

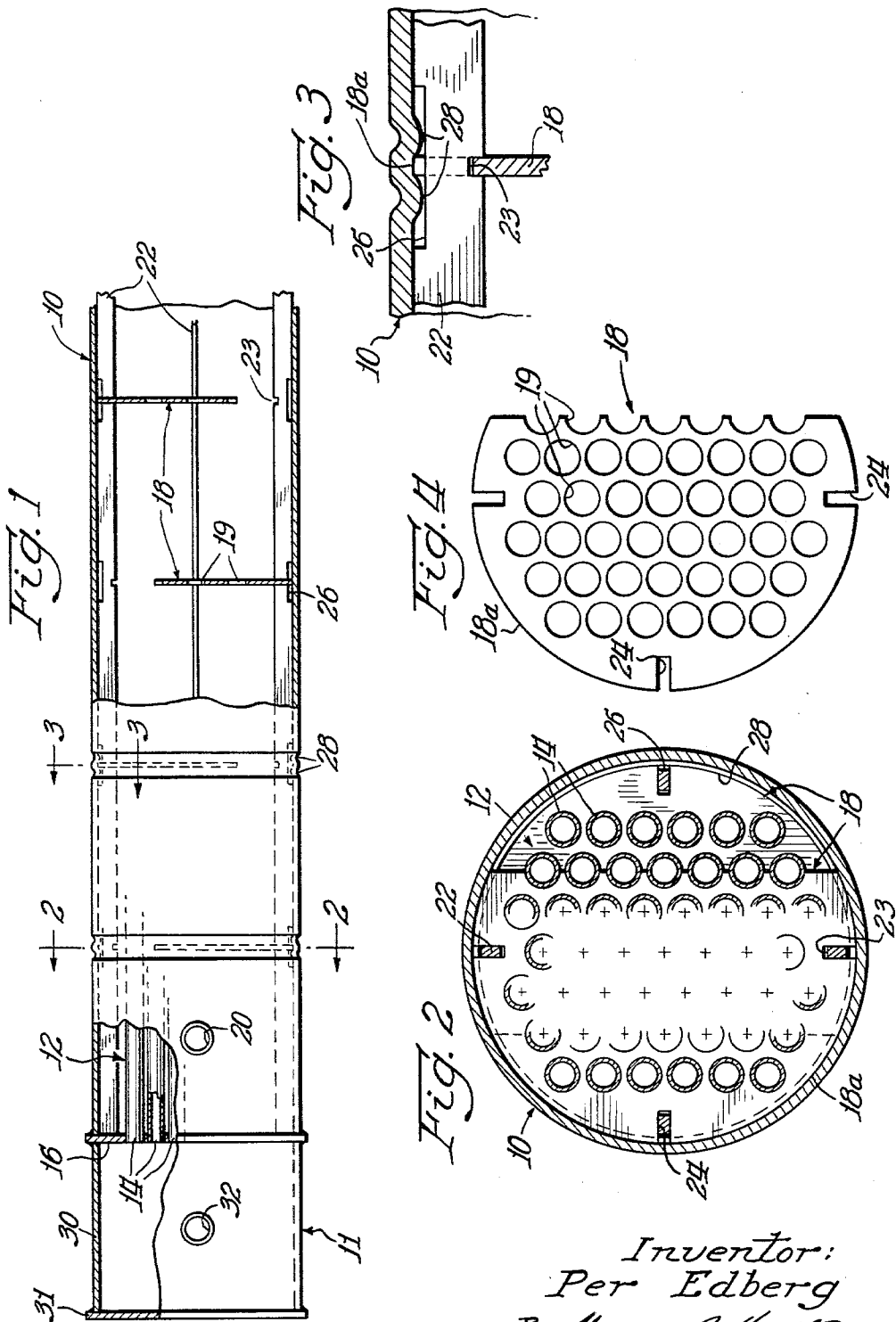
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HEAT EXCHANGER

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HEAT EXCHANGER

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This invention relates to improvements in heat exchangers.

The type of heat exchanger to which the present invention is directed is commonly referred to as a baffled, shell and tube heat exchanger, the term, "shell and tube," being generic to a wide variety of designs including U-tube, fin tube, fixed tube sheet, floating head and many others. Consequently, since the invention is more particularly directed to the manner in which the baffles are arranged within the heat exchanger shell, this specification describes a representative fixed tube sheet heat exchanger which includes a series of flow-directing cross baffles to obtain improved heat transfer performance.

In the manufacture of baffled heat exchangers, it has been established that a loss of heat transfer efficiency is caused by clearance space between and internal surface of the shell and the peripheral edge of the baffles. These clearance spaces provide auxiliary flow paths which cause short circuiting of fluid and results in a reduction of the effectiveness of the baffles as flow-directing means and a corresponding loss in heat transfer performance. In other words, a small portion of the shell-side fluid passes along the inside surface of the shell thereby avoiding the effect of the baffles in directing the fluid into heat exchange contact with the tube bundle or other heat exchange fluid conducting means disposed within the shell.

Clearance space between the baffles and the shell, has, for all practical purposes, been unavoidable because of the characteristic variations in the internal diameter and out-of-roundness of the heat exchanger shell, and the manufactured tolerance on the outside diameter of the baffles. These variations and tolerances could be eliminated with more precise manufacturing techniques, but the additional expense would outweigh the advantages gained by having a close fit between the shell and the baffles. This invention therefore proposes a novel and inexpensive technique for effecting a close, substantially sealing fit between the baffles and the heat exchanger shell.

It is therefore a principal object of the present invention to provide an improved heat exchanger including a shell formed in a manner to support the baffles so that undesirable clearance space is eliminated.

Other and more particular objects and advantages will be apparent from a reading of the following detailed description taken in conjunction with the drawings, wherein:

FIGURE 1 is a partial top plan view, partly in cross-section, of a heat exchanger constructed in accordance with the principles of the present invention;

FIGURE 2 is a cross-sectional view taken along the plane of line 2-2 of FIGURE 1;

FIGURE 3 is a detailed cross-sectional view taken along the plane of line 3-3 of FIGURE 1; and

FIGURE 4 is a plan view of one of the heat exchanger baffles.

Referring now to FIGURE 1, there is shown a heat exchanger comprising an elongated cylindrical shell 10, headers 11 (only one of which is shown), and heat exchange tube means forming a tube bundle 12 disposed within the heat exchanger shell 10. The terminal portions of each of the tubes 14 forming tube bundle 12 are fixedly secured to a pair of tube sheets 16 (only one of which is shown) dividing the shell from the header 11. The tubes are supported between the tube sheets 16 by baffle means

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comprising a series of baffles 18 which are arranged alternately in spaced relation on opposite sides of the heat exchanger shell 10 to provide a tortuous path for a first heat exchange fluid, herein referred to as the shell-side fluid, from the inlet 20 at one end of the shell to an outlet (not shown) at the other end of said shell. The baffles are held in fixed relation with respect to one another by a series of spacer rods 22 extending axially of the heat exchanger shell near the inside surface thereof (after assembly). Each spacer rod 22 is provided with spaced notches 23 receiving a corresponding notch 24 in the marginal portion of each of the baffles 18 and serving to locate the baffles in spaced relation. The spacer rods 22 are further provided with an axially extending notch 26 along the edge adjacent to the shell 10 for a purpose which will be apparent from the following description.

A pair of headers 11 (only one of which is shown in FIGURE 1) are secured to the tube sheets 16, said headers comprising a shell portion 30 and an end disc 31. Each header 11 is further provided with an outlet (or inlet) 32 for a second heat exchange fluid, hereinafter referred to as the tube-side fluid. It should be understood that the construction of the header (not shown) at the opposite end of the shell is substantially identical to the header at the left end of the shell as shown in FIGURE 1.

As best illustrated in FIGURE 4, each of the baffles 18 comprises a generally circular piece of metal plate stock having a chordal segment removed from one side to afford a passage for the shell-side fluid. The baffle elements are further provided with a plurality of apertures 19 which are adapted to support the heat exchange tubes 14 extending therethrough.

An important aspect of the present invention, as noted in the preliminary remarks, is the provision of improved means for substantially eliminating undesirable clearance space between the heat exchanger shell 10 and the peripheral edges 18a of each baffle 18. This object is accomplished by assembling the baffles inside the shell and then subjecting the shell to radially inwardly directed forces to deform the shell on both sides of each baffle. By limiting the deformation of the shell to narrow bands encircling said shell on both sides of each baffle, an integral radially inwardly extending projection 28 is formed, said projection being located immediately adjacent to the sides of each baffle near its periphery. When the shell is deformed or restricted in this manner, the area of the shell between projections 28 is also forced into engagement with the peripheral edge 18a to further effect the sealing relationship between the baffle and the shell. It will be noted that the notches or recessed portions 26 on the spacer rods serve to accommodate the projections 28.

The deformation of the shell, in a preferred manner of practicing the invention, is carried out by first fabricating the tubes, the baffles and the spacer rods into a sub-assembly and then inserting the sub-assembly into the shell 10. Thereafter, the entire heat exchanger is mounted on means, such as for example, a lathe or similar device, to rotate the shell about its longitudinal axis. While the heat exchanger is being rotated, a deforming tool, preferably in the form of a hardened steel roller, is forced radially inwardly against the shell in the area adjacent to each of the baffles. This procedure insures that the deformation of the shell is accurately located in the manner indicated above and results in a unit in which the baffles are securely fixed into position, with substantially no clearance between the baffles and the shell except in the area provided by the removal of the chordal segment.

While this invention has been described in connection with a certain specific embodiment thereof, it is to be understood that this is by way of illustration and not by

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way of limitation; and the scope of this invention is defined solely by the appended claims which should be construed as broadly as the prior art will permit.

What is claimed is:

1. A heat exchanger comprising: a shell including a generally cylindrical, rigid wall having predetermined internal dimensions; heat exchange tube means disposed within said shell; means for passing a first fluid inside said tube means; means for passing a second fluid into and through said shell in heat exchange relation with the outside of said tube means; a plurality of axially spaced, cross-flow baffles arranged within said shell to provide a tortuous path for said second fluid, said baffles having marginal edges generally conforming to and spaced from said cylindrical wall, the diametral dimensions of said baffles being less than said internal dimensions of said cylindrical wall, said cylindrical wall being deformed inwardly at axially spaced locations adjacent to and on opposite sides of the marginal edges of said baffles to provide circumferential, inwardly extending projections integral with said wall and engaging the marginal edges of said baffles, whereby said projections insure a sealing fit between said shell and said baffles to reduce leakage between said baffles and said cylindrical wall.

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2. A heat exchanger as defined in claim 1 including a plurality of elongated spacer rods having axially spaced notches, and means defining circumferentially spaced, complementary notches on the marginal edges of said baffles interengaging said spacer rod notches to locate said baffles in spaced relation.

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