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(54) HEAT EXCHANGER AND AIR CONDITIONING SYSTEM HAVING SAME

(57) Disclosed in the present invention are a heat exchanger and an air conditioning system having same. The heat exchanger comprises: a first heat exchanger core comprising a first sub-heat exchanger core and a second sub-heat exchanger core, wherein the first sub-heat exchanger core and the second sub-heat exchanger core comprise heat exchange tubes, the heat exchange tubes of the first sub-heat exchanger core and the second sub-heat exchanger core are connected to each other, and orthographic projections of the first sub-heat exchanger core and the second sub-heat exchanger core on a plane where the second sub-heat exchanger core is located at least overlap partially; and a second heat exchanger core comprising a heat exchange tube, wherein the heat exchange tube of the second heat exchanger core is connected to the heat exchange tubes of the first sub-heat exchanger core and the second sub-heat exchanger core. At the same incoming wind speed, the ratio of the wind resistance of the heat exchanger to the air passing through the first heat exchanger core to the wind resistance of the heat exchanger to the air passing through the second heat exchanger core is less than a predetermined value. By using the heat exchanger according to the present invention, the performance of the heat exchanger can be improved.

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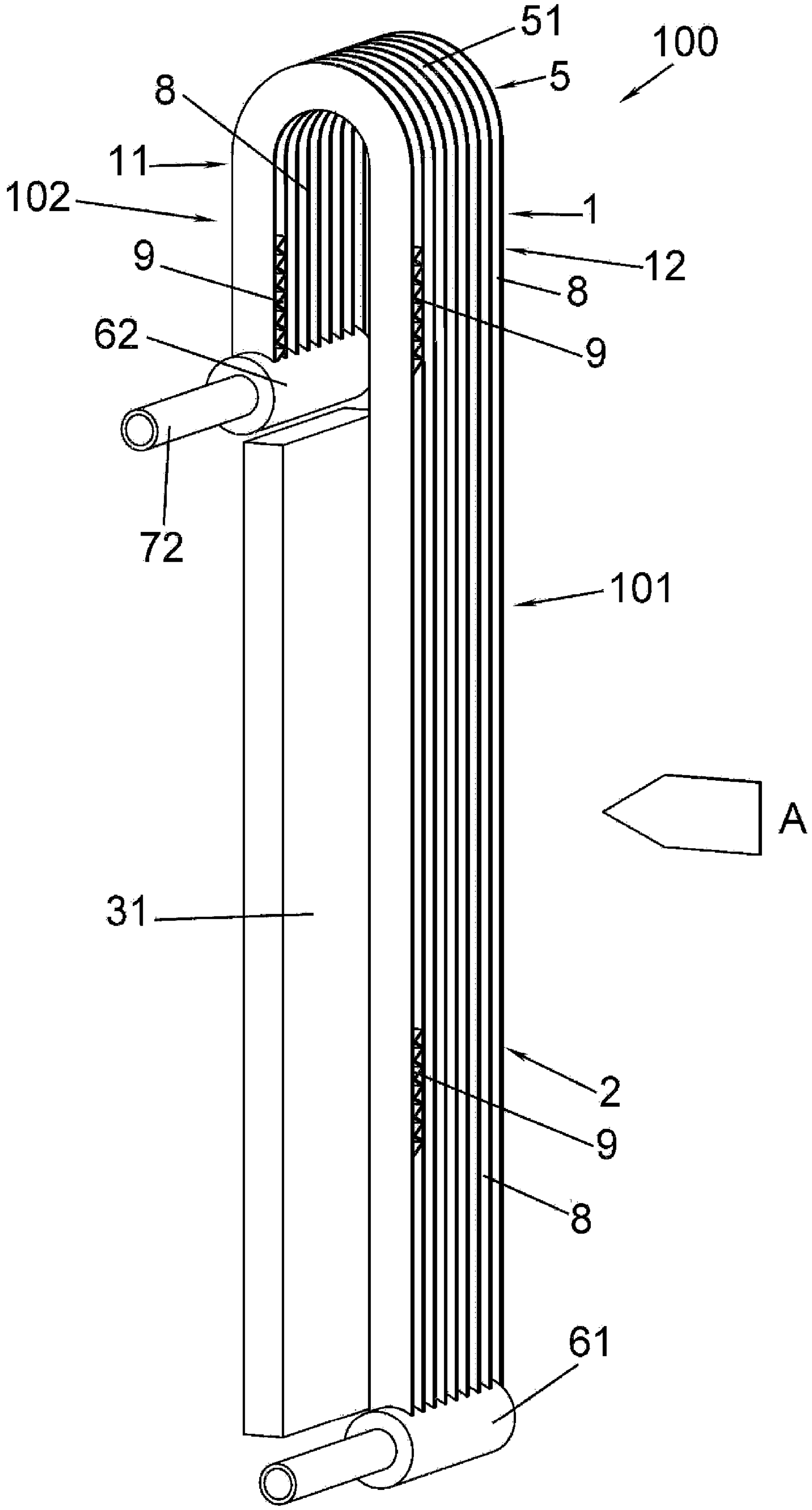

Fig.1

Description

Technical Field

[0001] The embodiments of the present invention relate to a heat exchanger and an air-conditioning system having same.

Background

[0002] A heat exchanger comprises a header and heat exchange tubes. The heat exchanger may comprise multiple rows of heat exchanger cores.

Summary of the Invention

[0003] An objective of embodiments of the present invention is to provide a heat exchanger and an air-conditioning system having same, which, for example, enable an improvement in heat exchanger performance.

[0004] Embodiments of the present invention provide a heat exchanger, comprising: a first heat exchanger core, the first heat exchanger core comprising a first secondary heat exchanger core and a second secondary heat exchanger core, each of the first secondary heat exchanger core and second secondary heat exchanger core comprising a heat exchange tube, the heat exchange tubes of the first secondary heat exchanger core and second secondary heat exchanger core being connected to each other, and orthographic projections of the first secondary heat exchanger core and second secondary heat exchanger core on a plane in which the second secondary heat exchanger core lies being at least partially overlapping; and a second heat exchanger core, the second heat exchanger core comprising a heat exchange tube, the heat exchange tube of the second heat exchanger core being connected to the heat exchange tube of the second secondary heat exchanger core of the first heat exchanger core, wherein, at the same incoming wind speed, the ratio of the wind resistance presented by the heat exchanger to air passing through the first heat exchanger core to the wind resistance presented by the heat exchanger to air passing through the second heat exchanger core is less than a predetermined value.

[0005] According to embodiments of the present invention, each of the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core further comprises a fin; the second heat exchanger core further comprises a fin; and at the same incoming wind speed, the wind resistance or pressure drop caused by at least a portion of at least one fin of the second heat exchanger core is greater than the wind resistance or pressure drop caused by at least a portion of at least one fin of the first heat exchanger core.

[0006] According to embodiments of the present invention, a cross-sectional area of at least one heat exchange tube of the second heat exchanger core is greater than a cross-sectional area of at least one heat exchange tube of the first heat exchanger core.

[0007] According to embodiments of the present invention, the heat exchanger further comprises: a first wind barrier plate, the first wind barrier plate being located at one side of the second heat exchanger core in the thickness direction of the second heat exchanger core; and orthographic projections of the first wind barrier plate and the second heat exchanger core on a plane in which the second heat exchanger core lies are at least partially overlapping.

[0008] According to embodiments of the present invention, the heat exchanger further comprises: a connecting part, the heat exchange tubes of the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core being connected via the connecting part,

the first wind barrier plate being located at the side of the first secondary heat exchanger core of the first heat exchanger core that is remote from the connecting part in the length direction of the heat exchange tube of the first secondary heat exchanger core of the first heat exchanger core.

[0009] According to embodiments of the present invention, the first wind barrier plate and the first secondary heat exchanger core of the first heat exchanger core are located at the same side of the second secondary heat exchanger core of the first heat exchanger core in the thickness direction of the second secondary heat exchanger core of the first heat exchanger core.

[0010] According to embodiments of the present invention, the heat exchanger further comprises: a second wind barrier plate, wherein orthographic projections of the second wind barrier plate and the first heat exchanger core on a plane in which the second secondary heat exchanger core of the first heat exchanger core lies are at least partially overlapping.

[0011] According to embodiments of the present invention, in the thickness direction of the second secondary heat exchanger core of the first heat exchanger core, the first wind barrier plate and the second wind barrier plate are located at the opposite side of the second secondary heat exchanger core of the first heat exchanger core from the first secondary heat exchanger core; and at the same incoming wind speed, the wind resistance of the second wind barrier plate is less than or equal to the wind resistance of the first wind barrier plate.

[0012] According to embodiments of the present invention, the heat exchanger further comprises: a third wind barrier plate, the third wind barrier plate being located between the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core in the thickness direction of the second secondary heat exchanger core of the first heat exchanger core.

[0013] According to embodiments of the present invention, the heat exchanger further comprises: a connecting part, the heat exchange tubes of the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core being connected via the connecting part; a first header, the first header being connected to the heat exchange tube of the second heat exchanger core at the side of the second heat exchanger core that is remote from the second secondary heat exchanger core of the first heat exchanger core; and a second header, the second header being connected to the heat exchange tube of the first secondary heat exchanger core of the first heat exchanger core at the side of the first secondary heat exchanger core of the first heat exchanger core that is remote from the connecting part.

[0014] According to embodiments of the present invention, a cross-sectional area of the first header is greater than a cross-sectional area of the second header.

[0015] According to embodiments of the present invention, the connecting part comprises multiple connecting tubes, and heat exchange tubes of the first secondary heat exchanger core of the first heat exchanger core are respectively connected to heat exchange tubes of the second secondary heat exchanger core of the first heat exchanger core via the multiple connecting tubes.

[0016] According to embodiments of the present invention, at least one of density, fin width, fin window angle, number of windows and window length of at least a portion of at least one fin of the second heat exchanger core is greater than at least one of density, fin width, fin window angle, number of windows and window length of at least a portion of at least one fin of the first heat exchanger core.

[0017] Embodiments of the present invention further provide an air-conditioning system, comprising the heat exchanger described above.

[0018] According to embodiments of the present invention, the heat exchanger further comprises: a connecting part, the heat exchange tubes of the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core being connected via the connecting part; a first header, the first header being connected to the heat exchange tube of the second heat exchanger core at the side of the second heat exchanger core that is remote from the second secondary heat exchanger core of the first heat exchanger core; and a second header, the second header being connected to the heat exchange tube of the first secondary heat exchanger core of the first heat exchanger core at the side of the first secondary heat exchanger core of the first heat exchanger core that is remote from the connecting part.

[0019] According to embodiments of the present invention, the first header and the second header are disposed horizontally in use.

[0020] According to embodiments of the present invention, the heat exchanger further comprises: a first header, the first header being connected to the heat exchange tube of the second heat exchanger core at the side of the second heat exchanger core that is remote from the second secondary heat exchanger core of the first heat exchanger core, wherein the first header is disposed horizontally in use, and the first header is below the second heat exchanger core in use.

[0021] According to embodiments of the present invention, in use, the first header is below the second heat exchanger core, and the second header is below the second secondary heat exchanger core of the first heat exchanger core.

[0022] According to embodiments of the present invention, in use, the first header is above the second heat exchanger core, and the second header is above the second secondary heat exchanger core of the first heat exchanger core.

[0023] According to embodiments of the present invention, in use, the second heat exchanger core and the second secondary heat exchanger core of the first heat exchanger core are located upstream of the first secondary heat exchanger core of the first heat exchanger core in the direction of flow of air through the heat exchanger.

[0024] According to embodiments of the present invention, in use, the second heat exchanger core and the second secondary heat exchanger core of the first heat exchanger core are located downstream of the first secondary heat exchanger core of the first heat exchanger core in the direction of flow of air through the heat exchanger.

[0025] By using the heat exchanger and the air-conditioning system having same according to embodiments of the present invention, for example, heat exchanger performance can be improved.

Brief Description of the Drawings

[0026]

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

Fig. 2 is a schematic perspective view of a heat exchanger according to another embodiment of the present invention.

Fig. 3 is a schematic perspective view of fins of a heat exchanger according to an embodiment of the present invention; and

Fig. 4 is a sectional view of the fins shown in Fig. 3.

Detailed Description of the Invention

[0027] The present invention is explained further below in conjunction with the accompanying drawings and specific embodiments.

[0028] An air-conditioning system according to embodiments of the present invention comprises a compressor, and heat exchangers serving as an evaporator and a condenser.

[0029] Referring to Figs. 1 - 2, a heat exchanger 100 according to embodiments of the present invention comprises: a first heat exchanger core 1, the first heat exchanger core 1 comprising a first secondary heat exchanger core 11 and a second secondary heat exchanger core 12, each of the first secondary heat exchanger core 11 and second secondary heat exchanger core 12 comprising a heat exchange tube 8, the heat exchange tubes 8 of the first secondary heat exchanger core 11 and second secondary heat exchanger core 12 being connected to each other, and orthographic projections of the first secondary heat exchanger core 11 and second secondary heat exchanger core 12 on a plane in which the second secondary heat exchanger core 12 lies being at least partially overlapping; and a second heat exchanger core 2, the second heat exchanger core 2 comprising a heat exchange tube 8, the heat exchange tube 8 of the second heat exchanger core 2 being connected to the heat exchange tube 8 of the second secondary heat exchanger core 12 of the first heat exchanger core 1. At the same incoming wind speed, the ratio of the wind resistance presented by the heat exchanger 100 to air A passing through the first heat exchanger core 1 to the wind resistance presented by the heat exchanger 100 to air A passing through the second heat exchanger core 2 is less than a predetermined value. For example, when the heat exchange tubes and fins of the first heat exchanger core and second heat exchanger core have the same structure and no wind barrier plate is installed, at the same incoming wind speed, the ratio of the wind resistance presented by the heat exchanger to passage through the first heat exchanger core to the wind resistance presented by the heat exchanger to passage through the second heat exchanger core is approximately 2. The wind resistance presented by the heat exchanger 100 to air A passing through the first heat exchanger core 1 is only the wind resistance presented by the first heat exchanger core 1 to air A if no wind barrier plate is present, but if a wind barrier plate is present, it is the wind resistance presented by the first heat exchanger core 1 and the wind barrier plate to air A. Similarly, the wind resistance presented by the heat exchanger 100 to air A passing through the second heat exchanger core 2 is only the wind resistance presented by the second heat exchanger core 2 to air A if no wind barrier plate is present, but if a wind barrier plate is present, it is the wind resistance presented by the second heat exchanger core 2 and the wind barrier plate to air A. It must be explained that the expression "at the same incoming wind speed" does not mean that the incoming wind speeds of the first heat exchanger core and second heat exchanger core when the heat exchanger is being used need to be the same; rather, it means that the ratio of the wind resistance presented by the heat exchanger to passage through the first heat exchanger core to the wind resistance presented by the heat exchanger to passage through the second heat exchanger core needs to be measured for comparison when the incoming wind speeds are the same. When mentioned below, the expression "at the same incoming wind speed" may be interpreted in a similar way.

[0030] In embodiments of the present invention, referring to Figs. 1-4, each of the first secondary heat exchanger core 11 and second secondary heat exchanger core 12 of the first heat exchanger core 1 further comprises a fin 9; the second heat exchanger core 2 further comprises a fin 9; and at the same incoming wind speed, the wind resistance or pressure drop caused by at least a portion of at least one fin 9 of the second heat exchanger core 2 is greater than the wind resistance or pressure drop caused by at least a portion of at least one fin 9 of the first heat exchanger core 1. For example, the density of at least a portion of at least one fin 9 of the second heat exchanger core 2 is greater than the density of the fin 9 of the first heat exchanger core 1. For the wave-shaped fin shown in Figs. 3 and 4, the fin density may be the number of crests or troughs per unit length of the wave. If the fin is a plate-like fin with a heat exchange tube passing through it, the fin density is the number of fins per unit length perpendicular to the plane of fin extension. In addition, the wind resistance or pressure drop may also be adjusted by changing at least one of the fin width W (in the wind direction A), the angle α of fin windows 91 (the angle α to the wind direction A), the number of windows 91, and the length H of the windows 91. For example, at least one of the density, fin width W, angle α of fin windows 91, number of windows 91 and length H of windows 91 of at least a portion of at least one fin 9 of the second heat exchanger core 2 is greater than at least one of the density, fin width W, angle α of fin windows 91, number of windows 91 and length H of windows 91 of at least a portion of at least one fin 9 of the first heat exchanger core 1. It must be explained that only some fins have been drawn demonstratively in Figs. 1 and 2; the number and distribution, etc. of fins are not limited to this.

[0031] In embodiments of the present invention, referring to Figs. 1 and 2, a cross-sectional area of at least one heat exchange tube 8 of the second heat exchanger core 2 is greater than a cross-sectional area of at least one heat exchange tube 8 of the first heat exchanger core 1.

[0032] In some embodiments of the present invention, the fin of the second heat exchanger core 2 may be the same as the fin of the second secondary heat exchanger core 12 of the first heat exchanger core 1; at the same incoming wind speed, the wind resistance or pressure drop caused by at least a portion of at least one fin 9 of the second heat exchanger core 2 is greater than the wind resistance or pressure drop caused by at least a portion of at least one fin 9 of the first secondary heat exchanger core 11 of the first heat exchanger core 1. In some examples of the present invention, a flat tube of the second heat exchanger core 2 may be the same as a flat tube of the second secondary heat exchanger core 12 of the first heat exchanger core 1, and a cross-sectional area of at least one heat exchange tube 8 of the second heat exchanger core 2 is greater than a cross-sectional area of at least one heat exchange tube 8 of the first secondary heat exchanger core 11 of the first heat exchanger core 1. By configuring the fin and/or heat exchange tube of the second heat exchanger core 2 to be the same as the fin and/or heat exchange tube of the second secondary heat exchanger core 12 of the first heat exchanger core 1, the manufacturing difficulty can be reduced.

[0033] In embodiments of the present invention, referring to Figs. 1 and 2, the heat exchanger 100 further comprises a first wind barrier plate 31, the first wind barrier plate 31 being located at one side of the second heat exchanger core 2 in the thickness direction of the second heat exchanger core 2; and orthographic projections of the first wind barrier plate 31 and the second heat exchanger core 2 on a plane in which the second heat exchanger core 2 lies are at least partially overlapping.

[0034] In embodiments of the present invention, referring to Figs. 1 and 2, the heat exchanger 100 further comprises a connecting part 5, wherein the heat exchange tubes 8 of the first secondary heat exchanger core 11 and second secondary heat exchanger core 12 of the first heat exchanger core 1 are connected via the connecting part 5; and in the length direction of the heat exchange tube 8 of the first secondary heat exchanger core 11 of the first heat exchanger core 1, the first wind barrier plate 31 is located at the side of the first secondary heat exchanger core 11 of the first heat exchanger core 1 that is remote from the connecting part 5. According to an example of the present invention, the first wind barrier plate 31 and the first secondary heat exchanger core 11 of the first heat exchanger core 1 are located at the same side of the second secondary heat exchanger core 12 of the first heat exchanger core 1 in the thickness direction of the second secondary heat exchanger core 12 of the first heat exchanger core 1.

[0035] In embodiments of the present invention, referring to Fig. 2, the heat exchanger 100 further comprises a second wind barrier plate 32, wherein orthographic projections of the second wind barrier plate 32 and the first heat exchanger core 1 on a plane in which the second secondary heat exchanger core 12 of the first heat exchanger core 1 lies are at least partially overlapping. According to an example of the present invention, in the thickness direction of the second secondary heat exchanger core 12 of the first heat exchanger core 1, the first wind barrier plate 31 and the second wind barrier plate 32 are located at the opposite side of the second secondary heat exchanger core 12 of the first heat exchanger core 1 from the first secondary heat exchanger core 11; and at the same incoming wind speed, the wind resistance of the second wind barrier plate 32 is less than or equal to the wind resistance of the first wind barrier plate 31.

[0036] In embodiments of the present invention, referring to Fig. 2, the heat exchanger 100 further comprises a third wind barrier plate 33, the third wind barrier plate 33 being located between the first secondary heat exchanger core 11 and second secondary heat exchanger core 12 of the first heat exchanger core 1 in the thickness direction of the second secondary heat exchanger core 12 of the first heat exchanger core 1.

[0037] In embodiments of the present invention, referring to Fig. 2, the heat exchanger 100 further comprises a first header 61, the first header 61 being connected to the heat exchange tube 8 of the second heat exchanger core 2 at the side of the second heat exchanger core 2 that is remote from the second secondary heat exchanger core 12 of the first heat exchanger core 1; and a second header 62, the second header 62 being connected to the heat exchange tube 8 of the first secondary heat exchanger core 11 of the first heat exchanger core 1 at the side of the first secondary heat exchanger core 11 of the first heat exchanger core 1 that is remote from the connecting part 5. A cross-sectional area of the first header 61 may be greater than a cross-sectional area of the second header 62.

[0038] In embodiments of the present invention, referring to Figs. 1 and 2, the connecting part 5 comprises multiple connecting tubes 51, and heat exchange tubes 8 of the first secondary heat exchanger core 11 of the first heat exchanger core 1 are respectively connected to heat exchange tubes 8 of the second secondary heat exchanger core 12 of the first heat exchanger core 1 via the multiple connecting tubes 51.

[0039] In embodiments of the present invention, referring to Figs. 1 and 2, the first header 61 and the second header 62 are disposed horizontally in use.

[0040] In embodiments of the present invention, referring to Figs. 1 and 2, the first header 61 is disposed horizontally in use, and the first header 61 is below the second heat exchanger core 2 in use.

[0041] In embodiments of the present invention, referring to Figs. 1 and 2, in use, the first header 61 is below the second heat exchanger core 2, and the second header 62 is below the second secondary heat exchanger core 12 of the first heat exchanger core 1.

[0042] In embodiments of the present invention, referring to Figs. 1 and 2, in use, the first header 61 is above the second heat exchanger core 2, and the second header 62 is above the second secondary heat exchanger core 12 of the first heat exchanger core 1.

[0043] In embodiments of the present invention, referring to Figs. 1 and 2, in use, the second heat exchanger core 2 and the second secondary heat exchanger core 12 of the first heat exchanger core 1 are located upstream of the first secondary heat exchanger core 11 of the first heat exchanger core 1 in the direction of flow of air A through the heat exchanger 100.

[0044] In embodiments of the present invention, referring to Figs. 1 and 2, in use, the second heat exchanger core 2 and the second secondary heat exchanger core 12 of the first heat exchanger core 1 are located downstream of the first secondary heat exchanger core 11 of the first heat exchanger core 1 in the direction of flow of air A through the heat exchanger 100.

[0045] Although the headers have been described with reference to the drawings, the headers may have any suitable shape and structure; there is no limitation to the headers shown in Figs. 1 and 2.

[0046] Referring to Figs. 1 - 2, the heat exchanger 100 according to embodiments of the present invention comprises: a first row of heat exchanger cores 101 formed by the second secondary heat exchanger core 12 of the first heat exchanger core 1 and the second heat exchanger core 2, the first row of heat exchanger cores 101 comprising multiple heat exchange tubes 8; a second row of heat exchanger cores 102 formed by the first secondary heat exchanger core 11 of the first heat exchanger core 1 and located at one side of the first row of heat exchanger cores 101 in the thickness direction of the first row of heat exchanger cores 101, the second row of heat exchanger cores 102 comprising multiple heat exchange tubes 8, the length of the heat exchange tubes 8 of the first row of heat exchanger cores 101 being greater than the length of the heat exchange tubes 8 of the second row of heat exchanger cores 102; and a connecting part 5, the multiple heat exchange tubes 8 of the first row of heat exchanger cores 101 being connected to the multiple heat exchange tubes 8 of the second row of heat exchanger cores 102 via the connecting part 5. The difference between the wind resistance presented by the heat exchanger 100 to air A passing through the second row of heat exchanger cores 102 and the wind resistance presented by the heat exchanger 100 to air A passing through the first row of heat exchanger cores 101 at an outer side of the second row of heat exchanger cores 102 is less than a predetermined value.

[0047] In embodiments of the present invention, referring to Figs. 1 and 2, the connecting part 5 comprises multiple connecting tubes 51, the multiple heat exchange tubes 8 of the first row of heat exchanger cores 101 being respectively connected to the multiple heat exchange tubes 8 of the second row of heat exchanger cores 102 via the multiple connecting tubes 51. In the embodiments shown in the figures, the first row of heat exchanger cores 101 and the second row of heat exchanger cores 102 are formed by bending the same heat exchanger cores, with the bent part of the heat exchanger cores forming the connecting part 5. The connecting part 5 may comprise heat exchange tubes as the multiple connecting tubes 51, and fins arranged alternately with the multiple connecting tubes 51.

[0048] In embodiments of the present invention, referring to Figs. 1-4, the first row of heat exchanger cores 101 further comprises multiple fins 9 arranged alternately with the multiple heat exchange tubes 8; the second row of heat exchanger cores 102 further comprises multiple fins 9 arranged alternately with the multiple heat exchange tubes 8; and the density of the fins 9 of the second row of heat exchanger cores 102 is less than the density of the fins 9 of the first row of heat exchanger cores 101. For example, the density of fins used in the second row of heat exchanger cores 102 is less than the density of fins of the first row of heat exchanger cores 101, so that the second row of heat exchanger cores 102 has low wind resistance. As another example, the density of fins used in the part of the first row of heat exchanger cores 101 that extends beyond the second row of heat exchanger cores 102 is greater than the density of fins in the part of the first row of heat exchanger cores 101 that faces the second row of heat exchanger cores 102, to increase the wind resistance of this part. The wind speed can thus be substantially equalized over the entire heat exchanger surface, to increase the amount of heat exchanged. At least one of the first row of heat exchanger cores 101 and the second row of heat exchanger cores 102 may not comprise fins.

[0049] In embodiments of the present invention, referring to Figs. 1 and 2, a cross-sectional area of the heat exchange tubes 8 of the second row of heat exchanger cores 102 is less than a cross-sectional area of the heat exchange tubes 8 of the first row of heat exchanger cores 101.

[0050] In embodiments of the present invention, referring to Figs. 1 and 2, the heat exchanger 100 further comprises a first wind barrier plate 31, the first wind barrier plate 31 being located at one side of the first row of heat exchanger cores 101 in the thickness direction of the first row of heat exchanger cores 101, and located at the side of the second row of heat exchanger cores 102 that is remote from the connecting part 5 in the length direction of the heat exchange tubes 8. The first wind barrier plate 31 is close to the first row of heat exchanger cores 101, and can generate wind resistance. This makes the wind field of the first row of heat exchanger cores 101 and the second row of heat exchanger cores 102 more uniform, to increase the amount of heat exchanged.

[0051] In an embodiment of the present invention, referring to Fig. 1, the first wind barrier plate 31 and the second row of heat exchanger cores 102 are located at the same side of the first row of heat exchanger cores 101 in the thickness direction of the first row of heat exchanger cores 101; in another embodiment of the present invention, referring to Fig. 2, the first wind barrier plate 31 and the second row of heat exchanger cores 102 are located at different sides of the first row of heat exchanger cores 101 in the thickness direction of the first row of heat exchanger cores 101. As shown in Fig. 1, the first wind barrier plate 31 may be placed at the windward side of the first row of heat exchanger cores 101. The size of the first wind barrier plate 31 is close to the difference in size of the first row of heat exchanger cores 101 and the second row of heat exchanger cores 102.

[0052] In embodiments of the present invention, referring to Fig. 2, the heat exchanger 100 further comprises a second wind barrier plate 32; the first wind barrier plate 31 and the second wind barrier plate 32 are located at the opposite side of the first row of heat exchanger cores 101 from the second row of heat exchanger cores 102 in the thickness direction of the first row of heat exchanger cores 101, the second wind barrier plate 32 is located at the side of the first wind barrier plate 31 that faces the connecting part 5 in the length direction of the heat exchange tubes 8, and the wind resistance of the second wind barrier plate 32 is less than the wind resistance of the first wind barrier plate 31. As shown in Fig. 1, air A flows through the first row of heat exchanger cores 101 and then flows through the first wind barrier plate 31 and second wind barrier plate 32. The overall size of the first wind barrier plate 31 and second wind barrier plate 32 may be close to the size of the heat exchanger 100.

[0053] In embodiments of the present invention, referring to Figs. 1 and 2, the heat exchanger 100 further comprises a first header 61, the first header 61 being connected to the multiple heat exchange tubes 8 of the first row of heat exchanger cores 101 at the side of the first row of heat exchanger cores 101 that is remote from the connecting part 5; and a second header 62, the second header 62 being connected to the multiple heat exchange tubes 8 of the second row of heat exchanger cores 102 at the side of the second row of heat exchanger cores 102 that is remote from the connecting part 5.

[0054] In embodiments of the present invention, referring to Fig. 1, the heat exchanger 100 further comprises a third wind barrier plate 33, the third wind barrier plate 33 being located between the first row of heat exchanger cores 101 and the second header 62 in the thickness direction of the first row of heat exchanger cores 101.

[0055] In embodiments of the present invention, the wind barrier plate may also be impermeable to wind. The wind barrier plate may have a filtering effect. The wind barrier plate may be a filter mesh, a grille or a perforated plate, etc. There are no restrictions on the wind barrier plate material, which may be metal, plastic, nylon, etc.

[0056] In embodiments of the present invention, referring to Figs. 1 and 2, the first header 61 is disposed horizontally in use, and the first header 61 is below the first row of heat exchanger cores 101 in use.

[0057] In embodiments of the present invention, referring to Figs. 1 and 2, the first header 61 and the second header 62 are disposed horizontally or substantially horizontally in use. For example, the first header 61 is below the first row of heat exchanger cores 101 and the second header 62 is below the second row of heat exchanger cores 102 in use; or the first header 61 is above the first row of heat exchanger cores 101 and the second header 62 is above the second row of heat exchanger cores 102 in use. For example, the first row of heat exchanger cores 101 is located upstream of the second row of heat exchanger cores 102 in the direction of flow of air A through the heat exchanger 100 in use; or the first row of heat exchanger cores 101 is located downstream of the second row of heat exchanger cores 102 in the direction of flow of air A through the heat exchanger 100 in use.

[0058] The first row of heat exchanger cores 101 is located upstream of the second row of heat exchanger cores 102 in the direction of flow of air A through the heat exchanger 100 in use; for example, when the heat exchanger is being used as an evaporator, refrigerant enters the heat exchanger 100 through a connecting tube 72 connected to the second header 62, and refrigerant can flow out of the heat exchanger 100 through a connecting tube connected to the first header 61. Air and refrigerant exchange heat in counterflow, and the amount of heat exchanged can thus be increased. Furthermore, a large amount of material is saved with only a small reduction in the amount of heat exchanged (only removing the material of the second row of heat exchanger cores 102). Compared with a single-row heat exchanger, this design can save space (in the length direction of the heat exchange tubes).

[0059] The first row of heat exchanger cores 101 is located downstream of the second row of heat exchanger cores 102 in the direction of flow of air A through the heat exchanger 100 in use. For example, when the heat exchanger is being used as an evaporator (the air temperature being higher than the refrigerant temperature, the second row of heat exchanger cores 102 being the first row in the wind flow direction, and the first row of heat exchanger cores 101 being the second row), refrigerant enters the heat exchanger 100 through the connecting tube 72 connected to the second header 62, and refrigerant can flow out of the heat exchanger 100 through the connecting tube connected to the first header 61. Air and refrigerant exchange heat in parallel flow; when the refrigerant reaches the extremities (close to the first header 61) of the heat exchange tubes 8 of the first row of heat exchanger cores 101, the refrigerant must attain an overheated state and increase in temperature. If the two rows of the heat exchanger were of the same length, then air would need to pass through the first row, and after passing through the first row would be reduced in temperature and begin to pass through the second row, but the temperature of the refrigerant in the second row is rising, so the temperature difference between the air and refrigerant will be very small or even non-existent, which is not conducive to heat exchange, and overheating of the refrigerant is unlikely to occur. This can be avoided by the design in question.

[0060] The first header 61 is below the first row of heat exchanger cores 101 in use. For example, when the heat exchanger is being used as a condenser, refrigerant undergoes a phase transition from a gaseous state to a liquid state in the flow direction, and its density increases greatly. If the first header 61 is in a lower region, then in the process of phase transition of refrigerant, liquid refrigerant can flow to the lower region automatically under the action of gravity, so the pressure drop of refrigerant along its course can be reduced, thereby increasing the amount of heat exchanged in the heat exchanger.

[0061] The first header 61 is above the first row of heat exchanger cores 101 in use. For example, when the heat exchanger is being used as an evaporator, refrigerant undergoes a phase transition from a dual-phase gaseous/liquid state to a purely gaseous state in the flow direction, and its density decreases greatly. If the first header 61 is in an upper region, then in the process of phase transition of refrigerant, gaseous refrigerant can rise to the upper region automatically under the action of buoyancy, so the pressure drop of refrigerant along its course can be reduced, thereby increasing the amount of heat exchanged in the heat exchanger.

[0062] In embodiments of the present invention, referring to Figs. 1 and 2, a cross-sectional area of the first header 61 is greater than a cross-sectional area of the second header 62. For example, the diameter of the first header 61 is greater than the diameter of the second header 62, the ratio of the diameter of the first header 61 to the diameter of the second header 62 being 2 - 1. When the diameter of the second header 62 is smaller, the distance from the multiple heat exchange tubes 8 of the first row of heat exchanger cores 101 to the multiple heat exchange tubes 8 of the second row of heat exchanger cores 102 can be reduced, thus reducing the volume of the heat exchanger in the wind direction. By configuring the first header 61 to be larger, the pressure drop at the refrigerant side in the first header 61 can be lowered. For example, when the heat exchanger is a condenser, the pressure drop of refrigerant through the first header 61 is lower, so the saturated condensing temperature of refrigerant in the heat exchange tubes will be higher; thus, the temperature difference with respect to air will be greater, thus increasing the amount of heat exchanged.

[0063] In embodiments of the present invention, referring to Figs. 1 and 2, when the heat exchanger 100 is used as an evaporator, refrigerant enters the heat exchanger 100 through the connecting tube 72 connected to the second header 62.

[0064] In embodiments of the present invention, referring to Figs. 1 and 2, the ratio of the length of the heat exchange tubes 8 of the first row of heat exchanger cores 101 to the length of the heat exchange tubes 8 of the second row of heat exchanger cores 102 is 0.1 - 1. The length of the heat exchange tubes 8 of the second row of heat exchanger cores 102 is greater than 100 mm.

[0065] By using the heat exchanger 100 according to embodiments of the present invention, the performance of the heat exchanger 100 can be improved.

[0066] Although the above embodiments have been described, certain features in the above embodiments can be combined to form new embodiments.

Claims

1. A heat exchanger, comprising:

a first heat exchanger core, the first heat exchanger core comprising a first secondary heat exchanger core and a second secondary heat exchanger core, each of the first secondary heat exchanger core and second secondary heat exchanger core comprising a heat exchange tube, the heat exchange tubes of the first secondary heat exchanger core and second secondary heat exchanger core being connected to each other, and orthographic projections of the first secondary heat exchanger core and second secondary heat exchanger core on a plane in which the second secondary heat exchanger core lies being at least partially overlapping; and

a second heat exchanger core, the second heat exchanger core comprising a heat exchange tube, the heat exchange tube of the second heat exchanger core being connected to the heat exchange tube of the second secondary heat exchanger core of the first heat exchanger core,

wherein, at the same incoming wind speed, the ratio of the wind resistance presented by the heat exchanger to air passing through the first heat exchanger core to the wind resistance presented by the heat exchanger to air passing through the second heat exchanger core is less than a predetermined value.

2. The heat exchanger as claimed in claim 1, wherein:

each of the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core further comprises a fin;

the second heat exchanger core further comprises a fin; and

at the same incoming wind speed, the wind resistance or pressure drop caused by at least a portion of at least one fin of the second heat exchanger core is greater than the wind resistance or pressure drop caused by at least a portion of at least one fin of the first heat exchanger core.

3. The heat exchanger as claimed in claim 1, wherein: a cross-sectional area of at least one heat exchange tube of the second heat exchanger core is greater than a cross-sectional area of at least one heat exchange tube of the first heat exchanger core.

4. The heat exchanger as claimed in claim 1, further comprising:
a first wind barrier plate, the first wind barrier plate being located at one side of the second heat exchanger core in the thickness direction of the second heat exchanger core; and orthographic projections of the first wind barrier plate and the second heat exchanger core on a plane in which the second heat exchanger core lies are at least partially overlapping.

5. The heat exchanger as claimed in claim 4, further comprising:

a connecting part, the heat exchange tubes of the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core being connected via

the connecting part,
the first wind barrier plate being located at the side of the first secondary heat exchanger core of the first heat exchanger core that is remote from the connecting part in the length direction of the heat exchange tube of the first secondary heat exchanger core of the first heat exchanger core.

6. The heat exchanger as claimed in claim 5, wherein: the first wind barrier plate and the first secondary heat exchanger core of the first heat exchanger core are located at the same side of the second secondary heat exchanger core of the first heat exchanger core in the thickness direction of the second secondary heat exchanger core of the first heat exchanger core.

7. The heat exchanger as claimed in claim 4, further comprising:
a second wind barrier plate, wherein orthographic projections of the second wind barrier plate and the first heat exchanger core on a plane in which the second secondary heat exchanger core of the first heat exchanger core lies are at least partially overlapping.

8. The heat exchanger as claimed in claim 7, wherein: in the thickness direction of the second secondary heat exchanger core of the first heat exchanger core, the first wind barrier plate and the second wind barrier plate are located at the opposite side of the second secondary heat exchanger core of the first heat exchanger core from the first secondary heat exchanger core; and at the same incoming wind speed, the wind resistance of the second wind barrier plate is less than or equal to the wind resistance of the first wind barrier plate.

9. The heat exchanger as claimed in claim 1, further comprising:
a third wind barrier plate, the third wind barrier plate being located between the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core in the thickness direction of the second secondary heat exchanger core of the first heat exchanger core.

10. The heat exchanger as claimed in claim 1, further comprising:

a connecting part, the heat exchange tubes of the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core being connected via the connecting part;
a first header, the first header being connected to the heat exchange tube of the second heat exchanger core at the side of the second heat exchanger core that is remote from the second secondary heat exchanger core of the first heat exchanger core; and
a second header, the second header being connected to the heat exchange tube of the first secondary heat exchanger core of the first heat exchanger core at the side of the first secondary heat exchanger core of the first heat exchanger core that is remote from the connecting part.

11. The heat exchanger as claimed in claim 10, wherein: a cross-sectional area of the first header is greater than a cross-sectional area of the second header.

12. The heat exchanger as claimed in claim 5 or 10, wherein:
the connecting part comprises multiple connecting tubes, and heat exchange tubes of the first secondary heat exchanger core of the first heat exchanger core are respectively connected to heat exchange tubes of the second secondary heat exchanger core of the first heat exchanger core via the multiple connecting tubes.

13. The heat exchanger as claimed in claim 1, wherein: at least one of density, fin width, fin window angle, number of windows and window length of at least a portion of at least one fin of the second heat exchanger core is greater than at least one of density, fin width, fin window angle, number of windows and window length of at least a portion of at least one fin of the first heat exchanger core.

14. An air-conditioning system, comprising:
the heat exchanger as claimed in claim 1.

15. The air-conditioning system as claimed in claim 14, wherein:
the heat exchanger further comprises:

a connecting part, the heat exchange tubes of the first secondary heat exchanger core and second secondary heat exchanger core of the first heat exchanger core being connected via the connecting part;
a first header, the first header being connected to the heat exchange tube of the second heat exchanger core at the side of the second heat exchanger core that is remote from the second secondary heat exchanger core of the first heat exchanger core; and
a second header, the second header being connected to the heat exchange tube of the first secondary heat exchanger core of the first heat exchanger core at the side of the first secondary heat exchanger core of the first heat exchanger core that is remote from the connecting part.

16. The air-conditioning system as claimed in claim 15, wherein:
the first header and the second header are disposed horizontally in use.

17. The air-conditioning system as claimed in claim 14, wherein:
the heat exchanger further comprises:

a first header, the first header being connected to the heat exchange tube of the second heat exchanger core at the side of the second heat exchanger core that is remote from the second secondary heat exchanger core of the first heat exchanger core;
wherein the first header is disposed horizontally in use, and the first header is below the second heat exchanger core in use.

18. The air-conditioning system as claimed in claim 15, wherein:
in use, the first header is below the second heat exchanger core, and the second header is below the second secondary heat exchanger core of the first heat exchanger core.

19. The air-conditioning system as claimed in claim 15, wherein:
in use, the first header is above the second heat exchanger core, and the second header is above the second secondary heat exchanger core of the first heat exchanger core.

20. The air-conditioning system as claimed in claim 14, wherein:
in use, the second heat exchanger core and the second secondary heat exchanger core of the first heat exchanger core are located upstream of the first secondary heat exchanger core of the first heat exchanger core in the direction of flow of air through the heat exchanger.

21. The air-conditioning system as claimed in claim 14, wherein:
in use, the second heat exchanger core and the second secondary heat exchanger core of the first heat exchanger core are located downstream of the first secondary heat exchanger core of the first heat exchanger core in the direction of flow of air through the heat exchanger.

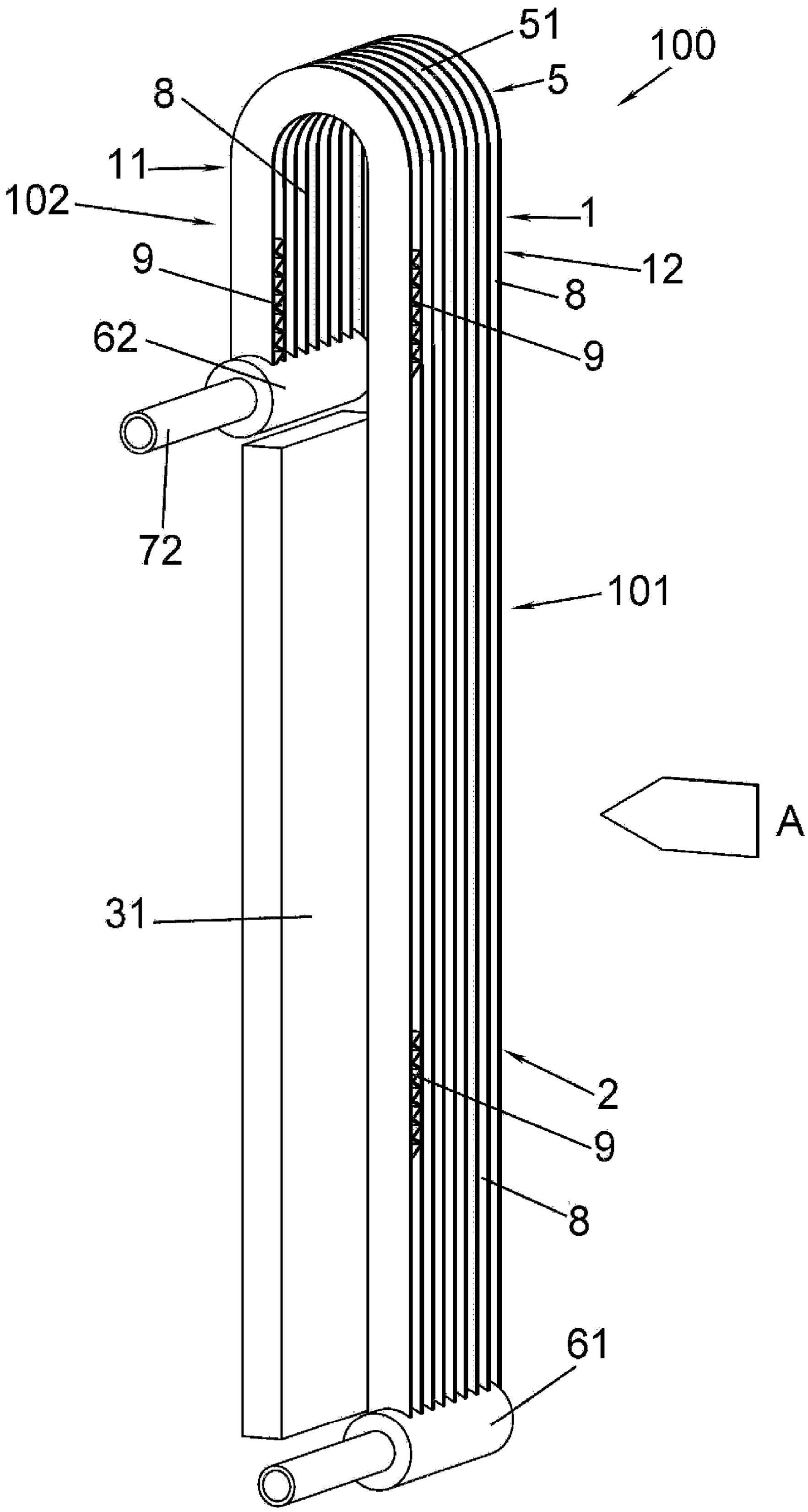

Fig.1

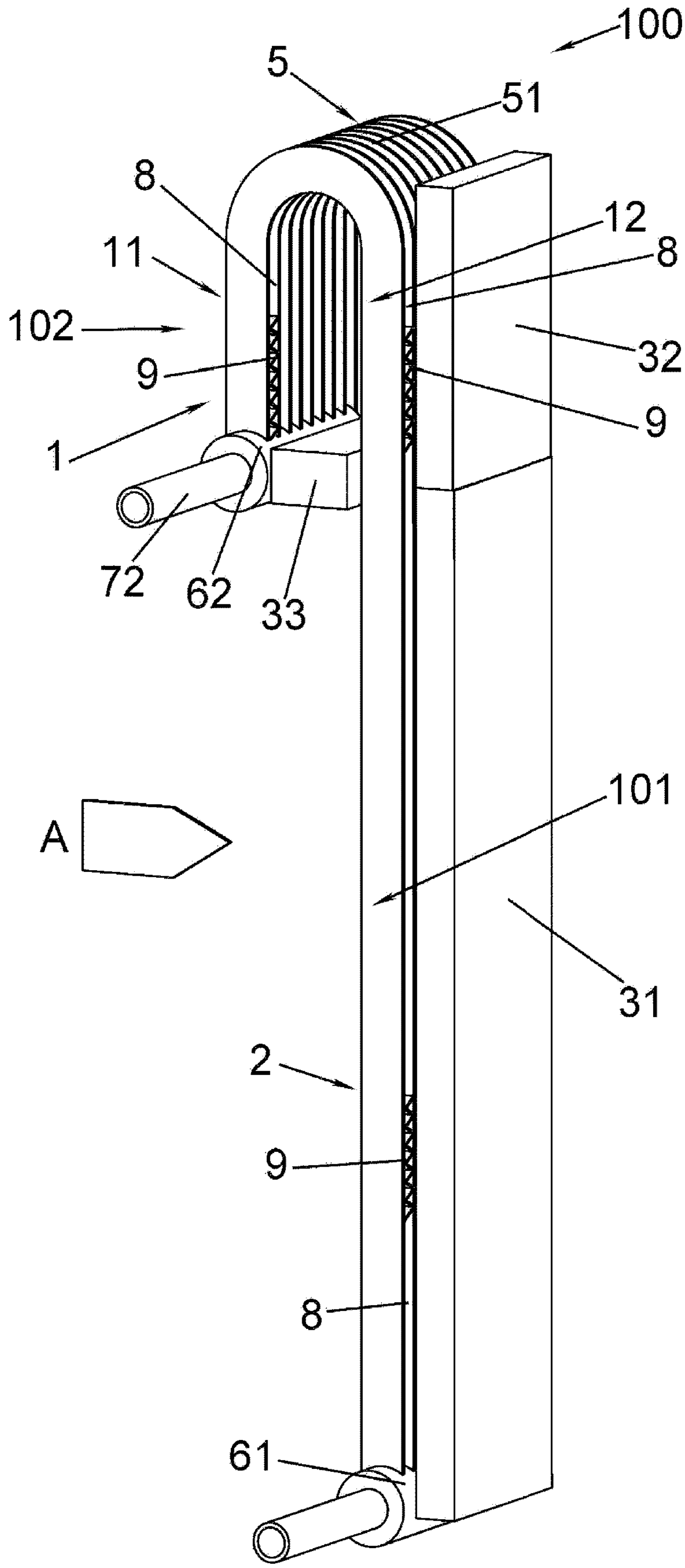

Fig.2

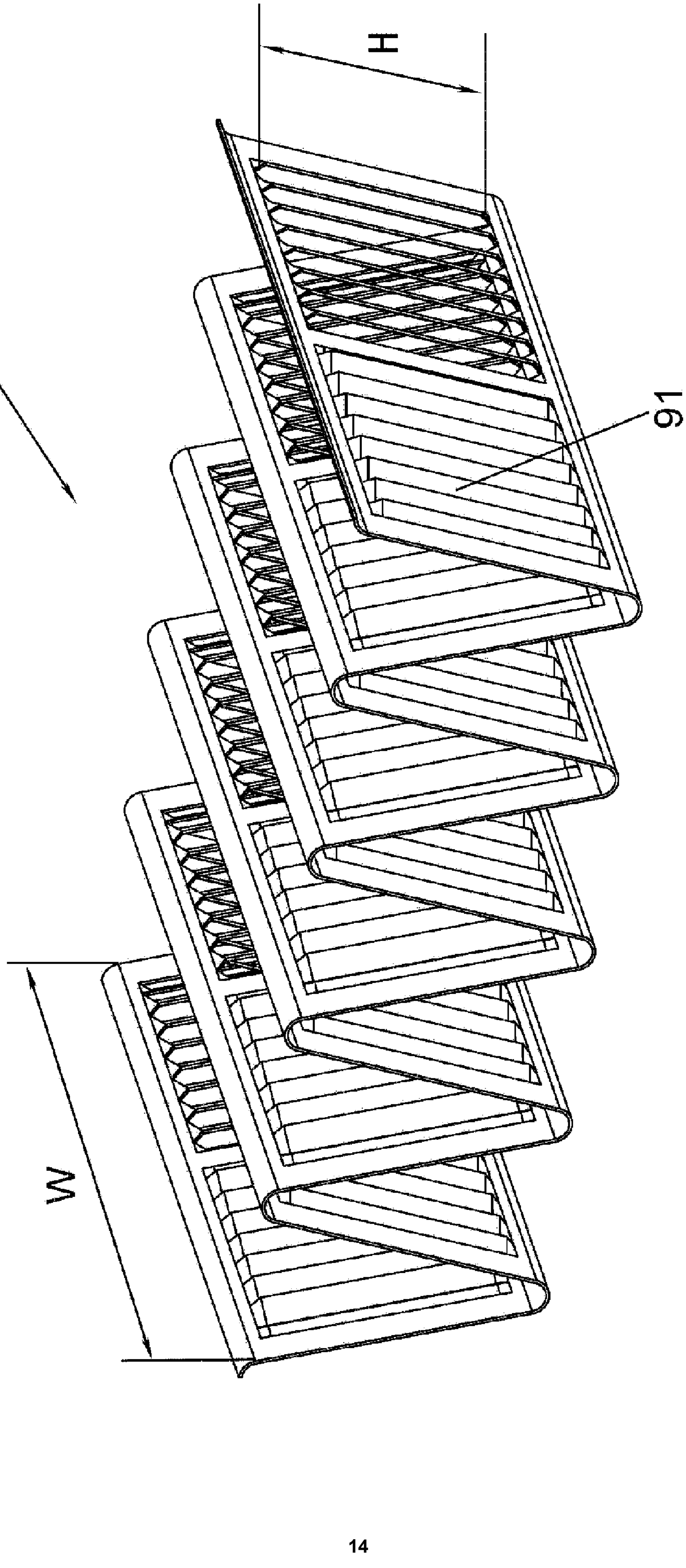

Fig.3

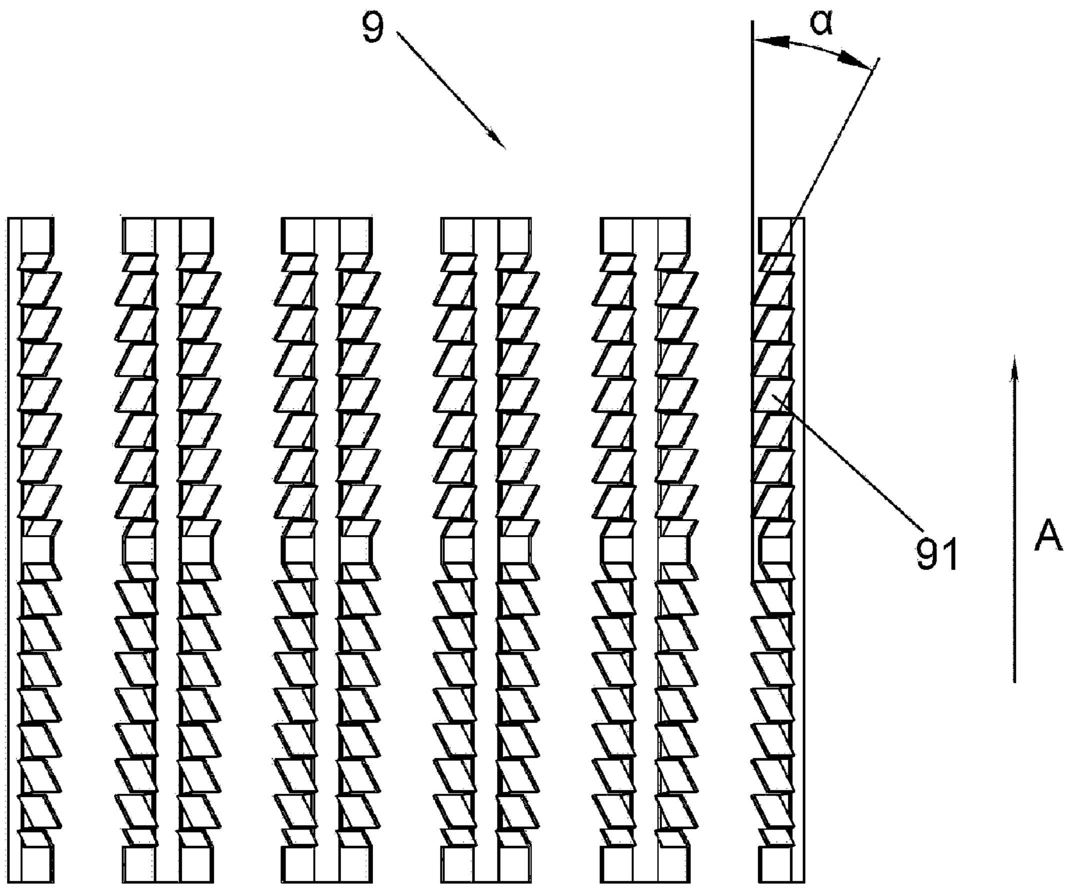

Fig.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/123738

A. CLASSIFICATION OF SUBJECT MATTER

F25B 39/00(2006.01)i; F24F 5/00(2006.01)i; F24F 13/30(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25B39,F24F,F28D,F28F

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

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

CNABS; CNTXT; CNKI; DWPI; SIPOABS: 换热器, 芯体, 集流管, 连接管, 风阻, 空气阻力, 翅片, heat, exchanger, header, tubu, pipe, connecting, air, wind, friction, resistance

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 214333108 U (DANFOSS AS) 01 October 2021 (2021-10-01) description, specific embodiments and figures	1-21
X	CN 209960732 U (SANHUA (HANGZHOU) MICRO CHANNEL HEAT EXCHANGER CO., LTD.) 17 January 2020 (2020-01-17) description paragraphs [0030]-[0034], paragraph [0062], figures 1-3	1, 10-12, 14-21
A	CN 205300044 U (DANFOSS MICRO-CHANNEL HEAT EXCHANGER (JIAXING) CO., LTD.) 08 June 2016 (2016-06-08) entire document	1-21
A	CN 106642826 A (DANFOSS MICRO-CHANNEL HEAT EXCHANGER (JIAXING) CO., LTD. et al.) 10 May 2017 (2017-05-10) entire document	1-21
A	CN 109780919 A (SANHUA (HANGZHOU) MICRO CHANNEL HEAT EXCHANGER CO., LTD.) 21 May 2019 (2019-05-21) entire document	1-21
A	WO 2017071355 A1 (DANFOSS MICRO CHANNEL HEAT EXCHANGER JIAXING CO LTD) 04 May 2017 (2017-05-04) entire document	1-21

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

* Special categories of cited documents:
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- "P" document published prior to the international filing date but later than the priority date claimed
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 December 2021	**06 January 2022**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China**	Authorized officer
Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/123738

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CN 205300044 U	08 June 2016	None	
CN 106642826 A	10 May 2017	EP 3370019 B1	17 June 2020
		KR 20180077188 A	06 July 2018
		JP 2018532093 A	01 November 2018
		EP 3370019 A1	05 September 2018
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		US 2018340746 A1	29 November 2018
		EP 3370019 A4	26 June 2019
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		KR 20180077188 A	06 July 2018
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		CN 106642826 B	19 April 2019
		US 2018340746 A1	29 November 2018
		EP 3370019 A4	26 June 2019

Form PCT/ISA/210 (patent family annex) (January 2015)