	2.4-2.6 [2]
	40	600	Ford, Lincoln, Mercury, Thunderbird	Ford	3400 [1]	6500 [1]	900 [1]	--	2.4-2.6 [2]
1964	40	600	Ford, Lincoln, Mercury, Thunderbird,	Ford	3400 [1]	6500 [1]	900 [1]	--	2.4-2.6 [2]
	42	630	Fairlane, Ford, Lincoln, Mercury, Thunderbird						
	52	780	Lincoln, Thunderbird	Ford	3400 [1]	6500 [1]	900 [1]	--	2.4-2.6 [2]
1965	38	570	Falcon, Comet, Fairlane, Mustang	Ford	1500	2500	325	--	2.8-3.3 [3]
	42	630	Falcon, Comet, Fairlane, Mustang	Ford	1625	2500	325	--	2.8-3.3 [3]
	42	630	Ford, Lincoln, Mercury, Thunderbird	Autolite	1800	2900	400	--	2.8-3.3 [3]
	45	675	Ford, Mercury, Thunderbird	Autolite	2200	2900	400	--	2.8-3.3 [3]
	53	795	Ford, Mercury	Leece-Neville	1700	2100	400	--	2.8-3.3 [3]
	55	825	Ford, Lincoln, Mercury, Thunderbird	Autolite	2200	2900	400	--	2.8-3.3 [3]
	60	840	Ford, Mercury	Leece-Neville	1600	2000	400	--	2.8-3.3 [3]
1966	38	570	Bronco, Comet, Fairlane, Falcon, Mustang	Autolite	1500	2900	400	Purple	2.5
	42	630	All Except Lincoln	Autolite	1600	2900	400	Orange	2.9
	45	675	Falcon, Thunderbird	Autolite	1700	2900	400	Black	2.9
	53	795	Fairlane, Ford, Mercury	Leece-Neville	1700	2100	400	--	2.9
	55	825	All Except Mustang	Autolite	1400	2900	400	Red	2.9
	60	840	Lincoln	Autolite	2000	2900	400	Green	4.6
	60	840	Ford, Mercury	Leece-Neville	1600	2000	400	--	2.9

NOTES:

[1] ALTERNATOR R.P.M.

[2] @ 10V.

[3] @ 12V. and 75°F.

ALTERNATOR DIMENSIONS, TOLERANCES, AND TORQUES (1964–66 DESIGNS)

SLIP RINGS – Minimum Turn-down Diameter (Inch):
- Ford and Autolite 1.22
- Leece-Neville . . . . Light Cut

Maximum Run-out (Inch):
- Ford and Autolite 0.0005
- Leece-Neville 0.0020

BRUSHES – Original Length (Inch):
- All Except Leece-Neville - 53 Amp. 1/2
- Leece-Neville - 53 Amp. 5/8

Wear Length (Inch):
- All Except Leece-Neville Brushes 5/16
- Leece-Neville - 53 Amp. 3/8
- Leece-Neville - 60 Amp. 9/32

PULLEY NUT – Torque: (Ft.-Lbs.)
- All 1965 Except Leece-Neville 60-80
- All 1966 Except Leece-Neville 60-100
- 1965-66 Leece-Neville 30-50

DRIVE BELT – Tension: (Lbs.)

Used Belt –
- 6-Cylinder Engines 60-90
- 8-Cylinder Engines 80-110

New Belt –
- All Except Ford Designed 38 & 42 Amp. Units. 110-140
- Ford Designed 38 & 42 Amp. Units. 90-120

(A used belt is one which has been in operation for a period of 10 minutes or more.)

STATOR BENCH TEST SPECIFICATIONS

ALTERNATOR OUTPUT RATING (AMPS.)	TEST CURRENT (AMPS.	INDICATED VOLTAGE	MAX. DIFFERENCE BETWEEN COILS (VOLTS)
38	20	6.0–6.6	0.6
42	20	5.2–5.7	0.5
45	20	5.2–5.7	0.5
55	20	3.6–4.0	0.3

1963–64 O.E. REGULATORS

APPLICATION	FIELD RELAY			VOLTAGE LIMITER		
	CONTACT CLOSING VOLTAGE	AIR GAP (INCHES)	CONTACT GAP (INCHES)	LOWER CONTACT VOLTAGE LIMITS (SEE NOTE 1)	AIR GAP (INCHES) (SEE NOTE 2)	LOWER CONTACT GAP (INCHES)
1963*	3.0–4.0	.022–.030	.015–.022	SEE NOTE 3	.045–.052	.010–.015
LATE 1963 & EARLY 1964	3.0–4.0	.015–.025	.015–.022	SEE NOTE 3	.045–.052	.010–.015
1964**	2.5–4.0	.012–.022	SEE NOTE 4	SEE NOTE 3	.049–.056	.017–.022

* Refer to Figure 12, View A, Page 10 for typical illustration.
** Refer to Figure 12, View B, Page 10 for typical illustration.

1. Upper contacts should measure ± 0.3 of voltage setting of lower contacts.
2. Both air gap and contact gap are adjusted with upper contacts closed.
3. In lower stage regulation, specified voltage limits must be corrected for the measured ambient air temperature. The chart in the adjacent column lists the applicable voltage limits for temperature readings between 50° F. and 175° F.
4. Field relay contact gap adjustment will vary with the closing voltage adjustment made.

AMBIENT AIR TEMPERATURE	VOLTAGE LIMIT
50° F.	14.3–15.1
75° F.	14.1–14.9
100° F.	13.9–14.7
125° F.	13.8–14.6
150° F.	13.6–14.4
175° F.	13.5–14.3

1964–1966 O.E. REGULATORS

VOLTAGE LIMITER GAPS (INCH):

Contact Gap –
All Except Leece-Neville 0.017–0.022
Leece-Neville . . . . 0.018–0.020 ①

Armature Air Gap – ②
All Except Leece-Neville 0.049–0.056
Leece-Neville . . . . 0.042–0.052 ①

FIELD RELAY GAPS (INCH):

Contact Gap – (Leece-Neville Only)
With Indicator Light 0.018–0.020
With Ammeter 0.024–0.026

Armature Air Gap –
All Except Leeve-Neville and Autolite used with Autolite Alternator 0.012–0.022
Leece-Neville 53 Amp ③. 0.009–0.011
Leece-Neville 53 & 60 Amp. . . . . 0.011–0.013 ③
Autolite with Autolite 0.010–0.018

Closing Voltage –
Ford Reg. with Ford Alt. (38-42 Amp.). 2.5
Autolite Reg. with Ford & Autolite, and Autolite Transistorized Circuits 2.5-4
Autolite Reg. with 42, 45, and 55 Amp. on T/Bird and Lincoln. 2.5
Leece-Neville –
53 Amp. with Indicator Light 1.6-2.6
53-60 Amp. with Ammeter. 6.2-7.2

NOTES

① With lower contacts closed.
② Temperature corrections listed previously for 1963-64 regulators also apply to 1964-66 units.
③ With contacts touching.

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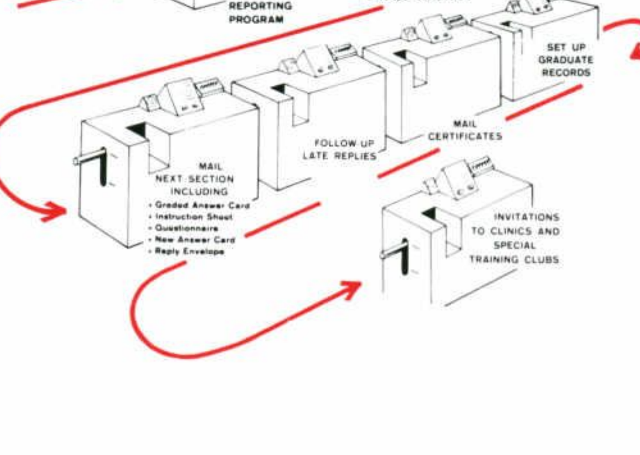

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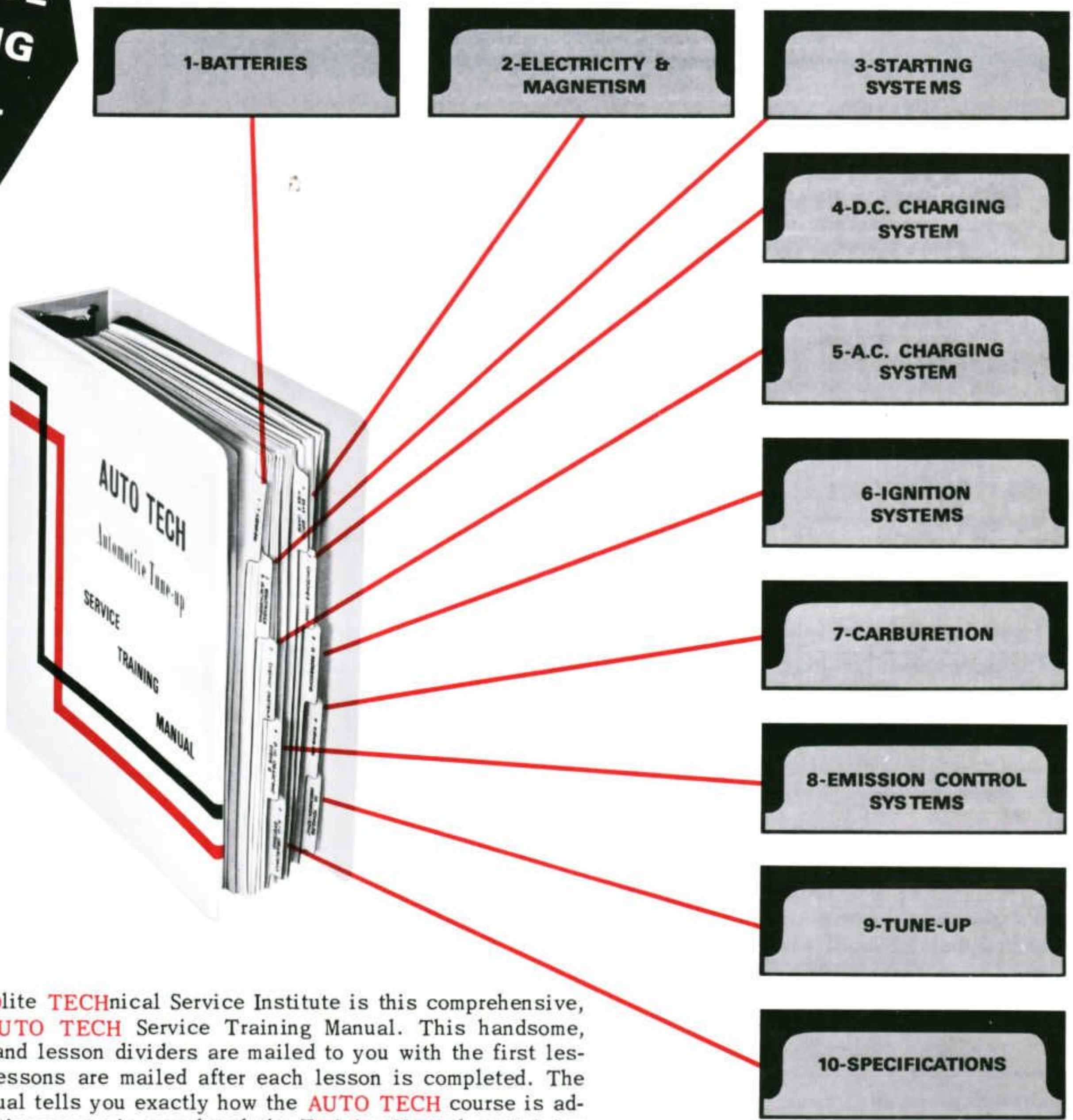

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