

(19)



(11)

EP 4 575 369 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.06.2025 Bulletin 2025/26

(51) International Patent Classification (IPC):
F28D 9/00 ^(2006.01) **F28F 3/08** ^(2006.01)
F28F 3/10 ^(2006.01)

(21) Application number: **23219588.3**

(52) Cooperative Patent Classification (CPC):
F28D 9/005; F28F 3/083; F28F 3/10; F28F 2230/00;
F28F 2280/04

(22) Date of filing: **22.12.2023**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(72) Inventor: **NILSSON, Johan**
SE-372 37 RONNEBY (SE)

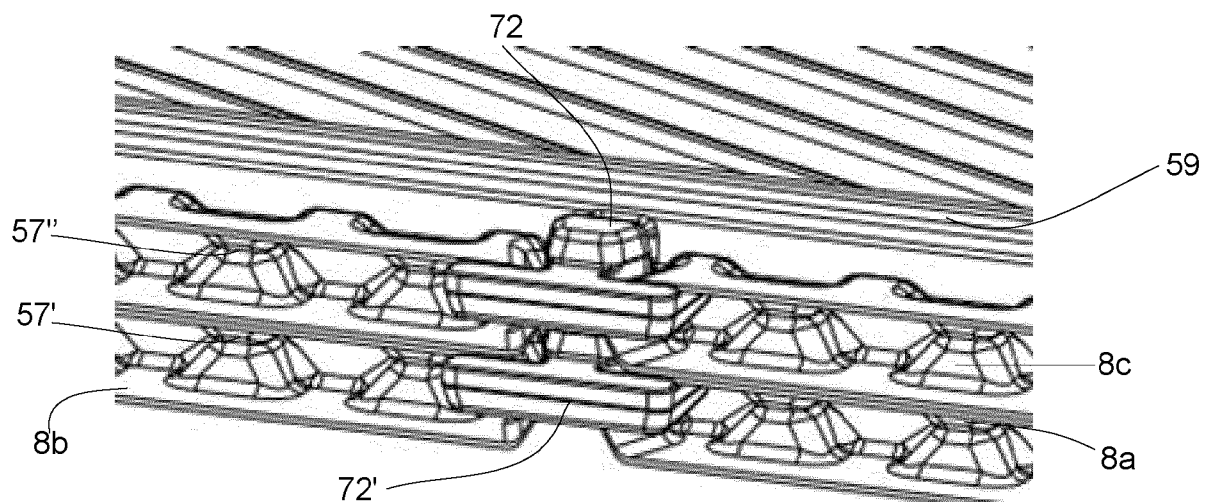
(74) Representative: **Alfa Laval Attorneys**
Alfa Laval Corporate AB
Group Patent
P.O. Box 73
221 00 Lund (SE)

(71) Applicant: **Alfa Laval Corporate AB**
221 00 Lund (SE)

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

(57) A heat transfer plate (8, 8a), a gasket arrangement (72), a cassette (57) and a heat exchanger (2) are provided. The plate (8, 8a) comprises a center part (36), imaginary first and second borderlines (47, 55) defining a longitudinal extension of the center part (36). The center part (36) comprises a heat transfer area (46) provided with a corrugation pattern comprising alternately arranged HT ridges (60) and HT valleys (62) extending in and between first and second planes (P1, P2). The plate (8, 8a) comprises a gasket groove (68) comprising a field gasket groove portion (68a) with a bottom (70a) extending at least partly between the first and second planes

(P1, P2), and second and fourth ring gasket groove portion (68b, 68c) with bottoms (70b, 70c) at least partly extending between the first and second planes (P1, P2). Further, the plate (8, 8a) comprises a first inner edge portion (61) and a first outer edge portion (63) extending along each other, from the first borderline (47) to the second borderline (55) and on an outside of the field gasket groove portion (68a). The first inner edge portion (61) extends between the field gasket groove portion (68a) and the first outer edge portion (63). The plate (8, 8a) is characterized in that more than 50% of the first outer edge portion (63) extends in the first plane (P1).

**Fig. 10**

Description

Technical Field

[0001] The invention relates to a heat transfer plate, 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] Parallel flow channels are formed 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, which fluids enter and exit the channels through inlet and outlet port holes in the heat transfer plates.

[0004] Gaskets, welds or a combination thereof may be used to seal, and define the channels, between the heat transfer plates. Gaskets have a limited lifetime due to degradation caused by internal factors such as fluids and temperatures. However, also external factors, such as oxidizing air exposure, may have an impact on the gasket lifetime. To increase the lifetime of the gaskets in a

plate heat exchanger, it is known to provide the gaskets with a respective outer lip to protect them from exposure to external conditions. However, such a lip demands additional gasket material which will not contribute to the sealing function of the gasket. Further, such a lip may not be compatible with all types of gaskets.

Summary

- [0005]** An object of the present invention is to provide a heat transfer plate arranged to protect a gasket, which is arranged in a gasket groove of the heat transfer plate, from the external surrounding so as to delay the degradation of the gasket and, thus, prolong the lifetime of it.
- The basic concept of the invention is to provide the heat transfer plate with a plane portion at an outer edge of the heat transfer plate, which plane portion extends above a bottom of the gasket groove of the heat transfer plate to enable shielding of a gasket arranged in the gasket groove. Another object of the invention is to provide a gasket arrangement designed for gasket shielding. Yet another object of the invention is 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 cassette and the heat exchanger are defined in the appended claims and discussed below.
- [0006]** 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. Imaginary first and second borderlines define a longitudinal extension of the center part, i.e. an extension of the center part along the longitudinal center axis of the heat transfer plate. The first and second borderlines cross the longitudinal center axis. The upper end part comprises a first port hole, a second port hole and an upper distribution area provided with an upper distribution corrugation pattern. The lower end part comprises a third port hole, a fourth port hole and a lower distribution area provided with a lower distribution corrugation pattern. The center part comprises a heat transfer area which is provided with a heat transfer corrugation pattern differing from the upper and lower distribution corrugation patterns. The heat transfer corrugation pattern comprises alternately arranged 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. The heat transfer plate further comprises, as seen from the first side, a gasket groove. The gasket groove comprises a field gasket groove portion enclosing the heat transfer area and the first and third holes, a second ring gasket groove portion enclosing the

second port hole and a fourth ring gasket groove portion enclosing the fourth port hole. The field gasket groove portion comprises an upper diagonal section extending between the upper distribution area and the second port hole and a lower diagonal section extending between the lower distribution area and the fourth port hole. A bottom of the field gasket groove portion extends between the first and second planes along the upper and lower diagonal sections. The second ring gasket groove portion comprises an inner section which extends between the second port hole and the upper diagonal section. A bottom of the second ring gasket groove portion extends between the first and second planes along the inner section. The fourth ring gasket groove portion comprises an inner section which extends between the fourth port hole and the lower diagonal section. A bottom of the fourth ring gasket groove portion extends between the first and second planes along the inner section. A bottom of the field gasket groove portion extends, along at least 50% of a length or a longitudinal extension of the field gasket groove portion, in a gasket groove plane arranged on a distance d from the second plane, $0 \leq d < D$. The heat transfer plate further comprises a first inner edge portion and a first outer edge portion. The first inner edge portion and the first outer edge portion extend along each other, i.e. side by side, from the first borderline to the second borderline and on an outside of the field gasket groove portion. The first inner edge portion extends between the field gasket groove portion and the first outer edge portion. The heat transfer plate is characterized in that more than 50% of the first outer edge portion extends in the first plane.

[0007] In that the bottom of the field gasket groove portion, along the upper and lower diagonal sections, and the bottoms of the second and fourth ring gasket groove portions, along the inner sections, extend between the first and second planes and not in the second plane, a fluid flow may be possible between the second and fourth port holes and the upper and lower distribution areas, respectively, on the second side of the heat transfer plate, when the heat transfer plate abuts, second side to second side, another "flipped" or "turned" heat transfer plate according to the invention. This may enable use of the heat transfer plate in a semi-welded heat exchanger. Typically, the circular second and fourth port holes are dedicated to one and the same fluid while the non-circular first and third port holes are dedicated to one and the same, and another fluid. The first and third port holes may be arranged on one and the same side, while the second and the fourth port hole may be arranged on another and the same side, of the longitudinal center axis of the plate. Such a port hole placement may enable a heat transfer plate of so-called parallel flow type, and a heat exchanger comprising heat transfer plates according to the invention which are "flipped" or "turned" in relation to each other.

[0008] Thus, more than 50%, more preferable more than 70%, of the first outer edge portion extends in the first plane. Even 100% of the first outer edge portion may

extend in the first plane, but to enable for the first outer edge portion to cooperate smoothly with a gasket arrangement, it may be suitable to allow a certain percentage of the first outer edge portion to extend outside the first plane.

[0009] In that the first outer edge portion 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, a continuous wall will be formed along at least half of the first inner and outer edge portions, which wall will be able to shield and protect, from the outside, a field gasket portion of a gasket engaging with the plate.

[0010] The first outer edge portion may extend on a distance from an outer edge of the heat transfer plate, which outer edge defines an outer periphery of the heat transfer plate. Alternatively, the first outer edge portion may comprise a portion of the outer edge of the heat transfer plate, i.e. extend all the way to the outer edge of the heat transfer plate. This may enable a mechanically straightforward design of the heat transfer plate.

[0011] As said above, the first outer edge portion of the heat transfer plate extends primarily in the first plane. The plate may be such that the first inner edge portion is corrugated, i.e. that it comprises alternately arranged edge ridges and edge valleys as seen from the first side of the heat transfer plate. The edge ridges and the edge valleys may extend in and between the first and second planes. Such a corrugation may improve the strength of the plate. When the plate is arranged in a plate pack with other plates which each comprises a similar corrugation, the corrugations may be arranged to abut each other which may enable a strong and rigid plate pack.

[0012] The plate may be such that a pitch between the edge ridges, and possibly also a pitch between the edge valleys, is essentially constant between the first and second borderlines. Such a design may enable a plate with a relatively uniform strength along the first inner and outer edge portions.

[0013] The plate may further comprise, as seen from the first side, a fixing valley extending from the field gasket groove portion through the first inner edge portion and the first outer edge portion. The fixing valley may be arranged to engage with an attachment means of a gasket arrangement which also comprises a gasket. Thus, the provision of the fixing valley may enable fastening of a gasket to the plate. In that the fixing valley extends through the first inner and outer edge portions, non-interfering engagement between the outer edge of the plate and the attachment means may be enabled. For a plate where the first inner edge portion is corrugated, one of the edge valleys may coincide with the fixing valley.

[0014] The fixing valley may comprise an inner part and an outer part, the inner part being arranged between the outer part and the field gasket groove portion. A bottom of the fixing valley may extend in the same plane, such as in the gasket groove plane, or in different planes, within the inner and outer parts of the fixing valley. As an example of

the latter option, the bottom of the fixing valley may extend in the gasket groove plane within the outer part and between the gasket groove plane and the first plane within the inner part. Such a configuration may offer an increased gasket support and enable a stronger engagement between the plate and an attachment means for fastening a gasket onto the plate.

[0015] 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.

[0016] A bottom of the sealing groove may extend in the second plane along more than 50% of a length of the sealing groove,

The plate may be so designed that $d=0$ which means that the gasket groove plane coincides with the second plane. Such a design may enable partial alignment of the gasket groove and the sealing groove.

[0017] A gasket arrangement according to the invention comprises a gasket and an attachment means for fastening the gasket to a heat transfer plate. The attachment means projects, in a projection direction, from an outer side of the gasket. The attachment means comprises a connection member, a first finger, and a bridge. A first connection part of the connection member engages with the gasket. 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 gasket. The gasket arrangement is characterized in that a maximum thickness of the connection member exceeds a maximum thickness of the bridge. A thickness direction extends perpendicular to a longitudinal extension of the bridge and perpendicular to the projection direction. Further, the attachment means further comprises an upper recess in an upper side of the connection member and a lower recess in an opposing lower side of the connection member.

[0018] In that the connection member has a maximum thickness that is larger than a maximum thickness of the bridge, it may shield a relatively large portion of the outer side of the gasket from exposure to external conditions, which, in turn, may prolong the lifetime of the gasket arrangement.

[0019] The upper and lower recesses give the connection member a locally reduced thickness at the recesses. The first and second recesses may be arranged to engage with a projection of a respective heat transfer plate. This may enable a stronger engagement between the gasket arrangement and the heat transfer plates.

[0020] The upper and lower recesses may be aligned

with each other along the thickness direction. Such a design may be suitable when the gasket arrangement is configured to be positioned between two similar heat transfer plates.

[0021] 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.

[0022] 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.

[0023] 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 of the gasket arrangements are arranged in the gasket grooves of two adjacent ones of the heat transfer plates.

[0024] The heat transfer plates may be welded in pairs, second side to second side, possibly along the sealing grooves, into cassettes. Further, each of the gaskets of the gasket arrangements may be arranged in the gasket grooves of two adjacent ones of the cassettes.

[0025] The above discussed advantages with the different embodiments of the heat transfer plate, and where applicable, the gasket arrangement, are naturally transferable to the cassette and the heat exchanger according to the invention.

[0026] As a general remark, herein, when it is said that some portion, part, section, etc., of the heat transfer plate 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.

[0027] It should be stressed that the above discussed advantages of the different embodiments of the heat transfer plate, as well as the gasket arrangement and the cassette, according to the invention appears first when the heat transfer plate, the gasket arrangement and the cassette are arranged in a PHE together with other heat transfer plates, gasket arrangements and cassettes (which possibly also are designed according to the present invention), and other components needed in a properly functioning PHE.

[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] 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 cassette and the gasket arrangement in Fig. 4,
 Fig. 6 is a cross section taken along line A-A in Fig. 5,
 Fig. 7 is a cross section taken along line B-B in Fig. 5,
 Fig. 8 is an enlargement of a portion of the cassette in Fig. 4,
 Fig. 9 is a perspective view of an attachment means of the gasket arrangement in Fig. 4,
 Fig. 10 is a perspective view of a part of the heat exchanger in Figs. 1 and 2,
 Fig. 11 is an enlargement of a portion of a cassette and a gasket arrangement according to an alternative embodiment,
 Fig. 12 is a cross section taken along line D-D in Fig. 11,
 Fig. 13 is an enlargement of a heat transfer plate and a gasket arrangement and according to the invention, and
 Fig. 14 is a cross section taken along line E-E in Fig. 13.

Detailed description

[0030] 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.

[0031] 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.

[0032] 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.

[0033] The plate 8a has a first side 30 (illustrated in Figs. 3 and 6) and an opposing second side 32 (illustrated in Fig. 6). 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. Imaginary first and second borderlines 47 and 55, which cross the longitudinal center axis L, define an extension of the center part 36 along the longitudinal center axis L. Here, the first and second borderlines 47 and 55 are similar and comprise both straight and curved portions. 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.

[0034] 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 comprise upper and lower distribution corrugation patterns 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. 6) facing the first side 30 of the plate 8a and an imaginary second plane P2 (Fig. 6) facing the second side 32 of the plate 8a. The first and second planes P1 and P2 are

arranged on a distance D from each other (Fig. 6). 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.

[0035] Moreover, the plate 8a comprises an edge part 54 extending along an outer edge 56 of the plate 8a, which outer edge 56 defines an outer periphery of the plate 8a. With reference to Figs. 3 and 5, the edge part 54 comprises a first inner edge portion 61 and a first outer edge portion 63 extending along each other and along the first long side 18 of the plate 8a, from the first borderline 47 to the second borderline 55. The first outer edge portion 63 comprises a portion of the outer edge 56 and, thus, extends on an outside of the first inner edge portion 61. In Fig. 5, a border between the first inner and outer edge portions 61 and 63 is illustrated with a dashed line.

[0036] With reference to Figs. 5 and 6, as seen from the first side 30 of the plate 8a, the first inner edge portion 61 is corrugated and comprises alternately arranged edge ridges 58a and edge valleys 58b extending in and between the first plane P1 and the second plane P2. A pitch between the edge ridges 58a is essentially constant along the first inner edge portion 61. Similarly, a pitch between the edge valleys 58b is essentially constant along the first inner edge portion 61 and essentially equal to the pitch between the edge ridges 58a.

[0037] Further, with reference also to Fig. 8, the plate 8a further comprises, as seen from the first side 30 of the plate 8a, a plurality of separated fixing valleys 65 which each extends, essentially perpendicular to the outer edge 56 of the plate 8a, through the complete first inner edge portion 61 and the complete first outer edge portion 63. As is clear from Figs. 5 and 8, a respective one of the edge valleys 58b coincides with each one of the fixing valleys 65, a pitch between the fixing valleys 65 being essentially constant along the first inner and outer edge portions 61 and 63. With reference mainly to Fig. 7 but also Fig. 8, each of the fixing valleys 65 comprises an inner part 67 and an outer part 69, the right-most vertical dashed line illustrating a border between the inner and outer parts 67 and 69. The outer part 69 comprises a portion of the outer edge 56 and, thus, extends on an outside of inner part 67. A respective bottom 71 of each the fixing valleys 65 extends in the second plane P2 within the outer part 69 and between the first and second planes P1 and P2 within the inner part 67. More particularly, within the inner part 67, the bottom 71 extends between the second plane P2 and an imaginary third plane P3, which third plane P3 extends between the first and second planes P1 and P2. Thereby, a projection 73 of the plate 8a is formed.

[0038] With reference again to Figs. 5 and 6, the first outer edge portion 63 is plane and extends in the first plane P1 between the fixing valleys 65.

[0039] Correspondingly, the edge part 54 comprises a second inner edge portion and a second outer edge portion extending along each other and along the second long side 20 of the plate 8a, from the first borderline 47 to the second borderline 55. The second outer edge portion comprises a portion of the outer edge 56 and, thus, extends on an outside of the second inner edge portion. Fixing valleys extend perpendicularly from the outer edge 56 and through the second inner and outer edge portions. Further, the second inner edge portion is corrugated while the second outer edge portion is plane and extends in the first plane P1 between the fixing valleys.

[0040] As is clear from Fig. 3, also other portions of the edge part 54 are corrugated and comprise alternately arranged edge ridges and edge valleys extending in and between the first and second planes P1 and P2. The edge ridges and valleys within the edge part 54 are arranged to abut edge ridges and valleys of adjacent plates in the plate pack of the plate heat exchanger 2. Similarly, 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 heat transfer corrugation patterns comprises corrugations arranged to abut corrugations of the adjacent plates in the plate pack of the plate heat exchanger 2.

[0041] With reference to Figs. 3 and 6, 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 extending in a bottom 66 of the sealing groove 64. 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.

[0042] A bottom 66a of the field sealing groove portion 64a extends in the second plane P2 (Fig. 6) 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.

[0043] Further, with reference to Figs. 3, 4 and 6, 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 is arranged on an inside of the first inner edge portion 61 and the second inner edge portion of the edge part 54 and partly coincides with the field sealing groove portion 64a. Therefore, a bottom 70a of the field gasket groove portion 68a extends in a gasket plane GP which coincides with the second plane P2 (Fig. 6) 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 upper and lower diagonal sections 68a', 68a" of the field gasket groove portion 68a along which the bottom 70a extends between, here halfway between, the first plane P1 and the second plane P2. As is illustrated in Fig. 3, the upper diagonal section 68a' extends between the upper distribution area 44 and the second port hole 42, while the lower diagonal section 68a" extends between the lower distribution area 52 and the fourth port hole 50. 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 between, here halfway between, the first plane P1 and the second plane P2 along the complete length of the second ring gasket groove portion 68b, including an inner section 68b' of the second ring gasket groove portion 68b which extends between the second port hole 42 and the upper diagonal section 68a' of the field gasket groove portion 68a. 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 between, here halfway between, the first plane P1 and the second plane P2 along the complete length of the fourth ring gasket groove portion 68c, including an inner section 68c' of the fourth ring gasket groove portion 68c which extends between the fourth port hole 50 and the lower diagonal section 68a" of the field gasket groove portion 68a.

[0044] With reference to Figs. 3 and 5, 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 two different types of attachment means; attachment means 74a and attachment means 74b. The attachment means 74a and the attachment means 74b have essentially the same configuration. However, the attachment means 74a are provided on an outside of the field gasket portion 59a and arranged to engage with the outer edge 56 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 attachment means 74a.

[0045] With reference to Fig. 4 and 7, each of the attachment means 74a projects, in a projection direction PD, from, and are essentially equidistantly arranged along, an outer side 76 of the gasket 59, or, more particularly, the field gasket portion 59a thereof. One of the attachment means 74a is illustrated in more detail in Fig. 9. 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 field gasket portion 59a 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 field gasket portion 59a. The dashed vertical line in Fig. 7 illustrates the border between the connection member 80 and the bridge 78. As is clear from Fig. 7, a maximum thickness of the connection member 80 exceeds a maximum thickness of the bridge 78, the thicknesses being measured in a direction TD which is perpendicular to a longitudinal extension BL of the bridge 78 as well as to the projection direction PD. This means that the connection member 80 shields the outer side 76 of the gasket 59 to a higher extent than the bridge 78. Further, an upper recess 86' is provided in an upper side US of the connection member 80 while a lower recess 86" is provided in a lower side LS of the connection member 80. The upper and lower sides US and LS are opposing surfaces of the connection member 80 and have an extension along the longitudinal extension BL and the projection direction PD. Further, the upper and lower recesses 86' and 86" are aligned with each other along the thickness direction TD.

[0046] As illustrated in Figs. 4 and 5, with reference also to Fig. 9, the connection member 80 of each of the attachment means 74a is arranged to be received in a respective one of the fixing valleys 65. As is clear from Fig. 8, the fixing valleys 65 extend from the field gasket groove portion 68a, the respective inner part 67 of the fixing valleys 65 being arranged between the field gasket groove portion 68a and the respective outer part 69 of the fixing valleys 65. Thus, with reference also to Fig. 7, when the gasket arrangement 72 engages properly with the plate 8a, inner parts of the connection members 80 engage with the inner parts 67 of the fixing valleys 65 while outer parts of the connection members 80 engage with the outer parts 69 of the fixing valleys 65. The projections 73 of the plate 8a will project into the lower recesses 86" in the lower side LS of the attachment means 74a. Thus, the connection members 80 of the attachment means 74a will engage with the first side of

the plate 8a. As is clear from Fig. 5, the first and second fingers 82 and 84 of the attachment means 74a will engage with the second side 32 of the plate 8a. Therefore, the attachment means 74a will "pinch" the edge part 54 of the plate 8a to fasten the gasket 59 to the plate 8a.

[0047] 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.

[0048] 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. Figs. 4 and 7 shows one of the cassettes 57' comprising the plate 8a illustrated in Fig. 3 and the plate 8b visible in Figs. 5-8. The plate 8b is "flipped" in relation to the plate 8a. With reference to Fig. 10, in the plate pack of the plate heat exchanger 2, the welded cassettes 57 are separated by the gaskets 59 of the gasket arrangements 72. 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. 10, 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 comprised is the gasket arrangement 72', which "pinches" the plate 8a in the above described way, the lower and upper recesses of the gasket arrangement 72' accommodating the projections 73 of the plate 8a and the corresponding projections of the plate 8c, respectively. Arranged like that, the first outer edge portion 63 of the plate 8a will, between the fixing valleys 65, abut the first outer edge portion of the plate 8c. Thereby, the outer edge portions of the plates 8a and 8c will enclose, and protect from external exposure, the gasket of the gasket arrangement 72' between the fixing valleys. Further, the spaces formed between the fixing valleys 65 of the plate 8a and the fixing valleys of the plate 8c will be filled out by the connection members of the gasket arrangement 72' such that the gasket of the gasket arrangement 72' is shielded from external exposure at the fixing valleys. Thus, the inventive design of the heat transfer plate and the inventive design of the gasket arrangement together protect the gasket from the outside conditions, which prolongs the lifetime of the gasket.

[0049] Figs. 11 and 12 illustrate an alternative embodiment of the plate according to the present invention (the gasket is similar to the previously described one). On this plate, the first inner edge portion is plane and extends in the first plane between the fixing valleys. Further, the first outer edge portion comprises a pair of edge ridges for each one of the fixing valleys, which edge ridges are

arranged on opposite sides of the respective fixing valley. Between the edge ridges, the first outer edge portion is plane and extends in the second plane. Therefore, here, the pitch between the edge ridges is not constant along the first outer edge portion. In a heat exchanger comprising plates of this type, it will be the inner edge portions of adjacent plates that will enclose, and protect from external exposure, the gaskets between the pairs of edge ridges.

[0050] Figs. 13 and 14 illustrate another alternative embodiment of the plate according to the present invention and a gasket arrangement. While the previously described plates and gasket arrangement are suitable for a semi-welded heat exchanger wherein the plates are welded in pairs to form cassettes, and the gaskets of the gasket arrangements are arranged between the cassettes, the plate and gasket arrangement illustrated in Figs. 13 and 14 are suitable for a so-called gasketed heat exchanger. In a gasketed heat exchanger, a gasket is arranged between each two adjacent ones of the plates such that all channels in the heat exchanger are gasketed channels. The main difference between the plate in Figs. 13-14 and the plate illustrated in Figs. 3-10 concerns the field gasket groove portion. On the plate illustrated in Figs. 3-10, the bottom of the field gasket groove portion extends in the gasket groove plane everywhere except for at the diagonal sections. The gasket groove plane is arranged on a distance $d = 0$ from the second plane, i.e. the gasket groove plane coincides with the second plane. At the diagonal sections, the bottom of the field gasket groove portion instead extends halfway between the first and the second plane. On the plate illustrated in Figs. 13-14, the bottom of the field gasket groove portion extends in the gasket groove plane everywhere. The gasket groove plane is arranged on a distance $d = D/2$ from the second plane, i.e. the gasket groove plane extends halfway between the first and second planes. In a heat exchanger comprising plates of this type, the outer edge portions of adjacent plates will enclose, and protect from external exposure, every second one of the gaskets in between the fixing valleys. The rest of the gaskets will not be shielded by the edge parts of the plates in the inventive way. The gasket arrangement illustrated in Figs. 13 and 14 is designed essentially like the gasket arrangement illustrated in Figs. 4-7. The gasket arrangement in Figs. 13-14 differs from the gasket arrangement in Figs. 4-7 mainly in that the connection member has the same thickness as the bridge. Naturally, also a gasket arrangement for a gasketed heat exchanger may be designed according to the present invention and, thus, comprise an attachment means having a connection member with a maximum thickness which is larger than the thickness of the bridge, like the gasket arrangement in Figs. 4-7.

[0051] 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.

[0052] The plate heat changer 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.

[0053] The bottom of the field gasket groove portion need not extend halfway between the first plane and the second plane at the two diagonal sections of the field gasket groove portion but may instead extend closer to one of the first and second planes. Similarly, the bottom of the second ring gasket groove portion, just like the bottom of the fourth ring gasket groove portion, need not extend halfway between the first plane and the second plane along their complete lengths but may instead, along part of their lengths or their complete lengths extend in another plane, for example closer to the first plane than the second plane. The bottom of the field gasket groove portion may extend between the first and second planes along the complete length of the field gasket portion.

[0054] The inventive idea is not limited to application between the first and second borderlines, i.e. along the center part, of the plate. Rather, it may be applied also within other parts of the edge part of the plate, or even along the inner edges of the plate defining the port holes of the plate.

[0055] The bottom of the fixing valleys of the plate need not extend in different planes within the inner and outer parts of the fixing valleys but may extend in one and the same plane, which plane may, or may not coincide with the gasket groove plane.

[0056] The plates illustrated in the figures are arranged to be "flipped" in relation to each other. However, the present invention is also applicable for plates arranged to be "rotated" or "turned" in relation to each other.

[0057] 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. The connection member(s) need not have a varying thickness, i.e. it may lack the upper and lower recesses.

[0058] With reference to the embodiments illustrated in Figs. 3-10 and in Figs. 13-14, where the first inner edge portion of the plate is corrugated, the gasket arrangement may further comprise knobs projecting from the outer side of the gasket. These knobs may be arranged to fill out the corrugations of the first inner edge portion of the plate so as to further shield the gasket from exposure to external conditions.

[0059] 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.

[0060] 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.

10 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), imaginary first and second borderlines (47, 55) defining a longitudinal extension of the center part (36), which first and second borderlines (47, 55) cross the longitudinal center axis (L), the upper end part (34) comprising a first port hole (40), a second port hole (42) and an upper distribution area (44) provided with an upper distribution corrugation pattern, the lower end part (38) comprising a third port hole (48), a fourth port hole (50) and a lower distribution area (52) provided with a lower distribution corrugation pattern, the center part (36) comprising a heat transfer area (46) provided with a heat transfer corrugation pattern differing from the upper and lower distribution corrugation patterns and comprising alternately arranged 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), the field gasket groove portion (68a) comprising an upper diagonal section (68a') extending between the upper distribution area (44) and the second port hole 42 and a lower diagonal section (68a'') extending between the lower distribution area (52) and the fourth port hole (50), a bottom (70a) of the field gasket groove portion (68a) extending between the first and second planes (P1, P2) along the upper and lower diagonal sections (68a', 68a''), the second ring gasket groove portion (68b) comprising an inner section (68b') extending between the second port hole (42) and the upper diagonal section (68a'), a bottom (70b) of the second ring gasket groove por-

- tion (68b) extending between the first and second planes (P1, P2) along the inner section (68b'), the fourth ring gasket groove portion (68c) comprising an inner section (68c') extending between the fourth port hole (50) and the lower diagonal section (68a"), a bottom (70c) of the fourth ring gasket groove portion (68c) extending between the first and second planes (P1, P2) along the inner section (68c'), a bottom (70a) of the field gasket groove portion (68a), along at least 50% of a length of the field gasket groove portion (68a), extending in a gasket groove plane (GP) arranged on a distance d from the second plane, $0 \leq d < D$, wherein the heat transfer plate (8, 8a) further comprises a first inner edge portion (61) and a first outer edge portion (63) extending along each other, from the first borderline (47) to the second borderline (55) and on an outside of the field gasket groove portion (68a), the first inner edge portion (61) extending between the field gasket groove portion (68a) and the first outer edge portion (63), **characterized in that** more than 50% of the first outer edge portion (63) extends in the first plane.
2. Heat transfer plate (8, 8a) according to claim 1, wherein the first outer edge portion (63) comprises a portion of an outer edge (56) of the heat transfer plate (8, 8a), which outer edge defines an outer periphery of the heat transfer plate (8, 8a).
 3. Heat transfer plate (8, 8a) according to any of the preceding claims, wherein the first inner edge portion (61) comprises alternately arranged edge ridges (58a) and edge valleys (58b) as seen from the first side (30) of the heat transfer plate (8, 8a), which edge ridges (58a) and edge valleys (58b) extend in and between the first and second planes (P1, P2).
 4. Heat transfer plate (8, 8a) according to claim 3, wherein a pitch between the edge ridges (58a) is essentially constant between the first and second borderlines (47, 55).
 5. 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 field gasket groove portion (68a) through the first inner edge portion (61) and the first outer edge portion (63).
 6. Heat transfer plate (8, 8a) according to claim 5, wherein the fixing valley (65) comprises an inner part (67) and an outer part (69), the inner part (67) being arranged between the outer part (69) and the field gasket groove portion (68a), wherein a bottom (71) of the fixing valley (65) extends in the gasket groove plane (GP) within the outer part (69) and between the gasket groove plane (GP) and the first plane (P1) within the inner part (67).
 7. 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).
 8. Heat transfer plate (8, 8a) according to any of the preceding claims, wherein $d=0$.
 9. Gasket arrangement (72) comprising a gasket (59) and an attachment means (74a) for fastening the gasket (59) to a heat transfer plate (8, 8a), wherein said attachment means (74a) projects, in a projection direction (PD), from an outer side (76) of the gasket (59) 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 gasket (59), 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 gasket (59), **characterized in that** a maximum thickness of the connection member (80) exceeds a maximum thickness of the bridge (78), a thickness direction (TD) extending perpendicular to a longitudinal extension (BL) of the bridge (78) and perpendicular to the projection direction (PD), the attachment means (74a) further comprises an upper recess (86') in an upper side (US) of the connection member (80) and a lower recess (86'') in an opposing lower side (LS) of the connection member (80).
 10. Gasket arrangement (72) according to claim 9, wherein the upper and lower recesses (86', 86'') are aligned with each other along the thickness direction (TD).
 11. A cassette (57) comprising two heat transfer plates (8, 8a) according to any of the claims 1-8, 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.
 12. A cassette (57) according to claim 11, wherein said another one of the two heat transfer plates (8, 8a) is rotated, in relation to said one of the two heat transfer plates, 180 degrees around a normal (N) of said another one of the two heat transfer plates (8, 8a).
 13. A heat exchanger (2) comprising a plurality of heat transfer plates (8, 8a) according to any of the claims 1-8 and a plurality of gaskets arrangements (72)

according to any of claims 9-10, wherein each of the gaskets (59) of the gasket arrangements (72) are arranged in the gasket grooves (68) of two adjacent ones of the heat transfer plates (8, 8a).

5

- 14.** A heat exchanger (2) according to claim 13, wherein the heat transfer plates (8, 8a) are welded in pairs, second side (32) to second side (32), into cassettes (57), and each of the gaskets (59) of the gasket arrangements (72) are arranged in the gasket grooves (68) of two adjacent ones of the cassettes (57).

10

15

20

25

30

35

40

45

50

55

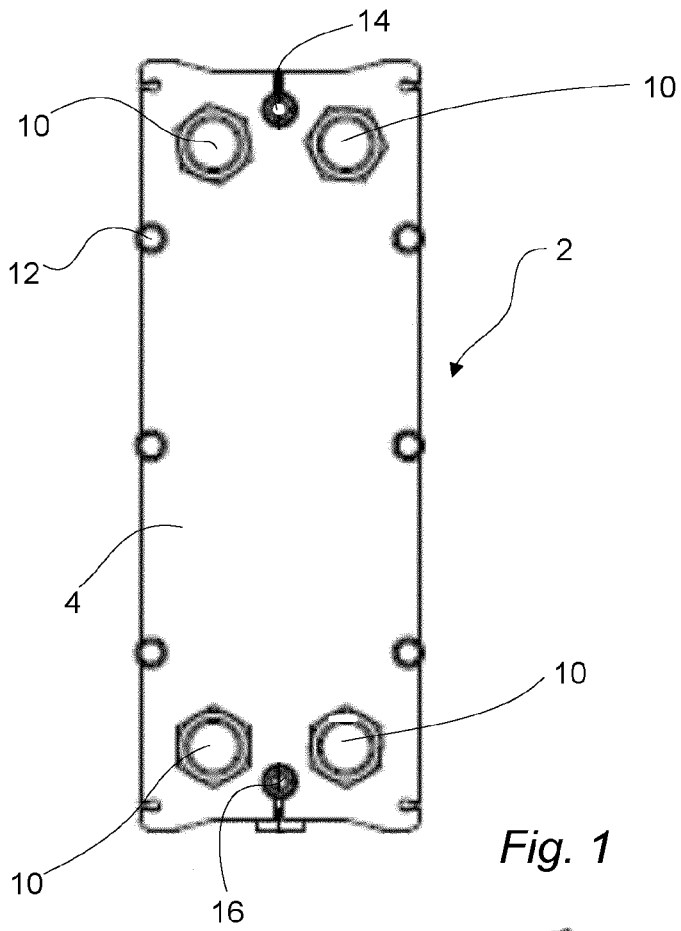


Fig. 1

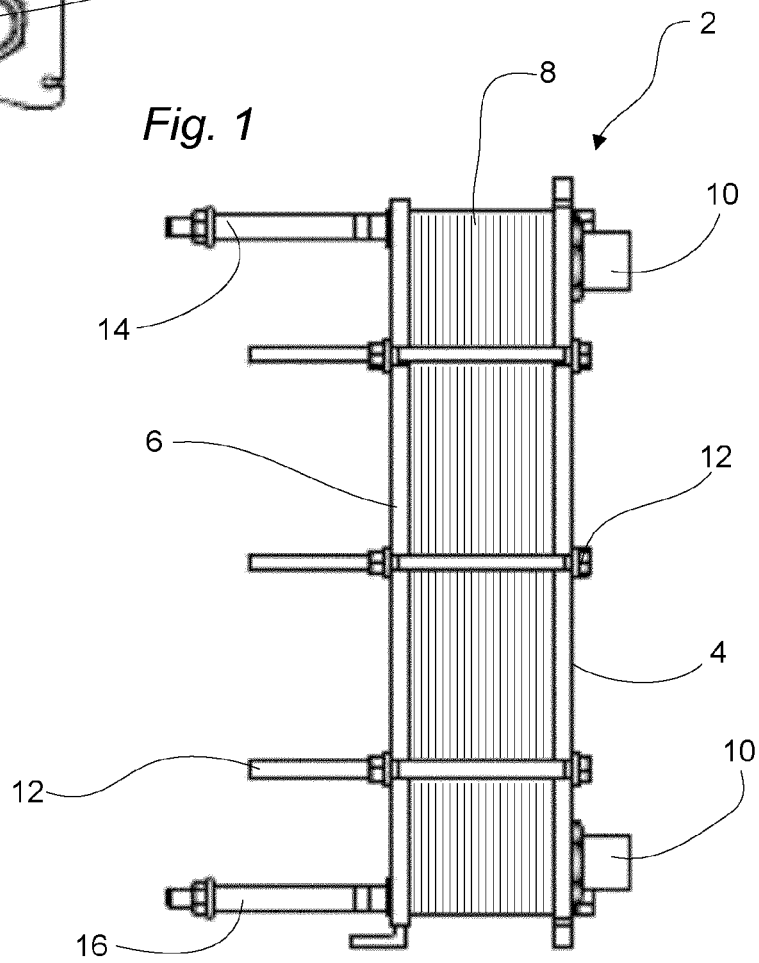


Fig. 2

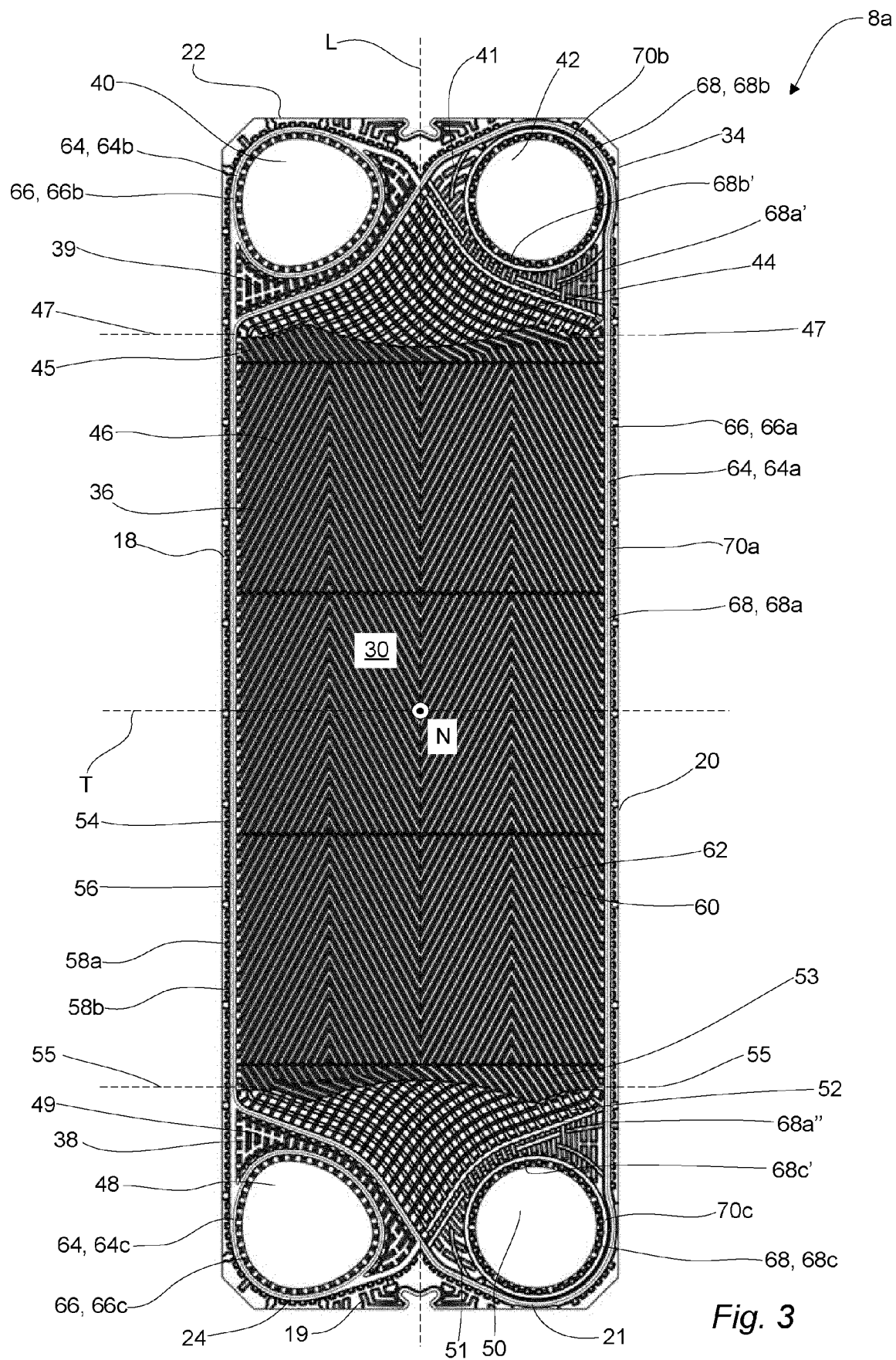


Fig. 3

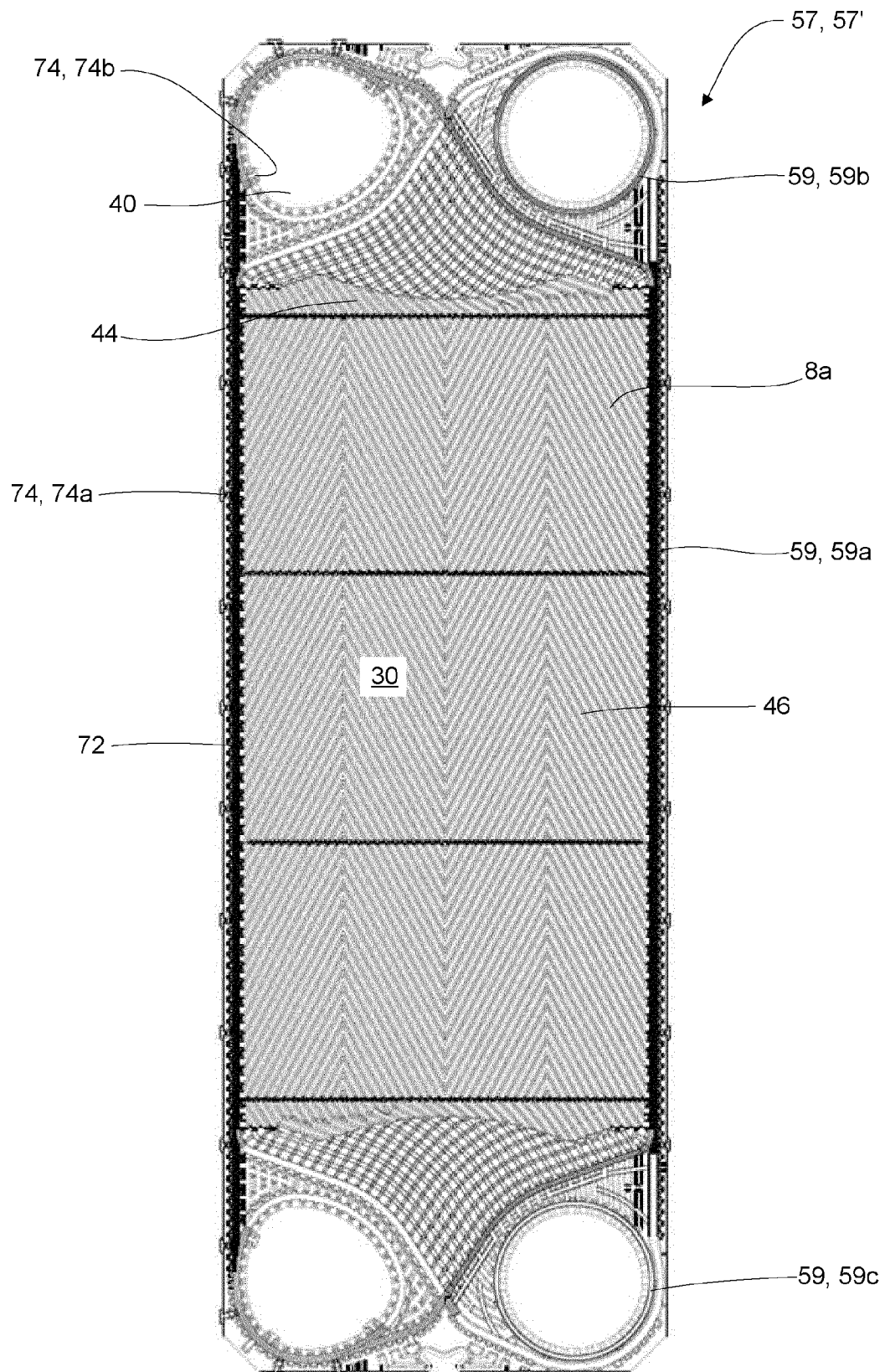
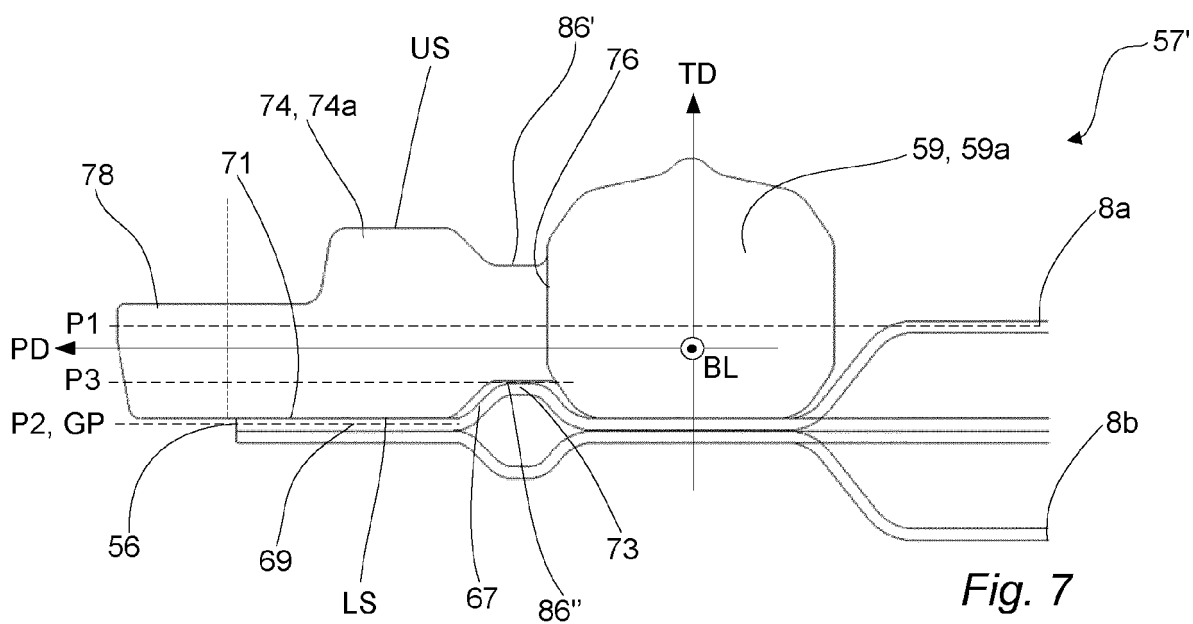
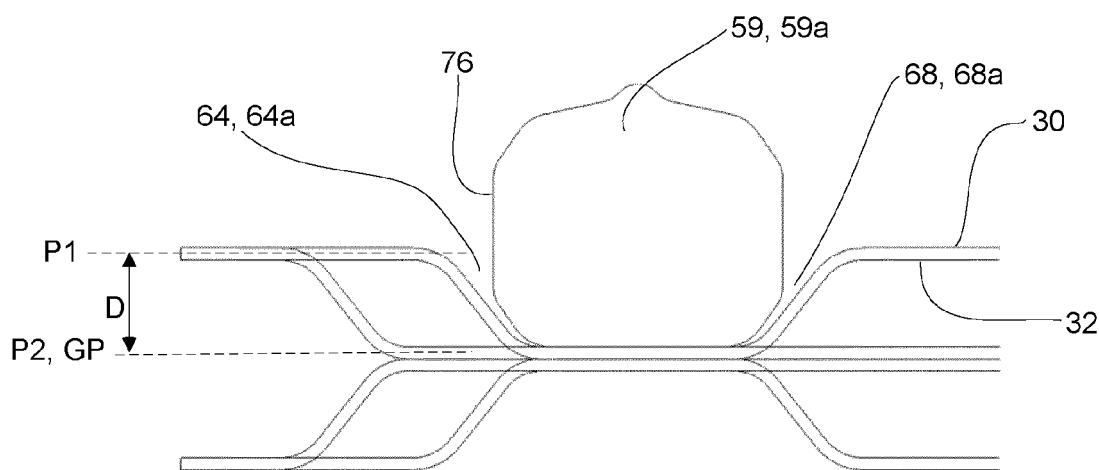
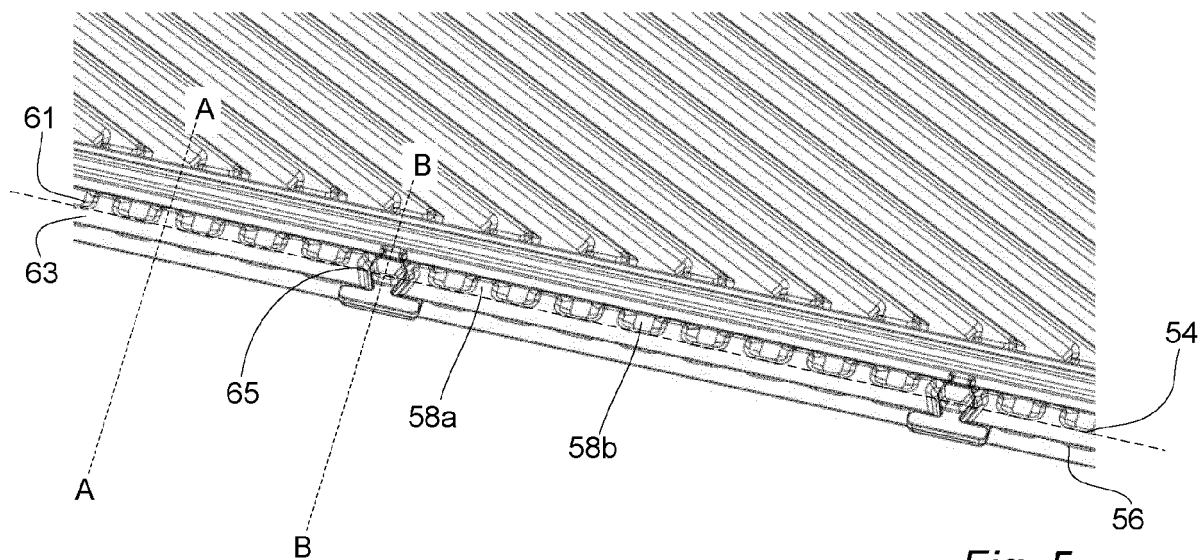


Fig. 4



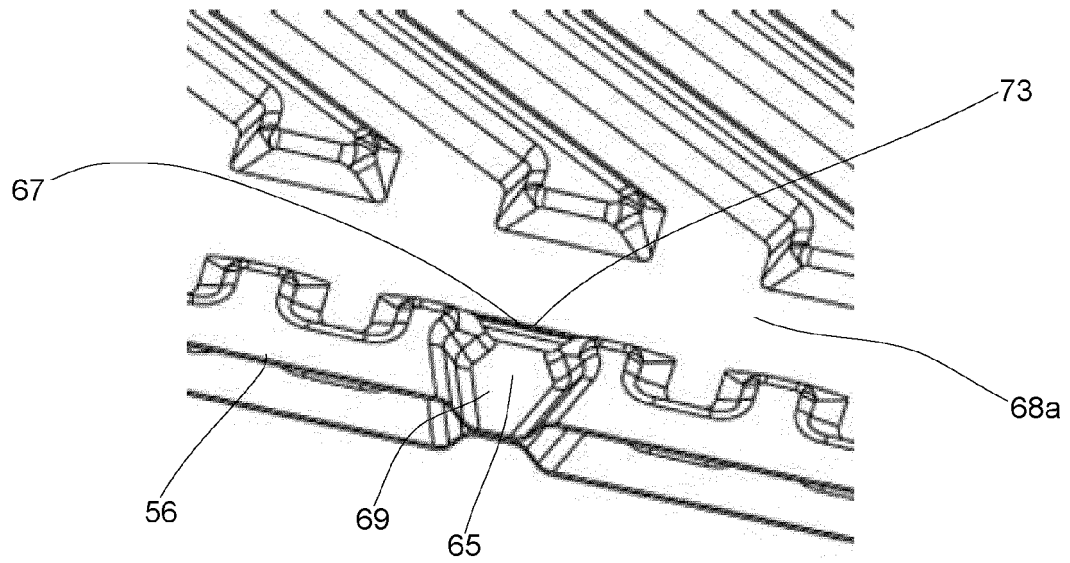


Fig. 8

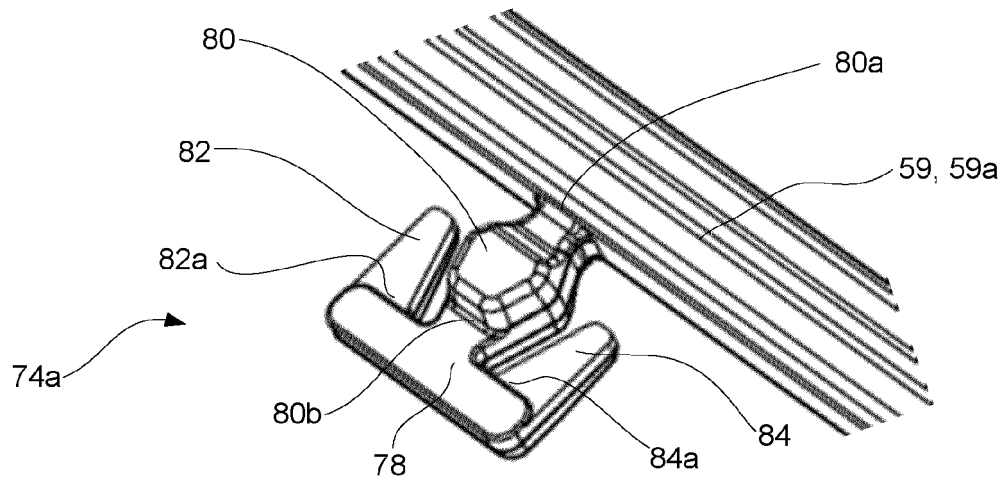


Fig. 9

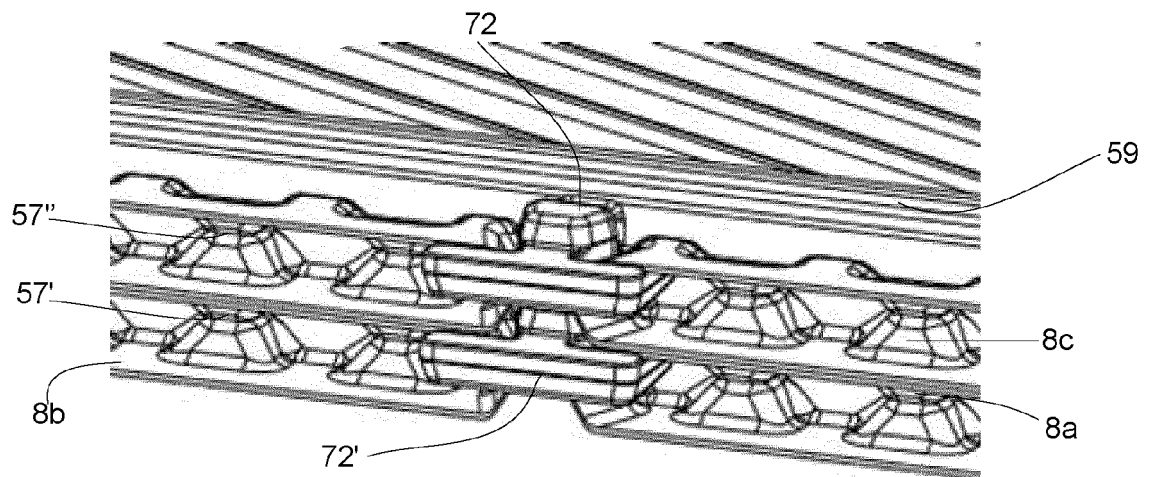


Fig. 10

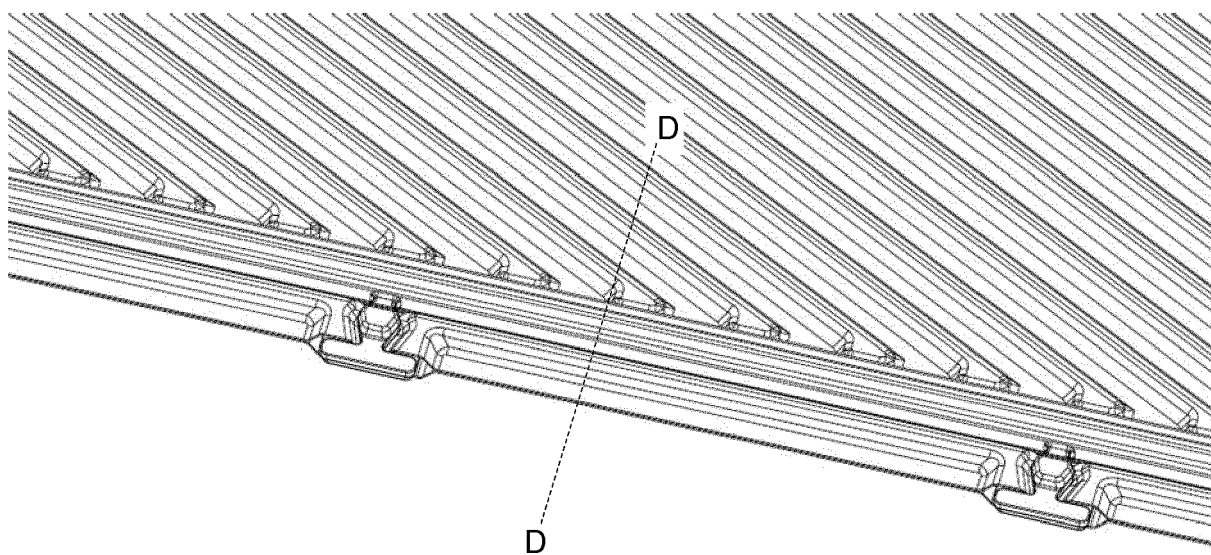


Fig. 11

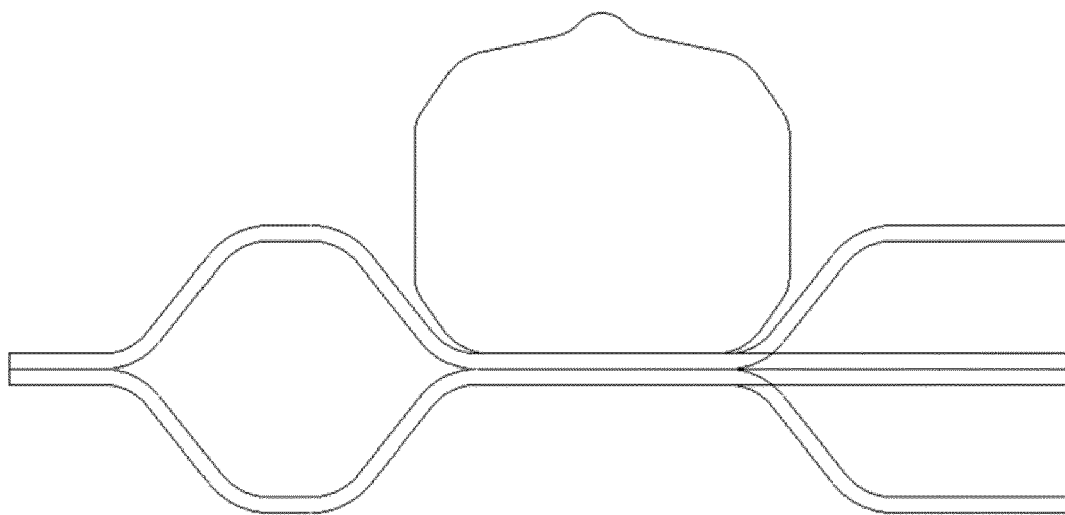


Fig. 12

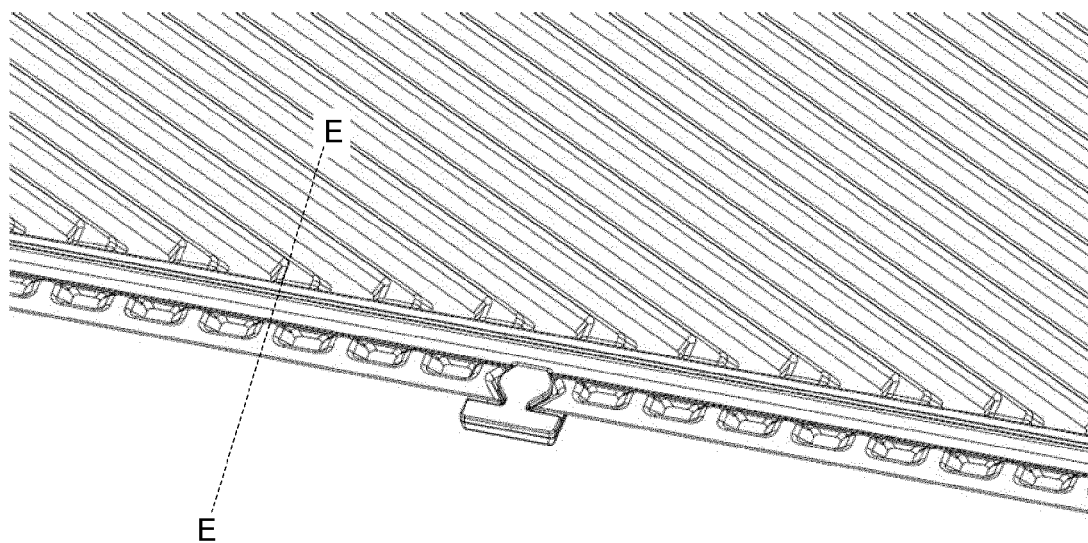


Fig. 13

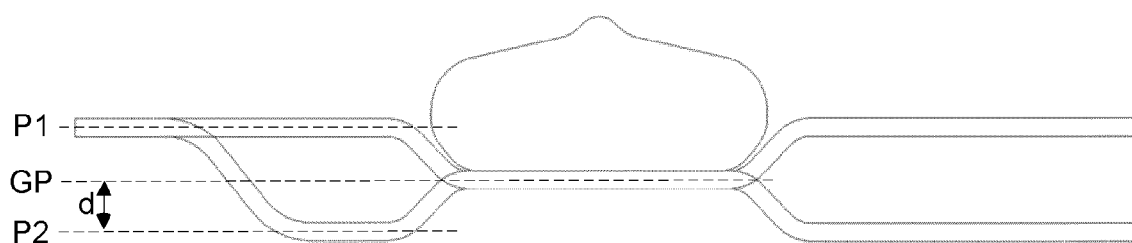


Fig. 14



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 9588

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2022/233563 A1 (ALFA LAVAL CORP AB [SE]) 10 November 2022 (2022-11-10) * figures *	1-14	INV. F28D9/00 F28F3/08 F28F3/10
A	US 2011/259561 A1 (KRANTZ JOAKIM [SE]) 27 October 2011 (2011-10-27) * figures *	1-14	
A	US 6 073 687 A (JENSEN BENNY [DK] ET AL) 13 June 2000 (2000-06-13) * figures *	1-14	
A	US 2016/282060 A1 (RASMUSSEN JENNY [SE]) 29 September 2016 (2016-09-29) * figures *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			F28D F28F
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		21 June 2024	Mellado Ramirez, J
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			

EPO FORM 1503 03.82 (P04C01)

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

EP 23 21 9588

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.

21-06-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2022233563 A1	10-11-2022	AU 2022270849 A1	07-12-2023
		BR 112023022404 A2	09-01-2024
		CA 3215595 A1	10-11-2022
		CN 117255929 A	19-12-2023
		EP 4086562 A1	09-11-2022
		JP 2024516446 A	15-04-2024
		KR 20240004727 A	11-01-2024
		US 2024200878 A1	20-06-2024
		WO 2022233563 A1	10-11-2022

US 2011259561 A1	27-10-2011	BR PI0923447 A2	12-01-2016
		CN 102317733 A	11-01-2012
		CN 104075609 A	01-10-2014
		DK 2361365 T3	25-01-2016
		EP 2361365 A2	31-08-2011
		ES 2554771 T3	23-12-2015
		JP 5307252 B2	02-10-2013
		JP 2012512382 A	31-05-2012
		KR 20110086169 A	27-07-2011
		PL 2361365 T3	31-03-2016
		RU 2011129630 A	27-01-2013
		SE 0850140 A1	17-06-2010
		US 2011259561 A1	27-10-2011
		WO 2010071551 A2	24-06-2010

US 6073687 A	13-06-2000	DE 19900629 A1	15-07-1999
		DK 2798 A	13-07-1999
		JP H11248391 A	07-09-1999
		US 6073687 A	13-06-2000

US 2016282060 A1	29-09-2016	CN 105814395 A	27-07-2016
		DK 2886998 T3	18-06-2018
		EP 2886998 A1	24-06-2015
		ES 2674657 T3	03-07-2018
		JP 6513679 B2	15-05-2019
		JP 2017500531 A	05-01-2017
		JP 2018044764 A	22-03-2018
		KR 20160101096 A	24-08-2016
		KR 20180082630 A	18-07-2018
		PL 2886998 T3	31-08-2018
		PT 2886998 T	28-06-2018
		RU 2641420 C1	17-01-2018
		US 2016282060 A1	29-09-2016
		US 2019390923 A1	26-12-2019
		WO 2015090931 A1	25-06-2015

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82