

Aug. 24, 1937.

V. O. MARSHALL
HEAT EXCHANGE APPARATUS

2,091,003

Filed March 14, 1936

4 Sheets-Sheet 1

FIG. 1.

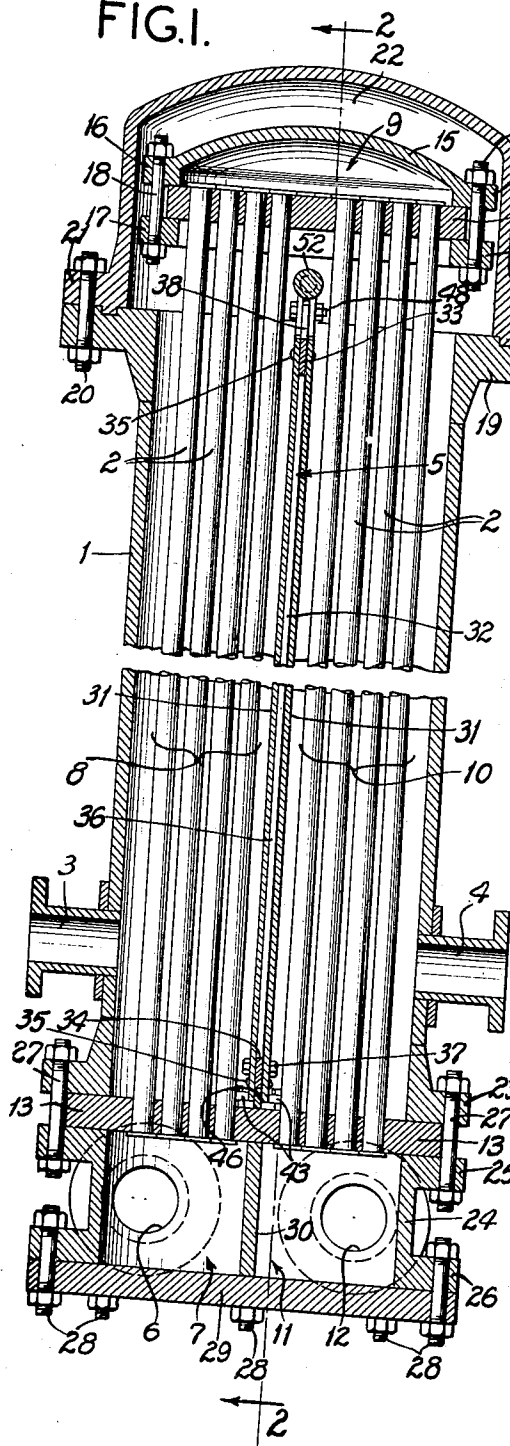
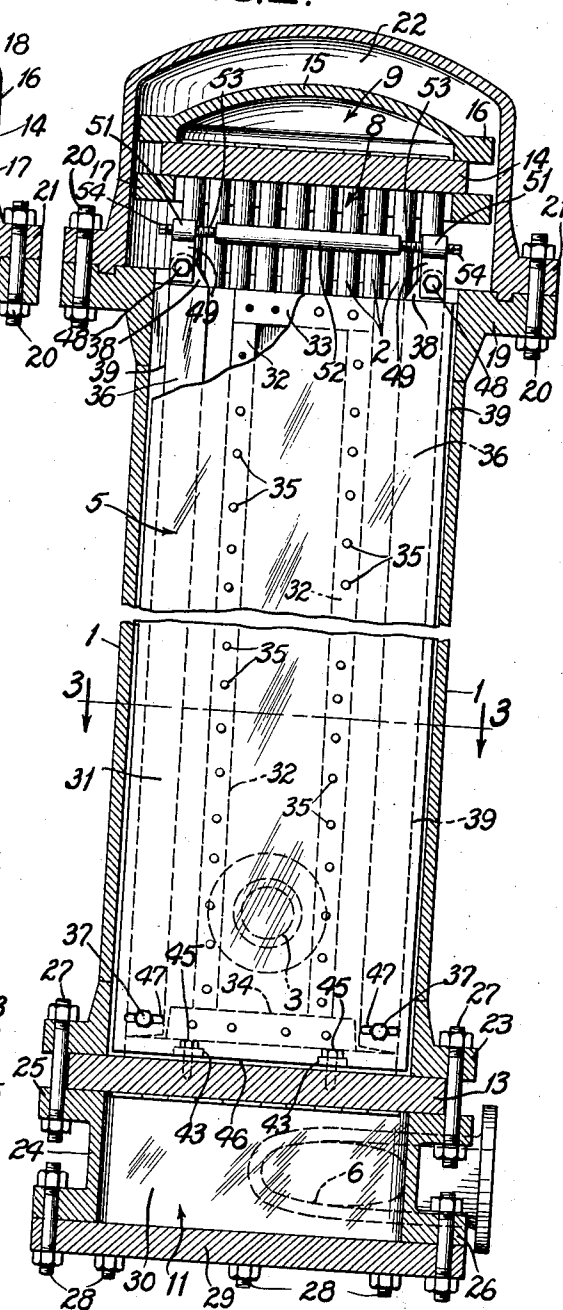


FIG.2.



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FIG. 3.

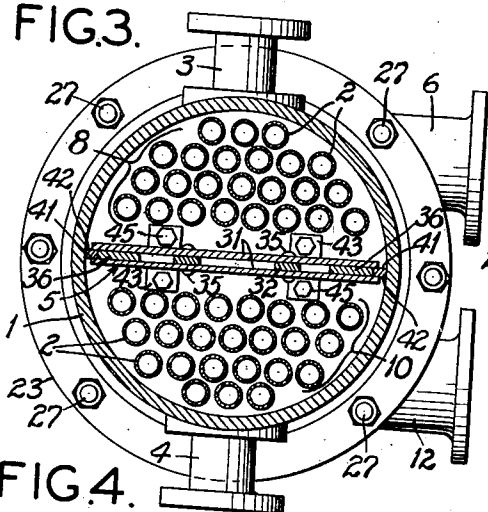


FIG. 4.

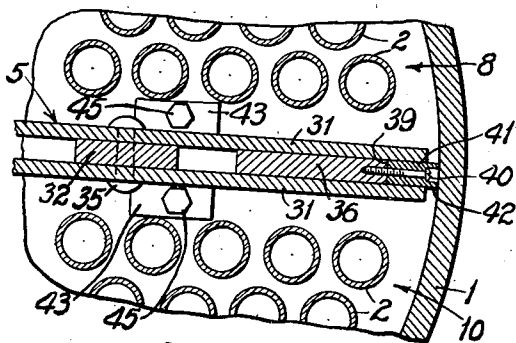


FIG. 5.

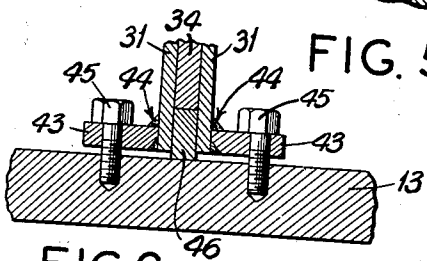


FIG. 6.

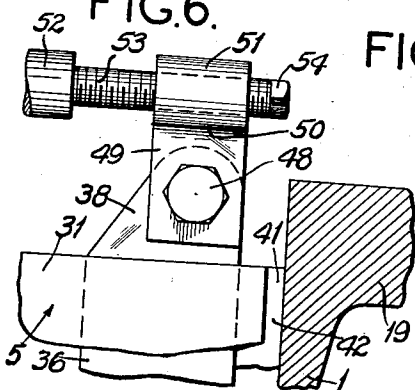


FIG. 7.

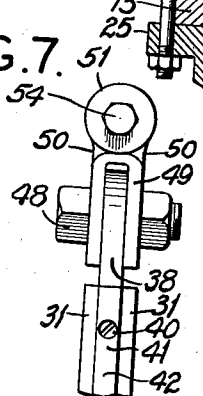
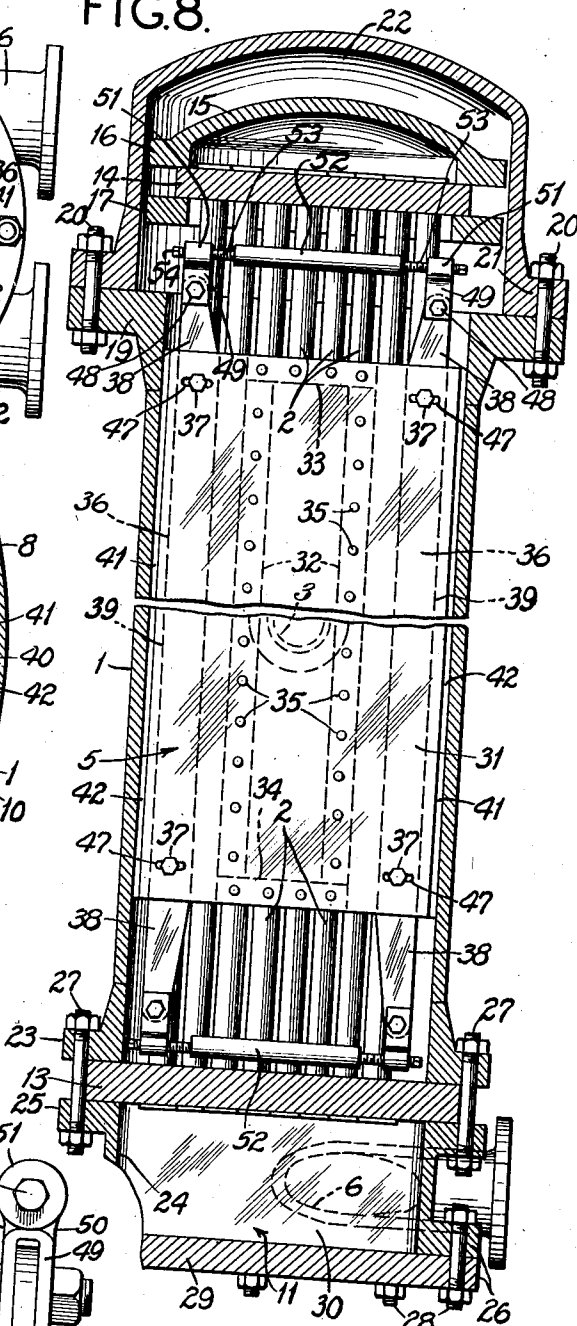


FIG. 8.



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FIG.9.

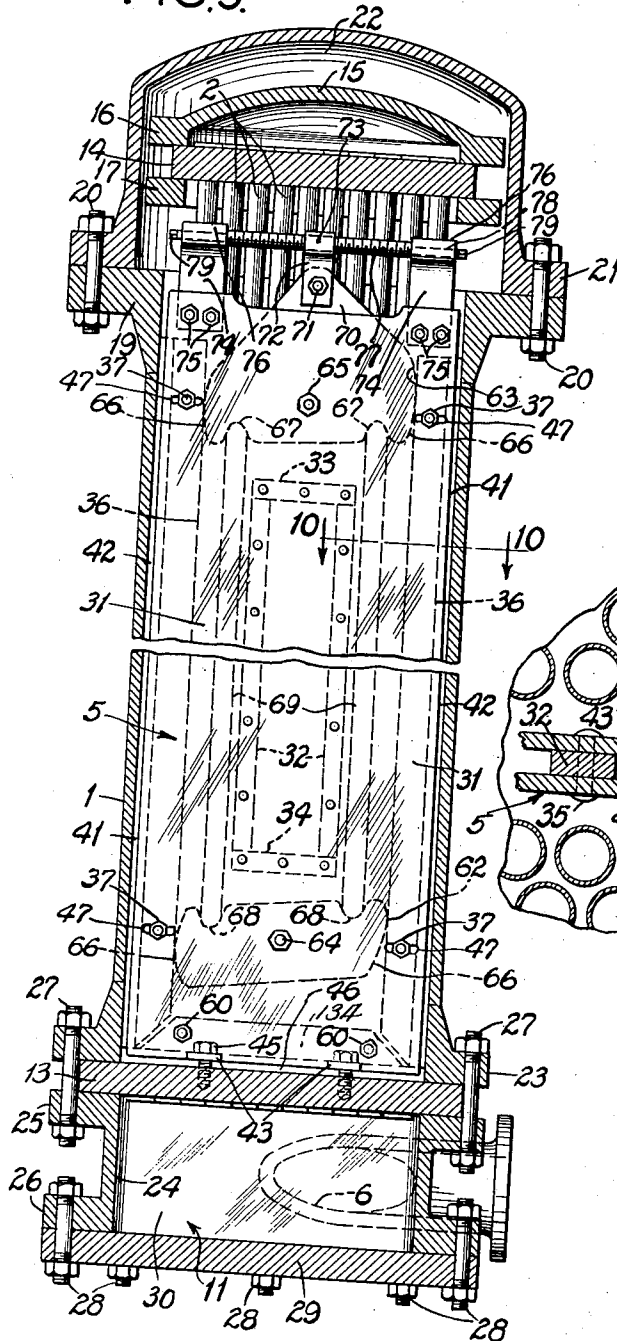
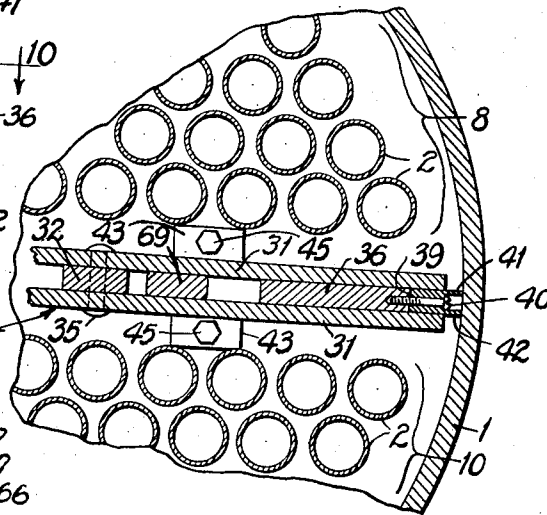


FIG.10.



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FIG.13.

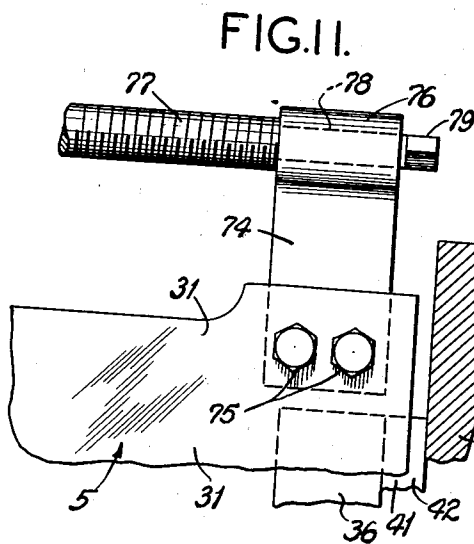
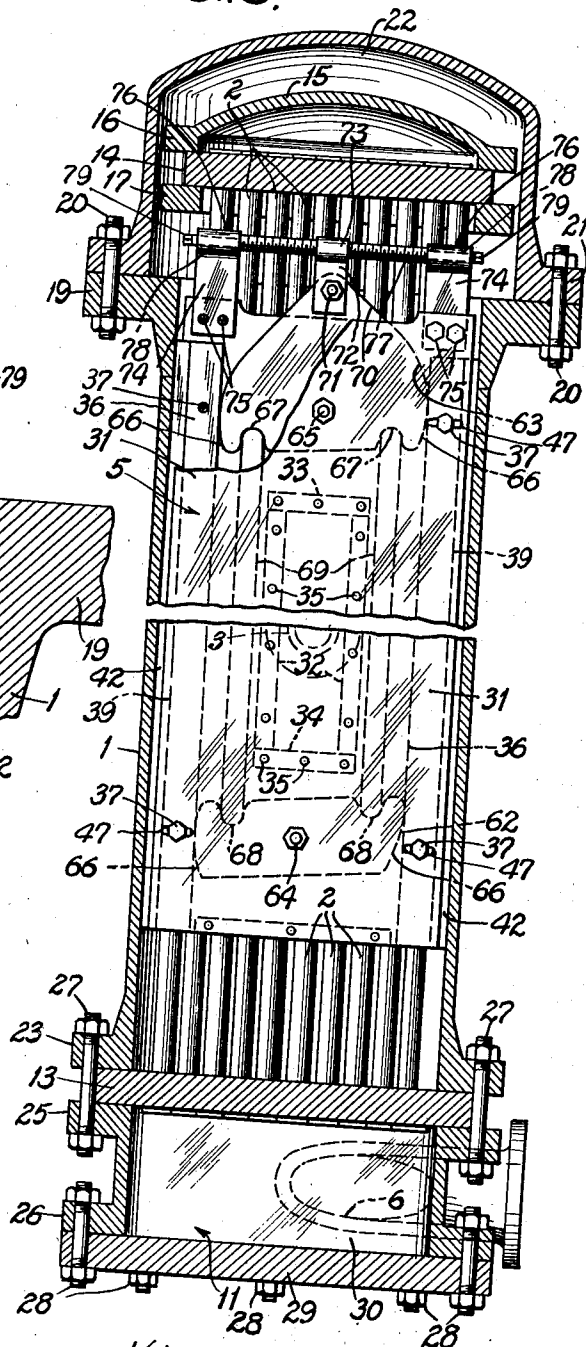
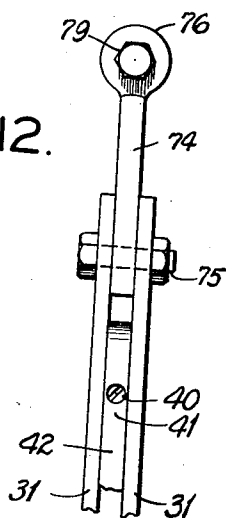


FIG.12.



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UNITED STATES PATENT OFFICE

2,091,003

HEAT EXCHANGE APPARATUS

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Application March 14, 1936, Serial No. 68,909

5 Claims. (Cl. 257—222)

This invention relates to heat exchange apparatus, and with regard to certain more specific features, to heat exchange apparatus of the shell and tube type.

Among the several objects of the invention may be noted the provision of apparatus for exchanging heat between two fluids, the said apparatus being dismountable for the purpose of cleaning and the like with maximum facility; the provision of heat exchange apparatus of the class described including efficient baffle means for providing for the circulation of one of the fluids; the provision, in heat exchange apparatus of the class described, of a removable fluid-directing baffle plate which is nevertheless adapted to maintain a substantially sealed relation between itself and certain other elements of the apparatus; and the provision of apparatus of the class described which is relatively simple and economical to construct and operate. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which are illustrated several of various possible embodiments of the invention,

Fig. 1 is a longitudinal section of heat exchange apparatus embodying the present invention;

Fig. 2 is another longitudinal section of the apparatus of Fig. 1, taken along line 2—2 of Fig. 1;

Fig. 3 is a cross section of the apparatus of Figures 1 and 2, taken along line 3—3 of Figure 2;

Fig. 4 is an enlargement of a fragment of Fig. 3;

Fig. 5 is an enlargement of a fragment of Fig. 1;

Fig. 6 is an enlargement of a fragment of Fig. 2;

Fig. 7 is an end elevation of the apparatus shown in Fig. 6;

Fig. 8 is a longitudinal section similar to Fig. 2, illustrating an alternative embodiment of the invention;

Fig. 9 is a longitudinal section similar to Fig. 2, illustrating a second alternative embodiment of the invention;

Fig. 10 is an enlarged fragmentary cross section taken substantially along line 10—10 of Fig. 9;

Fig. 11 is an enlarged fragment of Fig. 9;

Fig. 12 is an end elevation of the apparatus shown in Fig. 11; and,

Fig. 13 is a longitudinal section similar to Fig. 2, illustrating a third alternative embodiment of the invention.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to Figs. 1 and 2, there is shown a heat exchanger of the type to which the present invention relates. Basically, the heat exchanger comprises a shell 1 in which are positioned a plurality or bundle of tubes 2 arranged in parallel relationship. This type of heat exchanger is commonly known as the shell and tube type, or surface type.

Such heat exchangers are used chiefly in transferring heat between two fluids, either of which may be a vapor or gas, or a liquid. For example, in oil refining operations, the exchanger is frequently used for transferring heat between two liquids, while in steam power plants and industrial establishments, a heat exchanger of this type is frequently used for transferring heat between a liquid and a vapor or gas, such as steam.

One of the fluids enters the shell by way of an inlet 3 and leaves the shell by way of an outlet 4, the direction of flow of this fluid being regulated by a baffle 5. The other fluid enters the exchanger through an inlet 6 to a chamber 7, whence it passes through one group 8 of tubes 2 to a floating head 9. From the head 9 this fluid returns through a second group 10 of tubes 2 to an outlet chamber 11 and an outlet 12. The arrangement is such that neither fluid comes into direct contact with the other, except through the wall of the tubes 2 or the floating head 9. For the purpose of the heat exchange being accomplished between two fluids, it makes little difference which fluid passes through the shell and which passes through the tubes, but when heat is transferred between a liquid and a gas or vapor, the gas or vapor is usually passed into the shell and the liquid forced through the tubes.

The particular form of heat exchanger to which the present invention is applied is that form in which the tubes 2 are secured at their ends to a pair of spaced tube sheets 13 and 14. In this type of heat exchanger, provision must be made for relative expansion between the shell 1 and the tubes 2, inasmuch as it is frequently desirable to make the tubes 2 of a different metal than

that of the shell 1. For example, the tubes 2 might be made of copper and the shell 1 of steel, and since these metals have different temperature coefficients of expansion, a greater lengthening or shortening of the tubes as compared with the shell will take place for a given temperature change. Moreover, even when the tubes 2 and shell 1 are made from the same metal, there is not infrequently a difference in temperature between the interior of the tube bundles and the surface of the shell, which difference in temperature will set up expansion strains.

In the heat exchanger of the present invention, this relative expansion is taken care of by the provision of the head 9, which may be described as floating. The head 9, it will be seen, comprises a dome element 15 having a flat annular flange 16 at its outer periphery. Flange 16 rests upon the edge of the floating tube sheet 14. On the other side of the tube sheet 14 there is provided a ring 17. Circumferentially spaced bolts 18 clamp the tube sheet 14 between the flange 16 and the ring 17. The shell 2 has, at this end of the heat exchanger, an outwardly extending flange 19, to which is secured, by bolts 20, an outwardly extending flange 21 of a cap or end closure 22. The floating head 9 is entirely contained within the cap 22, but is free of any attachment thereto. At the other end of the heat exchanger, the shell 2 is provided with an outwardly extending flange 23. A cylinder 24, having outwardly extending flanges 25 and 26 at each end thereof, to which a closure plate 29 is attached, forms the end closure of the heat exchanger.

Between the flange 23 of the shell 1 and the flange 25 of the cylinder 24 is clamped the stationary tube sheet 13, by means of circumferentially disposed bolts 27. To the flange 26 of the cylinder 24 is secured, by means of bolts 28, a relatively flat closure plate 29. The cylinder 24 includes the inlet 6 and outlet 12, adjacent to each other as shown in Figures 1 and 3, and a vertical baffle 30 providing separate inlet and outlet chambers.

From this construction, it will be seen that the tubes 2 are rigidly attached to the shell 1 at one end thereof (the lower end in Figures 1 and 2), but are free of any attachment whatsoever at their other end (the upper end in Figures 1 and 2). Thus, relative expansion may take place between the shell 1 and the tubes 2, without placing either of these elements under compression or stretching strain, since the floating head 9 is permitted to move freely within the cap 22.

It is highly desirable in heat exchangers of this general construction, that provision be made so that the tube bundle, including the tube sheets 13 and 14 can be removed as a unit from the shell 1 for the purpose of occasional repair and the periodical cleaning which the use of oil and other viscous liquids entails. For this purpose, in the present construction, the tube sheet 14 is made of such a diameter that it will readily slide through the shell 1. The ring 17 is made in several segmental sections. Disassembly may accordingly be effected in the following manner:

The bolts 20 are first loosened and removed, permitting the removal of the cap 22 from the flange 19. The bolts 18 are then likewise loosened and removed, together with the dome element 15. Due to the segmental construction of the ring 17, it can likewise be removed. If the bolts 27 are then loosened and removed, the assembly at the lower end of Fig. 1 may be removed from its end of the shell 1, and thereupon the tube sheet 13 may be moved in a downward direction in

Fig. 1, thereby removing the tube bundle from the shell, inasmuch as the tube sheet 14 readily passes through the shell 1.

It is also important, in heat exchangers of this type, that the tube bundle as nearly as possible fill the interior of the shell, so as to prevent short circuiting, by which is meant a tendency of the fluid in the shell to pass along the space between the outer layer of tubes 2 and the inner wall of the shell, instead of passing into the interior of the tube bundle to contact with the surfaces of the tubes. For this reason, heat exchangers of this type are customarily constructed with the outside diameter of the tube bundle only slightly smaller than the inside diameter of the shell. The tube bundle, accordingly, substantially fills the interior of the shell. Figures 1 and 2 of the drawings are taken at such a section, and are so diagrammatized, that this feature is not illustrated therein, but Fig. 3, which is a cross section, does adequately illustrate this feature.

Another form of short circuiting of the fluid in the shell 1 that must be avoided, is the passage of said fluid directly from the inlet 3 to the outlet 4 without circulating through the length of the heat exchanger, thus exerting a heat exchange relationship only on the fluid in the tubes 2 in a localized region of the exchanger. For this reason, the longitudinal baffle 5 is provided. This baffle 5 comprises, generally speaking, a rectangular plate which is positioned in the shell 1, and which extends from the tube sheet 13 somewhat beyond the end of the said shell. The baffle 5 occupies a dimetrical relationship with respect to the shell 1, and is positioned between the two bundles 8 and 10 of tubes 2 hereinbefore mentioned. The baffle 5 divides the shell 1, in effect, into two compartments.

It is with the construction of the baffle 5 that the present invention is particularly concerned. If said baffle 5, for example, constituted a simple rectangular plate welded or secured, as by rivets, in position, in the shell 1 in a relatively permanent manner, it would comprise an obstacle preventing the removal of the tube bundle in the manner heretofore described. On the other hand, if the baffle 5 comprised a rectangular plate attached merely at its end to the tube piece 13, whereby it could be removed with the tube bundle, it would, in all probability, make poor contact with the walls of the shell 1 when in its operating position, permitting much leakage of the fluid in the shell 1 past the baffle along the walls of the shell. This is a form of short circuiting that should be avoided. The baffle 5 of the present invention is constructed in such a manner as to overcome the above difficulties.

Referring more particularly to Figures 2, 3, and 4, it will be seen that the baffle 5 comprises a pair of rectangular plates 31. Each of the plates 31 is substantially the same length as the shell 1, including both the flanges 19 and 23, but is in width somewhat less than the diameter of the shell 1. Between the plates 31 is positioned a rectangular frame made up of longitudinal spacer bars 32 and end spacer bars 33 and 34. The end bar 33 is positioned at the extreme end of the plates 31, while the end bar 34 is slightly displaced inwardly from the lower end of the plates 31. The longitudinal bars 32 are spaced inwardly a considerable distance from the longitudinal edges of the plate 31. Rivets 35 hold the plates 31 and the bars 32, 33, and 34 in permanent, rigid, parallel relationship. The plates 31 are thereby spaced apart a distance equal to the thickness of

the bars 32, 33 and 34, all of which are of substantially the same thickness.

Numerals 36 indicate longitudinal filler bars, which are sufficiently thinner than the spacer bars 32 to slide freely between the two plates 31. The filler bars 36 are positioned between the plates 31 near the longitudinal edges of said plates. At the lower end of the heat exchanger, the filler bars 36 are pivoted to the plates 31 by means of bolts 37. The upper ends of the filler bars 36 project somewhat beyond the end of the plates 31, as indicated at numeral 38. To the outer edges 39 of the filler bars 36 are affixed, by means of screws 40 (see Fig. 4), strips of compressible gasket material 41. The heads of the screws 40 are desirably countersunk a considerable distance below the outer edge of the gasket strips 41, as indicated in Fig. 4. The outer edges 42 of the gasket strips 41 project beyond the longitudinal edges of the plates 31.

The plates 31 are mounted at their lower end upon the stationary tube sheet 13 by means of clips 43 (see also Fig. 5) welded at right angles to the plate 31, as indicated at numeral 44, and studs 45 passing through the clips 43 and into the stationary tube sheet 13. These constitute the sole permanent supporting means for the plates 31. A block of compressible gasket material 46, still referring to Fig. 5, is desirably inserted between the edge of the spacer block 34 and the tube sheet 13, in order to effect a substantially liquid-proof joint between the plates 31 and the stationary tube sheets 13. The seal is in part secured by screwing down the studs 45 in such a manner as to compress the gasket block 46 against the stationary tube sheet 13.

The bolts 37, which attach the lower end of the filler bars 36 to the plates 31, desirably slide in lateral slots 47 provided in plates 31, in order that a degree of lateral adjustment of the filler bars 36 may be effected at this end of the exchanger.

To the ends 38 of the filler bars 36 projecting beyond the upper ends of the plate 31 are tightly secured, by means of bolts 48 (see Figs. 2, 6 and 7), U-shaped clips 49. The projections 38 are embraced between the legs of the clips. To the exteriors of the bends of the clips 49 are welded, as indicated at numeral 50, interiorly threaded collars 51. The collar 51 on one of the clips 49 carries a left-hand thread, while the collar 51 on the other clip 49 carries a right-hand thread. Numeral 52 indicates a rod which has a threaded portion 53 on each end thereof. One of the threaded portions 53 has a right-hand thread, and fits in the collar 51 having the corresponding thread, while the other portion 53 has a left-hand thread and fits into the left-hand threaded collar 51. The outer end of the threaded portion 53 is provided with a wrench-receiving polygonal head 54. It will readily be seen that when the rod 52 is turned in one direction, the filler bars 36 are moved outwardly from between the plates 31, pivoting upon the bolts 37, while when the rod 52 is rotated in the opposite direction, said filler bars are moved inwardly. The overall length of the rod 52 is less than the inner diameter of the shell 1.

The disassembly of a heat exchanger embodying such a baffle 5 constructed in the manner described is effected in the following manner:

By rotating the rod 52 in such a direction as to draw the filler bars 36 together (which may be done by applying a wrench to the polygonal portions 54 after the cap 22 has been removed from

the heat exchanger) the pressure exerted by the gasket strips 41 on the interior walls of the shell 1 is released. Thereupon, the heat exchanger may be disassembled in the manner heretofore indicated, the baffle 5 being removed from the heat exchanger along with the tube bundle. The bolts 37 may be adjusted to such a position that the lower ends of the gasket strips 41 are brought into tight engagement with the shell 1 or the flange 23, upon assembly. This tight engagement at one end does not prevent the ready insertion of the baffle 5 into the shell 1, because the other ends of the filler bars 36 are drawn inwardly so that gasket strips 41 do not bear against the shell walls. After such assembly, the rod 52 is turned in such a direction as to move the filler bars 36 outwardly, whereupon the gasket strips 41 are brought into tight, liquid-proof engagement with the walls of the shell substantially throughout their length. The tightening means, it will readily be seen, is available for manipulation merely upon moving the cap 22 from the heat exchanger.

Fig. 8, which is a section analogous to Fig. 2, shows another embodiment of the invention which is more particularly applicable to heat exchangers where the inlet 3 and outlet 4 of the shell 1 are positioned in the central portion of said shell. In this embodiment, fluid flowing in at the inlet 3 spreads and flows in two directions, part of the fluid flowing toward one end of the heat exchanger and the other part flowing towards the other end. The baffle 5 is so arranged that it is by-passed by fluid at each end of the heat exchanger, the two streams of fluid then converging and flowing out of the shell 1 through the outlet 4.

In this embodiment, the baffle 5 is substantially identical to the baffle of the Fig. 2 embodiment, except that the filler bars 36 project at each end beyond the end of the plate 31. Each end of each bar 36 is now provided with an adjusting rod 52, and all of the parts associated therewith. A bolt 37, sliding in slots 47 in the plates 31, is now provided for each end of each bar 36. In this embodiment, the baffle 5 is in no way attached to the stationary tube sheet 13.

In this embodiment, disassembly of the heat exchanger is accomplished in the following manner, assuming the elements originally to be in 50 their Fig. 8 position.

The cap 22 is removed by removing the bolts 20. The rod 52 at the upper end of the heat exchanger is then available for manipulation, and it is rotated in such a manner that the filler bars 36 are moved inwardly or towards each other. The bolts 27 are then removed, permitting removal of the cylinder 24 from the lower end of the heat exchanger. Thereupon, the stationary tube sheet 13 is freed, and may be drawn outwardly from the shell until the floating tube sheet 14 abuts the rod 52, it being assumed that the dome 9 and ring 17 have meanwhile been removed by removing the bolts 18. In this position, sufficient space is available for a hand wrench to be inserted into the lower end of the shell 1 for the purpose of rotating the lower rod 52 in a suitable direction to draw the lower ends of the filler bars 36 inwardly. The upper ends of the bars 36 having already been drawn inwardly, this results in the complete freeing of the baffle 5 from the walls of the shell 1. Thereupon, the entire tube bundle may be withdrawn from the shell 1, drawing the baffle 5 along with it.

In this embodiment, the bolts 37 are preferably

never screwed down in such a manner as to clamp the filler bars 36 tightly, but serve merely as guiding elements providing for proper lengthwise alignment of the filler bars 36 with respect to the plates 31.

Assembly of this embodiment is effected in a series of manipulations precisely the reverse of those just described in connection with the disassembly of the embodiment.

Fig. 9, which is a section similar to Figures 2 and 8, shows a third embodiment of the invention. In this embodiment, the baffle 5 is made up of the customary rectangular plates 31, together with the spacer bars 32, 33 and 34. The spacer bars 32, 33 and 34 of this embodiment, however, constitute a relatively small rectangle located well towards the center of the plates 31. Filler bars 36 are, as heretofore, positioned between the plates 31 at their longitudinal edges, and the construction of the filler bars 36, with their gasket strips 41, is the same as that heretofore described. However, in this instance the entire length of the filler bars 36 is included between the ends of the plates 31; in other words, the bars 36 are shorter than the plates 31. In this embodiment, as in the Fig. 2 embodiment, the lower ends of the plates 31 are secured to the stationary tube sheet 13 by means of clips 43 and bolts 45. A lateral filler bar 134 with an attached gasket strip 46 is also provided to seal the plates 31 to the stationary tube sheet 13, and, in the present embodiment, this lateral filler bar 134 is held in position on the plates 31 by bolts 60. The bolts 45 compress the gasket strip 46 in the same manner as in the Fig. 1 embodiment.

As in the Fig. 8 embodiment, a bolt 37 is provided at each end of each filler bar 36, each of the bolts 37 sliding in slots 47 in the plates 31.

Numerals 62 and 63 indicate camming pieces that are rotatably mounted on pivot bolts 64 and 65, respectively, and which are positioned in the space between the two plates 31. The camming pieces 62 and 63 have curved edges 66 on each side thereof, the curvature of the edges 66 being at increasing radii such that when the pieces 62 and 63 are rotated in one direction (clockwise, for example, in Fig. 9) the edges 66 engage the inner edges of the filler bars 36 to move said filler bars outwardly against the walls of the shell 1. When said pieces 62 and 63 are rotated in the other direction, the outward pressure on the filler bars 36 is relieved and said bars are permitted to move inwardly towards each other by the resilient expansion of the gasket strips 41. The camming piece 63 has a pair of notches 67 along its inner edge. The camming piece 62 has a pair of oppositely facing notches 68 along its inner edge. Supported between each notch 67 and its corresponding notch 68 is a bar 69. The bars 69 complete a parallelogram relation between the pieces 62 and 63, so that when one of said pieces is rotated, the other piece is obliged to rotate through a corresponding angle.

The camming piece 63 has a forward triangular projection 70, the point of which projects beyond the ends of the plates 31. Bolted to the projection 70 by means of a bolt 71 is a U-shaped piece 72, which is similar to the device shown in Figures 6 and 7 for the Fig. 1 embodiment. To the bend of the U-shaped member 72 is welded an interiorly threaded collar 73, comparable to the collar 51 of Figures 6 and 7.

Referring to Figures 11 and 12, in addition to Fig. 9, will be seen that flat pieces or blocks 74 extend from the upper end of the plates 31 near

the longitudinal edges thereof, the pieces 74 being rigidly mounted between the plates 31 by bolts 76. To the outer end of the blocks 74 are welded collars 76. The collars 76 (shown in Figures 11 and 12) are not threaded interiorly, but the collar 73 of Fig. 9 is internally threaded.

Numeral 77 indicates a centrally threaded rod which has unthreaded end portions 78 of reduced diameter. The extreme ends of the portions 78 are provided with wrench-receiving polygonal heads 79. The unthreaded portions 78 rotate freely in the collars 76. The threaded portion 77 of the rod engages the interiorly threaded collar 73 on the U-shaped clip 72.

The overall length of the rod 77 is less than the diameter of the shell, so that said rod 77 may be drawn through the shell 1 in removing the baffle from the heat exchanger in the manner heretofore described.

When the rod 77 is rotated, as by applying a wrench to either of the polygonal heads 79, the collar 73 is compelled to move longitudinally on said rod 77. Longitudinal movement of the collars 73 is transmitted, through the U-shaped clip 72 and the bolt 71, to the camming piece 63, causing rotation of said camming piece on the pivot 65. As has been explained, the camming piece 63 cannot rotate without causing a co-extensive rotation of the camming piece 62.

The use of this embodiment of the invention will be obvious from the description of the prior embodiment.

The embodiment of Fig. 9 offers a measure of superiority over the embodiment of Fig. 2, in that, because the action of camming pieces 62 and 63, the filler blocks 36, and hence the gaskets 41, are moved inwardly and outwardly in a uniform manner from end to end, instead of being pivoted as in the Fig. 2 embodiment. This eliminates the chance of whatever slight difficulties might be encountered through the tight binding of the lower end of the filler bars 36, for example, in the Fig. 2 embodiment. The Fig. 9 embodiment is assembled and disassembled in precisely the same manner as the Fig. 2 embodiment.

Fig. 13 illustrates an embodiment of the invention which bears the same relation to the embodiment of Fig. 9 that the embodiment of Fig. 8 bears to the embodiment of Fig. 2; in other words, the baffle 5 in the Fig. 13 embodiment is made shorter, and has no permanent attachment to the stationary tube plate 13. In this embodiment, an opening is provided at each end of the baffle 5 for the circulation of fluid in the shell 1, as in the Fig. 8 embodiment. This assumes, of course, that the inlet and outlet 3 and 4 for the shell 1 are positioned near the center of said shell.

Assembly and disassembly of this embodiment, which is comparable to the embodiment of Fig. 8, is considerably simpler than the assembly and disassembly of the Fig. 8 embodiment. For example, in this embodiment, disassembly may be effected by the following sequence of operations:

The cap 22 is first removed, after which the dome element 15 and the ring 17 of the floating head are likewise removed. The rod 77 is then rotated, by application of a wrench to one of the polygonal heads 79, in such a direction that the camming pieces 62 and 63 are rotated to relieve the pressure forcing the filler bars 36 outwardly against the shell wall. Thereupon, the stationary head 13 may be drawn away from the shell 1, pulling the baffle 5 along with it. As-

sembly is effected by a reverse sequence of operations.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In heat exchange apparatus of the class described, a removable baffle comprising a pair of rectangular plates, spacer bars secured between said plates in such manner as to establish said plates in fixed, parallel spaced relationship, filler bars positioned between said plates at the longitudinal edges thereof, and means available for manipulation outside of the confines of said plates for moving said spacer bars towards each other and inwardly from the longitudinal edges of the plates, or away from each other and outwardly from the longitudinal edges of the plates, said last-named means comprising portions of said filler bars projecting beyond the ends of said plates, interiorly threaded collars supported on said portions, and a screw element engaging both of said collars, said collars being threaded in opposite direction, and said screw element having portions threaded in the proper direction for engaging the respective collars.

2. In heat exchange apparatus of the class described, a removable baffle comprising a pair of rectangular plates, spacer bars secured between said plates in such manner as to establish said plates in fixed, parallel spaced relationship, filler bars positioned between said plates at the longitudinal edges thereof, and means available for manipulation outside of the confines of said plates for moving said spacer bars towards each other and inwardly from the longitudinal edges of the plates, or away from each other and outwardly from the longitudinal edges of the plates, said last-named means comprising portions of said filler bars projecting beyond the ends of said plates, interiorly threaded collars supported on said portions, and a screw element engaging both of said collars, said collars being threaded in opposite direction, and said screw element having portions threaded in the proper direction for engaging the respective collars, and means pivoting the filler bars to the plates at the other ends of said filler bars.

3. In heat exchange apparatus of the class described, a removable baffle comprising a pair of rectangular plates, spacer bars secured between said plates in such manner as to establish said

plates in fixed, parallel spaced relationship, filler bars positioned between said plates at the longitudinal edges thereof, and means available for manipulation outside of the confines of said plates for moving said spacer bars towards each other and inwardly from the longitudinal edges of the plates, or away from each other and outwardly from the longitudinal edges of the plates, said last-named means comprising portions of each filler bar extending from each end of said plates, interiorly threaded collars mounted on each of said projecting portions, and a threaded rod at each end of said plates engaging the collars on the filler bars at that end of the plates, the collars of the respective filler bars being threaded in opposite directions, and the threaded rods having portions threaded in opposite directions to engage the oppositely threaded collars.

4. In heat exchange apparatus of the class described, a removable baffle comprising a pair of rectangular plates, spacer bars secured between said plates in such manner as to establish said plates in fixed, parallel spaced relationship, filler bars positioned between said plates at the longitudinal edges thereof, and means available for manipulation outside of the confines of said plates for moving said spacer bars towards each other and inwardly from the longitudinal edges of the plates, or away from each other and outwardly from the longitudinal edges of the plates, said last-named means comprising camming plates pivotally mounted between said rectangular plates, the edges of said camming plates abutting the inside edges of said filler bars, whereby, upon rotation of said camming plates, said filler bars are forced outwardly to an increasingly great extent.

5. In heat exchange apparatus of the class described, a removable baffle comprising a pair of rectangular plates, spacer bars secured between said plates in such manner as to establish said plates in fixed, parallel spaced relationship, filler bars positioned between said plates at the longitudinal edges thereof, and means available for manipulation outside of the confines of said plates for moving said spacer bars towards each other and inwardly from the longitudinal edges of the plates or away from each other and outwardly from the longitudinal edges of the plates, said last-named means comprising camming plates pivotally mounted between said rectangular plates, the edges of said camming plates abutting the inside edges of said filler bars, whereby, upon rotation of said camming plates, said filler bars are forced outwardly to an increasingly great extent, and means for rotating said camming plates available for manipulation outside of the confines of said rectangular plates.

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