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(54) REFRIGERATION CYCLE DEVICE

(57) To provide a refrigeration cycle apparatus that uses a zeotropic refrigerant mixture and is capable of both ensuring the heat exchange efficiency in a heat exchanger and suppressing the performance degradation of the apparatus caused by a pressure loss experienced by the refrigerant flowing into the heat exchanger. A refrigeration cycle apparatus (1) using a zeotropic refrigerant mixture as a refrigerant includes a refrigerant circuit (100) and a control unit (50). The refrigerant circuit (100) includes a heat exchanger (11, 21). The control unit (50) performs a first operation that causes the heat exchanger (11, 21) to function as a radiator for the refrigerant and a second operation that causes the heat exchanger as an evaporator for the refrigerant. The refrigerant flows through the heat exchanger (11, 21) in a direction opposite to a flow of air during the first operation and the second operation. The refrigerant circuit (100) includes an inflow section (14, 24) through which the refrigerant immediately before flowing into the heat exchanger (11, 21) passes. A pressure loss experienced by the refrigerant passing through the inflow section (14, 24) during the first operation is smaller than a pressure loss experienced by the refrigerant passing through the inflow section (14, 24) during the second operation.

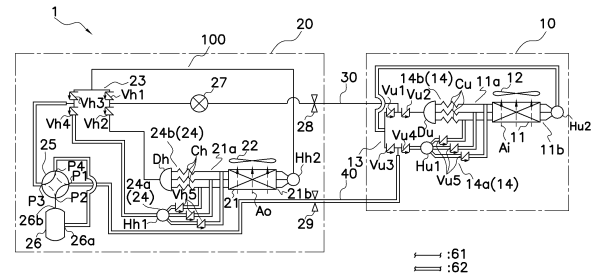


FIG. 1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a refrigeration cycle apparatus.

BACKGROUND ART

[0002] PTL 1 (Japanese Unexamined Patent Application Publication No. 7-280375) discloses a refrigeration cycle apparatus (refrigeration cycle apparatus) that suppresses a reduction in heat exchange efficiency in a heat exchanger due to reversal of the flow direction of a refrigerant between heating and cooling in a refrigerant circuit using a zeotropic refrigerant mixture, which is a mixture of two or more types of zeotropic refrigerants. PTL 1 discloses a refrigeration cycle apparatus that is provided with two refrigerant flow path switching devices in a refrigerant circuit, and includes a heat exchanger through which a refrigerant flows in a direction opposite to the flow of air in both cases, that is, during heating and cooling operations.

SUMMARY OF THE INVENTION

<Technical Problem>

[0003] There is known a refrigerant circuit provided with a flow rate adjustment section using a distributor and a capillary tube at an end portion serving as an inflow side in a case where a heat exchanger functions as an evaporator, in order to ensure distribution performance for a gas-liquid two-phase refrigerant flowing into the heat exchanger. When this technique is applied to the refrigerant circuit of PTL 1 in which the flow direction of the refrigerant passing through the heat exchanger is always the same, a gas refrigerant needs to pass through the distributor and the flow rate adjustment section in a case where the heat exchanger functions as a radiator. As a result, a pressure loss experienced by the gas refrigerant flowing into the heat exchanger increases compared to that in the related art, and thus the performance of the refrigeration cycle apparatus degrades, causing a problem.

[0004] The present disclosure provides a refrigeration cycle apparatus that uses a zeotropic refrigerant mixture and is capable of both ensuring the heat exchange efficiency in a heat exchanger and suppressing the performance degradation of the apparatus caused by a pressure loss experienced by the refrigerant flowing into the heat exchanger.

<Solution to Problem>

[0005] A refrigeration cycle apparatus according to a first aspect uses a zeotropic refrigerant mixture as a refrigerant. The refrigeration cycle apparatus includes

a refrigerant circuit and a control unit. The refrigerant circuit includes a heat exchanger that causes heat exchange between air and a refrigerant. The control unit performs a first operation that causes the heat exchanger to function as a radiator for the refrigerant and a second operation that causes the heat exchanger to function as an evaporator for the refrigerant. The refrigerant flows inside the heat exchanger in a direction opposite to a flow of the air during the first operation and the second operation.

[0006] The refrigerant circuit includes an inflow section through which the refrigerant immediately before flowing into the heat exchanger passes. A pressure loss experienced by the refrigerant passing through the inflow section during the first operation is smaller than a pressure loss experienced by the refrigerant passing through the inflow section during the second operation.

[0007] In the refrigeration cycle apparatus, the refrigerant flows inside the heat exchanger in a direction opposite to the flow of the air during heating and cooling operations. As a result, the heat exchange efficiency in the heat exchanger is ensured even in the refrigerant circuit using a zeotropic refrigerant mixture. Furthermore, in the refrigeration cycle apparatus, the pressure loss experienced by a gas refrigerant passing through the inflow section during the first operation is smaller than the pressure loss experienced by a gas-liquid two-phase refrigerant passing through the inflow section during the second operation. Therefore, the refrigeration cycle apparatus suppresses the performance degradation of the apparatus caused by a significant pressure loss experienced by the gas refrigerant immediately before flowing into the heat exchanger during the first operation. Accordingly, the refrigeration cycle apparatus is capable of both ensuring the heat exchange efficiency in the heat exchanger and suppressing the performance degradation of the apparatus caused by a pressure loss experienced by the refrigerant flowing into the heat exchanger, while using a zeotropic refrigerant mixture.

[0008] A refrigeration cycle apparatus according to a second aspect is the refrigeration cycle apparatus according to the first aspect, in which the inflow section includes a first flow path and a second flow path. A pressure loss experienced by the refrigerant passing through the first flow path is smaller than a pressure loss experienced by the refrigerant passing through the second flow path. The refrigerant passes through the first flow path and flows into the heat exchanger during the first operation, and passes through the second flow path and flows into the heat exchanger during the second operation.

[0009] The refrigeration cycle apparatus branches the refrigerant immediately before flowing into the heat exchanger into either the first flow path or the second flow path to change the pressure loss experienced by the refrigerant.

[0010] A refrigeration cycle apparatus according to a third aspect is the refrigeration cycle apparatus according

to the second aspect, in which a first refrigerant pipe included in the first flow path has a flow path area larger than a flow path area of a second refrigerant pipe included in the second flow path.

[0011] In the refrigeration cycle apparatus, since the flow path area of the first refrigerant pipe is larger than the flow path area of the second refrigerant pipe, the pressure loss experienced by the refrigerant passing through the first flow path is smaller than the pressure loss experienced by the refrigerant passing through the second flow path.

[0012] A refrigeration cycle apparatus according to a fourth aspect is the refrigeration cycle apparatus according to either the second aspect or the third aspect, in which the refrigerant circuit includes a branching section that switches a flow path of the refrigerant to either the first flow path or the second flow path.

[0013] A refrigeration cycle apparatus according to a fifth aspect is the refrigeration cycle apparatus according to the fourth aspect, in which the first flow path includes a fifth check valve provided at a refrigerant pipe on a downstream side.

[0014] In the refrigeration cycle apparatus, the fifth check valve suppresses the refrigerant from backflowing from the second flow path to the first flow path.

[0015] A refrigeration cycle apparatus according to a sixth aspect is the refrigeration cycle apparatus according to the fourth aspect, in which the first flow path includes a control valve provided at a refrigerant pipe on a downstream side.

[0016] In the refrigeration cycle apparatus, the control valve suppresses the refrigerant from backflowing from the second flow path to the first flow path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 is a schematic configuration diagram of a refrigeration cycle apparatus 1.

Fig. 2 is a block diagram of a control unit 50.

Fig. 3 is a schematic configuration diagram of a utilization-side heat exchanger 11.

Fig. 4 is a schematic configuration diagram of a heat-source-side heat exchanger 21.

Fig. 5 is a schematic configuration diagram illustrating a flow of a refrigerant during a heating operation. Fig. 6 is a schematic configuration diagram illustrating a flow of the refrigerant during a cooling operation.

Fig. 7 is a schematic configuration diagram of a refrigeration cycle apparatus 1a according to a modification A.

Fig. 8 is a schematic configuration diagram of a refrigeration cycle apparatus 1b according to a modification B.

Fig. 9 is a schematic configuration diagram of a refrigeration cycle apparatus 2.

Fig. 10 is a schematic configuration diagram illustrating a flow of the refrigerant during a heating operation.

Fig. 11 is a schematic configuration diagram illustrating a flow of the refrigerant during a cooling operation.

DESCRIPTION OF EMBODIMENTS

<First embodiment>

(1) Overall configuration

[0018] A refrigeration cycle apparatus 1 is an apparatus that utilizes a vapor compression refrigeration cycle. The refrigeration cycle apparatus 1 is an air-conditioning apparatus that performs a cooling operation that cools air in an air-conditioning target space (not illustrated) and heating that heats the air in the air-conditioning target space. The refrigeration cycle apparatus 1 mainly includes one utilization unit 10, one heat source unit 20, a liquid refrigerant connection pipe 30 and a gas refrigerant connection pipe 40, and a control unit 50. Fig. 1 is a schematic configuration diagram of the refrigeration cycle apparatus 1. Fig. 2 is a block diagram of the control unit 50.

[0019] Although details will be described later, the liquid refrigerant connection pipe 30 and the gas refrigerant connection pipe 40 are pipes that connect the utilization unit 10 and the heat source unit 20 to each other, and constitute a refrigerant circuit 100 together with the respective devices included in the heat source unit 20 and the utilization unit 10. The respective devices included in the heat source unit 20 and the utilization unit 10 are connected to each other using first refrigerant pipes 61 or second refrigerant pipes 62. The second refrigerant pipes 62 are formed to have flow path areas larger than those of the first refrigerant pipes 61.

[0020] The refrigerant circuit 100 is filled with a zeotropic refrigerant mixture, which is a mixture of two or more types of zeotropic refrigerants. In the present embodiment, although not limited thereto, R454C is used as the refrigerant.

[0021] Note that the refrigeration cycle apparatus 1 of the present embodiment includes one utilization unit 10, but the number of utilization units 10 is not limited to one. For example, the refrigeration cycle apparatus 1 may include a plurality of utilization units 10. Furthermore, the refrigeration cycle apparatus 1 of the present embodiment includes one heat source unit 20, but the number of heat source units 20 is not limited to one. For example, the refrigeration cycle apparatus 1 may include a plurality of heat source units 20. Moreover, the refrigeration cycle apparatus 1 may be an integrated apparatus in which the heat source unit 20 and the utilization unit 10 are assembled in a single housing, for example.

(2) Detailed configuration

(2-1) Utilization unit

[0022] The utilization unit 10 cools or heats air Ai in the air-conditioning target space. The utilization unit 10 includes a utilization-side heat exchanger 11, a utilization-side fan 12, a utilization-side branching section 13, a utilization-side inflow section 14, and a utilization-side second header Hu2. In the utilization unit 10, the heating operation is an example of a first operation, and the cooling operation is an example of a second operation.

(2-1-1) Utilization-side heat exchanger

[0023] The utilization-side heat exchanger 11 causes heat exchange between a refrigerant flowing inside the utilization-side heat exchanger 11 and the air Ai. The utilization-side heat exchanger 11 functions as a radiator during the heating operation, and functions as an evaporator during the cooling operation. Fig. 3 is a schematic configuration diagram of the utilization-side heat exchanger 11. In Fig. 3, directions in which the refrigerant flows are indicated by open arrows. Furthermore, a direction in which the air Ai supplied by the utilization-side fan 12 flows is indicated by a hatched arrow. In addition, a horizontal direction, a vertical direction, and respective directions such as up, down, windward, and leeward, referred to in the following description, correspond to directions indicated by arrows illustrated in Fig. 3.

[0024] The utilization-side heat exchanger 11 is a fin-and-tube heat exchanger including a plurality of tubular heat transfer tubes 11hp, a plurality of fins 11f, a plurality of first connecting tubes 11ca, and second connecting tubes 11cb. The heat transfer tubes 11hp are disposed so as to penetrate the plurality of fins 11f and extend along a first direction (in the present embodiment, the horizontal direction). The plurality of fins 11f are disposed in parallel to each other at predetermined intervals along the first direction.

[0025] The utilization-side heat exchanger 11 includes three paths 11pa, 11pb, and 11pc. The paths 11pa, 11pb, and 11pc have an identical shape. The paths 11pa, 11pb, and 11pc each include a plurality of the heat transfer tubes 11hp, a plurality of the first connecting tubes 11ca, and the second connecting tube 11cb. The paths 11pa, 11pb, and 11pc each have an inlet 11i and an outlet 11o. The paths 11pa, 11pb, and 11pc are disposed along the first direction.

[0026] The paths 11pa, 11pb, and 11pc each include a heat transfer tube group Ru1 and a heat transfer tube group Ru2 in each of which a plurality of the heat transfer tubes 11hp are arranged in parallel to each other along a second direction (in the present embodiment, the vertical direction). In the present embodiment, the heat transfer tube groups Ru1 and Ru2 each include four heat transfer tubes 11hp. In other words, the paths 11pa, 11pb, and 11pc are each formed such that the heat transfer tubes

11hp disposed in four stages in the second direction are arranged in two rows in the first direction.

[0027] The heat transfer tube groups Ru1 and Ru2 are disposed such that a plane including center axes of a plurality of the heat transfer tubes 11hp included in the heat transfer tube group Ru1 and a plane including center axes of a plurality of the heat transfer tubes 11hp included in the heat transfer tube group Ru2 are parallel to each other at a predetermined interval. Furthermore, the heat transfer tube groups Ru1 and Ru2 are disposed such that the planes including the center axes of the plurality of heat transfer tubes 11hp included in the heat transfer tube groups Ru1 and Ru2 are orthogonal to the direction in which the air Ai supplied by the utilization-side fan 12 flows (in the present embodiment, the horizontal direction). The heat transfer tube group Ru1 is disposed on the windward side of the heat transfer tube group Ru2 in the direction in which the air Ai supplied by the utilization-side fan 12 flows.

[0028] The inlet 11i is an opening of an end portion of the heat transfer tube 11hp disposed at the uppermost position in the heat transfer tube group Ru2. The inlet 11i is connected to the utilization-side inflow section 14.

[0029] The outlet 11o is an opening of an end portion of the heat transfer tube 11hp disposed at the lowermost position in the heat transfer tube group Ru1. The outlet 11o is connected to the utilization-side second header Hu2 via a first refrigerant pipe 61.

[0030] Each first connecting tube 11ca is provided at an end portion of the heat transfer tube 11hp so that the refrigerant flowing to the end portion of the heat transfer tube 11hp can flow into an adjacent heat transfer tube 11hp of another stage along the second direction.

[0031] The second connecting tube 11cb communicates the adjacent heat transfer tube groups Ru1 and Ru2 to each other. Specifically, the second connecting tube 11cb is provided so as to communicate an end portion of the heat transfer tube 11hp disposed at the lowermost position in the heat transfer tube group Ru2 and an end portion of the heat transfer tube 11hp disposed at the uppermost position in the heat transfer tube group Ru1 to each other.

[0032] Note that the number of heat transfer tube groups Ru1 and Ru2, the number of paths 11pa, 11pb, and 11pc, the number of heat transfer tubes 11hp, and the like described above are examples, and the present embodiment is not limited thereto.

(2-1-2) Utilization-side fan

[0033] The utilization-side fan 12 is a fan that supplies the air Ai to the utilization-side heat exchanger 11. The utilization-side fan 12 is driven by a fan motor 12m (see Fig. 2). The control unit 50 controls the number of rotations of the fan motor 12m to control an amount of the air Ai supplied to the utilization-side heat exchanger 11.

(2-1-3) Utilization-side branching section

[0034] The utilization-side branching section 13 switches the flow path of the refrigerant that flows out of the heat source unit 20 and the flow path of the refrigerant that flows out of the utilization-side heat exchanger 11 between the heating operation and the cooling operation. The utilization-side branching section 13 is connected to the liquid refrigerant connection pipe 30, the gas refrigerant connection pipe 40, the utilization-side inflow section 14, and the utilization-side second header Hu2.

[0035] The utilization-side branching section 13 includes a first check valve Vu1, a second check valve Vu2, a third check valve Vu3, and a fourth check valve Vu4. The first check valve Vu1, the second check valve Vu2, the third check valve Vu3, and the fourth check valve Vu4 each have an inlet and an outlet. The first check valve Vu1, the second check valve Vu2, the third check valve Vu3, and the fourth check valve Vu4 each allow the refrigerant to flow from the inlet to the outlet (in a direction indicated by each arrow in the drawing), and each restrict the refrigerant from flowing in a direction opposite to the direction indicated by the arrow.

[0036] The outlet of the first check valve Vu1 is connected to the inlet of the second check valve Vu2. The outlet of the third check valve Vu3 is connected to the inlet of the fourth check valve Vu4.

[0037] The inlet of the first check valve Vu1 and the inlet of the third check valve Vu3 are connected to the utilization-side second header Hu2 via a second refrigerant pipe 62.

[0038] The outlet of the first check valve Vu1 and the inlet of the second check valve Vu2 are connected to the liquid refrigerant connection pipe 30 via a first refrigerant pipe 61. The outlet of the third check valve Vu3 and the inlet of the fourth check valve Vu4 are connected to the gas refrigerant connection pipe 40 via a second refrigerant pipe 62.

[0039] The outlet of the second check valve Vu2 is connected to a second flow path 14b (described later) of the utilization-side inflow section 14 via a first refrigerant pipe 61. The outlet of the fourth check valve Vu4 is connected to a first flow path 14a (described later) of the utilization-side inflow section 14 via a second refrigerant pipe 62.

(2-1-4) Utilization-side inflow section

[0040] The utilization-side inflow section 14 is a flow path through which the refrigerant immediately before flowing into the utilization-side heat exchanger 11 passes. The utilization-side inflow section 14 includes the first flow path 14a and the second flow path 14b. The utilization-side inflow section 14 is configured such that a pressure loss experienced by the refrigerant passing through the first flow path 14a is smaller than a pressure loss experienced by the refrigerant passing through the

second flow path 14b.

(2-1-4-1) First flow path

[0041] The first flow path 14a is a flow path through which the refrigerant passes during an operation that causes the utilization-side heat exchanger 11 to function as a radiator for the refrigerant (specifically, the heating operation). The refrigerant that flows into the first flow path 14a is distributed to the respective paths 11pa, 11pb, and 11pc by the first flow path 14a. The first flow path 14a includes a utilization-side first header Hu1 and a plurality of fifth check valves Vu5.

[0042] The utilization-side first header Hu1 is a tubular member through which the refrigerant flows. The utilization-side first header Hu1 is connected to the utilization-side branching section 13 (specifically, the outlet of the fourth check valve Vu4) via the second refrigerant pipe 62, and is connected to inlets of the fifth check valves Vu5 via second refrigerant pipes 62.

[0043] The fifth check valves Vu5 each allow the refrigerant to flow from the inlet to an outlet (in a direction indicated by each arrow in the drawing), and each restrict the refrigerant from flowing in a direction opposite to the direction indicated by the arrow. The inlets of the fifth check valves Vu5 are connected to the utilization-side first header Hu1 via the second refrigerant pipes 62. The fifth check valves Vu5 suppress backflow of the refrigerant that comes from the utilization-side first header Hu1. The outlets of the fifth check valves Vu5 are connected to the respective inlets 11i of the paths 11pa, 11pb, and 11pc via second refrigerant pipes 62.

[0044] In the present embodiment, the first flow path 14a includes three fifth check valves Vu5, and the respective three fifth check valves Vu5 are connected to the utilization-side first header Hu1 via individual second refrigerant pipes 62. The number of fifth check valves Vu5 included in the first flow path 14a is not limited to three, and may be two, four, or more, for example.

(2-1-4-2) Second flow path

[0045] The second flow path 14b is a flow path through which the refrigerant passes during an operation that causes the utilization-side heat exchanger 11 to function as an evaporator for the refrigerant (specifically, the cooling operation). The refrigerant that flows into the second flow path 14b is distributed to the respective paths 11pa, 11pb, and 11pc by the second flow path 14b. The second flow path 14b includes a distributor Du and three flow rate adjustment sections Cu.

[0046] The distributor Du is a member that distributes the refrigerant that flows out of the utilization-side branching section 13. The distributor Du is connected to the utilization-side branching section 13 (specifically, the second check valve Vu2) via the first refrigerant pipe 61, and is connected to inlets of the flow rate adjustment sections Cu via first refrigerant pipes 61.

[0047] The flow rate adjustment sections Cu are connected to the respective paths 11pa, 11pb, and 11pc of the utilization-side heat exchanger 11, and adjust flow rates of the refrigerant flowing into the respective paths 11pa, 11pb, and 11pc. In the present embodiment, the flow rate adjustment sections Cu are narrow tubes (capillary tubes) each having an inlet and an outlet. The outlets of the flow rate adjustment sections Cu are connected to the respective inlets 11i of the paths 11pa, 11pb, and 11pc. In order to adjust the flow rate of the refrigerant passing through the inside of the flow rate adjustment section Cu, the flow rate adjustment section Cu is formed to have a flow path area smaller than those of the first refrigerant pipe 61 and the second refrigerant pipe 62. Therefore, a pressure loss experienced by the refrigerant when the refrigerant passes through the flow rate adjustment section Cu is larger than a pressure loss that the refrigerant receives when the refrigerant passes through the first refrigerant pipe 61 and the second refrigerant pipe 62. In order to adjust the flow rate of the refrigerant flowing into the respective paths 11pa, 11pb, and 11pc, the lengths and the flow path areas of the three flow rate adjustment sections Cu may be different from each other.

[0048] In this manner, the first flow path 14a includes the utilization-side first header Hu1 and the fifth check valves Vu5 connected via the second refrigerant pipes 62, whereas the second flow path 14b includes the flow rate adjustment sections Cu in each of which the pressure loss experienced by the refrigerant passing through the flow rate adjustment section Cu is larger than that of the second refrigerant pipe 62.

[0049] Accordingly, in the utilization-side inflow section 14, the pressure loss experienced by the refrigerant passing through the first flow path 14a is smaller than the pressure loss experienced by the refrigerant passing through the second flow path 14b.

(2-1-5) Utilization-side second header

[0050] The utilization-side second header Hu2 is a tubular member through which the refrigerant flows. The utilization-side second header Hu2 is connected to the outlets 11o of the utilization-side heat exchanger 11 via a plurality of the first refrigerant pipes 61, and is connected to the utilization-side branching section 13 (specifically, the inlet of the first check valve Vu1 and the inlet of the third check valve Vu3) via the second refrigerant pipe 62.

(2-1-6) Flow of refrigerant in utilization-side heat exchanger

[0051] The refrigerant that flows out of the utilization-side inflow section 14 flows into the uppermost heat transfer tubes 11hp in the heat transfer tube groups Ru2 from the respective inlets 11i of the paths 11pa, 11pb, and 11pc. The refrigerant that flows into the heat transfer tube group Ru2 alternately passes through the

heat transfer tube 11hp and the first connecting tube 11ca and moves downward while meandering through the heat transfer tube group Ru2. The refrigerant that flows into the lowermost heat transfer tube 11hp in the heat transfer tube group Ru2 passes through the second connecting tube 11cb, and flows into the uppermost heat transfer tube 11hp in the heat transfer tube group Ru1. The refrigerant that flows into the heat transfer tube group Ru1 also moves downward while meandering through the heat transfer tube group Ru1, passes through the outlet 11o, and flows out to the utilization-side second header Hu2.

[0052] In this manner, in the utilization-side heat exchanger 11, the refrigerant flowing through each of the paths 11pa, 11pb, and 11pc flows inside the utilization-side heat exchanger 11 in the order from the heat transfer tube group Ru2 to the heat transfer tube group Ru1, in a direction opposite to the flow of the air Ai supplied by the utilization-side fan 12.

(2-2) Heat source unit

[0053] The heat source unit 20 is disposed outside the air-conditioning target space. The heat source unit 20 includes a heat-source-side heat exchanger 21, a heat-source-side fan 22, a heat-source-side branching section 23, a heat-source-side inflow section 24, a heat-source-side second header Hh2, a flow direction switching mechanism 25, a compressor 26, an expansion mechanism 27, a first shut-off valve 28, and a second shut-off valve 29. In the heat source unit 20, the cooling operation is an example of the first operation, and the heating operation is an example of the second operation.

(2-2-1) Heat-source-side heat exchanger

[0054] The heat-source-side heat exchanger 21 causes heat exchange between the refrigerant flowing inside the heat-source-side heat exchanger 21 and air Ao outside the air-conditioning target space. The heat-source-side heat exchanger 21 functions as a radiator during the cooling operation, and functions as an evaporator during the heating operation. Fig. 4 is a schematic configuration diagram of the heat-source-side heat exchanger 21. In Fig. 4, directions in which the refrigerant flows are indicated by open arrows. Furthermore, a direction in which the air Ao supplied by the heat-source-side fan 22 flows is indicated by a hatched arrow. In addition, the horizontal direction, the vertical direction, and respective directions such as up, down, windward, and leeward, referred to in the following description, correspond to directions indicated by arrows illustrated in Fig. 4.

[0055] The heat-source-side heat exchanger 21 is a fin-and-tube heat exchanger including a plurality of tubular heat transfer tubes 21hp, a plurality of fins 21f, a plurality of first connecting tubes 21ca, and second connecting tubes 21cb. The heat transfer tubes 21hp are disposed so as to penetrate the plurality of fins 21f and

extend along the first direction. The plurality of fins 21f are disposed in parallel to each other at predetermined intervals along the first direction.

[0056] The heat-source-side heat exchanger 21 includes three paths 21pa, 21pb, and 21pc. The three paths 21pa, 21pb, and 21pc each have an identical shape. The three paths 21pa, 21pb, and 21pc each have an individual refrigerant flow path, including a plurality of the heat transfer tubes 21hp, a plurality of the first connecting tubes 21ca, and the second connecting tube 21cb. The paths 21pa, 21pb, and 21pc each have an inlet 21i and an outlet 21o. The three paths 21pa, 21pb, and 21pc are arranged along the first direction.

[0057] The paths 21pa, 21pb, and 21pc each include a heat transfer tube group Rh1 and a heat transfer tube group Rh2 in each of which a plurality of the heat transfer tubes 21hp are arranged in parallel to each other along the second direction. In the present embodiment, the heat transfer tube groups Rh1 and Rh2 each include four heat transfer tubes 21hp. In other words, the paths 21pa, 21pb, and 21pc are each formed such that the heat transfer tubes 21hp disposed in four stages in the second direction are arranged in two rows in the first direction.

[0058] The heat transfer tube groups Rh1 and Rh2 are disposed such that a plane including center axes of a plurality of the heat transfer tubes 21hp included in the heat transfer tube group Rh1 and a plane including center axes of a plurality of the heat transfer tubes 21hp included in the heat transfer tube group Rh2 are parallel to each other at a predetermined interval. Furthermore, the heat transfer tube groups Ru1 and Ru2 are disposed such that the planes including the center axes of the plurality of heat transfer tubes 21hp included in the heat transfer tube groups Ru1 and Ru2 are orthogonal to the direction in which the air Ao supplied by the heat-source-side fan 22 flows (in the present embodiment, the horizontal direction). The heat transfer tube group Rh1 is disposed on the windward side of the heat transfer tube group Rh2 in the direction in which the air Ao supplied by the heat-source-side fan 22 flows.

[0059] The inlet 21i is an opening of an end portion of the heat transfer tube 21hp disposed at the uppermost position in the heat transfer tube group Rh2. The inlet 21i is connected to the heat-source-side inflow section 24.

[0060] The outlet 21o is an opening of an end portion of the heat transfer tube 21hp disposed at the lowermost position in the heat transfer tube group Rh1. The outlet 21o is connected to the heat-source-side second header Hh2 via a first refrigerant pipe 61.

[0061] Each first connecting tube 21ca is provided at an end portion of the heat transfer tube 21hp so that the refrigerant flowing to the end portion of the heat transfer tube 21hp can flow into an adjacent heat transfer tube 21hp of another stage along the second direction.

[0062] The second connecting tube 21cb communicates the adjacent heat transfer tube groups Rh1 and Rh2 to each other. Specifically, the second connecting tube 21u is provided so as to communicate an end portion

of the heat transfer tube 21hp disposed at the lowermost position in the heat transfer tube group Rh2 and an end portion of the heat transfer tube 21hp disposed at the uppermost position in the heat transfer tube group Rh1 to each other.

[0063] Note that the number of heat transfer tube groups Rh1 and Rh2, the number of paths 21pa, 21pb, and 21pc, the numbers of heat transfer tubes 21hp, and the like described above are examples, and the present embodiment is not limited thereto.

(2-2-2) Heat-source-side fan

[0064] The heat-source-side fan 22 is a fan that supplies the air Ao (heat source air) to the heat-source-side heat exchanger 21. The heat-source-side fan 22 is driven by a fan motor 22m (see Fig. 2). The control unit 50 controls the number of rotations of the fan motor 22m to control an amount of the air Ao supplied to the heat-source-side heat exchanger 21.

(2-2-3) Heat-source-side branching section

[0065] The heat-source-side branching section 23 switches the flow path of the refrigerant that flows out of the utilization unit 10 and the flow path of the refrigerant that flows out of the heat-source-side heat exchanger 21 between the heating operation and the cooling operation. The heat-source-side branching section 23 is connected to the liquid refrigerant connection pipe 30, the gas refrigerant connection pipe 40, the utilization-side inflow section 14, and the utilization-side second header Hu2.

[0066] The heat-source-side branching section 23 includes a first check valve Vh1, a second check valve Vh2, a third check valve Vh3, and a fourth check valve Vh4. The first check valve Vh1, the second check valve Vh2, the third check valve Vh3, and the fourth check valve Vh4 each have an inlet and an outlet. The first check valve Vh1, the second check valve Vh2, the third check valve Vh3, and the fourth check valve Vh4 each allow the refrigerant to flow from the inlet to the outlet (in a direction indicated by each arrow in the drawing), and each restrict the refrigerant from flowing in a direction opposite to the direction indicated by the arrow.

[0067] The outlet of the first check valve Vh1 is connected to the inlet of the second check valve Vh2. The outlet of the third check valve Vh3 is connected to the inlet of the fourth check valve Vh4.

[0068] The inlet of the first check valve Vh1 and the inlet of the third check valve Vh3 are connected to the heat-source-side second header Hh2 via a first refrigerant pipe 61.

[0069] The outlet of the first check valve Vh1 and the inlet of the second check valve Vh2 are connected to the expansion mechanism 27 via a first refrigerant pipe 61. The outlet of the third check valve Vh3 and the inlet of the fourth check valve Vh4 are connected to a third port P3 (described later) of the flow direction switching mechanism.

ism 25 via a second refrigerant pipe 62.

[0070] The outlet of the second check valve Vh2 is connected to a second flow path 24b (described later) of the heat-source-side inflow section 24 via a first refrigerant pipe 61. The outlet of the fourth check valve Vh4 is connected to a first flow path 24a (described later) of the heat-source-side inflow section 24 via a second refrigerant pipe 62.

(2-2-4) Heat-source-side inflow section

[0071] The heat-source-side inflow section 24 is a flow path through which the refrigerant immediately before flowing into the heat-source-side heat exchanger 21 passes. The heat-source-side inflow section 24 includes the first flow path 24a and the second flow path 24b. The heat-source-side inflow section 24 is configured such that a pressure loss experienced by the refrigerant passing through the first flow path 24a is smaller than a pressure loss experienced by the refrigerant passing through the second flow path 24b.

(2-2-4-1) First flow path

[0072] The first flow path 24a is a flow path through which the refrigerant passes during an operation that causes the heat-source-side heat exchanger 21 to function as a radiator for the refrigerant (specifically, the cooling operation). The refrigerant that flows into the first flow path 24a is distributed to the respective paths 21pa, 21pb, and 21pc by the first flow path 24a. The first flow path 24a includes a heat-source-side first header Hh1 and a plurality of fifth check valves Vh5.

[0073] The heat-source-side first header Hh1 is a tubular member through which the refrigerant flows. The heat-source-side first header Hh1 is connected to the heat-source-side branching section 23 (specifically, the outlet of the fourth check valve Vh4) via the second refrigerant pipe 62, and is connected to inlets of the fifth check valves Vh5 via second refrigerant pipes 62.

[0074] The fifth check valves Vh5 each allow the refrigerant to flow from the inlet to an outlet (in a direction indicated by each arrow in the drawing), and each restrict the refrigerant from flowing in a direction opposite to the direction indicated by the arrow. The inlets of the fifth check valves Vh5 are connected to the heat-source-side first header Hh1 via the second refrigerant pipes 62. The fifth check valves Vh5 suppress backflow of the refrigerant that comes from the heat-source-side first header Hh1. The outlets of the fifth check valves Vh5 are connected to the respective inlets 21i of the paths 21pa, 21pb, and 21pc via second refrigerant pipes 62.

[0075] In the present embodiment, the first flow path 24a includes three fifth check valves Vh5, and the respective three fifth check valves Vh5 are connected to the heat-source-side first header Hh1 via individual second refrigerant pipes 62. The number of fifth check valves Vh5 included in the first flow path 24a is not limited to three,

and may be two, four, or more, for example.

(2-2-4-2) Second flow path

[0076] The second flow path 24b is a flow path through which the refrigerant passes during an operation that causes the heat-source-side heat exchanger 21 to function as an evaporator for the refrigerant (specifically, the heating operation). The refrigerant that flows into the second flow path 24b is distributed to the respective paths 21pa, 21pb, and 21pc by the second flow path 24b. The second flow path 24b includes a distributor Dh and three flow rate adjustment sections Ch.

[0077] The distributor Dh is a member that distributes the refrigerant that flows out of the heat-source-side branching section 23. The distributor Dh is connected to the heat-source-side branching section 23 (specifically, the second check valve Vh2) via the first refrigerant pipe 61, and is connected to inlets of the flow rate adjustment sections Ch via first refrigerant pipes 61.

[0078] The flow rate adjustment sections Ch are connected to the respective paths 21pa, 21pb, and 21pc of the heat-source-side heat exchanger 21, and adjust flow rates of the refrigerant flowing into the respective paths 21pa, 21pb, and 21pc. In the present embodiment, the flow rate adjustment sections Ch are narrow tubes (capillary tubes) each having an inlet and an outlet. The outlets of the flow rate adjustment sections Ch are connected to the respective inlets 21i of the paths 21pa, 21pb, and 21pc. In order to adjust the flow rate of the refrigerant passing through the inside of the flow rate adjustment section Ch, the flow rate adjustment section Ch is formed to have a flow path area smaller than those of the first refrigerant pipe 61 and the second refrigerant pipe 62. Therefore, a pressure loss experienced by the refrigerant when the refrigerant passes through the flow rate adjustment section Ch is larger than a pressure loss that the refrigerant receives when the refrigerant passes through the first refrigerant pipe 61 and the second refrigerant pipe 62. In order to adjust the flow rate of the refrigerant flowing into the respective paths 21pa, 21pb, and 21pc, the lengths and the flow path areas of the three flow rate adjustment sections Ch may be different from each other.

[0079] In this manner, the first flow path 24a includes the heat-source-side first header Hh1 and the fifth check valves Vh5 connected via the second refrigerant pipes 62, whereas the second flow path 24b includes the flow rate adjustment sections Cu in each of which the pressure loss experienced by the refrigerant passing through the flow rate adjustment section Cu is larger than that of the second refrigerant pipe 62.

[0080] Accordingly, in the heat-source-side inflow section 24, the pressure loss experienced by the refrigerant passing through the first flow path 24a is smaller than the pressure loss experienced by the refrigerant passing through the second flow path 24b.

(2-2-5) Heat-source-side second header

[0081] The heat-source-side second header Hh2 is a tubular member through which the refrigerant flows. The heat-source-side second header Hh2 is connected to the outlets 21o of the heat-source-side heat exchanger 21 via a plurality of the first refrigerant pipes 61, and is connected to the heat-source-side branching section 23 (specifically, the inlet of the first check valve Vh1 and the inlet of the third check valve Vh3) via the first refrigerant pipe 61.

(2-2-6) Flow direction switching mechanism

[0082] The flow direction switching mechanism 25 switches the flow direction of the refrigerant in the refrigerant circuit 100. The flow direction switching mechanism 25 is a four-way switching valve that switches between a first state and a second state. The flow direction switching mechanism 25 includes a first port P1, a second port P2, the third port P3, and a fourth port P4. The control unit 50 switches the flow direction switching mechanism 25 between the first state and the second state.

[0083] The first port P1 is connected to the gas refrigerant connection pipe 40 via a second refrigerant pipe 62. The second port P2 is connected to a discharge pipe 26b (described later) of the compressor 26 via a first refrigerant pipe 61. The third port P3 is connected to the heat-source-side branching section 23 (specifically, the outlet of the third check valve Vh3 and the inlet of the fourth check valve Vh4) via the second refrigerant pipe 62. The fourth port P4 is connected to a suction pipe 26a (described later) of the compressor 26 via a second refrigerant pipe 62.

[0084] In the first state, the flow direction switching mechanism 25 communicates the first port P1 and the second port P2 with each other, and communicates the third port P3 and the fourth port P4 with each other (see solid lines in the flow direction switching mechanism 25 in Fig. 1). In the second state, the flow direction switching mechanism 25 communicates the first port P1 and the third port P3 with each other, and communicates the second port P2 and the fourth port P4 with each other (see broken lines in the flow direction switching mechanism 25 in Fig. 1).

[0085] Note that the flow direction switching mechanism 25 is not limited to the four-way switching valve. For example, the flow direction switching mechanism 25 may be configured by combining a plurality of control valves and refrigerant pipes so as to achieve switching of the flow direction of the refrigerant described above.

(2-2-7) Compressor

[0086] The compressor 26 sucks a low-pressure refrigerant in the refrigeration cycle from the suction pipe 26a, compresses the refrigerant by using a compression mechanism (not illustrated), and discharges the com-

pressed refrigerant from the discharge pipe 26b. The compression mechanism of the compressor 26 is driven by a compression mechanism motor 26m (see Fig. 2). The control unit 50 controls the number of rotations of the compression mechanism motor 26m to control a capacity of the compressor 26.

[0087] The suction pipe 26a of the compressor 26 is connected to the fourth port P4 of the flow direction switching mechanism 25 via the second refrigerant pipe 62.

[0088] The discharge pipe 26b of the compressor 26 is connected to the second port P2 of the flow direction switching mechanism 25 via the first refrigerant pipe 61.

(2-2-8) Expansion mechanism

[0089] The expansion mechanism 27 adjusts the pressure and the flow rate of the refrigerant passing through the expansion mechanism 27. In the present embodiment, the expansion mechanism 27 is a variable-opening-degree electric expansion mechanism. The control unit 50 controls the opening degree of the expansion mechanism 27. One end of the expansion mechanism 27 is connected to the liquid refrigerant connection pipe 30 via a first refrigerant pipe 61. The other end of the expansion mechanism 27 is connected to the heat-source-side branching section 23 (specifically, the outlet of the first check valve Vh1 and the inlet of the second check valve Vh2) via the first refrigerant pipe 61.

[0090] Note that the expansion mechanism 27 is not limited to the electric expansion mechanism, and may be a temperature sensing cylinder type expansion mechanism or a capillary tube, for example. Alternatively, instead of the heat source unit 20 including the expansion mechanism 27, the utilization unit 10 may include an expansion mechanism similar to the expansion mechanism 27.

(2-2-9) First shut-off valve and second shut-off valve

[0091] The first shut-off valve 28 and the second shut-off valve 29 are valves, each of which shuts off the refrigerant pipe to interrupt the flow of the refrigerant. For example, the first shut-off valve 28 and the second shut-off valve 29 are manually operated valves, and are opened and closed by an operator during the installation or similar operations of the refrigeration cycle apparatus 1.

[0092] The first shut-off valve 28 is provided in the first refrigerant pipe 61 that connects the expansion mechanism 27 and the liquid refrigerant connection pipe 30 to each other.

[0093] The second shut-off valve 29 is provided in the second refrigerant pipe 62 that connects the flow direction switching mechanism 25 and the gas refrigerant connection pipe 40 to each other.

(2-2-10) Flow of refrigerant in heat-source-side heat exchanger

[0094] The refrigerant that flows out of the heat-source-side inflow section 24 flows into the uppermost heat transfer tubes 21hp in the heat transfer tube groups Rh2 from the respective inlets 21i of the paths 21pa, 21pb, and 21pc. The refrigerant that flows into the heat transfer tube group Rh2 alternately passes through the heat transfer tube 21hp and the first connecting tube 21ca and moves downward while meandering through the heat transfer tube group Rh2. The refrigerant that flows into the lowermost heat transfer tube 21hp in the heat transfer tube group Rh2 passes through the second connecting tube 21cb, and flows into the lowermost heat transfer tube 21hp in the heat transfer tube group Rh1. The refrigerant that flows into the heat transfer tube group Rh1 also moves downward while meandering through the heat transfer tube group Rh1, thereafter, passes through the outlet 21o, and flows out to the heat-source-side second header Hh2.

[0095] In this manner, in the heat-source-side heat exchanger 21, the refrigerant flowing through each of the paths 21pa, 21pb, and 21pc flows inside the heat-source-side heat exchanger 21 in the order from the heat transfer tube group Rh2 to the heat transfer tube group Rh1, in a direction opposite to the flow of the air Ao supplied by the heat-source-side fan 22.

(2-3) Refrigerant connection pipe and gas refrigerant connection pipe

[0096] The liquid refrigerant connection pipe 30 and the gas refrigerant connection pipe 40 are pipes that connect the utilization unit 10 and the heat source unit 20 to each other. More specifically, the liquid refrigerant connection pipe 30 is connected to the outlet of the first check valve Vu1 and the inlet of the second check valve Vu2 via the first refrigerant pipe 61, and is connected to one end of the expansion mechanism 27 via the first refrigerant pipe 61. The gas refrigerant connection pipe 40 is connected to the outlet of the third check valve Vu3 and the inlet of the fourth check valve Vu4 via the second refrigerant pipe 62, and is connected to the first port P1 of the flow direction switching mechanism 25 via the second refrigerant pipe 62.

[0097] The gas refrigerant connection pipe 40 is formed to have a flow path area larger than that of the liquid refrigerant connection pipe 30.

[0098] The liquid refrigerant connection pipe 30 and the gas refrigerant connection pipe 40 are pipes mounted at an installation site of the refrigeration cycle apparatus 1 during the installation of the refrigeration cycle apparatus 1, for example.

(2-4) Control unit

[0099] The control unit 50 is electrically connected so

as to be able to control the utilization-side fan 12, the heat-source-side fan 22, the flow direction switching mechanism 25, the compressor 26, and the expansion mechanism 27. Although details will be described later, when the refrigeration cycle apparatus 1 performs the cooling operation and the heating operation, the control unit 50 controls these devices.

[0100] The control unit 50 is implemented by a computer. The control unit 50 includes a control arithmetic device and a storage device (both not illustrated). As the control arithmetic device, a processor such as a CPU or a GPU can be used. The control arithmetic device reads a program stored in the storage device and executes predetermined image processing or arithmetic processing in accordance with the program. Moreover, the control arithmetic device can write an arithmetic result in the storage device and read information stored in the storage device in accordance with the program. The storage device can be used as a database.

(3) Action of refrigeration cycle apparatus

[0101] Actions of each part of the refrigeration cycle apparatus 1 during heating and cooling operations will be described. Fig. 5 is a schematic configuration diagram illustrating a flow of the refrigerant during a heating operation. Fig. 6 is a schematic configuration diagram illustrating a flow of the refrigerant during a cooling operation. In Figs. 5 and 6, the flow of the refrigerant is indicated by arrows.

(3-1) Action during heating operation

[0102] In response to an instruction for causing the refrigeration cycle apparatus 1 to perform a heating operation, the control unit 50 sets the flow direction switching mechanism 25 to the first state, starts operations of the utilization-side fan 12, the heat-source-side fan 22, and the compressor 26, and controls the opening degree of the expansion mechanism 27. When the refrigeration cycle apparatus 1 performs the heating operation, the refrigerant flows through the refrigerant circuit 100 as described below.

[0103] When the operation of the compressor 26 starts, a low-pressure gas refrigerant in the refrigeration cycle is sucked into the compressor 26 from the suction pipe 26a. The refrigerant that is compressed by the compressor 26 and becomes a high-pressure gas refrigerant in the refrigeration cycle flows into the flow direction switching mechanism 25 from the second port P2. The refrigerant that flows into the flow direction switching mechanism 25 flows out from the first port P1, and thereafter, flows into the utilization unit 10 by way of the gas refrigerant connection pipe 40. The refrigerant that flows into the utilization unit 10 flows into the outlet of the third check valve Vu3 and the inlet of the fourth check valve Vu4 of the utilization-side branching section 13. The refrigerant that flows into the utilization-side branching

section 13 is restricted from flowing to the inlet of the third check valve Vu3 while passing through the fourth check valve Vu4, and flows into the first flow path 14a of the utilization-side inflow section 14. The refrigerant that flows into the first flow path 14a flows into the utilization-side heat exchanger 11 from the inlets 11i by way of the utilization-side first header Hu1 and the fifth check valves Vu5. The refrigerant that flows into the utilization-side heat exchanger 11 releases heat by exchanging heat with the air Ai supplied by the utilization-side fan 12, and becomes a high-pressure liquid refrigerant. In other words, at this time, the utilization-side heat exchanger 11 functions as a radiator in the refrigerant circuit 100. The temperature of the air Ai supplied to the utilization-side heat exchanger 11 rises as the air Ai exchanges heat with the refrigerant that flows into the utilization-side heat exchanger 11, and thereafter, the air Ai is blown out of the utilization unit 10. After flowing out from the outlets 11o, the high-pressure liquid refrigerant that flows out of the utilization-side heat exchanger 11 flows into the inlet of the first check valve Vu1 of the utilization-side branching section 13 by way of the utilization-side second header Hu2. The refrigerant that passes through the first check valve Vu1 flows into the heat source unit 20 by way of the liquid refrigerant connection pipe 30.

[0104] The refrigerant that flows into the heat source unit 20 flows into the outlet of the first check valve Vh1 and the inlet of the second check valve Vh2 of the heat-source-side branching section 23 by way of the expansion mechanism 27. The refrigerant is depressurized to a pressure close to the suction pressure of the compressor 26 when passing through the expansion mechanism 27, and becomes a refrigerant in a gas-liquid two-phase state. The refrigerant that flows into the heat-source-side branching section 23 is restricted from flowing to the inlet of the first check valve Vh1 while passing through the second check valve Vh2, and flows into the second flow path 24b of the heat-source-side inflow section 24. The refrigerant that flows into the second flow path 24b flows into the heat-source-side heat exchanger 21 from the inlets 21i by way of the distributor Dh and the flow rate adjustment sections Ch. The refrigerant that is in a low-pressure gas-liquid two-phase state and flows into the heat-source-side heat exchanger 21 evaporates by exchanging heat with the air Ao supplied by the heat-source-side fan 22, and becomes a low-pressure gas refrigerant. In other words, at this time, the heat-source-side heat exchanger 21 functions as an evaporator in the refrigerant circuit 100. After flowing out from the outlets 21o, the low-pressure gas refrigerant that flows out of the heat-source-side heat exchanger 21 flows into the inlet of the third check valve Vh3 of the heat-source-side branching section 23 by way of the heat-source-side second header Hh2. The refrigerant that passes through the third check valve Vh3 flows into the flow direction switching mechanism 25 from the third port P3. The refrigerant that flows into the flow direction switching mechanism 25 flows out from the fourth port P4, and thereafter, is sucked

into the compressor 26 from the suction pipe 26a again.

[0105] In this manner, during the heating operation, the refrigerant passes through the first flow path 14a immediately before flowing into the utilization-side heat exchanger 11, and passes through the second flow path 24b immediately before flowing into the heat-source-side heat exchanger 21. More specifically, during the heating operation, the gas refrigerant immediately before flowing into the utilization-side heat exchanger 11 that functions as a radiator is distributed to the respective paths 11pa, 11pb, and 11pc in the first flow path 14a in which the pressure loss experienced is smaller than that of the second flow path 14b. Furthermore, during the heating operation, the gas-liquid two-phase refrigerant immediately before flowing into the heat-source-side heat exchanger 21 that functions as an evaporator is distributed to the respective paths 21pa, 21pb, and 21pc in the second flow path 24b in which the pressure loss experienced is larger than that of the first flow path 24a.

(3-2) Action during cooling operation

[0106] In response to an instruction for causing the refrigeration cycle apparatus 1 to perform a cooling operation, the control unit 50 sets the flow direction switching mechanism 25 to the second state, starts operations of the utilization-side fan 12, the heat-source-side fan 22, and the compressor 26, and controls the opening degree of the expansion mechanism 27. When the refrigeration cycle apparatus 1 performs the cooling operation, the refrigerant flows through the refrigerant circuit 100 as described below.

[0107] When the operation of the compressor 26 starts, a low-pressure gas refrigerant in the refrigeration cycle is sucked into the compressor 26 from the suction pipe 26a. The refrigerant that is compressed by the compressor 26 and becomes a high-pressure gas refrigerant in the refrigeration cycle flows into the flow direction switching mechanism 25 from the second port P2. The refrigerant that flows into the flow direction switching mechanism 25 flows out from the third port P3, and thereafter, flows into the outlet of the third check valve Vh3 and the inlet of the fourth check valve Vh4 of the heat-source-side branching section 23. The refrigerant that flows into the heat-source-side branching section 23 is restricted from flowing into the inlet of the third check valve Vh3 while passing through the fourth check valve Vh4, and flows into the first flow path 24a of the heat-source-side inflow section 24. The refrigerant that flows into the first flow path 24a flows into the heat-source-side heat exchanger 21 from the inlets 21i by way of the heat-source-side first header Hh1 and the fifth check valves Vh5. The refrigerant that flows into the heat-source-side heat exchanger 21 releases heat by exchanging heat with the air Ao supplied by the heat-source-side fan 22, and becomes a high-pressure liquid refrigerant. In other words, at this time, the heat-source-side heat exchanger 21 functions as a radiator in the refrigerant circuit 100.

After flowing out from the outlets 21o, the high-pressure liquid refrigerant that flows out of the heat-source-side heat exchanger 21 flows into the inlet of the first check valve Vh1 of the heat-source-side branching section 23 by way of the heat-source-side second header Hh2. The refrigerant that passes through the first check valve Vu1 flows into the utilization unit 10 by way of the expansion mechanism 27 and the liquid refrigerant connection pipe 30. The refrigerant is depressurized to a pressure close to the suction pressure of the compressor 26 when passing through the expansion mechanism 27, and becomes a refrigerant in a gas-liquid two-phase state.

[0108] The refrigerant that flows into the utilization unit 10 flows into the outlet of the first check valve Vu1 and the inlet of the second check valve Vu2 of the utilization-side branching section 13. The refrigerant that flows into the utilization-side branching section 13 is restricted from flowing into the inlet of the first check valve Vu1 while passing through the second check valve Vu2, and flows into the second flow path 14b of the utilization-side inflow section 14. The refrigerant that flows into the second flow path 14b flows into the utilization-side heat exchanger 11 from the inlets 11i by way of the distributor Du and the flow rate adjustment sections Cu. The refrigerant that is in a low-pressure gas-liquid two-phase state and flows into the utilization-side heat exchanger 11 evaporates by exchanging heat with the air Ai supplied by the utilization-side fan 12, and becomes a low-pressure gas refrigerant. In other words, at this time, the utilization-side heat exchanger 11 functions as an evaporator in the refrigerant circuit 100. The temperature of the air Ai supplied to the utilization-side heat exchanger 11 decreases as the air Ai exchanges heat with the refrigerant that flows into the utilization-side heat exchanger 11, and thereafter, the air Ai is blown out of the utilization unit 10. After flowing out from the outlets 11o, the low-pressure gas refrigerant that flows out of the utilization-side heat exchanger 11 flows into the inlet of the third check valve Vu3 of the utilization-side branching section 13 by way of the utilization-side second header Hu2. The refrigerant that passes through the third check valve Vu3 flows into the heat source unit 20 by way of the gas refrigerant connection pipe 40. The refrigerant that flows into the heat source unit 20 flows into the flow direction switching mechanism 25 from the first port P1. The refrigerant that flows into the flow direction switching mechanism 25 flows out from the fourth port P4, and thereafter, is sucked into the compressor 26 from the suction pipe 26a again.

[0109] In this manner, during the cooling operation, the refrigerant passes through the second flow path 24b immediately before flowing into the utilization-side heat exchanger 11, and passes through the first flow path 24a immediately before flowing into the heat-source-side heat exchanger 21. More specifically, during the cooling operation, the gas-liquid two-phase refrigerant immediately before flowing into the utilization-side heat exchanger 11 that functions as an evaporator is distributed to the respective paths 11pa, 11pb, and 11pc in the second flow

path 14b in which the pressure loss experienced is larger than that of the first flow path 14a. Furthermore, during the cooling operation, the gas-liquid two-phase refrigerant immediately before flowing into the heat-source-side heat exchanger 21 that functions as a radiator is distributed to the respective paths 21pa, 21pb, and 21pc in the first flow path 14a in which the pressure loss experienced is smaller than that of the second flow path 24b.

10 (4) Features

[0110] (4-1) The refrigeration cycle apparatus 1 uses a zeotropic refrigerant mixture as a refrigerant. The refrigeration cycle apparatus 1 includes the refrigerant circuit 100 and the control unit 50. The refrigerant circuit 100 includes heat exchangers 11 and 21 (the utilization-side heat exchanger 11 and the heat-source-side heat exchanger 21) that cause heat exchange between the air Ai and the Ao, respectively, and the refrigerant. The control unit 50 performs a first operation that causes the heat exchangers 11 and 21 to function as radiators for the refrigerant and a second operation that causes the heat exchangers 11 and 21 to function as evaporators for the refrigerant. The refrigerant flows inside the heat exchangers 11 and 21 in a direction opposite to the flows of the air Ai and Ao, respectively, during heating and cooling operations.

[0111] The refrigerant circuit 100 includes inflow sections 14 and 24 (the utilization-side inflow section 14 and the heat-source-side inflow section 24) through which the refrigerant immediately before flowing into the heat exchangers 11 and 21, respectively, passes. The pressure losses experienced by the refrigerant passing through the inflow sections 14 and 24 during the first operation are smaller than the pressure losses experienced by the refrigerant passing through the inflow sections 14 and 24 during the second operation.

[0112] In the refrigeration cycle apparatus 1, the refrigerant flows inside the heat exchangers 11 and 21 in a direction opposite to the flows of the air Ai and Ao, respectively, during heating and cooling operations. As a result, the heat exchange efficiency in the heat exchangers 11 and 21 is ensured even in the refrigerant circuit 100 using a zeotropic refrigerant mixture. Furthermore, in the refrigeration cycle apparatus 1, the pressure losses experienced by the refrigerant (gas refrigerant) passing through the inflow sections 14 and 24 during the first operation are smaller than the pressure losses experienced by the refrigerant (gas-liquid two-phase refrigerant) passing through the inflow sections 14 and 24 during the second operation. Therefore, the refrigeration cycle apparatus 1 suppresses the performance degradation of the apparatus caused by a significant pressure loss experienced by the gas refrigerant immediately before flowing into the heat exchangers 11 and 21 during the first operation. Accordingly, the refrigeration cycle apparatus 1 is capable of both ensuring the heat exchange efficiency in the heat exchangers 11 and 21 and suppressing

the performance degradation of the apparatus caused by a pressure loss experienced by the refrigerant flowing into the heat exchangers 11 and 21, while using a zeotropic refrigerant mixture.

[0113] (4-2) The inflow sections 14 and 24 include the first flow paths 14a and 24a, respectively, and the second flow paths 14b and 24b, respectively. The pressure losses experienced by the refrigerant passing through the first flow paths 14a and 24a are smaller than the pressure losses experienced by the refrigerant passing through the second flow paths 14b and 24b. The refrigerant passes through the first flow paths 14a and 24a and flows into the heat exchangers 11 and 21, respectively, during the first operation, and passes through the second flow paths 14b and 24b and flows into the heat exchangers 11 and 21, respectively, during the second operation.

[0114] The refrigeration cycle apparatus 1 branches the refrigerant immediately before flowing into the heat exchangers 11 and 21 into either the first flow paths 14a and 24a or the second flow paths 14b and 24b, respectively, to change the pressure loss experienced by the refrigerant.

[0115] (4-3) The first refrigerant pipes 61 included in the first flow paths 14a and 24a have flow path areas larger than those of the second refrigerant pipes 62 included in the second flow paths 14b and 24b.

[0116] In the refrigeration cycle apparatus 1, since the flow path area of the first refrigerant pipe 61 is larger than the flow path area of the second refrigerant pipe 62, the pressure losses experienced by the refrigerant passing through the first flow paths 14a and 24a are smaller than the pressure losses experienced by the refrigerant passing through the second flow paths 14b and 24b.

[0117] (4-4) The refrigerant circuit 100 includes branching sections (the utilization-side branching section 13 and the heat-source-side branching section 23) that switch the flow paths of the refrigerant to either the first flow paths 14a and 24a or the second flow paths 14b and 24b, respectively.

[0118] (4-5) The first flow paths 14a and 24a include fifth check valves Vu5 and Vh5, respectively, provided at the second refrigerant pipes 62 on the downstream side.

[0119] The fifth check valves Vu5 and Vh5 suppress the refrigerant from backflowing from the second flow paths 14b and 24b to the first flow paths 14a and 24a, respectively.

(5) Modification

(5-1) Modification A

[0120] Fig. 7 is a schematic configuration diagram of a refrigeration cycle apparatus 1a according to a modification A. The refrigeration cycle apparatus 1a does not include the utilization-side branching section 13 and the first flow path 14a of the utilization-side inflow section 14. In the refrigeration cycle apparatus 1a, the utilization-

side second header Hu2 is connected to the gas refrigerant connection pipe 40. Furthermore, the distributor Du of the second flow path 14b is connected to the liquid refrigerant connection pipe 30.

[0121] In the refrigeration cycle apparatus 1a, during the heating operation, the refrigerant that passes through the gas refrigerant connection pipe 40 and flows into the utilization unit 10 passes through the utilization-side second header Hu2, and flows into the utilization-side heat exchanger 11. The refrigerant that flows into the utilization-side heat exchanger 11 releases heat by exchanging heat with the air Ai, passes through the second flow path 14b and the liquid refrigerant connection pipe 30, and then flows into the heat source unit 20. Furthermore, during the cooling operation, the refrigerant that passes through the liquid refrigerant connection pipe 30 and flows into the utilization unit 10 passes through the second flow path 14b, and flows into the utilization-side heat exchanger 11. The refrigerant that flows into the utilization-side heat exchanger 11 evaporates by exchanging heat with the air Ai, passes through the utilization-side second header Hu2 and the gas refrigerant connection pipe 40, and then flows into the heat source unit 20. The flow of the refrigerant in other places is similar to that in the refrigeration cycle apparatus 1. Therefore, the description thereof will be omitted.

[0122] In the refrigeration cycle apparatus 1a, the direction in which the refrigerant flows in the utilization-side heat exchanger 11 is switched to the opposite direction between the heating operation and the refrigerant operation.

(5-2) Modification B

[0123] Fig. 8 is a schematic configuration diagram of a refrigeration cycle apparatus 1b according to a modification B. The refrigeration cycle apparatus 1b does not include the heat-source-side branching section 23 and the first flow path 24a of the heat-source-side inflow section 24. In the refrigeration cycle apparatus 1b, the heat-source-side second header Hh2 is connected to the third port P3 of the flow direction switching mechanism 25. Furthermore, the distributor Dh of the second flow path 24b is connected to the other end of the expansion mechanism 27.

[0124] In the refrigeration cycle apparatus 1b, during the heating operation, the refrigerant that passes through the liquid refrigerant connection pipe 30 and flows into the heat source unit 20 passes through the expansion mechanism 27 and the second flow path 24b, and flows into the heat-source-side heat exchanger 21. The refrigerant that flows into the heat-source-side heat exchanger 21 evaporates by exchanging heat with the air Ao, passes through the heat-source-side second header Hh2, and then flows into the third port P3 of the flow direction switching mechanism 25. Furthermore, during the cooling operation, the refrigerant that flows out from the third port P3 of the flow direction switching mechanism 25

passes through the heat-source-side second header Hh2, and flows into the heat-source-side heat exchanger 21. The refrigerant that flows into the heat-source-side heat exchanger 21 releases heat by exchanging heat with the air Ao, passes through the second flow path 24b, and then flows into the expansion mechanism 27. The flow of the refrigerant in other places is similar to that in the refrigeration cycle apparatus 1. Therefore, the description thereof will be omitted.

[0125] In the refrigeration cycle apparatus 1b, the direction in which the refrigerant flows in the heat-source-side heat exchanger 21 is switched to the opposite direction between the heating operation and the refrigerant operation.

(5-3) Modification C

[0126] As long as the refrigerant can flow inside the utilization-side heat exchanger 11 in a direction opposite to the flow of the air Ai supplied by the utilization-side fan 12, the number, shape, arrangement, and the like of the heat transfer tubes 11hp and fins 11f included in the utilization-side heat exchanger 11 are not limited to modes described in the embodiment. Similarly, as long as the refrigerant can flow inside the heat-source-side heat exchanger 21 in a direction opposite to the flow of the air Ao supplied by the heat-source-side fan 22, the number, shape, arrangement, and the like of the heat transfer tubes 21hp and fins 21f included in the heat-source-side heat exchanger 21 are also not limited to modes described in the embodiment.

(5-4) Modification D

[0127] For example, the fifth check valves Vu5 and Vh5 may be control valves whose opening and closing are controlled by the control unit 50. In this case, it is sufficient for the control unit 50 to open the control valves during an operation in which the refrigerant passes through the first flow paths 14a and 24a, and to close the control valves during an operation in which the refrigerant passes through the second flow paths 14b and 24b. Specifically, during the heating operation, it is sufficient for the control unit 50 to open the control valves included in the first flow path 14a and to close the control valves included in the first flow path 24a. Furthermore, during the cooling operation, it is sufficient for the control unit 50 to close the control valves included in the first flow path 14a and to open the control valves included in the first flow path 24a.

[0128] According to the refrigeration cycle apparatus 1 of the modification D, the control valves suppress the refrigerant from backflowing from the second flow paths 14b and 24b to the first flow paths 14a and 24a, respectively.

<Second embodiment>

(1) Overall configuration

[0129] The difference between the refrigeration cycle apparatus 1 and a refrigeration cycle apparatus 2 is that the refrigeration cycle apparatus 2 includes a utilization-side branching section 13a instead of the utilization-side branching section 13, and a heat-source-side branching section 23a instead of the heat-source-side branching section 23. Hereinafter, the difference between the refrigeration cycle apparatus 1 and the refrigeration cycle apparatus 2 will be mainly described. Fig. 9 is a schematic configuration diagram of the refrigeration cycle apparatus 1. The same or corresponding components between the refrigeration cycle apparatus 1 and the refrigeration cycle apparatus 2 are denoted by the same reference numerals, and description thereof will be appropriately omitted.

(2) Detailed configuration

(2-1) Utilization-side branching section

[0130] The utilization-side branching section 13a further includes a first control valve Vu6 and a second control valve Vu7 in addition to the first check valve Vu1, the second check valve Vu2, the third check valve Vu3, and the fourth check valve Vu4. The control unit 50 controls the respective opening degrees of the first control valve Vu6 and the second control valve Vu7. Furthermore, the outlets of the second check valve Vu2 and the fourth check valve Vu4 of the utilization-side branching section 13a are connected to one end of the first control valve Vu6 and one end of the second control valve Vu7 via a second refrigerant pipe 62.

[0131] The first control valve Vu6 is an electromagnetic valve whose opening and closing are controlled by the control unit 50. The other end of the first control valve Vu6 is connected to the utilization-side first header Hu1 of the first flow path 14a included in the utilization-side inflow section 14 via a second refrigerant pipe 62.

[0132] The second control valve Vu7 is an electromagnetic valve whose opening and closing are controlled by the control unit 50. The other end of the second control valve Vu7 is connected to the distributor Du of the second flow path 14b included in the utilization-side inflow section 14 via a first refrigerant pipe 61.

(2-2) Heat-source-side branching section

[0133] The heat-source-side branching section 23a further includes a first control valve Vh6 and a second control valve Vh7 in addition to the first check valve Vh1, the second check valve Vh2, the third check valve Vh3, and the fourth check valve Vh4. The control unit 50 controls the respective opening degrees of the first control valve Vh6 and the second control valve Vh7. Further-

more, the outlets of the second check valve Vh2 and the fourth check valve Vh4 of the utilization-side branching section 13a are connected to one end of the first control valve Vh6 and one end of the second control valve Vh7 via a second refrigerant pipe 62.

[0134] The first control valve Vh6 is an electromagnetic valve whose opening and closing are controlled by the control unit 50. The other end of the first control valve Vh6 is connected to the heat-source-side first header Hh1 of the first flow path 14a included in the heat-source-side inflow section 24 via a second refrigerant pipe 62.

[0135] The second control valve Vu7 is an electromagnetic valve whose opening and closing are controlled by the control unit 50. The other end of the second control valve Vh7 is connected to the distributor Dh of the second flow path 14b included in the heat-source-side inflow section 24 via a first refrigerant pipe 61.

(2-3) Control unit

[0136] The control unit 50 is electrically connected so as to be able to control the first control valves Vu6 and Vh6 and the second control valves Vu7 and Vh7 in addition to the utilization-side fan 12, the heat-source-side fan 22, the flow direction switching mechanism 25, the compressor 26, and the expansion mechanism 27.

(3) Action of refrigeration cycle apparatus

[0137] Actions of each part of the refrigeration cycle apparatus 2 during heating and cooling operations will be described, with a focus on differences from those in the refrigeration cycle apparatus 1. Fig. 10 is a schematic configuration diagram illustrating a flow of the refrigerant during a heating operation. Fig. 11 is a schematic configuration diagram illustrating a flow of the refrigerant during a cooling operation. In Figs. 10 and 11, the flow of the refrigerant is indicated by arrows.

(3-1) Action during heating operation

[0138] In response to an instruction for causing the refrigeration cycle apparatus 2 to perform a heating operation, the control unit 50 controls the first control valves Vu6 and Vh6 and the second control valves Vu7 and Vh7 in addition to the control of the devices described in the first embodiment. Specifically, the control unit 50 opens the first control valve Vu6 and the second control valve Vh7, and closes the second control valve Vu7 and the first control valve Vh6. When the refrigeration cycle apparatus 2 performs the heating operation, the refrigerant flows through the refrigerant circuit 100 as described below.

[0139] When the operation of the compressor 26 starts, a low-pressure gas refrigerant in the refrigeration cycle is sucked into the compressor 26 from the suction pipe 26a. The refrigerant that is compressed by the compressor 26 and becomes a high-pressure gas refrigerant

in the refrigeration cycle flows into the flow direction switching mechanism 25 from the second port P2. The refrigerant that flows into the flow direction switching mechanism 25 flows out from the first port P1, and thereafter, flows into the utilization unit 10 by way of the gas refrigerant connection pipe 40. The refrigerant that flows into the utilization unit 10 flows into the outlet of the third check valve Vu3 and the inlet of the fourth check valve Vu4 of the utilization-side branching section 13. The refrigerant that flows into the utilization-side branching section 13 is restricted from flowing to the inlet of the third check valve Vu3 while passing through the fourth check valve Vu4. The flow of the refrigerant that passes through the fourth check valve Vu4 is restricted by the second control valve Vu7, so that the refrigerant passes through the first control valve Vu6, and flows into the first flow path 14a of the utilization-side inflow section 14. Since the subsequent flow of the refrigerant until the refrigerant passes through the expansion mechanism 27 of the heat source unit 20 is the same as that in the first embodiment, description thereof will be omitted.

[0140] Thereafter, the refrigerant that passes through the expansion mechanism 27 and flows into the heat-source-side branching section 23 is restricted from flowing to the inlet of the first check valve Vh1 while passing through the second check valve Vh2. The flow of the refrigerant that passes through the second check valve Vh2 is restricted by the first control valve Vh6, so that the refrigerant passes through the second control valve Vh7, and flows into the second flow path 24b of the heat-source-side inflow section 24. Since the subsequent flow of the refrigerant is the same as that in the first embodiment, description thereof will be omitted.

(3-2) Action during heating operation

[0141] In response to an instruction for causing the refrigeration cycle apparatus 2 to perform a cooling operation, the control unit 50 controls the first control valves Vu6 and Vh6 and the second control valves Vu7 and Vh7 in addition to the control of the devices described in the first embodiment. Specifically, the control unit 50 closes the first control valve Vu6 and the second control valve Vh7, and opens the second control valve Vu7 and the first control valve Vh6. When the refrigeration cycle apparatus 2 performs the heating operation, the refrigerant flows through the refrigerant circuit 100 as described below.

[0142] When the operation of the compressor 26 starts, a low-pressure gas refrigerant in the refrigeration cycle is sucked into the compressor 26 from the suction pipe 26a. The refrigerant that is compressed by the compressor 26 and becomes a high-pressure gas refrigerant in the refrigeration cycle flows into the flow direction switching mechanism 25 from the second port P2. The refrigerant that flows into the flow direction switching mechanism 25 flows out from the third port P3, and thereafter, flows into the outlet of the third check valve Vh3 and the inlet of the fourth check valve Vh4 of the heat-

source-side branching section 23. The refrigerant that flows into the heat-source-side branching section 23 is restricted from flowing into the inlet of the third check valve Vh3 while passing through the fourth check valve Vh4. The flow of the refrigerant that passes through the fourth check valve Vh4 is restricted by the second control valve Vh7, so that the refrigerant passes through the first control valve Vh6, and flows into the first flow path 24a of the heat-source-side inflow section 24. Since the subsequent flow of the refrigerant until the refrigerant flows into the utilization unit 10 is the same as that in the first embodiment, description thereof will be omitted.

[0143] Thereafter, the refrigerant that flows into the utilization unit 10 flows into the outlet of the first check valve Vu1 and the inlet of the second check valve Vu2 of the utilization-side branching section 13. The refrigerant that flows into the utilization-side branching section 13 is restricted from flowing into the inlet of the first check valve Vu1 while passing through the second check valve Vu2. The flow of the refrigerant that passes through the second check valve Vu2 is restricted by the first control valve Vu6, so that the refrigerant passes through the second control valve Vu7, and flows into the second flow path 14b of the utilization-side inflow section 14. Since the subsequent flow of the refrigerant is the same as that in the first embodiment, description thereof will be omitted.

(4) Features

[0144] As has been described above, similarly to the refrigeration cycle apparatus 1, the refrigeration cycle apparatus 2 also suppresses the performance degradation of the apparatus caused by a significant pressure loss experienced by the gas refrigerant immediately before flowing into the heat exchangers 11 and 21 during the first operation. Accordingly, the refrigeration cycle apparatus 2 is capable of both ensuring the heat exchange efficiency in the heat exchangers 11 and 21 and suppressing the performance degradation of the apparatus caused by a pressure loss experienced by the refrigerant flowing into the heat exchangers 11 and 21, while using a zeotropic refrigerant mixture.

[0145] The embodiments of the present disclosure have been described heretofore, and it will be understood that a variety of modifications in mode and detail may be made without departing from the gist and scope of the present disclosure as set forth in claims.

REFERENCE SIGNS LIST

[0146]

1	REFRIGERATION CYCLE APPARATUS
10	UTILIZATION UNIT
11	UTILIZATION-SIDE HEAT EXCHANGER
12	UTILIZATION-SIDE FAN
13	UTILIZATION-SIDE BRANCHING SECTION
14	UTILIZATION-SIDE INFLOW SECTION

14a	FIRST FLOW PATH
Hu1	UTILIZATION-SIDE FIRST HEADER
Vu5	FIFTH CHECK VALVE
14b	SECOND FLOW PATH
5 Du	DISTRIBUTOR
Cu	FLOW RATE ADJUSTMENT SECTION
Hu2	UTILIZATION-SIDE SECOND HEADER
20	HEAT SOURCE UNIT
21	HEAT-SOURCE-SIDE HEAT EXCHANGER
10 22	HEAT-SOURCE-SIDE FAN
23	HEAT-SOURCE-SIDE BRANCHING SECTION
24	HEAT-SOURCE-SIDE INFLOW SECTION
24a	FIRST FLOW PATH
Hh1	UTILIZATION-SIDE FIRST HEADER
15 Vh5	FIFTH CHECK VALVE
24b	SECOND FLOW PATH
Dh	DISTRIBUTOR
Ch	FLOW RATE ADJUSTMENT SECTION
25	FLOW DIRECTION SWITCHING MECHANISM
20 26	COMPRESSOR
27	EXPANSION MECHANISM
28	FIRST SHUT-OFF VALVE
29	SECOND SHUT-OFF VALVE
30	LIQUID REFRIGERANT CONNECTION PIPE
25 40	GAS REFRIGERANT CONNECTION PIPE
50	CONTROL UNIT
61	FIRST REFRIGERANT PIPE
62	SECOND REFRIGERANT PIPE
100	REFRIGERANT CIRCUIT
30 Ai	AIR IN AIR-CONDITIONING TARGET SPACE
Ao	AIR OUTSIDE AIR-CONDITIONING TARGET SPACE

CITATION LIST

PATENT LITERATURE

[0147] PTL 1: Japanese Unexamined Patent Application Publication No. 7-280375

Claims

1. A refrigeration cycle apparatus (1) using a zeotropic refrigerant mixture as a refrigerant, the apparatus comprising:

a refrigerant circuit (100) including a heat exchanger (11, 21) that causes heat exchange between air (Ai, Ao) and the refrigerant; and a control unit (50) that performs a first operation that causes the heat exchanger to function as a radiator for the refrigerant and a second operation that causes the heat exchanger to function as an evaporator for the refrigerant, wherein the refrigerant flows inside the heat exchanger in a direction opposite to a flow of the air during the first

operation and the second operation,
 the refrigerant circuit
 includes an inflow section (14, 24) through which
 the refrigerant immediately before flowing into
 the heat exchanger passes, and 5
 a pressure loss experienced by the refrigerant
 passing through the inflow section during the
 first operation
 is smaller than a pressure loss experienced by
 the refrigerant passing through the inflow sec- 10
 tion during the second operation.

2. The refrigeration cycle apparatus according to claim
 1, wherein

the inflow section 15
 includes a first flow path (14a, 24a) and a second
 flow path (14b, 24b),
 a pressure loss experienced by the refrigerant
 passing through the first flow path 20
 is smaller than a pressure loss experienced by
 the refrigerant passing through the second flow
 path, and
 the refrigerant
 passes through the first flow path and flows into 25
 the heat exchanger during the first operation,
 and
 passes through the second flow path and flows
 into the heat exchanger during the second op-
 eration. 30

3. The refrigeration cycle apparatus according to claim
 2, wherein

a first refrigerant pipe (61) included in the first 35
 flow path
 has a flow path area larger than a flow path area
 of a second refrigerant pipe (62) included in the
 second flow path. 40

4. The refrigeration cycle apparatus according to claim
 2 or 3, wherein

the refrigerant circuit 45
 includes a branching section (13, 23) that
 switches a flow path of the refrigerant to either
 the first flow path or the second flow path.

5. The refrigeration cycle apparatus according to claim
 4, wherein 50

the first flow path
 includes a check valve (Vu5, Vh5) provided at a
 refrigerant pipe on a downstream side. 55

6. The refrigeration cycle apparatus according to claim
 4, wherein

the first flow path
 includes a control valve provided at a refrigerant
 pipe on a downstream side.

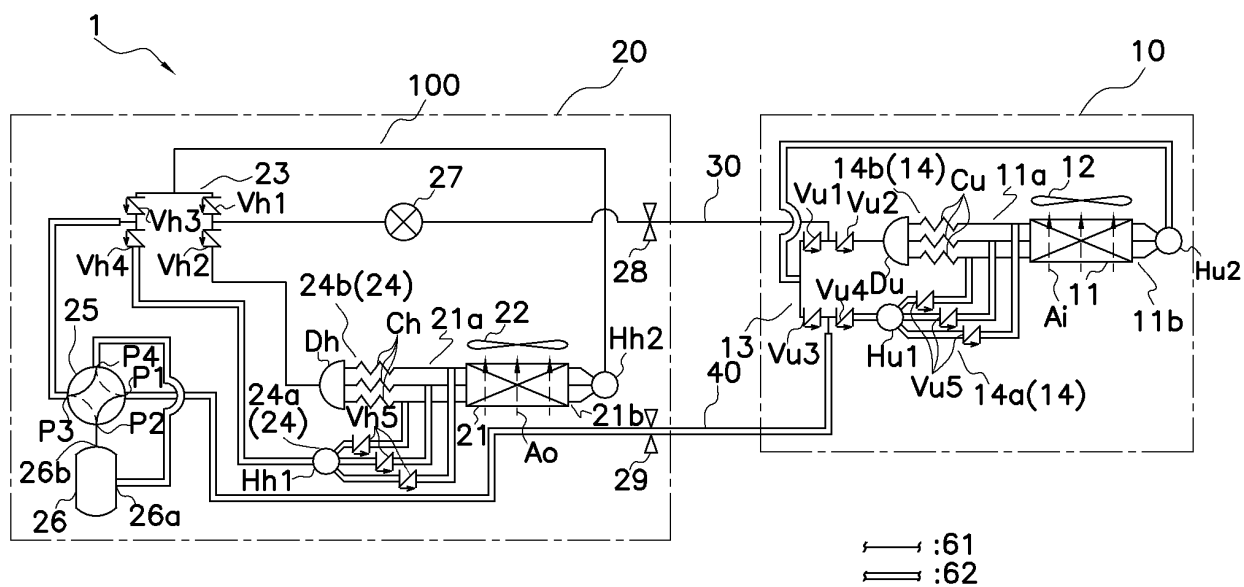


FIG. 1

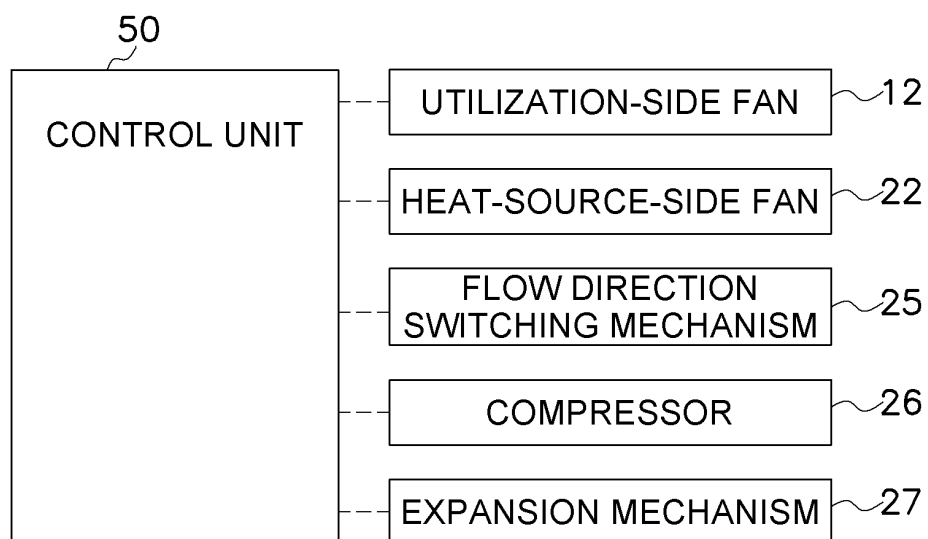


FIG. 2

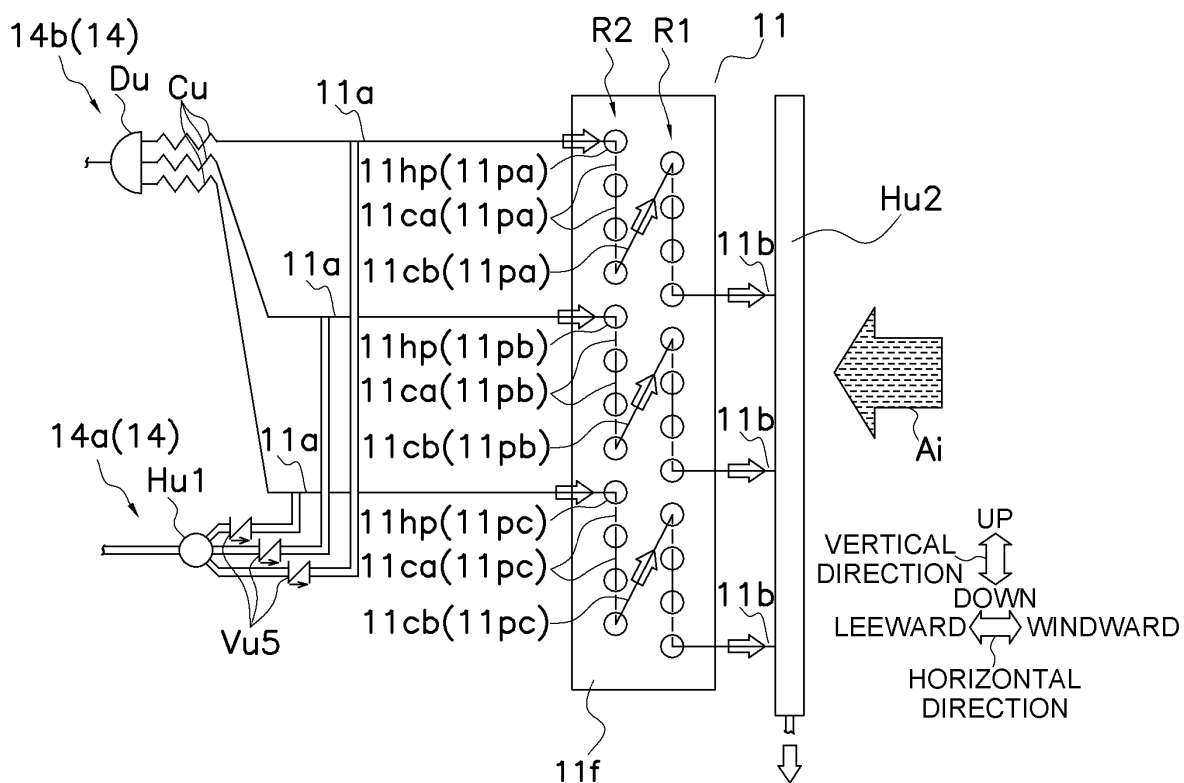


FIG. 3

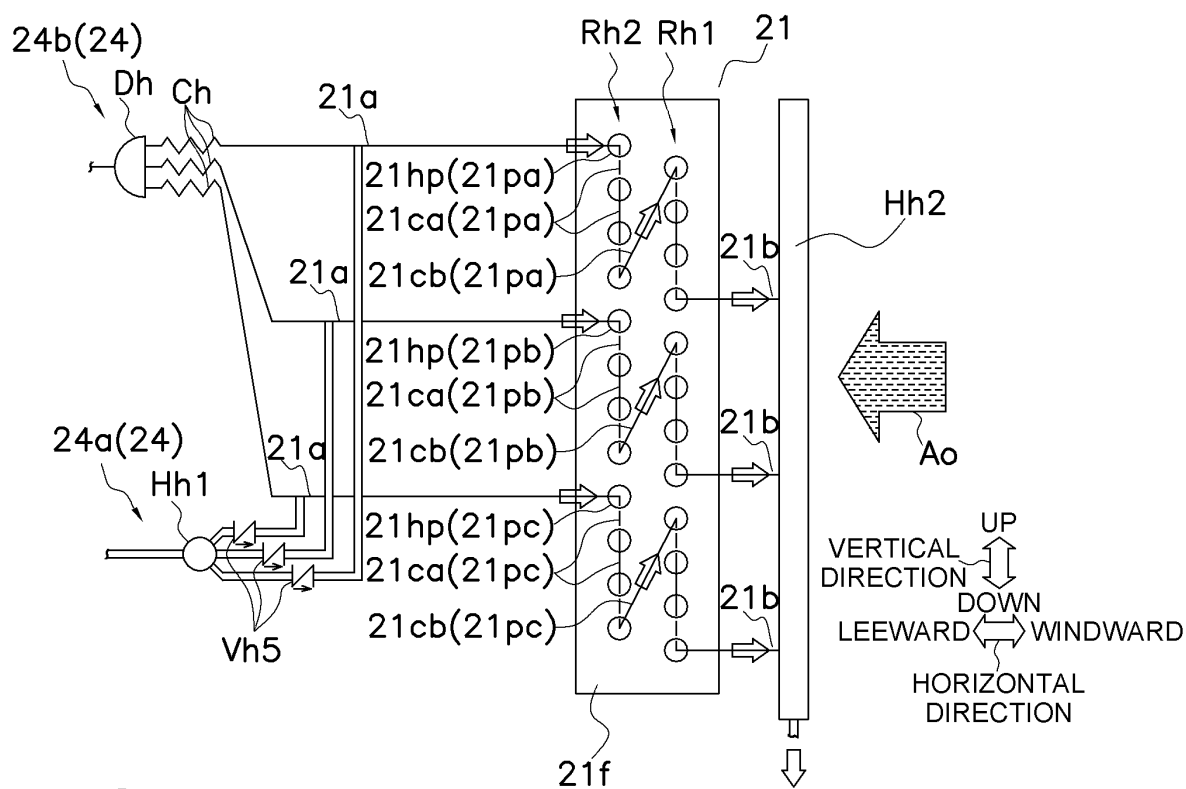


FIG. 4

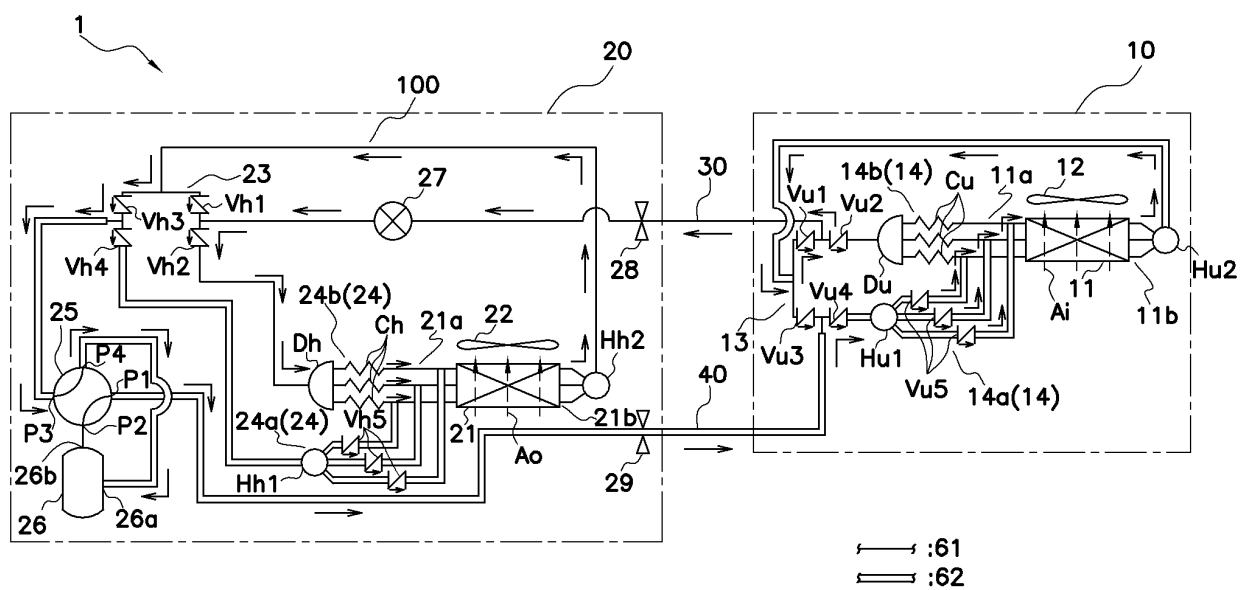


FIG. 5

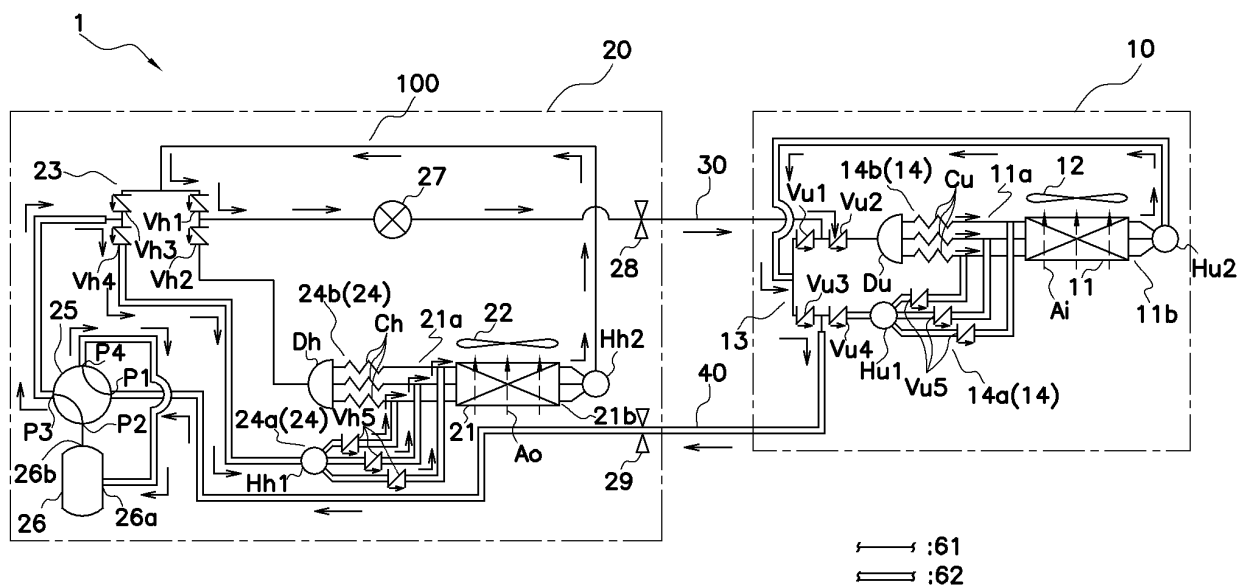


FIG. 6

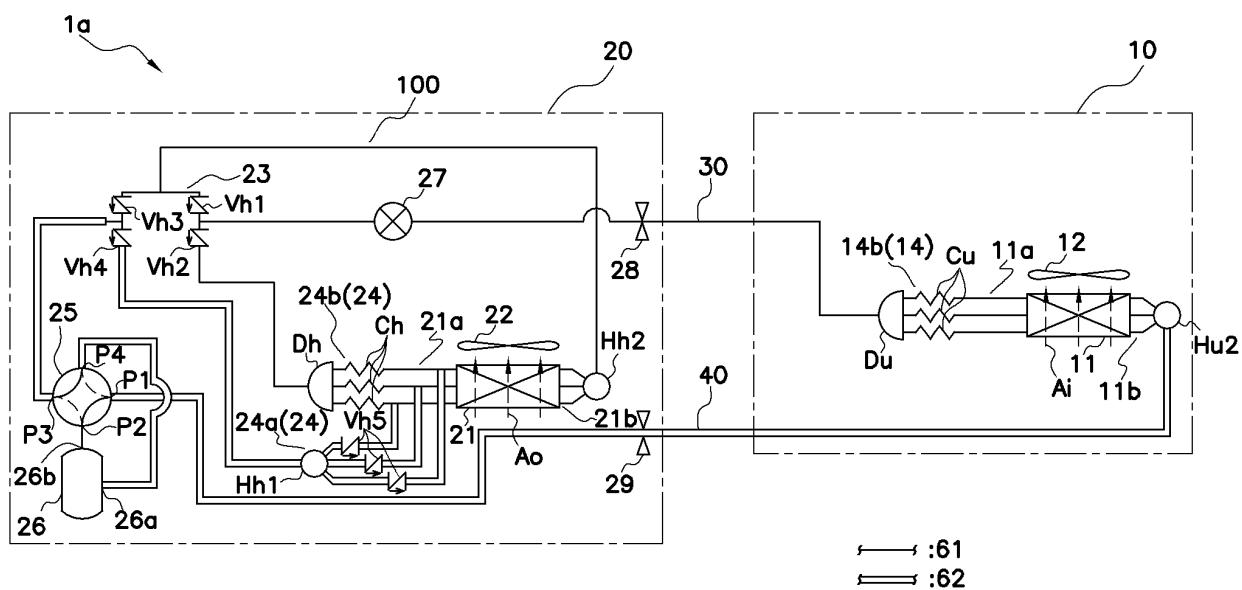


FIG. 7

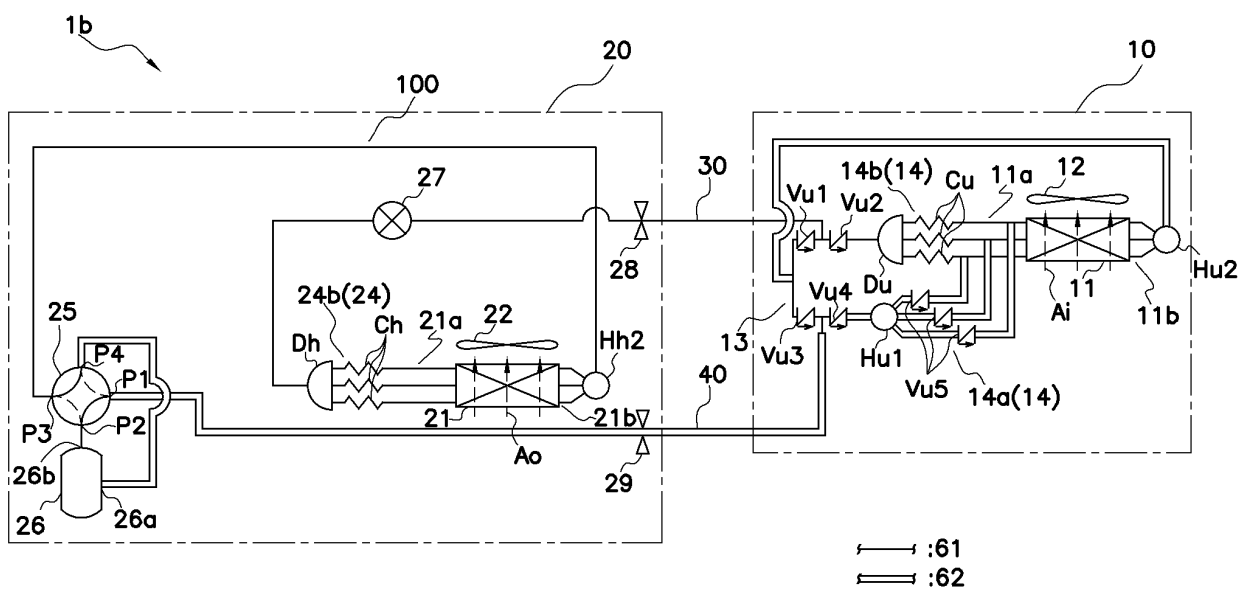


FIG. 8

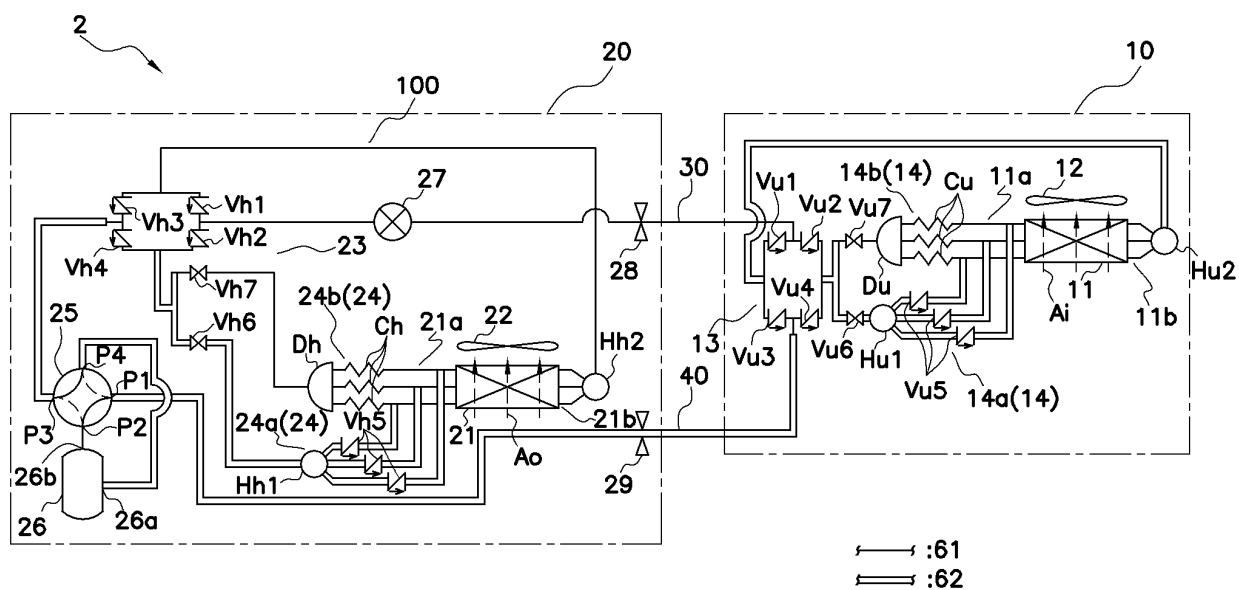


FIG. 9

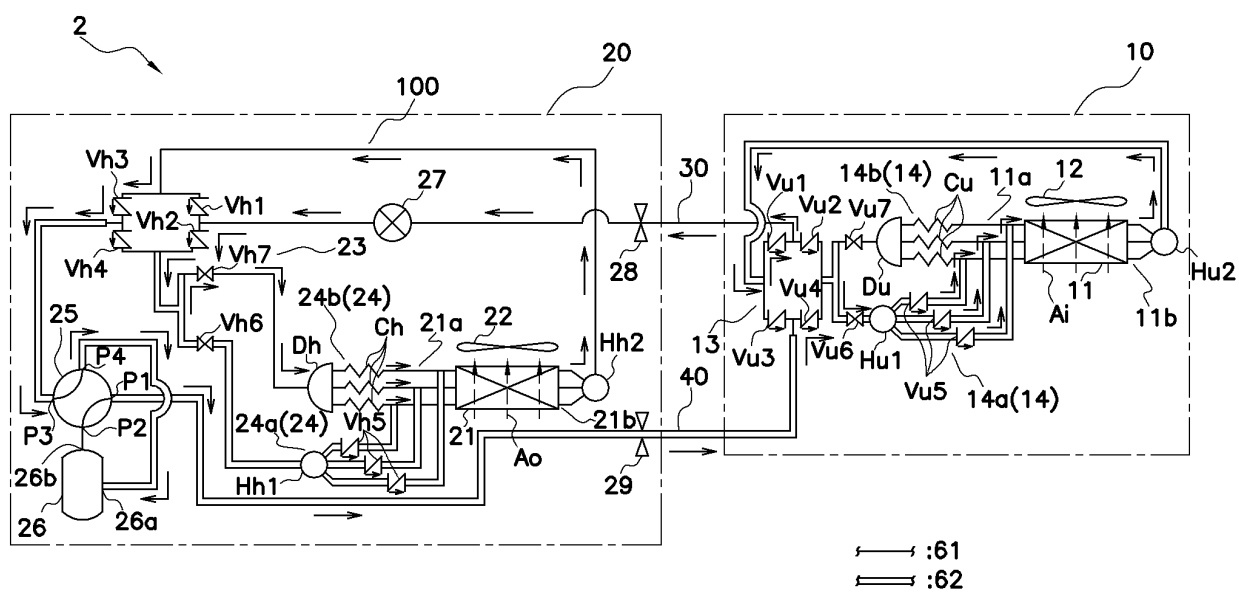


FIG. 10

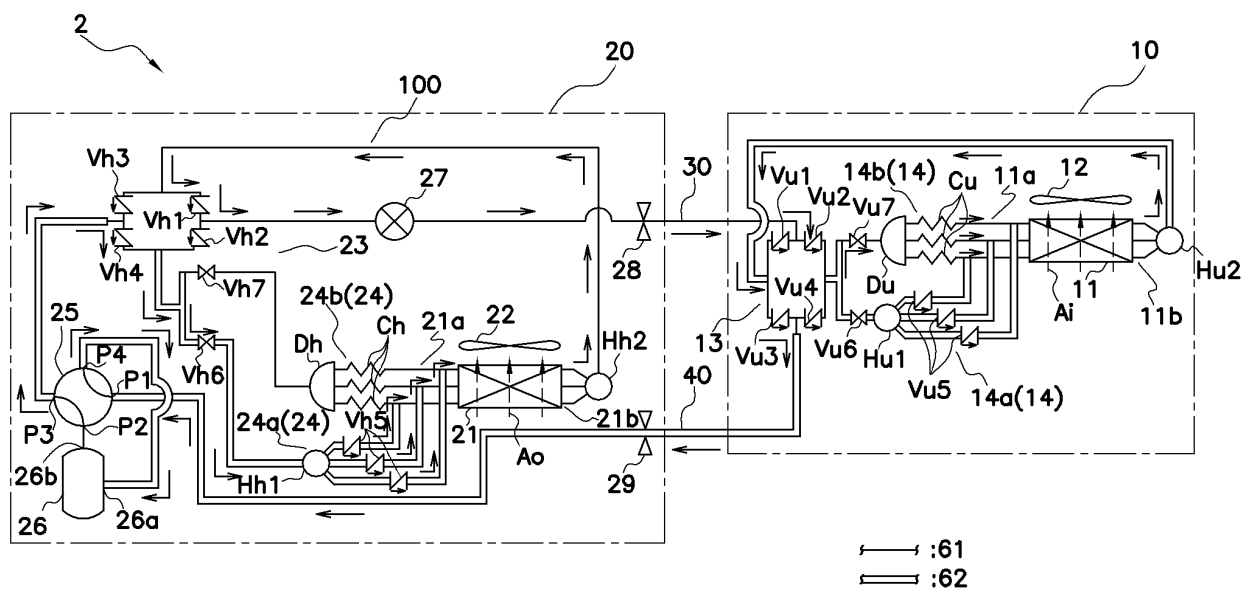


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/011916

A. CLASSIFICATION OF SUBJECT MATTER

F25B 13/00(2006.01)i; **F25B 1/00**(2006.01)i; **F25B 41/48**(2021.01)i
 FI: F25B13/00 A; F25B1/00 396B; F25B41/48

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 F25B13/00; F25B1/00; F25B41/48

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2015-158326 A (PANASONIC CORP) 03 September 2015 (2015-09-03) paragraphs [0011]-[0025], fig. 1-5	1-6
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 132665/1983 (Laid-open No. 39868/1985) (DAIKIN INDUSTRIES, LTD.) 20 March 1985 (1985-03-20), fig. 2	1-6
Y	JP 2015-141006 A (PANASONIC CORP) 03 August 2015 (2015-08-03) paragraph [0020]	1-6
Y	JP 7-280375 A (HITACHI LTD) 27 October 1995 (1995-10-27) fig. 3	1-6

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

24 May 2023

Date of mailing of the international search report

06 June 2023

Name and mailing address of the ISA/JP

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 Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/011916

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP	2015-158326	A	03 September 2015	(Family: none)	
JP	60-39868	U1	20 March 1985	(Family: none)	
JP	2015-141006	A	03 August 2015	(Family: none)	
JP	7-280375	A	27 October 1995	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 7280375 A [0002] [0147]