Oct. 29, 1940. R. L. ZIMMERMAN 2,219,860

HEATING APPARATUS

Filed Sept. 15, 1937

FIG. 1.

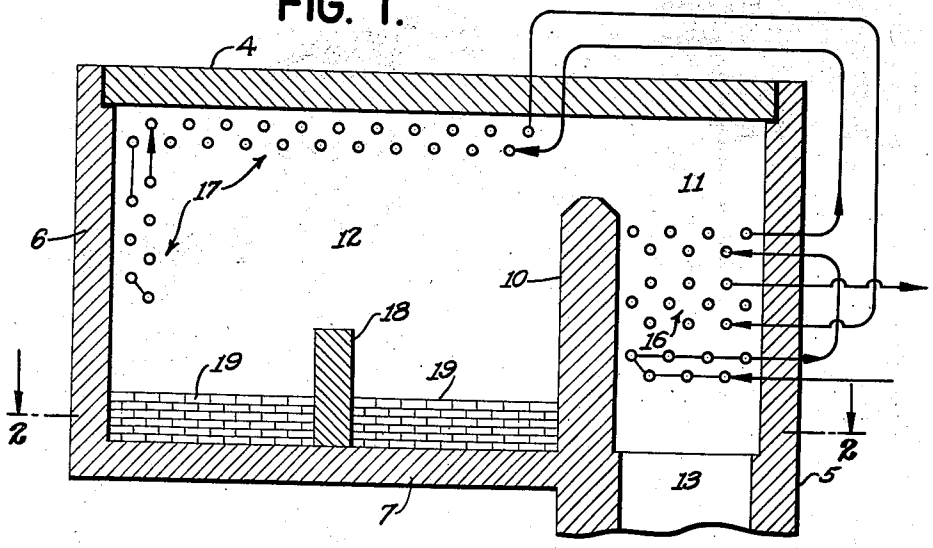
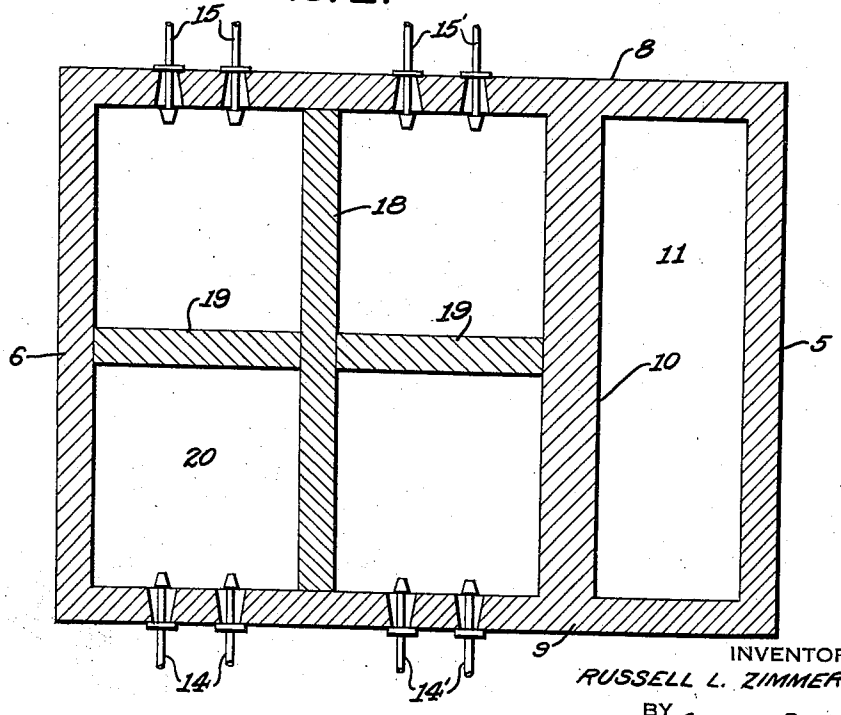


FIG. 2.



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HEATING APPARATUS

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9 Claims. (Cl. 196—116)

My invention relates to heating apparatus and more particularly to an improved apparatus for heating hydrocarbon fluids.

An object of the present invention is an improved heating apparatus of the type in which hot combustion products are introduced in one or more combustion or radiant heating chambers by means of burners positioned in opposing walls of each combustion or radiant heating chamber and wherein substantially complete uniformity of heat distribution throughout the apparatus is obtained by the presence within the combustion or radiant heating chamber of means, such as refractory walls extending across the lower part of the combustion chamber both horizontally and perpendicularly to the burner walls for deflecting the flow of ignited fuel and combustion products, and which means further function as heat radiating surfaces.

In heating fluids by passage through externally heated conduits positioned within a furnace structure it is necessary that heat distribution throughout the apparatus be uniform to insure proper heat absorption by the fluid during its flow through the apparatus. It is essential that concentrated localized zones of heating within the apparatus resulting in overheating of restricted sections of the fluid conduits and furnace structure be avoided. Proper conditions of heat distributions devoid of the above mentioned defects are quite essential in heating apparatus, particularly heating apparatus used for the conversion of hydrocarbons, wherein hot products of combustion are introduced to the interior of one or more combustion or heating chambers by means of burners located in opposing sides of the combustion or heating chambers. Uneven heat distribution may be greatly attributed to a tendency for the hot combustion products to sweep in a substantially concentrated stream along a narrow, well-defined, irregular path through the apparatus thus overheating those parts of the furnace structure and fluid conduits within the path of this concentrated stream. Such uneven heat distribution further results in a deficiency of heat absorption by other sections of the fluid conduits with a consequential loss of effective fluid heating surface.

In accordance with my invention a refractory partition is positioned in the lower part of the combustion chamber perpendicular to the burner walls and extending across the lower part of the combustion chamber to impede junction of streams of combustion products comprising ignited fuel, prior to their complete combustion, and to eliminate lateral sweeping of concentrated streams of combustion products within the chamber. A second refractory partition is positioned in the lower part of the combustion chamber perpendicular to the first partition and parallel to the burner walls to impede immediate juncture of opposing streams of combustion products and to deflect the streams of combustion products to prevent their flowing in concentrated streams against the forward or rear wall of the chamber. The second wall further serves to break up completely the stream undergoing combustion, bringing about substantially complete combustion before the products leave the lower part of the chamber. The walls thus arranged divide the lower part of the heating chamber into quadrants and act as radiating surfaces thus materially aiding in effecting uniform distribution of radiant heat to the heating conduits throughout the entire chamber.

The invention is useful in connection with any heating apparatus of the type in which combustion products are introduced to one or more combustion or heating chambers by means of burners positioned in opposing walls of each combustion chamber and in which apparatus fluids and other materials in general are raised to elevated temperatures. It is, however, especially useful in connection with the box-type heater of the bridge wall type used in the pyrolytic treatment of hydrocarbon fluids, such as, for example, the distillation of hydrocarbon oils, the conversion of hydrocarbon oils, and the polymerization of hydrocarbon gases.

The invention will be more fully understood from the following description read in connection with the accompanying drawing, in which like numerals are employed to designate like parts throughout the same.

Figure I is a longitudinal vertical cross section of an apparatus embodying my invention, and Figure II is a section of the same apparatus, the section being taken along a horizontal plane indicated by the line 2—2 in Figure I.

The drawing illustrates an apparatus embodying the invention and comprises a furnace structure of the bridge wall type including a roof 4, and walls 5, 6, a floor 7, a rear wall 8, and a forward wall 9. A bridge wall 10 separates the furnace into a combustion or radiant heating section 12 and a convection heating section 11. A flue 13 leads from convection heating section 11 to a stack not shown in the drawing. Burners 14, 14' for the introduction of fuel or combustion products into combustion chamber 12 are

positioned in the lower part of forward wall 9 of the furnace structure. Similar burners 15, 15' for the introduction of fuel or combustion products into combustion chamber 12 are similarly positioned in the lower part of rear wall 8 of the furnace structure. Fluid heating tubes 16 and 17 are positioned in the convection heating chamber 11 and radiant heating chamber 12 respectively, the tubes 16 being heated preponderantly by convection heat while the tubes 17 are heated preponderantly by radiant heat.

Efficient heating of conduits in such a furnace of the bridge wall type requires uniform distribution of radiant heat throughout combustion chamber 12 with the passage of combustion products over bridge wall 10 and downwardly through convection heating section 11 in a uniformly well distributed manner.

In operating furnaces, many factors, including the individual burners may cause combustion products to pass through the combustion chamber, over the bridge wall and through the convection chamber in a substantially narrow, concentrated stream, the cross sectional area of which is but a fractional part of the entire cross section of the furnace. Such concentrated stream of hot combustion products may at times sweep laterally against a section of the upper part of end wall 6 or bridge wall 10, and at other times against the rear wall 8 or the forward wall 9, resulting in overheating of the section of the furnace structure and heat absorbing tubes in the path of the concentrated stream and a deficiency of heat supply to a part of the heat absorbing tubes positioned in a part of the furnace remote from the path of the concentrated stream of hot combustion products. Such overheating, particularly to roof tubes, such as tubes 17, may take place due to the upward sweep of ignited fuel emanating from burners 14, 14', 15, 15' prior to substantially complete combustion thereof.

In the improved fluid heating apparatus according to my invention there is positioned within combustion or radiant chamber 12 a secondary bridge wall 18, extending across the lower part of the combustion chamber 12 from rear wall 8 to forward wall 9, parallel to the main bridge wall 10 and intermediate the main bridge wall 10 and end wall 6. The secondary bridge wall extends upward from the floor of combustion chamber 12 to a height not exceeding that of main bridge wall 10 and preferably to a height equal to about one half that of the main bridge wall 10. It has been found that the presence of such a secondary bridge wall definitely impedes lateral sweeping of concentrated streams of hot combustion products supplied to combustion chamber 12 by means of burners 14, 14', 15, 15'.

A second wall 19 is positioned in the lower part of combustion chamber 12, perpendicular to the secondary bridge wall 18, parallel to and intermediate burner walls 8 and 9, and extending from end wall 6 to the secondary bridge wall 18, and from secondary bridge wall 18 to main bridge wall 10, thus dividing the lower part of combustion chamber 12 into quadrants. Transverse wall 19 extends from the floor of combustion 12 to a height greater than the top part of burners 14, 14', 15, 15' but not greater than the height of the secondary bridge wall and should preferably extend from the floor of combustion chamber 12 to a height equal to about one half that of the secondary bridge wall 18. Wall 19 effectively breaks up the streams of hot combustion products comprising incompletely burned fuel emanating from burners 14, 14', 15, 15' and thus insures substantially complete combustion of the fuel prior to its leaving the vicinity of the lower part of combustion chamber 12. By deflecting the initial horizontal flow of combustion products, wall 19 definitely impedes the sweep of concentrated streams of hot combustion products against rear wall 8 and forward wall 9.

Although the relative heights of secondary bridge wall 18 and transverse wall 19 given are those preferred it is understood that the height of either or both walls may be varied to comply with varying operating conditions and types of burners. The secondary bridge wall 18 and the transverse wall 19 are constructed of a suitable refractory material, for example fire brick, and either wall or both walls may be of checkerbrick type construction.

The improved heating apparatus in accordance with my invention not only provides a box type heater in which defective heat distribution and harmful concentrated heating zones are eliminated but makes possible a much wider range of control over heat input into definite sections of the heat absorbing tubes positioned within the combustion or radiant heating chamber. This latter feature is made possible by separate control of each set of burners discharging into each of the separate quadrants comprised in the lower part of the combustion chamber. By increasing, for example, the intensity of firing of burners 14, discharging into quadrant 20 in the lower part of combustion chamber 12, more radiant heat will be reflected from those sections of secondary bridge wall 18 and transverse wall 19 marking the limits of quadrant 20, than will be reflected from other sections of these walls and thus controlled concentrated heating effects can be produced to increase the heat input into the those tubes receiving reflected heat from the inner faces of the walls limiting quadrant 20. Similarly the intensity of firing within any one or several of the other quadrants can be independently intensified or decreased to produce a desired controlled heating effect.

In Figure I, I have shown the tubes connected in a manner whereby the fluid being treated is first passed through tubes 16 in the cooler part of the convection section 11, thence through tubes 17 in the radiant section 12 and finally through tubes 16 in the hotter part of the convection section 11. The flow shown is for illustrative purposes only and may be widely varied as is well understood.

Although a furnace having but one combustion or radiant heating chamber and one convection section set forth in the illustrative description and drawing of the invention it is to be understood that the invention is in no wise limited to such a furnace but is equally applicable to box type furnaces having more than one combustion or radiant heating chamber in conjunction with a single or several convection heating chambers. Similarly the invention is not limited to the use of the specific number of burners nor to the specific arrangement of heat absorbing tubes shown in the drawing. Tubes may be variously placed in the chamber 12 as is well understood. The burners, for example, may be positioned in the burner walls in such a manner that only one burner or more than one burner discharges into a single one of the quadrants comprising the lower part of the combustion or radiant heating chamber. Furthermore, the number of burners discharging into each one of the said quadrants need not

necessarily be the same for each quadrant and the particular number so used is dependent upon the operating conditions desired.

While there is shown and described the preferred embodiment of the invention, it is to be understood that the invention is not confined to the precise details of construction herein set forth, by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit thereof, or exceeding the scope of the appended claims.

I claim:

1. A furnace for heating fluids to elevated temperatures comprising a radiant heating section, a convection heating section receiving hot combustion products from said radiant heating section, a bridge wall separating said radiant heating section from said convection heating section, burner means for supplying combustion products to said radiant heating section in a direction substantially parallel to said bridge wall, fluid heating tubes positioned in said radiant and convection heating sections, a separate wall dividing said burner means for supplying combustion products to said radiant heating section into separate opposing groups and adapted to prevent lateral overlapping of flames from burner means on opposite sides of said separate wall and to deflect laterally sweeping streams of combustion products, said separate wall being spaced from and parallel to said bridge wall and extending upwardly from the floor of said radiant heating section to a height about half that of said bridge wall.

2. A furnace for heating fluids to elevated temperatures comprising a radiant heating section, a convection heating section receiving hot combustion products from said radiant heating section, a bridge wall separating said radiant heating section from said convection heating section, burner means arranged in a wall of the furnace for supplying combustion products to said radiant heating section in a direction substantially parallel to said bridge wall, fluid heating tubes positioned in said radiant and convection heating sections, and a transverse wall for deflecting the horizontal flow of said combustion products and for preventing flame impingement upon walls opposing said burner means for supplying combustion products to said radiant heating section, said transverse wall extending across said radiant heating section and substantially perpendicular to said bridge wall.

3. In a furnace having a radiant zone and a convection zone adapted to receive combustion gases from said radiant zone, a primary bridge wall separating said convection zone from said radiant zone, a plurality of fluid heating conduits positioned in said convection and radiant zones, burner means for supplying combustion products to said radiant zone, a secondary bridge wall within the radiant zone parallel to said primary bridge wall, and a transverse wall within said radiant zone perpendicular to said primary and secondary bridge walls, said transverse wall extending from the end wall of said radiant zone to said primary bridge wall.

4. In a furnace for heating fluids a radiant chamber, a convection chamber adapted to receive combustion products from said radiant chamber, a bridge wall separating said radiant chamber from said convection chamber, means for supplying combustible fuel to said radiant chamber, said means including burners positioned in opposing walls of said radiant chamber, fluid heating conduits positioned within said radiant and convection chambers, and walls positioned at right angles to one another within said radiant chamber dividing the lower part of said radiant chamber into quadrants, one of said walls being adapted to prevent flame impingement upon walls opposing said burners.

5. In a heater for fluids, a radiant chamber, a convection chamber adapted to receive combustion gases from said radiant chamber, a primary bridge wall interposed between said chambers, means for supplying combustion products to said radiant chamber through a plurality of burners in a general direction parallel to said primary bridge wall, a refractory partition perpendicular to said primary bridge wall and extending from the end wall of said radiant chamber to the primary bridge wall and from the floor of said radiant chamber to a height not exceeding that of the primary bridge wall, a secondary bridge wall intermediate said primary bridge wall and the end wall of said radiant chamber, said secondary bridge wall extending from the floor of said radiant chamber to a height intermediate that of said primary bridge wall and that of said refractory partition.

6. In a furnace for heating hydrocarbon fluids comprising a main furnace structure having side walls, end walls, a roof and a floor, the combination of a primary bridge wall separating a combustion and radiant heating section from a convection heating section adapted to receive combustion gases from said radiant section, a plurality of fluid heating conduits positioned in said radiant and convection sections, means for supplying combustible fuel to said radiant section in a general direction parallel to said primary bridge wall through burners positioned in opposing walls of said radiant section, a secondary bridge wall extending across the lower part of said radiant section parallel to said primary bridge wall and from the floor of said radiant section to a height not exceeding that of the primary bridge wall, a transverse wall perpendicular to said primary and secondary bridge walls, said transverse wall extending from the end wall of said radiant section to said primary bridge wall and from the floor of said radiant section to a height greater than the distance from said burners to the floor of said radiant section but not exceeding that of said secondary bridge wall.

7. A furnace for heating hydrocarbon fluids to elevated temperatures comprising a radiant heating section, a convection heating section receiving hot combustion products from said radiant heating section, a primary bridge wall separating said radiant heating section from said convection heating section, means for supplying combustion products to said radiant heating section, fluid heating tubes positioned in said radiant and convection heating sections, a secondary bridge wall within said radiant heating section extending parallel to said primary bridge wall and from the floor of said radiant section to a height equal to half that of the primary bridge wall, a transverse wall extending across said radiant heating section perpendicular to said primary and secondary bridge walls and from the floor of said radiant heating section to a height equal to one half that of said secondary bridge wall.

8. In a furnace for heating fluids including a radiant chamber, a bridge wall forming one

boundary surface for the radiant section and burner means for supplying combustion products to said radiant chamber in streams substantially parallel to said bridge wall, the bridge wall being so arranged to permit combustion products leaving said radiant chamber to pass thereover, the improvement which includes a wall member substantially perpendicular to said bridge wall and extending upwardly from the floor of said radiant chamber to a height not exceeding that of said bridge wall, said wall member being adapted to prevent flame impingement upon walls opposite said burner means, a wall spaced from and substantially parallel to said bridge wall extending upwardly from the floor of said radiant chamber, said last mentioned wall being shorter in height than said bridge wall and being adapted to prevent plane overlapping from burner means on opposite sides of said wall.

9. A furnace for heating fluids including a radiant chamber provided with a bridge wall at one end thereof, means including a plurality of burners for supplying combustion products to said radiant chamber in streams substantially parallel to said bridge wall, a partition substantially perpendicular to said bridge wall and extending across said radiant chamber and upwardly from the floor of said radiant chamber to a height not exceeding that of said bridge wall, and a wall intermediate said bridge wall and the end wall of said radiant chamber, said intermediate wall extending upwardly from the floor of said radiant chamber to a height not exceeding that of said bridge wall, said partition and said wall being arranged in the lower portion only of said radiant chamber.

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