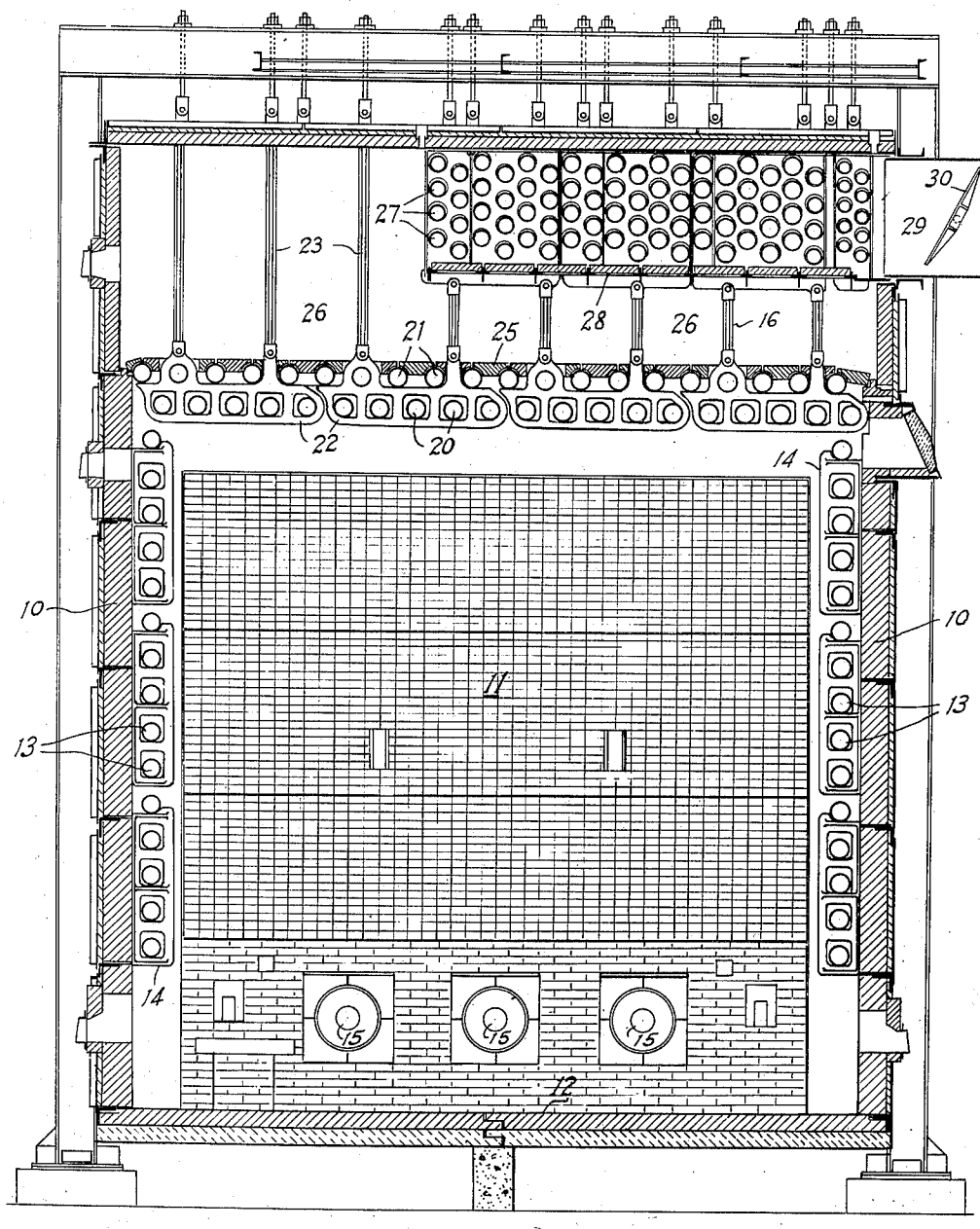
Feb. 14, 1939. M. A. ZIMMERMAN 2,147,610

FLUID HEATER

Original Filed Dec. 28, 1935 2 Sheets-Sheet 1

Fig. 1



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Fig. 2

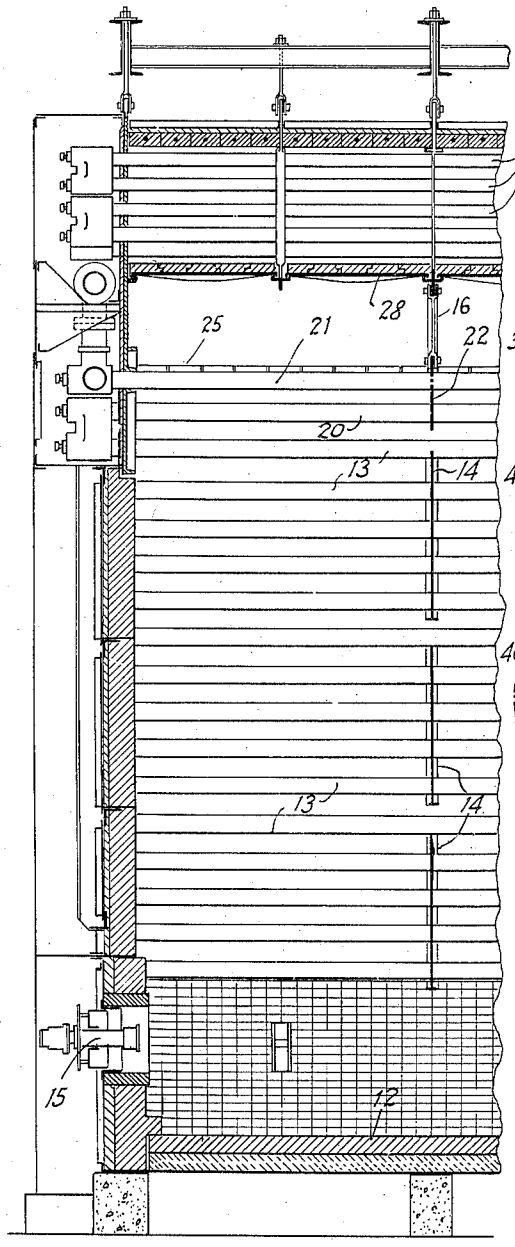


Fig. 3

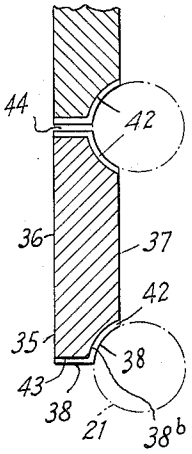


Fig. 4

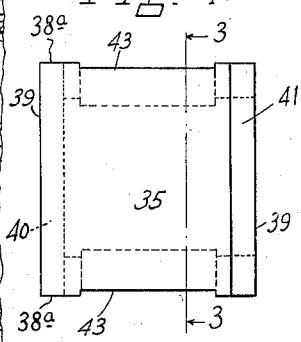


Fig. 5

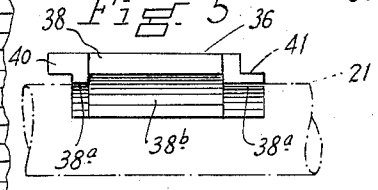
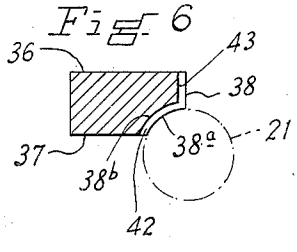


Fig. 6



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2,147,610

UNITED STATES PATENT OFFICE

2,147,610

FLUID HEATER

Merle A. Zimmerman, New York, N. Y., assignor to The Lummus Company, New York, N. Y., a corporation of Delaware

Application December 28, 1935, Serial No. 56,426
Renewed January 6, 1939

6 Claims. (Cl. 196—110)

My invention relates to an improved form of tile, and particularly to tile adapted for use in conjunction with a row of fluid heating tubes to form a diffusion baffle for heating gases flowing across the tube row.

The general object of my invention is the provision of tile of the type described which is further characterized by the resulting formation of gas passages in the diffusion baffle providing a uniform distribution of the heating gases across an associated tube row and an increased rate of heat transfer to the tubes in contact with the baffle tile. A further and more specific object is the provision of tube baffle tile which will effect a high rate of heat transfer to the tube wall portions over which my improved tile extends.

The baffle tile of my invention is especially designed and particularly adapted for use in a diffusion baffle for an oil heater of the type shown in a prior application of Carl S. Reed and Vincent W. Smith, Serial No. 632,154, filed Sept. 8, 1932.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of my invention.

Of the drawings:

Fig. 1 is a sectional elevation of an oil heater incorporating my invention;

Fig. 2 is a part section taken at right angles to Fig. 1;

Fig. 3 is a section of one of my improved tile taken on the line 3—3 of Fig. 4;

Figs. 4 and 5 are plan and side views respectively of the tile shown in Fig. 3; and

Fig. 6 is a view similar to Fig. 3 of one of the end half-tiles.

In the drawings, and particularly in Figs. 1 and 2, is shown an oil heater of the type disclosed and claimed in said prior application of Carl S. Reed and Vincent W. Smith, and comprising a pair of opposite vertical side walls 10 extending between and closed by a second pair of opposite vertical side walls 11, and a floor 12, collectively defining a box-shaped furnace chamber open at its top side or roof. Along the inner side of each side wall 10 extends a row of vertically spaced horizontally extending oil heating tubes 13 carried by longitudinally spaced supporting brackets 14 supported on the side wall. The end walls 11 are refractory faced and mounted therein adjacent the floor 12 are symmetrically arranged fluid fuel burners 15, with corresponding burners in the opposite walls 11 directed toward one another. The top side or roof of the furnace chamber is defined by two staggered rows of spaced oil heating tubes 20 and 21 arranged parallel to and of the same length as the wall tubes 13. The tubes 20 and 21 are supported in groups by spaced supporting means 22 swingably supported from the external steel work by pairs of hangers 16 or 23.

With this construction of the furnace chamber, streams of burning fuel are discharged at opposite ends thereof, the heating gases generated passing upwardly towards the roof tubes 20 and 21. The tubes 13, 20 and 21 will thus absorb radiant heat from the furnace chamber, with the roof tubes 20 absorbing much more radiant heat than the tubes 21. The utilization of the entire roof area of the furnace chamber as a heating gas exit results in a low velocity gas flow past the row of tubes 20. This is especially desirable in an oil heater of this type so as to avoid excessive convection heat transfer to the tubes 20. To avoid local overheating of the tubes 20 due to laning of the low velocity gases, a diffusion baffle 25, hereinafter described, is installed adjacent the upper row of tubes 21 with the passages therein uniformly distributed and of less aggregate flow area than the aggregate intertube area of the subjacent portions of the tubes 20, thereby providing a pressure drop at that level which will cause the heating gases to flow at a low velocity uniformly across the row of roof tubes 20. Any variation in heat absorption along the length of the tubes 20 due to higher temperature conditions adjacent the center of the furnace chamber is largely compensated by radiation from the refractory faced walls 11 to the adjacent end portions of the tubes 20.

Above the diffusion baffle 25 is provided a flow equalizing or plenum chamber 26 in which the heating gases collect before entering the convection heating section of the heater. The convection section is formed by a relatively shallow bank of staggered rows of oil heating tubes 27 extending parallel to and of the same length as the tubes 13, 20, and 21. Effective heat transfer conditions for the tubes 27 are maintained by causing a horizontal flow of the heating gases transversely of the tubes, and for this purpose a composite baffle 28 extends horizontally from one of the side walls 10 across the heater immediately below the tubes 27. A heating gas outlet 29 controlled by one or more dampers 30 is

formed in the wall 10 above the end of the baffle 28, so that heating gases entering the plenum chamber below the tubes 27 must first pass around the end of the baffle 28 and across the bank of tubes 27 before reaching the gas outlet 29. The oil to be heated enters the end of the tube bank 27 adjacent the outlet 29, then flows successively through the tubes 27, roof tubes 21, roof tubes 20, and side wall tubes 13 in one or two streams, as may be desired.

While various types of diffusion baffles have been suggested for the oil heater described, it has been found in practice that the most effective construction is obtained by employing refractory tile of the form shown in Figs. 3 to 6 in conjunction with the roof tubes 21. As shown in Figs. 1, and 3 to 5, each tile piece 35 is rectangular in plan and formed with a flat top and bottom 36 and 37 respectively, and its opposite sides 38 concavely curved adjacent the bottom 37 to fit against part of an upper quadrant of corresponding roof tubes 21, so that each baffle tile will be supported at its sides on a pair of adjacent tubes 21. The tile pieces are arranged in rows extending longitudinally of the tubes 21 with corresponding tiles in adjacent rows having their side portions above the tubes 21 slightly spaced apart along the vertical axial plane of the common supporting tube as shown in Fig. 3.

The opposite ends 39 of each tile piece are shaped to permit overlapping of adjacent tiles in the same row, so as to minimize gas leakage between the tile ends. For this purpose, each tile piece has a tongue or top extension 40 at one end and a corresponding notch or shoulder 41 formed in the top at its opposite end, so that the tongue 40 of one tile will fit into the notch 41 of the next tile.

The gas passages through the diffusion baffle are uniformly distributed and arranged therein so as to increase the heat absorption of the supporting tubes 21. The intermediate section of each curved lower side portion of the tile is recessed by curving it on a greater radius than the corresponding end sections so that each side 38 of the tile will have a pair of tube contacting concavely curved faces or ridges 38^a and a concentric recess 38^b intermediate the ridges. When installed on the tubes 21, a narrow arcuate passage 42 will be formed between each curved side portion of the tile and the upper quadrant of the corresponding contacted tube 21. While the side portions extending above the tubes are slightly spaced from those of the corresponding tile in the adjacent rows, additional gas flow area is advantageously provided by recessing the vertical side portions of each tile in alignment with the sides of the recess 38^b, as indicated at 43, to form when assembled uniformly spaced vertical passages 44 between the tile rows with each passage 44 connected at its bottom to a corresponding pair of arcuate passages 42. As shown in Figs. 1 and 6, only one side of the tile pieces in the end rows of the diffusion baffle is shaped to provide the described gas passages 42 and 44.

With the described diffusion baffle construction the heating gases passing at a low velocity across the lower row of roof tubes 20 will pass around the tubes 21 and through the arcuate passages 42 at a higher velocity, providing not only a high rate of heat transfer to the lower half of the tubes 21, but also substantially increasing the amount of heat absorbed by the upper half of the tubes 21 in view of the direct contact of the high velocity heating gases therewith. Additional heat is received by the upper half of the tubes 21 by secondary radiation from the passage-forming tile portions 38^b and by conduction from the tube-contacting tile ridges 38^a, so that much of the heat absorbed by the tile will be transferred to the tubes 21 and the latter will be heated substantially uniformly throughout the circumference thereof. The heating gases leaving the passages 42 pass upwardly through the vertical passages 44 between the transversely adjacent tile. By way of example and not limitation, with the roof tubes 20 and 21 each having an outside diameter of $5\frac{9}{16}$'' and spaced on 11'' centers and the tile 10'' in length by $10\frac{7}{8}$'' in width, the passages 42 and 44 were $\frac{1}{4}$'' in width and $\frac{5}{8}$'' in width respectively, and $6\frac{1}{4}$'' in length, thus providing a restricted gas flow area inducing a high gas velocity through the diffusion baffle passages.

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of my invention now known to me, those skilled in the art will understand that changes may be made in the form disclosed without departing from the spirit of the invention covered by my claims.

In the claims, the word "tile" is intended to generically cover such member made of any suitable refractory, i. e., heat resistant material, and is not to be construed as limited to ceramic material.

I claim:

1. An oil heater comprising a furnace chamber having a heating gas exit occupying a major portion of the area of the roof thereof, a row of horizontally extending heating tubes extending across said gas exit in transversely spaced relation and receiving radiant heat from said furnace chamber, a second adjoining row of heating tubes at the upper side of and staggered relative to said first row of tubes, and tile pieces supported on said second row of tubes and forming a diffusion baffle having uniformly distributed gas flow passages therein of less aggregate flow area than the aggregate intertube area of the subjacent portions of said first row of tubes, said tile pieces having a recessed portion along one side thereof concentric and cooperating with an adjacent tube portion to define opposite sides of a narrow curving gas flow passage.

2. A tubular oil heater comprising a furnace chamber having means for burning fuel therein and a heating gas exit occupying a major portion of the area of the roof thereof, adjoining upper and lower rows of oil heating tubes extending across said gas exit in transversely spaced relation, said lower row of tubes being arranged to receive heat mainly by direct radiation from said furnace chamber, said upper row of tubes being staggered relative to said lower row of tubes, and tile pieces supported on said upper row of tubes and forming a diffusion baffle having distributed gas flow passages therein, each of said tile pieces having a pair of longitudinally spaced concavely curved tube-contacting ridge portions extending transversely of at least one side thereof and a recessed portion extending longitudinally of said tile side intermediate said ridge portions and cooperating with the corresponding tube portion to define opposite sides of a heating gas passage therebetween.

3. A tubular oil heater comprising a furnace chamber having means for burning fuel therein and a heating gas exit occupying a major portion of the area of the roof thereof, adjoining upper and lower rows of horizontally extending

oil heating tubes extending across said gas exit in transversely spaced relation, said lower row of tubes being arranged to receive heat mainly by direct radiation from said furnace chamber, said upper row of tubes being staggered relative to said lower row of tubes, and tile pieces supported on said upper row of tubes and forming a diffusion baffle having distributed gas flow passages therein of less aggregate flow area than the aggregate intertube area of the subjacent portions of said lower row of tubes, each of said tile pieces having a pair of longitudinally spaced concavely curved tube-contacting ridge portions extending transversely of each side thereof and a recessed portion extending longitudinally of each tile side intermediate said ridge portions and cooperating with the corresponding wall portions of said tubes to define opposite sides of heating gas passages therebetween, each having a lower section curving around an upper quadrant of the corresponding tube and a vertical section above said tube.

4. A petroleum oil heater comprising a main combustion chamber, a row of fluid heating tubes in the roof thereof, which tubes are spaced so as to produce a low convection heat transfer thereto, a second row of fluid heating tubes above the first row of tubes, tile pieces supported on said second row of tubes and forming a diffusion baffle across the top of said second row of tubes, said tile pieces having a plurality of recessed portions extending from their top walls to their bottom walls and between adjacent tile pieces, said recessed portions being relatively shallow to effect a substantial pressure drop in the gases flowing across said second row of tubes and between said tile pieces, whereby the flow of gases is made substantially uniform across the entire first row of tubes, a flow equalizing chamber above the tile pieces, and a bank of fluid heating tubes in a convection chamber which leads from the flow equalizing chamber.

5. A fluid heater comprising a furnace chamber having a heating gas exit in the roof thereof, a horizontal row of well-spaced fluid heating tubes extending across said exit and positioned to receive mainly radiant heat from said furnace chamber, a second row of fluid heating tubes at the upper side of said first row of tubes, tile pieces supported on said second row of tubes to form a diffusion baffle, said tile pieces each having a recessed portion along one side thereof concentric and cooperating with an adjacent tube portion to define opposite sides of curving gas flow passages, said tile pieces each including a plurality of relatively small edge recesses which with the adjacent tile pieces and the recessed portions which are concentric with the tubes, form continuous gas flow passages, said passages being relatively small to establish a substantial pressure drop across the tubes for creating a uniform flow across all of the tubes in the first row extending across said exit, a plenum chamber beyond the tile pieces, and a bank of convectively heated tubes beyond the plenum chamber.

6. An oil heater comprising a furnace chamber having a heating gas exit in the roof thereof, a row of oil heating tubes extending across said exit, said tubes being spaced so as to produce a relatively low convection heat transfer thereto, a second row of oil heating tubes arranged above and staggered relative to the first row of tubes, tile pieces supported on and extending along said second row of tubes and forming a diffusion baffle across the top of said tubes, said tile pieces having a plurality of relatively shallow recessed portions extending from their top walls to their bottom walls and forming narrow gas flow passages between said tile pieces and second row tubes and between laterally adjacent tile pieces to effect a substantial pressure drop in the gases flowing across said second row of tubes and between said tile pieces, whereby the flow of gases is made substantially uniform across all of the tubes in said first row extending across said exit, a flow equalizing chamber beyond the tile pieces, and a bank of convectively heated oil heating tubes beyond and in a gas passage connected to the flow equalizing chamber.

MERLE A. ZIMMERMAN.

CERTIFICATE OF CORRECTION.

Patent No. 2,147,610. February 14, 1939.

MERLE A. ZIMMERMAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 29, after the word "tube" insert the numeral 21; and second column, line 37, claim 1, for "radiant heat" read heat mainly by direct radiation; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of April, A. D. 1939.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.