Tech Tips #4

written by "The Old Salt"

Well here we are again. Hope you all had a great, trouble free summer. We certainly did. Needed a few more patches on the mains'l but on the whole the annual cruise to the great State of Maine was extremely enjoyable. A major contributor to that enjoyment was the fact that nothing went seriously wrong, at least not for us, as long as you don't include finishing dead last at Rockland a real serious matter. I was hoping to gather more material for this column by listening to folks talk about their mechanical or electrical problems. But other than a battery failure (on my boat) and an engine that wouldn't start on another boat, things were pretty uneventful. Since I couldn't use anyone else's misfortune as a source for an article I guess we'll stick to the original plan. I was hoping that someone would ask a few specific questions that I could address. Hopefully, this column will be a forum for sharing the vast range of practical experience accumulated by our membership and not just my favorite topics. It is intended to be the place where you, the reader, can submit technical questions and either obtain answers or direction to appropriate reference material.

Since you have not asked for specifics I'll continue on course with the original list of topics. In case you don't remember, the topics are: electrical wiring, alternators and regulators, batteries, grounding and bonding, radios and antennas, and instrumentation (depth, speed, GPS, LORAN, etc.). We already did wiring and alternators, so let's look at regulators.

In the last article we looked at alternators and getting them operating in the correct speed range by sizing the pulley appropriately. Now that we are producing all that electrical power, how do you control it? And what are we really trying to control?

To understand things a little better let's look at a simple system like the one in your car. It is comprised of one engine, one alternator, one battery, the starter motor, lights, radios, power seats, cell phones, etc. that collectively we can call the "load" on the electrical system. In a simple system like this the alternator has an electronic regulator built into it that senses the output voltage of the alternator. Because the battery and the devices that constitute the load are connected directly to the alternator, whatever the alternator output voltage is, is the voltage across the battery and load. The regulator will try to maintain the voltage at approximately 14 volts by increasing or decreasing the current being produced by the alternator.

After you start the car, the voltage across the battery drops because you partially discharged it while turning the starter motor. In response to the drop in voltage the regulator increases the current through the rotor windings in the alternator. This in turn increases the intensity of the magnetic field of the rotor. As the engine starts to turn so does the alternator's rotor because the pulley drives it via the V-belt to the engine's crankshaft. The spinning magnetic field induces a current in the stator windings that are built into the outside housing of the alternator. This current "alternates" between a positive going and negative going current, hence the name "alternator". The alternating current is then fed through six large diodes where it is rectified, or changed, into a direct current that then recharges the battery. As the battery recharges its voltage increases, and sensing this, the regulator decreases the current going to the rotor. Decreasing the rotor current decreases the alternator's output. So by controlling the rotor current we control the output current of the alternator and the overall electrical system voltage.

The regulators built into automotive alternators, and those designed for simple marine systems are quite sophisticated. They recharge the battery at the proper rate, compensate for temperature changes, and regulate the current supplied to all the electrical accessories of a car or boat. But this sophistication also has its disadvantages. If you add a second battery, a battery switch, or larger load you have changed the electrical system design and the regulator built into the alternator may not be able to measure up. A boat's electrical system is usually much larger than that of an automobile, unless you have a really, really big car. As you add more wire, more of a load, the losses can start to add up. The primary problem is that the regulator is built into the alternator. As you add different components to the electrical system you need to sense the system voltage from a point closer to the battery or ideally at the battery itself.

In order to accomplish this you have to have an external regulator, and an alternator that will accept it. Many of the alternators that are supplied to the marine industry have external regulators mounted on the back of the alternator case. Motorola, Lucas and Delco are among the suppliers. Normally the voltage sensing wire is attached to the ignition switch, which is usually wired to the starting battery. If your system is one of these, make sure that the wire is large enough and the connections are clean. There are also a number of after-market regulators that are designed specifically for recharging deep-cycle batteries. The beauty of using a modern, stand-alone, regulator is that they will do a much better job of maintaining your batteries and prolonging their life.

I think they're a good investment. Remember that battery failure I mentioned earlier? This was one of the original batteries I bought for the boat fifteen years ago. And I still have its mate that I bought with it in the battery box. I don't get that kind of life out of my car batteries.

The advantage of these new regulators is the way they control recharging. Rather than following a simple recharge curve, they follow a three-step sequence that more closely matches the electrochemical needs of the battery. The steps are: bulk, absorption and float. In the bulk step the regulator provides a recharge current of 30-40% of the batteries amp-hour capacity until the battery voltage reaches about 14.4 Volts. After that it switches to the absorption step. In this mode the regulator tapers off the charging current while holding the voltage at 14.4 Volts. When the current drops to less than 5% of the amp-hour capacity the regulator switches again. In the float mode the output voltage of the alternator is regulated at 13.5 Volts, where it will stay until a discharged condition

(Continued from Page 6)

is sensed.

Another nice feature that many of these regulators have is that they are adjustable. But I don't recommend messing with the adjustments unless you have a good 4-digit digital multimeter. The factory settings are quite good for all but the most sophisticated electrical systems. If you really think it needs to be tweaked, a good marine electrician should be able to hook things up and adjust it in a few hours, depending of course on the condition of the system when the work starts.

Balmar, Heart Interface and Aqualine are three of the manufacturers of "smart" regulators. Most of the marine catalogs list various makes of alternators and regulators. If you decide to spend the dollars for an upgraded system I recommend that you purchase a regulator that matches the alternator. The hook-up will be much more straightforward. Good luck.