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(54) **DOUBLE PLATE HEAT EXCHANGER**

(57) The present invention relates to a plate element (2) comprising a first heat transfer plate (10) and a second heat transfer plate (20), the first heat transfer plate (10) and the second heat transfer plate (20) being connected to each other to form the plate element (2). Each of the first heat transfer plate (10) and the second heat transfer plate (20) is formed of a plate body with a main part with a heat exchanging portion (40) formed with a surface pattern (45). The first heat transfer plate (10) is formed with a first set of openings (3a, 3d) in first extension sections (50) reaching out from the main part of the plate body, and the second heat transfer plate (20) is formed with a second set of openings (3b, 3c) in second extension sections (50) reaching out from the main part of the plate body. The first extension sections (50) of the first heat transfer plate (10) and the second extension sections (50) of the second heat transfer plate (20) are positioned such that the first set of openings (3a, 3d) and the second set of openings (3b, 3c) are not overlapping. The present invention further relates to a plate heat exchanger (1).

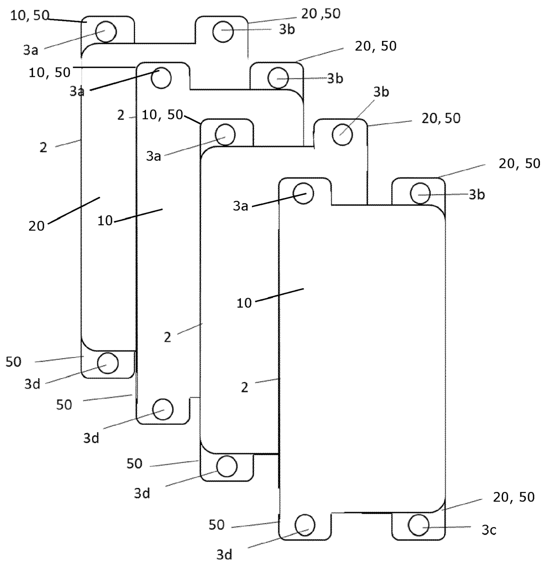

Fig. 5

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to plate heat exchangers of the kind having double plates. More specifically the present invention relates to double plate heat exchangers in which a leak in the opening areas does not lead to mixing of fluids.

BACKGROUND OF THE INVENTION

[0002] A plate heat exchanger exchanges heat between two or more fluids. In most plate heat exchangers, several stacked plate elements separate the fluids, each plate element having a central heat transferring part and a surrounding edge part. Sometimes particular care must be taken to avoid one heat exchanging fluid from leaking into the flow way of another heat exchanging fluid. This is, e.g., the case in heat exchangers which are used for heating or cooling potable fluids using non-potable fluids, in heat exchangers used for processing critical fluids, and in heat exchangers in which mixing of the two fluids would result in undesired chemical reactions. In these cases, a heat exchanger of the double wall type is normally used. In double wall heat exchangers, the plate elements separating the heat exchanging fluids each comprises two plates which are joined together. The opening areas are, however, still a critical part, since the area between the two plates of the double plate construction may lead fluid to the openings. The problem is especially severe for heat exchangers being subject to high pressure levels.

DESCRIPTION OF THE INVENTION

[0003] It is an object of embodiments of the invention to provide a plate element for a plate heat exchanger in which the risk of leaking between the flow paths of the plate heat exchanger is reduced as compared to prior art plate heat exchangers.

[0004] It is a further object of embodiments of the invention to provide a plate heat exchanger in which the risk of leaking between the flow paths of the plate heat exchanger is reduced as compared to prior art plate heat exchangers.

[0005] According to a first aspect the invention provides a plate element comprising a first heat transfer plate and a second heat transfer plate, the first heat transfer plate and the second heat transfer plate being connected to each other to form the plate element, each of the first heat transfer plate and the second heat transfer plate being formed of a plate body with a main part with a heat exchanging portion formed with a surface pattern, wherein the first heat transfer plate is formed with a first set of openings in first extension sections reaching out from the main part of the plate body, and the second heat transfer plate is formed with a second set of openings in second extension sections reaching out from the main part of the plate body,

wherein the first extension sections of the first heat transfer plate and the second extension sections of the second heat transfer plate are positioned such that the first set of openings and the second set of openings are not overlapping.

[0006] Thus, according to the first aspect, the invention provides a plate element comprising a first heat transfer plate and a second heat transfer plate, the first and second heat transfer plates being connected to each other to form the plate element. Accordingly, the plate element is of a double plate type.

[0007] The first heat transfer plate as well as the second heat transfer plate is formed of a plate body with a main part with a heat exchanging portion formed with a surface pattern. Thus, when the plate element, comprising the first and second heat transfer plates, forms part of a heat exchanger, heat exchange takes place across the plate element, in a region corresponding to the heat exchanging portions defined by the heat transfer plates.

[0008] The first heat transfer plate is formed with a first set of openings. The first set of openings are formed in first extension sections of the first heat transfer plate, and the first extension sections reach out from the main part of the plate body. Accordingly, the first extension sections do not form part of the main part of the plate body, and thereby of the patterned heat exchanging portion of the first heat transfer plate. Thus, the openings of the first set of openings are formed in a part of the first heat transfer plate which is not involved in the heat transfer across the plate element.

[0009] Similarly, the second heat transfer plate is formed with a second set of opening in second extension sections reaching out from the main part of the plate body of the second heat transfer plate. The remarks set forth above regarding the first set of openings formed in first heat transfer plate are equally applicable here.

[0010] The first extension sections of the first heat transfer plate and the second extension sections of the second heat transfer plate are positioned such that the first set of openings and the second set of openings are not overlapping. Accordingly, when the first heat transfer plate and the second heat transfer plate are connected in order to form the plate element, this is done in such a manner that there is no overlap between the first set of openings, i.e. the openings formed in the first heat transfer plate, and the second set of openings, i.e. the openings formed in the second heat transfer plate. This could, e.g., be obtained by ensuring that there is no overlap between the first extension sections, forming part of the first heat transfer plate, and the second extension sections, forming part of the second heat transfer plate.

[0011] This construction of the plate element efficiently enables a separation of fluid flow paths passing through the first set of openings and fluid flow paths passing through the second set of openings. This significantly reduces the risk of fluid leaking between the flow paths, and thereby of mixing of the heat exchanging fluids.

[0012] The surface patterns of the respective first heat transfer plate and second heat transfer plate may be formed such that they match each other, such that the surface pattern of one plate fits into the surface pattern of the other plate, thereby together appearing as a single surface pattern of the plate element.

[0013] According to this embodiment, the pattern formed in the heat exchanging portion of the first heat transfer plate matches the pattern formed in the heat exchanging portion of the second heat transfer plate, in the sense that hills and valleys of one pattern coincides with hills and valleys of the other pattern. Thereby the plate element appears as having one single surface pattern, and the distance from one side of the plate element to an opposite side of the plate element is minimised across the entire heat exchanging portion. Accordingly, at any given position on the heat exchanging portion, the distance through the plate element is minimal, ideally corresponding to the sum of the thickness of the first heat transfer plate and the thickness of the second heat transfer plate. This ensures an efficient heat transfer through the plate element across the entire area of the heat exchanging portion. Furthermore, this allows the plate element to be applied in a heat exchanger in a manner similar to a traditional single heat transfer plate.

[0014] The first heat transfer plate and the second heat transfer plate may be identical, and the second heat transfer plate may be rotated 180° relative to the first heat transfer plate around a centre axis extending along a length direction of the plate element.

[0015] According to this embodiment, the heat transfer plates are identical. However, when the heat transfer plates are connected to each other in order to form the plate element, one of the heat transfer plates is rotated 180° relative to the other heat transfer plate around a longitudinal centre axis defined by the plate element. Thus, the heat transfer plates may be regarded as comprising a first side and a second, opposite, side. When the heat transfer plates are connected to form the plate element, the first side of the first heat transfer plate faces the first side of the second heat transfer plate, and the second sides of the first and second heat transfer plates form the outer surfaces of the plate element.

[0016] By applying identical heat transfer plates, it is obtained that fewer different parts are required for manufacturing the plate element and a heat exchanger comprising a stack of such plate elements. This reduces the manufacturing costs and allows for simple and easy manufacture.

[0017] One of the first set of openings may be formed in an extension section arranged at one end of the first heat transfer plate, and the other of the first set of openings may be formed in an extension section arranged at another, oppositely arranged, end of the first heat transfer plate, along a line being parallel to a long edge of the first heat transfer plate.

[0018] According to this embodiment, the openings of the first set of openings are arranged at opposite ends of the first heat transfer plate, along the direction of the long edge thereof. Thereby a flow path can be defined along one side of the first heat transfer plate with an inlet defined by one of the openings of the first set of openings and an outlet defined by the other of the openings of the first set of openings. The flow path defined in this manner will extend along the entire length of the first heat transfer plate.

[0019] The oppositely arranged extension sections of the first heat transfer plate may be positioned directly opposite each other along the line being parallel to the long edge of the first heat transfer plate. According to this embodiment, the flow path defined along the side of the first heat transfer plate extends substantially parallel to the long edge of the first heat transfer plate.

[0020] As an alternative, the oppositely arranged extension sections of the first heat transfer plate may be positioned at diagonally opposite corners of the first heat transfer plate. According to this embodiment, the flow path defined along the side of the first heat transfer plate extends substantially diagonally along the first heat transfer plate.

[0021] Similarly, one of the second set of openings may be formed in an extension section arranged at one end of the second heat transfer plate, and the other of the second set of openings may be formed in an extension section arranged at another, oppositely arranged, end of the second heat transfer plate, along a line parallel to a long edge of the second heat transfer plate. The remarks set forth above with reference to the first heat transfer plate are equally applicable here.

[0022] In particular, the oppositely arranged extension sections of the second heat transfer plate may be positioned directly opposite each other along the line being parallel to the long edge of the second heat transfer plate, or, alternatively, the oppositely arranged extension sections of the second heat transfer plate may be positioned at diagonally opposite corners of the second heat transfer plate.

[0023] The first heat transfer plate may be made from a first material, and the second heat transfer plate may be made from a second material, wherein the second material differs from the first material.

[0024] According to this embodiment, the material of the first heat transfer plate and the material of the second heat transfer plate, respectively, may be selected independently of each other in order to meet various requirements. For instance, if the heat exchanging fluid flowing along the first heat transfer plate is highly corrosive, but the fluid flowing along the second heat transfer plate is not, a material which is very corrosive resistant may be selected for the first heat transfer plate. However, the material for the second heat transfer plate need not be particularly corrosive resistant, and therefore a material may be selected which meets other requirements, such as requirements related to strength, durability, heat conductance, cost, availability, etc.

[0025] For instance, the first material may be a metal and the second material may be a plastic material. The metal could, e.g., be steel, such as stainless steel, S316L, S904L, AL201 or other heat transferring materials which are normally applied in heat exchangers. The plastic material could, e.g., be a thermoplastic or a thermo-hardening plastic, with or without fibres of various types. Metals, such as stainless steel, are known to provide high strength and stability. On the other hand, some plastic materials, such as thermoplastics or thermo-hardening plastics, are known to be corrosive resistant as well as to have high heat transfer capability. Thus, by manufacturing the first heat transfer plate from a metal, such as stainless steel, and the second heat transfer plate from a plastic material, such as a thermoplastic or a thermo-hardening plastic, the resulting plate element will have the strength and stability provided by the metal of the first heat transfer plate, as well as the corrosive resistance and heat transfer capability provided by the plastic material of the second heat transfer plate.

[0026] According to a second aspect the invention provides a heat exchanger comprising two or more stacked plate elements according to the first aspect of the invention, thereby forming a first flow path along one side of a given plate element and along a connected first neighbouring plate element, between an inlet of the first set of openings and an outlet of the first set of openings, and forming a second flow path along an opposite side of the plate element and along a connected second neighbouring plate element, between an inlet of the second set of openings and an outlet of the second set of openings.

[0027] Thus, according to the second aspect the invention provides a heat exchanger comprising two or more stacked plate elements according to the first aspect of the invention, i.e. plate elements of the kind described above. Accordingly, the remarks set forth above with reference to the first aspect of the invention are equally applicable here.

[0028] The heat exchanger according to the second aspect of the invention is, thus, a plate heat exchanger, and the stacked plate elements form the heat transferring plates of the heat exchanger.

[0029] When the plate elements are stacked to form the heat exchanger, flow paths are formed between respective neighbouring plate elements, and fluid flowing in a given flow path is in thermal contact with both of the plate elements forming the flow path there between. Thus, for a given plate element, a first flow path is formed along one side of the plate element and a second flow path is formed along an opposite side of the plate element. Heat exchange takes place between fluid flowing in the first flow path and fluid flowing in the second flow path, via the heat exchanging portion defined by the heat transfer plates of the plate element.

[0030] The first flow path extends between an inlet and an outlet, respectively, in the form of the openings of the first set of openings, i.e. the openings formed in the extension sections of the first heat transfer plate. Similarly, the second flow path extends between an inlet and an outlet, respectively, in the form of the openings of the second set of openings, i.e. the openings formed in the extension sections of the second heat transfer plate. Accordingly, the first flow path is only in contact with the openings formed in the first heat transfer plate, and the second flow path is only in contact with the openings formed in the second heat transfer plate. Since the openings of the first set of openings and the openings of the second set of openings are non-overlapping, this efficiently ensures that the first flow path and the second flow path are separated, thereby efficiently preventing leaking between the first and second flow path and mixing of the heat exchanging fluids.

[0031] The plate elements may be stacked in such a manner that the first heat transfer plate of a given plate element is arranged adjacent to the first heat transfer plate of a first neighbouring plate element, and the second heat transfer plate of the given plate element is arranged adjacent to the second heat transfer plate of a second neighbouring plate element.

[0032] According to this embodiment, heat transfer plates of the same kind face each other and form flow paths there between. This is in particular an advantage in the case that the material of the first heat transfer plate differs from the material of the second heat transfer plate, because in this case a given flow path will have walls made from the same material. This would, e.g., allow a highly corrosive material to flow in one of the flow paths, without requiring that the walls of the other flow paths are made from a corrosive resistant material.

[0033] The plate elements may be stacked in such a manner that connecting rims of the second heat transfer plates of the plate elements are sandwiched between portions of two first heat transfer plates of the plate elements, the portions of the two first heat transfer plates facing an inner formed between the extension sections of the two first heat transfer plates.

[0034] Similarly, the plate elements may be stacked in such a manner that connecting rims of the first heat transfer plates of the plate elements are sandwiched between portions of two second heat transfer plates of the plate elements, the portions of the two second heat transfer plates facing an inner formed between the extension sections of the two second heat transfer plates.

[0035] This construction ensures that no flow path is formed within a given plate element between the first heat transfer plate and the second heat transfer plate between the openings formed in the respective heat transfer plates. In the case of a fluid leak in the region of one of the openings, the fluid will leak into the area or region between the heat transfer plates, rather than into the other flow path.

[0036] Connected first heat transfer plates and connected second heat transfer plates of neighbouring plate elements may be sealed at the circumference of the respective openings, thereby separating them from the inner formed between the respective extension sections of the heat transfer plates.

[0037] According to this embodiment, it is efficiently ensured that fluid leaking from one of the openings and entering the volume between two heat transfer plates of neighbouring plate elements leaks into the inner formed between the extension sections, rather than into the other flow path.

[0038] The extension sections of the first heat transfer plates of the plate elements may be positioned such that the respective first sets of openings are aligned, and the extension sections of the second heat transfer plates of the plate elements may be positioned such that the respective second sets of openings are aligned.

[0039] According to this embodiment, the openings being connected to the first flow path are aligned and the openings being connected to the second flow path are aligned. Thereby fluid flows of the respective heat transferring fluids can easily be supplied to the correct flow paths. This ensures that the two heat transferring fluids are efficiently separated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040]

Fig. 1 is a general illustration of the principle of a plate kind heat exchanger according to prior art,

Fig. 2 is a general illustration of the principle of a double plate for a heat exchanger according to prior art,

Fig. 3 is a general illustration of a first heat transfer plate and a second heat transfer plate formed with extension sections with openings according to an embodiment of the present invention,

Fig. 4 is a general illustration of a plate element formed of a first heat transfer plate and a second heat transfer plate formed with extension sections with openings according to an embodiment of the present invention,

Fig. 5 is a general illustration of four plate elements formed of a first heat transfer plate and a second heat transfer plate formed with extension sections with openings according to an embodiment of the present invention and adapted to be stacked into a heat exchanger,

Figs. 6A and 6B are general illustrations of four plate elements stacked into a heat exchanger showing the extension sections.

DETAILED DESCRIPTION OF THE DRAWINGS

[0041] The detailed description and specific examples, while indicating embodiments of the invention, are given by way of illustration only.

[0042] Fig. 1 illustrates a prior art heat exchanger 1 formed of plate elements 2 connected to neighbouring plate elements 2. Each plate element 2 is formed with openings 3a, 3b, 3c, 3b and a heat exchanging portion 40 with surface patterns 45. When stacked, the connected surface patterns 45 of neighbouring plate elements 2 form flow paths A, B at the respective opposite surfaces of the plate elements 2, a first flow path A at one surface and a second flow path B at the opposite surface, each passing the heat exchanging portion 40 from an inlet to an outlet opening 3a, 3b, 3c, 3b. Further, the openings 3a, 3b, 3c, 3b are aligned forming respectively a first set of openings 3a, 3d defining an inlet and outlet to a first flow path A, and a second set of openings 3b, 3c defining an inlet and outlet 3b, 3c to a second flow path B. The first set of openings 3a, 3d and first flow path A are sealed from the second set of openings 3b, 3c and second flow path B, allowing two fluids to pass through the heat exchanger 1 without the two fluids contacting and mixing. The heat exchanger 1 is adapted for heat to be transferring from the hotter to the colder of the fluids flowing in the flow paths A, B over the plate elements 2.

[0043] The plate elements 2 are of a double wall construction, see Fig. 2, comprising a first heat transfer plate 10 and a second heat transfer plate 20, each comprising a main part including at least the main portion of a central heat exchanging portion 40 provided with surface patterns 45. The first heat transfer plate 10 and the second heat transfer plate 20 are connected over most of their extension, such as at the central heat exchanging portion 40. If one of the heat transfer plates 10, 20 should fail, e.g. by forming cracks, the other will ensure that the fluids will not leak between the first flow path A and the second flow path B. The first heat transfer plate 10 and the second heat transfer plate 20 may not be tightly contacting over the full extension of the plates 10, 20, and the leaking fluid thus could flow into the volume between the two heat transfer plates 10, 20.

[0044] The surface patterns 45 of the respective first heat transfer plate 10 and second heat transfer plate 20 are formed such that they match each other, such that the surface pattern 45 of one plate 10, 20 fits into the surface pattern 45 of the other plate 20, 10, together appearing as a single surface pattern 45 of the plate element 2.

[0045] The surface pattern 45 of the plate element 2 is formed such that if a similar plate element 2, possible turned 180° around an axis through the centre of the plate element 2 in a length direction, then the contacting surface patterns 45 form respectively the first flow path A at the one side of the plate element 2, and the second flow path B at the opposite side of the plate element 2, relative to the first side.

[0046] Each of the plate elements 2 is formed with a first set of openings 3a, 3d as well as a second set of openings 3b, 3c. This introduces a risk of fluid leaking from the first flow path A or the second flow path B to the wrong of the first set of openings 3a, 3d or the second set of openings 3b, 3c. For example, fluid entering the volume between the two heat transfer plates 10, 20 of a plate element 2 may leak into the wrong of the first set of openings 3a, 3d or the second set of openings 3b, 3c.

[0047] Fig. 3 illustrates an embodiment solution where a first heat transfer plate 10 is formed with extension sections 50 reaching out of the main part of the heat transfer plate 10. The openings of a first set of openings 3a, 3d are formed in the extension sections 50.

[0048] In the illustrated embodiment an extension section 50 comprising one of the first set openings 3a is formed at the one end of the first heat transfer plate 10, and the other of the first set openings 3d is formed at the opposite end of the first heat transfer plate 10. The two extension sections 50 may be positioned directly opposite each other along a line parallel to the long edge of the first heat transfer plate 10, and thereby of a heat exchanger in which the first heat transfer plate 10 is arranged. In another embodiment the extension sections 50 may be positioned diagonally with respect to each other, e.g. at diagonally opposite corners of the first heat transfer plate 10, i.e. the opposite corners corresponding to the corners crossed by a diagonal of the first heat transfer plate 10. In a more general embodiment, they may be positioned at any position at the short edge or the long edge of the first heat transfer plate 10.

[0049] The second heat transfer plate 20 is very similar the first heat transfer plate 10, and it is formed in a similar manner, in the sense that a second set of openings 3b, 3c are formed in extension sections 50. In the illustrated embodiment an extension section 50 comprising one of the second set openings 3b is formed at the one end of the second heat transfer plate 20, and the other of the second set openings 3c is formed at the opposite end of the second heat transfer plate 20. Similarly to what is described above with reference to the first heat transfer plate 10, the two extension sections 50 of the second heat transfer plate 20 may be positioned directly opposite each other along a line parallel to the long edge of the second heat transfer plate 20, diagonally, or at any position at the short edge or the long edge of the second heat transfer plate 20.

[0050] The extension sections 50 of the first heat transfer plate 10 and the extension sections 50 of the second heat transfer plate 20 are positioned such that when the first heat transfer plate 10 and the second heat transfer plate 20 are positioned adjacent to each other with matching main parts, the extension sections 50, or at least the respective openings 3a, 3b, 3c, 3d, of the respective heat transfer plates 10, 20, are free from each other or are not contacting/overlapping. This is also illustrated in Fig. 4.

[0051] In general, the extension sections 50 may be formed with surface patterns 45 adapted to connect to surface patterns 45 of extension sections 50 of neighbouring plate elements 2 when stacked into a heat exchanger 1, and may thus form a minor part of the heat exchanging portion 40.

[0052] The extended sections 50 may also be formed with surface patterns adapted to distribute the fluid to the entire width of the plate element 2, and/or similarly to feed it to an opening 3a, 3b, 3c, 3d from the heat exchanging portion 40.

[0053] The main part of the heat transfer plate 10, 20 may be of a regular shape, such as substantially rectangular, oval, pentagonal, hexagonal, etc., where the extension sections 50 form 'ears' to the regular shape, or more generally, reach or protrude out from the regular shape.

[0054] The first heat transfer plate 10 and the second heat transfer plate 20, with their respective extension sections 50, may be formed such that when connected into a plate element 2 they appear as a single plate, possible having a combined shape and size similar to that of a standard plate element 2 as known in the prior art. Together they may be substantially rectangular (possible with rounded corners), or having another more regular shape. This is also reflected in that, even though each of the first heat transfer plate 10 and the second heat transfer plate 20 only comprises one set of openings, such as the first heat transfer plate 10 being formed with the first set of openings 3a, 3d and the second heat transfer plate 20 being formed with the second set of openings 3b, 3c, when combined into a plate element 2, the plate element 2 comprises the first set of openings 3a, 3d as well as the second set of openings 3b, 3c.

[0055] In general, the plate elements 2 may be adapted to function as general heat transfer plates of known single and double kind plate heat exchangers 1.

[0056] Fig. 5 illustrates four plate elements 2 to be positioned on top of each other for a plate heat exchanger 1, each formed of a first heat transfer plate 10 and a second heat transfer plate 20, showing the extension sections 50, each formed with an opening 3a, 3b, 3c, 3d.

[0057] In the illustrated embodiment the plate elements 2 are connected such that a first heat transfer plate 10 of a given plate element 2 connects to a first heat transfer plate 10 of one neighbouring plate element 2, and the second heat transfer plate 20 of the given plate element 2 connects to a second heat transfer plate 20 of the other neighbouring plate element 2. The extension sections 50 of the first heat transfer plates 10 are positioned such that the respective first set of openings 3a, 3d of a plate element 2 are aligned with the respective first set of openings 3a, 3d of the neighbouring plate elements 2. Correspondingly, the extension sections 50 of the second heat transfer plates 20 are positioned such that the respective second set of openings 3b, 3c of a plate element 2 are aligned with the respective second set of openings 3b, 3c of the neighbouring plate elements 2.

[0058] The neighbouring plate elements 2 may be fixed, or at least sealed, along the rims 10', 20' of the connected heat transfer plates 10, 20.

[0059] Figs. 6A and 6B illustrate the respective extension sections 50 of four plate elements 2, where Fig. 6A shows the extension sections 50 of the first heat transfer plates 10, and Fig. 6B shows the extension sections 50 of the second heat transfer plates 20.

[0060] Seen in Fig. 6A is the connected second heat transfer plates 20 not reaching the extension sections 50 of the first heat transfer plates 10 with the openings 3a, 3d. In the same manner, in Fig. 6B the connected first heat transfer plates 10 are seen not reaching the openings 3b, 3d, and not reaching the extension portions 50 of the second heat transfer plates 20.

[0061] This construction ensures that no path is formed within the plate elements 2 between the first heat transfer plate 10 and the second heat transfer plate 20 to the respective openings 3a, 3b, 3c, 3d. A fluid leaking, for some reason, into the area between first heat transfer plate 10 and the second heat transfer plate 20 of the plate element 2 will not have contact to the openings 3a, 3b, 3c, 3d, but would either be sealed within the area or leak out at the edges.

[0062] As illustrated, the connected first heat transfer plates 10 and the connected second heat transfer plates 20 are sealed 60 at the circumference of the respective openings 3a, 3b, 3c, 3d, separating them from the inner 55 of the connected extension sections 50. In this embodiment, the connected rims 20' of the second heat transfer plates 20 are sandwiched between two first heat transfer plates 10 (of the respective and the neighbouring plate element 2).

[0063] Leaking fluid entering the volume between the two heat transfer plates 10, 20 of the neighbouring plate elements 2, thus, would leak to the inner 55 rather than into the openings 3a, 3b, 3c, 3d.

[0064] The connected extension sections 50 may be open at their rims, e.g. formed with drain openings, allowing the fluid leaking into the inner 55 to exit the heat exchanger 1 to be detected.

[0065] In general, the openings 3a, 3b, 3c, 3d are known to form weak areas, in terms of risk of leaking, since this is the areas of the highest pressure differences. The construction according to the present invention prevent mixing of the fluids at the openings 3a, 3b, 3c, 3d. The invention further enables the use of substantially thin heat transfer plates 10, 20, even for high pressure systems, since a deforming or cracking heat transfer plate 10, 20 would not leak to the openings 3a, 3b, 3c, 3d of the other of the flow paths A, B, since they are separated.

[0066] Often two distinct heat exchangers are used, the present invention allows the use of a single heat exchanger.

References

[0067]

1 - Plate heat exchanger
2 - Plate element
3a, 3b, 3c, 3d - Openings
10 - First heat transfer plate
10' - First heat transfer plate rim
20 - second heat transfer plate
20' - Second heat transfer plate rim
40 - Heat exchanging portion
45 - Surface patterns
50 - Extension sections
55 - Inner
60 - Sealing

Claims

1. A plate element (2) comprising a first heat transfer plate (10) and a second heat transfer plate (20), the first heat transfer plate (10) and the second heat transfer plate (20) being connected to each other to form the plate element (2), each of the first heat transfer plate (10) and the second heat transfer plate (20) being formed of a plate body with a main part with a heat exchanging portion (40) formed with a surface pattern (45), wherein the first heat transfer plate (10) is formed with a first set of openings (3a, 3d) in first extension sections (50) reaching out from the main part of the plate body, and the second heat transfer plate (20) is formed with a second set of openings (3b, 3c) in second extension sections (50) reaching out from the main part of the plate body,
wherein the first extension sections (50) of the first heat transfer plate (10) and the second extension sections (50) of the second heat transfer plate (20) are positioned such that the first set of openings (3a, 3d) and the second set of openings (3b, 3c) are not overlapping.

2. A plate element (2) according to claim 1, wherein the surface patterns (45) of the respective first heat transfer plate (10) and second heat transfer plate (20) are formed such that they match each other, such that the surface pattern (45) of one plate (10, 20) fits into the surface pattern (45) of the other plate (20, 10), thereby together appearing as a single surface pattern (45) of the plate element (2).

3. A plate element (2) according to claim 1 or 2, wherein the first heat transfer plate (10) and the second heat transfer plate (20) are identical, and wherein the second heat transfer plate (20) is rotated 180° relative to the first heat transfer plate (10) around a centre axis extending along a length direction of the plate element (2).

4. A plate element (2) according to any of the preceding claims, wherein one of the first set of openings (3a) is formed in an extension section (50) arranged at one end of the first heat transfer plate (10), and the other of the first set of openings (3d) is formed in an extension section (50) arranged at another, oppositely arranged, end of the first heat transfer plate (10), along a line being parallel to a long edge of the

first heat transfer plate (10).

5. A plate element (2) according to claim 4, wherein the oppositely arranged extension sections (50) of the first heat transfer plate (10) are positioned directly opposite each other along the line being parallel to the long edge of the first heat transfer plate (10).

6. A plate element (2) according to claim 4, wherein the oppositely arranged extension sections (50) of the first heat transfer plate (10) are positioned at diagonally opposite corners of the first heat transfer plate (10).

7. A plate element (2) according to any of the preceding claims, wherein one of the second set of openings (3b) is formed in an extension section (50) arranged at one end of the second heat transfer plate (20), and the other of the second set of openings (3c) is formed in an extension section (50) arranged at another, oppositely arranged, end of the second heat transfer plate (20), along a line parallel to a long edge of the second heat transfer plate (20).

8. A plate element (2) according to claim 7, wherein the oppositely arranged extension sections (50) of the second heat transfer plate (20) are positioned directly opposite each other along the line being parallel to the long edge of the second heat transfer plate (10).

9. A plate element (2) according to claim 7, wherein the oppositely arranged extension sections (50) of the second heat transfer plate (20) are positioned at diagonally opposite corners of the second heat transfer plate (20).

10. A plate element (2) according to any of the preceding claims, wherein the first heat transfer plate (10) is made from a first material, and the second heat transfer plate (20) is made from a second material, wherein the second material differs from the first material.

11. A plate element (2) according to claim 10, wherein the first material is a metal and the second material is a plastic material.

12. A heat exchanger (1) comprising two or more stacked plate elements (2) according to any of the preceding claims, thereby forming a first flow path (A) along one side of a given plate element (2) and along a connected first neighbouring plate element (2), between an inlet of the first set of openings (3a, 3d) and an outlet of the first set of openings (3a, 3d), and forming a second flow path (B) along an opposite side of the plate element (2) and along a connected second neighbouring plate element (2), between an inlet of the second set of openings (3b, 3c) and an outlet of the second set of openings (3b, 3c).

13. A heat exchanger (1) according to claim 12, wherein the plate elements (2) are stacked in such a manner that the first heat transfer plate (10) of a given plate element (2) is arranged adjacent to the first heat transfer plate (10) of a first neighbouring plate element (2), and the second heat transfer plate (20) of the given plate element (2) is arranged adjacent to the second heat transfer plate (20) of a second neighbouring plate element (2).

14. A heat exchanger (1) according to claim 12 or 13, wherein the plate elements (2) are stacked in such a manner that connecting rims (20') of the second heat transfer plates (20) of the plate elements (2) are sandwiched between portions of two first heat transfer plates (10) of the plate elements (2), the portions of the two first heat transfer plates (10) facing an inner (55) formed between the extension sections (50) of the two first heat transfer plates (10).

15. A heat exchanger (1) according to any of claims 12-14, wherein the plate elements (2) are stacked in such a manner that connecting rims (10') of the first heat transfer plates (10) of the plate elements (2) are sandwiched between portions of two second heat transfer plates (20) of the plate elements (2), the portions of the two second heat transfer plates (20) facing an inner (55) formed between the extension sections (50) of the two second heat transfer plates (20).

16. A heat exchanger (1) according to claim 14 or 15, wherein connected first heat transfer plates (10) and connected second heat transfer plates (20) of neighbouring plate elements (2) are sealed (60) at the circumference of the respective openings (3a, 3b, 3c, 3d), thereby separating them from the inner (55) formed between the respective extension sections (50) of the heat transfer plates (10, 20).

17. A heat exchanger (1) according to any of claims 12-16, wherein the extension sections (50) of the first heat transfer plates (10) of the plate elements (2) are positioned such that the respective first sets of openings (3a, 3d) are aligned, and the extension sections (50) of the second heat transfer plates (20) of the plate elements (2) are positioned such that the respective second sets of openings (3b, 3c) are aligned.

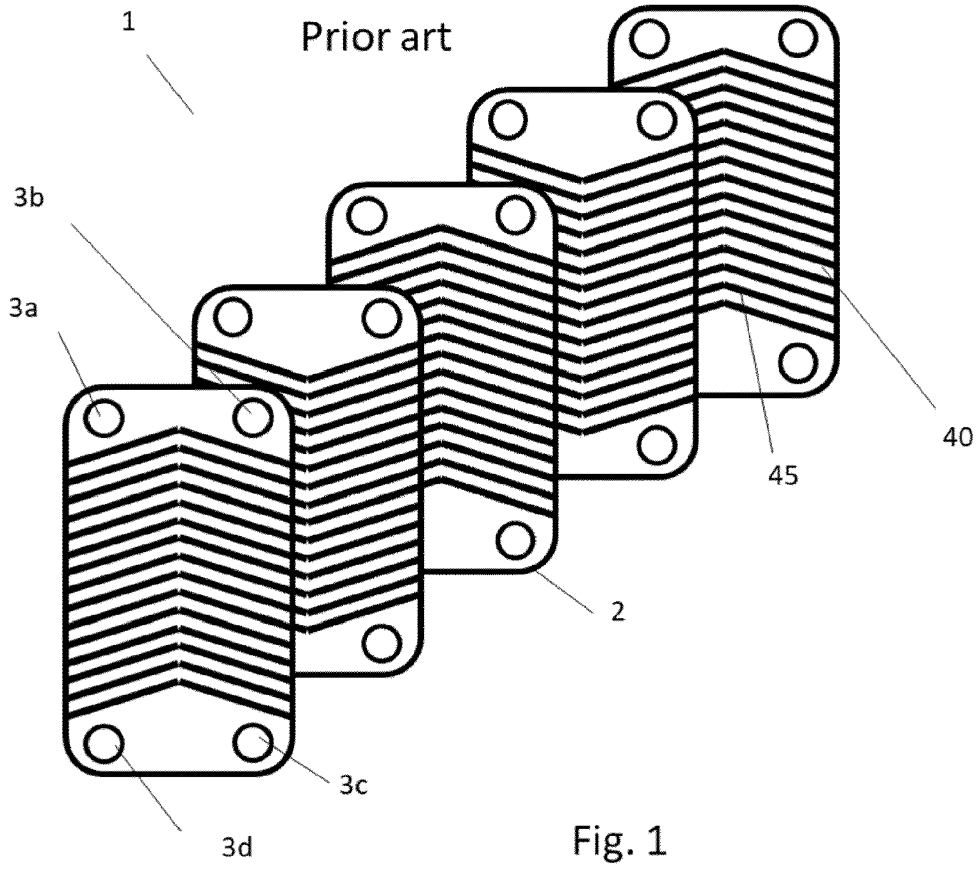
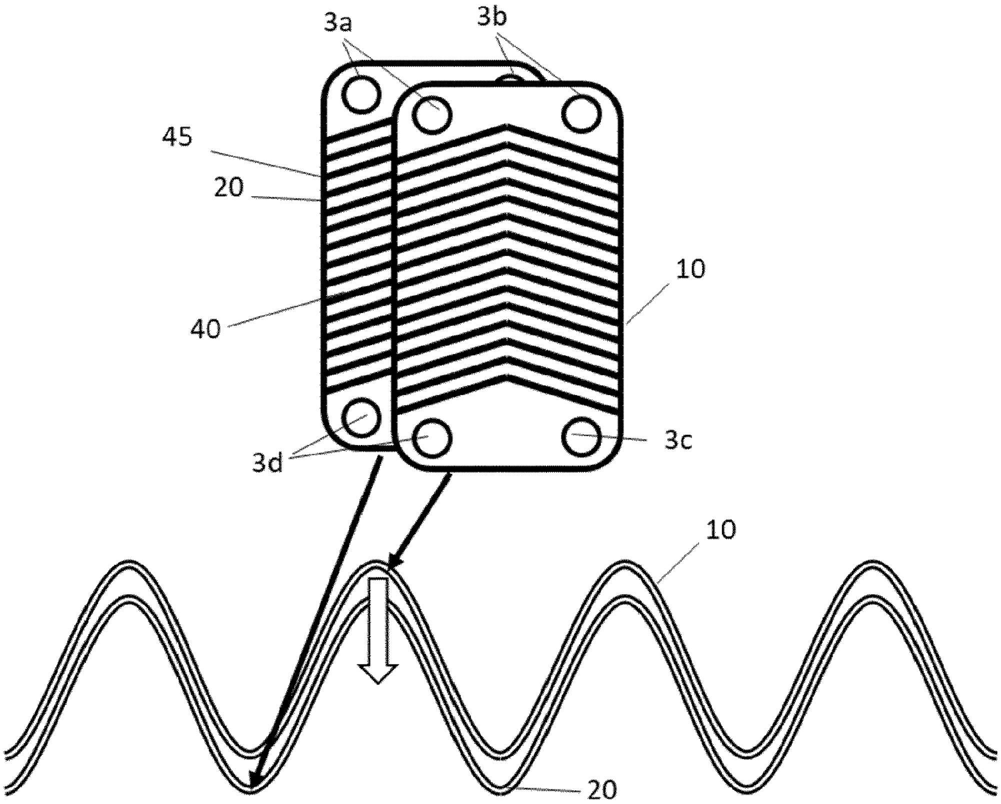


Fig. 1



Prior art
Fig. 2

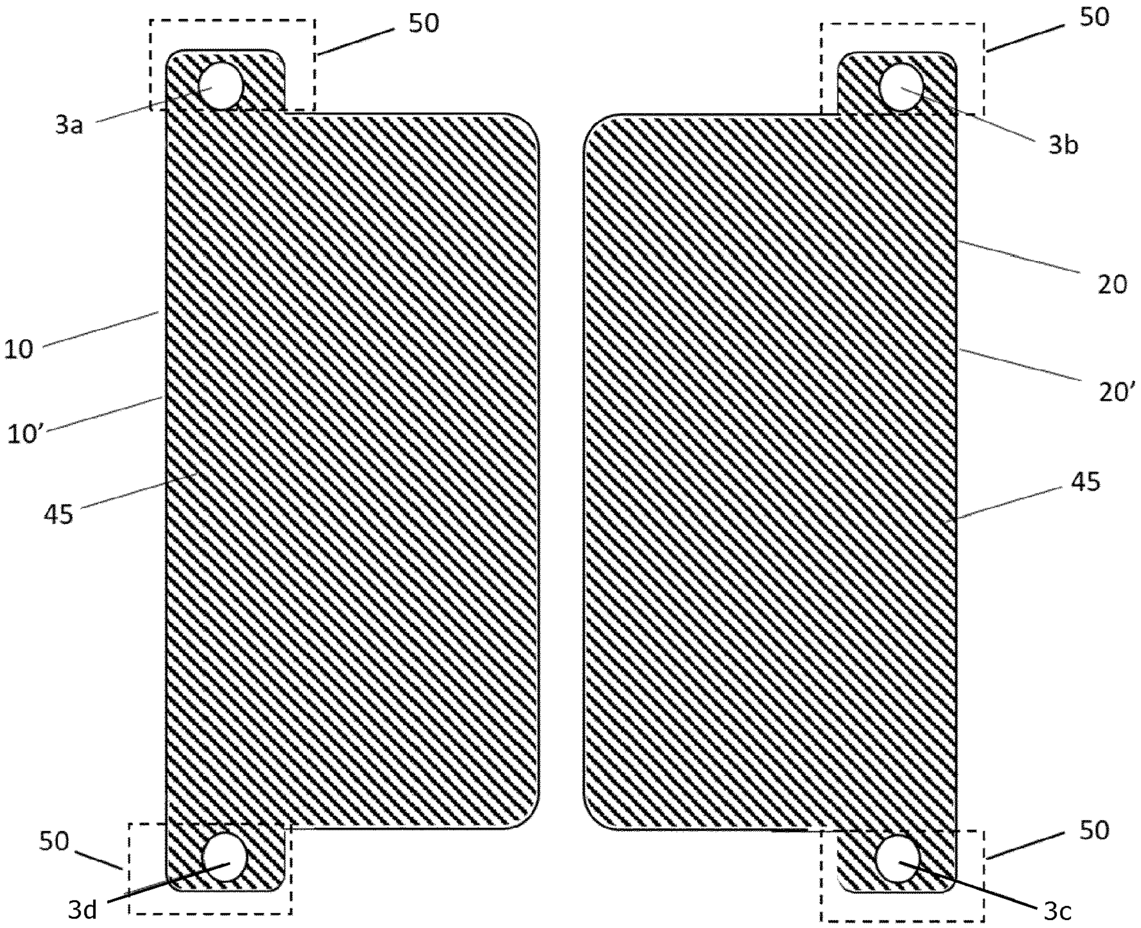


Fig. 3

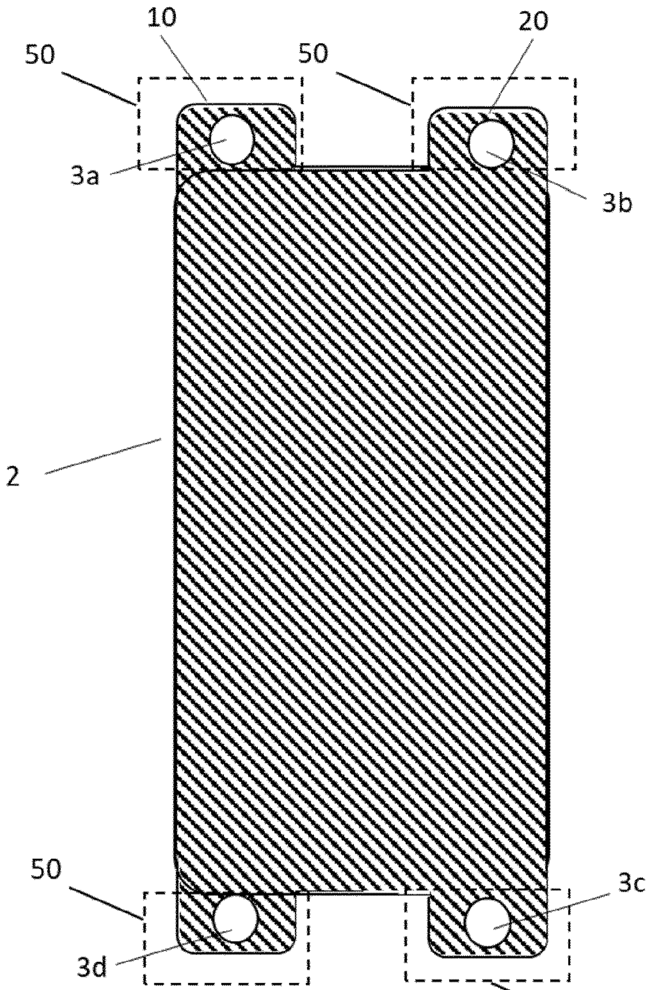


Fig. 4

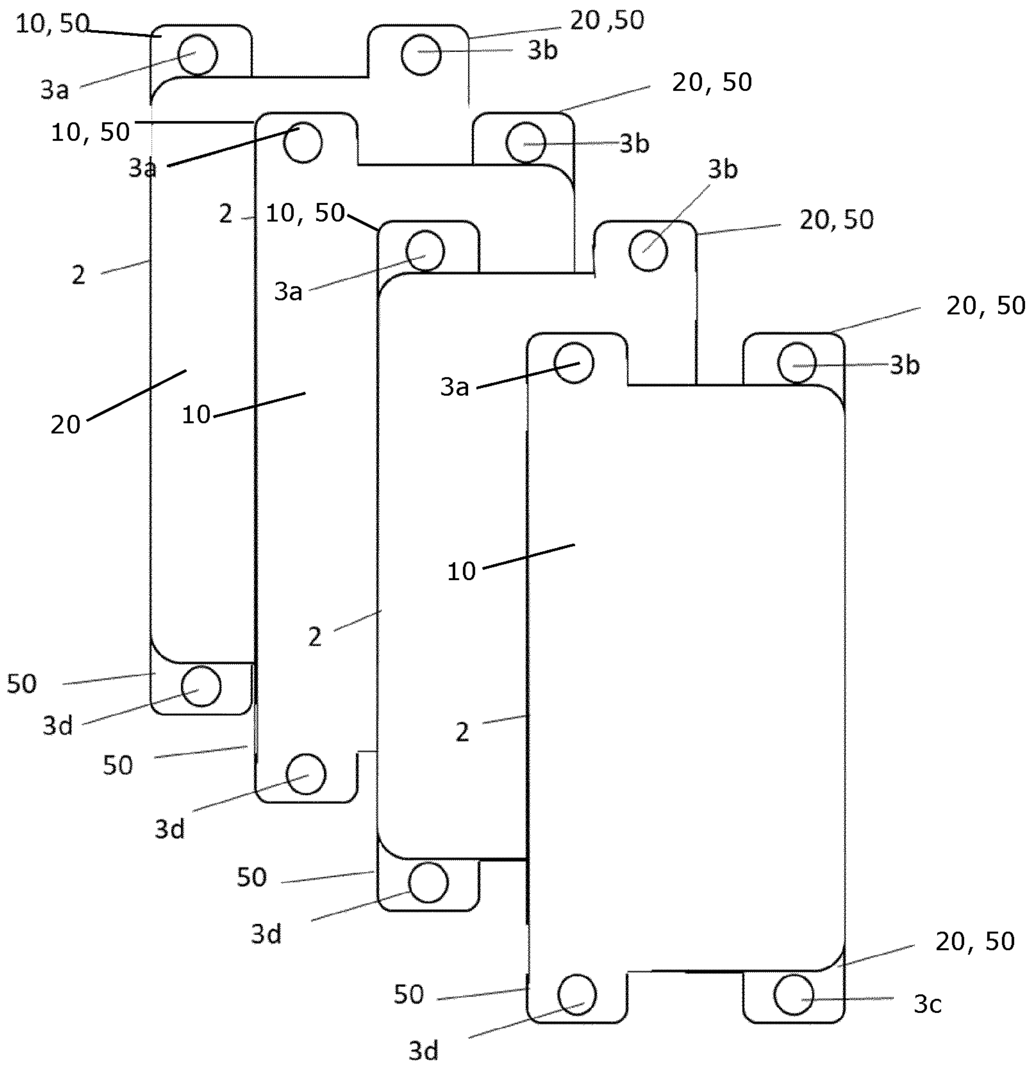

10, 50
20 ,50
3b
3a
20, 50
10, 50
3b
3a
3b
2
10, 50
20, 50
2
3a
20, 50
3a
3b
20
10
10
2
50
3d
50
3d
2
50
3d
20, 50
50
3c
3d

Fig. 5

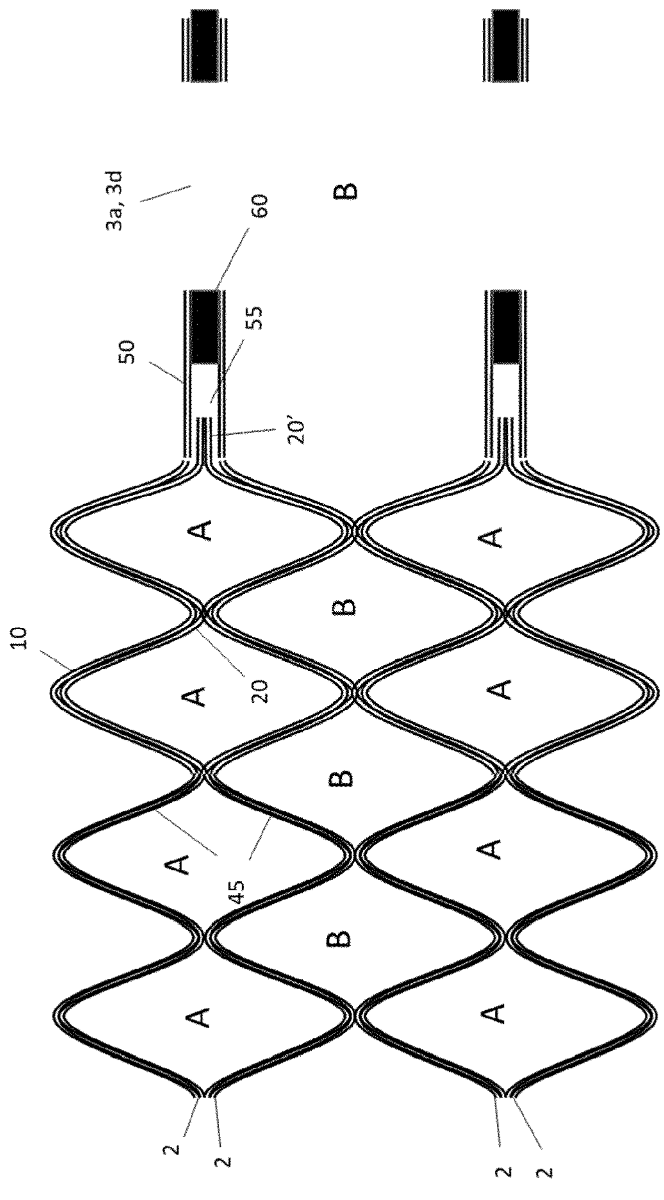


Fig. 6A

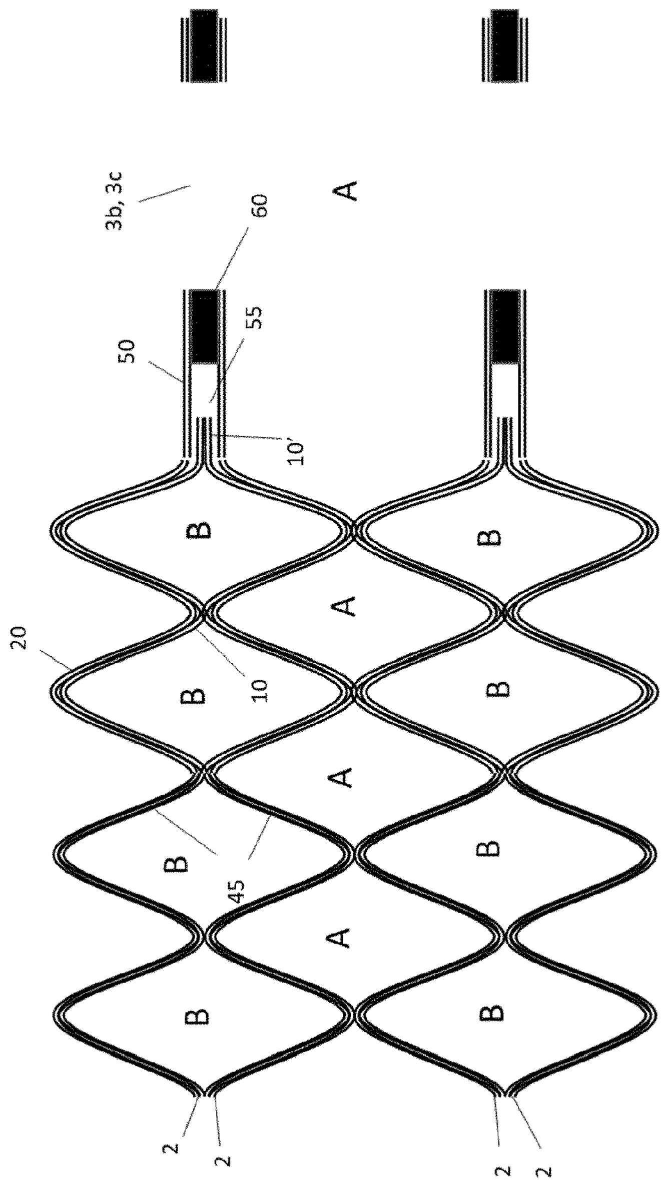


Fig. 6B

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EUROPEAN SEARCH REPORT

Application Number
EP 22 21 4234

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	10 May 2023	Vassoille, Bruno

CATEGORY OF CITED DOCUMENTS

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