Nov. 26, 1940. R. R. COLLINS 2,223,313

HEAT EXCHANGER

Filed Sept. 14, 1939

Fig. 1.

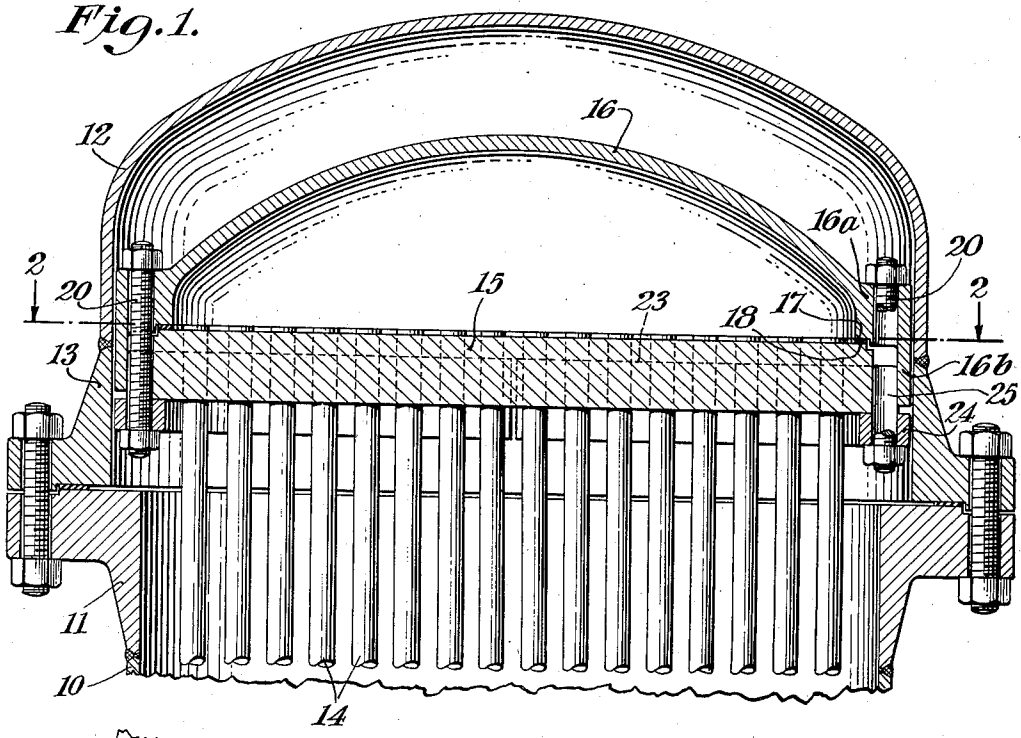


Fig. 2.

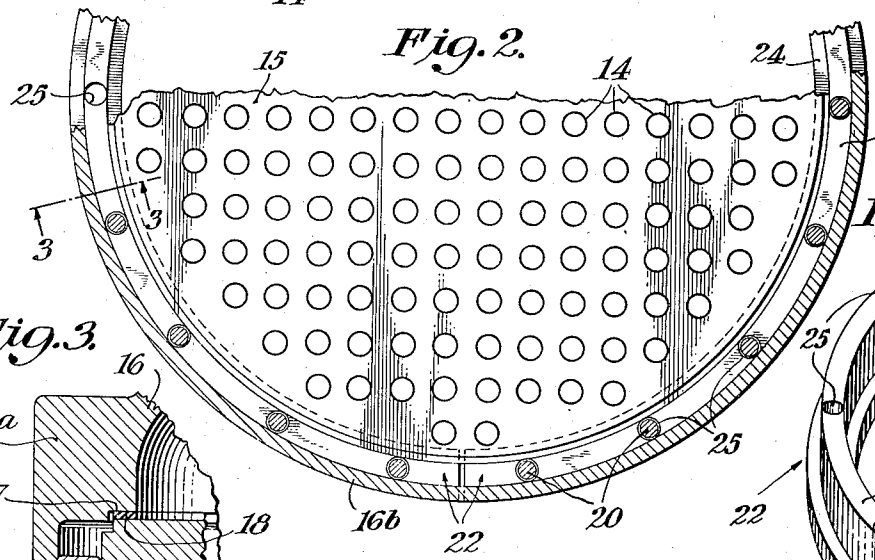


Fig. 3.

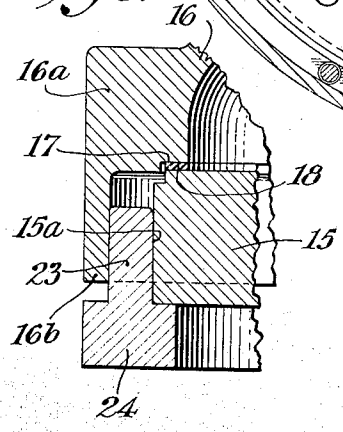
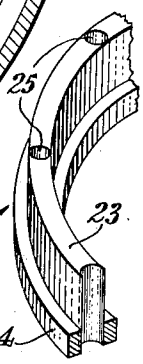


Fig. 4.



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HEAT EXCHANGER

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3 Claims. (Cl. 257—225)

This invention relates to improvements in heat exchangers and more particularly to improvements in the floating head construction thereof.

It is known that in heat exchangers of the shell and tube type, it is commonly found desirable to provide a floating tube sheet of a diameter smaller than the interior of the shell in order that the tube bundle may be withdrawn as desired. Such tube sheet is provided with a floating tube sheet cover by which the flow through the various tubes is redirected and such cover is customarily removable in order that the tubes may be cleaned. Such cover should be removable from the floating tube sheet end of the exchanger so that complete dismantling of the exchanger is unnecessary at each cleaning operation.

The manner of securing the floating head cover to the floating tube sheet of a shell and tube type heat exchanger has been the subject of considerable thought, due to the fact that space limitations and pressure limitations prevent a simple solution of the problem. It is not only desirable to remove the tube sheet through the shell, but it is equally important to keep the shell diameter as small as possible to avoid excessive costs of shell and flanges and to have a highly efficient heat exchanger with a minimum volume with respect to the number of available tubes.

In the past, it has been suggested that individual bolts of J form or split rings be used. The J bolts were spaced around the periphery of the cover and of necessity gave intermittent contact. The split rings were more effective in securing the joint, but elaborate means were required to prevent the split ring segments from canting outward and destroying the seal. After expansion and contraction, it was almost impossible to have a tight joint between the cover and tube sheet. It has also been suggested that the cover be bolted directly to the tube sheet, but this requires a substantial extension of the rim of the cover and of the tube sheet which requires an increased shell diameter. If the bolts are projected through the cover, leaking invariably occurs.

The principal object of the present invention is to provide an improved heat exchanger having a floating head cover which is provided with a depending integral skirt portion overlapping a split interlocking ring for securing the cover to the tube sheet, such cover thereby also preventing the interlocking ring from canting on application of sealing pressures.

A more specific object of the invention is to provide an improved type of interlocking split ring for securing the floating head cover to the floating tube sheet of a shell and tube type heat exchanger, in which the split ring is of inverted T shape with a substantial lever arm acting as a beam for reinforcing the tube sheet and offering a substantial support for the floating head cover securing means.

Further objects and advantages of my invention will appear from the following disclosure of a preferred form of embodiment thereof, taken in connection with the attached drawing, in which

Fig. 1 is a central vertical section of the floating tube sheet end of the heat exchanger;

Fig. 2 is a partial horizontal section taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a detailed vertical section taken substantially along the line 3—3 of Fig. 2;

Fig. 4 is a perspective view of a part of the retaining ring.

In accordance with a preferred form of embodiment of my invention, the shell 10 is of a typical heat exchanger and has flanges 11, to which the shell cover 12 is secured as by its flanges 13. Within such shell is a tube bundle generally indicated at 14, consisting of a plurality of tubes which terminate in the floating tube sheet 15. A floating tube sheet of this type is generally necessary to take care of the normal expansion and contraction of the tubes, as it is customary for the other end of the tubes to be secured to a fixed tube sheet (not shown) which is anchored to the shell. The floating tube sheet 15 is of a diameter smaller than the internal diameter of the shell 10, so that it may be withdrawn with the tube bundle.

A floating head cover 16 is provided for the tube sheet 15 so that liquids passing through certain of the tubes in the tube bundle 14 may be redirected to other tubes in the bundle. The cover 16 must be secured to the floating tube sheet 15 in a pressure tight manner. In the present construction, the cover 16 is provided with a rim 17, which engages a gasket 18, as more particularly shown in detail in Fig. 3, and the tube sheet 15 terminates at the line 15a only a slight distance beyond the edge of the gasket 18. The securing bolts 20 clear the outer diameter 15a.

These bolts 20 project through an interlocking ring 22, a portion of which is shown in Fig. 4, such ring being of inverted T shape having an upstanding arm 23 and a crosspiece 24. The assembly is illustrated in Fig. 3, it being noted that the inwardly extending portion of the crosspiece 24 projects under the tube sheet 15 and the

arm 23 extends upwardly and in close contact with the outer diameter 15*a* of the tube sheet. This ring 22 is of segmental construction, preferably being in two pieces, and is suitably drilled as at 25 to receive the bolts 20, which extend from the boss 16*a* on the edge of the cover 16 and project downwardly through the segmental ring 22 to hold the cover to the tube sheet. The arm 23 can be substantially the same width as the thickness of the bolts without increasing the diameter of the parts, and such increased width greatly improves its characteristic as a beam, not only to prevent canting, but to improve the strength between bolts thereby improving the continuity of seal between cover and tube sheet.

As the bolts 20 are beyond the edge of the tube sheet, the out-of-line stresses are such that there is a couple tending to rotate the segments of the ring away from the bottom of the tube sheet and under variations in temperature the excess loading has been known to deform the parts such that when the parts become cool leakage occurs. In my construction, however, the T-shape of the segmental ring 22 acts as a substantial beam, the arcuate form of which serves to resist, to a high degree, the tendency of the ring to cant outward.

In addition, the cover 16 has a continuous ring skirt portion 16*b* which surrounds the marginal portion of the tube sheet and overlaps the arm portion 23 of the ring 22 to such an extent that canting is completely resisted.

The construction is extremely simple to manufacture. The cover 16 is readily machined to a diameter to embrace the ring 22 and there are no substantial changes of diameter or shape. The ring 22 is also made as a simple machine operation and may be suitably split after machining. There are a minimum number of parts, and the mere assembly of the apparatus insures that all the parts are in place. The contact is with substantially the entire periphery of the tube sheet, and the boss 16*a* and depending skirt 16*b* of the cover, as well as the T shape of the ring, act as beams between securing bolts 20, and fewer bolts for a uniformly tight seal can be used. There is also established a minimum size of tube sheet for the number of tubes as the tube sheet has but the single function of anchoring the tubes. The bolt diameter for bolts 20 is also a minimum for clearance of the tube sheet, with a resulting smaller shell cover.

While I have shown and described a preferred form of embodiment of my invention, I am aware that modifications may be made thereto, and I, therefore, desire a broad interpretation of my invention within the scope and spirit of the description herein and of the claims appended hereinafter.

I claim:

1. In a heat exchanger having a shell, a tube bundle therein, a tube sheet for one end of the tube bundle, a cover for said tube sheet having a rim engaging the outer face thereof, said cover having a projecting marginal portion surrounding the tube sheet and spaced therefrom to form a marginal channel, the combination of a ring member having a stem portion in the channel embracing the periphery of the tube sheet and embraced by the marginal portion of the cover, said ring member having an integral inner shoulder portion underlying a part of the tube sheet and securing means extending through the ring member, in the channel portion, and through the cover for securing said cover to said tube sheet.

2. A heat exchanger of the class described in claim 1, in which the ring member is of inverted T-shape having a portion underlying in part the marginal portion of the cover to form a support for the securing means.

3. In a heat exchanger having a shell, a tube bundle therein, a tube sheet for one end of the tube bundle and a cover for said tube sheet, said cover having a rim engaging the outer face of the tube sheet, said cover having a projecting marginal portion surrounding the tube sheet and spaced therefrom to form a marginal channel, the combination of means for securing said cover to said tube sheet, said means including a plurality of segments forming a ring, said segments being T-shaped in cross-section, the stem of which extends into said marginal channel and embraces the periphery of the tube sheet and is embraced by the marginal portion of the cover, the head of said ring having a shoulder portion engaging under the periphery of the tube sheet and a second portion projecting under the periphery of the marginal portion of the cover, bolt members extending through the cover and the marginal channel and through the head of the ring whereby said cover may be sealed to the tube sheet, the bolts being of a diameter substantially equal to the width of the stem of the ring segments, said ring stem being substantially continuous between bolts whereby the resistance to unbalanced forces of loading by the bolts is great and canting of the segments is substantially prevented.

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