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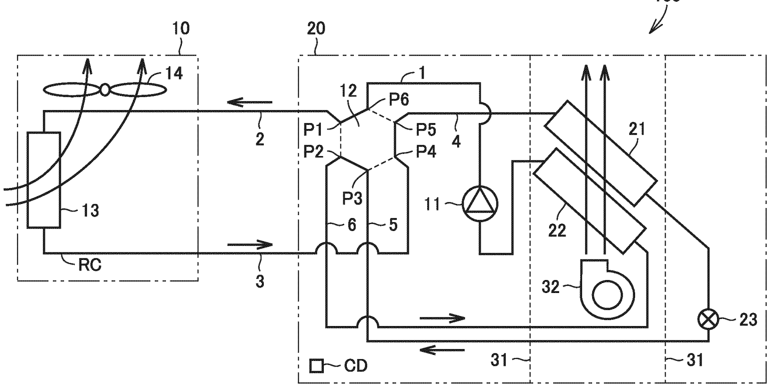
(54) AIR CONDITIONER

(57) An air conditioner (100) includes a refrigerant circuit (RC) and a blower (32). A refrigerant flow path switching mechanism (RF) is configured to be switched to a first switching state to allow refrigerant to flow through a reheater (21), a first expansion valve (23), and a cooler (22) in this order in the refrigerant circuit (RC). The refrigerant flow path switching mechanism (RF) is configured to be switched to a second switching state to allow the refrigerant to flow through the reheater (21), the first expansion valve (23), and the cooler (22) in this order in the refrigerant circuit (RC). The reheater (21) and the cooler (22) are configured to allow air blown by the blower (32) to pass through the cooler (22) and then pass through the reheater (21) during either of the first switching state and the second switching state.

FIG.1



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to an air conditioner.

BACKGROUND ART

[0002] An air conditioner is known that has: an outdoor unit including an outdoor heat exchanger functioning as a condenser; an indoor unit including a first indoor heat exchanger functioning as a cooler and a second indoor heat exchanger functioning as a reheater; and a compressor causing refrigerant to circulate through the outdoor heat exchanger, the first indoor heat exchanger, and the second indoor heat exchanger. In this air conditioner, air cooled and dehumidified by the first indoor heat exchanger is heated by the second indoor heat exchanger, so as to separately adjust the temperature and the humidity of the air blown out from the indoor unit into a space to be air-conditioned. Such an air conditioner is described for example in Japanese Patent Laying-Open No. 2002-89998 (PTL 1).

CITATION LIST

PATENT LITERATURE

[0003] PTL 1: Japanese Patent Laying-Open No. 2002-89998

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004] However, in the air conditioner described in the above publication, only one four-way valve is used as a refrigerant flow path switching mechanism. Thus, when a mainly cooling operation and a mainly heating operation are respectively performed for two switching states of the four-way valve, the direction of the refrigerant flowing through the indoor unit in the mainly cooling operation and that in the mainly heating operation are opposite to each other. Therefore, the indoor heat exchanger functioning as the cooler and the indoor heat exchanger functioning as the reheater in the mainly cooling operation replace each other in the mainly heating operation. As a result, in either one of the mainly cooling operation and the mainly heating operation, the air heated by the reheater is cooled by the cooler, which makes it impossible to perform sufficient dehumidification.

[0005] The present disclosure is made in view of the above problem, and an object thereof is to provide an air conditioner that enables refrigerant to flow in the same direction through a reheater and a cooler in both of a mainly cooling operation and a mainly heating operation.

SOLUTION TO PROBLEM

[0006] An air conditioner of the present disclosure includes a refrigerant circuit and a blower. The refrigerant circuit has a compressor, a six-way valve, an outdoor heat exchanger, a reheater, a first expansion valve, and a cooler, and is configured to allow refrigerant to circulate in the refrigerant circuit. The blower is configured to blow air to the reheater and the cooler. The six-way valve is configured to be switchable between a first switching state and a second switching state. The six-way valve is configured to be switched to the first switching state to allow the refrigerant to flow through the compressor, the six-way valve, the outdoor heat exchanger, the six-way valve, the reheater, the first expansion valve, the six-way valve, and the cooler in this order in the refrigerant circuit. The six-way valve is configured to be switched to the second switching state to allow the refrigerant to flow through the compressor, the six-way valve, the reheater, the first expansion valve, the six-way valve, the outdoor heat exchanger, the six-way valve, and the cooler in this order in the refrigerant circuit. The reheater and the cooler are configured to allow the air blown by the blower to pass through the cooler and then pass through the reheater during either of the first switching state and the second switching state.

ADVANTAGEOUS EFFECTS OF INVENTION

[0007] In the air conditioner of the present disclosure, a refrigerant flow path switching mechanism is configured to be switched to allow the refrigerant to flow through the reheater and the cooler in this order in the refrigerant circuit during either of the first switching state and the second switching state. Thus, in both of the mainly cooling operation and the mainly heating operation, the refrigerant can flow in the same direction through the reheater and the cooler.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

Fig. 1 is a refrigerant circuit diagram for a mainly cooling operation of an air conditioner according to Embodiment 1.

Fig. 2 is a refrigerant circuit diagram for a mainly heating operation of the air conditioner according to Embodiment 1.

Fig. 3 is a schematic diagram for a first switching state of a six-way valve of the rotary type of the air conditioner according to Embodiment 1.

Fig. 4 is a schematic diagram for a second switching state of the six-way valve of the rotary type of the air conditioner according to Embodiment 1.

Fig. 5 is a schematic diagram for a first switching state of a six-way valve of the slide type of the air conditioner according to Embodiment 1.

Fig. 6 is a schematic diagram for a second switching state of the six-way valve of the slide type of the air conditioner according to Embodiment 1.

Fig. 7 is a refrigerant circuit diagram for a mainly cooling operation of an air conditioner according to Embodiment 2.

Fig. 8 is a refrigerant circuit diagram for a mainly heating operation of the air conditioner according to Embodiment 2.

Fig. 9 is a refrigerant circuit diagram for a mainly cooling operation of an air conditioner according to Embodiment 3.

Fig. 10 is a refrigerant circuit diagram for a mainly heating operation of the air conditioner according to Embodiment 3.

Fig. 11 is a refrigerant circuit diagram for a mainly cooling operation of an air conditioner according to Embodiment 4.

Fig. 12 is a refrigerant circuit diagram for a mainly heating operation of the air conditioner according to Embodiment 4.

Fig. 13 is a refrigerant circuit diagram for a mainly cooling operation of an air conditioner according to Embodiment 5.

Fig. 14 is a refrigerant circuit diagram for a mainly heating operation of the air conditioner according to Embodiment 5.

Fig. 15 is a refrigerant circuit diagram for a mainly cooling operation of an air conditioner according to Embodiment 6.

Fig. 16 is a refrigerant circuit diagram for a mainly heating operation of the air conditioner according to Embodiment 6.

Fig. 17 is a perspective view of a reheater and a cooler of an air conditioner according to Embodiment 7.

DESCRIPTION OF EMBODIMENTS

[0009] Embodiments are described hereinafter with reference to the drawings. In the following, the same or corresponding parts are denoted by the same reference characters, and a description thereof is not herein repeated.

Embodiment 1.

[0010] Referring to Fig. 1, a configuration of an air conditioner 100 according to Embodiment 1 is described.

<Device Configuration>

[0011] Fig. 1 is a refrigerant circuit diagram for air conditioner 100 according to Embodiment 1. As shown in Fig. 1, air conditioner 100 includes a refrigerant circuit RC, an outdoor blower 14, an air passage 31, a blower 32, and a control device CD. Refrigerant circuit RC has a first pipe 1, a second pipe 2, a third pipe 3, a fourth pipe 4, a fifth pipe 5, a sixth pipe 6, a compressor 11, a six-way valve 12, an outdoor heat exchanger 13, a reheater 21, a cooler 22, and a first expansion valve 23.

[0012] In refrigerant circuit RC, compressor 11, six-way valve 12, outdoor heat exchanger 13, reheater 21, cooler 22, and first expansion valve 23 are connected by first pipe 1, second pipe 2, third pipe 3, fourth pipe 4, fifth pipe 5, and sixth pipe 6.

[0013] First pipe 1 connects compressor 11 and six-way valve 12. Second pipe 2 connects six-way valve 12 and outdoor heat exchanger 13. Third pipe 3 connects outdoor heat exchanger 13 and six-way valve 12. Fourth pipe 4 connects six-way valve 12 and reheater 21. Fifth pipe 5 connects reheater 21 and six-way valve 12 via first expansion valve 23. Sixth pipe 6 connects six-way valve 12 and cooler 22.

[0014] In a first switching state, refrigerant circuit RC is configured to allow refrigerant to flow through compressor 11, first pipe 1, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, fourth pipe 4, reheater 21, fifth pipe 5, first expansion valve 23, fifth pipe 5, six-way valve 12, sixth pipe 6, and cooler 22 in this order.

[0015] In a second switching state, refrigerant circuit RC is configured to allow the refrigerant to flow through compressor 11, first pipe 1, six-way valve 12, fourth pipe 4, reheater 21, fifth pipe 5, first expansion valve 23, fifth pipe 5, six-way valve 12, third pipe 3, outdoor heat exchanger 13, second pipe 2, six-way valve 12, sixth pipe 6, and cooler 22 in this order.

[0016] Refrigerant circuit RC is configured to cause the refrigerant to circulate. The refrigerant is a refrigerant mixture. The refrigerant mixture is a mixture of two or more types of refrigerants. The refrigerant may be a single refrigerant.

[0017] Air conditioner 100 includes an outdoor unit 10 and an indoor unit 20. Outdoor unit 10 and indoor unit 20 are connected by second pipe 2 and third pipe 3. Outdoor unit 10 has outdoor heat exchanger 13 and outdoor blower 14. Outdoor heat exchanger 13 and outdoor blower 14 are housed in outdoor unit 10. Indoor unit 20 has compressor 11, six-way valve 12, reheater 21, cooler 22, first expansion valve 23, air passage 31, blower 32, and control device CD. Compressor 11, six-way valve 12, reheater 21, cooler 22, first expansion valve 23, blower 32, and control device CD are housed in indoor unit 20. Indoor unit 20 is provided with air passage 31.

[0018] Compressor 11 is configured to compress the refrigerant. Compressor 11 is configured to compress the sucked refrigerant and discharge the resultant refrigerant. Compressor 11 is configured to have a variable capacity, for example. Compressor 11 is configured to have the capacity that is changed by adjustment of the rotational speed of compressor 11 based on an instruction from control device CD, for example.

[0019] Six-way valve 12 is configured to be switchable between the first switching state and the second switching state. Six-way valve 12 is configured to be switched between the first switching state and the second switching state, based on an instruction from control device CD, for example. Six-way valve 12 is configured to be switched to the first switching state to allow the refrigerant to flow through compressor 11, six-way valve 12, outdoor heat exchanger 13, six-way valve 12, reheater 21, first expansion valve 23, six-way valve 12, and cooler 22 in this order in refrigerant circuit RC. In a mainly cooling operation, six-way valve 12 is in the first switching state.

[0020] Six-way valve 12 is configured to be switched to the second switching state to allow the refrigerant to flow through compressor 11, six-way valve 12, reheater 21, first expansion valve 23, six-way valve 12, outdoor heat exchanger 13, six-way valve 12, and cooler 22 in this order in refrigerant circuit RC. In a mainly heating operation, six-way valve 12 is in the second switching state.

[0021] Six connection ports (a first connection port P1 to a sixth connection port P6) of six-way valve 12 are connected to first pipe 1, second pipe 2, third pipe 3, fourth pipe 4, fifth pipe 5, and sixth pipe 6, respectively. First connection port P1 is connected to second pipe 2. Second connection port P2 is connected to sixth pipe 6. Third connection port P3 is connected to fifth pipe 5. Fourth connection port P4 is connected to third pipe 3. Fifth connection port P5 is connected to fourth pipe 4. Sixth connection port P6 is connected to first pipe 1.

[0022] In the first switching state of six-way valve 12, refrigerant circuit RC is configured to extend through compressor 11, first pipe 1, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, fourth pipe 4, reheater 21, first expansion valve 23, fifth pipe 5, six-way valve 12, sixth pipe 6, and cooler 22, and return to compressor 11. In the first switching state of six-way valve 12, sixth connection port P6 is connected to first connection port P1, third connection port P3 is connected to second connection port P2, and fifth connection port P5 is connected to fourth connection port P4.

[0023] In the second switching state of six-way valve 12, refrigerant circuit RC is configured to extend through compressor 11, first pipe 1, six-way valve 12, fourth pipe 4, reheater 21, first expansion valve 23, fifth pipe 5, six-way valve 12, third pipe 3, outdoor heat exchanger 13, second pipe 2, six-way valve 12, sixth pipe 6, and cooler 22, and return to compressor 11. In the second switching state of six-way valve 12, second connection port P2 is connected to first connection port P1. Fourth connection port P4 is connected to third connection port P3. Sixth connection port P6 is connected to fifth connection port P5.

[0024] Outdoor heat exchanger 13 is configured to exchange heat between the refrigerant flowing inside outdoor heat exchanger 13 and air flowing outside outdoor heat exchanger 13. Outdoor heat exchanger 13 is configured to function as a condenser that condenses the refrigerant in the mainly cooling operation. Outdoor heat exchanger 13 is configured to function as an evaporator that evaporates the refrigerant in the mainly heating operation. Outdoor heat exchanger 13 is, for example, a fin-and-tube heat exchanger having a plurality of fins and a heat transfer tube extending through the plurality of fins.

[0025] Control device CD is configured to control each device and the like of air conditioner 100 by performing arithmetic operation/issuing an instruction, for example. Control device CD is electrically connected to compressor 11, six-way valve 12, first expansion valve 23, blower 32, and the like, and configured to control their operations.

[0026] Reheater 21 is configured to exchange heat between the refrigerant flowing inside reheater 21 and air flowing outside reheater 21. Reheater 21 is configured to function as a condenser that condenses the refrigerant in the mainly cooling operation and the mainly heating operation. Reheater 21 is, for example, a fin-and-tube heat exchanger having a plurality of fins and a heat transfer tube extending through the plurality of fins.

[0027] Cooler 22 is configured to exchange heat between the refrigerant flowing inside cooler 22 and air flowing outside cooler 22. Cooler 22 is configured to function as an evaporator that evaporates the refrigerant in the mainly cooling operation and the mainly heating operation. Cooler 22 is, for example, a fin-and-tube heat exchanger having a plurality of fins and a heat transfer tube extending through the plurality of fins.

[0028] First expansion valve 23 is configured to expand and thereby reduce the pressure of the refrigerant condensed by the condenser. In the mainly cooling operation and the mainly heating operation, first expansion valve 23 is configured to reduce the pressure of the refrigerant condensed by reheater 21. First expansion valve 23 is, for example, an electromagnetic expansion valve. First expansion valve 23 is configured to cause the amount of reduction of the pressure to be changed by adjustment of the degree of opening of first expansion valve 23 based on an instruction from control device CD, for example.

[0029] Air passage 31 is provided in a housing of indoor unit 20. Reheater 21 and cooler 22 are disposed in air passage 31. Blower 32 is configured to blow air to reheater 21 and cooler 22. Reheater 21 and cooler 22 are disposed side by side in the direction of flow of the air blown by blower 32. Reheater 21 is disposed on the leeward side of cooler 22 along the flow of the air blown by blower 32. In air passage 31, cooler 22 is disposed upstream of reheater 21.

[0030] Reheater 21 and cooler 22 share air passage 31 and blower 32. Reheater 21 and cooler 22 are configured to allow the air blown by blower 32 to pass through cooler 22 and then pass through reheater 21 during either of the first switching state and the second switching state. During operation of blower 32, reheater 21 and cooler 22 are configured to allow the air to pass through cooler 22 and then pass through reheater 21, regardless of whether six-way valve 12 is in the first switching state or the second switching state.

[0031] Reheater 21 and cooler 22 may be configured to allow the refrigerant to flow in the direction opposite to the direction in which the air flows. Both of reheater 21 and cooler 22 have a heat transfer tube flow path configuration in which the air and the refrigerant flow in respective directions opposite to each other. Each of reheater 21 and cooler 22 has a heat transfer tube on the windward side and a heat transfer tube on the leeward side. The heat transfer tube on the windward side is connected to the heat transfer tube on the leeward side. In the mainly cooling operation and the mainly heating operation, the refrigerant flows from the heat transfer tube on the leeward side to the heat transfer tube on the windward side. In both of the mainly cooling operation and the mainly heating operation, the direction in which the refrigerant flows inside the heat transfer tubes of reheater 21 and cooler 22 is opposite to the direction in which the air flows outside the heat transfer tubes.

[0032] Next, operations of air conditioner 100 according to Embodiment 1 are described.

<Mainly Cooling Operation>

[0033] First, referring to Fig. 1, the mainly cooling operation of air conditioner 100 according to Embodiment 1 is described. The mainly cooling operation is an operation in which the amount by which the air is cooled by cooler 22 is larger than the amount by which the air is heated by reheater 21 and outdoor heat exchanger 13 functions as a condenser, so that surplus heat is dissipated into outside air by this air conditioner acting as a heat pump. In the mainly cooling operation, the air after passing through reheater 21 has a lower temperature and a smaller moisture content than those of the air before passing through cooler 22.

[0034] For the mainly cooling operation, six-way valve 12 is switched to the first switching state as indicated by the solid line in Fig. 1. A vapor refrigerant compressed by compressor 11 to have a high temperature and a high pressure flows into first pipe 1, passes through six-way valve 12, and flows into outdoor heat exchanger 13 through second pipe 2. Outdoor heat exchanger 13 functions as a condenser. The high-temperature and high-pressure vapor refrigerant dissipates heat into outdoor air introduced into outdoor heat exchanger 13 by outdoor blower 14. Thus, the high-temperature and high-pressure vapor refrigerant is condensed into a high-temperature and high-pressure gas-liquid two-phase refrigerant.

[0035] The high-temperature and high-pressure gas-liquid two-phase refrigerant flows into third pipe 3, passes through six-way valve 12, and flows into reheater 21 through fourth pipe 4. Reheater 21 functions as a condenser. The high-temperature and high-pressure gas-liquid two-phase refrigerant dissipates heat into the air introduced into reheater 21 by blower 32. Thus, the high-temperature and high-pressure gas-liquid two-phase refrigerant is condensed into a high-pressure liquid refrigerant. The high-pressure liquid refrigerant flows into first expansion valve 23.

[0036] The high-pressure liquid refrigerant is expanded and reduced in pressure by first expansion valve 23 into a low-temperature and low-pressure gas-liquid two-phase refrigerant. The low-temperature and low-pressure gas-liquid two-phase refrigerant flows into fifth pipe 5, passes through six-way valve 12, and flows into cooler 22 through sixth pipe 6. Cooler 22 functions as an evaporator. By absorbing heat from the air introduced into cooler 22 by blower 32, the low-temperature and low-pressure gas-liquid two-phase refrigerant evaporates into a low-pressure vapor refrigerant. The low-pressure vapor refrigerant is thereafter sucked into compressor 11. In the mainly cooling operation, the refrigerant thereafter circulates in refrigerant circuit RC through the same process.

[0037] Reheater 21 and cooler 22 share air passage 31 and blower 32. The air introduced into air passage 31 by blower 32 first passes through cooler 22 to be cooled and dehumidified. Accordingly, the temperature of the air lowers and the moisture content of the air decreases. The air having passed through cooler 22 is guided by air passage 31 to pass through reheater 21 so that the air is heated. Thus, the temperature of the air rises. Generally, reheater 21 does not humidify the air, and therefore, the moisture content of the air remains the same before and after passing through reheater 21. The air having passed through reheater 21 is guided by air passage 31 to be blown out into a space to be air-conditioned.

[0038] The air is cooled and dehumidified by cooler 22, and thereafter heated by reheater 21 as required, and therefore, the amount by which the air is dehumidified and the temperature of the air can be adjusted separately. Accordingly, the air having a temperature and a humidity that are set by a user can be supplied into the space to be air-conditioned.

<Mainly Heating Operation>

[0039] Next, referring to Fig. 2, the mainly heating operation of air conditioner 100 according to Embodiment 1 is described. The mainly heating operation is an operation in which the amount by which the air is heated by reheater 21 is larger than the amount by which the air is cooled by cooler 22 and outdoor heat exchanger 13 functions as an evaporator, so that surplus cold is dissipated into the outside air by this air conditioner acting as a heat pump. In the mainly heating operation, the air after passing through reheater 21 has a higher temperature and a smaller moisture content than those of the air before passing through cooler 22.

[0040] For the mainly heating operation, six-way valve 12 is switched to the second switching state as indicated by the solid line in Fig. 2. A vapor refrigerant compressed by compressor 11 to have a high temperature and a high pressure flows into first pipe 1, passes through six-way valve 12, and flows into reheater 21 through fourth pipe 4. Reheater 21 functions as a condenser. The high-temperature and high-pressure vapor refrigerant dissipates heat into the air introduced into reheater 21 by blower 32. Thus, the high-temperature and high-pressure vapor refrigerant is condensed into a high-pressure liquid refrigerant. The high-pressure liquid refrigerant flows into first expansion valve 23.

[0041] The high-pressure liquid refrigerant is expanded and reduced in pressure by first expansion valve 23 into a low-temperature and low-pressure gas-liquid two-phase refrigerant. The low-temperature and low-pressure gas-liquid two-phase refrigerant flows into fifth pipe 5, passes through six-way valve 12, and flows into outdoor heat exchanger 13 through third pipe 3. Outdoor heat exchanger 13 functions as an evaporator. By absorbing heat from the outdoor air introduced into outdoor heat exchanger 13 by outdoor blower 14, a part of the low-temperature and low-pressure gas-liquid two-phase refrigerant evaporates. The low-temperature and low-pressure gas-liquid two-phase refrigerant thereafter flows into six-way valve 12 through second pipe 2, and flows into cooler 22 through sixth pipe 6.

[0042] Cooler 22 functions as an evaporator. By absorbing heat from the air introduced into cooler 22 by blower 32, the low-temperature and low-pressure gas-liquid two-phase refrigerant evaporates into a low-pressure vapor refrigerant. The low-pressure vapor refrigerant is sucked into compressor 11. In the mainly heating operation, the refrigerant thereafter circulates in refrigerant circuit RC through the same process.

[0043] Like the mainly cooling operation, the air introduced into air passage 31 by blower 32 is cooled and dehumidified by cooler 22, thereafter heated by reheater 21, and blown out into the space to be air-conditioned. Therefore, the amount by which the air is dehumidified and the temperature of the air can be adjusted separately. Accordingly, the air having a temperature and a humidity that are set by the user can be supplied into the space to be air-conditioned.

[0044] Next, functions and effects of air conditioner 100 according to Embodiment 1 are described.

[0045] In the air conditioner according to Embodiment 1, six-way valve 12 is configured to be switched to allow the refrigerant to flow through reheater 21 and cooler 22 in this order in refrigerant circuit RC during either of the first switching state and the second switching state. Six-way valve 12 is switched to the first switching state for the mainly cooling operation, and switched to the second switching state for the mainly heating operation. Thus, in both of the mainly cooling operation and the mainly heating operation, the refrigerant can flow in the same direction through reheater 21 and cooler 22. Therefore, in either of the mainly cooling operation and the mainly heating operation, the air cooled and dehumidified by cooler 22 can be heated by reheater 21. Accordingly, the air having a temperature and a humidity that are set by the user can be supplied into the space to be air-conditioned.

[0046] Further, reheater 21 and cooler 22 are configured to allow the air blown by blower 32 to pass through cooler 22 and then pass through reheater 21 during either of the first switching state and the second switching state. Thus, in both of the mainly cooling operation and the mainly heating operation, the air can be reheated after being cooled and dehumidified. Therefore, in both of the mainly cooling operation and the mainly heating operation, sufficient dehumidification can be performed.

[0047] In particular, sufficient dehumidification can be performed in the mainly heating operation, and therefore, the mainly heating operation can be utilized for drying and dehumidifying the space to be air-conditioned. Accordingly, air conditioner 100 according to Embodiment 1 can also be used for drying foods and raw materials.

[0048] Further, in the mainly cooling operation, the refrigerant having passed through outdoor heat exchanger 13 flows through reheater 21. In the mainly heating operation, the refrigerant having passed through outdoor heat exchanger 13 flows through cooler 22. Therefore, the amount of heat exchange of the refrigerant is easily adjusted by adjusting the effective heat transfer area of outdoor heat exchanger 13. Further, the amount of heat exchange of the refrigerant is easily adjusted by adjusting the rotational speed of outdoor blower 14. Since the refrigerant having the amount of heat (internal energy) adjusted in outdoor heat exchanger 13 can be supplied to reheater 21 or cooler 22, the amount of heat exchange in reheater 21 or cooler 22 can be adjusted continuously. Accordingly, it is possible to achieve operation of air conditioner 100 in which the blow-out temperature of indoor unit 20 is stable.

[0049] In the air conditioner according to Embodiment 1, in the first switching state, refrigerant circuit RC is configured to allow the refrigerant to flow through compressor 11, first pipe 1, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, fourth pipe 4, reheater 21, fifth pipe 5, first expansion valve 23, fifth pipe 5, six-way valve 12, sixth pipe 6, and cooler 22 in this order. In the second switching state, refrigerant circuit RC is configured to allow the refrigerant to flow through compressor 11, first pipe 1, six-way valve 12, fourth pipe 4, reheater 21, fifth pipe 5, first expansion valve 23, fifth pipe 5, six-way valve 12, third pipe 3, outdoor heat exchanger 13, second pipe 2, six-way valve 12, sixth pipe 6, and cooler 22 in this order. Accordingly, the refrigerant can flow through reheater 21 and cooler 22 in this order in refrigerant circuit RC during either of the first switching state and the second switching state.

[0050] In air conditioner 100 according to Embodiment 1, the refrigerant is a refrigerant mixture. The refrigerant mixture that is a mixture of two or more types of refrigerants is generally non-azeotropic, and therefore, the temperature is not constant in gas-liquid phase transition. Accordingly, when phase transition of the refrigerant mixture occurs, a temperature gradient is generated in a heat exchanger. This requires optimum design of the heat exchanger. In air conditioner 100 according to Embodiment 1, reheater 21 and cooler 22 can be designed dedicatedly to function as a reheater and a cooler respectively, so that high-performance air conditioner 100 can be achieved even when the refrigerant mixture is used.

[0051] In air conditioner 100 according to Embodiment 1, reheater 21 and cooler 22 are configured to allow the refrigerant to flow in the direction opposite to the direction in which the air flows. Accordingly, the temperature gradient of the refrigerant mixture in the heat exchanger can be utilized to reduce the difference in heat exchange temperature between the air and the refrigerant. Therefore, a high-performance operation of air conditioner 100 can be achieved.

[0052] The temperature of a non-azeotropic refrigerant rises with evaporation of the refrigerant, and therefore, the air and the refrigerant are allowed to flow in directions opposite to each other in cooler 22 functioning as an evaporator, so that the temperature rise in the refrigerant flow direction and the temperature fall in the air flow direction interact with each other, so that the difference in heat exchange temperature between the air and the refrigerant can be reduced in the whole of cooler 22.

[0053] Further, the temperature of the non-azeotropic refrigerant falls with condensation of the refrigerant, and therefore, the air and the refrigerant are allowed to flow in directions opposite to each other in reheater 21 functioning as a condenser, so that the temperature fall in the refrigerant flow direction and the temperature rise in the air flow direction interact with each other, so that the difference in heat exchange temperature between the air and the refrigerant can be reduced in the whole of reheater 21.

[0054] The position of blower 32 is not limited to the position located upstream of cooler 22 in air passage 31 as shown in Figs. 1 and 2. The position of blower 32 may be a position located between cooler 22 and reheater 21 in air passage 31 or may be a position located downstream of reheater 21 in air passage 31.

[0055] Further, referring to Figs. 3 and 4, six-way valve 12 may have a rotary-type configuration. Fig. 3 is a schematic diagram for the first switching state of six-way valve 12 of the rotary type. Fig. 4 is a schematic diagram for the second switching state of six-way valve 12 of the rotary type. Six-way valve 12 of the rotary type has a valve seat 12a and a valve body 12b configured to be rotatable with respect to valve seat 12a. As valve body 12b rotates with respect to valve seat 12a, the flow path is switched between the first switching state and the second switching state.

[0056] Further, referring to Figs. 5 and 6, six-way valve 12 may have a slide-type configuration. Fig. 5 is a schematic diagram for the first switching state of six-way valve 12 of the slide type. Fig. 6 is a schematic diagram for the second switching state of six-way valve 12 of the slide type. Six-way valve 12 of the slide type has valve seat 12a and valve body 12b configured to be slidable with respect to valve seat 12a. As valve body 12b slides with respect to valve seat 12a, the flow path is switched between the first switching state and the second switching state.

Embodiment 2.

[0057] Air conditioner 100 according to Embodiment 2 is identical to air conditioner 100 according to Embodiment 1 in terms of configuration, operations, as well as functions and effects, unless otherwise described.

[0058] Referring to Fig. 7, a configuration of air conditioner 100 according to Embodiment 2 is described. Fig. 7 is a refrigerant circuit diagram of air conditioner 100 according to Embodiment 2. When compared with air conditioner 100 according to Embodiment 1, air conditioner 100 according to Embodiment 2 has a configuration in which the positions where fifth pipe 5 and sixth pipe 6 are connected to six-way valve 12 are exchanged.

[0059] The six connection ports (first connection port P1 to sixth connection port P6) of six-way valve 12 are connected to first pipe 1, second pipe 2, third pipe 3, fourth pipe 4, fifth pipe 5, and sixth pipe 6, respectively. First connection port P1 is connected to second pipe 2. Second connection port P2 is connected to fifth pipe 5. Third connection port P3 is connected to sixth pipe 6. Fourth connection port P4 is connected to third pipe 3. Fifth connection port P5 is connected to fourth pipe 4. Sixth connection port P6 is connected to first pipe 1.

[0060] In the first switching state, refrigerant circuit RC is configured to allow the refrigerant to flow through compressor 11, first pipe 1, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, fourth pipe 4, reheater 21, fifth pipe 5, first expansion valve 23, fifth pipe 5, six-way valve 12, sixth pipe 6, and cooler 22 in this order.

[0061] In the second switching state, refrigerant circuit RC is configured to allow the refrigerant to flow through compressor 11, first pipe 1, six-way valve 12, fourth pipe 4, reheater 21, fifth pipe 5, first expansion valve 23, fifth pipe 5, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, sixth pipe 6, and cooler 22 in this order.

[0062] Next, referring to Figs. 7 and 8, operations of air conditioner 100 according to Embodiment 2 are described.

[0063] The operations of air conditioner 100 according to Embodiment 2 are basically the same as those in Embodiment 1. Referring to Fig. 7, in the mainly cooling operation of air conditioner 100 according to Embodiment 2, the refrigerant flows in refrigerant circuit RC through compressor 11, first pipe 1, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, fourth pipe 4, reheater 21, first expansion valve 23, fifth pipe 5, six-way valve 12, sixth pipe 6, cooler 22, and compressor 11 again.

[0064] Referring to Fig. 8, in the mainly heating operation of air conditioner 100 according to Embodiment 2, the refrigerant flows in refrigerant circuit RC through compressor 11, first pipe 1, six-way valve 12, fourth pipe 4, reheater 21, first expansion valve 23, fifth pipe 5, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, sixth pipe 6, cooler 22, and compressor 11 again.

[0065] Next, functions and effects of air conditioner 100 according to Embodiment 2 are described.

[0066] In air conditioner 100 according to Embodiment 2, in the first switching state, refrigerant circuit RC is configured to allow the refrigerant to flow through compressor 11, first pipe 1, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, fourth pipe 4, reheater 21, fifth pipe 5, first expansion valve 23, fifth pipe 5, six-way valve 12, sixth pipe 6, and cooler 22 in this order. In the second switching state, refrigerant circuit RC is configured to allow the refrigerant to flow through compressor 11, first pipe 1, six-way valve 12, fourth pipe 4, reheater 21, fifth pipe 5, first expansion valve 23, fifth pipe 5, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, sixth pipe 6, and cooler 22 in this order. Accordingly, the refrigerant can flow through reheater 21 and cooler 22 in this order in refrigerant circuit RC during either of the first switching state and the second switching state.

[0067] In air conditioner 100 according to Embodiment 2, in both of the mainly cooling operation and the mainly heating operation, the air introduced into outdoor heat exchanger 13 by outdoor blower 14 flows in the same direction. By causing the refrigerant flowing inside outdoor heat exchanger 13 to flow in the same direction in both of the first switching state and the second switching state of six-way valve 12, heat exchange between the air and the refrigerant in outdoor heat exchanger 13 can be performed by an opposite-flow method in both of the mainly cooling operation and the mainly heating operation. Since the temperatures of the air and the refrigerant change according to heat exchange, performing heat exchange by the opposite-flow method can reduce the difference in heat exchange temperature between the air and the refrigerant in the whole of outdoor heat exchanger 13, when compared with a parallel-flow heat exchange method. Thereby, performance and power consumption of air conditioner 100 can be optimized.

[0068] In particular, in recent years, for the purpose of reducing impact on global warming when the refrigerant leaks from air conditioner 100, and for the purpose of decreasing the refrigerant burning velocity when the refrigerant leaks, a mixture of a high-performance refrigerant and a refrigerant with a small global warming potential or a refrigerant with a slow burning velocity has been often proposed.

[0069] The refrigerant mixture that is a mixture of two or more types of refrigerants generally has non-azeotropic properties that a temperature change occurs in the course of phase transition during evaporation and condensation. Heat exchange performed by the opposite-flow method in outdoor heat exchanger 13 in Embodiment 2 is particularly effective when the refrigerant mixture that is a mixture of two or more types of refrigerants is enclosed in air conditioner 100.

[0070] The temperature of the non-azeotropic refrigerant falls with condensation of the refrigerant, and therefore, the air and the refrigerant are allowed to flow in directions opposite to each other in outdoor heat exchanger 13 functioning as a condenser in the mainly cooling operation, so that the temperature fall in the refrigerant flow direction and the temperature rise in the air flow direction interact with each other. Thereby, the difference in heat exchange temperature between the air and the refrigerant can be reduced in the whole of outdoor heat exchanger 13.

[0071] Further, the temperature of the non-azeotropic refrigerant rises with evaporation of the refrigerant, and therefore, the air and the refrigerant are allowed to flow in directions opposite to each other in outdoor heat exchanger 13 functioning as an evaporator in the mainly heating operation, so that the temperature rise in the refrigerant flow direction and the temperature fall in the air flow direction interact with each other. Therefore, the difference in heat exchange temperature between the air and the refrigerant can be reduced in the whole of outdoor heat exchanger 13.

Embodiment 3.

[0072] Air conditioner 100 according to Embodiment 3 is identical to air conditioner 100 according to Embodiment 1 in terms of configuration, operations, as well as functions and effects, unless otherwise described.

[0073] Referring to Fig. 9, a configuration of air conditioner 100 according to Embodiment 3 is described. Fig. 9 is a refrigerant circuit diagram of air conditioner 100 according to Embodiment 3. When compared with air conditioner 100 according to Embodiment 1, air conditioner 100 according to Embodiment 3 is different therefrom in that it has a liquid receiver 24.

[0074] In air conditioner 100 according to Embodiment 3, refrigerant circuit RC has liquid receiver 24. Liquid receiver 24 is disposed between reheater 21 and first expansion valve 23 in refrigerant circuit RC. Liquid receiver 24 is configured to store the refrigerant.

[0075] Next, referring to Figs. 9 and 10, operations of air conditioner 100 according to Embodiment 3 are described.

[0076] The operations of air conditioner 100 according to Embodiment 3 are basically the same as those in Embodiment 1. Referring to Fig. 9, in the mainly cooling operation of air conditioner 100 according to Embodiment 3, the refrigerant flows in refrigerant circuit RC through compressor 11, first pipe 1, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, fourth pipe 4, reheater 21, liquid receiver 24, first expansion valve 23, fifth pipe 5, six-way valve 12, sixth pipe 6, cooler 22, and compressor 11 again.

[0077] Referring to Fig. 10, in the mainly heating operation of air conditioner 100 according to Embodiment 3, the refrigerant flows in refrigerant circuit RC through compressor 11, first pipe 1, six-way valve 12, fourth pipe 4, reheater 21, liquid receiver 24, first expansion valve 23, fifth pipe 5, six-way valve 12, third pipe 3, outdoor heat exchanger 13, second pipe 2, six-way valve 12, sixth pipe 6, cooler 22, and compressor 11 again.

[0078] Next, functions and effects of air conditioner 100 according to Embodiment 3 are described.

[0079] When the amount of heat dissipated in outdoor heat exchanger 13 decreases in the mainly cooling operation, the amount of the liquid refrigerant remaining inside outdoor heat exchanger 13 decreases. In air conditioner 100 without having a refrigerant amount adjusting mechanism, when the amount of the charged refrigerant becomes excessive with respect to a suitable refrigerant amount for the operation, there may occur an operation failure due to an excessive rise in the temperature of the refrigerant discharged from the compressor or the pressure of the refrigerant discharged from the compressor.

[0080] In air conditioner 100 according to Embodiment 3, liquid receiver 24 is disposed between reheater 21 and first expansion valve 23 in refrigerant circuit RC. Thereby, the effective refrigerant amount within air conditioner 100 is adjusted, and thus an operating point for appropriate operation of compressor 11 can be achieved.

[0081] Further, it is desirable to supply the liquid refrigerant to first expansion valve 23 for the purpose of preventing a refrigerant flow sound. Since liquid receiver 24 is disposed upstream of first expansion valve 23 in the flow of the refrigerant, the refrigerant at an inlet of first expansion valve 23 can be stably maintained in a liquid state.

Embodiment 4.

[0082] Air conditioner 100 according to Embodiment 4 is identical to air conditioner 100 according to Embodiment 3 in terms of configuration, operations, as well as functions and effects, unless otherwise described.

[0083] Referring to Fig. 11, a configuration of air conditioner 100 according to Embodiment 4 is described. Fig. 11 is a refrigerant circuit diagram of air conditioner 100 according to Embodiment 4. When compared with air conditioner 100 according to Embodiment 3, air conditioner 100 according to Embodiment 4 is different therefrom in that it has a second expansion valve 25.

[0084] In air conditioner 100 according to Embodiment 4, refrigerant circuit RC has second expansion valve 25. Second expansion valve 25 is disposed between reheater 21 and liquid receiver 24 in refrigerant circuit RC. Second expansion valve 25 is configured to have an adjustable degree of opening.

[0085] Next, referring to Figs. 11 and 12, operations of air conditioner 100 according to Embodiment 4 are described.

[0086] The operations of air conditioner 100 according to Embodiment 4 are basically the same as those in Embodiment 3. Referring to Fig. 11, in the mainly cooling operation of air conditioner 100 according to Embodiment 4, the refrigerant flows in refrigerant circuit RC through compressor 11, first pipe 1, six-way valve 12, second pipe 2, outdoor heat exchanger 13, third pipe 3, six-way valve 12, fourth pipe 4, reheater 21, second expansion valve 25, liquid receiver 24, first expansion valve 23, fifth pipe 5, six-way valve 12, sixth pipe 6, cooler 22, and compressor 11 again.

[0087] Referring to Fig. 12, in the mainly heating operation of air conditioner 100 according to Embodiment 4, the refrigerant flows in refrigerant circuit RC through compressor 11, first pipe 1, six-way valve 12, fourth pipe 4, reheater 21, second expansion valve 25, liquid receiver 24, first expansion valve 23, fifth pipe 5, six-way valve 12, third pipe 3, outdoor heat exchanger 13, second pipe 2, six-way valve 12, sixth pipe 6, cooler 22, and compressor 11 again.

[0088] Next, functions and effects of air conditioner 100 according to Embodiment 4 are described.

[0089] In air conditioner 100 according to Embodiment 4, second expansion valve 25 is disposed between reheater 21 and liquid receiver 24 in refrigerant circuit RC. By adjusting the degree of opening of second expansion valve 25, the pressure of the refrigerant inside liquid receiver 24 can be adjusted. Thereby, the amount of the liquid refrigerant stored inside liquid receiver 24 can be actively adjusted, when compared with Embodiment 3. Therefore, air conditioner 100 can be operated more stably.

[0090] In Embodiments 1 to 4, a configuration in which a refrigerant inflow port of reheater 21 is located above a refrigerant outflow port thereof in the gravity direction is preferable for the purpose of stably supplying the liquid refrigerant to first expansion valve 23 or second expansion valve 25. That is, reheater 21 has a refrigerant inflow port and a refrigerant outflow port. The refrigerant inflow port of reheater 21 is located above the refrigerant outflow port thereof in the gravity direction.

[0091] With this configuration, the liquid refrigerant remaining in reheater 21 is sequentially discharged according to gravity, and thus the refrigerant at an inlet of first expansion valve 23 or second expansion valve 25 can be maintained in a liquid state. Therefore, air conditioner 100 can be stably operated.

Embodiment 5.

[0092] Air conditioner 100 according to Embodiment 5 is identical to air conditioner 100 according to Embodiment 2 in terms of configuration, operations, as well as functions and effects, unless otherwise described.

[0093] Referring to Fig. 13, a configuration of air conditioner 100 according to Embodiment 5 is described. Fig. 13 is a refrigerant circuit diagram of air conditioner 100 according to Embodiment 5. When compared with air conditioner 100 according to Embodiment 2, air conditioner 100 according to Embodiment 5 has different outdoor heat exchanger 13.

[0094] Refrigerant circuit RC has a first refrigerant closing mechanism 15 and a second refrigerant closing mechanism 16. First refrigerant closing mechanism 15 and second refrigerant closing mechanism 16 are electromagnetic valves, for example.

[0095] Outdoor heat exchanger 13 has a first heat exchange unit 13a and a second heat exchange unit 13b. First heat exchange unit 13a and second heat exchange unit 13b are disposed in parallel with each other in refrigerant circuit RC. First heat exchange unit 13a has an internal volume larger than that of second heat exchange unit 13b. First refrigerant closing mechanism 15 is connected to an inlet of first heat exchange unit 13a. Second refrigerant closing mechanism 16 is connected to an outlet of first heat exchange unit 13a.

[0096] Further, refrigerant circuit RC has a bypass circuit 17. Bypass circuit 17 has a bypass pipe 17a and a flow rate regulating mechanism 17b. Bypass pipe 17a is connected to second pipe 2 and third pipe 3. Flow rate regulating mechanism 17b is configured to have an adjustable degree of opening. Flow rate regulating mechanism 17b is configured to regulate the flow rate of the refrigerant flowing through bypass circuit 17. Flow rate regulating mechanism 17b is an electromagnetic valve, for example. Bypass circuit 17 is disposed in parallel with outdoor heat exchanger 13 in refrigerant circuit RC. Bypass circuit 17 is disposed between six-way valve 12 and outdoor heat exchanger 13 in refrigerant circuit RC.

[0097] The operations of air conditioner 100 according to Embodiment 5 are basically the same as those in Embodiment 1. Referring to Fig. 13, in the mainly cooling operation of air conditioner 100 according to Embodiment 5, the refrigerant flows in refrigerant circuit RC through compressor 11, first pipe 1, six-way valve 12, second pipe 2, outdoor heat exchanger 13 and bypass circuit 17, third pipe 3, six-way valve 12, fourth pipe 4, reheater 21, first expansion valve 23, fifth pipe 5, six-way valve 12, sixth pipe 6, cooler 22, and compressor 11 again.

[0098] Referring to Fig. 14, in the mainly heating operation of air conditioner 100 according to Embodiment 5, the refrigerant flows in refrigerant circuit RC through compressor 11, first pipe 1, six-way valve 12, fourth pipe 4, reheater 21, first expansion valve 23, fifth pipe 5, six-way valve 12, second pipe 2, outdoor heat exchanger 13 and bypass circuit 17, third pipe 3, six-way valve 12, sixth pipe 6, cooler 22, and compressor 11 again.

[0099] Next, functions and effects of air conditioner 100 according to Embodiment 5 are described.

[0100] The amount of dissipated heat of the amount of condensation heat and the amount of received heat of the amount of evaporation heat in outdoor heat exchanger 13 can be adjusted by adjusting the rotational speed of outdoor blower 14 and thereby decreasing the amount of outdoor air to be introduced into outdoor heat exchanger 13. Further, first heat exchange unit 13a and second heat exchange unit 13b of outdoor heat exchanger 13 are disposed in parallel with each other in refrigerant circuit RC. Thereby, flow of the refrigerant in a part of outdoor heat exchanger 13 is blocked, and thus the amount of heat exchange in outdoor heat exchanger 13 can be further suppressed. Therefore, a stable adjustment range of the amount of heat exchange in reheater 21 and cooler 22 can be increased.

[0101] Further, the amount of heat exchange in outdoor heat exchanger 13 can be finely adjusted by causing the refrigerant to flow through bypass circuit 17 and causing the refrigerant not to flow through outdoor heat exchanger 13. Thereby, in the mainly cooling operation, the amount of heat exchange in reheater 21 can be increased. Further, in the mainly heating operation, the amount of heat exchange in cooler 22 can be increased. Therefore, adjustment ranges of the temperature and the humidity of the air blown out by air conditioner 100 can be expanded.

Embodiment 6.

[0102] Air conditioner 100 according to Embodiment 6 is identical to air conditioner 100 according to Embodiment 5 in terms of configuration, operations, as well as functions and effects, unless otherwise described.

[0103] Referring to Fig. 15, a configuration of air conditioner 100 according to Embodiment 6 is described. Fig. 15 is a refrigerant circuit diagram of air conditioner 100 according to Embodiment 6. When compared with air conditioner 100 according to Embodiment 5, air conditioner 100 according to Embodiment 6 has different second refrigerant closing mechanism 16. Second refrigerant closing mechanism 16 is a check valve.

[0104] Referring to Figs. 15 and 16, the operations of air conditioner 100 according to Embodiment 6 are basically the same as those in Embodiment 5.

[0105] Next, functions and effects of air conditioner 100 according to Embodiment 6 are described.

[0106] In air conditioner 100 according to Embodiment 6, second refrigerant closing mechanism 16 is a check valve. Since the refrigerant inside outdoor heat exchanger 13 flows in the same direction in both of the mainly cooling operation and the mainly heating operation, a check valve can be used as second refrigerant closing mechanism 16. Since a check valve is less expensive and smaller than an electromagnetic valve, the refrigerant can be closed in a cost-saving and space-saving manner.

Embodiment 7.

[0107] Air conditioner 100 according to Embodiment 7 is identical to air conditioner 100 according to Embodiment 1 in terms of configuration, operations, as well as functions and effects, unless otherwise described.

[0108] Referring to Fig. 17, configurations of reheater 21 and cooler 22 according to Embodiment 7 are described. Fig. 17 is a perspective view of reheater 21 and cooler 22 according to Embodiment 7.

[0109] Reheater 21 has an internal volume smaller than that of cooler 22. Reheater 21 has a first heat transfer tube T1. Cooler 22 has a second heat transfer tube T2. For example, the inner diameter of first heat transfer tube T1 may be equal to the inner diameter of second heat transfer tube T2, and the length of first heat transfer tube T1 may be shorter than the length of second heat transfer tube T2.

[0110] Further, reheater 21 has a plurality of first fins F1. Cooler 22 has a plurality of second fins F2. The plurality of first fins F1 have a summed value of surface areas which is smaller than that of the plurality of second fins F2. For example, the length of first fins F1 may be shorter than the length of second fins F2, and the number of first fins F1 may be smaller than the number of second fins F2.

[0111] Next, functions and effects of air conditioner 100 according to Embodiment 7 are described.

[0112] In air conditioner 100 according to Embodiment 7, reheater 21 has an internal volume smaller than that of cooler 22. Since the air once cooled by cooler 22 is reheated by reheater 21, the difference in temperature between the refrigerant and the air in reheater 21 is larger than the difference in temperature between the refrigerant and the air in cooler 22. Accordingly, even when reheater 21 is designed to be small so as to have a size and an internal volume smaller than those of cooler 22, reheater 21 can exhibit heat dissipation ability necessary for a preset target blown-out air temperature.

[0113] Further, by designing reheater 21 to have a small internal volume, it is possible to decrease the amount of change of the amount of the liquid refrigerant stored in reheater 21 due to adjustment of the amount of heat exchange in reheater 21. This can suppress an excessive rise in the temperature of the refrigerant discharged from the compressor and the pressure of the refrigerant discharged from the compressor. Furter, when liquid receiver 24 is provided, its adjustment capacity can be decreased, and thus liquid receiver 24 can be downsized.

[0114] In air conditioner 100 according to Embodiment 7, the plurality of first fins F1 have a summed value of surface areas which is smaller than that of the plurality of second fins F2. When reheater 21 is downsized, reheater 21 and air conditioner 100 can be configured to be less expensive and smaller, by designing the summed value of the surface areas of first fins F1 in contact with the air of reheater 21 to be smaller than the summed value of the surface areas of second fins F2 in contact with the air of cooler 22.

[0115] Further, when reheater 21 and cooler 22 are disposed inside air passage 31, it is possible to achieve a configuration that exhibits optimum performance within dimensional constraints in designing air conditioner 100, by designing reheater 21 to be small and designing cooler 22 to be large.

[0116] It should be construed that the embodiments disclosed herein are given by way of illustration in all respects, not by way of limitation. It is intended that the scope of the present disclosure is defined by claims, not by the description above, and encompasses all modifications and variations equivalent in meaning and scope to the claims.

REFERENCE SIGNS LIST

[0117] 1: first pipe; 2: second pipe; 3: third pipe; 4: fourth pipe; 5: fifth pipe; 6: sixth pipe; 10: outdoor unit; 11: compressor; 12: six-way valve; 13: outdoor heat exchanger; 13a: first heat exchange unit; 13b: second heat exchange unit; 14: outdoor blower; 15: first refrigerant closing mechanism; 16: second refrigerant closing mechanism; 17: bypass circuit; 17a: bypass pipe; 17b: flow rate regulating mechanism; 20: indoor unit; 21: reheater; 22: cooler; 23: first expansion valve; 24: liquid receiver; 25: second expansion valve; 31: air passage; 32: blower; 100: air conditioner; F1: first fin; F2: second fin; T1: first heat transfer tube; T2: second heat transfer tube; RC: refrigerant circuit.

Claims

1. An air conditioner comprising:

a refrigerant circuit having a compressor, a six-way valve, an outdoor heat exchanger, a reheater, a first expansion valve, and a cooler, and configured to allow refrigerant to circulate in the refrigerant circuit; and

a blower configured to blow air to the reheater and the cooler,

the six-way valve being configured to be switchable between a first switching state and a second switching state,

the six-way valve being configured to be switched to the first switching state to allow the refrigerant to flow through the compressor, the six-way valve, the outdoor heat exchanger, the six-way valve, the reheater, the first expansion valve, the six-way valve, and the cooler in this order in the refrigerant circuit,

the six-way valve being configured to be switched to the second switching state to allow the refrigerant to flow through the compressor, the six-way valve, the reheater, the first expansion valve, the six-way valve, the outdoor heat exchanger, the six-way valve, and the cooler in this order in the refrigerant circuit, and

the reheater and the cooler being configured to allow the air blown by the blower to pass through the cooler and then pass through the reheater during either of the first switching state and the second switching state.

2. The air conditioner according to claim 1, wherein

the refrigerant circuit has a first pipe which connects the compressor and the six-way valve, a second pipe which connects the six-way valve and the outdoor heat exchanger, a third pipe which connects the outdoor heat exchanger and the six-way valve, a fourth pipe which connects the six-way valve and the reheater, a fifth pipe which connects the reheater and the six-way valve via the first expansion valve, and a sixth pipe which connects the six-way valve and the cooler,

in the first switching state, the refrigerant circuit is configured to allow the refrigerant to flow through the compressor, the first pipe, the six-way valve, the second pipe, the outdoor heat exchanger, the third pipe, the six-way valve, the fourth pipe, the reheater, the fifth pipe, the first expansion valve, the fifth pipe, the six-way valve, the sixth pipe, and the cooler in this order, and

in the second switching state, the refrigerant circuit is configured to allow the refrigerant to flow through the compressor, the first pipe, the six-way valve, the fourth pipe, the reheater, the fifth pipe, the first expansion valve, the fifth pipe, the six-way valve, the third pipe, the outdoor heat exchanger, the second pipe, the six-way valve, the sixth pipe, and the cooler in this order.

3. The air conditioner according to claim 1, wherein

the refrigerant circuit has a first pipe which connects the compressor and the six-way valve, a second pipe which connects the six-way valve and the outdoor heat exchanger, a third pipe which connects the outdoor heat exchanger and the six-way valve, a fourth pipe which connects the six-way valve and the reheater, a fifth pipe which connects the reheater and the six-way valve via the first expansion valve, and a sixth pipe which connects the six-way valve and the cooler,

in the first switching state, the refrigerant circuit is configured to allow the refrigerant to flow through the compressor, the first pipe, the six-way valve, the second pipe, the outdoor heat exchanger, the third pipe, the six-way valve, the fourth pipe, the reheater, the fifth pipe, the first expansion valve, the fifth pipe, the six-way valve, the sixth pipe, and the cooler in this order, and

in the second switching state, the refrigerant circuit is configured to allow the refrigerant to flow through the compressor, the first pipe, the six-way valve, the fourth pipe, the reheater, the fifth pipe, the first expansion valve, the fifth pipe, the six-way valve, the second pipe, the outdoor heat exchanger, the third pipe, the six-way valve, the sixth pipe, and the cooler in this order.

4. The air conditioner according to any one of claims 1 to 3, wherein the refrigerant is a refrigerant mixture.

5. The air conditioner according to any one of claims 1 to 4, wherein

the refrigerant circuit has a liquid receiver, and the liquid receiver is disposed between the reheater and the first expansion valve in the refrigerant circuit.

6. The air conditioner according to claim 5, wherein

the refrigerant circuit has a second expansion valve, and

the second expansion valve is disposed between the reheater and the liquid receiver in the refrigerant circuit.

7. The air conditioner according to any one of claims 1 to 6, wherein

the reheater has a refrigerant inflow port and a refrigerant outflow port, and

the refrigerant inflow port is located above the refrigerant outflow port in a gravity direction.

8. The air conditioner according to any one of claims 1 to 7, wherein

the refrigerant circuit has a first refrigerant closing mechanism and a second refrigerant closing mechanism,

the outdoor heat exchanger has a first heat exchange unit and a second heat exchange unit,

the first heat exchange unit and the second heat exchange unit are disposed in parallel with each other in the refrigerant circuit,

the first heat exchange unit has an internal volume larger than that of the second heat exchange unit,

the first refrigerant closing mechanism is connected to an inlet of the first heat exchange unit, and

the second refrigerant closing mechanism is connected to an outlet of the first heat exchange unit.

9. The air conditioner according to claim 8, wherein

the refrigerant circuit has a bypass circuit, and the bypass circuit is disposed in parallel with the outdoor heat exchanger in the refrigerant circuit.

10. The air conditioner according to claim 8, wherein the second refrigerant closing mechanism is a check valve.

11. The air conditioner according to any one of claims 1 to 10, wherein the reheater has an internal volume smaller than that of the cooler.

12. The air conditioner according to any one of claims 1 to 11, wherein

the reheater has a plurality of first fins,
the cooler has a plurality of second fins, and
the plurality of first fins have a summed value of surface areas which is smaller than that of the plurality of second fins.

FIG.1

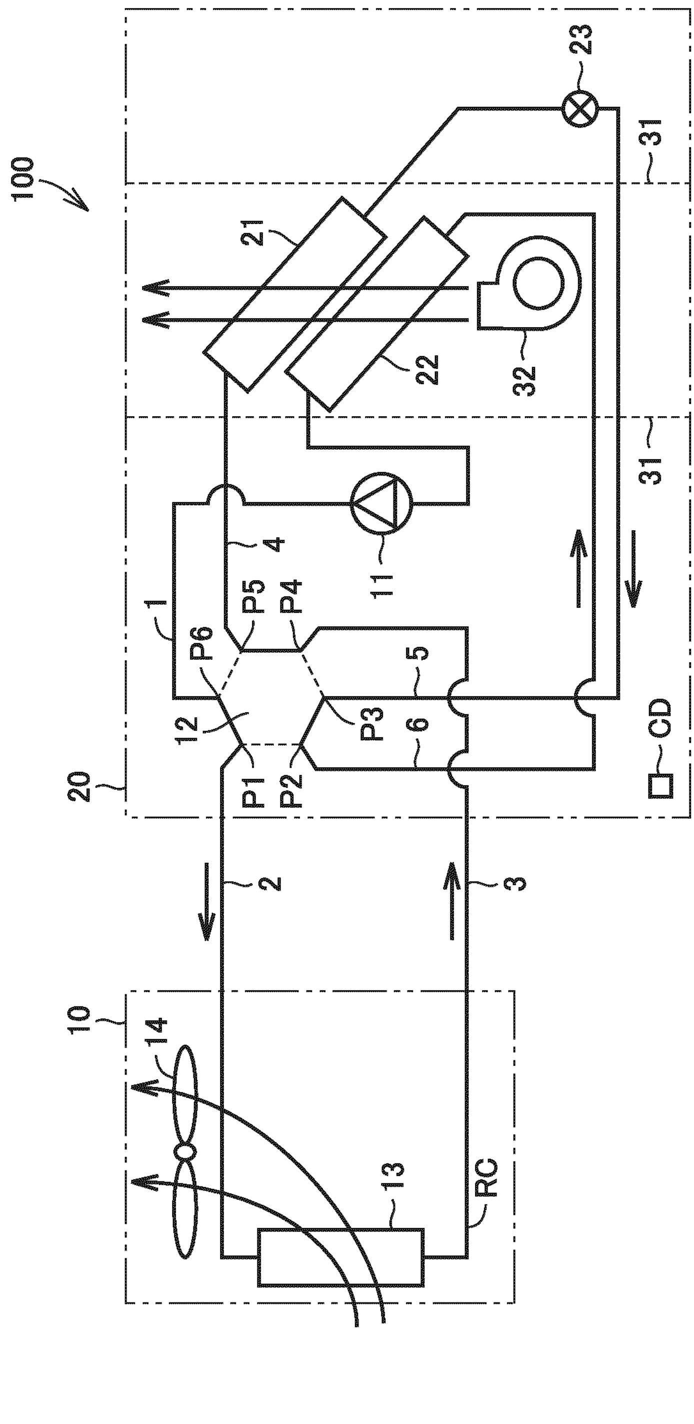


FIG.2

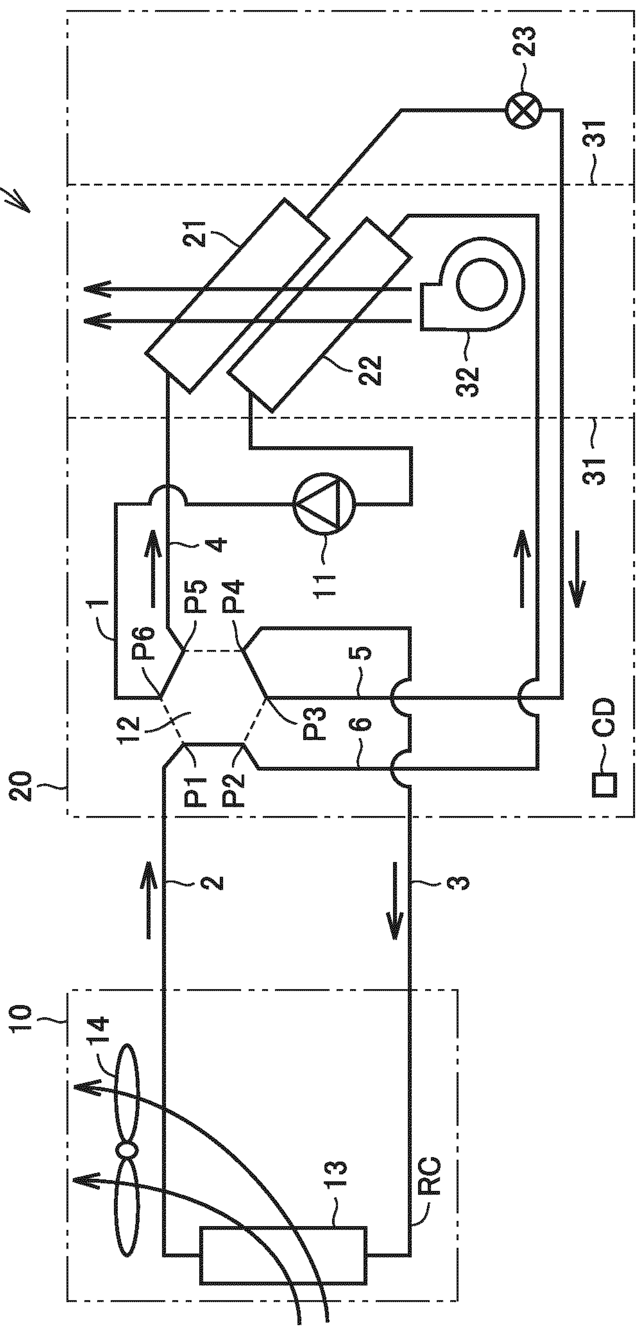


FIG.3

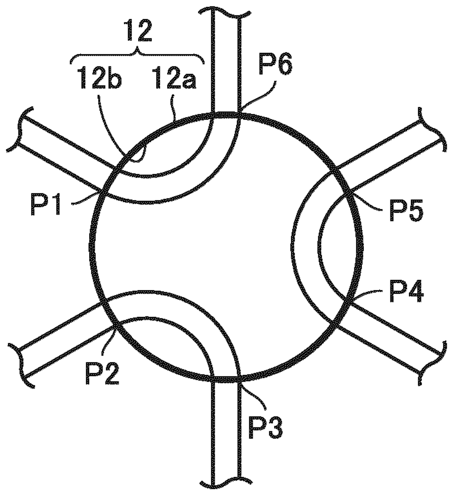


FIG.4

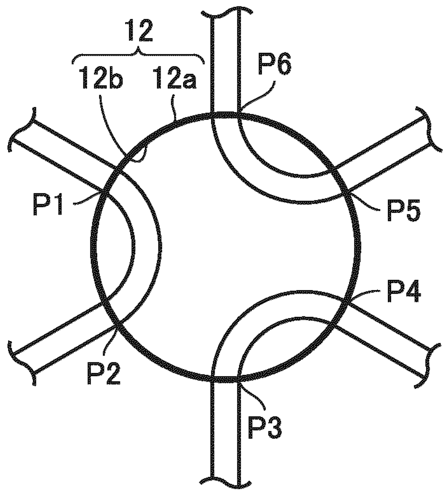


FIG.5

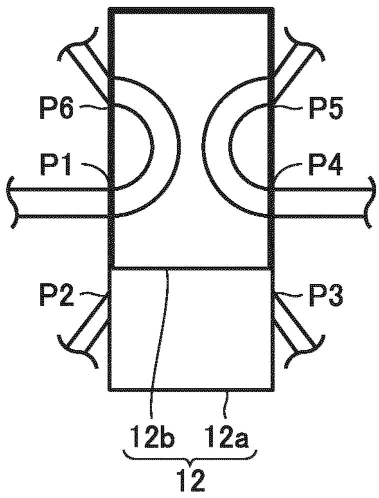


FIG.6

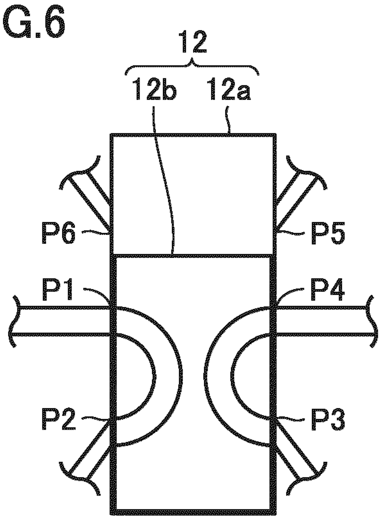


FIG.7

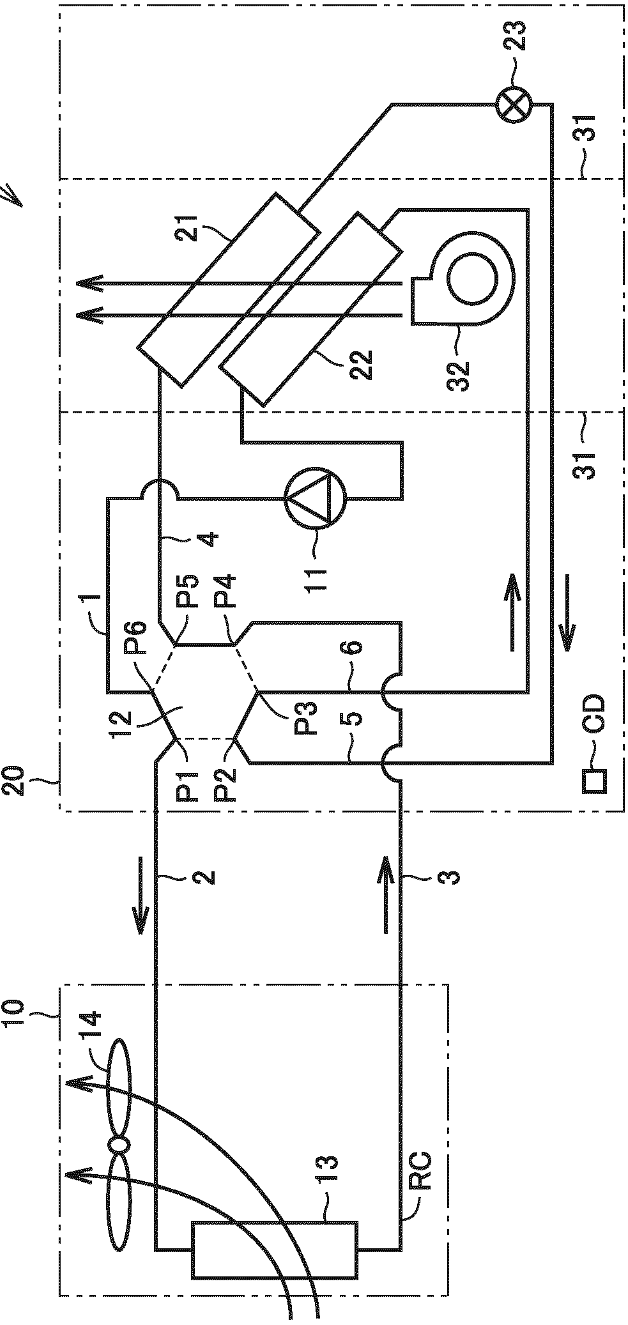
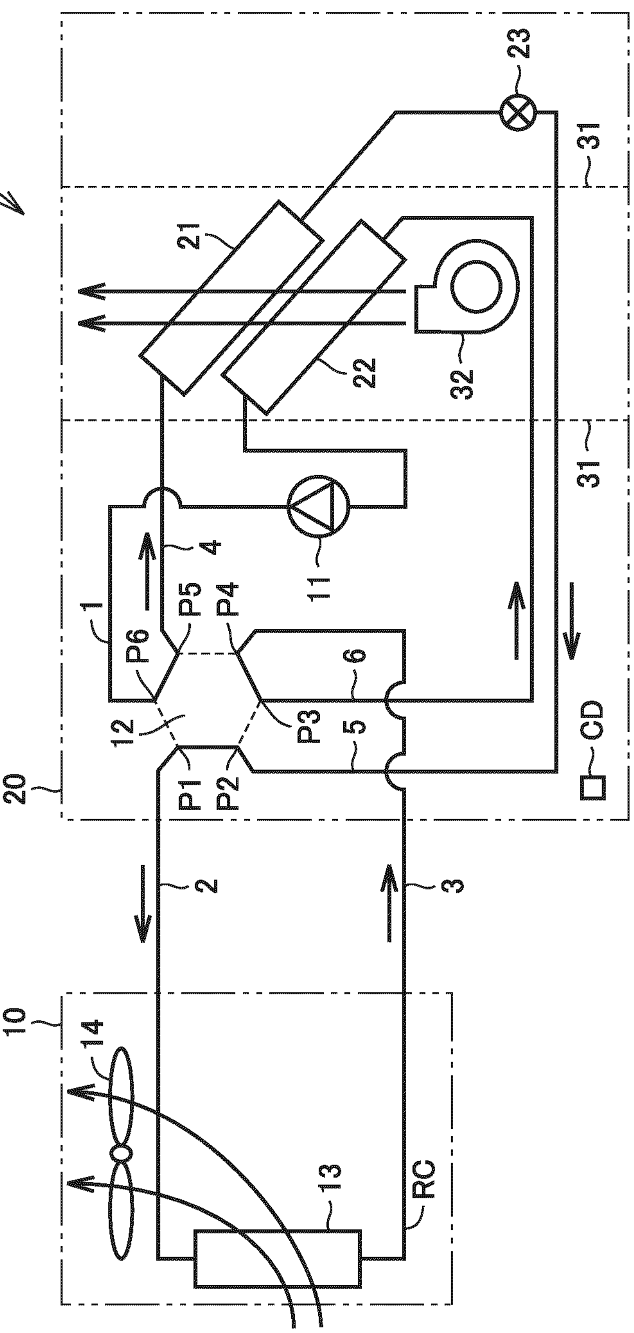
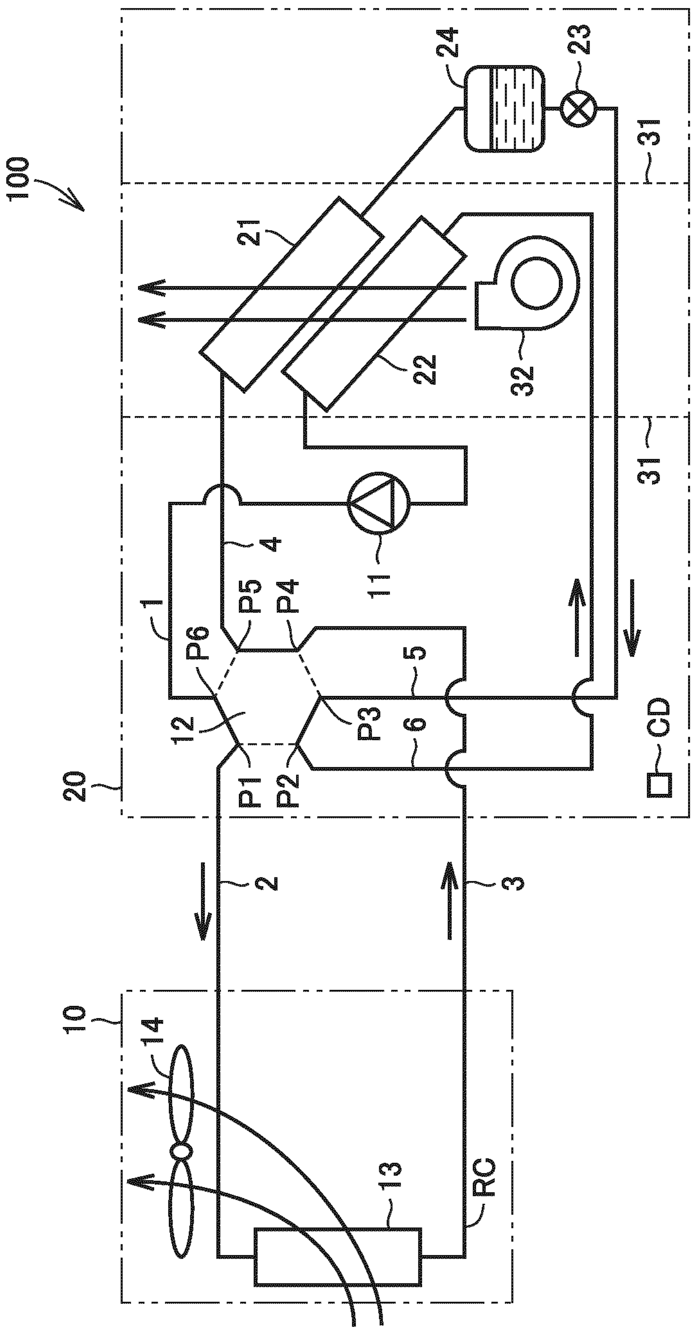


FIG.8




100
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12
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P2
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CD

FIG.9

FIG.10

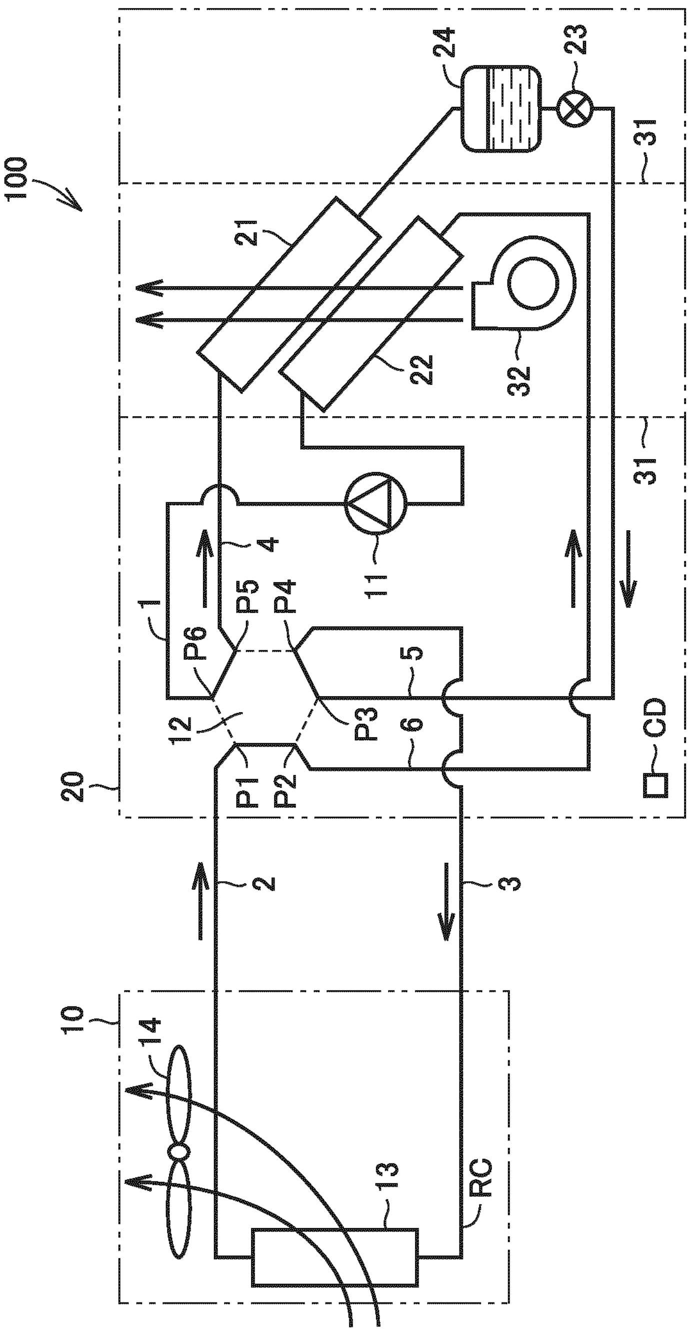
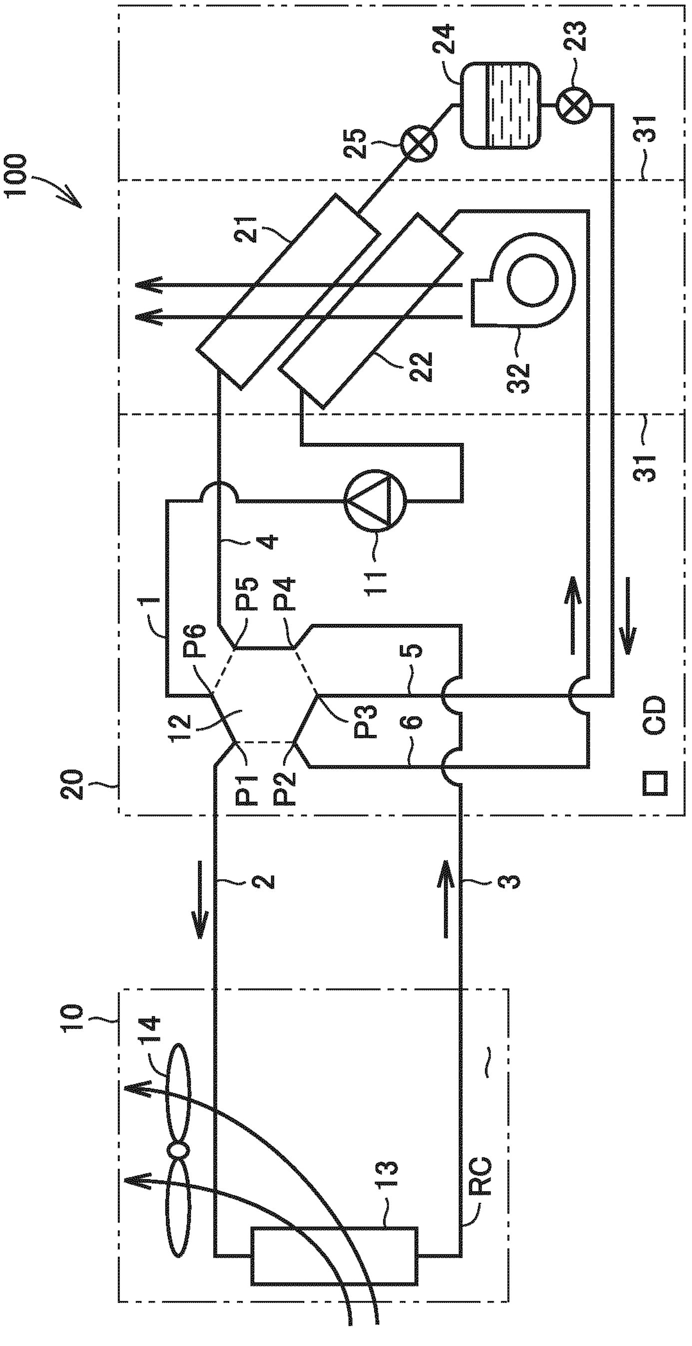


FIG.11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P3
P4
P5
P6
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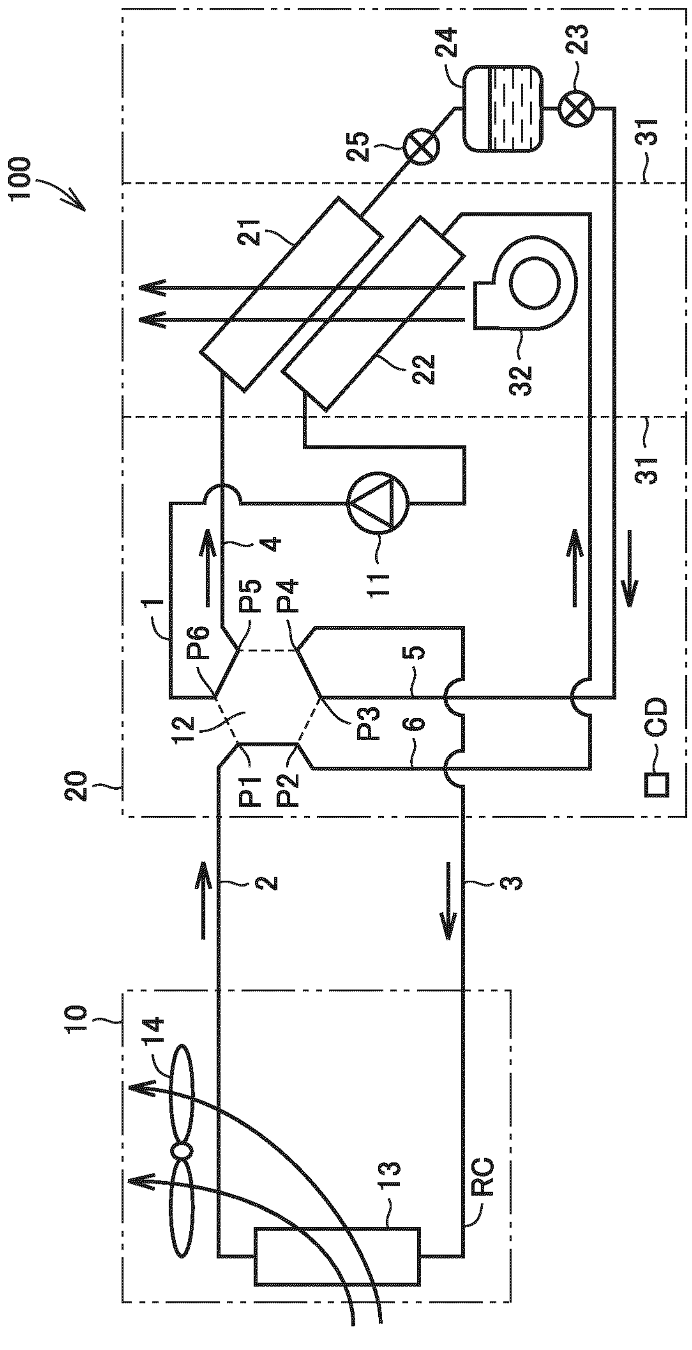
31
32
CD

FIG.12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32
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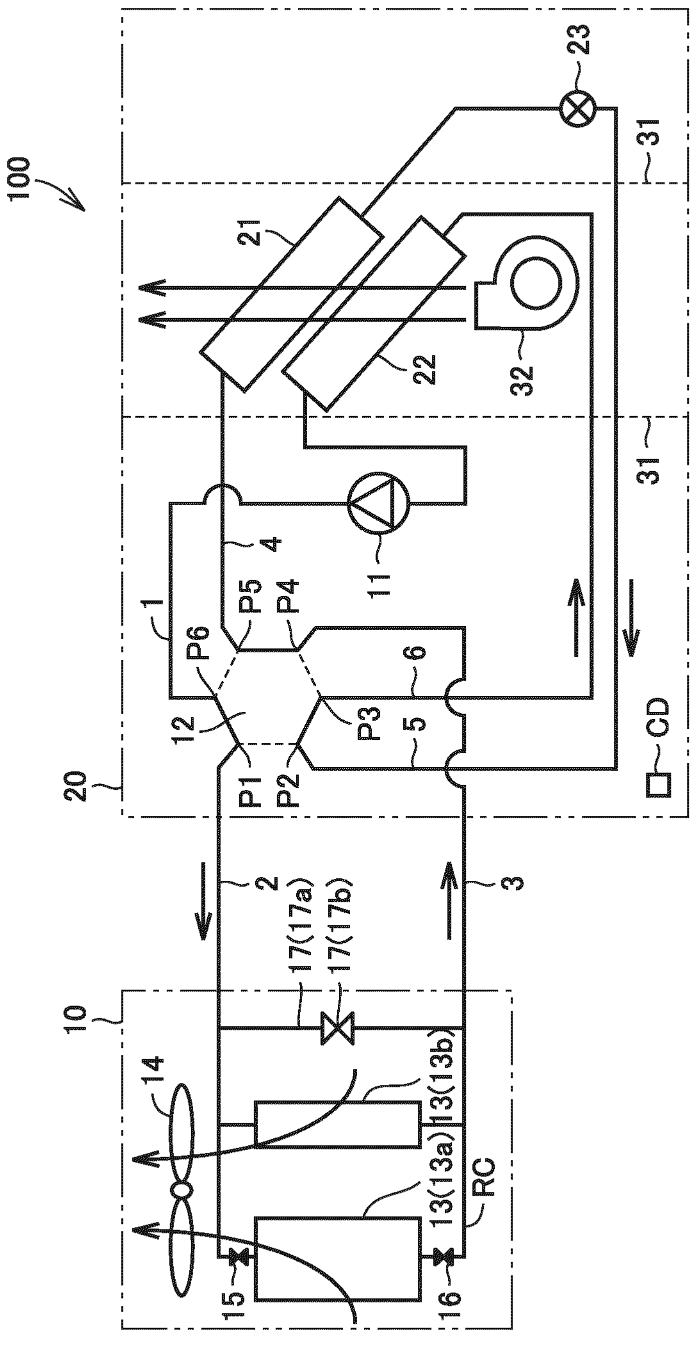
P2
P3
P4
P5
P6
RC
CD

FIG.13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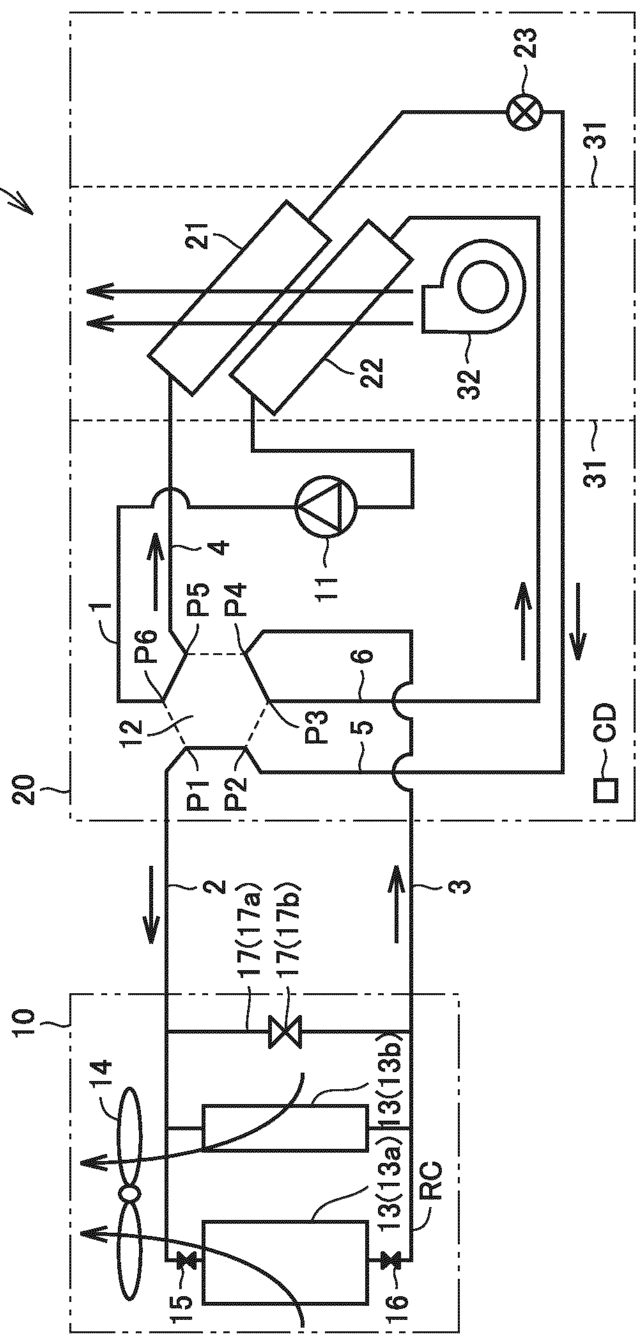
17(17b)
10
14
13(13b)
13(13a)
RC
15
16

FIG.14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13(13b)
RC
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17(17b)
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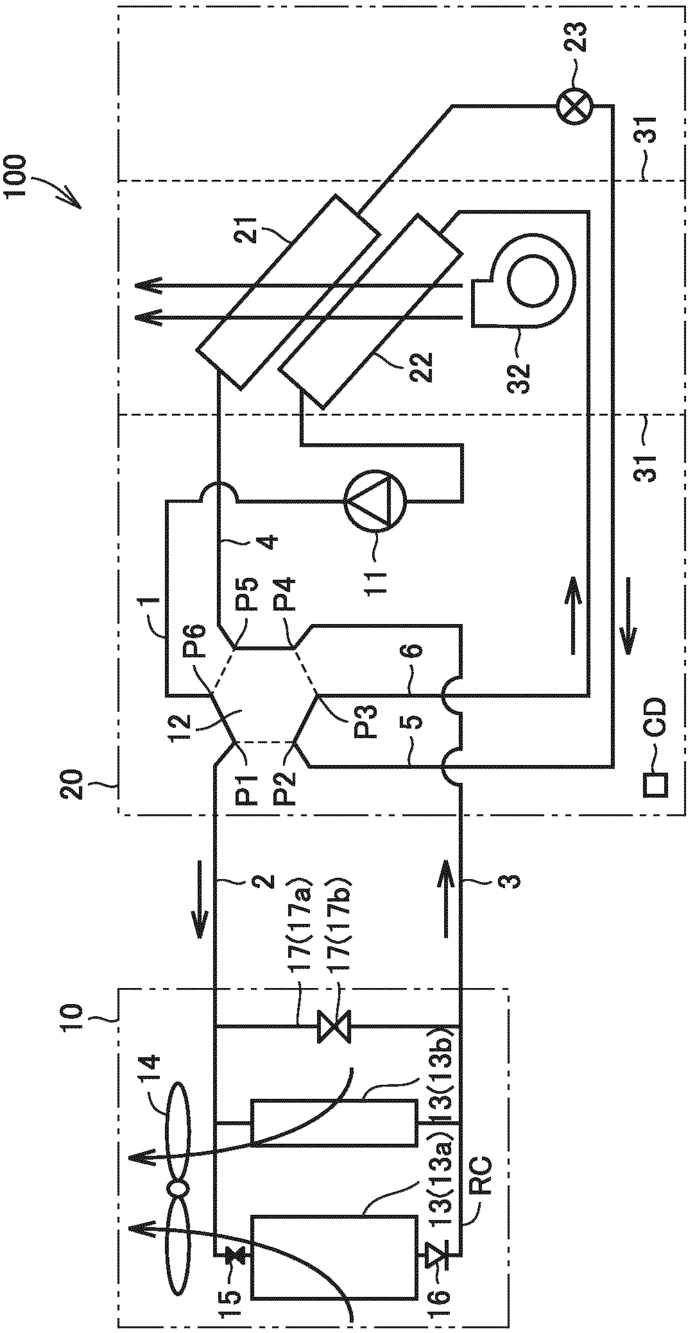
P1
P2
P3
P4
P5
P6
21
22
23
31
32
CD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13(13b)
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17(17a)
17(17b)
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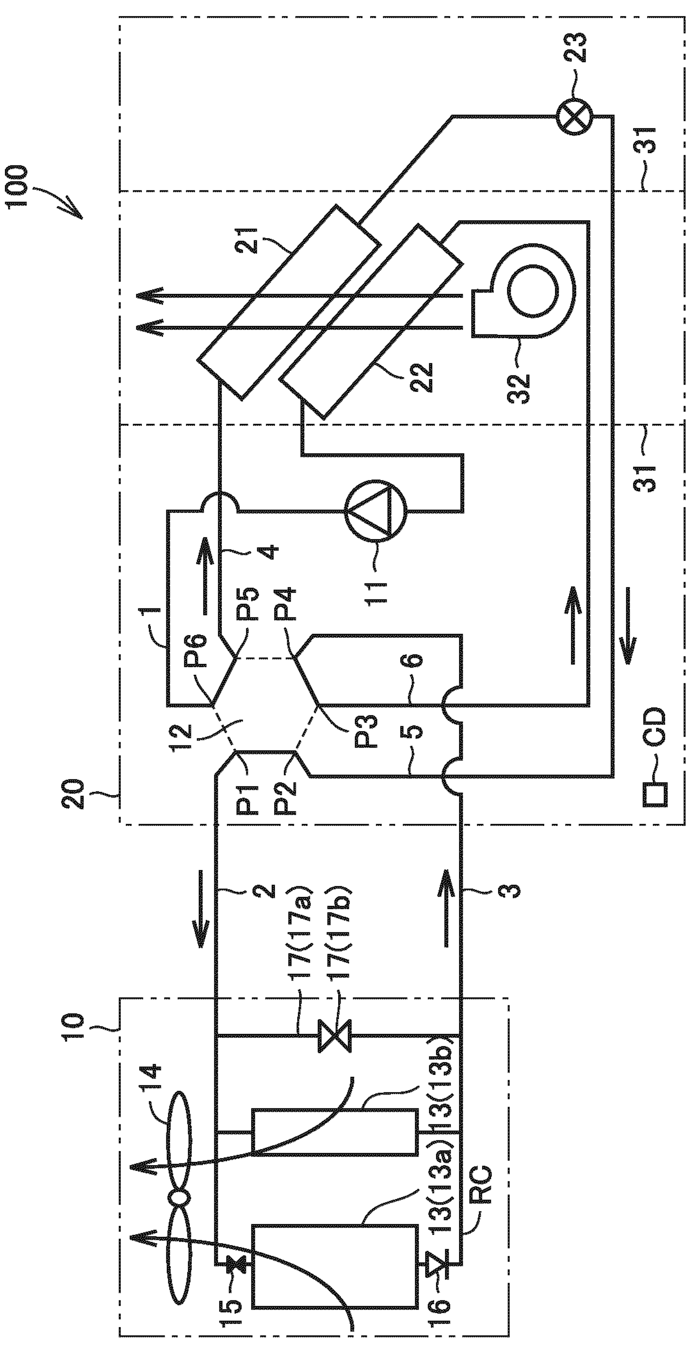
P3
P4
P5
P6
RC
CD

FIG.15

FIG.16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13(13b)
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P3
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RC
CD

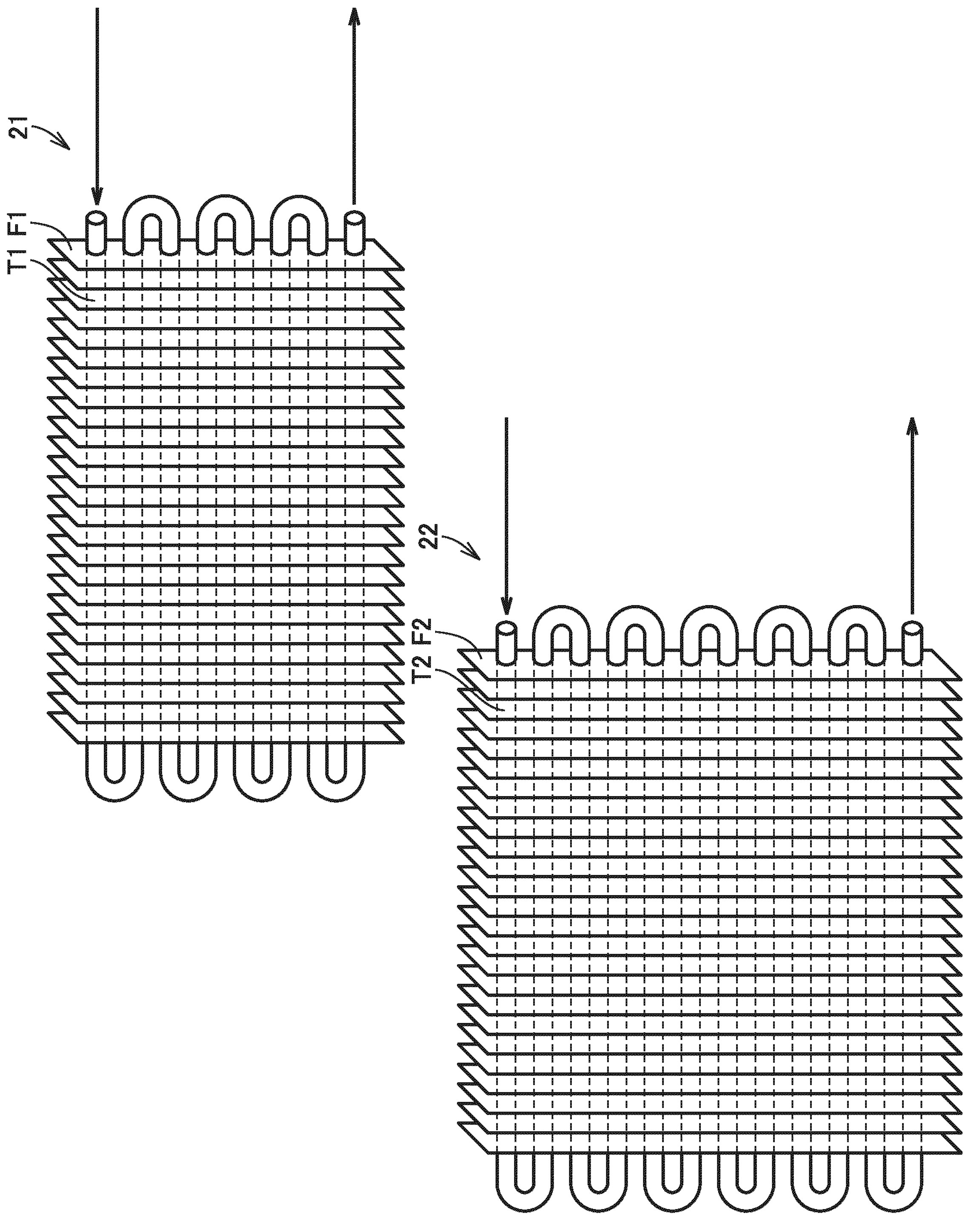

FIG.17

INTERNATIONAL SEARCH REPORT

International application No. **PCT/JP2022/024184**

A. CLASSIFICATION OF SUBJECT MATTER

F25B 13/00(2006.01)i; ***F25B 29/00***(2006.01)i; ***F24F 11/65***(2018.01)i; ***F25B 41/26***(2021.01)i
FI: F25B41/26 B; F25B29/00 391Z; F25B13/00 S; F24F11/65

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25B13/00; F25B29/00; F24F11/65; 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 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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.
A	US 5689962 A (STORE HEAT AND PRODUCE ENERGY, INC.) 25 November 1997 (1997-11-25) specification, column 5, line 23 to column 6, line 4, fig. 5	1-12
A	JP 2003-042583 A (SAGINOMIYA SEISAKUSHO INC.) 13 February 2003 (2003-02-13) paragraphs [0022]-[0038], fig. 1-10	1-12
A	JP 60-191139 A (HITACHI SEISAKUSHO KK) 28 September 1985 (1985-09-28) page 2, lower right column, line 15 to page 4, upper left column, line 1, fig. 4	1-12
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 112955/1973 (Laid-open No. 060838/1975) (TOKYO SHIBAURA ELECTRIC CO. LTD.) 04 June 1975 (1975-06-04), specification, page 2, line 1 to page 8, line 6, figures	1-12
A	JP 07-324844 A (SANYO ELECTRIC CO., LTD.) 12 December 1995 (1995-12-12) paragraphs [0018]-[0042], fig. 1-8	1-12

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

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 August 2022	**23 August 2022**

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/024184

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
US 5689962 A	25 November 1997	WO 1997/044625 A1 AU 3011297 A	
JP 2003-042583 A	13 February 2003	(Family: none)	
JP 60-191139 A	28 September 1985	(Family: none)	
JP 50-060838 U1	04 June 1975	(Family: none)	
JP 07-324844 A	12 December 1995	US 5634352 A specification, column 5, line 4 to column 11, line 36, fig. 2, 3, 13-18 EP 685693 A2 CN 1121161 A KR 10-1995-0033325 A	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2002089998 A **[0002] [0003]**