Chart 17

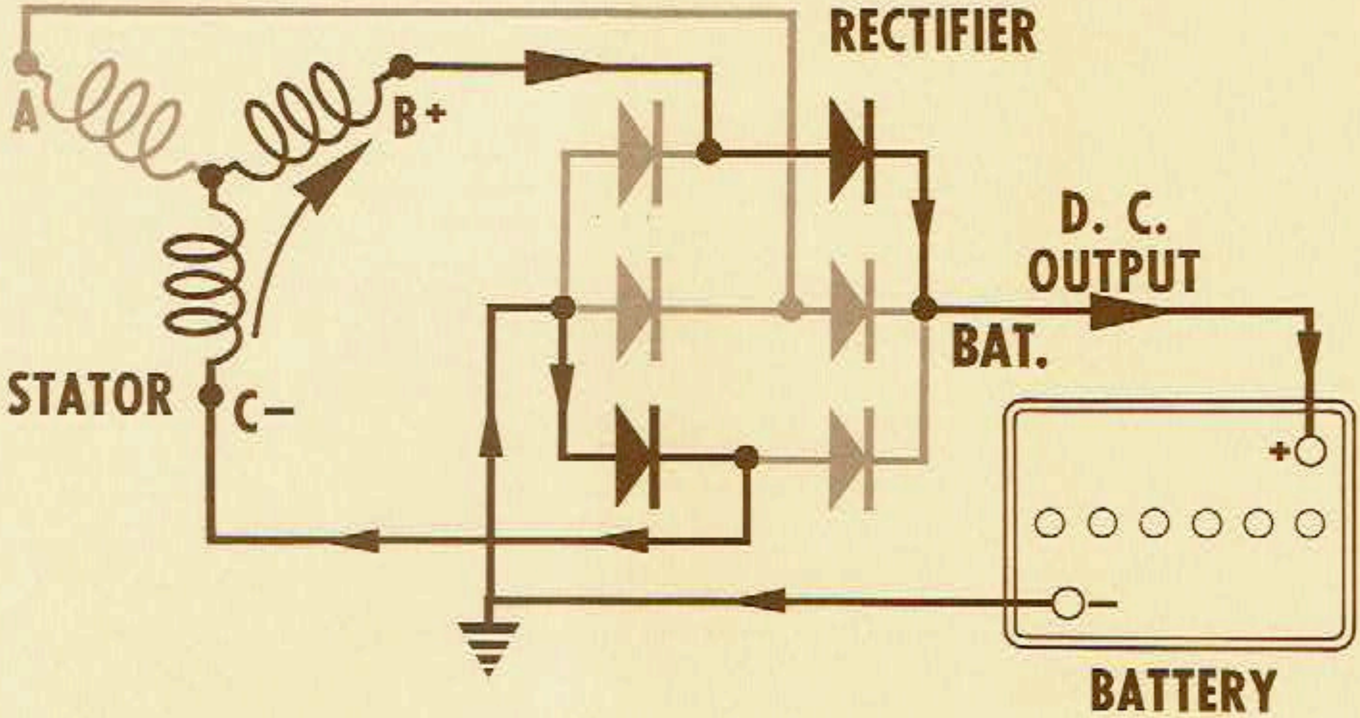
These wiring diagrams show the next two successive periods of rotor rotation. Current flows from two stator windings at a time and is blocked from the third stator winding.

The upper diagram illustrates the period when the rotor poles induce voltages in the windings "A," "B," and "C"; and "B" winding voltage is most positive. Current is blocked from "A" winding. In "B" and "C" windings, which are connected in series, current flows from the "B" terminal to the diode rectifier, through the conducting diode to the "BAT" terminal of the Delcotron generator. Then, through the battery and ground circuit back to the diode rectifier, through the conducting diode to the "C" terminal and through the "C" and "B" windings, the source of voltage.

The lower diagram illustrates the period when the rotor poles induce voltages in the windings "A," "B," and "C"; and "B" winding voltage still is most positive, but current flow is blocked from the "C" winding. In the "B" and "A" windings, in series, current flows from the "B" terminal to the diode rectifier, through the conducting diode to the "BAT" terminal of the Delcotron generator. Then, current flows through the battery and ground circuit back to the diode rectifier, through the conducting diode to the "A" terminal and through the "A" and "B" windings, the source of voltage.

Note that the direction of current flow through the battery is always the same, regardless of the direction of current flow from the Delcotron generator. Again, note that two diodes conduct while four diodes block.

DIODE—RECTIFIED THREE PHASE OUTPUT



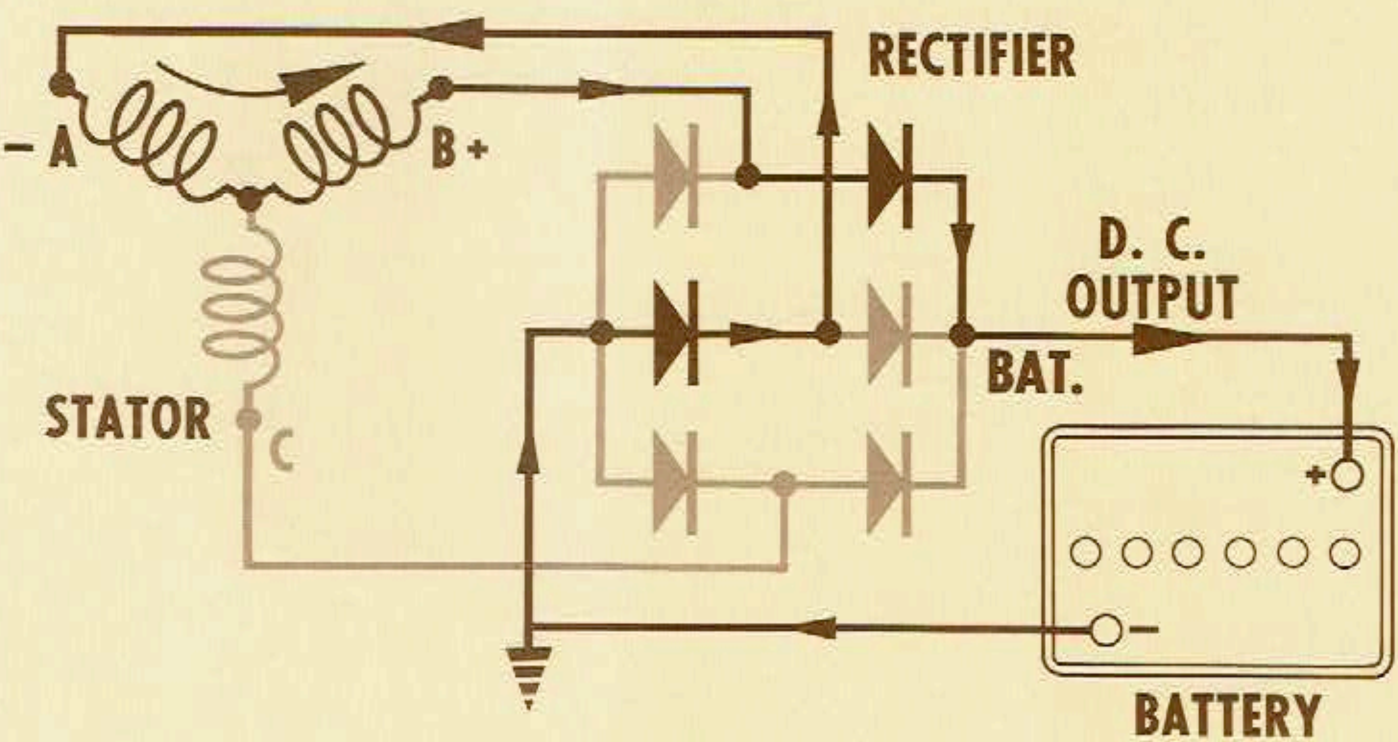


Chart 18

These wiring diagrams show the continuing two successive periods of rotor rotation, during which current flows from two stator windings at a time, while current flow from the third winding is blocked.

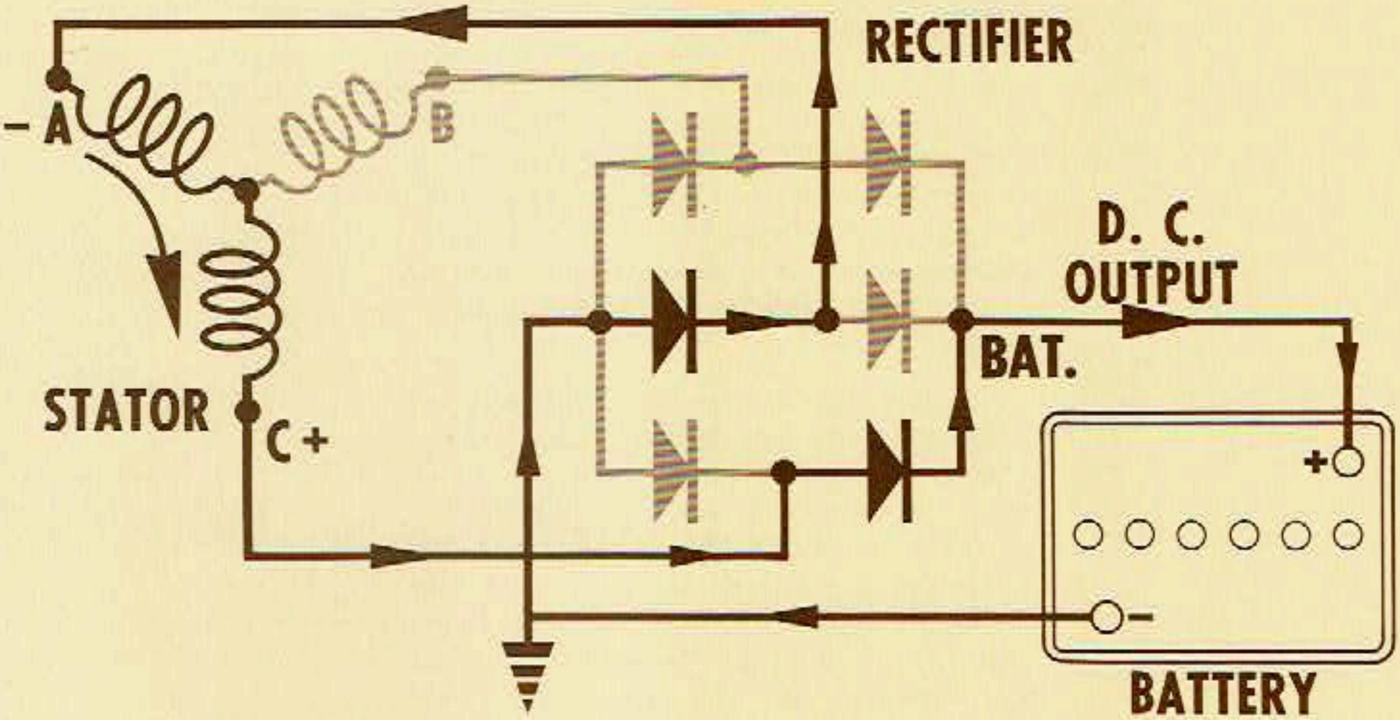
The upper diagram illustrates the period when the rotor poles induce voltages in the windings "A," "B," and "C"; and "C" winding voltage is most positive. "B" winding voltage is blocked from conducting current. In the "C" and "A" windings, in series, current flows from the "C" terminal to the diode rectifier, through the conducting diode to the "BAT" terminal of the Delcotron generator. Then, through the battery and ground circuit back to the diode rectifier, through the conducting diode to the "A" terminal, and through the "A" and "C" windings, the source of voltage.

The lower diagram illustrates the period when the rotor poles induce voltages in the windings "A," "B," and "C"; and "C" winding is still the most positive. However, "A" winding voltage is blocked from conducting current. In the "C" and "B" windings, in series, current flows from "C" terminal to the diode rectifier, through the conducting diode to the "BAT" terminal of the Delcotron generator. Then, through the battery and ground circuit back to the diode rectifier, through the conducting diode to the "B" terminal, and through the "B" and "C" windings, the source of voltage.

Note that battery current is d.c., regardless of the direction of current flow from the Delcotron generator. Again, two diodes conduct while four block.

The Charts 15, 16, and 17 illustrate the six periods of direct current flow to the battery during one cycle of "three phase" alternating current. The effect of the battery and the six rectifier diodes results in direct current from two phases or windings at a time, in series, as the source of voltage. One phase or winding does not conduct current during each period.

DIODE—RECTIFIED THREE PHASE OUTPUT



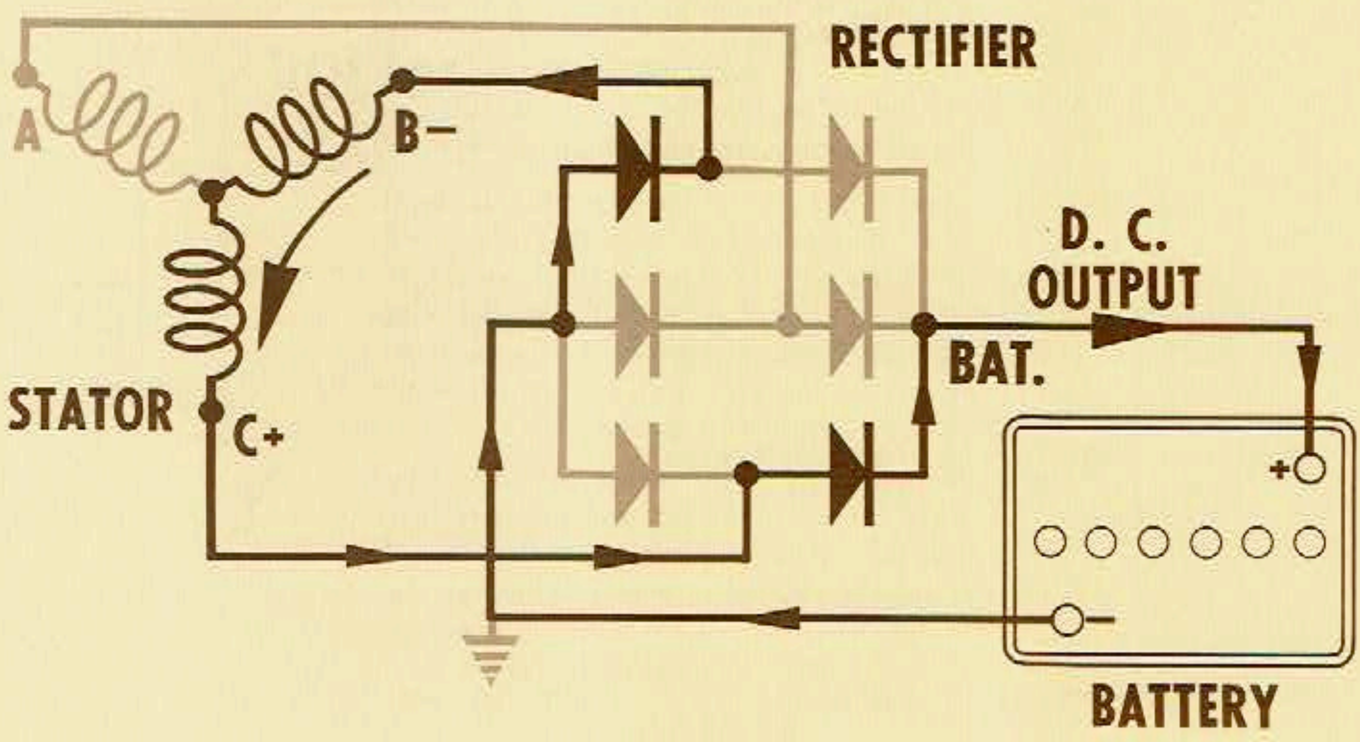


Chart 19

Previous discussions have shown how current through the field coil located in the rotor, creates magnetic lines of force.

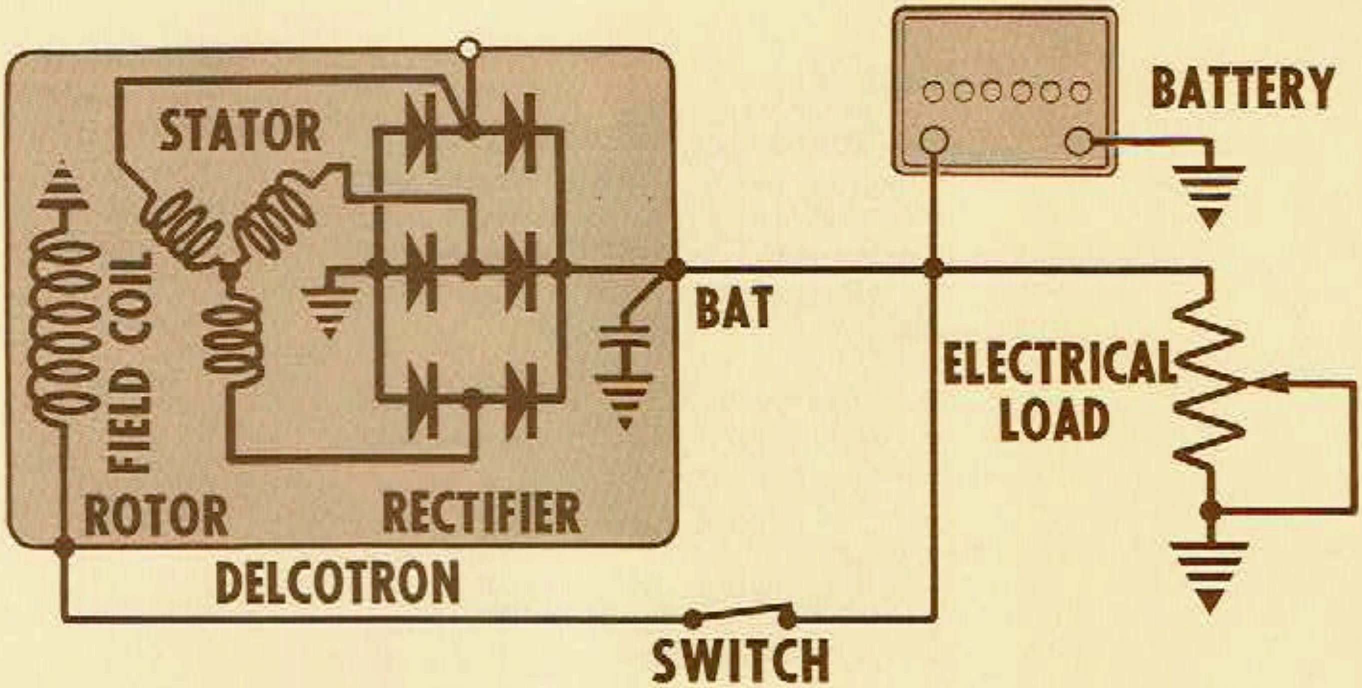
These magnetic lines of force cutting across the windings of the stator as the rotor turns induce an alternating voltage within the stator windings which causes current to flow through the diode rectifier to the "BAT" terminal of the Delcotron for use in charging the battery or for supplying power to the electrical accessories.

If the Delcotron were connected to both the battery and to the load circuit, as shown in the upper portion of the illustration, then either battery or Delcotron voltage would be impressed upon the field coil whenever the switch was in a closed position. Battery voltage would first provide the field current in the Delcotron, but as the speed of the Delcotron increases, the Delcotron itself would provide the voltage for field current. As Delcotron voltage increased, then more field current would result with an increase in magnetic lines of force within the rotor. This would develop even more voltage within the Delcotron and voltage would rapidly increase, as indicated in the lower portion of the chart.

The need to limit the voltage that is developed is, therefore, very critical. Without voltage control, light bulbs, external wiring, relay coils, contact points and all the other electrical components of the vehicle would be endangered by too high a voltage which would damage or greatly shorten their life.

A voltage regulator, consequently, is employed to limit the field current and magnetic field within the Delcotron in order that its voltage may be limited to a safe value. No current control of the Delcotron is necessary since it is capable of delivering only a given amount of current.

NEED FOR VOLTAGE REGULATION



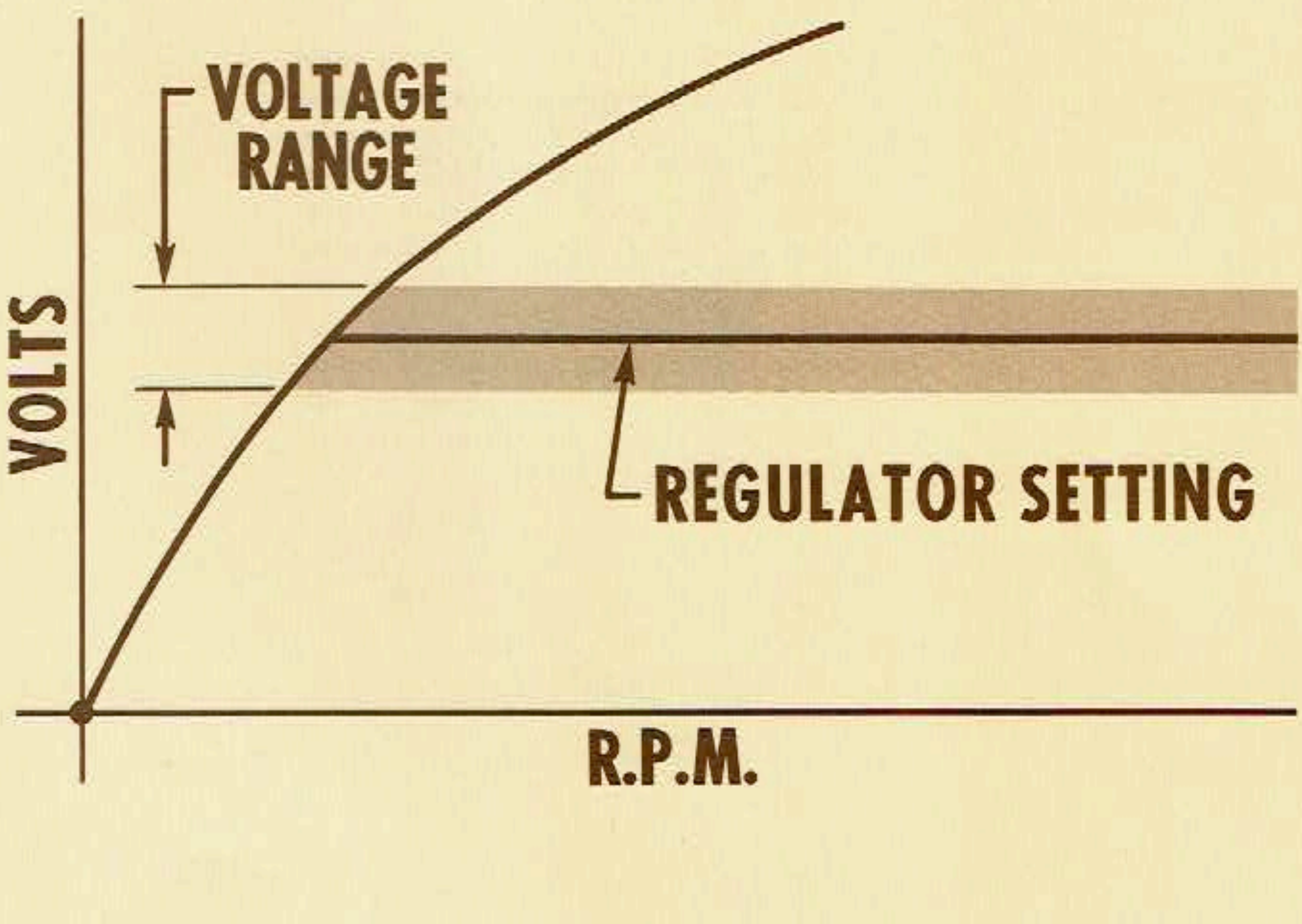


Chart 20

A two-unit double contact Delcotron regulator is shown in this illustration. It can be used in circuits containing either an indicator lamp or an ammeter. However, the external circuitry on the various applications may be quite different.

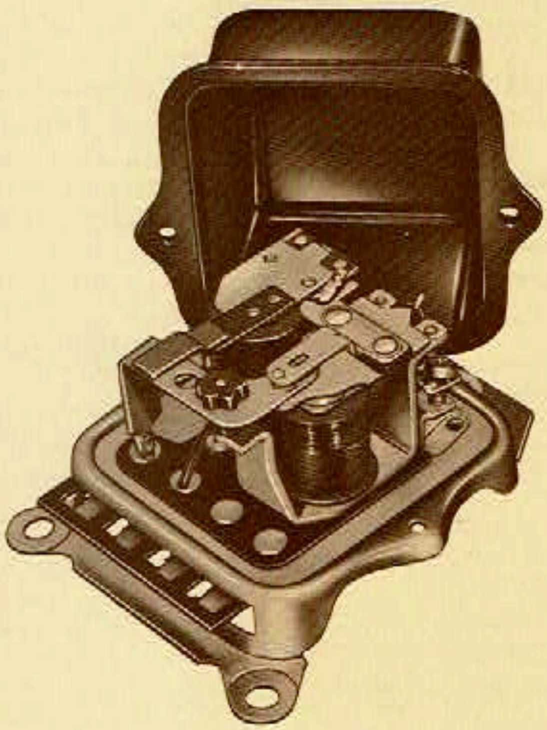
A single-unit regulator also is shown in the lower portion of this illustration. It is used only in circuits with an ammeter.

The voltage regulator unit in all types of regulators operates to limit the Delcotron generator voltage to a preset value. The field relay disconnects the Delcotron field coil and the voltage regulator winding from the battery when the relay contact points are opened and reconnects them when the points are closed.

The field relay of the two-unit regulator may also act as an indicator lamp relay on some applications. The circuitry of regulators used in conjunction with indicator lamps and indicator lamp relays is such that the indicator lamp lights when the ignition switch is first turned on.

Then, when the Delcotron generator builds voltage and begins to furnish power for the electrical system the indicator lamp goes out, indicating the system is operating.

DELCOTRON GENERATOR REGULATORS
(DOUBLE-CONTACT TYPE)



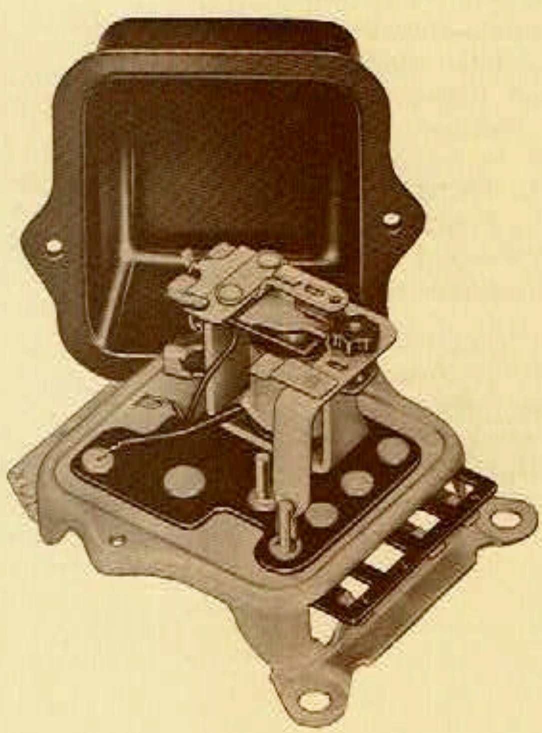


Chart 21

A typical wiring diagram depicting the internal circuits of the two-unit Delcotron regulator and Delcotron generator is shown. Following is a brief description of the operating principles of this particular circuit.

When the ignition switch is closed, and before the engine is started, current flows from the battery through the ignition switch to the "2" terminal of the regulator and on through the shunt winding of the field relay to ground. It then returns to the battery through ground to complete the circuit.

With current flow in the field relay shunt winding, a magnetic pull is created above the winding which attracts the relay armature toward the core, causing the relay contacts to close. Current then flows from the battery to the regulator "3" terminal, through the field relay contacts and through the lower contacts of the voltage regulator to the regulator "F" terminal. From this terminal it flows on through the generator field coil to ground. The circuit is then completed through ground to the battery.

When the engine starts and the Delcotron generator rotor begins to rotate, the magnetism created in the field coil by the field current induces alternating voltage in the stator windings. Six diodes, located in the end frame of the Delcotron, comprise the rectifier which changes the alternating voltage to d.c. voltage. The d.c. voltage is then routed to the "BAT" terminal of the Delcotron where it supplies the d.c. current to charge the battery and operate the vehicle's various electrical accessories.

As the speed of the Delcotron generator rotor increases, the voltage at the "BAT" terminal of the Delcotron also increases. When system voltage reaches a predetermined setting as established by the voltage regulator setting, this higher voltage increases the current flow from the Delcotron to the "3" terminal of the regulator on through the field relay contacts and through the voltage regulator shunt winding. The increased magnetism created about this winding attracts the armature of the voltage regulator causing the lower contact points to separate. The Delcotron field coil current then must flow through a resistor which reduces the field coil current. This reduced field coil current causes the Delcotron rotor magnetic field and Delcotron generator voltage to decrease, which, in turn, decreases the magnetic pull of the voltage regulator shunt winding. Spring pressure on the armature of the voltage regulator then causes the contacts to reclose and the field coil circuit is reestablished without the resistance in series with the field coils. This cycle is repeated many times per second to limit the Delcotron voltage to a preset value.

As the Delcotron rotor speed increases even further, the slightly higher voltage impressed across the voltage regulator shunt winding causes the upper contacts to close. When this happens, both ends of the field coil are placed at ground potential and no current passes through the coil. With no current in the field coil, the Delcotron voltage decreases, which also decreases the magnetism on the voltage regulator armature and the upper contact points open. With these points open, field current again flows through the regulator resistor and the field coil. As the voltage again increases, the upper contacts again reclose. This cycle is repeated many times per second to limit the Delcotron voltage to a preset value at higher operating speeds.

The voltage regulator unit thus operates to limit the value of Delcotron voltage throughout the entire Delcotron speed range.

A capacitor is attached to the No. 4 terminal of some models of this type of regulator for the purpose of radio suppression.

TWO-UNIT REGULATOR WITH AMMETER

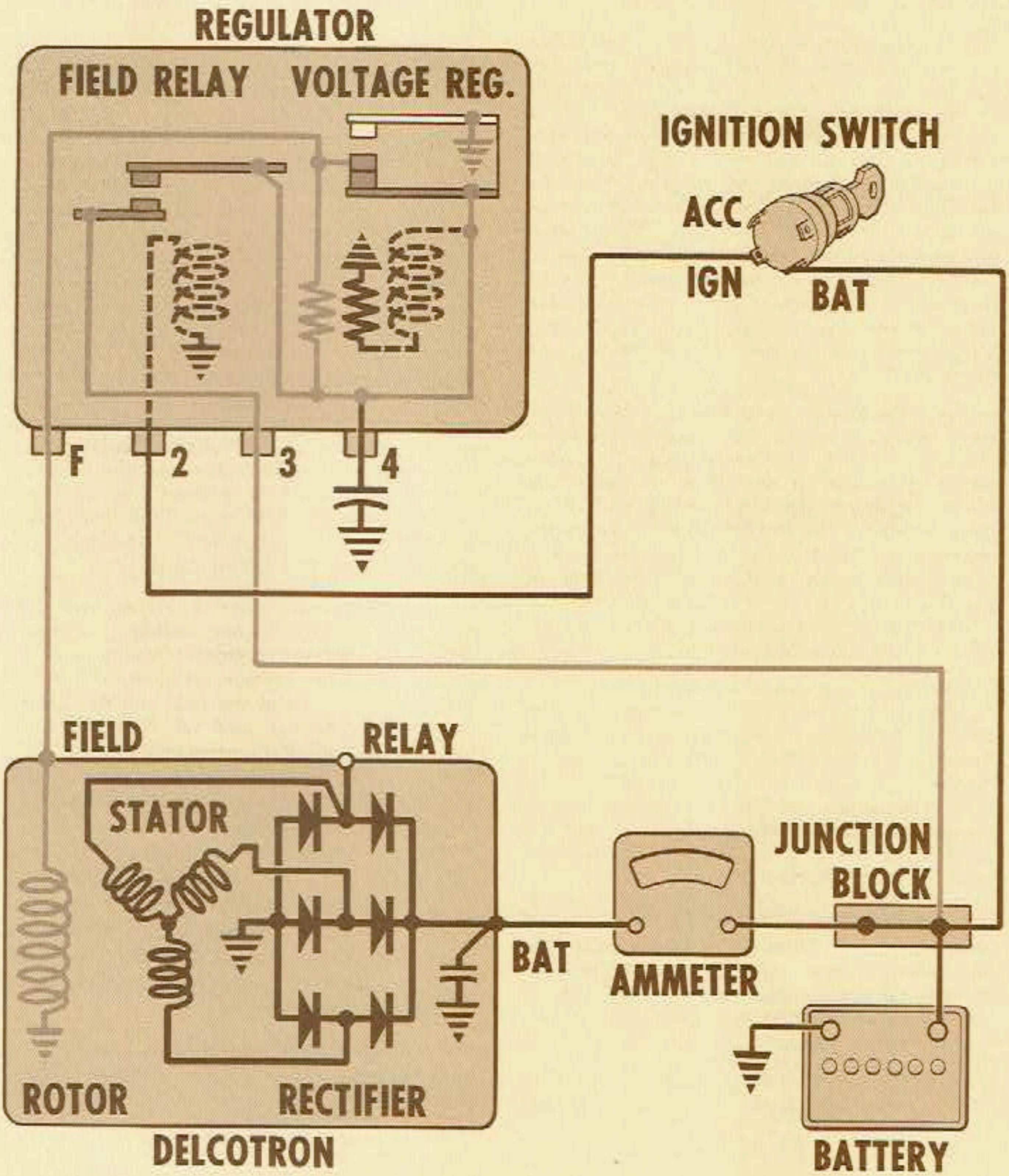


Chart 22

Another typical wiring diagram showing internal circuits of the two-unit regulator and Delcotron generator is illustrated.

When the ignition switch is closed, and before the engine is started, current flows from the battery through the indicator lamp, which is in parallel with the resistor to the "4" terminal of the regulator. From this terminal, current continues its flow through the contact points of the voltage regulator to the "F" terminal of the regulator. It continues through the external wiring to the Delcotron generator "F" terminal and on through the field coil of the Delcotron rotor. It returns to the battery through ground to complete the circuit. The lighted indicator lamp indicates that the Delcotron is not operating. This energizes the field coil winding and lights the indicator lamp.

When the engine starts and the Delcotron rotor begins to rotate, the magnetism created in the field coil by the field current induces alternating voltage in the stator windings. Six diodes, located in the end frame of the Delcotron, comprise the rectifier which changes the alternating voltage to d.c. voltage. The d.c. voltage is then routed to the "BAT" terminal of the Delcotron where it supplies the d.c. current to charge the battery and operate the vehicle's various electrical accessories.

The voltage which appears at the relay terminal of the Delcotron causes a current flow to the "2" terminal of the regulator and from there it travels on through the shunt winding of the field relay. With current flow in the field relay shunt winding, a magnetic field is created about the winding which attracts the relay armature toward the core, causing the relay contacts to close. Closure of the relay contacts permits the system voltage, which is impressed on terminal "3," to also be impressed on terminal "4." Since the indicator light now has system voltage on either side of the bulb, there is no current flow and the light will go out. This indicates that the Delcotron is producing system voltage.

If trouble should develop in the system to cause the voltage at the generator relay terminal to decrease to a low value, the field relay contacts will open causing the light to come on to indicate that there is trouble in the system.

As the Delcotron speed increases, the voltage at the "BAT" terminal of the Delcotron also increases. This higher voltage increases the current flow from the Delcotron to the "3" terminal of the regulator on through the field relay contacts and through the voltage regulator shunt winding. The increased magnetism created about this winding attracts the armature of the voltage regulator causing the lower contact points to separate. The Delcotron field coil current then must flow through a resistor which reduces the field coil current. This reduced field coil current causes the Delcotron magnetic field and voltage to decrease, which in turn, decreases the magnetic pull of the voltage regulator shunt winding. Spring tension on the armature of the voltage regulator then causes the contacts to reclose and the field coil circuit is reestablished without the resistance in series with the field coils. This cycle is repeated many times per second to limit the Delcotron voltage to a preset value.

As the Delcotron speed increases even further, the slightly higher voltage impressed across the voltage regulator shunt winding causes the upper contacts to close. When this happens, both ends of the field coil are placed at ground potential and no current passes through the coil. With no current in the field coil, the Delcotron voltage decreases, which also decreases the magnetism on the voltage regulator armature and the upper contact points open. With these points open, field current again flows through the regulator resistor and the field coil. As the voltage again increases, the upper contacts again reclose. This cycle is repeated many times per second to limit the Delcotron voltage to a preset value at higher operating speeds.

The voltage regulator unit thus operates to limit the value of Delcotron voltage throughout the entire Delcotron speed range.

TWO-UNIT REGULATOR WITH INDICATOR LAMP

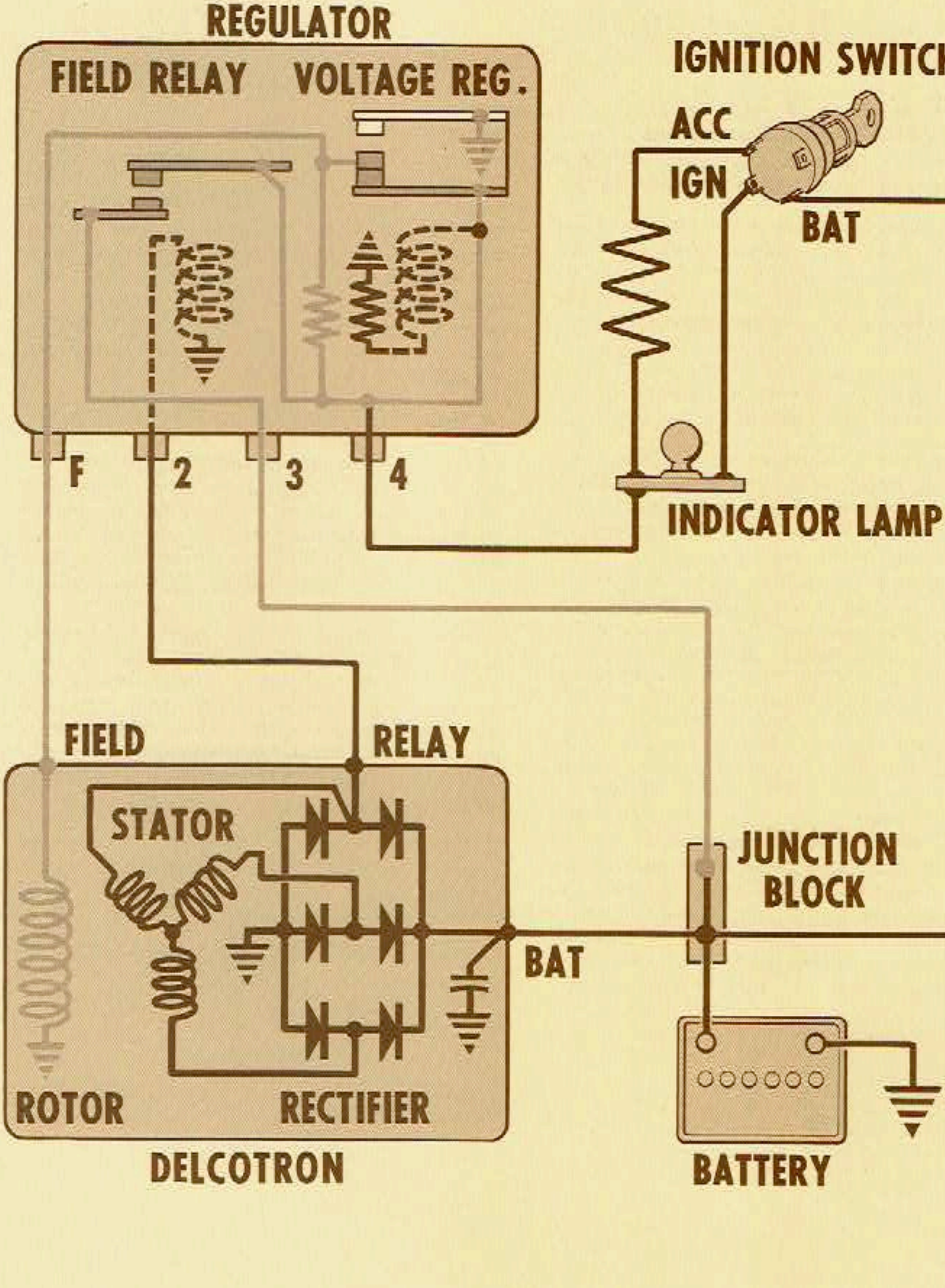


Chart 23

A typical wiring diagram depicting the internal circuits of the single-unit Delcotron regulator and "Delcotron" generator is shown.

When the ignition switch is closed, and before the engine is started, current flows from the battery through the ignition switch to the "3" terminal of the regulator and on through the lower contacts of the voltage regulator to the regulator "F" terminal. From this terminal it flows on through the Delcotron field coil to ground. The current flow is then completed through ground and back to the battery.

When the engine starts and the Delcotron rotor begins to rotate, the magnetism created in the field coil by the field current induces alternating voltage in the stator windings. Six diodes, located in the end frame of the Delcotron, comprise the rectifier which changes the alternating voltage to d.c. voltage. The d.c. voltage is then routed to the "BAT" terminal of the Delcotron from where the d.c. current is available to charge the battery and operate the vehicle's various electrical accessories.

As the speed of the Delcotron increases, the voltage at the "BAT" terminal of the Delcotron" also increases. This higher voltage increases the current flow from the Delcotron to the "3" terminal of the regulator on through the voltage regulator shunt winding. The increased magnetism created about this winding attracts the armature of the voltage regulator causing the lower contact points to separate. The Delcotron field coil current then must flow through a resistor which reduces the field coil current. This reduced field coil current causes the Delcotron magnetic field and voltage to decrease, which, in turn decreases the magnetic pull of the voltage regulator shunt winding. Spring tension becomes great, on the armature of the voltage regulator then, to cause the contacts to reclose and the field coil circuit is reestablished without the resistance in series with the field coils. This cycle is repeated many times per second to limit the "Delcotron" voltage to a preset value.

As the Delcotron speed increases even further, the slightly higher voltage impressed across the voltage regulator shunt winding causes the upper contacts to close. When this happens, both ends of the field coil are placed at ground potential and no current passes through the coil. With no current in the field coil, the Delcotron voltage decreases, which also decreases the magnetism on the voltage regulator armature and the upper contact points open. With these points open, field current again flows through the regulator resistor and the field coil. As the voltage again increases, the upper contacts again reclose. This cycle is repeated many times per second to limit the Delcotron voltage to a preset value at higher operating speeds.

The voltage regulator unit thus operates to limit the value of Delcotron voltage throughout the entire Delcotron speed range.

A capacitor is attached to the No. 4 terminal of some models of this type of regulator for the purpose of radio suppression.

SINGLE-UNIT REGULATOR WITH AMMETER

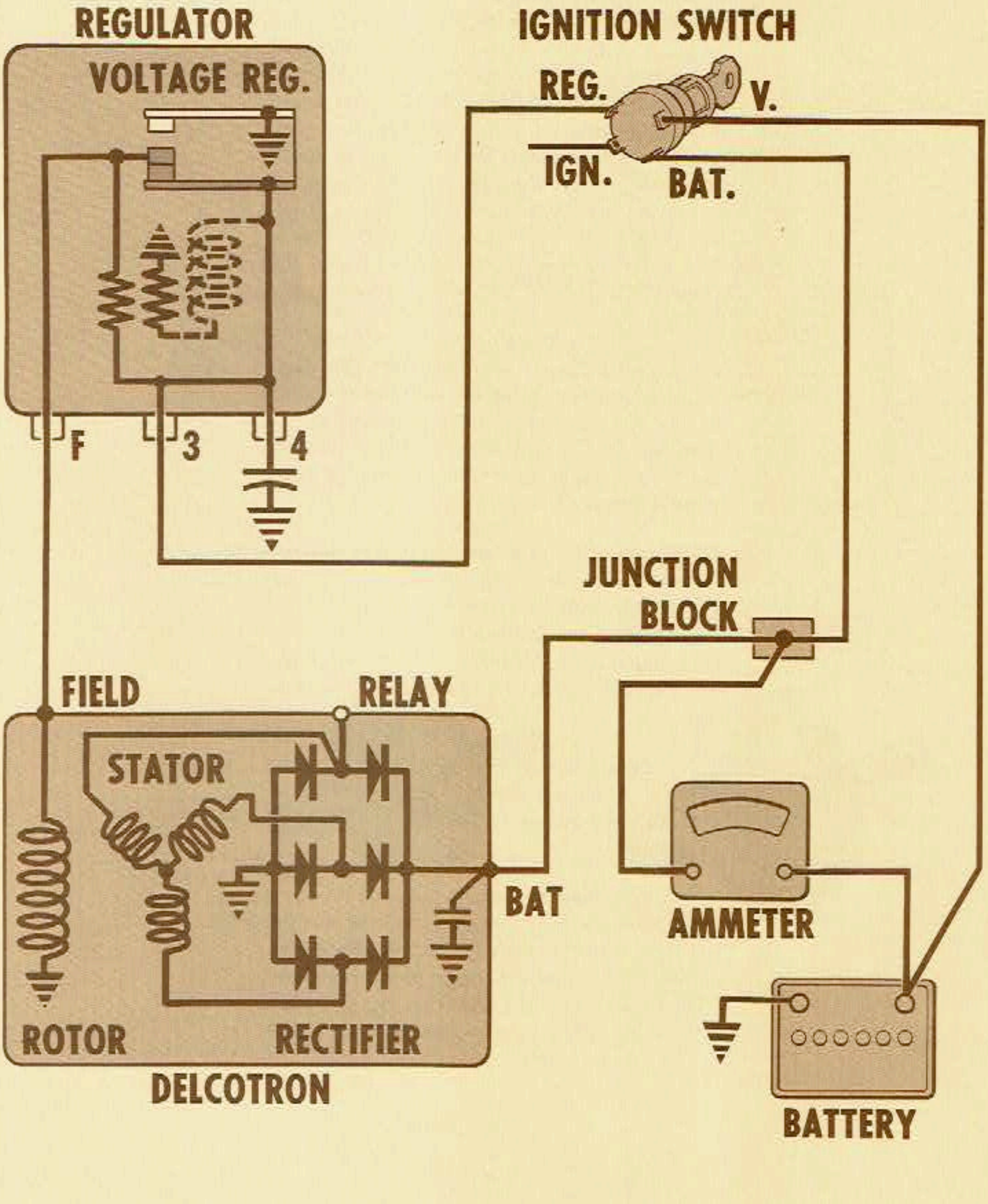


Chart 24

To check a Delcotron generator for output, connect a jumper lead from the generator output or "BAT" terminal to the field or "F" terminal, a voltmeter from the "BAT" terminal to ground, and an ammeter in the circuit at the "BAT" terminal. If two field terminals are present, ground the other field terminal with a jumper lead. Operate the generator at specified speed, adjust the variable load connected across the battery to obtain specified voltage, and observe the current output. If the output does not meet specifications, disassemble the generator for checks of the rotor, stator, and diodes.

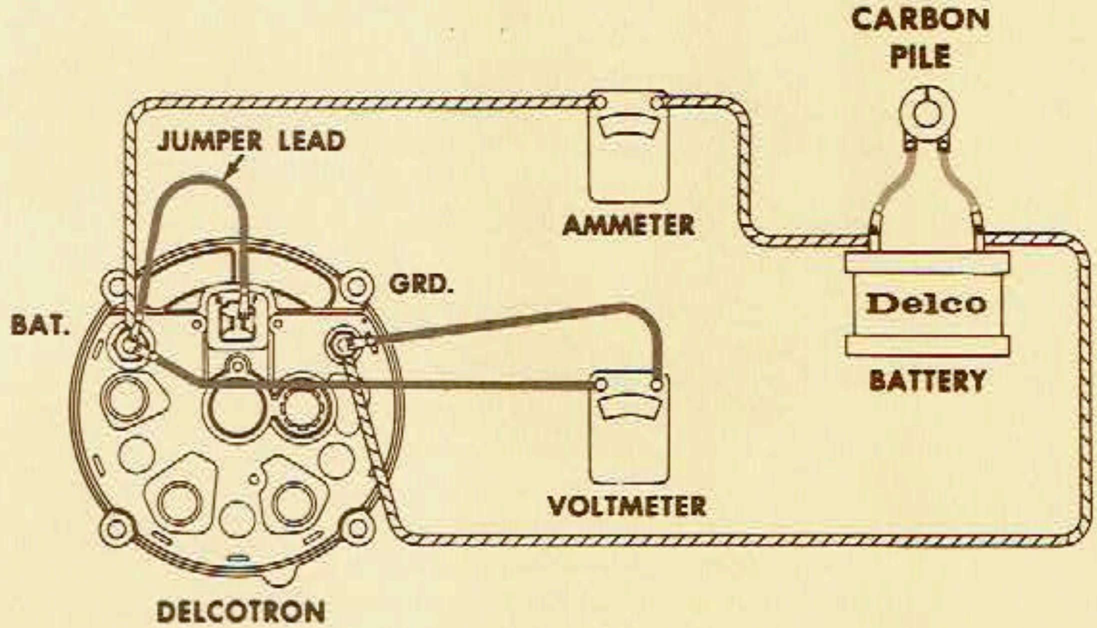
The rotor windings may be checked by connecting a battery, ammeter and voltmeter to the edge of the slip rings. If the current draw is above specifications, the windings are shorted, and if the current draw is low, excessive resistance is indicated.

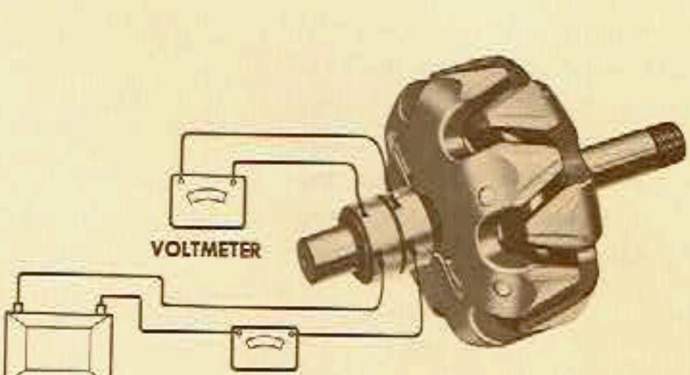
An ohmmeter may be used in place of the battery and ammeter. The specified resistance may be calculated by dividing the voltage by the current listed in the specifications booklet. A low resistance indicates shorted windings, and a high resistance an open or poor connection.

An ohmmeter connected from either slip ring to the shaft should show a high resistance. A low resistance indicates the field windings are grounded.

A test light may be used in place of an ohmmeter to check for opens and grounds, but the test light will not check for shorts. When connected across the slip rings, failure to light indicates an open. The windings are grounded if the lamp lights when connected from either slip ring to the shaft.

DELCOTRON GENERATOR OUTPUT AND ROTOR CHECKS (10-DN SERIES)





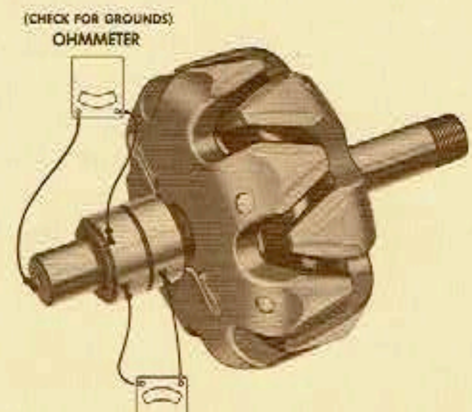


Chart 25

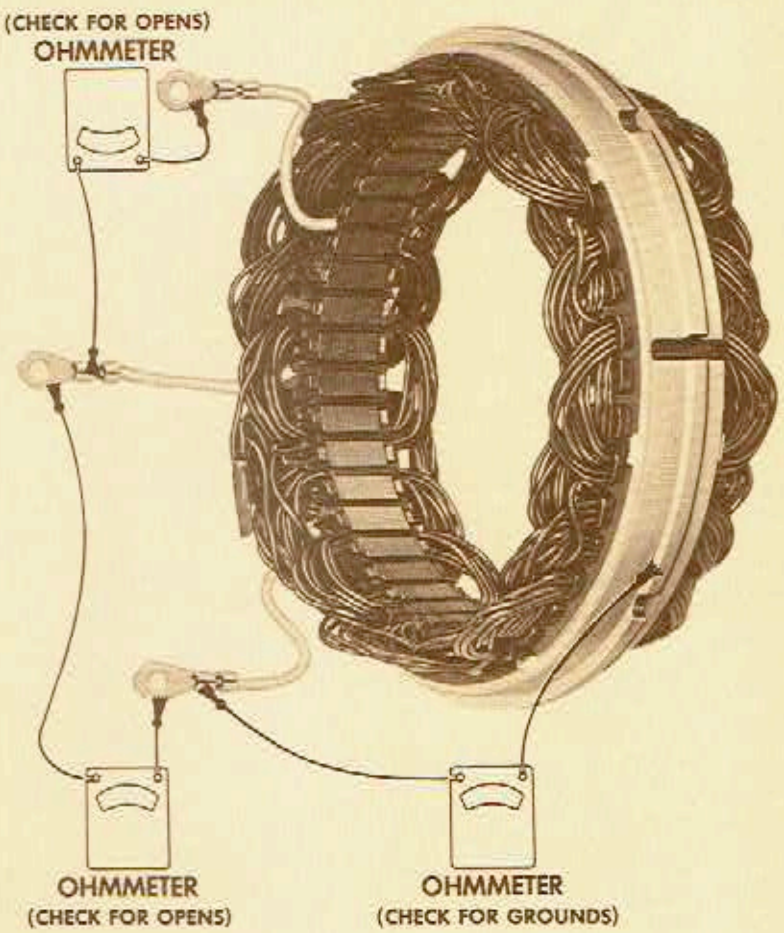
Checks on the stator should be made with all diodes disconnected from the stator. It is not practical to check the stator for shorts due to the very low resistance of the windings. Also, it is not practical to check the delta stator for opens because the windings are connected in parallel.

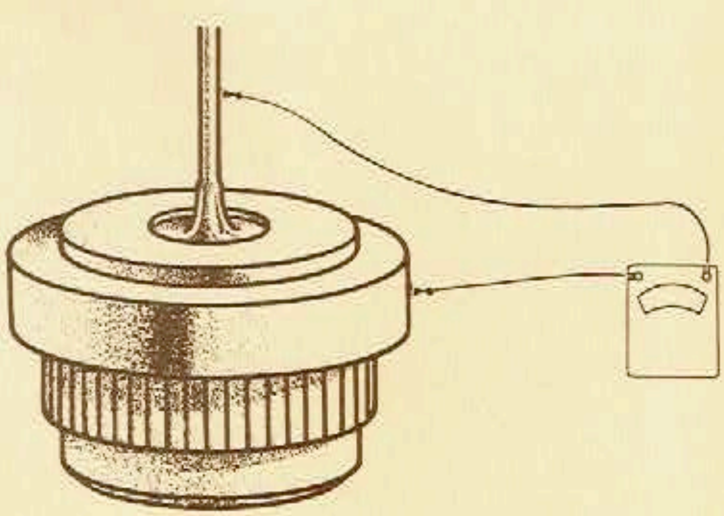
To check the "Y"-connected stator for opens, connect an ohmmeter or test light across each two pairs of terminals. A high ohmmeter reading, or no light, will reveal an open winding.

Either type of stator winding may be checked for grounds by connecting an ohmmeter or test light from either terminal to the stator frame. The windings are grounded if the ohmmeter reads low, or if the lamp lights.

Diodes when disconnected from the stator can be checked for defects with an ohmmeter having a 1½ volt cell. Using the lowest range scale, connect the ohmmeter leads to the diode case and the diode stem, and then reverse the connections. If both readings are very low, the diode is shorted. If both readings are very high, the diode is open.

STATOR AND DIODE CHECKS





USE TEST LAMP (NOT MORE THAN 12 VOLTS) OR OHMMET

Carl Schlender

DR

5133M

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