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Penetrating Oils, P-Terminal, Poor Reman, Winch Motors

SELF-EXCITING REGULATORS



Electrical Rebuilder's ERA ASSOCIATION FOUNDED 2001

A WORD FROM THE PRESIDENT

Keep the Faith



Lately our little industry seems to be evolving and changing at a fast pace, faster than I would have ever imagined. My dad started in the rotating electrical rebuilding business back in the early 1960s. He later went on to open his own rotating electrical rebuilding mobile repair shop in 1968. I grew up in and around this business and I have seen a lot of changes. And I can honestly say history does repeat itself.

There are several members, including myself, that have seen big changes in the industry. Companies like IPM (International Product Manufacturing), Ace Electric, Accurate Parts, Ennis, Holcombe Armature, Vulcan, Preferred Electric, Valley Forge, Wetherhill Associates, Transpo, RCP, Lester, DuBois, EMS, Quality Rebuilders and others that have either been acquired or closed. We saw it last year when Arrowhead Electrical announced it was acquiring J & N Electric. And now Genstar Capitol has acquired Arrowhead Electrical. What changes that will incur are anybody's guess.

Our supply chain of component parts and complete units has created some great challenges. And to make things worse, we are still experiencing repercussions from the global COVID-19 pandemic that has affected the global supply chain. So, for those who believe that our industry is doomed, I, along with some of your fellow members were thinking the same back thing back then. But here I am writing this message to you now, some 40 years later. With your affiliation with the Electrical Rebuilders Association and other associations, we can provide you and your business with the resources needed to overcome these obstacles.

Keep the faith.

Ken Plourde

ABOUT THE COVER

11385 Alternator
(Photo courtesy of Sammy's Auto Electric)

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Rebuilding is Recycling!

AUTO ELECTRIC CORNER —
Penetrating Oils, P-Terminal, Poor Reman, Winch Motors



BY MOHAMMAD SAMII

The search for the most effective penetrating oil to loosen up rusted bolts and nuts is an ongoing affair and I don't think I am alone in this endeavor.

The line-up of the ones I use often are shown in Figure-1. It starts with the ubiquitous WD-40 which is more of a water repellent/lubricant than penetrating oil but still has some good usage particularly for rust prevention of shot-blasted cast housings. There is also a particular WD-40 product called Specialist Rust Release Penetrant Spray which claims to be highly effective but is new to me and I cannot vouch for its effectiveness over the others yet. (*Figure-2*)



Figure 1 – A Collection of Penetrating Oils

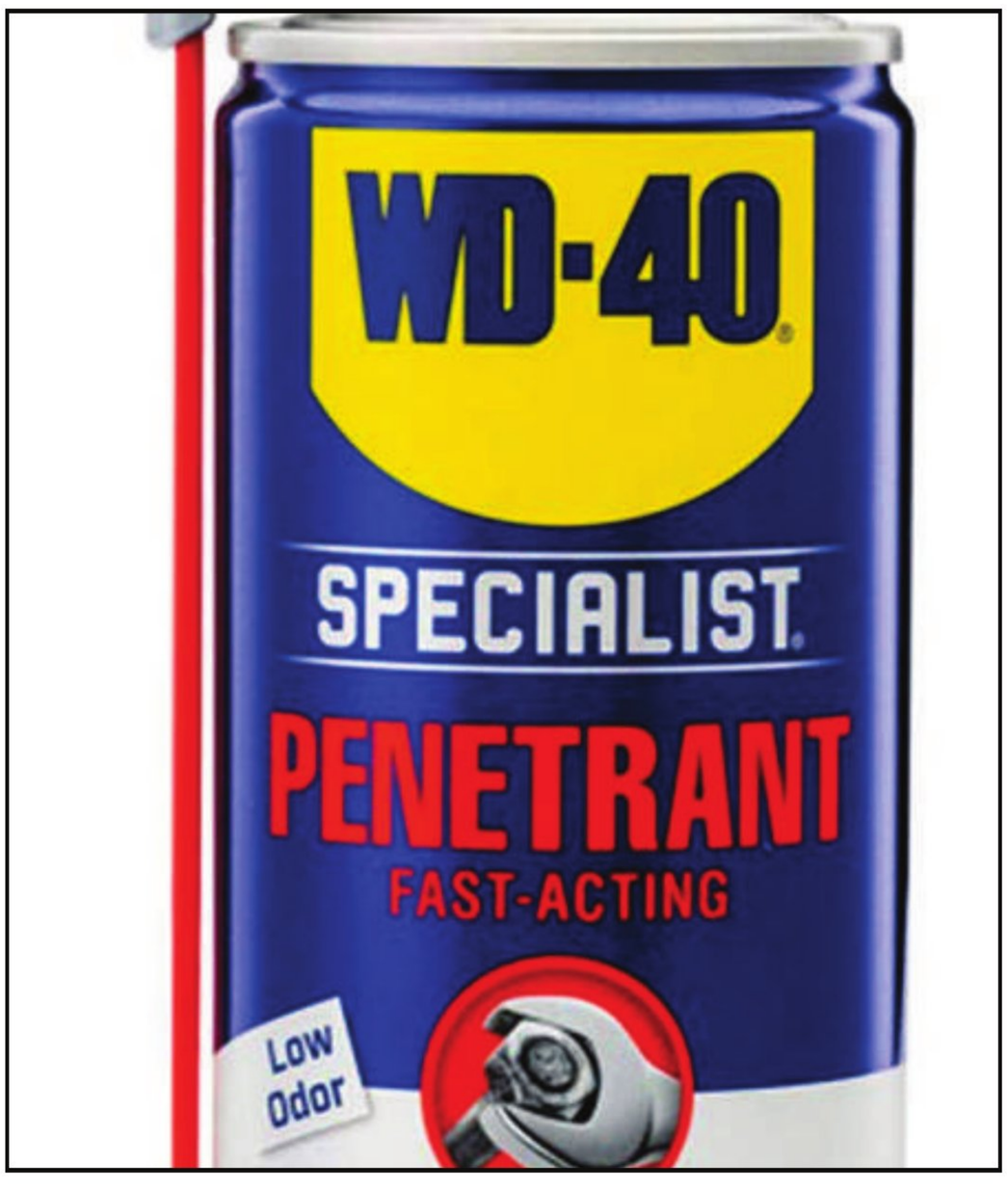


Figure 2 – New WD-40 Penetrant

The others in the picture like PB Blaster and Liquid Wrench have been around for years and do have a special place in the line-up. The less common ones; the Knock'er Loose (a CRC product) and Free All, are something I came across a while ago which also seems to be effective. The last but not least is Rust Reaper, a product that was first introduced and sold by Dubois Marketing a long time ago and seems to be effective if you have the time to let it sit for a while.

There is no real way to determine which one is the best, or if there is such thing as the best penetrating oil. If you use one and it doesn't work and the next one does, you really cannot determine how much the first one contributed to the second one to get the job done.

So, the search for a better penetrant continues and I am sure everyone has his or her favorite/preferred one. I just put this out here and encourage our readers to share their choices with me or on the website to get a feel for what else everyone is using and what seems to work better. I am sure there are as many varied opinions as there are electrical rebuilders…!

Denso P-terminal

A customer of ours who is a large construction equipment rental company sent this 102211-9050 alternator from one of their machines (an end-loader)



equipped with a Perkins 804D diesel engine. This 90-Amp alternator has a 126000-1940 regulator (WAI's IN-449, J&N's 230-52088) with a plug code 324 (*Figure-3*). The pins are P-IG-L which are common in some industrial equipment, particularly CAT that have a Denso alternator with this type of plug. The "P" is the stator voltage (half of system voltage, 7 Volts) that directly connects to the stator terminal on the regulator body, as shown by a zero Ohm measurement in Figure-4. Measuring between the two points is and should be zero Ohm.

After reconditioning the alternator, it was run on the test bench and worked fine with wires to its "IG" terminal and a light to "L" terminal but as soon as I connected the test bench's auxiliary voltmeter which is an analog one, the alternator warning light came on and it stopped charging. Connecting a test light between this pin and the ground resulted in the same: the alternator warning light came on and it stopped charging. Obviously, there was a problem in the internal circuitry of the regulator. Looking at the work order, our customer's technician had also indicated there was no voltage at the "P" terminal but I had related it to the alternator not charging due to worn brushes. The "P" on this machine feeds the hour-meter and the tach. Once the regulator was tested, I could only read very high resistance 12.7 KΩ between the regulator stator terminal and the P (*Figure-5*), where this resistance should be zero as it was shown before.

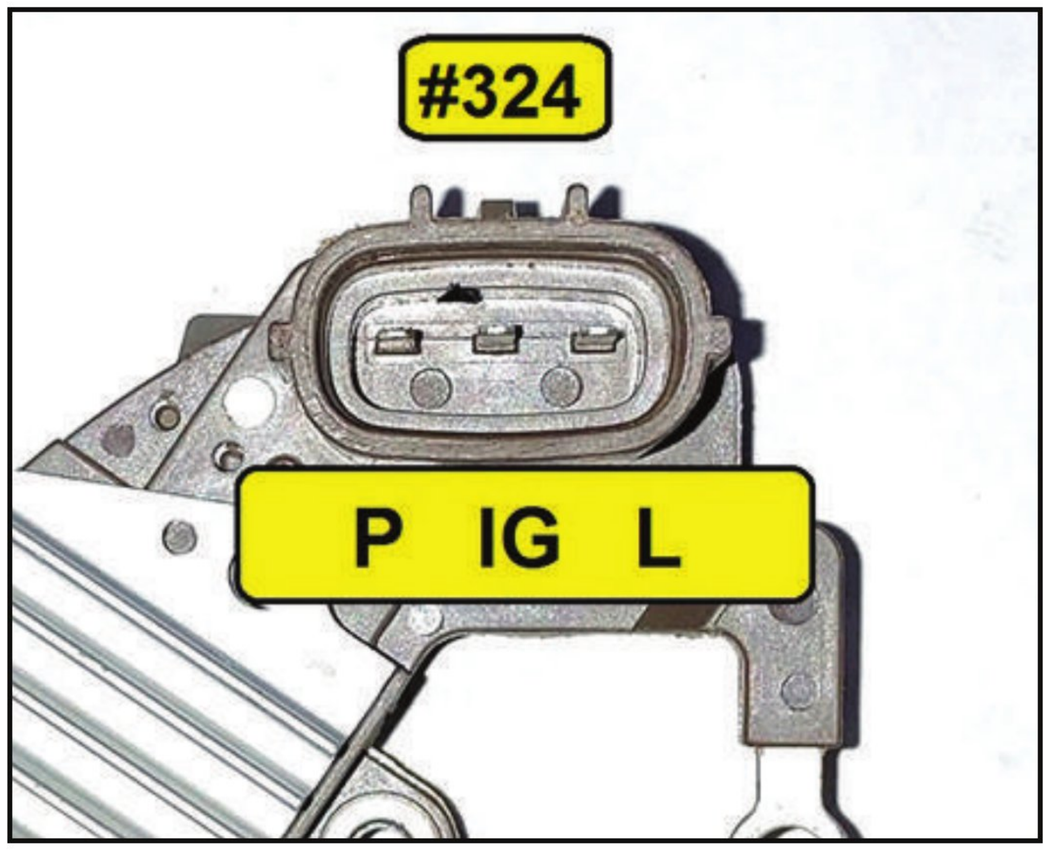


Figure 3 – Plug Code 324 (Notice: "P")

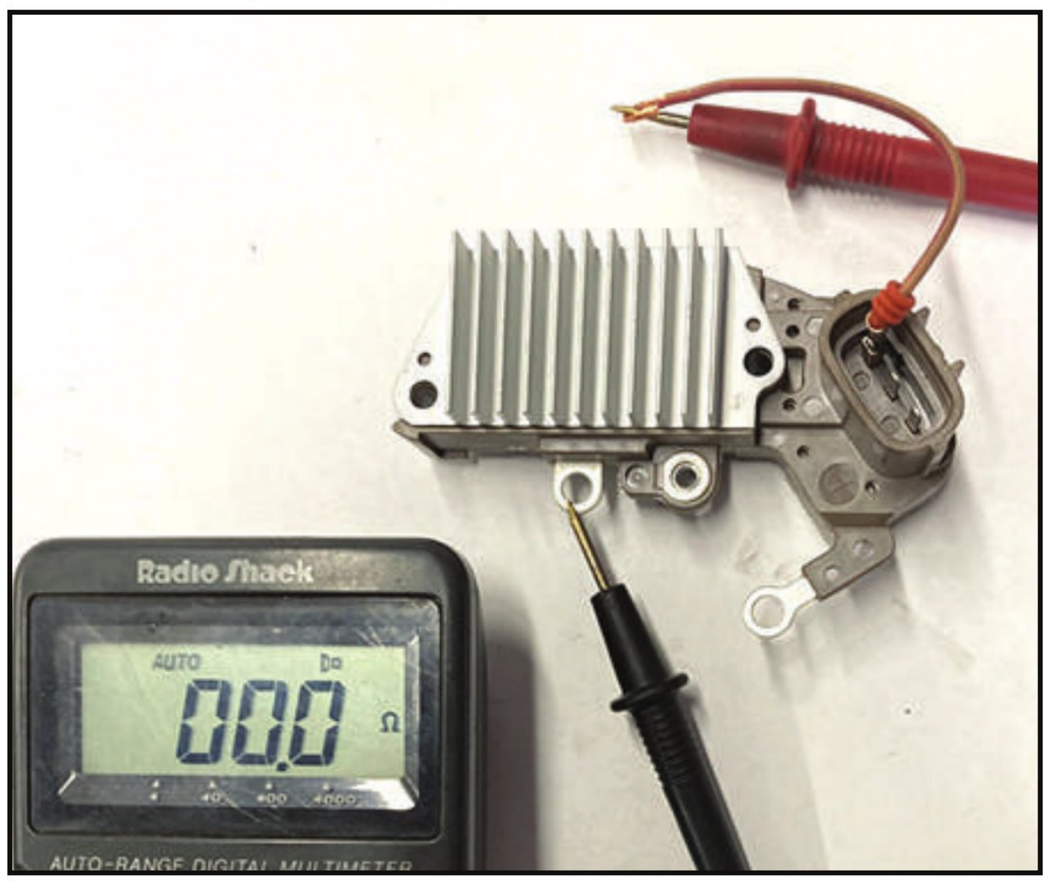


Figure 4 – Zero Ohm Measurement between Stator and "P"

So, a new regulator was installed and the unit tested to be fine with all of its functions. I even connected a larger 3057 bulb to the "P" terminal to simulate a larger load and make sure it was functional.

A day or so later I got a call from the same technician saying that the alternator worked fine for a few minutes but then the "P" voltage dropped off which stopped the tach and hour-meter….!

Upon getting the alternator back, I removed the regulator and made a quick measurement. Sure enough, our zero Ohm measurement was infinite as the DMM read OL (Overload). The internal connection in the regulator had gone open...again!

A call to technician to check for the possibility of an hour-meter or the tach having an internal short or shorted wiring on the machine was discussed. He asked for a new connector to the regulator, admitting it and most of wiring had been tampered with and he would not be surprised of such a problem,

So, I put another regulator in that alternator and did not charge them as they are a very good customer, but with the caveat if this alternator develops the same symptom again, it will not be covered by warranty.

Lesson learned was to check the "P" terminal function of such regulators from the cores a little more thoroughly, to determine that an external short has not affected the regulator. And by doing so, perhaps prevent a future alternator failure due to external problems.

Poor Reman

Our service customer from across the street needed an alternator for a 2008 Pontiac Vibe, which is actually a Toyota Matrix that also shares the same drivetrain with Corollas of the same vintage.

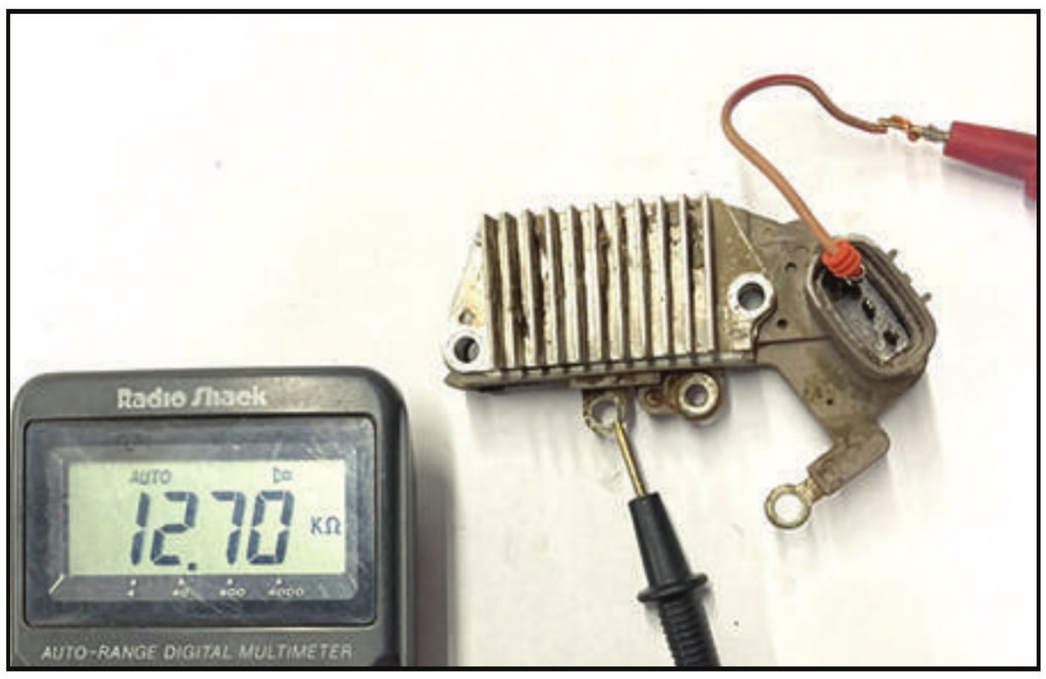


Figure 5 – High Resistance of the Blown Regulators

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The alternator (#11385) was already off the car when I dropped ours. I was surprised how clean and fresh the core looked. I inquired about it and they said that this alternator had been installed by some other shop very recently, and the owner of the Vibe was so unhappy that he wanted it fixed right and did not want to return it to that other shop for a warranty, or ever again…!

I became curious to see what had failed in this rather fresh alternator that was remanufactured in Mexico and sold by a major U.S. auto part store chain (*Figure-6*) as the tag showed. It did not take long to figure out the failure. As I took the brush holder off, one loose brush fell out, leaving only one brush in the holder!

After further disassembly I ran the rotor on the lathe, secured by the tail stock, and saw to my amazement how visibly out of round the slip-rings were. I had to take out over 0.010" to make it run true. As you see in Figure-7, after the second pass, the tool has cut part of the slip-ring quite clearly, while it has not touched the top part.

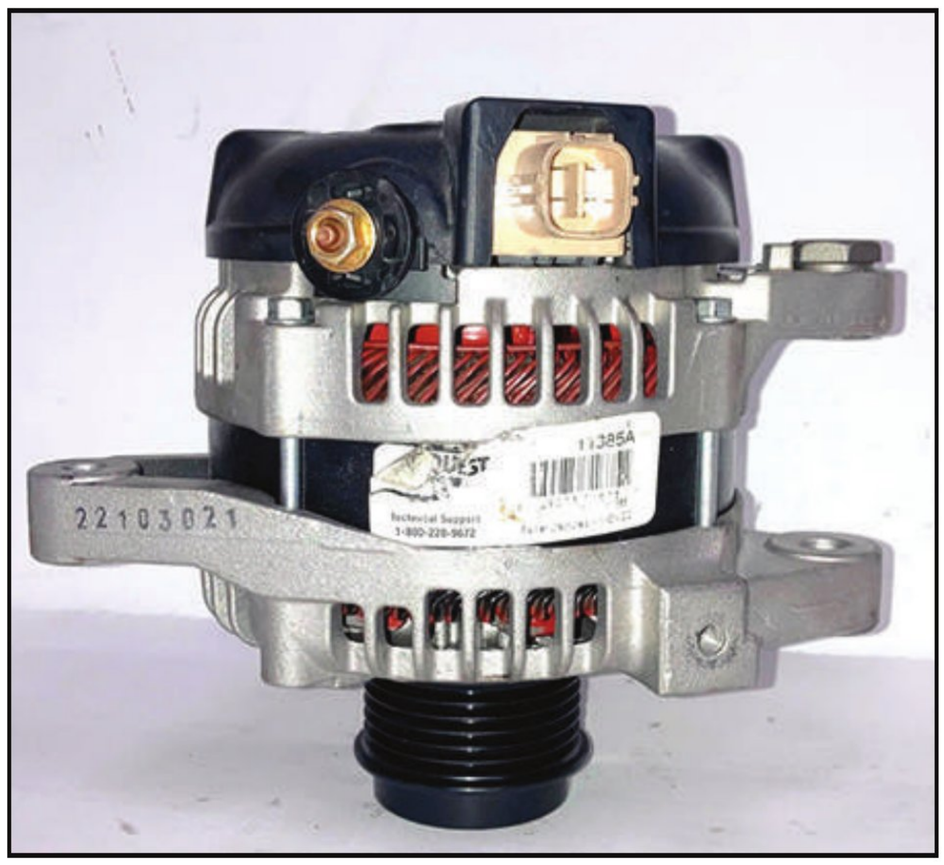


Figure 6 – 11385 Alternator, Fresh Reman but Failed

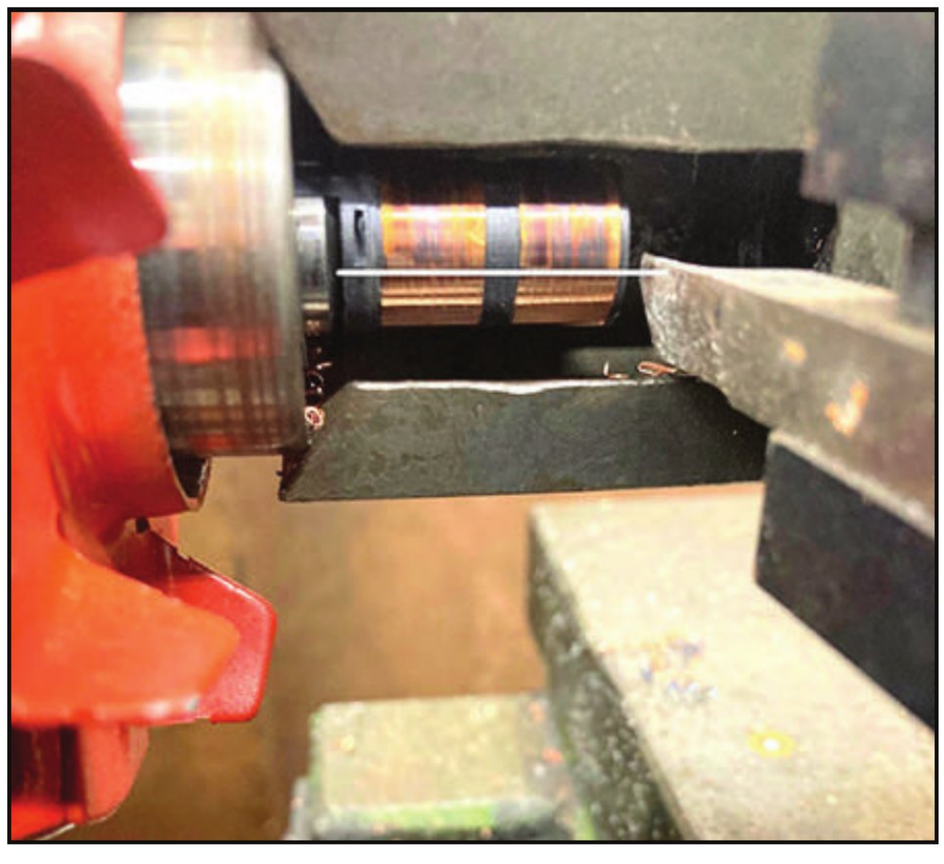


Figure 7 – Notice the cut pattern above and below the white line

Obviously, the wobbling rotor which caused severe brush bounce had broken off the lead from the brush, rendering the alternator useless (*Figure-8*). A new set of brushes and lathe work was all that was needed to restore this alternator to a functional unit. Then it was put back into our stock. Of course, I took off the *Remanufactured in Mexico* label because it no longer was…!

4-post Winch Motors

A construction company customer of ours who does a lot of highway work uses a great number of the 3-post winch motors. They are used to extend or retract the flashing arrow sign contraptions that are put up to warn drivers when any work is being done on the highway. These signs get hit by oblivious drivers repeatedly…!

Of the new batch of winch motors we received, there were these 4-post MBJ-6302B version made by Prestolite that Ramsey Winch uses in their Electric Worm Winch mechanism. (*Figure-9*)

Some service parts such a brushes and field coils are available but are not cheap. Rebuilding the motor and replacing brushes could get a little tricky as the end cap is enclosed and has only 3 holes to run those 3 posts through. New OE motors are also available. The seal behind the dive gear does not do a good job of keeping the oil out. Most such motors we get are full of oil which contributes to brush wear and resulting failure.

There have been many calls on the ERA Help-Line asking how to test some 3-post winch motors. The 3-post tandem type are a little different than the older ones with posts in a triangle configuration. Adding a 4th post adds to testing complexity. For clarification, I decided to provide a picture with imbedded instructions as how to connect test cables to these motors to make sure they run in both directions. Testing the 3-post in tandem motors is the same if you use the body as the 4th post. (*Figure-10*)

I think once this Exchange is distributed, I will post a larger picture on the web so one can be printed and saved as a test hook-up instruction. The important part is to be aware of the market value of these motors. Having the ability to repair or exchange it, make sure you are compensated well for your knowledge and skills.

Well, that all for this issue. Until I see you again, keep up the good work.

You can contact Mohammad Samii by email at: sammyselectric@sbcglobal.net, or by calling the ERA Tech Help Line at 636-584-8324.

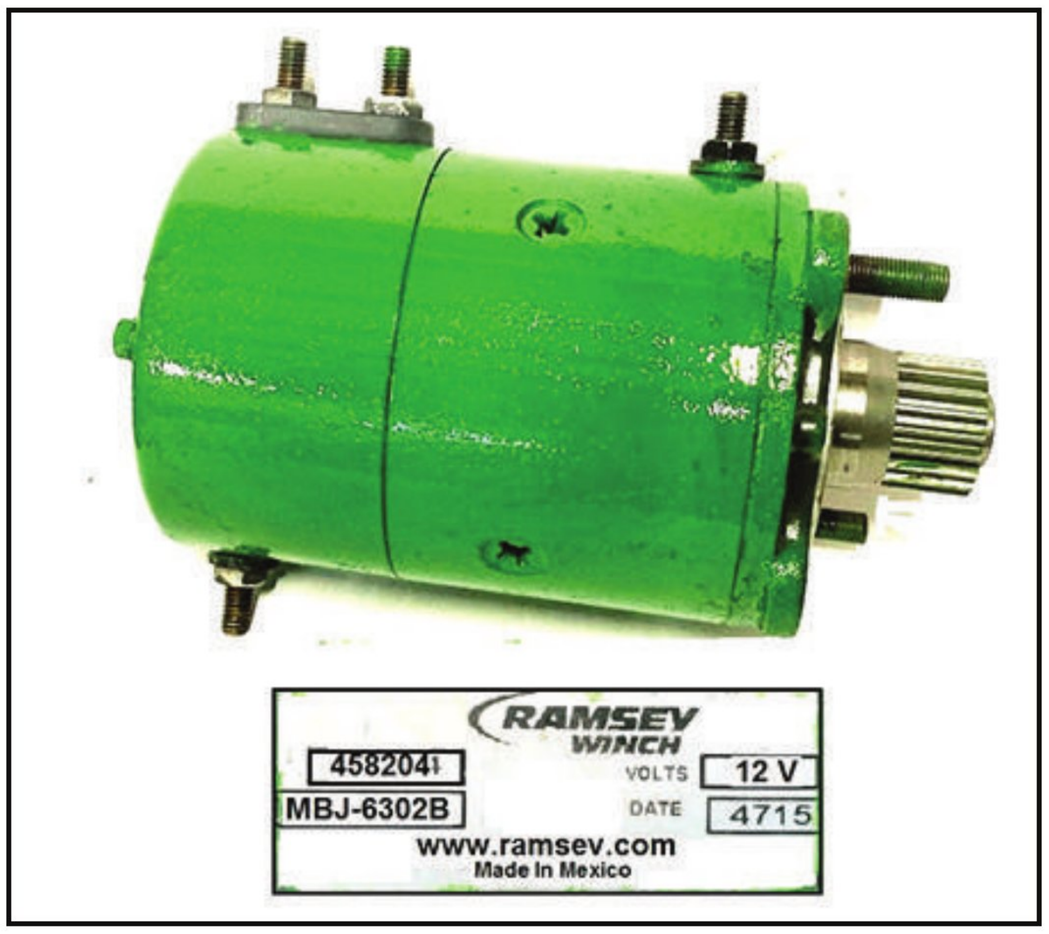


Figure 9 – MBJ-6302B, a 4-post Winch Motor Used by Ramsey

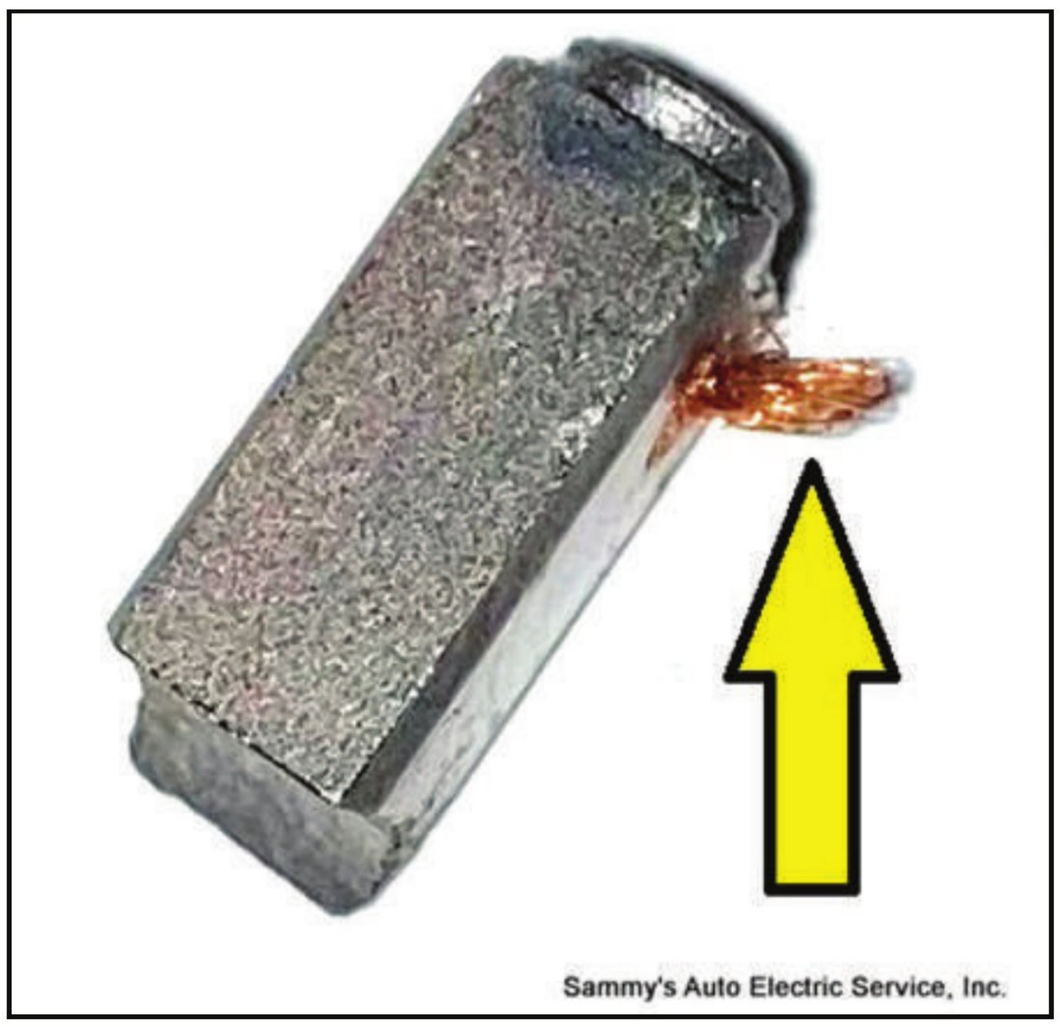


Figure 8 – Broken Brush Lead due to Excessive Bouncing

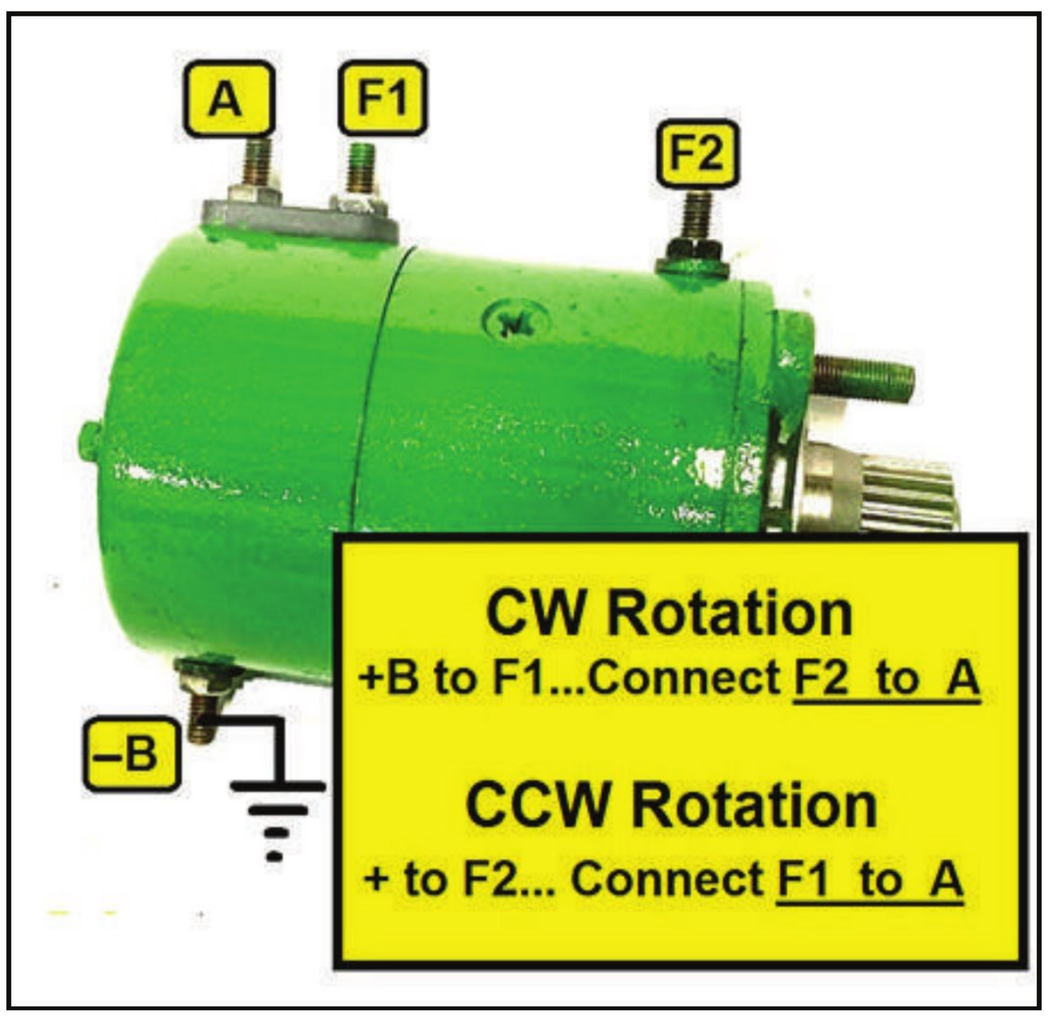


Figure 10 – Testing Hook-up for the 4-post Motor

SELF-EXCITING REGULATORS



BY NATHAN UNGER

Have you ever done that experiment in science class at school where you wrap many turns of wire around a nail, hook the wire ends to a battery, and then see how many iron filings that nail can pick up? (*See Figure 1*)

The teacher may have told you, or maybe you discovered it yourself, that when you disconnected the battery again, that nail could still pick up a few iron filings.

As it turns out, this little bit of magnetism is very significant. Not surprisingly, it's called remanence, or residual magnetism.

Iron can be blended with other elements or treated in special ways, and you could end up with even stronger residual magnetism. This fact becomes significant when purchasing mass-produced alternators because the "good steel" is more expensive.

To know what you are buying, I highly recommend everyone have a residual magnetism tester for quality control. As an example: https://www.mac-ndt.com/magnetism-detector or https://www.amazon.com/MAC-DET-Magnetism-Detector/dp/B00E0LGAQ8

It's only like, $90. (It is useful for other aspects of rebuilding too. More on that another time, probably.)

(If you are reading the digital copy, cut and paste the link into your browser. Otherwise, it's a DET-432 by Magnetic Analysis Corp.) It's also called a gauss meter. You can find it on Amazon.

But even if it's only residual, it IS magnetism, and as Michael Faraday discovered, if you move a coil in the presence of a magnet, you will generate electricity in the coil.

Air gap is another big deal. If the rotor and the stator of an alternator have a bigger gap between them, it will generate less electricity. It's actually an inverse square law.

So now, as soon as your alternator starts turning, there is a measurable voltage at the stator terminals, even if it isn't enough to get past the trio diodes to excite the field circuit. A normal trio diode will turn on somewhere around 0.7 volts, and this stator voltage can be sensed as low as 0.1 volts or lower. Almost all alternators used in our industry are three-phase machines. You can monitor that with your DVOM set on AC volts and connected between any of the three phases and ground. (An auto-ranging meter is better for this than one where you have to select the scale, because as soon as the alternator starts charging, that voltage will snap up to around 7 volts average.)

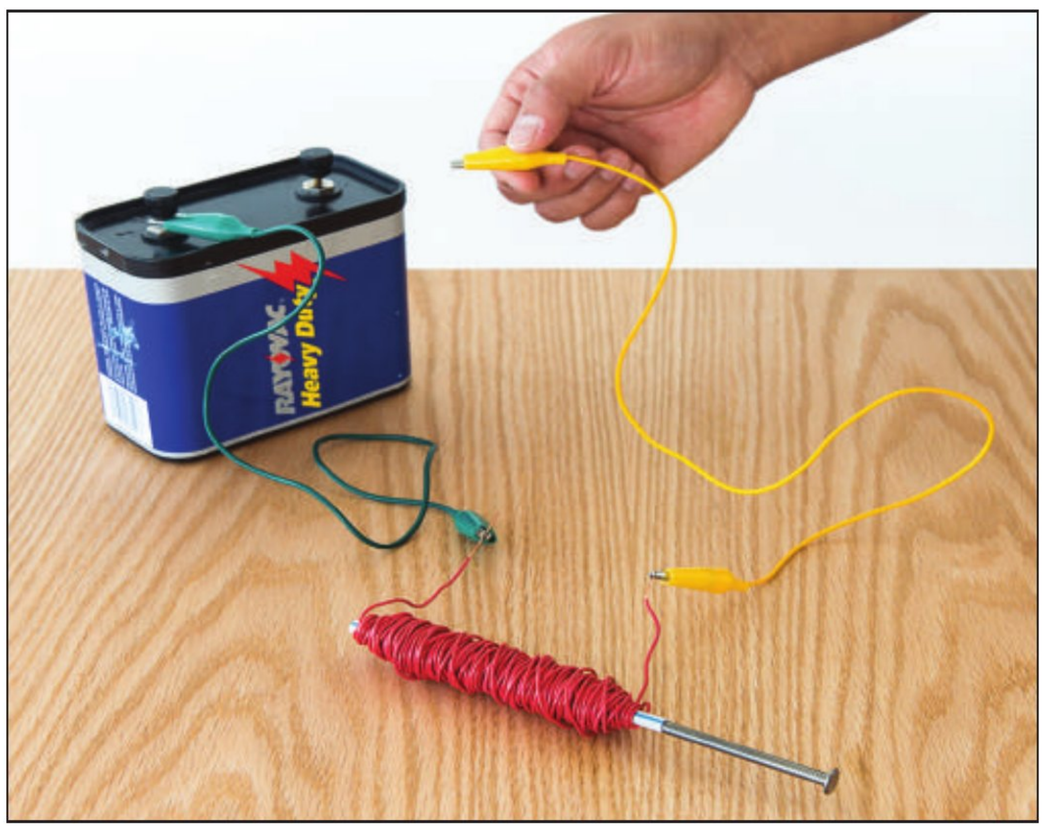


Figure 1 – Basic Electromagnet

Most stator activated regulators and low-cut-in-modules have very sensitive electronics inside that allows them to sense this low voltage due to the residual magnetism. This is then used to activate the regulator.

Once the regulator is activated, it applies voltage across the rotor coil, creating a powerful, spinning electromagnetic force, and the alternator begins charging.

Now, there are things that can give problems. If the diodes are leaky, some self-exciting regulators will see that as if the alternator's rotation was producing the voltage. So, you must check the diodes for leakage. Put 12v on the B+ of the alternator and ground the case. Then with an inexpensive analog (low sensitivity) voltmeter, if you see 6 or 7 volts across a stator/rectifier junction and ground, your diodes may be too leaky.

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SELF-EXCITING REGULATORS

Here's a must-read article on that subject: https://www.electricalrebuilders.org/techlib/tech_articles/ERA-tech-article-201802A.pdf

Bob Thomas and Gene Kaiser explain all about it in "Phase Activated Regulators". You can find this on the ERA website by going down the left column of the home page until you get to ERA Technical DOCS. Then, it's the second article under the "Alternators" tab.

Here are some things they discussed:

- Diode leakage

- Rotors may have lost their residual magnetism. Or, maybe the rotor had its residual magnetism reversed during testing, or because of the slip rings being replaced the other way from original.

- Self-exciting regulators may be isolated ground designs, making them suitable for use in positive ground applications.

Another problem we encountered is that sometimes ripple voltage would appear at the battery due to a battery charger being connected. Some self-exciting regulators see that and turn the alternator on, as if they were seeing ripple frequency from the alternator turning. If it is just an inexpensive battery charger, the alternator's rotor coil may draw more than the charger is putting in, and that will discharge the battery.

Most large industrial and truck alternators are designed with self-exciting stator activated regulators, but most automotive units are activated when the ignition key is turned on: either directly, via an indicator light, or via a signal from the vehicle computer system.

There are many other applications where we might want to have a self-exciting alternator.

- older farm equipment where the wiring has deteriorated, or where the generator/regulator system is too expensive to fix.
- Alternators that had an external regulator
- If the regulator is not identifiable or not available.
- marine or off-road applications
- light industrial units like skid-steers or forklifts
- off-the-grid power systems
- custom-built racing or street rods
- classic, antique cars, or old military vehicles
- high-amp alternator upgrades.
- Or even just a simple up-sell!

So that's where the aftermarket gets involved. Regitar and Transpo are the two main manufacturers that I know about that have an extensive line of such regulators.

There are several styles of self-exciting regulators available:

- stator activated: Occasionally I have found that if it states that a regulator is stator activated, even if it is not advertised as self-excited, it will be anyway. This is also true for some PWM or LIN/BSS types – some will self-excite and operate in a default mode.

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• stator activated that can activate from either wye-neutral or phase signals

• dual stator activated: sensing the 120-degree phase shift, not just the voltage.

• trio activated

• modules that can excite existing regulators. (This might be a good idea if the old regulator has a brush-holder on it that you need, or if the old regulator provides a seal for marine or severe duty use.)

• various voltages like 6-, 8-,12-,16- or 24-volt systems

• A or B circuit

• adjustable voltage setpoint

• extra wire/connection for the indicator light

Note: this does not turn the regulator on, it only makes the light on the dash work like normal, so if the bulb burns out, the alternator will still keep working.

• Some self-exciting regulators are a direct bolt-in replacement for the original, while some are modules that you can adapt a mount yourself, however you wish.

As I mentioned above, some stator activated regulators detect the voltage level, but some can sense the 120-degree difference in phase from one stator lead to another. (An alternator produces 3 phase AC which is then rectified to create DC.) A cycle is 360 degrees, that's why we say 360 / 3 = 120 degrees apart.

For more reading, see: www.electronics-tutorials.ws/power/three-phase-rectification.html or type into google: Electronics-tutorials three phase rectification

OK so now here is a puzzle.

I was working on a Motorola alternator Lester #8417 with an 8RG2043 (low cut in, self-exciting) regulator. I had it hooked up as in Figure 2, but it would not excite until I revved it up to over 2000 RPM. What was going on here? The answer is at the end of this article.

Next problem:

I'm sure many of us who have used self-exciting regulators have encountered this one: On the old Ford 1G (Lester# 7058), we see it has a stator terminal on the back of it. (*See Figure 3*)

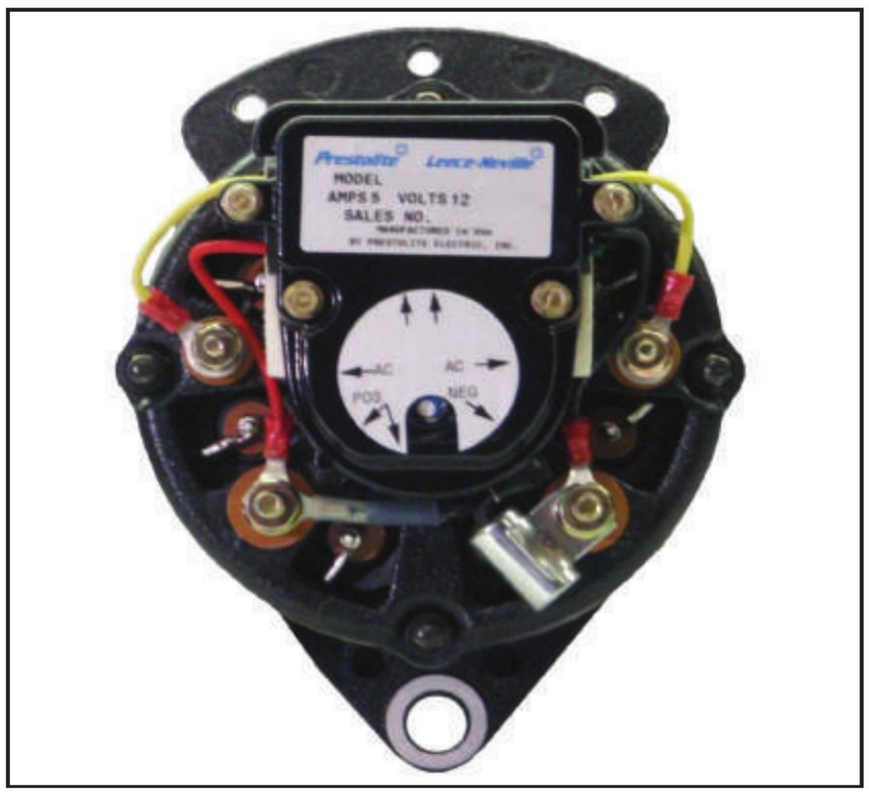


Figure 2 – Motorola alternator



But when I tried to connect the stator wire of a self-exciting regulator to it, it wouldn't activate. Then I re-read the directions, and it said I had to open up the alternator and connect the regulator's stator lead to a rectifier/stator connection inside. This is because the stator stud was connected to the neutral leg of a wye connected stator, and the self-exciting regulator required the use of one of the three phase leg connections instead.

Mohammed Samii did an excellent presentation on this subject. https://www.electricalrebuilders.org/forums/attachment.php?attachmentid=1240&d=1366914779



Figure 3 – Ford alternator

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Or you can find it by searching the forums for Mohammed's post on April 25th, 2013. Type 'neutral point' into the search menu and it's about 9 entries down, called *Phase vs. Neutral Point Connection.*

Here are some of my favorite self-exciting regulators:

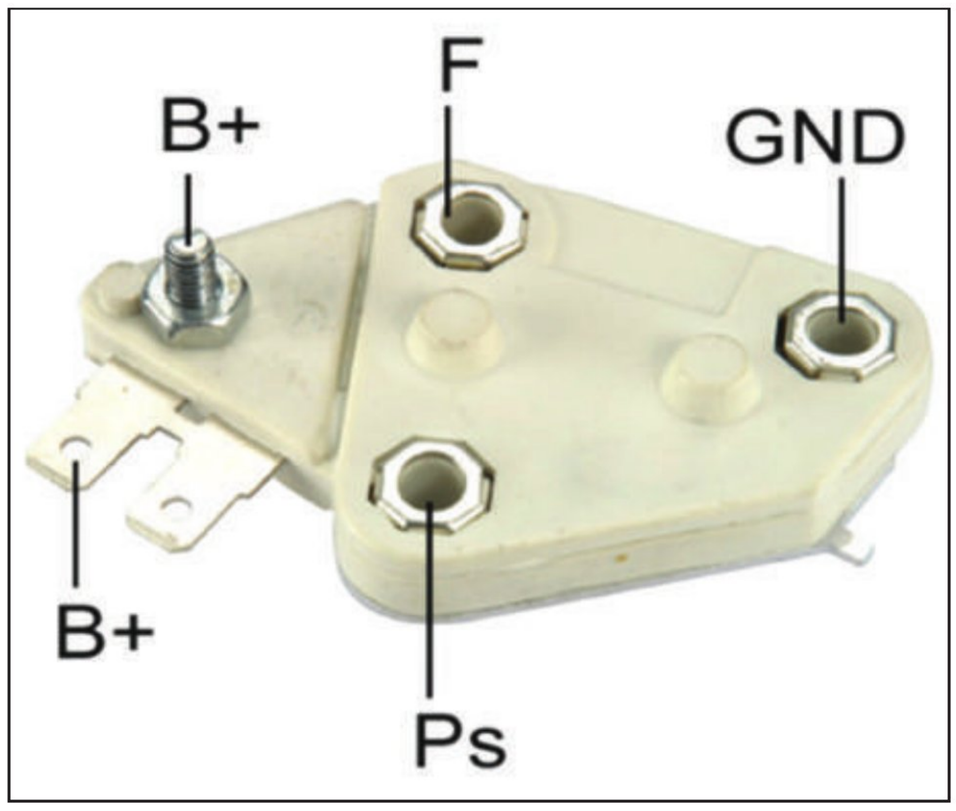


Figure 4 - Regitar D713 or Transpo D10AC

The regulator in Figure 4 changes a Delco 10SI to a self-exciting, one wire alternator. It does not need a diode trio (one less thing to go wrong) and is very sensitive. It will work even with larger air gaps, such as with heavily sanded rotors and stators, and it can even make those old low output rotors turn on too, for when you are mixing/matching rotors and stators to improve your salvage rates. The original regulator was A circuit, but this one changes it to B circuit. It can handle up to 8 amps of rotor current.

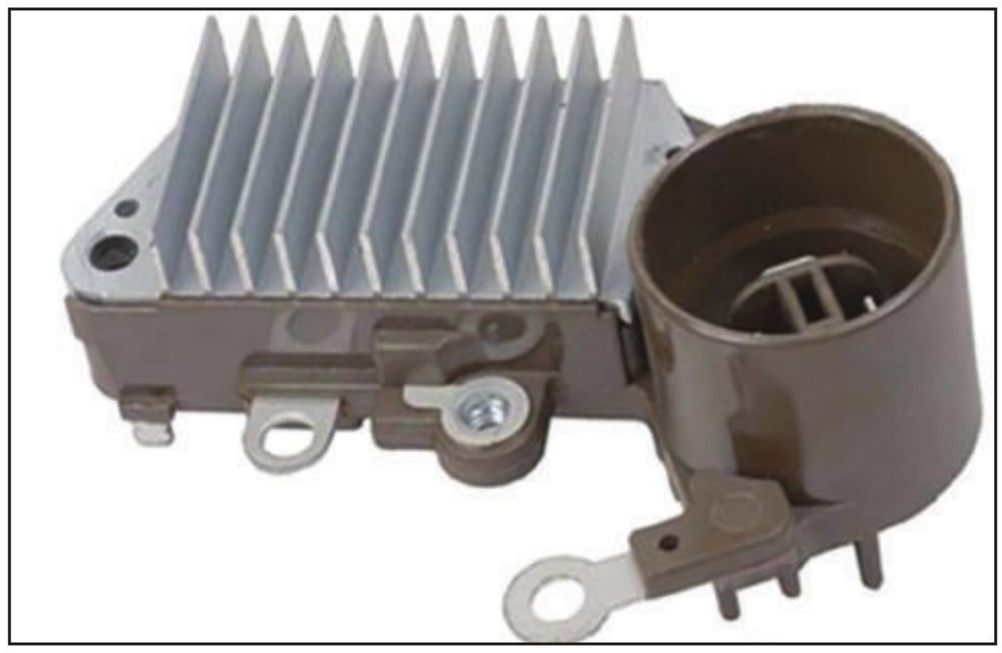


Figure 5 – VRH2005-4SE or IN220SE

121000-4280 is a popular alternator for Dodge pickups. Sometimes the ECM-built-in regulator fails. Larry Hagemeister wrote about this solution in July 2017 ERE. Use this regulator (See Fig 5), WAI 39-8203 brush holder, and a 46-82471 cover cap, and maybe grind a little metal from the CE housing under the regulator in the right spots to give it clearance. Because this regulator is self-exciting, there is no need to replace the ECM.

This one hangs off a through bolt, has an adjustment for voltage setpoint, and is B circuit (*See Figure 6*). It has a wire for a light too.

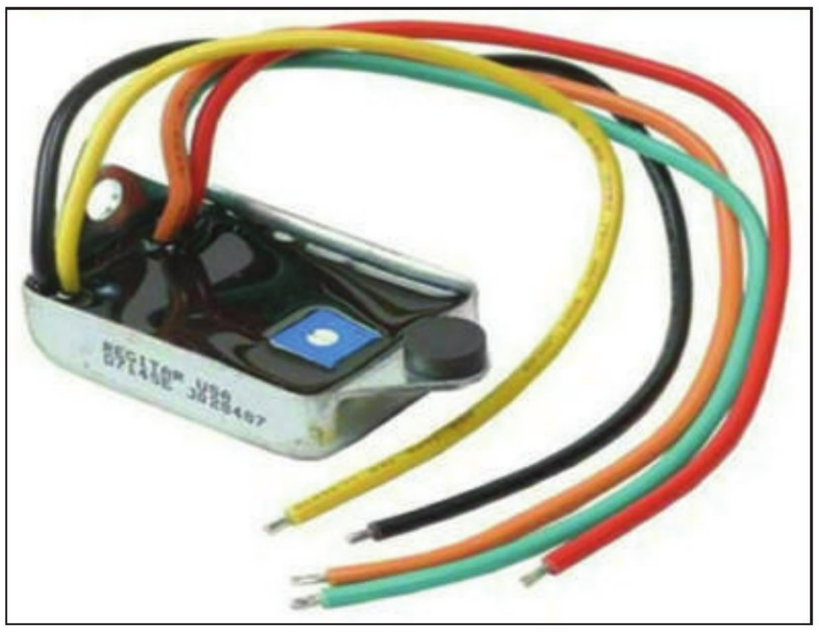


Figure 6 – D714SE or D7024

Of course, sometimes it is handier to use the A circuit version (*See Figure 7*). This one provides an extra wire for the other end of the field to connect to B+. It does not have a wire for a light.

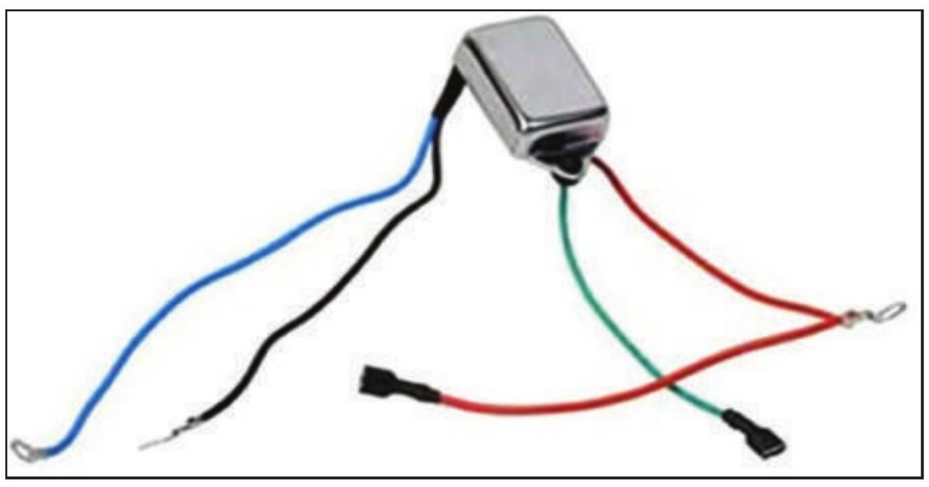


Figure 7 – D679, D7018

This one in Figure 8 is very tiny. It can mount inside an alternator, or in a convenient location on the back.

It can make any B circuit alternator into a one wire system. I believe it was developed for Dodge applications where the regulator in the ECM no longer supplied the proper field current to the alternator.

Sometimes a brush-holder is an integral part of a regulator, and you still need the old regulator to hold the brushes in place. Just snip the old regulator leads or conductors, and install this regulator nearby. You may have to run a ground wire for the other brush though.

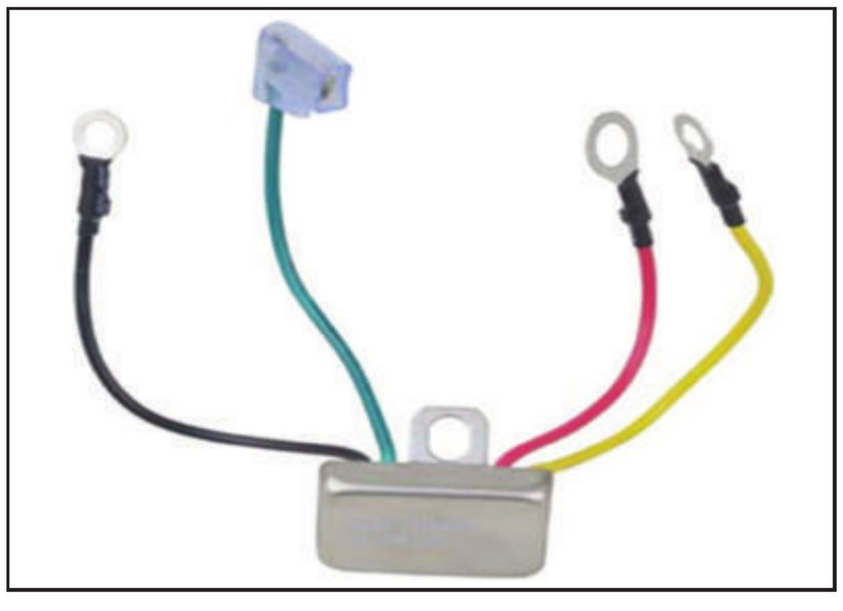


Figure 8 – Regitar VRD01M (I couldn't cross this one in Transpo)



SELF-EXCITING REGULATORS

High amperage (up to 220+ amps) Denso hairpin alternators can find a lot of applications if they are self-excited (*See Figure 9*).

Or how about those old Motorola alternators on the AMC's, Lincoln welders, or other ancient equipment? Wouldn't it be nice to get rid of the old regulator, ratty wiring, and that troublesome isolation diode plate on the back? This has adjustable voltage to compensate if necessary and is B circuit for easy hookup. It bolts to the back of the alternator with the 3-bolt mount. Or if you like, you can fabricate a mount yourself with standoffs, etc. (*See Figure 10*)

Self-exciting regulators are available in direct bolt-in versions for Ford 1G, 3G, 4G and 6G, Mitsubishi A5TA, A3TB, A2T, Delco 10DN, 10SI & up, AD230, AD237, AD244, CS130, CS130D, Delphi, various Denso, older Bosch, and so on. Some are also in 6-, 8-, 12-, 16-, and 24-volt versions. If anybody is interested, I am working on a chart I can send you. Perhaps we should get that posted on the website too if there is enough interest.

The answer to the Motorola alternator question:

Although the two yellow stator wires were hooked up at different places physically, they were actually still on the same phase electrically because of the way the forked stator wires were connected. When I changed one of the yellow wires to a different phase/diode connection, then the regulator could properly sense the 120-degree phase shift and the cut-in speed was now correct - below engine idle rpm. If you consider the pulley ratio of 2:1, that could be as high as 1800 alternator rpm, but in my case, it cut in as low as 350 rpm!

Many thanks to Mohammed Samii, Bob Thomas, Gene Kaiser, Larry Hagemeister, whose material was referred to from the ERA archives, or who worked behind the scenes to proof-read this article.



Figure 9 – VRH2005-101SEM, IN6324SE

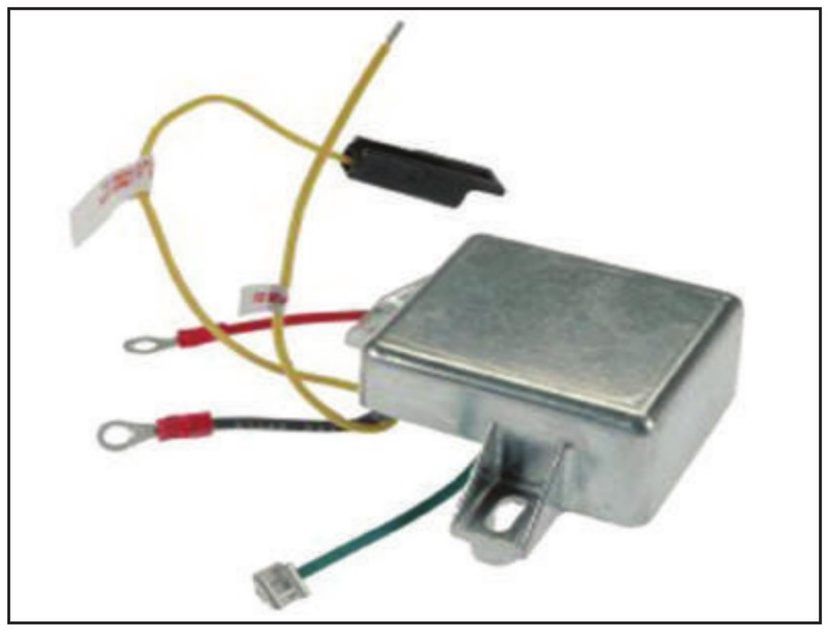


Figure 10 – WAI/Transpo M5-151SA12 or 24 (No cross in Regitar)



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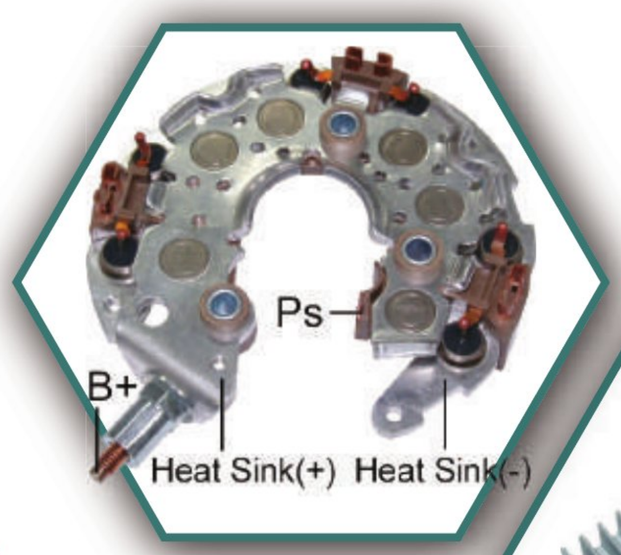
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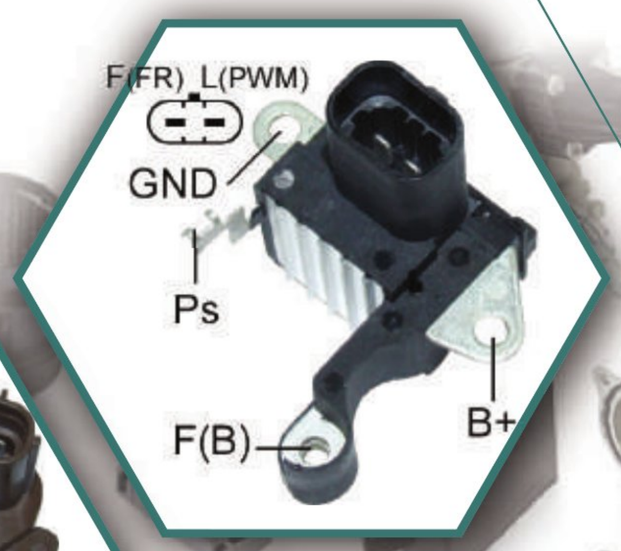
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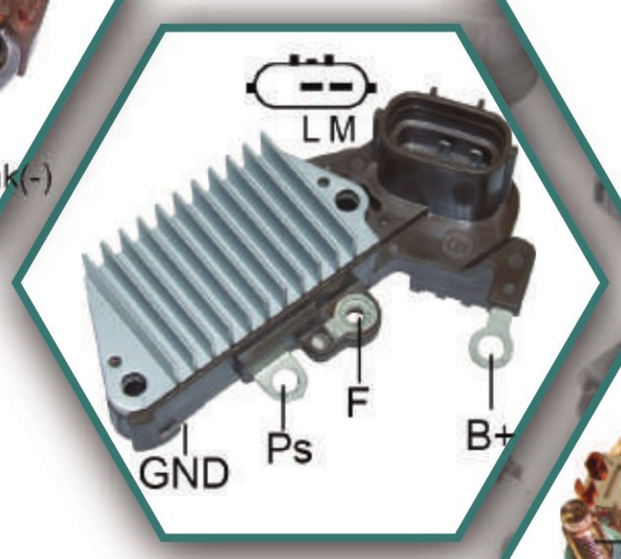
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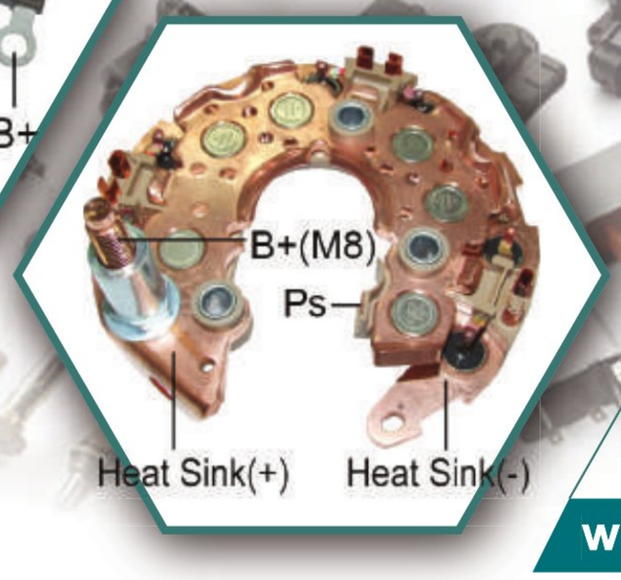
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