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C. S. REED

2,254,189

HEAT EXCHANGER

Filed March 7, 1940

Fig. 1.

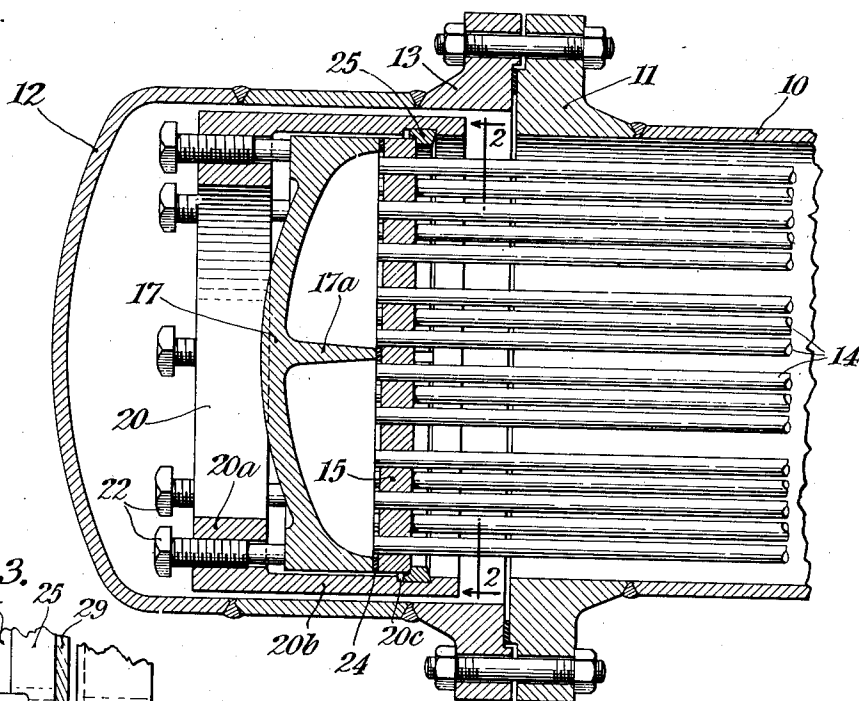
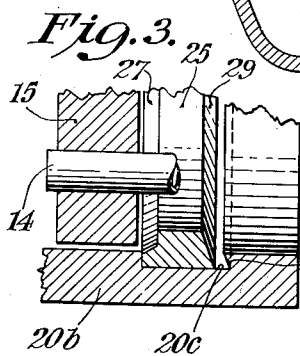
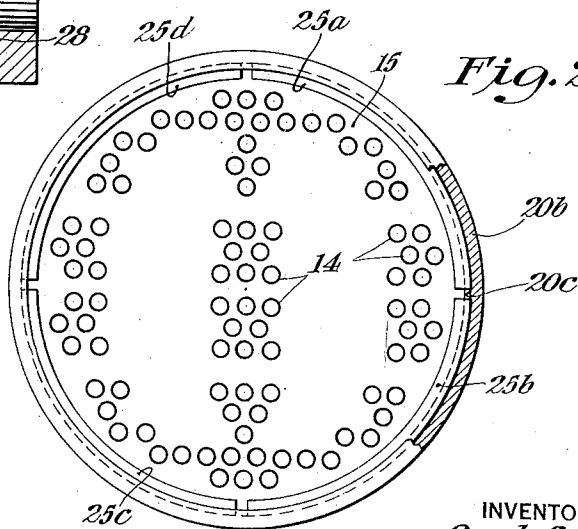


Fig. 2.



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HEAT EXCHANGER

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1 Claim. (Cl. 257—239)

This invention relates to improvements in heat exchangers more particularly of the shell and tube type and specifically relates to the construction of the floating tube sheet and cover therefor.

It has heretofore been proposed to provide a detachable cover for the floating tube sheet of a shell and tube type heat exchanger so that the tubes can be exposed for cleaning and inspection, and it has also been proposed that the cover be attached in such a manner that the tube sheet can be removed from the shell of the exchanger without requiring an inordinately large shell. In addition to the need of a detachable cover, which could be readily removed, and attaching means of such a type that the tube sheet could be withdrawn or inserted in the tube bundle, it is essential that the cover be secured in a tight manner not only when the construction is originally assembled, but so that it will remain tight even after extreme changes of temperature and pressure.

In the copending applications of Jacocks, Ser. No. 277,812, filed June 7, 1939, and Gibb, Ser. No. 294,797, filed Sept. 14, 1939, which on Nov. 26, 1940, issued, as Patent Nos. 2,223,319 and 2,223,318, respectively, it has been found most effective to provide a continuous embracing ring surrounding the cover and the tube sheet, such ring preferably being of inverted L-shape in cross section with the hold-down devices projecting through the overlapping flange to engage the cover directly and immediately above the gasket. The embracing leg portion of the ring was secured to the tube sheet in the particular manner specified in such applications.

Such constructions are of particular advantage in that with the continuous ring there are no unreacted moments brought about by the eccentric loading of the hold-down members, and the diameter of the cover and tube sheet can be a minimum. The thickness of the embracing ring was nominal as it was placed entirely in tension and it need be only of a minimum length to assure an adequate connection in shear with the tube sheet.

In accordance with a preferred form of embodiment of my invention, modifications have been made in the manner of attaching the continuous embracing ring to the tube sheet in order to reduce the cost, expedite the attachment and accomplish a secure connection. In particular, the present invention has for its principal object, the provision of a floating cover attachment to the floating tube sheet of a shell and

tube type heat exchanger by the use of a continuous embracing ring enveloping the peripheries of the cover and tube sheet and being anchored to the tube sheet by a detachable split key.

More specifically, the present invention includes the provision of a split key for the purpose hereinbefore set forth, which engages under the tube sheet and is embraced by the tube sheet on two sides so that during the initial setting up of the apparatus the split key is held in the determined position.

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

Fig. 1 is a vertical central section through a part of the heat exchanger showing the manner of attaching the cover to the floating tube sheet;

Fig. 2 is a vertical section taken substantially along the line 2—2 of Fig. 1 and being broken away in part to show the manner of attaching the keys;

Fig. 3 is a sectional detail showing the disassembled construction of the retaining ring and parts shown in Fig. 1.

In accordance with a preferred form of embodiment of my invention, as more particularly shown in Figs. 1, 2 and 3, the heat exchanger is of the shell and tube type, the outer wall 10 of which is normally cylindrical and is provided with suitable flanges 11 to which the shell cover 12 may be secured through its flanges 13. Within such shell is a tube bundle consisting of a plurality of tubes 14 which terminate in a tube sheet 15 generally known as a floating tube sheet in that it is free to expand and contract from the opposite end or fixed tube sheet, not herein indicated. The construction of such heat exchangers is such that the floating tube sheet 15 is necessarily of smaller diameter than the shell 10 so that the tube bundle may be inserted from the opposite end in the desired manner. It is also well known and important that the relative difference in diameter between the diameter of the outer tubes of the tube bundle and the inner diameter of the shell be a minimum, not only to reduce cost but to improve the efficiency of the heat exchanger.

In order to transfer the fluids flowing through the tubes from one group of the tubes to another, it is common to provide some form of cover generally indicated at 17 and being known as the floating tube sheet cover. This embraces the

tube sheet 15 and serves as a channel, and, if desired, may be provided with an internal baffle 17a which, in the present case, provides for a four-pass construction on the tube side.

My invention is more particularly related to the manner of attaching these covers 17 to the floating tube sheet 15. The preferred construction includes a continuous ring 20 which is preferably L-shape in cross section in that it is provided with an offset flange portion 20a which is provided with holes suitably screw threaded to receive the adjustable members 22 which contact directly with a boss on the cover 17. This is preferably as nearly in line with the gasket 24 contacting with the tube sheet as is possible to assure direct loading. The continuous member 20 is also provided with an extended embracing portion 20b which embraces the periphery of the cover 17 and the periphery of the tube sheet 15. In addition, it projects across the tube sheet and, as shown in Fig. 3, is provided with a recess 20c which is adapted to receive a retaining ring means 25 by which it can be secured to the tube sheet 15.

The retaining means 25 includes a plurality of split members generally indicated at 25a, 25b, 25c, and 25d in Fig. 2. Split rings of this type are readily assembled and can be readily disengaged so that the parts can be promptly assembled and disassembled. The split ring portions are also provided with a recess on the tube sheet side, which recess is indicated at 27 and, as shown in Fig. 1, is such that the tube sheet will embrace the retaining means on two faces, including the axially extending face which, as shown in Fig. 1, tends to hold the retaining rings in position in the recess 20c and a transverse face which serves as the abutment. The ring portions may also be provided with a chamfered edge indicated at 29 which will serve to establish an interlocking grip with the base of the recess 20c which may be oppositely cut at 28. When the load is applied through the adjustable bolts 22, the ring portions 25 will then be firmly anchored against the tube sheet and embracing ring, and dislodgment will be rendered almost impossible.

It will be apparent that with such a construction application of a load on the bolt 22 will apply a satisfactory compression on the gasket 24 and will anchor the cover with the desired uniformity and security. The load reaction is directly taken up by the leg 20b of the continuous ring 20 which, being in direct tension with a minimum of offset forces, will remain tight irrespective of pressure and temperature changes. Furthermore, the adjustable bolts 22 are in compression and there is no material differential in length which would tend to loosen the joint as the temperature increases.

The construction is also particularly helpful in

the assembly of the cover as it is possible to slip the segments of the retaining rings into position and as the continuous ring 20b is pushed into place, the ring members 25 will be held in the desired position. With heavy construction characteristic of heat exchangers, this is of especial benefit.

It will be appreciated that the use of a connection of this type for securing the cover to the floating tube sheet will make it possible to use the minimum size of shell for the maximum diameter of tubes, as the clearance required for the relatively thin continuous ring 20 is insignificant. The overall length of the continuous ring 20 is not excessive and does not require materially greater costs in the construction of the shell cover, and such costs are more than offset by the simplicity of the construction and the relatively low expense of machining.

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

I claim:

In a heat exchanger of the class described having a shell, a tube bundle therein including a tube sheet removable through said shell, and a cover for said tube sheet, the combination of means to secure said cover to said tube sheet, said cover being of substantially the same diameter as the tube sheet, said securing means including an independent continuous ring member having a skirt portion embracing the peripheries of the cover and the tube sheet and having an integral flange portion overlying the top of the cover, adjustable members in compression carried by said flange portion and engaging the top of the cover, said skirt portion being substantially cylindrical and relatively thin-walled and extending beyond the tube sheet, said skirt portion having a peripheral channel in the internal wall of the extended portion, and a split ring extending into said recess and detachable therefrom, said split ring projecting radially inwardly to engage the tube sheet on the side opposite the cover, whereby on adjustment of the adjustable members the split ring will anchor the continuous ring member to the tube sheet to resist the application of pressure on the cover with respect to the tube sheet, the peripheral channel in the continuous ring being inwardly recessed on its edge remote from the tube sheet, and the split ring being inwardly chamfered on the adjacent edge whereby the split ring will be interlocked on its edge remote from the tube sheet with the continuous ring on the application of sealing pressure on the cover.

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