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(54) **OUTDOOR UNIT FOR AIR-CONDITIONING DEVICE**

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CPC ***F24F 1/36*** (2013.01); ***F24F 1/46*** (2013.01)

(57) **ABSTRACT**

An outdoor unit includes a housing having a front and side panel in which an opening is formed, a fan disposed in an air-sending device chamber formed inside the housing, an outdoor heat exchanger disposed in the air-sending device chamber, a bell mouth which is disposed in the air-sending device chamber and extends backwards from the periphery of the opening, and a heater which is disposed in the air-sending device chamber in which the bell mouth is disposed, and extends in the up and down direction.

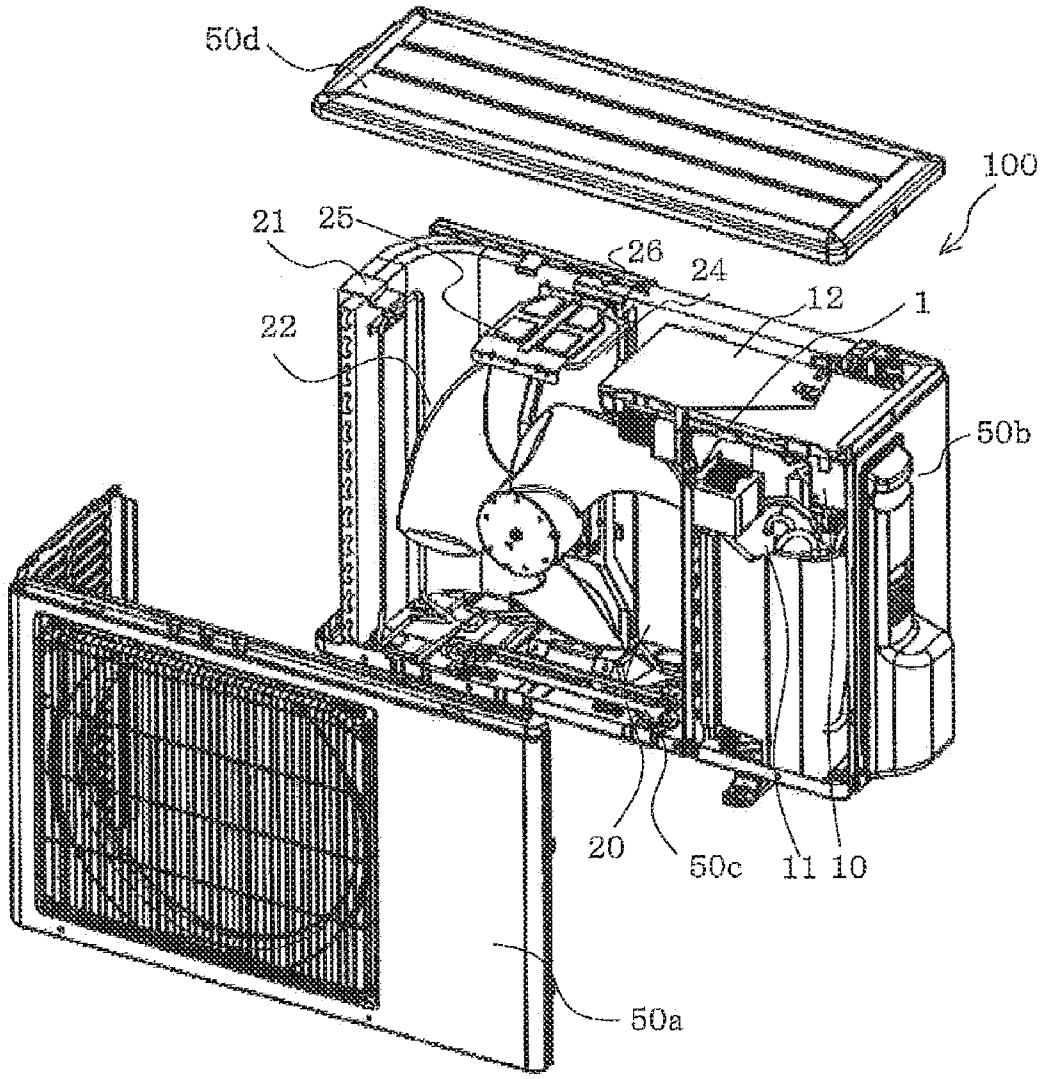


FIG. 1

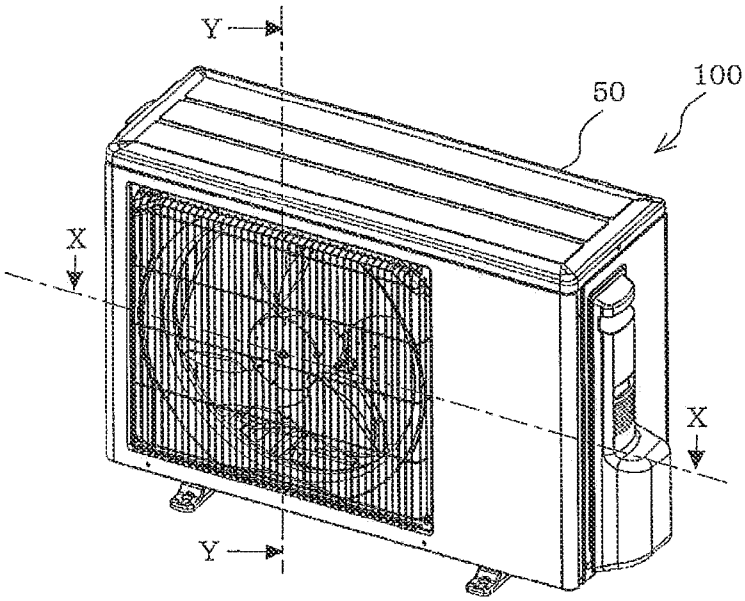


FIG. 2

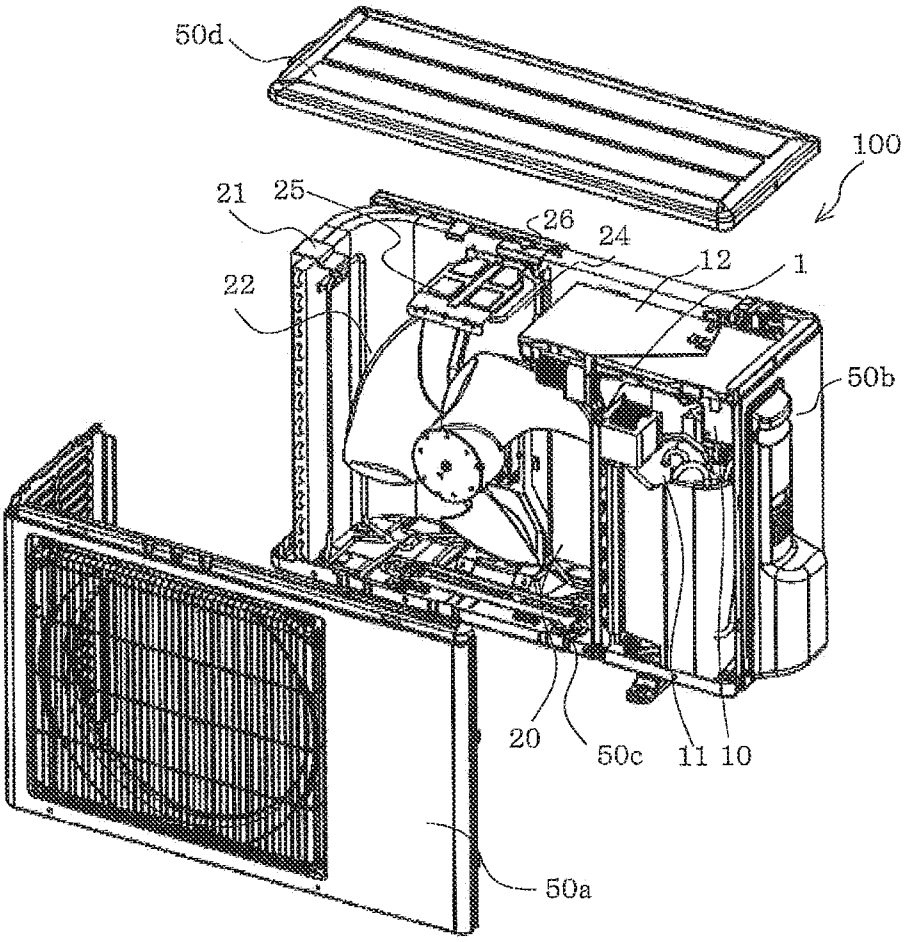


FIG. 3

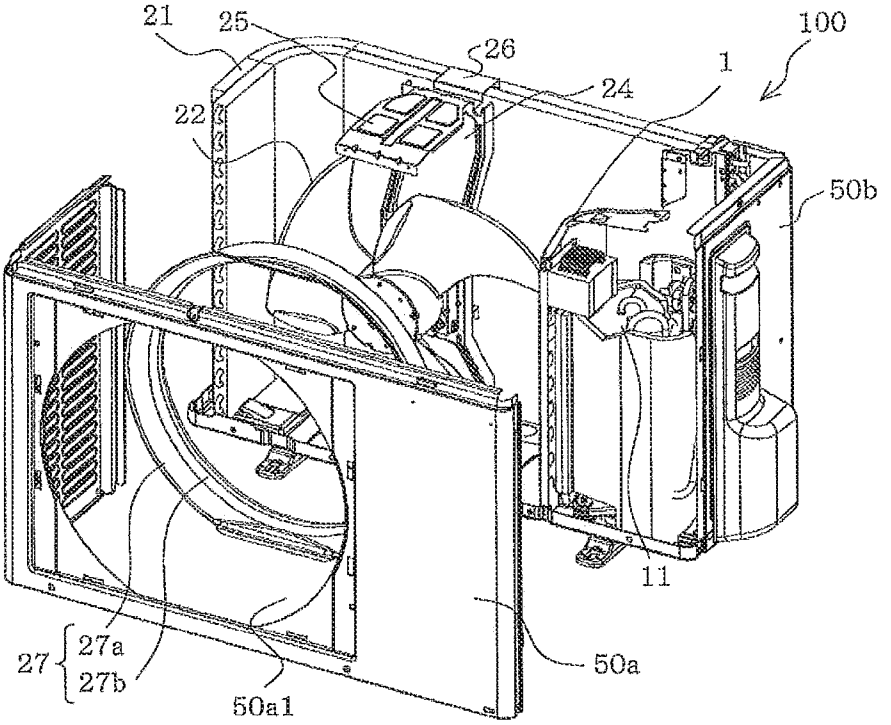

21
25
26
100
1
24
22
50b
11
27
27a
27b
50a1
50a

FIG. 4

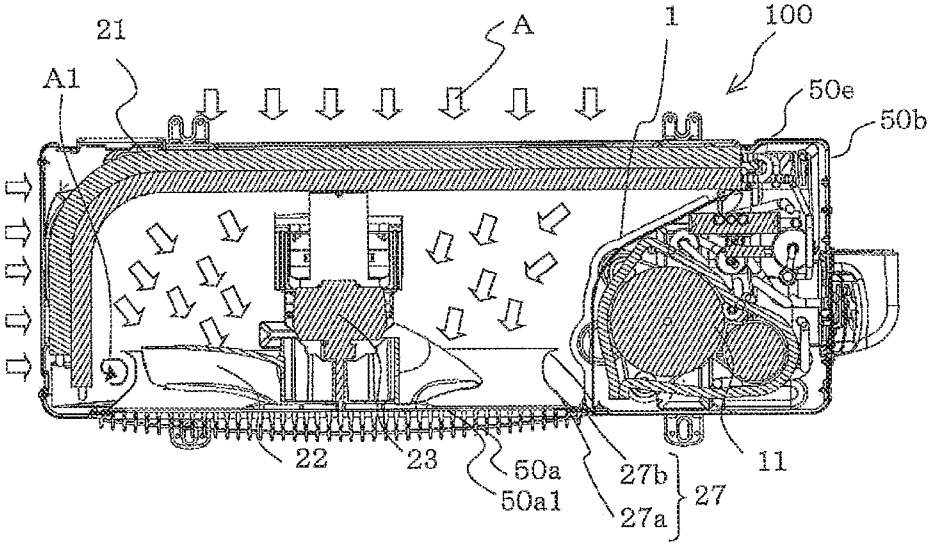

21
A
1
100
A1
50e
50b
22
23
50a
50a1
27b
27a
27
11

FIG. 5

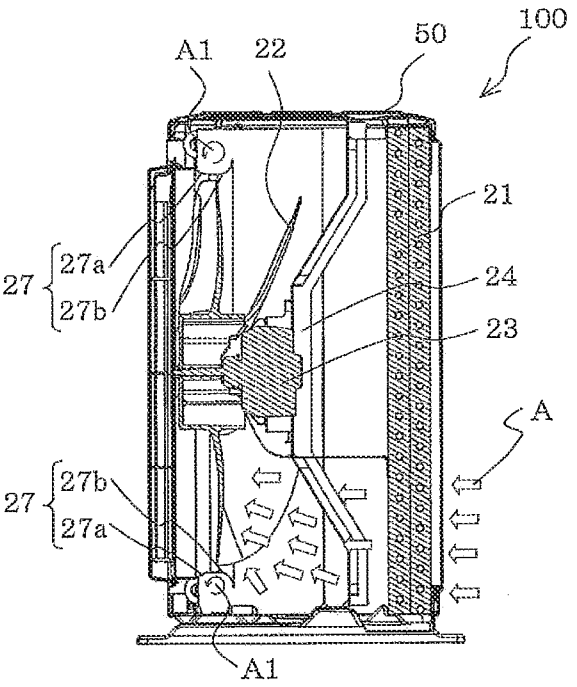


FIG. 6

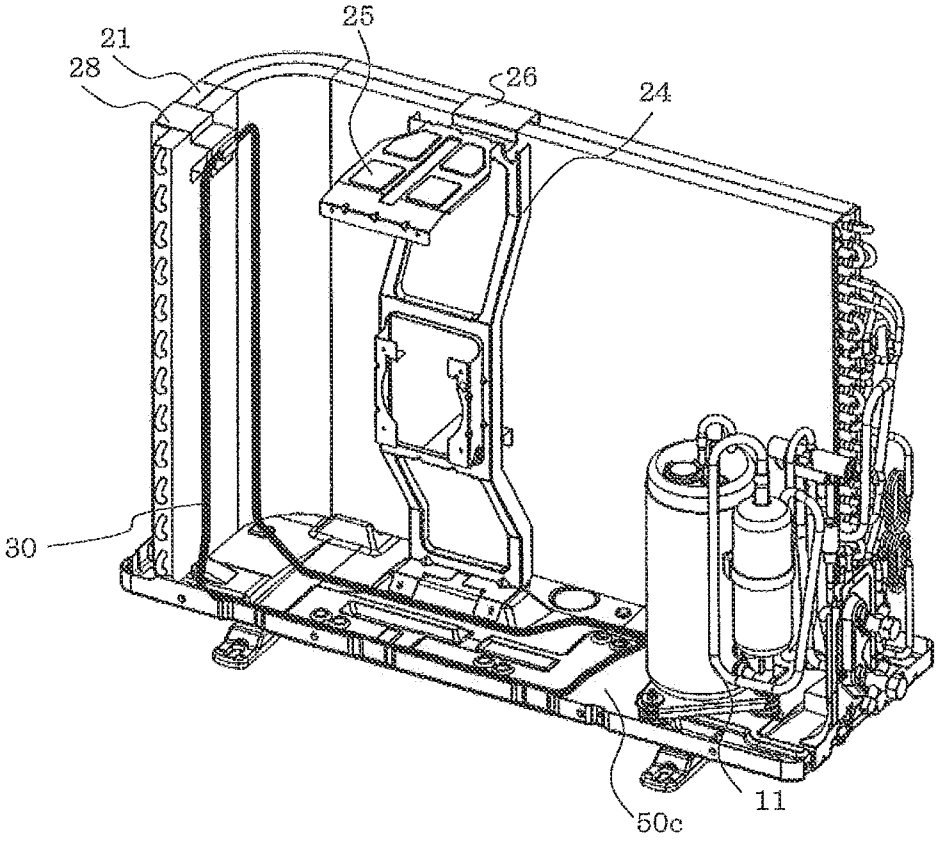


FIG. 7

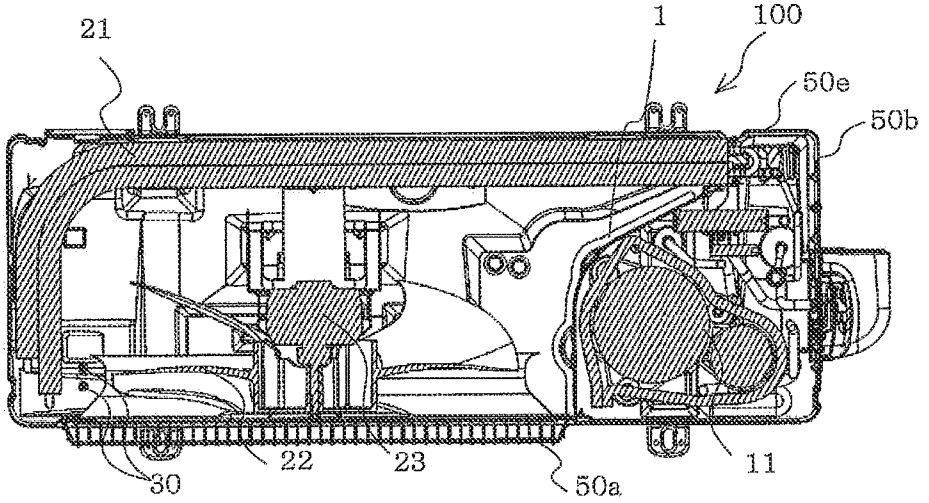


FIG. 8

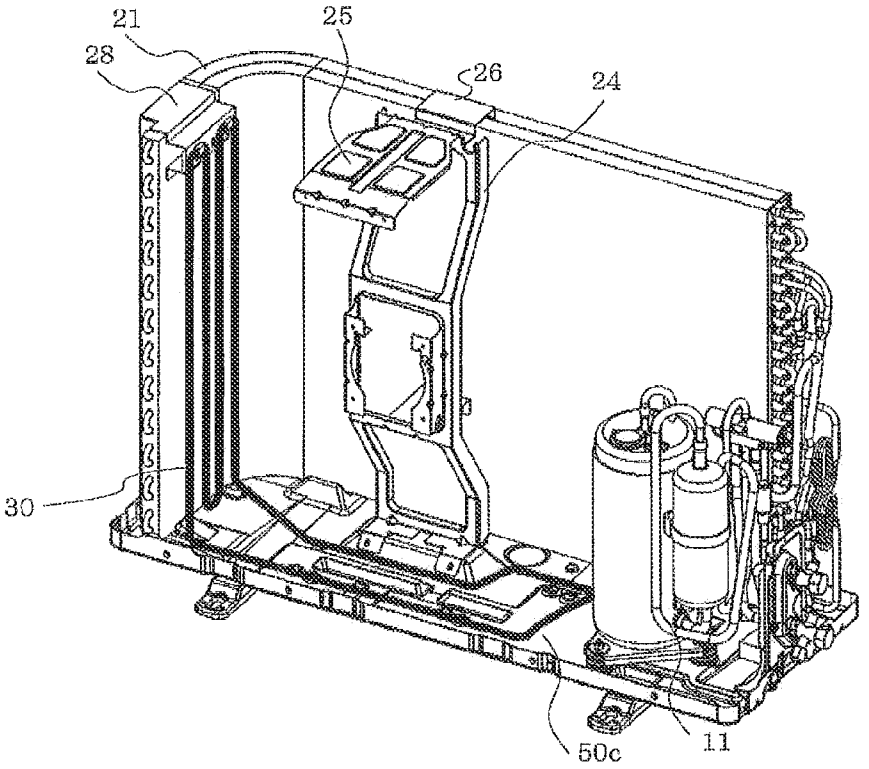


FIG. 9

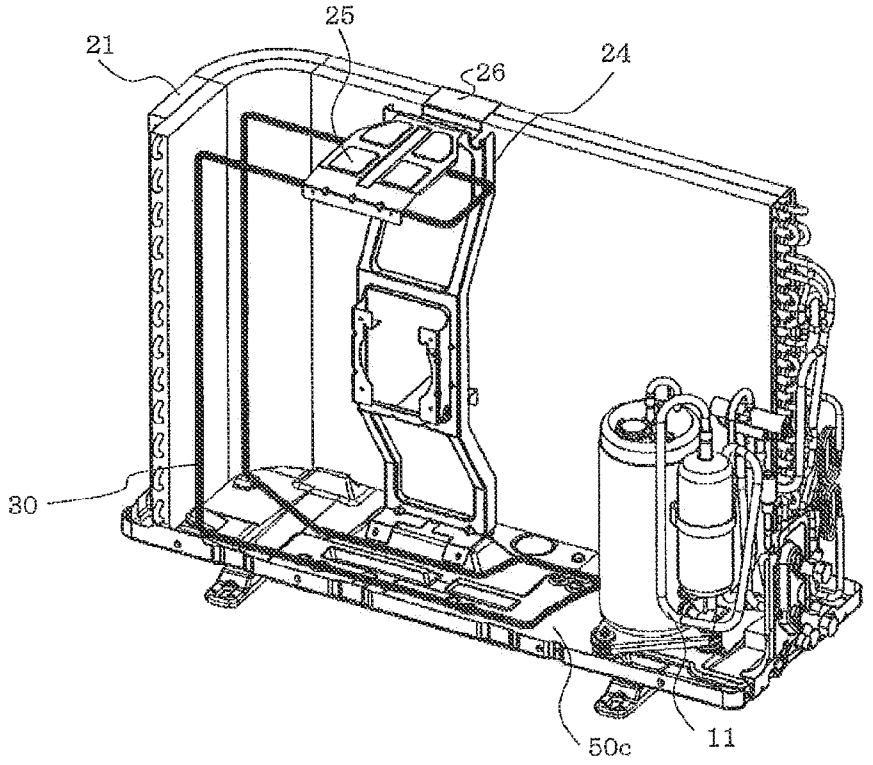
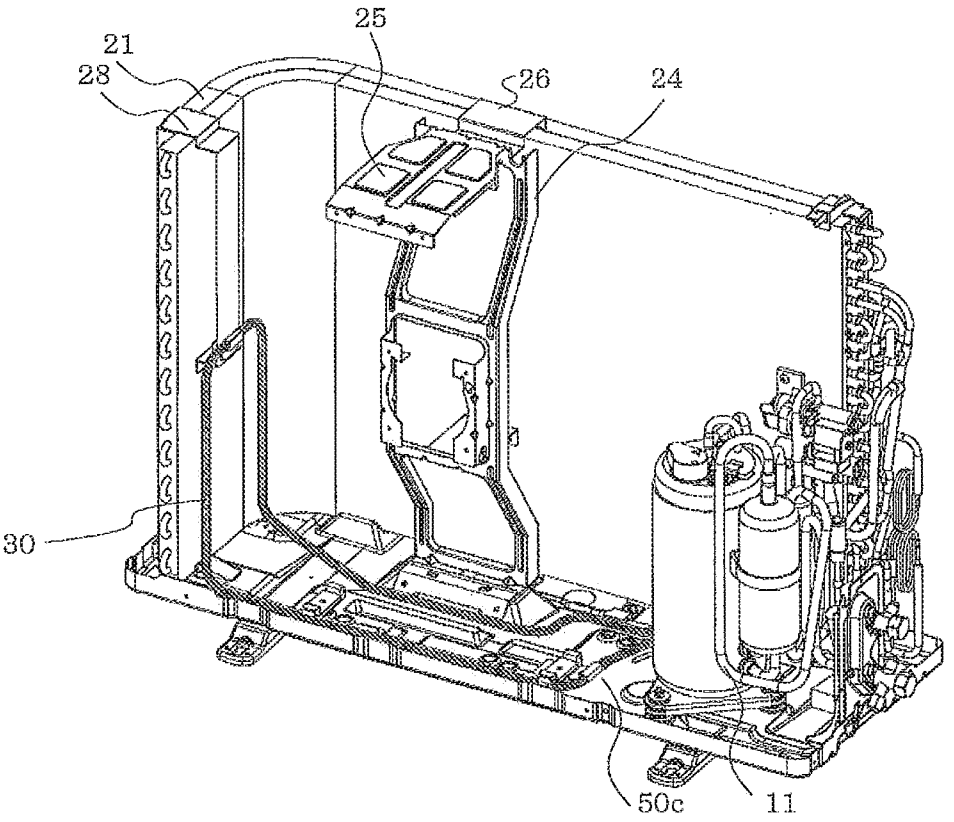


FIG. 10



OUTDOOR UNIT FOR AIR-CONDITIONING DEVICE

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, the amount of air flowing on the outer periphery of a bell mouth during a fan operation is small and air stagnation occurs. As a result, water vapor generated during the defrost operation tends to accumulate and ice tends to grow on the bell mouth. In such a case, there is a problem that ice generated from the frozen water vapor adhered on the bell mouth 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 bell mouth from freezing.

Solution to Problem

[0009] An outdoor unit for an air-conditioning device according to the present invention includes a housing having a front panel in which an opening is formed, a fan disposed in an air-sending device chamber which is formed inside the housing, an outdoor heat exchanger disposed in the air-sending device chamber, a bell mouth which is disposed in the air-sending device chamber and extends backwards from a periphery of the opening, and a heater which is disposed in the air-sending device chamber and extends in the up and down direction.

Advantageous Effects of Invention

[0010] According to the present invention, a heater which extends in the up and down direction is provided in an air-sending device chamber in which a bell mouth is provided. Accordingly, even if water vapor adheres to the bell mouth during a defrost operation, the temperature of the water vapor adhered on the bell mouth becomes 0 degrees C. or higher due to heat generated by the heater. As a result, it is possible to prevent the water vapor adhered on the bell mouth 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** is a perspective view of an outdoor unit **100** of an air-conditioning device according to Embodiment.

[0012] FIG. **2** is an exploded perspective view of an outdoor unit **100** of an air-conditioning device according to Embodiment.

[0013] 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] FIG. **4** is a cross-sectional view taken along the line X-X of FIG. **1**.

[0015] FIG. **5** is a cross-sectional view taken along the line Y-Y of FIG. **1**.

[0016] FIG. **6** is a view showing how a heater **30** is disposed in the outdoor unit **100** of the air-conditioning device according to Embodiment.

[0017] FIG. **7** is a cross-sectional view taken along the line X-X of FIG. **1**, and shows how the heater **30** is disposed in the outdoor unit **100**.

[0018] FIG. **8** is a view showing how the heater **30** is disposed in the outdoor unit **100** of the air-conditioning device according to Embodiment.

[0019] FIG. **9** is a view showing how the heater **30** is disposed in the outdoor unit **100** of the air-conditioning device according to Embodiment.

[0020] FIG. **10** is a view showing how the heater **30** is disposed in the outdoor unit **100** of the air-conditioning device according to Embodiment.

DESCRIPTION OF EMBODIMENT

[0021] 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.

[0022] 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**.

[0023] 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 **50***a*, a right side panel **50***b*, a bottom panel **50***c*, a top panel **50***d* and a back panel **50***e* (see FIG. **4**). The front and side panel **50***a* 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**.

[0024] The front and side panel **50***a* 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 **50***a* 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**.

[0025] 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.

[0026] 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**.

[0027] 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 **50***a* and the back panel **50***e*. The fan **22** serves as an air-sending unit 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**.

[0028] The fan motor **23** serves as a driving unit for driving the fan **22**, and is mounted on the fan motor supporting plate **24** by using a fixing member 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 **50***c*. 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.

[0029] The upper plate **25** is implemented using a plate member which is, for example, almost parallel to the bottom panel **50***c*. 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.

[0030] 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**.

[0031] As shown in FIG. **3**, an opening **50***a***1** is formed in the front and side panel **50***a*. The opening **50***a***1** 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 **50***a* so as to surround the outer periphery of the fan **22**.

[0032] The bell mouth **27** includes, for example, a convergent portion **27***a* which extends backwards so that its diameter is smaller in areas more radially inward and farther from the periphery of the opening **50***a***1**, and a divergent portion **27***b* which extends backwards so that its diameter is larger in areas more radially outward and farther from the back end of the convergent portion **27***a*. The bell mouth **27** is integrated with the front and side panel **50***a*. The bell mouth **27** serves to guide the outside air introduced in the housing **50** to the opening **50***a***1**. Note that the bell mouth **27** may be formed to have a portion extending in the front and back direction between the convergent portion **27***a* and the divergent portion **27***b*.

[0033] 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**.

[0034] 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 bell mouth **27** 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 **50***a***1**. As shown in FIGS. **4** and **5**, air stagnation A**1** tends to occur on the outer periphery of the bell mouth **27**.

[0035] FIG. **6** is a view showing how the heater **30** is disposed in the outdoor unit **100** of the air-conditioning device according to Embodiment. FIG. **7** is a cross-sectional view taken along the line X-X of FIG. **1**, and shows how the heater **30** is disposed in the outdoor unit **100**. As shown in FIG. **6**, the heater **30** which extends in the up and down direction is mounted in the outdoor heat exchanger **21** via a heater supporting member **28**.

[0036] The heater **30** serves as a heating unit 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**. As shown in FIG. **7**, the heater **30** has a circular cross-section.

[0037] The heater **30** is disposed between a portion of the outdoor heat exchanger **21** which extends in the front and back direction along the left side face of the front and side panel **50***a* and the back end of the convergent portion **27***a* of the bell mouth **27** which opposes the left side face of the front and side panel **50***a*. The heater **30** is bent in the vicinity of the heater supporting member **28** to form an inverted U shape, as seen in a side view, and is located around the outdoor heat exchanger **21**.

[0038] 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.

[0039] The heater **30** further extends in the right and left direction on the upper surface of the bottom panel **50***c*. The heater **30** is desirably disposed on the front part of the bottom panel **50***c*. Specifically, the heater **30** is preferably disposed, for example, on the upper surface of the bottom panel **50***c* more to the front than the back end of the bell mouth **27** as seen in a plan view. With this configuration, it is possible to reliably prevent the water vapor adhered on the bell mouth **27** from freezing, and, in turn, to prevent the water flowing out of the outdoor heat exchanger **21** from freezing.

[0040] Note that a configuration is also possible in which the heater **30** extends in the up and down direction in the vicinity of the left side face of the front and side panel **50***a* and does not extend on the front part of the upper surface of the bottom panel **50***c*. In this configuration as well, it is possible to prevent the water vapor adhered on the bell mouth **27** from freezing.

[0041] Also, a configuration is also possible in which the heater **30** extends in the up and down direction while curving to the right and left instead of the use of a heater **30** extending straight in the up and down direction as shown in FIG. **6**. With this configuration, since the surface area of the heater **30**, at which it emits heat to the bell mouth **27**, increases, it is possible to reliably prevent the water vapor adhered on the bell mouth **27** from freezing.

[0042] 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 unit (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.

[0043] 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 bell mouth **27** in the air-sending device chamber **20**. When the temperature of the outside air detected by the outside air temperature sensor reaches a predetermined 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 bell mouth **27**, thereby suppressing frost formation on the bell mouth **27**.

[0044] 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.

[0045] 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**.

[0046] Upon the defrost operation, the temperature of the frost adhered on the bell mouth **27** 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 bell mouth **27** heats the water vapor adhered on the bell mouth **27**. This makes it possible to prevent the water vapor adhered on the bell mouth **27** from refreezing.

[0047] Note that 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 the 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 bell mouth **27** can be heated by using heat generated by the refrigerant which flows in the hot gas bypass.

[0048] As described above, the outdoor unit **100** according to this Embodiment includes the housing **50** having the front and side panel **50***a* in which the opening **50***a***1** is formed, the fan **22** disposed in the air-sending device chamber **20** which is formed inside the housing **50**, the outdoor heat exchanger **21** disposed in the air-sending device chamber **20**, the bell mouth **27** which is disposed in the air-sending device chamber **20** and extends backwards from the periphery of the opening **50***a***1**, and the heater **30** which is disposed in the air-sending device chamber **20** and extends in the up and down direction.

[0049] With this arrangement, even if water vapor adheres to the bell mouth **27** during a defrost operation, the temperature of the water vapor adhered on the bell mouth **27** becomes 0 degrees C. or higher due to heat generated by the heater. As

a result, it is possible to prevent the water vapor adhered on the bell mouth **27** from freezing in an extremely cold environment where the outside air temperature is 0 degrees C. or below. Particularly, even if air stagnation occurs on the outer periphery of the bell mouth **27**, the water vapor adhered on the outer peripheral surface of the bell mouth **27** can be prevented from freezing.

[0050] Further, the heater **30** is disposed more to the side of the outdoor heat exchanger **21** which is provided to extend along the side face of the air-sending device chamber **20** than the bell mouth **27**. Accordingly, it is possible to transmit heat generated by the heater **30** to a portion of the bell mouth **27** where heat generated by the compressor **11** is less likely to be transmitted and water vapor is most likely to freeze.

[0051] FIG. **8** is a view showing how the heater **30** is disposed in the outdoor unit **100** of the air-conditioning device according to Embodiment. FIG. **9** is a view showing how the heater **30** is disposed in the outdoor unit **100** of the air-conditioning device according to Embodiment. FIG. **10** is a view showing how the heater **30** is disposed in the outdoor unit **100** of the air-conditioning device according to Embodiment.

[0052] As shown in FIG. **8**, a configuration is also possible in which the heater has a plurality of portions bent to form a plurality of inverted and non-inverted U shapes. With this configuration, since the surface area of the heater **30**, at which it emits heat to the bell mouth **27**, is relatively large, it is possible to reliably prevent the water vapor adhered on the bell mouth **27** from freezing.

[0053] Further, as shown in FIG. **9**, a configuration is also possible in which the heater **30** extends in the right and left direction in a portion above the top end of the bell mouth **27**. With this configuration, it is possible to prevent the water vapor adhered on the upper area of the bell mouth **27** as well as the water vapor adhered on the lower and side areas of the bell mouth **27** from freezing.

[0054] Further, as shown in FIG. **10**, a configuration is also possible in which the heater is bent around the center of the bell mouth **27** in the up and down direction. In the heater **30** having this configuration, it is possible to heat the central portion of the bell mouth **27** where air stagnation is most likely to occur. Accordingly, even if a sufficient space for installing the heater **30** is not provided, the water vapor adhered on the bell mouth **27** can be efficiently prevented from freezing.

REFERENCE SIGNS LIST

[0055] **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 **25** upper plate **26** upper plate connection portion **27** bell mouth **27***a* convergent portion **27***b* divergent portion **28** heater supporting member **30** heater **50** housing **50***a* front and side panel **50***a***1** opening **50***b* right side panel **50***c* bottom panel **50***d* top panel **50***e* back panel **100** outdoor unit A air flow A**1** air stagnation

1. An outdoor unit for an air-conditioning device comprising:
- a housing which includes a front panel in which an opening is formed;
- a fan disposed in an air-sending device chamber which is formed inside the housing;
- an outdoor heat exchanger disposed in the air-sending device chamber;
- a bell mouth which is disposed in the air-sending device chamber and extends backwards from a periphery of the opening; and
- a heater which is disposed in the air-sending device chamber in which the bell mouth is disposed, and extends in an up and down direction.

2. The outdoor unit for an air-conditioning device of claim **1**, wherein the outdoor heat exchanger is provided to extend along a side face of the housing which forms the air-sending device chamber, and the heater is disposed more to a side of the outdoor heat exchanger which is provided to extend along the side face of the air-sending device chamber than the bell mouth.

3. The outdoor unit for an air-conditioning device of claim **1**, further comprising:
- a compressor; and
- a partition that divides an inner space of the housing into a plurality of spaces,
- wherein the partition divides the inner space of the housing into a machine chamber which houses the compressor and the air-sending device chamber.

4. The outdoor unit for an air-conditioning device of claim **1**, wherein the heater is provided to form an inverted U shape as seen in a side view.

5. The outdoor unit for an air-conditioning device of claim **1**, wherein the heater is further provided on an upper surface of a bottom panel which forms the housing.

6. The outdoor unit for an air-conditioning device of claim **1**, wherein the heater is provided to extend in a right and left direction in a portion above a top end of the bell mouth.

7. The outdoor unit for an air-conditioning device of claim **1**, wherein the heater includes a plurality of bent portions.

8. The outdoor unit for an air-conditioning device of claim **1**, wherein the heater is implemented using a hot gas bypass pipe which directly supplies to the outdoor heat exchanger at least a part of a refrigerant discharged from a compressor which is disposed in the housing.

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