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(54) **OUTDOOR UNIT**

(57) It is impossible to detect a refrigerant leaking from a site other than a degassing valve in the machine chamber into a machine chamber. An outdoor unit 90 includes a refrigerant circuit, a water circuit, a refrigerant sensor 70, a gas-liquid separator 40, and a degassing valve 54. The refrigerant circuit connects, by means of a pipe, a compressor 12 and a second heat exchanger 20. The second heat exchanger 20 causes heat exchange between the refrigerant and water. The water circuit has a flow of water that exchanges heat with the refrigerant

in the second heat exchanger 20. The refrigerant sensor 70 detects the refrigerant to find refrigerant leakage. The gas-liquid separator 40 is connected to the water circuit. The degassing valve 54 is attached to the gas-liquid separator 40. The degassing valve 54 degasses the gas-liquid separator 40. The machine chamber R2 accommodates the compressor 12 and the second heat exchanger 20. The machine chamber R2 accommodates the degassing port 54a of the degassing valve 54 and the refrigerant sensor 70.

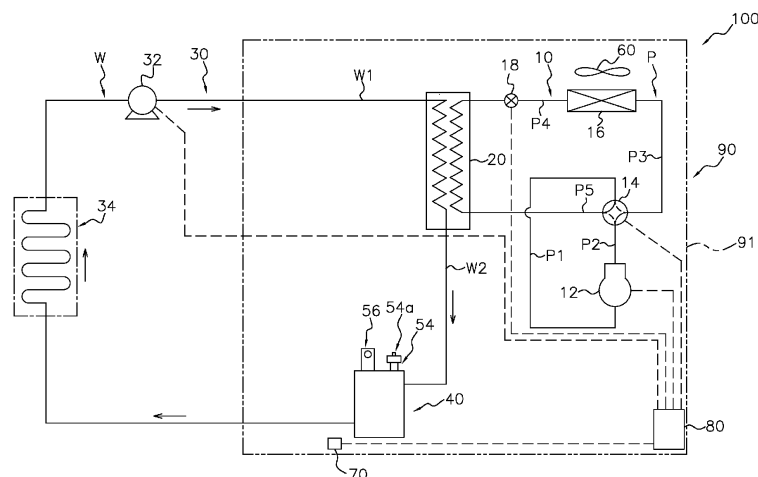


FIG. 1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to an outdoor unit.

BACKGROUND ART

[0002] As disclosed in Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2022-044867), there has been provided a technique for detection of refrigerant leakage.

SUMMARY OF THE INVENTION

<Technical Problem>

[0003] According to Patent Literature 1, a degassing port of a degassing valve disposed on a heating medium circuit in a machine chamber is extended with use of a pipe to a fan chamber. When a crack or the like is generated in a heat transfer partition wall between a refrigerant on a heat source side and a heating medium on a utilization side in a utilization heat exchanger, a refrigerant leaking from a refrigerant circuit having refrigerant circulation to the heating medium circuit having heating medium circulation is detected in accordance with a degree of decrease in temperature detected by a temperature sensor provided on the pipe. This case causes failure in detection of a refrigerant leaking into the machine chamber from a site other than the degassing valve in the machine chamber (e.g. a brazed portion of the pipe).

<Solution to Problem>

[0004] An outdoor unit according to a first aspect is an outdoor unit of a heat pump cycle apparatus. The outdoor unit includes a refrigerant circuit, a heating medium circuit, a sensor, a gas-liquid separator, a degassing valve, and a fan. The refrigerant circuit connects, by means of a pipe, a compressor, a first heat exchanger, and a second heat exchanger. The compressor compresses a refrigerant. The first heat exchanger causes heat exchange between a refrigerant and air. The second heat exchanger causes heat exchange between the refrigerant and a heating medium. The heating medium circuit has a flow of the heating medium that exchanges heat with the refrigerant in the second heat exchanger. The sensor detects the refrigerant to find leakage of the refrigerant. The gas-liquid separator is connected to the heating medium circuit. The degassing valve is attached to the gas-liquid separator. The degassing valve degasses the gas-liquid separator. The fan supplies the first heat exchanger with air. A fan chamber and a machine chamber are partitioned by a partitioning member. The fan chamber accommodates the fan. The machine chamber accommodates the compressor and the second heat exchanger.

The machine chamber accommodates a degassing port of the degassing valve and the sensor.

[0005] In the outdoor unit according to the first aspect, the machine chamber accommodates the degassing port of the degassing valve, and the sensor configured to detect a refrigerant. The outdoor unit can thus detect even a refrigerant leaking into the machine chamber from a site other than the degassing valve in the machine chamber (e.g. a brazed portion of the pipe).

[0006] An outdoor unit according to a second aspect is the outdoor unit according to the first aspect, in which the sensor is disposed in a space below the gas-liquid separator.

[0007] In the outdoor unit according to the second aspect, the sensor is disposed in the space below the gas-liquid separator, where a leaking refrigerant is highly possibly reserved. The outdoor unit can thus achieve accurate detection of refrigerant leakage.

[0008] An outdoor unit according to a third aspect is the outdoor unit according to the first or second aspect, in which the machine chamber is divided into a first area, a second area, a third area, and a fourth area in a top view. The first area is provided with the compressor. The second area is provided with the pipe of the refrigerant circuit. The third area is provided with the second heat exchanger. The fourth area is provided with a pipe of the heating medium circuit, the gas-liquid separator, and the degassing valve. The sensor is disposed in the fourth area.

[0009] An outdoor unit according to a fourth aspect is the outdoor unit according to any one of the first to third aspects, in which the outdoor unit drives the fan when the sensor detects leakage of the refrigerant.

[0010] The outdoor unit according to the fourth aspect is thus configured so as to enable agitation of a reserved refrigerant.

[0011] An outdoor unit according to a fifth aspect is the outdoor unit according to any one of the first to fourth aspects, in which an ignition source device, including the compressor, disposed in the machine chamber is explosion protected.

[0012] The outdoor unit according to the fifth aspect is thus configured so as to be able to prevent the leaking refrigerant from exploding the ignition source device.

[0013] An outdoor unit according to a sixth aspect is the outdoor unit according to any one of the first to fifth aspects, in which the refrigerant is categorized as having flammability in class 2 or higher flammability in class 3 by ISO 817.

[0014] An outdoor unit according to a seventh aspect is the outdoor unit according to any one of the first to sixth aspects, in which the sensor is disposed near the second heat exchanger.

[0015] The outdoor unit according to the seventh aspect is thus configured so as to be able to achieve accurate detection of a refrigerant leaking in the second heat exchanger.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a schematic configuration diagram of a heat pump cycle apparatus.

FIG. 2 is a perspective view of an outdoor unit with part of constituent components of the outdoor unit being detached therefrom.

FIG. 3 is a side view of the outdoor unit with part of the constituent components of the outdoor unit being detached therefrom.

FIG. 4 is a top view of the outdoor unit with part of the constituent components of the outdoor unit being detached therefrom.

DESCRIPTION OF EMBODIMENTS

(1) Entire configuration

[0017] FIG. 1 is a schematic configuration diagram of a heat pump cycle apparatus 100. As depicted in FIG. 1, the heat pump cycle apparatus 100 is configured to cool or heat a heating medium flowing in a heating medium circuit 30 with use of a refrigerant circulating in a refrigerant circuit 10, and condition air, supply hot water, heat a floor, or the like with use of the heating medium cooled or heated by the refrigerant. The heating medium flowing in the heating medium circuit 30 is water (hereinafter, the heating medium circuit 30 may be called a water circuit 30) in the present embodiment. Water flowing in the water circuit 30 should not be limited to pure water, but may alternatively be brine or the like. Examples of the brine include an aqueous solution of calcium chloride, an aqueous solution of ethylene glycol, and an aqueous solution of propylene glycol. The following description exemplifies a case where the heat pump cycle apparatus 100 functions as an air conditioner configured to execute cooling operation and heating operation in the present embodiment.

[0018] The heat pump cycle apparatus 100 principally includes an outdoor unit 90 and a utilization facility 34.

(2) Detailed configurations

(2-1) Outdoor unit

[0019] The outdoor unit 90 is disposed in an outdoor space such as on a roof of a building or around the building. FIG. 2 is a perspective view of the outdoor unit 90 with part of constituent components of the outdoor unit 90 being detached therefrom. FIG. 3 is a side view of the outdoor unit 90 with part of the constituent components of the outdoor unit 90 being detached therefrom. FIG. 4 is a top view of the outdoor unit 90 with part of the constituent components of the outdoor unit 90 being detached therefrom. As depicted in FIG. 1 to FIG. 4, the outdoor unit 90 includes a case 91, a partitioning member

92, a bottom frame 93, and a plate-shaped member 94. The case 91 constitutes an outer contour of the outdoor unit 90. The partitioning member 92 partitions the interior of the case 91 into a fan chamber R1 and a machine chamber R2. Specifically as depicted in FIG. 2, the case 91 includes a left side of the partitioning member 92 serving as the fan chamber R1 and a right side of the partitioning member 92 serving as the machine chamber R2. As depicted in FIG. 4, the machine chamber R2 is divided into a first area A1, a second area A2, a third area A3, and a fourth area A4 in a top view. The bottom frame 93 constitutes a lower surface of the case 91. The plate-shaped member 94 is disposed above the bottom frame 93 in the machine chamber R2 to be spaced apart from the bottom frame 93. The plate-shaped member 94 is supported by the bottom frame 93 with an elastic member 95 such as rubber or plastic being interposed therebetween.

[0020] The outdoor unit 90 principally includes the refrigerant circuit 10, part of the water circuit 30 (including a gas-liquid separator 40 connected to the water circuit 30), a fan 60, a refrigerant sensor 70, and a controller 80, which are accommodated in the case 91.

(2-1-1) Refrigerant circuit

[0021] The refrigerant circuit 10 achieves a vapor compression refrigeration cycle. The vapor compression refrigeration cycle includes repeating steps of compressing a gas refrigerant having low temperature and low pressure to have high temperature and high pressure in the refrigeration cycle, causing the refrigerant to radiate heat at a radiator (condenser), causing the refrigerant to expand at an expansion mechanism to have low temperature and low pressure, causing the refrigerant to absorb heat at an evaporator, and compressing again the gas refrigerant having low temperature and low pressure and having absorbed heat at the evaporator.

[0022] As depicted in FIG. 1, the refrigerant circuit 10 principally includes a compressor 12, a flow path switching mechanism 14, a first heat exchanger 16, an expansion mechanism 18, and a second heat exchanger 20. The refrigerant circuit 10 connects, by means of a pipe P, the compressor 12, the flow path switching mechanism 14, the first heat exchanger 16, the expansion mechanism 18, and the second heat exchanger 20. The pipe P of the refrigerant circuit 10 is principally disposed in the second area A2.

[0023] Described herein is the refrigerant circuit 10 having a merely exemplary configuration. For example, the refrigerant circuit 10 may further include a receiver configured to reserve a refrigerant, a device configured to subcool a refrigerant, or the like. Exemplarily described herein is a case where the heat pump cycle apparatus 100 functions as an air conditioner configured to execute cooling operation and heating operation, and the heat pump cycle apparatus 100 accordingly includes the flow path switching mechanism 14. In another case where the

heat pump cycle apparatus 100 functions as an air conditioner configured to execute only cooling operation or only heating operation, the heat pump cycle apparatus 100 may not include the flow path switching mechanism 14.

[0024] The refrigerant according to the present embodiment is categorized as having flammability in class 2 or higher flammability in class 3 by ISO 817. Examples of the refrigerant herein include R290 (propane) having higher flammability and a lower flammability limit (LFL) of 3.5% or less. The refrigerant should not be limited to these in terms of its type.

(2-1-1-1) Pipes

[0025] As depicted in FIG. 1, the pipe P of the refrigerant circuit 10 includes a suction pipe P1, a discharge pipe P2, a first gas pipe P3, a liquid pipe P4, and a second gas pipe P5.

[0026] The suction pipe P1 connects a suction port of the compressor 12 and the flow path switching mechanism 14. The suction pipe P1 is provided with an accumulator (not depicted). The discharge pipe P2 connects a discharge port of the compressor 12 and the flow path switching mechanism 14. The first gas pipe P3 connects the flow path switching mechanism 14 and a gas side of the first heat exchanger 16. The liquid pipe P4 connects a liquid side of the first heat exchanger 16 and the second heat exchanger 20. The liquid pipe P4 is provided with the expansion mechanism 18. The second gas pipe P5 connects the second heat exchanger 20 and the flow path switching mechanism 14.

(2-1-1-2) Compressor

[0027] The compressor 12 sucks a low-pressure refrigerant in the refrigeration cycle via the suction pipe P1, causes a compression mechanism (not depicted) to compress the refrigerant, and discharges a high-pressure refrigerant obtained by compression in the refrigeration cycle via the discharge pipe P2. The compressor 12 is exemplarily of a scroll type. The compressor 12 should not be limited in type to the scroll type, but may alternatively be of a screw type, a rotary type, or the like. The compressor 12 exemplarily has variable capacity, or may alternatively have a constant capacity.

[0028] As depicted in FIG. 2 to FIG. 4, the compressor 12 is disposed in the first area A1 in the machine chamber R2. The compressor 12 is mounted on the plate-shaped member 94 to be supported by the bottom frame 93 with the plate-shaped member 94 being interposed therebetween.

(2-1-1-3) Flow path switching mechanism

[0029] The flow path switching mechanism 14 is configured to switch a refrigerant flow direction in the refrigerant circuit 10 in accordance with an operating mode of

the heat pump cycle apparatus 100. The heat pump cycle apparatus 100 has operating modes including a mode of cooling water in the water circuit 30 with use of a refrigerant (hereinafter, called a cooling mode), and a mode of heating the water in the water circuit 30 (hereinafter, called a heating mode).

[0030] The flow path switching mechanism 14 according to the present embodiment is configured as a four-way switching valve. The flow path switching mechanism 14 should not be limited to the four-way switching valve, but may alternatively combine a plurality of electromagnetic valves and pipes so as to switch the refrigerant flow direction as follows.

[0031] In the cooling mode, the flow path switching mechanism 14 switches the refrigerant flow direction in the refrigerant circuit 10 such that the refrigerant discharged from the compressor 12 is sent to the first heat exchanger 16. Specifically, in the cooling mode, the flow path switching mechanism 14 allows the suction pipe P1 and the second gas pipe P5 to communicate with each other, and allows the discharge pipe P2 and the first gas pipe P3 to communicate with each other (see solid lines in the flow path switching mechanism 14 in FIG. 1).

[0032] In the heating mode, the flow path switching mechanism 14 switches the refrigerant flow direction in the refrigerant circuit 10 such that the refrigerant discharged from the compressor 12 is sent to the second heat exchanger 20. Specifically, in the heating mode, the flow path switching mechanism 14 allows the suction pipe P1 and the first gas pipe P3 to communicate with each other, and allows the discharge pipe P2 and the second gas pipe P5 to communicate with each other (see broken lines in the flow path switching mechanism 14 in FIG. 1).

(2-1-1-4) First heat exchanger

[0033] The first heat exchanger 16 causes heat exchange between air around the outdoor unit 90 and the refrigerant flowing in the first heat exchanger 16. The first heat exchanger 16 according to the present embodiment is a fin-and-tube heat exchanger of a cross-fin type. The first heat exchanger 16 may not necessarily be configured to cause heat exchange between air and a refrigerant, but may alternatively be configured to cause heat exchange between the refrigerant flowing in the first heat exchanger 16 and fluid (e.g. cooling water or warm water) sent to the first heat exchanger 16. The first heat exchanger 16 in this case is exemplarily configured as a plate heat exchanger.

[0034] The first heat exchanger 16 functions as a radiator (condenser) for a refrigerant when the heat pump cycle apparatus 100 is in the cooling mode as its operating mode. The first heat exchanger 16 functions as a heat absorber (evaporator) for a refrigerant when the heat pump cycle apparatus 100 is in a heating mode as its operating mode.

(2-1-1-5) Expansion mechanism

[0035] The expansion mechanism 18 is configured to expand the refrigerant flowing in the liquid pipe P4 to adjust pressure and a flow rate of the refrigerant. The expansion mechanism 18 according to the present embodiment is configured as an electronic expansion valve having an adjustable opening degree.

[0036] The expansion mechanism 18 should not be limited to the electronic expansion valve. Alternatively, the expansion mechanism 18 may be a temperature automatic expansion valve including a temperature sensitive cylinder, or may be a capillary tube.

(2-1-1-6) Second heat exchanger

[0037] The second heat exchanger 20 causes heat exchange between the refrigerant flowing in the refrigerant circuit 10 and water flowing in the water circuit 30. The second heat exchanger 20 according to the present embodiment is configured as a plate heat exchanger. The second heat exchanger 20 should not be limited to the plate heat exchanger in terms of its type, but may be appropriately selected from heat exchangers of types applicable to heat exchange between a refrigerant and water. As depicted in FIG. 2 to FIG. 4, the second heat exchanger 20 is disposed in the third area A3 in the machine chamber R2.

[0038] The second heat exchanger 20 is connected with the liquid pipe P4 and the second gas pipe P5 of the refrigerant circuit 10. The second heat exchanger 20 is connected with a first pipe W1 and a second pipe W2 of the water circuit 30.

[0039] When the heat pump cycle apparatus 100 is in the cooling mode, the refrigerant flows from the liquid pipe P4 into the second heat exchanger 20 and flows out to the second gas pipe P5. When the heat pump cycle apparatus 100 is in the heating mode, the refrigerant flows from the second gas pipe P5 into the second heat exchanger 20 and flows out to the liquid pipe P4.

[0040] Regardless of whether the heat pump cycle apparatus 100 is in the cooling mode or in the heating mode, water flows from the first pipe W1 into the second heat exchanger 20 and flows out of the second pipe W2. When the heat pump cycle apparatus 100 is in the cooling mode, water flowing from the first pipe W1 is cooled by the refrigerant flowing into the second heat exchanger 20, and flows out to the second pipe W2. When the heat pump cycle apparatus 100 is in the heating mode, water flowing from the first pipe W1 is heated by the refrigerant flowing into the second heat exchanger 20, and flows out to the second pipe W2.

(2-1-2) Water circuit

[0041] The water circuit 30 has a flow of water that exchanges heat with the refrigerant in the second heat exchanger 20. As depicted in FIG. 1, the water circuit 30

principally includes a pump 32, the second heat exchanger 20, the gas-liquid separator 40, and the utilization facility 34. The water circuit 30 connects, by means of a pipe W, the pump 32, the second heat exchanger 20, the gas-liquid separator 40, and the utilization facility 34. The pipe W of the water circuit 30 is principally disposed in the fourth area A4.

[0042] The pipe W of the water circuit 30 includes the first pipe W1 and the second pipe W2. The first pipe W1 connects the utilization facility 34 and the second heat exchanger 20, to allow water to flow from the utilization facility 34 to the second heat exchanger 20. The second pipe W2 connects the utilization facility 34 and the second heat exchanger 20, to allow water to flow from the second heat exchanger 20 to the utilization facility 34.

[0043] The first pipe W1 is connected with the pump 32. Examples of the pump 32 include a constant speed volute pump, and may alternatively include a variable flow pump. The pump 32 should not be limited to the volute pump, but may be of an appropriately selected type. The pump 32 according to the present embodiment is disposed on the first pipe W1 upstream of the second heat exchanger 20 in a water flow direction. However, the pump 32 should not be limitedly disposed in this manner, but may alternatively be disposed downstream of the second heat exchanger 20 in the water flow direction, in other words, on the second pipe W2.

[0044] The second pipe W2 is connected with the gas-liquid separator 40. The gas-liquid separator 40 should not be limitedly disposed on the second pipe W2, but may alternatively be disposed on the first pipe W1. In view of inhibiting the refrigerant from being sent to the utilization facility 34, the gas-liquid separator 40 is preferably connected to the second pipe W2.

(2-1-2-1) Gas-liquid separator

[0045] The gas-liquid separator 40 is configured to separate gas from inflow water, and exhaust the separated gas to outside. The gas-liquid separator 40 is disposed in the fourth area A4.

[0046] Typically, the water circuit 30 has a water flow and does not have any gas flow. But upon installation of the heat pump cycle apparatus 100, air existing in the pipe W may mix with water flowing in the pipe W. Also after installation of the heat pump cycle apparatus 100, air may enter the water circuit 30, or water may partially evaporate to generate vapor in the water circuit 30. The water circuit 30 is thus preferably provided with a mechanism configured to exhaust such gas from the water circuit 30. Relatively a large amount of air typically exists in the pipe W only upon installation of the heat pump cycle apparatus 100. Air entering the water circuit 30 or vapor generated in the water circuit 30 after installation of the heat pump cycle apparatus 100 does not have a large amount. Such air or vapor is handleable only by a degassing valve provided on the pipe W. However, a large amount of gas (refrigerant gas) may collectively

flow into water if any partition wall between a refrigerant flow path and a water flow path is damaged in the second heat exchanger 20 due to freezing or the like and the refrigerant flows from the refrigerant circuit 10 into the water circuit 30 (if the refrigerant leaks). The heat pump cycle apparatus 100 thus includes the gas-liquid separator 40 so as to easily trap the refrigerant in a case where a relatively large amount of gas flows into the water circuit 30.

[0047] As depicted in FIG. 3, the gas-liquid separator 40 is attached near an outlet for water having exchanged heat with the refrigerant in the second heat exchanger 20. The gas-liquid separator 40 is provided with an inflow port 42 allowing water to flow thereinto from the water circuit 30, and an outflow port 44 allowing water to flow out to the water circuit 30. The inflow port 42 is provided in a side wall of the gas-liquid separator 40, at a position near a top of the gas-liquid separator 40. The outflow port 44 is provided in the side wall of the gas-liquid separator 40, at a position near a bottom of the gas-liquid separator 40.

[0048] The gas-liquid separator 40 is provided with a degassing valve 54 configured to discharge, from the gas-liquid separator 40, gas flowing into the gas-liquid separator 40. The degassing valve 54 is disposed in the fourth area A4. The degassing valve 54 has a degassing port 54a allowing gas discharged from the gas-liquid separator 40 to flow out. The degassing valve 54 according to the present embodiment is attached to the top of the gas-liquid separator 40, and the degassing port 54a of the degassing valve 54 is disposed in the machine chamber R2. The degassing valve 54 should not be limited in terms of its structure, but exemplarily includes, as principal configurations, a body, and a float-shaped valve body accommodated in the body. In a case where the body is filled with liquid, the valve body is pushed upward by the liquid to close the degassing port 54a provided in an upper portion of the body, in order to inhibit the liquid from flowing out of the degassing port 54a. In another case where gas flows into the valve body to lower a liquid level, the valve body descends to keep the degassing port 54a opened, so as to allow gas to flow out of the degassing port 54a. In other words, when the second heat exchanger 20 has refrigerant leakage, most of a leaking refrigerant flows out of the degassing port 54a of the degassing valve 54.

[0049] Furthermore, the gas-liquid separator 40 is provided with a pressure relief valve 56 configured to release water in the gas-liquid separator 40 to outside when the water circuit 30 has high pressure exceeding a predetermined pressure value. The pressure relief valve 56 according to the present embodiment is attached to the top of the gas-liquid separator 40.

(2-1-3) Fan

[0050] The fan 60 supplies the first heat exchanger 16 with air that exchanges heat with the refrigerant. As de-

picted in FIG. 2 to FIG. 4, the fan 60 is disposed in the fan chamber R1. The fan 60 according to the present embodiment is configured as a propeller fan.

(2-1-4) Refrigerant sensor

[0051] The refrigerant sensor 70 detects the refrigerant to find refrigerant leakage. As depicted in FIG. 2 to FIG. 4, the refrigerant sensor 70 is disposed on the plate-shaped member 94 in the fourth area A4 in the machine chamber R2. The plate-shaped member 94 supports the refrigerant sensor 70. The refrigerant sensor 70 is thus less likely to get wet with water. Furthermore, the fourth area A4 is far from the fan chamber R1 accommodating the fan 60. Accordingly, a refrigerant or the like leaking in the second heat exchanger 20 and flowing out of the gas-liquid separator 40 to the fourth area A4 is relatively less likely to be agitated by the fan 60. The refrigerant sensor 70 disposed in the fourth area A4 can thus accurately detect the refrigerant leaking in the machine chamber R2 and flowing out to the fourth area A4.

[0052] Furthermore, the refrigerant sensor 70 is disposed in a space below the gas-liquid separator 40. The refrigerant sensor 70 can thus accurately detect a refrigerant leaking in the second heat exchanger 20 and flowing out of the gas-liquid separator 40.

[0053] Furthermore, the refrigerant sensor 70 is disposed near the first heat exchanger 16. The refrigerant sensor 70 can thus detect a refrigerant leaking in the first heat exchanger 16, that is, a refrigerant leaking from a brazed portion or the like of a refrigerant pipe in the first heat exchanger 16.

[0054] Moreover, the refrigerant sensor 70 is disposed near the second heat exchanger 20 in the machine chamber R2. FIG. 2 to FIG. 4 depict the refrigerant sensor 70 disposed near the rear of the second heat exchanger 20. The refrigerant sensor 70 can thus accurately detect the refrigerant leaking in the second heat exchanger 20 (including a refrigerant leaking from the second heat exchanger 20 not by way of the gas-liquid separator 40).

[0055] Furthermore, a height position of an upper surface of the plate-shaped member 94 or a height position of a refrigerant detector in the refrigerant sensor 70 is within a height range of 300 mm from a height position of an upper surface of the bottom frame 93. The refrigerant sensor 70 can thus accurately detect refrigerant leakage.

(2-1-5) Controller

[0056] The controller 80 includes a CPU (not depicted), a memory such as a ROM or a RAM, various electric components, and electronic components.

[0057] As depicted in FIG. 1, the controller 80 is electrically connected to the compressor 12, the flow path switching mechanism 14, the expansion mechanism 18, the pump 32, and the refrigerant sensor 70. When the CPU executes a program stored in the memory, the con-

troller 80 controls behavior of various configurations in the heat pump cycle apparatus 100, such as the compressor 12, the flow path switching mechanism 14, the expansion mechanism 18, the pump 32, and the refrigerant sensor 70, in order to cause the heat pump cycle apparatus 100 to execute desired behavior.

[0058] In an exemplary case where the refrigerant sensor 70 detects refrigerant leakage, the controller 80 drives the fan 60. This leads to agitation of a reserved refrigerant.

(2-2) Utilization facility

[0059] The utilization facility 34 is configured to utilize water cooled or heated in the second heat exchanger 20. Examples of the utilization facility 34 according to the present embodiment include an air handling unit or a fan coil unit configured to cause heat exchange between air and water cooled or heated in the second heat exchanger 20, to condition air. The utilization facility in the heat pump cycle apparatus should not be limited, in terms of its type, to the air handling unit or the fan coil unit, but may be appropriately selected for its purpose of use. In an exemplary case where the heat pump cycle apparatus is used in a plant or the like, the utilization facility 34 may be a manufacturing facility configured to cool or heat a manufacturing apparatus or a product with use of water cooled or heated in the second heat exchanger 20. In another case where the heat pump cycle apparatus is a water heater, the utilization facility 34 may be a tank configured to reserve water cooled or heated in the second heat exchanger 20. Water reserved in the tank serving as the utilization facility 34 is sent to a device or the like utilizing water with use of a pump (not depicted) or the like.

[0060] FIG. 1 depicts only one utilization facility 34, but the heat pump cycle apparatus 100 may alternatively include a plurality of utilization facilities. In this case, water cooled or heated in the second heat exchanger 20 is sent to the plurality of utilization facilities. When the heat pump cycle apparatus 100 includes the plurality of utilization facilities, the utilization facilities may be of an identical type, or may include a plurality of types of facilities.

(3) Characteristics

[0061] (3-1)

There has been conventionally provided a technique for detection of refrigerant leakage. According to the conventional technique, a degassing port of a degassing valve disposed on a heating medium circuit in a machine chamber is extended with use of a pipe to a fan chamber. When a crack or the like is generated in a heat transfer partition wall between a refrigerant on a heat source side and a heating medium on a utilization side in a utilization heat exchanger, a refrigerant leaking from a refrigerant circuit having refrigerant circulation to the heating medium circuit having heating medium circulation is detected

in accordance with a degree of decrease in temperature detected by a temperature sensor provided on the pipe. This case causes failure in detection of a refrigerant leaking into the machine chamber from a site other than the degassing valve in the machine chamber (e.g. a brazed portion of the pipe).

[0062] The outdoor unit 90 according to the present embodiment corresponds to the outdoor unit 90 of the heat pump cycle apparatus 100. The outdoor unit 90 includes the refrigerant circuit 10, the water circuit 30, the refrigerant sensor 70, the gas-liquid separator 40, the degassing valve 54, and the fan 60. The refrigerant circuit 10 connects, by means of the pipe P, the compressor 12, the first heat exchanger 16, and the second heat exchanger 20. The compressor 12 compresses a refrigerant. The first heat exchanger 16 causes heat exchange between the refrigerant and air. The second heat exchanger 20 causes heat exchange between the refrigerant and water. The water circuit 30 has a flow of water that exchanges heat with the refrigerant in the second heat exchanger 20. The refrigerant sensor 70 detects the refrigerant to find refrigerant leakage. The gas-liquid separator 40 is connected to the water circuit 30. The degassing valve 54 is attached to the gas-liquid separator 40. The degassing valve 54 degasses the gas-liquid separator 40. The fan 60 supplies the first heat exchanger 16 with air. The fan chamber R1 and the machine chamber R2 are partitioned by the partitioning member 92. The fan chamber R1 accommodates the fan 60. The machine chamber R2 accommodates the compressor 12 and the second heat exchanger 20. The machine chamber R2 accommodates the degassing port 54a of the degassing valve 54 and the refrigerant sensor 70.

[0063] In the outdoor unit 90 according to the present embodiment, the machine chamber R2 accommodates the degassing port 54a of the degassing valve 54, and the refrigerant sensor 70 configured to detect a refrigerant. The outdoor unit 90 can thus detect even a refrigerant leaking into the machine chamber R2 from a site other than the degassing valve 54 in the machine chamber R2 (e.g. a brazed portion of the pipe).

[0064] (3-2)

In the outdoor unit 90 according to the present embodiment, the refrigerant sensor 70 is disposed in the space below the gas-liquid separator 40.

[0065] In the outdoor unit 90 according to the present embodiment, the refrigerant sensor 70 is disposed in the space below the gas-liquid separator 40, where a leaking refrigerant is highly possibly reserved. The outdoor unit 90 can thus achieve accurate detection of refrigerant leakage.

[0066] (3-3)

In the outdoor unit 90 according to the present embodiment, the machine chamber R2 is divided into the first area A1, the second area A2, the third area A3, and the fourth area A4 in a top view. The first area A1 is provided with the compressor 12. The second area A2 is provided with the pipe P of the refrigerant circuit 10. The third area

A3 is provided with the second heat exchanger 20. The fourth area A4 is provided with the pipe W of the water circuit 30, the gas-liquid separator 40, and the degassing valve 54. The refrigerant sensor 70 is disposed in the fourth area A4.

[0067] (3-4)

When the refrigerant sensor 70 detects refrigerant leakage, the outdoor unit 90 according to the present embodiment drives the fan 60. The outdoor unit 90 can thus agitate a reserved refrigerant.

[0068] (3-5)

In the outdoor unit 90 according to the present embodiment, the refrigerant is categorized as having flammability in class 2 or higher flammability in class 3 by ISO 817.

[0069] (3-6)

In the outdoor unit 90 according to the present embodiment, the refrigerant sensor 70 is disposed near the second heat exchanger 20. The outdoor unit 90 can thus achieve accurate detection of a refrigerant leaking in the second heat exchanger 20.

(4) Modification examples

(4-1) Modification example 1A

[0070] The degassing valve 54 according to the present embodiment is attached to the top of the gas-liquid separator 40. But the degassing valve 54 may alternatively be attached to the side wall of the gas-liquid separator 40. Furthermore, the gas-liquid separator 40 may be provided with a plurality of degassing valves. For example, the degassing valve may be attached to each of the top and the side wall of the gas-liquid separator 40.

(4-2) Modification example 1B

[0071] An ignition source device, including the compressor 12, disposed in the machine chamber R2 may be explosion protected. The outdoor unit 90 is thus configured so as to be able to prevent a leaking refrigerant from exploding the ignition source device.

[0072] (4-3)

The embodiment of the present disclosure has been described above. Various modifications to modes and details should be available without departing from the object and the scope of the present disclosure recited in the claims.

REFERENCE SIGNS LIST

[0073]

- 10: Refrigerant circuit
- 12: Compressor
- 16: First heat exchanger
- 20: Second heat exchanger
- 30: water circuit (heating medium circuit)
- 40: Gas-liquid separator

- 54: degassing valve
- 54a: degassing port
- 60: Fan
- 70: refrigerant sensor (sensor)
- 90: Outdoor unit
- 92: partitioning member
- 100: heat pump cycle apparatus
- A1: first area
- A2: second area
- A3: third area
- A4: fourth area
- P: pipe
- R1: fan chamber
- R2: machine chamber
- W: pipe

CITATION LIST

PATENT LITERATURE

[0074] Patent Literature 1: Japanese Laid-Open Patent Publication No. 2022-044867

Claims

1. An outdoor unit (90) of a heat pump cycle apparatus (100), the outdoor unit (90) comprising:

a refrigerant circuit (10) connecting, by means of a pipe (P), a compressor (12) configured to compress a refrigerant, a first heat exchanger (16) configured to cause heat exchange between the refrigerant and air, and a second heat exchanger (20) configured to cause heat exchange between the refrigerant and a heating medium;
 a heating medium circuit (30) having a flow of the heating medium that exchanges heat with the refrigerant in the second heat exchanger;
 a sensor (70) configured to detect the refrigerant to find leakage of the refrigerant;
 a gas-liquid separator (40) connected to the heating medium circuit;
 a degassing valve (54) attached to the gas-liquid separator and configured to degas the gas-liquid separator; and
 a fan (60) configured to supply the first heat exchanger with air, wherein
 a fan chamber (R1) accommodating the fan and a machine chamber (R2) accommodating the compressor and the second heat exchanger are partitioned by a partitioning member (92), and the machine chamber accommodates a degassing port (54a) of the degassing valve and the sensor.

2. The outdoor unit (90) according to claim 1, wherein

the sensor is disposed in a space below the gas-liquid separator.

3. The outdoor unit (90) according to claim 1 or 2, wherein

the machine chamber is divided, in a top view, into a first area (A1) provided with the compressor, a second area (A2) provided with the pipe of the refrigerant circuit, a third area (A3) provided with the second heat exchanger, and a fourth area (A4) provided with a pipe (W) of the heating medium circuit, the gas-liquid separator, and the degassing valve, and the sensor is disposed in the fourth area.

4. The outdoor unit (90) according to any one of claims 1 to 3, wherein the fan is driven when the sensor detects leakage of the refrigerant.

5. The outdoor unit (90) according to any one of claims 1 to 4, wherein an ignition source device, including the compressor, disposed in the machine chamber is explosion protected.

6. The outdoor unit (90) according to any one of claims 1 to 5, wherein the refrigerant is categorized as having flammability in class 2 or higher flammability in class 3 by ISO 817.

7. The outdoor unit (90) according to any one of claims 1 to 6, wherein the sensor is disposed near the second heat exchanger.

Amended claims in accordance with Rule 137(2) EPC.

1. An outdoor unit (90) of a heat pump cycle apparatus (100), the outdoor unit (90) comprising:

a refrigerant circuit (10) connecting, by means of a pipe (P), a compressor (12) configured to compress a refrigerant, a first heat exchanger (16) configured to cause heat exchange between the refrigerant and air, and a second heat exchanger (20) configured to cause heat exchange between the refrigerant and a heating medium;

a heating medium circuit (30) having a flow of the heating medium that exchanges heat with the refrigerant in the second heat exchanger; a sensor (70) configured to detect the refrigerant to find leakage of the refrigerant;

a gas-liquid separator (40) connected to the heating medium circuit;

a degassing valve (54) attached to the gas-liquid separator and configured to degas the gas-liquid

separator; and

a fan (60) configured to supply the first heat exchanger with air, **characterized in that** a fan chamber (R1) accommodating the fan and a machine chamber (R2) accommodating the compressor and the second heat exchanger are partitioned by a partitioning member (92), and the machine chamber accommodates a degassing port (54a) of the degassing valve and the sensor.

2. The outdoor unit (90) according to claim 1, wherein the sensor is disposed in a space below the gas-liquid separator.

3. The outdoor unit (90) according to claim 1 or 2, wherein

the machine chamber is divided, in a top view, into a first area (A1) provided with the compressor, a second area (A2) provided with the pipe of the refrigerant circuit, a third area (A3) provided with the second heat exchanger, and a fourth area (A4) provided with a pipe (W) of the heating medium circuit, the gas-liquid separator, and the degassing valve, and the sensor is disposed in the fourth area.

4. The outdoor unit (90) according to any one of claims 1 to 3, wherein the fan is driven when the sensor detects leakage of the refrigerant.

5. The outdoor unit (90) according to any one of claims 1 to 4, wherein an ignition source device, including the compressor, disposed in the machine chamber is explosion protected.

6. The outdoor unit (90) according to any one of claims 1 to 5, wherein the refrigerant is categorized as having flammability in class 2 or higher flammability in class 3 by ISO 817.

7. The outdoor unit (90) according to any one of claims 1 to 6, wherein the sensor is disposed near the second heat exchanger.

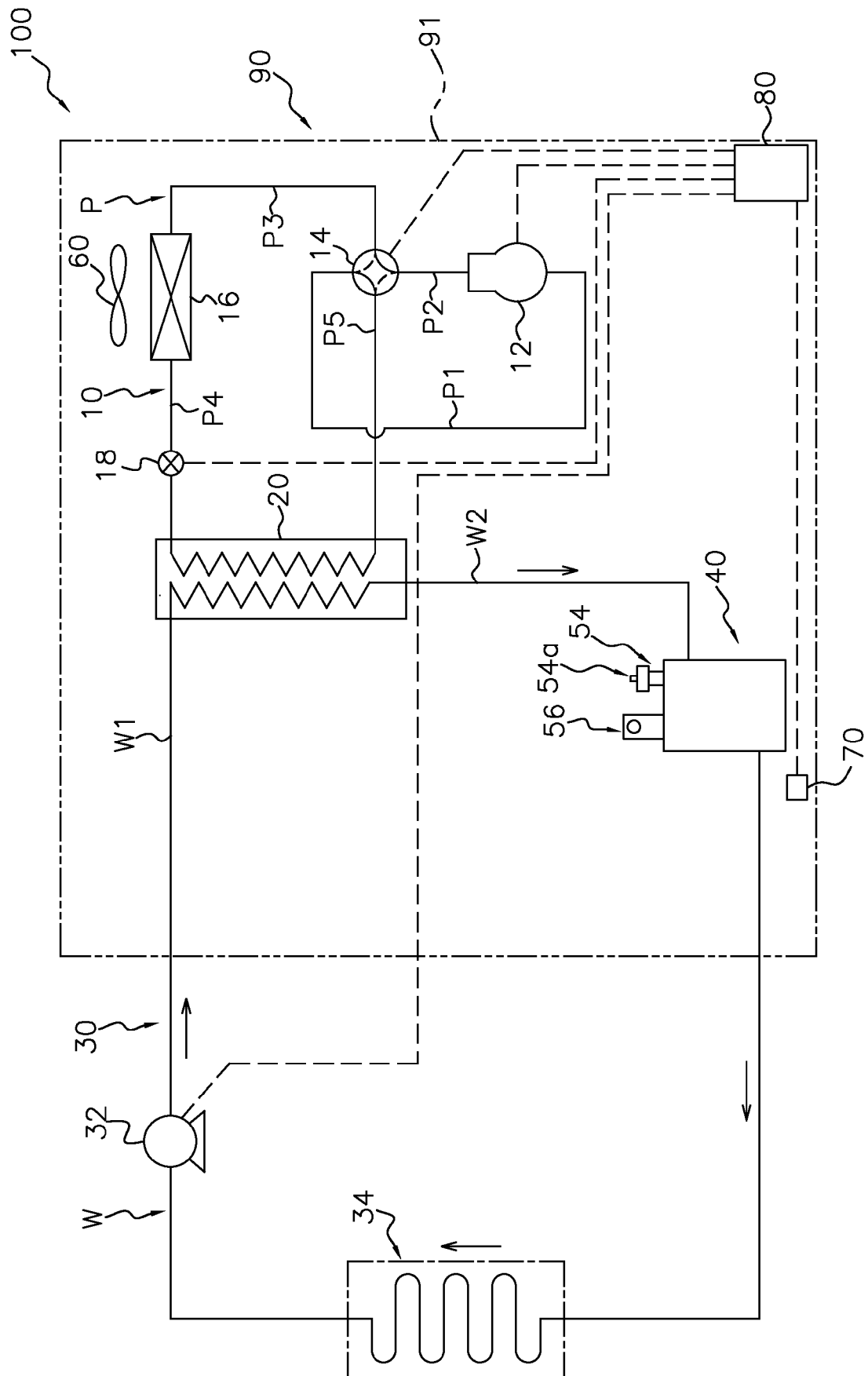


FIG. 1

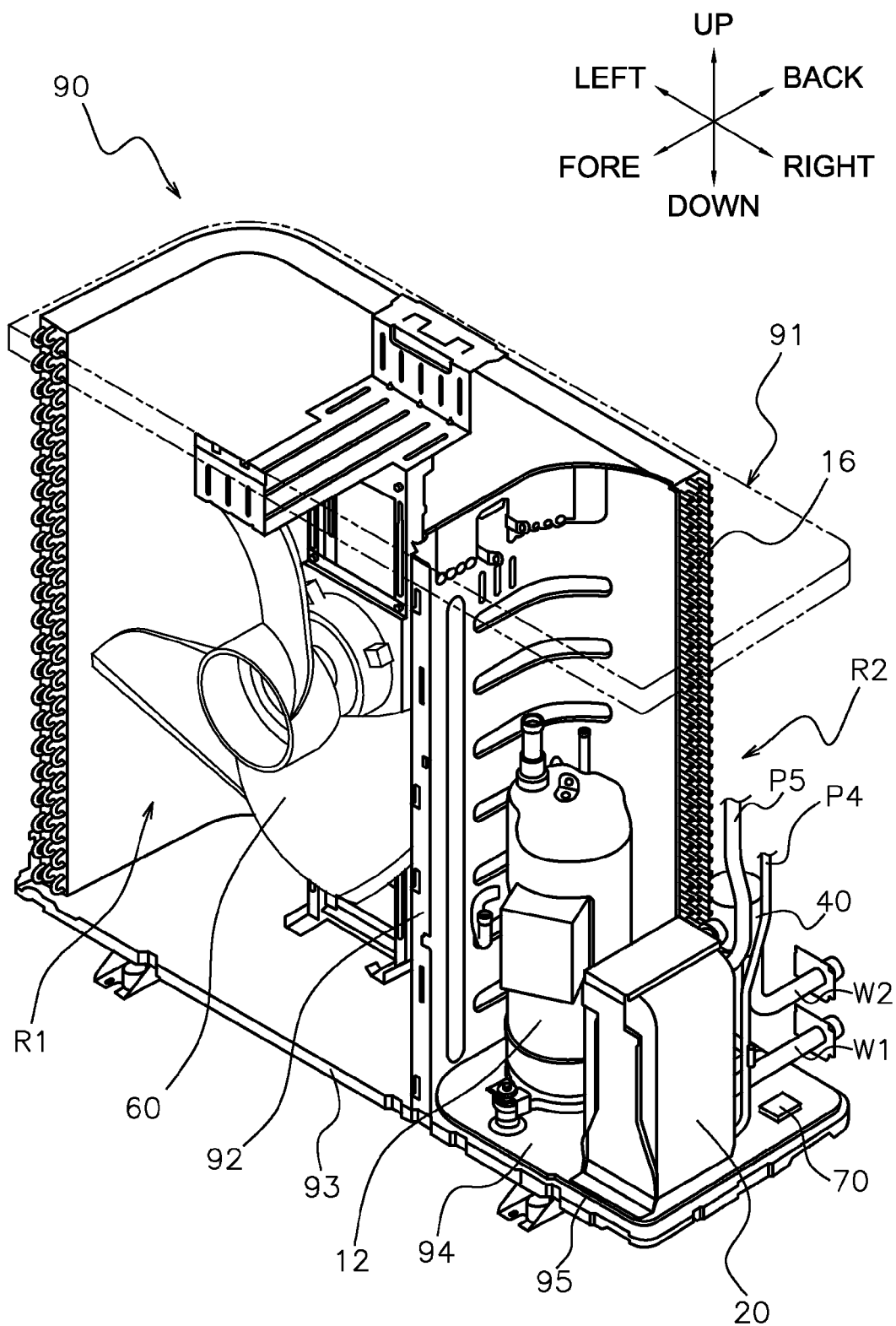


FIG. 2

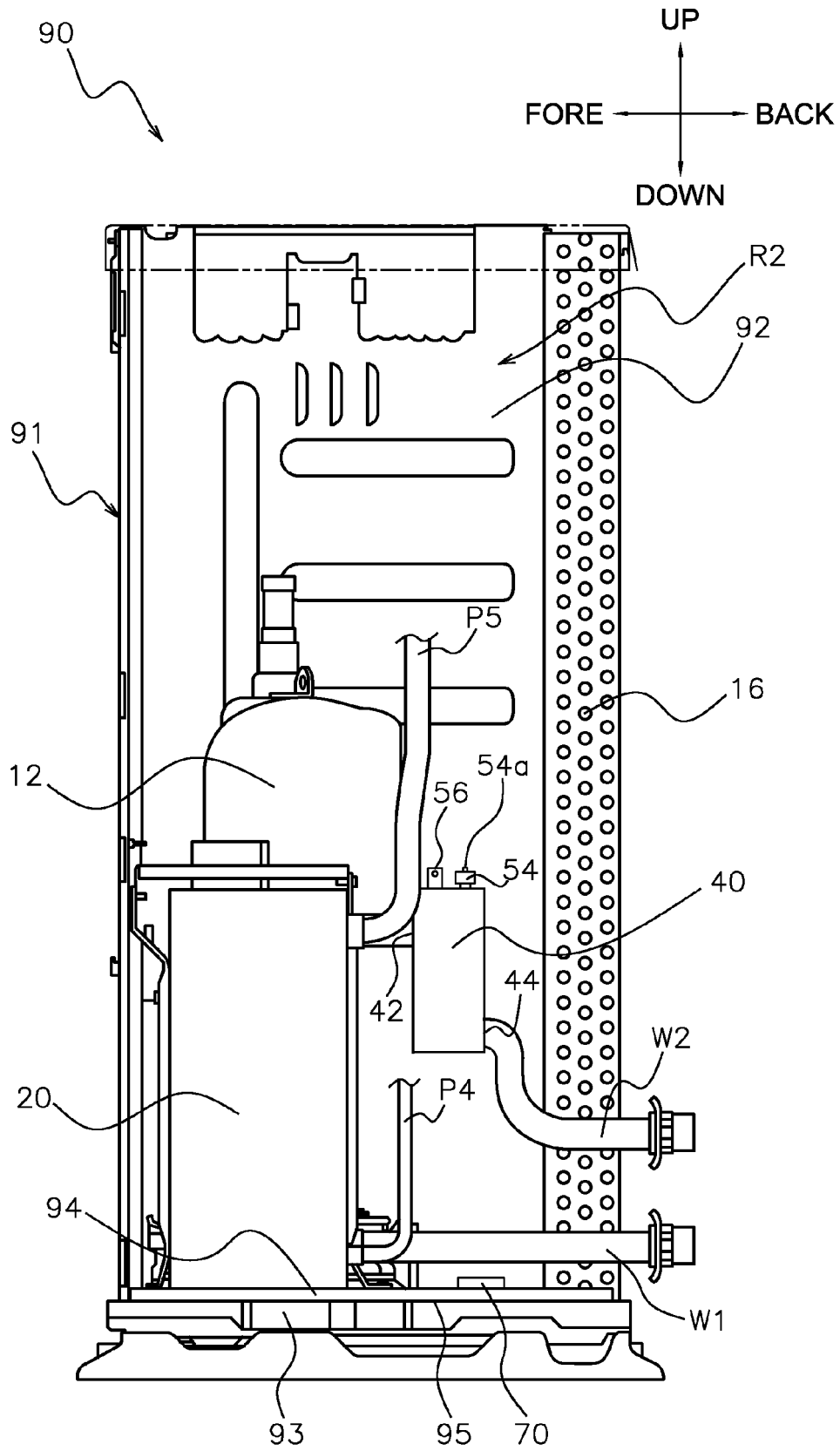


FIG. 3

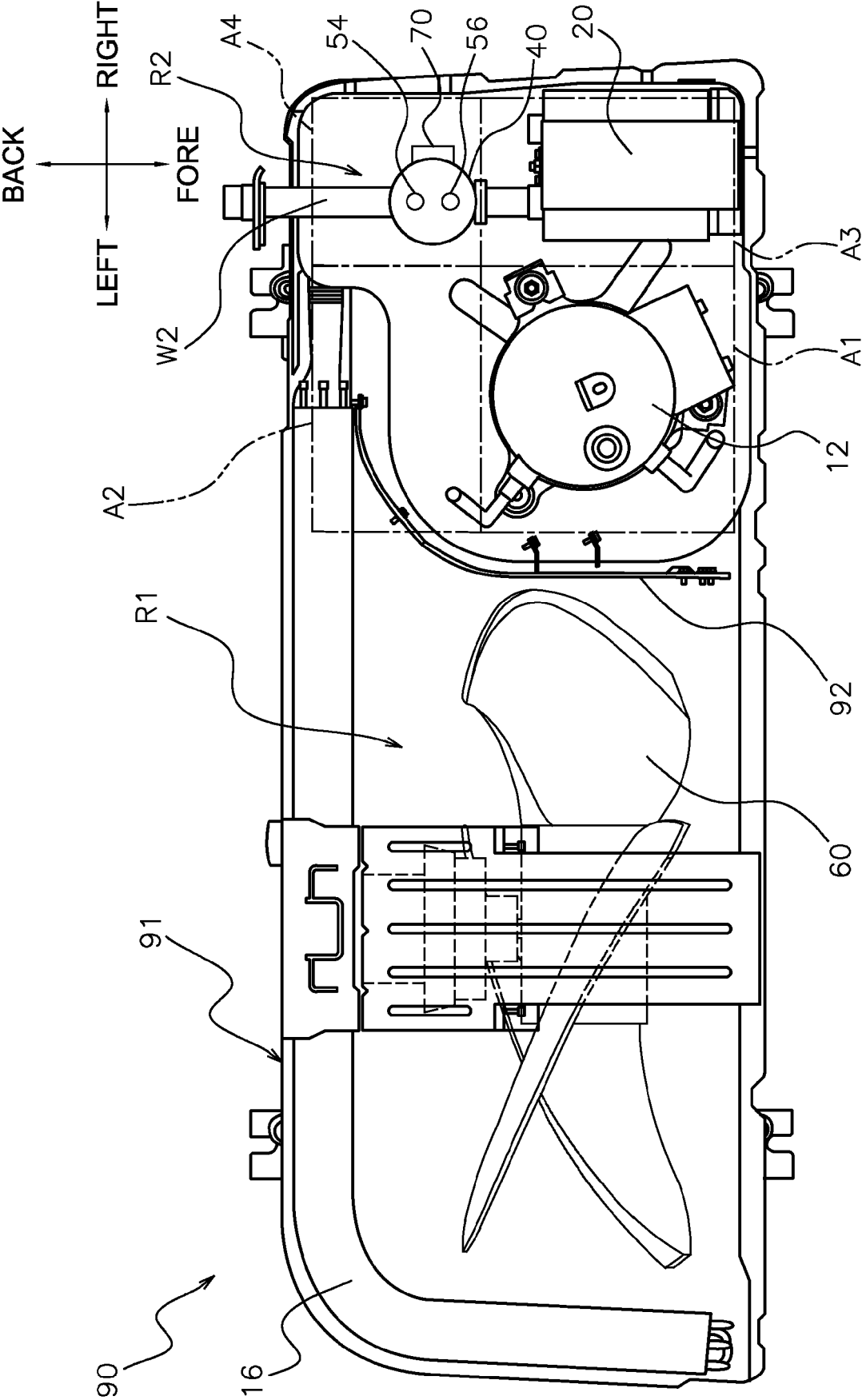


FIG. 4



EUROPEAN SEARCH REPORT

Application Number

EP 23 15 8240

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Place of search		Date of completion of the search	Examiner
Munich		18 July 2023	Silex, Anna
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons	
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