May 14, 1957 A. THOMAS ET AL 2,792,058

VAPORISING OIL BURNER AND METHOD OF VAPORISING AND BURNING HEAVY FUEL

Filed April 6, 1953 4 Sheets-Sheet 1

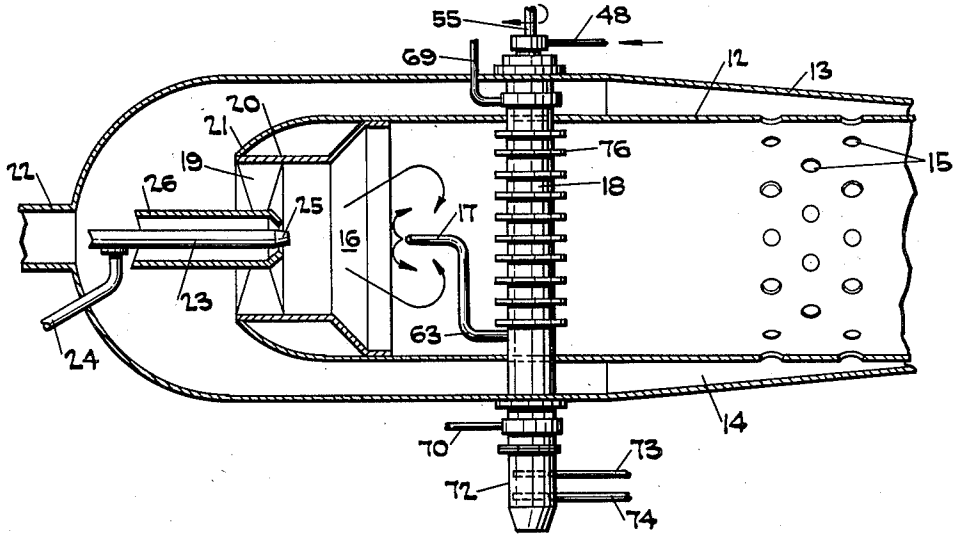


FIGURE 1

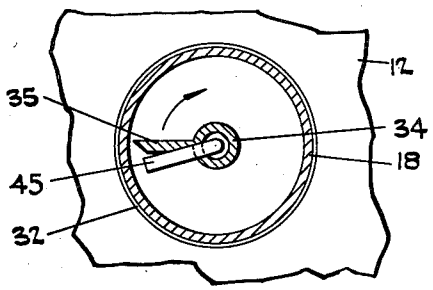


FIGURE 3

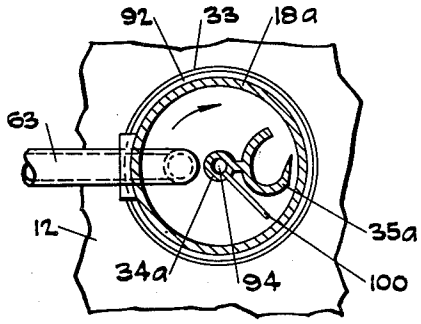


FIGURE 7

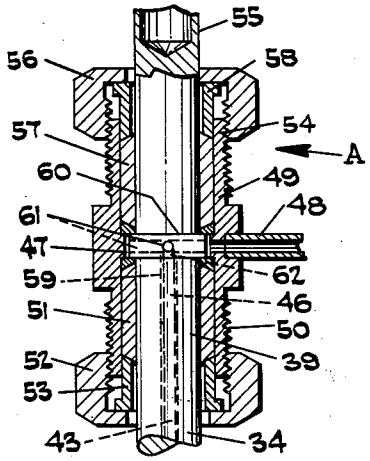


FIGURE 4

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VAPORISING OIL BURNER AND METHOD OF VAPORISING AND BURNING HEAVY FUEL

Filed April 6, 1953 4 Sheets-Sheet 2

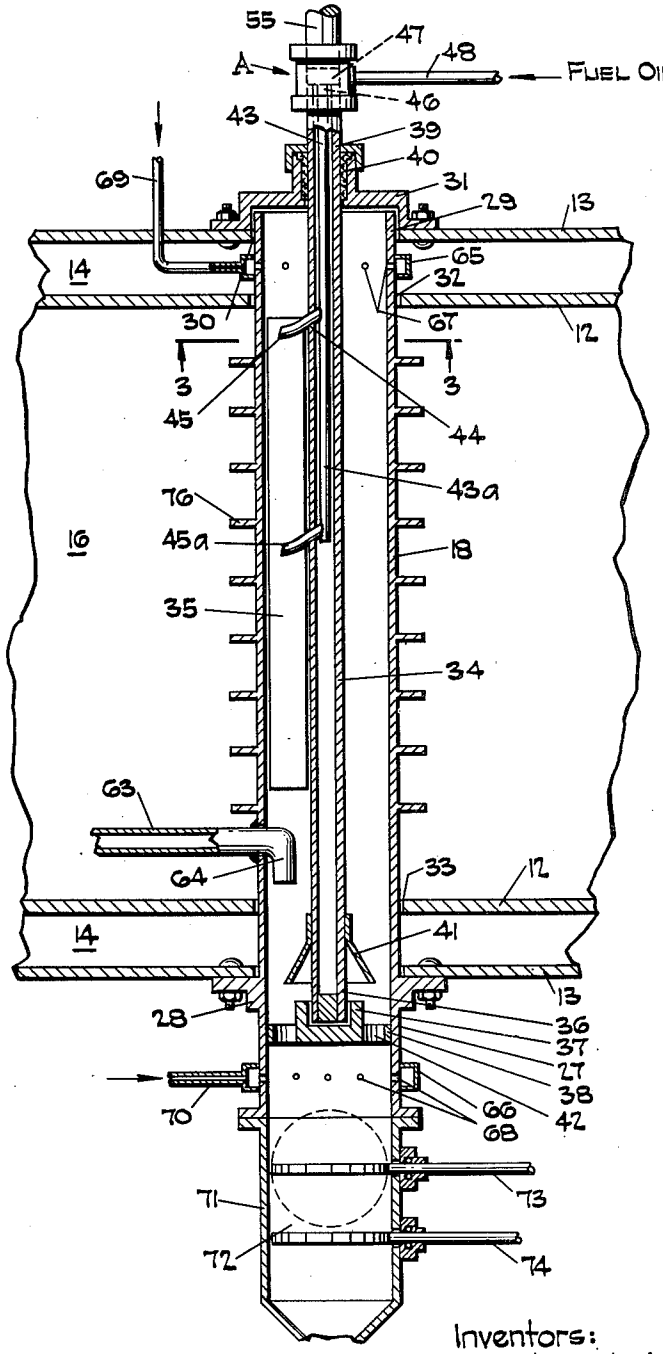


FIGURE 2

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May 14, 1957 A. THOMAS ET AL 2,792,058

VAPORISING OIL BURNER AND METHOD OF VAPORISING AND BURNING HEAVY FUEL

Filed April 6, 1953 4 Sheets-Sheet 3

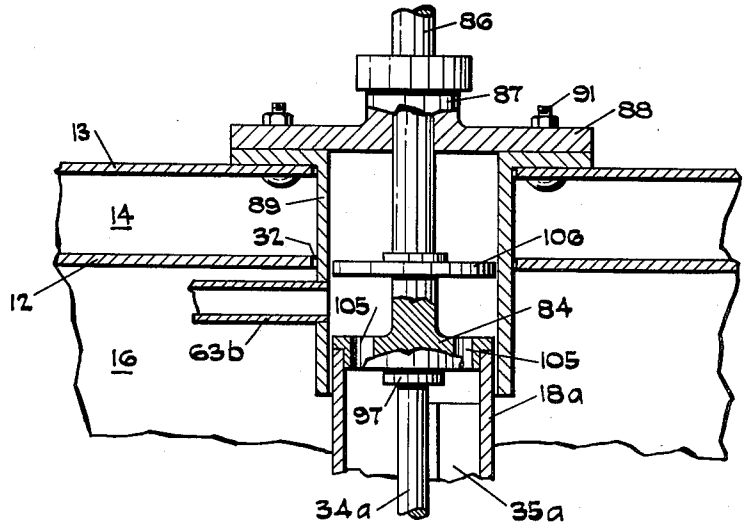


FIGURE 8

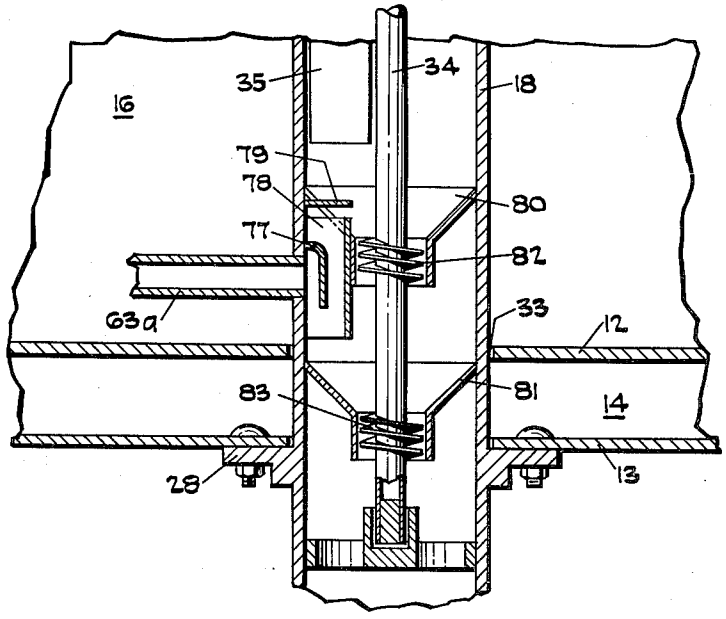


FIGURE 5

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VAPORISING OIL BURNER AND METHOD OF VAPORISING AND BURNING HEAVY FUEL

Filed April 6, 1953 4 Sheets-Sheet 4

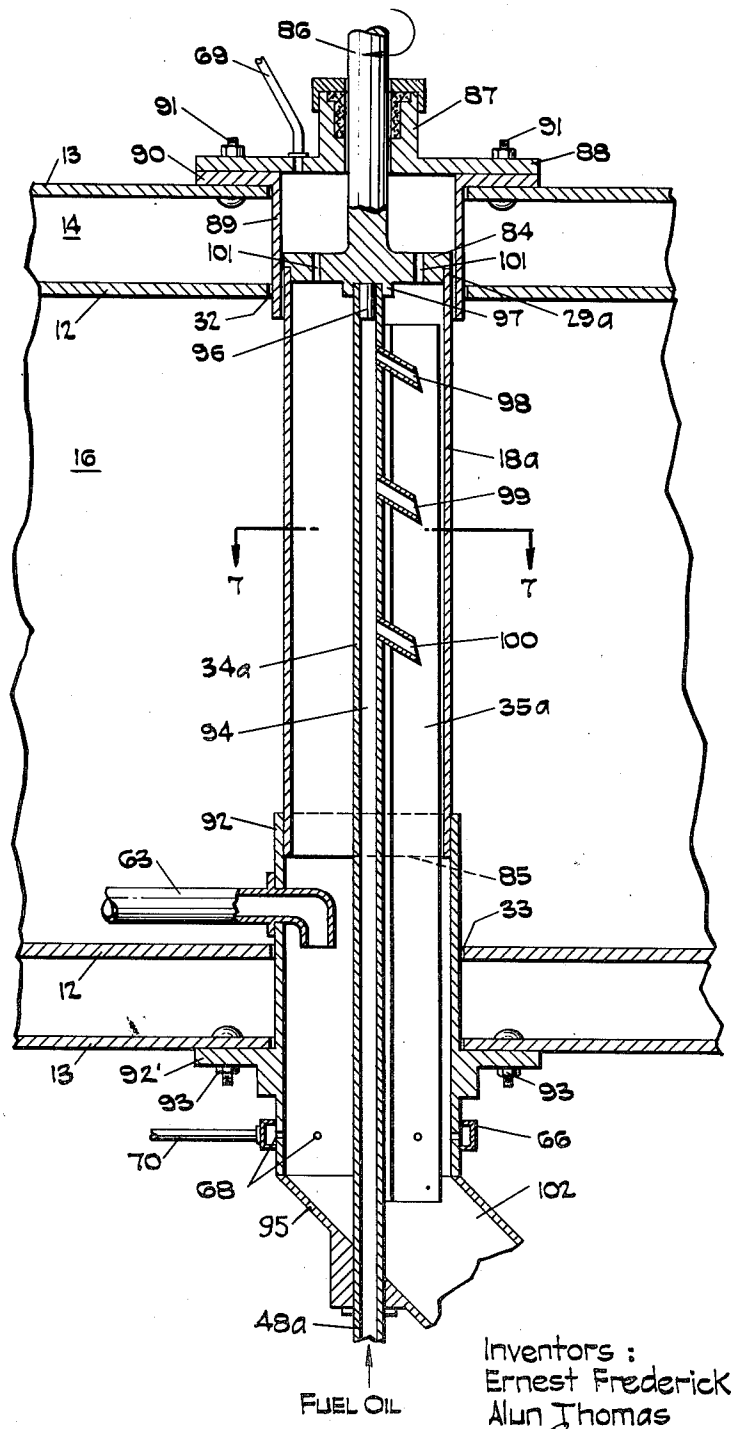


FIGURE 6

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United States Patent Office 2,792,058 Patented May 14, 1957

2,792,058

VAPORISING OIL BURNER AND METHOD OF VAPORISING AND BURNING HEAVY FUEL

Alun Thomas and Ernest Frederick Winter, London, England, assignors to Shell Development Company, Emeryville, Calif., a corporation of Delaware

Application April 6, 1953, Serial No. 346,954

Claims priority, application Great Britain April 17, 1952

18 Claims. (Cl. 158—5)

This invention relates to vaporising burners and is particularly although not exclusively useful for burning heavy residual oils in combustion chambers associated with combustion gas turbine plants, wherein it is important to avoid or minimize the presence in the combustion gases of substances that are solid or are readily condensible in the turbine. The invention is further applicable in any burner installation wherein heavy residual fuels are burned.

The combustion of heavy residual oils in boiler and furnace installations presents no problems of exceptional difficulty and various burners and systems have been proposed or used for burning such oils in boiler and furnace installations. By a suitable choice of equipment it is thus possible to achieve the combustion of such residual oils with reasonable efficiency and without serious corrosion, erosion, or ash deposition problems.

In the case of a gas turbine combustion system however, the use of a heavy fuel such as a heavy residual oil poses more formidable problems. A high ash content of the combustion products will tend to cause deposits on turbine blades and to give rise to corrosion or erosion of turbine parts. Also the physical characteristics of the fuel have hitherto necessitated a heater pressure fuel system thereby enhancing the cost of using such fuel. The difficulties of finding a satisfactory and cheap solution have retarded the use of such heavy oils as fuel in gas turbine systems, although the desirability of providing effective means for satisfactorily burning heavy oils such as heavy residual oils in gas turbine systems where the specific fuel consumption is so high is widely recognized.

The present invention is concerned with the provision of means for burning heavy liquid fuels such as heavy residual oils in gas turbine systems without the disadvantages mentioned above which hitherto have attended the use of such fuels.

According to the present invention a vaporising system for heavy liquid fuels comprises a heat-conducting vaporising tube wholly or mainly disposed within a combustion chamber so as to receive heat from the combustion products therein, means for supplying fuel to the inner wall surface of said tube, scraper means within the said tube adapted for rotational and/or oscillatory movement relative to said tube so as to disengage solid particles deposited on the tube inner wall, an outlet in said tube having a discharge opening or burner nozzle within the combustion chamber for discharge of vaporised fuel from the tube into or towards the combustion zone, and an outlet at one end of said tube for discharge of solid material disengaged by said scraper to a point outside the combustion chamber.

Also according to the invention a method of operating a gas turbine combustion system on heavy liquid fuel is provided wherein fuel delivered to the inner surface of a vaporising tube wholly or mainly located within a combustion chamber for the system is vaporised by the heat of the combustion products in the system before being discharged into or towards a combustion zone and solid material formed during this vaporisation is continuously removed from said vaporising tube and the combustion chamber by relative movement between said tube and a scraper device within said tube.

Generally the vaporising tube comprises a straight heat-conducting metal cylinder capable of withstanding the heat of the combustion products in the combustion chamber. The vaporising tube may be provided with external vanes, fins or ribs to achieve better heat transference from the combustion gases surrounding the tube to the tube and to the liquid fuel on the inner surface thereof, and the wall of the tube is advantageously relatively thick in order to facilitate heat transfer circumferentially thereof. Preferably the vaporising tube is so disposed within the combustion chamber and the thermal characteristics of the tube are such that the heated surface onto which the fuel oil is fed is maintained at between 500 and 700° C. and preferably between 550 and 600° C. Usually the vaporising tube will be mounted in the zone of primary combustion in the combustion chamber, the optimum location of the tube being that in which fuel vaporisation proceeds rapidly and continuously whilst avoiding excessive temperature conditions which might curtail the working life of the tube or which might vaporise solid material deposited on the inner surface of the tube.

In a simple form of the vaporising system of the invention the vaporising tube traverses the combustion chamber with an axis which is inclined to the horizontal, and is preferably vertical, in order to facilitate the downward flow of fuel oil over the inner wall surface and the discharge of solid material removed from this surface by the scraper device and discharged from the lower end of the tube. Whereas the top of the vaporising tube may lie within, at or outside the periphery of the combustion chamber or of any annular air conduit surrounding the same, the lower end of the tube lies outside and clear of the chamber and any such annular air conduit, or is in communication with a further tube which is so disposed that solid material such as coke and ash formed during fuel vaporisation is discharged to a point outside the combustion chamber. Preferably the lower part of the vaporising tube discharges into a collecting chamber for the solid material from which chamber this solid material can be continuously or periodically discharged. Some form of valve may be provided in such collecting chamber, as for instance, one or more slotted or perforated discs arranged to oscillate or rotate so as to permit the solid particles to pass through to a storage box while sealing the vaporising tube against downward discharge of vaporised oil. The vaporising tube may be in rotational or other movement with respect to a stationary scraper device, or the scraper may rotate or oscillate relative to the vaporising tube, which may be either rotatable or stationary.

The size of the vaporising tube is governed by the amount of fuel to be vaporised and the heat-transfer characteristics of the tube. In some cases it may be found desirable to employ two or more vaporising tubes positioned, for instance, to form a bank of tubes which together serve to vaporise sufficient fuel to meet the combustion needs which arise.

Preferably air or other gas or steam is injected into one end, e. g., the upper end, of the vaporising tube as a carrier stream for the vaporised fuel; such a stream facilitates the speedy discharge of vaporised fuel from

the tube and helps to minimise soot formation within the tube. Such carrier stream may be inert to the vaporised oil fuel or it may react with the fuel, for example, to improve gasification.

The desirability of a carrier gas stream in the upper part of the vaporising tube may diminish if the fuel flow to the heated wall of the tube is sufficiently high, the volume of vaporised products being in such case sufficient to ensure that they are swept too quickly through the tube. Loss of vaporised fuel via the outlet for solid material should preferably be countered by providing for the injection of a stream of gas or steam into the lower end of the tube or by suitable mechanical design of the lower end of the tube as by providing valve means or a screw for transferring solid material to the lower part of the tube, as will be described later, or by a combination of such means.

The vaporised products are conveyed from the vaporising tube into or towards the combustion zone in the combustion chamber where they are burnt. The exit port in the vaporising tube for such vaporised products is preferably provided with a baffle or like means to prevent soot or other solid material being carried over with the vaporised products. The vaporised products may be discharged into the combustion zone either in the same direction as, or in counter-flow to, the primary air entering the combustion chamber.

The vaporised fuel delivered from the vaporising tube may constitute the whole or only part of the combustible material for the gas turbine system. In the latter event a supply of liquid or gaseous fuel is fed to the combustion chamber independently of the vaporised oil fuel from the vaporising tube and this supplementary fuel supply may, for instance, serve to supply sufficient heat to vaporise the fuel oil in the vaporising tube, especially when starting up the burner from a cold condition.

Alternatively, an arrangement may be provided in which the initial air stream divides between two adjacent combustion systems running in parallel, one being fired conventionally and the other being fired with vaporised fuel from a vaporising tube which is conveniently heated by the first system. Control of combustion might thus conveniently be effected through controlling the rate of supply of residual fuel to the vaporising tube, while operating the conventionally fired combustion system under constant conditions. Again, there may be provided a bank of vaporising tubes, one of which serves to supply vaporised products which are burned in the combustion chamber to heat this and the remaining vaporising tubes.

The invention will now be described in more detail with reference to the accompanying drawings in which:

Figure 1 is a sectional view taken on a vertical, longitudinal section of a gas turbine combustion chamber embodying an oil vaporising system in accordance with the invention;

Figure 2 is an enlarged sectional view of a part of Figure 1 showing vaporising tube;

Figure 3 is a section on the line 3—3 of Figure 2;

Figure 4 is a detailed view on a larger scale of the upper part of Figure 2;

Figure 5 is a fragmentary sectional view including the lower part of the vaporising tube of Figure 2 and showing a modified construction;

Figure 6 is a sectional view corresponding to Figure 2 of a further alternative form of vaporising tube in which the tube rotates relative to a fixed scraper;

Figure 7 is a section on the line 7—7 of Figure 6; and

Figure 8 is a fragmentary sectional view including the upper part of an alternative form of the vaporising tube of Figure 6.

In the arrangement shown in Figure 1 the combustion chamber is defined by a flame tube 12 which is disposed within an outer casing 13 and separated therefrom by an annular air passage 14 through which dilution air passes to enter the flame tube through apertures 15 downstream of the primary combustion zone 16. The primary combustion zone 16 is supplied with vaporised fuel oil through a main burner nozzle 17 extending upstream from a heat-conductive vaporising tube 18 and in flow communication therewith. The combustion zone is supplied with combustion air through a conventional air swirler 19, that includes helical vanes or baffles in a cylindrical duct 20 fitted in the end wall 21 of flame tube 12. Air for the primary combustion zone and for dilution enters the outer casing 13 through an axial inlet 22 at the rear from a conventional or suitable source of pressure air (not shown).

The primary combustion zone 16 is also provided with an auxiliary fuel burner 23 which is supplied with gaseous or liquid fuel through a line 24 and has a suitable atomizing nozzle or burner tip 25 at the front. The auxiliary burner is mounted within a support tube 26 at the central axis of the air swirler 19 and serves to preheat the vaporising tube 18 to initiate vaporisation of fuel oil therein. As soon as the main burner, which includes the nozzle 17, is in full operation this auxiliary burner 23 can, if desired, be shut off. The auxiliary burner 23 is optional; it is not essential since vaporisation in tube 18 can be initiated by first passing a gaseous fuel through the vaporising tube 18 and thereafter discontinuing this gaseous fuel supply when sufficient heat is available to vaporise heavy oil inside the tube.

The tube 18 is made of heat-resistant metal alloy and is heat-conductive, so as to transmit heat from the outside thereof to the inner surface. As will be seen from Figure 1, the vaporising tube 18 is mounted with the axis thereof inclined to the horizontal at an angle of 90°, i. e., vertically, in the combustion chamber in the region of the primary combustion zone 16 and projects at each end through the flame tube 12 and the outer casing 13, the mounting being such as to allow relative movement between the various elements on thermal expansion or contraction. This is conveniently effected by bolting the lower end 27 (see Figure 2) of the vaporising tube 18 to the outer casing 13, for example through an annular flange 28 welded to the outside of the tube 18, and slidably locating the upper part 29 of the vaporising tube 18 within an aperture 30 in the casing 13 by enclosing it within a dished cover plate 31 bolted to the outer casing 13. The vaporising tube 18 passes through apertures 32, 33 in the flame tube 12 and aperture 30 in the casing 13 with sufficient clearance to allow for expansion.

Mounted for rotation within the vaporising tube 18 is a hollow, tubular shaft 34 carrying a single-bladed scraper 35, the shaft 34 being supported at its lower end 36 in a bearing 37 on a spider 38 which is fixed within tube 18. The upper end 39 of the shaft 34 passes through a gland 40 in the cover plate 31 and projects upwardly into a banjo fitting denoted collectively by reference "A" in Figure 2 and shown in detail in Figure 4. The lower end of the shaft 34 carries a downwardly and outwardly inclined frusto-conical baffle 41 which serves to deflect any solid particles away from bearing 37 and into apertures 42 in the spider 38.

Within the upper part of the shaft 34 is an oil feed pipe 43 the lower end of which projects through a hole 44 inside of shaft 34 and terminates in a nozzle 45 which is mounted on the scraper 35 for rotation therewith so as to direct oil onto the freshly scraped inner surface of the tube 18. The upper end 46 of the fuel pipe 43 is in communication through a chamber 47 in the banjo fitting "A" with a stationary feed pipe 48 forming part of a supply system (not shown) including a storage tank and a pump whereby heavy fuel oil, if desired heated to a suitable temperature, as for instance 100° C., can be supplied to the feed pipe 48.

The banjo fitting "A" (Figure 4) comprises a hollow body portion 49 housing at its lower end 50 the upper end 39 of the hollow shaft 34, which passes through, and is rotatably carried in a gland 51 retained by a collar 52

and ferrule 53. The upper end 54 of the body portion 49 receives the end of a driving shaft 55 actuated by a motor or other suitable means (not shown), the shaft 55 passing through a further gland 57 which is retained by a collar 56 and ferrule 58. The upper end of the hollow shaft 34 contains a cylindrical insert 59 serving to locate the end 46 of the feed tube 43 axially in the bore of the shaft 34 and to prevent oil from flowing into the interior of the shaft 34. The adjacent ends of the shafts 34 and 55 are coupled through a short cylindrical member 60 which is of slightly larger diameter than the shafts 34 and 55 and is disposed co-axially therewith. This member 60, which has a diameter less than and lies within the aforesaid chamber 47 in the body portion 49, contains four intersecting radial bores 61 and a communicating axial bore 62, extending downwards, together providing communication between the feed pipes 43 and 48 through the chamber 47 in all positions of the shaft 34.

A vapor exit tube 63 (see Figure 2) for the vaporised products is provided below the scraper 35, the open inner end 64 of the tube 63 being turned downwards to exclude or minimise removal of solid material with the fuel vapors. The discharge end of the tube 63 communicates with and supports the nozzle 17. Surrounding the upper and lower ends of the tube 18 and welded thereto are annular ducts 65 and 66, respectively, which are each in communication with the interior of the tube 18 through a series of circumferentially spaced holes 67 and 68, respectively. The ducts 65, 66 are each connected, through pipes 69 and 70, respectively, to a source of pressure air (not shown) and serve to direct streams of carrier air into the vaporising tube 18, the one flowing downwardly through the tube 18 to sweep the vaporised products out of the tube and the other flowing upwardly through the apertures 42 in the spider 38 and through the annular passage between the rotating baffle 41 and the tube 18 to prevent the vaporised products from flowing into the lower part of the tube 18. If desired, the diameter of the lower end of the baffle 41 can be of the order of 90% of that of the tube 18 in order to reduce the amount of upwardly flowing carrier gas required to prevent the vaporised products from flowing into the lower part of the tube 18. Both air streams flow out through the exit tube 63 with the vaporised products to the main burner nozzle 17. If desired steam, or a mixture of air and steam, instead of air may be injected into the vaporising tube 18 through either or both of the ducts 65 and 66.

Attached to the lower end of the vaporising tube 18 is a coke box 71 defining a collecting chamber 72 which can be closed at top and bottom by means of sliding or rotating valves 73, 74, respectively, which may be operated manually or mechanically as desired. In operation the upper valve 73 is opened to allow the solid material removed by the scraper 35 to collect in the chamber 72 from which it is removed periodically by closing valve 73 and opening valve 74 to allow the solid material to fall into the lower part of the box 71, which is open at the bottom.

Primary combustion occurs in the combustion zone 16, and the burning gases proceed through the flame tube 12 past the vaporising tube 18 to the apertures 15, where secondary air is admitted for further combustion and dilution. The vaporising tube 18 is advantageously provided with radial fins 76 to increase the rate of heat flow through the walls of the tube.

If desired, one or more additional fuel nozzles can be provided at spaced positions on the axis of the tube 18, as for example a second nozzle 45*a*, which is fed by a downward extension 43*a* of the fuel pipe 43.

The following data are illustrative of operating conditions, with a vaporising tube of the above-described nature having an internal diameter of 1⅜" and a vaporising surface extending over about 9" of the length of the tube. In both runs the scraper was rotated continuously and carrier gas was supplied at the top and bottom of the tube and the temperature of the tube wall was 600° C.

Nature of fuel		Carrier Gas	Ratio of mass flow rate of carrier gas to that of fuel	Pressure within vaporising tube	Solids collected (as a percentage of the mass of fuel)
Conradson Carbon Value	Viscosity (Redwood 1 at 100° F.)				
	Seconds				*Percent*
10.0	4,300	Steam	0.6	1 atmos.	2
12.5	7,050	air	1.5	5 atmos.	3

As will be seen from these figures, the major part (about 97–98%) of the oil fuel is vaporised and only a small amount is lost as coke.

In the modified form of vaporising tube 18 shown in Figure 5, wherein like numbers denote like or corresponding parts, the exit tube 63*a* terminates at the wall of the vaporising tube 18 which is apertured to afford communication. The open end of the exit tube 63*a* is protected from falling solid material by a hood 77 disposed within a vertical baffle 78 of semicircular section having the vertical edges sealed to the tube 18 and open at its upper and lower ends, and a further baffle 79 located above the baffle 78 in vertically spaced relation. Located within the vaporising tube 18 are two inverted frusto-conical baffles 80, 81 of which the upper baffle 80 is shaped to fit around the baffle 78. Both baffles 80 and 81 are flanged downwardly at their lower, inner edges to provide two constricted circular channels co-axial with the tubular scraper shaft 34 in which helical conveyor screws 82, 83, mounted on the shaft 34, rotate respectively. The arrangements above and beneath the parts shown in Figure 5 may be as shown in the previously described embodiment.

In operation, solid material dislodged from the walls of the vaporising tube 18 falls onto the upper baffle 80 whence it is conveyed through the upper helical screw 82 onto the lower baffle 81 and any material falling though the baffle 78 passes around the hood 77. Solid material collecting on the lower baffle 81 is conveyed downwards by the lower helical screw 83 and falls into a collecting chamber 72, shown in Figure 2. This arrangement has the further advantage of reducing the quantity of upwardly flowing carrier gas necessary to prevent vaporised products from passing outside the combustion chamber.

The vaporised products can be removed from the upper end of the vaporising tube 18 if desired. With such an arrangement it may be found that only one stream of carrier gas flowing upwardly through the tube 18 is required.

In an alternative arrangement shown in Figures 6 and 7, wherein like or corresponding parts bear like references, the vaporising tube 18*a* is rotatable and is closed at its upper end by a circular plate 84 and open at its lower end 85. A driving shaft 86 for the vaporising tube 18*a* is carried in a bearing 87 forming part of a cover plate 88 and is rigidly attached at its lower end to, e. g., made integral with, the tube end plate 84. The upper end 29*a* of the vaporising tube 18*a* is rotatably housed within the lower part of a short tube 89 rigidly secured to the outer casing 13 at its flanged upper end 90 by means of bolts 91 which also retain the cover plate 88 in position. The vaporising tube 18*a* is also rotatably and slidably housed at its lower end 85 in the upper part of a further fixed tube 92 which is attached, through bolts 93 and a flange 92' to the outer casing 13.

A stationary scraper 35*a* of approximately semi-circular section (see Figure 7) is carried by a hollow shaft tube 34*a*, which may be integral with the scraper 35*a*. The shaft tube has a bore 94 and thereby also serves as an oil feed pipe. The lower end of the shaft tube 34*a* is supported by the inclined lower wall 95 of the tube 92

and projects downwardly thereof at 48*a* for connection to the fuel supply system (not shown). The upper part of the shaft tube 34*a* is sealed at 96 and is centrally located within the tube 18*a* by a recessed boss 97 formed on the lower part of the tube end plate 84 and forming a bearing, whereby rotation of the plate 84 may take place in relation to the stationary shaft tube 34*a*.

Three downwardly inclined fuel nozzles 98, 99 and 100 (corresponding collectively to the nozzles 45 and 45*a*) are provided, the nozzles fitting in corresponding apertures in the wall of the shaft tube 34*a* and serving to direct fuel onto the freshly scraped inner wall surface of the vaporising tube 18*a*. An exit tube 63 for vaporized products discharging into the main burner nozzle 17 (Figure 1) is provided in the tube 92 and an annular duct 66 for carrier air or steam surrounds the lower part of the tube 92 and communicates with an interior thereof through an annular duct 66 and the holes 68. A supply duct 70 is fitted to the duct 66. Means are also provided for directing a stream of carrier air or other gas into the upper part of the tube 18*a* comprising a carrier gas tube 69 leading to a source of pressure air (not shown) and opening at its lower end through the cover plate 88 into the interior of the tube 89, from which the carrier gas flows through a number of spaced holes 101 in the tube end plate 84.

The lower end 102 of the tube 92 leads to a coke receiver (not shown) provided with slide valves (such as the valves 73 and 74 of Figure 2), or other suitable means, to collect and remove solid material removed by the scraper 35*a*. As will be seen from Figure 6, the scraper extends downwardly into the inclined lower portion of the tube 92 and this feature, with a scraper of the configuration shown, materially assists to reduce the possibility of solid material becoming entrained in the stream of vaporised produce entering the combustion chamber.

The operation is similar to that previously described, the oil being admitted at 48*a* and directed through the nozzles 98, 99 and 100 against the heated wall of the tube 18*a* which is rotated by the driving shaft 86 to bring successive portions of the surface into engagement with the stationary scraper 35*a*.

In the modified form of the vaporising tube assembly of Figure 6, shown in Figure 8, the upper carrier gas duct 69 is omitted and the vaporised fuel is removed through apertures 105 in the tube end plate 84. In this modification the flanged tube 89 extends farther into the flame tube 12 and carries an exit tube 63*b* for the vaporised oil, leading to the main burner nozzle 17 (Figure 1). In addition, the driving shaft 86 preferably carries a solid disc 106 which fits rotatably within the tube 89 and acts as a baffle and seal to confine the vaporised products to the lower part thereof. With such a construction the admission of carrier gas at the upper end of the vaporising tube 18*a* is unnecessary.

It is evident that numerous changes in the specific details may be made without departing from the spirit and scope of the invention.

We claim as our invention:

1. A vaporising liquid fuel burner including a combustion chamber, a heat-conducting vaporising tube having at least the major part thereof situated within said combustion chamber to be heated externally by products of combustion within said chamber, means for supplying liquid fuel to the inner surface of the wall of said tube, scraper means for said inner surface of the tube wall situated within the said tube, said tube and scraper means being mounted for relative movement during normal operation of the burner, a vapor outlet for said tube directly interconnecting an intermediate region of the tube with the interior of said combustion chamber for the discharge of vaporised fuel, and a solids outlet for said tube at one end thereof communicating directly with a point outside of the combustion chamber independently of said vapor outlet for the discharge of said solid particles during normal operation of the burner.

2. In combination with the vaporising fuel burner according to claim 1, means for admitting a current of carrier gas into said vaporising tube.

3. A vaporising fuel burner according to claim 2 wherein said means for admitting a carrier gas includes an inlet communicating with the vaporising tube near said solids outlet for flow of the carrier gas toward the vapor outlet in countercurrent to solid particles.

4. A vaporising liquid fuel burner including a combustion chamber, a heat-conducting vaporising tube having at least the major part thereof situated within said combustion chamber to be heated externally by products of combustion within said chamber, means for supplying liquid fuel to the inner surface of the wall of said tube, scraper means for said inner surface of the tube wall situated within the said tube, said tube and scraper means being mounted for relative movement during normal operation of the burner so as to disengage solid particles deposited on said inner surface, a vapor outlet for said tube communicating with the interior of said combustion chamber for the discharge of vaporised fuel, a solids outlet for said tube communicating with a point outside of the combustion chamber independently of said vapor outlet for the discharge of said solid particles during normal operation of the burner, and means for reducing the loss of vaporised fuel from the vaporising tube through the solids outlet.

5. A vaporising fuel burner according to claim 1 wherein said vaporising tube is disposed with the axis thereof inclined to the horizontal, said solids outlet being at the lower end of the tube and said means for supplying liquid fuel is situated to apply oil to the tube at an elevated part thereof for gravity flow along said inner surface.

6. A vaporising fuel burner according to claim 4 wherein said means for reducing loss of vaporised fuel comprises a pair of separately operable valves spaced apart along the path of flow of said solid particles to provide an intervening collecting chamber.

7. A vaporising fuel burner according to claim 4 wherein said means for reducing loss of vaporised fuel comprises means for admitting a carrier gas into said vaporising tube at a point situated near the said solids outlet thereof for flow into said vaporising tube and through said tube toward said vapor outlet in countercurrent to solid particles.

8. A vaporising fuel burner according to claim 4 wherein said means for reducing loss of vaporised fuel comprises baffle means within said vaporising tube constricting the cross sectional area of said tube between the said scraper means and the said solids outlet.

9. A vaporising fuel burner according to claim 8 wherein said means for reducing the loss of vaporised fuel comprises in combination with said baffle means, means for admitting a carrier gas into the tube at a point situated between said baffle means and said solids outlet for flow into said vaporising tube and through said constricted part of the tube in countercurrent to solid particles.

10. A vaporising fuel burner according to claim 8 wherein said means for reducing the loss of vaporised fuel comprises, in combination with said baffles means, a conveyor screw in said constricted part of the tube for conveying solid particles toward said solids outlet, and means for rotating said screw.

11. A vaporising fuel burner according to claim 10 wherein said vaporising tube includes a second baffle situated in spaced relation to said baffle means in a direction away from said solids outlet, said second baffle having a constricted passage and a conveyor screw for solid particles therein, and means for rotating said conveyor screw, said vapor outlet being in communication with said vaporising tube at a point situated intermediate said baffle means and said second baffle.

12. A vaporising liquid fuel burner including a com-

bustion chamber, a heat-conducting vaporising tube having at least the major part thereof situated within said combustion chamber to be heated externally by products of combustion within said chamber, a scraper blade within said tube disposed in scraping relation to the inner surface of the wall of said vaporising tube, said scraper blade and vaporising tube being relatively rotatable during the normal operation of the burner so as to disengage solid particles deposited on said inner surface, means for supplying liquid fuel to the said inner surface of the tube wall including one or more nozzles mounted in rotationally fixed and trailing relation to said scraper blade, whereby relative rotation between said nozzles and tube occurs for distributing the fuel over a freshly scraped portion of said surface, a vapor outlet for said tube communicating with the interior of said combustion chamber for the discharge of vaporised fuel, and a solids outlet for said tube communicating with a point outside of the combustion chamber independently of said vapor outlet for the discharge of said solid particles during normal operation of the burner.

13. A vaporising fuel burner according to claim 12 wherein said scraper blade is mounted on a tubular shaft disposed at the axis of the vaporising tube and said fuel supply nozzles are supplied with fuel through said tubular shaft.

14. A vaporising fuel burner according to claim 13 wherein said vaporising tube is stationary and said tubular shaft and scraper blade are rotatable.

15. A vaporising fuel burner according to claim 13 wherein said vaporising tube is rotatable and said tubular shaft and scraper blade are stationary.

16. A vaporising burner for heavy oil comprising, in combination: a combustion chamber including confining walls and means for admitting combustion air at one end thereof for flow through the combustion chamber; a vaporising tube having at least the major part thereof situated within said combustion chamber near to but spaced from said air inlet and inclined to the horizontal, so as to be heated externally by products of combustion within said chamber; means for supplying liquid fuel to the inner surface of the wall of said tube, said means including one or more fuel supplying nozzles and fuel supply means therefor, said nozzles and tube being mounted for relative rotation during normal operation of the burner to distribute the fuel circumferentially over the said inner surface of the tube; a scraper blade within said tube, said tube and scraper blade being mounted for relative rotation during normal operation of the burner to disengage solid particles deposited on said inner surface; a vapor exit tube within said combustion chamber communicating at the inlet end of the exit tube with said vaporising tube and having a discharge nozzle at the outlet end of the exit tube situated at a point between the vaporising tube and said air inlet; and a solids outlet at the lower end of said vaporising tube independent of said vapor outlet for the discharge of said solid particles to a point outside of the combustion chamber during normal operation of the burner.

17. Method of vaporising and burning heavy liquid fuel in a combustion chamber having a combustion zone wherein fuel is burned and a heat-conducting vaporising tube at least the major part of which is situated within said combustion chamber, comprising the steps of: heating said vaporising tube directly by combustion of fuel in said combustion zone; supplying said heavy liquid fuel continuously to the inner surface of said tube in the manner hereinafter specified; vaporising said fuel within said tube by the heat of the tube; discharging the resulting fuel vapors from said tube into said combustion zone and there effecting combustion thereof; continuously scraping said inner surface of the tube during said vaporisation by a relative circumferential motion between a scraper and said surface to dislodge solid particles deposited thereon during the vaporisation, said fuel being supplied by successively applying the liquid fuel to different circumferentially displaced, freshly scraped portions of said surface; and discharging said dislodged solid particles from the vaporising tube during said vaporisation to a point outside the combustion zone.

18. Method of vaporising and burning heavy liquid fuel in a combustion chamber having a combustion zone wherein fuel is burned and a heat-conducting vaporising tube which is disposed at an inclination to the horizontal and at least for the major part within said combustion chamber, comprising the steps of: heating said vaporising tube directly by combustion of fuel in said combustion zone; supplying said heavy liquid fuel continuously to the upper part of the inner surface of said vaporising tube; discharging the resulting fuel vapors from said tube into said combustion zone and there effecting combustion thereof; continuously scraping the said inner surface of the tube during said vaporisation to dislodge solid particles deposited thereon during the vaporisation; discharging said dislodged solid particles from a lower part of the vaporising tube during said vaporisation to a point outside the combustion zone; admitting a carrier gas into said vaporising tube during said vaporisation at a lower part thereof for passage upwards in countercurrent to said solid particles for reducing the loss of vaporised fuel with the discharged solid particles; and discharging said carrier gas from the vaporising tube to the combustion zone together with said vaporised fuel.

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