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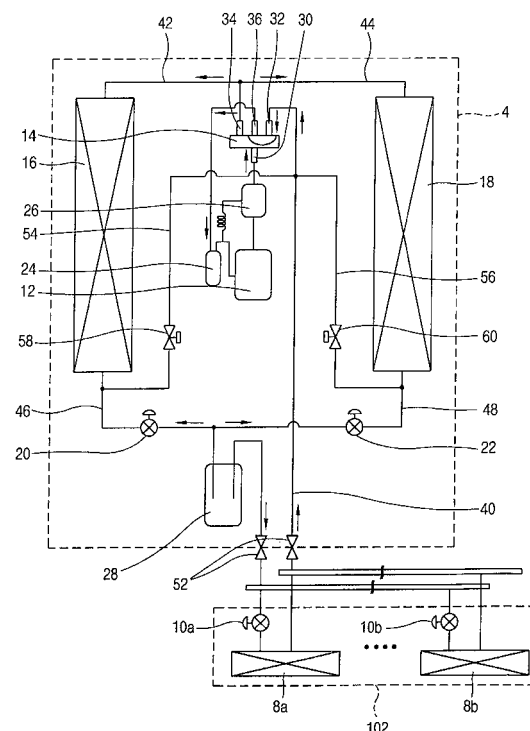
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(54) **Heat pump type air conditioner**

(57) In a heat pump type air conditioner capable of maintaining a room temperature constantly by including two outdoor heat exchangers (16,18) and performing a heating operation with one heat exchanger when the other heat exchanger performs a defrosting operation, the heat pump type air conditioner includes a compressor (12) for compressing a coolant; a four-way valve (14) for switching a flow of the coolant normally or reversely; a first and a second outdoor heat exchangers (16,18) respectively installed outdoors, used as a condenser in cooling and used as an evaporator in heating; plural indoor heat exchangers respectively installed at each indoor space and performing a cooling/heating operation; a first and a second outdoor expansion valves (20,22) respectively installed at coolant pipes for connecting the first and second outdoor heat exchangers (16,18) with the indoor heat exchangers (8a,8b) in order to turn the coolant into a low temperature-low pressure state and open/close the coolant pipes; and a control unit (6) for making one of the first and second outdoor heat exchangers (16,18) perform a defrosting operation and making the rest perform a heating operation by controlling the first and second outdoor expansion valves (20,22).

FIG.2



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a heat pump type air conditioner, and in particular to a heat pump type air conditioner which is capable of performing an indoor heating operation while performing an outdoor defrosting operation.

2. Description of the Prior Art

[0002] In general, a heat pump type air conditioner is an air conditioner performable both a cooling operation and a heating operation. Because it includes an evaporator and a condenser, etc., it can perform a heating operation as well as a cooling operation by reversing a cooling cycle.

[0003] Figure 1 illustrates a cooling cycle of the conventional heat pump type air conditioner.

[0004] The conventional heat pump type air conditioner includes an indoor unit 102 placed indoors and performing cooling or heating and an outdoor unit 104 placed outdoors and performing a heat exchange operation.

[0005] The indoor unit 102 includes at least one indoor heat exchanger 106 installed in each room and performing cooling and heating operations.

[0006] The outdoor unit 104 includes a compressor 108 for compressing a coolant; a four-way valve 110 for switching a flow of the coolant normally or reversely; an outdoor heat exchanger 112 used as a condenser in cooling and an evaporator in heating; and an expansion valve 116 installed at a coolant pipe 114 for connecting the outdoor heat exchanger 112 with the indoor heat exchanger 106 and turning coolant gas into low temperature-low pressure state.

[0007] And, a liquid receiver 118 for dividing the coolant into liquid and gas is installed at the rear of the expansion valve 116, and an opening/closing valve 120 is installed at the coolant pipe 114 between the outdoor heat exchanger 112 and the indoor heat exchanger 106 in order to open the coolant supply to the indoor unit 102 and the coolant discharge to the outdoor unit 104.

[0008] An accumulator 122 for turning the coolant into a gas state is installed at a certain side of the compressor 108, and an oil divider 124 is installed at a discharge side of the compressor 108.

[0009] The operation of the conventional heat pump type air conditioner will be described.

[0010] First, in the cooling operation, the coolant gas compressed in the compressor 108 passes the four-way valve 110, flows into the outdoor heat exchanger 112, is converted into a low temperature-low pressure state while passing the expansion valve 116 and flows into the indoor heat exchanger 106. And, the coolant gas

evaporated in the indoor heat exchanger 106 performs the indoor cooling operation while performing heat-exchange with indoor air and is sucked into the compressor 108 through the four-way valve 110 and is circulated again.

[0011] On the contrary, in the heating operation, by reversing the coolant flow with the four-way valve 110, the coolant gas discharged from the compressor 108 flows into the indoor heat exchanger 106 through the four-way valve 110, is condensed and performs the indoor heating operation while performing heat-exchange with indoor air. Afterward, the coolant passing the indoor heat exchanger 106 is turned into a low temperature-low pressure state and is evaporated through the outdoor heat exchanger 112. The evaporated coolant gas is sucked into the compressor 108 through the four-way valve 110 and is circulated again.

[0012] In the above-described heat pump type air conditioner, in order to perform a defrosting operation, by performing the cooling operation for a certain time, the outdoor heat exchanger 112 is used as a condenser, and accordingly frost formed at the outdoor heat exchanger 112 melts by the condensing heat.

[0013] However, because the heating operation is stopped while performing the defrosting operation, a room temperature is lowered, and accordingly it may have a bad influence upon the indoor circumstances.

[0014] In addition, in the conventional heat pump type air conditioner, in case of a multi type air conditioner in which plural indoor heat exchangers are respectively installed in rooms, because a coolant quantity supplied to each indoor heat exchanger is the same, a heat exchanger capacity of each indoor heat exchanger is the same, and accordingly it is impossible to vary a cooling/heating capacity according to a size of each room.

SUMMARY OF THE INVENTION

[0015] In order to solve the above-mentioned problem, it is an object of the present invention to provide a heat pump type air conditioner which is capable of maintaining a room temperature constantly by including two outdoor heat exchangers and performing a heating operation with one heat exchanger when the other heat exchanger performs a defrosting operation.

[0016] In a multi type air conditioner including plural indoor heat exchangers, it is another object of the present invention to provide a heat pump type air conditioner which is capable of improving a cooling/heating performance by varying a heat exchange performance of each indoor heat exchanger according to a size of each room.

[0017] A heat pump type air conditioner includes a compressor for compressing a coolant; a four-way valve for switching a flow of the coolant normally or reversely; a first and a second outdoor heat exchangers respectively installed outdoors, used as a condenser in cooling and used as an evaporator in heating; plural indoor heat

exchangers respectively installed at each indoor space and performing a cooling/heating operation; a first and a second outdoor expansion valves respectively installed at coolant pipes for connecting the first and second outdoor heat exchangers with the indoor heat exchangers in order to turn the coolant into a low temperature-low pressure state and open/close the coolant pipes; a control unit for making one of the first and second outdoor heat exchangers perform a defrosting operation and making the rest perform a heating operation by controlling the first and second outdoor expansion valves; and plural indoor expansion valves respectively installed at the indoor coolant pipes and variously adjusting a quantity of the coolant flowing into the plural indoor heat exchangers.

[0018] The four-way valve includes a first port connected to a discharge side of the compressor; a second port connected to the indoor heat exchangers by a first coolant pipe; a third port connected to the first and second outdoor heat exchangers by a second and a third coolant pipes; and a fourth port connected to a suction side of the compressor; wherein the first port communicates with the third port and the second port communicates with the fourth port in the cooling operation, and the first port communicates with the second port and the third port communicates with the fourth port in the heating operation.

[0019] The second coolant pipe connects the first outdoor heat exchanger with the four-way valve, a fourth coolant pipe connects the first outdoor heat exchanger with the indoor heat exchangers, a sixth coolant pipe connects the fourth coolant pipe with the second port of the four-way valve, and a first valve is installed at the sixth coolant pipe in order to open/close it according to an electric signal transmitted from the control unit.

[0020] The first valve is a solenoid type for opening the sixth coolant pipe according to an electric signal applied from the control unit.

[0021] The third coolant pipe connects the second outdoor heat exchanger with the four-way valve, a fifth coolant pipe connects the second outdoor heat exchanger with the indoor heat exchangers, a seventh coolant pipe connects the fifth coolant pipe with the second port of the four-way valve, and a second valve is installed at the seventh coolant pipe to open/close it according to an electric signal transmitted from the control unit.

[0022] The second valve is a solenoid type for opening the seventh coolant pipe according to an electric signal applied from the control unit.

[0023] The control unit opens the sixth coolant pipe by operating the first valve and closes the fourth coolant pipe by operating the first outdoor expansion valve in the defrosting operation of the first outdoor heat exchanger.

[0024] The control unit opens the seventh coolant pipe by operating the second valve and closes the fifth coolant pipe by operating the second outdoor expansion

valve in the defrosting operation of the second outdoor heat exchanger.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

[0026] In the drawings:

Figure 1 illustrates a construction of a cooling cycle of a heat pump type air conditioner in accordance with the conventional art;

Figure 2 illustrates a construction of a cooling cycle of a heat pump type air conditioner in accordance with the present invention;

Figure 3 is a block diagram illustrating a control structure of the heat pump type air conditioner in accordance with the present invention; and Figures 4 and 5 are state diagrams illustrating the cooling cycle of the heat pump type air conditioner in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0027] Hereinafter, the preferred embodiment of a heat pump type air conditioner in accordance with the present invention will be described with reference to accompanying drawings.

[0028] There can be plural embodiments of a heat pump type air conditioner in accordance with the present invention, hereinafter the most preferred embodiment will be described.

[0029] Figure 2 illustrates a construction of a cooling cycle of a heat pump type air conditioner in accordance with the present invention.

[0030] The heat pump type air conditioner in accordance with the present invention includes an indoor unit 2 installed indoors and performing a cooling or a heating operation; an outdoor unit 4 installed outdoors, connected to the indoor unit 2 by a coolant pipe and performing a heat exchange operation; and a control unit 6 respectively controlling a cooling operation, a heating operation and a defrosting operation.

[0031] The indoor unit 2 includes plural indoor heat exchangers 8a, 8b respectively installed at each indoor space; and plural indoor expansion valves 10a, 10b for turning the coolant into a low temperature-low pressure state and adjusting a flow amount of the coolant supplied to each indoor heat exchanger 8a, 8b.

[0032] And, the outdoor unit 4 includes a compressor 12 for compressing the coolant; a four-way valve 14 for switching a flow of the coolant into a normal direction or a reverse direction; a first and a second outdoor heat

exchangers 16, 18 used as a condenser in a cooling operation and an evaporator in a heating operation; and a first and a second outdoor expansion valves 20, 22 respectively installed at coolant pipes connecting the first and second heat exchangers 16, 18 with the indoor heat exchangers 8a, 8b, turning the coolant gas into a low temperature-low pressure state and opening/closing the coolant pipes.

[0033] An accumulator 24 for sucking the coolant is installed at a suction side of the compressor 12, and an oil divider 26 is installed at a discharge side of the compressor 12.

[0034] And, a liquid receiver 28 is connected to the coolant pipes connecting the first and second outdoor heat exchangers 16, 18 with the indoor heat exchangers 8a, 8b.

[0035] The four-way valve 14 includes a first port 30 connected to the discharge side of the compressor 12; a second port 32 connected to the indoor heat exchangers 8a, 8b; a third port 34 connected to the first and second outdoor heat exchangers 16, 18; and a fourth port 36 connected to the suction part of the compressor 12.

[0036] In the cooling operation, because the four-way valve 14 respectively connects the second port 32 and the fourth port 36 with the first port 30 and the third port 34, the coolant flows in the normal direction. And, in the heating operation, because the four-way valve 14 respectively connects the first port 30 and the second port 32 with the third port 34 and the fourth port 36, the coolant flows in the reverse direction.

[0037] A first coolant pipe 40 connects the second port 32 of the four-way valve 14 with the indoor heat exchangers 8a, 8b, a second coolant pipe 42 connects the third port 34 with the first outdoor heat exchanger 16, and a third coolant pipe 44 connects the third port 34 with the second outdoor heat exchanger 18.

[0038] And, a fourth coolant pipe 46 connects the first outdoor heat exchanger 16 with the indoor heat exchangers 8a, 8b, and a fifth coolant pipe 48 connects the second outdoor heat exchanger 18 with the indoor heat exchanger 8a, 8b. A first outdoor expansion valve 20 is installed at the fourth coolant pipe 46, and a second outdoor expansion valve 22 is installed at the fifth coolant pipe 48.

[0039] The fourth coolant pipe 46 and the fifth coolant pipe 48 get together and is connected to the liquid receiver 28, and plural indoor expansion valves 10a, 10b are installed at the coolant pipes connecting the liquid receiver 28 with each indoor heat exchanger 8a, 8b.

[0040] And, an opening/closing valve 52 for intermitting a coolant flow is respectively installed at a suction pipe and a discharge pipe connected to the indoor heat exchangers 8a, 8b.

[0041] A sixth coolant pipe 54 connects the fourth coolant pipe 46 with the first coolant pipe 40, and a seventh coolant pipe 56 connects the fifth coolant pipe 48 with the first coolant pipe 40. A first valve 58 is installed at the sixth coolant pipe 54 to open/close it, and a sec-

ond valve 60 is installed at the seventh coolant pipe 56 to open/close it.

[0042] Herein, it is preferable for the first and second valves 58, 60 to be a solenoid type for respectively opening the sixth and seventh coolant pipes 54, 56 when an electric signal is applied from the control unit 6.

[0043] Figure 3 is a block diagram illustrating a control structure of the heat pump type air conditioner in accordance with the present invention.

[0044] As depicted in Figure 3, the heat pump type air conditioner in accordance with the present invention includes an operation selecting unit 70 operated by a user; a first sensing unit 72 for sensing whether the first outdoor heat exchanger 18 is covered with frost not less than a setting value; a second sensing unit 74 for sensing whether the second outdoor heat exchanger 18 is covered with frost not less than a setting value; and a control unit 6 for performing the cooling operation, the heating operation and the defrosting operation in accordance with a signal transmitted from the operation selecting unit 70, the first and second sensing units 72, 74.

[0045] Various types such as a temperature sensor, etc. can be applied to the first and second sensing units 72, 74, and any method capable of grasping whether the first outdoor heat exchanger 16 and the second outdoor heat exchanger 18 are covered with frost can be applied.

[0046] The control unit 6 performs the cooling/heating switching by operating the four-way valve 14 according to the operation of the operation selecting unit 70. The control unit 6 makes one of the first outdoor heat exchanger 20 and the second outdoor heat exchanger 22 perform the defrosting operation and makes the rest perform the heating operation according to the signal received from the first and second sensing units 72, 74.

[0047] And, when the user sets a cooling/heating capacity of each indoor heat exchanger 8a, 8b by operating the operation selecting unit 70, the control unit 6 adjusts a quantity of the coolant supplied to each indoor heat exchanger 8a, 8b by adjusting opening of the indoor expansion valves 10a, 10b.

[0048] The operation of the heat pump type air conditioner in accordance with the present invention will be described.

[0049] First, in the cooling operation, as depicted in Figure 3, when the user selects the cooling operation by handling the operation selecting unit 70, the control unit 6 respectively connects the second port 32 and the fourth port 36 with the first port 30 and the third port 34 by operating the four-way valve 14. And, the first and second valves 58, 60 maintain the closed state.

[0050] In that state, when the compressor 12 is operated, the compressed coolant flows into the first port 30 of the four-way valve 14, is discharged to the third port 34, respectively flows into the first outdoor heat exchanger 16 and the second outdoor heat exchanger 18 through the second and third coolant pipes 42, 44 and

performs the heat exchange. The coolant finishing the heat exchange is discharged into the four and fifth coolant pipes 46, 48, is turned into the low temperature-low pressure state while passing the first and second outdoor expansion valves 20, 22 and flows into each indoor heat exchanger 8a, 8b. And, the coolant gas evaporated in each indoor heat exchanger 8a, 8b performs the indoor cooling while performing the heat exchange with indoor air, flows into the second port 32 of the four-way valve 14 through the first coolant pipe 40, is discharged into the third port 34, flows into the compressor 12, is compressed, and accordingly the coolant is circulated again.

[0051] Figure 4 is a state diagram illustrating the heating operation of the heat pump type air conditioner in accordance with the present invention.

[0052] When the user selects the heating operation by handling the operation selecting unit 70, the control unit 6 connects the first port 30 of the four-way valve 14 with the second port 32, connects the third port 34 with the fourth port 36, and accordingly the coolant flows in the reverse direction. Herein, the first valve 58 and the second valve 60 are in the closed state.

[0053] The coolant compressed by the operation of the compressor 12 flows into the first port 30 of the four-way valve 14, is discharged into the second port 32, flows into the indoor heat exchangers 8a, 8b through the first coolant pipe 40, is condensed and performs the heat exchange with indoor air, and accordingly the indoor heating is performed. The coolant passing the indoor heat exchangers 8a, 8b is turned into the low temperature-low pressure state while passing the indoor expansion valves 10a, 10b, the first and second outdoor expansion valves 10a, 10b and is evaporated while passing the first and second outdoor heat exchanges 16, 18 through the fourth and fifth coolant pipes 46, 48. The evaporated coolant flows again into the third port 34 of the four-way valve 14, is discharged into the fourth port 36, is sucked into the compressor 12, and accordingly the coolant is circulated again.

[0054] In the above-described cooling/heating operation, in case of varying a cooling/heating capacity of each indoor heat exchanger 8a, 8b installed at each indoor space according to a size of the indoor space, when the user selects a heat exchange capacity of each indoor heat exchanger 8a, 8b by handling the operation selecting unit 70, the control unit 6 adjusts opening of each indoor expansion valve 10a, 10b according to the signal of the operation selecting unit 70 in order to adjust a flow amount of the coolant supplied to each indoor heat exchanger 8a, 8b, and accordingly the cooling/heating capacity can be adjusted.

[0055] The defrosting operation of the air conditioner in accordance with the present invention will be described.

[0056] Figure 5 is a state diagram illustrating the defrosting operation of the heat pump type air conditioner in accordance with the present invention.

[0057] When the control unit 6 judges one of the outdoor heat exchanges is covered with frost not less than the setting value after receiving the signal transmitted from the first and second sensing units 72, 74, it makes the outdoor heat exchanger covered with frost to perform the defrosting operation and makes the rest to perform the heating operation.

[0058] For example, as depicted in Figure 5, in the heating operation, it is judged whether the first outdoor heat exchanger 16 requires the defrosting operation (it means the first outdoor heat exchanger 16 is covered with frost not less than a setting value) through the signal received from the first sensing unit 72, the control unit 6 opens the sixth coolant pipe 54 by operating the first valve 58 and closes the fourth coolant pipe 46 by operating the first outdoor expansion valve 20.

[0059] Then, the coolant compressed in the compressor 12 is discharged into the second port 32 of the four-way valve 14, is supplied to each indoor heat exchanger 8a, 8b through the first coolant pipe 40. Part of the coolant discharged into the second port 32 is supplied to the first outdoor heat exchanger 16 through the sixth coolant pipe 54, is condensed and performs the defrosting operation. And, the coolant discharged after finishing the defrosting operation of the first outdoor heat exchanger 16 flows into the compressor 12 through the second coolant pipe 42 and the four-way valve 14. Herein, the second outdoor heat exchanger 18 performs the normal heating operation same as the above-described heating operation.

[0060] As described above, even in the defrosting operation of the first outdoor heat exchanger 16, the second outdoor heat exchanger 18 performs the heating operation normally, and accordingly the indoor heating can be continually performed.

[0061] And, it is judged the second outdoor heat exchanger 18 requires the defrosting operation, the control unit 6 opens the seventh coolant pipe 56 by operating the second valve 60 and closes the fifth coolant pipe 48 by operating the second outdoor expansion valve 60.

[0062] Then, the coolant compressed in the compressor 12 is discharged into the second port 32 of the four-way valve 14, is supplied to each indoor heat exchanger 8a, 8b through the first coolant pipe 40. And, part of the coolant discharged into the second port 32 is supplied to the second outdoor heat exchanger 18 through the seventh coolant pipe 56, is condensed and performs the defrosting operation. And, the coolant discharged after finishing the defrosting operation of the second outdoor heat exchanger 18 flows again into the compressor 12 through the third coolant pipe 44 and the four-way valve 14. Herein, the first outdoor heat exchanger 16 can normally perform the heating operation same as the above-described heating operation.

[0063] As described above, in the heat pump type air conditioner in accordance with the present invention, by installing an indoor expansion valve at each indoor heat exchanger, a cooling/heating capacity can be varied ac-

according to a size of an indoor space by adjusting a quantity of the coolant supplied to each indoor heat exchanger by adjusting opening of each indoor expansion valve.

[0064] In addition, by including two outdoor heat exchangers, when one outdoor heat exchanger performs the defrosting operation, the rest performs the heating operation, a room temperature can be maintained constantly, and accordingly the indoor circumstances can be maintained pleasantly.

Claims

1. A heat pump type air conditioner, comprising:

a compressor for compressing a coolant;
 a four-way valve for switching a flow of the coolant normally or reversely;
 a first and a second outdoor heat exchangers respectively installed outdoors, used as a condenser in cooling and used as an evaporator in heating;
 plural indoor heat exchangers respectively installed at each indoor space and performing a cooling/heating operation;
 a first and a second outdoor expansion valves respectively installed at coolant pipes for connecting the first and second outdoor heat exchangers with the indoor heat exchangers in order to turn the coolant into a low temperature-low pressure state and open/close the coolant pipes; and
 a control unit for making one of the first and second outdoor heat exchangers perform a defrosting operation and making the rest perform a heating operation by controlling the first and second outdoor expansion valves.

2. The air conditioner of claim 1, further comprising:

plural indoor expansion valves installed at indoor coolant pipes in order to adjust a quantity of the coolant flowing into the plural indoor heat exchangers variously.

3. The air conditioner of claim 1, wherein the four-way valve includes:

a first port connected to a discharge part of the compressor;
 a second port connected to the indoor heat exchangers by a first coolant pipe;
 a third port connected to the first and second outdoor heat exchangers by a second and a third coolant pipes; and
 a fourth port connected to a suction part of the compressor;

wherein the first port communicates with the third port and the second port communicates with the fourth port in the cooling operation, and the first port communicates with the second port and the third port communicates with the fourth port in the heating operation.

4. The air conditioner of claim 1, wherein the second coolant pipe connects the first outdoor heat exchanger with the four-way valve, a fourth coolant pipe connects the first outdoor heat exchanger with the indoor heat exchangers, a sixth coolant pipe connects the fourth coolant pipe with the second port of the four-way valve, and a first valve is installed at the sixth coolant pipe in order to open/close it according to an electric signal transmitted from the control unit.

5. The air conditioner of claim 4, wherein the first valve is a solenoid type for opening the sixth coolant pipe according to an electric signal applied from the control unit.

6. The air conditioner of claim 1, wherein the third coolant pipe connects the second outdoor heat exchanger with the four-way valve, a fifth coolant pipe connects the second outdoor heat exchanger with the indoor heat exchangers, a seventh coolant pipe connects the fifth coolant pipe with the second port of the four-way valve, and a second valve is installed at the seventh coolant pipe to open/close it according to an electric signal transmitted from the control unit.

7. The air conditioner of claim 6, wherein the second valve is a solenoid type for opening the seventh coolant pipe according to an electric signal applied from the control unit.

8. The air conditioner of claim 4, wherein the control unit opens the sixth coolant pipe by operating the first valve and closes the fourth coolant pipe by operating the first outdoor expansion valve in the defrosting operation of the first outdoor heat exchanger.

9. The air conditioner of claim 6, wherein the control unit opens the seventh coolant pipe by operating the second valve and closes the fifth coolant pipe by operating the second outdoor expansion valve in the defrosting operation of the second outdoor heat exchanger.

10. A heat pump type air conditioner, comprising:

a compressor for compressing a coolant;
 a four-way valve for switching a flow of the coolant normally or reversely;

a first and a second outdoor heat exchangers respectively installed outdoors, used as a condenser in cooling and used as an evaporator in heating;

plural indoor heat exchangers respectively installed at each indoor space and performing a cooling/heating operation;

a first and a second outdoor expansion valves respectively installed at coolant pipes for connecting the first and second outdoor heat exchangers with the indoor heat exchangers and opening/closing the coolant pipes;

a control unit for making one of the first and second outdoor heat exchangers perform a heating operation when the other performs a defrosting operation by controlling the first, second outdoor expansion valves and the four-way valve; and

plural indoor expansion valves respectively installed at the indoor coolant pipes and variously adjusting a quantity of the coolant flowing into the plural indoor heat exchangers.

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FIG. 1

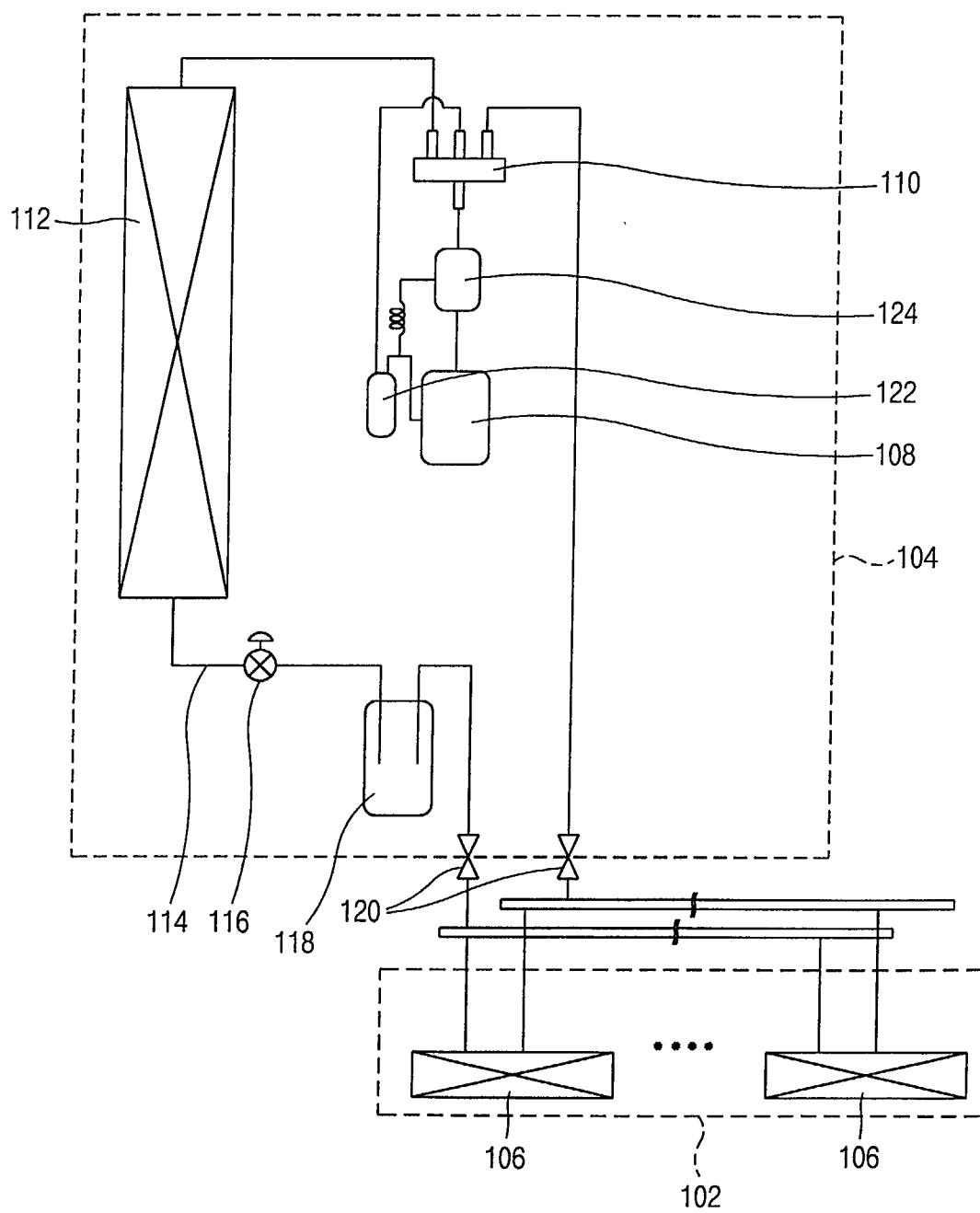


FIG.2

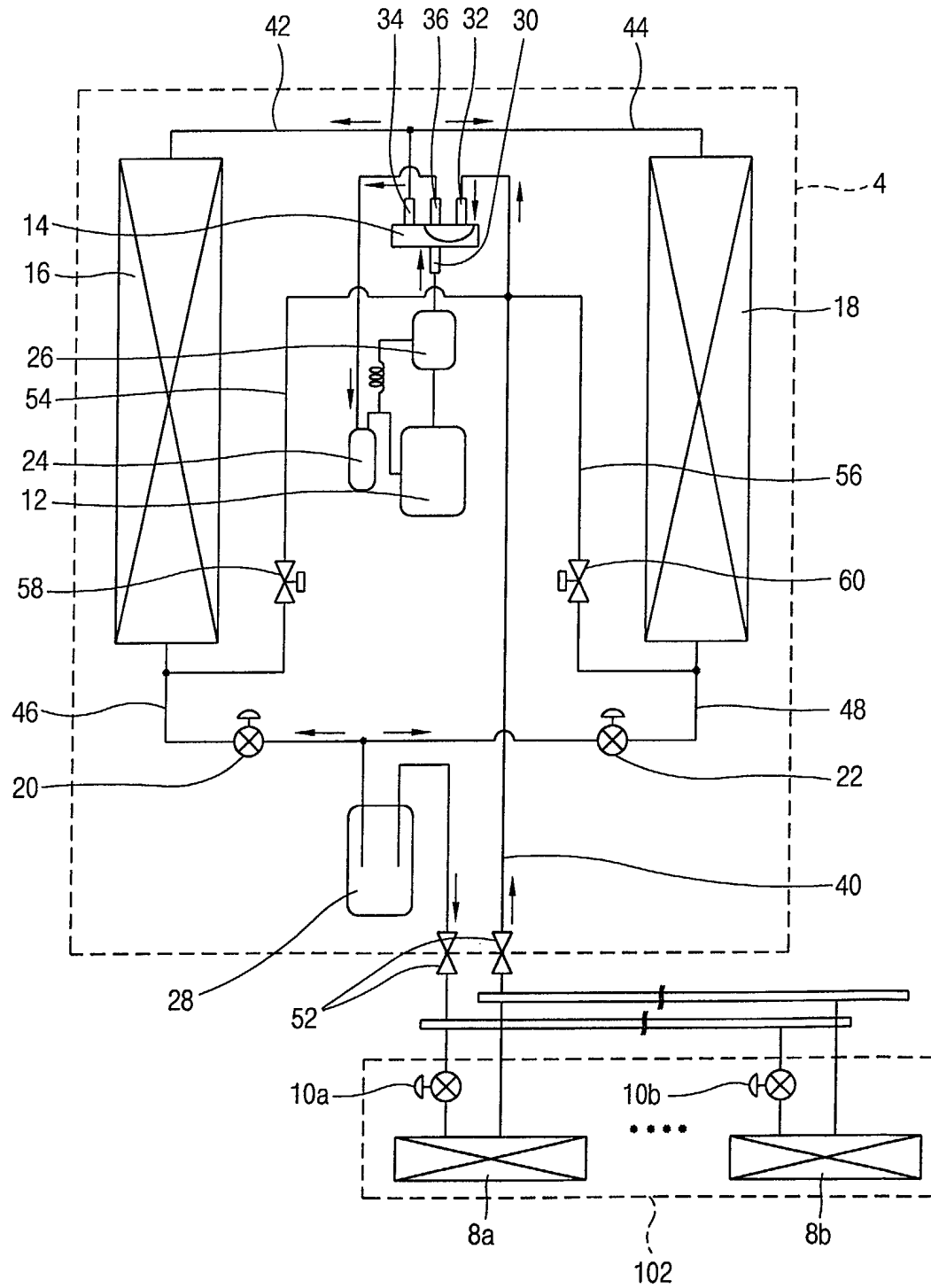


FIG.3

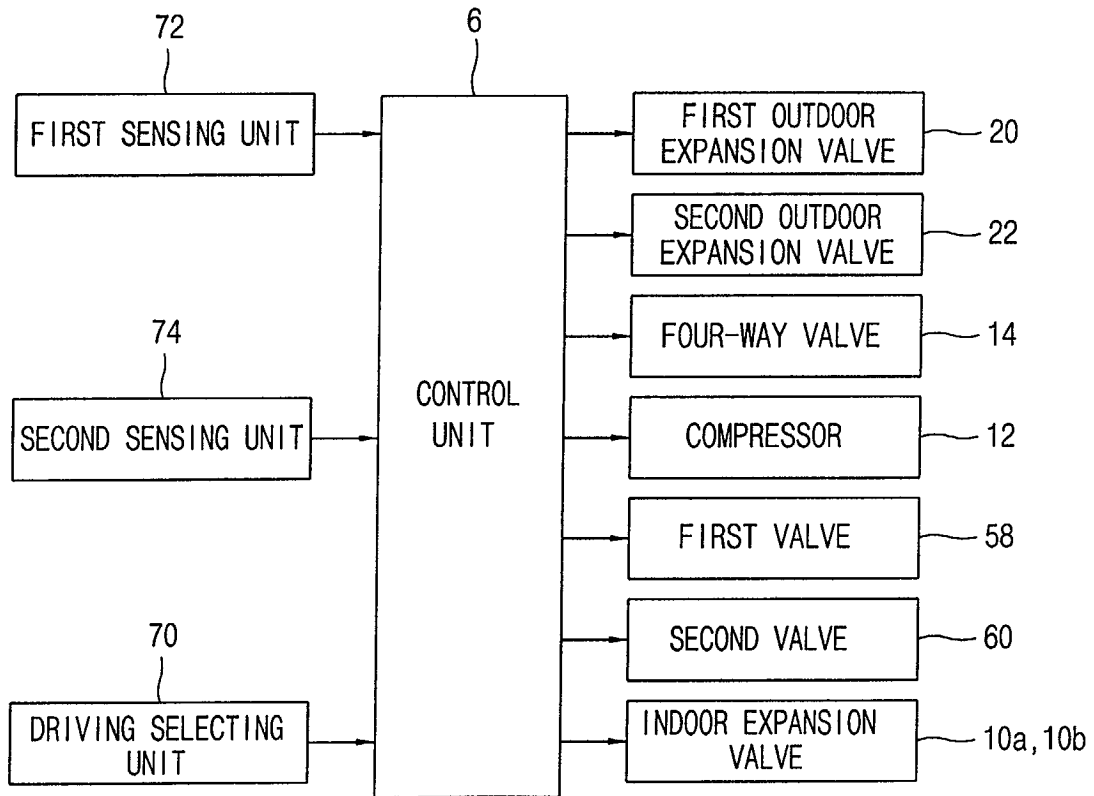


FIG.4

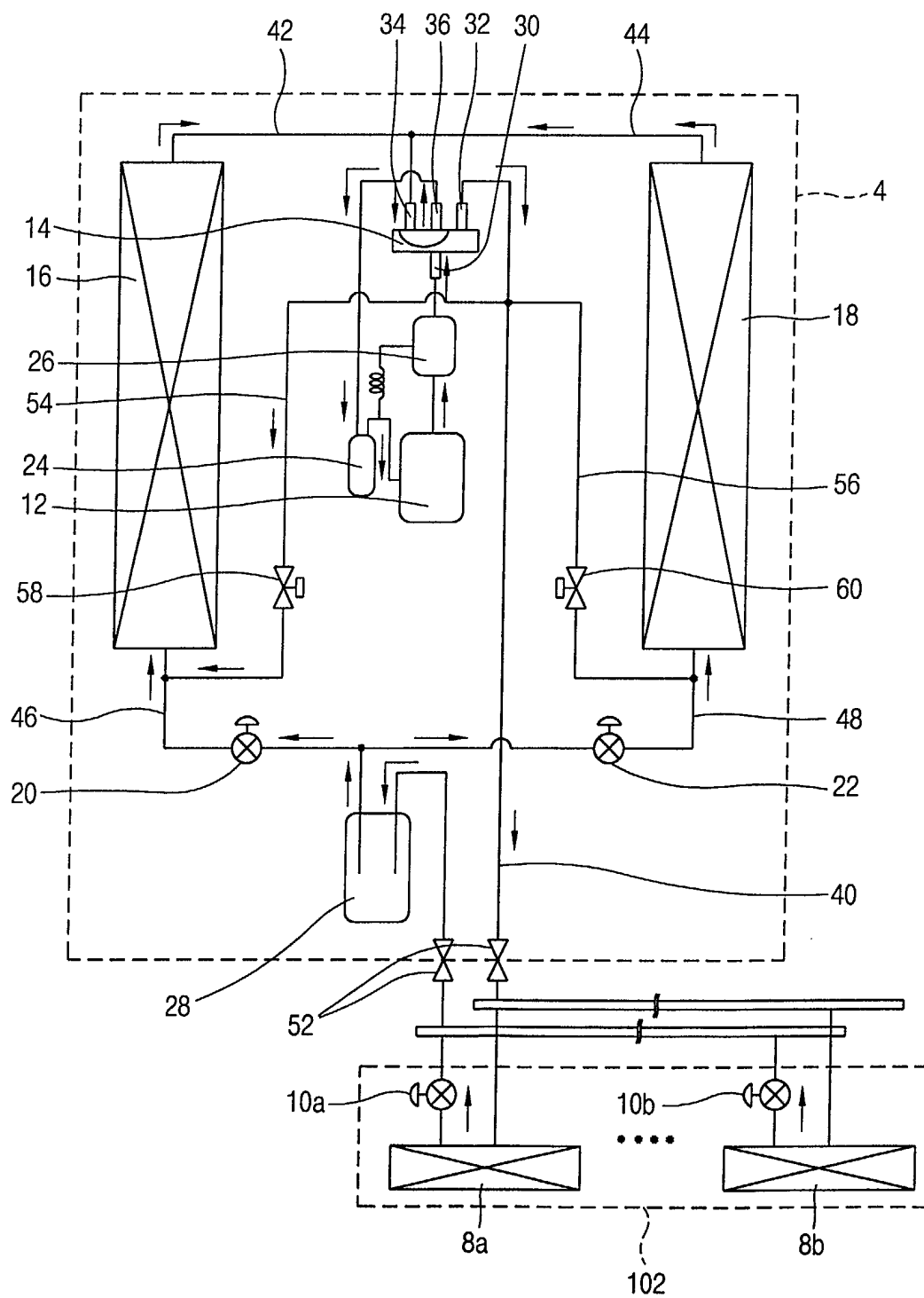


FIG. 5

