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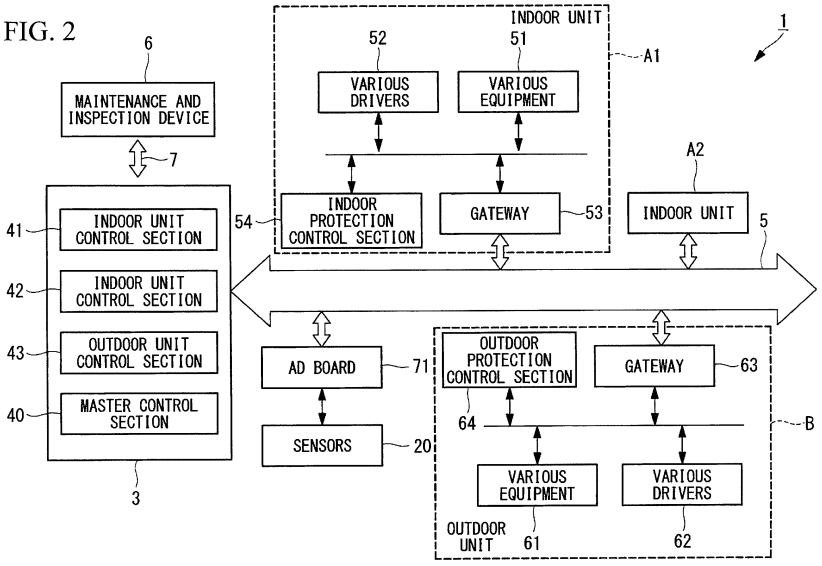
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(54) AIR-CONDITIONING SYSTEM

(57) An air conditioning system (1) includes indoor units (A1, A2), an outdoor unit (B), and a control device (3). Indoor unit control sections (41, 42), which respectively control the indoor units (A1, A2), and an outdoor unit control section (43), which controls the outdoor unit (B), are consolidated into the control device (3). The outdoor unit (B) is provided with an outdoor protection control section (64) that stops a compressor when an emergency stop condition is satisfied. The control device (3), the indoor units (A1, A2), the outdoor unit (B), and sensors (20) are adapted to be able to send and receive information to and from one another via a common bus (5). The indoor unit control sections (41, 42) and the outdoor unit control section (43) in the control device (3) acquire information from the sensors (20) via the common bus (5), and respectively create control instructions to various equipment constituting the indoor units (A1, A2) and the outdoor unit (B) by executing respective control programs.

FIG. 2



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Description

{Technical Field}

[0001] The present invention relates to an air conditioning system.

{Background Art}

[0002] Conventionally, an air conditioning system includes an indoor unit and an outdoor unit. For example, PTL 1 discloses an air conditioning system in which one outdoor unit and a plurality of indoor units are connected to each other via a common refrigerant piping, and the outdoor unit and each of the indoor units are respectively provided with corresponding control devices.

{Citation List}

{Patent Literature}

[0003] {PTL 1}
Japanese Unexamined Patent Application, Publication No. 2012-198020

{Summary of Invention}

{Technical Problem}

[0004] However, in the aforementioned air conditioning system, the indoor units and the outdoor unit are respectively provided with control devices (processors). Therefore, the respective costs of the indoor units and the outdoor unit increase. The air conditioning system is controlled while the indoor units and the outdoor unit communicate with each other. Therefore, all control programs used for the control need to have the same control program version. Therefore, some of the indoor units and the outdoor unit constituting the air conditioning system have not been easily changed to equipment with a new control specification.

[0005] The present invention has been made in view of such circumstances, and is directed to providing an air conditioning system which can implement respective low costs of a single indoor unit and a single outdoor unit while easily upgrading the system.

{Solution to Problem}

[0006] According to a first aspect of the present invention, there is provided an air conditioning system, including an outdoor unit including a communication means and an outdoor protection control means, an indoor unit including a communication means, an outdoor unit control section that is enabled to communicate with the outdoor unit via a communication medium while existing independently of the outdoor unit, and an indoor unit control section that is enabled to communicate with the indoor unit via a communication medium while existing independently of the indoor unit, in which the outdoor unit control section and the indoor unit control section are enabled to send and receive information to and from each other, the outdoor unit control section acquires information on equipment to be connected to the outdoor unit via the communication medium while outputting a control instruction to the equipment to be connected to the outdoor unit, the indoor unit control section acquires information on equipment to be connected to the indoor unit via the communication medium while outputting a control instruction to the equipment to be connected to the indoor unit, and the outdoor protection control means determines whether an emergency stop condition previously set is satisfied, and stops a compressor when the emergency stop condition is satisfied.

[0007] The aforementioned air conditioning system enables respective configurations of the indoor unit and the outdoor unit to be simplified because the indoor unit control section and the outdoor unit control section respectively exist independently of the indoor unit and the outdoor unit, enabling reduction in cost. Further, the indoor unit and the outdoor unit need not be respectively loaded with advanced programs (e.g., are loaded with only a communication function, a component actuation function, and an outdoor protection control function) so that the equipment does not become obsolete, and the outdoor unit and the indoor unit can be easily replaced.

[0008] Further, the indoor unit control section and the outdoor unit control section are respectively provided independently of the indoor unit and the outdoor unit. Therefore, when the indoor unit control section and the outdoor unit control section are placed under control of a manufacturer of the air conditioning system, for example, work such as a program update can be easily performed.

[0009] Furthermore, according to the aforementioned air conditioning system, the outdoor unit is provided with the outdoor protection control means having an emergency stop function. Therefore, even if communication between the outdoor unit and the outdoor unit control section remains blocked, the compressor can be quickly stopped when an event requiring emergency stop has occurred.

[0010] In the aforementioned control system, the outdoor protection control means determines, when low pressure is not more than a first threshold value previously set or when high pressure is not less than a second threshold value previously set, for example, that the emergency stop condition is satisfied, and stops the compressor.

[0011] In the aforementioned control system, the outdoor protection control means may perform protection control to reduce a rotation speed of the compressor when the low pressure is not more than a third threshold value set to a larger value than the first threshold value or when the high pressure is not less than a fourth threshold value set to a smaller value than the second threshold

value.

[0012] This control system enables the emergency stop to be prevented from occurring as much as possible because the protection control is performed before the emergency stop occurs.

[0013] In the aforementioned control system, the indoor unit may further include an indoor protection control means that brings an expansion valve into a fully closed state when the temperature of a heat exchanger is not more than a fifth threshold value previously set.

[0014] According to this air conditioning system, the indoor unit is provided with a function (anti-frost function) of bringing the expansion valve into a fully closed state when the temperature of the heat exchanger is reduced to not more than the fifth threshold value. Thus, even if the communication between the indoor unit and the indoor unit control section remains blocked, the expansion valve can be quickly brought into a fully closed state when an event requiring anti-frost has occurred.

[0015] In the aforementioned air conditioning system, the outdoor unit control section and the indoor unit control section may be respectively loaded as virtualized control sections onto a control device.

[0016] Thus, the control sections can be flexibly created depending on connection equipment by existing as the virtualized control sections. Further, hardware resources of the control device may be determined depending on the scale of the air conditioning system. Therefore, waste of CPU (Central Processing Unit) resources can be reduced.

{Advantageous Effects of Invention}

[0017] According to the present invention, respective low costs of a single outdoor unit and a single indoor unit can be implemented while the system can be easily upgraded.

{Brief Description of Drawings}

[0018]

{Fig. 1}
Fig. 1 is a diagram illustrating a refrigerant system in an air conditioning system according to an embodiment of the present invention.
{Fig. 2}
Fig. 2 is an electrical configuration diagram of the air conditioning system according to the embodiment of the present invention.
{Fig. 3}
Fig. 3 is a diagram illustrating an example of a hierarchical structure for communication of the air conditioning system according to the embodiment of the present invention.
{Fig. 4}
Fig. 4 is a flowchart illustrating a processing procedure at the time of startup of a control device.

{Description of Embodiments}

[0019] An air conditioning system according to an embodiment of the present invention and a method of controlling the same will be described below with reference to the drawings.

[0020] Fig. 1 is a diagram illustrating a refrigerant system in an air conditioning system 1 according to the present embodiment. As illustrated in Fig. 1, the air conditioning system 1 includes one outdoor unit B and a plurality of indoor units A1 and A2 connected to the outdoor unit B via a common refrigerant piping. While a configuration in which two indoor units A1 and A2 are connected to one outdoor unit B is illustrated for convenience in Fig. 1, the number of outdoor units to be installed and the number of indoor units to be connected thereto are not limited.

[0021] The outdoor unit B includes a compressor 11 that compresses and sends out a refrigerant, a four-way valve 12 that switches a circulation direction of the refrigerant, an outdoor heat exchanger 13 that exchanges heat between the refrigerant and external air, an outdoor fan 15, an accumulator 16 provided in an intake-side piping of the compressor 11 for the purpose of gas-liquid separation of the refrigerant, for example.

[0022] Each of the indoor units A1 and A2 includes an indoor heat exchanger 31a and 31b, an indoor fan 32a and 32b, an electronic expansion valve 33a and 33b, and the like. The two indoor units A1 and A2 are respectively connected to refrigerant pipings 21A and 21B that branch from each of a header 22 and a distributor 23 in the outdoor unit B.

[0023] Each of the outdoor unit B and the indoor units A1 and A2 is provided with various sensors 20 (see Fig. 2) such as a pressure sensor 21 that measures refrigerant pressure (including a pressure sensor 21a that measures high pressure and a pressure sensor 21b that measures low pressure) and a temperature sensor 24 that measures refrigerant temperature and the like (including a temperature sensor 24a that measures the temperature of the indoor heat exchanger 31a and a temperature sensor 24b that measures the temperature of the indoor heat exchanger 31b).

[0024] Fig. 2 is an electrical configuration diagram of the air conditioning system 1 according to the present embodiment. As illustrated in Fig. 2, the indoor units A1 and A2, the outdoor unit B, and a control device 3 are connected to one another via a common bus 5, and is adapted to be able to send and receive information to and from one another. The common bus 5 is one example of a communication medium irrespective of whether communication is wireless or wired.

[0025] The control device 3 is connected to a maintenance and inspection device 6, which performs maintenance and inspection, via a communication medium 7, and is adapted to be able to periodically transmit operation data and quickly notify, when an abnormality has occurred, the occurrence of the abnormality.

[0026] In the conventional air conditioning system, control devices are respectively provided inside the indoor unit control section and the outdoor unit control section, as illustrated in PTL 1. On the other hand, in the present embodiment, indoor unit control sections 41 and 42 and an outdoor unit control section 43 are respectively provided independently of the indoor units A1 and A2 and the outdoor unit B. More specifically, the indoor unit control section 41 that controls the indoor unit A1, the indoor unit control section 42 that controls the indoor unit A2, and the outdoor unit control section 43 that controls the outdoor unit B are respectively mounted as virtualized control sections on the control device 3.

[0027] That is, the indoor unit control sections 41 and 42 and the outdoor unit control section 43 are consolidated into the control device 3 having one hardware, and are made independently operable on the hardware of the control device 3. The control device 3 includes a master control section 40 for causing the indoor unit control sections 41 and 42 and the outdoor unit control section 43 to virtually exist in the control device. Processing for creating the indoor unit control sections 41 and 42 and the outdoor unit control section 43 by the master control section 40, for example, will be described below.

[0028] In the control device 3, the indoor unit control sections 41 and 42 and the outdoor unit control section 43 are adapted to be able to send and receive information to and from each other. The indoor unit control sections 41 and 42 and the outdoor unit control section 43 may respectively perform autonomous distributed controls to be independently implemented while sharing information, for example. Here, the autonomous distributed control means that the control section receives information from the sensors 20 and the other control section (e.g., the indoor unit control section 42 and the outdoor unit control section 43 correspond to the other control section if the control section is the indoor unit control section 41) and a predetermined application follows a control rule using the information as an input to issue a control instruction to the corresponding indoor unit or outdoor unit (e.g., the indoor unit A1 if the control section is the indoor unit control section 41).

[0029] The indoor unit A1 includes various equipment (including some of the sensors) 51 in the indoor unit A1, various drivers 52 respectively provided to correspond to the various equipment such as the indoor fan 32a and the electronic expansion valve 33a (see Fig. 1), a gateway (communication means) 53, and an indoor protection control section 54. Each of the equipments are connected to one another via an internal bus while being connected to the common bus 5 via the gateway 53.

[0030] The indoor protection control section 54 is implemented when a processor loads an indoor protection program (e.g., an anti-frost program) recorded on a computer readable recording medium into a main storage device and executes the loaded indoor protection program, for example. The indoor protection control section 54 receives a measurement value from the temperature sensor 24a, which measures the temperature of the indoor heat exchanger 31a (see Fig. 1), via the internal bus, determines, when the measurement value is not more than a threshold value (fifth threshold value) previously set, that freezing may occur, and performs anti-frost control to bring the electronic expansion valve 33a in the indoor unit A1 into a fully closed state.

[0031] The indoor protection control section 54 can also acquire a temperature measurement value of the indoor heat exchanger 31a via the common bus 5 and the gateway 53 from the sensors 20, as described below. However, in this case, when a communication failure has occurred in the common bus 5, the temperature measurement value cannot be acquired so that protection control becomes impossible. Accordingly, the temperature measurement value is preferably acquired via the internal bus. The temperature measurement value may be acquired from both respective routes via the internal bus and the common bus 5.

[0032] The indoor unit A2 also has a similar configuration to that of the indoor unit A1, although illustration thereof is omitted.

[0033] The outdoor unit B includes various equipment (including some of the sensors) 61 such as the compressor 11, the four-way valve 12, and the outdoor fan 15 (see Fig. 1), various drivers 62 respectively provided to correspond to the various equipment 61, a gateway (communication means) 63, and an outdoor protection control section 64. Each of the equipments are connected to one another via an internal bus while being connected to the common bus 5 via the gateway 63.

[0034] The outdoor protection control section 64 is a function implemented when the processor loads an outdoor protection program recorded on the computer readable recording medium into the main storage device and executes the loaded outdoor protection program, for example. The outdoor protection control section 64 acquires high pressure-side pressure and low pressure-side pressure, respectively, from the pressure sensor 21a and the pressure sensor 21b (see Fig. 1) at predetermined timings, determines, when the low pressure is not more than a first threshold value previously set or when the high pressure is not less than a second threshold value previously set, that emergency stop is required, and performs emergency stop control for stopping the compressor 11. Further, the outdoor protection control section 64 performs protection control to reduce a rotation speed of the compressor 11 when the low pressure is not more than a third threshold value set to a larger value than the first threshold value or when the high pressure of the compressor 11 is not less than a fourth threshold value set to a smaller value than the second threshold value.

[0035] The outdoor protection control section 64 can also acquire low pressure and high pressure, respectively, from the pressure sensors 21a and 21b (the sensors 20) via the common bus 5 and the gateway 63, as described below. However, in this case, when a communi-

cation failure occurs in the common bus 5, a pressure measurement value cannot be acquired so that the aforementioned emergency stop and protection control cannot be performed. Accordingly, the high pressure and the low pressure are preferably acquired via the internal bus. The pressure measurement value may be acquired from both respective routes via the internal bus and the common bus 5.

[0036] Each of the gateways 53 and 63 is a gathering of functions including a communication driver, an address storage region, an equipment attribute storage region, an OS (Operating System), and a communication framework, for example. The address storage region is a storage region for storing a specific address previously allocated to communicate with the control device 3 or the like. The equipment attribute storage region is a region for storing its own attribute information and attribute information on the retained equipment 51 or 61, and stores information such as either an indoor unit or an outdoor unit, a capability, on-board sensors (e.g., a temperature sensor, a pressure sensor, etc.), and equipment information (e.g., the number of taps of a fan, a full pulse of a valve, etc.).

[0037] Furthermore, the sensors 20 (e.g., a pressure sensor that measures refrigerant pressure, a temperature sensor that measures refrigerant temperature, etc.) provided in each of the outdoor unit B and the indoor units A1 and A2 are connected to the common bus 5 via an AD (Analog/Digital) board 71. If the measurement accuracy of the sensors 20 is low, a node having a correction function for correcting a measurement value may be provided between the AD board 71 and the sensors 20. Thus, a sensor, which is low in cost and is not so high in measurement accuracy, can be used as the sensors 20 by being made to have the correction function.

[0038] In this air conditioning system 1, each of the indoor unit control section 41 and 42 in the control device 3 acquires measurement data and control information from the sensors 20 and the various drivers 52 and 62 via the common bus 5, and outputs a control instruction to the various equipment (e.g., the indoor fans 32, the electronic expansion valves 33, etc.) provided in the indoor unit A1 or A2 by executing a predetermined indoor unit control program based on the measurement data, for example. The control instruction is sent to the various drivers 52 via the common bus 5 and the gateway 53. The various drivers 52 drive the respectively corresponding equipment based on the received control instruction. Thus, control of the indoor units A1 and A2 based on the control instructions is implemented.

[0039] Similarly, the outdoor unit control section 43 in the control device 3 acquires measurement data and control information from the sensors 20 and the various drivers 52 and 62 via the common bus 5, and outputs a control instruction to the various equipment (e.g., the compressor 11, the four-way valve 12, the outdoor heat exchanger 13, the outdoor fan 15, etc.) provided in the outdoor unit B by executing a predetermined outdoor unit control program based on the measurement data. The control instruction is sent to the various drivers 62 via the common bus 5 and the gateway 63. The various drivers 62 drive the respectively corresponding equipment based on the received control instruction.

[0040] Fig. 3 illustrates an example of a hierarchical structure for communication of the air conditioning system 1. As illustrated in Fig. 3, the air conditioning system 1 has a hardware layer (hereinafter referred to as an "HW layer"), a driver layer, an operation system layer (hereinafter referred to as an "OS" layer), a framework layer, and an application layer.

[0041] The HW layer has a common bus, a fan motor, a louver motor, and sensors. The driver layer has a communication driver for communication via the common bus 5, an equipment driver for driving the fan motor, the louver motor, and the like, and a sensor driver for driving the sensors. Particularly, communication among the control device 3, the indoor units A1 and A2, and the outdoor unit A3 is performed using a driver layer (information defined by the driver layer). Therefore, an amount of each information to be communicated via the common bus 5 can be made smaller than that when communication is performed using the application layer or the framework layer.

[0042] The framework layer has a communication framework, an equipment operation control framework, and a setting parameter. The framework layer converts a physical unit and a control unit of an actual equipment, for example. For example, the conversion is performed so that a physical unit such as 1 % valve opening corresponds to 12 pulses of a stepping motor.

[0043] The application layer has a function of operating equipment in the indoor unit A1 according to an instruction from the common bus 5 and sending out equipment failure information, and mainly has an equipment operation control application and a setting application. For example, the equipment operation control application is a program relating to control of the various equipment (e.g., the indoor heat exchanger 31, the indoor fan 32, the electronic expansion valve 33, etc.) constituting the indoor unit A1, e.g., a program for performing control relating to the start and the stop of the indoor unit A1, and change of a state such as an operation mode or a set temperature.

[0044] For the indoor units A1 and A2 and the outdoor unit B, autonomous distributed controls may be respectively performed by the indoor unit control sections 41 and 42 and the outdoor unit control section 43. In this case, a control rule is set between the indoor units A1 and A2 and the outdoor unit B, and each of the indoor units A1 and A2 and the outdoor unit B performs the control according to this control rule. For example, when refrigerant pressure is taken as an example, the indoor units A1 and A2 respectively determine, if refrigerant pressure acquired from the sensors 20 is within a predetermined first allowable variation range, control instructions for matching an actual temperature and an actual

air volume with a set temperature and a set air volume, which have been set by a user or the like, and output the control instructions to the indoor units A1 and A2 via the common bus 5. The indoor unit control sections 41 and 42 may respectively determine control instructions by giving and accepting information to and from each other to cooperate with each other. The outdoor unit control section 43 determines an output instruction from the air conditioning system 1 for maintaining the refrigerant pressure within a predetermined second allowable variation range, e.g., a control instruction relating to a rotation speed of the compressor 11, a rotation speed of the outdoor fan 15, and the like, and transmits the determined output instruction to the outdoor unit B via the common bus 5.

[0045] When the first allowable range is set wider than the second allowable range, for example, the outdoor unit control section 43 can grasp output change information on the indoor units A1 and A2 and determine a behavior of the outdoor unit B.

[0046] An example of processing performed in the control device 3 will be described below with reference to Fig. 4.

[0047] Fig. 4 is a flowchart illustrating a processing procedure performed by the control device 3 at the time of startup of the air conditioning system. First, at the time of startup of the air conditioning system 1, the master control section 40 in the control device 3 is first started. The startup of the master control section 40 is implemented when the CPU in the control device 3 executes a program. Here, the master control section 40 is also a control section virtually created in the control device 3. The master control section 40 transmits a connection equipment request (step SA1 illustrated in Fig. 4). Thus, the connection equipment request is transmitted to each of connection equipment via the common bus 5. The gateway 53 in each of the indoor units A1 and A2 and the gateway 63 in the outdoor unit B, which have received the connection equipment request, read out attribute information from an equipment attribute storage region while reading out address information from an address storage region, associates the information, and return the information to the control device 3 (step SA2).

[0048] Thus, the master control section 40 acquires connection of the indoor units A1 and A2 and the outdoor unit B as the connection equipment, and the equipment loaded on each of the indoor units A1 and A2 and the outdoor unit B and address information thereon.

[0049] The master control section 40 gets the number of connection equipment based on the received attribute information, and arranges virtual CPUs and memory regions depending on the number of connection equipment (step SA3). Thus, in the control device 3, each of the indoor units A1 and A2 and the outdoor unit B is assigned the virtual CPU and the memory region corresponding thereto. Then, the master control section 40 acquires a control module corresponding to each of the attribute information from a control module storage section (not illustrated), and creates custom control programs respectively corresponding to the indoor units A1 and A2 and the outdoor unit B (step SA4).

[0050] Here, the control module is a control program provided to correspond to each of a plurality of equipment (e.g., a fan, an expansion valve, a compressor, etc.) provided in each of the indoor units A1 and A2 and the outdoor unit B. Thus, when the control program is created in a control module unit, the custom control program can be customized depending on the equipment to be loaded by each of the indoor units A1 and A2 and the outdoor unit B. Thus, the custom control program can be created with the minimum necessary number of control modules so that a memory capacity can be reduced.

[0051] Instead of creating the custom control program in a control module unit, as described above, a general-purpose control program for an indoor unit and a general-purpose control program for an outdoor unit may be prepared and used as they are.

[0052] The control module storage section may be provided in the control device 3, or may be provided on a server connected via a network. When downloaded from an external server, resources of the control device 3 can be effectively used.

[0053] The master control section 40 stores, when it creates the custom control programs respectively corresponding to the indoor units A1 and A2 and the outdoor unit B, the created custom control programs in the memory regions previously arranged (step SA5). Then, the master control section 40 stores a memory image and connection equipment information stored in each of the memory regions in a master storage region (not illustrated) (step SA6). This is for quickly performing the second and subsequent startups. Then, the master control section 40 issues a start instruction to each of the virtual CPUs (step SA7). Thus, when the virtual CPUs respectively execute the custom control programs stored in the corresponding memory regions, the indoor unit control sections 41 and 42 and the outdoor unit control section 43 are started to enter a ready state (step SA8). That is, the indoor unit control sections 41 and 42 and the outdoor unit control section 43 are created in the control device 3 when the respective virtual CPUs execute the custom control programs stored in the corresponding storage regions.

[0054] Thus, control of the indoor units A1 and A2 by the indoor unit control sections 41 and 42 and control of the outdoor unit B by the outdoor unit control section 43 are implemented. After the indoor unit control sections 41 and 42 and the outdoor unit control section 43 are started, the master control section 40 may be brought into a stop state or deleted. When the master control section 40 is deleted, the CPU capability of the master control section 40 can be reduced to zero so that shortage of other resources can be avoided.

[0055] In parallel with respective controls of the indoor units A1 and A2 and the outdoor unit B by the indoor unit control sections 41 and 42 and the outdoor unit control

section 43, protection control by the indoor protection control section 54 is performed in each of the indoor units A1 and A2, and emergency stop/protection control by the outdoor protection control section 64 is performed in the outdoor unit B.

[0056] For example, the indoor protection control section 54 in the indoor unit A1 determines whether the temperature of the indoor heat exchanger 31a is not more than a threshold value at predetermined time intervals, and changes, when the temperature of the indoor heat exchanger 31a is not more than the threshold value, the electronic expansion valve 33a into a fully closed state, assuming that freezing may occur. If such protection control has been performed, the indoor unit control section 41 in the control device 3 is notified of information indicating that protection control has been performed via the gateway 53.

[0057] In the outdoor unit B, it is determined whether low pressure is not more than a third threshold value or high pressure is not less than a fourth threshold value at predetermined time intervals, and protection control to reduce a rotation speed of the compressor 11 is performed when this condition is satisfied. Further, it is determined whether low pressure is not more than a first threshold value or high pressure is not less than a second threshold value at predetermined time intervals, and it is determined that emergency stop is required when this condition is satisfied, to change the compressor 11 to an emergency stop.

[0058] If such protection control or emergency stop control has been performed, the outdoor unit control section 43 in the control device 3 is notified of information indicating that protection control or emergency stop control has been performed via the gateway 63.

[0059] As described above, according to the air conditioning system 1 according to the present embodiment and a method of controlling the same, the indoor unit control sections 41 and 42 and the outdoor unit control section 43 are consolidated into the control device 3 while being respectively created as the virtualized control sections. Thus, each of the indoor units A1 and A2 and the outdoor unit B need not be provided with a control section (excluding a CPU serving as a driver for driving various equipment). Therefore, respective configurations of the indoor units A1 and A2 and the outdoor unit B can be simplified. As a result, reduction in cost can be realized. Further, the indoor units A1 and A2 and the outdoor unit B need not be respectively loaded with advanced programs. Therefore, the equipment does not become obsolete. Moreover, a partial update (replacement) is enabled. Further, the control device 3 can reflect, when it updates a program used as a base of a loaded program, i.e., a control module, the update on the control section virtualized and created. Thus, the entire system can be easily upgraded. Further, hardware resources may be determined depending on the scale of the air conditioning system 1. Therefore, waste of CPU resources can be reduced.

[0060] The indoor units A1 and A2 are respectively provided with the indoor protection control sections 54 and the outdoor unit B is provided with the outdoor protection control section 64. Therefore, the indoor units A1 and A2 and the outdoor unit B can be made to respectively have protection functions as configurations separate from the indoor unit control sections 41 and 42 and the outdoor unit control section 43 provided in the control device 3. Thus, even if a communication failure has occurred in the common bus 5, for example, the protection functions can be continuously performed.

[0061] While the indoor unit control sections 41 and 42 and the outdoor unit control section 43 are consolidated into the control device 3, and respectively exist as virtualized control sections in the present embodiment, such an aspect need not necessarily be used. For example, the indoor unit control sections 41 and 42 and the outdoor unit control section 43 may respectively exist independently of the indoor units A1 and A2 and the outdoor unit B. The indoor unit control sections 41 and 42 and the outdoor unit control section 43 may be provided on a cloud. While the control device 3 and each of the indoor units A1 and A2 and the outdoor unit B2 are connected to each other via the common bus 5 in the present embodiment, the present invention is not limited to such an aspect. For example, each of the indoor unit control sections 41 and 42 and the indoor units A1 and A2 respectively corresponding thereto may be in a one-to-one communication. When the control section (e.g., the indoor unit control section 41) and the corresponding equipment (e.g., the indoor unit A1) are thus in a one-to-one communication, a communication delay caused by an increase in communication amount can be reduced. For communication between the control sections within the control device 3, high-speed communication can be applied. Therefore, an effect of a decrease in communication speed by an increase in data amount can be avoided.

[0062] Flap control or fan control in the indoor units A1 and A2 is not performed by the indoor unit control sections 41 and 42 created in the control device 3 but may be performed by control sections (not illustrated) respectively provided in the indoor units A1 and A2. Flap control or fan control is performed according to an instruction from a remote controller, and may be thus handled because the control is completed by the indoor units alone.

{Reference Signs List}

[0063]

1	Air conditioning system
3	Control device
40	Master control section
41, 42	Indoor unit control section
43	Outdoor unit control section
54	Indoor protection control section
64	Outdoor protection control section
A1, A2	Indoor unit

B Outdoor unit

Claims

1. An air conditioning system comprising:

   an outdoor unit including a communication means and an outdoor protection control means;
   an indoor unit including a communication means;
   an outdoor unit control section that is enabled to communicate with the outdoor unit via a communication medium while existing independently of the outdoor unit; and
   an indoor unit control section that is enabled to communicate with the indoor unit via a communication medium while existing independently of the indoor unit,
   wherein the outdoor unit control section and the indoor unit control section are enabled to send and receive information to and from each other,
   the outdoor unit control section acquires information on equipment to be connected to the outdoor unit via the communication medium while outputting a control instruction to the equipment to be connected to the outdoor unit,
   the indoor unit control section acquires information on equipment to be connected to the indoor unit via the communication medium while outputting a control instruction to the equipment to be connected to the indoor unit, and
   the outdoor protection control means determines whether an emergency stop condition previously set is satisfied, and stops a compressor when the emergency stop condition is satisfied.

2. The air conditioning system according to claim 1, wherein the outdoor protection control means determines, when low pressure is not more than a first threshold value previously set or when high pressure is not less than a second threshold value previously set, that the emergency stop condition is satisfied, and stops the compressor.

3. The air conditioning system according to claim 2, wherein the outdoor protection control means performs protection control to reduce a rotation speed of the compressor when the low pressure is not more than a third threshold value set to a larger value than the first threshold value or when the high pressure is not less than a fourth threshold value set to a smaller value than the second threshold value.

4. The air conditioning system according to any one of claims 1 to 3, wherein the indoor unit includes an indoor protection control means that changes an expansion valve into a fully closed state when the temperature of a heat exchanger is not more than a fifth threshold value previously set.

5. The air conditioning system according to any one of claims 1 to 4, wherein the outdoor unit control section and the indoor unit control section are respectively loaded as virtualized control sections onto a control device.

FIG. 1

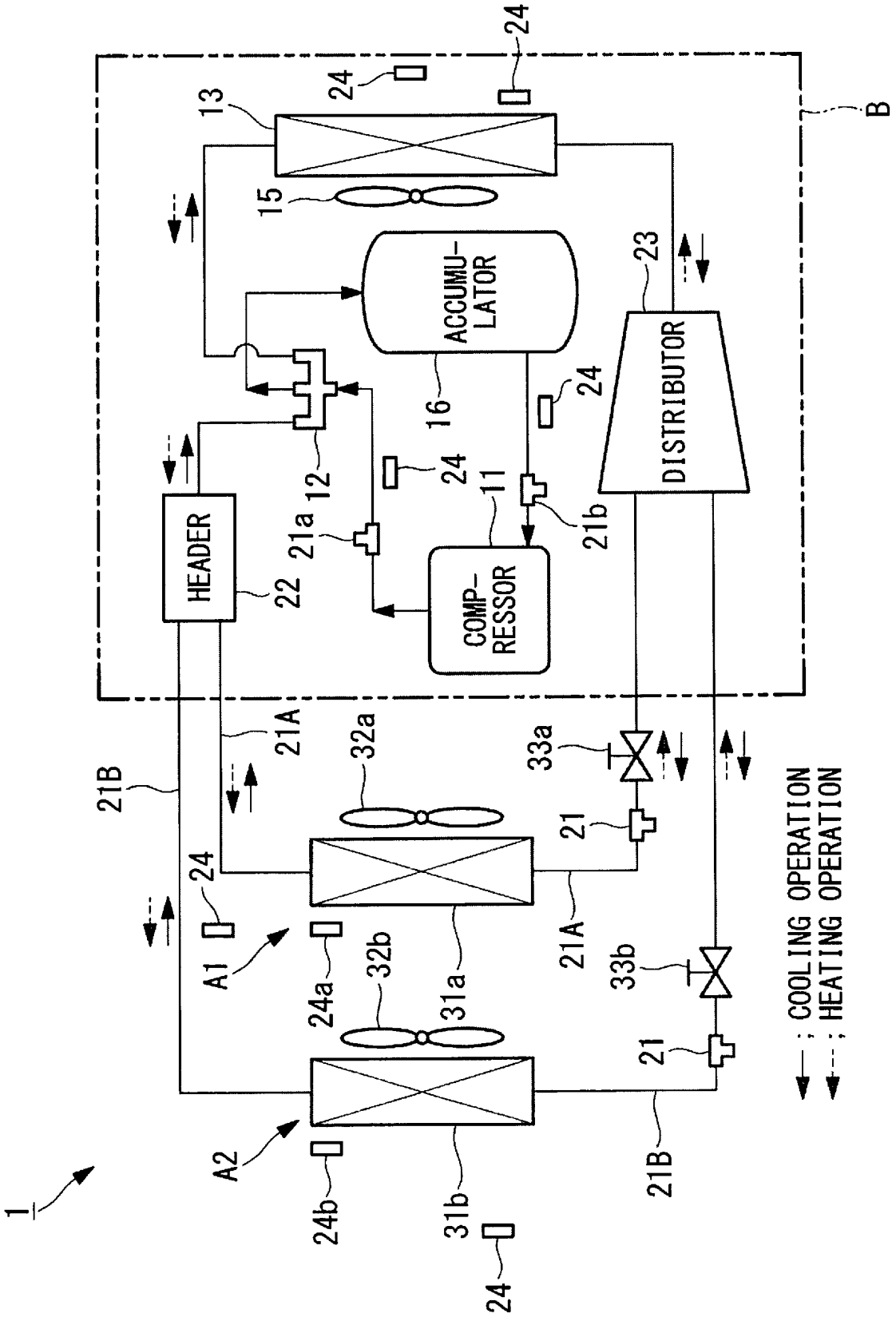

1
A1
A2
B
HEADER
22
ACCUMU-
LATOR
16
COMP-
RESSOR
DISTRIBUTOR
23
11
12
13
15
21
21A
21B
21a
21b
24
24a
24b
31a
31b
32a
32b
33a
33b
: COOLING OPERATION
: HEATING OPERATION

FIG. 2

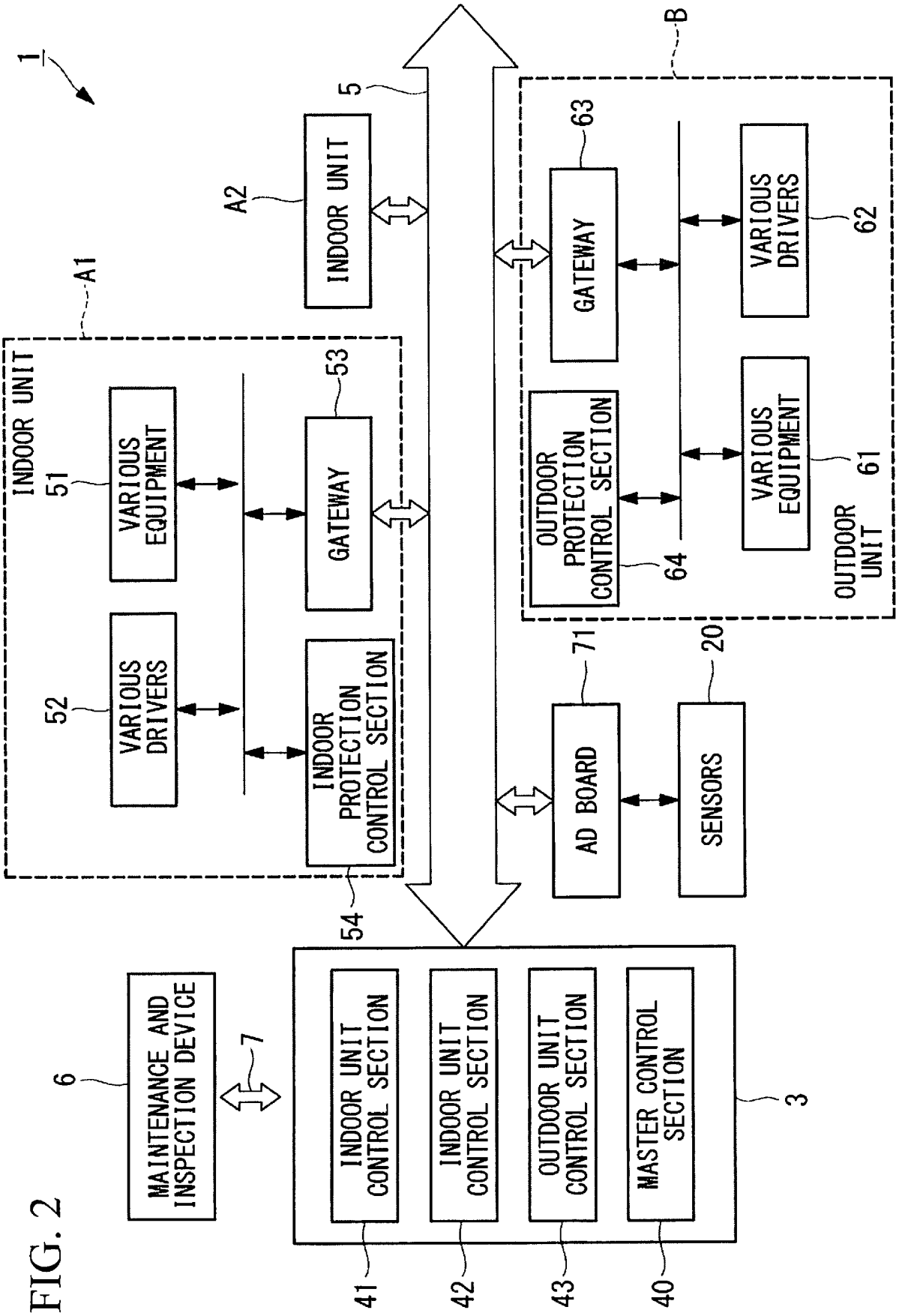

1
A1
INDOOR UNIT
51
VARIOUS EQUIPMENT
52
VARIOUS DRIVERS
53
GATEWAY
INDOOR PROTECTION CONTROL SECTION
54
A2
INDOOR UNIT
5
B
OUTDOOR UNIT
63
GATEWAY
62
VARIOUS DRIVERS
OUTDOOR PROTECTION CONTROL SECTION
64
VARIOUS EQUIPMENT
61
71
AD BOARD
20
SENSORS
6
MAINTENANCE AND INSPECTION DEVICE
7
INDOOR UNIT CONTROL SECTION
INDOOR UNIT CONTROL SECTION
OUTDOOR UNIT CONTROL SECTION
MASTER CONTROL SECTION
3
41
42
43
40

FIG. 3

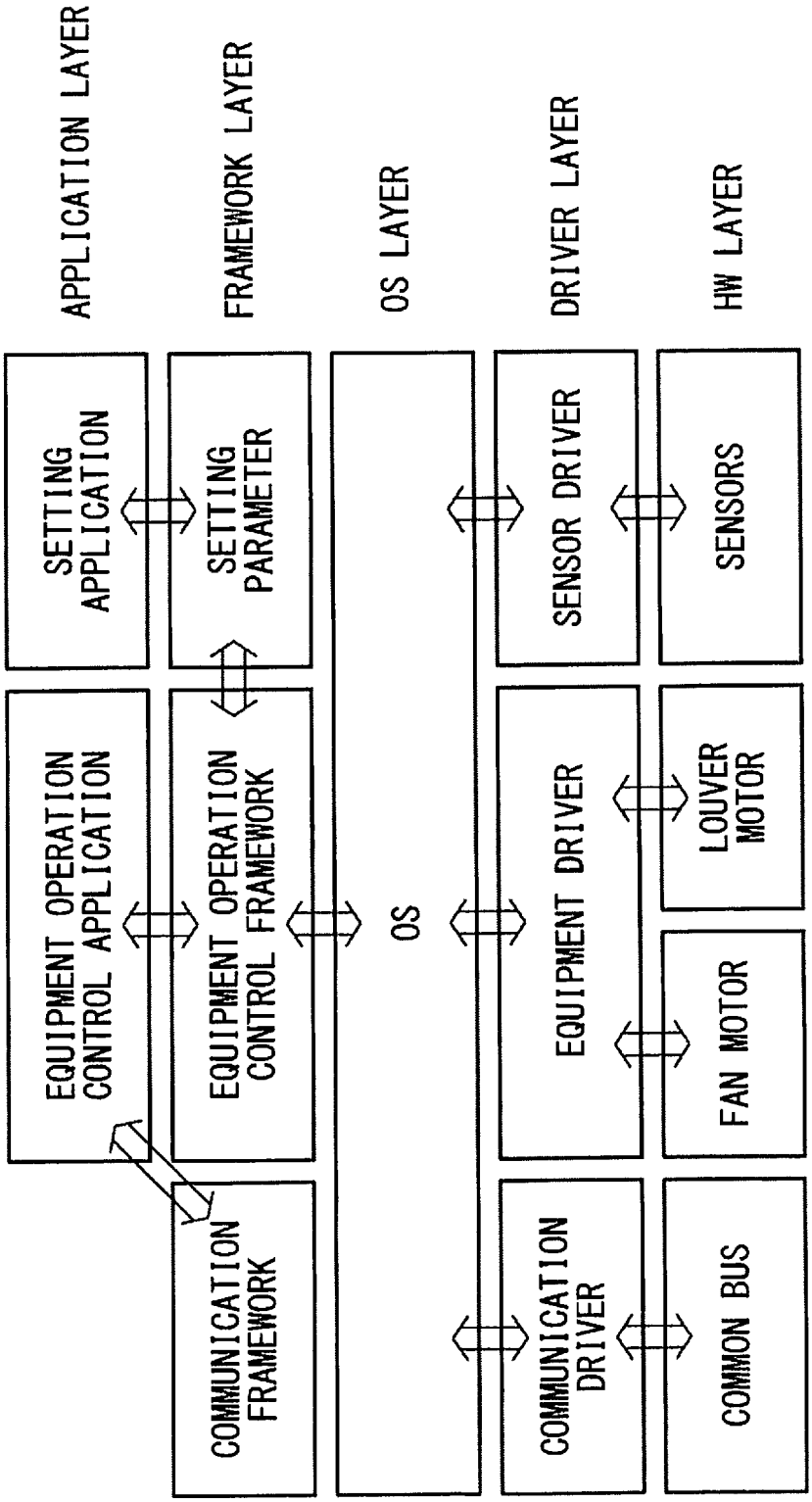
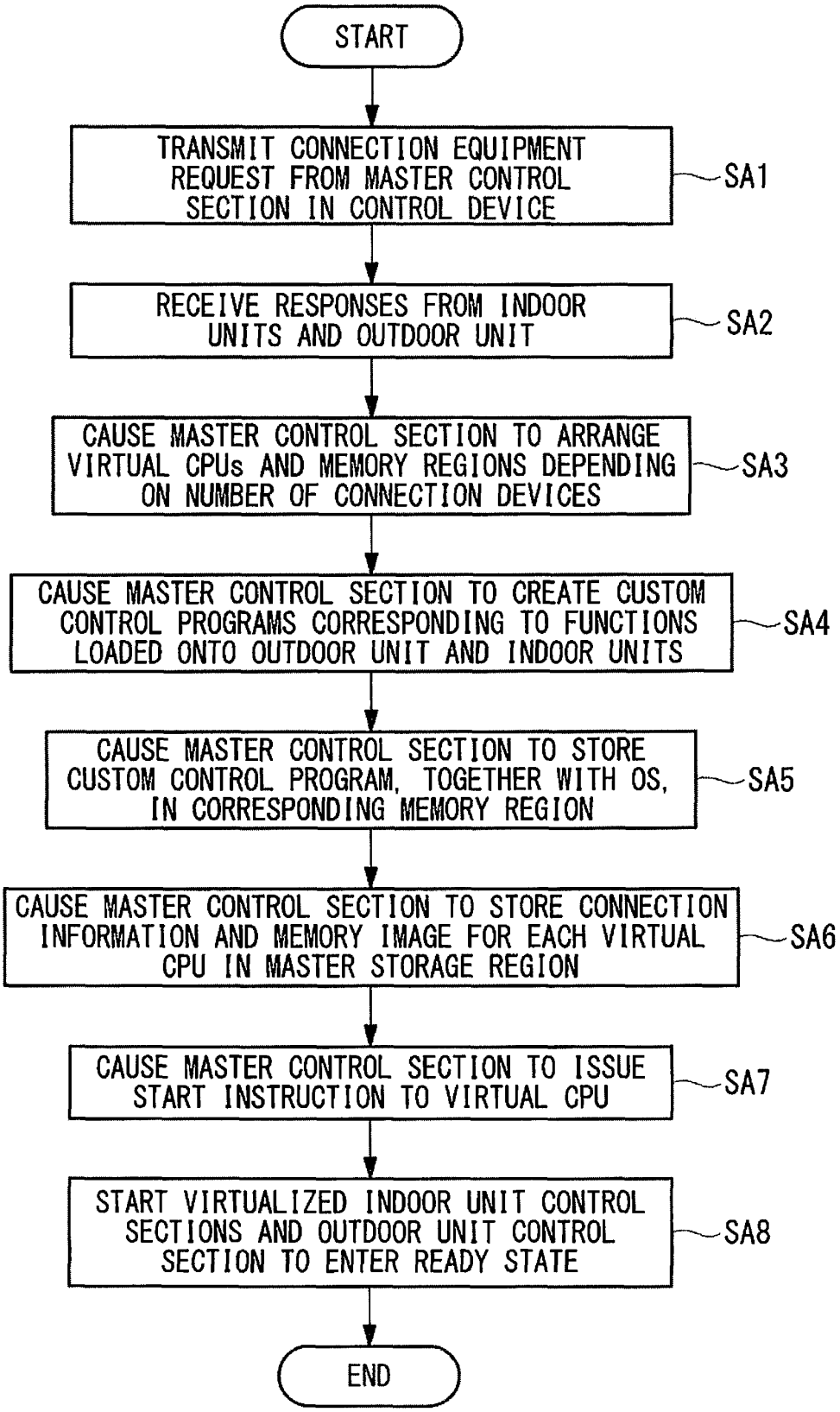

APPLICATION LAYER
FRAMEWORK LAYER
OS LAYER
DRIVER LAYER
HW LAYER
SETTING APPLICATION
SETTING PARAMETER
SENSOR DRIVER
SENSORS
EQUIPMENT OPERATION CONTROL APPLICATION
EQUIPMENT OPERATION CONTROL FRAMEWORK
OS
EQUIPMENT DRIVER
LOUVER MOTOR
FAN MOTOR
COMMUNICATION FRAMEWORK
COMMUNICATION DRIVER
COMMON BUS

FIG. 4


START
TRANSMIT CONNECTION EQUIPMENT REQUEST FROM MASTER CONTROL SECTION IN CONTROL DEVICE
SA1
RECEIVE RESPONSES FROM INDOOR UNITS AND OUTDOOR UNIT
SA2
CAUSE MASTER CONTROL SECTION TO ARRANGE VIRTUAL CPUs AND MEMORY REGIONS DEPENDING ON NUMBER OF CONNECTION DEVICES
SA3
CAUSE MASTER CONTROL SECTION TO CREATE CUSTOM CONTROL PROGRAMS CORRESPONDING TO FUNCTIONS LOADED ONTO OUTDOOR UNIT AND INDOOR UNITS
SA4
CAUSE MASTER CONTROL SECTION TO STORE CUSTOM CONTROL PROGRAM, TOGETHER WITH OS, IN CORRESPONDING MEMORY REGION
SA5
CAUSE MASTER CONTROL SECTION TO STORE CONNECTION INFORMATION AND MEMORY IMAGE FOR EACH VIRTUAL CPU IN MASTER STORAGE REGION
SA6
CAUSE MASTER CONTROL SECTION TO ISSUE START INSTRUCTION TO VIRTUAL CPU
SA7
START VIRTUALIZED INDOOR UNIT CONTROL SECTIONS AND OUTDOOR UNIT CONTROL SECTION TO ENTER READY STATE
SA8
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/052306

A. CLASSIFICATION OF SUBJECT MATTER
F24F11/02(2006.01)i, *F25B1/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F11/02, F25B1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2014-105966 A (Mitsubishi Electric Corp.), 09 June 2014 (09.06.2014), paragraphs [0011] to [0039]; fig. 1 to 2 (Family: none)	1-5
Y	JP 2008-57921 A (Sanyo Electric Co., Ltd.), 13 March 2008 (13.03.2008), paragraphs [0020] to [0032]; fig. 1 (Family: none)	1-5
Y	JP 2011-58718 A (Daikin Industries, Ltd.), 24 March 2011 (24.03.2011), paragraph [0050] (Family: none)	2-5

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 April 2015 (20.04.15)	28 April 2015 (28.04.15)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/052306

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2012-83084 A (Mitsubishi Electric Corp.), 26 April 2012 (26.04.2012), paragraph [0054] & US 2013/0167567 A1 & WO 2012/049820 A1 & EP 2629025 A1 & CN 103154625 A	3-5
Y	JP 2008-175430 A (Matsushita Electric Industrial Co., Ltd.), 31 July 2008 (31.07.2008), paragraphs [0020] to [0021] (Family: none)	4-5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2012198020 A **[0003]**