SERVICE REFERENCE BOOK

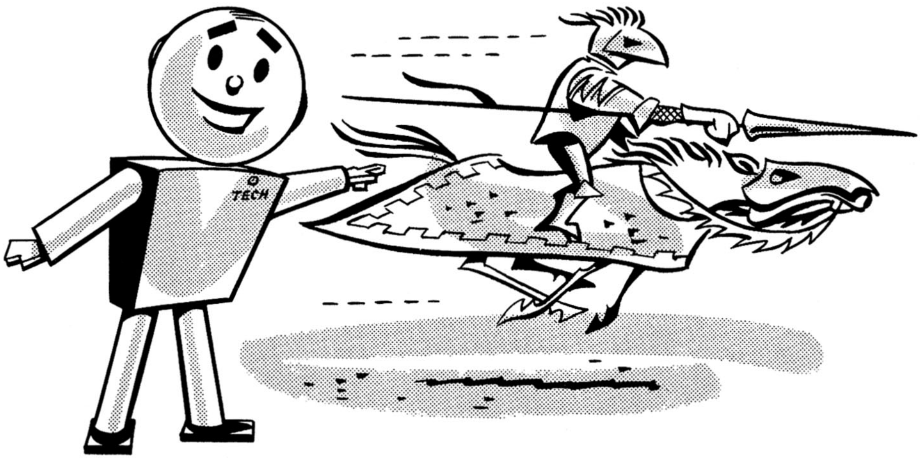
of the MASTER TECHNICIANS SERVICE CONFERENCE

session no. 148

ALTERNATOR (AC GENERATOR) SERVICE

PREPARED BY CHRYSLER CORPORATION

Dodge • Plymouth-De Soto-Valiant • Chrysler and Imperial Divisions



Tech sez: "Don't shy away from Alternator service"

Many fellows seem to think the alternator used on Valiant and Imperial cars and on Canadian Valiant taxicabs is some strange unit, and that servicing it is a mystery. Nothing could be farther from the truth.

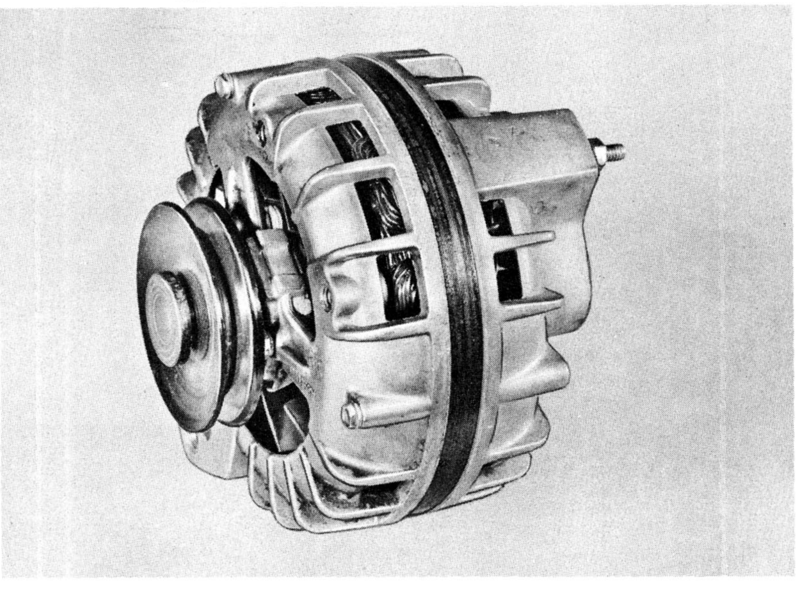
The alternator is simply a generator that develops AC or alternating current which is changed to DC current before it reaches the output terminal. As far as service is concerned, it is easier to service the alternator than it is to service the conventional generator.

So, just because the alternator looks different from the generator you have been looking at all these years, don't let it scare you. There's no mystery connected with it. Just bring it out into the light—by studying this Session—and you'll find that it is a pretty simple piece of mechanism that responds to normal service procedures just like anything else.

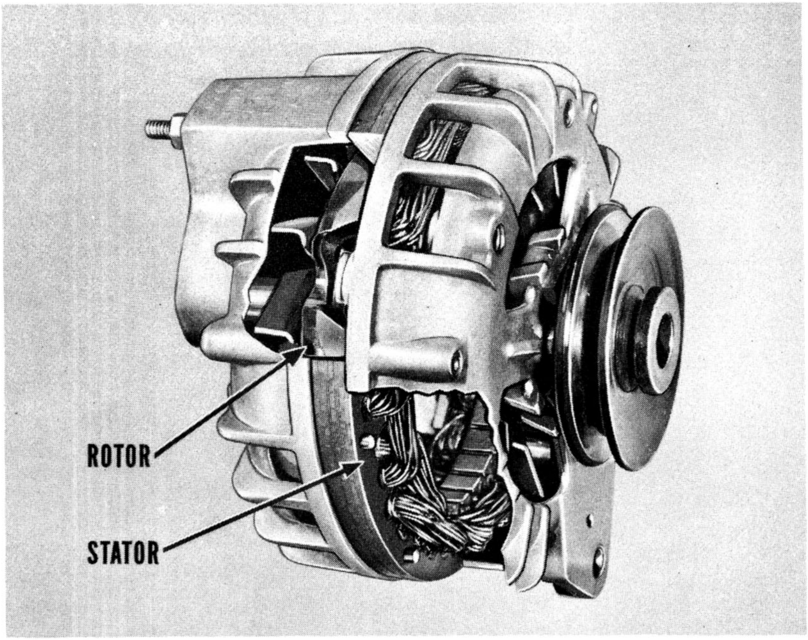
The following subjects are covered in this Reference Book:

DESCRIPTION

General. The alternator used on the Valiant and Imperial models, and on Canadian Valiant taxicabs is identified as a three-phase, Y-connected AC generator with integrally mounted silicon diode rectifiers for converting AC current to DC at the output terminal. The alternator is approximately nine pounds lighter than the conventional DC generator of comparable output. Another advantage is that the alternator has a good charging output at low speed.



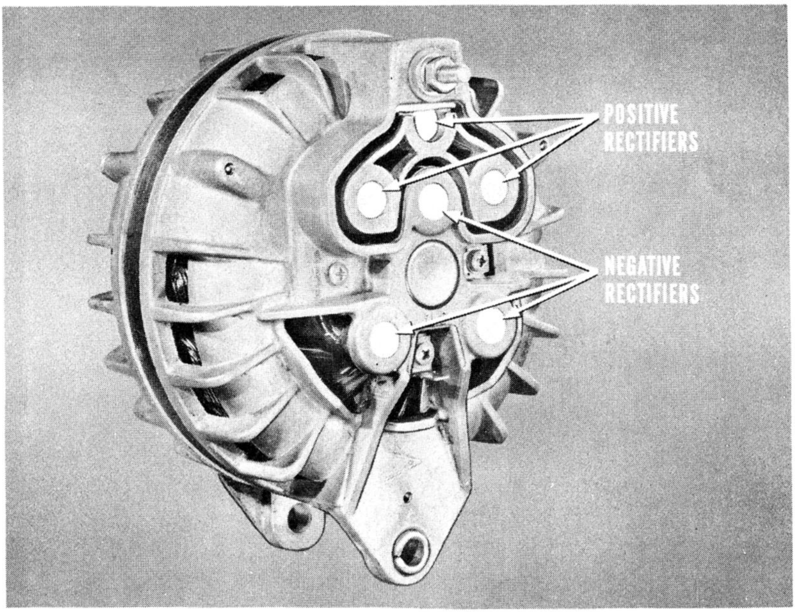
Operation. The DC generator develops voltage by revolving a conductor (armature) within a magnetic field. The field coils are mounted inside the generator housing, and surround the armature. Brushes held in contact with the armature commutator pick off current flowing in one direction (direct current) and make it available for the external circuit. The field coils receive their current from the brushes; therefore, the DC generator is said to be internally excited.



The alternator develops voltage by revolving a magnetic field (rotor) within a conductor (stator). The stator, consisting of three separate windings, is mounted to a frame assembled between the alternator end frames, and surrounds the rotor. The AC current produced in the windings flows through the diode rectifiers, making DC current available at the output terminal. Brushes held in contact with the rotor slip rings conduct battery current to the rotor field winding; therefore, the alternator is said to have an externally excited field.

The diode rectifier functions in the electric circuit somewhat the same way a one-way flow valve functions in a hydraulic circuit. It offers low electrical resistance to current flow in one direction, and very high resistance to current flow in the opposite direction.

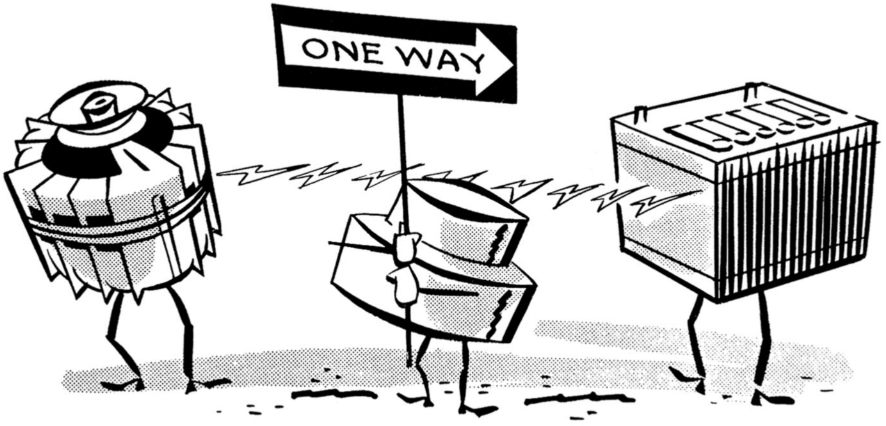
There are six diode rectifiers used. Three of the rectifiers are positive—that is, they permit current to flow from the lead wire to the base of the rectifier. These positive rectifiers are pressed into a die-cast aluminum holder called a heat sink. The heat sink is electrically insulated from the alternator end frame. Its function is to carry heat away from the rectifiers and transfer it to the air. All three positive rectifiers are electrically connected, through the heat sink, to the alternator output terminal. Therefore, rectified current is available at the output (BAT) terminal.



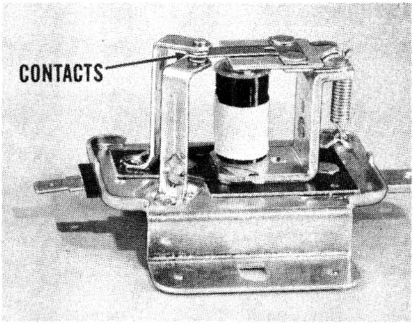
The other three rectifiers are negative—that is, they permit current flow from the battery ground terminal, through the grounded alternator end frame, through the rectifier base to the lead wire and into the stator winding, thereby completing the circuit. The negative rectifiers are pressed into the alternator end frame.

Output Control. The alternator output is controlled by a single voltage regulator. In this respect it is quite a bit different from the DC generator.

The DC generator requires a cut-out relay to prevent the battery from discharging through the generator when the generator output is lower than battery voltage. The alternator does not require the cut-out relay because of the silicon diode rectifiers. Since the rectifiers permit current flow in one direction only, the positive rectifiers will not allow current to flow from the battery into the alternator through the output terminal. This prevents the battery from discharging through the alternator.



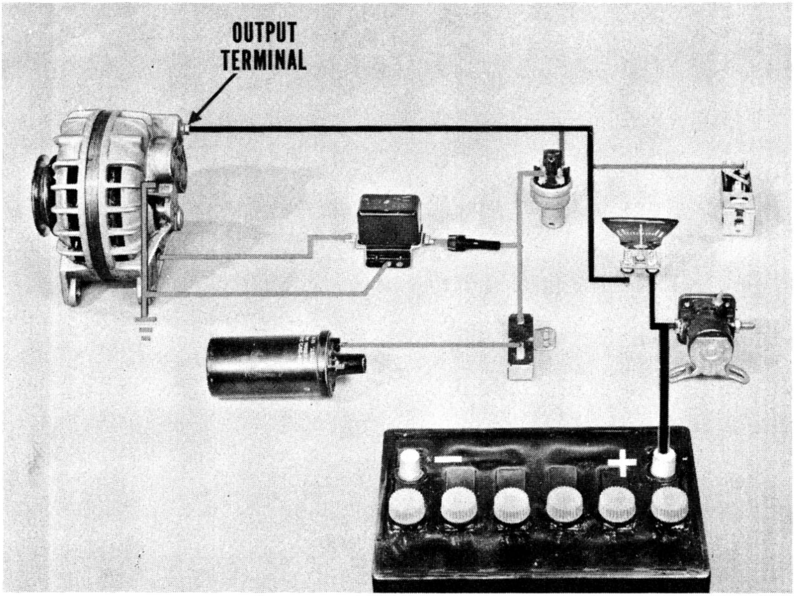
The DC generator requires a current regulator. The alternator does not. The stator windings, the rotor, and the air gap between the rotor poles and the stator are so designed that the alternator is self-limiting with respect to maximum current output. When current flow in the stator windings tries to go above rated output, an opposing voltage (counter electromotive force) is built up in the windings to restrict the excess current. This happens automatically, so there is no need for a separate current regulator.



This leaves the voltage regulator as the only external conrol needed for the alternator. The voltage regulator controls the voltage output of the alternator by regulating the current supplied to the field coil of the rotor.

The cover of the voltage regulator is marked above the terminals. The letters IGN indicate the ignition terminal, and the letters FLD indicate the field terminal.

The accompanying diagram is a schematic arrangement of the units in the charging circuit, and serves to illustrate the location and connection ot the various units.

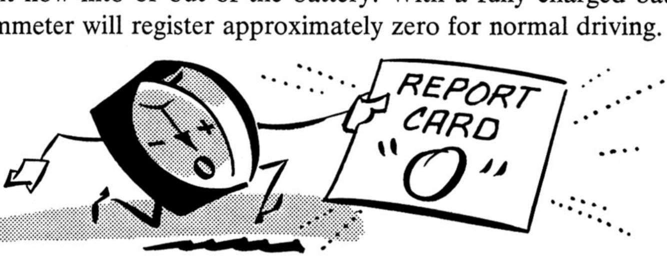


There's a connection from the field terminal of the alternator to the field terminal of the regulator. The connection from the ignition terminal of the regulator goes to the ignition side of the ignition switch. There's a 7.5-amp fuse in that lead to protect the circuit from an accidental short. The lead from the alternator output terminal disappears in a wiring harness, but it completes the circuit from the alternator to the battery positive terminal.

It is very important that the regulator have a good ground. Without it, the regulator cannot control the voltage to the rotor field coil. The regulator ground is provided, in some installations, by a ground clip at the regulator base; in other installations a ground wire is connected from the regulator base mounting screw to the ground screw in the alternator end frame.

Function of the Ammeter. It is important that all technicians understand the function of the car ammeter so they will not jump to the conclusion that the alternator is at fault when the ammeter does not register CHARGE.

As shown in the schematic circuit illustration, the car ammeter is in the circuit between the ignition switch and the battery. In that location it will register CHARGE only when the alternator output is greater than the electrical load so the current not needed to operate the electrical units is used to charge the battery. The ammeter will register DISCHARGE only when the alternator output is less than the electrical load so part of the current needed to operate the electrical units is being drawn from the battery. In other words, the car ammeter does not register the alternator output—it registers only current flow into or out of the battery. With a fully charged battery, the ammeter will register approximately zero for normal driving.



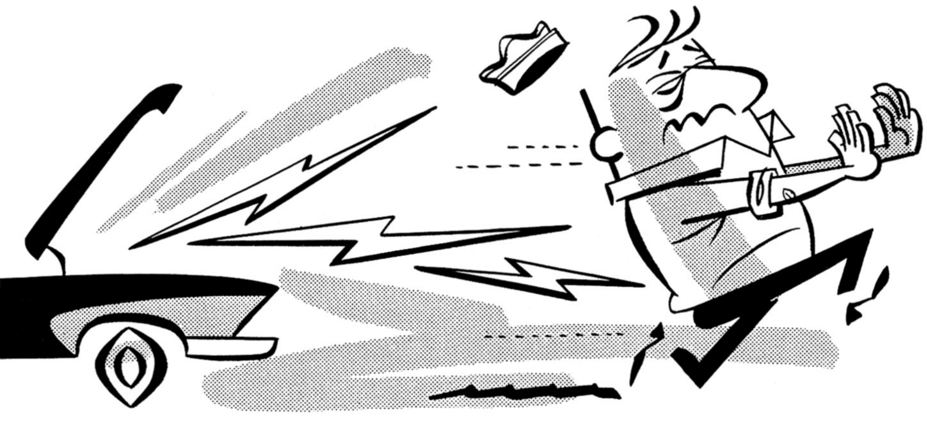
MAINTENANCE

Precautions. Before attempting on-the-car testing, or any maintenance work, there are certain precautions that must be observed.

For example, always disconnect the battery ground cable before connecting test instruments into the charging circuit. If this isn't done, and a short is caused, it could burn out the fuse, damage the regulator or the alternator.

Be sure the alternator drive belt is adjusted to the proper tension before testing alternator output.

Never short-circuit the alternator output terminal with a screw-driver to see if the alternator is charging. This would throw full battery voltage through the charging circuit and might burn out the regulator or the diode rectifiers—in addition to burning the alternator end frame.



Never connect a battery backward—be sure the negative terminal is the ground terminal. Reversing polarity will result in damage to the alternator.

If a booster battery is used as an aid to starting, be sure of its polarity before making the connections.

When using a battery charger to recharge the battery in the car, be sure to disconnect the ground cable.

The alternator will not "motor", so connecting a battery to it during bench repair won't prove anything. Furthermore, if you should happen to connect the battery backward you would immediately burn out the diode rectifiers.

Tests

There are three basic tests of the alternator charging circuit that can be made with the units installed on the car:

Circuit Resistance	Current Output	Voltage Regulator Control

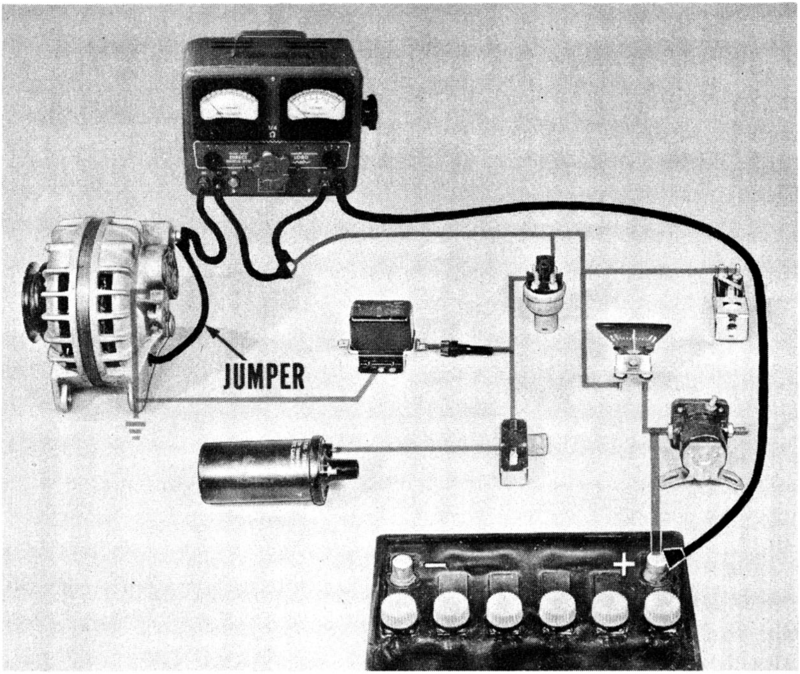
The circuit resistance test will show if there is high resistance somewhere in the circuit caused by corroded terminals, loose connections or poor grounds.

The current output test will show whether the alternator is capable of maximum output. This test is made with the regulator taken out of the field circuit, so it will determine whether the alternator or the regulator is at fault if the charging circuit is not up to specifications. If the alternator passes the current output test it is obvious that the regulator is responsible for the lack of standard output.

The voltage regulator performance test will show whether the regulator is limiting output voltage to a predetermined safe value.

All tests must be made with a fully charged battery, and should be made in the order given.

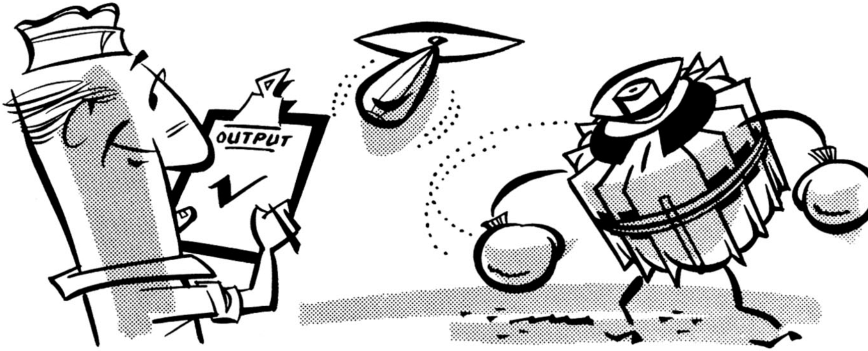
Circuit Resistance Test. The first test in any series of electrical testing procedures is a test for circuit resistance. The individual units of a circuit may be performing up to standard, but loose or dirty connections, or poor grounds can keep the entire circuit from doing its job. A circuit resistance test, therefore, may show up the cause of the trouble and save a lot of time that might otherwise be spent in unnecessary testing of the individual units.



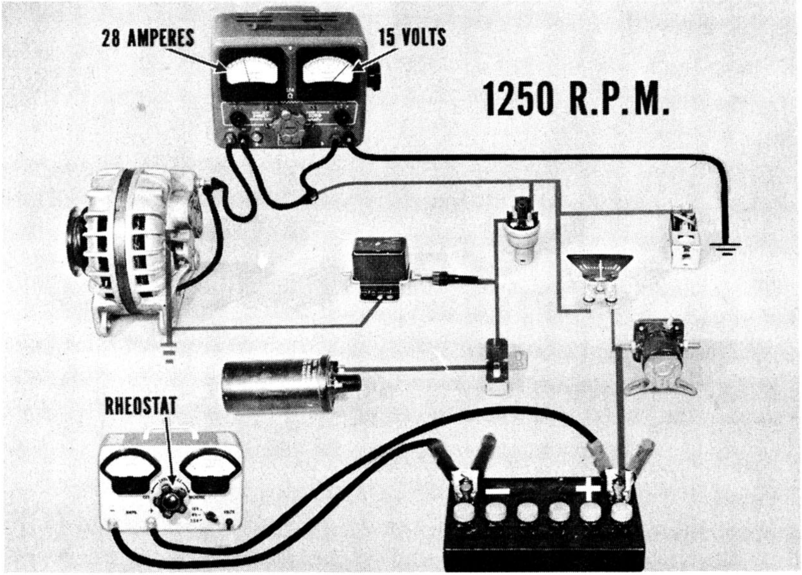
To perform the circuit resistance test, disconnect the battery ground cable. Disconnect the wire from the alternator output terminal. Connect the test ammeter positive lead to the alternator output terminal. Connect the ammeter negative lead to the wire removed from the output terminal. Connect the voltmeter positive lead to the wire removed from the output terminal. Connect the voltmeter negative lead to the battery positive terminal. Disconnect the lead from the alternator field terminal and the regulator field terminal. Connect a jumper wire between the alternator field and output terminals. Connect the battery ground cable.

Start the engine, and adjust the engine speed to get a reading of 10 amperes on the test ammeter. The voltmeter should register a voltage drop of not more than two-tenths of a volt. If it does, shut off the engine. Clean and tighten all connections in the circuit, and retest.

Current Output Test. Having determined that the circuit resistance is within limits, the next test is to determine whether the alternator is capable of producing its specified output.



The test meter connections are the same as for the circuit resistance test except for the voltmeter negative lead. Remove that lead from the battery terminal and place it on a good ground.



The output test is made at a specified engine speed, so connect a reliable tachometer. Also, since current output is stated at a specific voltage value, it is necessary to hold the voltage at a certain figure. Therefore, install a carbon pile rheostat across the battery terminals. If you do not have a carbon pile rheostat, use the battery-starter tester, and adjust the variable resistor in that piece of test equipment.

Start the engine. Adjust the engine speed to 1250 r.p.m. when testing the Valiant or the Imperial. Adjust the carbon pile rheostat (or the rheostat in the battery-starter tester) to get a voltmeter reading of 15 volts.

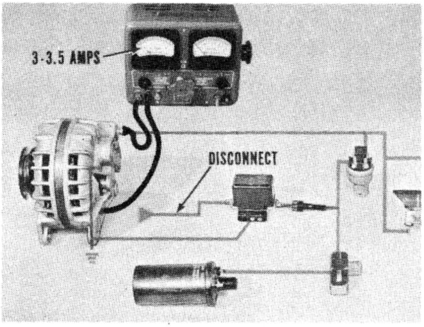
The test ammeter should show not less than 28 amps for the Valiant alternator. The Imperial alternator, when used on a car which has air conditioning, should show a minimum of 34 amps. Without air conditioning, the alternator should show 32.5 amps.

These test specifications are "cold" specifications (70°-80° F.), which means that the alternator is expected to meet these specifications without having been warmed up.

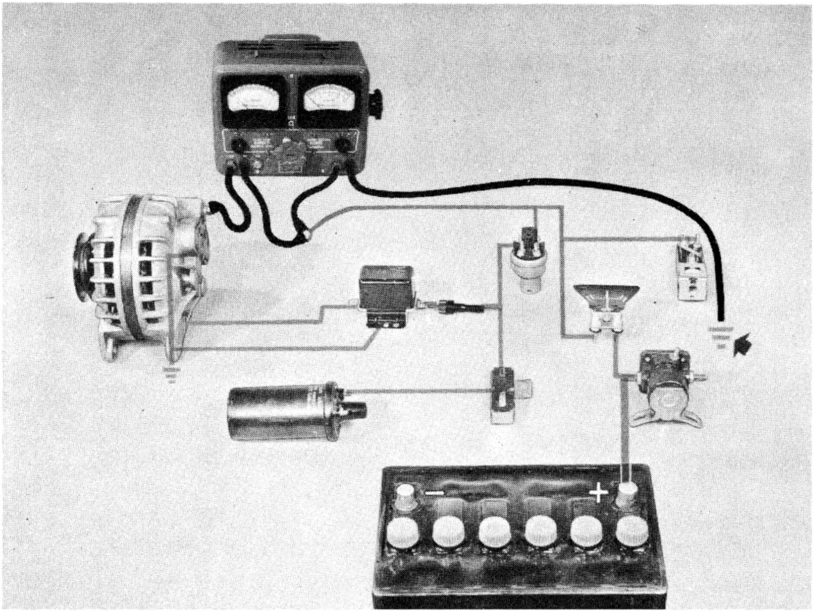
If the alternator meets these specifications, it is performing up to standard. And, since the battery is in good condition, the circuit resistance test has been made and resistance greater than two-tenths of a volt has been eliminated, it is obvious that any failure of the charging circuit to do its job must be due to the performance of the voltage regulator.

If, however, the alternator does not come up to specifications, it could be due to internal trouble, possibly resistance in the alternator field circuit. Failure to reach the specifications means that the alternator will have to be removed from the car and tested further to establish the cause. There is, however, another test that can be made before the alternator is removed—one that will indicate the possible cause of the condition—and that is a test of the field current draw.

Field Current Draw. Disconnect the field lead at the alternator. Connect the ammeter negative lead to the alternator field terminal, and the positive lead to the output terminal. With a fully charged battery, the ammeter should register between 3 and 3.5 amps. If it registers less, the cause could be dirty brushes or slip rings; if it registers more, it is an indication of a short in the rotor field winding.



Voltage Regulator Test. This is a test to determine how well the regulator controls the alternator output. It is made after the circuit resistance test has indicated there is no more than normal resistance in the circuit, and after the current output test has indicated the alternator output is up to specifications.



Connect the test ammeter between the alternator output terminal and the wire removed from that terminal. Connect the voltmeter between the wire removed from the output terminal, and ground. Connect the tachometer. Run the engine long enough (about 15 minutes) to be sure the charging system has become temperature-normalized. This is necessary because the voltage regulator is temperature-compensated, so the voltage reading must take temperature into consideration.

Set the engine speed at 1250 r.p.m. for Valiant or Imperial. Turn on lights and additional accessories as necessary to get a 15-amp reading on the test ammeter.

Take the temperature of the air about two inches from the regulator cover. Record the temperature, and the voltage reading. Compare them with the table given here to determine whether the voltage output is within specifications.

VOLTAGE SPECIFICATIONS—15-AMP LOAD, 1250 R.P.M.

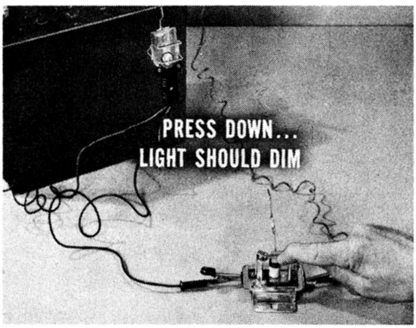
Temperature in Degrees F.	40	60	80	100	120	140
Minimum Setting	13.82	13.74	13.65	13.56	13.48	13.40
	to	to	to	to	to	to
Maximum Setting	14.42	14.34	14.25	14.16	14.08	14.00

Turn off the lights and any other accessories that may have been turned on, and run the engine speed up to 2200 r.p.m. The ammeter should read 5 amps or less, with a fully charged battery. The voltage reading should have increased between two-tenths and seven-tenths of a volt from the previous reading.

The minimum increase of two-tenths of a volt is important to insure proper voltage control under light load at higher speeds, particularly during cold weather. If the test didn't show the minimum increase, the result might be that the car ammeter would flop back and forth, indicating no control. The maximum of seven-tenths of a volt increase insures that the regulator is limiting output at the higher speeds.

If the regulator meets these specifications it is adjusted properly, and requires no further attention. If it does not meet these specifications it will have to be adjusted, which means it will have to be removed from its mounting.

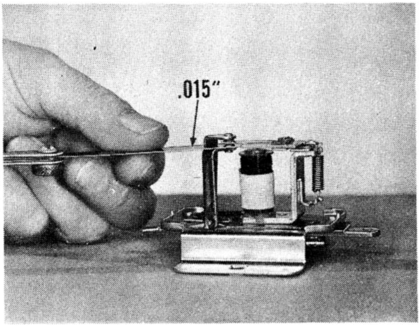
Voltage Regulator Adjustment. The first step in the regulator testing procedure is to test the air gap between the armature and the core. Connect a 12-volt test lamp between the regulator ignition terminal and one post of the battery. Connect a jumper from the other post of the battery to the field terminal of the regulator.



From the hinge side of the armature, insert a .048″ wire gauge between the armature and the core. Push the gauge up against the nylon stops. Press the armature down against the wire core, pressing on the armature and not the stainless-steel reed which carries the contact point. The light should dim slightly.

Remove the .048″ gauge and insert a .052″ gauge. Again press the armature down. This time the light should not dim.

If it is necessary to adjust the air gap, do it by bending the bracket which carries the upper stationary contact. Be careful to maintain alignment of the stationary and movable contacts.

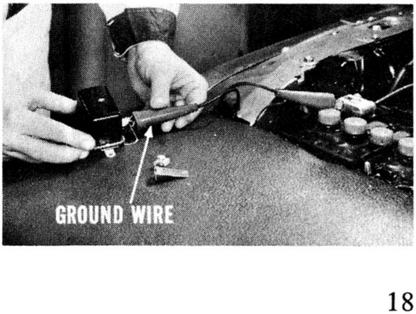


With the air gap adjusted properly, measure the clearance between the movable contact and the lower contact. It should be .015". If it isn't, adjust to this clearance by bending the lower contact bracket. Again, be careful to maintain contact alignment.

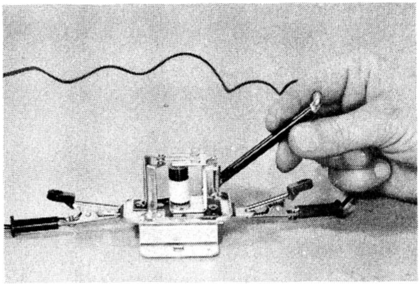
With the air gap and the point gap adjusted properly, the next step is to retest the regulator voltage setting to determine whether it requires a spring tension adjustment to bring the voltage setting within specifications.

After connecting the regulator, run the engine for a few minutes to temperature-normalize the system, and take new temperature and voltage readings. If the test readings are within specifications, no further adjustment is necessary. If they are not within specifications, a spring tension adjustment will have to be made.

The ignition must be turned off each time the cover is removed and replaced to guard against accidentally causing a short, and also to allow the voltage coil to discharge after each running. Also, the regulator must have a good ground. It is better to test the regulator when it is mounted on the car. However, if a ground wire is installed between the regulator base and a good ground, it is possible to get accurate voltage readings.



A very slight bend of the spring lower hanger will make quite a difference in the voltage reading, so make each adjustment carefully. Bend the spring lower hanger *up* to *decrease* voltage, *down* to *increase* voltage. Use an insulated bending tool just to be on the safe side—you might cause a short if you happened to forget to turn the ignition off before you started to bend the spring hanger.

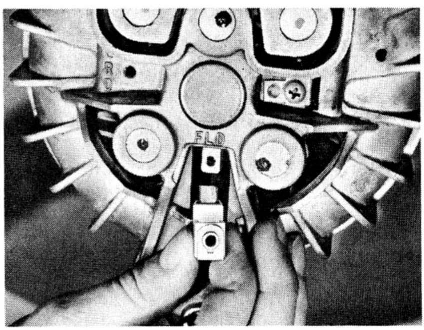


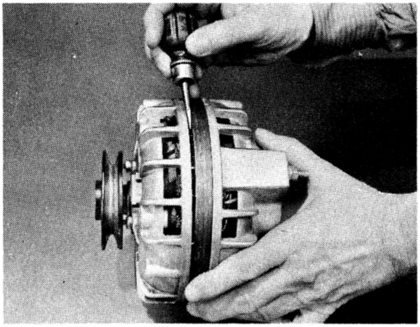
Retest the regulator after each adjustment until the voltage reading comes within specifications.

ALTERNATOR BENCH TESTS

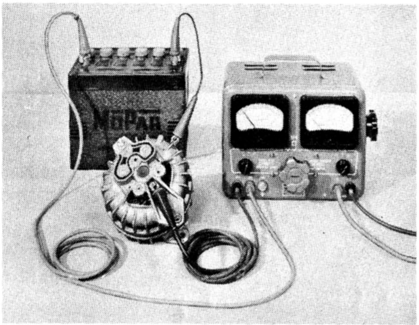
If it becomes necessary to disassemble the alternator for internal tests there are certain disassembly precautions that should be observed.

Precautions. For example, the insulated (field) brush should be removed before the alternator is disassembled—otherwise it may fall down and become lodged in the stator windings or become damaged by grease. It is mounted in a plastic holder, and held in place by a retaining screw. When reinstalling this brush, be sure the terminal is fitted properly in the recessed portion of the plastic holder—otherwise the holder may crack when the screw is tightened.





The two end frames are held together by three through-bolts. When these bolts are removed, carefully pry the drive end (the pulley end) from the stator frame, leaving the stator frame resting in the other (rectifier) end frame.



Rotor Test. An amperage draw test of the rotor field circuit can be made on the bench, before the alternator is disassembled. Simply connect one lead of a test ammeter to one terminal of a fully charged battery. Connect a jumper to the other terminal of the battery, and ground it to the alternator end frame. Connect the other ammeter lead to the field terminal of the alternator. The ammeter should show a current draw of from 3 to 3.5 amps. If it does, the field circuit is good.

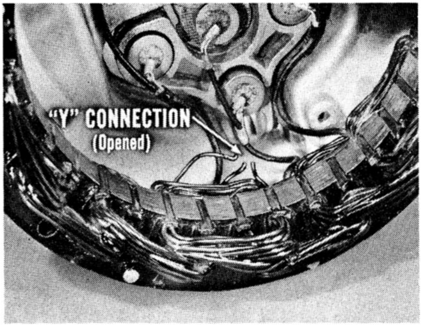
The first thing to do after the alternator has been disassembled is to examine the slip rings and brushes. Be sure the slip rings are clean, that the brushes are clean and in good condition, that the brush springs have proper tension, and that the brush holders are not cracked. If cleaning the slip rings and installing new brushes does not correct the condition, replace the rotor assembly.

If the amperage draw is less than specified it indicates high internal resistance; if the draw is greater than specified it indicates an internal short. In either case, install a new rotor assembly, since the rotor cannot be repaired.

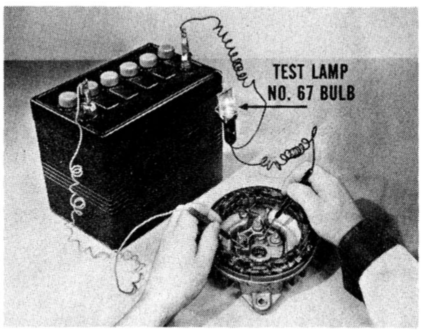
Rectifier Test. The positive diode rectifiers are pressed into the heat sink, which is electrically insulated from the alternator end frame. Therefore, when testing the positive rectifier with a 12-volt test lamp, the test prods must be touched to the rectifier lead and either the output terminal or the heat sink.

The negative rectifiers are pressed into the alternator end frame, so the test light prods must be touched between the rectifier lead and the end frame to complete the circuit.

If it is desired to test each rectifier, cut the stator "Y" connections. Cut them as close to the connector as possible because they will have to be soldered together again. If they are cut too short it may be difficult to get them together again for soldering.

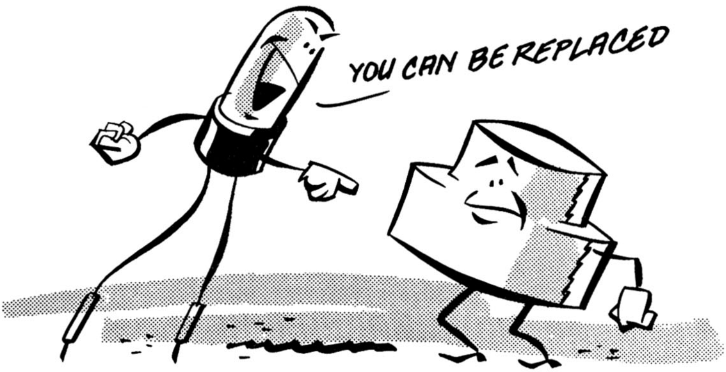


Connect a 12-volt test lamp to the battery positive terminal, and connect a jumper from the battery negative terminal to ground. Touch the test lamp lead to the rectifier lead, and observe whether the lamp lights. Then reverse the leads at the battery terminals to change polarity, and again touch the test lamp lead to the rectifier lead.

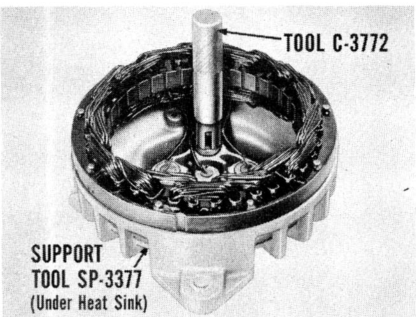


If the test lamp lights during one test, but not the other, the rectifier is good because it is allowing current to flow in one direction but not the other. If the test lamp doesn't light in either test, the rectifier has an open circuit and will have to be replaced.

If the test lamp lights in both tests the rectifier is shorted and is allowing current to flow in both directions, and must be replaced.

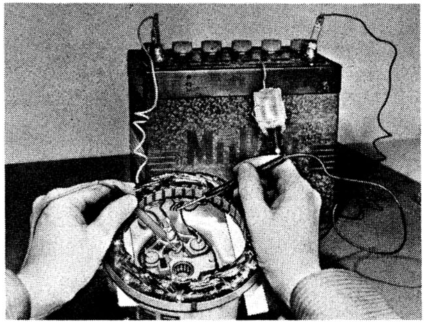


Replacing A Rectifier. If it becomes necessary to replace a rectifier, cut the lead at the point of the crimp. Support the end frame on tool C-3771, and press the rectifier out of the mounting by using tool SP-3380.

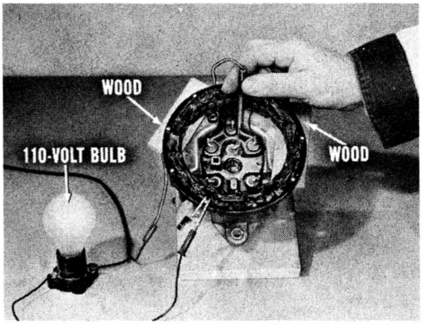


Positive rectifiers are identified by red paint; negative rectifiers by black paint. Start the new rectifier into the mounting squarely, and press it into position with tool C-3772. Solder the wire lead. Hold the wire lead with pliers while soldering it. This will help to dissipate heat, protecting the rectifier.

Stator Test. To test for a shorted stator winding, open the "Y" connection. Touch one prod of the test lamp to the end of one winding, and the other prod to the rectifier lead. If the lamp lights at more than one rectifier it is an indication that one winding is shorted to another. Replace the stator.



To test for a grounded stator winding, insulate the stator frame from the alternator end frame by placing a block of wood between them. Use a 110-volt test lamp for this test because a 12-volt test may not show up a ground which might occur under heavy load. Touch one prod of the test lamp to each stator winding in turn, and the other prod to the stator frame. If the lamp lights, the winding is grounded, and the stator assembly will have to be replaced.



CONCLUSION

The alternator is just coming into use in the automotive field as a standard production item. Learning to service it is just as important as learning to service any other component of the car. The point to keep in mind is that, while it is new, it is not complicated. Every technician should study this manual so he will feel confident of his ability to diagnose and correct any condition that may come up in connection with alternator performance.

RECORD YOUR ANSWERS TO THESE QUESTIONS ON QUESTIONNAIRE NO. 148

Statement		No.	
AC current in the stator windings is converted to DC current at the output terminal by silicon diode rectifiers.	RIGHT	1	WRONG
The positive diode rectifiers are the ones pressed into the alternator end frames; negative rectifiers are the ones pressed into the heat sink.	RIGHT	2	WRONG
Shorting the alternator output terminal to the case is a quick way of telling whether the alternator output is okay.	RIGHT	3	WRONG
Either terminal of the battery can be grounded, and it will have no effect on the alternator.	RIGHT	4	WRONG
A circuit resistance test should show a voltage drop of not more than two-tenths of a volt.	RIGHT	5	WRONG
When testing the voltage regulator, be sure to run the system for at least 15 minutes to temperature-normalize the regulator.	RIGHT	6	WRONG
The voltage regulator cover must be in place when taking voltage readings.	RIGHT	7	WRONG
When testing the diode rectifiers with a test lamp, reverse the test leads at the battery terminals to change polarity, so the current flow will be in each direction.	RIGHT	8	WRONG
When soldering a rectifier lead, hold the lead with pliers to conduct heat from the rectifier.	RIGHT	9	WRONG
When testing for a grounded stator winding, insulate the stator from the end frame.	RIGHT	10	WRONG

Litho in U.S.A.