

April 30, 1946.

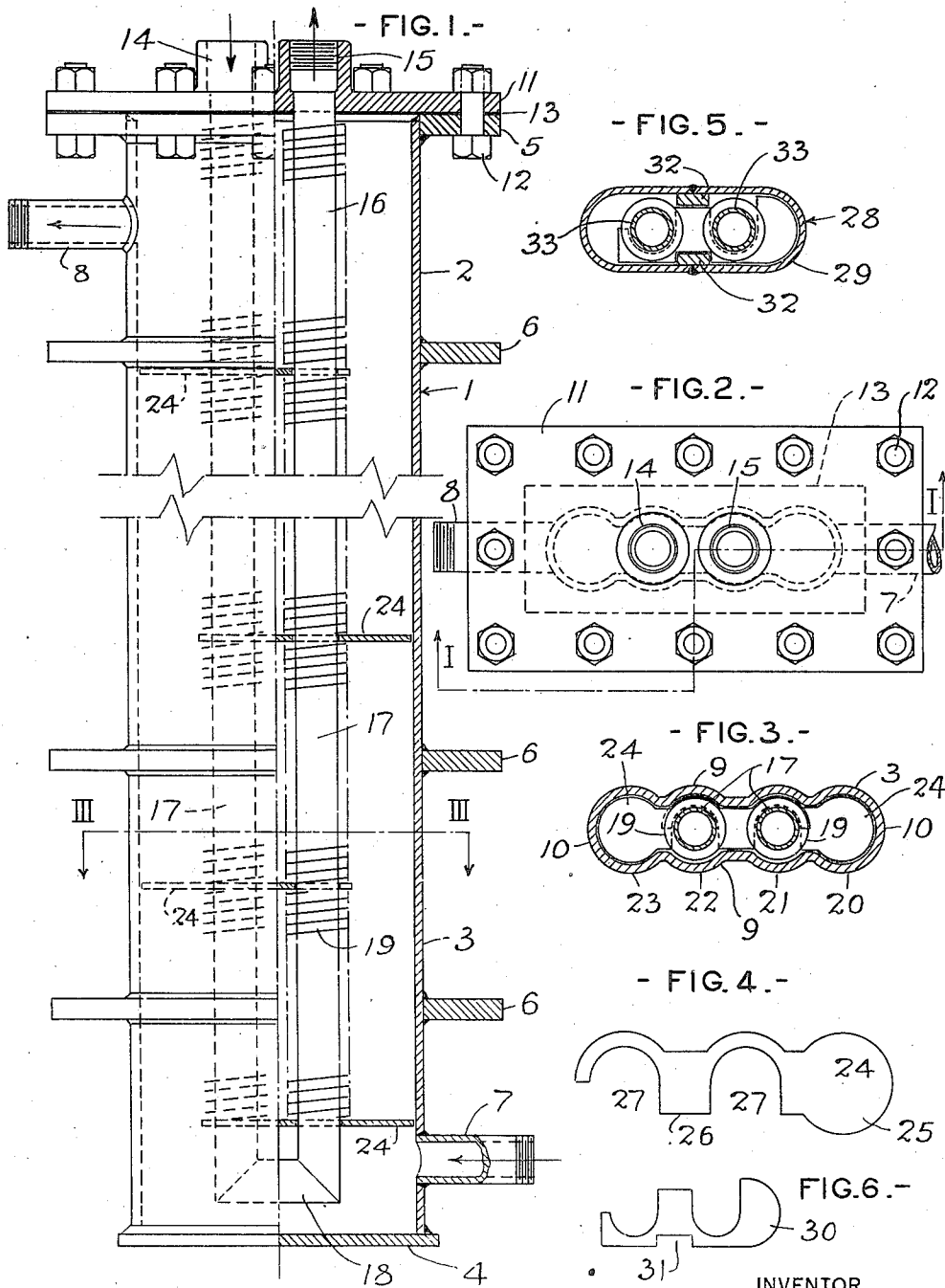
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2,399,484

HEAT EXCHANGER

Filed Dec. 27, 1943

2 Sheets-Sheet 1



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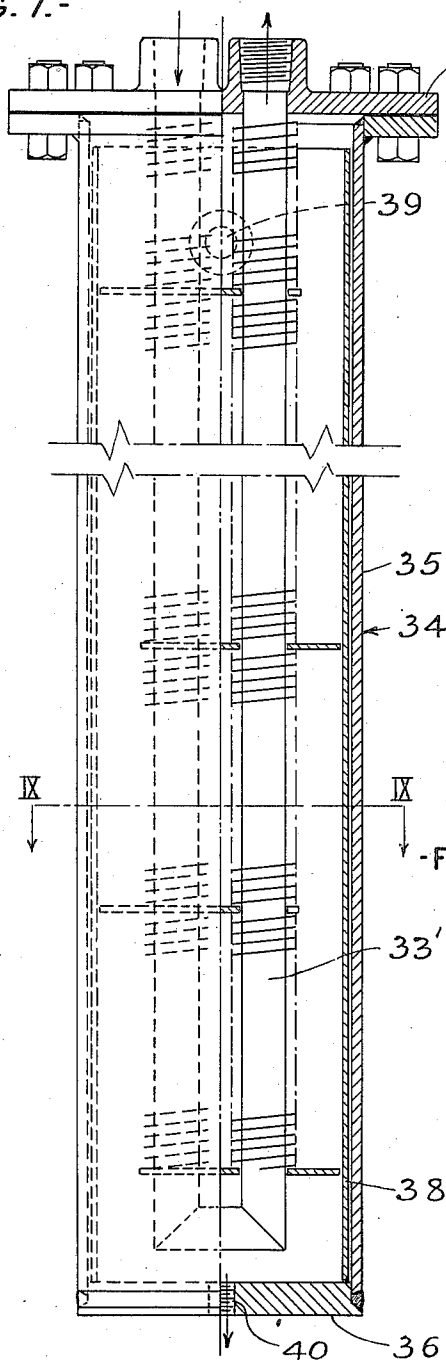
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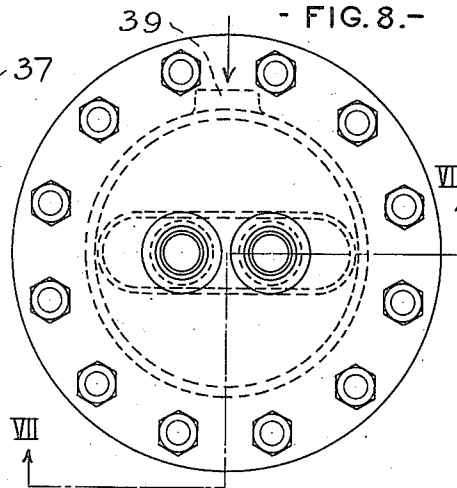
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2 Sheets-Sheet 2

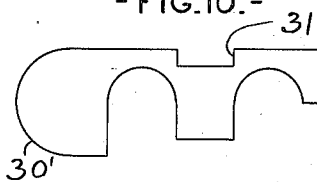
- FIG. 7.-



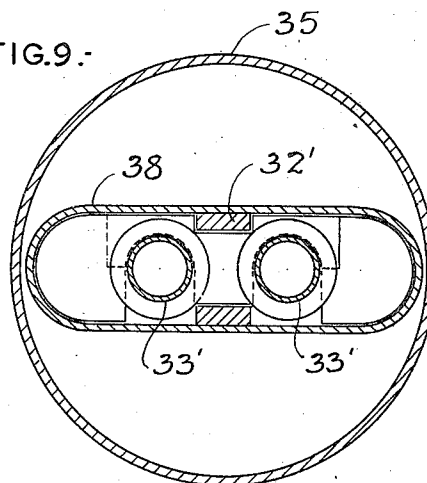
- FIG. 8.-



- FIG. 10.-



- FIG. 9.-



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2,399,484

HEAT EXCHANGER

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Application December 27, 1943, Serial No. 515,923

3 Claims. (Cl. 257-221)

This invention relates to heat exchangers.

An object of the present invention is to provide a heat exchanger having a single cross fin U-tube and a shell therefor adapted to maintain at a minimum the net free area for flow of shell fluid.

Other and further objects of this invention will appear from the following description, the accompanying drawings and the appended claims.

Referring to the drawings forming a part of this application, Figure 1 is a foreshortened view of a heat exchanger embodying the present invention taken on the line I—I of Fig. 2, parts being shown in full and the fins on the tube being indicated diagrammatically; Fig. 2 is a plan view of the exchanger of Fig. 1, parts being broken away; Fig. 3 is a section on the line III—III of Fig. 1; Fig. 4 is an enlarged view of one of the baffles of the exchanger; Fig. 5 is a view similar to Fig. 3 showing a modified form of heat exchanger embodying the present invention; Fig. 6 is a view of one of the baffles of the exchanger of Fig. 5; Fig. 7 is a view similar to Fig. 1, taken on the line VII—VII of Fig. 8, showing another modification of the invention; Fig. 8 is a plan view of the exchanger of Fig. 7; Fig. 9 is an enlarged section on the line IX—IX of Fig. 7; and Fig. 10 is a view of one of the baffles shown in Fig. 9.

Referring to Figs. 1-4, the heat exchanger shown therein is indicated generally by the reference numeral 1. The heat exchanger is shown vertically disposed and will be so described. However, it will be understood that it, and the other exchangers shown in the drawings, may be employed in a horizontal or other position if desired. Exchanger 1 includes a welded built-up shell 2 having a body 3 of the cross-sectional shape shown in Fig. 3. The body is closed at the bottom by a wall 4 and is open at its top and provided around its open end with a bolting flange 5. Stiffening members 6, welded crosswise externally of the shell, strengthen the shell. An inlet nozzle 7 opens into the shell at its bottom at one side and an outlet nozzle 8 opens into the shell at its top on the opposite side. The shell has wide corrugated side walls 9 and narrow walls 10 connecting the wide walls.

A tube sheet 11 is secured to the flange 5 by bolts 12, closing the upper end of the shell, a gasket 13 being provided in the usual manner. The tube sheet has an inlet nozzle 14 and an outlet nozzle 15 disposed centrally in a plane parallel to the walls 9. A cross fin U-tube 16,

having two spaced legs 17 connected at the bottom by a bend 18 and being secured at the top ends one in the inlet nozzle 14, and the other in the outlet nozzle 15, is disposed in the shell 2. Each of the legs is provided with external cross fins 19. Cross fins, employed with staggered baffles, have been found preferable in the present construction due to the higher heat exchange rate obtained from them than from longitudinal fins.

The cross-sectional shape of the shell 2, as is clearly shown in Fig. 3, includes four cylindrical portions, each of a diameter only slightly larger than the diameter of the fins 19. These cylindrical portions are numbered 20, 21, 22 and 23.

The legs 17 are disposed in the portions 21 and 22.

The tube fluid, which for the purpose of illustration may be assumed to be steam, enters the tube through the nozzle 14 and leaves it through the nozzle 15. The shell fluid, which may be assumed to be cold oil, and which it is desired to heat, enters the shell through the nozzle 7. It is desired to cause the oil to flow substantially crosswise of the tube in a circuitous path back and forth across the tube and through the shell to the outlet nozzle 8. For this reason baffles 24 are provided, one being shown in Fig. 4. Each baffle has a circular portion 25 for shutting off one of the portions 20 or 23, a portion 26 for shutting off the space between the legs 17, and two cut out portions 27 for disposition around the legs 17. The baffles are supported on the legs between the fins of the tube and may be secured thereto as by soldering.

The first baffle 24 is disposed with portion 25 in portion 20. The next baffle is disposed with portion 25 in portion 23, and so on. Thus the baffles are staggered so that the shell fluid must flow crosswise of the tube in its passage from the inlet nozzle 7 to the outlet nozzle 8.

The reentrant curve of each wall 9 between portions 21 and 22 serves to deflect the fluid flowing crosswise of the shell, forcing it to impinge on the tube legs.

From the foregoing description, it will be apparent that a heat exchanger in which the net free flow area for shell fluid is maintained at a minimum, is provided. This is due to the cross-sectional shape of the shell, conforming closely to the outer edges of the fins 19 of the U-tube, and to the shape of the baffles, closing off the spaces between the legs of the tube and alternately closing off the portions 20 and 23.

A modified form of heat exchanger, indicated generally by the reference numeral 28, and also adapted to be vertically disposed, is shown in

Fig. 5. It differs from the exchanger 1 in that it has a shell 29 oval in cross section and of smaller cross-sectional area than the shell 2. It has baffles 30, one of which is shown in Fig. 6, and each is provided with a slot 31 for engagement with a bar 32. Two bars 32 are provided. They are secured to the shell as by welding (plug welding) and serve to deflect the fluid flowing crosswise of the shell, forcing it to impinge on the tube legs 33 in a manner similar to that provided by the reentrant curves in the exchanger of Figs. 1-4.

Another modified form of heat exchanger, indicated generally by the reference numeral 34, is shown in Figs. 7-10 vertically disposed. It includes a cylindrical outer shell 35 closed at its bottom by a wall 36 and at its top by a tube sheet 37 similar to tube sheet 11 except that it is circular. An oval inner shell 38 is disposed in shell 35 and secured at its bottom to the wall 36. The upper end of shell 38 opens into shell 35. An inlet nozzle 39 opens into the outer shell 35 a short distance below the top of the inner shell, and an outlet 40 is formed in the wall 36 at the center of the inner shell. The inner shell substantially fills the outer shell on one diameter, but as the inner shell is oval, large spaces are provided between the inner and outer shells adjacent the wide sides of the inner shell.

The U-tube and baffles employed in the inner shell 38 are similar to those employed in the shell 29 of Fig. 5 and no further description thereof is deemed necessary, the parts being indicated by the same references used in describing similar parts in Figs. 5 and 6, with an accent added. The operation of the exchanger 34 is substantially the same as that of the exchangers 1 and 28 except that the shell fluid enters the space between the outer and inner shells through the nozzle 39 and enters the inner shell by flowing over the top thereof. Shell fluid leaves the inner shell through the outlet 40.

In all three of the aforescribed embodiments of the invention, the tube sheet, U-tube and baffles may be easily removed as a unit from the shell for the purpose of cleaning or repair.

A greater number of staggered baffles may be employed than are shown, if desired, the number of baffles employed and the positioning of these baffles determining the velocity and heat transfer rate of the shell fluid.

While there have been hereinbefore described approved embodiments of this invention, it will be understood that many and various changes and modifications in form, arrangement of parts and details of construction thereof may be made without departing from the spirit of the invention and that all such changes and modifications as fall within the scope of the appended claims are contemplated as a part of this invention.

The invention claimed as new and desired to be secured by Letters Patent is:

1. A heat exchanger comprising a shell elongated in cross section provided with an inlet and an outlet; longitudinally spaced staggered baffles extending alternately from the opposite narrow sides of said shell part way thereacross, said baffles each having two slots opening through the same side thereof, said slots being arranged in two longitudinal rows; and a cross fin-tube in each row of slots, said tubes being connected together at one of their ends and open at their other ends providing an inlet and an outlet, the inner face portion of said shell wide sides at the space between said tubes projecting inwardly part way into said space to deflect the transverse flow of shell fluid.

2. A heat exchanger as defined in claim 1 wherein the edge of each baffle is similar in contour and in close proximity to the inner face portion of the exchanger shell opposite thereto.

3. A heat exchanger comprising a shell elongated in cross section provided with an inlet and an outlet; longitudinally spaced staggered baffles extending alternately from the opposite narrow sides of said shell part way thereacross, the baffles extending from one of said narrow sides each having a slot opening through a side thereof providing a longitudinal row of slots, and the baffles extending from the other of said narrow sides each having a slot opening through a side thereof providing a longitudinal row of slots, said rows of slots being spaced from each other; and a cross fin-tube in each row of slots, said tubes being connected together at one of their ends and open at their other ends providing an inlet and an outlet, the inner face portion of the wide sides of said shell at the space between said tubes projecting inwardly part way into said space to deflect the transverse flow of shell fluid.

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