Sept. 3, 1929. E. N. SIEDER 1,726,995

HEAT EXCHANGE APPARATUS

Filed Oct. 26, 1928

FIG. 1.

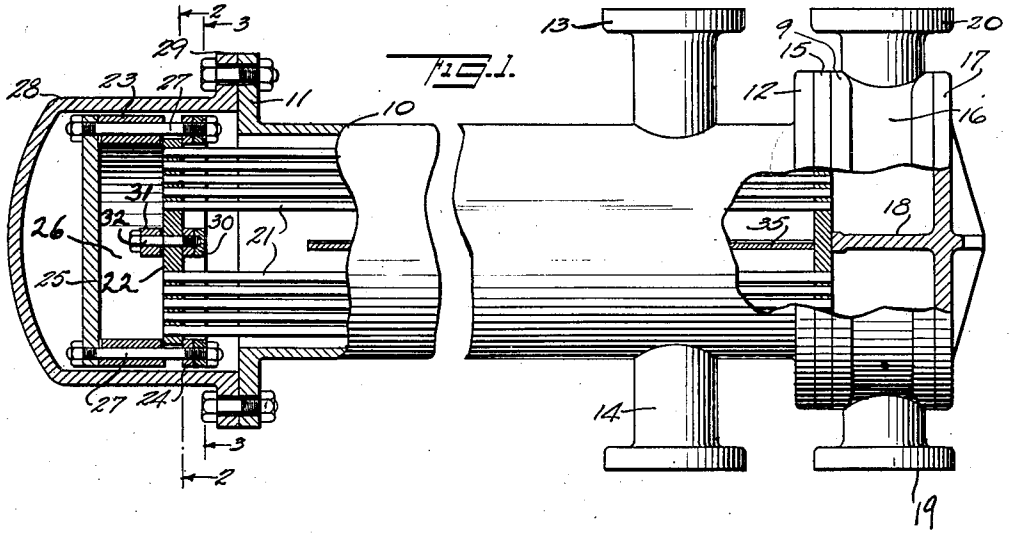


FIG. 2.

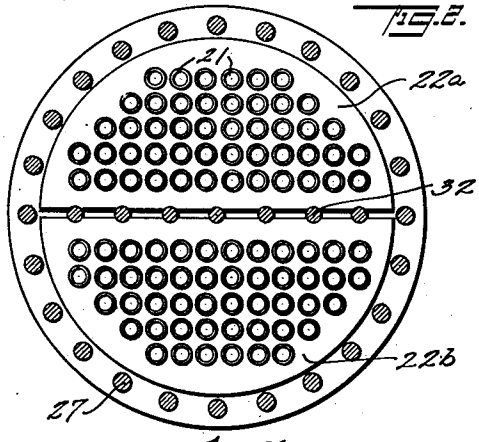


FIG. 4.

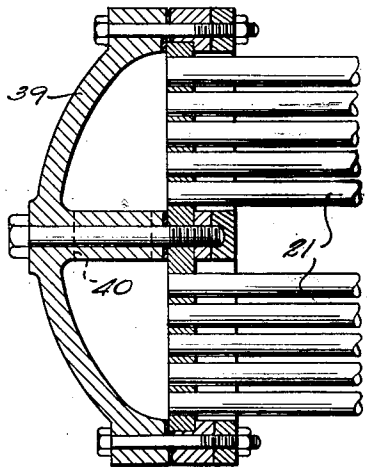


FIG. 3.

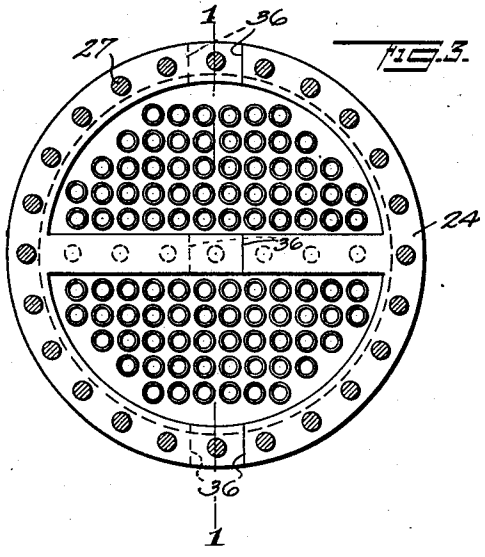
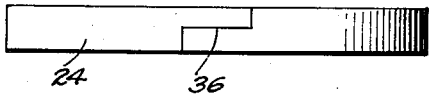


FIG. 5.



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HEAT-EXCHANGE APPARATUS.

Application filed October 26, 1928. Serial No. 315,285.

My invention relates to heat exchange apparatus and particularly to tubular heat exchangers wherein a plurality of tubes are contained within a shell and are arranged to be removable therefrom. Still more particularly, my invention relates to heat exchange apparatus of the type comprising a stationary tube sheet and a floating tube sheet between which extend tubes, the tube unit being removable from the shell by pulling the tubes and floating head attached through the shell and the shell containing one or more baffles.

The object of my invention is to improve the efficiency of heat exchangers of the above described type. This is accomplished by decreasing flow of fluid past the baffle. Baffles have generally been made removable along with the tubes and have generally been attached to the stationary tube sheet. I fix the baffle within the shell, preferably welding it to the shell along all edges adjacent to the shell. The baffle is usually placed between groups of tubes. To remove the tubes as a unit, I split the floating tube sheet in line with the baffle. Where several baffles are used I may make several splits in this tube sheet. The arrangement is such that the parts of the split tube sheet are joined to form a unit tube sheet when assembled but so separated, when disassembled, as to permit being drawn through the shell past the baffle.

The invention will be described in connection with the accompanying drawings showing several heat exchange apparati embodying my invention and whereon:

Fig. 1 is a side view, partly in section of a heat exchange apparatus embodying the invention;

Fig. 2 is a transverse cross-sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a transverse cross-sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 shows a part of a heat exchange apparatus embodying the invention in another form; and

Fig. 5 is a side view of a part of the heat exchange apparatus looking down on Fig. 3.

Referring to the apparatus shown on Figs. 1, 2 and 3, a cylindrical extended shell 10 has end flanges 11 and 12. One fluid such as steam of low pressure is admitted to shell 10 through connection 13 and this fluid, which, if the apparatus is a condenser, becomes water, leaves shell 10 through connection 14. Attached to flange 12 is a stationary tube sheet 15 and attached to this tube sheet is a flange 9 of a casting or box 16, these parts being secured in adjacent fluid tight connection by bolts or other suitable means. End plate 17 is connected in the same manner to the main portion of box 16. Box 16 is provided with an inlet connection 19 and an outlet connection 20 for a second fluid, such as water, designed to have exchange of heat with the fluid passing through connections 13 and 14.

Within shell 10 is a bundle of tubes 21 which are suitably expanded or otherwise fitted into tube holes in tube head 15.

Box 16 is provided with a transverse partition wall 18 dividing it into two separate compartments. When used as a condenser, water passes through box 16 and through tubes 21 while steam passes within shell 10 around tubes 21.

At the opposite end of shell 10 is a floating tube sheet 22. According to the present invention, this is a split tube sheet made of two halves or semi-tube sheets 22^a and 22^b. (See Fig. 2.) The tube bundle is composed of two groups of tubes spaced apart, of which one group is secured into the semi-tube sheet 22^a and the other into semi-tube sheet 22^b by expanding or the like into tube holes. Attached to one side of floating tube sheet 22 is a return channel ring 23 and to the other side a split backing ring 24. A cover 25 covers the end of return channel ring 23 to form a return channel 26 bounded by tube sheet 22, ring 23 and cover 25. Bolts 27 draw cover 25 against ring 23, and rings 23 and 24 against tube sheet 22. A bonnet 28 fits over parts 22, 23, 24, 25 and 27 and has a flange 29 which is bolted or otherwise suitably secured to flange 11. Suitable gaskets are preferably used in all joints.

The manner in which the two halves of split-tube sheet 22 are held together is as follows:

A diametrically extending backing bar 30 is formed integral with backing ring 24. The tube-sheet side of this backing bar is arranged to lie in the plane of the tube sheet side of the circumferential part of the backing ring 24 so that the inside straight edges of the semi-tube sheets can be placed against the backing bar. A corresponding bar 31 which I will term a retaining bar is formed integral with channel ring 23 and, when the parts are properly assembled, lies opposite backing bar 30 and immediately adjacent to the inside straight edges of the semi-tube sheets. The tube sheet side of the retaining bar is likewise in the plane of the tube sheet side of the circumferential part of the channel ring. Semi-tube sheets 22^a and 22^b are not quite semi-circular but are slightly separated when assembled forming a crack between them. The straight edges are cut away, if necessary, to form spaces for passage of suitable size stud bolts 32 through the crack. The stud bolts pass through holes in the retaining bar, pass through the crack between the tube sheet halves and screw into the backing bar. Setting up on the bolts 32 serves to draw the retaining bar, semi-tube sheets and backing bar together, hold the semi-tube sheets together and seal the crack between the semi-tube sheets to prevent passage of fluid therethrough. Packing may be employed between the various parts.

Within the shell 10 is a longitudinal baffle 35 which is placed between the two groups of tubes. Baffle 35 is welded to the shell 10 along all of its longitudinal edges. It extends from fixed tube sheet 15 to a point some distance from backing ring 30.

Assuming that the heat exchanger shown is a condenser, the operation is as follows: Cooling water enters inlet 19 and passes through the lower group of tubes to return chamber 26 and thence through the upper group of tubes and out through connection 20. Steam enters connection 13, passes longitudinally in shell 10, around the upper tubes and above baffle 35, thence around the end of baffle 35, between it and backing ring 30, thence longitudinally under baffle 35 around the lower group of tubes, and as condensate, out through connection 14.

Assuming that the heat exchanger shown in Fig. 1 is assembled as shown, I will describe how it is disassembled and from that description it will become evident how the parts are assembled.

First, bonnet 28 is removed by removing the bolts holding flanges 11 and 29 together. Access can now be had to the nuts at both ends of bolts 27 and these bolts are all removed. This removes cover 25 but not rings 23 and 24; these rings remaining in place on account of stud bolts 32. These bolts are then removed. Channel ring 23 with retaining bar 31 then come off and as backing ring 24 is split as indicated at 36 in Fig. 3, the two halves of this ring including the two halves of backing bar 30 are readily removed. At the same time the two halves of tube sheet 22 have been made independent.

We now go to the other end of the heat exchanger and disconnect connections 19 and 20 from the associated pipes. Next the bolts holding flanges 9 and 12 and the tube sheet 15 are removed. This permits removal of box 16. Tube sheet 15 is then pulled out endwise of shell 10 taking the tubes and floating head 22 with it. Baffle 35 is not connected to tube sheet 15 and remains in shell 10. Semi-tube sheets 22^a and 22^b are of such a size that they can pass through shell 10, one to each side of baffle 35. By using the arrangement of return channel ring 23 and backing ring 24 it is possible to have a floating tube sheet of less diameter than the inside diameter of shell 10. The crack between the semi-tube sheets may be considered as a passage for baffle 35.

It will be seen that the arrangement above described permits of welding baffle 35 to shell 10 and thus short-circuiting of fluid past the longitudinal edges of the baffle is prevented. Leakage past the end of the baffle adjacent tube sheet 15 is not nearly as great as would be the leakage past the longitudinal edges of the baffles if the baffle were attached and came out with the stationary tube sheet 15 as has been previous practice.

Fig. 4 shows another form of the invention wherein the return channel ring and cover are combined into a unitary return channel member 39. The retaining bar extends to the cover position of member 39 and has one or more passages 40 for fluid through it. The type of floating head shown in Fig. 4 may be used with a four pass heat exchanger. Obviously the floating tube sheet may be split into more than two parts as when it is desired to have more than one baffle such as 35.

It will be understood that the invention is not limited to the forms shown and that variations may be made without departing from the spirit and scope of the invention.

What I claim is:—

1. In heat exchange apparatus, a split tube sheet and means for holding the parts of the tube sheet together.

2. Heat exchange apparatus comprising a shell, a baffle fixed within said shell, tubes within said shell on both sides of the baffle, a tube sheet at one end of said shell, said tube sheet being of substantially the same size as the cross-sectional area within said shell and said tube sheet being divided so that portions thereof may pass through the shell past the sides of the baffle, means for uniting the portions of the tube sheet, and a second tube sheet at the other end of said shell, said tubes being connected into said tube sheets.

3. Heat exchange apparatus comprising a shell, a tube unit within said shell comprising tubes and tube sheets at the ends of the tubes, a baffle within said shell between groups of said tubes and means whereby the tube unit can be removed from the shell without removing the baffle.

4. A head for tubes comprising semi-tube sheets, a head member, a backing ring, means for clamping the semi-tube sheets between the head member and the backing ring, a retaining bar integral with said head member and a backing bar integral with said backing ring and means for clamping the retaining bar and the backing bar together, with the joining edges of the semi-tube sheets there between, said retaining bar and said backing bar serving to seal the joint between the semi-tube sheets.

5. Heat exchange apparatus comprising a shell, tubes within said shell, a baffle fixed within said shell and a tube sheet connected to said tubes said tube sheet being split in longitudinal alignment with the baffle and means for holding the parts of the tube sheet together.

6. Heat exchange apparatus comprising a cylindrical shell, tubes within said shell, a baffle fixed longitudinally within said shell and a circular tube sheet having less diameter than the inside diameter of the shell connected to the tubes, said tube sheet having a jointed crack in line with the baffle.

EVERETT NORMAN SIEDER.