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(54) PLATE-TYPE HEAT EXCHANGER

(71) I, HELMUT FISCHER, an Austrian citizen, of Kuniglberggasse 5, 1130 Wien, Austria, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a plate-type heat exchanger comprising two thick plates and three or more heat exchange plates, which consist of pressed sheet metal and are gripped between the thick plates and arranged in a row and have a fluid-guiding body which is surrounded by a gasket that is seated in a recessed flange of the heat exchange plate.

In most plate-type heat exchangers, similar influences are exerted on the flow of fluids in two adjacent plate interspaces or chambers between plates so that the heat will be transferred at the same rates through the chambers on both sides of a given heat exchange plate if the two fluids have the same physical properties and flow at equal rates through both chambers. Under these conditions the pressure losses are also equal.

In many cases, however, plate-type heat exchangers must be used for a heat exchange between fluids flowing at greatly different rates. To avoid an excessive resistance to the flow of the fluid at the higher flow rate, it is then necessary to provide for the flow of that fluid a larger number of flow passages connected in parallel than for the fluid which flows at a lower rate. So far, it has been attempted to avoid this disadvantage by designing plate-type heat exchangers which exert influences on the flow of fluids in adjacent chambers between plates. This has normally been accomplished in that those chambers between plates which are intended to handle higher flow rates are enlarged in that the spacing of the plates is increased.

For this purpose, these plates are in most cases provided with gaskets which are thicker than normal, although this has the disadvantage that the fluid-guiding bodies of the plates which are spaced a larger distance apart no longer contact and support each other, as is otherwise usual to maintain a constant spacing between the plates. When the fluid pressure in the wider chambers is lower than in the narrower ones, the plates will be deflected so that the wider chambers will be constricted and the resistance to flow therein will increase.

It has also been proposed to arrange similar plates in a row in pairs in such a manner that alternate interfaces between the plates are defined by forward and rear faces, respectively, of the contacting plates so that there are two types of chambers, which exert different influences on the flow of the fluids between heat is exchanged. That proposal gives rise to a sealing problem because these chambers could be sealed toward both sides only if the plates were provided with two gaskets arranged on both sides and this is not practicable with plates of pressed sheet metal. For this reason that proposal has not been accepted in practice.

It is an object of the invention to provide plate-type heat exchangers in which the plates are spaced equal distances apart and flow paths having different flow-influencing properties are respectively provided for the two fluids between which heat is exchanged so that the heat exchanger can be adapted as closely as possible to changing requirements.

The invention provides at least two types of heat exchange plates, which form flow path chambers having different flow-influencing properties. The plates are provided in known manner with numerous embossed corrugations, which extend at an oblique angle to the direction of flow and have a height which is equal to the center spacing of the plates. Numerous connecting webs or embossed knobs are provided between the corrugations and are as high as the latter. The corrugations of the plates of the two types have the same cross-section and include opposite angles of inclination with a center line of the plate. The plates are arranged in a row in such a manner that the corrugations of some adjacent plates cross each other and those of other adjacent plates are parallel to each other.

Fluid flow chambers defined by parallel corrugations present a much lower resistance to fluid flow than fluid flow chambers defined by crossing corrugations.

The design according to the invention permits of the provision of a heat exchanger in which the flow path for the first fluid has other flow-influencing properties than the flow path for the second fluid if alternate chambers are defined by crossing corrugations and parallel corrugations respectively. Alternatively, the flow path for one and the same fluid may be defined in one part by crossing corrugations and in another part by parallel corrugations. This enables a particularly close matching of the thermal characteristics of the plate-type heat exchanger to the requirements.

Two embodiments of the invention are shown by way of example on the accompanying drawing in which

Figs. 1, 2, 3, 4 are elevations showing heat exchange plates of a heat exchanger according to the invention in the order in which they succeed each other in the heat exchanger when flow paths having different flow-influencing characteristics are desired for the two fluids.

Figs. 5, 6, 7 and 8 show a similar heat exchanger in which each heat exchange plate has a body which is symmetric with respect to the transverse axis of the plate.

Fig. 1 shows a plate A which has a fluid, guiding body 1 that is surrounded by a gasket 2. As is usual in such plate-type heat exchangers, the gasket is seated in a recessed flange, which is not shown. The rectangular body of the plate is formed with corrugations $4A_1$, which extend at an oblique angle to the longitudinal axis 3 of the plate and which have a height which is equal to the center spacing of the plates. The corrugations are interconnected by webs 5, which have the same height as the corrugations. The ridges of the corrugations and the connecting webs are represented by solid lines. Alternatively, the connecting webs might be provided on the underside and connect the troughs of the corrugations.

When the plate 1 shown in Fig. 1 is rotated through 180° about its center line 11, which is at right angles to the plane of the plate, the plate shown in Fig. 2 is obtained, which has corrugations $4A_2$, that are congruent with those of the plate of Fig. 1 but in which the webs 5 are so arranged that when two such plates rotated through 180° relative to each other are superimposed the webs 5 of each plate bear on the corrugations of the adjacent plate to provide for the required support.

Fig. 3 shows a plate B which differs from the plate shown in Fig. 1 in that the corrugations $4B_1$ provided on the body 1 of the plate include an angle β with the longitudinal axis whereas the corrugations of the body 1 of the plate A of Fig. 1 include with the longitudinal axis of the plate an equal but opposite angle α. When the plate of Fig. 3 is laid on that of Fig. 2, the corrugations defining the chamber between the plates will cross each other so that high heat transfer rates will be obtained even at low velocities of flow. Just as the plate of Fig. 2 is related to that of Fig. 1, the plate shown in Fig. 4 is obtained in that the plate of Fig. 3 is rotated so that the plates of Figs. 3 and 4 can be combined so that the chamber between them is defined by parallel corrugations. When the plate of Fig. 4 is succeeded by another set of plates as shown in Figs. 1 to 4, alternate chambers of the entire arrangement will be defined by parallel corrugations and by crossing corrugations, respectively.

In the embodiment shown in Figs. 5 to 8, the plates have bodies formed with embossed corrugations which are symmetrical with respect to the transverse center plane 6 of the plate. The webs are so arranged that when two plates having identical corrugations are superimposed (Figs. 5 and 6) the webs of the lower plate bear on the lower ridges of the corrugations of the upper plate to support the same. A plate shown in Fig. 6 is obtained in that a plate as shown in Fig. 5 is rotated through 180° about the axis 11. The fluid flow chamber between the plates of Figs. 6 and 7 is defined by crossing corrugations.

The upper half 7 of the body of the plate shown in Fig. 5 is identical to the lower half 9 of the body of the plate shown in Fig 7. The lower half 8 of the body of the plate shown in Fig. 5 is identical to the upper half 10 of the body of the plate shown in Fig. 7. This embodiment has the advantage, inter alia, that the one and the same tool can be used to press the plates if only parts of the tools are interchanged, so that the tooling costs are greatly reduced.

WHAT I CLAIM IS:—

1. A plate-type heat exchanger comprising two thick plates and three or more heat exchange plates which consist of pressed sheet metal and are gripped between the thick plates and are equally spaced in a row, two adjacent plates each defining an interspace therebetween, each of said plates having a fluid-guiding surface which is surrounded by a gasket that is seated in a recessed flange of the heat exchange plate, and being formed with a plurality of corrugations which extend obliquely to the longitudinal axis of the plate and the height of which equals the distance between the plates and which are provided with numerous connecting webs or integrally formed knobs which have the same height as the corrugations, characterized in that the heat exchanger comprises two or more types of such heat exchange plates, which have corrugations that have the same cross-section and extend at equal but opposite angles of inclination with the median plane of the plate, and the heat exchange plates are superimposed or juxtaposed in such a manner that in one or more plate interspaces the adjacent heat exchange plates engage each other with their

corrugations crossing each other and in one or more plate interspaces the adjacent heat exchange plates engage each other with their corrugations parallel to each other.

2. A plate-type heat exchanger as claimed in claim 1, characterized in that in the plates of each of said types the corrugations extending obliquely to the median plane of the plate are symmetrical with respect to the transverse center plane of the plate, the body of each plates of one type is rectangular, the corrugations and webs or knobs provided in the upper half of the body of each plate of one type are identical to the corrugations and webs or knobs provided in the lower half of the body of each plate of another type, and the corrugations and webs or knobs formed in the lower half of the body of each plate of said one type are identical to the corrugations and webs or knobs formed in the upper half of the body of each plates of said other type.

3. A plate-type heat exchanger as claimed in claim 1 or 2, characterized in that plates of the same type, which are rotated relative to each other through 180° about a center line which is at right angles to the plane of each plate, are arranged next to each other so that the interspace between two such plates is defined by corrugations which are parallel to each other, and plates of different types are arranged adjacent to each other so that the interspace between two such plates is defined by crossing corrugations.

4. A plate-type heat exchanger, substantially as described hereinbefore with reference to the accompanying drawing.

GEE & CO.,
Chancery House,
Chancery Lane,
London WC2A 1QU
— and —
39, Epsom Road,
Guildford,
Surrey.
Agents for the Applicant.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1

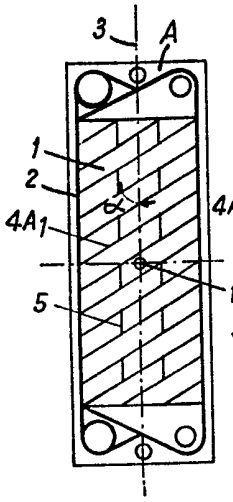


FIG. 2

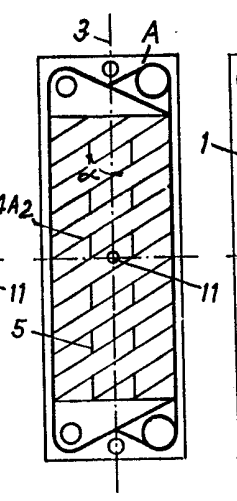


FIG. 3

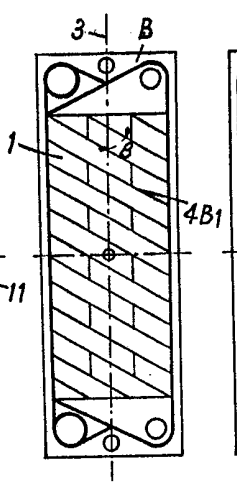


FIG. 4

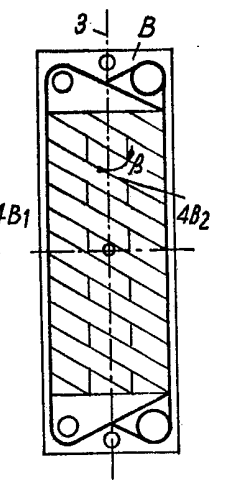


FIG. 5

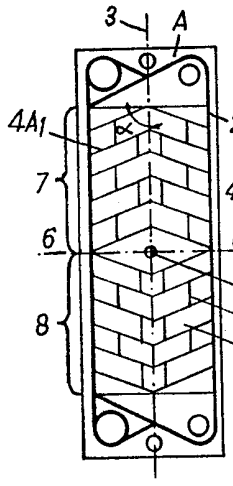


FIG. 6

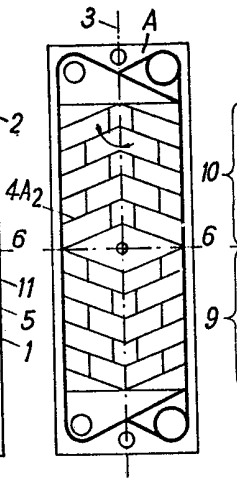


FIG. 7

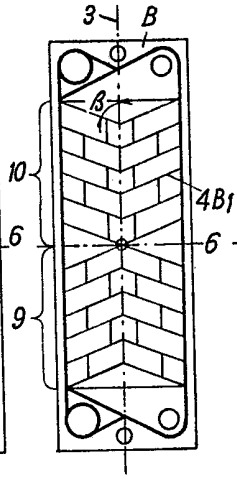


FIG. 8

