Aug. 4, 1953 E. F. CIGLIA 2,647,567

OIL BURNER

Filed July 30, 1951

Fig. 1.

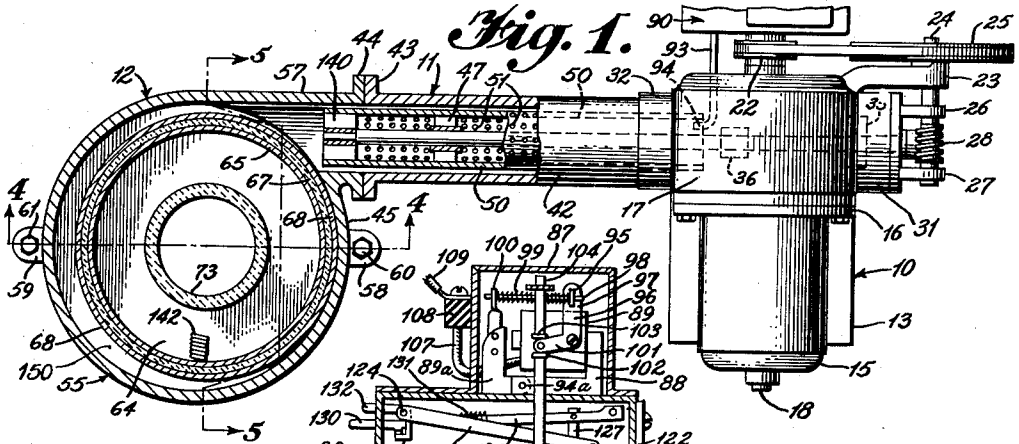


Fig. 6.

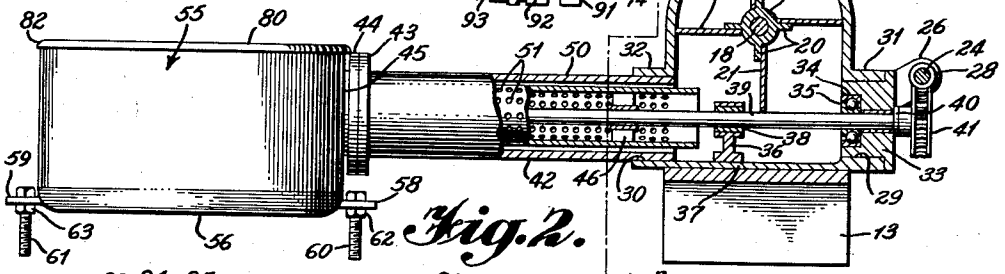


Fig. 2.

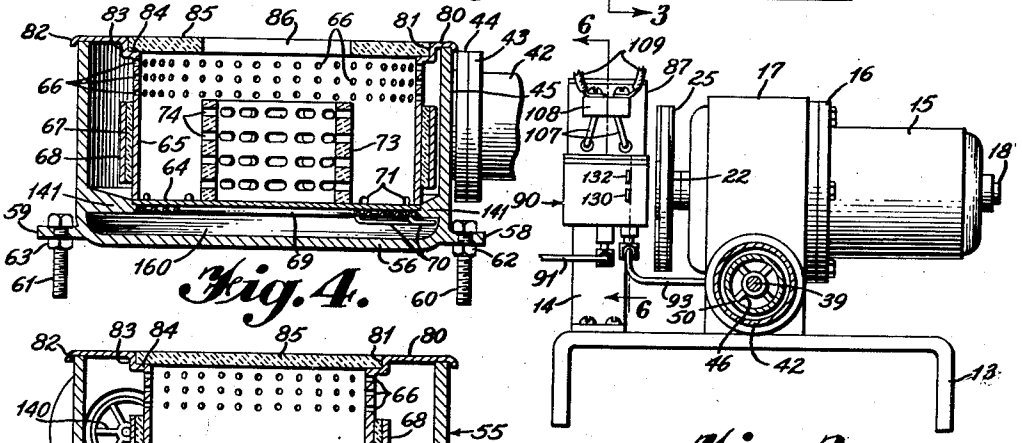


Fig. 4.

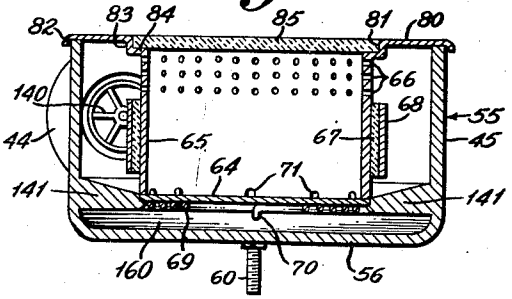


Fig. 5.

Fig. 3.

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OIL BURNER

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Application July 30, 1951, Serial No. 239,235

17 Claims. (Cl. 158—53)

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This invention relates to an oil burner and more particularly to a type of oil burner which is capable of handling very low grade fuels. In the usual practice, with respect to pot-type oil burners, liquid oil is conducted directly to the burner pot and vaporized in the pot. These burners are objectionable in that at the point of entry of the oil into the pot objectionable and harmful amounts of carbon accumulate. This invention overcomes these difficulties.

This application is a continuation-in-part of application, Serial No. 138,312, filed January 13, 1950, for Oil Burner, and now abandoned.

While there have previously been offered pot-type burners in which previous vaporization of the fuel is obtained, they have been expensive, noisy and incapable of handling low grade fuels. Further, as far as is known, these previous vaporizing pot-type burners have introduced fuel at a single point only and have not widely distributed the fuel as in the present invention.

It is, accordingly, one object of this invention to provide a pot-type oil burner in which the oil is previously vaporized or gasified and then fed to the burning section so that the deposition of carbon is eliminated.

It is another object of this invention to provide such a pot-type burner in which the fuel in its vaporized or gasified state is distributed to the burning section through a plurality of points, widely distributed.

It is a primary object of this invention to provide a pot-type oil burner of the type described which will handle extremely low grade fuels even those resulting from catalytic cracking of petroleum and commonly referred to in the trade as "cat oil."

It is a feature of this invention that complete combustion is obtained even of the very low grade fuels, thus eliminating carbon deposits and providing a highly efficient smokeless flame.

These and other objects and advantages of this invention will be apparent from the annexed specification, in which:

Figure 1 is a plan view partly in section and with parts broken away for clarity of illustration;

Figure 2 is a side view partly in section;

Figure 3 is a view taken along the line 3—3 of Figure 2;

Figure 4 is a view taken along the line 4—4 of Figure 1;

Figure 5 is a section taken along line 5—5 of Figure 1; and

Figure 6 is a section taken along the line 6—6 of Figure 3.

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Referring now more particularly to the drawing, the invention is shown as comprising three primary sections, a fan and fuel supply section 10, a vaporizing section 11, and a burning section 12. The fan section is provided with a channel shaped base member 13 upon which is mounted a bracket 14 which carries the metering and thermostatic elements hereinafter described.

An electromotor 15 is provided having its flanges 16 bolted directly to the side of a fan casing or housing 17. The electromotor drives a shaft 18 which shaft 18 carries a hub 19 having spokes 20 to which are affixed the blades 21 of a fan.

The shaft 18 also continues beyond the outer wall of the fan and carries a small pulley 22 on the end thereof as shown in Figure 3. The housing 17 is also provided with a bracket 23 in which is journalled a shaft 24 which mounts a large pulley 25. Shaft 24 is also journalled in two outstanding bearings 26, 27 and is provided intermediate these bearings with worm 28.

The housing 17 is provided with a pair of circular openings 29 and 30 in extensions 31 and 32, respectively. The opening 29 is provided with a bearing carrier 33 which is provided with a reduced recess 34 in which is seated a ball bearing 35. Bracket 36 is affixed to the floor 37 of the housing and carries a bearing 38. A shaft 39 is journalled in the bearings 38 and 35 and extends outward beyond the bearing carrier 33. The outer end of the shaft 39 is provided with a thrust bearing 40 and a worm gear 41 engaging the worm 28, as clearly shown in Figure 2. A tube 42 is mounted in the opening 30, as shown in Figure 2, and has a flange 43 which is secured to a similar flange 44 formed upon the wall 45 of the burner. A tube 50 is provided within tube 42 and carries a pair of spiders 46 and 47 connecting the tube 50 for unitary rotation with the shaft 39. The spiders comprise hubs on shaft 39 and radial legs engaging the inside of tube 50 at spaced points. The tube 50 may, if desired, be provided with a plurality of openings or holes 51, as indicated. It is preferred that tube 50 be imperforate and it is contemplated that in commercial production the tube will be without the perforations 51. A perforated tube is shown in the drawings to illustrate how such a construction would appear. The principle of the present invention may be exemplified with an imperforate tube since the inner surface thereof can conveniently support a thin film of fuel oil in heat conducting relation to the tube for purpose of vaporization. By omitting the perforations considerable sav-

ing in the cost of production is accomplished and the danger of depositing liquid oil on the bottom portion of hot tube 42 is obviated to a large extent, particularly in the event of failure of the mechanism for driving tube 50 in rotation. As shown in Figures 1 and 3, the tube 50 is spaced from the inner wall of the tube 42, leaving a clearance for a purpose hereinafter described.

The burner comprises a pot 55 having the side wall 45 and the bottom wall 56. The side wall 45 is extended at 57 and upon this extension is formed the flange 44 shown in Figure 1. A pair of lugs 58 and 59 may be formed upon the bottom wall 56 and are provided with studs 60 and 61, and lock nuts 62 and 63, for the purpose of adjusting the height of the pot. A circular plate 64 is provided within the pot, spaced from the bottom 56, as shown in Figure 4. A cylinder 65 is provided, disposed eccentrically of the wall 45, and defining a crescent-shaped space 150 as clearly shown in Figures 1 and 4, and having its upper portion apertured by a plurality of holes 66 extending entirely about the upper section of the cylinder, as shown in Figures 4 and 5. Asbestos insulation 67 is provided in the form of a ring about the cylinder 65 and retaining ring 68 is provided to hold the asbestos in firm contact with the cylinder 65. The insulation does not extend to the bottom of cylinder 65 but terminates above the lower end thereof. Resting upon the plate 64 and centrally thereof, there is provided a cylindrical body of ceramic material 73, which body 73 has substantially radial perforations through it, as shown at 74.

The top of the burner is provided with a ring 80 having an eccentric opening 81 therein, a turned over flange 82, a depending flange 83 and an inwardly extending flange 84. A ceramic ring 85 is provided having an opening 86 therein and seated upon the flange 84. The opening 86 is coaxial with the ceramic body 73, as shown in Figure 4.

Mounted upon the bracket 14 is a fuel reservoir 90 to which oil is fed through an inlet 91 and from which oil is fed through an outlet 92. The outlet 92 is in communication with a tube 93, which tube 93 has an end 94 bent to extend into the opening of the tube 50, as shown in Figure 1. The end 94 of tube 93 extends inwardly and downwardly in the end of tube 50 with its open end closely adjacent the inner surface of tube 50 somewhat below the center thereof.

Mounted upon the reservoir 90 is a housing 87 in which is mounted a bracket 88. A pivoted armature 89*a* of a solenoid 89 is pivoted to the bracket as at 94*a*. A bell crank 96 is pivoted to one side of the solenoid and its upper arm 97 carries a bracket 95 engaging a shaft 98 which is surrounded by a compression spring 99 abutting bracket 95. The other end of the shaft 98 passes through an arm 100 fixed to the pivoted armature 89*a*, as shown in Figure 6. The lower arm 101 of the bell crank is bifurcated to embrace shaft 104 between collars 102 and 103 carried by the shaft 104. Shaft 104 extends downwardly into the reservoir 90 and has its lower end slotted as at 105 where it enters upstanding cylinder 106 forming a portion of the outlet 92. Solenoid 89 may be energized through the conductors 107. Conductors 107 lead to an insulated connecting block 108, and other conductors 109 are provided adapted to lead to a thermostat suitably placed so as to regulate the flow of oil to the burner, and thence to a source of electric power.

It will be apparent that if the solenoid is energized, pivoted armature 89*a* will be drawn into contact with the core 110 of the solenoid and compress spring 99 while moving the shaft 98 to the right, as shown in Figure 6, pivoting the bell crank 96 raising the shaft 104 at that point to its upper limit established by the top of casing 87 and allowing oil to flow into the outlet 92 through the slots 105. De-energizing of the solenoid will permit the spring 99 to pivot the armature 89*a* to the left and release the shaft 104 to gravity to shut off the flow of oil to the burner.

The reservoir 90 is also provided with an overflow mechanism. This overflow mechanism comprises upstanding cylinder 120 in which is provided a float 121 having an upwardly extending member 122 carried thereby. A link 123 is pivotally connected to the top of the upstanding member 122 and has its other end fixedly connected as at 124 to a dogging mechanism 125. A link 126 is pivotally mounted within the reservoir 90 and intermediate its ends pivotally carries a shaft 127, the lower end of which carries a plug 128 adapted to fit within the cylinder 129 forming a part of the inlet and in one position closes the inlet and in another position opens the inlet. The link 126 has one end extending through a slot outwardly of the reservoir 90, as shown at 130. A compression spring 131 has one end attached to the link 126 intermediate its ends and the spring has its other end attached to the dogging mechanism 125. The dogging mechanism 125 is in the form of a bell crank having an arm 132 extending outward through a slot in the reservoir 90 as shown.

Upon the rising of the float within the cylinder 120, the link 123 correspondingly pivots the dogging mechanism 125 against the force of the spring 131, thus releasing the dog 133 from engagement with the extension 134 on the link 126 and permitting the link 126 to pivot downwardly and thus plug the member 129. After the overflow mechanism has thus once been tripped, it is necessary to reset the same by hand, and for this reason the extensions 130 and 132 extend outwardly beyond the boundaries of the reservoir 90. The float mechanism thus limits the head of liquid acting to force fuel through slot 105 so that fuel will not be delivered to tube 50 at greater than a predetermined rate. Of course, other means may be employed to control the rate of fuel delivery to tube 50.

The innermost end of the tube 50 and the shaft 39 is provided with a spider 140 similar to the spiders 46 and 47, as shown in Figures 1 and 2.

Referring now particularly to Figures 4 and 5, a spirally coiled resistance-type heating element 69 is arranged below plate 64 and held in heat conducting contact therewith by any suitable means. The resistance element 69 may be connected by conductors 70 to a suitable source of electric current and appropriate control means. As also shown in Figures 4 and 5, the insulating material 67 does not extend all the way to the bottom of cylinder 65 but terminates short thereof. The cylinder 65 is provided with additional openings 71 adjacent the bottom edge thereof and below the lowermost edge of the insulating band 67. The openings 71 are at substantially the same level as the upper surface of plate 64.

The plate 64 is supported by inwardly directed flange portions 141 in the pot 55. The flange 141 is of relatively large mass, being quite thick, and is provided with an upper surface sloping downwardly, as shown, to a level adjacent the bottom portion of the openings 71. The flange portions 141 are shown integral with the pot 55 and integral with bottom 56. Clearly the construction may be readily modified to provide a pot having a terminal flange at its lowermost edge providing the upper portion of the flange 141 and the plate 64 could extend entirely across the bottom thereof with a relatively heavy peripheral clamping ring below the outer margin of plate 64 to hold the assembly in the desired relationship. In such construction the bottom 56 would be omitted or could be integral with the clamping ring suggested.

When the burner assembly herein described is installed in a furnace or the like the burner pot and a portion of the outer tube 42 will extend into the furnace and be exposed to the heat within the fire box therein. Such heat will raise the temperature of the outer tube 42, which temperature is also raised to some extent by conduction and radiation of heat from the inside of pot 55. The temperature attained by tube 42 will be quite high, of the same order as that existing in the fire box of the furnace and the hot tube 42 performs an important function in the operation of the present oil burner, as will be described later.

As clearly shown in the drawings the drive effecting rotation of shaft 39 and tube 50 is such that the speed of rotation of the tube is very small relative to the speed of the motor 15. In the specific embodiment illustrated the motor 15 operates at about 1725 R. P. M. whereas the drive mechanism from there to the shaft 39 effects a speed reduction of about 30 to 1. Thus it will be seen that tube 50 rotates at somewhat less than 20 revolutions per minute (preferably in a clockwise direction as viewed in Fig. 3). It is contemplated that the speed of rotation of tube 50 be sufficiently high to receive liquid fuel from tube 94 and spread the same in a thin film over the inner surface of the tube. The spreading of the oil film longitudinally of the tube is assisted by the blast of air produced by the fan previously described. It is further necessary that the speed of rotation of tube 50 be sufficiently low so that no liquid fuel will be thrown therefrom by centrifugal force to the hot inner surface of tube 42, particularly if tube 50 is perforated. In the embodiment illustrated it was found that the speed of rotation should not exceed about 20 R. P. M. but it will be apparent that a different maximum speed may result if a tube of larger or lesser diameter is employed. The actual speed of rotation for which the burner is constructed must be determined by the dimensions of the parts and will also be affected by the viscosity or character of the fuel oil employed.

The herein described apparatus operates as follows:

Assuming that the thermostat previously referred to calls for operation of the burner, the fuel feed mechanism described in connection with Figure 6 will operate in the manner described to start rotation of the fan and tube 50 and to commence feeding liquid fuel through the discharge end 94 of tube 93 into the tube 50. At the same time suitable control mechanism (not shown) energizes the heating coil 69 below plate 64. Since the entire burner apparatus is "cold" at this time the liquid fuel will not be vaporized but will migrate along tube 50 and some liquid fuel will eventually drop to the bottom of the portion 57 of the pot 55 and thence to the upper surface of the flange 141. That liquid fuel will then be fed by gravity through the openings 71 in cylinder 65 onto plate 64 which is being heated by resistance element 69. As soon as the plate 64 has acquired a temperature sufficient to vaporize the liquid fuel thereon additional control means cause energization of an incandescent ignition coil 142 (Fig. 1) within the cylinder 65 and will cause ignition of the fuel vapors therein. At this stage in the operation automatic means may effect an opening of the circuit leading to heater 69 since combustion of vaporized fuel and air in the burner will supply sufficient heat to continue the operation. During the preheating period and the initial combustion period some heat will be transferred to the flange 141 but since that flange is of such large mass it can absorb a relatively large quantity of heat without rising to a very high temperature and a large part of the heat absorbed thereby will be conducted to the outer wall of pot 55 and dissipated therefrom by radiation. It is important that the temperature of flange 141 be maintained at a relatively low value during the starting cycle to prevent carbonization of the liquid fuel thereon and/or pre-ignition of fuel in the space between cylinder 65 and pot 55.

As the apparatus becomes warmer the tube 42 will become heated and heat radiating therefrom onto tube 50 will heat the latter to a sufficiently high temperature to directly vaporize all of the liquid fuel existing as a film, as previously described. It is important that the temperature of all portions of the tube 50 be maintained at a value less than that at which cracking or carbonization of the fuel oil would occur. That temperature is of the general order of 500° F. The air passing along the outer surface of tube 50, between that tube and tube 42, is effective to "cool" tube 50 and prevent its temperature from rising above the point at which carbonization of liquid fuel would take place. The sectional area of the passageway between tubes 42 and 50 will depend upon the material of those tubes, their diameters, the operating temperature within the fire box of the furnace and other forseeable factors all of which can be determined in designing the apparatus. The fan must, of course, furnish a sufficient quantity of air to provide oxygen for use of the fuel fed to the device at the previously mentioned predetermined rate. When the apparatus reaches the point where all of the liquid fuel in tube 50 is being vaporized therein the blast of air moving through the apparatus will entrain all those fuel vapors and deliver a fuel and air mixture into the space 150 between cylinder 65 and pot 55. That fuel and air mixture enters the openings 66 where it is exposed to the heat therein and itself becomes ignited to cause continuous operation of the apparatus. The ceramic body 73 becomes incandescent and insures ignition of all fuel therein and insures maintenance of a high temperature within the cylinder 65, sufficiently high to oxidize any free carbon that may exist. The insulating material 67 acts to maintain the cylinder 65 at a sufficiently high temperature to insure that no vaporized fuel will condense thereon or form a deposit of free carbon thereon.

The vaporized fuel and air mixture entering the space 150 outside the cylinder 65 is at a relatively low temperature compared to the temperature within the burner pot and acts to maintain

the upper portion of cylinder 65, adjacent the openings 66 and the pot 55, at a sufficiently low temperature to prevent pre-ignition of the fuel in the space outside cylinder 65. The "flame" produced by the apparatus is directed outwardly through opening 86 in ceramic ring 85 and a peripheral zone immediately below the ring 85 and adjacent the openings 66 contains fresh fuel and air entering the cylinder which mixture has not yet started to burn. Thus there is no danger of "backfire" through the openings 66.

The escape of heat from the cylinder 65 in the lower portion thereof by either radiation or conduction is minimized by the asbestos insulation 67. While the tube 50 is shown as horizontal, it need not necessarily be so arranged, it could slope downwardly toward the pot 55 or might conceivably even be arranged vertically.

So complete is the combustion obtained in the above described burner, that even the lowest grade catalytic cracking oils can be burned with a smokeless, non-carbon-forming flame.

While there has been described what at present is considered a preferred embodiment of the present invention, it will be appreciated by those skilled in the art that various changes and modifications can be made therein without departing from the essence of the invention and it is intended to cover herein all such changes and modifications as come within the true spirit and scope of the appended claims.

I claim:

1. A pot-type oil burner comprising, a burner pot having an outer wall, a cylinder disposed eccentrically and vertically within said pot to define a crescent-shaped space therebetween, the inside of said cylinder comprising a combustion chamber, means closing the top and bottom of said space, circumferentially spaced apertures through the upper portion of said cylinder to admit fuel to said combustion chamber, a fuel vaporizing tube, means defining a passageway from said tube into the crescent-shaped space between said outer wall and cylinder tangentially of said cylinder and adjacent one end of said space, said tube being arranged to receive heat from combustion in said pot, means for effecting vaporization of liquid fuel on a surface of said tube including a fan arranged to blow air and vaporized fuel through said tube and passageway into said pot, and heat insulating means around said cylinder below said apertures to substantially prevent radiation into said vaporizing tube.

2. In an oil burner, a burner pot comprising a generally cylindrical outer wall, a hollow metal cylinder within and spaced from said outer wall, means closing the ends of the space between said cylinder and outer wall, a heat conductive plate closing the bottom end of said cylinder, means for admitting vaporized fuel and air to the space between said outer wall and cylinder, circumferentially spaced apertures through the upper portion of said cylinder providing for admission of fuel and air to the inside of said cylinder from said space, means for admitting liquid starting fuel into said cylinder on said heat conductive plate, and auxiliary heating means below said plate to initially heat the same and vaporize the starting fuel thereon.

3. A burner pot as defined in claim 2 wherein said means for admitting liquid starting fuel to said cylinder comprises, openings through said cylinder adjacent the bottom thereof, a bottom wall for the space between said outer wall and cylinder, said bottom wall sloping inwardly and downwardly to the level of said openings, said bottom wall being of heat conductive material and being of large mass, and means for dissipating heat absorbed by said bottom wall.

4. A liquid fuel vaporizing apparatus comprising, a stationary outer cylindrical tube, a vaporizing tube rotatably mounted coaxially within said outer tube, the outer surface of said vaporizing tube being spaced radially inwardly of the inner surface of said outer tube, means for blowing air through said vaporizing tube and the space between said tubes from one end thereof, means for positively depositing a film of liquid fuel on the inner surface of said vaporizing tube on a localized portion thereof adjacent said one end and at a predetermined rate, means independent of air flow for rotating said vaporizing tube at a controlled speed sufficient to cause said liquid fuel film to spread over a substantial portion of the inner surface thereof as a relatively thin film but at a speed not exceeding about twenty revolutions per minute, and means for heating said outer tube whereby to heat said vaporizing tube by radiation to vaporize the fuel film thereon.

5. In an oil burner, a burner pot comprising, an outer cylindrical wall having a closed bottom, an inner hollow metallic cylindrical wall supported by said bottom and eccentrically positioned within said outer wall, means closing the upper end of the annular space between said cylinder and wall, means for admitting vaporized fuel and air to the said closed space, circumferentially spaced apertures through the upper portion of said cylinder to provide for admission of fuel and air to said cylinder from said space, a layer of heat insulating material around said cylinder below said apertures, and an annular flange of ceramic material extending inwardly from the upper edge of said cylinder.

6. A burner pot as defined in claim 5 including a perforate body of ceramic material centrally positioned in said cylinder on said bottom.

7. In a method of vaporizing liquid fuel, the steps of; depositing a film of liquid fuel on a heat conductive surface at a predetermined rate, moving said film over said surface at a predetermined and controlled speed so as to spread said fuel film over a substantial portion of said surface, flowing a current of air over said surface and film, supplying sufficient heat to said surface to vaporize said fuel into said current of air, and limiting the heat supplied to said surface so that the temperature of unvaporized fuel does not exceed about 500° F.

8. In a method of vaporizing liquid fuel, the steps of; depositing a film of liquid fuel on one face of a heat conductive surface at a predetermined rate, moving said film over a substantial portion of said surface at a predetermined and controlled speed to spread said liquid fuel over said one face as a thin film, heating said surface by radiation sufficiently to vaporize said film, and blowing a stream of air over both sides of said surface to carry away vaporized fuel and to maintain said surface at a sufficiently low temperature to prevent carbonizing said fuel.

9. A fuel vaporizing device for use with a pot burner comprising: a fuel vaporizing tube, means spaced from said tube and defining a discharge passageway leading from said tube, said tube being arranged to receive heat by radiation from said means, means for positively depositing liquid fuel on a surface of said tube to form a liquid film thereon adjacent the end thereof remote from said discharge passageway and at a prede-

termined rate, a fan arranged to blow air through said tube and passageway, and means independent of air flow for rotating said tube about its axis at a predetermined controlled rate great enough to spread the film of liquid fuel over said surface but not great enough to throw said liquid fuel therefrom by centrifugal force.

10. A device as defined in claim 9 wherein said passageway is defined by a fixed tube coaxial with and surrounding said fuel vaporizing tube but radially spaced therefrom, and means for heating said fixed tube, said fan being arranged to also blow air along the space between said tubes.

11. A device as defined in claim 9 wherein said fuel vaporizing tube is arranged with its axis substantially horizontal and wherein said fuel depositing means is arranged to deposit liquid fuel on the inner surface of said tube.

12. A pot-type oil burner comprising: a burner pot having an outer wall, a cylinder disposed eccentrically and vertically within said pot to define a generally crescent-shaped space therebetween, circumferentially spaced apertures through the upper portion of said cylinder, means defining a passageway for a vaporized fuel mixture into said crescent-shaped space generally tangentially of said cylinder and adjacent one end of said space, and means closing the top and bottom of said crescent-shaped space.

13. An oil burner as defined in claim 12 including a cylindrical body of ceramic material disposed substantially concentrically within said cylinder.

14. An oil burner as defined in claim 13 wherein said cylindrical body is of tubular form and provided with openings therethrough at a plurality of spaced points about its periphery.

15. An oil burner as defined in claim 12 including a layer of heat insulating material around the outside of said cylinder below the said apertures.

16. An oil burner as defined in claim 12 wherein said space between said outer wall and cylinder is closed at the top, a body of ceramic material disposed substantially centrally within said cylinder, and a ring of ceramic material disposed over said cylinder and partially closing the top thereof, there being an opening through said ring substantially centrally of the top of said cylinder.

17. A pot-type oil burner comprising: wall means defining a combustion space, further wall means defining a closed fuel chamber adjacent said combustion space and means defining a flow path for conducting vaporized fuel from said chamber to said space, vaporizing means for liquid fuel including an open-ended vaporizing tube directed toward said chamber, means spaced from said tube defining an open passageway therefrom to the interior of said chamber and being in heat conducting contact with the wall means defining said chamber, and radiation obstructing means interposed between the wall of said combustion space and the interior of said passageway to prevent direct radiation of heat from said combustion space into said vaporizing tube.

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