

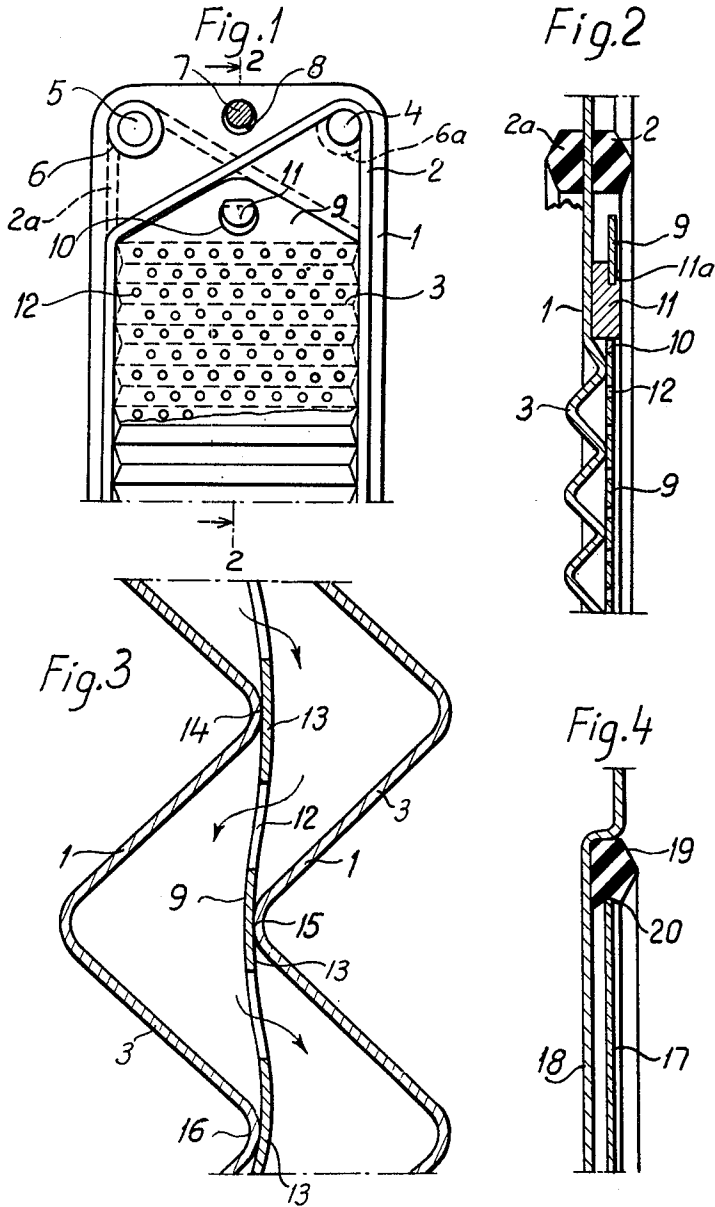
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PLATE HEAT EXCHANGER FOR PROMOTING TURBULENT FLOW

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PLATE HEAT EXCHANGER FOR PROMOTING TURBULENT FLOW

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This invention relates to heat exchangers of the type having a pack of heat exchange plates separated by packing cords, whereby each pair of adjacent plates and the intervening packing cord define a flow path along these plates for passage of a fluid medium. More particularly, the invention relates to a heat exchanger of this type having improved means for promoting turbulence in the flow of at least one of the fluid media between which the heat exchange is to be effected.

For good heat transmission between the two fluids flowing through the plate interspaces in a plate heat exchanger, it is important that the flow through the plate interspaces have the greatest possible turbulence. For this reason it is common practice to make the plates of relatively thin sheet-metal and to press them into such a shape that the desired degree of turbulence is obtained. When exchanging heat between fluids of relatively low viscosity, the turbulence obtained through these measures is satisfactory. When exchanging heat between liquids of high viscosity, the turbulence is reduced and the flow often becomes more or less laminar, whereby the heat transmission is seriously impaired. To avoid this inconvenience, it has been necessary to increase the number of heat exchange plates considerably. This, however, is a costly measure since the heat exchange plates must be made of a material which is non-corrosive and easily pressed into the desired shape and which also has good thermal conductivity. Moreover, the plates must not be made too thin, because the liquid pressure on the two fluids is often high and varies largely in the various plate interspaces. Additionally, the plates are provided with marginal packing cords and therefore will be relatively large in relation to their effective heat exchange surface.

It has been proposed to improve the heat transmission by inserting perforated and possibly corrugated members, referred to as bowl discs, in the plate interspaces in order to cause the high-viscosity medium to flow in zig-zag paths through the chambers between the heat exchange plates and thus increase the turbulence. In this case, the bowl discs have been designed as ordinary heat exchange plates provided with marginal packing cords and have been arranged to be carried by the same carrying bars as the ordinary plates. Consequently, even if this arrangement increases the turbulence and provides an improved heat transmission, it is not a satisfactory solution because the cost of the inserted plates is no less than that of the ordinary plates.

The present invention has for its principal object the provision of a plate heat exchanger provided with turbulence-promoting bowl discs arranged in the plates interspaces and in which the above-mentioned inconveniences are substantially overcome. According to the invention, the bowl discs are detachably carried by the heat exchange plates by means of knobs, hooks or the like on the plates or by means of marginal packing cords attached to the heat exchange plates, the discs being disposed within the confines of the marginal packing cords.

The bowl discs of the new heat exchanger are considerably less expensive than the ordinary heat exchange plates because they are much smaller and can be made of thinner sheet-metal (the pressure being equal on either side of the bowl discs) and also because no marginal packing

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cords are necessary. Due to their relatively simple shape, it is easy to manufacture them by compression-molding. As one and the same fluid passes on both sides of each bowl disc, it cannot be damaged by corrosive action. Therefore the bowl discs may be made of a cheaper, corrosive material. It may even be advantageous to make the bowl discs of a less corrosion-resistant material than that used for the heat exchange plates themselves, such as zinc sheet metal, as any corrosive action is not directed to the costly heat exchange plates but to the cheaper bowl discs which, when required, may be replaced by new ones at relatively low cost.

It is also possible to make the bowl discs of a non-metallic material, such as a plastic material. The heat-conducting metallic materials, however, give a better heat transmission and are therefore preferable in general.

The fact that the bowl discs are carried by the heat exchange plates facilitates assembling and disassembling of the plate heat exchanger, which is especially valuable with respect to the cleaning of the apparatus. This also permits easy adaptation of the capacity of the heat exchanger to different needs, since the bowl discs can be inserted or removed according to circumstances.

By providing the turbulence-promoting discs and/or the heat exchange plates with projections, as by corrugating the plates and/or the discs, it is possible to fix their relative lateral positions, which is of special importance when the bowl discs are suspended on hooks, knobs or the like on the heat exchange plates. The construction can be made particularly simple if the heat exchange plates are corrugated and the bowl discs are planar and are fixed laterally by engagement with opposing wave ridges of the adjacent corrugated heat exchange plates. The latter may be so arranged that the bowl discs, when the plates are pressed together as usual, become more or less deformed into waves, as this gives good linear contact between the bowl discs and the heat exchange plates, whereby the heat transmission is considerably improved.

For a better understanding of the invention, reference may be made to the accompanying drawing, in which—

FIG. 1 is a face view of the upper portion of a preferred form of a heat exchange plate and bowl disc embodying the invention;

FIG. 2 is an enlarged sectional view of part of the combination illustrated in FIG. 1, as seen on line 2—2 in FIG. 1;

FIG. 3 is an enlarged sectional view of a part of a heat exchanger embodying the invention, showing a pair of adjacent heat exchange plates and an intermediate bowl disc; and

FIG. 4 is a detailed sectional view of part of a heat exchange plate and bowl disc embodying a modified form of the invention.

Referring to the drawing, reference numeral 1 designates a heat exchange plate made of metal of good heat conductivity and which is of rectangular form, as is customary. A packing cord 2 engages one side of the plate and extends along its marginal portion to define, in conjunction with an adjacent plate, a flow path for one of the fluid media between which the heat exchange is to be effected. The packing cord 2 is made of the usual resilient material such as rubber, or the like. Within the confines of the endless packing cord 2, the plate 1 is bent to form corrugations 3 extending generally transversely of the plate and of the direction of fluid flow along the plate. In its corner portions, the plate is provided in the usual manner with holes for passage of the fluid media, two of these holes being shown at 4 and 5. The hole 4 is surrounded by the marginal packing cord 2 and, through the flow path defined by this packing, communicates with a similar hole (not shown) located in the lower

right-hand corner portion of the plate and which is likewise surrounded by the packing 2. The hole 5 is surrounded by a packing 6 and communicates with the plate interspace on the opposite side of the plate where a packing cord 2a extends along the marginal portion to define with the adjacent plate a flow path through which the other fluid medium is adapted to flow toward a similar hole (not shown) located in the lower left-hand corner of the plate, as will be readily understood by those skilled in the art. The plate 1 and a group of similar plates are carried as a pack by the usual supporting means including two carrying bars, one of which is shown at 7 in FIG. 1 and is passed through a hole 8 in the upper end portion of each plate.

Within the confines of the marginal packing cord 2 is a turbulence-promoting member 9 which is here referred to as a bowl disc. The latter is provided at its upper portion with a hole 10 by which the bowl disc is hooked on a knob or projection 11 welded to the plate 1, this knob having a groove 11a in which the part of the plate forming the upper edge of hole 10 rests. The bowl disc 9 is provided with a large number of holes 12 arranged in rows extending transversely of the plate and the disc. Two such rows of holes are situated between each pair of adjacent wave ridges of the corrugations 3. As best shown in FIG. 2, the bowl disc 9 lies in contact with the adjacent ridges of the corrugations 3, the disc opposing substantially the entire corrugated area of the plate (FIG. 1).

It will be understood that the carrying bar 7 supports a pack of plates similar to the plate 1 and separated by packings 2-2a and 6-6a, so that one of the fluid media has a flow path along every other plate interspace while the other fluid medium has a flow path along the alternate plate interspaces, whereby each plate has the respective fluid media flowing along the opposite sides of the plate. As shown in FIG. 3, a bowl disc 9 is located between adjacent plates 1 of the pack and lies in contact with the adjacent ridges while spanning the valleys of the corrugations 3 of the respective plates, so that the fluid medium passing through the plate interspace will be forced to flow in a zig-zag path alternately on one side and then the other side of the bowl disc 9, as shown by the arrows in FIG. 3. More particularly, the disc part 13 located between adjacent rows of holes 12 contacts an adjacent ridge 14 of the left-hand plate 1 while the next lower disc portion 13 lying between adjacent rows of holes 12 contacts the ridge 15 of the right-hand plate 1, and the next lower disc portion 13 lying between adjacent rows of holes 12 contacts ridge 16 of the left-hand plate 1, and so on along the lengths of the corrugated portions of the plates. As also shown in FIG. 3, each bowl disc (which is normally flat or planar) when clamped between the adjacent plates 1, is somewhat distorted by contact with the wave ridges 14-15-16 so that the disc is held in a wave-like form in its clamped position. Accordingly, the bowl disc 9 will engage the wave ridges 14-15-16 with a certain pressure, thereby improving the contact between the heat exchange plates and the bowl disc so that the heat transmission along the lines of contact between the disc and the plates is facilitated.

In the construction illustrated in FIGS. 1-3, the bowl disc 9 is releasably secured to the corresponding plate 1 by knob 11 and therefore independently of the marginal packing cord 2, which may be cemented to the plate or otherwise secured in the position which it is to take when compressed between adjacent plates. In the embodiment illustrated in FIG. 4, the bowl disc 17 is releasably secured to the heat exchange plate 18 by the marginal packing cord 19, which in this case is releasably

secured to the plate in any conventional manner, as by confining the cord against a shoulder of the plate extending along its marginal portion. Along its inner edge, the endless packing cord 19 is formed with a groove or recess 20 in which the edge portion of the bowl disc 17 is engaged so as to hold this disc in position relative to the plate. Consequently, in this case no knob or hook is needed on the plate to hold the bowl disc, thus simplifying the manufacture of the assembly.

When exchanging heat between a fluid of high viscosity and a fluid of low viscosity, it may be sufficient to provide only the plate interspaces for the high-viscosity fluid with the bowl discs, since the turbulence required for the low-viscosity fluid may be obtained merely by the shape of the plates.

I claim:

1. The combination of a pair of heat exchange plates disposed in generally parallel spaced relation, a packing cord compressed between said plates and extending along the marginal portions thereof, said plates and cord defining a longitudinal path for flow of a fluid medium between the plates from one end portion to the opposite end portion of the plates, said plates having spaced opposing surfaces located within the confines of the marginal packing cord and formed with corrugations defining ridges and valleys extending generally transversely of said longitudinal flow path to provide said flow path with a wave-like form, and a perforated plate member in said path releasably secured to one of the plates and lying wholly within the confines of the packing cord, whereby said member is removable from the plates independently of the packing cord, said perforated plate member extending transversely of the ridges while substantially spanning the valleys of the corrugations of each said opposing plate surface and having perforations positioned for flow of said fluid medium along said path in zig-zag fashion alternately on one side and then the other side of said plate member.

2. The combination according to claim 1, in which said member is a perforated disc opposing a major portion of each plate area within the confines of the packing cord.

3. The combination according to claim 1, comprising also an element projecting from said one plate within said confines and releasably securing said member to the plate.

4. The combination according to claim 1, in which said member is releasably secured to said one plate through the packing cord.

5. The combination according to claim 1, in which the packing cord is formed with a recess facing said path and releasably receiving the edge portion of said member to secure said member to said one plate.

6. The combination according to claim 1, in which said member is engaged at opposite sides by said ridges of said corrugated opposing surfaces, to hold said plates and member in fixed relative positions.

7. The combination according to claim 1, in which said member is engaged at opposite sides by said ridges of said corrugated opposing surfaces, to hold said plates and member in fixed relative positions, said member being normally flat but deformed into a wave shape by engagement with said ridges.

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