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(54) **A HEAT EXCHANGER**

(57) A heat exchanger comprises a first set of tubes fluidically connected between a first and second manifold, wherein a first fluid flows from the first manifold to the second manifold through the first set of tubes. The heat exchanger comprises a second set of tubes fluidically connected between the first and second manifold, wherein a second fluid flows from the first manifold to the second manifold through the second set of tubes. The

heat exchanger comprises a third set of tubes fluidically connected between the first and second manifold, wherein at a first configuration, the second fluid flows from the second manifold to the first manifold through the third set of tubes; at a second configuration, the second fluid flows from the first manifold to the second manifold through the third set of tubes; and at a third configuration, the second fluid does not flow through the third set of tubes.

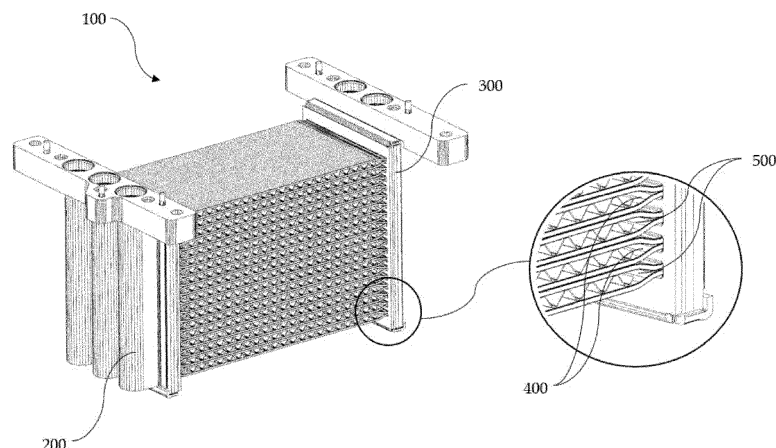


Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a heat exchanger. In particular, the present invention relates to an internal heat exchanger in an air conditioning loop.

BACKGROUND

[0002] Generally, an air conditioning loop comprises a high pressure fluid circuit and a low pressure fluid circuit. An internal heat exchanger is provided in the air conditioning loop to promote heat exchange between a high pressure fluid from the high pressure fluid circuit and a low pressure fluid from the low pressure circuit. In one example, the internal heat exchanger can be a tube inside tube type heat exchanger, wherein the internal heat exchanger can be integrated inside another part, for example, an accumulator. In another example, the internal heat exchanger can be a plate type heat exchanger, wherein the internal heat exchanger can have a construction based on a plate type heat exchanger, for example, a plate type chiller. When the high pressure fluid from the high pressure fluid circuit transfers heat energy to the low pressure fluid from the low pressure fluid circuit, the efficiency of the internal heat exchanger increases. However, when the efficiency of the internal heat exchanger increases beyond a threshold value, some problems occur in the air conditioning loop that are not preferred. Further, when the internal heat exchanger is configured with U-flow configuration, the efficiency of the internal heat exchanger also increases. Although the U-flow may be favorable in terms of the efficiency, it may cause drawbacks related to the increased pressure drop in the internal heat exchanger. This may squander all the advantages if not optimized correctly. Therefore it would be advantageous to provide a heat exchanger in which the efficiency and pressure drop may be regulated according to the needs, so that the optimization is easy and effective.

SUMMARY

[0003] An objective of the present invention is to provide a heat exchanger that alleviates the problems in the prior arts. To be more precise, an objective of the present invention is to regulate efficiency and pressure drop of the heat exchanger.

[0004] To achieve the above objectives, the present invention herein provides a heat exchanger. The heat exchanger for the circulation of at least a first fluid and a second fluid comprising: a first manifold; a second manifold arranged in a spaced manner from the first manifold; a first set of tubes fluidically connected between the first manifold and the second manifold, wherein the first fluid flows from the first manifold to the second manifold through the first set of tubes; a second set of tubes

fluidically connected between the first manifold and the second manifold, wherein the second fluid flows from the first manifold to the second manifold through the second set of tubes; and a third set of tubes fluidically connected between the first manifold and the second manifold, wherein at a first configuration, the second fluid flows from the second manifold to the first manifold through the third set of tubes; at a second configuration, the second fluid flows from the first manifold to the second manifold through the third set of tubes; and at a third configuration, the second fluid does not flow through the third set of tubes.

[0005] In one aspect, the second set of tubes together with the third set of tubes are stacked alternatively with the first set of tubes.

[0006] In another aspect, each tube from the second set of tubes and the third set of tubes, at both sides, are in contact with one tube from the first set of tubes.

[0007] In another aspect, a first channel is provided in the first manifold and is fluidically connected to the first set of tubes.

[0008] In another aspect, a second channel is provided in the second manifold and is fluidically connected to the first set of tubes.

[0009] In another aspect, the first fluid flows through the first channel and the second channel.

[0010] In another aspect, a third channel is provided in the first manifold and is fluidically connected to the second set of tubes.

[0011] In another aspect, a fourth channel is provided in the first manifold and is fluidically connected to the third set of tubes.

[0012] In another aspect, a fifth channel is provided in the second manifold and is fluidically connected to the second set of tubes and the third set of tubes.

[0013] In another aspect, at the first configuration, the second fluid flows through the third channel and the fourth channel, and does not flow through the fifth channel.

[0014] In another aspect, at the second configuration, the second fluid flows through the third channel, the fourth channel and the fifth channel.

[0015] In another aspect, at the third configuration, the second fluid flows through the third channel and the fifth channel, and does not flow through the fourth channel.

[0016] In another embodiment, the present invention herein provides an air conditioning loop. The air conditioning loop comprises: at least one heat exchanger as described in any one of preceding embodiments.

[0017] In another aspect, the first fluid is a low pressure fluid from a low pressure fluid circuit of the air conditioning loop and the second fluid is a high pressure fluid from a high pressure fluid circuit of the air conditioning loop.

[0018] According to the above embodiments, efficiency and pressure drop of the heat exchanger are regulated by switching the heat exchanger to any one of the first configuration, the second configuration and the third configuration. When high efficiency and pressure

drop are preferred, the heat exchanger is switched to the first configuration. When intermediate efficiency and pressure drop are preferred, the heat exchanger is switched to the second configuration. When low efficiency and pressure drop are preferred, the heat exchanger is switched to the third configuration.

BRIEF DESCRIPTION OF DRAWINGS

[0019] Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder. A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained, as the same becomes better understood by reference to the following description when considered in connection with the accompanying figures, wherein:

FIG. 1 illustrates an heat exchanger, in accordance with an embodiment of the present invention.

FIG. 2 illustrates a first manifold of the heat exchanger of FIG. 1;

FIG. 3 illustrates another view of the first manifold of FIG. 2;

FIG. 4 illustrates an exploded view of the first manifold of FIG. 2;

FIG. 5 illustrates a second manifold of the heat exchanger of FIG. 1;

FIG. 6 illustrates another view of the second manifold of FIG. 5;

FIG. 7 illustrates an exploded view of the second manifold of FIG. 5;

FIG. 8 illustrates the flow of a first fluid in the heat exchanger of FIG. 1;

FIG. 9 illustrates the flow of a second fluid in the heat exchanger of FIG. 1, at a first configuration;

FIG. 10 illustrates the flow of the second fluid in the heat exchanger of FIG. 1, at a second configuration; and

FIG. 11 illustrates the flow of the second fluid in the heat exchanger of FIG. 1, at a third configuration.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] It must be noted that the figures disclose the invention in a detailed enough way to be implemented, the figures helping to better define the invention, if need

be. The invention should however not be limited to the embodiments disclosed in the description.

[0021] In the present description, some elements or parameters may be indexed, such as a first element and a second element. In this case, unless stated otherwise, this indexation is only meant to differentiate and name elements that are similar but not identical. No idea of priority should be inferred from such indexation, as these may be switched without betraying the invention. Additionally, this indexation does not imply any order in mounting or use of the elements of the invention.

[0022] FIG. 1 illustrates an heat exchanger 100, in accordance with an embodiment of the present invention. The heat exchanger 100 comprises a first manifold 200 and a second manifold 300. The heat exchanger 100 further comprises a first set of tubes 400, a second set of tubes 500 and a third set of tubes 600 that are fluidically connected between the first manifold 200 and the second manifold 300.

[0023] In one embodiment, the heat exchanger 100 can comprise the first manifold 200 and the second manifold 300 arranged in a spaced manner from the first manifold 200. The heat exchanger 100 can comprise the first set of tubes 400, at one end, is fluidically connected to first manifold 200 and at another end, is fluidically connected to the second manifold 300. Further, a first fluid can flow from the first manifold 200 to the second manifold 300 through the first set of tubes 400. The heat exchanger 100 can comprise the second set of tubes 500, at one end, is fluidically connected to the first manifold 200 and at another end, is fluidically connected to the second manifold 300. Further, a second fluid can flow from the first manifold 200 to the second manifold 300 through the second set of tubes 500. The heat exchanger 100 can comprise the third set of tubes 600, at one end, is fluidically connected to the first manifold 200 and at other end, is fluidically connected to the second manifold 300. Further, the second fluid can flow in different configurations through the third set of tubes 600 at different configurations of the heat exchanger 100.

[0024] In one aspect, the second fluid can flow from the second manifold 300 to the first manifold 200 through the third set of tubes 600 at a first configuration, wherein at the first configuration, the efficiency of the heat exchanger 100 is high. In another aspect, the second fluid can flow from the first manifold 200 to the second manifold 300 through the third set of tubes 600 at a second configuration, wherein at the second configuration, the efficiency of the heat exchanger 100 is intermediate. In another aspect, the second fluid does not flow through the third set of tubes 600 at a third configuration, wherein at the third configuration, the efficiency of the heat exchanger 100 is low.

[0025] In another aspect, the second set of tubes 500 together with the third set of tubes 600 can be stacked alternatively with the first set of tubes 400. Further, the second set of tubes 500 and the third set of tubes 600 can be arranged one behind another, wherein each tube from

the second set of tubes 500 and the third set of tubes 600 is arranged in a coplanar manner. In one example, each tube from the second set of tubes 500 and the third set of tubes 600, at both sides, can be in contact with one tube from the first set of tubes 400. In another example, the

[0026] In another aspect, the first set of tubes 400, the second set of tubes 500 and the third set of tubes 600 can be any type of tube. In another example, the first set of tubes 400, the second set of tubes 500 and the third set of tubes 600 can be a multiport tube. In another example, the first set of tubes 400, the second set of tubes 500 and the third set of tubes 600 can be a sandwich tube, wherein each sandwich tube can comprise two tubes with a spacer sandwiched between the two tubes, and respective ends of the two tubes can be fluidically connected to a single orifice.

[0027] FIG. 2 and FIG. 3 illustrate two different views of the first manifold 200 of the heat exchanger 100 of FIG. 1. FIG. 4 illustrates an exploded view of the first manifold 200 of FIG. 2. In another aspect, the first manifold 200 can comprise a first connection block 210, a first cover 220, at least one first intermediate plate 230 and a first header

plater 240 assembled together. In another example, the first manifold 200 can comprise one first intermediate plate 230. In another example, the first manifold 200 can comprise two first intermediate plates 230.

[0028] In another aspect, the first connection block 210 can be adapted to fluidically connect to the first cover 220. The first connection block 210 can comprise a first connection orifice 214 adapted to fluidically connect to a first fluid circuit outside the heat exchanger 100, and a third connection orifice 212 and a fourth connection orifice 216 adapted to fluidically connect to a second fluid circuit outside the heat exchanger 100. The first cover 220 can comprise a first channel 224, a third channel 222 and a fourth channel 216 adapted to fluidically connect to the first connection orifice 214, the third connection orifice 212 and the fourth connection orifice 216 respectively.

[0029] In another aspect, the first cover 220 can be adapted to fluidically connect to the at least one first intermediate plate 230. The first cover 220 can comprise a first set of channel orifices 224A, a third set of channel orifices 222A and a fourth set of channel orifices 226A fluidically connected to the first channel 224, the third channel 222 and the fourth channel 226 respectively. The at least one first intermediate plate 230 can comprise a first set of intermediate plate orifices 234, a third set of intermediate plate orifices 232 and a fourth set of intermediate plate orifices 236 adapted to fluidically connect to the first set of channel orifices 224A, the third set of channel orifices 222A and the fourth set of channel orifices 226A respectively.

[0030] In another aspect, the at least one first intermediate plate 230 can be adapted to fluidically connect to the first header plate 240. The first header plate 240 can

comprise a first set of header plate orifices 244, a third set of header plate orifices 242 and a fourth set of header plate orifices 246 adapted to fluidically connect to the first set of intermediate plate orifices 234, the third set of intermediate plate orifices 232 and the fourth set of intermediate plate orifices 236 respectively.

[0031] In another aspect, the first header plate 240 can be adapted to fluidically connect to the first set to tubes 400, the second set of tubes 500 and the third set of tubes 600. The first set of header plate orifices 244, the third set of header plate orifices 242 and the fourth set of header plate orifices 246 of the first header plate 240 can be adapted to fluidically connect to the first set to tubes 400, the second set of tubes 500 and the third set of tubes 600 respectively.

[0032] FIG. 5 and FIG. 6 illustrate two different views of the second manifold 300 of the heat exchanger 100 of FIG. 1. FIG. 7 illustrates an exploded view of the second manifold 300 of FIG. 5. In another aspect, the second manifold 300 can comprise a second connection block 310, a second cover 320, at least one second intermediate plate 330 and a second header plater 340 assembled together. In another example, the second manifold 300 can comprise one second intermediate plate 330. In another example, the second manifold 300 can comprise two second intermediate plates 330.

[0033] In another aspect, the second connection block 310 can be adapted to fluidically connect to the second cover 320. The second connection block 310 can comprise a second connection orifice 312 adapted to fluidically connect to a first fluid circuit outside the heat exchanger 100 and a fifth connection orifice 314 adapted to fluidically connect to a second fluid circuit outside the heat exchanger 100. The second cover 320 can comprise a second channel 322 and a fifth channel 324 adapted to fluidically connect to the second connection orifice 312 and the fifth connection orifice 314 respectively.

[0034] In another aspect, the second cover 320 can be adapted to fluidically connect to the at least one second intermediate plate 330. The second cover 320 can comprise a second set of channel orifices 322A and a fifth set of channel orifices 324A fluidically connected to the second channel 322 and the fifth channel 324 respectively. The at least one second intermediate plate 330 can comprise a second set of intermediate plate orifices 332 and a fifth set of intermediate plate orifices 334 adapted to fluidically connect to the second set of channel orifices 322A and the fifth set of channel orifices 324A respectively.

[0035] In another aspect, the at least one second intermediate plate 330 can be adapted to fluidically connect to the second header plate 340. The second header plate 340 can comprise a second set of header plate orifices 342 adapted to fluidically connect to the second set of intermediate plate orifices 332, and a fifth set of header plate orifices 344 and a sixth set of header plate orifices 346 can be adapted to fluidically connect to the fifth set of

intermediate plate orifices 334 respectively.

[0036] In another aspect, the second header plate 340 can be adapted to fluidically connect to the first set of tubes 400, the second set of tubes 500 and the third set of tubes 600. The second set of header plate orifices 342, the fifth set of header plate orifices 344 and the sixth set of header plate orifices 346 of the second header plate 340 can be adapted to fluidically connect to the first set of tubes 400, the third set of tubes 600 and the second set of tubes 500 respectively.

[0037] FIG. 8 illustrates the flow of the first fluid in the heat exchanger 100 of FIG. 1. In another aspect, the first fluid can flow through the first channel 224 and the second channel 322. In another aspect, the first fluid can flow in a I-flow configuration, wherein the first fluid can flow in through the first connection orifice 214 of the first manifold 200, then flow through the first channel 224, the first set of tubes 400, the second channel 322, and then flow out through the second connection orifice 312 of the second manifold 300.

[0038] FIG. 9 illustrates the flow of the second fluid in the heat exchanger 100 of FIG. 1, at the first configuration. In another aspect, the second fluid flows through the third channel 222 and the fourth channel 226, and does not flow through the fifth channel 324 at the first configuration. In another aspect, the second fluid can flow in a U-flow configuration at the first configuration, wherein the second fluid can flow in through the third connection orifice 212 of the first manifold 200, then flow through the third channel 222, the second set of tubes 500, then make a U-turn in the second manifold 300, then flow through the third set of tubes 600, the fourth channel 226, and then flow out through the fourth connection orifice 216 of the first manifold 200.

[0039] FIG. 10 illustrates the flow of the second fluid in the heat exchanger 100 of FIG. 1, at the second configuration. In another aspect, the second fluid flows through the third channel 222, the fourth channel 226 and the fifth channel 324 at the second configuration. In another aspect, the second fluid can flow in a first I-flow configuration at the second configuration, wherein the second fluid can flow in through the third connection orifice 212 and the fourth connection orifice 216 of the first manifold 200, then flow through the third channel 222 and the fourth channel 226 respectively, then flow through the second set of tubes 500 and the third set of tubes 600 respectively, then flow through the fifth channel 324, and then flow out through the fifth connection orifice 314 of the second manifold 300.

[0040] FIG. 11 illustrates the flow of the second fluid in the heat exchanger 100 of FIG. 1, at the third configuration. In another aspect, the second fluid flows through the third channel 222 and the fifth channel 324, and does not flow through the fourth channel 226 at the third configuration. In another aspect, the second fluid can flow in a second I-flow configuration at the third configuration, wherein the second fluid can flow in through the third connection orifice 212 of the first manifold 200, then flow

through the third channel 222, the second set of tubes 500, the fifth channel 324, and then flow out through the fifth connection orifice 314 of the second manifold 300.

[0041] In another aspect, the heat exchanger 100 can be switched to any one of the first configuration, the second configuration and the third configuration by controlling the flow of the first fluid and the second fluid in the heat exchanger 100. In another example, flow control valves can be used to control the flow of the first fluid and the second fluid in the heat exchanger 100.

[0042] In another embodiment, the heat exchanger 100 can be an internal heat exchanger of an air conditioning loop that promotes heat exchange between a high pressure fluid from a high pressure fluid circuit of the air conditioning loop and a low pressure fluid from a low pressure fluid circuit of the air conditioning loop. In another aspect, the first fluid of the heat exchanger 100 can be a low pressure fluid from the low pressure fluid circuit of the air conditioning loop and the second fluid of the heat exchanger 100 can be a high pressure fluid from the high pressure fluid circuit of the air conditioning loop.

[0043] According to above-described embodiments, efficiency and pressure drop of the heat exchanger 100 can be regulated by switching the heat exchanger 100 to any one of the first configuration, the second configuration and the third configuration. When high efficiency and pressure drop are preferred, the heat exchanger 100 can be switched to the first configuration. When intermediate efficiency and pressure drop are preferred, the heat exchanger 100 can be switched to the second configuration. When low efficiency and pressure drop are preferred, the heat exchanger 100 can be switched to the third configuration.

[0044] All the above-described embodiments are just to explain the present invention while more embodiments and combinations thereof might exist. Hence, the present invention should not be limited to the above-described embodiments alone.

Claims

1. A heat exchanger (100) for the circulation of at least a first fluid and a second fluid comprising:

- a first manifold (200);
- a second manifold (300) arranged in a spaced manner from the first manifold (200);
- a first set of tubes (400) fluidically connected between the first manifold (200) and the second manifold (300), wherein the first fluid flows from the first manifold (200) to the second manifold (300) through the first set of tubes (400);
- a second set of tubes (500) fluidically connected between the first manifold (200) and the second manifold (300), wherein the second fluid flows from the first manifold (200) to the second manifold (300) through the second set of tubes (500);

- and
a third set of tubes (600) fluidically connected between the first manifold (200) and the second manifold (300), wherein
- at a first configuration, the second fluid flows from the second manifold (300) to the first manifold (200) through the third set of tubes (600);
at a second configuration, the second fluid flows from the first manifold (200) to the second manifold (300) through the third set of tubes (600); and
at a third configuration, the second fluid does not flow through the third set of tubes (600).
2. The heat exchanger (100) as claimed in preceding claim, wherein the second set of tubes (500) together with the third set of tubes (600) are stacked alternatively with the first set of tubes (400).
 3. The heat exchanger (100) as claimed in preceding claim, wherein each tube from the second set of tubes (500) and the third set of tubes (600), at both sides, are in contact with one tube from the first set of tubes (400).
 4. The heat exchanger (100) as claimed in any one of preceding claims, wherein a first channel (224) is provided in the first manifold (200) and is fluidically connected to the first set of tubes (400).
 5. The heat exchanger (100) as claimed in preceding claim, wherein a second channel (322) is provided in the second manifold (300) and is fluidically connected to the first set of tubes (400).
 6. The heat exchanger (100) as claimed in preceding claim, wherein the first fluid flows through the first channel (224) and the second channel (322).
 7. The heat exchanger (100) as claimed in any one of preceding claims, wherein a third channel (222) is provided in the first manifold (200) and is fluidically connected to the second set of tubes (500).
 8. The heat exchanger (100) as claimed in preceding claim, wherein a fourth channel (226) is provided in the first manifold (200) and is fluidically connected to the third set of tubes (600).
 9. The heat exchanger (100) as claimed in preceding claim, wherein a fifth channel (324) is provided in the second manifold (300) and is fluidically connected to the second set of tubes (500) and the third set of tubes (600).
 10. The heat exchanger (100) as claimed in preceding claim, wherein at the first configuration, the second fluid flows through the third channel (222) and the fourth channel (226), and does not flow through the fifth channel (324).
 11. The heat exchanger (100) as claimed in claim 9, wherein at the second configuration, the second fluid flows through the third channel (222), the fourth channel (226) and the fifth channel (324).
 12. The heat exchanger (100) as claimed in claim 9, wherein at the third configuration, the second fluid flows through the third channel (222) and the fifth channel (324), and does not flow through the fourth channel (226).
 13. An air conditioning loop comprises:
at least one heat exchanger (100) as claimed in any one of preceding claims.
 14. The air conditioning loop as claimed in preceding claim, wherein the first fluid is a low pressure fluid from a low pressure fluid circuit of the air conditioning loop and the second fluid is a high pressure fluid from a high pressure fluid circuit of the air conditioning loop.

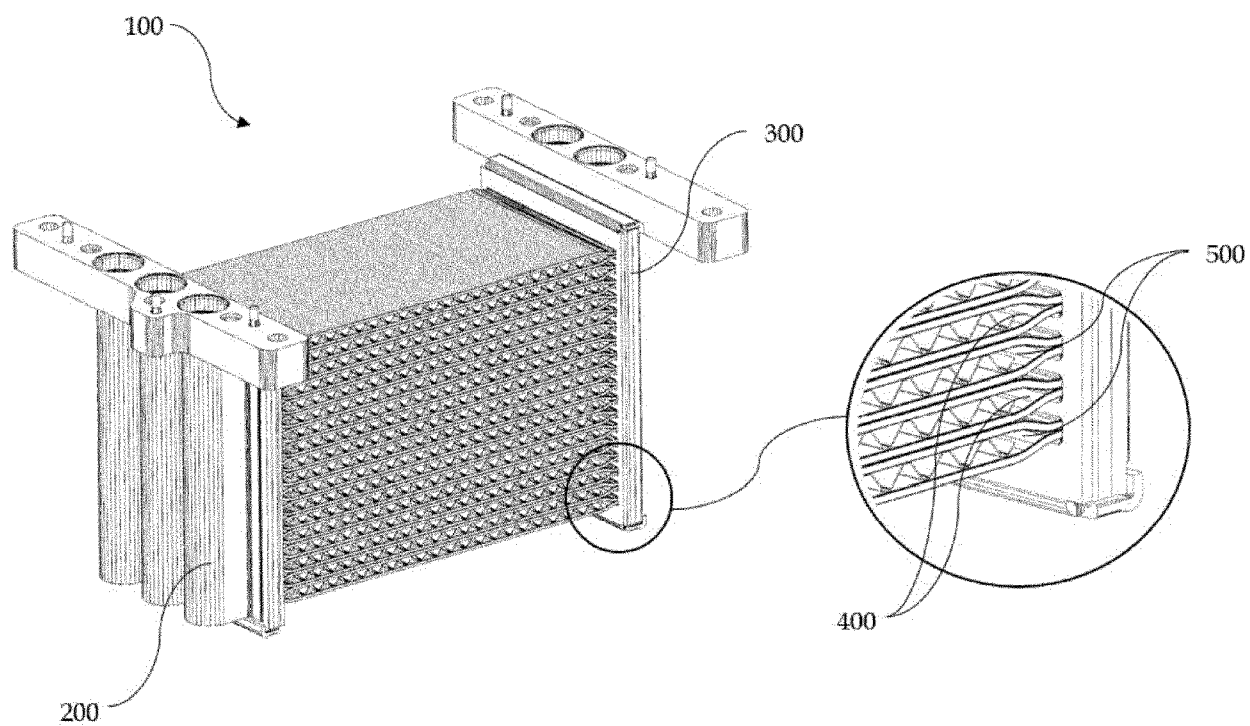


Fig. 1

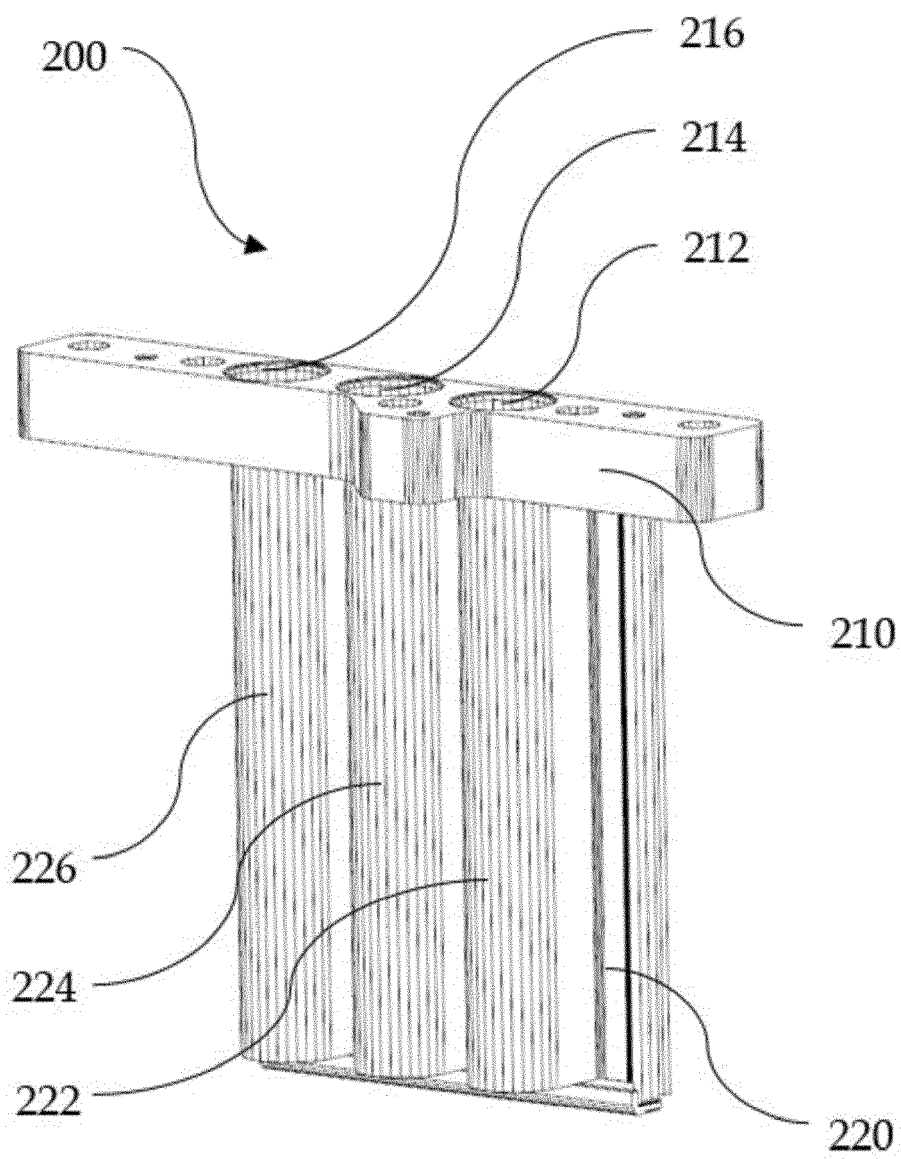


Fig. 2

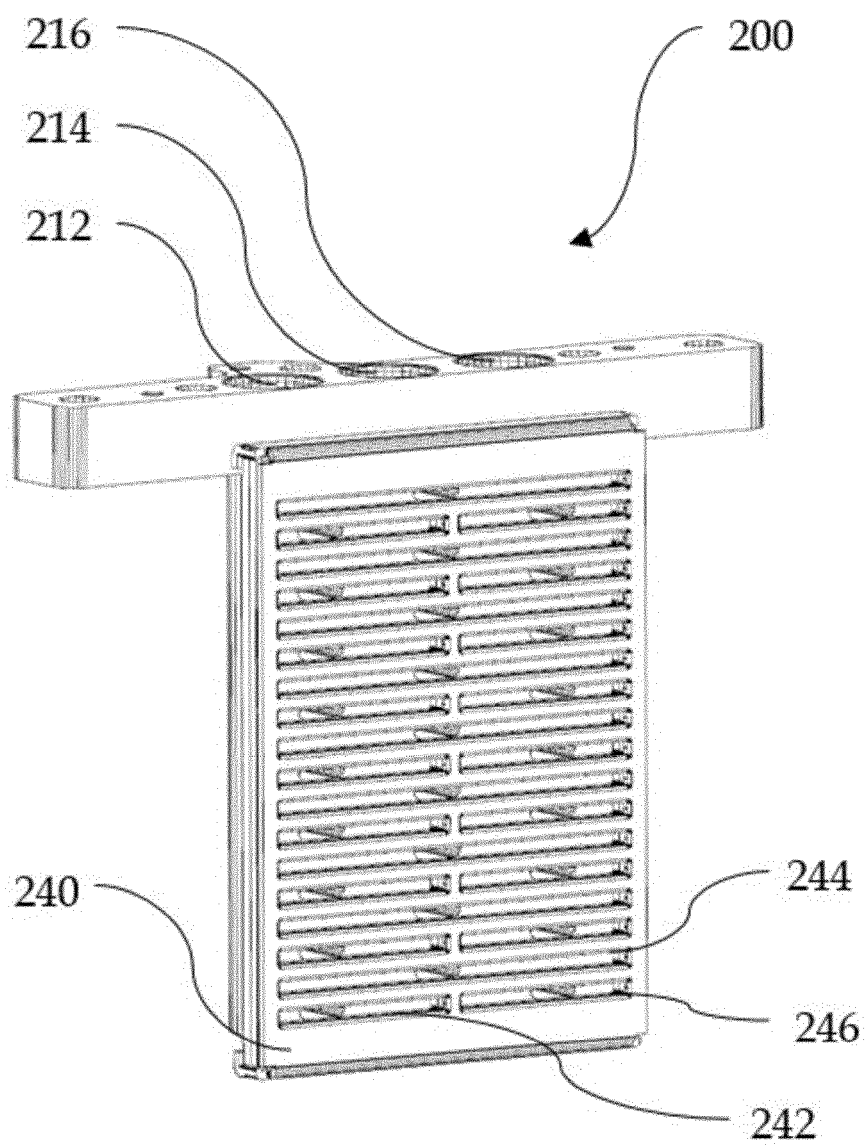


Fig. 3

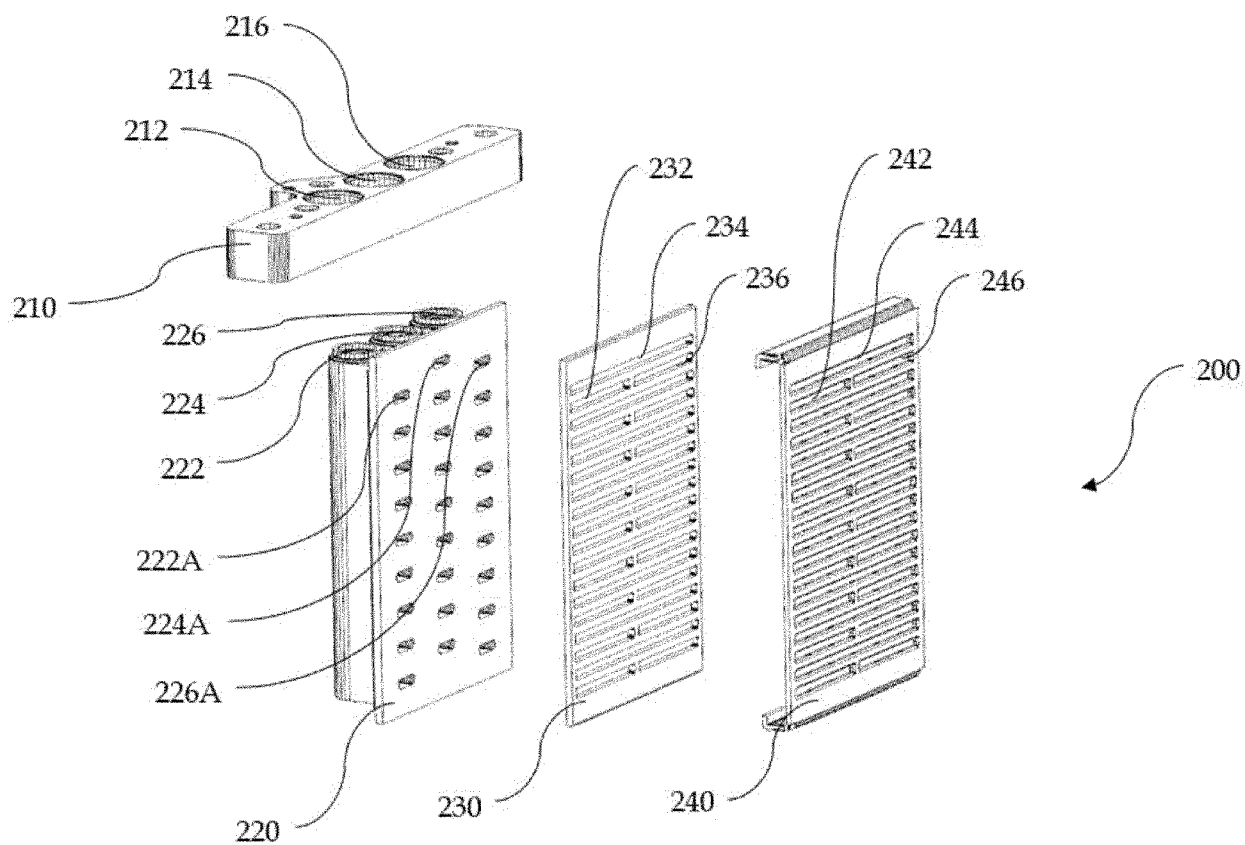


Fig. 4

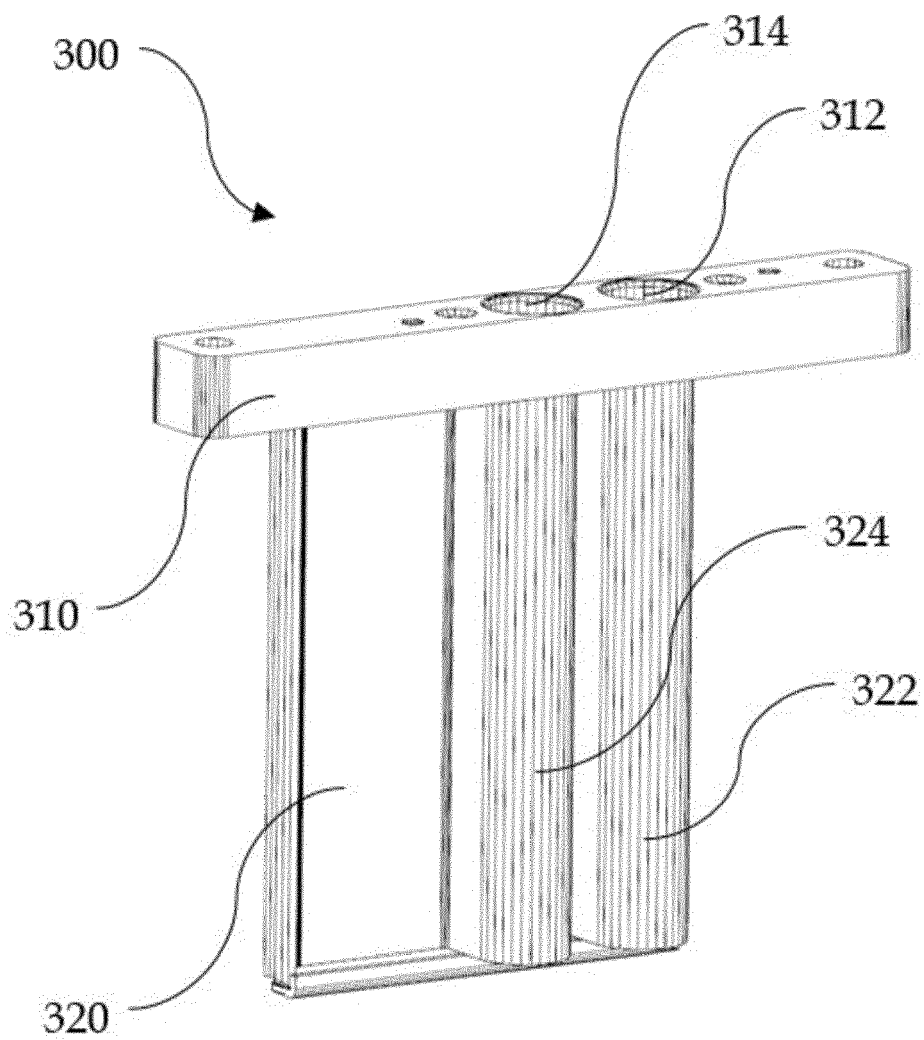


Fig. 5

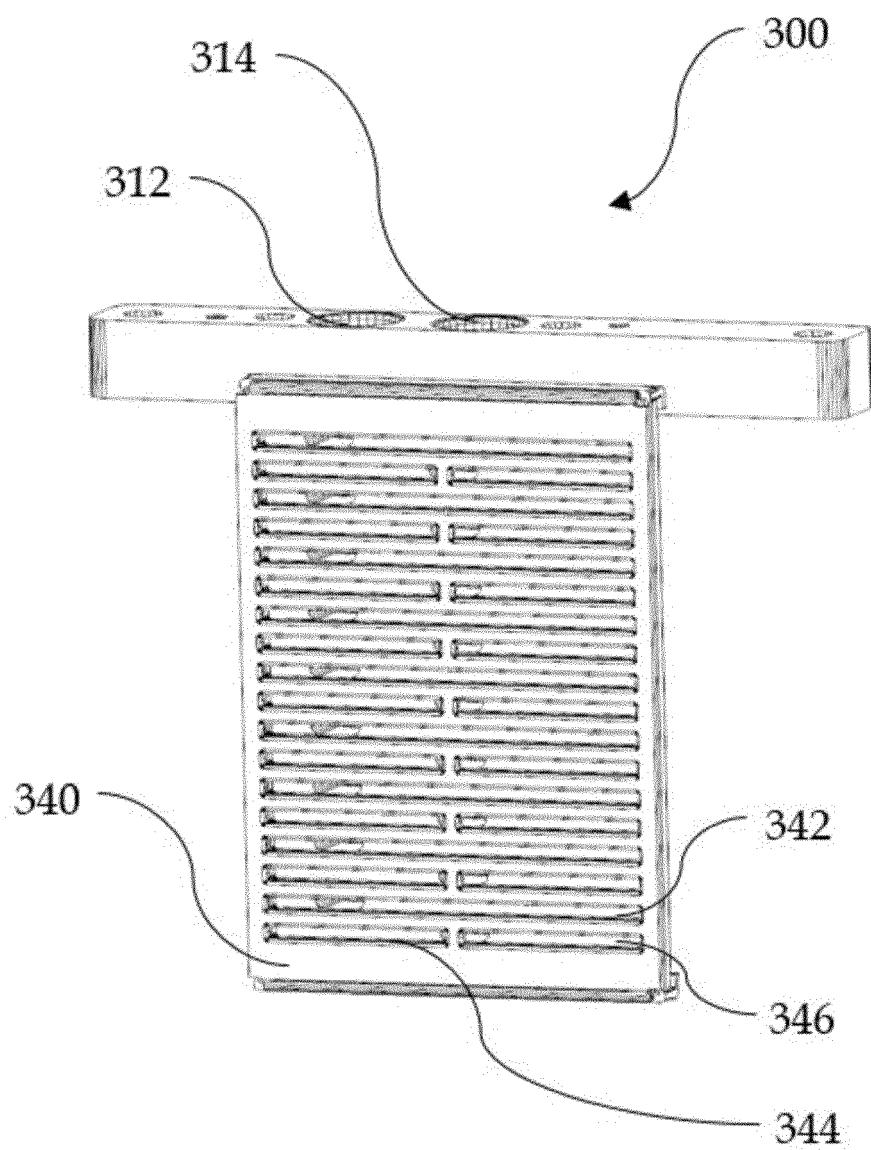


Fig. 6

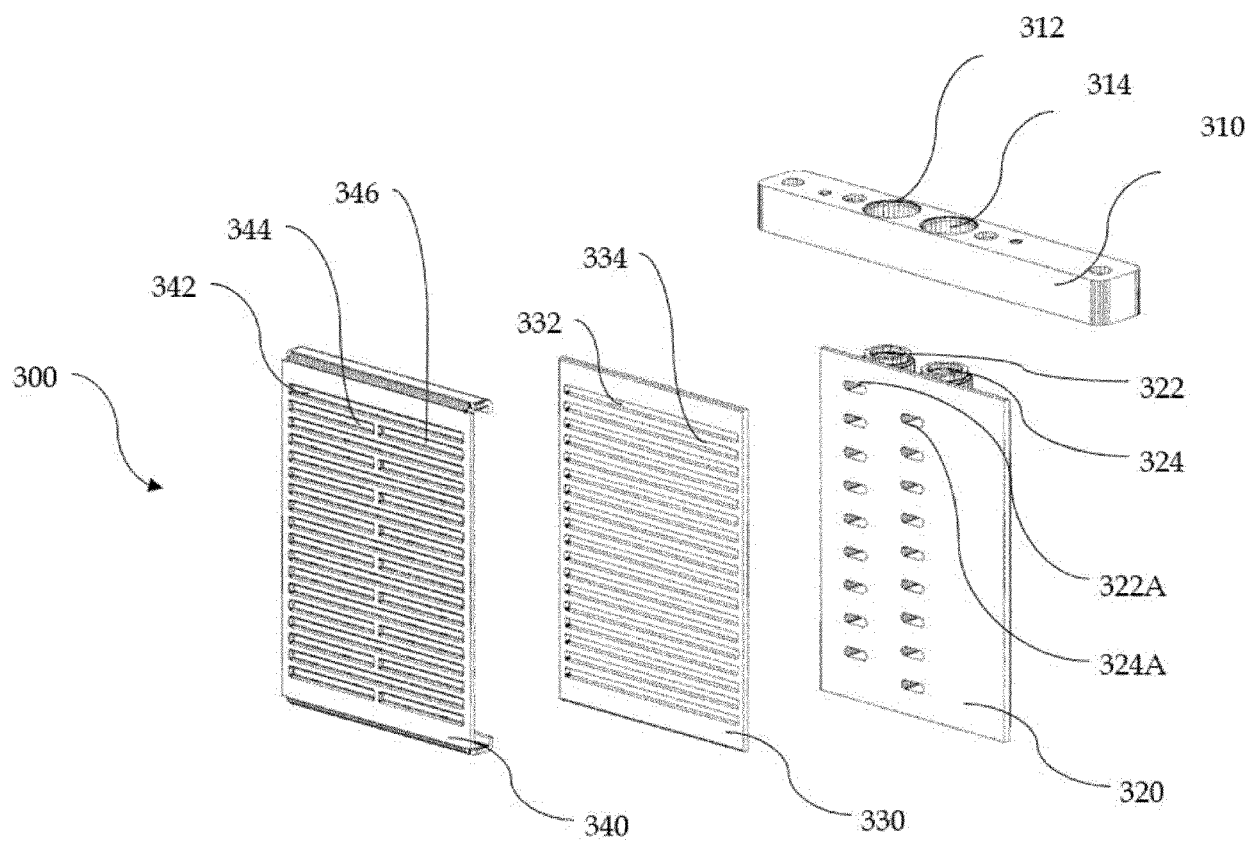


Fig. 7

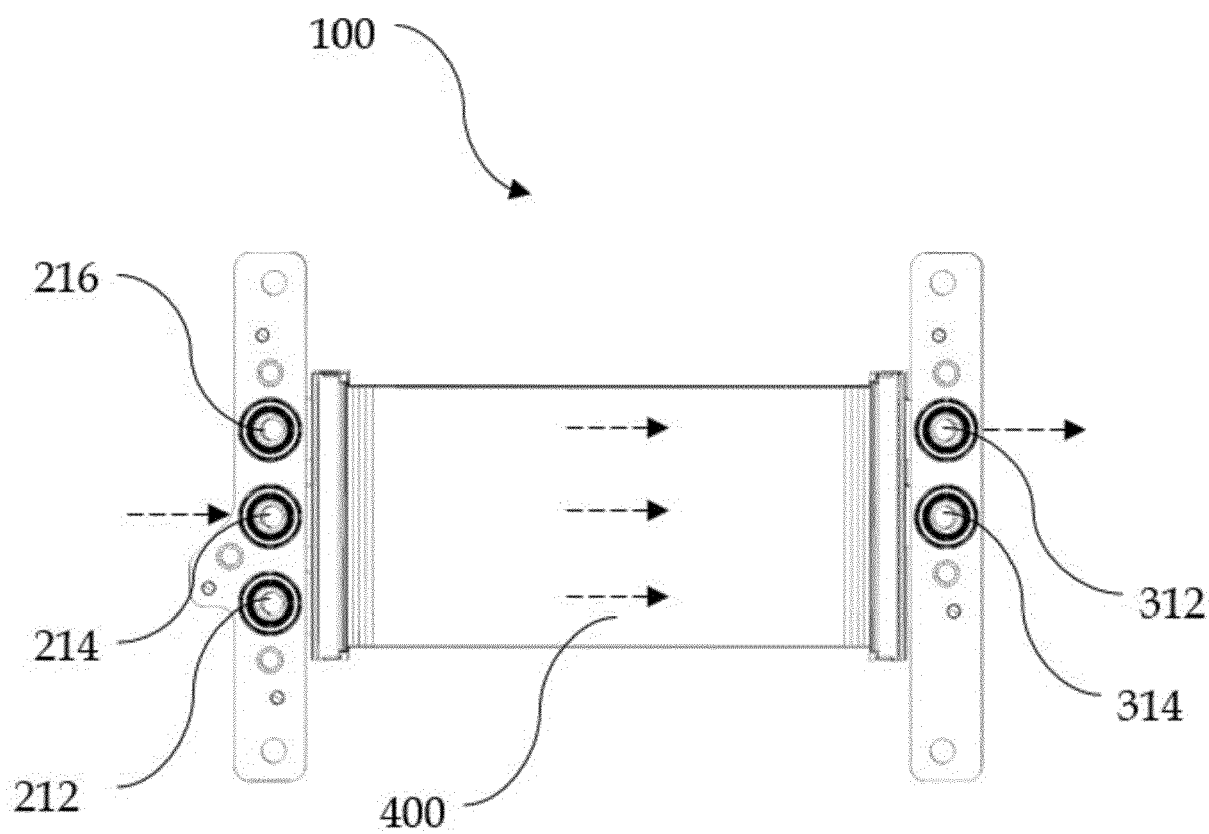


Fig. 8

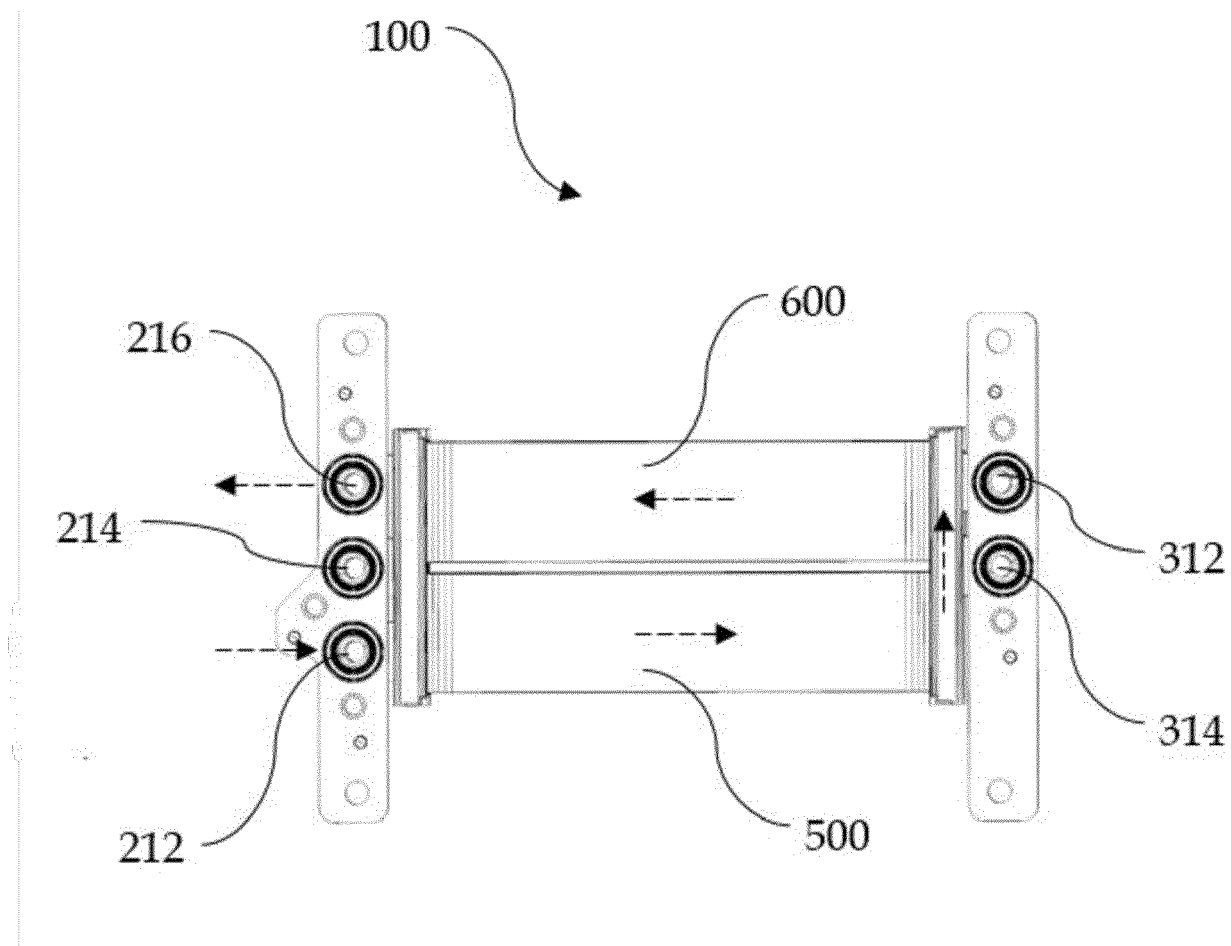


Fig. 9

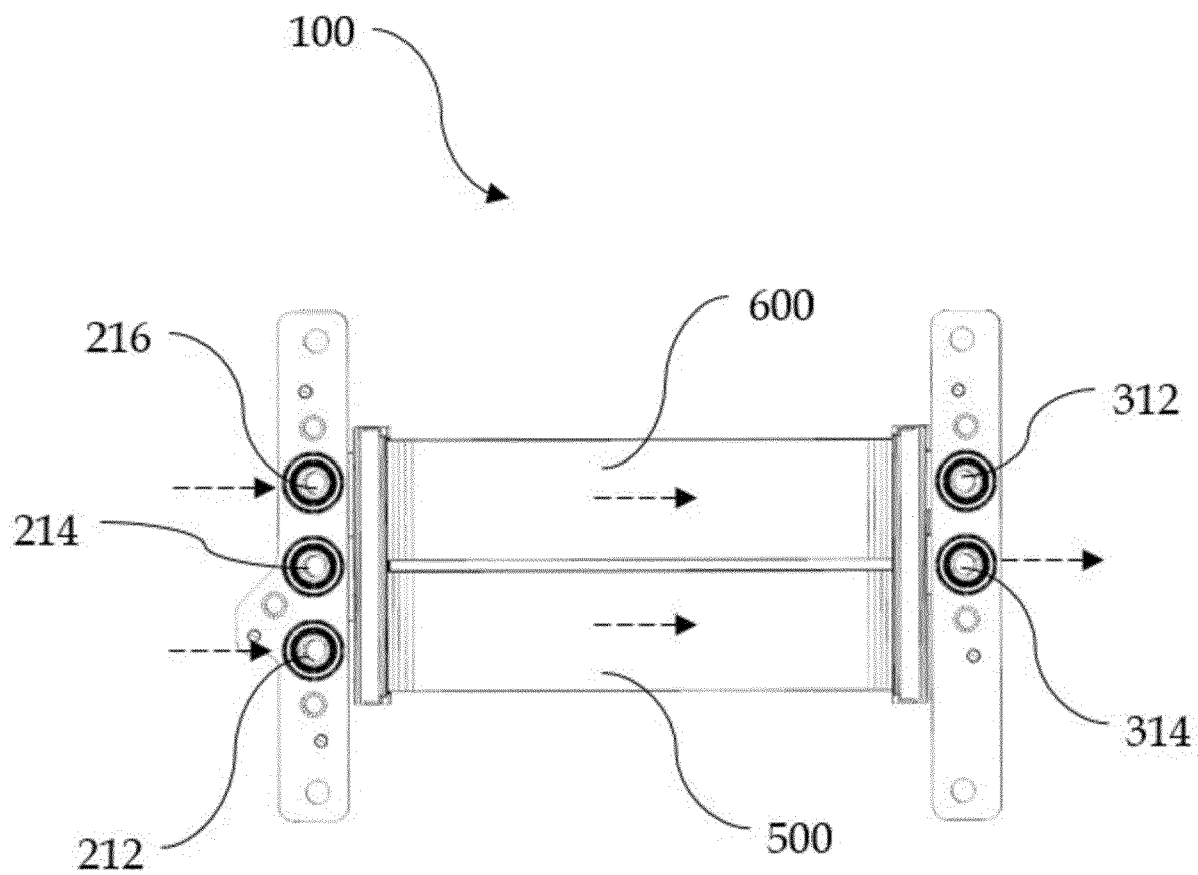


Fig. 10

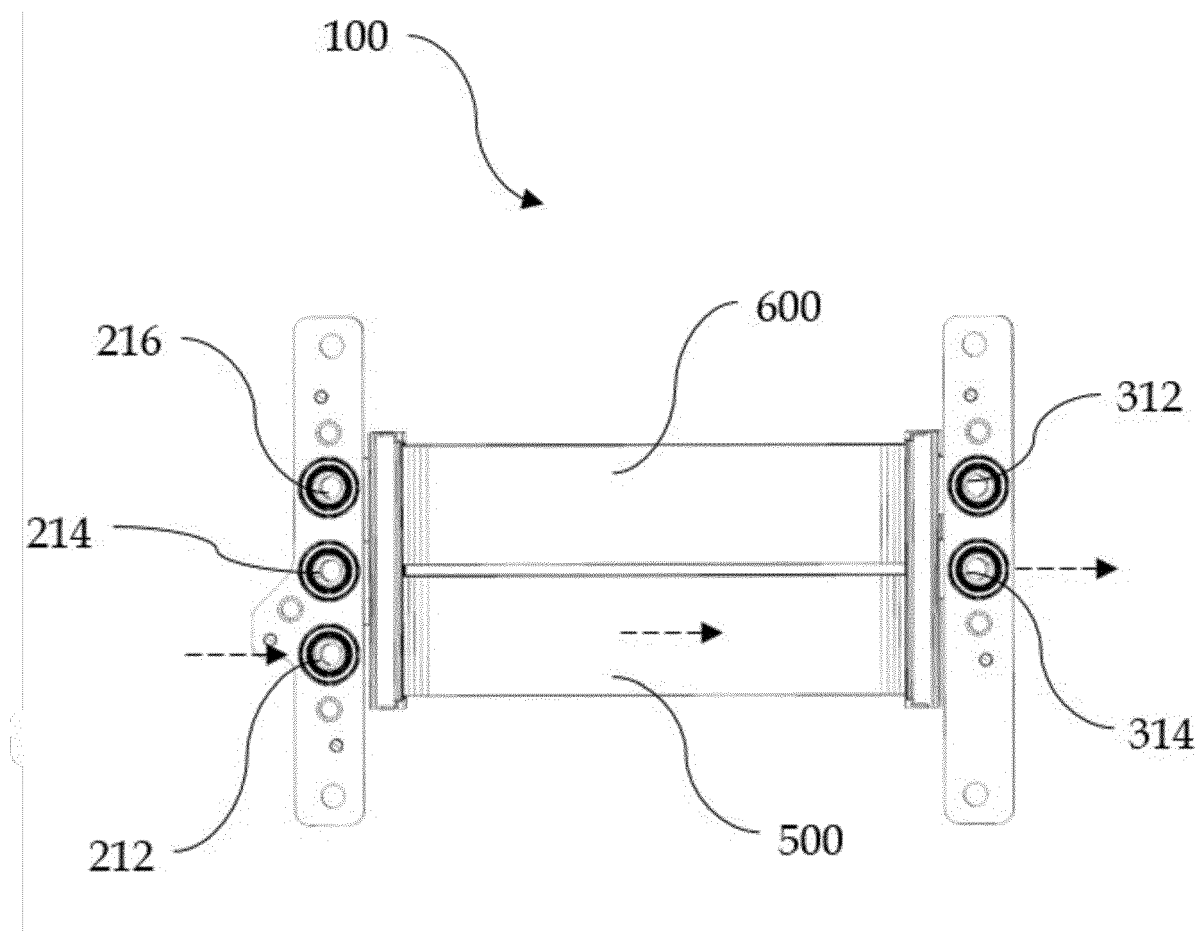


Fig. 11



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 0122

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		12 April 2024	Axters, Michael
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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