

# Creating a Waterproof Diesel Heater for Sub-Freezing Temperatures

## What is a diesel heater, and why do I need one?

A diesel heater is a piece of equipment that runs primarily on diesel fuel but can be run on other fuels such as kerosene. I need one for ice fishing, and there are several good reasons. Traditional propane heaters are great; they are small, generally light weight and produce massive amounts of heat. They are great options for small bursts of heat (i.e cooking) or heating a tent for a short period of time. The primary issue with propane heaters is their two byproducts; water vapor and carbon dioxide. This is not an issue in homes and commercial spaces, however, when the tent you are fishing in is approximately 100 square feet, this becomes an issue.

## Dangers

### Carbon Monoxide

Carbon monoxide is by far the most dangerous byproduct. It is an odorless gas that can not be detected by humans. Essentially, if there is a large amount of carbon monoxide present, humans will suffocate due to the lack of oxygen in the space (the oxygen is consumed in the burning of propane). A carbon monoxide detector would solve this problem, however, opening the windows or doors to the tent to let in more oxygen and release the carbon monoxide would also release the heat produced by the propane heater, which is highly counter productive.

### Water Vapor

The second and less dangerous byproduct is water vapor. This is not dangerous; however, it is highly irritating. Essentially, when propane is burned water molecules are released into the atmosphere (in this case the tent). The water sticks to the inside of the tent where it inevitably freezes for a short amount of time. As the tent slowly heats up, all of the ice that has formed on the inside of the tent starts to melt. This essentially creates a shower on the inside of the tent, soaking everyone and everything inside. Having wet gear while ice fishing is not only a quick way of ruining your day, but also opens you up to illness and hypothermia when traversing back to land after the outing.

## What is the solution?

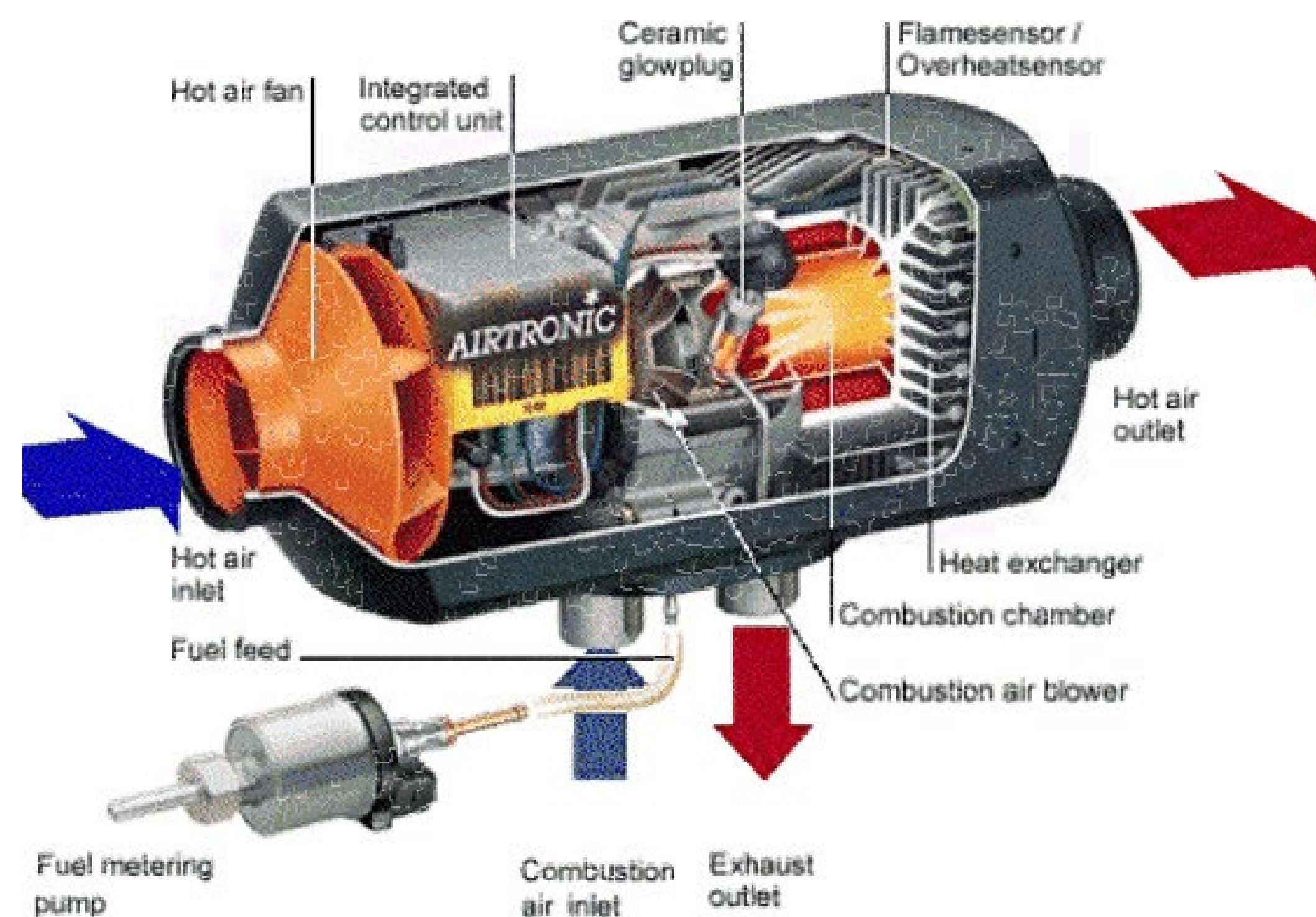
A diesel heater! Unlike a propane heater a diesel heater heats up a cast aluminum core which air is drawn over, warming it. This warmed air is then forced inside the tent, warming it with dry, carbon dioxide free air. Since this heater is located outside the tent, the carbon dioxide from burning the diesel is then released into the atmosphere (not inside the tent). This creates a simple way to control the temperature, keep items and people dry, and most importantly keep everyone safe from the dangerous effects of carbon monoxide.

## How does a Diesel Heater Core Work?

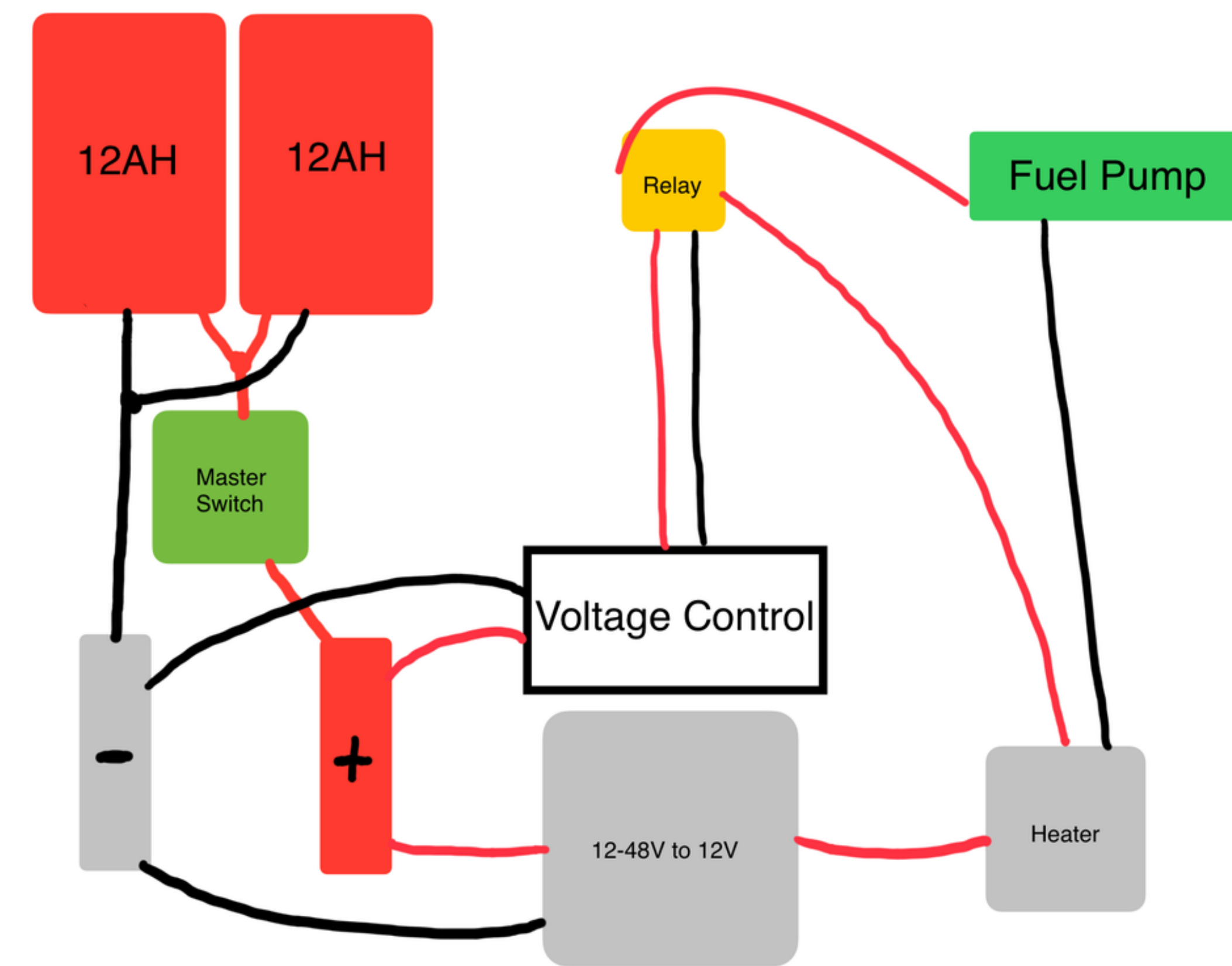
The key to how a diesel heater works is the fact that the combustion intake and exhaust are SEPARATE from the air that is warmed and forced into the space. This is the key difference between a diesel heater and a simple propane heater you may have in your garage. Let's look at the image below.

### Diesel Heater Core - Order Of Operations

1. 12V DC Power is applied to the ICU (Integrated Control Unit), turning on the heater's control panel
2. The user then uses the control panel (not shown) to turn on (send a signal) to the ICU, beginning the startup procedure.
3. The ceramic glow plug is then heated rapidly, warming the combustion chamber. NOTE: This step takes the most amount of power by far. If the heater always drew this much power, it would only run for about 7 hours and 15 minutes as I have 24ah of battery capacity.
4. Once the combustion chamber and glow plug have warmed, the fuel pump turns on, pumping small amounts of diesel fuel into the combustion chamber. At the same time, cold air is drawn through the combustion air inlet, mixed with the diesel fuel, and combustion occurs.
5. This then warms the heat exchanger (aluminum fin structure). The diesel exhaust is then exhausted through the exhaust outlet into the atmosphere, NOT the structure (tent).
6. Once the diesel heater has warmed the heat exchanger, the hot air fan turns on. This fan draws air from the atmosphere through the heater core, over the heat exchanger, and out the hot air outlet. The hot air outlet is then plumbed into the structure (tent), warming it.



## Wiring Diagram



## Two Options for Operation

### Using Two Batteries Until Failure

1. Master Switch is turned on
2. Voltage control unit turns on
3. Voltage control unit turns on relay
4. Diesel Heater turns on
5. Voltage control unit reads 20.60 volts
6. Heater runs until battery(s) reach 16.60 volts
7. Voltage control unit turns off relay
8. Fuel pump turns off
9. ICU detects fault
10. ICU shuts down diesel heater
11. Master switch is turned off
12. User replaces batteries
13. Repeat

### Replacing a Battery Before Shutdown

1. Master Switch is turned on
2. Voltage control unit turns on
3. Voltage control unit turns on relay
4. Diesel Heater turns on
5. Voltage control unit reads 20.60 volts
6. Heater runs until battery(s) reach 17 volts
7. Voltage control unit does not turn off relay
8. User takes out one battery
9. User puts in freshly charged battery
10. Voltage control unit reads about 19 volts
11. Repeat, replacing lower voltage battery

