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(54) **MICRO-CHANNEL HEAT EXCHANGER AND HEAT PUMP SYSTEM HAVING THE SAME**

(57) The present invention proposes a micro-channel heat exchanger (100). The micro-channel heat exchanger comprises: a first manifold (110) and a second manifold (120); a plurality of micro-channel flat tubes (130), sequentially connected from top to bottom between the first manifold and the second manifold; and a plurality of heat exchange fins (140), spaced at a predetermined distance from each other and formed with tube holes for the plurality of micro-channel flat tubes to pass through, wherein the plurality of heat exchange fins are provided with heat dissipation structures (150) for increasing the heat exchange area, where the heat dissipation structures are located above the micro-channel flat tube, and a drainage groove (16) is arranged vertically at the same side of the plurality of heat exchange fins, wherein, a portion of at least one heat exchange fin of the plurality of heat exchange fins below the bottommost micro-channel flat tube is provided with a guiding structure (170) for guiding water droplets condensed on the surface of the at least one heat exchange fin to the drainage groove. The present invention also proposes a heat pump system configured with the micro-channel heat exchanger. The micro-channel heat exchanger according to the present invention can effectively prevent accumulation of condensed water at the bottom of the heat exchange fins.

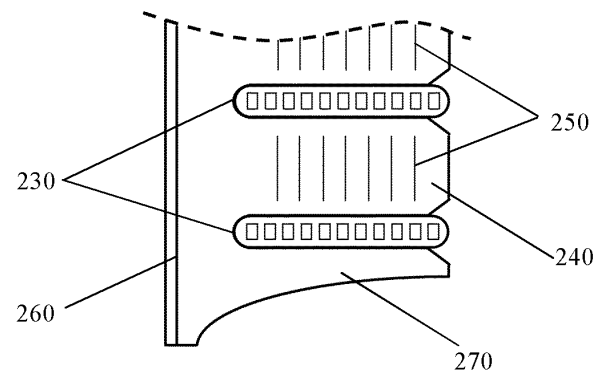


FIG. 6

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the technical field of heat exchange, in particular to a micro-channel heat exchanger, and further to a heat pump system configured with the micro-channel heat exchanger.

BACKGROUND OF THE INVENTION

[0002] Micro-Channel Heat Exchanger (MCHE) is a heat exchanger with a channel having an equivalent diameter ranging from 10 to 1000 μm . This kind of heat exchanger has dozens of fine flow channels inside its flat tube. Both ends of the flat tube are connected to a cylindrical manifold, where a partition is arranged inside the manifold to separate the flow channel of the micro-channel heat exchanger into several flow paths.

[0003] As shown in FIGS. 1 and 2, a micro-channel heat exchanger 10 typically includes an inlet manifold 11, an outlet manifold 12, a plurality of flat tubes 13 in connection with these manifolds, and a plurality of heat exchange fins 14. Each flat tube 13 has micro-channels or small paths for refrigerant, such as gas, liquid, or gas-liquid two-phase fluid, to pass through. During the operation of the micro-channel heat exchanger 10, the refrigerant first enters the inlet manifold 11 through the inlet of the inlet manifold 11, and then flows through the flat tube 13. When flowing inside the flat tube, the refrigerant exchanges heat with the fluid outside the flat tube 13, such as the ambient air. After heat exchange with the external fluid, the refrigerant leaves the flat tube 13 and enters the outlet manifold 12, and then leaves the outlet manifold 12 through the outlet of the outlet manifold 12. In order to increase the heat exchange area, an additional heat dissipation structure 15, such as a louver structure, is usually added to the surface of the heat exchange fin 14. When the micro-channel heat exchanger 10 operates as an evaporator, the surface temperature of the heat exchange fin 14 is lower than the dew point temperature of the ambient air, so the water vapor contained in the air will precipitate from the surface of the heat exchange fin 14. Due to gravity, water droplets gradually flow to the bottom of the heat exchange fins 14. As the heat exchange fins are arranged together, an extremely narrow channel is formed between the louver structures of two adjacent heat exchange fins, causing water droplets to gradually accumulate at the bottom of the heat exchange fins and unable to flow to the drainage groove 16 on one side of the heat exchange fins, resulting in poor drainage of the heat exchange fins, which leads to significant degradation of the performance of the micro-channel heat exchanger.

SUMMARY OF THE INVENTION

[0004] In view of the above, the present invention pro-

vides a micro-channel heat exchanger, so as to solve or at least alleviate one or more of the aforementioned problems and problems in other aspects existing in the prior art, or to provide an alternative technical solution for the prior art.

[0005] According to a first aspect of the present invention, a micro-channel heat exchanger is provided, comprising:

a first manifold and a second manifold, wherein the first manifold and the second manifold are spaced apart;

a plurality of micro-channel flat tubes, sequentially connected from top to bottom between the first manifold and the second manifold; and

a plurality of heat exchange fins, spaced at a predetermined distance from each other and formed with tube holes for the plurality of micro-channel flat tubes to pass through, wherein the plurality of heat exchange fins are provided with heat dissipation structures for increasing heat exchange area, where the heat dissipation structures are located above the micro-channel flat tube, and a drainage groove is arranged vertically at the same side of the plurality of heat exchange fins,

wherein, a portion of at least one heat exchange fin of the plurality of heat exchange fins below the bottommost micro-channel flat tube is provided with a guiding structure for guiding water droplets condensed on the surface of the at least one heat exchange fin to the drainage groove.

[0006] The portion of each of the plurality of heat exchange fins below the bottommost micro-channel flat tube may be provided with a guiding structure, and the guiding structure may have smooth planes on both sides.

[0007] The guiding structure may be the lower surface of the bottommost micro-channel flat tube.

[0008] The area of the portions of the plurality of heat exchange fins below the bottommost micro-channel flat tube may gradually increase towards the side of the drainage groove.

[0009] The bottom of the guiding structure may have a bent, curved, linear or non-linear contour.

[0010] The heat dissipation structure for increasing the heat exchange area may be at least one of a strip structure, a corrugated structure, a staggered teeth structure, a louver structure, a structure with openings, a structure with protrusions, or a structure with grooves on the surface.

[0011] The plurality of heat exchange fins may be of the same size and shape, and may be spaced apart from each other at the same distance.

[0012] The plurality of heat exchange fins may be made of aluminum alloy.

[0013] The micro-channel heat exchanger may be a condenser or an evaporator.

[0014] According to a second aspect of the present invention, a heat pump system comprising the aforementioned micro-channel heat exchanger is provided.

[0015] It can be appreciated that the micro-channel heat exchanger of the present invention adopts a specially designed guiding structure, which can ensure heat exchange efficiency while preventing accumulation of condensed water on the heat exchange fins, thereby improving the overall performance of the micro-channel heat exchanger.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The technical solution of the present invention will be described in further detail below in conjunction with the accompanying drawings and embodiments. However, it should be noted that these drawings are only designed for explanatory purposes and are intended to conceptually illustrate the structure described herein, without the need to be drawn proportionally.

FIG. 1 shows a structural schematic diagram of a micro-channel heat exchanger of the prior art;

FIG. 2 shows a local schematic diagram of a heat exchange fin of the micro-channel heat exchanger in FIG. 1;

FIG. 3 illustratively shows a structural schematic diagram of a micro-channel heat exchanger according to the present invention;

FIG. 4 illustratively shows a local schematic diagram of a heat exchange fin of the micro-channel heat exchanger in FIG. 3;

FIG. 5 illustratively shows a structural schematic diagram of a micro-channel heat exchanger according to the present invention;

FIG. 6 illustratively shows a local schematic diagram of a heat exchange fins of the micro-channel heat exchanger in FIG. 5;

FIG. 7 illustratively shows a structural schematic diagram of a micro-channel heat exchanger according to the present invention;

FIG. 8 illustratively shows a local schematic diagram of a heat exchange fin of the micro-channel heat exchanger in FIG. 7;

FIG. 9 illustratively shows a structural schematic diagram of a micro-channel heat exchanger according to the present invention; and

FIG. 10 illustratively shows a local schematic diagram of a heat exchange fin of the micro-channel heat exchanger in FIG. 9.

DETAILED DESCRIPTION

[0017] The technical solution in the embodiments of the present invention will be described in a clear and complete manner in conjunction with the accompanying drawings in the embodiments of the present invention. Obviously, the described embodiments are only a part of the embodiments of the present invention, not all of them. Based on the embodiments in the present invention, all other embodiments obtained by those skilled in the art without creative labor fall within the scope of protection of the present invention.

[0018] It should be noted that the orientation terms mentioned or possibly mentioned in the present invention, such as up, down, left, right, front, back, inner side, outer side, front side, top, bottom, etc., are defined relative to the structures shown in the respective drawings, and they are relative concepts. Therefore, they may vary accordingly according to their different positions and usage states. Therefore, these or other orientation terms should not be interpreted as restrictive terms.

[0019] In addition, descriptions related to "first", "second", etc. in the present invention are only used for descriptive purposes, and cannot be understood as indicating or implying their relative importance, or implicitly indicating the number of indicated technical features. Therefore, the features defined with "first" and "second" can explicitly or implicitly include at least one of these features. In the description of the present invention, "a plurality of" means at least two, such as two, three, etc., unless otherwise specified.

[0020] In the description of the present invention, reference to the terms "one embodiment", "some embodiments", "examples", "specific examples", or "some examples" means that the specific features, structures, materials, or features described in conjunction with the embodiment(s) or example(s) are included in at least one embodiment or example of the embodiments of the present invention. In the present invention, the illustrative expressions for the above terms do not necessarily refer to the same embodiment(s) or example(s). In addition, the specific characteristics, structures, materials, or features described can be combined in an appropriate manner in any one or more embodiments or examples. Moreover, those skilled in the art may combine the different embodiments or examples described in the present invention, as well as the features of the different embodiments or examples, without conflicting with each other.

[0021] In the present invention, unless otherwise specified and limited, the terms "connect", "fix", etc. should be interpreted in a broader sense. For example, "fix" can be a fixed connection, a detachable connection, or an integral connection. It can be a mechanical connection or an electrical connection. It can be a direct connection

or an indirect connection through an intermediate medium. It can be the internal connection of two components or the interaction relationship between two components, unless otherwise specified. The specific meanings of the above terms in the present invention can be understood by those skilled in the art based on specific circumstances.

[0022] FIG. 3 schematically illustrates the structure of an embodiment of a micro-channel heat exchanger of the present invention in general. As can be clearly seen in FIGS. 3 and 4, the micro-channel heat exchanger 100 is composed of a first manifold 110, a second manifold 120, a plurality of micro-channel flat tubes 130, and a plurality of heat exchange fins 140, and other parts. The first manifold 110 and the second manifold 120 are spaced apart, with one serving as the inlet manifold and the other as the outlet manifold. The plurality of micro-channel flat tubes 130 are sequentially connected from top to bottom between the first manifold 110 and the second manifold 120, and the plurality of heat exchange fins 140 are spaced at a predetermined distance from each other and formed with tube holes for the plurality of micro-channel flat tubes 130 to pass through. Refrigerant or coolant flows inside the plurality of micro-channel flat tubes 130, while fluid medium, such as air, flows outside the micro-channel flat tubes 130. Heat conduction is carried out between the refrigerant and air through the tube walls and heat exchange fins 140, thereby achieving heat exchange. In order to increase the heat exchange area, the plurality of heat exchange fins 140 are additionally configured with heat dissipation structures 150, which are located above the micro-channel flat tubes, so that more fluid medium can pass through the heat exchanger of the same size, thereby achieving higher heat exchange efficiency and heat transfer coefficient. In order to discharge the condensed water precipitated from the air, a drainage groove 160 is vertically arranged on the same side of the plurality of heat exchange fins 140. The portions of the at least one of the plurality of heat exchange fins 140 below the bottommost micro-channel flat tube is provided with a guiding structure 170, which is used to guide water droplets condensed on the surface of the at least one heat exchange fin to the drainage groove 160, thereby avoiding the accumulation of condensed water on the surface of the heat exchange fin at its bottom.

[0023] With continued reference to FIGS. 3 and 4, the guiding structure 170 can be the portion of each of the plurality of heat exchange fins 140 below the bottommost micro-channel flat tube, and the guiding structure 170 has smooth planes on both sides. Although the bottom portions of the plurality of heat exchange fins 140 are not provided with additional heat dissipation structures, such a design, however, can effectively prevent condensed water from accumulating in that area, so as to not affect the overall heat exchange efficiency. In the embodiment shown in FIGS. 3 and 4, the contour of the bottom of the guiding structure 170 is linear and is parallel to the con-

tour of the bottom of the micro-channel flat tube 130, so that the guiding structure 170 forms a substantially rectangular shape. In addition to configuring guiding structures on each of the plurality of heat exchange fins 140, it is also feasible to configure guiding structures on specific heat exchange fins among the plurality of heat exchange fins 140. For example, guiding structures are only configured on the leftmost and rightmost heat exchange fins of the plurality of heat exchange fins.

[0024] In the above embodiments, the area of the portions of the plurality of heat exchange fins below the bottommost micro-channel flat tube, i.e., the area of the guiding structure, can be designed to gradually increase towards the side of the drainage groove. Specifically, the bottom of the guiding structure has a bent, curved, linear, or non-linear contour. For example, in the micro-channel heat exchanger 200 of the present invention shown in FIGS. 5 and 6, the bottom of the guiding structure 270 has a curved contour. The first manifold 210, the second manifold 220, the plurality of micro-channel flat tubes 230, the plurality of heat exchange fins 240, the heat dissipation structures 250, and the drainage groove 260 and other parts in the micro-channel heat exchanger 200 can refer to the aforementioned embodiments, which will not be repeated here. For example, in the embodiment of the micro-channel heat exchanger shown in FIGS. 7 and 8, the bottom of the guiding structure 370 has a linear contour. The first manifold 310, the second manifold 320, the plurality of micro-channel flat tubes 330, the plurality of heat exchange fins 340, the heat dissipation structures 350, and the drainage groove 360 and other parts in the micro-channel heat exchanger 300 can refer to the aforementioned embodiments, which will not be repeated here. FIGS. 9 and 10 schematically illustrate the structure of another embodiment of the micro-channel heat exchanger of the present invention. In this embodiment, the guiding structure 470 is the lower surface of the bottommost micro-channel flat tube 430, thereby reducing the risk of accumulation of water droplets below the bottommost micro-channel flat tube. The first manifold 410, the second manifold 420, the plurality of micro-channel flat tubes 430, the plurality of heat exchange fins 440, the heat dissipation structures 450, and the drainage groove 460 and other parts in the micro-channel heat exchanger 400 can refer to the aforementioned embodiments, which will not be repeated here.

[0025] In conjunction with the above embodiments, in other optional embodiments, the heat dissipation structure 150 used to increase the heat exchange area can be constructed as a solid or hollow strip structure, a corrugated structure, a staggered teeth structure, a louver structure, a structure with openings, a structure with protrusions, or a structure with grooves on the surface, or other similar structures, which is conducive to further increasing the contact area between the fin body and the fluid medium, thereby achieving greater heat transfer efficiency.

[0026] It is easy to understand that in the micro-chan-

nel heat exchanger according to the present invention, the plurality of heat exchange fins 140 can be designed to be of the same size and shape, and spaced from each other at the same distance, so as to improve the heat exchange area and efficiency of the micro-channel heat exchanger. In addition, the heat exchange fins 140 can be made of aluminum alloy. Those skilled in the art are aware that aluminum materials have good processability and good heat exchange performance.

[0027] In addition, the present invention also provides a heat pump system. The heat pump system typically has multiple operating modes, including the cooling mode, heating mode, and dehumidification mode (also known as defogging mode). Specifically, the heat pump system mainly includes a coolant circulation circuit and a water circuit. The coolant circulation circuit is sequentially provided with a compressor, an indoor heat exchanger, a throttling device, and an outdoor heat exchanger, wherein, both the indoor and outdoor heat exchangers can be in the form of a micro-channel heat exchanger according to the present invention.

[0028] In the heating mode, the coolant is compressed into high-temperature and high-pressure gas through the compressor, and the high-temperature and high-pressure gas enters the indoor heat exchanger for heat exchange with circulating water to heat the water. After passing through the indoor heat exchanger, the coolant is further throttled by the throttling device to form a low-temperature and low-pressure liquid (or gas-liquid mixed refrigerant). The low-temperature and low-pressure liquid refrigerant evaporates in the outdoor heat exchanger, absorbs heat from the outside air, and converts into a gaseous refrigerant. The gaseous refrigerant can return to the compressor further using a gas-liquid separator or other means when necessary, thus completing the coolant circulation circuit. In this case, the indoor heat exchanger is a condenser, and the outdoor heat exchanger is an evaporator.

[0029] In the cooling mode, the coolant is compressed into high-temperature and high-pressure gas through the compressor, and the high-temperature and high-pressure gas enters the outdoor heat exchanger for heat exchange with air, etc., thus becoming a medium-temperature and high-pressure gas. After passing through the outdoor heat exchanger, the coolant is further throttled by the throttling device to form a low-temperature and low-pressure liquid (or gas-liquid mixed refrigerant). The low-temperature and low-pressure liquid refrigerant evaporates in the indoor heat exchanger, absorbs heat from the outside air, and converts into a gaseous refrigerant. The gaseous refrigerant can return to the compressor further using a gas-liquid separator or other means when necessary, thus completing the coolant circulation circuit. In this case, the outdoor heat exchanger is a condenser, and the indoor heat exchanger is an evaporator.

[0030] The aforementioned heat pump system can be used in other household, commercial or industrial devices

to improve the cooling or heating efficiency of these devices, where specific limitations are not made here.

[0031] In summary, the micro-channel heat exchanger of the present invention can prevent the accumulation of condensed water on the surface of the heat exchange fins while ensuring heat exchange efficiency, thereby improving the overall heat exchange performance of the micro-channel heat exchanger, and significantly improving the cooling and heating performance of the heat pump system.

[0032] The micro-channel heat exchanger and the heat pump system configured with the micro-channel heat exchanger according to the present invention have been described above in detail by enumerating several specific embodiments. These examples are merely used to illustrate the principles and embodiments of the present invention, rather than limiting the present invention. The scope of protection is defined by the appended claims.

Claims

1. A micro-channel heat exchanger (100, 200, 300, 400), comprising:

a first manifold (110, 210, 310, 410) and a second manifold (120, 220, 320, 420), wherein the first manifold and the second manifold are spaced apart;

a plurality of micro-channel flat tubes (130, 230, 330, 430), sequentially connected from top to bottom between the first manifold and the second manifold; and

a plurality of heat exchange fins (140, 240, 340, 440), spaced at a predetermined distance from each other and formed with tube holes for the plurality of micro-channel flat tubes to pass through, wherein the plurality of heat exchange fins are provided with heat dissipation structures (150, 250, 350, 450) for increasing heat exchange area, where the heat dissipation structures are located above the micro-channel flat tube, and a drainage groove (160, 260, 360, 460) is arranged vertically at the same side of the plurality of heat exchange fins,

wherein, a portion of at least one heat exchange fin of the plurality of heat exchange fins below the bottommost micro-channel flat tube is provided with a guiding structure (170, 270, 370, 470) for guiding water droplets condensed on a surface of the at least one heat exchange fin to the drainage groove.

2. The micro-channel heat exchanger according to claim 1, wherein the portion of each of the plurality of heat exchange fins below the bottommost micro-channel flat tube is provided with a guiding structure, and the guiding structure has smooth planes on both

sides.

3. The micro-channel heat exchanger according to claim 1, wherein the guiding structure is a lower surface of the bottommost micro-channel flat tube. 5
4. The micro-channel heat exchanger according to claim 2, wherein an area of the portions of the plurality of heat exchange fins below the bottommost micro-channel flat tube gradually increases towards one side of the drainage groove. 10
5. The micro-channel heat exchanger according to claim 4, wherein the bottom of the guiding structure has a bent, curved, linear or non-linear contour. 15
6. The micro-channel heat exchanger according to any of claims 1-4, wherein the heat dissipation structure for increasing heat exchange area is at least one of a strip structure, a corrugated structure, a staggered teeth structure, a louver structure, a structure with openings, a structure with protrusions, or a structure with grooves on surface. 20
7. The micro-channel heat exchanger according to any of claims 1-4, wherein the plurality of heat exchange fins are of the same size and shape, and are spaced apart from each other at the same distance. 25
8. The micro-channel heat exchanger according to any of claims 1-4, wherein the plurality of heat exchange fins are made of aluminum alloy. 30
9. The micro-channel heat exchanger according to any of claims 1-4, wherein the micro-channel heat exchanger is a condenser or an evaporator. 35
10. A heat pump system, wherein the heat pump system comprises the micro-channel heat exchanger according to any of claims 1-9. 40

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FIGURES

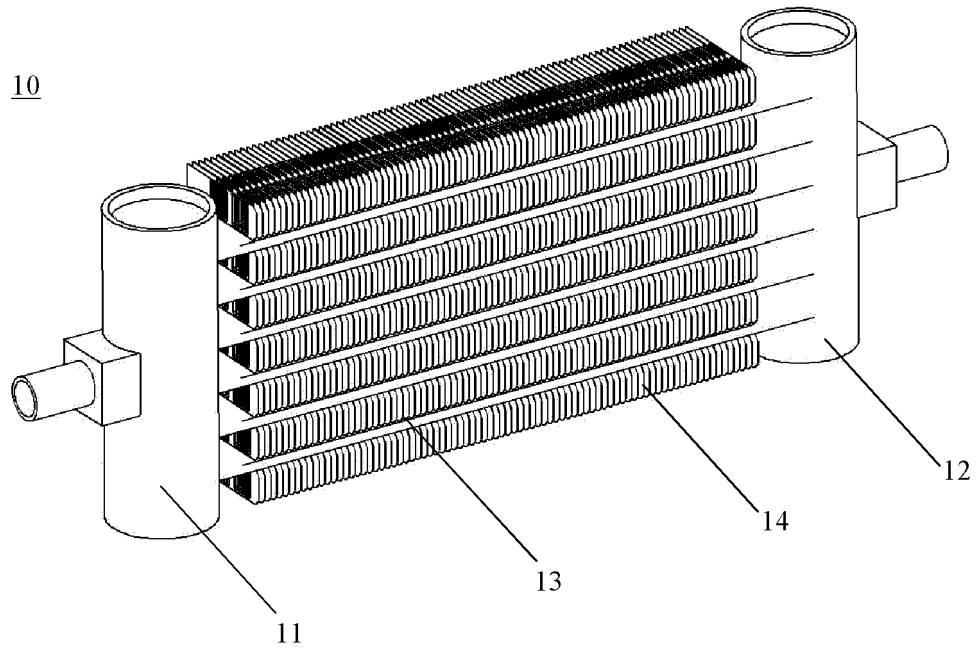


FIG. 1

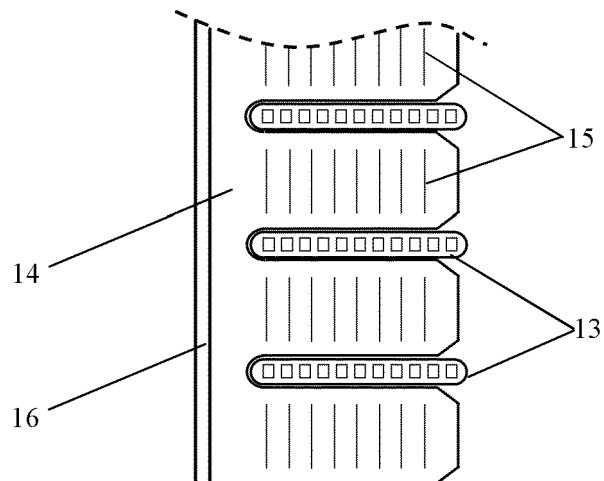


FIG. 2

100

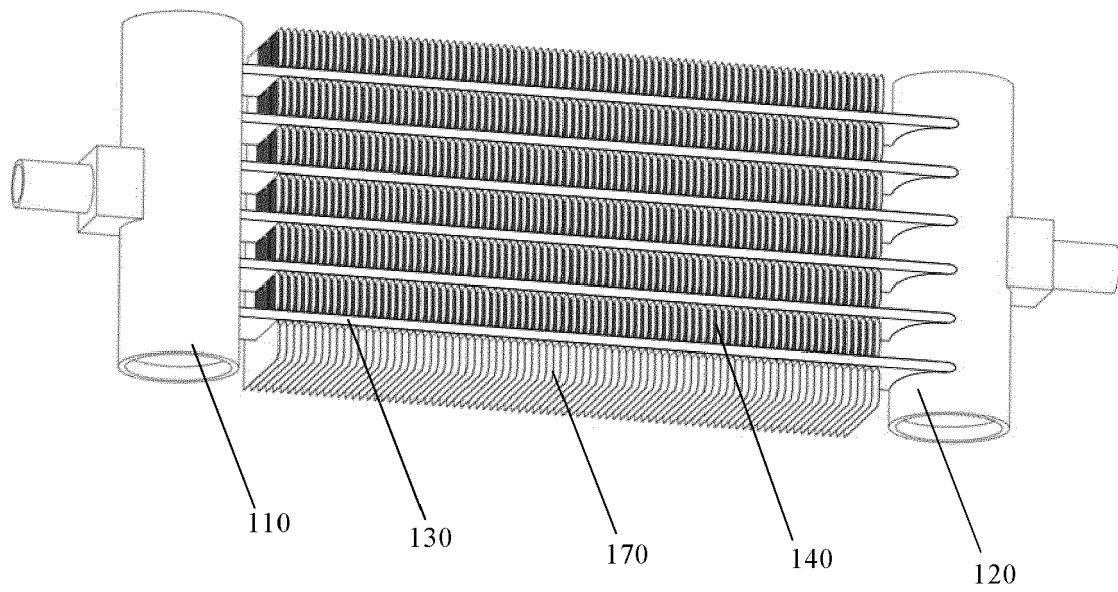


FIG. 3

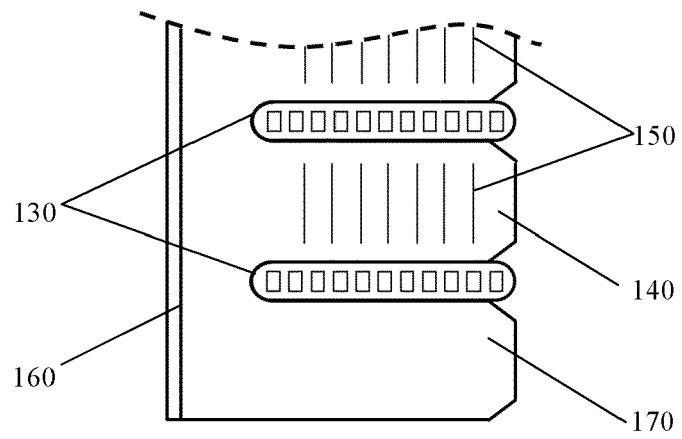


FIG. 4

200

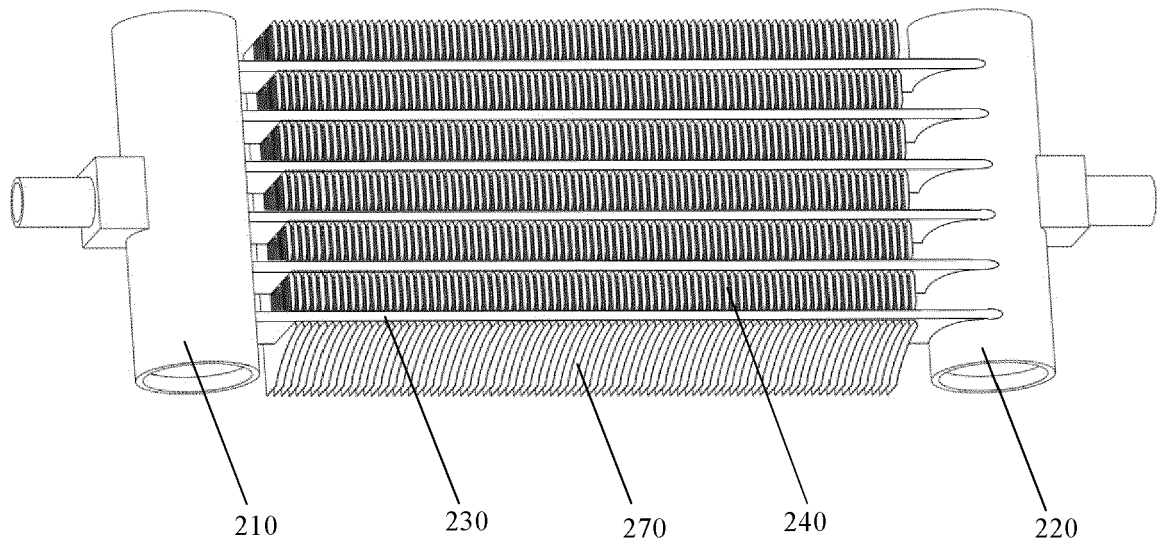


FIG. 5

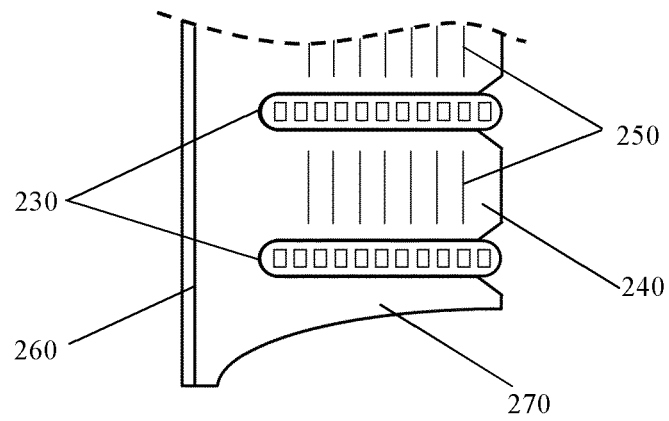


FIG. 6

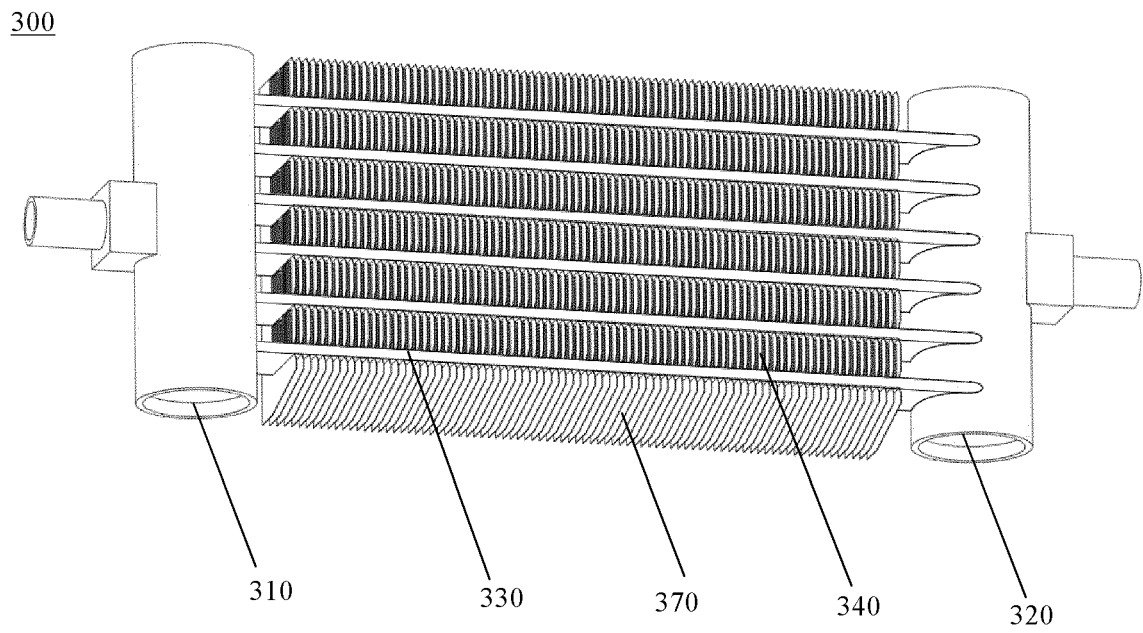


FIG. 7

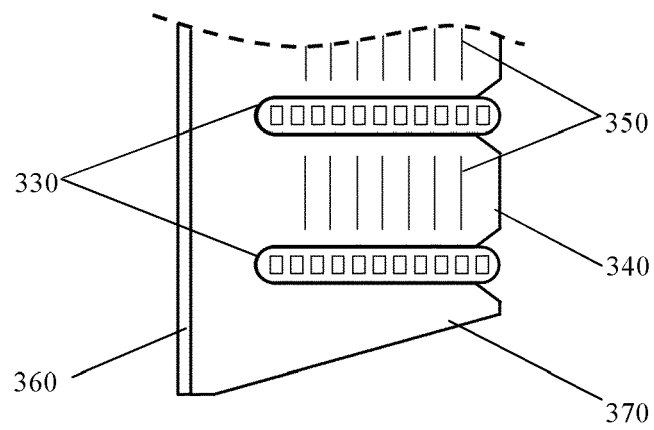


FIG. 8

400

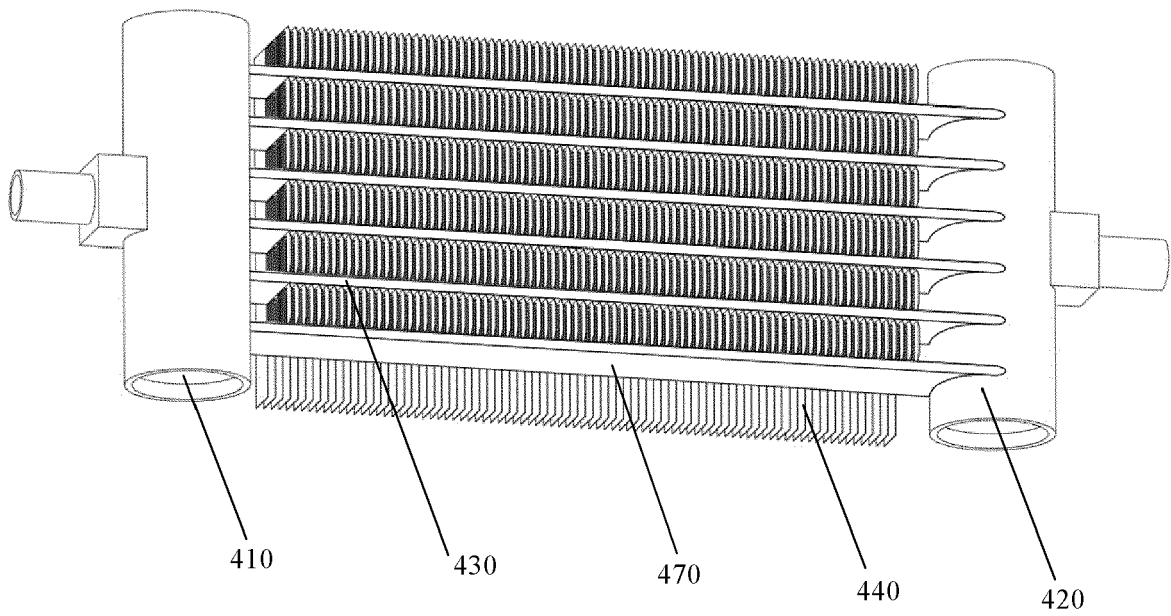


FIG. 9

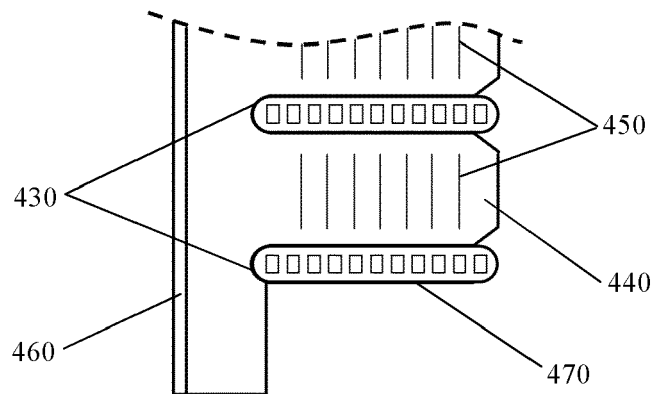


FIG. 10



EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2020/062721 A1 (GREE ELECTRIC APPLIANCES INC ZHUHAI [CN]) 2 April 2020 (2020-04-02)	1, 7 - 10	INV. F28F1/32 F28F17/00
Y	* figures 1-3 *	1 - 10	F28F1/02 F28D1/053
X	WO 2015/058452 A1 (MIDEA GROUP CO, LTD [CN]; CHENG ZHIMING [CN] ET AL.) 30 April 2015 (2015-04-30) * figure 5 *	1	
X	US 2018/356166 A1 (WANG LEILEI [CN] ET AL) 13 December 2018 (2018-12-13) * figure 9 *	1, 6	
Y	US 11 499 784 B2 (MITSUBISHI ELECTRIC CORP [JP]) 15 November 2022 (2022-11-15) * figure 6 *	1 - 10	
			TECHNICAL FIELDS SEARCHED (IPC)
			F28F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 July 2024	Examiner Martínez Rico, Celia
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EP 24 16 1809

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17-07-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2020062721 A1	02-04-2020	CN 109186304 A WO 2020062721 A1	11-01-2019 02-04-2020
WO 2015058452 A1	30-04-2015	NONE	
US 2018356166 A1	13-12-2018	CN 106546119 A US 2018356166 A1 WO 2017050237 A1	29-03-2017 13-12-2018 30-03-2017
US 11499784 B2	15-11-2022	CN 112771342 A EP 3862711 A1 JP 7019067 B2 JP WO2020070869 A1 US 2021325117 A1 WO 2020070869 A1	07-05-2021 11-08-2021 14-02-2022 03-06-2021 21-10-2021 09-04-2020

EPO FORM P0459

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