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(54) APPARATUS AND METHOD FOR CONTROLLING REFRIGERANT DISTRIBUTION IN MULTI-TYPE AIR CONDITIONER

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(57) **ABSTRACT**

An operation of a multi-type air conditioner, which includes a refrigerant distributor provided between one outdoor unit and a plurality of indoor units is controlled. A refrigerant supply controller determines indoor temperatures of a plurality of indoor units, decides to operate a compressor on the basis of the determined indoor temperatures, and transmits the determined operation of the compressor to an outdoor unit controller. The refrigerant supply controller determines the temperature of a refrigerant supplied to a plurality of operational indoor units and the temperature of a returned refrigerant, and adjusts the degree of opening/closing of a plurality of electronic expansion valves according to a difference between the determined temperatures of the supplied refrigerant and the returned refrigerant such that the amount of the refrigerant supplied to a plurality of indoor units are adjusted.

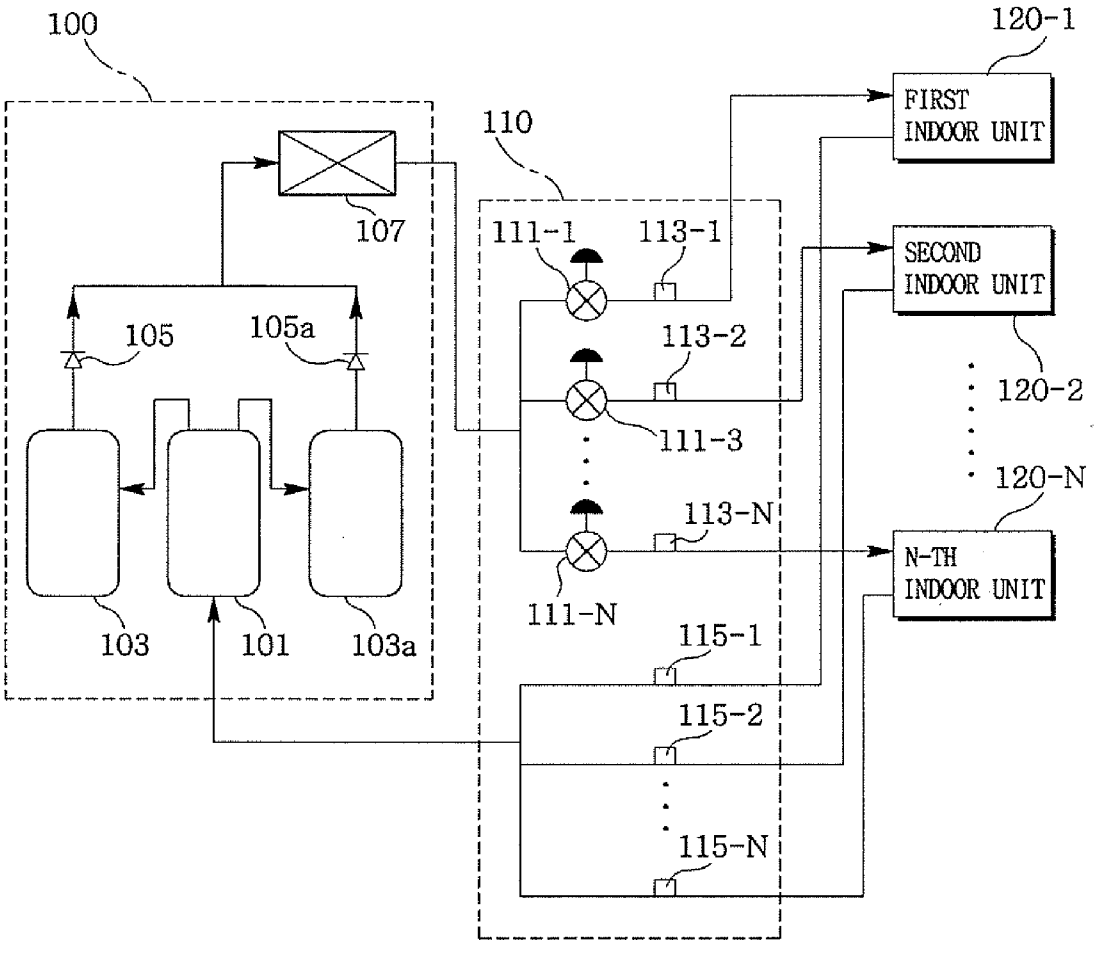


FIG. 1

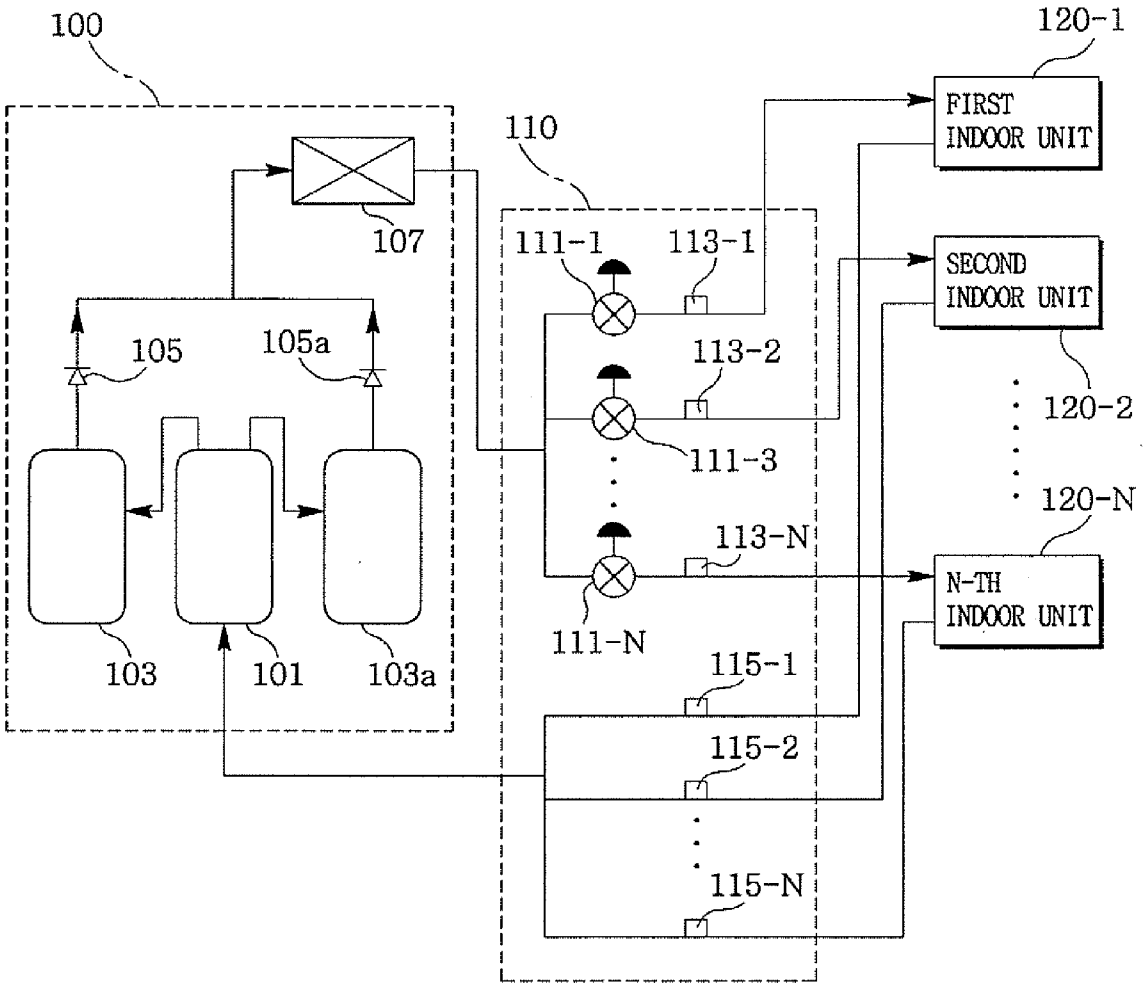

100
110
120-1
FIRST INDOOR UNIT
SECOND INDOOR UNIT
120-2
120-N
N-TH INDOOR UNIT
107
105
105a
103
101
103a
111-1
113-1
113-2
111-3
113-N
111-N
115-1
115-2
115-N

FIG. 2

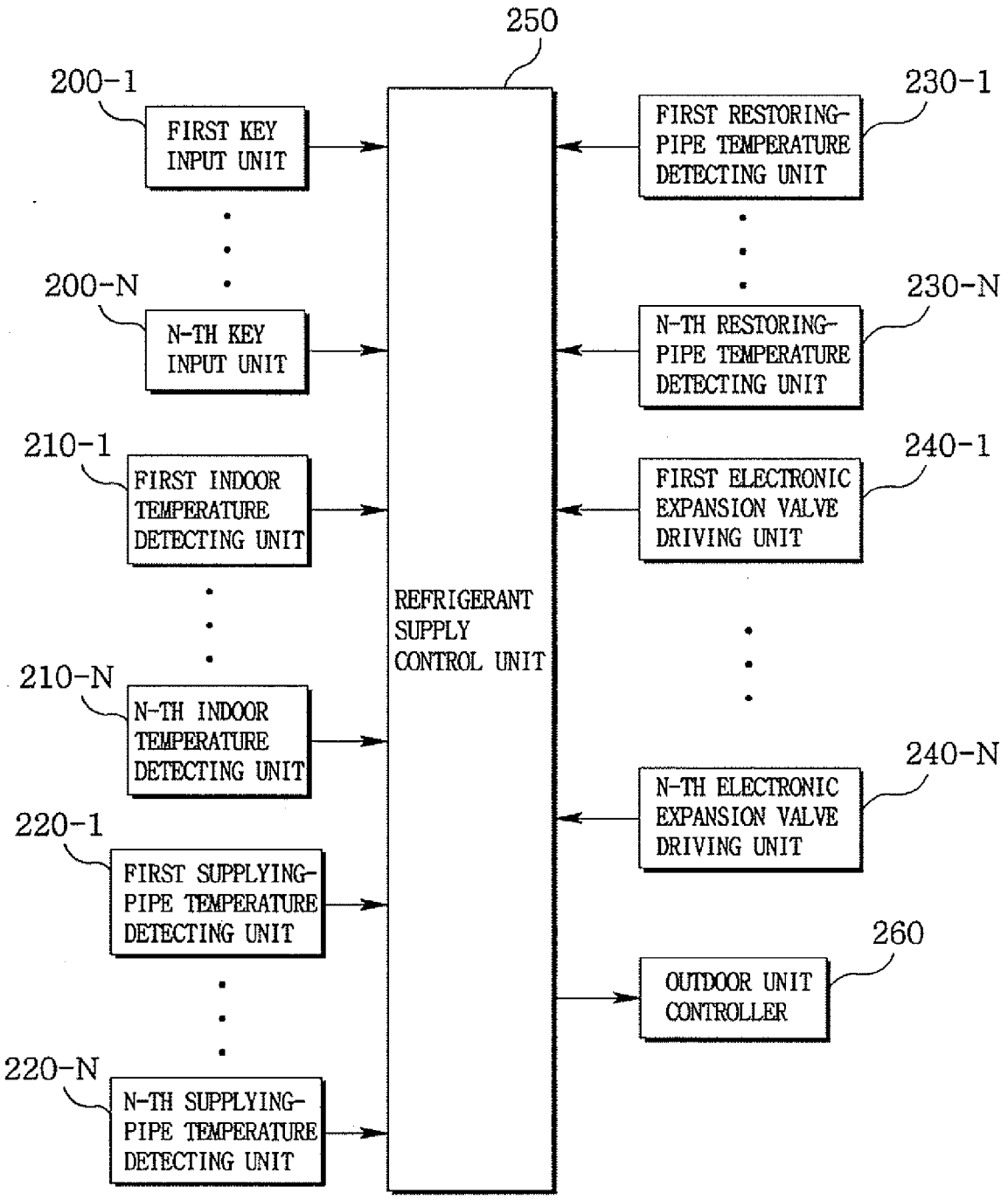

250
200-1
FIRST KEY INPUT UNIT
200-N
N-TH KEY INPUT UNIT
210-1
FIRST INDOOR TEMPERATURE DETECTING UNIT
210-N
N-TH INDOOR TEMPERATURE DETECTING UNIT
220-1
FIRST SUPPLYING-PIPE TEMPERATURE DETECTING UNIT
220-N
N-TH SUPPLYING-PIPE TEMPERATURE DETECTING UNIT
REFRIGERANT SUPPLY CONTROL UNIT
230-1
FIRST RESTORING-PIPE TEMPERATURE DETECTING UNIT
230-N
N-TH RESTORING-PIPE TEMPERATURE DETECTING UNIT
240-1
FIRST ELECTRONIC EXPANSION VALVE DRIVING UNIT
240-N
N-TH ELECTRONIC EXPANSION VALVE DRIVING UNIT
260
OUTDOOR UNIT CONTROLLER

FIG. 3a

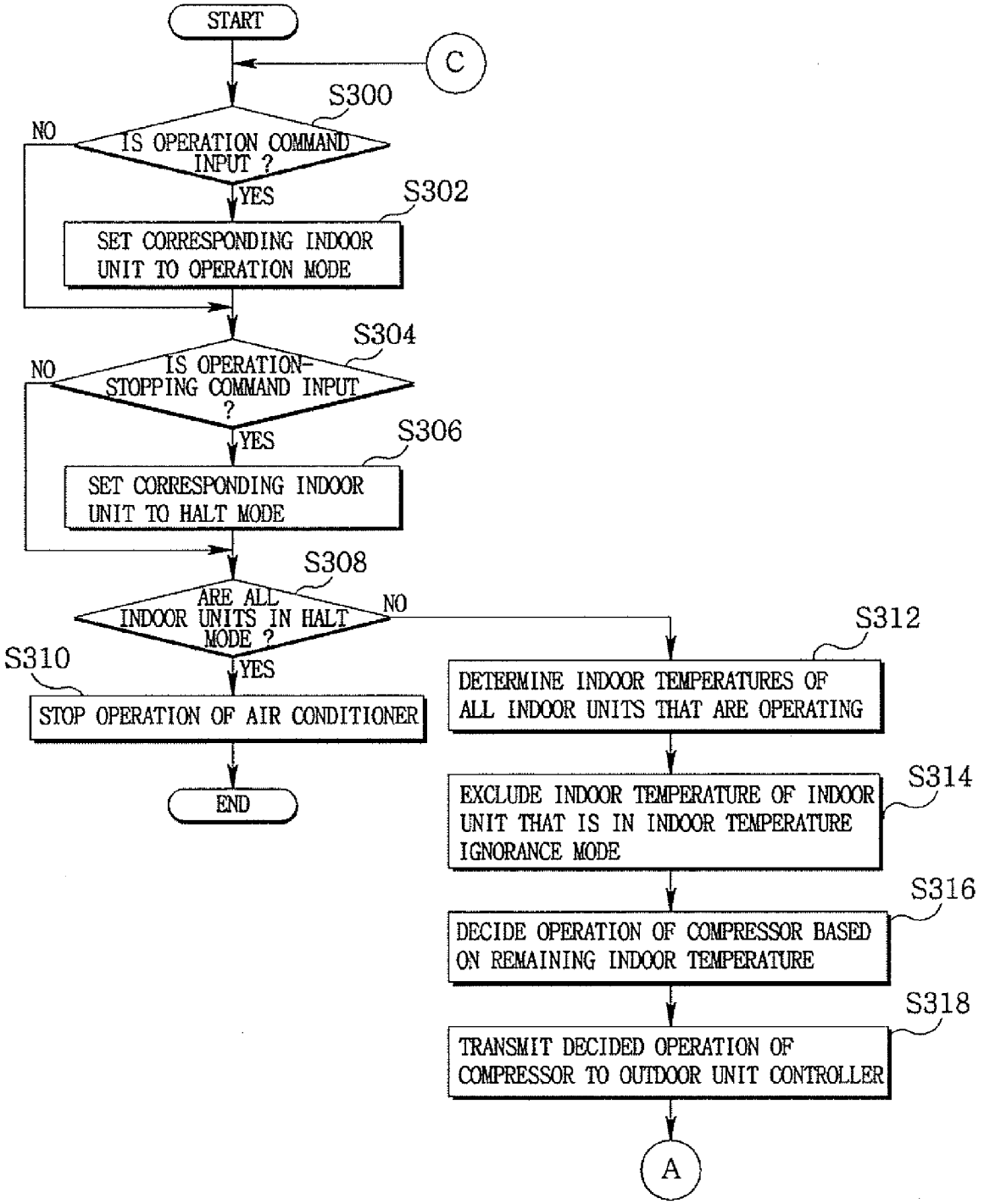

START
C
S300
IS OPERATION COMMAND INPUT ?
NO
YES
S302
SET CORRESPONDING INDOOR UNIT TO OPERATION MODE
S304
IS OPERATION-STOPPING COMMAND INPUT ?
NO
YES
S306
SET CORRESPONDING INDOOR UNIT TO HALT MODE
S308
ARE ALL INDOOR UNITS IN HALT MODE ?
NO
YES
S310
STOP OPERATION OF AIR CONDITIONER
END
S312
DETERMINE INDOOR TEMPERATURES OF ALL INDOOR UNITS THAT ARE OPERATING
S314
EXCLUDE INDOOR TEMPERATURE OF INDOOR UNIT THAT IS IN INDOOR TEMPERATURE IGNORANCE MODE
S316
DECIDE OPERATION OF COMPRESSOR BASED ON REMAINING INDOOR TEMPERATURE
S318
TRANSMIT DECIDED OPERATION OF COMPRESSOR TO OUTDOOR UNIT CONTROLLER
A

FIG. 3b

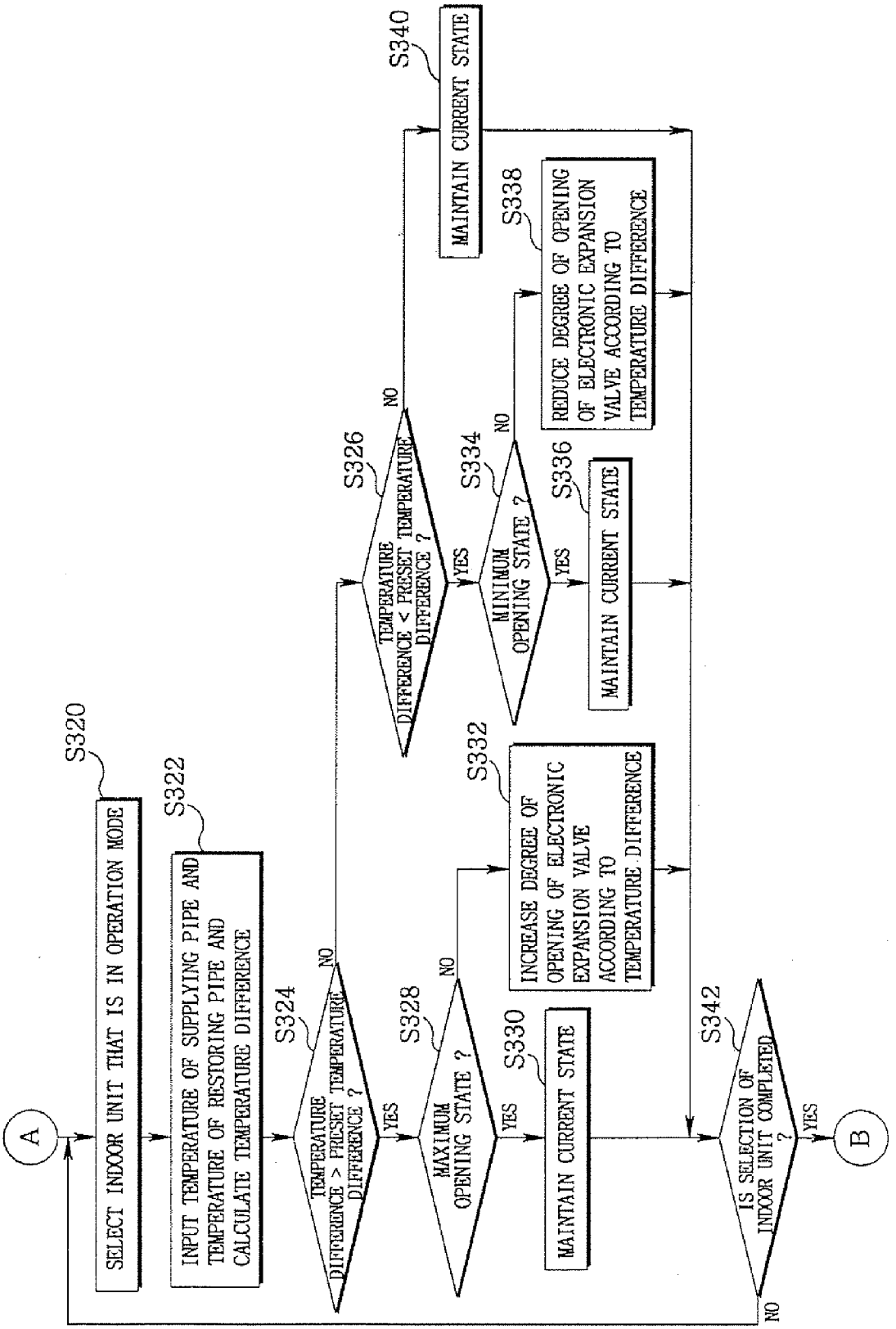
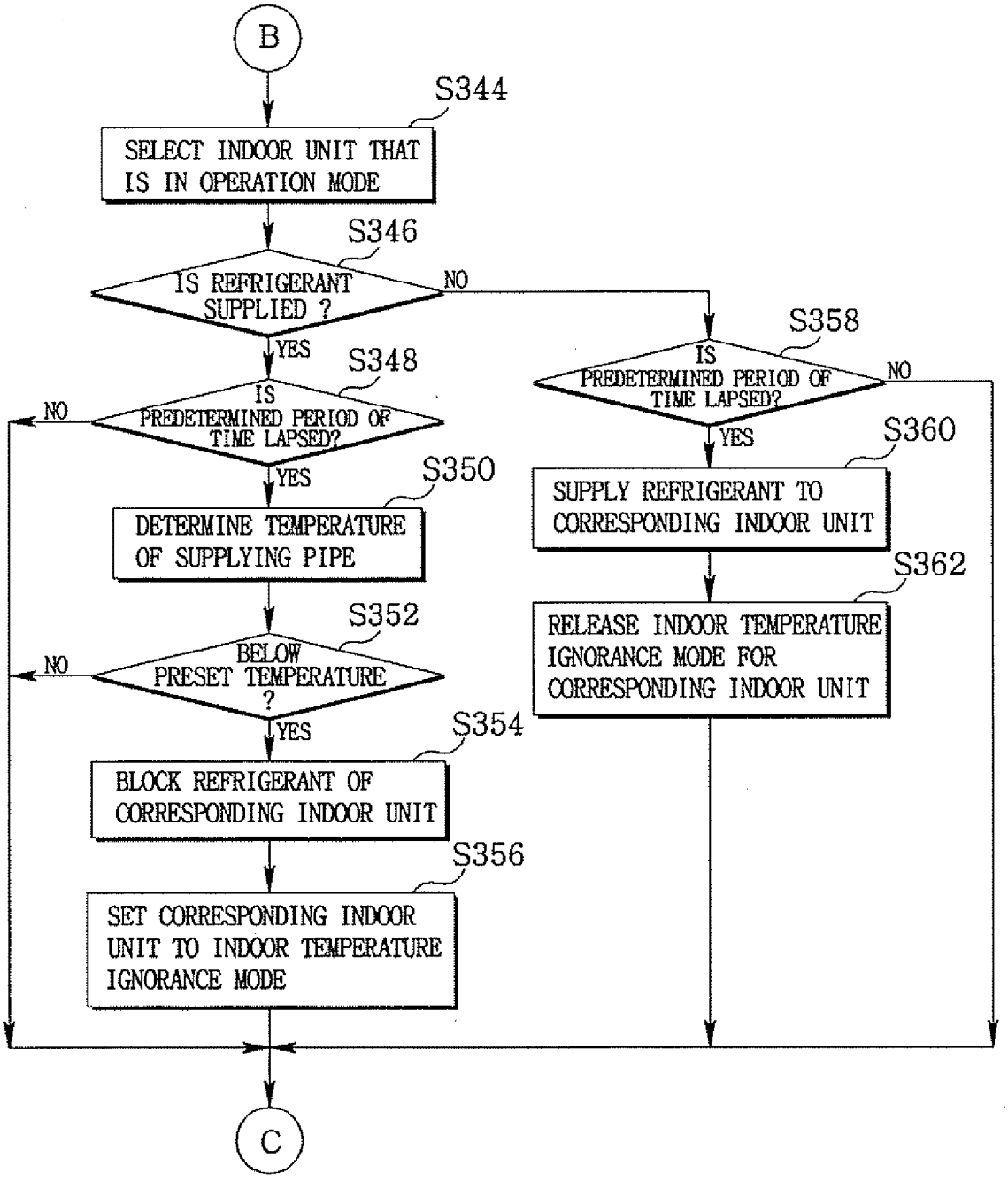

A
S320
SELECT INDOOR UNIT THAT IS IN OPERATION MODE
S322
INPUT TEMPERATURE OF SUPPLYING PIPE AND TEMPERATURE OF RESTORING PIPE AND CALCULATE TEMPERATURE DIFFERENCE
S324
TEMPERATURE DIFFERENCE > PRESET TEMPERATURE DIFFERENCE ?
NO
YES
S326
TEMPERATURE DIFFERENCE < PRESET TEMPERATURE DIFFERENCE ?
NO
YES
S328
MAXIMUM OPENING STATE ?
NO
YES
S330
MAINTAIN CURRENT STATE
S332
INCREASE DEGREE OF OPENING OF ELECTRONIC EXPANSION VALVE ACCORDING TO TEMPERATURE DIFFERENCE
S334
MINIMUM OPENING STATE ?
NO
YES
S336
MAINTAIN CURRENT STATE
S338
REDUCE DEGREE OF OPENING OF ELECTRONIC EXPANSION VALVE ACCORDING TO TEMPERATURE DIFFERENCE
S340
MAINTAIN CURRENT STATE
S342
IS SELECTION OF INDOOR UNIT COMPLETED ?
NO
YES
B

FIG. 3c


B
S344
SELECT INDOOR UNIT THAT IS IN OPERATION MODE
S346
IS REFRIGERANT SUPPLIED ?
NO
YES
S348
IS PREDETERMINED PERIOD OF TIME LAPSED?
NO
YES
S350
DETERMINE TEMPERATURE OF SUPPLYING PIPE
S352
BELOW PRESET TEMPERATURE ?
NO
YES
S354
BLOCK REFRIGERANT OF CORRESPONDING INDOOR UNIT
S356
SET CORRESPONDING INDOOR UNIT TO INDOOR TEMPERATURE IGNORANCE MODE
S358
IS PREDETERMINED PERIOD OF TIME LAPSED?
NO
YES
S360
SUPPLY REFRIGERANT TO CORRESPONDING INDOOR UNIT
S362
RELEASE INDOOR TEMPERATURE IGNORANCE MODE FOR CORRESPONDING INDOOR UNIT
C

# APPARATUS AND METHOD FOR CONTROLLING REFRIGERANT DISTRIBUTION IN MULTI-TYPE AIR CONDITIONER

## CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. §119 to Korean Patent Application No. 10-2005-0102853 filed on Oct. 31, 2005, the entirety of which is hereby incorporated by reference.

## BACKGROUND

[0002] The present invention relates to an apparatus and method for controlling a refrigerant distributor in a multi-type air conditioner.

[0003] In general, an air conditioner sucks hot air in a room and the hot air is heat exchanged at an evaporator in a cooling cycle. Cool air generated by the heat exchange is discharged into the rooms and repeated operation thereof cools the room.

[0004] The cooling cycle typically includes a closed circuit having a compressor, a condenser, an expansion device and an evaporator.

[0005] The compressor compresses a gaseous refrigerant of low temperature and pressure for conversion into a gaseous refrigerant of high temperature and pressure. The gaseous refrigerant of high temperature and pressure converted by the compressor is condensed in the condenser and then converted into a liquid refrigerant of high temperature and pressure.

[0006] The liquid refrigerant of high temperature and pressure condensed in the condenser is expanded in the expansion device and then converted into a liquid refrigerant of low temperature and pressure. The liquid refrigerant of low temperature and pressure expanded in the expansion device is subjected to heat exchange with indoor air in the evaporator and then evaporated and converted into the gaseous refrigerant of low temperature and pressure.

[0007] The gaseous refrigerant of low temperature and pressure generated by the heat exchange in the evaporator is converted again into the gaseous refrigerant of high temperature and pressure in the compressor.

[0008] That is, the cooling cycle including a closed circuit having a compressor, a condenser, an expansion device and an evaporator repeatedly performs compression, condensation, expansion and evaporation of a refrigerant. The cooling cycle carries out the heat exchange of hot indoor air with the refrigerant evaporated in the evaporator to generate cool air and then discharges the generated cool air into the room so that the room can be cooled.

[0009] In an air conditioner provided with such a cooling cycle, the compressor generates much noise when operating, and the condenser is provided with an additional condensing fan to dissipate heat generated from the condenser. Accordingly, the compressor, the condenser and the condensing fan are provided in an outdoor unit.

[0010] Noise is scarcely generated in the expansion device and the evaporator, and an evaporating fan is provided in the evaporator for generating cool air through heat exchange with indoor air. The evaporating fan generates very little noise. Thus, the expansion device, the evaporator and the evaporating fan are provided in an indoor unit.

[0011] The indoor and outdoor units are connected to each other through a connecting pipe, so that the refrigerant condensed in the condenser of the outdoor unit can be introduced into the evaporator through the connecting pipe and the expansion device of the indoor unit, and the refrigerant evaporated in the evaporator can be restored to the outdoor unit through the connecting pipe.

[0012] Generally, in such an air conditioner, one indoor unit is connected to one outdoor unit.

[0013] Recently, a multi-type air conditioner has been widely used, wherein a plurality of indoor units are connected to an outdoor unit. The multi-type air conditioner is provided with a refrigerant distributor between one outdoor unit and a plurality of indoor units. The refrigerant distributor distributes a refrigerant supplied from one outdoor unit. The distributed refrigerant is expanded in expansion devices and then supplied to the indoor units.

[0014] Since a plurality of indoor units can be selectively operated to selectively cool a plurality of rooms, such a multi-type air conditioner has an advantage in terms of energy consumption efficiency.

[0015] In the multi-type air conditioner, the outdoor unit is provided with a plurality of compressors for sufficient supply of a refrigerant to the plurality of indoor units.

[0016] Here, each of the plurality of compressors provided in the outdoor unit may have the same compression capacity. For example, assuming that the outdoor unit has two compressors, each of first and second compressors may equally share a total refrigerant compression capacity.

[0017] On the other hand, each of the two compressors provided in the outdoor unit may have a different compression capacity. For example, the first compressor may have a 40% of a total refrigerant compression capacity while the second compressor may have a 60% of the total refrigerant compression capacity.

[0018] A gaseous refrigerant of high temperature and pressure compressed by the plurality of compressors is condensed into a liquid refrigerant of high temperature and pressure by the condenser, and the liquid refrigerant of high temperature and pressure condensed by the condenser is supplied to the refrigerant distributor.

[0019] The refrigerant distributor includes a plurality of expansion devices provided in a plurality of pipes each connected to the indoor units. The refrigerant distributor distributes the refrigerant supplied from the condenser, and the distributed refrigerant is expanded by the plurality of expansion devices and then supplied to the plurality of indoor units.

[0020] This multi-type air conditioner typically includes an outdoor unit controller in the outdoor unit. The outdoor unit controller controls the compressors provided in the outdoor unit, and also controls the degrees of opening/closing of the plurality of expansion devices provided in the refrigerant distributor.

[0021] Accordingly, the outdoor unit and the refrigerant distributor should be connected to each other via a commu-

nication line, so that the outdoor unit controller can control the plurality of expansion devices through the communication line to adjust the degrees of opening/closing of the expansion devices.

[0022] Further, the conventional multi-type air conditioner should use only a refrigerant distributor predetermined for a specific outdoor unit, and only predetermined indoor units should be used as the plurality of indoor units.

[0023] Therefore, in North America where outdoor units and indoor units are separately sold, when a consumer intends to construct a multi-type air conditioner by connecting a plurality of indoor units to one outdoor unit, the consumer should purchase a specific indoor unit useable in the multi-type air conditioner.

[0024] That is, in the multi-type air conditioner, a refrigerant distributor is provided between one outdoor unit and a plurality of indoor units. The refrigerant distributor has a plurality of expansion devices in order to distribute a refrigerant supplied from the outdoor and to supply the distributed refrigerant to the plurality of indoor units.

[0025] In a general type air conditioner in which one indoor unit is connected to one outdoor unit, an expansion device, an evaporator and an evaporating fan are provided in the indoor unit.

[0026] In a case where an indoor unit for use in such a general type air conditioner is connected to the refrigerant distributor in the multi-type air conditioner, a refrigerant is first expanded in an expansion device provided in the refrigerant distributor and then supplied to the indoor unit. Thus, an expansion device provided in the indoor unit disturbs a flow of the refrigerant expanded in the refrigerant distributor, whereby the indoor unit cannot normally generate cool air.

[0027] For that reason, in the multi-type air conditioner, a standardized indoor unit that is not provided with an expansion device should be connected to the refrigerant distributor

## SUMMARY

[0028] A first object of the present invention is to provide an apparatus and method for controlling a refrigerant distributor in a multi-type air conditioner which can be operated by various kinds of indoor units that are not standardized for the multi-type air conditioner.

[0029] A second object of the present invention is to provide an apparatus and method for controlling a refrigerant distributor in a multi-type air conditioner, wherein operation of the multi-type air conditioner is controlled by the refrigerant distributor provided between an outdoor unit and a plurality of indoor units.

[0030] A third object of the present invention is to provide an apparatus and method for controlling a refrigerant distributor in a multi-type air conditioner, wherein the refrigerant distributor decides the operation of an outdoor unit according to indoor temperature detected by an indoor unit, and an outdoor unit controller controls the operation of the outdoor unit according to the decided operation of the outdoor unit.

[0031] In the present invention for achieving the above objects, the temperature of a refrigerant supplied to a plurality of indoor units connected to a refrigerant distributor and the temperature of a restored or returned refrigerant are determined, and a temperature difference therebetween is calculated. The degree of opening/closing of an electronic expansion valve is controlled by the calculated temperature difference to adjust the amount of the refrigerant supplied to each of the plurality of indoor units.

[0032] The adjustment of the amount of the refrigerant is decided by comparing the temperature difference between the supplied refrigerant and the returned refrigerant of each indoor unit with a preset temperature difference.

[0033] If the temperature difference between the supplied refrigerant and the returned refrigerant is larger than the preset temperature difference, this corresponds to a case where an expansion device is provided in the corresponding indoor unit to expand the refrigerant. At this time, the amount of the refrigerant supplied to the corresponding indoor unit increases.

[0034] If the temperature difference between the supplied refrigerant and the returned refrigerant is less than the preset temperature difference, this corresponds to a case where an expansion device is not provided in the corresponding indoor unit. At this time, the electronic expansion valve reduces the amount of the refrigerant supplied to the corresponding indoor units.

[0035] According to the present invention, the amount and expansion of the refrigerant are adjusted by an electronic expansion valve in an indoor unit which is not provided with an expansion device. An electronic expansion valve is fully opened in an indoor unit provided with an expansion device, and the amount and expansion of the refrigerant are adjusted by an expansion device provided in the indoor unit.

[0036] Therefore, an apparatus for controlling a refrigerant distributor in a multi-type air conditioner according to the present invention includes a plurality of electronic expansion valves for supplying a refrigerant fed from an outdoor unit to a plurality of indoor units; a plurality of supplying-pipe temperature detecting units for detecting the temperature of the refrigerant supplied from the electronic expansion valves to the indoor units; a plurality of return-pipe (or return-pipe) temperature detecting units for detecting the temperature of the refrigerant returned (or returned) from the indoor units to the outdoor unit; and a refrigerant supply control unit for adjusting the degrees of opening/closing of the electronic expansion valves according to the temperature of the refrigerant detected by the supplying-pipe temperature detecting units and the temperature of the refrigerant detected by the return-pipe temperature detecting units.

[0037] A method for controlling a refrigerant distributor in a multi-type air conditioner according to the present invention includes a refrigerant supply control unit, determining a temperature of a refrigerant supplied to at least one operating indoor unit and a returned temperature of a refrigerant; and calculating a difference between the determined temperatures of the supplied refrigerant and the returned refrigerant, and adjusting the degree of opening/closing of an electronic expansion valve through which the refrigerant is supplied to a relevant indoor unit, on the basis of the calculated temperature difference.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The present invention is further described in the detailed description which follows, in reference to the noted plurality of drawings, by way of non-limiting examples of preferred embodiments of the present invention, in which like characters represent like elements throughout the several views of the drawings, and wherein:

[0039] FIG. **1** is a view showing the configuration of a refrigeration cycle according to a control apparatus of the present invention;

[0040] FIG. **2** is a block diagram showing the configuration of the control device of the present invention; and

[0041] FIGS. **3***a* to **3***c* are flowcharts illustrating a control method of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

[0042] The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the present invention may be embodied in practice.

[0043] FIG. **1** is a view showing the configuration of a refrigeration cycle according to a control device of the present invention. Here, reference numeral "**100**" designates an outdoor unit, reference numeral "**110**" designates a refrigerant distributor, and reference numerals "**120-1**", . . . , "**120**-N" designate first to N-th indoor units.

[0044] The outdoor unit (**100**) is provided with an accumulator (**101**), first and second compressors (**103**, **103***a*), back-flow preventing means (**105**, **105***a*), and a condenser (**107**).

[0045] The accumulator (**101**) stores a gaseous refrigerant of low temperature and pressure returned from the first to N-th indoor units (**120-1**, . . . , **120**-N) through the refrigerant distributor (**110**) and supplies the stored gaseous refrigerant of low temperature and pressure to the first and second compressors (**103**, **103***a*). The accumulator (**101**) prevents a liquid refrigerant of low temperature and pressure from being supplied to the first and second compressors (**103**, **103***a*).

[0046] Although most of the refrigerant returned from the first to N-th indoor units (**120-1**, . . . , **120**-N) is a gaseous refrigerant of low temperature and pressure, some of the refrigerant is returned in a liquid phase. Accordingly, the outdoor unit (**100**) is provided with the accumulator (**101**) to prevent the liquid refrigerant of low temperature and pressure from being supplied to the first and second compressors (**103**, **103***a*).

[0047] The first and second compressors (**103**, **103***a*) suck the gaseous refrigerant of low temperature and pressure stored in the accumulator (**101**) and then converts it into a gaseous refrigerant of high temperature and pressure.

[0048] Here, the configuration in which the outdoor unit (**100**) is provided with the two compressors (**103**, **103***a*) has been described by way of example. However, the outdoor unit (**100**) may be provided with, any number of compressors, such as three or more compressors.

[0049] The compression capacity of the first compressor (**103**) may be different from that of the second compressor (**103***a*). For example, the first compressor (**103**) may have a 40% refrigerant compression capacity of the total refrigerant compression capacity of the outdoor unit (**100**) and the second compressor (**103***a*) may have a 60% refrigerant compression capacity of the total refrigerant compression capacity.

[0050] Further, the compression capacity of the first compressor (**103**) may be identical to that of the second compressor (**103***a*). For example, each of the first compressor (**103**) and the second compressor (**103***a*) may have a 50% refrigerant compression capacity of the total refrigerant compression capacity of the outdoor unit (**100**).

[0051] The back-flow preventor or preventing means (**105**, **105***a*) prevent the gaseous refrigerant of high temperature and pressure, which have been compressed in the first and second compressors (**103**, **103***a*), from flowing backward to the first and second compressors (**103**, **103***a*). Check valves may be used as the back-flow preventing means (**105**, **105***a*) to prevent the backflow of the refrigerant. Of course other back flow preventors can be used.

[0052] The condenser (**107**) condenses the gaseous refrigerant of high temperature and pressure, which has been compressed in the first and second compressors (**103**, **103***a*) and has passed through the back-flow preventing means (**105**, **105***a*), into a liquid refrigerant of high temperature and pressure, and then supplies the liquid refrigerant to the refrigerant distributor (**110**).

[0053] The refrigerant distributor (**110**) is provided with first to N-th electronic expansion valves (**111-1**, . . . , **111**-N), first to N-th supplying-pipe temperature sensors (**113-1**, . . . , **113**-N) and first to N-th return-pipe (i.e., return pipe) temperature sensors (**115-1**, . . . , **115**-N).

[0054] The first to N-th electronic expansion valves (**111-1**, . . . , **111**-N) expand the liquid refrigerant of high temperature and pressure, which has been condensed in the condenser (**107**) of the outdoor unit (**100**), into a liquid refrigerant of low temperature and pressure, and then supply the liquid refrigerant of low temperature and pressure to the first to N-th indoor units (**120-1**, . . . , **120**-N), respectively.

[0055] The first to N-th supplying-pipe temperature sensors (**113-1**, . . . , **113**-N) are mounted on supplying pipes through which the refrigerant is supplied to the first to N-th indoor units (**120-1**, . . . , **120**-N), respectively, and generate temperature-detecting signals according to the temperatures of the supplying pipes. That is, the first to N-th supplying-pipe temperature sensors (**113-1**, . . . , **113**-N) generate temperature-detecting signals according to the temperature of the refrigerant supplied to the first to N-th indoor units (**120-1**, . . . , **120**-N) through the supplying pipes.

[0056] The first to N-th return-pipe temperature sensors (**115-1**, . . . , **115**-N) are mounted on return or return pipes

through which the refrigerant is returned from the first to N-th indoor units (**120-1**, . . . , **120**-N), respectively, and generate temperature-detecting signals according to the temperatures of the return pipes. That is, the first to N-th return-pipe temperature sensors (**115-1**, . . . , **115**-N) generate temperature-detecting signals according to the temperature of the refrigerant returned from the first to N-th indoor units (**120-1**, . . . , **120**-N) through the return pipes.

[**0057**] In the cooling cycle constructed as above, the first and second compressors (**103**, **103***a*) of the outdoor unit (**100**) suck the gaseous refrigerant of low temperature and pressure stored in the accumulator (**101**) and compress it into the gaseous refrigerant of high temperature and pressure. The gas refrigerant of high temperature and pressure, which has been compressed in the first and second compressors (**103**, **103***a*), is introduced into the condenser (**107**) through the back-flow preventing valves (**105**, **105***a*) and then condensed into the liquid refrigerant of high temperature and pressure.

[**0058**] The liquid refrigerant of high temperature and pressure, which has been condensed in the condenser (**107**), is supplied to the refrigerant distributor (**110**). Assuming that all the first to N-th indoor units (**120-1**, . . . , **120**-N) are in operation, the refrigerant distributor (**110**) expands the liquid refrigerant of high temperature and pressure supplied from the condenser (**107**) through the first to N-th electronic expansion valves (**111-1**, . . . , **111**-N) to convert it into the liquid refrigerant of low temperature and pressure that in turn is supplied to the first to N-th indoor units (**120-1**, . . . , **120**-N).

[**0059**] In the first to N-th indoor units (**120-1**, . . . , **120**-N), the liquid refrigerant of low temperature and pressure supplied through the first to N-th electronic expansion valves (**111-1**, . . . , **111**-N) of the refrigerant distributor (**110**) is evaporated in evaporators (not shown) provided in the indoor units and then converted into the gaseous refrigerant of low temperature and pressure. The liquid refrigerant of low temperature and pressure is evaporated in the evaporators to be gaseous refrigerant of low temperature and pressure while being subjected to heat exchange with indoor air to generate cool air to be used for cooling spaces or rooms.

[**0060**] The gaseous refrigerant of low temperature and pressure, which has been generated through the evaporation in the evaporator, is returned through the return or return pipes and then stored in the accumulator (**101**) of the outdoor unit **100**. These processes are repeated.

[**0061**] When a cooling operation is performed by circulating the refrigerant in the refrigeration cycle as described above, the first to N-th supplying-pipe temperature sensors (**113-1**, . . . , **113**-N) generate temperature-detecting signals according to the temperatures of the supplying pipes through which the refrigerant is supplied to the first to N-th indoor units (**120-1**, . . . , **120**-N). The first to N-th returnreturn-pipe temperature sensors (**115-1**, . . . , **115**-N) generate temperature-detecting signals according to the temperatures of the return pipes through which the refrigerant is returned from the first to N-th indoor units (**120-1**, . . . , **120**-N).

[**0062**] FIG. **2** is a block diagram showing the configuration of the control device of the present invention, which controls the refrigeration cycle of the air conditioner of the present invention to perform a cooling operation. Here, reference numerals "**200-1**", . . . , "**200**-N" designate first to N-th key input units. The first to N-th key input units (**200-1**, . . . , **200**-N) are provided on the first to N-th indoor units (**120-1**, . . . , **120**-N), respectively, and have a plurality of function keys that are manipulated by a user to generate an operation command for the air conditioner. Of course any other type of input mechanism including, but not limited to, touch screens, and mouse activated cursors are also included in the present invention.

[**0063**] Reference numerals "**210-1**", . . . , "**210**-N" designate first to N-th indoor temperature detecting units. The first to N-th indoor temperature detecting units (**210-1**, . . . , **210**-N) are provided in the first to N-th indoor units (**120-1**, . . . , **120**-N), respectively, and each of the indoor temperature detecting units employs a temperature sensor to detect indoor temperature. For example, a thermostatic is used as the temperature sensor, and the temperature of indoor air to be detected varies according to a preset temperature set by the user. Of course the use of other temperature sensors is also within the scope of the present invention.

[**0064**] Reference numerals "**220-1**", . . . , "**220**-N" designate first to N-th supplying-pipe temperature detecting units. The first to N-th supplying-pipe temperature detecting units (**220-1**, . . . , **220**-N) are provided in the refrigerant distributor (**110**), and utilize temperature-detecting signals of the first to N-th supplying-pipe temperature sensors (**113-1**, . . . , **113**-N) to detect the temperatures of the supplying pipes through which the refrigerant is supplied to the first to N-th indoor units (**120-1**, . . . , **120**-N).

[**0065**] Reference numerals "**230-1**", . . . , "**230**-N" represent first to N-th returnreturn-pipe temperature detecting units. The first to N-th returnreturn-pipe temperature detecting units (**230-1**, . . . , **230**-N) are provided in the refrigerant distributor (**110**) and utilizes temperature-detecting signals of the first to N-th returnreturn-pipe temperature sensors (**115-1**, . . . , **115**-N) to detect the temperatures of the returnreturn pipes through which the refrigerant is returned from the first to N-th indoor units (**120-1**, . . . , **120**-N).

[**0066**] Reference numerals "**240-1**", . . . , "**240**-N" are first to N-th electronic expansion valve driving units. The first to N-th electronic expansion valve driving units (**240-1**, . . . , **240**-N) are provided in the refrigerant distributor (**110**), and control the degrees of opening/closing of the first to N-th electronic expansion valves (**111-1**, . . . , **111**-N) to adjust the amounts of refrigerant which are supplied to the first to N-th indoor units (**120-1**, . . . , **120**-N).

[**0067**] Reference numeral "**250**" defines a refrigerant supply control unit. The refrigerant supply control unit (**250**) is provided in the refrigerant distributor and controls the operation of the air conditioner according to an operation command generated by the first to N-th key input units (**200-1**, . . . , **200**-N). The refrigerant supply control unit (**250**) controls the first and second compressors (**103**, **103***a*) according to indoor temperature detected by each of the first to N-th indoor temperature detecting units (**210-1**, . . . , **210**-N). The refrigerant supply control unit (**250**) controls the first to N-th electronic expansion valve driving units (**240-1**, . . . , **240**-N) according to the temperature of the supplying pipes detected by the first to N-th supplying-pipe temperature detecting units (**220-1**, . . . , **220**-N) and the temperature of the returnreturn pipes detected by the first to N-th return-pipe temperature detecting units (**230-1**, . . . ,

230-N) to adjust the degrees of opening/closing of the first to N-th electronic expansion valves (111-1, . . . , 111-N).

[0068] Reference numeral "260" designates an outdoor unit controller. The outdoor unit controller (260) is provided in the outdoor unit (100) and selectively operates the first and second compressors (103, 103*a*) under control of the refrigerant supply control unit (250).

[0069] In the control device of the present invention as constructed above, if the user selectively manipulates the first to N-th key input units (200-1, . . . , 200-N) to instruct the air conditioner to operate, a command for operating the air conditioner is inputted into the refrigerant supply control unit (250).

[0070] Here, the operation of the air conditioner will be described on the assumption that a user manipulates the first key input unit (200-1) provided on the first indoor unit (120-1) to instruct the air conditioner to operate while the second to N-th indoor units (120-2, . . . , 120-N) are not in operation.

[0071] The refrigerant supply control unit (250) determines that the first indoor unit (120-1) is in operation in response to the operation command inputted from the first key input unit (200-1) and sends a driving signal to the outdoor unit controller (260).

[0072] Successively, the outdoor unit controller (260) selectively drives the first and second compressors (103, 103*a*) according to the driving signal, thereby compressing the gaseous refrigerant of low temperature and pressure stored in the accumulator (101) into the gaseous refrigerant of high temperature and pressure. The compressed refrigerant is condensed in the condenser (107) to be supplied to the refrigerant distributor (110).

[0073] Under this circumstance, the refrigerant supply control unit (250) receives an indoor temperature detected by the first indoor temperature detecting unit (210) and determines that the outdoor unit is in operation. The refrigerant supply control unit (250) transmits the determined operation status of the outdoor unit to the outdoor unit controller (260), so that the outdoor unit controller (260) can selectively operate the first compressor (103) or the second compressor (103*a*), or operates both the first and second compressors (103, 103*a*).

[0074] That is, if the temperature of a room with the first indoor unit (120-1) installed therein is high, the refrigerant supply control unit (250) causes the outdoor unit controller (260) to increase the refrigerant compression capacity of the first and second compressors (103, 103*a*) so that the first indoor unit (120-1) can rapidly lower the temperature of the room. If the temperature of the room with the first indoor unit (120-1) installed therein is low, the refrigerant supply control unit (250) causes the outdoor unit controller (260) to reduce the refrigerant compression capacity of the first and second compressors (103, 103*a*), thereby preventing the first indoor unit (120-1) from operating in an overcooling state.

[0075] The refrigerant supply control unit (250) receives the temperature of the supplying pipe detected by the first supplying-pipe temperature detecting unit (220-1) and the temperature of the return pipe detected by the first return-pipe temperature detecting unit (230), calculates a difference between the two temperatures, and compares the calculated temperature difference with a preset temperature difference.

[0076] According to results of the comparison of the preset temperature difference with the difference between the temperature of the supplying pipe and the temperature of the return pipe, the refrigerant supply control unit (250) controls the first electronic expansion valve driving unit (240-1) to adjust the degree of opening/closing of the first electronic expansion valve (111-1).

[0077] Moreover, the refrigerant supply control unit (250) determines whether the temperature of the supplying pipe detected by the first supplying-pipe temperature detecting unit (220-1) is below the preset temperature. If it is determined that the temperature of the supplying pipe is below the preset temperature, the refrigerant supply control unit (250) controls the first electronic expansion valve driving unit (240-1) to close the first electronic expansion valve (111-1), thereby preventing the overcooling operation thereof.

[0078] Following the closure of the first electronic expansion valve (111-1), the refrigerant supply control unit (250) adjusts the degree of opening/closing of the first electronic expansion valve (111-1) according to the preset temperature difference and the difference between the temperature of the supplying pipe and the temperature of the return pipe after passage of a predetermined period of time.

[0079] Meanwhile, FIGS. 3*a* to 3*c* are flowcharts illustrating the control method of the present invention. Referring to FIGS. 3*a* to 3*c*, if a user manipulates the function keys of the first key input unit (200-1) or the second to N-th key input units (200-2, . . . , 200-N) provided in the first indoor unit (120-1) or the second to N-th indoor units (120-2, . . . , 120-N) in order to instruct the air conditioner to operate, the first key input unit (200-1) or the second to N-th key input units (200-2, . . . , 200-N) generate an operation command for the air conditioner. An operation command generated from the first key input unit (200-1) or the second to N-th key input units (200-2, . . . , 200-N) is inputted into the refrigerant supply control unit (250) provided in the refrigerant distributor (110) (S300).

[0080] If the operation command is inputted into the refrigerant supply control unit (250), the control unit first determines whether the operation command has been inputted from the first key input unit (200-1) or the second to N-th key input units (200-2, . . . , 200-N), and then sets into operation mode (S302) the first indoor unit (120-1) or the second to N-th indoor units (120-2, . . . , 120-N) corresponding to the determined first key input unit (200-1) or the second to N-th key input units (200-2, . . . , 200-N),

[0081] If the user manipulates the function keys of the first key input unit (200-1) or the second to N-th key input units (200-2, . . . , 200-N) to instruct the air conditioner to stop its operation, the first key input unit (200-1) or the second to N-th key input units (200-2, . . . , 200-N) generate a command for stopping the operation of the air conditioner, and the command for stopping the operation is inputted into the refrigerant supply control unit (250) (S304).

[0082] Then, the refrigerant supply control unit (250) determines that a command for stopping the operation of the air conditioner has been generated, and subsequently sets into halt mode (S306) the first indoor unit (120-1) or the

second to N-th indoor units (**120-2**, . . . , **120**-N) corresponding to the first key input unit (**200-1**) or the second to N-th key input units (**200-2**, . . . , **200**-N), which has generated the command for stopping the operation.

[**0083**] In this state, the refrigerant supply control unit (**250**) determines whether all the first to N-th indoor units (**120-1**, . . . , **120**-N) are in halt mode (S**308**). If it is determined that all the first to N-th indoor units (**120-1**, . . . , **120**-N) are in halt mode, the refrigerant supply control unit (**250**) stops the operation of the air conditioner (S**310**) and terminates the procedures.

[**0084**] If it is determined that all the first to N-th indoor units (**120-1**, . . . , **120**-N) are not in halt mode, the refrigerant supply control unit (**250**) determines the temperatures of rooms in which currently operating indoor units are installed (S**312**).

[**0085**] For example, assuming that only the first indoor unit (**120-1**) is in operation mode and the second to N-th indoor units (**120-2**, . . . , **120**-N) are in halt mode, the refrigerant supply control unit (**250**) determines indoor temperature detected by the first indoor temperature detecting unit (**210-1**) provided in the first indoor unit (**120-1**). If it is assumed that the first and second indoor units (**120-1**, **120-2**) are in operation mode and the third to N-th indoor units (**120-3**, . . . , **120**-N) are in halt mode, the refrigerant supply control unit (**250**) determines indoor temperatures detected by the first and second indoor temperature detecting units (**210-1**, **210-2**) that detect the temperatures of rooms with the first and second indoor units (**120-1**, **120-2**) installed therein. If it is assumed that all the first to N-th indoor units (**120-1**, . . . , **120**-N) are in operation mode, the refrigerant supply control unit (**250**) determines all indoor temperatures detected by the first to N-th indoor temperature detecting units (**210-1**, **210**-N) that detect the temperatures of rooms with the first to N-th indoor units installed therein.

[**0086**] If the indoor temperature of the first indoor unit (**120-1**) or the second to N-th indoor units (**120-2**, . . . , **120**-N) that are in operation mode is determined, the refrigerant supply control unit (**250**) excludes the indoor temperature of the first indoor unit (**120-1**) or the second to N-th indoor units (**120-2**, . . . , **120**-N), which are in indoor temperature ignorance mode, among the first indoor unit (**120-1**) and the second to N-th indoor units (**120-2**, . . . , **120**-N) that are in operation mode (S**314**). The refrigerant supply control unit (**250**) decides the operation of the outdoor unit (**100**) at the indoor temperature of the remaining first indoor unit (**120-1**) or second to N-th indoor units (**120-2**, . . . , **120**-N), which are not in indoor temperature ignorance mode (S**316**).

[**0087**] For example, assume that only the first and second indoor units (**120-1**, **120-2**) are in operation mode and the second indoor unit (**120-2**) is in indoor temperature ignorance mode. Then, by using only the indoor temperature detected by the first indoor temperature detecting unit (**210-1**), the refrigerant supply control unit (**250**) determines whether either or both of the two compressors (**103**, **103***a*) of the outdoor unit **100** are operated.

[**0088**] If it is determined that the compressors (**103**, **103***a*) are in operation, the refrigerant supply control unit (**250**) transmits the determined operation of the compressors to the outdoor unit controller (**260**) (S**318**). The outdoor unit controller (**260**) selectively operates the first compressor (**103**) and the second compressor (**103***a*) according to the determined operation of the compressors (**130**, **130***a*) transmitted by the refrigerant supply control unit (**250**).

[**0089**] The refrigerant supply control unit (**250**) selects one by one the first indoor unit (**120-1**) or the second to N-th indoor units (**120-2**, . . . , **120**-N), which are in operation mode and are supplied with the refrigerant (S**320**), and receives the temperature of a supplying pipe and the temperature of a return pipe corresponding to the selected first indoor unit (**120-1**) or second to N-th indoor units (**120-2**, . . . , **120**-N), to calculate a difference between the two temperatures (S**322**).

[**0090**] For example, if the first indoor unit (**120-1**) is in operation mode and is supplied with the refrigerant, the refrigerant supply control unit (**250**) receives the temperature of the supplying pipe detected by the first supplying-pipe temperature detecting unit (**220-1**) using the supplying-pipe temperature sensor (**113-1**) and the temperature of the return pipe detected by the first return-pipe temperature detecting unit (**223-1**) using the return-pipe temperature sensor (**115-1**), to calculate a temperature difference between the supplying pipe and the return pipe.

[**0091**] When the temperature difference is calculated, the refrigerant supply control unit (**250**) compares the calculated temperature difference with a preset temperature difference (S**324**, S**326**).

[**0092**] As a result of the comparison, if a difference between the temperature of the supplying pipe and the temperature of the return pipe is larger than the preset temperature difference, the refrigerant supply control unit (**250**) determines whether the electronic expansion valve (**111-1**) through which the refrigerant is supplied to the first indoor unit (**120-1**) is in a maximum opening state (S**328**). If it is determined that the electronic expansion valve (**111-1**) is in the maximum opening state, the refrigerant supply control unit (**250**) continuously maintains the electronic expansion valve (**111-1**) in the maximum opening state, which is a current state (S**330**). On the contrary, if it is determined that the electronic expansion valve (**111-1**) is not in the maximum opening state, the refrigerant supply control unit (**250**) increases the degree of opening of the electronic expansion valve (**111-1**) according to the temperature difference between the supplying pipe and the return pipe, thereby increasing the amount of the refrigerant supplied to the first indoor unit (S**332**).

[**0093**] In other words, if the temperature difference between the supplying pipe and the restoring pipe is larger than the preset temperature difference, this corresponds to a case where the expansion device is mounted at the first indoor unit (**120-1**) to expand the refrigerant. Accordingly, if the temperature difference between the supplying pipe and the return pipe is larger than the preset temperature difference, the refrigerant supply control unit (**250**) increases the opening of the first electronic expansion valve (**111-1**) to a maximum to prevent the refrigerant from being expanded in the first electronic expansion valve (**111-1**) and to enable a sufficient supply of the refrigerant to the first indoor unit (**120-1**).

[**0094**] As a result of the comparison, if the temperature difference between the supplying pipe and the return pipe is

less than the preset temperature difference, the refrigerant supply control unit (**250**) determines whether the first electronic expansion valve (**111-1**) is in a minimum opening state (S**334**).

[**0095**] If the electronic expansion valve (**111-1**) is the minimum opening state, the refrigerant supply control unit (**250**) keeps the electronic expansion valve (**111-1**) in the minimum opening state, which is a current state (S**336**). On the contrary, if the electronic expansion valve (**111-1**) is not in the minimum opening state, the refrigerant supply control unit (**250**) reduces the degree of opening of the electronic expansion valve (**111-1**) according to the temperature difference between the supplying pipe and the return pipe, thereby reducing the amount of the refrigerant supplied to the first indoor unit (**120-1**) (S**338**).

[**0096**] To be more specific, if the temperature difference between the supplying pipe and the return pipe is less than the preset temperature difference, this corresponds to a case where the expansion device is not disposed at the first indoor unit (**120-1**) and thus cannot expand the refrigerant and the heat exchange is not performed in the evaporator.

[**0097**] Accordingly, if the temperature difference between the supplying pipe and the return pipe is less than the preset temperature difference, the refrigerant supply control unit (**250**) adjusts the first electronic expansion valve (**111-1**) for the first indoor unit (**120-1**) to a minimum opening state so that the refrigerant can be expanded in the first electronic expansion valve (**111-1**) and supplied to the first indoor unit (**120-1**).

[**0098**] As a result of the comparison, if the temperature difference between the supplying pipe and the return pipe is identical with the preset temperature difference, the refrigerant supply control unit (**250**) maintains the current opening/closing state of the first electronic expansion valve (**111-1**) at a current level, thereby maintaining the current amount of the refrigerant supplied to the first indoor unit (**120-1**) (S**340**).

[**0099**] When the adjustment of supply of the refrigerant to one indoor unit that is in operation mode is completed, the refrigerant supply control unit (**250**) selects all the indoor units that are in operation mode and determines whether the adjustment of supply of the refrigerant is completed (S**342**).

[**0100**] If it is determined that the adjustment of supply of the refrigerant to all the operation-moded indoor units is not completed, the refrigerant supply control unit (**250**) returns to step S**302** and selects remaining indoor units, which are in operation mode and are supplied with the refrigerant, one by one. Then, the refrigerant supply control unit calculates a temperature difference between a supplying pipe and a return pipe of the selected indoor unit, compares the calculated temperature difference with a preset temperature difference, and repeatedly performs a process of adjusting the amount of the refrigerant supplied to the corresponding indoor unit according to the comparison results.

[**0101**] If it is determined at step S**342** that the adjustment of supply of the refrigerant to all the operation-moded indoor units is completed, the refrigerant supply control unit (**250**) selects the indoor units, which are in operation mode, one by one (S**344**) and determines whether the refrigerant is currently supplied to the corresponding indoor unit (S**346**).

[**0102**] If it is determined that the refrigerant is currently supplied to the selected indoor unit, the refrigerant supply control unit (**250**) determines whether a predetermined period of time, e.g., 10 minutes, has lapsed after the refrigerant is supplied to the corresponding indoor unit (S**348**). If the predetermined period of time has lapsed after the refrigerant is supplied to the corresponding indoor unit, the refrigerant supply control unit (**250**) determines the temperature of the supplying pipe through which the refrigerant is supplied to the corresponding indoor unit (S**350**). For example, assuming that the operation-moded first indoor unit (**120-1**) is selected, the refrigerant supply control unit (**250**) determines the temperature of the supplying pipe detected by the first supplying-pipe temperature detecting unit (**210-1**).

[**0103**] If the determined temperature of the supplying pipe is not greater than a preset temperature, e.g., 0° C. (S**352**), this means that a relevant indoor unit is operating under an overcooling state. The refrigerant supply control unit (**250**) therefore blocks the refrigerant supplied to the corresponding indoor unit (s**354**). That is, the refrigerant supply control unit (**250**) controls the first electronic expansion valve driving unit (**240-1**) to close the first electronic expansion valve (**111-1**) and prevents the refrigerant from being supplied to the corresponding indoor unit (**120-1**).

[**0104**] Now, an indoor temperature ignorance mode (e.g., in which the first indoor temperature is ignored or excluded, and operation of the compressor is decided based on the remaining indoor temperatures) is set for the first indoor unit (**120-1**) so that the indoor temperature of the first indoor unit (**120-1**) can be excluded from step S**314**. The refrigerant supply control unit decides to operate the compressors (**130**, **130***a*) according to the indoor temperatures of the indoor units that are in operation mode but are not set to the indoor temperature ignorance mode, in step **316**.

[**0105**] If the refrigerant is blocked not to be supplied to the selected first indoor unit (**120-1**) that is in operation mode, the refrigerant supply control unit (**250**) determines whether a predetermined period of time has lapsed after causing the refrigerant not to be supplied to the first indoor unit (**120-1**) (S**358**). For example, the refrigerant supply control unit (**250**) determines whether three minutes, which is an example of a predetermined period of time, has lapsed after blocking the refrigerant not to be supplied to the first indoor unit (**120-1**).

[**0106**] If the predetermined period of time has passed after blocking the refrigerant not to be supplied to the first indoor unit (**120-1**), the refrigerant supply control unit (**250**) causes the refrigerant to be supplied again to the first indoor unit (**120-1**) (S**360**). For example, the refrigerant supply control unit (**250**) controls the first electronic expansion valve driving unit (**240-1**) to open the first electronic expansion valve (**111-1**), thereby causing the refrigerant to be supplied again to the first indoor unit (**120-1**). The refrigerant supply control unit (**250**) releases the indoor temperature ignorance mode set for the first indoor unit (**120-1**) (S**362**) and decides to operate the compressors (**130**, **130***a*) in consideration of the inner temperature of the first indoor unit (**120-1**) in step S**316**.

[**0107**] According to the present invention described above, the refrigerant supply control unit is provided in the refrigerant distributor to decide the operation of the outdoor

unit according to indoor temperatures detected by a plurality of indoor temperature detecting units installed in operational indoor units and the outdoor unit controller controls the operations of the compressors of the outdoor unit according to the decided operation of the outdoor unit.

[0108] The refrigerant supply control unit detects the temperature of a supplying pipe through which the refrigerant is supplied to an indoor unit and the temperature of a return pipe through which the refrigerant is returned from the indoor unit, calculates a temperature difference between the supplying pipe and the return pipe, and adjusts the degree of opening/closing of the electronic expansion valve according to the calculated temperature difference and a preset temperature difference so as to adjust the amount and expansion of the refrigerant supplied to the indoor unit.

[0109] Accordingly, the amount and expansion of the refrigerant in an indoor unit that is not provided with an expansion device (i.e., at least one expansion-less indoor unit) are adjusted in an electronic expansion valve provided in the refrigerant distributor. An electronic expansion valve provided in the refrigerant distributor, for an indoor unit that is provided with the expansion device (i.e., at least one expansion-having indoor unit), is fully opened, so that the expansion device provided in the indoor unit can adjust the amount and expansion of the refrigerant.

[0110] Therefore, according to the present invention, a multi-type air conditioner can be connected to the refrigerant distributor regardless of whether an indoor unit provided with an expansion device or an indoor unit which is not provided with an expansion device is utilized therewith.

[0111] It is further noted that the foregoing examples have been provided merely for the purpose of explanation and are in no way to be construed as limiting of the present invention. While the present invention has been described with reference to a preferred embodiment, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Changes may be made, within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the present invention in its aspects. Although the present invention has been described herein with reference to particular means, materials and embodiments, the present invention is not intended to be limited to the particulars disclosed herein; rather, the present invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.

What is claimed is:

1. An apparatus for controlling a refrigerant distributor in a multi-type air conditioner having a plurality of supply and return pipes, said apparatus comprising:

a plurality of electronic expansion valves that supply a refrigerant introduced from an outdoor unit to a plurality of indoor units;

a plurality of supply-pipe temperature detectors that detect the temperature of the refrigerant supplied from the electronic expansion valves to the indoor units;

a plurality of returnreturn-pipe temperature detectors that detect the temperature of the refrigerant returned from the indoor units to the outdoor unit; and

a refrigerant supply controller that adjusts a degree of opening/closing of the electronic expansion valves according to the temperature of the refrigerant detected by the supply-pipe temperature detectors and the temperature of the refrigerant detected by the returnreturn-pipe temperature detectors.

2. The apparatus according to claim 1, further comprising:

a plurality of indoor temperature detectors, having sensors provided in the indoor units, that detect temperature; and

an outdoor unit controller, provided in the outdoor unit, that controls an operation of the outdoor unit,

wherein the refrigerant supply controller decides to operate the outdoor unit according to an indoor temperature detected by each of the indoor temperature detectors, and

wherein the outdoor unit controller controls the outdoor unit such that the outdoor unit is operated in accordance to a decided operation of the outdoor unit.

3. The apparatus as claimed in claim 2, wherein the operation of the outdoor unit comprises an operation of at least one compressor provided in the outdoor unit.

4. The apparatus as claimed in claim 1, further comprising:

a plurality of electronic expansion valve drivers that control the degrees of opening/closing of the electronic expansion valves controlled by the refrigerant supply controller, the electronic expansion valve drivers being provided between the refrigerant supply controller and the electronic expansion valves, respectively.

5. The apparatus according to claim 1, further comprising:

a calculator that calculates a temperature difference between the temperature of the refrigerant detected by the supply-pipe temperature detectors and the temperature of the refrigerant detected by the return-pipe temperature detectors.

6. The apparatus according to claim 5, wherein the calculator is provided in the refrigerant supply controller, and compares the calculated temperature difference with a preset temperature difference, and

wherein the degree of opening/closing of the electronic expansion valve is adjusted according to a result of the comparison.

7. The apparatus according to claim 3, wherein the at least one compressor comprises a plurality of compressors having different compression capacities.

8. The apparatus according to claim 3, wherein the at least one compressor comprises a plurality of compressors having the same compression capacity.

9. The apparatus according to claim 1, wherein, when the plurality of indoor units comprises at least one expansion device-less indoor unit lacking an expansion device, and at least one expansion device-having indoor unit that is provided with an expansion device; and

the amount and expansion of the refrigerant in the at least one indoor unit lacking an expansion device is adjusted by a corresponding electronic expansion valve provided in the refrigerant distributor, and wherein an electronic expansion valve in the refrigerant distributor corresponding to the indoor unit having an expansion

device is fully opened such that the expansion device, provided in the indoor unit, adjusts the amount and expansion of the refrigerant.

**10**. A method for controlling a refrigerant distributor in a multi-type air conditioner, comprising:

providing a refrigerant supply controller that determines a first temperature of a refrigerant supplied to at least one indoor unit in operation, and a second temperature of a refrigerant that is returned to an outdoor unit; and

calculating a supply/return temperature difference between the determined first and second temperatures, and adjusting a degree of opening/closing of an electronic expansion valve, through which the refrigerant is supplied to a corresponding indoor unit, on the basis of the calculated supply/return temperature difference.

**11**. The method as claimed in claim 10, wherein adjusting the degree of opening/closing of the electronic expansion valve comprises:

comparing the supply/return temperature difference with a preset temperature difference; and

increasing the degree of opening of the electronic expansion valve when the supply/return temperature difference is larger than the preset temperature difference, and reducing the degree of opening of the electronic expansion valve when the supply/return temperature difference is smaller than the preset temperature difference.

**12**. The method as claimed in claim 10, wherein, in increasing the degree of opening of the electronic expansion valve, a maximum opening state is maintained when the degree of opening of the electronic expansion valve is at a maximum value.

**13**. The method as claimed in claim 10, wherein, in reducing the degree of opening of the electronic expansion valve, a minimum opening state is maintained when the degree of opening of the electronic expansion valve is at a minimum value.

**14**. The method as claimed in claim 10, further comprising:

maintaining a current degree of opening/closing of the electronic expansion valve when the supply/return temperature difference is identical to the preset temperature difference.

**15**. The method as claimed in claim 10, further comprising:

determining, by the refrigerant supply controller, an operation to operate the outdoor unit; and

operating the outdoor unit according to the determined operation.

**16**. The method as claimed in claim 15, wherein determining an operation to operate the outdoor unit comprises:

determining, by the refrigerant supply controller, the temperature of a room in which at least one indoor unit, which is in an operation mode, is installed; and

deciding to operate the outdoor unit on the basis of a determined indoor temperature.

**17**. The method as claimed in claim 10, further comprising:

blocking the refrigerant supplied to the corresponding indoor unit by closing the corresponding electronic expansion valve if the temperature of the supplied refrigerant is below a preset temperature; and

after blocking the refrigerant, supplying the refrigerant to the corresponding indoor unit by opening the corresponding electronic expansion valve if a predetermined period of time has elapsed.

**18**. The method as claimed in claim 17, wherein, after the refrigerant is supplied through the electronic expansion valve and the predetermined period of time has elapsed, closing of the electronic expansion valve is performed when the temperature of a supplying pipe is below a preset temperature.

**19**. The method according to claim 10, further comprising:

transmitting, by the supply controller, a determined operation status of an outdoor unit to an outdoor unit controller, such that the outdoor unit controller selectively operates either one of a first compressor, a second compressor, or both the first and second compressors.

**20**. The method according to claim 19, further comprising:

providing the first and second compressors to have different compression capacities.

**21**. The method according to claim 19, further comprising:

providing the first and second compressors to have the same compression capacity.

**22**. The method according to claim 10, further comprising:

providing the plurality of indoor units with at least one expansion device-less indoor unit that lacks an expansion device, and at least one expansion device-having indoor unit that is provided with an expansion device;

adjusting the amount and expansion of the refrigerant in the at least one indoor unit that lacks an expansion device, by operating a corresponding electronic expansion valve provided in the refrigerant distributor; and

fully opening an electronic expansion valve, corresponding to the indoor unit having an expansion device, such that the expansion device provided in the expansion device-having indoor unit adjusts the amount and expansion of the refrigerant.

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