March 25, 1930. H. TAYLOR 1,751,533

OIL HEATER

Filed July 7, 1926 4 Sheets-Sheet 1

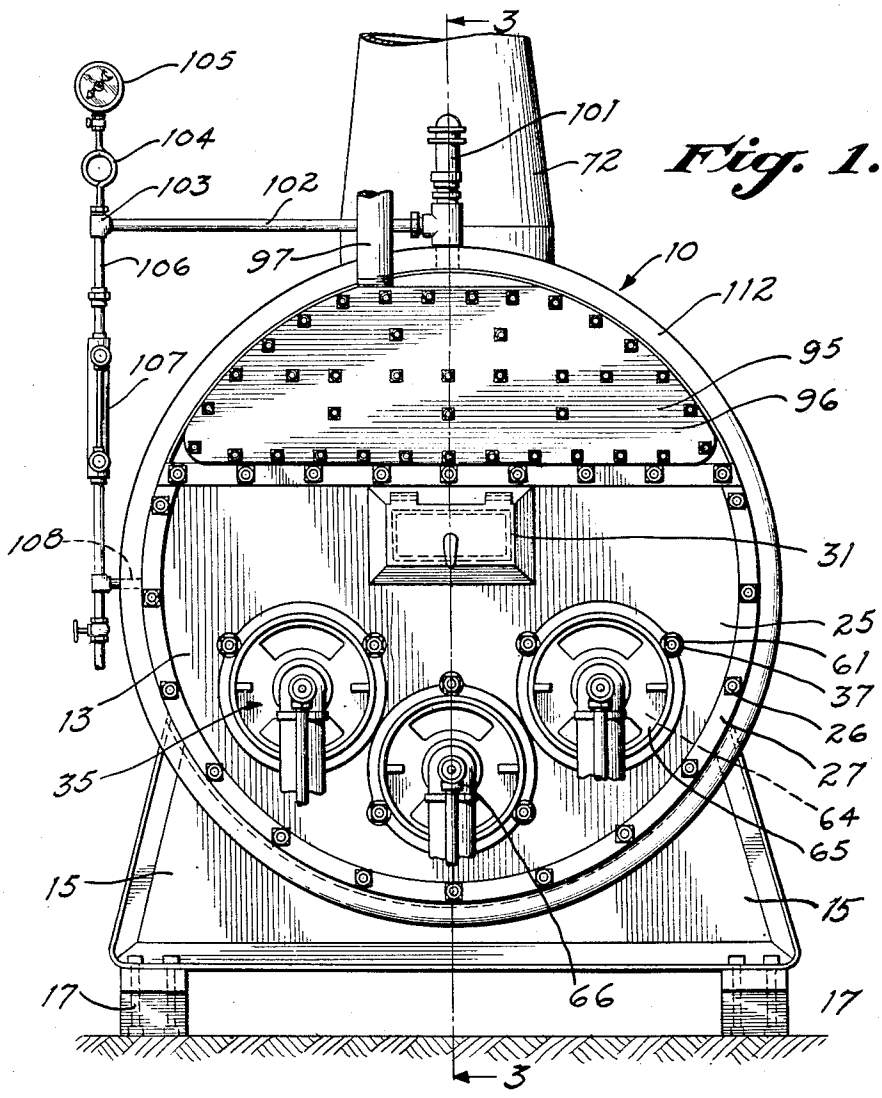
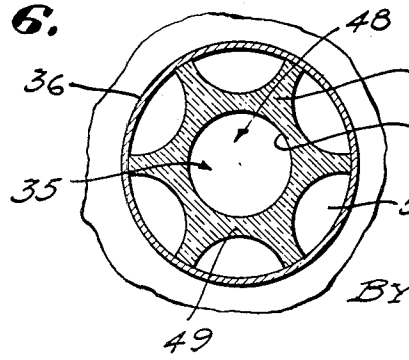


Fig. 1.

Fig. 6.



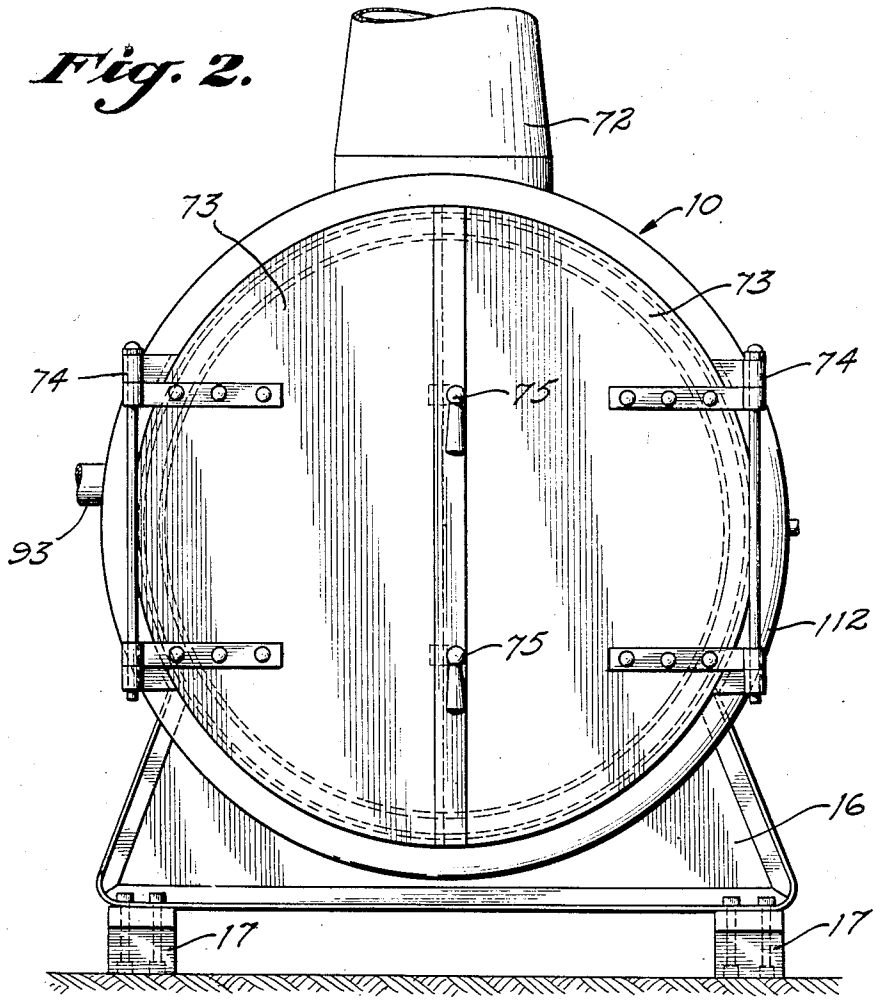
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Fig. 2.



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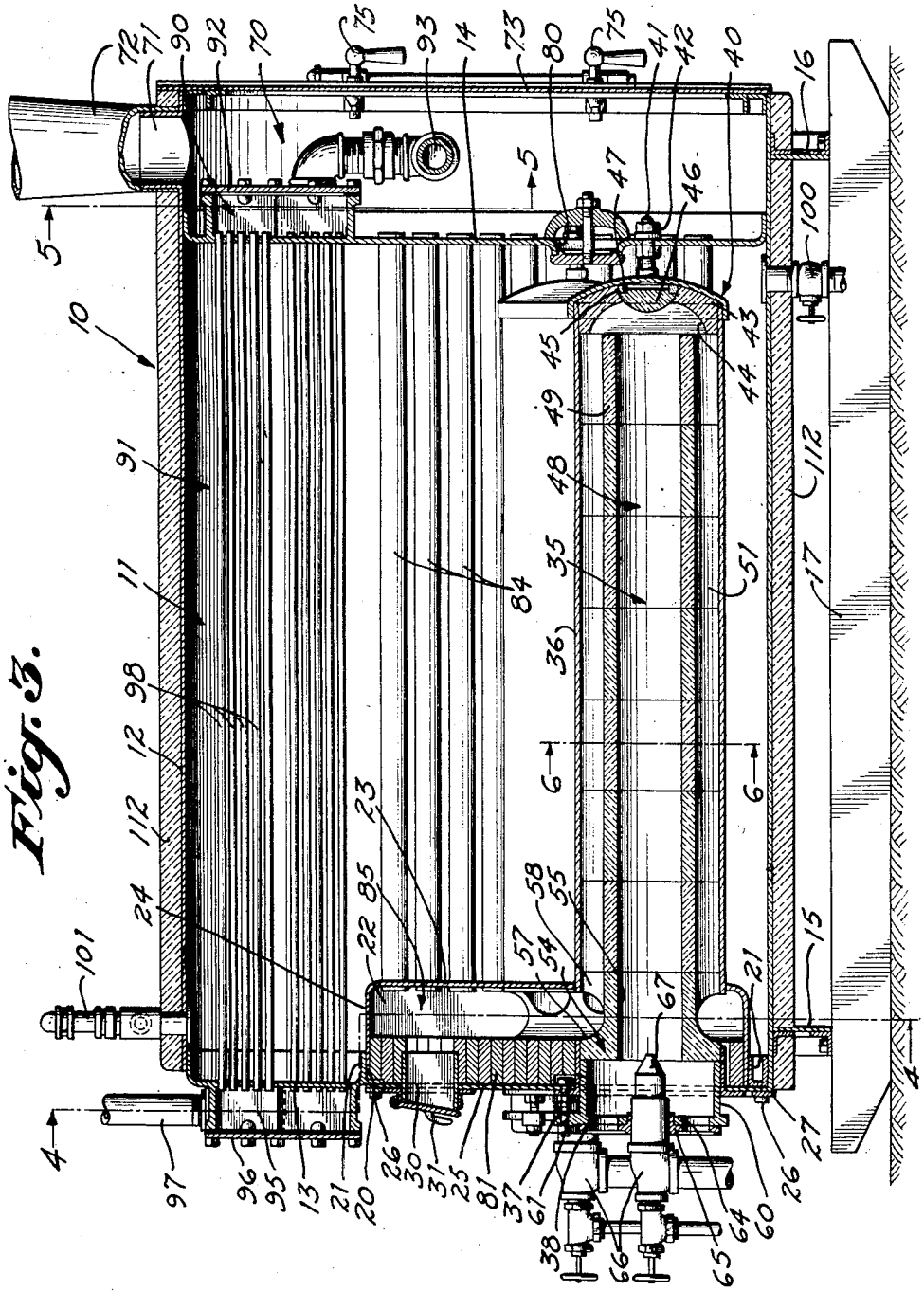


Fig. 3.

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Fig. 4.

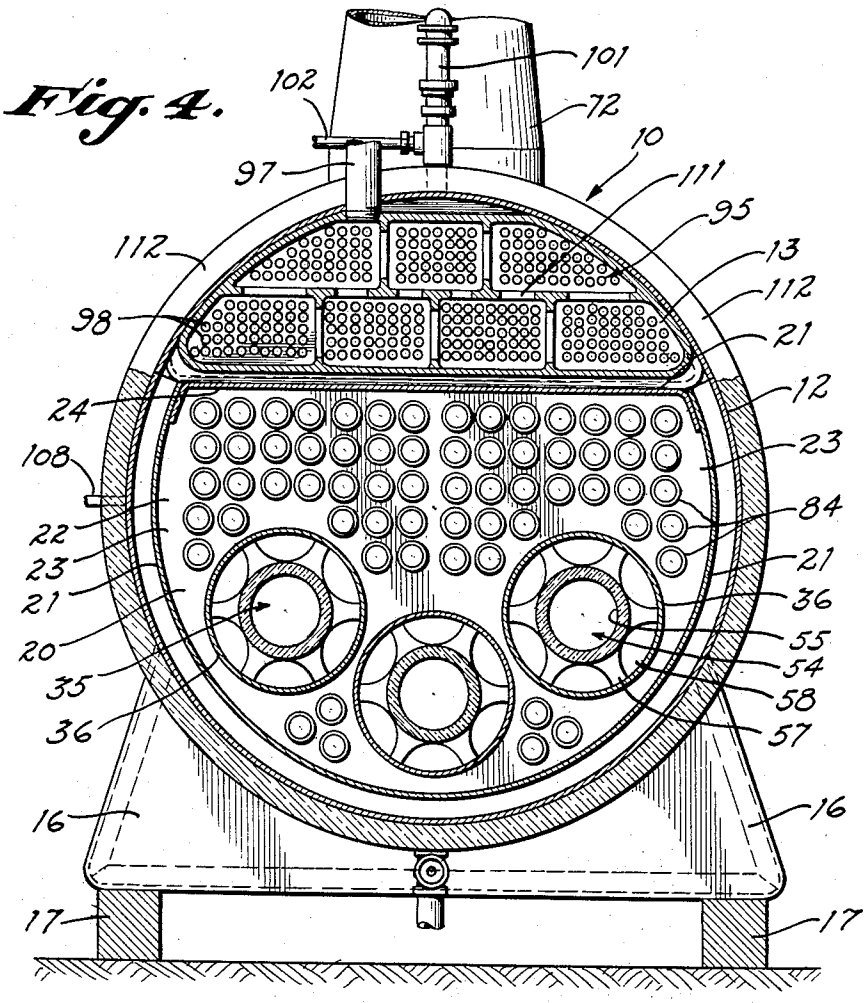
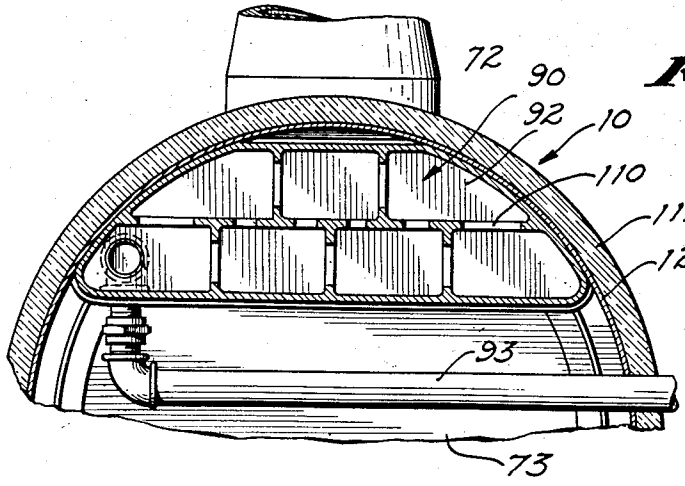


Fig. 5.



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UNITED STATES PATENT OFFICE

HUSTON TAYLOR, OF PASADENA, CALIFORNIA

OIL HEATER

Application filed July 7, 1926. Serial No. 120,907.

My invention relates to an oil heating apparatus and more particularly to a petroleum preheater.

In certain petroleum refining processes it is necessary to preheat the petroleum and this is commonly done by passing the petroleum through an oil heater having a battery of metal tubes which are subjected directly to contact with a heating flame. Due to the high temperature to which the tubes are heated by the direct contact of the flame, a layer of coke is formed on the interior surface of these tubes. This layer of coke insulates the walls of the tubes and prevents the heat from radiating into the oil. This results in localized overheating of the tubes to a point where they are in danger of rupture, because of the lowered tensile strength of the metal at the excessive temperature.

It is the broad object of my invention to provide an oil heater by which petroleum may be preheated without the formation of coke inside the pipes through which heat is transferred to the petroleum.

It is also an object of my invention to provide an oil heater having a high degree of heat efficiency whereby an economical use of fuel may be effected in the refining of petroleum.

Other objects and advantages will be made manifest in the following description and in the accompanying drawings, in which:

Fig. 1 is a front elevational view of a preferred embodiment of the oil heater of my invention.

Fig. 2 is a rear elevational view of Fig. 1.

Fig. 3 is a vertical longitudinal sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is a vertical transverse sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is a fragmentary vertical sectional view taken on the line 5—5 of Fig. 3.

Fig. 6 is a fragmentary vertical sectional view taken on the line 6—6 of Fig. 3.

The preferred embodiment of my invention shown in the drawings is indicated by the numeral 10.

The oil heater 10 has a tight boiler 11 which is formed of a cylindrical shell 12 having a front head-plate 13 and a rear head-plate 14. The boiler 11 is mounted by fore and aft frame members 15 and 16 upon a pair of skids 17. The front head-plate 13 has an opening 20 formed therein which occupies slightly more than the lower semi-circular portion of the head-plate 13. A flange 21 is formed about the edge of the hole 20. A shallow box 22, having a face-plate 23 and a perimetrical wall 24, formed upon the face-plate 23, closes the hole 20, the wall 24 being tightly secured to the flange 21. A cover-plate 25 covers the front of the hole 20 and overlaps the adjacent edges of the head-plate 13 to which it is bolted by bolts 26. If desired, a reinforcing strap 27 may be placed between nuts of the bolts 26 and the cover-plate 25. A look-box 30 is mounted in the upper portion of the cover-plate 25 and has a hinged door 31 which may be lifted to view the interior of the box 22.

A plurality of combustion units 35 are secured to the cover-plate 25, the box 22, and the rear boiler head-plate 14. In the present embodiment, three combustion units 35 are thus mounted, these being disposed parallel with the axis of the boiler 11 and spaced an equal distance from the axis of the boiler 11, and at equal angles from each other. Each combustion unit 35 has a tubular shell 36 which is tightly secured in a suitable aperture formed in the face-plate 23. Secured in a hole in the cover-plate 25 by bolts 37, so as to be in alignment with the tubular shell 36 of each combustion unit 35, is a short flanged tube 38 of the same diameter as the tubular shell 36. A metallic cap 40 is tightly secured upon the inner end of each of the tubular shells 36. A stud 41 is formed centrally upon each of the caps 40 and is rigidly secured by nuts 42 in a suitable aperture in the end-plate 14 to form supports for the inner ends of combustion units 35.

Each cap 40 is convex in form and receives an annular member 43 which is formed of a refractory material and which has an annular arcuate face 44 which is disposed toward the opposite end of the tube 36. The member 43 has a central opening 45 formed therein in which an impact-head 46, formed of a refractory material, is adapted to be

inserted, this head being held in place against the restricted mouth of the opening 45 by a metallic spacer-ring 47 which contacts the cap 40. Disposed within the shell 36 is a combustion barrel 48 which is formed of sections 49 which are composed of a refractory material. All of the sections 49, with the exception of the outermost, are formed with a cross section as illustrated in Fig. 6. A central cylindrical hole 50 is formed through each section 49 while semi-cylindrical channels 51 are formed parallel with the hole 50 in the outer surface of the section 49 and equally spaced about the periphery thereof. The sections 49 are placed in the shell 36 so that the corresponding channels 51 of these sections are in alignment with each other. The outermost section 49, which is indicated by the numeral 54, has a central hole 55 of the same size and in alignment with the holes 50 of the other sections 49. The section 54 has an annular channel 57 in the periphery thereof which connects with each of the channels 51 in the adjacent section 49 through a short channel 58. Forcing the combustion barrel 48 inwardly, against the member 43, is a follower 60 which slidingly fits within the short flanged tube 38 and is held against the section 54 by nuts 61 turned down upon extending ends of the bolts 37. Each follower 60 has a spider 64 formed upon its forward face, this spider being adapted to rotatably receive a valve member 65 centrally thereupon. The valve member 65 is rotatable to control the passage of air through the openings in the spider 64. Mounted centrally in the valve member 65 is a gun burner 66, the tip 67 of which is disposed in the mouth of the hole 55 of the section 54.

As will be seen in Fig. 3 the rear head-plate 14 is mounted in the cylindrical boiler shell 12 a short distance inward from the rear end of this shell, so as to form a stack chamber 70 from which an opening 71 is provided which connects with a stack 72. The rear end of the stack chamber 70 is closed by a pair of semi-circular doors 73 as clearly shown in Fig. 2. The doors 73 are mounted upon hinges 74 provided upon the rear end of the boiler shell 12 and the doors are held in closed position by manually operated locks 75. A manhole 80 is provided in the rear end-plate 14 to provide access to the interior thereof.

Fire bricks 81 are stacked within the box 22 against the rear face of the cover-plate 25 so as to effectively protect the cover-plate 25 from the heat of products of combustion which, as will be explained later, pass through the box 22. Flues 84 are provided in the boiler 11 so that opposite ends are tightly rolled into aligned holes in the face-plate 23 and in the rear end-plate 14, so as to set up communication between the vestibule 85 in the box 22 and the stack chamber 70.

An oil inlet header-box 90 is formed integrally with the rear end-plate 14 opposite a heating chamber 91 which is formed by the space in the boiler 11 above the combustion units 35 and the flues 84. The inlet header-box 90 has a cover-plate 92 tightly secured thereto. An oil inlet pipe 93 connects with the header-box 90 through the cover-plate 92. An outlet oil header-box 95 is formed integrally with the front head-plate 13 on the outside thereof and positioned directly opposite the header-box 90 across the oil heating chamber 91. The outlet header-box 95 has a cover-plate 96 tightly secured thereto. An outlet pipe 97 connects to the header-box 95 through a wall thereof. Oil heating pipes 98 are disposed in the oil heating chamber 91, their opposite ends being rolled into suitable holes formed in the front and rear head-plates 13 and 14 so as to cause the inlet header-box 90 to communicate with the outlet header-box 95 through the oil heating pipes 98.

From the above description it may be seen that the interior of the boiler 11 is a perfectly tight chamber, of which the chamber 91 is merely the upper portion. This chamber may be filled with a fluid heat conveying medium through a valve inlet 100 provided in the bottom of the cylindrical shell 12. A safety valve 101 is provided in the upper portion of the cylindrical shell 12 and connects to a pipe 102 and through the upper end of a T 103, to a siphon 104 and a steam gage 105. The pipe 102 connects through the lower end of the T 103, and a pipe 106, with a water column 107, the lower end of which connects by a nipple 108 with the middle portion of the shell 12.

As will be seen by reference to Figs. 4 and 5, the inlet and outlet header-boxes 90 and 95 are provided with reinforcing webs 110 and 111 respectively. The webs 110 and 111 reinforce the structure of the header-box and act as baffles.

The cylindrical boiler shell 12 is provided with a covering of heat insulating material 112 in order to prevent undue radiation of heat therefrom.

The operation of my crude oil heater is as follows:

The boiler 11 is first filled through the valved inlet pipe 100 with a fluid heat conveying medium such as water. The fuel is now caused to be injected by the gun burners 66, into the central passageways formed by the openings 50 and throughout the length of the combustion barrels 48. This fuel which is preferably a gas, or crude oil, in the form of finely divided vapor and mixed with steam, is ignited when the burners 66 are first turned on. The products of combustion of the fuel, which is thus burned in the

combustion barrel 48, pass out of the inner end of the barrel 48, impinge against the impact-head 46, and are then forced outwardly and given a reverse motion by the arcuate surface 44 of the annular member 43, so that these products of combustion return through the channels 51 to the outer section 54 of the combustion barrel 48. Here these products are discharged into the vestibule 85 from which they pass through the flues 84 into the stack chamber 70 and thence through the opening 71 up the stack 72.

The confining of the fuel vapors in the first steps of their combustion within the confines of the elongated cylindrical passageway of the combustion barrel 48 produces a much higher temperature than would be obtained by the burning of the fuel in a larger fire-box. This higher temperature heats the refractory material of the sections 49 to an incandescent state. Carbon monoxide is formed in the first stages in the combustion of the fuel and this carbon monoxide will burn only at a high temperature. In the presence of the incandescent refractory material the carbon monixide is burned, thus causing a complete combustion of the fuel oil in the combustion barrel 48. The impact head 46 is raised to an extremely high temperature by the impact of the completely burned fuel therewith; and this impact-head must therefore be made of a refractory material which has the quality of resisting chemical change at extremely high temperatures. One of the features of the construction of the combustion units 35 is that the impact-head 46 is removable so that it may be replaced when worn away through the erosion caused by impact therewith of the gases of combustion. In returning from the inner end of a combustion unit 35 along the channels 51 of the combustion barrel 48 the gases, at their extremely high temperature, are brought directly against its tubular shell 36 which is surrounded by water; thus a large portion of the heat units, contained in these hot products of combustion, is conducted through the tubular shells 36 into the water. When entering the vestibule 85, however, these gases are still at a much higher temperature than the water within the boiler 11; therefore, in passing through the flues 84 to the stack chamber 70 a still further transfer of heat occurs from the gases to the water.

When the water has been raised to a fairly high temperature, oil is admitted through the inlet pipe 93 to the header-box 90 and flows through the tubes 98 to the header-box 95 from which it is conducted through the outlet pipe 97. The water in the space 91, or the steam produced by the water, surrounds the pipes 98 and heat is conducted from the water or steam through the walls of the pipes 98 to raise the temperature of the oil flowing therethrough. Owing to the small size of the pipes 98, the oil in flowing through these pipes from the header-box 90 to the header-box 95 will be heated substantially to the temperature of the water or steam in the boiler 11. However, there is no possibility of coke being formed on the inner surface of the tubes 98, due to the fact that fire does not touch these tubes directly and these tubes can therefore never be heated to a sufficient temperature to separate coke from the oil flowing therethrough. The temperature of the water and superheated steam contained in the boiler 11 is sufficient to heat the oil to the temperature at which it must be raised in this step of the refining process.

The amount of air which is admitted through the valve member 65 for mixture with the fuel ejected from the burner tip 67 may be regulated by rotary adjustment of the valve member 65 so that the proper mixture of air and fuel may be attained to insure perfect combustion of the mixture in the combustion barrel 48.

As will be noted, the oil heater of my invention is very compact in structure and comparatively light in weight so that it is feasible to mount the same on the skids 17 as shown in the drawings. The oil heater may thus be drawn through the fields from point to point, wherever it is necessary to heat crude oil for any reason. Thus the oil heater of my invention might be utilized along a pipe line for emergency use during cold seasons of the year when it is necessary to employ auxiliary heating apparatus between the regular heating and pumping stations along the pipe line.

I claim as my invention:

1. An oil heating apparatus comprising a shell containing a heat exchange fluid, a combustion chamber projecting into said shell, a relatively large outlet vestibule for receiving the combusted gases and discharging them to the atmosphere, a multiplicity of small oil conveying tubes situated within said shell, and a large oil distributing pipe connected to said tubes and extending through said outlet vestibule with its outer surface in direct contact with the outlet gases passing through said vestibule.

2. An oil heating apparatus comprising a shell containing a heat exchange medium, an elongated combustion chamber projecting into said shell, an outlet vestibule adjoining a surface of the shell and in communication with the atmosphere, a plurality of oil conveying tubes extending through said shell, a header for the set of tubes arranged within said vestibule, an oil distributing conduit connected to said header and passing through said vestibule to a point outside thereof, and a plurality of flues within said shell for conducting gases from said combustion chamber in a tortuous path to said outlet vestibule, whereby the gases lose sufficient heat to per-

mit them to make safe heat-exchanging contact with said header and said conduit as they exit through said vestibule.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 2nd day of July, 1926.

HUSTON TAYLOR.