

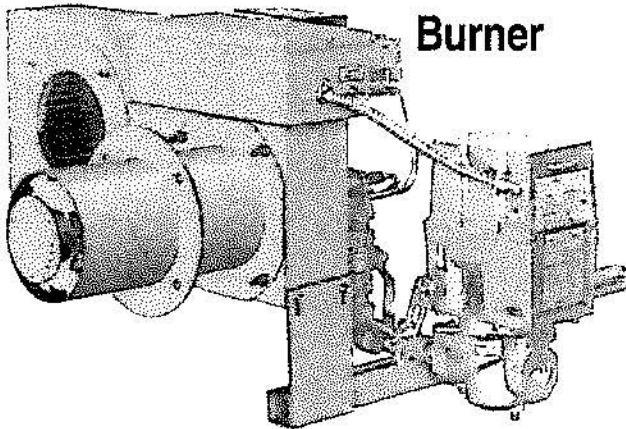
# MODEL V

# Burner Instruction Manual

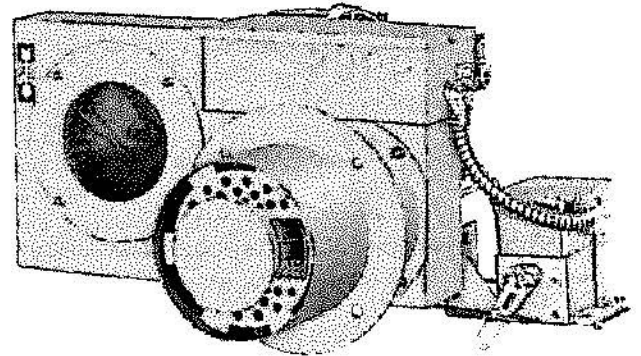
FOR  
GAS FUEL SYSTEMS

**NOTE:** YOUR BURNER MAY HAVE A LETTER *PREFIX* OR *SUFFIX* ADDED TO THE MODEL DESIGNATION, HOWEVER, THIS IS FOR IDENTIFICATION PURPOSES ONLY AND DOES NOT AFFECT THE INSTRUCTIONS IN THIS MANUAL

Typical  
Model V6  
Burner



Typical  
Model V8 Burner



## 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 your building.
- Immediately call your gas supplier from a neighbor's phone. 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.

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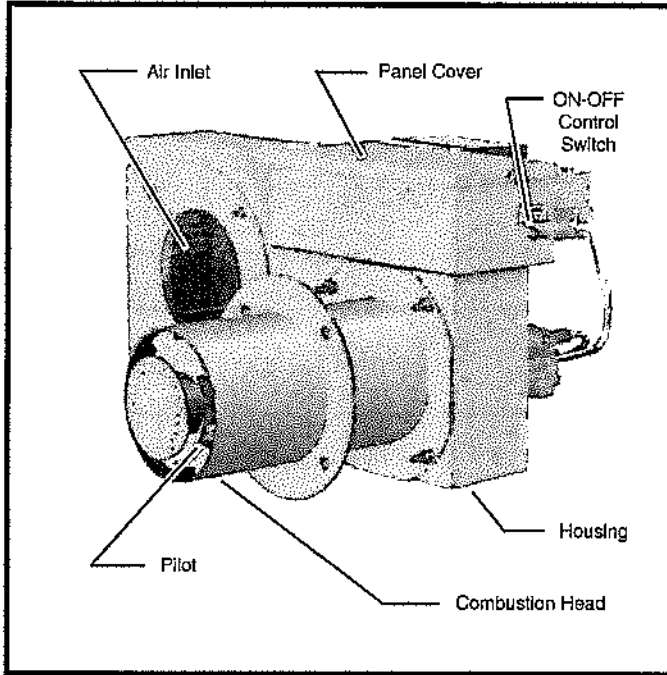
# PART I

## BURNER FAMILIARIZATION AND PRELIMINARY INSPECTION

**BURNER FAMILIARIZATION** - Study the following burner illustrations and determine the one which matches your unit. Take special note of the PART NAMES shown in the call-outs. Fuel Systems are described in detail in Part III.

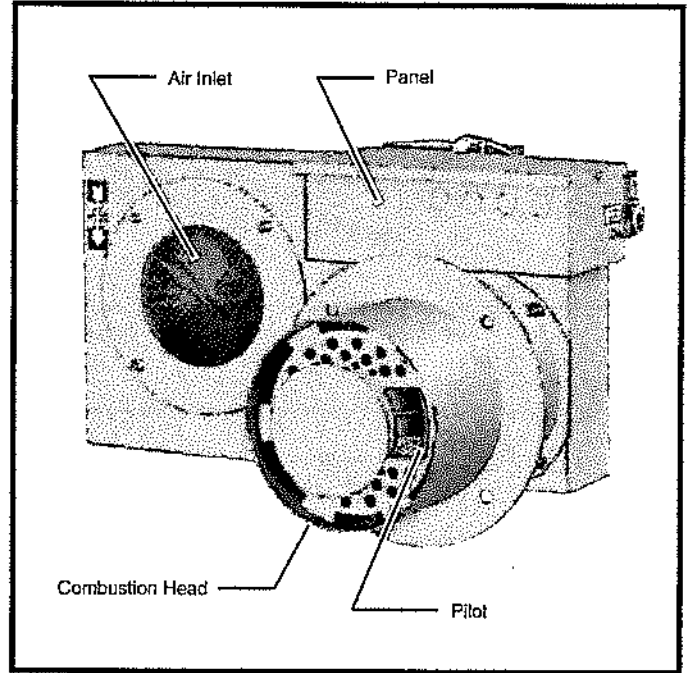
### Burner Identification

**Figure 1**



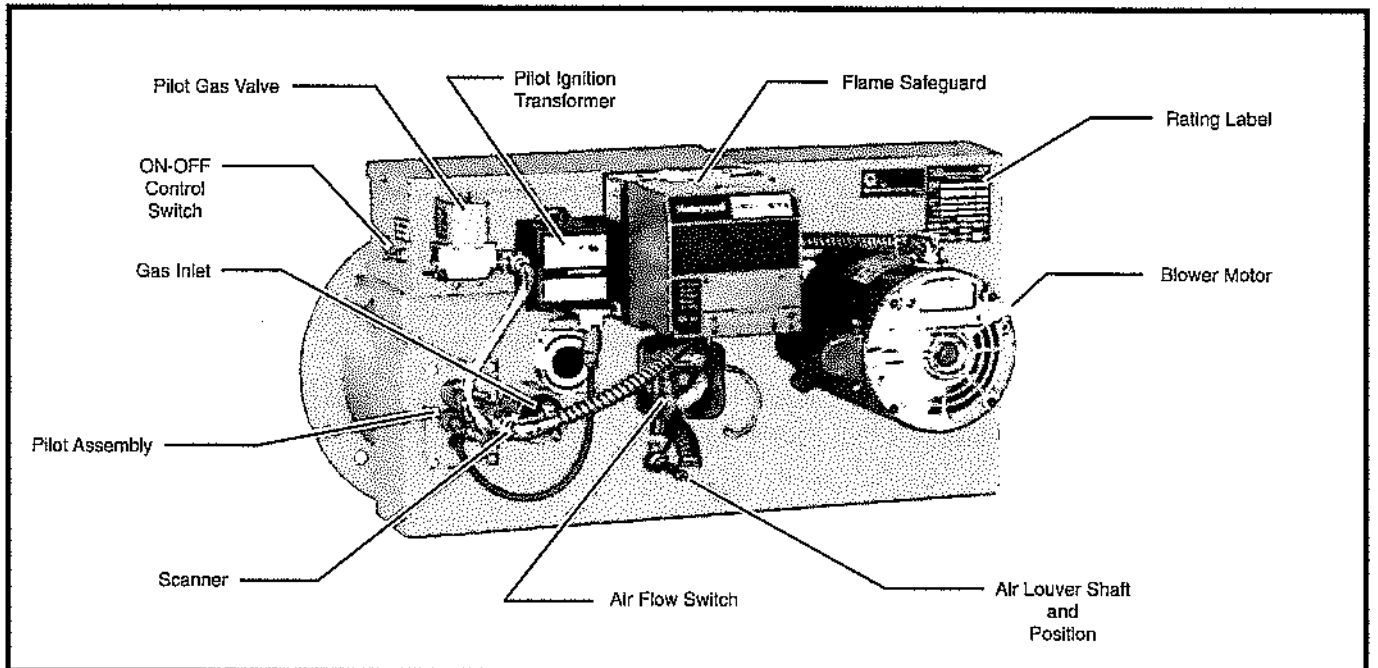
**Model V6 Head Identification**

**Figure 2**



**Model V8 Head Identification**

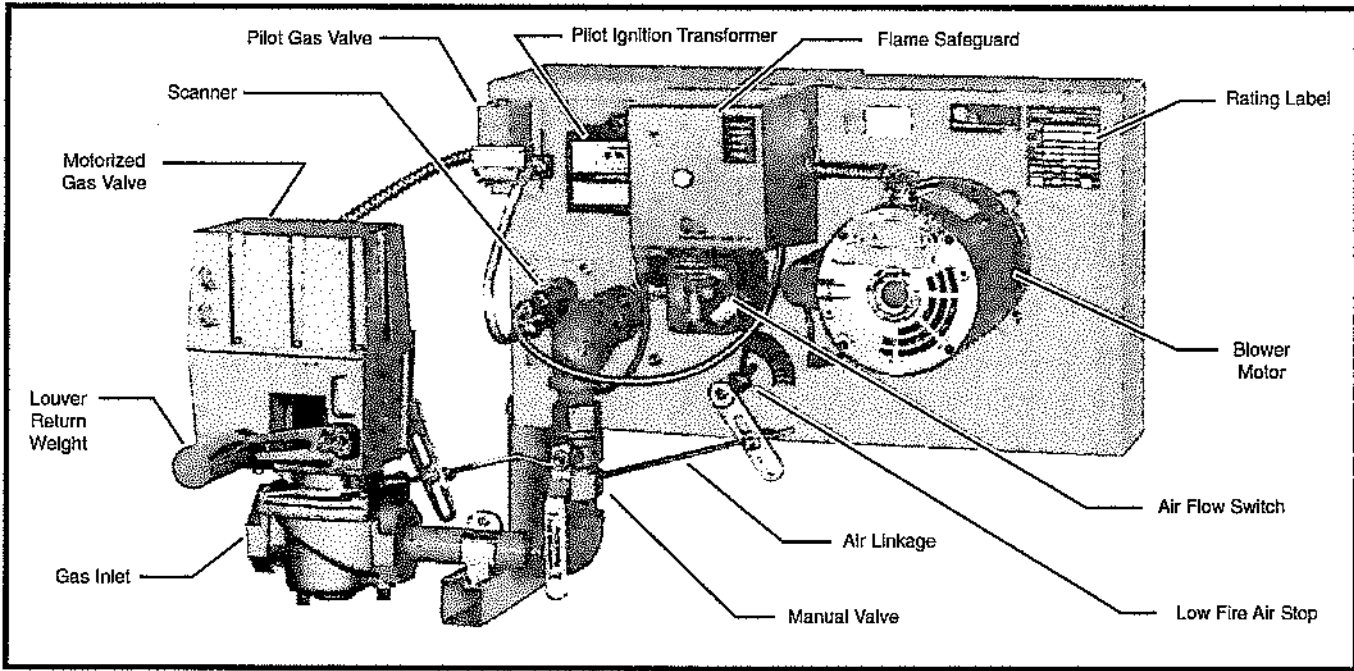
**Figure 3**



**Typical Model V with On-Off Control System**

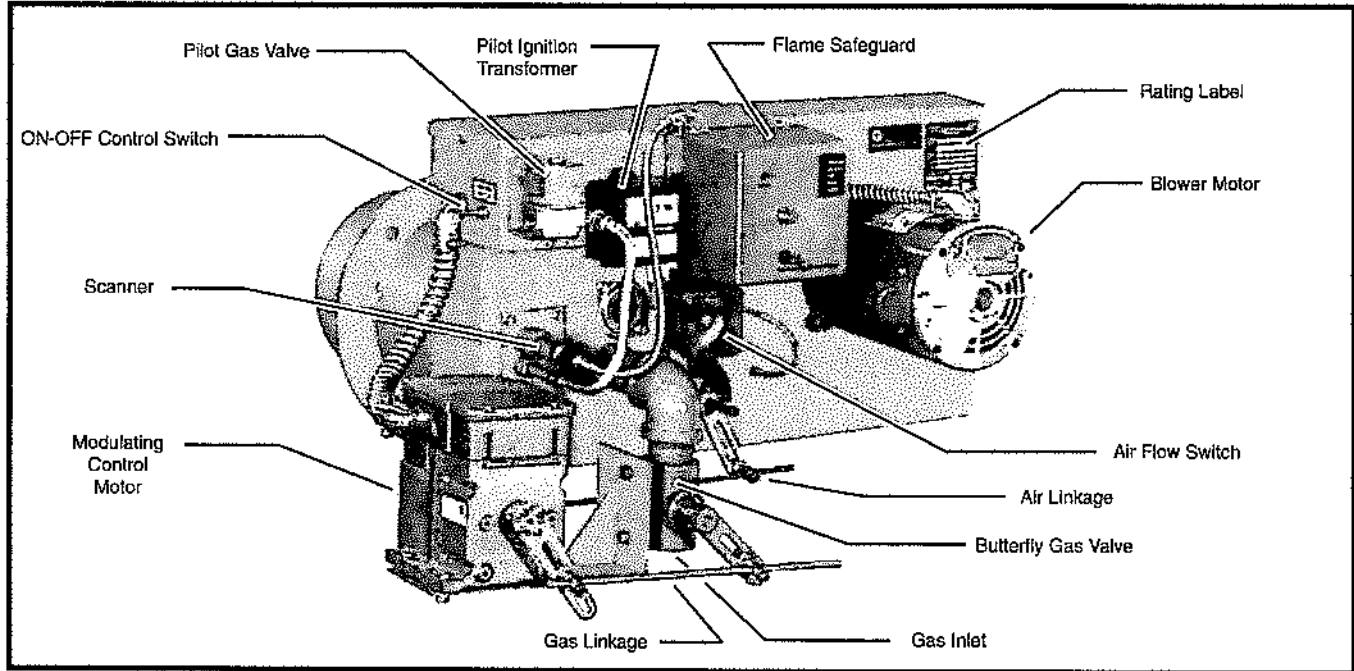
## Burner Identification

**Figure 4**



**Typical Model V with High-Low Control System**

**Figure 5**



**Typical Model V with Modulating Control System**

**PRELIMINARY INSPECTION** - The burner should be visually checked for damage and loose components. These conditions can occur during shipment, through improper handling, tampering, or through improper care and storage at the job site.

**CHECK FOR:**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li><input type="checkbox"/> Obvious damage to housing, air inlet, and components mounted thereon.</li> <li><input type="checkbox"/> Tightness of fasteners, tube fittings, plugs, etc.</li> </ul> | <ul style="list-style-type: none"> <li><input type="checkbox"/> Tightness of electrical terminals and connections.</li> <li><input type="checkbox"/> Accumulations of oil, dust, dirt, water and other foreign matter on, in, or near the burner.</li> </ul> |
|---|--|

# PART II

## INTRODUCTION

### WARNINGS

If you smell gas:

1. Open windows.
2. Don't touch electrical switches.
3. Extinguish any open flame.
4. EVACUATE people from building.
5. Immediately call the gas supplier.

The use and storage of gasoline or other flammable liquids and vapors in open containers in the vicinity of this appliance is hazardous.

In accordance with OSHA standard 1910.147, all equipment, machines and processes shall be locked out prior to servicing.

If not installed, vented, operated and maintained in accordance with the manufacturer's instructions, this product could expose you to substances in fuel or from fuel combustion which can cause death or serious illness and which are known to the State of California to cause cancer, birth defects or other reproductive harm.

Improper servicing of this equipment may create a potential hazard to equipment and operators.

#### SERVICING MUST BE DONE ONLY BY FULLY TRAINED AND QUALIFIED PERSONNEL.

Before disconnecting or opening up a fuel line and before cleaning or replacing parts of any kind.

- Turn **OFF** the manual fuel shutoff valves including pilot gas cock, if applicable. If a multiple fuel burner, shut **OFF** all fuels.
- Turn **OFF** all electrical disconnects to the burner and any other equipment or systems electrically interlocked with the burner.

Do **NOT** use TEFLON TAPE or compounds with TEFLON content as an oil or gas pipe sealant. TEFLON can cause valves to fail creating a SAFETY HAZARD. Warranties are nullified and liability rests solely with the installer when evidence of TEFLON is found.

Rectorseal No. 2 pipe thread compound is used for factory assembly of oil and gas piping.

This manual has been prepared to assist in the installation, operation and maintenance of your burner. It is good practice to know as much as possible about a piece of equipment before trying to install or operate it. Read the contents carefully before proceeding.

### NOTE

Installation requirements and instructions should always be covered in appropriate engineering drawings and specifications which detail the applicable building codes, etc. Information contained herein is to be used as a guide **ONLY** and not as the final authority.

## GENERAL INFORMATION

- Starting a burner is an event which normally culminates the efforts of several different contractors, manufacturers, utility and engineering concerns, sales and factory representatives, and others.
- In order for the burner to operate safely and meet its design capabilities, the interfacing fuel, air, electrical, exhaust and heating control systems must be properly sized, selected, installed and tested. Additionally, all conditions must be such that the heat generated by the burner can be safely used without endangering personnel or equipment.
- It shall be the policy that no responsibility is assumed by the company nor any of its employee(s) for any liability or damages caused by an inoperable, inadequate or unsafe burner condition which is the result, either directly or indirectly, of any of the improper or inadequate conditions described above. To insure that a safe and satisfactory installation has been made, a pre-start inspection is necessary. This inspection must be performed by an individual who is thoroughly familiar with all aspects of proper boiler/burner installation and how it interfaces with other plant or building control systems.

- Part I of this bulletin sets forth major inspection items that must be considered.

**NOTE**

This inspection should be performed before the burner startup specialist is called in. An incomplete or inadequate installation may require additional time and effort by startup personnel and cause an untimely and costly delay.

- The results of this inspection will often times identify corrections that must be made prior to start-up as well as point out potential or long range problems that may occur if corrections are not made.
- Burner start-up is a serious matter and should not be viewed as a time for "crowd gathering" by unconcerned, uninformed or unauthorized personnel. The number of persons present should be held to a absolute minimum. Instruction of operating and other concerned personnel should be done after the burner has been successfully fired and adjusted by a qualified service agency or factory start-up specialist.

**FUEL**

The model V burner will fire natural gas or LP gas. The burners must be used only with the gas specified on the rating plate.

**FIRING SYSTEM**

The burner can operate ON-OFF with fixed air inlet louver, high-low, or full modulation.

**BLOWER MOTOR**

The burner uses a capacitor start, 115 volts, 60 cycle, single phase, motor.

**AIR CONTROL**

Discharge damper provided as integral part of blower housing.

**CONTROL PANEL**

Burner mounted on blower housing.

**BLOWER WHEEL**

Squirrel cage type. The tips of the forward curved blades point in the direction of rotation.

**GAS TRAIN**

Gas trains are provided to meet installation and code requirements. See gas piping illustrations and descriptions for components.

**GAS PILOT IGNITION**

The intermittent gas pilots are ignited by an interrupted spark of approximately 14,000 volts which is supplied by the ignition transformer.

**AIR FLOW SAFETY SWITCH**

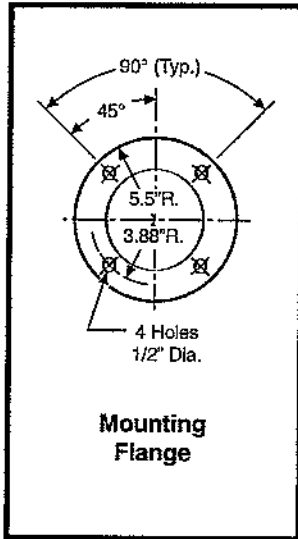
Diaphragm switch that closes only when adequate combustion air is delivered to the firing head. Loss of combustion air causes fuel valve(s) to close immediately.

**LIMIT AND OPERATING CONTROLS**

Not included with burner. Must be rated & wired for 115 volts. Limit controls should be manual reset type.



**Figure 6**

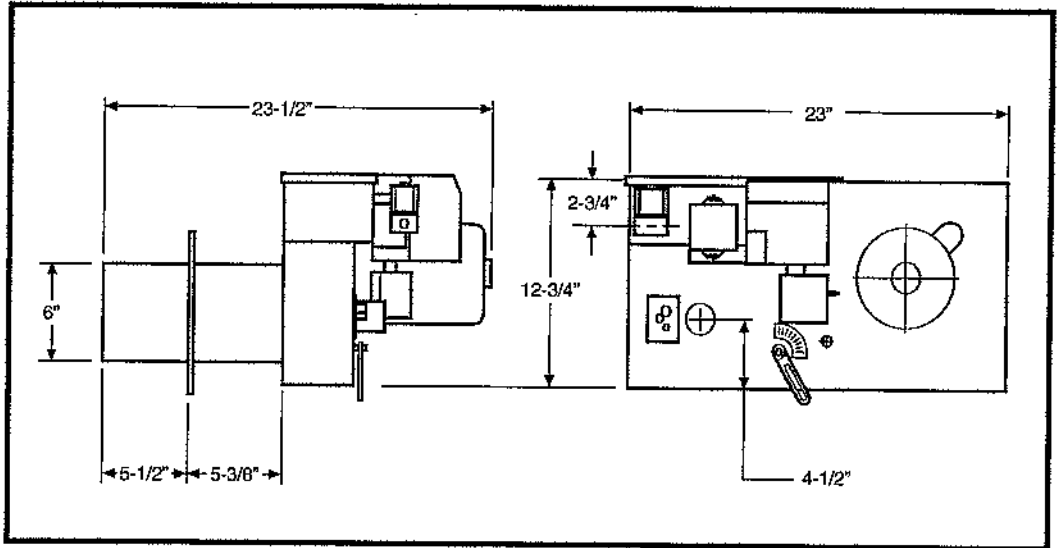


**Model V6**

**Figure 7**

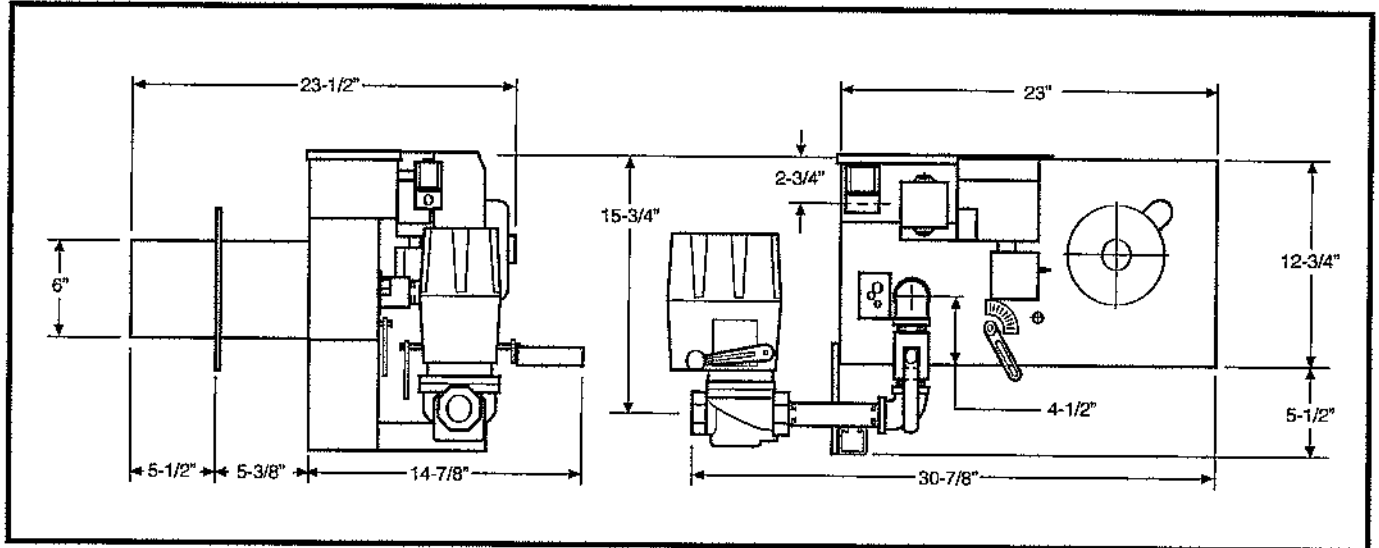
**Dimensions**

Dimensions May Be Changed Without Notice



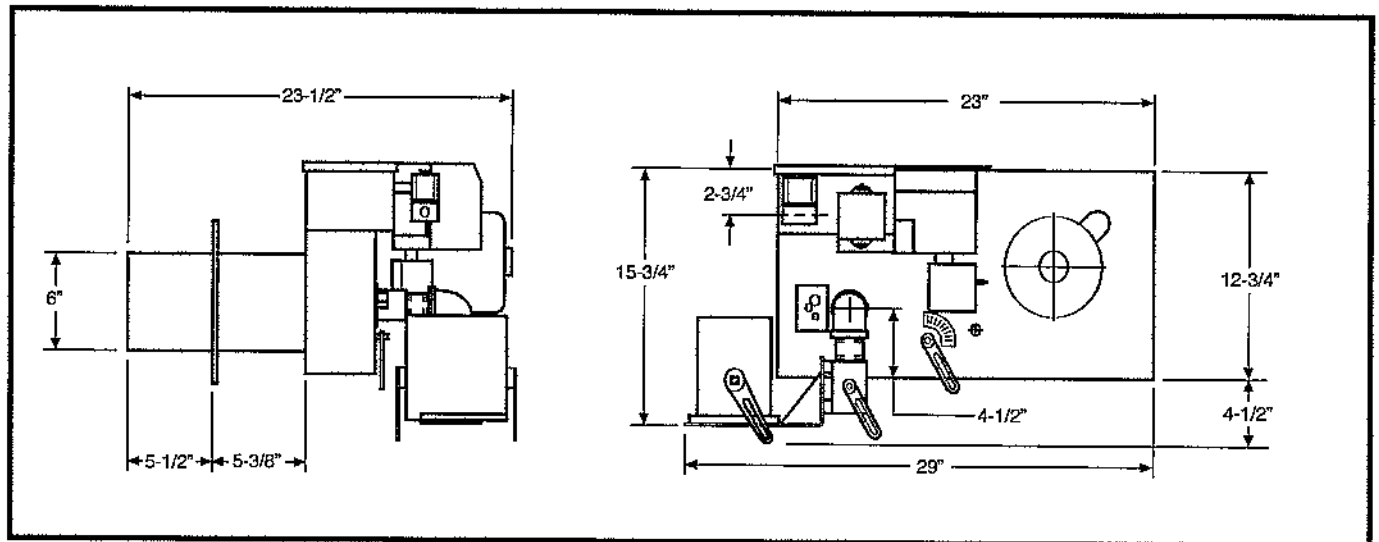
**Typical Model V6 with "B" Gas System**

**Figure 8**



**Typical Model V6 with "H" Gas System**

**Figure 9**



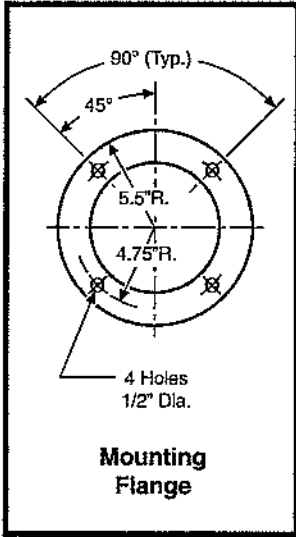
**Typical Model V6 with "E2" Gas System**

**Figure 10**

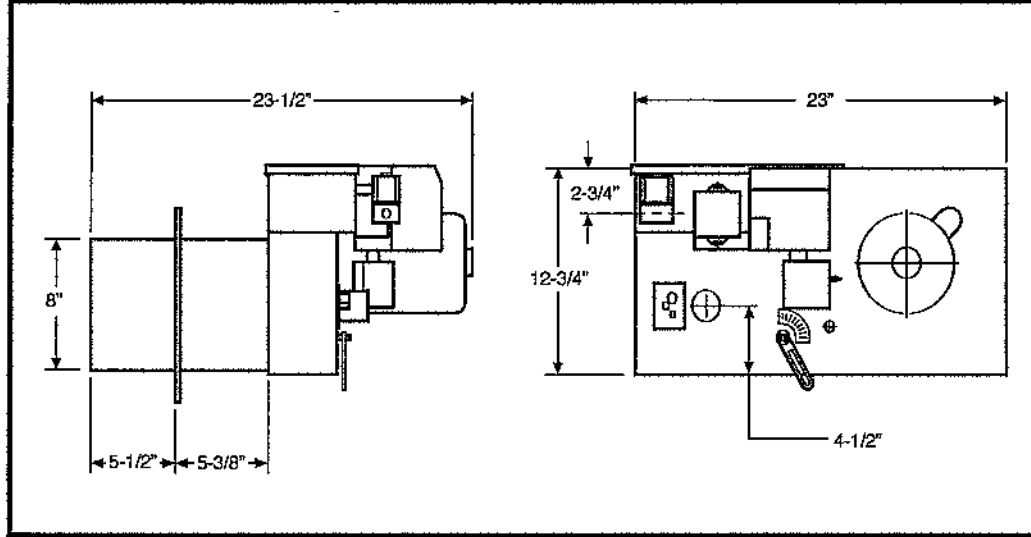
**Figure 11**

**Dimensions**

Dimensions May Be Changed Without Notice

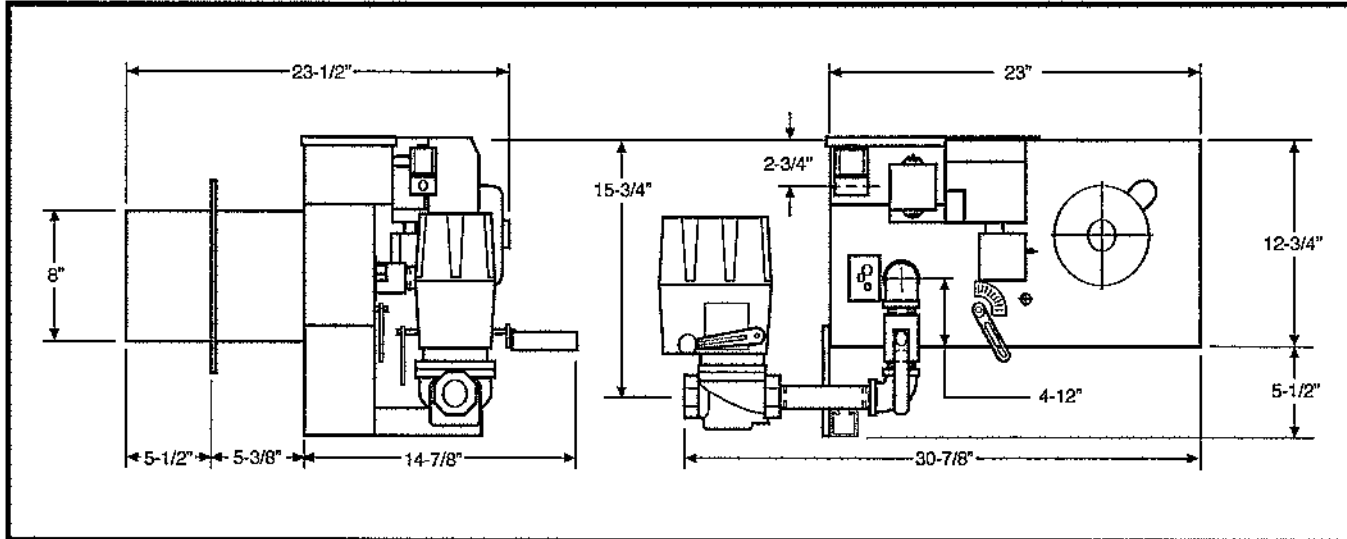


**Model V8**



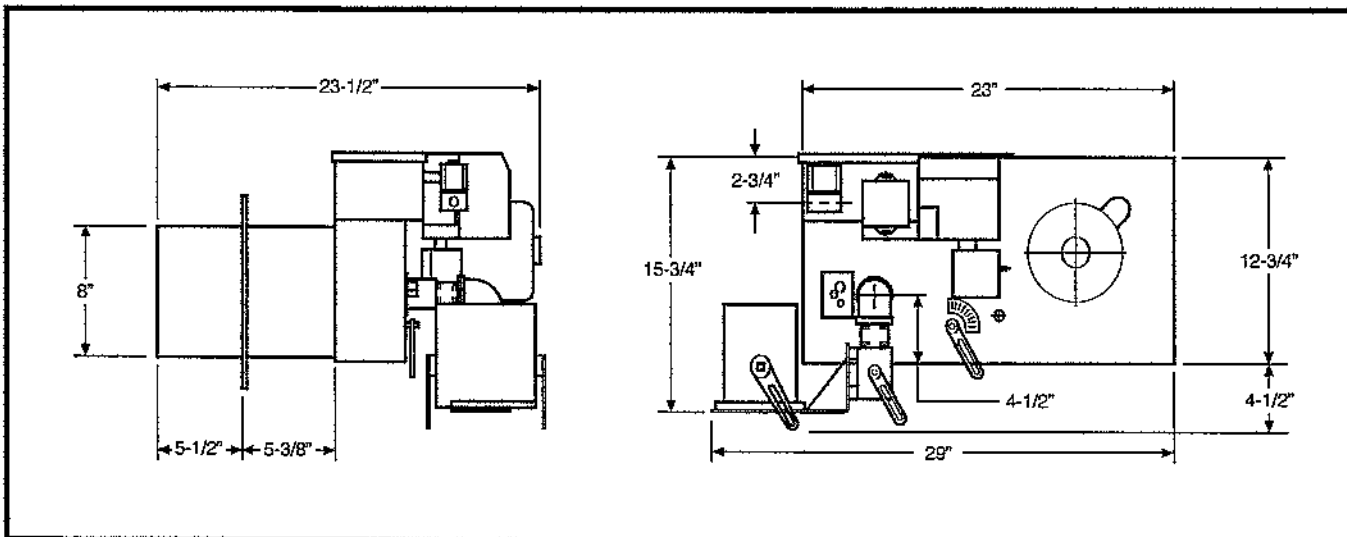
**Typical Model V8 with "B" Gas System**

**Figure 12**



**Typical Model V8 with "H" Gas System**

**Figure 13**



**Typical Model V8 with "E2" Gas System**



# PART III

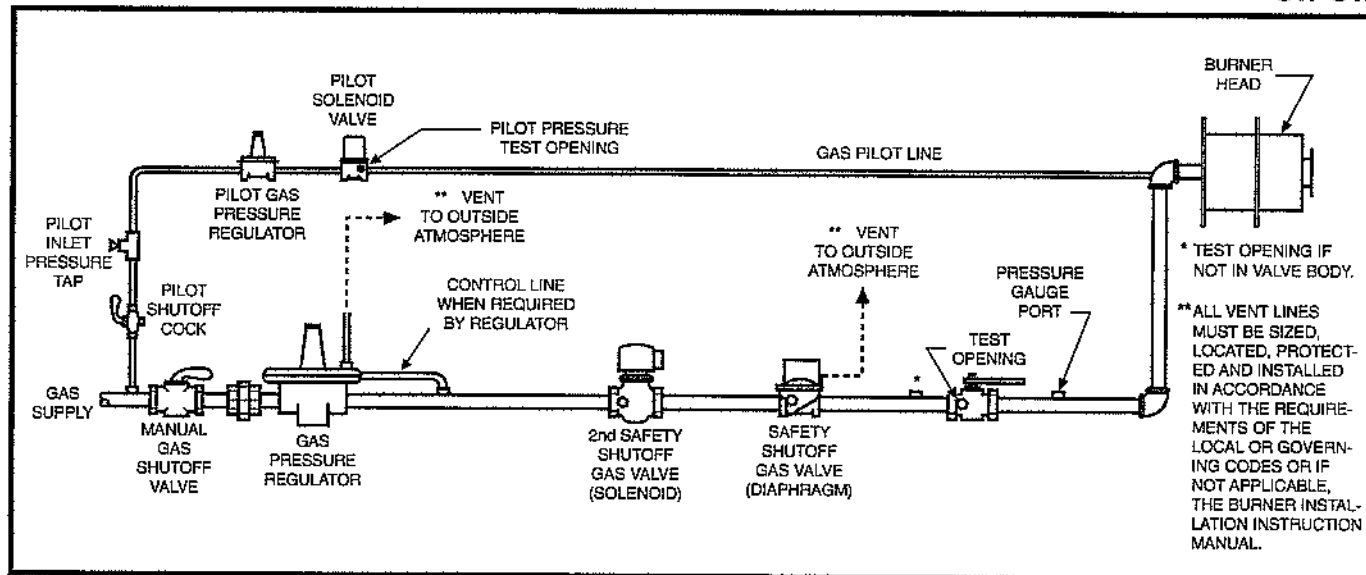
## FUEL SYSTEM

**GAS SYSTEM DESCRIPTION** - The Model V burners are equipped with U.L. Listed gas trains as standard equipment.

The following schematics depict U.L. Listed systems used on burners with inputs of 400 through 2,500 MBh.

### B - GAS SYSTEM

On-Off



**"B" Gas System Schematic**  
 (As shown meets U. L. requirements)

**APPLICATION** - The "B" gas system is used for on-off firing. It is commonly used on burners with 400 to 2,500 MBh capacity.

**DESCRIPTION** - The "B" system uses a slow opening diaphragm or motorized valve and a quick opening solenoid valve to control gas flow. Gas pressure is adjusted and maintained by a pressure regulator. Combustion air available to the burner is fixed in an open (high fire) position.

**OPERATING SEQUENCE** - The burner motor starts on a call for heat by the operating control and the pre-purge cycle begins.

At the end of pre-purge, the ignition transformer is

energized and the pilot valve opens, igniting the gas pilot.

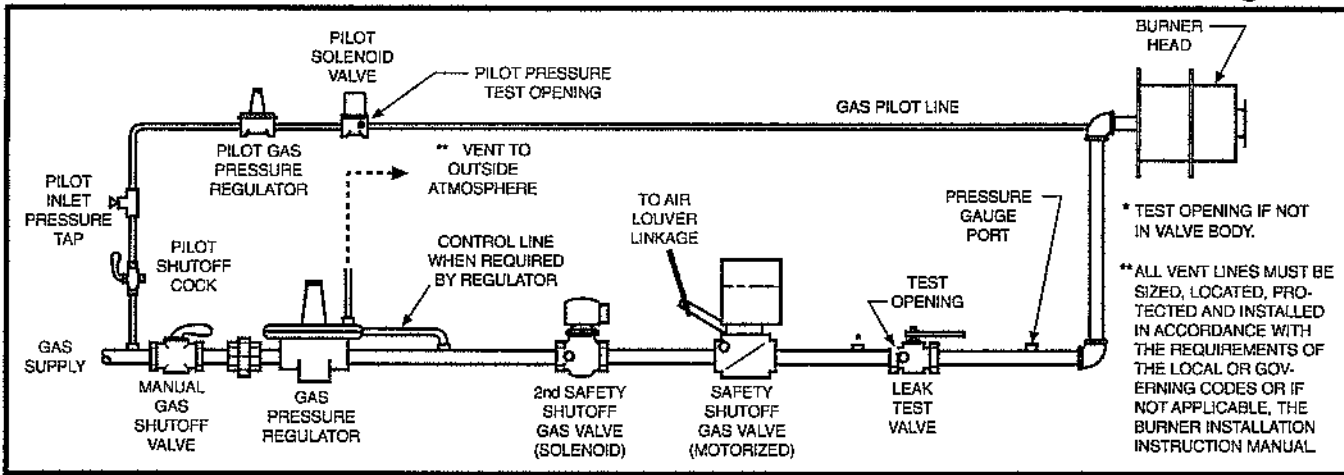
The flame detector proves the flame and the safety shutoff gas valves open, supplying gas to the orifices at the pressure setting required and the burner ignites.

The ignition transformer is de-energized and the pilot valve will remain energized.

When the operating control is satisfied, the gas valves close and the burner motor is switched off, causing the burner to shut down and await the next call for heat.

## H - GAS SYSTEM On-Off Low Fire Start

## H4 - GAS SYSTEM High-Low



**"H" Gas System Schematic**  
(As shown meets U. L. requirements)

**APPLICATION** - The "H" gas system is used for on-off, low fire start control. The "H4" gas system is used for high-low, low fire start control in firing. They are commonly used on burners with 400 MBh to 5,000 MBh capacity.

**DESCRIPTION** - The "H" system uses a motorized gas valve and a quick opening solenoid gas valve arrangement to control gas flow. The "H4" system uses a motorized high-low gas valve and a quick opening solenoid gas valve arrangement to control gas flow. Gas pressure is adjusted and maintained by a pressure regulator.

Combustion air available to the burner is controlled by connection of the air louver to the motorized gas valve through a linkage arrangement.

**OPERATING SEQUENCE** - The burner motor starts on a call for heat by the operating control and the pre-purge cycle begins. The motorized valve is in the closed position, allowing low fire combustion air through the louver.

At the end of pre-purge, the ignition transformer is energized and the pilot valve opens, igniting the gas pilot.

The flame detector proves the flame and the safety shutoff gas valves open, slowly supplying gas to the orifices at the low fire rate, and the burner ignites in the low fire position.

The ignition transformer is de-energized and the pilot valve will remain energized.

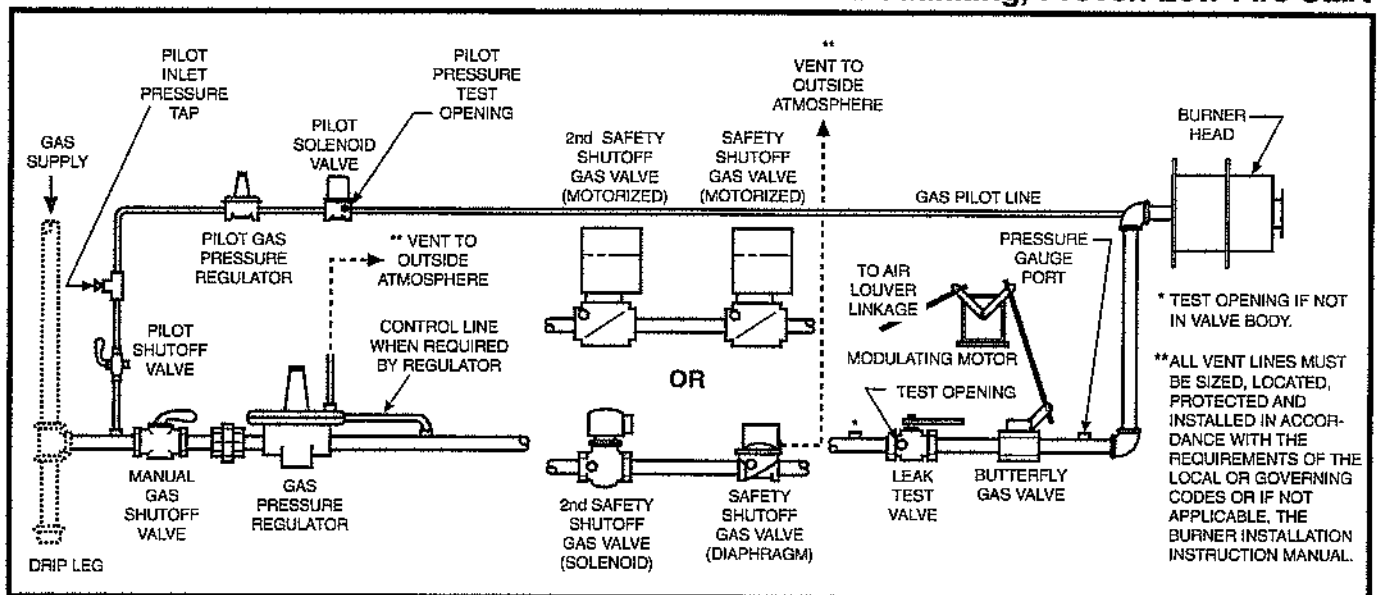
The motorized gas valve continues to open, allowing the linkage to drive the air louver to the full open position and the burner goes to high fire.

**HIGH-LOW OPERATION** - The high fire controller, when satisfied, drives the motorized valve to the low fire position, allowing less gas flow through the burner. Simultaneously, the air louver is closed to the low fire position. If low fire cannot maintain pressure or temperature in the boiler, the high fire controller will re-energize the motorized valve and the air louver and the burner will sequentially return to high fire.

When the operating control is satisfied, the gas valves close and the burner motor is switched off, causing the burner to shut down and await the next call for heat.

## E2 - GAS SYSTEM

## Modulating, Proven Low Fire Start



**"E2" Gas System Schematic**  
(As shown meets U. L. requirements)

**APPLICATION** - The "E2" gas system is used for modulation or high-low proven low fire start control in firing. It is commonly used on burners with 1,000 MBh and above capacity.

**DESCRIPTION** - The "E2" gas system uses motorized gas valves or quick opening solenoid gas valves and a modulating motor to provide a low fire to high fire gas flow and simultaneously regulate the combustion air available to the burner. Gas pressure is adjusted and maintained by a pressure regulator. Head or orifice pressure is varied by a butterfly metering valve linked to the modulating motor. The gas butterfly metering valve is opened for high fire and gas is delivered to the orifices at the pressure setting of the pressure regulator. The air louver is also linked to the modulating motor, thus combustion air is increased proportionately as the orifice pressure increases.

**OPERATING SEQUENCE** - The burner motor starts on a call for heat by the operating control and the pre-purge cycle begins. At the end of pre-purge, the air louver must be in the closed (low fire) position for the low fire guarantee switch to close and allow ignition.

At the end of pre-purge, the ignition transformer is energized and the pilot valve opens, igniting the gas pilot.

The flame detector proves the flame and the safety shutoff gas valves open, supplying gas to the orifices at the low fire setting of the butterfly metering valve and the burner ignites at the low fire rate.

The ignition transformer is de-energized and the pilot valve will remain energized.

After a short delay, the modulating motor is switched to the control of a potentiometer or high-low controller, which drives the motor from the low fire position toward the high fire position to match the boiler load. Since both the air louver and butterfly metering valve are linked to the modulating motor, the combustion air is increased proportionately as gas increases.

As the boiler load is overcome, the potentiometer or high-low controller drives the motor back toward the low fire position. On modulating units, the burner modulates over the range between low fire and high fire in response to the boiler load.

When the operating control is satisfied, the gas valves close and the burner motor is switched off, causing the burner to shut down and await the next call for heat.

**Table 1**

**Gas Flow Capacity of Pipe - CHF**

WITH PRESSURE DROP OF 0.3" wc and SPECIFIC GRAVITY OF 0.60									
PIPE LENGTH IN FEET	Pipe Size - Inches (IPS) (Schedule 40)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
10	132	278	520	1050	1600	3050	4800	8500	17500
20	92	190	350	730	1100	2100	3300	5900	12000
30	73	152	285	590	890	1650	2700	4700	9700
40	63	130	245	500	760	1450	2300	4100	8300
50	56	115	215	440	670	1270	2000	3600	7400
60	50	105	195	400	610	1150	1850	3250	6800
70	46	96	180	370	560	1050	1700	3000	6200
80	43	90	170	350	530	990	1600	2800	5800
90	40	84	160	320	490	930	1500	2600	5400
100	38	79	150	305	460	870	1400	2500	5100
125	34	72	130	275	410	780	1250	2200	4500
150	31	64	120	250	380	710	1130	2000	4100
175	28	59	110	225	350	650	1050	1850	3800
200	26	55	100	210	320	610	980	1700	3500

**MULTIPLIERS USED WITH ABOVE TABLE**

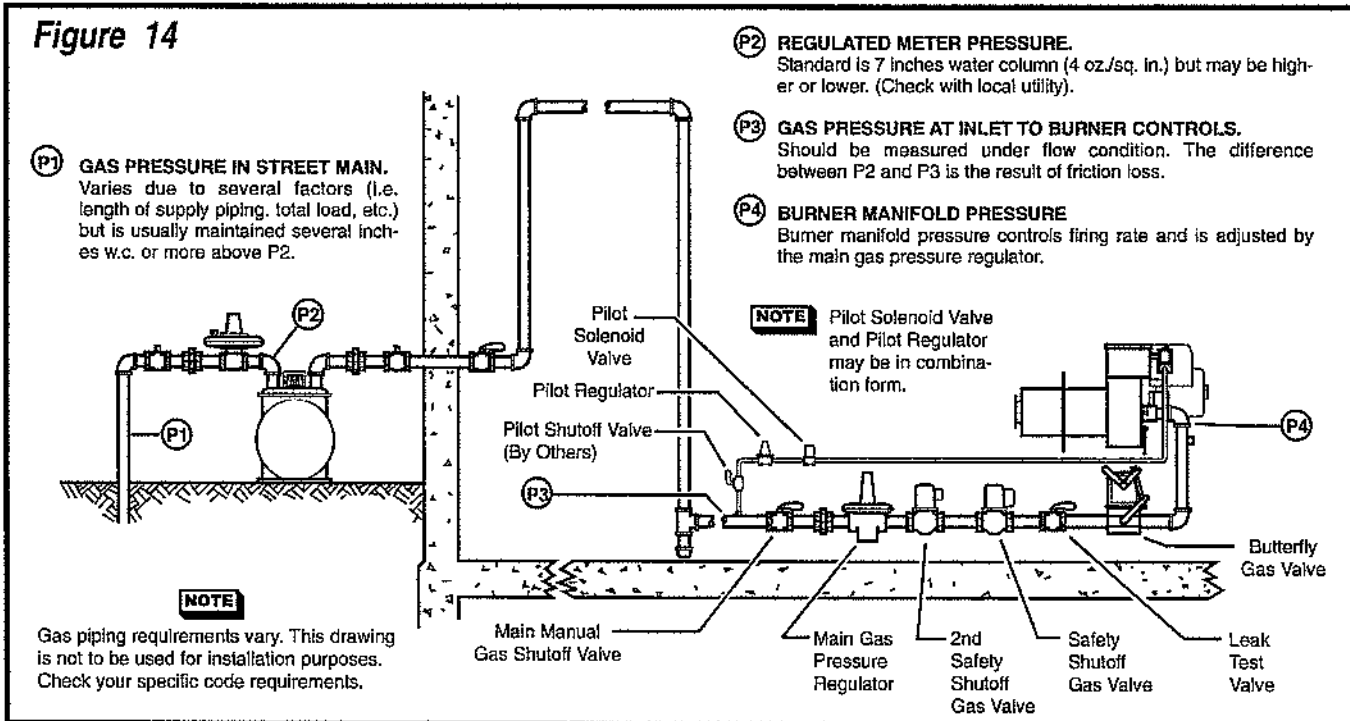
Specific Gravity Other Than 0.60	
Specific Gravity	Multiplier
0.50	1.100
0.60	1.000
0.70	0.926
0.80	0.867
0.90	0.817
1.00	0.775

Pressure Drop Other Than 0.3" wc			
Pressure Drop	Multiplier	Pressure Drop	Multiplier
0.1	0.577	1.0	1.83
0.2	0.815	2.0	2.58
0.3	1.000	3.0	3.16
0.4	1.160	4.0	3.65
0.6	1.420	6.0	4.47
0.8	1.640	8.0	5.15

**WARNING**

Use a pipe joint compound resistant to the action of liquefied petroleum gases rather than teflon tape as a gas sealant. Teflon tape can cause valves to fail, creating a safety hazard. Warranties are nullified and liability rests solely with the installer when teflon tape is used.

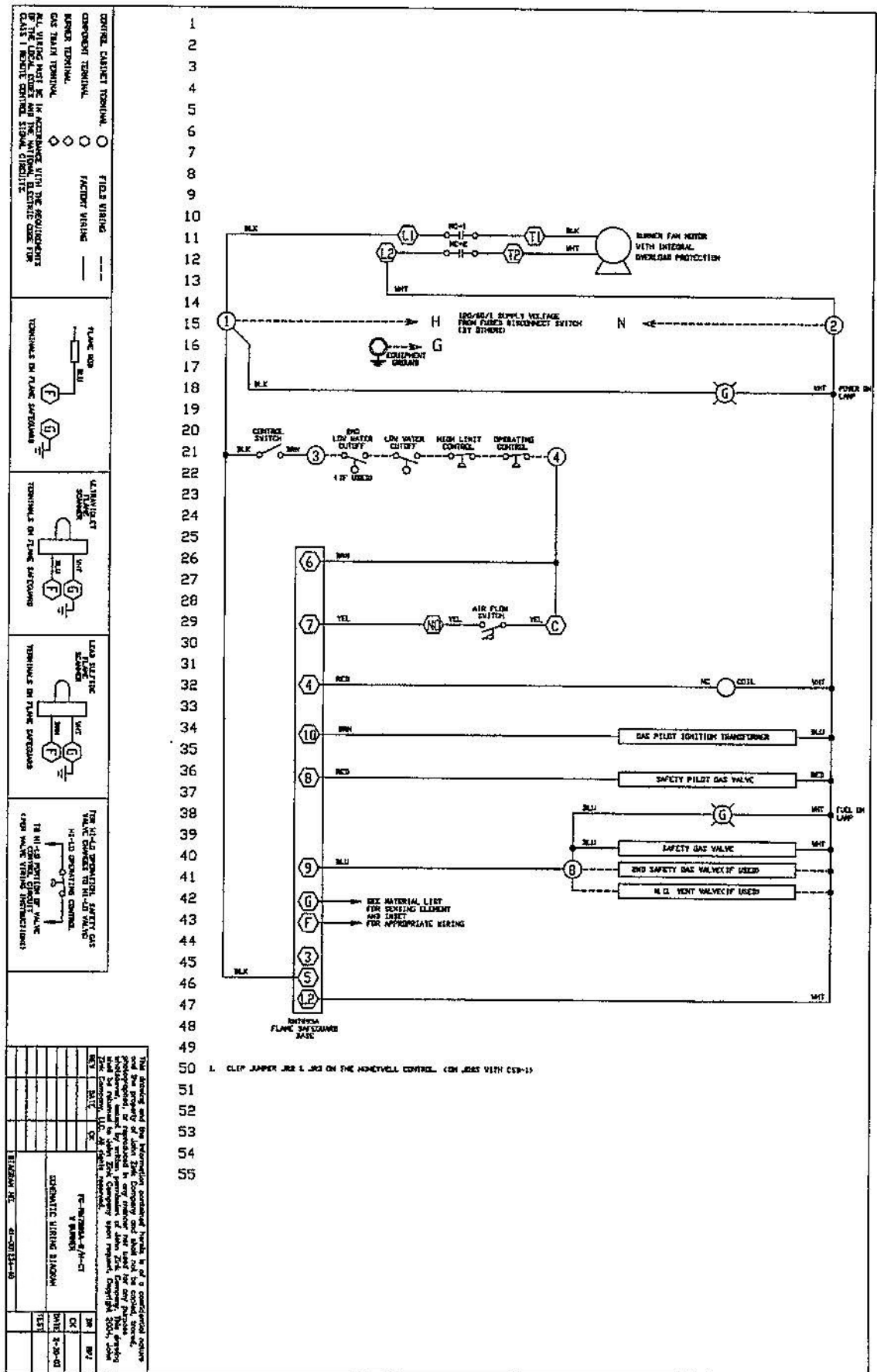
**Figure 14**



**Typical Gas Piping Installation**

Figure 15

WIRING DIAGRAM

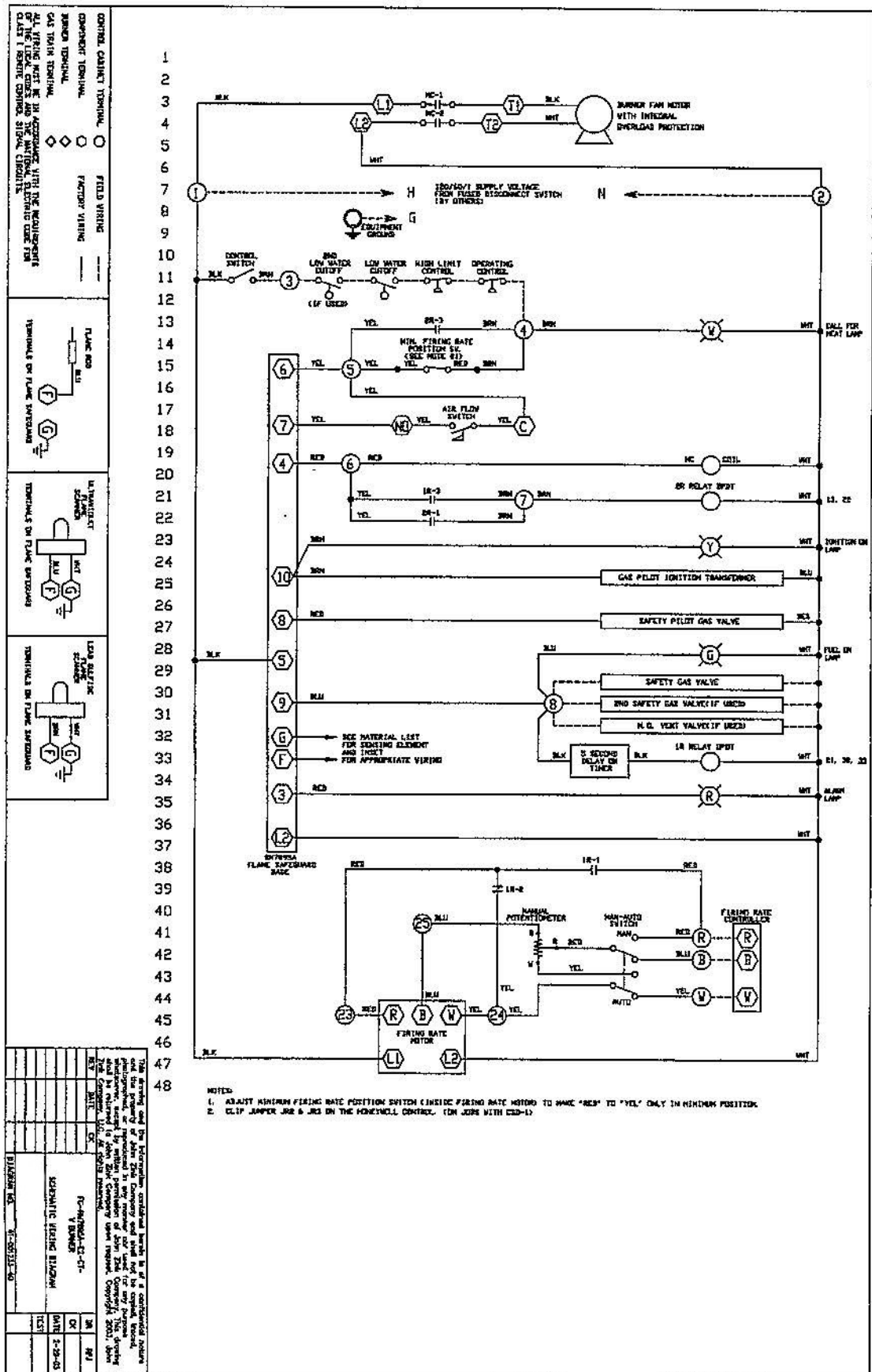


“B” or “H” Fuel System with RM7895A Control



Figure 17

WIRING DIAGRAM

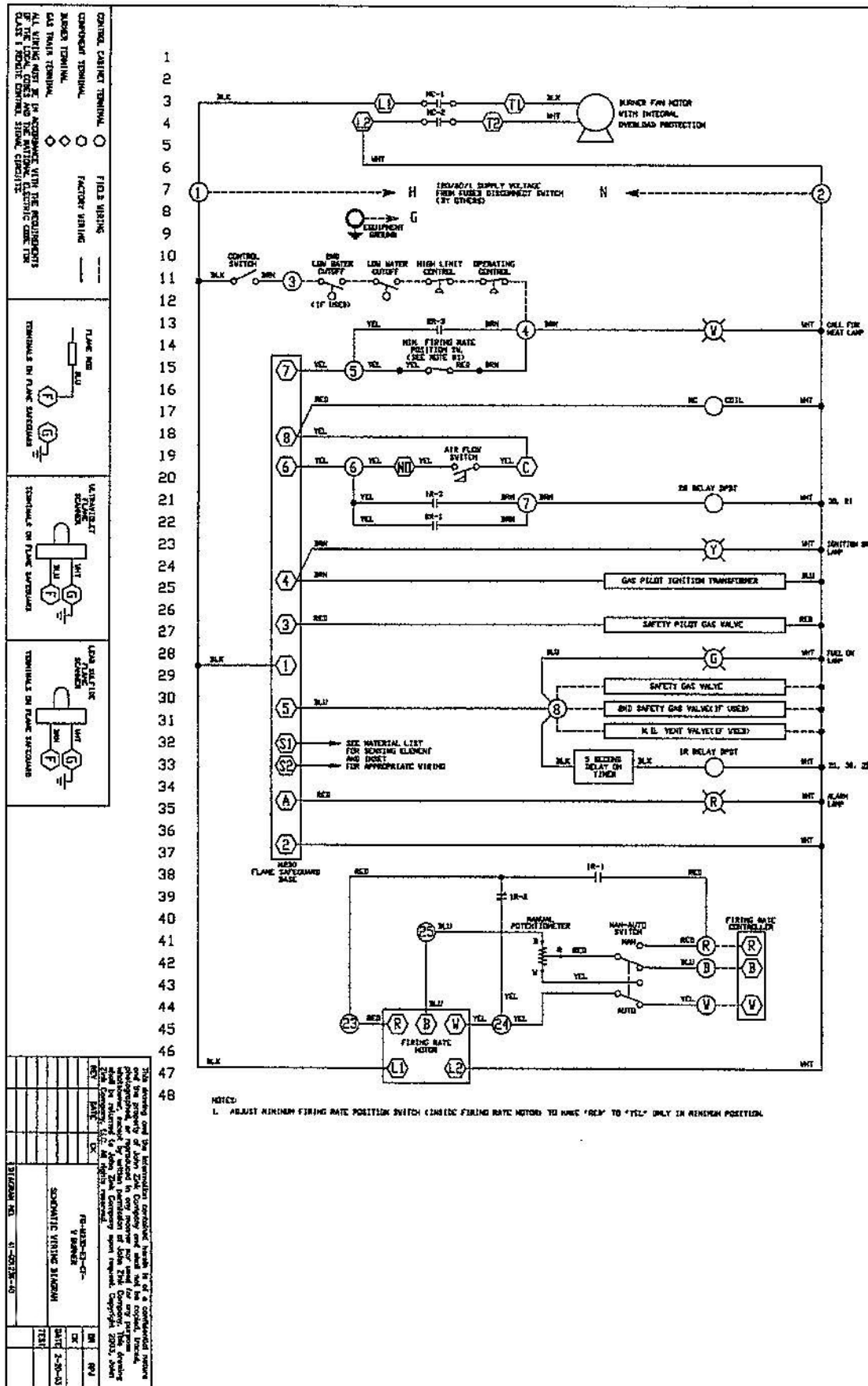


"E2" Fuel System with RM7895A Control



Figure 18

WIRING DIAGRAM



"E2" Fuel System with M230 Control

## BURNER OPERATING SEQUENCE



THIS IS NOT A START-UP PROCEDURE.  
REFER TO PART VI.

1. Close control switch. With all limit and operating controls calling for heat, the burner will follow sequence below.
2. This is a typical sequence. For exact details of operation, see flame safeguard manufacturer's specification sheets.

### *Pre-Purge*

The burner motor starts.

When the air flow switch makes, pre-purge timing begins.

### *Pilot Ignition*

When pre-purge is complete, safety shutoff pilot gas valve and gas pilot ignition transformer are energized to ignite pilot.

Pilot flame must be proven or flame safeguard locks out as a pilot flame failure.

### *Main Burner*

With the pilot proven, the safety shutoff gas valve(s) open and main burner ignites.

The ignition transformer is de-energized and the pilot valve remains energized.

Normal run position. Burner continues to operate unit, heat demand is satisfied.

## AUTOMATIC SHUTDOWN

Limit or operating controls open:  
Gas valve(s) close.

Burner motor stops. Burner is ready for start-up on the next call for heat.

## MANUAL SHUTDOWN

1. Turn control switch off. Burner shuts down as in Automatic Shutdown above.
2. When burner motor stops, close all manual gas valves.

## SAFETY SHUTDOWN

1. If at any time during the operating cycle a flame failure occurs, the burner shuts down as in Automatic Shutdown.

Manual reset of the flame safeguard must be made before the burner will fire again.

2. If a limit or running interlock failure occurs, the burner shuts down as in Automatic Shutdown.

Condition must be corrected before the burner will fire again. Manual reset of a device may be required.

3. If an air flow failure occurs, the gas valves close and the flame safeguard locks out.

Condition must be corrected before the burner will fire again.

# PART IV

## INSTALLATION INSTRUCTIONS

### GENERAL

Check burner parts illustrated on preceding pages. The burner has been carefully checked at the factory, thus missing or damaged parts must be reported at once in order that appropriate action may be taken to replace them. Give burner model number and serial number when ordering parts.

The installation must conform with the latest revisions of local codes or, in the absence of local codes, with the latest Standard for the Installation of Domestic Gas Conversion Burners, ANSI Z21.8, and the National Fuel Gas Code, ANSI Z223.1.

The heat transfer surfaces of the furnace or boiler should be cleaned before the burner is mounted. Consult your local gas utility company regarding any special requirements in the preparation of the furnace or boiler.

### VENTING REQUIREMENTS

Flue pipe, double acting barometric damper, draft hood, or vent should not be smaller than recommended by the furnace or boiler manufacturer. The size is typically represented by the dimension of the smoke outlet. If existing flue pipe is used, it must be cleared of all soot and other deposits.

### GAS REQUIREMENTS

Maximum inlet pressure to gas train must not exceed the inlet pressure rating of the main gas regulator. For maximum capacity, minimum gas supply pressure must not be less than that indicated on order entry form. If lower pressures are required consult factory.

### COMBUSTION AIR SUPPLY

The boiler room in which the burner is located must be provided with an adequate fresh air supply to assure proper combustion. The American National Standard ANSI Z223.1 specifies that two permanent openings each having a total free area of not less than one square inch per 4,000 BTU per hour total input rating of all appliances shall be required.

### WIRING

The burner is prewired at the factory as far as practical. Refer to burner wiring diagram Figures 15-18 for complete wiring information and study thoroughly before making any connections. Make sure all connections on the flame safeguard are tight as they may have been loosened during shipment.

Power to the burner must be 120 volts. All wiring, including electrical ground, must be done in accordance with Local Code requirements or, in the absence of local codes, with the latest revision of the National Electric Code, ANSI/NFPA 70. Burner electric power should be provided from a separate fused disconnect switch located in the Boiler Room.

### BURNER GASKET

Attach a rope gasket or sheet gasket to the burner mounting flange to prevent leakage or combustion gases from the boiler firebox.

### BURNER MOUNTING

Attach burner to the boiler frontplate by firmly tightening nuts on the mounting studs or clamps so that a rigid installation is accomplished. Make sure burner is level before tightening clamps. Support burner housing to base or floor. Provide adequate clearances for servicing and proper operation of the burner.

### NOTE

The installer must identify the main electrical power disconnect, and the manual shutoff on the gas supply drop line to the burner prior to leaving the job.

**Table 2**

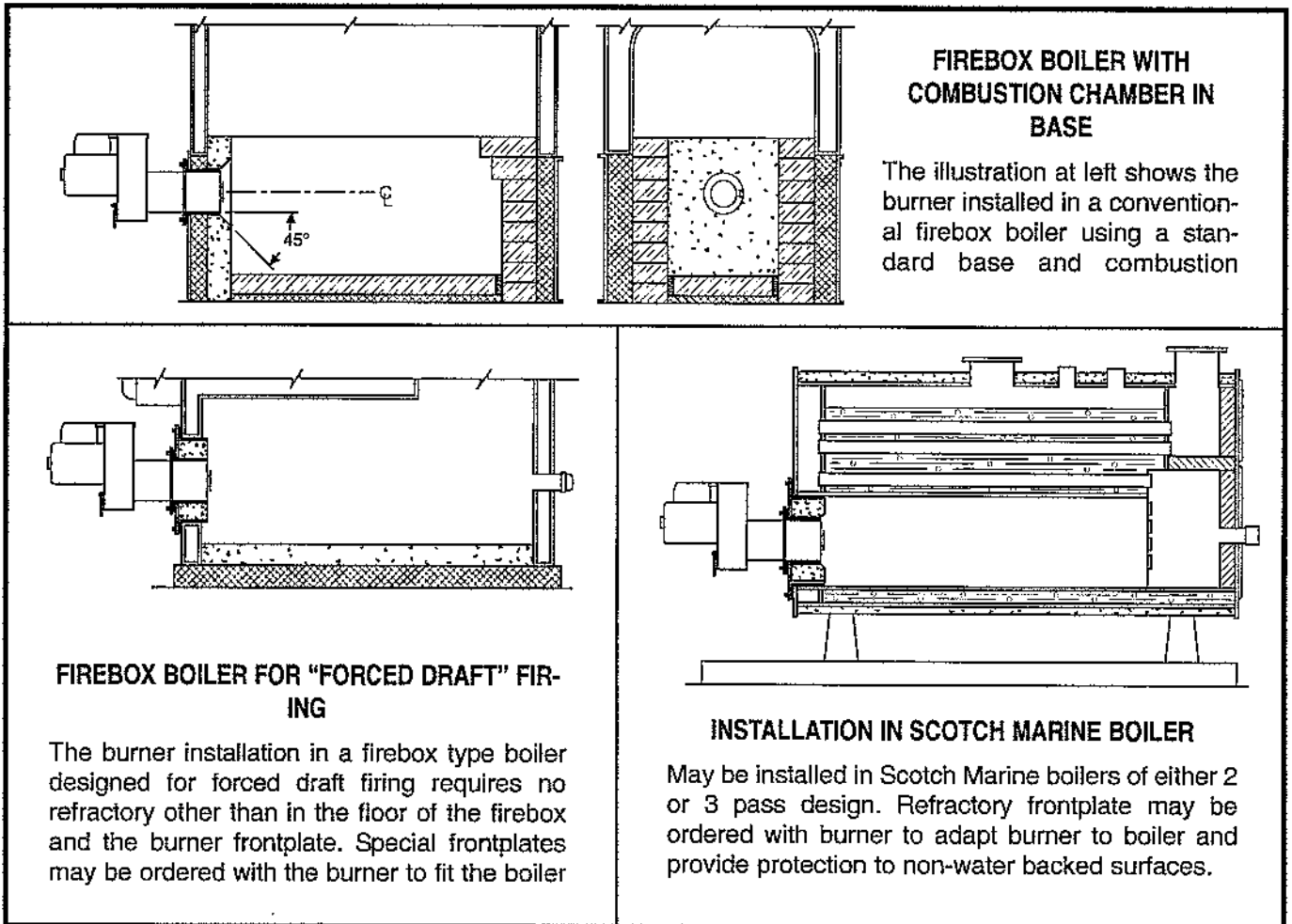
**COMBUSTION CHAMBER AND APPLICATIONS DATA**

Minimum Recommended Combustion Chamber Dimensions (Inches)			
Input MBh	Rectangular Chamber		Round Chamber
	Inside Width	Inside Length	Inside Diameter
450-600 601-800	14 15	19 24	14 16
801-1000 1001-1200	18 20	29 34	18 20
1201-1400 1401-1600	21 22	39 44	22 22
1601-1800 1801-2000	24 26	49 54	24 26
2001-2200 2201-2500	27 28	57 60	28 28

**NOTE**

Combustion chamber dimensions may vary from table to fit job conditions. Floor area should not be less than 50 square inches per 100 MBh input. Larger floor areas are desirable as combustion chamber temperatures will be reduced giving longer refractory life. Combustion chamber length should not be less than 1 1/2 times the width. Combustion chamber height should equal chamber width or approximately twice the center line height of the burner from the floor. Recommended minimum distance from center line of burner head to the floor is 6".

**Figure 19**



# SUGGESTED INSTALLATION INSPECTION CHECKLIST

## GENERAL

- Is burner installed in accordance with applicable installation drawings?
- If a refractory combustion chamber is part of the installation, is it completely dry, cured, and ready for firing at full boiler input?
- Is the electrical voltage connected to the burner control cabinet 120 volt, 60 cycle, single phase?
- Has the burner wiring been checked for completeness and accuracy?
- Are the boiler mounted limit and operating controls such as low water cutoffs, high limit controls, etc., properly installed and wired?
- Is the boiler water supply, including feed pumps, properly connected and is boiler filled with water?
- Is sufficient load connected to the boiler so that it can be fired continuously at full rating without endangering personnel or equipment?
- If the installation is a hot water boiler, have the circulating pumps been completely installed, wired and tested to assure proper operation so that the burner can be fired continuously at full rating?
- For new boiler installations, has the boiler been boiled out in accordance with the boiler manufacturer's instructions?
- Have the boiler breeching connections to the stack been completed and are they open and unobstructed?
- Is draft control equipment required and, if so, installed?
- Have adequate provisions for combustion air been installed?
- Have the persons listed below been notified of the burner start-up date?

- Owner's Representative
- Mechanical Contractor's Representative

- Electrical Contractor's Representative
- Service Organization's Representative
- Boiler Manufacturer's Representative
- Gas Utility Co. or Inspector

- Is all specified auxiliary equipment mounted and wired? This may include outdoor temperature controls, space thermostats, water flow switches, motorized combustion air louvers, etc.?

## GAS FIRE

- Has piping into building, meter and service regulator been installed, tested and ready for service?
- Are all gas train components installed and have they been properly selected, sized and assembled?
- Have properly sized vent lines been installed on all gas train components which require venting? This includes such items as pressure regulators, normally open vent valves, diaphragm valves, low and high gas pressure switches, etc.
- Have gas train piping and components been tested and proven gas tight?

## CAUTION

The burner and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psig.

The burner must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig.

- Have the gas lines been purged?
- Is the proper gas pressure available at the inlet to the controls?

# BURNER PRESTART-UP CHECKLIST

## CAUTION

This manual has been prepared as a guide in burner start-up operations. It is written for the start-up specialists who are thoroughly qualified both by training and experience.

1. **GENERAL** - The following data is pertinent to the burner start-up and should be carefully studied before any attempt to operate the burner is made. The following is a part of the manual shipped with the burner.
  - Burner Material List
  - Burner Wiring Diagram and Operating Sequence (if different from this manual)
  - Flame Safeguard Bulletin
  - Misc. Manufacturer's Data on Controls, Valves, Regulators, etc.
3. **REVIEW BURNER MATERIAL LIST IN THE INSTRUCTION MANUAL AND NOTE THE FOLLOWING INFORMATION:**
  - A. Firing rate (MBTU)
  - B. Cubic feet of gas per hour (CFH)
  - C. BTU per cubic foot (BTU/CF)
  - D. Required gas pressure at control inlet (inches wc)
  - E. Required gas pressure at combustion head gas manifold port.

## NOTE

The above cited manual is ONE OF A KIND in that it contains material covering your SPECIFIC burner. To replace it, considerable time, special handling and significant costs are involved. Accordingly, it should be handled with care and kept in a location free of dust and moisture.

The above information is pertinent to setting up the burner.

2. **IDENTIFICATION OF CONTROLS** - Review the burner wiring diagram and operating sequence. Study these items and identify the various controls.

## NOTE

Do not proceed with start-up unless all applicable check list items in Part IV and preliminary adjustment requirements in Part V have been satisfied.

# PART V

## BURNER ADJUSTMENT

**FACTORY ADJUSTMENTS** - The burner is not adjusted at the factory and must be set to meet your firing conditions. See the following figures for suggested settings. These settings are acceptable for initial start-up, however, final adjustments should be based upon carefully conducted combustion testing of O<sub>2</sub>, CO<sub>2</sub>, CO and stack temperature.

**FIELD ADJUSTMENTS** - Illustrations which follow show the items which are subject to adjustment. Determine the applicability of each illustration to your burner, then proceed to familiarize yourself with how the item functions. Where a setting is indicated, verify the setting or make preliminary adjustments to facilitate initial start-up.

### BURNER AIR AND FUEL ADJUSTMENTS

#### ADJUSTMENT OF AIR INLET LOUVER - "B" Fuel System

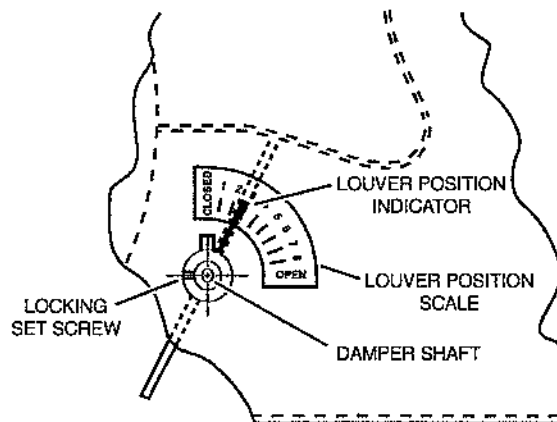
Figure 20

##### DESCRIPTION: "B" Gas System

This system uses an air louver to control the flow of combustion air and operates in a fixed position.

##### ADJUSTMENT PROCEDURE:

1. Loosen locking set screw
2. Turn damper shaft clockwise to increase air flow or counter clockwise to decrease air flow.
3. Set to desired position and lock in place with the locking set screw.





## ADJUSTMENT OF AIR INLET LOUVER - "H" Fuel System

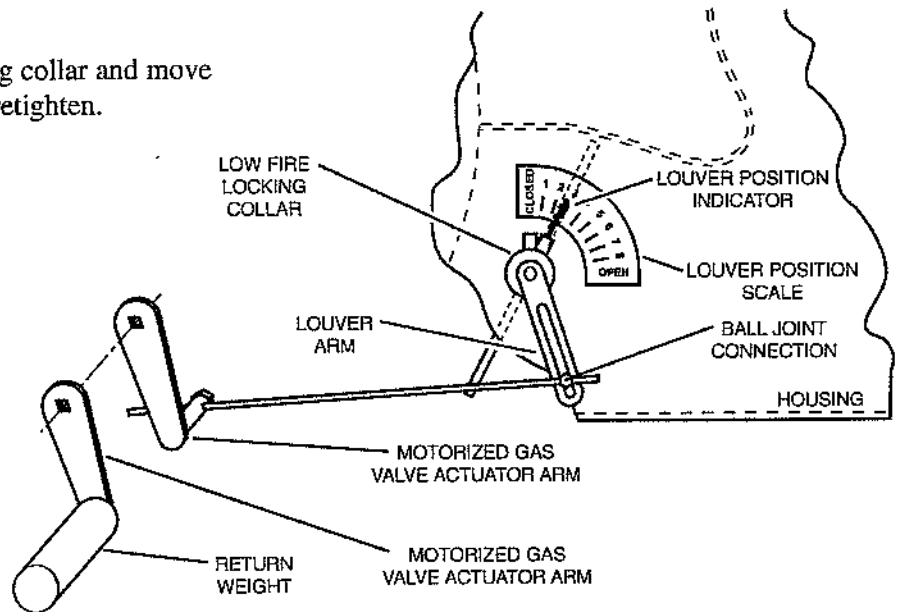
Figure 21

### DESCRIPTION (H Gas System)

This system uses an air louver which is weight loaded **CLOSED** against an adjustable stop. A linkage arrangement to a motorized gas valve moves the louver **OPEN**. The system function is **ON-OFF** or **HIGH-LOW, LOW FIRE START**.

### ADJUSTMENT PROCEDURE

1. Loosen screw in low fire locking collar and move louver to desired position then retighten.
2. For initial start-up:
  - a. Set the louver so it is at position 2.
  - b. Adjust linkage arrangement to motorized gas valve so louver will open to the high fire position when the gas valve opens.



- c. Burner should light before gas valve starts driving the air louver open.
- d. Weight on motorized gas valve arm must return air louver to low fire position when valve is de-energized.

## ADJUSTMENT OF AIR INLET LOUVER - "E2" Fuel System

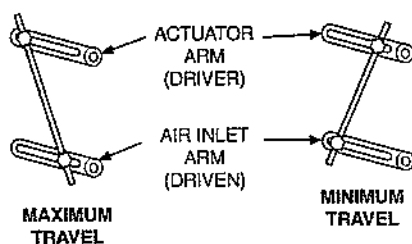
Figure 22

### DESCRIPTION:

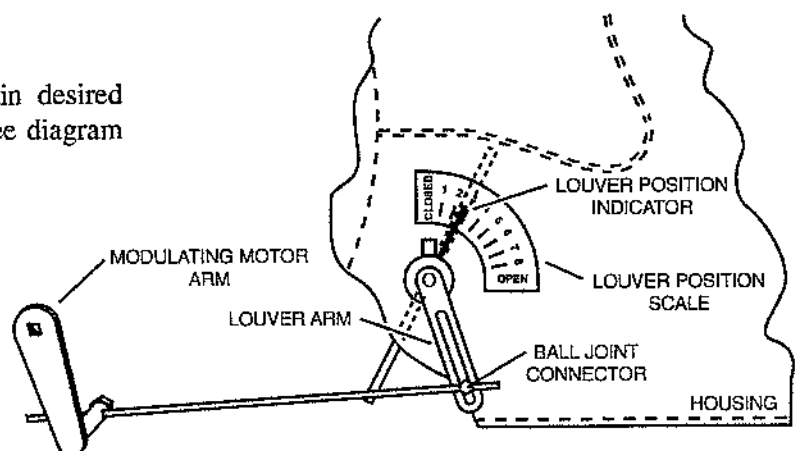
This system uses an air louver which is opened and closed by an actuator, commonly termed a modulating motor. The system function is **ON-OFF, HIGH-LOW** or **MODULATING, LOW FIRE START**.

### ADJUSTMENT PROCEDURE:

1. Position ball-joint connectors to obtain desired opening for low fire and high fire. [See diagram below]



2. For initial start-up, set louver at position 2 for low fire.



## ADJUSTMENT OF GAS PRESSURE REGULATOR

Figure 23

### DESCRIPTION:

Gas burners have two gas pressure regulators, one to regulate the pressure to the main flame and the other to regulate the gas to the pilot.

The gas flow is controlled by a spring of known load range which works against the supply [from the meter] gas pressure, therefore, each regulator must be fitted with the right spring for it to function properly. Additionally, the tension on the regulator spring must be adjusted to obtain the exact gas pressure required at the inlet to the controls.

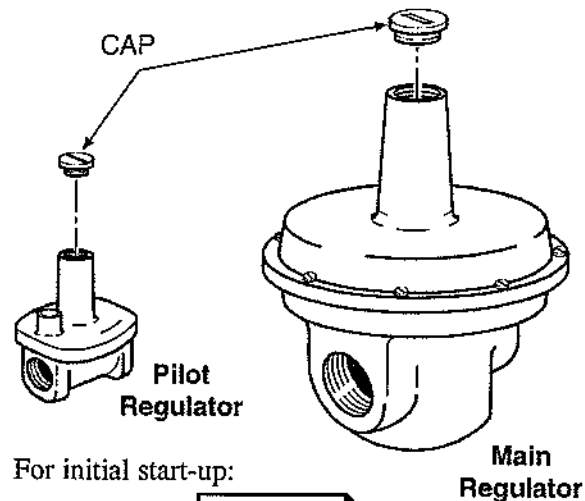
### ADJUSTMENT PROCEDURE:

#### NOTE

See gas pressure regulator manufacturer's instructions for detailed procedures.

1. Remove cap or bonnet from regulator to gain access to adjustment screw or button.
2. Turn clockwise to increase and counter-clockwise to decrease outlet pressure.

### GAS PRESSURE REGULATOR



3. For initial start-up:

#### NOTE

Pressure at which gas will be delivered to the burner cannot be determined without gas flowing through the regulator. Be prepared to adjust the regulator as the burner is test fired.

4. Reinstall cap or bonnet after adjustment.

## ADJUSTMENT OF BUTTERFLY GAS VALVE

Figure 24

### DESCRIPTION:

The butterfly gas valve is a fuel throttling device which proportions the gas in proper ratio to the combustion air. The valve is opened or closed by an actuator as the combustion control programs the burner firing rate to meet the boiler load.

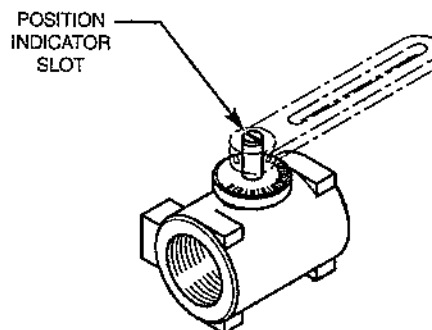
A centrally located disc turns within a cylindrical body which regulates the gas flow to the main burner flame. The butterfly valves used are the non-tight shutoff type.

Through a linkage system an actuator drives the valve open or closed in response to electrical signals from the combustion control. Since the amount of air available for combustion is controlled by the same actuator, a proper fuel-air ratio is maintained at all times.

### ADJUSTMENT PROCEDURE:

1. Use box end or socket wrench to loosen or tighten ball joint connector.

### BUTTERFLY GAS VALVE



2. To adjust low fire [minimum] fuel setting, loosen ball joint connector holding drive rod and manually position butterfly disc to desired opening, then retighten connector.

#### NOTE

Slot in end of butterfly shaft indicates position of internal disc.

3. For initial start-up: Position actuator arm so internal disc is approximately 15° open.

## DESCRIPTION:

Gas pressure switches are pressure-actuated electrical switching devices designed for safety shutoff when gas pressures are either too low or too high.

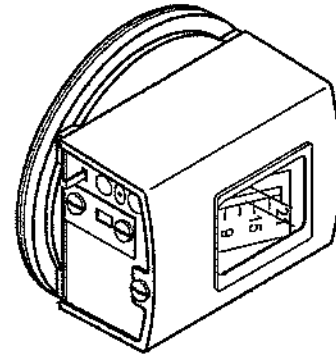
The pressure switch senses any change in gas pressure and, if properly adjusted, will transmit an electrical signal to the automatic shutoff valve and/or other interlocking devices when an unsafe condition exists. The burner will then recycle or completely shut down depending upon the flame safeguard used. Gas pressure switches are designed to operate over a specified pressure range; therefore, each switch must be selected to be compatible with the burner operating gas pressure and also to obtain the desired electrical features.

## ADJUSTMENT PROCEDURE:

### NOTE

See gas pressure switch manufacturers instructions for detailed procedures. Units with mercury switching device must be properly leveled.

## GAS PRESSURE SWITCH



(Typical)

1. For initial start-up:
  - a. Low Gas Pressure Switch - Adjust to a lower pressure than that to be experienced for normal operation to allow the burner to be set up.
  - b. High Gas Pressure Switch - Adjust to a higher pressure than that to be experienced for normal operation to allow the burner to be set up.

### NOTE

Final adjustment must be done after the burner has been test fired. See burner start-up procedures.

# ADJUSTMENT OF AIR FLOW SWITCH

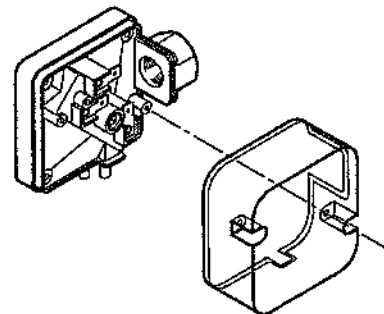
## DESCRIPTION:

The air flow switch is used to prove the flow of combustion air from the blower assembly. It causes the fuel valve to close or fail to open upon loss of or inadequate combustion air.

## ADJUSTMENT PROCEDURE:

1. Switches should be set to break (open) when combustion air is substantially reduced.
2. If applicable, remove cover to adjusting screw.
3. Turn adjusting screw clockwise to increase set point or counterclockwise to decrease set point.
4. With burner at high fire, increase switch setting until switch contacts open.
5. Reduce switch setting by 10 to 15% and check for proper operation.

## AIR FLOW SWITCH



## DESCRIPTION

The gas pilot igniter is composed of [1] An ignition electrode with insulator which transfers an arc between it and the adjacent ground, and [2] A fuel tube through which the gas is directed to the point of the electrical arc.

A charge from a high voltage transformer is routed to the ignition electrode causing an intense arc to ground. The arc ignites pilot gas and when pilot flame is proven, the electrical discharge from the transformer terminates and the pilot stands ready to ignite the main burner flame.

## ADJUSTMENT PROCEDURE

### NOTE

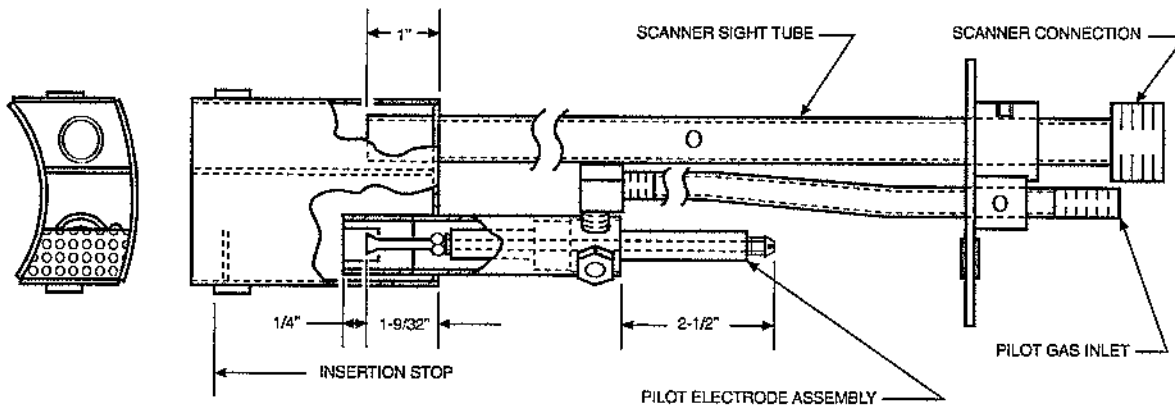
The gas pilot igniter assembly is a vital part of the burner and must be kept clean and properly adjusted at all times.

### WARNING

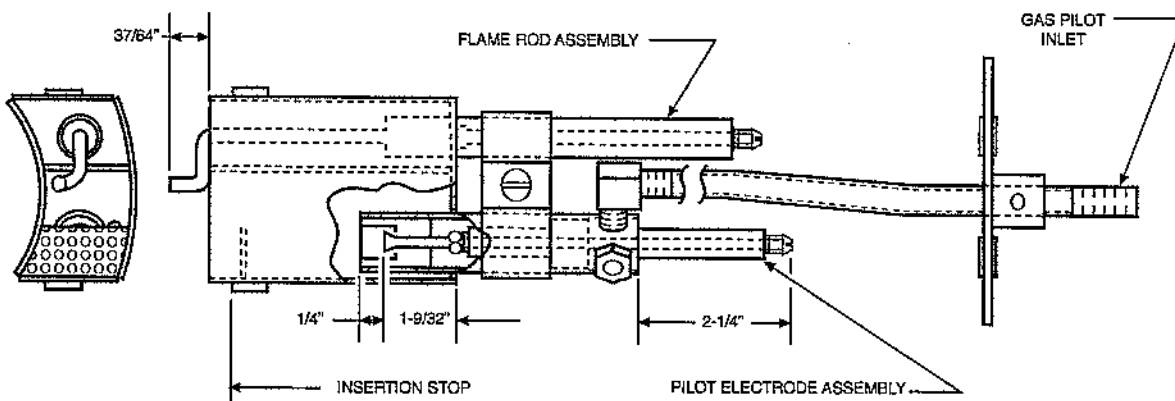
Turn off power at the master switch and remove flame safeguard from the subbase. Turn pilot gas cock OFF.

1. Disconnect cables, lines or tubes from the igniter assembly and remove from burner housing.
2. Inspect components for cleanliness and proper adjustment settings as shown in the following illustrations.
3. Reinstall igniter assembly and flame safeguard after cleaning, adjustment or inspection.
4. Turn pilot gas cock back ON.

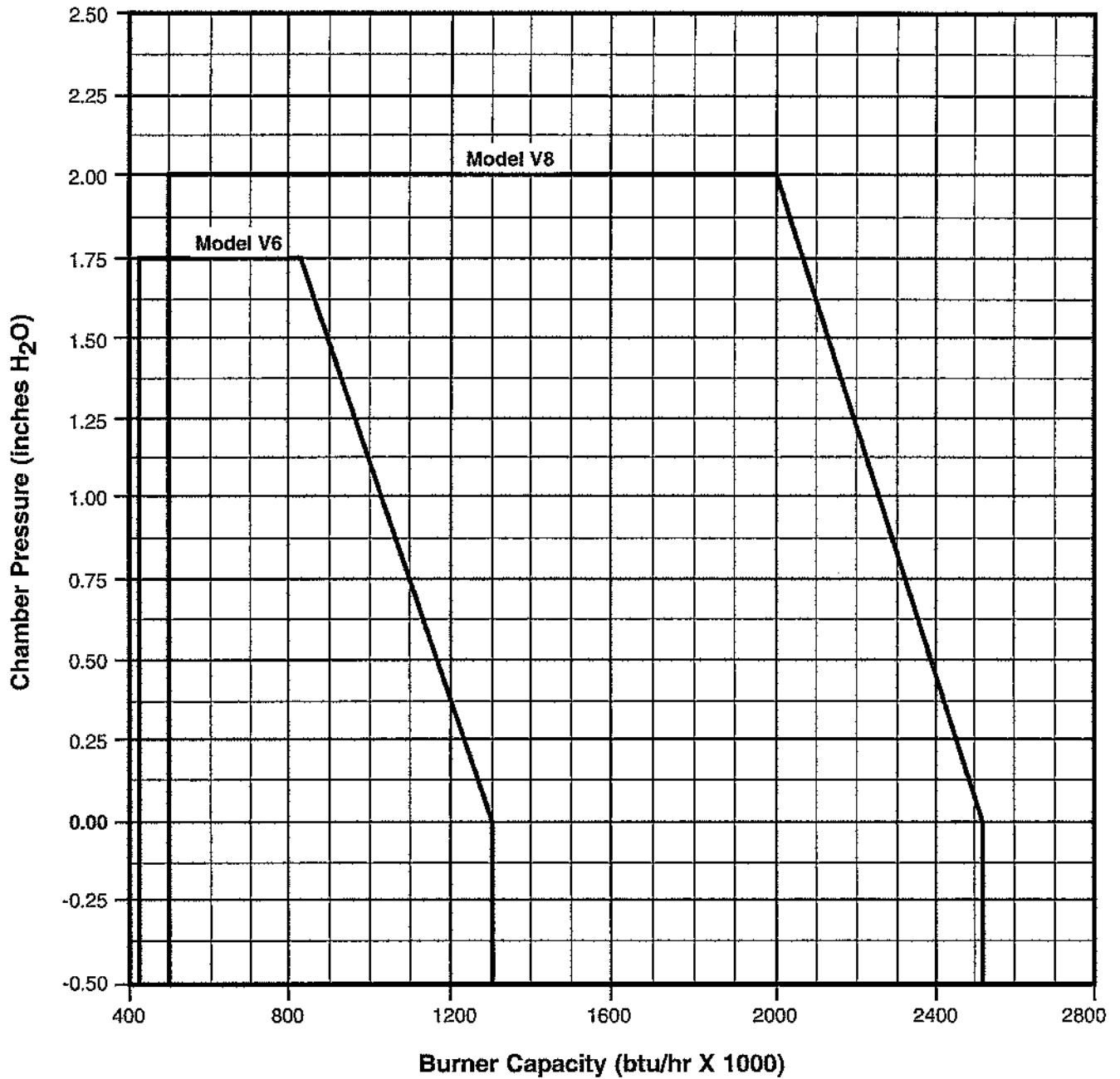
Gas Pilot Assembly with Scanner Sight tube



Gas Pilot Assembly with Flame Rod



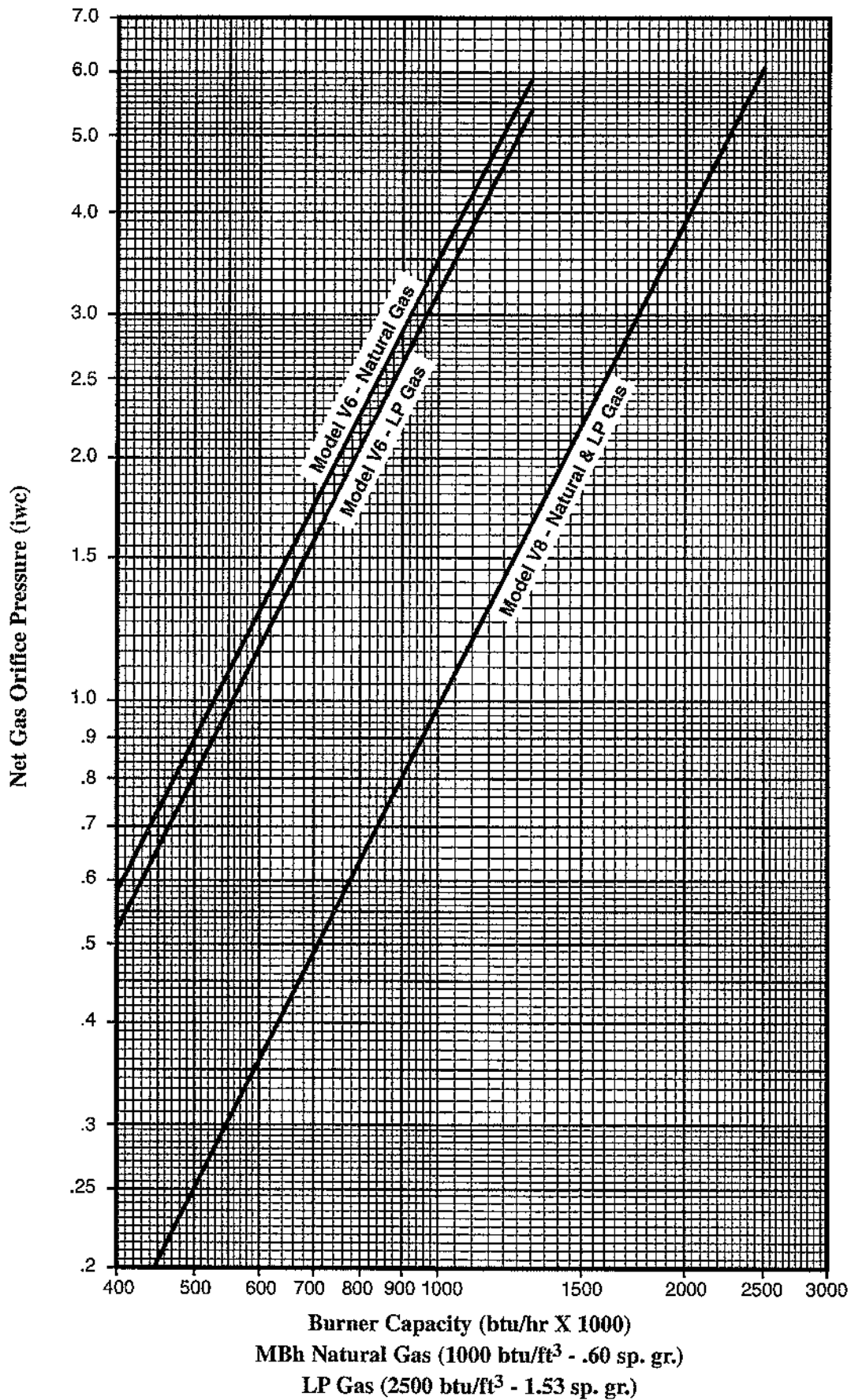
# BURNER CAPACITY VS COMBUSTION CHAMBER PRESSURE



## NOTES

1. Capacities are typical and may vary for each application.
2. Maximum capacities are based on 70°F ambient air, 2000 ft. above sea level, 60 Hz operation, 20% excess air firing natural gas or LP gas.
3. Capacities for 50 Hz operation multiply maximum rates by .83.
4. Turndown ratio dependent on fuel system selected and application.
5. When chamber pressure exceeds .75 iwcc, a low fire start control system is required.

# NET ORIFICE GAS PRESSURE



**NOTE** Net gas orifice pressure is manifold gauge pressure minus firebox pressure.

# PART VI

## BURNER START-UP



Burner start-up, adjustment and service must be done by fully trained and qualified personnel.

A representative of the owner or the operator of the equipment should be present to receive instruction in care and adjustment of the unit. Upon completion of the initial start-up, he should sign the start-up form acknowledging that instruction has been received and a date established for start of service period, if provided.

Proper combustion adjustments involve setting the fuel input rate and the combustion air to achieve maximum practical efficiency. The gas input is adjusted by regulating the main gas pressure regulator (Fig. 23).

The operator should become familiar with the location and purpose of all controls covering the burner's operation. Schematic wiring diagrams and identification photographs in this manual show the most important valves, instruments and electrical controls which regulate the burner operation.



Examine the material list, wiring diagram and other information supplied with your burner.

### BEFORE START-UP

1. **VOLTAGE CHECK - 120 VOLT MOTOR & 120 VOLT CONTROLS** - With burner control switch OFF turn on burner power at disconnect switch. Check voltage with meter between terminals 1 and 2. If voltage is not within +10% -15% of 120 volts, contact local utility.
2. **CALL FOR HEAT** - Operating and limit controls must be calling for burner operation. These controls may include the low water cutoff, steam pressure or hot water temperature controls, and other remote switches or controls, if used.

3. **PURGE GAS LINE -**



Purging of gas lines must be done in accordance with American National Standard, ANSI Z223.1.

4. **LUBRICATION** - If blower motor is equipped with lubrication devices, add (2) drops of SAE20 lubricating oil to each bearing.
5. **AIR DAMPER** - Adjust air damper per instructions in adjustment section.

### START-UP



This manual has been prepared as a guide in burner start-up operations. It is written for the start-up specialist who is thoroughly qualified both by training and experience. Gas piping must be checked for leaks prior to start-up.



Do not proceed with start-up unless all applicable checklist  items in Part IV and preliminary adjustment requirements in Part V have been satisfied.



## WARNING

Be certain combustion chamber, flues, and surrounding areas are free of GAS accumulations, or other combustibles such as paint thinners, cleaning solutions, etc. An explosimeter [Mine Safety Appliances Co. model No. 2A or equivalent] should be used to make this determination.

## WARNING

During initial start-up, the operator must be on constant alert for emergency conditions such as fuel leaks, electrical malfunctions, etc. The location of all manual shutoff valves and switches should be clearly in mind so the burner can be quickly shut down if necessary. Should the burner fail to ignite, never manually manipulate the flame safeguard sequence which provides for purging of the combustion chamber.

### 1. FLAME SAFEGUARD INSTALLATION -

Assure flame safeguard is properly installed in its subbase. See separate instructions on Flame Safeguard for mounting the unit in the subbase.

2. With the operating control set to on and all manual gas valves closed, turn control switch on and observe prepurge and ignition spark. Allow flame safeguard control to proceed to a safety lockout, thereby checking the control for flame failure. Reset control.
3. Turn pilot gas cock on and turn control switch on. With pilot running, set pilot pressure and visually inspect pilot flame.
4. Turn manual gas shutoff valve ON. Establish main flame by manually opening the leak test cock. Visually inspect main gas flame. Set manifold gas pressure to that shown on material list or that shown on orifice chart for your firing rate. Check gas piping for leaks. Clock the firing rate of the burner

with the gas utility company meter and adjust burner pressure regulator, if necessary, to obtain rated capacity.

5. Adjust combustion air inlet louver to obtain 8 1/2% to 9 1/2% carbon dioxide (CO<sub>2</sub>) on natural gas or 10% to 11% carbon dioxide (CO<sub>2</sub>) on propane gas without forming excessive carbon monoxide (CO).

## CAUTION

Do not adjust flame visibly. Instruments are the only safe and reliable means to determine the proper adjustments.

## **BURNER SAFETY CHECK**

1. Start and stop burner several times to insure proper operation.
2. Check operation of combustion safeguard control by simulating a flame failure, making certain the burner locks out on safety within the proper time limit. See flame safeguard instructions for procedure.
3. Check operation of the air flow switch, making certain fuel valve closes when the air flow diaphragm switch opens. Adjust per Figure 26.

### 4. LOW AND HIGH GAS PRESSURE SWITCHES -

If burner is equipped with low and high gas pressure switches, perform the following steps:

#### **LOW GAS PRESSURE SWITCH ADJUSTMENT**

- a. Close the main manual gas shutoff valve and install a manometer in the upstream test port of the safety shutoff gas valve.
- b. Reopen the main manual gas shutoff valve.
- c. Cycle the burner to high fire and take gas pressure reading on manometer. Using the main manual gas shutoff valve, throttle down the gas flow to a point where the manometer reading is approximately 10% below the previous reading, then adjust the low gas pressure switch

downward until it breaks and shuts down the burner. Restore main manual gas shutoff valve to full open.

- d. To insure the switch is functionally sound and properly installed, recycle the burner to high fire and again use the main manual gas shutoff valve to throttle the gas flow. The low gas pressure switch should immediately break and shut down the burner at 10% reduced pressure.
- e. Turn main manual gas shutoff valve to off, then remove manometer and reinstall test plug in gas safety shutoff valve. Restore main manual gas shutoff valve to full open.
- f. Cycle the burner on-off several times to assure the switch will not cause nuisance shutdowns as the burner ignites.

#### **HIGH GAS PRESSURE SWITCH ADJUSTMENT**

- a. Cycle the burner to high fire. Slowly adjust the switch downward until the switch breaks and shuts down the burner, then reverse the adjustment so the setting is approximately 10% greater than the reading at which the switch broke.

##### **Example**

If the switch broke and shut down the burner at 4.0" wc, then set the switch at 4.5" wc.

- b. Cycle the burner on-off several times to assure the switch will not cause nuisance shutdowns as the burner ignites.
5. **FINAL CO<sub>2</sub> AND CO ANALYSIS** - With gas input rate established, perform a final CO<sub>2</sub> analysis and make air adjustments as necessary. The final air settings should produce a flue gas analysis of between 8 1/2% and 9 1/2% CO<sub>2</sub> without CO.



Do not set fire visually. Instruments are the only safe and reliable means to determine the proper adjustments.

#### **6. MOTOR RUNNING CURRENT AND VOLTAGE CHECK**

- a. Measure motor running current after final air adjustments have been made. Current should not exceed motor service factor amps shown on motor nameplate.
  - b. Check control voltage on terminals 1 and 2 as motor starts. Voltage should not drop below 102 volts [even momentarily] or difficulty may occur in control operation. Extreme voltage drop indicates inadequate service wire size to the burner.
7. Set the high limit control 2 to 3 psi or 10 degrees F. to 15 degrees F. higher than the desired operating pressure or temperature. Set the operating control pressure or temperature higher than the high limit control for this test. Permit burner to run until desired HIGH LIMIT pressure or temperature is indicated and then adjust high limit control, if necessary, to shut off the burner at the desired high limit pressure or temperature.
8. Reset operating control to desired pressure or temperature. Permit burner to run until it is shut off by the operating control. Adjust operating control, if necessary until it causes burner to stop and start within desired range.
9. With the burner running, open the blow-down valve on the low water cutoff (if used). The burner should shut off immediately. The burner should restart automatically when the proper level of water in the low water cutoff is reestablished.
10. Conduct minimum pilot turn down test, reduce gas pressure to pilot with manual shutoff cock to the point pilot flame is extinguished or fails to prove. Increase gas flow slightly, main flame must with this pilot flame.
11. **NORMAL OPERATION** - Providing the setup and checkout operations outlined above have been properly completed and all tests have been found to be satisfactory, the burner is now ready for normal gas firing operations.

12. The following readings should be taken and recorded after final adjustments have been made.

- A. Burner input (CFH Gas)
- B. Percent CO<sub>2</sub> or O<sub>2</sub>
- C. CO indication

- D. Stack Temperature
- E. Firebox Pressure (inches wc)
- F. Fuel Pressure (inches wc - Gas) (main and pilot)
- G. Voltage to burner

13. Give instruction to owner (operator).

The Items Below Summarize the Flame Safeguard Checkout Tests Required for Each Type of Installation	
Checkout Item	When Performed
1. Preliminary Inspection	For All Installations
2. Flame Signal Measurement	For All Installations
3. Initial Lightoff Check with Proven Pilot	If Pilot Must be Proven Before the Main Fuel Valve Can Open
4. Pilot Turndown Test	If Pilot Must be Proven Before the Main Fuel Valve Can Open
5. Hot Refractory Hold-In Test	For All Photocell (Rectifying or Infrared Lead Sulfide) Applications
6. Hot Refractory Over-ride Test	For All Infrared (Lead Sulfide Photocell) Detector Applications
7. Ignition Spark Response Test	For All Ultraviolet Detector Applications
8. Flame Signal with Hot Combustion Chamber	For All Installations
9. Safety Switch Lockout Tests	For All Installations

**WARNING**

Should overheating or an emergency condition occur:

- 1. Shut off the manual gas controls to the burner.
- 2. Shut off control switch on burner.

**NOTE**

Under some conditions power should remain on for the water pumps or air circulating blowers. Determine proper response prior to an emergency.

# PART VII

## BURNER MAINTENANCE and TROUBLE SHOOTING

Frequency of maintenance depends on the condition of the heating plant area. For dusty or adverse conditions, preventive maintenance should be performed once a month, or as often as necessary for proper burner operation. **PREVENTIVE AND YEARLY MAINTENANCE** can be performed

by building maintenance personnel. **ALL SERVICE AND ADJUSTMENT OF THE BURNER SHOULD BE PERFORMED ONLY BY QUALIFIED BURNER SERVICE PERSONNEL.**



Always turn electrical power and gas fuel supply OFF before undertaking any maintenance that does not require the burner to be in operation.

### PERIODIC TESTING RECOMMENDED CHECK LIST

ITEM	FREQUENCY	ACCOMPLISHED	REMARKS
Check burner and boiler control linkage	Daily	Operator	Make visual inspection
Check fuel system for leaks	Daily	Operator	Make inspection visually and with leak detection instrumentation
Gauges, monitors and indicators	Daily	Operator	Make visual inspection and record readings in log
Instrument and equipment settings	Daily	Operator	Make visual check against recommended specifications
Check burner flame	Daily	Operator	Visual inspection for changes
Firing rate control	Weekly Semiannually Annually	Operator Service technician Service technician	Verify factory settings Verify factory settings Check with combustion test
Stack temperature	Daily	Operator	Record in log
Flue, vent, stack or outlet dampers	Monthly	Operator	Make visual inspection of linkage, check for proper operation
Igniter	Weekly	Operator	Make visual inspection, check flame signal strength if meterfitted (see "Combustion safety controls")
<b>Fuel Valves</b>			
Pilot and main	Weekly	Operator	Open limit switch - make aural and visual check - check valve position indicators and check fuel meters if so fitted
Pilot and main gas	Annually	Service technician	Perform leakage tests - refer to instructions

## PERIODIC TESTING RECOMMENDED CHECK LIST

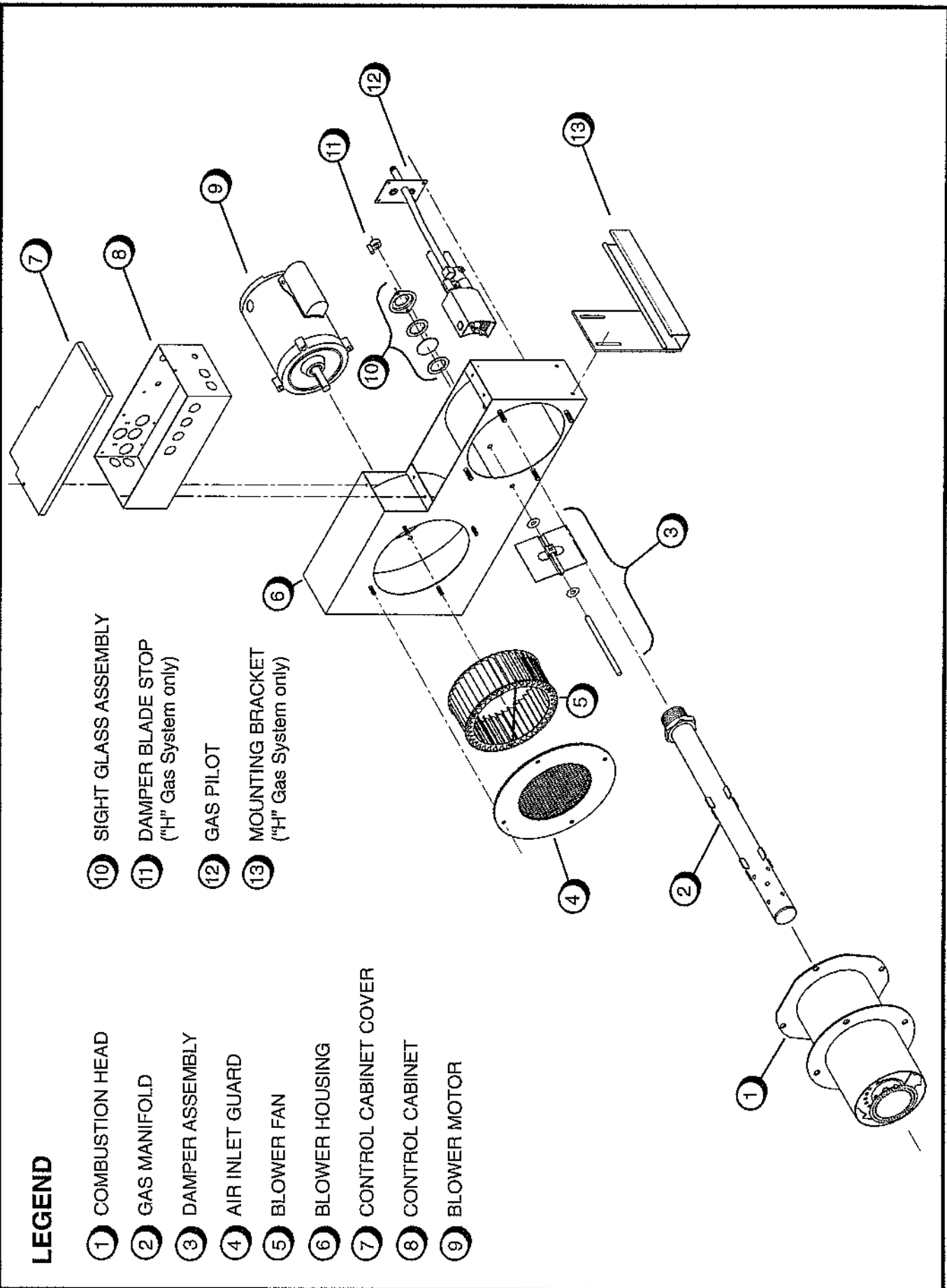
ITEM	FREQUENCY	ACCOMPLISHED	REMARKS
Combustion safety controls			
Flame failure	Weekly	Operator	Close manual fuel supply for (1) pilot, (2) main fuel cock, and/or valve(s); check safety shutdown timing; log
Flame signal strength	Weekly	Operator	If flame signal meter installed, read and log; for both pilot and main flames, notify service organization if readings are very high, very low, or fluctuating; refer to instructions
Pilot turndown tests	As required/annually	Service technician	Required after any adjustments to flame scanner mount or pilot burner verify annually- refer to instructions
Refractory hold in	As required/annually	Service technician	See "Pilot turndown tests"
Low-water fuel cutoff and alarm	Daily/Weekly Semiannually	Operator Operator	Refer to instructions Perform a slow drain test in accordance with ASME Boiler and Pressure Vessel Code Section VI
High limit safety control	Annually	Service Technician	Refer to instructions
Operating control	Annually	Service technician	Refer to instructions
Low draft, fan, air pressure, and damper position interlocks	Monthly	Operator	Refer to instructions
High and low gas pressure interlocks	Monthly	Operator	Refer to instructions
Fuel valve interlock switch	Annually	Service technician	Refer to instructions
Burner position interlock	Annually	Service technician	Refer to instructions
Low fire start interlock	Annually	Service technician	Refer to instructions
Safety vaives	As required	Operator	In accordance with procedure in Section VI, ASME Boiler and Pressure Vessel Code, Recommended Rules for Care and Operation of Heating Boilers
Inspect burner components	Semiannually	Service technician	Refer to instructions
Clean burner fan	Annually or as required	Operator	Remove buildup on fan blades
Extended shutdown	As required	Operator	If the unit is to be out of service for an extended period of time, close all manual fuel valves. Turn off burner by control switch being sure to leave electrical power on the control panel. Leaving power on the control panel will help prevent humidity damage to the flame safeguard.

## Trouble Shooting

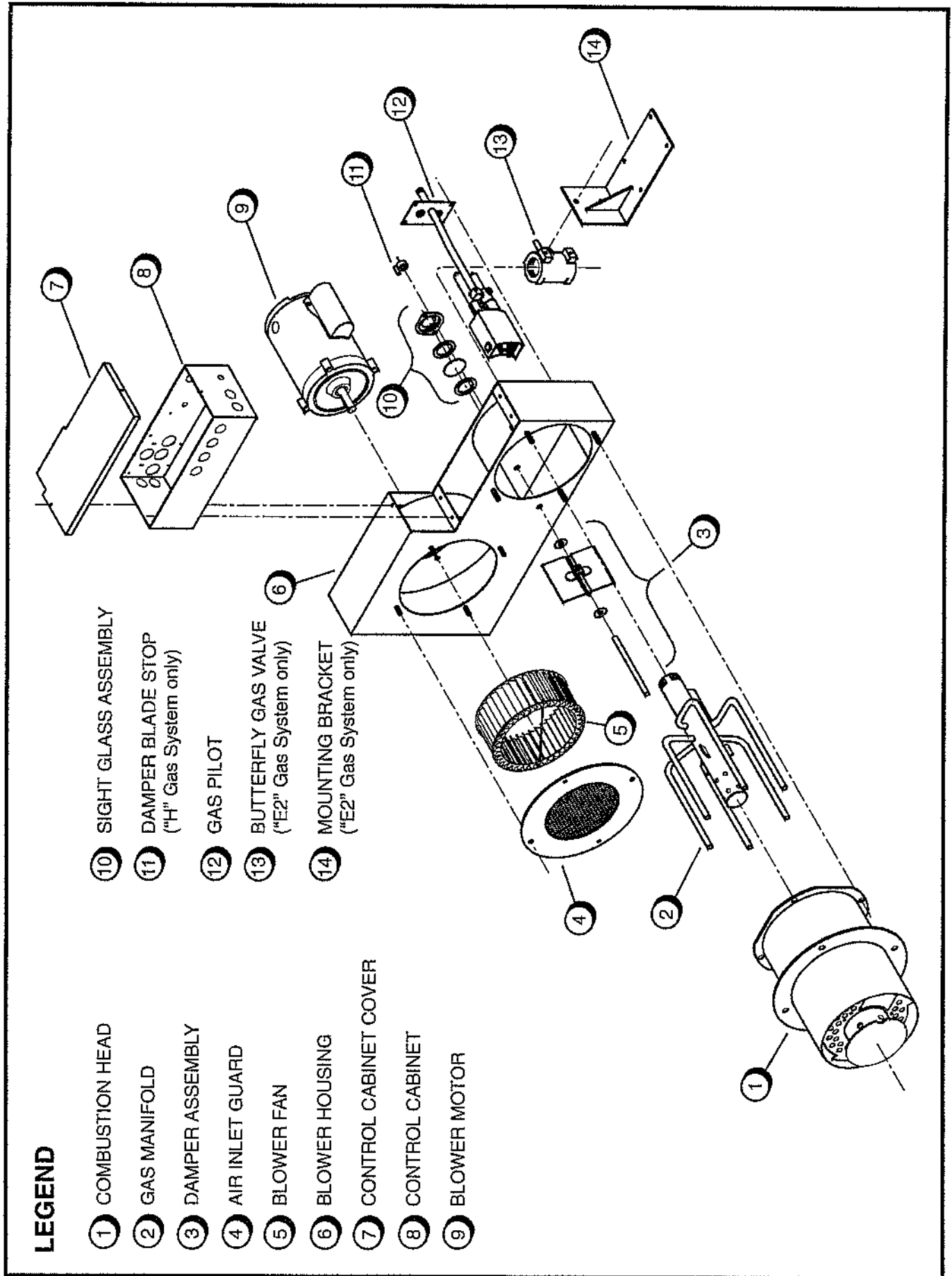
TROUBLE	PROBABLE CAUSE	ACTION
Blower Motor does not operate when switch is closed.	Power disconnected	Check voltage between terminals 1 & 2, If no voltage, check power supply, 120 volt, 60 hertz.
	Operating control not calling for heat or high limit control open.	Check voltage between terminals 2 & 3 or 2 & 4 If no voltage, check for open operating, limit control or thermostat.
	Overload tripped out on motor.	Reset. Check motor current for possible overload.
	Defective motor.	If voltage at motor terminals is correct, replace motor.
Motor runs but ignition spark does not occur.	Air flow switch fails to make.	Adjust per instruction manual.
	Ignition cable or electrode loose or grounded.	Check to insure that ignition cable is securely plugged into electrode. Check cable and clean if necessary. Remove and check electrode insulator for cracks.
	Defective flame safeguard	Replace flame safeguard.
Motor runs, ignition spark occurs, but gas pilot does not ignite	No gas being supplied to pilot.	Check all manual gas valves leading to burner to insure that they are open or that separate manual pilot valve is open.
	Pilot gas valve does not open.	Check for 120 volts to coil on trial for ignition. Check valve action by sound and feel. Replace coil or valve body as needed. If no voltage to coil, replace the flame safeguard control.
	Improper gas supply to pilot.	Adjust pilot gas regulator.
Motor runs, gas pilot establishes, pilot flame does not prove	Improper gas flow	Increase or decrease gas pressure to pilot.
	Flame sensor dirty/scaled.	Clean/descale or replace sensor, rod.
	Defective flame safeguard/-amplifier.	Replace amplifier or flame safeguard.
Motor runs, gas pilot establishes, main gas flame does not ignite.	Manual valve(s) not in proper position.	Turn to On or Open position.
	Main Gas Valve does not open.	Check for 120 volts to coil of main gas valve. Check valve action by sound and feel. Replace coil or valve body as needed. If no voltage to coil, replace the flame safeguard.
	Excessive air to fuel ratio.	If gas flow rate is less than 50% of rated capacity, increase gas pressure or decrease air inlet shutter.
	Manifold gas pressure low.	Adjust pressure regulator to value shown on burner material list or rating tag. Inlet pressure to combination gas control or main shutoff cock too low. If it is , consult your local gas utility company,
Lockout on flame failure.	Interrupted fuel supply.	Establish fuel supply to burner.
	Improper combustion.	Adjust burner to obtain a clean flame.
	Weak flame signal.	Refer to flame safeguard control manufacturer's bulletin. Adjust pilot if necessary.
Carbon Monoxide (CO) formation	Flame impingement on cold surface due to excessive firing rate.	Check gas flow rate. Adjust flow rate, if necessary.
Check CO with reliable instrument. Be certain to check for CO before leaving burner location.	Flame impingement on a cold surface due to undersized chamber.	See Specification Table.
	Insufficient combustion air.	Increase air shutter opening or decrease gas pressure.

**FIGURE 28**

**Typical Model V6 Burner**







NOTES:

NOTES:

## **PART VIII**

### **SUPPLEMENTARY DATA**

This manual should be kept with other literature on your boiler room equipment as a complete reference source for maintenance and service. A copy of this manual should be posted and maintained in legible condition.