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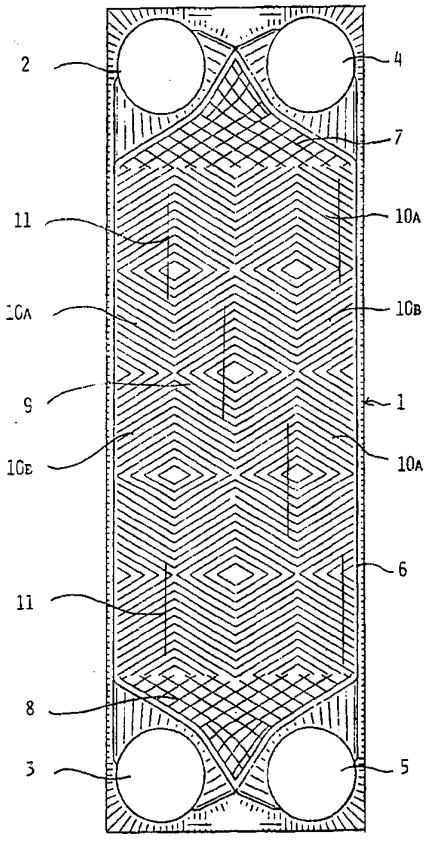
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(54) Title: A PLATE HEAT EXCHANGER

(57) Abstract

The present invention refers to a plate heat exchanger for heat transfer between two fluids, comprising several thin heat transfer plates (1) abutting towards each other and between the heat transfer plates (1) arranged sealing members (6), which in alternate plate interspace delimit a flow space for a first fluid and in the remaining plate interspaces delimit flow spaces for a second fluid, each heat transfer plate (1) having a pressed corrugation pattern, which has two distribution portions (7, 8) and, arranged between these, a main heat transfer portion (9), which is divided in several areas (10a, 10b) with parallel ridges and valleys, and the plate heat exchanger having inlets and outlets for said fluids, arranged such that the fluids will have a flow direction between the heat transfer plates (1) essentially from one to the other of the distribution portions (7, 8) at each heat transfer plate. According to the invention the heat transfer portion (9) of each heat transfer plate (1) comprises a row with at least three areas (10a, 10b) located after each other in said flow direction and an even number of such rows are arranged next to each other across the flow direction, by which the parallel ridges and valleys of each pair of adjacent areas (10a, 10b) extend in such a way that they form mirror images of each other with reference to an imaginary line between respective areas (10a, 10b).



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A plate heat exchanger

The present invention refers to a plate heat exchanger for heat transfer between two fluids, comprising several towards each other abutting thin heat transfer plates and between the heat transfer plates arranged sealing members, which in alternate plate interspace delimit a flow space for a first fluid and in the remaining plate interspaces delimit flow spaces for a second fluid, each heat transfer plate having a pressed corrugation pattern, which has two distribution portions and, arranged between these, a main heat transfer portion, which is divided into several areas with parallel ridges and valleys, and the plate heat exchanger having inlets and outlets for said fluids, arranged in such a way that the fluids will have a flow direction, between the heat transfer plates, essentially from one to the other of the distribution portions of each heat transfer plate.

From GB 1468514 a plate heat exchanger for heat transfer between two fluids is previously known, which is assembled of several heat transfer plates arranged such that the fluids flow on both sides of the plates. The heat transfer plates have a pressed corrugation pattern with an upper distribution portion and a lower distribution portion and, arranged between these, a main heat transfer portion. The heat transfer portion comprises a pressed corrugation pattern with parallel ridges and valleys and is formed with several band like areas, extending along the plates. Between the heat transfer plates sealing members are arranged, which in alternate plate interspace delimit a flow space for a first fluid and in the remaining plate interspaces delimit flow spaces for a second fluid.

From GB 1339542 a plate heat exchanger for heat transfer between two fluids is previously known, which is assembled of

several heat transfer plates arranged such that fluids flow on each sides of these. The heat transfer plates show two distribution portions and, arranged between these, a main heat transfer portion. The heat transfer portion comprises a pressed corrugation pattern with parallel ridges and valleys and is formed with several band like areas, extending across the plates.

Despite that the previously known plate heat exchangers show heat transfer portions formed with several areas, which extend across or along the plates, a problem occurs in that the plates are deformed. I.e. the plates bend or bulge in different directions. Thus, the plates become difficult to handle, e.g. during mounting on a conventional carrying bar or during welding of the plates.

The problem depends on that a strong corrugation of the heat transfer portion of the plates admits an elongation of the plates in said portion. This problem occurs especially when the parallel ridges and valleys have a small angle compared to an imaginary axle around which the plate may have a risk of being curved, simultaneously as the remaining parts of the plate, e.g. sealing grooves or portions of the ports, cannot give sufficient rigidity to restrain the deformation.

The object of the present invention is, in a plate heat exchanger of the present kind, to achieve a heat transfer plate in which the corrugation pattern is so shaped that the risk of deformation decreases and by that enhancing the handling of the heat transfer plates compared with previously known heat transfer plates.

According to the invention these objects are achieved by a plate heat exchanger of the introductory described kind, which is characterised by that the heat transfer portion of

each heat transfer plate comprises a row with at least three areas, located after each other in said flow direction, that an even number of such rows are arranged adjacent to each other across the flow direction, and that the parallel ridges and valleys of each pair of adjacent areas extend in such a way, that they form mirror images of each other with reference on an imaginary line between respective areas.

The invention is also applicable for other types of plate heat exchangers and refers also to a heat transfer plate for a plate heat exchanger, comprising inlets and outlets, for at least two heat transfer fluids and, arranged between these, a heat transfer portion, the inlets and the outlets being arranged such that said fluids will have a flow direction essentially from respective inlet to respective outlet and the heat transfer portion being provided with a pressed corrugation pattern, which is divided into several areas, having parallel ridges and valleys, characterised by that the heat transfer portion comprises a row with at least three areas located after each other in said flow direction, and that an even number of such rows is arranged next to each other across the flow direction, and that the parallel ridges and valleys of each pair of adjacent areas extend in such a way that they form mirror images of each other with reference to an imaginary line between respective areas.

The invention will be described closer in the following with reference to the enclosed drawing, in which

figure 1 shows a front view of a heat transfer plate formed according to the invention.

The present plate heat exchanger is intended to transfer heat between two media, preferably fluids, and is assembled of several towards each other abutting thin, mainly rectangular

elongated heat transfer plates. Also, other shapes of the heat transfer plates, such as round, could be possible.

In figure 1 a heat transfer plate 1 is shown, formed according to the invention, which conventionally is provided with an inlet port 2 and an outlet port 3, for a first heat transfer fluid, and an inlet port 4 and an outlet port 5, for a second heat transfer fluid. A sealing member 6 extends around the ports 4 and 5 and around the periphery of the plate, the sealing member 6 together with an additional heat transfer plate delimiting a flow space for one of said heat transfer fluids and passages for through flow of the other heat transfer fluid. The sealing member 6 may be made of a gasket located in a gasket groove, but also other known sealing arrangements could be used, such as welding, brazing or gluing.

The heat transfer plate 1 has by pressing been provided with a corrugation pattern and has between the inlet ports 2 and 4, respectively, and the outlet ports 3 and 5, respectively, two distribution portions 7 and 8 and a main heat transfer portion 9 located between these, which latter portion is divided into several areas 10a and 10b, each area comprising several parallel ridges and valleys.

I a plate heat exchanger according to the invention several identical heat transfer plates 1 are piled to a package, in which one of the two adjacent heat transfer plates is rotated 180° in its own plane relatively the other. By this, the ridges in said areas 10a on one of the heat transfer plates 1 will abut towards the ridges, which are produced by the valleys, in said area 10b on the second heat transfer plate. Naturally, the plate heat exchanger may also consist of two different kinds of heat transfer plates stapled on each other.

The plate heat exchanger thus has the inlets and outlets arranged such that a heat transfer fluid will have a flow direction between the heat transfer plates 1, extending essentially from one distribution portion 7 to the other distribution portion 8 of each heat transfer plate 1. In this case the flow direction is essentially parallel with the long sides of the heat transfer plates. Alternately plate interspaces of the plate heat exchanger delimit flow spaces for a first fluid and the remaining plate interspaces delimit flow spaces for a second fluid.

The heat transfer portion 9 of each heat transfer plate 1 comprises a row with at least three areas 10a and 10b located after each other in said flow direction, and an even number of such rows are arranged next to each other across the flow direction. By this, the parallel ridges and valleys at each pair of adjacent areas 10a and 10b will extend in such way that they form mirror images of each other with reference to an imaginary line between respective areas 10a and 10b. Consequently, the parallel ridges and valleys of two diagonally located areas (either 10a or 10b) will be identical.

By splitting the heat transfer portion 9 in several smaller areas 10a and 10b, in which the adjacent areas form mirror images of the viewed, four such areas will effectively act against each others tendency of prolonging themselves and by that stiffen the heat transfer plate in its plane. I.e. a prolonging of an area 11a, through en flattening of its ridges and valleys, in a direction perpendicular to the ridges and the valleys, is prohibited by adjacent areas 11b, whose ridges and valleys will not admit prolonging in said direction. The diagonally located areas will form a kind of framework that counteract the prolonging of the heat transfer plate.

Preferably, the heat transfer portion 9 of each heat transfer plate 1 comprises rows with an odd number of areas 10a and 10b located after each other in the flow direction, by which it is possible to form a plate heat exchanger of only one kind of plates.

Most of the known heat transfer plates could be formed with a heat transfer portion having several areas in accordance with invention, but the most tangible effect of the proposed dividing of the heat transfer portion is obtained in huge heat transfer plates. Mainly, long plates intended for small flow, i.e. in which the parallel ridges and valleys of each pair of adjacent areas 10a and 10b extend with an intermediate angle, which is obtuse in relation to the flow direction, a so-called high-θ plate.

To further prohibit prolonging of the heat transfer plate the heat transfer portion may be provided with upwards pressed reinforcement grooves 11, extending in the flow direction along one or several areas. In order that these reinforcing grooves shall not form bypass ducts for the heat transfer fluid, they should not extend along the entire length of the heat transfer portion or a major part thereof. Instead, the reinforcing grooves may be displaced relative to each other, so that they overlap the entire length of the heat transfer portion, but they should not coincide with each other when two heat transfer plates are arranged towards each other.

Claims.

1. A plate heat exchanger for heat transfer between two fluids, comprising several thin heat transfer plates (1) abutting towards each other and sealing members (6) arranged between the heat transfer plates, which in alternate plate interspace delimit a flow space for a first fluid and in the remaining plate interspaces delimit flow spaces for a second fluid, each heat transfer plate (1) having a pressed corrugation pattern, which has two distribution portions (7,8) and, arranged between these, a main heat transfer portion (9), which is divided in several areas (10a,10b) with parallel ridges and valleys, and the plate heat exchanger has inlets and outlets for said fluids, arranged in such a way that the fluids will have a flow direction, between the heat transfer plates (1), essentially from one to the other of the distribution portions (7,8) of each heat transfer plate (1),

c h a r a c t e r i z e d b y

that the heat transfer portion (9) of each heat transfer plate (1) comprises a row with at least three areas (10a,10b) located after each other in said flow direction,

that an even number of such rows is arranged next to each other across flow direction, and

that the parallel ridges and valleys of each pair of adjacent areas (10a,10b) extend in such a way, that they form mirror images of each other with reference to an imaginary line between respective areas (10a,10b).

2. A plate heat exchanger according to claim 1, c h a r a c t e r i z e d b y that the heat transfer portion (9) of each heat transfer plate (1) comprises rows with an

odd number of areas (10a,10b) located after each other in the flow direction located.

3. A plate heat exchanger according to claim 1 or 2, characterized by that the parallel ridges and valleys of each pair of adjacent areas (10a,10b) extend with an intermediate angle, which is obtuse in relation to the flow direction.

4. A plate heat exchanger according to any of the claims 1 to 3, characterized by that the heat transfer portion (9) is provided with upwards pressed reinforcing grooves (11), extending in the flow direction.

5. A plate heat exchanger according to claim 4, characterized by that the reinforcing grooves (11) are displaced relatively each other in the flow direction.

6. A plate heat exchanger according to claim 5, characterized by that each reinforcing groove extends only over a part of the heat transfer portion.

7. A heat transfer plate (1) for a plate heat exchanger, comprising inlets (2,4) and outlets (3,5) for at least two heat transfer fluids and, arranged between these, a heat transfer portion (9), the inlets and the outlets being arranged such that said fluids will have a flow direction essentially from respective inlet (2,4) to respective outlet (3,5) and the heat transfer portion (9) being provided with a pressed corrugation pattern, which is divided in several areas (10a,10b) with parallel ridges and valleys,

characterized by

that the heat transfer portion (9) comprises a row with at least three areas (10a,10b) located after each other in said flow direction,

that an even number of such rows are arranged next to each other across the flow direction, and

that the parallel ridges and valleys at each pair of adjacent areas (10a,10b) extend in such a way that they form mirror images of each other with reference to an imaginary line between respective areas (10a,10b).

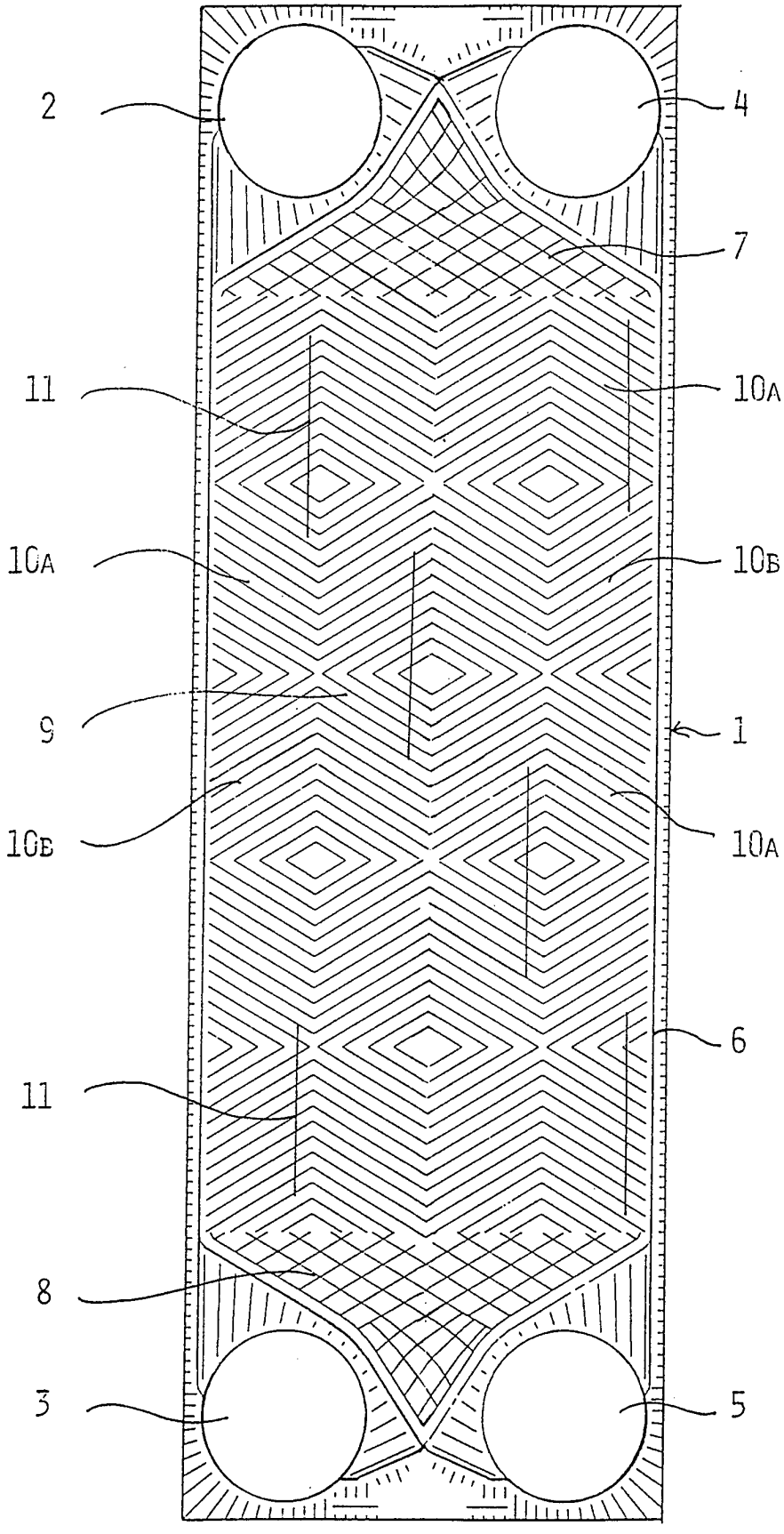


FIG 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 94/00040

A. CLASSIFICATION OF SUBJECT MATTER

IPC[5]: F28F 3/04, F28F 3/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[5]: F28D, F28F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4176713 (FISHER), 4 December 1979 (04.12.79)	7
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Y	US, A, 4434643 (ALMQVIST ET AL), 6 March 1984 (06.03.84)	7
A	--	1-6
A	US, A, 4781248 (PFEIFFER), 1 November 1988 (01.11.88)	1,2
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

07/05/94

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		DE-A- 2704183	18/08/77
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