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Moench

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[54] **FUEL VAPORIZER BURNER ASSEMBLY AND METHOD**

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[52] **U.S. Cl.** **431/11,** 431/215, 431/243, 431/247, 431/242, 431/244

[51] **Int. Cl.** **F23d 11/44**

[58] **Field of Search** 431/11, 215, 232, 242, 431/243, 244, 247

[56] **References Cited**

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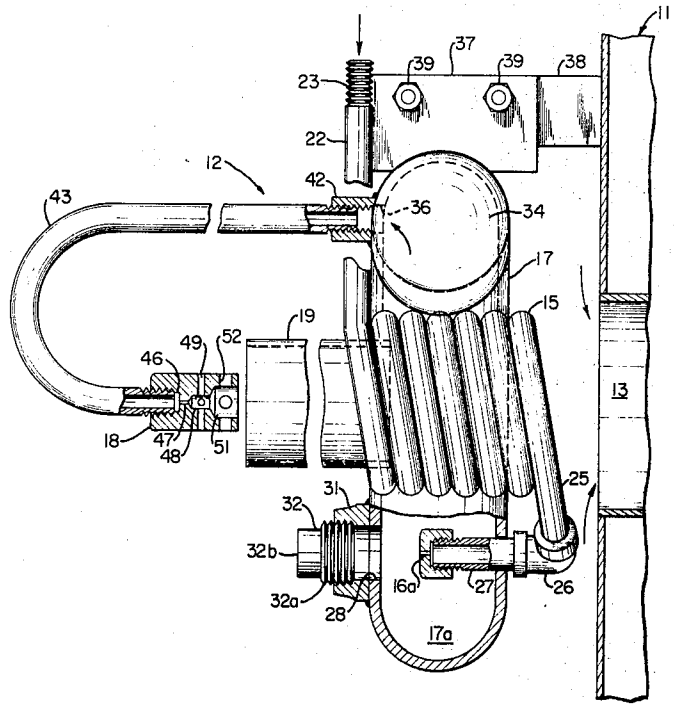
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[57] **ABSTRACT**

A fuel burner assembly and fuel burning method for surface heating apparatus and the like wherein a feed coil preheats a liquid fuel and has a spray nozzle at the outlet to discharge the heated fuel in a fine spray, an upright, arcuate, expansion chamber is arranged to expand and vaporize the fuel spray as it is directed upwardly in a generally arcuate course of travel, a multi-stage burner nozzle located below and coupled to the outlet of the expansion chamber inspires additional air into the fuel passing from the expansion tube and the flame is directed from the outlet of the burner nozzle through a blast tube and the feed coil to confine the flame. Additional air for increased burning efficiency is introduced ahead of the blast tube and prior to the discharge into a surface heating lined combustion device being heated by the flame produced.

11 Claims, 3 Drawing Figures



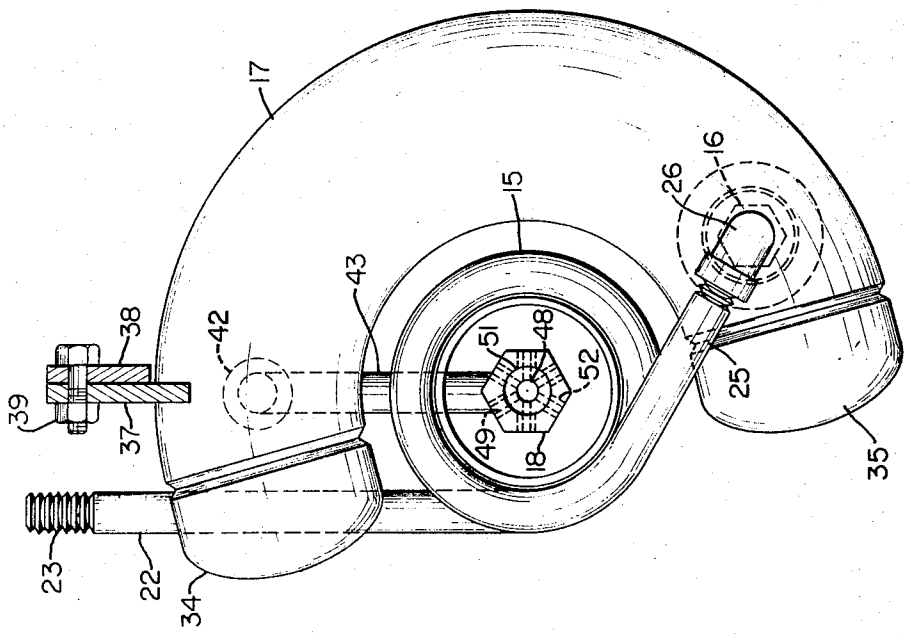


FIG. 2

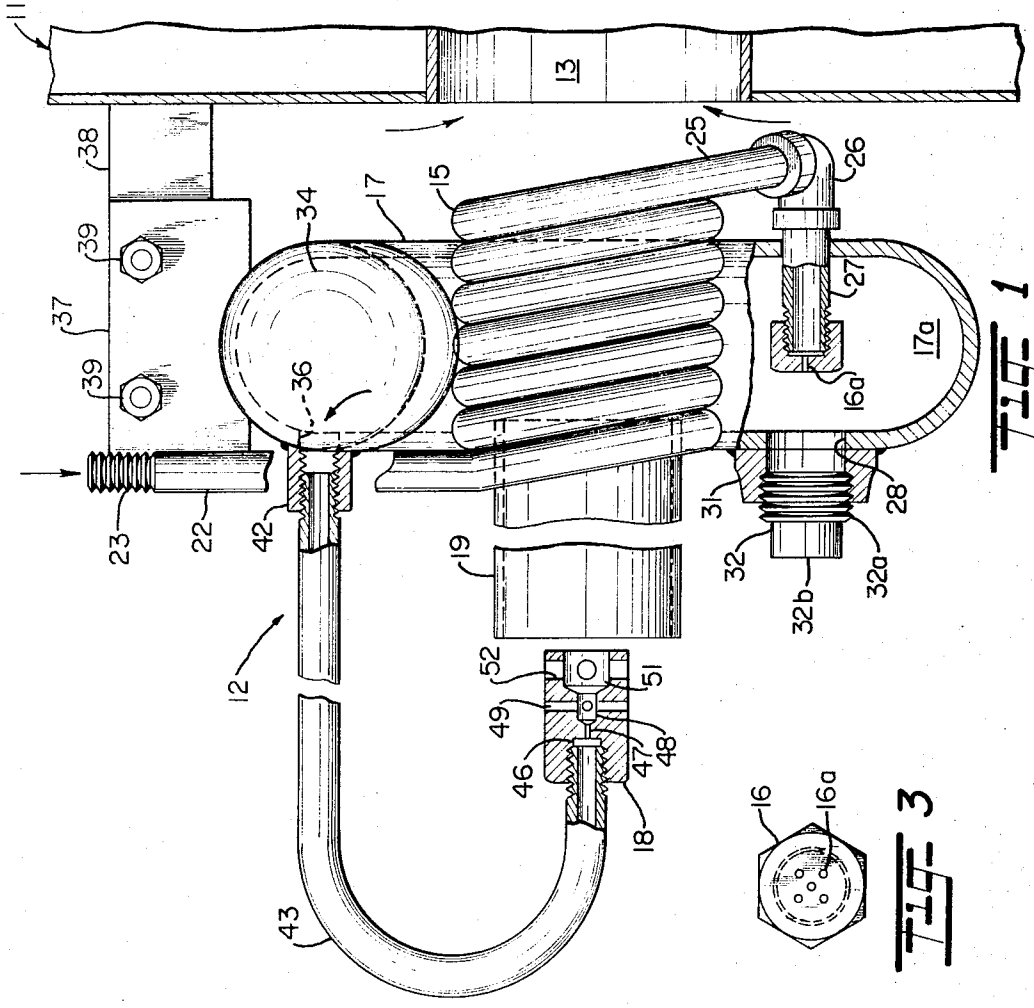


FIG. 1

FIG. 3

FUEL VAPORIZER BURNER ASSEMBLY AND METHOD

This invention relates to improvements in liquid fuel burners and fuel burning methods in which the fuel is heated, expanded and vaporized and inspired with additional air before burning in such a way as to achieve increased efficiency and increased heat output.

In the burning of low pressure liquid fuels such as propane, there is a tendency for known burners to produce a surging or pulsing and this results in a non-uniform, non-continuous flame which greatly affects the quality of the heating and burning efficiency. Moreover, it has been found that the heat output and efficiency of burning of such fuels is greatly affected by the manner in which the fuel is heated, expanded and vaporized and air is added prior to burning.

A burner of the type described herein is particularly suitable for use in multiples on surface heating lined combustion devices for heating asphalt pavement and the like which may be of the type described in U.S. Pat. Nos. 3,233,605 and 3,279,458. Moreover, the present invention is believed to have significant features of improvement over the fuel burner assembly described in U.S. Pat. No. 3,289,728 which is a predecessor of the present invention.

Accordingly, it is an object of this invention to provide a durable, efficient and relatively compact fuel burner assembly.

Another object of this invention is to provide an improved fuel burner assembly for low pressure liquid fuels such as propane which substantially eliminates surging and non-uniformity of flame propagation.

Still a further object of this invention is to provide an improved fuel burner assembly which more effectively utilizes heat from the lined combustion device being heated to vaporize the fuel for the burner and is highly effective in preheating, expanding and vaporizing the fuel by using the flame being produced by the burner.

Yet another object of this invention is to provide an improved fuel burner assembly characterized by having a generally arcuate expansion tube forming a chamber disposed in an upright manner in a coaxial alignment with and axially spaced downstream from the burner nozzle into which preheated fuel is sprayed in a fine stream, the chamber directing the fuel upwardly in a generally arcuate course of travel prior to delivery to the burner nozzle below the outlet of the expansion tube whereby fuel is expanded and vaporized in a highly efficient manner to provide a substantially continuous, non-surging flame.

In accordance with the present invention in a preferred form shown, there is provided an improved fuel burner assembly wherein a generally arcuate expansion tube forms a chamber disposed in coaxial alignment with and axially spaced from a fuel feed coil preheated fuel and directs the fuel upwardly in an arcuate course of travel to a point above the burner nozzle prior to delivery to the burner nozzle. A blast tube and the fuel feed coil are in coaxial alignment with and are located downstream of the outlet of the burner nozzle to confine the flame and direct it toward a lined combustion device for heating asphalt pavement or the like.

Other objects, advantages and capabilities of the present invention will become more apparent as the description proceeds taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a side elevation view of feed burner assembly shown in relation to a forward portion of a lined combustion device embodying features of the present invention with portions broken away and shown in cross-section to show interior construction;

FIG. 2 is a front elevation view of the fuel burner assembly shown in FIG. 1 with the lined combustion device omitted for clarity; and

FIG. 3 is a front elevation view of the spray nozzle.

Referring now to the drawings in FIG. 1 there is shown a forward end portion of a surface heating lined combustion device **11** on which there is mounted a burner assembly **12** embodying features of the present invention. The lined combustion device **11** is particularly suitable for heating asphalt or "blacktop" surfaces and generally may be of the type as described in more detail in the above referred to U.S. Pat. Nos. 3,233,605 and 3,279,458. Typically, a plurality of individual burner assemblies **12** are mounted at the front end with the flame directed rearwardly through an opening **13** in the forward wall thereof for each burner. In the direction of travel during operation, the burner assembly moves to the left as shown in FIG. **1.**

Briefly stated, the fuel burner assembly **12** shown comprises a fuel feed coil **15** terminating at its outlet end in a spray nozzle **16,** a fuel heating and expansion tube **17** enclosing the spray nozzle, a burner nozzle **18** arranged to receive the fuel from the expansion tube **17** with the nozzle directing the flame through a blast tube **19** extending into the end of the fuel feed coil **15** so that the flame is confined by the blast tube **19** and fuel feed coil **15.**

The fuel feed coil **15** has a vertically disposed inlet conduit or line portion **22** with external threads **23** for coupling to a source of low pressure liquid fuel and an outlet conduit or line portion **25** on which there is mounted an elbow **26.** A nipple or threaded tubing **27** has one end fitted in the outlet end of the elbow **26** with the nipple extending through a sidewall of the expansion tube at the lower end thereof with the outlet end of the nipple terminating approximately midway between the spaced sidewalls of the expansion tube. The spray nozzle **16** is in the form of a metal fitting with a head and internal threads which thread on the distal or free end of the nipple inside the expansion tube to spray against a side wall of the expansion tube. The spray nozzle **16** is commonly known as a "rosebud" and in the form shown has five spaced, axially extending orifices **16*a*** through which the fuel passes. To provide for the removal and replacement of the spray nozzle, an access opening **28** is formed in the forward sidewall of the expansion tube which is generally coaxially aligned with the nipple **27** and spray nozzle **16.** An annular flange **31** with internal threads is secured to the expansion tube as by welding and surrounds the access opening **28.** The annular flange **31** is made by cutting a standard pipe coupling in a transverse direction in two halves. A plug **32,** preferably a one inch American standard pipe plug made of brass or bronze to prevent locking, has an externally threaded portion **32*a*** which threads into the flange **31** and has a hexagonal head portion **32*b*** to facilitate the removal and replacement thereof by threading it into flange **31** to close off the ex-

pansion chamber except through the inlet and outlet thereof.

The expansion tube **17** is preferably made from a length of metal pipe or conduit bent or shaped along its length into an arcuate shape and spans approximately a semicircle. In practice, the expansion tube is a conventional return elbow and has a pair of end caps **34** and **35** welded to the ends thereof to form an enclosed expansion chamber designated **17***a*. The arcuate expansion tube **17** extends upwardly around the feed coil **15** and as best seen in FIG. **2** and more specifically is arranged concentric with or is coaxially aligned with the center of the feed coil **15.** This arrangement disposes the coil adjacent to and along the side of the lined combustion device being heated by the flame so that the expansion chamber receives more heat from both the feed coil and the lined combustion device from that of the previously mentioned burner assembly patent. Moreover, the expansion tube **17** is disposed in an upright manner with the fuel inlet in communication with the feed coil at the lower end thereof and the fuel outlet at the upper end thereof so that the fuel is directed upwardly in an arcuate course of travel as it is heated and expanded and vaporized. This construction and arrangement of the expansion tube with orifices in the spray nozzle reduced in size has been found to be highly effective in reducing surging of the liquid fuel being delivered from a low pressure fuel source such as propane fuel.

The fuel outlet of the expansion tube is provided by means of an aperture **36** in one sidewall of the tube above the coil **15** at the upper end thereof located with its center on a vertical line through the center of the coil and the center of the arc of the expansion tube. A mounting bracket **37** is affixed to the top of the expansion tube as by welding to support it in a dependent manner at the front of the lined combustion device **11** from a horizontal bracket **38** on the device **11** using bolt fasteners **39** or the like.

A tube section **42** surrounds the outlet opening **36** and is affixed to the expansion tube as by welding. The tube section **42** has internal threads and receives the inlet end of a coupling tube **43.** The coupling tube **43** generally C-shaped which extends outwardly and downwardly and then toward the lined combustion device from the expansion tube to couple fuel from the outlet of the expansion tube into the burner nozzle **18,** the burner nozzle **18** being threaded on external threads at the lower end of the coupling tube **43.**

The burner nozzle **18** is of a multi-stage type and in general comprises a nozzle body with a hexagonal exterior shape and a central throughbore passing axially through the body from the fuel inlet to the fuel outlet. The central throughbore has axially extending sections of different internal sizes or diameters inclusive of an inlet chamber **46** leading into a restricted orifice **47** of minimum diameter which in turn leads into a first stage chamber **48** having a plurality of spaced radial openings **49,** which function to inspire air into the fuel stream passing through the nozzle body. The first stage chamber **48** opens into a second stage chamber **51** of larger diameter than chamber **48** and it also has spaced radial openings **52** to inspire additional air into the fuel stream. From the second stage chamber, the fuel passes through the nozzle outlet and projects a flame through the blast tube **19** axially spaced from the outlet end of the burner nozzle and partially telescoped in the forward end of the feed coil **15.**

OPERATION

In the fuel sequence of operation for the abovedescribed burner assembly, liquid fuel such as propane is delivered under a relatively low pressure into the coil **15** via inlet line portion **22.** For liquid propane stored in a tank this tank pressure is up to 250 psi and controlled to be on the order of 40 psi to 140 psi at the burner inlet. The heat from the flame heats and partially vaporizes the fuel prior to its being sprayed in a fine stream into the lower end of the expansion tube by spray nozzle **16.** In the expansion tube the fuel is heated and expands and vaporizes as it rises in an arcuate course of travel to a point above the nozzle and then passes through the outlet of the expansion tube and downwardly to the inlet of the burner nozzle **18.** In the burner nozzle additional air is inspired into the vaporized fuel stream via the radial openings **49** and **52.** The flame then projects through the blast tube and coil where it is confined or directed through opening **13.** Additional air for burning is drawn into the inlet end of the blast tube and also between the end of the coil and lined combustion device to further increase the heat output.

It has been found that improved efficiency and greater heat output is achieved by reducing the size of the orifices in the spray nozzle and burner nozzle by approximately one half from that of previous burners of the same type. By way of illustration and not by way of limitation the fuel burner assembly above described may have the following dimensions:

Spray nozzle **16** — ¾ inch hex. stock
Spray nozzle orifices **16***a* — No. **56** diameter drill
Burner nozzle **18** — 15/16 inch hex. stock
Burner nozzle orifice **47** (diameter) — 0.081 inch –0.086 inch
Burner nozzle first stage chamber **48** (diameter) — 0.25 inch
Burner nozzle first stage radial openings **49** (diameter) — ⅛ inch
Burner nozzle second stage chamber **51** (diameter) — ¼ inch
Burner nozzle second stage radial opening **52** (diameter) — ¼ inch
Expansion tube I. D. — 2½ inch
Coil I. D. ½ inch

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made by way of example and that changes in details of structure may be made without departing from the spirit thereof.

What is claimed is:

1. In a fuel burner assembly, the combination comprising:

a fuel feed coil with a central passage having an inlet arranged for coupling to a source of liquid fuel and an outlet terminating in a spray nozzle for spraying the fuel passing from the coil in a fine stream, said coil having a plurality of coil turns arranged along and spaced outwardly from a common axis, said coil having a flame inlet end and a flame outlet end;

an expansion tube disposed outwardly of and along in heat receiving relation to the coil and between said flame inlet end and said flame outlet end defin-

ing an expansion chamber for expanding and vaporizing the fuel passing from the spray nozzle, said chamber having a lower portion with said spray nozzle disposed therein and an upper portion having an outlet substantially above the spray nozzle to cause the vaporized fuel to rise in the expansion chamber and pass through the outlet; and

a burner nozzle located below the outlet of the expansion chamber having a fuel inlet coupled to the fuel outlet of the expansion chamber to receive vaporized fuel therefrom and an outlet arranged for directing a flame through said feed coil to heat the fuel passing therethrough; and

a blast tube downstream of the outlet of the burner nozzle and aligned with said coil to confine and direct the flame from the burner nozzle and through the flame outlet end of said coil.

2. In a fuel burner assembly as set forth in claim **1** wherein said expansion tube has a generally arcuate shape and is coaxially aligned around said fuel feed coil.

3. In a fuel burner assembly as set forth in claim **1** wherein said expansion tube is essentially semicircular in arcuate extent.

4. In a fuel burner assembly as set forth in claim **1** wherein the internal diameter of said expansion tube is about five times the internal diameter of said coil.

5. In a fuel burner assembly as set forth in claim **1** wherein said burner nozzle includes a body with a restricted orifice between the fuel inlet and outlet thereof which the fuel must pass to provide a high velocity stream of fuel, a first stage chamber with radial openings through the body adjacent the restricted orifice for the inspiration of air into the fuel passing therethrough, said body having a second stage chamber downstream of said first stage chamber with second radial openings through the body adjacent the second stage chamber to inspire additional air into the fuel stream.

6. In a fuel burner assembly as set forth in claim **1** wherein a space is maintained between the outlet of said burner nozzle and the inlet of said blast tube and at the downstream end of said feed coil to draw additional air into the flame being produced.

7. In a fuel burner assembly comprising:

a fuel feed coil with a central passage having an inlet at the upper end arranged for coupling to a source of liquid fuel and an outlet at the lower end for spraying the fuel passing from the coil in a fine stream, said coil having a plurality of coil turns arranged along and spaced outwardly from a common axis, said coil having a flame inlet end and a flame outlet end;

a generally upright substantially semi-circular expansion tube disposed adjacent to and along the side of the coil rearwardly of said flame outlet end having a circular transverse cross-section, and closed at the ends by end caps defining an expansion chamber for expanding and vaporizing the fuel passing from the spray nozzle, said chamber having a lower portion with said spray nozzle disposed therein and an upper portion having an outlet substantially above the spray nozzle to cause the vaporized fuel to rise in the expansion chamber and pass through the outlet, said expansion tube being coaxially aligned with and around the center of the feed coil and directing the fuel in a generally upward arcuate course of travel and through the upper outlet;

a burner nozzle located below the outlet of the expansion chamber having a fuel inlet coupled to the outlet of the expansion chamber to receive fuel therefrom and an outlet arranged for directing a flame through said feed coil to heat the fuel passing therethrough, said nozzle having a narrow restricted axially extending orifice leading into a pair of successive stages which induce air into the fuel stream and deliver the feed through the burner outlet; and

a blast tube coaxially aligned with and spaced downstream of the outlet of said burner nozzle to confine and direct the flame end having the outlet and telescoped in said coil so that said coil forms an axial extension thereof.

8. In fuel burning apparatus, the combination comprising:

a surface heating device having a wall and an aperture extending through the wall,

a fuel burner assembly mounted on the surface heating device to direct a flame produced through the aperture, said fuel burner comprising:

a fuel feed coil with a central passage having an inlet arranged for coupling to a source of liquid fuel and an outlet terminating in a spray nozzle for spraying the fuel passing from the coil in a fine stream said coil being adjacent the wall leaving a space therebetween, said coil having a plurality of coil turns arranged along a common longitudinal axis and spaced outwardly from a common axis, said coil having a flame inlet end and a flame outlet end,

an expansion tube disposed outwardly of and transverse to the common longitudinal axis of the coil and between said flame inlet end and said flame outlet end defining an expansion chamber for expanding and vaporizing the fuel passing from the spray nozzle, said chamber having a lower portion with said spray nozzle disposed therein and an upper portion having an outlet substantially above the spray nozzle to cause the vaporized fuel to rise in the expansion chamber and pass through the outlet; and

a burner nozzle located below the outlet of the expansion chamber having a fuel inlet coupled to the fuel outlet of the expansion chamber to receive vaporized fuel therefrom and an outlet arranged for directing a flame through said feed coil to heat the fuel passing therethrough; and

a blast tube downstream of the outlet of the burner nozzle and aligned with said coil to confine and direct the flame from the burner nozzle and through the apertures.

9. In a method of burning a liquid fuel comprising the steps of:

preheating a flow of liquid fuel and discharging the heated fuel as a spray;

spraying the heated fuel into the lower portion of a heated expansion chamber to vaporize the fuel;

causing the vaporized fuel to rise in the expansion chamber, removing the vaporized fuel from an upper portion of the expansion chamber; and

directing the vaporized fuel in a downward direction from the expansion chamber into a burner nozzle which produces a flame therefrom.

10. In a method as set forth in claim 9 further including the inspiration of additional air into the fuel stream prior to burning.

11. In a fuel burner assembly as set forth in claim 1 wherein said feed coil extends through a lower side wall portion of the expansion tube locating the spray nozzle within the expansion tube, said expansion tube having an access opening normally closed by a removable plug in a lower wall portion opposite said spray nozzle.

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