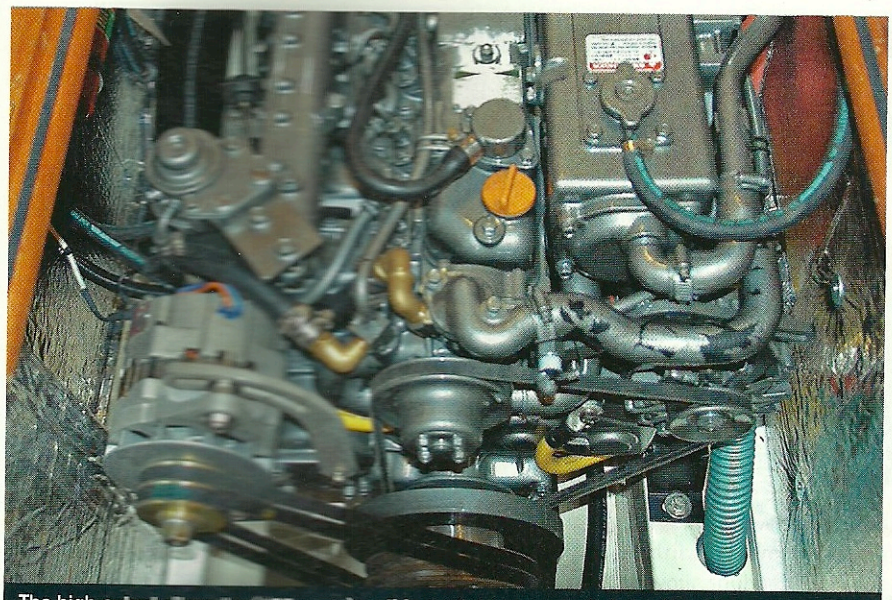
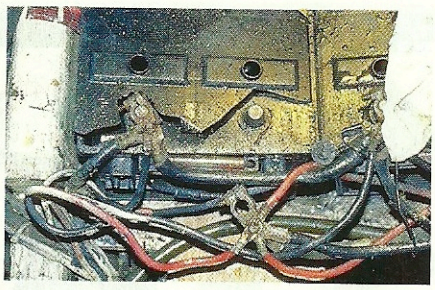
TECH NOTES





The high-output alternator (300 amps) on this engine can generate lots of heat in a conventional battery (above). The aftermath of a battery explosion caused by thermal runaway (right)

boats, then push charging systems to the limit with "smart" multi-step regulators, we bring ourselves ever closer to the edge.

PREVENTIVE MEASURES

It should be obvious by now that batteries, especially house batteries, need to be in a cool location. They certainly shouldn't be in the engine room. Beyond this, attention should be paid to getting heat out of batteries that are worked hard. At the least, batteries should be spaced a half-inch or so apart, so air can circulate around them and allow heat to escape. With larger battery banks and powerful charging devices, some kind of forced-air ventilation (using spark-proof fans) is recommended. In fact, Lloyds regulations in Europe require this any time charge rates can exceed 2.5kW.

Most boats of any size now have more than one battery in their house bank. Power capacity is usually increased by paralleling two or more batteries. Whenever batteries are joined in parallel, they should be kept at the same ambient temperature. If temperatures vary, you can get into the situation described above, where one gets warmer than the others, does more work (charging and discharging), gets warmer still, and eventually goes into thermal runaway. I received an e-mail just last week describing exactly this situation. The charge acceptance rate of half the batteries in a house bank was climbing from 20 amps to 40 amps at a near full state of charge, without any rise in voltage, but with a considerable rise in temperature. In this case, the hot batteries were located in a different part of the boat than the cool batteries. All batteries joined in a bank need to be in the same place.

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Another way parallel batteries can get into a temperature imbalance is if there are long, or undersized, connecting cables between them, or if there are poor connections. In effect, this puts a resistor in the circuit, reducing the charging and discharging currents to and from one or more batteries. These batteries then do less work and don't heat up at the same rate as the others.

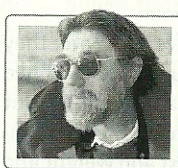
Voltage regulators for powerful charging devices should always include temperature sensors at the batteries, as they don't do much good anywhere else. Battery temperature sensors are, in fact, quite common these days, but I still often see them stuck on top of battery cases, where they do no good at all! There is an air pocket inside the top of all batteries that acts as a heat insulator. Temperature sensors should be firmly attached to the battery post, or should be glued onto the case at least halfway down the side of a battery. In a bank of batteries, the sensor should be at what is likely to be the warmest spot, which typically is on the side of a battery at the center of the bank.

LOOKING TO THE FUTURE

The fundamental problem we are dealing with here, as with so many other bits and pieces in our marine electrical systems, is the inherent inefficiency of conventional lead-acid batteries. The new Thin Plate Pure Lead (TPPL) batteries that I've discussed in previous columns have significantly lower energy losses (approximately on the order of a total of 15 percent over a full discharge/recharge cycle, compared to 30 percent for conventional batteries). This substantially reduces heating issues. For several years, I have been involved in some pretty brutal destructive testing of these batteries, including at elevated temperatures, and have yet to see one go into thermal runaway.

Lithium batteries, meanwhile, lose virtually no energy while discharging and recharging, so almost no heat is generated. But they have all kinds of other issues (in addition to costing a fortune) that must be addressed with sophisticated battery management systems.

In practical terms, most of us will be relying on conventional lead-acid batteries for quite a while. If we are to drive our DC systems ever harder, with ever increasing electrical loads, it's essential that we help our batteries maintain their cool.



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