May 20, 1930. G. H. LIFUR 1,759,360

HEAT EXCHANGER

Filed Aug. 3, 1927

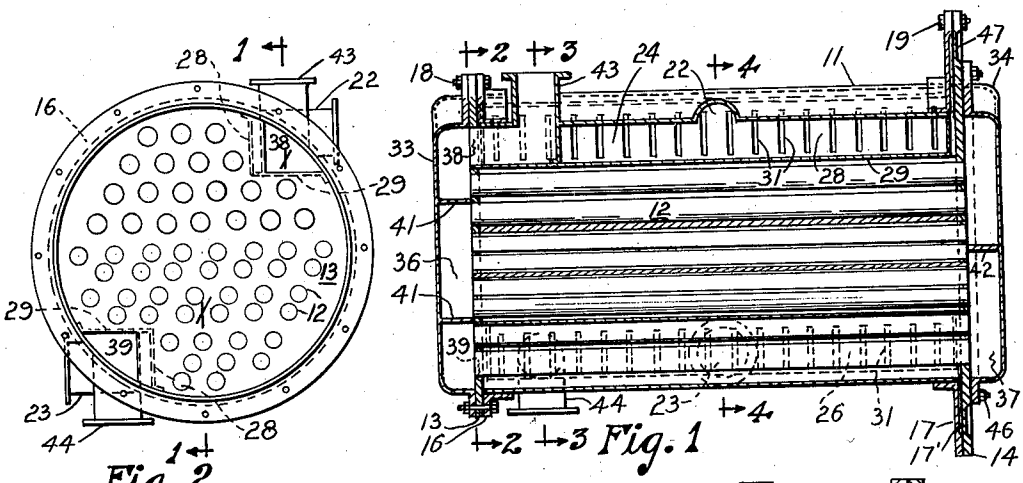


Fig. 1

Fig. 2

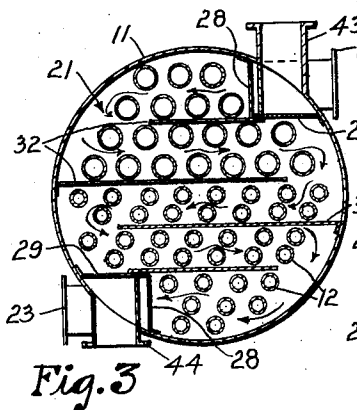


Fig. 3

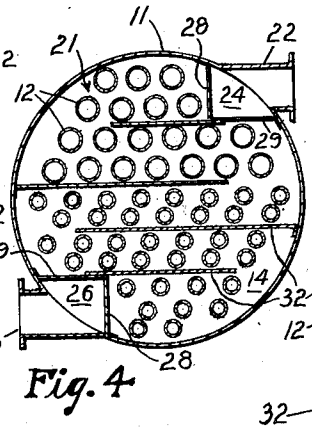


Fig. 4

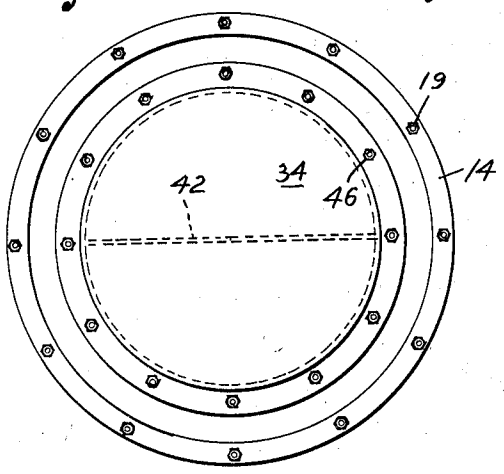


Fig. 5

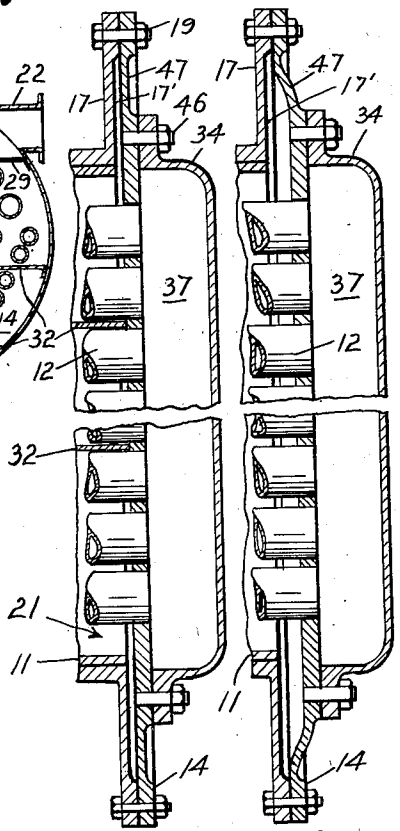


Fig. 6

Fig. 7

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UNITED STATES PATENT OFFICE

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HEAT EXCHANGER

Application filed August 3, 1927. Serial No. 210,297.

My invention relates to a device in which independent streams of fluid are circulated in thermal contact whereby heat may be transferred from one fluid to the other, and particularly to devices in which one fluid is circulated through heat conducting tubes traversing a chamber through which the other fluid is circulated.

An object of the invention is to provide in a device of the character described, means for effecting an even circulation of fluid through the chamber thereof.

Another object of the invention is to provide a structure of the character described so arranged that the tubes may be rendered accessible for cleaning without in any way involving a disconnecting of the structure from the flow circuits in which it is connected.

A further object of the invention is to provide a heat exchanger having a tube plate which functions as an end of the circulation chamber containing the tubes, and which at the same time permits a thermal expansion or contraction of the tubes.

The invention possesses other objects and features of advantage, some of which will be set forth in the following description of the preferred form of the invention which is illustrated in the accompanying drawings, in which:

Figure 1 is a sectional elevation of the exchanger on the broken line 1—1 of Fig. 2.

Fig. 2 is an end elevation taken on the line 2—2 of Fig. 1.

Fig. 3 and Fig. 4 are sectional views taken respectively at lines 3—3 and 4—4 in Fig. 1.

Fig. 5 is an end view of the device.

Figs. 6 and 7 are enlarged fragmentary views particularly designed to show a tube plate forming part of the invention in different operative positions.

As illustrated in the figures, the heat exchanger of my invention comprises a cylindrical shell 11 in which is mounted a plurality of tubes 12. Support for the tubes is provided by fixing their extremities in tube plates 13 and 14 mounted on outwardly extending flanges 16 and 17 provided at opposite ends of the shell. Preferably, the shell is cylindrical and the flanges 16 and 17 are annular, with the tube plates fixed to the respective flanges as by bolts 18 and 19, it being noted that the tube plates are thus arranged to cooperate with the shell to define a closed chamber 21 surrounding the tubes. Inlet and outlet pipes 22 and 23 for the chamber 21 are provided, such pipes being preferably diametrically related and horizontally disposed, as shown.

Means are provided for insuring an even distribution and discharge of incoming and outgoing fluid to and from the chamber 21, and as here shown, such means comprises the provision of passages 24 and 26 within the shell connected with the pipes 22 and 23 respectively, and extending the full length of the shell. The passages 24 and 26 are most simply defined by means of partitions having vertical and horizontal portions 28 and 29 respectively, which portions cooperate with the shell wall to form the passages 24 and 26 as of generally triangular section. Formed in the partition portions 28 are perforations 31, such perforations being here shown in the form of vertical slits, it being noted that the slits are so spaced and proportioned that the flow of fluid therethrough and across the chamber will be equal along the length of the chamber, and it being further noted that the structures thus provided are in effect intake and outlet manifolds. To further increase the efficiency of the device, baffles 32 are provided, such baffles being carried by and between the tube plates in any suitable manner and being so disposed that the fluid follows a zig-zag course downwardly from the inlet to the outlet. As here shown, the baffles 32 are horizontally disposed and extend alternately from opposed sides of the shell. In this manner, an even and maximum circulation of fluid is assured through the chamber, as all dead spaces or pockets are avoided.

To provide for the circulation of the second fluid through the tubes 12, heads 33 and 34 are utilized at the different ends of the structure, such heads lying outwardly of the tube plates 13 and 14, respectively, to cooperate therewith to define distribution chambers 36 and 37 at the ends of the tubes. The

head 33, it will be noted, is secured in position by means of the bolts 18, and the chamber 36 is arranged to provide both for the inlet and outlet of fluid for circulation through the tubes 12. Formed in the plate 13 adjacent the top and bottom thereof, are openings 38 and 39 respectively, such openings communicating with chamber 36 to provide for the flow of fluid into and out of the chamber. To insure a flow of liquid through the tubes as it passes between the openings 38 and 39, the chamber 36 is provided with horizontal partitions 41 carried by the head 33 and staggeredly related to a horizontal partition 42 provided in chamber 37 and carried by the head 34, it being obvious that the number of partitions 41 and 42 is immaterial, provided only that there be one more of the former than of the latter, since the inlet and outlet of fluid are to take place at the same end of the structure. Pipes or conduits 43 and 44 are provided for connection to the openings 38 and 39 respectively, and when, as particularly disclosed, the aforesaid openings lie within the area of the shell, the conduits 43 and 44 are generally L-shaped with a free end thereof extending outwardly of the shell. In this manner, removal of the head 33 may be effected without disturbing any of the pipe connections to the apparatus, and access to the tubes for inspection or cleaning is readily effected, it being noted that the head 34 is likewise removable for the same purpose.

The tubes 12, are threaded or otherwise set in the tube plates to provide tight joints thereat. But, owing to the variations in temperature which the tubes may undergo, it is necessary to provide for the thermal expansion or contraction thereof and at the same time not interfere with the function of the tube plates. Owing to the desirably fixed relation of conduits 43 and 44 in the openings 38 and 39 of plate 13, the necessary means to accomplish the thermal expansion or contraction is preferably provided in connection with plate 14; such means comprising the provision for a displacement of the inner portion of plate 14 with respect to the fixed edge or rim thereof. The head 34, it will be noted, is circular and is somewhat smaller than is the plate 14 and is secured to the latter by means of a series of bolts 46 around the edge thereof. The portion 47 of plate 14 between the edge of the head 34 and the line of bolts 18 is made very much thinner than is the remaining portions of the plate 14, so that when expansion or contraction of the tubes occurs, the central plate portion carrying the head 34 and tubes may become offset out of its normal plane, and buckling and loosening of the tubes is thus avoided. It will be noted that the normal position and a displaced position of the plate 14 are shown in Figures 6 and 7, the displacement being, however, somewhat exaggerated in the latter figure. When the tubes contract, as when cold brine is circulated therethrough or thereabout, the plate 14 is displaced in the opposite direction to that shown in Fig. 7. The flange 17 is recessed as at 17′ to allow the tube plate to be drawn inwardly.

The apparatus hereinbefore described may be used both with liquids and gases with equal readiness, and the directions of flow of the fluids in the independent fluid circuits provided therethrough are determined primarily by the conditions to be met in connection with the fluids and are independent of the structure of the exchanger.

I claim as new and desire to secure by Letters Patent of the United States the following:

1. In a heat exchanger, a body providing a fluid circulation chamber, tube plates defining the ends of said chamber, tubes extending through and between said plates, heads disposed outwardly of said tube plates and cooperating therewith to define fluid distribution chambers communicating with said tubes, one of said tube plates being provided with an inlet opening for the adjacent distribution chamber whereby a fluid may be introduced thereinto.

2. In a heat exchanger, a body providing a fluid circulation chamber, tube plates defining the ends of said chamber, tubes extending through and between said plates, heads removably mounted outwardly of said tube plates and cooperating therewith to define fluid distribution chambers communicating with said tubes, one of said tube plates being provided with an outlet opening for the adjacent distribution chamber whereby a fluid may flow from said chamber.

3. In a heat exchanger, a body providing a fluid circulation chamber, tube plates defining the ends of said chamber, tubes extending through and between said plates, heads disposed outwardly of said tube plates and cooperating therewith to define fluid distribution chambers communicating with said tubes, one of said tube plates being provided with inlet and outlet openings for the adjacent distributing chamber whereby a fluid stream may be caused to flow through said chamber, and means in said last chamber operative to effect a flow of liquid through said tubes and between the chambers as it passes from the inlet opening to the outlet opening.

4. In a heat exchanger, a body providing a fluid circulation chamber, tube plates defining the ends of said chamber, tubes extending through and between said plates, heads cooperating with said tube plates to define fluid distribution chambers communicating with said tubes, and a conduit passing through said circulation chamber and a tube plate to effect the connection of the passage thereof with a distributing chamber.

5. In a heat exchanger, a body providing a fluid circulation chamber, tube plates defining the ends of said chamber, tubes extending through and between said plates, heads cooperating with said tube plates to define distribution chambers communicating with said tubes, and inlet and outlet conduits each passing through said first chamber and a tube plate into the distribution chamber adjacent the plate.

6. In a heat exchanger, a body providing a chamber, tube plates secured to said body and closing the ends of the chamber, one of said plates having a central portion thereof arranged for transverse deflection with respect to its rim portion and the other of said plates being substantially rigid transversely thereof, tubes extending through and between central portions of said plates and fixed thereto, a head mounted on said central portion of said first plate to define therewith a closed distributing chamber communicating with said tubes, a head cooperative with said second plate to define a second distributing chamber communicating with said tubes, and inlet and outlet conduits for said last distributing chamber, said conduits providing the sole external connections for said chambers and tubes.

In testimony whereof, I affix my signature.

GREGORY H. LIFUR.