March 21, 1933. L. C. HUFF 1,901,970

FLUID HEATING APPARATUS

Filed Sept. 27, 1930

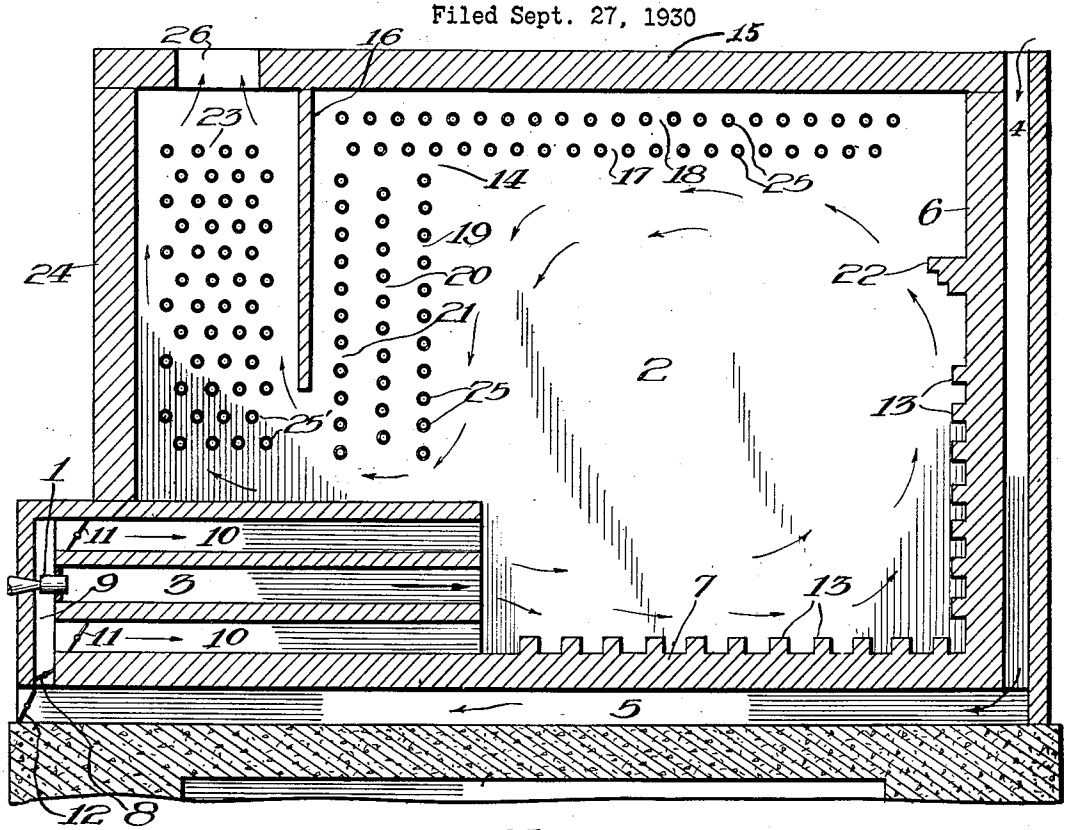


Fig. 1.

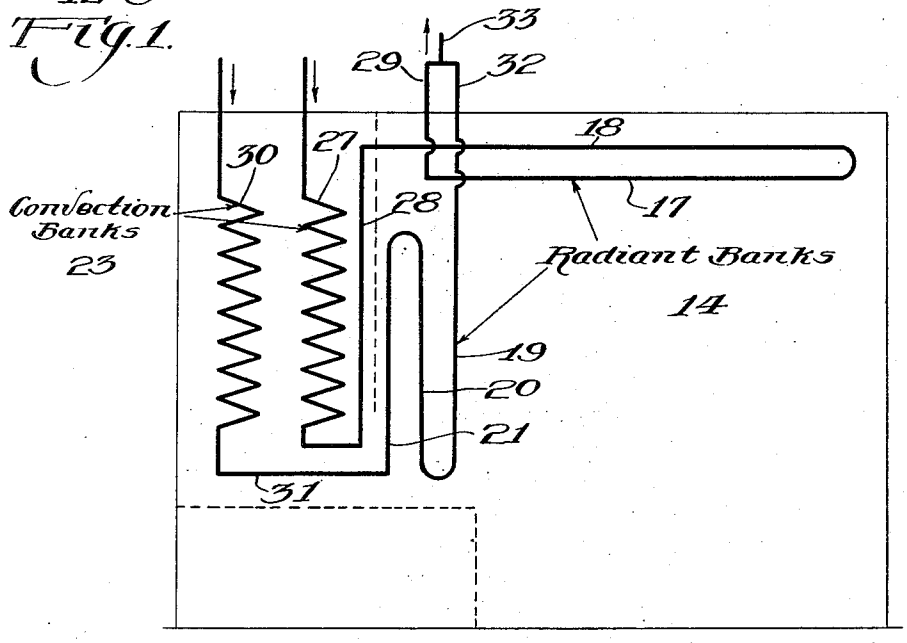


Fig. 2.

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UNITED STATES PATENT OFFICE

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FLUID HEATING APPARATUS

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This invention relates to the treatment of hydrocarbon oils, and particularly to an improved form of furnace for heating oils to relatively high temperatures such as those employed in cracking.

Primarily the present invention comprises a furnace including a combustion chamber to which combustible material is supplied through a firing tunnel or similar arrangement, a heating element disposed along two adjacent walls of said combustion chamber and directly opposite two other adjacent walls of the combustion chamber which are directly heated or exposed to direct firing and which radiate heat to said heating element, a second or convection heating element adjacent the point of entrance of combustible materials into the combustion zone and also adjacent that portion of the aforementioned heating element disposed along one wall of the combustion chamber and means for admitting gases from the combustion chamber to contact with the convection heating element.

Other embodiments of the invention as well as advantageous features which the invention provides will be apparent by reference to the attached drawing which diagrammatically illustrates one form of my improved furnace.

In the drawing, Fig. 1 is a diagrammatic sectional elevation of a furnace constructed in accordance with the principles of my invention.

Fig. 2 is a schematic drawing showing one method of passing the oil through the furnace.

Referring particularly to Fig. 1, fuel such as oil, gas or mixtures of these with air is supplied through burner 1 and introduced into combustion chamber 2 through firing tunnel 3. One or a plurality of firing tunnels similar to that indicated at 3 may be utilized, and a plurality of burners may, of course, be employed to supply fuel thereto. Air may be admitted through the ducts 4 and 5 located along the rear wall 6 and floor 7 of the furnace, serving to cool these walls and becoming preheated by contact with the relatively hot walls. A portion or all of this preheated air may be admitted past damper 8, in duct 9, into tunnels 10, past dampers 11. The air tunnels 10 may be disposed adjacent the firing tunnel or tunnels 3 and the air passing therethrough may be further preheated by contact with the hot walls of the firing tunnels before it is admitted to combustion chamber 2. Regulated amounts of air can also be supplied to tunnels 10 and 3 by regulating damper 12. Rear wall 6 and floor 7 of the comubstion chamber may have projections such as indicated at 13 which present a rough surface to the materials undergoing combustion and may be heated to incandescence.

A heating element 14 comprising, in the case illustrated, a plurality of tubes 25, connected serially or otherwise, is disposed along the roof 15 and baffle wall 16 of the furnace. A plurality of rows of tubes may be disposed along these walls and as illustrated the radiant roof bank may comprise a lower or exposed row of tubes 17 and an upper or shielded row of tubes 18 while that portion of the radiant heat bank disposed along the baffle wall 16 may comprise an inner or exposed row of tubes 19, an intermediate row of tubes 20 and an outer or shielded row of tubes 21. It will be noted that the two walls 6 and 7 directly opposite heating element 14 are exposed to direct firing and may be heated so as to present substantially incandescent surfaces which radiate heat to this heating element. It will also be noted that owing to the location of heating element 14 relative to the hot walls 6 and 7, a circulatory movement of combustion gases will be thermally induced in the combustion zone. A projecting ledge 22 may be provided along the rear wall 6 of the furnace to deflect the combustion gases away from the roof 15 and the radiant heating element 14 and to assist in directing the circulation of the gases within this zone.

A convection heating element 23, comprising a plurality of rows of tubes 25′, connected in series or otherwise, may be located adjacent the front wall 24 of the furnace and may be separated from the combustion chamber 2 and from the radiant heating element 14 by baffle wall 16. It will be noted that the convection heating element 23 is disposed adja-

cent the firing tunnel 3 and the arrangement is such that the gases passing to this heating element leave combustion chamber 2 at a point close to the point of entrance of combustible materials into this zone but also that the gases, leaving chamber 2 to pass around heating element 23, are substantially the coolest gases within this zone, having passed entirely around the combustion zone in a path substantially as indicated by the arrows. Spent combustion products leave the furnace to a stack (not shown) through flue opening 26.

As a feature of the present invention the convection heating element 23 and the radiant heating element 14 may each be divided into a plurality of sections, permitting the oil entering the heating elements to be divided into a plurality of streams of variable proportions and thus permitting control of the amount of heat absorbed in each heating bank of the heating elements. This feature will be more apparent by reference to Fig. 2 of the attached drawing which diagrammatically illustrates one path of flow of oil through the heating elements. A portion of the charging stock enters that portion of the convection heating element 23 indicated at 27, passing downwardly through successive rows of tubes countercurrent to the flow of combustion gases and may thence be transferred through line 28 to the upper or shielded row 18 of radiant heating element 14, thence through the lower or exposed row 17 of the radiant heating element and out through line 29. Another portion of the charging stock, which may be material of the same nature as that introduced into portion 27 of the convection bank or may be, if desired, a different charging stock and which may bear any desired ratio to that portion of the total charge introduced into 27, is supplied to that portion of the convection bank 23 indicated at 30. This oil also passes downwardly through successive rows of heating tubes countercurrent to the flow of combustion gases and may be transferred through line 31 to the outer or shielded row 21 of radiant heating element 14, thereafter passing through first the intermediate row 20 and then the inner or exposed row 19 of the radiant heating element finally leaving the furnace through line 32. The two streams of heated oil may preferably be combined in line 33 and pass to subsequent stages of the process.

It will be apparent that the improved method and means of heating hydrocarbon oils embodied by the present invention may be utilized to advantage either in heating oils to the relatively high temperatures employed in cracking, or may be utilized in lower temperature distillation processes, for example, in the distillation or topping of crude petroleum.

It will also be apparent that while one particular path of flow for the oil undergoing heating is illustrated and described the invention is not so limited as many combinations of the various portions of the radiant and convection heating elements may be utilized to advantage in combination with the features of the invention.

I claim as my invention:

1. A furnace comprising in combination, a combustion chamber, means for introducing combustible fuel into said chamber, a heating chamber, means for directing the hot products of combustion from the combustion chamber into the heating chamber into contact with the floor and opposite wall of the heating chamber, and a row of fluid passageways disposed in said heating chamber opposite and parallel to said floor and a second row of fluid passageways disposed in said heating chamber opposite and parallel to said wall, and means for removing combustion gases from said heating chamber at a point opposite said wall and adjacent said combustion chamber.

2. A furnace comprising in combination, a combustion chamber, means for introducing combustible fuel into said chamber, a heating chamber, means for directing the hot products of combustion from the combustion chamber into the heating chamber into contact with the floor and opposite wall of the heating chamber, a row of fluid passageways disposed in said heating chamber opposite and parallel to said floor, a second row of fluid passageways disposed in said heating chamber opposite and parallel to said wall, and an outlet duct disposed above and adjacent said combustion chamber and opposite said wall and in communication with said heating chamber.

3. A furnace comprising in combination, a combustion chamber, means for introducing combustible fuel into said chamber, a heating chamber, means for directing the hot products of combustion from the combustion chamber into the heating chamber into contact with the floor and opposite wall of the heating chamber, a row of fluid passageways disposed in said heating chamber opposite and parallel to said floor, a second row of fluid passageways disposed in said heating chamber opposite and parallel to said wall, an outlet duct disposed above and adjacent said combustion chamber and opposite said wall and in communication with said heating chamber, and a plurality of fluid passageways disposed in said outlet duct.

4. A furnace comprising in combination, a combustion chamber, means for introducing combustible fuel into said chamber, a heating chamber, means for directing the hot products of combustion from the combustion chamber into the heating chamber into contact with the floor and opposite wall of the

heating chamber, a row of fluid passageways disposed in said heating chamber opposite and parallel to said floor, a second row of fluid passageways disposed in said heating chamber opposite and parallel to said wall, an outlet duct disposed above and adjacent said combustion chamber and opposite said wall and in communication with said heating chamber, and a plurality of fluid passageways disposed in said outlet duct, said products of combustion entering the heating chamber being adapted to circulate adjacent the confining walls of the heating chamber and be discharged through the outlet duct.

5. In combination, a furnace comprising a combustion chamber, a heating zone communicating with said combustion chamber, means for introducing combustible fuel into said combustion chamber and passing the hot products of combustion into the heating zone along the floor and against the opposite wall thereof, and means for removing the substantially spent products of combustion from the heating zone at a point adjacent the point of entrance of said hot products into said heating zone.

6. In combination, a furnace comprising a combustion chamber, a heating zone communicating with said combustion chamber, means for introducing combustible fuel into said combustion chamber and passing the hot products of combustion into the heating zone, means for removing the substantially spent products of combustion from the heating zone at a point adjacent the point of entrance of said hot products into said heating zone, and means for establishing a circulation of said products of combustion from the combustion chamber to the spent products exit, which comprises a floor and wall of the heating zone disposed respectively adjacent and opposite the point of entrance of the hot products of combustion into the heating zone and a plurality of fluid passageways disposed in said heating zone opposite said floor and wall and adjacent the exit of the spent products of combustion.

In testimony whereof I affix my signature.

LYMAN C. HUFF.