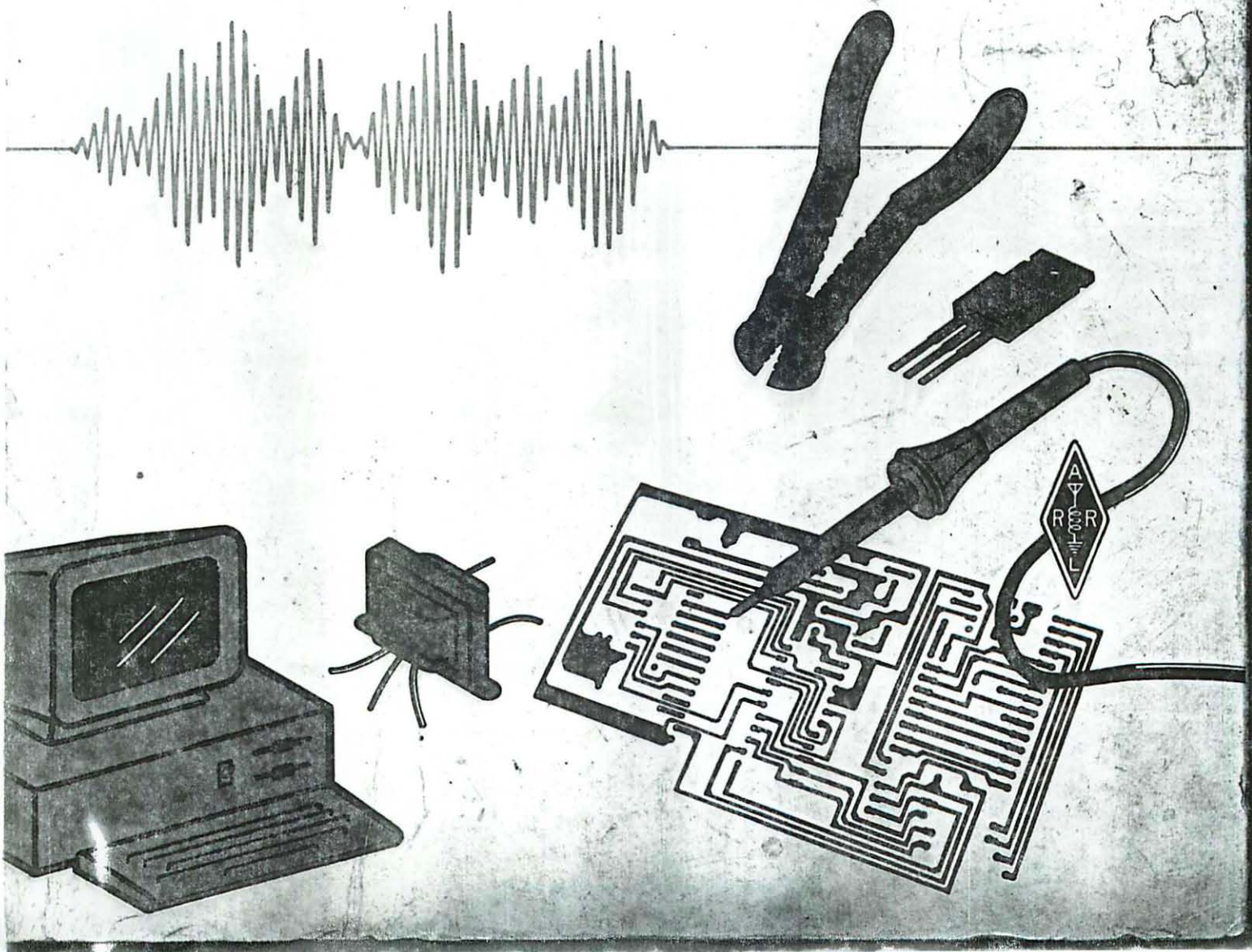
for Bill

1989

$5.00

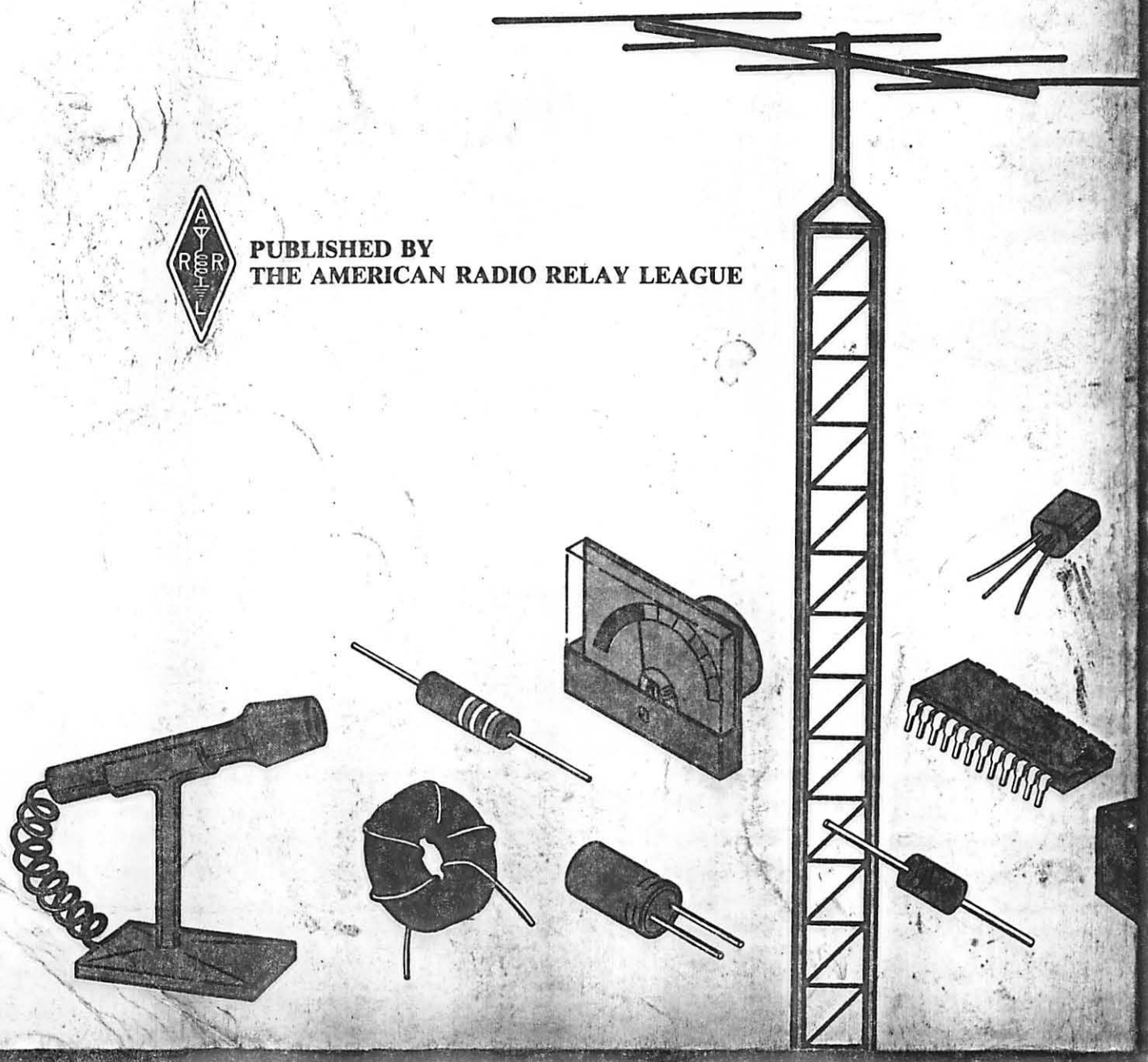
HINTS AND KINKS for the RADIO AMATEUR

A collection of practical ideas gleaned from the pages of *QST*



HAM RADIO KNOW-HOW FROM HAMS WHO KNOW HOW

Join the contributors to *QST*'s most popular technical column as they share hands-on experience in virtually every aspect of ham radio. Whether you sample Amateur Radio's delights by way of mike, key, keyboard or camera; whether you prefer the test bench to the traffic net, or mobiling to moonbounce; whether your enjoyment of ham radio spans days or decades, *Hints and Kinks* contains fixes, tidbits, updates, projects and practical tips for *you!*



PUBLISHED BY
THE AMERICAN RADIO RELAY LEAGUE

See Also Popular Electronics Nov 1968 Page 94 Battery Charger Instructions

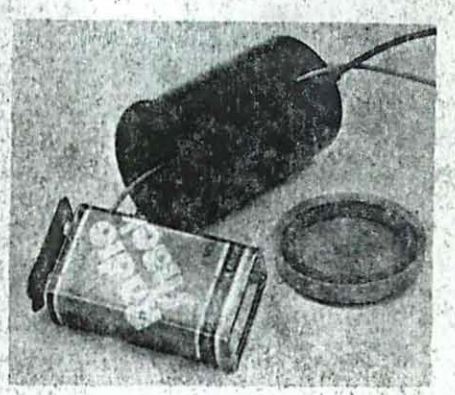


Fig 3—W5TJT's battery holder, which is made from a 35-mm film holder.

battery. If you leave the leads long enough to remove the battery, you can seal the lead hole and have a moisture-proof battery compartment.—*Vaughn D. Nogle, W5TJT, Vadito, New Mexico*

RECTIFIER HASH FROM THE POWER SUPPLY

☐ I decided to try an old trick and use just the center of the coaxial feed line on my 80- and 40-meter dipole to load up on 160 meters. I slid the coaxial-connector sleeve off the back of my KWM 380 and found that the antenna loaded very nicely (low VSWR). However, I noticed a loud buzz in the receiver! I grabbed a portable a-m radio and started searching for the noise source, since it sounded close. It was obviously on the ac mains somewhere, so I started turning off everything in sight. I noticed that unplugging the dc supply to the 2-meter rig reduced the noise. But the switch was off! That didn't make any sense at all. I turned on another receiver and tuned to 160 meters. There it was, from bc on up to about 2 MHz. Anything that I unplugged or plugged into the ac line had an effect. Then I turned the KWM 380 off ... and so went the noise!

I remembered having the same trouble with a TR7 once — the power supply! The problem was caused by hash from the low-voltage rectifiers. Placing a 0.05-μF capacitor across the secondary of the power transformer eliminated the hash. Apparently this is a common problem with low-voltage, high-current dc supplies. The hash is transmitted into the ac mains.

The noise had been there all the time, but using a shielded feed line prevented me from hearing it. When the shield was lifted, the antenna lead was exposed to the radiation from the ac line. Simple problem, simple cure; but sometimes those "simple" problems can make you feel "simple minded"! — *James Beckett, WA2KTJ, Horseheads, New York*

A 1.5-VOLT REFERENCE

When the need arises to use a low-voltage reference, it is common practice to employ silicon diodes singly or in series, depending upon the voltage needed. Typically, a silicon diode will act as a regulator or reference at approximately 6 to 0.7 volt. By using one or more in series the voltage level can be elevated.

Following a hint given to the writer by W7ZOI, an LED was used to provide 1.5-volt reference as shown in Fig. 4. The diode will illuminate of course, which may give rise to a mild psychological trauma for those who view the pc board with a red, green or yellow glow beaming up from amid a group of passive and nonglowing components!

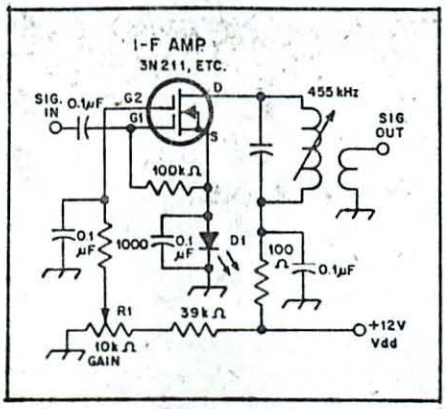


Fig 4—A nifty circuit employing an LED providing a 1.5-V reference.

The diagram illustrates one use to which the writer has put an LED for the goal of obtaining a 1.5-volt reference. The requirement was to place gate 2 of the FET at −1.5 volts respective to gate 1 during minimum gain of the i-f amplifier. This was necessary in order to realize a wide range of manual gain control by means of R1. This method of bootstrapping the stage proved quite effective, even though the curves for the TI 3N211 indicate that −2 volts at gate 2 is the preferred reverse bias.

This concept for LEDs is entirely suitable for other applications that call for a 1.5-volt reference. In many instances the LED can serve double duty as a panel-mounted function indicator or on-off lamp. — *Doug DeMaw, W1FB*

GASOLINE-ENGINE POWER SUPPLY

☐ When Dwight and Ann Mueller were planning to spend a year in the Alaskan wilderness, they needed a small, portable power supply.[1] Dwight built a gasoline-engine-powered unit that

746 Watts per Horse power

included a 12-V automobile alternator and a 2500-W, 117-V alternator (Fig. 5).

A 5-hp engine is used to drive either the 12-V or the 117-V alternator. The pulley sizes are the same on the engine and both alternators. Full output from the 117-V unit was achieved at 3500 rev/min, and at a slightly slower speed for the 12-V alternator. Both alternators were never driven simultaneously, but this should be possible if a slightly larger pulley is used on the 12-V unit so it can be run somewhat slower than the 117-V alternator. A larger engine may be needed if both alternators are to be driven at once, but a smaller one would be sufficient to run only a 12-V alternator.

Fig. 6 shows how this device can be wired

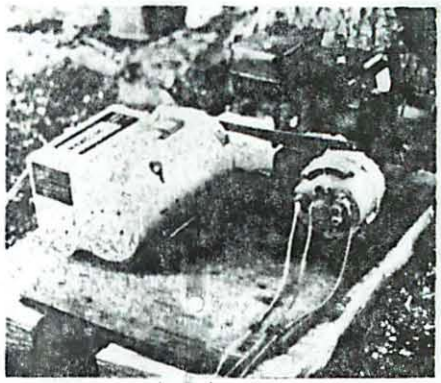


Fig 5—Photo of a gasoline-engine power supply for 117-V ac and 12-V dc.

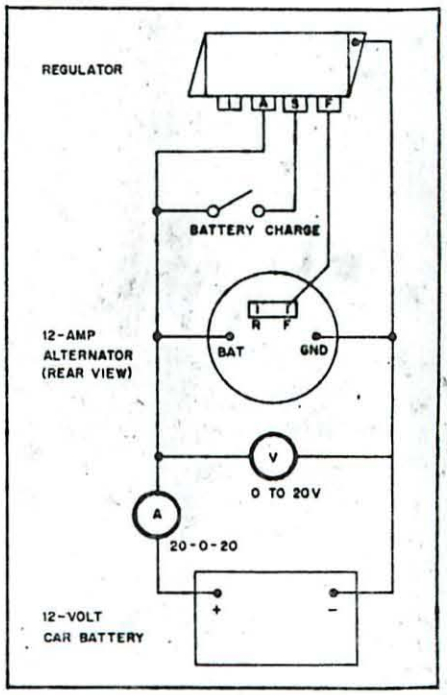


Fig 6—Sketch of the connections used to maintain the charge on a 12-V battery. The battery can be used to power a small transceiver and even some 12-V lamps for reading.

with an automotive voltage regulator to maintain the charge on a 12-V battery. The Muellers' installation had meters and a battery

10 Amps Required for Sears 2 Horse Power 7 1/4 Hand Circular Saw

printed cir-
Optolinear
eye of the
the upper
tects small
mbient light
alarm.

unters" mu-
FF or open
er to the cir-
e whooping
n will switch
usic for an-
IC3 switch
ll repeat in-
ate only the
nove IC2.
any applica-
nections be-
d D of the
timing cir-
uded in the

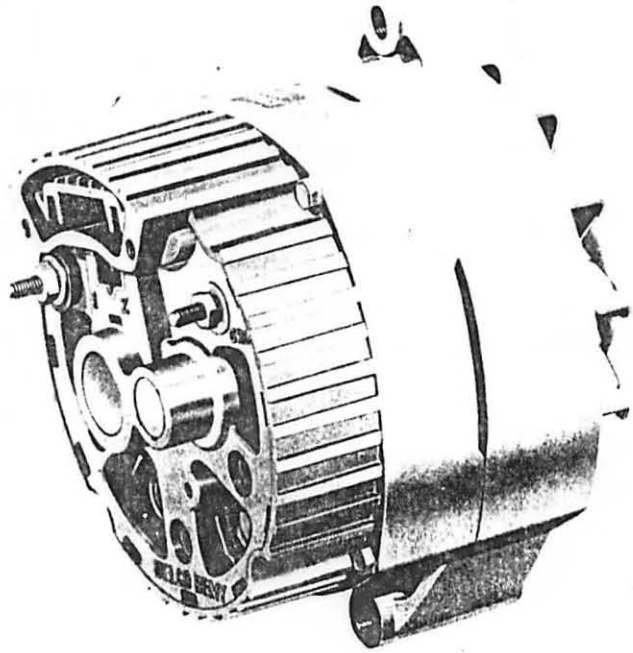
sound and
be produced
and setting
tion. Delete
uous "Close

RITY SENSORS.

grated circuit
1 in diagram)
ronics, 7 Oak-
y, MA 01913.

ime or experi-
bled unit may
tronics.

This is the utimate in charging systems—an alternator with built-in voltage regulation.



Maintaining Alternator Output

This job is advanced for a novice, but an experienced weekend mechanic can handle it

VIRTUALLY ALL CARS built in recent years (Volkswagen a notable exception) have AC generators, commonly called alternators.

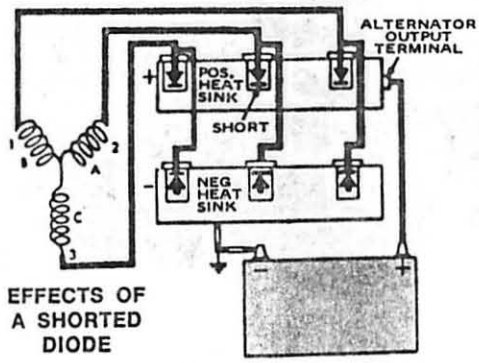
The alternator electrical system represents a high achievement in obtaining the most electrical power from a minimum draw on engine output. It has been termed the ultimate electrical power source for automotive use.

The alternator offers the potential for longer battery life in addition to its primary advantage—higher output. The higher output is due to the comparatively low weight of the rotor and coil assembly allowing greater pulley ratios for higher rpm. The result, of course, is higher output—even at engine idle. Maintaining the advantage an alternate gives your electrical system is just a matter of knowing the alternator and keeping it in top tune.

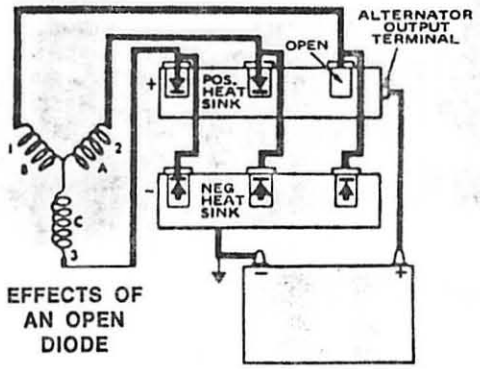
Construction. All alternators consist of a stator, which corresponds to the generator's field circuit, and a rotor, which corresponds to the generator's armature. The only essential difference between the two is the method used to convert alternating current to direct current. Alternator construction can be seen in the accompanying illustrations.

In generators, as you've seen, brushes are used to pick the alternating current off a commutator, converting that current to direct. Alternators, however, employ silicon rectifiers or, for short, diodes. Don't be confused by the fact that alternators also contain brushes because they are used for a different purpose than in a generator. Alternator brushes supply field current to the rotor by connecting two slip rings mounted concentrically on the rotor shaft.

The rectifier in the alternator is a chemical disc that changes alternating current to direct current since it permits current to



Shorted diode will allow current to flow in both directions. It will flow back to the A winding instead of to the battery.



Open diode will not let current flow in either direction. The circuit is not complete through the B winding to battery.

The diode, also called rectifier, converts the AC output of the alternator into DC by permitting current to flow only one way.

flow in one direction only. In other words, the rectifiers used in alternators have a low resistance to the flow of electrical current in one direction and a high resistance to the flow of electrical current in the other direction.

This low resistance allows current to flow from the alternator to the battery, but the rectifier's high resistance prevents a return flow from the battery to the alternator when battery current exceeds alternator output, as it does when the engine idles.

Both alternator and generator have regulator units, but the makeup of each is different. One difference is the absence of a circuit breaker (the cut-out relay) in the alternator regulator.

In the generator's regulator, as you've seen, the circuit breaker connects and disconnects the battery and generator at the proper time. Since the alternator is self-rectifying, though, allowing current to flow only in one direction—toward the battery—there is no need for a circuit breaker. The constant, steady flow of current from the alternator to the battery allows the battery to maintain a full state of charge.

Another difference is the absence of a current regulator. The alternator cannot overcharge so long as the voltage regulation is correct, so there is no need for other than a voltage regulator.

The simple requirements of the alternator for regulation hastened the development of the fully-electronic voltage regulator.

Now used on virtually all cars with alternators, the fully-electronic regulator has no vibrating contacts and is not adjustable. Either it works or it doesn't, and it usually does.

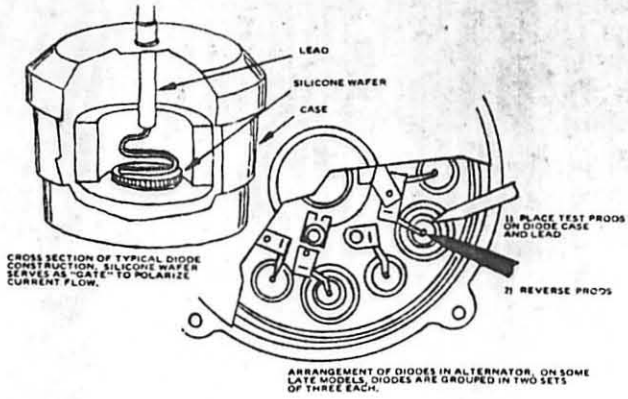
On most cars, the fully electronic regulator is either a plug-in to the alternator or built into it.

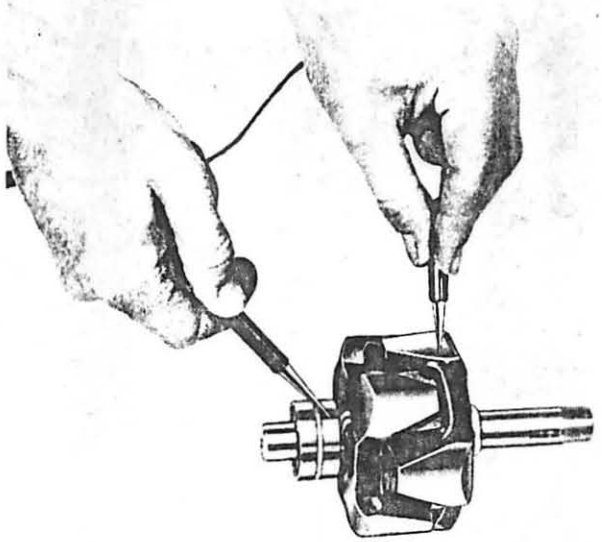
The service information in this article on voltage regulators, therefore, refers to the vibrating contact type used mostly in older car models.

Maintenance. The alternator is no harder to tune than the generator. If trouble is apparent, you don't usually have to replace the entire unit. The unit breaks into two parts—the stator and rotor—allowing you to replace the one that is giving the trouble.

In many cases, you don't even have to replace one of those major components. A common problem, low output, is normally traced to either of two things: a slipping fan belt or defective diodes (rectifiers).

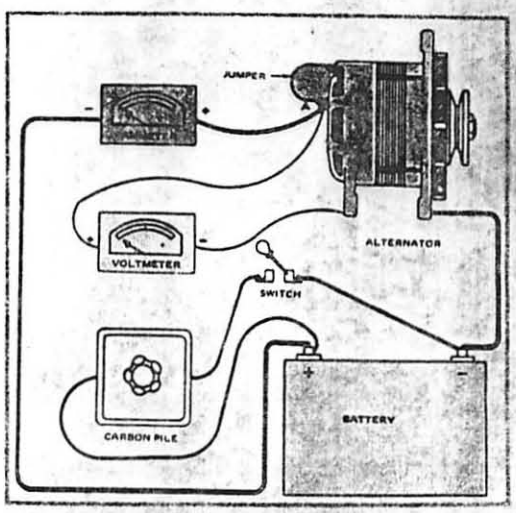
Fan belt tension is critical with the





Top: Testing diode requires a 12-volt test lamp with battery built in or a third connector for car's battery. Test prods should be touched at points shown in illustration, then reversed. Test lamp bulb should light in only one direction. If it fails to light in either connection, or lights in both connections, at least one diode in a group is defective. Center: Defective diode replacement is not for the weekend mechanic, as special tools to press out and install are necessary. Bottom: Alternator rotor should be checked for internal ground—a defect—with diode test lamp, as shown. If lamp lights, stator is internally grounded and should be replaced.

Alternator output test requires an ammeter and voltmeter, connected as shown, and a fully-charged battery. Carbon pile is a load-adjusting rheostat, but you can also load battery by turning on accessories and lights. For this test, disconnect battery cables and alternator connections. On some GM Delcotron alternators, field terminal has "2" below it; on all others, the letter "F" is used. When fully loaded, alternator should put out within three amps of specifications. If five amps or more below specifications, bad diode is indicated.



alternator. Always make sure the belt is in good condition and adjusted to specification.

The one precaution you must keep in mind when working with the alternator is guarding against reverse polarity. Reverse the polarity of the alternator or the battery for even an instant and you stand a chance of burning out the rectifiers. To prevent accidental grounding, furthermore, you should always use insulated tools when working in the area of the alternator.

Following adjustment of the fan belt, turn your attention to the regulator. Make sure all connections at this unit are tight. Follow this by checking the condition of the regulator points. If you find they're burned or pitted, you'll have to replace the regulator. Now, check and tighten all connections including those to the ignition switch, the ballast resistor, the regulator and the conducting surfaces of the fuse and holder.

Unscrew the brushes from the alternator and inspect them for wear. If worn, replace them.

In some cars, the brushes can be removed from the alternator with the unit in the car. This is done by unscrewing the external cap screws to which the brushes are attached. In other cars, the unit must be removed from the car to reach the brushes, which can then be unscrewed.

If it becomes necessary to take the unit apart, remove it from the car and split it open, separating the stator from the rotor. Test the rectifiers first. This can be done with a commercial diode tester, although you can also use any continuity tester, such as an ohmmeter or a test lamp that plugs into household current. The test connections are illustrated.

If a diode is defective, it must be replaced. This requires special tools and should be left to a professional shop.

Next inspect the stator wiring carefully for breaks. To be absolutely sure there are none, you should test from the stator leads to the stator core with a 110-volt test lamp or other suitable tester. If the lamp lights, the stator is grounded and should be replaced.

Finally, test the field windings in the rotor part of the alternator. This is done with an ammeter hooked to the alternator battery output terminal while turning the rotor shaft by hand. The correct field current draw should be recorded on the meter. This reading differs from car to car, so check your service manual.

The above description tells you what to do if you are not getting output from the alternator. However, there are things a faultily adjusted or malfunctioning alternator can cause—most can be checked on the car.

Low charging rate. A low charging rate is indicated when the ammeter or trouble light in your car begins to show discharge at low engine speed and idle. It is also indicated if a battery gets run-down.

Look at the fan belt first and make sure it's properly adjusted. Then check the battery terminals where high resistance could be causing the trouble. Remove the cables and clean the terminals and posts. Make sure the ground cable is clean and tight.

Finally, check at the alternator for loose connections. If the trouble still persists, replace the brushes in the alternator since poor contact between brushes and slip rings is a major factor for a low charging rate. As a final tuneup procedure, remove the alternator from the car and check the stator. Open windings cause an unsteady low charging rate.

If the ammeter trouble light flicks on and off at all speeds and you get a run-down battery, which indicates low voltage output, check the regulator first. To do this, hook the negative lead of a voltmeter to the battery's negative post and the positive to the positive post. Connect a jumper wire from the ignition terminal to the field

terminal on the regulator and then start the engine. The voltmeter should read about 14 to 15 volts for a 12-volt charging system. If not, the regulator is faulty. Try adjusting the regulator points; if that does not increase the voltage output, get a new regulator.

But if the regulator does check out, go to the alternator and tighten all connections. The trouble could also be a shorted rectifier or grounded stator, so check them as well.

High charging rate. It is possible for the alternator to throw out too much charge. An over-charge condition will show up by acid salts on the battery and the battery beginning to use too much water. Check the regulator first; if it's set too high, adjust the points. If this doesn't help, don't scrap the regulator yet.

First remove the unit and clean its mounting surface. A poorly grounded regulator could be causing the problem. If not, the problem is either that the regulator points are stuck or that there are open windings in the unit. If so, replace the regulator.

If the battery is using too much water or a lot of acid salts begin to form, it could also mean that the regulator points are oxidizing. The cause could be a loose or dirty ground connection, so clean the mounting surface and tighten all attaching bolts. Now, test the regulator. If the meter shows a high voltage, set the points.

Finally, check and adjust the regulator air gap to specification as given in your car's manual. To do this, connect a test lamp between the regulator ignition and field terminals. Insert the proper wire gauge (one of .048 inch). Press the armature plate down. The contacts should open and the test lamp should dim.

Now, insert a larger wire gauge in the same position (usually one of .052 inch). Depress the armature plate. The upper contact should be closed and the test lamp should remain lighted. If the air gap doesn't check out, adjust it by bending the upper contact support until you get the right openings and test readings.

Another reason for oxidized points could be shorted field windings in the rotor pole. In this case, the rotor has to be replaced.

Again, excessive use of water by the battery and acid salts on the battery are indications of another condition—burned regulator points. The trouble is probably a regulator set too high or shorted field windings in the rotor pole. In the former case, adjust the points—in the latter, replace the rotor.

Mechanical problems. An alternator that is noisy is one that is either loose on its mountings or one that has internal problems. First check the mounting bolts and make sure the alternator is tightly connected. The drive pulley could also be causing the noise, so ensure that it is tight.

If this fails to stop the noise, remove the alternator from the car and break it open. Inspect the rotor fan blades. If bent, replace the rotor. Now test each rectifier for a short. If this doesn't stop the trouble, the problem is a sprung rotor shaft, worn shaft bearings or open or shorted windings in the stator and a rubbing rotor pole.

In the event of a sprung rotor shaft, replace the rotor. If the problem boils down to worn shaft bearings, you can have them replaced too. If, though, the stator windings are shorted and the rotor poles are rubbing, you'll have to replace the entire alternator.

If the battery keeps running down for no rhyme or reason, it indicates that the regulator points are stuck closed. This was probably caused by a poor ground connection between the alternator and regulator. Replace the regulator and make sure the new unit is properly grounded so the trouble doesn't recur. P.W.

See also: ENGINE; ELECTRICAL, AUTO.