...and be sure to

say "BLUE STREAK"

when ordering

BATTERY and

IGNITION CABLE!

the WHYS and HOWS of voltage regulators

This is the latest in the "Standard" series of informative booklets on Starting, Lighting and Ignition.

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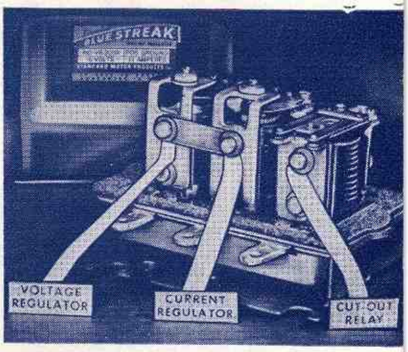
A VOLTAGE REGULATOR is on the car just for one purpose . . . to keep a normal generator battery system in balance. Yes, a normal system, a system that has a good battery, a good generator, no loose or high resistance connections . . . a system that is 100% O.K.

It gives the battery a high charge . . . a lot of juice—when the battery is low, it cuts down the charge as the battery gets filled up.

THE VOLTAGE REGULATOR CONSISTS OF 3 UNITS:

The Cutout . . . *that's the one on the end with a heavy winding.*

The Voltage Control . . . *that's the one on the other end without a heavy winding.*



The Current Control . . . *that's always in the middle.*

THE CUTOUT:

Just an automatic switch . . . has nothing to do with actual voltage regulation. It's there to connect and disconnect the generator and the battery to and from each other at the proper time.

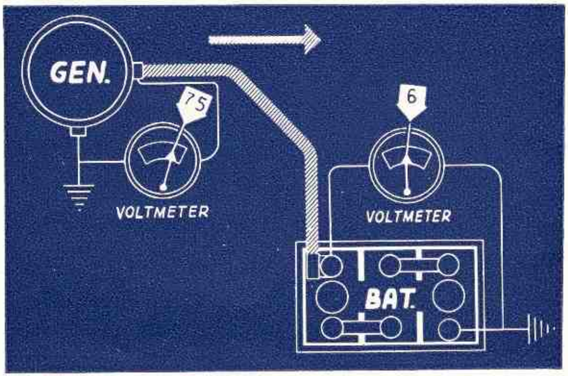
It works like this:

The generator creates all the electrical energy available in the car system. It creates energy only while it is rotated by the engine above a certain speed. When the engine idles or is shut off, the generator is dead . . . it produces nothing.

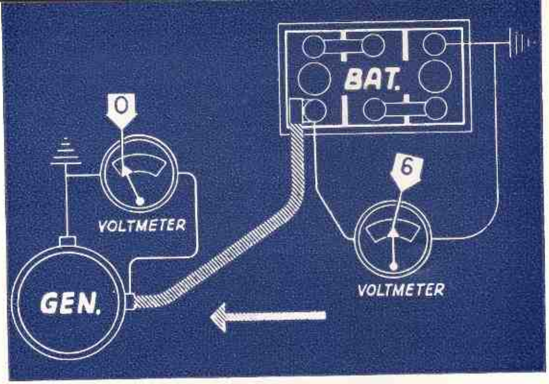
The battery just stores electrical energy furnished by the generator, to be used when the generator is not in operation.

When the generator operates, its voltage is usually about 7½ volts. When the generator is idle, its voltage is to be considered as zero (0), (actually about 2 volts). Current always flows from a higher voltage to a point of lower voltage—just as water flows from a higher level to a lower level.

When the generator operates at 7½ volts, it will send current into the 6 volt battery . . . this is as it should be.



When the generator is idle, the 6 volt battery would try to send current through the 0 volt generator. This would discharge the battery and probably burn out the generator . . . *and we don't want that to happen.*



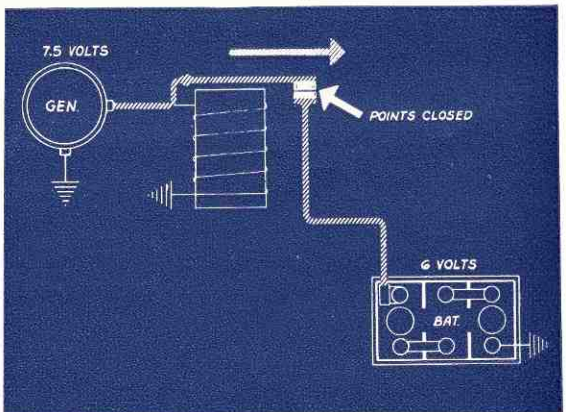
So —

(A) We must arrange to connect the generator to the battery when the generator operates.

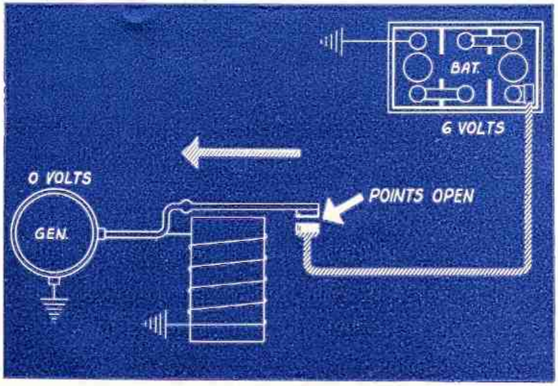
(B) We must separate the generator from the battery when the generator is idle.

The Cutout does it this way:

The generator operates . . . sends current through the winding of the cutout . . . the winding becomes an electromagnet . . . attracts the armature . . . this closes the two points . . . current now flows from the generator to the battery.



You stop or idle the engine . . . the generator dies . . . sends no more current to the winding . . . the armature is not attracted anymore . . . the points open . . . the connection is broken . . . no current can flow from the battery to the generator.



That's all there is to the cutout . . . there just isn't any more.

THE VOLTAGE CONTROL

That's the unit that does most of the work . . . keeps the battery charged but not overcharged. It's also a kind of switch; it switches resistances in and out of the generator field.

The generator field is really a magnet. When an electrical conductor, a wire, is moved through a magnetic field, electrical current is produced in the conductor. The stronger the magnet the more current in the wire and vice versa.

That's your generator.

The magnet is the field coil . . . the wire is the armature . . . just a bundle of wires connected together in a certain manner.

So: When we want to send a lot of current to the battery, we make the field coil stronger and vice versa.

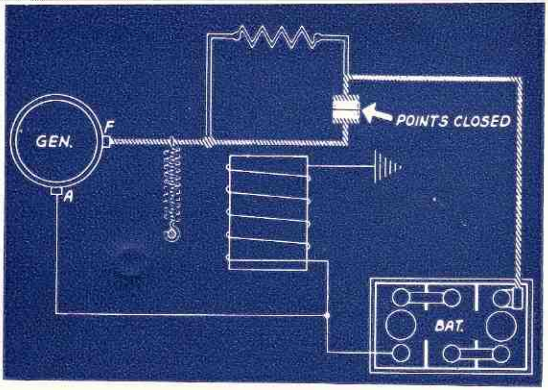
How? —Resistance! —You know how it is: Put resistance into an electrical circuit and you cut down the current in it . . . cut out the resistance and you increase the current. *Just what the doctor ordered for the voltage regulator. Here is the prescription:*

Take one generator armature . . . connect it to the battery and also to a magnetic winding. Add one armature over the winding with a contact at one end and a spring on the other end . . . the spring tries to pull the armature up, away from the winding . . . the winding, when it gets enough current, will try to pull the armature down, against the pull of the spring.

When the armature is up, its contact closes against a mating contact above it—when the armature is down, the contacts are open. Now add one set of generator field coils. To operate, the field coils must be provided with a path to ground. We will provide the path but in our own way.

Now connect the field to the regulator armature. Connect the upper contact of the regulator to ground. Now we start the engine. The generator is turning over fast enough to send out current. Let it run while you take a look at the diagram to see what is happening.

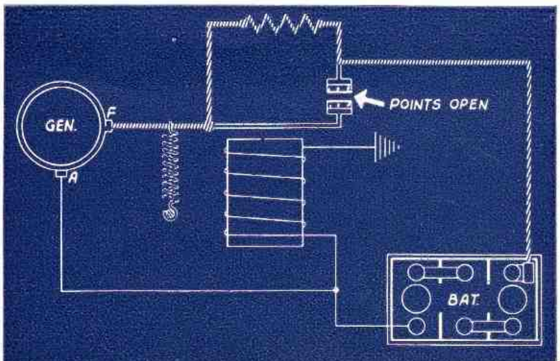
Right now the regulator armature is up . . . the contacts are closed, and you see that the generator field has no trouble at all getting to



ground. The path is direct . . . from the field, through the contact to ground . . . no resistance whatsoever in the field circuit. No resistance means a strong field. A strong field means a lot of current from the armature.

So a lot of current flows from the armature to the battery and through the winding. The voltage in the circuit goes up. The winding becomes strong . . . pulls down the armature towards it . . . breaks the contacts.

How will the generator field get to ground now? Very simple: Through the resistor—of course, that's a lot tougher road to travel than direct through the contact—so the field strength oozes out a bit and the field gets weak.



So less magnetism is produced by the field . . . less current comes out of the generator armature. The voltage in the circuit drops . . . the winding gets weak and lets the spring pull the regulator armature away from it . . . the contacts close again.

The business starts up all over again.

Fifteen thousand times a minute this happens . . . resistor in . . . resistor out . . . field weak . . . field strong . . . voltage up . . . voltage down. Fifteen thousand times a minute . . . fast? . . . plain dizzy.

But—because it's so fast, you don't get high hills and low valleys in voltage . . . more like a straight line . . . like the blades of a fan going around so fast that you don't see them turning. That's why you get a constant voltage in the line . . . that's how the voltage control unit works.

THE CURRENT CONTROL?
. . . works the same way:

Windings, armatures, contacts, resistor . . . except that it operates when the total generator current gets up high . . . when you turn on the radio, lights, heater and other gadgets.

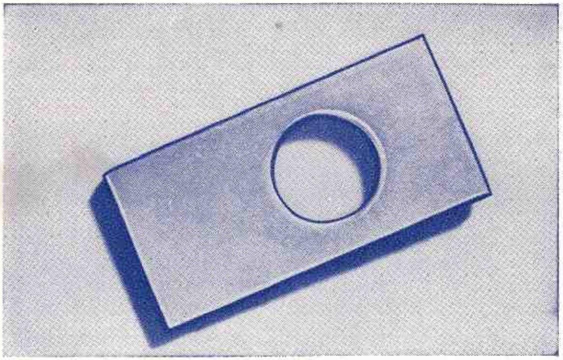
You see, a generator has a certain safe current rating . . . say 35 amperes, and will last for a long time if no more than that is pulled out of it. But if you overload it and pull out more than the safe amperage, it would heat up and burn up.

So the current control of the regulator stops the output of the generator at the rated safe limit and saves it from overload . . . like the third brush used to do in the older generators.

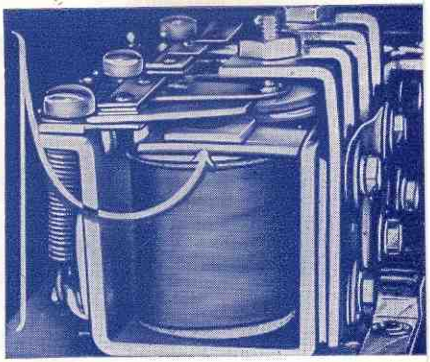
TEMPERATURE COMPENSATION

That's another thing we have to take care of to keep a regulator working through thick and thin, hot and cold. That's it . . . hot and cold . . . the regulator starts cold and gradually gets hot. That's where the snag comes in . . . it would work differently at different temperatures if we didn't do something about it. It's those regulator windings we were talking about. They're really like spools of fine copper wire with an iron core in the center. Like all electrical conductors, copper wire has a low resistance when it's cold and a high resistance when it's hot.

Low resistance, a lot of current . . . a lot of current, a lot of magnetism . . . a lot of magnetism, a strong pull on the armature. And vice versa. So if we don't take care of this hot and cold business, the regulator armature will go crazy trying to keep up with the winding. So we add the compensator . . . a sort of temperature sneak thief.

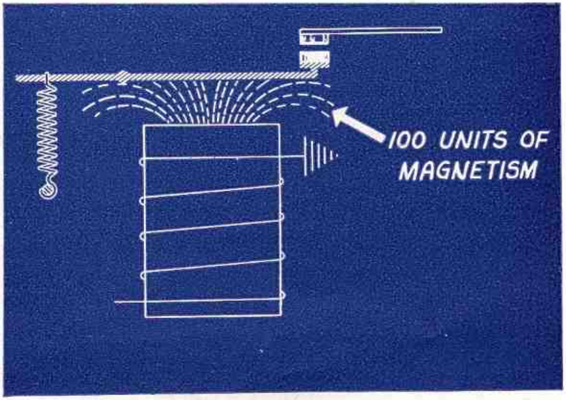


This compensator is a plain looking piece of metal, but it's full of tricks . . . when cold, it is a good magnet . . . when hot, it is no magnet at all.

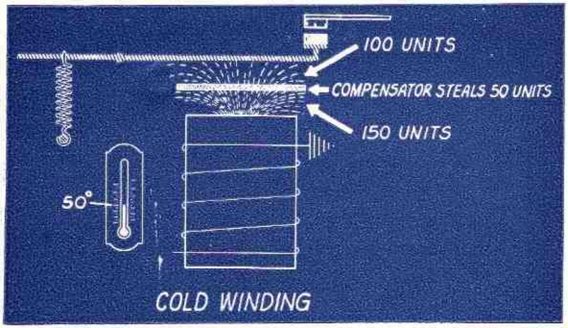


We put this compensator between the winding and the armature.

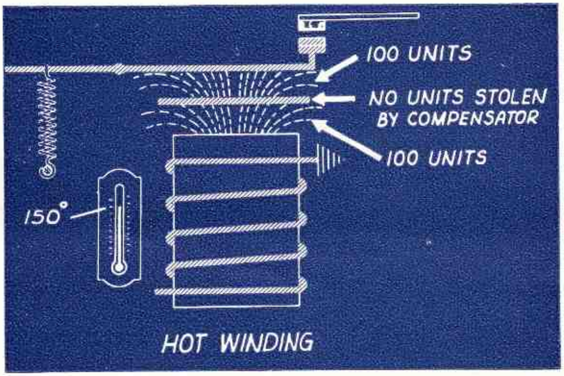
Now, let us say that it takes 100 units of magnetism to pull down the armature and separate the contacts.



We designed the winding to produce 150 units of magnetism when it's cold . . . that would be too much when we need only 100. But the compensator is also cold at that moment, so it is a good magnet and shorts out or actually steals 50 units out of the 150. Only 100 units reach the armature . . . just what we need.



After a while the winding gets hot . . . the resistance increases . . . the winding weakens and produces only 100 units of magnetism. At the same time, the compensator also heats up . . . It is not a magnet anymore . . . it steals no more units and the whole 100 units reaches the armature. That is again what we need.

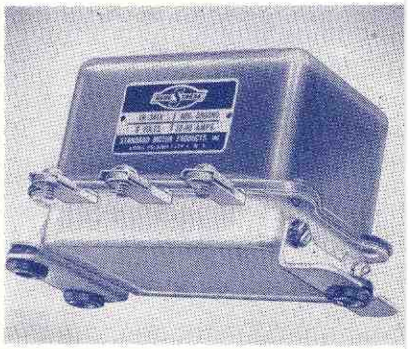


That's all there is to the mystery box, the voltage regulator.

A few more words and the regulator is all yours, but before we turn it over to you we want to call your attention to a special gimmick we have on our BLUE STREAK Voltage Regulator, which you will find on no other.

The resistors we talked about are always on the underside of the regulator. On all regulators, except the BLUE STREAK, these vital resistors are not protected in any way against accidental physical damage or electrical shorts.

In the BLUE STREAK Regulator we have a special bottom enclosure.



This casing entirely surrounds the resistors and other live parts and connections of the regulator. This exclusive BLUE STREAK construction prevents regulator failures caused by physical damage to the resistors, or by electrical shorts of live parts.

The BLUE STREAK Voltage Regulator is the *only* one with a special bottom that completely protects the regulator against such hazards. It is one of the numerous BLUE STREAK extras.

a few DOs and DONTs

DO make up your mind that . . . a new regulator won't fix anything that's screwy in the rest of the system. You can put in one or five new regulators and still be in trouble if you have a bad battery—a loose connection—a grounded generator field.

DO polarize the generator . . . any time you do *any* work on the generator or regulator—anybody's regulator. It's very simple and quick . . . after you install the regulator and before you start the engine, just touch two ends of a wire to the A and B terminals of the regulator . . . a pair of pliers . . . anything of metal . . . count one, two, three, four and it's done. *What if you don't? . . . you'll be sorry, that's all. You'll burn up the cutout contacts and nobody will like you.*

DO read the instruction sheets . . . you may not put on a new regulator, but you won't kill it either. And, when you do put the new one on, it will stay put . . . it will work . . . just a little thing like a satisfied customer.

DON'T try to check a regulator when it's cold . . . it has to be at operating temperature, 145° to 150°. No thermometer? Try this: run it until it feels hot to the touch and too hot to hold on to.

all of this applies to any regulator . . . anybody's make

DON'T try to adjust a regulator by breaking the seals and screwing the contacts up or down or changing the tension of the springs by guess work. Without meters the best engineer can't do it. He wouldn't even try.

DON'T try to use any old regulator with any old generator . . . it won't work. The regulator must be *matched* to the generator.

DON'T use a "positive" regulator on a car with a negative battery ground connection and vice versa. The regulator will fool you. It will work for a while . . . maybe a day, maybe a week . . . then the points will stick and burn out the generator, the regulator and the customer's good-will.

DON'T connect the wires to the regulator any old way . . . make sure the correct wire goes on the correct terminal. The thin wire always goes on the "F" terminal . . . the thick wire that throws a spark when you touch it to a ground must go on the "B" terminal. You only have one thick wire left . . . connect it to the "A" terminal. *What if you don't? Well, if you interchange the A and F wires you won't go to jail but the regulator will be knocking at the Pearly Gates in about three minutes—yes, it will die a hot and quick death.*

SO do it right and you'll be on top

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