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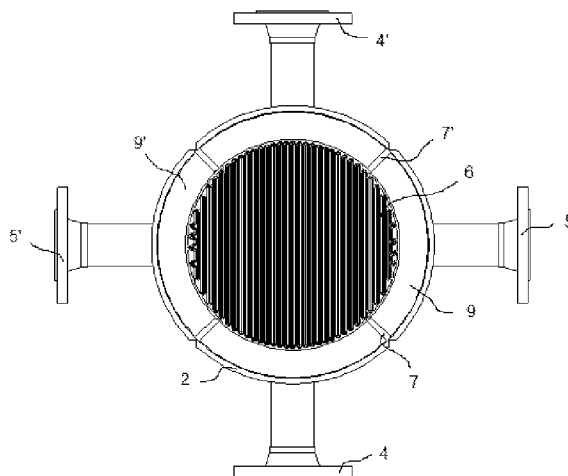


Fig. 4

(57) Abstract: The invention relates to a plate heat exchanger and a method for manufacturing a plate heat exchanger. In a typical plate heat exchanger according to the invention baffle plates have been arranged between the outer surface of the plate pack and the outer casing surrounding the plate pack, which baffle plates form a flow channel between the outer surface of the plate pack and the outer casing for at least one heat-yielding and/or at least one heat-receiving heat exchange medium from the inlet connection to the plate pack and a flow channel from the plate pack to the outlet connection.



Plate heat exchanger and method for manufacturing of a plate heat exchanger

Field of the invention

- 5 The invention relates to a plate heat exchanger and a method for manufacturing it according to the preambles of the independent claims presented below.

Background of the invention

- 10 Plate and Shell type welded plate heat exchangers are previously known, which are composed of a plate pack formed by heat exchange plates and a shell surrounding it, functioning as a pressure vessel. The core of the heat exchanger is usually formed by a plate pack composed of circular heat exchange plates, where the plates have been welded tightly together at openings therein and/or at the
- 15 perimeters of the plates. A primary circuit of the heat exchanger is formed between the openings in the plates and a secondary circuit between connections of the shell surrounding the plate pack, so that a primary side flow medium flows in every other plate space and a secondary side flow medium in every other plate space. In heat exchangers of this type the flow connections of the pack side are usually
- 20 placed in the ends of the heat exchanger and the flow connections of the shell side in the shell. Due to the small openings the flow pattern of the pack side is not always the best possible, as a large part of the flow strives to pass through the middle part of the heat exchange plate. A disadvantage of heat exchangers of the Plate and Shell type is also that separate flow guides are needed on the shell side,
- 25 which are used to prevent bypass flow between the plate pack and the shell. Construction of the flow guides to be completely tight has been discovered to be a difficult task. In order to obtain a sufficient tightness, the flow guides are manufactured from flexible materials, such as rubber or the like. A Plate and Shell type plate heat exchanger is described for example in patent publication WO
- 30 2008/046952.

- A so-called Raucell type welded plate heat exchanger is also previously known. In Raucell type heat exchangers the plate pack is formed by heat exchange plates stacked on top of each other, which have been welded to each other by their
- 35 edges. The plates form a solid heat exchange complex, whereby the welded outer surface of the plate pack functions as a pressure vessel. Pipes, which have partly been split in the longitudinal direction, have been welded to the sides of the plate pack as connections for the plate pack. These split pipes function as bypass

manifolds for the heat exchanger. Due to the small size of the bypass manifolds for heat exchange mediums, the heat exchange surface is also in this type of exchanger not utilised fully. A Raucell type plate heat exchanger is described for example in patent publication WO 89/00671.

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Description of the invention

10 It is an object of the present invention to present a novel structure for a plate heat exchanger, which reduces or even eliminates the above-mentioned problems appearing in prior art.

15 It is an object of the invention to present a structurally simple plate heat exchanger, where the heat exchange surfaces can be utilised more efficiently than in previously known plate heat exchangers.

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It is an object of the invention to provide a plate heat exchanger, where no sealings at all are needed.

20 It is an object of the invention to provide a plate heat exchanger, where easy cleaning of both the primary and the secondary side is made possible.

It is an object of the invention to provide a plate heat exchanger, which can easily be arranged to have multiple passes both on its primary and secondary side.

25 It is an object of the invention to provide a plate heat exchanger, which can easily be constructed to function with more than two heat exchange mediums.

It is an object of the invention to provide a plate heat exchanger, where no separate bypass manifolds are needed.

30

It is an object of the invention to provide a plate heat exchanger, where the positions of the inlet and outlet connections can be almost freely selected.

35 The plate heat exchanger and method for manufacturing a plate heat exchanger according to the invention are characterised in what is presented in the enclosed independent claims.

The other, dependent claims present some preferred embodiments of the invention.

5 The embodiments and advantages mentioned in this text are in suitable parts applicable to both a plate heat exchanger and a method according to the invention, even if this is not always specifically mentioned.

A typical plate heat exchanger according to the invention comprises

- 10 - a plate pack formed by heat exchange plates arranged on top of each other, which plate pack comprises ends in the direction of the heat exchange plates and an outer surface defined by the outer edges of the heat exchange plates;
- an outer casing surrounding the plate pack, which casing comprises end plates mainly in the direction of the ends of the plate pack and a shell connecting the end plates, which shell is arranged at least mainly at a
15 distance from the outer surface of the plate pack, and
- inlet and outlet connections arranged through the outer casing for at least one heat-yielding heat exchange medium and/or at least one heat-receiving heat exchange medium.

20 In a typical plate heat exchanger according to the invention baffle plates in the longitudinal direction of the plate pack have been arranged between the outer surface of the plate pack and the outer casing, which baffle plates extend from the first end plate of the outer casing to the second end plate, forming a flow channel between the outer surface of the plate pack and the outer casing for at least one
25 heat-yielding heat exchange medium and/or at least one heat-receiving heat exchange medium from the inlet connection to the plate pack and a flow channel from the plate pack to the outlet connection.

A typical method according to the invention for manufacturing a plate heat exchanger comprises

- 30 - forming a plate pack, where heat exchange plates have been attached together on top of each other, whereby the plate pack has ends in the direction of the heat exchange plates and an outer surface defined by the outer edges of the heat exchange plates;
- arranging an outer casing around the plate pack, which casing comprises
35 end plates mainly in the direction of the ends of the plate pack and a shell connecting the end plates, which shell is arranged at least mainly at a distance from the outer surface of the plate pack;

- arranging inlet and outlet connections through the outer casing for at least one heat-yielding heat exchange medium and/or at least one heat-receiving heat exchange medium; and
- forming flow channels for a heat exchange medium between the outer surface of the plate pack and the outer casing leading from the inlet connection to the plate pack and from the plate pack to the outlet connection by arranging baffle plates in the longitudinal direction of the plate pack between the outer surface of the plate pack and the outer casing, which baffle plates extend from the first end plate of the outer casing to the second end plate.

10 The invention is based on the idea that when placing the shell of the outer casing of the heat exchanger, which outer casing functions as a pressure vessel, at a distance from the outer surface of the plate pack, flow channels for heat exchange mediums can be formed in the space between the shell and the plate pack by arranging baffle plates on both sides of the inlet and outlet connections.

15 The height of the baffle plates, i.e. the distance between the inner surface of the shell of the heat exchanger and the outer surface of the plate pack, can for example be 5–200 mm or 10–150 mm or 20–100 mm. The diameter of the heat exchange plates can for example be in the range of 200–1400 mm.

20 In one embodiment of the invention the baffle plates are mainly straight. In one embodiment of the invention the baffle plate is arranged at a mainly right angle, for example an angle of 85–95 degrees or 89–91 degrees, in relation to the surface or surfaces it is attached to. In one embodiment of the invention the baffle plate is arranged at a mainly right angle in relation to the outer surface of the plate pack or a tangent of the outer surface. In one embodiment of the invention the baffle plate is arranged at a mainly right angle in relation to the inner surface of the shell or a tangent of the inner surface. In one embodiment of the invention the baffle plates are arranged at a mainly right angle in relation to the inner surface of the end plate of the outer casing.

35 In one embodiment of the invention the baffle plates are substantially as long as the entire shell, typically extending from the first end plate of the outer casing to the second end plate. Thus the flow channels for the heat exchange mediums are formed to have the length of the entire plate pack. Thus the entire heat exchange surface of the plate pack formed by heat exchange plates can be efficiently utilised, because the heat exchange mediums flow from the flow channels through

the plate pack over the entire length of the plate pack and over the width of the outer perimeter of the plate pack delimited by the baffle plates.

5 In the heat exchanger according to the invention the shell is arranged to completely or partly surround the plate pack.

10 The heat exchanger according to the invention does not have a separate shell and pack side, such as in Plate and Shell type heat exchangers, but the primary and secondary sides can be made identical. A circular plate pack has advantageously been fitted inside the shell of the heat exchanger according to the invention, such as in Plate and Shell type plate heat exchangers.

15 In one embodiment of the invention the heat exchange mediums are fed from the flow channel into the plate pack and removed from the plate pack into the flow channel through the outer surface of the plate pack. Both the primary and secondary side heat exchange mediums are thus fed into the plate pack from its outer perimeter, in the same way as the shell side flow in heat exchangers of the Plate and Shell type.

20 In one embodiment of the invention the shell and ends of the outer casing of the heat exchanger, the outer perimeter of the plate pack and the baffle plates arranged between the outer casing and the plate pack delimit a space functioning as a flow channel, which space functions like a bypass manifold. No separate bypass manifolds are thus needed in the heat exchanger according to the invention.

30 In a preferred embodiment of the invention the plate pack and the shell of the outer casing have a circular cylindrical shape. Thus the flow channels formed in the heat exchanger with the aid of the baffle plates between the inner surface of the shell of the outer casing and the outer surface of the plate pack have the cross-sectional shape of a sector of a circular ring.

35 In one embodiment of the invention the baffle plates are attached tightly by their ends to the end plates of the heat exchanger, by their inner edge to the plate pack and by their outer edge to the inner surface of the shell. The baffle plates can for example be welded to the other structures.

In the heat exchanger according to the invention the outer surface of the plate pack also functions as a heat exchange surface, because the shell of the heat exchanger is arranged at a distance from the plate pack and the flow channels formed with the aid of the baffle plates utilise the entire outer surface of the plate pack.

Also the baffle plates function as heat exchange surfaces in the heat exchanger according to the invention. The baffle plates function as an especially efficient heat exchange surface in an embodiment of the invention, where on a first side of one baffle plate there is the flow channel of a heat-yielding heat exchange medium and on the second side the flow channel of a heat-receiving heat exchange medium.

In one embodiment of the invention the shell is arranged to completely surround the plate pack and each baffle plate is arranged tightly to the outer casing between two connections, i.e. either inlet or outlet connections. In other words the baffle plates used for forming the flow channels are placed between the inlet and outlet connections when seen from the end of the heat exchanger, so that they separate the heat exchange mediums passing through the heat exchanger from each other and prevent them from mixing together in the space between the shell of the heat exchanger and the plate pack. For example in the case of two heat exchange mediums, the heat exchanger can comprise two inlet connections, two outlet connections and four baffle plates, which are placed between each inlet and outlet connections, whereby four separate flow channels are formed. One inlet or outlet connection has thus been connected to each flow channel delimited between the shell and plate pack, which channel has the length of the plate pack.

In one embodiment according to the invention, which has inlet and outlet connections for a first (heat-yielding) and second (heat-receiving) heat exchange medium, the heat exchange mediums are led via their inlet connections to a flow channel delimited by the outer casing of the heat exchanger, the outer surface of the plate pack and the baffle plates. Via these flow channels the flow of the first and second heat exchange medium can be led through the plate pack advantageously over the entire length of the plate pack, so that the first heat exchange medium flows in every other plate space of the plate pack and the second heat exchange medium in every other plate space, whereafter the flow of the first and second heat exchange medium is led through their outlet connections out of the heat exchanger. The plate spaces are closed at the edges of the heat exchange plates, so that the plate spaces meant for the second heat exchange

medium are closed in the flow channels for the first heat exchange medium. On the other hand, the plate spaces meant for the first heat exchange medium are closed in the flow channels for the second heat exchange medium.

- 5 In one embodiment of the invention the plate pack is composed of profiled plates, which are stacked on top of each other and attached to each other, so that a heat-yielding heat exchange medium flows in every other plate space and a heat-receiving heat exchange medium in every other plate space. The height of the profile of the heat exchange plates determines, at least partly, the distance
10 between the heat exchange plates, i.e. the size of the flow routes formed between the heat exchange plates. The effect of the heat exchanger can be affected for example by selecting the material, thickness, surface area, profile shape and height of the heat exchange plates as desired. The effect can be affected also by selecting the ridge angle between the bulges of the opposite heat exchange plates
15 as desired.

- In one embodiment of the invention the plate pack is formed by superposed profiled heat exchange plates, which have been attached together by their outer edges with the aid of separate strips arranged between the heat exchange plates.
20 The thickness of the strips is selected according to the distance between the plates. The strip can be left out in the point, where it is desirable for the heat exchange medium to flow into the plate space or away from there. The heat exchange plates and strips can be welded tightly together.

- 25 In one embodiment of the invention the plate pack is formed by superposed profiled heat exchange plates attached together, the outer edge of which is bent, advantageously substantially perpendicularly, in relation to the rest of the plate. The heat exchange plate thus forms a cup-like structure, whereby the bent outer edge is placed against the next heat exchange plate. The length of the bend can
30 be selected according to the desired distance between the heat exchange plates. An opening can be cut in the edge in the point, where it is desirable for the heat exchange medium to flow into the plate space or away from there. It is also possible that the edge can be left unbent or it can be bent less than the rest of the edge in the point, where it is desirable for the heat exchange medium to flow into
35 the plate space or away from there. The heat exchange plates can be welded tightly together by the bends.

In one embodiment of the invention the outer perimeters of the heat exchange plates are welded together at desired points with an abutment joint, such as in traditional Plate and Shell type heat exchangers. The openings formed in the ends of the seams are when necessary covered, advantageously with triangular strips cut in the outer perimeters of the plates. The strips are bent and welded into place, advantageously after the outer perimeter is welded.

In one embodiment of the invention the location of the baffle plate between the inlet and/or outlet connections can be freely selected. Thus the properties of the heat exchanger can be selected according to need at any time.

In one embodiment of the invention the locations of the inlet and outlet connections of the heat exchanger can be almost freely selected. The connections can be placed through the shell, through one end plate or through both end plates or so that some of the connections are arranged through the end plate and some through the shell. Thus the properties of the heat exchanger can be selected according to need at any time.

In one embodiment of the invention the sizes of the connections are the same both on the primary and the secondary side. This is an advantage especially in gas/gas applications.

The plate heat exchanger according to the invention is structurally simple. The structure of the heat exchanger can easily be modified, because a heat exchanger suitable for different purposes can from the basic structure formed by the outer casing and plate pack easily be constructed by altering the placement of the baffle plates and connections. The heat exchanger according to the invention can also easily be constructed to function with more than two heat exchange mediums. The heat exchanger according to the invention can be used in liquid/liquid, liquid/gas and gas/gas applications.

The structure of the heat exchanger according to the invention can be completely welded, whereby no sealings are needed in the structure, unless it is desirable to make it possible to open the structure. In an opening heat exchanger according to the invention the shell of the outer casing comprises parts, which are attached in a detachable manner by means of bolts or the like. Thus the primary and secondary sides of the heat exchanger can easily be cleaned.

In one embodiment of the invention at least one first heat exchange medium is arranged to travel directly through the outer surface of the plate pack, without a flow channel according to the invention. Openings have been left in the outer surface of the plate pack in the inlet and outlet point for the first heat exchange medium in the first plate spaces for the first heat exchange medium. Such a heat exchanger can have flow channels according to the invention for example only for one second heat exchange medium. The second heat exchange medium is led into the second plate spaces of the plate pack through an inlet connection and a flow channel according to the invention, and correspondingly out of the plate pack into the flow channel according to the invention and further through an outlet connection out of the heat exchanger. In such an embodiment the outer casing and/or its shell surrounds the plate pack at a distance only by one or more flow channels for the second heat exchange medium, i.e. the shell surrounds the plate pack only partly. Such an embodiment can be used among others in gas/liquid applications, such as air conditioning channels. Thus the plate pack of the heat exchanger can be arranged for example in the air conditioning channel, so that the gas, such as the air flowing in the air conditioning channel, travels directly through the outer surface of the plate pack and the second heat exchange medium through the flow channels according to the invention.

In the plate heat exchangers according to the invention substantially the entire outer perimeter of the plate pack is used for the flows of the heat exchange mediums and thus the heat exchange surfaces can be utilised efficiently.

Short description of the figures

In the following, the invention will be described in more detail with reference to the appended schematic drawing, in which

- Figure 1 shows a heat exchanger according to the invention, which is completely welded and cannot be opened,
Figure 2 shows a plate heat exchanger according to the invention, which can be opened,
Figure 3 shows a plate heat exchanger according to the invention, where all the connections are fitted in the end of the heat exchanger,
Figure 4 shows a cross-section of a plate heat exchanger according to the invention,

- Figure 5 shows a plate pack of a plate heat exchanger according to the invention,
- Figure 6 shows a grooved heat exchange plate,
- Figure 7 shows a plate pack according to the invention cut open by the baffle plate,
- 5 Figure 8 shows a cross-section of the structure according to Figure 7,
- Figure 9 shows a plate pack according to the invention cut open by the baffle plate, where the edges of the heat exchange plates are bent in a cup-like manner and welded together,
- 10 Figure 10 shows a cross-section of the structure according to Figure 9,
- Figure 11 shows the attaching of the baffle plates used in the heat exchanger according to the invention to the shell and the plate pack, and
- Figure 12 shows a principled view of an embodiment according to the invention.

15 Detailed description of the invention

Figure 1 shows as an example a heat exchanger according to the invention seen from the outside. The heat exchanger 1 has a cylindrical outer casing functioning as a pressure vessel, which comprises a shell 2 and end plates 3a, 3b. A plate pack (not shown in the figure) arranged inside the heat exchanger is attached between the end plates. The shell 2 and the end plates 3a, 3b functioning as the outer casing of the heat exchanger can be assembled and attached together by welding, whereby the structure cannot be opened, as shown in Figure 1. Figure 2 shows an opening model, where the shell 2 is divided into parts, which are attached with bolts or the like to the baffle plates and end plates. An advantage of the opening model is that both the primary and secondary side can be cleaned.

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In Figure 1 inlet connections 4, 5 and outlet connections 4', 5' have been arranged through the shell 2 of the heat exchanger for a heat-yielding first and a heat-receiving second heat exchange medium. The inlet and outlet connections can be arranged in the shell, end and/or ends of the heat exchanger. Figures 1 and 2 show the placement of the connections in the shell and Figure 3 shows the placement of all connections in one end 3a of the heat exchanger. The connections are advantageously welded to the outer casing of the heat exchanger.

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35 The heat exchanger according to the invention generally has at least four connections, two inlet connections and two outlet connections. More connections can however also be arranged, whereby the heat exchanger can be used for more than two heat exchange mediums.

Figure 4 shows the cross-section of a heat exchanger according to the invention. A circular plate pack 6 formed by superposed heat exchange plates has been arranged inside the shell 2 of the heat exchanger. The shell 2 of the heat exchanger is arranged at a distance from the plate pack 6 and to surround the plate pack 6 completely, whereby a space remains between the plate pack and the shell over the entire outer surface of the plate pack. Baffle plates 7, 7', which have the length of the shell, have been arranged between the plate pack 6 and the shell 2, which baffle plates are attached, advantageously welded, by their ends to the end plates of the heat exchanger, by their inner edge to the plate pack and by their outer edge to the inner surface of the shell. The height of the baffle plate, i.e. the distance between the shell 2 and the plate pack 6 of the heat exchanger, can for example be 5–200 mm. The baffle plates 7, 7' arranged on both sides of the inlet and/or outlet connection thus form a flow channel 9, 9' defined by the height of the plate pack in the area between the baffle plates, the width of the part of the outer surface of the plate pack and the part of the shell remaining between the baffle plates and the height of the baffle plate, through which flow channel the heat exchange medium can flow into the plate pack and correspondingly out of it. The formed flow channels 9, 9' have a cross-sectional shape of a sector of a circular ring, as is seen in Figure 4. The inlet connections 4, 5 and outlet connections 4', 5' of the heat exchange mediums have been connected to the flow channels 9, 9'.

By each flow channel 9, 9' every other plate space between superposed heat exchange plates is open, so that the flow can transfer from the flow channel into these plate spaces or vice versa, and every other plate space is closed, so that the passage of the flow into these plate spaces is prevented. The plate spaces, which are open to the flow of the first heat exchange medium, are thus closed from the second heat exchange medium, and correspondingly the open plate spaces of the second heat exchange medium are closed from the first heat exchange medium. Thus the first and the second heat exchange medium are led through every other plate space through the heat exchanger so that their flows are not mixed together.

The location of the baffle plates 7, 7' functioning as flow guides can be freely selected, whereby it is possible to alter the heat exchange surface area of the plate pack used by the heat exchange medium.

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Separate flow guides can, if necessary, be placed in the flow channels 9, 9' formed between the baffle plates, if it is necessary to control the flow of the heat exchange medium in another way.

- 5 For the assembly of the heat exchanger it is advantageous to divide the shell 2 into parts by the baffle plates 7, 7' and assemble it by welding the parts together.

Figure 5 shows a plate pack 6 according to the invention and thereto attached baffle plates 7, 7' functioning as flow guides.

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The plate pack 6 is composed of circular profiled plates according to Figure 6, which are stacked on top of each other and attached to each other by their outer perimeters, so that a heat-yielding heat exchange medium flows in every other plate space and a heat-receiving heat exchange medium in every other plate space. The height of the profile of the heat exchange plates determines, at least partly, the distance between the heat exchange plates, i.e. the size of the flow routes formed between the heat exchange plates. The ridge angle between the bulges 12 of opposite heat exchange plates can be freely selected.

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- 20 In one solution according to the invention the attaching of the plates 10, 10' occurs with the aid of separate strips 11, 11', as is shown in Figures 7 and 8. The thickness of the strips naturally depends on the height of the profile of the heat exchange plate, i.e. the height of the bulges 12 in the plate. Flow openings are formed in the plate pack by leaving out the strip 11, 11' by the opening. Thus there is a strip in every other plate space by the flow openings of the plate pack. Figure 25 8 shows the flow openings in the plate pack as a cross-section of the plate pack by the baffle plate. The open plate spaces 13, 13' on the left side of the baffle plate 7 shown in the figure are closed plate spaces 14, 14' on the right side of the baffle plate. Thus a heat-yielding heat exchange medium flows in every other plate space of the plate pack and a heat-receiving heat exchange medium in every 30 other plate space. By the baffle plates 7 there are strips in every space, whereby they close off the primary and secondary sides from each other.

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- 35 In one embodiment of the invention the outer edges of the heat exchange plates 10 are bent substantially perpendicularly in relation to the plate, whereby a cup-like structure is formed. The cups are attached together by welding at their outer perimeters. Necessary flow openings are cut into the edges of the cups. By the baffle plates the edges of the cups are whole, whereby the structure can be

closed. The details of this embodiment are shown in Figures 9 and 10. Figure 10 shows in a corresponding manner as Figure 8 that an open plate space 13, 13' is on the other side of the baffle plate a closed plate space 14, 14', whereby the heat-yielding and heat-receiving heat exchange medium can be made to flow in every other plate space.

As was already mentioned above, the locations of flow channels and the inlet and outlet connections of the heat exchanger according to the invention can be freely selected, whereby the heat exchanger can be built to be either a cross-current, a counter-current or a concurrent exchanger and/or a combination thereof. The placement of the baffle plates can be used to affect the size of the flow channel being formed, the flow channels can be constructed to be identical on the primary and secondary sides, or alternatively the flow channel on one side can be constructed to be larger. The entire outer perimeter of the plate pack is advantageously used as flow channels for the heat exchange medium.

Figure 11 shows as an example the attaching of a baffle plate 7 functioning as a flow guide to the shell 2 and plate pack 6 of a heat exchanger, whereby a flow channel 9 can be formed in the space between the shell and the plate pack. The heat exchange plates are attached to each other with the aid of a strip 11, which is in the structure also by the baffle plate, and advantageously extends also to the other side of the baffle plate.

Figure 12 shows a principled view of an embodiment according to the invention, where flow channels have been arranged in the plate pack of the heat exchanger only for one heat exchange medium, whereby the shell 2 of the heat exchanger surrounds the plate pack 6 only partly. In the embodiment shown in Figure 12 the plate pack 6 of the heat exchanger is arranged for example inside a pipe 15, so that the substance flowing in the pipe, such as a gas, can flow directly through the plate pack. The second heat exchange medium is led into the plate pack 6 through the inlet connection 4 and flow channel 9, and correspondingly out of the plate pack 6 into the flow channel 9' arranged on the opposite side of the plate pack and further through the outlet connection 4' out of the heat exchanger. The plate pack 6 has been formed by superposed profiled heat exchange plates, so that the substance flowing in the pipe flows in every other plate space and the heat exchange medium led into the heat exchanger through the flow channel flows in every other plate space. The plate pack is formed in the manner shown in the above-presented examples. The flow channels 9, 9' are formed by welding baffle

plates 7, 7' to the outer surface of the plate pack and an outer casing functioning as a shell 2 between these plates at a distance from the outer casing of the plate pack.

- 5 The invention is not intended to be limited to the above-presented exemplary embodiments, but the intention is to apply the invention widely within the inventive idea defined by the claims defined below.

Claims

1. A plate heat exchanger (1), which comprises
- 5 - a plate pack (6) formed by heat exchange plates arranged on top of each other, which plate pack comprises ends in the direction of the heat exchange plates and an outer surface defined by the outer edges of the heat exchange plates;
- 10 - an outer casing surrounding the plate pack (6), which casing comprises end plates (3a, 3b) mainly in the direction of the ends of the plate pack and a shell (2) connecting the end plates, which shell is arranged at least mainly at a distance from the outer surface of the plate pack; and
- 15 - inlet and outlet connections (4, 4', 5, 5') arranged through the outer casing for at least one heat-yielding and/or at least one heat-receiving heat exchange medium;
- 20 **characterised** in that baffle plates (7, 7') in the longitudinal direction of the plate pack have been arranged between the outer surface of the plate pack and the outer casing, which baffle plates extend from the first end plate (3a) of the outer casing to the second end plate (3b), forming a flow channel (9) between the outer surface of the plate pack and the shell (2) of the outer casing for at least one heat-yielding and/or at least one heat-receiving heat exchange medium from the inlet connection (4, 5) to the plate pack (6) and a flow channel (9') from the plate pack (6) to the outlet connection (4', 5').
- 25 2. The plate heat exchanger according to claim 1, **characterised** in that the heat exchange mediums are fed from the flow channel (9) into the plate pack (6) and removed from the plate pack (6) into the flow channel (9') through the outer surface of the plate pack.
- 30 3. The plate heat exchanger according to claim 1 or 2, **characterised** in that the baffle plates (7, 7') are attached tightly, for example welded, by their ends to the end plates (3a, 3b) of the heat exchanger, by their inner edge to the plate pack (6) and by their outer edge to the inner surface of the shell (2).
- 35 4. The plate heat exchanger according to any of the preceding claims, **characterised** in that the shell (2) is arranged to completely surround the plate pack (6).

16

5. The plate heat exchanger according to any of the preceding claims, **characterised** in that each baffle plate (7, 7') is arranged tightly to the outer casing between two inlet or outlet connections.

5 6. The plate heat exchanger according to claim 5, **characterised** in that the position of the baffle plate (7, 7') between the inlet or outlet connections can be freely selected.

10 7. The plate heat exchanger according to any of the preceding claims, **characterised** in that there are four flow channels (9, 9'), which are formed by arranging four baffle plates (7, 7') between the outer casing and the plate pack.

15 8. The plate heat exchanger according to any of the preceding claims, **characterised** in that one or more inlet or outlet connections (4, 4', 5, 5') are arranged through the end plate (3a, 3b) of the outer casing.

20 9. The plate heat exchanger according to any of the preceding claims, **characterised** in that the plate pack (6) is formed by attaching profiled heat exchange plates (10, 10') together on top of each other, so that a heat-yielding medium flows in every other plate space and a heat-receiving heat exchange medium in every other plate space.

25 10. The plate heat exchanger according to any of the preceding claims, **characterised** in that the plate pack (6) is formed by superposed profiled heat exchange plates (10, 10'), which are attached together by their outer edges with the aid of separate strips (11, 11') arranged between the heat exchange plates, whereby the strips define the distance between the plates.

30 11. The plate heat exchanger according to any of the preceding claims 1–9, **characterised** in that the plate pack (6) is formed by superposed profiled heat exchange plates (10, 10') attached together, the outer edge of which is bent, advantageously substantially perpendicularly, in relation to the rest of the plate, forming a cup-like structure, whereby the bent outer edge defines the distance between the heat exchange plates.

35 12. The plate heat exchanger according to any of the preceding claims 1–9, **characterised** in that the outer perimeters of the heat exchange plates (10, 10') are welded together with an abutment joint.

13. The plate heat exchanger according to any of the preceding claims, **characterised** in that on the first side of one baffle plate there is the flow channel for the heat-yielding heat exchange medium and on the second side there is the
5 flow channel for the heat-receiving heat exchange medium.

14. The plate heat exchanger according to any of the preceding claims, **characterised** in that the structure of the heat exchanger (1) is completely welded.

10 15. The plate heat exchanger according to any of the preceding claims 1–13, **characterised** in that the shell (2) of the outer casing comprises parts, which are attached to the heat exchanger in a detachable manner with bolts or the like.

15 16. A method for manufacturing a plate heat exchanger (1), the method comprising

- forming a plate pack (6), where heat exchange plates (10, 10') have been attached together on top of each other, whereby the plate pack has ends in the direction of the heat exchange plates and an outer surface defined by the outer edges of the heat exchange plates;
- 20 - arranging an outer casing around the plate pack (6), which casing comprises end plates (3a, 3b) mainly in the direction of the ends of the plate pack and a shell (2) connecting the end plates, which shell is arranged at least mainly at a distance from the outer surface of the plate pack;
- arranging inlet and outlet connections (4, 4', 5, 5') through the outer casing
25 for at least one heat-yielding and/or at least one heat-receiving heat exchange medium;

characterised in

- forming one or more flow channels (9, 9') leading from the inlet connection (4, 5) to the plate pack and from the plate pack to the outlet connection (4', 5') between the outer surface of the plate pack (6) and the shell (2) of the
30 outer casing, by arranging baffle plates (7, 7') in the longitudinal direction of the plate pack between the outer surface of the plate pack and the outer casing, which baffle plates extend from the first end plate (3a) of the outer casing to the second end plate (3b).

35

17. The method according to claim 16, **characterised** in

- attaching the baffle plates (7, 7') tightly, for example by welding, by their ends to the end plates (3a, 3b) of the heat exchanger, by their inner edge to the plate pack (6) and by their outer edge to the inner surface of the shell (2).

5

18. The method according to any of the preceding claims 16–17, **characterised** in

- arranging the shell (2) of the outer casing to completely surround the plate pack.

10 19. The method according to any of the preceding claims 16–18, **characterised** in

- arranging four baffle plates (7, 7') between the outer casing and the plate pack, and thus forming four flow channels (9, 9') between the outer casing and the plate pack.

15 20. The method according to any of the preceding claims 16–19, **characterised** in

- arranging one or more inlet or outlet connections (4, 4', 5, 5') through the end plate (3a, 3b) of the outer casing.

21. The method according to any of the preceding claims 16–20, **characterised** in

- 20
- arranging separate strips (11, 11') between the outer perimeters of the heat exchange plates (10, 10') of the plate pack (6), whereby the thickness of the strips defines the distance between the heat exchange plates.

22. The method according to any of the preceding claims 16–20, **characterised** in

- 25
- bending the outer edges of the heat exchange plates (10, 10') of the plate pack (6), advantageously substantially perpendicularly in relation to the rest of the plate, forming a cup-like structure, whereby the bent outer edge defines the distance between the heat exchange plates.

30 23. The method according to any of the preceding claims 16–22, **characterised** in

- arranging the structure of the heat exchanger (1) to be completely welded.

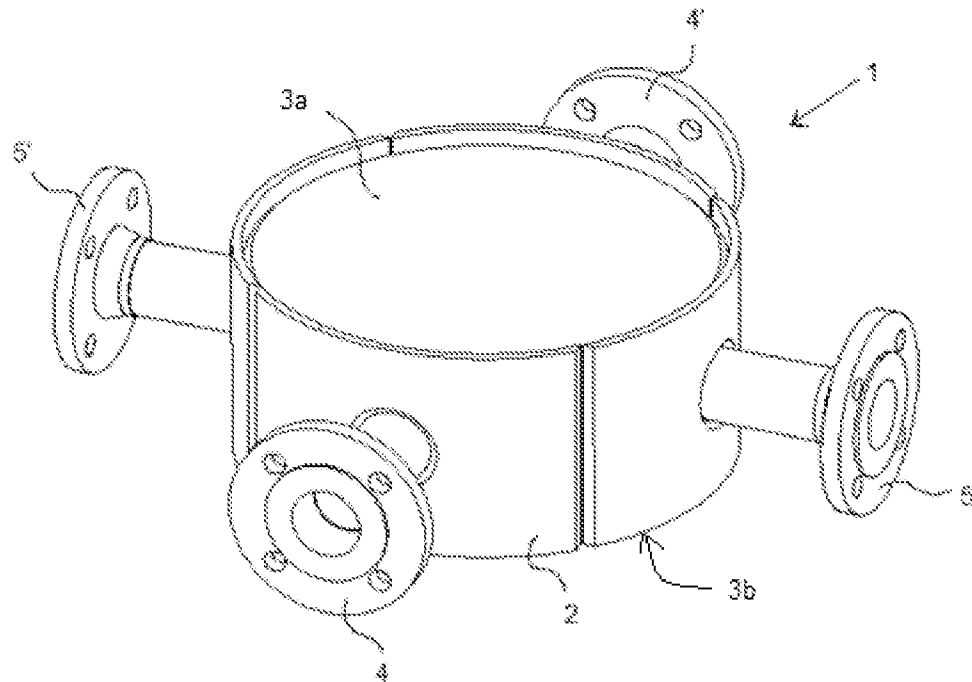


Fig. 1

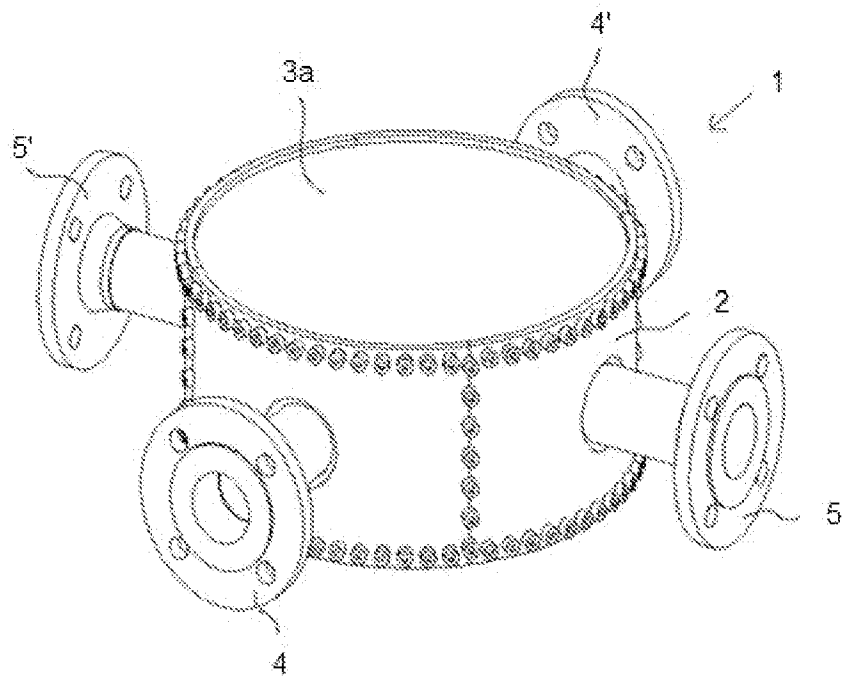
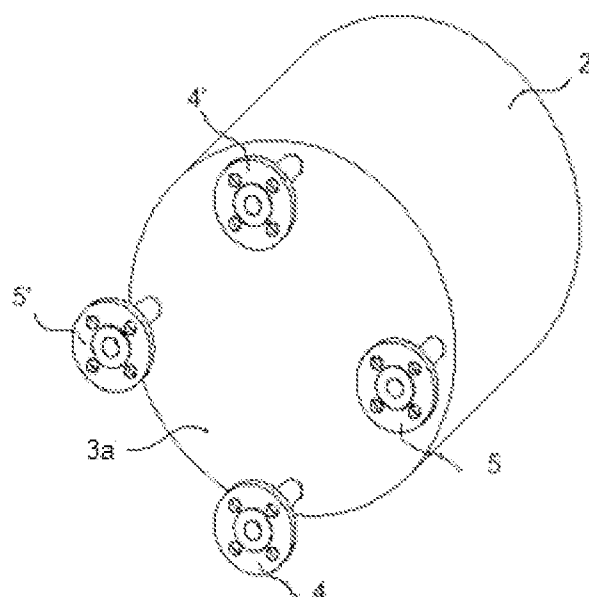
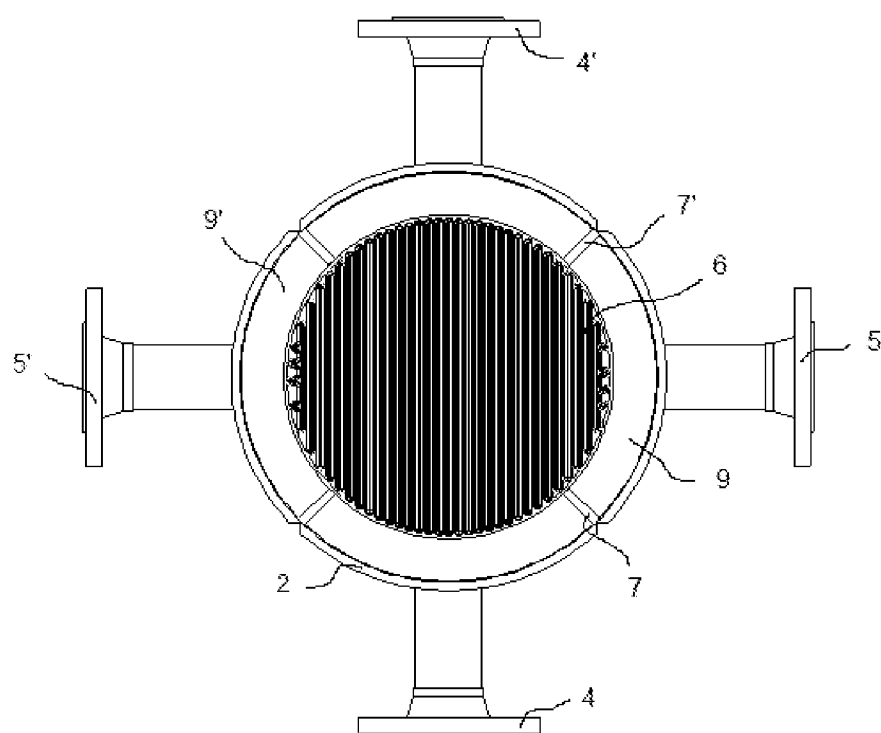


Fig. 2

**Fig. 3****Fig. 4**

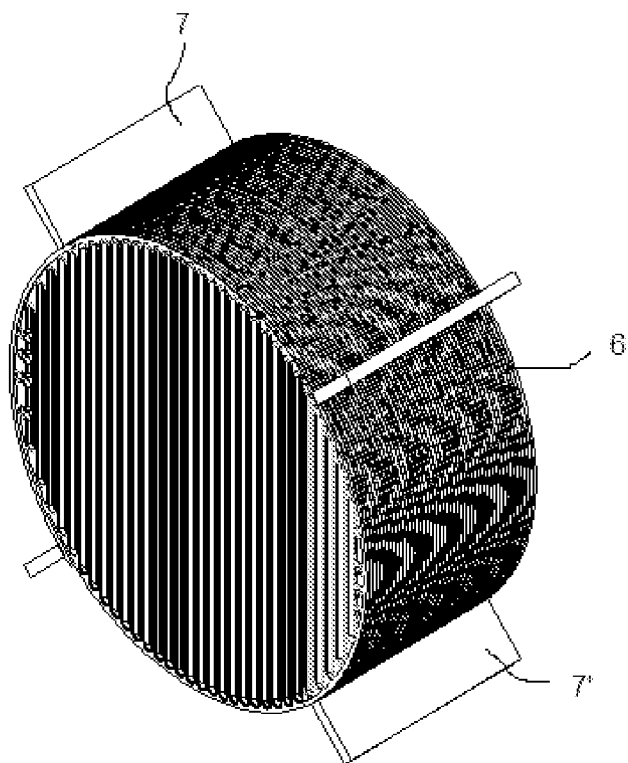


Fig. 5

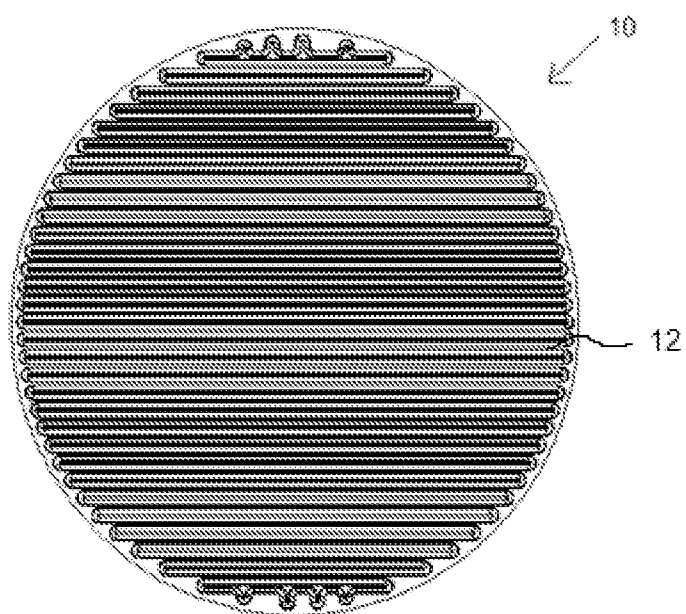


Fig. 6

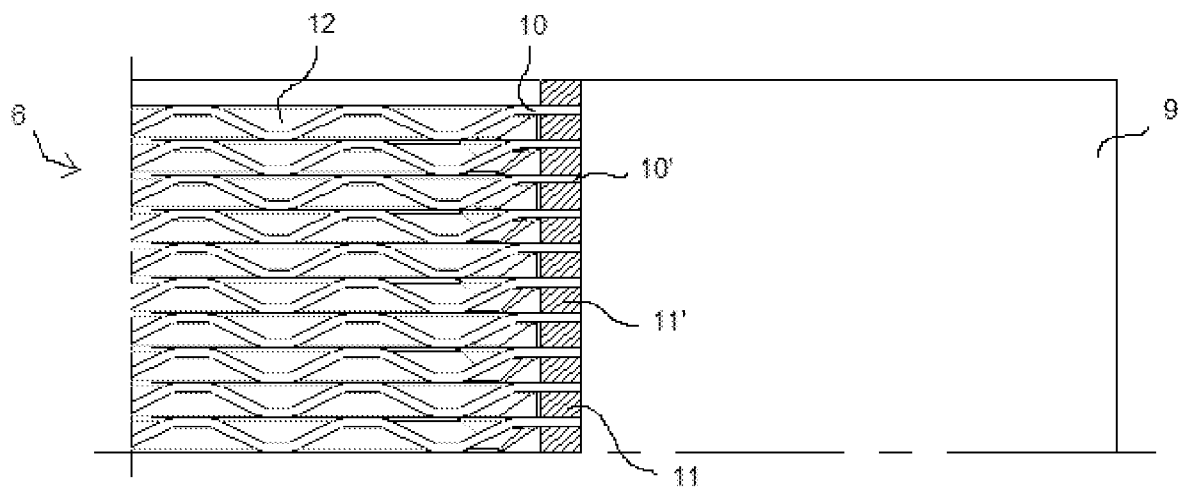


Fig. 7

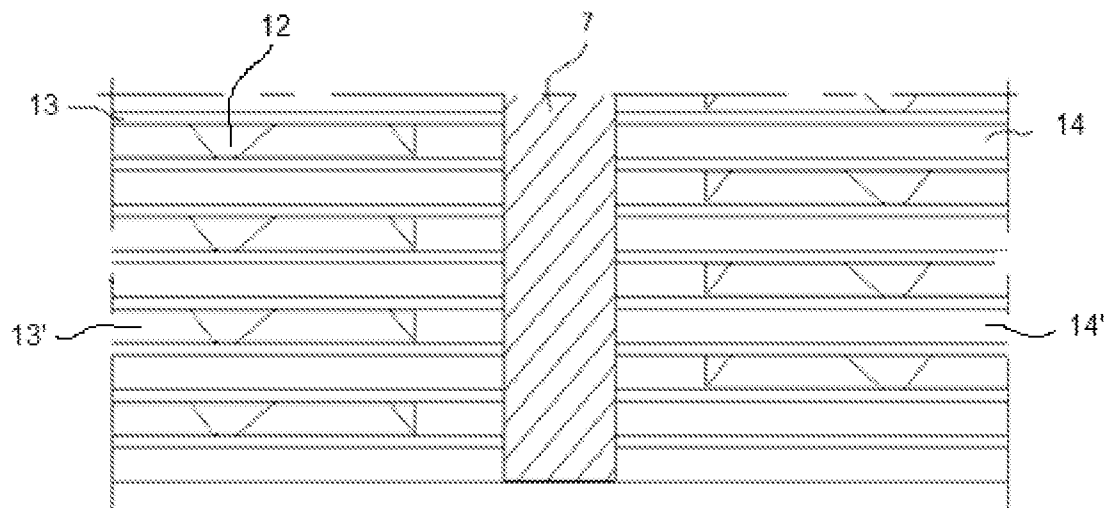


Fig. 8

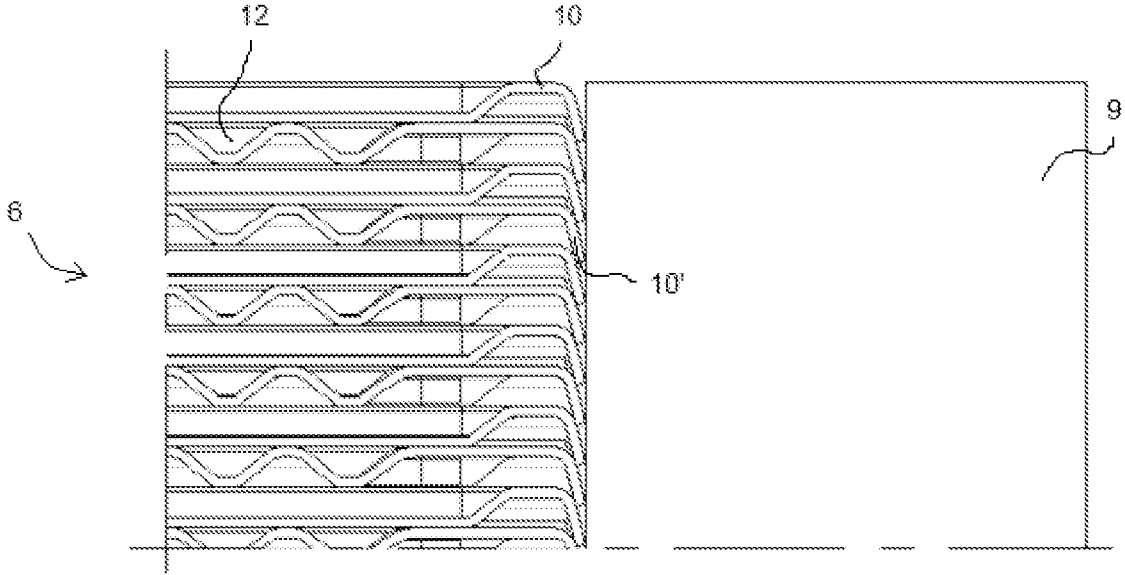


Fig. 9

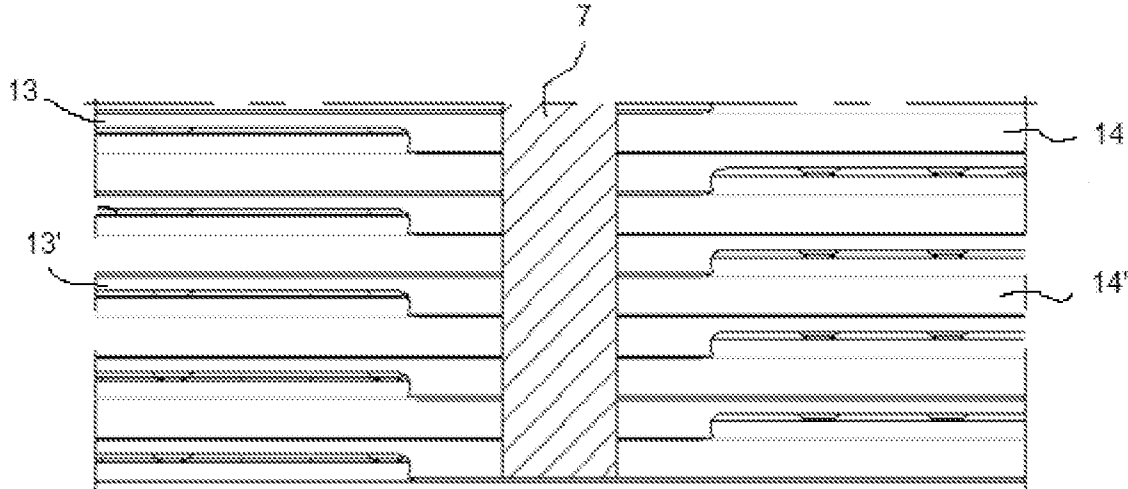


Fig. 10

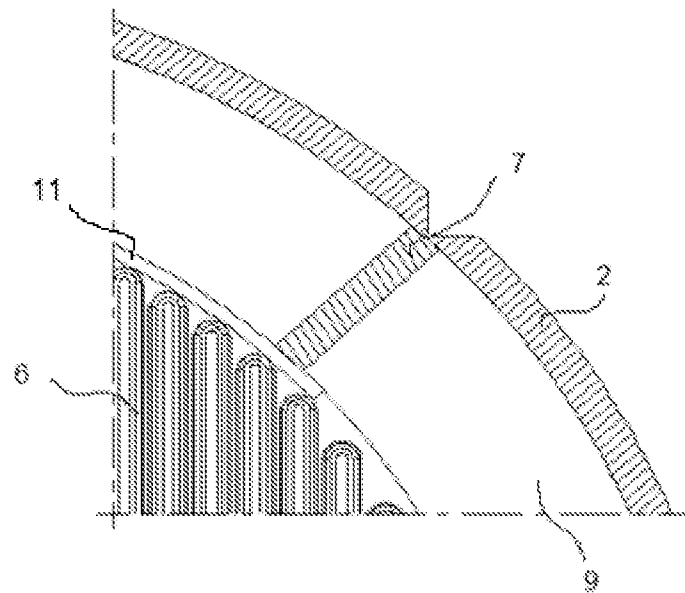


Fig. 11

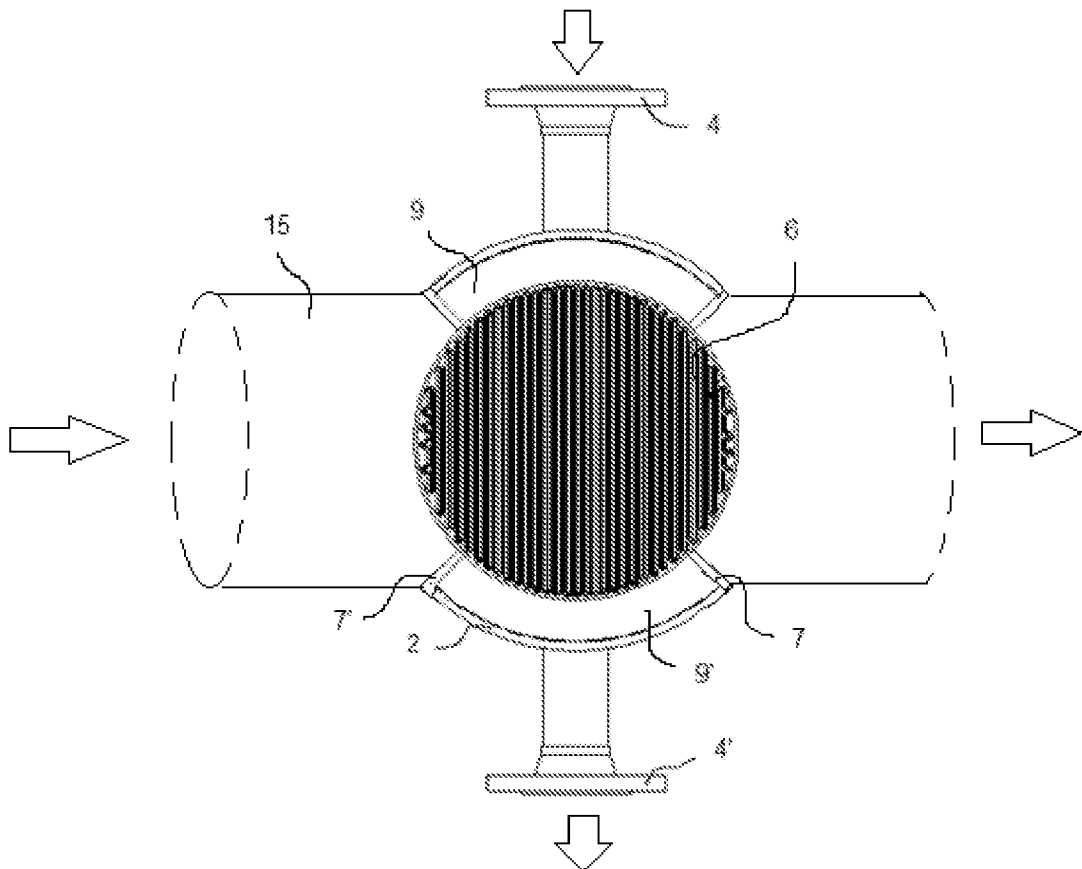


Fig. 12