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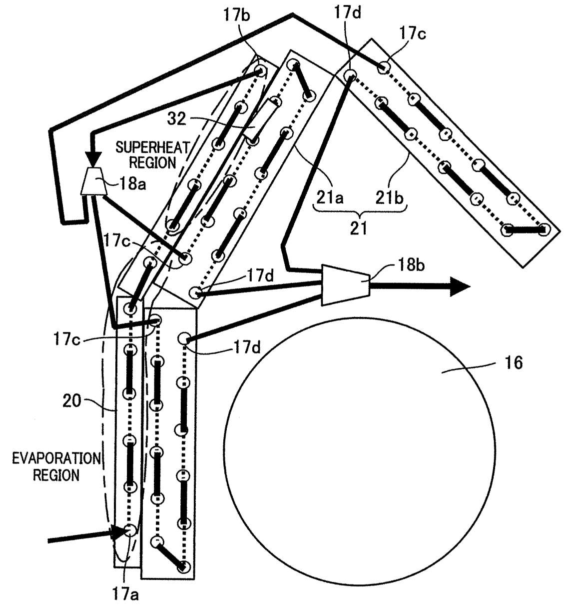
(54) **AIR CONDITIONER**

(57) In addition to a sensor for detecting the completion of the evaporation of a liquid refrigerant, there is a need to provide a sensor for detecting a condensation temperature in a heating operation and/or an evaporation temperature in the cooling operation. In an air conditioner of the present invention, an indoor heat exchanger includes an auxiliary heat exchanger 20 and a main heat exchanger 21 disposed leeward from the auxiliary heat exchanger 20. In an operation in a predetermined dehumidification operation mode, a liquid refrigerant supplied to the auxiliary heat exchanger 20 all evaporates midway in the auxiliary heat exchanger 20. Therefore, only an upstream partial area in the auxiliary heat exchanger 20 is an evaporation region, while an area downstream of the evaporation region in the auxiliary heat exchanger 20 is a superheat region. Further, an indoor heat exchanger temperature sensor 32 is disposed leeward from the superheat region of the auxiliary heat exchanger 20 and in or in the vicinity of a middle portion of the indoor heat exchanger.

FIG.3



EP 2 857 768 A1

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Description

Technical Field

[0001] The present invention relates to an air conditioner configured to perform a dehumidification operation.

Background Art

[0002] There has been a conventional air conditioner in which: an auxiliary heat exchanger is disposed rearward of a main heat exchanger; and a refrigerant evaporates only in the auxiliary heat exchanger to locally perform dehumidification so that dehumidification can be performed even under a low load (even when the number of revolution of a compressor is small), for example, when the difference between room temperature and a set temperature is sufficiently small and therefore the required cooling capacity is small. In this air conditioner, an evaporation region is limited to be within the auxiliary heat exchanger, and a temperature sensor is disposed downstream of the evaporation region, to make control so that the superheat degree is constant.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Patent Publication No. 14727/1997 (Tokukaihei 09-14727)

Summary of Invention

Technical Problem

[0004] If a temperature sensor for detecting the completion of the evaporation is provided in the vicinity of an outlet of the auxiliary heat exchanger in the above air conditioner, the sensor is situated nearer to a liquid side in the indoor heat exchanger. Therefore, in a cooling operation under a high load, the sensor detects a higher temperature which is improper as the evaporation temperature of the heat exchanger, on account of a pressure drop in the refrigerant. Meanwhile, in a heating operation, the sensor detects a temperature which is lower than the actual condensation temperature and is improper as the condensation temperature, on account of subcooling. Then, the liquid may be sucked by the compressor, resulting in a loss of reliability of the compressor.

[0005] To avoid the above problem, it is necessary to additionally provide a sensor for detecting the condensation temperature in the heating operation and/or the evaporation temperature in the cooling operation, but this causes another problem of an increase in cost.

[0006] In view of the above, an object of the present invention is to provide an air conditioner in which a sensor for detecting the completion of the evaporation of a liquid refrigerant also serves as a sensor for detecting a condensation temperature in a heating operation and/or an evaporation temperature in a cooling operation.

Solution to Problem

[0007] An air conditioner according to a first aspect of the present invention includes a refrigerant circuit in which a compressor, an outdoor heat exchanger, an expansion valve, and an indoor heat exchanger are connected to one another. The indoor heat exchanger includes an auxiliary heat exchanger which is disposed on a most windward side and to which a liquid refrigerant is supplied in a dehumidification operation, and a main heat exchanger disposed leeward from the auxiliary heat exchanger. In the dehumidification operation, the auxiliary heat exchanger includes an evaporation region where the liquid refrigerant evaporates and a superheat region downstream of the evaporation region. A temperature detecting means for detecting completion of the evaporation of the liquid refrigerant in the auxiliary heat exchanger is disposed downstream of the auxiliary heat exchanger.

[0008] In this air conditioner, if the refrigerant is in a fully superheated state at an outlet of the auxiliary heat exchanger during the dehumidification operation, air passing through this superheat region is hardly cooled, and therefore does not cool heat-transfer tubes leeward from this region. Accordingly, by detecting the temperature of the refrigerant circuit leeward from the auxiliary heat exchanger, it is possible to determine whether the refrigerant is in the superheated state at the outlet of the auxiliary heat exchanger. Further, avoided is unstable operation resulting from the detection of an improper temperature, which is different from a proper temperature due to the subcooling in the heating operation or the pressure drop in the cooling operation.

[0009] According to a second aspect of the present invention, in the air conditioner of the first aspect, the temperature detecting means is disposed in or in the vicinity of a middle of a refrigerant path in the indoor heat exchanger.

[0010] In this air conditioner, the condensation temperature in the heating operation and/or the evaporation temperature in the cooling operation is/are detected using the temperature detecting means for detecting the completion of the evaporation of the liquid refrigerant in the auxiliary heat exchanger in the dehumidification operation.

[0011] According to a third aspect of the present invention, in the air conditioner of the first or the second aspect, a liquid inlet of the auxiliary heat exchanger is provided at a lower portion of the auxiliary heat exchanger; and the temperature detecting means is disposed in the vicinity of an upper end of the auxiliary heat exchanger.

[0012] In this air conditioner, it is possible to enlarge the extent of the evaporation region of the auxiliary heat exchanger.

[0013] According to a fourth aspect of the present invention, in the air conditioner of any one of the first to the third aspects, the main heat exchanger includes a front heat exchanger disposed on a front side in the indoor unit, and a rear heat exchanger disposed on a rear side in the indoor unit; and the auxiliary heat exchanger is disposed forward of the front heat exchanger.

[0014] In this air conditioner, it is possible to increase the size of the auxiliary heat exchanger, and therefore to enlarge the extent of the evaporation region of the auxiliary heat exchanger.

Advantageous Effects of Invention

[0015] As described above, the present invention provides the following advantageous effects.

[0016] In first aspect of the present invention, if the refrigerant is in a fully superheated state at an outlet of the auxiliary heat exchanger during the dehumidification operation, air passing through this superheat region is hardly cooled, and therefore does not cool heat-transfer tubes leeward from this region. Accordingly, by detecting the temperature of the refrigerant circuit leeward from the auxiliary heat exchanger, it is possible to determine whether the refrigerant is in the superheated state at the outlet of the auxiliary heat exchanger. Further, avoided is unstable operation resulting from the detection of an improper temperature, which is different from a proper temperature due to the subcooling in the heating operation or the pressure drop in the cooling operation.

[0017] In the second aspect of the present invention, the condensation temperature in the heating operation and/or the evaporation temperature in the cooling operation is/are detected using the temperature detecting means for detecting the completion of the evaporation of the liquid refrigerant in the auxiliary heat exchanger in the dehumidification operation.

[0018] In the third aspect of the present invention, it is possible to enlarge the extent of the evaporation region of the auxiliary heat exchanger.

[0019] In the fourth aspect of the present invention, it is possible to increase the size of the auxiliary heat exchanger, and therefore to enlarge the extent of the evaporation region of the auxiliary heat exchanger.

Brief Description of Drawings

[0020]

[FIG. 1] FIG. 1 is a circuit diagram showing a refrigerant circuit of an air conditioner of an embodiment of the present invention.

[FIG. 2] FIG. 2 is a schematic cross section of an indoor unit of the air conditioner of the embodiment of the present invention.

[FIG. 3] FIG. 3 is a diagram illustrating the structure of an indoor heat exchanger.

[FIG. 4] FIG. 4 is a diagram illustrating a control unit of the air conditioner of the embodiment of the present invention.

[FIG. 5] FIG. 5 is a graph showing, by way of example, how the flow rate changes as the opening degree of an expansion valve is changed.

Description of Embodiments

[0021] The following describes an air conditioner 1 of an embodiment of the present invention.

<Overall Structure of Air Conditioner 1>

[0022] As shown in FIG. 1, the air conditioner 1 of this embodiment includes: an indoor unit 2 installed inside a room; and an outdoor unit 3 installed outside the room. The air conditioner 1 further includes a refrigerant circuit in which a compressor 10, a four-way valve 11, an outdoor heat exchanger 12, an expansion valve 13, and an indoor heat exchanger 14 are connected to one another. In the refrigerant circuit, the outdoor heat exchanger 12 is connected to a discharge port of the compressor 10 via the four-way valve 11, and the expansion valve 13 is connected to the outdoor heat exchanger 12. Further, one end of the indoor heat exchanger 14 is connected to the expansion valve 13, and the other end of the indoor heat exchanger 14 is connected to an intake port of the compressor 10 via the four-way valve 11. The indoor heat exchanger 14 includes an auxiliary heat exchanger 20 and a main heat exchanger 21.

[0023] In the air conditioner 1, operations in a cooling operation mode, in a predetermined dehumidification operation mode, and in a heating operation mode are possible. Using a remote controller, various operations are possible: selecting one of the operation modes to start the operation, changing the operation mode, stopping the operation, and the like. Further, using the remote controller, it is possible to adjust indoor temperature setting, and to change the air volume of the indoor unit 2 by changing the number of revolutions of an indoor fan.

[0024] As indicated with solid arrows in the figure, in the cooling operation mode and in the predetermined dehumidification operation mode, there are respectively formed a cooling cycle and a dehumidification cycle, in each of which: a refrigerant discharged from the compressor 10 flows, from the four-way valve 11, through the outdoor heat exchanger 12, the expansion valve 13, and the auxiliary heat exchanger 20, to the main heat exchanger 21 in order; and the refrigerant having passed through the main heat exchanger 21 returns back to the compressor 10 via the four-way valve 11. That is, the outdoor heat exchanger 12 functions as a condenser, and the indoor heat exchanger 14 (the auxiliary heat exchanger 20 and the main heat exchanger 21) functions as an evaporator.

[0025] Meanwhile, in the heating operation mode, the state of the four-way valve 11 is switched, to form a heating cycle in which: the refrigerant discharged from the compressor 10 flows, from the four-way valve 11, through the main heat exchanger 21, the auxiliary heat exchanger 20, and the expansion valve 13, to the outdoor heat exchanger 12 in order; and the refrigerant having passed through the outdoor heat exchanger 12 returns back to the compressor 10 via the four-way valve 11, as indicated with broken arrows in the figure. That is, the indoor heat exchanger 14 (the auxiliary heat exchanger 20 and the main heat exchanger 21) functions as the condenser, and the outdoor heat exchanger 12 functions as the evaporator.

[0026] The indoor unit 2 has, on its upper surface, an air inlet 2a through which indoor air is taken in. The indoor unit 2 further has, on a lower portion of its front surface, an air outlet 2b through which air for air conditioning comes out. Inside the indoor unit 2, an airflow path is formed from the air inlet 2a to the air outlet 2b. In the airflow path, the indoor heat exchanger 14 and a cross-flow indoor fan 16 are disposed. Therefore, as the indoor fan 16 rotates, the indoor air is taken into the indoor unit 1 through the air inlet 2a. In a front portion of the indoor unit 2, the air taken in through the air inlet 2a flows through the auxiliary heat exchanger 20 and the main heat exchanger 21 toward the indoor fan 16. Meanwhile, in a rear portion of the indoor unit 2, the air taken in through the air inlet 2a flows through the main heat exchanger 21 toward the indoor fan 16.

[0027] As described above, the indoor heat exchanger 14 includes: the auxiliary heat exchanger 20; and the main heat exchanger 21 located downstream of the auxiliary heat exchanger 20 in an operation in the cooling operation mode or in the predetermined dehumidification operation mode. The main heat exchanger 21 includes: a front heat exchanger 21a disposed on a front side of the indoor unit 2; and a rear heat exchanger 21b disposed on a rear side of the indoor unit 2. The heat exchangers 21a and 21b are arranged in a shape of a counter-V around the indoor fan 16. Further, the auxiliary heat exchanger 20 is disposed forward of the front heat exchanger 21a. Each of the auxiliary heat exchanger 20 and the main heat exchanger 21 (the front heat exchanger 21a and the rear heat exchanger 21b) includes heat exchanger pipes and a plurality of fins.

[0028] In the cooling operation mode and in the predetermined dehumidification operation mode, a liquid refrigerant is supplied through a liquid inlet 17a provided in the vicinity of a lower end of the auxiliary heat exchanger 20, and the thus supplied liquid refrigerant flows toward an upper end of the auxiliary heat exchanger 20, as shown in FIG. 3. Then, the refrigerant is discharged through an outlet 17b provided in the vicinity of the upper end of the auxiliary heat exchanger 20, and then flows to a branching section 18a. The refrigerant is divided at the branching section 18a into branches, which are respectively supplied, via three inlets 17c of the main heat exchanger 21, to a lower portion and an upper portion of the front heat exchanger 21a and to the rear heat exchanger 21b. Then, the branched refrigerant is discharged through outlets 17d, to merge together at a merging section 18b. In the heating operation mode, the refrigerant flows in a reverse direction of the above direction.

[0029] When the air conditioner 1 operates in the predetermined dehumidification operation mode, the liquid refrigerant supplied through the liquid inlet 17a of the auxiliary heat exchanger 20 all evaporates midway in the auxiliary heat exchanger 20, i.e., before reaching the outlet. Therefore, only a partial area in the vicinity of the liquid inlet 17a of the auxiliary heat exchanger 20 is an evaporation region where the liquid refrigerant evaporates. Accordingly, in the operation in the predetermined dehumidification operation mode, only the upstream partial area in the auxiliary heat exchanger 20 is the evaporation region, while (i) the area downstream of the evaporation region in the auxiliary heat exchanger 20 and (ii) the main heat exchanger 21 each functions as a superheat region, in the indoor heat exchanger 14.

[0030] Further, the refrigerant having flowed through the superheat region in the vicinity of the upper end of the auxiliary heat exchanger 20 flows through the lower portion of the front heat exchanger 21a disposed leeward from a lower portion of the auxiliary heat exchanger 20. Therefore, among the air taken in through the air inlet 2a, air having been cooled in the evaporation region of the auxiliary heat exchanger 20 is heated by the front heat exchanger 21a, and then blown out from the air outlet 2b. Meanwhile, among the air taken in through the air inlet 2a, air having flowed through the superheat region of the auxiliary heat exchanger 20 and through the front heat exchanger 21a, and air having flowed through the rear heat exchanger 21b are blown out from the air outlet 2b at a temperature substantially the same as an indoor temperature.

[0031] In the air conditioner 1, an evaporation temperature sensor 30 is attached to the outdoor unit 3, as shown in FIG. 1. The evaporation temperature sensor 30 is configured to detect an evaporation temperature and is disposed downstream of the expansion valve 13 in the refrigerant circuit. Further, to the indoor unit 2, there are attached: an indoor temperature sensor 31 configured to detect the indoor temperature (the temperature of the air taken in through the air inlet 2a of the indoor unit 2); and an indoor heat exchanger temperature sensor 32 configured to detect whether evaporation of the liquid refrigerant is completed in the auxiliary heat exchanger 20.

[0032] As shown in FIG. 3, the indoor heat exchanger temperature sensor 32 is disposed in the vicinity of the upper end of the auxiliary heat exchanger 20 and leeward from the auxiliary heat exchanger 20. Further, in the superheat region in the vicinity of the upper end of the auxiliary heat exchanger 20, the air taken in through the air inlet 2a is hardly cooled. Therefore, when the temperature detected by the indoor heat exchanger temperature sensor 32 is substantially the same as the indoor temperature detected by the indoor temperature sensor 31, it is indicated that evaporation is completed midway in the auxiliary heat exchanger 20, and that the area in the vicinity of the upper end of the auxiliary heat exchanger 20 is the superheat region. Furthermore, the indoor heat exchanger temperature sensor 32 is provided to a heat-transfer tube in a middle portion of the indoor heat exchanger 14. Thus, in or in the vicinity of the middle portion of the indoor heat exchanger 14, detected is/are the condensation temperature in the heating operation and/or the evaporation temperature in the cooling operation.

[0033] As shown in FIG. 4, the control unit of the air conditioner 1 is connected with: the compressor 10; the four-way valve 11; the expansion valve 13; a motor 16a for driving the indoor fan 16; the evaporation temperature sensor 30; the indoor temperature sensor 31; and the indoor heat exchanger temperature sensor 32. Therefore, the control unit controls the operation of the air conditioner 1 based on: a command from the remote controller (for the start of the operation, for indoor temperature setting, or the like); the evaporation temperature detected by the evaporation temperature sensor 30; the indoor temperature detected by the indoor temperature sensor 31 (the temperature of the intake air); and a heat exchanger middle temperature detected by the indoor heat exchanger temperature sensor 32.

[0034] Further, in the air conditioner 1, the auxiliary heat exchanger 20 includes the evaporation region where the liquid refrigerant evaporates and the superheat region downstream of the evaporation region in the predetermined dehumidification operation mode. The compressor 10 and the expansion valve 13 are controlled so that the extent of the evaporation region varies depending on a load. Here, "the extent varies depending on a load" means that the extent varies depending on the quantity of heat supplied to the evaporation region, and the quantity of heat is determined, for example, by the indoor temperature (the temperature of the intake air) and an indoor air volume. Further, the load corresponds to a required dehumidification capacity (required cooling capacity), and the load is determined taking into account, for example, the difference between the indoor temperature and the set temperature.

[0035] The compressor 10 is controlled based on the difference between the indoor temperature and the set temperature. When the difference between the indoor temperature and the set temperature is large, the load is high, and therefore the compressor 10 is controlled so that its frequency increases. When the difference between the indoor temperature and the set temperature is small, the load is low, and therefore the compressor 10 is controlled so that its frequency decreases.

[0036] The expansion valve 13 is controlled based on the evaporation temperature detected by the evaporation temperature sensor 30. While the frequency of the compressor 10 is controlled as described above, the expansion valve 13 is controlled so that the evaporation temperature falls within a predetermined temperature range (10 to 14 degrees Celsius) close to a target evaporation temperature (12 degrees Celsius) . It is preferable that the predetermined evaporation temperature range is constant, irrespective of the frequency of the compressor 10. However, the predetermined range may be slightly changed with the change of the frequency as long as the predetermined range is substantially constant.

[0037] Thus, the compressor 10 and the expansion valve 13 are controlled depending on the load in the predetermined dehumidification operation mode, and thereby changing the extent of the evaporation region of the auxiliary heat exchanger 20, and causing the evaporation temperature to fall within the predetermined temperature range.

[0038] In the air conditioner 1, each of the auxiliary heat exchanger 20 and the front heat exchanger 21a has twelve rows of the heat-transfer tubes. When the number of rows of the tubes functioning as the evaporation region in the auxiliary heat exchanger 20 in the predetermined dehumidification operation mode is not less than a half of the total number of rows of the tubes of the front heat exchanger 21a, it is possible to sufficiently increase the extent of the evaporation region of the auxiliary heat exchanger, and therefore a variation in the load is addressed sufficiently. This structure is effective especially under a high load.

[0039] FIG. 5 is a graph showing how the flow rate changes when the opening degree of the expansion valve 13 is changed. The opening degree of the expansion valve 13 continuously changes with the number of driving pulses input to the expansion valve 13. As the opening degree decreases, the flow rate of the refrigerant flowing through the expansion valve 13 decreases. The expansion valve 13 is fully closed when the opening degree is t0. In the range of the opening degrees t0 to t1, the flow rate increases at a first gradient as the opening degree increases. In the range of the opening degrees t1 to t2, the flow rate increases at a second gradient as the opening degree increases. Note that the first gradient is larger than the second gradient.

[0040] Now, description will be given for an example of the control made so that the extent of the evaporation region of the auxiliary heat exchanger 20 varies. For example, when the load increases in the predetermined dehumidification operation mode on the condition that the extent of the evaporation region of the auxiliary heat exchanger 20 is of a predetermined size, the frequency of the compressor 10 is increased and the opening degree of the expansion valve 13 is changed so as to increase. As a result, the extent of the evaporation region of the auxiliary heat exchanger 20 becomes larger than that of the predetermined size, and this increases the volume of the air actually passing through the evaporation region even when the volume of the air taken into the indoor unit 2 is constant.

[0041] Meanwhile, when the load becomes lower in the predetermined dehumidification operation mode on the condition that the extent of the evaporation region of the auxiliary heat exchanger 20 is of the predetermined size, the frequency of the compressor 10 is decreased and the opening degree of the expansion valve 13 is changed so as to decrease. Therefore, the extent of the evaporation region of the auxiliary heat exchanger 20 becomes smaller than that of the predetermined size, and this decreases the volume of the air actually passing through the evaporation region even when the volume of the air taken into the indoor unit 2 is constant.

<Characteristics of the Air Conditioner of This Embodiment>

[0042] In the air conditioner 1 of this embodiment, if the refrigerant is in a fully superheated state at the outlet of the auxiliary heat exchanger 20 during the dehumidification operation, air passing through this superheat region is hardly cooled, and therefore does not cool heat-transfer tubes leeward from this region. Accordingly, by detecting the temperature of the refrigerant circuit leeward from the auxiliary heat exchanger 20, it is possible to determine whether the refrigerant is in the superheated state at the outlet of the auxiliary heat exchanger 20. Further, avoided is unstable operation resulting from the detection of an improper temperature, which is different from a proper temperature due to the subcooling in the heating operation or the pressure drop in the cooling operation.

[0043] Further, in the air conditioner 1 of this embodiment, the indoor heat exchanger temperature sensor 32 is provided to the heat exchanger pipe in the middle portion of the indoor heat exchanger 14. Therefore, in or in the vicinity of the middle portion of the indoor heat exchanger 14, detected is/are the condensation temperature in the heating operation and/or the evaporation temperature in the cooling operation.

[0044] Furthermore, in the air conditioner 1 of this embodiment, the liquid inlet 17a of the auxiliary heat exchanger 20 is provided at the lower portion of the auxiliary heat exchanger 20, and the indoor heat exchanger temperature sensor 32 is disposed in the vicinity of the upper end of the auxiliary heat exchanger 20. This allows the extent of the evaporation region of the auxiliary heat exchanger 20 to be enlarged.

[0045] Furthermore, in the air conditioner 1 of this embodiment, the main heat exchanger 21 includes the front heat exchanger 21a disposed on the front side in the indoor unit 2, and the rear heat exchanger 21b disposed on the rear side in the indoor unit 2, and the auxiliary heat exchanger 20 is disposed forward of the front heat exchanger 21a. This makes it possible to increase the size of the auxiliary heat exchanger 20, and this allows the increase of the range within which the evaporation region of the auxiliary heat exchanger 20 varies.

[0046] While the embodiment of the present invention has been described based on the figures, the scope of the invention is not limited to the above-described embodiment. The scope of the present invention is defined by the appended claims rather than the foregoing description of the embodiment, and various changes and modifications can be made herein without departing from the scope of the invention.

[0047] In the above-described embodiment, the auxiliary heat exchanger and the main heat exchanger may be formed into a single unit. In this case, the indoor heat exchanger is formed as a single unit, and a first portion corresponding to the auxiliary heat exchanger is provided on the most windward side of the indoor heat exchanger, and a second portion corresponding to the main heat exchanger is provided leeward from the first portion.

[0048] Further, the above-described embodiment deals with the air conditioner configured to operate in the cooling operation mode, in the predetermined dehumidification operation mode, and in the heating operation mode. However, the present invention may be applied to an air conditioner configured to conduct a dehumidification operation in a dehumidification operation mode other than the predetermined dehumidification operation mode, in addition to the dehumidification operation in the predetermined dehumidification operation mode.

Industrial Applicability

[0049] With the present invention, a sensor for detecting the completion of the evaporation of the liquid refrigerant also serves as a sensor for detecting a condensation temperature in a heating operation and/or an evaporation temperature in a cooling operation.

Reference Signs List

[0050]

- 1 air conditioner
- 2 indoor unit
- 3 outdoor unit
- 10 compressor
- 12 outdoor heat exchanger
- 13 expansion valve
- 14 indoor heat exchanger
- 16 indoor fan
- 20 auxiliary heat exchanger
- 21 main heat exchanger

Claims

1. An air conditioner comprising

a refrigerant circuit in which a compressor, an outdoor heat exchanger, an expansion valve, and an indoor heat exchanger are connected to one another, wherein:

the indoor heat exchanger includes an auxiliary heat exchanger which is disposed on a most windward side and to which a liquid refrigerant is supplied in a dehumidification

operation, and a main heat exchanger disposed downstream of the auxiliary heat exchanger in the dehumidification operation;
in the dehumidification operation, the auxiliary heat exchanger includes an evaporation region where the liquid refrigerant evaporates and a superheat region downstream of the evaporation region; and
a temperature detecting means for detecting completion of the evaporation of the liquid refrigerant in the auxiliary heat exchanger is disposed leeward from the auxiliary heat exchanger.

2. The air conditioner according to claim 1, wherein the temperature detecting means is disposed in or in the vicinity of a middle of a refrigerant path in the indoor heat exchanger.

3. The air conditioner according to claim 1 or 2, wherein:

a liquid inlet of the auxiliary heat exchanger is provided at a lower portion of the auxiliary heat exchanger; and
the temperature detecting means is disposed in the vicinity of an upper end of the auxiliary heat exchanger.

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

the main heat exchanger includes a front heat exchanger disposed on a front side in the indoor unit, and a rear heat exchanger disposed on a rear side in the indoor unit; and
the auxiliary heat exchanger is disposed forward of the front heat exchanger.

FIG.1

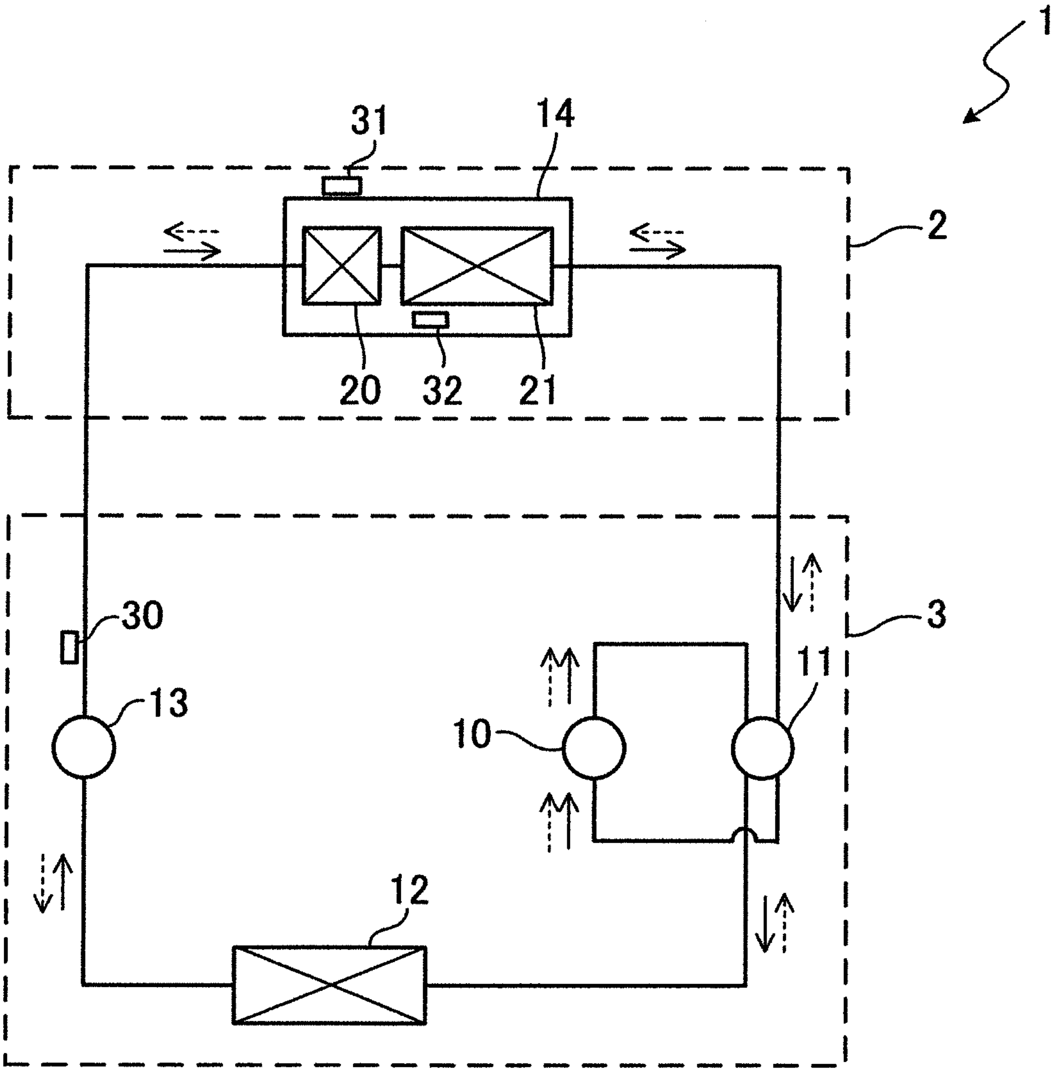

FIG.2

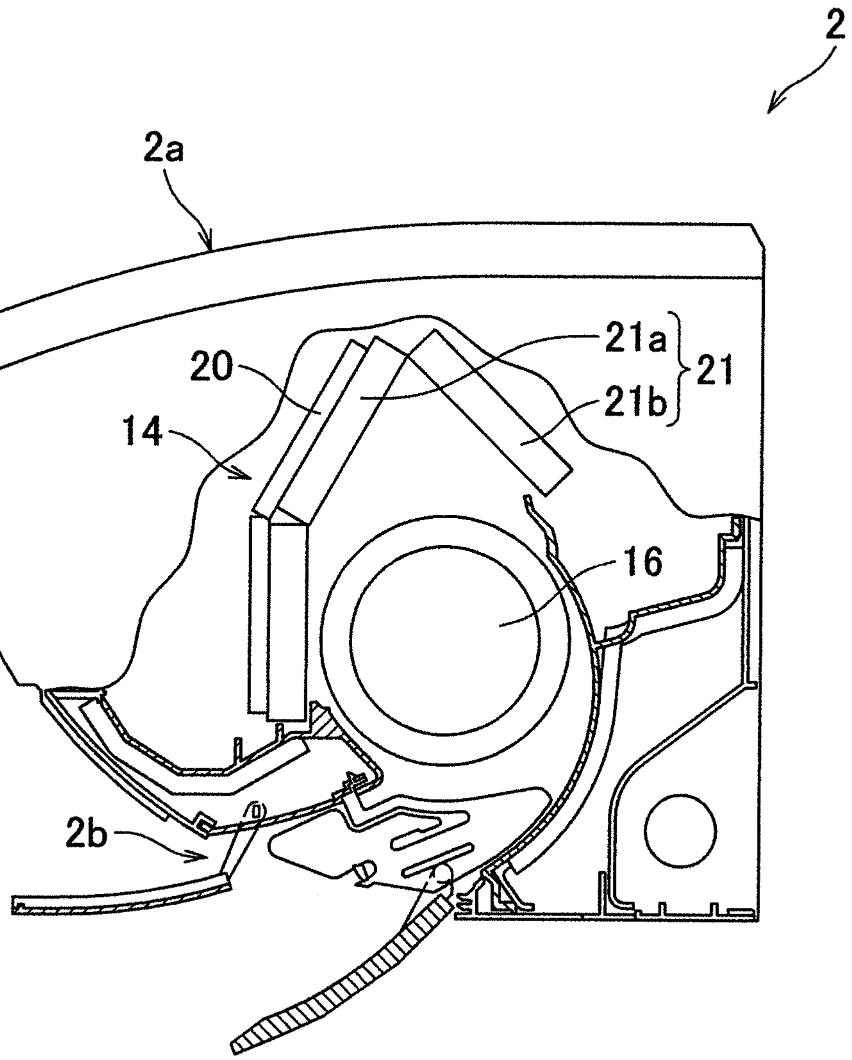

FIG.3

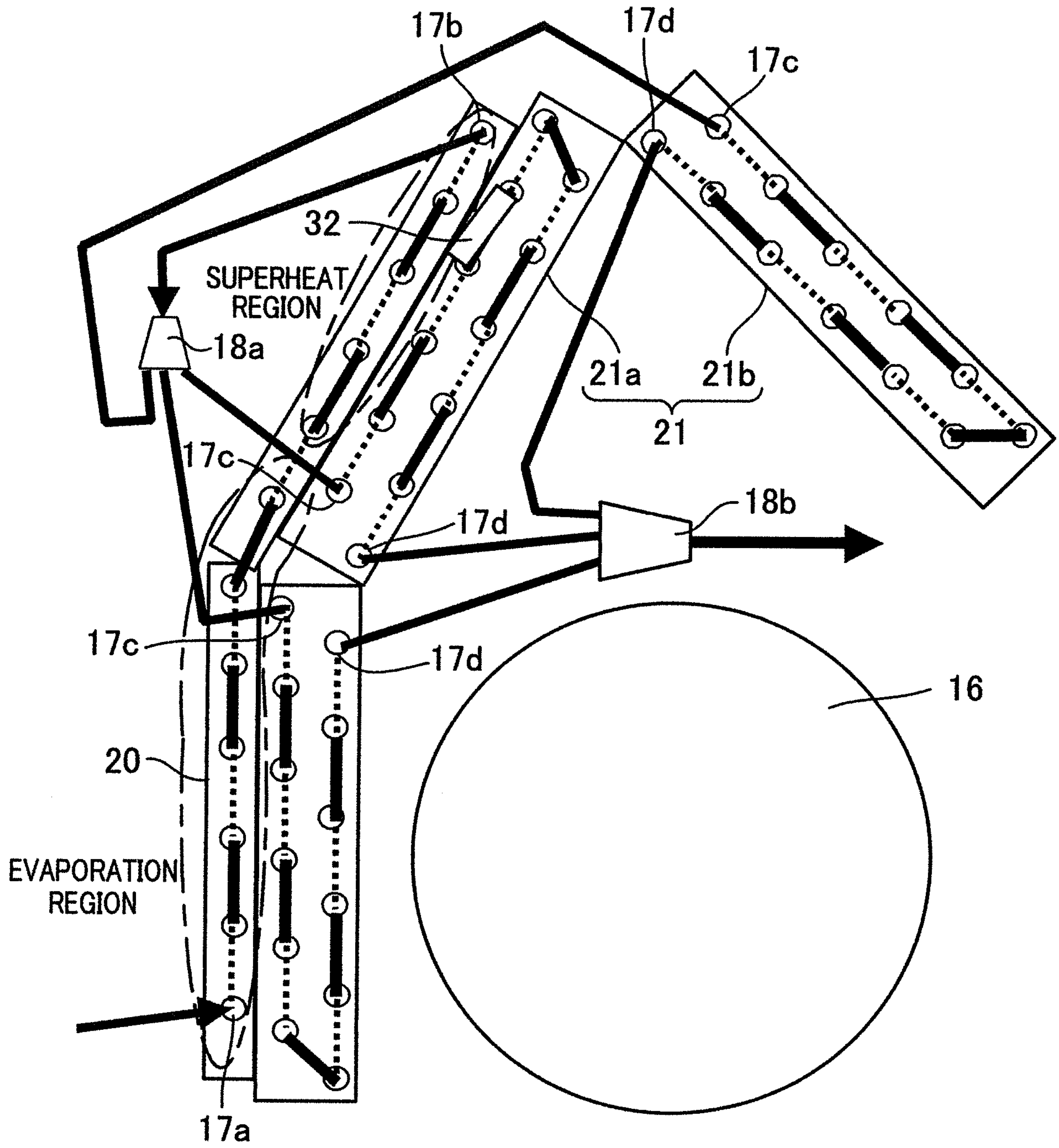
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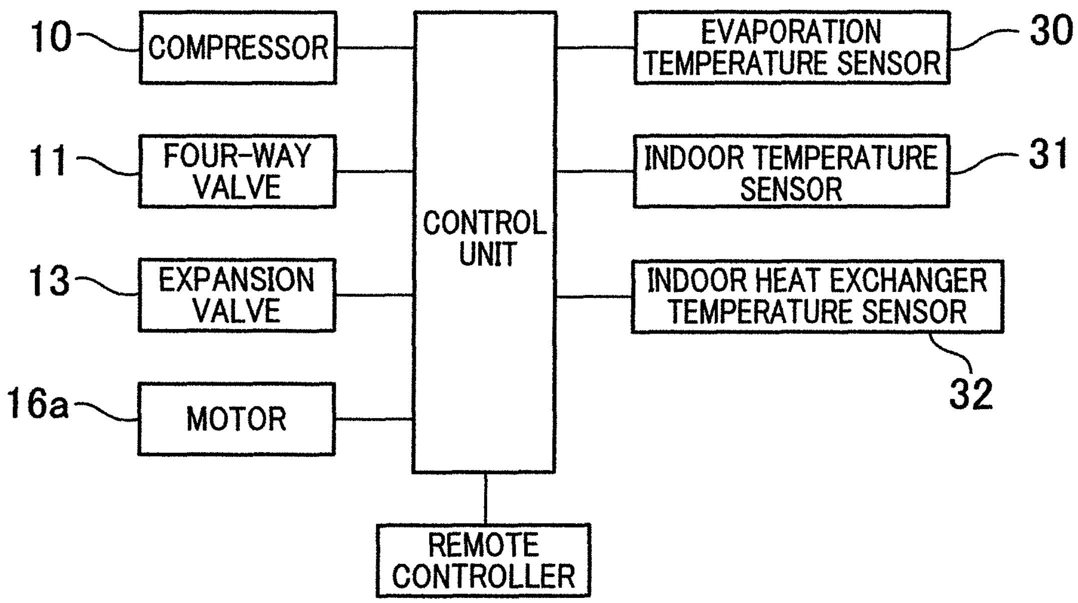
FIG.4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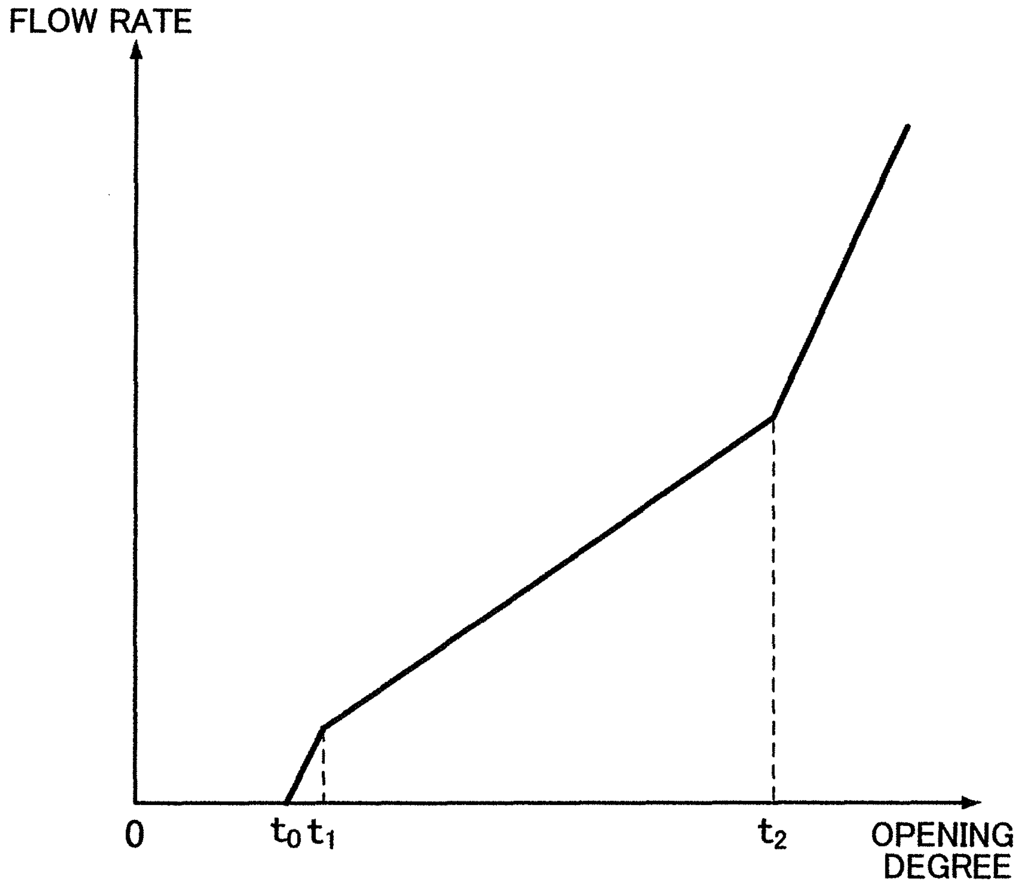
REMOTE CONTROLLER

FIG.5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OPENING DEGREE

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2013/060348

A. CLASSIFICATION OF SUBJECT MATTER
F24F11/02(2006.01)i

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)
F24F11/02

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

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	JP 6-34184 A (Fujitsu General Ltd.), 08 February 1994 (08.02.1994), entire text; all drawings (Family: none)	1-4
A	JP 9-72599 A (Toshiba AVE Co., Ltd.), 18 March 1997 (18.03.1997), entire text; all drawings & US 5678417 A & CN 1145468 A	1-4
A	JP 9-96433 A (Toshiba Corp.), 08 April 1997 (08.04.1997), entire text; all drawings & US 5678417 A & CN 1145468 A	1-4

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

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Date of the actual completion of the international search	Date of mailing of the international search report
27 May, 2013 (27.05.13)	04 June, 2013 (04.06.13)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/060348

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 9-14727 A (Toshiba Corp.), 17 January 1997 (17.01.1997), entire text; all drawings (Family: none)	1-4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 9014727 A **[0003]**
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