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(72) Inventors:
• **SANO, Mitsukuni**
Fuji-shi, Shizuoka 416-8521 (JP)
• **SUITO, Shoichiro**
Fuji-shi, Shizuoka 416-8521 (JP)

(74) Representative: **Gramm, Lins & Partner**
Patent- und Rechtsanwälte PartGmbB
Theodor-Heuss-Straße 1
38122 Braunschweig (DE)

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(71) Applicant: **Toshiba Carrier Corporation**
Kawasaki-Shi,
Kanagawa 212-8585 (JP)

(54) **OUTDOOR UNIT OF REFRIGERATION CYCLE APPARATUS**

(57) To provide an outdoor unit of a refrigeration apparatus that can reliably drain water to be generated by the defrosting operation regardless of whether a sheathed heater is used as in the conventional outdoor unit or a heater that has a lower heat generation capacity per unit area than a sheathed heater is used. The outdoor unit 1 includes: a bottom plate 21 having a drain outlet 43; a heat exchanger 17 disposed above the bottom plate 21; a first heat-transfer member 51 that has a plate-shape and is in contact with all or part of a bottom face of the heat exchanger 17; and a linear heater 52 that provided on the first heat-transfer member 51.

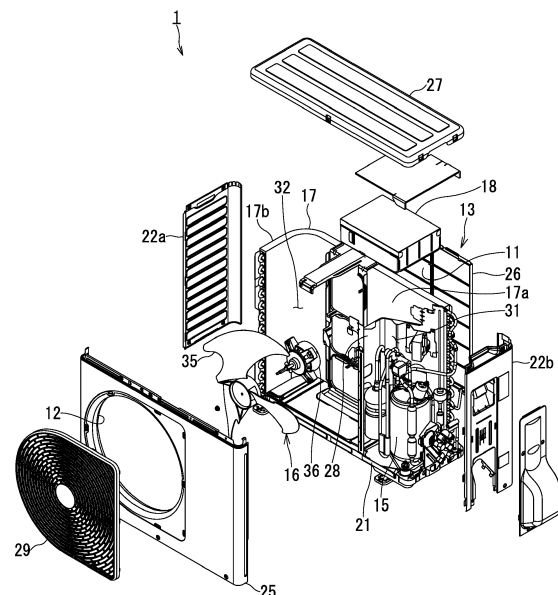


FIG. 1

EP 3 690 329 A1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] Embodiments of the present invention relates to an outdoor unit of a refrigeration cycle apparatus.

Description of the Related Art

[0002] An outdoor unit of a refrigeration cycle apparatus is exemplified as the outdoor unit of an air conditioner and the outdoor unit of a heat pump water heater. The outdoor unit of the refrigeration cycle apparatus is installed outdoors. Refrigeration components are housed inside the outdoor unit. The outdoor unit of the refrigeration cycle apparatus includes a housing that has a bottom plate, a compressor, a heat exchanger, and a blower that generates air flow around the heat exchanger. The compressor, the heat exchanger, and the blower are accommodated inside the housing.

[0003] When the heating operation of the refrigeration cycle apparatus is continued under an environment where the outside air temperature is low such as a cold region or a snowfall region, there is a possibility that the heat exchanger of the outdoor unit is frosted. When the heat exchanger of the outdoor unit is frosted, the heat-exchange performance of the refrigeration cycle apparatus is significantly reduced.

[0004] For this reason, the refrigeration cycle apparatus periodically performs a so-called defrosting operation for melting frost attached to the heat exchanger of the outdoor unit. In the defrosting operation, the frost adhered to the heat exchanger is melted by circulating a high-temperature refrigerant through the heat exchanger of the outdoor unit. The melted frost, i.e., drain water (drainage) is dripped onto the bottom plate of the housing, and then drained to the outside of the outdoor unit through a drain outlet provided on the bottom plate of the housing of the outdoor unit.

[0005] However, in an environment where the outside air temperature is equal to the freezing point or lower, the drain water to be generated by the defrosting operation may freeze on the bottom plate before being drained to the outside of the outdoor unit. When the drain water freezes before reaching the drain outlet, the drain water is not drained to the outside of the outdoor unit normally.

[0006] For this reason, the conventional outdoor unit of the refrigeration cycle apparatus includes an electric heating device provided on the top face of the bottom plate.

[0007] [Patent Document 1] JP 2015-055455 A

[0008] The electric heating device of the conventional outdoor unit includes a sheathed heater that may be bent slightly but has not enough flexibility to be laid out to fit free paths. In other words, the sheathed heater as the electric heating device of the conventional outdoor unit

needs to be manufactured in a shape that fits the laying path in advance.

[0009] For this reason, a so-called cord heater or heating cord is applied to the electric heating device of the outdoor unit in some cases, because such heater has enough flexibility to be bent freely. The flexible heater make it possible to set the laying path more flexible.

[0010] However, in general, a flexible heater is inferior to a sheathed heater in terms of heat generation capacity per unit area. In other words, there is a trade-off relationship between the degree of freedom of the laying path of the heater and the heat generation capacity per unit area of the heater.

[0011] When the bottom plate is heated using the electric heating device as in the conventional outdoor unit, the amount of heat of the electric heating device is widely transmitted to the bottom plate. Thus, a considerable amount of heat is required to prevent the drain water from freezing before reaching the drain outlet of the bottom plate. In detail, when the amount of heat to be generated using the electric heating device is insufficient, the amount of heat necessary for preventing freezing of the drain water dripped on the bottom plate is insufficient. In other words, when the bottom plate is heated using the electric heating device as in the conventional outdoor unit, there is a possibility that the drain water on the bottom plate freezes before reaching the drain outlet.

SUMMARY OF THE INVENTION

[0012] To solve the problem described above, it is an object of the present invention to provide an outdoor unit of a refrigeration apparatus that can reliably drain water to be generated by the defrosting operation regardless of whether a sheathed heater is used as in the conventional outdoor unit or a heater that has a lower heat generation capacity per unit area than a sheathed heater is used.

[0013] To achieve the above object, an aspect of the present invention provides an outdoor unit of a refrigeration cycle apparatus includes: a bottom plate having a drain outlet; a heat exchanger disposed above the bottom plate; a heat-transfer member that has a plate-shape and is in contact with all or part of a bottom face of the heat exchanger; and a linear heater that provided on the heater heat-transfer member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is an exploded perspective view illustrating an outdoor unit of a refrigeration cycle apparatus according to one embodiment of the present invention. Fig. 2 is a perspective view of the inside of the outdoor unit according to the embodiment of the present invention.

Fig. 3 is a perspective view of an electric heating

device and a bottom plate of the outdoor unit according to the embodiment of the present invention.

Fig. 4 is a partial cross-sectional view of a first electric heating device and the bottom plate of the outdoor unit according to the embodiment of the present invention.

Fig. 5 is a partial cross-sectional view of a second electric heating device and the bottom plate of the outdoor unit according to the embodiment of the present invention.

Fig. 6 is a perspective view of another aspect of the first electric heating device of the outdoor unit according to the embodiment of the present invention.

DETAILED DESCRIPTION

[0015] Embodiments of an outdoor unit of a refrigeration cycle apparatus according to the present invention will be described by referring to Fig. 1 to Fig. 6. The same reference signs are given to identical or equivalent components in each figure.

[0016] Fig. 1 is an exploded perspective view of one aspect of the outdoor unit of the refrigeration cycle apparatus according to the embodiment of the present invention.

[0017] As shown in Fig. 1, the outdoor unit 1 of the refrigeration cycle apparatus according to the present embodiment includes: a housing 13 having an air intake 11 and an air outlet 12; a compressor 15 disposed inside the housing 13; a blower 16 disposed inside the housing 13; a heat exchanger 17 disposed inside the housing 13; and an electrical-component box 18 disposed inside the housing 13.

[0018] The housing 13 is in the form of a rectangular parallelepiped. The width dimension (i.e., dimension in the right-left direction) of the housing 13 is larger than the depth dimension (i.e., dimension in the front-rear direction) of the housing 13. The housing 13 includes a bottom plate 21, a left side plate 22a that covers the left side, a right side plate 22b that covers the right side, a front plate 25 that covers the front, a fin guard 26 that covers the back, a top plate 27 that covers the top, and a partition plate 28 that is provided upright on the bottom plate 21 and partitions the inside of the housing 13 to the right and left.

[0019] The bottom plate 21 has a rectangular shape in plan view. The width dimension of the bottom plate 21 is larger than the depth dimension of the bottom plate 21. The bottom plate 21 is substantially parallel to the ground plane of the outdoor unit 1. The bottom plate 21 is, for example, a sheet metal product made of iron-based alloy. The bottom plate 21 supports respective components included in the outdoor unit 1. For this reason, the thickness of the bottom plate 21 is larger than the thickness of the front plate 25, the thickness of the left side plate 22a, the thickness of the right side plate 22b, and the thickness of the top plate 27. The compressor 15, the blower 16, and the heat exchanger 17 are fixed and supported on

the bottom plate 21.

[0020] The front plate 25 is a sheet metal product. The thickness of the front plate 25 is smaller than the thickness of the bottom plate 21. The front plate 25 has the circular air outlet 12 in the center. A fan guard 29 is provided at the air outlet 12.

[0021] The fan guard 29 has a large number of fine openings in a grid pattern. The fin guard 26 covers and hides the heat exchanger 17.

[0022] The partition plate 28 is a sheet metal product. The partition plate 28 is a plate-shaped member that extends in the vertical direction. The partition plate 28 is fixed to the bottom plate 21 using a fixing method such as screwing. The partition plate 28 divides the inside of the housing 13 into two in the width direction (right-left direction) of the housing 13. The right space in the housing 13 partitioned by the partition plate 28 is a machine chamber 31. The left space in the housing 13 partitioned by the partition plate 28 is a blower chamber 32.

[0023] The compressor 15 is disposed in the machine chamber 31. The compressor 15 includes: a compression mechanism (not shown) that compresses and sends out the refrigerant circulating in the refrigeration cycle; and an electric motor (not shown) that drives the compression mechanism. The compressor 15 is connected to a refrigerant pipe 33 that circulates the refrigerant in the refrigeration cycle. Note that the refrigerant pipe 33 in Fig. 1 is part of the refrigerant piping of the entire refrigeration cycle.

[0024] The blower 16 and the heat exchanger 17 are disposed in the blower chamber 32.

[0025] The heat exchanger 17 is a fin tube type made of aluminum or aluminum alloy. The heat exchanger 17 extends along the inner face of the back face of the housing 13 and the inner face of the left side-face, and has L-shape in plan view of the housing 13.

[0026] The blower 16 includes a propeller fan 35 and an electric motor 36 that drives the propeller fan 35 to rotate. The blower 16 is disposed between the heat exchanger 17 and the front plate 25 of the housing 13 with the rotation centerline of the propeller fan 35 directed in the front-rear direction of the housing 13. The blower 16 is disposed above the bottom plate 21. The blower 16 faces the heat exchanger 17. That is, the propeller fan 35 is disposed above the bottom plate 21. The propeller fan 35 faces the heat exchanger 17. The propeller fan 35 to be rotationally driven using the electric motor 36 sucks in air from the back side of the outdoor unit 1 and blows out the air to the front side of the outdoor unit 1. That is, the propeller fan 35 sucks in air from the side of the fin guard 26 and blows out the air to the air outlet 12 of the front plate 25. Thus, the air to be subjected to heat exchange using the heat exchanger 17, i.e., the atmosphere around the outdoor unit 1 flows from the back side toward the front side of the heat exchanger 17.

[0027] When the heating operation of the refrigeration cycle apparatus is continued under an environment where the outside air temperature is low such as a cold

region or a snowfall region, the heat exchanger 17 of the outdoor unit 1 is frosted. Thus, the refrigeration cycle apparatus performs the defrosting operation for melting frost adhered to the heat exchanger 17 periodically or each time frost formation is detected. The defrosting operation is performed under the state where a four-way valve (not shown) for switching the flow direction of the refrigerant in the refrigeration cycle is driven and the refrigeration cycle is switched to the cooling operation. The heat exchanger 17, which has functioned as an evaporator during the heating operation, functions as a condenser by switching the four-way valve. Accordingly, the high-temperature refrigerant circulates in the heat exchanger 17. Consequently, the temperature of the heat exchanger 17 rises, the frost adhered to the fins and pipes constituting the heat exchanger 17 is melted, and the melted water flows down below the heat exchanger 17. Further, the blower 16 is stopped during the defrosting operation. Part of the frost melted by the defrosting operation becomes steam (water vapor) and such steam is condensed by the propeller fan 35 of the blower 16. The water condensed by the propeller fan 35 flows down below the propeller fan 35. The water flowing down from the heat exchanger 17 and the propeller fan 35 by the defrosting operation is hereinafter referred to as drain water or drainage.

[0028] In order to drain the drain water to the outside of the outdoor unit 1, the bottom plate 21 has an appropriate drain outlet (i.e., drainage hole) below the heat exchanger 17 and mainly directly below the heat exchanger 17.

[0029] However, when the outside air temperature is equal to the freezing point or lower, there is a possibility that the water flowing down from the heat exchanger 17 to the bottom plate 21 by the defrosting operation freezes before reaching the drain outlet of the bottom plate 21 (i.e., before being drained to the outside of the outdoor unit 1).

[0030] For this reason, the outdoor unit 1 according to the present embodiment includes at least one electric heating device that prevents the drain water from freezing. Hereinafter, the electric heating devices of the outdoor unit 1 according to the present embodiment will be described.

[0031] Fig. 2 is a perspective view of the inside of the outdoor unit according to the embodiment of the present invention.

[0032] Fig. 3 is a perspective view of the bottom plate and the electric heating device of the outdoor unit according to the embodiment of the present invention.

[0033] In Fig. 2, the front plate 25, the fin guard 26, the left side plate 22a, the right side plate 22b, and the top plate 27 of the outdoor unit 1 are omitted.

[0034] As shown in Fig. 2 and Fig. 3, the outdoor unit 1 according to the present embodiment includes a first electric heating device 41 and a second electric heating device 42. The first electric heating device 41 is disposed at the bottom of the heat exchanger 17. The first electric

heating device 41 prevents freezing of the drain water dripping from the heat exchanger 17 during the defrosting operation. The second electric heating device 42 is disposed directly below the propeller fan 35 of the blower 16. The second electric heating device 42 prevents the drain water dripping from the propeller fan 35 from freezing and accumulating to an extent that the rotation of the blower 16 is inhibited.

[0035] As to the heat exchanger 17, the portion along the inner face of the back face of the outdoor unit 1 is referred to as a back-face portion 17a, and the portion along the inner face of the left side-face of the outdoor unit 1 is referred to as a side-face portion 17b.

[0036] The bottom plate 21 of the housing 13 is provided with a plurality of drain outlets 43 through which drain water to be dripped from the heat exchanger 17 is drained to the outside of the outdoor unit 1.

[0037] At least one of the drain outlets 43 is disposed directly under the heat exchanger 17 so that the drain water dripping from the heat exchanger 17 can be smoothly drained to the outside of the outdoor unit 1. Specifically, the plurality of drain outlets 43 include a first drain outlet 43a, a second drain outlet 43b, a third drain outlet 43c, a fourth drain outlet 43d, and a fifth drain outlet 43e. The first to third drain outlets 43a, 43b, and 43c are disposed along the back face of the outdoor unit 1. The fourth drain outlet 43d is disposed at the left back side corner of outdoor unit 1, and the fifth drain outlet 43e is disposed along the left side-face of the outdoor unit 1.

[0038] The second drain outlet 43b is interposed (or sandwiched) between the first drain outlet 43a and the third drain outlet 43c. The second drain outlet 43b has a circular shape. The second drain outlet 43b is disposed directly behind the blower 16 in a plan view of the outdoor unit 1. The second drain outlet 43b is disposed directly below the approximate center of the back-face portion 17a of the heat exchanger 17.

[0039] The first drain outlet 43a is disposed on the right side of the second drain outlet 43b, and the third drain outlet 43c is disposed on the left side of the second drain outlet 43b. The third drain outlet 43c is closer to the left back side corner of the outdoor unit 1 than the second drain outlet 43b. The third drain outlet 43c is disposed near the back left side corner of the outdoor unit 1.

[0040] The first drain outlet 43a, the second drain outlet 43b, and the third drain outlet 43c mainly drain the drain water dripped from the back-face portion 17a of the heat exchanger 17 to the outside of the outdoor unit 1.

[0041] The fourth drain outlet 43d is disposed directly under the bent portion of the L-shaped heat exchanger 17. The fourth drain outlet 43d mainly drains the drain water dripped from the bent portion of the heat exchanger 17 to the outside of the outdoor unit 1.

[0042] The fifth drain outlet 43e is disposed directly under the side-face portion 17b of the heat exchanger 17. The fifth drain outlet 43e mainly drains the drain water dripped from the side-face portion 17b of the heat exchanger 17 to the outside of the outdoor unit 1.

[0043] Further, the bottom plate 21 of the housing 13 is provided with a drain outlet 45 for draining the drain water dripped from the propeller fan 35 to the outside of the outdoor unit 1.

[0044] The first electric heating device 41 includes: a first heat-transfer member 51 that is in contact with the heat exchanger 17; and a linear heater 52 provided on the first heat-transfer member 51. The second electric heating device 42 includes: a second heat-transfer member 55 disposed directly below the propeller fan 35; and the linear heater 52 provided on the second heat-transfer member 55. That is, the heater 52 is shared by the first electric heating device 41 and the second electric heating device 42.

[0045] The first electric heating device 41 and the second electric heating device 42 may occupy individual heaters. In this case, the first electric heating device 41 occupies the first heater, and the second electric heating device 42 occupies the second heater. In other words, the first heat-transfer member 51 holds the first heater, and the second heat-transfer member 55 holds the second heater.

[0046] Fig. 4 is a partial cross-sectional view of the first electric heating device and the bottom plate of the outdoor unit according to the embodiment of the present invention. Fig. 4 is a cross-sectional view taken along line IV-IV in Fig. 3.

[0047] As shown in Fig. 4 in addition to Fig. 2 and Fig. 3, the first electric heating device 41 of the outdoor unit 1 according to the present embodiment further includes a first heat insulating member 58 interposed (i.e., sandwiched) between the bottom plate 21 and the first heat-transfer member 51, in addition to the first heat-transfer member 51 and the heater 52.

[0048] As to the heat exchanger 17, the surface of the heat exchanger 17 facing the fin guard 26 or the left side plate 22a of the housing 13 is referred to as an upstream face 17c of the heat exchanger 17 for convenience, and the surface of the heat exchanger 17 facing the blower 16 is referred to as a downstream face 17d of the heat exchanger 17 for convenience.

[0049] The heater 52 shared with the first and second electric heating devices 41 and 42 is a so-called cord heater or heating cord. The heater 52 has flexibility. That is, the heater 52 can be bent readily. The first and second electric heating devices 41 and 42 share a single linear heater 52 disposed along an appropriate route. A cord heater is less expensive than a sheathed heater but generate less heat than a sheathed heater.

[0050] The heater 52 includes: two wires 61 that run in parallel; and a covering 62 that covers the periphery of the two wires. The covering 62 is made of, for example, silicon rubber. One end (i.e., starting end) 52a of the heater 52 is an electric input end for connection to a power source. At the other end (i.e., terminal) 52b of the heater 52, the two internal wires 61 are electrically connected using, for example, crimping. One of the two wires 61 is a heat wire, and the other of the two wires 61 is an electric

wire that allows electricity to flow through the heat wire.

[0051] The heater 52 is laid on the top face of the bottom plate 21 of the housing 13 in the state of being held by the first heat-transfer member 51 and the second heat-transfer member 55. That is, after the heater 52 is laid on the first heat-transfer member 51 and the second heat-transfer member 55, the heater 52 is laid on the bottom plate 21 of the housing 13 together with the first heat-transfer member 51 and the second heat-transfer member 55 while maintaining its laying path.

[0052] The first heat-transfer member 51 is L-shaped similarly to the heat exchanger 17 that is bent in an L-shape in a plan view of the outdoor unit 1. The first heat-transfer member 51 includes: a plate-shaped first portion 65 that is in contact with all or part of the bottom face 17e of the heat exchanger 17; and a second portion 66 that is connected to and is formed integrally with the first portion 65 and holds (supports) the heater 52.

[0053] The first portion 65 is L-shaped similarly to the heat exchanger 17 that is bent in an L-shape in a plan view of the outdoor unit 1. The first portion 65 receives the drain water dropped on the bottom face of the heat exchanger 17 before it drips onto the bottom plate 21 of the housing 13, and heats the received drain water with the heat of the heater 52 transmitted from the second portion 66. In other words, the first portion 65 is a heating plate for drain water.

[0054] The first portion 65 includes: an outer side section 65a near the upstream face 17c of the heat exchanger 17; and an inner side section 65b near the downstream face 17d of the heat exchanger 17.

[0055] The second portion 66 is disposed at the downstream side of the first portion 65 in the flow direction of air subjected to heat-exchange using the heat exchanger 17 (i.e., in the direction indicated by the solid arrow f in Fig. 4). In other words, the second portion 66 is connected to and is formed integrally with the inner side section 65b of the first portion 65. The second portion 66 prevents the dropping water, which flows down from the heat exchanger 17 to the first portion 65, from flowing out and splashing in the downstream direction of the heat exchanger 17 (i.e., toward the blower 16).

[0056] The second portion 66 has a concave shape that opens downward. The second portion 66 encloses and holds the heater 52 in a concave recess. The second portion 66 collectively holds a doubly-laid region 68 in which the heater 52 configured as one cord is doubly laid by folding.

[0057] The first heat-transfer member 51 includes a plurality of fixing flanges 71 extending from the second portion 66 toward the bottom plate 21. The fixing flanges 71 fix the first heat-transfer member 51 to the bottom plate 21 in the vicinity of the third drain outlet 43c of the bottom plate 21 and in the vicinity of the fifth drain outlet 43e of the bottom plate 21. Each of the fixing flanges 71 has a screw hole (not shown). The first heat-transfer member 51 is fixed to the bottom plate 21 using screws 72 that are tightened to the bottom plate 21 through the

respective screw holes. In other words, the screws 72 are fixing members that fix the first heat-transfer member 51 to the bottom plate 21.

[0058] The first heat-transfer member 51 is a sheet metal product made of aluminum or aluminum alloy. The first heat-transfer member 51 is preferably a sheet metal obtained by performing sheet-metal processing on a sheet material having a thickness of 0.8 millimeters (mm) or more.

[0059] Further, it is preferred that the first heat-transfer member 51 is appropriately surface-treated so as not to be corroded by the drain water flowing down from the heat exchanger 17 and does not hinder the heat transfer from the heater 52 to the drain water. For this reason, the first heat-transfer member 51 is subjected to alumite treatment.

[0060] It is sufficient that the first heat-transfer member 51 is in contact with the heat exchanger 17 so as to efficiently transfer the heat of the heater 52 to the heat exchanger 17, and the first heat-transfer member 51 is not necessarily required to be in contact with the bottom plate 21 of the housing 13. The first heat-transfer member 51 may be a sheet metal product of copper, copper alloy, or iron-based alloy.

[0061] The first heat insulating member 58 thermally insulates the first heat-transfer member 51 and the heater 52 from the bottom plate 21. The first heat insulating member 58 is lower in thermal conductivity than the bottom plate 21 made of iron-based alloy and the first heat-transfer member 51 made of aluminum or aluminum alloy. The first heat insulating member 58 is made of, for example, polyethylene foam. It is preferred that the first heat insulating member 58 has a thickness of 1 millimeter (mm) or more. The first heat insulating member 58 is interposed between the bottom plate 21 made of iron-based alloy and the first heat-transfer member 51 made of aluminum or aluminum alloy so as to prevent bimetallic corrosion (i.e., galvanic corrosion) between both.

[0062] The first heat insulating member 58 is L-shaped in cross-sectional view in Fig. 4. The first heat insulating member 58 includes a first plate-shaped portion 75, and a second plate-shaped portion 76 that is connected to and is formed integrally with the first plate-shaped portion 75.

[0063] The first plate-shaped portion 75 is interposed between the bottom plate 21 and the first portion 65 of the first heat-transfer member 51 and blocks the doubly-laid region 68 of the heater 52 from directly facing the bottom plate 21, which doubly-laid region 68 is located at the second portion 66 opened downward.

[0064] The second plate-shaped portion 76 rises upward from the edge of the first plate-shaped portion 75 and reaches the end face of the first heat-transfer member 51 so as to close the second portion 66.

[0065] The first heat insulating member 58 prevents the heat of the heater 52 and the heat exchanger 17 from being transmitted to the bottom plate 21 that is lower in temperature than the heat exchanger 17. The heater 52

heats the first heat-transfer member 51, and high-temperature refrigerant flows through the heat exchanger 17 during the defrosting operation. Thus, the drain water flowing down from the heat exchanger 17 to the first heat-transfer member 51 during the defrosting operation is heated to a higher temperature than the case where the bottom plate is heated with a heater as in the conventional outdoor unit.

[0066] The first heat-transfer member 51 of the first electric heating device 41 is heated using the heater 52 so as to maintain or raise the temperature of the drain water that flows down from the heat exchanger 17 by the defrosting operation. This drain water maintained warm or heated to a higher temperature flows down from the outer side edge 65a of the first heat-transfer member 51 to the bottom plate 21 (as indicated by the solid-line arrow d in Fig. 4).

[0067] Afterward, the drain water having flowed down to the bottom plate 21 is drained from the plurality of drain outlets 43 to the outside of the outdoor unit 1.

[0068] In the case of the conventional outdoor unit in which the bottom plate is heated using the heater directly, the heat of the heater diffuses over a wide area of the bottom plate. Thus, in the case of the conventional outdoor unit, it is difficult to maintain or raise the temperature of the drain water flowing down from the heat exchanger 17. The bottom plate made of iron-based alloy dissipates the heat of the heater to the surroundings of the outdoor unit like a heatsink. Accordingly, there is a possibility that heat retention and temperature rise of the drain water becomes insufficient and thereby the drain water freezes before reaching the drain outlet.

[0069] To solve the above problem, in the outdoor unit 1 according to the present embodiment, the heater 52 is provided in the first electric heating device 41 that contacts the heat exchanger 17 to be heated by the high-temperature refrigerant. Such heater 52 maintains the drain water warm, heats it up to a higher temperature, and drains it to the bottom plate 21. Thus, the drain water flowing down to the bottom plate 21 more reliably reaches the drain outlets 43 and is more reliably drained to the outside of the outdoor unit 1.

[0070] Fig. 5 is a partial cross-sectional view of the second electric heating device and the bottom plate of the outdoor unit according to the embodiment of the present invention. Fig. 5 is a cross-sectional view taken along line V-V in Fig. 3.

[0071] As shown in Fig. 5 in addition to Fig. 2 and Fig. 3, the second electric heating device 42 of the outdoor unit 1 according to the present embodiment further includes a second heat insulating member 78 interposed between the bottom plate 21 and the second heat-transfer member 55, in addition to the heater 52 and the second heat-transfer member 55.

[0072] The second heat-transfer member 55 linearly extends in the region below the blower 16 in the width direction of the outdoor unit 1 (i.e., in the right-left direction). The second heat-transfer member 55 includes: a

plate-shaped first portion 85 disposed immediately below the propeller fan 35; and a pair of second portions 86 that are connected to and is formed integrally with the first portion 85 and hold the heater 52.

[0073] The first portion 85 has a long rectangular shape in the width direction of the outdoor unit 1. In order to prevent the drain water dripped from the propeller fan 35 from freezing and accumulating to the extent that it inhibits the rotation of the propeller fan 35, the first portion 85 maintains or raises the temperature of the drain water dripped directly below the propeller fan 35 using the heat of the heater 52 to be transmitted from the second portions 86. This drain water maintained warm or heated to a higher temperature is drained from the drain outlet 45, which is adjacent to one short side of the second heat-transfer member 55, to the outside of the outdoor unit 1.

[0074] The pair of second portions 86 are connected to and is formed integrally with the respective two long sides of the first portion 85. In detail, the two long sides of the first portion 85 are discriminated as the one long side near the heat exchanger 17 and the opposite long side far from the heat exchanger 17. The pair of second portions 86 include the second portions 86a provided on the long side near the heat exchanger 17, and the second portions 86b provided on the opposite long side far from the heat exchanger 17 of the first portion 85.

[0075] Each of the second portions 86 (i.e., 86a and 86b) has a concave shape that opens downward. Each of the second portions 86 encloses and holds the heater 52 in a concave recess.

[0076] The second heat-transfer member 55 has screw holes (not shown) in the first portion 85. The second heat-transfer member 55 is fixed to the bottom plate 21 using screws 72 that are tightened to the bottom plate 21 through the screw holes. In other words, the screws 72 are fixing members that fix the second heat-transfer member 55 to the bottom plate 21.

[0077] The second heat-transfer member 55 is a sheet metal product made of aluminum or aluminum alloy plate. The second heat-transfer member 55 is preferably a sheet metal obtained by performing sheet-metal processing on a sheet material having a thickness of 0.8 millimeters (mm) or more.

[0078] Further, it is preferred that the second heat-transfer member 55 is appropriately surface-treated so as not to be corroded by the drain water flowing down from the propeller fan 35 and does not prevent the heat transfer from the heater 52 to the drain water. For this reason, the second heat-transfer member 55 is subjected to alumite treatment.

[0079] The second heat-transfer member 55 may be a sheet metal product made of copper, copper alloy, or iron-based alloy.

[0080] The second heat insulating member 78 thermally insulates the second heat-transfer member 55 and the heater 52 from the bottom plate 21. The second heat insulating member 78 is lower in thermal conductivity than the bottom plate 21 made of iron-based alloy and

the second heat-transfer member 55 made of aluminum or aluminum alloy. The second heat insulating member 78 is made of, for example, polyethylene foam. It is preferred that the second heat insulating member 78 has a thickness of 1 millimeter (mm) or more. The second heat insulating member 78 is interposed or sandwiched between the bottom plate 21 made of iron-based alloy and the second heat-transfer member 55 made of aluminum or aluminum alloy so as to prevent bimetallic corrosion between both.

[0081] The second heat insulating member 78 has a concave shape in cross-sectional view in Fig. 5. The second heat insulating member 78 includes a first plate-shaped portion 95 and a pair of second plate-shaped portions 96 that are connected to and is formed integrally with the first plate-shaped portion 95.

[0082] The first plate-shaped portion 95 is interposed between the bottom plate 21 and the first portion 85 of the second heat-transfer member 55, and shields part of the heater 52 disposed in the second portion 86 opened downward from the bottom plate 21.

[0083] One of the second plate-shaped portions 96 rises upward from the edge of the first plate-shaped portion 95 on the side near the heat exchanger 17, and reaches one end face of the second heat-transfer member 55 so as to close the second portion 86a. The other of the second plate-shaped portions 96 rises upward from the edge of the first plate-shaped portion 95 on the side far from the heat exchanger 17, and reaches the other end face of the second heat-transfer member 55 so as to close the second portion 86b.

[0084] The second heat insulating member 78 prevents the heat of the heater 52 from being transmitted to the bottom plate 21 that is lower in temperature than the second heat-transfer member 55 to be heated using the heater 52. Thus, the drain water flowing down from the propeller fan 35 to the second heat-transfer member 55 during the defrosting operation is heated to a higher temperature than the case where the bottom plate is heated using the heater in the same manner as the conventional outdoor unit.

[0085] Returning to Fig. 3, as to the disposition of the heater 52 configured as one long cord, the laying path from its one end (i.e., starting end) 52a to the other end (i.e., termination) 52b will be described below.

[0086] One end 52a of the heater 52 is connected to an AC power supply inside the electrical-component box 18 provided in the machine chamber 31 of the outdoor unit 1. The heater 52 extends from one end 52a and enters the inside of the blower chamber 32 through the vicinity of the inside of the front-side edge of the bottom plate 21.

[0087] The heater 52 entering the inside of the blower chamber 32 reaches the second heat-transfer member 55 across the front of the drain outlet 45 below the propeller fan 35 from the right side to the left side (as indicated by the portion 52c in Fig. 3).

[0088] The heater 52 reaching the second heat-trans-

fer member 55 passes through the second portion 86b on the far side from the heat exchanger 17 and is further crossed the space below the propeller fan 35 from the right side to the left side. Next, the heater 52 bypasses the left side of the second heat-transfer member 55 (i.e., is folded back at the portion 52d in Fig. 3) so as to reach the second heat-transfer member 55 again. The heater 52, which reaches the second heat-transfer member 55 again, passes through the second portion 86a on the side close to the heat exchanger 17, and then crosses the space below the propeller fan 35 from the left side to the right side.

[0089] Next, the heater 52 extends to the rear of the bottom plate 21 on the right side of the second heat-transfer member 55, then pass through the vicinity of the first drain outlet 43a, and then reaches the right end (i.e., the portion 52e in Fig. 3) of the second portion 66 of the first heat-transfer member 51. The heater 52, which reaches the right end of the second portion 66 of the first heat-transfer member 51, reciprocates from the right end to the left end of the second portion 66. This reciprocating portion of the heater 52 is the doubly-laid region 68. The heater 52, which returns to the right end of the second portion 66 of the first heat-transfer member 51 through the doubly-laid region 68, reaches its other end 52b.

[0090] The first heat-transfer member 51 may be divided into a plurality of components. For example, the first heat-transfer member 51 may be divided into: a first component provided directly below the back-face portion 17a of the heat exchanger 17; a second component provided directly below the side-face portion 17b of the heat exchanger 17; and a third component provided directly below the bent portion that connects the back-face portion 17a and the side-face portion 17b of the heat exchanger 17.

[0091] Fig. 6 is a perspective view of another aspect of the first electric heating device of the outdoor unit according to the embodiment of the present invention.

[0092] As shown in Fig. 6, the first electric heating device 41A includes a first heat-transfer member 51A that contacts the heat exchanger 17.

[0093] The first heat-transfer member 51A is L-shaped similarly to the heat exchanger 17 that is bent in an L-shape in plan view. The first heat-transfer member 51A includes: a plate-shaped first portion 65A that is in contact with all or part of the bottom face 17e of the heat exchanger 17; and a second portion 66A that surrounds the first portion 65A and is disposed above the first portion 65A.

[0094] The first portion 65A is L-shaped similarly to the heat exchanger 17 that is bent in an L shape in plan view. The first portion 65A receives the drain water dropping on the bottom face of the heat exchanger 17 before the drain water drops on the bottom plate 21, and heats it with the heat of the heater 52 to be transmitted from the second portion 66A. In other words, the first portion 65A is a heating plate for heating the drain water.

[0095] The first portion 65A has a drain outlet 101 for

draining the water flowing down from the heat exchanger 17. The first heat insulating member 58 also has a drain outlet (not shown) disposed immediately below the drain outlet 101 of the first heat-transfer member 51A.

[0096] The second portion 66A corresponds to a bank or dike that surrounds the edge of the first portion 65A. The second portion 66A holds the heater 52 that is disposed so as to surround the first portion 65A. The second portion 66A prevents the water, which flows down from the heat exchanger 17 to the first portion 65A, from flowing out or splashing from any portion except the drain outlet 101 of the first portion 65A.

[0097] The second portion 66A has a concave shape that opens downward. The second portion 66A encloses and holds the heater 52 in the concave recess. The heater 52 configured as one cord is disposed so as to go around the edge of the first portion 65A at least one turn, preferably two turns. When the heater 52 goes around the edge of the first portion 65A two turns, the doubly-laid region 68 is formed in the second portion 66A. The second portion 66 collectively holds the doubly-laid region 68 in which the heater 52 configured as one cord is doubly laid.

[0098] The first heat-transfer member 51A is a sheet metal product made of aluminum or aluminum alloy. The first heat-transfer member 51A is preferably a sheet metal obtained by performing sheet-metal processing on a sheet material having a thickness of 0.8 millimeters (mm) or more. Since the first portion 65A of the first heat-transfer member 51A is exposed to drain water, the first heat-transfer member 51A is subjected to alumite treatment.

[0099] It is sufficient that the first heat-transfer member 51A is in contact with the heat exchanger 17 so as to efficiently transfer the heat of the heater 52 to the heat exchanger 17, and the first heat-transfer member 51 is not necessarily required to be in contact with the bottom plate 21.

[0100] In the first electric heating device 41A, the first heat-transfer member 51A to be heated using the heater 52 maintains or raises the temperature of the drain water that flows down from the heat exchanger 17 due to the defrosting operation. The drain water maintained warm or heated to a higher temperature flows down through the drain outlet 101 of the first heat-transfer member 51A and the drain outlet of the first heat insulating member 58.

[0101] The drain water having flowed down through the drain outlet 101 of the first heat-transfer member 51A and the drain outlet of the first heat insulating member 58 is drained from the drain outlets 43 of the bottom plate 21 to the outside of the outdoor unit 1. It is preferred that the drain outlet 101 of the first heat-transfer member 51A is disposed immediately above the drain outlets 43 of the bottom plate 21. In such a case, the drain water flowing down from the drain outlet 101 of the first heat-transfer member 51A is drained directly to the outside of the outdoor unit 1 without staying on the bottom plate 21.

[0102] The outdoor unit 1 of the refrigeration cycle apparatus according to the present embodiment includes:

the first heat-transfer member 51 that has the plate-shaped first portion 65 in contact with all or part of the bottom face of the heat exchanger 17 and is made of aluminum or aluminum alloy; and the linear heater 52 provided on the first heat-transfer member 51. Consequently, even when the heater 52 (for example, a cord heater) having a heat generation capacity per unit area inferior to that of a sheathed heater is adopted, the outdoor unit 1 can maintain or raise the temperature of the drain water flowing down from the heat exchanger 17. The high temperature drain water is prevented from being frozen on the bottom plate 21, and thus is reliably drained to the outside of the outdoor unit 1.

[0103] A portion of the refrigerant pipe 33 that circulates the refrigerant in the refrigeration cycle apparatus, in which the refrigerant having a temperature of 0C° or higher flows, may be used as a substitute for the heater 52.

[0104] In addition, the outdoor unit 1 of the refrigeration cycle apparatus according to the present embodiment includes the first heat-transfer member 51 that is subjected to alumite treatment. Consequently, the outdoor unit 1 can prevent the first heat-transfer member 51 from being corroded by the drain water flowing down from the heat exchanger 17, and thus can maintain the drainage performance during the defrosting operation for a longer period.

[0105] Further, the outdoor unit 1 of the refrigeration cycle apparatus according to the present embodiment includes the first heat insulating member 58 interposed between the bottom plate 21 and the first heat-transfer member 51. Consequently, the outdoor unit 1 can readily prevent a decrease in function of maintaining or raising the temperature of the drain water from the heat exchanger 17, since the heat of the heater 52 being transmitted from the first heat transfer member 51 to the bottom plate 21 is reduced using the first heat insulating member 58.

[0106] Furthermore, the outdoor unit 1 of the refrigeration cycle apparatus according to the present embodiment is provided with the first heat-transfer member 51A that includes: the first portion 65A having the drain outlet 101 for draining water flowing down from the heat exchanger 17; and the second portion 66A surrounding the first portion 65 and disposed above the first portion 65 to hold the heater 52. Consequently, the outdoor unit 1 can drain the drain water maintained warm or heated in the first portion 65A intensively onto the bottom plate 21 from the drain outlet 101 of the first portion 65A. In other words, when the drain outlet 101 of the first portion 65A is disposed directly above the drain outlets 43 of the bottom plate 21, the outdoor unit 1 can directly drain the drain water to the outside of the outdoor unit 1 so as to eliminate the risk that the drain water freezes on the bottom plate 21.

[0107] Moreover, the outdoor unit 1 of the refrigeration cycle apparatus according to the present embodiment includes: the second heat-transfer member 55 disposed below the propeller fan 35 and made of aluminum or alu-

minum alloy; and the heater 52 or the second heater to be provided on the second heat-transfer member 55. Consequently, the outdoor unit 1 can smoothly drain the drain water during the defrosting operation, and can prevent the operation of the blower 16 from being hindered due to freezing of the drain water flowing down from the propeller fan 35.

[0108] Therefore, the outdoor unit 1 of the refrigeration cycle apparatus according to the embodiment can drain water to be generated by the defrosting operation regardless of whether a sheathed heater is used as in the conventional outdoor unit or a heater with a lower heat generation capacity per unit area than the sheathed heater is used.

[0109] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Claims

1. An outdoor unit of a refrigeration cycle apparatus comprising:
 - a bottom plate having a drain outlet;
 - a heat exchanger disposed above the bottom plate;
 - a heat-transfer member that has a plate-shape and is in contact with all or part of a bottom face of the heat exchanger; and
 - a linear heater that provided on the heater heat-transfer member.
2. The outdoor unit of a refrigeration cycle apparatus according to claim 1, wherein the heat-transfer member is made of aluminum or aluminum alloy.
3. The outdoor unit of a refrigeration cycle apparatus according to claim 2, wherein the heat-transfer member is subjected to alumite treatment.
4. The outdoor unit of a refrigeration cycle apparatus according to any one of claim 1 to claim 3, further comprising a heat insulating member interposed between the bottom plate and the heat-transfer member.
5. The outdoor unit of a refrigeration cycle apparatus according to any one of claim 1 to claim 4, wherein:

the heat-transfer member includes a first portion that is in contact with all or part of the bottom face of the heat exchanger, and a second portion that surrounds the first portion and is disposed above the first portion;

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the first portion has plate-shaped and includes a drain outlet that drains water flowing down from the heat exchanger; and

the second portion holds the heater.

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6. The outdoor unit of a refrigeration cycle apparatus according to any one of claim 1 to claim 5, further comprising:

a blower having a fan that is disposed to face the heat exchanger; and

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a second heat-transfer member disposed below the fan and made of aluminum or aluminum alloy,

wherein the heater is also provided on the second heat-transfer member or the outdoor unit further comprises a second heater provided on the second heat-transfer member.

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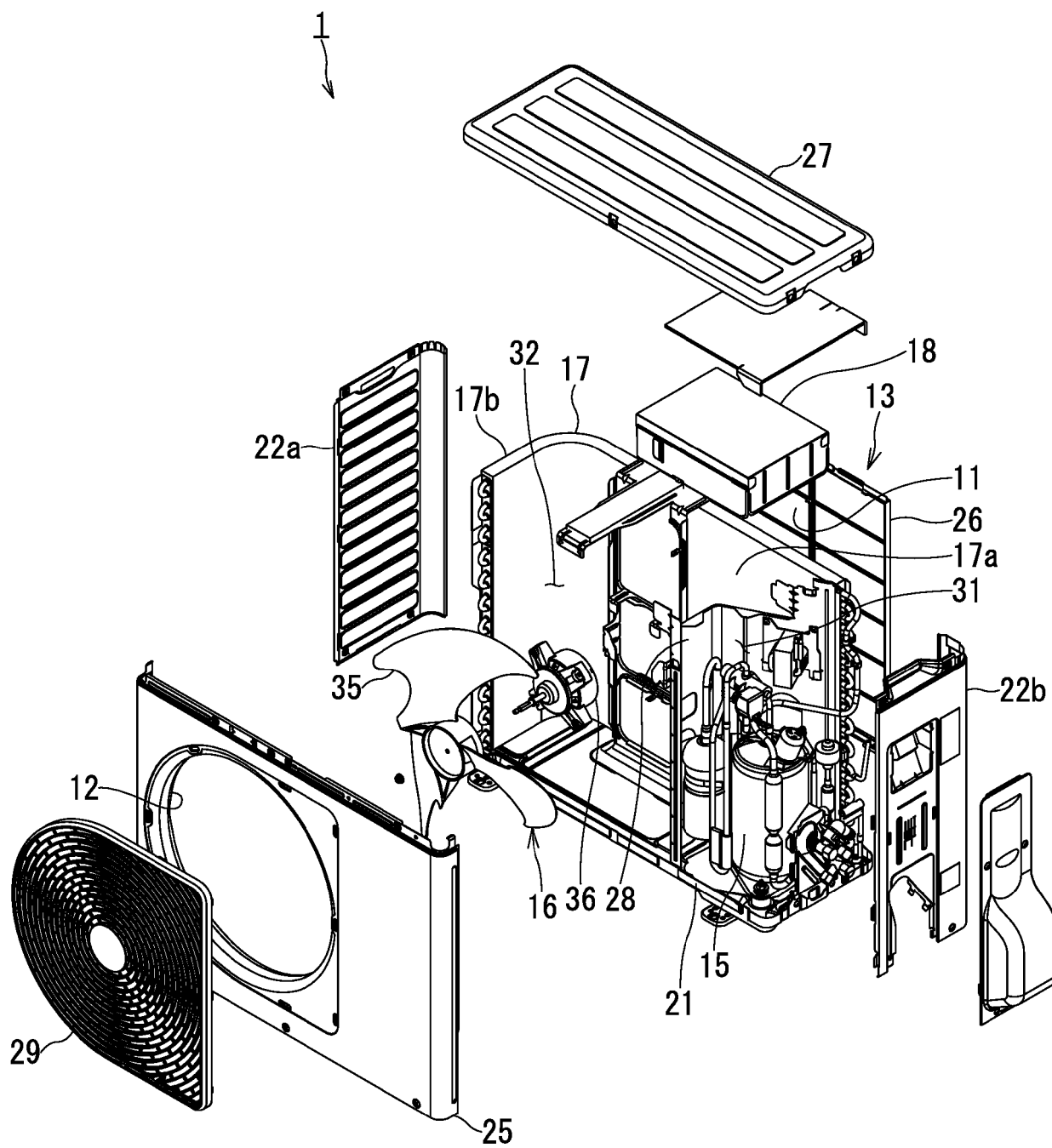


FIG. 1

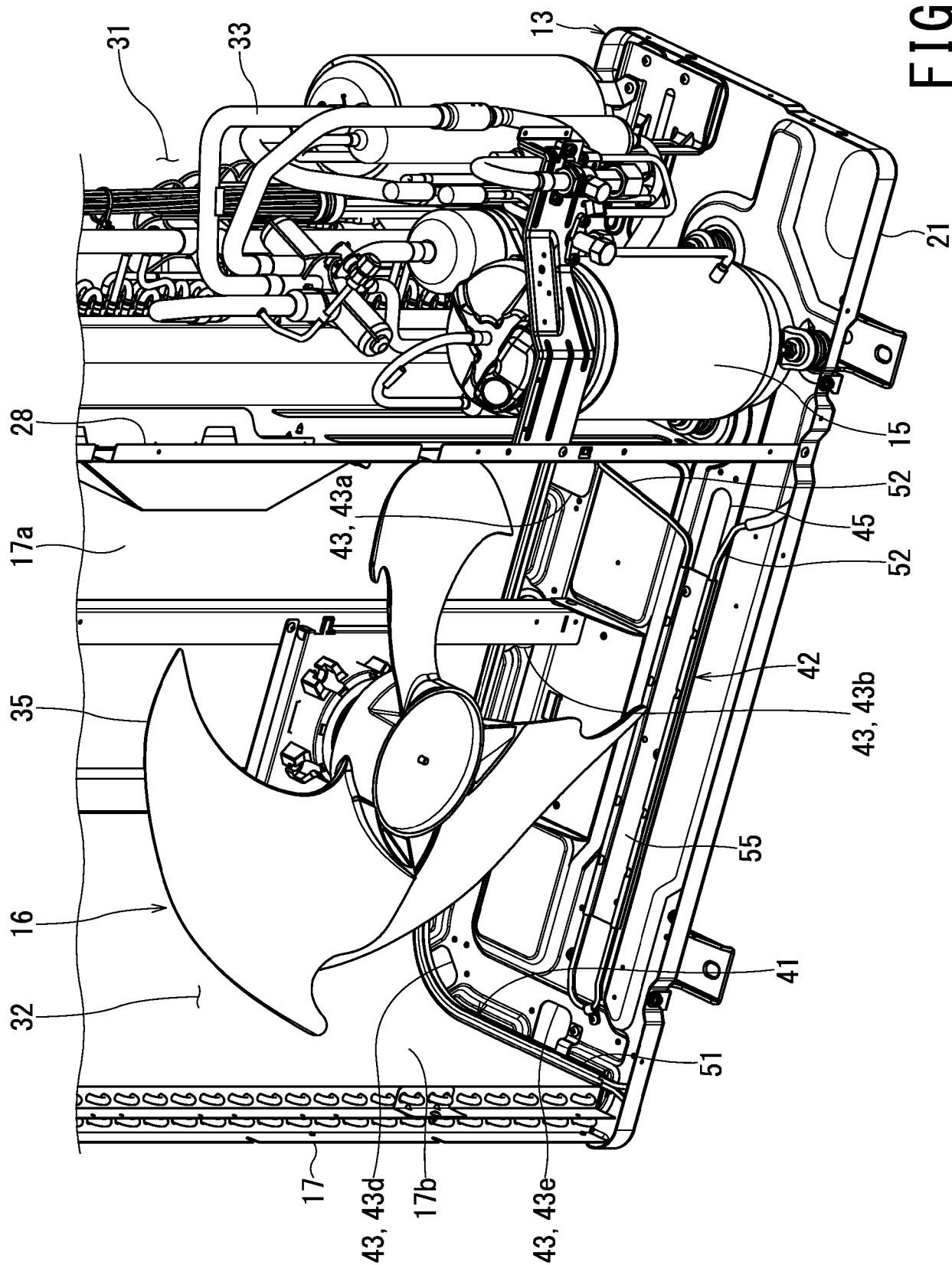


FIG. 2

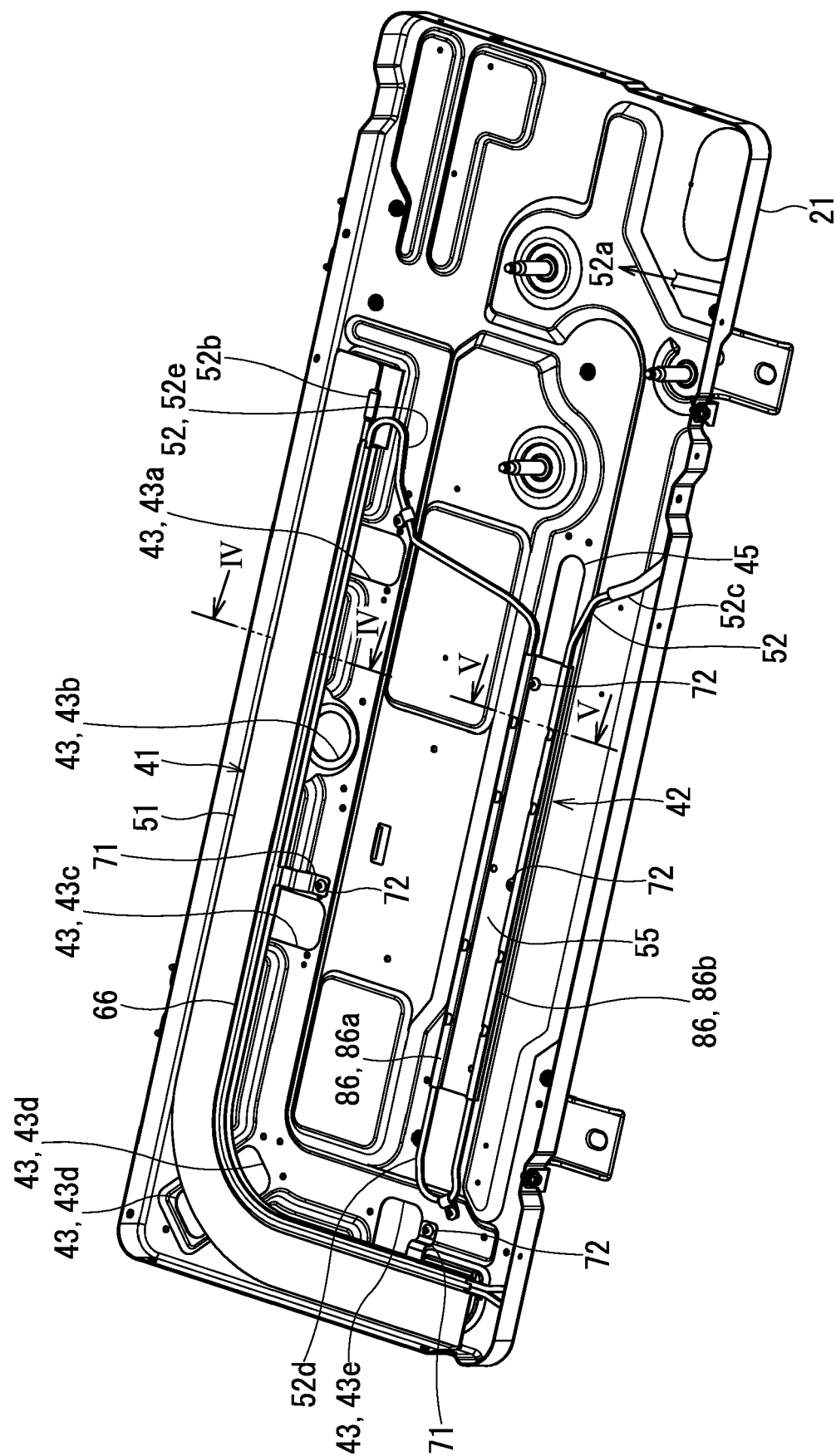


FIG. 3

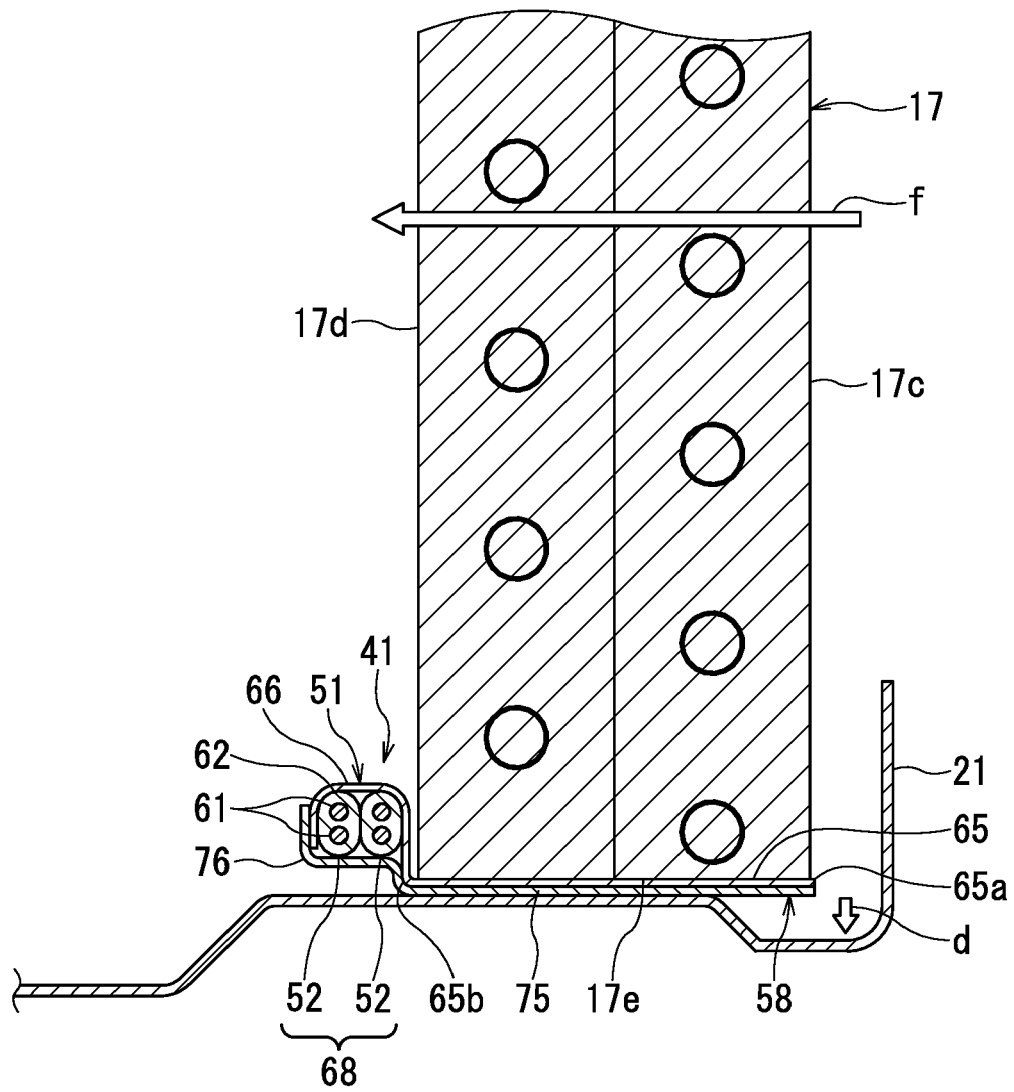


FIG. 4

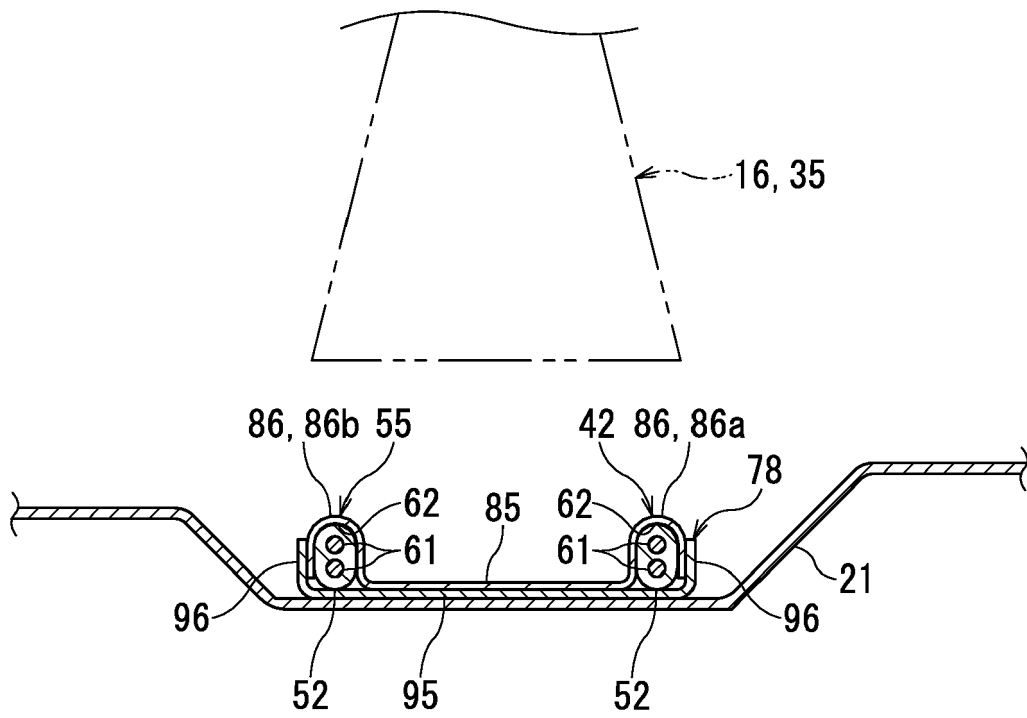


FIG. 5

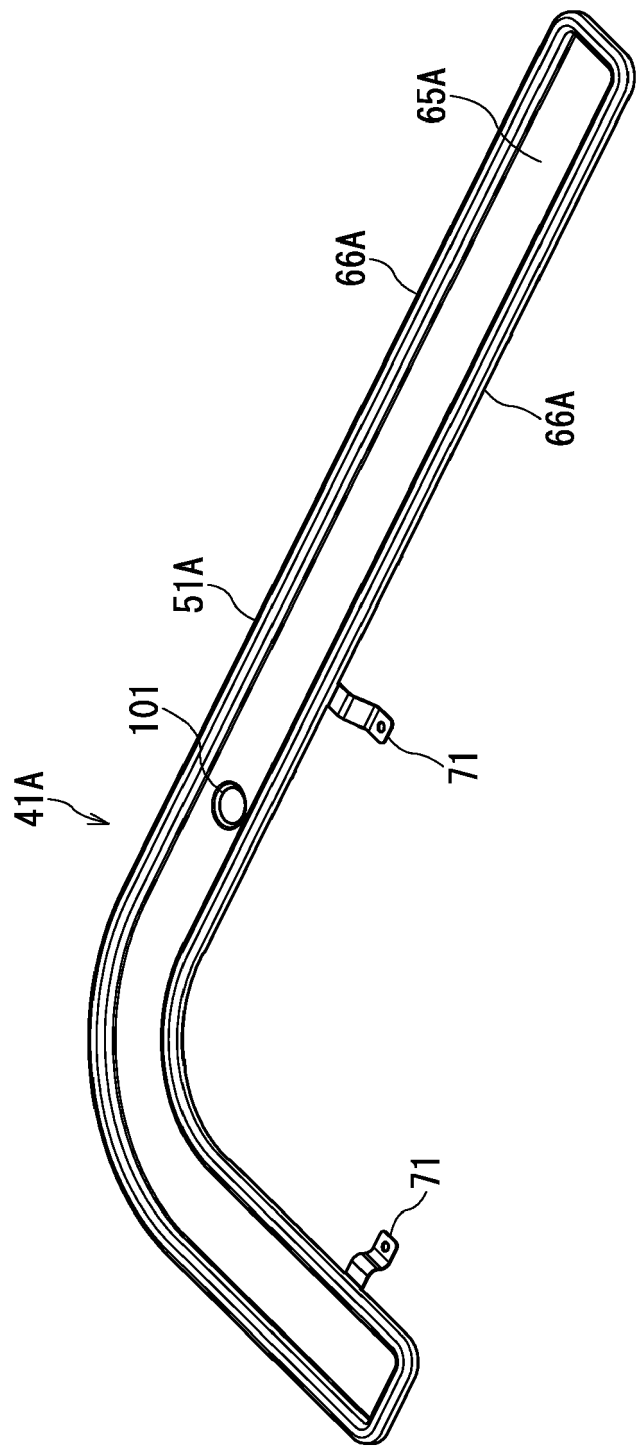


FIG. 6



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