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(54) **HEAT EXCHANGER**

(57) Disclosed in the present invention is a heat exchanger. The heat exchanger comprises: an inlet header pipe, which is used for a heat exchange medium to flow into the heat exchanger, and comprises a first inlet header pipe portion and a second inlet header pipe portion; and heat exchange medium inlet pipes, which are respectively arranged at mutually adjacent ends of the first inlet header pipe portion and the second inlet header pipe portion and are respectively in fluid communication with the first inlet header pipe portion and the second inlet header pipe portion, wherein each heat exchange medium inlet pipe has an inlet. Since the heat exchange medium enters the inlet header pipe from the middle of the inlet header pipe, the optimization of distribution of the heat exchange medium is facilitated, and the heat exchange efficiency is increased.

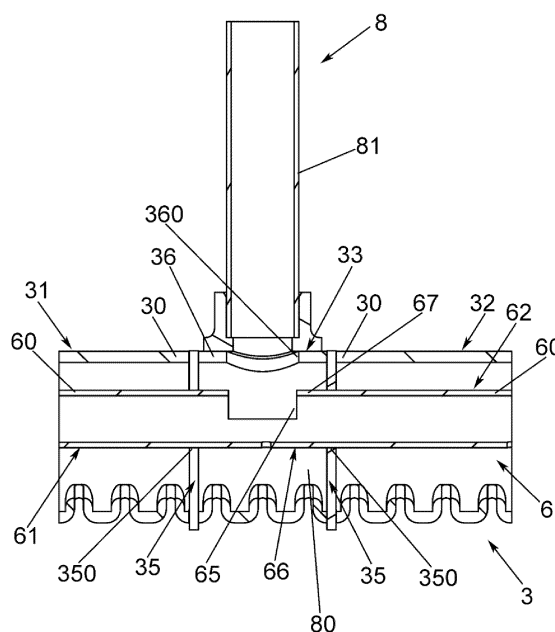


Fig. 2

Description

Technical Field

[0001] The present invention relates to a heat exchanger.

Background

[0002] A heat exchanger comprises heat exchange tubes, an outlet manifold, an inlet manifold and a distribution tube. The distribution tube is arranged in the inlet manifold to distribute a heat exchange medium.

Summary of the Invention

[0003] The object of the present invention is to provide a heat exchanger, whereby, for example, optimization of heat exchange medium distribution and enhancement of heat exchange efficiency can be facilitated.

[0004] Embodiments of the present invention provide a heat exchanger, comprising: an inlet manifold, the inlet manifold being used for the flow of a heat exchange medium into the heat exchanger, and the inlet manifold comprising a first inlet manifold part and a second inlet manifold part, and heat exchange medium inlet tubes, respectively arranged at mutually adjacent ends of the first inlet manifold part and the second inlet manifold part, and in fluid communication with the first inlet manifold part and the second inlet manifold part respectively, the heat exchange medium inlet tube having an inlet.

[0005] According to an embodiment of the present invention, the inlet manifold further comprises: a distribution tube, the distribution tube comprising a first distribution tube part and a second distribution tube part, the first distribution tube part and the second distribution tube part having distribution tube distributing portions respectively arranged in the first inlet manifold part and the second inlet manifold part, and distribution tube connecting portions respectively extending out of the first inlet manifold part and the second inlet manifold part from the distribution tube distributing portions, the distribution tube connecting portions forming the heat exchange medium inlet tubes.

[0006] According to an embodiment of the present invention, the first inlet manifold part and the second inlet manifold part respectively have closure plates which close the mutually adjacent ends of the first inlet manifold part and the second inlet manifold part, the closure plate having a through-hole; and the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part extend out through the through-holes of the closure plates of the first inlet manifold part and the second inlet manifold part respectively.

[0007] According to an embodiment of the present invention, the inlet manifold further comprises an inlet manifold connecting part connected between the first

inlet manifold part and the second inlet manifold part, a transitional chamber is defined by the inlet manifold connecting part together with the closure plates of the first inlet manifold part and the second inlet manifold part, the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part extend out into the transitional chamber through the through-holes of the closure plates of the first inlet manifold part and the second inlet manifold part respectively, and the inlet manifold connecting part has an opening penetrating a tube wall of the inlet manifold connecting part, allowing the heat exchange medium to enter the transitional chamber through the opening in the tube wall of the inlet manifold connecting part.

[0008] According to an embodiment of the present invention, the heat exchanger further comprises a connecting tube assembly, the connecting tube assembly comprising a connecting tube, the connecting tube being connected to the inlet manifold connecting part, and in fluid communication with the transitional chamber via the opening in the tube wall of the inlet manifold connecting part.

[0009] According to an embodiment of the present invention, the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part are connected to each other to form a common heat exchange medium inlet tube, and the inlet of the heat exchange medium inlet tube is an opening penetrating a tube wall of the common heat exchange medium inlet tube.

[0010] According to an embodiment of the present invention, the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part have ends which are separated from each other, and the inlet of the heat exchange medium inlet tube is an opening at the end of the heat exchange medium inlet tube.

[0011] According to an embodiment of the present invention, the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part are connected to each other to form a common heat exchange medium inlet tube, and the inlet of the heat exchange medium inlet tube is an opening penetrating a tube wall of the common heat exchange medium inlet tube; and the heat exchanger further comprises a connecting tube assembly, the connecting tube assembly comprising a connecting tube, the connecting tube being connected to the common heat exchange medium inlet tube, and in fluid communication with the opening in the tube wall of the common heat exchange medium inlet tube.

[0012] According to an embodiment of the present invention, the first inlet manifold part and the second inlet manifold part of the inlet manifold are two separate inlet

manifold parts.

[0013] According to an embodiment of the present invention, the first inlet manifold part and the second inlet manifold part of the inlet manifold are two parts of a single inlet manifold.

[0014] According to an embodiment of the present invention, the heat exchanger further comprises multiple heat exchange tubes, first ends of the multiple heat exchange tubes being connected to and in fluid communication with the inlet manifold, the multiple heat exchange tubes comprising a first heat exchange tube which is connected to and in fluid communication with the first inlet manifold part of the inlet manifold, and a second heat exchange tube which is connected to and in fluid communication with the second inlet manifold part of the inlet manifold.

[0015] According to an embodiment of the present invention, in a direction of arrangement of the heat exchange tubes, the first heat exchange tube is located at one side, and the second heat exchange tube is located at the other side.

[0016] According to an embodiment of the present invention, the first end of the first heat exchange tube is bent towards one side in a thickness direction of the heat exchanger, and/or the first end of the second heat exchange tube is bent towards the other side in the thickness direction of the heat exchanger, such that the first inlet manifold part and the second inlet manifold part of the inlet manifold are offset in relation to each other in the thickness direction of the heat exchanger.

[0017] According to an embodiment of the present invention, the first inlet manifold part and the second inlet manifold part of the inlet manifold are offset in relation to each other in a direction which is perpendicular to a thickness direction of the heat exchanger and to a direction of arrangement of the heat exchange tubes.

[0018] According to an embodiment of the present invention, the heat exchanger further comprises a connecting tube assembly, the connecting tube assembly comprising a three-way tube and a connecting tube, the connecting tube being connected via the three-way tube to the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part.

[0019] According to an embodiment of the present invention, there is an angle between an axis of the first inlet manifold part and an axis of the second inlet manifold part.

[0020] According to an embodiment of the present invention, the heat exchanger further comprises an outlet manifold, the outlet manifold being used for the flow of the heat exchange medium out of the heat exchanger; second ends of the multiple heat exchange tubes are connected to and in fluid communication with the outlet manifold, and the outlet manifold comprises a first outlet manifold part and a second outlet manifold part, the first heat exchange tube being connected to and in fluid communication with the first outlet manifold part of the

outlet manifold, and the second heat exchange tube being connected to and in fluid communication with the second outlet manifold part of the outlet manifold.

[0021] According to an embodiment of the present invention, the first heat exchange tube and the second heat exchange tube are arranged in a length direction of the outlet manifold.

[0022] According to an embodiment of the present invention, the heat exchanger further comprises a first secondary heat exchanger and a second secondary heat exchanger, the first secondary heat exchanger comprising the first inlet manifold part, the first outlet manifold part and the first heat exchange tube, the second secondary heat exchanger comprising the second inlet manifold part, the second outlet manifold part and the second heat exchange tube, and an angle being formed between the first secondary heat exchanger and the second secondary heat exchanger.

[0023] According to an embodiment of the present invention, the angle between the first secondary heat exchanger and the second secondary heat exchanger is in the range of 45 degrees to 135 degrees.

[0024] According to an embodiment of the present invention, the first outlet manifold part and the second outlet manifold part of the outlet manifold are two separate outlet manifold parts, and connected to each other via an outlet manifold connecting tube.

[0025] According to an embodiment of the present invention, the first outlet manifold part and the second outlet manifold part of the outlet manifold are two parts of a single outlet manifold.

[0026] According to an embodiment of the present invention, the first inlet manifold part and the second inlet manifold part respectively have closure plates which close the mutually adjacent ends of the first inlet manifold part and the second inlet manifold part, the closure plate having a through-hole; and the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part are in communication with the through-holes of the closure plates of the first inlet manifold part and the second inlet manifold part respectively.

[0027] Using the heat exchanger according to embodiments of the present invention, the fact that the heat exchange medium enters the inlet manifold through the middle of the inlet manifold helps to optimize distribution of the heat exchange medium and increase heat exchange efficiency.

Brief Description of the Drawings

[0028]

Fig. 1 is a schematic main view of a heat exchanger according to an embodiment of the present invention;

Fig. 2 is a schematic sectional view of part of the heat

exchanger shown in Fig. 1, said part including a connecting tube assembly;

Fig. 3 is a schematic sectional view of part of a heat exchanger according to another embodiment of the present invention, said part including a connecting tube assembly;

Fig. 4 is a schematic main view of a heat exchanger according to another embodiment of the present invention;

Fig. 5 is a schematic sectional view of part of the heat exchanger shown in Fig. 4, said part including a connecting tube assembly;

Fig. 6 is a schematic perspective view of a heat exchanger according to another embodiment of the present invention;

Fig. 7 is a schematic side view of part of a heat exchanger according to a variant of the embodiment shown in Fig. 6;

Fig. 8 is a schematic main view of a heat exchanger according to another variant of the embodiment shown in Fig. 6;

Fig. 9 is a schematic top view of a heat exchanger according to another variant of the embodiment shown in Fig. 6;

Fig. 10 is a schematic bottom view of a heat exchanger according to another variant of the embodiment shown in Fig. 6; and

Fig. 11 is a schematic bottom view of a heat exchanger according to a further variant of the embodiment shown in Fig. 6.

Detailed Description of the Invention

[0029] The present invention is explained further below in conjunction with the drawings and specific embodiments.

[0030] Referring to Figs. 1 - 6, 8 and 9, a heat exchanger 100 according to embodiments of the present invention comprises: an inlet manifold 3, the inlet manifold 3 being used for the flow of a heat exchange medium into the heat exchanger 100, and the inlet manifold 3 comprising a first inlet manifold part 31 and a second inlet manifold part 32; and heat exchange medium inlet tubes 66, respectively arranged at mutually adjacent ends 30 of the first inlet manifold part 31 and the second inlet manifold part 32, and in fluid communication with the first inlet manifold part 31 and the second inlet manifold part 32 respectively, the heat exchange medium inlet tube 66 having an inlet 65.

[0031] Referring to Figs. 1 - 6, 8 and 9, in embodiments of the present invention, the inlet manifold 3 further comprises a distribution tube 6, the distribution tube 6 comprising: a first distribution tube part 61 and a second distribution tube part 62, the first distribution tube part 61 and the second distribution tube part 62 having distribution tube distributing portions 60 respectively arranged in the first inlet manifold part 31 and the second inlet manifold part 32, and distribution tube connecting portions which respectively extend out of the first inlet manifold part 31 and the second inlet manifold part 32 from the distribution tube distributing portions 60 and form the heat exchange medium inlet tubes 66. The distribution tube distributing portions 60 may have multiple distributing holes arranged in a longitudinal direction.

[0032] Referring to Figs. 2, 3 and 5, in embodiments of the present invention, the first inlet manifold part 31 and the second inlet manifold part 32 respectively have closure plates 35 which close the mutually adjacent ends 30 of the first inlet manifold part 31 and the second inlet manifold part 32, the closure plate 35 having a through-hole 350; and the heat exchange medium inlet tube 66 arranged on the first inlet manifold part 31 and the heat exchange medium inlet tube 66 arranged on the second inlet manifold part 32 extend out through the through-holes 350 of the closure plates 35 of the first inlet manifold part 31 and the second inlet manifold part 32 respectively. If no distribution tube distributing portions 60 are employed, the heat exchange medium inlet tube 66 arranged on the first inlet manifold part 31 and the heat exchange medium inlet tube 66 arranged on the second inlet manifold part 32 are in communication with the through-holes 350 of the closure plates 35 of the first inlet manifold part 31 and the second inlet manifold part 32 respectively.

[0033] Referring to Figs. 2 and 3, in embodiments of the present invention, the inlet manifold 3 further comprises: an inlet manifold connecting part 33 connected between the first inlet manifold part 31 and the second inlet manifold part 32, wherein a transitional chamber 80 is defined by the inlet manifold connecting part 33 together with the closure plates 35 of the first inlet manifold part 31 and the second inlet manifold part 32, the heat exchange medium inlet tube 66 arranged on the first inlet manifold part 31 and the heat exchange medium inlet tube 66 arranged on the second inlet manifold part 32 extend out into the transitional chamber 80 through the through-holes 350 of the closure plates 35 of the first inlet manifold part 31 and the second inlet manifold part 32 respectively, and the inlet manifold connecting part 33 has an opening 360 penetrating a tube wall 36 of the inlet manifold connecting part 33, allowing a heat exchange medium to enter the transitional chamber 80 through the opening 360 in the tube wall 36 of the inlet manifold connecting part 33. The heat exchanger 100 further comprises a connecting tube assembly 8, the connecting tube assembly 8 comprising a connecting tube 81, the connecting tube 81 being connected to the inlet manifold

connecting part 33, and in fluid communication with the transitional chamber 80 via the opening 360 in the tube wall 36 of the inlet manifold connecting part 33. The heat exchange medium enters the transitional chamber 80 via the connecting tube 81, then passes through the inlets 65 of the heat exchange medium inlet tubes 66 to enter the first distribution tube part 61 and the second distribution tube part 62 of the distribution tube 6, which are located at two sides.

[0034] Referring to Figs. 2, 4 and 5, in some embodiments of the present invention, the heat exchange medium inlet tube 66 arranged on the first inlet manifold part 31 and the heat exchange medium inlet tube 66 arranged on the second inlet manifold part 32 are connected to each other to form a common heat exchange medium inlet tube 66, and the inlet 65 of the heat exchange medium inlet tube 66 is an opening penetrating a tube wall 67 of the common heat exchange medium inlet tube 66. Referring to Figs. 3, 6, 8 and 9, in other embodiments of the present invention, the heat exchange medium inlet tube 66 arranged on the first inlet manifold part 31 and the heat exchange medium inlet tube 66 arranged on the second inlet manifold part 32 have ends which are separated from each other, and the inlet 65 of the heat exchange medium inlet tube 66 is an opening at the end 68 of the heat exchange medium inlet tube 66.

[0035] Referring to Figs. 4 and 5, in embodiments of the present invention, the heat exchange medium inlet tube 66 arranged on the first inlet manifold part 31 and the heat exchange medium inlet tube 66 arranged on the second inlet manifold part 32 are connected to each other to form a common heat exchange medium inlet tube 66, and the inlet 65 of the heat exchange medium inlet tube 66 is an opening penetrating the tube wall 67 of the common heat exchange medium inlet tube 66. The connecting tube assembly 8 comprises the connecting tube 81, the connecting tube 81 being connected to the common heat exchange medium inlet tube 66, and in fluid communication with the opening in the tube wall 67 of the common heat exchange medium inlet tube 66. The connecting tube 81 is located between the first inlet manifold part 31 and the second inlet manifold part 32, and the heat exchange medium enters the heat exchange medium inlet tube 66 directly via the connecting tube 81, e.g. directly enters a centrally located common distribution tube connecting portion of the distribution tube 6, and then enters the first distribution tube part 61 and the second distribution tube part 62 of the distribution tube 6, which are located at the two sides.

[0036] Referring to Figs. 4 - 6, 8 and 9, in some embodiments of the present invention, the first inlet manifold part 31 and the second inlet manifold part 32 of the inlet manifold 3 are two separate inlet manifold parts. For example, there is an angle between an axis of the first inlet manifold part 31 and an axis of the second inlet manifold part 32. Thus, an installation space is provided between the end of the first inlet manifold part 31 and the end of the second inlet manifold part 32. Referring to Figs.

1 - 3, in other embodiments of the present invention, the first inlet manifold part 31 and the second inlet manifold part 32 of the inlet manifold 3 are two manifold parts of a single inlet manifold 3.

[0037] Referring to Figs. 1, 4 and 6 - 8, in embodiments of the present invention, the heat exchanger 100 further comprises: multiple heat exchange tubes 5; and fins 7 arranged alternately with the heat exchange tubes 5. First ends 51 of the multiple heat exchange tubes 5 are connected to and in fluid communication with the inlet manifold 3. Referring to Figs. 4 - 9, the multiple heat exchange tubes 5 comprise first heat exchange tubes 5A which are connected to and in fluid communication with the first inlet manifold part 31 of the inlet manifold 3, and second heat exchange tubes 5B which are connected to and in fluid communication with the second inlet manifold part 32 of the inlet manifold 3. In a direction of arrangement of the heat exchange tubes 5, the first heat exchange tubes 5A are located at one side, and the second heat exchange tubes 5B are located at the other side.

[0038] Referring to Fig. 6, in some embodiments of the present invention, the first ends 51 of the first heat exchange tubes 5A are bent towards one side in a thickness direction of the heat exchanger 100, or the first ends 51 of the second heat exchange tubes 5B are bent towards the other side in the thickness direction of the heat exchanger 100, such that the first inlet manifold part 31 and the second inlet manifold part 32 of the inlet manifold 3 are offset in relation to each other in the thickness direction of the heat exchanger 100. Referring to Fig. 7, in other embodiments of the present invention, the first ends 51 of the first heat exchange tubes 5A are bent towards one side in the thickness direction of the heat exchanger 100, and the first ends 51 of the second heat exchange tubes 5B are bent towards the other side in the thickness direction of the heat exchanger 100, such that the first inlet manifold part 31 and the second inlet manifold part 32 of the inlet manifold 3 are offset in relation to each other in the thickness direction of the heat exchanger 100. According to this embodiment of the present invention, it can be ensured that the heat exchange tubes are uninterrupted over the entire wind-facing side, thus increasing the heat exchange area.

[0039] Referring to Fig. 8, in embodiments of the present invention, the first inlet manifold part 31 and the second inlet manifold part 32 of the inlet manifold 3 are offset in relation to each other in a direction (the vertical direction in Fig. 8) which is perpendicular to the thickness direction of the heat exchanger 100 and to the direction of arrangement of the heat exchange tubes 5. It may be that, based on the embodiments shown in Figs. 6 and 7, the first inlet manifold part 31 and the second inlet manifold part 32 of the inlet manifold 3 are offset in relation to each other in a direction (the vertical direction in Fig. 7) which is perpendicular to the thickness direction of the heat exchanger 100 and to the direction of arrangement of the heat exchange tubes 5; or based on the embodiment shown in Fig. 4, the first inlet manifold part 31 and the

second inlet manifold part 32 of the inlet manifold 3 are offset in relation to each other in a direction (the vertical direction in Fig. 7) which is perpendicular to the thickness direction of the heat exchanger 100 and to the direction of arrangement of the heat exchange tubes 5. The heat exchangers according to these embodiments can fully utilize a heat exchange area in certain installation scenarios, thus increasing heat exchange efficiency.

[0040] Referring to Figs. 6 and 8, in embodiments of the present invention, the connecting tube assembly 8 comprises a three-way tube 85 and the connecting tube 81, the connecting tube 81 being connected via the three-way tube 85 to the heat exchange medium inlet tube 66 arranged on the first inlet manifold part 31 and the heat exchange medium inlet tube 66 arranged on the second inlet manifold part 32, e.g. connected to the distribution tube connecting portions of the first distribution tube part 61 and the second distribution tube part 62 of the distribution tube 6.

[0041] Referring to Figs. 1, 4, 6, 8, 10 and 11, in embodiments of the present invention, the heat exchanger 100 further comprises: an outlet manifold 2, the outlet manifold 2 being used for the flow of the heat exchange medium out of the heat exchanger 100, and second ends 51 of the multiple heat exchange tubes 5 are connected to and in fluid communication with the outlet manifold 2. Referring to Figs. 4, 6, 8, 10 and 11, the outlet manifold 2 comprises a first outlet manifold part 21 and a second outlet manifold part 22, the first heat exchange tubes 5A are connected to and in fluid communication with the first outlet manifold part 21 of the outlet manifold 2, and the second heat exchange tubes 5B are connected to and in fluid communication with the second outlet manifold part 22 of the outlet manifold 2. The multiple heat exchange tubes 5 are arranged in a length direction of the outlet manifold 2. That is, the first heat exchange tubes 5A and the second heat exchange tubes 5B are arranged in the length direction of the outlet manifold 2. The heat exchanger 100 further comprises: a first secondary heat exchanger 101 and a second secondary heat exchanger 102. The first secondary heat exchanger 101 comprises the first inlet manifold part 31, the first distribution tube part 61, the first outlet manifold part 21 and the first heat exchange tubes 5A. The second secondary heat exchanger 102 comprises the second inlet manifold part 32, the second distribution tube part 62, the second outlet manifold part 22 and the second heat exchange tubes 5B. An angle is formed between the first secondary heat exchanger 101 and the second secondary heat exchanger 102, wherein the angle may be in the range of 45 degrees to 135 degrees. The angle between the first secondary heat exchanger 101 and the second secondary heat exchanger 102 may be in the range of 85 degrees to 95 degrees; for example, the angle between the first secondary heat exchanger 101 and the second secondary heat exchanger 102 is approximately 90 degrees. According to an example of the present invention, as shown in Fig. 10, the first outlet manifold part 21 and the

second outlet manifold part 22 of the outlet manifold 2 are two separate outlet manifold parts, and connected to each other via an outlet manifold connecting tube 25. According to another example of the present invention, as shown in Fig. 11, the first outlet manifold part 21 and the second outlet manifold part 22 of the outlet manifold 2 are two parts of a single outlet manifold. That is, the heat exchangers shown in Figs. 4 and 6 can be bent. If a heat exchanger core body needs to be bent, the heat exchangers shown in Figs. 4 and 6 can be bent easily.

[0042] Using the heat exchanger according to embodiments of the present invention, the fact that the heat exchange medium enters the distribution tube through the middle of the inlet manifold helps to optimize distribution of the heat exchange medium and increase heat exchange efficiency.

[0043] Although the above embodiments have been described, certain features in the above embodiments can be combined to form new embodiments.

[0044] For example, although the inlet manifold has been described as comprising the first inlet manifold part and the second inlet manifold part, the inlet manifold could also comprise three or more parts, and correspondingly, the distribution tube could also comprise three or more parts.

Claims

1. A heat exchanger, comprising:
an inlet manifold, the inlet manifold being used for the flow of a heat exchange medium into the heat exchanger, and the inlet manifold comprising a first inlet manifold part and a second inlet manifold part, and heat exchange medium inlet tubes, respectively arranged at mutually adjacent ends of the first inlet manifold part and the second inlet manifold part, and in fluid communication with the first inlet manifold part and the second inlet manifold part respectively, the heat exchange medium inlet tube having an inlet.
2. The heat exchanger as claimed in claim 1, the inlet manifold further comprising:
a distribution tube, the distribution tube comprising a first distribution tube part and a second distribution tube part, the first distribution tube part and the second distribution tube part having distribution tube distributing portions respectively arranged in the first inlet manifold part and the second inlet manifold part, and distribution tube connecting portions respectively extending out of the first inlet manifold part and the second inlet manifold part from the distribution tube distributing portions, the distribution tube connecting portions forming the heat exchange medium inlet tubes.
3. The heat exchanger as claimed in claim 1, wherein:

- the first inlet manifold part and the second inlet manifold part respectively have closure plates which close the mutually adjacent ends of the first inlet manifold part and the second inlet manifold part, the closure plate having a through-hole; and
the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part extend out through the through-holes of the closure plates of the first inlet manifold part and the second inlet manifold part respectively.
4. The heat exchanger as claimed in claim 3, wherein: the inlet manifold further comprises an inlet manifold connecting part connected between the first inlet manifold part and the second inlet manifold part, a transitional chamber is defined by the inlet manifold connecting part together with the closure plates of the first inlet manifold part and the second inlet manifold part, the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part extend out into the transitional chamber through the through-holes of the closure plates of the first inlet manifold part and the second inlet manifold part respectively, and the inlet manifold connecting part has an opening penetrating a tube wall of the inlet manifold connecting part, allowing the heat exchange medium to enter the transitional chamber through the opening in the tube wall of the inlet manifold connecting part.
5. The heat exchanger as claimed in claim 4, further comprising:
a connecting tube assembly, the connecting tube assembly comprising a connecting tube, the connecting tube being connected to the inlet manifold connecting part, and in fluid communication with the transitional chamber via the opening in the tube wall of the inlet manifold connecting part.
6. The heat exchanger as claimed in any one of claims 1 - 5, wherein:
the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part are connected to each other to form a common heat exchange medium inlet tube, and the inlet of the heat exchange medium inlet tube is an opening penetrating a tube wall of the common heat exchange medium inlet tube.
7. The heat exchanger as claimed in any one of claims 1 - 5, wherein:
the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part have ends which are separated from each other, and the inlet of the heat exchange medium inlet tube is an opening at the end of the heat exchange medium inlet tube.
8. The heat exchanger as claimed in any one of claims 1 - 3, wherein:
the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part are connected to each other to form a common heat exchange medium inlet tube, and the inlet of the heat exchange medium inlet tube is an opening penetrating a tube wall of the common heat exchange medium inlet tube; and
the heat exchanger further comprises a connecting tube assembly, the connecting tube assembly comprising a connecting tube, the connecting tube being connected to the common heat exchange medium inlet tube, and in fluid communication with the opening in the tube wall of the common heat exchange medium inlet tube.
9. The heat exchanger as claimed in claim 1, wherein: the first inlet manifold part and the second inlet manifold part of the inlet manifold are two separate inlet manifold parts.
10. The heat exchanger as claimed in claim 1, wherein: the first inlet manifold part and the second inlet manifold part of the inlet manifold are two parts of a single inlet manifold.
11. The heat exchanger as claimed in claim 1 or 9, further comprising:
multiple heat exchange tubes, first ends of the multiple heat exchange tubes being connected to and in fluid communication with the inlet manifold, the multiple heat exchange tubes comprising a first heat exchange tube which is connected to and in fluid communication with the first inlet manifold part of the inlet manifold, and a second heat exchange tube which is connected to and in fluid communication with the second inlet manifold part of the inlet manifold.
12. The heat exchanger as claimed in claim 11, wherein: in a direction of arrangement of the heat exchange tubes, the first heat exchange tube is located at one side, and the second heat exchange tube is located at the other side.
13. The heat exchanger as claimed in claim 11, wherein: the first end of the first heat exchange tube is bent

towards one side in a thickness direction of the heat exchanger, and/or the first end of the second heat exchange tube is bent towards the other side in the thickness direction of the heat exchanger, such that the first inlet manifold part and the second inlet manifold part of the inlet manifold are offset in relation to each other in the thickness direction of the heat exchanger.

- 14.** The heat exchanger as claimed in any one of claims 11 - 13, wherein:

the first inlet manifold part and the second inlet manifold part of the inlet manifold are offset in relation to each other in a direction which is perpendicular to a thickness direction of the heat exchanger and to a direction of arrangement of the heat exchange tubes.

- 15.** The heat exchanger as claimed in claim 9, further comprising:

a connecting tube assembly, the connecting tube assembly comprising a three-way tube and a connecting tube, the connecting tube being connected via the three-way tube to the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part.

- 16.** The heat exchanger as claimed in claim 9, wherein: there is an angle between an axis of the first inlet manifold part and an axis of the second inlet manifold part.

- 17.** The heat exchanger as claimed in claim 11, further comprising:

an outlet manifold, the outlet manifold being used for the flow of the heat exchange medium out of the heat exchanger; second ends of the multiple heat exchange tubes are connected to and in fluid communication with the outlet manifold, and the outlet manifold comprises a first outlet manifold part and a second outlet manifold part, the first heat exchange tube being connected to and in fluid communication with the first outlet manifold part of the outlet manifold, and the second heat exchange tube being connected to and in fluid communication with the second outlet manifold part of the outlet manifold.

- 18.** The heat exchanger as claimed in claim 17, wherein: the first heat exchange tube and the second heat exchange tube are arranged in a length direction of the outlet manifold.

- 19.** The heat exchanger as claimed in claim 17, further comprising:

a first secondary heat exchanger and a second secondary heat exchanger, the first secondary heat

exchanger comprising the first inlet manifold part, the first outlet manifold part and the first heat exchange tube, the second secondary heat exchanger comprising the second inlet manifold part, the second outlet manifold part and the second heat exchange tube, and an angle being formed between the first secondary heat exchanger and the second secondary heat exchanger.

- 20.** The heat exchanger as claimed in claim 19, wherein: the angle between the first secondary heat exchanger and the second secondary heat exchanger is in the range of 45 degrees to 135 degrees.

- 21.** The heat exchanger as claimed in claim 17, wherein: the first outlet manifold part and the second outlet manifold part of the outlet manifold are two separate outlet manifold parts, and connected to each other via an outlet manifold connecting tube.

- 22.** The heat exchanger as claimed in claim 17, wherein: the first outlet manifold part and the second outlet manifold part of the outlet manifold are two parts of a single outlet manifold.

- 23.** The heat exchanger as claimed in claim 1, wherein:

the first inlet manifold part and the second inlet manifold part respectively have closure plates which close the mutually adjacent ends of the first inlet manifold part and the second inlet manifold part, the closure plate having a through-hole; and the heat exchange medium inlet tube arranged on the first inlet manifold part and the heat exchange medium inlet tube arranged on the second inlet manifold part are in communication with the through-holes of the closure plates of the first inlet manifold part and the second inlet manifold part respectively.

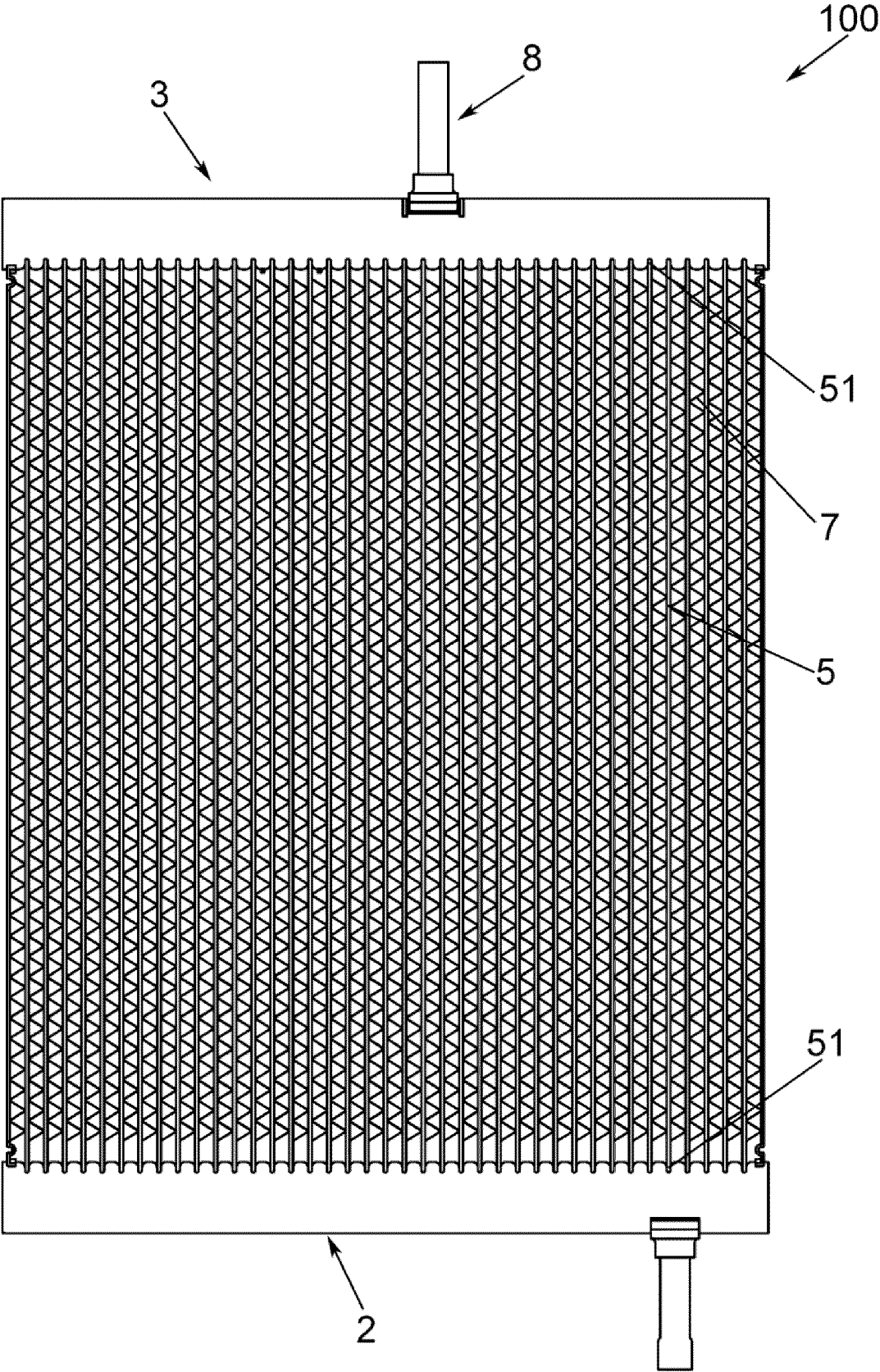


Fig.1

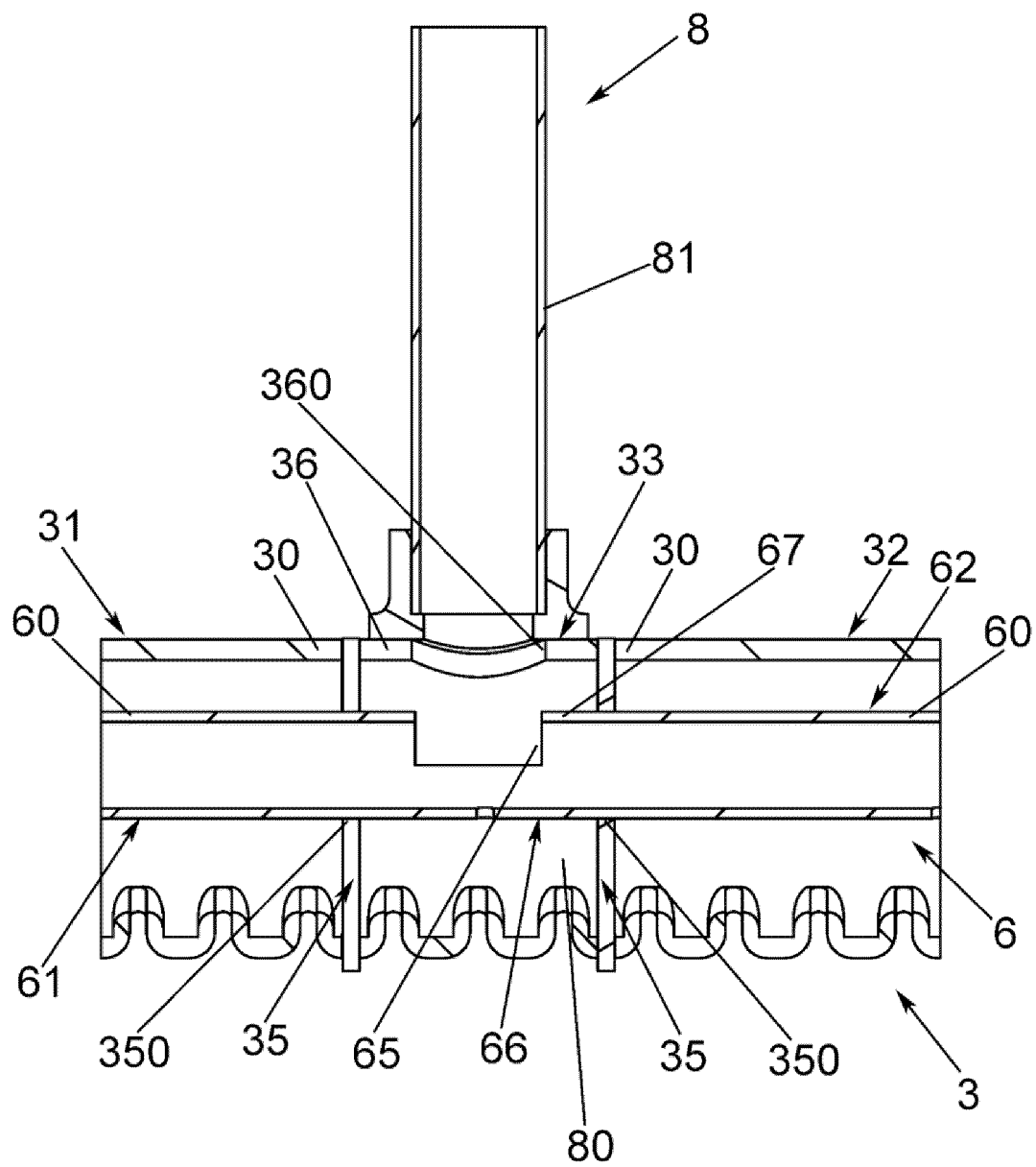


Fig. 2

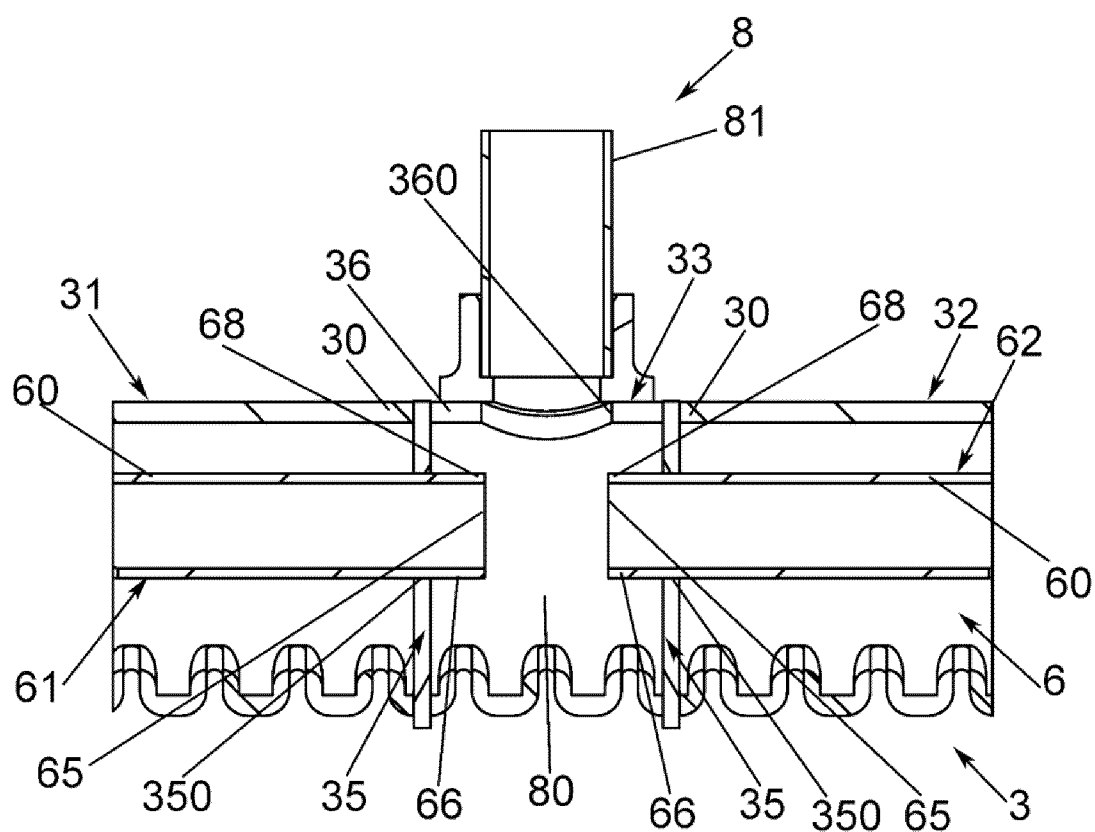


Fig. 3

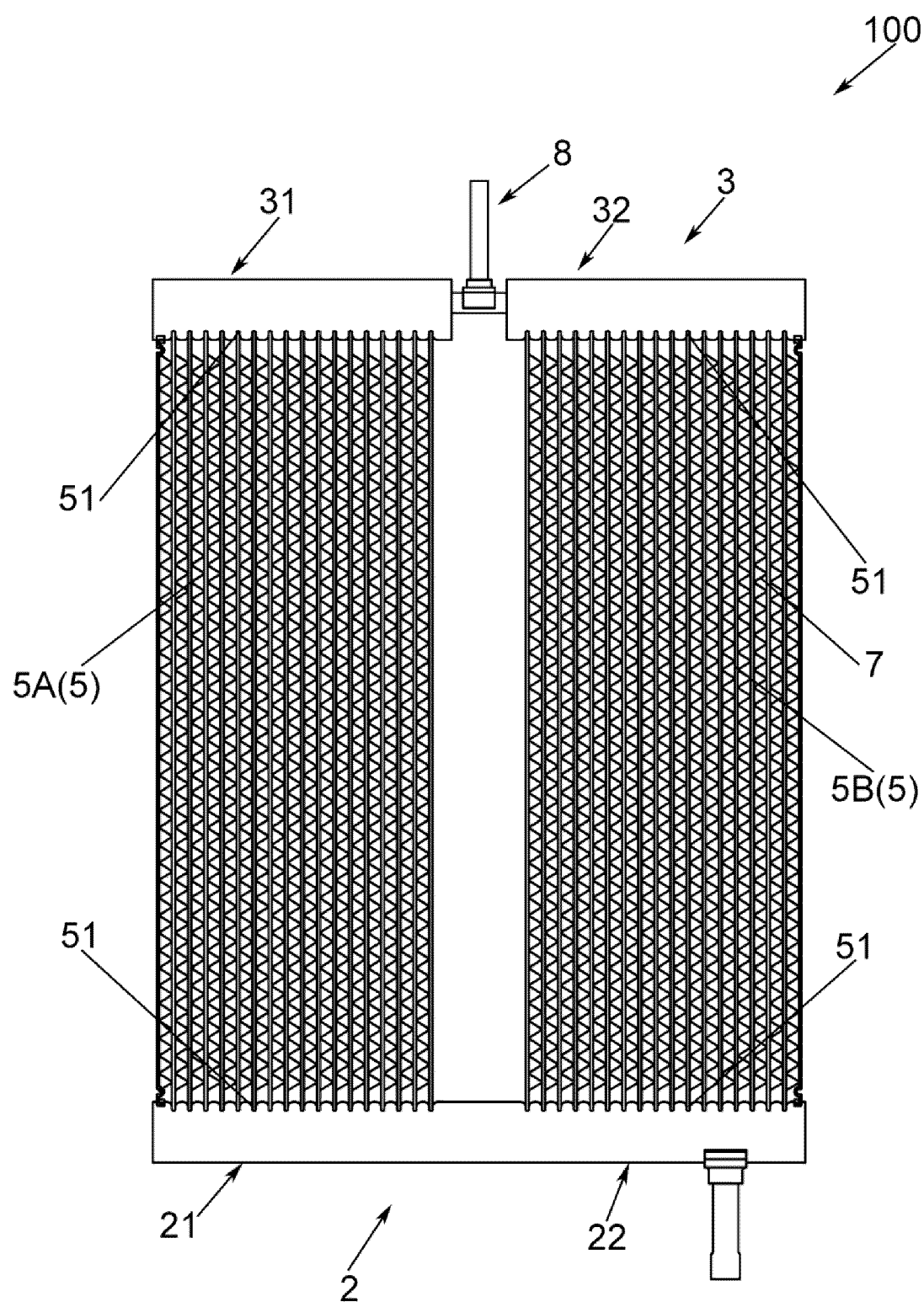


Fig.4

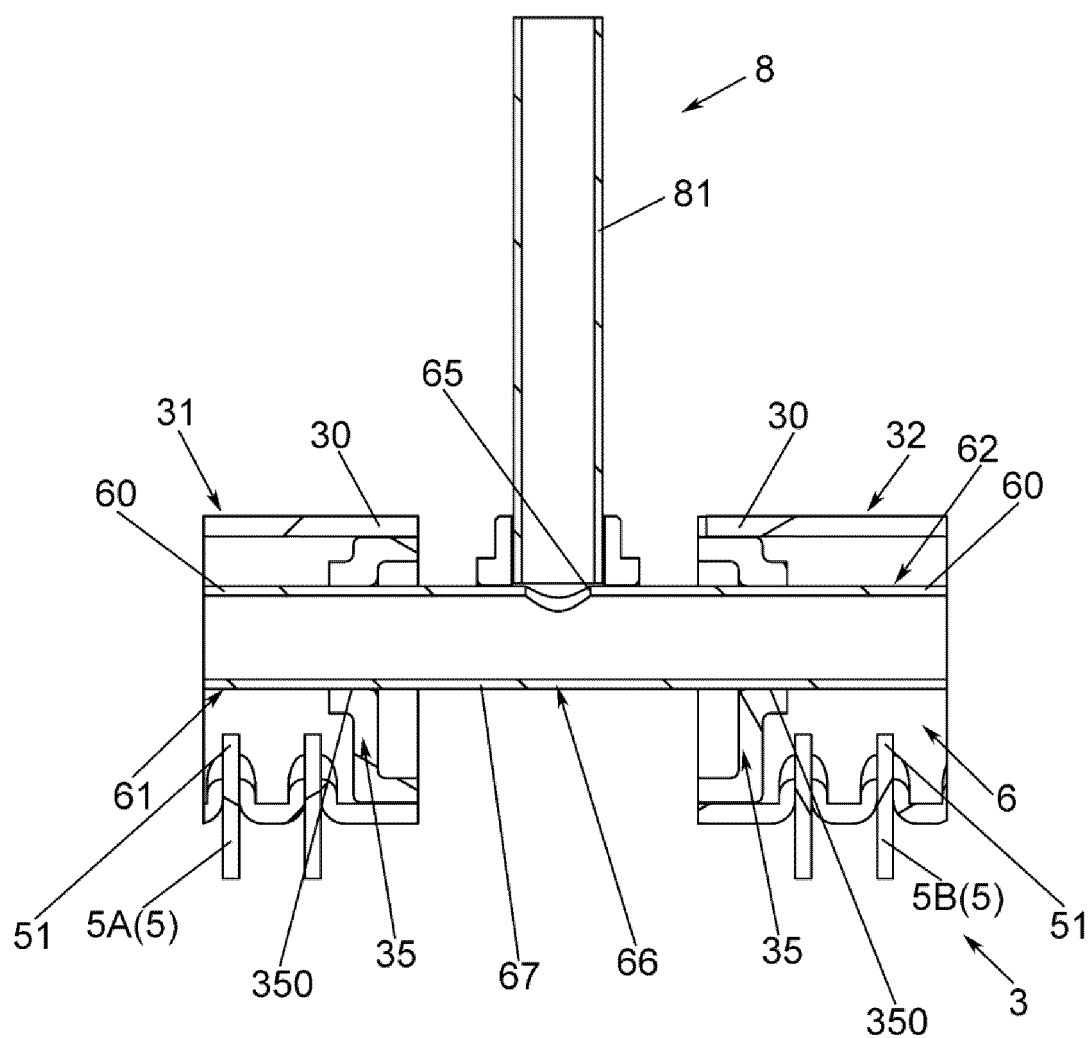


Fig.5

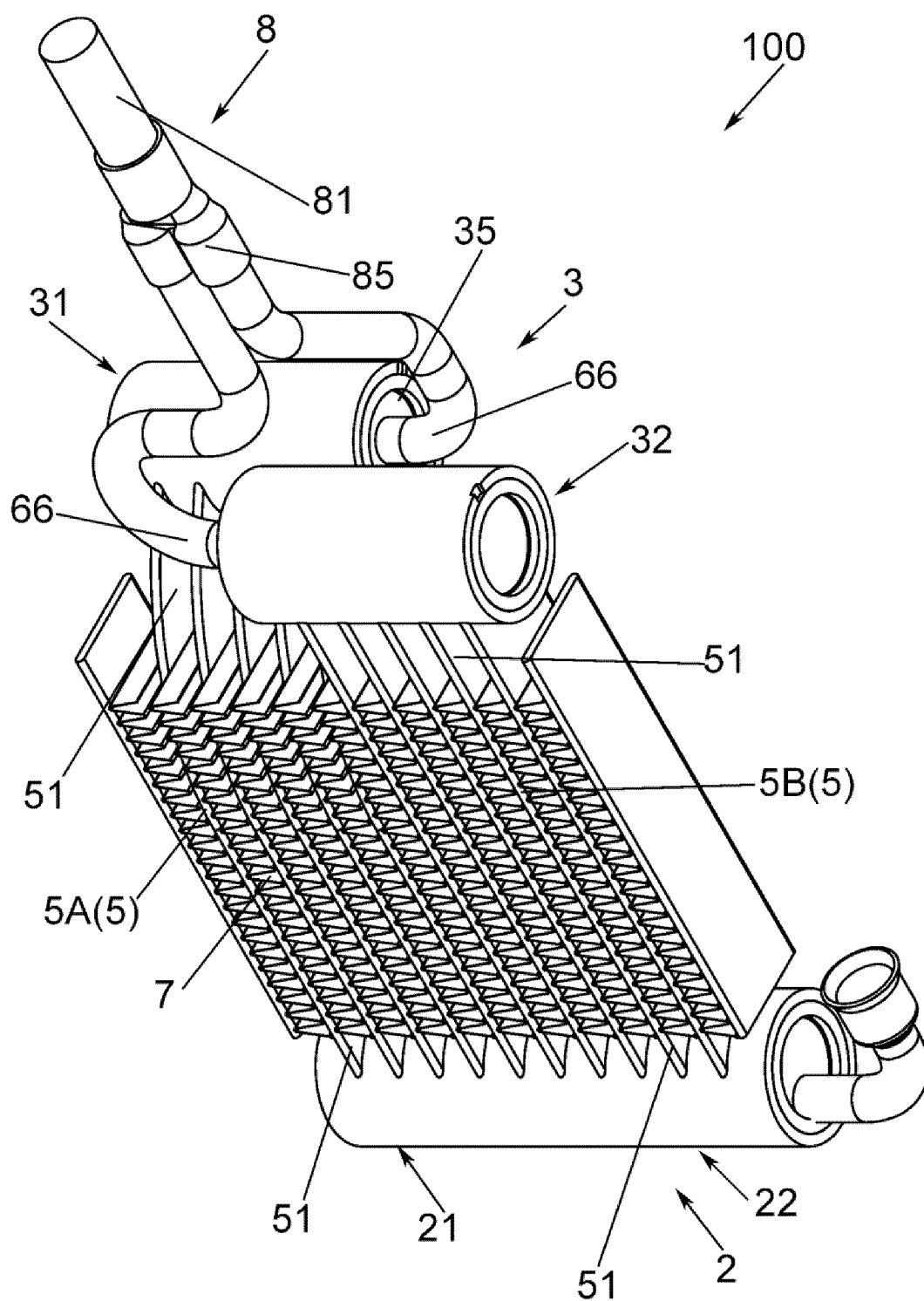


Fig.6

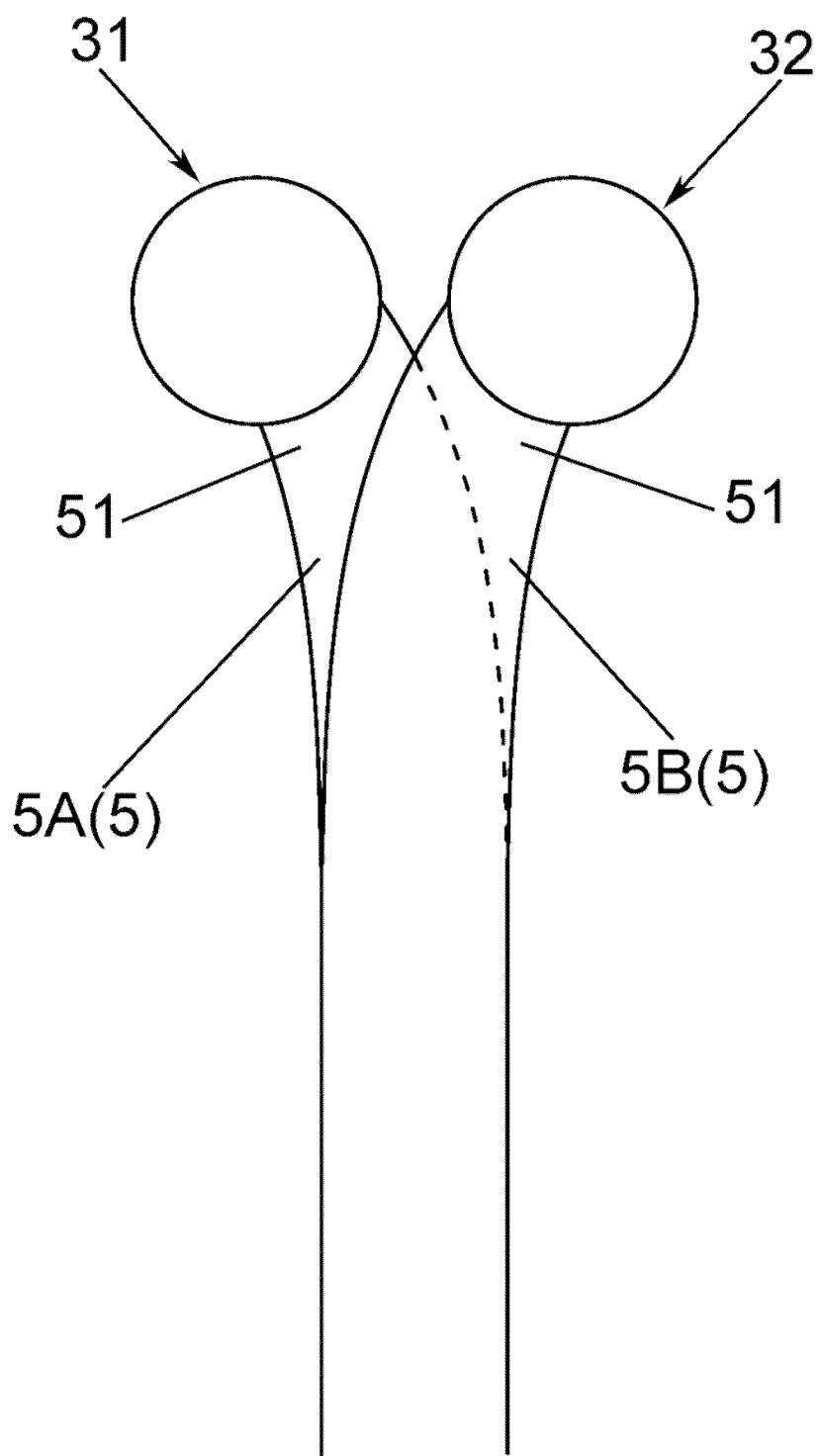
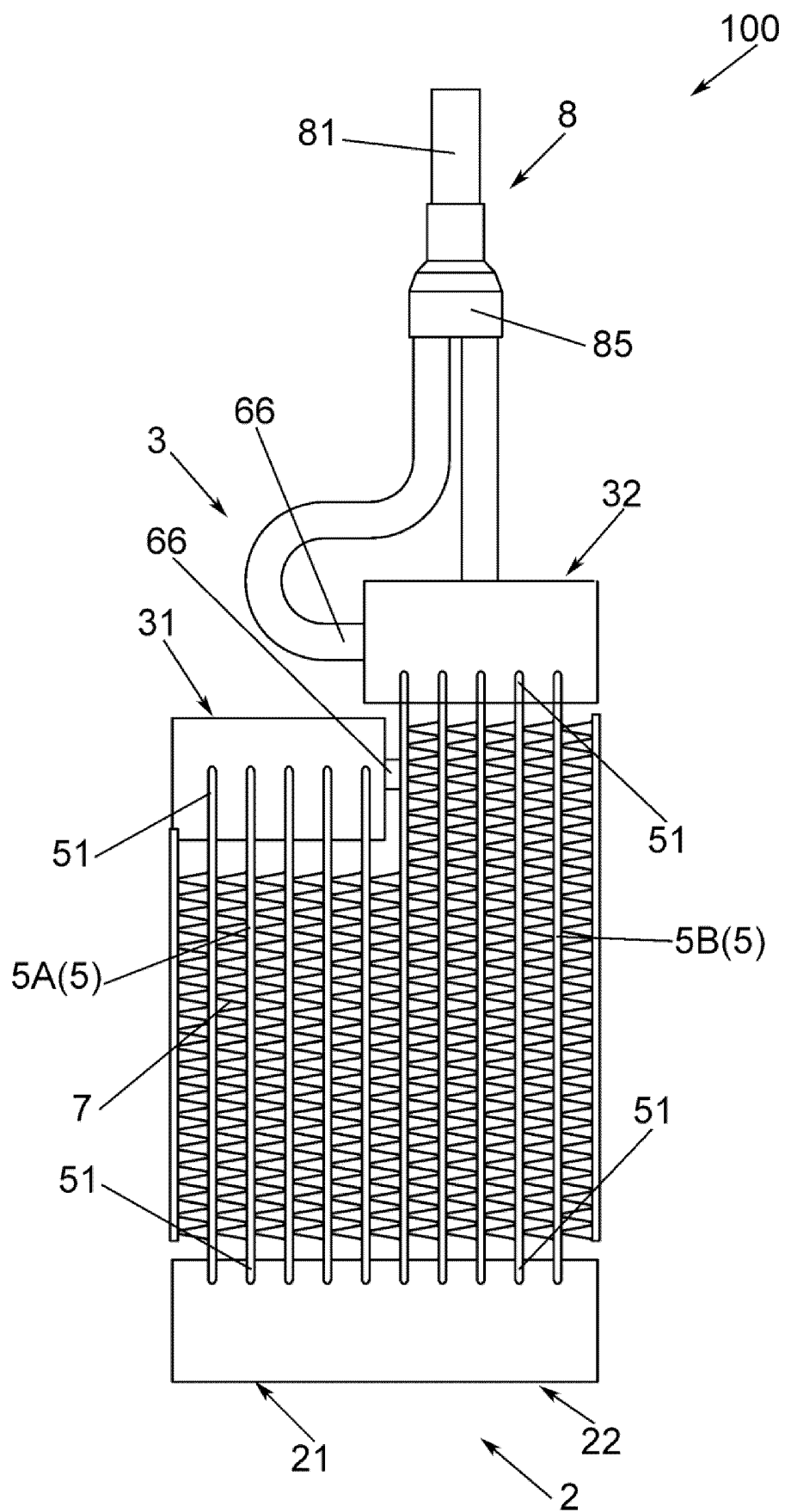


Fig.7



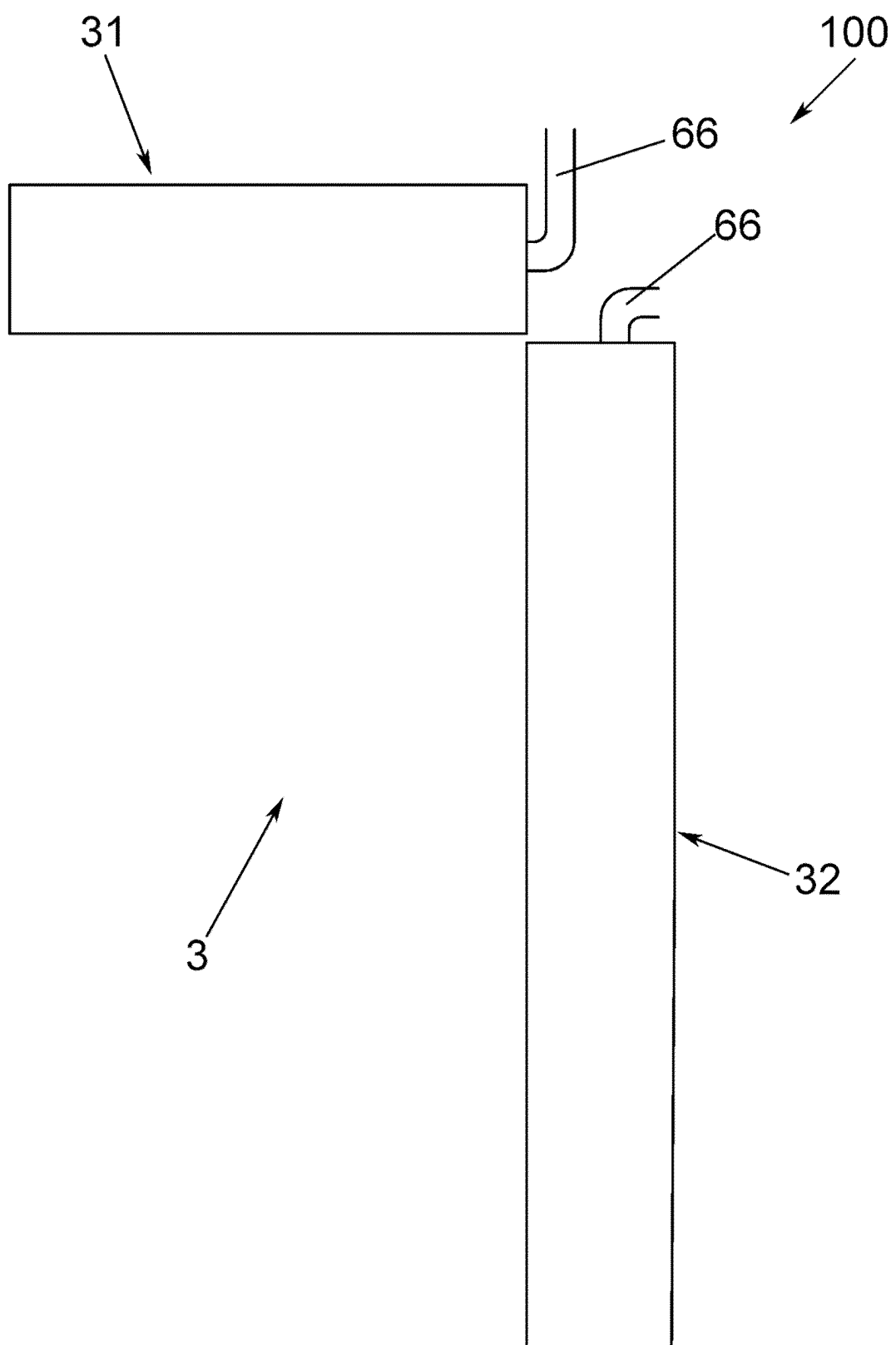


Fig. 9

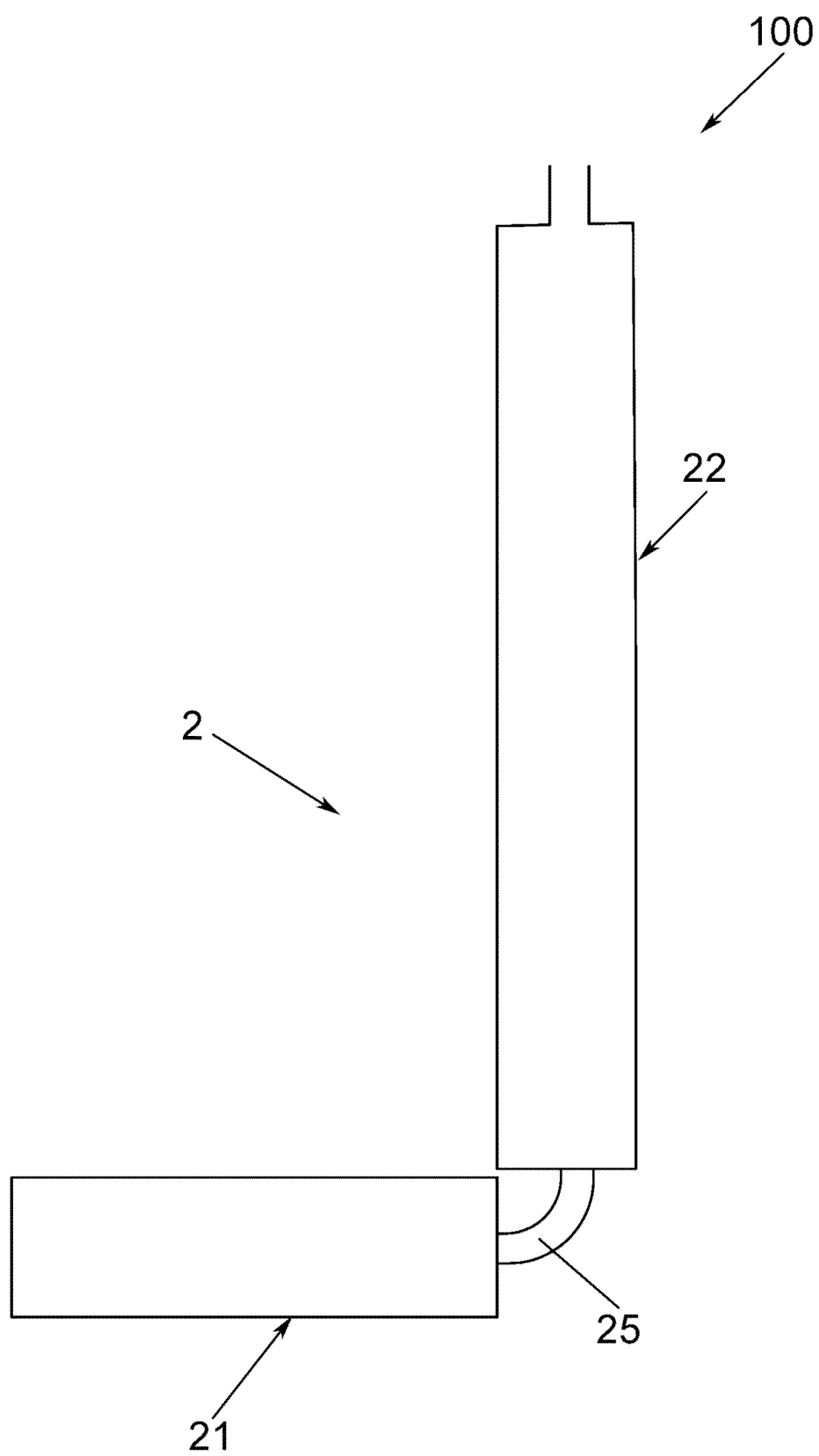


Fig.10

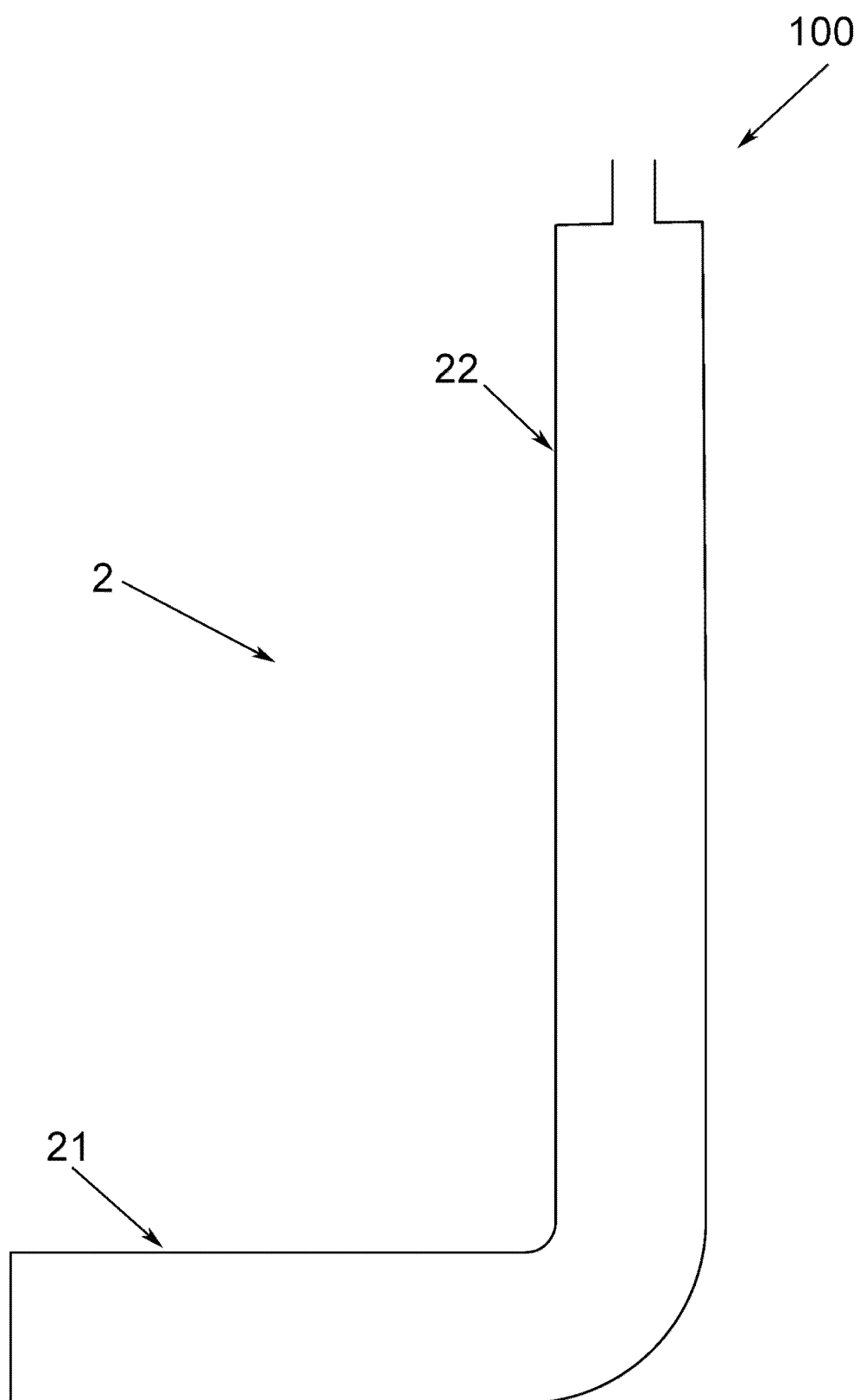


Fig.11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/101025

A. CLASSIFICATION OF SUBJECT MATTER

F28F 9/02(2006.01)i; F28D 1/053(2006.01)i; F25B 39/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F28F 9 , F28D 1 , F25B 39

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

VEN; CNABS; CNKI: 集液管, 集管, 集箱, 分配管, 三通, 中间, 交错, 隔板, 端部, tank, branch, distribut+, middle+, between, interl+, overlay, baffl+, end

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2015055411 A (DAIKIN INDUSTRIES, LTD.) 23 March 2015 (2015-03-23) description, paragraphs 38-68, and figure 3	1, 3-5, 7, 9-12, 15-23
A	CN 215810397 U (ZHEJIANG DUNAN THERMAL TECHNOLOGY CO., LTD.) 11 February 2022 (2022-02-11) entire document	1-23
A	CN 103063076 A (SANHUA HOLDING GROUP CO., LTD. et al.) 24 April 2013 (2013-04-24) entire document	1-23
A	CN 105593628 A (DAIKIN INDUSTRIES, LTD.) 18 May 2016 (2016-05-18) entire document	1-23
A	CN 107270591 A (JIANGSU BILING ENERGY TECHNOLOGY CO., LTD.) 20 October 2017 (2017-10-20) entire document	1-23
A	CN 208635379 U (ZHEJIANG DUNAN THERMAL TECHNOLOGY CO., LTD.) 22 March 2019 (2019-03-22) entire document	1-23

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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“P” document published prior to the international filing date but later than the priority date claimed

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“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

17 August 2023

Date of mailing of the international search report

01 September 2023

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)
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Beijing 100088

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/101025

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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP H05118705 A (AISIN SEIKI CO., LTD.) 14 May 1993 (1993-05-14) entire document	1-23
A	KR 20220047082 A (BHI CO., LTD.) 15 April 2022 (2022-04-15) entire document	1-23

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2023/101025

5

10

15

20

25

30

35

40

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50

55

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2015055411 A	23 March 2015	None	
CN 215810397 U	11 February 2022	None	
CN 103063076 A	24 April 2013	None	
CN 105593628 A	18 May 2016	US 2016238322 A1	18 August 2016
		US 10655917 B2	19 May 2020
		AU 2014325773 A1	19 May 2016
		AU 2014325773 B2	09 March 2017
		WO 2015045564 A1	02 April 2015
		JP 2015068623 A	13 April 2015
		JP 5754490 B2	29 July 2015
		ES 2702378 T3	28 February 2019
		EP 3054255 A1	10 August 2016
		EP 3054255 A4	07 June 2017
		EP 3054255 B1	19 September 2018
		BR 112016006545 A2	01 August 2017
		BR 112016006545 B1	01 December 2020
CN 107270591 A	20 October 2017	None	
CN 208635379 U	22 March 2019	None	
JP H05118705 A	14 May 1993	None	
KR 20220047082 A	15 April 2022	None	