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(54) **Multi-unit air conditioner and method for controlling the same**

Mehrzonenklimaanlage und Verfahren zur Steuerung derselben

Conditionneur d'air comprenant plusieurs unités et procédé de commande de celui-ci

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Description

[0001] The present invention relates to an air conditioning system comprising an outdoor unit, a plurality of indoor units, a refrigerant circuit including control valves, an outdoor air temperature sensor and control means configured to control the control valves such that the refrigerant circuit operates in a mainly cooling or a mainly heating operation mode dependent on the current operational heating and cooling capacities of the indoor units and the output of said temperature sensor.

[0002] The present invention also relates to a method of controlling an air conditioning system comprising an outdoor unit, a plurality of indoor units, a refrigerant circuit including control valves and an outdoor air temperature sensor, the method comprising the steps of controlling the control valves such that the refrigerant circuit operates in a mainly cooling or a mainly heating operation mode in dependence on the current operational heating and cooling capacities of the indoor units and the output of said temperature sensor.

[0003] Such an air conditioning system and method of operating an air conditioning system in known from EP 1 437 558 A1. An air conditioning system and method for controlling the same is also known from EP 1 371 914 A1.

[0004] Generally, a multi air conditioner system comprises an outdoor unit, a plurality of indoor units connected in parallel to the outdoor unit, a branch unit having a plurality of high-pressure and low-pressure gas valves to control the flow rate of refrigerant, introduced into the indoor units, and high-pressure and low-pressure gas pipes connected between the outdoor unit and valves of the branch unit. An example of such an air conditioner system is disclosed in JP-A-1 993-099525.

[0005] The conventional multi air conditioner system is capable of performing a cooling operation, a heating operation, a mainly cooling operation and a mainly heating operation based on a heating ratio (or a cooling ratio). As shown in Figure 1, the cooling operation is performed when the heating ratio is 0 % (i.e., when the indoor unit (s) in operation are operated in cooling mode), the heating operation is performed when the heating ratio is 100 % (i.e., when the indoor unit(s) in operation are operated in heating mode), the mainly cooling operation is performed when the heating ratio is greater than 0 % and less than 50 % (i.e., when the total capacity of the indoor unit(s) in cooling operation is greater than the total capacity of the indoor unit(s) in heating operation), and mainly heating operation is performed when the heating ratio is greater than or equal to 50 % and less than 100 % (i.e., when the total capacity of the indoor unit(s) in cooling operation are less than or equal to the total capacity of the indoor unit(s) in heating operation). The heating ratio means the ratio of the capability of indoor unit(s) performing the heating operation to the total capability of the indoor unit(s) in operation.

[0006] When the multi air conditioner system is operated in the mainly heating mode or the mainly cooling mode, the high-pressure gas valve(s), connected to the indoor unit(s) in heating operation, are opened and the low-pressure gas valve(s), connected to the indoor unit (s) in heating operation, are closed. Also, the high-pressure gas valve(s) connected to the indoor unit(s) where the cooling operation is set are closed, and the low-pressure gas valve(s) connected to the indoor unit(s) where the cooling operation is set are opened. As a result, high-temperature gas refrigerant is introduced into the indoor unit(s) for heating operation and low-temperature gas refrigerant is introduced into the indoor unit(s) for cooling operation, so that cooling and heating operations can be performed concurrently by different indoor units.

[0007] In the conventional multi air conditioner system, describe above, however, the mainly cooling or heating operation is identified on the basis of the heating ratio and, therefore, mainly heating or cooling operation modes may be set inappropriately some cases.

[0008] When the heating ratio is 53 %, for example, mainly heating operation is performed irrespective of outdoor temperature. If the outdoor temperature is high at this time, the temperature of an outdoor heat exchanger of the outdoor unit is high and, therefore, the pressure of the outdoor heat exchanger is relatively high. Consequently, the temperature of the indoor heat exchangers of the indoor units, connected to the outdoor heat exchanger through a four-way valve, is increased and, therefore, the cooling efficiency of the indoor units performing cooling operation is reduced.

[0009] Since the temperature of the outdoor heat exchanger is high, the discharge pressure of the system's compressor is also increased. For this reason, the compression capacity of the compressor must be reduced to protect the compressor. If the compression capacity of the compressor is reduced, however, the heating efficiency of the indoor units performing heating operation as well as the cooling efficiency of the indoor units performing the cooling operation is reduced.

[0010] When the total capacity of the indoor units in cooling operation is less than or equal to approximately 20 % of the total capacity of the indoor units and the heating ratio is 40 %, for example, the mainly cooling operation is performed. If the interior temperature of a room being cooled is decreased, the temperature of the indoor heat exchanger of the indoor unit performing the cooling operation is also decreased. As a result, the indoor heat exchanger of the indoor unit performing the cooling operation becomes frozen. The compression capacity of the compressor must be reduced in order to prevent the indoor heat exchanger of the indoor unit performing the cooling operation from being frozen and, therefore, the heating and cooling efficiencies of the respective indoor units are lowered. In the above case, the capabilities of the outdoor heat exchanger and the indoor units in heating operation are greater than the capability of the indoor units in cooling operation.

As a result, it is difficult to form high pressure at the outlet side of the compressor and, therefore, the heating efficiency of the indoor unit(s) performing the heating operation is also lowered.

[0011] An air conditioning system, according to the present invention, is **characterised in that** the control means is configured to set a mode changeover reference, corresponding to a ratio of operational heating or cooling capacity to operational heating and cooling capacity, in dependence on the output of said temperature sensor, and set the operation mode in dependence on a comparison between the current operational heating or cooling capacities and the mode changeover reference.

[0012] Preferably, the mode changeover reference is set such that changeover occurs at a reduced ratio of current heating operation capacity to current heating and cooling operation capacity when the temperature sensed by said temperature sensor is below a predetermined reference temperature.

[0013] A method of controlling an air conditioning system according to the present invention is characterised by the steps of setting a mode changeover reference, which corresponds to a ratio of the operational heating or cooling capacity to operational heating and cooling capacities of the indoor units, in dependence on the output of said temperature sensor, and setting the operation mode in dependence on a comparison between the current operational heating or cooling capacities and the mode changeover reference.

[0014] Advantageously, the method further comprises the steps of setting the mode changeover reference to a first reference value when the temperature sensed by the outdoor air temperature sensor is higher than or equal to a reference temperature, and setting the mode changeover reference to a second reference value, which is less than the first reference value, when the outdoor temperature is lower than said reference temperature.

[0015] An embodiment of the present invention will now be described, by way of example, with reference to Figures 2 to 7 of the accompanying drawings, in which:

Figure 1 illustrates the combined heating and cooling operation modes of a conventional multi air conditioner system;

Figure 2 is a refrigerant circuit diagram of a multi air conditioner system according to the present invention;

Figure 3 is a block diagram showing the construction of the multi air conditioner system shown in Figure 2;

Figure 4 illustrates a combined heating and cooling operations modes of a first embodiment of the present invention;

Figure 5 is a flowchart illustrating the simultaneous cooling and heating operation of the first embodiment of the present invention;

Figure 6 illustrates combined heating and cooling operations modes of a second embodiment of the present invention; and

Figure 7 is a flowchart illustrating the simultaneous cooling and heating operation of the second embodiment of the present invention.

[0016] Referring to Figure 2, a multi air conditioner system comprises: an outdoor unit 10, first to fourth indoor units 20a, 20b, 20c, 20d, connected in parallel to the outdoor unit 10, and a mode switching unit 30 for switching the indoor units 20a, 20b, 20c, 20d between their heating and cooling modes.

[0017] The outdoor unit 10 comprises a four way valve 12 to control the flow direction of refrigerant discharged from a compressor 11, an outdoor heat exchanger 13 to perform heat exchange with outdoor air introduced into the outdoor unit 10, an outdoor motor-operated valve 14 to expand the refrigerant and a receiver tank 15 and an accumulator 16 for separating gaseous refrigerant and liquid refrigerant from each other. The indoor units 20a, 20b, 20c, 20d are connected to the outdoor unit 10 by a high-pressure gas pipe 17, a low-pressure gas pipe 18 and a high-pressure liquid pipe 19, through which refrigerant is supplied from the outdoor unit 10 to the indoor units 20a, 20b, 20c, 20d.

[0018] The low-pressure gas pipe 18 is connected to the inlet of the compressor 11 of the outdoor unit 10, the outdoor motor-operated valve 14 is connected in series with the outdoor heat exchanger 13 and the high-pressure liquid pipe 19 is connected to the outdoor motor-operated valve 14 via the receiver tank 15. To the outdoor motor-operated valve 14 are connected, in parallel, a bypass valve 41 a serving as a flow rate control valve and a non-return valve 41 b so that liquid refrigerant discharged from the outdoor heat exchanger 13 passes through the bypass valve 41 a and the non-return valve 41b during a cooling operation, and refrigerant passes through the outdoor motor-operated valve 14 when the bypass valve 41a is closed during a heating operation.

[0019] Between the four-way valve 12 and the high-pressure liquid pipe 19 is disposed a high-pressure branch pipe 42, which braches off from the high-pressure gas pipe 17. On the high-pressure branch pipe 42 are mounted a high-pressure branch pipe electromagnetic valve 43a, serving as an on/off valve, and a non-return valve 43b to prevent refrigerant back-flow from the high-pressure gas pipe 17. Between the four-way valve 12 and the high-pressure gas pipe 17 is mounted another non-return valve 44 to prevent refrigerant backflow. On the high-pressure liquid pipe 19 are mounted switching unit pipe electromagnetic valves 24a, 24b to control the flow rate of refrigerant flowing from the mode switching unit 30 to the high-pressure liquid pipe 19.

[0020] The first to fourth indoor units 20a, 20b, 20c, 20d comprise first to fourth indoor heat exchangers 21 a, 21 b, 21c, 21d, first to fourth indoor motor-operated valves 22a, 22b, 22c, 22d connected in series with respective ones of the first to fourth indoor heat exchangers 21a, 21 b, 21c, 21d and first to fourth temperature sensors 37a, 37b, 37c, 37d mounted between respective indoor units 20a, 20b, 20c, 20d and the mode switching unit 30.

[0021] The mode switching unit 30 comprises first to fourth heating valves 31a, 31 b, 31c, 31d mounted on first to fourth high-pressure gas branch pipes 33a, 33b, 33c, 33d, which branch off from the high-pressure gas pipe 17 and first to fourth cooling valves 32a, 32b, 32c, 32d mounted on first to fourth low-pressure gas branch pipes 34a, 34b, 34c, 34d, which branch off from the low-pressure gas pipe 18. The first heating and cooling valve set is connected to a first refrigerant pipe 35a, which is connected to the first indoor heat exchanger 20a. Similarly, the second to fourth heating and cooling valve sets are connected to second to fourth refrigerant pipes 35b, 35c, 35d respectively.

[0022] When the mainly cooling operation of the multi air conditioner system is performed, a first port 12a of the four-way valve 12 communicates with a second port 12b of the four-way valve 12 and a third port 12c of the four-way valve 12 communicates with a fourth port 12d of the four-way valve 12. At the same time, the high-pressure branch pipe electromagnetic valve 43a of the high-pressure branch pipe 42 is opened. Also, heating valves of the mode switching unit 30, connected to indoor units in cooling operation, are closed and cooling valves of the mode switching unit 30, connected to indoor units in cooling operation, are open. Conversely, heating valves of the mode switching unit 30, connected to indoor units in cooling operation, are open and cooling valves of the mode switching unit 30, connected to the indoor units in cooling operation, are closed.

[0023] As a result, some of the refrigerant discharged from the compressor 11, condensed by the outdoor heat exchanger 13, is supplied to indoor units in cooling operation through the high-pressure liquid pipe 19 and is then evaporated by indoor heat exchangers to cool rooms. The refrigerant heat-exchanged by indoor heat exchangers, which is low-pressure gas refrigerant, flows to the inlet of the compressor 11 through cooling valves of the mode switching unit 30 and the low-pressure gas pipe 18.

[0024] Some of the refrigerant, discharged from the compressor 11 and passing through the four-way valve 12, is supplied to indoor units in heating operation through the high-pressure branch pipe 42, the high-pressure gas pipe 17, and heating valves of the mode switching unit 30, and is then condensed by indoor heat exchangers to heat rooms. The refrigerant, having passed through indoor heat exchangers, is supplied to the high-pressure liquid pipe 19, at which the refrigerant joins refrigerant supplied to the indoor units in cooling operation cool rooms, and then flows to the compressor 11 through the low-pressure gas pipe 18.

[0025] When mainly heating operation is performed, the first port 12a of the four-way valve 12 communicates with the third port 12c of the four-way valve 12 and the second port 12b of the four-way valve 12 communicates with the fourth port 12d of the four-way valve 12. At the same time, the high-pressure branch pipe electromagnetic valve 43a of the high-pressure branch pipe 42 is closed. Also, heating valves of the mode switching unit 30, connected to indoor units in heating operation, are opened and cooling valves of the mode switching unit 30, connected to indoor units in cooling operation are closed. Conversely, heating valves of the mode switching unit 30, connected to indoor units in cooling operation, are closed and cooling valves of the mode switching unit 30, connected to the indoor units in cooling operation, are opened.

[0026] As a result, the refrigerant discharged from the compressor 11 is supplied to indoor heat exchangers of indoor units in heating operation through the high-pressure gas pipe 17, is condensed by the indoor heat exchangers to heat rooms and is then delivered to the high-pressure liquid pipe 19 through expansion valves. Some of the refrigerant, delivered to the high-pressure liquid pipe 19, is supplied to indoor units in cooling operation, is evaporated by the indoor heat exchangers to cool rooms, and then flows to the inlet of the compressor 11 through the low-pressure gas pipe 18 and the accumulator 16.

[0027] The remainder of the refrigerant, delivered to the high-pressure liquid pipe 19, is returned to the outdoor unit 10. Specifically, the refrigerant is supplied to the outdoor heat exchanger 13 through the receiver tank 15 and the outdoor motor-operated valve 14, is evaporated by the outdoor heat exchanger 13 and then flows to the compressor 11 through the third and fourth ports 12c and 12d of the four-way valve 12 and the accumulator 16.

[0028] As shown in Figure 3, the outdoor unit 10 further comprises: an outdoor unit microcomputer 23 to control the components of the outdoor unit 10 and an outdoor temperature sensor 25 to measure the temperature of outdoor air.

[0029] The first to fourth indoor units 20a, 20b, 20c, 20d further comprise first to fourth indoor unit microcomputers 36a, 36b, 36c, 36d to control the components of respective indoor units.

[0030] The mode switching unit 30 further comprises a mode switching unit microcomputer 38 to control the first to fourth cooling valves 32a, 32b, 32c, 32d and the first to fourth heating valves 31a, 31b, 31c, 31d.

[0031] Now, a simultaneous cooling and heating operation controlling method of the multi air conditioner system of a first embodiment of the present invention will be described with reference to Figures 4 and 5.

[0032] First, the outdoor temperature is measured by the outdoor temperature sensor 25 to determine the outdoor temperature as well as the heating ratio when deciding the combined (i.e. mainly heating or mainly cooling) operation mode (50) and then the sum of the capacities of the indoor units in cooling operation and the sum of the capacities of the indoor units in heating operation are obtained to calculate the heating ratio (52).

[0033] Subsequently, it is determined whether the outdoor temperature is higher than or equal to a first reference temperature (54). The first reference temperature is preferably set to a minimum outdoor temperature, where the temperature of the outdoor heat exchanger 13 is raised in mainly heating mode reducing the cooling and heating efficiencies of the entire system. In the illustrated embodiment, the first reference temperature is 15 °C as shown in Figure 4, although the first reference temperature may be different in different systems.

[0034] If the outdoor temperature is lower than the first reference temperature, it is determined whether the heating ratio is less than or equal to a second reference value (64). If the heating ratio is less than or equal to the second reference value, the system operates in mainly cooling mode (66) and, if the heating ratio is greater than the second reference value, the system operates in mainly heating mode (68). Preferably, the second reference value is set to 50 % as shown in Figure 4, although the second reference value may be different for different systems.

[0035] If the outdoor temperature is higher than or equal to the first reference temperature in Operation 54, it is determined whether the heating ratio is less than or equal to a first reference value (56). The first reference value is preferably set to above the second reference value. As shown in Figure 4, the first reference value is 55 %. If the heating ratio is less than or equal to the first reference value, the system operates in mainly cooling mode (58) and, if the heating ratio is greater than the first reference value, the system operates in mainly heating mode (62).

[0036] When the outdoor temperature is higher than or equal to the first reference temperature as described above, the heating ratio reference value, which is a critical factor in deciding which combined operation mode to use, is set to high and, therefore, the system operates in mainly cooling mode for a portion of the heating ratio at which the system operates in mainly heating mode (when the heating ratio is 50 to 55 % in Figure 4) in the prior art. Consequently, the system operates in mainly heating mode, when the outdoor temperature is high, to prevent the cooling and heating efficiencies of the multi air conditioner system from being reduced.

[0037] If the capacities of indoor units in heating operation or the capacities of the indoor units in cooling operation are changed, while after the combined operation mode has been decided upon, Operation 50 is performed to reset the combined operation mode (60).

[0038] In the illustrated embodiment, the combined operation mode is decided upon using two different reference values according to the outdoor temperature, although the outdoor temperature may be divided to set reference values based on the divided outdoor temperature. In this case, the reference values are preferably predetermined and stored in the microcomputer.

[0039] A simultaneous cooling and heating operation controlling method of the multi air conditioner system of a second embodiment of the present invention will be described hereinafter with reference to Figures 6 and 7.

[0040] First, the outdoor temperature is measured by the outdoor temperature sensor 25 and the indoor temperatures are measured by the first to fourth temperature sensors 37a, 37b, 37c, 37d of the indoor units 20a, 20b, 20c, 20d to set the combined operation mode (70) and then the sum of capacities of the indoor units in cooling operation and the sum of capacities of the indoor units in heating operation are obtained to calculate the heating ratio (72).

[0041] Subsequently, it is determined whether the required cooling capacity is less than or equal to 20 % of the total capacity of the indoor units (74). The required cooling capacity is the sum of capacities of the indoor units in cooling operation. If the required cooling capacity is greater than 20 % of the total capacity of the indoor units, Operation 54 of Figure 5 is performed. If the required cooling capacity is less than or equal to 20 % of the total capacity of the indoor units, on the other hand, it is determined whether the temperatures of the rooms, in which the indoor units are in cooling operation, are lower than or equal to a second reference temperature (76). The second reference temperature is the maximum temperature at which the heat exchangers of the indoor units in the cooling operation may be frozen in the mainly cooling mode.

[0042] If the temperatures of the rooms, in which the indoor units are in cooling operation, are higher than the second reference temperature, Operation 54 of Figure 5 is performed. If the temperatures of the rooms, in which the indoor units are in cooling operation, are lower than or equal to a second reference temperature, it is determined whether the heating ratio is greater than or equal to a third reference value (78). The third reference value is set at a heating ratio of below 50 % as shown in Figure 6. In the illustrated embodiment, the third reference value is 30 %. Consequently, mainly heating mode is used instead of mainly cooling mode in a range where the prior art employs mainly cooling mode (i.e. 30 to 50 %) to prevent the performance of the system from being lowered due to control to prevent the indoor units from being frozen.

[0043] If the capacity of the indoor units in heating operation or the capacity of the indoor units in cooling operation are changed while the system is operating in mainly heating mode, Operation 70 is performed. If the conditions of Operations 74, 76 and 78 are not satisfied, Operation 54 of Figure 5 is performed, although the main operation mode may be set according to the conventional method as shown in Figure 1 (i.e. only based on the heating ratio).

[0044] In the first and second embodiments, the combined operation modes of the multi air conditioner system is decided upon considering both the heating ratio and other conditions, although the combined operation mode of the multi air conditioner system may be decided considering both cooling ratio and other conditions.

[0045] As apparent from the above description, the main operation mode may be decided considering the outdoor temperature as well as the heating ratio (or the cooling ratio) in combined heating and cooling operation. Consequently, the present invention can have the effect of preventing the combined operation mode from being improperly set at the specific range of the heating ratio and, therefore, preventing performance of the system from being deteriorated.

[0046] Furthermore, when the capacity of the indoor units in cooling operation is less than or equal to the reference ratio of the total capacities of the indoor units and the temperatures of the room where the cooling operation is performed is lower than or equal to the reference temperature, the relatively small heating ratio reference value is set to determine the combined operation mode. Consequently, the present invention can have the effect of preventing the combined operation mode from being improperly set at a specific range of the heating ratio and, therefore, preventing the performance of the system from being deteriorated.

[0047] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from, the scope of the invention which is defined in the appended claims.

Claims

1. An air conditioning system comprising an outdoor unit (10), a plurality of indoor units (20a,20b,20c, 20d), a refrigerant circuit including control valves (12,31 a,31 b,31 c,31 d,32a,32b,32c,32d), an outdoor air temperature sensor (25) and control means (23) configured to control the control valves such that the refrigerant circuit operates in a mainly cooling or a mainly heating operation mode dependent on the current operational heating and cooling capacities of the indoor units (20a,20b,20c,20d) and the output of said temperature sensor (25) **characterised in that** the control means (23) is configured to set a mode changeover reference, corresponding to a ratio of operational heating or cooling capacity to operational heating and cooling capacity, in dependence on the output of said temperature sensor (25), and set the operation mode in dependence on a comparison between the current operational heating or cooling capacities and the mode changeover reference.

2. A system according to claim 1, wherein the mode changeover reference is set such that changeover occurs at a reduced ratio of current heating operation capacity to current heating and cooling operation capacity when the temperature sensed by said temperature sensor (25) is below a predetermined reference temperature.

3. A method of controlling an air conditioning system comprising an outdoor unit (10), a plurality of indoor units (20a,20b,20c,20d), a refrigerant circuit including control valves (12,31a,31b,31c,31d,32a,32b, 32c,32d) and an outdoor air temperature sensor (25), the method comprising the steps of controlling the control valves such that the refrigerant circuit operates in a mainly cooling or a mainly heating operation mode in dependence on the current operational heating and cooling capacities of the indoor units (20a,20b,20c,20d) and the output of said temperature sensor (25) and **characterised by** the steps of setting a mode changeover reference, which corresponds to a ratio of the operational heating or cooling capacity to operational heating and cooling capacities of the indoor units (20a,20b,20c,20d), in dependence on the output of said temperature sensor (25), and setting the operation mode in dependence on a comparison between the current operational heating or cooling capacities and the mode changeover reference.

4. The method according to claim 3, further comprising the steps of setting the mode changeover reference to a first reference value when the temperature sensed by the outdoor air temperature sensor (25) is higher than or equal to a reference temperature, and setting the mode changeover reference to a second reference value, which is less than the first reference value, when the outdoor temperature is lower than said reference temperature.

Patentansprüche

1. Klimaanlage, die Folgendes umfasst: eine Außeneinheit (10), mehrere Inneneinheiten (20a, 20b, 20c, 20d), einen Kühlmittelkreislauf mit Steuerventilen (12, 31a, 31b, 31c, 31d, 32a, 32b, 32c, 32d), einen Außenlufttemperatursensor (25) und Steuermittel (23) zum Steuern der Steuerventile, so dass der Kühlmittelkreislauf in Abhängigkeit von den aktuellen Heiz- und Kühlbetriebskapazitäten der Inneneinheiten (20a, 20b, 20c, 20d) und dem Ausgang des genannten Temperatursensors (25) hauptsächlich in der Kühloder hauptsächlich in der Heizbetriebsart arbeitet, **dadurch gekennzeichnet, dass** das Steuermittel (23) zum Einstellen einer Betriebsartwechselreferenz konfiguriert ist, die einem Verhältnis zwischen Heiz- oder Kühlbetriebskapazität und Heiz- und Kühlbetriebskapazität entspricht, in Abhängigkeit vom Ausgang des genannten Temperatursensors (25), und zum Einstellen der Betriebsart in Abhängigkeit von einem Vergleich zwischen den aktuellen Heiz- oder Kühlbetriebskapazitäten und der Betriebsartwechselreferenz.

2. Anlage nach Anspruch 1, wobei die Betriebsartwechselreferenz so eingestellt wird, dass der Wech-

sel bei einem reduzierten Verhältnis zwischen aktueller Heizbetriebskapazität und aktueller Heiz- und Kühlbetriebskapazität erfolgt, wenn die von dem genannten Temperatursensor (25) erfasste Temperatur unter einer vorbestimmten Referenztemperatur liegt.

3. Verfahren zum Steuern einer Klimaanlage, die Folgendes umfasst: eine Außeneinheit (10), mehrere Inneneinheiten (20a, 20b, 20c, 20d), einen Kühlmittelkreislauf mit Steuerventilen (12, 31a, 31b, 31c, 31d, 32a, 32b, 32c, 32d) und einen Außenlufttemperatursensor (25), wobei das Verfahren die Schritte des Steuerns der Steuerventile beinhaltet, so dass der Kühlmittelkreislauf je nach den aktuellen Heiz- und Kühlbetriebskapazitäten der Inneneinheiten (20a, 20b, 20c, 20d) und dem Ausgang des genannten Temperatursensors (25) hauptsächlich in der Kühloder hauptsächlich in der Heizbetriebsart arbeitet, und **gekennzeichnet durch** die Schritte des Einstellens einer Betriebsartwechselreferenz, die einem Verhältnis zwischen Heiz- oder Kühlbetriebskapazität und Heiz- und Kühlbetriebskapazität der Inneneinheiten (20a, 20b, 20c, 20d) entspricht, in Abhängigkeit vom Ausgang des genannten Temperatursensors (25), und des Einstellens der Betriebsart in Abhängigkeit von einem Vergleich zwischen den aktuellen Heiz- oder Kühlbetriebskapazitäten und der Betriebsartwechselreferenz.

4. Verfahren nach Anspruch 3, das ferner die Schritte des Einstellens der Betriebsartwechselreferenz auf einen ersten Referenzwert, wenn die vom Außenlufttemperatursensor (25) erfasste Temperatur gleich oder höher als eine Referenztemperatur ist, und des Einstellens der Betriebsartwechselreferenz auf einen zweiten Referenzwert beinhaltet, der kleiner ist als der erste Referenzwert, wenn die Außentemperatur niedriger ist als die genannte Referenztemperatur.

Revendications

1. Système de conditionnement de l'air comprenant une unité extérieure (10), une pluralité d'unités intérieures (20a, 20b, 20c, 20d), un circuit de frigorigène comprenant des vannes de commande (12, 31a, 31b, 31c, 31d, 32a, 32b, 32c, 32d), un capteur de température d'air extérieur (25) et un moyen de commande (23) configuré pour commander les vannes de commande de telle sorte que le circuit de frigorigène fonctionne dans un mode principalement de refroidissement ou principalement de chauffage selon les capacités opérationnelles de chauffage et de refroidissement actuelles des unités intérieures (20a, 20b, 20c, 20d) et la sortie dudit capteur de température (25), **caractérisé en ce que** le moyen de commande (23) est configuré pour fixer une référence de changement de mode, correspondant à un rapport de la capacité opérationnelle de chauffage ou de refroidissement à la capacité opérationnelle de chauffage et de refroidissement, en fonction de la sortie dudit capteur de température (25), et pour fixer le mode de fonctionnement en fonction d'une comparaison entre les capacités opérationnelles actuelles de chauffage ou de refroidissement et la référence de changement de mode.

2. Système selon la revendication 1, dans lequel la référence de changement de mode est fixée de telle sorte que le changement intervient à un rapport réduit de la capacité opérationnelle de chauffage actuelle à la capacité opérationnelle de chauffage et de refroidissement actuelle lorsque la température détectée par ledit capteur de température (25) est inférieure à une température de référence prédéterminée.

3. Procédé de régulation d'un système de conditionnement de l'air comprenant une unité extérieure (10), une pluralité d'unités intérieures (20a, 20b, 20c, 20d), un circuit de frigorigène comprenant des vannes de commande (12, 31a, 31b, 31c, 31d, 32a, 32b, 32c, 32d) et un capteur de température d'air extérieur (25), le procédé comprenant les étapes consistant à commander les vannes de commande de telle sorte le circuit de frigorigène fonctionne dans un mode de fonctionnement principalement de refroidissement ou principalement de chauffage selon les capacités opérationnelles de chauffage et de refroidissement actuelles des unités intérieures (20a, 20b, 20c, 20d) et la sortie dudit capteur de température (25) et **caractérisé en ce que** les étapes consistant à fixer une référence de changement de mode, correspondant à un rapport de la capacité opérationnelle de chauffage ou de refroidissement aux capacités opérationnelles de chauffage et de refroidissement des unités intérieures (20a, 20b, 20c, 20d), en fonction de la sortie dudit capteur de température (25), et à fixer le mode de fonctionnement en fonction d'une comparaison entre les capacités opérationnelles actuelles de chauffage ou de refroidissement et la référence de changement de mode.

4. Procédé selon la revendication 3, comprenant en outre les étapes consistant à fixer la référence de changement de mode à une première valeur de référence lorsque la température détectée par le capteur de température d'air extérieure (25) est supérieure ou égale à une température de référence, et à fixer la référence de changement de mode à une deuxième valeur de référence, qui est inférieure à la première valeur de référence, lorsque la température extérieure est inférieure à ladite température de référence.

Fig 1

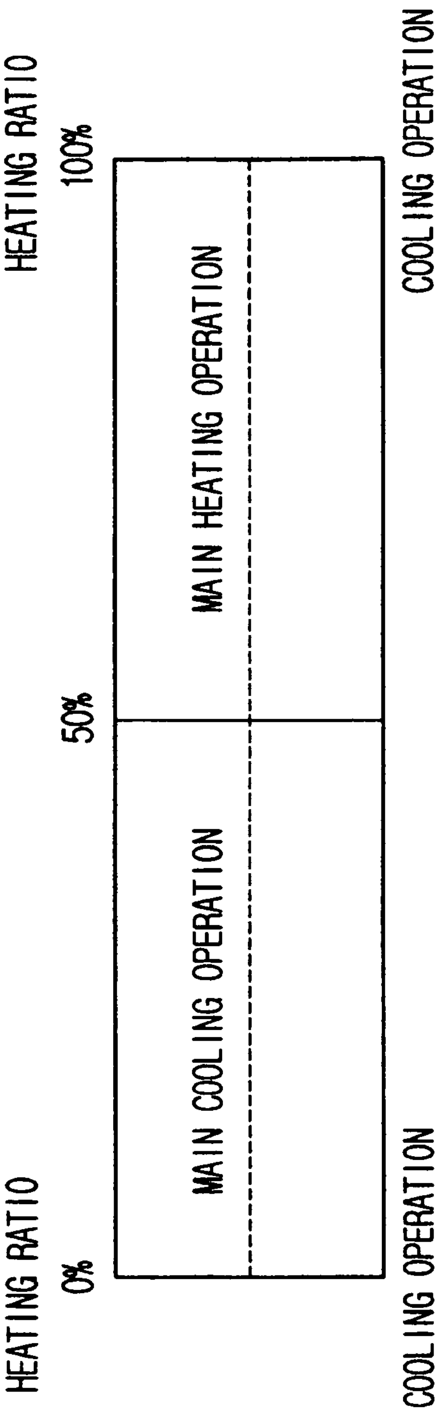

HEATING RATIO
100%
COOLING OPERATION
MAIN HEATING OPERATION
50%
MAIN COOLING OPERATION
HEATING RATIO
0%
COOLING OPERATION

Fig 2

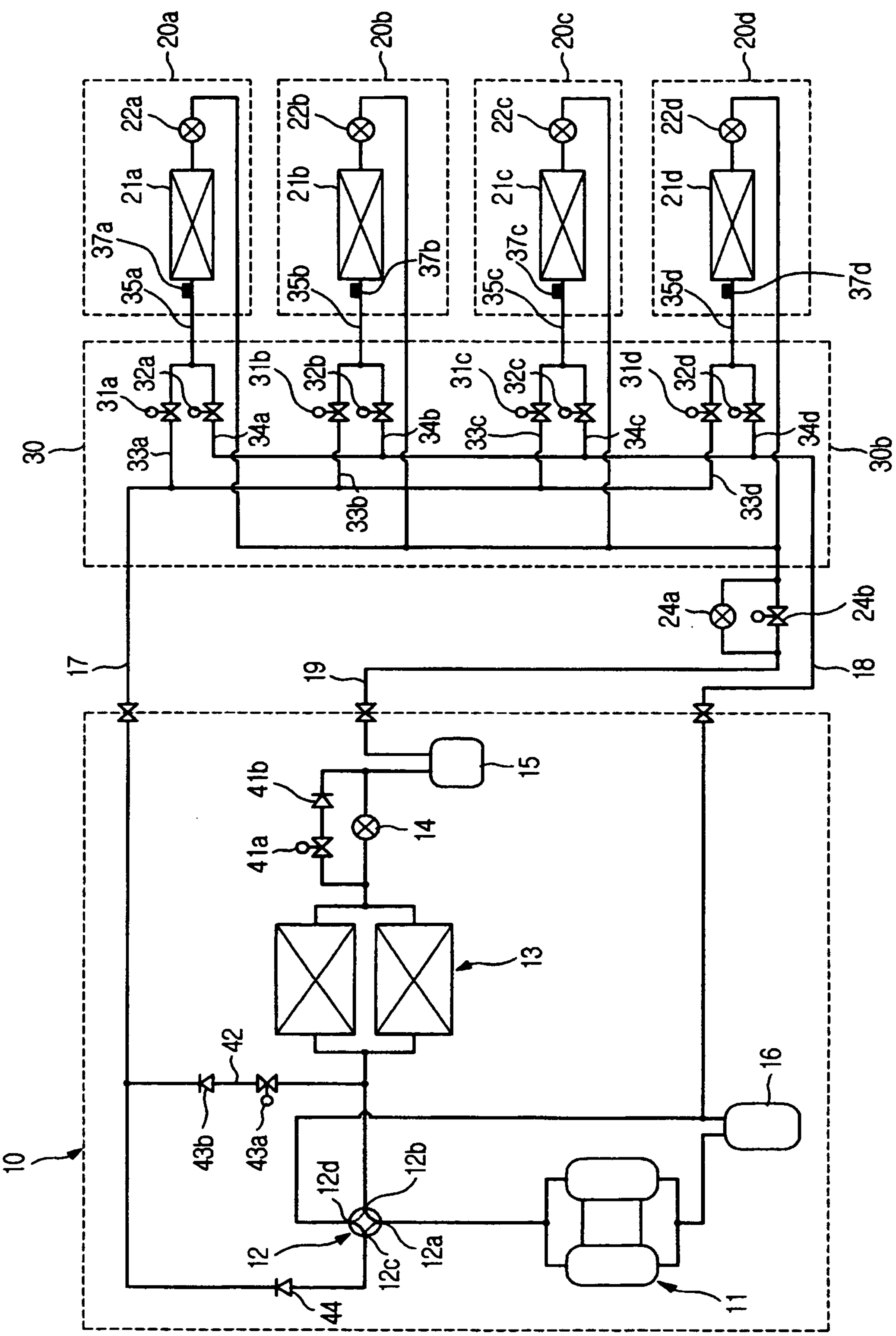

20a
20b
20c
20d
22a
22b
22c
22d
21a
21b
21c
21d
37a
37b
37c
37d
35a
35b
35c
35d
31a
32a
31b
32b
31c
32c
31d
32d
30
33a
34a
33b
34b
33c
34c
33d
34d
30b
17
19
18
24a
24b
15
41b
41a
14
13
42
43b
43a
16
10
12d
12b
12
12c
12a
44
11

Fig 3

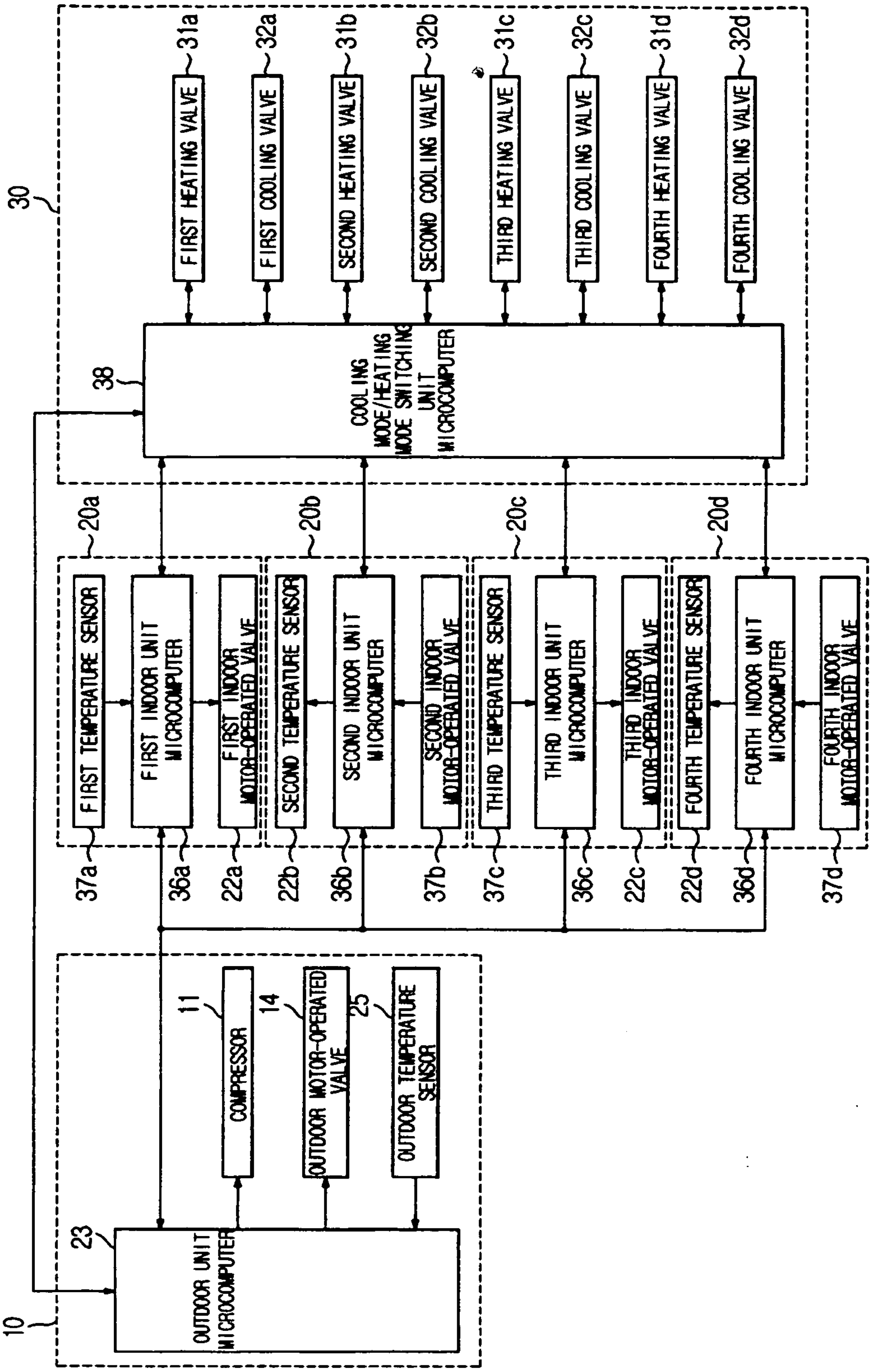

30
31a
FIRST HEATING VALVE
32a
FIRST COOLING VALVE
31b
SECOND HEATING VALVE
32b
SECOND COOLING VALVE
31c
THIRD HEATING VALVE
32c
THIRD COOLING VALVE
31d
FOURTH HEATING VALVE
32d
FOURTH COOLING VALVE
38
COOLING MODE/HEATING MODE SWITCHING UNIT MICROCOMPUTER
20a
20b
20c
20d
FIRST TEMPERATURE SENSOR
FIRST INDOOR UNIT MICROCOMPUTER
FIRST INDOOR MOTOR-OPERATED VALVE
SECOND TEMPERATURE SENSOR
SECOND INDOOR UNIT MICROCOMPUTER
SECOND INDOOR MOTOR-OPERATED VALVE
THIRD TEMPERATURE SENSOR
THIRD INDOOR UNIT MICROCOMPUTER
THIRD INDOOR MOTOR-OPERATED VALVE
FOURTH TEMPERATURE SENSOR
FOURTH INDOOR UNIT MICROCOMPUTER
FOURTH INDOOR MOTOR-OPERATED VALVE
37a
36a
22a
22b
36b
37b
37c
36c
22c
22d
36d
37d
10
23
OUTDOOR UNIT MICROCOMPUTER
11
COMPRESSOR
14
OUTDOOR MOTOR-OPERATED VALVE
25
OUTDOOR TEMPERATURE SENSOR

Fig 4

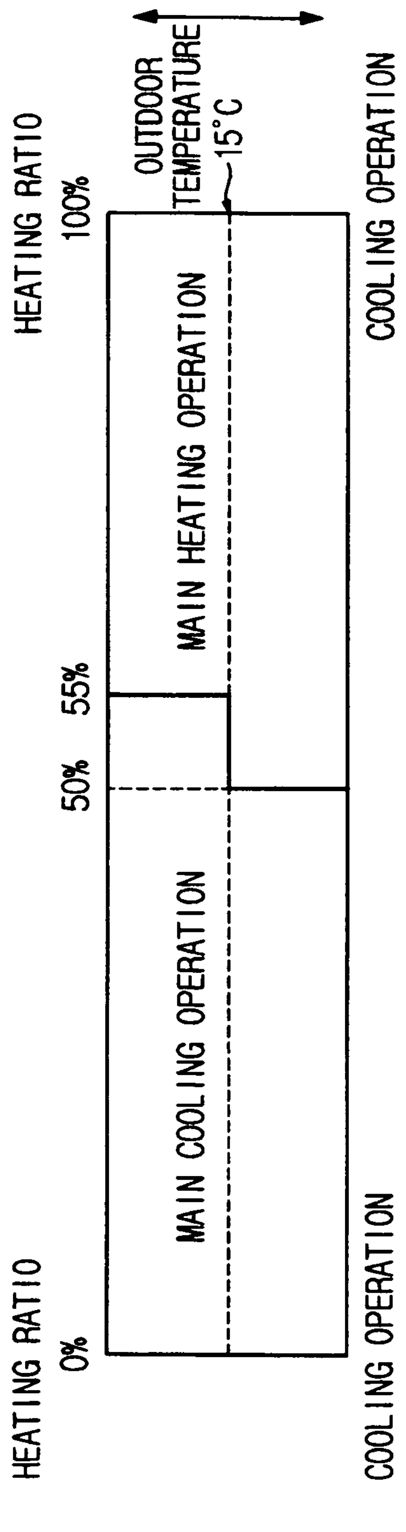

HEATING RATIO
100%
OUTDOOR
TEMPERATURE
15°C
COOLING OPERATION
MAIN HEATING OPERATION
55%
50%
MAIN COOLING OPERATION
HEATING RATIO
0%
COOLING OPERATION

Fig 5

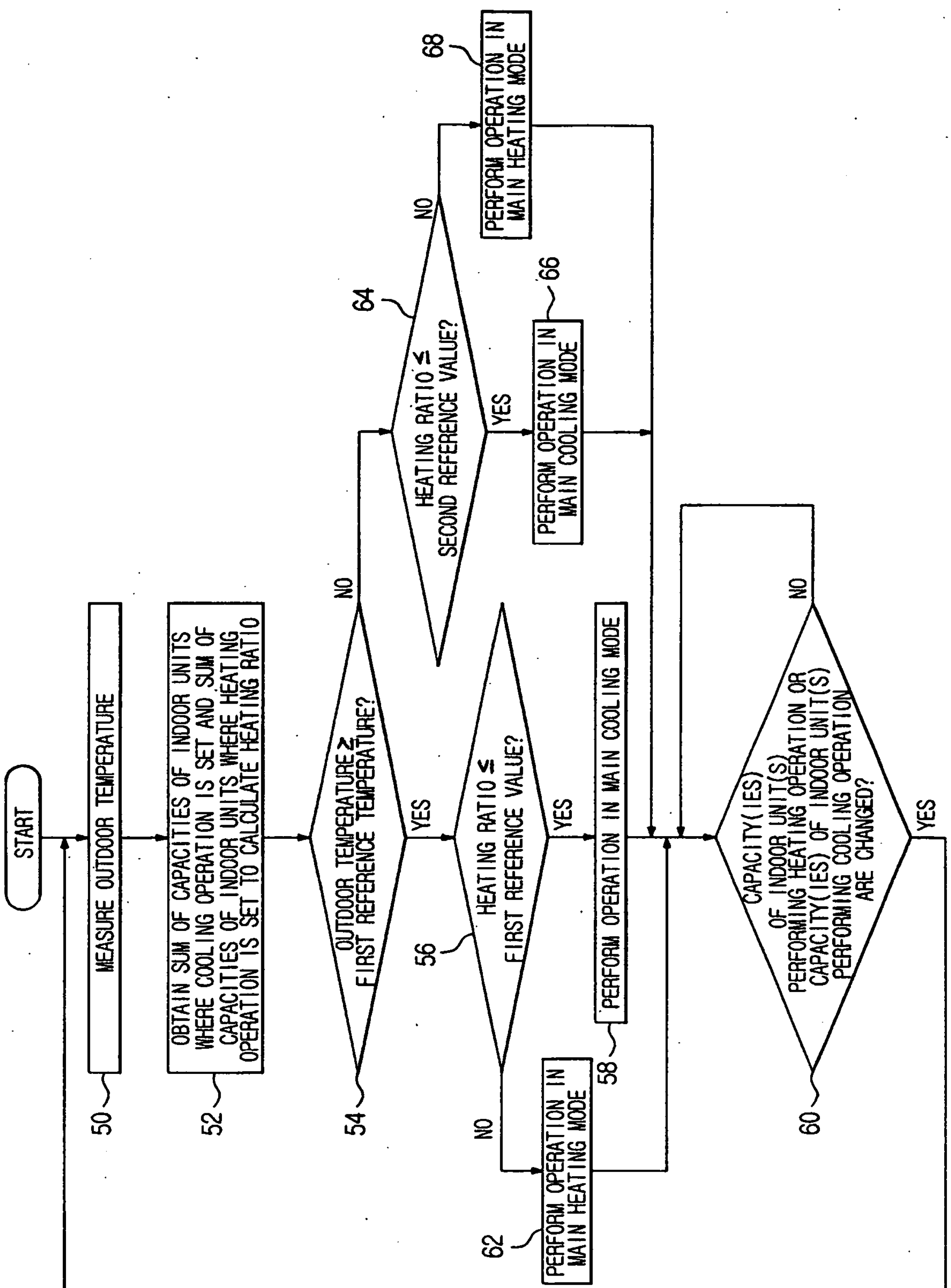

START
MEASURE OUTDOOR TEMPERATURE
50
OBTAIN SUM OF CAPACITIES OF INDOOR UNITS WHERE COOLING OPERATION IS SET AND SUM OF CAPACITIES OF INDOOR UNITS WHERE HEATING OPERATION IS SET TO CALCULATE HEATING RATIO
52
OUTDOOR TEMPERATURE ≥ FIRST REFERENCE TEMPERATURE?
54
YES
NO
HEATING RATIO ≤ FIRST REFERENCE VALUE?
56
YES
NO
PERFORM OPERATION IN MAIN COOLING MODE
58
PERFORM OPERATION IN MAIN HEATING MODE
62
HEATING RATIO ≤ SECOND REFERENCE VALUE?
64
YES
NO
PERFORM OPERATION IN MAIN COOLING MODE
66
PERFORM OPERATION IN MAIN HEATING MODE
68
CAPACITY(IES) OF INDOOR UNIT(S) PERFORMING HEATING OPERATION OR CAPACITY(IES) OF INDOOR UNIT(S) PERFORMING COOLING OPERATION ARE CHANGED?
60
YES
NO

Fig 6

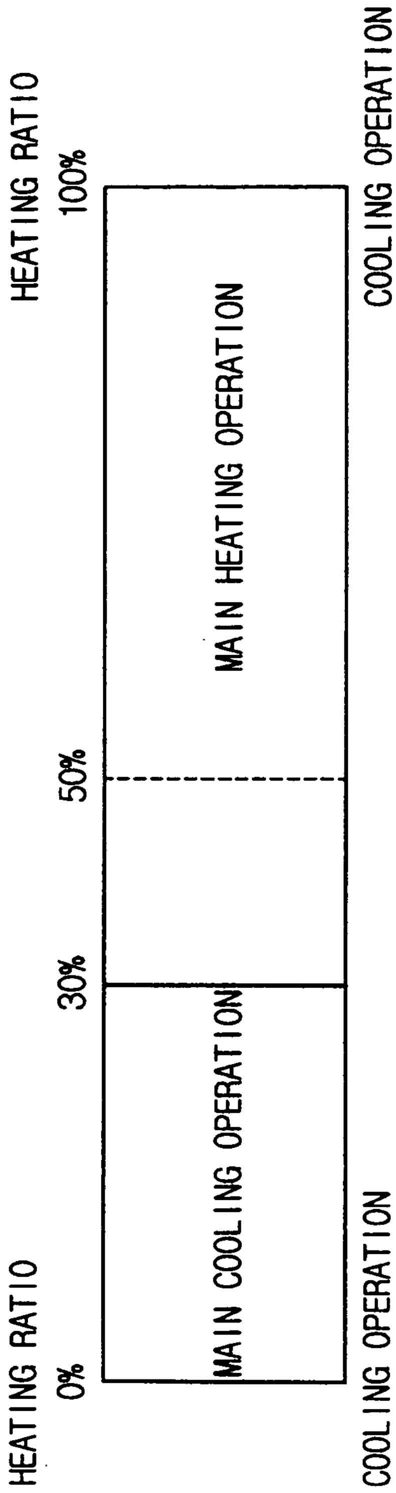
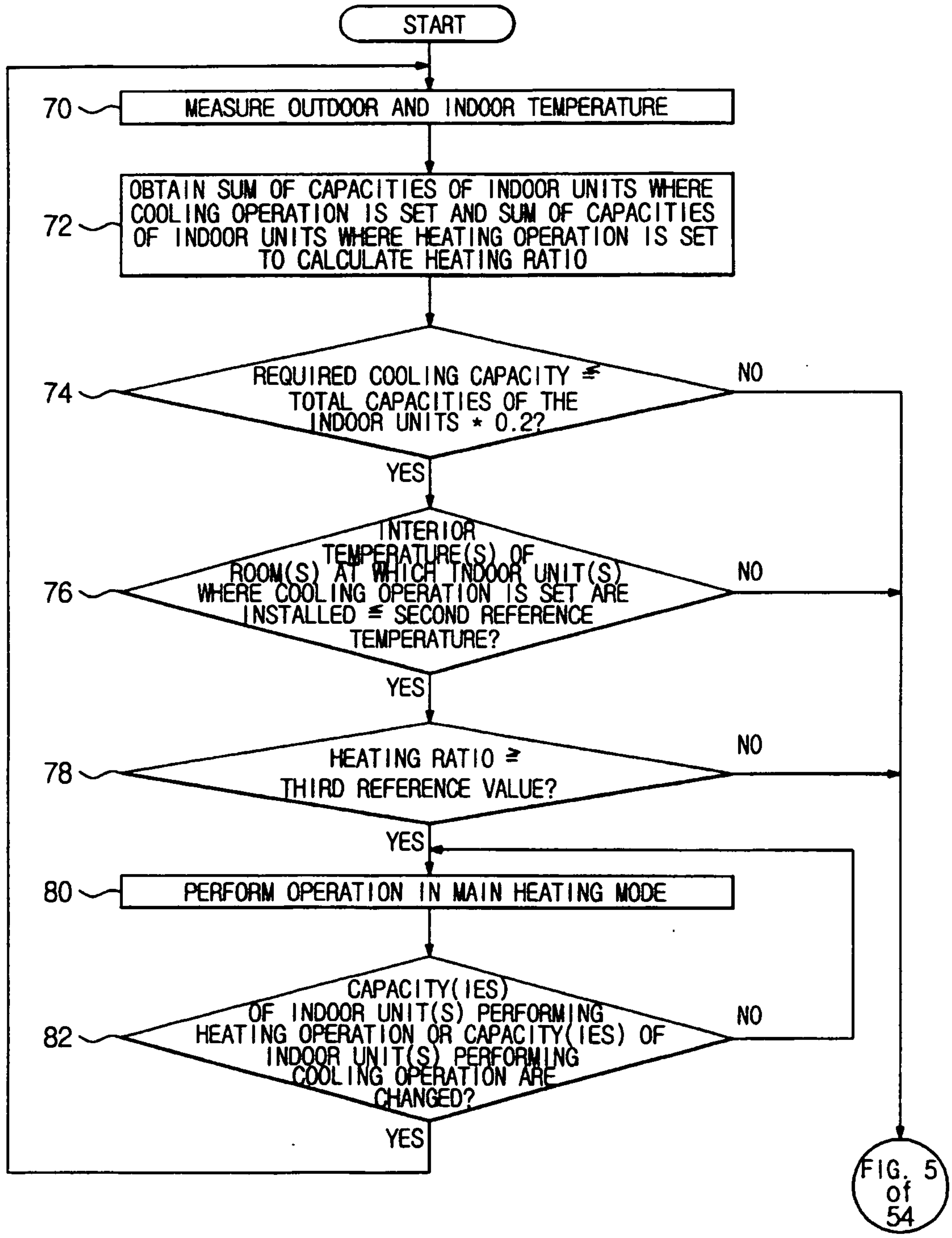

HEATING RATIO
100%
COOLING OPERATION
MAIN HEATING OPERATION
50%
30%
MAIN COOLING OPERATION
HEATING RATIO
0%
COOLING OPERATION

Fig 7


START
70
MEASURE OUTDOOR AND INDOOR TEMPERATURE
72
OBTAIN SUM OF CAPACITIES OF INDOOR UNITS WHERE COOLING OPERATION IS SET AND SUM OF CAPACITIES OF INDOOR UNITS WHERE HEATING OPERATION IS SET TO CALCULATE HEATING RATIO
74
REQUIRED COOLING CAPACITY ≤ TOTAL CAPACITIES OF THE INDOOR UNITS * 0.2?
NO
YES
76
INTERIOR TEMPERATURE(S) OF ROOM(S) AT WHICH INDOOR UNIT(S) WHERE COOLING OPERATION IS SET ARE INSTALLED ≤ SECOND REFERENCE TEMPERATURE?
NO
YES
78
HEATING RATIO ≥ THIRD REFERENCE VALUE?
NO
YES
80
PERFORM OPERATION IN MAIN HEATING MODE
82
CAPACITY(IES) OF INDOOR UNIT(S) PERFORMING HEATING OPERATION OR CAPACITY(IES) OF INDOOR UNIT(S) PERFORMING COOLING OPERATION ARE CHANGED?
NO
YES
FIG. 5 of 54

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1437558 A1 **[0003]**
- EP 1371914 A1 **[0003]**
- JP 1993099525 A **[0004]**