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(54) **HEAT EXCHANGER SYSTEM**

(57) A heat exchanger system is disclosed by embodiments of the present invention. The heat exchanger system comprises an upper manifold, a middle manifold and a lower manifold arranged successively from top to bottom, wherein a first heat-exchanging tube is arranged between the upper manifold and the middle manifold, and a second heat-exchanging tube is arranged between the middle manifold and the lower manifold. The middle manifold has a first chamber and a second chamber separated from each other. During circulation of refrigerant, the refrigerant in the upper manifold flows through the first heat-exchanging tube down to the first chamber, and flows via a first communicating part into the chamber of the lower manifold, and subsequently the refrigerant flows through the second heat-exchanging tube up into the second chamber and then returns via a second communicating part to the upper manifold.

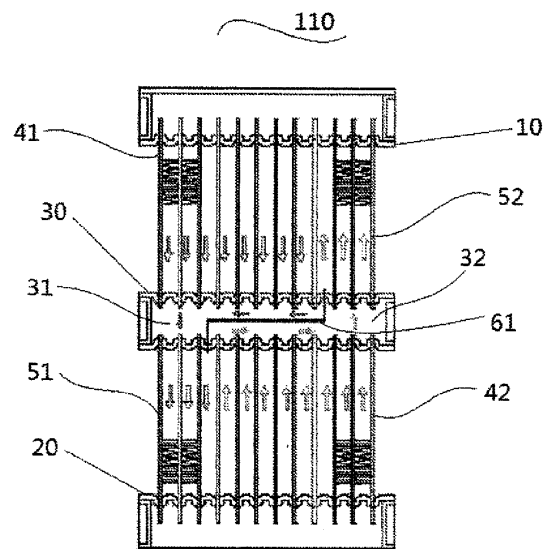


Fig. 1

Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority of Chinese Patent Application No. 201510303770.8 filed on June 3, 2015 with the title of "Heat Exchanger System", all the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE DISCLOSURE

Field of the Disclosure

[0002] The present invention relates to the field of refrigeration, in particular to a heat exchanger system to be used for an air conditioner of a base station.

Description of the Related Art

[0003] Energy shortage has become a key factor restricting the development of national economy, and the energy saving and energy efficiency promoting represent an important issue in the national economy. The heat tube technique (in which the heat tube is activated when the outdoor environment temperature is lower than the indoor temperature of server room by a certain extent, approximately above 5°C) can shorten the running time of compressor, reach the goal of saving energy and reducing consumption, and extend the service life of the compressor.

[0004] Currently, a separate-type heat tube exchanger has been known. In this kind of exchanger, the refrigerant in the heat-exchanging tube is warmed by the indoor hot air, as a hot fluid, to become vapour refrigerant. The vapour rises up and is condensed to form liquid refrigerant in the condenser by exchanging heat with the outdoor cool air, and the liquid refrigerant enters into the evaporator to absorb heat. Thus a heat tube cycle is formed and the effect of refrigeration is achieved.

[0005] However, this kind of separate-type heat tube exchanger has disadvantages of long connecting tubes between the two heat exchangers, high costs, high demanding requirement of installation space due to the placement in an integral unit, and so on.

SUMMARY OF THE DISCLOSURE

[0006] Therefore, one of objects of the present invention is to provide a heat exchanger system which can overcome or at least alleviate the above-mentioned deficiencies.

[0007] According to one aspect of the present invention, a heat exchanger system is provided which comprises an upper manifold, a middle manifold and a lower manifold arranged successively from top to bottom, wherein a first heat-exchanging tube is arranged between the upper manifold and the middle manifold, and a second heat-exchanging tube is arranged between the

middle manifold and the lower manifold, wherein the middle manifold has a first chamber and a second chamber separated from each other; and during circulation of refrigerant, the refrigerant in the upper manifold flows through the first heat-exchanging tube down to the first chamber, and flows via a first communicating part into a chamber of the lower manifold, and subsequently the refrigerant flows through the second heat-exchanging tube up into the second chamber and then returns via a second communicating part to the upper manifold.

[0008] In an example, the first communicating part is a communicating or connecting tube with a communication function.

[0009] In an example, the second communicating part is a communicating or connecting tube with a communication function.

[0010] In an example, the first communicating part is at least one round or flat tube arranged between the lower manifold and the middle manifold, and the round or flat tube and the second heat-exchanging tube are arranged in a row between the lower manifold and the middle manifold; and/or

[0011] the second communicating part is at least one round or flat tube arranged between the upper manifold and the middle manifold, and the round or flat tube and the first heat-exchanging tube are arranged in a row between the upper manifold and the middle manifold.

[0012] In an example, the upper manifold, the middle manifold and the first heat-exchanging tube arranged therebetween constitute a first heat exchanger, preferably a condenser, and the middle manifold, the lower manifold and the second heat-exchanging tube arranged therebetween constitute a second heat exchanger, preferably an evaporator.

[0013] In an example, the middle manifold is divided into the first chamber and the second chamber by a main partition extending obliquely, vertically, curvedly or windingly from an upper portion to a lower portion of the middle manifold.

[0014] In an example, the middle manifold is divided into the first chamber and the second chamber by a main partition extending in a longitudinal direction of the middle manifold from one of its ends to the other.

[0015] In an example, a first opening and a second opening are provided in the main partition, the refrigerant coming from the first heat exchanger enters from the first chamber via the first opening into the second heat exchanger, and the refrigerant flowing out of the second heat exchanger flows into the second chamber and via the second opening enters into the first heat exchanger.

[0016] In an example, a communicating flat or round tube in the second heat exchanger, situated between the middle manifold and the lower manifold, serves as the first communicating part, one end of the communicating flat or round tube in the second heat exchanger inserts through the first opening into the first chamber, and the other end communicates with a chamber of the lower

manifold; and/or

a communicating flat or round tube in the first heat exchanger, situated between the middle manifold and the upper manifold, serves as the second communicating part, one end of the communicating flat or round tube in the first heat exchanger inserts through the second opening into the second chamber, and the other end communicates with the chamber of the upper manifold.

[0017] In an example, the first communicating part is a first connecting tube communicating the chamber of the lower manifold with the first chamber of the middle manifold, and/or the second communicating part is a second connecting tube communicating the chamber of the upper manifold with the second chamber of the middle manifold.

[0018] In an example, a liquid distributing structure for distribution of the fluid coming from the first connecting tube is provided in the chamber of the lower manifold.

[0019] In an example, the liquid distributing structure is a fluid guiding tube connected to or integrally formed with the first connecting tube, on which fluid guiding tube spaced openings are provided.

[0020] In an example, the middle manifold further comprises at least one auxiliary baffle provided between the main partition and an upper and/or lower wall of the middle manifold, so as to divide a chamber of the middle manifold into at least one communicating chamber with a communication function, at least one said first chamber and at least one said second chamber.

[0021] In an example, the first chamber and the second chamber communicate with the at least one communicating chamber via respectively the first opening and the second opening in the main partition, and the at least one communicating chamber communicates with the corresponding first or second communicating part.

[0022] In an example, the first heat exchanger and/or the second heat exchanger, preferably the first heat-exchanging tube and/or the second heat-exchanging tube of the first heat exchanger and/or the second heat exchanger, are bent; or the first heat-exchanging tube and the second heat-exchanging tube are inserted respectively into the middle manifold in directions oblique to each other.

[0023] According to a further aspect of the present invention, another heat exchanger system is provided which comprises an upper manifold, a first middle manifold, a second middle manifold and a lower manifold arranged successively from top to bottom, wherein a first heat-exchanging tube is arranged between the upper manifold and the first middle manifold, and a second heat-exchanging tube is arranged between the second middle manifold and the lower manifold, the first middle manifold is provided with a first partition by which the first middle manifold is divided into at least one first chamber and at least one first communicating chamber separated from each other, and the second middle manifold is provided with a second partition by which the second middle manifold is divided into at least one

second chamber and at least one second communicating chamber separated from each other;

during circulation of refrigerant, the refrigerant in the upper manifold flows through the first heat-exchanging tube down to the first chamber and via a first connecting tube into the second communicating chamber, and flows via a first communicating part into a chamber of the lower manifold; subsequently, the refrigerant flows through the second heat-exchanging tube up into the second chamber and via a second connecting tube into the first communicating chamber, and then returns via a second communicating part to the upper manifold.

[0024] In an example, the first communicating part is a communicating or connecting tube with a communication function.

[0025] In an example, the second communicating part is a communicating or connecting tube with a communication function.

[0026] In an example, the first communicating part is at least one round or flat tube arranged between the lower manifold and the second middle manifold, and the round or flat tube and the second heat-exchanging tube are arranged in a row between the lower manifold and the second middle manifold; and/or

the second communicating part is at least one round or flat tube arranged between the upper manifold and the first middle manifold, and the round or flat tube and the first heat-exchanging tube are arranged in a row between the upper manifold and the first middle manifold.

[0027] In an example, the upper manifold and the first middle manifold and the first heat-exchanging tube arranged therebetween constitute a first heat exchanger, preferably a condenser, and the second middle manifold and the lower manifold and the second heat-exchanging tube arranged therebetween constitute a second heat exchanger, preferably an evaporator.

[0028] In an example, the first heat exchanger and/or the second heat exchanger, preferably the first heat-exchanging tube and/or the second heat-exchanging tube of the first heat exchanger and/or the second heat exchanger, are bent; or the first heat-exchanging tube and the second heat-exchanging tube are inserted respectively into the first middle manifold and the second middle manifold in directions oblique to each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] These and other aspects and advantages of the present invention will become more obvious and understandable from the following description of the preferred embodiments with reference to the drawings, wherein:

Figure 1 is a schematic view showing the structure of a first heat exchanger system according to a first embodiment of the present invention;

Figure 2 is a schematic view showing the structure of a second heat exchanger system according to a

first embodiment of the present invention;

Figure 3 is a schematic view showing the structure of a third heat exchanger system according to a first embodiment of the present invention;

Figure 4 is a schematic view showing the structure of a fourth heat exchanger system according to a first embodiment of the present invention;

Figure 5 is a schematic view showing the structure of a fifth heat exchanger system according to a first embodiment of the present invention;

Figure 6 is a schematic view showing the structure of a sixth heat exchanger system according to a first embodiment of the present invention;

Figure 7 is a schematic view showing the structure of a seventh heat exchanger system according to a first embodiment of the present invention;

Figure 8 is a schematic view showing the structure of the heat exchanger system according to a second embodiment of the present invention;

Figure 9 is a schematic view showing the structure of the heat exchanger system according to a third embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0030] Technical solutions of the present invention will be described hereinafter in more detail by the way of embodiment with reference to the Figures 1-9. The same or similar reference numerals refer to the same or similar elements throughout the description. The description of the embodiment of the present invention with reference to the accompanying drawings is intended to interpret the general inventive concept of the present invention, and shall not be construed as limiting to the present invention.

[0031] Fig. 1 shows schematically the structure of a first heat exchanger system 110 according to a first embodiment of the present invention. Specifically, the first heat exchanger system 110 comprises an upper manifold 10, a middle manifold 30 and a lower manifold 20 arranged successively from top to bottom. A first heat-exchanging tube 41 is arranged between the upper manifold 10 and the middle manifold 30, and a second heat-exchanging tube 42 is arranged between the middle manifold 30 and the lower manifold 20.

[0032] As shown in the figure, the middle manifold 30 has a first chamber 31 and a second chamber 32 separated from each other. During its circulation (the directions in which the refrigerant flows are indicated by arrows in Fig. 1, a manner that will be adopted hereinafter and will not be iterated), the refrigerant in the upper manifold 10 flows through the first heat-exchanging tube 41 down to the first chamber 31, and flows via a first communicating part 51 into the chamber of the lower manifold 20, and subsequently the refrigerant flows through the second heat-exchanging tube 42 upwardly into the second chamber 32 and then returns via a second communicating part 52 to the upper manifold 10.

[0033] It is to be understood here that the first communicating part 51 and the second communicating part 52 can be a communicating or connecting tube with a communication function. Preferably, as shown in Fig. 1, the first communicating part 51 is at least one round or flat tube arranged between the lower manifold 20 and the middle manifold 30, and the round or flat tube and the second heat-exchanging tube 42 are arranged in a row between the lower manifold 20 and the middle manifold 30. The second communicating part 52 is at least one round or flat tube arranged between the upper manifold 10 and the middle manifold 30, and the round or flat tube and the first heat-exchanging tube 41 are arranged in a row between the upper manifold 10 and the middle manifold 30.

[0034] The upper manifold 10, the middle manifold 30 and the first heat-exchanging tube 41 arranged therebetween constitute a first heat exchanger, and the middle manifold 30, the lower manifold 20 and the second heat-exchanging tube 42 arranged therebetween constitute a second heat exchanger. For the purpose of illustration of the present invention, the first heat exchanger is referred to as condenser and the second heat exchanger is referred to as evaporator. Of course, the first heat exchanger and the second heat exchanger can be configured by a person skilled in the art, when necessary, to be a condenser, an evaporator or a heat exchanger of any other type, and there is no restriction in this respect within the scope of the present invention.

[0035] The first heat-exchanging tube 41 and the second heat-exchanging tube 42 can be a heat-exchanging tube of any type. Generally, the first heat-exchanging tube 41 and the second heat-exchanging tube 42 are any one of a round tube and a flat tube. In the one and same heat exchanger system, the first heat-exchanging tube 41 and the second heat-exchanging tube 42 are not necessarily to be configured to be of the same type, such as exclusively round or flat. Rather, it is possible that one is a round tube and the other is a flat tube. It is also possible that a part of the first or second heat-exchanging tube 41, 42 is a round tube and the other part is a flat tube. That is, the first and the second heat-exchanging tube 41, 42 can be configured when necessary to be a practical heat-exchanging tube of any type, and there is no special restriction in this respect within the scope of the present invention.

[0036] Furthermore, fins can be provided between two adjacent first heat-exchanging tubes 41 or two adjacent second heat-exchanging tubes 42, independent of the type of the heat-exchanging tubes.

[0037] It is to be understood that, if the first heat-exchanging tube 41 and the second communicating part 52 are both configured to be for example round tubes and/or flat tubes, the first heat-exchanging tube 41 and the second communicating part 52 can be arranged in a row between the upper manifold 10 and the middle manifold 30, as shown in Fig. 1. Likewise, if the second heat-exchanging tube 42 and the first communicating part 51

are both configured to be for example round tubes and/or flat tubes, the second heat-exchanging tube 42 and the first communicating part 51 can be arranged in a row between the lower manifold 20 and the middle manifold 30, as shown in Fig. 1. As such, the first heat exchanger and/or the second heat exchanger can be manufactured in a simpler and easier process, their thickness can be reduced, and their aesthetic attraction can be enhanced.

[0038] As shown in Fig. 1, in the first heat exchanger, a plurality of first heat-exchanging tubes 41 are arranged in the left side of the first heat exchanger, and the second communicating part 52 is arranged in the right side of the first heat exchanger. Beside, in the second heat exchanger, a plurality of second heat-exchanging tubes 42 are arranged in the right side of the second heat exchanger, and the first communicating part 51 is arranged in the left side of the second heat exchanger. It is to be understood that, the relative position of the first heat-exchanging tube 41 and the second communicating part 52 can be configured as necessary by a person skilled in the art, and is not necessarily to be limited as shown. For example, it is possible that the first heat-exchanging tube 41 is arranged in the middle and the second communicating part 52 on both sides of it. The same applied to the second heat-exchanging tube 42 and the first communicating part 51, and therefore the detailed description is dispensed with.

[0039] A main partition 61 is provided to divide the middle manifold 30 into the first chamber 31 and the second chamber 32 separated from each other. It is to be understood that the main partition 61 can be configured to be of any appropriate form without limitation to that shown in Fig. 1, insofar as the division into the first chamber 31 and the second chamber 32 is guaranteed. For example, the main partition 61 can be configured to extend obliquely, vertically, curvedly or windingly from the upper portion to the lower portion of the middle manifold 30.

[0040] It shall also be noted that only a single circulation of refrigerant is shown in Fig. 1. Of course, the first heat exchanger system can be configured to have a plurality of circulations of refrigerant, that is, on the basis of extending the upper manifold 10, the middle manifold 30 and the lower manifold 20 in the longitudinal direction, repeating the structural unit shown in Fig. 1, as needed, on either side thereof to achieve the above objective.

[0041] A main partition 61 of a bent form as shown in Fig. 1 is provided to divide the middle manifold 30 along its longitudinal direction into two chambers, that is, the first chamber 31 and the second chamber 32.

[0042] Upon performing refrigeration the working principle of the first heat exchanger system according to the present invention is to be explained by an example in which the first heat exchanger is a condenser and the second heat exchanger is an evaporator and the heat-exchanging tubes are flat ones. Specifically, the refrigerant in the condenser in the form of vapour condenses to liquid refrigerant by heat releasing, and flows downward under the action of gravity along the flat tube for

heat release (the first heat-exchanging tube 41). After it flows into the evaporator, the refrigerant absorbs heat there so as to be converted into the form of vapour and flows upward along the flat tube for heat absorption (the second heat-exchanging tube 42), finally into the condenser. The circulation proceeds in this way to obtain the effect of refrigeration.

[0043] It shall be noted here that the second to seventh heat exchanger systems according to the first embodiment of the present invention shown in Figs. 2-7 are all variations of the first heat exchanger system, and thus the structural configurations or description with respect to the first heat exchanger system are all applicable to these variations. Therefore, the aspects common to them will not be detailed herein and only the differences between them will be emphasised.

[0044] Referring to Fig. 2, the structure of a second heat exchanger system 120 according to the first embodiment of the present invention is schematically shown. By comparing Fig. 2 with Fig. 1, it is apparent that the second heat exchanger system 120 is identical to the first heat exchanger system 110 with the only exception of the way of partitioning the chamber of the middle manifold 30.

[0045] Specifically, the chamber of the middle manifold 30 is divided into the first chamber 31, the second chamber 32 and two communicating chambers 33 and 34 by the main partition 621 extending along the longitudinal direction of the middle manifold 30 from the left end to the right end of the middle manifold 30 and by at least one auxiliary baffle 622, 623 provided between the main partition 621 and the upper and/or lower wall of the middle manifold.

[0046] It shall be noted here that the auxiliary baffles 622, 623 can be so configured as to extend obliquely, vertically, curvedly or windingly from the upper or lower portion of the middle manifold to the main partition 621. There is no restriction in this respect within the scope of the present invention, insofar as a first chamber and a second chamber arise by division.

[0047] In the present example, the first chamber 31 and the second chamber 32 communicate with the associated communicating chambers 33, 34 through respectively the first opening 71 and the second opening 72 correspondingly provided in the main partition 621.

[0048] During the circulation of refrigerant in the second heat exchanger system 120, the refrigerant in the upper manifold 10 flows through the first heat-exchanging tube 41 down to the first chamber 31, and flows via the first opening 71 into the communicating chamber 33. The refrigerant in the communicating chamber 33 flows through the first communicating part 51 to the chamber of the lower manifold 30, and then flows through the second heat-exchanging tube 42 up to the second chamber 32. The refrigerant in the second chamber 32 flows through the second opening 72 into the other communicating chamber 34, and then returns through the second communicating part 52 up to the upper manifold 10.

[0049] Referring to Fig. 3, the structure of a third heat exchanger system 130 according to the first embodiment of the present invention is schematically shown. By comparing Fig. 3 with Fig. 2, it is apparent that the third heat exchanger system 130 is identical to the second heat exchanger system 120 with the only exception of the way of partitioning the chamber of the middle manifold 30 and the way of arranging the first and the second communicating parts.

[0050] In the present example, the first communicating part 51 and the second communicating part 52 are configured as a plurality of flat tubes. The view on the lower portion of Fig. 3 is a top view showing the holes for flat tube, provided in the main partition 60 for receiving the flat tubes.

[0051] The middle manifold 30 is divided by the main partition 60 extending along its longitudinal direction into two upper and lower chambers, that is, the first chamber 31 and the second chamber 32. A first opening 71 and a second opening 72 (specifically, a plurality of holes for flat tube in the present example) are provided in the main partition 60, in the positions corresponding to the flat tubes of the first and the second communicating parts 51 and 52. One end of each flat tube of the first and the second communicating parts 51 and 52 inserts through each corresponding hole 71, 72 for flat tube into the first chamber 31 or the second chamber 32, so as to form a loop for the refrigerant. It is to be understood that the number of the flat tubes of the first and the second communicating parts 51 and 52 can be set as needed, without limitation to that shown in the figure. To reduce the pressure drop, it is generally preferred that the communicating flat tubes are those with inner flow channels in larger size or number, which probably means larger (broader, taller) flat tubes, and thus the size of the connectors matching with the flat tubes varies depending on the size of the selected flat tubes. Therefore, it is possible that the first opening 71 and/or the second opening 72, i.e. the holes for flat tube for connecting the communicating flat tubes, have a larger size or a larger width or height.

[0052] During the circulation of refrigerant in the third heat exchanger system 130, the refrigerant in the upper manifold 10 flows through the first heat-exchanging tube 41 down to the first chamber 31, and then flows via the flat tubes of the first communicating part 51 into the chamber of the lower manifold 30. Subsequently, the refrigerant flows through the second heat-exchanging tube 42 up to the second chamber 32, and then returns via the flat tubes of the second communicating part 52 to the upper manifold 10.

[0053] Referring to Fig. 4, the structure of a fourth heat exchanger system 140 according to the first embodiment of the present invention is schematically shown. By comparing Fig. 4 with Fig. 3, it is apparent that the fourth heat exchanger system 140 is identical to the third heat exchanger system 130 with the only exception of using, instead of flat tubes, round tubes with the equivalent diameter as the first communicating part 51 and the second

communicating part 52. As such, the heat-exchanging area of a single row of heat exchanger can be maximized in a limited installing room. Thus, at least one first opening 71 and a second opening 72 for receiving the round tubes, specifically the round holes 71 and 72, are formed in the main partition 60.

[0054] Since the structural arrangement and the operation principle of the fourth heat exchanger system 140 are the same as those of the third exchanger system 130, they are not described in detail herein.

[0055] Referring to Fig. 5, the structure of a fifth heat exchanger system 150 according to the first embodiment of the present invention is schematically shown. By comparing Fig. 5 with Fig. 1, it is apparent that the fifth heat exchanger system 150 differs from the first heat exchanger system 110 in that the first communicating part 51 and the second communicating part 52 are connecting tubes arranged outside of the cavities of the corresponding manifolds, and that the middle manifold 30 is divided by the main partition 60 arranged along the longitudinal direction of the middle manifold 30 into upper and lower two chambers, i.e. the first chamber 31 and the second chamber 32.

[0056] Specifically, the first communicating part 51 and the second communicating part 52 are configured to be respectively a first connecting tube and a second connecting tube with equivalent diameter. It is not necessary for the main partition to undergo any further processing, such as the machining of the openings, the arrangement of auxiliary baffles etc. The two ends of the first connecting tube 51 are inserted through the corresponding openings into respectively the first chamber 31 and the chamber of the lower manifold 20, and the two ends of the second connecting tube 52 are inserted through the corresponding openings into respectively the second chamber 32 and the chamber of the upper manifold 10.

[0057] During the circulation of refrigerant in the fifth heat exchanger system, the refrigerant in the upper manifold 10 flows through the first heat-exchanging tube 41 down to the first chamber 31, and then flows via the first connecting tube 51 into the chamber of the lower manifold 30. Subsequently, the refrigerant flows through the second heat-exchanging tube 42 up to the second chamber 32, and then returns via the second connecting tube 52 to the upper manifold 10.

[0058] Referring to Fig. 6, the structure of a sixth heat exchanger system 160 according to the first embodiment of the present invention is schematically shown. By comparing Fig. 6 with Fig. 5, it is apparent that the sixth heat exchanger system 160 is identical to the fifth heat exchanger system 150 with the only exception that a liquid distributing structure 80 for the distribution of the fluid coming from the first connecting tube 51 is provided in the chamber of the lower manifold 20. The liquid distributing structure 80 can be a fluid guiding tube connected to or monolithically formed with the first connecting tube 51, on which fluid guiding tube spaced openings are provided.

[0059] For a heat exchanger with long manifolds, its heat-exchanging area will be more efficiently utilized if a liquid distributing structure is added in the manifold on the side of evaporator.

[0060] Referring to Fig. 7, the structure of a seventh heat exchanger system 170 according to the first embodiment of the present invention is schematically shown. By comparing Fig. 7 with Fig. 2, it is apparent that the seventh heat exchanger system 170 differs from the second heat exchanger system 120 in that in the former more auxiliary baffles are provided. By providing more auxiliary baffles, the relative position of the first heat-exchanging tube and the second heat-exchanging tube in the first heat exchanger and the second heat exchanger can be so adjusted that the tubes are not necessarily in an exact left-and-right arrangement (as shown in Figs. 1 to 6). The first heat-exchanging tube and the second heat-exchanging tube with mainly a heat-exchanging function can thereby be arranged, depending on the wind field distribution of the heat exchanger, in positions with highest wind speed to increase the heat exchange amount.

[0061] Specifically, the chamber of the middle manifold 30 is divided into two first chambers 31, a second chamber 32 and three communicating chambers 33 and 34 by the main partition 621 extending along the longitudinal direction of the middle manifold 30 from the left end to the right end of the middle manifold 30 and by two auxiliary baffles 622 provided between the main partition 621 and the upper wall of the middle manifold and two auxiliary baffles 623 provided between the main partition 621 and the lower wall of the middle manifold.

[0062] It shall be noted here that the auxiliary baffles 622, 623 can be so configured as to extend obliquely, vertically, curvedly or windingly from the upper or lower portion of the middle manifold to the main partition 621. There is no restriction in this respect within the scope of the present invention, insofar as a first chamber and a second chamber arise by division.

[0063] In the present example, the first chamber 31 and the second chamber 32 communicate with the associated communicating chambers 33, 34 through respectively the first opening 71 and the second opening 72 correspondingly provided in the main partition 621.

[0064] During the circulation of refrigerant in the seventh heat exchanger system, the refrigerant in the upper manifold 10 flows through the first heat-exchanging tube 41 on the left and right sides down to the corresponding first chamber 31, and then flows via the first opening 71 into the corresponding communicating chamber 33. The refrigerant in the communicating chamber 33 flows through the two first communicating parts 51 respectively down to the chamber of the lower manifold 30, and then flows through the second heat-exchanging tube 42 up to the second chamber 32. The refrigerant in the second chamber 32 flows through the second opening 72 into the communicating chamber 34, and then returns through the second communicating part 52 up to the upper manifold 10.

[0065] That is, a plurality of circulation loops for refrigerant can be formed when necessary between the first and the second heat exchangers by for example providing auxiliary baffles or providing openings in the main partition. Although most of the first to the seventh heat exchanger systems illustrated in Figs. 1 to 7 have only one circulation loop for refrigerant, a person skilled in the art can, when necessary, repeats the shown structural arrangements or otherwise changes the structural arrangements in the heat exchangers to realize more circulation loops for refrigerant. All of these substitutions or variations fall within the protection scope of the present invention.

[0066] Referring to Fig. 8, a heat exchanger system 200 according to a second embodiment of the present invention is shown. The heat exchanger system 200 comprises an upper manifold 210, a first middle manifold 230, a second middle manifold 240 and a lower manifold 220 arranged successively from top to bottom. A first heat-exchanging tube 241 is arranged between the upper manifold 210 and the first middle manifold 230, and a second heat-exchanging tube 242 is arranged between the second middle manifold 240 and the lower manifold 220.

[0067] The first middle manifold 230 is provided with a first partition 261 by which the first middle manifold 230 is divided into at least one first chamber 231 and at least one first communicating chamber 234 separated from each other. The second middle manifold 240 is provided with a second partition 262 by which the second middle manifold 240 is divided into at least one second chamber 232 and at least one second communicating chamber 233 separated from each other.

[0068] During the circulation of refrigerant, the refrigerant in the upper manifold 210 flows through the first heat-exchanging tube 241 down to the first chamber 231 and via a first connecting tube 281 into the second communicating chamber 233, and flows via a first communicating part 251 into the chamber of the lower manifold 220; subsequently, the refrigerant flows through the second heat-exchanging tube 242 up into the second chamber 232 and via a second connecting tube 282 into the first communicating chamber 234, and then returns via a second communicating part 252 to the upper manifold 210.

[0069] As shown in Fig. 8, the first middle manifold 230 is divided by the provided first partition 261 into the first chamber 231 and the first communicating chamber 234, and the second middle manifold 240 is divided by the provided second partition 262 into the second chamber 232 and the second communicating chamber 233. Apparently, more partitions 261, 262 can be provided, when necessary, by a person skilled in the art in the first and the second middle manifolds 230, 240 respectively to form more circulation loops for refrigerant. It will not be illustrated and described in detail here the way to form more circulation loops for refrigerant, which can be configured by a skilled person when required.

[0070] Furthermore, openings for the first connecting tube 281 and the second connecting tube 282 can be, where necessary, arranged by a skilled person in the appropriate positions on the first and the second middle manifolds 230, 240, without being limited to the situation shown in Fig. 8 where two openings are arranged in the lower portion of the first middle manifold 230 and two corresponding openings are arranged in the upper portion of the second middle manifold 240.

[0071] It shall be noted here that the first communicating part 251 and the second communicating part 252 can be a communicating or connecting tube with a communication function. Preferably, as shown in Fig. 8, the first communicating part 251 is at least one round or flat tube arranged between the lower manifold 220 and the second middle manifold 230, and the round or flat tube and the second heat-exchanging tube 242 are arranged in a row between the lower manifold 220 and the second middle manifold 240. The second communicating part 252 is at least one round or flat tube arranged between the upper manifold 210 and the first middle manifold 230, and the round or flat tube and the first heat-exchanging tube 241 are arranged in a row between the upper manifold 210 and the first middle manifold 230.

[0072] The upper manifold 210 and the first middle manifold 230 and the first heat-exchanging tube 241 arranged therebetween constitute a first heat exchanger, and the second middle manifold 240 and the lower manifold 220 and the second heat-exchanging tube 242 arranged therebetween constitute a second heat exchanger. For the purpose of illustration of the present invention, the first heat exchanger is referred to as condenser and the second heat exchanger is referred to as evaporator. Of course, the first heat exchanger and the second heat exchanger can be configured by a person skilled in the art, when necessary, to be a condenser, an evaporator or a heat exchanger of any other type, and there is no restriction in this respect within the scope of the present invention.

[0073] The first heat-exchanging tube 241 and the second heat-exchanging tube 242 can be a heat-exchanging tube of any type. Generally, the first heat-exchanging tube 241 and the second heat-exchanging tube 242 are any one selected from the group of a round tube and a flat tube. In the one and same heat exchanger system, the first heat-exchanging tube 241 and the second heat-exchanging tube 242 are not necessarily to be configured as of the same type, such as exclusively round or flat. Rather, it is possible that one is a round tube and the other is a flat tube. It is also possible that one part of the first or second heat-exchanging tube 241, 242 is a round tube and the other part is a flat tube. That is, the first and the second heat-exchanging tube 241, 242 can be configured when necessary to be a practical heat-exchanging tube of any type, and there is no special restriction in this respect within the scope of the present invention.

[0074] Furthermore, fins can be provided between two adjacent first heat-exchanging tubes 241 or two adjacent

second heat-exchanging tubes 242, independent of the type of the heat-exchanging tubes.

[0075] It is to be understood that, if the first heat-exchanging tube 241 and the second communicating part 252 are both configured to be for example round tubes and/or flat tubes, the first heat-exchanging tube 241 and the second communicating part 252 can be arranged in a row between the upper manifold 210 and the first middle manifold 230, as shown in Fig. 8. Likewise, if the second heat-exchanging tube 242 and the first communicating part 251 are both configured to be for example round tubes and/or flat tubes, the second heat-exchanging tube 242 and the first communicating part 251 can be arranged in a row between the lower manifold 220 and the second middle manifold 240, as shown in Fig. 8. As such, the first heat exchanger and/or the second heat exchanger can be manufactured in a simpler and easier process, and their thickness can be reduced.

[0076] As shown in Fig. 8, in the first heat exchanger, a plurality of first heat-exchanging tubes 241 are arranged in the left side of the first heat exchanger, and the second communicating part 252 is arranged in the right side of the first heat exchanger. Beside, in the second heat exchanger, a plurality of second heat-exchanging tubes 242 are arranged in the right side of the second heat exchanger, and the first communicating part 251 is arranged in the left side of the second heat exchanger. It is to be understood that, the relative position of the first heat-exchanging tube 241 and the second communicating part 252 can be configured as necessary by a person skilled in the art, and is not necessarily to be limited as shown. For example, it is possible that the first heat-exchanging tube 241 is arranged in the middle and the second communicating part 252 on both sides of it. The same applied to the second heat-exchanging tube 242 and the first communicating part 251, and therefore the detailed description is dispensed with.

[0077] A first partition 261 and a second partition 262 are provided to divide the first and the second middle manifolds 230, 240 into the first chamber 231 and the second chamber 232 separated from each other and the corresponding communicating chambers 233, 234. It is to be understood that the first and the second partitions 261, 262 can be configured to be of any appropriate form without limitation to that shown in Fig. 8, insofar as the division into the first chamber 231 and the second chamber 232 is guaranteed. For example, the first and the second partitions 261, 262 can be configured to extend obliquely, vertically, curvedly or windingly from the upper wall to the lower wall of the first middle manifold 230 or the second middle manifold 240.

[0078] It shall also be noted that only a single circulation of refrigerant is shown in Fig. 8. Of course, the heat exchanger system can be configured to have a plurality of circulations of refrigerant, that is, by extending for this purpose the upper manifold 210, the first middle manifold 230, the second middle manifold 240 and the lower manifold 220 in the longitudinal direction and repeating the

structural unit shown in Fig. 8, as necessary, on either side of itself.

[0079] The refrigeration working principle of the heat exchanger system according to the present invention shown in Fig. 8 is to be explained by an example in which the first heat exchanger is a condenser and the second heat exchanger is an evaporator and the heat-exchanging tubes are flat ones. Specifically, the refrigerant in the condenser in the form of vapour condenses to liquid refrigerant by heat releasing, and flows downward under the action of gravity along the flat tube for heat release (the first heat-exchanging tube 241). After it flows into the evaporator, the refrigerant absorbs heat therein so as to be converted into the form of vapour and flows upward along the flat tube for absorbing heat (the second heat-exchanging tube 242), finally into the condenser. The circulation proceeds in this way to obtain the effect of refrigeration.

[0080] Referring to Fig. 9, a heat exchanger system 300 according to a third embodiment of the present invention is shown. The heat exchanger system 300 comprises an upper manifold 310, a middle manifold 330 and a lower manifold 320. A first heat-exchanging tube 341 is arranged between the upper manifold 310 and the middle manifold 330, and a second heat-exchanging tube 342 is arranged between the middle manifold 330 and the lower manifold 320.

[0081] The upper manifold 310 and the middle manifold 330 and the first heat-exchanging tube 341 arranged therebetween constitute a first heat exchanger, preferably a condenser, and the middle manifold 330 and the lower manifold 320 and the second heat-exchanging tube 342 arranged therebetween constitute a second heat exchanger, preferably an evaporator.

[0082] The heat exchanger system 300 according to the third embodiment of the present invention can have a structure similar to that of the first to seventh heat exchanger system according to the first embodiment of the present invention, with the exception that a part of the first heat exchanger or the second heat exchanger is bent, enabling an installation in a more compact room. That is to say, in the heat exchanger system according to the third embodiment of the present invention, the upper manifold 310, the middle manifold 330 and the lower manifold 320 are not arranged successively from top to bottom (or generally within a same vertical plane), but at an angle to each other. The specific angle to each other can be set as necessary. As shown in Fig. 9, for example, the upper manifold 310 can be configured to form an angle of 45° with the middle manifold 330, whereas the middle manifold 330 and the lower manifold 320 are configured to lie in generally the same horizontal plane.

[0083] Specifically, the first heat-exchanging tube 341 or the second heat-exchanging tube 342 in the first heat exchanger or the second heat exchanger can be bent so as to achieve the purpose of bending the heat exchanger.

[0084] Also, the first heat-exchanging tube 341 and the second heat-exchanging tube 342 can be inserted into

the middle manifold 330 in directions oblique to each other (for example, installation holes in the middle manifold 330 are not aligned directly to each other, but inclined to one another at an angle) so as to achieve the purpose of bending the heat exchanger.

[0085] Of course, the above conception to arrange the first heat exchanger and the second heat exchanger to be oblique to each other also applies to the heat exchanger system according to the second embodiment of the present invention. For example, the first heat-exchanging tube 241 or the second heat-exchanging tube 242 in the first heat exchanger or the second heat exchanger can be bent so as to achieve the purpose of bending the heat exchanger.

[0086] Also, the first heat-exchanging tube 241 and the second heat-exchanging tube 242 can be inserted into the corresponding first and second middle manifolds in directions oblique to each other (for example, installation holes in the first middle manifold and the second middle manifold are not aligned directly to each other, but inclined to one another at an angle) so that the first heat exchanger and the second heat exchanger are inclined to one another.

[0087] In the third embodiment, by bending of the first heat exchanger and/or the second heat exchanger or the inclined arrangement thereof relative to each other, it is enabled to further facilitate the installation and arrangement of ventilator or air duct in case where the system has a demanding requirement on the installation space.

[0088] It shall be noted that, in all of the heat exchanger systems shown according to the first to third embodiments of the present invention, a single-row heat exchanger is taken as example to illustrate how to arrange the evaporator and condenser. However, a skilled person can configure the evaporator and/or the condenser to be a multiple-row heat exchanger, and there is no limitation in this respect within the scope of the present invention. Furthermore, although in all of the heat exchanger systems shown according to the first to third embodiments of the present invention, it suffices to realize the circulation of refrigerant if the heat exchanger system includes a condenser and an evaporator in communication with each other, it is possible to add a compressor in the circulation loop of refrigerant to increase the cycle efficiency of refrigerant.

[0089] It is also to be understood that, in the first to third embodiments of the present invention, the first communicating part and the second communicating part can be identical or different, and the way by which the first communicating part communicates with the first chamber and the way by which the second communicating part communicates with the second chamber can be identical or different. In other words, in the light of those shown in Figs. 1 to 8 according to the present invention, a person skilled in the art can select or appropriately combine, where necessary, the first communicating part, the second communicating part, the way by which the first communicating part communicates with the first chamber,

and the way by which the second communicating part communicates with the second chamber.

[0090] As can be seen from the forgoing description, the heat exchanger systems according to the first to the third embodiments of the present invention have at least one of the following advantages:

1. high processability;
2. low costs;
3. low risk of system safety failure;
4. low demand on the installation space;
5. efficient utilization of the heat-exchanging area in case of a heat exchanger with long manifolds by providing a liquid distributing structure;
6. the possibility to flexibly arrange the heat-exchanging tubes depending on the wind field distribution, so as to increase the heat exchange amount;
7. the possibility to more conveniently arrange ventilator and air duct so as to meet various installation requirements, by bending the evaporator and/or the condenser or by arranging the evaporator and/or the condenser obliquely to each other.

[0091] All of the forgoing are only some embodiments of the present invention. It would be appreciated by those skilled in the art that modifications may be made in these embodiments without departing from the principles and spirit of the general inventive concept of the disclosure. The scope of present invention is defined in the appended claims and their equivalents.

Claims

1. A heat exchanger system, comprising an upper manifold, a middle manifold and a lower manifold arranged successively from top to bottom, wherein a first heat-exchanging tube is arranged between the upper manifold and the middle manifold, and a second heat-exchanging tube is arranged between the middle manifold and the lower manifold, **characterized in that**, the middle manifold has a first chamber and a second chamber separated from each other; and that during circulation of refrigerant, the refrigerant in the upper manifold flows through the first heat-exchanging tube down to the first chamber, and flows via a first communicating part into a chamber of the lower manifold, and subsequently the refrigerant flows through the second heat-exchanging tube up into the second chamber and then returns via a second communicating part to the upper manifold.
2. The heat exchanger system of claim 1, **characterized in that** the first communicating part is a communicating or connecting tube with a communication function.

3. The heat exchanger system of claim 1 or 2, **characterized in that** the second communicating part is a communicating or connecting tube with a communication function.
4. The heat exchanger system of any one of claims 1 to 3, **characterized in that** the first communicating part is at least one round or flat tube arranged between the lower manifold and the middle manifold, and the round or flat tube and the second heat-exchanging tube are arranged in a row between the lower manifold and the middle manifold; and/or the second communicating part is at least one round or flat tube arranged between the upper manifold and the middle manifold, and the round or flat tube and the first heat-exchanging tube are arranged in a row between the upper manifold and the middle manifold.
5. The heat exchanger system of any one of claims 1 to 4, **characterized in that** the upper manifold, the middle manifold and the first heat-exchanging tube arranged therebetween constitute a first heat exchanger, preferably a condenser, and the middle manifold, the lower manifold and the second heat-exchanging tube arranged therebetween constitute a second heat exchanger, preferably an evaporator.
6. The heat exchanger system of claim 5, **characterized in that** the middle manifold is divided into the first chamber and the second chamber by a main partition extending obliquely, vertically, curvedly or windingly from an upper portion to a lower portion of the middle manifold.
7. The heat exchanger system of claim 5, **characterized in that** the middle manifold is divided into the first chamber and the second chamber by a main partition extending in a longitudinal direction of the middle manifold from one of its ends to the other.
8. The heat exchanger system of claim 7, **characterized in that** a first opening and a second opening are provided in the main partition, the refrigerant coming from the first heat exchanger enters from the first chamber via the first opening into the second heat exchanger, and the refrigerant flowing out of the second heat exchanger flows into the second chamber and via the second opening enters into the first heat exchanger.
9. The heat exchanger system of claim 8, **characterized in that** a communicating flat or round tube in the second heat exchanger, situated between the middle manifold and the lower manifold, serves as the first communicating part, one end of the communicating flat or round tube in the second heat exchanger inserts through the first opening into the first

- chamber, and the other end communicates with a chamber of the lower manifold; and/or a communicating flat or round tube in the first heat exchanger, situated between the middle manifold and the upper manifold, serves as the second communicating part, one end of the communicating flat or round tube in the first heat exchanger inserts through the second opening into the second chamber, and the other end communicates with the chamber of the upper manifold.
10. The heat exchanger system of claim 7, **characterized in that** the first communicating part is a first connecting tube communicating the chamber of the lower manifold with the first chamber of the middle manifold, and/or the second communicating part is a second connecting tube communicating the chamber of the upper manifold with the second chamber of the middle manifold.
11. The heat exchanger system of claim 10, **characterized in that** a liquid distributing structure for distribution of the fluid coming from the first connecting tube is provided in the chamber of the lower manifold.
12. The heat exchanger system of claim 11, **characterized in that** the liquid distributing structure is a fluid guiding tube connected to or integrally formed with the first connecting tube, on which fluid guiding tube spaced openings are provided.
13. The heat exchanger system of claim 8, **characterized in that** the middle manifold further comprises at least one auxiliary baffle provided between the main partition and an upper and/or lower wall of the middle manifold, so as to divide a chamber of the middle manifold into at least one communicating chamber with a communication function, at least one said first chamber and at least one said second chamber.
14. The heat exchanger system of claim 13, **characterized in that** the first chamber and the second chamber communicate with the at least one communicating chamber via respectively the first opening and the second opening in the main partition, and the at least one communicating chamber communicates with the corresponding first or second communicating part.
15. The heat exchanger system of any one of claims 5-14, **characterized in that** the first heat exchanger and/or the second heat exchanger, preferably the first heat-exchanging tube and/or the second heat-exchanging tube of the first heat exchanger and/or the second heat exchanger, are bent; or the first heat-exchanging tube and the second heat-exchanging tube are inserted respectively into the middle manifold in directions oblique to each other.
16. A heat exchanger system, comprising an upper manifold, a first middle manifold, a second middle manifold and a lower manifold arranged successively from top to bottom, wherein a first heat-exchanging tube is arranged between the upper manifold and the first middle manifold, and a second heat-exchanging tube is arranged between the second middle manifold and the lower manifold, the first middle manifold is provided with a first partition by which the first middle manifold is divided into at least one first chamber and at least one first communicating chamber separated from each other, and the second middle manifold is provided with a second partition by which the second middle manifold is divided into at least one second chamber and at least one second communicating chamber separated from each other; during circulation of refrigerant, the refrigerant in the upper manifold flows through the first heat-exchanging tube down to the first chamber and via a first connecting tube into the second communicating chamber, and flows via a first communicating part into a chamber of the lower manifold; subsequently, the refrigerant flows through the second heat-exchanging tube up into the second chamber and via a second connecting tube into the first communicating chamber, and then returns via a second communicating part to the upper manifold.
17. The heat exchanger system of claim 16, **characterized in that** the first communicating part is a communicating or connecting tube with a communication function.
18. The heat exchanger system of claim 16 or 17, **characterized in that** the second communicating part is a communicating or connecting tube with a communication function.
19. The heat exchanger system of any one of claims 16 to 18, **characterized in that** the first communicating part is at least one round or flat tube arranged between the lower manifold and the second middle manifold, and the round or flat tube and the second heat-exchanging tube are arranged in a row between the lower manifold and the second middle manifold; and/or the second communicating part is at least one round or flat tube arranged between the upper manifold and the first middle manifold, and the round or flat tube and the first heat-exchanging tube are arranged in a row between the upper manifold and the first middle manifold.
20. The heat exchanger system of any one of claims 16 to 19, **characterized in that** the upper manifold and

the first middle manifold and the first heat-exchanging tube arranged therebetween constitute a first heat exchanger, preferably a condenser, and the second middle manifold and the lower manifold and the second heat-exchanging tube arranged therebetween constitute a second heat exchanger, preferably an evaporator.

21. The heat exchanger system of claim 20, **characterized in that** the first heat exchanger and/or the second heat exchanger, preferably the first heat-exchanging tube and/or the second heat-exchanging tube of the first heat exchanger and/or the second heat exchanger, are bent; or the first heat-exchanging tube and the second heat-exchanging tube are inserted respectively into the first middle manifold and the second middle manifold in directions oblique to each other.

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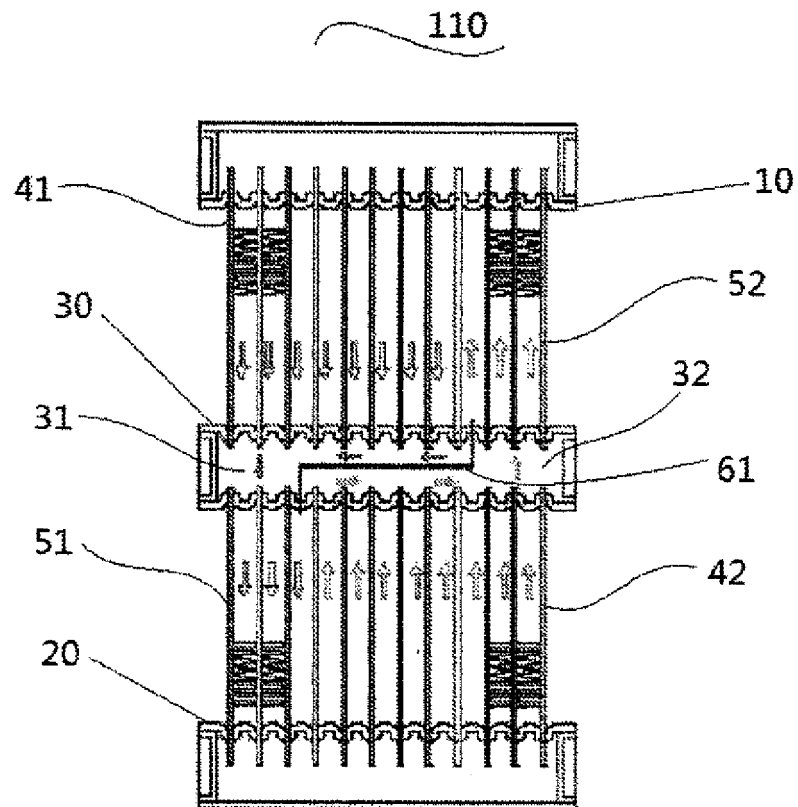


Fig. 1

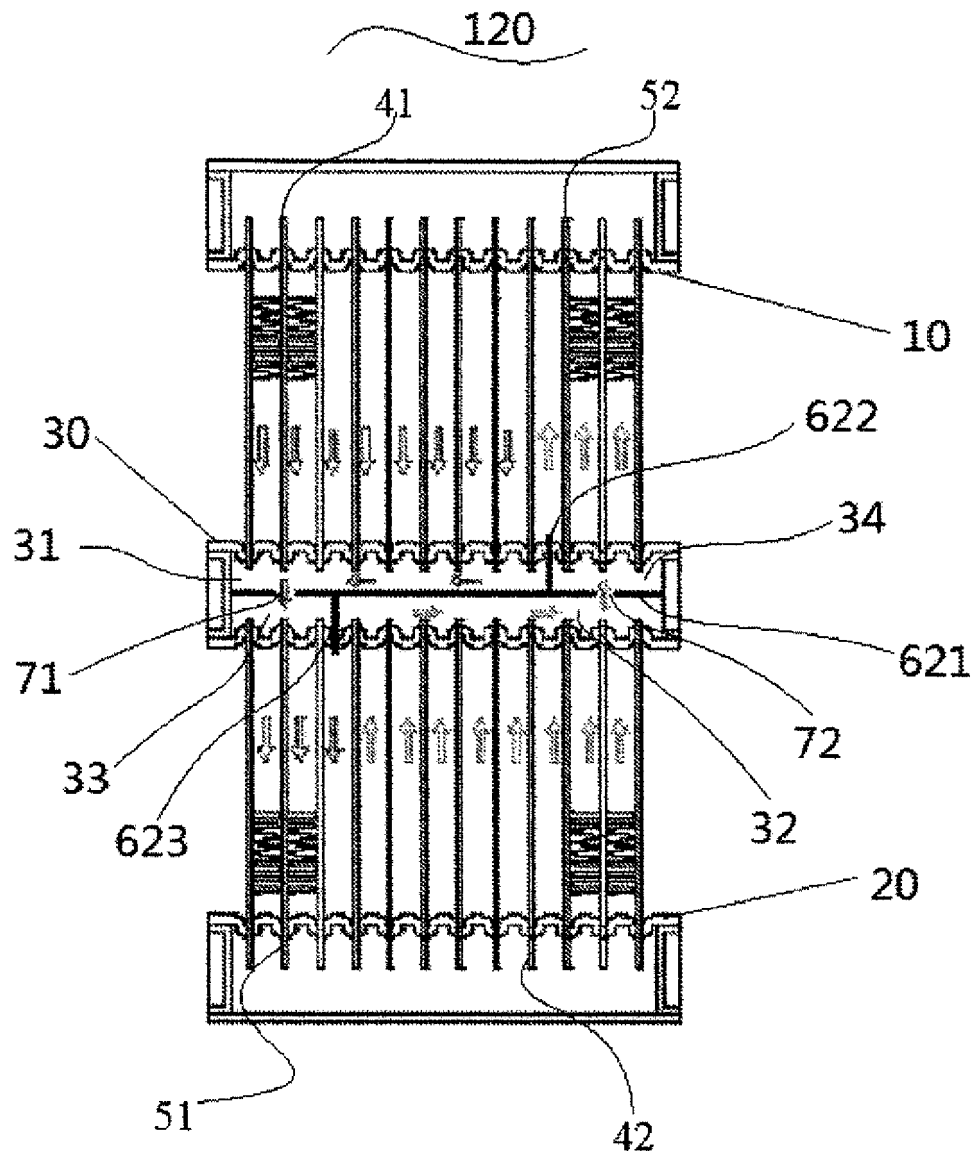


Fig. 2

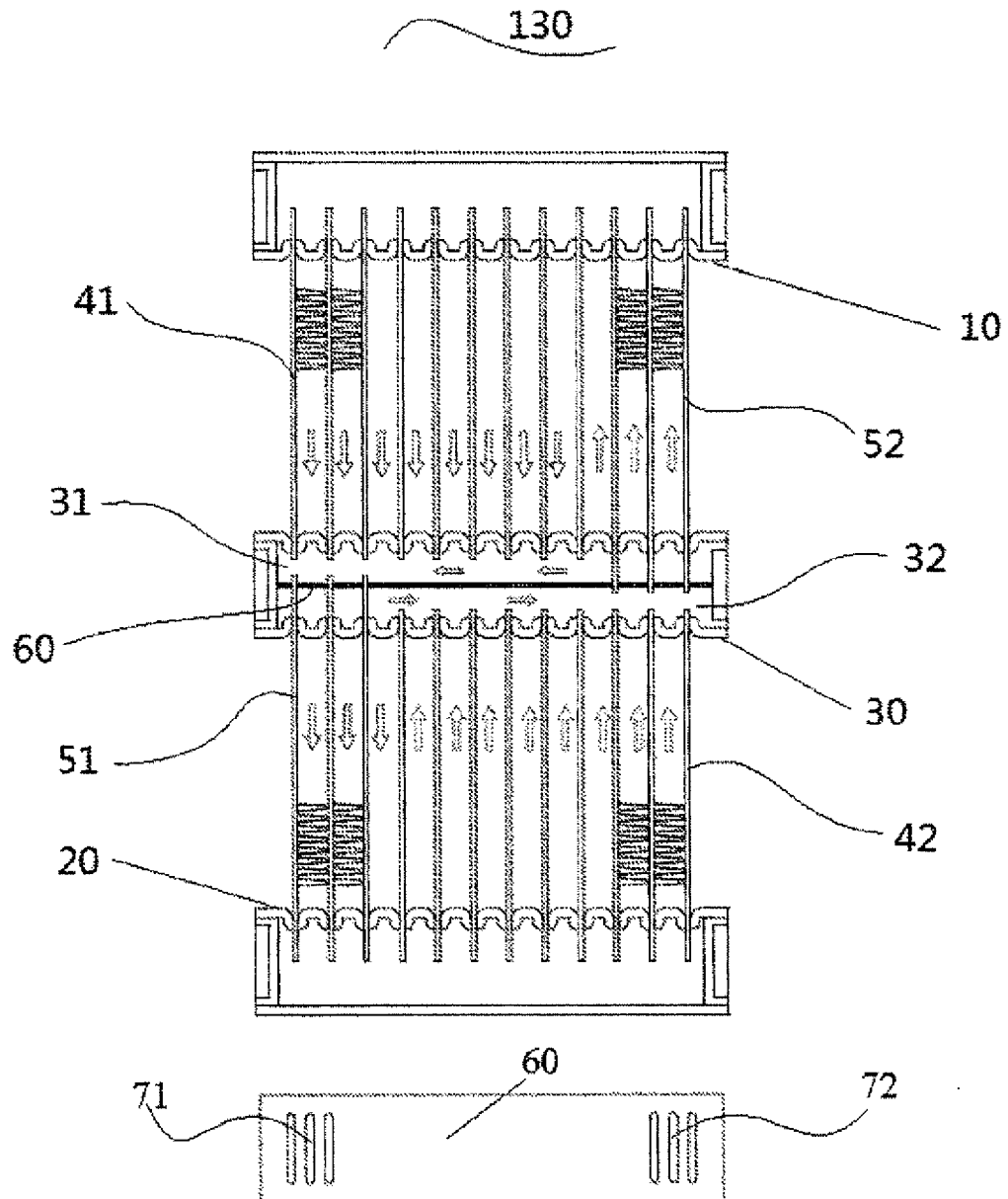


Fig. 3

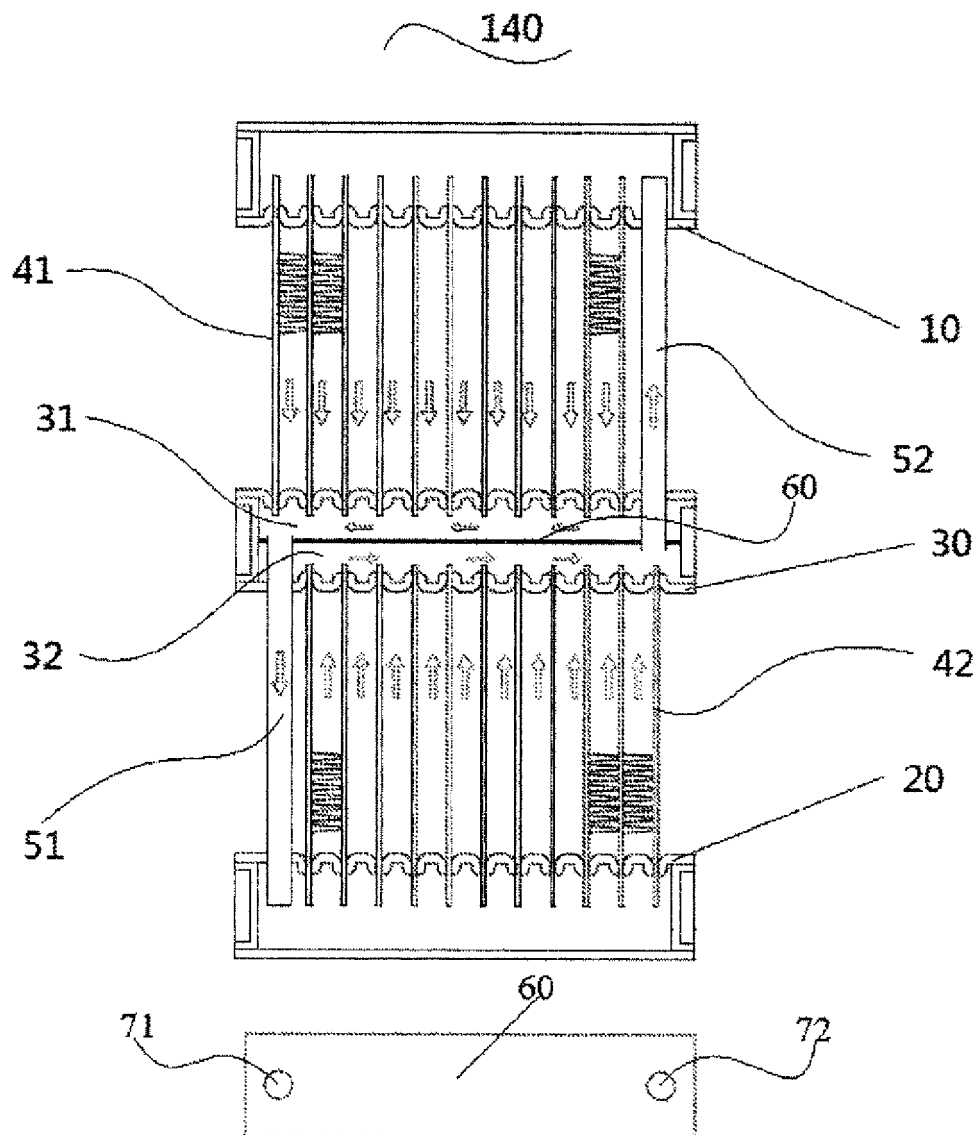


Fig. 4

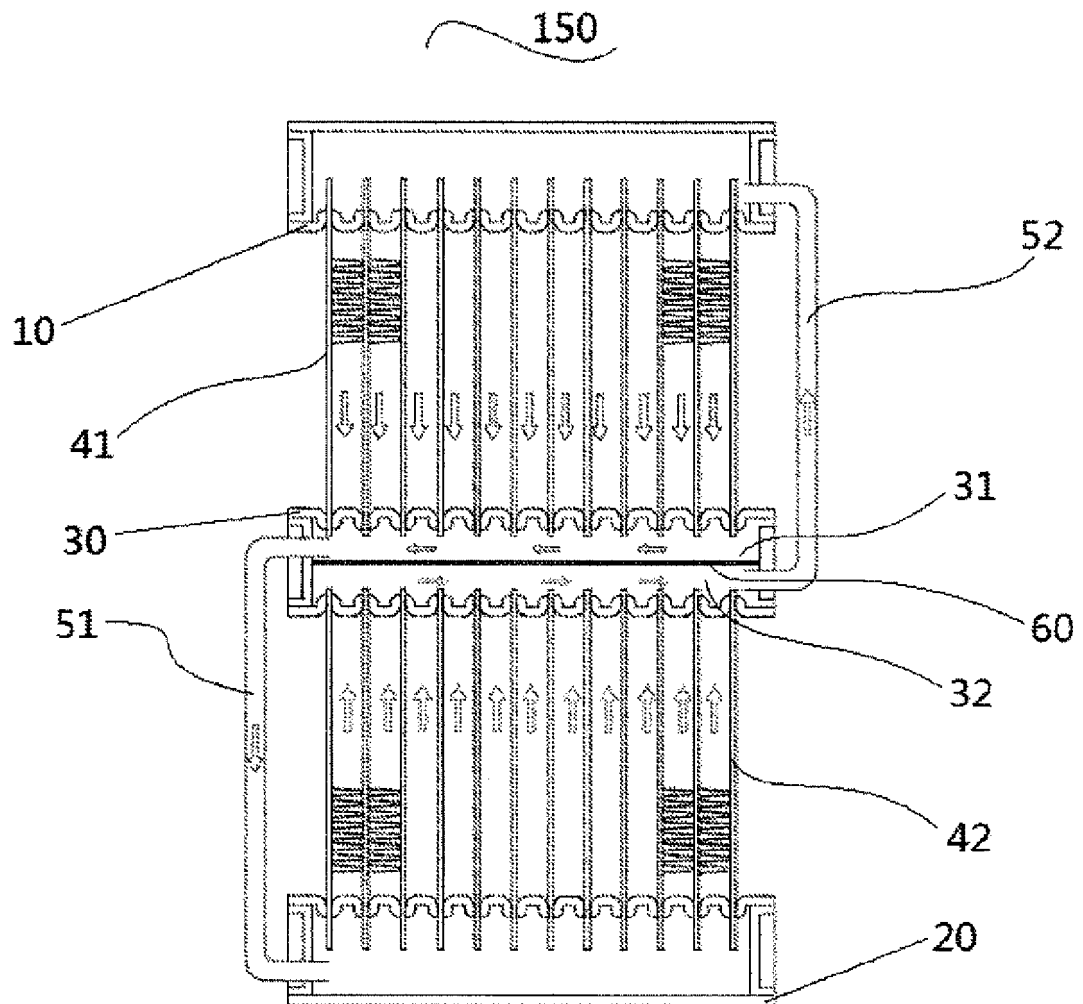


Fig. 5

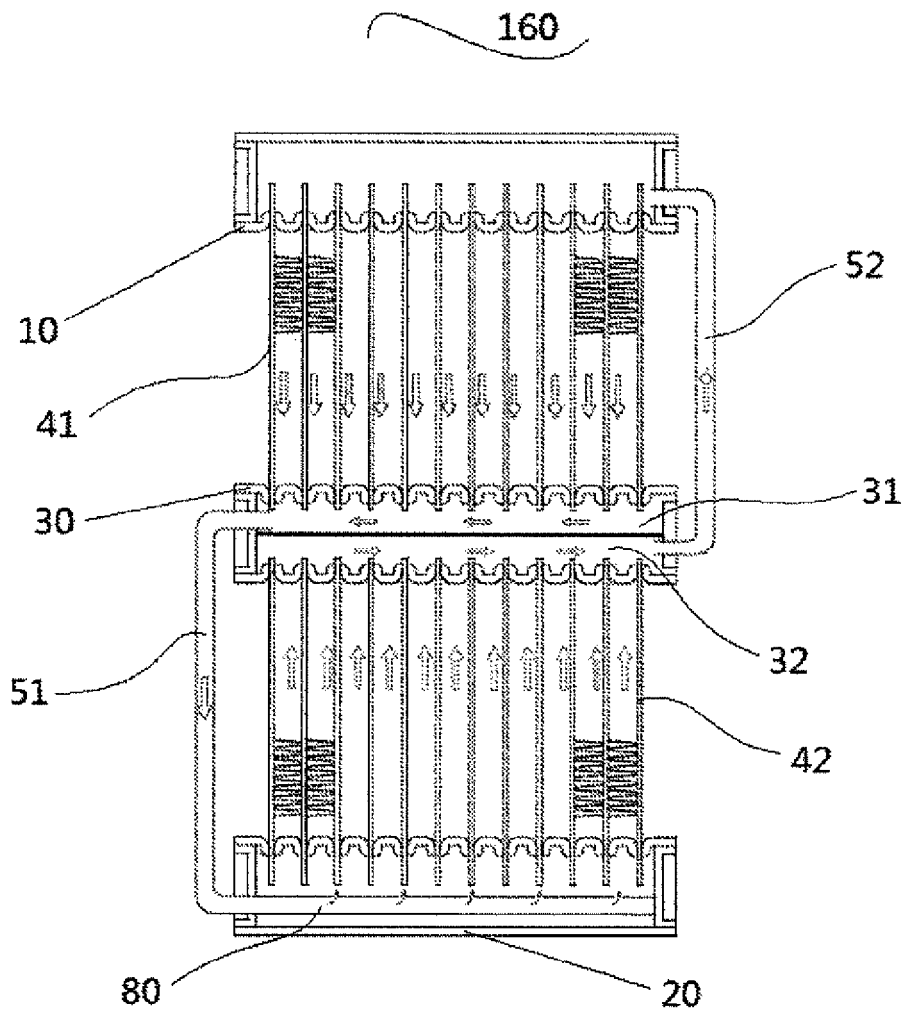


Fig. 6

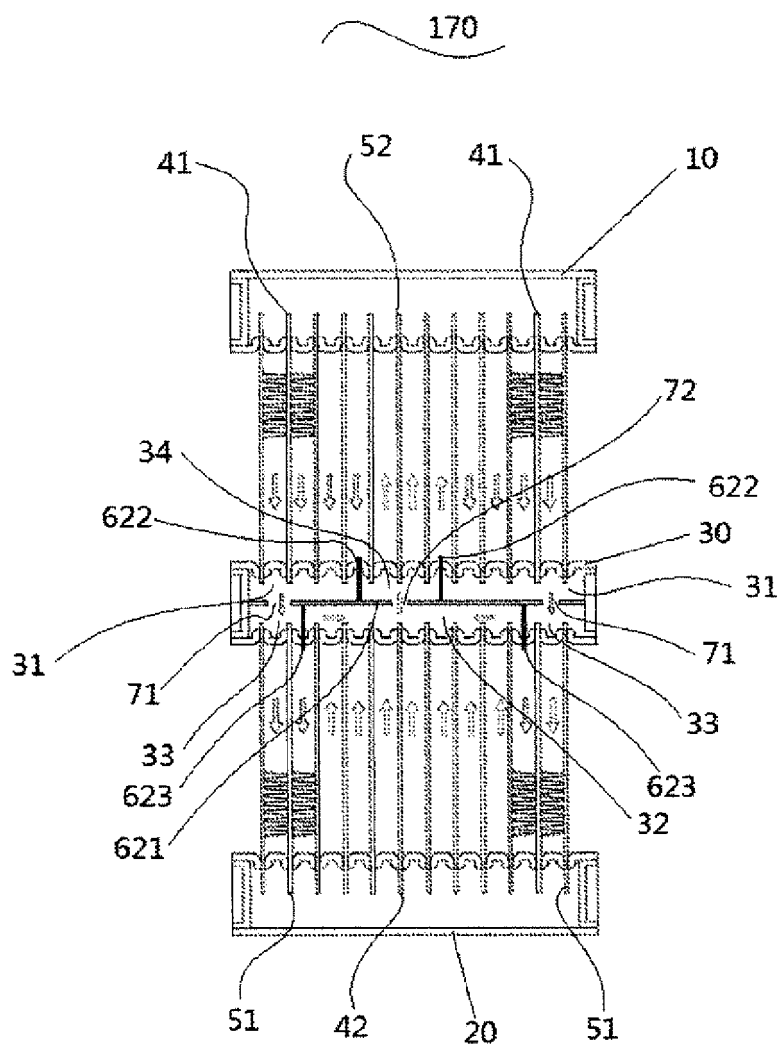


Fig. 7

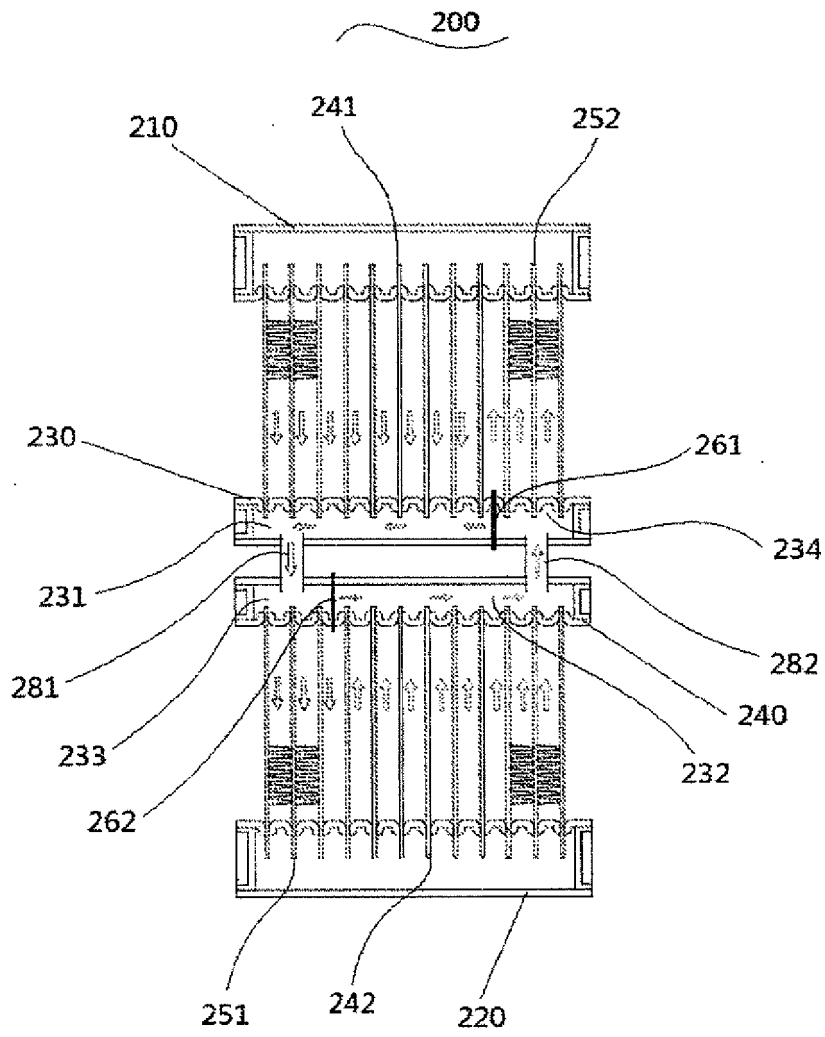


Fig. 8

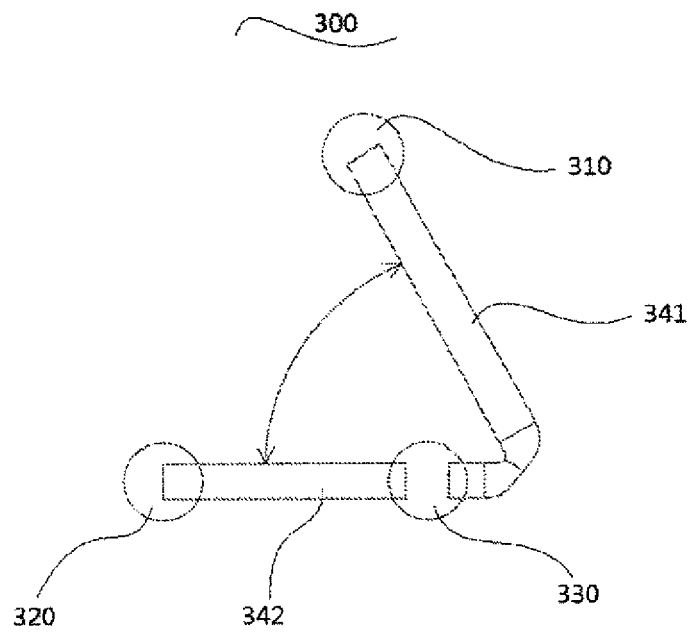


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/084500

A. CLASSIFICATION OF SUBJECT MATTER

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)

F25B 39; F28D 1; F28F

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)

CNKI, CPRS, EPODOC, WPI, TWABS: collecting tube, collecting tank, refrigera+, cold, produc+, medium, allocat+, dispens+, distribut+, header, manifold, collector, first, second, third, middle, midist, mid, condenser, condensator, evaporator

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 205209304 U (DANFOSS MICRO CHANNEL HEAT EXCHANGER JIAXING CO., LTD.), 04 May 2016 (04.05.2016), claims 1-25	1-21
A	CN 104296424 A (SANHUA (HANGZHOU) MICRO CHANNEL HEAT EXCHANGER CO., LTD.), 21 January 2015 (21.01.2015), description, paragraphs [0025]-[0047], and figures 1-5	1-21
A	DE 102005048838 A1 (DAIMLER CHRYSLER AG), 21 September 2006 (21.09.2006), the whole document	1-21
A	DE 10112697 A1 (BEHR GMBH & CO.), 19 September 2002 (19.09.2002), the whole document	1-21
A	DE 4441503 C2 (BEHR GMBH & CO.), 05 January 2000 (05.01.2000), the whole document	1-21
A	CN 103968613 A (GUANGDONG CHIGO AIR CONDITIONING CO., LTD.), 06 August 2014 (06.08.2014), the whole document	1-21

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
29 August 2016 (29.08.2016)Date of mailing of the international search report
13 September 2016 (13.09.2016)Name and mailing address of the ISA/CN:
State Intellectual Property Office of the P. R. China
No. 6, Xitucheng Road, Jimenqiao
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Facsimile No.: (86-10) 62019451Authorized officer
DUAN, Xiaoning
Telephone No.: (86-10) 010-62084193

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/084500

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	CN 203824169 U (DANFOSS MICRO CHANNEL HEAT EXCHANGER JIAXING CO., LTD.), 10 September 2014 (10.09.2014), the whole document	1-21

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/084500

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DE 4441503 C2	05 January 2000	DE 4441503 A1	23 May 1996
CN 103968613 A	06 August 2014	None	
CN 203132214 U	14 August 2013	None	
CN 203824169 U	10 September 2014	None	

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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