July 7, 1953 S. KOPP 2,644,675

HEAT EXCHANGER

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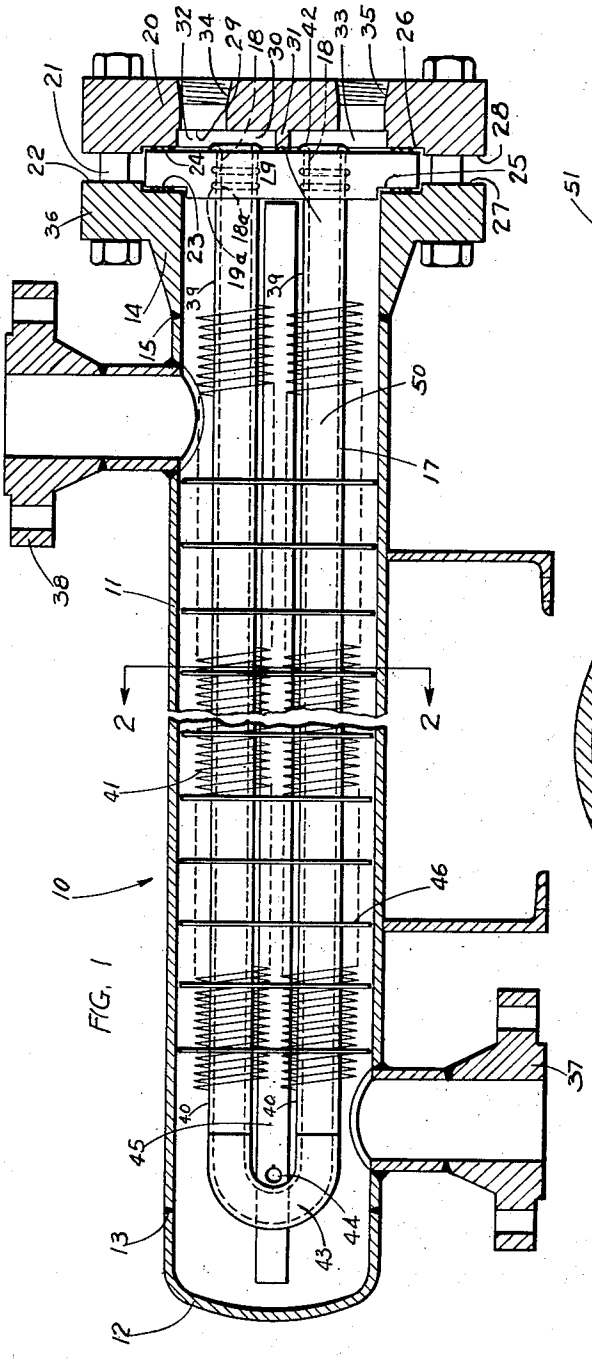


FIG. 1

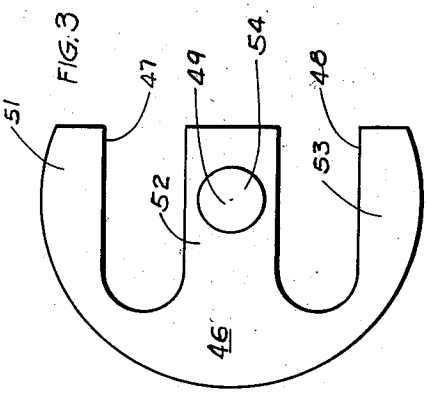


FIG. 3

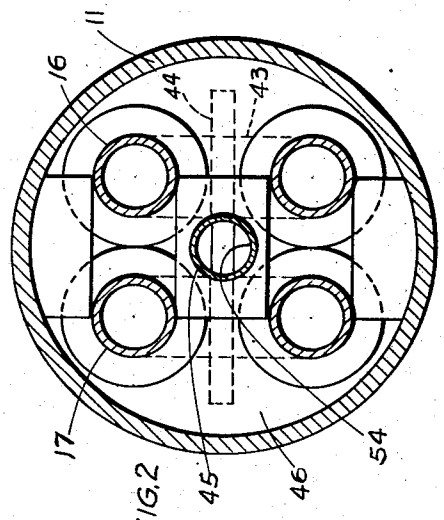


FIG. 2

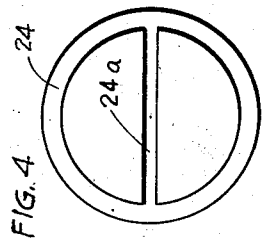


FIG. 4

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HEAT EXCHANGER

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2 Claims. (Cl. 257—239)

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This invention relates to heat exchangers.

The principal object of the invention is to provide a heat exchanger having a shell with an openable head closure and an improved type of fin tube-baffle assembly therein which is easily assembled, which will function more effectively, and which is removable through the head end of the shell for cleaning and repair, the baffles being thereafter easily removed from the fin tube for cleaning, repair, replacement, or adjustment.

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

Referring now to the drawing.

Fig. I is a foreshortened side view of a heat exchanger constructed in accordance with the invention, shown partly in central section and with only a portion of the fins shown, the remainder of the fins being indicated in dotted lines; Fig. II is a cross section through the exchanger taken on the line II—II in Fig. I; and Fig. III is a front elevation of a baffle plate. The "forward" and "rear" portions of the heat exchanger are shown respectively at the right and left of Fig. I. Fig. IV is a view of one of the sealing gaskets used on the tube sheet.

The heat exchanger includes a cylindrical shell, generally indicated at 10, which has a main body 11, an end closure 12 permanently connected to the body at the rear end by a weld 13, and a flanged end member 14 permanently connected to the forward end of the body by a weld 15. Fluid conducting U-tubes 16 and 17 are arranged to extend longitudinally of the shell with their forward ends supported in orifices 18 in the tube sheet 19. Orifices 18 may be formed with annular grooves 18a therein for the reception of corresponding annular projections 19a on the tubes, which are expanded into the grooves upon assembly by swaging in the well known manner. Tube sheet 19 is clamped in operative position by a head closure 20 rigidly secured by bolts 21 to the bolting flange 22 of the shell. Annular gaskets 23 and 24 are arranged respectively in recesses 25 and 26 formed for their reception in the opposed faces 27 and 28 of the shell end member 14 and head closure 20 respectively. Head closure 20 has a central recess 29 which forms a chamber 30 adjacent the tube sheet. Fabricated integrally with the head closure at the horizontal center line thereof and on its rear face is a partition 31 which divides chamber 30 into compartments 32 and 33. Gasket 24 is formed with an integral central cross bar 24a which is disposed between partition 31 and tube

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sheet 19 to provide a seal between compartments 32 and 33. When the head closure is clamped into operative position against the tube sheet, partition 31 is brought into flush relation therewith. Inlet passage 34 and outlet passage 35 are threaded for the reception of fluid conductors (not shown) forming part of a system to supply one of the fluids to be transferred through the heat exchanger. Such inlet and outlet passages may, if desired, be provided with nozzles.

The inside diameters of the main shell body 11, end closure 12, and the flanged forward end member 14 are equal so that the inside of the shell provides an unobstructed and continuous wall extending from the forward face of the bolting flange 36 to the inside curvature of the end cover 12. Inlet nozzle 37 and outlet nozzle 38 communicate with the interior of the main shell body to supply a second fluid which will pass through the shell for heat exchange with the fluid passing through the U-tubes in the well known manner. End closure 12 and inlet nozzle 37 may be replaced by an end flange and opening similar to flange 14 and the opening at the forward end of the shell so that the unit may be joined with another similar unit or with other fluid containers such as a pipe or tank.

Each U-tube has bare end portions 39 and 40; and mounted upon the tubes between such bare portions are extended surface elements in the form of cross fins 41 to aid in the heat transfer function of the exchanger. Such fins may be helical, (as shown in Fig. I), in which case they are of continuous ribbon-like construction; or they may be parallel, in which case they are fabricated individually and disposed along the tubes transverse to the axis thereof. For steel tubes of 1½ inches outside diameter, fins of sheet ingot iron of approximately .012 inch thickness, ½ inch in height, and 7 to each axial inch of tubing have been found to be satisfactory.

The extreme forward end portions 42 of the tubes are flared back to prevent slippage of the tubes to the rear, such flaring to be welded to the tube sheet, if desired. Alternately, the tubes may have straight end portions disposed flush with the outer face of the tube sheet and welded securely into position. Baffle support member 45 is disposed centrally of the U-tubes equidistant from the legs thereof and extends longitudinally through the shell. In operative position, the rear end of member 45 is spaced at some distance from the wall of closure 12 and its forward end is spaced closely to the tube sheet. Adjacent and immediately forward of the return bend 43 of the

U-tubes, retainer pin 44 is mounted in the support member 45 to extend transversely to the axes of the tubes to prevent slippage or movement of the member 45 to the rear in response to fluid pressure upon the baffles. Support member 45 has another important function, as will later appear. In lieu of retainer pin 44, support member 45 may be threaded at its forward end and the tube sheet 19 provided with a tapped receiving bore for the reception of member 45 so that rearward slippage will be prevented.

A plurality of baffle members 46 are provided to perform the usual function of providing turbulence in the shell fluid. The construction of such baffles is an important feature of the invention. Each baffle (see Fig. III) has the form of a slotted plate of disc truncated so that its periphery is the arc of a circle somewhat greater than 180°. That is to say, the disc is a segment greater than a half circle. The slots 47 and 48 are disposed on opposite sides of the plate or disc center 49, and each slot has a dimension equal to the outside diameter of the tube leg 50. The inner end of the slot is curved with a radius equal to the radius of curvature of the outside of the tube legs so that each baffle may be positioned across both legs of one U-tube with the curved ends of the slots flush against the tubes throughout half their circumference. The fingers 51, 52, and 53 of the disc are positioned (as shown in Fig. II) to extend across both legs of one U-tube 17 and further to engage the corresponding legs of the adjacent tube 16.

The baffles are disposed alternately, one extending across the tubes from the left to the right (as viewed in Fig. II), and the next extending across the tubes from the right to the left. Each baffle has a circular aperture 54 at its center, the diameter of which is equal to the outside diameter of support member 45.

To assemble the heat exchanger unit, the U-tubes with the fins disposed thereon, are placed in parallel position in an assembly fixture with the end portions of their legs extending through the orifices 18 in the tube sheet 19. The tube ends are thereupon rolled into the tube sheet and flared against the forward face thereof. The baffle plates or discs are then mounted in spaced relation across the legs of the tubes between fins, with the truncated edges of the alternate baffles facing in opposite directions. The apertures 54 are in alignment, and the support member 45 is threaded therethrough from the end opposite the tube sheet in a tight fit and moved to a position so that its end is adjacent the tube sheet. Pin 44 is inserted through the receiving orifice in the member 45. The entire fin tube-baffle assembly may then be moved into the shell and the head closure 20 clamped into position. The nozzles are thereupon connected to the sources of the two fluid supplies.

Since the baffle plates are machined to be positioned snugly against the inside walls of the shell body, they will rest thereon and accordingly serve as supports for the U-tubes. As indicated in the statement of invention herein, the exchanger may be dismantled by removing the head closure and sliding the U-tube-baffle assembly therefrom. The baffles and fins are then available for cleaning, repair, replacement, and adjustment.

The mounting member 45 has been shown herein as circular in cross section and the baffle plate central aperture 54 is circular to correspond thereto. Obviously, member 45 could be of other shapes, provided the baffle apertures 54 corresponded thereto so that mounting of the baffle plates upon the member could be effected. Such mounting member, in whatever its shape, will serve as a deflector to prevent excessive flow of shell fluid between the legs of the U-tubes, thereby directing the flow of fluid across the tubes in a more efficient manner for heat exchange purposes.

While there has been hereinbefore described an improved embodiment of this invention, it will be understood that many and various changes and modifications in form, arrangement of parts and details of construction may be made thereto 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 and desired to be secured by Letters Patent is:

1. In a heat exchanger of the class wherein a shell is provided with a removable head closure, a tube and baffle plate assembly removable from the shell as a unit comprising a tube sheet a plurality of fluid conducting U-tubes having legs anchored at their open ends to the tube sheet, apertured baffle plates upon the U-tubes, a rigid member extending through the baffle plate apertures, and longitudinal movement restraining means for the rigid member comprising a pin disposed through the rigid member transversely to the axis of the legs of the U-tubes and adjacent the return bends thereof, said pin being adapted to engage such bends to prevent movement of the rigid member rearwardly in response to the pressure of the shell fluid upon the baffle plates.

2. In a heat exchanger of the class wherein a shell is provided with a removable head closure, a tube and baffle plate assembly removable from the shell as a unit comprising a tube sheet, a plurality of fluid-conducting U-tubes having legs disposed in parallel relation and anchored at their open ends to the tube sheet, a plurality of apertured baffle plates each shaped as a segmented disc and having a pair of parallel slots therein, said plates being arranged transversely to the U-tube legs with the slots in engagement with the legs, and a rigid member extending through the apertures of the baffle plates, and longitudinal movement restraining means for the rigid member comprising a pin disposed through the rigid member transversely to the axis of the legs of the U-tubes and adjacent the return bends thereof, said pin being adapted to engage such bends to prevent movement of the rigid member rearwardly in response to the pressure of the shell fluid upon the baffle plates.

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