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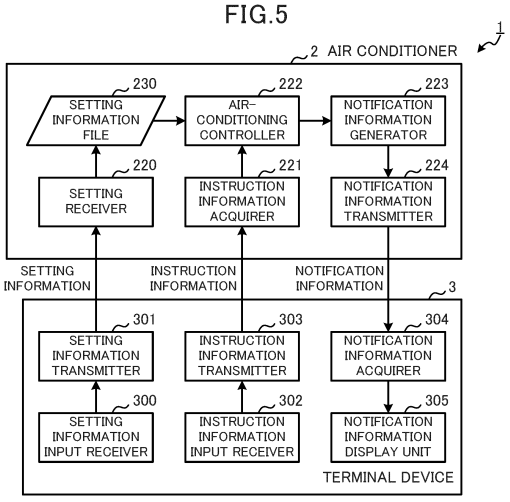
(54) AIR CONDITIONER AND AIR CONDITIONING CONTROL METHOD

(57) An air conditioner (2) includes a setting receiver (220) and an air-conditioning controller (222). The setting receiver (220) receives from a user a setting of setting information including ceiling height information relating to a ceiling height for each section of predetermined sections in an air-conditioning target area and saves the received setting information in a setting information file (230). The air-conditioning controller (222) controls air conditioning of the air-conditioning target area based on the ceiling height information of each section.

FIG.5



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Description

Technical Field

[0001] The present disclosure relates to an air conditioner and an air conditioning control method.

Background Art

[0002] A function of an air conditioner is widely known for adjusting flow of discharged air to uniformly spread air-conditioned air in an air-conditioning target space. Due to such function, a user can feel similar comfort regardless of whether the user is near the air conditioner or not.

[0003] For example, Patent Literature 1 discloses changing a direction of Coanda airflow by selecting an orientation of a Coanda vane based on a size of an air-conditioning target space that is inputted by a user.

Citation List

Patent Literature

[0004] Patent Literature 1: Unexamined Japanese Patent Application Publication No. 2013-96639

Summary of Invention

Technical Problem

[0005] However, although the technique disclosed in Patent Literature 1 can be used for an air-conditioning target space with a uniform ceiling height, achieving a desired effect by using this technique in an air-conditioning target space in which a ceiling height varies by location is difficult.

[0006] For this reason, proposals are desired of a new technique that enables appropriate air conditioning by an air conditioner even in the case in which a ceiling height in an air-conditioning target area to be air-conditioned by this air conditioner varies by location.

[0007] The present disclosure is made in view of the aforementioned circumstances, and an objective of the present disclosure is to provide an air conditioner and the like that can perform appropriate air conditioning even in an air-conditioning target area in which the ceiling height varies by location.

Solution to Problem

[0008] To achieve the aforementioned objective, an air conditioner according to the present disclosure includes setting reception means for receiving from a user a setting of ceiling height information relating to a ceiling height for each section of predetermined sections in an air-conditioning target area, and air-conditioning control means for controlling air conditioning of the air-conditioning target area based on the ceiling height information of each section.

Advantageous Effects of Invention

[0009] According to the present disclosure, appropriate air conditioning can be performed even in an air-conditioning target area in which the ceiling height varies by location.

Brief Description of Drawings

[0010]

FIG. 1 illustrates overall configuration of an air conditioning system according to an embodiment;
FIG. 2 is a block diagram illustrating hardware configuration of an indoor unit according to the embodiment;
FIG. 3 is a block diagram illustrating hardware configuration of an outdoor unit according to the embodiment;
FIG. 4 is a block diagram illustrating hardware configuration of a terminal device according to the embodiment;
FIG. 5 is a block diagram illustrating functional configuration of an air conditioner and the terminal device according to the embodiment;
FIG. 6 illustrates an example of a ceiling height information input screen according to the embodiment;
FIG. 7 illustrates another example of a ceiling height information input screen according to the embodiment;
FIG. 8 is a drawing for explanation of control of a vertical air deflection plate during a cooling operation in a case of a normal ceiling height according to the embodiment;
FIG. 9 is a drawing for explanation of control of the vertical air deflection plate during the cooling operation in a case of a high ceiling according to the embodiment;
FIG. 10 is a drawing for explanation of control of the vertical air deflection plate during the cooling operation in a case of an open ceiling according to the embodiment;
FIG. 11 is a drawing for explanation of airflow in a case of a lowered ceiling;
FIG. 12 illustrates content of control in a room shape adapted mode during the cooling operation according to the embodiment;
FIG. 13 is a drawing for explanation of control of the vertical air deflection plate during a heating operation in the case of the normal ceiling height according to the embodiment;
FIG. 14 is a drawing for explanation of control of the vertical air deflection plate during the heating operation in the case of the high ceiling according to the embodiment;

FIG. 15 is a drawing for explanation of control of the vertical air deflection plate during the heating operation in a case of the open ceiling according to the embodiment;
FIG. 16 is a drawing for explanation of control according to the embodiment, for avoiding blowing air to a section with an open ceiling space during the heating operation;
FIG. 17 illustrates content of control in the room shape adapted mode during the heating operation according to the embodiment;
FIG. 18 is a drawing for explanation of a wind-hitting mode during the heating operation according to the embodiment;
FIG. 19 illustrates a display example of a notification screen according to the embodiment;
FIG. 20 is a flowchart illustrating a sequence of air-conditioning control processing according to the embodiment; and
FIG. 21 illustrates content of control of underfloor air conditioning according to a modified example of the embodiment.

Description of Embodiments

[0011] Hereinafter, an embodiment of the present disclosure is described in detail with reference to the drawings.

[0012] FIG. 1 illustrates overall configuration of an air conditioning system 1 according to an embodiment of the present disclosure. The air conditioning system 1 is a system for air conditioning of a house H and includes an air conditioner 2 and a terminal device 3.

Air Conditioner 2

[0013] The air conditioner 2 is an example of an air conditioner according to the present disclosure. The air conditioner 2 is a domestic air conditioner and includes an indoor unit 20 installed indoors and an outdoor unit 21 installed outdoors. The indoor unit 20 and the outdoor unit 21 are connected via a communication line 22 and refrigerant piping 23 for circulation of refrigerant.

[0014] The indoor unit 20 is a wall-mounted type air conditioner that is installed by mounting on a wall of a room. The indoor unit 20 includes, as illustrated in FIG. 2, a first communication interface 200, a second communication interface 201, a main unit 202, multiple sensors 203 and a control circuit 204.

[0015] The first communication interface 200 is hardware for communication with the outdoor unit 21 via the communication line 22. The second communication interface 201 is hardware for wireless communication with the terminal device 3. The second communication interface 201 performs, for example, communication with the terminal device 3 based on a widely-known wireless communication standard such as Wi-Fi® and Wi-SUN®.

[0016] The main unit 202 is a component for achievement of fundamental functions of a general indoor unit and includes, for example, a vertical air deflection plate, a lateral air deflection plate, a fan, a heat exchanger, and the like. The vertical air deflection plate is an air deflection plate for changing a wind direction of blown air in a vertical direction, and the lateral air deflection plate is an air deflection plate for changing the wind direction of the blown air in a lateral direction.

[0017] Each of the sensors 203 is, for example, an inlet temperature sensor for measuring a temperature of air taken in by the fan, an inlet humidity sensor for measuring a humidity of the air taken in by the fan, a thermal image sensor of a thermopile type, diode type, bolometer type or the like for acquiring thermal image data of indoors, or the like.

[0018] The control circuit 204 performs overall control of the air conditioner 2. Although not illustrated, the control circuit 204 includes a central processing unit (CPU), a read only memory (ROM), a read only memory (RAM) and an auxiliary storage device.

[0019] The auxiliary storage device includes a readable/rewritable nonvolatile semiconductor memory. The readable/rewritable nonvolatile semiconductor memory is, for example, an electrically erasable programmable read-only memory (EEPROM), a flash memory, or the like. The auxiliary storage device stores (i) a program that is hereinafter called the "control program" for overall control of operation of the air conditioner 2 and (ii) data for use in execution of this control program.

[0020] The outdoor unit 21 includes, as illustrated in FIG. 3, a communication interface 210, a main unit 211, multiple sensors 212 and a control circuit 213. The communication interface 210 is hardware for communication with the indoor unit 20 via the communication line 22.

[0021] The main unit 211 is a component for achievement of fundamental functions of a general outdoor unit and includes, for example, a compressor, a heat exchanger, an expansion valve, a four-way valve, a fan, and the like.

[0022] Each of the sensors 212 is, for example, a current sensor for measuring an operating current of the compressor, an outdoor temperature sensor for measuring an outdoor temperature, or the like.

[0023] The control circuit 213 controls each element of the outdoor unit 21 in accordance with an instruction from the indoor unit 20. Although not illustrated, the control circuit 213 includes a CPU, a ROM, a RAM and an auxiliary storage device.

[0024] The auxiliary storage device includes a readable/rewritable nonvolatile semiconductor memory and stores (i) a program for control of operation of the outdoor unit 21 and (ii) data for use in execution of this control program. The readable/rewritable nonvolatile semiconductor memory is, for example, an EEPROM, a flash memory, or the like.

Terminal Device 3

[0025] The terminal device 3 is an electronic device that serves in the air conditioning system 1 as an interface with a user. The terminal device 3 is, for example, a smart device such as a smartphone and a tablet terminal, an air conditioning remote controller, or the like. The terminal device 3 includes, as illustrated in FIG. 4, a display 30, an operation receiver 31, a communication interface 32, a CPU 33, a ROM 34, a RAM 35 and an auxiliary storage device 36. These structural elements are connected to one another via a bus 37.

[0026] The display 30 includes a display device such as a liquid crystal display and an organic electro luminescence (EL) display. The display 30 displays, under control by the CPU 33, various screens or the like according to operations by the user.

[0027] The operation receiver 31 includes one or more input devices, such as a push-button, a touch panel and a touch pad, receives an input operation from the user, and sends to the CPU 33 a signal according to the received operation.

[0028] The communication interface 32 is hardware for wireless communication, by use of the aforementioned wireless communication standard, with the air conditioner 2. In the case in which the terminal device 3 is an air conditioning remote controller, communication between the terminal device 3 and the air conditioner 2 may be infrared communication or may be wired communication via a non-illustrated signal line.

[0029] The CPU 33 performs overall control of the terminal device 3. The ROM 34 stores multiple pieces of firmware and data for use in execution of the pieces of firmware. The RAM 35 is used by the CPU 33 as a work area.

[0030] The auxiliary storage device 36 includes a readable/rewritable nonvolatile semiconductor memory. The readable/rewritable nonvolatile semiconductor memory is, for example, an EEPROM, a flash memory, or the like. The auxiliary storage device 36 stores (i) various programs including an application program according to an operation of the air conditioner 2 that is hereinafter called the "air conditioning application" and (ii) data for use in execution of these programs.

[0031] The air conditioning application and an update program for updating the air conditioning application are downloadable onto the terminal device 3 from a server that is installed and operated by a manufacturer, a vendor, or the like of the air conditioner 2, other program distribution server, or the like. The air conditioning application and the update program can be distributed by storage in a computer-readable recording medium, such as a compact disc read only memory (CD-ROM), a digital versatile disc (DVD), a magneto-optical disc, a universal serial bus (USB) memory, a memory card, a hard disk drive (HDD) and a solid state drive (SSD).

[0032] Functional Configuration of the Air Conditioner 2 and the Terminal Device 3

[0033] FIG. 5 is a block diagram illustrating functional configuration of the air conditioner 2 and the terminal device 3. The air conditioner 2 includes, as illustrated in FIG. 5, a setting receiver 220, an instruction information acquirer 221, an air-conditioning controller 222, a notification information generator 223 and a notification information transmitter 224. These functional elements of the air conditioner 2 are achieved by execution, by the CPU included in the control circuit 204 of the indoor unit 20, of the aforementioned control program.

[0034] The terminal device 3 includes a setting information input receiver 300, a setting information transmitter 301, an instruction information input receiver 302, an instruction information transmitter 303, a notification information acquirer 304 and a notification information display unit 305. These functional elements of the terminal device 3 are achieved by execution, by the CPU 33, of the aforementioned air conditioning application.

[0035] The setting information input receiver 300 of the terminal device 3 receives, from the user, input of information relating to a setting of air conditioning that is hereinafter called the "setting information". Specifically, the setting information input receiver 300 displays a non-illustrated main setting screen on the display 30 and receives from the user a selection as to whether to enable a room shape adapted mode. The room shape adapted mode is described later in detail. In the case in which the user selects to enable the room shape adapted mode, the setting information input receiver 300 displays on the display 30 a ceiling height information input screen as illustrated in FIG. 6.

[0036] The ceiling height information input screen is a screen for receiving, from the user, input of ceiling height information relating to a ceiling height for each of predetermined multiple sections in an air-conditioning target area of the air conditioner 2. In the present embodiment, the air-conditioning target area is divided into twelve sections as illustrated in FIG. 6, and the setting information input receiver 300 receives, from the user, input of ceiling height information of each section that is information of the ceiling height expressed in meters. The setting information input receiver 300 may display on the display 30 a ceiling height information input screen as illustrated in FIG. 7 and receive, from the user, as the ceiling height information of each section, a selection of any one of "normal ceiling", "high ceiling" and "open ceiling".

[0037] The setting information transmitter 301 transmits, to the air conditioner 2, the setting information inputted by the user, that is, information indicating whether the room shape adapted mode is enabled and the ceiling height information.

[0038] The setting receiver 220 of the air conditioner 2 is an example of setting reception means according to the present disclosure. The setting receiver 220 receives and accepts the setting information transmitted from the terminal device 3 and saves the accepted setting information in a setting information file 230. The setting information file 230 is a file for saving the setting information

and is stored in the auxiliary storage device included in the control circuit 204 of the indoor unit 20.

[0039] The instruction information input receiver 302 of the terminal device 3 receives, from the user, input of instruction information that is information of an instruction to the air conditioner 3. The instruction information includes, for example, (i) information providing instruction to start or stop an operation among various operations including a cooling operation, a heating operation, an air-blowing operation and a dehumidification operation, (ii) information indicating whether to enable a wind-hitting mode or a wind-avoiding mode, (iii) information providing instruction to change a temperature setting, a volume of blown air, the wind direction, or the like. The wind-hitting mode is a mode for adjusting the wind direction such that wind hits a human, and the wind-avoiding mode is a mode for adjusting the wind direction such that wind does not hit a human. Detection of a human in these modes is performed by analyzing the thermal image data of the indoors that is acquired by the thermal image sensor included in the indoor unit 20, that is, by the sensor 203.

[0040] The instruction information transmitter 303 transmits to the air conditioner 2 the instruction information inputted by the user. The instruction information acquirer 221 of the air conditioner 2 receives and acquires the instruction information transmitted from the terminal device 3 and supplies the acquired instruction information to the air-conditioning controller 222.

[0041] The air-conditioning controller 222 is an example of air-conditioning control means according to the present disclosure. The air-conditioning controller 222 controls air conditioning of the air-conditioning target area in the house H based on the instruction information supplied from the instruction information acquirer 221 and the setting information saved in the setting information file 230. In the case in which the setting information includes information indicating that the room shape adapted mode is enabled and the instruction information indicates the starting of the cooling operation or the heating operation, the air-conditioning controller 222 causes the starting of the cooling operation or the heating operation, and additionally, based on the ceiling height information included in the setting information, determines a control index for use in estimation of a room temperature and adjusts flow of blown air. Hereinafter, control by the air-conditioning controller 222 in the room shape adapted mode is described specifically.

Control Index

[0042] Conventional techniques have a problem that performing appropriate air conditioning by control using an inlet temperature as a control index is difficult in the case in which an indoor unit is installed in an area with an open ceiling space, since the indoor unit takes in a higher-temperature air of a space corresponding to the open ceiling space. In view of above, in the air conditioner 2 of the present disclosure, the air-conditioning controller 222 uses both an inlet temperature and a floor surface temperature as control indexes in a case in which the indoor unit 20 is installed in a section with an open ceiling space, that is, a section with a ceiling height of 5,100 millimeters or higher, enabling a more accurate estimation of the room temperature of the air-conditioning target area, that is, eliminating a large deviation from an actual room temperature as compared to a case of using the inlet temperature as the room temperature. The floor surface temperature is obtained by analyzing indoor thermal image data acquired by the thermal image sensor included in the indoor unit 20, that is, by the sensor 203.

[0043] In the case in which the terminal device 3 includes a temperature sensor for measuring an air temperature, the air temperature measured by the terminal device 3 may be additionally used as the control index.

[0044] In the case in which the indoor unit 20 is installed in a section with a normal ceiling height (for example, 2,400 millimeters) or with a high ceiling (for example, 2,700 millimeters), the inlet temperature is used as the control index in the conventional manner. Even in the case of the high ceiling, the control indexes used in the case of the open ceiling are used when the ceiling height is "high". A boundary value for determination of this "high" is a design matter. The boundary value is determined during design by using a degree of deviation of the inlet temperature from the room temperature.

Control of a Rotation Speed of the Fan and the Vertical Air Deflection Plate of the Indoor Unit 20 during the Cooling Operation

[0045] During the cooling operation, a rotation speed of the fan of the indoor unit 20 (hereinafter called the "fan rotation speed") and an angle of the vertical air deflection plate are adjusted so as to form airflow along a ceiling. During the cooling operation, since air with a higher temperature accumulates near the ceiling due to a difference in air density, the airflow formed along the ceiling enables eliminating temperature unevenness through mixing of the blown air and the high-temperature air, enabling homogenization of the room temperature.

[0046] Specifically, for example, in the case in which the indoor unit 20 is installed in a section with the normal ceiling height (for example, 2,400 millimeters) as illustrated in FIG. 8, the angle of the vertical air deflection plate is adjusted horizontally so as to be oriented along the ceiling, similarly to the convention techniques. In the case in which the indoor unit 20 is installed in a section with the high ceiling (for example, 2,700 millimeters) as illustrated in FIG. 9, the angle of the vertical air deflection plate is adjusted to be an angle at which the vertical air deflection plate is inclined upward in comparison to the case of the angle of the vertical air deflection plate corresponding to the normal ceiling height (0° in FIG. 8), for example, adjusted to 30°. In this case, the fan rotation speed, that is, a volume of air blown from the indoor unit 20 is adjusted to a value that is larger than in the case

of the normal ceiling height as illustrated in FIG. 8.

[0047] In the case in which the indoor unit 20 is installed in a section with an open ceiling space as illustrated in FIG. 10, that is, in the case of a section with a ceiling height of 5,100 millimeters or higher, the angle of the vertical air deflection plate is adjusted to be an angle at which the vertical air deflection plate is inclined upward in comparison to the case of the angle of the vertical air deflection plate corresponding to the high ceiling (30° in FIG. 9), for example, adjusted to 60°. In this case, the fan rotation speed is adjusted to a value that is larger than in the case of the high ceiling as illustrated in FIG. 9.

[0048] Furthermore, blowing wind so as to hit a lowered ceiling generates wind flowing below the lowered ceiling. Thus, in the case in which a ceiling height of a ceiling on the near side with respect to the indoor unit 20 is high and a ceiling height of a ceiling on the far side is low, that is, in the case in which the ceiling on the far side with respect to the indoor unit 20 is a lowered ceiling, the air-conditioning controller 222 adjusts, during cooling operation, the angle of the vertical air deflection plate so as to be adapted to the ceiling height that is lower. This configuration can prevent a human near a boundary of the different ceiling heights from being directly hit by cold air, as illustrated in FIG. 11.

[0049] FIG. 12 schematically illustrates a summary of content of control in the room shape adapted mode during the cooling operation. Note that, even in the case in which the room shape adapted mode is enabled and the instruction information indicates the starting of the cooling operation, the air-conditioning controller 222 adjusts, on condition that the wind-hitting mode is enabled and a human is in the air-conditioning target area, the angle of the vertical air deflection plate such that the human is hit by cold air. Further, even after starting the cooling operation with the airflow adjusted based on the ceiling height information, in response to an instruction from the user via the terminal device 3 to change the volume of blown air or the angle of the vertical air deflection plate, the air-conditioning controller 222 changes, in accordance with the instruction, the fan rotation speed or the angle of the vertical air deflection plate.

Control of the Fan Rotation Speed, the Vertical Air Deflection Plate and the Lateral Air Deflection Plate During the Heating Operation

[0050] During the heating operation, with increase in ceiling height, the angle of the vertical air deflection plate is adjusted for increasingly downward air direction, and the fan rotation speed is increased.

[0051] Specifically, for example, in the case in which the indoor unit 20 is installed in a section with the normal ceiling height (for example, 2,400 millimeters) as illustrated in FIG. 13, the angle of the vertical air deflection plate is adjusted to be an angle similar to that in the convention techniques for example, to -65°. In the case in which the indoor unit 20 is installed in a section with the high ceiling (for example, 2,700 millimeters) as illustrated in FIG. 14, the angle of the vertical air deflection plate is adjusted to be an angle at which the vertical air deflection plate is inclined downward in comparison to the case of the angle of the vertical air deflection plate corresponding to the normal ceiling height (-65° in FIG. 13), for example, adjusted to -70°. In this case, the fan rotation speed, that is, the volume of air blown from the indoor unit 20, is adjusted to a value that is larger than in the case of the normal ceiling height as illustrated in FIG. 13.

[0052] In the case in which the indoor unit 20 is installed in a section with an open ceiling space as illustrated in FIG. 15, that is, in the case of a section with a ceiling height of 5,100 millimeters or higher, the angle of the vertical air deflection plate is adjusted to be an angle at which the vertical air deflection plate is inclined downward in comparison to the case of the angle of the vertical air deflection plate corresponding to the high ceiling (-70° in FIG. 14), for example, adjusted to -75°. In this case, the fan rotation speed is adjusted to a value that is larger than in the case of the high ceiling as illustrated in FIG. 14.

[0053] During the heating operation, directing wind toward the section with an open ceiling space is avoided unless otherwise particularly specified by the user. Since an open ceiling space provides a space extended in the vertical direction, warm air is more likely to move to a high location, that is, to a ceiling of the second floor, due to a density difference. For this reason, directing wind toward an open ceiling space in the case of heating the first floor in the heating operation can be said to be wasteful air conditioning. Thus, during the heating operation, the air-conditioning controller 222 adjusts the angle of the lateral air deflection plate so as to avoid directing wind toward the section with an open ceiling space, as illustrated in FIG. 16.

[0054] FIG. 17 schematically illustrates a summary of content of control in the room shape adapted mode during the heating operation. Note that, even in the case in which the room shape adapted mode is enabled and the instruction information indicates the starting of the heating operation, the air-conditioning controller 222 adjusts, on condition that the wind-hitting mode is enabled and a human is in the area with an open ceiling space, the angle of the vertical air deflection plate and/or the angle of the lateral air deflection plate such that the human is hit by warm air, as illustrated in FIG. 18. Further, even after starting the heating operation with the airflow adjusted based on the ceiling height information, in response to an instruction from the user via the terminal device 3 to change the volume of blown air, the angle of the vertical air deflection plate or the angle of the lateral air deflection plate, the air-conditioning controller 222 changes, in accordance with the instruction, the volume of blown air, the angle of the vertical air deflection plate or the angle of the lateral air deflection plate.

[0055] Again with reference to FIG. 5, the notification information generator 223 generates, when air conditioning in the room shape adapted mode is performed, noti-

fication information for user notification to that effect. The notification information generator 223 supplies the generated notification information to the notification information transmitter 224. The notification information transmitter 224 transmits to the terminal device 3 the notification information generated by the notification information generator 223. The notification information generator 223 and the notification information transmitter 224 are examples of notification means according to the present disclosure.

[0056] The notification information acquirer 304 of the terminal device 3 receives and acquires the notification information transmitted from the air conditioner 2. The notification information acquirer 304 supplies the acquired notification information to the notification information display unit 305. The notification information display unit 305 displays on the display 30 a screen that is hereinafter called the notification screen and is based on content of the notification information. FIG. 19 illustrates an example of the notification screen.

[0057] FIG. 20 is a flowchart illustrating a sequence of air-conditioning control processing executed by the air conditioner 2. The air conditioner 2 executes the air-conditioning control processing described below with each reception of the instruction information transmitted from the terminal device 3.

[0058] The air conditioner 2 determines whether the received instruction information is information providing the instruction to start cooling operation or heating operation (step S101). When the instruction information is not the information providing the instruction to start the cooling operation or the heating operation (NO in step S101), the air conditioner 2 performs control according to the instruction information (step S102). Thereafter, the air conditioner 2 ends the air-conditioning control processing.

[0059] Conversely, when the instruction information is the information providing the instruction to start cooling operation or heating operation (YES in step S 101), the air conditioner 2 reads the setting information from the setting information file 230 and determines, with referencing the read setting information, whether the room shape adapted mode is enabled (step S103).

[0060] When the room shape adapted mode is not enabled (NO in step S 103), the air conditioner 2 starts cooling operation or heating operation in a conventional manner (step S104). Thereafter, the air conditioner 2 ends the air-conditioning control processing.

[0061] Conversely, when the room shape adapted mode is enabled (YES in step S103), the air conditioner 2 starts cooling operation or heating operation, and based on the ceiling height information included in the setting information, determines a control index and adjusts flow of blown air (step S105).

[0062] After step S105, the air conditioner 2 generates the notification information indicating that the air conditioning is performed in the room shape adapted mode, and transmits to the terminal device 3 the generated notification information (step S106). Thereafter, the air conditioner 2 ends the air-conditioning control processing.

[0063] As described above, according to the air conditioning system 1 according to the present embodiment, the air conditioner 2 receives from the user a setting of the ceiling height information for each of the predetermined multiple sections in the air-conditioning target area and controls air conditioning of the air conditioning target area based on the ceiling height information of each section. This configuration enables, not only achieving appropriate air conditioning based on a ceiling height of a section in which the indoor unit 20 is installed, but also performing appropriate air conditioning even in the case of sections with different ceiling heights.

[0064] Furthermore, when air conditioning in the room shape adapted mode is performed, notification to that effect is sent to the user. This allows the user to figure out the reason for unusual air conditioning and therefore to feel relieved.

[0065] The present disclosure is not limited to the above embodiment, and various modifications and applications are of course possible without departing from the gist of the present disclosure.

[0066] For example, a body of the indoor unit 20 may include an input interface for receiving input of the setting information from the user.

[0067] Furthermore, although input of the ceiling height information is received from the user for twelve sections into which the air-conditioning target area is divided in the above embodiment, the number of sections may be any number larger than two.

[0068] Furthermore, configuration may be employed in which (i) the user can input an installation height (in meters) of the indoor unit 20 via the terminal device 3 and (ii) the setting information includes information indicating the inputted installation height. This configuration allows the air conditioner 2 (i) to perform more accurate adjustment of the angle of the vertical air deflection plate, the angle of the lateral air deflection plate and the fan rotation speed in accordance with a distance from the indoor unit 20 to the ceiling, a distance from the indoor unit 20 to a floor surface, and the like and therefore (ii) to generate more appropriate airflow.

[0069] Furthermore, the air conditioner 2 may determine the control index based on the ceiling height information regardless of whether the room shape adapted mode is enabled.

[0070] Furthermore, various types of methods are usable for providing notification to the user. For example, the terminal device 3 may output a sound based on the notification information. As another example, the main body of the indoor unit 20 may include an output interface for sending to the user a sound notification or a notification in a visible manner using light, a screen, or the like.

[0071] Furthermore, the setting information received by the air conditioner 2 from the user may indicate whether the indoor unit 20 is installed under the floor, that is, whether an underfloor air conditioner is used. In the case

of an underfloor air conditioner, the air conditioner 2, both in performing the cooling operation and performing the heating operation, performs air-conditioning control of content as illustrated in FIG. 21.

[0072] Furthermore, the present disclosure can also be used in an air conditioner for air conditioning of a building other than a house.

[0073] The technical concepts according to the above modified examples may be achieved separately of one another or may be achieved in an appropriate combination.

[0074] The foregoing describes some example embodiments for explanatory purposes. Although the foregoing discussion has presented specific embodiments, persons skilled in the art will recognize that changes may be made in form and detail without departing from the broader spirit and scope of the invention. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense. This detailed description, therefore, is not to be taken in a limiting sense, and the scope of the invention is defined only by the included claims, along with the full range of equivalents to which such claims are entitled.

Industrial Applicability

[0075] The present disclosure can be suitably used for an air conditioner for air conditioning of a building.

Reference Signs List

[0076]

1	Air conditioning system
2	Air conditioner
3	Terminal device
20	Indoor unit
21	Outdoor unit
22	Communication line
23	Refrigerant piping
30	Display
31	Operation receiver
32, 210	Communication interface
33	CPU
34	ROM
35	RAM
36	Auxiliary storage device
37	Bus
200	First communication interface
201	Second communication interface
202, 211	Main unit
203,212	Sensor
204, 213	Control circuit
220	Setting receiver
221	Instruction information acquirer
222	Air-conditioning controller
223	Notification information generator
224	Notification information transmitter
230	Setting information file
300	Setting information input receiver
301	Setting information transmitter
302	Instruction information input receiver
303	Instruction information transmitter
304	Notification information acquirer
305	Notification information display unit

Claims

1. An air conditioner comprising:

   setting reception means for receiving from a user a setting of ceiling height information relating to a ceiling height for each section of predetermined sections in an air-conditioning target area; and
   air-conditioning control means for controlling air conditioning of the air-conditioning target area based on the ceiling height information of each section.

2. The air conditioner according to claim 1, wherein the setting reception means acquires the ceiling height information by communication with a terminal device.

3. The air conditioner according to claim 1 or 2, wherein the air-conditioning control means (i) determines, based on the ceiling height information of a section in which an indoor unit is installed, a control index for use in estimation of a room temperature in the air-conditioning target area and (ii) adjusts, based on the ceiling height information of each section, flow of blown air.

4. The air conditioner according to any one of claims 1 to 3, further comprising:
   notification means for sending to the user a notification that the air conditioning of the air-conditioning target area is performed based on the ceiling height information of each section.

5. An air conditioning control method comprising:

   receiving from a user a setting of ceiling height information relating to a ceiling height for each section of predetermined sections in an air-conditioning target area; and
   controlling air conditioning of the air-conditioning target area based on the ceiling height information of each section.

FIG.1

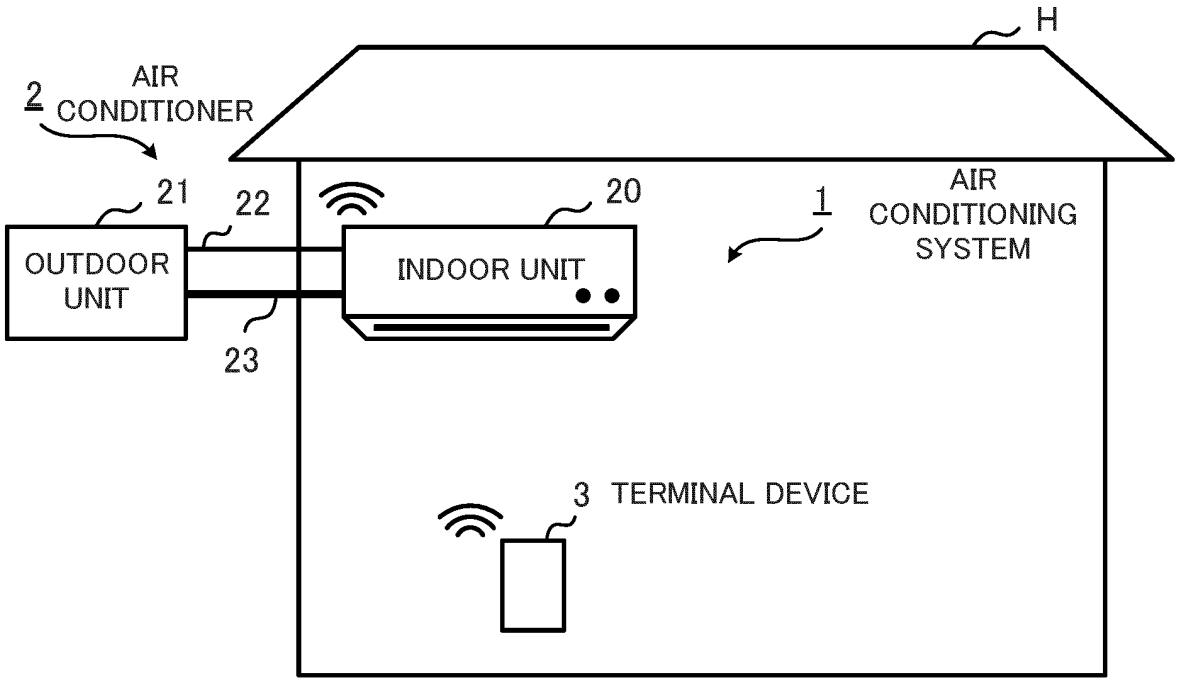
H
2
AIR
CONDITIONER
21
22
20
1
AIR
CONDITIONING
SYSTEM
OUTDOOR
UNIT
INDOOR UNIT
23
3
TERMINAL DEVICE

FIG.2

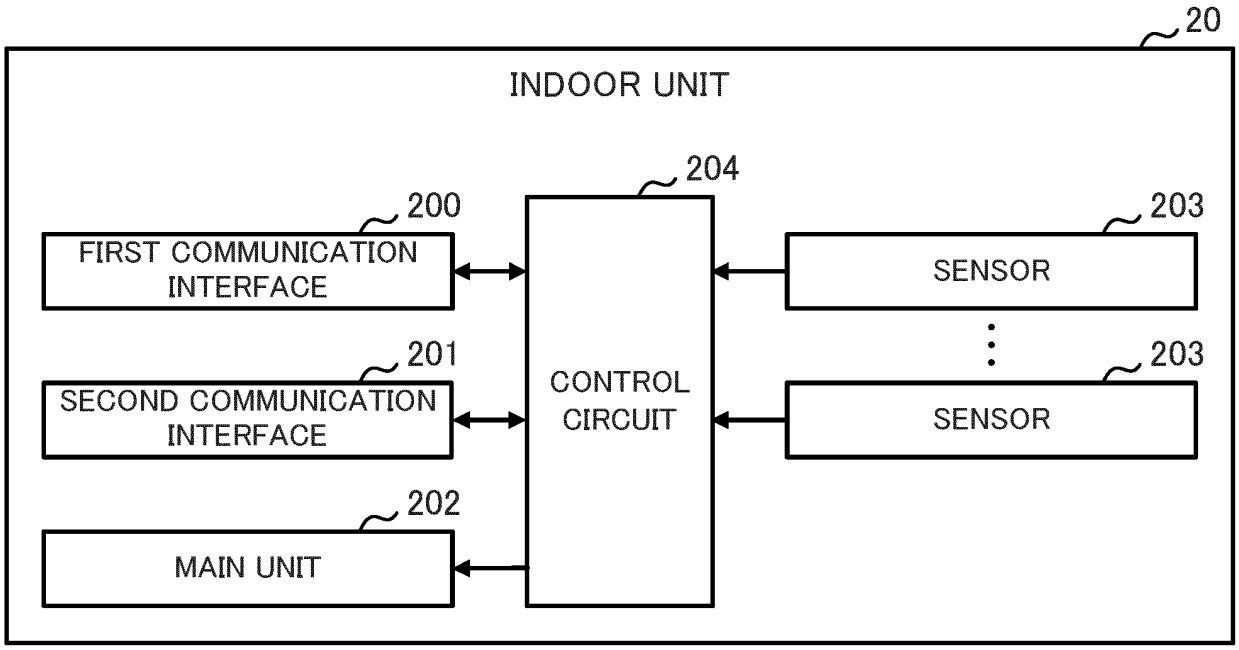
20
INDOOR UNIT
204
200
203
FIRST COMMUNICATION
INTERFACE
SENSOR
201
203
SECOND COMMUNICATION
INTERFACE
CONTROL
CIRCUIT
SENSOR
202
MAIN UNIT

FIG.3

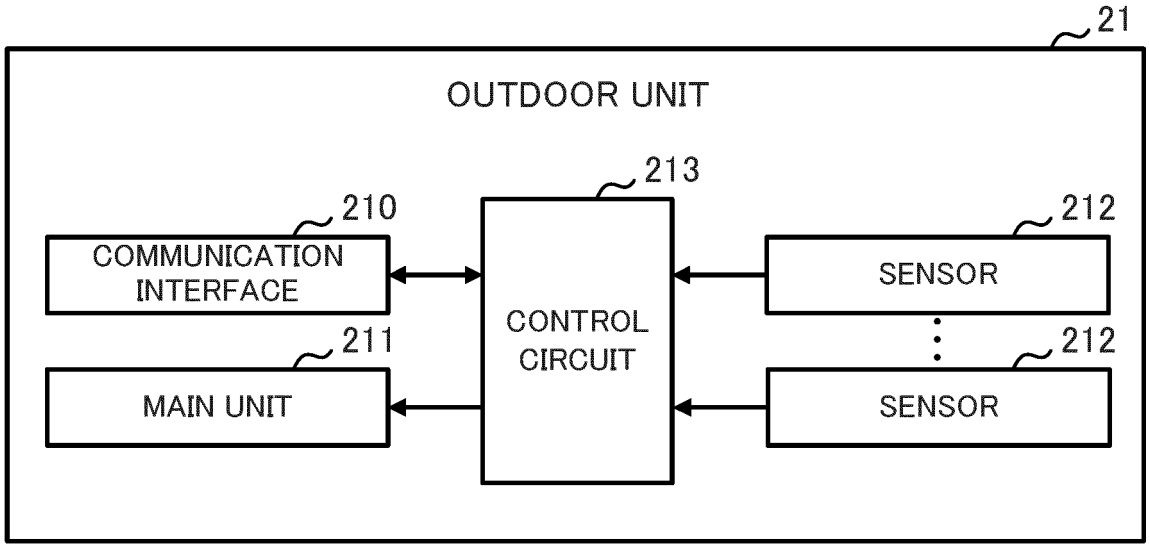
21
OUTDOOR UNIT
213
210
COMMUNICATION INTERFACE
211
MAIN UNIT
CONTROL CIRCUIT
212
SENSOR
212
SENSOR

FIG.4

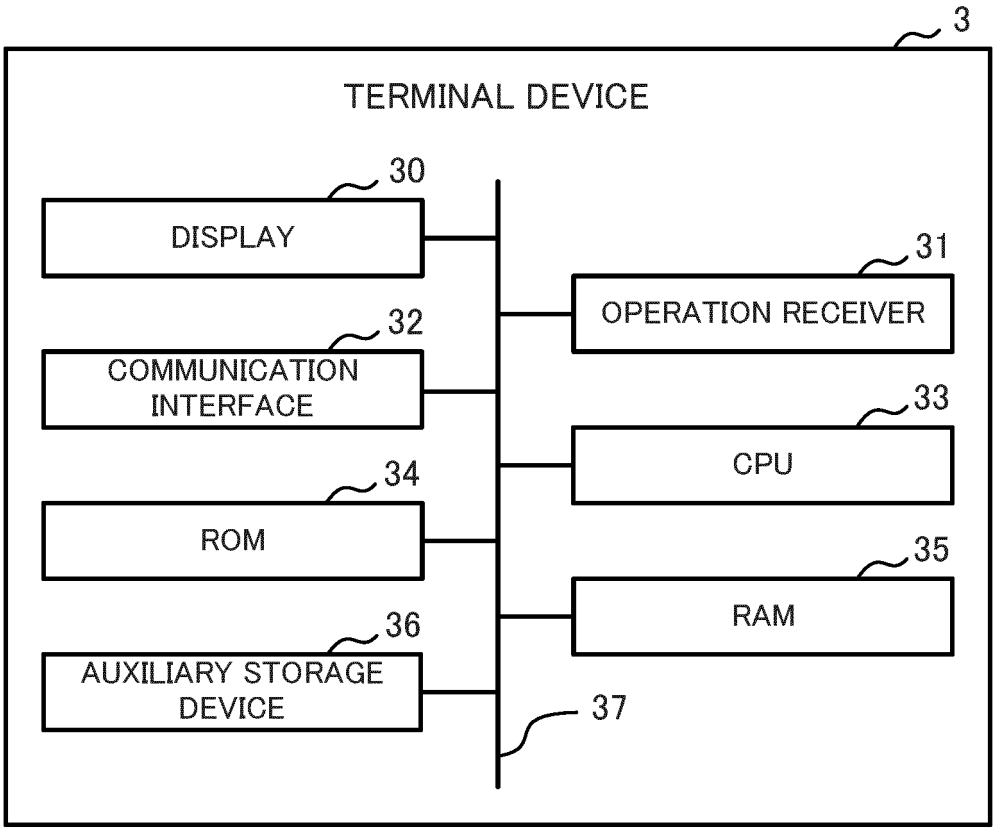
3
TERMINAL DEVICE
30
DISPLAY
31
OPERATION RECEIVER
32
COMMUNICATION INTERFACE
33
CPU
34
ROM
35
RAM
36
AUXILIARY STORAGE DEVICE
37

FIG.5

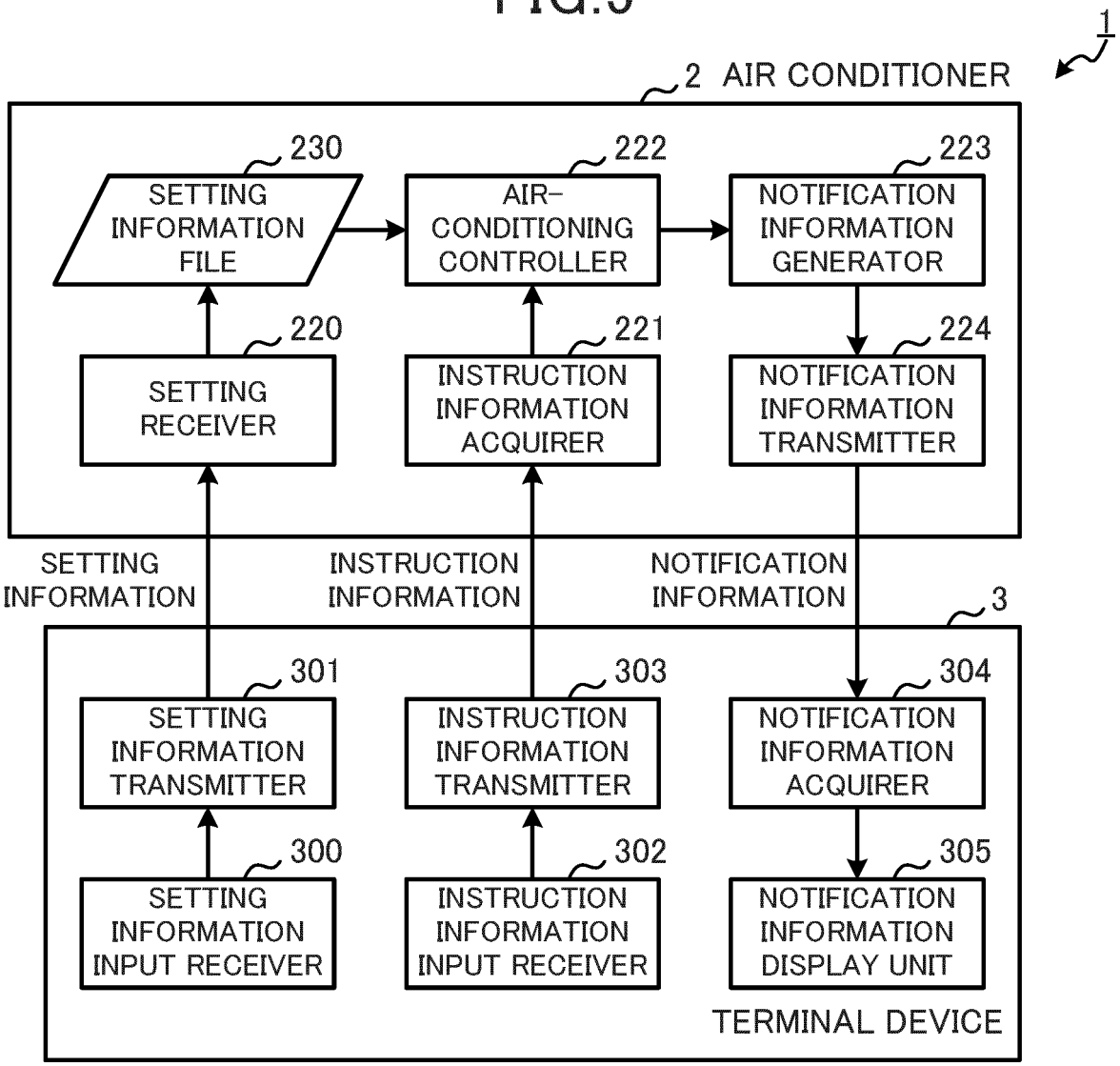
1
2 AIR CONDITIONER
230
SETTING INFORMATION FILE
222
AIR-CONDITIONING CONTROLLER
223
NOTIFICATION INFORMATION GENERATOR
220
SETTING RECEIVER
221
INSTRUCTION INFORMATION ACQUIRER
224
NOTIFICATION INFORMATION TRANSMITTER
SETTING INFORMATION
INSTRUCTION INFORMATION
NOTIFICATION INFORMATION
3
301
SETTING INFORMATION TRANSMITTER
303
INSTRUCTION INFORMATION TRANSMITTER
304
NOTIFICATION INFORMATION ACQUIRER
300
SETTING INFORMATION INPUT RECEIVER
302
INSTRUCTION INFORMATION INPUT RECEIVER
305
NOTIFICATION INFORMATION DISPLAY UNIT
TERMINAL DEVICE

FIG.6

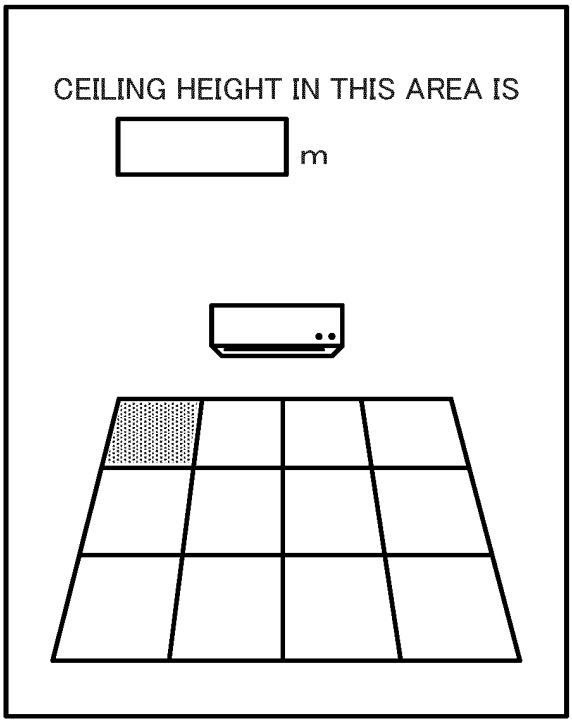
CEILING HEIGHT IN THIS AREA IS
m

FIG.7

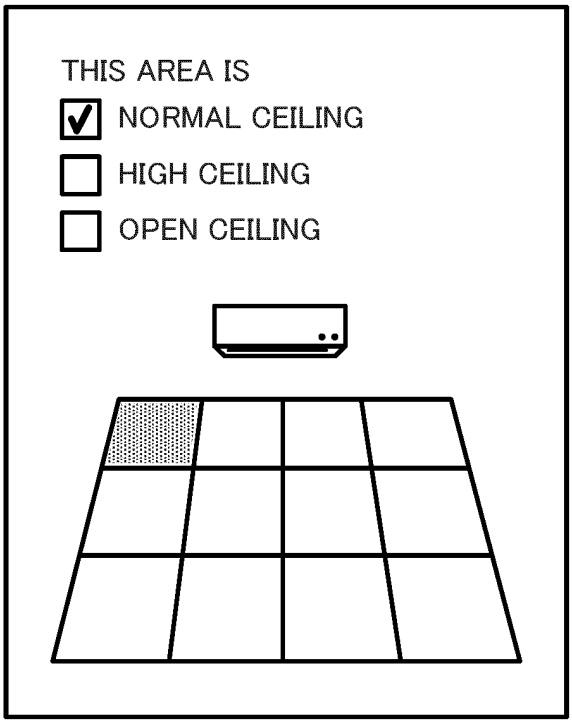
THIS AREA IS
NORMAL CEILING
HIGH CEILING
OPEN CEILING

FIG.8

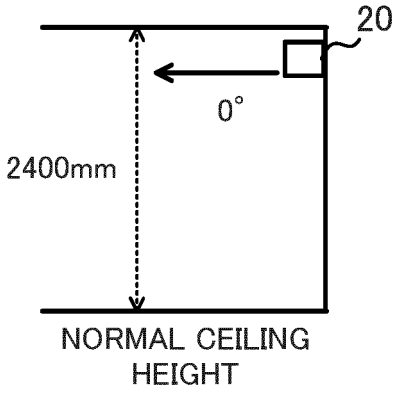

FIG.9

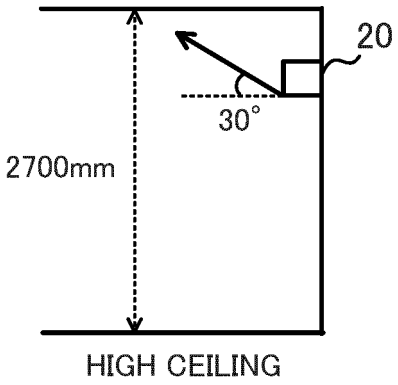

FIG.10

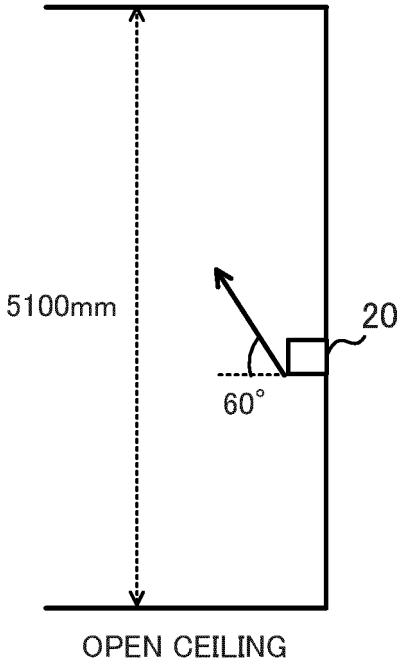

FIG.11

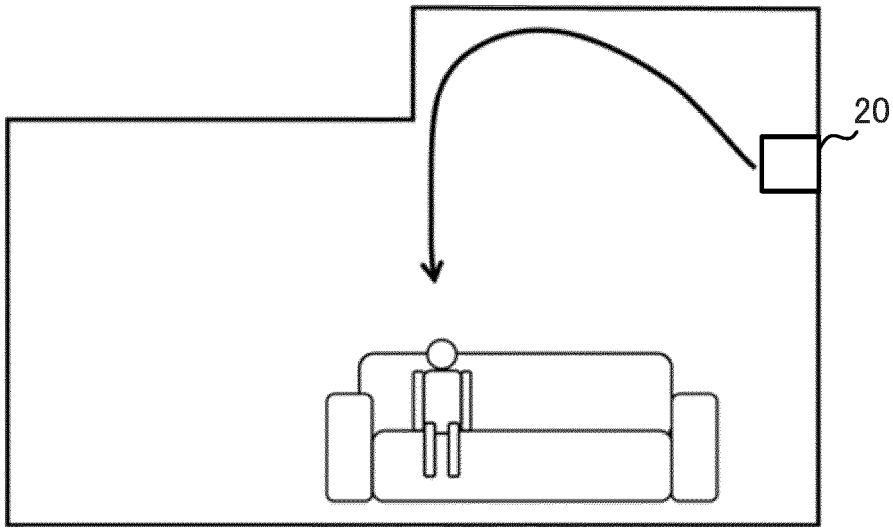

FIG.12

CONTENT OF CONTROL IN ROOM SHAPE ADAPTED MODE DURING COOLING OPERATION

NORMAL CEILING HEIGHT	SIMILAR TO CONVENTIONAL MANNER
HIGH CEILING	· CONTROL INDEX: INLET TEMPERATURE · LATERAL AIR DEFLECTION PLATE: SIMILAR TO CONVENTIONAL MANNER · VERTICAL AIR DEFLECTION PLATE: INCLINED UPWARD IN COMPARISON TO CASE OF NORMAL CEILING HEIGHT; IN CASE IN WHICH CEILING ON FAR SIDE IS LOW, ADJUSTED FOR CEILING HEIGHT ON FAR SIDE · FAN ROTATION SPEED: HIGHER THAN IN CASE OF NORMAL CEILING HEIGHT
OPEN CEILING	·CONTROL INDEX: INLET TEMPERATURE AND FLOOR SURFACE TEMPERATURE ·LATERAL AIR DEFLECTION PLATE: SIMILAR TO CONVENTIONAL MANNER ·VERTICAL AIR DEFLECTION PLATE: INCLINED UPWARD IN COMPARISON TO CASE OF HIGH CEILING; IN CASE IN WHICH CEILING ON FAR SIDE IS LOW, ADJUSTED FOR CEILING HEIGHT ON FAR SIDE ·FAN ROTATION SPEED: HIGHER THAN IN CASE OF HIGH CEILING

FIG.13

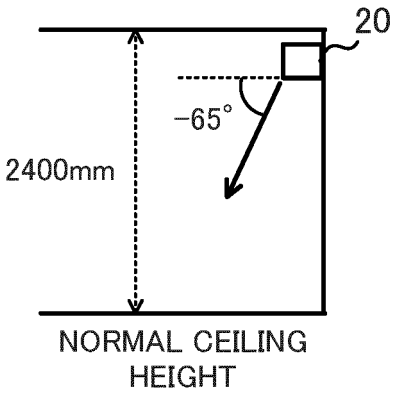

FIG.14

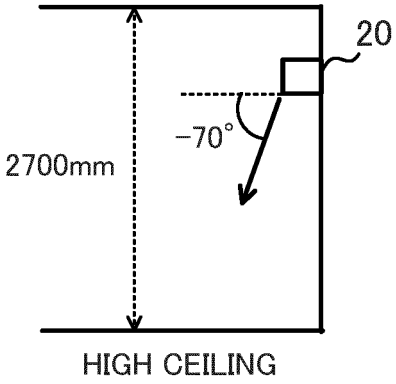

FIG.15

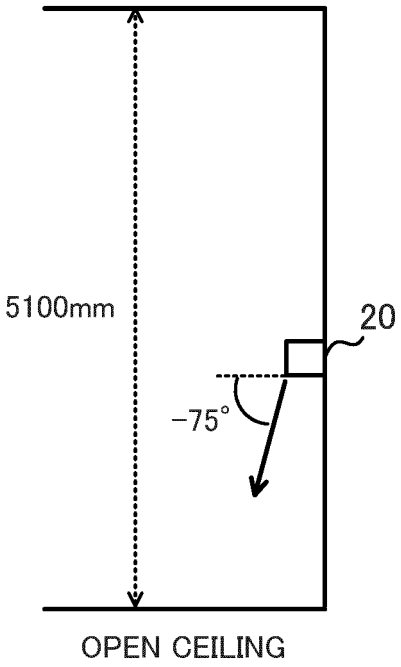

FIG.16

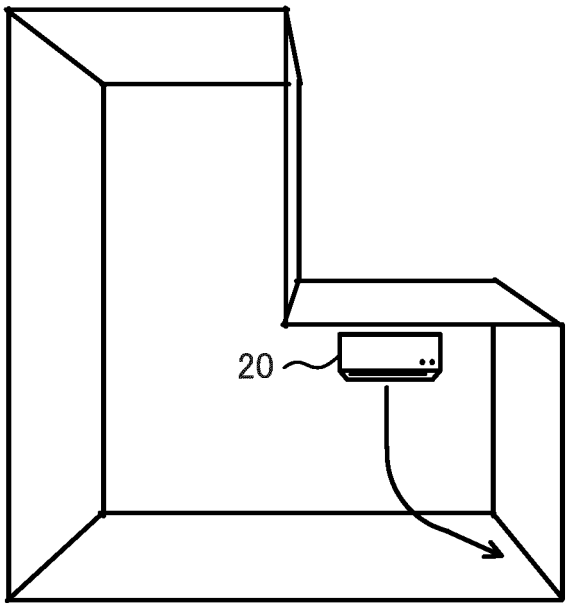

FIG.17

CONTENT OF CONTROL IN ROOM SHAPE ADAPTED MODE DURING HEATING OPERATION

NORMAL CEILING HEIGHT	· CONTROL INDEX: INLET TEMPERATURE · LATERAL AIR DEFLECTION PLATE: AVOID OPEN CEILING SPACE · VERTICAL AIR DEFLECTION PLATE: SIMILAR TO CONVENTIONAL MANNER · FAN ROTATION SPEED: SIMILAR TO CONVENTIONAL MANNER
HIGH CEILING	· CONTROL INDEX: INLET TEMPERATURE · LATERAL AIR DEFLECTION PLATE: AVOID OPEN CEILING SPACE · VERTICAL AIR DEFLECTION PLATE: INCLINED DOWNWARD IN COMPARISON TO CASE OF NORMAL CEILING HEIGHT · FAN ROTATION SPEED: HIGHER THAN IN CASE OF NORMAL CEILING HEIGHT
OPEN CEILING	· CONTROL INDEX: INLET TEMPERATURE AND FLOOR SURFACE TEMPERATURE · LATERAL AIR DEFLECTION PLATE: AVOID OPEN CEILING SPACE · VERTICAL AIR DEFLECTION PLATE: INCLINED DOWNWARD IN COMPARISON TO CASE OF HIGH CEILING · FAN ROTATION SPEED: HIGHER THAN IN CASE OF HIGH CEILING

FIG.18

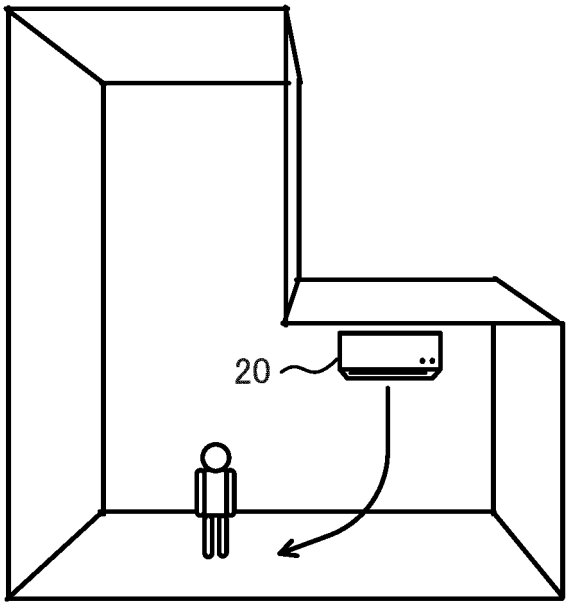
20

FIG.19

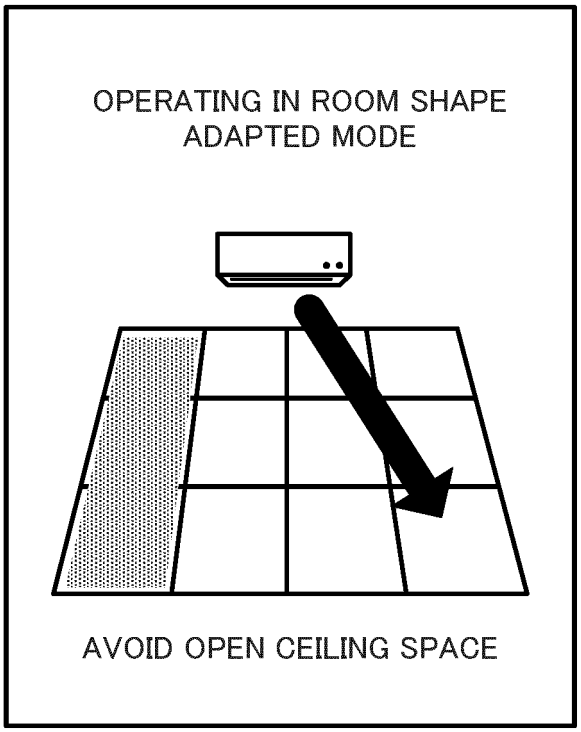
OPERATING IN ROOM SHAPE ADAPTED MODE
AVOID OPEN CEILING SPACE

FIG.20

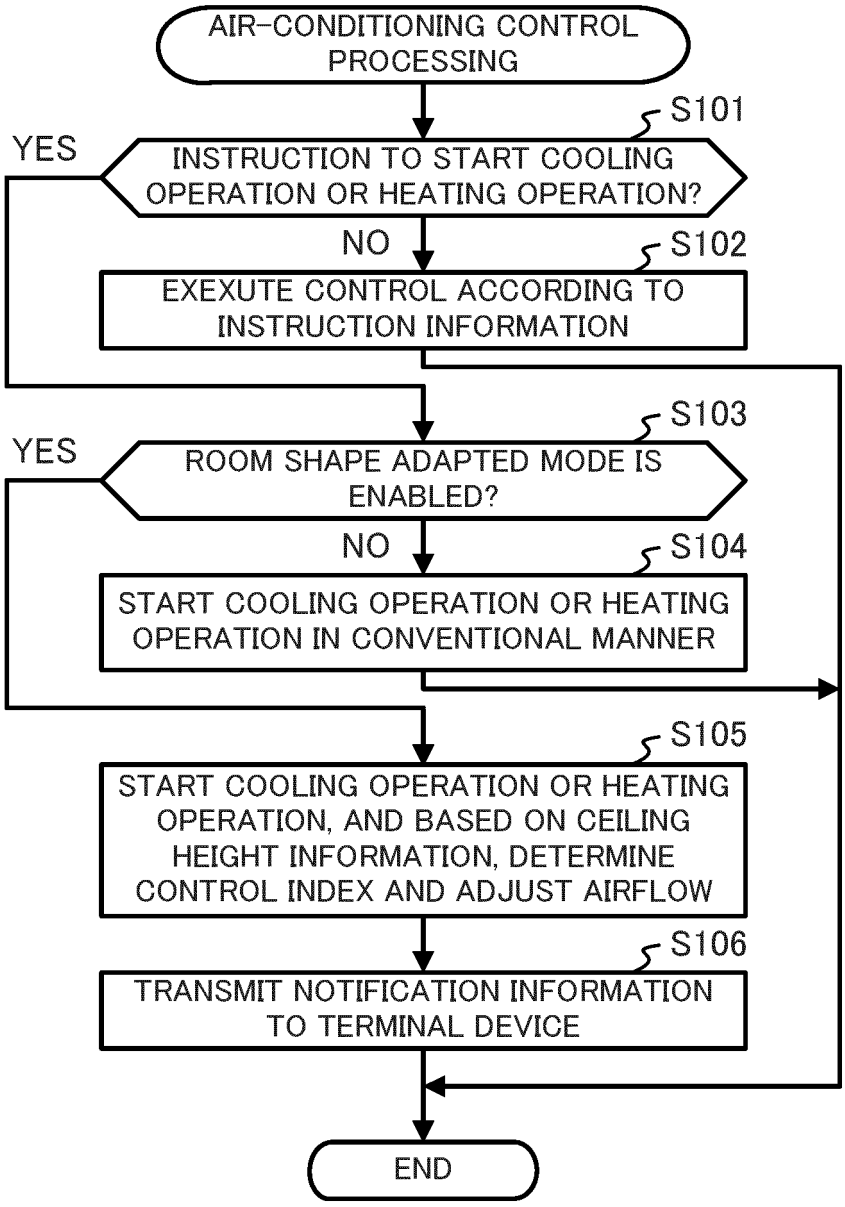
AIR-CONDITIONING CONTROL PROCESSING
S101
YES
INSTRUCTION TO START COOLING OPERATION OR HEATING OPERATION?
NO
S102
EXEXUTE CONTROL ACCORDING TO INSTRUCTION INFORMATION
S103
YES
ROOM SHAPE ADAPTED MODE IS ENABLED?
NO
S104
START COOLING OPERATION OR HEATING OPERATION IN CONVENTIONAL MANNER
S105
START COOLING OPERATION OR HEATING OPERATION, AND BASED ON CEILING HEIGHT INFORMATION, DETERMINE CONTROL INDEX AND ADJUST AIRFLOW
S106
TRANSMIT NOTIFICATION INFORMATION TO TERMINAL DEVICE
END

FIG.21

CONTENT OF CONTROL IN UNDERFLOOR AIR CONDITIONING
(BOTH IN COOLING OPERATION AND HEATING OPERATION)

- CONTROL INDEX: INLET TEMPERATURE AND AIR TEMPERATURE MEASURED BY AIR CONDITIONING REMOTE CONTROLLER (TERMINAL DEVICE)
- LATERAL AIR DEFLECTION PLATE: SIMILAR TO CONVENTIONAL MANNER
- VERTICAL AIR DEFLECTION PLATE: HORIZONTAL (0°)
- FAN ROTATION SPEED: SIMILAR TO CONVENTIONAL MANNER

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/038975

A. CLASSIFICATION OF SUBJECT MATTER
F24F 11/50(2018.01)i; F24F 11/72(2018.01)i
FI: F24F11/72; F24F11/50

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)
F24F11/50; F24F11/72

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	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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 10-300165 A (MITSUBISHI ELECTRIC CORP.) 13 November 1998 (1998-11-13) paragraphs [0020]-[0026], [0049], fig. 3-4	1-5
Y	JP 2018-128155 A (JOHNSON CONTROLS-HITACHI AIR CONDITIONING) 16 August 2018 (2018-08-16) paragraphs [0028], [0105], fig. 5	1-5
Y	JP 2001-59639 A (MITSUBISHI ELECTRIC CORP.) 06 March 2001 (2001-03-06) paragraph [0019]	1-5
Y	JP 2017-101871 A (FUJITSU GENERAL LTD.) 08 June 2017 (2017-06-08) paragraphs [0032], [0041]-[0044], fig. 1	3-4
A	WO 2017/203704 A1 (MITSUBISHI ELECTRIC CORP.) 30 November 2017 (2017-11-30) paragraphs [0085]-[0095], fig. 10-11	1-5

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

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 December 2020 (01.12.2020)	15 December 2020 (15.12.2020)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/038975

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2014-159890 A (MITSUBISHI ELECTRIC CORP.) 04 September 2014 (2014-09-04) paragraph [0026]	1-5
A	JP 2019-45057 A (ASAHI KASEI HOMES CORP.) 22 March 2019 (2019-03-22) entire text, all drawings	1-5

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/038975

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
JP 10-300165 A	13 Nov. 1998	(Family: none)	
JP 2018-128155 A	16 Aug. 2018	(Family: none)	
JP 2001-59639 A	06 Mar. 2001	(Family: none)	
JP 2017-101871 A	08 Jun. 2017	(Family: none)	
WO 2017/203704 A1	30 Nov. 2017	US 2019/0113250 A1 paragraphs [0142]-[0154], fig. 10-11	
JP 2014-159890 A	04 Sep. 2014	(Family: none)	
JP 2019-45057 A	22 Mar. 2019	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013096639 A **[0004]**