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(54) **HEAT TRANSFER PLATE, GASKET ARRANGEMENT, ASSEMBLY, CASSETTE AND HEAT EXCHANGER**

(57) A heat transfer plate (8, 8a), a gasket arrangement (72), an assembly (90), a cassette (57) and a heat exchanger (2) are provided. The heat transfer plate (8, 8a) comprises first, second, third and fourth portholes and a heat transfer area (46) provided with a heat transfer corrugation pattern comprising HT ridges (60) and HT valleys (62) extending in and between parallel first and second planes (P1, P2). The heat transfer plate (8, 8a) further comprises a gasket groove (68) comprising a field gasket groove portion (68a), a second ring gasket groove portion (68b) enclosing the second port hole (42) and a fourth ring gasket groove portion (68c) enclosing the fourth port hole (50). An annular second inner edge

(37) defines the second port hole (42). An annular second edge portion (58) encloses the second port hole (42) and extends between the second inner edge (37) and the second ring gasket groove portion (68b). The heat transfer plate is characterized in that the second edge portion (58) comprises annular concentric inner, intermediate and outer sections (58a, 58b, 58c). More than 50% of the inner section (58a) extends in the first plane (P1), and the outer section (58c) is provided with an outer corrugation pattern (61) comprising outer edge ridges (61a) and outer edge valleys (61b) which extend in and between the second plane (P2) and an imaginary third plane (P3) arranged between the first and second planes (P1, P2).

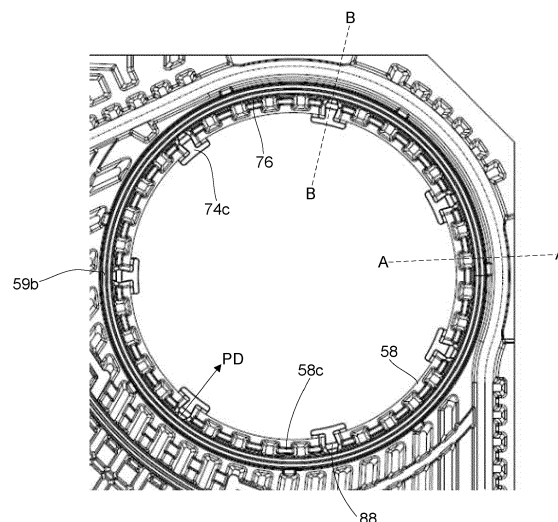


Fig. 7

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Description

Technical Field

[0001] The invention relates to a heat transfer plate, a gasket arrangement, an assembly comprising such a heat transfer plate and such a gasket arrangement, a cassette comprising two such heat transfer plates and a heat exchanger comprising a plurality of such heat transfer plates and a plurality of such gasket arrangements.

Background Art

[0002] Plate heat exchangers, PHEs, typically comprises two end plates in between which a number of heat transfer plates are arranged in an aligned manner, i.e. in a stack or pack. The heat transfer plates of a PHE may be stacked in different ways. In some PHEs, the heat transfer plates are stacked with the first side and the second side of one heat transfer plate facing the second side and the first side, respectively, of other heat transfer plates, and every other heat transfer plate turned upside down in relation to the rest of the heat transfer plates. In other words, every second one of the heat transfer plates is rotated 180 degrees, around its normal, in relation to the rest of the plates. Typically, this is referred to as the heat transfer plates being "rotated" in relation to each other. In other PHEs, the heat transfer plates are stacked with the first side and the second side of one heat transfer plate facing the first side and second side, respectively, of other heat transfer plates, and every other heat transfer plate turned upside down in relation to the rest of the heat transfer plates. In other words, every second one of the heat transfer plates is rotated 180 degrees, around its transverse center axis, in relation to the rest of the plates. Typically, this is referred to as the heat transfer plates being "flipped" in relation to each other. In other PHEs, the heat transfer plates are stacked with the first side and the second side of one heat transfer plate facing the first side and second side, respectively, of other heat transfer plates. In other words, every second one of the heat transfer plates is rotated 180 degrees, around its longitudinal center axis, in relation to the rest of the plates. Typically, this is referred to as the heat transfer plates being "turned" in relation to each other.

[0003] Typically, in PHEs, sealing means, such as gaskets or welds, or a combination of gaskets and welds, are arranged between the heat transfer plates. Further, the heat transfer plates comprise corrugations, such as corrugated or wave-shaped inner and outer edge portions, and the corrugations of each of the heat transfer plates abut corrugations of the adjacent heat transfer plates. The sealing means define parallel flow channels between the heat transfer plates, one channel between each pair of heat transfer plates. Two fluids of initially different temperatures can flow through every second channel for transferring heat from one fluid to the other.

[0004] The fluids enter and exit the channels through

inlet and outlet ports, respectively, which extend through the PHE and are formed by respective aligned port holes in the heat transfer plates and the sealing means which seal, completely or partly, around the port holes. The port holes in the heat transfer plates are typically defined by corrugated inner edge portions of the heat transfer plates, and the sealing means extending completely or partly around the port holes are typically arranged immediately outside the corrugated inner edge portions. The inlet and outlet ports communicate with inlets and outlets, respectively, of the PHE for feeding the fluids to and from the PHE.

[0005] As said above, in a PHE, corrugations of each of the heat transfer plates abut corrugations of the adjacent heat transfer plates while the sealing means seal between the heat transfer plates. For example, the corrugations of the inner edge portions of each of the heat transfer plates abut, in contact areas, the corrugations of the inner edge portions, respectively, of the adjacent heat transfer plates. Thereby, the inner edge portions of the heat transfer plates in the plate pack form a "honeycomb" pattern in the inlet and outlet ports, where the cells of the "honeycomb" pattern are gaps between the heat transfer plates formed outside the plate contact areas. Though these cells, any gaskets sealing, completely or partly, around the port holes, may be exposed to the fluids flowing through the inlets and outlet ports of the PHE. The turbulence in these fluids may cause leaching, and thus a shortened life time, of the gaskets. Also, leaching gasket material may contaminate the fluids in a way that may harm equipment connected to the PHE, for example compressors.

Summary

[0006] An object of the present invention is to provide a heat transfer plate arranged to protect a gasket which seals, completely or partly, around a port hole of the heat transfer plate, from the fluid flowing through the port hole to prevent leaching of the gasket. The basic concept of the invention is to provide the heat transfer plate with a plane section at an inner edge defining the port hole of the heat transfer plate, which plane section extends above a bottom of a gasket groove for receiving the gasket, to enable shielding of the gasket. Another object of the invention is to provide a gasket arrangement designed for optimum cooperation with the heat transfer plate. Yet another object of the invention is to provide an assembly comprising a heat transfer plate according to the invention and a gasket arrangement according to the invention. Yet other objects of the invention are to provide a cassette comprising two heat transfer plates according to the invention and a heat exchanger comprising a plurality of heat transfer plates and a plurality of gasket arrangements according to the invention. The heat transfer plate, which is also referred to herein as just "plate", the gasket arrangement, the assembly, the cassette and the heat exchanger are defined in the appended claims and dis-

cussed below.

[0007] A heat transfer plate according to the invention comprises an upper end part, a center part and a lower end part arranged in succession along a longitudinal center axis of the heat transfer plate. The upper end part comprises a first port hole and a second port hole. The lower end part comprises a third port hole and a fourth port hole. The center part comprises a heat transfer area provided with a heat transfer corrugation pattern which comprises HT ridges and HT valleys as seen from a first side of the heat transfer plate. The HT ridges and HT valleys extend in and between imaginary parallel first and second planes arranged on a distance D from each other. The first side of the heat transfer plate faces the first plane. An opposite second side of the heat transfer plate faces the second plane. As seen from the first side, the heat transfer plate further comprises a gasket groove. The gasket groove comprises a field gasket groove portion enclosing the heat transfer area and the first and third port holes, a second ring gasket groove portion enclosing the second port hole and a fourth ring gasket groove portion enclosing the fourth port hole. Along at least more than half of a length of the second ring gasket groove portion, a bottom of the second ring gasket groove portion extends in an imaginary gasket groove plane arranged on a distance d from the second plane, $0 \leq d < D$. An annular second inner edge defines the second port hole. An annular second edge portion encloses the second port hole and extends between the second inner edge and the second ring gasket groove portion. The heat transfer plate is characterized in that the second edge portion comprises annular concentric inner, intermediate and outer sections. The intermediate section encloses the inner section and is enclosed by the outer section. More than 50% of the inner section extends in the first plane. The outer section is provided with an outer corrugation pattern comprising outer edge ridges and outer edge valleys as seen from the first side of the heat transfer plate. The outer edge ridges and outer edge valleys extend in and between the second plane and an imaginary third plane, which third plane extends between the first and second planes.

[0008] Thus, more than 50%, more preferable more than 65%, of the inner section extends in the first plane. Even 100% of the inner section may extend in the first plane, but to enable for the second edge portion to cooperate smoothly with a gasket arrangement, it may be suitable to allow a certain percentage of the inner section to extend outside the first plane.

[0009] The first, second, third and fourth port holes may have any suitable form, such as a circular, curved triangular or oval form. Consequently, the second inner edge defining the second port hole, just like the second edge portion enclosing the second port hole, may have any suitable form. Thus, it should be noted that "annular", as used herein, not necessarily is "circular".

[0010] In that the inner section of the second edge portion of the heat transfer plate extends primarily in

the first plane, which is arranged above the gasket groove plane as seen from the first side of the heat transfer plate, it may contact another plate abutting the first side of the heat transfer plate. Thereby, the two plates may together enclose and shield a gasket arranged in the second ring gasket groove portion so as to protect it from turbulence in a fluid conveyed through the second port hole. Thereby, leaching of the gasket may be decreased, whereby the lifetime of the gasket may be prolonged and leaching residues in the fluid may be reduced. However, such an extension of the inner section of the second edge portion of the heat transfer may also create containments between the heat transfer plate and said another plate abutting the first side of the heat transfer plate. In these containments, fluid conveyed through the second port hole may be trapped, even when an attempt has been made to empty a PHE containing the two plates. Large amounts of fluid trapped like this could be problematic from a safety and corrosion point of view. In that the corrugations of the outer section of the second edge portion of the heat transfer plate extend below the first plane as seen from the first side of the heat transfer plate, they may be arranged at a distance from another plate abutting the first side of the heat transfer plate. Thereby, a channel linking together the containments may be formed between the two plates at the outer section of the second edge portion of the heat transfer plate, which channel can be used for conveying trapped fluid downwards, by gravity, when the PHE is to be emptied. Conveying the trapped fluid downwards causes forced draining of it from the containments, except for from the containments arranged closest to the ground where the remaining trapped fluid will be accumulated. This will result in a decreased total amount of trapped fluid inside the containments which may be advantageous from a safety and corrosion point of view.

[0011] Also the intermediate section may be provided with an intermediate corrugation pattern comprising intermediate edge ridges and intermediate edge valleys as seen from the first side of the heat transfer plate. The intermediate edge ridges and intermediate edge valleys may extend in and between the first and second planes. These intermediate edge ridges and valleys may improve the mechanical strength of the heat transfer plate around the second port hole. Also, these intermediate edge ridges and valleys of the heat transfer plate may abut adjacent plates in a plate pack and contribute to the rigidity of the plate pack.

[0012] At least a majority of the intermediate edge ridges and intermediate edge valleys may be aligned with a respective one of the outer edge ridges and outer edge valleys, respectively. In other words, each of the intermediate edge ridges may be an extension, with an increased maximum pressing height, of a respective one of the outer edge ridges, while each of the intermediate edge valleys may be an extension, with an unchanged maximum pressing depth, of a respective one of the outer edge valleys. Such a configuration may enable a me-

chanically straightforward design of the heat transfer plate.

[0013] The heat transfer plate may be such that the gasket groove plane extends between, possibly halfway between, the first and second planes.

[0014] The third plane may be arranged between the first plane and the gasket groove plane. Such a configuration may result in a sufficiently deep channel for conveying fluid and a plate which is still relatively straightforward to press and which still has sufficient space available for interaction with a gasket arrangement.

[0015] The inner section of the second edge portion of the heat transfer plate may extend on a distance from the second inner edge defining the second port hole. Alternatively, the inner section may comprise the second inner edge, i.e. extend all the way to the second inner edge of the heat transfer plate. This may enable a mechanically straight-forward design of the heat transfer plate. This may also facilitate manufacturing of the plate, especially when the second port hole is cut after pressing of the plate.

[0016] The heat transfer plate may further comprise, as seen from the first side, a fixing valley. The fixing valley may extend from the second ring gasket groove portion through the inner, intermediate and outer sections of the heat transfer plate. The fixing valley may be arranged to engage with an attachment means of a gasket arrangement which also comprises a second ring gasket portion. Thus, the provision of the fixing valley may enable fastening of a second ring gasket portion to the plate. In that the fixing valley extends through the inner, intermediate and outer sections, non-interfering (with other plates and gasket arrangements) engagement between the second inner edge of the plate and the attachment means may be enabled. One of the outer edge valleys, and if present, one of the intermediate edge valleys, may coincide with the fixing valley.

[0017] A bottom of the fixing valley may extend in one and the same plane, or in different planes, along its longitudinal extension. According to one embodiment of the invention, at least 50% of the bottom of the fixing valley extends in the second plane. Such a configuration may enable a mechanically straightforward design of the heat transfer plate.

[0018] Since the field gasket groove portion of the gasket groove of the heat transfer plate encloses the first and third port holes of the heat transfer plate, the first and third port holes are dedicated to one and the same fluid while the second and fourth port holes are dedicated to one and the same, and another, fluid. The first and third port holes, just like the second and fourth port holes, may be arranged on opposite sides of the longitudinal center axis of the heat transfer plate. Such a port hole placement may enable a heat transfer plate of so-called diagonal flow type, and a heat exchanger comprising heat transfer plates according to the invention which are "rotated" in relation to each other. However, such a heat exchanger typically demands gasket arrangements of two different

designs and it may also require heat transfer plates of two different designs. Alternatively, the first port hole and the third port hole may be arranged on one side of the longitudinal center axis of the heat transfer plate, while the second port hole and the fourth port hole may be arranged on another side of the longitudinal center axis of the heat transfer plate. Such a port hole placement may enable a heat transfer plate of so-called parallel flow type, and a heat exchanger comprising similar heat transfer plates according to the invention which are "flipped" in relation to each other.

[0019] The heat transfer plate may further comprise, as seen from the first side, a sealing groove. The sealing groove may comprise a field sealing groove portion enclosing the heat transfer area and the second and fourth port holes, a first ring sealing groove portion enclosing the first port hole and a third ring sealing groove portion enclosing the third port hole. Such a configuration may enable permanent joining of the heat transfer plate to another heat transfer plate, along the sealing groove, for instance by a weld extending within the sealing groove, to form a cassette.

[0020] The plate may be so designed that a bottom of the field sealing groove portion, along at least more than half of a length of the field sealing groove portion, extends in the second plane. Such a design may facilitate permanent joining of the heat transfer plate to another heat transfer plate, along the field sealing groove portion.

[0021] Further, the plate may be so designed that a bottom of the first ring sealing groove portion, along at least more than half of a length of the first ring sealing groove portion, and a bottom of the third ring sealing groove portion, along at least more than half of a length of the third ring sealing groove portion, extends in the second plane. Such a design may facilitate permanent joining of the heat transfer plate to another heat transfer plate, along the ring sealing groove portion(s).

[0022] A gasket arrangement according to the invention comprises a second ring gasket portion and an attachment means for fastening the second ring gasket portion to a heat transfer plate. The attachment means projects, in a projection direction, from an inner side of the second ring gasket portion. The attachment means comprises a connection member, a first finger, and a bridge. A first connection part of the connection member engages with the second ring gasket portion. A second connection part of the connection member engages with the bridge. A connection part of the first finger engages with the bridge. The first finger extends from the bridge towards the second ring gasket portion. The gasket arrangement is characterized in that the connection member comprises a recess in an upper surface thereof. The recess extends all the way across, i.e. from one long side to another long side of, the connection member and crosses, possibly perpendicularly, the projection direction.

[0023] The recess may be arranged for conveying a fluid such that a fluid may be fed past the attachment

means through the recess. The recess may thus prevent blocking of fluid passage past the attachment means, as will be further discussed below. The recess may be arranged in an intermediate or a center part of the connection member.

[0024] An assembly according to the invention comprises a heat transfer plate as described above and a gasket arrangement as described above. The second ring gasket portion of the gasket arrangement is accommodated in the second ring gasket groove portion of the heat transfer plate. The attachment means of the gasket arrangement engages with the second edge portion of the heat transfer plate. The recess of the connection member of the attachment means is at least partly aligned with the outer section of the second edge portion.

[0025] A cassette according to the invention comprises two heat transfer plates as described above. The second side of one of the two heat transfer plates faces the second side of another one of the two heat transfer plates. The two heat transfer plates are welded to each other, possibly along the sealing grooves.

[0026] Said another one of the two heat transfer plates may be rotated, in relation to said one of the two heat transfer plates, 180 degrees around a normal of said another one of the two heat transfer plates. In other words, one of the heat transfer plates may be "flipped" or rotated 180 degrees around its transverse center axis in relation to the other one of the heat transfer plates. Alternatively, said another one of the two heat transfer plates may be "turned" or rotated 180 degrees around the longitudinal center axis of said another one of the two heat transfer plates.

[0027] A heat exchanger according to the invention comprises a plurality of heat transfer plates according to the above. The heat exchanger further comprises a plurality of gaskets arrangements according to the above. Each of the gaskets arrangements is arranged in the gasket grooves of two adjacent ones of the heat transfer plates.

[0028] The heat transfer plates may be welded in pairs, second side to second side into cassettes. Further, each of the gasket arrangements may be arranged in the gasket grooves of two adjacent ones of the cassettes.

[0029] The above discussed advantages with the different embodiments of the heat transfer plate, and where applicable, the gasket arrangement, are naturally transferable to the assembly, the cassette and the heat exchanger according to the invention.

[0030] As a general remark, herein, when it is said that some portion, part, section, etc., of the heat transfer plate or gasket arrangement extends in a certain plane or direction, it is the main extension of the portion, part, section, etc. that is referred to. Naturally, a portion, part, section, etc., may locally have an extension deviating from the main extension, for example at a transition to another adjacent portion, part, section, etc.

[0031] It should be stressed that the above discussed advantages of the different embodiments of the heat

transfer plate, as well as the gasket arrangement, the assembly and the cassette, according to the invention appears first when the heat transfer plate, the gasket arrangement, the assembly and the cassette are arranged in a PHE together with other heat transfer plates, gasket arrangements, assemblies and cassettes (which possibly also are designed according to the present invention), and other components needed in a properly functioning PHE.

[0032] 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

[0033] The invention will now be described in more detail with reference to the appended schematic drawings, in which

Fig. 1 is a schematic front view of a heat exchanger according to the invention,

Fig. 2 is schematic side view of the heat exchanger in Fig. 1,

Fig. 3 is a plan view of a heat transfer plate according to the invention,

Fig. 4 is a plan view of a cassette and a gasket arrangement according to the invention,

Fig. 5 is an enlargement of a portion of the heat transfer plate in Fig. 3,

Fig. 6 is an enlargement of a portion of Fig. 5,

Fig. 7 is an enlargement of a portion of the cassette and the gasket arrangement in Fig. 4,

Fig. 8 is a cross section taken along line A-A in Fig. 7,

Fig. 9 is a cross section taken along line B-B in Fig. 7,

Fig. 10 is a perspective view of an attachment means of the gasket arrangement in Fig. 4,

Fig. 11 is a cross section of a part of a plate pack of the heat exchanger in Fig. 1,

Fig. 12a is an enlargement of a portion of a cassette and a gasket arrangement corresponding to Fig. 7 but for an alternative embodiment of the gasket arrangement,

Fig. 12b illustrates the gasket arrangement in Fig. 12a separately,

Fig. 13 is a cross section of a part of an assembly according to the invention, and

Fig. 14 is a cross section of a part of a plate pack of a gasketed heat exchanger.

Detailed description

[0034] Figs. 1 and 2 show a semi-welded plate heat exchanger 2. It comprises a frame plate 4, a pressure plate 6, a pack of heat transfer plates 8, fluid inlets and outlets 10, tightening means 12, an upper bar 14 and a lower bar 16.

[0035] At least a majority of the heat transfer plates 8, hereinafter also referred to as just "plates", are all similar.

As will be further discussed below, the plates 8 are welded in pairs, second side to second side, to form tight cassettes, with gaskets arranged between the cassettes. The frame and pressure plates 4 and 6, and therefore the cassettes, are pressed towards each other by the tightening means 12 whereby the gaskets seal between the cassettes. Parallel flow channels are formed between the heat transfer plates 8, one channel between each pair of adjacent heat transfer plates 8. Two fluids of initially different temperatures, which are fed to/from the plate heat exchanger 2 through the fluid inlets and outlets 10, can flow alternately through every second channel for transferring heat from one fluid to the other, which fluids enter/exit the channels through inlet/outlet port holes in the heat transfer plates 8, which inlet/outlet port holes form inlet/outlet ports which communicate with the fluid inlets and outlets 10 of the plate heat exchanger 2.

[0036] One of the plates 8 of the plate heat exchanger 2, denoted 8a, is illustrated in further detail in Fig. 3. The plate 8a is an essentially rectangular sheet of stainless steel. It comprises first and second opposing long sides 18, 20 and first and second opposing short sides 22, 24. Further, the plate 8a has a longitudinal center axis L extending parallel to, and halfway between, the long sides 18, 20 so as to divide the plate 8a into a first half 19 and a second half 21. The plate 8a further has a transverse center axis T extending parallel to, and halfway between, the short sides 22, 24 and thus perpendicular to the longitudinal center axis L.

[0037] The plate 8a has a first side 30 (illustrated in inter alia Figs. 3, 5, 8 and 9) and an opposing second side 32 (illustrated in Figs. 8 and 9). Further, the plate 8a comprises an upper end part 34, a center part 36 and a lower end part 38 arranged in succession along the longitudinal center axis L of the heat transfer plate 8a. The upper end part 34 comprises a first port hole 40, a second port hole 42, a first adiabatic area 39, a second adiabatic area 41 and an upper distribution area 44. The center part 36 comprises an upper transition area 45, a heat transfer area 46 and a lower transition area 53. The lower end part 38 comprises a third port hole 48, a fourth port hole 50, a third adiabatic area 49, a fourth adiabatic area 51 and a lower distribution area 52. The first and third port holes 40 and 48 are arranged on one side of the longitudinal center axis L while the second and the fourth port holes 42 and 50 are arranged on the other side of the longitudinal center axis L.

[0038] The heat transfer plate 8a is pressed, in a conventional manner, in a pressing tool, to be given a desired structure, such as different corrugation patterns within different portions of the heat transfer plate. The corrugation patterns are optimized for the specific functions of the respective plate portions. Accordingly, the upper and lower distribution areas 44 and 52 each comprises a distribution corrugation pattern adapted for optimized fluid distribution across the heat transfer plate 8a. Further, the heat transfer area 46 comprises a heat transfer corrugation pattern adapted for optimized heat

transfer between two fluids flowing on opposite sides of the heat transfer plate 8a. The heat transfer corrugation pattern is of so-called herringbone type. As seen from the first side 30 of the plate 8a, it comprises alternately arranged elongate HT ridges 60 and HT valleys 62 extending in and between an imaginary first plane P1 (Fig. 8) facing the first side 30 of the plate 8a and an imaginary second plane P2 (Fig. 8) facing the second side 32 of the plate 8a. The first and second planes P1 and P2 are separated by a distance D. The upper and lower transition areas 45 and 53 comprises a transition corrugation pattern adapted for an optimized combination of strength and fluid distribution. Furthermore, the first, second, third and fourth adiabatic areas 39, 41, 49 and 51 each comprises a corrugation pattern adapted to convey fluid between the port holes and the distribution areas with the lowest possible pressure drop. Further, the plate 8a comprises, along an outer edge 54 thereof, corrugations 56 extending in and between the first and second planes P1 and P2. Corrugations are also provided along port hole defining inner edges of the plate 8a, as will be further discussed below.

[0039] With reference to Fig. 3, pressed into the plate 8a, as seen from the first side 30 of the plate, is a sealing groove 64 comprising a field sealing groove portion 64a, a first ring sealing groove portion 64b and a third ring sealing groove portion 64c. The sealing groove 64 is illustrated with lines in Fig. 3. The field sealing groove portion 64a encloses the heat transfer area 46, the upper and lower transition areas 45 and 53, the upper and lower distribution areas 44 and 52, the second and fourth adiabatic areas 41 and 51, and the second and fourth port holes 42 and 50. A bottom 66a of the field sealing groove portion 64a extends in the second plane P2 (Fig. 8) along the complete length of the field sealing groove portion 64a. The first ring sealing groove portion 64b encloses the first port hole 40. A bottom 66b of the first ring sealing groove portion 64b extends in the second plane P2 along the complete length of the first ring sealing groove portion 64b. The third ring sealing groove portion 64c encloses the third port hole 48. A bottom 66c of the third ring sealing groove portion 64c extends in the second plane P2 along the complete length of the third ring sealing groove portion 64c.

[0040] Further, with reference to Figs. 3, 4 and 7, pressed into the plate 8a, as seen from the first side 30 of the plate, is also a gasket groove 68 for receiving a gasket 59. The gasket groove 68 comprises a field gasket groove portion 68a, a second ring gasket groove portion 68b and a fourth ring gasket groove portion 68c. The field gasket groove portion 68a encloses the heat transfer area 46, the upper and lower transition areas 45 and 53, the upper and lower distribution areas 44 and 52, the first and third adiabatic areas 39 and 49, and the first and third port holes 40 and 48. The field gasket groove portion 68a partly coincides with the field sealing groove portion 64a. Therefore, a bottom 70a of the field gasket groove portion 68a extends in the second plane P2 (Fig. 8) where

the field gasket groove portion 68a coincides with the field sealing groove portion 64a. In fact, the bottom 70a of the field gasket groove portion 68a extends in the second plane P2 everywhere except for at two diagonal sections 68a' of the field gasket groove portion 68a along which the bottom 70a extends between, possibly approximately halfway between, the first plane P1 and the second plane P2 (**Sant?**). The second ring gasket groove portion 68b encloses the second port hole 42. A bottom 70b of the second ring gasket groove portion 68b extends in a gasket groove plane GP (Fig. 8) arranged on a distance d , $0 \leq d < D$, from the second plane P2. Here, the gasket groove plane GP is arranged between the first plane P1 and the second plane P2 along the complete length of the second ring gasket groove portion 68b. Further, here, the gasket groove plane GP is arranged slightly closer to the first plane P1 than to the second plane P2. The fourth ring gasket groove portion 68c encloses the fourth port hole 50. A bottom 70c of the fourth ring gasket groove portion 68c extends in the gasket groove plane GP along the complete length of the fourth ring gasket groove portion 68c.

[0041] With reference to Figs. 5, 6 and 8, the plate 8a comprises an annular second edge portion 58 extending around the second port hole 42 and between an annular second inner edge 37 defining the second port hole 42 and the second ring gasket groove portion 68b of the gasket groove 68. The second edge portion 58 comprises an annular inner section 58a which includes the second inner edge 37, an annular intermediate section 58b enclosing the inner section 58a and an annular outer section 58c enclosing the intermediate section 58b. The inner, intermediate and outer sections 58a, 58b and 58c are concentric and the borders between them are illustrated with dashed lines in Figs. 6 and 8. As seen from the first side 30 of the plate 8a, the outer section 58c is provided with an outer corrugation pattern 61 comprising alternately arranged outer edge ridges 61a and outer edge valleys 61b. As is illustrated in Fig. 8, the outer edge ridges and valleys 61a and 61b extend in and between the second plane P2 and an imaginary third plane P3 which extends between the gasket groove plane GP and the first plane P1. Further, again as seen from the first side 30 of the plate 8a, the intermediate section 58b is provided with an intermediate corrugation pattern 63 comprising alternately arranged intermediate edge ridges 63a and intermediate edge valleys 63b. As is illustrated in Fig. 8, the intermediate edge ridges and valleys 63a and 63b extend in and between the first plane P1 and the second plane P2. As is clear from Figs. 5 and 6, each of the outer edge ridges 61a and outer edge valleys 61b is aligned, and integrally formed, with a respective one of the intermediate edge ridges 63a and intermediate edge valleys 63b, respectively. With reference also to Fig. 9, the plate 8a further comprises, as seen from the first side 30, a plurality of, here seven, fixing valleys 65 which are equidistantly arranged along the second inner edge 37. Each of the fixing valleys 65

extends, essentially perpendicular to the second inner edge 37, from the second ring gasket groove portion 68b through the complete outer, intermediate and inner sections 58c, 58b and 58a of the second edge portion 58. A respective one of the outer edge valleys 61b and a respective one of the intermediate edge valleys 63b coincide with each one of the fixing valleys 65. Further, a respective bottom 67 of the fixing valleys 65 extends in the second plane P2. Outside or between the fixing valleys 65, the inner section 58a of the second edge portion 58 extends in the first plane P1.

[0042] Further, the plate 8a comprises an annular first edge portion extending around the first port hole 40 and between an annular first inner edge defining the first port hole 40 and the first ring sealing groove portion 64b of the sealing groove 64. This first edge portion comprises corrugations arranged to abut corrugations of adjacent plates in the plate pack of the heat exchanger. However, this is not described in further detail herein.

[0043] The plate 8a also comprises annular third and fourth edge portions which are mirrorings, along the transverse center axis T of the plate 8a, of the first and second edge portions. Therefore, the above descriptions of the first and second edge portions are transferable to the third and fourth edge portions.

[0044] For the sake of order it should be said that the HT ridges and valleys 60 and 62 are arranged to abut HT ridges and valleys of the adjacent plates in the plate pack of the plate heat exchanger 2. Also the distribution and transition corrugation patterns comprise corrugations arranged to abut corrugations of the adjacent plates in the plate pack of the plate heat exchanger 2.

[0045] With reference to Figs. 3, 4, 7 and 10, the gasket 59 is comprised in a gasket arrangement 72 further comprising a plurality of attachment means 74 for fastening the gasket 59 to the plate 8a. The gasket 59 comprises a field gasket portion 59a arranged to be received in the field gasket groove portion 68a of the plate 8a, a second ring gasket portion 59b arranged to be received in the second ring gasket groove portion 68b of the plate 8a, and a fourth ring gasket portion 59c arranged to be received in the fourth ring gasket groove portion 68c of the plate 8a. The attachment means 74 comprises different types of attachment means; attachment means 74a, attachment means 74b and attachment means 74c. The attachment means 74a are provided on an outside of the field gasket portion 59a and arranged to engage with the outer edge 54 of the plate 8a, while the attachment means 74b are provided on an inside of the field gasket portion 59a and arranged to engage with inner edges of the plate 8a, which inner edges define the first and third port holes 40 and 48 of the plate 8a. In the following description of the attachment means 74, focus will be on the seven attachment means 74c connected to the second ring gasket portion 59b.

[0046] As is illustrated in Fig. 7, each of the attachment means 74c projects, in a projection direction PD, perpendicularly from, and are essentially equidistantly ar-

ranged along, an inner side 76 of the gasket 59, or, more particularly, the second ring gasket portion 59b thereof. One of the attachment means 74c is illustrated in more detail in Fig. 10. It comprises a bridge 78, a connection member 80, a first finger 82 and a second finger 84. A first connection part 80a of the connection member 80 engages with the second ring gasket portion 59b of the gasket 59, while a second connection part 80b of the connection member 80 engages with the bridge 78. Thereby, the connection member 80 connects the bridge 78 and the gasket 59. Further, a connection part 82a of the first finger 82 engages with the bridge 78 while a connection part 84a of the second finger 84 engages with the bridge 78. The first and second fingers 82 and 84 are arranged on opposite sides of the connection member 80 and extend from the bridge 78 towards the second ring gasket portion 59b. With special reference to Figs. 9 and 10, an intermediate part of the connection member 80 has a reduced thickness. Thereby, the connection member 80 comprises, in an upper surface 86 thereof, a recess 88 which extends, essentially perpendicular to a longitudinal extension, and the projection direction PD, of the connection element 80, all the way from one long side to another long side of the connection element 80.

[0047] The fourth ring gasket portion 59c and the attachment means connected thereto have a configuration similar to the above described.

[0048] The attachment means 74a and 74b are configured essentially like the attachment means 74c except for that the attachment means 74a and 74b lack a recess in an upper surface.

[0049] With reference to Figs. 4, 5, 7 and 10, the connection member 80 of each of the attachment means 74c is arranged to be received in a respective one of the fixing valleys 65 so as to engage with the first side 30 of the plate 8a. When the connection member 80 is correctly positioned in the respective one of the fixing valleys 65, the recess 88 will be aligned with the outer section 58c of the of the second edge portion 58. The first and second fingers 82 and 84 of the attachment means 74c are arranged to engage with the second side 32 of the plate 8a. Thus, when the gasket arrangement 72 cooperates properly with the plate 8a, the attachment means 74c will "pinch" the second edge portion 58 of the plate 8a to fasten the gasket 59 to the plate 8a.

[0050] In the plate pack of the plate heat exchanger 2, the plates 8 are arranged with the first side 30 and the second side 32 of one plate 8 facing the first side and the second side, respectively, of the neighboring heat transfer plates. Further, every second plate 8 is turned upside-down or rotated 180 degrees, in relation to a reference orientation, around a normal direction N which is normal to the figure plane of Fig. 3. In other words, every second plate 8 is "flipped", i.e. rotated 180 degrees around its transverse center axis T, in relation to the rest of the plates.

[0051] As mentioned above, the plates 8 of the plate pack are welded together in pairs, second side 32 to

second side 32, along their respective sealing grooves 64, to form cassettes 57. Fig. 4 shows one of the cassettes 57' comprising the plate 8a illustrated in Fig. 3 and the plate 8b visible in Figs. 8-9. The plate 8b is "flipped" in relation to the plate 8a. With reference also to Fig. 11, in the plate pack of the plate heat exchanger 2, the welded cassettes 57 are separated by the gaskets of the gasket arrangements. Thus, the heat exchanger 2 comprises channels of two different types; welded channels inside the cassettes 57 and gasketed channels between the cassettes 57. As is clear from Fig. 11, in the plate pack, the plate 8a of the cassette 57' and a plate 8c (also configured as described above) of a cassette 57" are separated by the gasket 59 comprised in the previously described gasket arrangement 72 (Fig. 10), which "pinches" the plate 8a in the above discussed way. Arranged like that, the inner section 58a of the second edge portion 58 of the plate 8a will, between the fixing valleys 65 (Fig. 5), abut the inner section of the fourth edge portion of the plate 8c. Thereby, the inner sections of the second and fourth edge portions of the plates 8a and 8c will, between the fixing valleys, enclose, and protect from fluid turbulence, the second ring gasket portion 59b. When the heat exchanger 2 is emptied, for example to enable maintenance of it, fluid trapped between the second and fourth edge portions of the plates 8a and 8c is conveyed downwards, by gravity, via a route R defined by the outer sections of the second and fourth edge portions of the plates 8a and 8c and the recesses 88 in the connection members 80 of the attachment means 74c (Figs. 7 and 10) arranged on the inside of the second ring gasket portion 59b. The fluid conveyed downwards is forced into the port holes surrounded by the second and fourth edge portions and out of the heat exchanger 2. After emptying, only a relatively small amount of fluid will be left within the lowermost parts of the second and fourth edge portions of the plates 8a and 8c which is advantageous from a safety and corrosion point of view.

[0052] In the plate pack of the plate heat exchanger 2, the configuration around the fourth port hole 50 of the plate 8a and the second port hole 42 of the plate 8c will be as described above. As regards the areas around the first and third port holes of the plates 8a and 8c, the plates are welded in these areas why the problems to be solved by the present invention are not present for these areas.

[0053] Thus, in accordance with the present invention, the ring gasket portions of a gasket arrangement is shielded, from fluid turbulence, by the heat transfer plates between which the gasket arrangement is positioned. This is achieved by having the heat transfer plates abutting each other around the port holes enclosed by the ring gasket portions such that the heat transfer plates enclose the ring gasket portions. However, this enclosure may result in fluid being trapped between the plates. By reducing the pressing depth locally within the outer sections of two of the edge portions of the plates, and by the provision of a recess in the connection member of the attachment means of the gasket arrangement, trapped

fluid may be drained from between the plates. Some fluid may, however, remain at the "bottoms" of the port holes of the plates. To avoid this, the gasket arrangement may be configured as is illustrated in Figs. 12a and 12b. The gasket arrangement in Figs. 12a and 12b comprises diametrically arranged nobs projecting from an inner side of the ring gasket portions. These nobs are arranged to be positioned at the "bottom" and "top" of the port holes so as to prevent accommodation of fluid in these areas irrespective of orientation ("upright" or "upside down") of the heat transfer plates.

[0054] In the so far described embodiments, the invention has been applied in a semi-welded heat exchanger. However, the invention can also be applied in a so-called gasketed heat exchanger wherein all channels are gasketed channels, and a gasket arrangement is arranged between each adjacent two of the plates. Fig. 13 illustrates an assembly 90 for a gasketed plate heat exchanger comprising a heat transfer plate 8a and a gasket arrangement 72. Fig. 14 illustrates the assembly 90 in cooperation with another heat transfer plate 8c in a plate pack. The heat transfer plate 8a illustrated in Fig. 13 is to a large extent configured as described above. However, it is not arranged to be welded to another plate which necessitates some differences which are not discussed herein. Another difference between the heat transfer plate illustrated in Fig. 13 and the previously described plates is that the gasket groove plane GP, in which the bottom 70b of the second ring gasket groove portion 68b for accommodating the second ring gasket portion 59b extends, is arranged halfway between the first and the second planes P1 and P2. As regards the gasket arrangement 72 illustrated in Fig. 13 this is configured essentially as the above described gasket arrangement. Accordingly, inter alia, it comprises an attachment means 74c (not visible in Fig. 13 but designed as illustrated in Fig. 10) engaging with the second edge portion 58 of the plate 8a and comprising a recess 88 in the connection member 80 aligned with the outer section 58c of the second edge portion 58 of the plate 8a. When the invention is applied in a gasketed plate heat exchanger, the same advantages as regards gasket shielding and fluid drainage may be obtained as when the invention is applied in a semi-welded heat exchanger.

[0055] The above described embodiments of the present invention should only be seen as examples. A person skilled in the art realizes that the embodiments discussed can be varied and combined in a number of ways without deviating from the inventive conception.

[0056] The plate heat exchanger above comprises one plate type only. Naturally, the plate heat exchanger could instead comprise two or more different types of alternately arranged heat transfer plates. Further, the heat transfer plates could be made of other materials than stainless steel.

[0057] The bottom of the field gasket groove portion need not extend as defined above but may have other extensions. As an example, the bottom of the field gasket

groove portion may extend between, possibly halfway between, the first and second planes along the complete length of the field gasket groove portion. As another example, the bottom of the field gasket groove portion may extend in the second plane along the complete length of the field gasket groove portion. Further, the gasket groove plane may extend halfway between the first and second planes. Alternatively, the gasket groove plane may coincide with the second plane. Thus, the bottom of the gasket groove may extend in the second plane along the complete length of the gasket groove.

[0058] The present invention is not limited to plates being arranged to be "flipped" in relation to each other. It is also applicable for plates arranged to be "rotated" in relation to each other. As a third alternative, every second plate in a plate pack may also be rotated, in relation to the rest of the plates, 180 degrees around its longitudinal center axis.

[0059] The attachment means of the gasket arrangements need not be designed as illustrated in the figures but may have any suitable design. For example, the attachment means may comprise more than one connection member, and/or less than, or more than, two fingers. The attachment means may even lack fingers and the connection member(s) may be arranged to interlock with the fixing valley(s) of the plate.

[0060] It should be stressed that the attributes front, back, upper, lower, first, second, third, etc. is used herein just to distinguish between details and not to express any kind of orientation or mutual order between the details.

[0061] Further, it should be stressed that a description of details not relevant to the present invention has been omitted and that the figures are just schematic and not drawn according to scale. It should also be said that some of the figures have been more simplified than others. Therefore, some components may be illustrated in one figure but left out on another figure.

Claims

1. A heat transfer plate (8, 8a) comprising an upper end part (34), a center part (36) and a lower end part (38) arranged in succession along a longitudinal center axis (L) of the heat transfer plate (8, 8a), the upper end part (34) comprising a first port hole (40) and a second port hole (42) and the lower end part (38) comprising a third port hole (48) and a fourth port hole (50), the center part (36) comprising a heat transfer area (46) provided with a heat transfer corrugation pattern comprising HT ridges (60) and HT valleys (62) as seen from a first side (30) of the heat transfer plate (8, 8a), which HT ridges (60) and HT valleys (62) extend in and between imaginary parallel first and second planes (P1, P2) arranged on a distance D from each other, the first side (30) of the heat transfer plate (8, 8a) facing the first plane (P1) and an opposite second side (32) of the heat transfer

- plate (8, 8a) facing the second plane (P2), the heat transfer plate (8, 8a) further comprising, as seen from the first side (30), a gasket groove (68) comprising a field gasket groove portion (68a) enclosing the heat transfer area (46) and the first and third port holes (40, 48), a second ring gasket groove portion (68b) enclosing the second port hole (42) and a fourth ring gasket groove portion (68c) enclosing the fourth port hole (50), a bottom (70b) of the second ring gasket groove portion (68b), along at least more than half of a length of the second ring gasket groove portion (68b), extending in an imaginary gasket groove plane (GP) arranged on a distance d from the second plane, $0 \leq d < D$, an annular second inner edge (37) defining the second port hole (42), an annular second edge portion (58) enclosing the second port hole (42) and extending between the second inner edge (37) and the second ring gasket groove portion (68b), **characterized in that** the second edge portion (58) comprises annular concentric inner, intermediate and outer sections (58a, 58b, 58c), the intermediate section (58b) enclosing the inner section (58a) and being enclosed by the outer section (58c), wherein more than 50% of the inner section (58a) extends in the first plane (P1), and wherein the outer section (58c) is provided with an outer corrugation pattern (61) comprising outer edge ridges (61a) and outer edge valleys (61b) as seen from the first side (30) of the heat transfer plate (8, 8a), which outer edge ridges (61a) and outer edge valleys (61b) extend in and between the second plane (P2) and an imaginary third plane (P3), which third plane (P3) extends between the first and second planes (P1, P2).
2. A heat transfer plate (8, 8a) according to claim 1, wherein the intermediate section (58b) is provided with an intermediate corrugation pattern (63) comprising intermediate edge ridges (63a) and intermediate edge valleys (63b) as seen from the first side (30) of the heat transfer plate (8, 8a), which intermediate edge ridges (63a) and intermediate edge valleys (63b) extend in and between the first and second planes (P1, P2).
 3. A heat transfer plate (8, 8a) according to claim 2, wherein at least a majority of the intermediate edge ridges (63a) and intermediate edge valleys (63b) are aligned with a respective one of the outer edge ridges (61a) and outer edge valleys (61b), respectively.
 4. A heat transfer plate (8, 8a) according to any of the preceding claims, wherein the gasket groove plane (GP) extends between the first and second planes (P1, P2).
 5. A heat transfer plate (8, 8a) according to any of the preceding claims, wherein the third plane (P3) is arranged between the first plane (P1) and the gasket groove plane (GP).
 6. A heat transfer plate (8, 8a) according to any of the preceding claims, wherein the inner section (58a) of the second edge portion (58) of the heat transfer plate (8, 8a) comprises the second inner edge (37) defining the second port hole (42).
 7. A heat transfer plate (8, 8a) according to any of the preceding claims, further comprising, as seen from the first side (30), a fixing valley (65) extending from the second ring gasket groove portion (68b) through the inner, intermediate and outer sections (58a, 58b, 58c) of the heat transfer plate (8, 8a).
 8. A heat transfer plate (8, 8a) according to claim 7, wherein at least 50% of a bottom (71) of the fixing valley (65) extends in the second plane (P2).
 9. A heat transfer plate (8, 8a) according to any of the preceding claims, wherein the first port hole (40) and the third port hole (48) are arranged on one side of the longitudinal center axis (L) of the heat transfer plate (8, 8a), and the second port hole (42) and the fourth port hole (50) are arranged on another side of the longitudinal center axis (L) of the heat transfer plate (8, 8a).
 10. A heat transfer plate (8, 8a) according to any of the preceding claims, further comprising, as seen from the first side (30), a sealing groove (64) comprising a field sealing groove portion (64a) enclosing the heat transfer area (46) and the second and fourth port holes (42, 50), a first ring sealing groove portion (64b) enclosing the first port hole (40) and a third ring sealing groove portion (64c) enclosing the third port hole (48).
 11. A heat transfer plate (8, 8a) according to claim 10, wherein a bottom (66a) of the field sealing groove portion (64a), along at least more than half of a length of the field sealing groove portion (64a), extends in the second plane (P2), and/or a bottom (66b) of the first ring sealing groove portion (64b), along at least more than half of a length of the first ring sealing groove portion (64b), extends in the second plane (P2), and/or a bottom (66c) of the third ring sealing groove portion (64c), along at least more than half of a length of the third ring sealing groove portion (64c), extends in the second plane (P2).
 12. A gasket arrangement (72) comprising a second ring gasket portion (59b) and an attachment means (74c) for fastening the second ring gasket portion (59b) to a heat transfer plate (8, 8a), wherein said attachment means (74c) projects, in a projection direction (PD), from an inner side (76) of the second ring gasket

portion (59b) and comprises a connection member (80), a first finger (82), and a bridge (78), a first connection part (80a) of the connection member (80) engaging with the second ring gasket portion (59b), a second connection part (80b) of the connection member (80) engaging with the bridge (78), a connection part (82a) of the first finger (82) engaging with the bridge (78), the first finger (82) extending from the bridge (78) towards the second ring gasket portion (59b), **characterized in that** the connection member (80) comprises a recess (88) in an upper surface (86) thereof, which recess (88) extends all the way across the connection member (80) and crosses the projection direction (PD).

13. An assembly (90) comprising a heat transfer plate (8, 8a) according to any of claims 1-11 and a gasket arrangement (72) according to claim 12, wherein the second ring gasket portion (59b) is accommodated in the second ring gasket groove portion (68b) and said attachment means (74c) engages with the second edge portion (58), wherein the recess (88) of the connection member (80) is at least partly aligned with the outer section (58c) of the second edge portion (58).
14. A cassette (57) comprising two heat transfer plates (8, 8a) according to any of the claims 1-11, wherein the second side (32) of one of the two heat transfer plates (8, 8a) faces the second side (32) of another one of the two heat transfer plates (8, 8a) and the two heat transfer plates (8, 8a) are welded to each other.
15. A heat exchanger (2) comprising a plurality of heat transfer plates (8, 8a) according to any of the claims 1-11 and a plurality of gaskets arrangements (72) according to claim 12, wherein each of the gasket arrangements is arranged in the gasket grooves (68) of two adjacent ones of the heat transfer plates (8, 8a).

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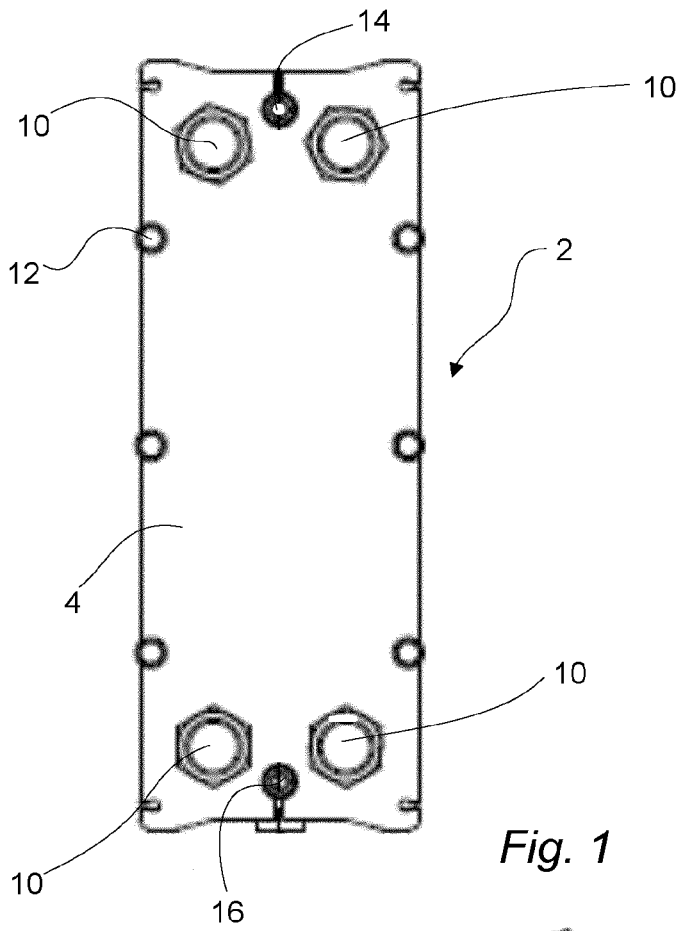


Fig. 1

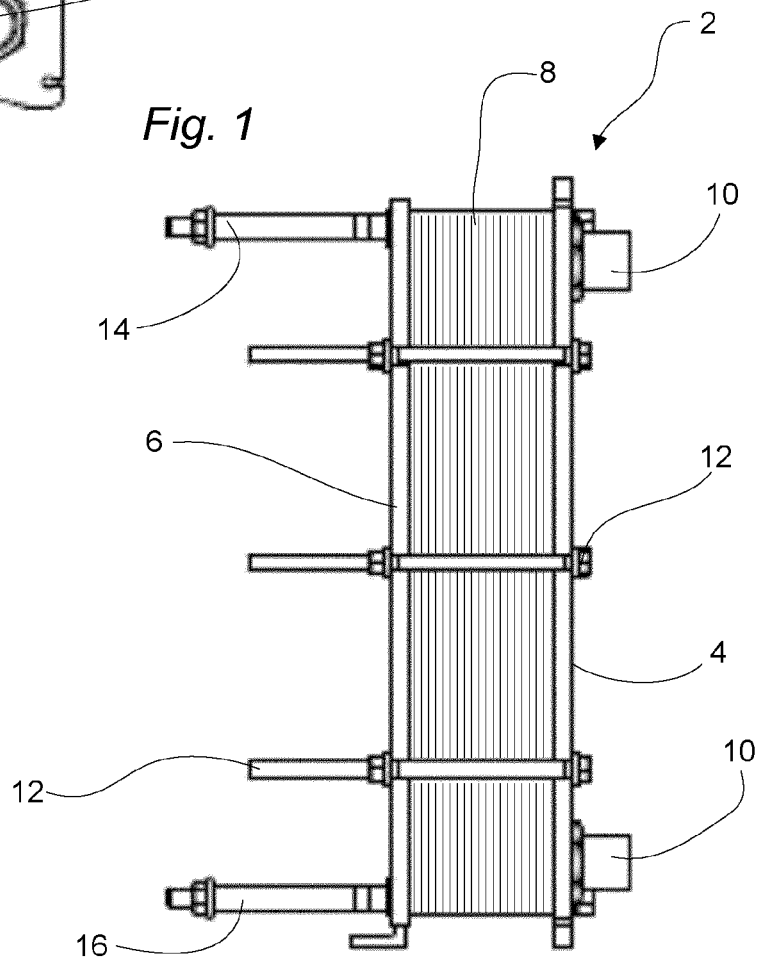
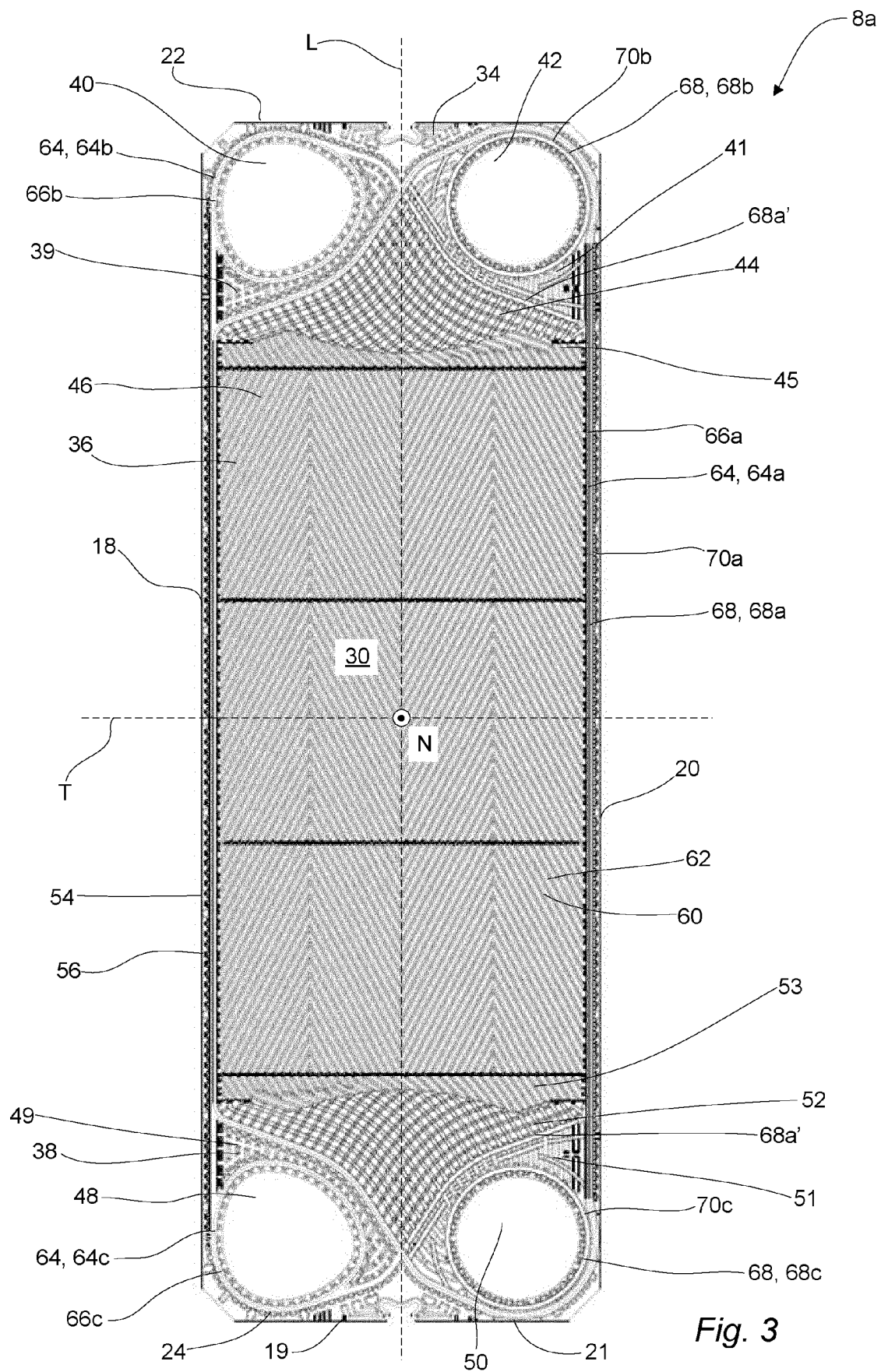


Fig. 2



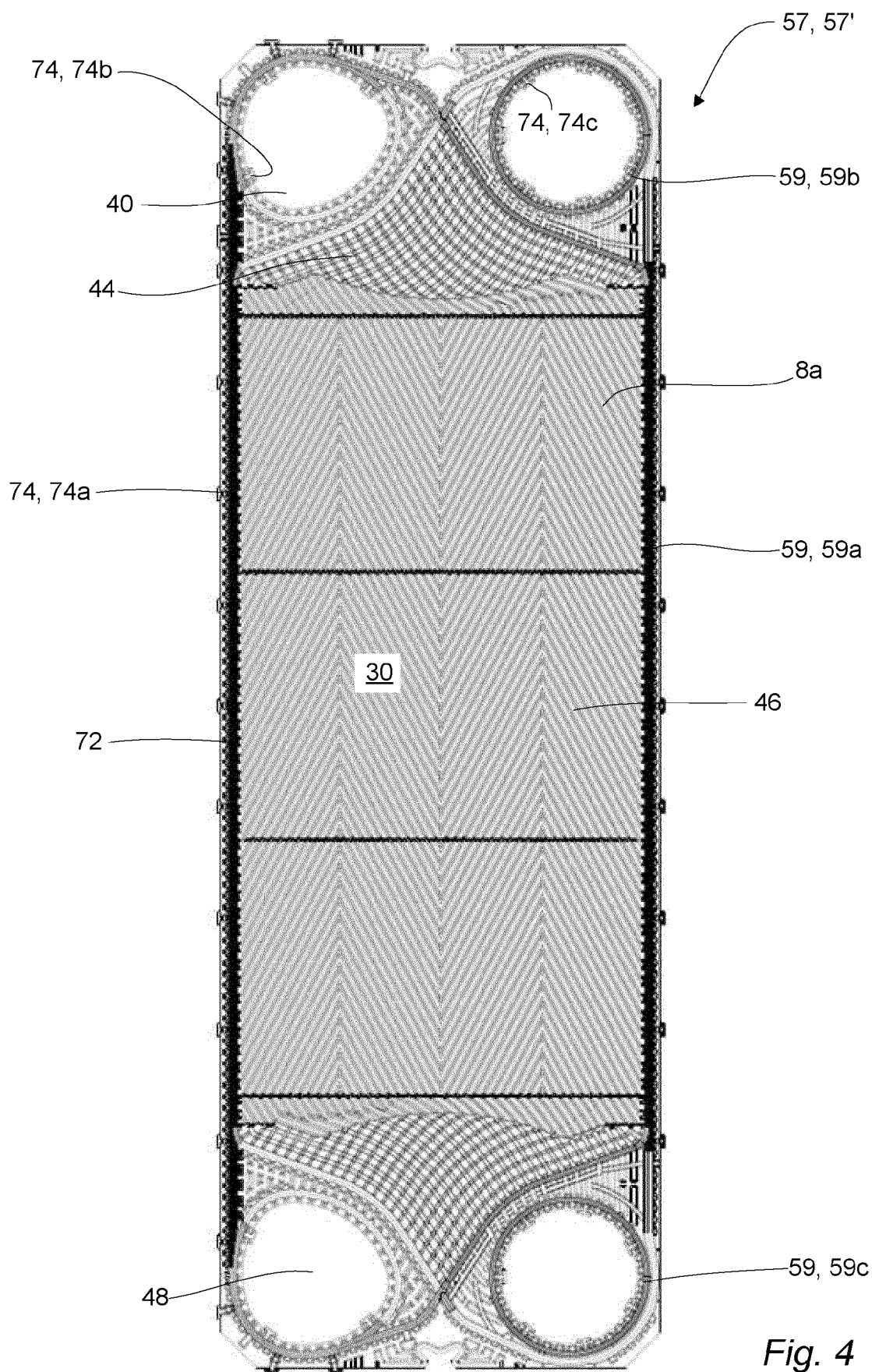


Fig. 4

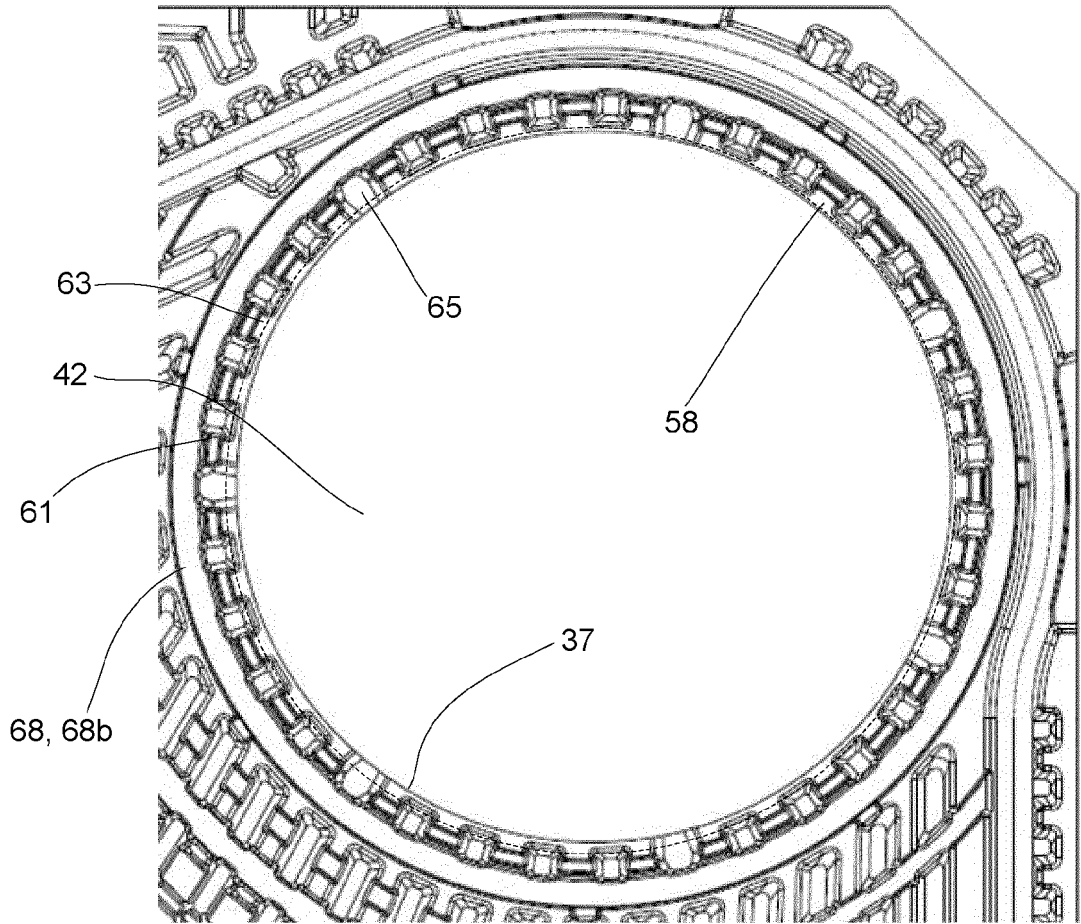


Fig. 5

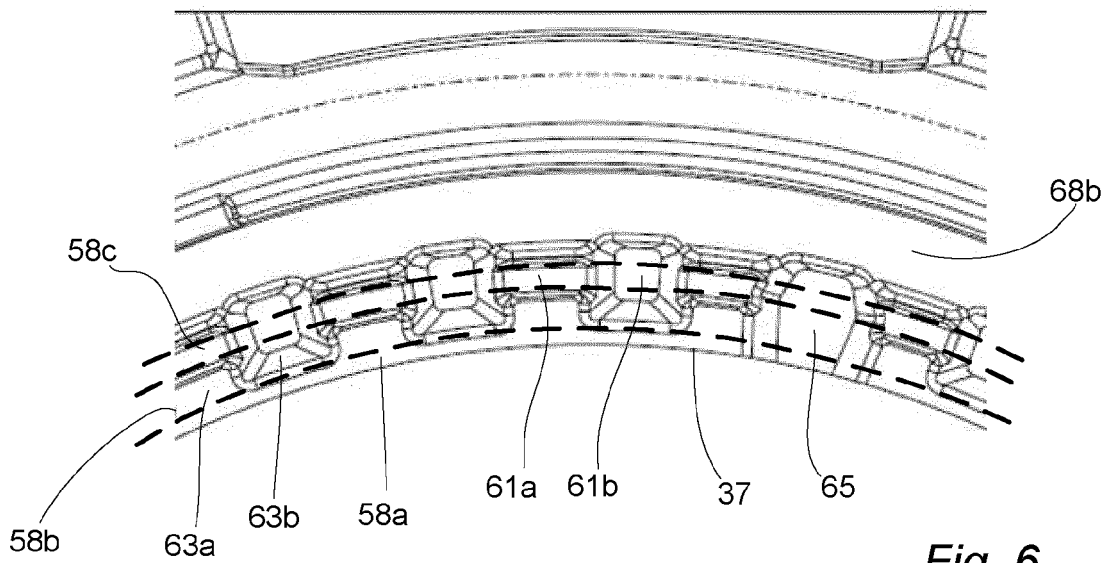


Fig. 6

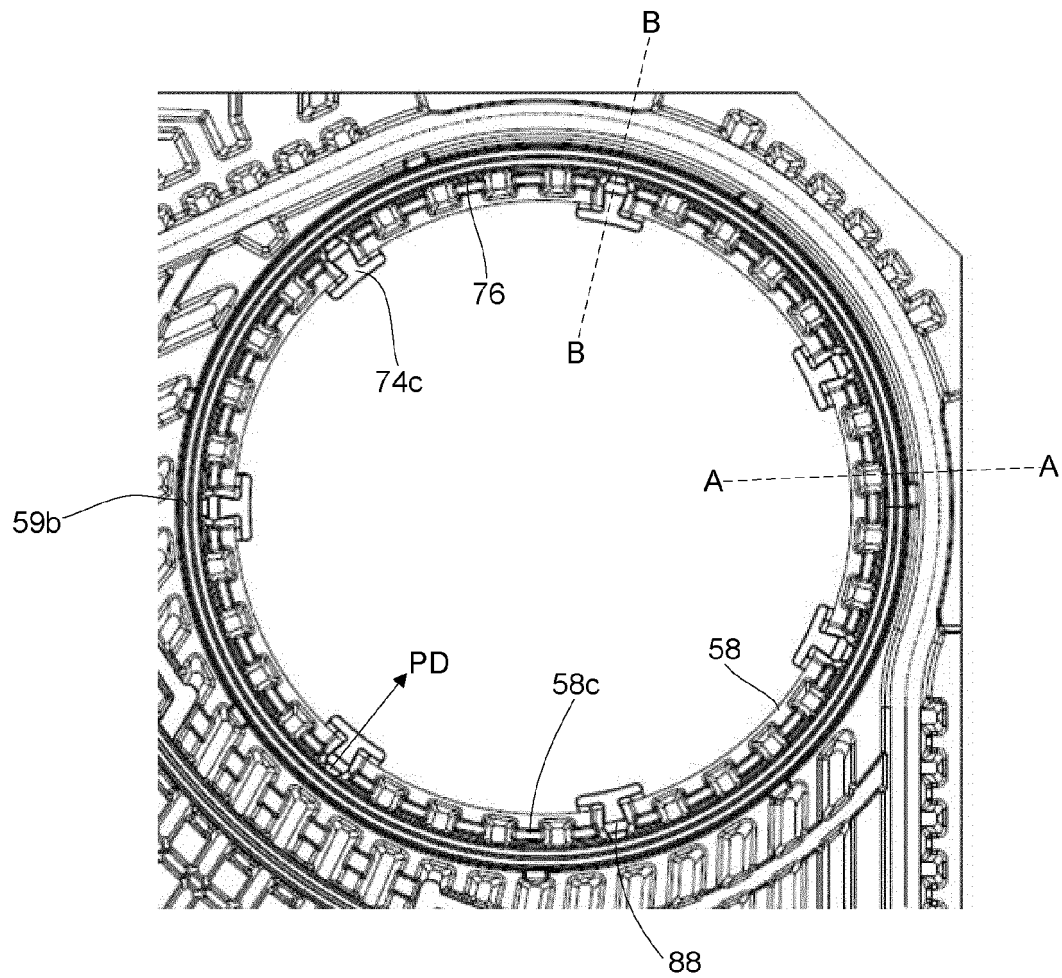


Fig. 7

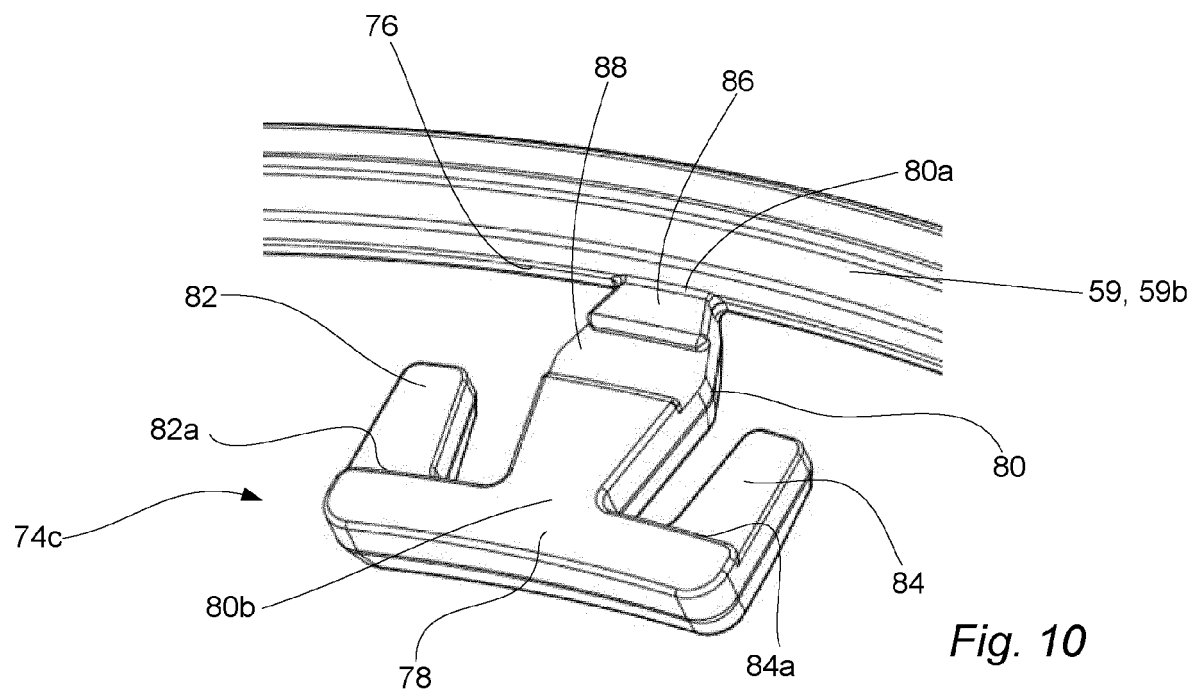


Fig. 10

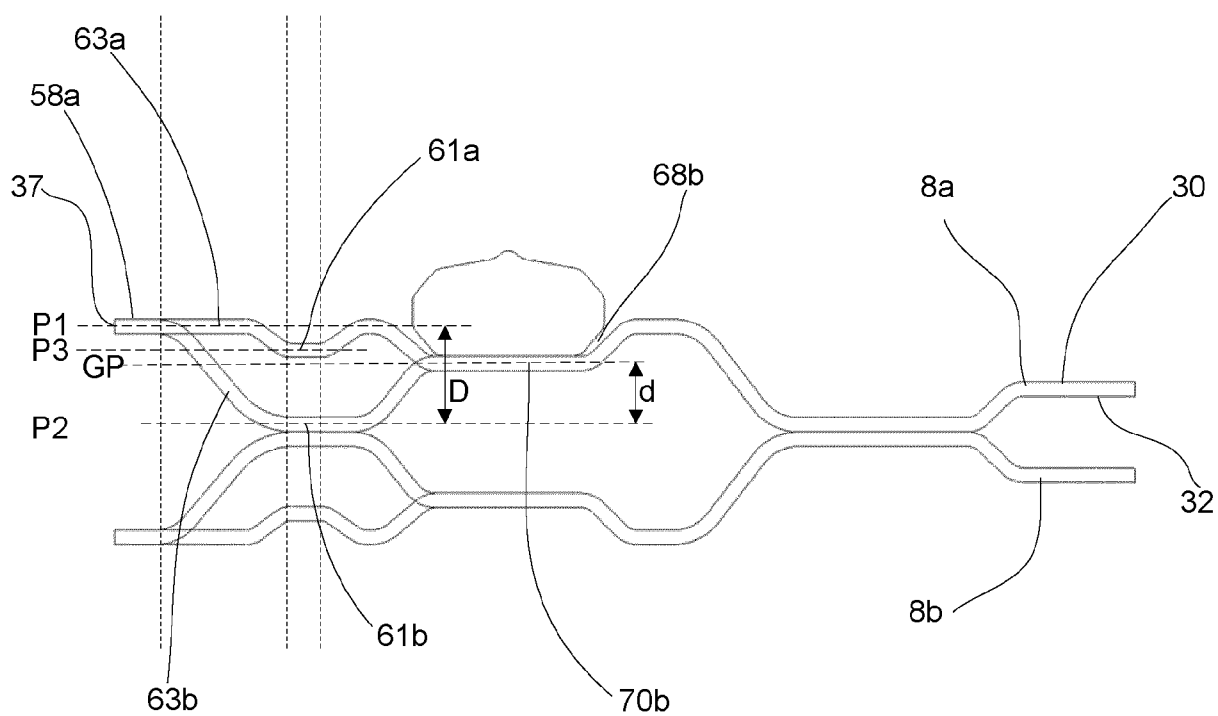


Fig. 8

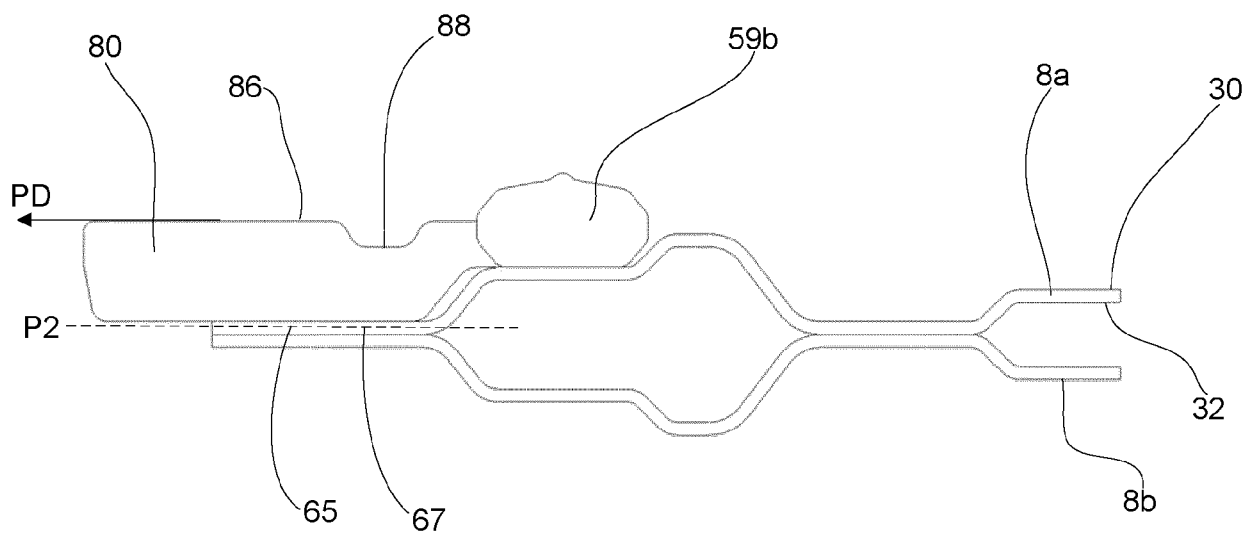


Fig. 9

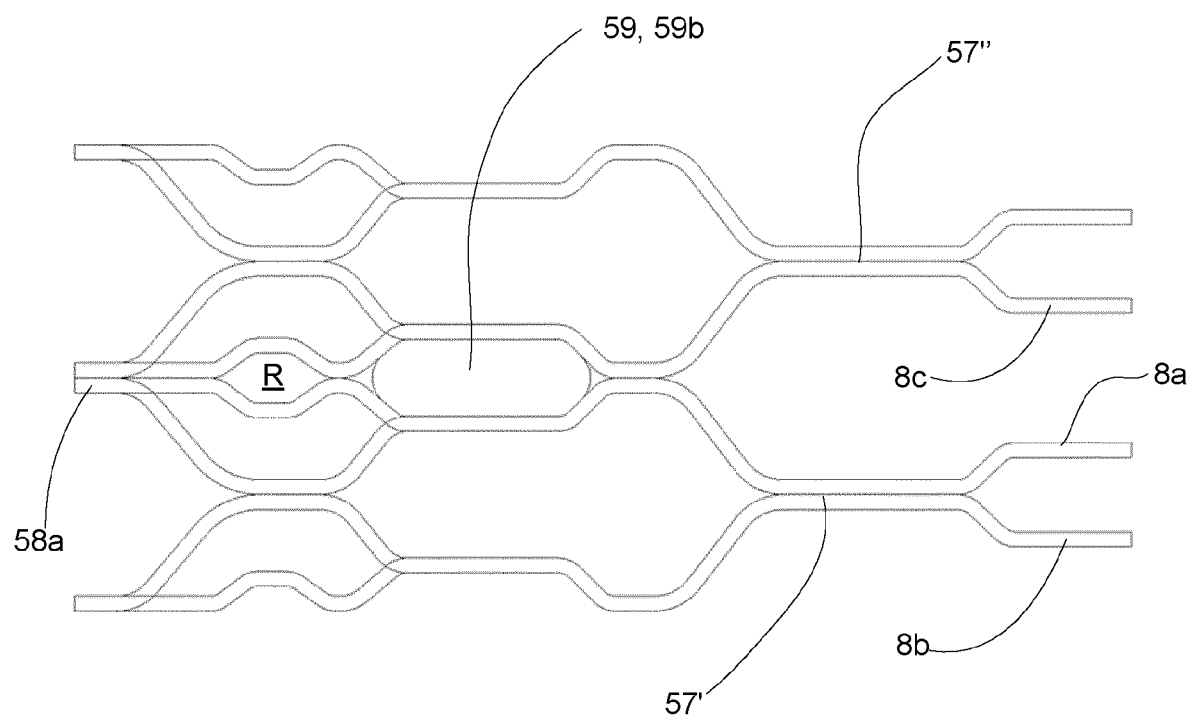


Fig. 11

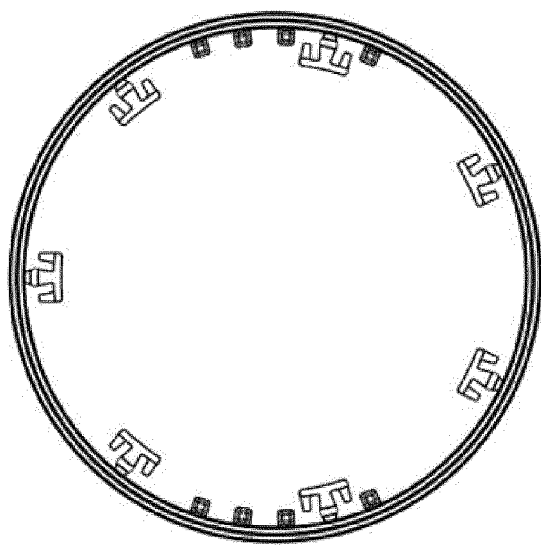


Fig. 12b

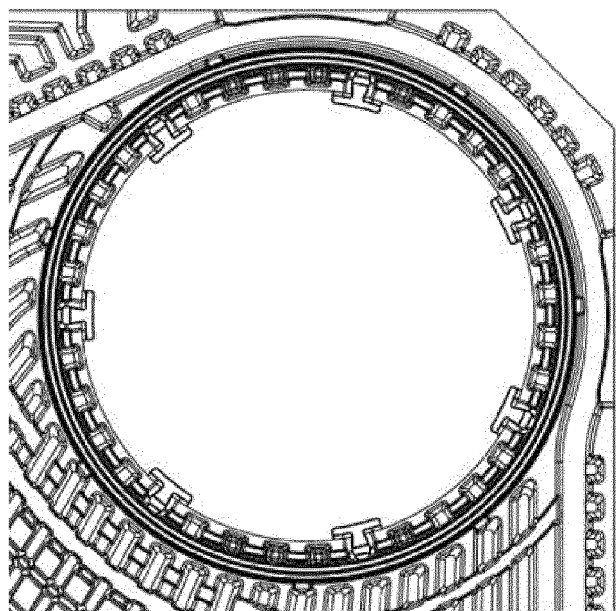


Fig. 12a

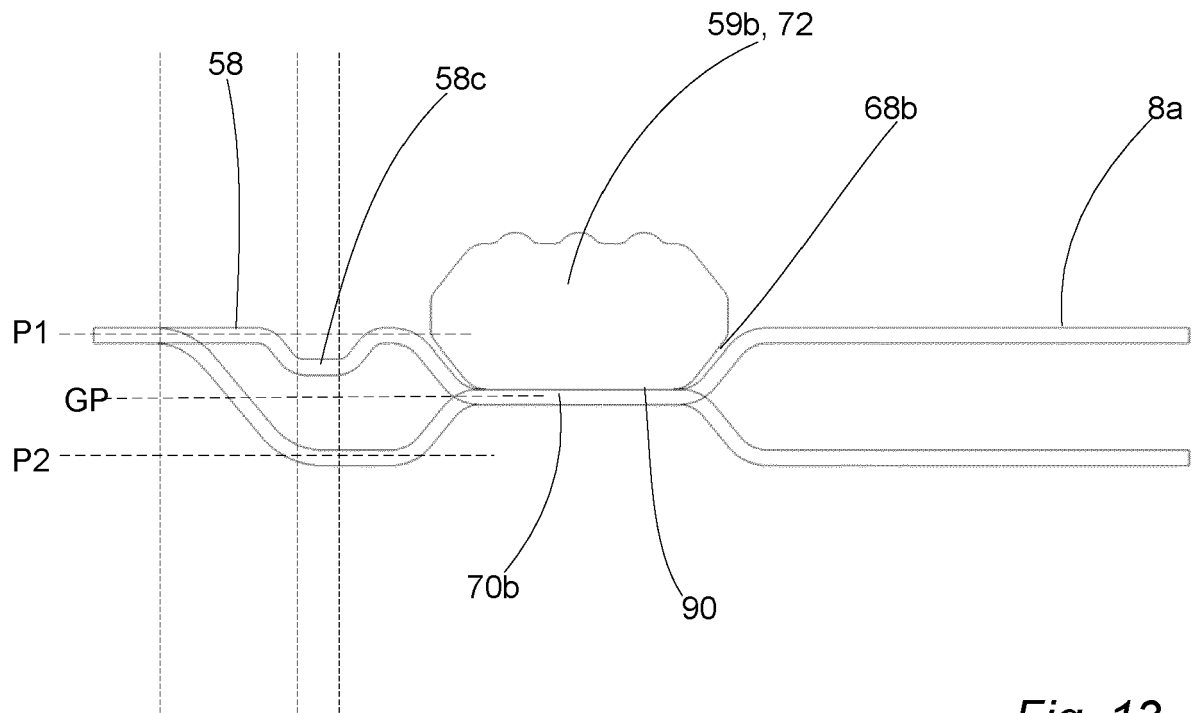


Fig. 13

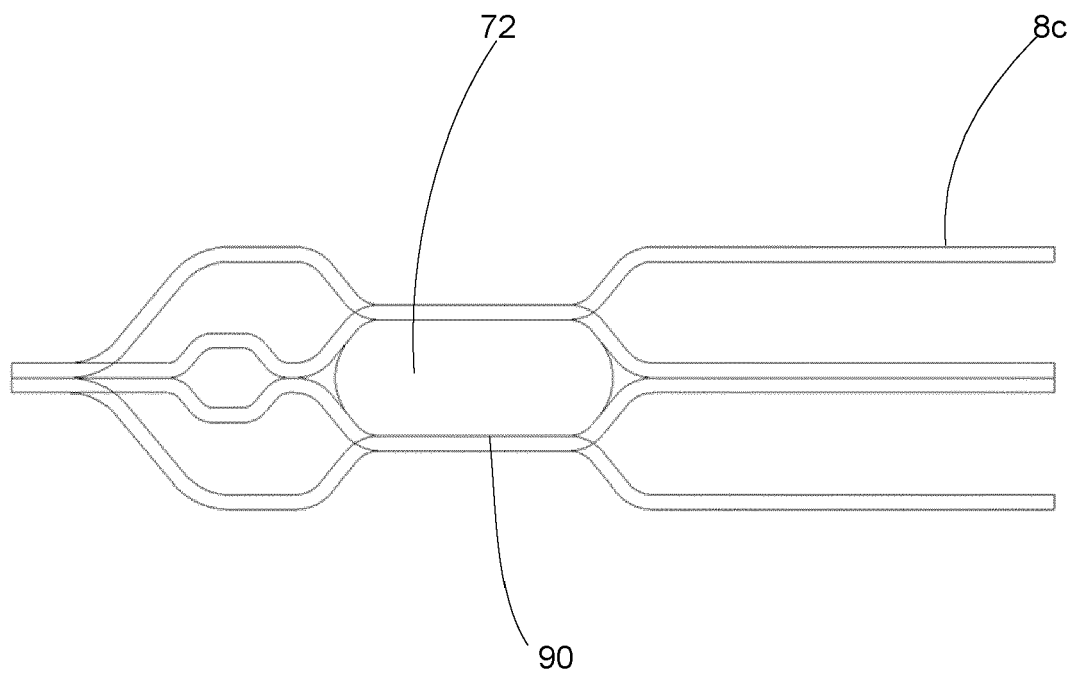


Fig. 14



EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

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A	WO 2007/142590 A1 (ALFA LAVAL CORP AB [SE]; GUSTAFSSON HELEN [SE]) 13 December 2007 (2007-12-13) * the whole document *	1-11,14	
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 June 2024	Examiner Jessen, Flemming
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	



Application Number

EP 23 21 9589

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 23 21 9589

5

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

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1. claims: 1-11, 14

Heat transfer plate.

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2. claims: 12, 13, 15

Gasket arrangement.

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 23 21 9589

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-06-2024

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