

# A Current Topic

## Caution about Overloading Electrical Systems

By Steve Watson

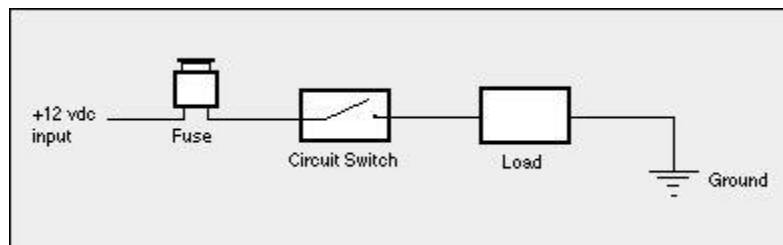
Once we start changing parts on our rides it seems that they are never done. There are always new, bigger, brighter and more powerful products coming on the market. Many are visual improvements or reflections of personal taste. Still others are aimed to provide us with more creature comforts, such as air conditioning, stereo systems, power windows and power seats. Items like high wattage headlights and taillights help by making our ride safer -the ability to see and be seen is very important.

Putting on a new set of valve covers is pretty much a no-brainer. But when we add horsepower, it is imperative that we consider the possible affects upon the other components of the drive train so as not to overload anything. And yet even more important, but often overlooked, is the same potential for overloading electrical components with new added goodies. Overload the U-joints and they brake -inconvenient but repairable. Overload an electrical circuit and you could experience a meltdown and possible fire that could take your whole vehicle.

To that end, we want to discuss three specific areas of the electrical system -switches (like the headlight switch and ignition switch), connections (like wires and terminals) and the alternator.

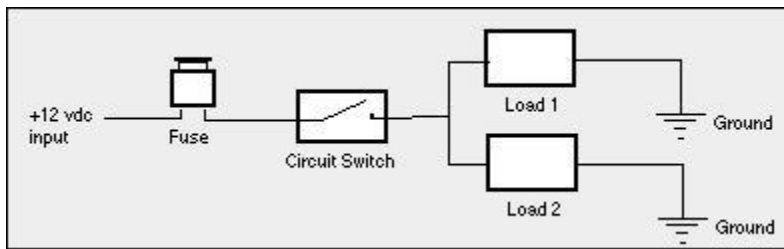
### A River Runs through It

No, we're not going to review the movie! We wanted a catch phrase to remind you that electrical current "flows" kind of like water in a river. The speed of the flow will vary (based upon the voltage pressure pushing it and the resistance holding it back) but the flow volume at any point in the river is pretty much the same. In the electrical river, called a circuit, the current flow is exactly the same at all points of the circuit, excluding any branches. So, if the main load in the circuit is drawing 20 amps, every other component of that circuit will also have 20 amps flowing through it -the fuse, the switch, the wires, the terminals, the ground, everything.



**Every part of a simple electrical circuit carries the same amperage as the load, from initial feed wire all the way through to the load.**

Now consider the case of running two loads off the same feed, such as a pair of driving lights fed by the same fused source and switch. If each light draws 15 amps, the fuse, switch and primary feed will carry 30 amps -the sum of the two circuit branches.



**In a branched, parallel load type circuit, the feed wires, connectors, fuse and switch will carry the sum of the amperage drawn by each load. Know the amperage load and size components accordingly.**

The most frequent problems brought to us this season had to do with overloaded switches, specifically the headlight switch and the ignition switch.

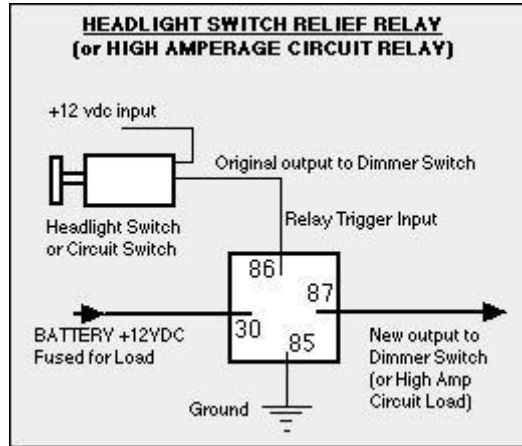
Have you heard ( or maybe said) any of these? "My headlights are dull and keep getting worse. Why would that be?" Or, "My headlight switch gets hot after about a half an hour. What's going on?" And my favorite comment, "I put some of those real bright halogen headlights in my car and now some really funky things are happening -even my turn signals don't work right!" All of these complaints point to the same problem -the amount of amperage going through the headlight switch and the resultant effects. Remember, that one switch feeds multiple circuits.

Typical headlights these days are rated at 55 watts to 70 watts each on high beam. Two units then will pull 110 to 140 watts or as much as about 12 amps (140 watts /12 volts = 11.7 amps). High powered 100 watts halogens will draw nearly 17 amps. Add some additional juice for the taillights and other running lights and it's pretty easy to be putting 20 amps through a headlight switch. Unfortunately, the most common aftermarket headlight switch is only rated at 15 amps! It's no wonder why it starts getting hot or won't feed enough amperage to keep those lights bright. And in a worst case scenario the switch will completely fail and leave you literally in the dark.



**Relays -we've all heard about them, but what do we do with them? Think of this relay as a remote, high amperage switch. We can replace a "weaker" original switch with a relay and then use the original switch as a trigger to turn the relay on. The net effect is reduced amperage stress on the original switch and increased switching power and dependability from the relay. This 70 amp relay, from Watson's StreetWorks, makes a great relay for the ignition switch accessories. It has 10 gauge wire power feeds and the connectors to make installation a breeze.**

So, what-are-ya-gonna-do? Put a relay in the circuit of course. As a reminder, a relay is a "switched-switch" or "triggered-switch" which is capable of handling higher amperage than the switch it's replacing. A typical relay only needs about 120 milliamps (0.120 amps) to be triggered and held closed but can then supply 30, 40 or more amps (depending upon the relays rating) to the load being fed. By making the relay the main switch in the headlight circuit and using the headlight switch as the trigger for the relay, we shift the amperage load off the headlight switch and onto the relay which is designed to do the job.



**Wiring in a relief relay for the headlight circuit feed is quite straight forward and will make sure the lights get full power.**

In our high wattage headlight example used earlier, either a 30 or 40 amp relay will be sufficient to handle the nearly 20 amps used by the lighting system. For ease in wiring, we recommend only feeding the headlights themselves through the relay and leaving the lower amperage running lights fed by the headlight switch. But if you've had a problem already, don't forget to replace the headlight switch with a new unit. Excess amperage and the resulting heat can corrode switch contacts and cause problems down the line.

### **There Are Other Problems, Too**

Similar ignition switch problems are definitely on the increase. Why, you may ask? The ignition system doesn't pull very much amperage and the starter is run through the starter solenoid (which also acts as a relay!), so what's the problem? Accessories! You'll recall that all of the circuits in your car come through the fuse panel and are either battery fed (on all of the time -like the headlights, brake lights, horn, etc.) or ignition fed (on only when the ignition is on -like fuel pump, heater, A/C, radio, etc.). This last group, the accessory circuits, are all routed through the ignition switch.



**Ignition switches were never intended to carry the juice we feed through them due to added accessories. This unit also from Watson's StreetWorks is one of the highest rated at 30 amps and is available with a machined billet nut with C-ring (not shown).**

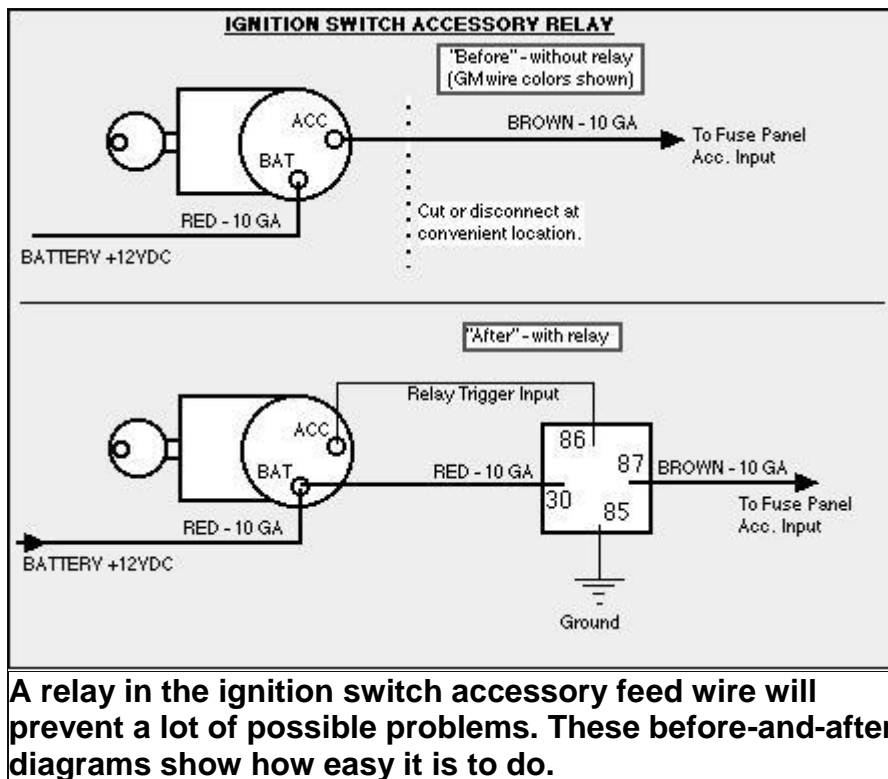
Let me tell you about our very good friend, Dale, who often helps us out in our booth at some of the shows we do. Dale arrived at the last show with a problem. While en route to the show -A/C on full, radiator fan churning, tunes on the stereo -the accessory terminal on his ignition switch got so hot that it melted right off . It wasn't able to take the total amperage being drawn through it and result was heat and failure.

If we start adding up typical amperage loads for accessories the total gets surprising -fuel pump, 10 amps; heater/defroster, 15 amps; windshield wipers, 15 amps; A/C, 30 amps; power windows, 15 amps; radio, power seats...the list goes on and on. Fortunately, not all of these items are in use at the same time and some may have their own built-in relays. But the cumulative effect still puts a tremendous strain on your ignition switch, which is seldom rated for over 30 amps.

We've even known of two different guys who thought they were experiencing the classic hot start problem when in fact it was due to their ignition switch. After running the car for a half hour or more they shut it off, may be to get gas for example, then get back into the car...and it won't turn over. Or sometimes it will turn over but not start (particularly with electronic ignitions). Persistent detective work with a volt-ohm meter shows that the ignition switch is getting a 12 volt supply but only giving up 8 or 9 volts to the starter and ignition feeds. Not enough to get the job done. Especially with many of the new electronic ignitions that need about 11.5 volts minimum to work at all.

The answer (excuse me while I get back on my soapbox) -put a relay in the circuit. But this time we recommend a 70 amp relay to cover all of those electrical goodies. The ignition switch will trigger the relay off of the accessory (ACC) post and the relay will feed the fuse panel accessory input. Hey, it's not rocket science but it sure could help you to keep your ride flyin' high.

Now, in the above example of our friend Dale, another item to consider is the terminal itself and the feed wire size. Wires and terminals come in a variety of sizes for a reason. Higher amperage circuits require bigger wire and terminals of higher ratings. The same is true if you are running an extra long circuit or bundling many circuit wires together in a loom. Just like the switches, these parts need to be sized to carry the amperage and need to be able to ventilate to prevent heat buildup. Soldered connections are not necessary -a good crimp joint is fine. In fact, amateurs can overheat solder joints and cause a brittle solder. The OEM's as-a-rule use crimp joints for everything including many main battery connections. Again, every single piece in a circuit has the total amperage running through it and needs to be sized accordingly.



Finally, a quick word about your alternator. (Feel relieved, there is no mention of a relay here.) With all of these amperage hungry lights and accessories, you may have experienced the idle-speed-low-chargein'-blues. Hot day, A/C on, sitting at the stop light with the battery discharging...what a bummer.

The usual answer, to borrow from TV, is that we need "more power" so we run out to buy a 100 amp alternator. Buyer beware. Big numbers aren't always where it's at. It's not the maximum possible output of the alternator that we need to know (100 amps at some driving RPM) but rather the amperage output at idle speed where the problem exists! Said differently, what does the amperage-to-RPM output curve look like? The flatter the curve, i.e., the more uniform the possible amperage over a broad range of RPM's, the better. Top alternator suppliers will provide an output curve or chart to support their product. Ask before buying and you will be more likely to get the product and results that you want and need.

And to feed all this new amperage from the alternator to the rest of the car, let's upgrade to an 8 gauge primary feed wire. For existing wiring where you already have a 10 gauge feed wire it may be more convenient to add than to replace. A second 10 gauge wire can be added along side the first but be sure that all of the connections and terminals are right to do the job.

Electrical system problems can be some of the most frustrating and difficult to solve. But if we approach electricity with knowledge and remember to consider the effects of one small (?) change upon other components and upon the whole system, we're more likely to keep our ride on the road, safe and running the way it should.

**SOURCE:**

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