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(54) MANAGEMENT SYSTEM, AIR-CONDITIONING EQUIPMENT MANAGEMENT METHOD, AND PROGRAM

(57) A management system capable of maintaining comfort in an air-conditioned space and reducing energy consumption of air-conditioning equipment is provided.

The management system in the present disclosure includes a setting unit that sets a set temperature to the air-conditioning equipment, an acquisition unit that acquires operation data indicating temperature change operation of changing the set temperature of the air-conditioning equipment, a determination unit that determines whether or not the acquired operation data acquired by the acquisition unit in a predetermined period satisfies a condition necessary for processing of determining a control parameter for executing control of the air-conditioning equipment, and a processing unit that determines the control parameter including at least the set temperature of the air-conditioning equipment based on the acquired operation data in a case where it is determined that the acquired operation data satisfies the condition, and in a case where the determination unit determines that the acquired operation data does not satisfy the condition, the setting unit changes the set temperature of the air-conditioning equipment, and the acquisition unit acquires the operation data.

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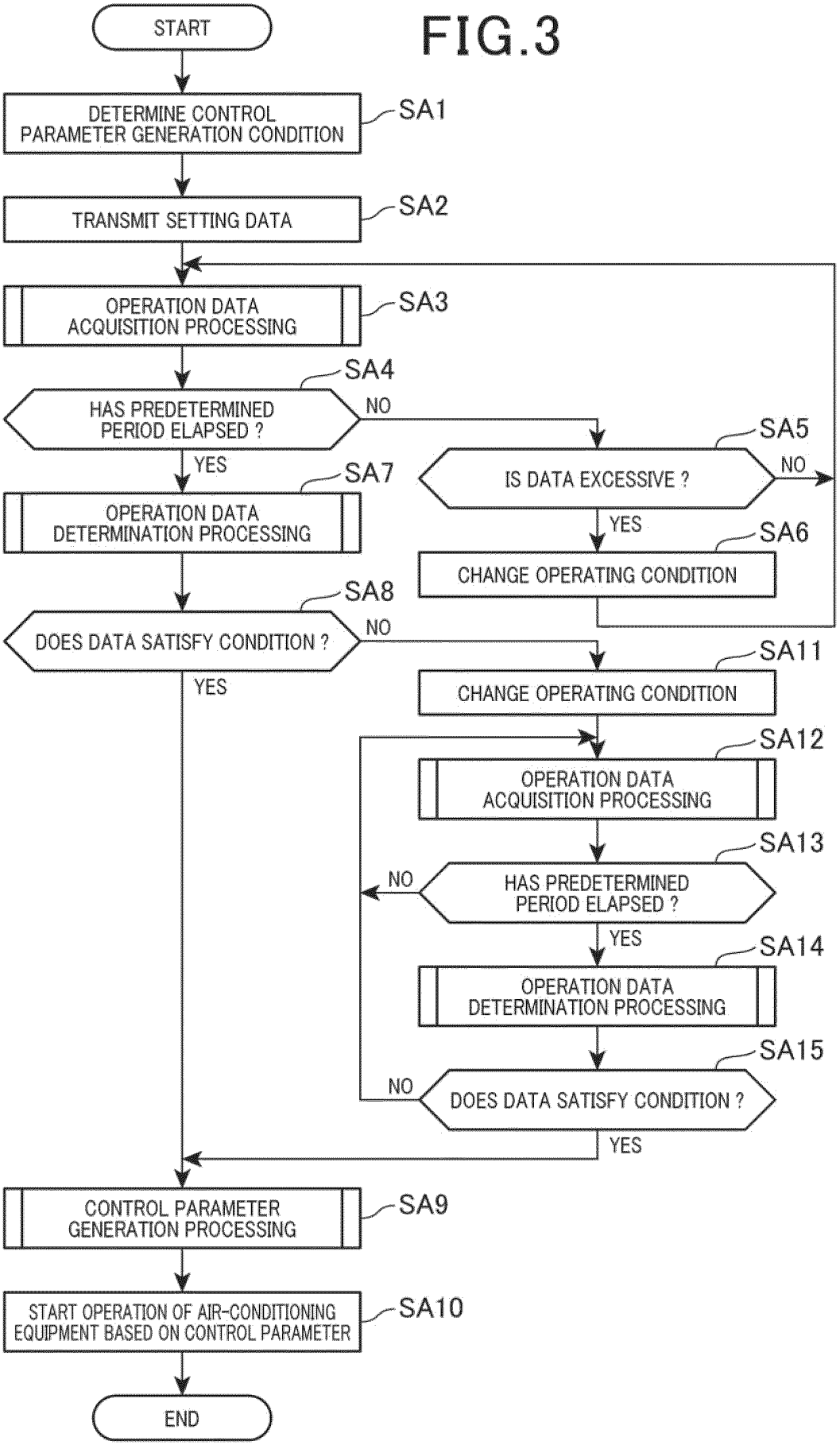
FIG.3


START
DETERMINE CONTROL PARAMETER GENERATION CONDITION
SA1
TRANSMIT SETTING DATA
SA2
OPERATION DATA ACQUISITION PROCESSING
SA3
SA4
HAS PREDETERMINED PERIOD ELAPSED ?
NO
YES
SA5
IS DATA EXCESSIVE ?
NO
YES
SA6
CHANGE OPERATING CONDITION
SA7
OPERATION DATA DETERMINATION PROCESSING
SA8
DOES DATA SATISFY CONDITION ?
NO
YES
SA11
CHANGE OPERATING CONDITION
SA12
OPERATION DATA ACQUISITION PROCESSING
SA13
NO
HAS PREDETERMINED PERIOD ELAPSED ?
YES
SA14
OPERATION DATA DETERMINATION PROCESSING
SA15
NO
DOES DATA SATISFY CONDITION ?
YES
CONTROL PARAMETER GENERATION PROCESSING
SA9
START OPERATION OF AIR-CONDITIONING EQUIPMENT BASED ON CONTROL PARAMETER
SA10
END

Description

[Technical Field]

[0001] The present disclosure relates to a management system, an air-conditioning equipment management method, and a program.

[Background Art]

[0002] Patent Literature 1 discloses a temperature control device of an air conditioner which performs control so that a set temperature of the air conditioner changes stepwise in accordance with change of an outside air temperature.

[Citation List]

[Patent Literature]

[0003] [Patent Literature 1]
Japanese Patent Laid-Open No. 2005-061716

[Summary of Invention]

[Technical Problem]

[0004] The present disclosure provides a management system capable of maintaining comfort in an air-conditioned space and reducing energy consumption of air-conditioning equipment.

[Solution to Problem]

[0005] The present specification incorporates entire content of Japanese Patent Application No. 2022-029429 filed on February 28, 2022.

[0006] A management system in the present disclosure includes a setting unit that sets a set temperature to air-conditioning equipment, an acquisition unit that acquires operation data indicating temperature change operation of changing the set temperature of the air-conditioning equipment, a determination unit that determines whether or not the acquired operation data acquired by the acquisition unit in a predetermined period satisfies a condition necessary for processing of determining a control parameter for executing control of the air-conditioning equipment, and a processing unit that determines the control parameter including at least the set temperature of the air-conditioning equipment based on the acquired operation data in a case where it is determined that the acquired operation data satisfies the condition, and in a case where the determination unit determines that the acquired operation data does not satisfy the condition, the setting unit changes the set temperature of the air-conditioning equipment, and the acquisition unit acquires the operation data.

[Advantageous Effects of Invention]

[0007] A management system in the present disclosure can acquire sufficient data regarding operation of changing a set temperature of air-conditioning equipment to determine a control parameter of the air-conditioning equipment. It is therefore possible to determine an appropriate control parameter regarding control of the air-conditioning equipment.

[Brief Description of Drawings]

[0008]

Fig. 1 is a view illustrating a configuration of a management system.
Fig. 2 is a block diagram of a management server.
Fig. 3 is a flowchart indicating operation of the management system.
Fig. 4 is a sequence diagram indicating operation data acquisition processing.
Fig. 5 is a flowchart indicating operation data determination processing.
Fig. 6 is a diagram indicating an example of a regression straight line.
Fig. 7 is a flowchart indicating an example of control parameter generation processing.

Fig. 8 is a diagram indicating an example of a regression straight line.
Fig. 9 is a flowchart indicating another example of the control parameter generation processing.
Fig. 10 is a flowchart indicating still another example of the control parameter generation processing.
Fig. 11 is an explanatory diagram indicating an aspect of operation of air-conditioning equipment based on a control parameter.
Fig. 12 is a sequence diagram indicating operation of the management system
Fig. 13 is a diagram indicating an example of display data based on comparison data.
Fig. 14 is a diagram indicating another example of the display data based on the comparison data.

[Description of Embodiment]

(Knowledge, and the like, that are basis of the present disclosure)

[0009] At the time when the present inventors have conceived of the present disclosure, there has been a technique of detecting an outside air temperature of a building in which air-conditioning equipment is installed and changing a set temperature of the air-conditioning equipment in accordance with change of the outside air temperature.

[0010] However, the outside air temperature is merely one of the elements that affect comfort in an air-conditioned space, and thus, even if the set temperature of the air-conditioning equipment is changed based on the outside air temperature, comfort in the air-conditioned space is less likely to be secured. Thus, the present inventors have found a problem that the set temperature of the air-conditioning equipment is often changed to secure comfort in the air-conditioned space, which makes it difficult to reduce energy consumption of the air-conditioning equipment, and have achieved a configuration of a subject matter of the present disclosure to solve the problem. Further, the present inventors have also found a problem that in a case where the set temperature of the air-conditioning equipment is changed, a user typically tends to excessively demand comfort, which makes it more likely to increase energy consumption of the air-conditioning equipment, and have achieved the configuration of the subject matter of the present disclosure to solve the problem. Note that excessively demanding comfort indicates, for example, lowering the set temperature more than necessary during cooling operation and raising the set temperature more than necessary during heating operation.

[0011] The present disclosure therefore provides a management system capable of maintaining comfort in an air-conditioned space and reducing energy consumption of air-conditioning equipment.

[0012] An embodiment will be described in detail below with reference to the drawings. However, explanation that is detailed more than necessary may be omitted. For example, detailed description of matters that have already been well known or redundant description of components that are substantially the same may be omitted.

[0013] Note that the accompanying drawings and the following description are provided for a person skilled in the art to sufficiently understand the present disclosure and are not intended to limit the subject matter recited in the claims.

[1. Configuration of air-conditioning monitoring system]

[0014] Fig. 1 is a view illustrating a configuration of a management system 1000.

[0015] The management system 1000 is a management system of air-conditioning equipment 10, the management system including a management server 100 communicably connected to a plurality of pieces of air-conditioning equipment 10, and the management server 100 making setting regarding operation of the air-conditioning equipment 10.

[0016] The air-conditioning equipment 10 to be managed by the management server 100 only requires to be communicably connected to the management server 100. There is no limitation in the number of pieces of the air-conditioning equipment 10 connected to the management server 100 and a place where the air-conditioning equipment 10 is installed. Fig. 1 illustrates an example where air-conditioning equipment 10A is installed in a facility 1A, air-conditioning equipment 10B is installed in a facility 1B, air-conditioning equipment 10C is installed in a facility 1C, and air-conditioning equipment 10D is installed in a facility 1D. In a case where the respective pieces of the air-conditioning equipment 10A, 10B, 10C and 10D are not distinguished, they will be expressed as air-conditioning equipment 10. Further, there is no limitation in a specific configuration of the air-conditioning equipment 10. While in the present embodiment, description will be provided assuming that the air-conditioning equipment 10 is a packaged air conditioner or a room air conditioner which operates with electric power, the air-conditioning equipment 10 may be gas heat pump (GHP)-type air conditioning equipment that operates with gas energy.

[0017] Each of the facilities 1A, 1B, 1C and 1D has an air-conditioned space. The air-conditioned space is a space in which air is to be conditioned by the air-conditioning equipment 10. In a case where the facilities 1A, 1B, 1C and 1D are not distinguished, they will be expressed as a facility 1. The air-conditioned space of the facility 1 may be the entire building or may be a space partitioned inside the building. Scales and types of the facility 1 and the air-conditioned space are not limited. The air-conditioned space is, for example, a house, an office, a store, a medical facility, a public facility or other facilities. While examples of air conditioning of the air-conditioned space can include heating, cooling, dehumidification,

blast, ventilation, and the like, in the present embodiment, a case will be described where the air-conditioned space is cooled and heated by the air-conditioning equipment 10.

[0018] The management server 100 may be constituted with one server computer or may have a configuration in which a plurality of server computers functions as the management server 100. The management server 100 may be a so-called cloud server.

[0019] A communication network N is a communication line including a dedicated line, a public network, the Internet, and the like. The communication network N may include network devices (not illustrated) such as a Wi-Fi (registered trademark) router, a switch, a router, a gateway and various kinds of server devices. Further, the communication network N may include a wireless base station installed by a telecommunication carrier.

[0020] The management system 1000 includes a device to be used by a manager who manages the air-conditioning equipment 10. In the example in Fig. 1, the management system 1000 includes a terminal device 5 and a mobile terminal device 7 as examples of a device to be used by the manager. The terminal device 5 and the mobile terminal device 7 have a function of communicating with the management server 100. Specific configurations of the terminal device 5 and the mobile terminal device 7 are not limited. For example, the terminal device 5 may be a personal computer (PC), a smartphone, a tablet computer, or a wearable terminal such as a smartwatch. This similarly applies to the mobile terminal device 7. The number of terminal devices 5 and mobile terminal devices 7 included in the management system 1000 is not limited.

[0021] The terminal device 5 illustrated in Fig. 1 is a laptop-type PC and includes a display 51. The mobile terminal device 7 is a smartphone and includes a display 71 that functions as a touch panel. The terminal device 5 and the mobile terminal device 7 display information regarding a power consumption amount and a use state of the air-conditioning equipment 10 on the displays 51 and 71 based on data generated by the management server 100.

[0022] The air-conditioning equipment 10A includes a control device 11, an outdoor unit 12, an indoor unit 13, an operation unit 14, a communication device 15, and an outside air temperature sensor 18. The air-conditioning equipment 10B, 10C, 10D and other air-conditioning equipment 10 are constituted in a similar manner. Note that the configuration in Fig. 1 is one example, and there is no limitation in the number of outdoor units 12 and indoor units 13 included in the air-conditioning equipment 10A. For example, the air-conditioning equipment 10A may have a configuration in which a plurality of indoor units 13 performs air conditioning of a plurality of air-conditioned spaces in the facility 1A.

[0023] The outdoor unit 12, while not illustrated, includes a compressor, various kinds of valves such as a four-way valve and an on-off valve, an outdoor heat exchanger and a refrigerant circuit that connects these. The indoor unit 13 includes various kinds of valves such as an expansion valve and an on-off valve, an indoor heat exchanger and a refrigerant circuit that connects these. The refrigerant circuit of the outdoor unit 12 is connected to the refrigerant circuit of the indoor unit 13.

[0024] The control device 11 is connected to the outdoor unit 12, the indoor unit 13, the operation unit 14 and the outside air temperature sensor 18. The control device 11 causes the air-conditioning equipment 10 to operate so that an air temperature of the air-conditioned space becomes a set target temperature by controlling operation of the compressor provided in the outdoor unit 12 and opening and closing of valves provided in the outdoor unit 12 and the indoor unit 13. The control device 11, for example, includes a memory and a processor and controls the air-conditioning equipment 10A in accordance with data stored in the memory by the processor executing the program stored in the memory. The processor of the control device 11 is, for example, a micro controller integrated with the memory. The control device 11 corresponds to one example of a control unit in the present disclosure.

[0025] The outside air temperature sensor 18 is connected to the control device 11. The outside air temperature sensor 18 is a temperature sensor that detects an air temperature, and a detection scheme of the outside air temperature sensor 18 is not limited. The outside air temperature sensor 18 is, for example, installed in the outdoor unit 12.

[0026] The target temperature set in the air-conditioning equipment 10A will be referred to as a "set temperature" in the following description.

[0027] The operation unit 14 includes a switch, and the like, that operate the air-conditioning equipment 10A. The operation unit 14 is, for example, a controller installed in the facility 1A. By operating the operation unit 14, it is possible to instruct the control device 11 to start operation, stop operation and change the set temperature of the air-conditioning equipment 10A. The control device 11 starts operation, stops operation, changes the set temperature, or the like, of the air-conditioning equipment 10A in accordance with operation of the operation unit 14. In the following description, operation of changing the set temperature of the air-conditioning equipment 10 among the operation to be performed by the operation unit 14 will be referred to as temperature change operation.

[0028] The communication device 15 is a device that executes communication with the management server 100 via the communication network N. The communication device 15 is connected to the communication network N via a public network, a wide area network (WAN), a local area network (LAN), an IP communication network, or the like, and executes data communication. The communication device 15 may be a wireless communication device that is connected to the communication network N by executing wireless communication such as a cellular communication scheme and Wi-Fi. The communication device 15 receives setting data SD which will be described later from the management server 100 and transmits operation data RD which will be described later to the management server 100. The communication device 15

corresponds to one example of a transmission unit in the present disclosure.

[0029] The air-conditioning equipment 10B, 10C and 10D and other air-conditioning equipment 10 included in the management system 1000 have configurations similar to the configuration of the air-conditioning equipment 10A. The air-conditioning equipment 10 includes the control device 11. The control device 11 performs air conditioning of the air-conditioned space by causing the outdoor unit 12 and the indoor unit 13 to operate in accordance with operation of the operation unit 14.

[0030] The management server 100 transmits the setting data SD to the air-conditioning equipment 10 connected to the management server 100. The setting data SD and operation regarding the operation data RD which will be described later are common among all pieces of the air-conditioning equipment 10 managed by the management server 100.

[0031] The setting data SD includes the set temperature of the air-conditioning equipment 10 and specifically includes the set temperature during cooling operation and the set temperature during heating operation. The control device 11 receives the setting data SD by the communication device 15 and causes the air-conditioning equipment 10 to operate at the set temperature designated by the received setting data SD.

[0032] The setting data SD may include information regarding temperature change operation. Specifically, the setting data SD may include information as to whether or not to allow the temperature change operation. The setting data SD may include information that gives an instruction to restore the set temperature to the temperature before the change in a case where the control device 11 changes the set temperature in accordance with the temperature change operation. In this case, the setting data SD may include information that designates a time limit from when the set temperature is changed until when the set temperature is restored to the temperature before the change.

[0033] The control device 11 determines whether or not to allow the temperature change operation in accordance with the setting data SD. In a case where the setting data SD designates allowance of the temperature change operation, the control device 11 changes the set temperature in accordance with the temperature change operation.

[0034] Further, the management server 100 transmits to the air-conditioning equipment 10, a control parameter CP to be used by the control device 11 to determine the set temperature of the air-conditioning equipment 10 based on the outside air temperature detected by the outside air temperature sensor 18. The control device 11 autonomously determines the set temperature of the air-conditioning equipment 10 based on the control parameter CP received by the communication device 15. The control parameter CP will be described later.

[0035] In the present embodiment, in the facility 1, it is possible to start operation, stop operation and switch operation between cooling and heating of the air-conditioning equipment 10 by the operation of the operation unit 14. The set temperature of the air-conditioning equipment 10 is a temperature designated by the setting data SD or a temperature determined by the control device 11 in accordance with the control parameter CP. Further, in the air-conditioning equipment 10, it is allowed to change the set temperature in accordance with operation of the temperature change operation. In a case where the control device 11 accepts the temperature change operation, the control device 11 changes the set temperature in accordance with the temperature change operation and restores the set temperature to the temperature before the change after a predetermined time limit has elapsed since the change of the set temperature.

[0036] The control device 11 generates the operation data RD indicating that the temperature change operation has been accepted, and the communication device 15 transmits the operation data RD to the management server 100. As illustrated in Fig. 1, the operation data RD includes, for example, at least one of a facility ID or an air conditioner ID. The facility ID is identification information that identifies each of the facilities 1A, 1B, 1C, 1D and other facilities 1. The air conditioner ID is identification information that identifies each of the air-conditioning equipment 10A, 10B, 10C, 10D and other air-conditioning equipment 10.

[0037] The operation data RD includes date and time at which the temperature change operation has been performed and an outside air temperature when the operation has been performed. The operation data RD may include the changed set temperature.

[0038] The management server 100 receives and stores the operation data RD transmitted by the air-conditioning equipment 10. The management server 100 determines the control parameter CP to be used for processing of determining the set temperature of the air-conditioning equipment 10 in accordance with the outside air temperature based on the operation data RD. The management server 100 determines the control parameter CP for each facility 1 or for each of the air-conditioning equipment 10.

[0039] Setting the set temperature of the air-conditioning equipment 10 while giving priority to comfort of a person in the air-conditioned space is not recommended in terms of energy saving. Specifically, for example, if the person in the air-conditioned space is allowed to freely change the set temperature by operating the operation unit 14, energy consumption of the air-conditioning equipment 10 is not taken into account, and thus, it is considered that energy consumption becomes large. It is therefore considered to limit the set temperature of air conditioning in terms of energy saving. For example, the Ministry of Economy, Trade and Industry recommends that the set temperature of air conditioning should be 28 °C during cooling operation in summer and should be 20 °C during heating operation in winter. However, in a case where these temperatures are set as the set temperature of the air-conditioning equipment 10, comfort in the air-conditioned space may become low, which means that achieving both comfort in the air-conditioned space and energy saving is a challenge.

[0040] An indoor temperature of the air-conditioned space is affected by the outside air temperature. Further, a position and a shape of a building, a position of the air-conditioned space in the building, sunlight of the air-conditioned space, and the like, affect the indoor temperature of the air-conditioned space. If the set temperature of the air-conditioning equipment 10 is determined based on only the outside air temperature without these factors being taken into account, a possibility of lowering the comfort in the air-conditioned space of the air-conditioning equipment 10 cannot be excluded.

[0041] Thus, the management system 1000 of the present embodiment enables determination of the set temperature of the air-conditioning equipment 10 in accordance with characteristics of the air-conditioned space. In other words, the management server 100 generates the control parameter CP for determining the set temperature of the air-conditioning equipment 10 based on the outside air temperature for each of the air-conditioning equipment 10 and transmits the control parameter CP to the air-conditioning equipment 10. The air-conditioning equipment 10 determines the set temperature from the outside air temperature detected by the outside air temperature sensor 18 in accordance with the control parameter CP transmitted by the management server 100. The control parameter CP generated by the management server 100 is adapted to a state of each of the air-conditioning equipment 10. Thus, in each of the air-conditioning equipment 10, it is possible to achieve reduction in energy consumption while maintaining comfort in the air-conditioned space.

[2. Configuration of management server]

[0042] Fig. 2 is a block diagram of the management server 100.

[0043] The management server 100 includes a control unit 110 and a server communication device 150.

[0044] The control unit 110 includes a processor 120 and a memory 130. The processor 120 is constituted with a central processing unit (CPU), a micro-processing unit (MPU), and other arithmetic processing devices. The memory 130 is a storage device that stores programs to be executed by the processor 120 and data in a non-volatile manner. The memory 130 is constituted with a magnetic storage device, a semiconductor storage element or other types of non-volatile storage devices. Specifically, the memory 130 includes a hard disk drive (HDD), a flash read only memory (ROM), a solid state drive (SSD) constituted with the flash ROM, and the like. The memory 130 may include a random access memory (RAM) constituting a work area of the processor 120. The processor 120 is one example of a computer in the present disclosure.

[0045] The memory 130 stores a control program 131 to be executed by the processor 120. The control program 131 corresponds to one example of a program in the present disclosure.

[0046] The memory 130 stores temperature setting data 132, a history database (DB) 133, the control parameter CP and a power consumption amount DB 135. These are data to be processed or generated by the processor 120.

[0047] The temperature setting data 132 is data of the set temperature of the air-conditioning equipment 10. The temperature setting data 132 includes data of the set temperature included in the setting data SD. The temperature setting data 132 may be data of the set temperature common to all the air-conditioning equipment 10. Further, the temperature setting data 132 may include data of the set temperature different for each of the air-conditioning equipment 10 or each facility 1.

[0048] The history DB 133 includes history of the temperature change operation in the air-conditioning equipment 10.

[0049] Fig. 2 illustrates a configuration example of the history DB 133. The history DB 133 stores data of the temperature change operation performed in the air-conditioning equipment 10. The data stored in the history DB 133 is, for example, data in a record format in which the air conditioner ID is associated with a setting change history. This configuration is one example, and in place of the air conditioner ID, the facility ID may be associated with the setting change history in the record stored in the history DB 133.

[0050] One record stored in the history DB 133 corresponds to one time of the temperature change operation in one piece of air-conditioning equipment 10. In the record of the history DB 133, the setting change history includes date and time at which setting has been changed, a type of operation, an outside air temperature, a set temperature and the changed set temperature. The date and time at which setting has been changed is date and time at which the set temperature has been changed in accordance with operation of the operation unit 14 and is substantially the same as date and time at which the control device 11 has accepted the operation of the operation unit 14. The type of operation indicates an operating state of the air-conditioning equipment 10 when the temperature change operation is performed. In the present embodiment, the type of operation is either cooling or heating. The outside air temperature is an outside air temperature when the temperature change operation is performed. The set temperature is a set temperature of the air-conditioning equipment 10 when the temperature change operation is performed. This set temperature is a temperature designated by the management server 100 to the air-conditioning equipment 10 by the setting data SD. The changed set temperature is the set temperature of the air-conditioning equipment 10 changed as a result of the temperature change operation being performed.

[0051] In this manner, the history DB 133 includes a history of the temperature change operation in association with the air conditioner ID for each of the air-conditioning equipment 10. While the example of Fig. 2 illustrates only records in a case where the type of operation is cooling, the history DB 133 can store data received by the management server 100

throughout the year.

[0052] The control parameter CP is data for the control device 11 to autonomously determine the set temperature of the air-conditioning equipment 10. The control parameter CP may be data to be processed by the control device 11. Further, the control parameter CP may be a program that specifies arithmetic processing to be executed by the control device 11 or an arithmetic expression for the arithmetic processing to be executed by the control device 11. Further, the control parameter CP may include coefficients and constants to be used in the arithmetic processing to be executed by the control device 11. The control parameter CP includes at least the set temperature of the air-conditioning equipment 10 corresponding to the outside air temperature or data for determining the set temperature.

[0053] The power consumption amount DB 135 stores data indicating a power consumption amount of the air-conditioning equipment 10. The power consumption amount DB 135, for example, stores data indicating the power consumption amount in association with the air conditioner ID of the air-conditioning equipment 10. The data to be stored in the power consumption amount DB 135 is, for example, data of the power consumption amount for each day. A range of the data can be changed as appropriate, and the data to be stored in the power consumption amount DB 135 may be data of the power consumption amount for each facility 1.

[0054] The processor 120 controls respective units of the management server 100 by executing the control program 131. The processor 120 includes an acquisition unit 121, a determination unit 122, a setting unit 123 and a processing unit 124 as functional units. These respective functional units are implemented by cooperation of software and hardware by the processor 120 executing the control program 131.

[0055] A server communication device 150 is connected to the control unit 110. The server communication device 150 is a communication device connected to the communication network N. The server communication device 150 includes, for example, a connector connecting a communication cable, and an interface circuit that inputs/outputs signals through the connector. Further, for example, the server communication device 150 may be a wireless communication device which includes an antenna and a wireless circuit and which is connected to the communication network N via a wireless communication line.

[0056] The acquisition unit 121 executes communication with the air-conditioning equipment 10 by the server communication device 150 to receive the operation data RD from the air-conditioning equipment 10. The acquisition unit 121 adds the data to the history DB 133 based on the operation data RD to update the history DB 133.

[0057] Further, the acquisition unit 121 executes communication with the air-conditioning equipment 10 by the server communication device 150 to receive data regarding the power consumption amount from the air-conditioning equipment 10. The acquisition unit 121 adds the data to the power consumption amount DB 135 based on the received data to update the power consumption amount DB 135.

[0058] The determination unit 122 determines whether or not the data acquired by the acquisition unit 121 satisfies a condition necessary for processing of determining the control parameter CP. For example, the determination unit 122 determines whether or not the number of pieces of the data acquired by the acquisition unit 121 is equal to or larger than the number necessary for processing of determining the control parameter CP.

[0059] The setting unit 123 sets the set temperature of the air-conditioning equipment 10. For example, the setting unit 123 generates the setting data SD based on the temperature setting data 132 and transmits the setting data SD to the air-conditioning equipment 10 by the server communication device 150.

[0060] The processing unit 124 generates the control parameter CP based on the data stored in the history DB 133. Generating the control parameter CP is synonymous with determining the control parameter CP. The processing unit 124, for example, generates the control parameter CP for each of the air-conditioning equipment 10 and stores the control parameter CP in the memory 130. The control parameter CP stored in the memory 130 is transmitted to the air-conditioning equipment 10 by the temperature setting data 132.

[0061] The processing unit 124 generates comparison data that compares a case where the air-conditioning equipment 10 operates not based on the control parameter CP and a case where the air-conditioning equipment 10 operates in accordance with the control parameter CP. The processing unit 124, for example, generates the comparison data that compares the power consumption amount based on the data stored in the power consumption amount DB 135. In this case, the comparison data is data that compares the power consumption amount in a case where the air-conditioning equipment 10 operates at a temperature designated by the setting data SD and the power consumption amount in a case where the air-conditioning equipment 10 operates while determining the set temperature in accordance with the control parameter CP. The comparison data includes, for example, a graph and a table that visually compares the power consumption amount in a case where the air-conditioning equipment 10 operates at the set temperature designated by the setting data SD and the power consumption amount in a case where the air-conditioning equipment 10 operates while determining the set temperature in accordance with the control parameter CP. The comparison data is transmitted to one or both of the terminal device 5 and the mobile terminal device 7 and displayed at the display 51 and the display 71.

[3. Operation of management system]

[0062] Fig. 3 is a flowchart indicating operation of the management system 1000.

[0063] In Fig. 3, operation in step SA1 to SA2, SA4 to SA9, SA1 1, and SA13 to SA15 is executed by the management server 100. Operation in step SA3, SA10 and SA12 is executed by the management server 100 and the air-conditioning equipment 10.

[0064] The processing unit 124 determines a control parameter generation condition (step SA1). The processing unit 124 generates the control parameter CP corresponding to each of the air-conditioning equipment 10 that is to be managed by the management server 100. Further, the processing unit 124 generates the control parameter CP for heating operation of the air-conditioning equipment 10 and the control parameter CP for cooling operation. Thus, in step SA1, the processing unit 124 determines the control parameter generation condition that is a condition regarding generation of the control parameter CP. The control parameter generation condition specifically includes the air conditioner ID of the air-conditioning equipment 10 to which the control parameter CP is to be applied. The control parameter generation condition may include a type of operation to which the control parameter CP is to be applied. The type of operation is heating or cooling.

[0065] By the determination in step SA1, the air-conditioning equipment 10 for which the control parameter CP is to be generated is specified. The management server 100 can execute operation in Fig. 3 on a plurality of pieces of the air-conditioning equipment 10 in parallel. In the following description, an example of a case will be described where in step SA1, it is determined that the air-conditioning equipment for which the control parameter CP is to be generated is the air-conditioning equipment 10A.

[0066] The setting unit 123 transmits the setting data SD including the set temperature to the air-conditioning equipment 10A for which the control parameter CP is to be generated (step SA2).

[0067] The acquisition unit 121 executes operation data acquisition processing on the air-conditioning equipment 10A (step SA3). The operation data acquisition processing is processing of acquiring the operation data RD from the air-conditioning equipment 10A and accumulating the operation data RD in the history DB 133.

[0068] Fig. 4 is a sequence diagram indicating the operation data acquisition processing to be executed in step SA3 in Fig. 3. In Fig. 4, step SB1 to SB4 indicates operation of the management server 100, and step SC1 to SC9 indicates operation of the air-conditioning equipment 10. Here, an example will be described where the air-conditioning equipment 10A executes step SC1 to SC9.

[0069] The control device 11 receives the setting data SD transmitted by the management server 100 and starts operation of the air-conditioning equipment 10A in accordance with the setting data SD (step SC1). During operation of the air-conditioning equipment 10A, the control device 11 determines whether or not temperature change operation is performed by the operation unit 14 (step SC2). In a case where it is determined that the temperature change operation is not performed (step SC2: No), the processing of the control device 11 transitions to step SC7 which will be described later.

[0070] In a case where it is determined that the temperature change operation is performed (step SC2: Yes), the control device 11 changes the set temperature of the air-conditioning equipment 10A in accordance with the temperature change operation (step SC3). The control device 11 generates the operation data RD including content of the temperature change operation by the operation unit 14 (step SC4). The control device 11 determines whether or not a restoration timing of restoring the set temperature has come (step SC5), and in a case where the restoration timing has not come (step SC5: No), the control device 11 stands by while continuing operation of the air-conditioning equipment 10A.

[0071] The restoration timing is, for example, determined by a time limit from when the set temperature has been changed in accordance with the temperature change operation. The time limit is, for example, designated by the setting data SD. For example, in a case where the time limit is 30 minutes, the control device 11 determines that the restoration timing has come when 30 minutes have elapsed since the change of the set temperature in step SC3 (step SC5). The restoration timing may be determined based on a time point. For example, the control device 11 may set the first hour after the set temperature has been changed as the restoration timing or may set the second hour after the set temperature has been changed as the restoration timing. Also in this case, the restoration timing is designated by the setting data SD. This configuration can be applied to a case where the control device 11 includes a real time clock (RTC) and can acquire current time.

[0072] In a case where it is determined that the restoration timing has come (step SC5: Yes), the control device 11 returns the set temperature of the air-conditioning equipment 10A to the set temperature before the change (step SC6). The set temperature before the change is the set temperature before the set temperature has been changed in step SC3. Then, the processing of the control device 11 transitions to step SC6.

[0073] In step SC6, the control device 11 determines whether or not a transmission timing of transmitting the operation data RD has come (step SC7). In a case where it is determined that the transmission timing has not come (step SC7: No), the processing of the control device 11 returns to step SC2. In a case where it is determined that the transmission timing has come (step SC7: Yes), the control device 11 transmits the operation data RD to the management server 100 by the communication device 15 (step SC8).

[0074] The transmission timing is designated by the setting data SD or set to the control device 11 in advance. The transmission timing may be one or a plurality of time points in a day. In this case, the control device 11 transmits the operation data RD once or a plurality of times in one day. The control device 11 generates the operation data RD corresponding to the temperature change operation performed until the transmission timing has come and transmits the operation data RD to the management server 100. The control device 11 may generate the operation data RD including data regarding a plurality of times of the temperature change operation or may collectively transmit a plurality of pieces of the operation data RD each corresponding to one time of the temperature change operation to the management server 100. The transmission timing may be once in a plurality of days or may be a longer period. Further, the transmission timing may be determined by the number of times of the temperature change operation. For example, the transmission timing may be a timing every time the temperature change operation is performed the set number of times.

[0075] The acquisition unit 121 receives the operation data RD transmitted by the air-conditioning equipment 10A (step SB1). The acquisition unit 121 stores information included in the received operation data RD in the history DB 133 in association with the air conditioner ID of the air-conditioning equipment 10A to update the history DB 133 (step SB2).

[0076] Further, the control device 11 transmits data indicating the power consumption amount of the air-conditioning equipment 10A to the management server 100 (step SC9). The acquisition unit 121 receives the data of the power consumption amount transmitted by the air-conditioning equipment 10A (step SB3). The acquisition unit 121 stores the received data of the power consumption amount in the power consumption amount DB 135 in association with the air conditioner ID of the air-conditioning equipment 10A to update the power consumption amount DB 135 (step SB4).

[0077] The air-conditioning equipment 10A executes operation in accordance with operation of starting operation, operation of ending operation and operation of changing the temperature by the operation unit 14 unless an instruction is provided from the management server 100 and repeats operation from step SC1 to SC10.

[0078] In the operation example in Fig. 4, a frequency of the control device 11 transmitting the operation data RD is equal to a frequency of transmitting the data of the power consumption amount. This is one example, and, for example, a timing of transmitting the data of the power consumption amount may be different from a timing of transmitting the operation data RD. For example, the control device 11 may transmit the data of the power consumption amount of the air-conditioning equipment 10A of each day to the management server 100 at a timing of once per week or once per month in step SC9.

[0079] Further, the control device 11 may be configured to generate the operation data RD only for temperature change operation of giving an instruction to change the temperature in a specific direction among the temperature change operation. The specific direction is, for example, a direction of improving comfort in the air-conditioned space of the air-conditioning equipment 10A. In this case, the temperature change operation of giving an instruction to change the temperature in the specific direction is specifically temperature change operation of changing the set temperature to a lower temperature during cooling operation of the air-conditioning equipment 10A and temperature change operation of changing the set temperature to a higher temperature during heating operation. Further, the specific direction may be a direction in which the power consumption amount of the air-conditioning equipment 10A increases.

[0080] In this case, in a case where it is determined that the temperature change operation is performed (step SC2: Yes), the control device 11 changes the set temperature of the air-conditioning equipment 10A in step SC3 regardless of a temperature change direction. Then, the control device 11 generates the operation data RD in step SC4 in a case where the temperature change operation is temperature change operation of changing the set temperature in the specific direction. Further, in a case where the temperature change operation is not operation of changing the set temperature in the specific direction, the control device 11 skips step SC4. By this means, data regarding the temperature change operation in the specific direction is accumulated in the history DB 133.

[0081] Returning to Fig. 3, the determination unit 122 determines whether or not a predetermined period set in advance has elapsed since start of the operation data acquisition processing in step SA3 (step SA4). The predetermined period is a period set in advance and may be, for example, one week, one month, several months or a longer period.

[0082] In a case where it is determined that the predetermined period has not elapsed (step SA4: No), the determination unit 122 determines whether or not an amount of the operation data RD acquired in step SA3 is excessive (step SA5). The acquisition unit 121 and the air-conditioning equipment 10A repeatedly execute the operation data acquisition processing in step SA3 until the predetermined period elapses. The determination unit 122 determines whether or not the number of pieces of the acquired operation data RD is excessive at a halfway time point until the predetermined period elapses. In step SA5, the determination unit 122, for example, compares a threshold determined corresponding to a period from when the operation data acquisition processing in step SA3 has been started with the number of pieces of data stored in the history DB 133.

[0083] In a case where the determination unit 122 determines that the acquired data is not excessive (step SA5: No), the processing returns to step SA3, and the acquisition unit 121 executes operation data acquisition processing with the air-conditioning equipment 10A.

[0084] In a case where the determination unit 122 determines that the acquired data is excessive (step SA5: Yes), the setting unit 123 changes an operating condition of the air-conditioning equipment 10A (step SA6). The operating condition includes the set temperature of the air-conditioning equipment 10A. The operating condition includes the restoration timing

of the air-conditioning equipment 10A. In step SA6, the setting unit 123 transmits the setting data SD that designates the changed operating condition of the air-conditioning equipment 10A to the air-conditioning equipment 10A.

[0085] In step SA6, the setting unit 123 changes the operating condition so as to reduce or make it difficult to increase the number of times of temperature change operation at the air-conditioning equipment 10A. In other words, the setting unit 123 changes the operating condition so as to increase comfort in the air-conditioned space of the air-conditioning equipment 10A. For example, the setting unit 123 changes the set temperature to a lower temperature in a case where the air-conditioning equipment 10A performs cooling operation and sets the set temperature to a higher temperature during heating operation. Further, the setting unit 123 may delay the restoration timing. In this case, a period required for the set temperature changed by the temperature change operation to return to the temperature before the change becomes longer, so that it is possible to prevent the temperature change operation.

[0086] On the other hand, in a case where it is determined that the predetermined period has elapsed (step SA4: Yes), the determination unit 122 executes operation data determination processing (step SA7). The operation data determination processing is processing of determining whether or not data included in the history DB 133 is data sufficient for determining the control parameter CP.

[0087] As described above, the determination unit 122 may set the number of times of temperature change operation as a criterion for determining whether or not the data is sufficient for determining the control parameter CP. In this case, the determination unit 122 determines whether or not the data acquired from the air-conditioning equipment 10A satisfies the condition by determining whether or not the number of times of temperature change operation performed in a predetermined period is equal to or larger than a threshold set in advance in step SA7. Then, the determination unit 122 determines that the data acquired from the air-conditioning equipment 10A does not satisfy the condition in a case where the number of times of the temperature change operation performed in the predetermined period is less than the threshold in step SA7, and determines that the data acquired from the air-conditioning equipment 10A satisfies the condition in a case where the number of times of the temperature change operation performed in the predetermined period is equal to or larger than the threshold. The number of times of the temperature change operation executed in the air-conditioning equipment 10A in the predetermined period can be determined from data of the temperature change operation included in the history DB 133.

[0088] In the present embodiment, an example where the determination unit 122 performs determination including quality of the data of the history DB 133 will be described with reference to Fig. 5. Fig. 5 is a flowchart indicating the operation data determination processing to be executed in step SA7 in Fig. 3.

[0089] The determination unit 122 specifies the air conditioner ID of a target of the determination processing (step SD1) and extracts data of a setting change history associated with the specified air conditioner ID from the history DB 133 (step SD2).

[0090] The determination unit 122 tallies the number of times of the temperature change operation for each date and for each outside air temperature based on the data extracted in step SD2 (step SD3). By this means, the determination unit 122 associates the number of times of the temperature change operation per day with the outside air temperature. The determination unit 122 performs regression analysis on a correlation between the number of times of the temperature change operation per day and the outside air temperature to obtain a regression straight line (step SD4).

[0091] Fig. 6 is a diagram indicating an example of the regression straight line. Fig. 6 is a scatter diagram in which data is plotted while the outside air temperature is set on a horizontal axis and the number of times of the temperature change operation per day is set on a vertical axis, and points P1 in the diagram indicate data tallied in step SD3. Fig. 6 indicates an example of a regression straight line RG1 obtained by the regression analysis. The regression straight line RG1 is a straight line generated using a least-square method, but this is one example. As a method of regression analysis, geometric mean regression, principal-component regression or other methods can be used in addition to the least-square method, and it is only necessary to use a method with which a regression straight line can be obtained as an approximation expression. Further, the determination unit 122 may perform processing of simply obtaining an approximation expression in step SD4.

[0092] A magnitude of a slope of the regression straight line RG1 indicates a degree of change of the number of times of temperature change operation by the outside air temperature. A large magnitude of the slope of the regression straight line RG1 indicates large change of the number of times of temperature change operation by the outside air temperature. Here, the magnitude of the slope of the regression straight line RG1 means a magnitude of an absolute value of the slope. While in the example in Fig. 6, the number of times of the temperature change operation per day has a positive correlation with the outside air temperature, the number of times of the temperature change operation can have a negative correlation with the outside air temperature.

[0093] Returning to Fig. 5, the determination unit 122 determines whether or not the slope of the regression straight line obtained in step SD4 is equal to or larger than a threshold (step SD5). The threshold is a value set in advance by the control unit 110 and, for example, stored in the memory 130. In a case where the slope of the regression straight line is equal to or larger than the threshold (step SD5: Yes), the determination unit 122 determines that the data acquired from the air-conditioning equipment 10A in the operation data acquisition processing satisfies the condition (step SD6), and the

processing returns to the processing in Fig. 3.

[0094] On the other hand, in a case where the slope of the regression straight line is smaller than the threshold (step SD5: No), the determination unit 122 determines that the data acquired from the air-conditioning equipment 10A does not satisfy the condition (step SD7), and the processing returns to the processing in Fig. 3.

[0095] The determination unit 122 refers to a determination result of the operation data determination processing (step SA8). Here, in a case where it is determined that the data acquired from the air-conditioning equipment 10A in the operation data acquisition processing satisfies the condition (step SA8: Yes), the processing unit 124 executes control parameter generation processing based on the data in the history DB 133 (step SA9). The control parameter generation processing will be described later.

[0096] Thereafter, in step SA10, operation of the air-conditioning equipment 10A based on the control parameter CP is started (step SA10). Here, the setting unit 123 transmits the control parameter CP generated in step SA9 to the air-conditioning equipment 10A, and the air-conditioning equipment 10A receives the control parameter CP. The control device 11 detects the outside air temperature by the outside air temperature sensor 18 and determines the set temperature of the air-conditioning equipment 10A by applying the outside air temperature to the control parameter CP. The control device 11 executes operation based on the set temperature determined by the control parameter CP.

[0097] In a case where it is determined that the data does not satisfy the condition in the operation data determination processing (step SA8: No), the setting unit 123 changes the operating condition of the air-conditioning equipment 10A (step SA11). Details of the operating condition are as described regarding step SA6.

[0098] In step SA11, the operating condition of the air-conditioning equipment 10A in the operation data acquisition processing is changed so as to make it easier to acquire the operation data RD. In other words, the setting unit 123 changes the operating condition so as to increase the number of times of the temperature change operation at the air-conditioning equipment 10A. This change is change of the operating condition so as to lower comfort in the air-conditioned space of the air-conditioning equipment 10A. For example, the setting unit 123 changes the set temperature to a higher temperature in a case where the air-conditioning equipment 10A performs cooling operation and changes the set temperature to a lower temperature during heating operation. Further, the setting unit 123 may advance the restoration timing. In this case, a period required for the set temperature changed by the temperature change operation to return to the temperature before the change becomes shorter, so that it is possible to promote the temperature change operation. In step SA11, the setting unit 123 transmits the setting data SD that designates the changed operating condition of the air-conditioning equipment 10A to the air-conditioning equipment 10A.

[0099] The acquisition unit 121 executes operation data acquisition processing similar to that in step SA7 (step SA12). Then, the determination unit 122 determines whether or not a predetermined period set in advance has elapsed since start of the operation data acquisition processing in step SA12 (step SA13). The predetermined period is similar to that in step SA4.

[0100] In a case where the determination unit 122 determines that the predetermined period has not elapsed (step SA13: No), the processing returns to step SA12. The acquisition unit 121 and the air-conditioning equipment 10A repeatedly execute the operation data acquisition processing in step SA12 until the predetermined period elapses.

[0101] In a case where it is determined that the predetermined period has elapsed (step SA13: Yes), the determination unit 122 executes operation data determination processing in a similar manner to step SA7 (step SA14). Then, the determination unit 122 refers to a determination result of the operation data determination processing (step SA15). Here, in a case where it is determined that the data acquired from the air-conditioning equipment 10A in the operation data acquisition processing does not satisfy the condition (step SA15: No), the processing of the control unit 110 returns to step SA12. Here, the processing of the control unit 110 may return to step SA11, and the setting unit 123 may change the operating condition. Specifically, the setting unit 123 may further change the operating condition of the air-conditioning equipment 10A in the operation data acquisition processing so as to make it easier to acquire the operation data RD.

[0102] In a case where it is determined that the data acquired from the air-conditioning equipment 10A in the operation data acquisition processing satisfies the condition (step SA15: Yes), the processing transitions to step SA9, and the processing unit 124 executes control parameter generation processing (step SA9).

[0103] Fig. 7 is a flowchart indicating an example of the control parameter generation processing to be executed in step SA9 in Fig. 3.

[0104] The processing unit 124 specifies the air conditioner ID of the air-conditioning equipment 10 to which the control parameter CP is to be applied (step SE1). Here, the processing unit 124 specifies the air conditioner ID of the air-conditioning equipment 10A. The processing unit 124 extracts data corresponding to the air conditioner ID specified in step SE1 from the history DB 133 (step SE2).

[0105] The processing unit 124 further extracts the outside air temperature and the set temperature changed by the temperature change operation from the data extracted in step SE2 (step SE3). The set temperature changed by the temperature change operation will be referred to as the changed temperature. The processing unit 124 executes regression analysis of obtaining a correlation between the outside air temperature and the changed temperature to obtain a regression straight line (step SE4). A method of regression analysis is as described in step SD4, and as one

example, processing of obtaining an approximation expression using a least-square method can be employed.

[0106] Fig. 8 is a diagram indicating an example of the regression straight line and indicates an example of the regression straight line calculated in step SE4 in Fig. 7. Fig. 8 is a scatter diagram in which data is plotted while the outside air temperature is set on a horizontal axis and an average set temperature in the air-conditioning equipment 10A is set on a vertical axis. The set temperature on the vertical axis is the set temperature after change by the temperature change operation in the air-conditioning equipment 10A. In the diagram in Fig. 7, a value of the set temperature to be plotted may be an average value obtained by averaging a plurality of values of the changed set temperature corresponding to one outside air temperature. Points P2 in the drawing indicate the data extracted in step SE3.

[0107] Fig. 7 indicates an example of a regression straight line RG2 obtained by the regression analysis. While the regression straight line RG2 is a straight line generated using a least-square method, this is one example. As a method of regression analysis, geometric mean regression, principal-component regression or other methods can be used in addition to the least-square method, and it is only necessary to use a method with which a regression straight line can be obtained as an approximation expression. Further, the processing unit 124 may perform processing of simply obtaining an approximation expression in step SE4.

[0108] The regression straight line RG2 indicates a correlation between the outside air temperature and the set temperature of the air-conditioning equipment 10A set by the operation of the operation unit 14. For example, it indicates that in a case where the set temperature is set at a low temperature in a state where the outside air temperature is high, a person in the air-conditioned space feels that it is hot in the air-conditioned space.

[0109] Returning to Fig. 7, the processing unit 124 calculates a recommended set temperature for each outside air temperature by utilizing the regression straight line obtained in step SE4 (step SE5). The processing unit 124 generates the control parameter CP that enables the control device 11 to perform processing of obtaining the recommended set temperature based on the outside air temperature (step SE6). The processing unit 124 stores the generated control parameter CP in the memory 130 in association with the air conditioner ID of the air-conditioning equipment 10A (step SE7). As illustrated in Fig. 8, the control parameter CP generated in this manner reflects the correlation between the set temperature set by the person in the air-conditioned space and the outside air temperature. Based on this, the control parameter CP is a parameter that determines the set temperature of the air-conditioning equipment 10A so as to operate the air-conditioning equipment 10A so that energy consumption of the air-conditioning equipment 10A becomes smaller.

[0110] The air-conditioning equipment 10A determines the set temperature of the air-conditioning equipment 10A based on the outside air temperature detected by the outside air temperature sensor 18 by utilizing the control parameter CP generated in the processing in Fig. 7. The air-conditioning equipment 10A can execute control appropriate for an environment of the air-conditioned space of the air-conditioning equipment 10A by utilizing the control parameter CP generated by utilizing the operation data RD generated by the air-conditioning equipment 10A. Thus, the air-conditioning equipment 10A can be made to operate while influence of an environment of a building including the air-conditioned space, sunlight of the air-conditioned space, and the like, is taken into account, so that it is possible to maintain comfort in the air-conditioned space. Further, it is possible to prevent the set temperature of the air-conditioning equipment 10A from being set to an excessively low temperature or an excessively high temperature, so that it is possible to reduce energy consumption of the air-conditioning equipment 10A while maintaining comfort in the air-conditioned space.

[0111] The number of times the operation in Fig. 3 is executed in the management system 1000 is not limited to once. The management system 1000 may execute the operation in Fig. 3 to generate the control parameter CP for cooling operation when the air-conditioning equipment 10 performs cooling operation and may apply the control parameter CP to the air-conditioning equipment 10. In this case, the operation in Fig. 3 is started at a timing at which the air-conditioning equipment 10 starts cooling operation. For example, in a case where operation of designating cooling operation as the type of operation is performed, the air-conditioning equipment 10 transmits the operation data RD indicating start of the cooling operation to the management server 100, and the management server 100 executes the processing in Fig. 3 by being triggered by the operation data RD. In a similar manner, the management system 1000 may execute the operation in Fig. 3 to generate the control parameter CP for heating operation when the air-conditioning equipment 10 starts heating operation and may apply the control parameter CP to the air-conditioning equipment 10.

[0112] The processing unit 124 can generate the control parameter CP for cooling operation by extracting and utilizing data during cooling operation from the history DB 133, and in a similar manner, can generate the control parameter CP for heating operation.

[0113] Further, the management system 1000 may execute the operation in Fig. 3 while the air-conditioning equipment 10 is executing operation by utilizing the control parameter CP. In this case, the operation in step SA1 and SA2 can be omitted. For example, the operation in Fig. 3 may be executed with a period of one year, two years or with a longer period. In this case, the control parameter CP can be updated in accordance with change of an environment of the air-conditioned space and change of a use form of the air-conditioned space. Further, in a case where the air-conditioned space is a working place, the control parameter CP can be updated in accordance with change of persons who work in the air-conditioned space. Still further, it is also possible to employ a configuration where the control parameter CP is updated by the operation in Fig. 3 being executed at a timing designated by the operation of the operation unit 14. In this case, the

control parameter CP can be updated in accordance with usage states of a manager who manages the air-conditioning equipment 10 and a user in the air-conditioned space.

[0114] In this case, the management system 1000 only requires to manage date on which the control parameter CP is applied to each of the air-conditioning equipment 10 by the management server 100. The management server 100 updates the control parameter CP for which a predetermined period has elapsed since the application by the operation in Fig. 3.

[0115] Fig. 9 is a flowchart indicating another example of the control parameter generation processing. The operation in Fig. 9 is executed by the processing unit 124 in place of the operation indicated in Fig. 7.

[0116] In Fig. 9, operation from step SE1 to SE6 is in common with the operation in Fig. 7. After the control parameter CP is generated in step SE6, the processing unit 124 tallies the number of times of the temperature change operation for each outside air temperature based on the data extracted in step SE2 (step SE11).

[0117] The processing unit 124 generates additional data to be added to the control parameter CP (step SE12). In step SE12, the processing unit 124 determines the allowable number of times of the temperature change operation for each outside air temperature and a temperature width in which the set temperature can be changed by the temperature change operation based on the number of times tallied in step SE11. Then, the processing unit 124 generates additional data indicating the determined allowable number of times and temperature width.

[0118] The processing unit 124 updates the control parameter CP by adding the additional data generated in step SE12 to the control parameter CP generated in step SE6 and stores the updated control parameter CP in the memory 130 (step SE13).

[0119] The allowable number of times of the temperature change operation determined in step SE12 indicates whether or not the air-conditioning equipment 10A allows the temperature change operation and the number of times of the temperature change operation to be accepted by the air-conditioning equipment 10A per day or per predetermined period. The allowable number of times of the temperature change operation can be set at, for example, once, three times, five times, or the like, per day or per predetermined period. Further, the processing unit 124 can make determination so as to set the allowable number of times of the temperature change operation at 0 times, that is, so as not to allow the temperature change operation. The processing unit 124 determines the allowable number of times of the temperature change operation for each outside air temperature. It is only necessary to determine a width of the outside air temperature range as appropriate and it is possible to set the width at 5 °C, 2 °C or 1 °C.

[0120] The temperature width of the temperature change operation refers to a temperature range in which the set temperature of the air-conditioning equipment 10A can be changed by the temperature change operation. For example, the processing unit 124 has a first threshold T1 and a second threshold T2 as thresholds for the number of times of the temperature change operation and sets T1 > T2. Concerning a first outside air temperature range, the processing unit 124 sets the temperature width in which the set temperature can be changed by the temperature change operation in the first outside air temperature range at ± 5 °C in a case where the number of times NT of the temperature change operation tallied in step SE11 satisfies T1 < NT. Concerning a second outside air temperature range, the processing unit 124 sets the temperature width in which the set temperature can be changed by the temperature change operation in the second outside air temperature range at ± 3 °C in a case where the number of times NT of the temperature change operation tallied in step SE11 satisfies T2 < NT < T1. Concerning a third outside air temperature range, the processing unit 124 sets the temperature width in which the set temperature can be changed by the temperature change operation in the third outside air temperature range at ± 1 °C in a case where the number of times NT of the temperature change operation tallied in step SE11 satisfies NT < T2. Further, concerning a fourth outside air temperature range, the processing unit 124 sets the temperature width in which the set temperature can be changed by the temperature change operation in the fourth outside air temperature range at 0 °C in a case where the number of times NT of the temperature change operation tallied in step SE11 is 0.

[0121] According to the operation example in Fig. 9, the temperature change operation while the air-conditioning equipment 10A is operating based on the control parameter CP can be allowed in an appropriate range. It is therefore possible to further improve comfort of a person in the air-conditioned space of the air-conditioning equipment 10A.

[0122] In the operation example in Fig. 9, the control parameter CP may include a time limit from when the temperature change operation is performed until when the set temperature is restored to the temperature before the change. In other words, the control parameter CP may include additional data indicating the time limit in addition to or in place of the temperature width in which the set temperature can be changed by the temperature change operation. For example, the control parameter CP may designate a long time limit in association with an outside air temperature range in which the number of times of the temperature change operation is large or may designate a short time limit in association with an outside air temperature range in which the number of times of the temperature change operation is large. It is only necessary to determine the time limit stepwise like, for example, 30 minutes, 60 minutes, 120 minutes, or the like.

[0123] Fig. 10 is a flowchart indicating another example of the control parameter generation processing. The operation in Fig. 10 is executed by the processing unit 124 in place of the operation indicated in Fig. 7 or Fig. 9.

[0124] In Fig. 10, operation from step SE1 to SE5 are in common with the operation in Fig. 7.

[0125] The processing unit 124 executes processing of generating a first control parameter CP (step SE21) and processing of generating a second control parameter CP (step SE22) based on the recommended set temperature calculated in step SE5.

[0126] Both the first control parameter CP and the second control parameter CP enable the control device 11 to perform processing of obtaining the recommended set temperature based on the outside air temperature in the air-conditioning equipment 10A. Among these, the first control parameter CP is used in a case where the air-conditioning equipment 10A performs normal operation. The second control parameter CP is used in a case where the air-conditioning equipment 10A performs energy saving operation. In other words, the processing unit 124 generates the control parameter CP for normal operation and the control parameter CP for energy saving operation in step SE21 and SE22. The processing in Fig. 10 is effective in a case where operation can be switched between the normal operation and the energy saving operation by the operation of the operation unit 14 in the air-conditioning equipment 10A.

[0127] The processing unit 124 tallies the number of times of the temperature change operation for each outside air temperature based on the data extracted in step SE2 (step SE23). The processing unit 124 generates additional data to be added to the control parameter CP (step SE24). In step SE24, the processing unit 124 determines the allowable number of times of the temperature change operation for each outside air temperature and a temperature width in which the set temperature can be changed by the temperature change operation based on the number of times tallied in step SE22. This processing is similar to the processing in step SE12. Further, the processing unit 124 generates first additional data to be applied to the first control parameter CP and second additional data to be applied to the second control parameter CP in step SE24.

[0128] In a case where the first control parameter CP is a parameter for normal operation, and the second control parameter CP is a parameter for energy saving operation, the second additional data has a narrower allowable range of the temperature change operation than that of the first additional data. For example, the second additional data has a smaller allowable number of times of the temperature change operation and a narrower temperature width in which the set temperature can be changed than those of the first additional data in the same outside air temperature range.

[0129] The processing unit 124 performs processing of updating the control parameter CP and storing the updated control parameter CP in the memory 130 (step SE25). In step SE25, the processing unit 124 updates the first control parameter CP by adding the first additional data to the first control parameter CP. Further, the processing unit 124 updates the second control parameter CP by adding the second additional data to the second control parameter CP. The processing unit 124 stores the updated first control parameter CP and the updated second control parameter CP in the memory 130 in association with the air conditioner ID of the air-conditioning equipment 10A.

[0130] According to the operation example in Fig. 10, the manager of the air-conditioning equipment 10A can set the set temperature of the air-conditioning equipment 10A based on the outside air temperature in response to switching of the operating state of the air-conditioning equipment 10A between the normal operation and the energy saving operation. This makes it possible to change balance of comfort in the air-conditioned space and energy consumption in accordance with a request of the manager in a range in which comfort in the air-conditioned space of the air-conditioning equipment 10A is not impaired.

[0131] The processing in step SE21, SE22 and SE25 explained in Fig. 10 can be also applied to step SE6 and step SE7 in Fig. 7. In this case, the control parameter CP for normal operation and the control parameter CP for energy saving operation can be respectively generated in an aspect in which the control parameters do not include the allowable number of times of temperature change operation and the temperature width in which the set temperature can be changed.

[0132] In this manner, in the management system 1000, the management server 100 generates the control parameter CP appropriate for each of the air-conditioning equipment 10 and causes the air-conditioning equipment 10 to operate based on the control parameter CP. This makes it possible to reduce energy consumption while maintaining comfort in the air-conditioned space by each of the air-conditioning equipment 10.

[0133] Fig. 11 is an explanatory diagram indicating an aspect of operation of the air-conditioning equipment 10 based on the control parameter CP. Fig. 11 indicates an example of the set temperature of the air-conditioning equipment 10 set in accordance with the outside air temperature based on the control parameter CP. Further, Fig. 11 indicates the set temperature during energy saving operation as a comparative example.

[0134] Air conditioners 1, 2, 3 and 4 in Fig. 11 indicate different pieces of air-conditioning equipment 10. For example, the air conditioner 1 indicates the air-conditioning equipment 10A. In a similar manner, it may be considered that the air conditioner 2 indicates the air-conditioning equipment 10B, the air conditioner 3 indicates the air-conditioning equipment 10C, and the air conditioner 4 indicates the air-conditioning equipment 10D. Further, Fig. 11 indicates a case where the control parameter CP is applied during cooling operation as one example.

[0135] As described above, the set temperature during energy saving operation is, for example, 28 °C regardless of the outside air temperature. On the other hand, if the control parameter CP is applied, the air-conditioning equipment 10 can determine the set temperature appropriate for an environment in which the air-conditioning equipment 10 is installed in accordance with the outside air temperature.

[0136] For example, it is assumed that the set temperature of the air conditioner 1 in Fig. 11 is 25 °C in a case where the

outside air temperature is lower than 22 °C and is 24 °C in a case where the outside air temperature is equal to or higher than 23 °C and lower than 26 °C. In contrast, it is assumed that the set temperature of the air conditioner 2 is 28°C in a case where the outside air temperature is lower than 24 °C. Different control parameters CP are provided to the air-conditioning equipment 10A, 10B, 10C and 10D from the management server 100. Thus, the respective pieces of the air-conditioning equipment 10 can determine set temperatures different from each other in accordance with the same outside air temperature as indicated in Fig. 11.

[0137] All the set temperatures during cooling operation of the air-conditioning equipment 10 indicated in Fig. 11 are lower than the set temperature during energy saving operation, and thus, comfort in the air-conditioned space is improved. Further, by changing the set temperature of the air-conditioning equipment 10 in accordance with the outside air temperature, it is possible to reduce energy consumption of the air-conditioning equipment 10 by avoiding a situation where cooling operation is too strong. Similar effects can be obtained also during heating operation.

[0138] Further, the management system 1000 has a function of visualizing change in energy consumption of the air-conditioning equipment 10 and comfort in the air-conditioned space before and after the control parameter CP is applied and providing the visualized change to the manager.

[0139] Fig. 12 is a sequence diagram indicating operation of the management system 1000. Operation from step SF1 to SF7 in Fig. 12 indicates operation of the management server 100, and operation from step SG1 to SG3 indicates operation of the terminal device 5. The operation from step SG1 to SG3 may be executed by the mobile terminal device 7.

[0140] The terminal device 5 transmits a comparison data request to the management server 100 in accordance with operation by the manager who uses the terminal device 5 (step SG1). The comparison data request includes the air conditioner ID that specifies the air-conditioning equipment 10 for which comparison data is to be generated. The comparison data request may specify a type of the comparison data. The type of the comparison data includes, for example, one or more of comparison of the power consumption amount and the number of times of temperature change operation. In the following description, a case will be described where comparison of the power consumption amount is designated as the type of the comparison data.

[0141] The acquisition unit 121 receives the comparison data request transmitted by the terminal device 5 (step SF1). The processing unit 124 specifies the air conditioner ID included in the comparison data request (step SF2). The processing unit 124 tallies the power consumption amount of the air-conditioning equipment 10 before the control parameter CP is applied by extracting data corresponding to the specified air conditioner ID from the power consumption amount DB 135 (step SF3).

[0142] The processing unit 124 tallies the power consumption amount of the air-conditioning equipment 10 after the control parameter CP is applied based on the data extracted from the power consumption amount DB 135 (step SF4).

[0143] The processing unit 124 generates comparison data that compares before and after the control parameter CP is applied based on a result of tallying in step SF3 and a result of tallying in step SF4 (step SF5). The processing unit 124 generates display data based on the comparison data by performing processing of visualizing the comparison data (step SF6). The processing unit 124 transmits the generated display data to the terminal device 5 that has transmitted the comparison data request (step SF7).

[0144] The terminal device 5 receives the display data transmitted by the management server 100 (step SG2) and displays the display data at the display 51 (step SG3).

[0145] Fig. 13 is a diagram indicating an example of the display data based on the comparison data.

[0146] Fig. 13 is a scatter diagram in which data is plotted while the outside air temperature is set on a horizontal axis and the power consumption amount per day or per predetermined period is set on a vertical axis. Fig. 13 indicates the comparison data that compares the power consumption amount in a case where the air-conditioning equipment 10A executes normal operation in which the control parameter CP is not used, energy saving operation in which the control parameter CP is not used and operation in which the control parameter CP is used. The normal operation is operation in a state where the temperature change operation can be executed without limitation by operation of the operation unit 14. The energy saving operation is operation in which a temperature determined by the Ministry of Economy, Trade and Industry, or the like, is set as the set temperature of the air-conditioning equipment 10A. The set temperature during the energy saving operation is, for example, 28 °C during cooling operation and 20 °C during heating operation. In the energy saving operation, the temperature change operation cannot be executed, or the number of times of the temperature change operation or the temperature width in which the set temperature can be changed are restricted more strictly than in the normal operation.

[0147] Points P3 in the drawing indicate data of normal operation in which the control parameter CP is not used, and points P4 indicate data of energy saving operation in which the control parameter CP is not used. Points P5 indicate data of operation in which the control parameter CP is used.

[0148] The display data in Fig. 13 includes regression curved lines obtained through regression analysis to facilitate comparison of the data. A reference numeral RG3 indicates a regression curved line obtained by performing regression analysis on the data of the points P3. A reference numeral RG4 is a regression curved line obtained by performing regression analysis on data of the points P4, and a reference numeral RG5 is a regression curved line obtained by

performing regression analysis on data of the points P5. These regression curved lines are obtained by the processing unit 124 executing regression analysis in step SF5. As a method of regression analysis, a least-square method, geometric mean regression, principal-component regression or other methods can be used, and the method is selected as appropriate as described above. The regression curved lines RG3, RG4 and RG5 may be straight lines.

[0149] Through the display data in Fig. 13, an aspect where the power consumption amount of the air-conditioning equipment 10A changes between a case where the air-conditioning equipment 10A uses the control parameter CP and a case where the air-conditioning equipment 10A does not use the control parameter CP is visualized and presented to the manager. For example, the display data indicates that as a result of the air-conditioning equipment 10A using the control parameter CP, the power consumption amount is reduced compared to a case where the air-conditioning equipment 10A executes energy saving operation in which the control parameter CP is not used.

[0150] Fig. 14 is a diagram indicating another example of the display data based on the comparison data.

[0151] Fig. 14 indicates the comparison data obtained by comparing an execution state of the temperature change operation in the air-conditioning equipment 10A. In other words, Fig. 14 is a scatter diagram in which data is plotted while the outside air temperature is set on a horizontal axis, and the number of times of the temperature change operation per day or per predetermined period is set on a vertical axis.

[0152] The data in Fig. 14 compares the temperature change operation in a case where the air-conditioning equipment 10A executes normal operation in which the control parameter CP is not used, in a case where the air-conditioning equipment 10A executes energy saving operation in which the control parameter CP is not used, and in a case where the air-conditioning equipment 10A executes operation in which the control parameter CP is used.

[0153] Points P6 in the drawing indicate data of normal operation in which the control parameter CP is not used, and points P7 indicate data of energy saving operation in which the control parameter CP is not used. Points P8 indicate data of operation in which the control parameter CP is used.

[0154] The display data in Fig. 14 includes regression curved lines obtained through regression analysis to facilitate comparison of the data. A reference numeral RG6 indicates a regression curved line obtained by performing regression analysis on data of the points P6. A reference numeral RG7 is a regression curved line obtained by performing regression analysis on data of the points P7, and a reference numeral RG8 is a regression curved line obtained by performing regression analysis on data of the points P8. These regression curved lines are obtained by the processing unit 124 executing regression analysis in step SF5.

[0155] Through the display data in Fig. 14, the number of times the temperature change operation is performed in the air-conditioned space is visualized and presented to the manager for each of a case where the air-conditioning equipment 10A uses the control parameter CP and a case where the air-conditioning equipment 10A does not use the control parameter CP. The temperature change operation is performed by a person in the air-conditioned space to improve comfort in the air-conditioned space. It can be therefore considered that as the number of times of the temperature change operation is larger, comfort in the air-conditioned space is lower. Further, it is effective to restrict the temperature change operation in terms of energy saving, and the points P7 and the regression curved line RG7 indicate that the temperature change operation is restricted in the energy saving operation.

[0156] The example in Fig. 14 indicates that in a case where the air-conditioning equipment 10A uses the control parameter CP, the number of times of the temperature change operation is reduced compared to normal operation in which the control parameter CP is not used. In other words, it can be said that comfort in the air-conditioned space is improved by using the control parameter CP.

[0157] The display data in Fig. 13 and Fig. 14 is visualized data regarding any one piece of air-conditioning equipment 10 connected to the management server 100. This is one example, and data obtained by comparing the power consumption amount or the number of times of the temperature change operation in a plurality of pieces of air-conditioning equipment 10 may be collectively visualized to make one piece of display data, and the display data may be displayed at the display 51, 71.

[4. Effects, and the like]

[0158] As described above, in the present embodiment, the management system 1000 includes the setting unit 123 that sets the set temperature to the air-conditioning equipment 10, the acquisition unit 121 that acquires the operation data RD indicating temperature change operation of changing the set temperature of the air-conditioning equipment 10, the determination unit 122 that determines whether or not the acquired operation data RD acquired by the acquisition unit 121 in a predetermined period satisfies a condition necessary for processing of determining the control parameter CP for executing control of the air-conditioning equipment 10, and the processing unit 124 that determines the control parameter CP including at least the set temperature of the air-conditioning equipment 10 based on the acquired operation data RD in a case where it is determined that the acquired operation data RD satisfies the condition, and in a case where the determination unit 122 determines that the acquired operation data RD does not satisfy the condition, the setting unit 123 changes the set temperature of the air-conditioning equipment 10, and the acquisition unit 121 acquires the operation data

RD.

[0159] By this means, the operation data RD can be efficiently acquired from the air-conditioning equipment 10 to generate the control parameter CP of the air-conditioning equipment 10. This enables the management server 100 to acquire sufficient data regarding the temperature change operation, the data being necessary for determination or generation of the control parameter CP. It is therefore possible to generate an appropriate control parameter CP regarding control of the air-conditioning equipment 10.

[0160] A management method of the air-conditioning equipment 10 of the present embodiment includes setting a set temperature to the air-conditioning equipment 10, acquiring operation data RD indicating temperature change operation of changing the set temperature of the air-conditioning equipment 10, determining whether or not the acquired operation data RD acquired in a predetermined period satisfies a condition necessary for processing of determining the control parameter CP for executing control of the air-conditioning equipment 10, and determining the control parameter CP including at least the set temperature of the air-conditioning equipment 10 based on the acquired operation data RD in a case where it is determined that the acquired operation data RD satisfies the condition, and in a case where it is determined that the acquired operation data RD does not satisfy the condition, the set temperature of the air-conditioning equipment 10 is changed, and the operation data RD is acquired. According to this method, it is possible to efficiently acquire the operation data RD from the air-conditioning equipment 10 to generate the control parameter CP of the air-conditioning equipment 10. By this means, it is possible to acquire sufficient data regarding the temperature change operation from the air-conditioning equipment 10, the data being necessary for determination or generation of the control parameter CP. It is therefore possible to generate an appropriate control parameter CP regarding control of the air-conditioning equipment 10.

[0161] The control program 131 of the present embodiment is a program executable by the management server 100 which is a computer that manages the air-conditioning equipment 10. The control program 131 causes the management server 100 to function as the setting unit 123 that sets a set temperature to the air-conditioning equipment 10, the acquisition unit 121 that acquires operation data RD indicating temperature change operation of changing the set temperature of the air-conditioning equipment 10, the determination unit 122 that determines whether or not the acquired operation data RD acquired by the acquisition unit 121 in a predetermined period satisfies a condition necessary for processing of determining the control parameter CP for executing control of the air-conditioning equipment 10, and the processing unit 124 that determines the control parameter CP including at least the set temperature of the air-conditioning equipment 10 based on the acquired operation data RD in a case where the determination unit 122 determines that the acquired operation data RD satisfies the condition, and in a case where the determination unit 122 determines that the acquired operation data RD does not satisfy the condition, the program causes the management server 100 to execute control so that the setting unit 123 changes the set temperature of the air-conditioning equipment 10, and the acquisition unit 121 acquires the operation data RD. According to this program, it is possible to efficiently acquire the operation data RD from the air-conditioning equipment 10 to generate the control parameter CP of the air-conditioning equipment 10. This makes it possible to acquire sufficient data regarding temperature change operation from the air-conditioning equipment 10, the data being necessary for determination or generation of the control parameter CP. It is therefore possible to generate an appropriate control parameter CP regarding control of the air-conditioning equipment 10.

[0162] As in the present embodiment, in a case where the determination unit 122 determines that the acquired operation data RD does not satisfy the condition, the management system 1000 may change the set temperature of the air-conditioning equipment 10 so as to reduce energy consumption of the air-conditioning equipment 10 by the setting unit 123 and acquire the operation data RD by the acquisition unit 121. By this means, the set temperature is changed so as to make it easier for temperature change operation of the air-conditioning equipment 10 to be performed in accordance with an acquisition state of the operation data RD. It is therefore possible to efficiently acquire data necessary for determination of the control parameter CP from the air-conditioning equipment 10.

[0163] As in the present embodiment, the control parameter CP may be a parameter for executing control so that the air-conditioning equipment 10 changes the set temperature in accordance with change of the outside air temperature, the parameter including data that associates the outside air temperature in a place where the air-conditioning equipment 10 is installed and the set temperature of the air-conditioning equipment 10. By this means, it is possible to appropriately set the set temperature of the air-conditioning equipment 10 in accordance with an environment and characteristics of the air-conditioned space of the air-conditioning equipment 10 by causing the air-conditioning equipment 10 to operate in accordance with the control parameter CP. It is therefore possible to implement control of the air-conditioning equipment 10 while achieving both comfort in the air-conditioned space and reduction in energy consumption of the air-conditioning equipment 10.

[0164] As in the present embodiment, the control parameter CP may be a parameter for executing control so that the air-conditioning equipment 10 changes the set temperature in accordance with change of the outside air temperature and temperature change operation, the parameter including data that associates the outside air temperature at a place where the air-conditioning equipment 10 is installed, the set temperature of the air-conditioning equipment 10, and a temperature width in which the air-conditioning equipment 10 can change the set temperature in accordance with the temperature change operation. This makes it possible to allow the temperature change operation in a case where the air-conditioning

equipment 10 is caused to operate in accordance with the control parameter CP, in an appropriate range. It is therefore possible to further improve comfort in the air-conditioned space and achieve reduction in energy consumption of the air-conditioning equipment 10.

[0165] As in the present embodiment, the management system 1000 may change the set temperature of the air-conditioning equipment 10 in accordance with the temperature change operation in a case where the temperature change operation is performed and may restore the set temperature of the air-conditioning equipment 10 to a temperature before the temperature change operation is performed after a predetermined period has elapsed since the change of the set temperature of the air-conditioning equipment 10. This makes it possible to efficiently acquire data necessary for determining the control parameter CP while maintaining a preferred state of comfort in the air-conditioned space.

[0166] As in the present embodiment, the management system 1000 may change the set temperature of the air-conditioning equipment 10 in accordance with the temperature change operation in a case where the temperature change operation is performed and may restore the set temperature of the air-conditioning equipment 10 to a temperature before the temperature change operation is performed at a predetermined timing after the set temperature of the air-conditioning equipment 10 has been changed. This makes it possible to efficiently acquire data necessary for determining the control parameter CP while maintaining a preferred state of comfort in the air-conditioned space.

[0167] As in the present embodiment, the processing unit 124 may generate the control parameter CP for heating operation based on the operation data RD acquired by the acquisition unit 121 while the air-conditioning equipment 10 is performing heating operation and may determine the control parameter CP for cooling operation based on the operation data RD acquired by the acquisition unit 121 while the air-conditioning equipment 10 is performing cooling operation. By this means, the control parameters CP respectively corresponding to cooling operation and heating operation of the air-conditioning equipment 10 can be determined. It is therefore possible to implement control of the air-conditioning equipment 10 while achieving comfort in the air-conditioned space and reduction in energy consumption of the air-conditioning equipment 10 both in a case where the air-conditioning equipment 10 executes heating operation and in a case where the air-conditioning equipment 10 executes cooling operation.

[0168] As in the present embodiment, the processing unit 124 may generate comparison data that compares a power consumption amount of the air-conditioning equipment 10 in a case where the air-conditioning equipment 10 is caused to operate using the control parameter CP and a power consumption amount of the air-conditioning equipment 10 in a case where the air-conditioning equipment 10 is caused to operate in accordance with temperature change operation without using the control parameter CP. This enables the manager or the user of the air-conditioning equipment 10 to visually grasp a reduction effect of energy consumption in a case where the control parameter CP is used.

[0169] As in the present embodiment, the management system 1000 may include the air-conditioning equipment 10 and the management server 100 that can perform communication with the air-conditioning equipment 10, the air-conditioning equipment 10 may include the operation unit 14 that accepts temperature change operation, the communication device 15 that transmits the operation data RD to the management server 100 based on the temperature change operation, and the control device 11 that controls the air-conditioning equipment 10 based on temperature setting data transmitted by the management server, and the control device 11 may change the set temperature of the air-conditioning equipment 10 based on the control parameter CP generated by the management server 100 and the outside air temperature at a place where the air-conditioning equipment 10 is installed. By this means, the management server 100 transmits the control parameter CP to the air-conditioning equipment 10, and the air-conditioning equipment 10 operates at the set temperature corresponding to the outside air temperature based on the control parameter CP provided by the management server 100. Thus, the set temperature of the air-conditioning equipment 10 can be appropriately set under control of the management server 100, so that it is possible to achieve both comfort in the air-conditioned space and reduction in energy consumption of the air-conditioning equipment 10.

[5. Other embodiments]

[0170] The embodiment has been described above as an example of disclosure in the present application. However, the technique in the present disclosure is not limited to this and can be applied to embodiments in which changes, replacements, additions, omissions, and the like, are performed. Further, a new embodiment can be obtained by combining respective components described in the above-described embodiment.

[0171] Thus, other embodiments will be described as an example below.

[0172] While in the above-described embodiment, a configuration in which the outside air temperature sensor 18 detects the outside air temperature has been described as an example, this is one example. For example, the air-conditioning equipment 10 or the management server 100 may acquire data of the outside air temperature at a place where the facility 1 is installed using a weather information delivery service provided by a cloud server, or the like, to acquire the outside air temperature that is not affected by insolation, influence of the outdoor unit 12 being filled with heat, or the like. In a case where the management server 100 can acquire data of the outside air temperature, the operation data RD does not have to include the outside air temperature. In this case, the data of the outside air temperature may be transmitted to the

air-conditioning equipment 10 from the management server 100.

[0173] In the above-described embodiment, a configuration has been described where linear regression is performed as an example of regression analysis to be executed by the determination unit 122 in step SD4 (Fig. 5) and regression analysis to be executed by the processing unit 124 in step SE4 (Fig. 7). This is one example, and the determination unit 122 and the processing unit 124 may, for example, perform processing of obtaining a regression curved line. In this case, processing of comparing a slope of a regression straight line with a threshold in step SD5 can be replaced with processing of comparing a maximum value or an average value of the slope of the regression curved line with a threshold.

[0174] Further, in the above-described embodiment, a configuration has been described where each of the air-conditioning equipment 10 includes the communication device 15. In this configuration, a plurality of pieces of air-conditioning equipment 10 may be connected to a communication device which is independent of the air-conditioning equipment 10 or which is built in one piece of the air-conditioning equipment 10 and may execute communication with the management server 100 using this communication device.

[0175] Further, a configuration has been described in the above-described embodiment where each of the air-conditioning equipment 10 includes the control device 11 that determines the set temperature based on the control parameter CP. In this configuration, a central control device that controls a plurality of pieces of air-conditioning equipment 10 may be provided. In this case, the central control device may determine the set temperatures of the respective pieces of air-conditioning equipment 10 in accordance with the control parameters CP generated by the management server 100 so as to respectively correspond to the plurality of pieces of air-conditioning equipment 10.

[0176] It is only necessary that a configuration of the communication unit in the present disclosure enables communication between the device of the present disclosure and external equipment. When a subject matter of the invention is expressed, there is a case where the configuration that enables communication between the device of the present disclosure and external equipment may be expressed as communication means, a communication unit, transmission/-reception means, a transmission/reception unit or a term similar to these other than a communicator. The communicator constituting the communication device 15, the server communication device 150 and the communication unit (not illustrated) provided in the terminal device 5 or the mobile terminal device 7 may be implemented in various aspects. For example, the communicator may have an aspect of connecting the device of the present disclosure and external equipment in a wired manner or an aspect of connecting the device of the present disclosure and external equipment in a wireless manner. A communicator that connects the device of the present disclosure and the external equipment in a wired manner is effective in communication security and communication reliability. Examples of the communicator that performs connection in a wired manner can include, for example, a wired LAN based on Ethernet (registered trademark) standards, a wired connection using an optical fiber cable, and the like. Examples of the communicator that performs connection in a wireless manner can include wireless connection with external equipment via a base station, or the like, direct wireless connection to external equipment, and the like. Examples of wireless connection to external equipment via a base station, or the like, can include, for example, wireless LAN supporting IEEE802.11 in which communication is performed with a Wi-Fi router in a wireless manner, a third generation mobile communication system (which is called 3G), a fourth generation mobile communication system (which is called 4G), WiMax (registered trademark) supporting IEEE802.16, a low power wide area (LPWA), and the like. Using the communicator that directly connects the device of the present disclosure and external equipment in a wireless manner is effective to improve communication security and enables the device of the present disclosure to communicate with external equipment even at a place where there is no relay equipment such as a Wi-Fi router. Examples of the communicator that directly connects the device of the present disclosure and external equipment in a wireless manner can include, for example, communication using Bluetooth (registered trademark), communication using near field communication (NFC) via a loop antenna, infrared communication, and the like.

[0177] The respective units illustrated in Fig. 1 and Fig. 2 are one example, and a specific implementation form is not particularly limited. In other words, hardware individually corresponding to the respective units do not necessarily have to be mounted, and functions of the respective units can be of course implemented by one processor executing programs. Further, part of functions to be implemented by software in the above-described embodiment may be implemented by hardware or part of functions to be implemented by hardware may be implemented by software. In addition, specific detailed configurations of other units of the air-conditioning equipment 10, the management server 100, the terminal device 5 and the mobile terminal device 7 can be arbitrarily changed within a range not deviating from the gist of the present disclosure.

[0178] Further, for example, a unit of step of the operation indicated in Figs. 3 to 5, 7, 9, 10 and 12 is a unit divided in accordance with main processing content to facilitate understanding of operation of the respective units of the management system 1000, and the present disclosure is not limited by how to divide a unit of the processing or name of the unit of the processing.

[0179] Note that the above-described embodiment is an example of the technique in the present disclosure, and various changes, replacements, additions, omissions, and the like, can be made within the scope of the claims or its equivalent scope.

[Industrial Applicability]

[0180] As described above, the management system, the air-conditioning equipment management method, and the program according to the present disclosure can be used in application of managing operation of the air-conditioning equipment.

[Reference Signs List]

[0181]

5	Terminal device
7	Mobile terminal device
10, 10A, 10B, 10C, 10D	Air-conditioning equipment
11	Control device (control unit)
12	Outdoor unit
13	Indoor unit
14	Operation unit
15	Communication device (transmission unit)
18	Outside air temperature sensor
51, 71	Display
100	Management server
110	Control unit
120	Processor
121	Acquisition unit
122	Determination unit
123	Setting unit
124	Processing unit
130	Memory
131	Control program (program)
132	Temperature setting data
150	Server communication device
1000	Management system
CP	Control parameter
RD	Operation data
N	Communication network
SD	Setting data

Claims

1. A management system comprising:

a setting unit that sets a set temperature to air-conditioning equipment;
an acquisition unit that acquires operation data indicating temperature change operation of changing the set temperature of the air-conditioning equipment;
a determination unit that determines whether or not the acquired operation data acquired by the acquisition unit in a predetermined period satisfies a condition necessary for processing of determining a control parameter for executing control of the air-conditioning equipment; and
a processing unit that determines the control parameter including at least the set temperature of the air-conditioning equipment based on the acquired operation data in a case where it is determined that the acquired operation data satisfies the condition,
wherein in a case where the determination unit determines that the acquired operation data does not satisfy the condition, the setting unit changes the set temperature of the air-conditioning equipment, and the acquisition unit acquires the operation data.

2. The management system according to claim 1,
wherein in a case where the determination unit determines that the acquired operation data does not satisfy the condition, the setting unit changes the set temperature of the air-conditioning equipment so as to reduce energy consumption of the air-conditioning equipment, and the acquisition unit acquires the operation data.

3. The management system according to claim 1 or 2,
wherein the control parameter is a parameter for executing control so that the air-conditioning equipment changes the set temperature in accordance with change of an outside air temperature, the parameter including data that associates the outside air temperature at a place where the air-conditioning equipment is installed and the set temperature of the air-conditioning equipment.

4. The management system according to claim 1 or 2,
wherein the control parameter is a parameter for executing control so that the air-conditioning equipment changes the set temperature in accordance with change of an outside air temperature and the temperature change operation, the parameter including data that associates the outside air temperature at a place where the air-conditioning equipment is installed, the set temperature of the air-conditioning equipment and a temperature width in which the air-conditioning equipment can change the set temperature in accordance with the temperature change operation.

5. The management system according to any of claims 1 to 4,
wherein in a case where the temperature change operation is performed, the set temperature of the air-conditioning equipment is changed in accordance with the temperature change operation, and the set temperature of the air-conditioning equipment is restored to a temperature before the temperature change operation is performed after a predetermined period has elapsed since the change of the set temperature of the air-conditioning equipment.

6. The management system according to any of claims 1 to 4,
wherein in a case where the temperature change operation is performed, the set temperature of the air-conditioning equipment is changed in accordance with the temperature change operation, and the set temperature of the air-conditioning equipment is restored to a temperature before the temperature change operation is performed at a predetermined timing after the set temperature of the air-conditioning equipment has been changed.

7. The management system according to any of claims 1 to 6,
wherein the processing unit determines the control parameter for heating operation based on the operation data acquired by the acquisition unit while the air-conditioning equipment is performing heating operation and determines the control parameter for cooling operation based on the operation data acquired by the acquisition unit while the air-conditioning equipment is performing cooling operation.

8. The management system according to any of claims 1 to 7,
wherein the processing unit generates comparison data that compares a power consumption amount of the air-conditioning equipment in a case where the air-conditioning equipment is caused to operate using the control parameter and a power consumption amount of the air-conditioning equipment in a case where the air-conditioning equipment is caused to operate in accordance with the temperature change operation without using the control parameter.

9. The management system according to any of claims 1 to 8, comprising:

the air-conditioning equipment; and
a management server capable of communicating with the air-conditioning equipment,
wherein the air-conditioning equipment comprises:

an operation unit that accepts the temperature change operation;
a transmission unit that transmits the operation data to the management server based on the temperature change operation; and
a control unit that controls the air-conditioning equipment based on temperature setting data transmitted by the management server,
wherein the control unit changes the set temperature of the air-conditioning equipment based on the control parameter generated by the management server and an outside air temperature at a place where the air-conditioning equipment is installed.

10. An air-conditioning equipment management method, comprising:

setting a set temperature to air-conditioning equipment;
acquiring operation data indicating temperature change operation of changing the set temperature of the air-conditioning equipment;

determining whether or not the acquired operation data acquired in a predetermined period satisfies a condition necessary for processing of determining a control parameter for executing control of the air-conditioning equipment; and

determining the control parameter including at least the set temperature of the air-conditioning equipment based on the acquired operation data in a case where it is determined that the acquired operation data satisfies the condition,

wherein in a case where it is determined that the acquired operation data does not satisfy the condition, the set temperature of the air-conditioning equipment is changed, and the operation data is acquired.

11. A program executable by a computer that manages air-conditioning equipment, the program causing the computer to function as:

a setting unit that sets a set temperature to the air-conditioning equipment;

an acquisition unit that acquires operation data indicating temperature change operation of changing the set temperature of the air-conditioning equipment;

a determination unit that determines whether or not the acquired operation data acquired by the acquisition unit in a predetermined period satisfies a condition necessary for processing of determining a control parameter for executing control of the air-conditioning equipment; and

a processing unit that determines the control parameter including at least the set temperature of the air-conditioning equipment based on the acquired operation data in a case where the determination unit determines that the acquired operation data satisfies the condition,

wherein in a case where the determination unit determines that the acquired operation data does not satisfy the condition, the program causes the computer to execute control so that the setting unit changes the set temperature of the air-conditioning equipment, and the acquisition unit acquires the operation data.

FIG.1

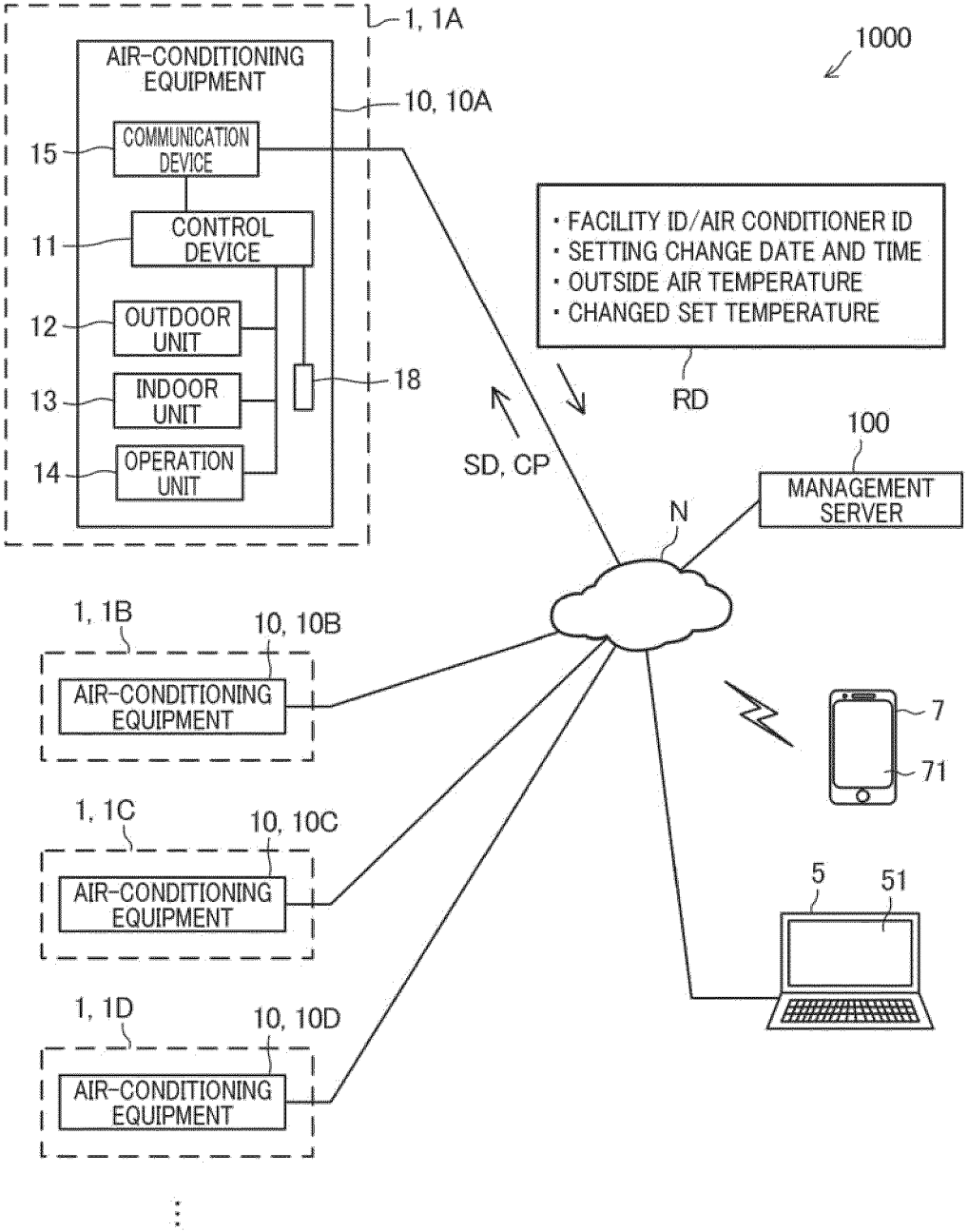
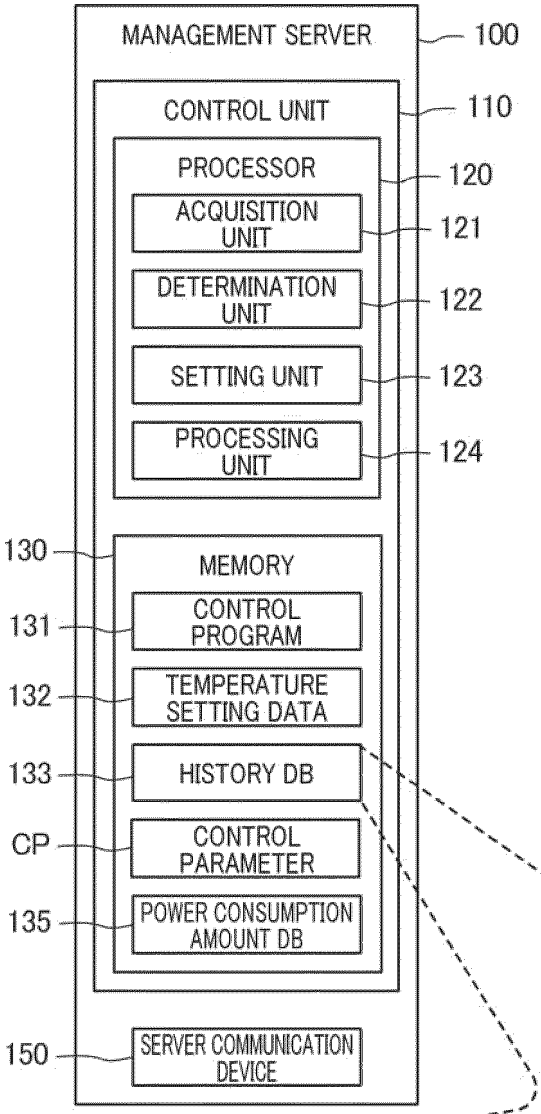

1, 1A
1000
AIR-CONDITIONING EQUIPMENT
10, 10A
15
COMMUNICATION DEVICE
11
CONTROL DEVICE
12
OUTDOOR UNIT
13
INDOOR UNIT
14
OPERATION UNIT
18
• FACILITY ID/AIR CONDITIONER ID
• SETTING CHANGE DATE AND TIME
• OUTSIDE AIR TEMPERATURE
• CHANGED SET TEMPERATURE
RD
SD, CP
100
MANAGEMENT SERVER
N
1, 1B
10, 10B
AIR-CONDITIONING EQUIPMENT
7
71
1, 1C
10, 10C
AIR-CONDITIONING EQUIPMENT
5
51
1, 1D
10, 10D
AIR-CONDITIONING EQUIPMENT

FIG.2



AIR CONDITIONER ID	SETTING CHANGE HISTORY				
	SETTING CHANGE DATE AND TIME	TYPE OF OPERATION	OUTSIDE AIR TEMPERATURE	SET TEMPERATURE	CHANGED SET TEMPERATURE
0001	2021.7.10 09:00	COOLING	29°C	28°C	27°C
0001	2021.7.10 12:15	COOLING	30°C	28°C	23°C
0001	2021.7.10 14:40	COOLING	32°C	28°C	24°C
0001	2021.7.10 23:05	COOLING	24°C	28°C	27°C
⋮	⋮	⋮	⋮	⋮	⋮

FIG.3

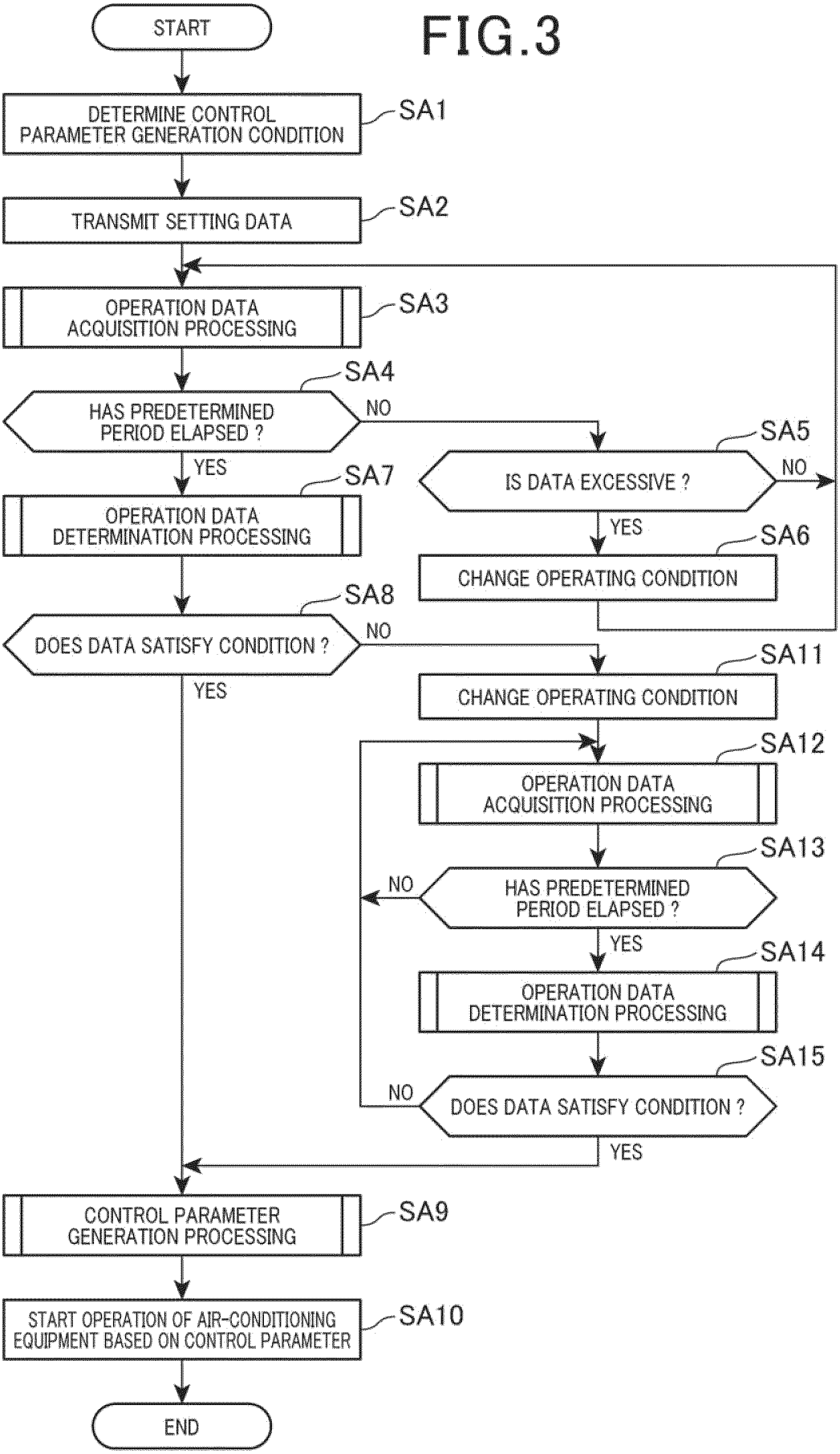

START
DETERMINE CONTROL PARAMETER GENERATION CONDITION
SA1
TRANSMIT SETTING DATA
SA2
OPERATION DATA ACQUISITION PROCESSING
SA3
SA4
HAS PREDETERMINED PERIOD ELAPSED ?
NO
YES
SA5
IS DATA EXCESSIVE ?
NO
YES
SA6
CHANGE OPERATING CONDITION
SA7
OPERATION DATA DETERMINATION PROCESSING
SA8
DOES DATA SATISFY CONDITION ?
NO
YES
SA11
CHANGE OPERATING CONDITION
SA12
OPERATION DATA ACQUISITION PROCESSING
SA13
NO
HAS PREDETERMINED PERIOD ELAPSED ?
YES
SA14
OPERATION DATA DETERMINATION PROCESSING
SA15
NO
DOES DATA SATISFY CONDITION ?
YES
CONTROL PARAMETER GENERATION PROCESSING
SA9
START OPERATION OF AIR-CONDITIONING EQUIPMENT BASED ON CONTROL PARAMETER
SA10
END

FIG.4

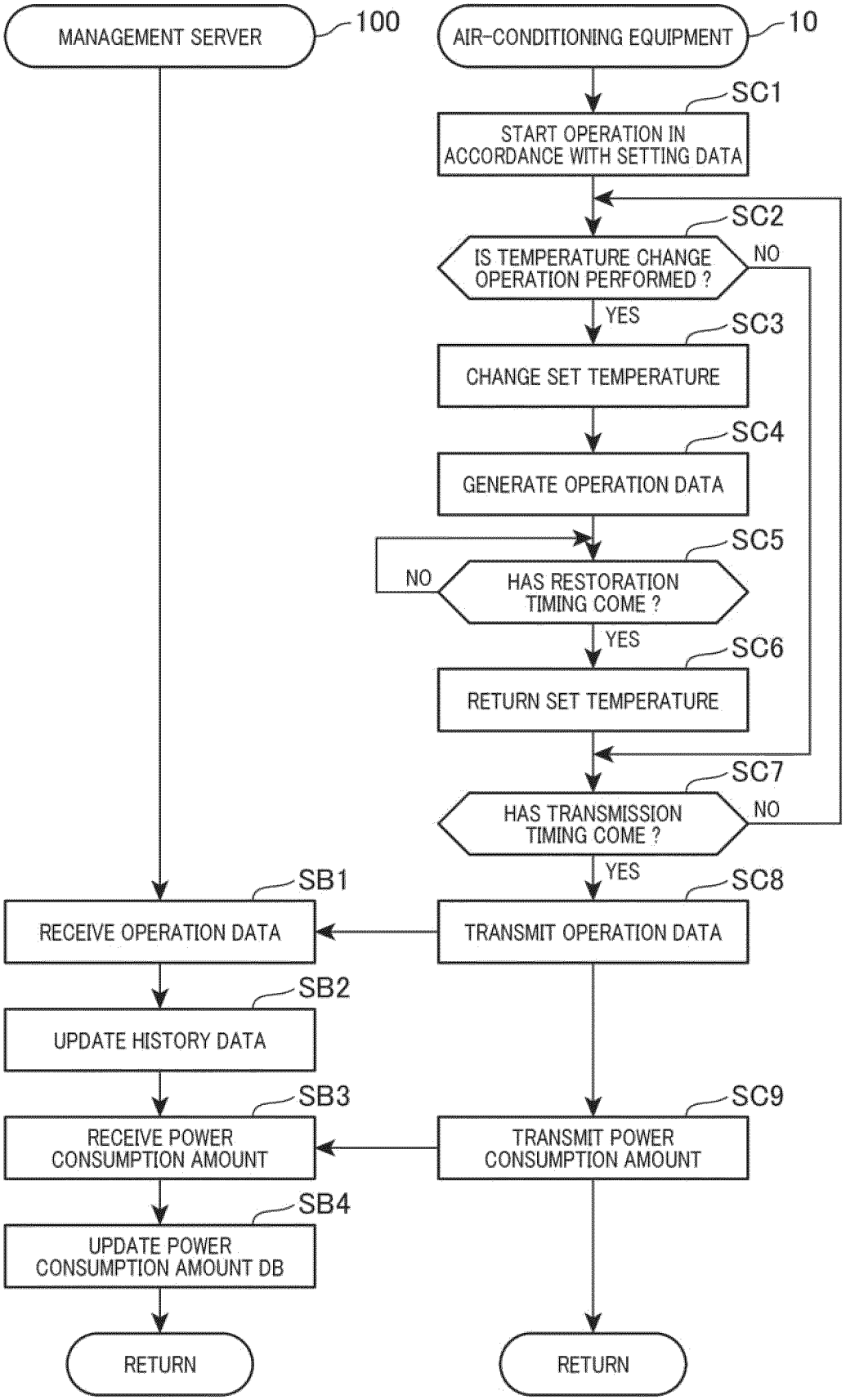

MANAGEMENT SERVER
100
AIR-CONDITIONING EQUIPMENT
10
SC1
START OPERATION IN ACCORDANCE WITH SETTING DATA
SC2
IS TEMPERATURE CHANGE OPERATION PERFORMED ?
NO
YES
SC3
CHANGE SET TEMPERATURE
SC4
GENERATE OPERATION DATA
SC5
NO
HAS RESTORATION TIMING COME ?
YES
SC6
RETURN SET TEMPERATURE
SC7
HAS TRANSMISSION TIMING COME ?
NO
YES
SC8
SB1
RECEIVE OPERATION DATA
TRANSMIT OPERATION DATA
SB2
UPDATE HISTORY DATA
SB3
SC9
RECEIVE POWER CONSUMPTION AMOUNT
TRANSMIT POWER CONSUMPTION AMOUNT
SB4
UPDATE POWER CONSUMPTION AMOUNT DB
RETURN
RETURN

FIG.5

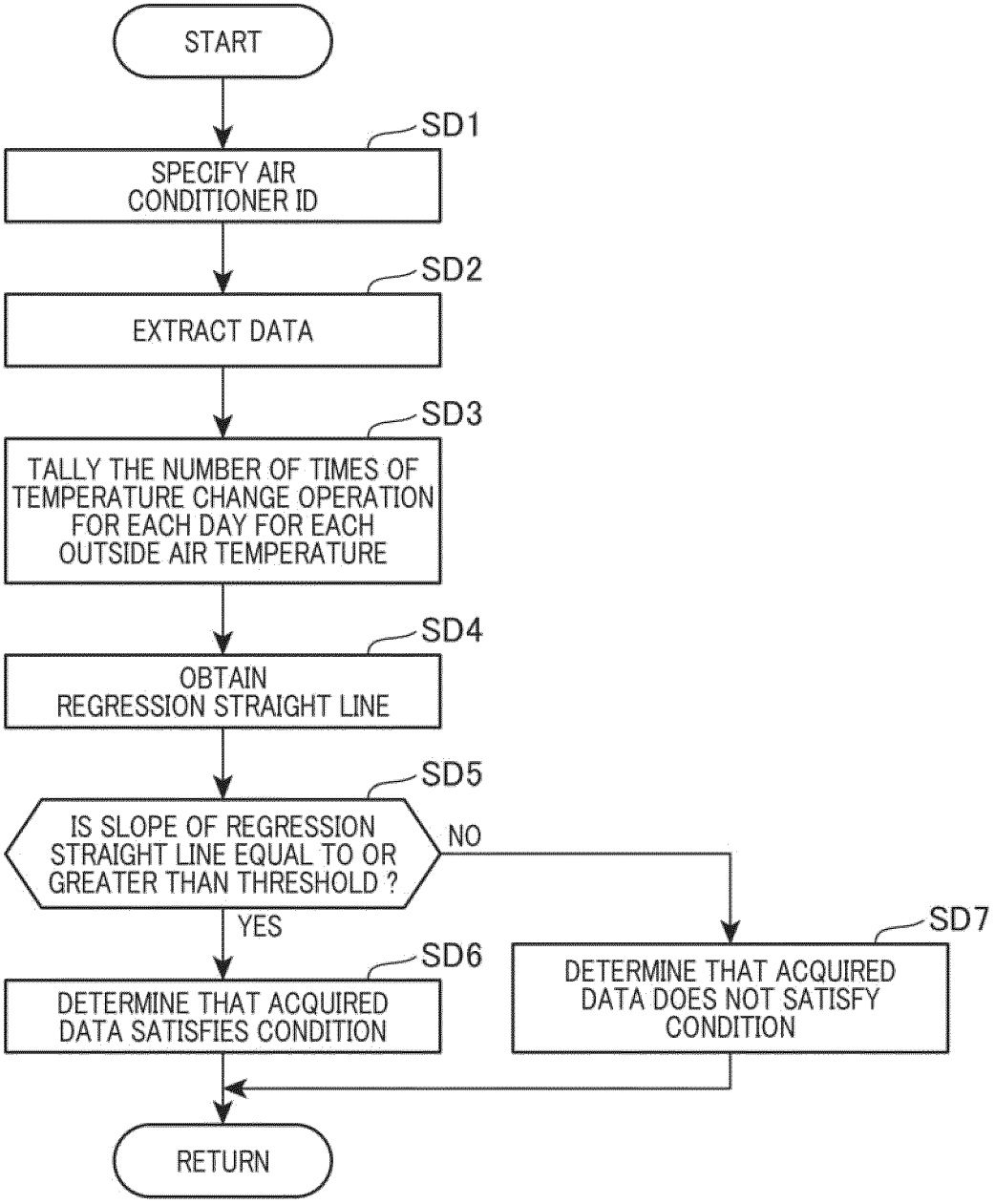

START
SD1
SPECIFY AIR CONDITIONER ID
SD2
EXTRACT DATA
SD3
TALLY THE NUMBER OF TIMES OF TEMPERATURE CHANGE OPERATION FOR EACH DAY FOR EACH OUTSIDE AIR TEMPERATURE
SD4
OBTAIN REGRESSION STRAIGHT LINE
SD5
IS SLOPE OF REGRESSION STRAIGHT LINE EQUAL TO OR GREATER THAN THRESHOLD ?
NO
YES
SD6
DETERMINE THAT ACQUIRED DATA SATISFIES CONDITION
SD7
DETERMINE THAT ACQUIRED DATA DOES NOT SATISFY CONDITION
RETURN

FIG.6

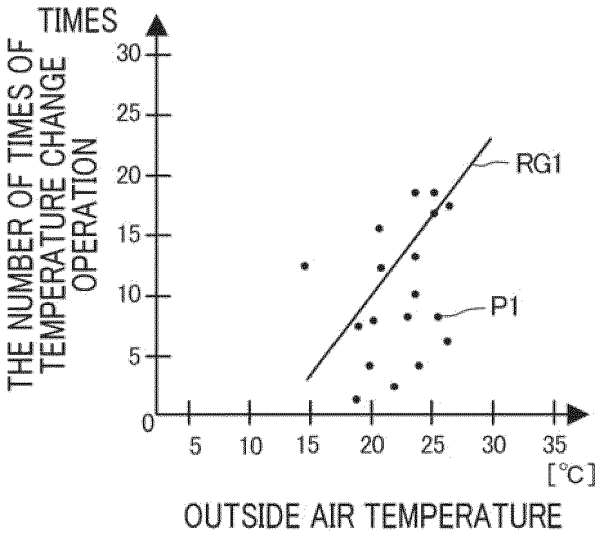

TIMES
THE NUMBER OF TIMES OF TEMPERATURE CHANGE OPERATION
30
25
20
15
10
5
0
RG1
P1
5
10
15
20
25
30
35
[°C]
OUTSIDE AIR TEMPERATURE

FIG.7

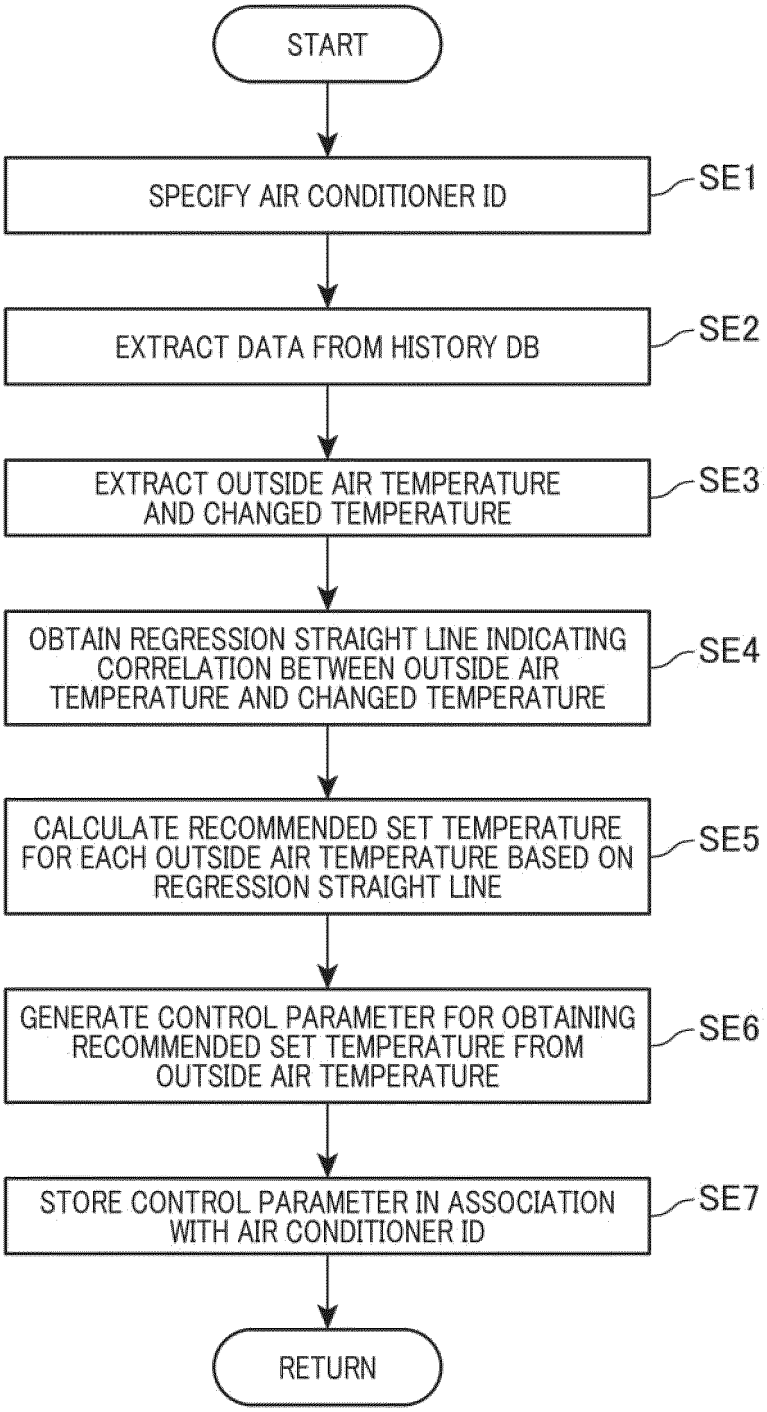

START
SPECIFY AIR CONDITIONER ID
SE1
EXTRACT DATA FROM HISTORY DB
SE2
EXTRACT OUTSIDE AIR TEMPERATURE AND CHANGED TEMPERATURE
SE3
OBTAIN REGRESSION STRAIGHT LINE INDICATING CORRELATION BETWEEN OUTSIDE AIR TEMPERATURE AND CHANGED TEMPERATURE
SE4
CALCULATE RECOMMENDED SET TEMPERATURE FOR EACH OUTSIDE AIR TEMPERATURE BASED ON REGRESSION STRAIGHT LINE
SE5
GENERATE CONTROL PARAMETER FOR OBTAINING RECOMMENDED SET TEMPERATURE FROM OUTSIDE AIR TEMPERATURE
SE6
STORE CONTROL PARAMETER IN ASSOCIATION WITH AIR CONDITIONER ID
SE7
RETURN

FIG.8

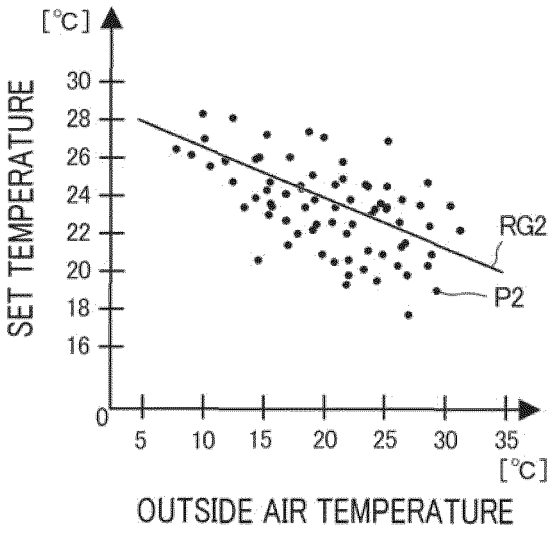

[°C]
30
28
26
24
22
20
18
16
0
SET TEMPERATURE
RG2
P2
5
10
15
20
25
30
35
[°C]
OUTSIDE AIR TEMPERATURE

FIG.9

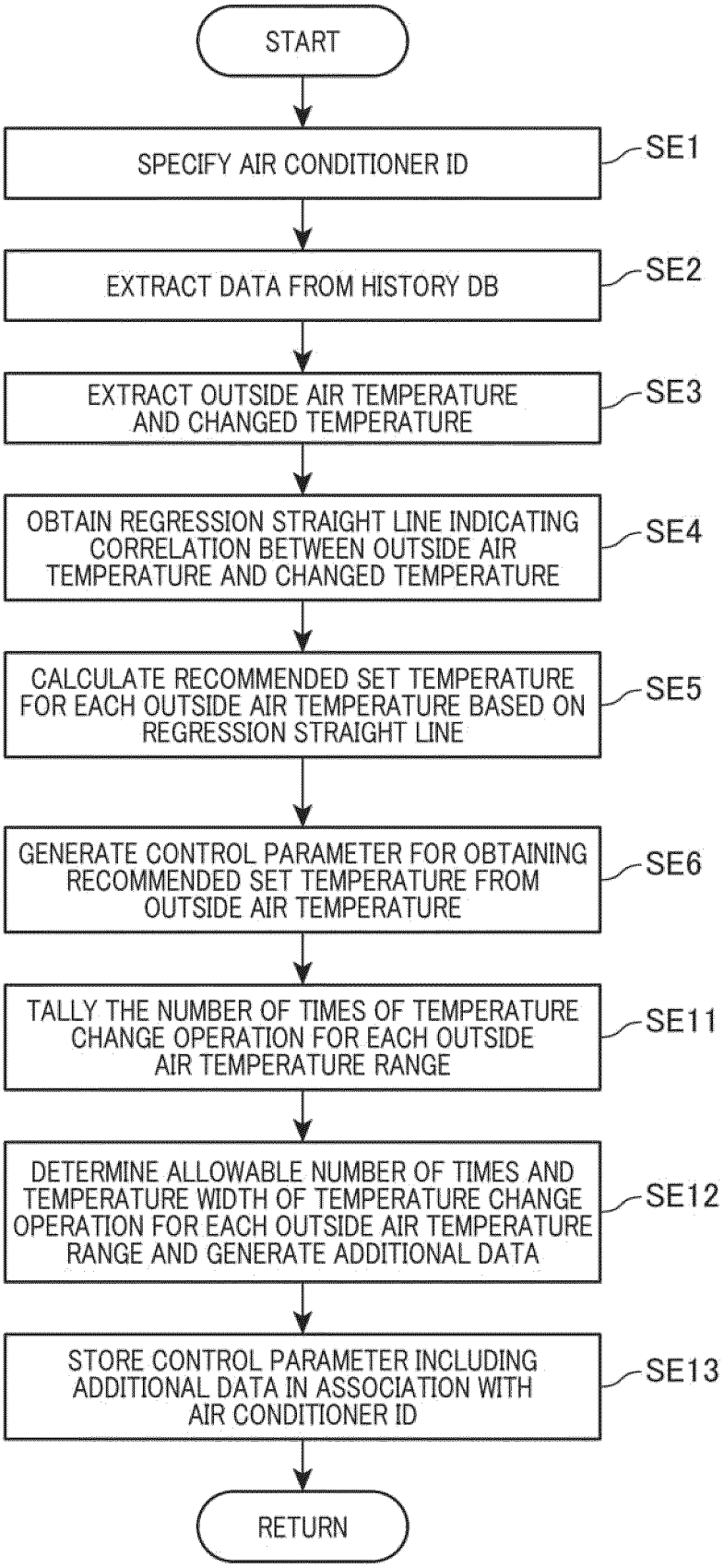

START
SPECIFY AIR CONDITIONER ID
SE1
EXTRACT DATA FROM HISTORY DB
SE2
EXTRACT OUTSIDE AIR TEMPERATURE AND CHANGED TEMPERATURE
SE3
OBTAIN REGRESSION STRAIGHT LINE INDICATING CORRELATION BETWEEN OUTSIDE AIR TEMPERATURE AND CHANGED TEMPERATURE
SE4
CALCULATE RECOMMENDED SET TEMPERATURE FOR EACH OUTSIDE AIR TEMPERATURE BASED ON REGRESSION STRAIGHT LINE
SE5
GENERATE CONTROL PARAMETER FOR OBTAINING RECOMMENDED SET TEMPERATURE FROM OUTSIDE AIR TEMPERATURE
SE6
TALLY THE NUMBER OF TIMES OF TEMPERATURE CHANGE OPERATION FOR EACH OUTSIDE AIR TEMPERATURE RANGE
SE11
DETERMINE ALLOWABLE NUMBER OF TIMES AND TEMPERATURE WIDTH OF TEMPERATURE CHANGE OPERATION FOR EACH OUTSIDE AIR TEMPERATURE RANGE AND GENERATE ADDITIONAL DATA
SE12
STORE CONTROL PARAMETER INCLUDING ADDITIONAL DATA IN ASSOCIATION WITH AIR CONDITIONER ID
SE13
RETURN

FIG.10

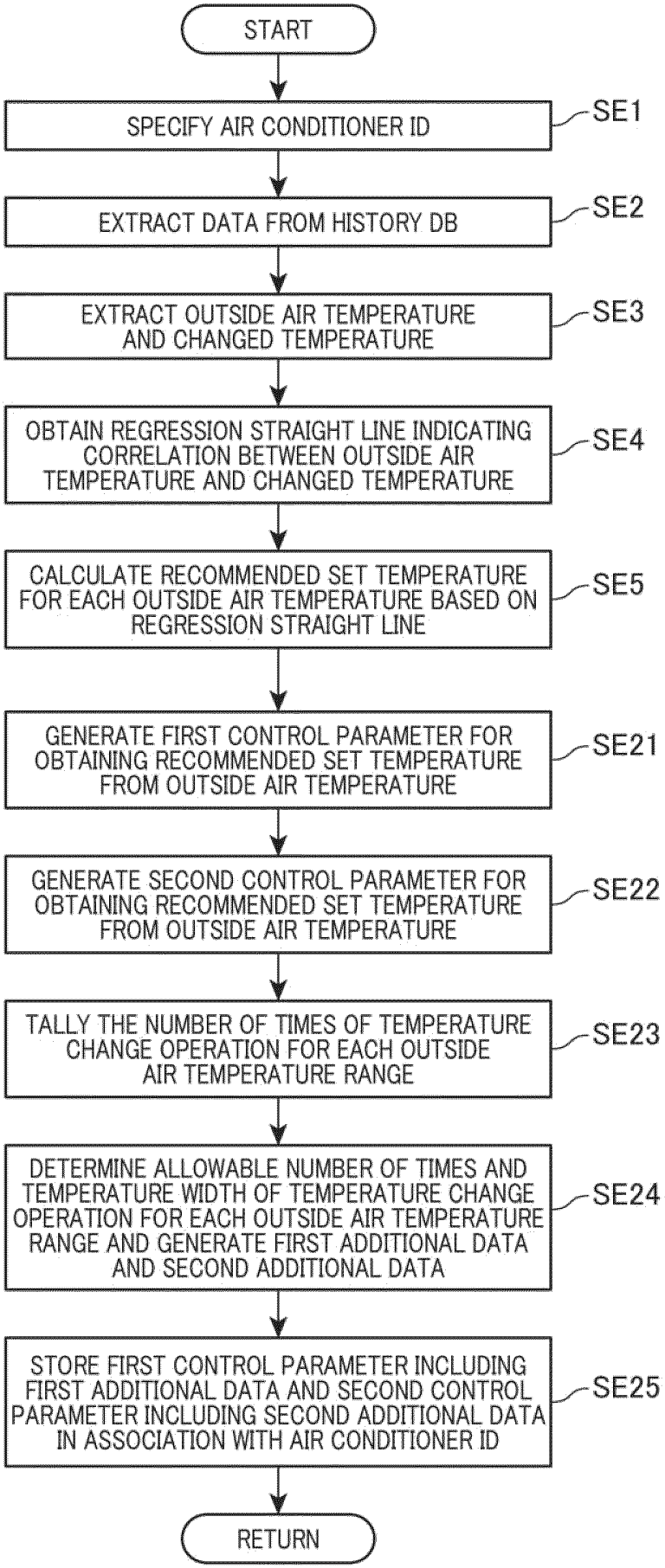

START
SPECIFY AIR CONDITIONER ID
SE1
EXTRACT DATA FROM HISTORY DB
SE2
EXTRACT OUTSIDE AIR TEMPERATURE AND CHANGED TEMPERATURE
SE3
OBTAIN REGRESSION STRAIGHT LINE INDICATING CORRELATION BETWEEN OUTSIDE AIR TEMPERATURE AND CHANGED TEMPERATURE
SE4
CALCULATE RECOMMENDED SET TEMPERATURE FOR EACH OUTSIDE AIR TEMPERATURE BASED ON REGRESSION STRAIGHT LINE
SE5
GENERATE FIRST CONTROL PARAMETER FOR OBTAINING RECOMMENDED SET TEMPERATURE FROM OUTSIDE AIR TEMPERATURE
SE21
GENERATE SECOND CONTROL PARAMETER FOR OBTAINING RECOMMENDED SET TEMPERATURE FROM OUTSIDE AIR TEMPERATURE
SE22
TALLY THE NUMBER OF TIMES OF TEMPERATURE CHANGE OPERATION FOR EACH OUTSIDE AIR TEMPERATURE RANGE
SE23
DETERMINE ALLOWABLE NUMBER OF TIMES AND TEMPERATURE WIDTH OF TEMPERATURE CHANGE OPERATION FOR EACH OUTSIDE AIR TEMPERATURE RANGE AND GENERATE FIRST ADDITIONAL DATA AND SECOND ADDITIONAL DATA
SE24
STORE FIRST CONTROL PARAMETER INCLUDING FIRST ADDITIONAL DATA AND SECOND CONTROL PARAMETER INCLUDING SECOND ADDITIONAL DATA IN ASSOCIATION WITH AIR CONDITIONER ID
SE25
RETURN

FIG.11

<table>
<tr><th>OUTSIDE AIR TEMPERATURE</th><th>ENERGY SAVING SET TEMPERATURE</th><th>SET TEMPERATURE OF AIR-CONDITIONER 1</th><th>SET TEMPERATURE OF AIR-CONDITIONER 2</th><th>SET TEMPERATURE OF AIR-CONDITIONER 3</th><th>SET TEMPERATURE OF AIR-CONDITIONER 4</th></tr>
<tr><td>−20°C</td><td rowspan="7">28°C</td><td rowspan="2">25°C</td><td rowspan="2">28°C</td><td rowspan="3">28°C</td><td>27°C</td></tr>
<tr><td>21°C−22°C</td><td rowspan="3">26°C</td></tr>
<tr><td>23°C−24°C</td><td rowspan="2">24°C</td><td></td><td></td></tr>
<tr><td>25°C−26°C</td><td></td><td>27°C</td><td></td></tr>
<tr><td>27°C−28°C</td><td rowspan="2">23°C</td><td>27°C</td><td></td><td>25°C</td></tr>
<tr><td>29°C−30°C</td><td></td><td></td><td></td></tr>
<tr><td>31°C−33°C</td><td rowspan="2">22°C</td><td rowspan="2">26°C</td><td rowspan="2">26°C</td><td rowspan="2">24°C</td></tr>
<tr><td>34°C−</td></tr>
</table>

FIG.12

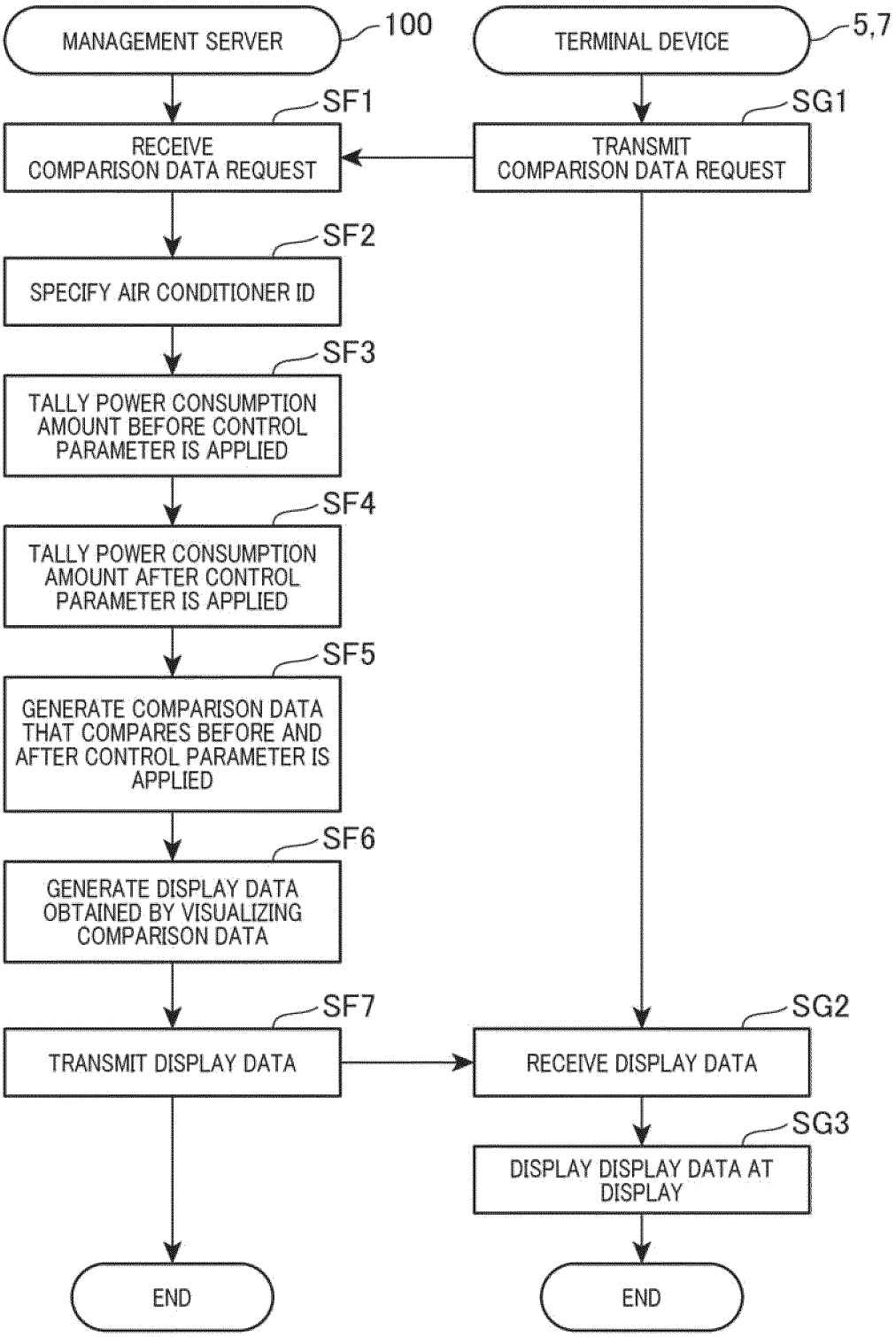

MANAGEMENT SERVER
100
TERMINAL DEVICE
5,7
SF1
RECEIVE COMPARISON DATA REQUEST
SG1
TRANSMIT COMPARISON DATA REQUEST
SF2
SPECIFY AIR CONDITIONER ID
SF3
TALLY POWER CONSUMPTION AMOUNT BEFORE CONTROL PARAMETER IS APPLIED
SF4
TALLY POWER CONSUMPTION AMOUNT AFTER CONTROL PARAMETER IS APPLIED
SF5
GENERATE COMPARISON DATA THAT COMPARES BEFORE AND AFTER CONTROL PARAMETER IS APPLIED
SF6
GENERATE DISPLAY DATA OBTAINED BY VISUALIZING COMPARISON DATA
SF7
TRANSMIT DISPLAY DATA
SG2
RECEIVE DISPLAY DATA
SG3
DISPLAY DISPLAY DATA AT DISPLAY
END
END

FIG.13

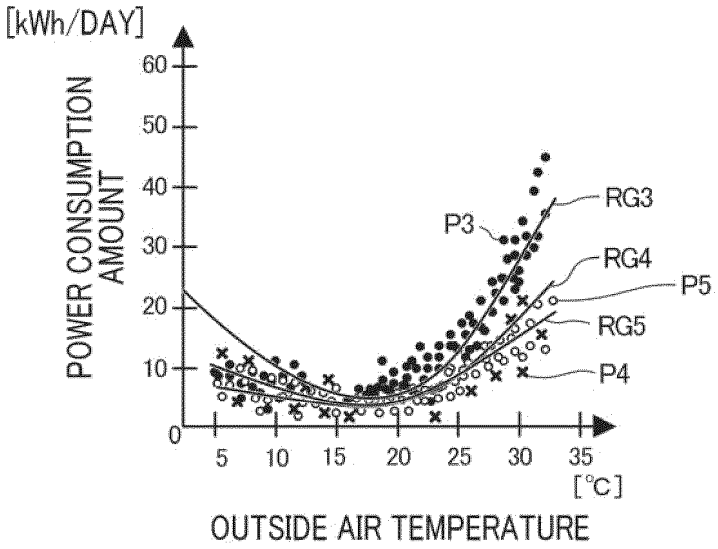
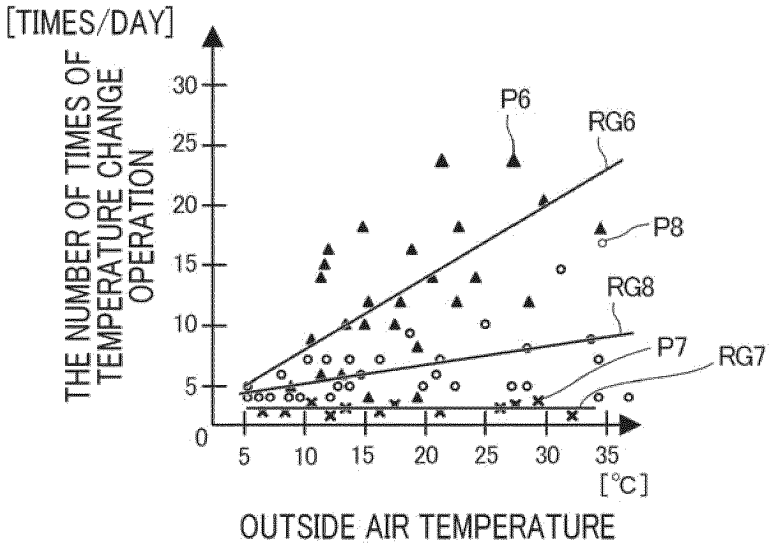

[kWh/DAY]
POWER CONSUMPTION AMOUNT
60
50
40
30
20
10
0
5
10
15
20
25
30
35
[°C]
OUTSIDE AIR TEMPERATURE
P3
RG3
RG4
P5
RG5
P4

FIG.14


[TIMES/DAY]
THE NUMBER OF TIMES OF TEMPERATURE CHANGE OPERATION
30
25
20
15
10
5
0
P6
RG6
P8
RG8
P7
RG7
5
10
15
20
25
30
35
[°C]
OUTSIDE AIR TEMPERATURE

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/007088

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/56(2018.01)i; ***F24F 11/61***(2018.01)i; ***F24F 11/64***(2018.01)i; *F24F 110/12*(2018.01)n
FI: F24F11/64; F24F11/61; F24F11/56; F24F110:12

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)

F24F11/56; F24F11/61; F24F11/64; F24F110/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2010-266090 A (DAIKIN IND LTD) 25 November 2010 (2010-11-25) paragraphs [0032]-[0153], fig. 1-10	1-11
Y	JP 2020-197337 A (MITSUBISHI ELECTRIC CORP) 10 December 2020 (2020-12-10) paragraphs [0010]-[0063], fig. 1-5	1-11
Y	JP 2008-241156 A (MATSUSHITA ELECTRIC WORKS LTD) 09 October 2008 (2008-10-09) paragraph [0016]	5-9
A		10-11
Y	JP 2002-228225 A (YAMATAKE BUILDING SYSTEMS CO LTD) 14 August 2002 (2002-08-14) paragraph [0012]	5-9
Y	JP 2021-042877 A (SHARP KK) 18 March 2021 (2021-03-18) paragraphs [0016]-[0141], fig. 1-11	8-9
A		10-11

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

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"T" 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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Date of the actual completion of the international search	Date of mailing of the international search report
01 May 2023	**16 May 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/007088

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2010-266090 A	25 November 2010	WO 2010/131443 A1 paragraphs [0017]-[0084], fig. 1-10	
JP 2020-197337 A	10 December 2020	(Family: none)	
JP 2008-241156 A	09 October 2008	(Family: none)	
JP 2002-228225 A	14 August 2002	(Family: none)	
JP 2021-042877 A	18 March 2021	CN 112460749 A paragraphs [0016]-[0141], fig. 1-11	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005061716 A **[0003]**
- JP 2022029429 A **[0005]**