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(71) Applicant: **Mitsubishi Electric Corporation**
Chiyoda-ku
Tokyo 100-8310 (JP)

(72) Inventors:
- **Yamaguchi, Koji**
  Tokyo, 100-8310 (JP)
- **Yamashita, Tetsuo**
  Tokyo, 100-8310 (JP)
- **Hatta, Masatomo**
  Tokyo, 100-8310 (JP)
- **Ishii, Minoru**
  Tokyo, 100-8310 (JP)
- **Morioka, Reiji**
  Tokyo, 100-8310 (JP)
- **Tazawa, Tetsuya**
  Tokyo, 102-0073 (JP)

(74) Representative: **Pfenning, Meinig & Partner GbR**
Patent- und Rechtsanwälte
Theresienhöhe 11a
80339 München (DE)

(54) Outdoor unit for air-conditioning device

(57) [Object] It is an object to provide an outdoor unit for an air-conditioning device that prevents water vapor adhered on a fan motor supporting plate from freezing.

[Solution] An outdoor unit includes a housing 50 having a bottom panel 50c, an outdoor heat exchanger 21 disposed inside the housing 50, a fan 22 disposed inside the housing 50, a fan motor 23 which is disposed inside the housing 50 and drives the fan 22, a fan motor supporting plate 24 disposed inside the housing 50 more to the front than the outdoor heat exchanger 21 and supports the fan motor 23, and a heater 30 at least partially disposed on or around the fan motor supporting plate 24.

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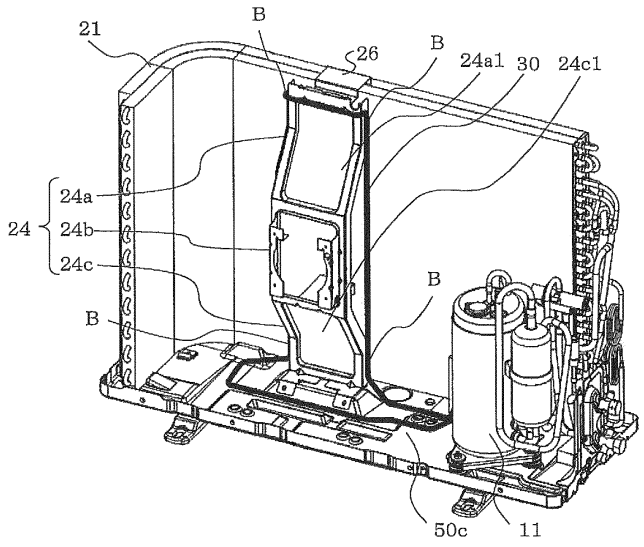

EP 2 871 428 A1

Description

[Technical Field]

[0001] The present invention relates to an outdoor unit for an air-conditioning device.

[Background Art]

[0002] In heat pump air-conditioning devices, during a heating operation in which an outdoor heat exchanger serves as an evaporator, heat exchange may be interrupted due to frost formed on the outdoor heat exchanger. Accordingly, heat pump air-conditioning devices have conventionally been proposed which perform a defrost operation to remove frost when frost formation is detected.

[0003] When a defrost operation is performed, frost adhered on the outdoor heat exchanger melts into drain water and, by extension, into water vapor. The drain water generated by the defrost operation drops on the upper surface of a bottom panel which forms the bottom of a housing of the outdoor unit, and is then discharged to the outside of the outdoor unit through a drain discharging hole which is formed on the bottom panel. Further, water vapor generated by the defrost operation is discharged to the outside of the outdoor unit by natural convection or by rotation of a fan during a heating operation after the end of the defrost operation.

[0004] Particularly in a cold climate where the outside air temperature stays considerably low, frost is likely to be formed, and the drain water dropped on the upper surface of the bottom panel from the outdoor heat exchanger may refreeze on the upper surface of the bottom panel before being discharged to the outside of the outdoor unit through the drain discharging hole. Accordingly, in order to prevent the drain water from refreezing on the upper surface of the bottom panel, an outdoor unit having a heater (sheath heater) disposed on the upper surface of the bottom panel has conventionally been available (see, for example, Patent Literature 1).

[Citation List]

[Patent Literature]

[0005] [Patent Literature 1] Japanese Unexamined Patent Application Publication No. 2011-52941 (p. 10, Figs. 1 & 2)

[Summary of Invention]

[Technical Problem]

[0006] Upon wide use of heat pump air-conditioning devices, the outdoor unit is sometimes installed in an extremely cold climate (where the outside air temperature is 0 degrees C or below) in addition to a cold climate, as in the conventional case. In the extremely cold climate, the surface temperatures of the outdoor heat exchanger and the housing are 0 degrees C or below, as well as the outside air temperature. Accordingly, water vapor generated during a defrost operation may collect and refreeze in the housing, which remains frosted. Further, ice which is generated from frozen water vapor does not melt during a defrost operation. Upon repeated defrost operations, the ice may grow into icicles by repeating refreezing. In the heater described in Patent Literature 1, there is a problem that the water vapor adhered on a member other than the bottom panel cannot sufficiently be prevented from freezing since the heater is disposed on the upper surface of the bottom panel.

[0007] Particularly, water vapor may adhere to a fan motor supporting plate that supports a fan motor, and freeze. In such a case, there is a problem that ice generated from the frozen water vapor may come into contact with a propeller fan disposed inside the outdoor unit, and break the propeller fan, or may apply a load to a fan motor which drives the propeller fan, and break the propeller fan.

[0008] The present invention is made in light of the above problems, and has as its object to provide an outdoor unit for an air-conditioning device that prevents water vapor adhered on the fan motor supporting plate from freezing.

[Solution to Problem]

[0009] An outdoor unit for an air-conditioning device according to the present invention includes a housing which includes a bottom panel; an outdoor heat exchanger which is disposed inside the housing; a fan which is disposed inside the housing; a fan motor which is disposed inside the housing and configured to drive the fan; a fan motor supporting plate which is disposed inside the housing more to the front than the outdoor heat exchanger and supports the fan motor; and a heater which is at least partially disposed at one of a position on the fan motor supporting plate and a position around the fan motor supporting plate.

[Advantageous Effects of Invention]

[0010] According to the present invention, the heater is provided on or around the fan motor supporting plate. Accordingly, even if water vapor adheres to the fan motor supporting plate during a defrost operation, the temperature of the water vapor adhered on the fan motor supporting plate becomes 0 degrees C or higher since the heater generates heat. As a result, it is possible to prevent the water vapor adhered on the fan motor supporting plate from freezing in an extremely cold environment where the outside air temperature is 0 degrees C or below.

[Brief Description of Drawings]

[0011]

[Fig. 1] Fig. 1 is a perspective view of an outdoor unit 100 of an air-conditioning device according to Embodiment.

[Fig. 2] Fig. 2 is an exploded perspective view of the outdoor unit 100 of the air-conditioning device according to Embodiment.

[Fig. 3] Fig. 3 is an exploded perspective view of the outdoor unit 100 of the air-conditioning device according to Embodiment, and shows details of Fig. 2.

[Fig. 4] Fig. 4 is a cross-sectional view taken along the line X-X of Fig. 1.

[Fig. 5] Fig. 5 is a cross-sectional view taken along the line Y-Y of Fig. 1.

[Fig. 6] Fig. 6 is a view showing an exemplary internal configuration of the outdoor unit 100 of the air-conditioning device according to Embodiment.

[Fig. 7] Fig. 7 is a view showing how a heater 30 is disposed in the outdoor unit 100 of the air-conditioning device according to Embodiment.

[Fig. 8] Fig. 8 is a view showing an exemplary internal configuration of the outdoor unit 100 of the air-conditioning device according to Embodiment.

[Fig. 9] Fig. 9 is a view showing how a heater 30 is disposed in the outdoor unit 100 of the air-conditioning device according to Embodiment.

[Description of Embodiment]

[0012] An embodiment of the present invention will be described below with reference to the accompanying drawings. In the drawings including Fig. 1, the relationships of size between components may be different from the actual relationships. Also, in the drawings including Fig. 1, the same reference numerals denote the same or equivalent components, and this applies to the entire specification. Further, the modes of the components described in the entire specification are merely illustrative examples, and the invention is not limited thereto.

[0013] Fig. 1 is a perspective view of an outdoor unit 100 of an air-conditioning device according to Embodiment. Fig. 2 is an exploded perspective view of the outdoor unit 100 of the air-conditioning device according to Embodiment. Fig. 3 is an exploded perspective view of the outdoor unit 100 of the air-conditioning device according to Embodiment, and shows details of Fig. 2.

[0014] As shown in Fig. 1, an outer cover of the outdoor unit 100 is implemented in a housing 50. As shown in Fig. 2, the housing 50 includes a front and side panel 50a, a right side panel 50b, a bottom panel 50c, a top panel 50d and a back panel 50e (see Fig. 4). The front and side panel 50a is implemented using, for example, a member having an L shape, as seen in a plan view, and forms the front face and the left side face of the housing 50. Again, as shown in Fig. 2, a partition 1 is provided in the housing 50. Using the partition 1, the inner space of the housing 50 is divided into a machine chamber 10 and an air-sending device chamber 20.

[0015] The front and side panel 50a may be implemented using separate members, which individually form the front face and the left side face of the housing 50. That is, the front and side panel 50a may be divided into a front panel which forms the front face of the housing 50, and a left side panel which forms the left side face of the housing 50.

[0016] A compressor 11 and an electrical component box 12 are provided in the machine chamber 10. A control board (not shown) is provided in the electrical component box 12. The control board (not shown) serves as a member for controlling the rotation speed of the compressor 11 and driving, for example, a heater 30 (to be described later). Further, the control board (not shown) is implemented using hardware such as a circuit device that implements its function, or software running on an arithmetic unit such as a microcomputer or CPU.

[0017] The air-sending device chamber 20 is provided with an outdoor heat exchanger 21, a fan 22, a fan motor 23 (see Fig. 4), a fan motor supporting plate 24, an upper plate 25 and a supporting plate connection portion 26. The outdoor heat exchanger 21 is positioned more to the back of the outdoor unit 100 than the fan 22, the fan motor 23, the fan motor supporting plate 24, the upper plate 25 and the supporting plate connection portion 26.

[0018] The outdoor heat exchanger 21 has, for example, an L shape, as seen in a plan view, and is disposed to extend along the surface of the left side face of the front and side panel 50a and the back panel 50e. The fan 22 serves as an air-sending means implemented in, for example, a propeller fan, and generates an air circulating flow for effectively exchanging heat. The fan 22 serves to introduce the outside air from the back side of the outdoor unit 100 into the outdoor unit 100, and exhausting it to the front face of the outdoor unit 100.

[0019] The fan motor 23 serves as a driving means for driving the fan 22, and is mounted on the fan motor supporting plate 24 by using a fixing means such as a screw. The fan motor supporting plate 24 serves to support the fan motor 23, and is a frame-shaped member which extends upwards from the bottom panel 50c. Note that a plurality of fan motor supporting plates 24 may be provided, instead of a single fan motor supporting plate 24 as shown in the drawings.

[0020] The upper plate 25 is implemented using a plate member which is, for example, almost parallel to the bottom panel 50c. The upper plate 25 serves as a member for reinforcing the strength of the fan motor supporting plate 24 to cope with the situation in which the fan motor 23 is comparatively large. The upper plate 25 is connected to the fan motor supporting plate 24. The upper plate 25 is mounted, for example, on the top end of the fan motor supporting plate 24 and extends to the front.

[0021] The supporting plate connection portion 26 is, for example, a U-shaped member, and is integrated with

the fan motor supporting plate 24. The inner surface of the supporting plate connection portion 26 is in contact with the upper surface of the outdoor heat exchanger 21. Thus, the fan motor supporting plate 24 is fixed to the outdoor heat exchanger 21 by mounting the supporting plate connection portion 26 on the outdoor heat exchanger 21.

[0022] As shown in Fig. 3, an opening 50a1 is formed in the front and side panel 50a. The opening 50a1 serves to exhaust, to the outside of the outdoor unit 100, the outside air introduced into the outdoor unit 100. Further, a bell mouth 27 is provided on the back side of the front and side panel 50a so as to surround the outer periphery of the fan 22.

[0023] The bell mouth 27 includes, for example, a convergent portion 27a which extends backwards so that its diameter is smaller in areas more radially inward and farther from the periphery of the opening 50a1, and a divergent portion 27b which extends backwards so that its diameter is larger in areas more radially outward and farther from the back end of the convergent portion 27a. The bell mouth 27 is integrated with the front and side panel 50a. The bell mouth 27 serves to guide the outside air introduced in the housing 50 to the opening 50a1. Note that the bell mouth 27 may be formed to have a portion extending in the front and back direction between the convergent portion 27a and the divergent portion 27b.

[0024] Fig. 4 is a cross-sectional view taken along the line X-X of Fig. 1. Fig. 5 is a cross-sectional view taken along the line Y-Y of Fig. 1. Referring to Figs. 4 and 5, a flow of air is schematically shown as an air flow A using arrows. An air flow passage formed inside and outside the housing 50 will be described below with reference to Figs. 4 and 5.

[0025] When a fan 22 rotates by driving the fan motor 23, the outside air is introduced into the housing 50. The outside air introduced in the housing 50 is blown to a member such as the fan motor supporting plate 24 through the outdoor heat exchanger 21. After circulating inside the housing 50, the outside air is exhausted to the outside of the housing 50 through the opening 50a1.

[0026] Fig. 6 is a view showing an exemplary internal configuration of the outdoor unit 100 of the air-conditioning device according to Embodiment. Fig. 7 is a view showing how a heater 30 is disposed in the outdoor unit 100 of the air-conditioning device according to Embodiment. The heater 30 as shown in Fig. 7 is disposed on the fan motor supporting plate 24 shown in Fig. 6.

[0027] As shown in Figs. 6 and 7, the fan motor supporting plate 24 includes an upper portion 24a, a body portion 24b and a lower portion 24c. The body portion 24b is located under the upper portion 24a, and the lower portion 24c is located under the body portion 24b. The upper portion 24a is connected to the support plate connection portion 26. The body portion 24b is equipped with the fan motor 23. The lower portion 24c is fixed to the bottom panel 50c by a fixing means such as a screw (not shown).

[0028] The upper portion 24a is implemented using, for example, a rectangular frame member which includes a hollow portion 24a1. The lower portion 24c is implemented using, for example, a rectangular frame member which includes a hollow portion 24c1. Since the hollow portions 24a1 and 24c1 are provided, a part of the air flow A which is blown to the fan motor supporting plate 24 is exhausted to the front side of the housing 50 through the hollow portions 24a1 and 24c1. That is, blocking of the air flow A can be suppressed using the hollow portions 24a1 and 24c1.

[0029] The heater 30 serves as a heating means implemented in, for example, a sheath heater, and heats the water vapor generated inside the housing 50. A nichrome wire is provided inside the heater 30. Note that the heater 30 may be implemented in a flexible heater. This configuration facilitates positioning of the heater 30 in the housing 50.

[0030] The heater 30 is mounted on the fan motor supporting plate 24 by using a fixing means such as a screw. The heater 30 is bent in the upper portion of the fan motor supporting plate 24 so as to form an inverted U shape as seen in a front view. The heater 30 is fixed to the fan motor supporting plate 24 at, for example, four positions B shown in Fig. 7. Note that the heater 30 may extend in the up and down direction and be bent not in the upper portion of the fan motor supporting plate 24 but around this upper portion.

[0031] The heater 30 is used with a power consumption of, for example, 100 W at a temperature of, for example, 30 degrees C. The heater 30 is activated when an outside air temperature sensor (not shown) detects a predetermined temperature or below during a heating operation. Note that the power consumption and temperature of the heater 30 are not limited to the above-mentioned values, and are determined as appropriate so that the water vapor generated in the housing 50 is heated.

[0032] The operation of the outdoor unit 100 in an extremely cold climate where the outside air temperature is 0 degrees C or below will be described next. The above-described control board (not shown) controls the operation of the outdoor unit 100 in response to, for example, an operation of an operation means (not shown) through which a user sets an operation mode. Although the operation mode can be, for example, a heating operation or a cooling operation, the following description assumes a heating operation as the set operation mode.

[0033] When a heating operation is set, the fan 22 rotates and the outside air is introduced into the housing 50, as described above. Since the outdoor heat exchanger 21 functions as an evaporator, the outside air introduced in the housing 50 exchanges heat with the refrigerant in the outdoor heat exchanger 21 and has its temperature lowered. The outside air whose temperature is lowered is blown to a member such as the fan motor supporting plate 24 in the air-sending device chamber 20. When the temperature of the outside air detected by the outside air temperature sensor reaches a predeter-

mined temperature or below, the control board activates the heater 30. Accordingly, when the heater 30 is activated, heat generated by the heater 30 is transmitted to the fan motor supporting plate 24, thereby suppressing frost formation on the fan motor supporting plate 24.

[0034] At a predetermined time after the start of a heating operation, the control board stops the operation of the compressor 11 and switches a four-way valve (not shown) to enable a cooling operation. Then, the control board resumes the operation of the compressor 11 and stops the rotation of the fan 22. Upon this operation, a defrost operation starts.

[0035] In the defrost operation, since the outdoor heat exchanger 21 functions as a condenser, the refrigerant discharged from the compressor 11 flows into the outdoor heat exchanger 21 so as to generate heat in the outdoor heat exchanger 21. Accordingly, by the defrost operation the temperature inside the housing 50 can be increased using the heat in the outdoor heat exchanger 21.

[0036] Upon the defrost operation, the temperature of the frost adhered on the fan motor supporting plate 24 increases and the frost turns into water vapor. The water vapor naturally refreezes if it remains untreated in an extremely cold climate where the outside air temperature is 0 degrees C or below. However, the heater 30 provided on the fan motor supporting plate 24 heats the water vapor adhered on the fan motor supporting plate 24. Accordingly, the water vapor adhered on the fan motor supporting plate 24 can be prevented from refreezing.

[0037] The heater 30 may be provided not only on the fan motor supporting plate 24 but also around the fan motor supporting plate 24. This configuration can similarly transmit to the fan motor supporting plate 24 heat generated by the heater 30, as in the case where the heater 30 is mounted on the fan motor supporting plate 24.

[0038] Although the heater 30 may be provided to extend along the fan motor supporting plate 24, the heater 30 is preferably provided so as not to be in contact with wires, which are located in the vicinity of the fan motor supporting plate 24.

[0039] Further, the heater 30 may not extend straight in the up and down direction, as shown in Fig. 7, but may also extend in the up and down direction while curving in the right and left direction. With this configuration, since the surface area of the heater 30, at which it emits heat to the fan motor supporting plate 24, is relatively large, it is possible to more reliably prevent the water vapor adhered on the fan motor supporting plate 24 from freezing.

[0040] Moreover, the heater 30 may be bent several times in the up and down direction along the fan motor supporting plate 24. With this configuration, it is possible to more reliably prevent water vapor from freezing.

[0041] The position of the heater 30 is not limited to the example shown in Fig. 7, and the heater 30 may also be provided to extend along the lower front surface of the outdoor heat exchanger 21. With this configuration, it is possible to prevent the water vapor adhered on the fan motor supporting plate 24 from freezing, and prevent the water drained from the outdoor heat exchanger 21 from freezing.

[0042] Further, the heater 30 may be implemented using a hot gas bypass (not shown) which directly supplies to the outdoor heat exchanger 21 at least a part of a refrigerant discharged from the compressor 11. In this case, a refrigerant stream having a temperature and pressure higher than those of a refrigerant stream discharged from the compressor 11 and supplied to the outdoor heat exchanger 21 through an indoor heat exchanger (not shown) flows in the hot gas bypass. Accordingly, the fan motor supporting plate 24 or an area around the fan motor supporting plate 24 can be heated by using heat generated by the refrigerant which flows in the hot gas bypass.

[0043] As described above, the outdoor unit 100 according to Embodiment includes the housing 50 having the bottom panel 50c, the outdoor heat exchanger 21 disposed inside the housing 50, the fan 22 disposed inside the housing 50, the fan motor 23 which is disposed inside the housing 50 and configured to drive the fan 22, the fan motor supporting plate 24 which is disposed inside the housing 50 more to the front than the outdoor heat exchanger 21 and supports the fan motor 23, and the heater 30 at least partially disposed on or around the fan motor supporting plate 24. Accordingly, even if water vapor adheres to the fan motor supporting plate 24 during a defrost operation, the temperature of the water vapor adhered on the fan motor supporting plate 24 becomes 0 degrees C or higher since the heater 30 generates heat. As a result, it is possible to prevent the water vapor adhered on the fan motor supporting plate 24 from freezing in an extremely cold environment where the outside air temperature is 0 degrees C or below.

[0044] Fig. 8 is a view showing an exemplary internal configuration of the outdoor unit 100 of the air-conditioning device according to Embodiment. Fig. 9 is a view showing how a heater 30 is disposed in the outdoor unit 100 of the air-conditioning device according to Embodiment.

[0045] As shown in Fig. 8, the upper plate 25 may be connected to the fan motor supporting plate 24 in the upper portion of the fan motor supporting plate 24. Further, as shown in Fig. 9, the heater 30 may be provided around the upper surface of the upper plate 25. Accordingly, the water vapor adhered on the upper plate 25 can be prevented from freezing.

[0046] Although the heater 30 is provided on the upper surface of the upper plate 25 in Fig. 9, it may also be provided on the lower surface of the upper plate 25. With this configuration, it is possible to more reliably prevent the water vapor adhered on the lower surface of the upper plate 25, where water vapor is most likely to adhere to the upper plate 25, from freezing. Further, there is no need to ensure a sufficient space to place the heater 30 between the upper surface of the upper plate 25 and the

lower surface of the top panel 50d. This makes it possible to save the space for the outdoor unit 100.

[0047] The heater 30 may be provided not around the upper surface of the upper plate 25 but on the upper plate 25. This configuration can similarly transmit to the upper plate 25 heat generated by the heater 30, as in the case where the heater 30 is provided around the upper surface of the upper plate 25.

[0048] Further, in the air-sending device chamber 20, the temperature of the right part of the air-sending device chamber 20 (its part on the side of the machine chamber 10) is higher than that of the left part of the air-sending device chamber 20 during the operation of the outdoor unit 100 since the compressor 11 in the machine chamber 10 rotates. In light of such a situation, the left part of the fan motor supporting plate 24 may further be heated more than the right part of the fan motor supporting plate 24.

[Reference Signs List]

[0049] 1: partition, 10: machine chamber, 11: compressor, 12: electrical component box, 20: air-sending device chamber, 21: outdoor heat exchanger, 22: fan, 23: fan motor, 24: fan motor supporting plate, 24a: upper portion, 24a1: hollow portion, 24b: body portion, 24c: lower portion, 24c1: hollow portion, 25: upper plate, 26: upper plate connection portion, 27: bell mouth, 27a: convergent portion, 27b: divergent portion, 30: heater, 50: housing, 50a: front and side panel, 50a1: opening, 50b: right side panel, 50c: bottom panel, 50d: top panel, 50e: back panel, 100: outdoor unit, A: airflow

Claims

1. An outdoor unit for an air-conditioning device comprising:

   a housing (50) which includes a bottom panel (50c);
   an outdoor heat exchanger (21) which is disposed inside the housing (50);
   a fan (22) which is disposed inside the housing (50);
   a fan motor (23) which is disposed inside the housing (50) and configured to drive the fan (22);
   a fan motor supporting plate (24) which is disposed inside the housing (50) more to front than the outdoor heat exchanger (21) and supports the fan motor (23); and
   a heater (30) which is at least partially disposed at one of a position on the fan motor supporting plate (24) and a position around the fan motor supporting plate (24).

2. The outdoor unit for an air-conditioning device of claim 1, wherein the heater (30) extends in an up and down direction, and is bent at one of a position of an upper portion of the fan motor supporting plate (24) and a position around the upper portion of the fan motor supporting plate (24) to form an inverted U shape as seen in a front view.

3. The outdoor unit for an air-conditioning device of claim 1, wherein an upper plate (25) is connected to the fan motor supporting plate (24) in an upper portion of the fan motor supporting plate (24), and the heater (30) is further provided at one of a position on the upper plate (25) and a position around the upper plate (25).

4. The outdoor unit for an air-conditioning device of any one of claims 1 to 3, wherein the fan motor supporting plate (24) is mounted on the bottom panel (50c), and the heater (30) is further provided on an upper surface of the bottom panel (50c).

5. The outdoor unit for an air-conditioning device of any one of claims 1 to 4, wherein the fan motor supporting plate (24) includes a plurality of the fan motor supporting plates (24).

6. The outdoor unit for an air-conditioning device of any one of claims 1 to 5, wherein the heater (30) is implemented using a hot gas bypass pipe which directly supplies to the outdoor heat exchanger (21) at least a part of a refrigerant discharged from a compressor (11) which is disposed in the housing (50).

FIG. 1

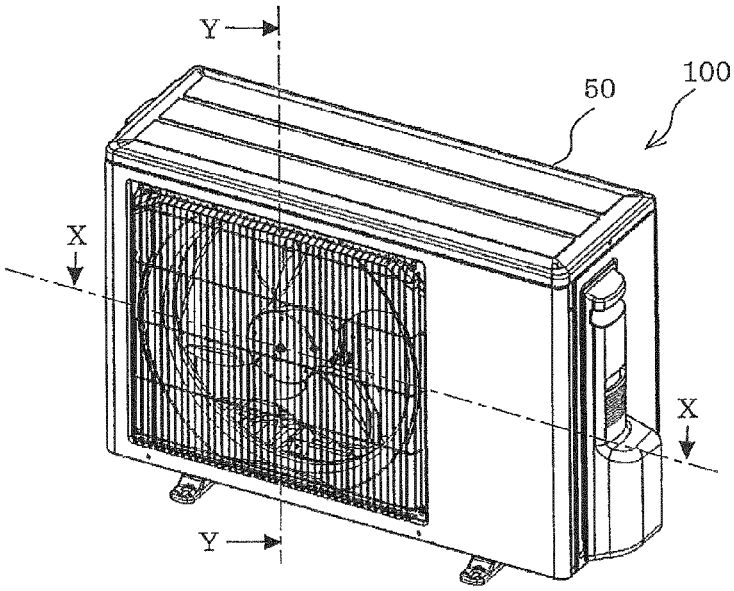

FIG. 2

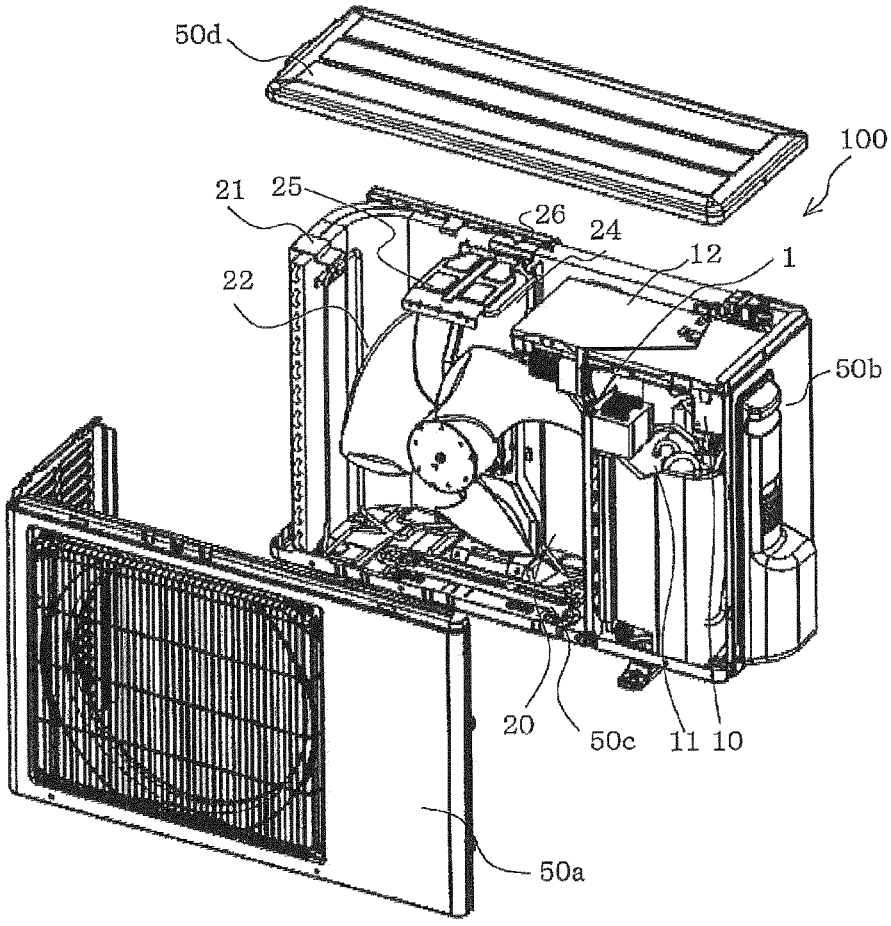

FIG. 3

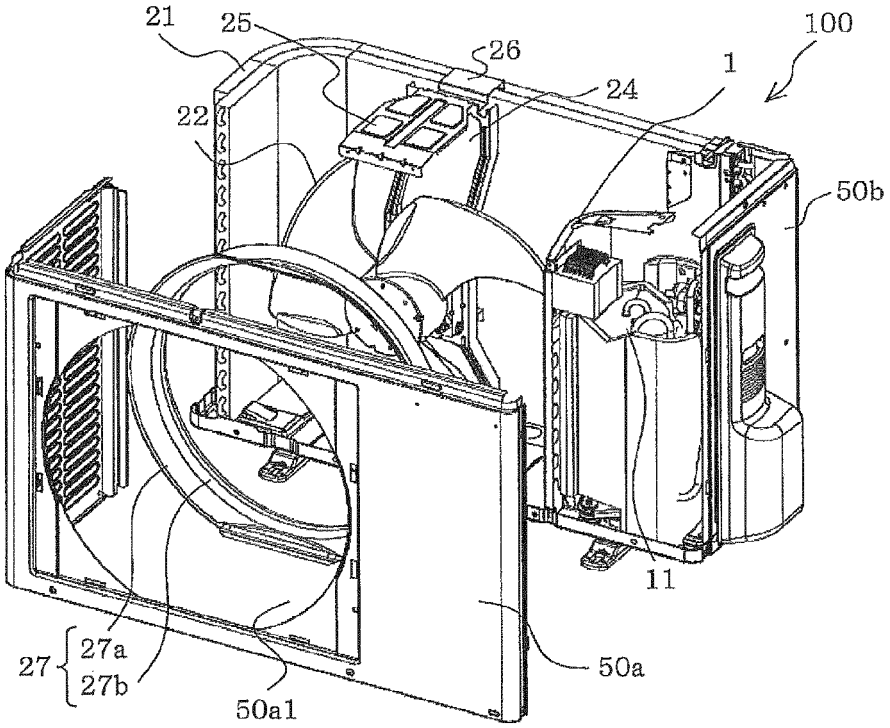
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FIG. 4

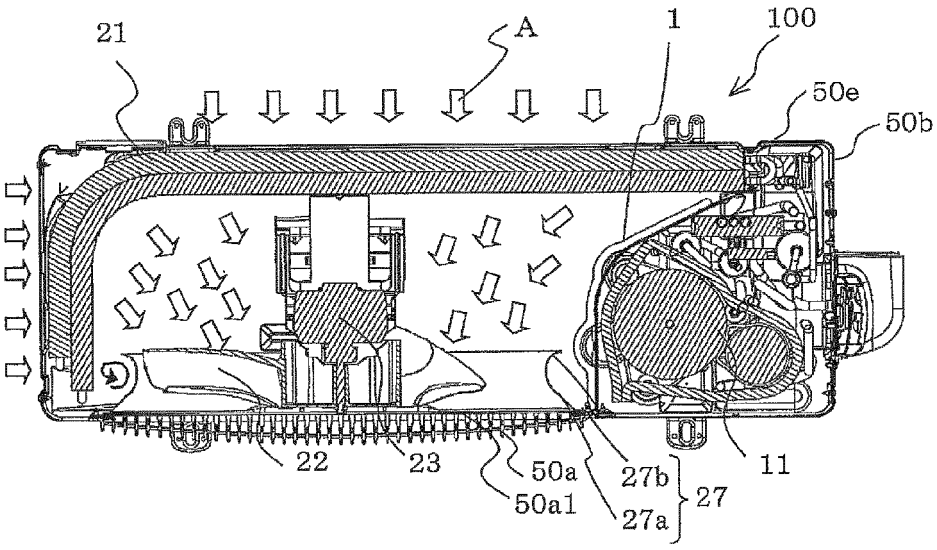
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FIG. 5

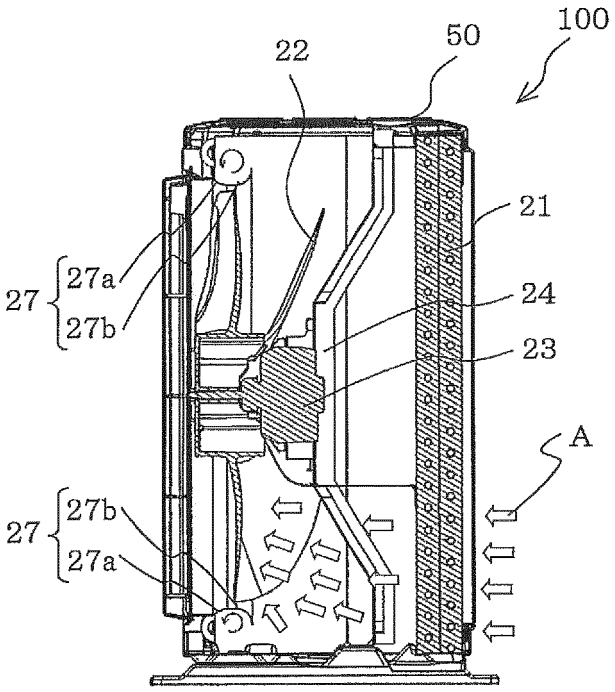

FIG. 6

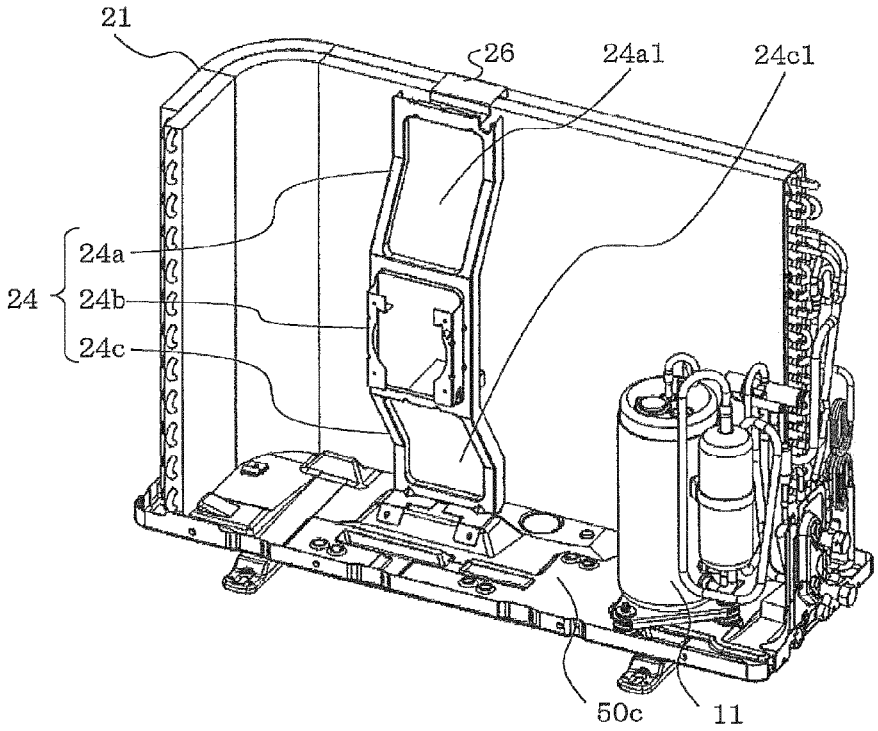
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FIG. 7

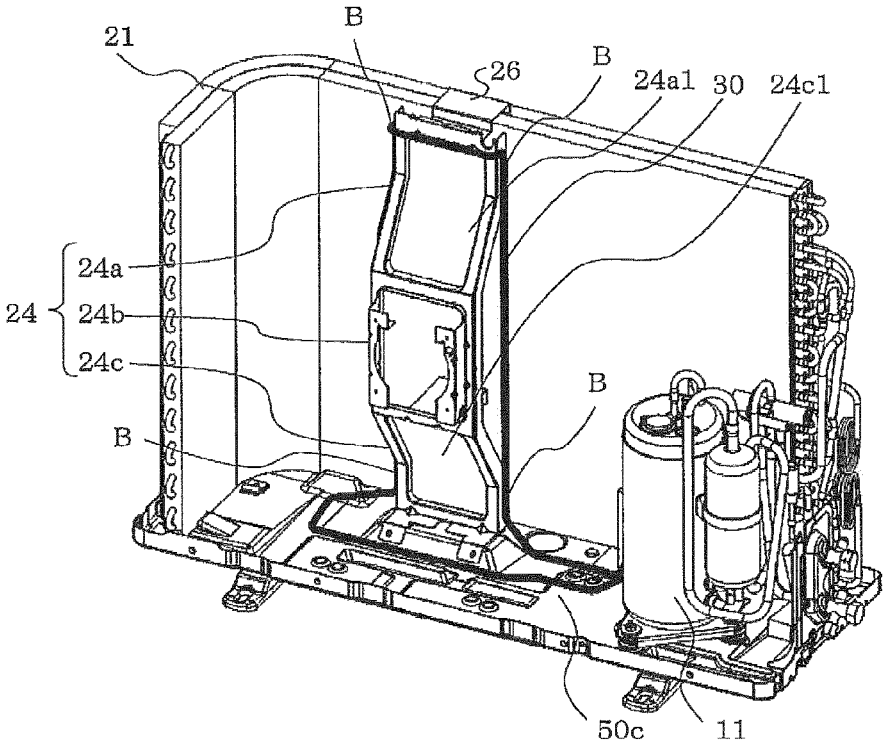
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FIG. 8

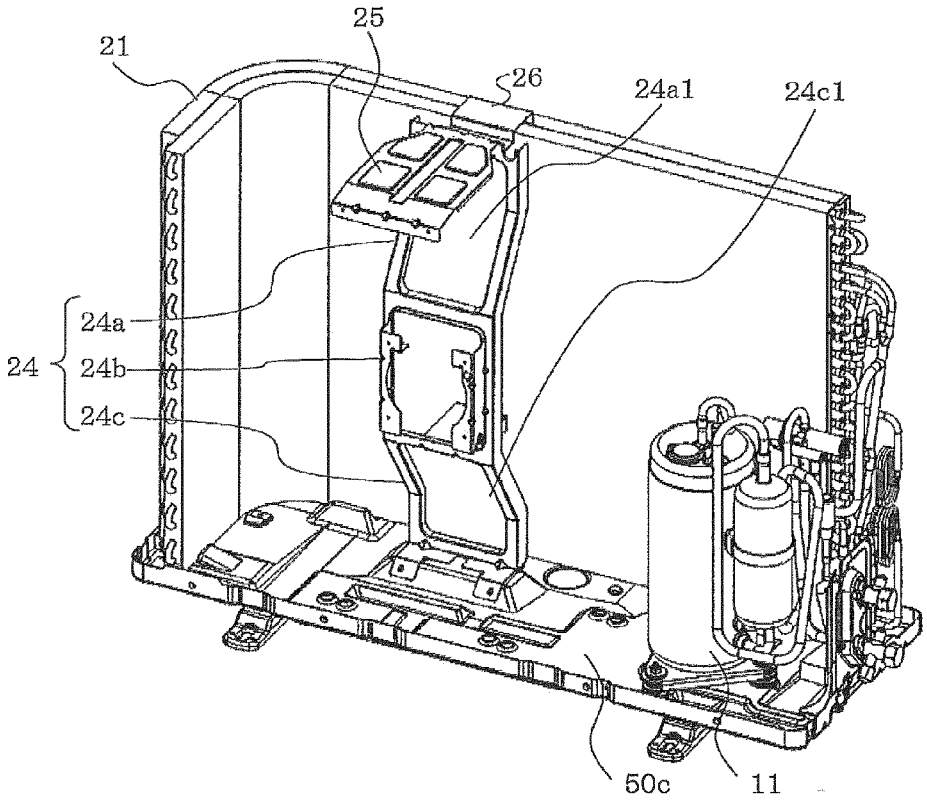
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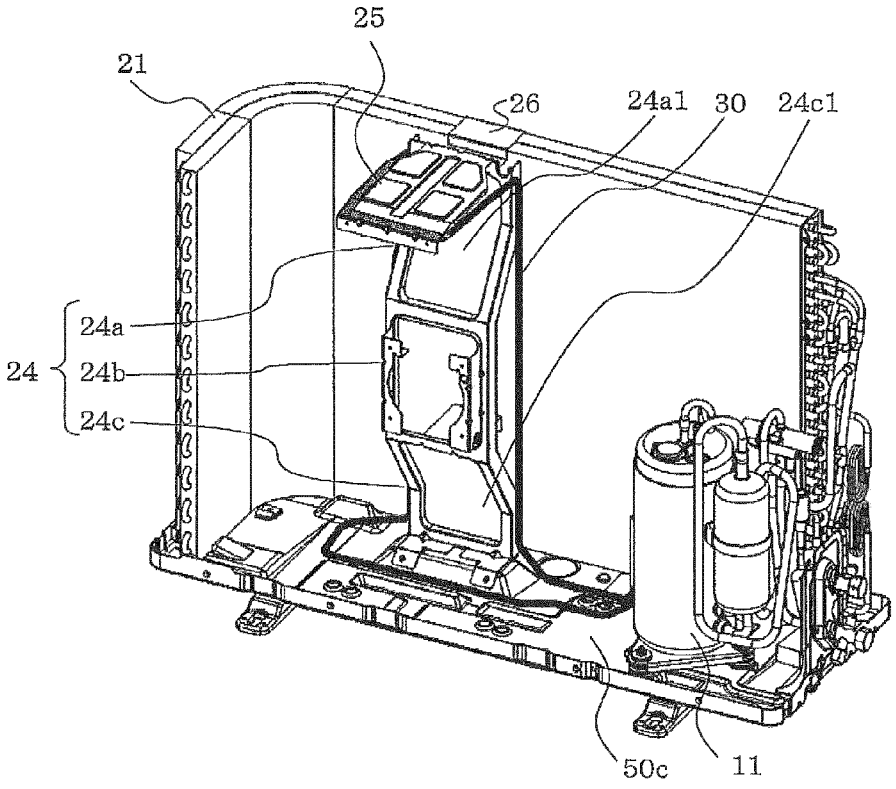
FIG. 9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Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 1151

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 February 2015	Valenza, Davide

CATEGORY OF CITED DOCUMENTS

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REFERENCES CITED IN THE DESCRIPTION

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