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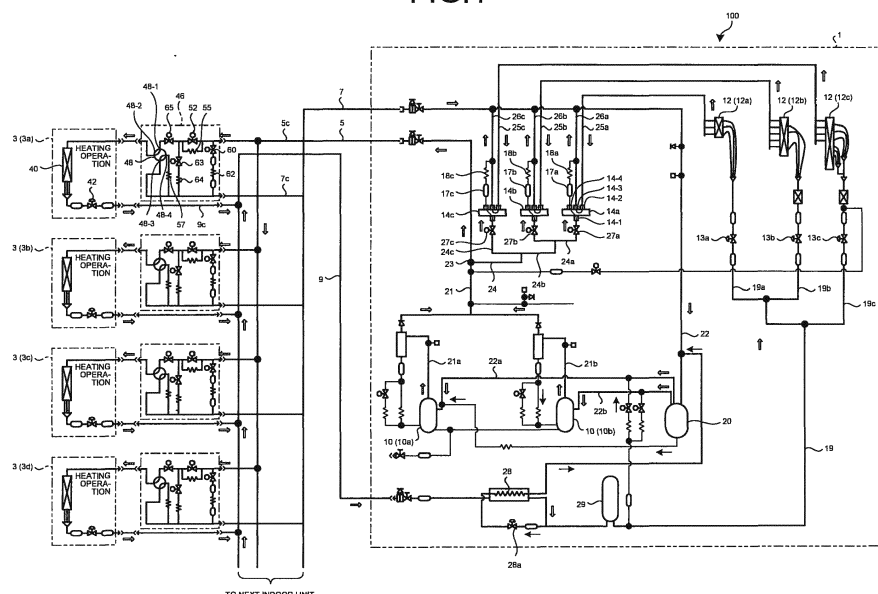
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(54) **AIR CONDITIONING APPARATUS**

(57) To provide an air conditioning apparatus 100 provided with an outdoor unit 1. The outdoor unit 1 includes a compressor 10 with a discharge side thereof being connected to a high-pressure gas pipe 5 and a suction side thereof being connected to a low-pressure gas pipe 7, a plurality of outdoor heat exchangers 12a to 12c connected to a liquid pipe 9 in parallel, a plurality of outdoor four-way valves 14a to 14c provided between

the compressor 10 and the respective outdoor heat exchangers 12a to 12c to switch a high-pressure gas flow channel and a low-pressure flow channel selectively, and outdoor control valves 27a to 27c arranged between at least one of the outdoor four-way valves 14a to 14c and the discharge side of the compressor 10 to control flow from the compressor 10 to the outdoor four-way valves 14a to 14c.

FIG.1



Description

Field

[0001] The present invention relates to an air conditioning apparatus provided with an outdoor device and an indoor device connected to each other by a high-pressure gas pipe, a low-pressure gas pipe, and a liquid pipe.

Background

[0002] Generally, an air conditioning apparatus provided with an outdoor device having a compressor and an outdoor heat exchanger, and a plurality of indoor devices having an indoor heat exchanger has been known. In the air conditioning apparatus, the outdoor device and the indoor devices are connected to each other by a high-pressure gas pipe, a low-pressure gas pipe, and a liquid pipe so that the indoor devices can perform a cooling operation or a heating operation independently (for example, see Japanese Patent Application Laid-open No. 2006-125761). In this type of air conditioning apparatus, an outdoor four-way valve that switches a high-pressure gas flow channel from a discharge side of the compressor toward the outdoor heat exchanger and a low-pressure gas flow channel from the outdoor heat exchanger toward a suction side of the compressor is provided between the compressor and the outdoor heat exchanger. A capillary tube that guides a refrigerant from the discharge side of the compressor to the suction side of the compressor (a low-pressure gas pipe) when the low-pressure gas flow channel of the outdoor four-way valve is selected is provided in the outdoor four-way valve, thereby preventing that a liquid refrigerant is accumulated before the outdoor four-way valve.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Patent Application Laid-open No. 2006-125761

Summary

Technical Problem

[0004] The air conditioning apparatus described above enables the plurality of indoor devices to perform a cooling operation or a heating operation independently. Therefore, by providing a plurality of outdoor heat exchangers in parallel, heat balance between evaporation heat quantity and condensation heat quantity can be controlled finely and the air conditioning apparatus becomes effective. In this configuration, for example, in order to improve the cooling performance under a low external temperature environment, a control valve that stops flow of a refrigerant from the discharge side of the compressor to the outdoor heat exchanger is required in the outdoor heat exchanger that is not used as a condenser, so that

the refrigerant is not accumulated in the outdoor heat exchanger.

[0005] In this case, such a configuration is assumed that the control valve is provided before the outdoor heat exchanger, that is, between the outdoor four-way valve and the outdoor heat exchanger. However, when the outdoor heat exchanger is used as an evaporator, a low-pressure gas more expanded than a high-pressure gas circulates in a pipe line that connects the outdoor four-way valve to the outdoor heat exchanger. Therefore, in the configuration in which the control valve is provided between the outdoor four-way valve and the outdoor heat exchanger, it is necessary to provide a control valve having a large bore while allowing the flow in both directions, in order to suppress a performance decline due to a pressure loss. Further, when the outdoor heat exchanger is used as an evaporator, a refrigerant flows out, though slightly, from the discharge side of the compressor to the suction side of the compressor through the capillary tube provided in the outdoor four-way valve, thereby causing a performance decline.

[0006] The present invention has been achieved in view of the above problems, and an object of the present invention is to provide an air conditioning apparatus that can suppress a performance decline when an outdoor heat exchanger is used as an evaporator, without using a control valve having a large bore.

Solution to Problem

[0007] To solve the above problems and achieve the object, an air conditioning apparatus according to a present invention is provided with an outdoor device having a compressor and an outdoor heat exchanger and a plurality of indoor devices respectively having an indoor heat exchanger, in which the outdoor device and the indoor device are connected to each other by a high-pressure gas pipe, a low-pressure gas pipe, and a liquid pipe so that the indoor devices can perform a cooling operation or a heating operation independently.

[0008] The outdoor device includes:

a compressor with a discharge side thereof being connected to the high-pressure gas pipe and a suction side thereof being connected to the low-pressure gas pipe,
a plurality of outdoor heat exchangers connected to the liquid pipe in parallel,
a plurality of outdoor four-way valves provided between the compressor and the respective outdoor heat exchangers to switch a high-pressure gas flow channel from the discharge side of the compressor toward the outdoor heat exchanger and a low-pressure flow channel from the outdoor heat exchanger toward the suction side of the compressor respectively selectively,
a plurality of capillary tubes with one end thereof connected to a port of the outdoor four-way valve com-

municating with the discharge side of the compressor and the other end thereof connected to the suction side of the compressor, when the low-pressure gas flow channel of the outdoor four-way valve is selected, and

an outdoor control valve arranged between at least one of the outdoor four-way valves and the discharge side of the compressor to control flow from the compressor to the outdoor four-way valve.

[0009] According to this configuration, because the outdoor control valve that is arranged between at least one of the outdoor four-way valves and the discharge side of the compressor to control flow from the compressor to the outdoor four-way valves is provided, the refrigerant does not flow to the outdoor heat exchanger in a channel provided with the outdoor control valve by closing the outdoor control valve. Therefore, an outdoor heat exchanger that is not required as a capacity at the time of a cooling operation or a heating operation can be shut off. For example, at the time of a cooling operation under a low external temperature environment, the capacity of the outdoor heat exchanger used as a condenser can be suppressed, thereby enabling to prevent accumulation of a liquid refrigerant in the outdoor heat exchanger that is not used. Furthermore, by arranging the outdoor control valve between the outdoor four-way valves and the discharge side of the compressor, the outdoor control valve is outside the flow channel of the refrigerant when the outdoor heat exchanger is used as an evaporator, and thus an outdoor control valve having a large bore is not required. Further, when the outdoor heat exchanger is used as an evaporator, by closing the outdoor control valve, flow of the refrigerant from the discharge side of the compressor to the suction side of the compressor can be shut off by the capillary tube, thereby enabling to suppress a performance decline.

[0010] In this configuration, the outdoor heat exchangers may respectively have a configuration in which a heat exchange capacity is different from each other, and the outdoor control valve may be arranged between at least the outdoor four-way valve corresponding to the outdoor heat exchanger having a largest heat exchange capacity and the discharge side of the compressor. According to this configuration, flow of the refrigerant to the outdoor heat exchanger having the largest heat exchange capacity can be shut off. Therefore, at the time of a cooling operation for example under a low external temperature environment, the capacity of the outdoor heat exchanger used as a condenser can be easily suppressed, thereby enabling to prevent accumulation of a liquid refrigerant in the outdoor heat exchanger that is not used.

[0011] Furthermore, the outdoor control valves may respectively be arranged between the outdoor four-way valves and the discharge side of the compressor. According to this configuration, the outdoor heat exchanger to be used can be finely controlled depending on an air conditioning load.

[0012] Furthermore, when the low-pressure gas flow channel of the outdoor four-way valve is selected, the outdoor control valve may be closed, and the outdoor control valve may be regularly or irregularly released for a predetermined time. According to this configuration, the refrigerant accumulated between the outdoor control valve and the discharge side of the compressor can be caused to flow out through the capillary tubes.

10 Advantageous Effects of Invention

[0013] According to the present invention, an outdoor control valve arranged between at least one of outdoor four-way valves and a discharge side of a compressor to control flow from the compressor to the outdoor four-way valves is provided. Accordingly, a performance decline when an outdoor heat exchanger is used as an evaporator can be suppressed without using an outdoor control valve having a large bore.

Brief Description of Drawings

[0014]

FIG. 1 is a schematic configuration diagram of a cooling/heating free multi-type air conditioner according to an embodiment of the present invention.

FIG. 2 is a schematic configuration diagram illustrating an operation pattern of a mainly cooling operation under a low external temperature environment. Description of Embodiments

[0015] Exemplary embodiments of the present invention will be explained below with reference to the accompanying drawings. The present invention is not limited to the embodiments. In addition, constituent elements in the embodiments include those that can be easily replaced or assumed by persons skilled in the art, or that are substantially equivalent. Further, constituent elements described below can be combined as appropriate.

[0016] FIG. 1 is a schematic configuration diagram of a cooling/heating free multi-type air conditioner according to an embodiment of the present invention. A cooling/heating free multi-type air conditioner (air conditioning apparatus) 100 includes one outdoor unit (outdoor device) 1, and a plurality of (for example, four) indoor units (indoor devices) 3a, 3b, 3c, and 3d. The cooling/heating free multi-type air conditioner 100 includes a high-pressure gas pipe 5, a low-pressure gas pipe 7, and a liquid pipe 9 that connect these respective units. When it is not particularly necessary to discriminate the indoor units from each other, the indoor units are simply referred to as "indoor unit 3". The cooling/heating free multi-type air conditioner 100 can perform a cooling operation or a heating operation respectively independently by the indoor units 3a to 3d. FIG. 1 illustrates an operation pattern in which all the indoor units 3a to 3d perform a heating operation.

[0017] The outdoor unit 1 includes a plurality of (for example, two) compressors 10a and 10b, and a plurality of (for example, three) outdoor heat exchangers 12a, 12b, and 12c. When it is not particularly necessary to discriminate the compressors and the outdoor heat exchangers from each other, they are simply referred to as "compressor 10" and "outdoor heat exchanger 12".

[0018] The compressors 10a and 10b are for compressing a refrigerant and a scroll compressor is preferably used therefor. There may be a case where two compressors 10a and 10b are operated simultaneously, or a case where only one compressor is operated and the other compressor is set as a backup, according to required capacity. For example, R401A is used for the refrigerant. The R401A has a density 1.4 times (5°C) as high as that of R22 or R407C, which are conventional refrigerants, and has a pressure about 1.6 times (5°C) as high as that of the R22 or R407C. Such high-density and high-pressure refrigerant exerts high refrigeration performance, and has a less pressure loss.

[0019] The refrigerant compressed by the respective compressors 10a and 10b becomes a high-pressure gas refrigerant. After the refrigerant flows through respective refrigerant discharge pipes 21a and 21b, the refrigerant converges in an outdoor high-pressure gas pipe 21. The outdoor high-pressure gas pipe 21 is connected to the high-pressure gas pipe 5 described above. The outdoor high-pressure gas pipe 21 includes a high-pressure branch pipe 24 further branched at a branch point 23, and the high-pressure branch pipe 24 is branched into three pipes, that is, a first high-pressure branch pipe 24a, a second high-pressure branch pipe 24b, and a third high-pressure branch pipe 24c. The first high-pressure branch pipe 24a, the second high-pressure branch pipe 24b, and the third high-pressure branch pipe 24c are connected to a first outdoor four-way valve 14a, a second outdoor four-way valve 14b, and a third outdoor four-way valve 14c respectively via a first outdoor control valve 27a, a second outdoor control valve 27b, and a third outdoor control valve 27c. The first to third outdoor four-way valves 14a to 14c, and the first to third outdoor control valves 27a to 27c are described later in detail.

[0020] Refrigerant suction pipes 22a and 22b are provided respectively on suction sides of the compressors 10a and 10b, and the refrigerant suction pipes 22a and 22b are connected to an accumulator 20 that separates a liquid refrigerant contained in the gas refrigerant sucked by the compressors 10a and 10b. An outdoor low-pressure gas pipe 22 connected to the low-pressure gas pipe 7 is coupled to the accumulator 20. The outdoor low-pressure gas pipe 22 is branched into three pipes, including a first low-pressure branch pipe 26a, a second low-pressure branch pipe 26b, and a third low-pressure branch pipe 26c. The first low-pressure branch pipe 26a, the second low-pressure branch pipe 26b, and the third low-pressure branch pipe 26c are connected respectively to the first to third outdoor four-way valves 14a to 14c.

[0021] The outdoor heat exchanger 12 performs heat

exchange with outdoor air, and operates as a condenser or an evaporator according to the state of the refrigerant passing therethrough. In the present embodiment, the outdoor heat exchanger 12 includes the first outdoor heat exchanger 12a, the second outdoor heat exchanger 12b, and the third outdoor heat exchanger 12c arranged in parallel. The degree of heat exchange capacity (heat exchange performance) of the outdoor heat exchanger is set in the order of "the first outdoor heat exchanger 12a < the second outdoor heat exchanger 12b < the third outdoor heat exchanger 12c". A first outdoor-liquid branch pipe 19a, a second outdoor-liquid branch pipe 19b, and a third outdoor-liquid branch pipe 19c are connected respectively to one end of the first outdoor heat exchanger 12a, the second outdoor heat exchanger 12b, and the third outdoor heat exchanger 12c. The first outdoor-liquid branch pipe 19a, the second outdoor-liquid branch pipe 19b, and the third outdoor-liquid branch pipe 19c are respectively provided with a first outdoor-side expansion valve 13a, a second outdoor-side expansion valve 13b, and a third outdoor-side expansion valve 13c near the respective outdoor heat exchangers 12a to 12c.

[0022] The first outdoor-liquid branch pipe 19a, the second outdoor-liquid branch pipe 19b, and the third outdoor-liquid branch pipe 19c are connected to one outdoor liquid pipe 19. The outdoor liquid pipe 19 is connected to the liquid pipe 9 described above, and is provided with a receiver 29 that stores therein the liquid refrigerant, and a super-cooler 28 that super-cools the refrigerant flowing through the outdoor liquid pipe 19 at the time of a cooling operation. The super-cooler 28 extracts a part of the liquid refrigerant flowing through the outdoor liquid pipe 19, and super-cools the liquid refrigerant flowing through the outdoor liquid pipe 19 by the refrigerant cooled by expanding and vaporizing the refrigerant by an expansion valve 28a. The gas refrigerant used for super-cooling and vaporized is returned to the accumulator 20.

[0023] The other end of the first outdoor heat exchanger 12a, the second outdoor heat exchanger 12b, and the third outdoor heat exchanger 12c is connected respectively to the first to third outdoor four-way valves 14a to 14c via a first gas refrigerant pipe 25a, a second gas refrigerant pipe 25b, and a third gas refrigerant pipe 25c.

[0024] Because the first to third outdoor control valves 27a to 27c have the same configuration, only the first outdoor control valve 27a is described. The first outdoor control valve 27a is an on-off valve that is provided in the first high-pressure branch pipe 24a to supply the gas refrigerant discharged from the compressor 10 to the first outdoor heat exchanger 12a via the first outdoor four-way valve 14a, or to shut off the supply. In the present embodiment, the first to third outdoor control valves 27a to 27c are provided respectively corresponding to the first outdoor heat exchanger 12a, the second outdoor heat exchanger 12b, and the third outdoor heat exchanger 12c. However, it suffices to provide the outdoor control valve at least in the third high-pressure branch pipe 24c corresponding to the third outdoor heat exchanger 12c

having the largest heat exchange capacity.

[0025] Because the first to third outdoor four-way valves 14a to 14c have the same configuration, only the first outdoor four-way valve 14a is described by adding a like reference sign. The first outdoor four-way valve 14a includes a high-pressure gas-pipe port 14-1 connected with the first high-pressure branch pipe 24a, an outdoor heat exchanger-side port 14-2 connected with the first gas refrigerant pipe 25a, a low-pressure gas pipe-side port 14-3 connected with the first low-pressure branch pipe 26a, and a bypass pipe-side port 14-4 connected with the first low-pressure branch pipe 26a via a strainer 17a and a capillary tube 18a.

[0026] The first outdoor four-way valve 14a forms a flow channel of a refrigerant by causing the four ports described above to communicate with each other. Specifically, the high-pressure gas-pipe port 14-1 and the outdoor heat exchanger-side port 14-2 communicate with each other, and the low-pressure gas pipe-side port 14-3 and the bypass pipe-side port 14-4 communicate with each other. Accordingly, a high-pressure gas flow channel is formed through which a refrigerant flows from a discharge side of the compressor 10 to the first outdoor heat exchanger 12a via the first high-pressure branch pipe 24a, the first outdoor control valve 27a, the first outdoor four-way valve 14a, and the first gas refrigerant pipe 25a. In this case, flow of a refrigerant to the first outdoor heat exchanger 12a can be shut off by closing the first outdoor control valve 27a, and the heat exchange capacity of the outdoor heat exchanger 12 to be used as a condenser at the time of, for example, a cooling operation under a low external temperature environment can be suppressed, thereby enabling to prevent accumulation of a liquid refrigerant in the unused outdoor heat exchanger (the first outdoor heat exchanger 12a). In this case, the capillary tube 18a is connected to the first low-pressure branch pipe 26a at opposite ends thereof via the first outdoor four-way valve 14a to form a closed loop.

[0027] The first outdoor four-way valve 14a causes the outdoor heat exchanger-side port 14-2 to communicate with the low-pressure gas pipe-side port 14-3, and causes the high-pressure gas-pipe port 14-1 to communicate with the bypass pipe-side port 14-4. Accordingly, a low-pressure gas flow channel is formed through which a refrigerant flows from the first outdoor heat exchanger 12a to the suction side of the compressor 10 via the first gas refrigerant pipe 25a, the first outdoor four-way valve 14a, and the first low-pressure branch pipe 26a. In this case, the first outdoor heat exchanger 12a is used as an evaporator. Therefore, the first outdoor control valve 27a is outside the flow channel of the refrigerant, and thus the outdoor control valve having a large bore is not required as compared to a case where the first outdoor control valve 27a is provided in the first gas refrigerant pipe 25a. Further in this case, a high-pressure refrigerant flowing through the first high-pressure branch pipe 24a is depressurized by the capillary tube 18a, and flows into the first low-pressure branch pipe 26a. Due to this con-

figuration, by closing the first outdoor control valve 27a, flow of a refrigerant from the discharge side of the compressor 10 to the suction side of the compressor 10 can be shut off via the capillary tube 18a. Therefore, flow of a refrigerant that is not directly involved with an air conditioning operation can be shut off, and as a result, a decline in air conditioning performance can be suppressed. Meanwhile, if the first outdoor control valve 27a is kept closed, it is assumed that the high-pressure gas refrigerant between the first outdoor control valve 27a and the compressor 10 is cooled and liquefied, and the liquid refrigerant accumulates therein. Accordingly, by releasing the first outdoor control valve 27a regularly or irregularly for a predetermined time (for example, 10 seconds) during a period with the first outdoor control valve 27a being closed, the accumulated liquid refrigerant can be discharged via the capillary tube 18a.

[0028] The indoor unit 3 is provided in plural, and the configurations of the respective indoor units 3a to 3d are the same. The indoor unit 3a is described here, and descriptions of the other indoor units 3b to 3d are omitted. The indoor unit 3a includes an indoor heat exchanger 40 that performs heat exchange with indoor air. An indoor-side expansion valve 42 is provided in a liquid-refrigerant branch pipe 9c that connects the indoor heat exchanger 40 with the liquid pipe 9.

[0029] The indoor unit 3a is provided with a shunt controller 46 that switches the high-pressure gas pipe 5 and the low-pressure gas pipe 7 and connects one of them with the indoor heat exchanger 40. The shunt controller 46 includes an indoor-side four-way valve 48. The indoor-side four-way valve 48 includes a high-pressure gas-pipe port 48-1 connected to the high-pressure-gas branch pipe 5c branched from a main pipe of the high-pressure gas pipe 5, an indoor heat exchanger-side port 48-2 connected to the side of the indoor heat exchanger 40, a low-pressure gas-pipe port 48-3 connected to an indoor-side low-pressure-gas branch pipe 7c branched from a main pipe of the low-pressure gas pipe 7, and a low-pressure bypass pipe port 48-4 connected to the indoor-side low-pressure-gas branch pipe 7c via a first capillary tube 57.

[0030] At the time of a heating operation, the indoor-side four-way valve 48 causes the high-pressure gas-pipe port 48-1 to communicate with the indoor heat exchanger-side port 48-2, and causes the low-pressure gas-pipe port 48-3 to communicate with the low-pressure bypass pipe port 48-4. At the time of a cooling operation described later, the indoor-side four-way valve 48 causes the high-pressure gas-pipe port 48-1 to communicate with the low-pressure bypass pipe port 48-4, and causes the indoor heat exchanger-side port 48-2 to communicate with the low-pressure gas-pipe port 48-3.

[0031] A high-pressure-gas branch-pipe on-off valve 52 is provided in the high-pressure-gas branch pipe 5c on the upstream side of the indoor-side four-way valve 48. A second capillary tube 55 is provided to bypass the high-pressure-gas branch-pipe on-off valve 52. A

high/low-pressure bypass pipe provided with a first high/low-pressure bypass-pipe on-off valve 60 and a third capillary tube 62 sequentially from the side of the high-pressure-gas branch pipe 5c toward the indoor-side low-pressure-gas branch pipe 7c is connected between the high-pressure-gas branch pipe 5c on the upstream side of the second capillary tube 55 and the indoor-side low-pressure-gas branch pipe 7c. A high/low-pressure bypass pipe provided with a second high/low-pressure bypass-pipe on-off valve 63 and a fourth capillary tube 64 sequentially from the side of the high-pressure-gas branch pipe 5c toward the indoor-side low-pressure-gas branch pipe 7c is connected between the high-pressure-gas branch pipe 5c on the downstream side of the second capillary tube 55 and the indoor-side low-pressure-gas branch pipe 7c. An indoor-side control valve 65 that supplies a refrigerant to the indoor-side four-way valve 48 or shuts off supply of the refrigerant is provided in the high-pressure-gas branch pipe 5c on the upstream side of the indoor-side four-way valve 48 between the indoor-side four-way valve 48 and the high-pressure-gas branch-pipe on-off valve 52. At the time of a cooling operation, similarly to the first outdoor control valve 27a described above, the indoor-side control valve 65 shuts off flow of a refrigerant from the side of the high-pressure-gas branch pipe 5c toward the side of the indoor-side low-pressure-gas branch pipe 7c via the first capillary tube 57. Flow of a refrigerant that is not directly involved with an air conditioning operation can be shut off by the indoor-side control valve 65, and as a result, a decline of air conditioning performance can be suppressed. Meanwhile, if the indoor-side control valve 65 is kept closed, it is assumed that the high-pressure gas refrigerant flowing through the high-pressure-gas branch-pipe on-off valve 52 on the downstream side of the indoor-side control valve 65 or the gas refrigerant depressurized by the second capillary tube 55 is cooled and liquefied, and the liquid refrigerant accumulates therein. Accordingly, by releasing the indoor-side control valve 65 regularly or irregularly for a predetermined time (for example, 10 seconds), the accumulated liquid refrigerant can be discharged via the first capillary tube 57.

[0032] Next, operations of the cooling/heating free multi-type air conditioner 100 having the configuration described above are described according to each operation mode. The cooling/heating free multi-type air conditioner of the present embodiment can appropriately change the operation of the outdoor heat exchanger 12 according to the required condensation performance and evaporation performance.

[Full heating operation pattern]

[0033] Operations when a heating operation is selected in all the indoor units 3a to 3d as in the winter time are described next with reference to FIG. 1. In this case, all of the first outdoor heat exchanger 12a to the third outdoor heat exchanger 12c operate as an evaporator.

[0034] A high-pressure gas refrigerant compressed by the compressor 10 is guided to the respective indoor units 3a to 3d through the outdoor high-pressure gas pipe 21 and the high-pressure gas pipe 5. A small portion of the high-pressure gas refrigerant flows toward the respective first to third outdoor four-way valves 14a to 14c through the high-pressure branch pipe 24 branched at the branch point 23 of the outdoor high-pressure gas pipe 21, and the first high-pressure branch pipe 24a, the second high-pressure branch pipe 24b, and the third high-pressure branch pipe 24c which are branched from the high-pressure branch pipe 24. In this case, in the first to third outdoor four-way valves 14a to 14c, the high-pressure gas-pipe port 14-1 communicates with the bypass pipe-side port 14-4, and the outdoor heat exchanger-side port 14-2 communicates with the low-pressure gas pipe-side port 14-3. Further, the first outdoor control valve 27a, the second outdoor control valve 27b, and the third outdoor control valve 27c respectively provided in the first high-pressure branch pipe 24a, the second high-pressure branch pipe 24b, and the third high-pressure branch pipe 24c are all closed.

[0035] Therefore, inflow of the refrigerant having flowed into the first high-pressure branch pipe 24a, the second high-pressure branch pipe 24b, and the third high-pressure branch pipe 24c to the first outdoor four-way valve 14a, the second outdoor four-way valve 14b, and the third outdoor four-way valve 14c is shut off by the first outdoor control valve 27a, the second outdoor control valve 27b, and the third outdoor control valve 27c. Therefore, it is prevented that the high-pressure gas refrigerant having flowed into the respective first to third outdoor four-way valves 14a to 14c flows into the first low-pressure branch pipe 26a to the third low-pressure branch pipe 26c after having passed through the bypass pipe-side port 14-4 and having been depressurized by the capillary tube 18a, a capillary tube 18b, and a capillary tube 18c.

[0036] The high-pressure gas refrigerant guided to the indoor units 3a to 3d by the high-pressure gas pipe 5 passes through the respective high-pressure-gas branch pipes 5c and flows into the respective shunt controllers 46. The indoor-side four-way valve 48 of the shunt controller 46 causes the high-pressure gas-pipe port 48-1 to communicate with the indoor heat exchanger-side port 48-2, and causes the low-pressure gas-pipe port 48-3 to communicate with the low-pressure bypass pipe port 48-4. In this operation pattern, the high-pressure-gas branch-pipe on-off valve 52 and the indoor-side control valve 65 are opened, and the first high/low-pressure bypass-pipe on-off valve 60 and the second high/low-pressure bypass-pipe on-off valve 63 are closed.

[0037] Therefore, the high-pressure gas refrigerant passes through the indoor-side four-way valve 48 and is guided to the indoor heat exchanger 40, and the high-pressure gas refrigerant is condensed and liquefied in the indoor heat exchanger 40, such that heat is applied to indoor air for heating. The high-pressure liquid refrigerant

erant liquefied in the indoor heat exchanger 40 passes through the liquid-refrigerant branch pipe 9c and converges in the liquid pipe 9 that is the main pipe. After the high-pressure liquid refrigerant is guided to the outdoor unit 1 by the liquid pipe 9 and circulated in the outdoor liquid pipe 19, the high-pressure liquid refrigerant is branched to flow to the first outdoor-liquid branch pipe 19a, the second outdoor-liquid branch pipe 19b, and the third outdoor-liquid branch pipe 19c, and is respectively depressurized by the first outdoor-side expansion valve 13a, the second outdoor-side expansion valve 13b, and the third outdoor-side expansion valve 13c to become a low-pressure liquid refrigerant. The low-pressure liquid refrigerant draws heat from outdoor air in the first outdoor heat exchanger 12a, the second outdoor heat exchanger 12b, and the third outdoor heat exchanger 12c, thereby evaporating to become a low-pressure gas refrigerant. The low-pressure gas refrigerant is guided to the respective first to third outdoor four-way valves 14a to 14c described above via the first to third gas refrigerant pipes 25a to 25c, and then converges in the outdoor low-pressure gas pipe 22 via the first to third low-pressure branch pipes 26a to 26c. The low-pressure gas refrigerant is branched again to the refrigerant suction pipes 22a and 22b and returned to the compressors 10a and 10b.

[0038] In this manner, when all the indoor units 3a to 3d perform a heating operation, the first outdoor control valve 27a, the second outdoor control valve 27b, and the third outdoor control valve 27c are closed. Therefore, inflow of a refrigerant to the first outdoor four-way valve 14a, the second outdoor four-way valve 14b, and the third outdoor four-way valve 14c is shut off. Therefore, it can be prevented that a high-pressure gas refrigerant having flowed into the respective first to third outdoor four-way valves 14a to 14c flows into the first low-pressure branch pipe 26a to the third low-pressure branch pipe 26c after having passed through the bypass pipe-side port 14-4 and having been depressurized by the capillary tubes 18a to 18c. On the other hand, if the first outdoor control valve 27a is kept closed, it is assumed that a high-pressure gas refrigerant between the first outdoor control valve 27a and the compressor 10 is cooled and liquefied, and a liquid refrigerant accumulates therein. Accordingly, by releasing the first outdoor control valve 27a regularly or irregularly for a predetermined time (for example, 10 seconds), the accumulated liquid refrigerant can be discharged via the capillary tube 18a.

[Mainly cooling operation pattern (low external temperature)]

[0039] FIG. 2 is a schematic configuration diagram illustrating an operation pattern of a mainly cooling operation under a low external temperature environment. This operation pattern indicates a case such as in a computer room where even under an environment in which the external temperature is a predetermined temperature (for example, 20°C or lower), a mainly cooling operation is

performed.

[0040] In FIG. 2, a heating operation is selected in the indoor unit 3a, and a cooling operation is selected in the indoor units 3b, 3c, and 3d. In this operation pattern, the required cooling performance is not so high as in the summer time, and the required condensation performance is relatively small (for example, 50% of the performance). Therefore, the second outdoor heat exchanger 12b and the third outdoor heat exchanger 12c are shut down.

[0041] A high-pressure gas refrigerant compressed by the compressor 10 is guided to the respective indoor units 3a to 3d through the outdoor high-pressure gas pipe 21 and the high-pressure gas pipe 5. A portion of the high-pressure gas refrigerant flows toward the respective first to third outdoor four-way valves 14a to 14c through the high-pressure branch pipe 24 branched at the branch point 23 of the outdoor high-pressure gas pipe 21, and the first high-pressure branch pipe 24a, the second high-pressure branch pipe 24b, and the third high-pressure branch pipe 24c which are branched from the high-pressure branch pipe 24. In this case, in the first to third outdoor four-way valves 14a to 14c, the high-pressure gas-pipe port 14-1 communicates with the outdoor heat exchanger-side port 14-2 and the low-pressure gas pipe-side port 14-3 communicates with the bypass pipe-side port 14-4. Further, the first outdoor control valve 27a is opened, and the second outdoor control valve 27b and the third outdoor control valve 27c are closed. Accordingly, inflow of the high-pressure gas refrigerant from the compressor 10 to the second outdoor heat exchanger 12b and the third outdoor heat exchanger 12c is prevented, and the second outdoor heat exchanger 12b and the third outdoor heat exchanger 12c are shut down.

[0042] The high-pressure gas refrigerant having flowed into the first outdoor four-way valve 14a through the first outdoor control valve 27a flows into the first outdoor heat exchanger 12a via the first gas refrigerant pipe 25a, and is condensed and liquefied in the first outdoor heat exchange 12a to discharge heat to outdoor air. The liquid refrigerant is depressurized by the first outdoor-side expansion valve 13a, to become a low-pressure liquid refrigerant. The low-pressure liquid refrigerant is supercooled by the super-cooler 28, and fed to the indoor units 3a to 3d through the outdoor liquid pipe 19 and the liquid pipe 9.

[0043] The indoor unit 3a is switched from a cooling operation to a heating operation by switching the indoor-side four-way valve 48. That is, the indoor-side four-way valve 48 is switched so that the high-pressure gas-pipe port 48-1 communicates with the indoor heat exchanger-side port 48-2 and the low-pressure gas-pipe port 48-3 communicates with the low-pressure bypass pipe port 48-4 at the time of a heating operation.

[0044] On the other hand, because the indoor units 3b, 3c, and 3d are performing a cooling operation, the indoor-side four-way valve 48 causes the high-pressure gas-pipe port 48-1 to communicate with the low-pressure by-

pass pipe port 48-4 and causes the indoor heat exchanger-side port 48-2 to communicate with the low-pressure gas-pipe port 48-3. In this configuration, in the indoor unit 3a that performs a heating operation, the high-pressure-gas branch-pipe on-off valve 52 and the indoor-side control valve 65 are opened, and the first high/low-pressure bypass-pipe on-off valve 60 and the second high/low-pressure bypass-pipe on-off valve 63 are closed. In the indoor units 3b, 3c, and 3d that perform a cooling operation, the high-pressure-gas branch-pipe on-off valve 52, the indoor-side control valve 65, the first high/low-pressure bypass-pipe on-off valve 60, and the second high/low-pressure bypass-pipe on-off valve 63 are all closed.

[0045] Therefore, the high-pressure gas refrigerant passes through the indoor-side four-way valve 48 of the indoor unit 3a and is guided to the indoor heat exchanger 40, and condensed and liquefied in the indoor heat exchanger 40, such that heat is applied to indoor air for heating. The high-pressure liquid refrigerant liquefied in the indoor heat exchanger 40 passes through the liquid-refrigerant branch pipe 9c and converges in the liquid pipe 9 that is the main pipe, and converges with the liquid refrigerant flowing from the outdoor unit 1 in the liquid pipe 9.

[0046] The liquid refrigerant flows into the respective indoor units 3b to 3d through the liquid-refrigerant branch pipe 9c and is guided to the indoor heat exchanger 40, and is evaporated in the indoor heat exchanger 40 to perform cooling of indoor air. The low-temperature gas refrigerant evaporated in the indoor heat exchanger 40 passes through the indoor-side four-way valve 48, flows into the indoor-side low-pressure-gas branch pipe 7c to converge in the low-pressure gas pipe 7, and is returned to the compressors 10a and 10b through the outdoor low-pressure gas pipe 22, and the refrigerant suction pipes 22a and 22b. On the other hand, at the time of a cooling operation, if the indoor-side control valve 65 of the respective indoor units 3b to 3d is kept closed, it is assumed that the high-pressure gas refrigerant flowing through the high-pressure-gas branch-pipe on-off valve 52 on the downstream side of the indoor-side control valve 65, or the gas refrigerant depressurized in the second capillary tube 55 is cooled and liquefied, and the liquid refrigerant accumulates therein. Accordingly, by releasing the indoor-side control valve 65 regularly or irregularly for a predetermined time (for example, 10 seconds), the accumulated liquid refrigerant can be discharged via the first capillary tube 57.

[0047] In this configuration, because the first to third outdoor control valves 27a to 27c that control flow of a refrigerant from the compressor 10 to the first to third outdoor four-way valves 14a to 14c are provided, by closing the first to third outdoor control valves 27a to 27c, the refrigerant does not flow to the first to third outdoor heat exchangers 12a to 12c corresponding to the first to third outdoor control valves 27a to 27c. Therefore, for example at the time of a cooling operation under a low external

temperature environment, the capacity of the outdoor heat exchanger to be used as a condenser can be suppressed, and accumulation of a liquid refrigerant in the unused second outdoor heat exchanger 12b and third outdoor heat exchanger 12c can be prevented. Further, because the first to third outdoor control valves 27a to 27c are arranged between the first to third outdoor four-way valves 14a to 14c and the discharge side of the compressor 10, the first to third outdoor control valves 27a to 27c are outside the flow channel of the refrigerant, and thus the outdoor control valve having a large bore is not required as compared to a case where the first to third outdoor control valves 27a to 27c are provided in the first to third gas refrigerant pipes 25a to 25c.

[0048] While embodiments of the present invention have been described above, the present embodiments are only examples and are not intended to limit the scope of the invention. These embodiments can also be carried out by various other modes, and various omissions, replacements, and changes can be made without departing from the scope of the invention. Such embodiments and modifications thereof are included in the scope of the invention and are also included in the scope of the invention described in the claims and equivalents thereof. In the embodiments, while the number of the outdoor heat exchanger 12 is three, the number is not limited thereto and can be appropriately changed according to the required performance. The number of the indoor unit 3 can also be appropriately changed according to the intended application. Further, while the number of the compressor 10 is two in the embodiments, the number is not limited thereto and can be appropriately changed according to the required performance.

Reference Signs List

[0049]

- 1 outdoor unit (outdoor device)
- 3, 3a, 3b, 3c, 3d indoor unit (indoor device)
- 5 high-pressure gas pipe
- 7 low-pressure gas pipe
- 9 liquid pipe
- 10, 10a, 10b compressor
- 12 outdoor heat exchanger
- 12a first outdoor heat exchanger
- 12b second outdoor heat exchanger
- 12c third outdoor heat exchanger
- 14a first outdoor four-way valve
- 14b second outdoor four-way valve
- 14c third outdoor four-way valve
- 18a capillary tube
- 24a first high-pressure branch pipe
- 24b second high-pressure branch pipe
- 24c third high-pressure branch pipe
- 25a first gas refrigerant pipe
- 25b second gas refrigerant pipe
- 25c third gas refrigerant pipe

26a first low-pressure branch pipe
 26b second low-pressure branch pipe
 26c third low-pressure branch pipe
 27a first outdoor control valve
 27b second outdoor control valve
 27c third outdoor control valve
 40 indoor heat exchanger
 42 indoor-side expansion valve
 46 shunt controller
 48 indoor-side four-way valve
 57 first capillary tube
 65 indoor-side control valve
 100 cooling/heating free multi-type air conditioner
 (air conditioning apparatus)

Claims

1. An air conditioning apparatus (100) provided with an outdoor device (1) and a plurality of indoor devices (3, 3a, 3b, 3c) respectively having an indoor heat exchanger (40), in which the outdoor device (1) and the indoor devices are connected to each other by a high-pressure gas pipe (5), a low-pressure gas pipe (7), and a liquid pipe (9) so that the indoor devices can perform a cooling operation or a heating operation independently, wherein the outdoor device includes a compressor (10) with a discharge side thereof being connected to the high-pressure gas pipe and a suction side thereof being connected to the low-pressure gas pipe, a plurality of outdoor heat exchangers (12a, 12b, 12c) connected to the liquid pipe in parallel, a plurality of outdoor four-way valves (14a, 14b, 14c) provided between the compressor and the respective outdoor heat exchangers to switch a high-pressure gas flow channel from the discharge side of the compressor toward the outdoor heat exchanger and a low-pressure flow channel from the outdoor heat exchanger toward the suction side of the compressor respectively selectively, a plurality of capillary tubes (18a, 18b, 18c) with one end thereof connected to a port of the outdoor four-way valve communicating with the discharge side of the compressor and the other end thereof connected to the suction side of the compressor, when the low-pressure gas flow channel of the outdoor four-way valve is selected, and an outdoor control valve (27a, 27b, 27c) arranged between at least one of the outdoor four-way valves and the discharge side of the compressor to control flow from the compressor to the outdoor four-way valve.
2. The air conditioning apparatus (100) according to claim 1, wherein the outdoor heat exchangers respectively have a

configuration in which a heat exchange capacity is different from each other, and the outdoor control valve is arranged between at least the outdoor four-way valve corresponding to the outdoor heat exchanger having a largest heat exchange capacity and the discharge side of the compressor.

3. The air conditioning apparatus (100) according to claim 1 or 2, wherein the outdoor control valves are respectively arranged between the outdoor four-way valves and the discharge side of the compressor.
4. The air conditioning apparatus (100) according to any one of claims 1 to 3, the apparatus being configured so that when the low-pressure gas flow channel of the outdoor four-way valve is selected, the outdoor control valve is closed, and the outdoor control valve is regularly or irregularly released for a predetermined time.

FIG.1

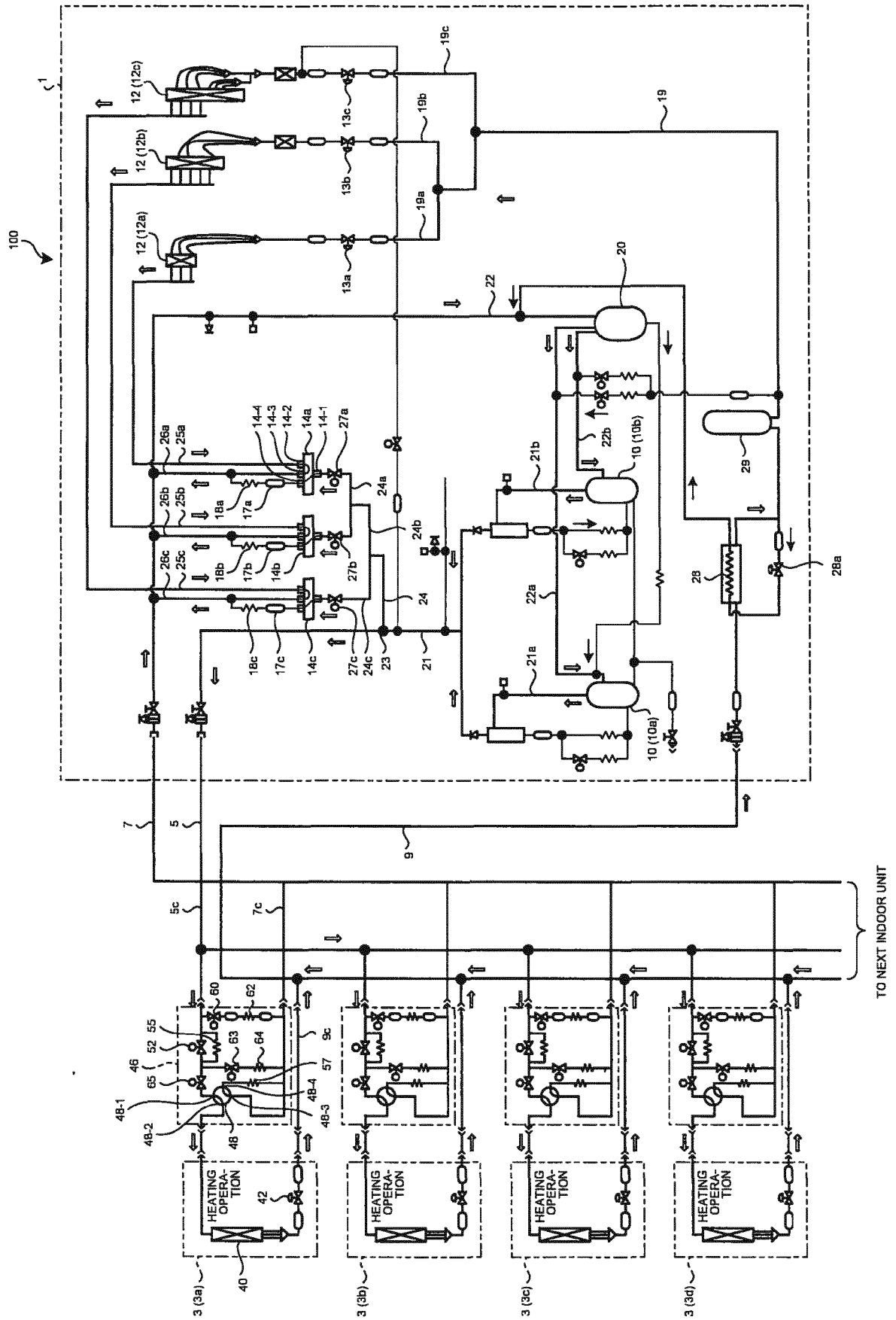
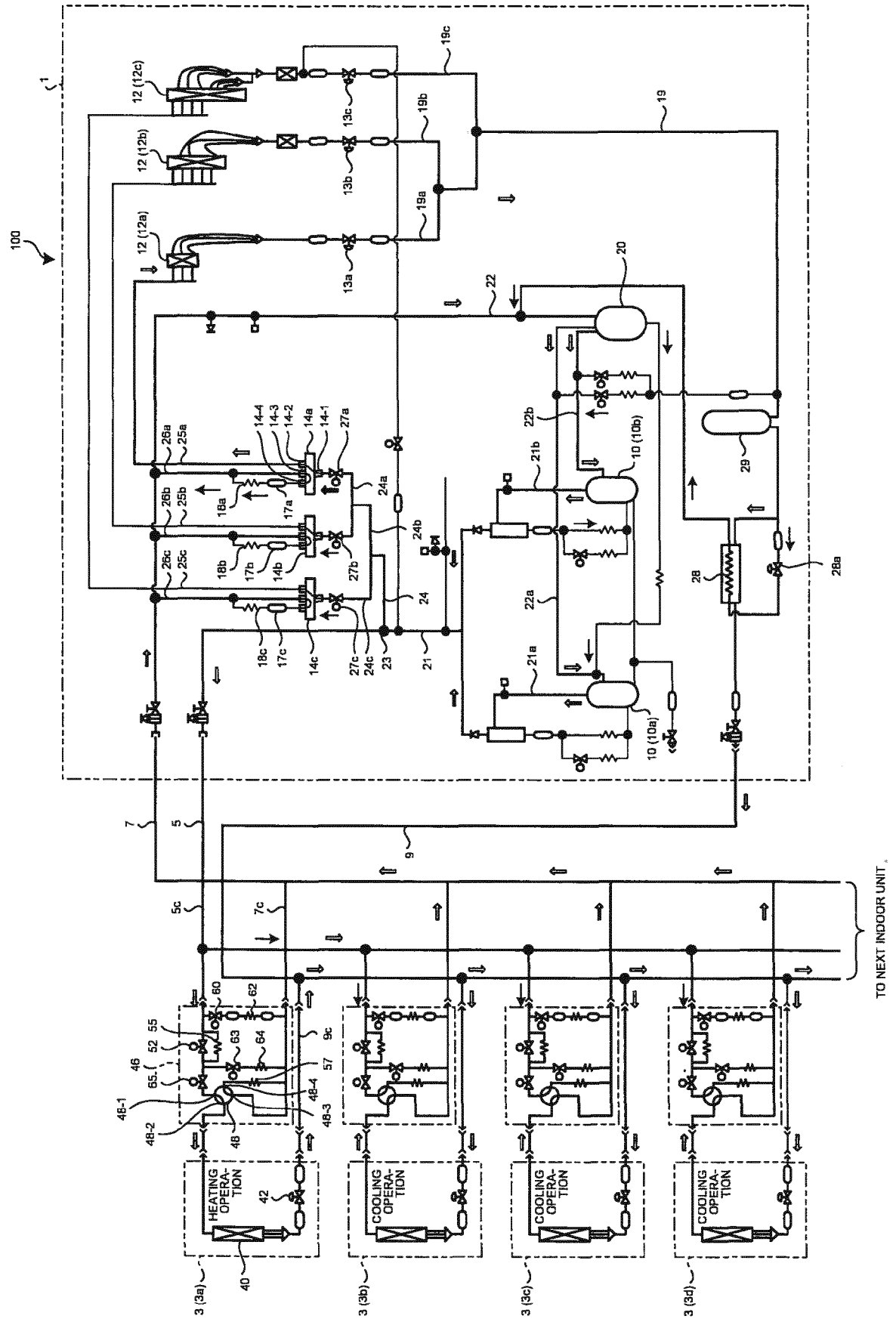


FIG. 2





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