(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 431 843 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
18.09.2024 Bulletin 2024/38

(21) Application number: **21964013.3**

(22) Date of filing: **10.11.2021**

(51) International Patent Classification (IPC):
F25B 29/00 *(2006.01)* ***F25B 41/26*** *(2021.01)*

(52) Cooperative Patent Classification (CPC):
F25B 29/00; F25B 41/26

(86) International application number:
PCT/JP2021/041422

(87) International publication number:
WO 2023/084658 (19.05.2023 Gazette 2023/20)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **MITSUBISHI ELECTRIC CORPORATION**
Chiyoda-ku
Tokyo 100-8310 (JP)

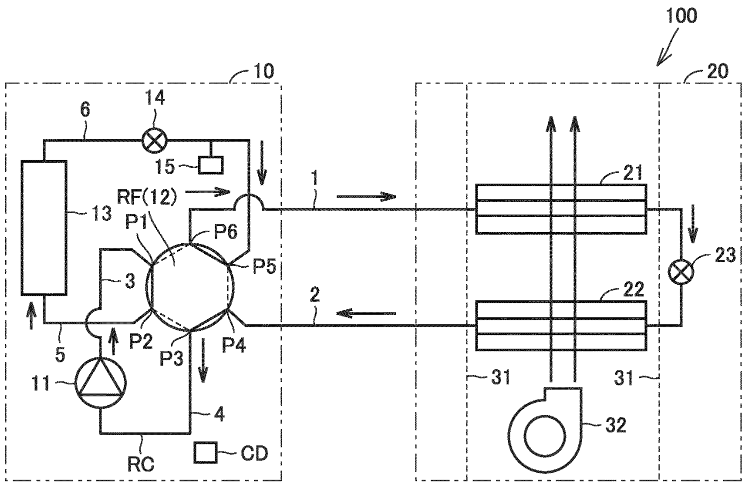
(72) Inventor: **TANAKA, Chitose**
Tokyo 100-8310 (JP)

(74) Representative: **Pfenning, Meinig & Partner mbB**
Patent- und Rechtsanwälte
Theresienhöhe 11a
80339 München (DE)

(54) **AIR CONDITIONER**

(57) An air conditioner (100) has a refrigerant circuit (RC) and a blower (32). A refrigerant flow path switching mechanism (RF) is configured to switch to a first switching state to allow refrigerant to flow through a reheater (21), a second expansion valve (23), and a cooler (22) in this order in a refrigerant circuit (RC). The refrigerant flow path switching mechanism (RF) is configured to switch to a second switching state to allow refrigerant to flow through the reheater (21), the second 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



EP 4 431 843 A1

Description

TECHNICAL FIELD

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

BACKGROUND ART

[0002] An air conditioner is known that includes: an outdoor unit provided with an outdoor heat exchanger functioning as a condenser; an indoor unit provided with 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 from the indoor unit into a space to be air-conditioned. Such an air conditioner is disclosed 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] In the air conditioner disclosed in the above-referenced publication, only one four-way valve is used as a refrigerant flow path switching mechanism. Therefore, when a mainly cooling operation and a mainly heating operation are performed for two switching states respectively of the four-way valve, the direction of refrigerant flowing in the indoor unit in the mainly cooling operation and that in the mainly heating operation are opposite to each other. Thus, 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 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 of the present disclosure is to provide an air conditioner that enables refrigerant to flow in the same direction through the reheater and the cooler in both the mainly cooling operation and the mainly heating operation.

SOLUTION TO PROBLEM

[0006] An air conditioner of the present disclosure has a refrigerant circuit and a blower. The refrigerant circuit has a compressor, a refrigerant flow path switching mechanism, an outdoor heat exchanger, a first expansion valve, a reheater, a second 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 refrigerant flow path switching mechanism is configured to switch between a first switching state and a second switching state. The refrigerant flow path switching mechanism is configured to switch to the first switching state to allow the refrigerant to flow through the compressor, the refrigerant flow path switching mechanism, the outdoor heat exchanger, the first expansion valve, the refrigerant flow path switching mechanism, the reheater, the second expansion valve, the cooler, and the refrigerant flow path switching mechanism in this order in the refrigerant circuit. The refrigerant flow path switching mechanism is configured to switch to the second switching state to allow the refrigerant to flow through the compressor, the refrigerant flow path switching mechanism, the reheater, the second expansion valve, the cooler, the refrigerant flow path switching mechanism, the first expansion valve, the outdoor heat exchanger, and the refrigerant flow path switching mechanism 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, the refrigerant flow path switching mechanism is configured to switch to allow 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 be flown 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 perspective view of a reheater of the air conditioner according to Embodiment 3.

Fig. 12 is a perspective view of a cooler of the air conditioner according to Embodiment 3.

Fig. 13 is a perspective view of a reheater of an air conditioner according to Embodiment 4.

Fig. 14 is a perspective view of a cooler of the air conditioner according to Embodiment 4.

Fig. 15 is a cross-sectional view of a fin of the reheater of the air conditioner according to Embodiment 4.

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 has a refrigerant circuit RC, a sensor 15, an air passage 31, a blower 32, and a control device CD. Refrigerant circuit RC includes a high-pressure pipe 1, a low-pressure pipe 2, a discharge pipe 3, a suction pipe 4, a gas pipe 5, a liquid pipe 6, a compressor 11, a refrigerant flow path switching mechanism RF, an outdoor heat exchanger 13, a first expansion valve 14, a reheater 21, a cooler 22, and a second expansion valve 23.

[0012] In refrigerant circuit RC, high-pressure pipe 1, low-pressure pipe 2, discharge pipe 3, suction pipe 4, gas pipe 5, and liquid pipe 6 connect compressor 11, refrigerant flow path switching mechanism RF, outdoor heat exchanger 13, first expansion valve 14, reheater 21, cooler 22, and second expansion valve 23 to each other.

[0013] High-pressure pipe 1 is connected to refrigerant flow path switching mechanism RF and reheater 21. Low-pressure pipe 2 is connected to refrigerant flow path switching mechanism RF and cooler 22. Discharge pipe 3 is connected to the discharge side of compressor 11 and refrigerant flow path switching mechanism RF. Suction pipe 4 is connected to the suction side of compressor 11 and refrigerant flow path switching mechanism RF. Gas pipe 5 is connected to refrigerant flow path switching mechanism RF and outdoor heat exchanger 13. Liquid pipe 6 connects outdoor heat exchanger 13 and refrigerant flow path switching mechanism RF to each other via first expansion valve 14.

[0014] Refrigerant circuit RC is configured to cause 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.

[0015] Air conditioner 100 has an outdoor unit 10 and an indoor unit 20. Outdoor unit 10 and indoor unit 20 are connected to each other by high-pressure pipe 1 and low-pressure pipe 2. Outdoor unit 10 includes compressor 11, refrigerant flow path switching mechanism RF, outdoor heat exchanger 13, first expansion valve 14, sensor 15, and control device CD. Compressor 11, refrigerant flow path switching mechanism RF, outdoor heat exchanger 13, first expansion valve 14, sensor 15, and control device CD are housed in outdoor unit 10. Indoor unit 20 includes reheater 21, cooler 22, second expansion valve 23, air passage 31, and blower 32. Reheater 21, cooler 22, second expansion valve 23, and blower 32 are housed in indoor unit 20. Indoor unit 20 is provided with air passage 31.

[0016] Compressor 11 is configured to compress 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.

[0017] Refrigerant flow path switching mechanism RF is configured to switch between a first switching state and a second switching state. Refrigerant flow path switching mechanism RF is configured to switch between the first switching state and the second switching state, based on an instruction from control device CD, for example. Refrigerant flow path switching mechanism RF is configured to switch to the first switching state to allow the refrigerant to flow through compressor 11, refrigerant flow path switching mechanism RF, outdoor heat exchanger

13, first expansion valve 14, refrigerant flow path switching mechanism RF, reheater 21, second expansion valve 23, cooler 22, and refrigerant flow path switching mechanism RF in this order in refrigerant circuit RC. In a mainly cooling operation, refrigerant flow path switching mechanism RF is in the first switching state.

[0018] Refrigerant flow path switching mechanism RF is configured to switch to the second switching state to allow the refrigerant to flow through compressor 11, refrigerant flow path switching mechanism RF, reheater 21, second expansion valve 23, cooler 22, refrigerant flow path switching mechanism RF, first expansion valve 14, outdoor heat exchanger 13, and refrigerant flow path switching mechanism RF in this order in refrigerant circuit RC. In a mainly heating operation, refrigerant flow path switching mechanism RF is in the second switching state.

[0019] In Embodiment 1, refrigerant flow path switching mechanism RF is a six-way valve 12. Six connection ports (first connection port P1 to sixth connection port P6) of six-way valve 12 are connected to high-pressure pipe 1, low-pressure pipe 2, discharge pipe 3, suction pipe 4, gas pipe 5, and liquid pipe 6 respectively. First connection port P1 is connected to discharge pipe 3. Second connection port P2 is connected to gas pipe 5. Third connection port P3 is connected to suction pipe 4. Fourth connection port P4 is connected to low-pressure pipe 2. Fifth connection port P5 is connected to liquid pipe 6. Sixth connection port P6 is connected to high-pressure pipe 1.

[0020] In the first switching state of six-way valve 12, refrigerant circuit RC is configured to extend through compressor 11, discharge pipe 3, six-way valve 12, gas pipe 5, outdoor heat exchanger 13, liquid pipe 6, first expansion valve 14, six-way valve 12, high-pressure pipe 1, reheater 21, second expansion valve 23, cooler 22, low-pressure pipe 2, six-way valve 12, and suction pipe 4 and return to compressor 11. In the first switching state of six-way valve 12, second connection port P2 is connected to first connection port P1, the fourth connection port is connected to third connection port P3, and the sixth connection port is connected to the fifth connection port.

[0021] In the second switching state of six-way valve 12, refrigerant circuit RC is configured to extend through compressor 11, discharge pipe 3, six-way valve 12, high-pressure pipe 1, reheater 21, second expansion valve 23, cooler 22, low-pressure pipe 2, six-way valve 12, first expansion valve 14, liquid pipe 6, outdoor heat exchanger 13, gas pipe 5, six-way valve 12, and suction pipe 4, and return to compressor 11. In the second 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.

[0022] Outdoor heat exchanger 13 is configured to exchange heat between 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 refrigerant in the mainly cooling operation and the cooling operation. Outdoor heat exchanger 13 is configured to function as an evaporator that evaporates refrigerant in the mainly heating operation and the heating operation. Outdoor heat exchanger 13 is, for example, a fin-and-tube heat exchanger including a plurality of fins and a heat transfer tube extending through the plurality of fins.

[0023] First expansion valve 14 is configured to expand and thereby reduce the pressure of refrigerant condensed by the condenser. In the mainly cooling operation and the mainly heating operation, first expansion valve 14 is fully open and does not function as a pressure reducing device. In the cooling operation, first expansion valve 14 is configured to reduce the pressure of refrigerant condensed by outdoor heat exchanger 13. In the heating operation, first expansion valve 14 is configured to reduce the pressure of refrigerant condensed by reheater 21 and cooler 22.

[0024] First expansion valve 14 is, for example, an electromagnetic expansion valve. First expansion valve 14 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 14 based on an instruction from control device CD, for example.

[0025] Sensor 15 is disposed between first expansion valve 14 and refrigerant flow path switching mechanism RF in refrigerant circuit RC. Sensor 15 is placed on a pipe connecting first expansion valve 14 and refrigerant flow path switching mechanism RF to each other. Sensor 15 is configured to measure the pressure or the temperature of refrigerant in this pipe. Sensor 15 is configured to measure the pressure or the temperature of refrigerant in refrigerant circuit RC. Sensor 15 may be a refrigerant pressure sensor configured to measure the pressure of refrigerant, or may be a refrigerant temperature sensor configured to measure the temperature of refrigerant.

[0026] 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, refrigerant flow path switching mechanism RF, first expansion valve 14, sensor 15, second expansion valve 23, and blower 32, for example, and configured to control their operations.

[0027] Reheater 21 is configured to exchange heat between refrigerant flowing inside reheater 21 and air flowing outside reheater 21. Reheater 21 is configured to function as a condenser that condenses refrigerant in the mainly cooling operation, the mainly heating operation, and the heating operation. Reheater 21 is configured to function as an evaporator that evaporates refrigerant in the cooling operation. Reheater 21 is, for example, a fin-and-tube heat exchanger including a plurality of fins and a heat transfer tube extending through the plurality of fins.

[0028] Cooler 22 is configured to exchange heat between refrigerant flowing inside cooler 22 and air flowing outside cooler 22. Cooler 22 is configured to function as an evaporator that evaporates refrigerant in the mainly cooling operation, the mainly heating operation, and the cooling operation. Cooler 22 is configured to function as a condenser that condenses refrigerant in the heating operation. Cooler 22 is, for example, a fin-and-tube heat exchanger including a plurality of fins and a heat transfer tube extending through the plurality of fins.

[0029] Second expansion valve 23 is configured to expand and thereby reduce the pressure of refrigerant condensed by the condenser. In the mainly cooling operation and the mainly heating operation, second expansion valve 23 is configured to reduce the pressure of refrigerant condensed by reheater 21. In the cooling operation and the heating operation, second expansion valve 23 is fully open and does not function as a pressure reducing device. Second expansion valve 23 is, for example, an electromagnetic expansion valve. Second 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 second expansion valve 23 based on an instruction from control device CD, for example.

[0030] 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 arranged 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 air blown by blower 32. In air passage 31, cooler 22 is disposed upstream of reheater 21.

[0031] Reheater 21 and cooler 22 share air passage 31 and blower 32. Reheater 21 and cooler 22 are configured to allow air blown by blower 32 to pass through cooler 22 and subsequently 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 air to pass through cooler 22 and subsequently pass through reheater 21, regardless of whether six-way valve 12 is in the first switching state or the second switching state.

[0032] Reheater 21 and cooler 22 may be configured to allow 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 includes 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, refrigerant flows from the heat transfer tube on the leeward side to the heat transfer tube on the windward side. In both the mainly cooling operation and the mainly heating operation, the direction in which refrigerant flows inside the heat transfer tubes of reheater 21 and cooler 22 is opposite to the direction in which air flows outside the heat transfer tubes.

[0033] Next, operations of air conditioner 100 according to Embodiment 1 are described.

<Mainly Cooling Operation>

[0034] 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 air is cooled by cooler 22 is larger than the amount by which air is heated by reheater 21 and outdoor heat exchanger 13 functions as a condenser, so that surplus heat is dissipated into the outside air by this air conditioner acting as a heat pump. In the mainly cooling operation, air after passing through reheater 21 has a lower temperature and a smaller moisture content than air before passing through cooler 22.

[0035] 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. Vapor refrigerant compressed to have a high temperature and a high pressure by compressor 11 flows into discharge pipe 3, passes through six-way valve 12, and flows into outdoor heat exchanger 13 through gas pipe 5. 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 an outdoor blower (not shown). Thus, the high-temperature and high-pressure vapor refrigerant is condensed into a high-temperature and high-pressure gas-liquid two-phase refrigerant.

[0036] The high-temperature and high-pressure gas-liquid two-phase refrigerant flows into liquid pipe 6, passes through six-way valve 12 through first expansion valve 14, and flows into reheater 21 through high-pressure pipe 1. Reheater 21 functions as a condenser. The high-temperature and high-pressure gas-liquid two-phase refrigerant dissipates heat into 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 second expansion valve 23.

[0037] The high-pressure liquid refrigerant is expanded and reduced in pressure by second 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 cooler 22. Cooler 22 functions as an evaporator. By absorbing heat from 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 thereafter flows into six-way valve 12 through low-pressure pipe 2, and is sucked into compressor 11 through suction pipe 4. In the mainly cooling operation, the refrigerant thereafter circulates in refrigerant circuit RC through the same process.

[0038] Reheater 21 and cooler 22 share air passage

31 and blower 32. 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 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.

[0039] 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 a space to be air-conditioned.

<Mainly Heating Operation>

[0040] 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 air is heated by reheater 21 is larger than the amount by which 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, air after passing through reheater 21 has a higher temperature and a smaller moisture content than air before passing through cooler 22.

[0041] 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. Vapor refrigerant compressed to have a high temperature and a high pressure by compressor 11 flows into discharge pipe 3, passes through six-way valve 12, and flows into reheater 21 through high-pressure pipe 1. Reheater 21 functions as a condenser. The high-temperature and high-pressure vapor refrigerant dissipates heat into 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 second expansion valve 23.

[0042] The high-pressure liquid refrigerant is expanded and reduced in pressure by second 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 cooler 22. Cooler 22 functions as an evaporator. By absorbing heat from air introduced into cooler 22 by blower 32, 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 low-pressure pipe 2, flows into liquid pipe 6, and flows into outdoor heat exchanger 13 through first expansion valve 14.

[0043] Outdoor heat exchanger 13 functions as an evaporator. By absorbing heat from outdoor air introduced into outdoor heat exchanger 13 by an outdoor blower (not shown), the low-temperature and low-pressure gas-liquid two-phase refrigerant evaporates into a low-pressure vapor refrigerant. The low-pressure vapor refrigerant flows into six-way valve 12 through gas pipe 5, and is sucked into compressor 11 through suction pipe 4. In the mainly heating operation, the refrigerant circulates in refrigerant circuit RC through the same process.

[0044] Like the mainly cooling operation, air introduced into air passage 31 by blower 32 is cooled and dehumidified by cooler 22, thereafter heated by reheater 21, and blown into a 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 a user can be supplied into the space to be air-conditioned.

<Cooling Operation>

[0045] Referring again to Fig. 1, the cooling operation is described. In the cooling operation, first expansion valve 14 expands refrigerant. In other words, in the cooling operation, first expansion valve 14 functions as an expansion valve. In contrast, second expansion valve 23 is fully open and does not function as an expansion valve in the cooling operation.

[0046] In the cooling operation, refrigerant circulates in refrigerant circuit RC through compressor 11, refrigerant flow path switching mechanism RF, outdoor heat exchanger 13, first expansion valve 14, refrigerant flow path switching mechanism RF, reheater 21, second expansion valve 23, cooler 22, and refrigerant flow path switching mechanism RF in this order.

<Heating Operation>

[0047] Referring again to Fig. 2, the heating operation is described. In the heating operation, first expansion valve 14 expands refrigerant. In other words, in the heating operation, first expansion valve 14 functions as an expansion valve. In contrast, in the heating operation, second expansion valve 23 is fully open and does not function as an expansion valve.

[0048] In the heating operation, refrigerant circulates in refrigerant circuit RC through compressor 11, refrigerant flow path switching mechanism RF, reheater 21, second expansion valve 23, cooler 22, refrigerant flow path switching mechanism RF, first expansion valve 14, outdoor heat exchanger 13, and refrigerant flow path switching mechanism RF in this order.

[0049] Next, functions and advantageous effects of air conditioner 100 according to Embodiment 1 are described.

[0050] In the air conditioner according to Embodiment 1, refrigerant flow path switching mechanism RF is configured to switch to allow 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. Refrigerant flow path switching mechanism RF is switched into the first switching state for the mainly cooling operation, and switched into the second switching state for the mainly heating operation. Thus, in both of the mainly cooling operation and the mainly heating operation, refrigerant can flow in the same direction through reheater 21 and cooler 22.

[0051] Reheater 21 and cooler 22 are configured to allow air blown by blower 32 to pass through cooler 22 and thereafter 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, air can be reheated after being cooled and dehumidified. As a result, in both of the mainly cooling operation and the mainly heating operation, sufficient dehumidification can be performed.

[0052] 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 a space to be air-conditioned. Accordingly, air conditioner 100 according to Embodiment 1 can also be used for drying foods and raw materials.

[0053] In air conditioner 100 according to Embodiment 1, refrigerant flow path switching mechanism RF is a six-way valve 12. Therefore, in either of the mainly cooling operation and the mainly heating operation, refrigerant can be flown in the same direction through reheater 21 and cooler 22. Thus, in either of the mainly cooling operation and the mainly heating operation, air cooled and dehumidified by cooler 22 can be heated by reheater 21. Accordingly, air having a temperature and a humidity that are set by a user can be supplied into a space to be air-conditioned.

[0054] When noise and vibration in an indoor space are not desired, for example, a configuration of air conditioner 100 called a separate type in which compressor 11 is placed in outdoor unit 10 is more preferable than a configuration of air conditioner 100 called a remote type in which compressor 11 is placed in indoor unit 20. In the case of the remote type, the refrigerant circuit generally has a configuration in which one end of reheater 21 is connected to discharge pipe 3 without refrigerant flow path switching mechanism RF interposed therebetween, and the other end of reheater 21 is connected to liquid pipe 6. In this refrigerant circuit configuration, if the separate-type configuration is employed in which compressor 11 is placed in outdoor unit 10, outdoor unit 10 and indoor unit 20 have to be connected to each other by three pipes, i.e., discharge pipe 3, liquid pipe 6, and low pressure pipe 2. In the configuration of air conditioner 100 according to Embodiment 1, outdoor unit 10 and indoor unit 20 are connected to each other by high-pressure pipe 1 and low-pressure pipe 2. Thus, outdoor unit 10 and indoor unit 20 can be connected to each other by the two pipes, i.e., high-pressure pipe 1 and low-pressure pipe 2, which enables reduction of the construction work.

[0055] In air conditioner 100 according to Embodiment 1, sensor 15 is configured to measure the pressure or the temperature of refrigerant in refrigerant circuit RC. Therefore, in the mainly cooling operation, the amount by which air is to be heated can be adjusted by first expansion valve 14, based on the result of measuring the pressure or the temperature of refrigerant in reheater 21 by sensor 15. Moreover, in the mainly heating operation, the amount by which air is to be cooled can be adjusted by first expansion valve 14, based on the result of measuring the pressure or the temperature of refrigerant in cooler 22 by sensor 15. Thus, it is possible to finely adjust the refrigerant condensation temperature in reheater 21 in the mainly cooling operation, and finely adjust the refrigerant evaporation temperature in cooler 22 in the mainly heating operation. Accordingly, it is possible to stably control the temperature and the humidity of air to be blown out from air conditioner 100.

[0056] Specifically, when the refrigerant pressure value in reheater 21 in the mainly cooling operation or the refrigerant pressure value in cooler 22 in the mainly heating operation, associated with a temperature and a humidity of air to be blown from air conditioner 100 that are set by a user, is known in advance, for example, a command for the degree of opening of first expansion valve 14 is adjusted so that a value measured by sensor 15 approaches the refrigerant pressure value.

[0057] In air conditioner 100 according to Embodiment 1, 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. Therefore, when phase transition of the refrigerant mixture occurs, a temperature gradient is generated in the 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.

[0058] In air conditioner 100 according to Embodiment 1, reheater 21 and cooler 22 are configured to allow refrigerant to flow in the direction opposite to the direction in which air flows. Therefore, 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. Accordingly, a high-performance operation of air conditioner 100 can be achieved.

[0059] 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 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.

[0060] 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.

[0061] 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.

[0062] 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 includes a valve seat 12a and a valve body 12b configured to rotate 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.

[0063] 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. Slide-type six-way valve 12 includes a valve seat 12a and a valve body 12b configured to slide 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

[0064] An 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 advantageous effects, unless otherwise described.

<Device Configuration>

[0065] Fig. 7 is a refrigerant circuit diagram of air conditioner 100 according to Embodiment 2. Referring to Fig. 7, a configuration of air conditioner 100 according to Embodiment 2 is described.

[0066] In Embodiment 2, refrigerant flow path switching mechanism RF includes a four-way valve 41 and a check valve bridge circuit NC. Four-way valve 41 is connected to compressor 11, outdoor heat exchanger 13, and check valve bridge circuit NC. Check valve bridge circuit NC includes a first check valve 42, a second check valve 43, a third check valve 44, and a fourth check valve 45.

[0067] Four connection ports (first connection port P1 to fourth connection port P4) of four-way valve 41 are connected to high-pressure pipe 1 or low-pressure pipe 2, discharge pipe 3, suction pipe 4, and gas pipe 5, respectively. First connection port P1 is connected to discharge pipe 3. Second connection port P2 is connected to gas pipe 5. Third connection port P3 is connected to an inlet port of first check valve 42 and an outlet port of fourth check valve 45. Fourth connection port P4 is connected to suction pipe 4.

[0068] An outlet port of first check valve 42 and an outlet port of third check valve 44 are connected to high-pressure pipe 1. An inlet port of fourth check valve 45 and an inlet port of second check valve 43 are connected to low-pressure pipe 2. An outlet port of second check valve 43 and an inlet port of third check valve 44 are connected to liquid pipe 6.

[0069] In a first switching state of four-way valve 41, refrigerant circuit RC is configured to extend through compressor 11, discharge pipe 3, four-way valve 41, gas pipe 5, outdoor heat exchanger 13, liquid pipe 6, first expansion valve 14, third check valve 44, high-pressure pipe 1, reheater 21, second expansion valve 23, cooler 22, low-pressure pipe 2, fourth check valve 45, four-way valve 41, and suction pipe 4, and return to compressor 11. In the first switching state of four-way valve 41, second connection port P2 is connected to first connection port P1, and the fourth connection port is connected to third connection port P3.

[0070] In a second switching state of four-way valve 41, refrigerant circuit RC is configured to extend through compressor 11, discharge pipe 3, four-way valve 41, first check valve 42, high-pressure pipe 1, reheater 21, second expansion valve 23, cooler 22, low-pressure pipe 2, second check valve 43, first expansion valve 14, liquid pipe 6, outdoor heat exchanger 13, gas pipe 5, four-way valve 41, and suction pipe 4, and return to compressor 11. In the second switching state of four-way valve 41, third connection port P3 is connected to first connection port P1, and fourth connection port P4 is connected to second connection port P2.

[0071] Next, operations of air conditioner 100 according to Embodiment 2 are described.

[0072] 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, refrigerant flows in refrigerant circuit RC through compressor 11, discharge pipe 3, four-way valve 41, gas pipe 5, outdoor heat exchanger 13, liquid pipe 6, first expansion valve 14, third check valve 44, high-pressure pipe 1, reheater 21, second expansion valve 23, cooler 22, low-pressure pipe 2, fourth check valve 45, four-way valve 41, suction pipe 4, and compressor 11 again.

[0073] Referring to Fig. 8, in the mainly heating operation of air conditioner 100 according to Embodiment 2, refrigerant flows in refrigerant circuit RC through compressor 11, discharge pipe 3, four-way valve 41, first check valve 42, high-pressure pipe 1, reheater 21, second expansion valve 23, cooler 22, low-pressure pipe 2, second check valve 43, first expansion valve 14, liquid pipe 6, outdoor heat exchanger 13, gas pipe 5, four-way valve 41, suction pipe 4, and compressor 11 again.

[0074] Referring again to Fig. 7, in the cooling operation of air conditioner 100 according to Embodiment 2, refrigerant flows in refrigerant circuit RC in the same manner as that in the mainly cooling operation. Referring again to Fig. 8, in the heating operation of air conditioner 100 according to Embodiment 2, refrigerant flows in refrigerant circuit RC in the same manner as that in the mainly heating operation.

[0075] Next, functions and advantageous effects of air conditioner 100 according to Embodiment 2 are described.

[0076] In air conditioner 100 according to Embodiment 2, refrigerant flow path switching mechanism RF includes four-way valve 41 and check valve bridge circuit NC. Therefore, in either of the mainly cooling operation and the mainly heating operation, refrigerant can be flown in the same direction through reheater 21 and cooler 22. Thus, in either of the mainly cooling operation and the mainly heating operation, air cooled and dehumidified by cooler 22 can be heated by reheater 21. Accordingly, air having a temperature and a humidity that are set by a user can be supplied into a space to be air-conditioned.

[0077] Moreover, refrigerant flow path switching mechanism RF can be made up of four-way valve 41 and check valve bridge circuit NC, and therefore, refrigerant flow path switching mechanism RF can be made up of inexpensive components.

Embodiment 3

[0078] An 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 advantageous effects, unless otherwise described.

[0079] Referring to Figs. 9 and 10, a configuration of air conditioner 100 according to Embodiment 3 is described.

[0080] As shown in Figs. 9 and 10, reheater 21 includes a plurality of first heat transfer flow paths T1 arranged in parallel lines. Cooler 22 includes a plurality of second heat transfer flow paths T2 arranged in parallel lines.

[0081] Referring to Figs. 11 and 12, the number of the parallel lines of the plurality of second heat transfer flow paths T2 of cooler 22 is larger than the number of the parallel lines of the plurality of first heat transfer flow paths T1 of reheater 21. The number of parallel lines is the number of branches. In other words, the number of parallel lines is the number of paths.

[0082] Next, functions and advantageous effects of air conditioner 100 according to Embodiment 3 are described.

[0083] Refrigerant in reheater 21 is in a high-temperature and high-pressure state and has a high density. Therefore, the number of parallel lines of first heat transfer flow paths T1 can be reduced to increase the refrigerant flow velocity and thereby increase the heat transfer coefficient in the heat transfer flow paths. Thus, reduction of the number of parallel lines of first heat transfer flow paths T1 contributes to improvement of the performance of air conditioner 100.

[0084] Refrigerant in cooler 22 is in a low-temperature and low-pressure state and has a low density. Therefore, the number of parallel lines of second heat transfer flow paths T2 can be increased to lower the refrigerant flow velocity and thereby reduce a pressure loss in the heat transfer flow paths. Thus, increase of the number of parallel lines of second heat transfer flow paths T2 contributes to improvement of the performance of air conditioner 100.

[0085] Thus, in air conditioner 100 according to Embodiment 3, the number of parallel lines of a plurality of second heat transfer flow paths T2 of cooler 22 is larger than the number of parallel lines of a plurality of first heat transfer flow paths T1 of reheater 21, and accordingly, high-performance air conditioner 100 can be achieved.

[0086] The heat exchanger on the upstream side along the air passage can be designed dedicatedly to function as cooler 22 and the heat exchanger on the downstream side along the air passage can be designed dedicatedly to function as reheater 21, and therefore, in terms of the design of the number of parallel branches of heat transfer pipes in the heat exchanger, an optimum design can be done to achieve the advantageous effect that the performance is improved by improvement of the refrigerant heat transfer coefficient, and the advantageous effect that the performance is improved by reduction of the refrigerant pressure loss.

Embodiment 4

[0087] An air conditioner 100 according to Embodiment 4 is identical to air conditioner 100 according to Embodiment 1 in terms of configuration, operations, as well as functions and advantageous effects, unless otherwise described.

[0088] Referring to Figs. 13 to 15, a configuration of reheater 21 and cooler 22 of air conditioner 100 according to Embodiment 4 is described.

[0089] As shown in Fig. 13, reheater 21 includes a first fin F1. Reheater 21 may include a plurality of first fins F1. As shown in Fig. 14, cooler 22 includes a second fin. Cooler 22 may include a plurality of second fins F2. The contact angle between a surface of second fin F2 of cooler 22 and water is smaller than the contact angle between a surface of first fin F1 of reheater 21 and water.

[0090] As shown in Fig. 15, the surface of second fin F2 of cooler 22 where air is cooled and condensed is preferably subjected to a hydrophilic treatment, in order to prevent dew from dropping into the air passage and improve water drainage of the fin surface. Second fin F2 of cooler 22 includes a main body portion Fa and a hydrophilic treatment portion Fb that covers the surface of main body portion Fa. In contrast, no dew condensation water is generated on the fin surface of reheater 21, and therefore, the costly hydrophilic treatment is unnecessary.

[0091] Next, functions and advantageous effects of air conditioner 100 according to Embodiment 4 are described.

[0092] In air conditioner 100 according to Embodiment 4, the contact angle between the surface of second fin F2 of cooler 22 and water is smaller than the contact angle between the surface of first in F1 of reheater 21 and water. Accordingly, air conditioner 100 satisfying both the dehumidification performance requirement and the cost requirement can be achieved.

[0093] The heat exchanger on the upstream side along the air passage can be designed dedicatedly to function as cooler 22 and the heat exchanger on the downstream side along the air passage can be designed dedicatedly to function as reheater 21, and therefore, only the fin surface of cooler 22 can be subjected to the hydrophilic treatment to reduce the contact angle between the surface of second fin F2 of cooler 22 and water, relative to the contact angle between the surface of first fin F1 of reheater 21 and water.

[0094] 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

[0095] 1 high-pressure pipe; 2 low-pressure pipe; 3 discharge pipe; 4 suction pipe; 5 gas pipe; 6 liquid pipe; 10 outdoor unit; 11 compressor; 12 six-way valve; 13 outdoor heat exchanger; 14 first expansion valve; 15 sensor; 20 indoor unit; 21 reheater; 22 cooler; 23 second expansion valve; 31 air passage; 32 blower; 41 four-way valve; 42 first check valve; 43 second check valve; 44 third check valve; 45 fourth check valve; 100 air conditioner; F1 first fin; F2 second fin; NC check valve bridge circuit; RC refrigerant circuit; RF refrigerant flow path switching mechanism; T1 first heat transfer flow path; T2 second heat transfer flow path

Claims

1. An air conditioner comprising:

a refrigerant circuit comprising a compressor, a refrigerant flow path switching mechanism, an outdoor heat exchanger, a first expansion valve, a reheater, a second 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 refrigerant flow path switching mechanism being configured to switch between a first switching state and a second switching state,

the refrigerant flow path switching mechanism being configured to switch to the first switching state to allow the refrigerant to flow through the compressor, the refrigerant flow path switching mechanism, the outdoor heat exchanger, the first expansion valve, the refrigerant flow path switching mechanism, the reheater, the second expansion valve, the cooler, and the refrigerant flow path switching mechanism in this order in the refrigerant circuit,

the refrigerant flow path switching mechanism being configured to switch to the second switching state to allow the refrigerant to flow through the compressor, the refrigerant flow path switching mechanism, the reheater, the second expansion valve, the cooler, the refrigerant flow path switching mechanism, the first expansion valve, the outdoor heat exchanger, and the refrigerant flow path switching mechanism 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 flow path switching mechanism is a six-way valve.

3. The air conditioner according to claim 1, wherein

the refrigerant flow path switching mechanism comprises a four-way valve and a check valve bridge circuit, and

the four-way valve is connected to the compressor, the outdoor heat exchanger, and the check valve bridge circuit.

4. The air conditioner according to any one of claims 1 to 3, wherein

the reheater comprises a plurality of first heat transfer flow paths arranged in parallel lines,

the cooler comprises a plurality of second heat transfer flow paths arranged in parallel lines, and

the number of the parallel lines of the plurality of second heat transfer flow paths of the cooler is larger than the number of the parallel lines of the plurality of first heat transfer flow paths of the reheater.

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

the reheater comprises a first fin,
the cooler comprises a second fin, and
a contact angle between a surface of the second fin of the cooler and water is smaller than a contact angle between a surface of the first fin of the reheater and water.

6. The air conditioner according to any one of claims 1 to 5, further comprising:

an outdoor unit comprising the compressor and the outdoor heat exchanger;
an indoor unit comprising the reheater and the cooler;
a high-pressure pipe; and
a low-pressure pipe, wherein
the outdoor unit and the indoor unit are connected to each other by the high-pressure pipe and the low-pressure pipe.

7. The air conditioner according to any one of claims 1 to 6, further comprising a sensor on a pipe that connects the first expansion valve and the refrigerant flow path switching mechanism to each other, wherein
the sensor is configured to measure a pressure or a temperature of the refrigerant in the pipe.

8. The air conditioner according to any one of claims 1 to 7, wherein the refrigerant is a refrigerant mixture.

9. The air conditioner according to claim 8, wherein the reheater and the cooler are configured to allow the refrigerant to flow in an opposite direction to a direction in which the air flows.

FIG.1

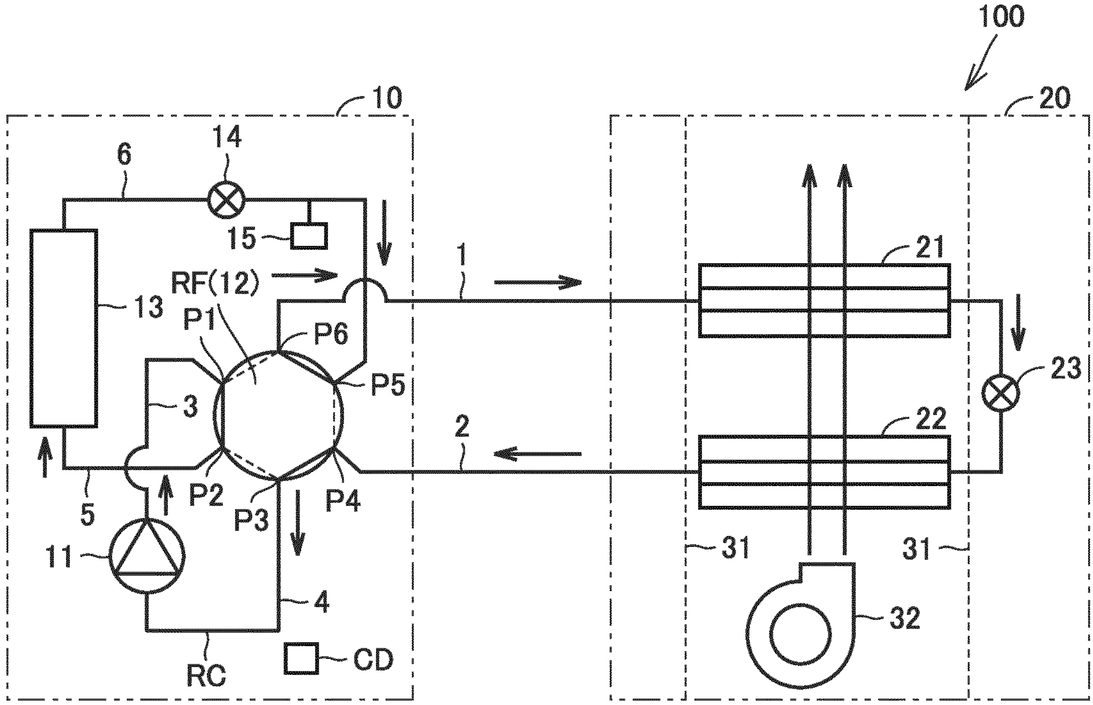

100
10
20
6
14
15
13
RF(12)
1
21
P1
P6
P5
23
3
2
22
P2
P4
5
P3
11
31
31
4
32
RC
CD

FIG.2

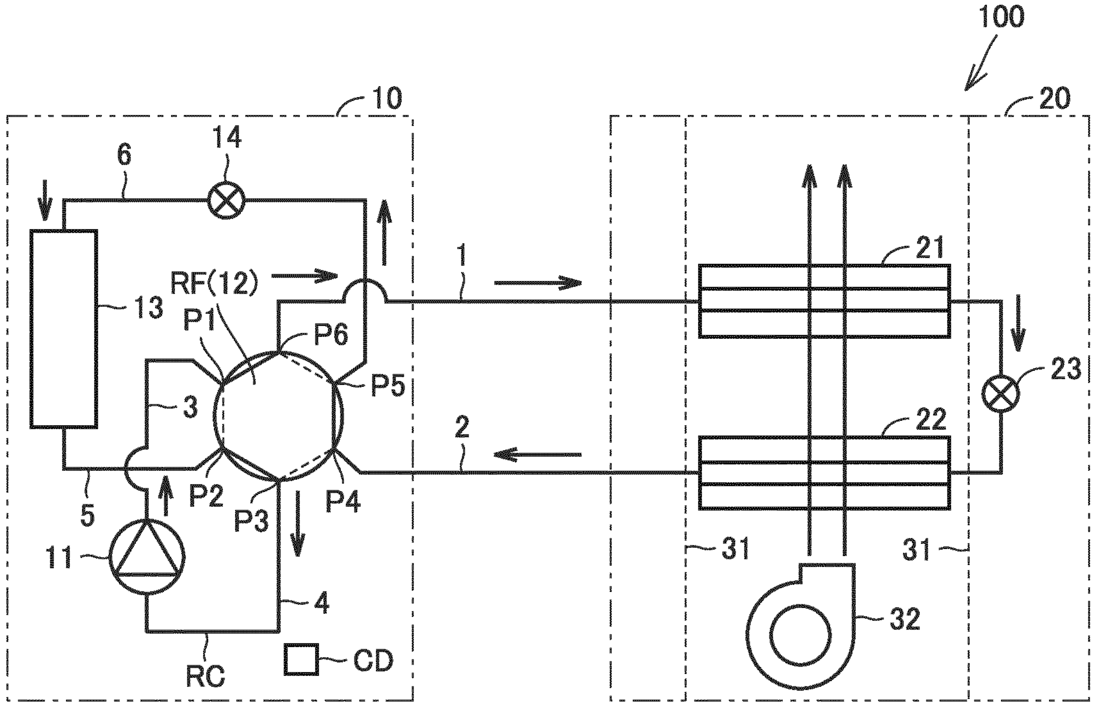

100
10
20
14
6
13
RF(12)
P1
P6
P5
P2
P3
P4
3
5
11
4
RC
CD
1
2
21
22
23
31
31
32

FIG.3

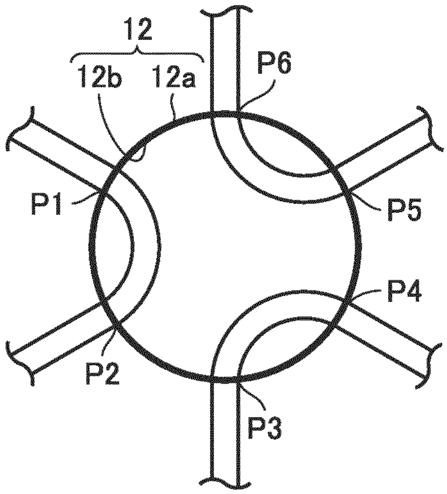


FIG.4

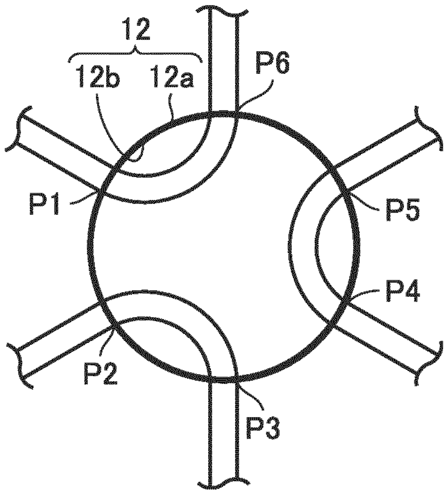


FIG.5

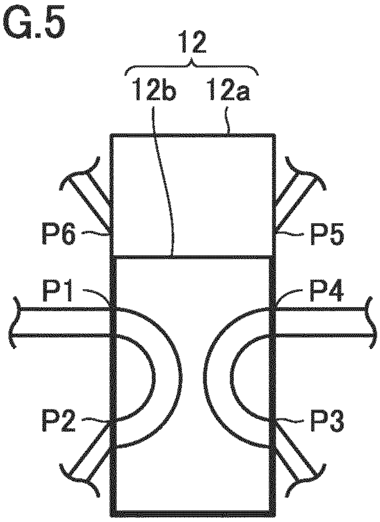


FIG.6

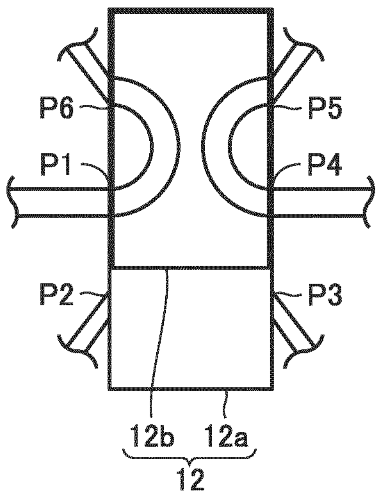


FIG.7

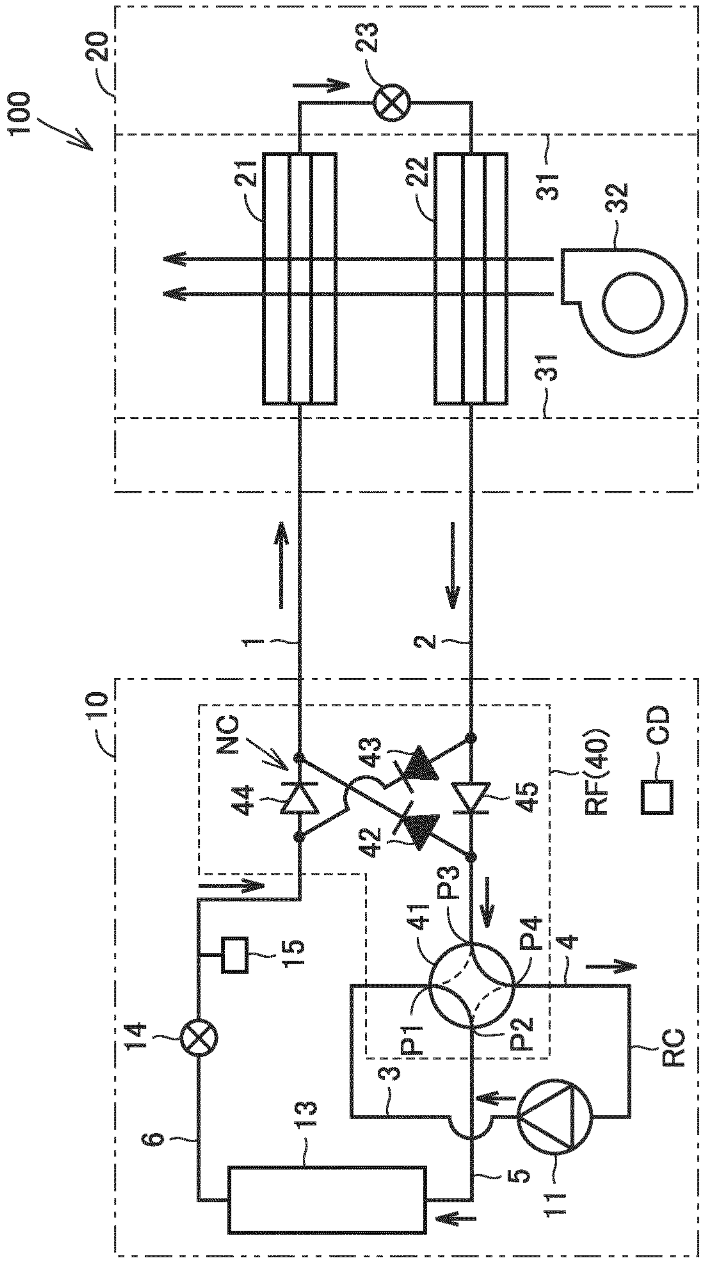

100
20
23
21
22
31
32
31
1
2
10
NC
44
43
42
45
RF(40)
CD
15
14
41
P3
P4
P1
P2
4
RC
3
13
6
5
11

FIG.8

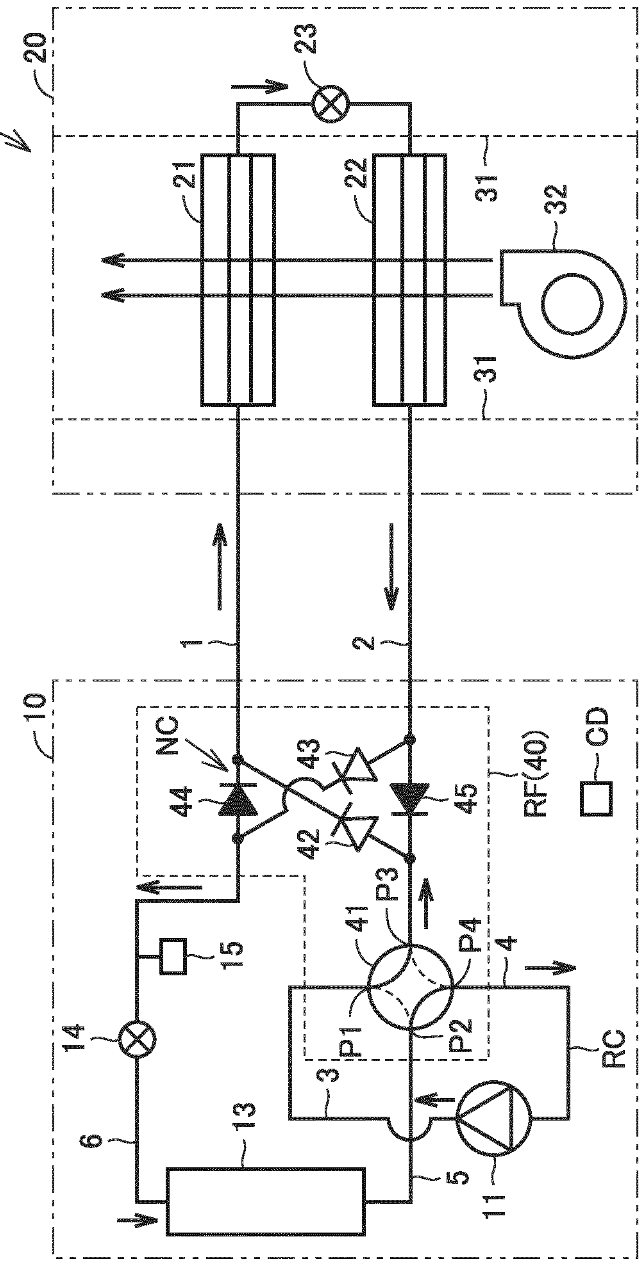

100
20
23
21
22
31
32
31
1
2
10
NC
43
44
45
42
RF(40)
CD
41
P3
P4
P1
P2
4
15
14
RC
3
6
13
5
11

FIG.9

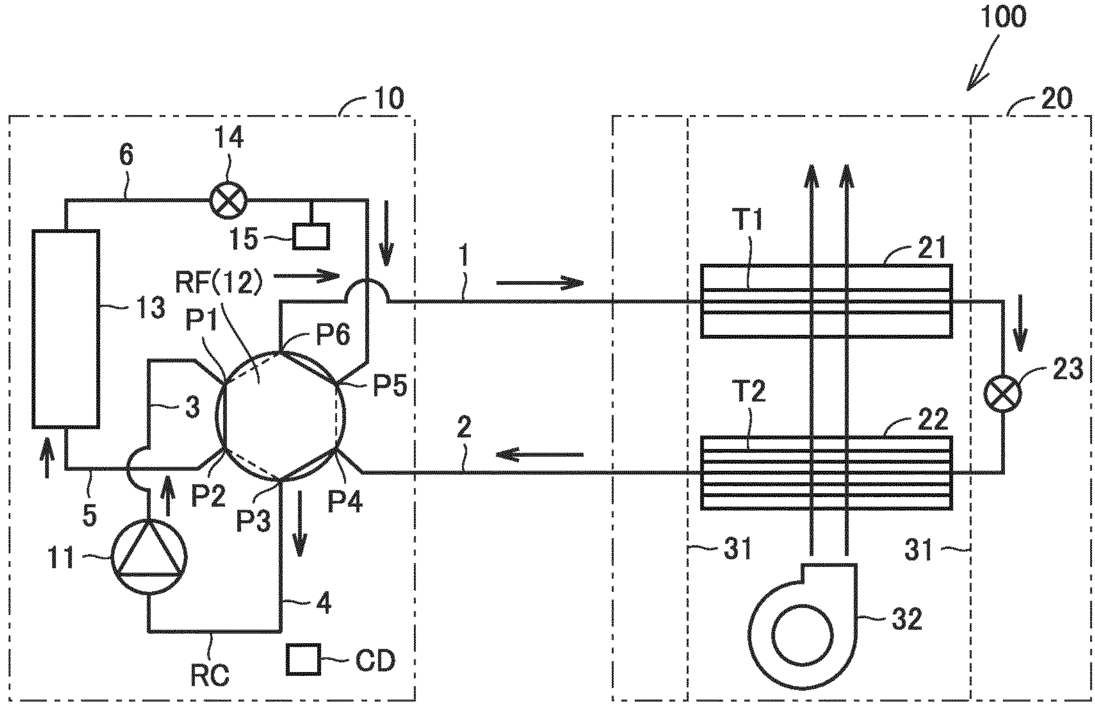

100
10
20
6
14
15
RF(12)
13
P1
P6
P5
P2
P3
P4
3
5
11
4
RC
CD
1
2
T1
21
T2
22
23
31
31
32

FIG.10

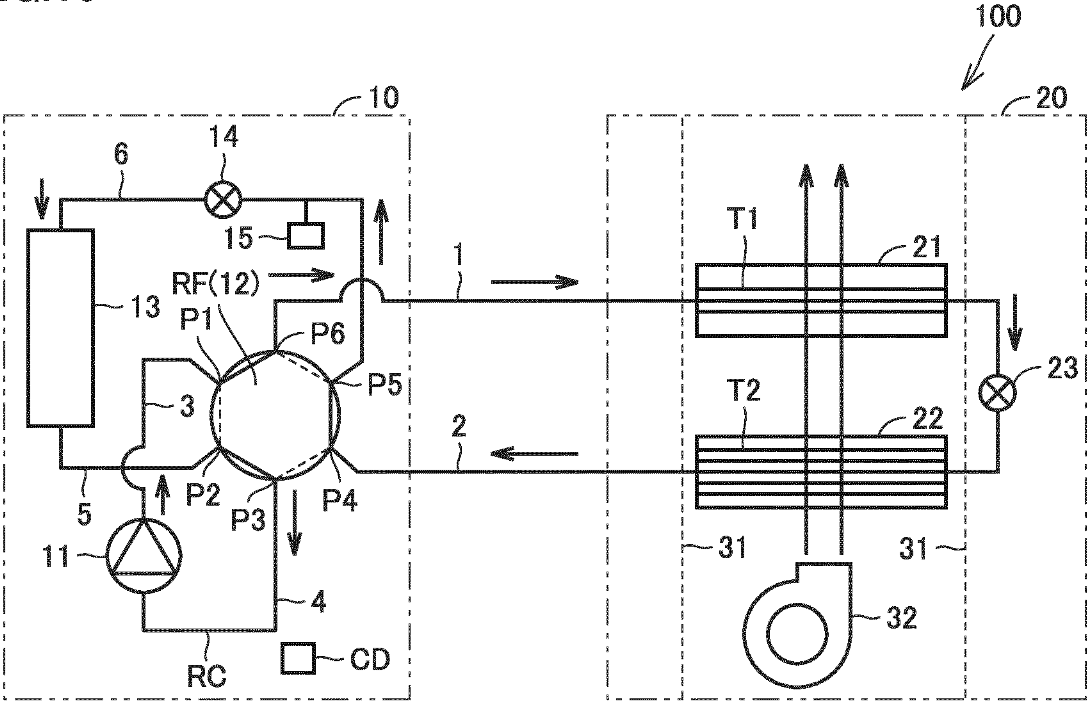

100
10
20
6
14
15
13
RF(12)
P1
P6
P5
P2
P3
P4
3
5
11
4
RC
CD
1
2
T1
21
T2
22
23
31
31
32

FIG.11

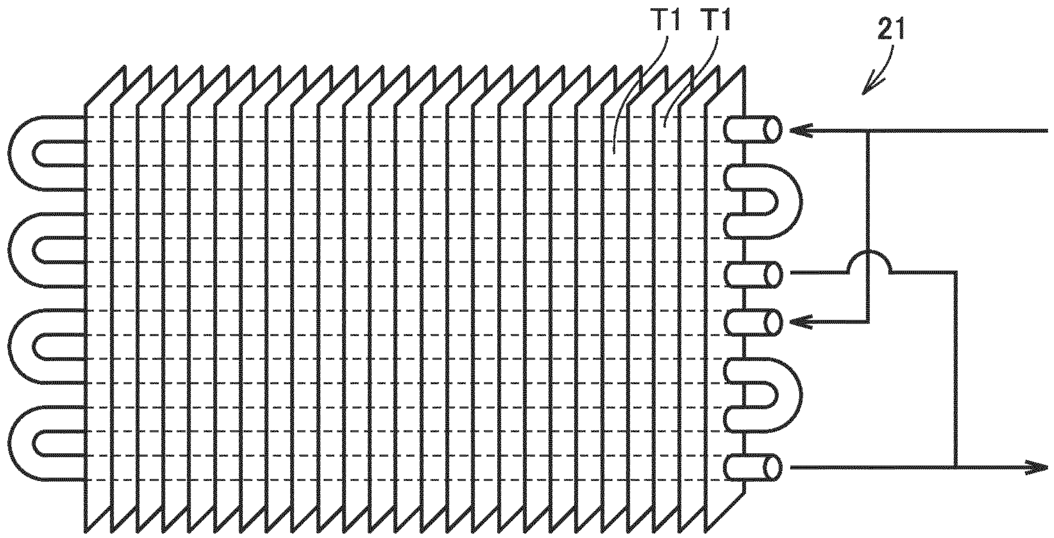


FIG.12

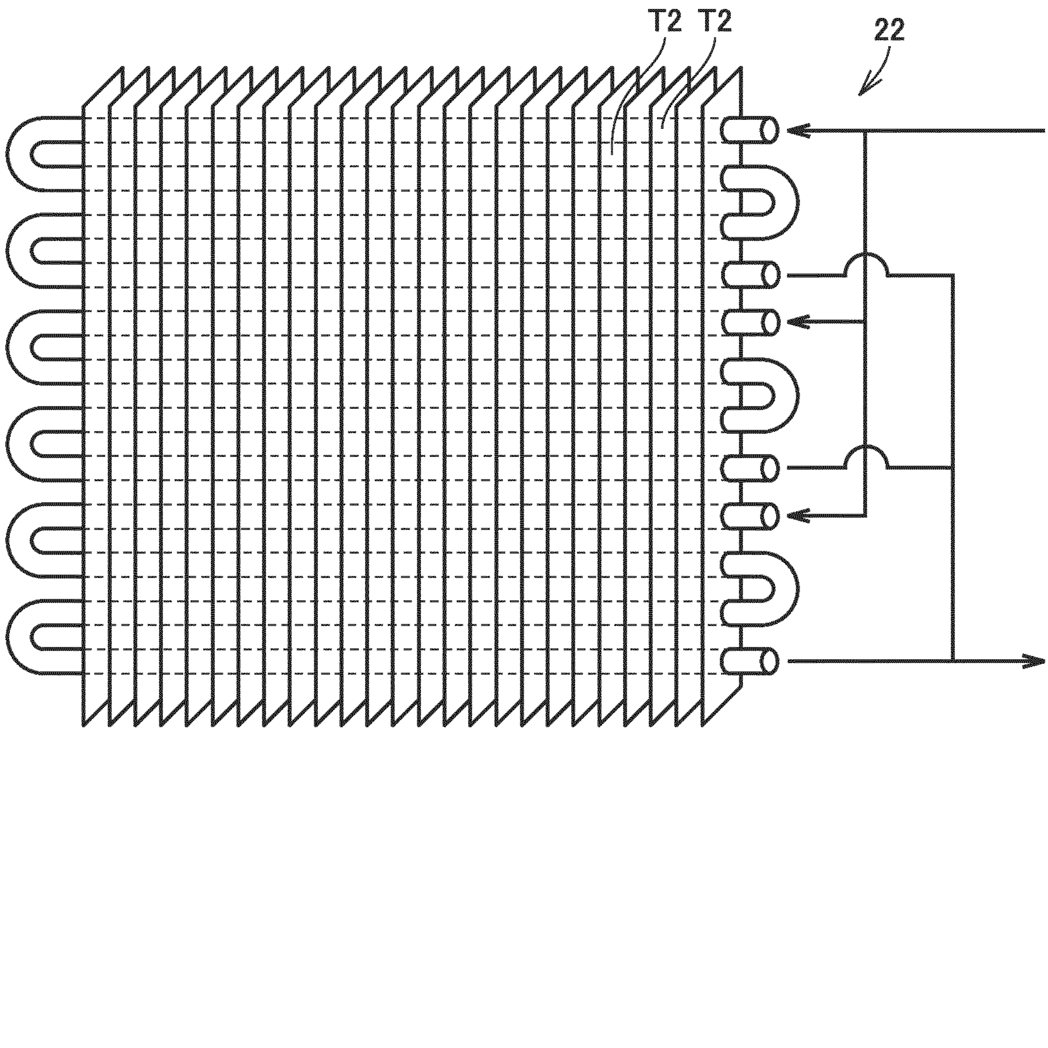


FIG.13

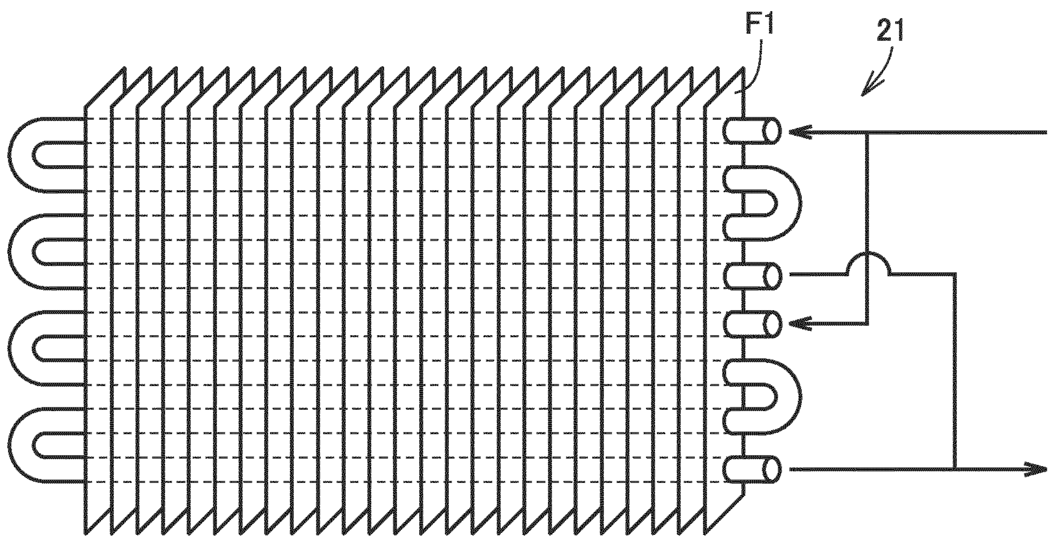


FIG.14

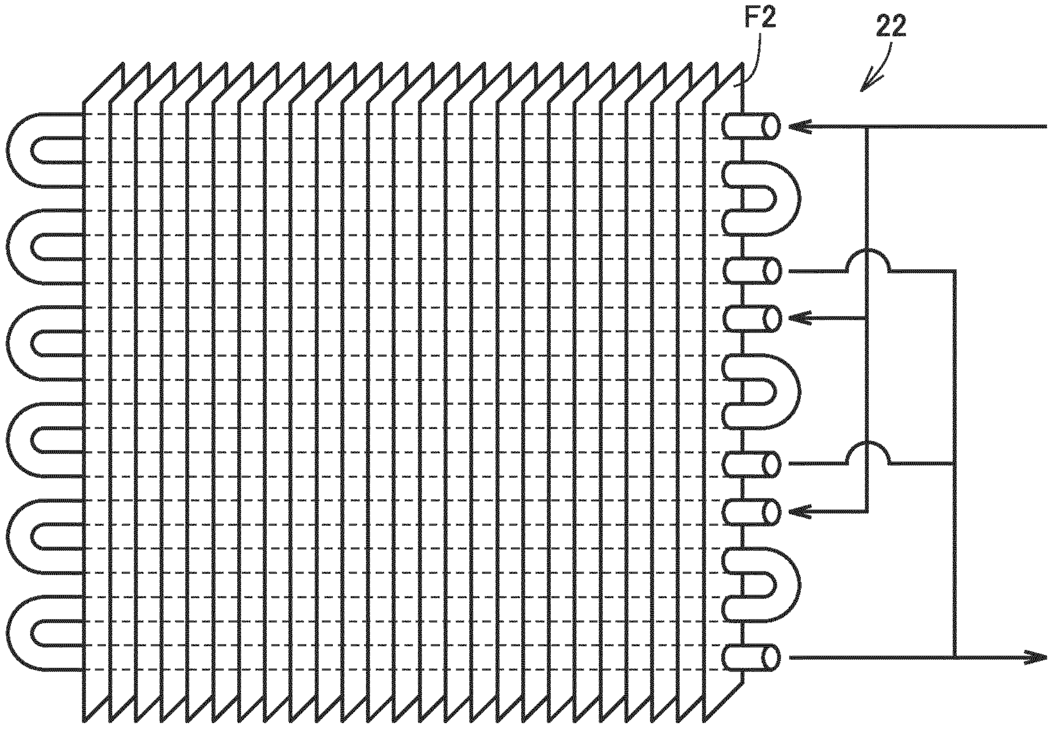
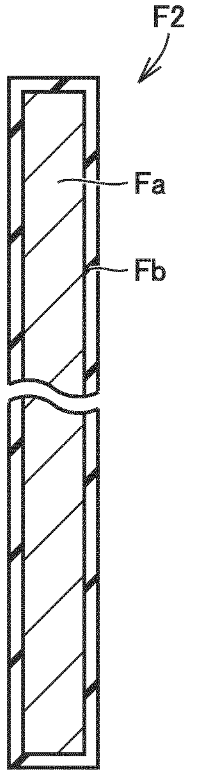


FIG.15



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/041422

A. CLASSIFICATION OF SUBJECT MATTER

F25B 29/00(2006.01)i; ***F25B 41/26***(2021.01)i
FI: F25B29/00 391Z; F25B41/26 Z

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25B1/00; F25B29/00; F25B41/26

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2021
Registered utility model specifications of Japan 1996-2021
Published registered utility model applications of Japan 1994-2021

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 3-31640 A (MITSUBISHI ELECTRIC CORP.) 12 February 1991 (1991-02-12) p. 1, lower right column, line 1 to p. 5, upper right column, line 13, fig. 1-4	1, 3, 6, 9
Y		2, 4, 7-8
A		5
Y	WO 2017/145219 A1 (MITSUBISHI ELECTRIC CORP.) 31 August 2017 (2017-08-31) fig. 5	2
Y	CN 104089393 A (SHENZHEN WOSEN AIR-CONDITIONING TECHNOLOGY CO., LTD.) 08 October 2014 (2014-10-08) paragraph [0030], fig. 1	4
Y	JP 2017-40464 A (SAMSUNG ELECTRONICS CO., LTD.) 23 February 2017 (2017-02-23) fig. 23	7
Y	JP 2016-61489 A (FUJITSU GENERAL LTD.) 25 April 2016 (2016-04-25) fig. 1	7

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
25 November 2021	**18 January 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.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/041422

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2014-1917 A (DAIKIN INDUSTRIES, LTD.) 09 January 2014 (2014-01-09) fig. 5	7
Y	JP 2003-50061 A (MITSUBISHI ELECTRIC CORP.) 21 February 2003 (2003-02-21) paragraph [0040], fig. 5, 7	8
A	JP 2019-138522 A (FUJITSU GENERAL LTD.) 22 August 2019 (2019-08-22) entire text, all drawings	5
A	CN 103822391 A (GUANGDONG CHIGO AIR CONDITIONING CO., LTD.) 28 May 2014 (2014-05-28) entire text, all drawings	1-9

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/041422

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 3-31640 A	12 February 1991	(Family: none)	
WO 2017/145219 A1	31 August 2017	US 2019/0024951 A1 fig. 5 GB 2562646 A	
CN 104089393 A	08 October 2014	(Family: none)	
JP 2017-40464 A	23 February 2017	US 2017/0276413 A1 fig. 23 WO 2016/036176 A1 EP 3190355 A1 KR 10-2016-0028400 A	
JP 2016-61489 A	25 April 2016	US 2016/0084535 A1 fig. 1 EP 3001122 A1 AU 2015201594 A CN 106152312 A HK 1226124 A	
JP 2014-1917 A	09 January 2014	US 2015/0096321 A1 fig. 5 WO 2013/175912 A1 EP 2878901 A1 AU 2013264129 A CN 104321597 A KR 10-2015-0020219 A BR 112014028992 A	
JP 2003-50061 A	21 February 2003	(Family: none)	
JP 2019-138522 A	22 August 2019	US 2021/0048200 A1 WO 2019/155685 A1 EP 3751217 A1	
CN 103822391 A	28 May 2014	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

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