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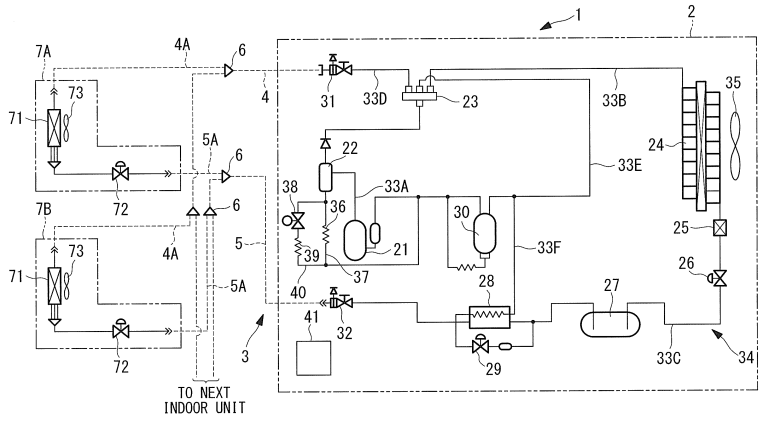
(54) CONTROL DEVICE, METHOD, AND PROGRAM, AND MULTI-TYPE AIR CONDITIONING SYSTEM COMPRISING SAME

(57) An insufficient state of refrigerant gas is prevented and a fan of an indoor unit is allowed to perform an intermittent operation in a state in which a thermostat is turned off while preventing excessive heating. A control device (41) for controlling operation of a packaged air conditioning system (1), a plurality of indoor units (7) being connected to an outdoor unit (2) and a flow volume of refrigerant circulating through a refrigerant pipe being regulated depending on opening of an indoor electric expansion valve (72) in the packaged air conditioning system, controls, during a heating operation, the opening of the indoor electric expansion valve (72) in a period in which fan of each of the indoor units (7) is turned off to be larger than the opening in a period in which the fan of the indoor unit (7) is turned on, and to be equal to or smaller than the opening set for noise control if the fan of the indoor unit (7) performs an intermittent operation for repeating ON/OFF operations to stop for a predetermined time after rotating for a predetermined time at a time at which a thermostat is turned off.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a control device, a control method, a control program, and a packaged air conditioning system including the control device.

{Background Art}

[0002] A packaged air conditioning system used for air-conditioning a building or the like is configured so that a plurality of indoor units are connected to one outdoor unit. In the packaged air conditioning system of this type, the operation is controlled to be started/stopped per indoor unit, and a thermostat is controlled to be turned on/off depending on whether an indoor temperature reaches a set temperature range.

[0003] In heating operation, if the thermostat is turned off after the indoor temperature reaches the set temperature range, the corresponding indoor unit does not require a heating capability. However, if the other indoor units connected to the common outdoor unit are in operation, the compressor of the outdoor unit continues to operate and refrigerant, therefore, continuously flows in the system as a whole. Owing to this, in the indoor unit in which the thermostat is turned off or the indoor unit that is stopped to operate, the expansion valve of the indoor unit is not set closed but slightly opened to allow for the flow of the refrigerant so as to prevent the refrigerant from being accumulated in the indoor unit.

[0004] The following situation may possibly occur in the packaged air conditioning system. In the indoor unit in the state in which the thermostat has been turned off in the heating operation, even when the indoor temperature falls out of the set temperature range and the thermostat should be turned on to restart heating, the temperature sensor of the indoor unit does not operate properly to turn on the thermostat because of warm air filled in the indoor unit. To avoid such a situation, the conventional packaged air conditioning system has been designed such that the fan of each indoor unit can perform an intermittent operation to be appropriately turned on/off even in the state in which the thermostat is turned off so as to be able to detect the indoor temperature.

[0005] For example, PTL 1 discloses the following technique. Among a plurality of indoor units each in a state in which a thermostat is turned off, the number of the simultaneouslydriven fans of the indoor units is limited, and the timing of driving these fans is made different from that of driving the other fans, thereby suppressing a sharp decrease in the temperature of the air blown off from the indoor units.

{Citation List}

{Patent Literature}

{PTL 1}

[0006] The Publication of Japanese Patent No. 3778117

{Summary of Invention}

{Technical Problem}

[0007] In PTL 1, the following problems unavoidably occur. The refrigerant is condensed in each indoor unit by allowing the fan of the indoor unit to operate in the state in which the thermostat is turned off, resulting in an increase in the amount of the refrigerant necessary for the system. To force the refrigerant accumulated in the indoor unit out of the indoor unit, it is necessary to open the expansion valve of the indoor unit. If the expansion valve is opened to an unnecessarily large degree, the indoor unit exhibits the heating capability despite no need of the heating capability because the thermostat is turned off, whereby the room is excessively heated or a noise problem occurs.

[0008] The present invention has been made in view of aforementioned situations, and an object of the present invention is to provide a control device, a control method, a control program, and a packaged air conditioning system including the control device capable of preventing an insufficient state of refrigerant gas and allowing a fan of each indoor unit in a state in which a thermostat is turned off to perform an intermittent operation while preventing excessive heating.

{Solution to Problem}

[0009] In a first aspect of the present invention, there is provided a control device for controlling operation of a packaged air conditioning system in which a plurality of indoor units are connected to an outdoor unit, and a flow volume of refrigerant circulating through a refrigerant pipe is regulated depending on opening of an electric expansion valve of each of the indoor units, wherein the control device controls, during a heating operation, the opening of the electric expansion valve of each of the indoor units in a period in which an indoor fan circulating indoor air of each of the indoor units is turned off to be larger than the opening in a period in which the indoor fan is turned on, and to be equal to or smaller than the opening set for noise control if the indoor fan performs an intermittent operation for repeating ON/OFF operations to stop for a predetermined time after rotating for a predetermined time at a time at which a thermostat is turned off.

[0010] According to the first aspect, the control device for controlling operation of the packaged air conditioning

system, the plurality of indoor units being connected to the outdoor unit and the flow volume of refrigerant circulating through the refrigerant pipe being regulated depending on the opening of the electric expansion valve of each of the indoor units in the packaged air conditioning system, controls the opening of the electric expansion valve of each of the indoor units in the period in which the indoor fan of each of the indoor units is turned off to be larger than the opening in the period in which the indoor fan is turned on, and to be equal to or smaller than the opening set for noise control if the indoor fan performs the intermittent operation for repeating the ON/OFF operations to stop for the predetermined time after rotating for the predetermined time at a time at which the thermostat is turned off during the heating operation, the indoor fan circulating indoor air.

[0011] In this way, the electric expansion valve is set to be larger in the opening in the period in which the indoor fan is turned off (that is, the indoor fan does not rotate) than the period in which the indoor fan is turned on. Therefore, as compared with a case in which the opening is set larger in the period in which the indoor fan is turned on, it is possible to prevent excessive heating. Furthermore, since the electric evaporation valve is set to be larger in the opening in the period in which the indoor fan is turned off than the period in which the indoor fan is turned on, it is possible to force the refrigerant out from the indoor unit in the state in which the thermostat is turned off, and to prevent the system from turning into an insufficient state of the refrigerant gas. Moreover, by restricting the opening to be equal to or smaller than the opening set for the noise control, noise can be suppressed and complaints about sound from the surrounding residents or entities can be suppressed if the opening is set to be equal to or smaller than that at which the noise is generated.

[0012] In the first aspect, if the opening of the electric expansion valve in the period in which the indoor fan is turned on is set to a slightly open state in which a slight amount of the refrigerant flows to prevent the spontaneously condensed refrigerant from being accumulated in a heat exchanger of each of the indoor units, the control unit preferably controls the opening of the electric expansion valve in the period in which the indoor fan is turned off to be 1.1 times to 2.5 times as large as the opening at which the electric expansion valve is slightly open.

[0013] This can prevent the electric expansion valve from being excessively opened, so that it is possible to ensure preventing excessive heating and suppress complaints about sound.

[0014] In the first aspect, the control device may control the opening of the electric expansion valve of each of the indoor units in a partial period in the period in which the indoor fan is turned off.

[0015] It is thereby possible to force the refrigerant accumulated in the indoor unit out of the indoor unit in the period in which the indoor fan is turned off.

[0016] In a second aspect of the present invention, there is provided a control method for controlling operation of a packaged air conditioning system in which a plurality of indoor units are connected to an outdoor unit, and a flow volume of refrigerant circulating through a refrigerant pipe is regulated depending on opening of an electric expansion valve of each of the indoor units, the control method including controlling, during a heating operation, the opening of the electric expansion valve of each of the indoor units in a period in which an indoor fan circulating indoor air of each of the indoor units is turned off to be larger than the opening in a period in which the indoor fan is turned on, and to be equal to or smaller than the opening set for noise control if the indoor fan performs an intermittent operation for repeating ON/OFF operations to stop for a predetermined time after rotating for a predetermined time at a time at which a thermostat is turned off.

[0017] In a third aspect of the present invention, there is provided a control program for controlling operation of a packaged air conditioning system in which a plurality of indoor units are connected to an outdoor unit, and a flow volume of refrigerant circulating through a refrigerant pipe is regulated depending on opening of an electric expansion valve of each of the indoor units, the control program causing a computer to execute controlling, during a heating operation, the opening of the electric expansion valve of each of the indoor units in a period in which an indoor fan circulating indoor air of each of the indoor units is turned off to be larger than the opening in a period in which the indoor fan is turned on, and to be equal to or smaller than the opening set for noise control if the indoor fan performs an intermittent operation for repeating ON/OFF operations to stop for a predetermined time after rotating for a predetermined time at a time at which a thermostat is turned off.

{Advantageous Effects of Invention}

[0018] The present invention produces the effects that it is possible to prevent the insufficient state of the refrigerant gas and to allow the fan of each indoor unit to perform the intermittent operation in the state in which the thermostat is turned off while preventing excessive heating.

{Brief Description of Drawings}

[0019]

{Fig. 1}
Fig. 1 is a schematic configuration diagram of a refrigerant circuit in an air conditioner according to an embodiment of the present invention.

{Fig. 2}
Fig. 2 shows an exemplary relation between on/off states of an indoor fan and states of the opening of an indoor electric expansion valve.

{Description of Embodiments}

[0020] A control device, a control method, a control program, and a packaged air conditioning system including the control device according to an embodiment of the present invention will be described hereinafter with reference to the drawings.

[0021] Fig. 1 is a schematic configuration diagram of a packaged air conditioning system 1 including a control device according to the embodiment of the present invention, with a refrigerant cycle also shown therein.

[0022] The packaged air conditioning system 1 includes one outdoor unit 2, a gas-side pipe 4 and a liquid-side pipe 5 led out from the outdoor unit 2, and a plurality of indoor units 7 connected in parallel between the gas-side pipe 4 and the liquid-side pipe 5 via branch units 6. In Fig. 1, the number of the indoor units 7 is two, that is, indoor units 7A and 7B are shown by way of example. The indoor units will be described as "indoor units 7" hereinafter unless specified otherwise.

[0023] The outdoor unit 2 includes an inverter-driven compressor 21 that compresses refrigerant, an oil separator 22 that separates chiller oil from refrigerant gas, a four-way change-over valve 23 changing over a circulation direction of the refrigerant, an outdoor heat exchanger 24 that exchanges heat between the refrigerant and outdoor air, a supercooling coil 25 configured integrally with the outdoor heat exchanger 24, an outdoor electric expansion valve for heating (EEVH) 26, a receiver 27 that stores therein liquid refrigerant, a supercooling heat exchanger 28 that supercools the liquid refrigerant, an electric expansion valve for supercooling (EEVSC) 29 that controls an amount of the refrigerant branched to the supercooling heat exchanger 28, an accumulator 30 that separates the liquid refrigerant from the refrigerant gas absorbed into the compressor 21 so as to absorb only gas refrigerant into the compressor 21, a gas-side operating valve 31, and a liquid-side operating valve 32.

[0024] The constituent elements of the outdoor unit 2 described above are connected to one another via refrigerant pipes such as a discharge pipe 33A, a gas pipe 33B, a liquid pipe 33C, a gas pipe 33D, an suction pipe 33E, and an supercooling branch pipe 33F by a well-known manner, and constitute an outdoor refrigerant circuit 34. The outdoor unit 2 also includes an outdoor fan 35 that sends the outdoor air to the outdoor heat exchanger 24.

[0025] Furthermore, for returning the chiller oil separated from the discharged refrigerant gas within the oil separator 22 to the compressor 21 by a predetermined amount at a time, a parallel circuit constituted by a first oil return circuit 37 that includes a fixed throttle (throttle) 36 such as a capillary tube and a second return circuit 40 that includes a solenoid valve 38 and a fixed throttle (throttle) 39 such as a capillary tube is connected between the oil separator 22 and the suction pipe 33E connected to the compressor 21.

[0026] The gas-side pipe 4 and the liquid-side pipe 5 are the refrigerant pipes connected to the gas-side operating valve 31 and the liquid-side operating valve 32 of the outdoor unit 2. At a time of installing the packaged air conditioning system 1 on site in a construction phase, lengths of the gas-side pipe 4 and the liquid-side pipe 5 are set depending on distances between the outdoor unit 2 and the indoor units 7A and 7B connected to the outdoor unit 2. An appropriate number of branch units 6 are provided halfway along the gas-side pipe 4 and the liquid-side pipe 5, and an appropriate number of indoor units 7A and 7B are each connected to the gas-side pipe 4 and the liquid-side pipe 5 via these branch units 6. A closed one-system refrigerant cycle 3 is thereby constituted.

[0027] Each of the indoor units 7A and 7B includes an indoor heat exchanger 71 that exchanges heat between the refrigerant and indoor air to be used for indoor air-conditioning, an indoor electric expansion valve (indoor-unit electric expansion valve) for cooling (EEVC) 72, and an indoor fan 73 that circulates the indoor air through the indoor heat exchanger 71. Each of the indoor units 7A and 7B is connected to the branch units 6 via an indoor-side branch gas pipe 4A and an indoor-side branch liquid pipe 5A.

[0028] In the aforementioned packaged air conditioner 1, cooling operation is performed as follows.

[0029] The high-temperature and high-pressure refrigerant gas compressed by the compressor 21 is discharged to the discharge pipe 33A, and the oil separator 22 separates the chiller oil contained in the refrigerant. Thereafter, the refrigerant gas circulates toward the gas pipe 33B via the four-way change-over valve 23, exchanges heat with the outdoor air sent by the outdoor fan 35, and is condensed into liquid refrigerant in the outdoor heat exchanger 24. After being further cooled by the supercooling coil 25, this liquid refrigerant passes through the outdoor electric expansion valve 26 and is temporarily stored in the receiver 27.

[0030] The liquid refrigerant the circulating amount of which is regulated in the receiver 27 is branched in part to the supercooling branch pipe 33F while being distributed through the supercooling heat exchanger 28 via the liquid pipe 33C. The resultant liquid refrigerant exchanges heat with the refrigerant adiabatically expanded by the electric expansion valve for supercooling (EEVSC) 29, and is thereby supercooled. This liquid refrigerant is led out from the outdoor unit 2 to the liquid-side pipe 5 via the liquid-side operating valve 32. The liquid refrigerant led out to the liquid-side pipe 5 is further branched to the branch liquid pipes 5A and 5B of the respective indoor units 7A and 7B by the branch units 6.

[0031] The liquid refrigerant branched to the branch liquid pipes 5A and 5B flows into the indoor units 7A and 7B adiabatically expanded by the indoor electric expansion valve (EEVC) 72, in each of which the liquid refrigerant flows, as a gas-liquid two-phase flow, into the indoor heat exchanger 71. In the indoor heat exchanger 71, the indoor air circulated by the indoor fan 73 exchanges heat

with the refrigerant, and the indoor air is cooled and used for indoor cooling. On the other hand, the refrigerant is transformed into gas, the gas refrigerant reaches the branch units 6 via the branch gas pipes 4A and 4B, and the gas refrigerant meets with the refrigerant gas from the other indoor units in the gas-side pipe 4.

[0032] The refrigerant gas meeting together in the gas-side pipe 4 returns toward the outdoor unit 2, reaches the suction pipe 33E via the gas-side operating valve 31, the gas pipe 33D, and the four-way change-over valve 23, meets with the refrigerant gas from the branch pipe 33F, and is then led into the accumulator 30. In the accumulator 30, the liquid refrigerant contained in the refrigerant gas is separated and only the gas refrigerant is absorbed into the compressor 21. This refrigerant is compressed again by in the compressor 21. Thus, the cooling operation is performed by repeating the aforementioned cycle.

[0033] Meanwhile, heating operation is performed as follows.

[0034] The high-temperature and high-pressure refrigerant gas compressed by the compressor 21 is discharged to the discharge pipe 33A, the oil separator 22 separates the chiller oil contained in the refrigerant, and then the refrigerant gas circulates toward the gas pipe 33D by the four-way change-over valve 23. This refrigerant is led out from the outdoor unit 2 via the gas-side operating valve 31 and the gas-side pipe 4, and further led into the indoor units 7A and 7B via the indoor-side branch gas pipes 4A and 4B, respectively.

[0035] The high-temperature and high-pressure refrigerant gas led into the indoor units 7A and 7B exchange heat with the indoor air circulated by the indoor fan 73, and the indoor air is heated and used for indoor heating in the indoor heat exchanger 71. The liquid refrigerant resulting from condensation in the indoor heat exchanger 71 reaches the branch units 6 via the indoor electric expansion valve (EEVC) 72 and the branch liquid pipe 5A or 5B, meets with the refrigerant from the other indoor units, and then returns to the outdoor unit 2 via the liquid-side pipe 5.

[0036] The refrigerant back to the outdoor unit 2 reaches the supercooling heat exchanger 28 via the liquid-side operating valve 32 and the liquid pipe 33C, and is supercooled similarly to the cooling operation. Thereafter, the resultant refrigerant flows into the receiver 27 and is temporarily stored in the receiver 27, whereby the circulating amount of the refrigerant is regulated in the receiver 27. This liquid refrigerant is supplied to the outdoor electric expansion valve (EEVH) 26 via the liquid pipe 33C and adiabatically expanded in the outdoor electric expansion valve (EEVH) 26, and the liquid refrigerant then flows into the outdoor heat exchanger 24 via the supercooling coil 25.

[0037] In the outdoor heat exchanger 24, the refrigerant exchanges heat with the outdoor air sent from the outdoor fan 35, and the refrigerant absorbs the heat from the outdoor air and is evaporated into gas. This refrigerant led out from the outdoor heat exchanger 24 meets with the refrigerant from the supercooling branch pipe 33F via the gas pipe 33B, the four-way change-over valve 23, and the suction pipe 33E, and is led into the accumulator 30. In the accumulator 30, the liquid refrigerant contained in the refrigerant gas is separated and only the gas refrigerant is absorbed into the compressor 21. This refrigerant is compressed again by the compressor 21. Thus, the heating operation is performed by repeating the aforementioned cycle.

[0038] During the cooling operation or the heating operation described above, the chiller oil separated from the discharged refrigerant gas in the oil separator 22 is returned toward the compressor 21 via the first oil return circuit 37 including the fixed throttle 36 and the second oil return circuit 40 including the solenoid valve 38 and the fixed throttle 39 that are connected to each other in parallel. This secures the chiller oil of a certain amount in the compressor 21, and allows slide portions in the compressor 21 to be lubricated. The solenoid valve 38 provided in the second oil return circuit 40 is configured to be able to regulate an amount of the oil separated in the oil separator 22 by which the separated oil is returned toward the compressor 21 by being actuated to be opened/closed at appropriate timing during the steady cooling operation or heating operation.

[0039] A control unit (control device) 41 controls the opening of the indoor electric expansion valve of each indoor unit 7 in a period in which the indoor fan is turned off (stops rotating) to be larger than that in a period in which the indoor fan of the indoor unit 7 is turned on (rotates) and to be equal to or smaller than that set for noise control if the indoor fan performs an intermittent operation for repeating ON/OFF operations to stop for a predetermined time after rotating for a predetermined time at a time at which a thermostat is turned off during the heating operation. Specifically, if the opening of the indoor electric evaporation valve in the period in which the indoor fan is turned on is set to the opening indicating "slightly open" for making the indoor unit 7 into a state in which a slight amount of the refrigerant flows to prevent spontaneously condensed refrigerant from being accumulated in the heat exchanger of the indoor unit 7, the control unit 41 controls the opening of the indoor electric evaporation valve to be set to 1.1 times to 2.5 times as large as the opening indicating "slightly open" in the period in which the indoor fan is turned off so as to prompt the refrigerant to flow out from within the heat exchanger. The opening of the indoor electric evaporation valve in the period in which the indoor fan is turned off is set herein to the opening indicating "slightly open+α". That is, "slightly open+α" is the opening larger than the opening indicating slightly open and equal to or smaller than the opening at which noise is generated (the opening that suppresses the noise and that prevents complaints about sound from surrounding residents or entities).

[0040] Fig. 2 shows a relation between ON/OFF states of the indoor fan and states of the opening of the indoor

electric expansion valve.

[0041] At the time at which the thermostat is turned off during the heating operation, the intermittent operation in which the state of the indoor fan is switched to an ON or OFF state at predetermined intervals. If the indoor fan is in the ON-state in which the indoor fan rotates, the opening of the indoor electric expansion valve 72 is set to the opening indicating "slightly open". At time t1, when it is detected that the indoor fan is turned off, the opening of the indoor electric expansion valve 72 is controlled to the opening indicating "slightly open+α" at time t2. At time t3 after passage of a predetermined period in the period in which the indoor fan is turned off, the opening of the indoor electric expansion valve 72 is controlled to the opening indicating "slightly open".

[0042] At time t4, when the indoor fan is turned on, the indoor electric expansion valve 72 is kept in a "slightly open" state. At time t5, when it is detected that the indoor fan is turned off, the opening of the indoor electric expansion valve 72 is controlled to the opening indicating "slightly open+α" at time t6. In this way, when the thermostat is turned off during the heating operation, the control unit 41 controls the opening of the indoor electric expansion valve 72 to the opening indicating "slightly open" if the indoor fan is turned on, and to be 1.1 times to 2.5 times as large as the opening indicating "slightly open", that is, the opening indicating "slightly open+α" if the indoor fan is turned off.

[0043] The control unit 41 according to the aforementioned embodiment may be configured so that all of or a part of the processes described above are performed by software provided separately. In this case, the control unit 41 includes a CPU (Central Processing Unit), a main storage unit such as a RAM (Random Access Memory), and a computer-readable recording medium in which a program (control program, for example) for realizing all of or a part of the above processes is recorded. The CPU reads the program recorded in the recording medium and executes information processing and computing processes, thereby realizing similar processes to those performed by the control unit 41 described above.

[0044] Examples of the computer-readable recording medium referred to herein include a magnetic disk, a magnetooptical disk, a CD (Compact Disk)-ROM (Read Only Memory), a DVD (Digital Versatile Disk)-ROM, and a semiconductor memory. Alternatively, this computer program may be distributed to a computer over a communication line and the computer to which the computer program is distributed may execute the program.

[0045] As described so far, according to the control unit 41, the control method, the control program, and the packaged air conditioning system 1 including the control unit 41 in the embodiment, the opening of the electric expansion valve of each of the indoor units in the period in which the indoor fan of each of the indoor units 7 is turned off is controlled to be larger than the opening in the period in which the indoor fan is turned on, and to be equal to or smaller than the opening set for the noise control if the indoor fan of the indoor unit 7 for circulating the indoor air performs the intermittent operation for repeating ON/OFF operations to stop for a predetermined time after rotating for a predetermined time at a time at which the thermostat is turned off during the heating operation.

[0046] The indoor electric expansion valve is set to be larger in the opening in the period in which the indoor fan is turned off (that is, the indoor fan does not rotate) than the period in which the indoor fan is turned on. As compared with a case in which the opening is set larger in the period in which the indoor fan is turned on, it is possible to prevent excessive heating. Furthermore, since the indoor electric evaporation valve is set to be larger in the opening in the period in which the indoor fan is turned off than the period in which the indoor fan is turned on, it is possible to force the refrigerant out from the indoor unit 7 in the state in which the thermostat is turned off, and to prevent the system from turning into an insufficient state of the refrigerant gas. Moreover, since the opening is restricted to be equal to or smaller than the opening set for the noise control, the opening can be set to be equal to or smaller than that at which noise is generated and measures against complaints about sound can be taken.

[0047] In the embodiment, it has been described that the control unit 41 controls the opening of the indoor electric expansion valve in the partial period in the period in which the indoor fan is turned off. However, the present invention is not limited to the embodiment. The control unit 41 may control the opening of the indoor electric expansion valve in a period simultaneous with the period in which the indoor fan is turned off (that is, the period in which the indoor fan is turned off matches the period in which the opening of the indoor electric expansion valve 72 is set to the opening indicating "slightly open+α").

{Reference Signs List}

[0048]

1 packaged air conditioning system
2 outdoor unit
7, 7A, 7B indoor unit
41 control unit (control device)

Claims

1. A control device for controlling operation of a packaged air conditioning system in which a plurality of indoor units are connected to an outdoor unit, and a flow volume of refrigerant circulating through a refrigerant pipe is regulated depending on opening of an electric expansion valve of each of the indoor units, wherein
the control device controls, during a heating operation, the opening of the electric expansion valve of

each of the indoor units in a period in which an indoor fan circulating indoor air of each of the indoor units is turned off to be larger than the opening in a period in which the indoor fan is turned on, and to be equal to or smaller than the opening set for noise control if the indoor fan performs an intermittent operation for repeating ON/OFF operations to stop for a predetermined time after rotating for a predetermined time at a time at which a thermostat is turned off.

2. The control device according to claim 1, wherein
if the opening of the electric expansion valve in the period in which the indoor fan is turned on is set to a slightly open state in which a slight amount of the refrigerant flows to prevent the spontaneously condensed refrigerant from being accumulated in a heat exchanger of each of the indoor units,
the control unit controls the opening of the electric expansion valve in the period in which the indoor fan is turned off to be 1.1 times to 2.5 times as large as the opening at which the electric expansion valve is slightly open.

3. The control device according to claim 1 or 2, wherein the control device controls the opening of the electric expansion valve of each of the indoor units in a partial period in the period in which the indoor fan is turned off.

4. A packaged air conditioning system comprising the control device according to any of claims 1 to 3.

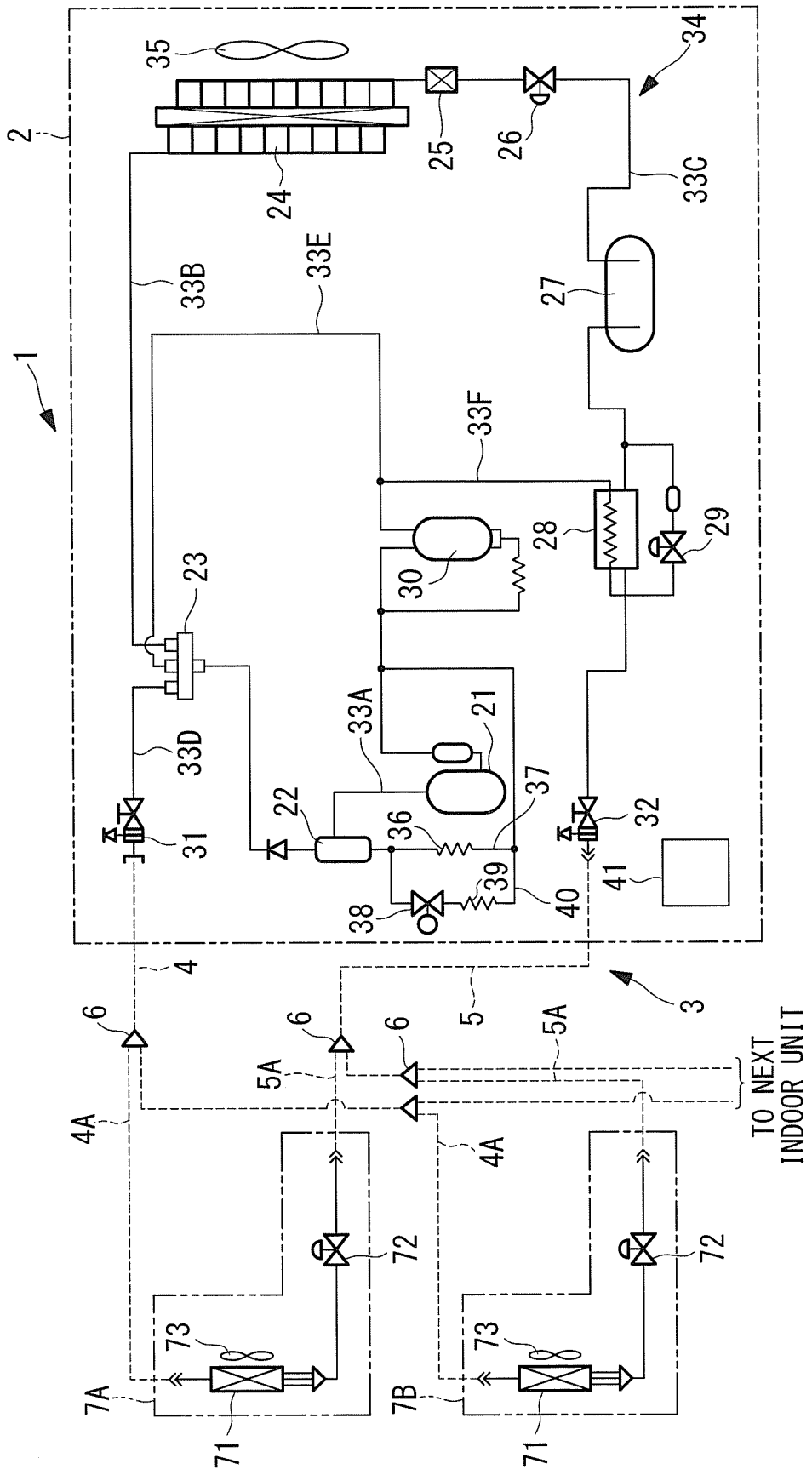
5. A control method for controlling operation of a packaged air conditioning system in which a plurality of indoor units are connected to an outdoor unit, and a flow volume of refrigerant circulating through a refrigerant pipe is regulated depending on opening of an electric expansion valve of each of the indoor units, the control method comprising:

controlling, during a heating operation, the opening of the electric expansion valve of each of the indoor units in a period in which an indoor fan circulating indoor air of each of the indoor units is turned off to be larger than the opening in a period in which the indoor fan is turned on, and to be equal to or smaller than the opening set for noise control if the indoor fan performs an intermittent operation for repeating ON/OFF operations to stop for a predetermined time after rotating for a predetermined time at a time at which a thermostat is turned off.

6. A control program for controlling operation of a packaged air conditioning system in which a plurality of indoor units are connected to an outdoor unit, and a flow volume of refrigerant circulating through a refrigerant pipe is regulated depending on opening of an electric expansion valve of each of the indoor units, the control program causing a computer to execute:

controlling, during a heating operation, the opening of the electric expansion valve of each of the indoor units in a period in which an indoor fan circulating indoor air of each of the indoor units is turned off to be larger than the opening in a period in which the indoor fan is turned on, and to be equal to or smaller than the opening set for noise control if the indoor fan performs an intermittent operation for repeating ON/OFF operations to stop for a predetermined time after rotating for a predetermined time at a time at which a thermostat is turned off.

FIG. 1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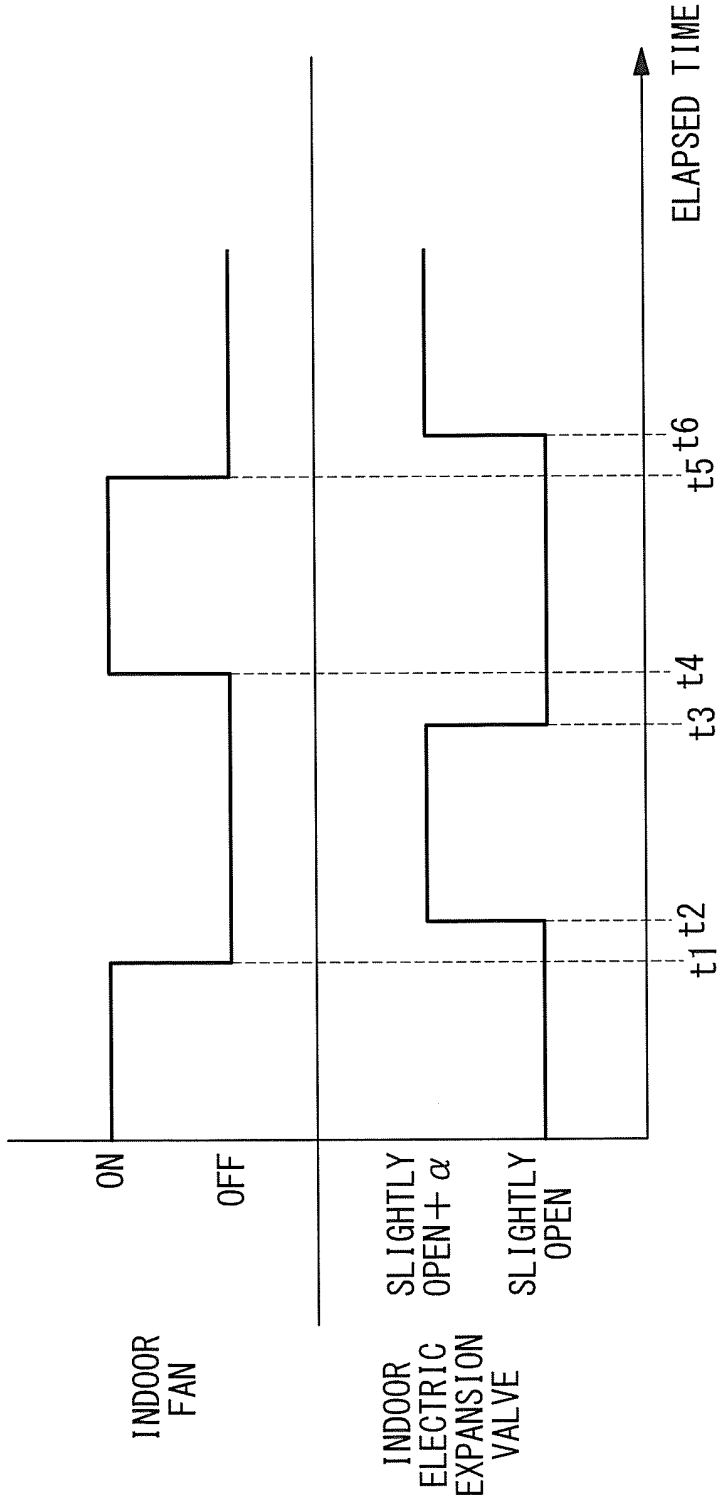
TO NEXT INDOOR UNIT

FIG. 2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ELAPSED TIME

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/057585

A. CLASSIFICATION OF SUBJECT MATTER
F24F11/02(2006.01)i, *F24F11/04*(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, F24F11/04

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 8-21668 A (Mitsubishi Electric Corp.), 23 January 1996 (23.01.1996), entire text (Family: none)	1-6
A	JP 2004-144377 A (Mitsubishi Heavy Industries, Ltd.), 20 May 2004 (20.05.2004), entire text (Family: none)	1-6

☐ 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
04 June, 2013 (04.06.13)	11 June, 2013 (11.06.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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Patent documents cited in the description

- JP 3778117 B **[0006]**