Alternator Conversion for a Morgan 4/4 Series V

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I have nothing against generators and I think the originals are good 'nuff for getting the job done in a more-or-less original Morgan. I also feel little need for any electrical add-ons: a big thumping sub-woofer would cause even more loose fasteners; heated mirrors, remote starters, and DVD players seem a little out of place; seats that have nowhere to go don't need power adjusters; and I don't drive the car a lot at night, so a passel of lights can be done without. (Now that I think about it, heated seats could be pretty darn cozy at times.) Anyway, while a good generator gets the job done, I'm not so sure about the rebuilds, and the rear bushings are a little on the fragile side, and the buggers can be hard to get quickly. So upon finding myself with the second bum generator in less than 1000 miles, and being unable to get one within more than a week, I decided to make the switch.

The auto involved here is a 1967 4/4 Series V Competition with the Ford 116E Cortina GT 1500 cc version of the Kent engine. Everything herein probably applies to the entire series from 997 cc to 1600 cc, but I don't know that for a fact. I'll also state the usual disclaimer at this point. I'm doing my best to describe my recollection of what I did, which so far is working fine, but you will need to exercise your own good judgment. If you manage to blow your car up as a consequence of trying to follow my directions, I'll be heartily sorry about it and will happily stand you to a Guinness or two while hearing the story, but will be in no way responsible.

The first order of business is that the car must be converted to negative ground. There are directions for doing that in numerous places. See for example http://www.lotus-cortina.com/electric/convert.htm. Since you will be replacing the generator, this really consists only of disconnecting the battery, reversing the wires at the ignition coil, reversing the wires on the ammeter (if adding the additional charging wire recommended here, you can skip the ammeter), making a small but tedious change in the electronic tachometer, and switching the battery connections. Check it out, though, it has been a while since I've done this.

The Alternator

The 4/4 engine compartment leaves plenty of room for the tried, true, ubiquitous and cheap GM 10-SI unit – once you get it into the right vicinity, but that is a bit of a chore. On my car, the GM unit could fit in from below if the brake line were not in the way. It might be possible to re-rout the brake line to make room, but it is not totally clear that it would work. Moreover, when a simple electrical repair begins to involve bending and double-flaring brake lines, red flags involving obsessive-compulsive behavior should begin to go up in one's mind. To put the unit in from the top, it is necessary to remove the top radiator hose and the adjacent small hose, and the fitting to which it attaches, from the head. At about this point, I spent a good deal of time net browsing for smaller

alternators. There are very pricey ones available. There are also a couple reasonably priced Japanese units that might slide in, but they are on rather obscure cars and are not in stock at most stores. I should have talked to the OhMOG Tech Adviser Steve Stierman at this point, who would have told me that units for Ford Fiestas and Saturns are smaller and worth a look, but I didn't. I have no clue if they are small enough, and the Saturn would need a pulley change. Anyway, I ultimately chose to go with the GM unit because you can find a replacement pretty much anywhere any time, and to put up with a little more effort putting it in. The GM alternator comes in several current capacities and with the plug on the rear in different positions, and a variety of pulleys. I used the 63 amp version with a single pulley and the plug in the "9 o'clock" position, which is away from the block on the Ford (NAPA 213-4011B, AC-DELCO # 321-41, Lester #7127-9). We can tell the auto parts counter person that the alternator is for a 1979 Buick Regal, 8 cylinder 4.9L (301W) engine, with air conditioning. This GM application reference is useful info that is worth having along when you travel. The smaller capacity 42 amp version (NAPA 213-4010B) is plenty for the Morgan and might justify leaving out the additional wire discussed later, but I think these days the 63 amp version is the universal substitute anyway.

Now, if you choose to go this route, the fitting for the small hose is going to be the key to your quality of life for a while. It is made from some very light alloy. I was fortunate in that it came out with no problem. I put it back with plenty of Teflon tape, so I'm pretty confident that it will come out gracefully the next time, too. However, it is easy to imagine it being corroded into the head and collapsing under your wrench when you try to remove it. Then you'll have a drilling, tapping and cursing exercise, and you'll need to find a replacement. The latter is probably not a problem. I think it is a pretty standard fitting, in fact maybe the same as one I had to replace on the intake manifold, but I won't swear to it. Now that I think of it, possibly a right-angle replacement would eliminate the need to remove it in the future -- might be worth a look. Anyway, the prudent thing to do is before doing anything else, carefully try the thing to see if it is going to break lose for you. If not, you can get the new fitting before screwing up the old one, or invest a little more time and money into finding a small enough alternator that you don't have to remove it at all. Anyway, to put in the GM unit, you'll need to drain at least half the coolant and remove the hoses and the fitting.

Mechanical

The main requirement for doing the conversion is a bracket. I made my own, but there is a possible alternative in the "universal" adapter at http://www.alternatorparts.com/Alternator_brackets_1.htm. It has a bit of a Rube Goldberg look to it, but also looks like it might work on the original generator bracket. I am pretty proud of my bracket design. It doesn't look all that special, but it has some wonderful features. Namely, it can be fabricated simply with not a lot in the way of tools, requires very little precision in the fabrication, and requires only two simple welds that require no elaborate fixturing or subtlety whatsoever. The latter means that you can hand the thing to your neighbor's brother-in-law Bubba and tell him you'd like a spot weld here and one there and have high expectations of getting back something useable. If

you are paying someone to do it, it will be cheap. Figure 1 is a drawing of the two pieces that you'll need to make. Don't worry about all the significant digits in the dimensions. They are there because that's what the drawing program does, not because the precision is needed. The starting stock is 3/16 inch thick, 1 inch wide "weldable" mild steel strap. You can buy it at your local hardware or big-box home improvement store.

One reason most dimensions are not critical is that there is no ready way to make the bracket a close fit to the alternator boss. If it were, the aft ear would need to be directly over one of the bracket-to-block bolts. Hence, the bracket span must be longer than the boss that fits into it, and shims are required. We'll use a stack of washers as shims and adjust the locations to get the alignment correct.

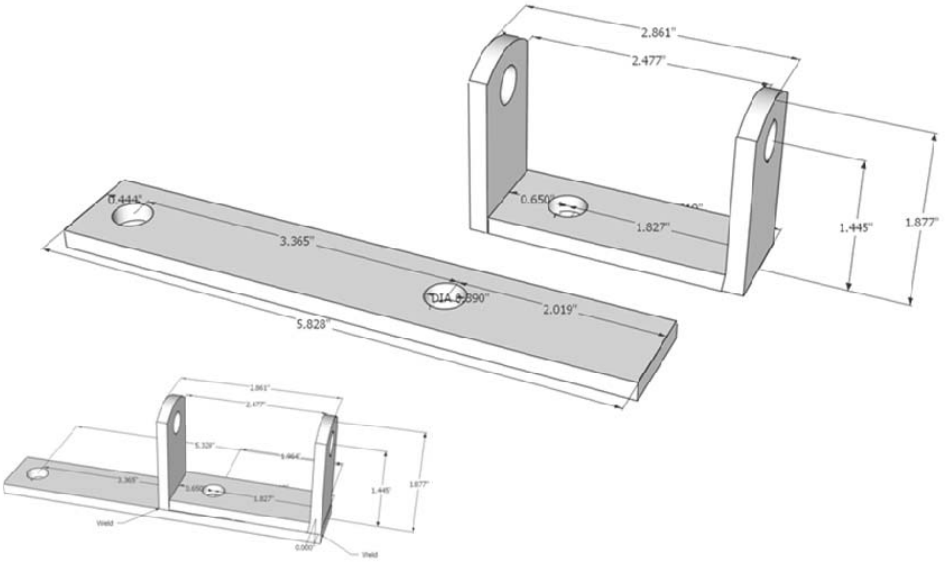

Figure 1. Bracket for GM alternator on Ford 1500 (should fit any Kent engine)

The material is 3/16" x 1" mild steel. Many of the dimensions can be rounded (not worth sorting out in the drawing program). The key dimensions are the spacing between holes, and the height of the holes in the ears must be the same. All holes are for 3/8" bolts. The spacing between the ears must be oversize relative to the alternator to allow room for the bolt head between. Shim washers should be used to fill all space and align the pulley properly. (This is the way I did it – no guarantees.)

The sequence of events in making the bracket is important. Start by making the bends for the u-shaped portion. Don't cut the strap to length first because you want the leverage of the full length for doing the bending. Be aware that, try as you might using my shade-tree approach to this, the bend will not be exactly where you intend it to be. So we'll cut the ears to length after the bending. We're going to make two 90 degree bends and wind up with a square cornered u-shaped piece with one ear a little longer than needed and the other a lot longer than needed. We're going to be careful that the bottom portion of the "u" is at least 2-7/16 in. Before starting, you'll need to decide which bend to do first. I did the short ear first – the bend nearest the end of the bar, but that requires that the vice provides clearance for the bent portion below the jaws when you clamp it for the second

bend. If it doesn't, you'll need to do the bend away from the end first. That way the portion in the vice is always straight. Either approach should work.

I scribed a line and then blackened it with a Sharpie. I then heated the area of the line with a MAPP-gas torch as hot as I could get it, which was a dull red glow – probably about 680 C, if memory serves and anybody actually cares. I then stuck it in the vice with the glowing line just above the edge of the vice as quickly as humanly possible and bent it over to a right angle. Starting at about 60 degrees or so I started beating the crap out of the region of the bend with a 3-pound hand sledge in order to sharpen and square the bend. I then stuck the piece in a little water to cool it and admired the pretty good bend and also marveled at how far it was from the intended spot. No problem though. Make the second bend in the same fashion being sure that the bottom length of the "u" is at least 2-7/16. At this point, I did a little touch-up heating and beating to get the bottom of the "u" near flat and the ears at right angles.

Next I used a Vernier caliper to mark the height of the ear from the bottom of the "u" and cut the ears to length with an angle grinder with cut-off wheel mounted. I then used the caliper to mark the position of the holes and then used a center punch and hammer to put a dimple for starting a drill. While still not high precision, the positions of the holes are among the few dimensions that matter, so be a little careful here. I used a drill press for the holes, but careful hand drill work will do. Make a pilot hole with a small bit, say 1/8", then something around ¼" and finally the large bit.

Cut the flat piece of strap to length and drill the holes in it. Be careful with the spacing between the holes. Bolt the two pieces together in the correct alignment. If you already have the generator bracket off the car, you can use one of those bolts. Your parts are now fixtured for welding. I had it welded at each end of the base of the "u", but on reflection, I think it would be better to weld along each side, or spot weld at each end of each side. That way the heat affected zone is not right at the bend, which is the most critical area for strength. If you have a welder, have at it. If not, go see Bubba.

Before doing anything with the wiring, disconnect the ground terminal from the battery. Remove the generator and generator bracket from the car and be sure that the hole spacing on your new bracket is correct by loosely bolting the bracket onto the engine block. If it isn't quite right, you can grind or drill on the single-thickness hole. After a little grinding, brushing, priming and painting, the bracket should look like Figure 2.

The other part you'll need is a new slotted upper bracket. The old one will not be long enough. Turns out that Auto Zone (or was it Advance Auto Parts?), and probably others, carry a Spectre Part number 4226 Universal Alternator Arm. I think "universal" means that it fits most 30-year old domestic V-8s. This little item is chrome plated, but fret not as by the time we're done with it, it will be small enough to be relatively inconspicuous. If you really don't like the chrome, you can rough it up with some abrasive and prime and paint it. Anyway, you need only about 9-1/8 inches of the curved end (measuring along the outside of the curve) and so need to cut 7-1/8 inch or so off of the straight end. Clean

up the cut end on the remaining curved portion with the slot, which is the part you want, of course.

Figure 2. *The finished bracket.*

Figure 3. *The bracket on the block.*

Remove the old slotted arm. This piece is captured by one of the water pump mounting bolts. To get the bolt out, you need to remove the fan and pulley. You'll need to drill a corresponding hole in your new arm. Don't mount the new arm yet as a little bending will be required.

Put the bracket on the block. Line up the boss on the alternator with the bracket holes and slip the bolt in place. Carefully slip the alternator fore and aft on the bolt until the pulley is aligned with the water pump and crank pulleys. This is not as easy as you'd think because the pulley rims are different thicknesses, but laying a straight edge across the "Vs" and peering at it from various angles should get you close enough. From under the car, you can compare stacks of washers with the spaces between the boss and bracket ears on either end and sort out the number that should go on each side to maintain the correct position. Stainless washers are about half the thickness of plated steel ones and make good fine adjustment shims. Put the washers on, bolt the whole thing up, recheck the position, and adjust the shims if need be. (Figure 4.)

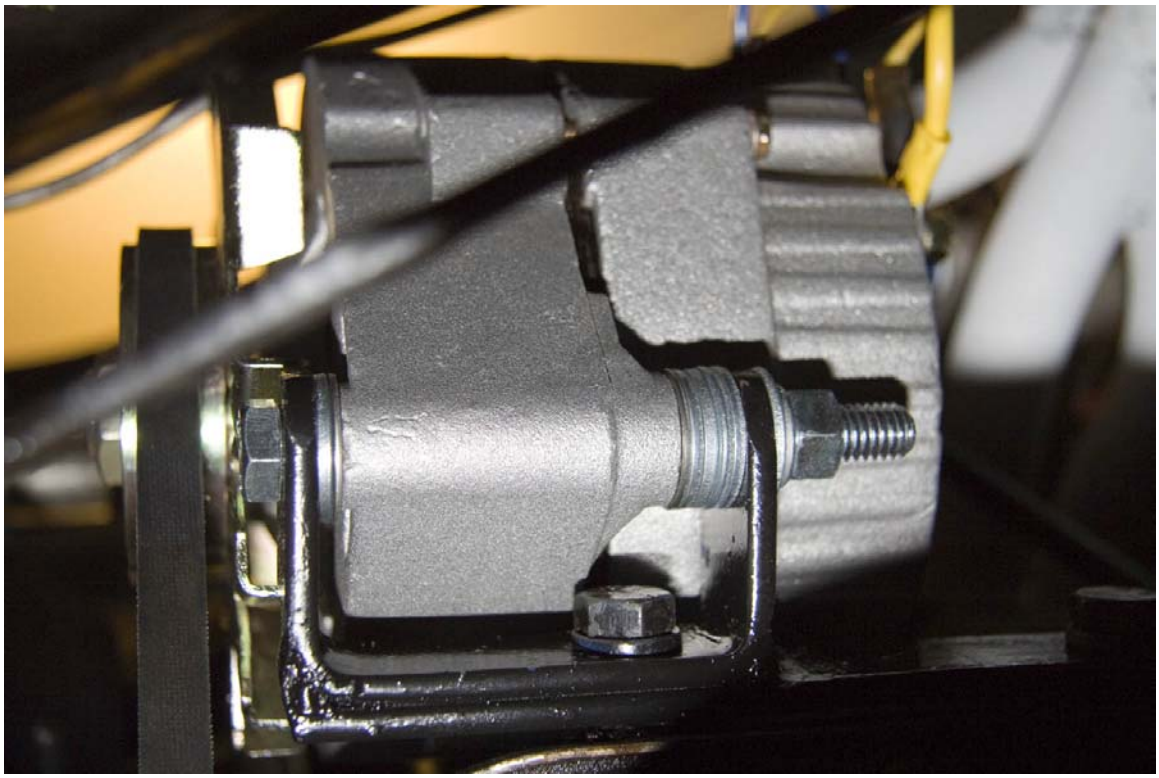

Figure 4. *The alternator installed with steel and thinner stainless steel washers for shims.*

You'll find that with the pulley properly aligned, the upper boss for the adjustment arm is a little forward of the plane of water pump where the arm mounts. You want the arm to lie flat on both the water pump boss and the alternator boss when it is bolted up, so you need to put two slight bends in the arm. The bend near the pump end will be forward and another a little before the slot will be aft such that the 2 flats where the bolts go will be parallel but in slightly different planes. When bending near the slot, put the slotted part in the vice. The other way around and it will surely bend at the beginning of the slot

rather than a little inboard of it where you'd prefer it. Also, be careful not to over do the bends. If you go too far and try to go back, it'll wind up being wavy.

Another alternative would be to adjust the position of the pulley on the shaft of the generator so that it all fits with the arm being straight. There is a spacer behind the pulley for this purpose, I believe. The adjustment would be done by using a different size spacer. The only problem with that is that if you ever need to replace the alternator, you need to swap the spacer from the old one to the new one. No big deal, but if you're on the side of the road, it could be annoying. I chose to bend the bracket so that an alternator for the aforementioned 1979 Buick Regal V-8 with AC drops right in. Well, after moving the hoses and removing the fitting, it drops right in. Do it whichever way you prefer.

Anyway, you should now be able to bolt all this up and put on the new belt. That belt should be a #7300 (Gates/NAPA). Adjust the tension until you can't slip the alternator pulley by hand and admire your work.

Electrical

At this point, we're done with the mechanical part of this and need only do a few electrical things. There is a good description of what is being done (for an MGA) and nice diagrams at http://mgaguru.com/mgtech/electric/ac101.htm . The diagrams are basically correct except for two things: 1) The GM alternator has a third terminal for remote sensing, and 2) For the 4/4, there are minor variations in the wire color, and the Morgan has an ammeter in the line from terminal A of the control box to the battery terminal on the starter solenoid. I basically did what is shown in the 3rd diagram with the optional additional yellow wire. Using the additional wire shorts around the ammeter and renders it non-functional. However, you want to do it anyway. The problem is that the 63 amp GM alternator puts out almost 3 times the current of the generator and more than twice the 30 amp capacity of the ammeter. Under normal conditions, everything would be OK, but let the battery get low so that it is putting a serious draw on the alternator and the under-sized wiring and ammeter are apt to get seriously warm. The additional 10 gauge wire solves that problem. If you choose not to put in the additional wire, maybe it'll be OK, but be sure you have a fire extinguisher close at hand all the time, and don't come whining to me about how nice your Morgan was before the fire. There is a good diagram of the basic alternator setup with explanation of the functions of the terminals at http://www.expeditionlandrover.info/Delco_Alternators.html. Moss Motors instructions for an MGA are close to the Morgan can be found at http://www.mossmotors.com/graphics/products/PDF/130-078MGA.pdf. Finally, the 64-68 Morgan wiring diagram is at http://www.gomog.com/allmorgan/wiring1964to68.jpg. For other diagrams, delete everything after the last slash from the link and find what you need from the list.

One more side discussion before we cut to the chase. The GM alternator is set up for remote sensing, which electrical purists believe is the really proper way to go. I think it is more trouble than it is worth, but for completeness, here's the deal and you can choose

for yourself. See http://www.madelectrical.com/electricaltech/delcoremy.shtml for advocacy and a whole lot of info on the GM alternator and conversions. The idea is to have the alternator sensing the voltage at the major junction point in the wiring and adjusting its output to make it 14.6 v at that point, rather than at the output of the alternator. Doing that requires running another new wire. Frankly, especially if you're running the additional charging wire directly to the solenoid, I don't think it is worth the trouble. I used the alternative, which is to sense right at the alternator and requires a short jumper on the back of the alternator. So, here's the deal on the wiring without remote sensing:

The additional charging wire: Use a 10-guage or larger yellow wire about 12 feet long. From the alternator, feed it along side the original wires through the inner fender well, under the wing, back into the engine compartment then immediately through the firewall. Run it across the car under the dash and back through the firewall on the passenger side under the main harness. Connect the end to the battery connection on the starter solenoid. This will require a suitable ring terminal. The end at the alternator will need another ring terminal to fit the output stud on the alternator.

At the alternator: There were 2 wires connected to the generator; a fatter yellow one and a smaller yellow and green one. The large yellow one goes to the output stud on the alternator along with the new 10-ga yellow wire. You may have either a ring or a spade terminal on this lead. If it is a spade, you may want to make an adapter in the manner described below. The smaller green and yellow goes to terminal 1 of the two-terminal plug on the alternator. You need to make a short jumper; 16 gauge wire is probably sufficient. One end of the jumper goes on the output stud along with the 2 large yellow wires. The other end goes to terminal 2 of the two-terminal plug on the alternator. That is the sensing circuit terminal. Quarter-inch female spade terminals fit on the plug terminals. You also need to make a ground wire to run from the ground screw on the back of the alternator to a convenient chassis ground. This may not be absolutely necessary, but it is a good idea.

At the control box (regulator): All you do here is move 2 wires. The fat (12 gauge) yellow wire needs to move from terminal D to terminal A. This wire has the larger 3/8 female spade terminal. Adapters, and even male terminals, seem to be unavailable in that size. I didn't want to change any more connectors than absolutely necessary, so I made adapters that will allow leaving all the terminals as original. It turns out this is easy to do. Remove the plastic insulator from a 10-12 gauge (yellow) crimp-on ¼ inch female spade connector. Use an awl and needle nose pliers to unfold the tube that forms the wire receptacle and flatten it out. Then cut it to fit in the 3/8 inch female lug. Slide your adaptor on to the control box terminal and the yellow wire onto it. The second step simply moves the yellow and green wire from terminal F to terminal D. This requires the opposite adapter, made in the same way starting with a 3/8" female terminal, which is available. See Figure 5.

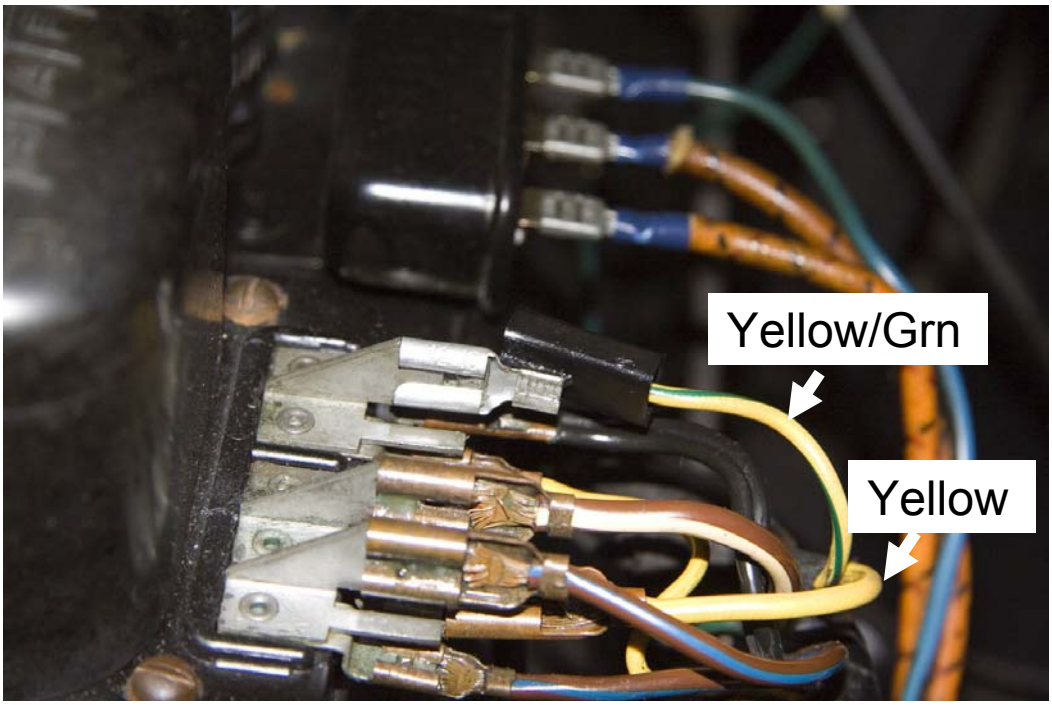

Figure 5. *At the control box: The silver connector on the F terminal at the top of the control box array in the photo is the homemade adapter with 3/8" female on one end and ¼" male on the other. It was made from a 3/8" female by opening, flattening and trimming the wire tube to make the ¼" male spade, on to which the black plastic-covered ¼" female connector on the yellow/green wire is about to be connected. The yellow wire near the bottom of the photo that was on terminal D was connected to an open spade on terminal A using the opposite adapter, ¼" female on one end and 3/8" male on the other, made using a ¼" female terminal.*

What you have done is essentially to wire around the control box altogether, but it still looks original except for the two wire locations, and can be quickly reconverted should you get religion later. There are two other ways to handle this. One is to redo the internal wiring of the box to do the same thing without changing the two external wire positions. This really preserves the original look, but that nice shiny GM alternator is going to give the game away anyway, so wazza point, really? Unless you happen to have a bad box, in which case, you might as well. The other approach is to physically eliminate the box and simply tie the appropriate wires together. You can then use the newly available space for your remote tire pressure sensor or storing your MMC martini shaker or something. Both of these options are discussed in Fred Sisson's book should you want to go that way.

Checkout: Recheck all the wiring and then reconnect the battery terminal. Look around for any problems like smoke, sparks, etc. If all appears OK, turn on the ignition. The charging light should glow as usual. Start the engine. The first time the revs exceed 1500 or so the charging light should extinguish. It should stay out even at normal idle. Use a volt meter to check the voltage at the terminals on the dash. At not much over idle, the voltage should be ~14.2 volts. At this point, you should be good to go.

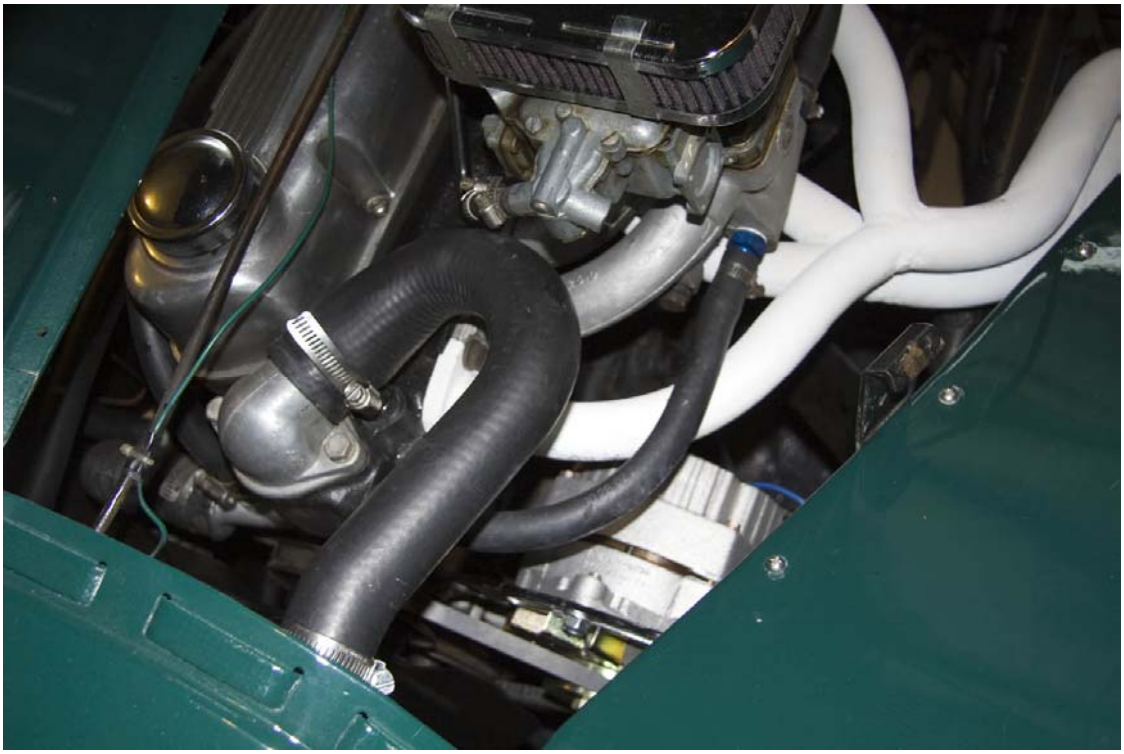

Figure 6. *The finished product.*

Drive Time

Returning the car to original is trivial, should you decide at some point to do so. Replace the original bracket, generator, adjustment arm and belt (7290), reconnect the two wires at the generator, and pull out the new yellow wire. Remove your adapters from the control box and return the two wires to their original positions. If the generator is new to the car, you should "pole" it when you put it on – info on this is readily available with a little browsing. If you are returning it to positive ground, switch the battery cables, ammeter leads and coil leads, and un-convert the tachometer. The tachometer is the only thing that makes this a chore.

One other thing; I read somewhere (and it makes sense) that it is possible to have an alternator fault that has the alternator not charging but that does not turn on the charging light. The ammeter would advise you of the situation, but we just eliminated it. FYI.

Go forth and enjoy a healthier battery, brighter lights, and, we hope, a long and happy life untroubled by charging system problems. If you have any problems or questions at all, don't hesitate to contact the OHMOG Technical Editor/Advisor Steve Stierman at any hour of the day or night. ;-)