

POWER FLAME INCORPORATED



THE CX TANK HEATING SYSTEM CX SYSTEM INSTALLATION & START-UP MANUAL

THE POWER TO MANAGE ENERGY
2001 South 21st Street, Parsons, Kansas 67357
Telephone 620-421-0480, Fax 620-421-0948
Web site: www.powerflame.com
E-Mail: CSD@powerflame.com

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

FOR YOUR SAFETY

If you smell gas:

1. Open windows.
2. Do not touch electrical switches.
3. Extinguish any open flame.
4. Call your gas supplier immediately.

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

IMPORTANT - APPLICATION PRECAUTIONS

The CX burner is designed to fire into small diameter immersion tubes that will heat water or other aqueous type solutions. It is not intended for use in highly viscous liquids such as asphalt, molasses or similar products. If in doubt, consult with Power Flame.

PHOSPHATING APPLICATIONS - The CX burner can be satisfactorily applied to this type of application but it is essential to be aware of the information in Section 3.2(b).

TYPE CX BURNER INSTALLATION MANUAL

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>	
1	1	SUMMARY OF INSTALLATION PROCEDURE
	2	STANDARD BURNER / INDUCED DRAFT FAN RATINGS
	3	INTRODUCTION AND GENERAL DESCRIPTION
2	3	BURNER ASSEMBLY
3	5	HEAT EXCHANGERS
4	8	HEAT EXCHANGER EXHAUST DAMPER
5	9	GAS TRAIN ASSEMBLY
6	9	CONTROL SYSTEMS
	11	LIQUID TEMPERATURE CONTROLS
	12	COMBUSTION AIR PROVING SYSTEM
7	13	COMBUSTION AIR SUPPLY SYSTEM
8	14	HEAT EXCHANGER EXHAUST PIPING
9	14	START-UP INSTRUCTIONS
	14	PRE-START-UP CHECKLIST
	15	START-UP PROCEDURE
	16	ON-OFF OPERATIONAL MODE
	17	LOW-HIGH-LOW OPERATIONAL MODE
	19	MODULATING OPERATIONAL MODE
10	21	START-UP COMPLETION
11	22	TYPICAL CX BURNER INSTALLATION - FIG. 1
	22A	CX IMMERSION TUBE BURNER ASSEMBLY - FIG. 1A
	22B	CX BURNER AIR FLOW SWITCH AIR PIPING SCHEMATIC - FIG. 1B
	23	CX BURNER SYSTEM COMPONENTS AND CONNECTIONS - FIG. 2
	24	HEAT EXCHANGER DETAILS FOR MOUNTING CX BURNER - FIG. 3
	25	DIMENSIONS OF BENDS AND MITERS/HEAT EXCHANGER INSTALLATION DIMENSIONS - FIG. 4
	26	CX15 AND CX20 BURNER ASSEMBLY INSTALLATION DIMENSIONS - FIG. 5
	27	CX25 AND CX30 BURNER ASSEMBLY INSTALLATION DIMENSIONS - FIG. 6
	28	CX40 BURNER ASSEMBLY INSTALLATION DIMENSIONS - FIG. 7
	28A	CX60 BURNER ASSEMBLY INSTALLATION DIMENSIONS - FIG. 7A
	29	BUTTERFLY TYPE FLUE GAS DAMPER CUTAWAY DWG - FIG. 8
	30	CX BUTTERFLY FLUE GAS DAMPER DIMENSIONAL DATA - FIG. 9

TYPE CX BURNER INSTALLATION MANUAL

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>	
	31	M436 DAMPER MOTOR AND M934 MOD MOTOR ON EXHAUST BUTTERFLY DAMPER - FIG. 10
	32	STANDARD GAS PIPING FOR CX BURNERS - FIG. 11
	33	TYPICAL CX ON/OFF CONTROL PANEL - FIG. 12
	34	CX BURNER AUXILIARY CONTROL PANEL - FIG. 13
11	35	CX15 and CX20 BURNER ELECTRODE SETTING DETAILS - FIG. 14
	36	CX25, 30, 40 AND 60 BURNER ELECTRODE SETTING DETAILS - FIG. 15
	37	CX INDUCED DRAFT FAN DIMENSIONS - FIG. 16
	38	BURNER MOUNTING AND DRAFT FAN INLET FLANGE DETAILS - FIG. 17
	39	FLUE PIPING SIZING - FROM HEAT EXCHANGER FLUE GAS DAMPER TO INDUCED DRAFT FAN INLET - FIG. 18
	39	EQUIVALENT LINEAL FEET FOR SCHEDULE 40 PIPE FITTINGS - FIG. 19
	40	FAN DISCHARGE FLUE SIZING DATA - FIG. 20A, FIG. 20B
	41	FAN DISCHARGE FLUE SIZING DATA - FIG. 20C
	41	EQUIVALENT LINEAL FEET FOR FLUE EXHAUST FITTINGS - FIG. 21
	41	CX TURNDOWN RATIO INFORMATION - FIG. 22
	42	CX NATURAL GAS BURNER PRESSURE VS. CAPACITY CHART - FIG. 23
	42A	CX PROPANE GAS BURNER PRESSURE VS. CAPACITY CHART - FIG. 24
	42B	CAPACITY OF PIPE-NATURAL GAS - FIG. 25
	42B	SPECIFIC GRAVITY CORRECTION FACTORS - FIG. 26
	42B	EQUIVALENT LENGTH OF FITTING - FIG. 27
12	43	TROUBLE SHOOTING SUGGESTIONS
13	46	MAINTENANCE SECTION
14	49	LIST OF RECOMMENDED SPARE PARTS
		CX BURNER START-UP TEST DATA SHEET
		POWER FLAME INCORPORATED LIMITED WARRANTY

STANDARD BURNER RATINGS

BURNER MODEL	NOMINAL RATINGS				TYPICAL (3) HEAT EXCH. TUBE SIZE
	INPUT (1) (BTU/HR)	SUPPLY (2) GAS PRESS. REQUIRED O-O MODE	SUPPLY (2) GAS PRESS. REQUIRED L-H-L MODE	SUPPLY (2) GAS PRESS. REQUIRED MOD MODE	
CX 15	150,000	4.0" W.C.	4.0" W.C.	N/A	1 1/2"
CX 20	275,000	7.0" W.C.	7.0" W.C.	N/A	2"
CX 25	475,000	5.0" W.C.	5.0" W.C.	5.5" W.C.	2 1/2"
CX 30	750,000	6.0" W.C.	6.0" W.C.	6.5" W.C.	3"
CX 40	1,500,000	8.0" W.C.	8.0" W.C.	8.5" W.C.	4"
CX 60	2,500,000	11.0" W.C.	11.0" W.C.	11.5" W.C.	6"

- (1) These are nominal ratings and can vary depending upon specific application conditions.
 (2) These are pressures required at the gas train supply inlet for natural gas. L.P. gas can also be supplied but with varying pressure requirements.
 (3) Under certain conditions, the heat exchanger tube may be increased to the next larger tube size.

INDUCED DRAFT FANS (Combustion Air Source for CX Burners)

FAN MODEL	NOMINAL RATINGS*			
	CAPACITY (BTU/HR)	FLOW (CFM)	SUCTION IN. W.C.	MOTOR H.P. 220/440/3/60
142 Q	300,000	70	12"	1.0
142.5Q	1,000,000	250	12"	1.5
144 Q	1,500,000	350	12"	2.0
193 Q	1,500,000	350	24"	3.0
194 Q	3,000,000	700	24"	5.0
195 Q	4,000,000	950	24"	7.5
222.5Q	1,500,000	350	30"	5.0
224 Q	4,000,000	950	30"	10.0

***NOTE:** This data is provided for informational purposes only. CX systems fans are specially designed direct drive high temperature units. No substitutions allowed.

Fan selection is based upon Burner Rating as well as Pressure Drop across the selected heat exchanger. Both will vary based upon application. The Power Flame Rapid Design System (RDS) must be used for final Fan Model and Burner Model Selection. The RDS utilizes a computer program that selects the burner size, heat exchanger configuration and induced draft fan, to ensure maximum system efficiency and component compatibility. See Fig. 16 Pg. 37 for additional fan information.

1.1 Introduction and General Description (See Fig 1. Pg 22 & Fig.2 Pg 23)

Power Flame Type CX gas fired immersion tube burners are designed for high efficiency fluid heating in industrial tanks, baths and vats. Each system consists of an induced draft burner firing down a small diameter heat exchanger immersed in the liquid. The units are individually controlled to ensure maximum flexibility and to minimize process operating costs.

A centrifugal suction fan supplies the burner with induced draft combustion air. The volume of air is controlled by fixed or automatic positioning of a flue gas damper butterfly valve mounted on the exhaust end of the heat exchanger tube.

The burner controls supplied are designed to meet Power Flame standards. Controls to meet FM, IRI or other standards are an available option. The burner control system includes a pressure regulator, safety shut off valve and gas cocks plus fully automatic burner programmer, ignition transformer and differential air pressure switch. After a suitable prepurge period, the gas is ignited by a high voltage spark. A rectifying flame rod or U.V. scanner (option) proves the presence of the flame. The flame is monitored throughout the burner operation. Burner components are automatically sequenced by the burner programming control.

The fluid temperature is controlled by an immersion thermostat or temperature controller that switches the burner between high and low settings or off as required. These control devices are offered as an option available through Power Flame.

Mounted internally, the heat exchanger (supplied by others) passes through the tank wall via a sealing flange. The burner assembly bolts onto a removable flange on one end of the heat exchanger and the flue gas damper screws onto the other end. The remaining pipework to the fan and flue must be completed on site to suit each installation. Remote control cabinet (if supplied) is factory tested and pre-wired to terminal strips ready for external wiring on site to the electrical supply, gas train components, fans, thermostats, clocks, etc.

Certain installations are supplied with one suction fan to provide combustion air for more than one burner. In these instances, each burner may be cycled on and off independently for maximum temperature control flexibility.

2. BURNER ASSEMBLY

2.1 Description

This unit is supplied ready for connection to the heat exchanger and gas supply. It comprises a burner head assembly, flame cone and flame tube enclosed within a mild steel body that is packed with flame retardant sound absorbing material.

Heavy duty flame rod and ignition electrodes are mounted on the flame cone and their respective cables pass through the outer case near the rear of the assembly. (The burner may be ordered with an ultraviolet (UV) scanner in lieu of the flame rod.) A gas pressure test point, sight port and air proving connection are also provided.

2.2 Design Considerations

(a) Installation (See Fig. 1 Pg 22)

The burner assembly may be fired down either of the two "exiting" heat exchanger legs except in the following instances:

- (i) If the heat exchanger legs have unequal straight run lengths to the first elbow or miter, the burner should fire down the longer leg.
- (ii) The burner should fire towards a swept bend or elbow in preference to a mitered bend.
- (iii) If there is any vertical separation between the heat exchanger legs, the burner should be fired, if possible, down the lower leg.

The burner assembly should be readily accessible and adequate space must be allowed at the rear of the assembly to permit servicing and start-up. See Fig. 5 Pg 26, Fig. 6, Pg 27 and Fig. 7 Pg 28.

(b) Splashing and Mechanical Damage

The burner assembly is fabricated from mild steel with an enamel finish. A splash guard is advisable in harsh environments or where tanks contain corrosive or caustic fluid.

Adequate protection from mechanical damage (e.g. by forklift trucks, etc.) must be provided.

(c) Combustion Air

Combustion air is drawn through the gap between the burner assembly and baffle plate at the rear of the unit. This gap, once correctly adjusted, must not be altered. See Fig. 5 Pg 26, Fig. 6 Pg 27, Fig. 7 Pg 28 and Fig. 7A, Pg 28A. This gap must not be restricted while the burner is in operation.

(d) Fresh Air Source

Make certain that an adequate source of combustion air is available and that the fresh air source is provided in compliance with the controlling authorities. At minimum, we suggest 1/2 square inch free opening per 1000 Btu/hr input. Under no circumstances should the burner be subjected to a negative ambient air pressure environment. If a negative ambient air pressure condition exists, or if the combustion air entering the burner carries a high concentration of matter that could cause fouling of the burner or heat exchanger tube, a fresh air ducting system should be used. This fresh air burner entrance adaptor is available through Power Flame. Contact factory for complete information.

2.3 Installation (See Fig. 3 Pg 24)

Refer to the previous section to establish burner location on the most appropriate heat exchanger exiting leg.

Screw the locknut and connection flange provided onto the end of the heat exchanger firing leg. Bolt the burner assembly onto the connection flange and rotate it to the desired position. Tighten the locknut up to the flange to prevent any further rotation. The burner assembly is designed to operate in any orientation and the final position should be chosen to accommodate the connection to the gas train.

The unit is now ready for connection to the gas train, air pressure switch and electrical controls. If splash guards are required (supplied by others), they should be attached when the installation is complete.

3. HEAT EXCHANGERS (Supplied by Others)

3.1 Description (See Fig. 1 Pg 22, Fig. 3 Pg 24, & Fig. 4 Pg 25)

(a) Flange mounted heat exchangers should be supplied fully pressure tested and assembled complete with fixed sealing flanges and bolts, gaskets, slip-on sealing flanges, nuts and washers. Heat exchanger tube design should include tube supports appropriately placed. One method is to weld threaded rod nuts on to the bottom of the tube and at installation cut the threaded rods to length and screw into the welded nuts. To allow for thermal expansion, do not weld or otherwise permanently secure the bottom end of the rod to the tank.

(b) Plate Mounted Heat Exchangers

Essentially the same as a flange mounted heat exchanger except the tube assembly is mounted on a plate to permit installation from outside of the tank.

(c) Selection of Liquid Side Materials

Consult with your chemist and/or chemical supplier to determine type of material out of which the heat exchanger coil, sealing flanges and gaskets should be constructed - as well as any precautions necessary to safely heat the solution.

(d) Stress Relieving

If solution is a strong caustic, we suggest heat stress relieving of mild steel heat exchangers after fabrication. Consult your chemist and/or chemical supplier as necessary.

3.2 Design Consideration

(a) Heat Exchanger Effectiveness

For maximum effectiveness, the heat exchanger should be installed as close to the tank bottom as possible unless there is continuous mechanical agitation or pumped circulation of the fluid.

(b) Sludge

To avoid permanent damage through overheating, the heat exchanger must not come into contact with any sludge that may collect in the tank.

CAUTION

Phosphating processes can produce sludge and/or scale which -

- (1) Builds up on the tank floor.
- (2) Adheres to heat exchanger surfaces.

Heat exchanger must therefore be -

- (1) Positioned above the anticipated sludge level.
- (2) Accessible for cleaning without removal.
- (3) On this type of application, we suggest the installation of a stack temperature alarm device that would alert the operator that his heat exchanger surfaces were beginning to develop a serious scale build-up and should be cleaned.

IF STAINLESS STEEL HEAT EXCHANGERS ARE USED, IT MAY BE APPROPRIATE TO POLISH THE OUTSIDE SURFACE (EITHER MECHANICALLY OR PREFERABLY BY ELECTROPOLISHING) SO THAT CLEANING IS MADE EASIER (USUALLY BY MEDIUM/HIGH PRESSURE WATER JET, RUBBER OR WOODEN HAMMER/SCRAPER).

(No hard implements should be used for cleaning polished pipes as once 'scratched' the polishing process is rendered ineffective and 'stronger' scale adhesions will result.)

(c) Mechanical Protection

The heat exchanger must not be used to support dip baskets, components, etc. and should be protected from components that are accidentally detached from conveyors, etc.

(d) Installation

Flange mounted heat exchangers for installation through the tank wall are lowered into the top of the tank during installation; allowance must therefore be made for the physical size of the heat exchanger. See Fig. 4 Pg 25.

(e) Liquid Level

The heat exchanger must be completely immersed when the unit is firing. The system should include a level switch if there is any possibility of the liquid level falling below the highest point of the heat exchanger. For down firing installation, an automatic make-up level switch must be installed to ensure that the distance between the liquid level and burner will not exceed 3". Under no circumstance on any application (horizontal or otherwise) should the distance between the burner and the liquid be more than 3".

3.3 Installation

With reference to the previous section, determine the desired location for the heat exchanger within the tank.

(a) Flange Mounted Heat Exchangers

Carefully mark the tank wall to suit the heat exchanger firing and exit leg centers and flanges, using the slip-on flange as a template. Note: If supplied, the support nuts welded onto the heat exchanger tubes must be facing down. Cut and deburr the holes in the tank wall and install the heat exchanger from inside the tank. The heat exchanger must not be forced to suit the cut holes - or stress will be set up in the tank and heat exchanger that may act as points for corrosion. Temporarily support the heat exchanger in its final position with the gasket in place between the fixed flange and tank wall; fit the slip-on flange from the outside of the tank and complete the seal by tightening the nuts and washers onto the fixed bolts.

Note: Where possible, the heat exchanger should be horizontal to minimize the build up of condensation.

If supplied, adjust/modify the support rods to the correct length and screw into the fixed nuts provided on the underside of the heat exchanger tube. Remove the temporary support and fill the tank with fluid to test the seal at the flanges; tighten the nuts if necessary. Paint the exposed threads to stop the nuts from working loose in service.

(b) Plate Mounted Heat Exchangers

If the plate has not been pre-drilled, mark, cut and deburr the holes to suit the mating surface. Note: If supplied, the support nuts welded onto the heat exchanger tubes must be facing down. With the gasket in place, install the heat exchanger from the outside of the tank and temporarily support the assembly in its final position. Note: Where possible, the heat exchanger should be horizontal to minimize the build-up of condensation. Tighten the plate and gasket onto the mating surface.

If supplied, adjust the support rods to the correct length and screw into the fixed nuts provided on the underside of the heat exchanger tube. Remove the temporary supports and fill the tank with fluid to test the gasket seal; tighten if necessary. Paint the threads to prevent the nuts from working loose in service.

4. HEAT EXCHANGER EXHAUST DAMPER (See Fig. 8 Pg 29 and Fig. 9 Pg 30)

4.1 Description

An adjustable butterfly type flue gas damper is mounted on the heat exchanger exhaust leg to control the amount of air being induced through the combustion air baffle plate gap at the rear of the burner assembly.

The flue gas damper is threaded female at each end for connection to the heat exchanger and flue (not supplied). At start-up, this damper will be adjusted and locked into a fixed position for on-off mode burners. For low-high-low and modulating modes of operation, this damper will be motor drive to attain maximum combustion efficiencies for the various firing rates. Refer to Fig. 10 Pg 31.

Gas sampling points and a compression fitting to suit 1/4" O.D. tubing for the air pressure proving system are also provided on the unit.

4.2 Design Considerations

The flue gas damper should be physically accessible for adjusting as required. Do not connect fittings heavier than Schedule 40 into the exhaust damper outlet.

4.3 Installation

After the heat exchanger has been fitted into the tank, screw the damper onto the heat exchanger leg with the pressure test point on the burner side (i.e. upstream) of the butterfly spindle. Position the assembly so that the damper shaft is horizontal.

If necessary to accommodate access to the damper, it may be located at a point somewhat removed from its normal mounting position - which is usually immediately outside of the heat exchanger. The alternate location can include elbows and flanges if required - but the location chosen must be prior to any junction with exhaust piping from any other burner.

- 4.4 If the burner is low-high-low or modulating, install the automatic damper motor, mounting bracket, damper drive arms and linkage provided in accordance with Fig. 10 Pg 31. The damper motor must be installed in its upright vertical position (i.e., the exhaust damper valve must be in a horizontal pipe run). If ambient temperatures between the tank and the motor exceed 125°F - insulate between the motor and the tank to reduce temperatures accordingly.
- 4.5 Connect the flue damper to the fan inlet pipework (fan inlet companion flange supplied by Power Flame - see Fig. 17 Pg 38). See Fig 10 Pg 31 and Fig. 16 Pg 37. Connect air pressure lines. See Fig. 1B Pg 22B. If used, wire damper motor per wiring diagram supplied by Power Flame.

5. GAS TRAIN ASSEMBLY

FOR DETAILS ON GAS TRAINS REFER TO FIG. 11 PG 32 & Figs. 25, 26 & 27 Pg 42B.

Standard gas trains conform to Power Flame requirements - however, special code requirements such as IRI, FM, etc. are available.

5.1 Installation

All installation work should be carried out by competent engineers and comply with all relevant current Local Authority and National regulations such as Building Regulations, Gas Safety Regulations, and relevant Code of Practice.

The gas train must be firmly supported with all gas valves mounted with coils or motor operators in the vertical position. Install gas train components as shown in Fig. 11 Pg 32. Pipe components as close as possible bearing in mind future service requirements. Install the gas train assembly as close as possible to the burner unit. (Excessive distance may create light off problems due to lack of adequate gas at the burner head in the allotted ignition time.) The components must not be subjected to excessive vibration or temperature.

Install splash guards, railings, etc. to provide the necessary protection for the gas train assembly.

Note: The gas piping must be fully tested and purged before any attempt is made to start-up the equipment.

6. CONTROL SYSTEMS (See Fig. 12 Pg 33 and Fig. 13 Pg 34)

FOR CONTROL SYSTEMS DETAILS REFER TO SECTION 9 IN THIS MANUAL ("START-UP INSTRUCTIONS") AS WELL AS WIRING DIAGRAMS AND PROGRAMMING CONTROL INFORMATION SHIPPED WITH THE BURNER.

6.1 Design Considerations

All external wiring, connections, safety devices, grounding connections, etc. must be in accordance with the current and relevant electrical codes.

Control cabinets and all components in the control system must be protected on site from mechanical or liquid damage as well as any build-up of dirt.

6.2 Installation

All the electrical installation work must be carried out by competent personnel and must comply with all relevant regulations. The electrical installation must also be fully complete before any attempt is made to start-up the equipment.

Any variations in equipment used and not shown on the wiring diagram should be referred to Power Flame, Inc. before they are connected to the control system.

Note: The electrical supply to the controls must not be used to switch the burner on/off. Instead an on/off switch should be installed as shown in a control circuit. (The on/off switch is standard if a control panel is supplied by Power Flame.)

The tank must be fully grounded on all installations.

(a) Supply Voltage

A 115V., 60Hz supply is required for the control circuit. The actual voltage for the control panel is stated on the control panel rating plate. The draft fan motor may be single or three phase. Refer to the bill of materials supplied with the burner.

(b) Flame Rod (See Fig. 2 Pg 23, Fig. 14 Pg 35, Fig 15. Pg 36)

A flame rod connecting cable of approximately 10 ft. length is supplied with the burner and should be connected between the flame rod electrode on the burner and the appropriate connection in the control system.

Note: This cable should be run separately from the ignition cable. Maximum cable length between flame rod and programming control is 500 ft.

(c) UltraViolet (U.V.) Scanner (See Fig. 2 Pg 23, Fig. 5 Pg 26, Fig. 6 Pg 27 and Fig. 7A Pg 28A)

A U.V. flame scanner may be supplied in lieu of a flame rod. The scanner wires should be run separately from the ignition cable and other control wiring. Maximum wire length between U.V. scanner and programming control is 1000 ft.

Note: When a control circuit stepdown transformer is used, one side of the secondary winding MUST be grounded.

(d) Ignition (See Fig. 14 Pg 35, Fig. 15 Pg 36)

An ignition cable of approximately 10 ft. length is supplied with the burner and should be connected between the ignition electrode on the burner and the ignition transformer high tension connection. The maximum distance between the burner ignition electrode and the transformer is 10 ft. If Power Flame supplies the burner system control panel, we in many instances, will also supply an auxiliary control panel that will contain the ignition transformer, air flow switch, and, if required, a 3-way solenoid valve.

Note: The ignition cable should be run separately from flame rod or U.V. scanner wiring.

(e) Gas Train

Install the required wiring between the gas train operating valves (and any other components such as low/high gas pressure switches) and the control panel. Refer to the wiring diagram included with the burner for details.

(f) Temperature Control Device

Connect as shown on the wiring diagram, included with the burner.

6.3 Liquid Temperature Controls

(Available as an option from Power Flame)

Description

(a) Aquastat Type Thermostat

The basic type of Aquastat controls the temperature of the liquid by switching the burner on and off. The Aquastat has an adjustable setpoint. (Check that the setpoint/range is suitable for the process application.)

When low-high-low burner operation is required, a dual Aquastat may be used. This Aquastat has an additional setpoint to switch the burner from low to high. Aquastats must be installed into a protecting well that passes through the tank wall into the liquid.

(b) Temperature Controllers

A variety of electronic temperature controllers are available for on-off, low-high-low or modulating modes.

The range of temperatures that can be controlled by a temperature controller are designed according to the maximum operating temperature of the temperature sensor.

Reference should be made to the control manufacturer's literature for details pertaining to adjustment and start-up.

Sensor Well Installation

The temperature sensor well should be mounted through and about two-thirds of the way up the side of the tank but must not be positioned directly above the heat exchanger inlet or outlet. Under no circumstances should the temperature sensor well be mounted below the heat exchanger or become uncovered while the tank heater is running. Temperature sensor elements can be damaged if the protecting well is damaged so care must be taken during tank cleaning and maintenance. Free access to the well must be provided on the outside of the tank so that temperature sensing element stems may be inserted or withdrawn without bending the stem.

A splash guard should be installed over the temperature control if it is operating in a hostile environment.

Installation

If Power Flame supplied the temperature control, refer to the temperature control manufacturer's bulletin supplied with the burner. Make certain the well material is suitable for the liquid being heated.

6.4 Combustion Air Proving System (See Fig. 1B Pg 22B, Fig. 2 Pg 23, Fig. 12 Pg 33 and Fig. 13 Pg 34)

(a) Air Pressure Switch

Description

An adjustable differential air pressure switch is provided on all installations to close the fuel valve should the combustion air flow drop below a minimum safe limit. The pressure switch continuously monitors the differential pressure between the heat exchanger exhaust (measured at the flue damper) and the burner assembly. Maximum sensing line distance between the air flow switch and the tapping on the burner head or the exhaust flue damper should be 10 ft. (Also see section 6.2(d).)

Design Consideration

Moisture from condensate in the heat exchanger and burner assembly must not enter the air pressure switch or its' supply tubing. This problem is avoided if the pressure tappings are above pipe centerline on the flue damper.

Installation

Using suitable copper or similar tubing (not supplied), connect the 'high pressure' tapping of the pressure switch to the fitting on the burner assembly. Connect the 'low pressure' tapping of the pressure switch to the fitting on the flue damper. A plugged tee will be installed in both the high and low pressure lines at the air flow switch. The tee will allow for connection of a manometer. Refer to the combustion air piping schematic supplied with the burner for connection details.

Note: If a three-way air valve is included, refer to the following section.

To prevent condensate entering the air pressure switch or tubing, the compression fitting must be above the piping centerline on the burner assembly and flue damper.

(b) Three-Way Solenoid Air Valve (See Fig. 8 Pg 29, Fig. 12 Pg 33 and Fig. 13 Pg 34)

Description

The three-way solenoid air valve can be used when two or more burners are operating with a common suction fan. The valve should be installed in the

low pressure sensing line of the air pressure switch to vent the pressure switch to atmosphere. When vented, the air flow switch contacts should open, enabling the start of the ignition sequence. When the sequence starts, the valve is energized, allowing the sensed pressure to reach the pressure switch. This valve, therefore, proves that the air pressure switch is functioning correctly even when the fan is operating constantly. If Power Flame supplied a control panel, the three-way valve will be mounted in the panel and tubed to the air flow switch. (Also see section 6.2(d).) Refer to the combustion air piping schematic supplied with the burner for connection details, as well as Fig. 1B Pg 22B.

Design Consideration

As with the rest of the air pressure switch system, moisture from condensate in the heat exchanger must not enter the three-way air valve. This problem is avoided if the pressure tapping on the flue damper is above the pipe centerline.

7. COMBUSTION AIR SUPPLY SYSTEM

7.1 Fan Specification

See Fig. 16 Pg 37 for induced draft fan data.

7.2 Design Consideration (See Figs. 18 & 19 Pg 39)

As a general rule, flues should be kept as short as possible and with a minimum number of bends and restrictions. Contact Power Flame if Figs. 18 and 19 do not provide adequate information for your application.

The induced draft fans should be mounted with the motor shaft horizontal and should be readily accessible for servicing. All fans are designed to handle gases at elevated temperatures and so precautions should be taken to prevent personnel touching the flue or fan casing and to avoid damage to other equipment from radiant heat. Temperatures in excess of 575°F may cause fan assembly damage.

7.3 Installation

Mount the fan in its final operating position and connect appropriate size piping to the fan inlet and outlet. Power Flame supplies the fan inlet fitting but all other required piping is by others. Wire the fan to the rest of the controls and test run to see that the wheel rotates in the correct direction. The direction of rotation can be determined when the installation is complete by observing the motor shaft where it enters the fan casing. A rotational arrow is also affixed to the fan housing.

Note: The installation should be designed to allow easy removal of the complete fan/motor assembly in the event of a breakdown. Under no circumstances should the fan be used to support the weight of either the inlet or outlet flue pipework.

8. HEAT EXCHANGER EXHAUST PIPING

8.1 Description

Heat exchanger exhaust piping is not supplied by Power Flame. The piping between the butterfly flue gas damper and the draft fan inlet should be constructed from mild steel pipe, properly sealed and insulated.

8.2 Design

See Fig. 17 Pg 38 and Figs. 18 & 19 Pg 39 for specific sizing information. As a general rule, flues should be kept as short as possible and with a minimum number of bends and restrictions. A total pressure drop of 1/2" W.C. should not be exceeded between the butterfly damper outlet and the exhaust fan inlet.

8.3 Fan Discharge Flue Piping

The fan discharge flue should extend to at least 36" above the roof line and/or any other obstruction and should be terminated with an approved flue cap. See Fig. 16 Pg 37 and Figs 20 Pg 40 & Fig.21 Pg 41 for specific sizing information. Vent material should be selected to meet flue gas temperature conditions (insulate for safety of employees if need be) as well as compliance with applicable codes.

Care should be taken to prevent products of combustion from entering openings in the building in such concentrations as to be hazardous to health or a nuisance.

The flue should be self-supporting and designed so that the centrifugal fan may be removed without disturbing the pipework.

9. START-UP INSTRUCTIONS

9.1 Pre-Start-Up Checklist

The following steps must be completed prior to start-up.

1. The installation of all components must be complete.
2. The tanks must contain enough fluid to completely cover the heat exchangers.
3. The gas supply to the unit must be complete, fully purged and tested.
4. The electrical supply and all the wiring must be complete in accordance with the pertinent wiring diagram and applicable codes.
5. The fan must be wired so that it runs in the correct direction as indicated by the arrows on the fan housing.
6. The tanks must be grounded electrically.

7. The combustion air proving lines must be complete.
8. The temperature controls must be fitted in the tanks with the wells covered by liquid and must be wired to the control system.

9.2 Start-Up Procedure

Start-up must only be carried out by qualified personnel.

To properly set the burner up, it is necessary to adjust for correct fuel/air ratio. The O₂ test point in the exhaust damper is under a high suction pressure and as such, in order to get a proper O₂ sample, it might be necessary to use combustion test equipment that has a minimum pump suction pressure of 20" W.C. (NOTE: A Bacharach Fyrite manual O₂ analyzer will provide the necessary suction pressure).

The following procedure serves as a guide to start-up but is not intended as fully comprehensive description.

- (a) Ensure that both electrical characteristics and gas supply pressures are in accordance with the specifications and components supplied.
- (b) Visually inspect the system to check that the installation work is complete.
- (c) Close main and low fire (if supplied) checking gas cocks and open main and low fire (if supplied) shutoff cocks. Note that on-off and modulating burners will not have a "low fire gas train - only a "main train." Determine that the gas train piping is tight and free of gas leaks.
- (d) Test for leaks in the automatic gas valves by connecting a water gauge to each pressure test point between the automatic valves and the checking cocks. The pressure indicated on the gauge should not rise; if it does, the valve(s) concerned are leaking gas. Correct or replace valves or fittings before proceeding any further.
- (e) Check that the air baffle gap at the burner and the air fan inlet and exhaust ductwork are free from obstruction and that the fan is free to rotate.
- (f) Check that the lines for the air pressure proving system are complete and all the associated fittings tight. Adjust the flue gas outlet damper to its fully open position for on-off burners and about 25% open for low-high-low and modulating burners.
- (g) Ensure that the on/off switch for the burner is in the "off" position. Turn on the main electrical supply and adjust the temperature control to the desired liquid temperature. Adjust any other components (e.g., level switches, time clocks, etc.) so that they are in the "on" position.
- (h) Connect a manometer to the burner head gas pressure test point.

- (i) Check to make certain the solenoid gas valve(s) are not open due to mechanical or electrical problems during prepurge.
- (j) Turn the burner on/off switch to "on". The induced draft fan will start. At the end of the burner prepurge period (can vary with the type of system supplied but will be a minimum of 10 and a maximum of 90 seconds - approx.), the burner ignition transformer and solenoid gas valve will be energized.
 - (1) If after the specified prepurge time period the ignition system is not energized, it is possible that the differential air pressure switch did not make its circuit. Attach a manometer to the pressure points on the air switch, check that at least .5" W.C. differential pressure is obtained and adjust the switch to close its contacts. (If less than .5" W.C. differential is noted, check to make sure the exhaust damper is not closed and/or fan rotational direction is correct).
 - (2) Once the ignition system is energized, the spark and open solenoid gas valve will attempt to produce a flame but will not do so as the gas supply checking cock(s) is closed. In 10 seconds (approx.) the ignition system should be deenergized and the programming control will go into safety lockout and (if supplied) energize an alarm light and/or bell. If the system does not lockout at the end of the ignition sequence, shut the system down and determine the cause for abnormal operation. Once the programming control goes into a safety lockout mode - it will be necessary to manually reset the safety lockout switch in order to attempt burner relight. After a lockout, allow two (2) minutes for the safety switch to cool, before resetting.

Select appropriate mode of operation in below sections 9.3, 9.4 or 9.5 and continue start-up procedure.

9.3 On-Off Operational Mode

- (a) Restart the burner and open the leakage test gas cock. After the prepurge period, the burner ignition transformer and solenoid shutoff valve will be energized. The flame should light immediately. If not, it may be necessary to purge air from the gas supply line. Do not allow the accumulation of unburned gas in the heat exchanger.
- (b) With air purging complete, if burner still does not light - check and, if necessary, reset the ignition spark gap and/or adjust the gas pressure regulator.
- (c) Once flame is established - adjust the pressure regulator to provide the approximate gas pressure at the burner head gas pressure test point as shown on the burner rating plate. (Reference can also be made to Fig. 23 Pg 42 or Fig. 24 Pg 42A which provides pressure versus gas input for CX burners).

- (d) Adjust the butterfly type flue gas damper to attain an oxygen (O₂) level of 5-6% in the exhaust flue gases. This sample must be taken at the sampling point provided on the flue gas damper.
- (e) It may be necessary to reduce the gas pressure at the burner assembly to attain the required level of oxygen in the exhaust gases.
- (f) Let the unit run until the liquid temperature nears the desired operating temperature; repeat section (c) and (d). Test all other limit controls and safety devices.
- (g) Adjust the air pressure switch during the purge cycle. Increase the air switch adjustable set point (by turning clockwise) so that the switch contacts open. Decrease the set point by adjusting the screw counterclockwise 1/2 of a full turn. Switch contact should close and burner will start its ignition sequence.
- (h) Check for acceptable flame signal at programming control amplifier. Check that the system locks out correctly on flame failure during normal burner run. Check that the air flow switch closes the burner fuel valve(s) in the event of loss of fan suction pressure.

9.4 Low-High-Low Operational Mode

- (a) Temporarily power the M436 butterfly (BFV) type flue gas damper motor operator and set the linkage so the BFV is open about 25% in the deenergized position and 100% open in the energized position. Power a few times to make certain the linkage operates freely and does not attempt to drive the BFV beyond full open or closed position. Remove temporary power source from the M436.
- (b) Disconnect one of the motor operator wires (not the auxiliary switch wires) to the M436 and leave hanging loose. (Don't let it short or ground out.) Open the low fire leakage test cock and low fire adjusting cock. Start the burner. After the prepurge period, the burner ignition transformer and low fire solenoid shutoff valve will be energized. If no ignition attempt is made, the air flow switch may need to be reset. The flame should light immediately. If not, it may be necessary to purge air from the gas supply line. Do not allow the accumulation of unburned gas in the heat exchanger.

With air purging complete, if burner still does not light - check and if necessary reset the ignition spark gap and/or adjust the low fire gas pressure regulator.

- (c) Once the low fire flame is established - shut the burner off and reconnect the M436 power wire. Turn burner on and establish low fire.
- (d) Set the burner temperature control to go to high fire. When the M436 is nearly full open, its integral auxiliary switch will close and the main gas solenoid valve will open and the burner will be at high fire. The auxiliary switch should be set to energize the high fire solenoid valve just before the motor completes its high fire stroke. (Refer to the M436 manufacturer's bulletin shipped with the burner for switch adjustment instructions.)

- (e) Adjust the main gas pressure regulator to provide the approximate high fire pressure at the burner head pressure test point as shown on the burner rating plate. Reference can also be made to Fig. 23 Pg 42 or Fig. 24 Pg 42A which provides pressure versus gas input for CX burners.
- (f) Adjust the butterfly type flue gas damper linkage to attain an oxygen (O₂) level of 5 to 6% in the exhaust flue gases. This sample must be taken at the sampling point provided on the flue gas damper.
- (g) It may be necessary to reduce the gas pressure at the burner assembly to attain the required level of oxygen in the exhaust gases.
- (h) Set the temperature controls to drive the burner to low fire. The M436 damper motor will deenergize and drive the flue gas BFV to its low fire position and at the same time the damper motor auxiliary switch will open, deenergizing the main gas solenoid valve, placing the burner in its low fire position.

CAUTION - MAKE SURE THE BFV DAMPER DOES NOT GO FULLY CLOSED.

- (i) Low fire adjustment varies based on turndown required. Refer to Fig. 22 Pg 41, which lists 3 to 1 turndown rates (based on maximum burner capacity).
 - 1) If low fire rate is greater than or equal to the 3 to 1 turndown rate shown in Fig. 22 Pg 41, adjust as follows.
 - a) Adjust the low fire pressure regulator to provide the approximate low fire pressure at the burner head test point as shown in Fig. 22 Pg 41. It may also be necessary to adjust the low fire adjustment cock in order to control to desired low fire input.
 - b) Adjust the BFV flue gas damper linkage to attain an oxygen level of 5 to 6% in the exhaust flue gases.
 - 2) If low fire rate is less than the low fire rate shown in Fig. 22 Pg 41, adjust as follows:
 - a) Adjust to low fire pressure regulator to provide the 3 to 1 turndown pressure at the burner head test point as shown in Fig. 22 Pg 41. It may also be necessary to adjust the low fire adjustment cock in order to get down to this desired input.
 - b) Adjust the BFV flue gas damper linkage to attain an oxygen level of 5 to 6% in the exhaust flue gases. This 3 to 1 turndown position is as far closed as the damper should ever go at low fire.
 - c) Finally, decrease pressure at burner head test point to that shown in Fig. 23 Pg 42 or Fig. 24 Pg 42A by adjusting either the low fire pressure regulator or, if necessary, the low fire adjustment cock.

- (j) Once low and high fire settings have been made, run the burner up close to liquid operating temperature and sequence the burner through several starts, low and high fire runs - to make certain light off is smooth and linkage positioning repeats correctly. Recheck all gas pressure and oxygen values again.
- (k) Let the unit run to liquid operating temperatures and set the temperature controller for on and off - and high and low operation.
- (l) Test all other limit controls and safety devices.
- (m) Adjust the air pressure switch during the purge cycle and with the flue damper in the low fire position. Increase the air switch adjustable set point (by turning clockwise) so that the switch contacts open. Decrease the set point by adjusting the screw counterclockwise 1/2 of a full turn. Switch contacts should close and burner will start its ignition sequence.
- (n) Check for acceptable flame signal at programming control amplifier. Check that the system locks out correctly on flame failure during normal burner run. Check that the air flow switch closes the burner fuel valve(s) in the event of loss of fan suction pressure.

9.5 Modulating Operational Mode

- (a) Temporarily power the M934 butterfly (BFV) type flue gas damper motor operator and set the linkage so the BFV is open about 100% in the high fire position and open about 25% in the low fire (same as light off) position. Disconnect wires so the unit will stay at low fire. (Don't allow them to short or ground out.)
- (b) Follow the same instructions as (a) above for the M934 modulating gas input BFV on the burner gas train.
- (c) Open the leakage test cock. Start the burner. After the prepurge period the burner ignition transformer and solenoid shutoff valve will be energized. If no ignition attempt is made, it may be necessary to reset the air flow switch. The flame should light immediately. If not it may be necessary to purge air from the gas supply line and/or open the modulating gas supply BFV further.

Do not allow the accumulation of unburned gas in the heat exchanger.
- (d) With air purging complete if burner still does not light - check and if necessary, reset the ignition spark gap and/or adjust the gas pressure regulator.
- (e) Once the low fire flame is established - shut the burner off and reconnect the wires removed from both mod motors. (In order to aid in initial burner adjustments, a manual potentiometer could be temporarily wired into the circuit in place of the temperature control wiring connections.)

- (f) Turn the burner on and set the temperature control to run the burner to high fire. Adjust the gas butterfly control valve to provide the approximate high fire pressure at the burner head pressure test point as shown on the burner rating plate. Reference can also be made to Fig. 23 Pg 42 & Fig. 24 Pg 42A which provides pressure versus gas input for CX burners. Mark the linkage at this setting. Additional adjustment can be obtained by varying the gas pressure regulator.
- (g) Adjust the butterfly type flue gas damper linkage to attain an oxygen (O_2) level of 5-6% in the exhaust flue gases. This sample must be taken at the sampling point provided on the flue gas damper.
- (h) It may be necessary to reduce the gas pressure at the burner assembly to attain the required level of oxygen in the exhaust gases.
- (i) Set the temperature control to drive the burner to low fire. Both mod motors will be driven to the low fire position. Low fire adjustment varies based on turndown required. Refer to Fig. 22 Pg 41 which lists 3 to 1 turndown rates (based on maximum burner capacity).
 - 1) If low fire gas input rate is greater than or equal to the 3 to 1 turndown rate shown in Fig. 22 Pg 41, adjust as follows:
 - a) Adjust the gas butterfly control valve linkage to provide the approximate low fire pressure at the burner head test point as shown in Fig. 23 Pg 42 or Fig. 24 Pg 42A.
 - b) Adjust the BFV flue gas damper to attain an oxygen level of 5 to 6% in the exhaust flue gases.
 - 2) If the low fire gas input rate is less than the 3 to 1 turndown rate shown in Fig. 22 Pg 41, adjust as follows:
 - a) Adjust the gas supply butterfly control valve linkage to provide the approximate desired low fire pressure at the burner head test point as shown in Fig. 23 Pg 42 or Fig. 24 Pg 42A.
 - b) Vary the temperature control to drive the gas supply butterfly valve further open to provide the 3 to 1 turndown pressure at the burner head test point as shown in Fig. 22 Pg 41.
 - c) The supply voltage for the exhaust damper and motor should be wired through one of the auxiliary switches in the gas supply valve mod motor. (Refer to wiring diagram supplied with burner.) At the 3 to 1 position, adjust the gas supply valve mod motor limit switch cam so that the switch contacts open and the exhaust damper mod motor locks in position. (Refer to the Honeywell mod motor installation manual for detailed instructions on limit switch adjustment.)

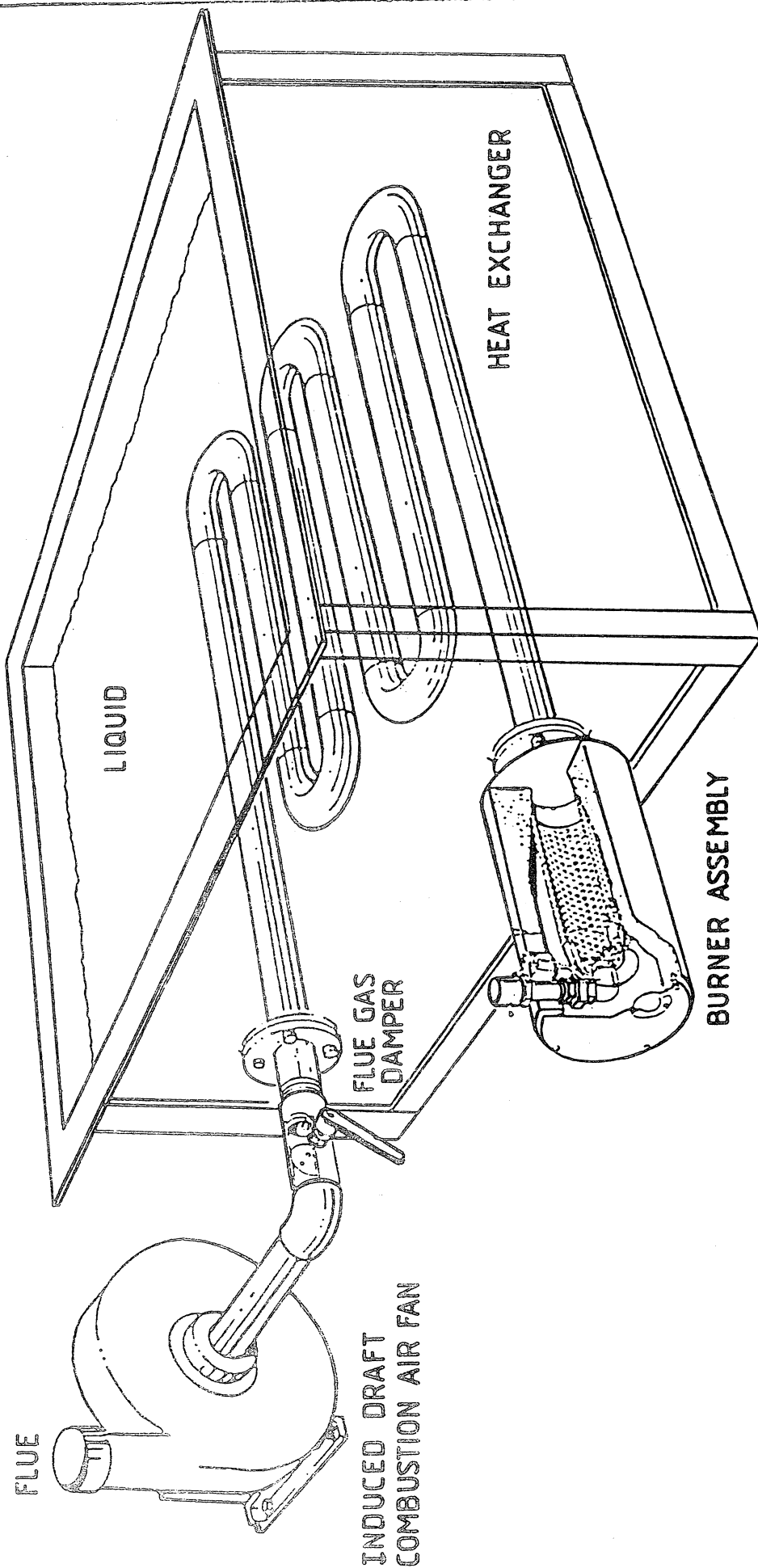
- d) Adjust the flue gas damper to attain an oxygen level of 5 to 6% in the exhaust flue gases.
- e) As the gas supply butterfly valve modulates between low fire and 3 to 1 turndown, the exhaust butterfly damper should remain fixed at the 3 to 1 turndown position. Between high fire and 3 to 1 turndown, the gas valve and flue damper should modulate synchronously.
- (j) Once low and high fire settings have been made, run the burner up close to liquid operating temperature and sequence the burner through several complete operations to make certain light off is smooth and linkage positioning repeats correctly. Recheck all gas pressure and oxygen values again.
- (k) Let the unit run to liquid operating temperatures and set the temperature controller for on-off and modulating operation.
- (l) Test all other limit controls and safety devices.
- (m) Adjust the air pressure switch during the purge cycle and with the flue damper in the low fire position. Increase the air switch adjustable set point (by turning clockwise) so that the switch contacts open. Decrease the set point by adjusting the screw counterclockwise 1/2 of a full turn. Switch contacts should close and burner will start its ignition sequence.
- (n) Check for acceptable flame signal at programming control amplifier. Check that the system locks out correctly on flame failure during normal burner run. Check that the air flow switch closes the burner fuel valve(s) in the event of loss of fan suction pressure.

10. **START-UP COMPLETION AND TEST DATA FORM**

Each burner is shipped with an installers information envelope containing the "CX Burner Start-Up Information & Test Data" form. All sections as appropriate for the application should be filled in and returned to PFI in the self-addressed postage paid envelope provided. We further suggest that a copy be made of this completed form and kept with the other installation documentation. Another copy of this form can be found on the last page of this manual.

When the start-up is completed, the operators and maintenance staff should be given a familiarization session on the operation and maintenance of the system.

It is further suggested that "Warranty Registration" prepaid post card be returned to Power Flame. This card and a cover letter are found in the "Important - Owners Information" envelope shipped with the burner.

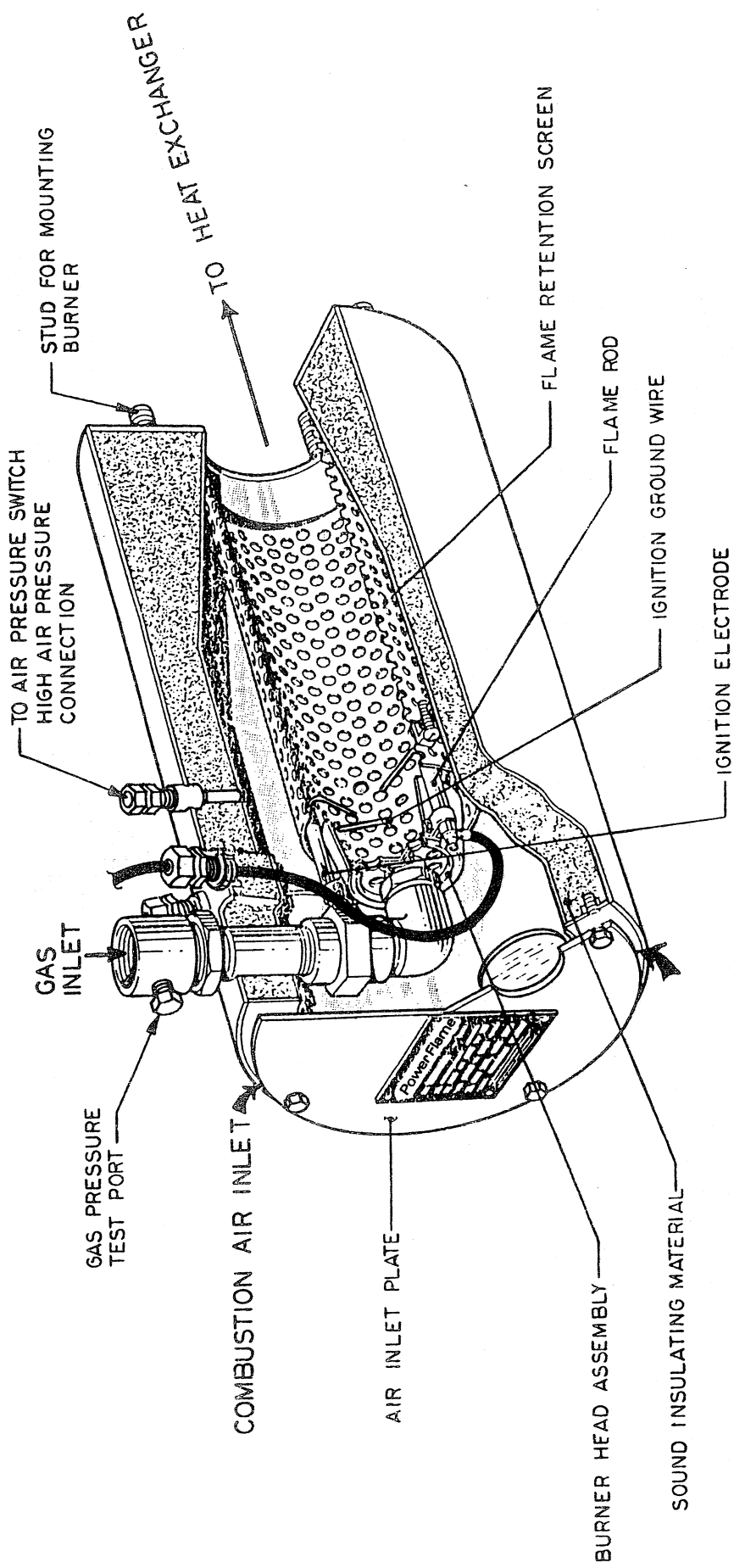


Power Flame Incorporated

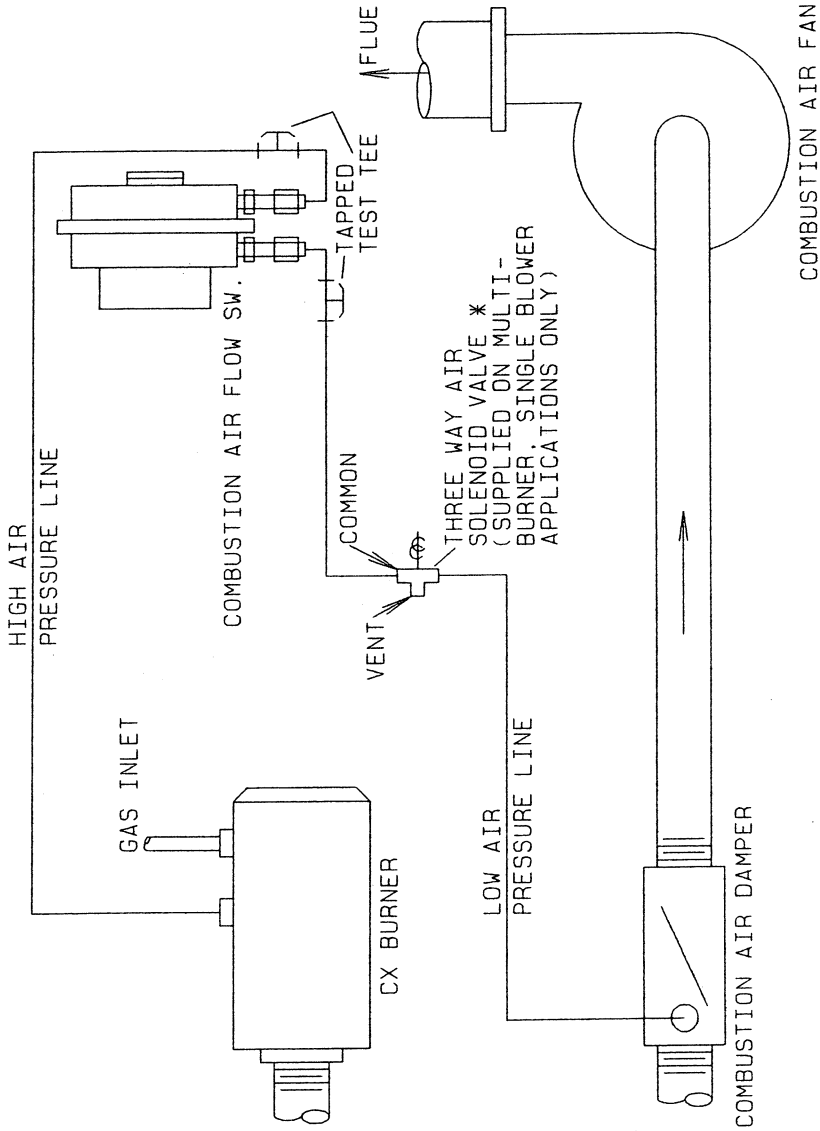
2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480


DWN. BY: RAP	CHKD BY:	APVD. BY:	SCALE: NTS	DATE: 6/14/89
JOB NAME: TITRE. TYPICAL CX BURNER INSTALLATION			FILE LOC.: 3-12-13-1	PLATE NO. OF PLATES
				DWG. NO. 90P474-1

FIG. No. 1



		Power Flame Incorporated 2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480	
		DWN BY: RAP CHKD. BY:	APVD. BY:
JOB NAME: CX IMMERSION TUBE BURNER ASSEMBLY FIG. No. 1A		FILE NO. OF PLATES	DWG. NO. 90P503-2





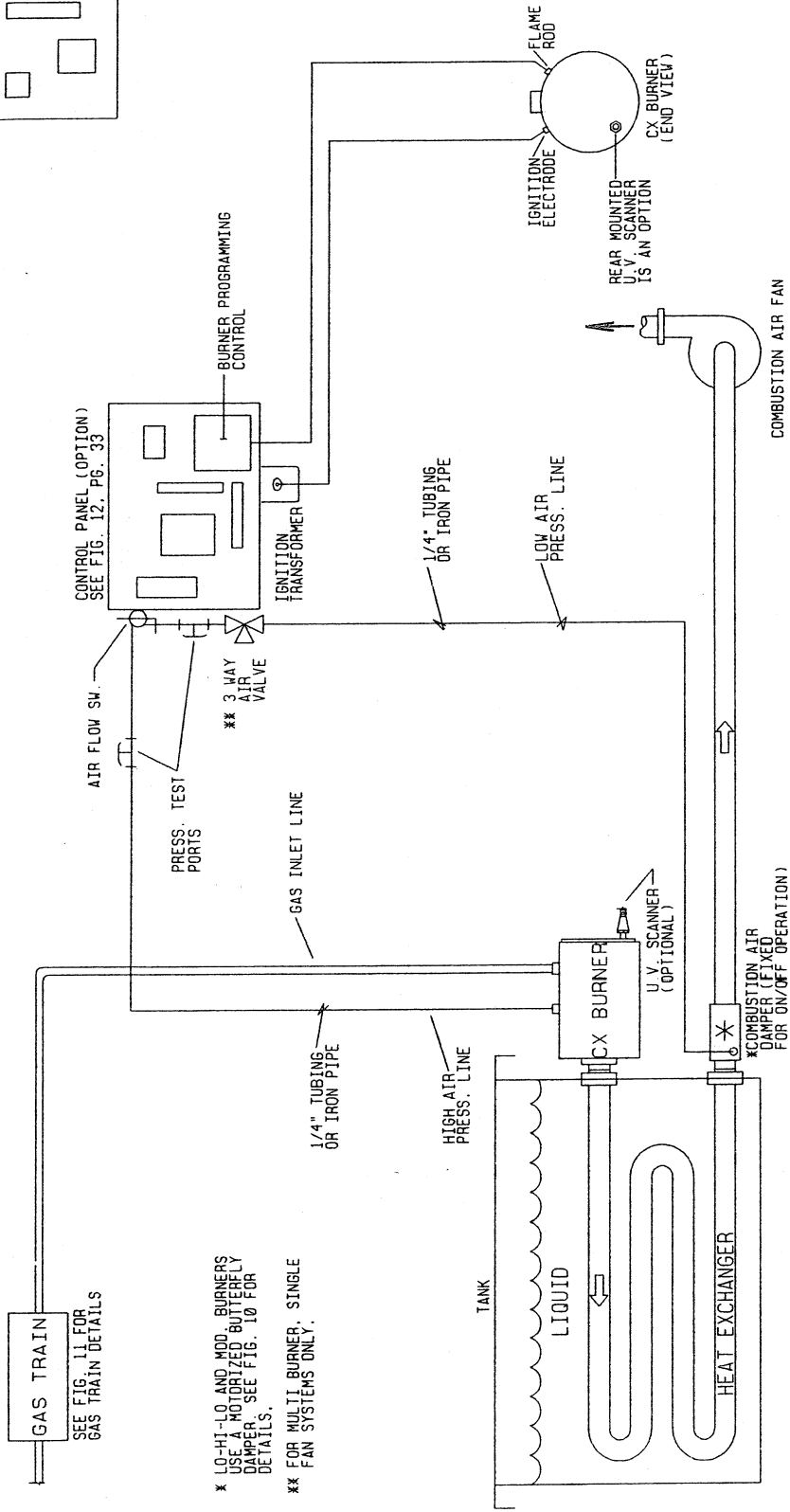
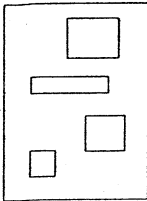
Power Flame Incorporated
 2001 South 21st Street Phone (316) 421-0480
 Parsons, Kansas 67357 FAX (316) 421-0948

DRAWN: KIDD	APPVD: NF	FILE: 498	DATE:
PARENT:			DWG.: PDA-1001
DRAWING PARAMETERS: N/A			
TITLE: CX BURNER AIR FLOW		JOB NAME:	
SW. PIPING SCHEMATIC		CODE:	

* SEE SPECIFIC AIRFLOW SWITCH PIPING DIAGRAM SHIPPED WITH BURNER FOR ACTUAL PORT NUMBER IDENTIFICATIONS.

FIG. NO. 1B

AUX. CONTROL PANEL (OPTION)
SEE FIG. 13, PG. 34



CONTROL PANEL (OPTION)
SEE FIG. 12, PG. 33

AIR FLOW SW.

PRESS. TEST PORTS

* LO-HI-LO AND MDD BURNERS
USE A MOTORIZED BUTTERFLY
DAMPER. SEE FIG. 10 FOR
DETAILS.
** FOR MULTI BURNER, SINGLE
FAN SYSTEMS ONLY.

BURNER PROGRAMMING
CONTROL

GAS INLET LINE

1/4" TUBING
OR IRON PIPE

1/4" TUBING
OR IRON PIPE

IGNITION
ELECTRODE

REAR MOUNTED
U.V. SCANNER
IS AN OPTION

FLAME
ROD

CX BURNER
(END VIEW)

COMBUSTION AIR FAN

*COMBUSTION AIR
DAMPER (FIXED
FOR ON/OFF OPERATION)



PowerFlame Incorporated

2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480

DWG. BY: RAP	CHKD. BY:	SCALE: N/A	DATE: 6/14/89
JOB NAME:		FILE LOC: 3-12-14-1	

TITLE: CX BURNER SYSTEM COMPONENTS AND CONNECTIONS (LIT DWG.)

DWG. NO. 90P475-6

FIG. 2

FLANGE MOUNTED HEAT EXCHANGER

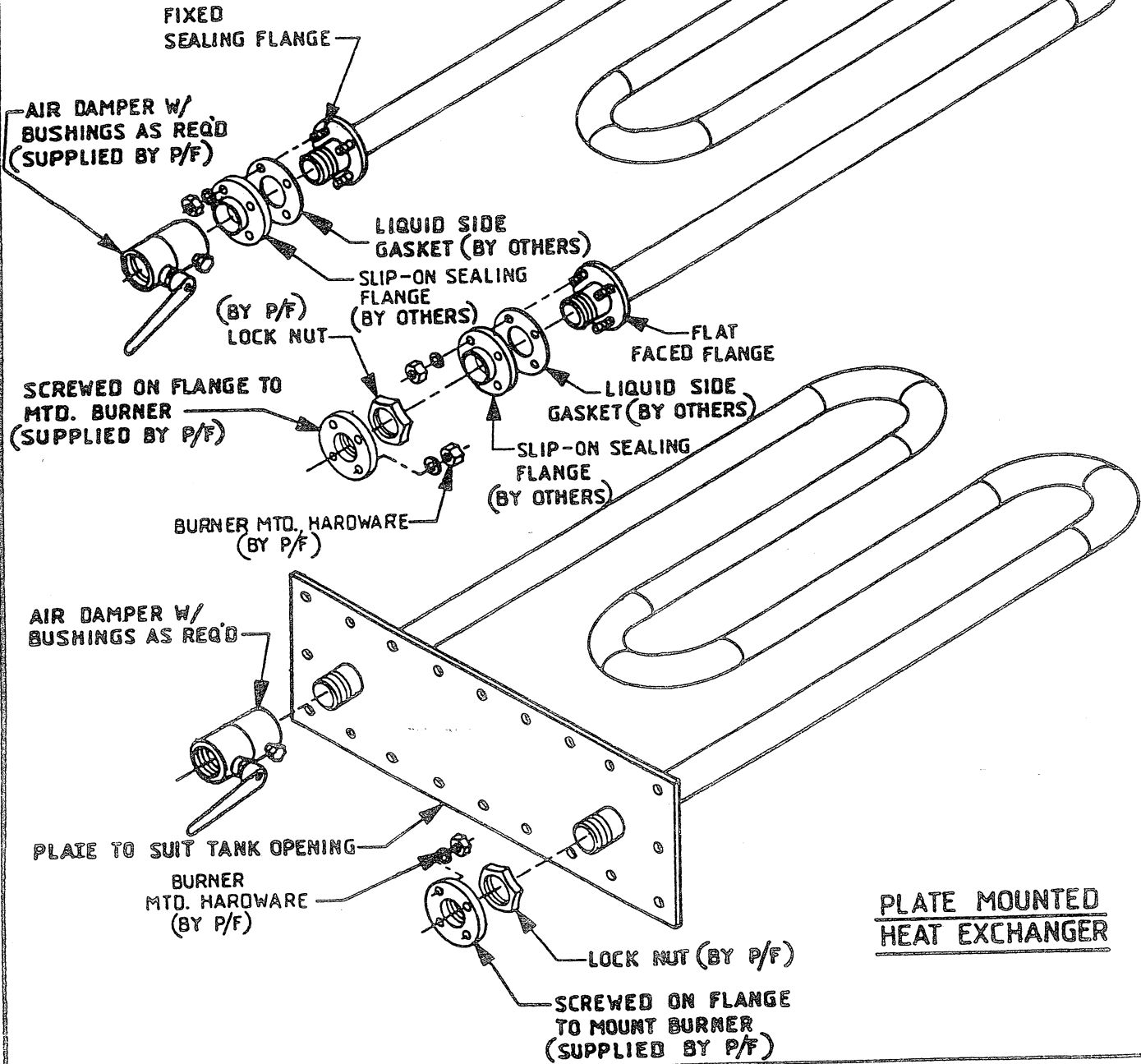

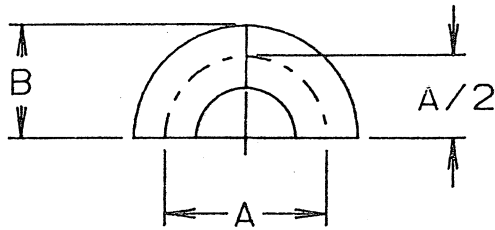


PLATE MOUNTED HEAT EXCHANGER

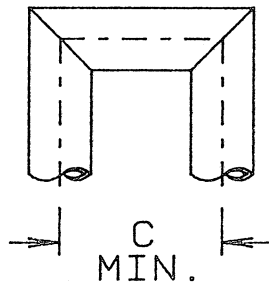
		PowerFlame Incorporated	
2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480			
DWN BY: RAP	CHKD. BY:	APVD. BY:	SCALE: ~
JOB NAME:		FILE LOC.: 3-9-43-1	DATE: 8/9/89
TITLE: HEAT EXCHANGER DETAILS FOR MOUNTING		PLATE NO. OF PLATES	
CX BURNERS FIG. 3		DWG. NO. 90P453-3	

90° & 180° WELD ELBOWS



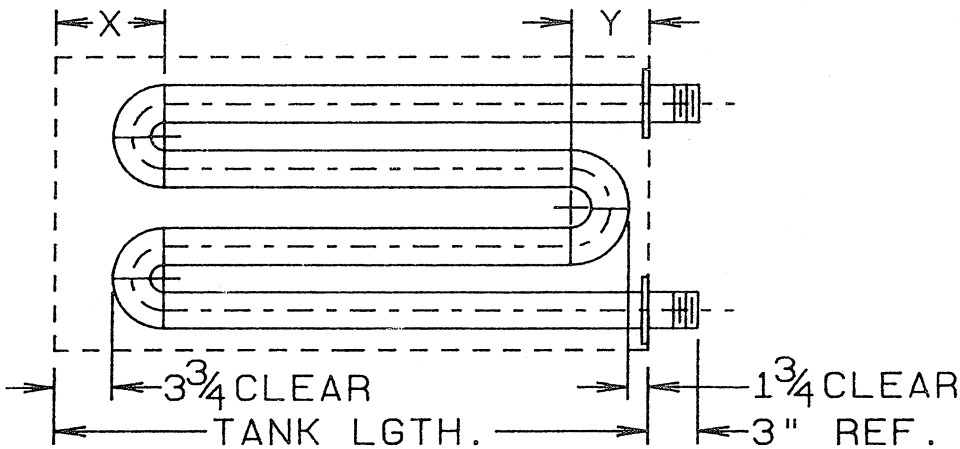
PIPE SIZE	A	B	LENGTH	
			180°	90°
1½	4½	3¼	7	3½
2	6	4¼	9½	4¾
2½	7½	5¼	12	6
3	9	6¼	14	7
4	12	8¼	19	9½
6	18	12¼	28	14

MITRES



PIPE SIZE	C
1½	4.4
2	4.9
2½	5.5
3	6.0
4	7.0
6	9.1

HEAT EXCHANGER INSTALLATION DIM'S



PIPE SIZE	X	Y
1½	7	5
2	8	6
2½	9	7
3	10	8
4	12	10
6	16	14

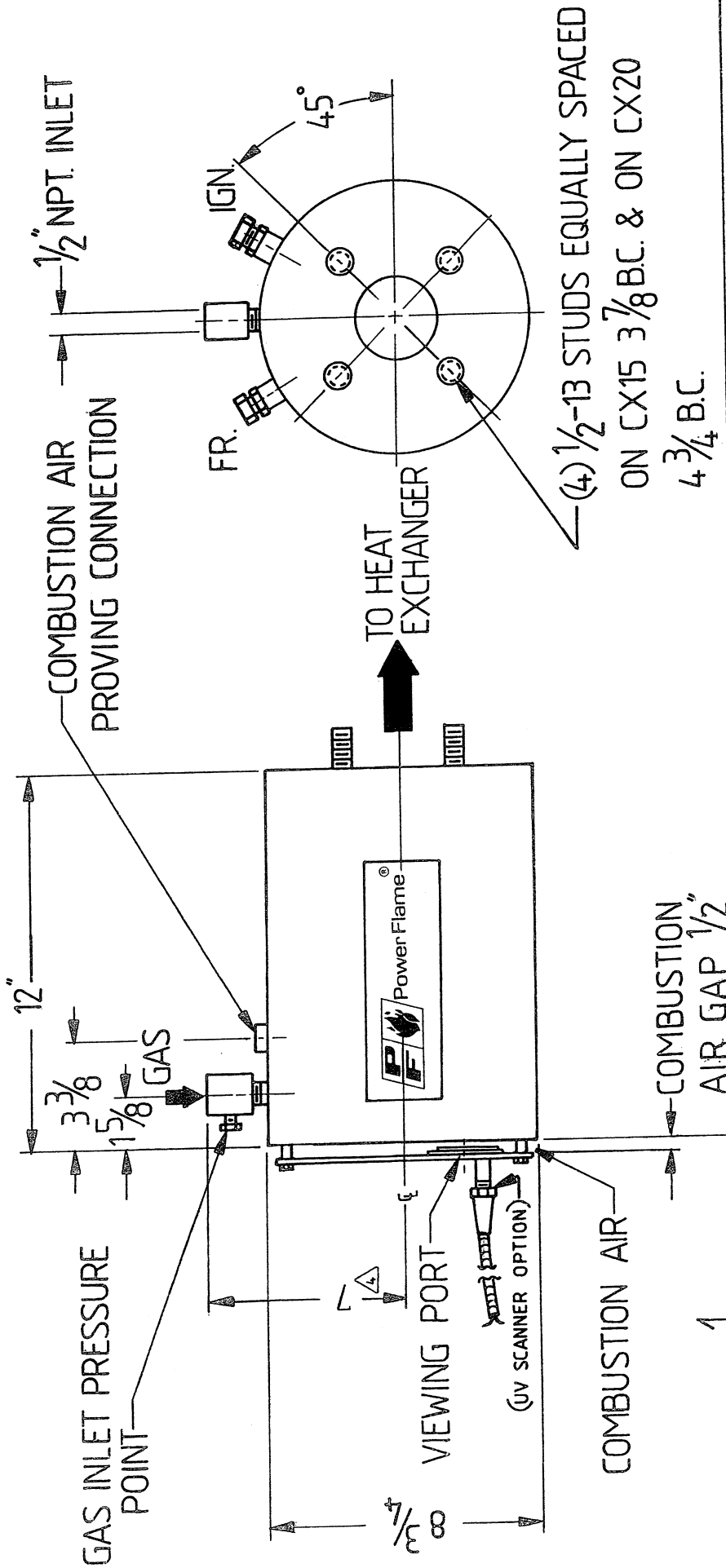


Power Flame Incorporated

2001 S. 21st · PARSONS, KANSAS 67357 · PHONE (316) 421-0480

DWG. BY: CA	CHKD. BY: RAP	PARENT DWG.	SCALE NTS	DATE: 10/17/94
JOB NAME: FIG. 4		FILE LOC:	3-9-44-1	
TITLE: DIMENSIONS OF BENDS AND MITRES. HEAT EXCHANGER INSTALLATION DIMENSIONS.			DISK #	109
			DWG. NO.	90P454-3

THE BURNER HEAD CAN BE ROTATED TO ANY POSITION TO ACCOMMODATE GAS TRAIN CONNECTIONS.



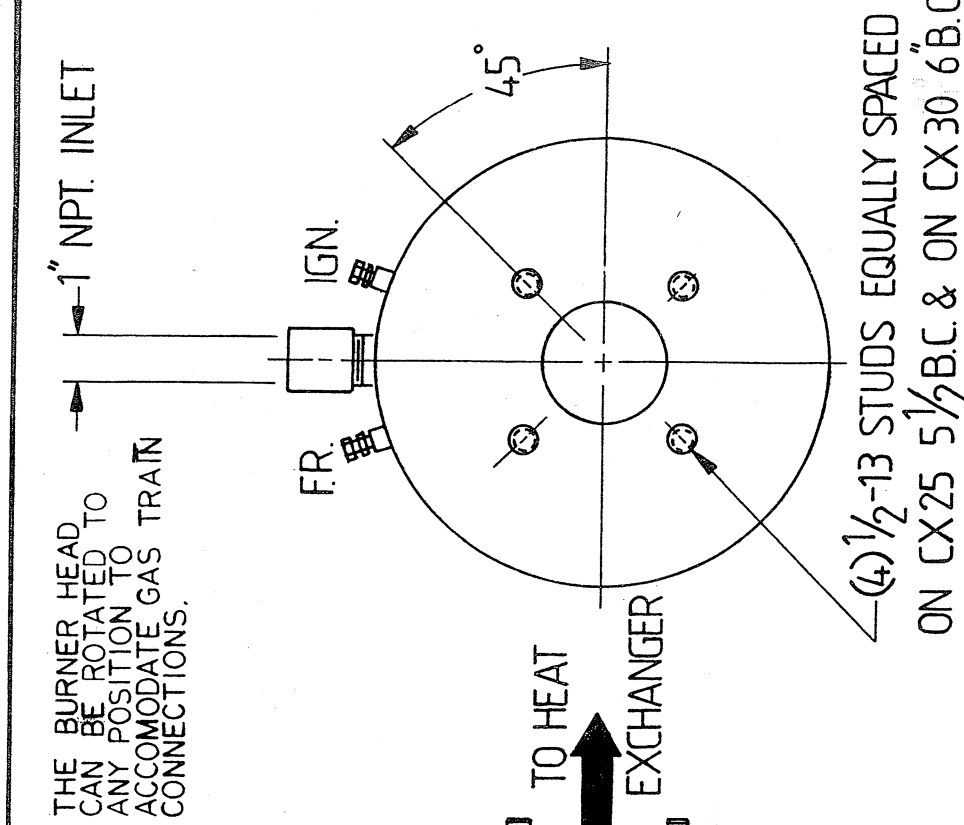
PowerFlame Incorporated

2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0490

OWN. BY:	RAP	CHKD. BY:	SCALE	NIS	DATE	3-20-89
JOB NAME:		FILE LOC.	7-6-26-1			
TITLE:	CX15 & CX20 BURNER ASSY. INSTALLATION	PLATE NO.		OF		PLATES
REVISION	DATE	REV.	DATE	REV.	DATE	
1	7" WAS 5 7/8 DESIGN CH 1012	RAP	5-6-96			
2	REV'D AIR GAP WORDING	RAP	12-13-90			
3	ADDED DIM 6 TO TOP OF COUP	RAP	9-5-90			

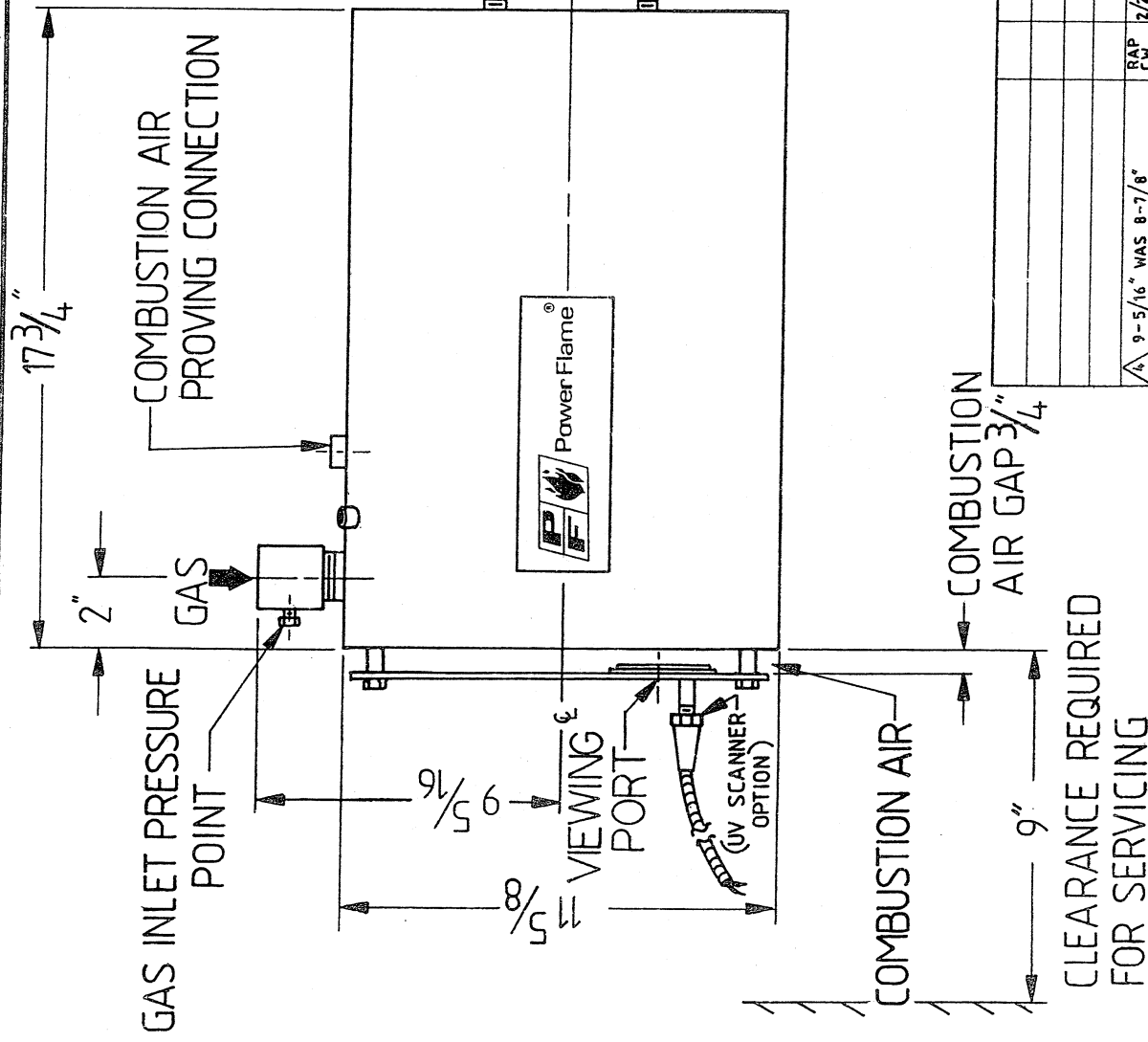
CLEARANCE REQUIRED FOR SERVICING

CX



THE BURNER HEAD CAN BE ROTATED TO ANY POSITION TO ACCOMMODATE GAS TRAIN CONNECTIONS.

(4) 1/2-13 STUDS EQUALLY SPACED ON CX25 5 1/2 B.C. & ON CX30 6 B.C.



TO HEAT EXCHANGER

PowerFlame Incorporated
 2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480

DWN. BY: **RAP** CHKD. BY: ARVD. BY: SCALE: **N.T.S.** DATE: **3-20-89**

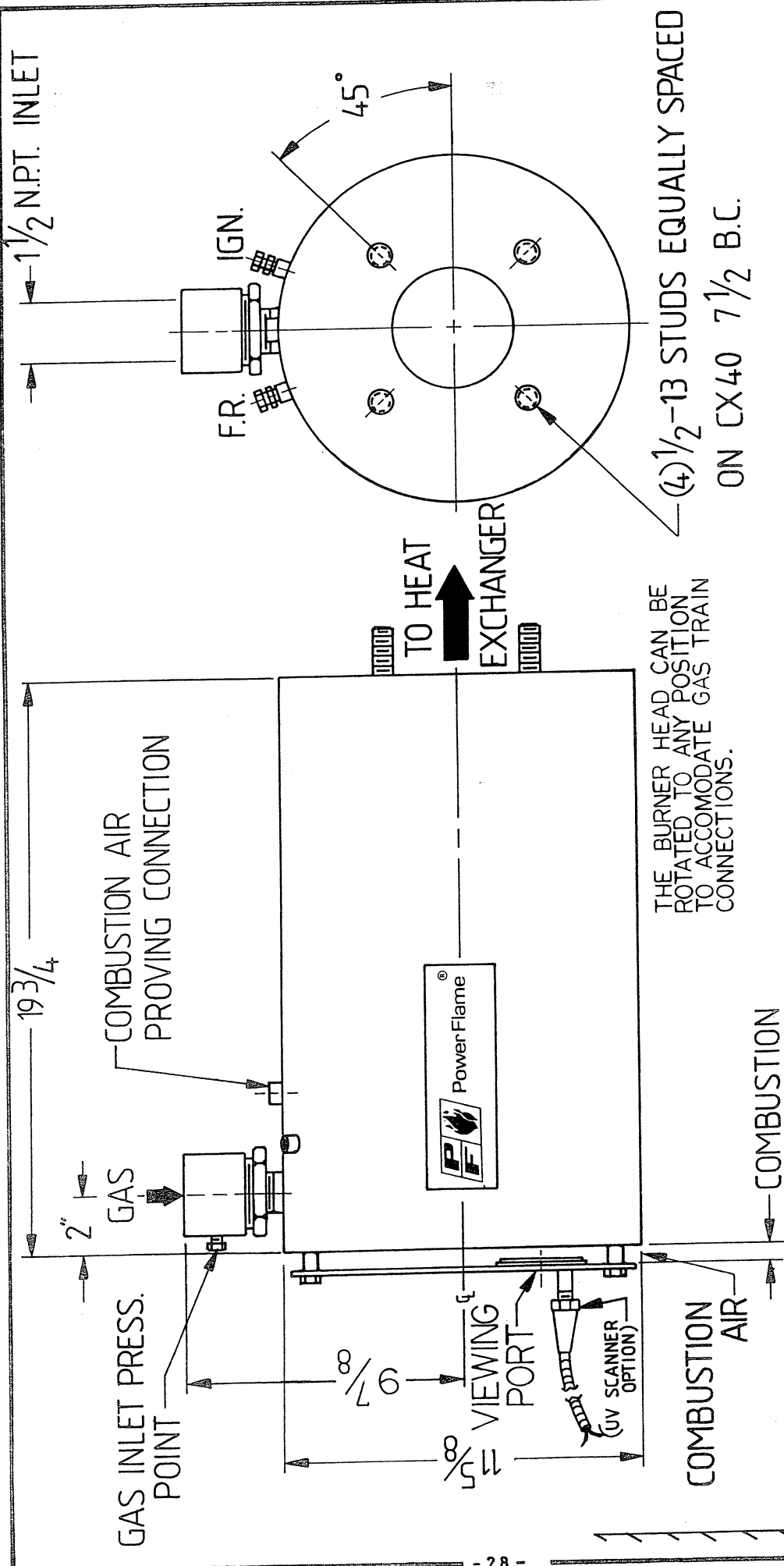
JOB NAME: **CX 25 & CX 30 BURNER ASSY INSTALLATION** FILE LOC.: **7-4-25-1**

TITLE: **DIMENSIONS** F I G. 6 PLATE NO. **90P461-4** OF **PLATES**

REV.	DATE	REVISION
1	2/2/2000	RAP CW 9-5/16" WAS 8-7/8"
2	12-13-90	REV'D AIR GAP WORDING
3	9-5-90	ADDED 6" TO COUP. TOP DIM.

CLEARANCE REQUIRED FOR SERVICING

CX



		PowerFlame Incorporated 2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480	
DOWN BY: RAP JOB NAME: CX 40 BURNER ASSY. INSTALLATION TITLE: DIMENSIONS FIG. 7	CHKD BY: RAP SCALE: N.T.S. DATE: 3-22-89	FILE NO.: 7-4-26-1 PLATE NO.: OF PLATES	DWG. NO.: 90P662-4
9-78 WAS 9-1/4 REV'D AIR GAP WORDING ADDED 5 TO TOP OF COUR. DIM.	RAP CV 2/2/2000 RAP 12-13-90 RAP 9-5-90	REVISION DATE	DATE

THE BURNER HEAD CAN BE ROTATED TO ANY POSITION TO ACCOMMODATE GAS TRAIN CONNECTIONS.

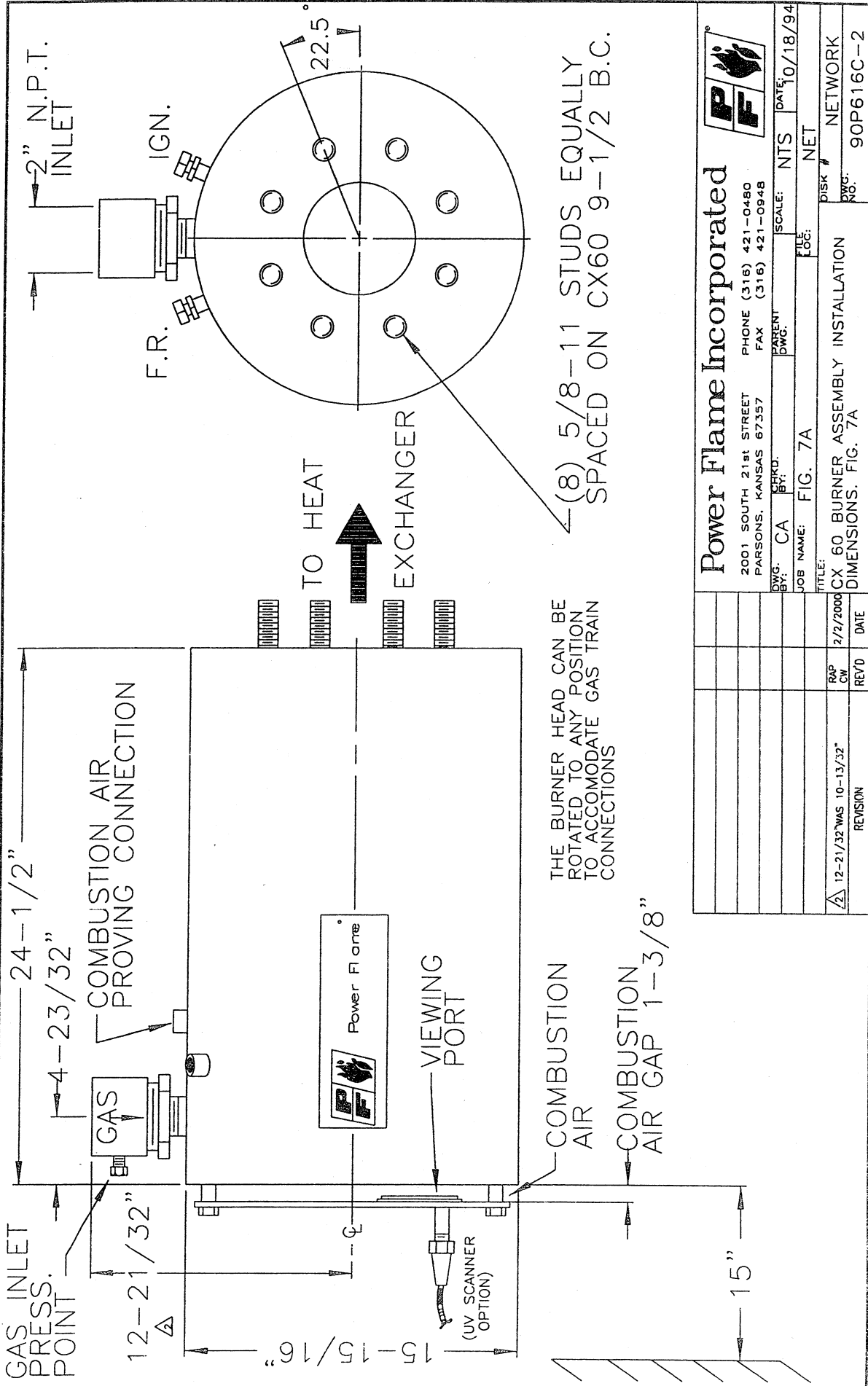
TO HEAT
 ↑
 EXCHANGER

(4) 1/2-13 STUDS EQUALLY SPACED
 ON CX40 7 1/2 B.C.

12" CLEARANCE REQUIRED FOR SERVICING

COMBUSTION AIR GAP 3/4"

CX



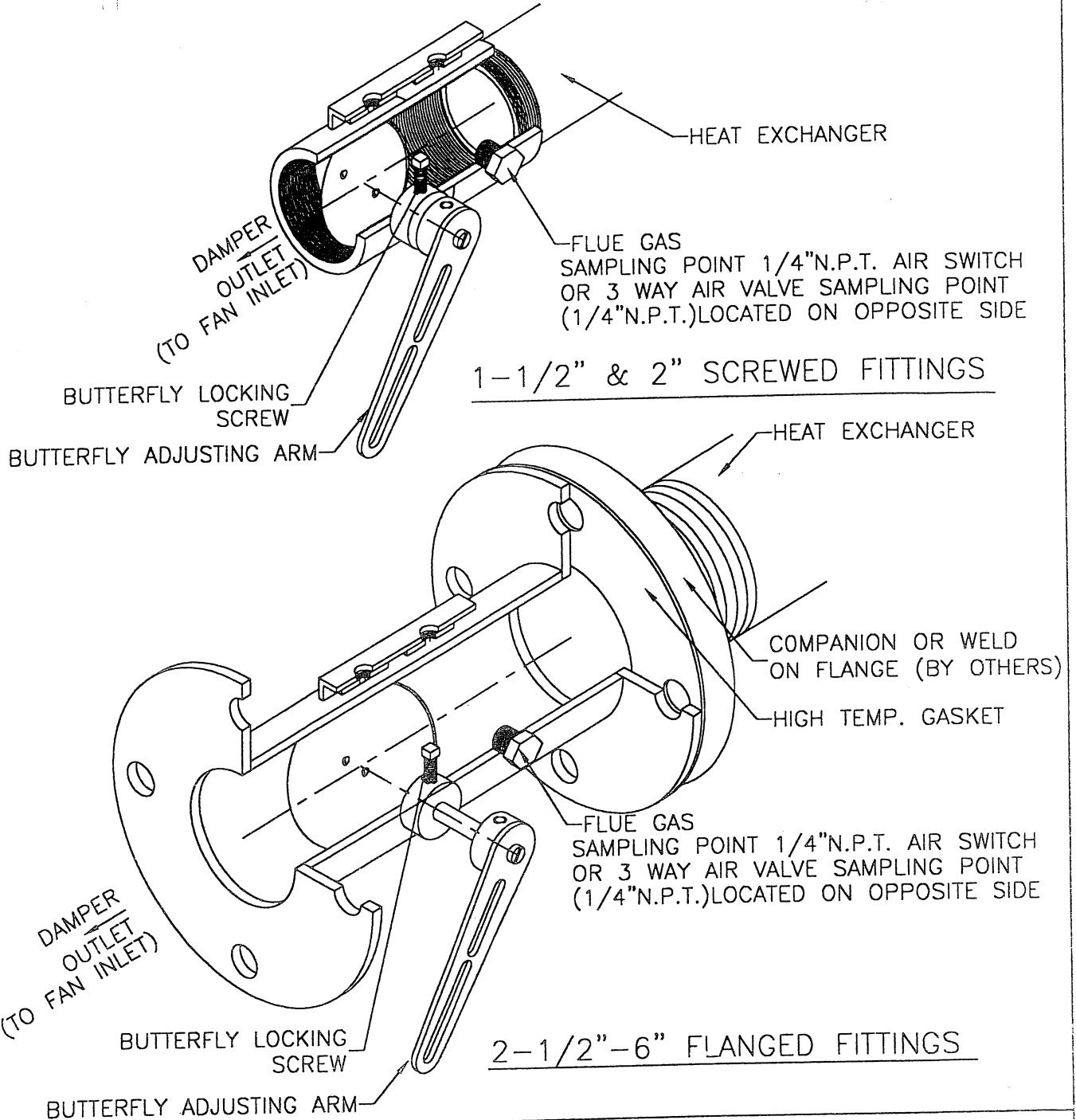
Power Flame Incorporated
 2001 SOUTH 21st STREET
 PARSONS, KANSAS 67357
 PHONE (316) 421-0480
 FAX (316) 421-0948

DFI

DATE: 10/18/94
 SCALE: NTS
 DWG. NO.: CA
 BRD. NO.:
 JOB NAME: FIG. 7A
 TITLE: NET
 DISK # NETWORK
 REV. NO. 90P616C-2

REV	DATE	DESCRIPTION
2	12-21/32 WAS 10-13/32"	REVISION
1	2/2/2000	RAP CW

NOTE: DO NOT CONNECT FITTINGS HEAVIER THAN SCHEDULE 40 INTO EXHAUST DAMPER OUTLET.



Power Flame Incorporated

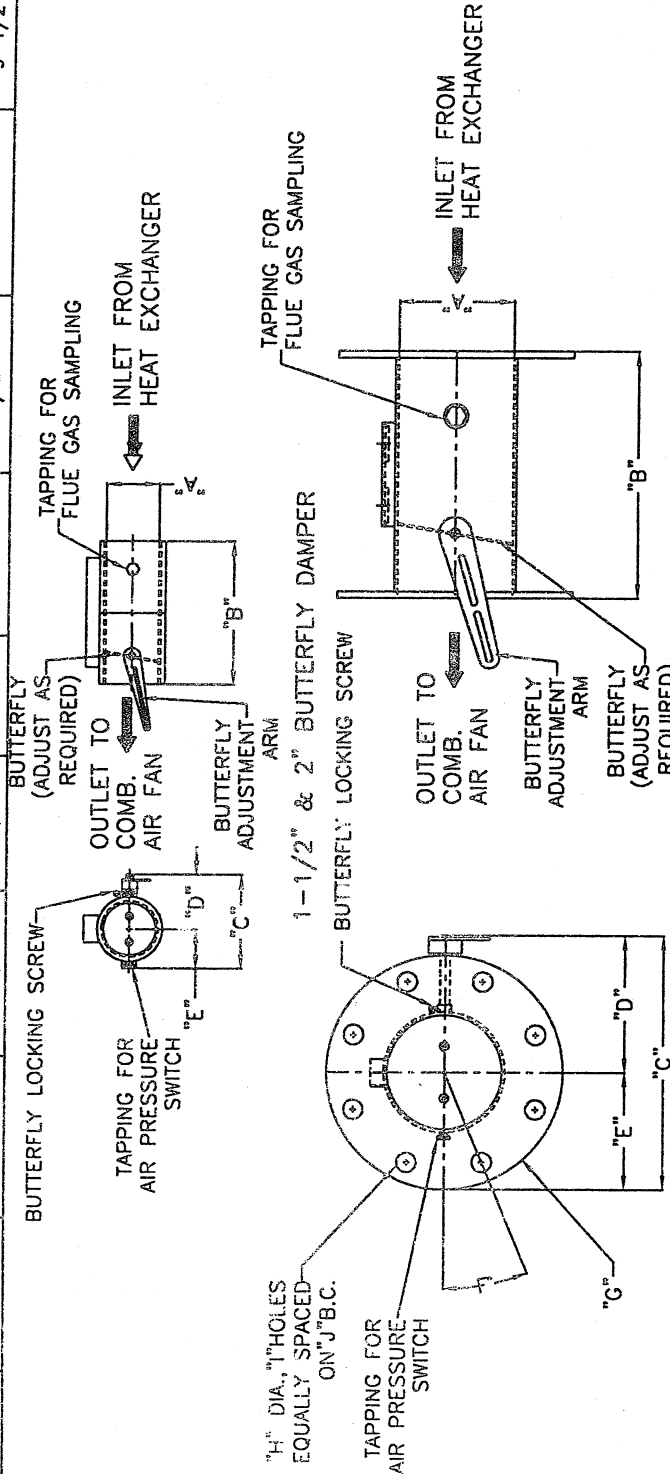


2001 SOUTH 21st STREET
PARSONS, KANSAS 67357

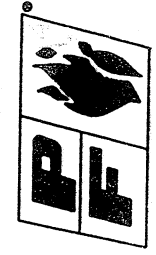
PHONE (316) 421-0480
FAX (316) 421-0948

DWG. BY: RAP	CHKD. BY: <i>GR</i>	APVD. BY:	SCALE 1"=1"	DATE: 5/7/99
JOB NAME:			FILE LOC: 3-11-45-1	
TITLE: FIG. 8 BUTTERFLY TYPE FLUE GAS DAMPER CUTAWAY				NET
3 DC#1212 ON CAD RAP 5/7/99				DWG. NO. 90P464C-3

PIPE SIZE DIM. "A"	DIM. "B"	DIM. "C"	DIM. "D"	DIM. "E"	DIM. "F"	DIM. "G"	DIM. "H"	DIM. "I"	DIM. "J"
1-1/2"	4"	4-1/4"	2-5/8"	1-5/8"	N/A	N/A	N/A	N/A	N/A
2"	5-1/8"	4-3/4"	2-7/8"	1-7/8"	N/A	N/A	N/A	N/A	N/A
2-1/2"	9-1/2"	7-3/4"	4-1/4"	3-1/2"	0"	7"	3/4"	4	5-1/2"
3"	9-1/2"	8-1/4"	4-1/2"	3-3/4"	0"	7-1/2"	3/4"	4	6"
4"	9-1/2"	9-1/2"	5"	4-1/2"	22.5"	9"	3/4"	8	7-1/2"
6"	13-1/2"	12-3/16"	6-11/16"	5-1/2"	22.5"	11"	7/8"	8	9-1/2"



TOLERANCES
 FAB ±1/32", WELD ±1/16"
 ON ALL DIMENSIONS
 EXCEPT AS NOTED.



Power Flame Incorporated

2001 SOUTH 21st STREET PHONE (316) 421-0480
 PARSONS, KANSAS 67357 FAX (316) 421-0948

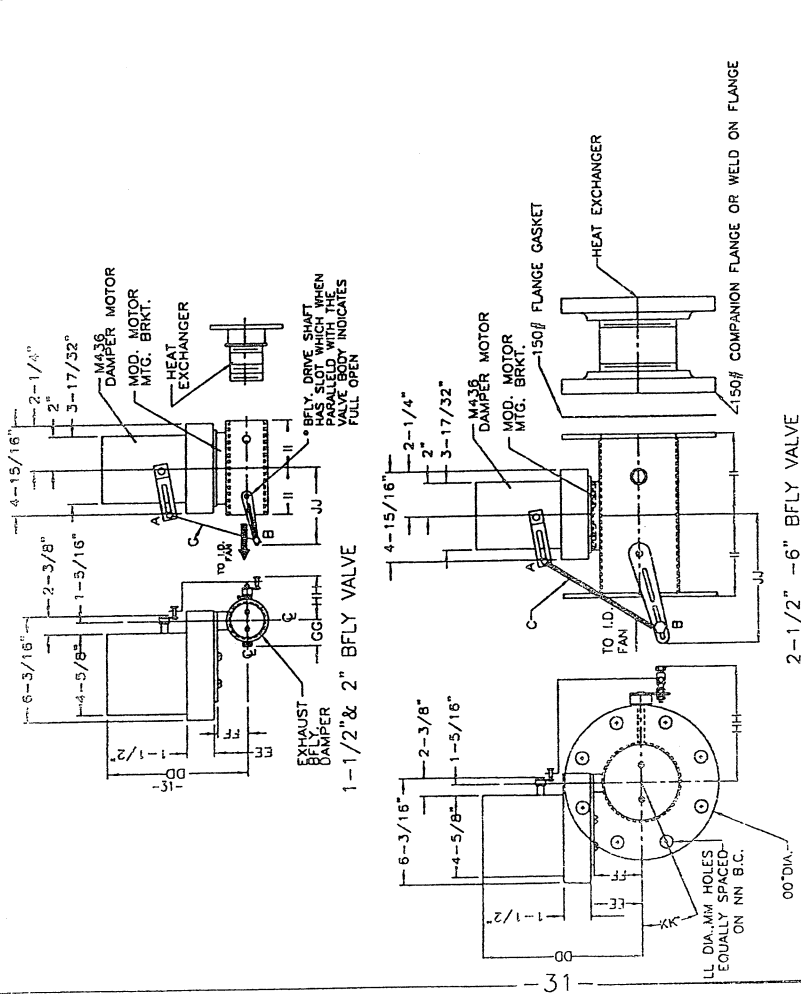
DWG. RAP	CHKD.	APVD.	SCALE	DATE
BY:	BY:	BY:	1"=1"	11/19/99
JOB NAME:			FILE LOC:	
TITLE:			NET	
CX BUTTERFLY FLUE GAS DAMPER			DWG. NO.	
DIMENSIONAL DATA FIG. 9			NO. 90P463C	

NO.	DESCRIPTION	REV'D	CHK'D	DATE
4	DCP1212 CHANGED 2.5" & UP TO FLANGE	SW		11/19/99
5	REDRAWN TO END	CA		10/17/99

BFLY PIPE SIZE	DIM. DD	DIM. EE	DIM. FF	DIM. GG	DIM. HH	DIM. II	DIM. JJ	DIM. KK	DIM. LL	DIM. MM	DIM. NN	DIM. OO
1-1/2	8.1/8"	1.5/8"	1.1/2"	1.5/8"	4.1/8"	2"	5.3/4"	N/A	N/A	N/A	N/A	N/A
2	3.5/16"	1.13/16"	1.11/16"	1.7/8"	4.3/8"	2.9/16"	6.3/16"	N/A	N/A	N/A	N/A	N/A
2-1/2	8.9/16"	2.1/16"	1.15/16"	2.3/32"	5.11/16"	4.3/4"	6.11/16"	0"	3/4"	4	5.1/2"	7"
3	6.7/8"	2.3/8"	2.1/4"	2.3/8"	5.15/16"	4.3/4"	6.11/16"	0"	3/4"	4	6"	7.1/2"
4	8.3/8"	2.7/8"	2.3/4"	3.1/4"	6.7/16"	4.3/4"	7.3/8"	22.5/32"	3/4"	6	7.1/2"	9"
5	10.1/4"	3.3/4"	3.5/8"	3.13/16"	8.1/8"	6.3/4"	8.3/8"	22.5/32"	7/8"	8	9.1/2"	11"

LOW-HIGH-LOW OPERATION

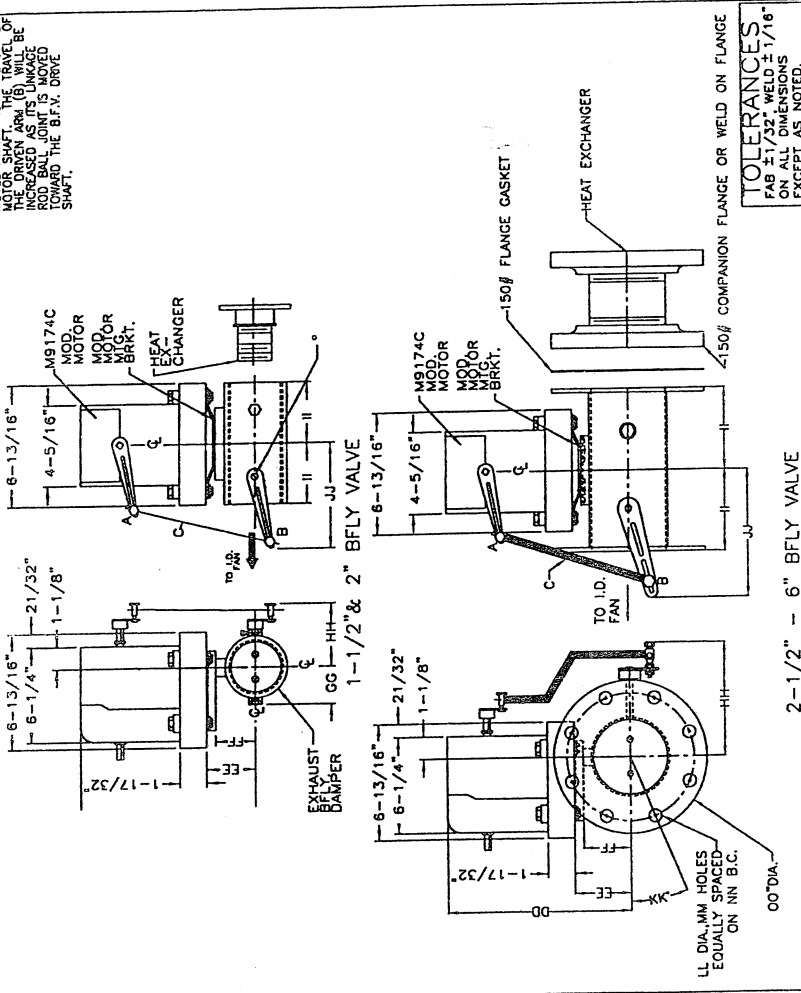
SEE NOTES THIS PAGE UNDER MODULATING OPERATIONS FOR UNPAGE ADJUSTMENTS.



BFLY PIPE SIZE	DIM. DD	DIM. EE	DIM. FF	DIM. GG	DIM. HH	DIM. II	DIM. JJ	DIM. KK	DIM. LL	DIM. MM	DIM. NN	DIM. OO
1-1/2	10.3/16"	2.1/8"	1.1/2"	1.5/8"	4.1/8"	2"	5.3/4"	N/A	N/A	N/A	N/A	N/A
2	10.3/8"	2.5/16"	1.11/16"	1.7/8"	4.3/8"	2.9/16"	6.3/16"	N/A	N/A	N/A	N/A	N/A
2-1/2	10.5/8"	2.9/16"	1.15/16"	2.3/32"	5.11/16"	4.3/4"	6.11/16"	0"	3/4"	4	5.1/2"	7"
3	10.15/16"	2.7/8"	2.1/4"	2.3/8"	5.15/16"	4.3/4"	6.11/16"	0"	3/4"	4	6"	7.1/2"
4	11.7/16"	3.3/8"	2.3/4"	3.1/4"	6.7/16"	4.3/4"	7.3/8"	22.5/32"	3/4"	6	7.1/2"	9"
5	12.5/16"	4.1/4"	3.5/8"	3.13/16"	8.1/8"	6.3/4"	8.3/8"	22.5/32"	7/8"	8	9.1/2"	11"

MODULATING OPERATION

WHEN MAKING ADJUSTMENTS, MAKE CERTAIN THE MOTOR DAMPER IS FULLY OPEN. BINDING OR BFLY OVERTRAVEL DRIVER ARM (A) WILL INCREASE THE TRAVEL OF AGE ROD (C) BALL JOINT IS MOVED AWAY FROM THE DRIVE OF MOTOR SHAFT. THE TRAVEL OF AGE ROD (C) BALL JOINT IS INCREASED AS ITS UNPAGE BE TOWARD THE BFLY DRIVE SHAFT.



JOB NAME:		FILE LOC:
M4.36 DAMPER MOTOR & M9174 MOD. MOTOR ON EXHAUST BUTTERFLY DAMPER OVERALL DIMENSIONS. FIG.# 10		7-6-48-1
DWG BY: RAP	CHKD BY:	DATE: 4/27/99
TOLERANCES FAB ±.002" WELD ±.1/16" ON ALL DIMENSIONS EXCEPT AS NOTED.		

Power Flame Incorporated

2001 SOUTH 21st STREET
PARSONS, KANSAS 67357

PHONE (316) 421-0480
FAX (316) 421-0948

SCALE: 1" = 1"

DATE: 4/27/99

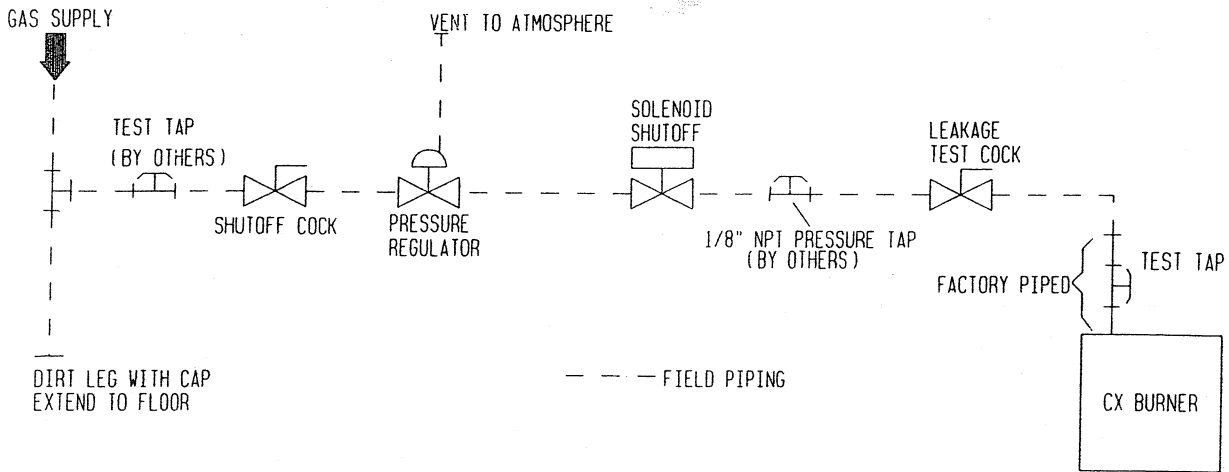
REV. NO. 90P504C-4

REVISION

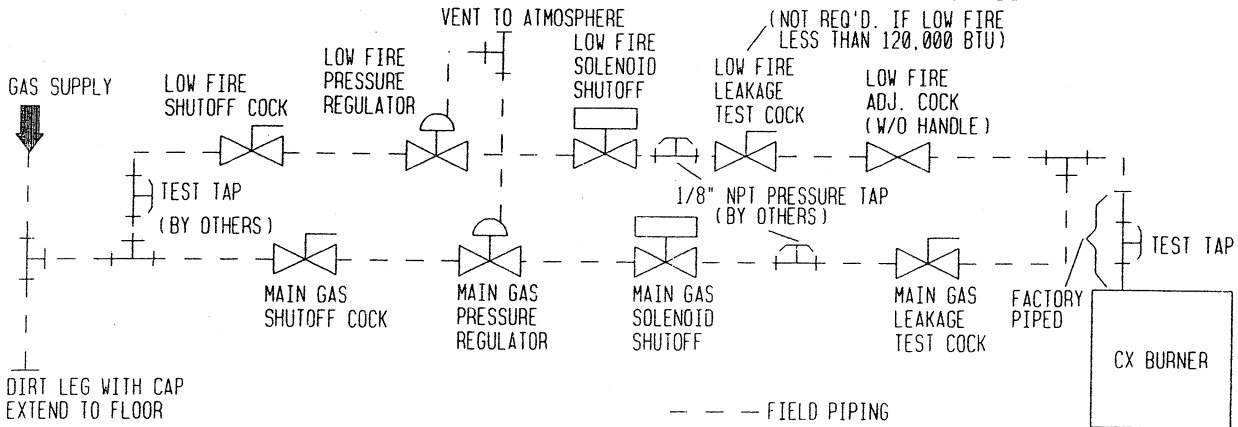
4 DC#1212 CHANGED 2.5 & UP TO FLANGED
3 REV'D FROM M934 TO M9174

DATE

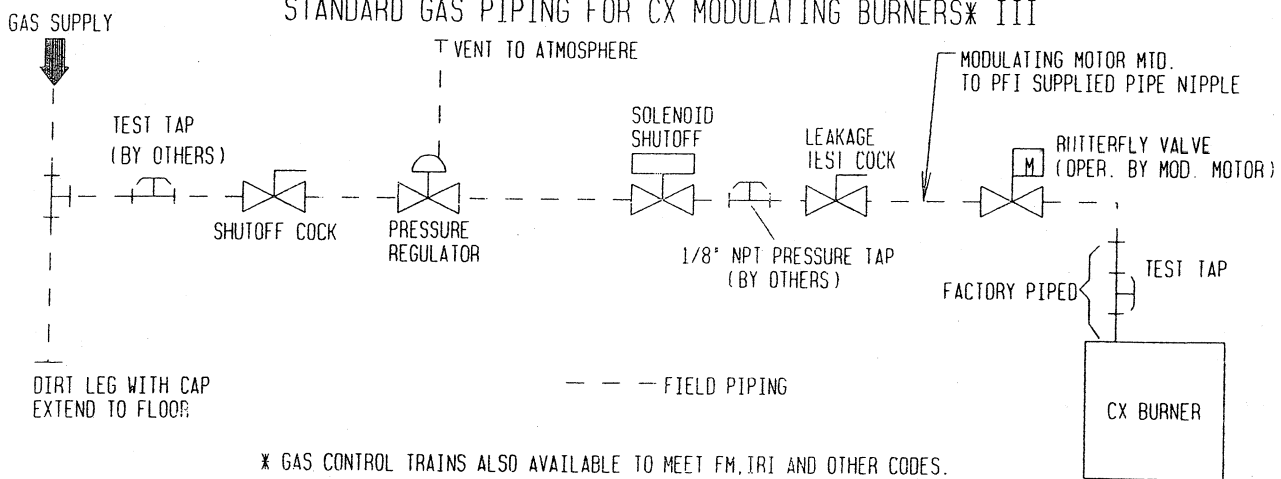
STANDARD GAS PIPING FOR CX ON-OFF BURNERS* I



STANDARD GAS PIPING FOR CX LO-HI-LO BURNERS* II



STANDARD GAS PIPING FOR CX MODULATING BURNERS* III



* GAS CONTROL TRAINS ALSO AVAILABLE TO MEET FM, IRI AND OTHER CODES.

PowerFlame Incorporated

2001 South 21st Street
Parsons, Kansas 67357

Phone (316) 421-0480
FAX (316) 421-0948



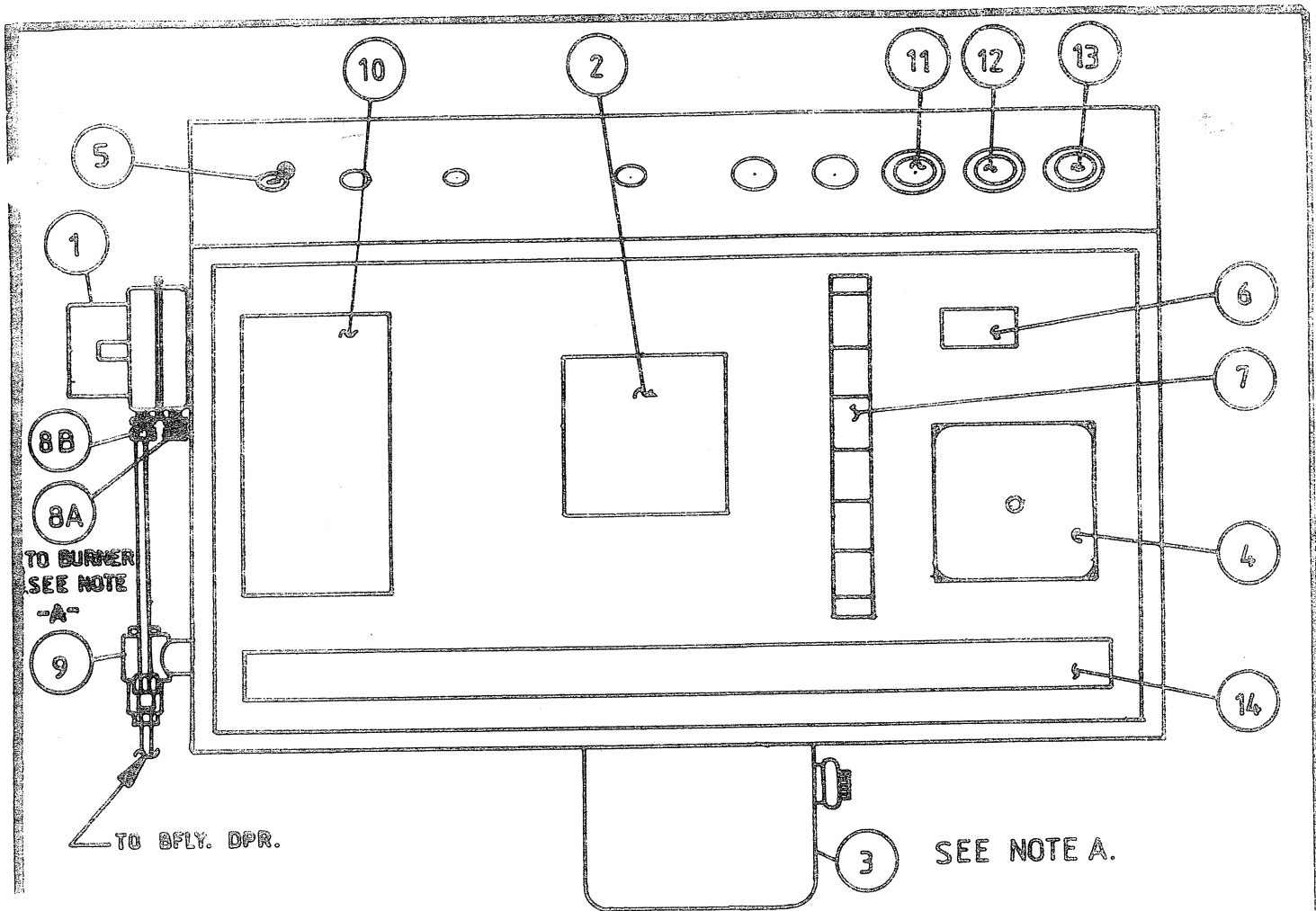
TITLE:

STANDARD CX PIPING OPTIONS

DATE:

5/27/92

FIGURE 11



- | |
|--|
| 1. AIR PRESSURE SWITCH |
| 2. BURNER TEMP. CONTROLLER (OPTION) |
| 3. IGNITION TRANSFORMER |
| 4. FLAME SAFEGUARD CONTROL W/RESET |
| 5. ON-OFF SWITCH |
| 6. FUSE TERMINAL |
| 7. TERMINAL STRIP |
| 8A. AIR FLOW SW. HIGH PRESS. PORT (BNR.) |
| 8B. AIR FLOW SW. LOW PRESS. PORT (EXHAUST DAMPER) |
| 9. 3 WAY AIR VALVE (MULTI BURNER SINGLE BLOWER ONLY) |
| 10. FAN MOTOR STARTER |

- | |
|---------------------------|
| 11. "POWER ON" LIGHT |
| 12. "MAIN FUEL" LIGHT |
| 13. "FLAME FAILURE" LIGHT |
| 14. WIRING TROUGH |

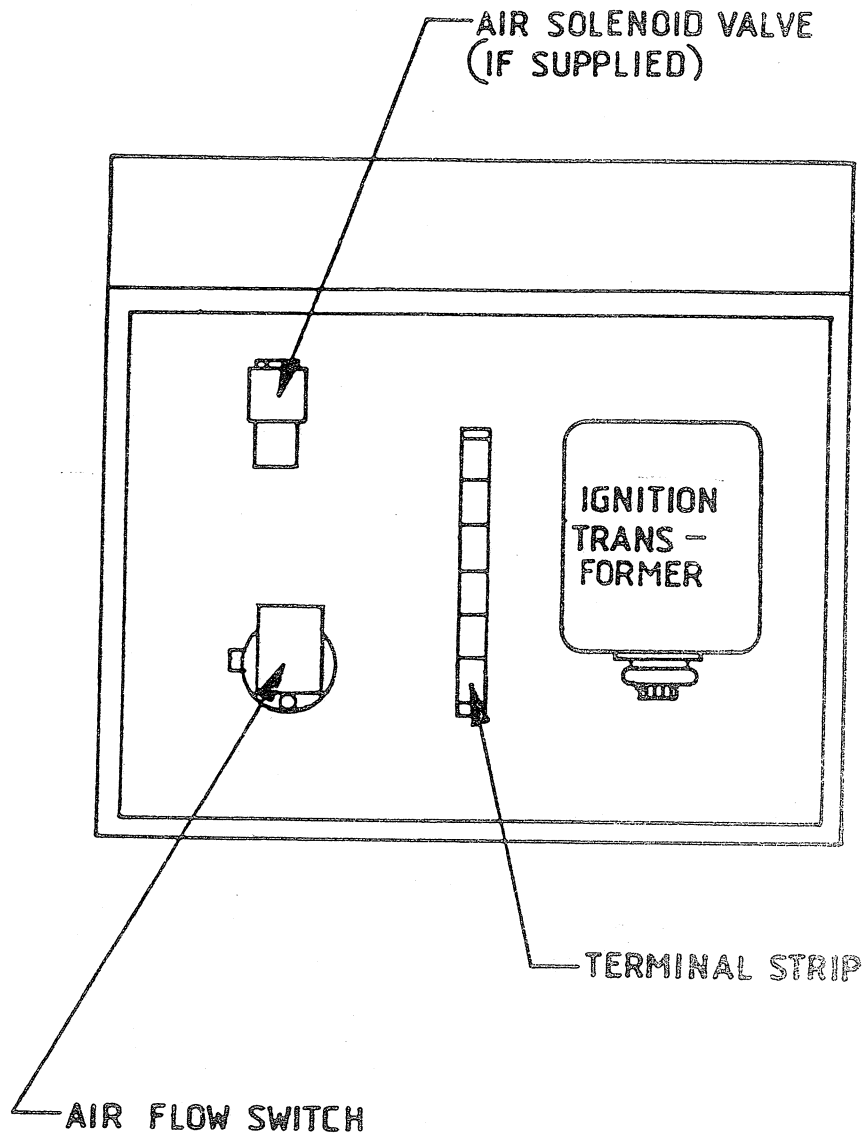
NOTE A. ITEMS 1, 3, 8 & 9 CAN BE SUPPLIED IN OPTIONAL AUXILIARY CONTROL PANEL. SEE FIGURE 13. REFER ALSO TO PG. 22B, FIG. 1B FOR AIR FLOW SWITCH CONNECTION DETAILS AS WELL AS INFO SUPPLIED WITH THE BURNER




PowerFlame Incorporated

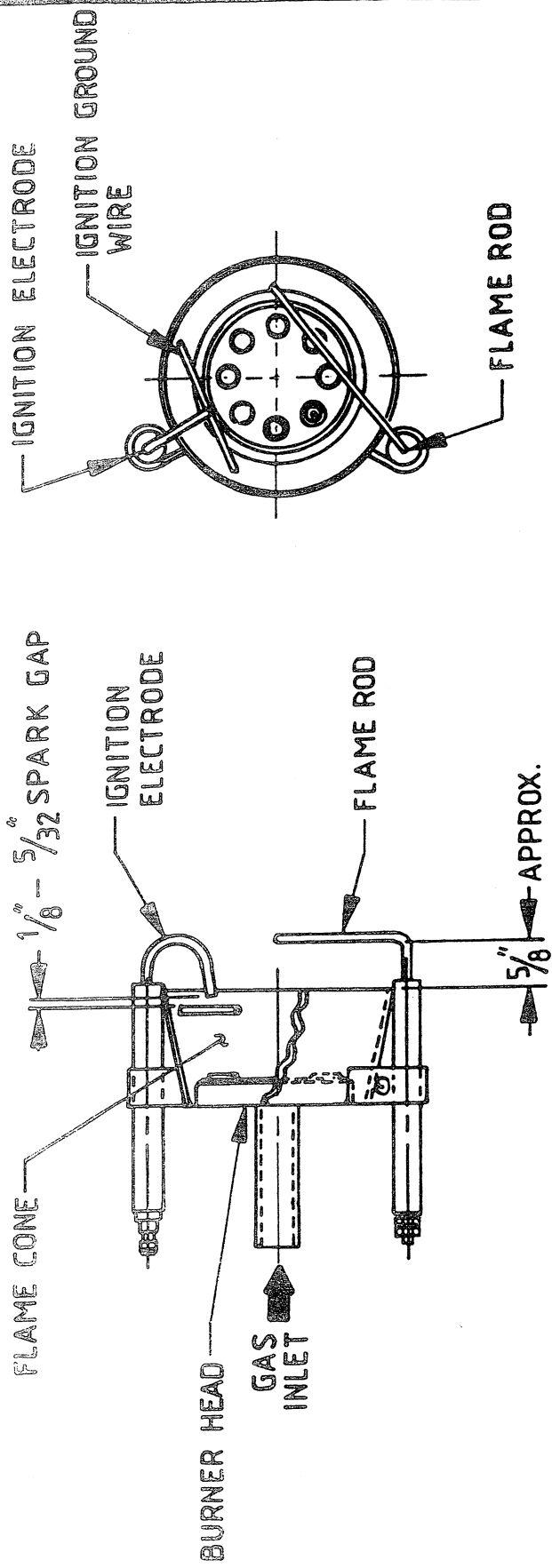
2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0400

OWN. BY: RAP	CHKD. BY:	APVD. BY:	SCALE: $\frac{1}{8}'' = 1''$	DATE: 6-21-89
JOB NAME:		FILE LOC.:	3-12-16-1	
TITLE: TYPICAL CX ON/OFF CONTROL PANEL			PLATE NO.:	OF PLATES:
FIG. NO. 12			DWG. NO.:	90P677-6



REFER TO COMBUSTION AIR PIPING SCHEMATIC
 SUPPLIED WITH BURNER FOR CONNECTION DETAILS

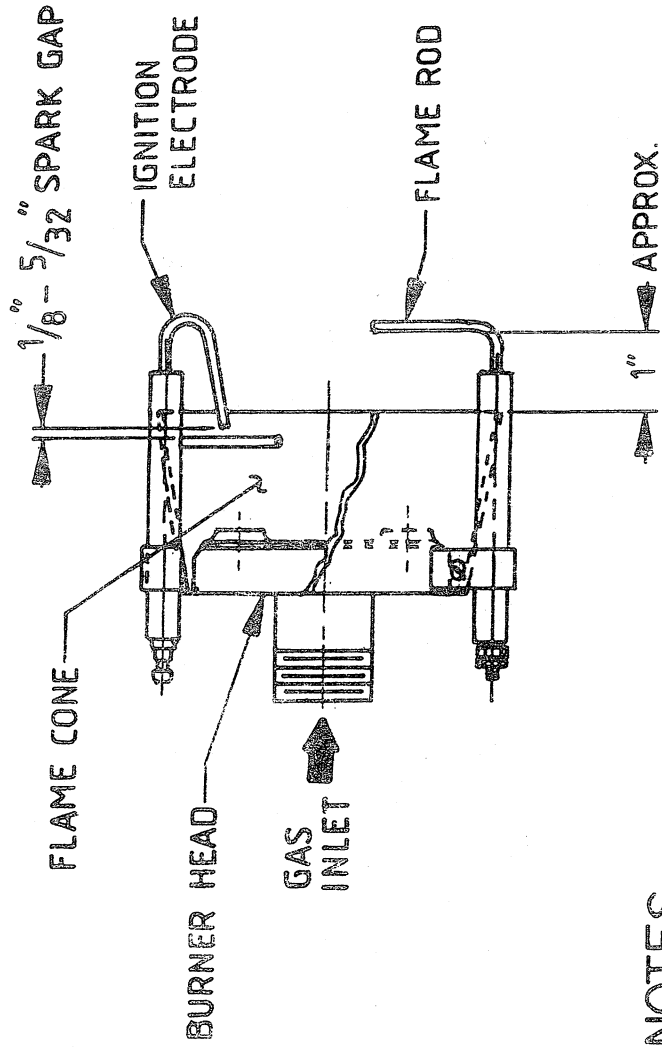
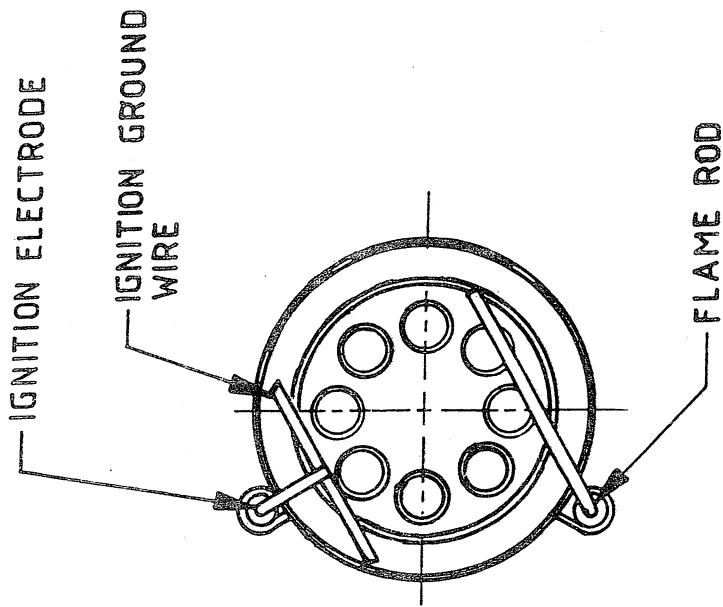
		PowerFlame Incorporated	
2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480			
DWN. BY:	RAP	CHKD. BY:	
		APVD. BY:	
		SCALE	$\frac{1}{8} = 1''$
		DATE:	8/1/89
JOB NAME:		FILE LOC	3-12-29-1
TITLE		PLATE NO.	OF PLATES
CX AUXILIARY CONTROL PANEL FIG. NO. 13		DWG. NO.	90P479-1



NOTES

1. SPARK IGNITION IS FROM THE ELECTRODE WIRE TO THE IGNITION GROUND WIRE THAT IS WELDED TO THE FLAME CONE. THE SPARK GAP SHOULD BE SET TO THE SPECIFIED DISTANCE $1/8 - 5/32$ "
2. THE FLAME ROD LIES ACROSS THE BURNER FACE AS SHOWN & IS APPROX. $5/8$ " ABOVE THE CONE LIP - UNDER NO CIRCUMSTANCES SHOULD THE FLAME ROD BE ALLOWED TO CONTACT ANY METALLIC PARTS.

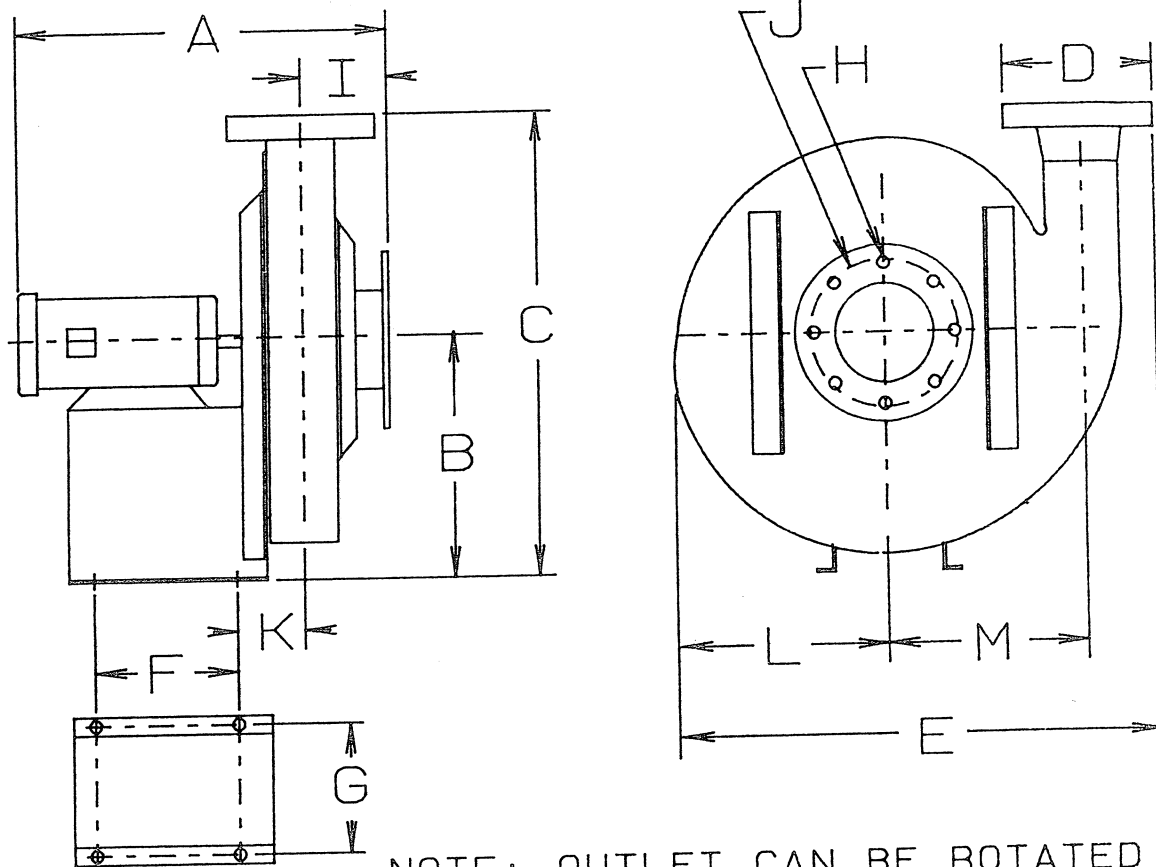
		PowerFlame Incorporated	
		2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480	
DWN BY RAP	CHKC BY APVD BY	SCALE M.T.S.	DATE 3/23/89
JOB NAME CX 15 & 20 BURNER ELECTRODE		FILE LOC. 3-11-47-1	PLATE NO OF PLATES DWG. NO. 90P466-3
SETTING DETAILS		FIG. 14	



NOTES

1. SPARK IGNITION IS FROM THE ELECTRODE WIRE TO THE IGNITION GROUND WIRE THAT IS WELDED TO THE FLAME CONE. THE SPARK GAP SHOULD BE SET TO THE SPECIFIED DISTANCE $1/8 - 5/32$ "
2. THE FLAME ROD LIES ACROSS THE BURNER FACE AS SHOWN & IS APPROX. 1" ABOVE THE CONE LIP - UNDER NO CIRCUMSTANCES SHOULD THE FLAME ROD BE ALLOWED TO CONTACT ANY METALLIC PARTS

		PowerFlame Incorporated 2001 S. 21st • PARSONS, KANSAS 67357 • PHONE (316) 421-0480		SCALE: N.T.S.	DATE: 3-23-89
				APVD. BY:	FILE LOC.: 3-11-46-1
DWN. BY: RAP	CHKD. BY:	JOB NAME: CX 25,30,40,60 BURNER ELECTRODE		PLATE NO. OF PLATES	DWG. NO. 90P46-4
4 REV'D TITLE CA	10-17-94	TITLE: SETTING DETAILS FIG. 15		REV'D. KLB	DATE 7-26-89
3 REV'D FOR CORRECT PROJECTION RAP	9-18-90	REVISION		REV'D.	DATE
2. REV'D. FLAME ROD GAP	7-26-89	REVISION		REV'D.	DATE



NOTE: OUTLET CAN BE ROTATED 360

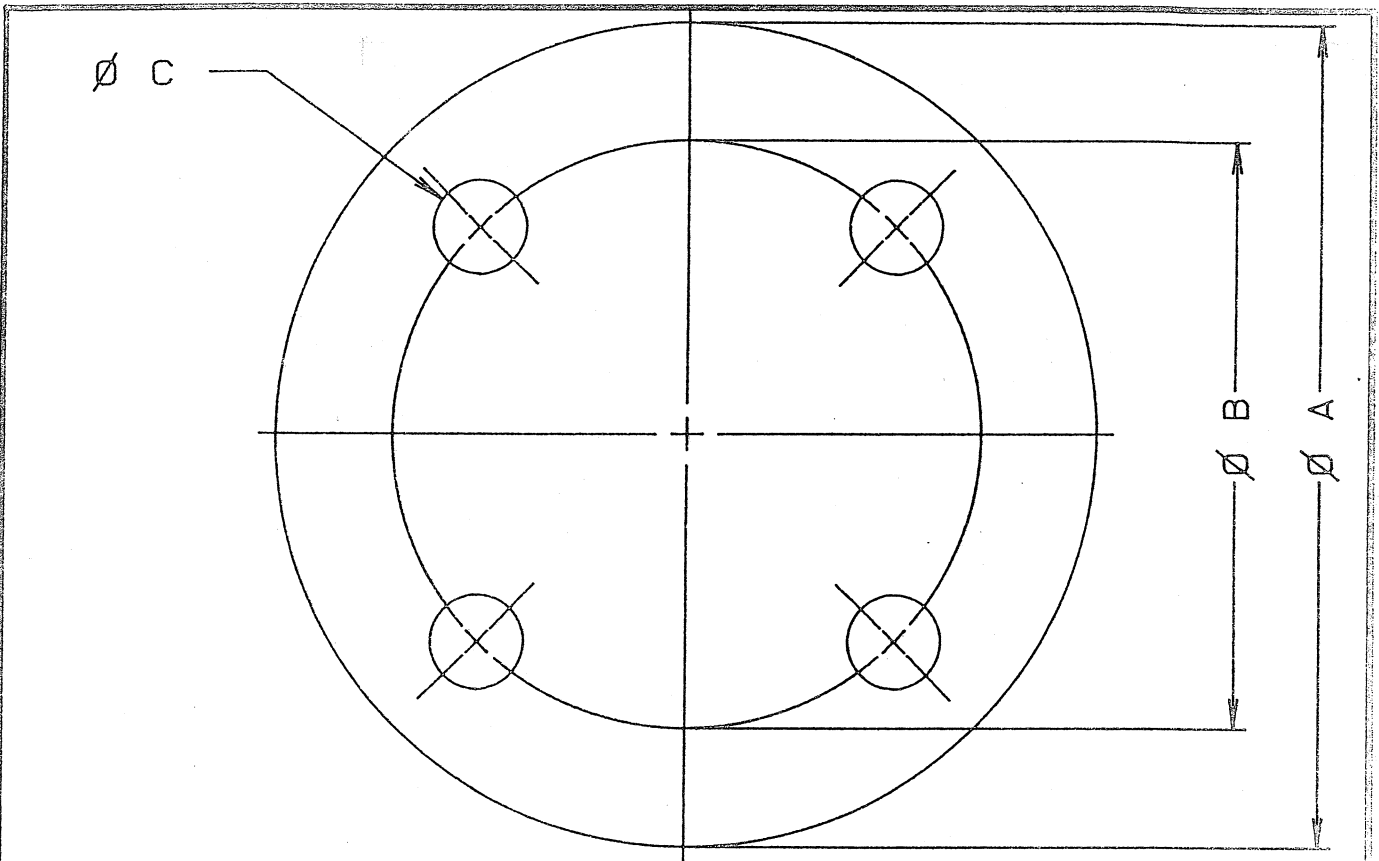
FAN MODEL	HP	BURNER RATING MBH	DIMENSIONS													APPRX. WEIGHT
			A	B	C	D	E	F	G	H	I	J	K	L	M	
142 Q	1	300	$15 \frac{1}{16}$	$13 \frac{3}{16}$	$23 \frac{11}{16}$	4	$20 \frac{5}{8}$	$9 \frac{5}{8}$	$10 \frac{13}{16}$	$\frac{3}{4}$	$3 \frac{3}{8}$	$7 \frac{1}{2}$	$2 \frac{5}{8}$	$9 \frac{3}{4}$	$9 \frac{1}{4}$	80#
142.5 Q	$1 \frac{1}{2}$	1000	$15 \frac{7}{8}$	$13 \frac{3}{16}$	$23 \frac{11}{16}$	6	$21 \frac{5}{8}$	$9 \frac{5}{8}$	$10 \frac{13}{16}$	$\frac{3}{4}$	$3 \frac{3}{8}$	$7 \frac{1}{2}$	$2 \frac{5}{8}$	$9 \frac{3}{4}$	$9 \frac{1}{4}$	100#
144 Q	2	1500	$18 \frac{1}{8}$	$13 \frac{3}{16}$	$23 \frac{15}{16}$	6	23	$9 \frac{5}{8}$	$10 \frac{13}{16}$	$\frac{7}{8}$	$4 \frac{1}{8}$	$9 \frac{1}{2}$	$3 \frac{1}{8}$	10	$9 \frac{7}{8}$	110#
193 Q	3	1500	$18 \frac{7}{8}$	$17 \frac{1}{2}$	$30 \frac{1}{2}$	6	$26 \frac{5}{8}$	$11 \frac{1}{2}$	$13 \frac{13}{16}$	$\frac{7}{8}$	$3 \frac{3}{8}$	$9 \frac{1}{2}$	$2 \frac{1}{2}$	$11 \frac{7}{8}$	$11 \frac{3}{4}$	115#
194 Q	5	3000	$21 \frac{3}{8}$	$17 \frac{1}{2}$	$30 \frac{3}{4}$	8	29	$11 \frac{1}{2}$	$13 \frac{13}{16}$	$\frac{7}{8}$	$4 \frac{1}{8}$	$9 \frac{1}{2}$	$3 \frac{1}{8}$	$12 \frac{9}{16}$	$12 \frac{3}{8}$	135#
195 Q	$7 \frac{1}{2}$	4000	$23 \frac{1}{2}$	$18 \frac{1}{4}$	$31 \frac{13}{16}$	10	$30 \frac{5}{8}$	$11 \frac{1}{2}$	$13 \frac{13}{16}$	$\frac{7}{8}$	$4 \frac{5}{8}$	$11 \frac{3}{4}$	$3 \frac{1}{2}$	$12 \frac{7}{8}$	$12 \frac{3}{4}$	180#
222.5 Q	5	1500	$19 \frac{15}{16}$	$18 \frac{11}{16}$	$33 \frac{3}{16}$	6	$29 \frac{3}{4}$	$11 \frac{3}{8}$	15	$\frac{7}{8}$	$3 \frac{3}{8}$	$9 \frac{1}{2}$	$2 \frac{7}{16}$	$13 \frac{3}{8}$	$13 \frac{1}{4}$	150#
224 Q	10	4000	$22 \frac{3}{4}$	$19 \frac{7}{16}$	$34 \frac{5}{16}$	10	$32 \frac{7}{8}$	$11 \frac{3}{8}$	15	$\frac{7}{8}$	$4 \frac{1}{8}$	$9 \frac{1}{2}$	$3 \frac{3}{32}$	14	$13 \frac{7}{8}$	220#



Power Flame Incorporated

2001 S. 21st · PARSONS, KANSAS 67357 · PHONE (316) 421-0480

DWG. BY: RLS	CHKD. BY: CA	APVD. BY:	SCALE NTS	DATE: 6-1-94
JOB NAME:			FILE LOC: 5-9-40-1	
TITLE: CX INDUCED DRAFT FAN OVERALL DIMENSIONS FIG. NO. 16 (REV 694)				DISK 86
				DWG. NO. 90P613C-1



PIPE SIZE	A		B		C		NO. OF HOLES
	INCHES	mm	INCHES	mm	INCHES	mm	
1 1/2"	5"	127	3 7/8"	98	5/8"	16	4
2"	6"	152	4 3/4"	121	3/4"	19	4
2 1/2"	7"	178	5 1/2"	140	3/4"	19	4
3"	7 1/2"	191	6"	152	3/4"	19	4
4"	9"	229	7 1/2"	191	3/4"	19	8 ^{NOTE 1}
6"	11"	279	9 1/2"	241	7/8"	22	8 ^{NOTE 1}
8"	13 1/2"	343	11 3/4"	299	7/8"	22	8

NOTE 1: WHEN FLG IS USED FOR MOUNTING CX 30/40/60 BNR. ONLY 4 HLS. USED. WHEN FLG USED ON BLOWER HSG OR TANK ALL HLS. USED.



Power Flame Incorporated

2001 S. 21st · PARSONS, KANSAS 67357 · PHONE (316) 421-0480

DWG. BY: CA	CHKD. BY: RAP	PARENT DWG.	SCALE NTS	DATE: 10/17/94
JOB NAME: FIG. 17		FILE Loc:	3-9-45-1	
TITLE: BURNER MOUNTING & DRAFT FAN INLET FLANGE DETAILS (150# ANSI FLANGE).			DISK #	109
			DWG. No.	90P455-4

FLUE PIPING SIZING - (1) FROM HEAT EXCHANGER FLUE GAS DAMPER TO INDUCED DRAFT FAN INLET

To determine minimum pipe size - Add equivalent feet of fitting from Figure 19 to actual straight pipe lineal feet for total feet and select pipe from Figure 18.

MINIMUM PIPE SIZE - SCHEDULE 40 STEEL PIPE								
BURNER MODEL	MAXIMUM FEET FROM EXHAUST DAMPER TO FAN INLET							
	10' (1)	20'	30'	40'	50'	75'	100'	200'
CX 15	2 1/2"	2 1/2"	3"	3"	3"	4"	4"	4"
CX 20	3"	4"	4"	4"	4"	4"	6"	6"
CX 25	4"	4"	6"	6"	6"	6"	6"	8"
CX 30	4"	6"	6"	6"	6"	6"	8"	8"
CX 40	6"	8"	8"	8"	8"	8"	10"	10"
CX 60	8"	8"	10"	10"	10"	10"	12"	12"

Figure 18

(1) Typical for Single Burner Systems. In cases where the heat exchanger tube is actually one pipe size larger than the burner model being supplied (i.e., a 4" heat exchanger tube could be supplied with a model CX30 burner), use the flue size column that relates to the actual heat exchanger pipe size (the CX40 column would be used in this example). Consult with Power Flame for sizing and physical component arrangements on applications utilizing a single fan for 2 or more burners.

EQUIVALENT LINEAL FEET FOR SCHEDULE 40 PIPE FITTINGS									
BURNER MODEL	NOMINAL PIPE SIZE								
	1 1/2"	2"	2 1/2"	3"	4"	6"	8"	10"	12"
45° EL	2.0'	2.7'	3.4'	4.0'	5.4'	8.0'	10.7'	13.4'	25.5'
90° EL	3.8'	5.0'	6.3'	7.5'	10.0'	15.0'	20.0'	25.0'	50'
TEE STRAIGHT FLOW	2.5'	3.4'	4.2'	5.0'	6.7'	10.0'	13.4'	16.7'	32'

Figure 19

FAN DISCHARGE FLUE SIZING DATA

To determine minimum flue size - add equivalent feet of fittings from Figure 21 to actual straight flue lineal feet for total feet of flue and select flue size from Figure 20A, B or C as appropriate.

RECOMMENDED FLUE INTERNAL DIAMETER - 14 SERIES FAN MODELS								
HEAT INPUT BTU INPUT X 1000	MINIMUM FAN MODEL	FAN DISCHARGE SIZE	DISTANCE FROM FAN DISCHARGE TO FLUE EXHAUST					
			10'	20'	40'	60'	80'	100'
150	142Q	4"	4"	4"	4"	4"	4"	4"
300	142Q	4"	4"	4"	4"	4"	6"	6"
500	142.5Q	6"	6"	6"	6"	6"	6"	6"
800	142.5Q	6"	6"	6"	6"	6"	8"	8"
1,000	142.5Q	6"	6"	6"	6"	8"	8"	8"
1,500	144Q	6"	6"	6"	8"	8"	8"	10"

Figure 20,A

RECOMMENDED FLUE INTERNAL DIAMETER - 19 SERIES FAN MODELS								
HEAT INPUT BTU INPUT X 1000	MINIMUM FAN MODEL	FAN DISCHARGE SIZE	DISTANCE FROM FAN DISCHARGE TO FLUE EXHAUST					
			10'	20'	40'	60'	80'	100'
250	193Q	6"	6"	6"	6"	6"	6"	6"
300	193Q	6"	6"	6"	6"	6"	6"	6"
500	193Q	6"	6"	6"	6"	6"	6"	6"
800	193Q	6"	6"	6"	6"	6"	8"	8"
1,000	193Q	6"	6"	6"	6"	8"	8"	8"
1,500	193Q	6"	6"	6"	8"	8"	8"	10"
2,000	194Q	8"	8"	8"	8"	10"	10"	10"
2,500	194Q	8"	8"	8"	10"	10"	10"	12"
3,000	194Q	8"	8"	8"	10"	10"	12"	12"
3,500	195Q	10"	10"	10"	10"	12"	12"	12"
4,000	195Q	10"	10"	10"	10"	12"	12"	14"

Figure 20,B

RECOMMENDED FLUE INTERNAL DIAMETER - 22 SERIES FAN MODELS								
HEAT INPUT BTU INPUT X 1000	MINIMUM FAN MODEL	FAN DISCHARGE SIZE	DISTANCE FROM FAN DISCHARGE TO FLUE EXHAUST					
			10'	20'	40'	60'	80'	100'
150	222.5Q	6"	6"	6"	6"	6"	6"	6"
300	222.5Q	6"	6"	6"	6"	6"	6"	6"
500	222.5Q	6"	6"	6"	6"	6"	6"	6"
800	222.5Q	6"	6"	6"	6"	6"	8"	8"
1,000	222.5Q	6"	6"	6"	6"	8"	8"	8"
1,500	222.5Q	6"	6"	6"	8"	8"	8"	10"
2,000	224Q	10"	10"	10"	10"	10"	10"	10"
2,500	224Q	10"	10"	10"	10"	10"	10"	12"
3,000	224Q	10"	10"	10"	10"	10"	12"	12"
3,500	224Q	10"	10"	10"	10"	12"	12"	12"
4,000	224Q	10"	10"	10"	12"	12"	12"	14"

Figure 20,C

EQUIVALENT LINEAL FEET FOR FAN DISCHARGE FLUE FITTINGS						
FITTING TYPE	FLUE INTERNAL DIAMETER					
	4"	6"	8"	10"	12"	14"
45° EL	9.0'	13.3'	17.8'	22.2'	26.6'	31.0'
90° EL	16.8'	25.0'	33.3'	41.7'	50.0'	58.0'
TEE STRAIGHT FLOW	11.2'	16.7'	22.2'	27.8'	33.0'	39.0'

Figure 21

BURNER MODEL	MAXIMUM BURNER CAPACITY		3 TO 1 TURNDOWN	
	FIRING RATE MBH	GAS PRESSURE AT BURNER HEAD "W.C.	FIRING RATE MBH	GAS PRESSURE AT BURNER HEAD "W.C.
CX 15	150	2.0	50	.25
CX 20	275	6.0	92	.8
CX 25	475	1.6	158	.2
CX 30	750	4.0	250	.5
CX 40	1500	6.0	500	.8
CX 60	2500	6.0	833	.75

Figure 22 - CX TURNDOWN RATIO INFORMATION FOR NATURAL GAS

CX Burner Firing Natural Gas

Gas Pressure vs Capacity

Burner Capacity x 1000 Btu/hr
(Based on Natural Gas, 1000 Btu/cu.ft)

Figure 23

NOTE: Consult Power Flame for applications requiring higher turndowns than those shown here.

CX Burner Firing Propane Gas

Gas Pressure vs Capacity

Burner Capacity x 1000 Btu/hr
(Based on Propane Gas, 2500 Btu/cu.ft)

Figure 24

NOTE: Consult Power Flame for applications requiring higher turndowns than those shown here.

GAS SUPPLY PIPING PRESSURE DROP CHARTS

All gas piping should be appropriately pressure tested to ensure leak free operation. It is recommended that a dirt pocket or trap be piped into the gas supply system just ahead of the burner train inlet manual shutoff cock. When testing with pressures higher than the maximum pressure ratings of the gas train components, be sure to isolate these components and test their piping for gas leaks with correct pressures only. On many burners, the maximum gas train components pressure is 1/2 PSIG (14"W.C.).

Refer to page 32, Figure 11 for typical gas piping schematics.

CAPACITY OF PIPE - NATURAL GAS (CFH)
With Pressure Drop of 0.3" W.C. and Specific Gravity of 0.60

PIPE LENGTH IN FEET	PIPE SIZE - INCHES (NPS)						
	1	1 1/4	1 1/2	2	2 1/2	3	4
10	520	1050	1600	3050	4800	8500	17500
20	350	730	1100	2100	3300	5900	12000
30	285	590	890	1650	2700	4700	9700
40	245	500	760	1450	2300	4100	8300
50	215	440	670	1270	2000	3600	7400
60	195	400	610	1150	1850	3250	6800
70	180	370	560	1050	1850	3000	6200
80	170	350	530	990	1600	2800	5800
90	160	320	490	870	1400	2600	5400
100	150	305	460	870	1400	2500	5100
125	130	275	410	780	1250	2200	4500
150	120	250	380	710	1130	2000	4100
175	110	225	350	650	1050	1850	3800
200	100	210	320	610	980	1700	3500

Figure 25

NOTE: Use multiplier in Figure 26 for other specific gravities and pressure drops.

CORRECTION FACTORS

SPECIFIC GRAVITY OTHER THAN 0.60		PRESSURE DROP OTHER THAN 0.3	
SPECIFIC GRAVITY	MULTIPLIER	PRESSURE DROP	MULTIPLIER
0.50	1.10	0.1	0.577
0.60	1.00	0.2	0.816
0.70	0.926	0.3	1.00
0.80	0.867	0.4	1.16
0.90	0.817	0.6	1.42
1.00	0.775	0.8	1.64
PROPANE - AIR		1.0	1.83
		2.0	2.58
PROPANE		3.0	3.16
		4.0	3.65
BUTANE		6.0	4.47
		8.0	5.18
1.10	0.740		
1.55	0.622		
2.00	0.547		

Figure 26

EQUIVALENT LENGTH OF FITTINGS IN FEET

PIPE SIZE - INCHES (NPS)	1	1.25	1.5	2	2.5	3	4
STD. TEE THROUGH SIDE	5	6.3	7.5	10	12.5	15	20
STD. EII	2.5	3.2	3.8	5	6.3	7.5	10
45° EII	1.4	1.7	2	2.7	3.4	4	5.4
PLUG COCK	1.5	1.9	2.3	3	3.8	4.5	6

Figure 27

12 TROUBLE SHOOTING SUGGESTIONS

(Additional information can be found in the manufacturer's programming control bulletin supplied with the burner.)

12.1 Burner Fails to Start

- A. Defective on/off switch. Replace switch.
- B. Control circuit has an open control contact. Check limits, low liquid cutoff switch, and others as applicable.
- C. Bad fuse or switch open on in-coming power source. Correct as required.
- D. Motor overloads tripped. Reset and correct cause for trip out.
- E. Flame safeguard control safety switch tripped out. Reset and determine cause for apparent flame failure.
- F. Loose connection or faulty wiring. Tighten all terminal screws and consult wiring diagram furnished with the burner.
- G. Programming control starting circuit blocked due to flame relay being energized. Possible defective amplifier - replace. Detection of flame due to leaking fuel valve - correct unwanted flame cause. Defective flame safeguard control - replace.
- H. Defective motor. Repair or replace.

12.2 Occasional Lockouts for No Apparent Reason

- A. Gas ignition failure. Adjust electrodes to make certain that ignition is instantaneous and that flame signal readings are stable and above minimum values. Use a manometer or 0 to 10" W.C. gas pressure gauge on test tee to make certain that pressure is as recommended.
- B. Verify that there are no cracks in the ignition/flame rod porcelains and that transformer end and electrode end plug-in connections are tight.
- C. Loose or broken wires. Check all wire nut connections and tighten all terminal screw connections in panel and elsewhere as appropriate.
- D. Occasional low voltage supply. Have local utility correct. Make certain that the burner control circuit transformer (if supplied) is correct for the voltage being supplied.
- E. Occasional low gas supply pressure. Have local utility correct.

12.3 Induced Draft Fan Motor Runs, But Flame Does Not Light

- A. Gas supply to burner shut off - make sure all manual gas supply valves are open. Automatic high pressure valve at meter such as "Sentry" type tripped shut due to high gas pressure - reset valve and correct cause for trip out.
- B. Automatic valve not opening - listen and feel for valve actuation. Automatic valve not being powered - check electrical circuitry. Replace coil or entire valve if coil is burned out.
- C. Defective gas regulator - replace.
- D. Gas pressure too high or too low. Refer to Power Flame supply and burner head pressure information.
- E. Defective ignition transformer - replace. Incorrect ignition electrode settings - refer to electrode adjustments for correct settings.
- F. Defective flame safeguard control or plug-in purge timing card. Replace as required.
- G. Air flow switch not making circuit - check out electrically and correct pressure adjustment on switch if required. Defective air flow switch - replace. Air switch pressure sensing line damaged - or fittings loose - replace/tighten.
- H. On multi-burner single fan jobs equipped with 3-way air solenoid valve, make certain of correct valve operation.

12.4 For Low-High-Low Systems

Low Fire Lights, but Main Gas Flame is not Established -

- A. Main shut off or test cock closed. Check to make certain fully open.
- B. Low fire flame signal reading too low to pull in flame safeguard relay. Readjust as required.
- C. Defective automatic gas shut off valves. Check electrical circuitry to valves. Replace valves or correct circuitry as required.
- D. Defective programming control or plug-in amplifier. Check and replace as required.
- E. Main gas pressure regulator atmospheric vent line obstructed. Correct.
- F. Defective main gas pressure regulator - replace. Misadjusted main gas pressure regulator - readjust to meet required operational values.

12.5 Gas High Fire Input Cannot Be Achieved

- A. Gas company pressure regulator or meter operating incorrectly, not allowing required gas pressure at burner train inlet. Have Gas Company correct.
- B. Gas cock upstream of train inlet not full open. Check and correct.
- C. Gas line obstructed. Check and correct.
- D. Gas train main and/or leak test cocks not fully open. Check and correct.
- E. Gas supply line between gas company regulator and burner inlet too small. Check supply pressure at meter, determine pressure drop and increase line size as required, or raise supply pressure to compensate for small line. Do not raise pressure so high that under static (no flow) conditions the pressure exceeds the maximum allowable pressure to the gas train components on the burner.
- F. Burner gas train components sized too small for supply pressure. Increase component size as appropriate.
- G. Automatic gas valve not opening fully due to defective operation. Replace gas valve.
- H. On modulating or low-high-low burner, butterfly gas supply valve and/or exhaust butterfly valve not fully opened. Readjust.
- I. Defective main gas pressure regulator. Replace.
- J. Incorrect spring in main gas pressure regulator. Replace as required.
- K. Main gas pressure regulator vent line obstructed. Check and correct.
- L. Normally open vent valve (if supplied) not closing when automatic gas valves open. Check to see if valve is fully closed when automatic valves are open. Replace vent valve, if not closing fully.

13. MAINTENANCE SECTION

13.1 Burner Assembly

(a) General

After one month's operation, check the burner assembly to establish required periodic service intervals. Under clean environmental conditions we recommend service inspections every six (6) months - at minimum once a year. In very dusty areas it may be necessary to clean the unit more frequently. The burner assembly contains no moving parts and is, therefore, virtually maintenance free.

Shut off the gas supply and electric power to the unit and clean off any build-up of dirt that may have accumulated on the outside of the assembly. Measure and record the air gap distance between the combustion air baffle plate and burner assembly; remove the baffle plate to gain access to the inside of the unit and visually inspect the flame screen and cone for corrosion or flame damage. Replace these components if necessary.

Note: The casing and sound retardant material must not be immersed in water or any solvents.

Unless subjected to extremely abnormal conditions, i.e., water in the gas supply and/or, etc., the burner head itself will usually not require any service.

Reconnect the combustion air baffle plate to the burner assembly and adjust the air gap to its original setting; turn on gas and power supplies. Restart the system and check combustion values to ensure correct performance.

(b) Electrodes (See Fig. 14 Pg 35 and Fig. 15 Pg 36)

The electrodes should be renewed at each annual service and periodically wiped clean and dry to maintain the reliability of the system. Shut off the gas supply and electric power to the unit before attempting to replace or adjust the electrodes.

Measure and record the air gap distance between the combustion air baffle plate and burner assembly; remove the baffle plate to gain access to the electrodes on the flame cone. Carefully disconnect the cables from the electrodes and remove the union in the gas feed pipe to the burner head; withdraw the burner head and flame cone assembly taking care not to damage the electrodes mounted on the cone. When the new electrodes are in place, adjust the spark gap and position as shown in Figs. 14 and 15.

Caution: Do not over tighten the electrode securing screw or the ceramic may be cracked and consequently damaged beyond repair.

Carefully reinstall the burner head into the unit and reassemble. Reconnect the combustion air baffle plate to the burner assembly and adjust the air gap to its original setting. Restart the system and check.

(c) UV Scanner

If UV scanner has been supplied, periodically clean the lens. See information provided in the programming control bulletin supplied with the burner.

13.2 Heat Exchanger Tube

The heat exchanger should be kept clean on the inside and outside tube surfaces, to ensure efficient heat transfer to the fluid and minimum fuel consumption.

Cleaning the inside of the tubes will only be necessary if the unit has been running fuel rich for a period of time. The sooting can be removed by air or water pressure or such as drain line auguring devices used by plumbing contractors.

Scale on the outside of the tubes should be removed with a wire brush, by sand blasting or high pressure water jets. If the heat exchanger pipe has been electropolished, non-abrasive cleaning methods must be employed such as, water jets, rubber or wooden mallets. The frequency of external descaling can only be determined over a period of time because it depends on the fluid in the tank, its working temperature and work load.

Note: Failure to descale the outside of the heat exchanger will result in poor fuel efficiency and heat transfer.

If scaling is heavy, the flue temperature may rise and damage the heat exchanger and fan beyond repair.

13.3 Butterfly Exhaust Damper (See Fig. 8 Pg 29 and Fig. 10 Pg 31)

Periodically check that the butterfly spindle locknut has not worked loose on on-off mode burners. Check linkage tightness and correct operation of all moving parts on low-high-low and modulating mode burners.

13.4 Gas Train Assembly (See Fig. 11 Pg 32)

The gas train assembly should be kept clean and dry at all times and at approximately monthly intervals the "automatic" gas valves should be checked for proper gas cutoff operation.

To check for gas leakage, turn the electrical supply off, leave the main gas cock open and connect a water gauge to the pressure test point down stream of the valve being tested. With the cock gas closed, the reading on the gauge should not rise. If it does, the valve must be repaired or replaced. Refer to gas valve test procedures as provided in the gas valve manufacturer's bulletin supplied with the burner.

When the equipment is re-started, after extended shutdown, the setting of the regulators and other components must be checked.

13.5 Temperature Controls

Periodically check that the temperature controller is switching when the liquid in the tank reaches the desired temperature. No other maintenance should be required.

13.6 Air Flow Switch

At monthly intervals check that the air pressure switch is functioning normally by disconnecting the tubing on the low pressure side of the pressure switch while the unit is running. The control system should close the gas valve(s) almost immediately. Refer to programming control information for the sequence of operation for your specific system. At the regular service, inspect the pipework to the air pressure switch for corrosion or mechanical damage and replace if necessary. Disconnect the pressure switch and clear the pipework of any moisture or debris using compressed air.

13.7 3-Way Air Valve (If supplied)

Inspect the pipework to the 3-way air valve during the annual service for corrosion or mechanical damage; replace if necessary. Disconnect the air valve and air pressure switch and clear the pipework of any moisture or debris using compressed air.

13.8 Control System

The operation of the controls should be checked at regular intervals to ensure reliability and reduce nuisance shut downs. The most important function is flame sensing and this should be checked at least at monthly intervals especially if the system is in continuous operation. Refer to the programming control bulletin supplied with the burner to determine the correct sequence of burner shutdown on flame failure.

Flame sensing may be checked by either disconnecting the flame sensing lead from the flame rod on the burner assembly or by closing the main and pilot shut off cocks while the burner is in operation. If U.V. scanner is supplied, its response to flame loss may be checked by closing the main and pilot leak test cocks or by removing the scanner from its mounting pipe and covering the flame viewing and while the burner is in operation.

The controls must be kept clean and dry and, during the regular service, all the wiring must be visually inspected and electrically tested for continuity and insulation.

Note: Under no circumstances should any liquid be used to clean the controls. Liquids must not come into contact with the controls while the tank is operating or at any time.

13.9 Draft Fan (See Fig. 16 Pg 37)

These units are direct driven (by TEFC motors) so little maintenance is required. At the regular service the wiring must be tested and the motor bearings checked for noise and wear.

13.10 Flue Piping

Periodically check that the flue pipework is sound and in good condition.

14. LIST OF RECOMMENDED SPARE PARTS

1. Flame Rod and Porcelain (if supplied)
2. UV Scanner (if supplied)
3. Ignition Electrode and Porcelain
4. Programming Control
5. Air Pressure Switch
6. 3-Way Air Valve (If Supplied)
7. U.V. Flame Scanner (If Supplied)
8. Ignition Transformer
9. Exhaust Fan Wheel
10. Exhaust Fan Motor
11. Temperature Controller

CX BURNER START UP INFORMATION & TEST DATA

The following data form should be completed at the time of system start up. Please return to Power Flame in the enclosed self addressed postage paid envelope.

Power Flame Model No. _____ Invoice No. _____ Serial No. _____

Installation Name _____ Start Up Date _____

Start Up Contractors Name _____ Phone _____

Name of Technician Doing Start Up _____

Type of Gas: Nat. _____ Propane _____ Butane _____

Tank or Unit Identification _____

**Gas Pressure at Train Inlet
Burner in Off Position** _____ " W.C.

Gas Pressure at Train Inlet
Low Fire _____
High Fire _____

Gas Pressure at Firing Head
Low Fire _____
High Fire _____

Power Supply
Volts _____ Ph _____ Hz _____
Control Circuit Volts _____
I.D. Fan Motor amps at high fire _____

Flame Signal Readings
Low Fire _____
High Fire _____

**CO2 or O2 (Specify) at exhaust
damper**
Low Fire _____
High Fire _____

CO at Exhaust Damper
Low Fire _____
High Fire _____

Input Rate BTU/HR
Low Fire _____
High Fire _____

ID Fan Outlet Flue Gas Temperature
Low Fire _____
High Fire _____

**Flue Gas Temperature at Exhaust
Damper**
Low Fire _____
High Fire _____

Combustion Efficiency
Low Fire _____
High Fire _____

OPERATION CHECKLIST

	<u>YES</u>	<u>NO</u>
Checked for proper operation of	()	()
Flame Safeguard Control Ignition Failure	()	()
Flame Safeguard Control Main Flame Failure	()	()
Burner Air Flow Switch	()	()
Temperature Controls	()	()
Limit Controls	()	()
Other Interlock Devices	()	()
All Gas Valves Checked for Leaks	()	()
All Gas Lines Checked for Leaks	()	()
Gas Lines and Controls Properly Vented	()	()

POWER FLAME INCORPORATED LIMITED WARRANTY

Power Flame Incorporated, hereinafter called the Seller, of 2001 South 21st Street, Parsons, Kansas, hereby warrants its equipment manufactured by it and bearing its nameplate (hereinafter called Warranted Equipment) in the respects and exclusively for the benefit of those users, described herein. THIS LIMITED WARRANTY SHALL EXTEND SOLELY TO THOSE PERSONS WHO ARE OWNERS OF THE WARRANTED EQUIPMENT DURING THE WARRANTY PERIOD HEREINAFTER DEFINED AND WHO USE SUCH WARRANTED EQUIPMENT IN THE PROJECT AND FOR THE PURPOSE FOR WHICH SUCH WARRANTED EQUIPMENT WAS ACQUIRED FROM THE SELLER. The Seller warrants its equipment to be free from defects in the material and workmanship under normal use and service for fifteen (15) months from date of shipment. EXCLUDED FROM ANY COVERAGE UNDER THIS WARRANTY ARE DEFECTS IN WARRANTED EQUIPMENT FROM DAMAGE IN SHIPMENT, FAULTY INSTALLATION, MISUSE OR NEGLIGENCE. If any person becomes entitled to a claim under this Warranty, such person shall, as a condition precedent to securing warranty performance, return the Warranted Equipment to the Seller's plant, 2001 South 21st Street, Parsons, Kansas, transportation prepaid. If the Warranted Equipment thus returned is found by the Seller to be defective for a cause and within a time covered by this Warranty, such equipment shall be repaired or replaced without charge; and returned to its owner or job site at the Seller's cost for transportation and handling. If inspection of the Warranted Equipment discloses defects not covered by this Warranty, the Seller shall notify the owner. Said equipment, at the owner's option (to be determined thirty (30) days from the date of notification), may be repaired or replaced at the expense of the owner and Seller's regular charges shall apply. Owner shall assume the cost of transportation and handling. Equipment which is repaired or replaced shall carry a warranty equal to the unexpired portion of the original warranty. The Seller will commence inspection of any Warranted Equipment returned to it for warranty claim within seven (7) working days after the arrival of such Warranty Equipment at Seller's plant, and shall complete any repairs required under this Warranty within sixty (60) days after such arrival, unless Seller shall sooner notify said owner of reasonable cause for delay beyond control of Seller. Warranty obligations hereunder will be performed only between the hours of 9:00 a.m. and 4:00 p.m. Monday through Friday and excluding holidays. Any person believing himself entitled to warranty performance hereunder is required to notify the Warranty Claims Department of Power Flame Incorporated, 2001 S. 21st Street, Parson, Kansas, prior to return of any Warranted Equipment for repair hereunder. IN ALL EVENTS, SELLER WILL NOT BE LIABLE FOR AND WILL NOT REIMBURSE ANY LABOR, MATERIAL, OR OTHER REPAIR CHARGES INCURRED BY ANYONE OTHER THAN SELLER ON ANY WARRANTY EQUIPMENT, UNLESS SUCH CHARGES HAVE BEEN SPECIFICALLY AUTHORIZED IN ADVANCE IN WRITING BY SELLER. ANY WARRANTY IMPLIED BY LAW WITH RESPECT TO THE MERCHANTABILITY OR FITNESS OF THE WARRANTED EQUIPMENT IS HEREBY LIMITED TO THE DURATION OF THE WARRANTY PERIOD HEREUNDER. THE SELLER WILL NOT IN ANY EVENT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES ATTRIBUTABLE TO THE WARRANTED EQUIPMENT.

080888

