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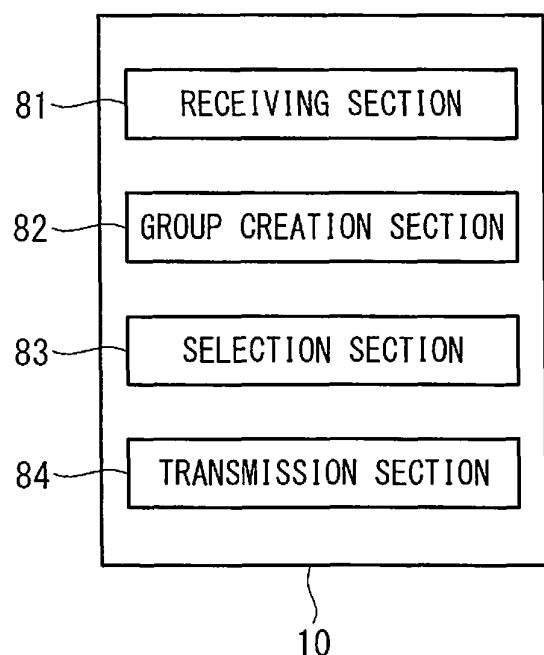
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(54) **DEVICE THAT SUPPORTS SAVING ENERGY, AIR-CONDITIONING SYSTEM, AND AIR-CONDITIONING NETWORK SYSTEM**

(57) Information contributing to energy saving is provided to an air conditioning system. There is provided an energy saving support apparatus connected to a plurality of air conditioning systems via a network, and includes a receiving section (81) that receives data on an installation environment of each of the air conditioning systems, input data and an intermediate value in control calculation, and power consumption, a group creation section (82) that groups the air conditioning systems, which are approximate to one another in installation environment, using the data on the installation environment received by the receiving section (81), a selection section (83) that selects the air conditioning system having the lowest power consumption or having the highest coefficient of performance among the air conditioning systems belonging to the same group, and a transmission section (84) that transmits an intermediate value of the air conditioning system selected by the selection section (83) to the other air conditioning systems belonging to the same group.

FIG. 4



Description

{Technical Field}

[0001] The present invention relates to an energy saving support apparatus, an air conditioning system, and an air conditioning network system.

{Background Art}

[0002] PTL 1 discloses an apparatus for controlling electrical equipment according to an operation pattern corresponding to an operation mode selected by a user while confirming that the electrical equipment is reliably controlled. More specifically, PTL 1 discloses that operation patterns defining during which period and on which operating condition energy consumption equipment is to be operated are stored in a storage section by operation modes, and an operation state of the energy consumption equipment is controlled according to the operation pattern corresponding to the operation mode selected by the user.

{Citation List}

{Patent Literature}

[0003] {PTL 1} PCT International Publication No. WO2014/049748

{Summary of Invention}

{Technical Problem}

[0004] In the apparatus disclosed in the aforementioned PTL 1, it has been difficult to determine whether the operation pattern stored in the storage section is set to the most appropriate pattern from the viewpoint of energy saving. Even if an operation pattern capable of more effectively saving energy than the current operation pattern exists, the pattern has inconveniently been unable to be actively adopted.

[0005] The present invention has been made in view of such circumstances, and is directed to providing an energy saving support apparatus, an air conditioning system, and an air conditioning network system capable of providing information contributing to energy saving.

{Solution to Problem}

[0006] According to a first aspect of the present invention, there is provided an energy saving support apparatus connected to a plurality of air conditioning systems via a network, the energy saving support apparatus including a receiving means that receives data on an installation environment of each of the air conditioning systems, input data and an intermediate value in control calculation, and power consumption, a group creation

means that groups the air conditioning systems, which are approximate to one another in installation environment, using the data on the installation environment received by the receiving means, a selection means that selects the air conditioning system having the lowest power consumption or having the highest coefficient of performance among the air conditioning systems belonging to the same group, and a transmission means that transmits an intermediate value of the air conditioning system selected by the selection means to the other air conditioning systems belonging to the same group.

[0007] According to the aforementioned aspect, the receiving means receives various types of data on each of the air conditioning systems, the group creation means groups the air conditioning systems, which are approximate to one another in installation environment, based on the data, and the selection means selects the air conditioning system having the lowest power consumption or having the highest coefficient of performance in each of the groups. The transmission means transmits an intermediate value (e.g., a low pressure-side target pressure value) of the air conditioning system selected by the selection means as a bench mark to the air conditioning systems belonging to the same group. As a result, each of the air conditioning systems can be given information on the air conditioning system, which is approximate in installation environment to the air conditioning system and has achieved more energy saving than the air conditioning system, i.e., information useful to contribute to energy saving.

[0008] The aforementioned energy saving support apparatus may further include a data storage means that stores data, wherein the selection means may select the air conditioning system having the highest power consumption or having the lowest coefficient of performance among the air conditioning systems belonging to the same group, and store all or some pieces of received data on the selected air conditioning system in the data storage means.

[0009] According to this energy saving support apparatus, the selection means selects the air conditioning system having the highest power consumption or having the lowest coefficient of performance in each of the groups, and all or some pieces of the received data on the selected air conditioning system are stored in the data storage means. As a result, the data stored in the data storage means can be expected to be effectively used to detect abnormality prediction because a tendency toward the abnormality prediction can be grasped by being analyzed, for example.

[0010] In the aforementioned energy saving support apparatus, the data on the installation environment may include at least one of an external air temperature, an amount of solar radiation, and a direction of a building.

[0011] According to the aforementioned energy saving support apparatus, the air conditioning systems, which are approximate to one another in installation environment, can be grouped using at least one of the external

air temperature, the amount of solar radiation, and the direction of the building.

[0012] According to a second aspect of the present invention, there is provided an energy saving support apparatus connected to a plurality of air conditioning systems via a network, the energy saving support apparatus including a receiving means that receives data on a configuration of each of the air conditioning systems, an intermediate value in control calculation, and power consumption, a group creation means that groups the air conditioning systems, which are approximate to one another in configuration, using the data on the configuration received by the receiving means, a selection means that selects the air conditioning system having the lowest power consumption or having the highest coefficient of performance among the air conditioning systems belonging to the same group, and a transmission means that transmits an intermediate control value of the air conditioning system selected by the selection means to the other air conditioning systems belonging to the same group.

[0013] According to the aforementioned aspect, the receiving means receives various types of data on each of the air conditioning systems, the group creation means groups the air conditioning systems, which are approximate to one another in equipment configuration, based on the data, and the selection means selects the air conditioning system having the lowest power consumption or having the highest coefficient of performance in each of groups. The transmission means transmits the intermediate value of the air conditioning system selected by the selection means as a bench mark to the air conditioning systems belonging to the same group. As a result, each of the air conditioning systems can be given information on the air conditioning system, which is approximate in equipment configuration to the air conditioning system and has achieved more energy saving than the air conditioning system, i.e., information useful to contribute to energy saving.

[0014] The aforementioned energy saving support apparatus further includes a data storage means that stores data, wherein the selection means may select the air conditioning system having the highest power consumption or having the lowest coefficient of performance among the air conditioning systems belonging to the same group, and store all or some pieces of the received data on the selected air conditioning system in the data storage means.

[0015] According to this energy saving support apparatus, the selection means selects the air conditioning system having the highest power consumption or having the lowest coefficient of performance in each of the groups, and all or some pieces of the received data on the selected air conditioning system are stored in the data storage means. As a result, the data stored in the data storage means can be expected to be effectively used to detect abnormality prediction because a tendency toward the abnormality prediction can be grasped by

being analyzed, for example.

[0016] In the aforementioned energy saving support apparatus, the data on the configuration may include at least one of the capacity of an outdoor unit, the number of indoor units, and a capacity configuration of the indoor units.

[0017] According to the aforementioned energy saving support apparatus, the air conditioning systems, which are approximate to one another in equipment configuration, can be grouped using at least one of the capacity of the outdoor unit, the number of the indoor units, and the capacity configuration of the indoor units.

[0018] According to a third aspect of the present invention, there is provided an air conditioning system connected to an energy saving support apparatus via a network, the air conditioning system including an outdoor unit including a communication means, an indoor unit including a communication means, and a control device which can communicate with the outdoor unit and the indoor unit via a communication medium, in which the control device includes an outdoor unit control means that controls the outdoor unit, an indoor unit control means that controls the indoor unit, a power consumption management means that manages power consumption, and a display means, the outdoor unit control means acquires equipment information and a sensor value on the outdoor unit via the communication medium while outputting a control instruction to equipment connected to the outdoor unit, the indoor unit control means acquires equipment information and a sensor value on the indoor unit via the communication medium while outputting a control instruction to equipment connected to the indoor unit, and the power consumption management means makes data on an installation environment of each of the air conditioning systems, data on a configuration, input data and an intermediate value in control calculation, and power consumption transmittable to the energy saving support apparatus, and displays, when it acquires an intermediate value from the energy saving support apparatus, the intermediate value as a benchmark value on the display means.

[0019] According to the aforementioned aspect, the indoor unit control means and the outdoor unit control means are consolidated into one control device. Thus, the respective configurations of the indoor unit and the outdoor unit can be simplified, enabling reduction in cost. Further, the indoor unit and the outdoor unit need not install advanced program respectively (for example, are each loaded with only a communication function and a component actuation function) so that the equipment does not become obsolete, and the outdoor unit and the indoor unit can be easily replaced.

[0020] Furthermore, the indoor unit control means and the outdoor unit control means are respectively provided in the control device independently of the indoor unit and the outdoor unit. Therefore, when the indoor unit control means and the outdoor unit control means are placed under control of a manufacturer of the air conditioning

system, for example, work such as a program update can be easily performed.

[0021] In the aforementioned air conditioning system, the outdoor unit control means and the indoor unit control means may be respectively loaded as virtualized control sections onto the control device.

[0022] The control means 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.

[0023] According to a fourth aspect of the present invention, there is provided an air conditioning network system including any one of the aforementioned energy saving support apparatuses and any one of the aforementioned air conditioning systems.

{Advantageous Effects of Invention}

[0024] The present invention produces an effect of providing information contributing to energy saving.

{Brief Description of Drawings}

[0025]

{Fig. 1}

Fig. 1 is a diagram schematically illustrating an entire configuration of an air conditioning network system according to a first embodiment of the present invention.

{Fig. 2}

Fig. 2 is a diagram illustrating an example of a refrigerant system of an air conditioning system according to the first embodiment of the present invention.

{Fig. 3}

Fig. 3 is a diagram illustrating an example of an electrical configuration of the air conditioning system according to the first embodiment of the present invention.

{Fig. 4}

Fig. 4 is a functional block diagram of an energy saving support apparatus according to the first embodiment of the present invention.

{Fig. 5}

Fig. 5 is a functional block diagram of an energy saving support apparatus according to a second embodiment of the present invention.

{Fig. 6}

Fig. 6 is a functional block diagram of an energy saving support apparatus according to a third embodiment of the present invention.

{Fig. 7}

Fig. 7 is a functional block diagram of an energy saving support apparatus according to a fourth embod-

iment of the present invention.

{Description of Embodiments}

[0026] An air conditioning network system according to a first embodiment of the present invention will be described below with reference to the drawings.

[0027] Fig. 1 is a diagram schematically illustrating an entire configuration of the air conditioning network system according to the present embodiment. As illustrated in Fig. 1, an air conditioning network system 100 includes a plurality of air conditioning systems 1a, 1b, ..., 1n and an energy saving support apparatus 10. Each of the air conditioning systems 1a to 1n and the energy saving support apparatus 10 are connected to each other via a network 4, and are adapted to be able to send and receive information to and from each other.

[0028] Fig. 2 is a diagram illustrating an example of a refrigerant system in the air conditioning system 1a. The following is an example of a configuration of an air conditioning system constituting the air conditioning network system 100, and does not limit respective configurations of all air conditioning systems. That is, each of the air conditioning systems can adopt various configurations depending on the purpose, and may be, as its one example, a general multi-type air conditioning system or such an air conditioning system that an indoor unit and an outdoor unit exist in a one-to-one correspondence, like a household air conditioner in addition to the following configuration.

[0029] As illustrated in Fig. 2, the air conditioning system 1a 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.

[0030] 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, and 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. The outdoor unit B is provided with various sensors 20 (see Fig. 3) such as a pressure sensor 21 that measures refrigerant pressure and a temperature sensor 24 that measures refrigerant temperature or the like.

[0031] Each of the indoor units A1 and A2 includes an indoor heat exchanger 31, an indoor fan 32, an electronic expansion valve 33, 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.

[0032] Fig. 3 is an electrical configuration diagram of the air conditioning system 1a according to the present embodiment. As illustrated in Fig. 3, the indoor units A1 and A2, the outdoor unit B, and the control device 3 are connected to one another via a common bus 5, and are 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.

[0033] In the general multi-type air conditioning system, control devices are respectively provided inside the indoor units and the outdoor unit. On the other hand, in the present embodiment, indoor unit control sections 41 and 42 and an outdoor unit control section 43 respectively exist independently of the indoor units A1 and A2 and the outdoor unit B, and are consolidated into the control device 3. In the control device 3, the indoor unit control sections 41 and 42 and the outdoor unit control section 43 may be respectively provided as individual hardware pieces, or may be virtually created on one hardware piece. If the control sections are virtually created, a program for causing the control sections to virtually exist may be previously prepared. 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.

[0034] The control device 3 further includes a power consumption management section 44 and a display section 45.

[0035] The power consumption management section 44 is adapted to send and receive information to and from the indoor unit control sections 41 and 42 and the outdoor unit control section 43. The power consumption management section 44 manages the power consumption of the air conditioning system 1a not to exceed a demand value previously set, for example. The power consumption management section 44 compares the power consumption with the demand value, for example, and outputs an operation control instruction to the outdoor unit control section 43 according to a predetermined algorithm. The power consumption management section 44 acquires equipment information and input data and an intermediate value in control calculation on the indoor units A1 and A2, and equipment information and input data and an intermediate value in control calculation on the outdoor unit B, respectively, from the indoor unit control sections 41 and 42 and the outdoor unit control section 43, and transmits all or some pieces of the data, together with the power consumption, to the energy saving support apparatus 10. When the intermediate value or the like is received from the energy saving support apparatus 10, the intermediate value or the like is displayed on the display section 45, and thus is presented to a user. The power consumption management section 44 may virtually exist on one hardware piece, or may be provided as a separate hardware piece, like the aforementioned indoor unit control section 41 or the like. The display section 45 is a liquid crystal display, for example.

[0036] In the indoor unit A1, various drivers 52 respectively provided to correspond to various equipment 51 such as the indoor fan 32 and the electronic expansion valve 33 (see Fig. 2) are connected to the common bus 5 via a gateway (a communication means) 53. The indoor unit A2 has a similar configuration to that of the indoor

unit A1, although illustration thereof is omitted.

[0037] In the outdoor unit B, various drivers 62 respectively provided to correspond to various equipment 61 such as the compressor 11, the four-way valve 12, and the outdoor fan 15 (see Fig. 2) are connected to the common bus 5 via a gateway (a communication means) 63.

[0038] 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 and 61, and stores information such as either an indoor unit or an outdoor unit, a capability, on-board sensors (e.g., a temperature sensor and a pressure sensor), equipment information (e.g., fan speed and the number of pulses of a valve when in full open state).

[0039] Furthermore, the sensors 20 (e.g., a pressure sensor that measures refrigerant pressure and a temperature sensor that measures refrigerant temperature) 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.

[0040] In this air conditioning system, each of the indoor unit control sections 41 and 42 in the control device 3 acquires measurement data (input data in control calculation, etc.) 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 and the electronic expansion valve 33) provided in the indoor units A1 and 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 types of 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 instruction is implemented.

[0041] Similarly, the outdoor unit control section 43 in the control device 3 acquires measurement data (input data in control calculation, etc.) 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, and the outdoor fan 15) 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.

[0042] Autonomous decentralized controls may be respectively performed for 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. 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 control according to the 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 the 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 sending and receiving 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.

[0043] When the first allowable range is set wider than the second allowable variation 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.

[0044] An energy saving support apparatus 10 will be described below. Fig. 4 is a functional block diagram of the energy saving support apparatus 10 according to the present embodiment. The energy saving support apparatus 10 is a computer, for example, and includes a processor, a main storage device (e.g., a RAM (Random Access Memory)), a hard disk, and the like. When the processor loads various types of programs (e.g., an energy saving support program) stored in the hard disk into a main storage device and executes the loaded programs, functions described below are implemented.

[0045] As illustrated in Fig. 4, the energy saving support apparatus 10 includes a receiving section 81, a group creation section 82, a selection section 83, and a transmission section 84.

[0046] The receiving section 81 receives data transmitted from each of the air conditioning systems. Specific examples of the received data include data on an installation environment of each of the air conditioning systems, input data and an intermediate value in control calculation (e.g., a low pressure target value), and power

consumption.

[0047] Examples of the data on the installation environment include an external air temperature, an amount of solar radiation, and a direction of a building. Examples of the input data in control calculation include an external air temperature, a set temperature, an indoor suction temperature, low pressure, high pressure, and an expansion valve opening. Examples of the intermediate value include a low pressure-side target pressure value.

[0048] The group creation section 82 extracts air conditioning systems, which are approximate to one another in installation environment, using the data on the installation environment received by the receiving section 81, to create a group.

[0049] The selection section 83 selects the air conditioning system having the lowest power consumption among the air conditioning systems belonging to the same group.

[0050] The transmission section 84 transmits an intermediate value (e.g., a low pressure target value) of the air conditioning system selected by the selection section 83 as a bench mark (a target value) to the other air conditioning systems belonging to the same group.

[0051] An operation of the air conditioning network system 100 having the aforementioned configuration will be described below.

[0052] First, in each of the air conditioning systems 1a to 1n that are being operated, data on an installation environment (an external air temperature, an amount of solar radiation, etc.), control input data (an external air temperature, a set temperature, an indoor suction temperature, low pressure, high pressure, and an expansion valve opening, etc.), and an intermediate value on control calculation (e.g., a low pressure target value) are collected by the power consumption management section 44, and these types of information, together with power consumption, are transmitted to the energy saving support apparatus 10 via the communication medium 4.

[0053] In the energy saving support apparatus 10, the data sent from each of the air conditioning systems is received in the receiving section 81 (see Fig. 4), and is output to the group creation section 82.

[0054] The group creation section 82 compares data on respective installation environments in the air conditioning systems, extracts the air conditioning systems, among which there are differences within a predetermined approximate range, and groups the extracted air conditioning systems which are approximate to one another in installation environment. For example, the group creation section 82 groups the air conditioning systems, among which there are differences within 1°C in external air temperature and differences within 300 [W/m²] in amount of solar radiation.

[0055] Then, the selection section 83 selects, among the air conditioning systems belonging to the same group, the air conditioning system having the lowest power consumption. The transmission section 84 transmits an intermediate value (e.g., a low pressure-side target

pressure value) of the air conditioning system selected by the selection section 83 to the other air conditioning systems belonging to the same group.

[0056] As a result, the air conditioning system, which has not been selected by the selection section 83, can acquire an intermediate value of the air conditioning system, which is in an approximate installation environment to that of itself and is being operated with lower power consumption than that of itself, as a bench mark (a target). In each of the air conditioning systems that have received the intermediate value, the intermediate value serving as the bench mark is displayed on the display section 45. As a result, one method for further dropping the power consumption can be further presented to the user. When the intermediate value received from the energy saving support apparatus 10 is incorporated into control, the power consumption can be expected to be further reduced.

[0057] When the aforementioned processing is repeatedly performed at predetermined time intervals, in each of the air conditioning systems, information on the air conditioning system, which is being more effectively operated from the viewpoint of energy saving than itself, can be continuously obtained.

[0058] As described above, in the energy saving support apparatus, the air conditioning systems, and the air conditioning network system according to the present embodiment, various types of data on each of the air conditioning systems are collected, the air conditioning systems, which are approximate to one another in installation environment, are grouped based on the data, the air conditioning system having the lowest power consumption in each of the groups is selected, and an intermediate value (e.g., a low pressure target value) of the air conditioning system is transmitted as a bench mark to the air conditioning systems belonging to the same group. As a result, each of the air conditioning systems can obtain information on the air conditioning system, which is in an approximate installation environment to that of itself and has achieved more energy saving than itself, i.e., control information useful to contribute to its own energy saving.

[0059] In the air conditioning systems, which are similar in operation status, for example, respective methods for determining low pressure target values set depending on a set temperature may differ as the reason why the air conditioning systems differ in power consumption. Therefore, a clue to saving energy can be given by presenting these values (the intermediate value) to the other air conditioning systems.

[0060] A threshold value or the like referred to when protection control is made to function may also be transmitted in addition to the aforementioned intermediate value. The power consumption varies depending on the threshold value referred to when protection control is made to function, e.g., a low pressure threshold value and a high pressure threshold value used for emergency stop and protection control of a compressor. Thus, a clue

to saving energy can also be given by presenting these values to each of air conditioning systems.

[0061] Various types of data to be transmitted to the energy saving support apparatus 10 from each of the air conditioning systems 1a to 1n may be an instantaneous value or an average value in a predetermined period (e.g., an average value in one hour).

{Second Embodiment}

[0062] An energy saving support apparatus, air conditioning systems, and an air conditioning network system according to a second embodiment of the present invention will be described below.

[0063] The air conditioning network system according to the present embodiment differs from that in the aforementioned first embodiment in configuration of the energy saving support apparatus.

[0064] A difference between the energy saving support apparatus according to the present embodiment and that in the air conditioning network system according to the aforementioned first embodiment will be mainly described below.

[0065] Fig. 5 is a functional block diagram of the energy saving support apparatus according to the present embodiment. As illustrated in Fig. 5, the energy saving support apparatus 10a includes a receiving section 81, a group creation section 82, a selection section 83', and a data storage section 85. The receiving section 81 and the group creation section 82 are similar to those in the aforementioned first embodiment. The selection section 83' selects, among the air conditioning systems belonging to the same group, the air conditioning system having the highest power consumption, and stores received data on the air conditioning system in the data storage section 85. As a result, the data on the air conditioning system having the highest power consumption in each of the groups is stored in the data storage section 85.

[0066] The data thus stored is used to detect abnormality prediction by being handled as abnormality prediction data and analyzed.

[0067] As described above, in the energy saving support apparatus, the air conditioning systems, and the air conditioning network system according to the present embodiment, the receiving section 81 collects various types of data on each of the air conditioning systems, the group creation section 82 groups the air conditioning systems, which are approximate to one another in installation environment, based on the data, the selection section 83' selects the air conditioning system having the highest power consumption in each of the groups and stores received data on the selected air conditioning system as abnormality prediction data in the data storage section 85. As a result, an enormous amount of data stored in the data storage section 85 can be expected to be effectively used to detect abnormality prediction because a tendency toward the abnormality prediction can be grasped by being analyzed.

[0068] Furthermore, the received data on the air conditioning system selected by the selection section 83' may be compared with respective received data on the other air conditioning systems belonging to the same group or their average data, and only the received data, which differs by more than a predetermined value from the received data on the other air conditioning systems, may be stored in the data storage section 85. When only the received data, which apparently differs from the received data on the other air conditioning systems, is thus stored, for example, an amount of stored data can be reduced. Therefore, the data can be easily analyzed while the capacity of the data storage section 85 can be inhibited from increasing.

[0069] The energy saving support apparatus 10a according to the present embodiment and the energy saving support apparatus 10 according to the aforementioned first embodiment may be combined with each other. When the selection section 83' and the data storage section 85 are thus combined with the energy saving support apparatus 10 according to the first embodiment, information contributing to energy saving can be provided to each of the air conditioning systems while analysis of abnormality prediction is enabled.

{Third Embodiment}

[0070] An energy saving support apparatus, air conditioning systems, and an air conditioning network system according to a third embodiment of the present invention will be described below.

[0071] Although the group creation section 82 groups the air conditioning systems, which are approximate to one another in installation environment, in the aforementioned first embodiment, the present embodiment differs from the first embodiment in that a group creation section groups air conditioning systems which are approximate to one another in air conditioning system configuration.

[0072] A difference between the energy saving support apparatus according to the present embodiment and that in the air conditioning network system according to the aforementioned first embodiment will be mainly described below.

[0073] Fig. 6 is a functional block diagram of an energy saving support apparatus 10b according to the present embodiment. As illustrated in Fig. 6, the energy saving support apparatus 10b includes a receiving section 81, a group creation section 82', a selection section 83, and a transmission section 84.

[0074] In the energy saving support apparatus 10b, the receiving section 81 receives data on a configuration (e.g., an output of an outdoor unit (a capability which the outdoor unit exhibits while being operated) and the number of indoor units that are being operated and the capacity of the indoor unit that is being operated), control input data (an external air temperature, a set temperature, an indoor suction temperature, low pressure, high pressure, an expansion valve opening, etc.), and an in-

termediate value on control calculation (e.g., a low pressure target value), which have been transmitted from each of the air conditioning systems.

[0075] The group creation section 82' then compares respective data on configurations received by the receiving section 81, and groups air conditioning systems which are identical (or approximate) to one another in configuration. For example, the air conditioning systems are put in the same group when an output of the outdoor unit is within a predetermined range and the sum of the capacities of the indoor units that are being operated is within a predetermined range in each of the air conditioning systems. A grouping condition is not limited to this, and another condition may be used. For example, a case where air conditioning systems are put in the same group when an output of an outdoor unit is within a predetermined range, the number of indoor units remains the same, and the capacities of the indoor units are within a predetermined range in each of the air conditioning systems is illustrated as an example.

[0076] Then, the selection section 83 selects, among the air conditioning systems belonging to the same group, the air conditioning system having the lowest power consumption. The transmission section 84 transmits an intermediate value (e.g., a low pressure target value) of the air conditioning system selected by the selection section 83 to the other air conditioning systems belonging to the group.

[0077] As described above, in the energy saving support apparatus, the air conditioning systems, and the air conditioning network system according to the present embodiment, the air conditioning systems are grouped based on a system configuration. As a result, each of the air conditioning systems can obtain information on the air conditioning system that is on the same scale as that of itself and has achieved more energy saving than itself, i.e., useful control information contributing to its own energy saving.

{Fourth Embodiment}

[0078] An energy saving support apparatus, air conditioning systems, and an air conditioning network system according to a fourth embodiment of the present invention will be described below.

[0079] The air conditioning network system according to the present embodiment differs from that in the aforementioned third embodiment in a configuration of the energy saving support apparatus.

[0080] A difference between an energy saving support apparatus 10c according to the present embodiment and that in the air conditioning network system according to the aforementioned first embodiment will be mainly described below.

[0081] Fig. 7 is a functional block diagram of the energy saving support apparatus 10c according to the present embodiment. As illustrated in Fig. 7, the energy saving support apparatus 10c includes a receiving section 81,

a group creation section 82', a selection section 83', and a data storage section 85. The receiving section 81 and the group creation section 82' are similar to those in the aforementioned third embodiment. The selection section 83' selects, among the air conditioning systems belonging to the same group, the air conditioning system having the highest power consumption, and stores received data on the air conditioning system in the data storage section 85. As a result, the data on the air conditioning system having the highest power consumption in each of the groups is stored in the data storage section 85. The data thus stored is used to detect abnormality prediction by being handled as abnormality prediction data and analyzed.

[0082] As described above, the energy saving support apparatus according to the fourth embodiment has a configuration in which the selection section 83' and the data storage section 85 according to the second embodiment and the group creation section and the like according to the third embodiment are combined with each other.

[0083] As described above, in the energy saving support apparatus, the air conditioning systems, and the air conditioning network system according to the present embodiment, the receiving section 81 collects various types of data on each of the air conditioning systems, the group creation section 82 groups the air conditioning systems, which are approximate to one another in equipment configuration, based on the data, the selection section 83' selects the air conditioning system having the highest power consumption in each of groups and stores received data on the selected air conditioning system as abnormality prediction data in the data storage section 85. As a result, an enormous amount of data stored in the data storage section 85 can be expected to be effectively used to detect abnormality prediction because a tendency toward the abnormality prediction can be grasped by being analyzed.

[0084] In the present embodiment, the received data on the air conditioning system selected by the selection section 83' may be further compared with respective received data on the other air conditioning systems belonging to the same group or their average data, and only the received data, which differs by more than a predetermined value from the received data on the other air conditioning systems, may be stored in the data storage section 85. When only the received data, which apparently differs from the received data on the other air conditioning systems, is thus stored, for example, an amount of stored data can be reduced. Therefore, the data can be easily analyzed while the capacity of the data storage section 85 can be inhibited from increasing.

[0085] The energy saving support apparatus 10c according to the present embodiment and the energy saving support apparatus 10b according to the aforementioned third embodiment may be combined with each other. When the selection section 83' and the data storage section 85 are thus combined with the energy saving support apparatus 10b according to the third embodiment,

information contributing to energy saving can be provided to each of the air conditioning systems while analysis of abnormality prediction is enabled.

[0086] While the embodiments of the present invention have been described above, the present invention is not limited to only the aforementioned embodiments, and various modifications are possible. An example of the modifications will be illustrated below.

[0087] While the selection section 83 or 83' selects the air conditioning system having the highest or lowest power consumption in each of the aforementioned embodiments, the selection section may select the air conditioning system having the highest or lowest coefficient of performance (COP) instead of this. Even if the air conditioning system is thus selected based on the coefficient of performance, data effective to grasp information contributing to energy saving and a tendency toward abnormality prediction can be obtained.

[0088] Furthermore, the group creation section 82 or 82' may group the air conditioning systems, which are approximate to one another in equipment configuration and installation environment, or may further group the air conditioning systems, which are close to one another in difference between a suction temperature and a set temperature, in addition to these conditions. Thus, the group creation section can group the air conditioning systems, which are approximate to one another in operation state, by adding a condition.

[0089] While a case where an intermediate value (e.g., a low pressure target value), a threshold value referred to when protection control is made to function, and the like are transmitted to each of the air conditioning systems from the energy saving support apparatus 10 or 10b has been illustrated as an example in the aforementioned embodiment, input data, installation environment data, equipment configuration data, or the like on the air conditioning system having the lowest power consumption in the group may be transmitted in addition to this. When more types of data are thus provided, more specific analysis based on more types of data is enabled in the air conditioning system that has acquired these types of information. Which value is to be changed and how the value is to be changed can be examined to further promote energy saving.

{Reference Signs List}

[0090]

1a - 1n Air conditioning system
 3 Control device
 10, 10a, 10b, 10c Energy saving support apparatus
 41, 42 Indoor unit control section
 43 Outdoor unit control section
 44 Power consumption management section
 45 Display section
 81 Receiving section
 82, 82' Group creation section

83, 83' Selection section
 84 Transmission section
 85 Data storage section
 100 Air conditioning network system
 A1, A2 Indoor unit
 B Outdoor unit

Claims

1. An energy saving support apparatus connected to a plurality of air conditioning systems via a network, the energy saving support apparatus comprising:

a receiving means that receives data on an installation environment of each of the air conditioning systems, input data and an intermediate value in control calculation, and power consumption;

a group creation means that groups the air conditioning systems, which are approximate to one another in installation environment, using the data on the installation environment received by the receiving means;

a selection means that selects the air conditioning system having the lowest power consumption or having the highest coefficient of performance among the air conditioning systems belonging to the same group; and

a transmission means that transmits an intermediate value of the air conditioning system selected by the selection means to the other air conditioning systems belonging to the same group.

2. The energy saving support apparatus according to claim 1, further comprising a data storage means that stores data,

wherein the selection means selects the air conditioning system having the highest power consumption or having the lowest coefficient of performance among the air conditioning systems belonging to the same group, and stores all or some pieces of the received data on the selected air conditioning system in the data storage means.

3. The energy saving support apparatus according to claim 1 or 2, wherein the data on the installation environment includes at least one of an external air temperature, an amount of solar radiation, and a direction of a building.

4. An energy saving support apparatus connected to a plurality of air conditioning systems via a network, the energy saving support apparatus comprising:

a receiving means that receives data on a configuration of each of the air conditioning systems, an intermediate value in control calculation,

and power consumption;

a group creation means that groups the air conditioning systems, which are approximate to one another in configuration, using the data on the configuration received by the receiving means; a selection means that selects the air conditioning system having the lowest power consumption or having the highest coefficient of performance among the air conditioning systems belonging to the same group; and

a transmission means that transmits an intermediate control value of the air conditioning system selected by the selection means to the other air conditioning systems belonging to the same group.

5. The energy saving support apparatus according to claim 4, further comprising a data storage means that stores data,

wherein the selection means selects the air conditioning system having the highest power consumption or having the lowest coefficient of performance among the air conditioning systems belonging to the same group, and stores all or some pieces of the received data on the selected air conditioning system in the data storage means.

6. The energy saving support apparatus according to claim 4 or 5, wherein the data on the configuration includes at least one of the capacity of an outdoor unit, the number of indoor units, and a capacity configuration of the indoor units.

7. An air conditioning system connected to an energy saving support apparatus via a network, the air conditioning system comprising:

an outdoor unit including a communication means;

an indoor unit including a communication means; and

a control device which can communicate with the outdoor unit and the indoor unit via a communication medium,

wherein the control device comprises

an outdoor unit control means that controls the outdoor unit,

an indoor unit control means that controls the indoor unit,

a power consumption management means that manages power consumption, and

a display means,

the outdoor unit control means acquires equipment information and a sensor value on the outdoor unit via the communication medium while outputting a control instruction to equipment loaded onto the outdoor unit,

the indoor unit control means acquires equip-

ment information and a sensor value on the indoor unit via the communication medium while outputting a control instruction to equipment loaded onto the indoor unit, and

the power consumption management means 5
makes data on an installation environment of each of the air conditioning systems, data on a configuration, input data and an intermediate value in control calculation, and power consumption transmittable to the energy saving support apparatus, and displays, when it acquires an intermediate value from the energy saving support apparatus, the intermediate value as a benchmark value on the display means. 10

- 15
8. The air conditioning system according to claim 7, wherein the outdoor unit control means and the indoor unit control means are respectively loaded as virtualized control sections onto the control device. 20

9. An air conditioning network system comprising:

the energy saving support apparatus according to any one of claims 1 to 6, and 25
the air conditioning system according to claim 7 or 8.

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FIG. 1

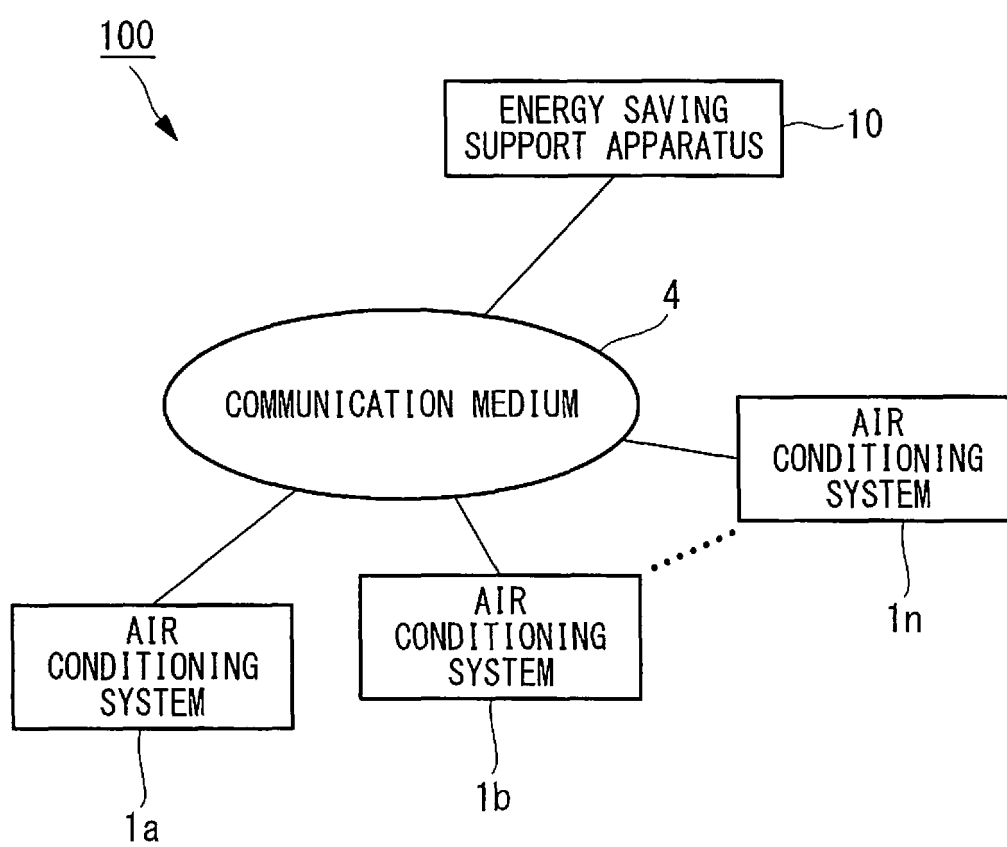


FIG. 2

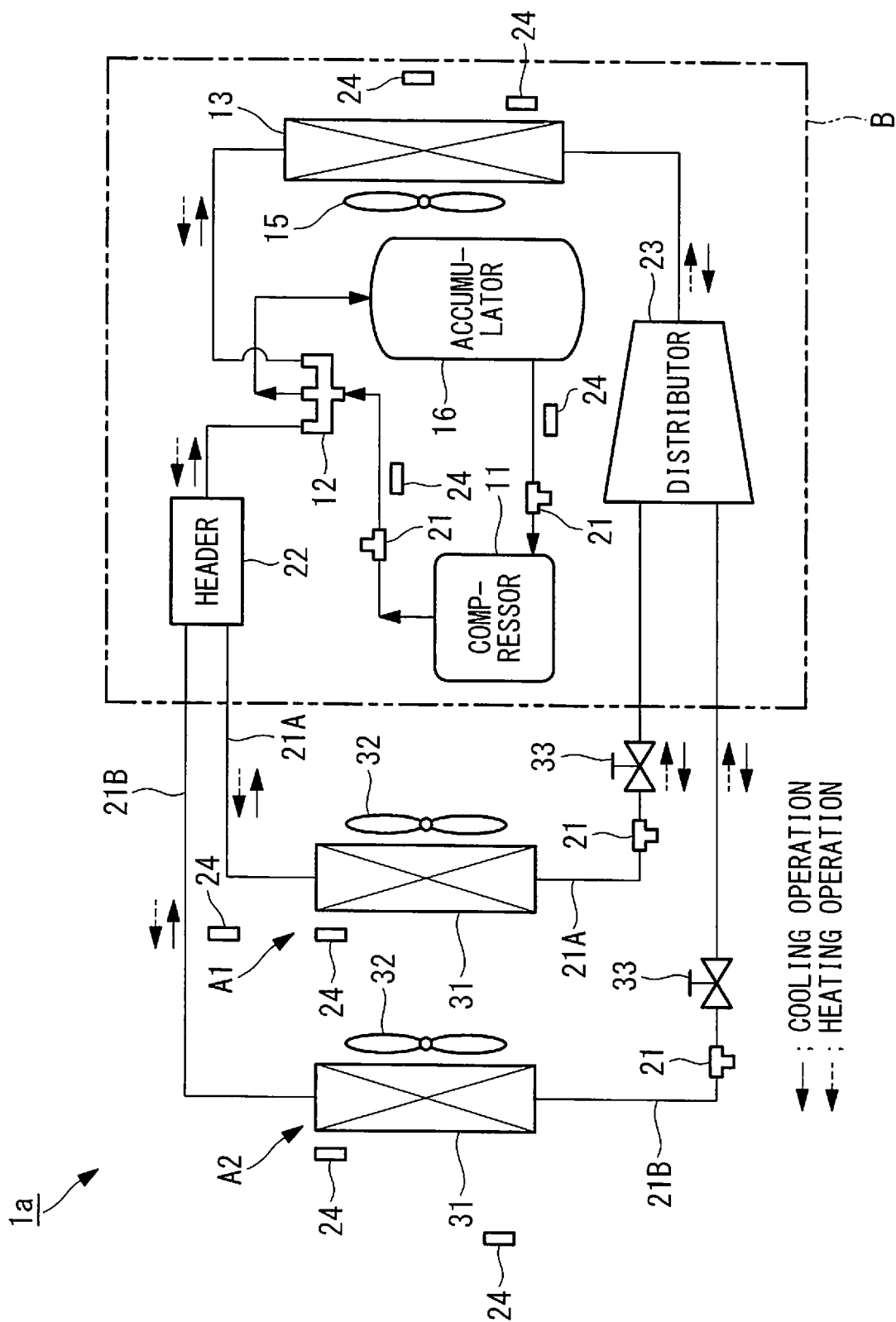


FIG. 3

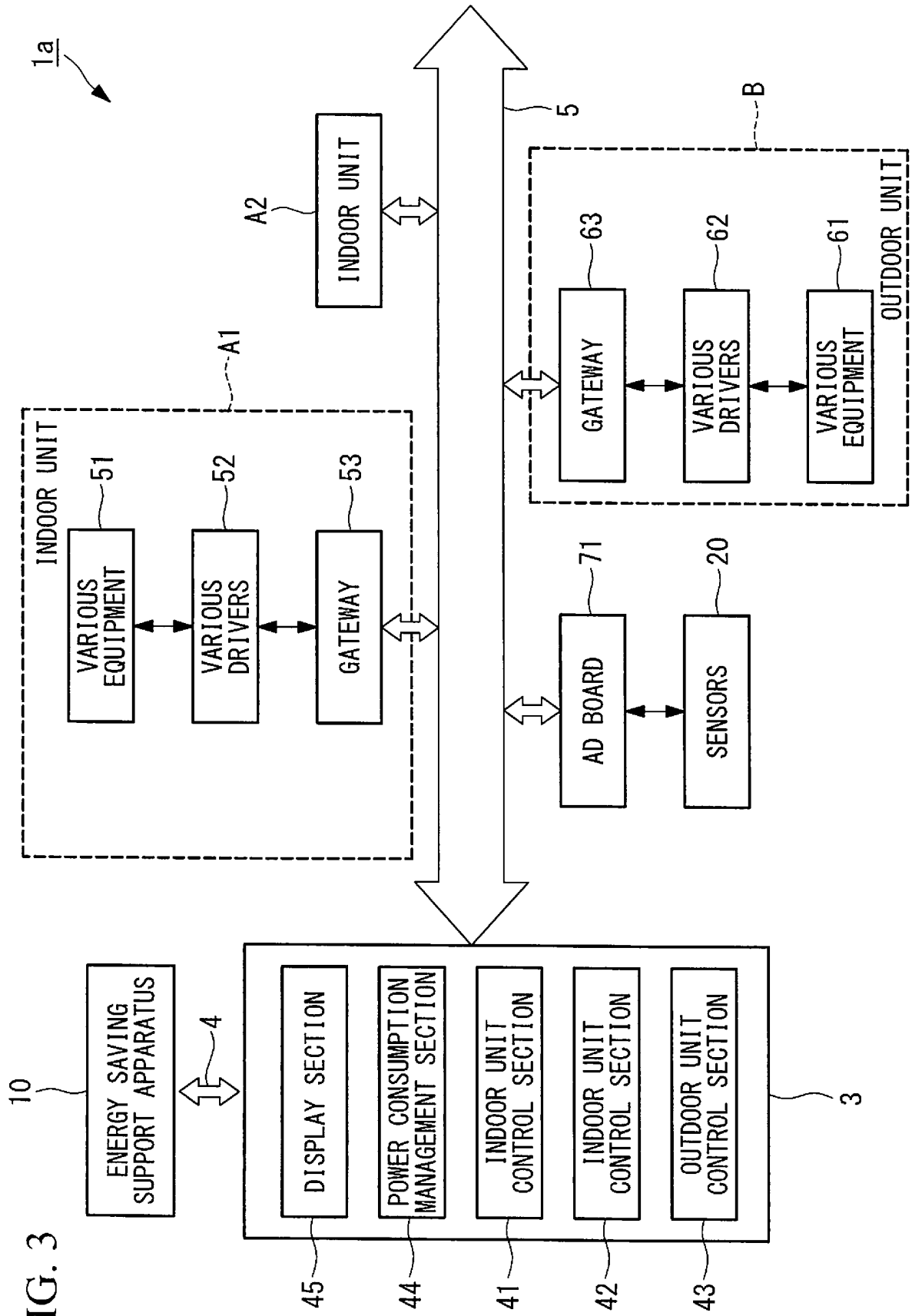


FIG. 4

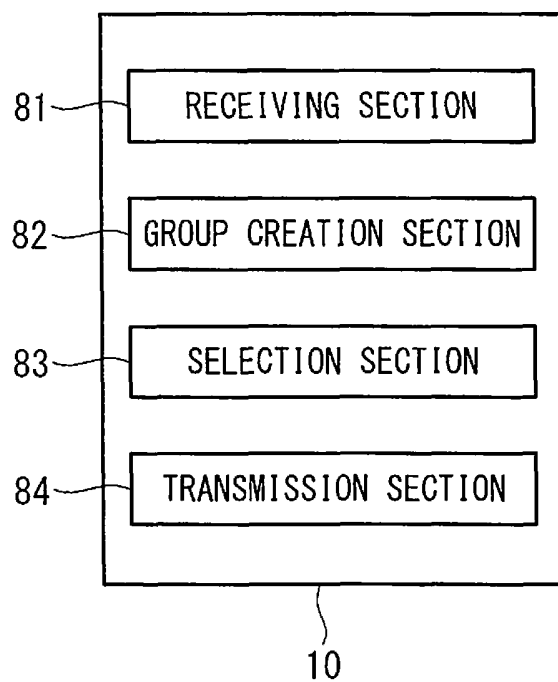


FIG. 5

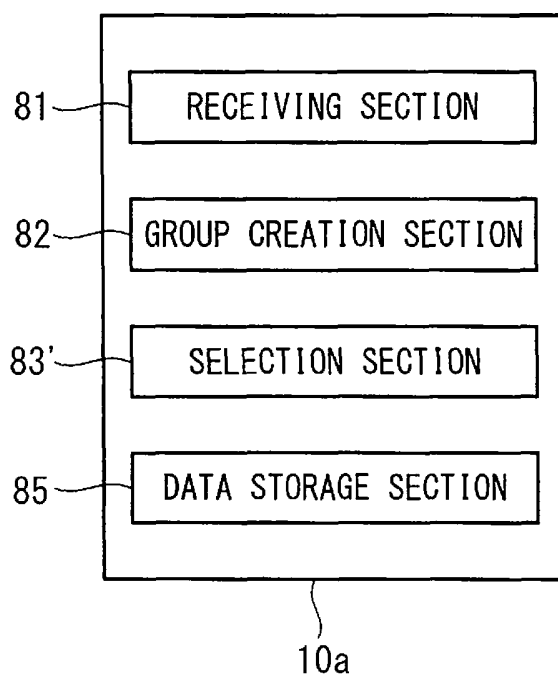


FIG. 6

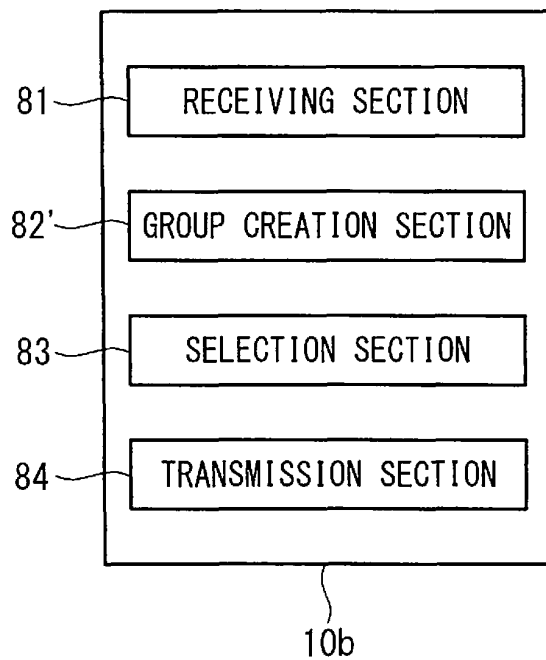
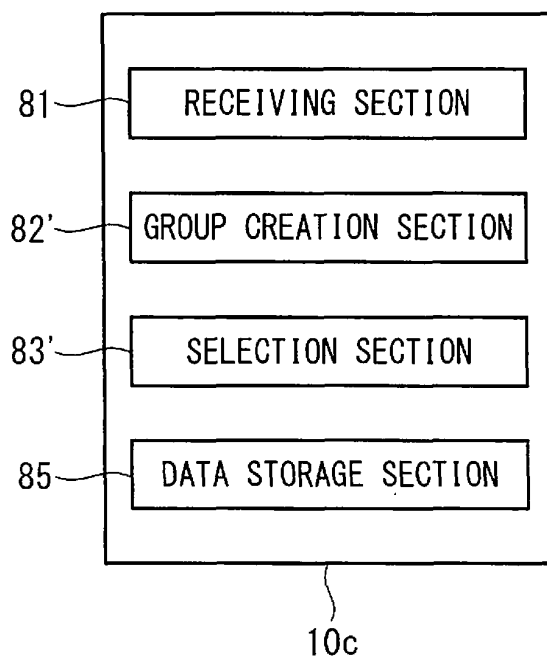


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

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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

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Y	JP 2008-128526 A (Matsushita Electric Works, Ltd.), 05 June 2008 (05.06.2008), claim 2; paragraphs [0064] to [0075]; fig. 8 to 10 (Family: none)	1-9
Y	JP 2008-157533 A (Daikin Industries, Ltd.), 10 July 2008 (10.07.2008), paragraphs [0073] to [0078]; fig. 8 & US 2008/0306632 A1 & EP 2096367 A1 & KR 10-2008-0097423 A & CN 101389908 A	2, 5

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

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Date of the actual completion of the international search
23 April 2015 (23.04.15)Date of mailing of the international search report
12 May 2015 (12.05.15)Name and mailing address of the ISA/
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Tokyo 100-8915, Japan

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/052375

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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