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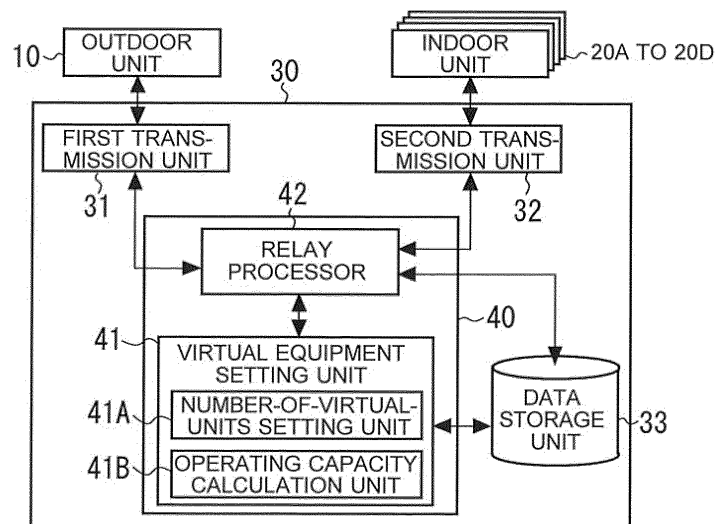
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(54) **TRANSMISSION RELAY AND AIR-CONDITIONING APPARATUS USING SAME**

(57) A transmission relay device configured to relay communication between an outdoor unit and a plurality of indoor units connected by refrigerant pipes includes: a virtual device setting unit configured to set a virtual indoor unit by unifying two or more of the plurality of indoor units; a data storage unit configured to store an address

of the outdoor unit, addresses of the plurality of indoor units, and an address of the virtual indoor unit; a relay processor configured to communicate as the virtual indoor unit with the outdoor unit and relay a signal transmitted from the outdoor unit to the plurality of indoor units, based on the addresses stored in the data storage unit.

FIG. 4



Description

Technical Field

[0001] The present invention relates to a transmission relay device connected between an outdoor unit and indoor unit and configured to relay data transmission as well as to an air-conditioning device that uses the transmission relay device.

Background Art

[0002] In a conventional air-conditioning device, an outdoor unit and indoor unit are connected to each other through a transmission line, and communicate with each other, enabling coordinated operation control. The outdoor unit and indoor unit are assigned respective addresses for identification and communicate with various pieces of equipment based on the addresses. It is proposed to install a transmission relay device between the outdoor unit and indoor unit to reduce process concentration on a centralized control apparatus as well as communication traffic (see, for example, Patent Literature 1). Patent Literature 1 discloses that a transmission relay device is installed between the outdoor unit and indoor unit and that the transmission relay device has a function to transmit part or all of various data handled by the centralized control apparatus.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Patent No. 5084502

Summary of Invention

Technical Problem

[0004] Now, in an air-conditioning device such as in Patent Literature 1, the number of addresses for indoor units is set in advance, and it is common to set restrictions on the number of indoor units connected within a same communication system. Consequently, the air-conditioning device can be connected with only a predetermined number of indoor units due to restrictions on communication traffic or communication addresses. On the other hand, from a functional perspective on a refrigeration cycle, with upsizing of outdoor units or spread of interaction control of a plurality of outdoor units, outdoor units and indoor units may be able to be installed in excess of numbers determined by the above-mentioned number of addresses, in a same refrigerant system or in a large-scale system including a plurality of refrigerant systems. Thus, it is desired that indoor units of a number in excess of the number determined by the number of addresses can be installed.

[0005] The present invention has been made to overcome the above problem and has an object to provide a transmission relay device that makes it possible to increase the number of indoor units connected to an outdoor unit without being restricted by the number of addresses that can be set in a system as a whole and to provide an air-conditioning device that uses the transmission relay device.

10 Solution to Problem

[0006] An embodiment of the present invention provides a transmission relay device configured to relay communication between an outdoor unit and a plurality of indoor units connected by refrigerant pipes, the transmission relay device comprising: a virtual device setting unit configured to set a virtual indoor unit unifying two or more of the plurality of indoor units; a data storage unit configured to store an address of the outdoor unit, addresses of the plurality of indoor units, and an address of the virtual indoor unit; and a relay processor configured to communicate as the virtual indoor unit with the outdoor unit and relay a signal transmitted from the outdoor unit to the plurality of indoor units, using the addresses stored in the data storage unit. Advantageous Effects of Invention

[0007] With the transmission relay device of an embodiment of the present invention, since the virtual device setting unit sets a virtual indoor unit by unifying a plurality of indoor units and the relay processor relays communication with the outdoor unit, it is possible to expand the number of indoor units connected to one or more refrigerant systems without being restricted by the number of addresses that can be set in a system as a whole.

35 Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 is a refrigerant circuit diagram showing an example of an air-conditioning device according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a schematic diagram showing an example of an outdoor unit in the air-conditioning device of Fig. 1.

[Fig. 3] Fig. 3 is a schematic diagram showing an example of an indoor unit in the air-conditioning device of Fig. 1.

[Fig. 4] Fig. 4 is a block diagram showing an example of a transmission relay device in the embodiment of the present invention.

[Fig. 5] Fig. 5 is a schematic diagram showing how a virtual indoor unit is built in the transmission relay device of Fig. 4.

[Fig. 6] Fig. 6 is a schematic diagram showing an example of data stored in a data storage unit of the transmission relay device of Fig. 4.

[Fig. 7] Fig. 7 is a flowchart showing an operation

example of the transmission relay device of Fig. 4. [Fig. 8] Fig. 8 is a flowchart showing an example of control over the transmission relay device of Fig. 5 in which a virtual indoor unit is set up. Description of Embodiments

[0009] A transmission relay device an air-conditioning device using the transmission relay device according to the present invention and an embodiment will be described below with reference to the drawings. Fig. 1 is a refrigerant circuit diagram showing an example of the air-conditioning device according to the embodiment of the present invention. The air-conditioning device 1 of Fig. 1 performs cooling operation and heating operation using a refrigeration cycle (heat pump cycle) based on refrigerant circulation. The air-conditioning device 1 of Fig. 1 includes an outdoor unit 10 and a plurality of indoor units 20A to 20D connected to the outdoor unit 10 via refrigerant pipes 2, and makes up a single refrigerant system A (refrigeration cycle) from the outdoor unit 10 and a plurality of indoor units 20A to 20D. The outdoor unit 10 and a plurality of indoor units 20A to 20D are connected to a transmission relay device 30 via respective transmission lines 3 and data transmission between the outdoor unit 10 and a plurality of indoor units 20A to 20D is carried out via the transmission relay device 30. Also, the air-conditioning device 1 is connected to a centralized control apparatus 1 A in such a way as to be able to carry out data transmission, and air-conditioning device 1 of other refrigerant systems B and C are also connected to the centralized control apparatus 1 A in such a way as to be able to carry out data transmission. The centralized control apparatus 1 A monitors and controls operation of each of the air-conditioning device 1.

[0010] Note that whereas Fig. 1 illustrates by example a case in which the air-conditioning device 1 includes one outdoor unit 10 and four indoor units 20A to 20D, the air-conditioning device 1 may include plural, i.e., two or more, outdoor units 10 or one indoor unit 20. Also, although the refrigerant pipes 2 are indicated by a single line, actually at least two pipes are used to circulate refrigerant. Furthermore, the air-conditioning device 1 may perform only cooling operation or heating operation at a time in all of the plurality of indoor units 20A to 20D or perform simultaneous heating and cooling operation in which the plurality of indoor units 20A to 20D perform either cooling operation or heating operation individually at a same time. Besides, although each air-conditioning device 1 includes a transmission relay device 30, a single transmission relay device 30 may be shared by a plurality of air-conditioning device 1 (a plurality of refrigerant systems).

[0011] Fig. 2 is a schematic diagram showing an example of an outdoor unit in the air-conditioning device of Fig. 1. In Fig. 2, the outdoor unit 10 includes a compressor 11, a flow switching device 12, an outdoor-side heat exchanger 13, an accumulator 15, and other components. The compressor 11 is designed to compress sucked re-

frigerant, compress the refrigerant at any pressure based on operating frequency, and discharge the refrigerant. The flow switching device 12 is connected to a discharge side of the compressor 11 and made up of a four-way valve configured to switch a pipe circuit according to, for example, whether an operation mode is cooling or heating. The outdoor-side heat exchanger 13 is, for example, a fin tube heat exchanger and is designed to exchange heat between refrigerant and air. An outdoor-side fan 14 is designed to send air to the outdoor-side heat exchanger 13. The accumulator (liquid separator) 15 is connected to a suction side of the compressor 11 and designed to accumulate surplus refrigerant.

[0012] The outdoor unit 10 includes an outdoor-side communication unit 16, an outdoor-side control unit 17, and an outdoor-side storage unit 18. The outdoor-side communication unit 16 is connected to the transmission relay device 30 via a transmission line 3 and designed to serve as an interface for signal communication between the transmission relay device 30 and outdoor-side control unit 17. The outdoor-side control unit 17 is designed to control operation of various equipment of the outdoor unit 10 including the compressor 11, flow switching device 12, and outdoor-side fan 14. The outdoor-side control unit 17 performs operation control based on, for example, signals transmitted from the transmission relay device 30 and received by the outdoor-side communication unit 16. The outdoor-side storage unit 18 stores data needed by the outdoor-side control unit 17 to perform processing. Furthermore, the outdoor-side storage unit 18 stores address information, data on relationships among refrigerant systems, and other data/information.

[0013] Fig. 3 is a schematic diagram showing an example of the indoor unit in the air-conditioning device of Fig. 1. Although the indoor unit 20A is illustrated by example in Fig. 3, the indoor units 20B to 20D have a same configuration. The indoor unit 20A includes an indoor-side heat exchanger 21, an expansion valve 22, and an indoor unit fan 23, etc. The indoor-side heat exchanger 21 is, for example, a fin tube heat exchanger and is designed to exchange heat between the refrigerant flowing in from the side of the outdoor unit 10 and air in an air-conditioned space. The indoor unit fan 23 sends air to the indoor-side heat exchanger 21 in order for the indoor-side heat exchanger 21 to exchange heat and sends the heat-exchanged air into a room. The expansion valve 22 comprises, for example, an electronic expansion valve or another valve, which decompress the refrigerant and controls a flow rate of the refrigerant by going through an adjustment of an opening degree thereof.

[0014] The indoor unit 20A includes an indoor-side communication unit 24, an operating unit 25, an indoor-side control unit 26, and an indoor-side storage unit 27. The indoor-side communication unit 24 is connected to the transmission relay device 30 via a transmission line 3 and serves as an interface for signal communication between the transmission relay device 30 and indoor-side control unit 26. The operating unit 25 is made up,

for example, of a remote controller and designed to transmit, for example, a setting temperature, operation mode, and other inputs entered by an operator, as a signal to the indoor-side control unit 26. The indoor-side control unit 26 is designed to control operation of devices such as the expansion valve 22 or indoor unit fan 23. The indoor-side control unit 26 controls various equipment of the indoor unit 20A including the expansion valve 22 and indoor unit fan 23 based, for example, on a command signal from the operating unit 25 or a signal received by the indoor-side communication unit 24. The indoor-side storage unit 27 stores data needed by the indoor-side control unit 26 to perform processing as well as operating capacity of the indoor unit 20A. Furthermore, the indoor-side storage unit 27 stores address information, data on relationships among refrigerant systems, and operating capacity.

[0015] Fig. 4 is a block diagram showing an example of the transmission relay device in the air-conditioning device of Fig. 1. Various components of the transmission relay device shown in Fig. 4 are realized, for example, by executing a program on a microcomputer or computer or other devices. The transmission relay device 30 of Fig. 4 is designed to relay communication between the outdoor unit 10 and a plurality of indoor units 20A to 20D and provided with a first transmission unit 31, a second transmission unit 32, a data storage unit 33, and a computational processing unit 40. The first transmission unit 31 is connected to the outdoor unit 10 via a transmission line 3 and designed to serve as an interface for signal communication with the outdoor unit 10. The second transmission unit 32 is connected to the plurality of indoor units 20A to 20D via the transmission line 3 and designed to serve as an interface for signal communication with the plurality of indoor units 20A to 20D.

[0016] The computational processing unit 40 is designed to process various data exchanged between the first transmission unit 31 and second transmission unit 32. In particular, the computational processing unit 40 is designed to internally set a virtual indoor unit and conduct communication, as a virtual indoor unit, with the outdoor unit 10 and is provided with a virtual device setting unit 41 and a relay processor 42.

[0017] The virtual device setting unit 41 is designed to set a virtual indoor unit by unifying two or more of the plurality of indoor units 20A to 20D. Fig. 5 is a schematic diagram showing a virtual indoor unit built in the transmission relay device of Fig. 4. As shown in Fig. 5, the transmission relay device 30 behaves as a single virtual indoor unit VI when communicating with the outdoor unit 10, and behaves as a unit substituting the outdoor unit 10 in a manner similar to the outdoor unit 10 when communicating with the plurality of indoor units 20A to 20D.

[0018] The virtual device setting unit 41 of Fig. 4 includes a number-of-virtual-units setting unit 41 A configured to set the number of virtual indoor units VI, and an operating capacity calculation unit 41 B configured to calculate virtual operating capacity of each of the virtual in-

door units VI, of which the virtual number has been set by the number-of-virtual-units setting unit 41 A, using the operating capacities of the indoor units 20A to 20D stored in the data storage unit 33. The operating capacities of the indoor units 20A to 20D are stored in the data storage unit 33.

[0019] The number-of-virtual-units setting unit 41 A sets a predetermined number of units (e.g., one unit) and the operating capacity calculation unit 41 B calculates the virtual operating capacity of the virtual indoor unit VI by adding up the operating capacities of running indoor units 20A to 20D. The operating capacity calculation unit 41 B is designed to recalculate the virtual operating capacity when the number of running indoor units 20A to 20D changes or when the operation mode changes.

[0020] Alternatively, the number-of-virtual-units setting unit 41 A may set the number of units according to the operation modes of the indoor units 20A to 20D. Then, the number-of-virtual-units setting unit 41 A sets an address of the virtual indoor unit VI, and stores the address in the data storage unit 33. When setting the number of units according to the operation modes, the number-of-virtual-units setting unit 41 A classifies the plurality of indoor units 20A to 20D by the operation mode, and sets a virtual indoor unit VI for each group of indoor units resulting from the classification. For example, when all the plurality of indoor units 20A to 20D are performing cooling operation or heating operation, one virtual indoor unit VI is set by unifying the four indoor units 20A to 20D. Then, the operating capacity calculation unit 41 B calculates the virtual operating capacity of the virtual indoor unit VI by adding up the operating capacities of the four indoor units 20A to 20D and stores the virtual operating capacity in the data storage unit 33. In this way, when a plurality of operation modes coexist, as the virtual device setting unit 41 sets virtual indoor units by classifying the indoor units by the operation mode, in performing mixed simultaneous heating and cooling operation, the air-conditioning device 1 can perform control effectively by keeping down a volume of communication traffic and amount of signal processing.

[0021] Although a case in which the number-of-virtual-units setting unit 41 A sets the number of virtual indoor units VI for each operation mode of the indoor units 20A to 20D is illustrated by example, this is not restrictive, and that one virtual indoor unit VI may be set for a predetermined number of indoor units (e.g., three units) or for each floor, regardless of the operation modes of the indoor units 20A to 20D.

[0022] It is assumed that, for example, the indoor units 20A and 20B performing cooling operation and the indoor units 20C and 20D performing heating operation coexist among the plurality of indoor units 20A to 20D. In so doing, on the plurality of indoor units 20A to 20D, the number-of-virtual-units setting unit 41 A sets two virtual indoor units VI: one of two virtual indoor units VI is set by unifying the indoor units 20A and 20B performing heating operation and the other virtual indoor unit VI is set by

unifying the indoor units 20C and 20D performing cooling operation. Then, the operating capacity calculation unit 41 B calculates a total operating capacity of the indoor units 20A and 20B performing heating operation and a total operating capacity of the indoor units 20C and 20D performing cooling operation and stores the total operating capacities in the data storage unit 33.

[0023] The relay processor 42 performs signal processing to relay data received by the first transmission unit 31 to the second transmission unit 32 and performs signal processing to relay data received by the second transmission unit 32 to the second transmission unit 32. That is, when the first transmission unit 31 receives a signal, the relay processor 42 determines whether to transmit the signal from the outdoor unit 10 to predetermined indoor units 20A to 20D via the second transmission unit 32. Also, the relay processor 42 performs processing based on the received data and determines which of the plurality of indoor units 20A to 20D to transmit the signal to. Upon determining to transmit the signal, the relay processor 42 transfers the signal to the second transmission unit 32 and thereby transmits the signal to the appropriate ones of the indoor units 20A to 20D.

[0024] Similarly, when the second transmission unit 32 receives a signal from any of the indoor units 20A to 20D, the relay processor 42 determines whether to transfer the signal to the outdoor unit 10 via the first transmission unit 31. Upon determining to transmit the signal, the relay processor 42 transfers the signal to the first transmission unit 31 and thereby transmits the signal to the outdoor unit 10.

[0025] A communication scheme (a protocol) in relation to the outdoor unit 10 may be either identical to or different from a communication scheme (a protocol) in relation to the indoor units 20A to 20D. When the communication schemes are different, the relay processor 42 has a function to do protocol conversion before making signals transmitted. The relay processor 42 may be designed to do not only protocol conversion of signals, but also protocol conversion of data contained in the signals.

[0026] In so doing, the relay processor 42 performs processing to transmit a signal for, for example, polling the outdoor unit 10, via the transmission line 3 and transmits the signal to the outdoor unit 10 via the first transmission unit 31. Then, the relay processor 42 processes data contained in a signal transmitted from the outdoor unit 10 and stores the data in the data storage unit 33. Also, the relay processor 42 performs processing to transmit signals for polling the indoor units 20A to 20D via the transmission lines 3 and makes the second transmission unit 32 transmit the signals. Then, the relay processor 42 processes data contained in signals transmitted from the indoor units 20A to 20D in response and stores the data, for example, in the data storage unit 33. Although a case in which the transmission relay device 30 performs communication control, including data collection, using a polling scheme is illustrated by example, the transmission relay device 30 may conduct communica-

tion using well-known communication control such as a token-based scheme or CSMA/CD scheme.

[0027] Here, using the addresses stored in the data storage unit 33, the relay processor 42 communicates, as a virtual indoor unit VI, with the outdoor unit 10 and relays the signal transmitted from the outdoor unit 10 to the plurality of indoor units 20A to 20D. The relay processor 42 is designed to collect refrigerant system data, address data of a communication system, and the operating capacities of the indoor units 20A to 20D from the outdoor unit 10 and the indoor units 20A to 20D and stores the data in the data storage unit 33. Although a case in which various data is collected through communication and stored in the data storage unit 33 by the relay processor 42 is illustrated by example, data may be stored by being entered by a user via a keyboard or another input device.

[0028] Fig. 6 is a schematic diagram showing an example of data stored in the data storage unit of the transmission relay device of Fig. 4. As shown in Fig. 6, the data storage unit 33 stores a first transmission address a1 of the outdoor unit 10 connected to the same refrigerant system A, respective second transmission addresses b2 to b5 of the plurality of indoor units 20A to 20D, and a first transmission address a3 of the virtual indoor unit VI. The first transmission address a1 of the outdoor unit 10 and the first transmission address a3 of the virtual indoor unit VI belong to a first transmission address group while respective second transmission addresses b2 to b5 of the plurality of indoor units 20A to 20D belong to a second transmission address group. Also, as addresses of the transmission relay device 30, the data storage unit 33 stores a first transmission address a2 used in communicating with the outdoor unit 10 via the first transmission unit 31 and a second transmission address b1 used in communicating with the plurality of indoor units 20A to 20D. Furthermore, as information about the plurality of indoor units 20A to 20D, the respective operating capacities of the indoor units 20A to 20D are stored. Also, the data storage unit 33 stores data needed by the computational processing unit 40 to perform processing.

[0029] Then, in communicating with the outdoor unit 10, the relay processor 42 acting as a virtual indoor unit VI relays the communication using the first transmission addresses a1 to a3. In particular, for example, when a request to transmit operating capacities is made by the outdoor unit 10 to the indoor units 20A to 20D, the relay processor 42 transmits the virtual operating capacity of the virtual indoor unit VI to the outdoor unit 10. When a signal to be transmitted to the outdoor unit 10 from the indoor units 20A to 20D is received via the second transmission unit 32, the relay processor 42 acting as a virtual indoor unit VI transmits the signal to the outdoor unit 10 via the first transmission unit 31. Also, when data is received from the outdoor unit 10, the relay processor 42 acting as a virtual indoor unit VI selects one or more indoor units to which the data is to be transmitted from

among the plurality of indoor units 20A to 20D and transmit the data via the second transmission unit 32. The relay processor 42 selects one or more appropriate indoor units from the plurality of indoor units 20A to 20D using any of various well-known routing techniques.

[0030] In this way, based on the addresses stored in the data storage unit 33, the relay processor 42 relays communication between the outdoor unit 10 and virtual indoor unit VI as well as communication between the virtual indoor unit VI and a plurality of indoor units 20A to 20D. In other words, the computational processing unit 40 controls communication by treating the first transmission unit 31 and second transmission unit 32 independently of each other.

[0031] Fig. 7 is a flowchart showing an operation example of the transmission relay device of Fig. 4. Once the transmission relay device 30 is powered on, the transmission relay device 30 starts communication with the outdoor unit 10 and with the indoor units 20A to 20D (Step ST1). Then, the transmission relay device 30 checks the number of outdoor units 10 (Step ST2) and checks the number of connected indoor units 20A to 20D (Step ST3). When the outdoor unit 10 is not connected (NO in Step ST2) or when none of the indoor units 20A to 20D is connected (NO in Step ST3), the transmission relay device 30 determines that there is a communication error (Step ST4). Then, the transmission relay device 30 is restarted or connection conditions of the transmission lines 3 are checked, etc.

[0032] When one or more outdoor units 10 and one or more indoor units 20A to 20D are connected (YES in Steps ST2 and ST3), information about the outdoor unit(s) 10 and indoor unit(s) 20A to 20D is collected and stored in the data storage unit 33 (Step ST5). In so doing, information about a refrigerant system of each unit is collected and information such as information about the addresses and operating capacities of the indoor units 20A to 20D is collected. Subsequently, the relay processor 42 determines whether or not any of the plurality of indoor units 20A to 20D is running with an operation mode such as cooling operation specified (Step ST6). If there is no indoor unit 20A to 20D for which an operation mode is set (NO in Step ST6), the relay processor 42 waits until any of the indoor units 20A to 20D starts operation (Steps ST6 and ST7).

[0033] On the other hand, when any of the indoor units 20A to 20D is running (YES in step ST6), the virtual device setting unit 41 sets a virtual indoor unit VI (Step ST8). In so doing, the operating capacities of the indoor units 20A to 20D running in any operation mode are read out of the data storage unit 33 and saved in the data storage unit 33 as an operating capacity of the virtual indoor unit VI. Subsequently, by acting as the virtual indoor unit VI having the total operating capacity, the transmission relay device 30 sends information to the outdoor unit 10. Then, the operating capacity of the virtual indoor unit VI is recalculated each time the operation mode of any of the indoor units 20A to 20D is changed halfway after the start

of operation (Steps ST6 to ST19).

[0034] Fig. 8 is a flowchart showing an example of control over the transmission relay device of Fig. 5 in which a virtual indoor unit is set up. When a signal is received from any of the indoor units 20A to 20D, the second transmission unit 32 takes out communication data and transmits the data to the computational processing unit 40. Then, the computational processing unit 40 processes the communication data, and the first transmission unit 31 specifies a destination (communication address) and sets transmit data. In so doing, the data storage unit 33 stores the data resulting from the processing performed by the computational processing unit 40. Subsequently, the transmission relay device 30 acting as the virtual indoor unit VI transmits a signal to the outdoor unit 10.

[0035] On the other hand, when communication are received from the outdoor unit 10, the first transmission unit 31 extracts communication data and transmits the data to the computational processing unit 40. Then, the computational processing unit 40 processes the communication data, and the second transmission unit 32 sets a destination and transmits signals to the indoor units 20A to 20D. In so doing, the data storage unit 33 stores the data such as the data resulting from the processing performed by the computational processing unit 40.

[0036] According to the embodiment described above, since the virtual indoor unit VI set by unifying the indoor units 20C and 20D controls communication with the outdoor unit 10, the number of connected units can be caused to appear smaller than it really is, making it possible to increase the number of connected units. That is, as shown in Fig. 5, when the outdoor unit 10 and four indoor units 20A to 20D communicate with each other, instead of assigning four first transmission addresses, it is enough to assign a first transmission address to a single virtual indoor unit VI. Consequently, even if there is a restriction on the number of addresses within the system, the number of connectable indoor units 20A to 20D can be expanded.

[0037] Furthermore, by conducting communication between the outdoor unit 10 and virtual indoor unit VI, communication traffic can be reduced. That is, in conventional transmission relay devices, the outdoor unit 10 needs to communicate with each of the four indoor units 20A to 20D. On the other hand, when the indoor units are operated as a single unified indoor unit via the transmission relay device 30, transmission is performed from the outdoor unit 10 to the virtual indoor unit VI built in the transmission relay device 30, signal processing is performed by the computational processing unit 40 of the transmission relay device 30, and then optimum communication are conducted with the plurality of indoor units 20A to 20D. This reduces volumes of communication on a first transmission line connecting between the outdoor unit 10 and transmission relay device 30 and on second transmission lines connecting between the transmission relay device 30 and indoor units 20A to 20D, making it possible to reduce the total communication traffic.

[0038] Also, the virtual device setting unit 41 includes the number-of-virtual-units setting unit 41 A configured to set the number of virtual indoor units VI, and the operating capacity calculation unit 41 B configured to calculate the virtual operating capacity of each of the virtual indoor units VI, of which the virtual number has been set by the number-of-virtual-units setting unit 41 A, using the operating capacities of the indoor units stored in the data storage unit 33, and when the relay processor 42 transmits the virtual operating capacities of the virtual indoor units VI to the outdoor unit 10, even if the virtual indoor units VI are set, operation control can be performed on the outdoor unit 10 based on the operating capacities of the actual indoor units 20A to 20D.

[0039] In particular, when the virtual device setting unit 41 sets the number of virtual indoor units VI for each operation mode of the plurality of indoor units 20A to 20D, for example, in the case of simultaneous heating and cooling operation in which indoor units 20A and 20B performing cooling operation and indoor units 20C and 20D performing heating operation coexist, signal processing and communication processing can be performed efficiently.

[0040] Embodiments of the present invention are not limited to the one described above, and various changes can be made. For example, although a case in which all the plurality of indoor units 20A to 20D are connected to the second transmission unit 32 has been illustrated by example in the above embodiment, the plurality of indoor units 20A to 20D may be connected to a plurality of transmission relay device 30 in a distributed manner or part of the indoor units may be connected directly to the outdoor unit 10 without an intervening transmission relay device 30.

[0041] Also, although a case in which the virtual device setting unit 41 sets a virtual indoor unit VI by unifying two or more indoor units 20A to 20D has been illustrated by example in the above embodiment, when a plurality of outdoor units 10 are connected, the virtual device setting unit 41 may have a function to set a virtual outdoor unit by unifying multiple outdoor units 10.

Reference Signs List

[0042] 1 air-conditioning device 1A centralized control apparatus 2 refrigerant pipe 3 transmission line 10 outdoor unit 11 compressor 12 flow switching device 13 outdoor-side heat exchanger 14 outdoor-side fan 15 accumulator 16 outdoor-side communication unit 17 outdoor-side control unit 18 outdoor-side storage unit 20A - 20D indoor unit 21 indoor-side heat exchanger 22 expansion valve 23 indoor unit fan 24 indoor-side communication unit 25 operating unit 26 indoor-side control unit 27 indoor-side storage unit 30 transmission relay device 31 first transmission unit 32 second transmission unit 33 data storage unit 40 computational processing unit 41 virtual device setting unit 41 A number-of-virtual-units setting unit 41 B operating capacity calculation unit 42 relay

processor A refrigerant system a1 - a3 first transmission address b1 - b5 second transmission address VI virtual indoor unit

Claims

1. A transmission relay device configured to relay communication between an outdoor unit and a plurality of indoor units connected by refrigerant pipes, the transmission relay device comprising:

a virtual device setting unit configured to set a virtual indoor unit unifying two or more of the plurality of indoor units;
a data storage unit configured to store an address of the outdoor unit, addresses of the plurality of indoor units, and an address of the virtual indoor unit; and
a relay processor configured to communicate as the virtual indoor unit with the outdoor unit and relay a signal transmitted from the outdoor unit to the plurality of indoor units, using the addresses stored in the data storage unit.

2. The transmission relay device of claim 1, wherein the data storage unit stores operating capacities of the plurality of indoor units, the virtual device setting unit includes

a number-of-virtual-units setting unit configured to set the number of the virtual indoor units, and an operating capacity calculation unit configured to calculate virtual operating capacity of each of the virtual indoor units, of which a virtual number is set by the number-of-virtual-units setting unit, using the operating capacities of the indoor units stored in the data storage unit, and

the relay processor transmits the virtual operating capacities of the virtual indoor units to the outdoor unit.

3. The transmission relay device of claim 2, wherein the number-of-virtual-units setting unit sets the number of the virtual indoor units for each operation mode of the plurality of indoor units.

4. The transmission relay device of claim 3, wherein the number-of-virtual-units setting unit sets the virtual indoor unit performing heating operation and the virtual indoor unit performing cooling operation out of the plurality of indoor units for two of the virtual indoor units, and

the operating capacity calculation unit calculates a total operating capacity of the indoor units performing heating operation and a total operating capacity of the indoor units performing cooling operation.

5. The transmission relay device of any one of claims 1 to 4, wherein the relay processor uses different communication schemes between communication with the outdoor unit and communication with the indoor units.
6. An air-conditioning apparatus comprising the transmission relay device of any one of claims 1 to 5.

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FIG. 1

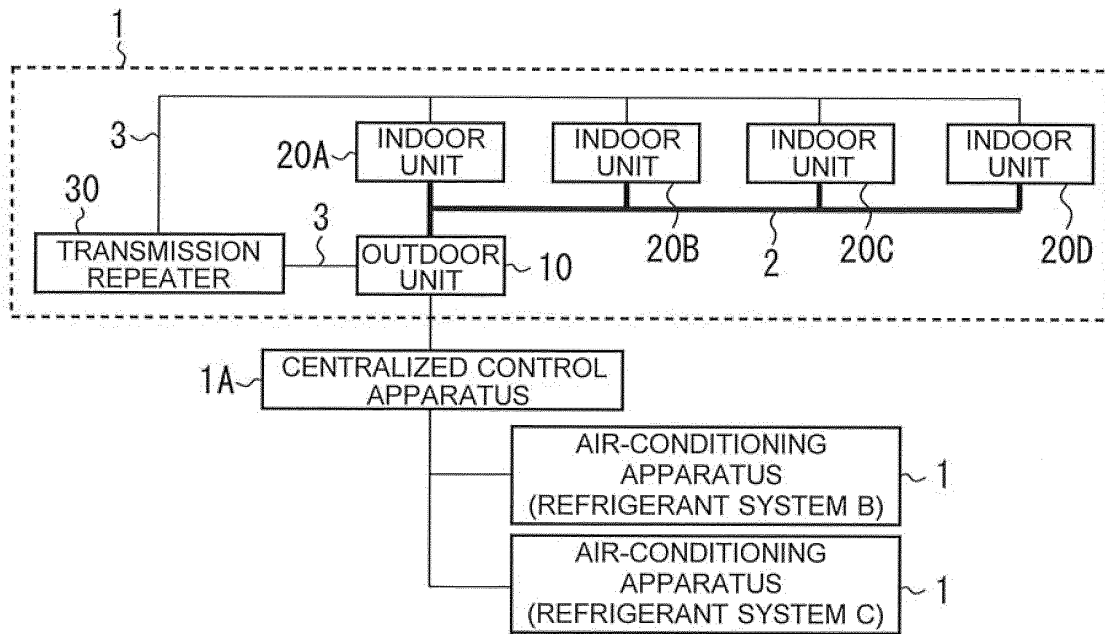


FIG. 2

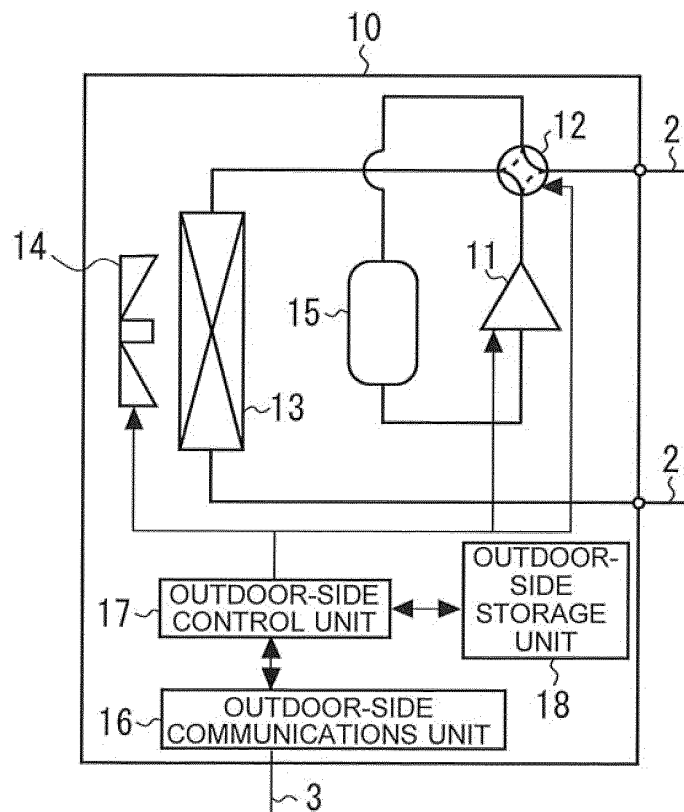


FIG. 3

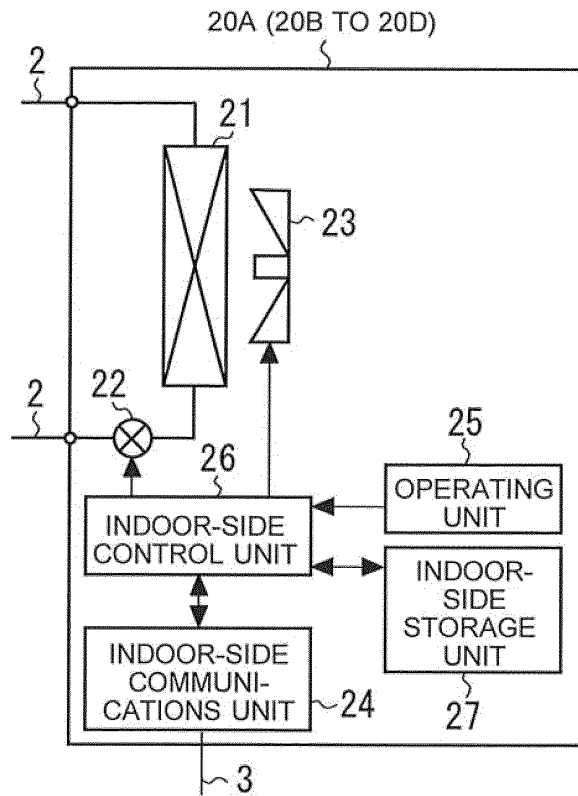


FIG. 4

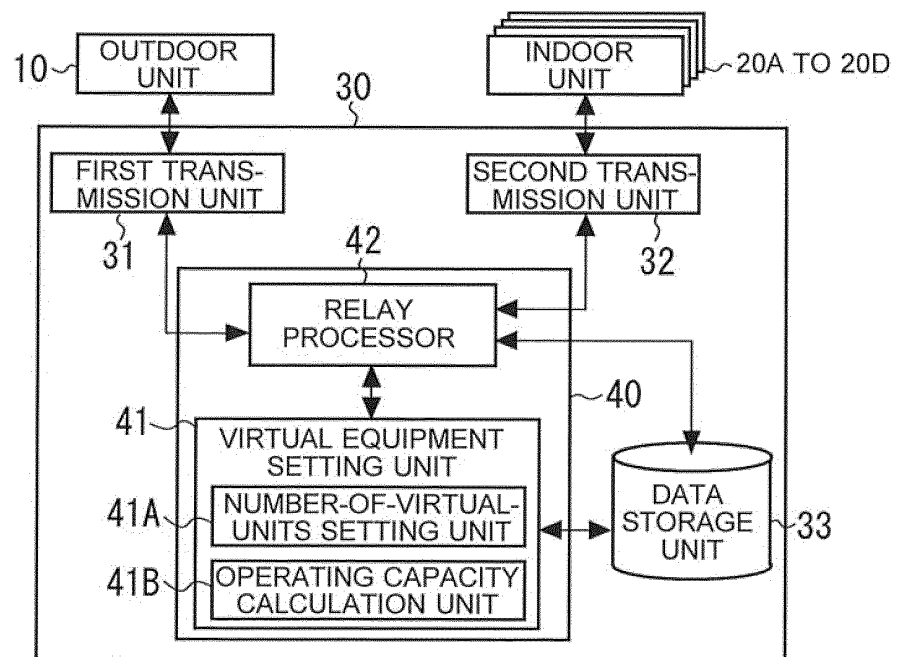


FIG. 5

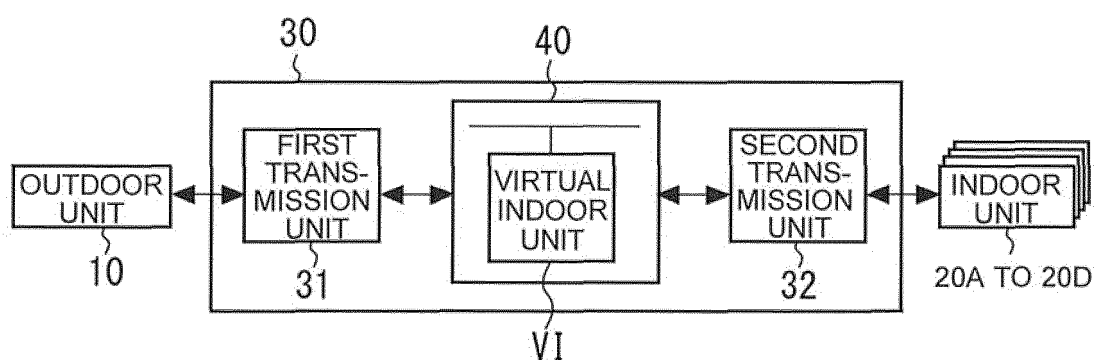


FIG. 6

AIR-CONDITIONING APPARATUS 1 (REFRIGERANT SYSTEM A)		
EQUIPMENT	ADDRESS	OPERATING CAPACITY
OUTDOOR UNIT 10	a1	—
VIRTUAL INDOOR UNIT VI	a3	
TRANSMISSION REPEATER 30	a2/b1	—
INDOOR UNIT 20A	b2	
INDOOR UNIT 20B	b3	
INDOOR UNIT 20C	b4	
INDOOR UNIT 20D	b5	

FIG. 7

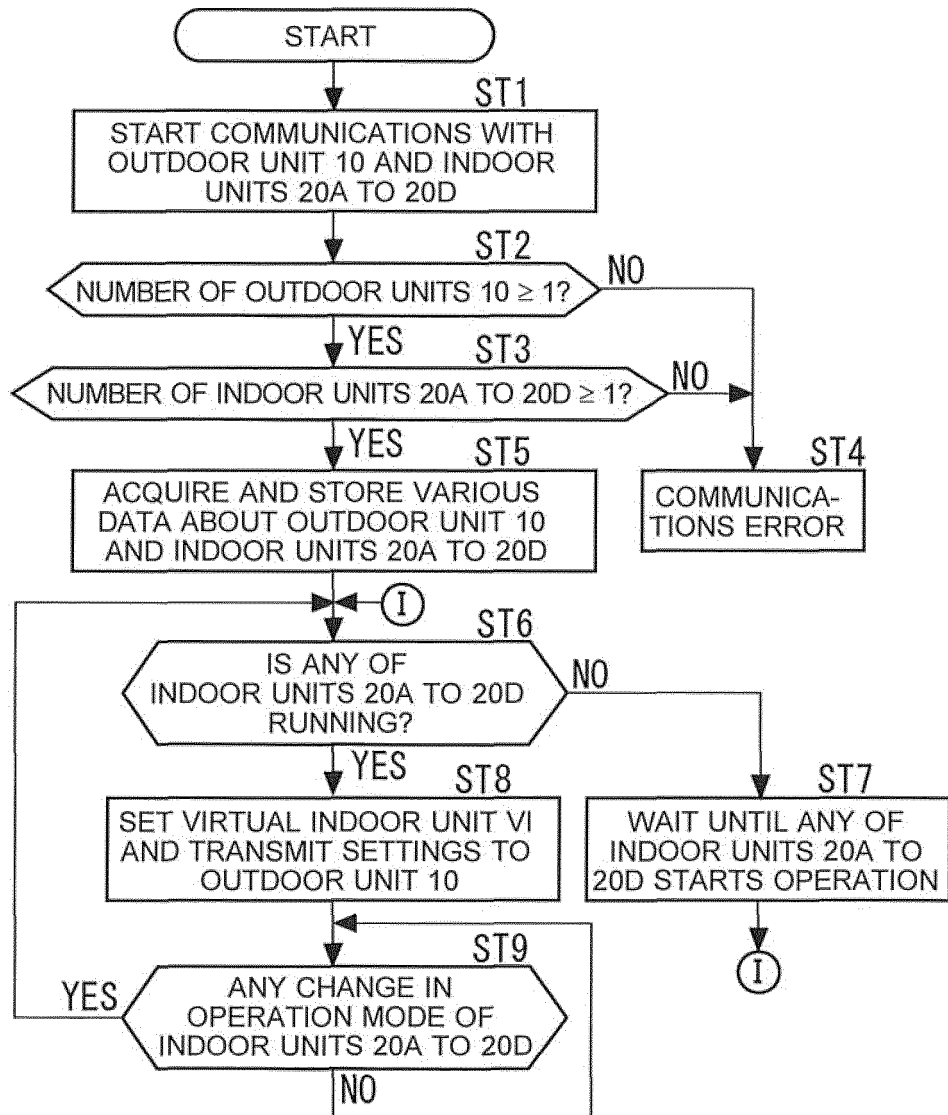
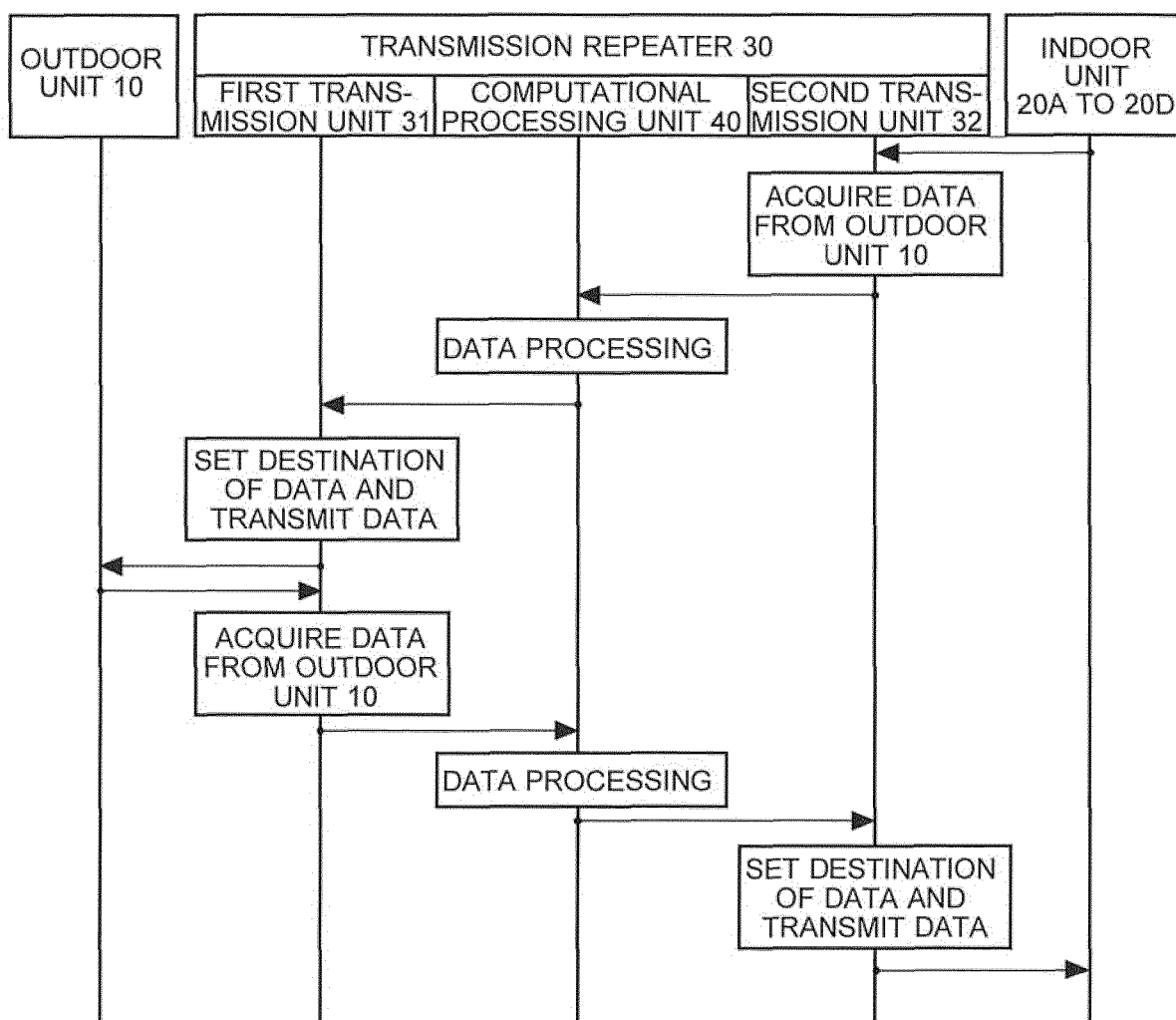


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/070578

A. CLASSIFICATION OF SUBJECT MATTER

F24F11/02(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

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 A	WO 2008/035402 A1 (Mitsubishi Electric Corp.), 27 March 2008 (27.03.2008), paragraphs [0008] to [0009], [0027] to [0033]; fig. 1 & US 2009/0139251 A1 & EP 1936294 A1 & CN 101278156 A	1, 5-6 2-4
Y	JP 2014-194309 A (Hitachi Appliances, Inc.), 09 October 2014 (09.10.2014), claim 4; paragraphs [0037] to [0053] (Family: none)	1, 5-6
Y	JP 2003-90587 A (Fujitsu General Ltd.), 28 March 2003 (28.03.2003), paragraphs [0013] to [0016]; fig. 1 to 2 (Family: none)	1, 5-6

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

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later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search
16 September 2015 (16.09.15)Date of mailing of the international search report
06 October 2015 (06.10.15)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/JP2015/070578

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 2014-149117 A (Fujitsu General Ltd.), 21 August 2014 (21.08.2014), paragraphs [0010] to [0060]; fig. 1 to 3 (Family: none)	1, 5-6
A	JP 2005-265235 A (Hitachi, Ltd.), 29 September 2005 (29.09.2005), paragraphs [0008] to [0026]; fig. 1 to 3 (Family: none)	1-6
A	JP 2009-52769 A (Mitsubishi Electric Corp.), 12 March 2009 (12.03.2009), paragraphs [0008] to [0049]; fig. 1 to 7 (Family: none)	1, 5-6
A	JP 2010-223482 A (Yanmar Co., Ltd.), 07 October 2010 (07.10.2010), paragraphs [0006] to [0016] (Family: none)	1-6
A	US 2006/0090483 A1 (LG ELECTRONICS INC.), 04 May 2006 (04.05.2006), paragraphs [0019] to [0053]; fig. 1 to 5 & EP 1653161 A2 & KR 10-2006-0038264 A & CN 1767412 A	1, 5-6

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Patent documents cited in the description

- JP 5084502 B [0003]