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(54) HEAT EXCHANGER AND AIR CONDITIONER COMPRISING SAID HEAT EXCHANGER

WÄRMETAUSCHER UND KLIMAANLAGE MIT DEM WÄRMETAUSCHER

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(73) Proprietor: **MITSUBISHI ELECTRIC CORPORATION**
Chiyoda-ku
Tokyo 100-8310 (JP)

(72) Inventors:
- **HARA, Naoto**
  Tokyo 100-8310 (JP)
- **SAIKUSA, Tetsuji**
  Tokyo 100-8310 (JP)

(74) Representative: **Witte, Weller & Partner Patentanwälte mbB**
Postfach 10 54 62
70047 Stuttgart (DE)

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EP 4 155 645 B1

Description

Technical Field

[0001] The present disclosure relates to a heat exchanger including a plurality of flat tubes and fins each of which is provided between adjacent flat tubes, and relates to an air-conditioning apparatus including the heat exchanger.

Background Art

[0002] Conventionally, there is a known heat exchanger including a plurality of heat transfer tubes and a plurality of fins, each of the plurality of heat transfer tubes having refrigerant flow passages, each of the plurality of fins being provided between adjacent heat transfer tubes. For example, a heat exchanger disclosed in Patent Literature 1 is configured to include a pair of headers, flat refrigerant flow pipes, and corrugated fins, the pair of headers being disposed in a spaced apart manner in the lateral direction and extending in the up-down direction, the flat refrigerant flow pipes being arranged at intervals in the up-down direction and each having both end portions, that is, left and right end portions, respectively connected to the headers, each of the corrugated fins being disposed between the adjacent refrigerant flow pipes.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Patent No. 4423096

Summary of Invention

Technical Problem

[0004] The heat exchanger disclosed in Patent Literature 1 is affected by weight when distributing refrigerant to the refrigerant flow pipes through the header and hence, refrigerant non-uniformly flows into the refrigerant flow pipes. For example, during a heating operation, refrigerant easily flows toward a lower portion where wind speed is low and a lesser amount of refrigerant flows to a position of an upper portion where wind speed is high and hence, heat exchange may not be efficiently performed. To improve such a distribution of refrigerant, for example, there is a method that uses capillary tubes. However, in this case, it is necessary to distribute refrigerant to the respective refrigerant flow pipes at appropriate flow rates by adjusting distribution of refrigerant with the plurality of capillary tubes having different diameters and lengths and hence, costs may increase. Document WO 2009/104659 A1, which is considered as the closest prior art, discloses a heat exchanger having fins which are distanced from both the upper and lower header. The fins are provided at the same distance for both headers.

[0005] To solve the above-mentioned problem, a heat exchanger is developed that includes: a plurality of flat tubes each of which has refrigerant flow passages through which refrigerant flows in the up-down direction, the plurality of flat tubes being arranged parallel to each other at intervals; a plurality of fins each of which is provided between adjacent flat tubes of the plurality of flat tubes; an upper header to which an upper end portion of each of the plurality of flat tubes are connected; and a lower header to which a lower end portion of each of the plurality of flat tubes are connected. However, in such a heat exchanger, there is a possibility that moisture in the air forms condensation on the surfaces of the fins and condensation water flows down through the fins to the lower portions of the fins and water drops collect at the lower end portions of the fins. When outside air drops below freezing point, there is a possibility that water collecting at the lower end portions of the fins freezes, thus damaging the heat exchanger. For this reason, it is necessary for water drops flowing through the fins to the lower portions of the fins to be drained to the outside without being allowed to collect at the lower end portions of the fins.

[0006] The present disclosure has been made to solve the above-mentioned problems, and it is an object of the present disclosure to provide a heat exchanger having a structure, where a plurality of flat tubes have a plurality of refrigerant flow passages extending in the up-down direction and fins are provided between the plurality of flat tubes, thus preventing a situation where water drops collect at the lower end portions of the fins, and to provide an air-conditioning apparatus including the heat exchanger. Solution to Problem

[0007] A heat exchanger according to the invention is defined in independent claim 1 and includes: a plurality of flat tubes each of which has a refrigerant flow passage through which refrigerant flows in an up-down direction, the plurality of flat tubes being arranged parallel to each other at intervals; a plurality of fins each of which is provided between adjacent flat tubes of the plurality of flat tubes; an upper header to which an upper end portion of each of the plurality of flat tubes is connected; and a lower header to which a lower end portion of each of the plurality of flat tubes is connected, wherein lower end portions of the plurality of fins are not joined to the lower header, and a lower gap is formed between the lower end portions of the plurality of fins and the lower header.

[0008] An air-conditioning apparatus according to another embodiment of the present disclosure includes the above-mentioned heat exchanger.

Advantageous Effects of Invention

[0009] In the heat exchanger and the air-conditioning apparatus including the heat exchanger according to the invention, the lower end portions of the respective fins are not joined to the lower header, and the lower gap for

drainage is formed between the lower end portions of the respective fins and the lower header. Accordingly, it is possible to cause water drops to fall down to an area below the fins and to drain through the lower gap and hence, it is possible to prevent a situation where water drops collect at the lower end portions of the fins.

Brief Description of Drawings

[0010]

[Fig. 1] Fig. 1 is a refrigerant circuit diagram of an air-conditioning apparatus according to Embodiment 1.

[Fig. 2] Fig. 2 is a perspective view showing the external appearance of an outdoor unit of the air-conditioning apparatus according to Embodiment 1.

[Fig. 3] Fig. 3 is a front view schematically showing a heat exchanger according to Embodiment 1.

[Fig. 4] Fig. 4 is a perspective view of a cross section of a portion IV shown in Fig. 3 as viewed from above.

[Fig. 5] Fig. 5 is a front view schematically showing a heat exchanger according to Embodiment 2.

Description of Embodiments

[0011] Hereinafter, Embodiments of the present invention will be described with reference to drawings. In the respective drawings, identical or corresponding components are given the same reference symbols, and the description of such components is omitted or simplified when appropriate. The shapes, the sizes, the arrangement, and the like of the components described in the respective drawings may be suitably changed.

Embodiment 1.

[0012] Fig. 1 is a refrigerant circuit diagram of an air-conditioning apparatus according to Embodiment 1. As shown in Fig. 1, an outdoor unit 100 of an air-conditioning apparatus 300 according to Embodiment 1 forms the air-conditioning apparatus 300 together with an indoor unit 200 that performs air conditioning in the room. The air-conditioning apparatus 300 includes a refrigerant circuit through which refrigerant cycles. The refrigerant circuit is formed by connecting a compressor 101, a flow switching device 102, an indoor heat exchanger 201, an expansion mechanism 103, and an outdoor heat exchanger 104 by refrigerant pipes 105. The outdoor unit 100 includes the compressor 101, the flow switching device 102, the expansion mechanism 103, and the outdoor heat exchanger 104. The indoor unit 200 includes the indoor heat exchanger 201. Constitutional elements that the air-conditioning apparatus 300 includes are not limited to the constitutional elements shown in the drawings, and the air-conditioning apparatus 300 may include other constitutional elements.

[0013] The compressor 101 compresses suctioned refrigerant into a high temperature and high pressure state, and discharges the refrigerant. For example, the compressor 101 may be a positive-displacement compressor configured to be able to vary an operating capacity (frequency) and driven by a motor controlled by an inverter.

[0014] The flow switching device 102 is a four-way valve, for example, and has a function of switching a flow passage for refrigerant. During a cooling operation, the flow switching device 102 switches a refrigerant flow passage such that the refrigerant discharge side of the compressor 101 is connected with the gas side of the outdoor heat exchanger 104 and the refrigerant suction side of the compressor 101 is connected with the gas side of the indoor heat exchanger 201. In contrast, during a heating operation, the flow switching device 102 switches the refrigerant flow passage such that the refrigerant discharge side of the compressor 101 is connected with the gas side of the indoor heat exchanger 201 and the refrigerant suction side of the compressor 101 is connected with the gas side of the outdoor heat exchanger 104. The flow switching device 102 may be formed by combining two-way valves or three-way valves.

[0015] During the cooling operation, the indoor heat exchanger 201 serves as an evaporator, thus causing refrigerant that flows out from the expansion mechanism 103 to exchange heat with air. During the heating operation, the indoor heat exchanger 201 serves as a condenser, thus causing refrigerant that is discharged from the compressor 101 to exchange heat with air. The indoor heat exchanger 201 suctions indoor air by using an indoor fan, causes the air to exchange heat with refrigerant, and then supplies the air to the inside of the room.

[0016] The expansion mechanism 103 causes refrigerant flowing through the refrigerant circuit to expand by reducing the pressure of the refrigerant. For example, the expansion mechanism 103 may be an electronic expansion valve where an opening degree is variably controlled.

[0017] During the cooling operation, the outdoor heat exchanger 104 serves as a condenser, thus causing refrigerant discharged from the compressor 101 to exchange heat with air. During the heating operation, the outdoor heat exchanger 104 serves as an evaporator, thus causing refrigerant that flows out from the expansion mechanism 103 to exchange heat with air. The outdoor heat exchanger 104 suctions outdoor air by using an outdoor fan, causes the air to exchange heat with refrigerant, and then discharges the air to the outside.

[0018] Next, the action of the air-conditioning apparatus 300 during the cooling operation will be described. Gas refrigerant at high temperature and high pressure discharged from the compressor 101 passes through the flow switching device 102. Then, the gas refrigerant flows into the outdoor heat exchanger 104 and is caused to exchange heat with air, thus condensing and liquifying. The condensed and liquified refrigerant is reduced in pressure by the expansion mechanism 103, thus becoming two-phase gas-liquid refrigerant of low pressure.

Then, the two-phase gas-liquid refrigerant flows into the indoor heat exchanger 201 and is caused to exchange heat with air, thus being gasified. The gasified refrigerant passes through the flow switching device 102 and is suctioned by the compressor 101.

[0019] Next, the action of the air-conditioning apparatus 300 during the heating operation will be described. Gas refrigerant at high temperature and high pressure discharged from the compressor 101 passes through the flow switching device 102. Then, the gas refrigerant flows into the indoor heat exchanger 201 and is caused to exchange heat with air, thus condensing and liquifying. The condensed and liquified refrigerant is reduced in pressure by the expansion mechanism 103, thus becoming two-phase gas-liquid refrigerant of low pressure. Then, the two-phase gas-liquid refrigerant flows into the outdoor heat exchanger 104 and is caused to exchange heat with air, thus being gasified. The gasified refrigerant passes through the flow switching device 102 and is suctioned by the compressor 101.

[0020] Next, the structure of the outdoor unit 100 of the air-conditioning apparatus 300 according to Embodiment 1 will be described with reference to Fig. 2. Fig. 2 is a perspective view showing the external appearance of the outdoor unit of the air-conditioning apparatus according to Embodiment 1. As shown in Fig. 2, the outdoor unit 100 of the air-conditioning apparatus 300 is a top-flow type outdoor unit where the upper surface of a housing 5 has an air outlet 54 and the outdoor fan is disposed at a position directly below the air outlet 54. The outdoor unit 100 of the air-conditioning apparatus 300 is configured such that components, such as the compressor 101, the flow switching device 102, the expansion mechanism 103, the outdoor heat exchanger 104, the outdoor fan, and a controller, are housed in the housing 5 forming an outer shell.

[0021] The housing 5 includes a bottom plate 50 and frame members 51, the bottom plate 50 being provided on the bottom surface, the frame members 51 extending upward from corner portions of the bottom plate 50. The housing 5 has a quadrangular shape as viewed in a plan view. The housing 5 has four side surfaces surrounded by the frame members 51 disposed at corner portions, and each side surface has an opening port. The upper portion of each opening port forms an air inlet 53 that takes air into the housing 5, and the outdoor heat exchanger 104 is disposed along the air inlet 53. The lower portion of each opening port is closed by a side panel 52 being a designed metal plate. The left and right side edge portions of the side panel 52 are fixed to the frame members 51 by fastening parts, such as screws, and the lower edge portion of the side panel 52 is fixed to the bottom plate 50 by fastening parts, such as screws. When the inside of the outdoor unit 100 is released by removing the side panel 52, it is possible to perform maintenance of a component disposed in the outdoor unit 100.

[0022] The upper surface of the housing 5 has the air outlet 54, and the outdoor fan is disposed at a position directly below the air outlet 54. A bell mouth 55 that surrounds the periphery of the outdoor fan is provided to the air outlet 54. A fan guard 54a is attached to the air outlet 54. The outdoor fan is a propeller fan, for example, and is driven by a fan motor. By driving the outdoor fan, air suctioned into the housing 5 from the air inlets 53 passes through the outdoor heat exchangers 104 and is caused to exchange heat with refrigerant and, thereafter, passes through the outdoor fan and is discharged from the air outlet 54.

[0023] Next, the features of the heat exchanger according to Embodiment 1 will be described with reference to Fig. 3 and Fig. 4. Fig. 3 is a front view schematically showing the heat exchanger according to Embodiment 1. Fig. 4 is a perspective view of the cross section of a portion IV shown in Fig. 3 as viewed from above.

[0024] The heat exchanger according to Embodiment 1 is used as the outdoor heat exchanger 104. As shown in Fig. 3 and Fig. 4, the outdoor heat exchanger 104 has refrigerant flow passages 10 through which refrigerant flows in an up-down direction Y. The outdoor heat exchanger 104 includes a plurality of flat tubes 1, a plurality of fins 2, an upper header 3, and a lower header 4, the plurality of flat tubes 1 being arranged parallel to each other at intervals, each of the plurality of fins 2 being provided between adjacent flat tubes 1, the upper end portion of each of the plurality of flat tubes 1 being connected to the upper header 3, the lower end portion of each of the plurality of flat tubes 1 being connected to the lower header 4.

[0025] The flat tubes 1 are made of aluminum, for example. The flat tubes 1 are arranged parallel to each other at intervals in a lateral direction X to be orthogonal to a direction Z of air flow. The flat tubes 1 are arranged such that the flat surfaces of the flat tubes 1 are substantially parallel to the direction Z of air flow. In each flat tube 1, the plurality of refrigerant flow passages 10 through which refrigerant flows in the up-down direction Y are formed in parallel along the direction Z of air flow. Note that the up-down direction Y includes not only the vertical direction but also directions inclined relative to the vertical direction. Further, the lateral direction X includes not only the horizontal direction but also directions inclined relative to the horizontal direction.

[0026] The fins 2 are made of aluminum, for example. The fins 2 are parts that transfer heat of refrigerant flowing through the flat tubes 1. Each fin 2 is a corrugated fin formed by bending a thin plate into a corrugated shape. Each fin 2 is provided between adjacent two flat tubes 1 of the plurality of flat tubes 1. Each bent top of the fin 2 is joined to the flat surface of one of two flat tubes 1. Spaces formed between the fin 2 and the flat tubes 1 form ventilation passages through which air flows. Although not shown in the drawings, the fin 2 may be configured such that each inclined surface of the fin 2 has drain holes, louvers, or other parts to drain condensed water. The fin 2 is not limited to a corrugated fin. For example, the fin 2 may be formed by plate fins arranged

parallel to each other along the up-down direction.

[0027] The upper header 3 is connected to the upper end of each of the plurality of flat tubes 1, and is connected to the flow switching device 102 via the refrigerant pipe 105. The upper header 3 is made of aluminum, for example. When the outdoor heat exchanger 104 serves as a condenser, the upper header 3 distributes, to the respective flat tubes 1, gas refrigerant that flows into the upper header 3 from the refrigerant pipe 105. When the outdoor heat exchanger 104 serves as an evaporator, the upper header 3 causes gas refrigerant merged from the flat tubes 1 to flow out to the refrigerant pipe 105.

[0028] The lower header 4 is connected to the lower end of each of the plurality of flat tubes 1, and is connected to the expansion mechanism 103 via the refrigerant pipe 105. The lower header 4 is made of aluminum, for example. When the outdoor heat exchanger 104 serves as a condenser, the lower header 4 causes liquid refrigerant merged from the flat tubes 1 to flow out to the refrigerant pipe 105. When the outdoor heat exchanger 104 serves as an evaporator, the lower header 4 distributes, to the respective flat tubes 1, two-phase gas-liquid refrigerant that flows into the lower header 4 from the refrigerant pipe 105.

[0029] When the outdoor heat exchanger 104 is used as an evaporator, the evaporating temperature of refrigerant is lower than the temperature of surrounding air. Therefore, there is a possibility that moisture in the air forms condensation on the surfaces of the fins 2 and condensation water flows down through the fins 2 to the lower portions of the fins 2 and collects at the lower end portions of the fins 2. In the outdoor heat exchanger 104, a defrosting operation may be performed to remove frost formed on the fins 2 and the flat tubes 1. When the defrosting operation is performed, the frost melts, so that water drops adhere to the fins 2 and the flat tubes 1. The water drops adhering to the fins 2 and the flat tubes 1 may flow down through the fins 2 to the lower portions of the fins 2 and collect at the lower end portions of the fins 2. When outside air drops below freezing point, there is a possibility that water collecting at the lower portions of the fins 2 freezes, thus damaging the outdoor heat exchanger 104. For this reason, it is necessary for water drops flowing through the fins 2 to the lower portions of the fins 2 to be drained to the outside without being allowed to collect at the lower portions of the fins 2.

[0030] In the outdoor heat exchanger 104, the upper ends of the plurality of flat tubes 1 are connected to the upper header 3, and the lower ends of the plurality of flat tubes 1 are connected to the lower header 4. The flat tubes 1 are joined to the upper header 3 and the lower header 4 by brazing, for example. Therefore, it is necessary to ensure spaces for brazing the flat tubes 1 to the upper header 3 and the lower header 4.

[0031] For this reason, in the heat exchanger 104 according to Embodiment 1, as shown in Fig. 3, the lower end portions of the respective fins 2 are not joined to the lower header 4, and a lower gap 6 for drainage is formed between the lower portions of the respective fins 2 and the lower header 4. By forming the lower gap 6, it is possible to cause water drops flowing down to the lower portions of the fins 2 to fall downward without being allowed to collect at the lower end portions of the fins 2 and hence, the outdoor heat exchanger 104 can have improved drainage properties. Further, in the outdoor heat exchanger 104, the lower end portions of the flat tubes 1 can be brazed to the lower header 4 by making use of the lower gap 6. The lower gap 6 is provided with a size for which drainage properties are taken into account.

[0032] In the heat exchanger 104 according to Embodiment 1, the upper end portions of the respective fins 2 are not joined to the upper header 3, and an upper gap 7 is formed between the upper end portions of the respective fins 2 and the upper header 3 to braze the flat tubes 1 to the upper header 3. In the outdoor heat exchanger 104, the upper end portions of the flat tubes 1 can be brazed to the upper header 3 by making use of the upper gap 7.

[0033] The vertical width dimension of the upper gap 7 is set to be smaller than the vertical width dimension of the lower gap 6. In the outdoor heat exchanger 104, wind speed is high at the upper portion close to the fan, and wind speed is low at the lower portion away from the fan. The upper portion of the outdoor heat exchanger 104 where wind speed is high is an area having the highest heat exchange efficiency. In the outdoor heat exchanger 104, when the vertical width dimension of the upper gap 7 is increased, there is a possibility that the flow rate of bypass air not performing heat exchange is increased, so that heat exchange efficiency is lowered. For this reason, it is desirable to cause the upper gap 7 to have the minimum dimension that allows brazing but suppresses the flow rate of bypass air not performing heat exchange as much as possible. For example, in the outdoor heat exchanger 104, there may be a case where the wind speed at the upper portion is approximately three times higher than the wind speed at the lower portion. In view of the above, setting the vertical width dimension of the upper gap 7 to one third or less of the vertical width dimension of the lower gap 6 is considered by taking into account the ratio between the wind speed at the upper portion and the wind speed at the lower portion. This ratio is merely an example, and may be changed according to conditions, such as performance of the fan and the size of the outdoor unit.

[0034] As described above, the heat exchanger 104 according to Embodiment 1 has the refrigerant flow passages 10 extending in the up-down direction Y, and includes the plurality of flat tubes 1, the plurality of fins 2, the upper header 3, and the lower header 4, the plurality of flat tubes 1 being arranged parallel to each other at intervals in the lateral direction X, each of the plurality of fins 2 being provided between adjacent flat tubes 1, the upper end portion of each of the plurality of flat tubes 1 being connected to the upper header 3, the lower end portion of each of the plurality of flat tubes 1 being con-

nected to the lower header 4. The lower end portions of the respective fins 2 are not joined to the lower header 4, and the lower gap 6 is formed between the lower end portions of the respective fins 2 and the lower header 4.

[0035] Accordingly, in the heat exchanger 104, it is possible to cause water drops flowing through the fins 2 to the lower portions of the fins 2 to fall down to an area below the fins 2 and to drain through the lower gap 6 and hence, it is possible to prevent a situation where water drops collect at the lower end portions of the fins 2. Further, in the heat exchanger 104, the lower end portions of the flat tubes 1 can be joined to the lower header 4 by brazing by making use of the lower gap 6.

[0036] Further, in the heat exchanger 104, the upper end portions of the respective fins 2 are not joined to the upper header 3, and the upper gap 7 is formed between the upper end portions of the respective fins 2 and the upper header 3. Therefore, in the heat exchanger 104, the upper end portions of the flat tubes 1 can be joined to the upper header 3 by brazing by making use of the upper gap 7.

[0037] The vertical width dimension of the upper gap 7 is smaller than the vertical width dimension of the lower gap 6. That is, the heat exchanger 104 according to Embodiment 1 has a structure that can suppress the flow rate of bypass air not performing heat exchange in the upper gap 7 while increasing drainage properties by the lower gap 6.

Embodiment 2.

[0038] Next, a heat exchanger according to Embodiment 2 will be described with reference to Fig. 5. Fig. 5 is a front view schematically showing the heat exchanger according to Embodiment 2. An outline arrow shown in Fig. 5 shows the direction Z of air flow. Constitutional elements identical to the corresponding constitutional elements of the heat exchanger described in Embodiment 1 are given the same reference symbols, and the description of such constitutional elements will be omitted when appropriate.

[0039] A heat exchanger 104A according to Embodiment 2 is also used as an outdoor heat exchanger. The outdoor heat exchanger 104 is characterized in a configuration where in addition to the structure of the heat exchanger 104 of the above-mentioned Embodiment 1, each fin 2 is provided with a portion A with a small pitch of the waveform and a portion B with a large pitch of the waveform. As described above, in the heat exchanger, wind speed is high at the upper portion close to the fan, and wind speed is low at the lower portion away from the fan. Therefore, by increasing a heat transfer area in the upper portion close to the fan, it is possible to increase heat exchange performance of the heat exchanger. For this reason, each fin 2 of the outdoor heat exchanger 104A according to Embodiment 2 has a configuration where the portion A with a small pitch of the waveform is provided at the upper portion where wind speed is high, and the portion B with a large pitch of the waveform is provided at the lower portion where wind speed is low.

[0040] Specifically, the fin 2 is divided into two regions in the up-down direction Y. The substantially upper half of the fin 2 is the portion A with a small pitch of the waveform, and the substantially lower half of the fin 2 is the portion B with a large pitch of the waveform. The pitch at the portion A with a small pitch of the waveform is approximately one half to one third of the pitch at the portion B with a large pitch of the waveform. Such a pitch is merely an example, and may be suitably changed according to the size, the place of installation, or the like of the outdoor unit.

[0041] The arrangement of the portion A with a small pitch of the waveform in the fin 2 and the arrangement of the portion B with a large pitch of the waveform in the fin 2 are not limited to the configuration shown in the drawing. Although a detailed illustration is omitted, a configuration may be adopted, for example, where the fin 2 is divided into three or more regions in the up-down direction Y, and the pitch of the waveform reduces in a stepwise manner for each region from the lower side toward the upper side. Alternatively, the fin 2 may be configured such that the pitch of the waveform reduces gradually from the lower side toward the upper side. In short, it is sufficient to have a configuration where a portion with a small pitch of the waveform is disposed at a position higher than a portion with a large pitch of the waveform.

[0042] The heat exchanger 104A and the air-conditioning apparatus 300 including the heat exchanger according to Embodiment 2 have a configuration where the fin 2 is formed by bending into a corrugated shape extending in the up-down direction Y, and includes the portion A with a small pitch of the waveform and the portion B with a large pitch of the waveform. The portion A with a small pitch of the waveform is disposed at a position higher than the portion B with a large pitch of the waveform.

[0043] Accordingly, in the heat exchanger 104A and the air-conditioning apparatus 300 including the heat exchanger according to Embodiment 2, the upper portion close to the fan and where wind speed is high is provided with the portion A with a small pitch of the waveform to increase the heat transfer area of the fins 2 and hence, it is possible to effectively increase heat exchange performance.

[0044] Heretofore, the heat exchangers (104, 104A) and the air-conditioning apparatus 300 including the heat exchanger (104, 104A) have been described based on Embodiments. However, the heat exchangers (104, 104A) and the air-conditioning apparatus 300 are not limited to the configurations of the above-mentioned Embodiments. For example, a configuration may be adopted where the heat exchangers (104, 104A) are arranged in two or more rows in the direction Z of air flow. Constitutional elements that the heat exchanger (104, 104A) or the air-conditioning apparatus 300 includes are not limited to the above-mentioned constitutional elements, and the heat exchanger (104, 104A) or the air-conditioning

apparatus 300 may include other constitutional elements. In short, the heat exchanger (104, 104A) and the air-conditioning apparatus 300 include variations to which design changes or applications are regularly added by those who are skilled in the art without departing from the technical concept. The scope of the invention is defined by the the claims. Reference Signs List

[0045] 1: flat tube, 2: fin, 3: upper header, 4: lower header, 5: housing, 6: lower gap, 7: upper gap, 10: refrigerant flow passage, 50: bottom plate, 51: frame member, 52: side panel, 53: air inlet, 54: air outlet, 54a: fan guard, 55: bell mouth, 100: outdoor unit, 101: compressor, 102: flow switching device, 103: expansion mechanism, 104, 104A: outdoor heat exchanger, 105: refrigerant pipe, 106: component, 200: indoor unit, 201: indoor heat exchanger, 300: air-conditioning apparatus.

Claims

1. A heat exchanger (104, 104A) comprising:

   a plurality of flat tubes (1) each of which has a refrigerant flow passage (10) through which refrigerant flows in an up-down direction, the plurality of flat tubes (1) being arranged parallel to each other at intervals;
   a plurality of fins (2) each of which is provided between adjacent flat tubes (1) of the plurality of flat tubes (1);
   an upper header (3) to which an upper end portion of each of the plurality of flat tubes (1) is connected; and
   a lower header (4) to which a lower end portion of each of the plurality of flat tubes (1) is connected, wherein
   lower end portions of the plurality of fins (2) are not joined to the lower header (4), and a lower gap (6) is formed between the lower end portions of the plurality of fins (2) and the lower header (4),
   upper end portions of the plurality of fins (2) are not joined to the upper header (3), and an upper gap (7) is formed between the upper end portions of the plurality of fins (2) and the upper header (3), and **characterized in that**
   the vertical width dimension of the upper gap (7) is one third or less of the vertical width dimension of the lower gap (6).

2. The heat exchanger (104A) of claim 1, wherein

   each of the plurality of fins (2) is formed by bending into a corrugated shape extending in the up-down direction, and includes a portion with a small pitch of waveform (A) and a portion with a large pitch of waveform (B), and
   the portion with the small pitch of the waveform (A) is disposed at a position higher than the portion with the large pitch of the waveform (B).

3. An air-conditioning apparatus (300) comprising an outdoor unit (100) including the heat exchanger (104, 104A) of claim 1 or 2.

4. The air-conditioning apparatus (300) of claim 3, wherein the outdoor unit (100) further comprises a casing (5) including an air outlet (54) provided at an upper surface thereof, and an outdoor fan disposed at a position directly below the air outlet (54).

5. An air-conditioning apparatus (300) comprising:

   the heat exchanger (104, 104A) of any of claims 1 to 4;
   a casing (5) including an air outlet (54) provided at an upper surface thereof;
   an outdoor unit (100) including a fan disposed at a position directly below the air outlet (54).

Patentansprüche

1. Wärmetauscher (104, 104A), aufweisend:

   eine Vielzahl von Flachrohren (1), von denen jedes einen Kältemittelströmungskanal (10) aufweist, durch den das Kältemittel in einer Auf-Ab-Richtung strömt, wobei die Vielzahl von Flachrohren (1) parallel zueinander in Abständen angeordnet sind;
   eine Vielzahl von Lamellen (2), von denen jede zwischen benachbarten Flachrohren (1) der Vielzahl von Flachrohren (1) angeordnet ist;
   einen oberen Sammler (3), an den ein oberer Endabschnitt jedes der Vielzahl von Flachrohren (1) angeschlossen ist; und
   einen unteren Sammler (4), an den ein unterer Endabschnitt jedes der Vielzahl von Flachrohren (1) angeschlossen ist, wobei
   untere Endabschnitte der Vielzahl von Lamellen (2) nicht mit dem unteren Sammler (4) verbunden sind und ein unterer Spalt (6) zwischen den unteren Endabschnitten der Vielzahl von Lamellen (2) und dem unteren Sammler (4) gebildet ist,
   obere Endabschnitte der Vielzahl von Lamellen (2) nicht mit dem oberen Sammler (3) verbunden sind und ein oberer Spalt (7) zwischen den oberen Endabschnitten der Vielzahl von Lamellen (2) und dem oberen Sammler (3) gebildet ist, und **dadurch gekennzeichnet, dass**
   die vertikale Breite des oberen Spalts (7) ein Drittel oder weniger der vertikalen Breite des unteren Spalts (6) beträgt.

2. Wärmetauscher (104A) nach Anspruch 1, wobei

jede der Vielzahl von Lamellen (2) durch Biegen in eine in der Auf-Ab-Richtung verlaufende Wellenform ausgebildet ist und einen Abschnitt mit einem kleinen Wellenformabstand (A) und einen Abschnitt mit einem großen Wellenformabstand (B) aufweist, und
der Abschnitt mit dem kleinen Wellenformabstand (A) an einer Position angeordnet ist, die höher liegt als der Abschnitt mit dem großen Wellenformabstand (B).

3. Klimaanlage (300), die eine Außeneinheit (100) aufweist, die den Wärmetauscher (104, 104A) nach Anspruch 1 oder 2 enthält.

4. Klimaanlage (300) nach Anspruch 3, wobei die Außeneinheit (100) des Weiteren ein Gehäuse (5) umfasst, das einen Luftauslass (54) aufweist, der an einer Oberseite des Gehäuses angebracht ist, und einen Außenlüfter, der an einer Position direkt unterhalb des Luftauslasses (54) angeordnet ist.

5. Klimaanlage (300) aufweisend:

den Wärmetauscher (104, 104A) nach einem der Ansprüche 1 bis 4;
ein Gehäuse (5), das einen Luftauslass (54) aufweist, der an einer Oberseite des Gehäuses angebracht ist;
eine Außeneinheit (100), die ein Gebläse aufweist, das an einer Position direkt unterhalb des Luftauslasses (54) angeordnet ist.

Revendications

1. Échangeur de chaleur (104, 104A) comprenant :

une pluralité de tubes plats (1) dont chacun possède un passage de flux de réfrigérant (10) à travers lequel le réfrigérant s'écoule dans une direction ascendante descendante, la pluralité de tubes plats (1) étant disposés parallèlement les uns aux autres à intervalles ;
une pluralité d'ailettes (2) dont chacune est placée entre des tubes plats adjacents (1) de la pluralité de tubes plats (1) ;
un collecteur supérieur (3) auquel est reliée une partie d'extrémité supérieure de chacun de la pluralité de tubes plats (1) ; et
un collecteur inférieur (4) auquel est reliée une partie d'extrémité inférieure de chacun de la pluralité de tubes plats (1), dans lequel
les parties d'extrémité inférieure de la pluralité d'ailettes (2) ne sont pas reliées au collecteur inférieur (4), et un espace inférieur (6) est formé entre les parties d'extrémité inférieure de la pluralité d'ailettes (2) et le collecteur inférieur (4),
les parties d'extrémité supérieure de la pluralité d'ailettes (2) ne sont pas reliées au collecteur supérieur (3), et un espace supérieur (7) est formé entre les parties d'extrémité supérieure de la pluralité d'ailettes (2) et le collecteur supérieur (3), et **caractérisé en ce que**
la dimension de la largeur verticale de l'espace supérieur (7) est inférieure ou égale à un tiers de la dimension de la largeur verticale de l'espace inférieur (6).

2. Échangeur de chaleur (104A) selon la revendication 1, dans lequel

chacune de la pluralité d'ailettes (2) est formée par pliage en une forme ondulée s'étendant dans la direction ascendante descendante, et comporte une partie avec un petit pas de forme d'onde (A) et une partie avec un grand pas de forme d'onde (B), et
la partie avec le petit pas de forme d'onde (A) est disposée à une position plus élevée que la partie avec le grand pas de forme d'onde (B).

3. Appareil de climatisation (300) comprenant une unité extérieure (100) comportant l'échangeur de chaleur (104, 104A) selon la revendication 1 ou 2.

4. Appareil de climatisation (300) selon la revendication 3, dans lequel l'unité extérieure (100) comprend en outre un boîtier (5) comportant une sortie d'air (54) située sur sa surface supérieure, et un ventilateur extérieur disposé au niveau d'une position directement sous la sortie d'air (54).

5. Appareil de climatisation (300) comprenant :

l'échangeur de chaleur (104, 104A) selon l'une quelconque des revendications 1 à 4 ;
une enveloppe (5) comportant une sortie d'air (54) située sur sa surface supérieure ;
une unité extérieure (100) comportant un ventilateur disposé au niveau d'une position directement sous la sortie d'air (54).

FIG. 1

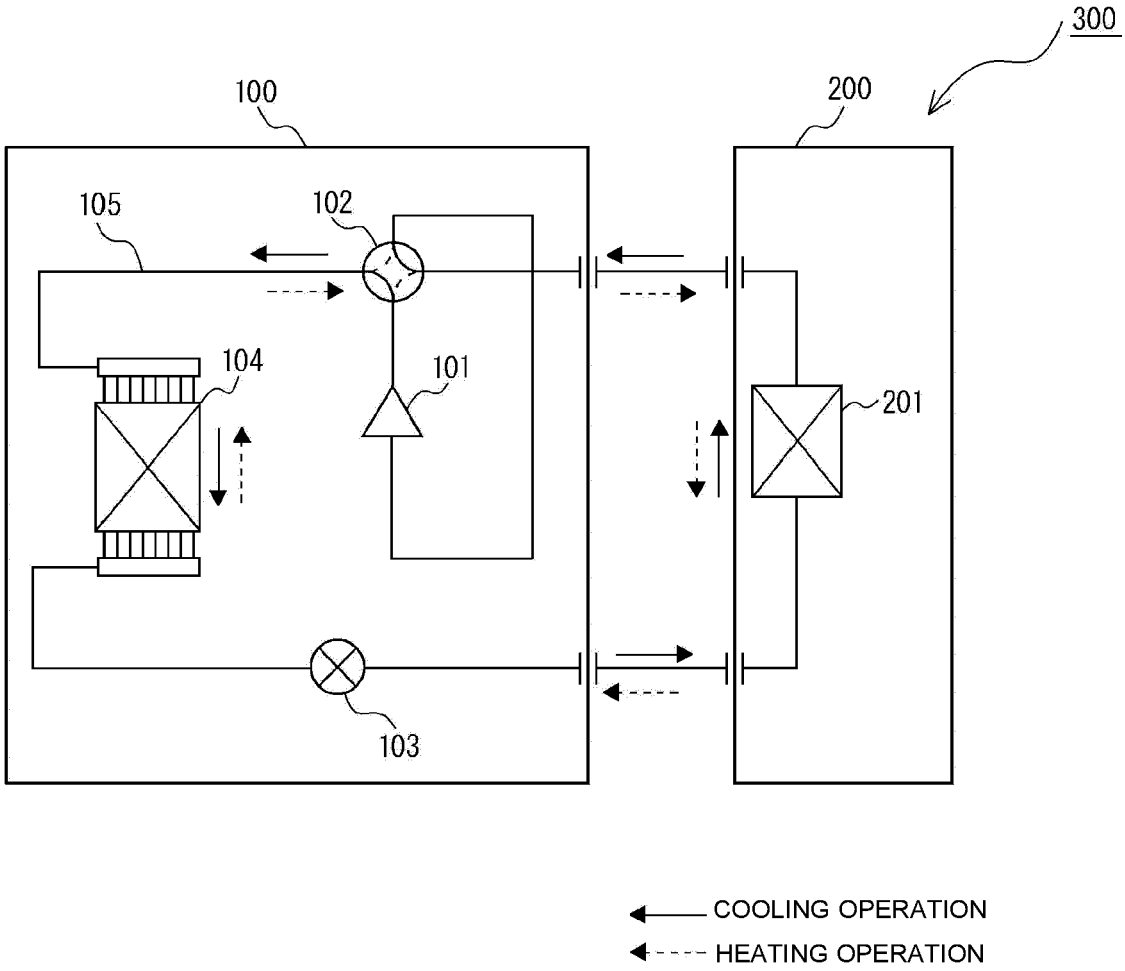

300
100
200
105
102
104
101
201
103
COOLING OPERATION
HEATING OPERATION

FIG. 2

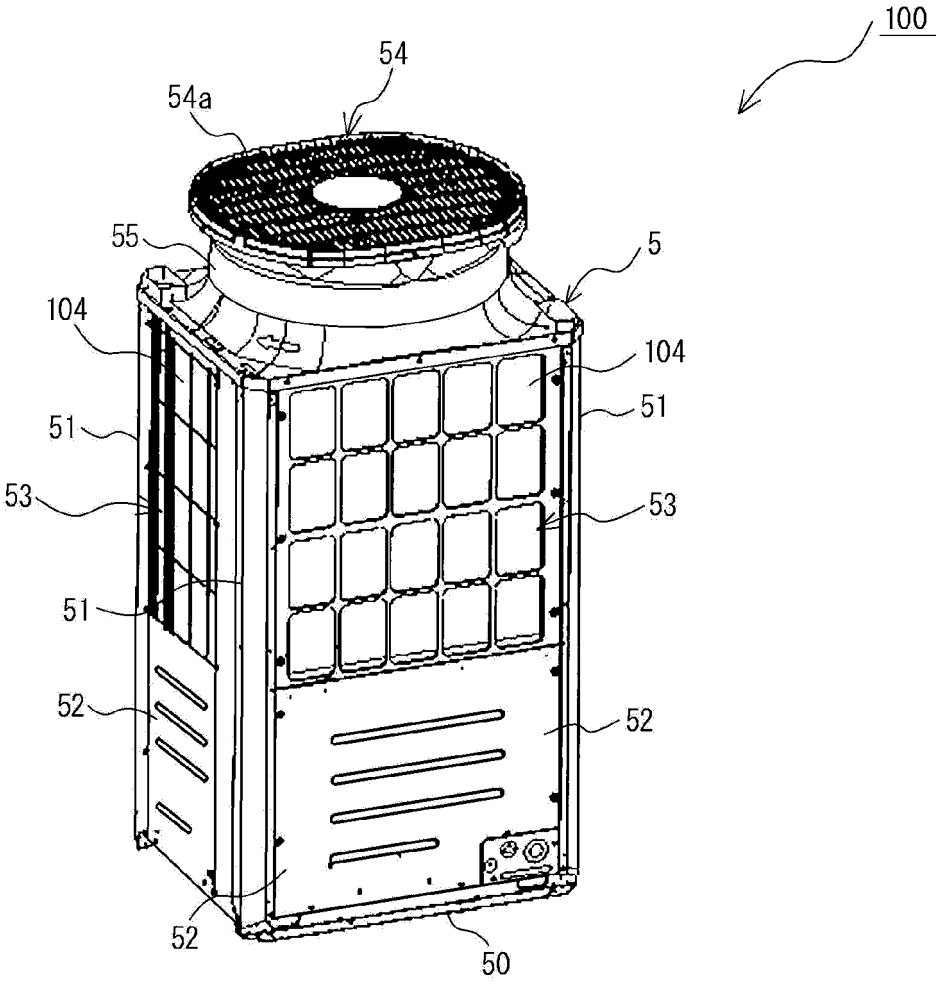


FIG. 3

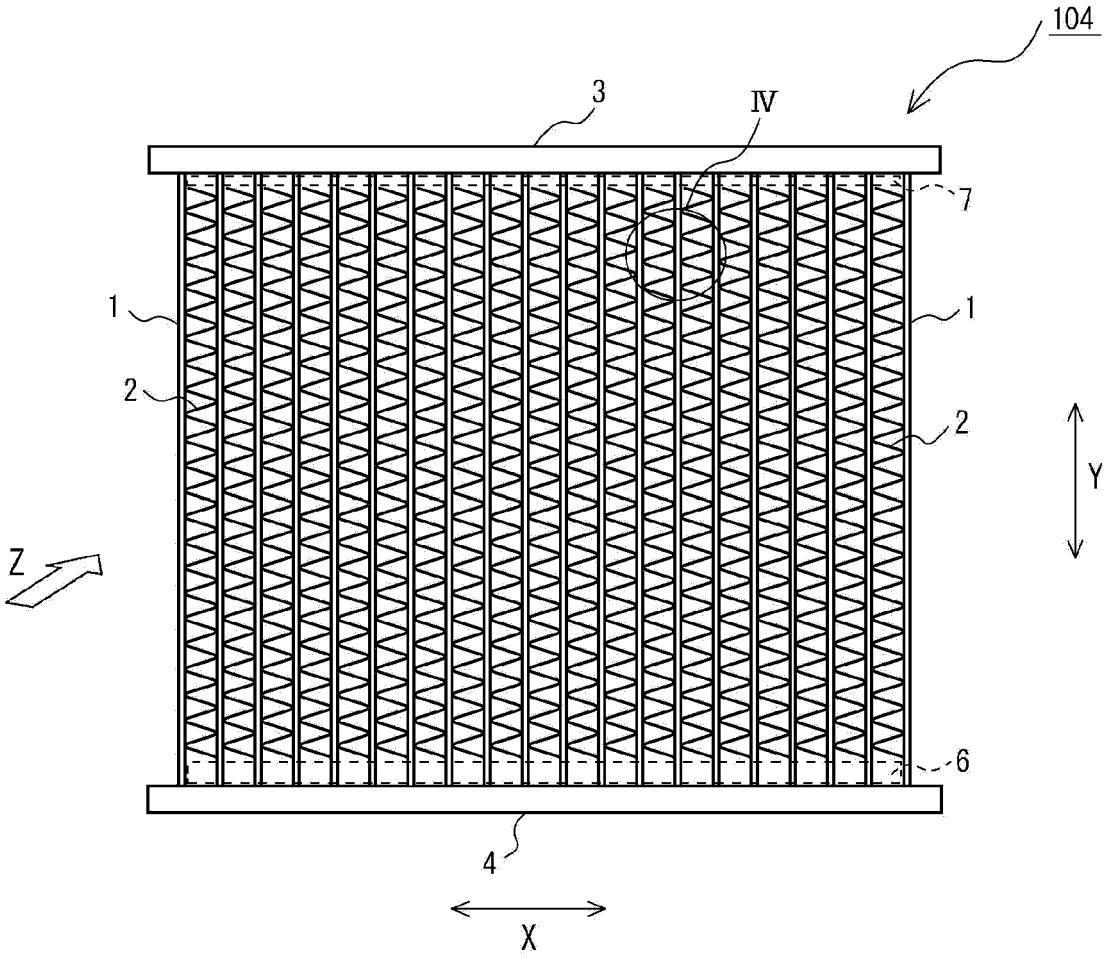


FIG. 4

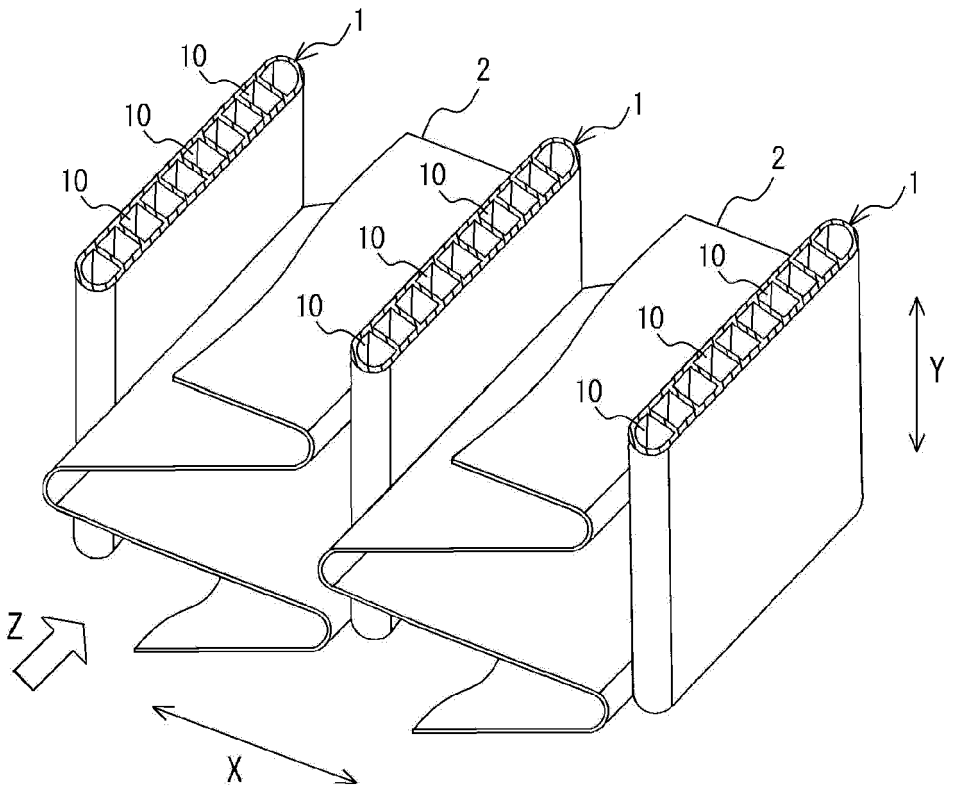
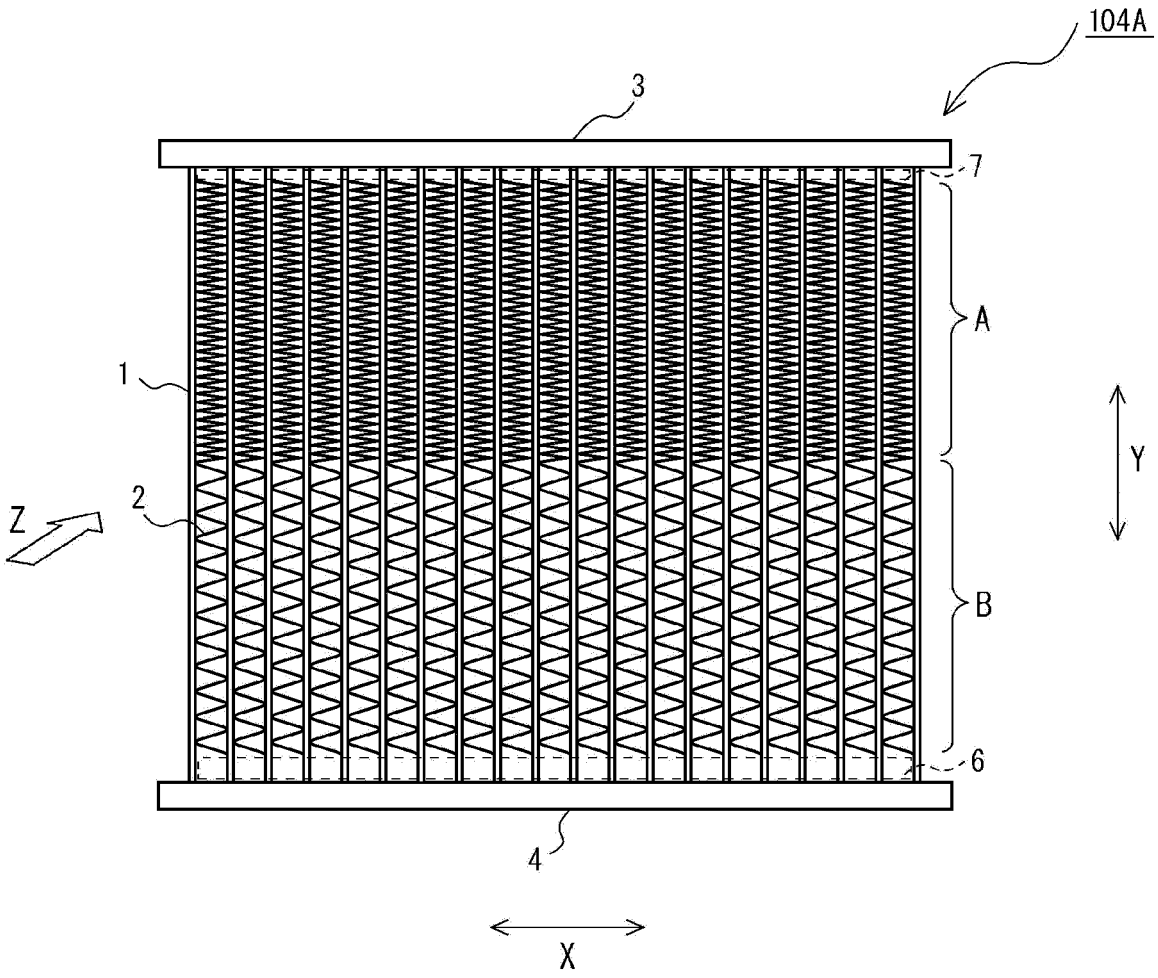


FIG. 5



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- WO 2009104659 A1 **[0004]**