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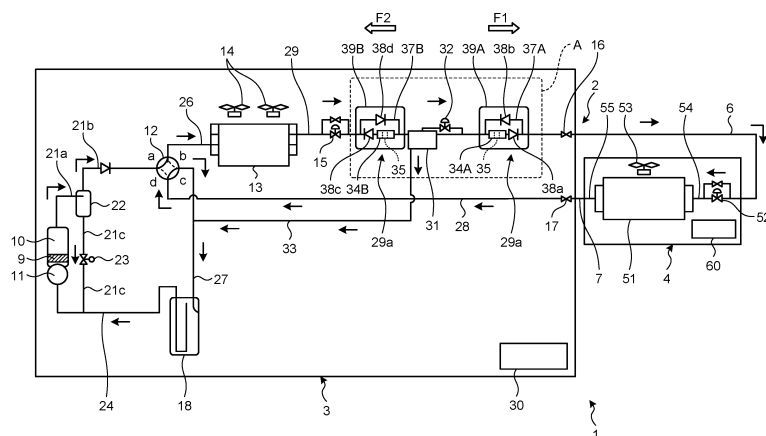
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(54) **REFRIGERATION CYCLE DEVICE**

(57) The refrigeration cycle apparatus (1) includes a refrigerant circuit (2) that includes a flow channel (29a) through which a refrigerant in a liquid single-phase state

flows, and a filter member (35) that is provided in the flow channel (29a) and that captures acid contained in the refrigerant, which passes through the flow channel.

FIG.1



Description

Field

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

Background

[0002] In refrigeration cycle apparatuses, it has been proposed to use an R466A refrigerant as a refrigerant with a low global warming potential (GWP) (Patent Literature 1). The R466A refrigerant is made of mixed refrigerants containing three components of an R32 refrigerant, an R125 refrigerant, and trifluoroiodomethane (CF₃I), and is decomposed under a high temperature environment to generate acid, so that a refrigeration cycle apparatus may be damaged as a result of corrosion of metal parts, such as pipes, constituting a refrigerant circuit, caused by acid. Accordingly, as a related technology, in some cases, an acid capturing filter, which captures acid generated from the R466A refrigerant, is provided in the refrigerant circuit (Patent Literature 2).

Citation List

Patent Literature

[0003]

Patent Literature 1: Japanese Laid-open Patent Publication No. 2020-34261
Patent Literature 2: Japanese Laid-open Patent Publication No. 2018-96571

Summary

Technical Problem

[0004] In the related technology described above, the acid capturing filter is disposed between an expansion valve and an evaporator, or, between an expansion valve and a condenser, and a gas-liquid two-phase refrigerant passes through the acid capturing filter. The acid capturing filter has a structure in which a flow resistance is large in order to increase a contact area with the refrigerant. As a result, there is a problem in that a pressure loss is generated when the gas-liquid two-phase refrigerant passes through the acid capturing filter, and the refrigeration capacity of the refrigeration cycle apparatus is decreased.

[0005] Accordingly, the disclosed technology has been conceived in light of the circumstances described above, and an object thereof is to provide a refrigeration cycle apparatus that is able to suppress a pressure loss of a refrigerant, which passes through a filter member, and that is able to suppress a decrease in refrigeration capacity of the refrigeration cycle apparatus that includes

the filter member.

Solution to Problem

[0006] According to an aspect of an embodiments in the present application, a refrigeration cycle apparatus includes: a refrigerant circuit that includes a flow channel through which a refrigerant in a liquid single-phase state flows; and a filter member that is provided in the flow channel and that captures acid contained in the refrigerant, which passes through the flow channel. Advantageous Effects of Invention

[0007] According to an aspect of an embodiment of a refrigeration cycle apparatus disclosed in the present application, it is possible to suppress a pressure loss of the refrigerant, which passes through the filter member, and a decrease in refrigeration capacity of the refrigeration cycle apparatus that includes the filter member.

Brief Description of Drawings

[0008]

FIG. 1 is a schematic view illustrating the entire of a refrigeration cycle apparatus according to a first embodiment.

FIG. 2 is a schematic view illustrating a first acid capturing unit and a second acid capturing unit included in the refrigeration cycle apparatus according to the first embodiment.

FIG. 3 is a schematic view illustrating the main part of a refrigeration cycle apparatus according to a second embodiment.

FIG. 4 is a schematic view illustrating the main part of a refrigeration cycle apparatus according to a third embodiment.

FIG. 5 is a schematic view illustrating the main part of a refrigeration cycle apparatus according to a fourth embodiment.

Description of Embodiments

[0009] Preferred embodiments of a refrigeration cycle apparatus, disclosed in the present invention, will be described in detail below with reference to the accompanying drawings. Furthermore, the refrigeration cycle apparatus, disclosed in the present invention, is not limited by the embodiments described below.

First Embodiment

[0010] As a refrigeration cycle apparatus according to an embodiment, an air conditioning apparatus is used as an example in which one indoor unit is connected to one outdoor unit, and the indoor unit is configured to be able to perform a cooling operation or a heating operation will be described. FIG. 1 is a schematic view illustrating the entire of the refrigeration cycle apparatus according to

the first embodiment.

Refrigerant

[0011] First, a refrigerant that is used in a refrigeration cycle apparatus 1 according to the embodiment, will be described. In the refrigeration cycle apparatus 1 according to the embodiment, an R466A refrigerant is used as a refrigerant. The R466A refrigerant is a mixed refrigerant containing three components of an R32 refrigerant, an R125 refrigerant, and trifluoriodomethane (CF_3I). In some cases, after the R466A refrigerant is compressed by a compression unit in a compressor, the R466A refrigerant is decomposed under a high temperature environment and generates acid, so that the refrigeration cycle apparatus may be damaged as a result of corrosion of a refrigerant circuit caused by acid. Accordingly, in the refrigeration cycle apparatus 1 according to the embodiment, acid contained in the refrigerant is captured by a first acid capturing unit 34A and a second acid capturing unit 34B, which will be described later, and acid is removed from the refrigerant, thereby suppressing the damage of the refrigeration cycle apparatus 1.

[0012] Furthermore, the refrigerant is not limited to the R466A refrigerant, and another refrigerant may be used as long as a refrigerant may generate acid. For example, in a refrigerant containing hydrofluoroolefin (HFO), a vapor pressure [kPa] of the refrigerant is low, and an area, in which a negative pressure that is lower than the atmospheric pressure, is likely to be generated during an operation in the refrigerant circuit, so that, in a section in which a refrigerant at high pressure is decompressed, oxygen is likely to flow into the refrigerant as a result of absorbing outside air into the refrigerant circuit, and thus, acid is likely to be generated because the refrigerant is subjected to oxidative decomposition. In also the case where such a refrigerant is used, the first embodiment may be applied, and, similar to the first embodiment, the effects described later is obtained.

Configuration of refrigeration cycle apparatus

[0013] As illustrated in FIG. 1, the refrigeration cycle apparatus 1 includes a refrigerant circuit 2 in which a refrigerant circulates, an outdoor unit 3 and an indoor unit 4 that are provided in the refrigerant circuit 2. In FIG. 1, the flow of the refrigerant in the case where a cooling operation is performed in the indoor unit 4, is indicated by arrows. The refrigerant circuit 2 includes a liquid pipe 6 and a gas pipe 7 that connect the outdoor unit 3 and the indoor unit 4. One end of the liquid pipe 6 is connected to a shut-off valve (liquid two-way valve) 16 of the outdoor unit 3, and the other end thereof is connected to the indoor unit 4. One end of the gas pipe 7 is connected to a shut-off valve (gas three-way valve) 17 of the outdoor unit 3, and the other end thereof is connected to the indoor unit 4.

Configuration of outdoor unit

[0014] First, the outdoor unit 3 will be described. The outdoor unit 3 includes a compressor 10, an accumulator 11, a four-way valve 12, an outdoor heat exchanger 13, an outdoor fan 14, an outdoor expansion valve 15, the shut-off valve 16 to which one end of the liquid pipe 6 is connected, the shut-off valve 17 to which one end of the gas pipe 7 is connected, and an accumulator 18 that is a refrigerant retainer.

[0015] The compressor 10 is a rotary compressor with a variable capacity type capable of changing its operational capacity as a result of being driven by a motor (not illustrated) whose rotation speed is controlled by an inverter. The interior portion of the compressor 10 retains therein refrigerator oil 9 functioning as lubricating oil that lubricates a sliding portion (not illustrated). The refrigerant discharge side of the compressor 10 is connected to, via a discharge pipe 21a, an oil separator 22 that separates the refrigerator oil 9 from the refrigerant, which has been discharged from the compressor 10. Furthermore, the oil separator 22 is connected, via a refrigerant pipe 21b, a port a of a four-way valve 12 that will be described later, and the refrigerant separated from the refrigerator oil 9 is sent to the four-way valve 12. Furthermore, the oil separator 22 is connected to a refrigerant pipe 21c that is connected to a refrigerant inflow side of the accumulator 18, and the refrigerator oil 9, which is separated from the refrigerant, is sent to the compressor purpose accumulator 11 together with the gas refrigerant that is sent from the accumulator 18. The refrigerant pipe 21c is provided with a pressure reduction valve 23 that is used to decompress the refrigerator oil 9, which is received from the oil separator 22. In addition, the refrigerant pipe 21c may be provided with a capillary tube (not illustrated) instead of the pressure reduction valve 23. A refrigerant intake side of the compressor 10 is connected to the refrigerant outflow side of the accumulator 18 and the refrigerant pipe 21c via an intake pipe 24. In this way, the compressor 10 is connected to the refrigerant circuit 2 in which the refrigerant is filled.

[0016] The four-way valve 12 is a switching valve for switching a flow direction of the refrigerant flows, and includes four ports a, b, c, and d. As described above, the port a is connected to the refrigerant discharge side of the compressor 10 by using the discharge pipe 21a via the oil separator 22 that is connected by the refrigerant pipe 21b. The port b is connected to one of the refrigerant inlet/outlet ports of the outdoor heat exchanger 13 by using a refrigerant pipe 26. The other of the refrigerant inlet/outlet ports of the outdoor heat exchanger 13 is connected to the liquid pipe 6 by using an outdoor unit liquid pipe 29. The port c is connected to the refrigerant inflow side of the accumulator 18 via a refrigerant pipe 27. Furthermore, the port d is connected to the shut-off valve 17 by using an outdoor unit gas pipe 28.

[0017] The outdoor heat exchanger 13 performs heat exchange between the outside air that is brought into the

interior portion of the outdoor unit 3 by the outdoor fan 14 and the refrigerant. As described above, the one refrigerant inlet/outlet port of the outdoor heat exchanger 13 is connected to the port b of the four-way valve 12 by using the refrigerant pipe 26, and the other refrigerant inlet/outlet port is connected to the shut-off valve 16 via the outdoor unit liquid pipe 29.

[0018] The outdoor expansion valve 15 is provided in the outdoor unit liquid pipe 29. The outdoor expansion valve 15 is an electronic expansion valve, and adjusts an amount of the refrigerant flowing into the outdoor heat exchanger 13 or an amount of the refrigerant flowing out from the outdoor heat exchanger 13 as a result of adjustment of the degree of opening of the outdoor expansion valve 15. The degree of opening of the outdoor expansion valve 15 is fully opened in a case in which the refrigeration cycle apparatus 1 performs a cooling operation. Furthermore, in a case in which the refrigeration cycle apparatus 1 performs a heating operation, by controlling the degree of opening of the outdoor expansion valve 15 in accordance with a discharge temperature of the refrigerant received from the compressor 10, adjustment is performed such that the discharge temperature of the refrigerant does not exceed an upper limit of the compressor 10 at the time of operation.

[0019] The refrigerant inflow side of the accumulator 18 is connected to the port c of the four-way valve 12 via the refrigerant pipe 27, and the refrigerant outflow side of the accumulator 18 is connected to the refrigerant intake side of the compressor 10 via the intake pipe 24. In this way, the accumulator 18 is connected to the refrigerant circuit 2 and the compressor 10. The accumulator 18 separates the refrigerant flowing from the refrigerant pipe 27 into the interior portion of the accumulator 18 into a gas refrigerant and a liquid refrigerant. The separated gas refrigerant is taken into the compressor 10 via the compressor purpose accumulator 11.

[0020] Furthermore, the outdoor unit 3 includes an outdoor unit control circuit 30 that functions as a control unit. Although not illustrated, the outdoor unit control circuit 30 is mounted on a control substrate that is stored in an electric component box (not illustrated) of the outdoor unit 3. The outdoor unit control circuit 30 performs control of driving of the compressor 10 and the outdoor fan 14, on the basis of a detection result and a control signal that are detected by various sensors (not illustrated) of the outdoor unit 3. Furthermore, the outdoor unit control circuit 30 performs switching control of the four-way valve 12 on the basis of the detection result and the control signal detected by the various sensors of the outdoor unit 3, and adjusts the degree of opening of the outdoor expansion valve 15.

Main part of first embodiment

[0021] Furthermore, in the outdoor unit liquid pipe 29 that is located between the outdoor heat exchanger 13 and the shut-off valve 16, the refrigerant circuit 2 is provided

with a supercooling heat exchanger 31, which functions as a supercooler that allows the gas-liquid two-phase refrigerant to be changed to a liquid single-phase supercooling refrigerant. In addition, the refrigerant circuit 2 includes a refrigerant pipe 33 that allows some of the refrigerant, which flows between the supercooling heat exchanger 31 and the shut-off valve 16, to flow into the refrigerant pipe 27, which extends from the port c of the four-way valve 12 to the accumulator 18, via a supercooling expansion valve 32. The supercooling heat exchanger 31 includes a high pressure side flow channel and a low pressure side flow channel that are not illustrated. The refrigerant, which flows out from the outdoor expansion valve 15, flows into the high pressure side flow channel at the time when the indoor unit 4 is in a cooling operation. The refrigerant, which flows into the high pressure side flow channel, is subjected to heat exchange with the refrigerant that is present in the low pressure side flow channel, and then flows out to the shut-off valve 16 side. The low pressure side flow channel is provided in the refrigerant pipe 33, and the refrigerant, which flows out from the supercooling expansion valve 32, flows into the low pressure side flow channel. The refrigerant, which flows into the low pressure side flow channel, is subjected to heat exchange with the refrigerant that is present in the high pressure side flow channel, and then, flows out to the refrigerant pipe 27 side. In addition, in a flow direction F2 of the refrigerant at the time when the indoor unit 4 is in a heating operation, a supercooling expansion valve 32 is provided in the outdoor unit liquid pipe 29 at a position closer to the upstream side than the supercooling heat exchanger 31. With this configuration described above, the downstream side of the supercooling heat exchanger 31, which is provided in the outdoor unit liquid pipe 29, becomes a flow channel 29a through which the liquid single-phase refrigerant flows.

[0022] In this way, the refrigerant circuit 2 includes the flow channel 29a through which the liquid single-phase refrigerant flows, and the flow channel 29a corresponds to one section of the outdoor unit liquid pipe 29 in the refrigerant circuit 2. In the case where a cooling operation is performed by the indoor unit 4, the section, between the supercooling heat exchanger 31 and the shut-off valve 16 in the outdoor unit liquid pipe 29, is the flow channel 29a through which the liquid single-phase refrigerant. In the case where a heating operation is performed by the indoor unit 4, the section, between the supercooling heat exchanger 31 and the outdoor expansion valve 15 in the outdoor unit liquid pipe 29, is the flow channel 29a through which the liquid single-phase refrigerant flows.

[0023] In addition, as illustrated in FIG. 1, the flow channel 29a of the refrigerant circuit 2 is provided with the first acid capturing unit 34A and the second acid capturing unit 34B each having an acid capturing filter 35 that functions as a filter member and that captures acid included in the passing refrigerant. The filter member includes the acid capturing filter 35, which functions as the first filter

member for the first acid capturing unit 34A, and the acid capturing filter 35, which functions as the second filter member for the second acid capturing unit 34B.

[0024] The first acid capturing unit 34A is disposed on the downstream side of the supercooling heat exchanger 31, that is, disposed between the supercooling heat exchanger 31 and the shut-off valve 16, in the flow direction F1 of the refrigerant at the time when the indoor unit 4 is in a cooling operation. The second acid capturing unit 34B is disposed on the downstream side of the supercooling heat exchanger 31, that is, disposed between the supercooling heat exchanger 31 and the outdoor expansion valve 15, in the flow direction F2 of the refrigerant at the time when the indoor unit 4 is in a heating operation.

[0025] In other words, the flow channel 29a in the refrigerant circuit 2 is provided with the supercooling heat exchanger 31, which allows the gas-liquid two-phase refrigerant to be changed to the liquid single-phase supercooling refrigerant, on the upstream side of the flow direction F1 of the refrigerant at the time when the indoor unit 4 is in a cooling operation with respect to the first acid capturing unit 34A, which includes the acid capturing filter 35. Furthermore, the flow channel 29a in the refrigerant circuit 2 is provided with the supercooling heat exchanger 31, which allows the gas-liquid two-phase refrigerant to be changed to the liquid single-phase supercooling refrigerant, on the upstream side of the flow direction F2 of the refrigerant at the time when the indoor unit 4 is in a heating operation with respect to the second acid capturing unit 34B, which includes the acid capturing filter 35.

[0026] FIG. 2 is a schematic view illustrating the first acid capturing unit 34A and the second acid capturing unit 34B included in the refrigeration cycle apparatus 1 according to the first embodiment. The first acid capturing unit 34A and the second acid capturing unit 34B have the same structure. As illustrated in FIG. 2, each of the first acid capturing unit 34A and the second acid capturing unit 34B includes a container 36 in which the refrigerant flows in one direction, and the acid capturing filter 35 is provided in the container 36. The acid capturing filter 35 is a porous material in which, for example, activated alumina particles are formed, and captures acid due to an absorption action acted by the porous material. Consequently, the refrigeration cycle apparatus 1 is less likely to receive a damage caused by acid that is generated as a result of the refrigerant being decomposed under a high temperature environment.

[0027] In the first embodiment, the liquid single-phase refrigerant, which does not have a gas phase, passes through the acid capturing filter 35. When a flow resistance at the time when the refrigerant passes through the interior portion of the porous material corresponding to the acid capturing filter 35, is considered, a pressure loss produced by the flow resistance at the time when the liquid single-phase refrigerant passes through the interior portion of the acid capturing filter 35, is smaller than that at the time when the gas-liquid two-phase refrigerant

passes through the interior portion of the acid capturing filter 35. This is because the flow resistance at the time when the gas phase refrigerant passes through the acid capturing filter 35 is larger than the flow resistance at the time when the liquid phase refrigerant passes through the acid capturing filter 35. In this way, it is possible to suppress the pressure loss due to the first acid capturing unit 34A and the second acid capturing unit 34B as a result of a decrease in the flow resistance at the time when the liquid single-phase refrigerant passes through the acid capturing filter, so that it is possible to suppress a decrease in refrigeration capacity of the refrigeration cycle apparatus 1 even in a case of the structure that uses the acid capturing filter 35.

[0028] Furthermore, the flow resistance of the refrigerant passing through the acid capturing filter 35, is reduced. If the flow resistance is reduced, it is possible to suppress a turbulent flow of the refrigerant at the acid capturing filter 35, so that it is possible to reduce noise generated when the refrigerant passes through the acid capturing filter 35.

[0029] Furthermore, the upstream side and the downstream side of the first acid capturing unit 34A in the flow channel 29a are connected via a first detour flow channel (bypass flow channel) 37A. Similarly to this, the upstream side and the downstream side of the second acid capturing unit 34B in the flow channel 29a are connected via a second detour flow channel (bypass flow channel) 37B.

[0030] A check valve 38a, which allows the refrigerant to flow in only the flow direction F1 from the supercooling heat exchanger 31 side toward the shut-off valve 16 side (an indoor expansion valve 52 side that will be described later), is provided between the first acid capturing unit 34A and the shut-off valve 16, on the downstream side of the first acid capturing unit 34A in the flow direction F1 of the refrigerant at the time when the indoor unit 4 is in a cooling operation. The first detour flow channel 37A is provided with a check valve 38b that blocks the refrigerant, which flows toward the flow direction F1.

[0031] A check valve 38c, which allows the refrigerant to flow in only the flow direction F2 from the supercooling heat exchanger 31 side toward the outdoor expansion valve 15 side, is provided between the outdoor expansion valve 15 and the second acid capturing unit 34B, on the downstream side of the second acid capturing unit 34B in the flow direction F2 of the refrigerant at the time when the indoor unit 4 is in a heating operation. The second detour flow channel 37B is provided with a check valve 38d that blocks the refrigerant, which flows toward the flow direction F2.

[0032] Therefore, in the case where the indoor unit 4 is in a cooling operation, the two-phase refrigerant, which has passed through the outdoor expansion valve 15, passes through the second detour flow channel 37B without passing through the second acid capturing unit 34B, and the refrigerant, which has passed through the supercooling heat exchanger 31, passes through the first acid capturing unit 34A without passing through the first de-

tour flow channel 37A. Furthermore, in the case where the indoor unit 4 is in a heating operation, the refrigerant, which has passed through the shut-off valve 16, passes through the first detour flow channel 37A without passing through the first acid capturing unit 34A, the two-phase refrigerant, which has passed through the supercooling heat exchanger 31, passes through the second acid capturing unit 34B without passing through the second detour flow channel 37B. In this way, the refrigerant passes through only one of the first acid capturing unit 34A and the second acid capturing unit 34B at the time of cooling operation and the heating operation.

[0033] In this way, the first acid capturing unit 34A, the first detour flow channel 37A, and the check valves 38a and 38b constitute a cooling operation filter circuit 39A for removing acid included in the refrigerant at the time when the indoor unit 4 is in a cooling operation. Similarly, the second acid capturing unit 34B, the second detour flow channel 37B, and the check valves 38c and 38d constitute a heating operation filter circuit 39B for removing acid included in the refrigerant at the time when the indoor unit 4 is in a heating operation.

Configurat, ion of indoor unit

[0034] In the following, the indoor unit 4 will be described. The indoor unit 4 includes an indoor heat exchanger 51, the indoor expansion valve 52, and an indoor fan 53. In the indoor unit 4, one of the refrigerant inlet/outlet ports of the indoor heat exchanger 51 is connected to the liquid pipe 6 by using an indoor unit liquid pipe 54, and the other of the refrigerant inlet/outlet ports of the indoor heat exchanger 51 is connected to the gas pipe 7 by using an indoor unit gas pipe 55.

[0035] The indoor heat exchanger 51 performs heat exchange between indoor air, which has been taken from an inlet port (not illustrated) into the interior portion of the indoor unit 4 by the indoor fan 53, and the refrigerant. The indoor heat exchanger 51 functions as an evaporator in the case where the air conditioner 1 is in a cooling operation, and functions as a condenser in the case where the indoor unit 4 is in a heating operation.

[0036] The indoor expansion valve 52 is provided in the indoor unit liquid pipe 54. The indoor expansion valve 52 is an electronic expansion valve, and is adjusted such that the degree of refrigerant superheat at a refrigerant outlet of the indoor heat exchanger 51 becomes a target degree of refrigerant superheat in the case where the indoor heat exchanger 51 functions as an evaporator, that is, in the case where the indoor unit 4 is in a cooling operation. Here, the target degree of refrigerant superheat is the degree of refrigerant superheat for the indoor unit 4 sufficiently exhibiting a cooling operation function. In addition, the indoor expansion valve 52 is adjusted such that the degree of refrigerant superheat at the refrigerant outlet of the indoor heat exchanger 51 becomes a target value in the case where the indoor heat exchanger 51 functions as a condenser, that is, in the case where

the indoor unit 4 is in a heating operation.

[0037] Furthermore, the indoor unit 4 includes an indoor unit control circuit 60. The indoor unit control circuit 60 is mounted on a control substrate that is stored in an electric component box (not illustrated) of the indoor unit 4. The indoor unit control circuit 60 performs opening adjustment of the indoor expansion valve 52 and performs control of driving of the indoor fan 53 on the basis of the detection results detected by various sensors (not illustrated) of the indoor unit 4 or a signal sent from the outdoor unit 3. In addition, the control circuit, included in the refrigeration cycle apparatus 1, is constituted by the outdoor unit control circuit 30 and the indoor unit control circuit 60 described above.

Operation of refrigeration cycle apparatus

[0038] In the following, the flow of the refrigerant and an operation of each of the units performed in the refrigerant circuit 2 at the time of air conditioning operation performed by the refrigeration cycle apparatus 1 according to the present embodiment, will be described with reference to FIG. 1. In the following, a case, in which the indoor unit 4 performs a cooling/dehumidification operation, will be described, and a detailed description of a case of a heating operation will be omitted. Furthermore, an arrow along the flow direction F1 of the refrigerant, illustrated in FIG. 1, indicates the flow of the refrigerant at the time of the cooling operation.

[0039] As illustrated in FIG. 1, in the case where the indoor unit 4 is in a cooling operation, the outdoor unit control circuit 30 switches a state of the four-way valve 12 to a state indicated by the solid line illustrated in FIG. 1, that is, the port a and the port b of the four-way valve 12 are allowed to be communicated, and the port c and the port d are allowed to be communicated. As a result, the refrigerant circuit 2 enters a cooling cycle in which the outdoor heat exchanger 13 functions as a condenser and the indoor heat exchanger 51 functions as an evaporator.

[0040] The high pressure refrigerant, which is discharged from the compressor 10, flows through the discharge pipe 21a and the refrigerant pipe 21b, flows into the four-way valve 12, flows from the four-way valve 12 to the refrigerant pipe 26, the outdoor heat exchanger 13, the outdoor expansion valve 15, the second detour flow channel 37B, the supercooling heat exchanger 31, the first acid capturing unit 34A, the shut-off valve 16, and the liquid pipe 6 in this order, and then, flows into the indoor unit 4. The refrigerant, which flows into the indoor unit 4, flows through the indoor unit liquid pipe 54, flows into the indoor heat exchanger 51, performs heat exchange with the indoor air taken into the interior portion of the indoor unit 4 caused by a rotation of the indoor fan 53, and is then evaporated. In this way, the indoor heat exchanger 51 functions as an evaporator, the indoor air, which has been cooled as a result of the heat exchange performed with the refrigerant performed at the indoor

heat exchanger 51, flows out from an outlet port (not illustrated) to inside a room, whereby a cooling operation is performed inside the room, in which the indoor unit 4 is installed.

[0041] The refrigerant, which flows out from the indoor heat exchanger 51, flows through the indoor unit gas pipe 55 and flows into the gas pipe 7. The refrigerant, which flows through the gas pipe 7, flows into the outdoor unit 3 via the shut-off valve 17. The refrigerant, which flows into the outdoor unit 3, flows through the outdoor unit gas pipe 28, the four-way valve 12, the refrigerant pipe 27, the accumulator 18, the intake pipe 24, and the compressor purpose accumulator 11 in this order, and is taken into the compressor 10 and is again compressed.

[0042] Furthermore, in the case where the indoor unit 4 performs a heating operation, a state of the four-way valve 12 is changed to the state indicated by the broken line illustrated in FIG. 1, that is, the port a and the port d of the four-way valve 12, are allowed to be communicated, and the port b and the port c are allowed to be communicated. As a result, the refrigerant circuit 2 enters a heating cycle in which the outdoor heat exchanger 13 functions as an evaporator, and the indoor heat exchanger 51 functions as a condenser.

Control of expansion valve

[0043] Here, control of the outdoor expansion valve 15 and the indoor expansion valve 52 performed in the refrigeration cycle apparatus 1 according to the first embodiment, will be described. In the following, regarding the temperature of the refrigerant, for example, a high temperature is about 90°C, a medium temperature is about 40°C, and a low temperature is about 10°C. Regarding a pressure of the refrigerant, for example, a high pressure is about 3.0 MPa, a medium pressure is about 2.8 MPa, and a low pressure is about 0.9 MPa.

[0044] At the time of cooling operation, a refrigerant at medium temperature and high pressure flows into the inlet of the outdoor expansion valve 15, and a refrigerant at medium temperature and high pressure flows out from the outlet of the outdoor expansion valve 15. As a result, a refrigerant at high pressure flows into the supercooling heat exchanger 31 that is located on the downstream side of the outdoor expansion valve 15 in the flow direction F1 of the refrigerant, and a liquid single-phase refrigerant flows out from the supercooling heat exchanger 31. At this time, in order to send the refrigerant while ensuring the supercooled state to the inlet of the indoor expansion valve 52, the outdoor unit control circuit 30, included in the refrigeration cycle apparatus 1, performs control such that the degree of opening of the outdoor expansion valve 15 is fully opened. That is, the outdoor expansion valve 15 does not decompress the refrigerant at the time of cooling operation.

[0045] Furthermore, at the time of cooling operation, a refrigerant at medium temperature and medium pressure flows into the inlet of the indoor expansion valve 52, and

a refrigerant at low temperature and low pressure flows out from the outlet of the indoor expansion valve 52. At this time, the indoor unit control circuit 60, included in the refrigeration cycle apparatus 1, decompresses the refrigerant up to an evaporation temperature in which appropriate evaporation capacity is able to obtain in the indoor heat exchanger 51, and controls a flow rate of the refrigerant. In addition, the indoor unit control circuit 60 performs control such that the degree of refrigerant superheat at the outlet of the indoor heat exchanger 51 (a value obtained by subtracting a temperature of the refrigerant at the inlet of the indoor heat exchanger 51 from a temperature of the refrigerant at the outlet of the indoor heat exchanger 51 (evaporator)) is maintained at a predetermined target value.

[0046] At the time of heating operation, a refrigerant at medium temperature and high pressure flows into the inlet of the indoor expansion valve 52, and a refrigerant at medium temperature and high pressure flows out from the outlet of the indoor expansion valve 52. As a result, a refrigerant at high pressure flows into the supercooling heat exchanger 31 that is located on the downstream side of the indoor expansion valve 52 in the flow direction F2 of the refrigerant, and a liquid single-phase refrigerant flows out from the supercooling heat exchanger 31. In addition, the indoor unit control circuit 60 performs control such that the degree of refrigerant supercooling (a value obtained by subtracting a temperature of the refrigerant at the outlet of the indoor heat exchanger 51 (condenser) from a high pressure saturation temperature) is maintained at a predetermined target value.

[0047] Furthermore, at the time of heating operation, a refrigerant at medium temperature and medium pressure flows into the inlet of the outdoor expansion valve 15, and a refrigerant at low temperature and low pressure flows out from the outlet of the outdoor expansion valve 15. At this time, the outdoor unit control circuit 30, included in the refrigeration cycle apparatus 1, decompresses the refrigerant up to the evaporation temperature in which appropriate evaporation capacity is able to be obtained in the outdoor heat exchanger 13 by adjusting the degree of opening of the outdoor expansion valve 15, and controls a flow rate of the refrigerant.

Effects of first embodiment

[0048] As described above, the refrigeration cycle apparatus 1 according to the first embodiment is provided with the refrigerant circuit 2 having the flow channel 29a through which the liquid single-phase refrigerant flows, and the acid capturing filter 35 that is provided in the flow channel 29a and that captures acid included in a flowing refrigerant. In this way, as a result of the liquid single-phase refrigerant passing through the acid capturing filter 35, the pressure loss, which is caused by the flow resistance at the time when the refrigerant passes through the acid capturing filter 35, is smaller than that at the time when the gas-liquid two-phase refrigerant passes

through the acid capturing filter 35. Consequently, it is possible to suppress the pressure loss of the refrigerant, which passes through the acid capturing filter 35, and it is thus possible to suppress a reduction in refrigeration capacity of the refrigeration cycle apparatus 1 that includes the acid capturing filter 35.

[0049] Furthermore, in the refrigeration cycle apparatus 1, a flow resistance at the time when a liquid single-phase refrigerant passes through the acid capturing filter 35, is smaller than that at the time when a gas-liquid two-phase refrigerant passes through the acid capturing filter 35. If the flow resistance is reduced, it is possible to suppress the turbulent flow of the refrigerant at the acid capturing filter 35, so that it is possible to reduce noise generated when the refrigerant passes through the acid capturing filter 35.

[0050] Furthermore, the refrigerant circuit 2, included in the refrigeration cycle apparatus 1 according to the first embodiment, is provided with the supercooling heat exchanger 31 that allows a gas-liquid two-phase refrigerant to be changed to a liquid single-phase supercooling refrigerant on the upstream side of the flow direction of the refrigerant with respect to the acid capturing filter 35. As a result, it is possible to reliably send the liquid single-phase refrigerant to the acid capturing filter 35. In addition, according to the first embodiment, the acid capturing filter 35 is disposed on the downstream side of the supercooling heat exchanger 31, so that, even if an air bubble is generated, what is called flash-gas is generated in the refrigerant as a result of some of the refrigerant being evaporated in accordance with, for example, a pressure loss produced in the outdoor unit liquid pipe 29, the refrigerant is subjected to supercooling in the supercooling heat exchanger 31; therefore, it is possible to appropriately send the liquid single-phase refrigerant to the acid capturing filter 35.

[0051] Furthermore, the acid capturing filter 35, included in the refrigeration cycle apparatus 1 according to the first embodiment, includes the acid capturing filter 35 that is provided in the first acid capturing unit 34A and that functions as the first filter member, and includes the acid capturing filter 35 that is provided in the second acid capturing unit 34B and that functions as the second filter member. The refrigerant circuit 2 is provided with, in the flow directions F1 and F2 of the refrigerant, the first detour flow channel 37A that connects the upstream side of the first acid capturing unit 34A and the downstream side of the first acid capturing unit 34A, and the second detour flow channel 37B that connects the upstream side of the second acid capturing unit 34B and the downstream side of the second acid capturing unit 34B, and the refrigerant passes only one of the first acid capturing unit 34A and the second acid capturing unit 34B at the time of heating operation and the cooling operation performed by the indoor unit 4. As a result, even in both of the flow direction F1 of the refrigerant at the time of cooling operation and the flow direction F2 of the refrigerant at the time of heating operation, the refrigerant passes through the acid

capturing filter 35 on the downstream side of the supercooling heat exchanger 31. Furthermore, the refrigerant passes through only one of the first acid capturing unit 34A and the second acid capturing unit 34B, so that the effect of the flow resistance, caused by the acid capturing filter 35 at the time of operation, is made by only one filter, it is thus possible to suppress a reduction in the refrigeration capacity of the refrigeration cycle apparatus 1.

[0052] Furthermore, according to the first embodiment, as a result of the liquid single-phase refrigerant passing through the acid capturing filter 35, it is possible to prevent the lubricating oil 9, which is included in the refrigerant, from being retained in the acid capturing filter 35, so that it is possible to suppress a decrease in an amount of the lubricating oil 9, which is contained in the compressor 10, and it is thus possible to appropriately maintain an operation of the compressor 10 using the lubricating oil 9. In the case of the refrigerant that is in a gas-liquid two-phase state including a gas phase refrigerant, the lubricating oil 9 may be separated and retained in the acid capturing filter 35; however, in the case of the liquid single-phase refrigerant, the lubricating oil 9 passes through the acid capturing filter 35 together with the liquid refrigerant, so that the lubricating oil 9 is not retained in the acid capturing filter 35.

[0053] In addition, in the first embodiment described above, the supercooling heat exchanger 31 is used to send the liquid single-phase refrigerant to the flow channel 29a; however, instead of the supercooling heat exchanger 31, a gas-liquid separator, which separates a refrigerant into a liquid single-phase refrigerant and a gas single-phase refrigerant, may be used. In the case where the gas-liquid separator is used instead of the supercooling heat exchanger 31 in the refrigerant circuit 2 illustrated in FIG. 1, the liquid single-phase refrigerant is sent to the flow channel 29a after passing through the gas-liquid separator, and the gas single-phase refrigerant is sent from the gas-liquid separator to the refrigerant pipe 27 by passing through the refrigerant pipe 33. However, the gas-liquid separator tends to exhibit high enthalpy of the liquid single-phase refrigerant, which flows out from the gas-liquid separator, as compared to the case where the supercooling heat exchanger 31 is used. As a result of the refrigerant at high enthalpy is sent to an evaporator (the outdoor heat exchanger 13 or the indoor heat exchanger 51), a coefficient of performance (COP) in the refrigeration cycle apparatus 1 is decreased, so that it is preferable to use the supercooling heat exchanger rather than the gas-liquid separator.

[0054] In the following, another embodiment will be described with reference to drawings. In the other embodiment, components, which have the same configuration as those described in the first embodiment, are assigned the same reference numerals as those assigned in the first embodiment and descriptions thereof will be omitted.

Second Embodiment

[0055] FIG. 3 is a schematic view illustrating the main part of a refrigeration cycle apparatus according to a second embodiment. The second embodiment is different from the first embodiment in that a bridge circuit, which is provided with a single acid capturing unit, is included.

[0056] As illustrated in FIG. 3, the refrigerant circuit 2, included in the refrigeration cycle apparatus according to the second embodiment, includes a bridge circuit 61 that includes the supercooling heat exchanger 31 and an acid capturing unit 34. The bridge circuit 61 is provided with a single acid capturing unit 34, and in which, as will be described later, a refrigerant flows only one direction with respect to the acid capturing unit 34. The acid capturing unit 34 has the same configuration as that of the first acid capturing unit 34A and the second acid capturing unit 34B according to the first embodiment, and includes the acid capturing filter 35. Although not illustrated in FIG. 3, the refrigerant pipe 33, which sends a gas refrigerant to the refrigerant pipe 27, is connected to the low pressure side flow channel of the supercooling heat exchanger 31 (see FIG. 1). The refrigerant pipe 33 allows some of the refrigerant, which flows between the supercooling heat exchanger 31 and the acid capturing unit 34, to flow into the refrigerant pipe 27, which extends from the port c of the four-way valve 12 to the accumulator 18, via the supercooling expansion valve 32 and the low pressure side flow channel.

[0057] In the second embodiment, the portion A, including the bridge circuit 61 that includes the supercooling heat exchanger 31 and the acid capturing unit 34, has the same configuration as the portion A that includes the supercooling heat exchanger 31, the first acid capturing unit 34A, and the second acid capturing unit 34B illustrated in FIG. 1.

[0058] The bridge circuit 61 includes a first flow channel 61a, a second flow channel 61b, a third flow channel 61c, a fourth flow channel 61d, and a fifth flow channel 61e, and a check valve 62 is provided in each of the first flow channel 61a, the second flow channel 61b, the fourth flow channel 61d, and the fifth flow channel 61e except for the third flow channel 61c. Specifically, the check valve 62, which is provided in the first flow channel 61a, regulates the flow of the refrigerant flowing from the supercooling heat exchanger 31 toward the outdoor expansion valve 15. The check valve 62, which is provided in the second flow channel 61b, regulates the flow of the refrigerant flowing from the outdoor expansion valve 15 toward the acid capturing unit 34. The check valve 62, which is provided in the fourth flow channel 61d, regulates the flow of the refrigerant flowing from the supercooling heat exchanger 31 toward the indoor expansion valve 52. The check valve 62, which is provided in the fifth flow channel 61e, regulates the flow of the refrigerant flowing from the indoor expansion valve 52 toward the acid capturing unit 34. In the bridge circuit 61, in the third flow channel 61c in which the refrigerant flows in only one

direction, the supercooling heat exchanger 31 and the acid capturing unit 34 are disposed in this order along the one direction. In the third flow channel 61c of the bridge circuit 61, one section in the flow direction of the refrigerant on the downstream side of the supercooling heat exchanger 31, corresponds to the flow channel 29a in which the liquid single-phase refrigerant flows. In the bridge circuit 61, the liquid single-phase refrigerant, which has passed through the supercooling heat exchanger 31, flows into the acid capturing filter 35 of the acid capturing unit 34.

[0059] In the case where the indoor unit 4 is in a cooling operation, the refrigerant, which flows from the outdoor expansion valve 15 into the bridge circuit 61, flows through the first flow channel 61a, the third flow channel 61c, and the fifth flow channel 61e in this order in the flow direction F1 of the refrigerant and is sent to the indoor expansion valve 52. In contrast, in the case where the indoor unit 4 is in a heating operation, the refrigerant, which flows from the indoor expansion valve 52 to the bridge circuit 61, flows through the fourth flow channel 61d, the third flow channel 61c, and the second flow channel 61b in this order in the flow direction F2 of the refrigerant and is sent to the outdoor expansion valve 15.

Effects of second embodiment

[0060] The refrigeration cycle apparatus according to the second embodiment includes the bridge circuit 61, so that it is possible to compactly constitute the refrigerant circuit 2 by using the single piece of the acid capturing unit 34 without using the two acid capturing units of the first acid capturing unit 34A and the second acid capturing unit 34B as described in the first embodiment.

[0061] Furthermore, in also the second embodiment, similar to the first embodiment, as a result of the liquid single-phase refrigerant passing through the acid capturing filter 35, it is possible to suppress the pressure loss of the refrigerant, which passes through the acid capturing filter 35, as compared to the case where the gas-liquid two-phase refrigerant passing through the acid capturing filter 35, so that it is possible to suppress a decrease in the refrigeration capacity of the refrigeration cycle apparatus that includes the acid capturing filter 35. Furthermore, in also the second embodiment, as compared to the case where the gas-liquid two-phase refrigerant passes through the acid capturing filter 35, it is possible to reduce noise generated at the time when the liquid single-phase refrigerant passes through the acid capturing filter 35.

Third Embodiment

[0062] FIG. 4 is a schematic view illustrating the main part of the refrigeration cycle apparatus according to a third embodiment. The third embodiment is different from the second embodiment in that the bridge circuit 61, which is provided with a gas-liquid separator, is included.

[0063] As illustrated in FIG. 4, the refrigeration cycle apparatus according to the third embodiment includes the bridge circuit 61 that includes a gas-liquid separator 64 and the acid capturing unit 34. In the third embodiment, the gas-liquid separator 64 is used instead of the supercooling heat exchanger 31 according to the second embodiment. The gas-liquid separator 64 is disposed, in the upstream side of the acid capturing unit 34, such that a liquid flow outlet is connected on the acid capturing unit 34 side. The gas-liquid separator 64 separates the liquid single-phase refrigerant from the gas-liquid two-phase refrigerant, and sends the liquid single-phase refrigerant to the acid capturing filter 35. Although not illustrated in FIG. 4, the refrigerant pipe 33, which sends the separated gas phase refrigerant (gas refrigerant) to the refrigerant pipe 27 (see FIG. 1), is connected to a gas flow outlet of the gas-liquid separator 64. The refrigerant pipe 33 allows some of the refrigerant, which flows between the gas-liquid separator 64 and the acid capturing unit 34, to flow into the refrigerant pipe 27, which extends from the port c of the four-way valve 12 to the accumulator 18, via a bypass expansion valve (corresponds to the supercooling expansion valve 32 according to the first embodiment). In the third flow channel 61c in the bridge circuit 61, one section on the downstream side of the gas-liquid separator 64 in the flow direction of the refrigerant, corresponds to the flow channel in which the liquid single-phase refrigerant that has been separated from the gas phase refrigerant flows. In this way, in the bridge circuit 61, the liquid single-phase refrigerant, which is sent from the gas-liquid separator 64, passes through the acid capturing filter 35 of the acid capturing unit 34.

[0064] In also the third embodiment, the portion A, including the bridge circuit 61 that includes the gas-liquid separator 64 and the acid capturing unit 34, has the same configuration and function as the portion A, including the supercooling heat exchanger 31, the first acid capturing unit 34A, and the second acid capturing unit 34B illustrated in FIG. 1.

Effect of third embodiment

[0065] Similarly to the second embodiment, the refrigeration cycle apparatus according to the third embodiment includes the bridge circuit 61, so that it is possible to compactly constitute the refrigerant circuit 2 without using the two acid capturing units of the first acid capturing unit 34A and the second acid capturing unit 34B as described in the first embodiment.

[0066] Furthermore, in the third embodiment, it is possible to send the liquid single-phase refrigerant that has been separated from the gas-liquid separator 64 to the acid capturing unit 34, so that, similar to the first embodiment, it is possible to suppress the pressure loss of the refrigerant, which passes through the acid capturing filter 35, as compared to the case where the gas-liquid two-phase refrigerant passes through the acid capturing filter 35, and it is thus possible to suppress a decrease in the

refrigeration capacity of the refrigeration cycle apparatus that includes the acid capturing filter 35. Furthermore, in also the second embodiment, it is possible to reduce noise generated when the liquid single-phase refrigerant passes through the acid capturing filter 35 as compared to the case in which the gas-liquid two-phase refrigerant passes through the acid capturing filter 35.

[0067] Furthermore, in also the first embodiment (FIG. 1), similar to the third embodiment, the gas-liquid separator 64 may be used, for example, the gas-liquid separator 64 may be provided on each of the upstream side of the first acid capturing unit 34A in the flow direction F1 of the refrigerant and the upstream side of the second acid capturing unit 34B in the flow direction F2 of the refrigerant. In this case, the two gas-liquid separators 64 are disposed such that the refrigerant is able to detour one of the gas-liquid separators 64 and the first acid capturing unit 34A by the first detour flow channel 37A, and are disposed such that the refrigerant is able to detour the other one of the gas-liquid separators 64 and the second acid capturing unit 34B by the second detour flow channel 37B. In addition, the one gas-liquid separator 64 is disposed such that the liquid flow outlet is connected to the first acid capturing unit 34A side, whereas the other gas-liquid separator 64 is disposed such that the liquid flow outlet is connected to the second acid capturing unit 34B side.

Fourth Embodiment

[0068] FIG. 5 is a schematic view illustrating the main part of a refrigeration cycle apparatus according to a fourth embodiment. The fourth embodiment is different from the second embodiment in that a receiver 65 is added to the bridge circuit 61 that is provided with the supercooling heat exchanger.

[0069] As illustrated in FIG. 5, the refrigeration cycle apparatus according to the fourth embodiment includes the bridge circuit 61 that includes the receiver 65, the supercooling heat exchanger 31, and the acid capturing unit 34. The receiver 65 is disposed on the upstream side of the supercooling heat exchanger 31 in the flow direction of the refrigerant, which flows through the third flow channel 61c, and a liquid single-phase refrigerant, which is separated by the receiver 65, is sent to the supercooling heat exchanger 31. Although not illustrated in FIG. 5, the refrigerant pipe 33, which sends a gas refrigerant to the refrigerant pipe 27 (see FIG. 1), is connected to the low pressure side flow channel of the supercooling heat exchanger 31. The refrigerant pipe 33 allows some of the refrigerant, which flows between the supercooling heat exchanger 31 and the acid capturing unit 34, to flow into the refrigerant pipe 27, which extends from the port c of the four-way valve 12 to the accumulator 18, via the supercooling expansion valve 32 and the low pressure side flow channel.

[0070] In also the fourth embodiment, the portion A, which includes the bridge circuit 61 that includes the re-

ceiver 65, the supercooling heat exchanger 31, and the acid capturing unit 34, has the same configuration as the portion A, which includes the supercooling heat exchanger 31, the first acid capturing unit 34A, and the second acid capturing unit 34B illustrated in FIG. 1.

Effect of fourth embodiment

[0071] The refrigeration cycle apparatus according to the fourth embodiment includes, on the upstream side of the supercooling heat exchanger 31, the receiver 65 that has a function of adjusting an amount of the refrigerant, which flows through the refrigerant circuit 2, so that it is also possible to cope with a variation in an environment load.

[0072] Furthermore, in also the fourth embodiment, similar to the first embodiment, as a result of the liquid single-phase refrigerant passing through the acid capturing filter 35, it is possible to suppress a pressure loss of the refrigerant, which passes through the acid capturing filter 35, as compared to a case where the gas-liquid two-phase refrigerant passes through the acid capturing filter 35, so that it is possible to suppress a reduction in the refrigeration capacity of the refrigeration cycle apparatus that includes the acid capturing filter 35. In addition, in also the fourth embodiment, it is possible to reduce noise generated when the liquid single-phase refrigerant passes through the acid capturing filter 35 as compared to a case where the gas-liquid two-phase refrigerant passes through the acid capturing filter 35.

[0073] Furthermore, in also the first embodiment (FIG. 1), similar to the fourth embodiment, the receiver 65 may be used, and the receiver 65 may be provided, for example, on one of the upstream side of the first acid capturing unit 34A in the flow direction F1 of the refrigerant and the upstream side of the second acid capturing unit 34B in the flow direction F2 of the refrigerant.

Reference Signs List

[0074]

- 1 refrigeration cycle apparatus
- 2 refrigerant circuit
- 15 outdoor expansion valve
- 29 outdoor unit liquid pipe
- 29a flow channel
- 31 supercooling heat exchanger (supercooler)
- 34A first acid capturing unit (acid capturing unit)
- 34B second acid capturing unit (acid capturing unit)
- 35 acid capturing filter (filter member, first filter member, second filter member)
- 37A first detour flow channel
- 37B second detour flow channel
- 52 indoor expansion valve
- 61 bridge circuit
- 64 gas-liquid separator
- 65 receiver

Claims

1. A refrigeration cycle apparatus comprising:

- 5 a refrigerant circuit that includes a flow channel through which a refrigerant in a liquid single-phase state flows; and
- 10 a filter member that is provided in the flow channel and that captures acid contained in the refrigerant, which passes through the flow channel.

2. The refrigeration cycle apparatus according to claim 1, wherein, on an upstream side of a flow direction of the refrigerant with respect to the filter member, the refrigerant circuit is provided with a supercooler that allows the refrigerant in a gas-liquid two-phase state to be changed to a supercooling refrigerant in a liquid single-phase state.

3. The refrigeration cycle apparatus according to claim 1, wherein, on an upstream side of a flow direction of the refrigerant with respect to the filter member, the refrigerant circuit is provided with a gas-liquid separator that separates the refrigerant in the liquid single-phase state from the refrigerant in a gas-liquid two-phase state and that sends the refrigerant in the liquid single-phase state to the filter member.

4. The refrigeration cycle apparatus according to claim 2, wherein, on the upstream side of the flow direction of the refrigerant with respect to the supercooler, the refrigerant circuit is provided with a receiver that separates the refrigerant in the liquid single-phase state from the refrigerant in the gas-liquid two-phase state and that sends the refrigerant in the liquid single-phase state to the supercooler.

5. The refrigeration cycle apparatus according to any one of claims 1 to 4, wherein

the filter member includes a first filter member and a second filter member, the refrigerant circuit is provided with, in the flow direction of the refrigerant, a first detour flow channel that connects an upstream side of the first filter member and a downstream side of the first filter member, and a second detour flow channel that connects an upstream side of the second filter member and a downstream side of the second filter member, and the refrigerant passes through only one of the first filter member and the second filter member at a time of a heating operation and a cooling operation performed by an indoor unit that is connected to the refrigerant circuit.

6. The refrigeration cycle apparatus according to any

one of claims 1 to 4, wherein

the refrigerant circuit includes a bridge circuit in which a single piece of the filter member is provided, and

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the refrigerant flows only one direction with respect to the filter member.

7. The refrigeration cycle apparatus according to any one of claims 1 to 6, wherein the refrigerant is an R466A refrigerant.

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FIG. 1

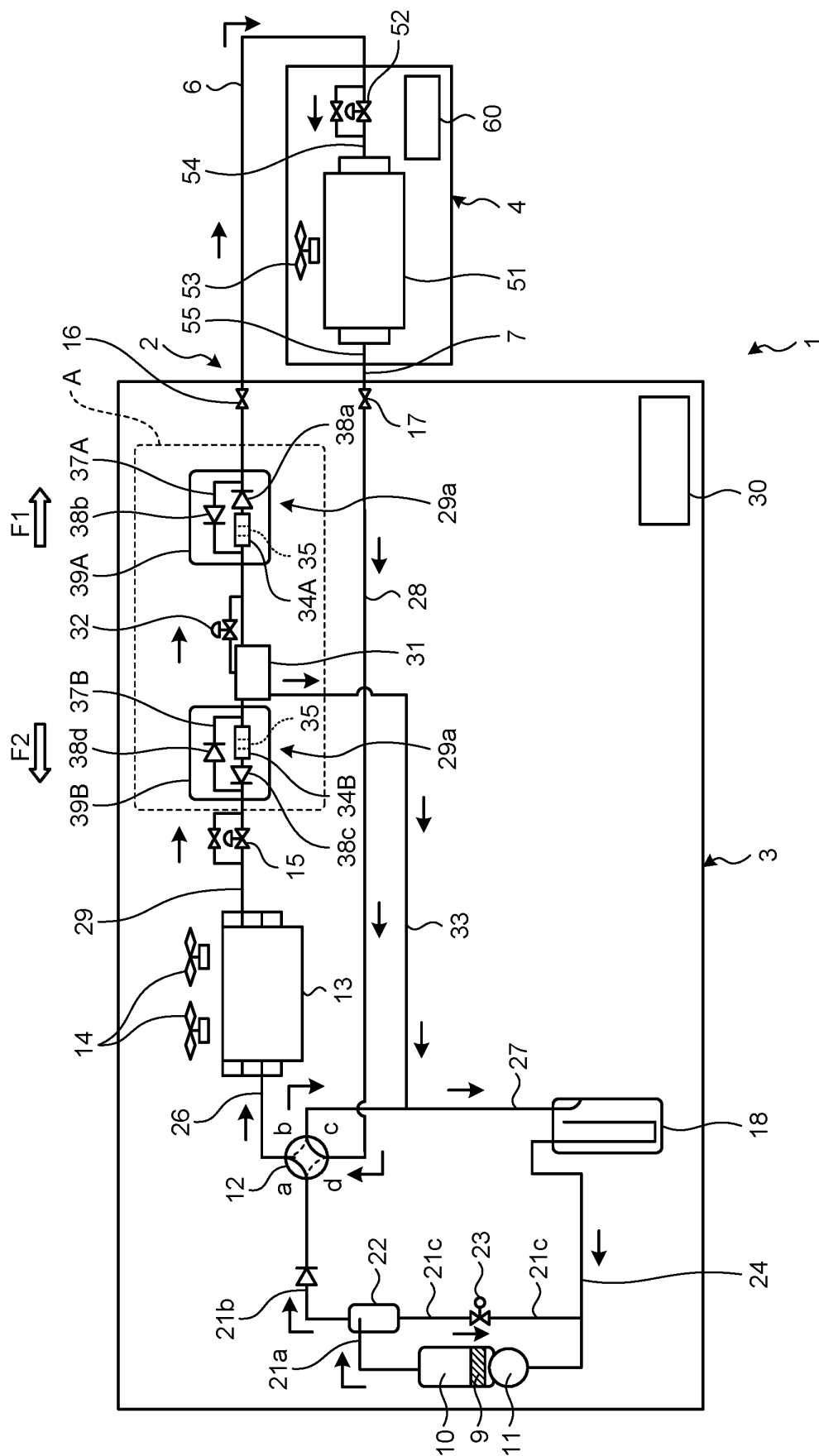


FIG.2

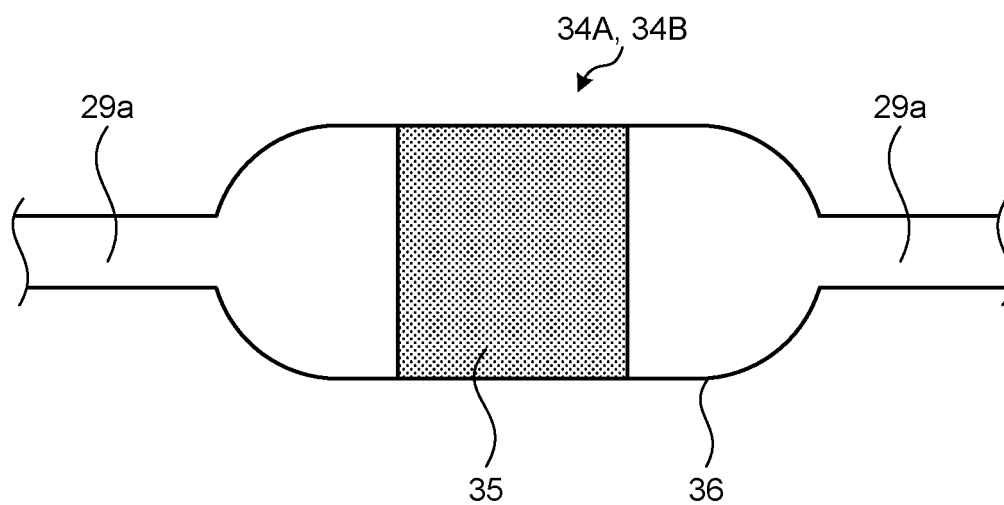


FIG.3

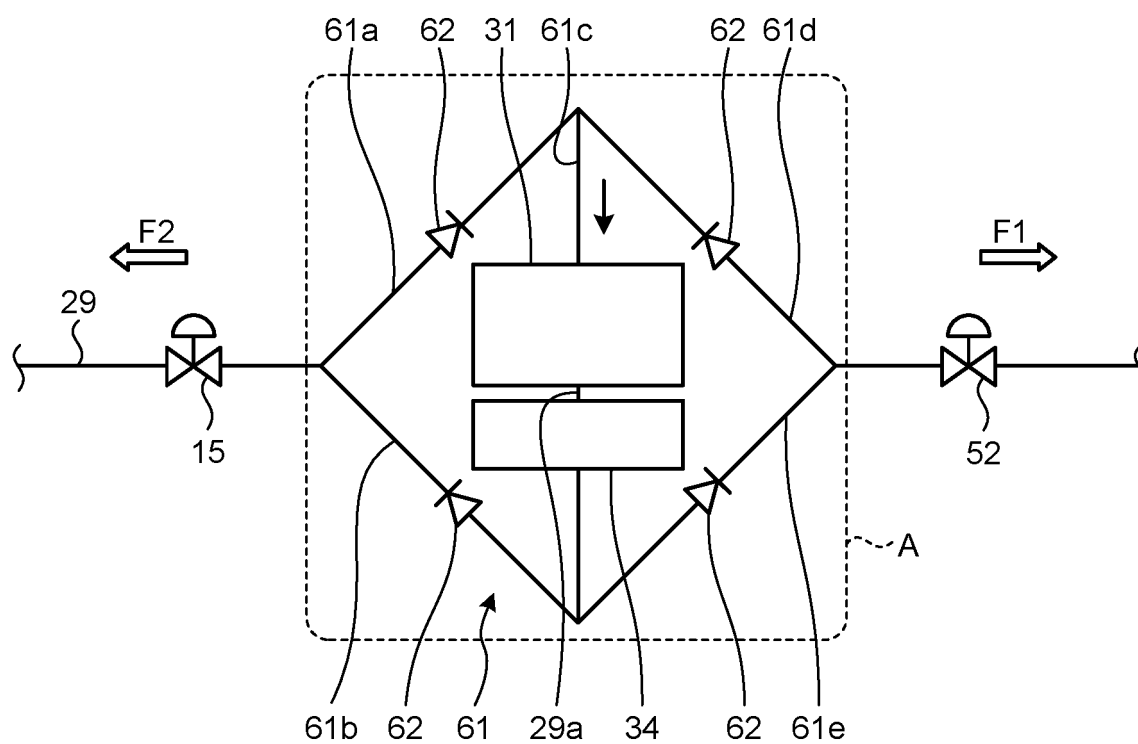


FIG.4

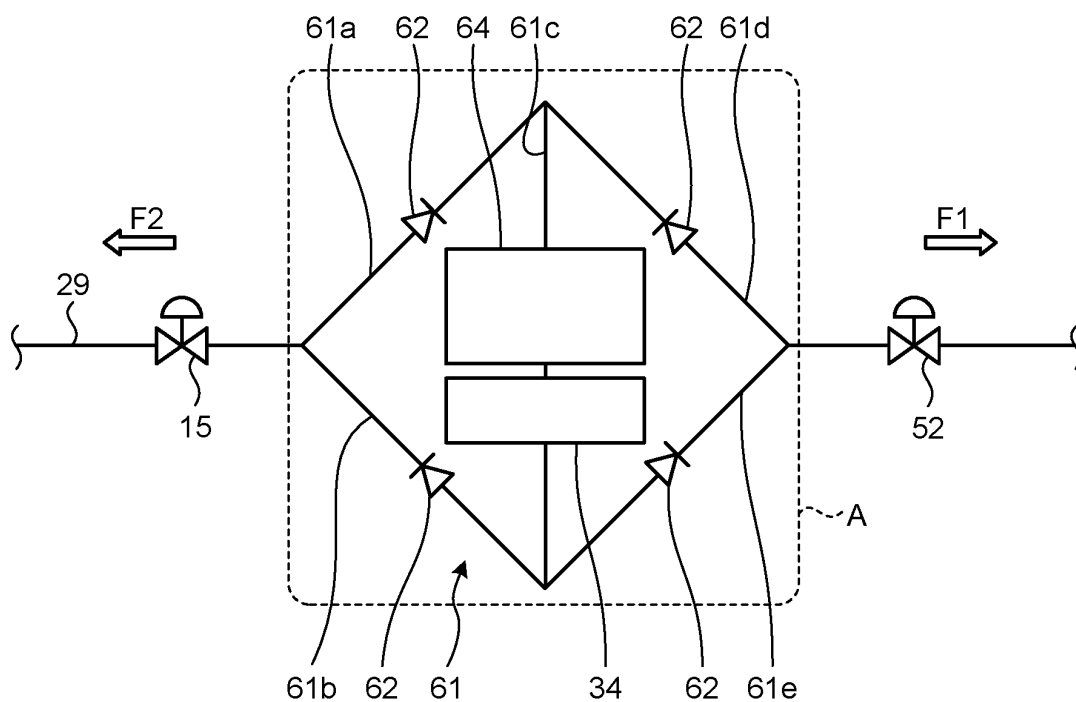
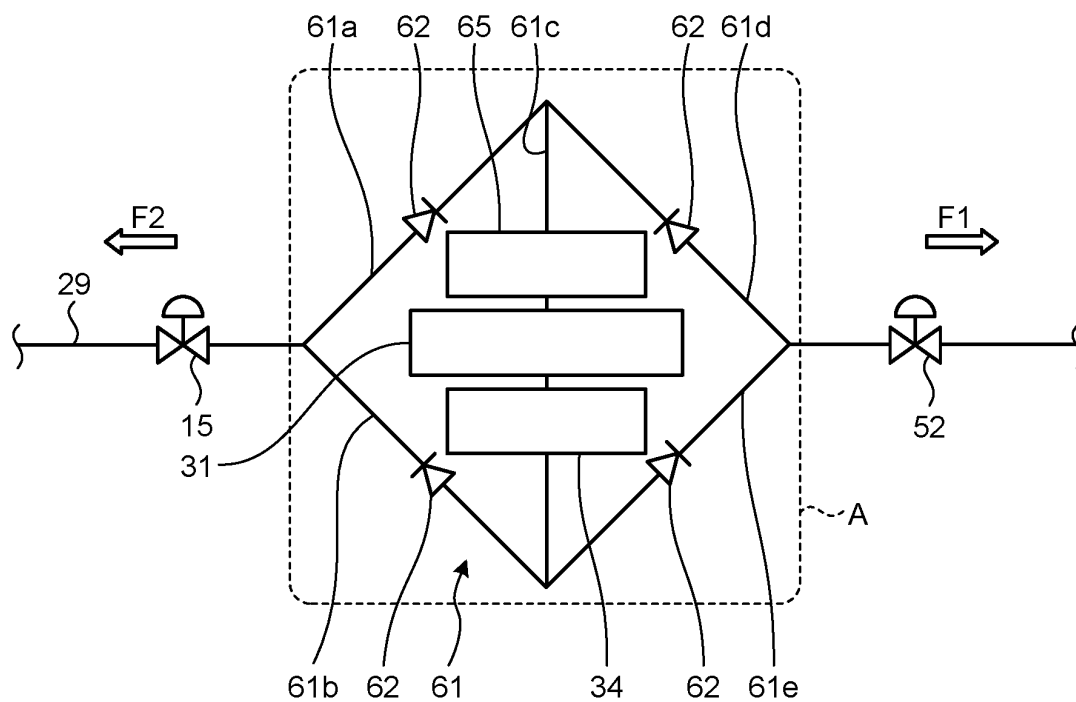


FIG.5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/028830

A. CLASSIFICATION OF SUBJECT MATTER**F25B 43/00**(2006.01)i; **F25B 1/00**(2006.01)i; **F25B 41/26**(2021.01)i

FI: F25B43/00 W; F25B1/00 396B; F25B43/00 A; F25B1/00 321A; F25B41/26 Z

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)

F25B43/00; F25B1/00; F25B41/26

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 1971-2021

Registered utility model specifications of Japan 1996-2021

Published registered utility model applications of Japan 1994-2021

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.
X	JP 2016-194377 A (MITSUBISHI HEAVY IND LTD) 17 November 2016 (2016-11-17) paragraph [0090], fig. 1	1
Y		2-7
Y	JP 2008-196849 A (HITACHI APPLIANCES INC) 28 August 2008 (2008-08-28) paragraphs [0008]-[0039], fig. 1-3	2-7
Y	JP 2019-27645 A (GASTAR CORP) 21 February 2019 (2019-02-21) paragraph [0010]	5-7
Y	JP 2002-286315 A (MITSUBISHI ELECTRIC CORP) 03 October 2002 (2002-10-03) paragraphs [0034]-[0036]	6-7
Y	JP 2020-34261 A (HITACHI JOHNSON CONTROLS AIR CONDITIONING INC) 05 March 2020 (2020-03-05) paragraph [0009]	7



Further documents are listed in the continuation of Box C.



See patent family annex.

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19 August 2021

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Name and mailing address of the ISA/JP

Japan Patent Office (ISA/JP)

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Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/028830

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JP	2008-196849	A	28 August 2008	(Family: none)	
JP	2019-27645	A	21 February 2019	(Family: none)	
JP	2002-286315	A	03 October 2002	(Family: none)	
JP	2020-34261	A	05 March 2020	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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