Converting From 6 Volts To 12 Volts

or

Double Your Pleasure, Double Your Fun

by John the Old Tractor Guy and llamas, his sidekick

As you know by now, your tractor was originally built with a 6 volt, positive ground electrical system. A relatively simple generator and cutout/regulator system took care of battery charging chores. This design closely followed standard automobile practice of the 1930s and 1940s, and it worked pretty well. Plenty of these tractors are running just fine today with the original electrical system.

The 9N and 2N models used a generator with a "cut out" relay, a simple voltage dependent switch which controls battery charging. This is possibly the simplest charging system there is, but it's not very efficient the generator only charges the battery at higher engine revolutions, and if the tractor runs at idle speeds for long periods, the battery tends to get discharged. Later versions of the generator recognized that this might be a problem in farm operations. A tractor is sometimes left idling for extended periods while hooked up to a power take off job, like an auger. So the generator was modified to add a "high/low" output selector it's a little tiny screwdriver slot on the back face of the generator with the words "high" and "low" around the edge. "Low" means "low output" and is most efficient, but not enough to keep the battery charged under some conditions. "High" means "high output", which means more electrical power. This was an adequate system but not very satisfactory.

The 8N models used a more sophisticated three terminal generator with a voltage regulator, which gives higher charging current over a wider range of engine speeds. The "high low" selector feature was eliminated and this function was addressed, to some degree, by the voltage regulator. The system gave better battery charging across a wider speed range.

In more recent years it has become very popular to modify the electrical system to the more modern, 12 volt, negative ground system which is now pretty much the automobile standard. Conversion kits to do this are sold by many of the large tractor parts suppliers. The heart of all these conversions is the modern 12 volt "alternator", as used in automobiles. This is a much improved design of generator, considerably more efficient than the older style, and virtually maintenance free in that it has no brushes to wear. A modern alternator will supply about 8 times the electrical power of the original generator set up, and this should be more than enough for anything you might want to connect to it.

Maybe you've been advised that you should do this, or seen it done on another tractor, and you're asking yourself "Should I do the same?". Well, there's a lot to consider, so let's try and go through the pros and cons. If you decide you want to do this, we're going to give you the absolutely guaranteed lowest cost, easiest to do and best function recipe for making this conversion. Our recipe will also cost you less than half of what you'll pay for one of those readymade conversion kits.

llamas: Why do this? Well, before we get into the "why's", let's cover the "why not's" If your 6 volt electrical system is working well starts well, battery is charging good and no other problems there's no good reason to do this just to make the tractor itself "better". The 6 volt system, properly maintained, will continue to work just fine. There must be other, more pressing problems on your tractor that you can spend money on.

And needless to say if you intend to show this tractor or restore it, the electrical system has to stay "original".

John: Now here are the reasons why you might want to do this.

If your 6 volt generator goes bad on you, it will be cheaper to convert to 12 volts than to have the generator repaired or replaced. There's no more "new " 6 volt generators available, and a good rebuilt generator will cost you about $120, more if your old generator is damaged and cannot be rebuilt. We'll show you how to upgrade to 12 volts for less than $100.

A 12 volt system will give better starting on a tractor which is hard to start.

12 volt lights are brighter and reach further than 6 volt.

A 12 volt system which uses a more modern alternator for charging has more electrical power available. This can be very helpful if you want to add lights or other electrical accessories. The original 6 volt system did not have enough power to run more than the headlights and a taillight for any extended period of time.

A 12 volt system allows you to use modern automotive electrical accessories (lights, tools, some implements) which are not available in a 6 volt version. Good examples would be an electric-powered road salt spreader, or an electric powered winch.

You can jump start a car with a 12 volt tractor. And you can jump start a 12 volt tractor with a car. There's a wonderful sort of symmetry there, isn't there?

llamas: There's some compelling reasons for doing this, especially on a "working" tractor. It makes service and repair more straightforward and it makes your tractor able to support a wide range of more modern accessories.

John: Damn right. Every tractor I refurbish and sell, I convert to 12 volts as a matter of course, unless the buyer specifically tells me otherwise. It's just a better system. If I get a well used tractor with unknown electrical problems, it's cheaper and easier for me to just remove the entire system and put in a 12 volt system with all known good parts. If you have a tractor with generator problems, and you don't care whether it's "original" or not, your quickest and best solution is to convert to 12 volts.

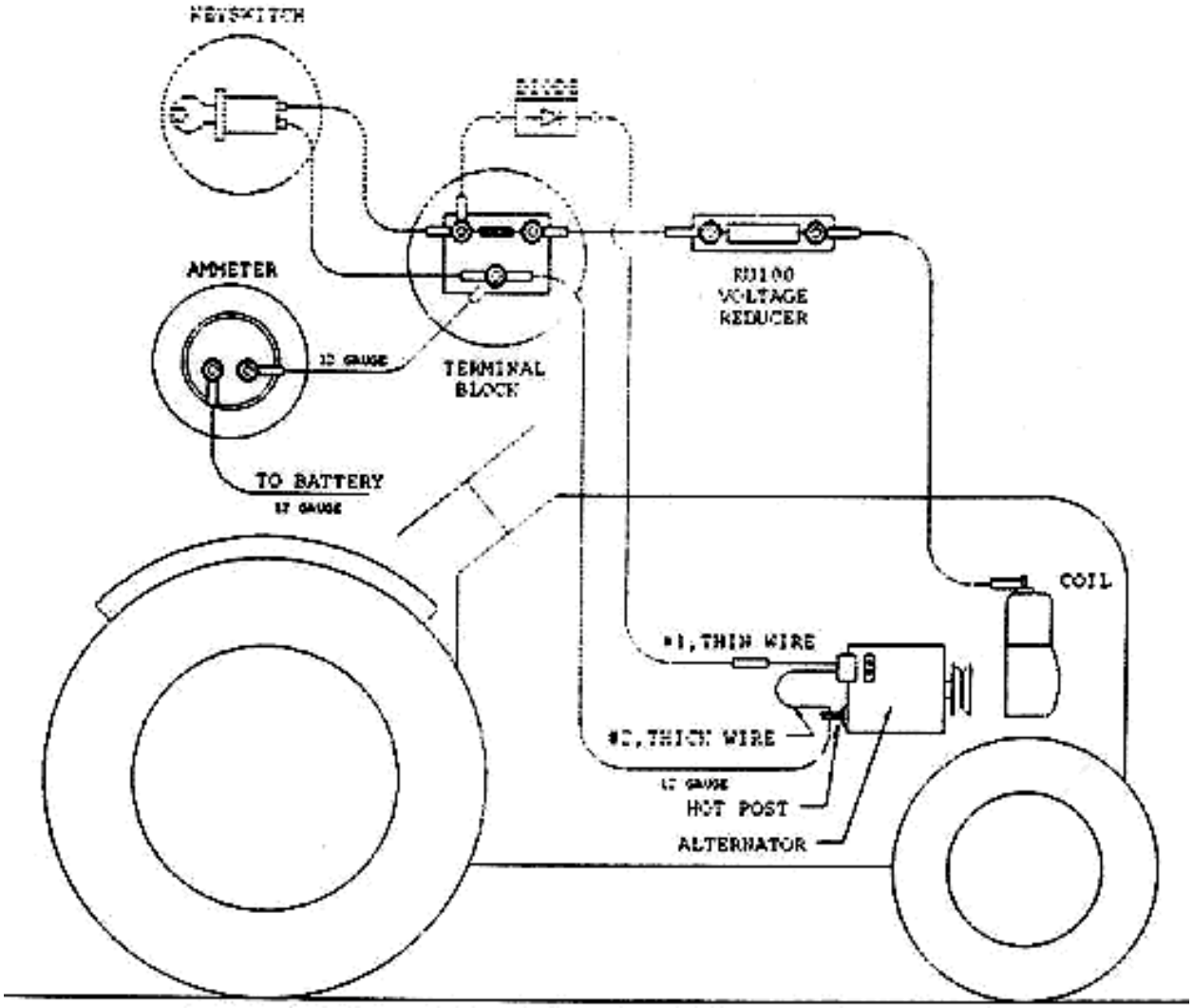
llamas: Well, I guess we know where HE stands on this! But he's right in many cases, this is your best choice. Review the options in light of your situation, and if you decide that 12-volts is the way to go, then here's how it's done. Before you start, take the time to review the circuit diagrams which we provide below.

There are three distinct systems, as follows:

9N/2N with single terminal generator and cutout relay
8N with two terminal generator, voltage regulator and FRONT mount distributor
8N with two terminal generator, voltage regulator and SIDE mount distributor

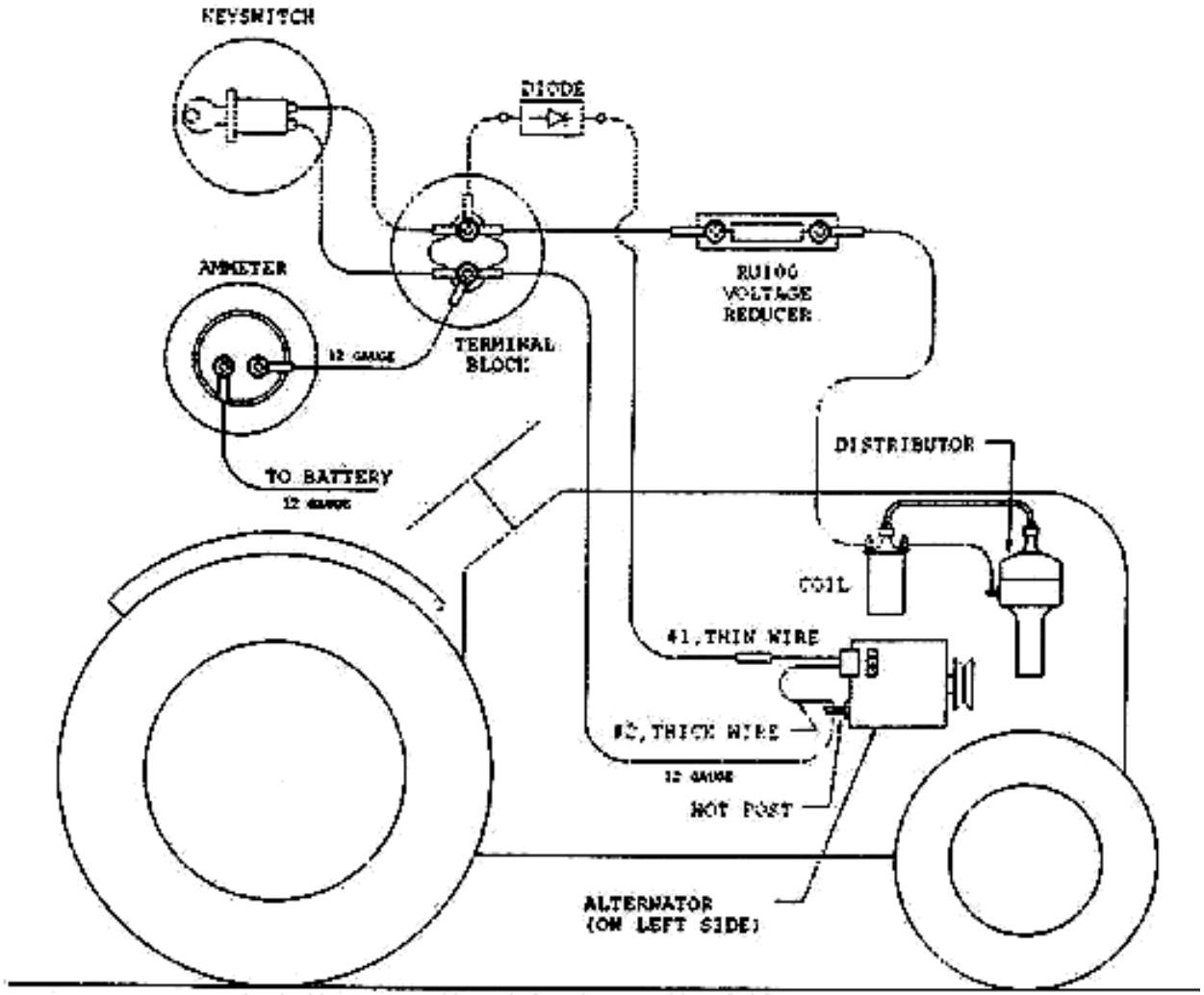
We provide complete "before and after" circuit diagrams for all three systems. For easier reference, we also supply two simplified diagrams showing the 12V conversion only. One is for any tractor with a FRONT mount distributor, the other is for later 8Ns with SIDE mount distributor.

Here's what the conversion will look like on a tractor with front mount distributor:



6-TO-12 VOLT CONVERSION FOR ANY FORD "N" TRACTOR WITH FRONT-MOUNT DISTRIBUTOR

Here’s what the finished result will look like on an 8N with the side-mount distributor:



6-TO-12 VOLT CONVERSION FOR FORD 8N TRACTOR WITH SIDE-MOUNT DISTRIBUTOR

Bear in mind that these are not hard and fast many 9Ns, for example, were upgraded to the more powerful 8N generator/regulator setup, so you may find mixed systems. That's fine, they all end up being one of the arrangements shown.

John: First thing you need to do is go shopping. You'll need about $90 cash in your pocket. You should also have all the light bulbs or sealed beam lamp assemblies with you, plus the battery, or an accurate sketch of it, with dimensions.

Go to your preferred auto parts dealer NAPA, Murrays, Pep Boys, whoever and tell them you need a rebuilt alternator for a 1975 Chevrolet Camaro, 250 cubic inch six cylinder engine, with air conditioning. This will get you a 55 amp alternator with built in regulator, externally excited. Tell them you need the plug assembly that goes with it, and you also need an ignition resistor (sometimes called a voltage reducer), General part number RU100. Finally, give them all the light bulbs and have them find all the equivalents in 12 volt. You'll walk out about $45 lighter in the wallet.

Next, head off down the road to Radio Shack and buy a 50 volt, 1 ampere diode. What's a diode? Right now, you don't care, so don't worry about it just get one. In fact, you'll get two, because they come two to a package. Your cost? About 50¢. You'll also need a small reel of 12gauge stranded wire, and a reel of 16 gauge, if you don't already have that sort of thing about the house. Don't use solid copper wire, and don't use the coarsely stranded wire used in domestic wiring you need good quality hook up wire which is flexible. Any color you like, you're not going to be making any 216 wire harnesses with this. If you can get it, the 12 gauge should be yellow and the 16 gauge red but don't worry about it. You'll also need some crimp style ring terminals, and a couple of butt splices, for both gauges of wire. The type that Radio Shack sells are fine. If you want to make a 50 year job of this, go to a marine supplier and get the type that has a heat shrinkable adhesive sleeve over it these will last a lifetime, but they're not cheap. Another $5 well spent.

Next, zoom over to the garden tractor supply place, or a full line auto battery supplier, and get a 12 volt, post terminal battery, the same size as the 6 volt battery that's in your tractor right now. This would be a good time to have the battery measurements written down, or even to have the old battery in the trunk of your car. The new battery will run you about $30. Don't be tempted to give the old battery to the battery store, you can get $5 in cash for it at any scrap merchant.

llamas: Remember, we told you this was the guaranteed lowest cost conversion we're going to squeeze every dime out of your budget here. Get all this stuff, and you'll have everything you need bar one item, which we'll cover in a moment.

Get this all home and cluster it round the tractor. Start operations by removing the battery if you haven't already done so. Next, disconnect the wires at the generator (one wire on a 9N, three on an 8N) and remove the generator and the belt tensioner mechanism.

Now here's the one item you can't buy off the shelf. Your new alternator will not just bolt onto the old generator mountings. You'll need to make, or have made, an adapter bracket and/or a tensioner to mount the alternator. The adapter will depend upon your own ingenuity and the materials you have to hand. Don't forget, when planning this bracket, that you need to be able to tension the drive belt. The alternator pulley needs to line up exactly with the crankshaft pulley and the water pump pulley, so the belt will run straight. And the alternator needs to be high enough that it will not be struck by the front axle/tie rods when the tractor tilts. Depending upon the bracket you design and build, you may well need a different length drive belt.

John: Use your common sense here. The bracket and tensioner need to be sturdy and
solid so the alternator doesn't move. This means they need to be steel. If this is beyond the facilities you have, then you'll find drawings of suitable

brackets and tensioners (one for front mount distributor tractors, and one for side mount distributors) below, which you can either copy or take to a machine shop or blacksmith and have made.

llamas: A tractor with a front mount distributor has the generator mounted on the right of the motor. To mount an alternator here, you'll need a mounting bracket (a suggested design is shown) and a new tensioner. The tensioner is shown flat, but be aware that you may need to shape this to make it match both the motor and the alternator. This tensioner does not use the existing tensioner location instead, it locates on the base of the hose neck, on top of the cylinder head. This may look a little inelegant but it works great.

If the tractor has a side mount distributor, the alternator will mount on the left side of the motor. To do this, you can use the existing mounting bracket for the generator, but turn it upside down in conjunction with a long bolt or a length of 3/8 threaded rod, you'll find that the alternator pulley can be made to line up perfectly. A design for a new tensioner, which is secured to the same stud as the old tensioner, is also shown.

John: Once you have the bracket and tensioner made, install the alternator and try the old fan belt on it. On motors with side mount distributor, if you make the tensioner/mounting just as we show, you can use the existing belt. If it fits and you can get it tensioned, great. If it does not, cut the old belt, wrap it round the pulleys and measure how much it is short or long. Take this back to your auto parts supplier and have him figure out what belt you need.

For tractors with front mount distributor, you will definitely need a new belt. If you make the mountings as we show, a 44" belt will fit. Otherwise, as before cut the belt and measure how much you are short, then have the parts guy at NAPA sort it out for you.

Whichever way, get the alternator mounted and the belt installed, and get everything lined up and tight.

Next, remove all the wires from the voltage regulator or cutout, and remove it. Remove the wire that runs from the regulator or cut out to the terminal block on the front left side of the dash. Trace the wires that run from the terminal block to the ammeter and from the ammeter to the starter switch terminal. Mark the ammeter terminals so you know which was connected to what, and remove both wires. All these wires need to be replaced with 12 gauge wire, to carry the additional power of the new alternator. This concludes the removing part, now it's time to rebuild for 12 volts.

llamas: Start by making new, 12 gauge wires to connect between the starter switch terminal and the ammeter, and between the ammeter and the terminal block. Whichever way the ammeter was connected before, you need to connect it the other way round, or it will read backwards.

Next, run two wires one 12 gauge, one 16 gauge from the area of the terminal block to the new alternator. If the "conduit" for the wires (across the top of the engine) is still in place, use one of the old generator wires to fish the new wires through. Once in place, remove all the old generator wires. If the "conduit" is gone, then secure the wires in whatever way seems suitable, making sure they are clear of any moving parts.

At the alternator, connect the new 12 gauge wire with a ring terminal to the terminal post on the back of the alternator. Find the plug assembly you bought with the alternator and plug it into the socket on the alternator body. The plug has two wires coming out of it, one thick and one thin. Connect the thick wire with a ring terminal to the terminal post as well. Connect the thin wire to the new 16 gauge wire with a butt splice. Make sure there are no bare spots visible and that the wires are clear of any moving parts. Take up any slack by pulling through to the rear of the tractor.

John: Find the end of the new 12 gauge wire from the alternator. Attach this with a ring terminal to the terminal block, on the same post as the wire from the ammeter. This is your "charge" or "hot" connection.

Next, find the end of the new 16 gauge wire from the alternator. This is the "exciter" circuit. This is where the diode that you bought comes in. The "exciter" wire needs a one way valve in it and that's what a diode is a one way valve for electricity. On the body of the diode, you'll see a printed arrow head this points the direction that electricity will flow. This arrow should point to the alternator. Connect the wire from the alternator to the end of the diode that the arrow is pointing to, using a butt splice. Connect a short length of wire to the other end of the diode with another butt splice. Cover the exposed diode wires and connections with a sleeve or a couple of layers of electricians tape. Now, trace the wires from the ignition switch there's two. One wire will connect to the "hot" terminal post. Connect the "exciter" wire with a ring terminal to the terminal post that the other switch wire connects to.

Almost there. Last connection. Trace the wire that runs from the terminal block to the ignition coil. On 9N/2N and 8Ns with front mount distributor, the post at the terminal block is connected to one end of the ignition resistor, which is mounted on the terminal block and looks like a little spring under a cover. On 8Ns with side mount distributor, there's no ignition resistor, just a terminal post. Find the voltage reducer that you bought this needs to be spliced into that wire. Either way round, doesn't matter. The voltage reducer is liable to get warm, so mount it to something solid the inside of the dash is a good place. Connect the wire from the coil to one end with a ring terminal, and connect the other end with a couple of ring terminals and a short length of wire to the terminal post that the coil wire used to be connected to.

Go round and install all the 12 volt light bulbs in the right places. Check and be sure that all connections are solid, no exposed wires laying around, and so on. Finally, install the battery Negative Ground! And crank it up. If you did it right, she'll fire right up with renewed vigor. Check the ammeter and make sure it shows a steady charge. If it does, you're all set.

llamas: Common problems? There's really only two. One is obvious. If the ammeter shows that you're charging when the engine is not running, and discharging when it is, you have the ammeter connected backwards! All you have to do is reverse the connections at the ammeter no harm done.

The other problem is a real eyebrow raiser, and it's this you shut the tractor off, but it goes right on running. Even remove the key, keeps right on going. This can be a headscratcher, but it's simple. The diode in the "exciter' circuit is either missing, backwards or defective. What's happening is that the alternator is powering the ignition circuit independent of the ignition switch, through the "exciter" wire. That's why we put a one way valve in there the diode. You can shut the tractor off by pulling the plug out of the alternator. Check for correct installation of the diode. If it's in there, and the right way round (arrow towards alternator) then it's bad. That's why they sell them in packets of two. If you find this problem, you need to fix it right away because if you don't, the battery will discharge through the "exciter" circuit and the ignition even with the tractor shut off. If you can't get to it right away, leave the alternator unplugged until you can.

John: And that's all there is to it. You now have a complete 12 volt electrical system with ample reserve power.

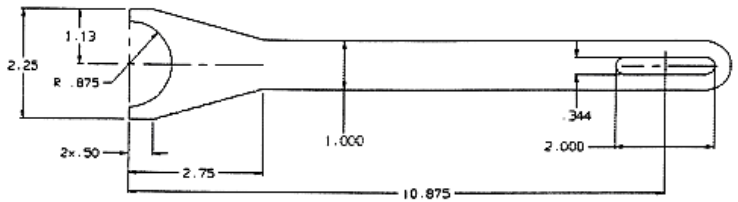
Now, the smart 9N/2N heads in our audience are saying to themselves "well, that's all well and good, but what about the starter motor and the starter switch? They didn't replace the 6 volt starter motor or the switch with a 12 volt, and they reversed the battery polarity! Won't they burn up when you put twice the voltage on them? And I remember from all those Batman serials in the 1960s if you reverse the polarity, it'll turn the other way won't it?".

Answer, in both cases no, it won't. Experience has shown that the original 6 volt starter motor is built so big and heavy that it will run just fine, and last just as long, if you use it at 12 volts. Now, it will get a little hotter when used, so we suggest that you limit the amount of cranking time that you ask of it say, not more than 10 seconds at a time without a break to cool down. The starter switch (or starter solenoid, if you have an 8N) will also

work just fine on 12 volts. And reversing the polarity not a problem. The starter motor is a series wound DC motor, which will turn the same way regardless of the polarity of the voltage you apply.

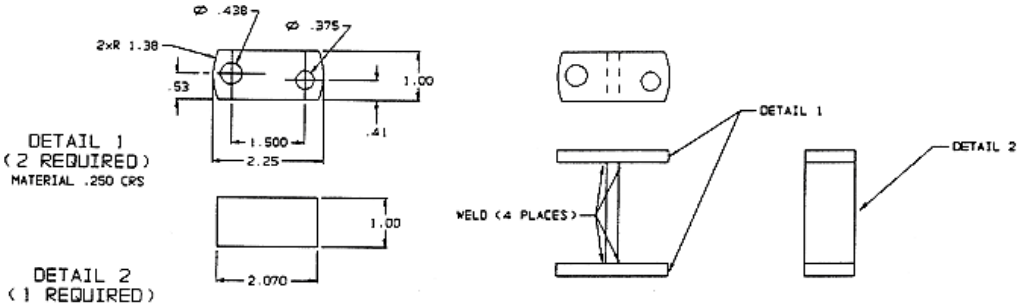
Meanwhile, all the smart 8N heads are thinking the same things, plus the additional thought of "well, my 8N has a 6 volt starter switch and also a 6 volt solenoid not only did they double the voltage but they reversed the polarity surely the solenoid will push the switch open rather than pulling it closed? How can this ever work?" Answer the 6 volt switch and solenoid contacts seem to be able to handle 12 volts just fine. And DC solenoids are like series wound DC motors they work the same regardless of polarity, so the starter solenoid will work just fine whichever way round you connect it.

llamas: Oh yes we promised you drawings of tensioners and adapter brackets, didn't we? Well, here they are. Wiring diagrams (before and after) for all models are found in the Appendix.

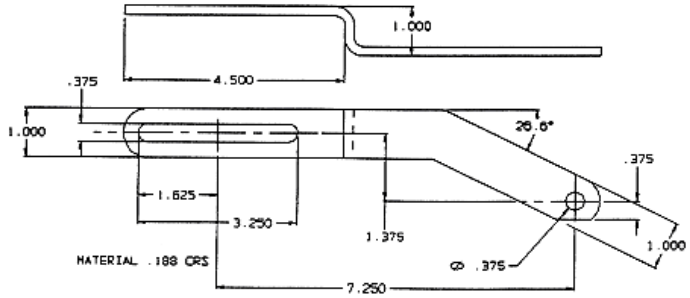


TENSIONER FOR ALTERNATOR MOUNTING ON MOTOR
WITH FRONT-MOUNT DISTRIBUTOR

MATERIAL .188 CRS



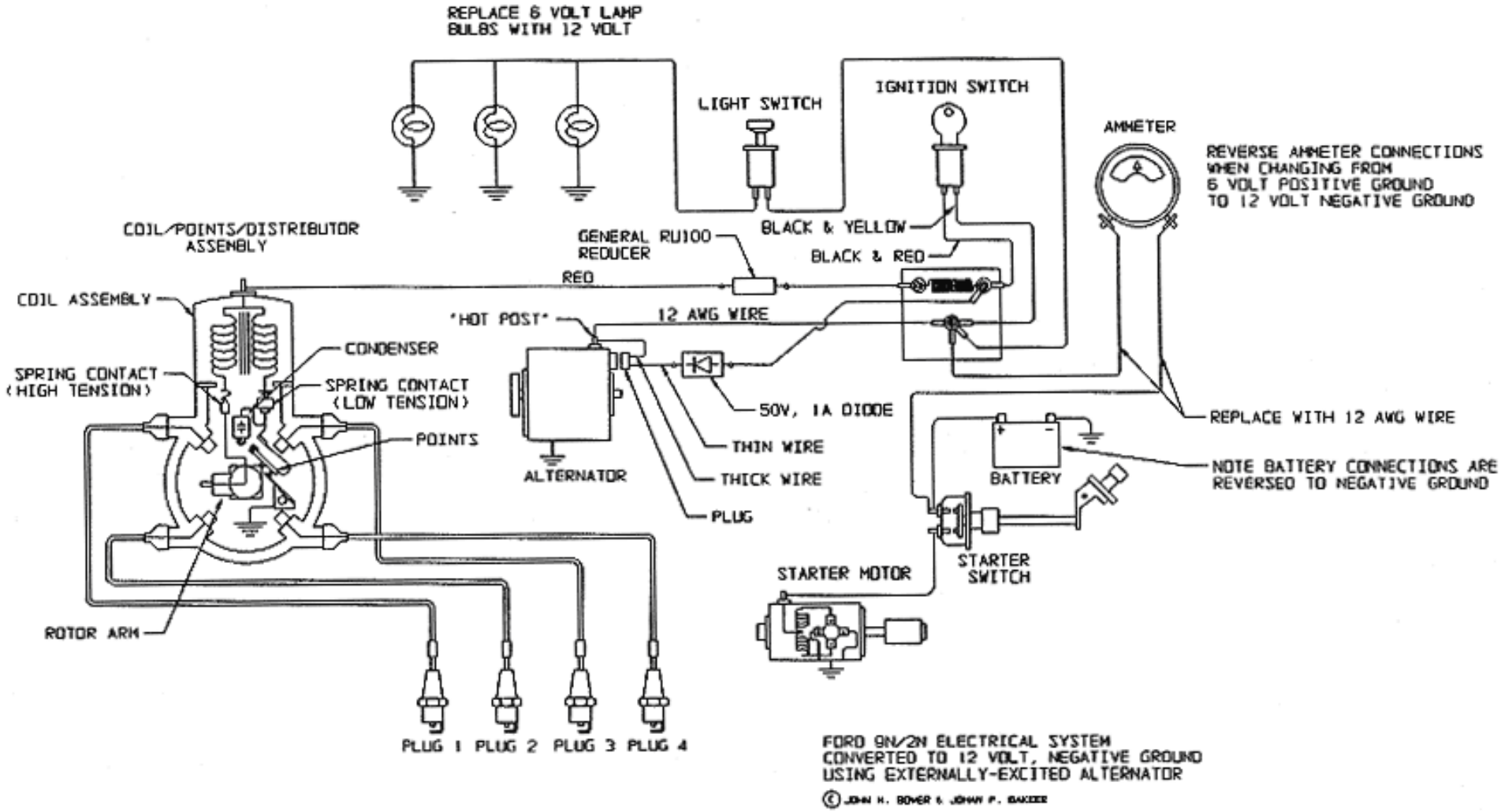
MOUNTING BRACKET FOR ALTERNATOR ON MOTOR
WITH FRONT-MOUNT DISTRIBUTOR

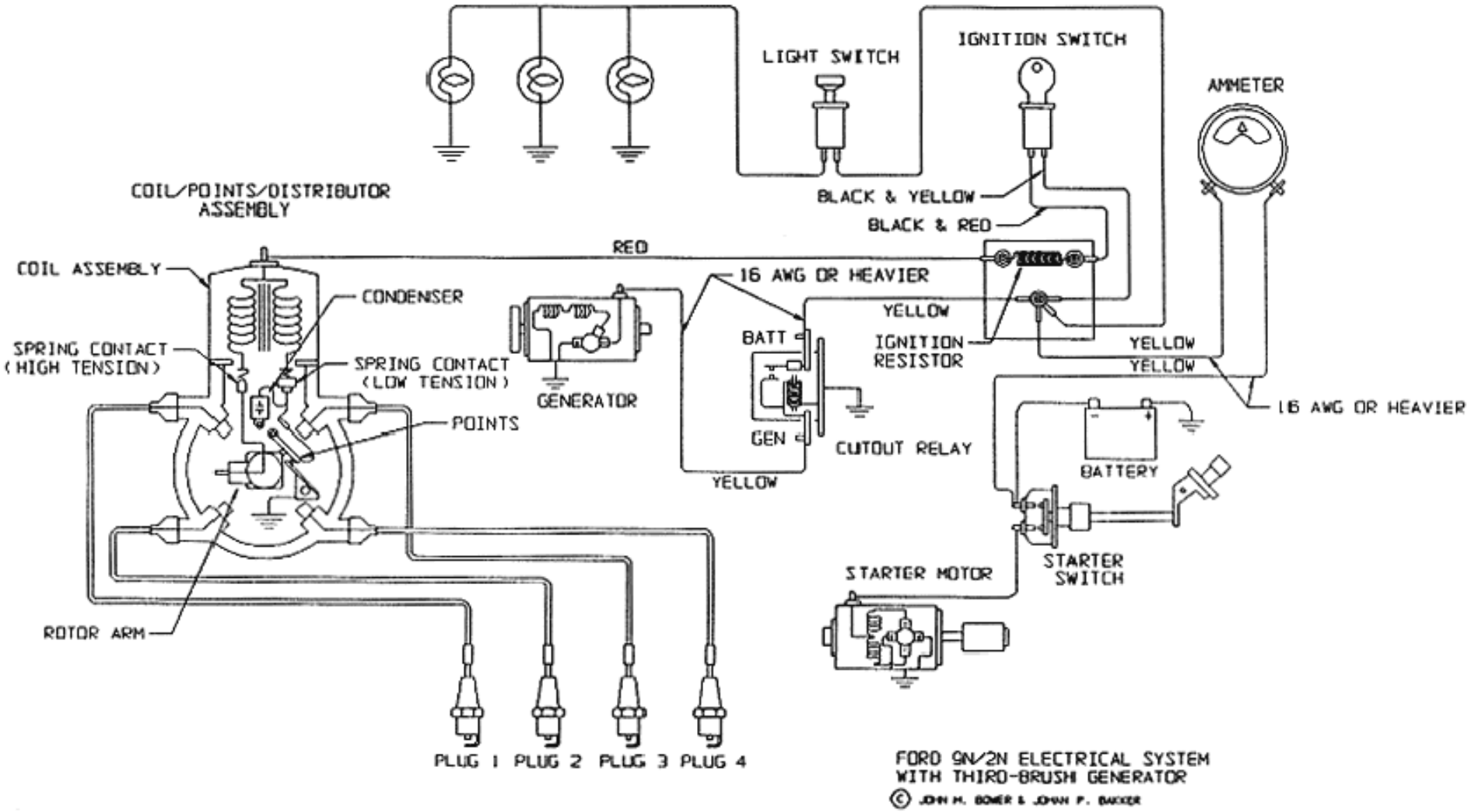


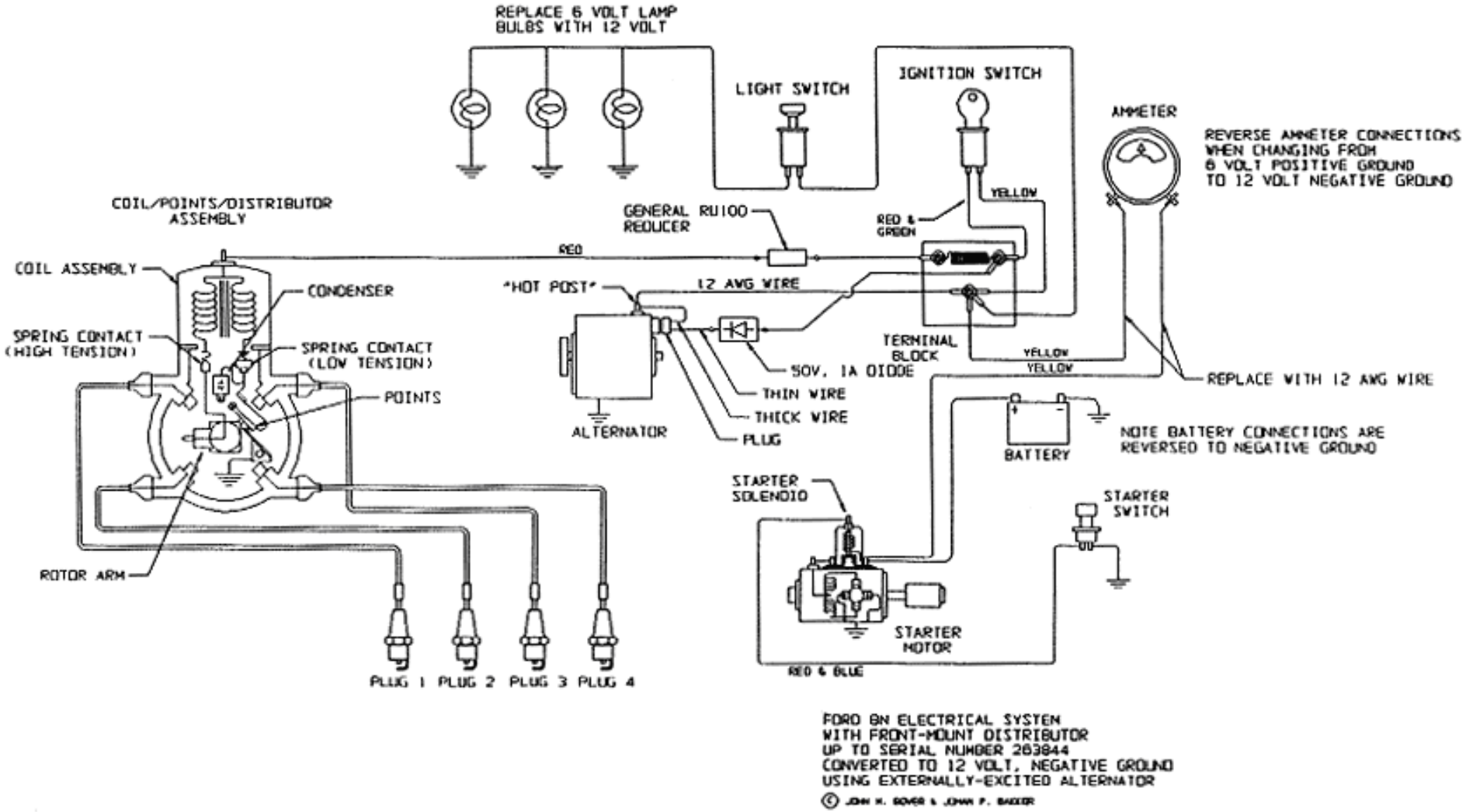
TENSIONER FOR ALTERNATOR MOUNTING ON MOTOR
WITH SIDE-MOUNT DISTRIBUTOR

MATERIAL .188 CRS

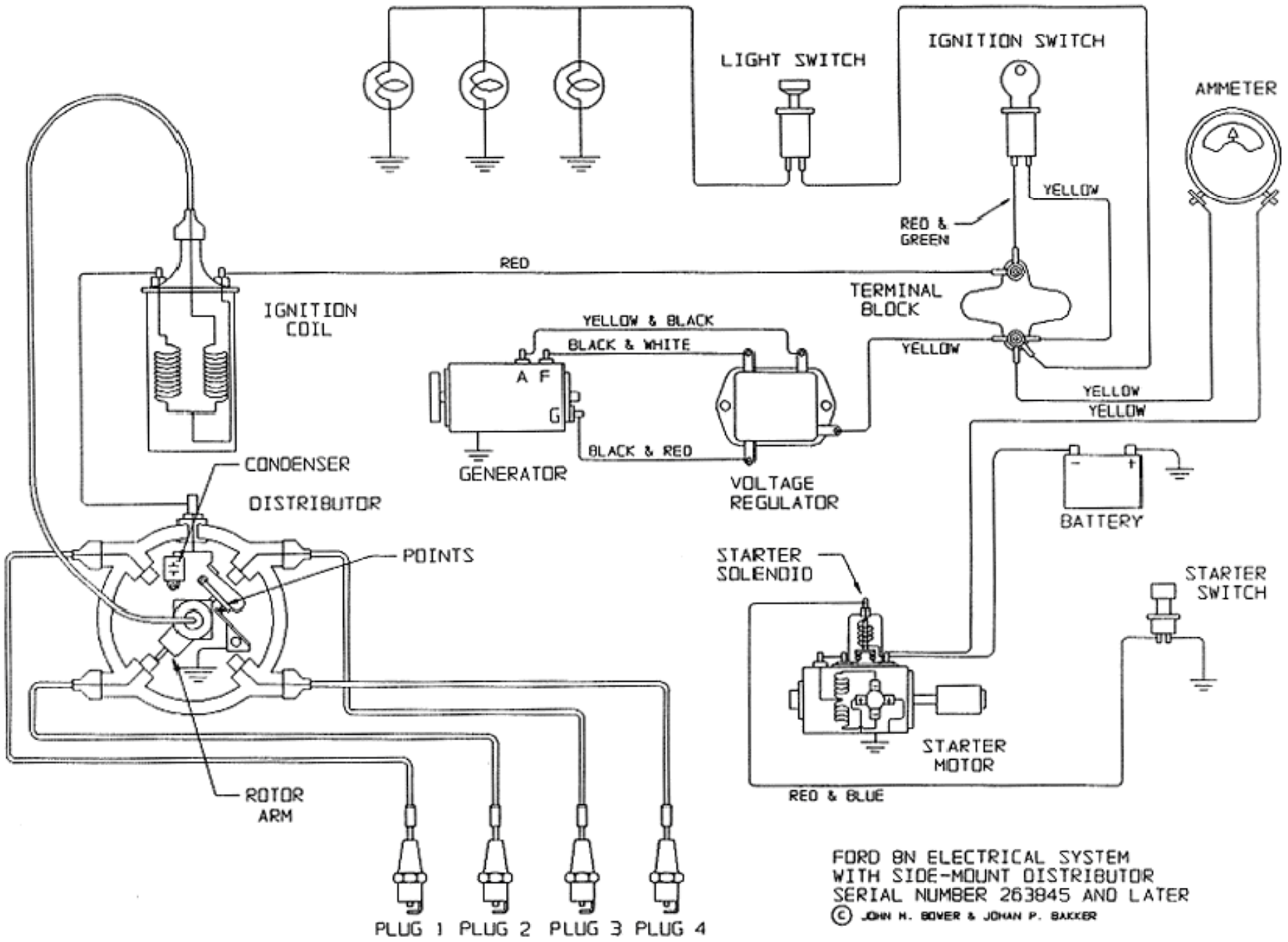
Another source of Alternator Brackets and Accessories



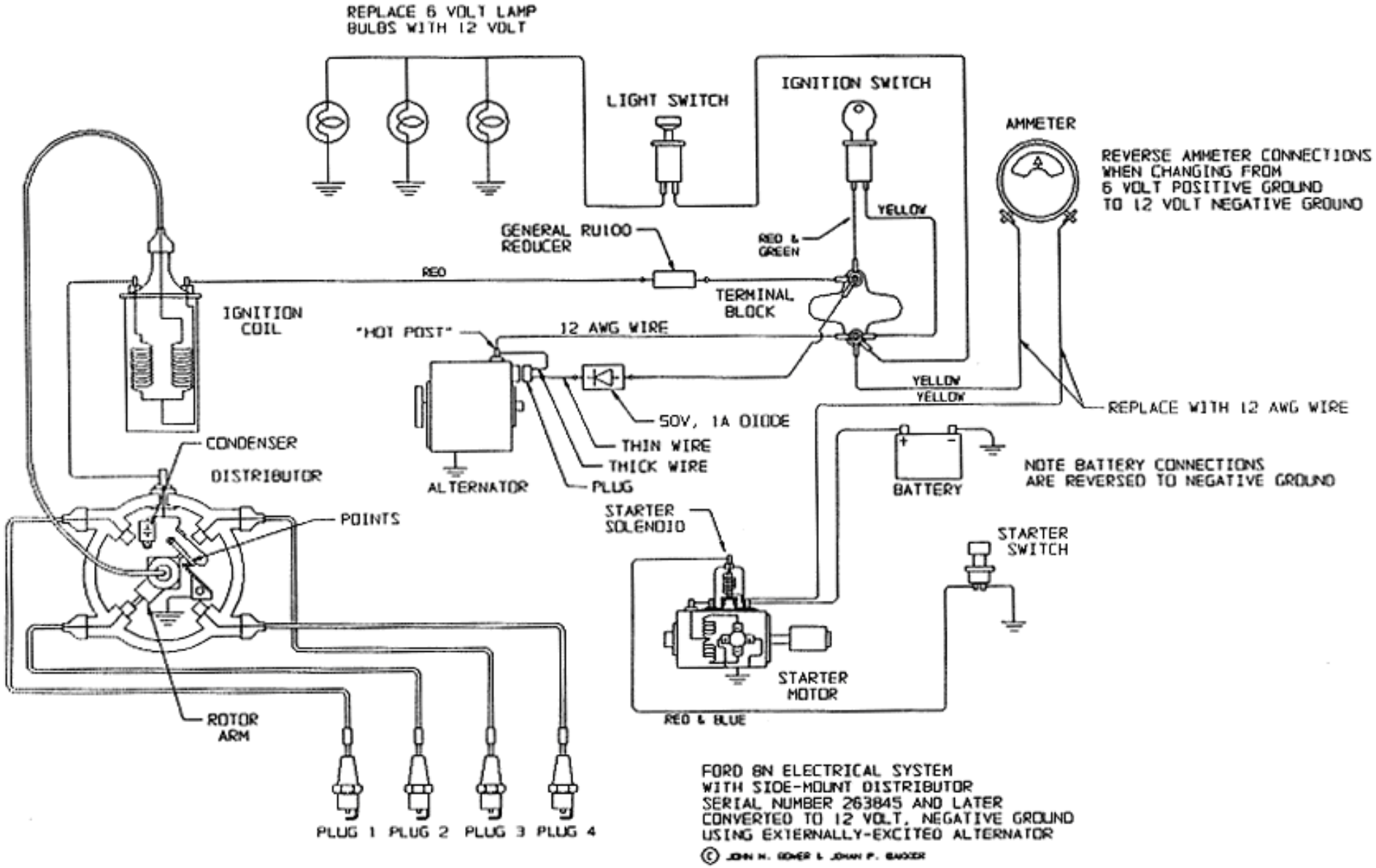


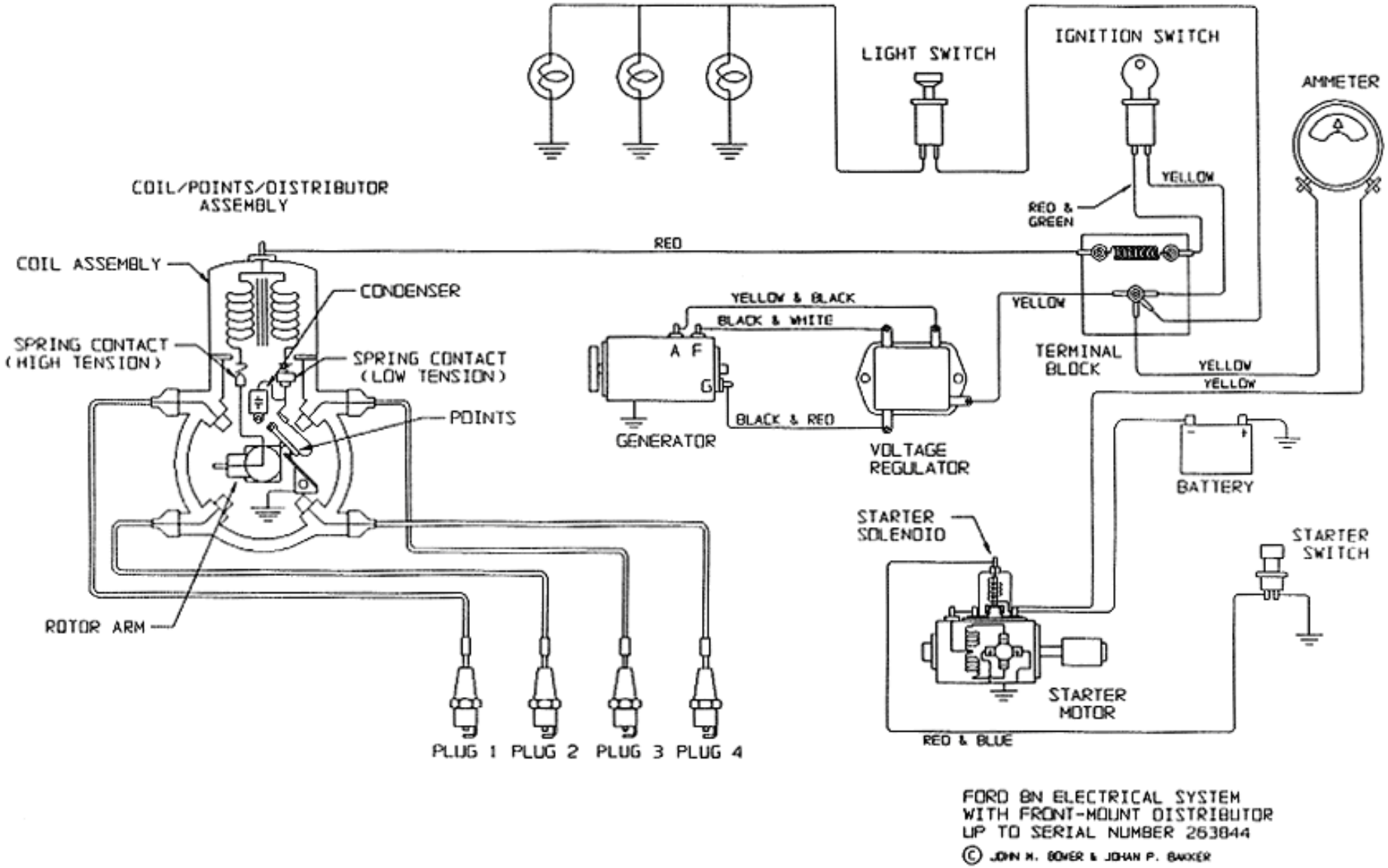


FORD 8N ELECTRICAL SYSTEM
WITH FRONT-MOUNT DISTRIBUTOR
UP TO SERIAL NUMBER 263844
CONVERTED TO 12 VOLT, NEGATIVE GROUND
USING EXTERNALLY-EXCITED ALTERNATOR



FORD 8N ELECTRICAL SYSTEM
WITH SIDE-MOUNT DISTRIBUTOR
SERIAL NUMBER 263845 AND LATER





FORD 8N ELECTRICAL SYSTEM
WITH FRONT-MOUNT DISTRIBUTOR
UP TO SERIAL NUMBER 263844