July 31, 1945. J. PRIMROSE ET AL. 2,380,464

HEATER

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Fig. 1.

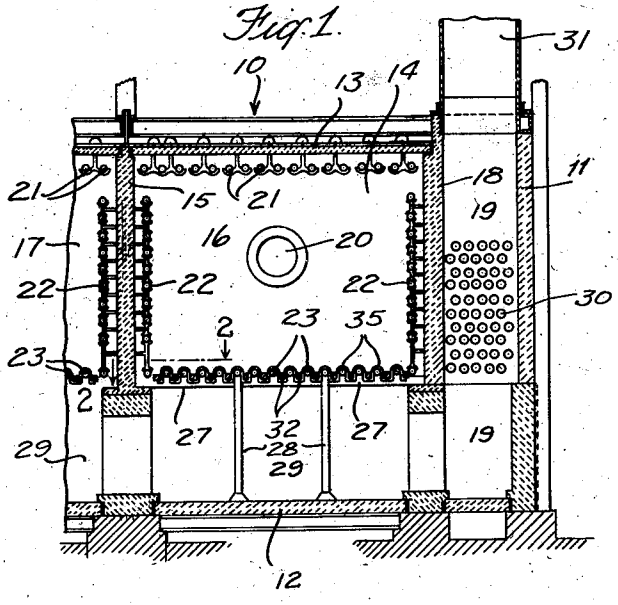
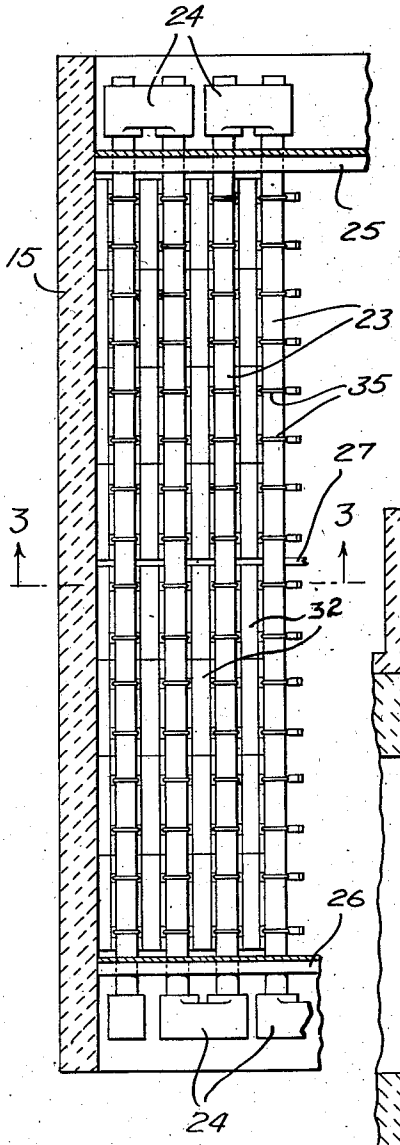


Fig. 2.



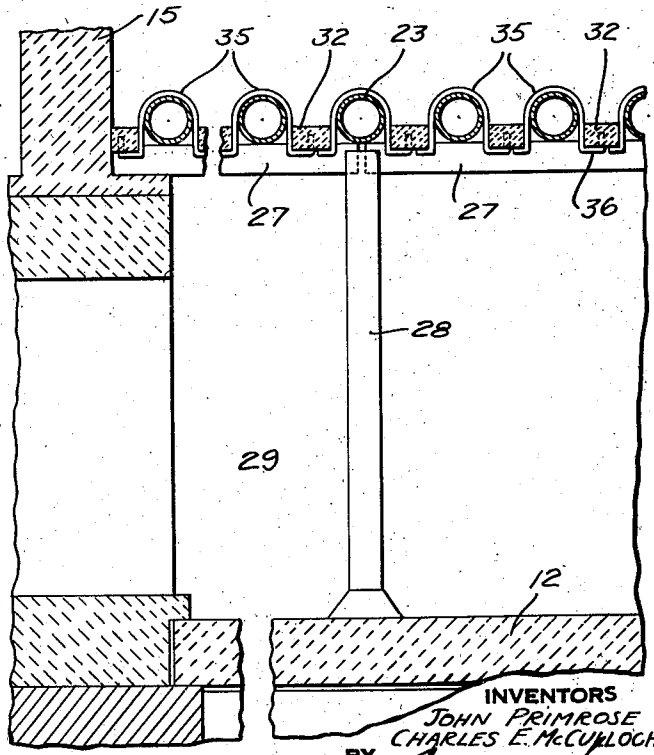


Fig. 3.

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Fig. 4.

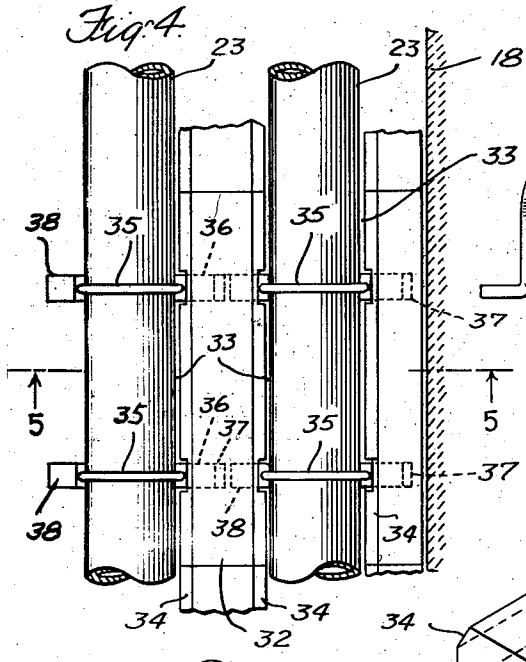
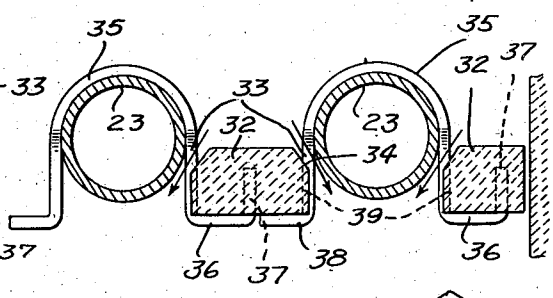


Fig. 5.



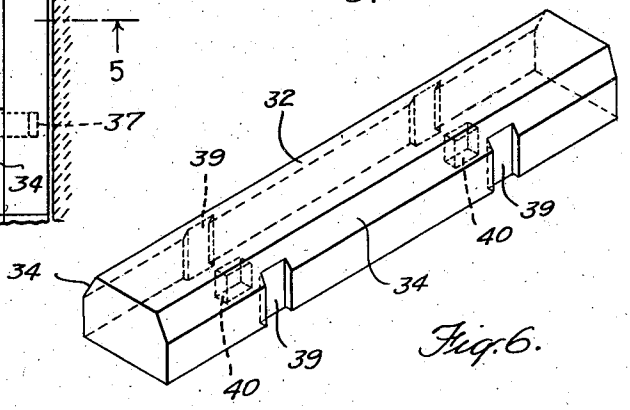


Fig. 6.

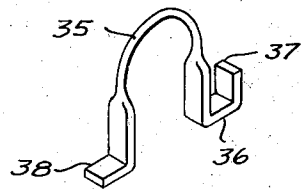
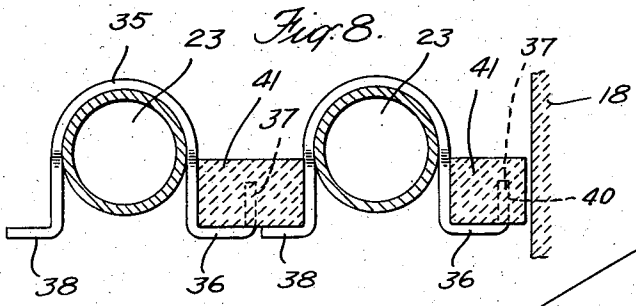


Fig. 7.

Fig. 8.



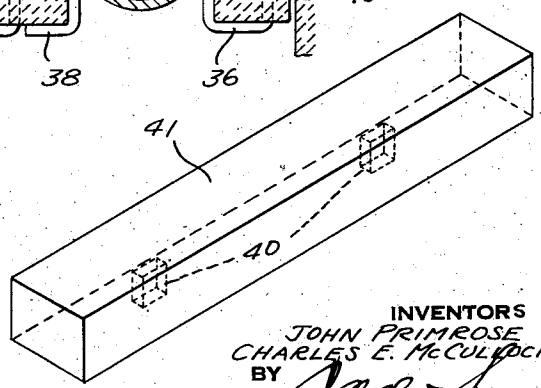


Fig. 9.

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2,380,464

HEATER

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Application October 22, 1942, Serial No. 462,938

12 Claims. (Cl. 122—356)

This invention relates to heaters, and more particularly pertains to fluid heating apparatus of the type in which the fluid to be heated is passed through tubular members in heat exchange relationship with a stream of products of combustion.

The invention provides novel means for controlling the flow of the heating gases over fluid conducting tubular members in such heaters, both with respect to direction and velocity. The flow controlling means is composed of a multiplicity of flow controlling units which are associated with the tubular members and are removably supported by them in such manner that the flow controlling means is not in contact with the tubular members and does not shield them from the heating gases. The advantages of this arrangement will appear hereinafter.

The invention will be understood from the following description when considered in connection with the accompanying drawings forming a part thereof, and in which:

Fig. 1 is a vertical sectional view of part of an oil heater embodying the invention;

Fig. 2 is a horizontal sectional view, on an enlarged scale, on line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view, on a further enlarged scale, on line 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 2, but on a larger scale;

Fig. 5 is a transverse sectional view on line 5—5 of Fig. 4;

Fig. 6 is a perspective view of a unit of the gas flow controlling means shown in Figs. 1 to 5;

Fig. 7 is a perspective view of a hanger for the flow controlling means;

Fig. 8 is a transverse vertical sectional view similar to Fig. 5, showing another form of gas flow controlling means embodying the invention, and

Fig. 9 is a perspective view of a unit of the gas flow controlling means shown in Fig. 7.

Like characters of reference refer to the same or to similar parts throughout the several views.

Referring to the drawings, reference character 10 designates a heater suitable for the heating of liquids such as hydrocarbon oils and the like, although it is not limited to the heating of such oils, but is useful in the heating of a wide variety of liquids, vapors and gases. The heater shown, Fig. 1, has two independently fired furnaces with the convection bank of tubes disposed at one side of one of the furnaces. The heater has a side wall 11, a bottom 12, a roof 13, and a front wall 14, which together with the other enclosing walls, forms a substantially rectangular enclosure. A vertical wall 15 parallel to the side walls, divides the enclosure into two furnaces 16 and 17, and a similar vertical wall 18 separates furnace 16 from the convection heating zone 19. The furnaces are separately fired, furnace 16 being fired by a burner 20 located in the front wall 14.

A bank of roof tubes 21 is supported just below the roof of each furnace, and a bank of wall tubes 22 is supported adjacent each side wall of each furnace. A row of tubes 23 defines the bottom of each furnace chamber, and these tubes are closely spaced and extend parallel to the roof tubes 21. The tubes 23 are connected at their ends by headers 24 to provide series flow therethrough of the medium to be heated, and are supported adjacent their ends by supports 25 and 26, and intermediate their ends by supports 27 which rest upon piers 28. The gases produced by the burner 20 in each furnace, are cooled by heat radiated to the heat absorbing surface therein and fall by gravity to the bottom of the furnace, whence they stream over the tubes 23 and between these tubes and the gas flow controlling means associated therewith into one or more gas passages 29, through which the gases flow into the heating zone 19 and over the tubes of an economizer 30 therein to a flue 31.

In the form of the invention shown in Figs. 1 to 7, the gas flow controlling means consists of baffles composed of a plurality of units 32 of firebrick, insulating firebrick or other suitable material, of generally rectangular parallelopiped form, which are removably supported from the tubes in positions between the tubes and in spaced relationship to the tubes, to provide relatively narrow, elongated gas passages 33 through which the gases flow from the furnaces to the passages 29. The upper side edges of the flow control units 32 are bevelled, as indicated at 34, to direct the flow of gases along the under sides of the tubes 23, so that the entire peripheries of the tubes will be heated. The units 32 are supported by hangers 35 of U-shape, having a flange 36 extending laterally outwardly from the outer end of one leg and a flange 38 extending laterally outwardly from the outer end of the other leg. Flange 36 has an extension 37 projecting parallel to the leg of the hanger of which it forms a part and toward the U-bend portion of the hanger. The units 32 are shown as located slightly below a plane passing through the axes of the tubes 23, but they may be positioned otherwise with relation to the tubes, if desired. The U-bend portion of each hanger preferably is circular or oval in transverse cross-sectional configuration, while the leg portions, the

flanges and the flange extension are of rectangular transverse cross-section configuration. Two hangers **35** are utilized to support each unit. The unit is slotted at **39** to receive the leg portions of the hangers, and is recessed at **40** to receive the flange extension **37** fairly snugly. As shown, the units **32** in each row are placed end to end, but they may be spaced apart if greater area for the flow of gases from the furnace is desired, or if space is required for expansion of the units. Preferably, the hangers are placed on the tubes with the flanges **36** and extensions **37** at one side of each tube as shown. With this arrangement, the baffle units rest on the flanges of the hangers and are securely retained in position, but are readily removable and replaceable without damage to the unit or to their supporting means or to the tubes.

The form of the baffle unit **41** shown in Figs. 8 and 9 is the same as the form shown in Figs. 1 to 7 excepting that its width is approximately equal to the distance between adjacent legs of hangers on adjacent tubes, thus eliminating the necessity for slots to receive the hanger legs, and it has no bevelled edges. Without the bevelled edges on the units **41**, the gases flowing from the furnaces through the passages between the units and the tubes will not be directed laterally to the extent they will be directed with the units **32**, but the units **41** will be satisfactory for the purpose intended.

By way of illustration but without any limiting effect on the invention, the dimensions of the units **32** which will be satisfactory for use with 5" tubes are: length 24"; width 4½"; height 3"; bevelled edges ½" from side and 1" from top; depth of recesses **40**, 1½". The dimensions of the units **41** for the same size of tubes are: length 24"; width 3¾"; height 3"; depth of recesses **40**, 1½". It will be understood that these dimensions may be varied as desired to suit the operating conditions to be encountered.

The hangers **35** may be made of any suitable material. A suitable chrome-nickel-steel alloy will contain 24% to 26% of chrome, 10% to 12% of nickel and up to 0.5% of carbon.

Baffle means embodying the invention possess numerous advantages, among which the following may be mentioned.

The baffle is utilized to block to the desired extent the openings between the tubes at the bottom of the furnace in the form of the invention selected for illustration, instead of covering these tubes as the ordinary form of "baffle," leaky or otherwise, does, with consequent reduction in its effectiveness, but the baffle of the invention actually increases the effectiveness of the heating surface by controlling the direction of the flow of gases with respect to the heating surface and the velocity with which the gases wipe the tubes. This is advantageous in preventing warping of the tubes, which is often caused by subjecting the tubes to greater heat on one side than on another, because the baffle of the invention offers no obstruction to radiation from either above or below the tubes and tends to increase the heating of the underside of the tubes by convection, thereby reducing any tendency for the tubes to warp.

The tubes of the furnace with which the flow controlling means is associated, are free to expand and contract without displacing the baffle means or any unit thereof. Any bowing of the tubes, due to improper firing of the furnace or other causes, will not displace the baffle units and permit uneven flow of the gases over the tubes.

The flow area of the gas passages **33** between the baffle units and the tubes may be varied as desired. This may be accomplished by substituting hangers having longer or shorter legs, or if the flow area of these passages are to be increased, this may be accomplished by removing material from the edges or side portions, or both, of the units, or by increasing the depth of the recesses **40** and providing slots for the reception of the flanges **36** and **38** to lower the positions of the units with respect to the tubes. Additional gas passage flow area may be provided by spacing the baffle units with respect to each other or by increasing the spacing between them.

The tubes of the heater with which the baffle means is associated may be removed and replaced without damage to any part of the baffle, simply by removing the units associated with the tube or tubes to be removed and replacing them after the tubes have been replaced. Also, the entire baffle means is readily accessible for repairs and adjustments, and if any repairs are required to the heater flooring under the baffle means, the baffle means may be removed readily and replaced after the floor has been repaired.

The baffle means is extremely simple in construction and is inexpensive to produce, to install, and to maintain. The units have small weight, width and volume, and inasmuch as the baffle units are all alike, and the hangers also are all alike, the number and cost of spare parts for the baffle means is reduced to a minimum. No special materials are required for the units and hangers, but readily available materials may be employed which are suitable for the temperature and other conditions to be encountered in the operation of the heater. As previously mentioned, the units may be either of firebrick or of insulating firebrick.

Due to the small size of the portions of the hangers which are in contact with the tubes, practically the entire length of the tubes at the bottom of the furnace are exposed to the flow of gases. And because the hangers are in contact with the tubes, they are cooled by the conduction of heat to the tubes due to the lower temperature of the medium flowing through the tubes. Because of the shape of the hangers, the baffle units will be held firmly in place, since any tendency of the hangers to rotate on the tubes will result in binding the units and the legs of the hangers. The units are not likely to be displaced accidentally, inasmuch as each unit and its two hangers will tend to move simultaneously.

It will be understood that the forms of the invention illustrated are preferred forms, and that changes may be made in the form, location and relative arrangement of the several parts of the baffle means and the associated apparatus without departing from the principles of the invention. In view, thereof, it is understood that the invention is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. In heat exchange apparatus having a plurality of spaced substantially horizontal and substantially parallel tubular members, means comprising a baffle disposed at least in part in the spaces between the tubular members with a space for fluid flow between the baffle and the adjacent tubes, the baffle having a recess in the under side thereof, and a hanger for supporting the baffles, said hanger being of substantially inverted U-shape supported by a tube with the legs on opposite sides of the tube, the legs of the hanger

having a laterally extending flange upon which the baffles on opposite sides of a tube rest, one flange having an extension substantially parallel to the leg having said one flange and adapted to extend into the recess in the baffle.

2. In heat exchange apparatus having a plurality of spaced substantially horizontal and substantially parallel tubular members, means comprising a baffle disposed at least in part in the spaces between the tubular members with a space for fluid flow between the baffle and the adjacent tubes, the baffles having recesses in the under side thereof, and a plurality of hangers for supporting the baffles, said hangers being of substantially inverted U-shape supported by and axially spaced on said tubes with the legs on opposite sides of the tube, the legs of the hangers having a laterally extending flange upon which the baffles on opposite sides of a tube rest, one flange having an extension substantially parallel to the leg having said one flange and adapted to extend into one of the recesses in a baffle, the hangers being disposed on the tubes so that the extension on the hangers on one of the tubes extend into the recesses in the baffle between said one tube and an adjacent tube and the extension on the hangers on said adjacent tube extend into the baffle between said adjacent tube and the next adjacent tube thereto.

3. In heat exchange apparatus having a plurality of spaced substantially horizontal and substantially parallel tubular members, a baffle comprising a plurality of blocks of generally rectangular parallelopiped form disposed at least in part in the spaces between the tubular members but out of contact with said members, the blocks having a recess in the under side thereof, and a plurality of hangers for supporting the blocks said hangers being of substantially inverted U-shape supported by a tube with the legs on opposite sides of the tube, the legs of the hanger having a laterally extending flange upon which the blocks on opposite sides of a tube rest, one flange having an extension substantially parallel to the leg having said one flange and adapted to extend into one of the recesses in one of the blocks of a baffle, the hangers being disposed on the tubes so that the extension on the hangers on one of the tubes extend into the recesses in the blocks of the baffle between said one tube and an adjacent tube and the extension on the hangers on said adjacent tube extend into the blocks of the baffle between said adjacent tube and the next adjacent tube thereto.

4. In fluid heating apparatus comprising means forming a furnace having a gas outlet at the bottom thereof, means for firing the furnace, and spaced, substantially horizontal and substantially parallel fluid conducting tubular members extending across the gas outlet, means comprising a baffle disposed at least in part in the space between adjacent tubes with a space for fluid flow between the baffle and the tube, and a hanger for supporting the baffle of substantially inverted U-shape supported by a tube with the legs on opposite sides of the tube, one leg of the hanger having a laterally extending flange upon which the baffle rests.

5. In fluid heating apparatus comprising means forming a furnace having a gas outlet at the bottom thereof, means for firing the furnace, and spaced, substantially horizontal and substantially parallel fluid conducting tubular members extending across the gas outlet, means comprising a baffle disposed at least in part in the spaces between the tubular members with a space for fluid flow between the baffle and the adjacent tubes, the baffle having a recess in the under side thereof, and a hanger for supporting the baffles, said hanger being of substantially inverted U-shape supported by a tube with the legs on opposite sides of the tube, the legs of the hanger having a laterally extending flange upon which the baffles on opposite sides of a tube rest, one flange having an extension substantially parallel to the leg having said one flange and adapted to extend into the recess in the baffle.

6. In fluid heating apparatus comprising means forming a furnace having a gas outlet at the bottom thereof, means for firing the furnace, and spaced, substantially horizontal and substantially parallel fluid conducting tubular members extending across the gas outlet, means comprising a baffle disposed at least in part in the space between adjacent tubes with a space for fluid flow between the baffle and the tube and positioned below a plane passing through the axes of said tubular members, and a hanger for supporting the baffle of substantially inverted U-shape supported by a tube with the legs on opposite sides of the tube, one leg of the hanger having a laterally extending flange upon which the baffle rests.

7. In fluid heating apparatus comprising means forming a furnace having a gas outlet at the bottom thereof, means for firing the furnace, and spaced, substantially horizontal and substantially parallel fluid conducting tubular members extending across the gas outlet, means comprising a baffle disposed at least in part in the space between adjacent tubes but out of contact with said members and below a plane passing through the axes of the tubular members, and a hanger for supporting the baffle of substantially inverted U-shape supported by a tube with the legs on opposite sides of the tube, one leg of the hanger having a laterally extending flange upon which the baffle rests.

8. In fluid heating apparatus comprising means forming a furnace having a gas outlet at the bottom thereof, means for firing the furnace, and spaced, substantially horizontal and substantially parallel fluid conducting tubular members extending across the gas outlet, a baffle comprising a plurality of blocks of generally rectangular parallelopiped form disposed at least in part in the spaces between the tubular members but out of contact with said members and below a plane passing through the axes of the tubular members, the blocks having a recess in the under side thereof, and a plurality of hangers for supporting the blocks said hangers being of substantially inverted U-shape supported by a tube with the legs on opposite sides of the tube, the legs of the hanger having a laterally extending flange upon which the blocks on opposite sides of a tube rest, one flange having an extension substantially parallel to the leg having said one flange and adapted to extend into one of the recesses in one of the blocks of a baffle, the hangers being disposed on the tubes so that the extension on the hangers on one of the tubes extend into the recesses in the blocks of the baffle between said one tube and an adjacent tube and the extension on the hangers on said adjacent tube extend into the blocks of the baffle between said adjacent tube and the next adjacent tube thereto.

9. In heat exchange apparatus having a plurality of spaced substantially horizontal and substantially parallel tubular members, means

comprising a baffle disposed at least in part in the space between adjacent tubes with a space for fluid flow between the baffle and the tube, adjacent baffles being spaced from one another to permit the flow of fluid in heat exchange relationship with a portion of the tube therebetween, and hangers for supporting the baffle of substantially inverted U-shape, the hangers being positioned on adjacent tubes and supported by a tube with the legs on opposite sides of the tube, one leg of a hanger on one of the tubes and one leg of a hanger on the adjacent tube having a flange extending laterally therefrom into the space between said adjacent tubes upon which flanges the baffle rests.

10. In heat exchange apparatus having a plurality of spaced substantially horizontal and substantially parallel tubular members, means comprising a baffle disposed at least in part in the space between adjacent tubes but out of contact with said members, adjacent baffles being spaced from one another to permit the flow of fluid in heat exchange relationship with a portion of the tube therebetween, and hangers for supporting the baffle of substantially inverted U-shape, the hangers being positioned on adjacent tubes and supported by a tube with the legs on opposite sides of the tube, one leg of a hanger on one of the tubes and one leg of a hanger on the adjacent tube having a flange extending laterally therefrom into the space between said adjacent tubes upon which flanges the baffle rests.

11. In heat exchange apparatus having a plurality of spaced substantially horizontal and substantially parallel tubular members, means comprising a baffle disposed at least in part in the spaces between the tubular members with a space for fluid flow between the baffle and the adjacent tubes, the baffle having a recess in the under side thereof, adjacent baffles being spaced from one another to permit the flow of fluid in heat exchange relationship with a portion of the tube therebetween, and hangers for supporting the baffle of substantially inverted U-shape, the hangers being positioned on adjacent tubes and supported by a tube with the legs on opposite sides of the tube, one leg of a hanger on one of the tubes and one leg of a hanger on the adjacent tube having a flange extending laterally therefrom into the space between said adjacent tubes upon which flanges the baffle rests, a flange of at least one of the legs having an extension substantially parallel to the leg having said flange and adapted to extend into the recess in the baffle.

12. In fluid heating apparatus comprising means forming a furnace having a gas outlet at the bottom thereof, means for firing the furnace, and spaced, substantially horizontal and substantially parallel fluid conducting tubular members extending across the gas outlet, means comprising a baffle disposed at least in part in the space between adjacent tubes with a space for fluid flow between the baffle and the tube, adjacent baffles being spaced from one another to permit the flow of fluid in heat exchange relationship with a portion of the tube therebetween, and hangers for supporting the baffle of substantially inverted U-shape, the hangers being positioned on adjacent tubes and supported by a tube with the legs on opposite sides of the tube, one leg of a hanger on one of the tubes and one leg of a hanger on the adjacent tube having a flange extending laterally therefrom into the space between said adjacent tubes upon which flanges the baffle rests.

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