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(54) **AIR CONDITIONING SYSTEM, AND CONTROL DEVICE AND CONTROL METHOD FOR SAME**
KLIMAANLAGE SOWIE STEUERUNGSVORRICHTUNG UND STEUERUNGSVERFAHREN DAFÜR
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EP 3 064 848 B1

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Description

Technical Field

[0001] The present invention relates to an air conditioning system, and a control device and a control method for the same, and more particularly, to control of an air conditioning system.

Background Art

[0002] Hitherto, an air conditioning system in which a plurality of outdoor units and a plurality of indoor units are connected to each other through common refrigerant pipes has been known (for example, refer to PTL 1). There may be cases where an air conditioning system undergoes autonomous decentralized control such that indoor unit control parts and outdoor unit control parts control corresponding indoor units and outdoor units according to a common control rule for causing a change in refrigerant pressure to be in an allowable range.

Citation List

Patent Literature

[0003] [PTL 1] Japanese Unexamined Patent Application Publication No. 2007-292407

[0004] US 5 499 510, WO 2012/099333, EP 2 693 130, EP 1 674 808, US 2005/005619 and EP 1 130 333 disclose other examples of air conditioning systems.

Summary of Invention

Technical Problem

[0005] However, under the autonomous decentralized control in the related art, the stability and the responsiveness in the system are incompatible with each other, and it is difficult to enable the two to be compatible with each other.

[0006] The present invention has been made taking the foregoing circumstances into consideration, and an object thereof is to provide an air conditioning system in which the responsiveness and the stability of the system are enabled to be compatible with each other, and a control device and a control method for the same.

Solution to Problem

[0007] According to a first aspect of the present invention, there is provided an air conditioning system as defined in claim 1. Such a system includes a plurality of outdoor units and a plurality of indoor units connected in parallel and undergoes autonomous decentralized control such that each of the indoor units and each of the outdoor units enable a predetermined state quantity to be constant, the system including: a plurality of indoor

unit control parts provided to respectively correspond to the indoor units; and a plurality of outdoor unit control parts provided to respectively correspond to the outdoor units, in which the indoor unit control parts and the outdoor unit control parts enable intercommunication, in a case where a target value in any of the indoor units is changed, the outdoor unit which operates to correspond to the corresponding indoor unit is determined through communication between the outdoor unit control parts, and the determined outdoor unit and the indoor unit in which the target value is changed are virtually grouped together, and the indoor unit control part and the outdoor unit control part respectively corresponding to the indoor unit and the outdoor unit which are grouped together respectively generate control commands for tracking the target value and enabling an amount of variation in the state quantity in the group to be in a predetermined range through communication therebetween, and transmit the generated control commands to the corresponding indoor unit and outdoor unit.

[0008] According to the aspect, in a case where the target value of the indoor unit is changed, the outdoor unit which operates in a pair with the indoor unit is selected, and the selected outdoor unit and the indoor unit in which the target value is changed are grouped together. In the indoor unit and the outdoor unit which are grouped together, the control commands for suppressing variation in the state quantity caused by the change in the target value to be in a predetermined range are generated, and the control commands are transmitted to the corresponding indoor unit and outdoor unit. Accordingly, the change in the state quantity caused by the change in the target value can be kept in the indoor unit and the outdoor unit which are grouped together, and thus the system can be stabilized. In addition, control performed due to the change in the target value is limited only to the indoor unit and the outdoor unit which are grouped together, and responsiveness can be enhanced.

[0009] In the air conditioning system, the indoor units and the outdoor units which are not grouped may lock operation amounts while the state quantity is changed according to the target value in the indoor unit and the outdoor unit which are grouped together, and may release locking of the operation amounts when the state quantity is stabilized.

[0010] Accordingly, even when the effect of the variation in the state quantity in the indoor unit and the outdoor unit which are grouped together acts as disturbance in the indoor units and the outdoor units which are not grouped, response to the disturbance can be avoided, and a stable operation can be maintained.

[0011] In the air conditioning system, each of the indoor units and the indoor unit control part corresponding to the indoor unit may communicate in a one-to-one correspondence with each other, and each of the outdoor units and the outdoor unit control part corresponding to the outdoor unit may communicate in a one-to-one correspondence with each other.

[0012] As described above, a corresponding device and the control part thereof communicate in a one-to-one correspondence with each other, and thus the amount of data communication can be reduced. Therefore, it becomes possible to avoid a delay in response due to a delay in communication.

[0013] In the air conditioning system, the plurality of indoor unit control parts and the plurality of outdoor unit control parts may be integrated and mounted as virtualized control parts on a single piece or a plurality of pieces of hardware.

[0014] As described above, since a plurality of control parts are integrated and mounted as virtualized control parts on a single piece or a plurality of pieces of hardware, it becomes possible to achieve a reduction in costs and a reduction in the size of the device.

[0015] According to a second aspect of the present invention, there is provided a control device as defined in claim 5. This control device is applied to an air conditioning system, which includes a plurality of outdoor units and a plurality of indoor units connected in parallel and undergoes autonomous decentralized control such that each of the indoor units and each of the outdoor units enable a predetermined state quantity to be constant, the device including: a plurality of indoor unit control parts provided to respectively correspond to the indoor units; and a plurality of outdoor unit control parts provided to respectively correspond to the outdoor units, in which the indoor unit control parts and the outdoor unit control parts enable intercommunication, in a case where a target value in any of the indoor units is changed, the outdoor unit which operates to correspond to the corresponding indoor unit is determined through communication between the outdoor unit control parts, and the determined outdoor unit and the indoor unit in which the target value is changed are virtually grouped together, and the indoor unit control part and the outdoor unit control part respectively corresponding to the indoor unit and the outdoor unit which are grouped together respectively generate control commands for tracking the target value and enabling an amount of variation in the state quantity in the group to be in a predetermined range through communication therebetween, and transmit the generated control commands to the corresponding indoor unit and outdoor unit.

[0016] According to a third aspect of the present invention, there is provided a control method of an air conditioning system as defined in claim 6, the air conditioning system including a plurality of outdoor units and a plurality of indoor units connected in parallel and undergoes autonomous decentralized control such that each of the indoor units and each of the outdoor units enable a predetermined state quantity to be constant, the method including: forming a configuration in which a plurality of indoor unit control parts provided to respectively correspond to the indoor units and a plurality of outdoor unit control parts provided to respectively correspond to the outdoor units enable intercommunication; in a case

where a target value in any of the indoor units is changed, determining the outdoor unit which operates to correspond to the corresponding indoor unit through communication between the outdoor unit control parts, and virtually grouping together the determined outdoor unit and the indoor unit in which the target value is changed; by the indoor unit control part and the outdoor unit control part respectively corresponding to the indoor unit and the outdoor unit which are grouped together, respectively generating control commands for tracking the target value and enabling an amount of variation in the state quantity in the group to be in a predetermined range through communication therebetween; and transmitting the generated control commands to the corresponding indoor unit and outdoor unit.

Advantageous Effects of Invention

[0017] According to the present invention, in a case based on the premise of autonomous decentralized control, an effect of enabling the responsiveness and the stability of the system to be compatible with each other is exhibited.

Brief Description of Drawings

[0018]

Fig. 1 is a view illustrating a schematic configuration of an air conditioning system according to an embodiment of the present invention.

Fig. 2 is a view illustrating a schematic configuration of a control device applied to the air conditioning system according to the embodiment of the present invention.

Fig. 3 is a view showing an example of the response of a high pressure side pressure in a case where the set temperature of an indoor unit is changed during general autonomous decentralized control.

Description of Embodiments

[0019] Hereinafter, an air conditioning system according to an embodiment of the present invention, and a control device and a control method for the same will be described with reference to the drawings.

[0020] Fig. 1 is a view schematically illustrating a refrigerant system of an air conditioning system 1 according to the embodiment. As illustrated in Fig. 1, the air conditioning system 1 includes a plurality of outdoor units 2a and 2b, and a plurality of indoor units 3a and 3b. The outdoor units 2a and 2b and the indoor units 3a and 3b are connected in parallel. Here, in Fig. 1, a configuration in which two outdoor units and two indoor units are provided is illustrated. However, the number of units is not limited to this example, and two or more units may be provided.

[0021] Each of the outdoor units 2a and 2b includes,

as main components, a compressor 21 which compresses and transmits the refrigerant, a four-way valve 22 which changes the circulation direction of the refrigerant, an outdoor heat exchanger 23 and an outdoor fan 24 for heat exchange between the refrigerant and outside air, an accumulator 25 provided in a suction side pipe of the compressor 21 for the purpose of vapor-liquid separation of the refrigerant, and the like. In addition, in each of the outdoor units 2a and 2b, a high pressure side pressure sensor 26 which measures the pressure of the refrigerant on a high pressure side, and a low pressure side pressure sensor 27 which measures the pressure of the refrigerant on a low pressure side are provided. Since the outdoor unit 2b has the same configuration as that of the outdoor unit 2a, the illustration thereof is omitted.

[0022] Each of the indoor units 3a and 3b includes, as main components, an expansion valve 31, an indoor heat exchanger 32, and indoor fan 33. In addition, in each of the indoor units 3a and 3b, a high pressure side pressure sensor 36 which measures the pressure of the refrigerant on a high pressure side, and a low pressure side pressure sensor 37 which measures the pressure of the refrigerant on a low pressure side, and a temperature sensor 38 which measures an air conditioning temperature are provided. Since the indoor unit 3b has the same configuration as that of the indoor unit 3a, the illustration thereof is omitted.

[0023] A high pressure side refrigerant pipe 5a of the outdoor unit 2a, a high pressure side refrigerant pipe 5b of the outdoor unit 2b, a high pressure side refrigerant pipe 6a of the indoor unit 3a, and a high pressure side refrigerant pipe 6b of the indoor unit 3b are connected by a header 7. In addition, a low pressure side refrigerant pipe 15a of the outdoor unit 2a, a low pressure side refrigerant pipe 15b of the outdoor unit 2b, a low pressure side refrigerant pipe 16a of the indoor unit 3a, and a low pressure side refrigerant pipe 16b of the indoor unit 3b are connected by a header 8.

[0024] Accordingly, for example, in a case of a cooling operation, streams of the refrigerant transmitted from the outdoor units 2a and 2b join in the header 7 and branch off to be supplied to the indoor units 3a and 3b, and streams of the refrigerant that return from the indoor units 3a and 3b join in the header 8 and branch off to be supplied to the outdoor units 2a and 2b. During a heating operation, the refrigerant reversely flows.

[0025] Fig. 2 is a view illustrating the schematic configuration of a control device of the air conditioning system 1 according to this embodiment. As illustrated in Fig. 2, a control device 10 includes an outdoor unit control part 40a which controls the outdoor unit 2a, an outdoor unit control part 40b which controls the outdoor unit 2b, an indoor unit control part 50a which controls the indoor unit 3a, and an indoor unit control part 50b which controls the indoor unit 3b. Hereinafter, the outdoor unit control part 40a and the like which are not distinguished from each other to mean all control parts are simply referred to as a "control part".

[0026] In this embodiment, the outdoor unit control part 40a, the outdoor unit control part 40b, the indoor unit control part 50a, and the indoor unit control part 50b are configured to enable intercommunication via a communication medium 11. As an example of the communication medium 11, for example, a local area network such as Ethernet (registered trademark) is employed regardless of whether it is a wired or wireless medium.

[0027] In addition, each of the outdoor unit control part 40a and the outdoor unit 2a, the outdoor unit control part 40b and the outdoor unit 2b, the indoor unit control part 50a and the indoor unit 3a, and the indoor unit control part 50b and the indoor unit 3b communicate in a one-to-one correspondence with each other via a communication medium 12.

[0028] As described above, the control parts enable intercommunication via the communication medium having a relatively high communication speed (for example, 1 Gbps or higher), such as Ethernet (registered trademark), and thus the responsiveness is not degraded by the delay of data communication. In general, as the communication medium 12 between the control parts and the units, a communication medium having a relatively low communication speed (for example, 19.2 kbps or the like) is used. However, by reducing the amount of communication data through communication in a one-to-one correspondence, it becomes possible to avoid the degradation of the responsiveness.

[0029] In addition, regarding the outdoor unit control part 40a, the outdoor unit control part 40b, the indoor unit control part 50a, and the indoor unit control part 50b, in addition to the above-described configuration, the control parts may be formed as virtualized control parts on a single piece or a plurality of pieces of hardware and may be configured to enable intercommunication and also their independent operations. As described above, by forming the control parts as the virtualized control parts, it becomes possible to achieve a reduction in the entire size of the device and a reduction in costs.

[0030] Otherwise, the outdoor unit control part 40a, the outdoor unit control part 40b, the indoor unit control part 50a, and the indoor unit control part 50b may also be present in a cloud.

[0031] As described above, the existence form of the outdoor unit control part 40a, the outdoor unit control part 40b, the indoor unit control part 50a, and the indoor unit control part 50b is not particularly limited, and an optimal method may be appropriately employed depending on the CPU resources, costs, the device size, and the like.

[0032] The outdoor unit control parts 40a and 40b and the indoor unit control parts 50a and 50b undergo autonomous decentralized control such that predetermined state quantities in the air conditioning system 1 are constant in a normal period.

[0033] For example, each of the indoor unit control parts 50a and 50b adjusts the opening degree of the expansion valve 31 to control the flow rate of the refrigerant such that the high pressure side pressure (state quantity)

of each of the corresponding indoor units 3a and 3b is in a predetermined indoor unit high pressure allowable range set in advance (for example, see Fig. 3) and the low pressure side pressure (state quantity) thereof is in a predetermined indoor unit low pressure allowable range set in advance.

[0034] In addition, each of the outdoor unit control parts 40a and 40b controls the rotation frequency of the corresponding compressor 21 such that the high pressure side pressure (state quantity) of each of the corresponding outdoor units 2a and 2b is in a predetermined outdoor unit high pressure allowable range set in advance (for example, see Fig. 3) and the low pressure side pressure (state quantity) thereof is in a predetermined outdoor unit low pressure allowable range set in advance.

[0035] Here, for example, the indoor unit low pressure allowable range is set to be wider than the outdoor unit low pressure allowable range, and the indoor unit high pressure allowable range is set to be wider than the outdoor unit high pressure allowable range.

[0036] Next, in the air conditioning system 1 according to this embodiment, the operation of each of the control parts in a case where the set temperature of an indoor unit is changed, for example, by operating a remote control (referred to as a "transition period" for the "normal period") will be described. In the following description, for convenience, a case where the set temperature of the indoor unit 3a is changed will be described.

[0037] In this case, information regarding the change in the set temperature is transmitted from the indoor unit control part 50a of the indoor unit 3a to the indoor unit control part 50b and the outdoor unit control parts 40a and 40b which are the other control parts. For example, the indoor unit control part 50a transmits information of the flow rate of the refrigerant, which is necessary for changing the set temperature. The outdoor unit control parts 40a and 40b exchange information and determine an outdoor unit corresponding to the fluctuation of the flow rate of the refrigerant of the indoor unit 3a.

[0038] For example, the operation efficiency (for example, coefficient of performance) is obtained on the basis of the fluctuation of a load factor caused by an increase in the flow rate of the refrigerant, and an outdoor unit having the highest operation efficiency is determined from the outdoor units 2a and 2b. As a determination method, an algorithm is stored in each of the outdoor unit control parts 40a and 40b in advance, and any outdoor unit may be selected according to the algorithm. Hereinafter, for convenience of description, description will be provided assuming that the outdoor unit 2a is selected.

[0039] As described above, when the outdoor unit 2a which operates to correspond to the indoor unit 3a having a changed set temperature is determined, the indoor unit control part 50a corresponding to the indoor unit 3a and the outdoor unit control part 40a corresponding to the outdoor unit 2a are virtually grouped together. A subdomain is formed between the indoor unit control part 50a and the outdoor unit control part 40a. In addition, by

causing the indoor unit control part 50a and the outdoor unit control part 40a in the subdomain to perform inter-communication, a control command for tracking a set temperature after the change and enabling the amount of variation in the pressure of the refrigerant in each of the indoor unit 3a and the outdoor unit 2a which are grouped together to be in a predetermined range is generated.

[0040] Specifically, the indoor unit control part 50a generates an opening degree command for the expansion valve 31 to track the set temperature after the change and the rotation frequency of the indoor fan 33 through feed-forward control, and the outdoor unit control part 40a estimates the amount of a change in the flow rate of the refrigerant on the basis of the opening degree command for the expansion valve 31 generated by the indoor unit control part 50a and generates a rotation frequency command for the compressor 21 according to the amount of the change and a rotation frequency command for the outdoor fan 24 through feed-forward control.

[0041] In addition, the indoor unit control part 50a transmits various commands which are generated to the indoor unit 3a via the communication medium 12, and the outdoor unit control part 40a transmits various commands which are generated to the outdoor unit 2a via the communication medium 12. Accordingly, in the indoor unit 3a, the opening degree of the expansion valve 31 and the rotation frequency of the indoor fan 33 are controlled on the basis of the received control command, and in the outdoor unit 2a, the rotation frequency of the compressor 21 and the rotation frequency of the outdoor fan 24 are controlled on the basis of the received control command.

[0042] As described above, since the opening degree of the expansion valve 31 of the indoor unit 3a and the rotation frequency of the compressor 21 of the outdoor unit 2a are changed substantially simultaneously, a change in the pressure of the refrigerant due to a change in the opening degree of the expansion valve 31 of the indoor unit 3a can be absorbed by a change in the flow rate of the refrigerant due to a change in the rotation frequency of the compressor 21. Therefore, a change in the pressure of the refrigerant caused by changing the set temperature of the indoor unit 3a is kept in the domain, in other words, in the group of the indoor unit 3a and the outdoor unit 2a, and it becomes possible to enable variation in the pressure of the refrigerant in the air conditioning system 1 to be suppressed in a predetermined range.

[0043] In addition, when the state of the refrigerant in the air conditioning system is stabilized by causing the temperature of the indoor unit 3a to be equal to the set temperature, the grouping of the indoor unit 3a and the outdoor unit 2a is released. Accordingly, autonomous decentralized control for a normal period by each of the control parts is resumed.

[0044] In addition, regarding the indoor unit 3b and the outdoor unit 2b which are not grouped, during a period

of time in which the opening degree of the expansion valve 31 of the grouped indoor unit 3a and the rotation frequency of the compressor 21 of the grouped outdoor unit 2a are changed, the indoor unit control part 50b and the outdoor unit control part 40b lock the operation amounts of the expansion valve, the compressor, and the like of the indoor unit 3b and the outdoor unit 2b and release the locking of the operation amounts after the pressure of the refrigerant in the air conditioning system 1 is stabilized.

[0045] Accordingly, even when the effect of the variation in the pressure of the refrigerant in the indoor unit 3a and the outdoor unit 2a acts as disturbance in the indoor unit 3b and the outdoor unit 2b, variation in the operation amount of the expansion valve (not illustrated) of the indoor unit 3b or the compressor (not illustrated) of the outdoor unit 2b in response to the disturbance can be avoided, and a stable operation can be maintained.

[0046] As described above, according to the air conditioning system 1 according to this embodiment, and the control device 10 and the control method for the same, in a case where the set temperature of an indoor unit is changed, an outdoor unit corresponding to the change in the set temperature of the indoor unit is selected, and the selected indoor unit and the outdoor unit are grouped together. In addition, in the indoor unit and the outdoor unit grouped together, the opening degree of the expansion valve and the rotation frequency of the compressor are substantially simultaneously controlled so as to suppress variation in the pressure of the refrigerant caused by the change in the set temperature to be in a predetermined range. Accordingly, the change in the pressure of the refrigerant caused by the change in the set temperature can be kept in the indoor unit and the outdoor unit which are grouped together, and thus the system can be stabilized. In addition, control performed due to the change in the set temperature is limited only to the indoor unit and the outdoor unit which are grouped together, and responsiveness can be enhanced.

[0047] Fig. 3 shows an example of the response of a high pressure side pressure in a case where the set temperature of an indoor unit is changed during general autonomous decentralized control. For example, during general autonomous decentralized control, the following control is performed.

[0048] That is, in a case where the set temperature of any of the indoor units is changed, the opening degree of the expansion valve of the indoor unit is controlled according to the set temperature. When the pressure of the refrigerant is changed as the opening degree of the expansion valve is changed, the other indoor units and the outdoor units which share the refrigerant pipes are operated to suppress the change in the pressure of the refrigerant to be in a predetermined range set in advance. Accordingly, in each of the indoor units, the opening degree of the expansion valve is adjusted, and the rotation frequency of the compressor of each of the outdoor units is controlled. Such control is performed by each of the

indoor units and the outdoor units as feedback control, and the pressure of the refrigerant gradually converges to a predetermined value. During the autonomous decentralized control, when a feedback gain is high, as indicated by solid line in Fig. 3, overshoot occurs although responsiveness is enhanced, and the system becomes unstable. On the other hand, when the feedback gain is decreased, as indicated by broken line in Fig. 3, the occurrence of overshoot is suppressed and the system is stabilized. However, responsiveness is deteriorated.

[0049] Contrary to this, according to the air conditioning system 1 according to this embodiment and the control device and the control method for the same, as described above, an outdoor unit which operates to correspond to an indoor unit in which the set temperature is changed is selected to be grouped with the indoor unit, and control of the expansion valve and control of the rotation frequency of the compressor are controlled on the indoor unit and the outdoor unit which are grouped together so as to enable the pressure of the refrigerant to become substantially constant. Therefore, variation in the pressure of the refrigerant can be suppressed compared to in the related art, and it becomes possible to enable the responsiveness and the stability of the system to be compatible with each other.

[0050] The present invention is not limited only to the above-described embodiment, and various modifications can be made within the scope of the invention as defined by the appended claims.

Reference Signs List

[0051]

1	AIR CONDITIONING SYSTEM
2a, 2b	OUTDOOR UNIT
3a, 3b	INDOOR UNIT
11, 12	COMMUNICATION MEDIUM
21	COMPRESSOR
24	OUTDOOR FAN
31	EXPANSION VALVE
33	INDOOR FAN
40a, 40b	OUTDOOR UNIT CONTROL PART
50a, 50b	INDOOR UNIT CONTROL PART

Claims

1. An air conditioning system (1) which includes a plurality of outdoor units (2a, 2b) and a plurality of indoor units (3a, 3b) connected in parallel and undergoes autonomous decentralized control in a normal period such that a predetermined state quantity in each of the indoor units (3a, 3b) and each of the outdoor units (2a, 2b) is in a predetermined allowable range set in advance, the system comprising:

a plurality of indoor unit control parts (50a, 50b)

- provided to respectively correspond to the indoor units (3a, 3b); and
 a plurality of outdoor unit control parts (40a, 40b) provided to respectively correspond to the outdoor units (2a, 2b),
 wherein the indoor unit control parts (50a, 50b) and the outdoor unit control parts (40a, 40b) enable intercommunication,
 in a transition period where a target value in any of the indoor units (3a, 3b) is changed, the indoor unit control part (50a, 50b) corresponding to the indoor unit (3a, 3b) in which the target value is changed is configured to transmit information regarding a change of the target value to the outdoor unit control parts (40a, 40b),
 the outdoor unit control parts (40a, 40b) are configured to perform intercommunication, and to determine, among the plurality of the outdoor units (2a, 2b), the outdoor unit which operates to correspond to the indoor unit (3a, 3b) in which the target value is changed, according to an algorithm stored in advance,
 a subdomain is formed between the outdoor unit control part (40a, 40b) corresponding to the determined outdoor unit and the indoor unit control part (50a, 50b) corresponding to the indoor unit in which the target value is changed, and the outdoor unit control part and the indoor unit control part are virtually grouped together, and
 the indoor unit control part (50a, 50b) and the outdoor unit control part (40a, 40b) which are virtually grouped together respectively generate control commands for tracking the changed target value and enabling an amount of variation in the state quantity, in the indoor unit (3a, 3b) and the outdoor unit (2a, 2b) respectively corresponding to the indoor unit control part and the outdoor unit control part which are virtually grouped together, to be in a predetermined range through communication therebetween, and transmit the generated control commands to the corresponding indoor unit and outdoor unit.
2. The air conditioning system (1) according to claim 1, wherein the indoor unit control parts (50a, 50b) and the outdoor unit control parts (40a, 40b) which are not virtually grouped lock operation amounts while the state quantity is changed according to the changed target value in the indoor unit and the outdoor unit respectively corresponding to the indoor unit control part (50a, 50b) and the outdoor unit control part (40a, 40b) which are virtually grouped together, and release locking of the operation amounts when the state quantity is stabilized.
 3. The air conditioning system (1) according to claim 1 or 2,

wherein each of the indoor units (3a, 3b) and the indoor unit control part (50a, 50b) corresponding to the indoor unit communicate in a one-to-one correspondence with each other, and each of the outdoor units (2a, 2b) and the outdoor unit control part (40a, 40b) corresponding to the outdoor unit communicate in a one-to-one correspondence with each other.

4. The air conditioning system (1) according to any one of claims 1 to 3,
 wherein the plurality of indoor unit control parts (50a, 50b) and the plurality of outdoor unit control parts (40a, 40b) are integrated and mounted as virtualized control parts on a single piece or a plurality of pieces of hardware.
5. A control device (10) for an air conditioning system (1) which includes a plurality of outdoor units (2a, 2b) and a plurality of indoor units (3a, 3b) connected in parallel and undergoes autonomous decentralized control in a normal period such that a predetermined state quantity in each of the indoor units (3a, 3b) and each of the outdoor units (2a, 2b) is in a predetermined allowable range set in advance, the device comprising:

a plurality of indoor unit control parts (50a, 50b) provided to respectively correspond to the indoor units (3a, 3b); and
 a plurality of outdoor unit control parts (40a, 40b) provided to respectively correspond to the outdoor units (2a, 2b),
 wherein the indoor unit control parts (50a, 50b) and the outdoor unit control parts (40a, 40b) enable intercommunication,
 in a transition period where a target value in any of the indoor units (3a, 3b) is changed, the indoor unit control part (50a, 50b) corresponding to the indoor unit in which the target value is changed transmits information regarding a change of the target value to the outdoor unit control parts (40a, 40b),
 the outdoor unit control parts (40a, 40b) perform intercommunication, and determine, among the plurality of the outdoor units (2a, 2b), the outdoor unit which operates to correspond to the indoor unit in which the target value is changed, according to an algorithm stored in advance,
 a subdomain is formed between the outdoor unit control part (40a, 40b) corresponding to the determined outdoor unit and the indoor unit control part (50a, 50b) corresponding to the indoor unit (3a, 3b) in which the target value is changed, and the outdoor unit, control part and the indoor unit control part are virtually grouped together, and
 the indoor unit control part (50a, 50b) and outdoor unit control part (40a, 40b) which are virtu-

ally grouped together respectively generate control commands for tracking the changed target value and enabling an amount of variation in the state quantity, in the indoor unit (3a, 3b) and the outdoor unit (2a, 2b) respectively corresponding to the indoor unit control part (50a, 50b) and the outdoor unit control part (40a, 40b) which are virtually grouped together, to be in a predetermined range through communication therebetween, and transmit the generated control commands to the corresponding indoor unit and outdoor unit.

6. A control method of an air conditioning system (1) which includes a plurality of outdoor units (2a, 2b) and a plurality of indoor units (3a, 3b) connected in parallel and undergoes autonomous decentralized control in a normal period such that a predetermined state quantity in each of the indoor units (3a, 3b) and each of the outdoor units (2a, 2b) is in a predetermined allowable range set in advance, the method comprising:

forming a configuration in which a plurality of indoor unit control parts (50a, 50b) provided to respectively correspond to the indoor units (3a, 3b) and a plurality of outdoor unit control parts (40a, 40b) provided to respectively correspond to the outdoor units (2a, 2b) enable intercommunication;

in a transition period where a target value in any of the indoor units (3a, 3b) is changed, the indoor unit control part corresponding to the indoor unit (3a, 3b) in which the target value is changed transmits information regarding a change of the target value to the outdoor unit control parts (40a, 40b),

by the outdoor unit control parts (40a, 40b) performing intercommunication, determining, among the plurality of the outdoor units (2a, 2b), the outdoor unit which operates to correspond to the indoor unit in which the target value is changed, according to an algorithm stored in advance,

forming a subdomain between the outdoor unit control part (40a, 40b) corresponding to the determined outdoor unit (2a, 2b) and the indoor unit control part (50a, 50b) corresponding to the indoor unit (3a, 3b) in which the target value is changed, and virtually grouping together the outdoor unit control part (40a, 40b) and the indoor unit control part (50a, 50b);

by the indoor unit control part (50a, 50b) and the outdoor unit control part (40a, 40b) which are virtually grouped together, respectively generating control commands for tracking the changed target value and enabling an amount of variation in the state quantity, in the indoor

unit (3a, 3b) and the outdoor unit (2a, 2b) respectively corresponding to the indoor unit control part (50a, 50b) and the outdoor unit control part (40a, 40b) which are virtually grouped together, to be in a predetermined range through communication therebetween; and transmitting the generated control commands to the corresponding indoor unit and outdoor unit.

Patentansprüche

1. Klimatisierungssystem (1), das eine Vielzahl von Außeneinheiten (2a, 2b) und eine Vielzahl von Inneneinheiten (3a, 3b), die parallel verbunden sind, beinhaltet und in einer normalen Periode einer autonomen dezentralisierten Steuerung unterzogen wird, derart, dass eine vorbestimmte Zustandsmenge in jeder der Inneneinheiten (3a, 3b) und jeder der Außeneinheiten (2a, 2b) in einem vorbestimmten zulässigen Bereich, der vorab eingestellt wird, liegt, wobei das System Folgendes umfasst:

eine Vielzahl von Inneneinheitsteuerteilen (50a, 50b), die bereitgestellt sind, um jeweils den Inneneinheiten (3a, 3b) zu entsprechen; und eine Vielzahl von Außeneinheitsteuerteilen (40a, 40b), die bereitgestellt sind, um jeweils den Außeneinheiten (2a, 2b) zu entsprechen, wobei die Inneneinheitsteuerteile (50a, 50b) und die Außeneinheitsteuerteile (40a, 40b) eine Interkommunikation ermöglichen,

in einer Übergangsperiode, in der ein Sollwert in einer der Inneneinheiten (3a, 3b) geändert wird, ist das Inneneinheitsteuerteil (50a, 50b), das der Inneneinheit (3a, 3b) entspricht, bei der der Sollwert geändert wird, dazu ausgelegt, Informationen über eine Änderung des Sollwerts zu den Außeneinheitsteuerteilen (40a, 40b) zu übertragen,

die Außeneinheitsteuerteile (40a, 40b) sind dazu ausgelegt, eine Interkommunikation durchzuführen und unter der Vielzahl der Außeneinheiten (2a, 2b) die Außeneinheit, die betrieben wird, um der Inneneinheit (3a, 3b), bei der der Sollwert geändert wird, zu entsprechen, gemäß einem Algorithmus, der vorab gespeichert wird, zu bestimmen,

zwischen dem Außeneinheitsteuerteil (40a, 40b), das der bestimmten Außeneinheit entspricht, und dem Inneneinheitsteuerteil (50a, 50b), das der Inneneinheit, bei der der Sollwert geändert wird, entspricht, wird eine Unterdomäne gebildet und das Außeneinheitsteuerteil und das Inneneinheitsteuerteil werden virtuell zusammengruppiert und

das Inneneinheitsteuerteil (50a, 50b) bzw. das Außeneinheitsteuerteil (40a, 40b), die virtuell

- zusammengruppiert sind, erzeugen mittels Kommunikation dazwischen Steuerbefehle zum Verfolgen des geänderten Sollwerts und Ermöglichen, dass ein Betrag einer Variation bei der Zustandsmenge in der Inneneinheit (3a, 3b) und der Außeneinheit (2a, 2b), die dem Inneneinheitsteuerteil bzw. dem Außeneinheitsteuerteil entsprechen, die virtuell zusammengruppiert sind, in einem vorbestimmten Bereich liegt, und übertragen die erzeugten Steuerbefehle zur entsprechenden Inneneinheit und Außeneinheit.
2. Klimatisierungssystem (1) nach Anspruch 1, wobei die Inneneinheitsteuerteile (50a, 50b) und die Außeneinheitsteuerteile (40a, 40b), die virtuell nicht gruppiert sind, Betriebsbeträge verriegeln, während die Zustandsmenge gemäß dem geänderten Sollwert in der Inneneinheit und der Außeneinheit, die dem Inneneinheitsteuerteil (50a, 50b) bzw. dem Außeneinheitsteuerteil (40a, 40b), die virtuell zusammengruppiert sind, entsprechen, geändert wird, und die Verriegelung der Betriebsbeträge freigeben, wenn die Zustandsmenge stabilisiert ist.
3. Klimatisierungssystem (1) nach Anspruch 1 oder 2, wobei jede der Inneneinheiten (3a, 3b) und das Inneneinheitsteuerteil (50a, 50b), das der Inneneinheit entspricht, in einer Eins-zu-eins-Entsprechung miteinander kommunizieren und jede der Außeneinheiten (2a, 2b) und das Außeneinheitsteuerteil (40a, 40b), das der Außeneinheit entspricht, in einer Eins-zu-eins-Entsprechung miteinander kommunizieren.
4. Klimatisierungssystem (1) nach einem der Ansprüche 1 bis 3, wobei die Vielzahl der Inneneinheitsteuerteile (50a, 50b) und die Vielzahl der Außeneinheitsteuerteile (40a, 40b) als virtuelle Steuerteile auf einem einzelnen Stück oder einer Vielzahl von Stücken von Hardware integriert und montiert sind.
5. Steuervorrichtung (10) für ein Klimatisierungssystem (1), das eine Vielzahl von Außeneinheiten (2a, 2b) und eine Vielzahl von Inneneinheiten (3a, 3b), die parallel verbunden sind, beinhaltet und in einer normalen Periode einer autonomen dezentralisierten Steuerung unterzogen wird, derart, dass eine vorbestimmte Zustandsmenge in jeder der Inneneinheiten (3a, 3b) und jeder der Außeneinheiten (2a, 2b) in einem vorbestimmten zulässigen Bereich, der vorab eingestellt wird, liegt, wobei die Vorrichtung Folgendes umfasst:
- eine Vielzahl von Inneneinheitsteuerteilen (50a, 50b), die bereitgestellt sind, um jeweils den Inneneinheiten (3a, 3b) zu entsprechen; und eine Vielzahl von Außeneinheitsteuerteilen (40a, 40b), die bereitgestellt sind, um jeweils

den Außeneinheiten (2a, 2b) zu entsprechen, wobei die Inneneinheitsteuerteile (50a, 50b) und die Außeneinheitsteuerteile (40a, 40b) eine Interkommunikation ermöglichen, in einer Übergangsperiode, in der ein Sollwert in einer der Inneneinheiten (3a, 3b) geändert wird, überträgt das Inneneinheitsteuerteil (50a, 50b), das der Inneneinheit entspricht, bei der der Sollwert geändert wird, Informationen über eine Änderung des Sollwerts zu den Außeneinheitsteuerteilen (40a, 40b), die Außeneinheitsteuerteile (40a, 40b) führen eine Interkommunikation durch und bestimmen unter der Vielzahl der Außeneinheiten (2a, 2b) die Außeneinheit, die betrieben wird, um der Inneneinheit, bei der der Sollwert geändert wird, zu entsprechen, gemäß einem Algorithmus, der vorab gespeichert wird, zwischen dem Außeneinheitsteuerteil (40a, 40b), das der bestimmten Außeneinheit entspricht, und dem Inneneinheitsteuerteil (50a, 50b), das der Inneneinheit (3a, 3b), bei der der Sollwert geändert wird, entspricht, wird eine Unterdomäne gebildet und das Außeneinheitsteuerteil und das Inneneinheitsteuerteil werden virtuell zusammengruppiert und das Inneneinheitsteuerteil (50a, 50b) bzw. das Außeneinheitsteuerteil (40a, 40b), die virtuell zusammengruppiert sind, erzeugen mittels Kommunikation dazwischen Steuerbefehle zum Verfolgen des geänderten Sollwerts und Ermöglichen, dass ein Betrag einer Variation bei der Zustandsmenge in der Inneneinheit (3a, 3b) und der Außeneinheit (2a, 2b), die dem Inneneinheitsteuerteil (50a, 50b) bzw. dem Außeneinheitsteuerteil (40a, 40b) entsprechen, die virtuell zusammengruppiert sind, in einem vorbestimmten Bereich liegt, und übertragen die erzeugten Steuerbefehle zur entsprechenden Inneneinheit und Außeneinheit.

6. Steuerverfahren eines Klimatisierungssystems (1), das eine Vielzahl von Außeneinheiten (2a, 2b) und eine Vielzahl von Inneneinheiten (3a, 3b), die parallel verbunden sind, beinhaltet und in einer normalen Periode einer autonomen dezentralisierten Steuerung unterzogen wird, derart, dass eine vorbestimmte Zustandsmenge in jeder der Inneneinheiten (3a, 3b) und jeder der Außeneinheiten (2a, 2b) in einem vorbestimmten zulässigen Bereich, der vorab eingestellt wird, liegt, wobei das Verfahren Folgendes umfasst:

Bilden einer Auslegung, bei der eine Vielzahl von Inneneinheitsteuerteilen (50a, 50b), die bereitgestellt sind, um jeweils den Inneneinheiten (3a, 3b) zu entsprechen, und eine Vielzahl von Außeneinheitsteuerteilen (40a, 40b), die bereit-

gestellt sind, um jeweils den Außeneinheiten (2a, 2b) zu entsprechen, eine Interkommunikation ermöglichen;
 in einer Übergangsperiode, in der ein Sollwert in einer der Inneneinheiten (3a, 3b) geändert wird, überträgt das Inneneinheitsteuerteil, das der Inneneinheit (3a, 3b) entspricht, bei der der Sollwert geändert wird, Informationen über eine Änderung des Sollwerts zu den Außeneinheitsteuerteilen (40a, 40b),
 durch die Außeneinheitsteuerteile (40a, 40b), die eine Interkommunikation durchführen, Bestimmen unter der Vielzahl der Außeneinheiten (2a, 2b) die Außeneinheit, die betrieben wird, um der Inneneinheit, bei der der Sollwert geändert wird, zu entsprechen, gemäß einem Algorithmus, der vorab gespeichert wird,
 Bilden einer Unterdomäne zwischen dem Außeneinheitsteuerteil (40a, 40b), das der bestimmten Außeneinheit (2a, 2b) entspricht, und dem Inneneinheitsteuerteil (50a, 50b), das der Inneneinheit (3a, 3b), bei der der Sollwert geändert wird, entspricht, und virtuelles Zusammengruppieren des Außeneinheitsteuerteils (40a, 40b) und des Inneneinheitsteuerteils (50a, 50b);
 durch das Inneneinheitsteuerteil (50a, 50b) bzw. das Außeneinheitsteuerteil (40a, 40b), die virtuell zusammengruppiert sind, Erzeugen mittels Kommunikation dazwischen von Steuerbefehlen zum Verfolgen des geänderten Sollwerts und Ermöglichen, dass ein Betrag einer Variation bei der Zustandsmenge in der Inneneinheit (3a, 3b) und der Außeneinheit (2a, 2b), die dem Inneneinheitsteuerteil (50a, 50b) bzw. dem Außeneinheitsteuerteil (40a, 40b) entsprechen, die virtuell zusammengruppiert sind, in einem vorbestimmten Bereich liegt; und
 Übertragen der erzeugten Steuerbefehle zur entsprechenden Inneneinheit und Außeneinheit.

Revendications

1. Système de climatisation (1) qui inclut une pluralité d'unités extérieures (2a, 2b) et une pluralité d'unités intérieures (3a, 3b) reliées en parallèle et qui est soumis à une commande décentralisée autonome dans une période normale de sorte qu'une grandeur d'état prédéterminée dans chacune des unités intérieures (3a, 3b) et chacune des unités extérieures (2a, 2b) est dans une plage admissible prédéterminée définie à l'avance, le système comprenant :

une pluralité de parties de commande d'unité intérieure (50a, 50b) fournies pour correspondre respectivement aux unités intérieures (3a, 3b) ;
 et

une pluralité de parties de commande d'unité extérieure (40a, 40b) fournies pour correspondre respectivement aux unités extérieures (2a, 2b),
 dans lequel les parties de commande d'unité intérieure (50a, 50b) et les parties de commande d'unité extérieure (40a, 40b) permettent une intercommunication,
 dans une période de transition au cours de laquelle une valeur cible dans l'une quelconque des unités intérieures (3a, 3b) est modifiée, la partie de commande d'unité intérieure (50a, 50b), correspondant à l'unité intérieure (3a, 3b) dans laquelle la valeur cible est modifiée, est configurée pour transmettre des informations portant sur une modification de la valeur cible aux parties de commande d'unité extérieure (40a, 40b),
 les parties de commande d'unité extérieure (40a, 40b) sont configurées pour réaliser une intercommunication et pour déterminer, parmi la pluralité des unités extérieures (2a, 2b), l'unité extérieure qui est actionnée pour correspondre à l'unité intérieure (3a, 3b) dans laquelle la valeur cible est modifiée, selon un algorithme stocké au préalable,
 un sous-domaine est formé entre la partie de commande d'unité extérieure (40a, 40b) correspondant à l'unité extérieure déterminée et la partie de commande d'unité intérieure (50a, 50b) correspondant à l'unité intérieure dans laquelle la valeur cible est modifiée, et la partie de commande d'unité extérieure et la partie de commande d'unité intérieure sont virtuellement regroupées, et
 la partie de commande d'unité intérieure (50a, 50b) et la partie de commande d'unité extérieure (40a, 40b) qui sont virtuellement regroupées génèrent respectivement des instructions de commande pour suivre la valeur cible modifiée et permettre à une quantité de variation de la grandeur d'état, dans l'unité intérieure (3a, 3b) et l'unité extérieure (2a, 2b) correspondant respectivement à la partie de commande d'unité intérieure et à la partie de commande d'unité extérieure qui sont virtuellement regroupées, d'être dans une plage prédéterminée au travers d'une communication entre elles, et transmettent les instructions de commande générées à l'unité intérieure et à l'unité extérieure correspondantes.

2. Système de climatisation (1) selon la revendication 1,
 dans lequel les parties de commande d'unité intérieure (50a, 50b) et les parties de commande d'unité extérieure (40a, 40b) qui ne sont pas virtuellement regroupées verrouillent des quantités de fonctionnement tandis que la grandeur d'état est modifiée en

fonction de la valeur cible modifiée dans l'unité intérieure et l'unité extérieure correspondant respectivement à la partie de commande d'unité intérieure (50a, 50b) et à la partie de commande d'unité extérieure (40a, 40b) qui sont virtuellement regroupées, et libèrent le verrouillage des quantités de fonctionnement lorsque la grandeur d'état est stabilisée.

3. Système de climatisation (1) selon la revendication 1 ou 2, dans lequel chacune des unités intérieures (3a, 3b) et la partie de commande d'unité intérieure (50a, 50b) correspondant à l'unité intérieure communiquent dans une correspondance biunivoque les unes avec les autres, et chacune des unités extérieures (2a, 2b) et la partie de commande d'unité extérieure (40a, 40b) correspondant à l'unité extérieure communiquent dans une correspondance biunivoque les unes avec les autres.
4. Système de climatisation (1) selon l'une quelconque des revendications 1 à 3, dans lequel la pluralité de parties de commande d'unité intérieure (50a, 50b) et la pluralité de parties de commande d'unité extérieure (40a, 40b) sont intégrées et montées sous la forme de parties de commande virtualisées sur une seule pièce ou une pluralité de pièces de matériel.
5. Dispositif de commande (10) pour un système de climatisation (1) qui inclut une pluralité d'unités extérieures (2a, 2b) et une pluralité d'unités intérieures (3a, 3b) reliées en parallèle et qui est soumis à une commande décentralisée autonome dans une période normale de sorte qu'une grandeur d'état prédéterminée dans chacune des unités intérieures (3a, 3b) et chacune des unités extérieures (2a, 2b) est dans une plage admissible prédéterminée définie à l'avance, le dispositif comprenant :

une pluralité de parties de commande d'unité intérieure (50a, 50b) fournies pour correspondre respectivement aux unités intérieures (3a, 3b) ; et

une pluralité de parties de commande d'unité extérieure (40a, 40b) fournies pour correspondre respectivement aux unités extérieures (2a, 2b),

dans lequel les parties de commande d'unité intérieure (50a, 50b) et les parties de commande d'unité extérieure (40a, 40b) permettent une intercommunication,

dans une période de transition au cours de laquelle une valeur cible dans l'une quelconque des unités intérieures (3a, 3b) est modifiée, la partie de commande d'unité intérieure (50a, 50b), correspondant à l'unité intérieure dans la-

quelle la valeur cible est modifiée, transmet des informations portant sur une modification de la valeur cible aux parties de commande d'unité extérieure (40a, 40b),

les parties de commande d'unité extérieure (40a, 40b) réalisent une intercommunication et déterminent, parmi la pluralité des unités extérieures (2a, 2b), l'unité extérieure qui est actionnée pour correspondre à l'unité intérieure dans laquelle la valeur cible est modifiée, selon un algorithme stocké au préalable,

un sous-domaine est formé entre la partie de commande d'unité extérieure (40a, 40b) correspondant à l'unité extérieure déterminée et la partie de commande d'unité intérieure (50a, 50b) correspondant à l'unité intérieure (3a, 3b) dans laquelle la valeur cible est modifiée, et la partie de commande d'unité extérieure et la partie de commande d'unité intérieure sont virtuellement regroupées, et

la partie de commande d'unité intérieure (50a, 50b) et la partie de commande d'unité extérieure (40a, 40b) qui sont virtuellement regroupées génèrent respectivement des instructions de commande pour suivre la valeur cible modifiée et permettre à une quantité de variation de la grandeur d'état, dans l'unité intérieure (3a, 3b) et l'unité extérieure (2a, 2b) correspondant respectivement à la partie de commande d'unité intérieure (50a, 50b) et à la partie de commande d'unité extérieure (40a, 40b) qui sont virtuellement regroupées, d'être dans une plage prédéterminée par une communication entre elles, et transmettent les instructions de commande générées à l'unité intérieure et à l'unité extérieure correspondantes.

6. Procédé de commande d'un système de climatisation (1) qui inclut une pluralité d'unités extérieures (2a, 2b) et une pluralité d'unités intérieures (3a, 3b) reliées en parallèle et qui est soumis à une commande décentralisée autonome dans une période normale de sorte qu'une grandeur d'état prédéterminée dans chacune des unités intérieures (3a, 3b) et chacune des unités extérieures (2a, 2b) est dans une plage admissible prédéterminée définie à l'avance, le procédé comprenant :

la formation d'une configuration dans laquelle une pluralité de parties de commande d'unité intérieure (50a, 50b) fournies pour correspondre respectivement aux unités intérieures (3a, 3b) et une pluralité de parties de commande d'unité extérieure (40a, 40b) fournies pour correspondre respectivement aux unités extérieures (2a, 2b) permettent une intercommunication ; dans une période de transition au cours de laquelle une valeur cible dans l'une quelconque

des unités intérieures (3a, 3b) est modifiée, la
partie de commande d'unité intérieure, corres-
pondant à l'unité intérieure (3a, 3b) dans laquel-
le la valeur cible est modifiée, transmet des in-
formations portant sur une modification de la va-
leur cible aux parties de commande d'unité ex-
térieure (40a, 40b),
par les parties de commande d'unité extérieure
(40a, 40b) réalisant une intercommunication, la
détermination, parmi la pluralité des unités ex-
térieures (2a, 2b), de l'unité extérieure qui est
actionnée pour correspondre à l'unité intérieure
dans laquelle la valeur cible est modifiée, selon
un algorithme stocké au préalable,
la formation d'un sous-domaine entre la partie
de commande d'unité extérieure (40a, 40b) cor-
respondant à l'unité extérieure déterminée (2a,
2b) et la partie de commande d'unité intérieure
(50a, 50b) correspondant à l'unité intérieure (3a,
3b) dans laquelle la valeur cible est modifiée, et
le regroupement virtuel de la partie de comman-
de d'unité extérieure (40a, 40b) et de la partie
de commande d'unité intérieure (50a, 50b) ;
par la partie de commande d'unité intérieure
(50a, 50b) et la partie de commande d'unité ex-
térieure (40a, 40b) qui sont virtuellement regrou-
pées, la génération respective d'instructions de
commande pour suivre la valeur cible modifiée
et permettre à une quantité de variation de la
grandeur d'état, dans l'unité intérieure (3a, 3b)
et l'unité extérieure (2a, 2b) correspondant res-
pectivement à la partie de commande d'unité
intérieure (50a, 50b) et à la partie de commande
d'unité extérieure (40a, 40b) qui sont virtuelle-
ment regroupées, d'être dans une plage prédé-
terminée par une communication entre elles ; et
la transmission des instructions de commande
générées à l'unité intérieure et à l'unité extérieu-
re correspondantes.

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FIG. 1

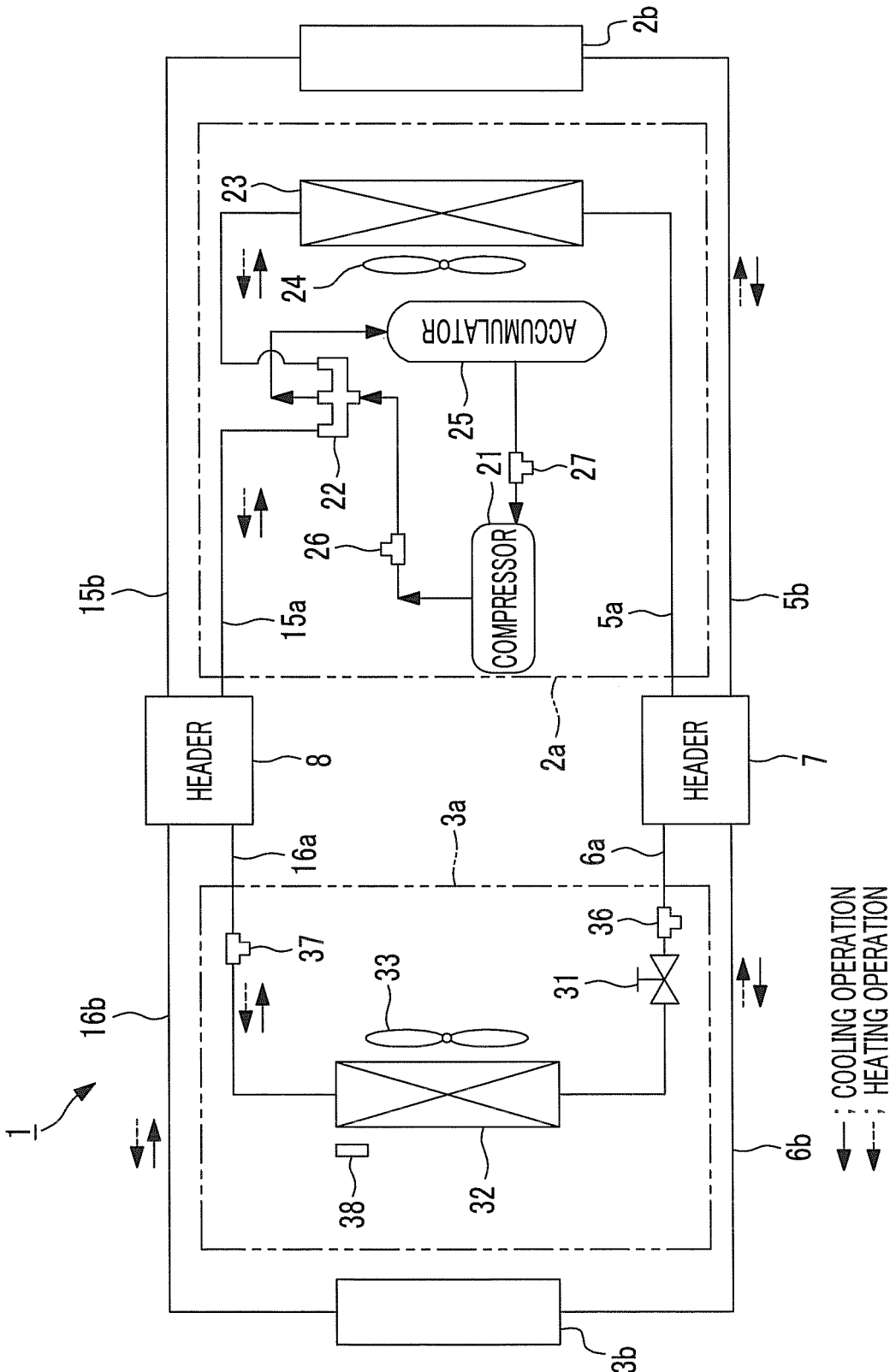


FIG. 2

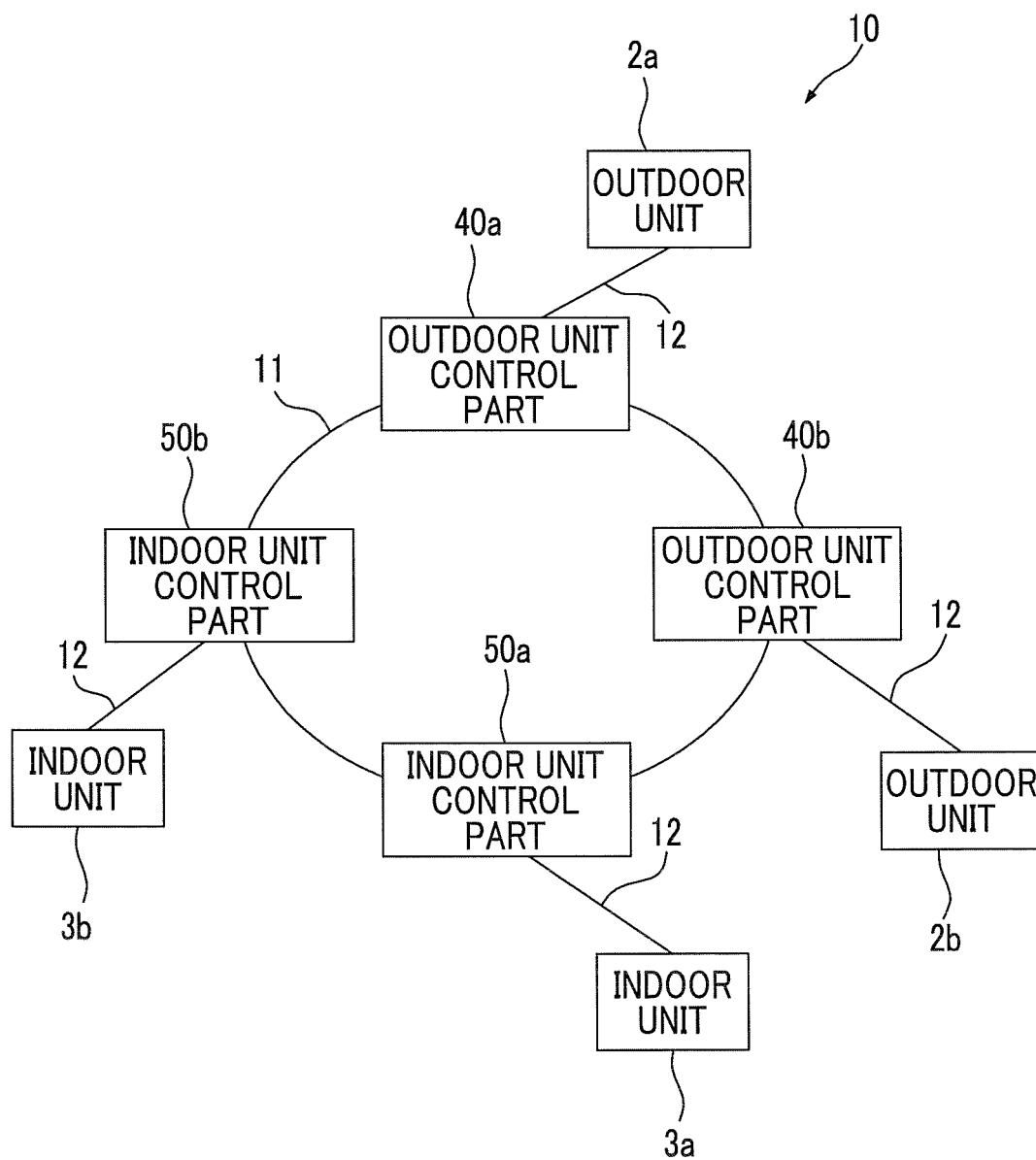
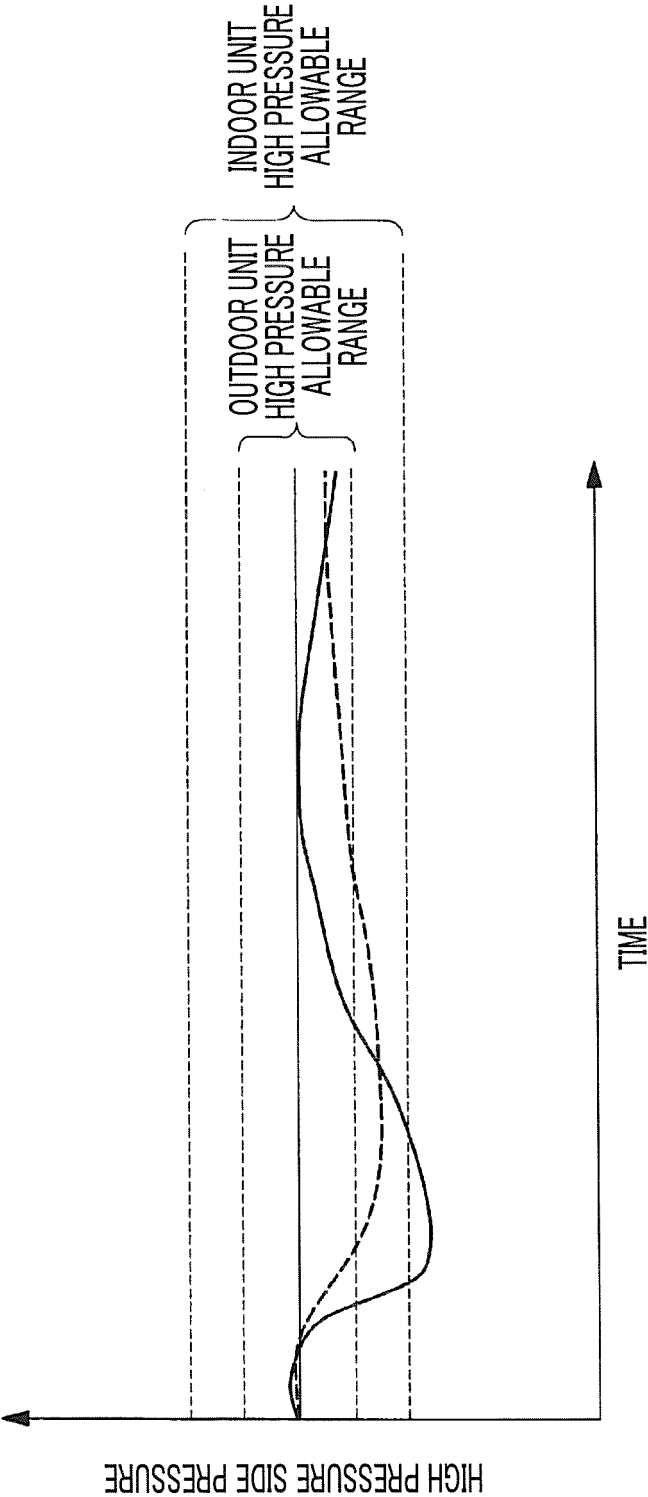


FIG. 3



REFERENCES CITED IN THE DESCRIPTION

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