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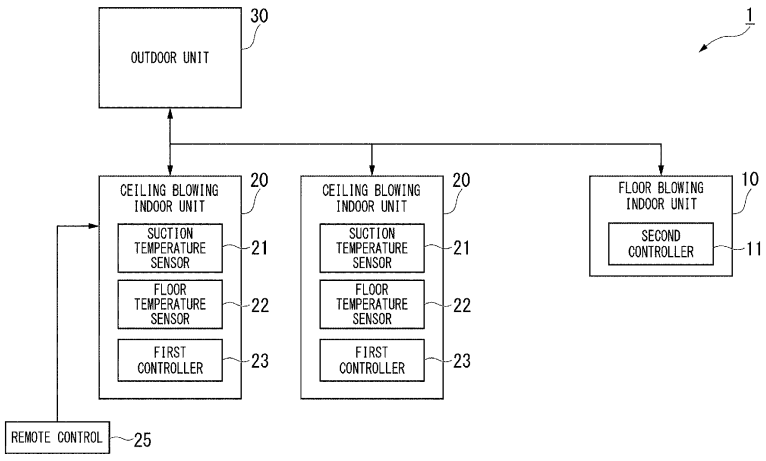
(54) AIR CONDITIONING SYSTEM, CONTROLLER, CONTROL METHOD, AND PROGRAM

(57) An air conditioning system of an embodiment includes a first indoor unit, a floor temperature sensor, a second indoor unit, and a control unit. The first indoor unit blows temperature-controlled air from an upper part of a space to the inside of the space. The floor temperature sensor outputs a signal. The signal corresponds to a floor temperature as a temperature of a floor surface under the first indoor unit. The second indoor unit blows temperature-controlled air from under a floor of the space to the inside of the space. The control unit controls an operation of the second indoor unit based on the floor temperature obtained by using the floor temperature sensor.

FIG. 2



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Description

[TECHNICAL FIELD]

[0001] An embodiment of the present invention relates to an air conditioning system, a controller, a control method, and a program.

[BACKGROUND ART]

[0002] Air conditioning system including a first indoor unit and a second indoor unit has been proposed. The first indoor unit blows temperature-controlled air from an upper part of a space to the inside of the space. The second indoor unit blows temperature-controlled air from under a floor of the space to the inside of the space. The air conditioning system is required to reduce deviation in temperature of the space.

[CITATION LIST]

[PATENT LITERATURE]

[0003] [Patent Literature 1] Japanese Patent No. 3263324

[SUMMARY OF THE INVENTION]

[PROBLEMS TO BE SOLVED BY THE INVENTION]

[0004] A problem to be solved by the present invention is to provide an air conditioning system, a controller, a control method, and a program capable of reducing deviation in temperature of a space.

[MEANS FOR SOLVING THE PROBLEMS]

[0005] An air conditioning system of an embodiment includes a first indoor unit, a floor temperature sensor, a second indoor unit, and a control unit. The first indoor unit blows temperature-controlled air from an upper part of a space to the inside of the space. The floor temperature sensor outputs a signal. The signal corresponds to a floor temperature as a temperature of a floor surface under the first indoor unit. The second indoor unit blows temperature-controlled air from under a floor of the space to the inside of the space. The control unit controls an operation of the second indoor unit based on the floor temperature obtained by using the floor temperature sensor.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0006]

FIG. 1 is a schematic view for explaining an overview of air conditioning control by an air conditioning system according to an embodiment.

FIG. 2 is a block diagram showing an overall configuration of the air conditioning system according to the embodiment.

FIG. 3 is an explanatory diagram of address setting with respect to a plurality of ceiling blowing indoor units and a floor blowing indoor unit.

FIG. 4 is a flowchart showing an operation of a ceiling blowing indoor unit.

FIG. 5 is a flowchart showing an operation of a floor blowing indoor unit.

[EMBODIMENTS FOR CARRYING OUT THE INVENTION]

[0007] Hereinafter, an air conditioning system, a controller, a control method, and a program according to an embodiment will be described with reference to the drawings.

[0008] FIG. 1 is a schematic view for explaining an overview of air conditioning control by the air conditioning system 1 according to the embodiment. FIG. 1 shows a vertical cross-sectional view of a portion of a building having a space S. The building is, for example, an office building, and the space S is a space. The air conditioning system 1 is a system for conditioning air of the space S. The air conditioning system 1 includes a plurality of ceiling blowing indoor units 20 (first indoor unit) and, a floor blowing indoor unit 10 (second indoor unit), an outdoor unit, and a remote controller 25 (remote control unit).

[0009] Each of the plurality of the ceiling blowing indoor units 20 is an indoor unit as a ceiling blowing air conditioner. Each of the plurality of the ceiling blowing indoor units 20 includes a heat exchanger, a blower, or the like. For example, each of the plurality of the ceiling blowing indoor units 20 is a ceiling cassette-type four-direction indoor unit. A plurality of the ceiling blowing indoor units 20 are provided at a distance on the ceiling of the space S. The plurality of the ceiling blowing indoor units 20 are provided such that they are evenly distributed in the space S with being balanced.

[0010] The floor blowing indoor unit 10 is an indoor unit as a floor blowing air conditioner. The floor blowing indoor unit 10 includes a heat exchanger, a blower, or the like. The floor blowing indoor unit 10 are provided above the ceiling of the space S. A vertical duct 40 is provided on a side wall of the space S. The underfloor portion of the space S is a double floor and functions as an underfloor air supply chamber 45. A horizontal duct may be provided instead of the underfloor air supply chamber 45. A plurality of blowing outlets 50 are provided on a floor surface of the space S. Air discharged from the floor blowing indoor unit 10 passes through the vertical duct 40 and the underfloor air supply chamber 45 and is blown into the space S from the plurality of the blowing outlets 50.

[0011] The outdoor unit 30 is provided outside the building. The outdoor unit 30 includes a compressor, a four-way valve, a heat exchanger, an expansion valve, or the like. The plurality of the ceiling blowing indoor units

20 and the floor blowing indoor unit 10 are connected in parallel to each other via a refrigerant pipe 35 with respect to the outdoor unit 30, and they form a refrigeration cycle device. The air conditioning system 1 is a multi-type air conditioning system.

[0012] The air conditioning system 1 includes a floor blowing air conditioner in addition to the ceiling blowing air conditioner in combination. Consequently, an upper and lower temperature difference of the space S is reduced. Since the feet of the person becomes warm, the person feels comfortable. Since the set temperature is lowered, energy consumption is reduced.

[0013] FIG. 2 is a block diagram showing an overall configuration of the air conditioning system 1 according to the embodiment.

[0014] The remote controller 25 is an input interface that receives user's input regarding a setting of the air conditioning system 1. The remote controller 25 receives the input regarding ON and OFF of a power source of the air conditioning system 1. The remote controller 25 receives the input regarding a set temperature of the space S. The remote controller 25 outputs a signal corresponding to input information to the ceiling blowing indoor unit 20.

[0015] The ceiling blowing indoor unit 20 includes a suction temperature sensor 21, a floor temperature sensor 22, and a first control unit 23.

[0016] The suction temperature sensor 21 measures the temperature (suction temperature) of the air suctioned into the ceiling blowing indoor unit 20 from the space S. The suction temperature sensor 21 outputs a signal corresponding to the suction temperature.

[0017] As shown in FIG. 1, the floor temperature sensor 22 (radiative temperature sensor) is attached to a panel of the ceiling blowing indoor unit 20. The floor temperature sensor 22 measures a radiative temperature of the floor surface under the ceiling blowing indoor unit 20 as a floor temperature. The floor temperature sensor 22 measures the average value of the floor temperature in a circular area of approximately 7.5 m in diameter centered directly under the floor temperature sensor 22. The floor temperature sensor 22 outputs a signal corresponding to the floor temperature.

[0018] FIG. 3 is an explanatory diagram of address setting with respect to the plurality of the ceiling blowing indoor units 20 and the floor blowing indoor unit 10. The plurality of the ceiling blowing indoor units 20 and the floor blowing indoor unit 10 included in the air conditioning system 1 are connected by the same communication line to form a group. A group address is set to all units connected to each other to form a group. For example, the unit having the group address of "1" is specified to a master unit, and the unit having the group address of "2" is specified to a slave unit. One of the plurality of the ceiling blowing indoor units 20 is the master unit (main first indoor unit). The remaining of the plurality of the ceiling blowing indoor units 20 and the floor blowing indoor unit 10 are the slave units. The remote controller 25 outputs the signal corresponding to input information to the master unit. The master unit outputs, to all of the slave units, information input to the remote controller 25.

[0019] The first control unit 23 receives the signal corresponding to the set temperature output from the remote controller 25 or the master unit. The first control unit 23 receives the signal corresponding to the suction temperature output from the suction temperature sensor 21. The first control unit 23 controls an operation of the ceiling blowing indoor unit 20 based on the set temperature and the suction temperature. Each of the operations of the plurality of the ceiling blowing indoor units 20 is individually controlled by the first control unit 23.

[0020] For each of the plurality of the ceiling blowing indoor units 20, the first control unit 23 receives the signal corresponding to the floor temperature output from the floor temperature sensor 22. The slave unit of the ceiling blowing indoor unit 20 outputs the signal of the floor temperature sensor 22 to the master unit. The first control unit 23 of the master unit receives signals of all of the floor temperature sensors 22 and calculates the average value (average floor temperature) of the floor temperature of the space S based on the signals. The first control unit 23 of the master unit outputs, to the floor blowing indoor unit 10, the signal corresponding to the calculated average floor temperature.

[0021] As mentioned above, the units included in the air conditioning system 1 are connected to form a group. A temperature communication (feedback) address is set to all units connected to each other to form a group. For example, the unit having the temperature communication address of "1" is specified to the transmission source of the average floor temperature, and the unit having the control temperature address of "2" is specified to the transmission destination of the average floor temperature. The unit having the control temperature address of "0" is specified as being excluded for the temperature communication. That is, the master unit is the transmission source of the average floor temperature, and the floor blowing indoor unit 10 is the transmission destination of the average floor temperature. The floor blowing indoor unit 10 receives information regarding the average floor temperature calculated by the master unit.

[0022] As shown in FIG. 2, the floor blowing indoor unit 10 includes a second control unit 11 (control unit, controller). The second control unit 11 controls an operation of the floor blowing indoor unit 10 based on the floor temperature (average floor temperature) obtained by using the floor temperature sensor 22.

[0023] The second control unit 11 receives information regarding the set temperature output from the master unit. The second control unit 11 receives information regarding the average floor temperature output from the master unit. The second control unit 11 controls the operation of the floor blowing indoor unit 10 based on the set temperature and average floor temperature.

[0024] Each of the first control unit 23 and the second control unit 11 includes, for example, a processor such

as a central processing unit (CPU) connected via a bus, a memory, an auxiliary storage device, and the like. Each of the first control unit 23 and the second control unit 11 reads and executes a program from, for example, an auxiliary storage device. The auxiliary storage device is configured using a storage medium such as, for example, a magnetic hard disk device or a semiconductor storage device. For example, the auxiliary storage device is configured using a non-volatile memory such as an electrically erasable programmable read-only memory (EEPROM).

[0025] The program may be stored in a storage (for example, a storage device including a non-transitory storage medium) in advance or may be stored in a removable storage medium (the non-transitory storage medium) such as a digital versatile disc (DVD) or a compact disc (CD)-read-only memory (ROM) and installed when the storage medium is mounted in a drive device.

[0026] All or part of the first control unit 23 and the second control unit 11 may be realized by using hardware such as an application specific integrated circuit (ASIC), a programmable logic device (PLD), or a field programmable gate array (FPGA). The program may be recorded on a computer-readable recording medium. The computer-readable recording medium refers to a portable medium such as, for example, a flexible disk, a magneto-optical disk, a ROM, or a CD-ROM, and a storage device such as a hard disk incorporated in a computer system. The program may be transmitted via a telecommunication line.

[0027] A control method of the air conditioning system 1 will be described.

[0028] In the following explanation, for example, a case of carrying out a heating operation by the air conditioning system 1 will be described. Similarly, the air conditioning system 1 is capable of carrying out a cooling operation. Hereinafter, each of temperatures for a specific example may be shown in parenthesis.

[0029] FIG. 4 is a flowchart showing an operation of the ceiling blowing indoor unit 20. The first control unit 23 of the ceiling blowing indoor unit 20 obtains a set temperature (S12).

[0030] Particularly, the remote controller 25 outputs a signal corresponding to a set temperature of the space S input by a user. The master unit of the ceiling blowing indoor units 20 receives the signal from the remote controller 25. The first control unit 23 of the master unit obtains the set temperature from the signal. For example, the master unit obtains 23°C as the set temperature. The master unit transmits the obtained set temperature to the slave units.

[0031] The first control unit 23 calculates a first target temperature TS1 (S14).

[0032] The first target temperature TS1 is the target value of the temperature of an upper part of the space S. Due to the effect of rise of warm air, the temperature of the upper part of the space S becomes higher than the temperature (intermediate temperature) of the intermediate part in a height direction of the space S. The first target temperature TS1 is the temperature obtained by subtracting a correction value 1a from the set temperature (23°C). The correction value 1a is set depending on, for example, the degree of ease of rising the temperature of the space S. The correction value 1a of the embodiment is, for example, 0°C, and the first target temperature TS1 is 23°C.

[0033] The first control unit 23 obtains the suction temperature Tb (S 16).

[0034] Particularly, the suction temperature sensor 21 outputs a signal corresponding to the suction temperature of the ceiling blowing indoor unit 20. The first control unit 23 receives the signal from the suction temperature sensor 21 and obtains the suction temperature Tb. For each of the plurality of the ceiling blowing indoor units 20, the first control unit 23 receives the signal from the suction temperature sensor 21 and obtains the suction temperature Tb. For example, in one of the ceiling blowing indoor units 20, the first control unit 23 obtains 10°C as the suction temperature.

[0035] The first control unit 23 obtains a floor temperature Tf (S18).

[0036] Particularly, the floor temperature sensor 22 outputs a signal corresponding to a floor temperature under the ceiling blowing indoor unit 20. The first control unit 23 receives the signal from the floor temperature sensor 22 and obtains the floor temperature Tf. For each of the plurality of the ceiling blowing indoor units 20, the first control unit 23 receives the signal from the floor temperature sensor 22 and obtains the floor temperature Tf under the corresponding ceiling blowing indoor unit 20.

[0037] The first control unit 23 determines whether or not the ceiling blowing indoor unit 20 to which the first control unit 23 belongs is the master unit (S20).

[0038] Particularly, the first control unit 23 refers to the group address set in the ceiling blowing indoor unit 20, and determines whether or not the ceiling blowing indoor unit 20 to which the first control unit 23 belongs is the master unit. In a case in which the ceiling blowing indoor unit 20 is the slave unit (the determination of S20 is No), that is, in a case in which the group address is not "1" in the embodiment, the first control unit 23 transmits the obtained floor temperature Tf to the master unit (S22).

[0039] In a case in which the ceiling blowing indoor unit 20 is the master unit (the determination of S20 is Yes), that is, in a case in which the group address is "1" in the embodiment, the first control unit 23 calculates an average floor temperature Tfa (S24). The average floor temperature Tfa is the average value of the floor temperatures Tf obtained by the master unit and all of the slave units. For example, the average floor temperature Tfa calculated by the master unit is 8°C.

[0040] The first control unit 23 of the master unit determines the transmission destination of the calculated average floor temperature Tfa. The transmission destination of the average floor temperature Tfa is determined by referring temperature communication addresses set

in the units included in the air conditioning system 1. As mentioned above, the floor blowing indoor unit 10 having the temperature communication address of "2" in the embodiment is the transmission destination of the average floor temperature Tfa. The first control unit 23 of the master unit serving as the transmission source of the average floor temperature Tfa transmits the average floor temperature Tfa to the floor blowing indoor unit 10 (S24).

[0041] The first control unit 23 sets a first control target temperature TA1 (S26).

[0042] The first control target temperature TA1 is the temperature of the space S as the control object to be closer to the first target temperature TS1. As described above, the first target temperature TS1 is the target value of the temperature of an upper part of the space S. Since the ceiling blowing indoor unit 20 is provided on the ceiling of the space S, the suction temperature Tb of the ceiling blowing indoor unit 20 is the temperature of the upper part of the space S. The first control unit 23 sets the first control target temperature TA1 by subtracting a correction value 1b from the suction temperature Tb. The correction value 1b is set corresponding to, for example, the height of the ceiling blowing indoor unit 20 provided in the space S. For example, the suction temperature Tb of one of the ceiling blowing indoor units 20 is 10°C, the correction value 1b is 0°C, and the first control target temperature TA1 is 10°C.

[0043] The first control unit 23 carries out normal temperature control (S28).

[0044] Particularly, the first control unit 23 controls the operation of the ceiling blowing indoor unit 20 based on the difference between the first target temperature TS1 (23°C) and the first control target temperature TA1 (10°C). As mentioned above, the first target temperature TS1 is calculated from the set temperature, and the first control target temperature TA1 is calculated from the suction temperature Tb.

[0045] A specific example of the normal temperature control is as follows. A table regarding output of a compressor included in the outdoor unit 30 is recorded in the auxiliary storage device of the first control unit 23. The output of the compressor corresponding to the difference between the first target temperature TS1 (23°C) and the first control target temperature TA1 (10°C) is recorded in the table. The first control unit 23 refers to the table, and calculates the output of the compressor based on the difference between the first target temperature TS1 and the first control target temperature TA1. The first control unit 23 drives the compressor based on the calculated output of the compressor and controls the operation of the ceiling blowing indoor unit 20. Consequently, the first control target temperature TA1 (10°C) comes close to the first target temperature TS1 (23°C). The first control unit 23 may calculate an opening angle of the expansion valve included in the outdoor unit 30 instead of the output of the compressor or together with the output of the compressor, and controls the operation of the ceiling blowing indoor unit 20.

[0046] The first control unit 23 determines whether or not it is necessary to complete the operation (S30).

[0047] The remote controller 25 outputs a signal corresponding to an instruction input by the user regarding ON and OFF of the power source of the air conditioning system 1. The master unit of the ceiling blowing indoor units 20 receives the signal from the remote controller 25. The first control unit 23 of the master unit obtains the instruction regarding ON and OFF of the power source from the signal. In a case in which the instruction of power OFF is obtained (the determination of S30 is Yes), the first control unit 23 of the master unit transmits the instruction of the power OFF to the slave unit. The first control unit 23 of each of the master unit and the slave unit completes the operation of the corresponding ceiling blowing indoor unit 20. In a case in which the instruction of power OFF is not obtained (the determination of S30 is No), the first control unit 23 of each of the master unit and the slave unit repeats the processes following the S16.

[0048] FIG. 5 is a flowchart showing an operation of the floor blowing indoor unit 10.

[0049] The second control unit 11 of the floor blowing indoor unit 10 obtains the set temperature (S42).

[0050] Particularly, the second control unit 11 obtains information regarding the set temperature (23 °C) from the master unit of the ceiling blowing indoor units 20.

[0051] The second control unit 11 calculates a second target temperature TS2 (S44).

[0052] The second target temperature TS2 is the target value of the temperature of a lower part of the space S. Due to the effect of rise of warm air, the temperature of the lower part of the space S becomes lower than the temperature of the intermediate temperature of the space S. The second target temperature TS2 is the temperature obtained by subtracting a correction value 2a from the set temperature (23°C). The correction value 2a is set depending on, for example, the degree of ease of rising the temperature of the space S. The correction value 2a of the embodiment is, for example, 0°C, and the second target temperature TS2 is 23°C. The correction value 2a of the second target temperature TS2 and the correction value 1a of the first target temperature TS1 may be the same as each other or different from each other.

[0053] The second control unit 11 obtains the average floor temperature Tfa (S46).

[0054] Particularly, the second control unit 11 obtains information regarding the average floor temperature Tfa (8°C) from the master unit of the ceiling blowing indoor units 20 serving as the transmission source of the average floor temperature Tfa.

[0055] The second control unit 11 sets a second control target temperature TA2 (S48).

[0056] The second control target temperature TA2 is the temperature of the space S as the control object to be closer to the second target temperature TS2. As described above, the second target temperature TS2 is the target value of the temperature of a lower part of the

space S. The average floor temperature Tfa is the temperature of the lower part of the space S. The second control unit 11 sets the second control target temperature TA2 by subtracting a correction value 2b from the average floor temperature Tfa (8°C). The correction value 2b is set corresponding to, for example, the height of the space S. The correction value 2b of the embodiment is, for example, 0°C, and the second control target temperature TA2 is 8°C.

[0057] The second control unit 11 carries out normal temperature control (S50).

[0058] Particularly, the second control unit 11 controls the operation of the floor blowing indoor unit 10 based on the difference between the second target temperature TS2 (23°C) and the second control target temperature TA2 (8°C). As mentioned above, the second target temperature TS2 is calculated from the set temperature, and the second control target temperature TA2 is calculated from the average floor temperature Tfa. The second control unit 11 controls an operation of the floor blowing indoor unit 10 based on the floor temperature (average floor temperature Tfa) obtained by using the floor temperature sensor 22.

[0059] A specific example of the normal temperature control is as follows. A table regarding output of a compressor included in the outdoor unit 30 is recorded in the auxiliary storage device of the second control unit 11. The output of the compressor corresponding to the difference between the second target temperature TS2 (23°C) and the second control target temperature TA2 (8°C) is recorded in the table. The second control unit 11 refers to the table, and calculates the output of the compressor based on the difference between the second target temperature TS2 and the second control target temperature TA2. The second control unit 11 drives the compressor based on the calculated output of the compressor and controls the operation of the floor blowing indoor unit 10. Consequently, the second control target temperature TA2 (8°C) comes close to the second target temperature TS2 (23°C). In a case in which the output of the compressor calculated by the second control unit 11 is different from the output of the compressor calculated by the first control unit 23, the compressor is only necessary to be driven based on a higher output in comparison of the two outputs. The second control unit 11 may calculate an opening angle of the expansion valve included in the outdoor unit 30 instead of the output of the compressor or together with the output of the compressor, and controls the operation of the floor blowing indoor unit 10.

[0060] The second control unit 11 determines whether or not it is necessary to complete the operation (S52).

[0061] The second control unit 11 obtains the instruction regarding ON and OFF of the power source from the master unit of the ceiling blowing indoor units 20. In a case in which the instruction of power OFF is obtained (the determination of S52 is Yes), the second control unit 11 completes the operation of the floor blowing indoor unit 10. In a case in which the instruction of power OFF is not obtained (the determination of S52 is No), the second control unit 11 repeats the processes following the S46.

[0062] An air conditioning system 1 of a Comparative Example includes a remote thermo sensor instead of the floor temperature sensor 22. The remote thermo sensor is provided on the side wall of the space S. The remote thermo sensor cannot detect the temperature near the center spaced apart from the side wall of the space S. In the air conditioning system 1 of the Comparative Example, it is difficult to control the temperature near the center of the space S to be close to the set temperature. Furthermore, in a case in which the remote thermo sensor is provided on the floor surface located at the center of the space S, the remote thermo sensor interferes with use of the space S.

[0063] The air conditioning system 1 according to the embodiment includes the ceiling blowing indoor unit 20, the floor temperature sensor 22, the floor blowing indoor unit 10, and the second control unit 11. The ceiling blowing indoor unit 20 blows temperature-controlled air from the upper part of the space S to the inside of the space S. The floor temperature sensor 22 outputs the signal corresponding to the floor temperature as the temperature of the floor surface under the ceiling blowing indoor unit 20. The floor blowing indoor unit 10 blows temperature-controlled air from under the floor of the space S to the inside of the space S. The second control unit 11 controls the operation of the floor blowing indoor unit 10 based on the floor temperature obtained by using the floor temperature sensor 22.

[0064] The ceiling blowing indoor unit 20 is provided on the ceiling near the center spaced apart from the side wall of the space S. The floor temperature sensor 22 detects and measures the temperature of the floor surface near the center spaced apart from the side wall of the space S. The floor blowing indoor unit 10 is controlled such that the floor temperature near the center of the space S comes close to the set temperature. Accordingly, it is possible to reduce deviation in temperature of the space S.

[0065] The air conditioning system 1 includes the plurality of the ceiling blowing indoor units 20 and the plurality of the floor temperature sensors 22 corresponding one-to-one to the plurality of the ceiling blowing indoor units 20. The master unit serving as the ceiling blowing indoor unit 20 specified in advance from the plurality of the ceiling blowing indoor units 20 calculates the average floor temperature Tfa as the average value floor temperatures obtained by using the plurality of the floor temperature sensors 22. The second control unit 11 controls the operation of the floor blowing indoor unit 10 based on the average floor temperature Tfa.

[0066] The plurality of the ceiling blowing indoor units 20 are provided such that they are evenly distributed and provided on the ceiling of the space S. The floor temperature on a wide area of the space S is detected and measured by the plurality of the floor temperature sensors 22.

The average floor temperature Tfa of the space S is detected and measured with a high degree of accuracy by calculating the average floor temperature Tfa using the plurality of the floor temperature sensors 22. Deviation in temperature of the space S is reduced by controlling the operation of the floor blowing indoor unit 10 based on the average floor temperature Tfa.

[0067] The units of the air conditioning system 1 are assigned to the master unit and the slave unit in accordance with the group addresses. The master unit of the ceiling blowing indoor units 20 calculates the average floor temperature Tfa from the measurement results of the plurality of the floor temperature sensors 22. The units of the air conditioning system 1 are assigned to the transmission source or the transmission destination of the average floor temperature Tfa in accordance with the temperature communication address. The master unit of the ceiling blowing indoor units 20 transmits the average floor temperature Tfa to the floor blowing indoor unit 10. It is possible to transmit and receive the control target temperature between the units having configurations different from each other. As stated above, the units having functions of communication and calculation in the group carry out cooperative control. An increase in load of instrumentation such as introduction of a host control unit is suppressed. An increase in cost of air conditioning system 1 is suppressed.

[0068] Part of the air conditioning system 1 of the above-described embodiment may be realized by a computer. In that case, a program for realizing these functions may be recorded on a computer-readable recording medium and realized by causing a computer system to read and execute the program recorded on the recording medium. Furthermore, the "computer system" described herein includes an operating system (OS) and a hardware such as peripherals. Also, the "computer-readable recording medium" refers to a portable medium such as a flexible disk, a magneto-optical disk, a read-only memory (ROM), or a compact disc read-only memory (CD-ROM), and a storage device such as a hard disk built in the computer system. Furthermore, the "computer-readable recording medium" may include one that holds a program dynamically for a short period of time such as a communication line in a case in which programs are transmitted via a network such as the Internet or a communication line such as a telephone line, and one that holds a program for a certain period of time such as volatile memories inside a computer system serving as a server or client in the above-described case. Furthermore, the above-described program may be a program for realizing some of the above-described functions, further may be a program for realizing the above-described functions in combination with programs already recorded on the computer system, and may be realized by using hardware such as a programmable logic device (PLD), a field programmable gate array (FPGA), or the like.

[0069] According to at least one embodiment described above, the air conditioning system 1 includes the second control unit 11 that controls an operation of the floor blowing indoor unit 10 based on the floor temperature obtained by using the floor temperature sensor 22. Accordingly, it is possible to suppress deviation in temperature of the space S.

[0070] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

[DESCRIPTION OF REFERENCE NUMERALS]

[0071] S...space, Tfa...average floor temperature, 1...air conditioning system, 10...floor blowing indoor unit (second indoor unit), 11...second control unit, 20...ceiling blowing indoor unit (first indoor unit), 22...floor temperature sensor.

Claims

1. An air conditioning system comprising:

   a first indoor unit that blows temperature-controlled air from an upper part of a space to an inside of the space;
   a floor temperature sensor that outputs a signal, the signal corresponding to a floor temperature as a temperature of a floor surface under the first indoor unit;
   a second indoor unit that blows temperature-controlled air from under a floor of the space to the inside of the space; and
   a control unit that controls an operation of the second indoor unit based on the floor temperature obtained by using the floor temperature sensor.

2. The air conditioning system according to claim 1, further comprising:

   a plurality of the first indoor units; and
   a plurality of the floor temperature sensors corresponding to the plurality of the first indoor units, wherein
   of the plurality of the first indoor units, the first indoor unit mainly specified in advance calculates an average floor temperature as the average value of the floor temperatures measured by the plurality of the floor temperature sensors, and

the control unit controls the operation of the second indoor unit based on the average floor temperature.

3. A controller of an air conditioning system,

the air conditioning system comprising:

a first indoor unit that blows temperature-controlled air from an upper part of a space to an inside of the space;
a floor temperature sensor that outputs a signal, the signal corresponding to a floor temperature as a temperature of a floor surface under the first indoor unit; and
a second indoor unit that blows temperature-controlled air from under a floor of the space to the inside of the space, wherein

the controller controls an operation of the second indoor unit based on the floor temperature obtained by using the floor temperature sensor.

4. A control method of an air conditioning system,

the air conditioning system comprising:

a first indoor unit that blows temperature-controlled air from an upper part of a space to an inside of the space;
a floor temperature sensor that outputs a signal, the signal corresponding to a floor temperature as a temperature of a floor surface under the first indoor unit; and
a second indoor unit that blows temperature-controlled air from under a floor of the space to the inside of the space, wherein

the control method comprises a step of controlling an operation of the second indoor unit based on the floor temperature obtained by using the floor temperature sensor.

5. A program used in a computer of an air conditioning system,

the air conditioning system comprising:

a first indoor unit that blows temperature-controlled air from an upper part of a space to an inside of the space;
a floor temperature sensor that outputs a signal, the signal corresponding to a floor temperature as a temperature of a floor surface under the first indoor unit; and
a second indoor unit that blows temperature-controlled air from under a floor of the space to the inside of the space, wherein

the program causes the computer of the air conditioning system to execute a step of controlling an operation of the second indoor unit based on the floor temperature obtained by using the floor temperature sensor.

FIG. 1

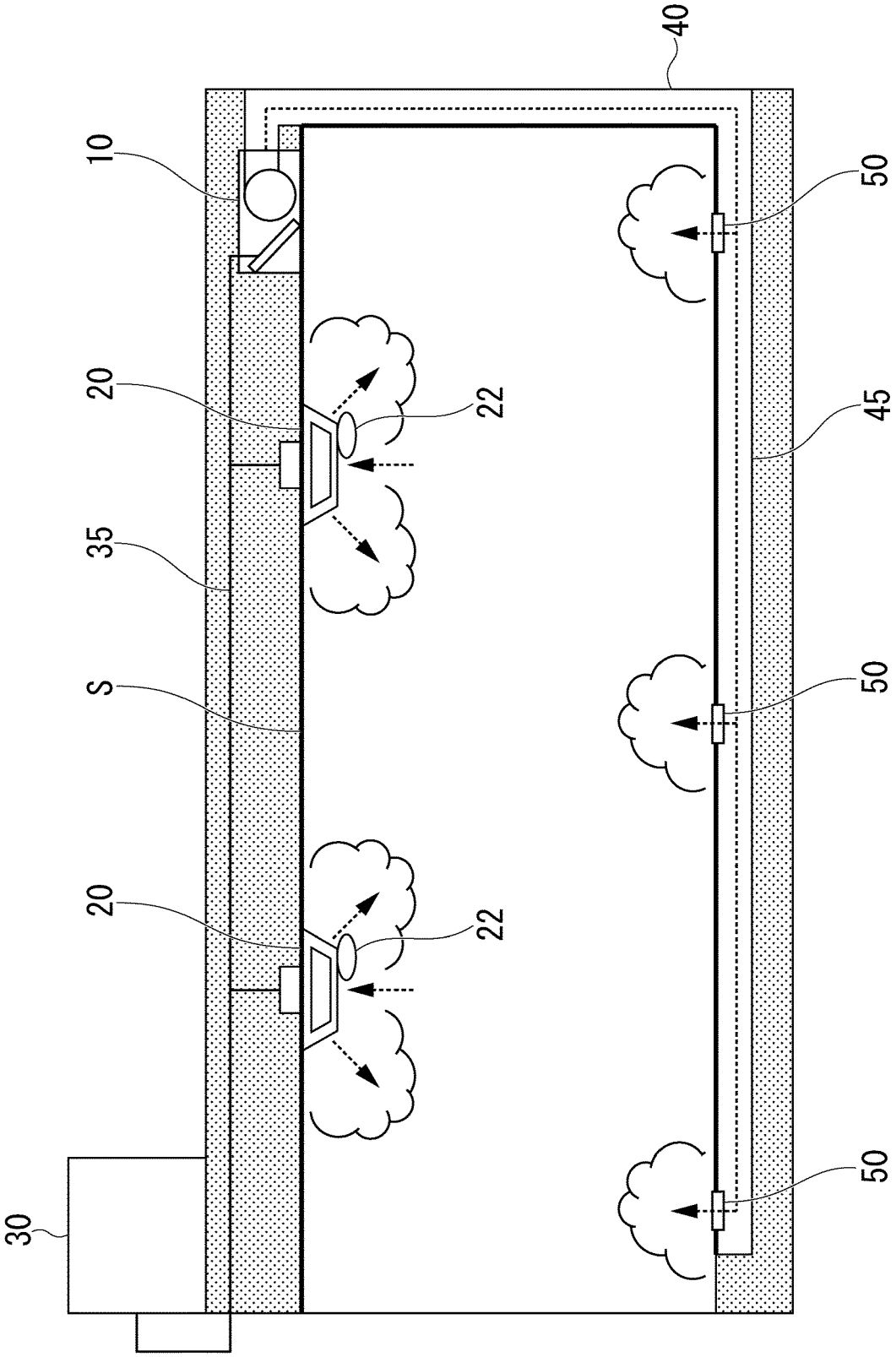


FIG. 2

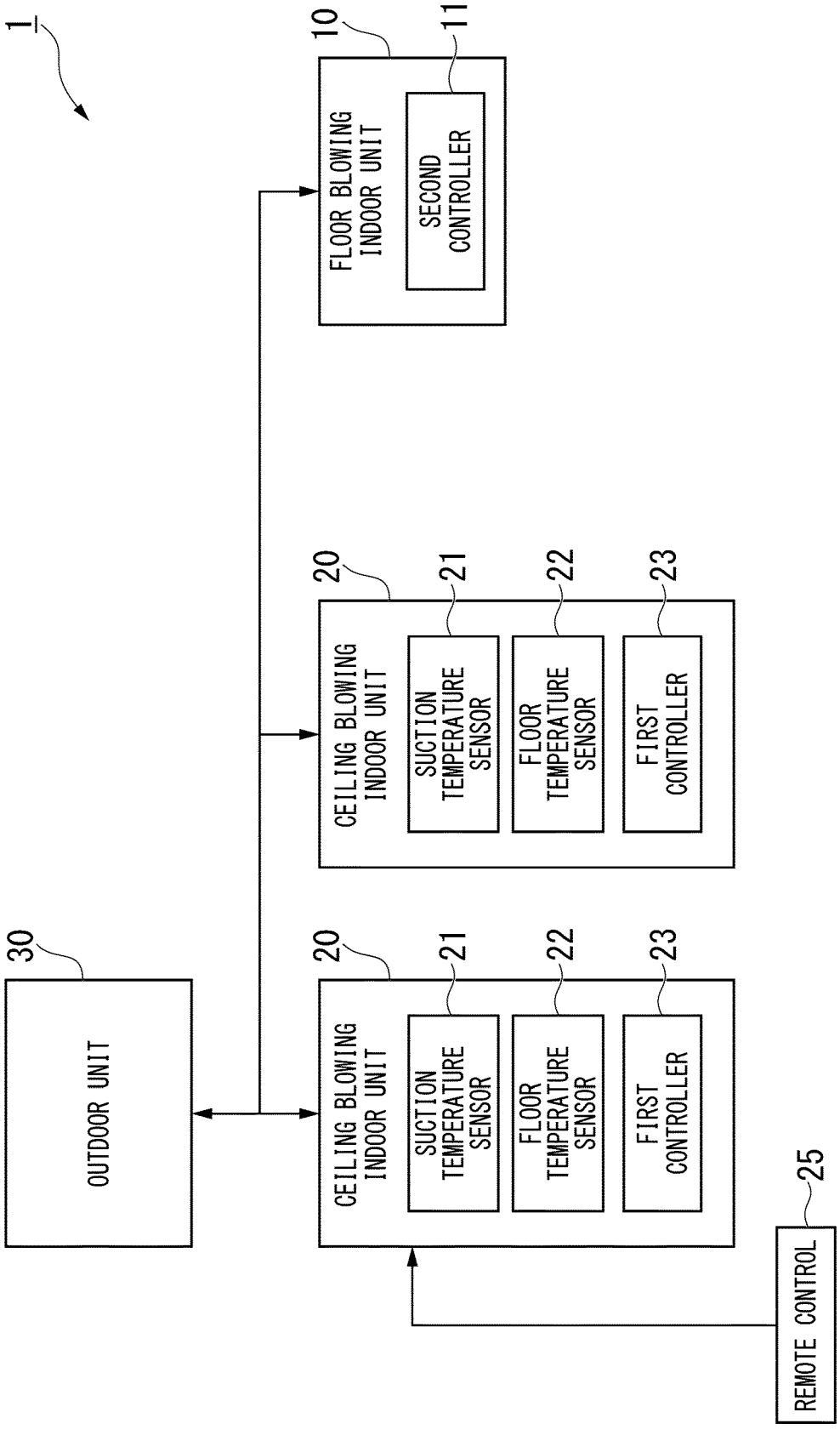

1
10
11
FLOOR BLOWING INDOOR UNIT
SECOND CONTROLLER
20
21
22
23
CEILING BLOWING INDOOR UNIT
SUCTION TEMPERATURE SENSOR
FLOOR TEMPERATURE SENSOR
FIRST CONTROLLER
30
OUTDOOR UNIT
25
REMOTE CONTROL

FIG. 3

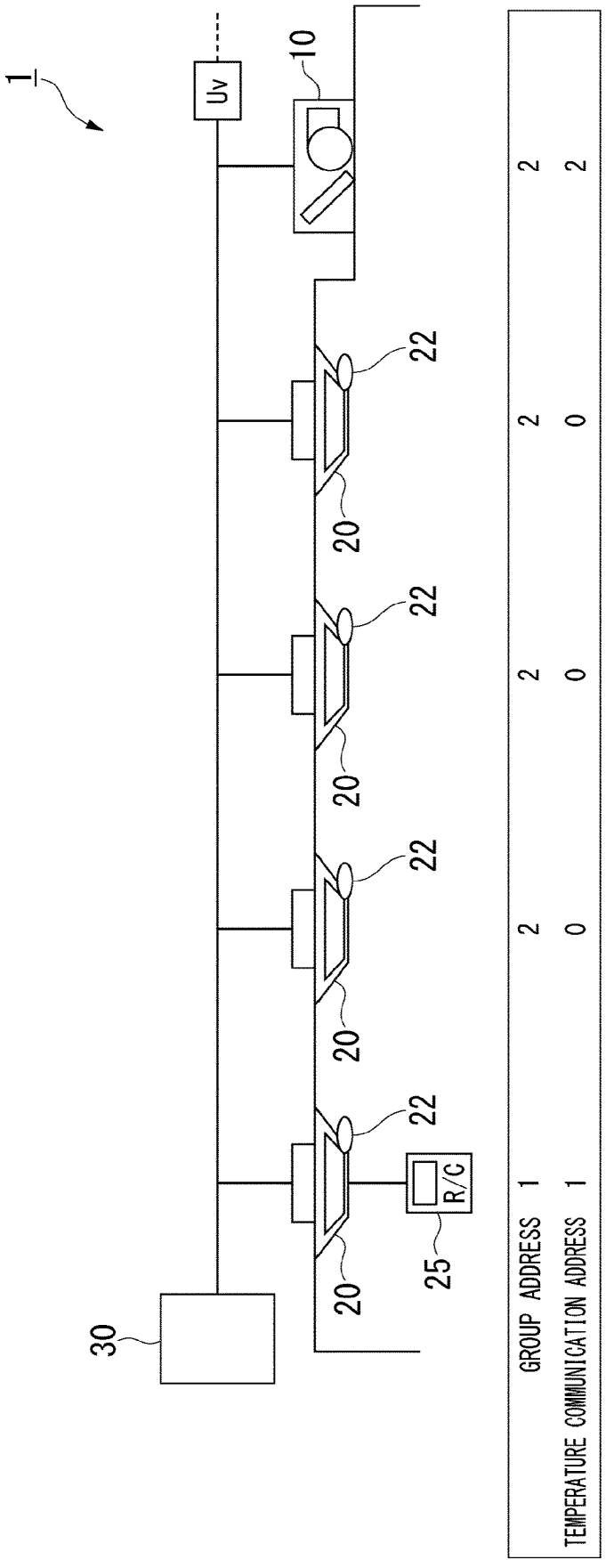

1
Uv
10
22
20
22
20
22
20
22
20
R/C
25
30
GROUP ADDRESS 1 2 2 2 2
TEMPERATURE COMMUNICATION ADDRESS 1 0 0 0 2

FIG. 4

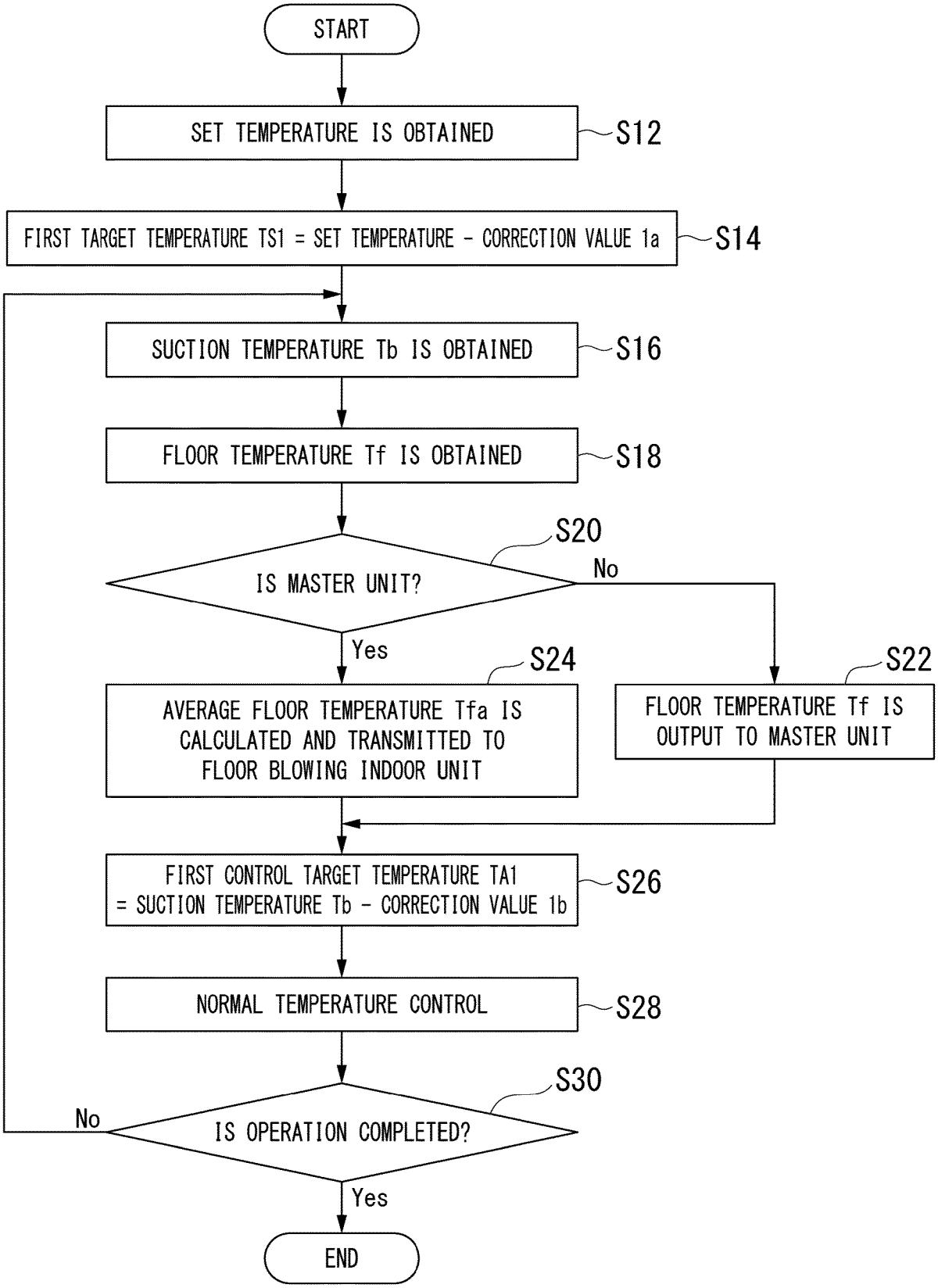
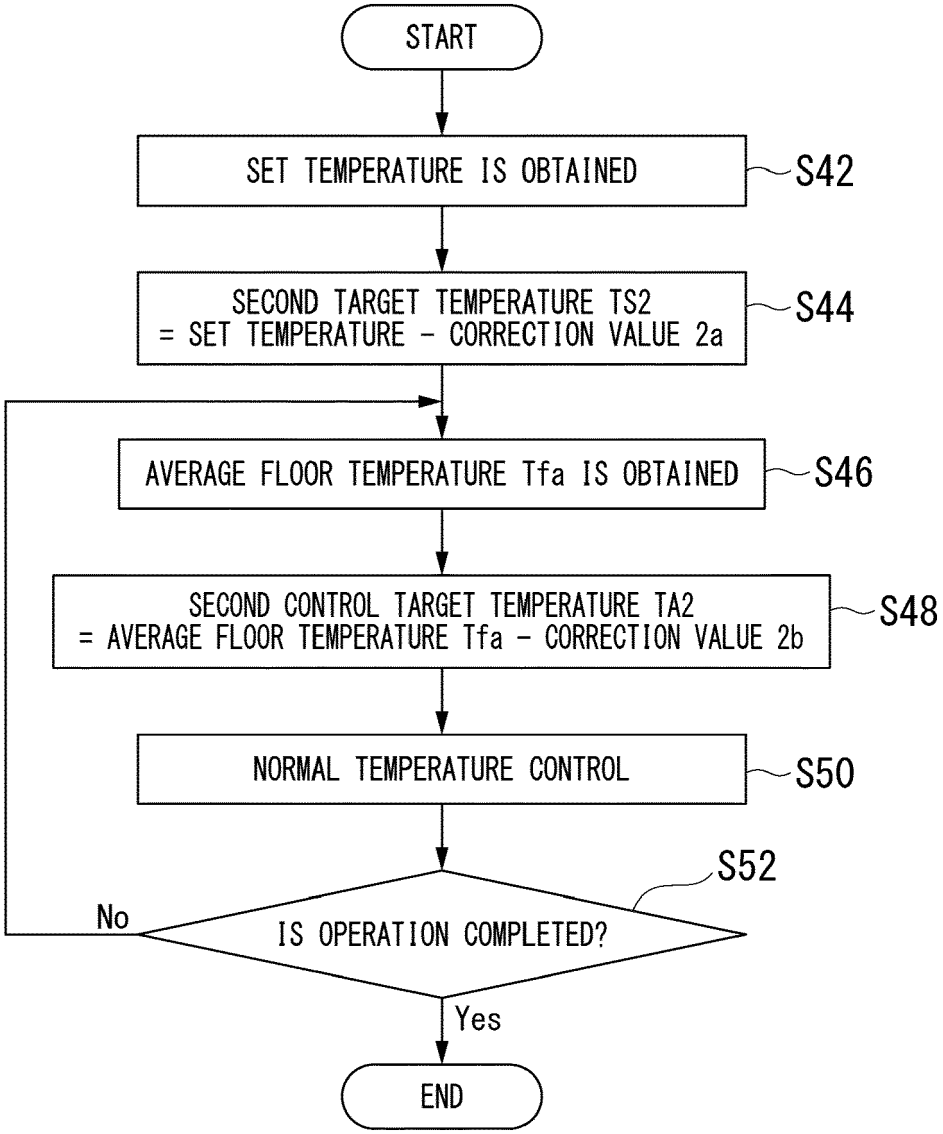

START
SET TEMPERATURE IS OBTAINED
S12
FIRST TARGET TEMPERATURE TS1 = SET TEMPERATURE - CORRECTION VALUE 1a
S14
SUCTION TEMPERATURE Tb IS OBTAINED
S16
FLOOR TEMPERATURE Tf IS OBTAINED
S18
S20
IS MASTER UNIT?
No
Yes
S24
AVERAGE FLOOR TEMPERATURE Tfa IS CALCULATED AND TRANSMITTED TO FLOOR BLOWING INDOOR UNIT
S22
FLOOR TEMPERATURE Tf IS OUTPUT TO MASTER UNIT
FIRST CONTROL TARGET TEMPERATURE TA1 = SUCTION TEMPERATURE Tb - CORRECTION VALUE 1b
S26
NORMAL TEMPERATURE CONTROL
S28
S30
No
IS OPERATION COMPLETED?
Yes
END

FIG. 5


START
SET TEMPERATURE IS OBTAINED
S42
SECOND TARGET TEMPERATURE TS2
= SET TEMPERATURE - CORRECTION VALUE 2a
S44
AVERAGE FLOOR TEMPERATURE Tfa IS OBTAINED
S46
SECOND CONTROL TARGET TEMPERATURE TA2
= AVERAGE FLOOR TEMPERATURE Tfa - CORRECTION VALUE 2b
S48
NORMAL TEMPERATURE CONTROL
S50
S52
No
IS OPERATION COMPLETED?
Yes
END

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EUROPEAN SEARCH REPORT

Application Number
EP 24 16 4284

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 July 2024	Anconetani, Mirco

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