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(54) Plate heat exchanger

(57) A stack of heat transfer plates configured to be arranged within a block-type heat exchanger. The stack of heat transfer plates comprises pairs (50, 60) of heat transfer plates that are stacked such that a flow path (67) for a first fluid is formed between the stacked pairs of heat transfer plates, wherein a pair (50) of the stacked pairs of heat transfer plates comprises a first heat transfer plate (51) and a second heat transfer plate (52) that are joined such that a flow path (57) for a second fluid is formed between the first and second heat transfer plates. The pair (50) of heat transfer plates comprises corrugations (101, 102) that are arranged on a respective side of an elongated joint (72) that joins the first and second heat transfer plates. A related plate heat exchanger is also disclosed.

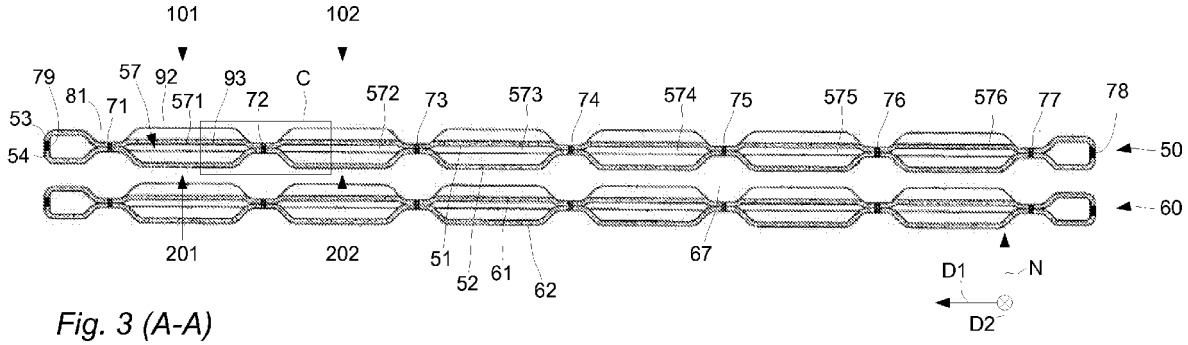

Fig. 3 (A-A)

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Description

Technical Field

[0001] The invention relates to a stack of heat transfer plates configured to be arranged within an enclosure formed by a certain type of plate heat exchanger. The certain type of plate heat exchanger comprises a top head, a bottom head and four side panels that are bolted together with a set of corner girders to form the enclosure for the stack of heat transfer plates.

Background Art

[0002] Today several different types of plate heat exchangers exist, which are employed in various applications depending on their type. One certain type of plate heat exchanger is assembled by bolting a top head, a bottom head and four side panels to a set of corner girders to form a box-like enclosure around a stack of heat transfer plates. This certain type of plate heat exchanger is often referred to as a block-type heat exchanger. One example of a commercially available block-type heat exchanger is the heat exchanger offered by Alfa Laval AB under the product name Compabloc.

[0003] A block-type heat exchanger typically has fluid inlets and fluid outlets arranged on the side panels while baffles are attached to the stack of heat transfer plates for directing a fluid back and forth through channels formed between heat transfer plates in the stack of heat transfer plates.

[0004] Since the stack of heat transfer plates is surrounded by the top head, the bottom head and the four side panels, the heat exchanger may withstand high pressure levels in comparison with many other types of plate heat exchangers. Still, the block-type heat exchanger is compact, it has good heat transfer properties and may withstand hard usage without breaking.

[0005] The stack of heat transfer plates is sometimes referred to as a plate pack and has a special, block-like design that is characteristic for block-type heat exchangers. The stack of heat transfer plates is often all-welded and no gaskets are needed between heat transfer plates for proper sealing of flow channels that are formed between the plates. This makes a block-type heat exchanger suitable for operation with a wide range of aggressive fluids, at high temperatures and at high pressures.

[0006] During maintenance of the block-type heat exchanger, the stack of heat transfer plates may be accessed and cleaned by removing e.g. two side panels and flushing the stack of heat transfer plates with a detergent. It is also possible to replace the stack of heat transfer plates with a new stack, which may be identical or different from the previous stack as long as it is capable of being properly arranged within the heat exchanger.

[0007] Generally, the block-type heat exchanger is suitable not only as a conventional heat exchanger but also as a condenser or reboiler. In the two latter cases the heat exchanger may comprise additional inlets/outlets for a condensate, which may eliminate the need for a special separator unit.

[0008] The design of the block-type heat exchanger with its stack of heat transfer plates provides, as indicated, a combination of advantages and properties that are quite specific for the type, and prior arts discloses a number of embodiments. For example, EP165179 discloses a heat exchanger in the form of a block with a plate pack arranged in the centre of the block. EP639258 discloses a similar heat exchanger with a plate pack that is surrounded by top and bottom heads and four side panels.

[0009] The prior art show block-type heat exchangers with a respective internal stack of heat transfer plates. In comparison with several other types of plate heat exchangers, these block-type heat exchangers have a compact design and may withstand high pressure levels. However, it is estimated that the particular designs may be improved in respect of the capability of efficiently transferring heat through plates in the stack of heat transfer plates, while still assuring that relatively high pressures levels may be handled.

Summary

[0010] It is an object of the invention to improve the above-described block-type heat exchanger. In particular, it is an object to provide a more efficient design that provides for improved heat transfer within the stack of heat transfer plates while still ensuring that the heat exchanger may withstand high pressure levels.

[0011] To fulfill these objects a stack of heat transfer plates is provided, which is configured to be arranged within an enclosure formed by a top head, a bottom head and four side panels that are bolted together with a set of corner girders. The stack of heat transfer plates comprises pairs of heat transfer plates that are stacked such that a flow path for a first fluid is formed between the stacked pairs of heat transfer plates. A pair of the stacked pairs of heat transfer plates comprises a first heat transfer plate and a second heat transfer plate that are joined such that a flow path for a second fluid is formed between the first and second heat transfer plates. The pair of heat transfer plates comprises corrugations that are arranged on a respective side of an elongated joint that joins the first and second heat transfer plates.

[0012] The elongated joint is, by virtue of being arranged between corrugations, capable of holding the plates together when fluid is passed between the first and second plates at high pressure levels. At the same time, the corrugations provide for efficient heat transfer. Also, the particular design of the stack may facilitate implementation of a number of additional features that are described below, which include e.g. a particular way of joining the pairs of heat transfer plates in the stack.

[0013] Typically, the joint may be a weld but may also be a brazed or soldered section or a section where the

plates are joined by some other suitable method of joining. Generally, all or most of the pairs of the stacked pairs of heat transfer plates may comprise a respective first heat transfer plate and a respective second heat transfer plate. These heat transfer plates are then joined such that the flow path for the second fluid is formed between the respective first and second heat transfer plates. Thus, each pair of the stacked pairs of heat transfer plates may comprise a respective first and second heat transfer plate that are joined such that a flow path for the second fluid is formed between the respective first and second heat transfer plate.

[0014] The first heat transfer plate may comprise an elongated joint groove along which the elongated joint is arranged.

[0015] The joint groove may extend unbroken along the flow path formed between the first and second heat transfer plates.

[0016] The second heat transfer plate may comprise an elongated joint groove along which the elongated joint is arranged, wherein the joint grooves of the first and second heat transfer plates abut each other such that the heat transfer plates are joined at the joint grooves.

[0017] The joint may comprise two at least partially overlapping joint sections.

[0018] The first heat transfer plate and the second heat transfer plate may be joined by a plurality of elongated joints, such that the flow path for the second fluid comprises multiple parallel flow channels.

[0019] The pair of heat transfer plates may comprise a first set of opposite, elongated side joints that join the first and second heat transfer plates.

[0020] The pair of heat transfer plates may comprise a second set of opposite, elongated side joints that are transverse the first set of elongated side joints. The second set of opposite, elongated side joints joins the pair of heat transfer plates with a similar pair of heat transfer plates, such that the flow path for the first fluid comprises a free-flow path between the second set of side joints. In this context, a free-flow path may be defined as a flow path for the first fluid where there are, between the elongated side joints that joins the pairs, no contact points between the pairs of heat transfer plates. Free-flow is advantageous in that there are less possibilities for e.g. bacteria or deposits from the first fluid to form in the flow path.

[0021] The free-flow path between the second set of side joints may be interrupted by at least one support for reducing bulging of heat transfer plates. The support typically reduces bulging of heat transfer plates when the stack of heat transfer plates is used in high-temperature applications where thermal expansion may occur.

[0022] Each of the first heat transfer plate and the second heat transfer plate may comprise corrugations that are arranged on a respective side of the elongated joint.

[0023] The pair of heat transfer plates may comprise sets of corrugations that are arranged between a plurality of elongated joints that join the first and second heat transfer plates.

[0024] The corrugations may comprise ridges and grooves that extend in a direction that is 45°-90° transverse a direction along which the elongated joint extends.

[0025] The first heat transfer plate and the second heat transfer plate may have similar shapes and the second heat transfer plate may be, in relation to the first heat transfer plate, turned 180° around an axis that is parallel to the plane of the second heat transfer plate.

[0026] The pair of heat transfer plates may have a rectangular shape and may comprise four corners that are welded to linings that at least partially surround the set of corner girders.

[0027] According to another aspect a plate heat exchanger is provided, which comprises a stack of heat transfer plates that may include any one of the above described features. The plate heat exchanger also comprises a top head, a bottom head and four side panels that are bolted together with a set of corner girders to form an enclosure in which the stack of heat transfer plates is arranged.

[0028] Still other objectives, features, aspects and advantages of the invention will appear from the following detailed description as well as from the drawings.

Brief Description of the Drawings

[0029] Embodiments of the invention will now be described, by way of example, with reference to the accompanying schematic drawings, in which

Fig. 1 is an exploded view of a block-type heat exchanger with a stack of heat transfer plates,
Fig. 2 is a top view of pairs of heat transfer plates that are used for the stack of heat transfer plates of Fig. 1,
Fig. 3 is a cross-sectional view along section A-A of Fig. 2,
Fig. 4 is a cross-sectional view along section B-B of Fig. 2,
Fig. 5 is an enlarged view of section C of Fig. 3, and
Fig. 6 is a cross-sectional view of a further embodiment of two pairs of heat transfer plates.

Detailed description

[0030] With reference to Fig. 1 a plate heat exchanger 2 of a block-type is shown. The plate heat exchanger 2 comprises a top head 15, a bottom head 16 and four side panels 11, 12, 13, 14 that are bolted together with a set of (typically four) corner girders 21-24 for assembling the plate heat exchanger 2. When assembled, the plate heat exchanger 2 has a box-like or block-like shape and an enclosure is formed by the top head 15, the bottom head 16 and the side panels 11-14. A stack of heat transfer plates 30 is arranged within the enclosure and comprises, as will be described in further detail, a number of pairs of heat transfer plates. The stack of heat transfer plates

30 also has a box-like or block-like shape, which shape corresponds to the shape of the enclosure formed by the heads 15, 16 and the side panels 11-14. The stack of heat transfer plates 30 has at its corners four linings 31-34 that are arranged to face the corner girders 21-24.

[0031] The assembly of the plate heat exchanger 2 is typically performed by using conventional methods and bolts (not shown) that attach the mentioned components to each other via bolt holes like holes 35 and 36. In brief, assembling the plate heat exchanger 2 includes arranging the stack of heat transfer plates 30 on the bottom head 16, sliding the corner girders 21-24 into the linings 31-34 and bolting them to the bottom head 16. A channel end plate 38 is arranged on top of the stack of heat transfer plates 30 and the top head 15 is bolted to the corner girders 21-24. Thereafter the side panels 11-14 are bolted to the corner girders 21-24 and to the heads 15, 16. Generally, the plate heat exchanger 2 also has a base 17 that facilitates attachment of the plate heat exchanger 2 to the ground.

[0032] Gaskets (not shown) are arranged on the side panels 11-14 at sections that face the corner girders 21-24 and the heads 15, 16, such that the enclosure formed by the heads 15, 16 and side panels 11-14 is properly sealed for preventing leakage from the plate heat exchanger 2.

[0033] A first side panel 11 and a second side panel 12 of the side panels 11-14 comprise inlets and outlets for two fluids. In detail, the first side panel 11 has an inlet 41 and an outlet 42 for a first fluid. The inlet 41 and outlet 42 of the first panel 11 form a flow path for the first fluid in combination with the stack of heat transfer plates 30, where the flow path extends from the inlet 41, within the stack of heat transfer plates 30 and to the outlet 42. This flow path is illustrated by the broken arrows that extend in directions parallel to the direction D1. Conventional baffles, such as baffle 39, are connected to sides of the stack of heat transfer plates 30 for directing the flow of the first fluid in a number of passes within the stack 30 (four passes in the illustrated figure).

[0034] The second side panel 12 has an inlet 43 and an outlet 44 for a second fluid. The inlet 43 and outlet 44 of the second side panel 12 form a flow path for the second fluid in combination with the stack of heat transfer plates 30, where the flow path extends from the inlet 43, within the stack of heat transfer plates 30 and to the outlet 44. This flow path is illustrated by the broken arrows that extend in directions parallel to the direction D2. Conventional baffles connected to sides of the stack of heat transfer plates 30 direct the flow of the second fluid in a number of passes within the stack 30 (here the same number of passes as for the first fluid).

[0035] The arrangement of baffles is per se accomplished by employing conventional techniques. However, the first flow path for the first fluid is between the pairs of heat transfer plates in the stack 30, while the second flow path for the second fluid is within the pairs of heat transfer plates in the stack 30. A pair of heat transfer plates comprises a first heat transfer plate and a second heat transfer plate, as will be described further on. This means that the flow of the first fluid is between heat transfer plates of different pairs of heat transfer plates, while the flow of the second fluid is between a first and a second heat transfer plate of the same pair, i.e. within a pair. The linings 31-34 seal the corners of the stack of heat transfer plates 30, which ensures that the two different fluids paths are separated.

[0036] With reference to Figs 2, 3 and 4 a first and a second pair 50, 60 of heat transfer plates are exemplified, where Fig. 3 is a cross-sectional view along section A-A of Fig. 2 and Fig. 4 is a cross-sectional view along section B-B of Fig. 2. The pairs 50, 60 of heat transfer plates are part of the stack of heat transfer plates 30 illustrated in Fig. 1. The stack 30 comprises a number of pairs of heat transfer plates that are similar to the pairs 50, 60, such as 4-200 pairs or even more.

[0037] For the pairs 50, 60 of heat transfer plates exemplified by Figs 2, 3 and 4, the first pair 50 of heat transfer plates comprises a first heat transfer plate 51 and a second heat transfer plate 52. The second pair 60 of heat transfer plates is typically similar to the first pair 50 of heat transfer plates, which means that it also comprises a first heat transfer plate 61 and a second heat transfer plate 62. Thus, the first heat transfer plate 61 of the second pair 60 of heat transfer plates is typically similar to the first heat transfer plate 51 of the first pair 50 of heat transfer plates, while the second heat transfer plate 62 of the second pair 60 of heat transfer plates may be similar to the second heat transfer plate 52 of the first pair 50 of heat transfer plates.

[0038] Also, the first heat transfer plate 51 and the second heat transfer plate 52 of the first pair 50 of heat transfer plates have similar shapes. From this follows that all heat transfer plates 51, 52, 61, 62 of the pairs 50, 60 of heat transfer plates may be similar or even identical. However, the second heat transfer plate 52 is, in relation to the first heat transfer plate 51, turned 180° around an axis A1 that is parallel to the plane of the second heat transfer plate 52. In detail, the axis A1 extends through the centre of the second heat transfer plate 52 and is parallel to two opposite sides of the second heat transfer plate 52, such that the second heat transfer plate 52 is, in relation to the first heat transfer plate 51, arranged as an inverted mirror-image of the first heat transfer plate 51. The second heat transfer plate 62 of the second pair 60 of heat transfer plates is in a corresponding manner arranged as an inverted mirror-image of the first heat transfer plate 61 of the second pair 60.

[0039] Depending on the configuration of the heat transfer plates, rotation of one heat transfer plate of a pair may be done around one or more different axes for arranging the plates of a pair as inverted mirror-images of each other. For example, the second heat transfer plate 52 may be arranged as an inverted mirror-images of the first heat transfer plate 51 when it is rotated 180° about an axis that is parallel to the illustrated direction

D2, followed by a rotation of 180° about an axis that is parallel to the illustrated normal N of the plates 51, 52.

[0040] Each heat transfer plate has, as exemplified by the first heat transfer plate 51 of the first pair 50 of heat transfer plates, a rectangular shape with a first 511, a second 512, a third 513 and a fourth elongated side 514. When the stack of heat exchanger plates 30 is arranged within the enclosure of the plate heat exchanger 2, the first elongated side 511 is facing the first side panel 11 while the third side 513 is facing the third side panel 13. The first heat transfer plate 51 is joined with the second heat transfer plate 52 via a joint 78 at the first elongated side 511 and via a joint 79 at the third elongated side 513, as may be seen in Fig. 3.

[0041] The first heat transfer plate 51 comprises sets of corrugations 101-106 that are arranged on respective sides of elongated joints 72-76 that join the first and second heat transfer plates 51, 52. It may also be said that the corrugations 101-106 are separated by the elongated joints 72-76. The sets of corrugations 101-106 extend a direction that is parallel to the joints 72-76, which direction in the exemplified embodiment is parallel to the direction D2. The sets of corrugations 101-106 have two outermost sets of corrugations 101, 106, and further joints 71, 77 may be arranged intermediate the outer sets of corrugations 101, 106 and the corresponding, closest elongated side 513, 511. As previously indicated, since all heat transfer plates may be similar, all or some of the heat transfer plates of the stack of heat transfer plates 30, such as plates 52, 61 and 62, may have the same properties and structural shape as plate 51.

[0042] The corrugations 101- 106 comprise ridges and grooves that extend in a direction D1 that is 45°-90° transverse a direction D2 along which the elongated joints 71-77 extend. The directions D1, D2 are here the same directions as previously discussed in respect of the flow of the first and second fluid. Corrugations 101, 102 on the first heat transfer plate 51 and corresponding corrugations 201, 202 on the second heat transfer plate 52 each comprise ridges and grooves, such as ridge 92 and groove 93 of the first heat transfer plate 51 and ridge 192 and groove 193 of the second heat transfer plate 52.

[0043] The first pair 50 of heat transfer plates comprises elongated joint grooves, as exemplified by joint grooves 81-87 of the first heat transfer plate 51, along which the elongated joints 71-77 are arranged. Each corrugation of the set of corrugations 101-106 comprising ridges and grooves that extend in a direction D1 that is transverse a direction D2 along which the elongated joint grooves 81-87 extend.

[0044] The ridges of the first heat transfer plate 51 may be aligned with the ridges of the second heat transfer plate 52, as seen in a direction parallel to a normal direction N of the first pair 50 of heat transfer plates. This is advantageous in that efficient heat transfer and flow of fluid may be accomplished.

[0045] As shown, the joints 71-77 are arranged in a respective joint groove 81-87. Since the second heat transfer plate 52 is similar to the first heat transfer plate 51 it also comprises elongated joint grooves along which the elongated joints 71-77 are arranged.

[0046] With reference to Fig. 3 and to Fig. 5 illustrating the enlarged section C of Fig. 3, it is shown that e.g. joint groove 82 of the first heat transfer plate 51 abut a corresponding joint groove 182 of the second heat transfer plate 52. The heat transfer plates 51, 52 are then joined at the joint grooves 82, 182 by virtue of the joint 72. In this context, a backside surface 515 of the joint groove 82 of the first heat transfer plate 51 is in contact with a backside surface 525 of the joint groove 182 of the second heat transfer plate 52.

[0047] The joints are typically formed by welding but may also be formed by brazing or by some other, suitable means of joining. The heat exchanger plates 51, 52, 61, 62 are typically made of metal, such as stainless steel. When welding is used for forming the joints, i.e. when the joint are welds, laser welding may be used as well as other welding techniques, such as resistance welding.

[0048] Each of the joints 71-77 may comprise two at least partially overlapping joint sections, as exemplified by a first section 721 and a second section 722 of the joint 72. The joint sections 721, 722 may be overlapping by a predetermined distance, such as 5-30 mm. The two joint sections 721, 722, or welding sections when the joints are formed by welding, may begin at a respective end section of the joint groove, as illustrated by the two end sections 821, 822 of joint groove 82.

[0049] As indicated, the joining of the first heat transfer plate 51 with the second heat transfer plate 52 at the first and third elongated sides 511, 513 may be accomplished by a first set of opposite, elongated side joints 78, 79, such that a flow path 57 for the second fluid is formed between the first set of opposite, elongated side joints 78, 79, i.e. within the first pair 50 of heat transfer plates. The flow path 57 is then parallel to the direction D2 discussed in connection with Fig. 1.

[0050] For facilitating joining of the plates in a pair 50, the first and second heat transfer plates 51, 52 have peripheral sections like sections 53, 54 that are folded towards each other. The peripheral sections 53, 54 are folded towards each other since the second heat transfer plate 52 is arranged as an inverted mirror-image of the first heat transfer plate 51, having in mind that the plates 51, 52 are similar. The related weld 79 is applied at a contact surface formed between the folded sections 53, 54.

[0051] The joint grooves 81-87 may extend unbroken along the flow path 57 that is formed between the first and second heat transfer plates 51, 52. Also since the first heat transfer plate 51 and the second heat transfer plate 52 are typically joined by multiple elongated joints 71-77, the flow path 57 for the second fluid formed between the first and second heat transfer plates 51, 52 comprises multiple parallel flow channels 571-576.

[0052] To form the stack of heat transfer plates 30, pairs of heat transfer plates like the first pair 50 of heat

transfer plates and the second pair 60 of heat transfer plates are joined via opposite, elongated side joints. Such joints are exemplified by a set of opposite, elongated side joints 781, 782 arranged between the first pair 50 of heat transfer plates and the second pair 60 of heat transfer plates. Such elongated side joints 781, 782 are transverse the first set of elongated side joints 78, 79 and joins a pair of heat transfer plates (exemplified by pair 50) with an adjacent pair of heat transfer plates (exemplified by pair 60). For facilitating joining, the plates 51, 52, 61, 62 have respective peripheral sections that are folded towards a heat transfer plate that belongs to another pair of heat transfer plates, such as folded sections 56 and 65. The related weld 781 is applied at a contact surface formed between the folded sections 56, 65.

[0053] When the pairs 50, 60 of heat transfer plates are joined, a flow path 67 for the first fluid is formed between the pairs 50, 60 of heat transfer plates. Since the pairs 50, 60 are joined only at the second set of side joints 781, 782 a so called free-flow path is formed between the joints 781, 782, i.e. a free-flow path is formed between the pairs 50, 60 of heat exchanger plates. A free-flow path may in this context be defined as a flow path without any contact points intermediate the side joints 781, 782. Generally, free-flow has been observed to be advantageous since occurrence of e.g. deposits from the fluid or the presence of bacteria may be reduced or, in practice, even eliminated.

[0054] Optionally, with reference to Fig. 6 which is a cross-sectional view that corresponds to Fig. 4, the first pair 50 of heat transfer plates and the second pair 60 of heat transfer plates may comprise one or more supports 783, 784. The supports 783, 784 may then be arranged intermediate the second set of opposite, elongated side joints 781, 782 for reducing the risk of bulging of the pairs 50, 60 of heat transfer plates due to e.g. thermal expansion.

[0055] As illustrated, the supports 781, 782 may be embodied as point-like indentations in the second heat transfer plate 52, but may also be embodied as indentations in both the first heat transfer plate 51 and in the second heat transfer plate 52, such that the second heat transfer plate 52 may be made similar to the first heat transfer plate 51. In principle, the supports 781, 782 of the second heat transfer plate 52 of the first pair 50 are in contact with the first heat transfer plate 61 of the second pair 60. The contact surfaces formed by the supports 781, 782 between these plates 52, 61 may be made as small as possible for avoiding occurrence of e.g. deposits from the first fluid.

[0056] A limited free-flow path is be accomplished when one or more supports between the side joints that join two pairs are used. However, free-flow properties may in practice still be obtained if the number of supports between the side joints is limited. To what number the supports should be limited depends on the size of the plates, and may be empirically determined.

[0057] To form the complete stack of heat transfer plates 30, a number of pairs of heat transfer plates are stacked adjacent each other and joined to each other in a manner like the joining of the first and the second pairs 50, 60 of heat transfer plates. The joining of the pairs may be accomplished by using the same methods (welding, brazing etc.) as when joining the plates of one pair.

[0058] For efficiently joining the heat transfer plates to the linings 31-34 each heat exchanger plate has four protrusions at its corners, such as protrusions 515-518 of the first heat transfer plate 51. The protrusions are then joined to the linings 31-34 by e.g. welding, brazing or by some other suitable means of joining. The linings 31-34 partially surround the set of corner girders 21-24 when the plate heat exchanger 2 is assembled, such that the stack of heat transfer plates 30 is firmly fixed within the enclosure that is formed by the heads 15, 16 and the side panels 11-14.

[0059] The heat transfer plates 51, 52, 61, 62 may per se be manufactured from steel sheets that are pressed with a press tool that forms the corrugations and the weld grooves. A cutting machine thereafter cuts the pressed plates along their periphery and the edges of the cut plates are folded in a machine that forms the folded, peripheral sections.

[0060] From the description above follows that, although various embodiments of the invention have been described and shown, the invention is not restricted thereto, but may also be embodied in other ways within the scope of the subject-matter defined in the following claims.

[0061] For example, other patterns of corrugations and weld grooves are achievable, as long as a pair of heat transfer plates comprises corrugations that are arranged on a respective side of an elongated joint that joins a first and second heat transfer plate of a pair of heat transfer plates. Also, the elongated joint comprises an unbroken, elongated joint, as well as comprises a number of spot-welds arranged in an elongated series.

Claims

1. A stack of heat transfer plates configured to be arranged within an enclosure formed by a top head (15), a bottom head (16) and four side panels (11-14) that are bolted together with a set of corner girders (21-24), the stack of heat transfer plates comprising pairs (50, 60) of heat transfer plates that are stacked such that a flow path (67) for a first fluid is formed between the stacked pairs (50, 60) of heat transfer plates, wherein a pair (50) of the stacked pairs (50, 60) of heat transfer plates comprises a first heat transfer plate (51) and a second heat transfer plate (52) that are joined such that a flow path (57) for a second fluid is formed between the first and second heat transfer plates (51, 52), **characterized in that** the pair (50) of heat transfer plates comprises corrugations (101, 102) that are arranged on a respec-

tive side of an elongated joint (72) that joins the first and second heat transfer plates (51, 52).

2. A stack of heat transfer plates according to claim 1, wherein the first heat transfer plate (51) comprises an elongated joint groove (82) along which the elongated joint (72) is arranged.

3. A stack of heat transfer plates according to claim 2, wherein the joint groove (82) extends unbroken along the flow path (57) formed between the first and second heat transfer plates (51, 52).

4. A stack of heat transfer plates according to claim 2 or 3, wherein the second heat transfer plate (52) comprises an elongated joint groove (182) along which the elongated joint (72) is arranged, and wherein the joint grooves (82, 182) of the first and second heat transfer plates (51, 52) abut each other such that the heat transfer plates (51, 52) are joined at the joint grooves (82, 182).

5. A stack of heat transfer plates according to any one of claims 1 - 4, wherein the joint (72) comprises two at least partially overlapping joint sections (721, 722).

6. A stack of heat transfer plates according to any one of claims 1 - 5, wherein the first heat transfer plate (51) and the second heat transfer plate (52) are joined by a plurality of elongated joints (71-77), such that the flow path (57) for the second fluid comprises multiple parallel flow channels (571 - 576).

7. A stack of heat transfer plates according to any one of claims 1 - 6, wherein the pair (50) of heat transfer plates comprises a first set of opposite, elongated side joints (78, 79) that join the first and second heat transfer plates (51,52).

8. A stack of heat transfer plates according to claim 7, wherein the pair (50) of heat transfer plates comprises a second set of opposite, elongated side joints (781, 782) that are transverse the first set of elongated side joints (78, 79) and joins the pair (50) of heat transfer plates with a similar pair (60) of heat transfer plates, such that the flow path (67) for the first fluid comprises a free-flow path between the second set of side joints (781, 782).

9. A stack of heat transfer plates according to claim 8, wherein the free-flow path between the second set of side joints (781, 782) is interrupted by at least one support (783) for reducing bulging of heat transfer plates (51, 52).

10. A stack of heat transfer plates according to any one of claims 1 - 9, wherein each of the first heat transfer plate (51) and the second heat transfer plate (52) comprises corrugations (101-106, 201, 202) that are arranged on a respective side of the elongated joint (72).

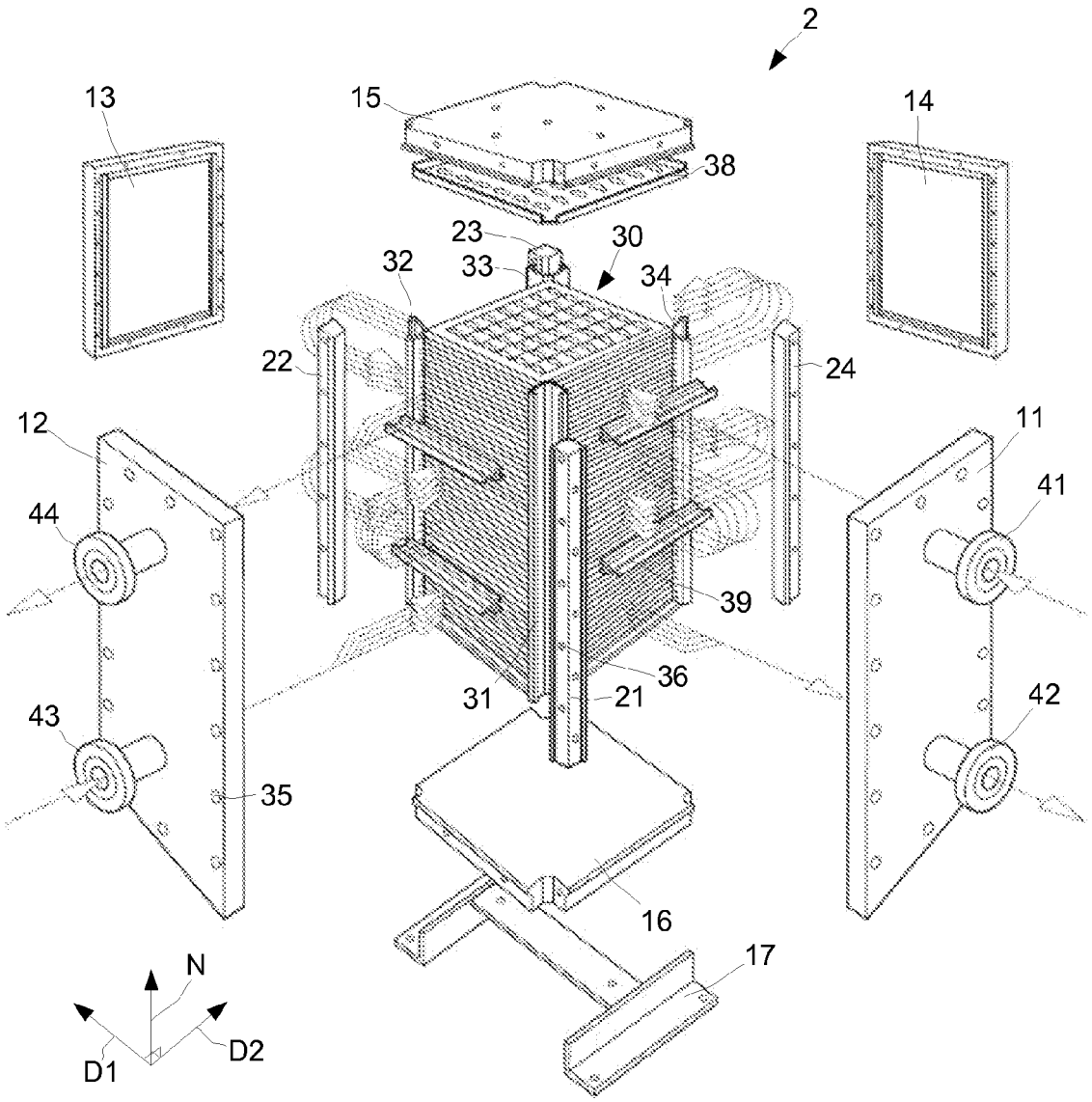
11. A stack of heat transfer plates according to claim 6 and 10, wherein the corrugations comprises sets of corrugations (101-106) that are arranged between the plurality of elongated joints (71-77) that join the first and second heat transfer plates (51, 52).

12. A stack of heat transfer plates according to any one of claims 1 - 11, wherein the corrugations (101, 102) comprise ridges (92) and grooves (93) that extend in a direction (D1) that is 45°-90° transverse a direction (D2) along which the elongated joint (72) extends.

13. A stack of heat transfer plates according to any one of claims 1 - 12, wherein the first heat transfer plate (51) and the second heat transfer plate (52) have similar shapes and the second heat transfer plate (52) is, in relation to the first heat transfer plate (51), turned 180° around an axis (A1) that is parallel to the plane of the second heat transfer plate (52).

14. A stack of heat transfer plates according to any one of claims 1 - 13, wherein the pair (50) of heat transfer plates has a rectangular shape and comprises four corners that are welded to linings (31-34) configured to at least partially surround the set of corner girders (21-24).

15. A plate heat exchanger comprising a stack of heat transfer plates (30) according to any one of claims 1 - 14, further comprising a top head (15), a bottom head (16) and four side panels (11-14) that are bolted together with a set of corner girders (21-24) to form an enclosure in which the stack of heat transfer plates (30) is arranged.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23
30
32
33
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22
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41
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39
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31
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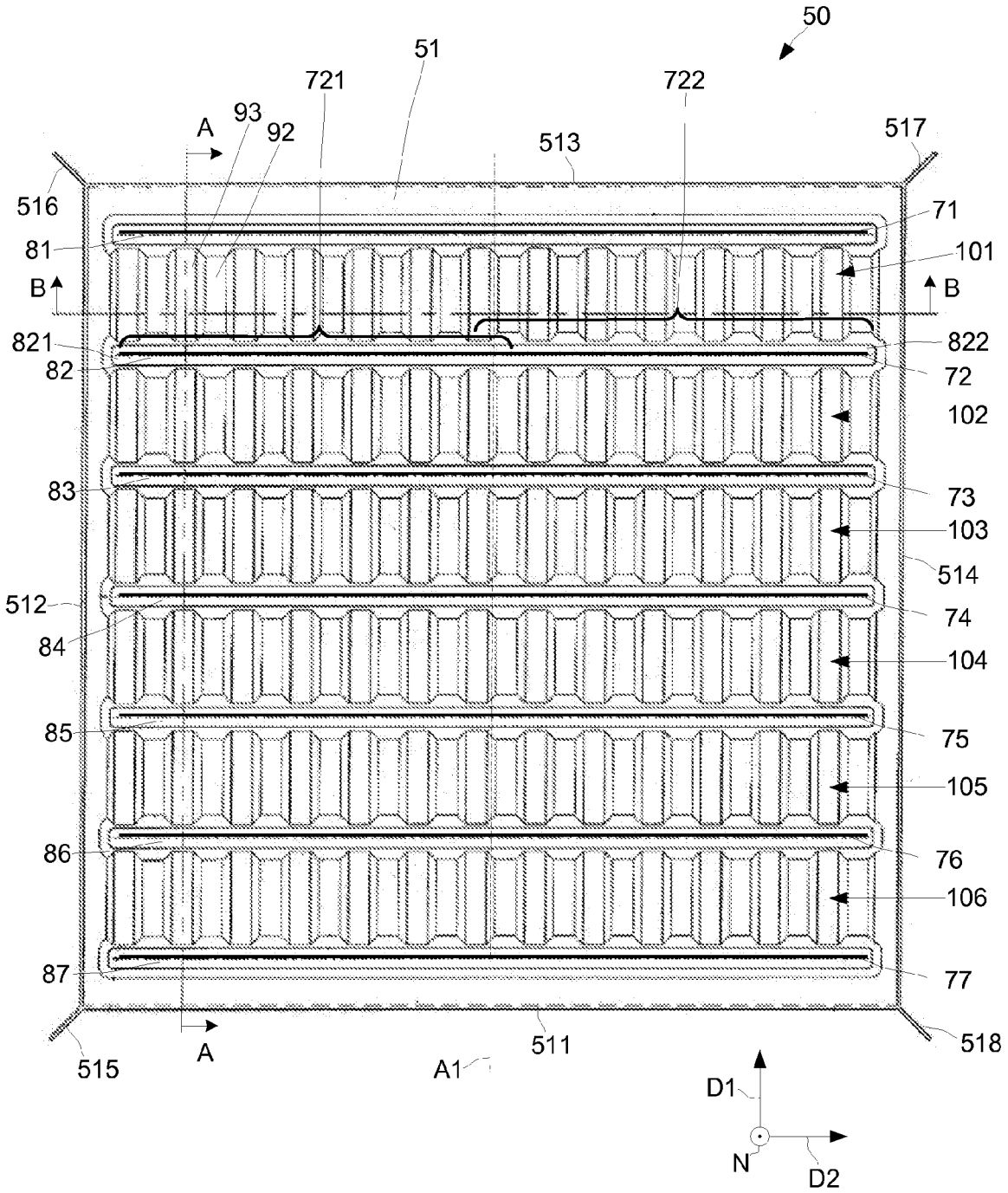
42
43
35
16
17
N
D1
D2

Fig. 1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92
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513
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101
B
B
821
822
82
72
102
83
73
103
514
512
74
84
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87
77
515
A
511
518
A1
D1
N
D2

Fig. 2

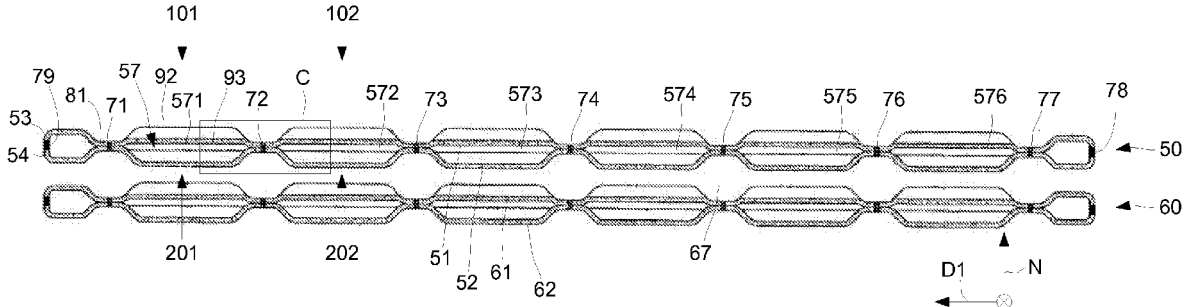

Fig. 3 (A-A)

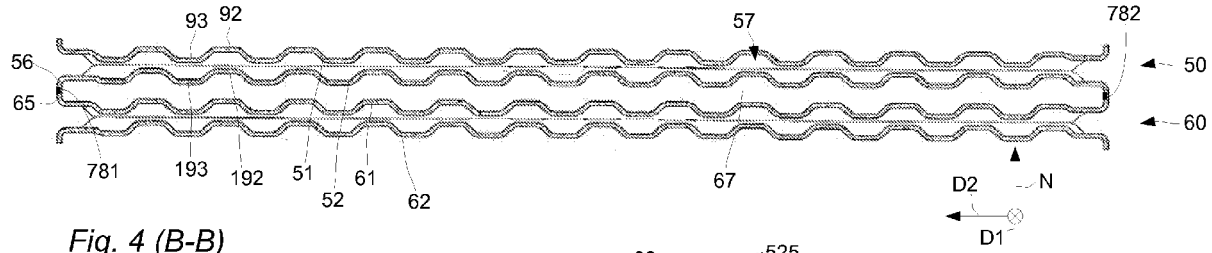

Fig. 4 (B-B)

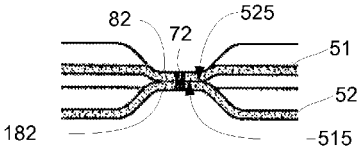

Fig. 5

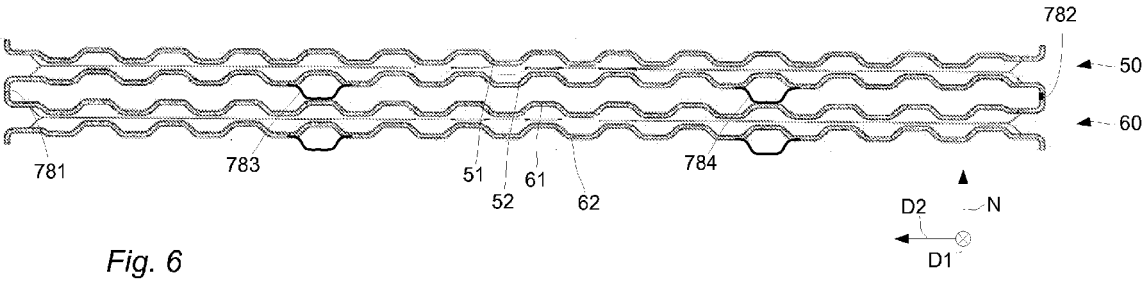

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 1423

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 462 421 A (PITT PAUL A) 22 February 1949 (1949-02-22) * column 2, line 47 - column 4, line 60; figures * -----	1-8, 10-14	INV. F28D9/00 F28F3/04
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 September 2011	Mootz, Frank

CATEGORY OF CITED DOCUMENTS

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