2370 SERIES TYPE "FL"™ LOW NO_X RECUPERATIVE RADIANT TUBE BURNER

CAPABILITIES

- Very high efficiency – as much as 75% (LHV)
- Quiet stable operation
- Uniform tube temperature
- Counter flow recuperator for high efficiency
- Internal combustion air vitiation for low NOx operation
- Suitable for 6"(150 mm) through 8" (200 mm) and larger I.D. 'U' tubes or 'W' tubes and can be mounted on either leg of the tube

FEATURES

- Rugged construction
- Internally insulated cast iron body
- Cast stainless steel recuperator and end cap

CONTROL

- Force air or push/pull design
- Typical turndown 5:1 with 10% excess air
- Pulse firing optional
- Fuel/Air ratio control is modulated based suction pressure (gas only)
- #2 Oil required on/off operation

FLAME MONITORING

- U.V. Detector
- Flame Rod with Pilot

APPLICATIONS

- Annealing Furnaces
- Galvanizing Furnaces
- Silicon Lines
- Wherever contact of the products of combustion with the material being heated is detrimental and where flame impingement is not allowed

BURNER IGNITION

- Air Assisted Direct Spark Igniter (gas only) 20,000 Btuh (5.86 kW)
- Spark Ignited Pilot

FUEL CAPABILITIES

- Natural Gas
- Coke Gas
- Butane (special nozzle)
- Propane
- #2 Fuel Oil

OPTIONS

- Internally insulated Meehanite burner body for air preheat over 1100°F (590°C)
- Fabricated sst exhaust tee for temperatures to 1800°F (980°C)
- Air staged nozzle for lower NOx requirements
- Custom designs with lab development capabilities

CAUTION: The improper use of combustion equipment can result in a condition hazardous to people and property. Users are urged to comply with National Safety Standards and/or Insurance Underwriters recommendations

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TYPICAL OPERATION

The new Bloom Type "FL" low NOx recuperative radiant tube burner (RRTB)[1] operates at much higher efficiencies than conventional RRTB. In addition, NOx levels produced are substantially lower. A conventional burner has NOx in the range of 0.25 to 0.35 #/MM Btu. The Bloom Type "FL" has NOx values as low as 0.06 #/MM Btu. These values are with 2% O_2 in the exhaust and firing natural gas with an average tube temperature of 1900°F (1038°C).

The Type "FL" burner is Bloom's standard RRTB head with an extended counter flow recuperator which includes a hot end jet pump to provide self recirculation of products of combustion (POC).

Ambient combustion air enters the burner at Point "A" and travels through multiple fins within the recuperator. As high pressure preheated combustion air exits the fins at Point "B", the air then discharges through the flow nozzle at Point "C", creating a negative pressure to induce POC across the multiple orifices at Point "F". The POC enters the recuperator at Point "D" and exits the exhaust tee at Point "E".

The burner is designed to operate with 2% O_2 in the POC exhaust stream. The combustion air is preheated in excess of 1000°F (538°C) at Point "B" and mixes with POC at 1900°F (1038°C) to 2000°F (1093°C) in proportions to obtain a vitiated stream with an oxygen content of 17% to 18% O_2. The vitiated stream then flows through the return duct within the recuperator and then to the burner where it passes around Bloom's flame retential nozzle. Fuel staging or air staging nozzles may be considered for further enhanced performance.

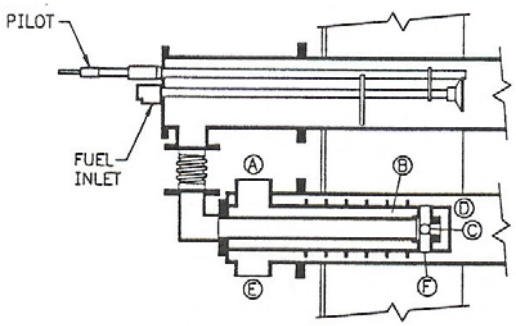

Figure 1

Figure 1 illustrates the arrangement requiring the radiant tube to operate with a positive pressure. If positive internal tube pressure is not acceptable, a push-pull system can be used. The burner system using a Type "FL" low NOx RRTB may be a push-pull or push only system.

Figure 2 illustrates the required control for a push-pull system. Air and gas flows are controlled either by using measurements from orifices or similar devices, or by adjusting the gas header pressure.

The burner is suitable for firing #2 Oil and operates with substantially lower excess air than is required with conventional burners on #2 Oil.

Pulse firing control is also possible.

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[1]Patent NO. 5,775,317

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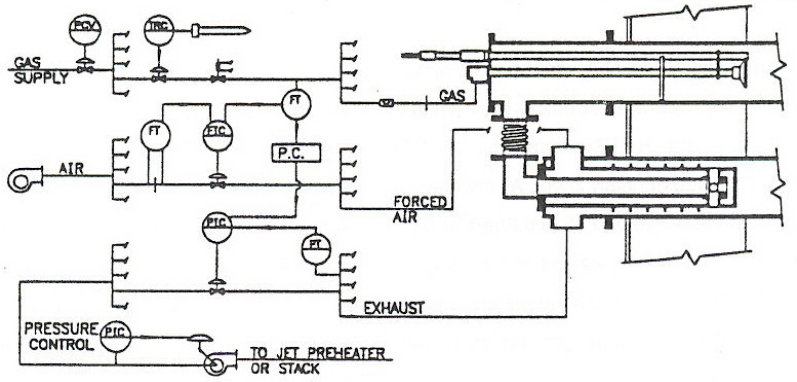
TYPICAL OPERATION (cont'd)

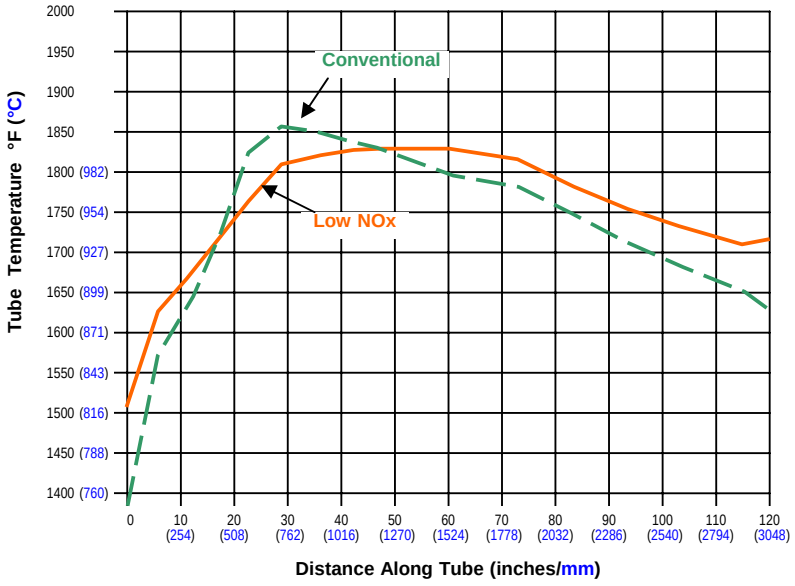
Figure 2



The air and fuel flow control logic must be a function of the suction pressure. This is to insure that the suction at Point "E" is not more negative than the suction within POC orifices at Point "F" created by the jet nozzle at Point "C". This guarantees that the air flow passes to the burner and does not short circuit into the exhaust causing unstable combustion and flames into the exhaust.

The Bloom Type "FL" RRTB produces a substantially more uniform tube temperature profile than the conventional RRTB as shown in Figure 3. This allows operation at higher inputs while maintain good tube life and producing NOx emission levels equal to or lower than a conventional burner, thereby allowing increased productivity without increased NOx emissions.

Figure 3



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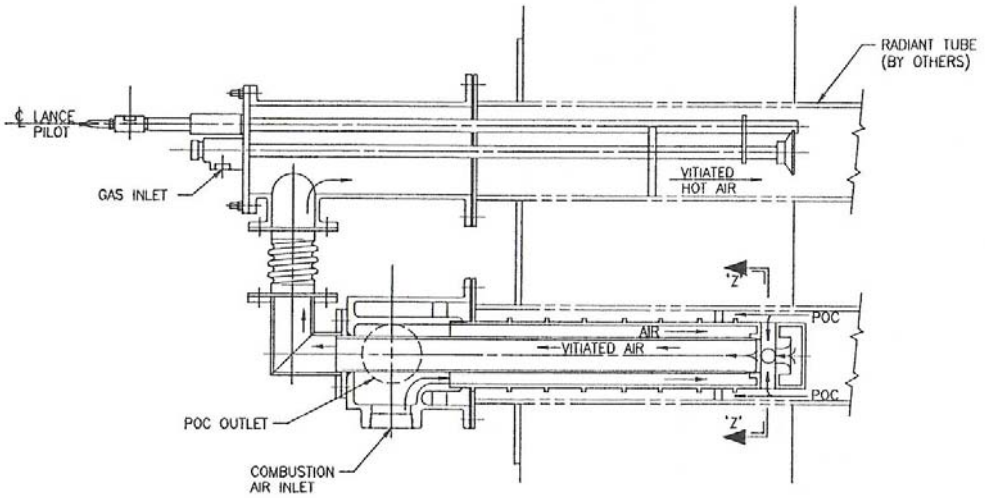
TYPICAL CONFIGURATION



Information Required for Final Design:

A) Tube and Furnace Configuration:
1. Drawing of tube and furnace wall is best.
2. Distance from the tube flanges to the furnace hot face. This is needed to determine how long the recuperator can be; i.e., does the recuperator extend into the furnace, or does something have to be done to the distance from the tube flange to the furnace hot face?
3. Tube I.D. and O.D. through its entire length
4. Enough dimensions to determine the tube length along the tube centerline. Need both the entire tube length and the portion that is inside the furnace.
5. Materials of construction or temperature use limit of the tube.
6. How is the tube supported? Particularly its attachment to the furnace shell or bung.

B) Furnace Operating Temperatures
1. Normal
2. Maximum
3. Minimum

The reason for the maximum temperature is to determine the required input or set the recuperator design.

C) Gross input per tube required. Net input to furnace or zone.

D) The fuel being used. Heating value and fuel analysis plus moisture content at point of use if it is not normal natural gas. (Fuel bound nitrogen?)

E) Any restrictions or special requirements such as:
1. Total pressure drop (not to exceed)
2. NOx
3. Direct spark ignition
4. CO

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