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(54) **HEAT EXCHANGER**

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a field of heat exchange, and specifically to a heat exchanger according to claim 1.

BACKGROUND

[0002] Heat exchange devices are required in automobile, household or commercial air conditioning systems. One solution in the related art is that a heat exchanger includes integrated heat exchange tubes and fin plates. As shown in FIG. 1, the fin plates 10 and heat exchange tubes 20 of the same structure and integrated with each other are arranged in multiple rows. In the related art, after the heat exchange assemblies composed of multiple integrated heat exchange tubes 20 and the fin plates 10 are arranged, the heat exchange tubes 20 of the multiple heat exchange assemblies correspondingly form several rows, and the heat exchange tubes 20 protrude to an air-side circulation passage relative to the fin plates 10. This channel structure causes a large pressure drop in the air-side circulation passage, which makes the heat exchanger poorer in heat exchange performance, high in energy consumption and easy to frost.

[0003] WO 2019/167840 A1 discloses a heat exchanger having the features of the preamble of claim 1 and includes a heat transfer unit formed of a heat transfer channel part which extends in a first direction, and a heat transfer auxiliary part aligned in a second direction that is inclined or orthogonal relative to the first direction. In the heat transfer unit, a first heat transfer auxiliary part is formed at an end in the second direction. A first length of the first heat transfer auxiliary part up to an adjacent heat transfer channel part is configured to be longer than a distance between heat transfer channel parts which are adjacent in the second direction when a plurality of heat transfer channel parts are present in the heat transfer unit.

[0004] DE 102018203299 A1 discloses a heat exchanger with a plurality of channel bodies. A first flow path for a first fluid, a second flow path for a second fluid, and at least one heat exchanger structure made of heat-transferring material are provided.

[0005] WO 2002/016834 A2 discloses a fin-less and seamless heat exchanger having a plurality of tubes which cooperatively form at least one serpentine flow path, which allows heat to be efficiently and cost effectively transferred to fluid movably contained in the tubes.

[0006] CN 108562176 A discloses a heat exchanger including a plurality of fins that are arranged at intervals; and a plurality of heat exchange pipes extended on a surface of the fins or formed in the fins.

SUMMARY

[0007] The present disclosure is beneficial to improve the performance of the heat exchanger.

[0008] The present invention provides a heat exchanger according to claim 1.

[0009] In the present disclosure, two adjacent heat exchange tubes are arranged in a staggered manner along the array direction of the heat exchange assemblies, which is beneficial to reduce the heat exchange tubes corresponding to the two adjacent heat exchange assemblies being concentratedly arranged at a path of the air-side flow passage, to the uniformity of the flow section of the air-side flow passage, to reduce the influence of the sudden expansion and contraction of the flow channel structure on the fluid pressure drop, and to improve the heat exchange performance of the heat exchanger.

[0010] In the heat exchanger of the present disclosure, the dimension of at least one connection area of the heat exchange assembly in the width direction of the heat exchange assembly is smaller than the dimension of the main heat exchange area in the width direction of the heat exchange assembly. In this way, when the end of the heat exchange assembly is connected and combined with the collecting pipe, it is beneficial to reduce the size of the collecting pipe in the width direction of the heat exchange assembly, reduce the thermal resistance effect caused by the wall thickness of the collecting pipe, and improve the heat exchange performance of the heat exchanger.

BRIEF DESCRIPTION OF DRAWINGS

[0011]

FIG. 1 is a schematic view of an integrated structure of fins and heat exchange tubes in related art;

FIG. 2 is a schematic perspective view of a heat exchanger in accordance with an embodiment of the present disclosure;

FIG. 3 is a schematic view of an exploded structure of the heat exchanger provided in FIG.2 of the present disclosure;

FIG. 4 is a schematic structural view of the heat exchange assembly provided by a specific embodiment of the present disclosure;

FIG. 5 is a schematic structural view of the heat exchange assembly provided by another specific embodiment of the present disclosure;

FIG. 6 is a schematic structural view of the heat exchange assembly provided by another specific embodiment of the present disclosure;

FIG. 7 is an enlarged schematic view of a partial structure of the heat exchange assembly provided by an embodiment of the present disclosure;

FIG. 8 is a schematic perspective view of a structure of the heat exchanger provided by another embodiment of the present disclosure;

FIG. 9 is a schematic side view of a heat exchanger not falling into the scope of the claims;

FIG. 10 is an enlarged schematic view of the partial structure of the heat exchange assembly of Fig. 9;

FIG. 11 is an enlarged schematic view of the partial structure of a collecting pipe of Fig. 9;

FIG. 12 is an enlarged schematic view of the partial structure of the heat exchange assembly provided by an embodiment of the present disclosure;

FIG. 13 is an enlarged schematic view of the partial structure of the collecting pipe corresponding to the embodiment of Fig. 12;

FIG. 14 is a schematic structural view of the multi-process heat exchanger provided by an embodiment of the present disclosure;

FIG. 15 is a schematic structural view of the connection between the second collecting pipe and the fourth collecting pipe of a heat exchanger not falling into the scope of the claims;

FIG. 16 is a schematic structural view of the connection between the second collecting pipe and the fourth collecting pipe of a heat exchanger not falling into the scope of the claims;

FIG. 17 is a schematic structural view of the multi-process heat exchanger provided by another embodiment of the present disclosure;

FIG. 18 is a schematic structural view of the multi-process heat exchanger provided by another embodiment of the present disclosure; and

FIG. 19 is another structural schematic view of the multi-process heat exchanger provided in FIG. 18 of the present disclosure.

DETAILED DESCRIPTION

[0012] Technical solutions in the embodiments of the present disclosure will be clearly and completely described below in conjunction with the figures in the embodiments of the present disclosure. Obviously, the described embodiments are only a part of the embodiments of the present disclosure, rather than all the embodiments. Based on the embodiments in the present disclosure, all other embodiments obtained by a person of ordinary skill in the art without creative work shall fall within the protection scope of the present disclosure. There are several specific embodiments in the present disclosure, and the features in these embodiments can be combined with each other if there is no conflict. When the description refers to the figures, unless otherwise specified, the same numbers in different figures indicate the same or similar elements.

[0013] Please refer to FIGS. 2 and 3, the present disclosure provides a heat exchanger 10 which includes a group of collecting pipes and a plurality of heat exchange assemblies 101. In an embodiment of the present disclosure, the group of collecting pipes include two collecting pipes 100 respectively located at both sides in a length direction of the heat exchange assembly 101. Each collecting pipe 100 includes a longitudinal pipe body 201 and an inner cavity 202 located in the pipe body 201. The length direction of the heat exchange assembly 101 is illustrated by a solid line segment L with arrows at both sides in FIG. 2. A width direction of the heat exchange assembly 101 is illustrated by a solid line segment W with arrows at both sides in FIG. 2.

[0014] The heat exchange assembly 101 is connected to the collecting pipes 100. The plurality of heat exchange assemblies 101 are arranged at intervals along a length direction D of the collecting pipes 100. The length direction D of the collecting pipes 100 can refer to a direction indicated by a dashed line in FIG. 2. Referring to FIG. 2, in an embodiment of the present disclosure, the length direction of the heat exchange assembly 101 is perpendicular to the width direction of the heat exchange assembly 101. The length direction D of the collecting pipes is perpendicular to the length direction of the heat exchange assembly 101 and the width direction of the heat exchange assembly 101. A gap between two adjacent heat exchange assemblies 101 forms an air-side flow passage.

[0015] Among the plurality of heat exchange assemblies 101, each heat exchange assembly 101 includes a fin plate 203 and at least one heat exchange tube 204. The heat exchange assemblies 101 are arranged at intervals. The gap between adjacent heat exchange assemblies 101 is adapted to circulate heat exchange airflow. Referring to the direction indicated by the arrows in FIG. 4, that is, two opposite surfaces of the two adjacent fin plates 203 both allow the heat exchange airflow to pass therethrough.

[0016] The heat exchange assembly 101 includes a main heat exchange area 301. In the main heat exchange area 301, the fin plate 203 and the heat exchange tubes 204 are combined as a whole, wherein the heat exchange tubes 204 are fixedly connected to the surface of the fin plate 203, or the fin plate 203 includes a plurality of sub-plates 2031 and the heat exchange tubes 204 are connected between two adjacent sub-plates 2031. The heat exchange tubes 204 are connected between the two collecting pipes 100 in the length direction. The heat exchange tube 204 includes an inner flow channel 2041 which communicates with the inner cavities 202 of the two collecting pipes 100. The inner flow channel 2041 of the heat exchange tube 204 and the inner cavities 202 of the collecting pipes 100 form part of a refrigerant flow passage.

[0017] The heat exchange assembly 101 also includes two connection areas 302 located at both sides of the main heat exchange area 301 in the length direction thereof. Refer to FIGS. 10 and 12, an end of the connection area 302 is mainly used to be connected and fixed to the collecting pipe 100. The heat exchange assembly 101 may not be provided with the fin plate 203 in the connection area 302. That is, the heat exchange tube 204 may extend beyond the fin plate 203 in the length direction, and an exceeded end of the heat exchange tube 204 is connected to the collecting pipe 100. It should be understood that the end includes a small section of physical structures of the heat exchange assembly, which is located at an outer side of the heat exchange assembly along the length direction, rather than just a "point".

[0018] The collecting pipe 100 is used for conveying the refrigerant, and the refrigerant is conveyed to the heat exchange tube 204 through the collecting pipe 100. The heat exchange tube 204 can exchange heat with the airflow through the tube wall 2042 and the fin plate 203. The fin plate 203 with a relatively large area can exchange heat with the air around the fin plate 203, thereby increasing or reducing the temperature of the air around the fin plate 203.

[0019] The heat exchange tube 204 is connected to the fin plate 203. The heat exchange tube 204 is formed on the surface of the fin plate 203 or the heat exchange tube 204 is connected between two adjacent sub-plates 2031. Most portion of the heat exchange tube 204 in the length direction is in contact with the fin plate 203, so that the heat exchange area between the heat exchange tube 204 and the fin plate 203 is maximized. This also maximizes the heat exchange and heat exchange efficiency between the heat exchange tube 204 and the fin plate 203.

[0020] At least part of the heat exchange tube 204 protrudes from at least one side of the fin plate 203 in an array direction of the heat exchange assembly 101. In an embodiment provided in the present disclosure, the height of the heat exchange tube 204 in the array direction of the heat exchange assembly 101 is greater than the thickness of the fin plate 203. Optionally, the fin plate 203 may be a relatively thin strip-shaped structure, and the fin plate 203 may include two opposite surfaces. The height or diameter of the heat exchange tube 204 in the array direction of the heat exchange assembly 101 is greater than the thickness of the fin plate 203. Therefore, whether the heat exchange tube 204 is connected between two adjacent sub-parts 2031, or the heat exchange tube 204 is formed on the surface of the fin plate 203, the heat exchange tube 204 protrudes from at least one surface of the fin plate 203.

[0021] Referring to the projections of the main heat exchange areas of the plurality of heat exchange assemblies 101 on a plane perpendicular to the length direction of the heat exchange assemblies 101 as shown in FIG. 4, in the main heat exchange area corresponding to two adjacent heat exchange assemblies 101, at least one pair of adjacent heat exchange tubes 204 are arranged in a staggered manner. The two adjacent heat exchange tubes 204 belong to the two adjacent heat exchange assemblies 101, respectively. Regard to one of the pair of heat exchange tubes 204, the other of the pair of the heat exchange tubes 204 is the heat exchange tube closest to the one of the pair of heat exchange tubes 204 in the heat exchange assembly 101 to which the other of the pair of heat exchange tubes 204 belongs. For example, two heat exchange assemblies 101 are denoted as a heat exchange assembly A and a heat exchange assembly B, respectively. One heat exchange tube in the heat exchange assembly A is marked as a heat exchange tube A, and there are several heat exchange tubes in heat exchange assembly B. Among them, the heat exchange tube closest to the heat exchange tube A is marked as a heat exchange tube B, so that the heat exchange tube A and the heat exchange tube B are a group of heat exchange tubes which have an adjacent relationship.

[0022] As shown in FIG. 4, the heat exchange tube 204 of the heat exchange assembly 101 and the heat exchange tube 204 of another adjacent heat exchange assembly 101 are arranged in a staggered manner. Generally, the tube diameter of the heat exchange tube 204 is larger than the thickness of the fin plate 203. Corresponding to the main heat exchange area of the adjacent heat exchange assembly 101, the staggered arrangement is beneficial to reduce the concentrated arrangement of the heat exchange tubes 204 in the air-side flow passage. From the perspective of the overall flow path at the air side, the position with a larger flow cross section and the position with a smaller flow cross section are homogenized, which reduces the influence of sudden expansion and contraction of the flow path structure on the fluid pressure drop. The present disclosure is beneficial to reduce heat exchange energy consumption, and the same flow of air can provide more heat exchange, thereby improving the heat exchange performance of the heat exchanger 10. At the same time, it helps the heat exchanger 10 to delay frosting.

[0023] In an embodiment provided by the present disclosure, the thickness of the fin plate 203 is 0.05mm to 0.5mm, the inner diameter of the heat exchange tube 204 is 0.4mm to 3.0mm, and the outer diameter of the heat exchange tube 204 is 0.6mm to 5mm. In a single heat exchange assembly 101, the distance between adjacent heat exchange tubes 204 is 3mm to 20mm. The distance between the fin plates 203 corresponding to two adjacent heat exchange assemblies 101 is 1.4mm to 6mm.

[0024] Further, in an alternative embodiment of the present disclosure, the thickness of the fin plate 203 is 0.2mm, the inner diameter of the heat exchange tube 204 is 1.1mm, the outer diameter of the heat exchange tube 204 is 1.6mm, the distance between adjacent heat exchange tubes 204 is 12mm, and the distance between the fin plates 203 corresponding to two adjacent heat exchange assemblies 101 is 1.8mm.

[0025] As shown in FIG. 2, the length direction of the heat exchange assembly 101 is substantially perpendicular to the length direction of the collecting pipe 100.

[0026] In an embodiment provided by the present disclosure, referring to FIGS. 5 and 6, in the main heat exchange area 301, the heat exchange tube 204 is welded to the surface of the fin plate 203. By protruding the heat exchange tube 204 beyond the surface of the fin plate 203, the surface of the fin plate 203 forms a concave-convex structure. When the heat exchange airflow flows through the surface of the fin plate 203, the concave-convex structure can disturb the heat exchange airflow, thereby improving the quantity of heat exchange and heat exchange efficiency between the fin plate 203 and the heat exchange airflow. At the same time, the heat exchange tube 204 is welded to the surface of the fin plate 203, which can also increase the heat exchange area of the air-side flow passage.

[0027] In a same heat exchange assembly 101, at least one heat exchange tube 204 protrudes at the same side surface of the fin plate 203. Of course, there can be many ways to arrange the heat exchange tube 204 on the fin plate 203. The heat exchange tube 204 may be arranged on a single surface of the fin plate 203, or the fin plate 203 may include several areas, such as a first area and a second area. In the first area, the heat exchange tube 204 is provided on one surface of the fin plate 203. In the second area, the heat exchange tube 204 is arranged on an opposite surface of the fin plate 203. Of course, all the fin plates 203 can be divided into areas, and the heat exchange tubes 204 can be arranged on different surfaces of the fin plates 203 in different areas. For example, regard to the first m pieces fin plates 203, the heat exchange tube 204 is provided on a surface corresponding to the fin plate 203. Regard to the last n pieces fin plates 203, the heat exchange tube 204 is provided on the other surface of the corresponding fin plate 203.

[0028] Optionally, among the two adjacent heat exchange assemblies 101, the heat exchange tubes 204 of one heat exchange assembly 101 and the heat exchange tubes 204 of the other heat exchange assembly 101 are located at different sides of the corresponding fin plate 203. The advantage of this arrangement is that the heat exchange tubes of the two heat exchange assemblies 101 can be simultaneously arranged in the airflow passage formed by the gap between the two heat exchange assemblies 101. Since the heat exchange tubes of the two heat exchange assemblies 101 are arranged in the staggered manner, it is helpful to form a continuous tortuous flow path in the airflow passage, increase the heat transfer coefficient of the airflow passage, and improve the heat exchange effect in the flow channel. The airflow passage formed by the gap between the two heat exchange assemblies 101 has a relatively uniform circulation section. Alternatively, the heat exchange tubes of the two heat exchange assemblies 101 may be simultaneously away from the airflow passage formed by the gap between the two heat exchange assemblies 101. Wall surfaces at both sides of the airflow passage are not provided with heat exchange tubes, and the circulation cross section is relatively uniform. Therefore, it is beneficial to improve the uniformity of the air-side flow passage, thereby improving the heat exchange performance of the heat exchanger.

[0029] The plurality of fin plates 203 are arranged at intervals. Optionally, a plurality of fin plates 203 are arranged in parallel at equal intervals, so that the heat exchange airflow passes uniformly, and at the same time, the wind resistance of the heat exchange airflow passing through the plurality of fin plates 203 is reduced. Or, the adjacent fin plates 203 may also be arranged at unequal intervals, which is not limited in the present disclosure.

[0030] As shown in FIG. 5, on a plane perpendicular to the length direction of the heat exchange assembly 101, a cross section of the fin plate 203 is a continuous polyline shape, and a cross section of the heat exchange tube 204 is a rhombus shape. The fin plate 203 has an angle adapted to the rhombus shape at wave crests and/or wave troughs of its polyline shape. The heat exchange tube 204 combines two adjacent side walls 2043 with the fin plate 203 based on its rhombus shape, so that the fin plate 203 forms a semi-enclosed arrangement for the heat exchange tube 204.

[0031] The fin plate 203 is designed as a continuous polyline shape, and the area of the fin plate 203 in the width direction is larger, thereby increasing the heat exchange area between the fin plate 203 and the heat exchange airflow. An airflow vortex can be formed between the wave crests and the wave troughs of the fin plate 203, so that the heat exchange airflow stays between the fin plates 203 for a longer time, thereby improving heat exchange efficiency.

[0032] Except for the polyline cross section, as shown in FIG. 6, on a plane perpendicular to the length direction of the heat exchange assembly 101, the cross section of the fin plate 203 has a wave shape. The cross section of the heat exchange tube 204 is circular or elliptical. FIG. 6 illustrates circular heat exchange tubes 204.

[0033] The fin plate 203 includes a plurality of straight portions 2033 and a plurality of curved portions 2032. The arc portion 2032 is located between two adjacent straight portions 2033. The arc portions 2032 form wave crests and wave troughs. Part of the outer surface of the heat exchange tube 204 is combined and fixed with the arc portions 2032 of the fin plate 203. The curvature of a connection portion of the heat exchange tube 204 and the arc portion 2032 is the same in size and direction as the curvature of the arc portion 2032.

[0034] Referring to FIG. 4, the heat exchange tube 204 includes a tube body 2042 located at a periphery of the inner flow channel 2041 thereof. The plurality of sub-plates 2031 of the fin plate 203 and the tube body 2042 are integrally formed by a die casting process or by an extrusion process.

[0035] The tube body 2042 of the heat exchange tube 204 and the plurality of sub-plates 2032 of the fin plate 203 can be integrally formed by a pouring process or an extrusion process. Equivalently, the inner channel 2041 of the heat exchange tube 204 is formed in a processing plate, a part of the processing plate forms the tube body 2042 of the heat exchange tube 204, and parts of the processing plate located at both sides of the heat exchange tube 204 form the sub-plates 2032. In an optional extrusion process, it is realized by a first mold and a second mold which are matched with each other. The first mold is used to form the inner channel 2041 of the heat exchange tube 204, and the second mold has a cavity to form the rest of the heat exchange assembly 101. The two molds are used in combination, so that the heat exchange assembly 101 is extruded from an opening of the cavity of the second mold.

[0036] In a single heat exchange assembly 101, the ratio of an area of the outer surface of the heat exchange assembly 101 to an area of the sum of the inner surfaces of all the heat exchange tubes 204 is 5 to 45. When the flow cross section of the heat exchange tube 204 may be round, square, rectangular, polygonal isosceles trapezoid or special shape, the area of the heat exchange tube 204 is positively correlated with its inner diameter or equivalent inner diameter. The inner diameter of the heat exchange tube affects the speed at which the same volume of refrigerant flows through the heat exchange tube 204. The ratio of an area of the outer surface of the heat exchange assembly 101 to an area of the sum of the inner surfaces of all the heat exchange tubes 204 is 5 to 45. The purpose of defining this range is that when the external surface area of the heat exchange assembly 101 is constant, the internal surface area of the heat exchange tube cannot be too large. That is, the tube diameter of the heat exchange tube should be as small as possible. As a result, it is trying to ensure that the refrigerant at the center of the flow section of the heat exchange tube 204 can also fully exchange heat with the tube body 2042 of the heat exchange tube 204, so as to increase the tube body of the heat exchange tube 204, thereby improving the quantity of heat exchange and heat exchange efficiency between the tube body 2042 of the heat exchange tube 204 and the refrigerant. At the same time, the wind resistance of the heat exchange tube 204 is reduced. Of course, it is also necessary to ensure that the inner surface area of the heat exchange tube 204 cannot be too small. The tube diameter of the heat exchange tube 204 shall be at least larger than the thickness of the fin plate 203, and the heat exchange performance of the heat exchanger 10 is improved on the premise of ensuring a small refrigerant charge. Further, the ratio of the area of the outer surface of the heat exchange assembly 101 to the area of the sum of the inner surfaces of all the heat exchange tubes 204 is 20 to 30.

[0037] The plurality of heat exchange assemblies 101 have the same structure and shape. One heat exchange assembly 101 of the two adjacent heat exchange assemblies 101 is turned 180° relative to the other heat exchange assembly 101.

[0038] In an embodiment provided by the present disclosure, two adjacent heat exchange assemblies 101 constitute a basic unit. In the basic unit, the second heat exchange assembly 101 is turned 180° relative to the first heat exchange assembly 101 and then arranged opposite to the first heat exchange assembly 101. After that, a plurality of heat exchange assemblies 101 are arrayed with the basic unit. This arrangement form realizes the staggered arrangement of the heat exchange tubes 204, helps to reduce the pressure drop at the air side and also helps delay frost formation.

[0039] In a single heat exchange assembly 101, the number of heat exchange tubes 204 is greater than or equal to two, and can be three, four, five, and so on. The plurality of heat exchange tubes 204 are arranged at intervals in the width direction of the heat exchange assembly 101.

[0040] As shown in FIG. 7, the fin plate 203 includes a body 400 and a plurality of bridges 401 protruding from a surface of the body 400. A projection of the bridge 401 on the surface of the body 400 has an elongated shape which extends along the length direction of the heat exchange assembly 101. A bridge hole 402 is formed between each bridge 401 and the body 400. The bridge holes 402 are adapted for the heat exchange airflow to pass therethrough.

[0041] Shapes of the bridge holes 402 of the bridges 401 may be arch, semicircle, square, isosceles trapezoid, and the like. When the heat exchange airflow passes through the fin plate 203, it can blow through the bridge holes 402. A top of the bridge 401 may abut against the fin plate 203 of another heat exchange assembly 101 or may be spaced a certain distance apart from the fin plate 203 of another heat exchange assembly 101. By providing the bridges 401, the heat exchange can be enhanced, and the heat exchange efficiency between the fin plate 203 and the air can be improved.

[0042] Referring to FIGS. 8, 9, 10 and 12, the heat exchange assembly 101 includes two connection areas 302 located at both sides of the main heat exchange area 301 in its length direction. The dimension of an end of at least one of the two connection areas 302 in the width direction of the heat exchange assembly 101 is smaller than the dimension of the main heat exchange area 301 in the width direction of the heat exchange assembly 101. The pipe body 201 of the collecting pipe 100 is provided with an insertion portion which is matched with the end of the connection area 302. At the insertion portion the pipe body 201 of the collecting pipe 100 is hermetically connected to the end of the connection area 302 of the heat exchange assembly 101. The inner flow channel 2041 of the heat exchange tube 204 communicates with the inner cavities 202 of the two collecting pipes 100. The inner flow channel 2041 of the heat exchange tube 204 and the inner cavities 202 of the collecting pipes 100 form part of the refrigerant flow passage.

[0043] Since the dimension of the end of at least one of the two connection areas 302 in the width direction of the heat exchange assembly 101 is smaller than the dimension of the main heat exchange area 301 in the width direction of the heat exchange assembly 101, in an alternative embodiment, in the connection area 302, the fin plate and the heat exchange tube 204 can be necked. For example, a part of the fin plate 203 is removed, and the heat exchange tubes 204 are bent and converged.

[0044] In an embodiment provided by the present disclosure, in the length direction of the heat exchange assembly 101, a length of the heat exchange tube 204 is greater than a length of the fin plate 203. The heat exchange tube 204 extends beyond the fin plate 203 at both sides in the length direction of the heat exchange assembly 101. The part of the heat exchange tube 204 located in the main heat exchange area 301 forms a main body section 501. In each connection area 302 of the heat exchange assembly 101, the heat exchange tube 204 includes a mounting section 503 and a matching section 502. The end of the connection area 302 forms the mounting section 503 for mating with the collecting pipe 100. The mounting section 503 is located at a side of the outer surface of the collecting pipe 100 close to the inner cavity 202 thereof. The matching section 502 is connected between the mounting section 503 and the main body section 501. In other words, the heat exchange tube 204 includes the main body section 501, two mounting sections 503 and two matching sections 502. The two ends of the heat exchange tube 204 in the length direction respectively form two mounting sections 503. The two matching sections 502 are respectively located at both sides of the length of the main body section 501. The matching section 502 is connected between the mounting section 503 and the main body section 501.

[0045] Referring to FIG. 10, the plurality of heat exchange tubes 204 of the heat exchange assembly 101 include at least one first heat exchange tube 204'. The matching section 502 of the first heat exchange tube 204' is bent relative to the main body section 501 thereof. The mounting section 503 and the main body section 501 of the heat exchange tube 204 may have substantially the same extending direction. The mounting sections 503 of the plurality of heat exchange tubes 204 are converged in the width direction of the heat exchange assembly 101 compared to the main body section 501.

[0046] The present disclosure provides an alternative embodiment for making this kind of heat exchange assembly. The length of the heat exchange tube 204 and the fin plate 203 of the preliminary processed heat exchange assembly may be the same. In a second processing step, a part of the fin plate 203 can be cut off at a position near the end of the heat exchange assembly 101 while remaining the heat exchange tube 204. The plurality of remained heat exchange tubes 204 are bent, so that the mounting sections 503 of the plurality of heat exchange tubes 204 are converged in the width direction of the heat exchange assembly 101 compared to the main body section 501. Of course, the heat exchange assembly 101 can also be obtained without cutting the fin plate 203. For example, an integrated processing of the heat exchange assembly 101 is performed.

[0047] The mounting sections 503 of the plurality of heat exchange tubes 204 may be converged into one or more rows in the width direction of the heat exchange assembly 101. In the case of multiple rows, that is, the mounting sections 503 of several heat exchange tubes 204 can spread in the length direction of the heat exchange assembly 101 compared to before being converged.

[0048] In the length direction of the heat exchange assembly 101, the length of the main body section 501 is greater than or equal to the length of the fin plate 203. Both the matching section 502 and the mounting section 503 extend beyond the fin plate 203 in the length direction of the heat exchange assembly 101.

[0049] The collecting pipe 100 is a cylindrical tube of which a cross section is approximately a perfect circle. An outer diameter of the collecting pipe 100 is less than or equal to a distance between the main body sections 501 of the two heat exchange tubes 204 which are farthest apart in the heat exchange assembly 101.

[0050] The pipe body 201 of the collecting pipe 100 is provided with an insertion portion. At the insertion portion, the pipe body 201 of the collecting pipe 100 and the mounting section 503 of the heat exchange tube 204 are connected in a sealed manner. The collecting pipe 100 and the fin plate 203 are arranged at intervals or in abutting arrangement, or the pipe body 201 of the collecting pipe 100 and the fin plate 203 are fixedly connected.

[0051] Referring to FIG. 11, which does not fall under the scope of the claims, the insertion portion includes a plurality of insertion holes 205 which extend through the pipe body 201 of the collecting pipe 100. The dimension of the insertion hole 205 is adapted to the end of the heat exchange tube 204. The plurality of insertion holes 205 are distributed at intervals on the pipe body 201 of the collecting pipe 100. The mounting sections 503 of the heat exchange tubes 204 are correspondingly arranged at intervals. The mounting sections 503 of the heat exchange tubes 204 are inserted into the collecting pipe 100 through the insertion holes 205. At the insertion holes 205, the pipe body 201 of the collecting pipe 100 and the tube body 2042 of the heat exchange tube 204 are connected in a sealed manner. The number of the insertion holes 205 matches the number of the heat exchange tubes 204, in a one-to-one relationship.

[0052] The plurality of insertion holes 205 are distributed in multiple rows along the length direction of the collecting pipe 100. The rows of insertion holes 205 of the collecting pipe 100 are alternately staggered. On a plane perpendicular to the length direction of the heat exchange assembly 101, a projection of a center line of each row of insertion holes is substantially perpendicular to the length direction of the collecting pipe 100. The plurality of heat exchange tubes 204 of one heat exchange assembly 101 are arranged corresponding to at least one row of the insertion holes 205. The number of heat exchange tubes 204 of the heat exchange assembly 101 matches the number of at least one row of the insertion holes 205 corresponding thereto.

[0053] In a single heat exchange assembly 101, axes of the mounting sections 503 of the plurality of heat exchange tubes 204 are all located on the same plane, the mounting sections 503 of the heat exchange tubes 204 are arranged in parallel, and the plurality of heat exchange tubes 204 are arranged corresponding to the row of insertion holes 205.

[0054] As shown in FIGS. 10 and 12, the plurality of heat exchange tubes 204 include a first heat exchange tube 204' and a second heat exchange tube 204". The main body section 501, the matching section 502 and the mounting section 503 of the second heat exchange tube 204" are axially coincident. A length direction of the second heat exchange tube 204" is approximately parallel to the length direction of the heat exchange assembly 101.

[0055] The main body section 501, the matching section 502 and the mounting section 503 of the first heat exchange tube 204' are substantially straight tubes. The length direction of the main body section 501 and the mounting section 503 of the first heat exchange tube 204' is substantially parallel to the length direction of the heat exchange assembly 101. The matching section 502 of the first heat exchange tube 204' is inclined from an end of the main body section 501 close to the collecting pipe 100, and is inclined toward the second heat exchange tube 204'.

[0056] The number of the first heat exchange tubes 204' is greater than or equal to two. The number of the second heat exchange tubes 204" is greater than or equal to one. The first heat exchange tube 204' is closer to an edge in the width direction of the heat exchange assembly 101 than the second heat exchange tube 204". The plurality of first heat exchange tubes 204' are distributed at both sides of the second heat exchange tubes 204' in the width direction of the heat exchange assembly 101.

[0057] In an exemplified embodiment, the number of the first heat exchange tube 204' is four, the number of the second heat exchange tube 204" is one, and in the width direction of the heat exchange assembly 101, there may be two first heat exchange tubes 204' at both sides of the second heat exchange tube 204", or the second heat exchange tube 204" has one first heat exchange tube 204' at one side and three first heat exchange tubes 204' at the other side. In another exemplified embodiment, the number of first heat exchange tubes 204' is four, the number of second heat exchange tubes 204" is two, and the two second heat exchange tubes 204" are located in the middle of the heat exchange assembly 101 in the width direction. The two second heat exchange tubes 204" serve as a unit. The four first heat exchange tubes 204' are distributed at both sides of the unit. The respective numbers of the first heat exchange tubes 204' at both sides may not be too limited.

[0058] In this embodiment, the heat exchange assembly 101 includes three heat exchange tubes 204 as an example. As shown in FIGS. 10 and 12, the three heat exchange tubes 204 include one second heat exchange tube 204" and two first heat exchange tubes 204' which bend the matching sections 502 of the first heat exchange tubes 204' at both sides in the width direction of the heat exchange assembly 101 toward the second heat exchange tubes 204" so as to be converged. When the heat exchange assembly 101 is connected to the collecting pipe 100, only the heat exchange tubes 204 are inserted into the collecting pipes 100.

[0059] Referring to FIG. 10, which does not fall under the scope of the claims, a certain gap may be left between the converged heat exchange tubes 204. A single heat exchange tube 204 is respectively inserted into the insertion hole 205 of the collecting pipe 100.

[0060] Or, referring to FIG. 12, the mounting sections 503 of the converged heat exchange tubes 204 have no gaps or the gaps are small. For example, the mounting sections 503 of the plurality of heat exchange tubes 204 are sequentially in contact with each other, and the mounting sections 503 of the plurality of heat exchange tubes 204 may be welded in sequence to form an integrated structure, which is inserted into the collecting pipe 100 as a whole. Correspondingly, referring to the partial structure of the collecting pipe 100 in FIG. 13, the insertion portion includes a plurality of mounting slots 207 which are adapted to the converged mounting sections 503 of the plurality of heat exchange tubes 204. The mounting sections 503 of the plurality of heat exchange tubes 204 are integrally inserted into the collecting pipe 100 through the mounting slots 207. At the mounting slot 207, the pipe body 201 of the collecting pipe 100 and the tube body 2042 of the heat exchange tube 204 are connected in a sealed manner.

[0061] The mounting slots 207 are also distributed in multiple rows along the length of the collecting pipe 100. Two adjacent mounting slots 207 are arranged in a staggered manner. At the same time, the mounting slot 207 may have an elongated shape in a direction perpendicular to the length of the collecting pipe 100, such as a rectangle shape, an oblong shape, and the like. The shape of the mounting slot 207 can be adapted to an outer contour of the mounting section 503 of the plurality of heat exchange tubes 204 which are converged into an integrated structure.

[0062] The mounting sections 503 of the plurality of heat exchange tubes 204 are converged in the width direction of the heat exchange assembly 101 compared to the main body section 501. In this way, when the mounting section 503 of the heat exchange tube 204 is connected and combined with the collecting pipe 100, it is beneficial to reduce the size of the collecting pipe 100 in the width direction of the heat exchange assembly 101, thereby helping to reduce the size of the collecting pipe 100 as a whole, reducing the thermal resistance effect caused by the wall thickness of the collecting pipe 100, and improving the heat exchange performance of the heat exchanger. At the same time, the relatively small welding dimension can also reduce the difficulty of welding, which further reduces the risk of leakage, and improves the stability of the heat exchanger.

[0063] The present disclosure also provides a heat exchanger 10 which includes a plurality of collecting pipes 100 and a plurality of heat exchange assemblies 101.

[0064] The collecting pipe 100 includes a longitudinal pipe body 201 and a collecting pipe inner cavity 202. The length directions of the collecting pipes 100 are substantially parallel. In the length direction of the collecting pipe 100, a plurality of heat exchange assemblies 101 are arranged at intervals. A gap between adjacent heat exchange assemblies 101 forms an air-side flow passage.

[0065] The heat exchange assembly 101 includes a fin plate 203 and a plurality of heat exchange tubes 204. The heat exchange assembly 101 includes a main heat exchange area 301 in which the plurality of heat exchange tubes 204 are distributed at intervals in the width direction of the heat exchange assembly 101. The heat exchange tube 204 is fixedly connected to the surface of the fin plate 203, or the fin plate 203 includes a plurality of sub-plates 2031 and the heat exchange tube 204 is connected between two adjacent sub-plates 2031. For each heat exchange assembly 101, in the length direction of the heat exchange assembly 101, the length of the heat exchange tube 204 is greater than the length of the fin plate 203. The two ends of the heat exchange tube 204 in the length direction extend beyond the fin plate 203.

[0066] The heat exchange tubes 204 of the heat exchange assembly 101 are divided into at least two groups along the width direction of the heat exchange assembly 101. The number of heat exchange tubes 204 in each group is at least one. Each group of heat exchange tubes 204 are connected between two collecting pipes 100.

[0067] Regard to the heat exchange tubes 204 of two adjacent groups, in the length direction of the heat exchange tubes 204, the inner flow channels 2041 of the heat exchange tubes 204 of the two groups communicate with the inner cavities 202 of two different collecting pipes at one side. The inner flow channels 2041 of the heat exchange tubes 204 of the two groups communicate with the inner cavity 202 of the same collecting pipe 100 at the other side; or the inner flow channels of the heat exchange tubes 204 of the two groups respectively communicate with the inner cavities 202 of two different collecting pipes 100 at the other side, and the inner cavities 202 of the two collecting pipes 100 at the other side communicate with each other, thereby the refrigerant is capable of flowing in opposite directions in the inner flow channels 2041 of the heat exchange tubes 204 of the two groups.

[0068] In a transverse direction of the heat exchange assembly 100, the heat exchanger 10 has at least two refrigerant flow processes formed by the plurality of heat exchange assemblies 101 and a plurality of collecting pipes 100. In the main heat exchange area 301 corresponding to the plurality of heat exchange assemblies 101, the heat exchange tubes 204 of the plurality of heat exchange assemblies 101 are alternately staggered in the length direction of the collecting pipe 100 with the heat exchange assembly 101 as a unit.

[0069] The pipe body 201 of each collecting pipe 100 is provided with a plurality of insertion holes 205. The plurality of insertion holes 205 are arranged at intervals. The plurality of insertion holes 205 have multiple rows in the length direction of the collecting pipe 100. The number of insertion holes 205 in each row matches the number of heat exchange tubes 204 connected to the collecting pipe 100 in a single heat exchange assembly 101. Multiple rows of insertion holes 205 are alternately staggered along the length direction of the collecting pipe 100. The dimension of the insertion hole 205 is adapted to the dimension of the heat exchange tube 204. At the position of the insertion hole 205, the pipe body 201 of the collecting pipe 100 and the tube body 2042 of the heat exchange tube 204 are connected in a sealed manner.

[0070] As shown in FIG. 14, the plurality of heat exchange tubes 204 are all straight tubes extending in the length direction of the heat exchange assembly 101. The plurality of collecting pipes 100 include a first collecting pipe 1001, a second collecting pipe 1002, a third collecting pipe 1003 and a fourth collecting pipe 1004. The first collecting pipe 1001 and the third collecting pipe 1003 are arranged side by side. The second collecting pipe 1002 and the fourth collecting pipe 1004 are arranged side by side.

[0071] The first collecting pipe 1001 and the second collecting pipe 1002 are oppositely arranged in the length direction of the heat exchange assembly 101. The third collecting pipe 1003 and the fourth collecting pipe 1004 are arranged oppositely in the length direction of the heat exchange assembly 101.

[0072] The heat exchanger 10 has two refrigerant flow processes in the width direction of the heat exchange assembly 101, and each refrigerant flow process includes at least one heat exchange tube 204 of each heat exchange assembly 101. Two of the plurality of collecting pipes 100 form a group, and each refrigerant flow process includes a group of collecting pipes 100. The two collecting pipes 100 of the group are respectively located at both sides along the length direction of the heat exchange tube 204 corresponding to the refrigerant flow process to which they belong.

[0073] Therefore, by arranging the heat exchange tubes 204 and the collecting pipes 100 which match the refrigerant flow process, multiple refrigerant flow processes of the heat exchanger can be realized, which is beneficial to extend the length of the refrigerant flow path, thereby improving the heat exchange performance of the heat exchanger.

[0074] The second collecting pipe 1002 and the fourth collecting pipe 1004 abut against each other. The tube bodies 201 of the second collecting pipe 1002 and the fourth collecting pipe 1004 are both provided with a first communication hole 208. The first communication hole 208 of the second collecting pipe 1002 is aligned with the first communication hole 208 of the fourth collecting pipe 1004, so that the inner cavity 202 of the second collecting pipe 1002 and the inner cavity of the fourth collecting pipe 1004 are communicated with each other through a mated first communication hole 208 at a position where the two pipe bodies 201 are abutted with each other.

[0075] In order to ensure the connection stability of the second collecting pipe 1002 and the fourth collecting pipe 1004, referring to fig. 15 , which does not fall under the scope of the claims, the heat exchanger 10 includes a first connection body 209 which is at least partially located between the second collecting pipe 1002 and the fourth collecting pipe 1004. The shape of the first connection body 209 is roughly a triangular prism of which two of its three side surfaces are recessed to form arc-shaped concave surfaces. The shapes of the two arc-shaped concave surfaces respectively correspond to the shapes of partial surfaces of the second collecting pipe 1002 and the fourth collecting pipe 1004. Part of the surfaces of the second collecting pipe 1002 and the fourth collecting pipe 1004 is welded to at least part of the arc-shaped concave surfaces. Among them, the welding method may be brazing.

[0076] Furthermore, the first connection body 209 is provided with a second communication hole 210 extending through the two concave surfaces. The pipe body 201 of the second collecting pipe 1002 and the pipe body 201 of the fourth collecting pipe 1004 are both provided with a third communication hole 211. Two sides of the second communication hole 210 are aligned with the third communication hole 211 of the second collecting pipe 1002 and the third communication hole 211 of the fourth collecting pipe 1004, respectively. The pipe body 201 of the second collecting pipe 1002 is separated from the pipe body 201 of the fourth collecting pipe 1004 at a position where the third communication hole 211 is opened. The third communication hole 211 of the second collecting pipe 1002 is communicated with the third communication hole 211 of the fourth collecting pipe 1004 through the second communication hole 210, so that the inner cavity 202 of the second collecting pipe 1002 is communicated with the inner cavity 202 of the fourth collecting pipe 1004.

[0077] As shown in FIG. 16, which does not fall under the scope of the claims, the heat exchanger 10 includes a second connection body 212 which is provided with a fourth communication hole 213. The second collecting pipe 1002 and the fourth collecting pipe 1004 are provided with a fifth communication hole 214 corresponding to the fourth communication hole 213. The second connection body 212 is welded between the second collecting pipe 1002 and the fourth collecting pipe 1004. The second connection body 212 may have a long plate shape. A side surface of the second connection body 212 facing the second collecting pipe 1002 is an arc-shaped inner concave surface which matches with the pipe body of the second collecting pipe 1002. A side surface of the second connection body 212 facing the second collecting pipe 1002 is an arc-shaped inner concave surface which matches with the pipe body of the fourth collecting pipe 1004. Two sides of the fourth communication hole 213 are aligned with the fifth communication hole 214 of the second collecting pipe 1002 and the fifth communication hole 214 of the fourth collecting pipe 1004, respectively. The inner cavity 202 of the second collecting pipe 1002 and the inner cavity 202 of the fourth collecting pipe 1004 are communicated with each other through the respective fifth communication hole 214 and the fourth communication hole 213.

[0078] Referring to FIG. 17, the present disclosure also provides a heat exchanger 10 without the first connection body 209 or the second connection body 212. The plurality of collecting pipes 100 include a first collecting pipe 1001, a second collecting pipe 1002 and a third collecting pipe 1003. The first collecting pipe 1001 and the third collecting pipe 1003 are arranged side by side. The first collecting pipe 1001 and the third collecting pipe 1003 are located at one side in the length direction of the heat exchange assembly 101, and the second collecting pipe 1002 is located at the other side in the length direction of the heat exchange assembly 101.

[0079] A plurality of groups of heat exchange tubes 204 include a first group of heat exchange tubes S1 and a second group of heat exchange tubes S2 which are adjacent to the first group of heat exchange tubes S1 in the width direction of the heat exchange assembly 101. The first group of heat exchange tubes S1 are connected between the first collecting pipe 1001 and the second collecting pipe 1002. The second group of heat exchange tubes S2 are connected between the third collecting pipe 1003 and the second collecting pipe 1002. The number of heat exchange tubes S1 in the first group and the number of heat exchange tubes S2 in the second group are both greater than or equal to one. The number of heat exchange tubes S1 in the first group and the number of heat exchange tubes S2 in the second group may be the same or different. In the embodiment provided in the present disclosure, the number of the first group of heat exchange tubes S1 is two, and the number of the second group of heat exchange tube S2 is one.

[0080] Each heat exchange tube 204 of the first group of heat exchange tubes S1 has a first end 11 connected to the first collecting pipe 1001 and a second end 12 connected to the second collecting pipe 1002. Each heat exchange tube 204 of the second group of heat exchange tubes S2 has a third end 13 connected to the third collecting pipe 1003 and a fourth end 14 connected to the second collecting pipe 1002. The second end 12 and the fourth end 14 are converged in the width direction of the heat exchange assembly 101 compared to the first end 11 and the third end 13.

[0081] The second end portion 12 and the fourth end portion 14 which are converged together can be inserted into the second collecting pipe 1002 as a whole, or welded into an integral structure and then inserted into the second collecting pipe 1002 as a whole. Of course, they can also be inserted into the second collecting pipe 1002 separately, which is not too limited in the present disclosure.

[0082] As shown in FIG. 18, three refrigerant flow processes are illustrated in the figure. At least two refrigerant flow processes are communicated in series to form part of the refrigerant flow passage, and the refrigerant flow directions of the two adjacent refrigerant flow processes are opposite. Of course, the refrigerant flow passage may also include more flow channel processes, such as four processes, five processes, etc., which are not too limited in the present disclosure.

[0083] Three or more refrigerant flow processes are superimposed on the basis of two refrigerant flow processes. As shown in FIG. 19, for example, in the case of three processes, compared with the two processes in which a fifth collecting pipe 1005 and a sixth collecting pipe 1006 are added, the first collecting pipe 1001, the third collecting pipe 1003 and the fifth collecting pipe 1005 are arranged side by side, the second collecting pipe 1002, the fourth collecting pipe 1004 and the sixth collecting pipe 1006 are arranged side by side, and the inner cavity 202 of the third collecting pipe 1003 is in communication with the inner cavity 202 of the fifth collecting pipe 1005. In this way, the three refrigerant flow processes have flow directions similar to a serpentine twist. Similarly, a first connection body 209 or a second connection body 212 may also be provided between the third collecting pipe 1003 and the fifth collecting pipe 1005. The function of the first connection body 209 or the second connection body 212 has been described in detail above, which will not be repeated here.

[0084] In the above embodiment, the plurality of collecting pipes 100 may all be cylindrical tubes with a perfect circular cross section, and tube diameters of the plurality of collecting pipes 100 are all the same.

[0085] Similarly, referring to FIGS. 4 and 5, in the heat exchanger 10 with at least two refrigerant flow processes, on a plane perpendicular to the length of the heat exchange assembly 101, a cross section of the fin plate 203 is a continuous polyline shape or a wave shape. The cross-sectional shape of the heat exchange tube 204 is adapted to the wave crests or the wave troughs of the polyline shape or the wave shape. Part of the outer surface of the heat exchange tube 204 is welded and fixed to the wave crests or the wave troughs of the polyline shape or the wave shape, so that the fin plate 203 partially surrounds the heat exchange tube 204 at the wave crests or the wave troughs of the polyline shape or the wave shape.

[0086] The foregoing descriptions are only preferred embodiments of the present disclosure, and do not impose any formal restrictions on the present disclosure. Although the present disclosure has been disclosed as above in preferred embodiments, it is not intended to limit this application. Any person skilled in the art can make use of the technical content disclosed above without departing from the scope of the invention as defined in the appended claims.

Claims

1. A heat exchanger (10), comprising: two collecting pipes (100) and a plurality of heat exchange assemblies (101);

    the collecting pipe (100) comprising a pipe body (201) and an inner cavity (202) located in the pipe body (201);
    the plurality of heat exchange assemblies (101) being arranged along a length direction of the collecting pipe (100), a gap for air circulation being formed between two adjacent heat exchange assemblies (101), the heat exchange assembly (101) comprising a fin plate (203) and at least one heat exchange tube (204), the heat exchange assembly (101) comprising a main heat exchange area (301) in which the heat exchange tube (204) is connected to the fin plate (203);
    the heat exchange tube (204) being provided with an inner flow channel (2041) communicating with the inner cavities (202) of the two collecting pipes (100), the inner flow channel (2041) of the heat exchange tube (204) and the inner cavities (202) of the two collecting pipes (100) forming part of a refrigerant flow passage; in the main heat exchange area (301) corresponding to two adjacent heat exchange assemblies (101), at least one pair of two adjacent heat exchange tubes (204) having an adjacent relationship being staggered along an array direction of the heat exchange assembly (101) in which the two adjacent heat exchange tubes (204) respectively belong to two adjacent heat exchange assemblies (101); wherein relative to the one of the pair of heat exchange tubes (204), the other of the pair of heat exchange tubes (204) is the heat exchange tube with a closest distance from the one of the pair of heat exchange tubes (204) in the heat exchange assembly (101);
    wherein the heat exchange assembly (101) comprises a plurality of the heat exchange tubes (204) which are distributed along a width direction of the heat exchange assembly (101);
    the heat exchange assembly (101) further comprises two connection areas (302) located at both sides of the main heat exchange area (301) along the length direction thereof; **characterized in that** a dimension of an end of at least one of the two connection areas (302) in the width direction of the heat exchange assembly (101) is smaller than a dimension of the main heat exchange area (301) in the width direction of the heat exchange assembly (101);
    wherein the heat exchange tube (204) comprises a main body section (501) located in

the main heat exchange area (301); the heat exchange tube (204) further comprises a mounting section (503) and a matching section (502) at each connection area (302) of the heat exchange assembly (101), the matching section (502) is located between the collecting pipe (100) and the fin plate (203), and the mounting section (503) is located at a side of an outer surface of the collecting pipe (100) close to the inner cavity (202) thereof;
wherein the mounting sections (503) of the plurality of heat exchange tubes (204) are converged in the width direction of the heat exchange assembly (101) compared to the main body section (501);
wherein the collecting pipe (204) comprises mounting slots (207), a dimension of the mounting slot (207) is adapted to a dimension of the mounting section (503) where the heat exchange tubes (204) are converged, the mounting sections (503) of the plurality of heat exchange tubes (204) are in order to fit and contact each other, the mounting sections (503) of the plurality of heat exchange tubes (204) are at least partially accommodated in corresponding mounting slots (207), and the pipe body (201) of the collecting pipe (100) and the tube body (2042) of the heat exchange tube (204) are hermetically connected at the mounting slots (207).

2. The heat exchanger (10) according to claim 1, wherein in the length direction of the heat exchange assembly (101), a length of the heat exchange tube (204) is greater than that of the fin plate (203), and both ends of the heat exchange tube (204) extend beyond the fin plate (203) in the length direction of the heat exchange assembly (101); at least a part of the heat exchange tube (204) extending beyond the fin plate (203) is fixedly connected to the pipe body (201) of the collecting pipe (100); and a distance is formed between the pipe body (201) of the collecting pipe (100) and the fin plate (203), or the pipe body (201) of the collecting pipe (100) is in contact with the fin plate (203).

3. The heat exchanger (10) according to claim 1, wherein the heat exchange tube (204) is welded to a surface of the fin plate (203) in the main heat exchange area (301);
all of the plurality of heat exchange tubes (204) in the same heat exchange assembly (101) protrude from a surface of the same side of the fin plate (203); and in two adjacent heat exchange assemblies (101), the heat exchange tubes (204) of one of the heat exchange assemblies (101) and the heat exchange tubes (204) of the other of the heat exchange assemblies (101) are located at different sides of the fin plate (203), respectively.

4. The heat exchanger (10) according to claim 2 or 3, wherein a cross section of the fin plate (203) perpendicular to the length direction of the heat exchange assembly (101) is a continuous polyline shape, a cross section of the heat exchange tube (204) is a rhombus shape; the fin plate (203) has an included angle which matches the rhombus shape of the heat exchange tube (204) at a bending position of the polyline shape, and two adjacent side walls of the heat exchange tube (204) are respectively fixed to the fin plate (203) based on the rhombus shape thereof, so that the fin plate (203) forms a semi-enclosed arrangement on the heat exchange tube (204).

5. The heat exchanger (10) according to claim 2 or 3, wherein a cross section of the fin plate (203) perpendicular to the length direction of the heat exchange assembly (101) has a wave shape; a cross section of the heat exchange tube (204) is circular or oval; the fin plate (203) comprises a plurality of straight portions (2033) and a plurality of arc portions (2032), the arc portions (2032) are located between two adjacent straight portions (2033), the arc portions (2032) form wave-shaped wave crests and wave troughs, part of an outer surface of the heat exchange tube (204) is fixed to the arc portions (2032) of the fin plate (203); and wherein a curvature of a fixed portion of the heat exchange tube (203) and the arc portion (2032) is the same in size and direction as a curvature of the corresponding arc portion (2032).

6. The heat exchanger (10) according to claim 1, wherein the fin plate (203) comprises a plurality of sub-plates (2031), the heat exchange tube (204) is connected between two adjacent sub-plates (2031); the heat exchange tube (204) comprises a tube body (2042) located at a periphery of the inner flow channel, and the plurality of sub-plates (2031) of the fin plate (203) and the tube body (2042) of the heat exchange tube (204) are integrally formed through a die casting process, or are integrally formed through an extrusion process.

7. The heat exchanger (10) according to any one of claims 1 to 6, wherein all of the plurality of heat exchange assemblies (101) have the same structure and shape, and one heat exchange assembly (101) of two adjacent heat exchange assemblies (101) is turned 180° relative to the other heat exchange assembly (101); and a ratio of an area of an outer surface of the heat exchange assembly (101) to an area of a sum of inner surfaces of all the heat exchange tubes (204) is 5 to 45 in a single heat exchange assembly (101).

8. The heat exchanger (10) according to any one of claims 1 to 7, wherein the fin plate (203) comprises a body (400) and a plurality of bridges (401) protruding from the body (400), a bridge hole (402) is formed between each bridge (401) and the body (400), and the bridge hole (402) is adapted for air to pass through.

9. The heat exchanger (10) according to claim 1, wherein multiple connecting pipes (100) and a plurality of the heat exchange tubes (204) are provided, the plurality of heat exchange tubes (204) are distributed along a width direction of the heat exchange assembly (101) in the main heat exchange area (301);

wherein the plurality of heat exchange tubes (204) of the heat exchange assembly (101) are divided into at least two groups along the width direction of the heat exchange assembly (101), the number of the heat exchange tubes (204) in each group is at least one, and each group of heat exchange tubes (204) is connected between two of the collecting pipes (100); and
wherein regard to the two adjacent groups of heat exchange tubes (204), in the length direction of the heat exchange tubes (204), the inner flow channels (2041) of the two groups of heat exchange tubes (204) respectively communicate with the inner cavities (202) of two different collecting pipes (100) at one side; the inner flow channels (2041) of the two groups of heat exchange tubes (204) are in communication with the inner cavity (202) of the same collecting pipe (100) at the other side, or the inner flow channels (2041) of the two groups of heat exchange tubes (204) are respectively communicated with the inner cavities (202) of two different collecting pipes (100) at the other side, and the inner cavities (202) of the two collecting pipes (100) at the other side are communicated, so that a refrigerant flow in opposite directions in the inner flow channels (2041) of the two groups of heat exchange tubes (204).

10. The heat exchanger (10) according to claim 9,

wherein the plurality of collecting pipes (100) comprise a first collecting pipe (1001), a second collecting pipe (1002), a third collecting pipe (1003) and a fourth collecting pipe (1004), the first collecting pipe (1001) and the third collecting pipe (1003) are arranged side by side, and the second collecting pipe (1002) and the fourth collecting pipe (1004) are arranged side by side; the first collecting pipe (1001) and the second collecting pipe (1002) are arranged oppositely in a length direction of the heat exchange assembly (101); the third collecting pipe (1003) and the fourth collecting pipe (1004) are arranged oppositely in the length direction of the heat exchange assembly (101);
the plurality of heat exchange tubes (204) comprise a first group of heat exchange tubes (S1) and a second group of heat exchange tubes (S2) which are adjacent to the first group of heat exchange tubes (S1) in the width direction of the heat exchange assembly (101), the first group of heat exchange tubes (S1) are connected between the first collecting pipe (1001) and the second collecting pipe (1002), and the second group of heat exchange tubes (S2) are connected between the third collecting pipe (1003) and the fourth collecting pipe (1004).

11. The heat exchanger (10) according to claim 9,

wherein the plurality of collecting pipes (100) comprise a first collecting pipe (1001), a second collecting pipe (1002) and a third collecting pipe (1003), the first collecting pipe (1001) and the third collecting pipe (1003) are arranged side by side, the first collecting pipe (1001) and the third collecting pipe (1003) are located at one side in a length direction of the heat exchange assembly (101), and the second collecting pipe (1002) is located at the other side in the length direction of the heat exchange assembly (101);
the plurality of heat exchange tubes (204) comprise a first group of heat exchange tubes (S 1) and a second group of heat exchange tubes (S2) which are adjacent to the first group of heat exchange tubes (S1) in the width direction of the heat exchange assembly (101), the first group of heat exchange tubes (S1) are connected between the first collecting pipe (1001) and the second collecting pipe (1002), the second group of heat exchange tubes (S2) are connected between the third collecting pipe (1003) and the second collecting pipe (1002), the first group of heat exchange tubes (S1) have a first end (11) connected to the first collecting pipe (1001) and a second end (12) connected to the second collecting pipe (1002), and the second group of heat exchange tubes (S2) have a third end (13) connected to the third collecting pipe (1003) and a fourth end (14) connected to the second collecting pipe (1002); and wherein the second end (12) and the fourth end (14) are converged, compared with the first end (11) and the third end (13), in the width direction of the heat exchange assembly (101).

Patentansprüche

1. Wärmetauscher (10), der aufweist: zwei Sammelleitungen (100) und eine Vielzahl von Wärmetauschanordnungen (101);

   wobei die Sammelleitung (100) einen Leitungskörper (201) und einen Innenhohlraum (202) aufweist, der sich in dem Leitungskörper (201) befindet;
   wobei die Vielzahl von Wärmetauschanordnungen (101) entlang einer Längenrichtung der Sammelleitung (100) angeordnet sind, wobei ein Spalt zur Luftzirkulation zwischen zwei angrenzenden Wärmetauschanordnungen (101) ausgebildet ist, wobei die Wärmetauschanordnung (101) eine Lamellenplatte (203) und mindestens ein Wärmetauschrohr (204) aufweist, wobei die Wärmetauschanordnung (101) einen Hauptwärmetauschbereich (301) aufweist, in dem das Wärmetauschrohr (204) mit der Lamellenplatte (203) verbunden ist;
   wobei das Wärmetauschrohr (204) mit einem inneren Strömungskanal (2041) versehen ist, der mit den Innenhohlräumen (202) der beiden Sammelleitungen (100) in Verbindung steht, wobei der innere Strömungskanal (2041) des Wärmetauschrohrs (204) und die Innenhohlräume (202) der beiden Sammelleitungen (100) Teil eines Kältemitteldurchflusses bilden; wobei in dem Hauptwärmetauschbereich (301), der zwei angrenzenden Wärmetauschanordnungen (101) entspricht, mindestens ein Paar von zwei angrenzenden Wärmetauschrohren (204), die eine angrenzende Beziehung haben, entlang einer Array-Richtung der Wärmetauschanordnung (101) versetzt ist, in der die beiden angrenzenden Wärmetauschrohre (204) jeweils zu zwei angrenzenden Wärmetauschanordnungen (101) gehören; wobei relativ zu dem einen des Paares von Wärmetauschrohren (204) das andere des Paares von Wärmetauschrohren (204) das Wärmetauschrohr ist, das einen geringsten Abstand zu dem einen des Paares von Wärmetauschrohren (204) in der Wärmetauschanordnung (101) hat;
   wobei die Wärmetauschanordnung (101) eine Vielzahl von Wärmetauschrohren (204) aufweist, die entlang einer Breitenrichtung der Wärmetauschanordnung (101) verteilt sind;
   wobei die Wärmetauschanordnung (101) ferner zwei Verbindungsbereiche (302) aufweist, die sich auf beiden Seiten des Hauptwärmetauschbereichs (301) entlang der Längenrichtung davon befinden;
   dadurch gekennzeichnet, dass
   eine Abmessung eines Endes von mindestens einem der beiden Verbindungsbereiche (302) in der Breitenrichtung der Wärmetauschanordnung (101) kleiner ist als eine Abmessung des Hauptwärmetauschbereichs (301) in der Breitenrichtung der Wärmetauschanordnung (101); wobei das Wärmetauschrohr (204) einen Hauptkörperabschnitt (501) aufweist, der sich in dem Hauptwärmetauschbereich (301) befindet; wobei das Wärmetauschrohr (204) ferner einen Befestigungsabschnitt (503) und einen Passabschnitt (502) an jedem Verbindungsbereich (302) der Wärmetauschanordnung (101) aufweist, wobei sich der Passabschnitt (502) zwischen der Sammelleitung (100) und der Lamellenplatte (203) befindet, und wobei sich der Passabschnitt (503) auf einer Seite einer Außenfläche der Sammelleitung (100) in der Nähe des Innenhohlraums (202) davon befindet; wobei die Befestigungsabschnitte (503) der Vielzahl von Wärmetauschrohren (204) in der Breitenrichtung der Wärmetauschanordnung (101) im Vergleich zum Hauptkörperabschnitt (501) konvergieren;
   wobei die Sammelleitung (204) Befestigungsspalte (207) aufweist, wobei eine Abmessung des Befestigungsspalts (207) an eine Abmessung des Befestigungsabschnitts (503) angepasst ist, an der die Wärmetauschrohre (204) konvergieren, wobei die Befestigungsabschnitte (503) der Vielzahl von Wärmetauschrohren (204) so angeordnet sind, dass sie zusammenpassen und einander kontaktieren, wobei die Befestigungsabschnitte (503) der Vielzahl von Wärmetauschrohren (204) zumindest teilweise in entsprechenden Befestigungsspalten (207) aufgenommen sind, und wobei der Leitungskörper (201) der Sammelleitung (100) und der Rohrkörper (2042) des Wärmetauschrohrs (204) an den Befestigungsspalten (207) hermetisch verbunden sind.

2. Wärmetauscher (10) nach Anspruch 1, wobei in der Längenrichtung der Wärmetauschanordnung (101) eine Länge des Wärmetauschrohrs (204) größer ist als die der Lamellenplatte (203), und wobei sich beide Enden des Wärmetauschrohrs (204) über die Lamellenplatte (203) in der Längenrichtung der Wärmetauschanordnung (101) hinaus erstrecken; wobei zumindest ein Teil des Wärmetauschrohrs (204), das sich über die Lamellenplatte (203) hinaus erstreckt, fest mit dem Leitungskörper (201) der Sammelleitung (100) verbunden ist, und wobei ein Abstand zwischen dem Leitungskörper (201) der Sammelleitung (100) und der Lamellenplatte (203) ausgebildet ist oder der Leitungskörper (201) der Sammelleitung (100) mit der Lamellenplatte (203) in Kontakt steht.

3. Wärmetauscher (10) nach Anspruch 1, wobei das

Wärmetauschrohr (204) mit einer Oberfläche der Lamellenplatte (203) in dem Hauptwärmetauschbereich (301) verschweißt ist;
wobei sämtliche der Vielzahl von Wärmetauschrohren (204) in derselben Wärmetauschanordnung (101) von einer Oberfläche derselben Seite der Lamellenplatte (203) vorstehen; und wobei sich in zwei angrenzenden Wärmetauschanordnungen (101) die Wärmetauschrohre (204) einer der Wärmetauschanordnungen (101) und die Wärmetauschrohre (204) der anderen der Wärmetauschanordnungen (101) jeweils auf verschiedenen Seiten der Lamellenplatte (203) befinden.

4. Wärmetauscher (10) nach Anspruch 2 oder 3, wobei ein Querschnitt der Lamellenplatte (203) senkrecht zur Längenrichtung der Wärmetauschanordnung (101) eine durchgehende Polylinienform ist, wobei ein Querschnitt des Wärmetauschrohrs (204) eine Rhombusform ist; wobei die Lamellenplatte (203) einen eingeschlossenen Winkel aufweist, welcher der Rhombusform des Wärmetauschrohrs (204) an einer Biegeposition der Polylinienform entspricht, und wobei zwei angrenzende Seitenwände des Wärmetauschrohrs (204) jeweils an der Lamellenplatte (203) basierend auf deren Rhombusform befestigt sind, so dass die Lamellenplatte (203) eine halb geschlossene Anordnung am Wärmetauschrohr (204) bildet.

5. Wärmetauscher (10) nach Anspruch 2 oder 3, wobei ein Querschnitt der Lamellenplatte (203) senkrecht zu Längenrichtung der Wärmetauschanordnung (101) eine Wellenform hat; wobei ein Querschnitt des Wärmetauschrohrs (204) kreisförmig oder oval ist; wobei die Lamellenplatte (203) eine Vielzahl von geraden Abschnitten (2033) und eine Vielzahl von Bogenabschnitten (2032) aufweist, wobei sich die Bogenabschnitte (2032) zwischen zwei angrenzenden geraden Abschnitten (2033) befinden, wobei die Bogenabschnitte (2032) wellenförmige Wellenberge und Wellentäler bilden, wobei ein Teil einer Außenfläche des Wärmetauschrohrs (204) an den Bogenabschnitten (2032) der Lamellenplatte (203) befestigt ist; und wobei eine Krümmung eines befestigten Abschnitts des Wärmetauschrohrs (203) und des Bogenabschnitts (2032) dieselbe Größe und Richtung wie eine Krümmung des entsprechenden Bogenabschnitts (2032) haben.

6. Wärmetauscher (10) nach Anspruch 1, wobei die Lamellenplatte (203) eine Vielzahl von Unterplatten (2031) aufweist, wobei das Wärmetauschrohr (204) zwischen zwei angrenzenden Unterplatten (2031) verbunden ist; wobei das Wärmetauschrohr (204) einen Rohrkörper (2042) aufweist, der sich an einem Umfang des inneren Strömungskanals befindet, und wobei die Vielzahl von Unterplatten (2031) der Lamellenplatte (203) und der Rohrkörper (2042) des Wärmetauschrohrs (204) durch einen Druckgießverfahren einstückig ausgebildet werden oder durch ein Extrusionsverfahren einstückig ausgebildet werden.

7. Wärmetauscher (10) nach einem der Ansprüche 1 bis 6, wobei sämtliche der Vielzahl von Wärmetauschanordnungen (101) dieselbe Struktur und Form aufweisen, und wobei eine Wärmetauschanordnung (101) von zwei angrenzenden Wärmetauschanordnungen (101) um 180° relativ zu der anderen Wärmetauschanordnung (101) gedreht wird; und wobei ein Verhältnis eines Bereichs einer Außenfläche der Wärmetauschanordnung (101) zu einem Bereich einer Summe von Innenflächen sämtlicher Wärmetauschrohre (204) in einer einzigen Wärmetauschanordnung (101) 5 zu 45 beträgt.

8. Wärmetauscher (10) nach einem der Ansprüche 1 bis 7, wobei die Lamellenplatte (203) einen Körper (400) und eine Vielzahl von Brücken (401) aufweist, die von dem Körper (400) vorstehen, wobei ein Brückenloch (402) zwischen jeder Brücke (401) und dem Körper (400) ausgebildet ist, und wobei das Brückenloch (402) dazu dient, dass Luft dort hindurch verlaufen kann.

9. Wärmetauscher (10) nach Anspruch 1, wobei die mehreren Verbindungsleitungen (100) und eine Vielzahl von Wärmetauschrohren (204) vorgesehen sind, wobei die Vielzahl von Wärmetauschrohren (204) entlang einer Breitenrichtung der Wärmetauschanordnung (101) in dem Hauptwärmetauschbereich (301) verteilt sind;

wobei die Vielzahl von Wärmetauschrohren (204) der Wärmetauschanordnung (101) in mindestens zwei Gruppen entlang der Breitenrichtung der Wärmetauschanordnung (101) unterteilt sind, wobei die Anzahl der Wärmetauschrohre (204) in jeder Gruppe mindestens eins beträgt, und wobei jede Gruppe von Wärmetauschrohren (204) zwischen zwei der Sammelleitungen (100) verbunden ist; und
wobei bei den beiden angrenzenden Gruppen von Wärmetauschrohren (204), in der Längenrichtung der Wärmetauschrohre (204), die inneren Strömungskanäle (2041) der beiden Gruppen von Wärmetauschrohren (204) jeweils mit den Innenhohlräumen (202) der beiden verschiedenen Sammelleitungen (100) auf einer Seite in Verbindung stehen; wobei die inneren Strömungskanäle (2041) der beiden Gruppen von Wärmetauschrohren (204) mit dem Innenhohlraum (202) desselben Sammelrohrs (100) auf der anderen Seite in Verbindung stehen, oder wobei die inneren Strömungskanäle

(2041) der beiden Gruppen von Wärmetauschrohren (204) jeweils mit den Innenhohlräumen (202) der beiden verschiedenen Sammelleitungen (100) auf der anderen Seite in Verbindung stehen, und wobei die Innenhohlräume (202) der beiden Sammelleitungen (100) auf der anderen Seite in Verbindung stehen, so dass ein Kühlmittel in entgegengesetzte Richtungen in den inneren Strömungskanälen (2041) der beiden Gruppen von Wärmetauschrohren (204) fließt.

10. Wärmetauscher (10) nach Anspruch 9, wobei die Vielzahl von Sammelleitungen (100) eine erste Sammelleitung (1001), eine zweite Sammelleitung (1002), eine dritte Sammelleitung (1003) und eine vierte Sammelleitung (1004) aufweist, wobei die erste Sammelleitung (1001) und die dritte Sammelleitung (1003) nebeneinander angeordnet sind, und wobei die zweite Sammelleitung (1002) und die vierte Sammelleitung (1004) nebeneinander angeordnet sind;

wobei die erste Sammelleitung (1001) und die zweite Sammelleitung (1002) in einer Längenrichtung der Wärmetauschanordnung (101) entgegengesetzt angeordnet sind; wobei die dritte Sammelleitung (1003) und die vierte Sammelleitung (1004) in der Längenrichtung der Wärmetauschanordnung (101) entgegengesetzt angeordnet sind;

wobei die Vielzahl von Wärmetauschrohren (204) eine erste Gruppe von Wärmetauschrohren (S1) und eine zweite Gruppe von Wärmetauschrohren (S2) aufweisen, die an die erste Gruppe von Wärmetauschrohren (S1) in der Breitenrichtung der Wärmetauschanordnung (101) angrenzen, wobei die erste Gruppe von Wärmetauschrohren (S1) zwischen der ersten Sammelleitung (1001) und der zweiten Sammelleitung (1002) verbunden sind, und wobei die zweite Gruppe von Wärmetauschrohren (S2) zwischen der dritten Sammelleitung (1003) und der vierten Sammelleitung (1004) verbunden sind.

11. Wärmetauscher (10) nach Anspruch 9, wobei die Vielzahl von Sammelleitungen (100) eine erste Sammelleitung (1001), eine zweite Sammelleitung (1002) und eine dritte Sammelleitung (1003) aufweisen, wobei die erste Sammelleitung (1001) und die dritte Sammelleitung (1003) nebeneinander angeordnet sind, wobei sich die erste Sammelleitung (1001) und die dritte Sammelleitung (1003) auf einer Seite in einer Längenrichtung der Wärmetauschanordnung (101) befinden, und wobei sich die zweite Sammelleitung (1002) auf der anderen Seite in der Längenrichtung der Wärmetauschanordnung (101) befindet;

wobei die Vielzahl von Wärmetauschrohren (204) eine erste Gruppe von Wärmetauschrohren (S1) und eine zweite Gruppe von Wärmetauschrohren (S2) aufweisen, die an die erste Gruppe von Wärmetauschrohren (S1) in der Breitenrichtung der Wärmetauschanordnung (101) angrenzen, wobei die erste Gruppe von Wärmetauschrohren (S1) zwischen der ersten Sammelleitung (1001) und der zweiten Sammelleitung (1002) verbunden sind, wobei die zweite Gruppe von Wärmetauschrohren (S2) zwischen der dritten Sammelleitung (1003) und der zweiten Sammelleitung (1002) verbunden sind, wobei die erste Gruppe von Wärmetauschrohren (S1) ein erstes Ende (11), das mit der ersten Sammelleitung (1001) verbunden ist, und ein zweites Ende (12) aufweisen, das mit der zweiten Sammelleitung (1002) verbunden ist, und wobei die zweite Gruppe von Wärmetauschrohren (S2) ein drittes Ende (13), das mit der dritten Sammelleitung (1003) verbunden ist, und ein viertes Ende (14) aufweisen, das mit der zweiten Sammelleitung (1002) verbunden ist; und wobei das zweite Ende (12) und das vierte Ende (14) im Vergleich zum ersten Ende (11) und dritten Ende (13) in der Breitenrichtung der Wärmetauschanordnung (101) konvergiert sind.

Revendications

1. Échangeur de chaleur (10), comprenant : deux tuyaux collecteurs (100) et plusieurs ensembles d'échange de chaleur (101) ;

le tuyau collecteur (100) comprenant un corps de tuyau (201) et une cavité interne (202) située dans le corps de tuyau (201) ;

la pluralité d'ensembles d'échange de chaleur (101) étant agencés le long d'une direction de longueur du tuyau collecteur (100), un espace pour la circulation de l'air étant formé entre deux ensembles d'échange de chaleur (101) adjacents, l'ensemble d'échange de chaleur (101) comprenant une plaque à ailettes (203) et au moins un tube d'échange de chaleur (204), l'ensemble d'échange de chaleur (101) comprenant une zone d'échange de chaleur principale (301) dans laquelle le tube d'échange de chaleur (204) est relié à la plaque à ailettes (203) ;

le tube d'échange de chaleur (204) étant pourvu d'un canal d'écoulement interne (2041) communiquant avec les cavités internes (202) des deux tuyaux collecteurs (100), le canal d'écoulement interne (2041) du tube d'échange de chaleur (204) et les cavités internes (202) des deux tuyaux collecteurs (100) faisant partie d'un passage d'écoulement de fluide frigorigène ; dans la zone d'échange de chaleur principale (301) correspondant à deux ensembles d'échange de chaleur (101) adjacents, au moins une paire de deux tubes d'échange de chaleur (204) adjacents ayant une relation adjacente étant décalés le long d'une direction de réseau de l'ensemble d'échange de chaleur (101) dans laquelle les deux tubes d'échange de chaleur (204) adjacents appartiennent respectivement à deux ensembles d'échange de chaleur (101) adjacents ; dans lequel, par rapport à l'un de la paire de tubes d'échange de chaleur (204), l'autre de la paire de tubes d'échange de chaleur (204) est le tube d'échange de chaleur ayant la distance la plus proche de l'un de la paire de tubes d'échange de chaleur (204) dans l'ensemble d'échange de chaleur (101) ;

l'ensemble d'échange de chaleur (101) comprend une pluralité de tubes d'échange de chaleur (204) qui sont répartis le long d'une direction de largeur de l'ensemble d'échange de chaleur (101) ;

l'ensemble d'échange de chaleur (101) comprend en outre deux zones de liaison (302) situées de part et d'autre de la zone d'échange de chaleur principale (301) le long de la direction de longueur de celle-ci ;

caractérisé en ce qu'une dimension d'une extrémité d'au moins une des deux zones de liaison (302) dans la direction de largeur de l'ensemble d'échange de chaleur (101) est inférieure à une dimension de la zone d'échange de chaleur principale (301) dans la direction de largeur de l'ensemble d'échange de chaleur (101) ;

le tube d'échange de chaleur (204) comprend une section de corps principale (501) située dans la zone d'échange de chaleur principale (301) ; le tube d'échange de chaleur (204) comprend en outre une section de montage (503) et une section d'adaptation (502) au niveau de chaque zone de liaison (302) de l'ensemble d'échange de chaleur (101), la section d'adaptation (502) est située entre le tuyau collecteur (100) et la plaque à ailettes (203), et la section de montage (503) est située au niveau d'un côté d'une surface externe du tuyau collecteur (100) à proximité de la cavité interne (202) de ce dernier ;

dans lequel les sections de montage (503) de la pluralité de tubes d'échange de chaleur (204) sont convergents dans la direction de largeur de l'ensemble d'échange de chaleur (101) par comparaison avec la section de corps principale (501) ;

dans lequel le tuyau collecteur (204) comprend des fentes de montage (207), une dimension de la fente de montage (207) est adaptée à une dimension de la section de montage (503) où les tubes d'échange de chaleur (204) sont convergents, les sections de montage (503) de la pluralité de tubes d'échange de chaleur (204) sont destinés à s'ajuster et à entrer en contact l'une avec l'autre, les sections de montage (503) de la pluralité de tubes d'échange de chaleur (204) sont au moins partiellement logées dans des fentes de montage (207) correspondantes, et le corps de tube (201) du tuyau collecteur (100) et le corps de tube (2042) du tube d'échange de chaleur (204) sont hermétiquement reliés au niveau des fentes de montage (207).

2. Échangeur de chaleur (10) selon la revendication 1, dans lequel dans la direction de longueur de l'ensemble d'échange de chaleur (101), une longueur du tube d'échange de chaleur (204) est supérieure à celle de la plaque à ailettes (203), et les deux extrémités du tube d'échange de chaleur (204) s'étendent au-delà de la plaque à ailettes (203) dans la direction de longueur de l'ensemble d'échange de chaleur (101) ; au moins une partie du tube d'échange de chaleur (204) s'étendant au-delà de la plaque à ailettes (203) est reliée de manière fixe au corps du tuyau (201) du tuyau collecteur (100) ; et une distance est formée entre le corps de tuyau (201) du tuyau collecteur (100) et la plaque à ailettes (203), ou le corps de tuyau (201) du tuyau collecteur (100) est en contact avec la plaque à ailettes (203).

3. Échangeur de chaleur (10) selon la revendication 1, dans lequel le tube d'échange de chaleur (204) est soudé à une surface de la plaque à ailettes (203) dans la zone d'échange de chaleur principale (301) ; tous les tubes de la pluralité de tubes d'échange de chaleur (204) dans le même ensemble d'échange de chaleur (101) font saillie d'une surface du même côté de la plaque à ailettes (203) ; et dans deux ensembles d'échange de chaleur (101) adjacents, les tubes d'échange de chaleur (204) de l'un des ensembles d'échange de chaleur (101) et les tubes d'échange de chaleur (204) de l'autre des ensembles d'échange de chaleur (101) sont situés respectivement au niveau de côtés différents de la plaque à ailettes (203).

4. Échangeur de chaleur (10) selon la revendication 2 ou 3, dans lequel une section transversale de la plaque à ailettes (203) perpendiculaire à la direction de longueur de l'ensemble d'échange de chaleur (101) est une forme polyligne continue, une section transversale du tube d'échange de chaleur (204) est une forme de losange ; la plaque à ailettes (203) a un angle inclus qui correspond à la forme en losange du tube d'échange de chaleur (204) au niveau d'une position de flexion de la forme polyligne, et deux parois latérales adjacentes du tube d'échange de chaleur (204) sont respectivement fixées à la plaque

à ailettes (203) sur la base de la forme en losange de celle-ci, de sorte que la plaque à ailettes (203) forme un agencement semi-fermé sur le tube d'échange de chaleur (204).

5. Échangeur de chaleur (10) selon la revendication 2 ou 3, dans lequel une section transversale de la plaque à ailettes (203) perpendiculaire à la direction de longueur de l'ensemble d'échange de chaleur (101) a une forme de vague ; la section transversale du tube d'échange de chaleur (204) est circulaire ou ovale ; la plaque à ailettes (203) comprend une pluralité de parties droites (2033) et une pluralité de parties en arc (2032), les parties en arc (2032) sont situées entre deux parties droites (2033) adjacentes, les parties en arc (2032) forment des crêtes et des creux d'onde en forme de vague, une partie d'une surface externe du tube d'échange de chaleur (204) est fixée aux parties en arc (2032) de la plaque à ailettes (203) ; et dans lequel une courbure d'une partie fixe du tube d'échange de chaleur (203) et de la partie en arc (2032) est de la même taille et de la même direction qu'une courbure de la partie en arc (2032) correspondante.

6. Échangeur de chaleur (10) selon la revendication 1, dans lequel la plaque à ailettes (203) comprend une pluralité de sous-plaques (2031), le tube d'échange de chaleur (204) est relié entre deux sous-plaques (2031) adjacentes ; le tube d'échange de chaleur (204) comprend un corps de tube (2042) situé au niveau d'une périphérie du canal d'écoulement interne, et la pluralité de sous-plaques (2031) de la plaque à ailettes (203) et le corps de tube (2042) du tube d'échange de chaleur (204) sont formés intégralement par un processus de moulage sous pression, ou sont formés intégralement par un processus d'extrusion.

7. Échangeur de chaleur (10) selon l'une quelconque des revendications 1 à 6, dans lequel tous les ensembles d'échange de chaleur de la pluralité d'ensembles d'échange de chaleur (101) ont la même structure et la même forme, et un ensemble d'échange de chaleur (101) de deux ensembles d'échange de chaleur (101) adjacents est tourné de 180° par rapport à l'autre ensemble d'échange de chaleur (101) ; et une rapport entre une aire d'une surface externe de l'ensemble d'échange de chaleur (101) et une aire d'une somme des surfaces internes de tous les tubes d'échange de chaleur (204) est de 5 à 45 dans un seul ensemble d'échange de chaleur (101).

8. Échangeur de chaleur (10) selon l'une quelconque des revendications 1 à 7, dans lequel la plaque à ailettes (203) comprend un corps (400) et une pluralité de ponts (401) faisant saillie du corps (400), un trou de pont (402) est formé entre chaque pont (401) et le corps (400), et le trou de pont (402) est adapté pour permettre à l'air de passer à travers.

9. Échangeur de chaleur (10) selon la revendication 1, dans lequel de multiples tuyaux de liaison (100) et une pluralité des tubes d'échange de chaleur (204) sont fournis, la pluralité de tubes d'échange de chaleur (204) sont répartis le long d'une direction de largeur de l'ensemble d'échange de chaleur (101) dans la zone d'échange de chaleur principale (301) ;

dans lequel la pluralité de tubes d'échange de chaleur (204) de l'ensemble d'échange de chaleur (101) sont divisés en au moins deux groupes le long de la direction de largeur de l'ensemble d'échange de chaleur (101), le nombre de tubes d'échange de chaleur (204) dans chaque groupe est au moins un, et chaque groupe de tubes d'échange de chaleur (204) est relié entre deux des tuyaux collecteurs (100) ; et

dans lequel, en ce qui concerne les deux groupes adjacents de tubes d'échange de chaleur (204), dans la direction de longueur des tubes d'échange de chaleur (204), les canaux d'écoulement internes (2041) des deux groupes de tubes d'échange de chaleur (204) communiquent respectivement avec les cavités internes (202) de deux tubes collecteurs (100) différents au niveau d'un côté ; les canaux d'écoulement internes (2041) des deux groupes de tubes d'échange de chaleur (204) sont en communication avec la cavité interne (202) du même tuyau collecteur (100) au niveau de l'autre côté, ou les canaux d'écoulement internes (2041) des deux groupes de tubes d'échange de chaleur (204) sont respectivement en communication avec les cavités internes (202) de deux tuyaux collecteurs (100) différents au niveau de l'autre côté, et les cavités internes (202) des deux tuyaux collecteurs (100) au niveau de l'autre côté sont en communication, de sorte qu'un fluide frigorigène circule dans des directions opposées dans les canaux d'écoulement internes (2041) des deux groupes de tubes d'échange de chaleur (204).

10. Échangeur de chaleur (10) selon la revendication 9, dans lequel la pluralité de tuyaux collecteurs (100) comprennent un premier tuyau collecteur (1001), un deuxième tuyau collecteur (1002), un troisième tuyau collecteur (1003) et un quatrième tuyau collecteur (1004), le premier tuyau collecteur (1001) et le troisième tuyau collecteur (1003) sont agencés côte à côte, et le deuxième tuyau collecteur (1002) et le quatrième tuyau collecteur (1004) sont agencés côte à côte ;

le premier tuyau collecteur (1001) et le deuxième tuyau collecteur (1002) sont agencés de manière opposée dans la direction de longueur de l'ensemble d'échange de chaleur (101) ; le troisième tuyau collecteur (1003) et le quatrième tuyau collecteur (1004) sont agencés de manière opposée dans la direction de longueur de l'ensemble d'échange de chaleur (101) ;

la pluralité de tubes d'échange de chaleur (204) comprennent un premier groupe de tubes d'échange de chaleur (S1) et un second groupe de tubes d'échange de chaleur (S2) qui sont adjacents au premier groupe de tubes d'échange de chaleur (S1) dans la direction de largeur de l'ensemble d'échange de chaleur (101), le premier groupe de tubes d'échange de chaleur (S1) sont reliés entre le premier tuyau collecteur (1001) et le deuxième tuyau collecteur (1002), et le second groupe de tubes d'échange de chaleur (S2) sont reliés entre le troisième tuyau collecteur (1003) et le quatrième tuyau collecteur (1004).

11. Échangeur de chaleur (10) selon la revendication 9, dans lequel la pluralité de tuyaux collecteurs (100) comprennent un premier tuyau collecteur (1001), un deuxième tuyau collecteur (1002) et un troisième tuyau collecteur (1003), le premier tuyau collecteur (1001) et le troisième tuyau collecteur (1003) sont agencés côte à côte, le premier tuyau collecteur (1001) et le troisième tuyau collecteur (1003) sont situés au niveau d'un côté dans la direction de longueur de l'ensemble d'échange de chaleur (101), et le deuxième tuyau collecteur (1002) est situé au niveau de l'autre côté dans la direction de longueur de l'ensemble d'échange de chaleur (101) ;

la pluralité de tubes d'échange de chaleur (204) comprennent un premier groupe de tubes d'échange de chaleur (S1) et un second groupe de tubes d'échange de chaleur (S2) qui sont adjacents au premier groupe de tubes d'échange de chaleur (S1) dans la direction de largeur de l'ensemble d'échange de chaleur (101), le premier groupe de tubes d'échange de chaleur (S1) sont reliés entre le premier tuyau collecteur (1001) et le deuxième tuyau collecteur (1002), le second groupe de tubes d'échange de chaleur (S2) sont reliés entre le troisième tuyau collecteur (1003) et le deuxième tuyau collecteur (1002), le premier groupe de tubes d'échange de chaleur (S1) ont une première extrémité (11) reliée au premier tuyau collecteur (1001) et une deuxième extrémité (12) reliée au deuxième tuyau collecteur (1002), et le second groupe de tubes d'échange de chaleur (S2) ont une troisième extrémité (13) reliée au troisième tuyau collecteur (1003) et une quatrième extrémité (14) reliée au deuxième tuyau collecteur (1002) ; et dans lequel la deuxième extrémité (12) et la quatrième extrémité (14) sont convergentes, par comparaison avec la première extrémité (11) et à la troisième extrémité (13), dans la direction de largeur de l'ensemble d'échange de chaleur (101).

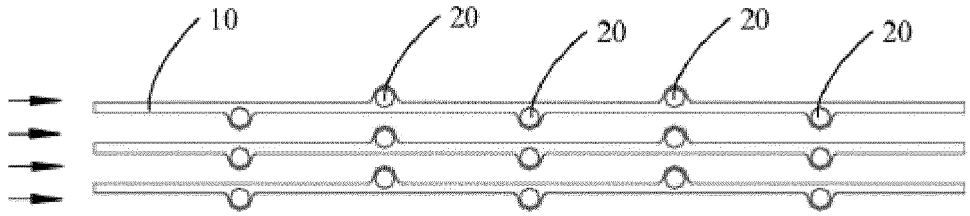

FIG. 1

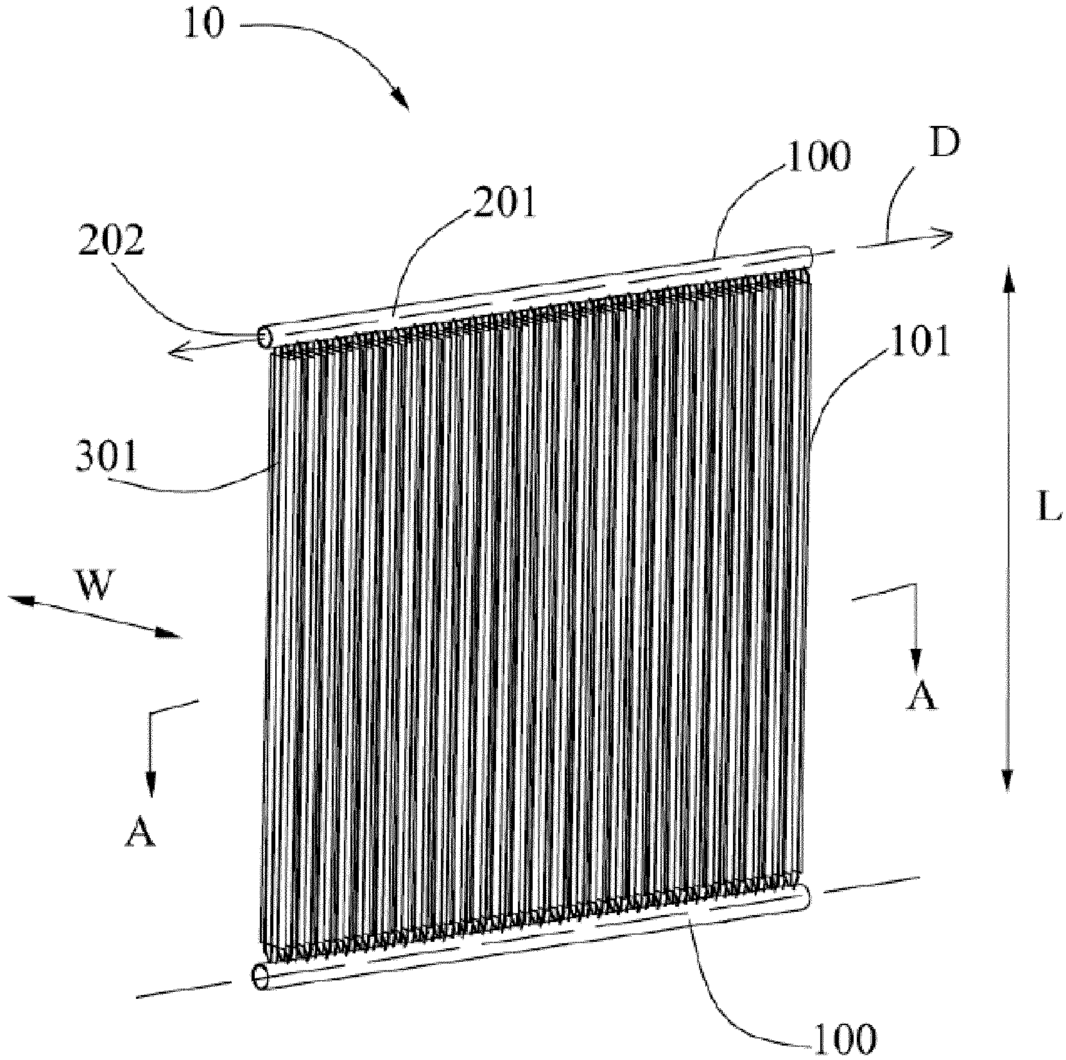

FIG. 2

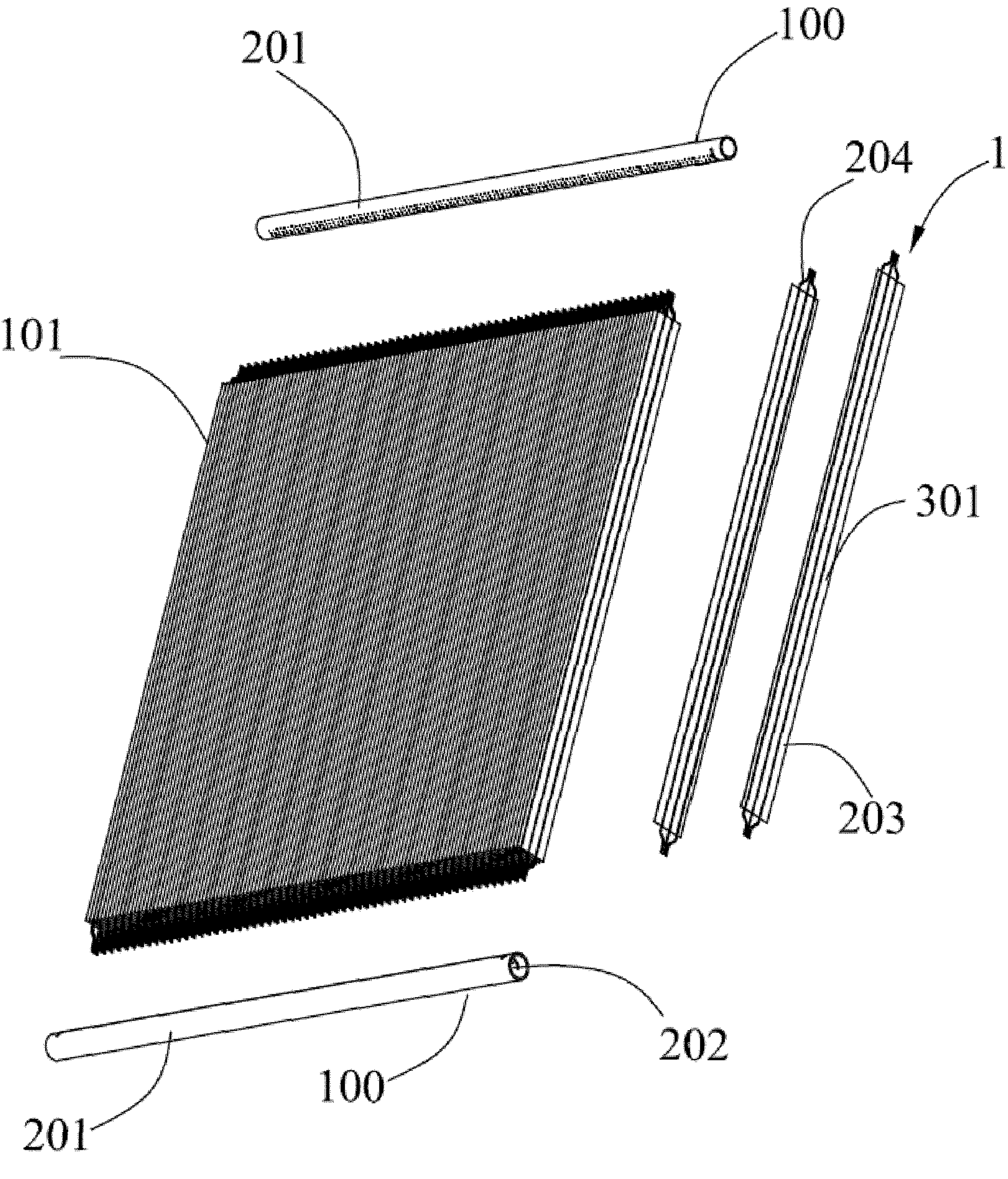

FIG. 3

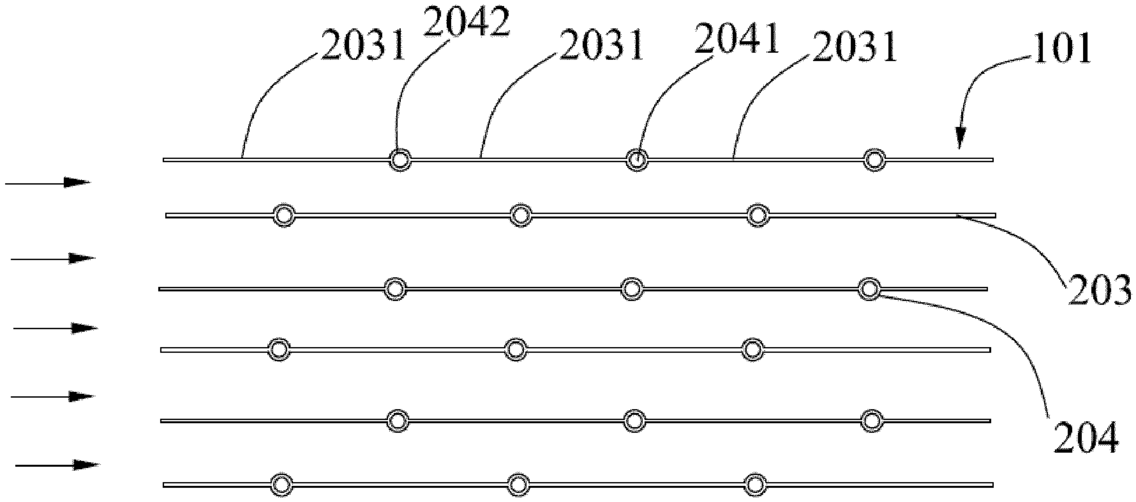

FIG. 4

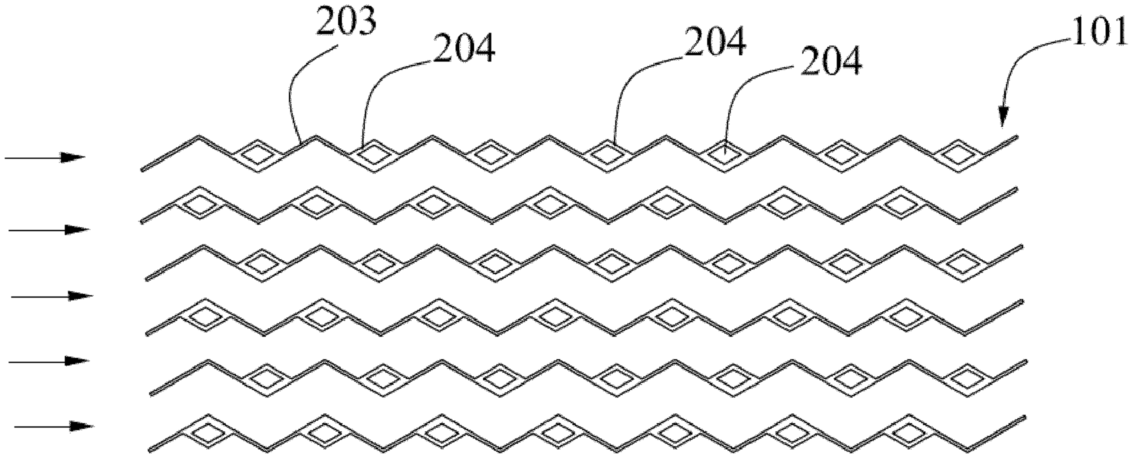

FIG. 5

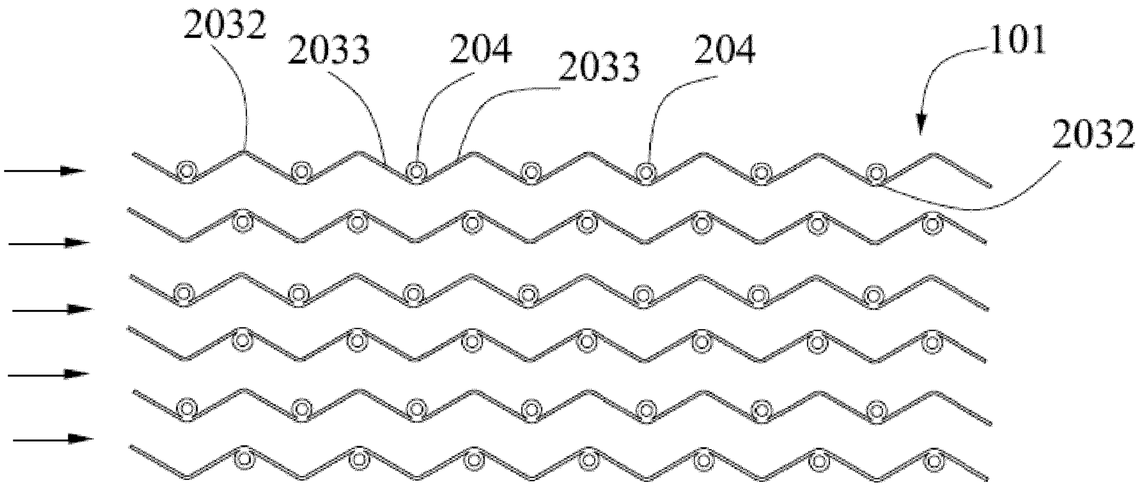

FIG. 6

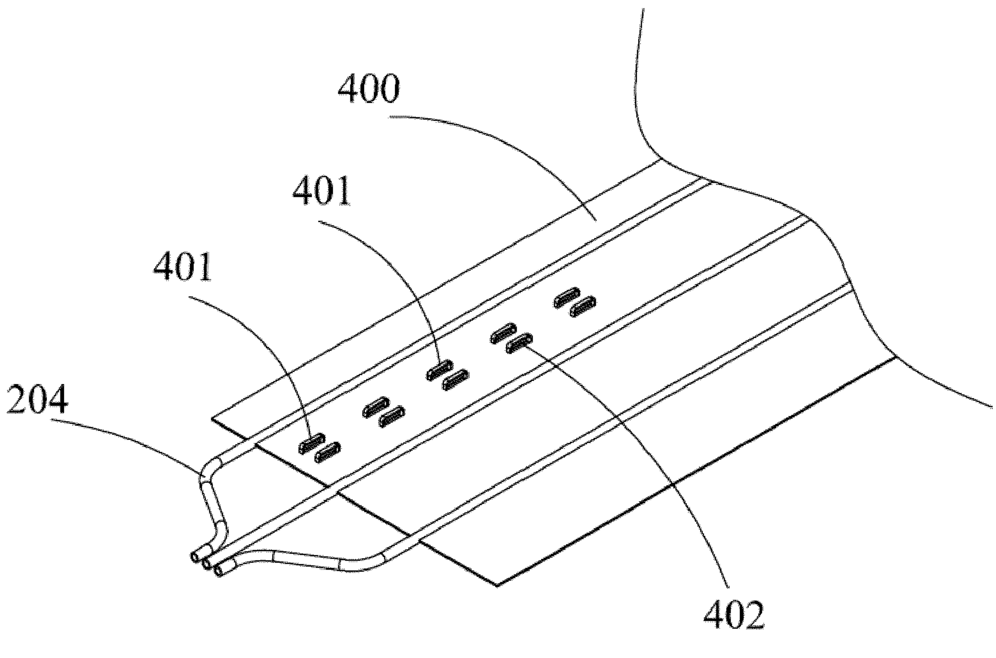

FIG. 7

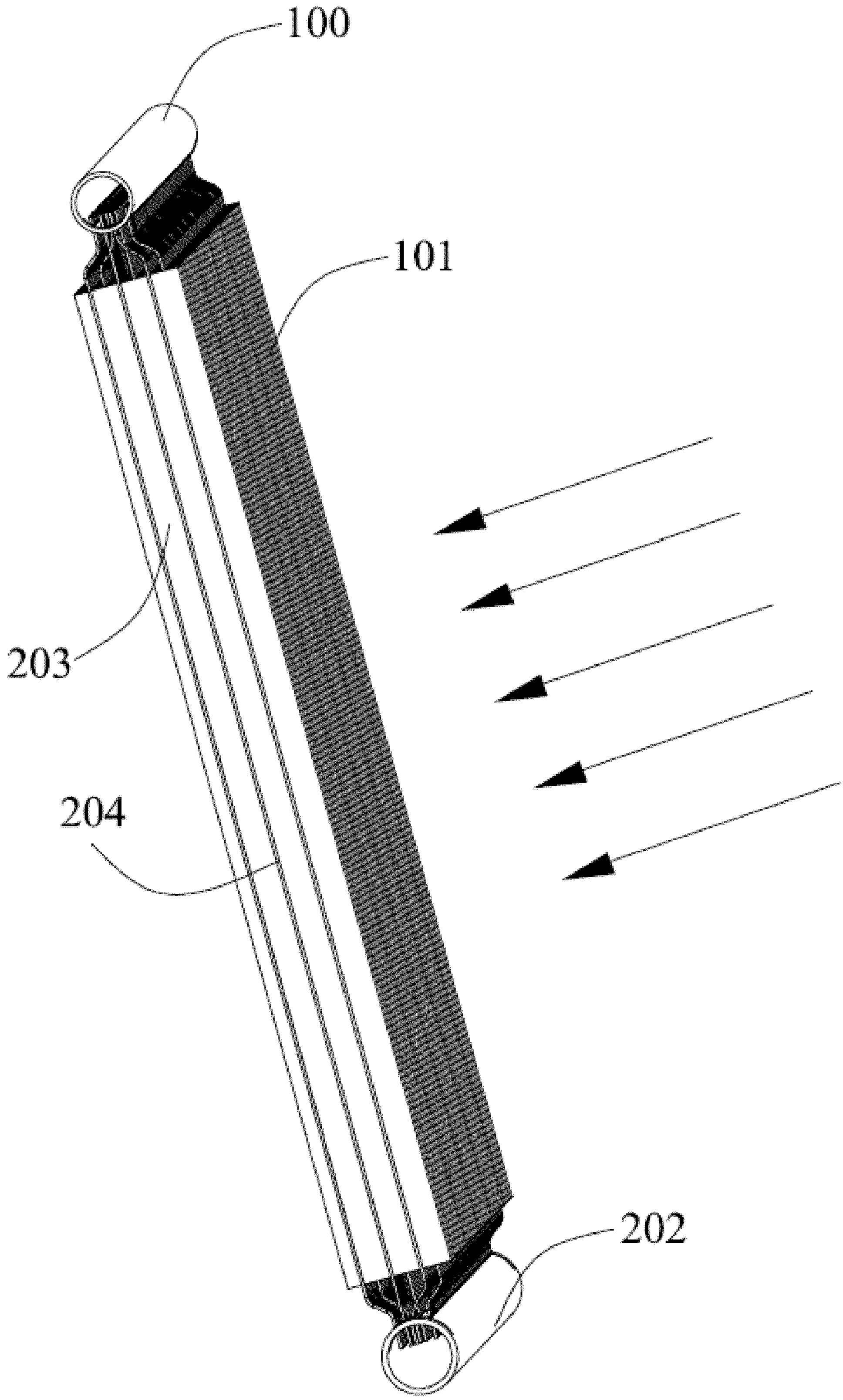

FIG. 8

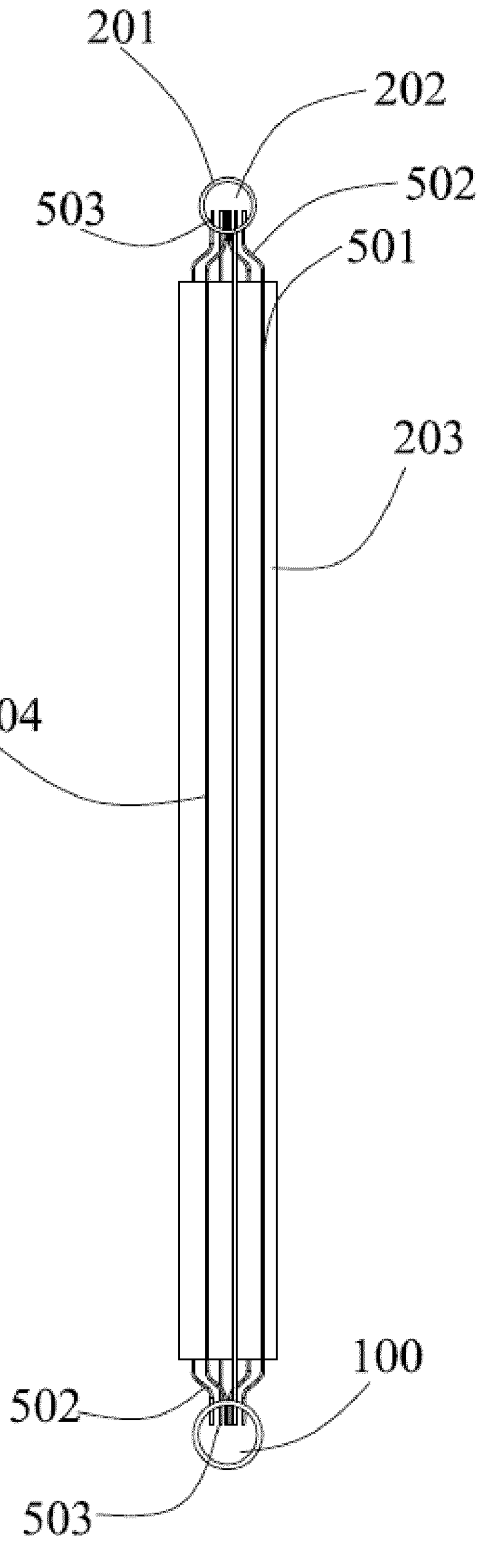

FIG. 9

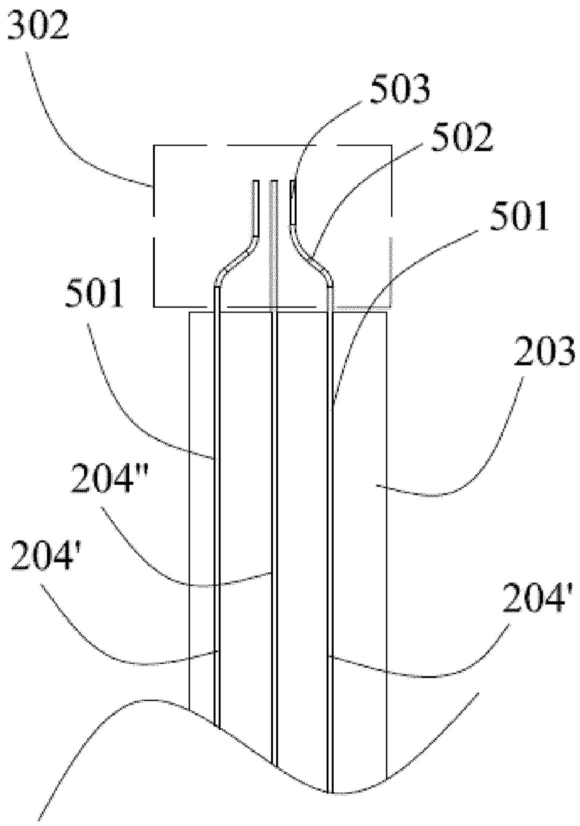

FIG. 10

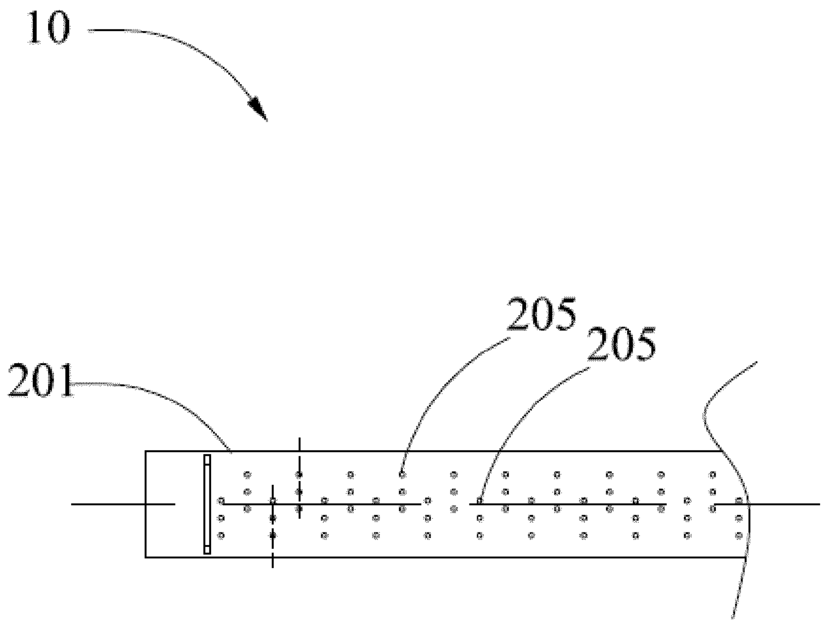

FIG. 11

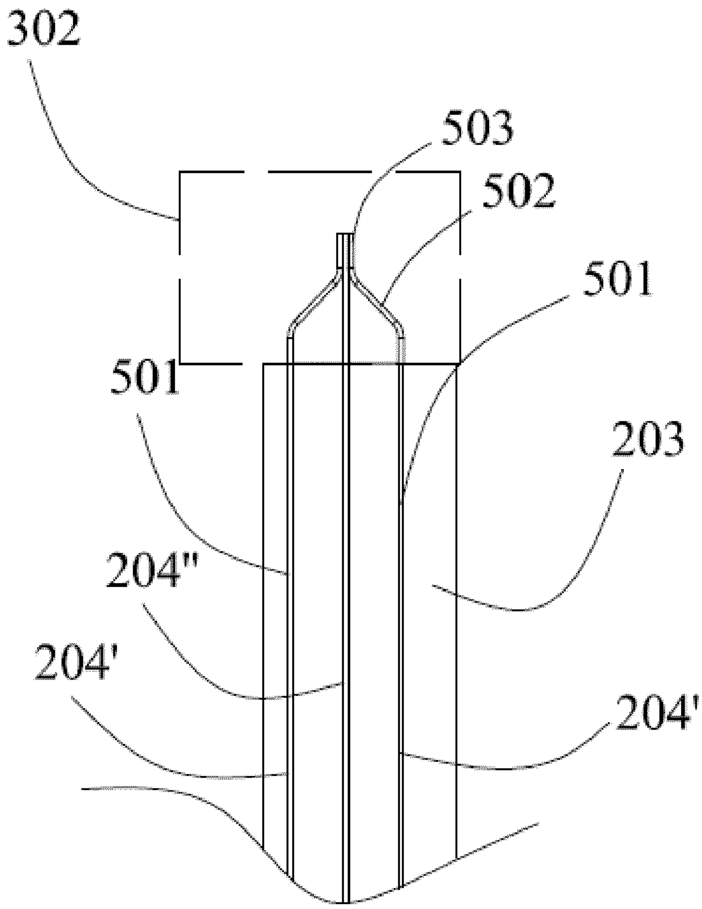

FIG. 12

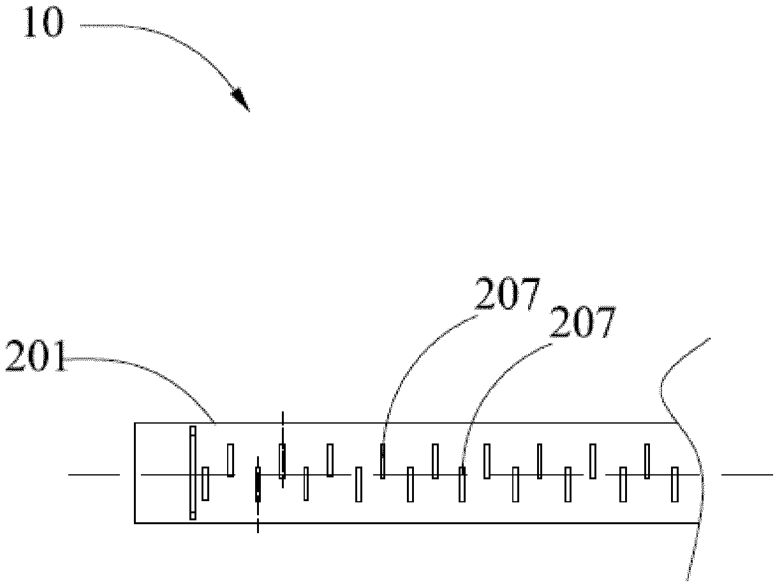

FIG. 13

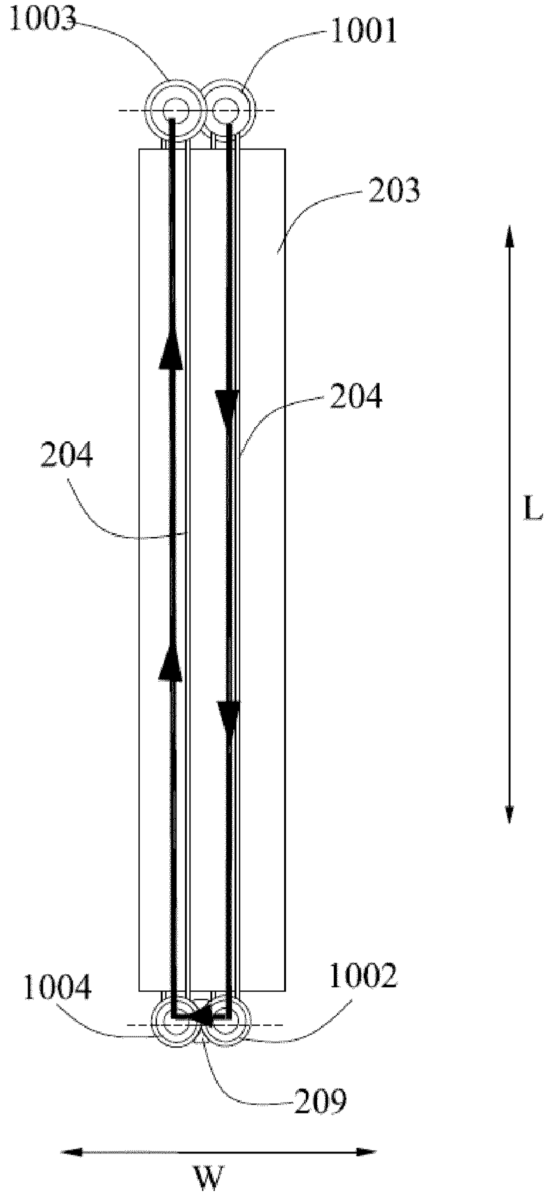

FIG. 14

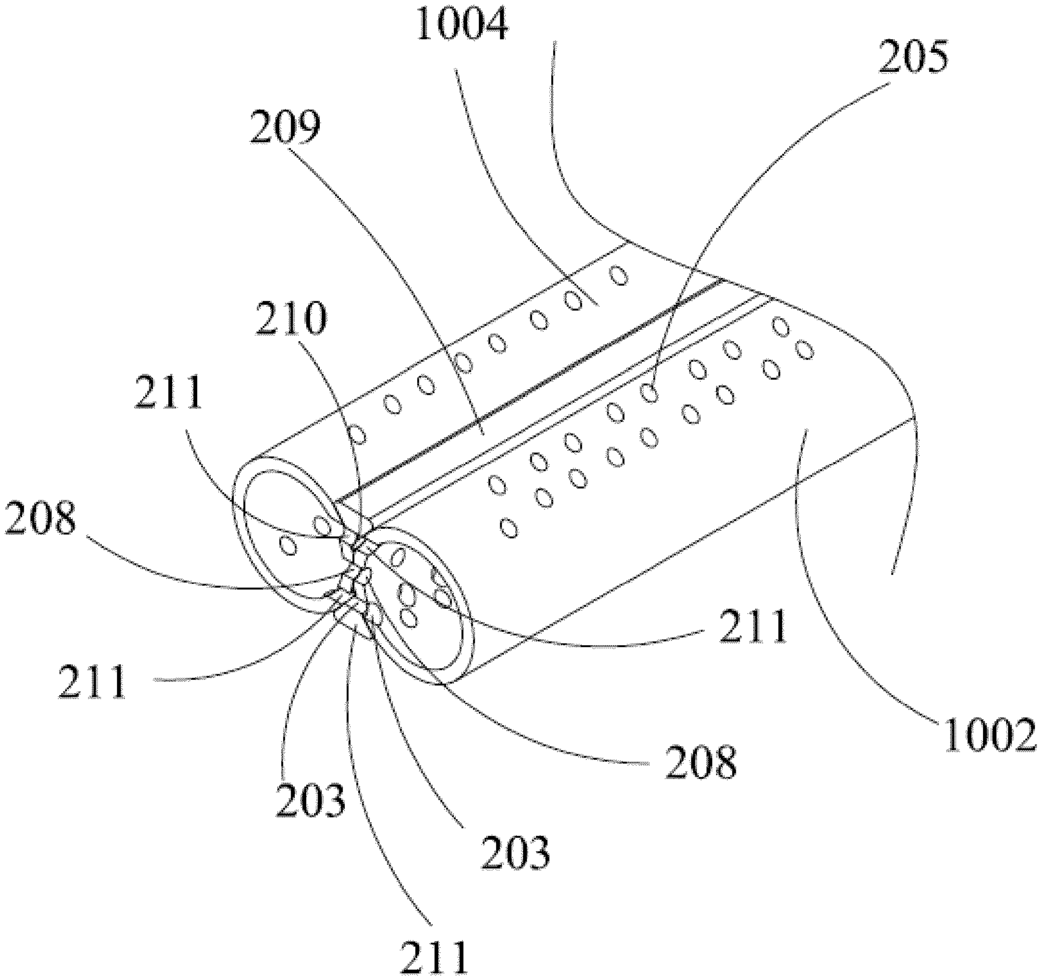

FIG. 15

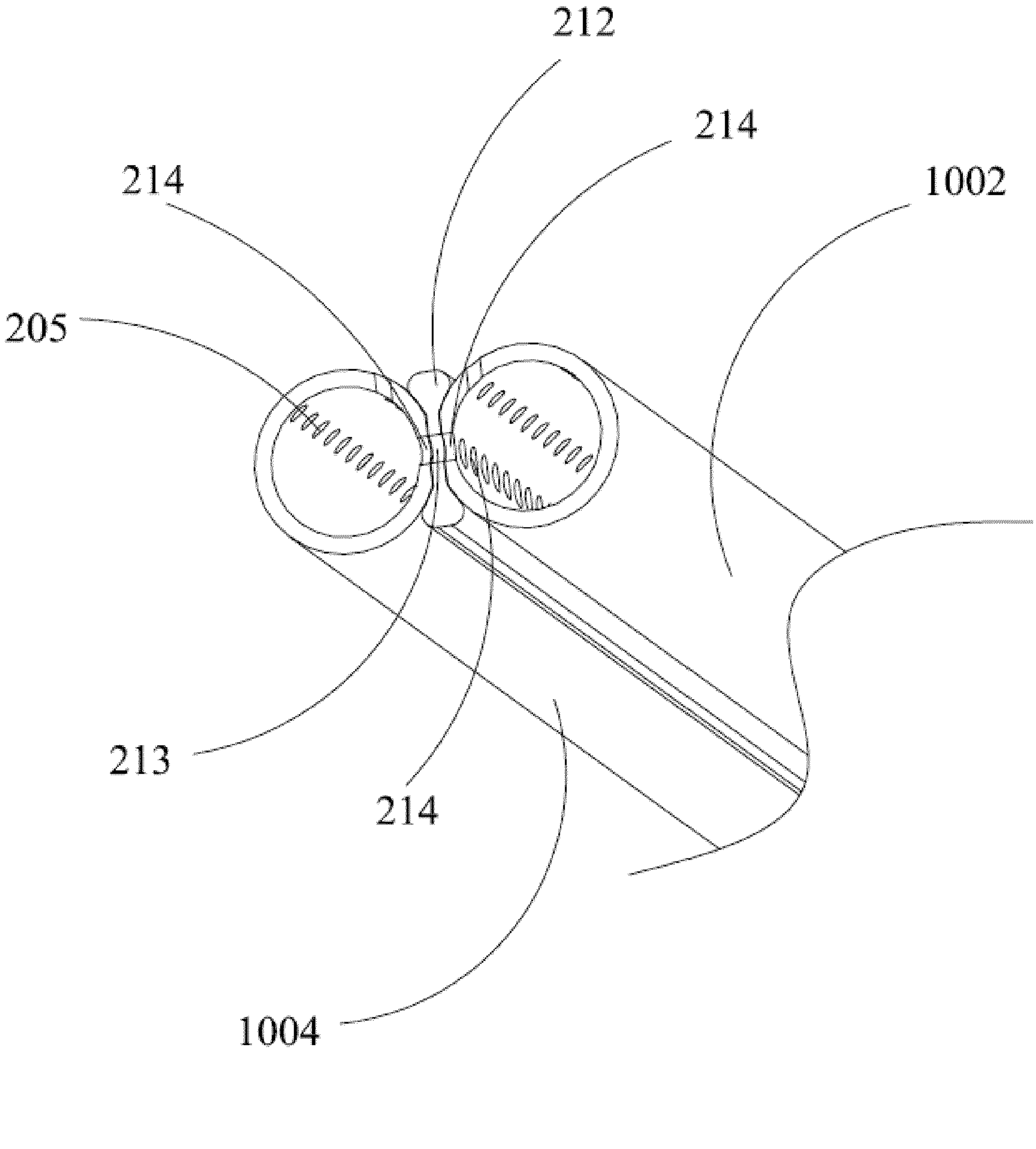

FIG. 16

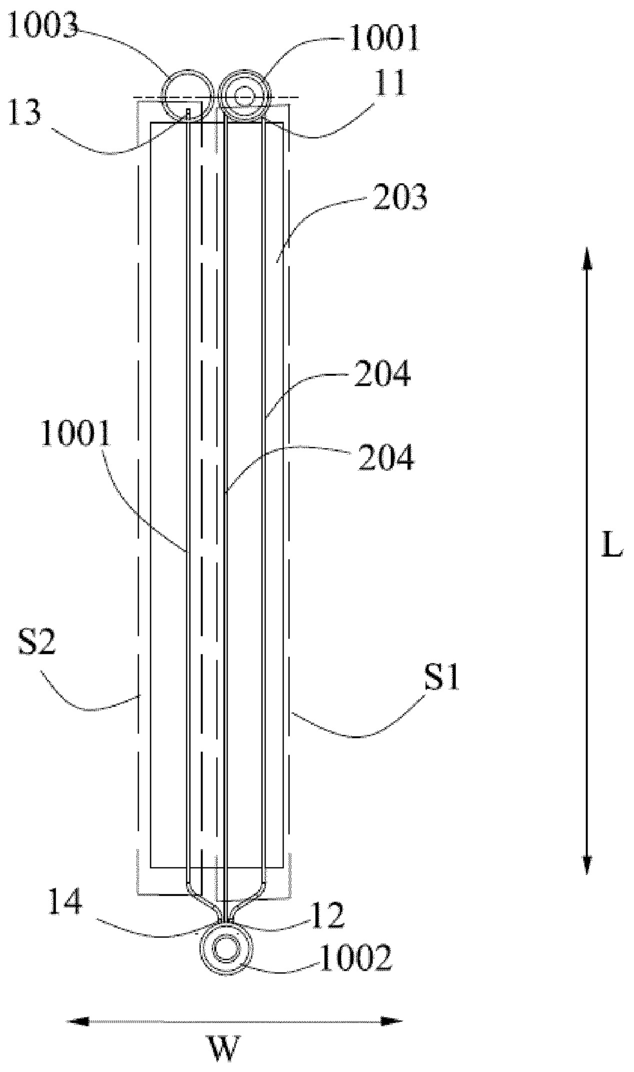

FIG. 17

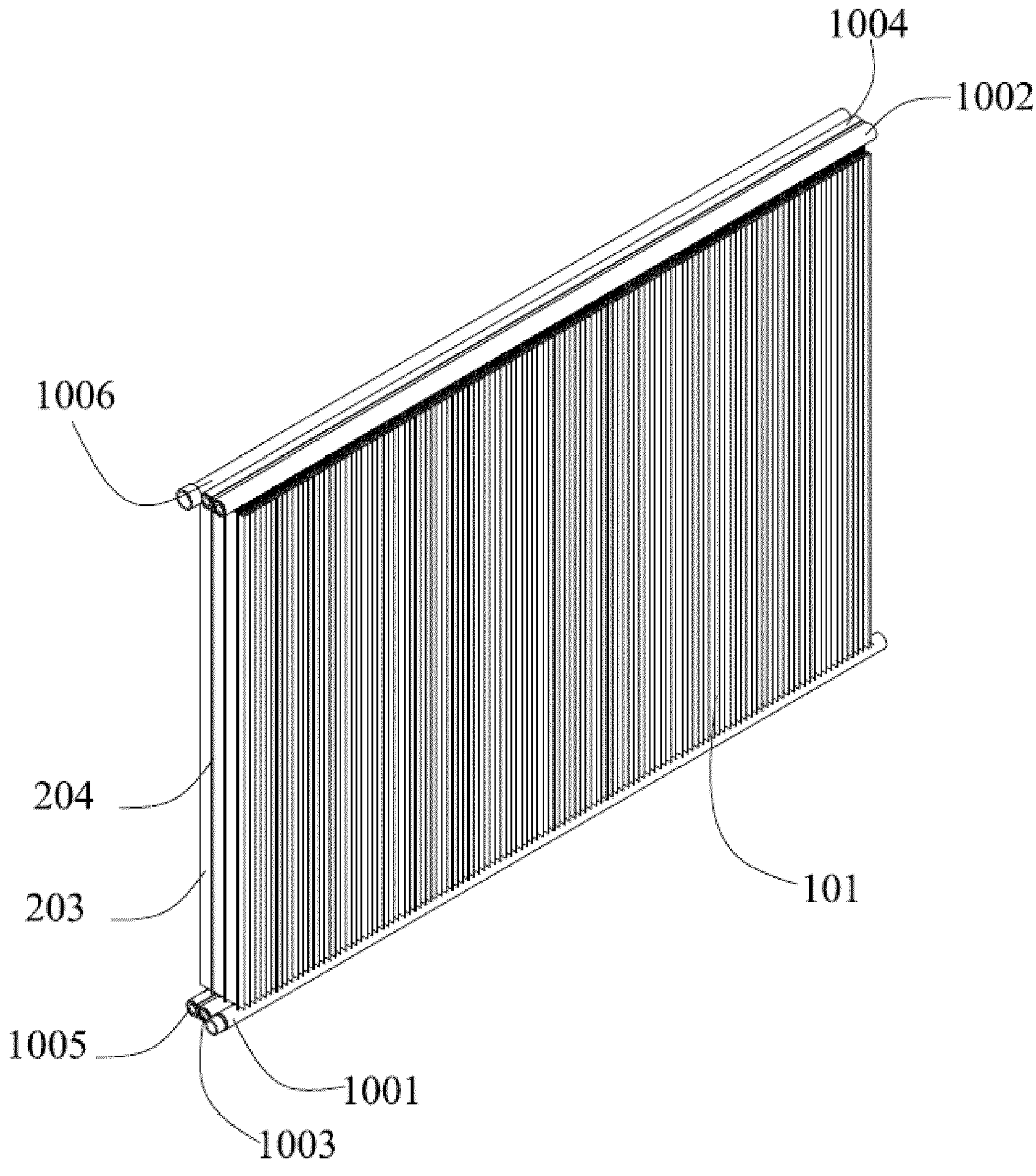

FIG. 18

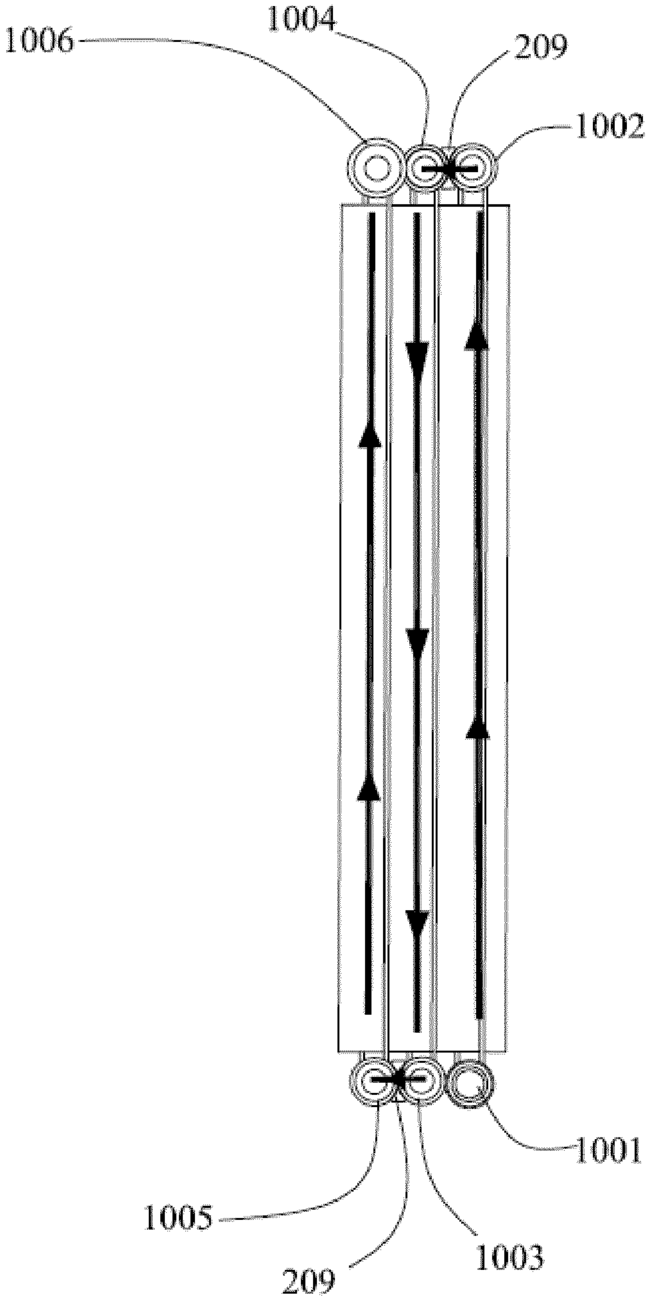

FIG. 19

REFERENCES CITED IN THE DESCRIPTION

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