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GAS PRESSURE REGULATED ATOMIZER TIP FOR GAS/OIL BURNER

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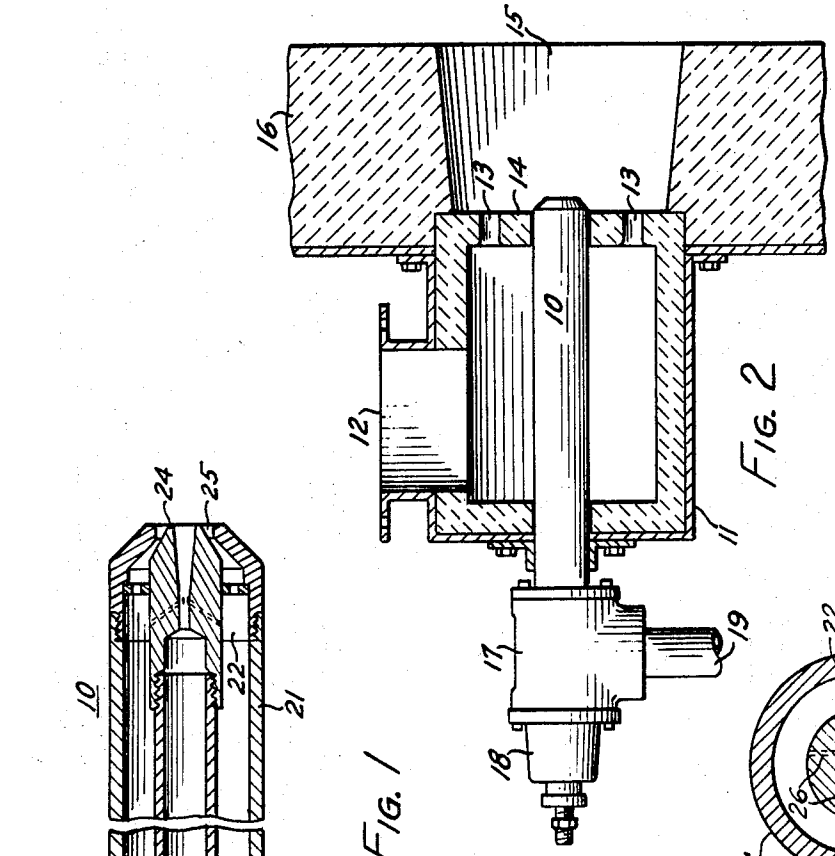


FIG. 2

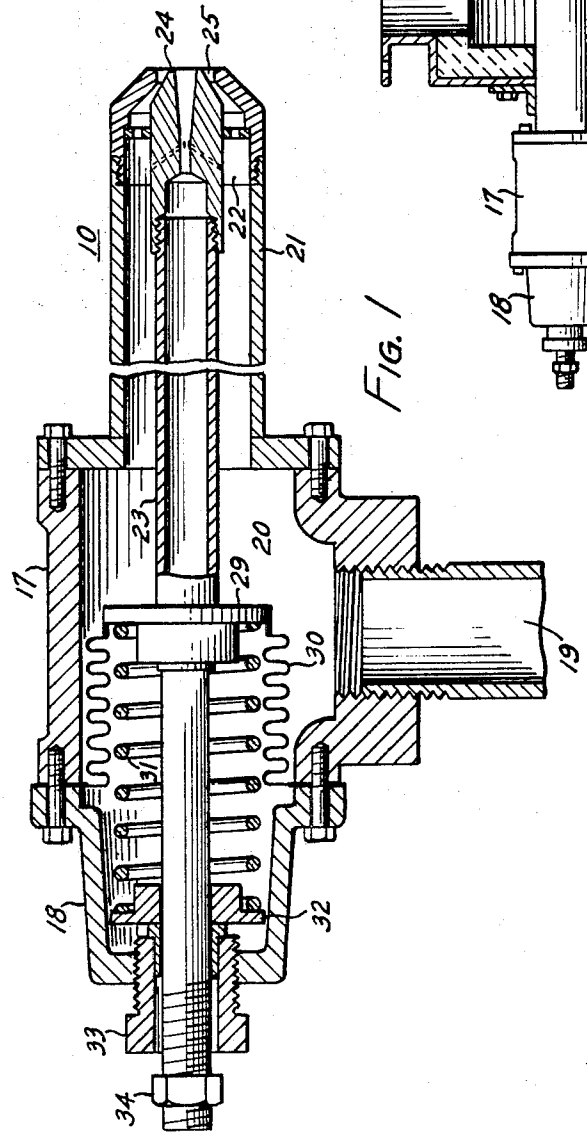


FIG. 1

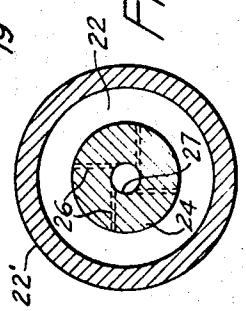


FIG. 4

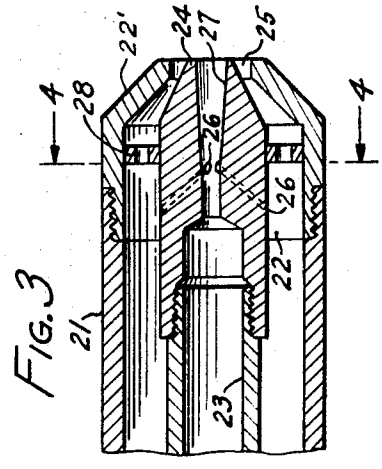


FIG. 3

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GAS PRESSURE REGULATED ATOMIZER TIP FOR GAS/OIL BURNER

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U.S. Cl. 239—407 3 Claims

ABSTRACT OF THE DISCLOSURE

A burner suitable for firing a gaseous fuel or a combination of a gaseous and a liquid fuel with the gas being used to atomize the liquid fuel. Primary gas is introduced tangentially into the oil stream in the throat of a venturi nozzle designed to expand the mixture. Secondary gas discharges through an outer annulus and impinges on the gas-oil mixture discharging from the venturi nozzle. The size of the annulus for admitting the secondary gas is rendered adjustable by automatically moving the oil atomizing nozzle in and out of said annulus, so as to maintain constant gas pressure in the primary gas tube at all gas inlet rates. The velocity of the mixture discharging from the nozzle will then be constant at all gas flow rates. The burner has given excellent results in atomizing fuel oil with gas flows as low as 17% of the total B.t.u. fired at a high firing rate (30 g.p.h. oil equivalent total fuel in the case of the burner tested), and also with 50% gas at a low firing rate (10 g.p.h. equivalent total fuel).

BACKGROUND OF THE INVENTION

The field of art to which this invention pertains is that of a high-temperature combination gas/oil burner with good atomization of the liquid fuel by the gas over a broad range of firing rates and gas/oil ratios.

SUMMARY OF THE INVENTION

When a liquid fuel such as No. 6 fuel oil is fired in a furnace, the oil, prior to combustion, must be atomized into fine droplets by some effective atomizing medium. In industrial furnaces, steam and air are widely used for atomization of liquid fuels. However, steam and compressed air are costly and make no significant thermal contribution to the flame. Furthermore, steam or air will tend to create undesired scale on heated ferrous metals, and also to have a decarburizing effect thereon. In contrast, gaseous fuel, e.g., natural gas, with its high calorific value, is an ideal medium for atomizing liquid fuel, provided that the gas pressure can be kept sufficiently high and constant for efficient atomization over a wide range of burner firing rates.

The present burner uses natural gas to atomize No. 6 fuel oil, but will give good performance with any gaseous fuel as an atomizing agent and virtually any atomized liquid fuel, including preheated tar or pitch. This combination gas/oil burner has proven capable of firing, on a B.t.u. basis, either 100% gas or up to 83% oil with a minimum of 17% gas required for atomization of the oil. The range of firing rates for the burner tested was 5 to 30 g.p.h. oil (720 to 4300 s.c.f.h. natural gas); however, this burner design is adaptable to burners of any industrial capacity.

It is an object of the present invention to provide an improved liquid/gaseous fuel burner which automatically maintains constant gas pressure required for good atomization of the liquid fuel.

Another object of the invention is to provide a burner which can fire gas over a wide range of rates above the minimum required for atomization of the liquid fuel.

Particular features of the present burner are:

(1) Introduction of primary gas tangentially into the oil stream at the throat of the oil nozzle.

(2) Venturi nozzle for expanding the gas-oil mixture.

(3) Adjustable annulus for supplying secondary gas and maintaining constant the primary gas pressure.

(4) Guide means to keep the oil atomizing nozzle centered in the gas nozzle.

(5) Impingement of high velocity secondary gas stream on primary gas-oil mixture.

DESCRIPTION OF THE DRAWINGS

In the annexed drawings:

FIG. 1 is a longitudinal vertical section of the subject burner;

FIG. 2 is a similar sectional view of said burner as installed in a refractory-lined casing within a large industrial furnace;

FIG. 3 is an enlarged sectional view of the forward end of the burner shown in FIG. 1;

FIG. 4 is a sectional view on the line 4—4 of FIG. 3.

DESCRIPTION OF THE INVENTION

Referring to the drawings, the body of the burner **10** of this invention is preferably enclosed within a protective refractory-lined metal outer shell **11** which is provided with a large upper air inlet **12** and a plurality of smaller air outlet holes **13** in a forward air distributing member **14** for supplying combustion air to the burner **10**. Said burner **10** projects forwardly through the port **15** in the refractories **16** of the furnace (not shown) to which it supplies heat.

Said burner **10** comprises a large tubular outer casing **17** which is provided with a substantially bell-shaped rear closure portion **18**, a bottom inlet portion **19** for receiving gaseous fuel under suitably high pressure (typically about 40 p.s.i.), a communicating inner chamber compartment **20** and a gaseous fuel tube **21** having an inwardly flanged orifice **22** in the cap fitting **22'** at its forward end.

Forwardly projecting in gas-tight relation through said rear closure portion **18**, inner chamber **20**, and gaseous fuel tube **21** is a reciprocably movable liquid fuel pipe **23**, upon the forward end of which is threaded or otherwise attached a venturi type nozzle **24**. The conical outer surface of the forward end of said nozzle **24** defines a tapering annular secondary or supplemental gaseous fuel outlet **25** with the gaseous fuel tube orifice **22**. A plurality of spaced ports **26** extend inwardly and tangentially through the side walls **27** of the forward end of said nozzle **24** and are in communication with said gaseous fuel tube **21** to supply primary gaseous fuel. Said nozzle **24** is kept properly centered within the gaseous fuel tube **21** by means of a centering device such as a spider or a radially perforated round plate **28**.

The rear end of the liquid fuel pipe **23** is attached to a piston **29** and extends rearwardly within a corrugated flexible metal bellows portion **30** and a compression spring **31** bearing against a spring seat **32**. A pressure adjusting screw **33** and spring release nut **34** are also provided. In operation, the spring loaded bellows **30** responds automatically to small changes in gas pressure in the chamber **20** and thereby enlarges or decreases the open area of the gas annulus **25** correspondingly, so as to maintain nearly constant the primary or atomizing gas pressure over the range of incoming gas flow rates, which tend to fluctuate with the furnace demand for heat. The spring expansion with decreases in gas pressure serves to close the annulus **25** to mantain constant the primary gas pressure, so that there is always a sufficient supply of gas for proper atomization of the oil.

In the specific embodiment of the invention as described, the venturi portion of the liquid fuel nozzle **24** is about ⅞" in outer diameter and 1¼" long, and its inner diam-

eter flares from ⅛" at its throat to ¼" at the mouth. Each of the tangential ports **26** in said nozzle **24** is .03" in diameter, and preferably consists of four equally spaced holes drilled at a forward inclination of 45° from horizontal. The outer face of the end portion of said nozzle **24** is tapered at an angle of 30° from horizontal. The gaseous fuel tube **21** has an interior diameter of 1⅝", and the diameter of its end orifice is ¾", with .002 clearance from the nozzle **24**. The outside diameter of the liquid fuel pipe **23** (which is concentric within said pipe **21**) may be ¾". Oil pressure is maintained at about 20 to 35 p.s.i.g., and the primary gas pressure is kept at approximately 40 p.s.i.g. as stated. Gas in excess of 720 s.c.f.h. serves as secondary gas.

We claim:

1. In combination with a liquid/gaseous fuel burner having a gaseous fuel tube with an orifice at its forward end, means to supply a gaseous fuel to said gaseous fuel tube, a reciprocably movable liquid fuel pipe extending within said gaseous fuel tube, and means to supply a liquid fuel to said liquid fuel tube, the improvement comprising:

(a) a nozzle at the forward end of said liquid fuel pipe having

(1) a longitudinally extending venturi orifice,

(2) a forward end defining an annular gaseous fuel outlet with said gaseous fuel tube orifice,

(3) a plurality of ports spaced from the forward end of said nozzle and extending inwardly from said gaseous fuel tube and in communication tangentially with said venturi orifice, and

(b) means for varying the size of said annular gaseous fuel outlet so as to maintain the pressure in the gaseous fuel tube substantially constant despite variations in the incoming gaseous fuel flow rate.

2. A burner as defined in claim **1**, wherein the means of subparagraph (b) includes means responsive to small variations in pressure in the gaseous fuel supply to the burner and connected to the liquid fuel pipe for varying the longitudinal position of said liquid fuel pipe within said gaseous fuel tube so as to vary the size of the annular gaseous fuel outlet.

3. A burner as defined in claim **2**, wherein the pressure-responsive means comprises a spring-loaded bellows arrangement which functions to constrict or enlarge the annular gaseous fuel outlet.

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U.C. Cl. X.R.

239—399, 417, 424.5, 430, 433