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(54) **HEAT EXCHANGER**

(57) The present invention relates to a heat exchanger (1) comprising a top plate (2) and a bottom plate (3), wherein between the top plate (2) and the bottom plate (3) two heat exchanger stacks (4,7) are provided, wherein the heat exchanger stacks (4,7) are separated by a separating plate (6).

The underlying problem of the present invention is to provide a heat exchanger (1) which can be adapted easily.

This problem is solved by a heat exchanger (1), wherein first heat exchanger plates (5) forming the first heat exchanger stack (4) differ from second heat exchanger plates (8) forming the second heat exchanger stack (7).

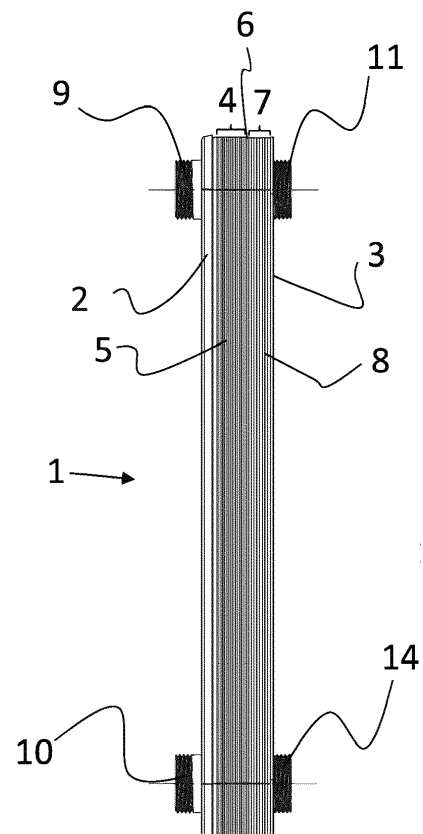


Fig. 1

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Description

[0001] The present invention relates to a heat exchanger comprising a top plate and a bottom plate, wherein a plurality of heat exchanger plates are arranged between the top plate and the bottom plate, wherein adjacent heat exchanger plates cooperate to form fluid channels, wherein several heat exchanger plates form a stack, wherein a first stack and a second stack are arranged between the top plate and bottom plate, wherein a separating plate is arranged between the first stack and the second stack, wherein the first stack comprises a first fluid channel and a second fluid channel and the second stack comprises a third fluid channel and a fourth fluid channel, wherein the second fluid channel and the third fluid channel are fluidly connected.

[0002] Further, the invention relates to a method to assemble said heat exchanger.

[0003] A heat exchanger is a system used to transfer heat between a first fluid and a second fluid. In the present case, the heat exchanger is used to transfer heat from the first fluid to a second fluid and to a third fluid. The first fluid is provided to the second fluid channel, which is fluidly connected to the third fluid channel. Within the first stack, heat is transferred from the second fluid channel to the first fluid channel, while in the second stack heat is transferred from the third fluid channel to the fourth fluid channel. The heat exchanger can also be used for cooling processes.

[0004] Several heat exchanger plates form a heat exchanger stack, in the following stack. Within such a stack, two fluid channels are formed, wherein the fluid channels are separated from each other. In order to separate the first fluid channel from the fourth fluid channel, the separating plate is provided between the first stack and the second stack. This separating plate comprises a fluidic recess, which connects the second fluid channel and the third fluid channel fluidly. Thus, heat can be transferred from fluid which is provided in the second and third fluid channel to the first and fourth fluid channel.

[0005] EP 3 385 653 B1 describes a heat exchanger comprising a first stack and a second stack of heat exchanger plates, wherein the first stack is separated from the second stack by a separating plate. Both stacks comprise two fluid channels, wherein one fluid channel of the first stack is connected to one fluid channel of the second stack.

[0006] The problem underlying this invention is to propose a simple adaption possibility for heat exchangers.

[0007] This problem is solved by the features of claims 1 and 8.

[0008] For this purpose, the first stack is formed of first heat exchanger plates, and the second stack is formed of second heat exchanger plates, wherein the first heat exchanger plates (5) or the second heat exchanger plates (8) are formed of single wall heat exchanger plates and the respective other heat exchanger plates (8, 5) are formed of double wall heat exchanger plates, or the first

heat exchanger plates (5) and the and the second heat exchanger plates (8) are formed of double wall heat exchanger plates. This allows a good flexibility of the heat exchanger, such that the heat exchanger is adaptable to different requirements with regard heat exchanging properties of the fluids, safety requirements etc.

[0009] In a preferred embodiment, the first heat exchanger plates differ in form, material, construction and/or type from the second heat exchanger plates. For example, the first heat exchanger plates are single wall heat exchanger plates or double wall heat exchanger plates, while the second heat exchanger plates are single wall heat exchanger plates or double wall heat exchanger plates. This allows a good heat exchanger efficiency between the fluid provided to the second respectively third fluid channel and fluid provided to the first fluid channel respectively fourth fluid channel. Depending on the properties of each fluid, and the respective heat transfer properties of each fluid, the first heat exchanger plates and the second heat exchanger plates can be adapted accordingly. Furthermore, the first and second heat exchanger plates respectively the first and second stacks can be adapted to fit certain security aspects. For example, materials used for the first heat exchanger plates and the second heat exchanger plates might be different from each other, such that for example the first heat exchanger plates are formed from a plastic, while the second heat exchanger plates are formed from the metal. This allows a good adaption of the heat exchanger.

[0010] In an embodiment, the first stack is a single wall heat exchanger stack formed of single wall heat exchanger plates. A single wall heat exchanger stack comprises two fluidic channels, wherein the fluidic channels are separated by a single wall. This layout allows a good heat transfer efficiency from the first fluid to the second fluid. Furthermore, the second stack might be a single wall heat exchanger stack as well, wherein the first stack and second stack differ for example in their structures of heat exchanger plates or alike. Thus, the heat exchanger can be easily adapted to different conditions.

[0011] In an embodiment, the second stack is a double wall heat exchanger stack formed of double wall heat exchanger plates. A double wall heat exchanger stack comprises similar to a single wall heat exchanger stack two fluidic channels. In a double wall heat exchanger stack, these fluidic channels are separated by a double wall, respectively two walls. The term "walls" is equivalent to a heat exchanger plate. Such a double wall heat exchanger stack results in a good security since it prohibits a mixing of the two fluids, in case one of the two walls breaks, or a leaking in another manner. Leaking fluid is drained through a section arranged between those two walls. Thus, the two fluids cannot mix with each other. The leakage can be detected by sensors or visual inspections, for example. This results in a good security of the heat exchanger.

[0012] In an embodiment, a flow direction of the second and third fluid channel is oriented from the first stack to

the second stack. The flow direction can also be oriented from the second stack towards the first stack. The flow direction should be oriented according to the fluid, which of the two stacks requires to be heated more, than the other stack.

[0013] In an embodiment the separating plate comprises at least one positioning geometry, which is configured to interact with at least one matching geometry of the first and/or second heat exchanger plate. The separating plate respectively the positioning geometry is adapted to interact with the neighbouring heat exchanger plates. For example, such a positioning geometry might comprise an indentation, which interacts during an assembly process and/or in an assembled manner of the heat exchanger with protrusions of the neighbouring plate. Furthermore, for example, the separating plate might comprise at least a first positioning geometry, which is configured to interact with at least a first matching geometries of the neighbouring first heat exchanger plate, while the separating plate comprises at least a second positioning geometry, which is configured to interact with at least a second matching geometry of the second heat exchanger plate. Furthermore, for example, the separating plate can be used as an adapting element to arrange the first heat exchanger plate and the second heat exchanger plate adjacent to the separating plate. Thus, different types of heat exchanger plates forming different types of heat exchanger stacks can be assembled to each other using the separating plate in between. This results in a good flexibility and adaptability of the heat exchanger.

[0014] In an embodiment, a second fluid is supplied to the second fluid channel, while a first fluid is supplied to the first fluid channel and/or a fourth fluid is supplied to the fourth fluid channel. The second fluid is provided by a district heating system and is used to heat the first and the fourth fluid. Since the first and the fourth fluid are heated in different stacks, for example the fourth fluid might be heated using a single wall heat exchanger, while the first fluid can be heated using the double wall heat exchanger stack. This allows, that the first fluid is distanced from the second fluid such that a mixing of the second fluid and the first fluid is not possible. For example, the first fluid is drinking water, the second fluid is a working fluid, and the fourth fluid is sanitary water.

[0015] The above-described problem is also solved by the method according to claim 7. This method comprises the following steps:

- i. assembling the first stack of first heat exchanger plates,
- ii. assembling the second stack of second heat exchanger plates,
- iii. mounting the first stack to the top plate,
- iv. mounting the separating plate to the first stack,
- v. mounting the second stack to the separating plate,
- vi. mounting the base plate to the second stack.

[0016] In order to achieve a tightly sealed heat ex-

changer, for example, the elements are bonded to each other. Depending on the materials, such an attachment can be performed using for example methods of brazing, welding, gluing, fusing, a combination of the previous mentioned or alike. Furthermore, the described method allows a preassembly of the heat exchanger stacks, such that the heat exchanger stacks (stacks) can be mounted as one element to the top plate, the separating plate and the bottom plate. For example, the first heat exchanger stack is preassembled by a first bonding technology, for example brazing, welding, gluing, fusing, while the second heat exchanger stack is preassembled by a second bonding technology, which is different from the first bonding technology, allowing an efficient preassembly. Thus, an assembly of the heat exchanger is quick.

[0017] The invention is described in the following with reference to the preferred embodiment in conjunction with the drawing. Herein shows:

- Fig. 1 a schematic side view of a heat exchanger,
- Fig. 2 a schematic top view of a heat exchanger,
- Fig. 3 a schematic cross section of a heat exchanger in a longitudinal direction,
- Fig. 4 a schematic cross section of a heat exchanger in a cross direction
- Fig. 5 a schematic view of a separating plate.

[0018] Fig. 1 depicts a heat exchanger 1 having a top plate 2 and a bottom plate 3, wherein between the top plate 2 and the bottom plate 3 a first stack 4 of first heat exchanger plates 5, a separating plate 6 and a second stack 7 of second heat exchanger plates 8 are arranged. The heat exchanger 1 comprises several inlets and outlets, wherein Fig. 1 shows a first inlet 9, a second inlet 10, a first outlet 11 and a third outlet 14. The first inlet 9 and the second inlet 10 are arranged on the top plate 2, wherein the top plate 2 comprises an in Fig. 1 not depicted second outlet 12. The bottom plate 3 comprises the first outlet 11, the third outlet 1 and an in Fig. 1 not depicted third inlet 13. The first stack 4 is formed of multiple first heat exchanger plates 5, wherein the first stack 4 is a double wall heat exchanger stack being formed of double wall heat exchanger plates. The second stack 7 is formed of multiple second heat exchanger plates 8, wherein the second stack 7 is a single wall or a double wall heat exchanger stack, wherein a single wall heat exchanger stack is formed of single wall heat exchanger plates, while a double wall heat exchanger stack is formed of double wall heat exchanger plates.

[0019] Fig. 2 shows a schematic top view of the heat exchanger 1 showing the top plate 2. The top plate 2 comprises the first inlet 9, the second inlet 10 and the second outlet 12.

[0020] Fig. 3 shows a longitudinal cross sectional view

of the heat exchanger 1. The heat exchanger 1 comprises the top plate 2, the bottom plate 3, the first stack 4 being formed of several first heat exchanger plates 5, the separating plate 6 and the second stack 7 formed of several second heat exchanger plates 8. Further, the heat exchanger 1 comprises the first inlet 9 and the first outlet 11, while the second inlet 10, second outlet 12, third inlet 13 and third outlet 14 are not depicted in Fig. 3.

[0021] Fig. 4 shows a schematic cross section of the heat exchanger 1 in a cross-sectional direction, wherein the bottom plate 3 comprises the first outlet 11, the third inlet 13, while the top plate 2 comprises the first inlet 9 and the second outlet 12. As depicted in Fig. 4, between the top plate 2 and the bottom plate 3, the first stack 4 is separated from the second stack 7 by the separating plate 6. The first stack 4 is formed of the first heat exchanger plates 5, forming a double wall heat exchanger stack. The second stack 7 is formed of second heat exchanger plates 8 forming a single wall or a double wall heat exchanger.

[0022] Fig. 5 depicts a schematic view of the separating plate 6, wherein the separating plate 6 comprises two first positioning geometries 15 which interact with first matching geometries the neighbouring first heat exchanger plate 5 in an assembled state, while the separating plate 6 comprises two secondary positioning geometries 16 which interact second matching geometries of a neighbouring second heat exchanger plate 8. The first and secondary matching geometries are not depicted in any of the figures. Further, the separating plate 6 comprises a fluidic recess 17, which connects the first inlet 9 to the first outlet 11. Thus, the fluidic recess 17 allows a fluidic connection between the first stack 4 and the second stack 7.

[0023] A single wall heat exchanger stack comprises two fluidic channels, wherein the fluidic channels are separated from each other by a single wall respectively single heat exchanger plate. A double wall heat exchanger stack comprises also two fluidic channels, wherein the fluidic channels of the double wall heat exchanger stack are separated from each other by a double wall, respectively two separated walls.

[0024] In a double wall heat exchanger stack, if one wall respectively plate fails or leaks, leaking fluid is drained through a sector between the two walls, such that a mixing of the two fluids is prohibited. Therefore, a double wall heat exchanger stack can be used in drinking water applications, heat pump applications, and/or industrial applications.

[0025] In the present embodiment, the first inlet 9 forms together with the first outlet 11 a first fluidic channel. The second inlet 10 is fluidly connected to the second outlet 12 forming a second fluidic channel. The third inlet 13 interacts together with the third outlet 14, forming a third fluid channel. Thus, the heat exchanger 1 comprises three fluidic channels: The first fluidic channel is arranged within the first stack 4 and the second stack 7, wherein the first fluidic channel passes through the fluidic recess

17 from the first stack 4 to the second stack 7. The third fluidic channel is arranged within the second stack 7, while the second fluidic channel is arranged within the first stack 4. Thus, working fluid provided to the first fluidic channel can transfer heat from the second fluid channel to a fluid within the second fluid channel and to a fluid within the third fluid channel.

[0026] The separating plate 6 can be regarded as adapting element, which adapts an adjacent first heat exchanger plate 5 to an adjacent second heat exchanger plate 8, such that different types of heat exchanger plates 5, 8 can be assembled to form a heat exchanger 1 according to the present invention.

[0027] The first heat exchanger plates 5 and the second heat exchanger plates 8 can be formed of different materials. Further, the first heat exchanger plates 5 might comprise a structure differing from a structure of the second heat exchanger plates 8.

[0028] To assemble the heat exchanger, the assembly process comprises several tasks:

- i. Several first heat exchanger plates 5 are assembled to a first heat exchanger stack 4.
- ii. Several second heat exchanger plates 8 are assembled to form a second heat exchanger stack 7.
- iii. The first heat exchanger stack 4 is mounted onto the top plate 2.
- iv. The separating plate 6 is mounted onto the first heat exchanger stack 4.
- v. The second heat exchanger stack 7 is mounted onto the separating plate 6.
- vi. The base plate 3 is mounted onto the second heat exchanger stack 7.

[0029] These tasks can be performed in any order. The above-described order allows a preassembly of the first and second heat exchanger stacks 4, 7, such that the remaining tasks can be performed quickly. Thus, manufacturing a heat exchanger 1 according to the present invention is fast.

Reference list

[0030]

- 1 heat exchanger
- 2 top plate
- 3 bottom plate
- 4 first stack
- 5 first heat exchanger plate
- 6 separating plate
- 7 second stack
- 8 second heat exchanger plate
- 9 first inlet
- 10 second inlet
- 11 first outlet
- 12 second outlet
- 13 third inlet

- 14 third outlet
- 15 first positioning geometry
- 16 secondary positioning geometry
- 17 fluidic recess

Claims

1. Heat exchanger (1) comprising a top plate (2) and a bottom plate (3),

a plurality of heat exchanger plates (5,8) arranged between the top plate (2) and the bottom plate (3), wherein

adjacent heat exchanger plates cooperate to form fluid channels, wherein several heat exchanger plates (5,8) form a stack (4,7), wherein a first stack (4) and a second stack (7) are arranged between the top plate (2) and bottom plate (3), wherein a separating plate (6) is arranged between the first stack (4) and the second stack (7), wherein

the first stack (4) comprises a first fluid channel and a second fluid channel and the second stack (7) comprises a third fluid channel and a fourth fluid channel, wherein the second fluid channel and the third fluid channel are fluidly connected, wherein the first stack (4) is formed of first heat exchanger plates (5), and the second stack is formed of second heat exchanger plates (8), wherein

the first heat exchanger plates (5) or the second heat exchanger plates (8) are formed of single wall heat exchanger plates and the respective other heat exchanger plates (8, 5) are formed of double wall heat exchanger plates, or the first heat exchanger plates (5) and the second heat exchanger plates (8) are formed of double wall heat exchanger plates.

2. Heat exchanger (1) according to claim 1, wherein the first heat exchanger plates (5) differ in form, material, construction and/or type from the second heat exchanger plates (8).

3. Heat exchanger (1) according to claim 1 or 2, **characterized in that** one of the first heat exchanger stack (4) is a single wall heat exchanger stack formed of single wall heat exchanger plates.

4. Heat exchanger (1) according to any of claims 1 to 3, **characterized in that** one of the second heat exchanger stack (7) is a double wall heat exchanger stack formed of double wall heat exchanger plates.

5. Heat exchanger (1) according to any of claims 1 to 4, **characterized in that** a flow direction of the second and third fluid channel is oriented from the first

heat exchanger stack (4) to the second heat exchanger stack (7).

6. Heat exchanger (1) according to any of claims 1 to 5, **characterized in that** the separating plate (6) comprises at least one positioning geometry (15,16), which is configured to interact with at least one matching geometry of the first heat exchanger plate (5) and/or second heat exchanger plate (8).

7. Heat exchanger (1) according to any of claims 1 to 6, **characterized in that** a second fluid is supplied to the second fluid channel, while a first fluid is supplied the first fluid channel and/or fourth fluid is supplied to the fourth fluid channel.

8. Method to assemble a heat exchanger (1) to any of claims 1 to 7, **characterized in that** the method comprises the following steps:

- i. assembling the first heat exchanger stack (4) of first heat exchanger plates (5),
- ii. assembling the second heat exchanger stack (7) of second heat exchanger plates (8),
- iii. mounting the first heat exchanger stack (4) to the top plate (2),
- iv. mounting the separating plate (6) to the first heat exchanger stack (4),
- v. mounting the second heat exchanger stack (7) to the separating plate (6),
- vi. mounting the base plate (3) to the second heat exchanger stack (7).

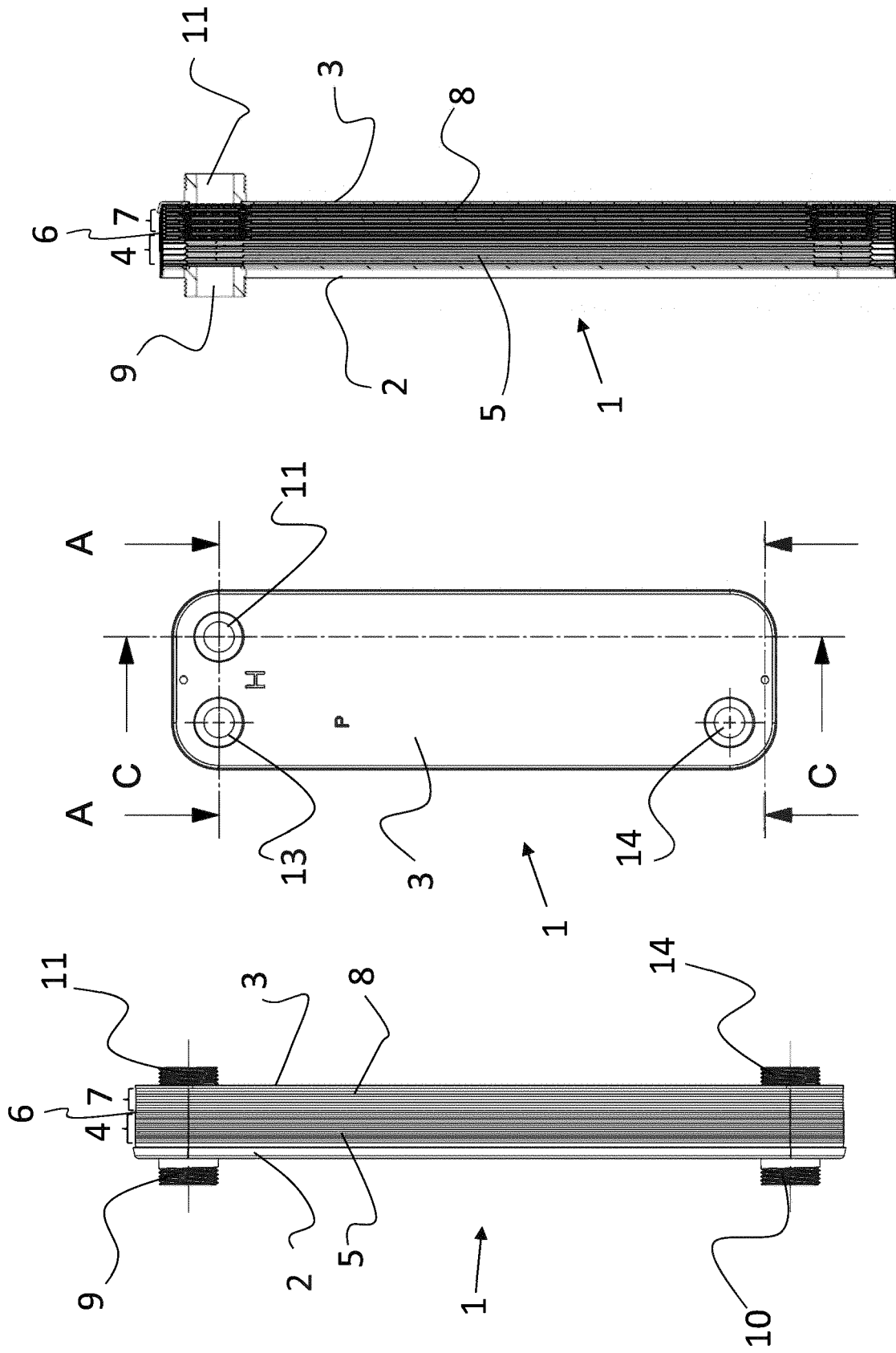
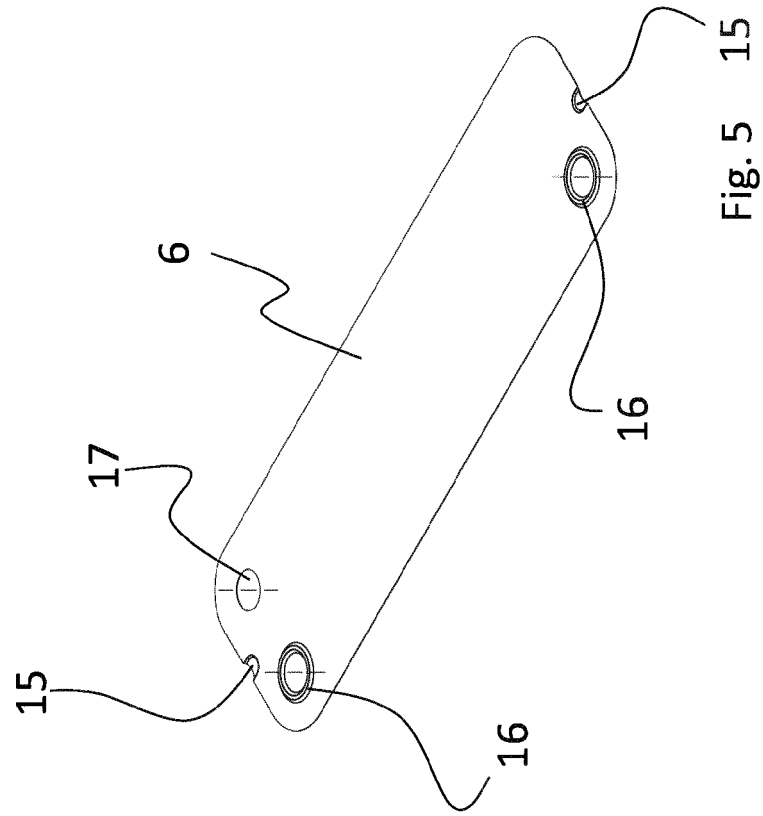
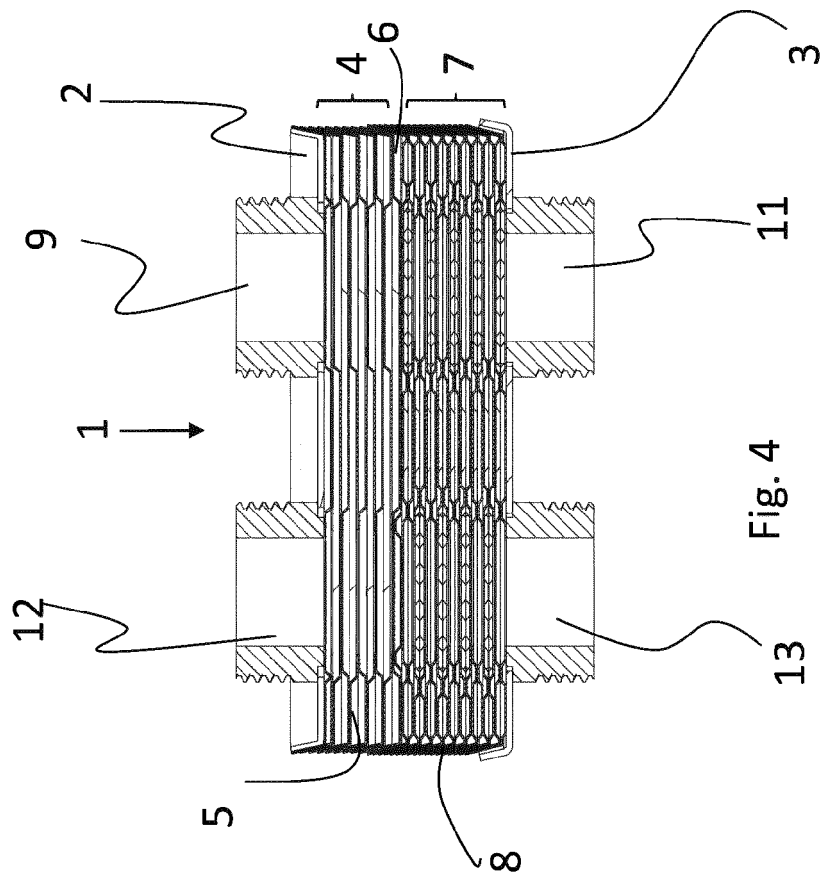


Fig. 1

Fig. 2

Fig. 3





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Application Number

EP 23 17 3647

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