CONDENSING GAS FURNACES

By: Heil-Quaker Corporation

INTRODUCTION

A condensing furnace is designed to utilize the latent heat of the flue gases, by condensing the moisture in these gases. This is possible because the flue gases are collected and piped back through a secondary heat exchanger or condensing coil, which is mounted directly over the discharge of the blower.

For generations, manufacturers have researched and designed higher efficiency gas furnaces to meet the needs of the buying public. As a 60 plus AFUE furnace of the 1960's evolved into the 70 plus AFUE range, our industry has tried to offer the customer the best buy for his dollar. As efficiency needs continued to rise, vent dampers and later induced draft systems became industry standards. These models were in the 80 plus AFUE range. We can now offer a furnace with an AFUE of over 90.

In 1979, the Federal Trade Commission (FTC) introduced a system which allows consumers to make direct efficiency comparisons between different furnace products and brands. Similar to the "Estimated MPG" system for automobiles, furnace manufacturer's now must provide consumers with an "Annual Fuel Utilization Efficiency" rating or AFUE number. The number presented by the manufacturer is determined by testing the furnace according to rigid procedures established by the Department of Energy. The higher the rating number, the more efficient the heating system.

The gas heating industry has undergone some major changes since the early days of gas heating and especially in the last few years. Gas ignition systems are changing from standing pilot to spark ignition systems. Venting methods and the temperature rise over the heat exchangers are also undergoing some changes. The basic fundamentals of combustion principles, however, have not changed.

The condensing furnace is designed to remove both sensible and latent heat from the combustion flue gases. At a first glance, the appearance and operation of the condensing furnace may seem complicated, but the main difference is simply that there are two heat exchangers used. The flue gases pass through the primary heat exchanger as in any standard furnace, until leaving the heat exchanger cells. A baffle plate is installed at the leaving end of the primary heat exchanger. The induced draft blower motor pulls the hot flue gases out of the first heat exchanger and then through the secondary heat exchanger.

The secondary heat exchanger is located directly over the indoor blower. As the cooler air from the blower is passed over the secondary heat exchanger, the hot flue combustion gases are cooled, dissipating more heat into the conditioned space. As the hot flue gases are cooled down below the dew point, condensation begins inside the secondary stainless steel heat exchanger. This condensate water drains from the secondary heat exchanger and out of the unit into a trap. It then travels through a neutralizer to a floor drain or condensate pump.

The condensing furnace operates with much lower vent temperatures. This is because we are using two heat exchangers, as discussed earlier.

The sizing of vent systems is critical in today's replacement market, mainly because many homes and businesses have added insulation and storm windows to help cut down the energy cost of operation. Keep in mind that many furnace

installations of the past were oversized. Some, if not many installations, will have oversized venting systems which will result in condensate forming on the flue vent system. Undersized vents may have operated for years with little or no spillage problems.

The application, installation and maintenance of condensing furnaces must be adhered to if the purchaser is to receive the full benefits of the improved design.

SEQUENCE OF OPERATION

The operation incorporates an induced draft blower and motor for controlled air flow for proper combustion. In addition to the spark ignition system, the furnace also is equipped with a negative pressure switch and blower motor relay as a safety feature to prove proper combustion air flow, prior to main burner operation.

Furnace operation is simple and easy to service. As the thermostat calls for heat, the following sequence takes place:

1. Thermostat calls for heat and completes a circuit to the individual blower relay.

2. Induced draft blower relay is energized, completing a circuit to the draft induced blower motor.

3. The induced draft blower starts and builds up a negative pressure in the blower housing.

4. The negative pressure switch senses this air flow and through a tube which is attached to the draft induced blower housing makes a set of contacts inside the pressure switch when the proper pressure is sensed, completing a circuit to the ignition system.

5. This completes the circuit to the gas control and ignition takes place.

6. When the thermostat is satisfied, the induced draft blower relay is de-energized. This also de-energizes the spark ignition system and gas control.

Be especially careful when a replacement part is required, to install the proper part. As an example: The negative pressure switch may look exactly the same as another switch, but could have a different set of points. Always use an exact replacement or verify a substitution with the furnace parts list. A parts list is packed with each furnace.

Overfiring of an induced draft furnace because of oversized orifices or excessive manifold gas pressure will cause the furnace to cycle on the negative pressure switch. Check to insure that only approved venting systems are installed to avoid nuisance call backs.

The addition of an induced draft blower relay may require a higher heat anticipator setting in some models. Be sure to check the gas control instruction or measure the current amp draw from “R” to “W” for the correct setting.

With the wide variety of equipment on the market today, and further changes anticipated, no attempt will be made in this section to give installation instructions. These must come from the specific manufacturer of the equipment you may be installing. Additionally, although the information given here is intended to be as “generic” as possible, always check with information made available by the specific manufacturer of the equipment you are working on; those instructions must take precedence in all cases.

START-UP PROCEDURE

On a new installation or if a major part such as the gas valve, pressure switch or fan/limit control has been replaced, the operation of the furnace must be checked.

Check the furnace operation as outlined in the following instructions. If any sparking, odors or unusual noises are encountered, shut off electric power immediately. Recheck for wiring errors, or obstructions in or near the blower motors.

DANGER OF EXPLOSION OR FIRE

LIQUEFIED PETROLEUM (LP) GAS IS HEAVIER THAN AIR AND IT WILL SETTLE IN ANY LOW AREA, INCLUDING OPEN DEPRESSIONS AND IT WILL REMAIN THERE UNLESS AREA IS VENTILATED.

NEVER ATTEMPT STARTUP OF UNIT BEFORE THOROUGHLY VENTILATING AREA.

START THE FURNACE

Start the furnace using the procedures in the Owners Information Manual and perform the following checks and adjustments.

CHECK GAS INPUT AND PRESSURES

For furnace located at altitudes between sea level and 2000 feet, the measured input must not be greater than the input shown on the rating plate of the furnace. For elevations above 2000 feet, the measured input must not exceed the input on the rating plate reduced by 4 percent for each 1000 feet that the furnace is above sea level.

Gas supply pressure and manifold pressure with the burners operating must also be as specified on the rating plate.

Type of Gas	Manifold Pressure, In. W.C.
Natural	3.5
L.P.	10

Rated input will be obtained on 2500 Btu propane at 10” manifold pressure with factory-sized orifices. If LP gas having a different heating value is supplied, orifices must be changed by a licensed liquefied petroleum gas installer before the furnace is operated.

CHECK THE MANIFOLD GAS PRESSURE

A tapped opening is provided in the gas valve to facilitate measuring the manifold gas pressure. A “U Tube” manometer having a scale range from 0 to 12 inches of water should be used for this measurement. The manifold pressure must be measured with the burner and pilot operating.

To adjust the pressure regulator, remove adjustment screw or cover on top of Gas Valve (labeled “Hi” on some valves) turn out (counterclockwise) to decrease pressure, turn in (clockwise) to increase pressure. Only small variations in gas flow should be made by means of the gas pressure regulator adjustment. In no case should the final manifold pressure vary more than plus or minus 0.3 inches water column from the above specified pressures. Any major changes in the flow should be made by changing the size of the burner orifice.

CHECK THE GAS INPUT (NATURAL GAS ONLY)

To measure the input using the gas meter proceed as follows:

1. Turn off gas supply to all other appliances except the furnace.

2. With the furnace operating, time the smallest dial on the meter for one complete revolution. If this is a 2 cubic foot dial, divide the seconds by 2; if it is a 1 cubic foot dial, use the time in seconds as is. This gives the seconds per cubic foot of gas being delivered to the furnace.

3. **Example:**

   Natural gas with a heating value of 1000 Btu per cubic foot and 34 seconds per cubic foot as determined by step (2), then:

   Input = 1000 ×3600 ÷ 34 = 106, 000 Btu per hour

Btu content of gas should be obtained from gas supplier.

This measured input must not be greater than the input indicated on the rating plate of the furnace.

4. Relight all other appliances turned off in step 1 above. Be sure all pilot burners are operating.

PRIMARY AIR ADJUSTMENT

If the burners are not equipped with Air Shutters, no adjustment is necessary. Adjustment of the air shutter may be necessary to obtain the correct flame characteristics and/or to minimize resonance heat exchanger noise generated by the burner flame.

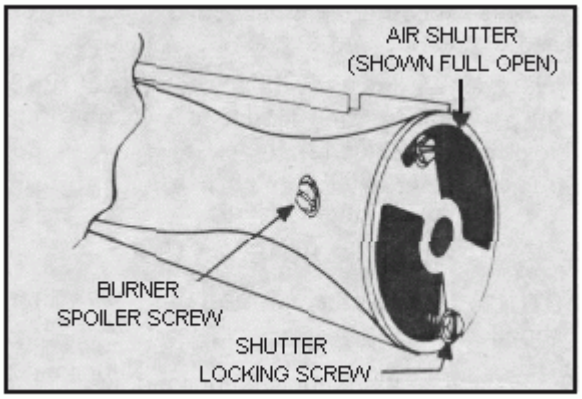

Figure 2

Spoiler Screw/Air Shutter

a. Check air shutter position - should be full open.

b. Start the furnace; See lighting instructions on furnace or in the Owners Information Manual.

c. Allow furnace to run for 10 minutes then check flame characteristics;

d. To adjust - Loosen shutter locking screw(s) and close shutter until flame has a yellow tip then open just enough to eliminate yellow tip, tighten locking screws.

e. If resonance noise occurs - close the air shutters just enough to permit the slightest amount possible of yellow tip in the flame, tighten locking screws.

A burner spoiler screw may be added for extreme cases of resonance noise which can not be held to an acceptable level by air shutter adjustment.

f. Install a #8× 1” long sheet metal screw in the side of the burner, Figure 2. A pilot hole for the screw is already in the burner. Install screw only far enough into the burner to be effective in conjunction with the air shutter to obtain acceptable flame characteristics and noise level. Repeat adjustment as necessary using combination of spoiler screw and air shutter to obtain proper flame characteristics and acceptable noise level. Check to insure that adjustment has not caused any sooting. Tighten air shutter locking screws.

g. Apply high temperature silicone sealant (500° F) to spoiler screw/burner to retain in adjusted position.

ADJUST PILOT BURNER

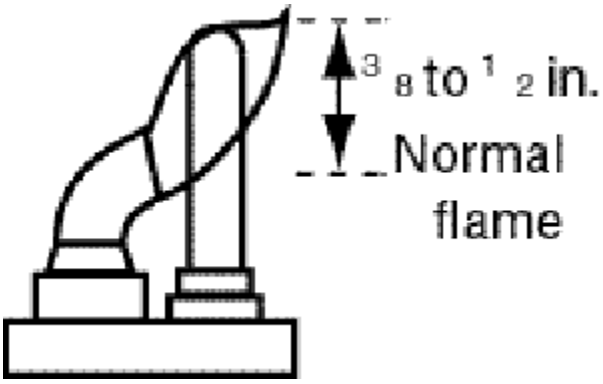

Figure 3 – Pilot Flame Adjustment

The furnace has an intermittent pilot. The flames should surround 3/8 “ to ½ “ of the ignitor/sensor tip (Figure 3). To adjust, remove cap or

screw from pilot adjusting screw on gas valve. Turn screw counterclockwise to increase or clockwise to decrease flame as required. Replace cap for adjusting screw. Pilot flame should be inspected monthly.

CHECK LIMIT AND FAN CONTROL

Check Limit Control function after 15 minutes of operation by blocking the return air grille(s).

1. After several minutes the main burners must go OFF. Blower will continue to run.

2. Remove air restrictions and main burner will relight after a cool down period of a few minutes.

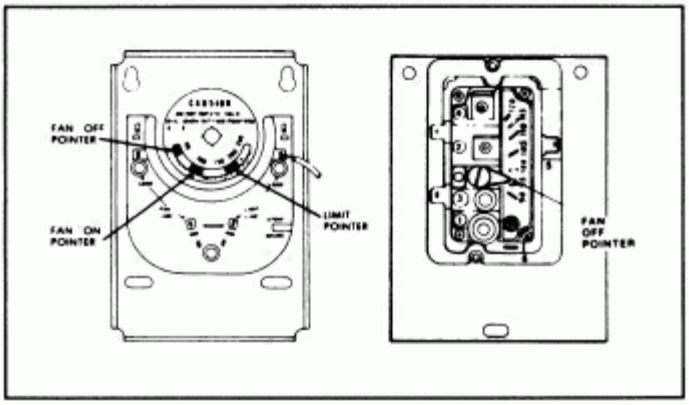

FIGURE 4

Fan/Limit Control

Adjust the thermostat setting below room temperature.

1. Main burners must go off.

2. Circulating Air Blower should continue to run briefly until supply air temperature drops to approximately 100° -90° .

Fan limit controls are preset at the factory. (Figure 4) The control is set for the fan to go off at 100° -90° .

If necessary, adjust fan OFF setting to obtain a satisfactory comfort level.
DANGER OF FIRE—THE LIMIT CONTROL IS FACTORY PRESET AND MUST NOT BE ADJUSTED.

CHECK TEMPERATURE RISE

Check temperature rise through the unit by placing thermometers in supply and return air registers as close to the furnace as possible.

1. All registers and duct dampers must be open and the unit should be operated for 15 minutes before taking readings.

2. It must be within the range specified on the rating plate.

Air temperature rise is the temperature difference be

With a properly designed system, the proper amount of temperature rise will normally be obtained when the unit is operating at rated input with the recommended blower speed.

If the correct amount of temperature rise is not obtained, it may be necessary to change the blower speed. A higher blower speed will lower the temperature rise. A slower blower speed will increase the temperature rise.

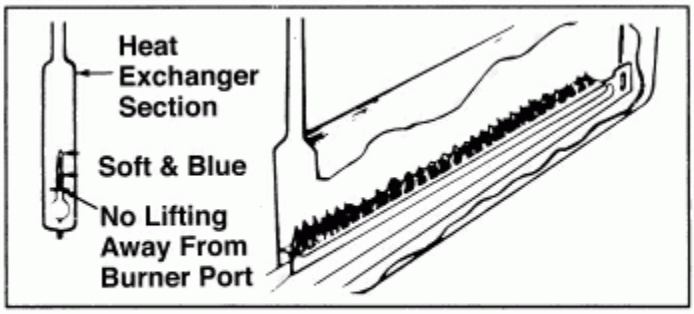

FIGURE 5

Main Burner Flame

Blower speed must be set to give the correct air temperature rise through the furnace as marked on the rating plate.

CHECK BLOWING SPEEDS

See manufacturer's information for blower performance chart.

DANGER OF ELECTRICAL SHOCK, BODILY INJURY OR DEATH IF ELECTRIC POWER IS NOT TURNED OFF BEFORE CHANGING SPEED TAPS.

If necessary to change the circulating air blower speed, the terminal block in the furnace junction box makes this a simple operation. The yellow wire is connected to the speed tap for heating. The violet wire is connected to the HI speed tap for cooling. Unplug and connect to desired speed tap.

If you must use the same speed tap for both heating and cooling, install a duplex spade terminal adapter on the motor speed tap to connect both yellow and violet wires or strip the yellow lead to expose bare wire about 1 ½ inches back from the terminal. Remove the terminal from the violet lead and strip ¾ inch from end. Twist this wire around exposed yellow wire several times. Solder and tape. Connect to the speed tap desired.

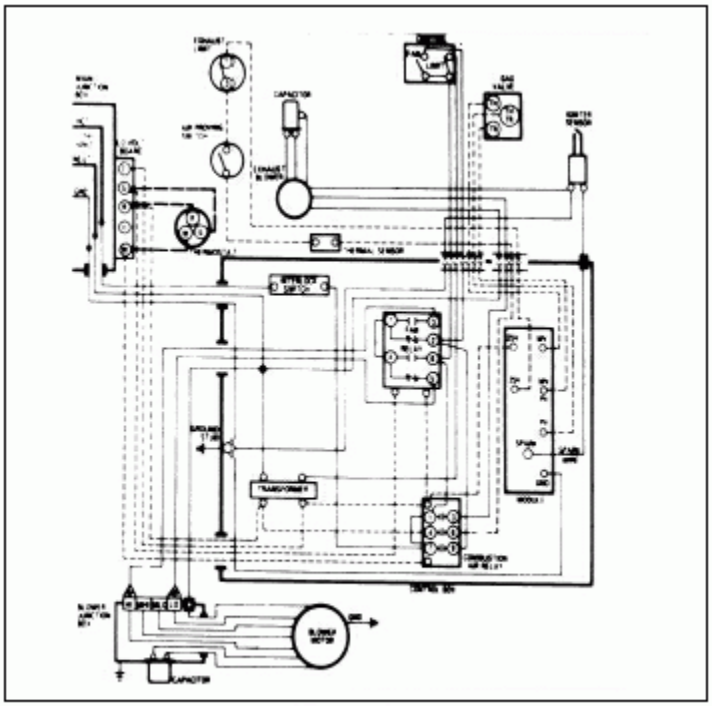

Figure 6

CHECK MAIN BURNER FLAME

Flames should be stable, soft and blue, (dust may cause orange tips or they may have wisps of yellow, but they must not have solid yellow tips). See Figure 5. They should extend directly upward from burner without curling, floating or lifting off. They must not touch the sides of the heat exchanger. Main burner flame should be inspected monthly.

DANGER OF ELECTRICAL SHOCK, BODILY INJURY OR DEATH.

The following tests involve working with and testing high voltage circuits.

SERVICE

ELECTRICAL RELAY CHECKS

COMBUSTION AIR RELAY

See Figure 6. Turn thermostat on call for heat.

Check for high voltage to combustion air relay by touching volt meter negative lead to ground stud and positive lead to #7 and then #1 terminals. Interlock switch must be closed.

If you do not have voltage: Check voltage to main junction box. Check circuit breakers/fuses.

Check that interlock switch is closed and not defective. Check continuity of electrical wiring.

Check for voltage at combustion air relay by touching positive lead of volt meter to #9 and then #3 terminals. If you do not have voltage at these points on relay, check low voltage circuit and relay coil (Coil must "pull in" to close the normally open contacts of the combustion air relay.)

Check low voltage to relay by checking at #4 terminal.

Check #6 terminal to determine if contact is closed.

FAN RELAY (HEATING)

Turn thermostat on call for heat.

Touch negative lead of volt meter to ground stud.

Touch positive lead of volt meter to #5 terminal, #4 terminal, #1 terminal, and #2 terminal of fan relay. You should have line voltage at all of these points.

If you have line voltage at #2 terminal but not at #1, #4 and #5 terminals fan relay is defective. If you do not have line voltage at #2 terminal check combustion air relay and continuity of wiring.

FAN RELAY (COOLING OR CONTINUOUS FAN OPERATION)

Set thermostat on call for cooling or continuous fan operation.

The fan relay coils should now be pulled in if thermostat is set for cooling or continuous fan. If not check low voltage circuit and relay coil.

If fan relay coil is pulled in, connect negative lead of volt meter to ground stud. Touch positive lead of volt meter to #6 terminal, #4 terminal, #1 terminal and #3 terminal of fan relay. You should have line voltage at all of these points.

If you have line voltage at #6 terminal but not #4, #1, and #3 terminal, fan relay is defective. If you do not have line voltage at #6 terminal, check interlock switch, continuity of wiring and electrical supply power.

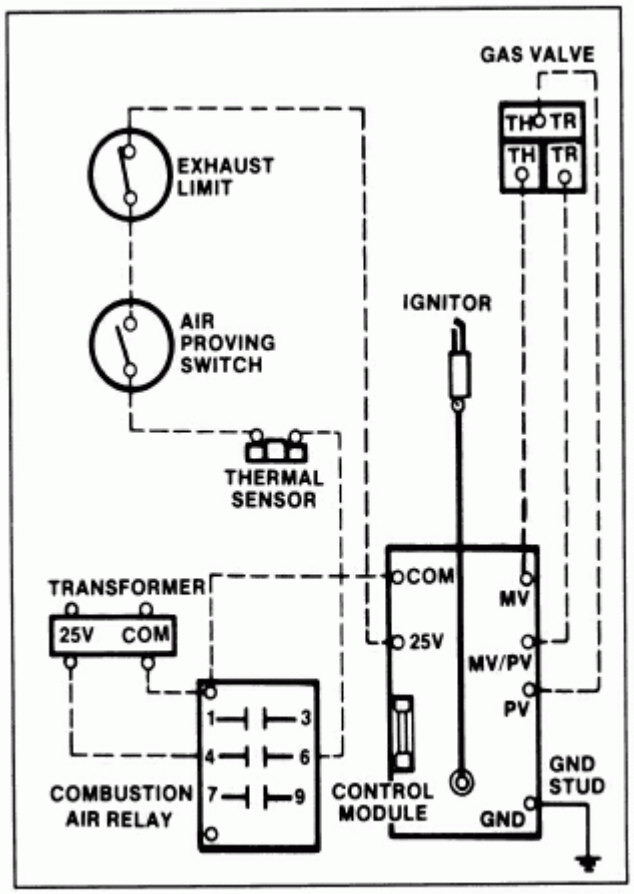

Figure 7

Typical Ignition System Wiring

HONEYWELL SPARK TO PILOT(S86F) NATURAL GAS IGNITION SYSTEM

The Honeywell S86F control module is for use with NATURAL GAS only. Do not use on LP Gas applications. With this control, gas will continue to flow to the pilot and sparking will continue until call for heat from the thermostat ends.

The “Typical Ignition System Wiring” (Figure 7) is for illustrative purposes only. Follow the wiring diagram supplied with your furnace.

SUPPLY GAS PRESSURE TO VALVE

Check gas inlet pressure to gas valve. Inlet pressure to valve must be a minimum of 4.5 in. w.c. with all other gas appliances fired.

DANGER OF EXPLOSION, FIRE, PERSONAL INJURY OR DEA

Before testing or working on the furnace, turn off the gas supply at the manual shut-off valve leading to the furnace.

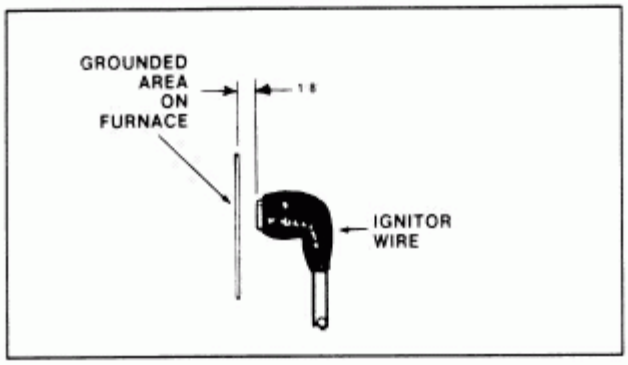

Figure 8

ELECTRICAL POWER TO FURNACE

Check fuse or circuit breakers to make sure they are not blown or tripped.

FURNACE ELEVRICAL GROUND

Furnace may not operate at all or operate intermittently if furnace is not properly grounded.

THERMOSTAT

A careful check of the thermostat and wiring must be made to insure that the thermostat is operating properly, no wires are broken and that the heat anticipator is not burned out and is set to specifications.

TRANSFORMER

With power on to furnace and thermostat calling for heat, check transformer low voltage side for minimum of 25 volts a.c. Replace transformer if below minimum output voltage is obtained.

VOLTAGE TO CONTROL MODULE (WITH EXHAUST BLOWER OPERATING)

Using a volt meter check for minimum voltage (24 volts) across the 25V (COM) and 25V, terminals of control module. If you do not have voltage to module, check voltage output from transformer, combustion air relay, thermal sensor, air proving switch and exhaust limit switch. Check for continuity of wiring and corroded leads. If any parts prove to be defective they must be replaced. Electrical leads must be clean, tight and defective wiring replaced.

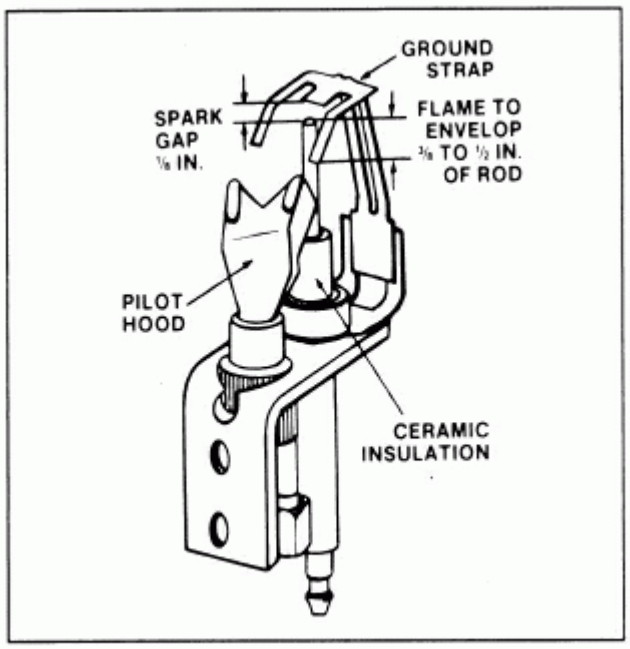

Figure 9

NO SPARKING ACROSS IGNITOR/SENSOR GAP

MANUALLY TURN OFF GAS SUPPLY AT MANUAL SHUT OFF VALVE.

DANGER OF SHOCK OR ELECTROCUTION

If you touch the high voltage terminals or the ignition cable end with electrical system on.

Remove ignition cable end from pilot ignitor/sensor. (Figure 8) Hold tip of cable 1/8 in. from a grounded area of the furnace using an insulated tool such as a fuse puller. Turn furnace on call for heat and observe spark.

If you do not have sparking across gap, check continuity of fuse. Replace fuse if blown, with same type of fuse as removed. Shorting across gas valve terminals will blow fuse. Do not use a fuse of a higher value, or control module can be destroyed. If you still do not have sparking, check continuity of ignition cable. Replace lead if you measure 5 ohms or more resistance using the R x 1 scale of an ohm meter.

Control module ground must be clean and free of corrosion. Replace control module if you do not have sparking across the 1/8 in. gap or if sparking appears weak.

Control module and pilot assembly must be grounded. Carefully check ground wiring and contact areas. If ground is poor or erratic, shutdown may occur even though operation is normal at time of the checkout. (Figure 9)

IGNITION CABLE

Carefully inspect ignition cable. Faulty ignition cable can cause shutdown, erratic firing, intermittent shutdown and continual sparking after pilot has fired.

CERAMIC INSULATOR

Insulator must not be cracked; if it is, replace pilot assembly. Keep ceramic clean. A cracked or dirty insulator can cause the high voltage spark to leak to ground and intermittent firing or possibly no firing across the gap can occur.

SPARK GAP

Spark gap must be adjusted to 1/8 in. between ignitor/ sensor electrode and ground strap.

PILOT FLAME

Pilot flame must envelop 3/8 in. to 1/2 in. of ignitor/sensor electrode.

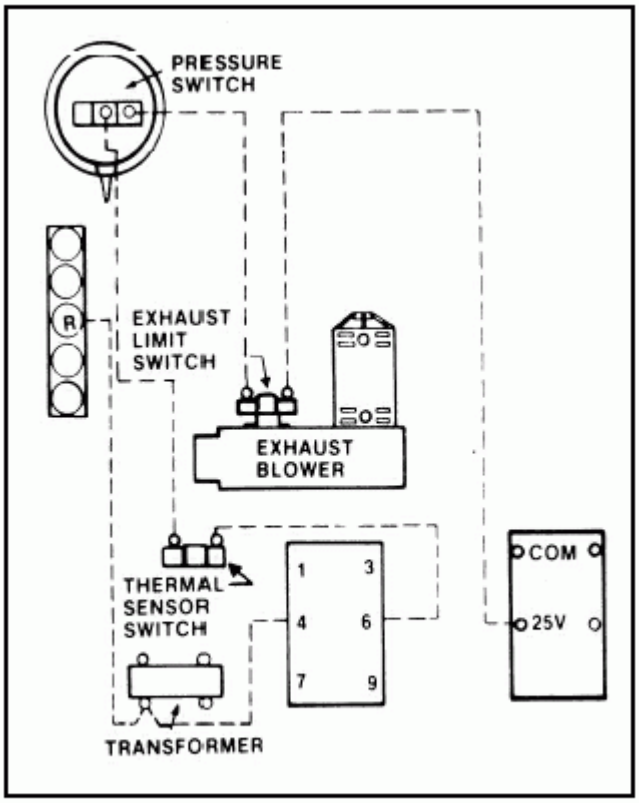

Figure 10

TURN FAS SUPPLY ON

DANGER OF EXPLOSION, FIRE, PERSONAL INJURY AND/OR DEATH

After turning gas supply on; check each joint with a soapy solution. If any leaks are detected, they must be repaired immediately.

Wait five minutes between each trial for ignition with combustion blower operating. This time will allow the gas to be vented out of the furnace.

GAS SUPPLY ON, PILOT BURNER DOES NOT LIGHT

Check all manual gas cocks to make sure they are open. Check supply lines, tubing and pressures. Check pilot burner orifice to make sure it is not blocked.

Check electrical connections and wiring between control module and pilot operator on gas valve. Using volt meter check for 25 volts a.c. across PV-MV/PV terminals on control module. If you do not have voltage across these two terminals with power on to control module, module is defective and must be replaced. If you have voltage and wiring is okay, check gas valve operation. If found to be defective, replace gas valve.

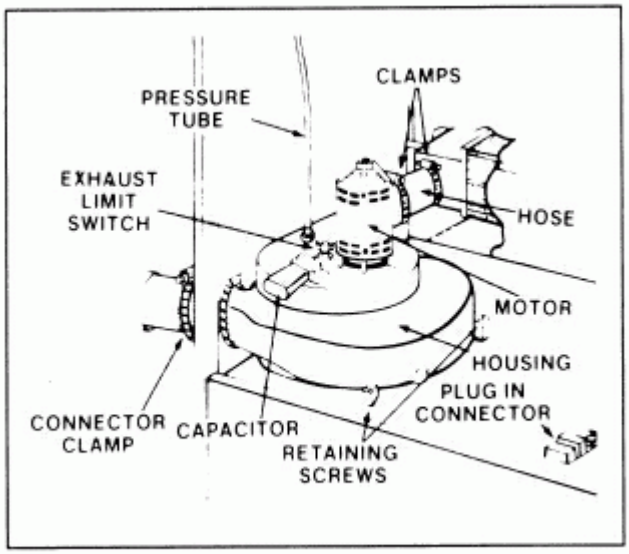

Figure 11

SPARKING DOES NOT STOP WHEN PILOT IS LIT

Check continuity of ignition cable and ground wire. Replace cable if 5 ohms or more resistance exists or cable is deteriorated. Check condition of ground wire and replace if necessary and clean contact areas of ground.

Check pilot flame. Flame must envelop 3/8 to 1/2 in. of electrode. If these checks are okay and sparking continues, replace ground wire and ignition cable. If problem still exists, replace control module.

MAIN BURNER DOES NOT LIGHT (PILOT BURNING)

Using a volt meter check across MV-MV/PV terminals for 25 volts a.c. If you do not have correct voltage, check for shorts to ground; if problem still exists replace control module.

If you have voltage, check electrical connections and wiring to the gas valve. If wiring is okay, check gas valve and replace if necessary.

SYSTEM DOES NOT RUN DURING CALL FOR HEAT

Check continuity of ignitor cable and ground wire.

If ground is poor or erratic, shutdown may occur occasionally even though operation is normal at time of checkout.

If checks are okay, replace control module.

CALL FOR HEAT ENDS, SYSTEM DOES NOT SHUTT OFF

Carefully check thermostat and thermostat wires for shorts.

Check for proper thermostat operation. Remove MV lead from control; if gas valve closes, replace control. If gas valve does not close, replace gas valve.

LIMIT SWITCH

EXHAUST LIMIT SWITCH

The exhaust limit switch is located on the exhaust blower housing and is used to sense high exhaust temperature.

Limit switch is a normally closed snap disc type switch. When high temperatures are sensed the switch will open, breaking the electrical circuit to the control module. When the temperature falls the switch will reset.

A possible cause for the limit switch to open may be soot and lint, which build up inside and outside preventing heat transfer from the exchangers. The primary heat exchanger must be cleaned with a long handle brush and the secondary heat exchanger flushed or vacuumed on the underside.

THERMAL SENSOR LIMIT SWITCH

The high temperature limit switch is located on the burner shield and is used to sense high temperature caused by blockage in the heat exchangers and flue.

Limit switch is a normally closed snap disc type switch. When high temperatures are sensed the switch will open breaking the electrical circuit to the gas valve from the control module. Whenever the temperature drops below specified temperature, switch will reset and ignition sequence will resume.

EXHAUST BLOWER

The exhaust blower is used to bring combustion air into the combustion chamber, and to expel the products of combustion into the flue.

BLOWER ASSEMBLY REMOVAL

1. Loosen connector clamp between exhaust assembly and exhaust blower assembly.
2. Loosen clamps at the back of the exhaust blower connecting blower to secondary heat exchanger.
3. Remove pressure tube from blower housing. Replace the tube if it shows signs of deterioration.
4. Disconnect the electrical leads to exhaust limit switch from pressure switch and plug in connector.
5. Disconnect the front plug-in-connector by squeezing the locking tabs and pulling up.
6. If the exhaust blower is to be completely removed, do not try to remove the pins from the plug-in connector. Remove the electrical leads from the fan and limit control, and the ground lead at the burner.
7. Remove electrical control box from blower compartment.
8. Remove retaining screws holding exhaust. (Screw heads are located on the underside of the blower deck.)
9. Pull exhaust blower from connections to heat exchanger and exhaust flue and remove from furnace.
10. The only parts of the exhaust blower assembly that can be serviced are the motor capacitor and exhaust limit switch. (To check motor capacitor, see section on capacitors.) The blower housing and motor must be replaced as an assembly.

INSTALLATION

Install exhaust blower assembly in reverse order as removed, replacing all parts that are deteriorated or worn.

CHECK TERMPERATURE RISE

Check temperature rise throughout the unit by placing thermometer in supply and return air ducts, as close to the unit as possible.

All registers and duct dampers must be open and the unit should be operated for 15 minutes before taking readings.

It must be within the range specified on the rating plate.

With a properly designed system, the proper amount of temperature rise will normally be obtained when the unit is operating at rated input with the recommended blower speed.

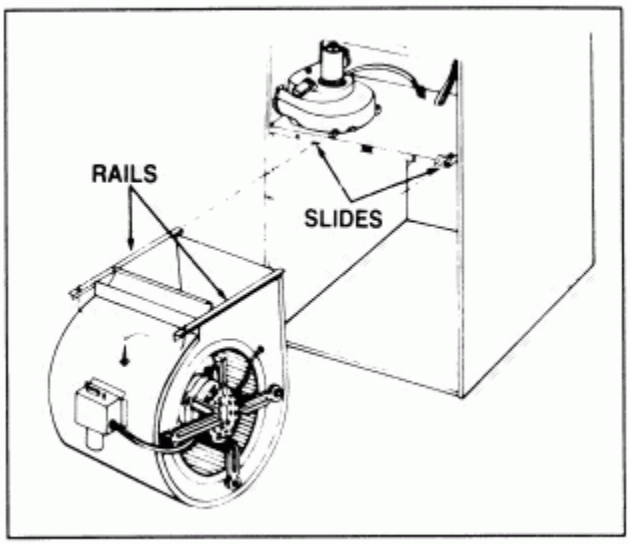

Figure 12

If the correct amount of temperature rise is not obtained, when operating on the recommended blower speed, it may be necessary to change the blower speed. A higher blower speed will lower the temperature rise. A slower blower speed will increase the temperature rise.

Air temperature rise is the temperature difference between supply and return air.

If rating plate calls for 45° - 70° temperature rise

Supply Temp. 170°

Return Temp. -70°

Air Temp. Rise 100° = Too high.

Increase blower speed.

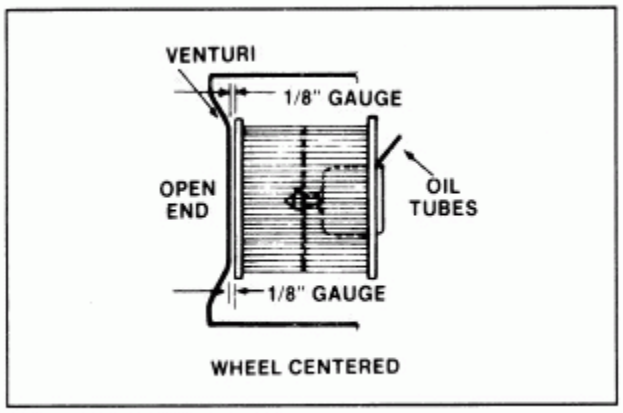

Figure 13

BLOWER ASSEMBLY REMOVAL

Remove the electrical control box.

Remove the two retaining screws holding blower into position in the slide rails. (Figure 12)

Blower can now be removed by pulling assembly from furnace.

BLOWER WHEEL INSTALLATION

The blower wheel must be centered in the venturi on both ends and motor end of the housing.

Place a piece of 1/8” gauge stock between venturi and wheel. (Figure 13)

Pull wheel against gauge and lock into position.

Oil motor by dropping 2 or 3 drops of 30W oil into each oil port.

BLOWER SPEEDS TAPS

Air flow can be increased (this will decrease the outlet air temperature) by changing the blower speed tap to a higher setting. The terminal block in the blower junction box makes this a simple operation. The violet wire is plugged into the desired speed tap for cooling.(Figure 14)

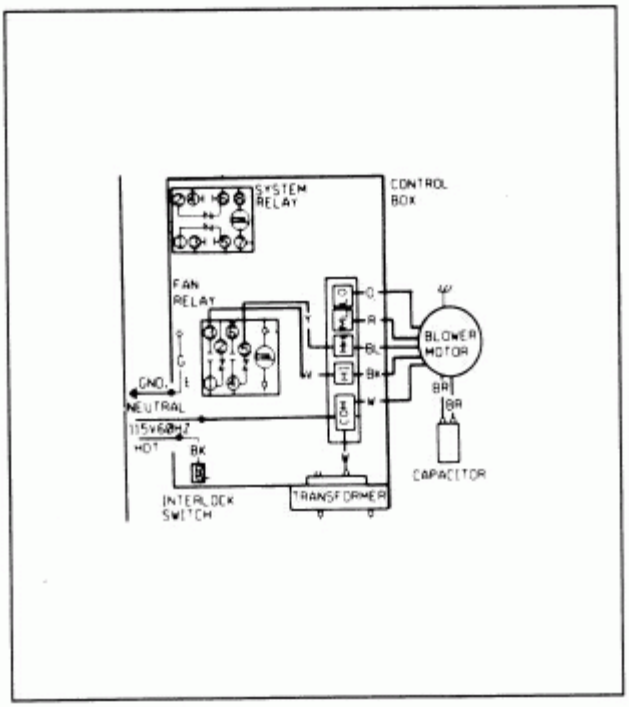

Figure 14

If you must use the same speed tap for both heating and cooling, strip the violet lead to expose base wire about 1 ½ inches back from the terminal. Remove the terminal from yellow lead and strip ¾ inch from end. Twist this wire around exposed yellow wire several times. Solder and tape. Plug into the speed tap desired.

DO NOT DISCONNECT THE FACTORY - MADE CONNECTION TO THE WHITE MOTOR LEAD. IMPROPER WIRING TO THIS LEAD WILL DAMAGE THE MOTOR.

Hazard of shock and electrocution. A capacitor can hold a charge for long periods of time. A service technician who touches these terminals can be injured. Never discharge the capacitor by shorting the terminals with a screwdriver.

Many motor capacitors are internally fused. Shorting the terminals will blow the fuse, ruining the capacitor. A 20,000-ohm, 2-watt resistor can be used to discharge capacitors safely.

CAPACITOR CHECK WITH CAPACITOR ANALYZER

The capacitor analyzer will show whether the capacitor is “open” or “shorted”. It will tell whether the capacitor is within its microfarad rating and it will show whether the capacitor is operating at the proper power-factor percentage.

To use the analyzer, set the line-voltage switch to the proper setting. Set the range switch to the correct range in microfarads to match the capacitor value. Attach the leads to the capacitor and push the test switch to “TEST”, and hold “ON”. Now turn the microfarad dial until the “eye” is as sharp as you can obtain. (You may find it necessary to use the power-factor dial to make the eye **very** sharp.) This test will tell you two things, whether the capacitor is within its microfarad rating and whether it has an acceptable power rating. If the “eye” will not sharpen, the capacitor is either “open” or “shorted.” By observing the eye, you can determine which by

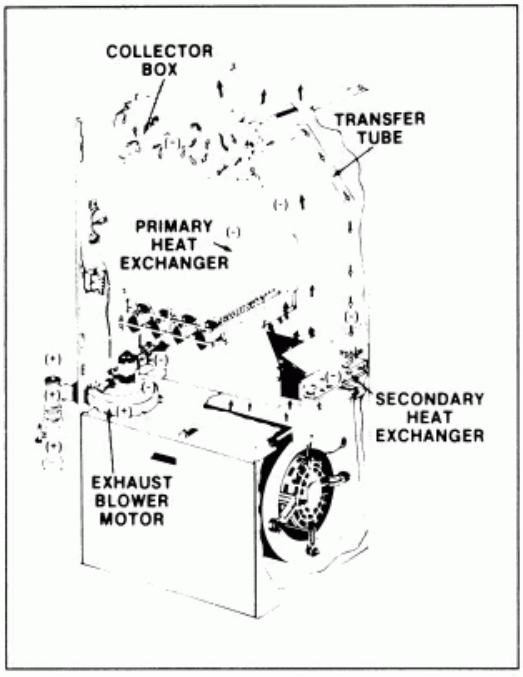

Figure 15

turning the microfarad dial all the way left for “open” or all the way right for “shorted”.

OHMMETER CAPACITOR CHECK

Since capacitors used are generally quite large, always discharge them (with a resistor) before attempting any checks. The ohmmeter test is not recommended and, at the very best, gives only an indication that the capacitor could be good. Set the ohmmeter scale to Rx100 and connect the test probes to the terminals of the capacitor. A shorted capacitor registers instantly at zero ohms or extremely low resistance. A good capacitor will cause the pointer to move toward zero at the instant the leads are connected; then the pointer will slowly return toward the high resistance end of the scale. A capacitor with a broken wire will register infinity on the meter scale.

EXHAUST BLOWER PRESSURE SWITCH

The exhaust blower pressure switch is in the negative side of the exhaust blower system. Switch is used to sense if there is a blockage in the exhaust system.

NORMAL OPERATION

On a call for heat from the thermostat, the exhaust blower starts to operate. (On one side of the blower a negative (-) pressure is created and the other side a positive (+) pressure is created.)

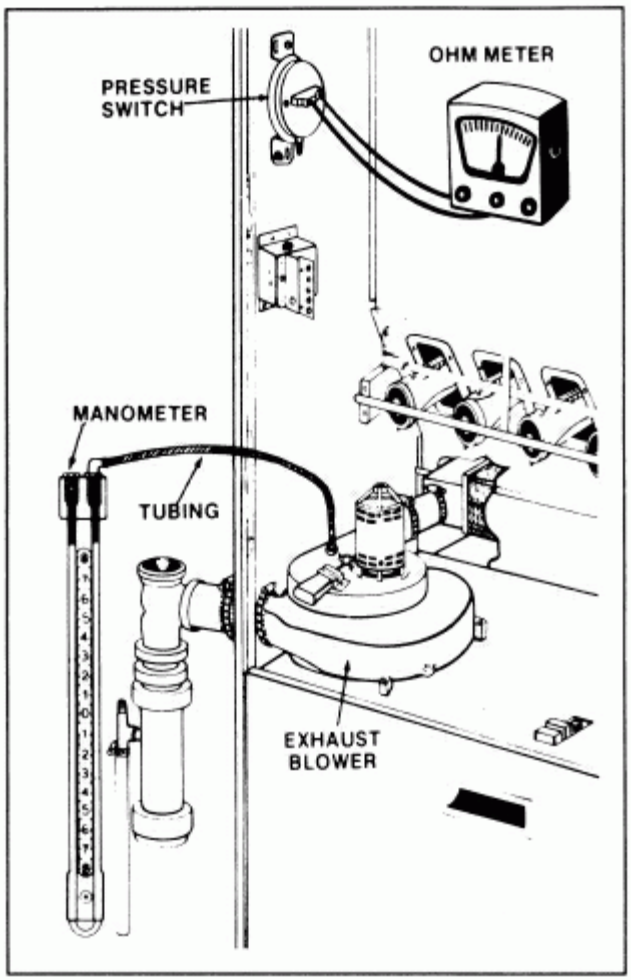

Figure 16

(Figure 15) Combustion (-pressure) air is drawn through the primary heat exchanger, through the tube to the secondary heat exchanger, through the secondary heat exchanger, through the exhaust blower (+pressure) and out the flue.

If the exhaust system is unobstructed, the negative (-) pressure is felt by the diaphragm in the pressure switch. The normally open contacts of the switch close, completing the electrical circuit through the switch.

TESTING THE SYSTEM (COLD)

1. Manually turn off gas supply to the furnace.
2. Pull tubing from pressure switch and install turning end to a “U Tube” manometer. (Figure 16)
3. Remove the electrical leads from the switch and install an ohm meter across the switch terminals. If you have continuity with the blower not operating, switch is defective. Contact must be open.
4. Set thermostat on call for heat. Exhaust blower should start to operate.
    a. Normal operation is between 3.0” w.c. and 5.0” w.c. negative pressure.

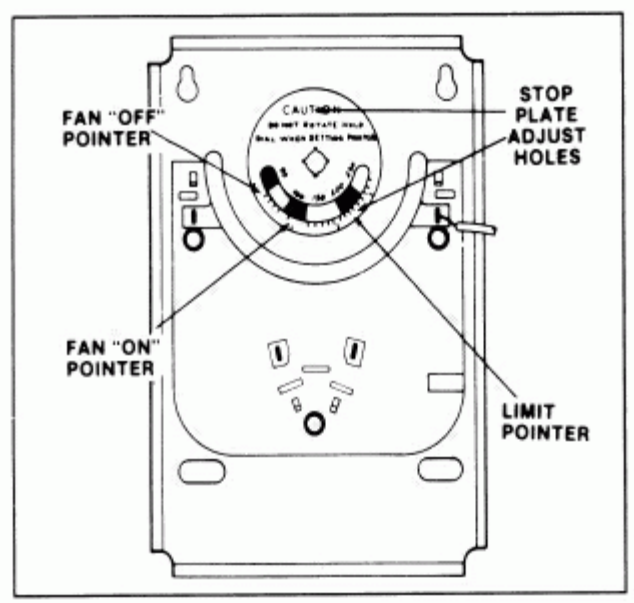

Figure 17

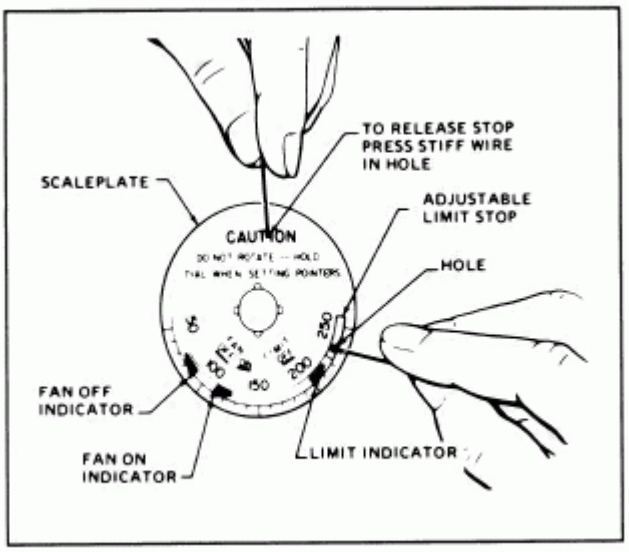

Figure 18

b. If you have normal operating pressure, reconnect tubing to pressure switch. You should now have continuity through the switch. If you do not, pressure switch is defective and must be replaced.

c. If you have less than 3.0” w.c., a blockage is indicated in the exhaust system and must be cleared.

FAN AND LIMIT CONTROL

LIMIT CONTROL

1. Check limit control function after 15 minutes of operation by blocking the return grille(s).
2. After several minutes the main burners should go OFF. Blower will continue to run.
3. Remove air restrictions and main burner will relight after a cool down period of a few minutes. Fan limit controls are preset at the factory.
4. Adjust the thermostat setting below room temperature.
5. Main burners should go off.
6. Circulation Air Blower should continue to run briefly until supply air temperature drops to approximately 90° .

Adjustment - DO NOT rotate dial when setting pointers.

7. If necessary, adjust fan ON - OFF settings to obtain a satisfactory comfort level.
8. If fan runs too long after furnace shutdown and blows cold air, turn fan “OFF” pointer up a few degrees. If fan goes off and then bumps on and off adjust fan “OFF” pointer a few degrees lower.

The limit control is factory preset and must not be adjusted.

9. Stop plate adjustment (replacement). Use a piece of small wire, press down lightly on top hole located in the word “CAUTION”. Turn plate by using another piece of wire turning plate to stop at specified setting. Then adjust limit pointer against “STOP”.

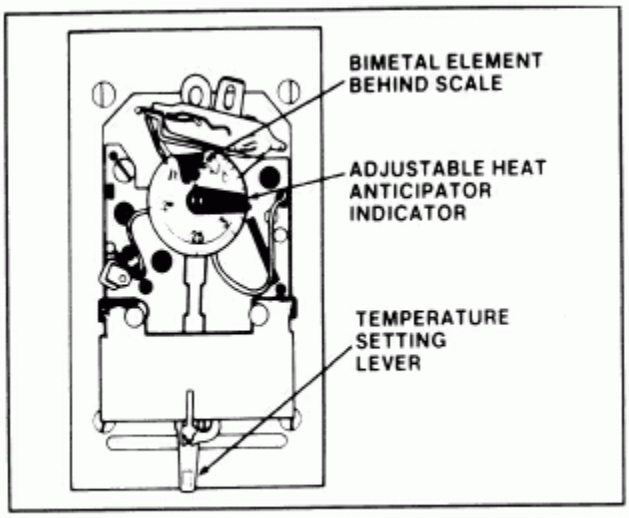

Figure 19

THERMOSTAT ANTICIPATOR

For more precise comfort control the thermostat has an adjustable Heat Anticipator. For most homes the anticipator should be set on the value listed in the manufacturer’s instructions. If your furnace cycles ON/OFF with very short ON intervals or if the OFF cycle is so long that room temperature becomes uncomfortable the anticipator setting may need to be adjusted.

Remove thermostat cover and locate anticipator. Check the setting: if not on the setting recommended for your furnace, move the lever to the proper setting and try it for a day or two.

To lengthen burner-on time move the indicator towards “Longer”. To decrease burner-on time move in opposite direction.

To accurately determine the effect do not adjust more than half a scale marking at a time and allow a day between adjustments.

Incoming gas pressure to the gas valve with all other gas appliances fired is a minimum of 4.5” w.c. and a maximum of 11.0” w.c. The ideal input pressure to gas valve should be 7.0” w.c. for these furnaces.

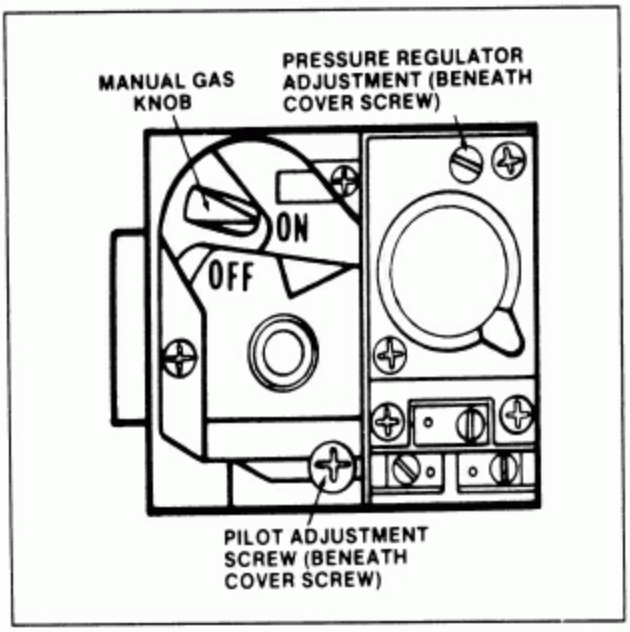

Figure 20

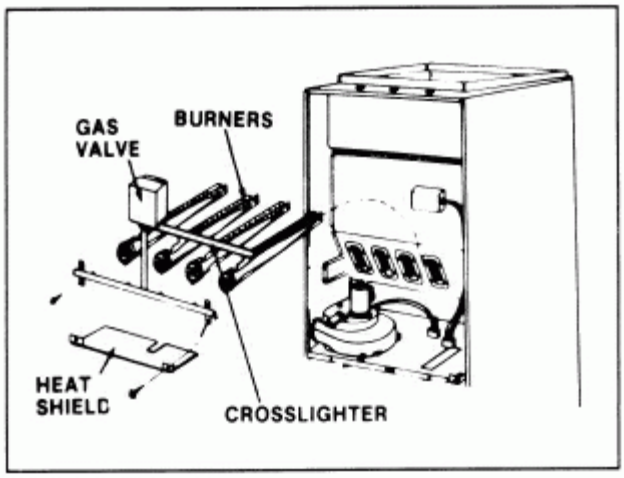

Figure 21

CHECKING SUPPLY GAS PRESSURE TO GAS VALVE (L.P. GAS)

Incoming gas pressure to the gas valve with all other gas appliances fired is a minimum of 11.0" w.c. and a maximum of 14.0" w.c. The ideal input pressure to gas valve should be 14.0" w.c. for these furnaces.

DANGER OF EXPLOSION AND FIRE

Manually turn off gas supply at manual shutoff valve before working on or removing the gas valve.

The VR8440P is a step opening gas valve. This means that a lower gas pressure is used during the ignition cycle. When the ignition cycle is completed the gas valve will automatically step to a higher pressure after several seconds.

The step pressure on this valve is not adjustable. If valve fails to step to high pressure replace the gas valve.

CHECKING STEP PRESSURE

Using a "U Tube" manometer or magnahelic gauge, remove the pressure tap plug on the gas valve. Install adapter and test gauge. Fire the furnace and immediately read pressure. The low pressure can be read during the trial for ignition period and immediately after.

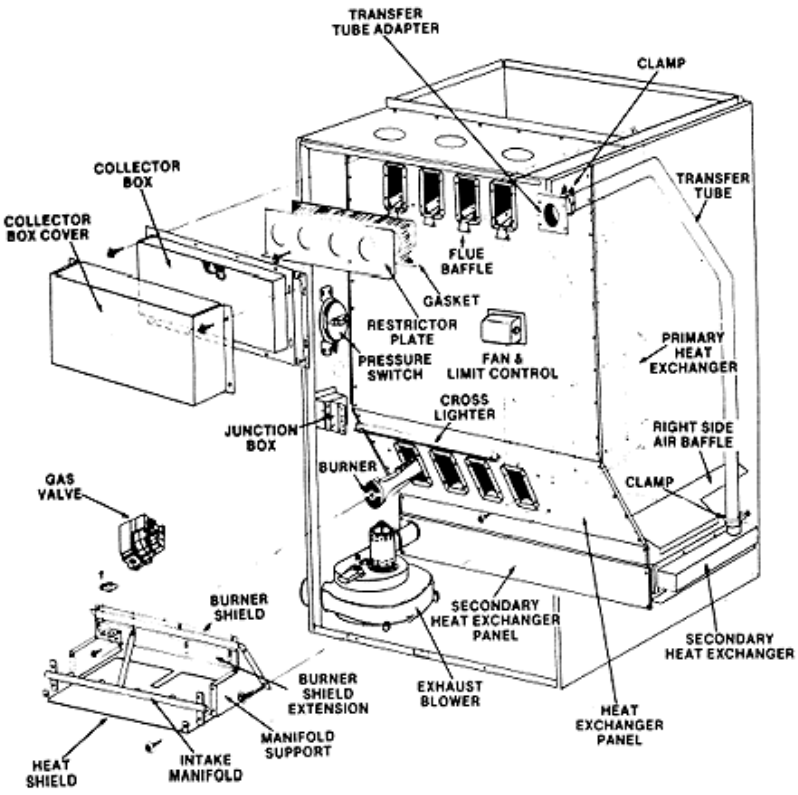

Figure 22

After several seconds following light off, gas valve should step to high pressure.

ADJUSTING HIGH PRESSURE

After furnace has fired and valve has stepped to high pressure, read the test gauge and compare to specifications in the chart.

If adjustment is required, remove pressure regulator adjustment cover screw. Using a small screwdriver, turn adjusting screw clockwise to increase pressure and counterclockwise to decrease gas pressure to burner. Replace adjustment cover screw.

Check burner performance at step pressure, observing burner ignition and flame characteristics. Burner should ignite properly and without flashback to orifice, and all ports should remain lit. Cycle furnace several times to insure that gas valve is operating properly. (Wait 30 seconds between cycles to allow servo regulator to resume step action.)

Remove test gauge and adapter.

Install pressure tap plug.

DANGER OF EXPLOSION AND FIRE

Carefully check each connection and joint of piping and gas valve with a soap and water solution. Bubbles indicate a gas leak and must be corrected immediately.

MODEL	TYPE GAS	REG. TYPE	MIN. PRES.	STEP PRES.
VR8440P	NAT.	STEP OPEN	3.5	1.2
VR8440P	L.P.	STEP OPEN	11.0	2.2

DANGER OF EXPLOSION, FIRE, PERSONAL INJURY OR DEATH

Manual shut-off valve in gas supply line must be turned off before removing gas valve and manifold.

GAS VALVE AND MANIFOLD REMOVAL

Turn off electrical power to furnace at disconnect, by turning circuit breakers off, or removing fuses.

Turn off manual shut-off valve in gas line.

Disconnect gas supply line to gas valve at union. (After removing gas valve, and line is to be open for an extended period of time, it is recommended that gas line be capped.)

Disconnect electrical leads to gas valve and ignition cable to ignitor/sensor and ground wire from pilot assembly.

Disconnect pilot tube from gas valve.

Remove retaining screws from manifold and gas valve as on assembly.

BURNERS, CROSSLIGHTER, HEAT SHIELD REMOVAL

Heat shield can now be removed by pulling out. (Figure 21) The shield is held in position by two offset tabs on the heat shield.

Burners and Crosslighter can now be pulled from heat exchangers.

Remove Crosslighter from burners by sliding Crosslighter toward the orifice end of burner.

CLEAN BURNERS

Clean burners by gently striking orifice end on a block of wood and then use a vacuum cleaner. This should remove any dirt or lint buildup in the tube.

Replace burners if extremely rusted, crushed, or the burner ports have collapsed.

CLEAN AND INSPECT CROSSLIGHTER

Crosslighter must not be bent, crushed, or the passages blocked.

Clean Crosslighter with a small wire brush.

REASSEMBLY

Reassemble all parts in reverse order as removed, with the following instructions.

Crosslighter - Install burner into slots of Crosslighter and press into position. Back of Crosslighter must be seated firmly against the burner ports.

Burners - Insert burners into heat exchanger. Burners must be inserted into the slots at the back of the heat exchanger and level.

Testing for leaks - After reassembly and the gas has been turned on. All joints must be checked for gas leaks using a soapy solution. All leaks must be repaired immediately.

HEAT EXCHANGERS: REMOVAL AND INSTALLATION

The following parts and assemblies must be removed before the heat exchangers can be removed.

Remove the collector box cover, collector box and restrictor plate.

Remove the exhaust blower assembly, following the instructions given in the “Exhaust Blower” section.

Remove the gas valve, intake manifold, heat shield and burners, following the instructions given in the “Burners” section.

Remove the burner shield, burner shield extension, and right and left manifold supports.

Remove flue baffle retaining screws and carefully pull baffles from heat exchanger. Be careful not to bend the flue baffles.

Remove the electrical junction box by disconnecting the high voltage electrical leads to furnace. Remove junction box retaining screws. Box can now be moved out of the way without removing the electrical leads to electrical control box.

Remove the electrical leads and air tube to the pressure switch. Remove retaining screws and remove pressure switch from furnace.

Remove the electrical leads to the fan and limit switch.

Remove the four sheet metal screws to the transfer tube adapter.

Remove the secondary heat exchanger panel.

Remove all sheet metal screws holding heat exchanger panel to furnace casing.

PRIMARY HEAT EXCHANGER

After all assemblies have been removed that were blocking heat exchangers from being removed, and sheet metal screws have been removed, heat exchangers can now be pulled out of the furnace casing. Carefully inspect each heat exchanger section and replace if it is rusted-through, split, cracked or deteriorated.

SECONDARY HEAT EXCHANGER

The primary heat exchangers must be removed before attempting to remove the secondary heat exchanger.

Remove the right and left side air baffles.

Tilt secondary heat exchanger slightly by pulling up on the right side until the sheet metal flanges on the furnace casing can be cleared and heat exchanger can be pulled from the furnace.

Replace secondary heat exchanger as an assembly if found to be defective.

REASSEMBLY

Any insulation that is torn or defective must be repaired or replaced as necessary. Replace all parts that were removed, in reverse order as removed, with the following instructions. Replace all gaskets and parts that are broken or deteriorated.

Flue baffles are to be installed into position see Figure 23. Baffle must be located below dimple in section halves and firm against bottom of flue outlet.

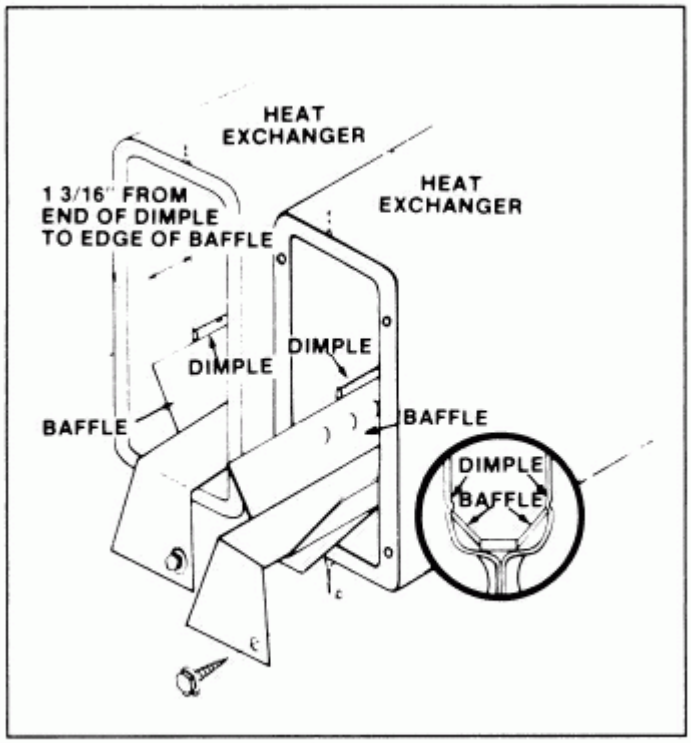

Figure 23

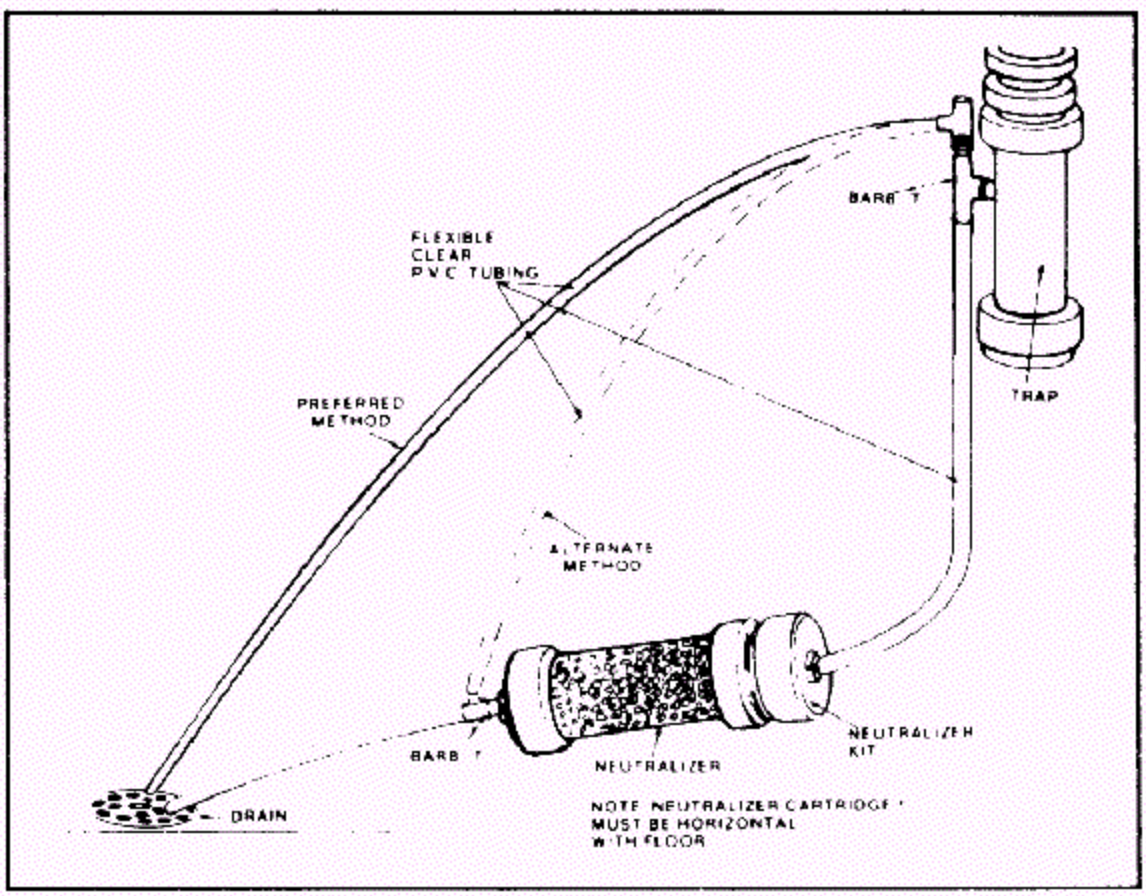

Figure 24

WARNING: DANGER OF PROPERTY DAMAGE

A properly installed overflow drain line must be used to avoid spillage of water-acid.

The furnace you are servicing may be equipped with an “Optional Accessory Neutralizer Kit” depending on local codes.

OVERFLOW DRAIN LINE

An overflow drain line should be added to the installation when furnace is located in an area that may be susceptible to water damage.

If the trap or neutralizer becomes blocked and there is not an overflow drain line, the water-acid solution will overflow onto the floor through the open end of the barb “T”. This spillage could cause property damage.

OVERFLOW DRAIN LINE INSTALLATION

PREFERRED METHOD

Install a barb “T” above the one already installed on exhaust trap. Run a clear flexible PVC line from the horizontal outlet of barb “T” to the drain.

ALTERNATE METHOD

Install a barb “T” above the one already installed on exhaust trap. Install a second barb “T” in the line on the outlet side of Neutralizer Kit. Run a clear flexible PVC line from the horizontal outlet of barb “T” installed on the outlet side of the Neutralizer Kit.

Seal all threaded surfaces with silicone rubber caulking (non-paintable).

MAINTENANCE

THE FOLLOWING MAINTENANCE INSTRUCTIONS ARE ACTUALLY DIRECTED TO THE HOMEOWNER; THE OWNER OF THE FURNACE. THESE INSTRUCTIONS ARE INCLUDED HERE SO THAT YOU, THE TECHNICIAN, WILL KNOW WHAT DIRECTIONS ARE BEING SUPPLIED TO THE OWNER FROM A TYPICAL MANUFACTURER.

The furnace should be inspected and serviced on an annual basis (before the heating season) by a qualified service technician.

If you perform maintenance on the furnace yourself, remember that certain mechanical and electrical skills and tools are required to properly perform maintenance on the furnace. Personal injury or death may result if you are not properly trained. You should call your installing dealer or place of purchase if you are uncertain about your ability to perform maintenance.

TURN OFF ELECTRIC POWER TO FURNACE BEFORE PERFORMING ANY MAINTENANCE OR REMOVING PANELS, BECAUSE OF THE DANGER OF ELECTRICAL SHOCK.

AIR FILTERS - MONTHLY

The air filter(s) should be inspected at least monthly and cleaned or replaced as required. There are two types of filters most commonly used. The most widely used is the fiberglass disposable type which should be replaced before it becomes clogged. The other type commonly in use is the washable type constructed of aluminum mesh, foam, or reinforced fibers. Washable filters may be cleaned by soaking in mild detergent and rinsing with water.

Some filters are marked with an arrow to indicate the proper direction of air flow through the filter. When installing the arrow must point in the direction of the air flow. Remember that dirty filters are the most common cause of inadequate heating or cooling performance.

The Owner’s Manual lists recommended sizes and types of filters that may be used with your furnace, based on air flow.

However, the furnace installer may have used a larger filter for additional air volume or if the furnace was installed for Heating Only with a remote filter cabinet or central return he may have installed a smaller filter. If air conditioning has been added since your furnace was installed, make sure the filter size is adequate.

Replacement filters should be the same type and size to ensure adequate air flow and filtering, unless a disposable low velocity filter is replaced with a washable high velocity type.

FILTER REPLACEMENT

The filter will normally be found inside the furnace blower compartment, but alternate locations may be a remote filter rack attached to the outside of the furnace, a separate return air cabinet attached to furnace or a remote filter grille.

Remote filter grilles and return air cabinets will usually have a hinged door or removable panel to be able to remove filter. Filter racks attached to the furnace will usually be made so the filter simply slides out one side for removal. Use only the same size filter. The type must be the same unless replacing a disposable low velocity type, with a washable high velocity type.

NEVER OPERATE FURNACE WITHOUT A FILTER INSTALLED AS DUST AND LINT WILL BUILD UP ON INTERNAL PARTS RESULTING IN LOSS OF EFFICIENCY, EQUIPMENT DAMAGE AND POSSIBLE FIRE.

1. Turn off electric power for furnace at circuit breaker or disconnect switch.

2. Remove blower compartment door.

3. Lift filter strap from hook on side or slide strap to side from underneath flange on front. Remove filter being careful not to dislodge dirt and debris.

4. Inspect filter and replace or clean washable type. If filter is aluminum mesh it should be recoated with filter coating spray.

5. Reinstall filter under strap. If filter is marked for air flow direction make sure it's installed correctly.

6. Replace blower compartment door making sure that it's tightly closed.

7. Turn on electric power for the furnace.

BLOWER MOTOR

Motor will require lubrication every five (5) years of normal operation. Add ½ teaspoon (2 cc) of SAE #10W30 motor oil to each motor bearing through oil tubes or by removing cap plugs in motor end bells.

DO NOT over-oil or use 3-in-1 oil, penetrating oil, WD40 or similar oils to oil motor bearings. Use of these may damage these motors.

CONDENSATE DISPOSAL - MONTHLY

Your furnace has a condensate trap as part of the vent system. The moisture in the flue gases will condense and collect in the trap to go to an inside drain or be pumped to a sewer line using a condensate pump.

The Condensate Trap and Condensate Neutralizer Cartridge (if used) in the drain line leading from the trap will require some maintenance. Disassemble and clean trap and cartridge prior to each heating season or if drain line becomes plugged.

Inspect the drain line and overflow line at least monthly. If the Condensate Neutralizer Cartridge becomes plugged the condensate will flow through the overflow line. If this happens clean both cartridge and trap.

TO CLEAN: Disconnect the drain line cartridge and unscrew end cap from cartridge. Pour the neutralizer out and thoroughly flush neutralizer and inside of cartridge with water. Pour neutralizer back into cartridge, adding neutralizer if cartridge is less than ¾ full. Unscrew trap from Vent Connecting Tee and flush thoroughly with water, use soap if necessary to clean, DO NOT USE any kind of solvents. Make sure float is reinstalled in trap. (Figure 25)

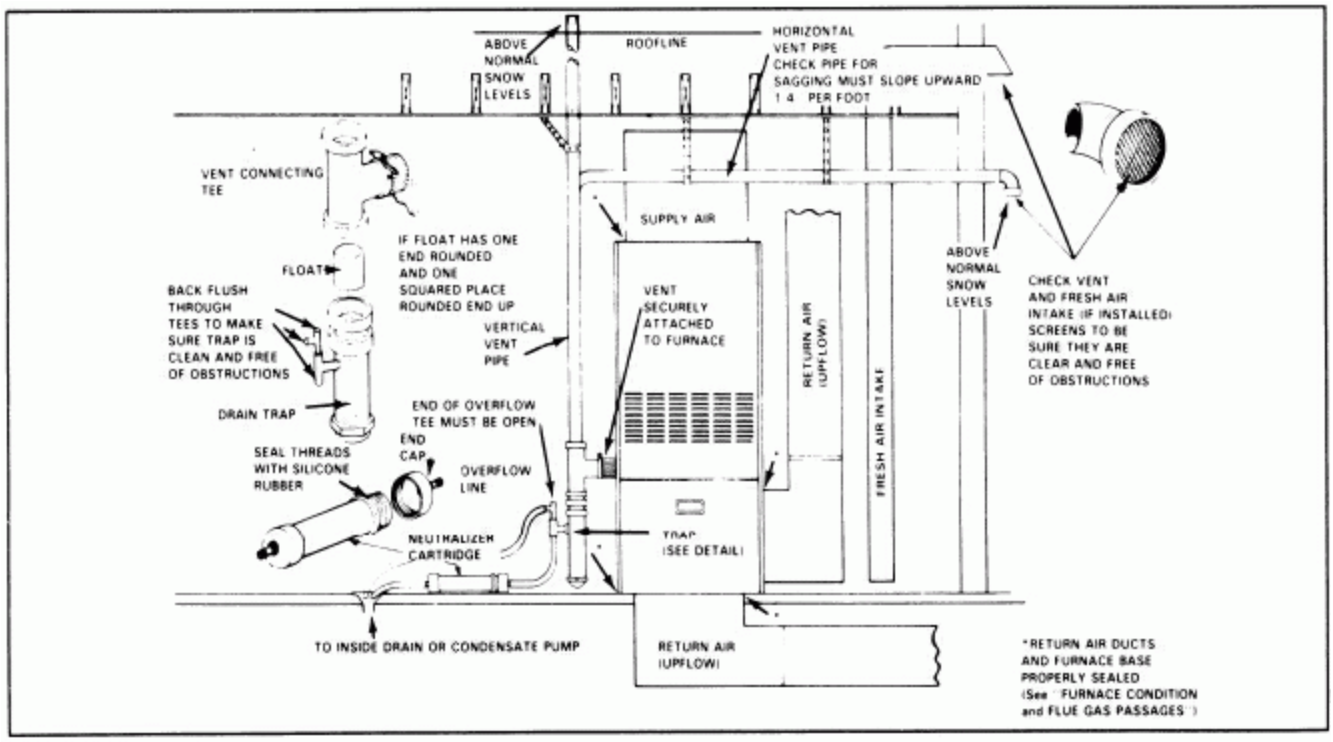

Figure 25

Typical Installation

Reassemble and seal threaded connections with silicone rubber (bathtub caulk) or pipe dope approved for plastic pipe.

See repair parts section in the Furnace Technical Support Manual, to order replacement neutralizer.

Do not use condensate for any reason as it is acidic.

FURNACE CONDITION AND FLUE GAS PASSAGES - MONTHLY

A properly adjusted gas furnace should not require cleaning at frequent intervals, but it should be inspected regularly to ensure safe and efficient operation. A brief monthly inspection is recommended that does not require disassembly. In addition you should have the furnace inspected, and cleaned (only if required), by a qualified service technician annually.

During the monthly inspection check the vent pipe and fresh air intake (if installed), to be sure they are clear and free of obstructions. Check vent pipe for evidence of condensate leakage, tight joints, secure attachment to furnace and sagging pipe.

Horizontal sections of pipe must slope upward ¼ " per foot except section between furnace and drain trap when trap is not mounted directly on furnace. That section (Max 4' Long) should slope down ¼ " per foot (Max 1") to trap.

Check return air duct to make sure it is sealed to furnace casing and that it is in good physical condition. It must terminate outside the space containing the furnace with no holes or inlets in furnace space.

The floor or furnace base must be in good physical condition. For up flow furnace with a bottom return the floor or base area around the furnace must form a seal (no sagging, cracks, defects, etc.) to prevent air from being pulled in from furnace area, or any defect area must be sealed between floor or base and furnace.

Remove the front panel and use a flashlight to inspect the visible part of the heat exchanger, burners and spark ignitor. Check for loose soot and give particular attention to obvious deterioration from corrosion or other sources. Check for any signs of condensate leakage inside furnace cabinet.

If soot or deterioration is found or if there is evidence of condensate leakage inside furnace, **DO NOT OPERATE FURNACE.**

Call a qualified service technician.

Allow furnace to run approximately 10 minutes then inspect the main burner flames and pilot flame.

MAIN BURNER FLAMES

should be stable, soft and blue, (dust may cause orange tips or they may have wisps of yellow but they must not have solid yellow tips.) They should extend directly upward from burner without curling, floating or lifting off. They must not touch the sides of the heat exchanger.

Contact a qualified service agency at once if an abnormal flame appearance should develop.

PILOT FLAME

should surround 3/8 " to 1/2 " of the ignitor/sensor tip. (Figure 3)

Qualified Service Technician Only Main Burner Orifices can be changed to operate furnace at alternate input rating or if required for high altitudes.

DANGER OF PROPERTY DAMAGE, BODILY INJURY OR DEATH IF ELECTRIC POWER (AT DISCONNECT) AND GAS SUPPLY (AT MANUAL SHUTOFF VALVE IN GAS LINE) ARE NOT SHUT OFF.

1. Disconnect gas line from gas valve. Wiring to valve can be disconnected if desired.

2. Disconnect pilot tube at gas valve, Figure 26.

3. Remove the four (4) screws holding the Manifold to the manifold brackets and remove, Figure 26.

4. Remove the orifices from the manifold and replace them with properly sized orifices.

    a. Tighten orifices so there is 9/16 " from the face of the orifice to the face of the manifold brackets. To check, place a straight edge across manifold brackets and measure to face of orifice as shown in Figure 26. Make sure orifice goes in straight so that it forms a right angle (90°) to the manifold brackets.

5. Reinstall manifold and other parts. Use caution when installing pilot line to avoid cross threading or stripping of threads. Make sure burners do not bind on new orifices.

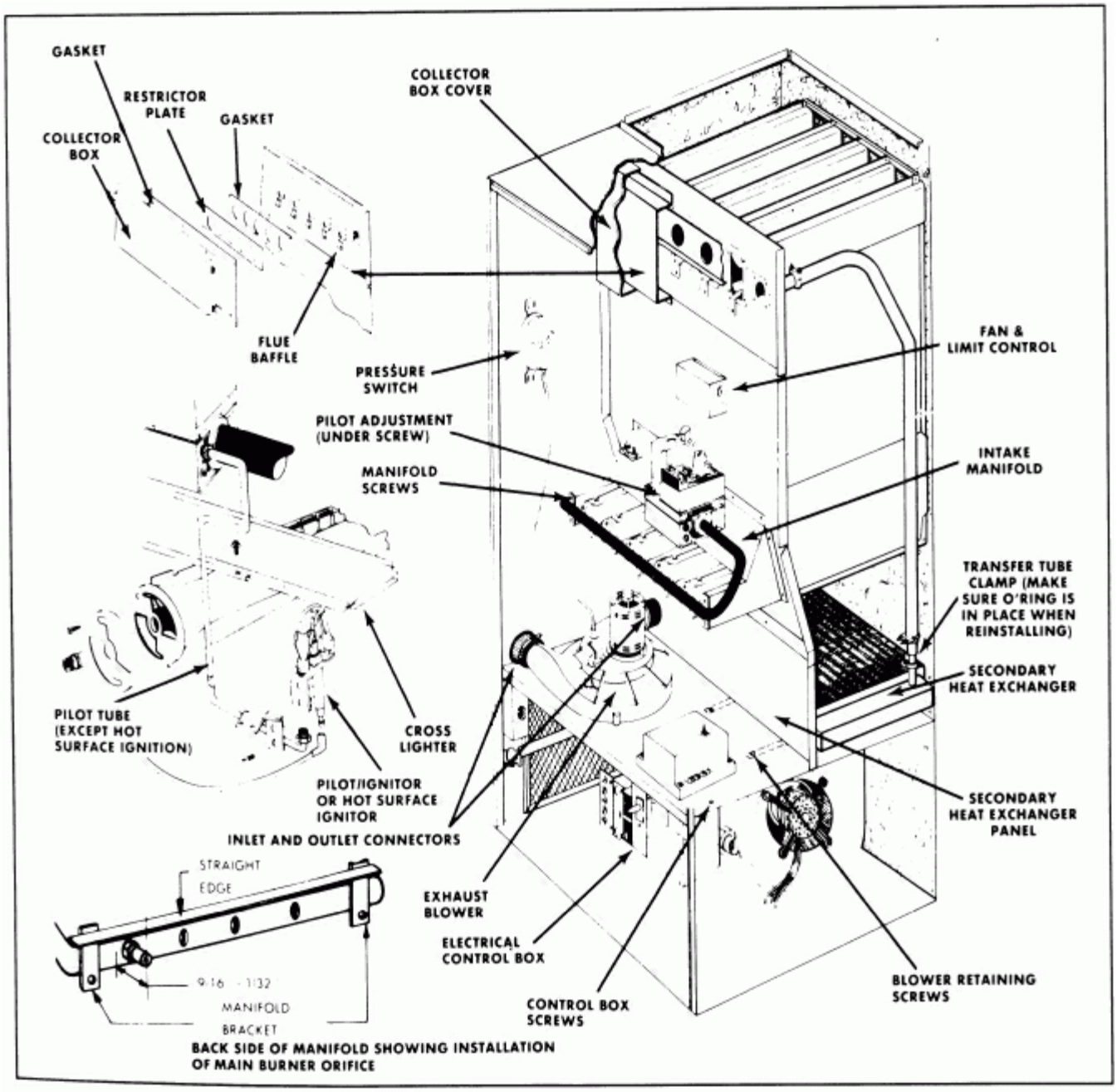

Figure 26

Cleaning Heat Exchangers/Changing Burner Orifices

Furnaces that are properly installed and maintained will normally not require cleaning of the heat exchangers.

If filters are inadequate or not maintained it may be necessary to clean the exterior surface of the Secondary Heat Exchanger to obtain proper airflow. If the Primary Heat Exchanger requires cleaning it can be completed without removing or cleaning of the Secondary Heat Exchanger.

The only time it should be necessary to disassemble and clean the interior of both the Primary and Secondary Heat Exchangers would be due to a sooting condition caused by abnormal combustion.

DANGER OF PROPERTY DAMAGE, BODILY INJURY OR DEATH IF ELECTRIC POWER (AT DISCONNECT) AND GAS SUPPLY (AT MANUAL SHUTOFF VALVE IN GAS LINE) ARE NOT SHUT OFF.

1. Remove the two retaining screws holding control box from the top of the blower deck, Figure 26.

2. Lift control box up and outward from furnace. Control box will have enough slack in the wiring to allow the box to be held out of the way to remove blower assembly.

3. Remove the two retaining screws holding blower in position in the slide rails, Figure 26.

4. Blower can now be removed by pulling assembly from furnace. Support blower next to furnace to avoid having to disconnect wiring.

5. Using a stiff bristle brush and a vacuum cleaner, clean dirt and lint build-up from bottom side of Secondary Heat Exchanger. Brush strokes must be with the fin surface to avoid damage to the fins. Use a fin comb to straighten fins, Figure 27.

6. Inspect and clean blower wheel using brush and vacuum. Be careful not to dislodge balance weights (clips) that may be on the blower wheel.

An unbalanced wheel may cause undesirable noise, vibration, or blower damage.

The following parts and assemblies must be removed before the heat exchanger can be cleaned.

1. Remove screws for the collector box cover, collector box and restrictor plate. Handle collector box gasket with care to avoid damage.

2. Remove screws that hold flue baffles in position and carefully pull baffles out.

3. Disconnect gas supply line at union and at gas valve if necessary for removal from furnace.

4. Disconnect electrical leads at gas valve, ignitor/ sensor and ground wire from pilot assembly.

5. Disconnect pilot tube from gas valve.

6. Remove retaining screws for manifold and remove gas valve/ manifold assembly.

7. Pull burners and Crosslighter from the heat exchanger.

8. Remove Crosslighter from burners by sliding Crosslighter toward the orifice end of burner.

CLEANING:

1. Clean interior of heat exchangers using a long flexible handle brush and vacuum cleaner.

2. Clean burners by gently striking orifice end on a block of wood. This should remove any dirt or lint buildup in the tube.

    a. Replace burners if extremely rusted, crushed, or if burner ports have collapsed.

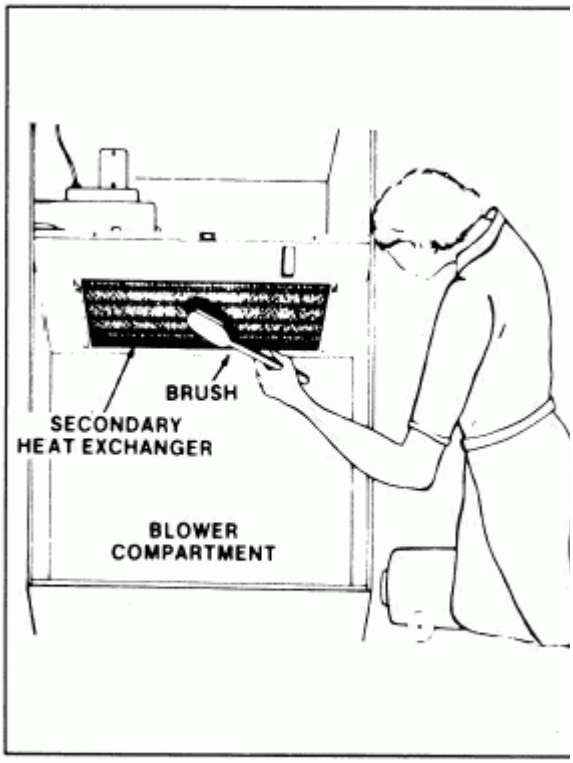

Figure 27

Cleaning Secondary Heat Exchanger

3. Use a brush and stiff wire to clean the Crosslighter.

4. Reassemble in reverse order, see Reassembly Instructions.

SECONDARY HEATING EXCHANGER

(INTERIOR CLEANING) DISASSEMBLY; (FIGURE 26)

The following parts and assemblies must be removed before the heat exchanger can be cleaned.

1. Loosen clamps on the inlet and outlet connectors on the Combustion Air Blower.

2. Remove screws holding Combustion Air Blower to blower deck.

3. Gently wiggle and pull blower outward to disengage from inlet and outlet connectors.

    a. Blower can be pulled out so it just clears the furnace casing on the left side without disconnecting any wiring. Support blower so it does not hang by the wiring.

4. Remove screws holding the electronic spark module to the blower deck.

5. Remove screws attaching the Secondary Heat Exchanger Panel and remove panel.

6. Remove screws holding Z bracket to division panel and remove bracket.

7. Loosen screw on the secondary Heat Exchanger inlet coupling by reaching in on the right side.

DANGER OF BODILY INJURY COIL HAS SHARP FINS; COVER WITH RAGS AND HANDLE WITH CARE TO AVOID CUTS.

8. Remove Secondary Heat Exchanger by pulling straight out and reposition spark module and wiring etc. to get past them.

CLEANING:

1. Use a 1-5/8 “ plastic cap plug or the palm of your hand to plug either the inlet or outlet port and fill heat exchanger coil with approx. 1-1/2 quarts of hot water.

2. Plug other port and shake coil vigorously. Drain and flush with a hard stream of water from a garden hose. Repeat Step 1 & 2 if required.

3. Thoroughly wash exterior. DO NOT use a hard stream of water on the exterior as it will bend coil fins.

REASSEMBLY

Reassemble all parts in reverse order as removed, with the following instructions.

Crosslighter - Install burner into slots of Crosslighter and press into position. Back of Crosslighter must be seated firmly against the burner ports.

Burners - Insert burners into heat exchanger. Burners must be inserted into the slots at the back of the heat exchanger and level.

Check and adjust Spark Gap for Pilot Ignitor.

Flue baffles are to be installed into position as illustrated, Figure 28. Baffle must be located below dimple in heat exchanger and firm against bottom of flue outlet.

Any insulation that is torn or defective must be repaired or replaced as necessary.

Replace all gaskets and parts that are broken or deteriorated.

Testing for leaks - After reassembly turn the gas on and check all joints for gas leaks using a soapy solution. All leaks must be repaired immediately. Perform an operational check of the furnace.

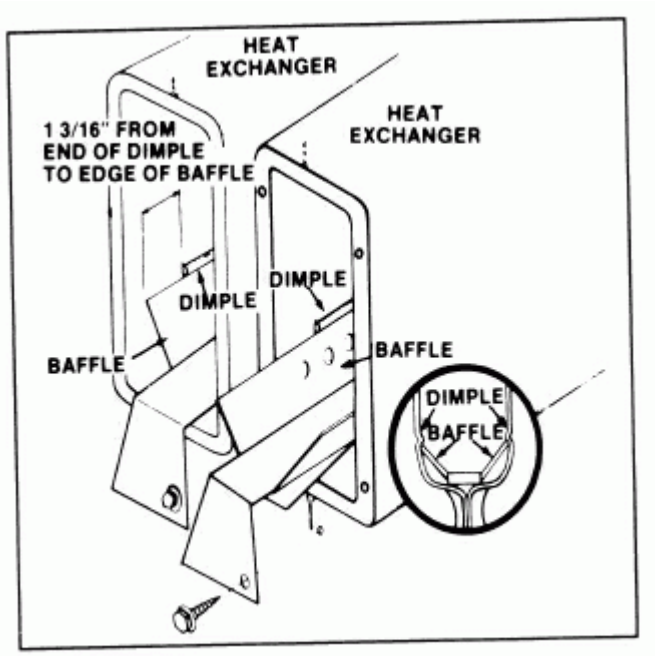

Figure 28

Installing Flue Baffles