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LIQUID-FUEL BURNER FOR FURNACES OR THE LIKE

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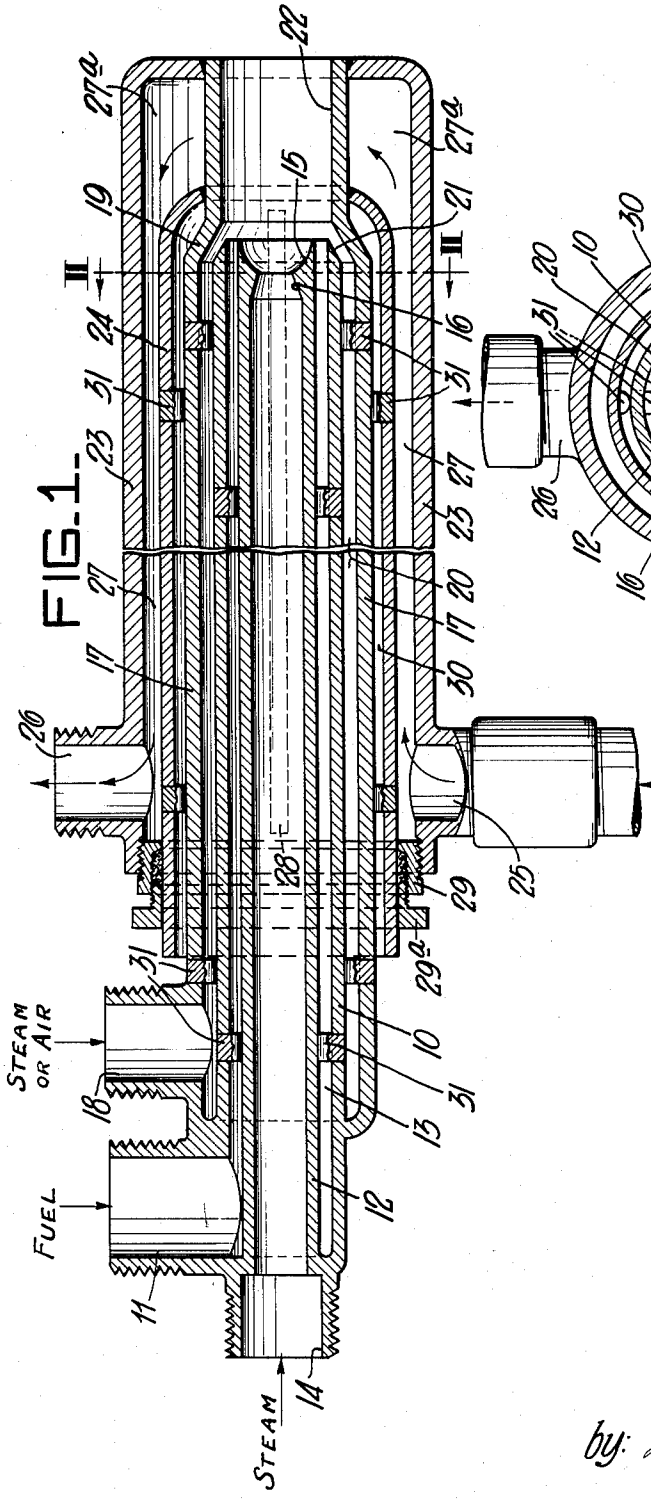

FIG. 1.

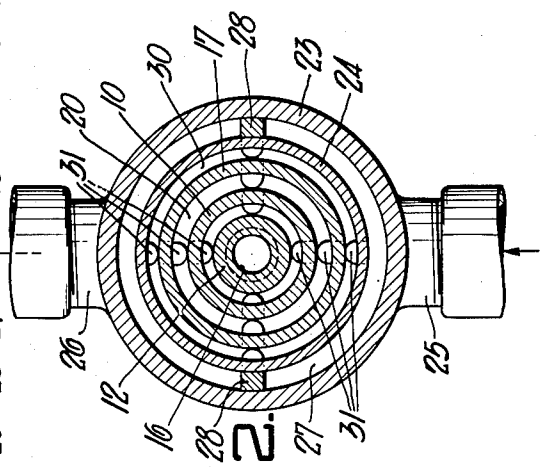

FIG. 2.

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LIQUID-FUEL BURNER FOR FURNACES OR THE LIKE

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1 Claim. (Cl. 299—140)

This invention relates to fuel burners and, in particular, to a burner for firing furnaces using liquid fuel such as oil or tar.

The object of my invention is to provide an improved burner which produces an unusually thorough mixture of the fuel with steam for atomization and vaporization and also with air supplied for combustion. As a result the burner achieves a greater fuel economy than has been obtainable with burners known previously.

A further object is to provide a burner having means for preventing the accumulation of carbon deposits adjacent the discharge end.

In a preferred embodiment of my improved burner, a central tube connected to a source of steam discharges a jet thereof outwardly into a hollow or annular stream of fuel flowing from a tube coaxial with and surrounding the central tube. Additional steam or air is directed inwardly toward the fuel stream from a third tube coaxial with and surrounding the first two. The discharge end of the first or inner steam tube is shaped to produce a jet flaring all directions while that of the third or outer steam tube is shaped to produce a converging jet. A nozzle projects beyond the point at which the fuel mixes with the steam and air and is provided with a jacket thereon for cooling liquid. The jacket extends rearwardly of the burner from the nozzle but is insulated from the third or outer tube of the burner proper.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating the present preferred embodiment. In the drawings:

Figure 1 is a longitudinal section through my improved burner; and

Figure 2 is a cross section taken on the plane of line II—II of Figure 1.

Referring now in detail to the drawings, my improved burner comprises a fuel tube **10** having a radial inlet **11** at the rear end adapted to be connected to a source of suitable fuel such as oil or tar. A steam tube **12** extends centrally through tube **10** and defines with the latter an annular space **13** through which fuel flows from inlet **11** to the discharge end of the tubes. The result of this arrangement is that the fuel is discharged from tube **10** in the form of a hollow cylindrical jet. Tube **12** has an axial inlet **14** adapted to be connected to a source of steam under pressure. Tubes **10** and **12** are substantially coterminous at their forward ends. Tube **12** has a hemispherical flaring mouth **15** at the end and a frusto-conical restriction **16** inwardly thereof and alined therewith. The effect thereof is to cause a flaring jet of steam to be discharged from tube **12**. The flaring steam jet, of course, impinges immediately on the interior of the hollow cylindrical fuel jet.

An outer tube **17** for steam or air surrounds tube **10** and has a radial inlet **18** adapted to be connected to a source of the gas used, under pressure. The tube **17** terminates adjacent the ends of tubes **10** and **12** in a

frusto-conical converging portion **19**. This has the effect of directing the gases flowing through space **20** between tubes **10** and **17** inwardly toward the exterior of the hollow jet of fuel issuing from tube **10**. The extreme end of the latter is beveled at **21** to aid the convergence of the gases. The steam traversing tubes **12** and **17** heats the fuel traversing tube **10** and may partially vaporize it. The flaring and converging jets discharged into the fuel stream by tubes **12** and **17**, furthermore, effect a thorough atomization of the fuel and the intimate mixture therewith of combustion-supporting gases. This produces high combustion efficiency with resulting economy of fuel. The connections to inlets **11**, **14** and **18**, of course, include suitable control valves (not shown).

A burner composed of the elements described so far exhibits a tendency to deposit carbon adjacent the discharge ends of the tubes **10**, **12** and **17** which eventually will plug them. I have found that this can be avoided by mounting a tubular shield or nozzle at the forward end of the burner and providing means for cooling it below the temperature at which carbon deposits readily. To this end, a nozzle **22** is formed on the discharge end of tube **17** and projects forward therefrom a short distance. A cooling jacket for the nozzle is formed by a shell **23** extending rearwardly from the front end thereof and a sleeve **24** extending rearwardly from the rear end of the nozzle, the shell and sleeve being welded to the nozzle. The shell has an inlet **25** on one side and an outlet **26** on the opposite side thereof whereby cooling water may be circulated through the space **27** between the shell and sleeve.

Elongated baffles **28** inserted between the shell and sleeve in the axial plane normal to that containing the axes of the inlet and oulet, cause the water to traverse the space **27***a* immediately surrounding the nozzle. The space between the sleeve and shell is closed at the rear ends thereof by a stuffing box **29** secured in the shell and a gland **29***a*. Sleeve **24** surrounds tube **17** leaving an annular air space **30** therebetween which insulates the body of the burner from the cooling jacket and prevents the latter from abstracting heat from the former. Spacer or centering studs **31** extend inwardly from sleeve **24** and tubes **17** and **10** for engagement with the exterior of the next tube inwardly. The studs are spaced along the sleeve and tubes and circumferentially thereof.

It will be evident that, when the inlets **11**, **14** and **18** are connected to sources of steam, fuel and steam or air, respectively, under suitable pressures, an intimate mixture thereof will be formed in nozzle **22** adjacent the discharge ends of tubes **10**, **12** and **17**. Upon ignition of the mixture, the burner fires a luminous flame which is intensely hot and highly efficient. Such a flame is particularly desirable in the operation of open-hearth steel furnaces. In that application, oxygen or oxygen-enriched air may advantageously be supplied to inlet **18** during the melt-down period, after which steam is used instead. This practice accelerates the melting-down stage of the process.

The heating of the fuel as it flows through tube **10** by the steam flowing in tube **12** and also tube **17**, if steam be supplied thereto, renders it easily atomizable by the impingence on the hollow fuel jet of the internal flaring and external converging jets of steam or steam and air, respectively. The prevention of carbon deposits by cooling the nozzle through which the combustible mixture flows to the combustion space assures trouble-free operation over long periods of time without the necessity of shut-downs to permit cleaning of fouled burners. The construction of the burner is simple and it may therefore be manufactured at low cost. No special precautions are necessary in the use thereof since there is nothing to

get out of order and no maintenance problem should arise.

Although I have disclosed herein the preferred embodiment of my invention, I intend to cover as well any change or modification therein which may be made without departing from the spirit and scope of the invention.

I claim:

A burner comprising a central tube having one end adapted to be connected to a source of gas, said tube having a substantially hemispherical concave mouth at the other end thereof and a frusto-conical restriction inwardly of said mouth and converging toward the latter, a second tube surrounding said central tube, coaxial therewith, spaced radially therefrom, having one end adapted to be connected to a source of fuel and having the other end substantially coterminous with said other end of said central tube, said other end of said second tube being beveled externally, and a third tube surrounding said second tube, coaxial therewith, spaced radially

therefrom, having one end adapted to be connected to a source of gas and having a frusto-conical constricting portion at the other end adjacent the beveled end of said second tube, said third tube having a cylindrical nozzle projecting forwardly from the minimum diameter of said frusto-conical constricting portion, whereby said second tube discharges a tubular cylindrical fuel jet and said central and said third tubes discharge diverging and converging gas jets, respectively, intermingling with said fuel jet in said nozzle.

References Cited in the file of this patent

UNITED STATES PATENTS

422,222	Jennings	Feb. 25, 1890
872,288	Koons	Nov. 26, 1907
966,704	Pickles	Aug. 9, 1910
1,481,419	Davies	Jan. 22, 1924
1,783,818	Werner	Dec. 2, 1930
2,419,336	Cress	Apr. 22, 1947