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SEALING END PLATES OF HEAT EXCHANGERS

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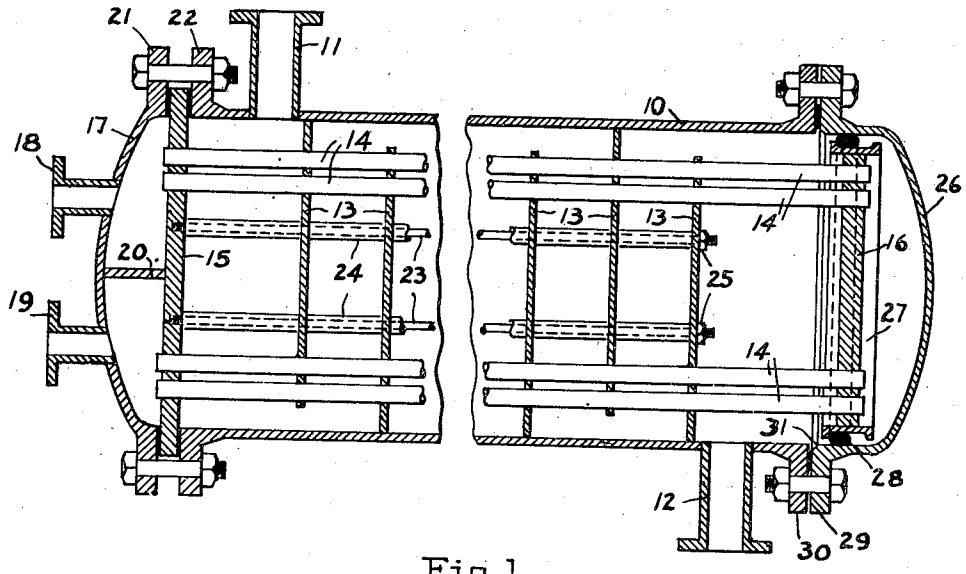

Fig. 1

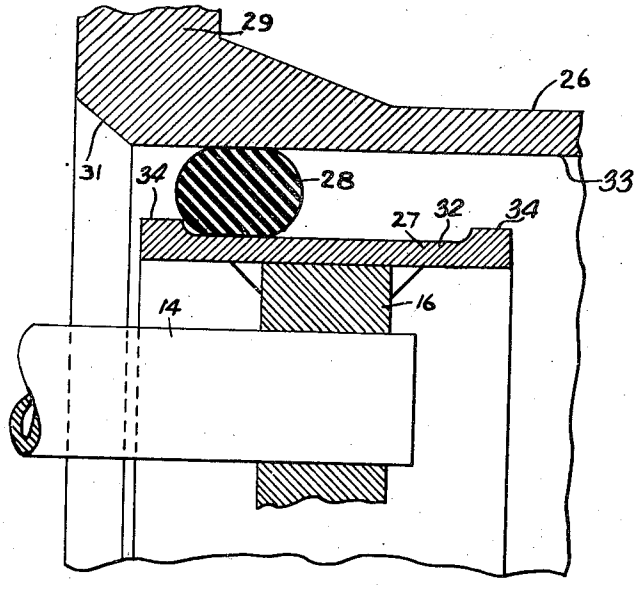

Fig. 2.

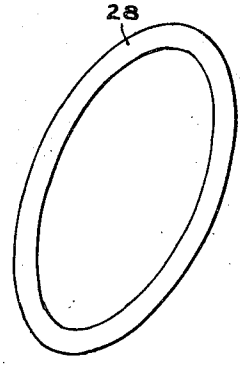

Fig. 3.

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SEALING END PLATES OF HEAT EXCHANGERS

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4 Claims. (Cl. 257—239)

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The present invention pertains to a heat exchanger and is concerned with an improvement in means for securing the parts of a heat exchanger in liquid-tight relationship to each other while permitting convenient assembly and disassembly of parts. The invention provides a connection which gives the important advantage of permitting a limited movement of end plate of the tube assembly independently of the shell and shell cover. A particular feature of the invention consists in the fact that it provides an economical and convenient means for assembling a heat exchanger tube bundle with an adjacent shell and end plates, so that the entire tube assembly may be removed as a unit with a minimum of labor. Other features and advantages of the invention will be evident from a reading of the following detailed description in the light of the attached drawing, in which,

Figure 1 is a central cross section through the heat exchanger of the invention,

Figure 2 is an enlarged detailed cross section through the end plate of the heat exchanger which is at the opposite end from the inlet for admitting fluid to the tube bundle, and

Figure 3 is a perspective view of a deformable elastic annulus.

Referring to the drawing by reference characters, the heat exchanger of the invention includes a shell 10 through which a liquid may flow from inlet 11 to outlet 12 through a tortuous passageway around successive baffles 13. A tube bundle 14, which may comprise a large number of tubes (of which only four are illustrated) extends through the shell 10 and provides a passageway for a second liquid by which said second liquid is conducted through the tubes in indirect heat exchange relationship with respect to liquid flowing through the space surrounding the tubes from inlet 11 to inlet 12. The individual tubes of the tube bundle 14 are interconnected by end plates 15 and 16 at opposite ends of shell 10, and these individual tubes pass through these end plates and are secured in liquid-tight relationship to each of said plates.

A shell cover 17 is secured to the shell 10, as illustrated at the left-hand end of Figure 1, and this shell cover 17 defines, together with end plate 15 inlet and outlet headers which are connected to inlet and outlet conduit connections 18 and 19, respectively, to direct liquid into the conduits through which said liquid flows to opposed end plate 16, and to discharge said liquid after return thereof from end plate 16. Shell cover 17 is provided with a dividing wall or plate 20 which,

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when the parts of the heat exchanger are assembled, provides a liquid-tight dividing wall which separates the inlet and outlet headers from each other. Flanges 21 and 22 are provided on the inlet shell cover 17 and adjacent end of shell 10, respectively, and the end plate 15 is retained between these flanges in liquid-tight relationship with respect to each of them.

A plurality of tie rods 23 are connected to the end plate 15, and spacer tubes 24 surround these tie rods and determine the positions of the respective baffles 13 longitudinally of the heater shell. The tie rods are threaded at their ends remote from the end plate 15 and nuts 25 secured to these threaded ends hold the individual tie rods and baffles in proper space relationship within the shell. A shell cover 26 is secured to the opposite end of the shell from the cover 17 and this shell cover, like the shell cover 17, is maintained in liquid-tight relation to end plate 16 and to the adjacent end of the shell 10.

The features of the heat exchanger as described up to this point are more or less conventional, and the operation of this heat exchanger will be evident to those skilled in the art. As pointed out above, liquid to be cooled or heated may be passed in a tortuous path from inlet 11 to outlet 12 of the main body of the shell 10. The second liquid, which is to have its temperature changed by indirect heat exchange with liquid flowing from inlet 11 to outlet 12, enters the inlet header defined by shell cover 17, wall 20 and plate 15 through inlet connection 18 and flows through the upper tubes 14, as illustrated in Figure 1 of the drawing, from this inlet header into the header defined by the shell cover 26 and end plate 16 at the opposite end of the heat exchanger. The liquid is then returned from this space through the tubes 14 illustrated in the lower part of Figure 1 to the outlet header constituting the lower chamber defined by wall 20, plate 15 and shell cover 17.

In a device of this character, it is desirable that the entire tube bundle assembly, including the tubes 14, end plates 15 and 16, baffles 13, tie rods 23 and spacer tubes 24 be readily removable as a unit from the tube shell. The present invention provides a convenient and economical means of accomplishing this result, as follows.

An annular metal ring 27, which is of smaller external diameter than the minimum internal diameter of the shell 10, is secured by welding or other appropriate means to, or integrally formed with, the outer diameter of the end plate 16. An annulus of deformable elastic material, such as

live rubber, is movably mounted about the outer diameter of the ring 27. This annulus may, for example, be a vulcanized rubber ring 28, as illustrated in Figure 3 of the drawing. The nature of the connection of the plate 16 to the shell cover will be evident from a description of the method of assembling the end plate 16 with the ring 28 and the surrounding surface of the shell cover.

This assembly may be accomplished by first mounting the annulus 28 about the right-hand portion of surface 32 of ring 27, this assembly and the associated tube bundle being placed in proper assembled relationship to the shell 10, cover 17 and associated parts, and thereafter placing the left-hand end of the cover 26 against the right-hand end of the annulus 28 and distorting the annulus 28 with rolling thereof to the left forcing the cover 26 to the left into the position illustrated in Figure 1. The inner circumference of the flange 29 is preferably bevelled as indicated at 31 to facilitate assembly and the initial distortion and rolling of the annulus 28 as the flange 29 is forced toward the flange 30. Since the inner diameter of the cover 26 will, in this preferred embodiment of the invention, be of smaller diameter than the outer diameter of the annulus 28 in its normal, undistorted, condition, the forcing of the inner circumferential surface 33 of the cover 26 across the outer surface of the annulus 28 incident to the bringing of the cover 26 into the position illustrated in Figure 1, will effect distortion and rolling of the annulus 28. The tendency of this annulus to return to its normal undistorted condition will be resisted by the contiguous outer surface 32 of the ring 27 and the contiguous inner surface 33 of the cover 26 by and between which surfaces the annulus 28 is held in its distorted shape, and will thus effect a tight sealing relationship between the annulus and these contiguous surfaces 32 and 33, thereby preventing leakage of liquid in either direction toward or from the header defined by the plate 16 and the cover 26. In this connection the shoulders 34 on ring 27 preferably are spaced apart sufficiently to permit unlimited rolling of the annulus 28 therebetween during assembly and disassembly, and thus do not act as stops to distort the annulus 28 when the parts are assembled. Accordingly, shoulders 34 may be eliminated, if desired. It will be seen that, when the tubes 14 and shell 10 expand differentially under the influence of heat, the annulus 28 will accommodate this expansion, permitting the longitudinal movement of the end plate 16 relative to cover 26. The only liquid which may enter or leave this header is therefore the liquid passing through the respective tubes of the tube bundle 14. The cover 26 may be secured to the shell 10 in any appropriate manner, as for example, by bolts or clamps which effect securement of the flange 29 on cover 26 to flange 30 on the adjacent end of shell 10.

It will be seen from the above discussion that, when the parts of the heat exchanger are constructed as above described, the tube bundle and associated parts may be clamped in position with respect to the shell 10 and cover 17, and that the assembly of parts may thereafter be completed by bringing the cover 26 home across the outer surface of the annulus 28. The parts may be disassembled with facility by simple removal of the cover 26, removal of the clamps or bolts which interconnect the flanges 21 and 22, removal of the inlet shell cover 17, and withdrawal of the tube assembly, including the end plate 15 and tubes and other parts secured thereto from within the shell 10.

Various modifications of the above-described details may be applied in practice of the invention.

Various other modifications are available to those skilled in the art, and I do not therefore wish to be limited except by the scope of the following claims.

I claim:

1. In a heat exchanger, the combination comprising a heater shell, a tube bundle interconnected by and extending through end plates designed for securement relatively to said shell to provide fluid conduits through said tubes interconnecting headers, and means for securing said end plates relatively to said shell, said means for securing one of said end plates to said shell comprising a longitudinally extending circumferential outer surface on said end plate but of smaller external diameter than the minimum internal diameter of said shell, a shell cover having a longitudinally extending circumferential inner surface positioned about said circumferential outer surface when said shell cover is in assembled position, said circumferential inner surface being movable with said shell cover longitudinally of said circumferential outer surface during assembly and disassembly of said shell cover, an annulus of deformable elastic material positioned circumferentially between said circumferential outer and inner surfaces and of a thickness to be distorted by compression between said circumferential surfaces and to roll between and with respect to said circumferential surfaces during assembly and disassembly of said shell cover.

2. In a heat exchanger, the combination comprising a heater shell, a tube bundle interconnected by and extending through end plates designed for securement relatively to said shell to provide fluid conduits through said tubes interconnecting headers, and means for securing said end plates relatively to said shell, said means for securing one of said end plates to said shell comprising a cylindrical outer surface on said end plate of smaller external diameter than the minimum internal diameter of said shell, a shell cover having a cylindrical inner surface positioned about said cylindrical outer surface when said shell cover is in assembled position, said cylindrical inner surface being movable with said shell cover longitudinally of said cylindrical outer surface during assembly and disassembly of said shell cover, an annulus of deformable elastic material positioned circumferentially between said cylindrical surfaces and of a thickness to be compressed and distorted between said surfaces and to roll along the same during assembly and disassembly of said shell cover.

3. A shell cover assembly, comprising an end plate, a longitudinally extending circumferential outer surface on said end plate, a shell cover having a longitudinally extending circumferential inner surface positioned about said circumferential outer surface when said shell cover is in assembled position, said circumferential inner surface being movable with said shell cover longitudinally of said circumferential outer surface during assembly and disassembly of said shell cover, an annulus of deformable elastic material about said circumferential outer surface and of a thickness to be compressed between said circumferential surfaces and to roll with respect thereto during assembly and disassembly of said shell cover.

4. A shell cover assembly, comprising an end plate, a cylindrical outer surface on said end plate, a shell cover having a cylindrical inner surface positioned about said cylindrical outer surface when said shell cover is in assembled position, said cylindrical inner surface being movable with said shell cover longitudinally of said cylindrical outer surface during assembly and disassembly of said shell cover, a rubber ring of circular cross section positioned about and in close contact with said cylindrical outer surface, said rubber ring being of a thickness to be substantially compressed and distorted between said cylindrical surfaces and to be caused to roll thereon during relative longitudinal movement of said cylindrical surfaces with respect to each other incident to assembly and disassembly of said shell cover.

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