Volts of Confidence

Rewiring The Headlight And Fan Circuits To Improve Performance And Reduce Component Fatigue

by Mike Drew

When people discuss the Pantera's less endearing qualities, often mention is made of the sometimes dubious electrical system. While for the most part the car is wired reasonably, there are two notable exceptions. An afternoon spent with a few simple tools and inexpensive aftermarket components to correct these faults can dramatically increase performance and longevity of expensive factory components, and virtually eliminate the risk of an electrical fire.

The radiator fans receive their power through a somewhat circuitous route, and it's not uncommon for considerable resistance to build up along the way, which has the effect of reducing the power to the fans, slowing the motors and thus causing the fans to push less air. This can be a contributing factor in overheating problems.

More importantly, all power for the fans travels through the ignition switch. The Pantera's ignition switch was manufactured with a very poor design, using stamped contacts (essentially an eyelet with a rivet through it) instead of proper soldered joints. With excessive amps from high-performance or additional fans flowing through these contacts, they can and often do eventually fail. They are virtually impossible to fix, and new replacement switches have been unavailable for years. Even beat-up used switches fetch in excess of $300 on the open market.

Of equal importance is the poorly designed headlamp circuit. In general, an electrical switch should be used to control a high-draw component, while the actual power should be sourced directly. (The radiator fans are an excellent example of this philosophy—the switch (either thermostatic in the radiator or a manual switch on the dash) simply trips a relay, but the power that actually turns the fan motors is routed through the relay, not the switch.) Unfortunately, the Pantera's headlight circuit routes *all* power (for both the headlamp motor and the light bulbs) directly through both the dash-mounted rocker switch, and the column-mounted high/low beam switch.

When 1970's-spec low-power sealed beam lamps were fitted, this was a marginal condition at best, but as many (if not most) owners have replaced their original headlamps with high-power halogen units, the stock wiring situation has been found to be wholly inadequate. With all that current flowing through the Lucas switches (which themselves are of poor quality), the switches can heat up internally, leading eventually to failure. Many Panteras are now on their third or fourth headlight switch, and owners curiously elect to plonk down $80 for replacement switches every few years rather than tackle the underlying problem. Should the high/low beam switch fail, the unlucky owner is facing a replacement cost of upwards of $300!

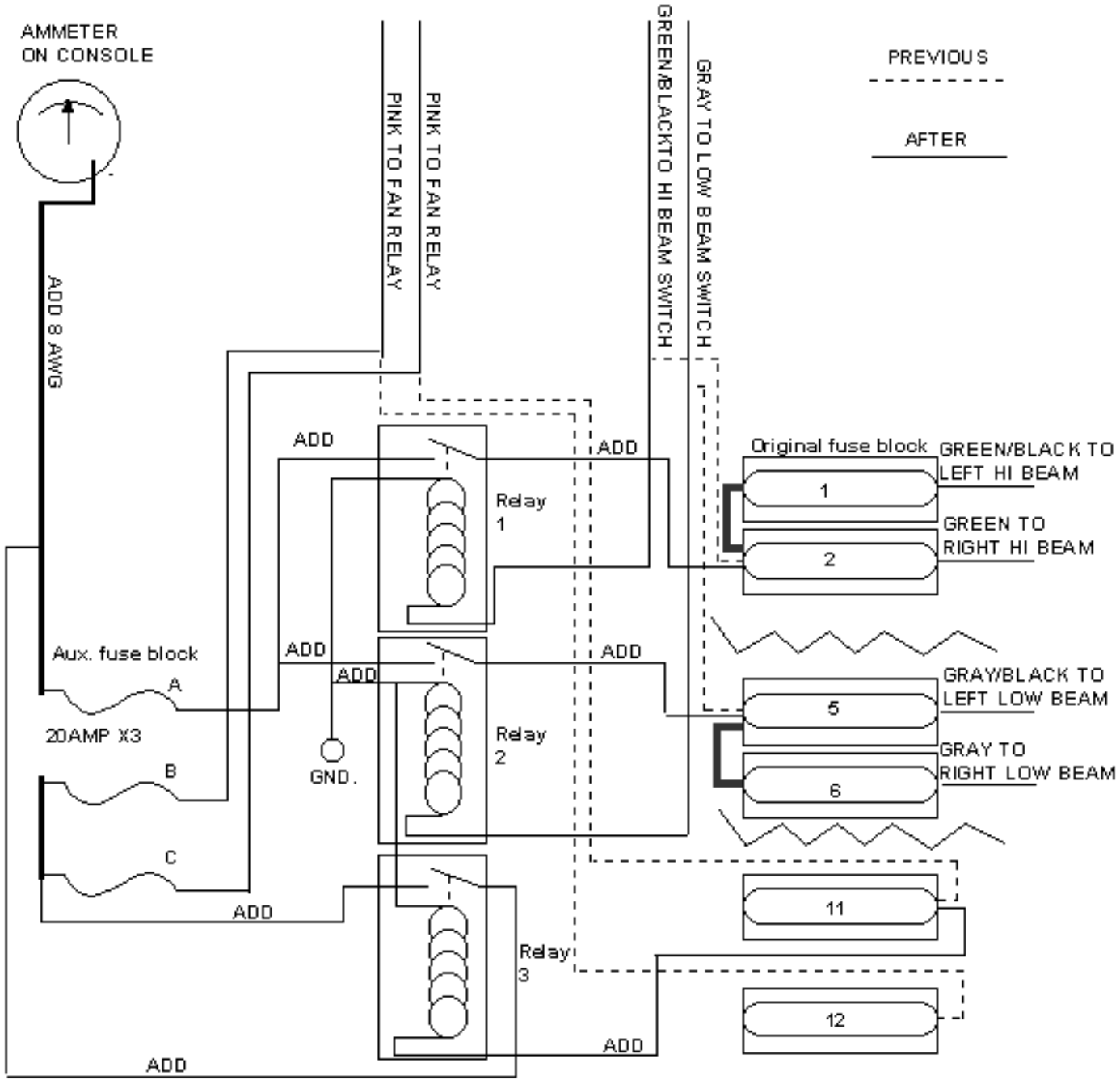
In an effort to address the aforementioned situations, I consulted with the Pantera Club of Northern California's resident electronics guru, Marcus Smith, and together we devised a set of circuits that fixed both problems at the same time. Although they're both described and presented in this article, these are in fact two completely different and wholly unrelated problems, so you can elect to duplicate one circuit without necessarily needing the other should you so desire.

In order to successfully work on the system, it's imperative that you have a factory wiring diagram to reference. There are at least three different factory-produced diagrams out there, so make sure you're using one that is correct for your car (or at least close!) They are available from the POCA club store for a very reasonable sum. Check the club store section of the POCA website at www.PanteraClub.com for the latest prices on this and other factory-produced service documents. To order, contact Asa Jay Laughton at AsaJay@concentric.net (or, for the internet-impaired, (509) 534-4809.) Assuming you have yours handy to follow the discussion, you're ready to begin.

First, let's examine how power is routed to the headlamps normally. 12 volts comes directly off the battery circuit via a big fat red wire to the positive post of the ammeter, flows through the ammeter, and then exits in a smaller (but still impressive) black wire. (While black is traditionally the color for ground, and the ammeter is marked "+" and "-", in fact both sides of the gauge have 12 volts and LOTS of amps.) The black wire off the ammeter then leads to the alternator.

When the system voltage is lower than the battery voltage, current flows out of the battery into the system through the ammeter, and the ammeter responds by indicating a discharge (-). When the system voltage is higher than the battery voltage, current flows into the battery and the ammeter indicates charging (+). When the engine is running, the alternator trys to keep the system voltage at a set value by "pushing" current through the voltage regulator into the system.

What's really curious though is that in the middle of the wiring harness, not one but *four* fat pink wires



Note: This wiring schematic applies to 1973 and later models. See the text for specific differences for earlier cars. Also, wiring may be different for GT5 and GT5-S Panteras (we haven't been able to check one out yet!)

Pantera key power relief circuit for off loading fans from key switch and headlights from hi-lo wand light switches.
MRS

sprout from this main black power wire, leading to different components on the car. One of these pink wires leads directly to the headlight switch. That means that the headlight switch is hot at all times, and the lights are not switched by the key in any fashion. (The headlight *motor* power is routed through the ignition switch however, so if you actuate the headlight switch without having the ignition key turned to the first position, the lights will all illuminate but the headlamps will not raise—if you have halogen lights, this will then start baking the paint on your fenders!)

The headlight switch acts sort of like a dam, stopping 12 volt power from flowing any further until the driver actuates it. Once he does, power then flows through the headlight switch, but instead of going straight to the lights, it instead veers off towards the steering column via a white wire, where it encounters the high/low beam switch.

If low beams are selected, the switch routes the power via a gray wire back to the main fusebox. Power is then split (via a brass junction) between fuses #5 and #6. A gray/black wire carries power from fuse #5 to left low beam, while a gray wire carries power from fuse #6 to the right low beam.

Similarly, if high beams are selected, power flows from the high/low beam switch to the fusebox via a green/black wire to the main fusebox. Power is again split with a brass junction between fuses #1 and #2. A green/black wire from fuse #1 carries power to the left high beam, while a gray wire from #2 carries the power to the right high beam.

(The early '71 cars follow a similar scheme although all the wires are different colors and different fuses are utilized. One significant difference appears to be that power to the headlight switch comes via the ignition switch, and not directly from the main alternator/battery circuit. A green wire leads from the headlight switch to the high/low beam switch. A light blue/red wire leads from there to fuses #2 and #3 and directs power from there to the high beams via a grey/black wire on the left side, grey wire on the right. Low beam power comes from a green and red wire to fuses #4 and #5, and from those fuses via a grey/black and a grey wire to the left and right low beams respectively.)

Sounds simple enough, but what is astounding is that the fuses are only used to protect the *light bulbs.* That means that if any problem is encountered anywhere in the circuit prior to the fifty-cent bulbs (i.e. in any of the mega-dollar switches), there is *no* fuse protection whatsoever, and a fire could potentially result.

Equally problematic is the overall low quality of the two switches used to control the headlights. The rocker switch is a fairly marginal piece, prone to breaking down internally due to excessive heat. The column-mounted high/low beam switch (a complex assembly from British cars shoehorned into the Italian wiring system) has absurdly small wires, and clearly wasn't designed to flow the kind of current a Pantera subjects it to. When high-power lights are fitted, either or both of these switches are subject to failure.

Fortunately, it's not terribly difficult to combat these problems. The goal is to utilize the switches *strictly* to control the system, and route the actual power that flows to the light bulbs themselves through relays, so that the high current draw never comes near the controlling switches.

To that end, an auxiliary fuse block and auxiliary 30-amp relays can be purchased at the local electrical parts store, with provisions for up to six new blade-type fuses (which are better-suited to handling high-amperage demands than the Pantera's stock-style or glass barrel-style fuses.) This block and relays will be mounted right alongside the stock fusebox, underneath the fusebox's sheet metal protective cover.

Before horsing around with any automotive electrical system, it is absolutely imperative that the battery be disconnected. Besides creating an excellent environment to do considerable damage to your body, leaving the battery connected and waving hot wires around is a good way to start a fire and damage the car!

A large 8-gauge wire is attached to the "-" post of the ammeter (to keep the gauge reading correctly) and routed carefully under the dash to one station on the auxiliary fuse block. Since this wire will be 'hot' at all times, it's important to route it carefully to ensure it won't rub or chafe against any metal structure that could lead to a short. Wrapping this wire with an additional layer of insulation is a good idea as well.

A 20 amp fuse (labeled "A" in the drawing) then sends the power to aux relays #1 and #2. (All added wires in the headlight circuit should be 16 gauge, same as the factory wires.)

The gray (low-beam) and green/black (high-beam) wires coming from the high/low beam switch (which used to run to factory fuses 1/2 and 5/6 respectively on the later cars, 2/3 and 4/5 on the '71's, sending power directly to the lamps) now are routed to the respective aux relays instead.

If low beams are selected, the power flows from the gray wire to the coil at the bottom of aux relay #2. This closes the relay, allowing 12 volts to pass from the aux fuse block, through the relay, directly to fuses #5 and #6 (#4 and #5 on early cars), and from there via their respective wires to the lamps.

Similarly, if high beams are selected, the power flows from the green/black wire to the coil at the bottom of aux relay #1. The relay closes, and power flows from the aux fuse block through the relay to fuses #1 and #2 (#2 and #3 on early cars), and from there to the high beam lamps. It's all really quite simple and elegant, and the current flowing through the switches is reduced by orders of magnitude.

The lights all function completely normally (the parking lights and headlamp motor circuits are unchanged), with the exception that actuating the switch to turn on the headlights or the switch selecting high or low beams causes a satisfying 'thunk' to emanate from the new relays as they close.

With the headlights sorted out, it's time to turn attention to the fans. First, to determine if your fans are running at optimum speed, try this simple experiment. Re-connect the battery, start the car and let it idle long enough for the automatic system to turn the fans both on. Notice the speed at which they're turning.

Now, shut the car off (the fans should stop) and disconnect *both* leads to each fan motor. (Pay careful attention regarding which wire goes where—if you reverse them when reconnecting them the fans will spin backwards!) To test them, run a large-diameter jumper wire directly from the positive battery post to the positive leads on the fan motors—yellow/green and blue respectively for the stock fans; aftermarket fans usually use red and black. Note that if an aftermarket fan intended for a 'sucking' application is installed in a 'pushing' Pantera, the wires may have to be reversed, i.e. the black wire will be power and the red wire to ground.

Once you have your jumper wire attached to one lead on the fan motor, firmly press the other lead to a good ground. This will complete the circuit and cause the motor to spin. (Note: If you only disconnect one wire from the fan, assuming that it's the 12 volt one, and inadvertently connect your jumper wire to the fan's ground wire instead of the 12 volt wire, the result is lots of smoke and melted wires from the center of the wiring harness—there they be dragons!)

Assuming you've avoided this calamity, do you notice the fans spinning measurably faster than before? If so, then you've got enough resistance in the stock fan circuit to warrant a fix. Even if they spin at the same speed as before, you still run the risk of toasting your ignition switch by keeping the stock wiring configuration, so this exercise is still worthwhile. As ever, before working on the electrical system, once again disconnect the battery!

Now it's time to tackle the relatively minor task of getting pure power to the fans. Before we begin, let's ensure we have a thorough understanding of how the stock system works.

Remember the pink wire that went directly from the ammeter/alternator wire to the headlight switch? Well, a similar pink wire (always hot) leads from the ammeter/alternator circuit to the ignition switch. On late 1972 and latera Panteras, when the switch is turned to the run position, power flows through the switch into two wires, red and light blue. The red wire sends power to fuse #11 while the light blue one carries power to fuse #12. (Curiously, these two wires are joined together at the switch, and the fuses are joined together by a brass junction.)

From these two fuses, large pink wires carry the power to each fan relay, and when the relays are closed by a switch (either thermostatic or manual), the power then flows (via a blue, and a yellow/green wire respectively) to the fan motors.

Late 1971 through fall 1972 Panteras have a slightly different situation, where a single red wire leads from the ignition switch to fuse #11. A pink wire carries power from there to one of the fan relays, and a jumper (presumably pink also—unmarked on the wiring diagram) carries this power to the second fan relay. Thus both fans are powered by a single circuit equipped with a 15-amp fuse—a truly marginal state of affairs indeed!

Owners of early 1971 Panteras, including pushbutton door cars and pre-USA European cars have an entirely different wiring scheme altogether. These cars featured one thermostatically actuated and one manually actuated fan; the manual fan was turned on and off by the second switch on the center console, immediately below the headlight switch. And the fan relays are not located at the front of the car, behind the radiator the way they are on later cars. On the early 1971 Panteras, the fan relays are contained with all the other relays (horn, etc.) on the relay panel that is bolted to the underside of the dashboard on the passenger side, above and forward of the glovebox.

On these cars, power to the fan relays comes from fuse #14, not #12. The diagram in the owners manual fails to detail what amperage each fuse is supposed to have. Two wires (one black, and one yellow, and possibly joined together just before they connect to the fusebox) lead from fuse #14 to the respective fan relays.

The simple solution to the fan power dilemma would be to remove the power wires (carrying ignition key switched power from fuse #14 on the early cars, fuse #11 for the mid-production cars, and fuses #11 and 12 to the two fan relays on the latest cars) from the stock fusebox and connect them to the output side of your new aux fuse block. Connecting two stations of the aux fuse block to the added power wire from the ammeter enables you to route unadulterated power through fuses B and C to the fan relays, bypassing the ignition switch and factory fuse box with their attendant resistance. Those cars whose stock wiring consists of a single power source for both fans would be well-served if a second, independant power source was contrived for the second radiator fan, mimicking the latest factory wiring scheme.

However, if you were to follow this simple repositioning of wires scenario, the fans would continue to run after you shut the car off until the water temperature in the radiator cooled enough for the thermostatic switches to close, depowering the fan relays. Most would agree this represents an unnecessary drain on

the battery.

To alleviate this condition, a third aux relay is introduced. Ignition key switched power from fuse #14 on early cars and fuse #11 on late 1971 and later cars (which used to flow to the fan relay) is instead routed to the coil portion of aux relay #3. A 10-gauge power wire is taken off the 8-gauge wire that powers the headlight portion of the aux fuse block, and is routed through aux relay #3 and then to two stations of the aux fuse block, to power fuses B and C. This only slightly adulterated power then flows through the factory pink wires to the relays, and from there to the fans.

Since the aforementioned factory fan relay powering fuse is powered by the ignition switch, the relay is only closed (and thus the fans can only receive power) when the key is on, which will keep the fans from draining the battery when the car is shut down with a hot motor. Furthermore, by removing the fans from fuse #12 (fall 1972 and later cars), the other components on that circuit (back-up lamps, stop lamps, etc.) can breathe easier, and the risk of a blown fuse that could extinguish your brake lights is reduced considerably.

There is ample room alongside the stock Pantera fusebox to fit the auxiliary fuse block and three auxiliary relays and still clear the fusebox cover door. By positioning them close to the factory fusebox, it's possible to simply unplug the necessary wires from the stock fusebox and plug them into the new fusebox or relays as required, with no additional splicing or hacking. In fact, both procedures described here do not require the cutting of a single factory wire; the only modification to the harness is the addition of supplementary wires.

The relays and new fusebox should be secured to the inner footwell by running self-tapping metal screws through the carpets, through the sheetmetal where they'll protrude into the right front wheelwell. Use a cutting tool to cut off any unwanted extra screw length from inside the wheelwell, then waterproof the holes by daubing some RTV or other sealant on the wheelwell side of the screws.

It goes without saying that proper-diameter wire, quality connectors and wire terminators should be used throughout. Ensure all added wires and components are thoroughly insulated to prevent short circuits.

In one afternoon, without working anywhere except in the immediate area of the stock fusebox (i.e. no crawling around chasing wires under the dash or through the car except to run the initial 8-gauge power wire from the ammeter to the aux fusebox), it's possible to dramatically increase the effectiveness of the radiator fans and the brightness of the headlamps, and at the same time eliminate annoying and potentially dangerous electrical problems from their respective circuits.

Hopefully this article will arm you with everything you need to know to perform the respective operations, but if not, strongly consider taking your Pantera to an electrical expert to have this work performed. The money you spend rewiring the headlights and fans will likely be offset by the savings encountered as your switches stop failing every few years!

An Update

In the above article I wrote for the PCNC and POCA newsletters (April '99 POCA newsletter, page 13) called "Volts of Confidence", I detailed how to rewire the radiator fan circuits using auxiliary fuse blocks to help deliver maximum power to the fans, and bypass the stock routing where power is run to the fans via a roundabout route incorporating the stock fusebox (twice) and the ignition switch (which lacks wire of sufficient gauge to handle the electrical draw.)

Several people have come forward to inquire about differences encountered in their cars when they tackled this project, differences that I failed to anticipate. Unfortunately I failed to take into account the several different wiring variations which exist in Panteras of different eras. However, the differences are trivial enough that the modifications can still performed simply and safely. Thanks to their efforts I can now issue this update.

In my article I was using the latest, greatest factory-produced wiring diagram to analyze the circuits. While this diagram is not dated (at least, the version I purchased from a vendor had no visible date), it's apparent that it's for an L-model car, and perhaps even a LATE L-model car (as opposed to a '72 L?); those later cars (and this diagram) have a starter interlock circuit consisting of a fairly large, bright yellow box which fits underneath the dash and has 11 wires leading to/from it. How about 1972 L-models? I dunno...

Although my car is a July '72 Pre-L, it has been retrofitted with a wiring harness from a '74 L and thus my car and the diagram were in complete agreement, and I (naively) believed that ALL Pantera fan circuits were wired more or less the same.

Hah.

I have in my possession three different factory wiring diagrams, and they all differ from one another in the fan circuit department. The first diagram is for very early '71 Panteras and is incorporated into the back of the blue-covered factory owner's manual. The second one is issued (or at least WAS issued) with the Ford shop manual, and is dated 6/15/72, while the third one is the one I originally used.

In my article, I reported that the two individual fan relays were each connected to separate fuses, #11 and #12. Pink wires carried power from each of these fuses (#11 is 15 amp and #12 is 25 amp) to the respective relays.

While this is obviously true for the later cars, this is NOT true for the earlier cars! On the diagram dated 6/15/72 (and which probably encompasses MOST 1972 Panteras and later 1971 cars), the fan relays are BOTH powered by fuse #11, which is fitted with only a 15-amp fuse! In all likelihood, the fans (which together draw considerably more than 15 amps) blew fuses until period owners 'fixed' the problem by installing higher-amperage fuses!

Actually, only one pink wire goes forward from the fusebox to the front of the car, and connects to one fan relay. A jumper wire then channels power from that first relay to the second one, enabling both fans to run. It's a fairly marginal situation, however.

Owners with cars wired thusly are advised to remove the single pink wire from fuse #11 and connect it to one output terminal on the new auxiliary fuse block. Remove the hokey jumper arrangement between the two fan relays, and instead string another wire (pink if you can find it) from a different terminal on the aux fuse block, forward and parallel to the existing pink wire and to the second relay. In so doing, you will essentially be mimicking the updated factory wiring scheme.

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On these cars, power to the fan relays comes from fuse #14, not #12. The diagram in the owners manual fails to detail what amperage each fuse is supposed to have. Two wires (one black, and one yellow, and possibly joined together just before they connect to the fusebox) lead from fuse #14 to the respective fan relays. The fix here is to simply reposition these two wires to the two new fuses on the aux fuse block, same as the article instructed—the only difference is the color of the wires you're moving (the article directed you to reposition two pink wires, instead of one black and one yellow wire.)

With a little head-scratching, it's possible to sort out virtually any Pantera electrical dilemma, PROVIDED that you have the CORRECT wiring diagram for your car. Although the conventional wisdom has always been to make sure you purchase the appropriate diagram, some old-timers advise that you first purchase a diagram, then go buy a Pantera to match it!