

# SUBURBAN RV GAS FURNACE

## HOW IT WORKS AND HOW TO MAINTAIN IT

### PART 2 FAULT FINDING

Last month, in part 1, we described the workings of the Suburban heating furnace and this month we will give some tips on fault finding. But please remember that if you are not confident in tackling this work please call in someone who is.

#### Operating Sequence

Firstly a quick resume of how the operating sequence of the Suburban heating furnace.

The furnace is controlled by a wall-mounted thermostat and integral on-off switch. When the switch is moved to the on position and the thermostat is calling for heat power (12 volts) is supplied to a delay relay inside the furnace enclosure. This relay controls the starting and stopping of the fan motor. After a delay of about 10-20 seconds the motor starts.

A micro-switch, called a sail switch, is operated by the air movement from the fan once it attains operating speed. If however the battery is low then the fan motor will not turn fast enough to create enough air movement to operate this switch.

The next component in the circuit is the over heat limit switch which is normally closed unless the heat exchanger has overheated or the switch is faulty.

As soon as the sail switch closes and providing that the limit switch is also closed the power (12 volts) 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.

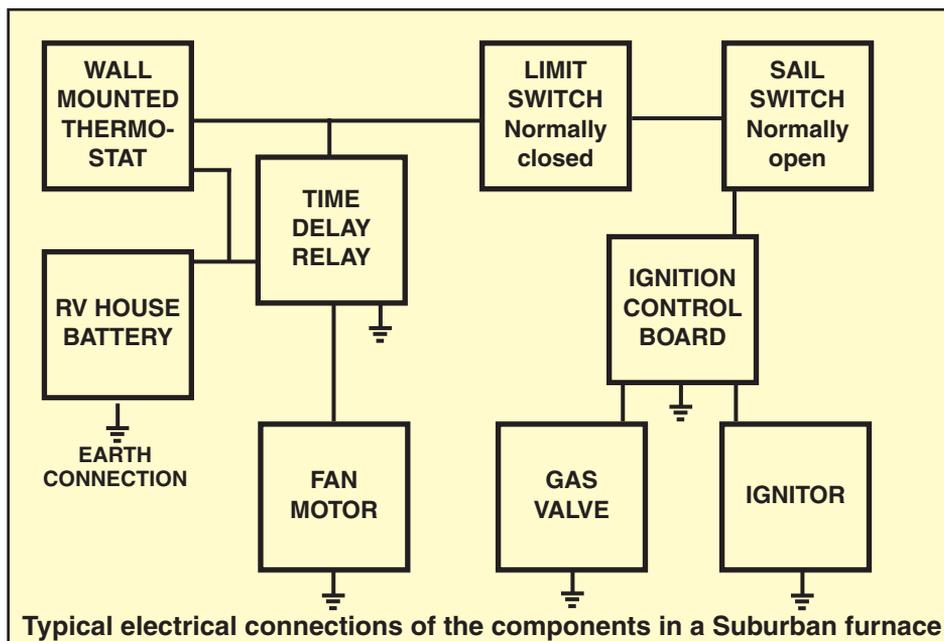
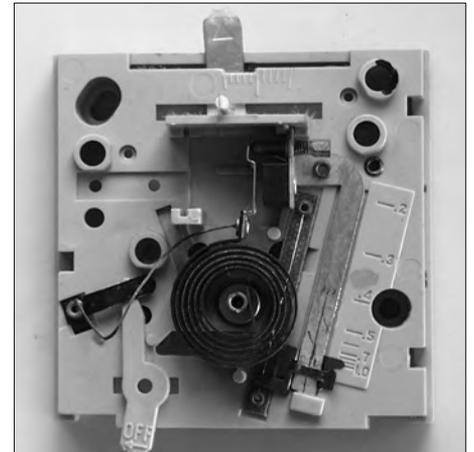
#### Fault Finding

When it works it is great but what can you do when it fails.

A motorhome furnace has two basic wiring circuits (see diagram below). One circuit controls the fan motor, and the second controls the ignition and gas valve. Both of these circuits are controlled by the thermostat switch.

#### Wall-mounted thermostat

The first item to check if the furnace appears completely dead is the wall-mounted thermostat. Make sure that the thermostat has power to it and if not check the 12 volt supply fuse. Next check that thermostat switch is closed, and the on-off switch is in the ON position. You can check this visually first and then use a continuity tester across the two connecting terminals.



Typical electrical connections of the components in a Suburban furnace

The on/off switch is simply a small strip of metal which springs down against a contact when the switch is moved to the on position. During periods when the motorhome is not being used and particularly when the air is moist the contacts become corroded and may need cleaning. The contacts that form the thermostat switch can also become corroded over a period of inactivity. If you need to clean these contacts do so with care otherwise you may permanently damage them permanently. You can check the operation of the bi-metal coil by gently blowing on it. The contacts should spring open almost immediately when warmed.

The other items to check is the thin wire of the anticipator and the adjuster which slides up a metal strip alongside the wire. Both can be checked visually or if necessary with a continuity tester. Finally check across the thermostat terminals with a continuity tester and operate the

on/off switch and the main thermostat switch to see if all is well. You will notice that the main thermostat switch has a screw adjuster but this usually does not need to be touched as it is factory set. However if there is a major discrepancy between the setting of the thermostat and the temperature reading on the built in temperature gauge then it can be carefully reset.

## THE FURNACE

If your furnace has an outside access cover then the next tests can be performed from the outside. However, if not then the furnace will have to be taken out and tested on the bench.

### Time Delay Relay

The next place to check for power when the furnace fails to operate is at the time-delay relay. This relay has four contacts. When the furnace is in the OFF position, one of the terminals of the time-delay relay should have 12 volts DC present. This terminal will provide power to the motor when the relay activates after the preset delay.

Once the thermostat has switched on, two terminals on the relay should be live with 12-volts. After approximately 20

seconds, the third terminal, the motor terminal, should become live. When using a voltage meter or a test light on the time-delay relay be very careful not to short the terminals directly to each other. If you short the terminal that is connected to the motor with the one that brings power from the thermostat you may well burn out the thermostat anticipator wire.

If the relay operates correctly and the motor terminal becomes live but there is still no fan operation, the motor or the wiring to it could be the problem. Use a voltage meter to check for 12 volts DC across the motor terminals. If there is 12 volts on both of these wires, you have an earthing problem. There must be no voltage present in the wire (negative) coming back from the motor; it's an earth wire. If this wiring checks out, the motor or wiring is faulty. There's no real need then to check the circuit-board side of the wiring if there is no fan operation because it is not switched on until the sail switch operates and the limit switch (overheat) is closed.

### Sail Switch and Over-heat Limit Switch

The components on the second circuit will have to be checked if the fan operates, but the furnace does not light up. There are

two components that control the supply of 12 volts to the ignition circuit board; the limit switch (overheat) and sail switch. You will know that sail switch has closed if you hear the igniter sparking for

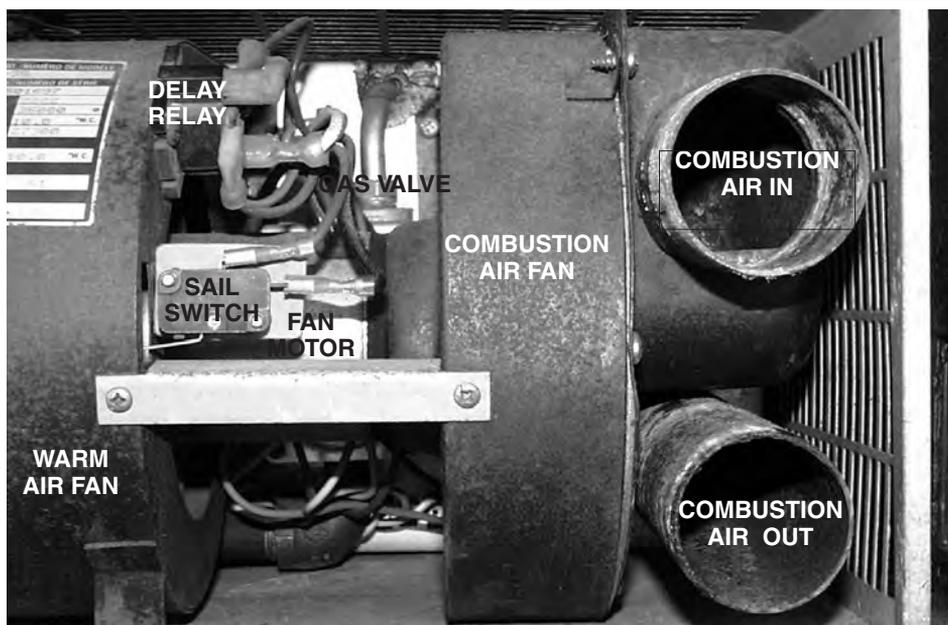


about six seconds after a delay of about 20 seconds from when the fan starts. If the ignition cycle does not start then it may mean that either the sail switch or limit switch, or both, are defective. If they are not then the ignition control board may be defective and will need replacing.

For the sail switch to operate, the fan must reach about 70 per cent of normal operating speed. Low battery voltage will cause the motor to run slower and there will not be enough air movement to operate the switch. For the motor to achieve normal running speed the battery voltage must be 10.5 volts or more. It is, however, recommended that you ensure that the batteries are fully charged when you are fault finding the furnace.

The motor should be in good operating order and free running. Check that the fans are not catching on the casings and that you remove any loose objects such as leaves etc which obstruct them. The motor shaft can become corroded after a period of time and may cause binding of the motor shaft bushings. Defective or tight bushings can reduce the speed of the motor, which will mean that there will not be enough air movement to operate the sail switch.

If the motor is running at full operating speed and still the furnace will not light up then the sail switch might be faulty. First check that the sail is not bent or catching on the frame of the furnace. Second check the continuity of the switch whilst operating the sail manually. If all is well then the other component to check is the limit switch (overheat). This is a temperature activated switch that is normally closed but opens when the furnace combustion chamber gets excessively hot. This switch should reset when the furnace temperature has cooled to a preset level. As it is designed to operate purely as a safety device it may fail if malfunctions of the furnace cause it to open and close several times in a burn cycle. Check the switch with a



continuity tester. Finally check that there are no obstructions to the intake air grill inside the motorhome and that all the outlet ductings and grills are free of obstructions such as carpet over floor grills.

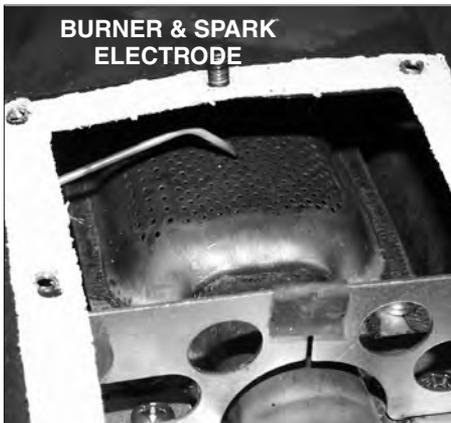
## Ignition Control Board

The ignition control circuit board controls the igniter and gas valve and monitors the burner flame. If this board fails it will need replacing as there is little or nothing that can be done to repair it.



There are several problems associated with the ignition control board. First, the circuit board could be receiving power, but fail to provide a spark and or open the gas valve. Next, the board could be producing a spark but this occurs at somewhere else other than at the burner; the burner or igniter alignment could be off and may need realigning, or the spark wire on the igniter ceramic could be faulty. The third function of the circuit board is to monitor the flame at the burner. If the burner does not light within a preset time, or if the burner goes out, the ignition sequence will stop immediately.

Once the ignition sequence starts you should be able to hear the spark and then the gas valve should open and the burner light up. The spark will be maintained for about six seconds and if the burner has not lit within that time the circuit board will shut down or go into lockout with the fan still running.



## Gas Valve and LPG Problems

Other problems which may cause the circuit board to go into lockout are the failure of the gas valve and either no gas, or air in the pipework. The failure of the gas valve may simply be caused by a bad earth connection or the actual failure of the operating coil which can be checked with a continuity tester. If the valve has failed it will need replacing. The other cause of no gas, or air in the pipework, can be caused by leaving the motorhome for periods of time with the gas turned off. An easy and reasonably safe way to clear the regulator and pipework of air is to light the gas hob first. The furnace may have to be cycled two or three times before it will light up when there is air in the pipework. If you do have to make several attempts to fire up the furnace it is best to switch it off after each attempt and allow it to recycle properly.

## Other Problems

Whilst many of the furnace failures relate to the burner not lighting, there is another problem that is quite prevalent. This is a sequence called 'cycling on the limit switch'. Firstly, the burner will switch off before the thermostat switch opens because the limit (overheat) switch has opened. The limit switch will then be cooled down as the fan continues to run, and it will again allow the burner to ignite. This sequence may happen many times before the furnace generates enough heat to cause the thermostat to switch off.

There are two likely causes of this problem. The first is that the return air vent of the furnace is blocked. Most furnace installations will have a louvred air inlet that allows the air to return from inside the motorhome to be reheated. If this return airflow is blocked, even partially, the combustion chamber will become overheated. Make sure that you do not use the area alongside the furnace as a place to store bags, wrapping materials, etc. Also ensure that the return air vent is free of debris, such as pet hair.

Poor ducting is another possible cause if the furnace cannot adequately move the heated air. A typical furnace requires one square inch of free ducting for every 10,000 BTUs of furnace capacity. Therefore a 28,000 BTU furnace would require approximately three 4-inch-round ducts. If there are excessive bends in the routing of the ducting, or if there are closable dampers in the line, the furnace can overheat. Throw rugs and other items that are placed over the top of floor registers, or floor registers that are closed, can cause overheating and cycling of the limit switch. In that situation, the motorhome will take a lot longer than normal to heat up and the limit switch can fail prematurely due to excessive cycling.

You should by now see that you don't have to be a technician to identify potential problems, but you do need to have the right skills to make the repairs. Unless you have the experience, leave furnace repairs to the experts. Since you already know that your furnace won't fail in hot weather, take the time at the end of the summer to make sure it's in good working order. If it is not, then get it fixed before the weather gets colder and you really need it to work.

