SUBURBAN RV GAS FURNACE

HOW IT WORKS AND HOW TO MAINT AIN IT

PART 1

HOW IT WORKS

Today you will find a variety of heating devices fitted in American RVs. The most common type being the blown air gas furnace made by Suburban or Atwood. These units are usually supplied as original equipment.

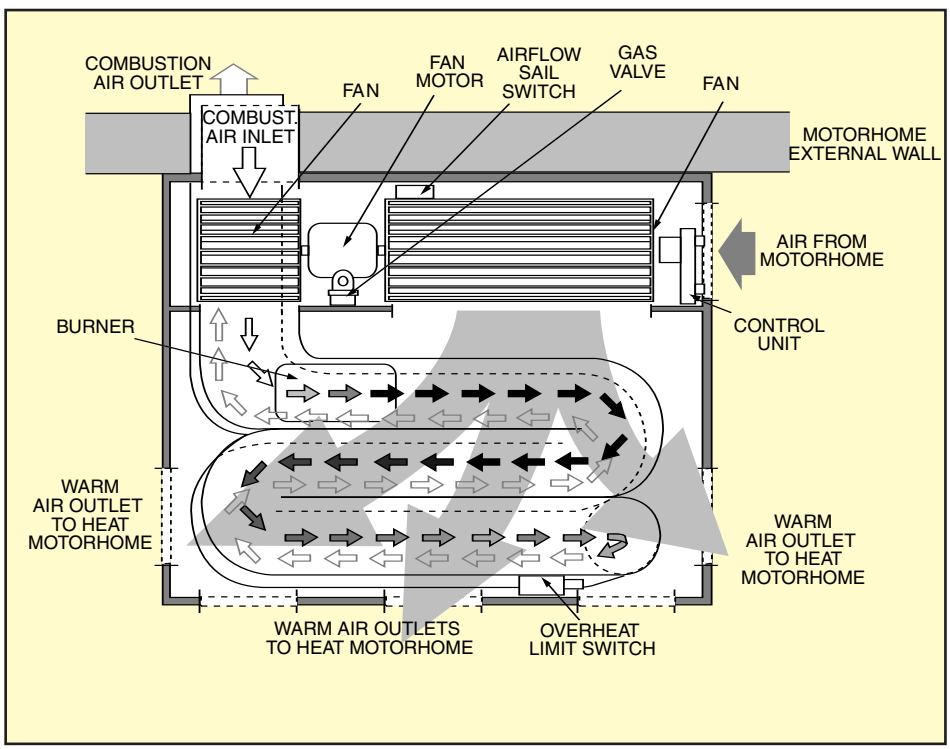
The major disadvantages of both these units is the operating noise and the heavy current draw, typically 7-8 amps, which will soon drain your batteries when used for extended periods. You really need to be on a hook-up, or have large batteries, when these furnaces are in operation.

One alternative to the warm air blown furnace is the catalytic gas heater which consumes no power from the batteries but unfortunately does cause a small amount of condensation. This can be reduced by leaving a roof vent open but of course much of the heat will escape as well.

The other alternative is to fit a wet system gas boiler and radiators such as the Alde system. Battery consumption is virtually nil and so is the noise level. It also maintains a fairly constant temperature within the RV unlike the blown units which are notorious for blowing hot and cold.

However, for now, we will concentrate on how the Suburban furnace works and also in Part 2 how to fault find it. The Atwood Hydroflame furnace is similar in operation and can usually be accessed from outside the RV for maintenance. The Suburban furnace is sometimes installed with an outside access but more often than not it has to be removed from the RV for any fault finding or maintenance.

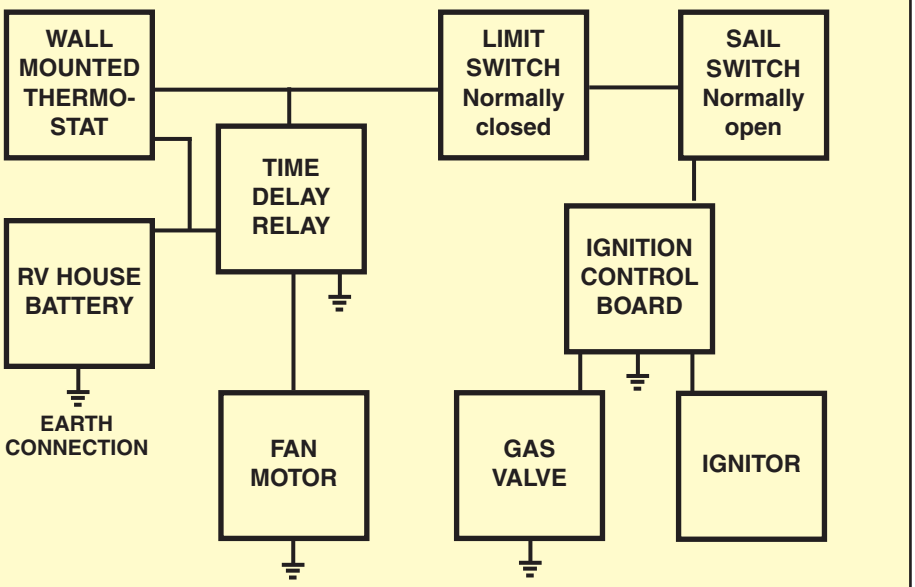
Over the years, motorhome heating systems have changed dramatically, but the blown units really have not changed very much over the last decade or so. The control systems have probably improved but the basics are still very much the same and the units still suffer from the same problems. Unfortunately the improvements that have been made, particularly to the electronics, now means that many parts are not repairable and can only be replaced, which can prove expensive in many cases.



The one thing that many of the furnaces suffer from most is lack of use. The furnace sits in your motorhome for extended periods not being used and then one day you need it. You switch it on and to your amazement it will not work. Damp winter days and nights have probably caused some vital part or other to corrode. Also damp on the electrics will play its part in causing a fault the moment power is applied. Run it regularly, even in the summer, and you will probably find that it will work when you want it to.

How your furnace works

The heating furnace is essentially a metal box within which is a LP gas fired burner in a sealed combustion chamber. A fan draws air in from outside the RV and forces it through the combustion chamber and heat exchanger, collecting the burnt gas on the way, and then exits outside the RV. A larger fan driven by the same motor as the combustion fan draws air from inside the RV and forces it around the outside of the heat exchanger and back



Typical electrical connections of the components in a Suburban furnace

into the motorhome. The warm air is distributed throughout the interior by means of flexible ducting and vents mounted in the bottom of cabinets and other fittings or through vents in the floor. The heater is controlled by a wall mounted switch and thermostat which switches on the control electronics for the motor and gas burner. There are also a number of safety devices built in to prevent fire or an explosion.

Today's heating furnaces are made of a variety of components - and safety devices - that are virtually universal to all models. The only difference that you might find would be in the sequence of the components and minor differences in the way they control the furnace.

Operating Sequence

The modern warm air furnace is usually controlled by a wall-mounted thermostat and integral on-off switch. The thermostat is actually a heat-sensitive switch that 'tells' the boiler when to produce heat, based on room temperature, and can easily be set to the temperature required. Basically it operates in exactly the same way as a domestic central heating thermostat.

The heat sensitive coil in the thermostat is a bimetallic strip. As the interior temperature of the RV changes, the two metals expand and contract at different rates and the switch contacts open and close as required. As the air cools, the coil contracts and the switch closes. As the air heats up the coil expands and at the required setting the switch contacts are opened. There is, however, an overlap in temperature between closing and opening which can sometimes be quite a few degrees. One minute you feel cold and the next you are too warm but unfortunately this is the way thermostats work. This problem can be reduced by heating the air near the thermostat coil artificially. This will cause the switch to open earlier and hence switch off the heater before the air temperature has reached the desired setting.

The device which heats the thermostat coil is called an anticipator and its purpose is to provide an adjustment on the cycle time of the furnace. The anticipator is a tiny wire that is located directly behind the coil of the thermostat. The wire has a high electrical resistance and heats up when an electric current flows through it. The effective length of the wire is adjustable, which will change its resistance and hence the amount of heat produced. When the thermostat calls for heat, the anticipator starts to heat up. This provides a small amount of `false heat' for the thermostat, the amount being controlled by adjusting the length of the anticipator. Longer anticipator wire provides more heat and opens the thermostat sooner. Shorter anticipator wire gives less heat and allows the thermostat to stay closed longer.

If there is a short circuit in the furnace wiring the anticipator may burn out and then the thermostat will not be able to switch on to allow the furnace to start up. Care should be exercised when checking the wiring with an electrical tester to make sure that the thermostat wiring is not shorted across at the furnace control panel.

If the anticipator does burn out then a new thermostat will probably have to be fitted.

Delay Relay

The closing of the thermostat switch activates a time-delay relay in the furnace which controls the fan motor. The relay switches on the motor after a delay of about 10-20 seconds after the thermostat switch has closed. The delay in starting the motor is part of the sequenced start up of the furnace.

The delay relay has two internal circuits; one is the relay coil to earth (negative), which is energised when the thermostat switch has closed. The second circuit is a switch that closes after the delay. This time-delay relay also allows the fan motor to run for about one minute after the thermostat switch has opened and the burner has switched off. The extended time for the fan motor ensures that the combustion chamber and heat exchanger is cooled down before the next heating cycle. A defective or poorly earthed time-delay will prevent the motor from starting.

Sail Switch

The sail switch is a micro-switch with a small piece of metal attached to the actuator and is the first of the safety devices which control the ignition control board. The fan motor requires a minimum voltage of approximately 10.5 volts in order to turn fast enough to force the air past the sail switch at a sufficient speed to operate the switch. This switch is a safety device to prevent the ignition cycle from starting when the motor is not turning fast enough. The fan must turn fast enough to provide the right flow of air for complete combustion; failure of this process could subject RV occupants to carbon-monoxide poisoning. RV owners sometimes think the boiler has failed when in actual fact low batteries are the culprit.

Over Heat or Limit Switch

The other component prior to the ignition control board is the over heat or high temperature limit switch. This is a temperature activated switch that is normally closed when the furnace is operating correctly. If, however, the combustion chamber gets excessively hot, it will shut off power to the ignition circuit board. The gas valve will close and the heating cycle will cease, leaving the fan to run. This switch automatically resets when the boiler temperature has cooled to a preset level. The limit switch is designed to operate as a safety device only, and if malfunctions cause it to open and close several times in one burn cycle, failure may result.

Ignition Control Board

As soon as the sail switch closes and providing that the limit switch is also closed the power then reaches the ignition control board, which controls the gas burner. Before ignition takes place there will be another 10 to 20-second delay to allow the combustion chamber fan to purge the chamber of any unburned vapours to prevent the furnace from starting with a bang.

After the delay, the circuit board will provide the high-voltage ignition spark and open the gas valve. Then the flame sensor will monitor the flame and allow the gas valve to be kept open as long as it senses a flame. When the thermostat switches off the gas valve closes immediately leaving the fan motor to run for about a minute to cool down the combustion chamber before the ignition cycle.

NEXT MONTH
PART 2 - FAULT FINDING