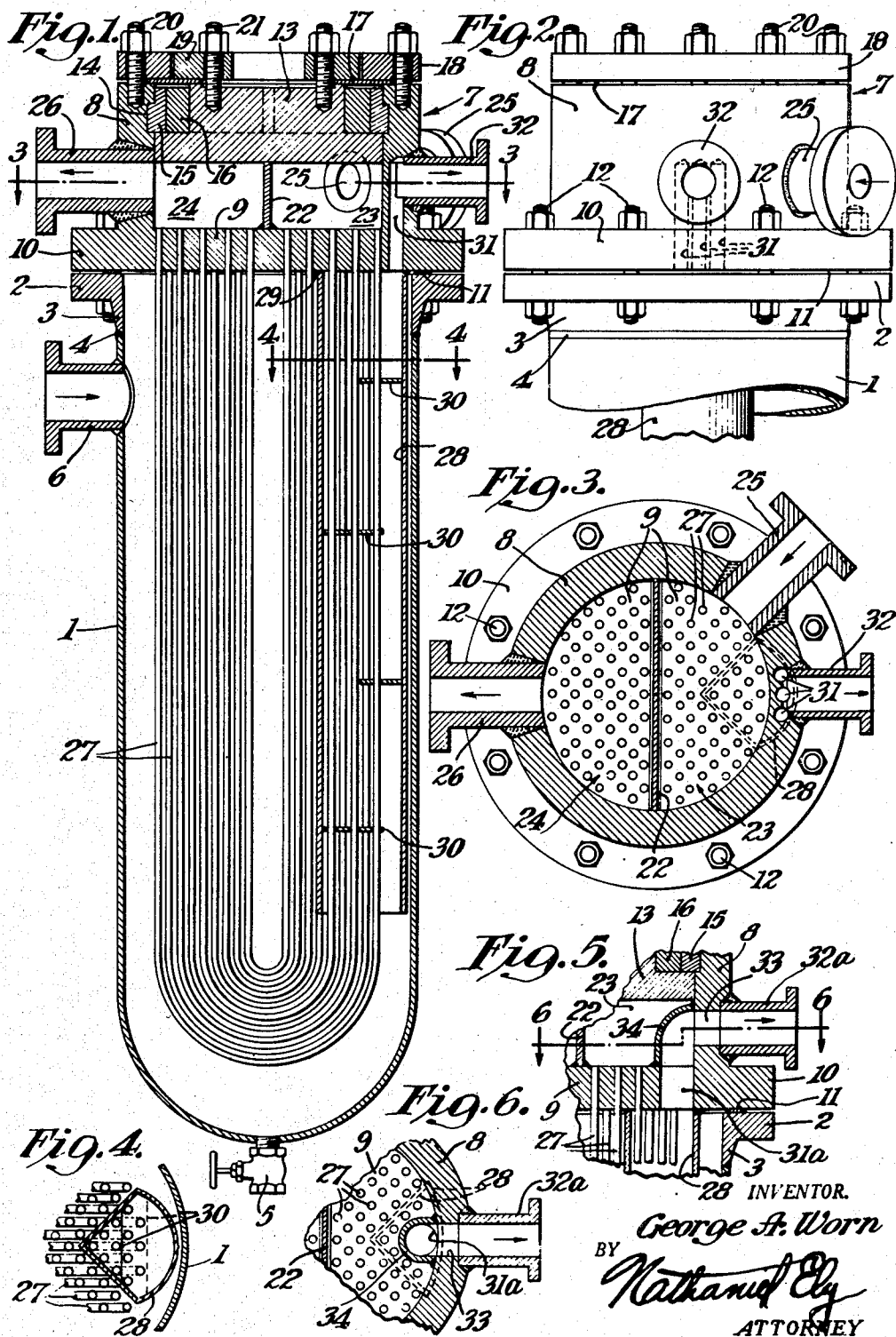


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HEAT EXCHANGER

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HEAT EXCHANGER

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This invention relates more particularly to improvements in a subcooler construction for heat exchangers of the shell-and-tube type.

A certain type of subcooler construction includes a tubular longitudinal baffle of the "bundle wrapper" type. In a heat exchanger having a plurality of tube passes and wherein a heated fluid is passed through the shell and a cooling fluid is passed through the tubes, such a baffle is employed to conduct the shell-side fluid, in its final cooling stage, along the coldest tubes of the exchanger. For that purpose, the baffle is arranged to enclose a group of tubes included in the first pass and to conduct the shell-side fluid along the enclosed tubes to a discharge point remote from the point where the fluid enters the baffle. For discharge of the fluid, the baffle is provided with a transverse nozzle which is attached to the baffle and projects outwardly through another nozzle welded to the side of the shell. Such a construction greatly complicates the manufacture and servicing of the exchanger. The discharge nozzle cannot be attached to the baffle until the latter has been inserted into the shell, along with the tube bundle, nor can the bundle and the baffle be removed without first breaking the connection between the nozzle and the baffle. Owing to the fact that the space available for making and breaking the connection is quite limited and difficult to reach, both operations are extremely laborious and time consuming.

The main object of my invention is to provide in a heat exchanger a positive and tight connection between an internally baffled space and an external nozzle, whereby fluids may be introduced to or removed from the baffled space without leaks, and whereby the shell may be readily removed from the remainder of the heat exchanger.

Another object of the present invention is to provide a subcooler discharge construction having a conduit carried entirely within and by the channel, which will permit full communication between the baffled section and nozzle with a minimum of loss of tubes and with a minimum structural cost.

Further objects and advantages of the invention will appear from the following description taken in connection with the accompanying drawing.

In the drawing:

Fig. 1 is a vertical longitudinal section of a heat exchanger embodying the invention;

Fig. 2 is a side elevation of the upper portion of the exchanger;

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Fig. 3 is a horizontal section on the line 3—3 of Fig. 1;

Fig. 4 is a detail sectional view on the line 4—4 of Fig. 1;

Fig. 5 is a detail sectional view showing a modified form of the invention; and

Fig. 6 is a section on the line 6—6 of Fig. 5.

The invention is shown as embodied in a vertically disposed heat exchanger unit but it is equally well adapted for embodiment in a unit arranged horizontally or otherwise.

Referring to Figs. 1 to 4, inclusive, the structure of the heat exchanger includes a vertical shell 1 having an outwardly extending flange 2 at its upper end. As shown, said flange may be formed on an annular section 3 welded to the body of the shell, as at 4. The lower end of the shell is dome-shaped and provided with a drain cock 5. A nozzle 6 for entry or discharge of shell-side fluid is welded to the shell adjacent the upper end of the latter.

A channel structure 7 is mounted upon the upper end of the shell and includes a flat bottom portion and upstanding annular body portion 8. Said bottom portion forms a tube sheet 9 and an outwardly extending flange 10. This flange overlies the shell flange 2. A gasket 11 is interposed between the flanges 2 and 10, and bolts 12 pass through said flanges and releasably secure the channel structure to the shell. A closure plate 13 is fitted within the upper portion of the body of the channel and secured by any suitable locking and sealing structure, such as that disclosed in Patent No. 2,268,507 of Gertzson, for example. In such case the annular channel wall is formed with an internal groove 14. A split locking ring 15 has a peripheral portion thereof projecting into said groove, and a backing ring 16 is fitted within the locking ring to hold the latter expanded. The closure plate is peripherally recessed to accommodate said rings. The upper faces of the channel and the closure plate are substantially flush and a gasket 17 overlaps both of said faces. A pair of concentric clamping rings 18 and 19 bear against the gasket. The ring 18 is secured to the channel by bolts 20, and the ring 19 is secured to the closure plate by bolts 21. This sealing member forms no part of the present invention, however.

A partition 22 divides the channel space into two compartments 23 and 24 respectively. An inlet nozzle 25 welded to the channel opens into the compartment 23, and an outlet nozzle 26 welded to the channel leads from the compartment 24. A bundle of U-tubes 27 depends from

the tube sheet 9 into the shell. One leg of each tube opens into the inlet compartment 23 and the other leg opens into the outlet compartment 24 of the channel. The legs opening into the compartment 23 define one pass of the tube-side circulation, and the legs opening into the compartment 24 define the other pass. The direction of flow determines which pass is first and, as shown, the tube fluid enters at 23 so that tubes entering such compartment are the first pass tubes.

The improved construction where used as a subcooler includes a tubular baffle 28. This baffle is welded, as at 29, to the under face of the tube sheet 9, and depends therefrom into the shell to a point adjacent the bend of the tubes. A group of tubes of the first pass are surrounded by the baffle, the cross-section of which may be of any suitable shape, depending upon the number of tubes to be enclosed and upon space limitations. In the present instance, the cross-section of the baffle is triangular at its inner side to follow the lay of the tubes, and arcuate at its outer side to conform to the shell shape. The lower end of the baffle is open to admit the shell-side fluid, and the interior of the baffle may be provided with a vertical series of transverse baffles 30 in staggered arrangement to cause a circuitous flow of the admitted fluid along the enclosed tubes.

The principal feature of my invention is the provision for discharge of the fluid from the interior of the baffle 28. For that purpose, the channel structure 7 is preferably provided with one or more passages 31 extending through the tube sheet 9 and upwardly within the thickness of the annular wall of the channel structure. An outlet nozzle 32 is welded into a bore or aperture in said channel wall, and said passages 31 open laterally at their upper ends into said nozzle. At their lower ends the passages 31 communicate directly with the upper end of the space enclosed by the baffle 28, so that the shell-side fluid may flow from said space through the passages 31 and the nozzle 32 to the exterior of the heat exchanger. A plurality of the passages 31 of relatively small diameter are provided in preference to a single passage of greater diameter in order to afford adequate discharge capacity without the necessity of making the wall of the channel excessively thick.

In operating the heat exchanger as a subcooler, heated fluid in either vapor or liquid phase enters the shell through the nozzle 6, and cooling fluid enters the tubes of the first pass through the nozzle 25 and the channel compartment 23 and flows downwardly through the tubes of said pass and then upwardly through the tubes of the second pass. Thence, the cooling fluid leaves the exchanger through the channel compartment 24 and the nozzle 26. The shell-side fluid introduced through the shell nozzle 6 passes downwardly countercurrent to the flow of cooling fluid within the tubes of the second pass and is thereby subjected to its first cooling stage. Then the shell-side fluid, in liquid phase, is passed upwardly through the baffle 28 and thereby subcooled by contact with the coldest tubes of the bundle. The subcooled liquid is then passed out of the baffle through the passages 31 and the nozzle 32. Other arrangements of flow of the fluids could be made if desired.

In the form of the invention shown in Figs. 5 and 6, a single passage 31a through the tube sheet affords egress from the space within the baffle 28. This passage is located inwardly of the channel wall and in this arrangement does

not penetrate the channel wall. A horizontal bore 33 is formed in the channel wall above the tube sheet and an outlet nozzle 32a is welded to said wall in alignment with said bore.

To complete the fluid path a hood-shaped element 34 is disposed in the angle between the tube sheet 9 and the channel wall. This element has a U-shaped lower edge welded to the tube sheet, around the margin of the passage 31a, and a U-shaped vertical edge welded to the channel wall. An elbow connection is thus formed between the passage 31a and the bore 33 for passage of fluid from the baffle to the nozzle 32a and the exterior of the heat exchanger. When it is possible or convenient to form a part of bore or passage 31a in the wall 8, the hood element 34 may be smaller (lesser radius), thus interfering with fewer cooling tubes 27.

Both forms of the invention provide a subcooler outlet conduit embodied entirely in the channel structure and independent of the shell. It is also entirely clear of the shell so that there is no obstruction to insertion or removal of the tube bundle. By extremely simple structural alteration, the difficult and time-consuming labor in assembly and disassembly caused by the usual subcooler construction is entirely eliminated.

While the invention has been shown and described in connection with a subcooler feature, its utility is by no means limited to a subcooler. For example, it is readily adaptable to a desuperheater feature for a heat exchanger employed to heat a fluid within the tubes by circulation of steam within the shell. For that service, the baffle 28 can be mounted to enclose tubes of the second or outgoing pass instead of the first pass, and the nozzle 32 or 32a and the conduit connecting the nozzle to the interior of the baffle may be disposed in the same relation to the baffle as that previously described herein. Then, superheated steam may be passed through the nozzle and the conduit to the interior of the baffle, and be desuperheated therein as it is conducted along the confined tubes.

It is, of course, to be understood that the present disclosure of my invention is merely illustrative and in nowise limiting, and that the invention comprehends such modifications as will come within the scope of the following claims.

I claim:

1. A heat exchanger comprising a vertical shell closed at its lower end; a vertical tube bundle therein; means for directing a fluid through the tube bundle in a plurality of passes and including a channel structure at the upper end of the shell and comprising a tube sheet for the bundle releasably secured to the upper end of the shell, an annular channel body having pass partition means therein, and an outer closure for said body; a vertical tubular baffle surrounding tubes of one of the passes and welded around the upper edge thereof to said tube sheet for leakproof connection therewith, said baffle extending from the tube sheet downwardly to the lower portion of the shell and being open at its lower end directly to the interior of the shell, the shell having a fluid inlet located outside of said baffle and at a substantially higher level than the lower end of the baffle; and a fluid conduit independent of the shell and leading from the space within the upper portion of said baffle upwardly through said tube sheet and laterally outward below said closure to an outer wall of the channel structure and placing the space within said baffle in communi-

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cation with the exterior of the exchanger, the tube bundle, the channel structure, the said baffle and the said conduit forming a unit separable from the shell after release of the channel structure from the shell.

2. A heat exchanger comprising a vertical shell; a vertical tube bundle therein, means for directing a fluid through the tube bundle in a plurality of passes and including a channel structure at the upper end of the shell and comprising a tube sheet for the bundle releasably secured to the upper end of the shell, an annular channel body having pass partition means therein, and an outer closure for said body; a vertical tubular baffle surrounding tubes of one of the passes and welded around the upper edge thereof to said tube sheet for leakproof connection therewith, said baffle extending from the tube sheet downwardly along a substantial length of the tubes enclosed thereby and being open at its lower end to the interior of the shell; and a fluid conduit placing the interior of said baffle in communication with the exterior of the exchanger and comprising a port extending through the thickness of the tube sheet from the space within the upper portion of said baffle, an upwardly extending element of channel form in horizontal section within the annular body of the channel structure and

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closed at its upper end, and a port extending from the upper end portion of said element laterally through said channel body to the outer periphery of the latter, said conduit element being entirely below the channel closure and being welded at its lower edge to the tube sheet and welded along its side edges and its top edge to the inner face of the channel body, all of said welding being continuous and rendering the conduit leak-proof, the tube bundle, the channel structure, the said baffle and the said conduit forming a unit separable from the shell after release of the channel structure from the shell.

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