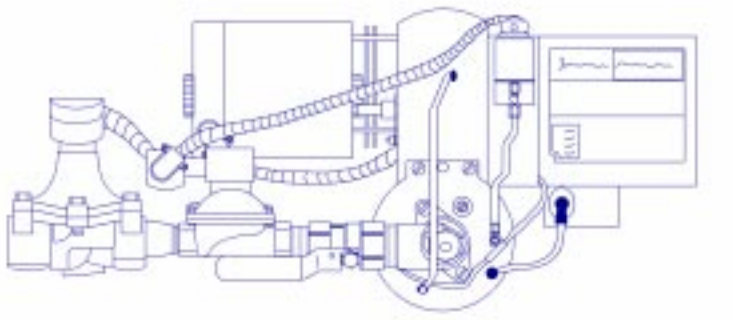
INSTALLATION AND SERVICE INSTRUCTIONS



CANADIAN GAS ASSOCIATION
LISTED

ECONOMITE MODELS 400-33 AND F400-33
Gas Conversion Burners

In the United States, Installation must conform with local codes or, in the absence of local codes, with Installation of the **National Fuel Gas Code, ANSI Z223.1-1992,** or latest edition available from American National Standard Institute. Further reference should be made to the recommendation of your fuel supplier.

In Canada, Installation must conform with local codes or, in the absence of local codes, with **Installation Codes for Gas Burning Appliances and Equipment, CGA Standard CAN/CGA 1B-149.1 or 2**. When the conversion burner is used on a Forced Air Central Furnace, the two yellow and black warning labels in the literature envelope shall be attached in accordance with **Installation Code, CGA Standard CAN/CGA 1-B149, Clause 5.4.4.4.** Further reference should be made to the recommendation of your fuel suppler.

⚠ WARNING: Additions, changes, conversions, and service must be performed by an authorized MIDCO representative, service agency, or the fuel supplier. Use only MIDCO specified and approved parts.

INSTALLER: Inform and demonstrate to the user the correct operation and maintenance of the gas utilization equipment. Inform the user of the hazards of storing flammable liquids and vapors in the vicinity of this gas utilization equipment and remove such hazards. Affix this manual and associated literature adjacent to the conversion burner. CODE COMPLIANCE IS THE SOLE RESPONSIBILITY OF THE INSTALLER.

USER: Retain this manual for future reference. If other than routine service or maintenance as described in this manual and associated literature is required, contact a qualified service agency. DO NOT ATTEMPT REPAIRS. An inadvertent service error could result in a dangerous condition.

⚠ WARNING: If the information in these instructions is not followed exactly, a fire or explosion may result, causing property damage, personal injury or death.

- **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

WHAT TO DO IF YOU SMELL GAS:

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in the building.**
- **Immediately phone your gas supplier from another building. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier call the fire department.**

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

BURNER MODEL _____

BILL OF MAT'L NUMBER _____

DATE CODE _____

WIRING DIAGRAM _____

FOR SERVICE CONTACT:

name _____

address _____

_____

phone _____

SAFETY INFORMATION TERMS. The following terms are used to identify hazards, safety precautions or special notations and have standard meanings throughout this manual. They are printed in all capital letters using a bold typeface as shown below, and preceded by the exclamation mark symbol:

DANGER: Identifies the most serious hazards which **will** result in severe personal injury or death.
WARNING: Signifies hazards that **could** result in personal injury or death.
CAUTION: Identifies unsafe practices which would result in minor personal injury or product and property damage.

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PRINTED IN U.S.A.

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SPECIFICATIONS[1]

The **ECONOMITE Models 400-33** and **F400-33** conversion burners with intermittent spark ignited pilot are adaptable to most gas utilization equipment, including gravity and forced circulation furnaces and boilers. They are particularly recommended for firing horizontal or downdraft equipment since they need no draft to maintain a pilot. Power burner design makes them perfectly suited for oil burner replacement, including rooftop and industrial applications

AIR DELIVERY (Approximate Air Delivery at Zero Draft)
- 400-33.....85 SCFM[2]
- F400-33.....146 SCFM[2]

FIRING RATE (NATURAL or PROPANE)[3]
- MAXIMUM 400-33.....400 MBH[4]
- MAXIMUM F400-33.....700 MBH[4]
- MINIMUM 400-33.....185 MBH[4]
- MINIMUM F400-33.....300 MBH[4]

GAS PRESSURE REQUIRED
- NATURAL.....5.0" to 14.0" W.C.
- PROPANE.....11.0" to 14.0" W.C.

TUBE DIAMETER.....4"
TUBE LENGTH.....8"
RECOMMENDED COMBUSTION CHAMBER SIZE
- 400-33 AT MAX BTU/HR.....10" x 16 1/2"
- F400-33 AT MAX BTU/HR.....15" x 25"

STANDARD VOLTAGE.....120 Volts.....60 Cycle
FLAME SAFETY.....Electronic Flame Safety with Spark Ignited Pilot and 100% Shut-Off.

TABLE1 Burner Specifications

1. Standard burners are shipped as NATURAL gas models. A kit is available for field conversion to PROPANE gas.
2. SCFM = Standard Cubic Feet / Minute.
3. All Ratings Based on 1000 BTU/Cu. Ft. NATURAL, 2500 BTU./Cu.Ft. PROPANE at Sea Level. Derate burner for altitudes over 2,000 feet by 4% for each 1,000 feet above sea level.
4. 1 MBH = 1,000 BTU/hr.
   One gallon of fuel oil = 140,000 BTU.

PART 1 INSTALLATION

⚠ **CAUTION: ECONOMITE Burners are not intended for outdoor installation and must be protected from excessive moisture. Provide adequate clearance for service and proper operation.**

I VENTILATION

If the former automatic oil burner gave trouble-free operation, it is probable that the heating plant area has sufficient infiltration of air for combustion and dilution of flue gases. **Nevertheless, the area must be checked.**

☐ Open basement or utility areas of normal construction, without storm windows or tight doors, will generally allow sufficient air infiltration. However, if the heating plant is located in a tight or separate room, ventilation to an open area as described above will be required. Install two permanently open grilles, each sized on the basis of one square inch free area per 1,000 BTU (but not less than 100 square inches) of the total input rating of all gas utilization equipment in the combined space. One grille should be located within 12 inches of the ceiling, the other within 12 inches of the floor.

☐ If the heating plant is located in an area of unusually tight construction, or if an exhaust fan, kitchen ventilation system, clothes dryer and/or fireplace is installed in the building, provisions must be made for an outside air supply near the heating appliance area. Install permanently open grilles sized at not less than one square inch free area per 4,000 BTU of burner input. When ventilating through horizontal ducts, grilles should be sized at not less than one square inch free area per 2,000 BTU of burner input. In any case, the minimum dimension of rectangular air ducts shall not be less than 3 inches.

☐ In Canada, for detailed ventilation requirements, refer to standard CAN 1-B149.1 or .2 and/or local codes.

II PREPARATION OF THE GAS UTILIZATION EQUIPMENT

☐ Clean the gas utilization equipment combustion chamber, heat exchanger interior, and flue connections. Remove all adhering tars, scale, dirt and soot. Inspect for actual or potential leaks.

☐ Cement all joints, including those in the heating appliance base and around the door frames, to prevent leakage into, or out of the combustion chamber.

☐ The access or firing door should open easily to relieve pressure. If positive latches exist, they should be modified to permit easy opening; a spring loaded door holder is recommended.

☐ On all boilers, make certain the pressure relief safety valve is in good operating condition.

III COMBUSTION CHAMBER

A combustion chamber liner is normally required to protect non-heat transfer surfaces and to provide a radiant bed for rapid heat transfer to the primary surfaces of the heat exchanger. In most cases the existing chamber liner can be used, if in good condition.

☐ In the case of wet base boilers, where the entire firing chamber is comprised of heat exchange surfaces and no chamber liner was provided for oil firing, a liner is usually not required for the ECONOMITE. However, a liner or target wall may be necessary if the firing chamber is unusually short, in order to avoid excess flame contact on the heat exchanger walls or flueways.

☐ If a built up chamber liner is required, use 2,300°F minimum insulating material.

☐ The burner tube, or the stainless steel sleeve that is included with the burner, must be sealed air tight into the combustion chamber opening with refractory material as shown by Figures 1and 2. The sleeve is preferred as it is designed to properly locate the end of the tube relative to the inside wall of the combustion chamber, and to permit burner removal without breaking the seal.

⚠ **CAUTION: In no case should the burner tube be allowed to extend into the chamber proper; it must be set at least 1" short of the inside surface.**

☐ Special heat resistant alloy extension tubes and instructions are available for those applications where the burner tube is too short to reach the combustion chamber (such as old-fashioned gravity warm air furnace installations).

⚠ **WARNING: BURNER CABINET MUST BE MOUNTED IN ORIENTATION SHOWN IN FIGURES 1 AND 2. ANY OTHER MOUNTINGS MAY CAUSE A DANGEROUS CONDITION, AND WILL VOID BURNER WARRANTY AND AGENCY APPROVALS. NON-STANDARD ARRANGEMENTS MAY BE AVAILABLE FOR SOME MODELS-CONSULT FACTORY FOR DETAILS IF REQUIRED.**

☐ Before permanently setting the burner in place, check that the main burner casting and pilot ports are free of foreign materials, and also that the spark electrode assembly has not been damaged or displaced. See Figure 7.

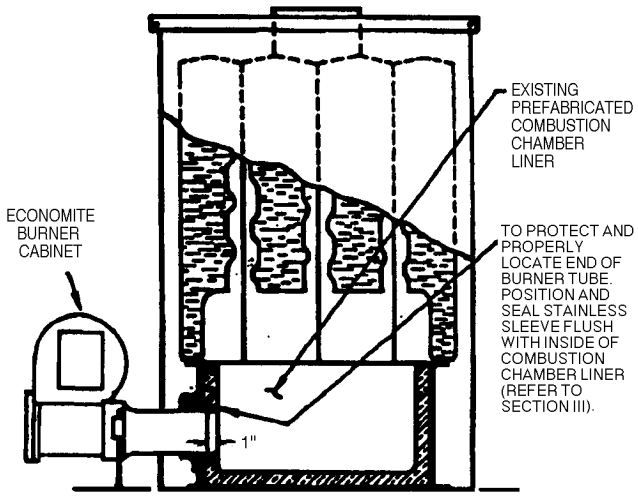

FIGURE 1 Dry Base Boiler with Combustion Chamber Liner (Warm Air Furnace Construction is Similar)

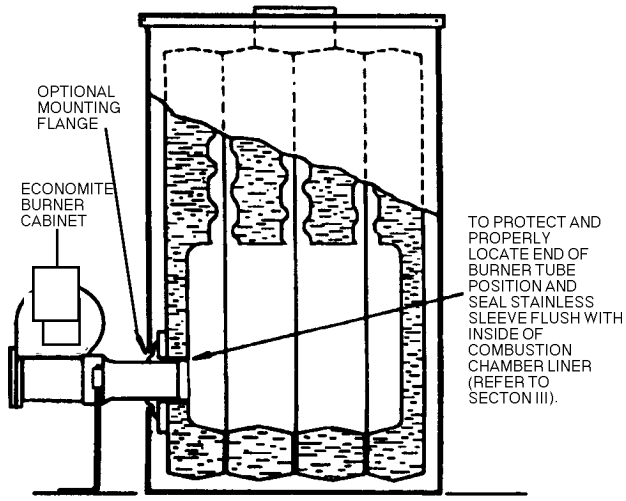

FIGURE 2 Wet Base Boiler with Unlined Combustion Chamber

IV CHIMNEY, VENT CONNECTOR AND DRAFT CONTROL

⚠ WARNING: The chimney shall be inspected for unsafe conditions such as deteriorated masonry and excessive soot or other blockage or potential blockage. Installation must conform with local codes or in the absence of local codes with NFPA , ANSI Z223.1 latest edition.

⚠ WARNING: The vent connector shall not be connected to a chimney already venting solid fuel burning equipment, an incinerator or an open fireplace.

☐ The Vent Connector shall be made of non-combustible, corrosion resistant material capable of withstanding the vent gas temperature produced by the gas utilization equipment and of sufficient thickness to withstand physical damage.

☐ The Vent Connector shall be as short as possible. The entire length shall be readily accessible for inspection, cleaning, and replacement.

☐ The length of horizontal uninsulated Vent Connector between chimney and a single gas utilization equipment shall not exceed 75% of the the height of the chimney above the connector, or 100% if the Vent Connector is insulated.

☐ The Vent Connector shall be installed so as to avoid turns or other construction features which create excessive resistance to flow of vent gas. It shall be installed without any dips or sags and shall slope upward at least 1/4" per foot.

☐ A manually operated damper shall not be placed in the Vent Connector or chimney of any gas utilization equipment.

☐ The Vent Connector shall be firmly attached to draft hood outlets and flue collars. Joints between sections of connector piping shall be fastened by sheet-metal screws or other approved means. The Vent Connector shall be supported for the design and weight of the material employed to maintain clearance and prevent physical damage and separation of joints.

☐ A draft hood or a barometric draft regulator shall be installed in the same room or enclosure as the equipment ins such a manner as to prevent any difference in the pressure between the hood or regulator and the combustion air supply (see Figures 3 and 4). In no case shall the relief opening of the draft hood or barometric draft regulator be located at a point lower than the top of the highest flue passage in the equipment.

☐ Gas utilization equipment requiring controlled draft may be equipped with a listed double acting barometric draft regulator, If approved by local codes (see Figure 4).

☐ A device which will automatically shut off gas to the burner in the event of sustained backdraft is required. It shall be of the listed manual reset type and installed and adjusted by a qualified service technician in accordance with the manufacturer's instructions.

☐ Refer to gas utilization equipment manufacturer for recommended vent connection requirements.

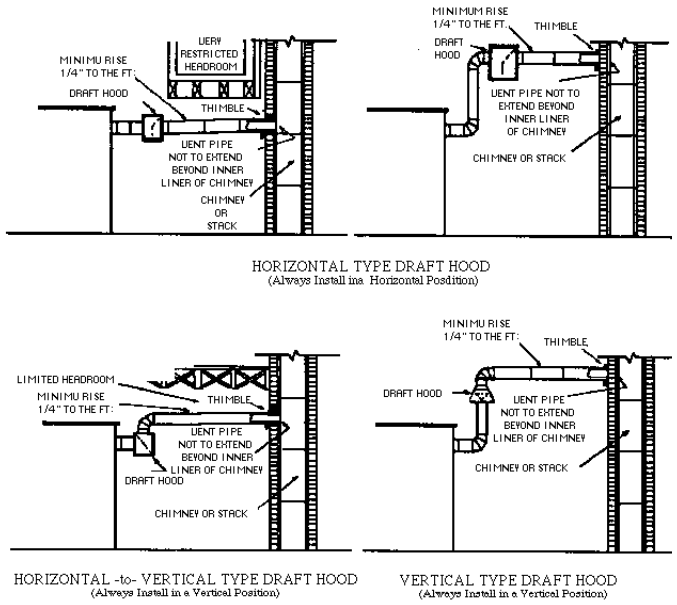

FIGURE 3 Recommended Locations forDraft Hoods

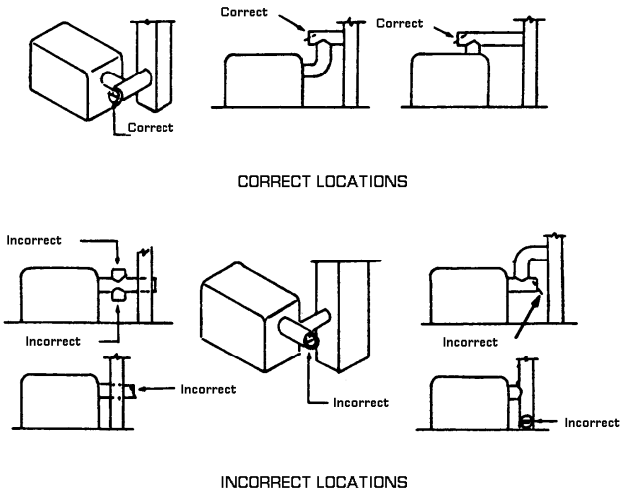

FIGURE 4 Location for Barometric Draft Regulators
Figure 3 and 4 : Copyright by the American Gas Association. Used by permission of the copyright holder.

V ELECTRICAL

⚠ **CAUTION: Refer to separate wiring diagram included with each burner.**

Installation wiring and grounding to the burner must conform to local codes, or, in their absence in the **United States** to **National Electric Code, ANSI/NFPA No. 70** latest edition; in **Canada**, to **Canadian Electrical Code Part 1, CSA Standard C22.1**

☐ Use copper wire not less than 14 gage for line voltage wiring. Hook up to a dedicated line with an on-off disconnect switch and a minimum 10 Amp breaker.

☐ The frame of the burner should be well grounded. Normally the piping and/or electric conduit will provide sufficient grounding. However, a ground lug is located in control box for positive grounding where insulated pipe couplings are used or where any doubt exists regarding grounding sufficiency.

☐ Confirm that the polarity is correct—hot wire to strip terminal L1, neutral L2—and that the neutral line is not subject to induced low voltage (check L2 to earth ground) from other equipment, as that can cause the electronic flame safeguard to malfunction.

☐ Each installation must include suitable limit control(s). Existing oil burner combination operating and limit controls are normally NOT SUITABLE for gas burner use.

☐ Connect motors used on forced air furnace fans or boiler pumps to a combination limit control and switch.

⚠ **CAUTION: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.**

VI PIPING

⚠ **CAUTION: The available gas pressure should be within the limits shown in SPECIFICATIONS section. Excessive pressure may damage electric valves, regulators and manual valves. If the supply pressure exceeds the 14.0"W.C. maximum, a suitable high pressure regulator must be installed ahead of the Main Manual Shut-Off Valve shown in Figure 5.**

☐ The burner gas supply piping should branch off from the main line as close to the gas meter as possible. Do not connect to the bottom of a horizontal section. Use new black pipe and malleable fittings free of cutting and threading burrs or defects.

☐ Provide a sediment trap, union and 1⁄8" pressure tap in piping close to burner as shown in Figure 5.

☐ Use pipe joint compound approved for use with Liquid Petroleum Gases.

☐ Piping must also comply with your local codes.

☐ To obtain the maximum firing rate of 700 MBH, the NATURAL gas supply piping must be sized to provide a minimum of 5.0"W.C. pressure (11.0"W.C. PROPANE) to the inlet of the main safety valve when the burner and all other gas utilization equipment are on. The pilot regulator can be mounted in any position, the main regulator should be mounted upright and in a horizontal run of pipe.

☐ If the burner piping must be rearranged because of space limitation, be sure to carry out the general arrangement shown in Figure 5.

☐ Run full size pipe or tubing from regulator vent openings to outside of building. Provide no traps in the vent lines and terminate away from all doors and windows; also make provisions for keeping rain and foreign objects from entering the vent piping.

☐ When the burner is installed in the vestibule of jacketed equipment, it is recommended that the Safety Shut - Off Valve(s) be left adjacent to the burner within the vestibule and the Main Manual Shut-Off Valve be installed outside.

☐ When high supply gas pressure is encountered, as in the case in many industrial plants, the gas line size can be reduced to allow for a greater pressure drop; however, the size must be sufficient to deliver burner rating pressure.

⚠ **CAUTION: High gas pressure supply lines require the proper pressure reducing regulators. Install two separate high pressure regulators of the Tight Shut-Off type upstream of the low pressure regulators. One sized for main gas input, and one suitable for the minimum flow regulating capacity of the pilot.**

☐ The high pressure regulators may be substituted for the low pressure regulators. If high pressure regulators are used as substitutes, they must be adjustable down to a minimum of 2.0"W.C. outlet pressure for the pilot and 5.0"W.C. for the main gas. If they are additions they must be adjustable down to the maximum burner inlet pressure rating (14.0"W.C.)

⚠ **DANGER: Explosion hazard.**
Do not use oxygen for pressure testing.
An explosion could occur during initial start up.

⚠ **CAUTION: Because it is difficult to accurately control pressure during supply pipe leak testing, it is recommended that all low pressure (14.0"W.C. max.) components, both main and pilot, be disconnected during testing. Exposing low pressure regulators and valves, including manual valves, to pressures over 1/2 PSIG (14.0"W.C.) will cause damage and void all warranties.**

☐ When the gas supply line is about to be put into service it must be rested to insure that it is gas tight. Use air or inert gas under pressure and test with soap and water or other liquids to locate leaks.

☐ Before gas is turned into the system, a check must be made to see that there are no open fittings and to make sure the burner main and pilot manual valves are closed.

☐ After checking above, purge the gas line up to the burner inlet. Purging the air from the gas supply line at this step will expedite the first light-off.

PIPE SIZE	TYPE OF GAS	APPROXIMATE CAPACITY-MBH LENGTH OF PIPE				
		10	20	40	60	100
3/4 (400-33 only)	Natural	275				
	Propane	400	300	200		
1	Natural	500	350	250	200	
	Propane	700	550	375	300	225
1 ¼	Natural	700	700	500	400	300
	Propane		700	700	625	475
1 ½	Natural			700	600	450
	Propane				700	700
2	Natural				700	700

⚠ CAUTION: Purge outside the building. Do not purge into the gas utilization equipment combustion chamber.

⚠ CAUTION: Do not exceed maximum or minimum rated capacity of burner model as shown in Table 1. Capacities shown are for a total pressure drop of 0.3"W.C. For 0.5"W.C. pressure drop, multiply capacity shown by 1.3 For higher permissible pressure drops, consult your utility.

TABLE 2: Schedule 40 NPT Pipe-Capacity Chart

VII MAIN GAS SPUD SELECTION

Burners are approved for use with NATURAL or PROPANE gas and should be used only with the gas specified on the rating plate.

☐ The gas input should be set at the heating rate determined by the building heat loss and/or heating plant survey, but not exceeding the rated maximum input of the gas utilization equipment or Economite burner.

☐ Burners are shipped equipped for NATURAL gas; the model 400 with a 11/32 drill spud installed, and the F400 with the spud removed. Compare the gas input required with the spud capacities shown in the spud table and, if necessary, install the spare spud (see Figure 7).

NATURAL GAS			PROPANE GAS		
SPUD DRILL SIZE	BURNER INPUT MBH[1]	MANIFOLD PRESSURE W.C.[2]	SPUD DRILL SIZE	BURNER INPUT MBH[1]	MANIFOLD PRESSURE W.C.[2]
11/32 (.343)	185	1.5"	#21(.159)	185	10.0"
	300	3.5"	#15(.180)	250	
25/64 (.390)	300	2.0"	#9(.196)	300	
	400	3.5"	#3(.213)	350	
7/16[3] (.437)	400	2.0"	#1(.228)	400	
	540	4.0"	17/64(.265)	540	
SPUD RE-MOVED	540	1.85"	9/32(.281)	625	
	700	3.2"	19/64(.296)	700	

DATA IS APPROXIMATE AND BASED ON "0" OVERFIRE PRESSURE AT SEA LEVEL

1. Input range of spud. Adjust the main regulator to vary the manifold gas pressure and burner input within the range shown for a specific spud drill size. With PROPANE, do not exceed 11.0"W.C. under any circumstances.
2. Approximate gas pressure at manifold gas pressure tap.
3. Drill out 25⁄64 spare spud to 7⁄16.

TABLE 3: Spud Capacity and Preliminary Gas Settings.

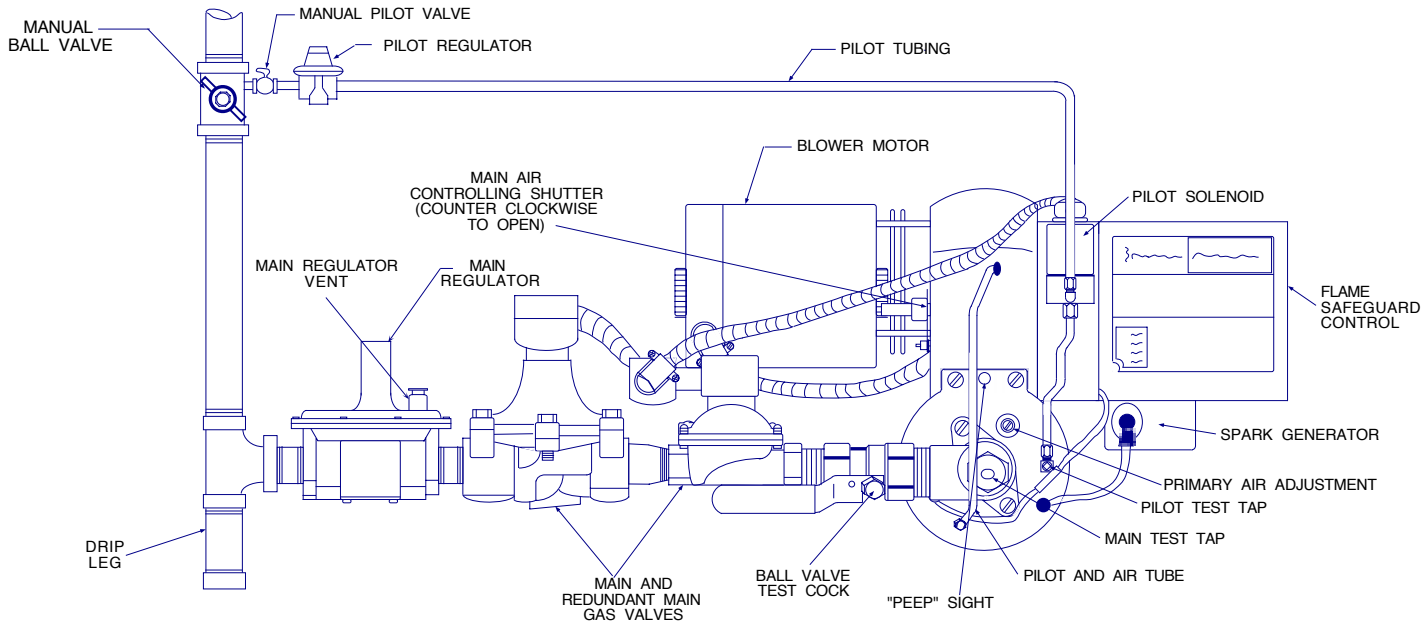

FIGURE 5 Piping Connections

VIII INITIAL START UP AND ADJUSTMENT

⚠ WARNING: Ignition is automatic. Make spark observations into combustion chamber only with Main and Pilot Manual Shut-Off Valves closed. Confirm that gas utilization equipment does not contain any accumulated gases. Purge as described below.

CAUTION: Cover plates, guards, and enclosures must be maintained in place at all times except during maintenance and service.

1. Check the piping and valves for gas leaks. Apply a weak liquid soap solution to unions and joints with the gas supply on. Leakage will be indicated by the appearance of soap bubbles. Locate and correct all gas leaks before proceeding.

⚠ WARNING: DO NOT USE OPEN FLAME

2. Make sure that the burner main and pilot gas lines are completely purged of air. Do not purge into the combustion chamber.
3. Make sure the burner power switch is off, Main and Pilot Manual Shut-Off Valves are closed, and motor is free to rotate. Reset flame safeguard and all limit controls.

⚠ CAUTION: **Make sure that the capacity range of the installed spud and the combustion air-shutter setting are suitable for the gas utilization equipment. Refer to Section VII and Table 2.**

4. Turn on the burner power switch, and allow motor to run through the pre-purge and ignition cycle. Check the blower wheel for proper rotation. After a short run, the flame safeguard will lock out, stopping the motor. Wait one minute, then reset flame safeguard.
5. Turn on pilot manual shut-off valve. With Main Manual Shut-Off Valve still closed, turn on main line switch. Motor will start. When pre-purge period has elapsed, flame safeguard will energize pilot solenoid valve and ignition transformer. Quickly observe pilot flame.When flamerod senses pilot flame, the flame safeguard will energize the main valves. No main flame will occur due to closed Main Manual Shut-Off Valve. Set pilot pressure to achieve the largest stable blue flame with a base that burns firmly within the pilot tip. The best operating pressure is usually about 3.5"W.C. Natural (2.25"W.C. Propane). If pilot fails to light see sections IX and XI.
6. Test for ignition and stability. Cycle the burner several times with both open and closed air shutter. Ignition and flame safeguard response will be prompt with a good flame. Check flame following the instructions provided by the flame safeguard manufacturer.

⚠ WARNING: Repeated unsuccessful attempts to light may result in accumulated gases in gas utilization equipment and chimney. To prevent these gases from reaching an explosive level, periodically purge the gas utilization equipment and chimney as described above.

7. Check operation of the electronic flame detection circuit by turning off the pilot manual valve with pilot burning and Main Manual Shut-Off Valve still closed. The circuit to the main automatic pilot valve should be broken immediately.
8. Turn off line switch to stop the burner. Reset flame safeguard. With On-Off burners, lock air shutter wide open. On modulating burners, remove wires of modulating controller from and "W" terminals on the modulating motor and jumper terminals "R-B" to drive input adjuster to high fire position when energized. On 2-step burners, jumper terminals "3-4" on valve actuator valve will open to high fire position when energized. main flame ignites. Slowly continue opening the Main Manual Shut-Off Valve to the wide open position when energized.
9. To make a preliminary setting of the burner input, determine the manifold gas pressure required from Table 3 and adjust the main gas pressure regulator accordingly. See Section XI.
10. To determine the firing rate for NATURAL gas, accurately time test dial for the number of seconds for one revolution and use the following formula. All other gas utilization equipment must be off.

$$\frac{3600 \times \text{test dial size} \times \text{BTU value}}{\text{no. of seconds for one rev. test dial}} = \text{BTU/Hr.}$$

Then divide by 1,000 for MBH value.

Example: $\frac{3600 \times 1 \times 1000}{10}$ = 360,000 BTU/Hr. = 360 MBH

11. Adjust combustion air shutter to provide a quiet, soft blue flame with well defined orange and yellow tips for NATURAL gas or with well defined yellow tips for PROPANE gas.
12. The primary air adjustment which affects the flame length has been set wide open for average conditions. Decrease the primary air if a longer, softer flame is desired.
13. Check the operation of the burner; start and stop it several times with the thermostat or operating control.
14. With the burner running, check the operation of all limit and associated controls.
15. PERFORM THE FOLLOWING FINAL ADJUSTMENTS for combustion and flue gas temperatures. Take the flue gas samples and temperature immediately ahead of the draft control.
    A. The flue gas temperature should be above 325°F but not exceeding 550°F. Excessive flue gas temperatures will result in low efficiencies. Low flue gas temperature may cause excessive condensation. Reset gas input if necessary to adjust stack temperature.
    B. Make the final setting of the combustion air shutter by checking the flue gases with an **ORSAT** or similar combustion testing instrument. The carbon monoxide content should conform to local codes, or, in their absence to the level specified in the Unites States or Canadian Standard referenced on the front cover of this manual. The carbon dioxide content should be approximately 9.5% for NATURAL and 12.1% for PROPANE, or within the limits prescribed by local codes.
16. Check the draft control to make sure there is no spillage of flue products into the room.

After the initial start-up procedure, the following steps can be followed for routine start-up and shut-down on a seasonal or extended basis.

BURNER START UP

1. Make sure burner power switch is off.
2. Set controller to call for heat.
3. Open firing door.
4. Open Main and Pilot Manual Shut-Off Valves.
5. Reset flame safeguard.
6. Turn on burner power switch.
7. Close firing door after main flame ignites.
8. Reset controller to desired setting.

BURNER SHUT DOWN

1. Turn off burner power switch.
2. Close Main Manual Shut-Off Valves.
3. Close pilot manual Shut-Off Valves.

PART 2 **SERVICE**

⚠ **DANGER: Do not tamper with the unit or controls. If trouble occurs contact the installing contractor, service agency, or fuel supplier. See front cover.**

⚠ **WARNING: Be sure that the main and pilot manual Shut-Off Valves are closed and the burner power supply is turned off before removing any parts for service.**

⚠ **CAUTION: Cover plates, guards, and enclosures must be maintained in place at all times except during maintenance and service.**

IX PILOT

The pilot is of the premix, blast type. The full force of blower air is brought into the mixing tube where the proper amount of gas is added through the pilot orifice. This mixture is discharged through the pilot which contains a perforated flame retention plate. The outer holes diverge to spray the mixture against the side wall of the pilot tip to provide flame retention. The mixture through the center port provides the flame that contacts the flame detection rod and also ignites the main gas.

☐ Surrounding the base of the pilot flame is a conical shroud which protects the flame against extraneous air currents and inhibits "blow-off" from an overly rich flame.

MODEL	ORIFICE DIAMETER	NOMINAL BTU/Cu. Ft. Hr. NATURAL 1000—PROPANE 2500		
		APPROX. CAPACITY BTU/Hr.	PILOT GAS PRESSURE	
			NATURAL	PROPANE
400-33	DRILL #68 .031 DIA.	2500	2.5"-4.0"W.C.	2.25"-3.5"W.C
F400-33	DRILL #55 .052 DIA.	7000		

TABLE 4: Pilot Specifications

⚠ **CAUTION: Do not indiscriminately increase pilot orifice size. Pilot troubles are rarely cured in this manner and new troubles may be created.**

☐ The pilot gas orifice is the same size for both natural and propane gas, consequently the gas pressure required for propane is lower than that required for natural gas. Under normal conditions, with a slight negative pressure in the combustion chamber, pilot operating pressures are 3.5"W.C. NATURAL gas and 2.25"W.C. PROPANE.

☐ Some conditions which may require a change from the normal setting include: extremely long tubing connections between the regulator and pilot solenoid, high negative or positive combustion chamber pressure, actual air shutter setting and altitude extremes.

☐ Do not subject the pilot to an inlet pressure over 14.0"W.C. See section VI PIPING for high pressure gas. Note that the standard pilot pressure regulator is not a tight shut-off and, during standby, the outlet pressure will build up to the full inlet pressure.

☐ The spark rod is located on the center line of the pilot and is positioned so the high tension voltage will arc to the inside of the center port of the retention plate (see Figure 7).

☐ The flame rod must be positioned as shown in Figure 7 so that the flame safeguard will detect a proper flame. Note that it is slightly above the centerline of the pilot.

☐ Both the spark and flame rods are currently carrying conductors and, along with their connecting wires, must be kept free of contact with conductive metal parts of the burner. Rod insulators and wire insulator should be clean, dry and free of cracks.

☐ Rods are made from heat resistant alloys and can be expected to have a long service life. They should be routinely inspected, however, for corrosion or loss of metal.

☐ The pilot air tube must be kept free of kinks or inside obstructions and its inlet end must be positioned per Figure 7, otherwise air flow could be reduced and adversely affect the pilot flame.

X MOTOR, BLOWER INTERLOCK & CENTRIFUGAL ACTUATOR

⚠ **CAUTION: BEFORE SERVICING, mark with a scribe line or measure position of combustion air controlling shutter, so that it can be reset to its original position following servicing.**

The blower, which is driven by the motor, functions to supply a constant and dependable source of combustion air. A centrifugal actuator is mounted on the blower wheel and, through the interlock switch, proves blower operation on every run.

☐ Cleaning of the blower wheel is usually the only service required. Need for cleaning is indicated if the air cage assembly shows an accumulation of dust and lint, or if the character of the flame indicates a deficiency of air. Motor cooling air vents if present should also be cleaned at this time.

☐ The blower side plate, motor and wheel are removed as an assembly. Disconnect the motor wires, and conduit then remove the side plate screws.

☐ Unless the blower wheel location has been disturbed, a replacement switch and bracket assembly will assume the correct position when mounted. Confirmation of the correct assembly can be made by measurement and test.

☐ A) With the switch assembly unmounted, insert a probe through the blower opening and push actuator disk inward as far as it will go. Mark the depth of insertion on the probe and measure. Measure the portion of the switch plunger (unrestrained) protruding past the bracket arms. The probe insertion measurement should exceed the switch stem protrusion by at least 1⁄16".

☐ B) Insert the switch stem through the blower opening until it just contacts the actuator disk. Then push in slowly. The switch should "click" and the actuator spring should compress approximately ⅛" before the bracket arms are seated. If conditions A and B are not met reset switch location in the mounting bracket.

☐ In both cases above check the results with an electrical continuity test. The circuit across terminals C and NC should be open when the blower is idle and closed when the blower is running.

☐ When shaft location of blower wheel is disturbed, reassemble with a 1/16" clearance as shown in Figure 6.

XI GAS PRESSURE REGULATOR

The main gas pressure regulator is used to automatically reduce and maintain constant gas pressure at the burner. The regulator furnished as standard is suitable for a maximum inlet pressure of 14.0"W.C. The springs installed provides for an adjustable outlet pressure range of 2.0" to 5.0"W.C. and are factory set for 3.0"W.C. This regulator is not of the “tight shut-off” type and, consequently, when the burner is on standby, the outlet pressure will build up to equal the full inlet line pressure. Outlet pressure settings must be checked while the main gas is flowing.

☐ To adjust the outlet pressure, remove the seal cap for access to the adjusting screw. Turning the screw clockwise will increase outlet pressure, counter-clockwise will decrease outlet pressure.

☐ When the gas supply pressure is over 14.0"W.C., special regulators are required. See Section VI.

☐ The vent in the upper diaphragm case normally breathes only air, but must be connected to the outside air to prevent escape of gas into the building in case of a ruptured diaphragm. The vent line must be of sufficient diameter, otherwise the restriction of air flow may cause sluggish opening of the regulator. The effect can be checked by comparing main flame start-up time with the vent line connected and disconnected. **The vent must never be connected to the burner combustion chamber**.

☐ When the regulator is to be installed, or replaced take care not to crush the body casting. Apply wrench only to the heavy body section adjacent to the pipe thread.

XII SOLENOID GAS SAFETY VALVES

(Main and Redundant Main; Standard Construction.)

When the valve operators are electrically energized the plungers lift the valve disk off the valve seats, allowing gas to flow. When the current is broken the valves close. They will normally require no service. However, dirt or foreign matter on the valve seats could cause leakage. If leakage is detected or if the operator malfunctions replace the entire valve. After replacement check for leakage. If the valve is removed from the piping do not use the operator assembly as a lever to turn valve. Apply wrench on the valve body flat adjacent to pipe being removed.

XIII OPTIONAL MOTORIZED MAIN AUTOMATIC VALVE

(Employed with Redundant Solenoid Valve.)

☐ Motorized Main On-Off, 2-Step, and Full Modulating Valves, are available on special order. The redundant and solenoid valve may be omitted if the motorized valve includes optional "Proof of Closure Switch".

☐ When the actuator is energized, hydraulic fluid is pumped from a reservoir to a metal bellows. The bellows transfers the resulting pressure through the drive stem to open the valve. A separate spring return drive arm operates the blower shutter.

☐ For general service, the valve should be checked for operation. The valve actuator may be removed from the valve body, however, do not disassemble actuator; if malfunction occurs, replace entire actuator assembly. The valve body is also not field reparable. If leakage is detected the entire valve body must be replaced.

XIV FLAME SAFEGUARD

⚠ WARNING: Explosion hazard. Do not use any electronic device if it gets wet. It can malfunction and cause serious injury or death. Replace any device that has been wet.

☐ Standard F400-33 and 400-33 burners are equipped with a Honeywell RM7895 microprocessor based burner control, employing a flame rectification system of flame detection. Burner construction for special codes and/or insurance requirements such as Factory Mutual or Industrial Risk Insurers (IRI) may require alternate controls. (Refer to Section XV Special Equipment). A safe start and run control sequence is provided with instantaneous response to presence or loss of flame signal. Flame failure response time is 3-seconds.; Pilot Flame Establishing Period (PFEP) is field selectable from 4 or 10-seconds. The RM7895 features a pre-purge time (30-seconds for ON-OFF, 90-seconds for 2-Step or Modulating burners), and a plug-in amplifier. An airflow circuit is also field selectable to allow either lockout or recycle upon loss of airflow. Five LED’s (light emitting diodes) are provided to display sequence information. Refer to the Honeywell RM7895 literature for detailed operating information, configuration requirements, testing, and service.

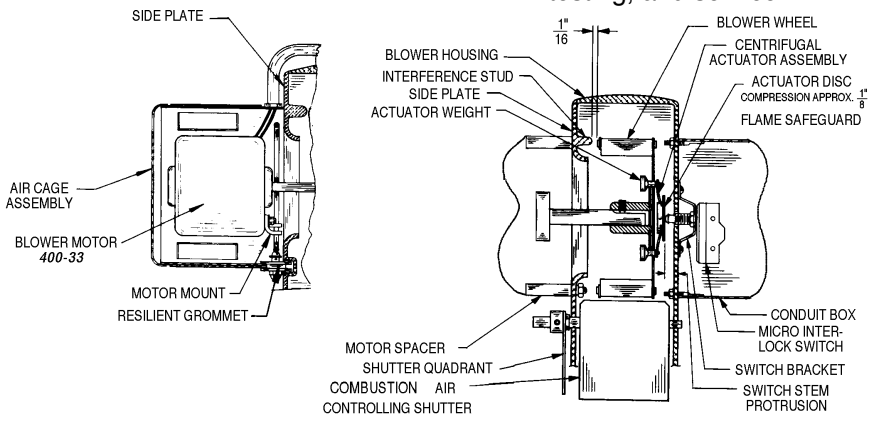

FIGURE 6 Motor, Blower, and Interlock Assembly

INITIATE ("POWER" LED is lit).

☐ The RM7895 enters the INITIATE sequence when it is powered. The **INITIATE** sequence lasts for ten seconds unless the voltage or frequency tolerances are not met (refer to Honeywell RM7895 literature for criteria). When tolerances are met, the **INITIATE** sequence will restart. If the conditions not corrected and the hold condition exists for four minutes, the RM7895 will lock-out. Causes for hold conditions in the **INITIATE** sequence are in the Honeywell RM7895 literature.

STANDBY ("POWER" LED is lit).

☐ The RM7895 is idle in this state of sequencing. When the burner switch, limits, operating limit controls, and all microprocessor monitored circuits are in the correct state for the RM7895 to continue, sequencing will advance to **PREPURGE**.

PREPURGE ("POWER" LED is lit).

☐ The RM7895 in this application features a prepurge time of 30-seconds for ON-OFF, 90-seconds for 2-Step or Modulating burners.

☐ Once the **STANDBY** sequence has a "**CALL FOR HEAT**" input, normal start-up prepurge will be initiated.

A. The blower motor is powered to start the prepurge sequence.
B. The airflow interlock switch must close in ten seconds of prepurge or within the specified purge card timing. Otherwise a recycle to the beginning of prepurge or lockout will occur, depending on how the airflow switch selectable jumper is configured. Refer to Honeywell RM7895 literature for configuration requirements.

IGNITION TRIAL

1. PILOT FLAME ESTABLISHING PERIOD (PFEP)
   A. The pilot valve and spark generator are energized.
   B. Flame must be proven by the end of the 4 or 10-second PFEP to allow the sequence to continue. If flame is not proven by the end of PFEP, a safety shutdown occurs.
2. MAIN FLAME ESTABLISHING PERIOD (MFEP)

☐ After the ignition trials, and with the presence of flame, the main valve is energized. ("MAIN" LED will be lit.) If a flame-out occurs, the RM7895 will lockout or recycle within 3-seconds, depending on "jumper" configuration. Refer to Honeywell literature for proper configuration.

RUN

☐ The RM7895 is now in **RUN** mode and will remain in run mode until the controller input opens, indicating that the call for heat has been satisfied or a limit has opened. Once this occurs the RM7895 will sequence back to the **STANDBY** mode.

Notes:
1. During **STANDBY** and during RM7895 sequencing the "**POWER**" LED will blink every four seconds. This is normal.
2. The "**ALARM**" LED will be lit in the event of any flame failure.
3. To maintain proper operation of this device in **MUST** be electrically grounded. Refer to Honeywell RM7895 literature for criteria.

XV SPECIAL EQUIPMENT (OEM VERSIONS)

Special equipment, either factory or field installed, can cause variations in the procedures and descriptions given in this manual. Generally, any burner ordered with special factory installed equipment will be supplied with the appropriate wiring diagram and related instruction manuals from the special equipment manufacturer Consult these manuals to identify any differences in construction, operation, and testing. Field installed special equipment is the responsibility of the installing contractor.

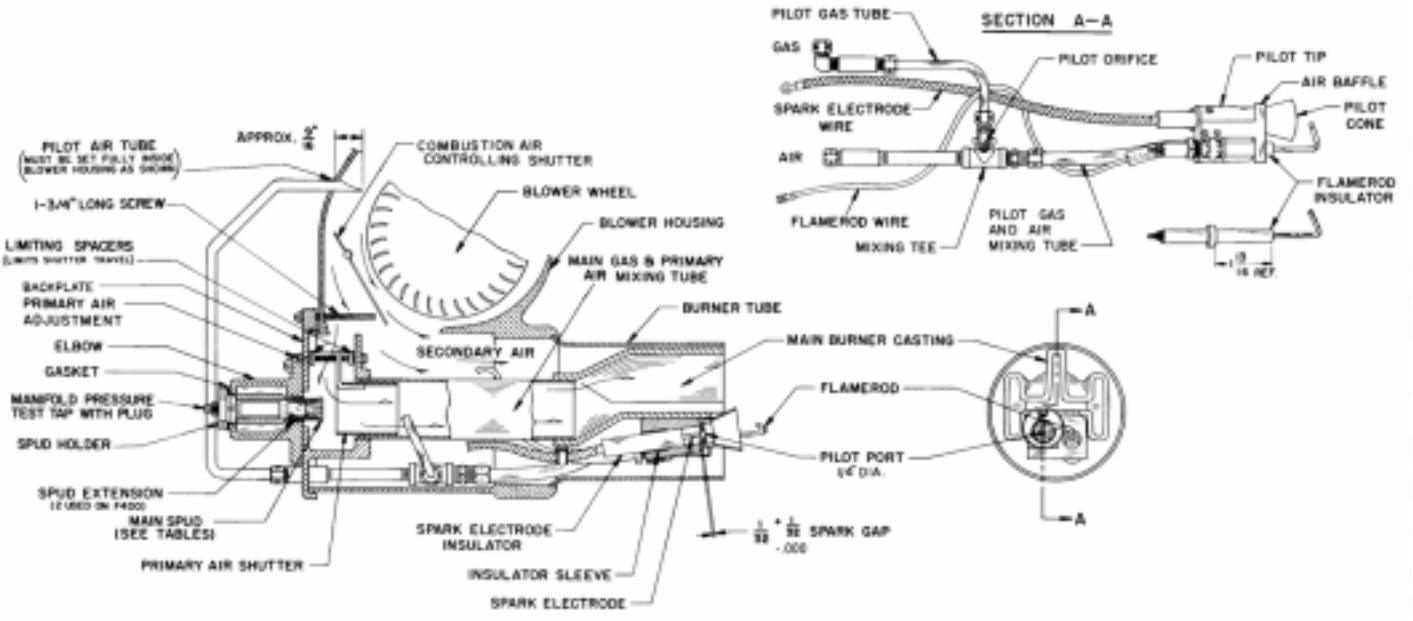

FIGURE 7 General Assembly

TROUBLE CHART

MAKE SURE THE THERMOSTAT AND OPERATING CONTROLS ARE CALLING FOR HEAT.

⚠ **CAUTION:** If a test indicates an electrical component may be defective, before replacing it, make sure that its associated wiring is not at fault.

1. MOTOR WILL NOT RUN.
- A. No current.
- B. Defective or misadjusted limit or thermostat.
- C. Flame safeguard control on lockout.
- D. Defective flame safeguard control.
- E. Motor overload out.
- F. Defective motor.

2. MOTOR RUNS, PILOT WILL NOT LIGHT, FLAME SAFEGUARD LOCKS OUT.
- A. Air in pilot gas line.
- B. Low gas pressure.
- C. Clogged pilot orifice.
- D. Pilot regulator misadjusted or defective.
- E. Defective spark electrode or spark generator.
- F. Defective high tension wire.
- G. Wrong pilot orifice.
- H. Defective pilot valve.
- I. Pilot air tube clogged.
- J. Incorrect spark gap.
- K. Pilot regulator vent clogged.
- L. False flame signal; flame safeguard control.
- M. Defective flame safeguard.

3. MOTOR RUNS, PILOT WILL NOT LIGHT, FLAME SAFEGUARD REMAINS "SET."
- A. Defective centrifugal actuator.
- B. Defective blower interlock switch.
- C. Slow motor.
- D. Defective purge timer.
- E. False flame signal.
- F. Defective flame safeguard.

4. PILOT LIGHTS, NO MAIN FLAME, RELAY LOCKS OUT.
- A. Poor pilot flame adjustment.
- B. Clogged pilot air tube.
- C. Defective flame rod or wire.
- D. Flame rod mislocated.
- E. Spark interference.
- F. Pilot regulator vent clogged.
- G. Defective plug-in amplifier.
- H. Defective flame safeguard.

5. PILOT LIGHTS, NO MAIN FLAME, RELAY REMAINS "SET."
- A. Defective main gas valve.
- B. Closed leak test cock.
- C. Low gas pressure.
- D. Grossly misadjusted main gas and air.
- E. Defective flame safeguard.

6. SPASMODIC START.
- A. Loose wiring.
- B. Low gas pressure.
- C. Poor pilot flame adjustment.

7. SHORT FLAME.
- A. Wrong main orifice.
- B. Low gas pressure.
- C. Air shutter misadjusted.
- D. Main regulator misadjusted.
- E. Test cock partially closed.
- F. Main regulator vent clogged.

8. LONG HAZY FLAME.
- A. Wrong main orifice.
- B. High gas pressure.
- C. Dirty blower wheel.
- D. Air shutter misadjusted.
- E. Main regulator misadjusted.

9. GAS FAILS TO SHUT OFF.
- A. Dirt on valve seat(s).
- B. Defective main valve(s).