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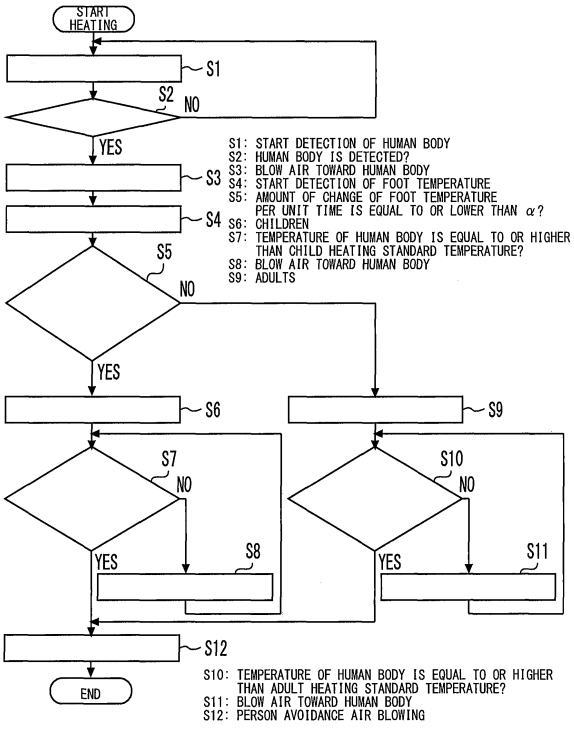
(54) AIR CONDITIONING APPARATUS

(57) Provided is an air conditioning apparatus capable of suitably blowing conditioned air in accordance with an age group of a user in a manner that is independent of the height of the user. Therefore, the air conditioning apparatus includes: an air blow mechanism arranged in a housing and generating an air flow which sucks air from an air intake port and blows conditioned air from an air outlet port, the air blow mechanism being able to change a direction of the conditioned air which blows from the air outlet port; temperature detection means for detecting a surface temperature in a predetermined detection range; and a controller that controls the air blow mechanism in accordance with a detection result of the temperature detection means. When a human body is identified from a distribution of the surface temperature detected by the temperature detection means, the direction of the conditioned air is set to the direction of the human body, and the direction of the conditioned air is kept to the direction of the human body until the surface temperature of the human body becomes a standard temperature. The standard temperature is set in accordance with an amount of change of the surface temperature of the human body.

FIG. 10



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Description

[Technical Field]

[0001] The present invention relates to an air conditioning apparatus.

[Background Art]

[0002] Conventionally, an air conditioning apparatus loaded with a situation recognition device has been known. The air conditioning apparatus includes an air conditioning control unit that realizes air conditioning control on the basis of a situation recognition result identified by situation recognition means. Further, an air conditioning apparatus has been known which includes, as the situation recognition means: foot position detection means for detecting the foot position of a person; and head position detection means for detecting the head position of the person, the air conditioning apparatus using height estimation means for detecting the height of the person with use of foot position information obtained by the foot position detection means and head position information obtained by the head position detection means (for example, see PTL 1).

[Citation List]

[Patent Literature]

[0003] [PTL 1] Japanese Patent Application Publication No. 2013-024534

[Summary of Invention]

[Technical Problem]

[0004] The air conditioning apparatus of the related art disclosed in PTL 1 can cause the air from the air conditioning apparatus to not directly hit children that are short in height and perform air conditioning with a low flowrate for the children, and cause the air from the air conditioning apparatus to directly hit adults that are sufficiently tall in height and perform air conditioning with a high flowrate for the adults, for example, by performing air conditioning control on the basis of the result estimated by the height estimation means.

[0005] However, in the air conditioning apparatus of the related art disclosed in PTL 1, it is determined whether the person is an adult or a child, that is, the age group is determined only on the basis of height. Therefore, for example, a wrong determination of the age group is made for children that are tall in height or adults that are short in height, and suitable air blow control according to the age group cannot be performed.

[0006] The present invention has been made in order to solve the abovementioned problem. An object thereof is to provide an air conditioning apparatus capable of realizing suitable blowing of conditioned air in accordance with the age group of a user in a manner that is independent of the height of the user, and capable of enhancing the comfort of the user.

Solution to Problem

[0007] An air conditioning apparatus according to the present invention includes: a housing having an air intake port and an air outlet port; a heat exchanger arranged in the housing, the heat exchanger configured to exchange heat with air sucked from the air intake port and to generate conditioned air; an air blow mechanism arranged in the housing, the air blow mechanism configured to generate air flow which sucks air from the air intake port and blows the conditioned air from the air outlet port, the air blow mechanism capable of changing a direction of the conditioned air which blows from the air outlet port; temperature detection means configured to detect surface temperature in a predetermined detection range, and a controller configured to control the air blow mechanism in accordance with a detection result of the temperature detection means, wherein when a human body is identified from a distribution of the surface temperature which the temperature detection means detect, the direction of the conditioned air is set to the direction of the human body and is kept to the direction of the human body until surface temperature of the human body becomes a standard temperature, and the standard temperature is set in accordance with an amount of change of the surface temperature of the human body.

[Advantageous Effects of Invention]

[0008] In the air conditioning apparatus according to the present invention, the suitable blowing of the conditioned air can be realized in accordance with the age group of the user in a manner that is independent of the height of the user, and the comfort of the user can be enhanced.

Brief Description of the Drawings

[0009]

Fig. 1 is an external perspective view of an air conditioning apparatus according to the Embodiment 1 of the present invention.

Fig. 2 is a longitudinal cross-sectional view of the air conditioning apparatus according to the Embodiment 1 of the present invention.

Fig. 3 is a view illustrating a detection range of a human body sensor included in the air conditioning apparatus according to the Embodiment 1 of the present invention.

Fig. 4 is a view illustrating the detection range of the human body sensor in the depth direction of the air conditioning apparatus according to the Embodi-

ment 1 of the present invention.

Fig. 5 is a view illustrating the detection range of the human body sensor in the horizontal direction of the air conditioning apparatus according to the Embodiment 1 of the present invention.

Fig. 6 is a block diagram illustrating the configuration of a control system of the air conditioning apparatus according to the Embodiment 1 of the present invention.

Fig. 7 is a block diagram illustrating the functional configuration of a controller of the air conditioning apparatus according to the Embodiment 1 of the present invention.

Fig. 8 is a diagram showing an example of the change of a foot temperature of a human body over time during a heating operation of the air conditioning apparatus according to the Embodiment 1 of the present invention.

Fig. 9 is a diagram showing an example of the change of a head temperature of the human body over time during the heating operation of the air conditioning apparatus according to the Embodiment 1 of the present invention.

Fig. 10 a flowchart illustrating air blow control during the heating operation of the air conditioning apparatus according to the Embodiment 1 of the present invention.

Fig. 11 is a flowchart illustrating the air blow control during the heating operation of the air conditioning apparatus according to the Embodiment 2 of the present invention.

Fig. 12 is a diagram showing an example of the change of the foot temperature of the human body during the heating operation of the air conditioning apparatus according to the Embodiment 3 of the present invention.

Fig. 13 is a flowchart illustrating the air blow control during the heating operation of the air conditioning apparatus according to the Embodiment 3 of the present invention.

[Description of Embodiments]

[0010] Embodiments of the present invention are described with reference to the accompanying drawings. In the drawings, the same or similar parts are denoted by the same reference symbols, and overlapping descriptions are simplified or omitted, as appropriate. The present invention is not limited the embodiments below, and can be modified in various ways within the scope of the present invention.

Embodiment 1

[0011] Fig. 1 to Fig. 10 are drawings according to Embodiment 1 of the present invention. Fig. 1 is an external perspective view of an air conditioning apparatus, Fig. 2 is a longitudinal cross-sectional view of the air conditioning apparatus, Fig. 3 is a view illustrating a detection range of a human body sensor included in the air conditioning apparatus, Fig. 4 is a view illustrating the detection range of the human body sensor in the depth direction of the air conditioning apparatus, Fig. 5 is a view illustrating the detection range of the human body sensor in the horizontal direction of the air conditioning apparatus, Fig. 6 is a block diagram illustrating the configuration of a control system of the air conditioning apparatus, Fig. 7 is a block diagram illustrating the functional configuration of a controller of the air conditioning apparatus, Fig. 8 is a diagram showing an example of the change of a foot temperature of a human body over time during a heating operation of the air conditioning apparatus, Fig. 9 is a diagram showing an example of the change of a head temperature of the human body over time during the heating operation of the air conditioning apparatus, and Fig. 10 a flowchart illustrating air blow control during the heating operation of the air conditioning apparatus.

[0012] An air conditioning apparatus 100 in Embodiment 1 of the present invention is an indoor unit of the air conditioner, for example. Therefore, the air conditioning apparatus 100 is installed on a surface of a wall or a surface of the ceiling in a room. The air conditioning apparatus 100 is herein installed on a surface of a wall in a room.

[0013] As illustrated in Fig. 1 and Fig. 2, the air conditioning apparatus 100 includes a housing 110. The housing 110 of the air conditioning apparatus 100 is formed as a substantially cuboid shape that is horizontally long and has a smooth curved surface from a front surface to a lower surface. An air intake port 111 is formed in an upper surface portion of the housing 110. The air intake port 111 is an opening for taking air into the housing 110 from the outside. An air outlet port 112 is formed in a lower portion of the front surface of the housing 110. The air outlet port 112 is an opening for discharging air from the inside of the housing 110 to the outside. An upper portion of the front surface of the housing 110 is covered with a front surface panel 113.

[0014] Vertical wind direction plates 131, 132, 141, and 142 are provided on the air outlet port 112. Those vertical wind direction plates are for adjusting the blowing angle of the air blowing from the air outlet port 112 in the vertical direction.

[0015] The vertical wind direction plates are installed on the near side and the far side when seen from the front surface of the air conditioning apparatus 100. The vertical wind direction plates on the near side and the far side are separated into the left and the right. That is, the vertical wind direction plates on the near side are separated into the left near-side vertical wind direction plate 131 on the left side and the right near-side vertical wind direction plate 132 on the right side when seen from the front surface of the air conditioning apparatus 100. The vertical wind direction plates on the far side are separated into the left far-side vertical wind direction plate 141 on the left side and the right far-side vertical wind direction

plate 142 on the right side when seen from the front surface of the air conditioning apparatus 100.

[0016] The position at which the vertical wind direction plates are separated into the left and the right is almost in the middle in the longitudinal direction (the horizontal direction of the air outlet port 112) when see from the front surface of the air conditioning apparatus 100. A slight gap is formed between the left near-side vertical wind direction plate 131 and the right near-side vertical wind direction plate 132. Similarly, a slight gap is also formed between the left far-side vertical wind direction plate 141 and the right far-side vertical wind direction plate 142.

[0017] The left near-side vertical wind direction plate 131, the right near-side vertical wind direction plate 132, the left far-side vertical wind direction plate 141, and the right far-side vertical wind direction plate 142 are plate-like members that extend in an elongated manner in the horizontal direction of the air outlet port 112. Those vertical wind direction plates 131, 132, 141, and 142 are curved so that the cross sections perpendicular to the longitudinal direction are arc-shaped.

[0018] The vertical wind direction plates 131, 132, 141, and 142 are attached to the housing 110 via support arms (not shown) . The support arms are rotatably attached to the housing 110. When the support arms rotate with respect to the housing 110, the direction of the vertical wind direction plates can be changed. By changing the direction of the vertical wind direction plates, the air conditioning apparatus 100 can vertically change the air blow direction.

[0019] The support arms of the vertical wind direction plates are provided so as to be able to adjust the angle by driving stepping motors for the vertical wind direction plates. Specifically, the directions of the left near-side vertical wind direction plate 131 and the left far-side vertical wind direction plate 141 are herein changed by a stepping motor 161 for the left-side vertical wind direction plates. The directions of the right near-side vertical wind direction plate 132 and the right far-side vertical wind direction plate 142 are changed by a stepping motor 162 for the right-side vertical wind direction plates.

[0020] As described above, the blowing angle (air blow direction) of the air blowing from the left side of the air outlet port 112 in the vertical direction, and the blowing angle (air blow direction) of the air blowing from the right side of the air outlet port 112 in the vertical direction can be separately adjusted. The drawing of the stepping motor 161 for the left-side vertical wind direction plate and the stepping motor 162 for the right-side vertical wind direction plate is omitted in Fig. 1 and Fig. 2.

[0021] A horizontal wind direction plate 150 is provided on the far side of the vertical wind direction plates 131, 132, 141, and 142 in the air outlet port 112. The horizontal wind direction plate 150 is for adjusting the blowing angle of the air blowing from the air outlet port 112 in the horizontal direction. The horizontal wind direction plate 150 is formed by a plurality of plate materials arranged toward the front surface of the air conditioning apparatus 100 along the longitudinal direction (the horizontal direction of the air outlet port 112). The horizontal wind direction plate 150 is attached so that the angle thereof can be adjusted by driving a stepping motor 163 for the horizontal wind direction plate (not shown in Fig. 1 and Fig. 2) as with the vertical wind direction plates 131, 132, 141, and 142.

[0022] An air passage that leads from the air intake port 111 to the air outlet port 112 is formed in the housing 110. A heat exchanger 121 is installed on the leeward of the air intake port 111 in the air passage. The heat exchanger 121 exchanges heat with the air flowing through the air passage, and heats or cools the air flowing through the air passage. Whether the air is heated or cooled depends on whether the air conditioning apparatus 100 is performing the heating operation or the cooling operation. Specifically, the heat exchanger 121 heats the air during the heating operation. Meanwhile, the heat exchanger 121 cools the air during the cooling operation.

[0023] The heat exchanger 121 adjusts the temperature, the humidity, and the like of the air flowing through the air passage and generates conditioned air by heating or cooling the air. As described above, the heat exchanger 121 exchanges heat with the air sucked from the air intake port 111 and generates the conditioned air. Warm air is generated as the conditioned air during the heating operation, and cool air is generated as the conditioned air during the cooling operation.

[0024] An air blow fan 122 is installed on the leeward of the heat exchanger 121 in the air passage. The air blow fan 122 is for generating an air flow heading from the air intake port 111 to the air outlet port 112 in the air passage.

[0025] When the air blow fan 122 operates, the air flow heading from the air intake port 111 to the air outlet port 112 is generated in the air passage, the air is sucked from the air intake port 111, and the air blows out from the air outlet port 112. The air sucked from the air intake port 111 becomes an air flow that passes through the air passage in the air conditioning apparatus 100 in the order of the heat exchanger 121 and the air blow fan 122, and blows from the air outlet port 112. At this time, the direction (air blow direction) of the air blowing from the air outlet port 112 is adjusted (changed) by the vertical wind direction plates 131, 132, 141, and 142 and the horizontal wind direction plate 150 placed on the leeward of the air blow fan 122.

[0026] The air blow fan 122, the vertical wind direction plates. 131, 132, 141, and 142, the horizontal wind direction plate 150, the stepping motors 161 and 162 for the vertical wind direction plates, and the stepping motor 163 for the horizontal wind direction plate form the air blow mechanism provided in the housing 110. The air blow mechanism formed as above generates an air flow that sucks air from the air intake port 111 and blows conditioned air from the air outlet port 112, and can change the direction of the conditioned air blowing from the air

outlet port 112.

[0027] A human body sensor 170 is attached to the center of the front surface of the air conditioning apparatus 100. However, the attachment position of the human body sensor 170 is not limited to the center of the front surface of the air conditioning apparatus 100. The human body sensor 170 may be attached to an end portion on the left side or the right side of the housing 110, for example.

[0028] The human body sensor 170 includes a plurality of infrared sensors (light receiving elements) arranged in the vertical direction, for example. The human body sensor 170 herein includes eight infrared sensors (light receiving elements), for example. Those eight infrared sensors are detection elements that can individually execute the reception of infrared light and detection of the temperature. Those infrared sensors (light receiving elements) are placed in a cylindrical metallic can 171 so as to be linearly arranged in the vertical direction as illustrated in Fig. 3, for example. As a result, the human body sensor 170 includes a function of detecting the room temperature by partitioning the room temperature into eight areas at different heights.

[0029] The detection ranges of the eight infrared sensors are set as square areas that are the same size as illustrated in Fig. 3. The light distribution viewing angle of one infrared sensor is set so that a vertical light distribution viewing angle in the vertical direction is set to 7 degrees and a horizontal light distribution viewing angle in the horizontal direction is set to 8 degrees, for example.

[0030] A light distribution viewing angle 173 of the entire human body sensor 170 obtained by combining the light distribution viewing angles of the infrared sensors is set as an area that is long and narrow in the vertical direction. The light distribution viewing angles (detection ranges) of the infrared sensor do not necessarily need to be the same shape and the same size. The specific values of the vertical light distribution viewing angles and the horizontal light distribution viewing angles are also not limited to the examples above. In addition, the number of the infrared sensors (light receiving elements) is not limited to eight, and the human body sensor 170 may include any number of infrared sensors (light receiving elements) that is seven or less or nine or more.

[0031] The human body sensor 170 can change the horizontal directions of the plurality of vertically-arranged infrared sensors within the predetermined angular range by a stepping motor 172 for the sensors (not shown in Fig. 1 and Fig. 2). In this way, the surface temperature can be detected for the range within the predetermined detection range (hereinafter referred to as a "temperature detection target range") in front of the air conditioning apparatus 100 by performing scanning in the horizontal direction by the plurality of vertically-arranged infrared sensors.

[0032] By the configuration as above, the human body sensor 170 scans the range within the temperature detection target range and acquires the surface temperature distribution (thermal image) within the range in a non-contact manner. That is, the human body sensor 170 forms temperature detection means for detecting the surface temperature within the predetermined detection range.

[0033] By processing the detection result of the human body sensor 170, that is, surface temperature distribution (thermal image) data acquired by the human body sensor 170 by a controller 180 and the like described later, whether there is a heat source including a person in the room and the position thereof, the surface temperature of the human body, the body part of the person (the exposed part and the unexposed part of the skin, the head, and the like), and the like can be detected from the temperature difference from the background, for example.

[0034] The apparent temperature of a person in the room can also be acquired on the basis of the detection result of the human body sensor 170. In that case, the apparent temperature becomes easier to detect as the skin of the human body is exposed more. As the pixel number of the light receiving element used in the human body sensor 170 increases, the detection accuracy of the human body sensor 170 increases. Specifically, for example, when a light receiving element having a pixel number of 30 pixels or more is used, the position of a person in the room and the distance from the human body sensor 170 to the person can be accurately detected.

[0035] The human body sensor 170 detects the temperature of a temperature detection target while horizontally scanning the temperature detection target range. The expression "horizontal" herein means being horizontal when seen from the air conditioning apparatus 100 side. When the thermal image data (temperature distribution data) of the walls and the floor in the room is acquired, for example, the direction of the human body sensor 170 is moved in the horizontal direction by the stepping motor 172 for the sensors, and the rotation of the stepping motor 172 for the sensors (that is, the rotation of the direction of the human body sensor 170) is stopped for a certain amount of time at every certain angle. The certain angle at this time is 1 degree to 5 degrees, for example. The certain amount of time at this time is 0.1 seconds to 0.2 seconds, for example. When the change of the direction of the human body sensor 170 is stopped, the detection result (thermal image data) of the eight light receiving elements of the human body sensor 170 is retrieved after an amount of time that is shorter than the certain amount of time (0.1 seconds to 0.2 seconds) elapses.

[0036] After the retrieval of the detection result by the human body sensor 170 ends, the stepping motor 172 for the sensors is rotated by the certain angle again and is stopped again. Then, the detection result (thermal image data) of the human body sensor 170 is retrieved by a similar operation. By repeating the operation as above, the detection result of the human body sensor 170 is acquired at 90 to 100 sections, for example, within the

detection range in the horizontal direction. The thermal image data (temperature distribution data) of the temperature detection target range can be acquired from the acquired detection result of the human body sensor 170.

[0037] Next, with reference to Fig. 4 and Fig. 5, the detection range of the human body sensor 170 formed as above is described. First, Fig. 4 is a view illustrating the detection range of the human body sensor 170 in the depth direction when see from the air conditioning apparatus 100. Fig. 4 illustrates a state of a room in which the air conditioning apparatus 100 is installed when seen from the horizontal direction. In Fig. 4, a state in which the air conditioning apparatus 100 is installed at a height of about 1800 mm, and the distance from the air conditioning apparatus 100 to the human body is about 3600 mm is exemplified.

[0038] The detection range of the human body sensor 170 is partitioned into a plurality of regions that are equal to the number (8 herein) of the infrared sensors (light receiving elements) in the depth direction. That is, the space in the room is partitioned into eight regions corresponding to the light distribution viewing angles of the light receiving elements in the depth direction. The areas of the partitioned regions are set in accordance with the spread angles of the light distribution viewing angles in the vertical direction.

[0039] The lowermost light receiving element of the human body sensor 170 detects a human body in a region on the near side that is nearest to the air conditioning apparatus 100. The light receiving element placed on the upper side of the human body sensor 170 is formed so as to detect a human body in a farther region.

[0040] Next, Fig. 5 is a view illustrating the detection range the human body sensor 170 in the horizontal direction when seen from the air conditioning apparatus 100. Fig. 5 illustrates a state in which the room in which the air conditioning apparatus 100 is installed is seen from above. The detection range of the human body sensor 170 is partitioned into a plurality of regions with respect to the certain angle at which the human body sensor 170 is rotated by the stepping motor 172 for the sensors in the horizontal direction.

[0041] In Fig. 5, a case where the detection range of the human body sensor 170 in the horizontal direction is set to about 90 degrees is exemplified. The detection range of the human body sensor 170 in the horizontal direction is not limited to the angle. For example, a configuration in which the human body sensor 170 can be completely rotated by the stepping motor 172 for the sensors may be used and the detection range may be set to 360 degrees.

[0042] The human body sensor 170 may also swing in the vertical direction by other stepping motors and the like. By causing the direction of the human body sensor 170 to also be able to change in the vertical direction, detailed thermal image data can be acquired not only in the horizontal direction but also in the vertical direction.

[0043] The human body sensor 170 may have a configuration in which the infrared sensor and other detection devices are used in combination. As a specific example, a configuration in which the position and the shape of the human body and the distance to the human body are detected with use of a camera, an ultrasonic sensor, and the like may be used. That is, as the human body sensor 170, an ultrasonic sensor that can detect an object, for example, can be further included in addition to the infrared sensor. In this way, the accuracy of detecting the position and the distance of the human body by the human body sensor 170 can be enhanced. Alternatively, a configuration in which the position of the human body in the horizontal direction in the room and the depth direction (front-back direction) when seen from the air conditioning apparatus 100 is detected with use of a pyroelectric sensor using a Fresnel lens may be used.

[0044] Next, the configuration of the control system of the air conditioning apparatus 100 is described with reference to Fig. 6. The air conditioning apparatus 100 includes the controller 180 and an operation display unit 190. The controller 180 is formed by an electric circuit including a microcomputer and the like, for example. When the controller 180 includes a microcomputer, the controller 180 includes a processor 181 and a memory 182. A program for control is stored in the memory 182. The processor 181 reads and executes the program stored in the memory 182.

[0045] When the processor 181 executes the program for control, the controller 180 executes predetermined processing and controls the operation of the air conditioning apparatus 100. In particular, when the processor 181 executes the program stored in the memory 182, the functions of the units, that is, a human body detection unit 183, a part identification unit 184, an age group determination unit 186, and an air blow control unit 187 described below are realized.

[0046] A sensor system including the human body sensor 170 and the like is connected to the input side of the controller 180. The air blow fan 122 and various actuators including the stepping motor 161 for the left-side vertical wind direction plate, the stepping motor 162 for the right-side vertical wind direction plate, the stepping motor 163 for the horizontal wind direction plate, and the stepping motor 172 for the sensors are connected to the output side of the controller 180.

[0047] The operation display unit 190 is for inputting various set values by a user, and displaying various information for the user. The operation display unit 190 is a remote controller, for example. The operation display unit 190 is connected to the controller 180 so as to be able to communicate with each other. The user can turn ON/OFF a power supply, switch between the heating operation and the cooling operation, set the temperature, the direction, the flowrate, and the like, for example, by operating the operation display unit 190. The operation display unit 190 includes a liquid-crystal display that displays various information, for example. Settings such as the operation mode, the temperature, the direction, and

the flowrate are displayed on the liquid-crystal display of the operation display unit.

[0048] The controller 180 drives the actuators on the basis of the input from the sensor system and the operation display unit 190, and controls the operation of the air conditioning apparatus 100. The control executed by the controller 180 includes control of the cooling operation, the heating operation, the air blow operation, and the scan operation of the human body sensor 170, for example. That is, the controller 180 controls the air blow mechanism in accordance with the detection result of the human body sensor 170 that is temperature detection means, for example.

[0049] The controller 180 includes the human body detection unit 183, the part identification unit 184, a temperature storage unit 185, the age group determination unit 186, and the air blow control unit 187. The human body detection unit 183 detects a human body in the temperature detection target range of the human body sensor 170 on the basis of the detection result of the human body sensor 170 that is the temperature detection means. The detection of the human body can be performed with use of the shapes, the distribution (relative positional relationship), the areas, and the like of the regions of which surface temperature detected by the human body sensor 170 is equal to or higher than a predetermined standard temperature, for example. The standard temperature at this time is specifically set to 30 degrees Celsius in consideration of the body temperature of a person, for example.

[0050] The part identification unit 184 identifies a determination part of the human body detected by the human body detection unit 183. The determination part is a part of the human body that is used to determine the age group of the human body by the age group determination unit 186. The part of the human body that becomes the determination part is specified in advance. The identification of the determination part may be performed by first identifying the entire shape of the human body and then identifying the determination part from the entire shape of the human body, or may be performed by directly identifying the determination part.

[0051] When the entire shape of the human body is identified, the part identification unit 184 first identifies the regions in which the human body detected by the human body detection unit 183 exists. The regions in which the human body exists can be identified with use of the shapes, the distribution (relative positional relationship), and the areas of the regions of which surface temperature is equal to or higher than a certain temperature, and the relative magnitude relationship and the like of the temperatures of the regions, for example. When the regions in which the human body exists are identified, the shapes of the regions are also identified, that is, the shape of the human body can be identified.

[0052] When the entire shape of the human body is identified, the part identification unit 184 may identify all of the regions in which the human body exists all at once, or may individually identify the regions in which the human body exists for each parts of the human body. When the regions in which the part of the human body exists are individually identified, the part identification unit 184 identifies the regions in which the parts exist for each of the parts, that is, the head, the chest, the arms, the upper legs, the lower legs, the hands, and the feet of the human body, for example. The expression of a "hand" herein means a part on the tip side with respect to the wrist. The expression of a "foot" herein means a part on the tip side with respect to the ankle.

[0053] At this time, the part identification unit 184 may particularly identify a portion of which surface temperature detected by the human body sensor 170 is equal to or higher than a predetermined temperature as a region in which at least one of the head, the chest, and the abdomen of the human body exists. When the part identification unit 184 identifies the regions in which the parts of the human body exist, the part identification unit 184 may also identify the temperatures, the positions, and the clothing states of the parts. The expression of a "clothing state" means a state relating to whether the skin of the part is covered with clothes and the like or is exposed.

[0054] When an ultrasonic sensor is also included as the human body sensor 170 in addition to the infrared sensor that detects the surface temperature, it is preferred that the part identification unit 184 detect the human body on the basis of the detection result of the infrared sensor and the detection result of the ultrasonic sensor, and identify the detected region in which the human body exists.

[0055] Next, with reference to Fig. 4 again, the identification of the regions in which the parts of the human body exist by the part identification unit 184 is described with specific examples. In the example illustrated in Fig. 4, the human body is detected in the detection regions of four light receiving elements, that is, the uppermost light receiving element to the fourth light receiving element.

[0056] Specifically, first, the uppermost light receiving element detects the head of the human body. The head is exposed and has a higher skin temperature than other portions of the human body, for example, a skin temperature equal to or higher than 30 degrees Celsius. Therefore, the part identification unit 184 can identify the region to which the head of the human body belongs on the basis of the thermal image data acquired by the human body sensor 170. In more detail, the part identification unit 184 analyzes the thermal image data acquired by the uppermost light receiving element through scanning in the horizontal direction. When the shape of the heat source of which detected temperature is 30 degrees Celsius or more matches with the shape (for example, a circular shape) of the head of the human body stored in advance in the horizontal direction, the heat source is identified as the head.

[0057] The second light receiving element from the top detects the chest and the arms of the human body. In

most cases, the chest is covered with clothes and the skin is rarely exposed. For the arms, there are cases where the skin is exposed and cases where the skin is not exposed. The part identification unit 184 can determine whether the arms are exposed on the basis of the surface temperature detected by the human body sensor 170. Specifically, when the skin of the arms is exposed, a skin temperature that is equivalent to or slightly lower than the skin temperature of the head is detected at a position corresponding to the arms. This is because the arms may be colder than the head, and the temperature of the arms are detected to have a temperature lower than that of the head in that case.

[0058] The third light receiving element from the top detects the upper legs of the human body. In most cases, the upper legs are covered with clothes. Therefore, the surface temperature of the clothes is detected at a position corresponding to the upper legs. The surface temperature of the clothes is lower than the temperature of the skin. When the hands are put down on the sides of the upper legs, for example, a temperature that is equivalent to or lower than that of the head is detected at the position of the hands. The hands may be colder than the head. In that case, a temperature that is lower than that of the head is detected at the position of the hands.

[0059] The fourth light receiving element from the top detects the lower legs of the human body. When the human body is wearing clothing such as socks, the surface temperature of the clothing is detected at the position of the lower legs. When the feet are cold, a temperature that is even lower than the surface temperature of the clothing is detected at the corresponding to the lower legs regardless of whether the human body is wearing the clothing.

[0060] Also for the parts of the human body, that is, the chest, the arms, the upper legs, the lower legs, the hands, and the feet, the part identification unit 184 identifies the regions in which the parts exist by comparing and collating the shapes of the regions that are equal to or higher than a certain temperature and the shapes of the parts that are stored in advance with each other, for example, as with the head of the human body.

[0061] The description is continued with reference to Fig. 7 again. The age group determination unit 186 determines the age group of the human body on the basis of the surface temperature of the determination part of the human body. The determination part of the human body is a part that is identified by the part identification unit 184 as the determination part out of the parts of the human body. As the surface temperature of the determination part of the human body, the surface temperature detected by the human body sensor 170 that is the temperature detection means is used herein. In Embodiment 1, the age group determination unit 186 determines the age group of the human body on the basis of the amount of change of the surface temperature of the determination part of the human body per unit time.

[0062] The age groups determined by the age group determination unit 186 at least include adults and children. As age groups other than the adults and the children, elderly people are conceived, for example. In the following, an example in which there are two age groups, that is, adults and children is described.

[0063] Fig. 8 shows an example of the change of the temperatures of the feet of adults and children over time after the heating operation starts. Fig. 9 shows an example of the change of the temperatures of the heads of adults and children over time after the heating operation starts. As shown in Fig. 8 and Fig. 9, when the heating operation starts and as the room temperature rises, both temperatures of the feet and the heads of the adults and the children rise. At this time, for the temperature of the head, there is hardly any difference in the amount of change of the temperature between the adults and the children over the course of time as shown in Fig. 9.

[0064] Meanwhile, for the temperature of the feet, a difference can be seen in the amount of change of the temperature between the adults and the children over the course of time as shown in Fig. 8. That is, the amount of change of the temperature of the feet over time for children is smaller than the amount of change of the temperature of the feet over time for adults. The inventors have experimented on eight pairs of parents and children, and have calculated the amount of change of the foot temperature per unit time for the adults and the children. As a result, a significant difference has been observed at a significance level of 1% for both. Meanwhile, for the amount of change of the head temperature per unit time (Fig. 9), a significant difference has not been able to be observed between the children and the adults.

[0065] The result above is conceived to be obtained because the thermoregulation function of the autonomic nerve of children is undeveloped as compared to adults, and children are influenced by the ambient temperature in an easier manner than adults. That is, the temperature of the feet is easily influenced by the temperature of the floor in contact with the feet, and the floor temperature is lower than the room temperature when the heating operation is started. As a result, it can be conceived that it is difficult for the temperature of the feet of children that are more easily affected by the floor temperature that is lower than the room temperature to rise as compared to the temperature of the feet of adults.

[0066] Therefore, in Embodiment 1 of the present invention, the feet of the human body are specified in advance as the determination parts. That is, the part identification unit 184 identifies the parts of the feet of the human body detected by the human body detection unit 183. Then, the age group determination unit 186 determines the age group of the human body on the basis of the surface temperature of the feet of the human body detected by the human body sensor 170. In detail, the age group determination unit 186 determines the age group of the human body on the basis of the amount of change of the surface temperature of the feet that are the determination parts per unit time.

[0067] As described above, the amount of change of the temperature of the feet over time for children is smaller than the amount of change of the temperature of the feet over time for adults. Thus, the age group determination unit 186 determines that the age group of the human body is children when the amount of change of the surface temperature of the feet of the human body (determination part) per unit time is equal to or lower than a predetermined standard value α. Meanwhile, the age group determination unit 186 determines that the age group of the human body is adults when the amount of change of the surface temperature of the feet of the human body per unit time is not equal to or lower than the standard value α.

[0068] In Embodiment 1, the controller 180 obtains the amount of change of the surface temperature of the determination part per unit time, and hence includes the temperature storage unit 185. The temperature storage unit 185 stores therein the value of the surface temperature of the determination part of the human body (the feet herein) detected by the human body sensor 170 per unit time. The age group determination unit 186 calculates the amount of change of the surface temperature of the determination part per unit time with use of the value of the surface temperature of the determination part stored in the temperature storage unit 185. Then, the age group determination unit 186 determines whether the human body is an adult or a child by comparing the calculated amount of change of the surface temperature of the determination part per unit time and the abovementioned standard value α.

[0069] A case where the feet are specified as the determination parts has been described here. However, the part of the human body that is set as the determination part is not limited to the feet. Specifically, other than the feet, the hands can also be conceived to be specified as the determination parts as parts that have a large number of blood capillaries and actively exchange temperature with the outside of the human body, for example.

[0070] When the cooling operation starts, the human body temperature drops over the course of time. Therefore, during the cooling operation, the age group determination unit 186 only needs to determine whether the age group of the human body is children or adults in accordance with whether the absolute value of the amount of change of the surface temperature of the feet of the human body per unit time is equal to or lower than the abovementioned standard value α.

[0071] The air blow control unit 187 controls the abovementioned air blow mechanism on the basis of the age group of the human body determined by the age group determination unit 186 as above. The specific content of the control of the air blow mechanism based on the determination result of the age group of the human body is described next for the case of the heating operation and the case of the cooling operation. The control of the air blow mechanism based on the determination result of the age group of the human body described below may be performed in only one of or both of the heating operation and the cooling operation.

[0072] First, the case of the heating operation is described. When the temperature of the human body detected by the human body sensor 170 is lower than a heating standard temperature during the heating operation, the air blow control unit 187 controls the air blow mechanism so that the direction of the conditioned air is toward the position of the human body. When the temperature of the human body detected by the human body sensor 170 is equal to or higher than the heating standard temperature during the heating operation, the air blow control unit 187 controls the air blow mechanism so that the direction of the conditioned air is different from a direction toward the position of the human body, and performs so-called "person avoidance air blowing".

[0073] When the "person avoidance air blowing" is performed, it is desired that the air blow mechanism be controlled so that the distance between the human body and the air flow of the conditioned air is 0.3 m or more. It is preferred that the distance between the air flow of the conditioned air and the human body be set to be 0.3 m or more even at the nearest position. According to the setting, in this way, a case where the air flow hits the human body can be sufficiently suppressed even when the air flow of the conditioned air diffuses to a certain degree.

[0074] Next, the "heating standard temperature" used as a standard in the air blow control as above is described. The "heating standard temperature" of the human body is a temperature that is a criterion for whether the human body needs to be heated.

[0075] In Embodiment 1 of the present invention, the "heating standard temperature" is set in accordance with the age group determined by the age group determination unit 186. That is, specifically, in Embodiment 1 of the present invention, two temperatures, that is, an adult heating standard temperature and a child heating standard temperature may be set as the "heating standard temperature". The adult heating standard temperature is a standard value used when the age group determined by the age group determination unit 186 is adults. The child heating standard temperature is a standard value used when the age group determined by the age group determination unit 186 is children.

[0076] In Embodiment 1 of the present invention, the adult heating standard temperature and the child heating standard temperature are calculated with use of all or a part of the temperatures of the parts of the human body, that is, the head, the chest, the arms, the upper legs, the lower legs, the hands, and the feet when the part identification unit 184 individually identifies the parts of the human body, for example. At this time, values obtained by multiplying the temperatures of the parts by weighting predetermined factors may be used in the calculation. In that case, the weighting factors are set in advance, and are stored in the memory 182 and the like of the controller 180 in advance.

[0077] For the temperatures of the parts to be used in the calculation of the heating standard temperature, the surface temperatures of the parts detected by the human body sensor 170 are used, for example. The parts of the human body and the weighting factors used in the calculation of the adult heating standard temperature, and the parts of the human body and the weighting factors used in the calculation of the child heating standard temperature may be different from each other. Specifically, for example, the temperatures of the parts of the whole body of the human body may be used in the calculation of the adult heating standard temperature, and the temperatures of the parts of the upper body of the human body (the head, the chest, the arms, and the hands of the human body) may be used in the calculation of the child heating standard temperature.

[0078] As described above, the air blow control unit 187 sets the heating standard temperature in accordance with the age group determined by the age group determination unit 186, and controls the air blow mechanism. That is, the air blow control unit 187 controls the above-mentioned air blow mechanism on the basis of the age group of the human body determined by the age group determination unit 186.

[0079] When a plurality of human bodies are detected in the room, and temperatures of two or more human bodies are lower than the heating standard temperatures according to the age groups thereof, the air blow control unit 187 may control the air blow mechanism so that the direction of the conditioned air is toward the position of the two or more human bodies of which human body temperatures are lower than the heating standard temperatures according to the age groups thereof so as to be toward an intermediate point between the human bodies. The expression of the "plurality of human bodies" herein includes both of a combination of people in the same age group (an adult and an adult, and a child and a child), and a combination of people in different age groups (an adult and a child).

[0080] Next, the case of the cooling operation is described. When the temperature of the human body detected by the human body sensor 170 is equal to or higher than a cooling standard temperature during the cooling operation, the air blow control unit 187 controls the air blow mechanism so that the direction of the conditioned air is toward the position of the human body. When the temperature of the human body detected by the human body sensor 170 is lower than the cooling standard temperature during the cooling operation, the air blow control unit 187 controls the air blow mechanism so that the direction of the conditioned air is different from a direction toward the position of the human body, and performs so-called "person avoidance air blowing". At this time, as with the heating operation, it is desired that the air blow mechanism be controlled so that the distance between the human body and the air flow of the conditioned air is 0.3 m or more.

[0081] The "cooling standard temperature" of the human body is a temperature that is a criterion for whether the human body needs to be cooled. In Embodiment 1 of the present invention, the "cooling standard temperature" is set in accordance with the age group determined by the age group determination unit 186. That is, in Embodiment 1 of the present invention, two temperatures, that is, an adult cooling standard temperature and a child cooling standard temperature may be specifically set as the "cooling standard temperature". The adult cooling standard temperature is a standard value used when the age group determined by the age group determination unit 186 is adults. The child cooling standard temperature is a standard value used when the age group determined by the age group determination unit 186 is children.

[0082] The adult cooling standard temperature and the child cooling standard temperature are set as with the adult heating standard temperature and the child heating standard temperature. That is, the adult cooling standard temperature and the child cooling standard temperature are calculated with use of all or a part of the parts of the human body, that is, the head, the chest, the arms, the upper legs, the lower legs, the hands, and the feet, for example. At this time, values obtained by multiplying the temperatures of the parts by weighting predetermined factors may be used in the calculation. The parts of the human body and the weighting factors used in the calculation of the adult cooling standard temperature and the parts of the human body and the weighting factors used in the calculation of the child cooling standard temperature may be different from each other.

[0083] As described above, the air blow control unit 187 sets the cooling standard temperature in accordance with the age group determined by the age group determination unit 186, and controls the air blow mechanism. That is, the air blow control unit 187 controls the above-mentioned air blow mechanism on the basis of the age group of the human body determined by the age group determination unit 186.

[0084] Next, an example of the flow of the operation of the heating operation of the air conditioning apparatus 100 formed as above is described with reference to Fig. 10. When the air conditioning apparatus 100 starts the heating operation by the operation and the like on the operation display unit 190 by the user, the human body sensor 170 first starts the detection of the surface temperature and the human body detection unit 183 starts the detection of a human body on the basis of the detection result of the human body sensor 170 in Step S1. Next, in Step S2, the human body detection unit 183 checks whether a human body is detected on the basis of the detection result of the human body sensor 170. When a human body is not detected, the processing returns to Step S1. Meanwhile, when the human body detection unit 183 detects a human body, the processing proceeds to Step S3.

[0085] In Step S3, the air blow control unit 187 controls the air blow mechanism so that the conditioned air blows toward the position of the human body detected by the

human body detection unit 183. The heating operation is performed here, and hence the conditioned air that blows is warm air. After Step S3, the processing proceeds to Step S4.

[0086] In Step S4, the part identification unit 184 first identifies the region in which the human body detected by the human body detection unit 183 exists. Then, the part identification unit 184 identifies the determination part of the human body from the region in which the human body detected by the human body detection unit 183 exists. The determination parts of the human body are the feet of the human body here. When the part identification unit 184 identifies the determination parts, that is, the feet of the human body, the human body sensor 170 starts the detection of the temperature of the feet (determination parts) of the human body. The human body sensor 170 detects the temperature of the feet (determination parts) of the human body at certain time intervals, for example, per unit time. The temperature of the feet (determination parts) of the human body detected by the human body sensor 170 is stored in the temperature storage unit 185 as time-series data.

[0087] Next, in Step S5, the age group determination unit 186 first calculates the amount of change of the foot temperature per unit time on the basis of time-series data of the temperature of the feet (determination parts) of the human body stored in the temperature storage unit 185. Next, the age group determination unit 186 checks whether the calculated amount of change of the foot temperature of the human body per unit time is equal to or lower than the abovementioned standard value α. When the amount of change of the foot temperature of the human body per unit time is equal to or lower than the standard value α, the processing proceeds to Step S6.

[0088] In Step S6, the age group determination unit 186 determines that the age group of the human body is children. Then, the processing proceeds to Step S7, and the air blow control unit 187 first calculates the specific value of the child heating standard temperature, and sets the calculated child heating standard temperature as the heating standard temperature. Next, the air blow control unit 187 checks whether the temperature of the human body is equal to or higher than the child heating standard temperature. When the temperature of the human body is not equal to or higher than the child heating standard temperature, the processing proceeds to Step S8.

[0089] In Step S8, the air blow control unit 187 controls the air blow mechanism so that the conditioned air blows toward the position of the human body. After Step S8, the processing proceeds to Step S7, and the blowing of air toward the human body is continued until the temperature of the human body becomes equal to or higher than the child heating standard temperature.

[0090] Meanwhile, in Step S5, when the amount of change of the foot temperature of the human body per unit time is not equal to or lower than the standard value α, the processing proceeds to Step S9. In Step S9, the age group determination unit 186 determines that the age group of the human body is adults. Then, the processing proceeds to Step S10, and the air blow control unit 187 first calculates the specific value of the adult heating standard temperature, and sets the calculated adult heating standard temperature as the heating standard temperature. Next, the air blow control unit 187 checks whether the temperature of the human body is equal to or higher than the adult heating standard temperature. When the temperature of the human body is not equal to or higher than the adult heating standard temperature, the processing proceeds to Step S11.

[0091] In Step S11, the air blow control unit 187 controls the air blow mechanism so that the conditioned air blows toward the position of the human body. After Step S11, the processing returns to Step S10, and the blowing of air toward the human body is continued until the temperature of the human body becomes equal to or higher than the adult heating standard temperature.

[0092] The processing proceeds to Step S12 when the temperature of the human body is equal to or higher than the child heating standard temperature in Step S7. The processing also proceeds to Step S12 when the temperature of the human body is equal to or higher than the adult heating standard temperature in Step S10. In Step S12, the air blow control unit 187 performs so-called person avoidance air blowing. That is, the air blow mechanism is controlled so that the conditioned air blows in a direction different from the direction of the position of the human body detected by the human body sensor 170. Then, the series of operation flow ends, but Step S1 to Step S12 described above are repeatedly executed until the heating operation of the air conditioning apparatus 100 stops.

[0093] The operation of the heating operation has been described above, but the cooling operation is about the same as the above. That is, the operation when the air conditioning apparatus 100 starts the cooling operation by the operation and the like on the operation display unit 190 by the user is the same as the heating operation illustrated in Fig. 8 for Step S1 to Step S6, Step S8, Step S9, Step S11, and Step S12.

[0094] Then, in the case of the cooling operation, only Step S7 and Step S10 are different from the heating operation. That is, in Step S7 of the cooling operation, the air blow control unit 187 first calculates the specific value of the child cooling standard temperature, and sets the calculated child cooling standard temperature as the cooling standard temperature. Next, the air blow control unit 187 checks whether the temperature of the human body is equal to or higher than the child cooling standard temperature. When the temperature of the human body is equal to or higher than the child cooling standard temperature, the processing proceeds to Step S8. Meanwhile, when the temperature of the human body is not equal to or higher than the child cooling standard temperature, the processing proceeds to Step S12.

[0095] In Step S10 of the cooling operation, the air blow control unit 187 first the air blow control unit 187 calcu-

lates the specific value of the adult cooling standard temperature, and sets the calculated adult cooling standard temperature as the cooling standard temperature. Next, the air blow control unit 187 checks whether the temperature of the human body is equal to or higher than the adult cooling standard temperature. When the temperature of the human body is equal to or higher than the adult cooling standard temperature, the processing proceeds to Step S11. Meanwhile, when the temperature of the human body is not equal to or higher than the adult cooling standard temperature, the processing proceeds to Step S12.

[0096] The air conditioning apparatus 100 formed as above includes the human body detection unit 183 that detects the human body on the basis of the surface temperature detected by the human body sensor 170, the part identification unit 184 that identifies the determination part of the detected human body specified in advance, the age group determination unit 186 that determines the age group of the human body on the basis of the surface temperature of the determination part of the human body, and the air blow control unit 187 that controls the air blow mechanism on the basis of the determined age group of the human body.

[0097] Therefore, the age group of the user can be accurately determined in a manner that is independent of the height of the user, the conditioned air can be suitably blown in accordance with the age group of the user, and the comfort of the user can be enhanced. At this time, the age group of the user can be accurately determined with use of the human body sensor 170 such as an infrared sensor without using an image recognition technology and the like by photographing a face image of the user, and hence the cost necessary for manufacturing the product can be kept down.

[0098] Children and adults have different metabolic rates and thermogenesis rates, and hence may have different thermal sensations even in the same environment. In general, children are sensitive to heat as compared to adults (in particular, women). Therefore, in many cases, when a child and an adult woman are in a room in which the heating operation is performed at the same time, the adult woman feels cold when the preset temperature is adjusted for the child and the child feels hot when the preset temperature is adjusted for the adult woman on the contrary. According to the air conditioning apparatus 100 according to Embodiment 1 of the present invention, the standard temperature at which the "person avoidance air blowing" is performed can be changed on the basis of the age group of the human body determined by the age group determination unit 186. Therefore, even when a child and an adult of the same height are in the same room, the conditioned air can suitably blow for each of the child and the adult, and the comfort of the user can be enhanced.

[0099] Specifically, in the heating operation, a case where an adult that is miss-determined as a child feels cold by being avoided by the blowing air even when a sufficiently warm state for the adult is not reached can be suppressed. Further, in the cooling operation, a case where a child that is miss-determined as an adult feels hot by being avoided the blowing air even when a sufficiently cool state for the child is not reached can be suppressed. In addition, in the case of heating, the direction of the conditioned air can be switched to a direction other than the direction toward the human body and the heating can transition to the heating of the entire room after the temperature of the human body has sufficiently risen, for example. An effect of noise reduction can also be obtained by reducing the flowrate.

[0100] The configuration describe above determines the age group of the human body on the basis of the amount of change of the surface temperature of the human body per unit time, and sets the heating standard temperature or the cooling standard temperature in accordance with the determined age group. However, with regards to the abovementioned feature, the heating standard temperature or the cooling standard temperature may be directly set from the amount of change of the surface temperature of the human body without determining the age group of the human body in Embodiment 1.

[0101] That is, when a human body is identified from the distribution of the surface temperature detected from the human body sensor 170 that is the temperature detection means, the air conditioning apparatus 100 may set the direction of the conditioned air to the direction of the human body, and may keep the direction of the conditioned air to the direction of the human body until the surface temperature of the human body becomes the standard temperature. Then, the heating standard temperature or the cooling standard temperature that is the standard temperature at this time is set in accordance with the amount of change of the surface temperature of the human body.

[0102] In that case, for example, the controller 180 stores therein a table of the heating standard temperature or the cooling standard temperature corresponding to the amount of change of the surface temperature of the human body per unit time in advance. Then, the controller 180 refers to the content of the table, and sets the heating standard temperature or the cooling standard temperature from the detection result of the human body sensor 170.

[0103] Also in the configuration as above, suitable blowing of the conditioned air in accordance with the age group of the user can be realized in a manner that is independent of the height of the user, and the comfort of the user can be enhanced as with the case where the age group of the human body is determined and the heating standard temperature or the cooling standard temperature is set in accordance with the determined age group.

[0104] In the configuration above, the determination result of the age group determination unit may be displayed on the operation display unit 190. That is, the air

conditioning apparatus 100 may include a display unit that displays the determination result of the age group determination unit. In this way, the user can know how the age group of the user determined by the air conditioning apparatus 100 by checking the display of the operation display unit 190.

Embodiment 2

[0105] Fig. 11 is a flowchart according to Embodiment 2 of the present invention that illustrates the air blow control during the heating operation of the air conditioning apparatus.

[0106] Embodiment 2 described here uses the determination of the age group of the human body based on the height of the human body together with the configuration in Embodiment 1. That is, the human body sensor 170 detects the height of the detected human body, and the age group determination unit 186 first determines the age group from the height of the human body and determines the age group on the basis of the temperature of the determination part of the human body as described in Embodiment 1 when the age group cannot be determined with only the height. The air conditioning apparatus according to Embodiment 2 is described by mainly focusing on the differences from Embodiment 1.

[0107] First, the basic configuration included in the air conditioning apparatus 100 according to Embodiment 2 is similar to that of Fig. 1 to Fig. 6 described in Embodiment 1. The configuration of the controller 180 included in the air conditioning apparatus 100 according to Embodiment 2 is also basically the same as the configuration of Embodiment 1 illustrated in Fig. 7.

[0108] However, in Embodiment 2, the function of the age group determination unit 186 is different from that in Embodiment 1. That is, in Embodiment 2, the age group determination unit 186 first detects the height of the human body on the basis of the shape of the human body identified by the part identification unit 184. Then, the age group determination unit 186 determines the age group of the human body on the basis of the detected height of the human body.

[0109] For example, the age group determination unit 186 determines that the age group of the human body is children when the detected height of the human body is equal to or lower than a height standard value. The height standard value is set in advance in accordance with the setting place, the usage, and the like of the air conditioning apparatus 100 after individually considering those features. Specific examples of the height standard value include values such as 130 cm. Meanwhile, when the detected height of the human body is not equal to or lower than the height standard value, the age group determination unit 186 determines the age group of the human body on the basis of the surface temperature of the determination part of the human body. The determination of the age group of the human body based on the surface temperature of the determination part of the human body is completely the same as that in Embodiment 1 described above.

[0110] Other configurations are also similar to those in Embodiment 1, and hence detailed description thereof is omitted.

[0111] Next, an example of the flow of the operation of the heating operation of the air conditioning apparatus 100 formed as above is described with reference to Fig. 11. In the flowchart of Fig. 11, Step S1 to Step S3 are the same as Step S1 to Step S3 in the flowchart of Fig. 10, and hence description thereof is omitted. In Embodiment 2, the processing proceeds to Step S21 after Step S3.

[0112] In Step S21, the age group determination unit 186 detects the height of the human body on the basis of the shape of the human body identified by the part identification unit 184. The processing proceeds to Step S22 after Step S21.

[0113] In Step S22, the age group determination unit 186 checks whether the height of the human body detected in Step S21 is equal to or lower than the height standard value. When the height of the human body is equal to or lower than the height standard value, the processing proceeds to Step S6, and the age group determination unit 186 determines that the age group of the human body is children.

[0114] Meanwhile, when the height of the human body is not equal to or lower than the height standard value in Step S22, the processing proceeds to Step S4. Then, in Step S4 and steps thereafter, the age group determination unit 186 determines the age group on the basis of the temperature of the determination part of the human body. Step S4 to Step S12 are the same as Step S4 to Step S12 in the flowchart of Fig. 10, and hence description thereof is omitted.

[0115] The air conditioning apparatus 100 according to Embodiment 2 formed as above first tries to determine whether the age group of the human body is children on the basis of the height of the human body. Then, when it can be determined that the age group of the human body is children on the basis of the height of the human body, the age group of the human body is considered to be children at that time point. Meanwhile, when it cannot be determined that the age group of the human body is children on the basis of the height of the human body, the age group is determined on the basis of the temperature of the determination part of the human body as described in Embodiment 1.

[0116] Therefore, an effect similar to that of Embodiment 1 can be exhibited. In addition, when it can obviously be determined that the height of the human body is that of a child, the age group of the human body can be determined without identifying the determination part of the human body and determining the age group on the basis of the temperature of the determination part. As a result, the processing load on the controller 180 can be reduced. In particular, when the human body sensor 170 detects a plurality of human bodies, a significant en-

hancement in the processing speed of the controller 180 can be expected by reducing the processing load on the controller 180.

[0117] A case where the height standard value is set to a value with which the age group can be determined to be children and it is first determined whether the age group of the human body is children on the basis of the height of the human body has been described above. However, with regards to the abovementioned feature, the height standard value may be set to a value with which the age group can be determined to be adults, and it may be first determined whether the age group of the human body is adults on the basis of the height of the human body.

[0118] In that case, specific examples of the height standard value include values such as 170 cm. When the detected height of the human body is equal to or higher than the height standard value, the age group determination unit 186 determines that the age group of the human body is adults. Meanwhile, when the detected height of the human body is lower than the height standard value, the age group determination unit 186 determines that the age group of the human body on the basis of the surface temperature of the determination part of the human body.

[0119] As described above, particularly in the cooling operation, the air blow control that causes the air to blow less against adults that are generally more sensitive to cold as compared to children can be realized earlier by determining first whether the age group is adults with a height condition. Meanwhile, in the heating operation, the air blow control that causes the air to blow less against children that are generally sensitive to heat as compared to adults can be realized earlier by determining first whether the age group is children with the height condition.

Embodiment 3

[0120] Fig. 12 and Fig. 13 are diagrams according to Embodiment 3 of the present invention. Fig. 12 is a diagram showing an example of the change of the foot temperature of the human body during the heating operation of the air conditioning apparatus. Fig. 13 is a flowchart illustrating the air blow control during the heating operation of the air conditioning apparatus.

[0121] Embodiment 1 and Embodiment 2 described above determine the age group of the human body on the basis of the amount of change of the surface temperature of the determination part of the human body per unit time. Meanwhile, Embodiment 3 described here determines the age group of the human body on the basis of the amount of change of the surface temperature of the determination part of the human body when the room temperature changes by the unit of temperature in the configurations in Embodiment 1 or Embodiment 2 described above. The air conditioning apparatus according to Embodiment 3 is described below by mainly focusing on differences from Embodiment 1 while giving examples configured on the basis of Embodiment 1.

[0122] First, the basic configuration included in the air conditioning apparatus 100 according to Embodiment 3 is similar to that of Fig. 1 to Fig. 6 described in Embodiment 1. The configuration of the controller 180 included in the air conditioning apparatus 100 according to Embodiment 3 is also basically the same as the configuration in Embodiment 1 illustrated in Fig. 7.

[0123] However, in Embodiment 3, the function of the age group determination unit 186 is different from that in Embodiment 1. That is, in Embodiment 3, the age group determination unit 186 the age group determination unit 186 determines the age group of the human body on the basis of the amount of change of the surface temperature of the determination part of the human body when the room temperature changes by the unit of temperature.

[0124] Fig. 12 shows an example of a relationship between the room temperature and the temperatures of the feet of adults and children after the heating operation starts. When the heating operation starts and as the room temperature rises, the temperatures of the feet of the adults and the children rise. The inventors have found that, at this time, the amount of change of the temperature of the feet for children is smaller than the amount of change of the temperature of the feet for adults when the room temperature changes by the unit of temperature as shown in Fig. 12.

[0125] Therefore, in Embodiment 3 of the present invention, the feet of the human body are specified in advance as the determination parts as with Embodiment 1. That is, the part identification unit 184 identifies the parts of the feet of the human body detected by the human body detection unit 183. Then, the age group determination unit 186 determines the age group of the human body on the basis of the amount of change per unit time of the surface temperature of the feet that are the determination parts when the room temperature changes by the unit of temperature.

[0126] Specifically, when the amount of change of the surface temperature of the feet (determination parts) of the human body when the room temperature changes by the unit of temperature is equal to or lower than a predetermined standard value β, the age group determination unit 186 determines that the age group of the human body is children. Meanwhile, when the amount of change of the surface temperature of the feet of the human body when the room temperature changes by the unit of temperature is not equal to or lower than the standard value β, the age group determination unit 186 determines that the age group of the human body is adults.

[0127] In Embodiment 3, the amount of change of the surface temperature of the feet (determination parts) of the human body when the room temperature changes by the unit of temperature is acquired, and hence the air conditioning apparatus 100 includes room temperature detection means for detecting the room temperature. For example, a temperature sensor may be provided on the

housing 110 of the air conditioning apparatus 100, the air intake port 111, and the like as the room temperature detection means. The temperature sensor may be provided in a section different from the housing 110 of the air conditioning apparatus 100, and the temperature sensor and the air conditioning apparatus 100 may be connected to each other so as to be able to communicate with each other.

[0128] When a surface of the floor or a surface of a wall is included in the temperature detection target range of the human body sensor 170, the temperature of the surface of the floor or the surface of a wall in the room detected by the infrared sensor included in the human body sensor 170 may be used as the room temperature. In that case, the human body sensor 170 serves both as the temperature detection means for detecting the surface temperature within the predetermined detection range, and the room temperature detection means for detecting the room temperature.

[0129] In Embodiment 3, the temperature storage unit 185 stores therein a value of the surface temperature of the determination part of the human body (the feet herein) detected by the human body sensor 170 and a value of the room temperature detected by the room temperature detection means every certain amount of time. The age group determination unit 186 calculates the amount of change of the surface temperature of the determination part when the room temperature changes by the unit of temperature with use of the value of the surface temperature of the determination part and the value of the room temperature stored in the temperature storage unit 185. Then, the age group determination unit 186 determines whether the human body is an adult or a child by comparing the calculated amount of change of the surface temperature of the determination part and the abovementioned standard value β with each other.

[0130] Other configurations are also similar to those in Embodiment 1, and hence detailed description thereof is omitted.

[0131] Next, an example of the flow of the operation of the heating operation of the air conditioning apparatus 100 formed as above is described with reference to Fig. 13. In the flowchart of Fig. 13, Step S1 to Step S4 are the same as Step S1 to Step S4 in the flowchart of Fig. 10, and hence description thereof is omitted. In Embodiment 3, the processing proceeds to Step S31 after Step S4.

[0132] In Step S31, the age group determination unit 186 the age group determination unit 186 calculates the amount of change of the foot temperature when the room temperature changes by the unit of temperature on the basis of time-series data of the temperature of the feet (determination parts) of the human body and the room temperature stored in the temperature storage unit 185. Next, the age group determination unit 186 checks whether the calculated amount of change of the foot temperature of the human body is equal to or lower than the abovementioned standard value β. When the amount of change of the foot temperature of the human body is equal to or lower than the standard value β, the processing proceeds to Step S6. Meanwhile, when the amount of change of the foot temperature of the human body is not equal to or lower than the standard value β, the processing proceeds to Step S9. Step S6 to Step S12 are the same as Step S6 to Step S12 in the flowchart of Fig. 10, and hence description thereof is omitted.

[0133] The air conditioning apparatus 100 formed as above determines the age group of the human body on the basis of the amount of change of the surface temperature of the determination part of the human body when the room temperature changes by the unit of temperature. When the amount of change of the surface temperature of the determination part of the human body per unit time is used as in Embodiment 1, the amount of change of the temperature per unit time is small when the preset temperature is close to the room temperature in the heating and the cooling, and hence there is a fear that the situation is unsuitable for the determination of the age group. Meanwhile, when the amount of change of the surface temperature of the determination part of the human body when the room temperature changes by the unit of temperature is used, the case as above does not happen, and the age group can be determined on the basis of the surface temperature of the determination part in a larger number of cases.

[0134] In the configurations in Embodiment 1 to Embodiment 3 described above, only one or both of the air blow control during the heating operation and the air blow control during the cooling operation may be employed. The air blow control during the heating operation and the air blow control during the cooling operation in different embodiments may be employed in combination with each other.

[0135] When the air blows toward the human body, the air may blow not toward the entire human body but toward a particular part of the human body. Specifically, the air may intensively blow toward the feet of the human body, for example. In addition, the air may intensively blow toward the hands of the human body, for example.

[0136] The blowing of air may be controlled with use of temperature information of the room temperature, the temperature at the air intake port 111 of the air conditioning apparatus, the temperature at the air outlet port 112, and the like in addition to the floor temperature and the skin temperature. At this time, the amount of change, the change rate, or the like per certain amount of time of the temperature information can also be used.

[Industrial Applicability]

[0137] The present invention can be used in an air conditioning apparatus including an air blow mechanism capable of changing the direction of conditioned air that blows from an air outlet port.

[Reference Signs List]

[0138]

100	Air conditioning apparatus
110	Housing
111	Air intake port
112	Air outlet port
113	Front surface panel
121	Heat exchanger
122	Air blow fan
131	Left near-side vertical wind direction plate
132	Right near-side vertical wind direction plate
141	Left far-side vertical wind direction plate
142	Right far-side vertical wind direction plate
150	Horizontal wind direction plate
161	Stepping motor for left-side vertical wind direction plate
162	Stepping motor for right-side vertical wind direction plate
163	Stepping motor for horizontal wind direction plate
170	Human body sensor
171	Cylindrical metallic can
172	Stepping motor for sensor
173	Light distribution viewing angle
180	Controller
181	Processor
182	Memory
183	Human body detection unit
184	Part identification unit
185	Temperature storage unit
186	Age group determination unit
187	Air blow control unit
190	Operation display unit

Claims

1. An air conditioning apparatus comprising:

a housing having an air intake port and an air outlet port;
a heat exchanger arranged in the housing, the heat exchanger configured to exchange heat with air sucked from the air intake port and to generate conditioned air;
an air blow mechanism arranged in the housing, the air blow mechanism configured to generate air flow which sucks air from the air intake port and blows the conditioned air from the air outlet port, the air blow mechanism capable of changing a direction of the conditioned air which blows from the air outlet port;
temperature detection means configured to detect surface temperature in a predetermined detection range, and
a controller configured to control the air blow mechanism in accordance with a detection result of the temperature detection means, wherein
when a human body is identified from a distribution of the surface temperature which the temperature detection means detect, the direction of the conditioned air is set to the direction of the human body and is kept to the direction of the human body until surface temperature of the human body becomes a standard temperature, and
the standard temperature is set in accordance with an amount of change of the surface temperature of the human body.

2. The air conditioning apparatus according to claim 1, wherein the controller includes:

a human body detection unit configured to detect a human body on the basis of the detection result of the temperature detection means;
a part identification unit configured to identify a determination part of the detected human body that is specified in advance;
an age group determination unit configured to determine an age group of the human body on a basis of a surface temperature of the determination part of the human body; and
an air blow control unit configured to control the air blow mechanism on a basis of the determined age group of the human body.

3. The air conditioning apparatus according to claim 2, wherein the age group includes at least adults or children.

4. The air conditioning apparatus according to claim 3, wherein the age group determination unit determines that the age group of the human body is children when an amount of change of the surface temperature of the determination part of the human body per unit time is equal to or lower than a predetermined standard value.

5. The air conditioning apparatus according to claim 3, further comprising room temperature detection means configured to detect a room temperature, wherein
the age group determination unit determines that the age group of the human body is children when an amount of change of the surface temperature of the determination part of the human body when the room temperature changes by a unit of temperature is equal to or lower than a predetermined standard value.

6. The air conditioning apparatus according to any one of claims 3 to 5, wherein the age group determination unit:

determines that the age group of the human body is children when a detected height of the human body is equal to or lower than a predetermined height standard value; and
determines the age group of the human body based on the surface temperature of the determination part of the human body when the detected height of the human body is not equal to or lower than the height standard value.

7. The air conditioning apparatus according to any one of claims 3 to 5, wherein the age group determination unit:

determines that the age group of the human body is adults when a detected height of the human body is equal to or higher than a predetermined height standard value; and
determines the age group of the human body based on the surface temperature of the determination part of the human body when the detected height of the human body is not equal to or higher than the height standard value.

8. The air conditioning apparatus according to any one of claims 2 to 7, further comprising a display unit configured to display a determination result of the age group determination unit.

FIG. 1

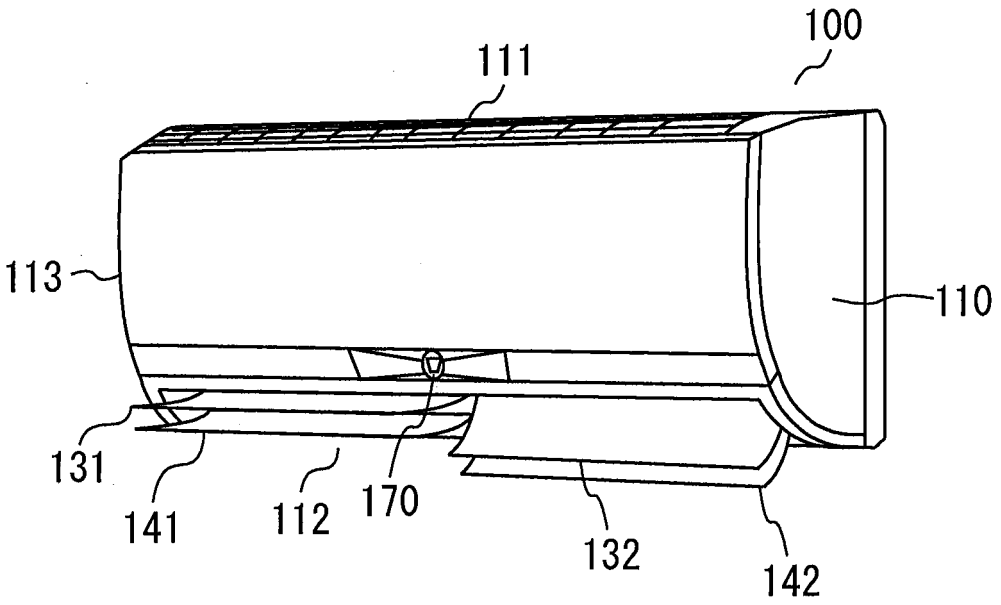

100
111
113
110
131
141
112
170
132
142

FIG. 2

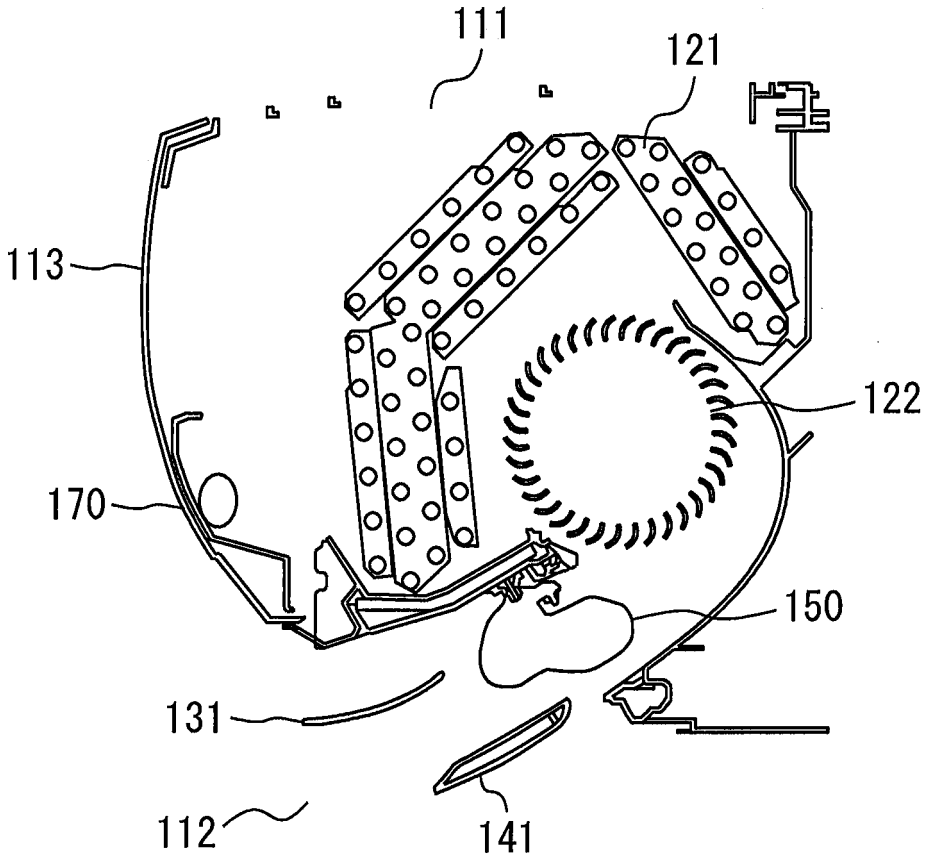

111
121
113
122
170
150
131
112
141

FIG. 3

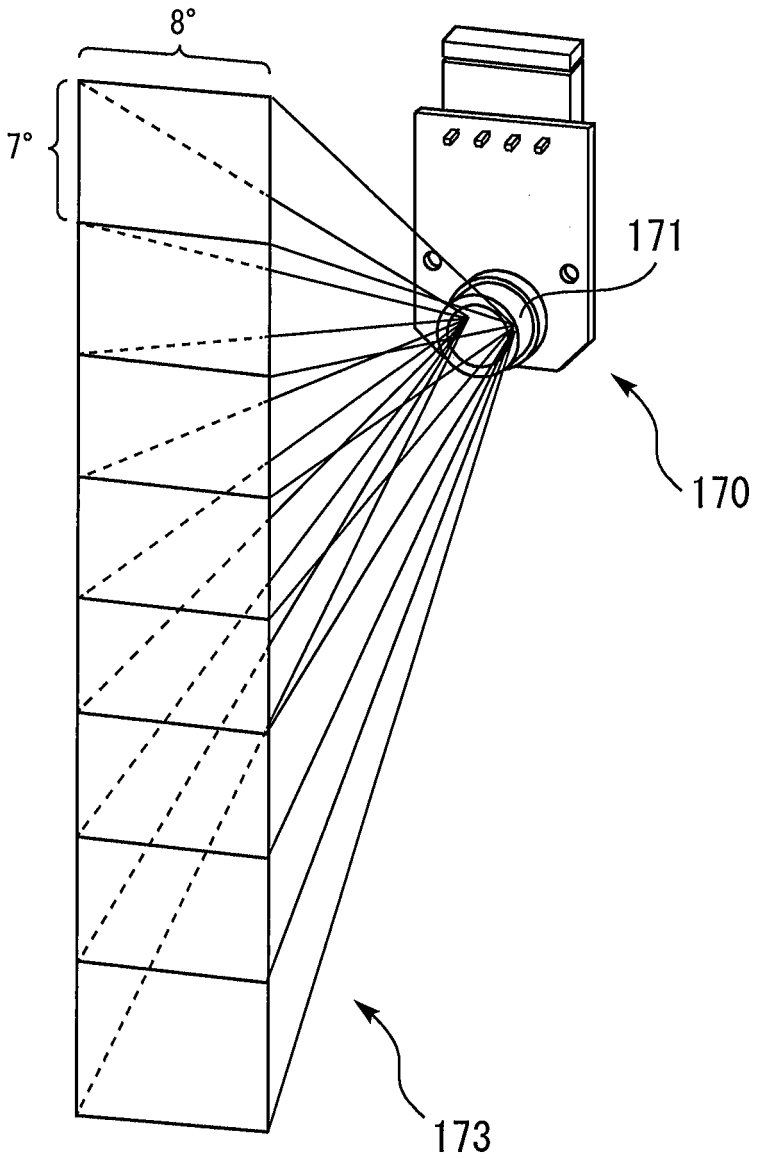


FIG. 4

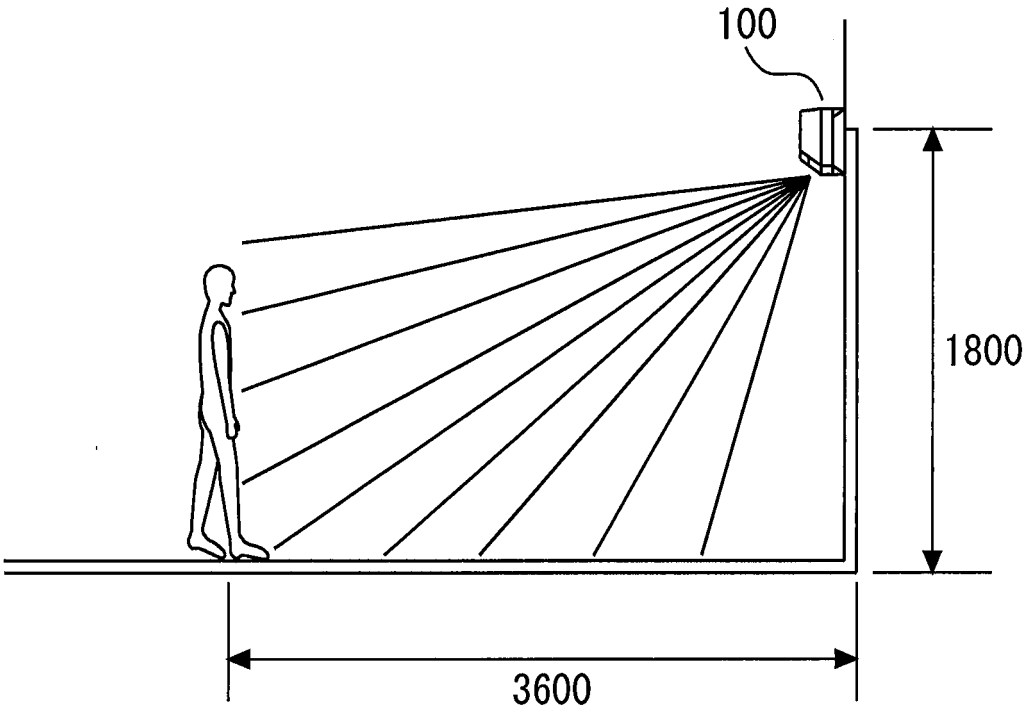


FIG. 5

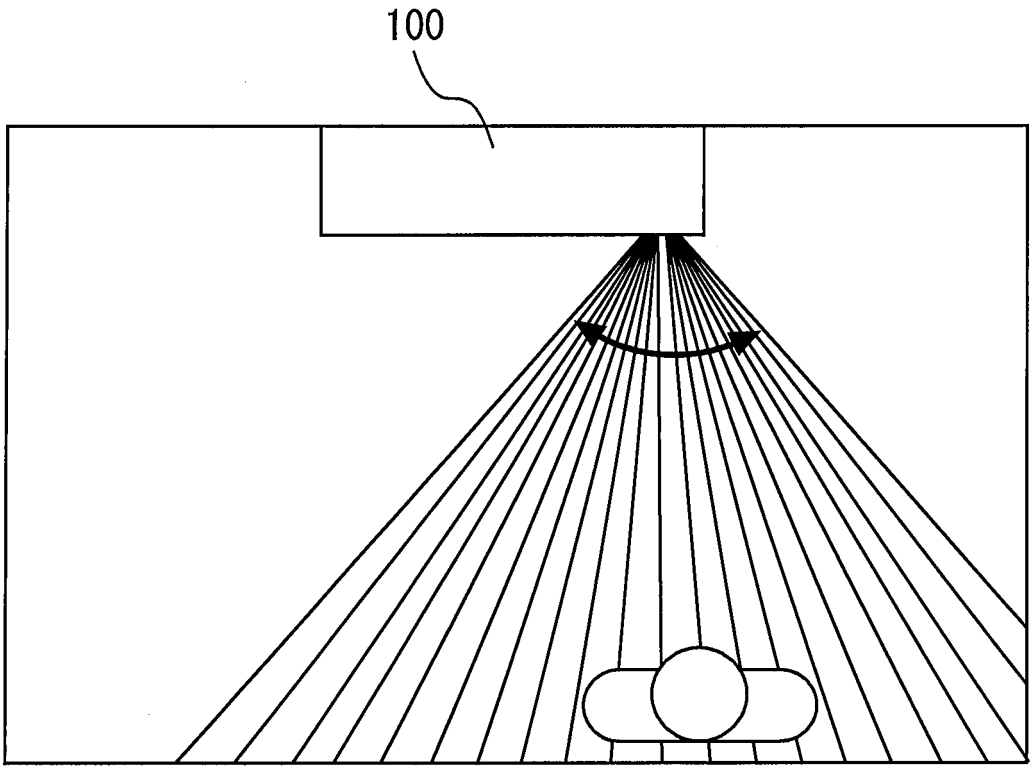
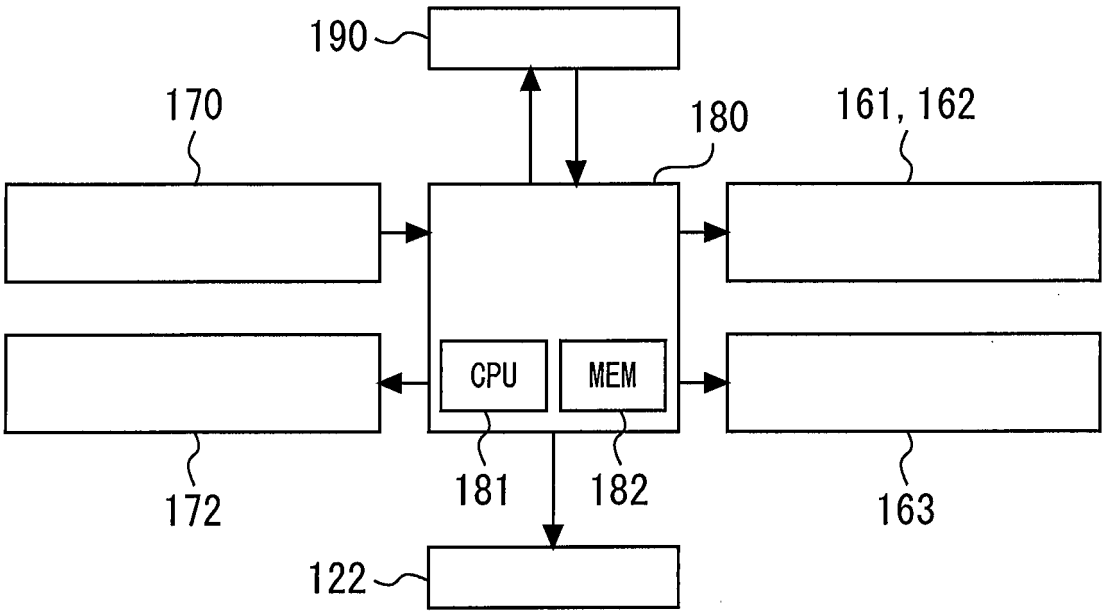
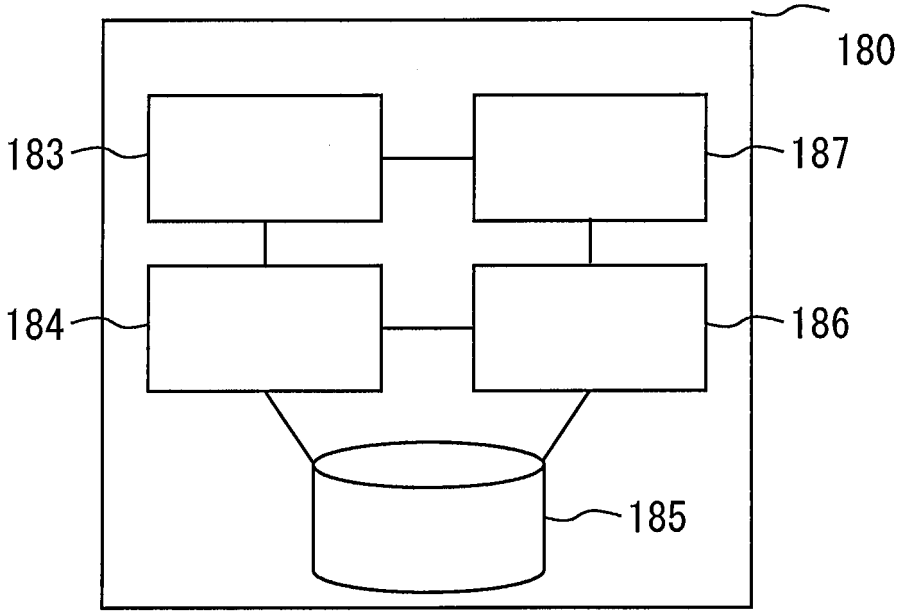


FIG. 6



122: AIR BLOW FAN
161, 162: STEPPING MOTOR FOR VERTICAL WIND DIRECTION PLATE
163: STEPPING MOTOR FOR HORIZONTAL WIND DIRECTION PLATE
170: HUMAN BODY SENSOR
172: STEPPING MOTOR FOR SENSOR
180: CONTROLLER
190: OPERATION DISPLAY UNIT

FIG. 7



180: CONTROLLER
183: HUMAN BODY DETECTION UNIT
184: PART IDENTIFICATION UNIT
185: TEMPERATURE STORAGE UNIT
186: AGE GROUP DETERMINATION UNIT
187: AIR BLOW CONTROL UNIT

FIG. 8

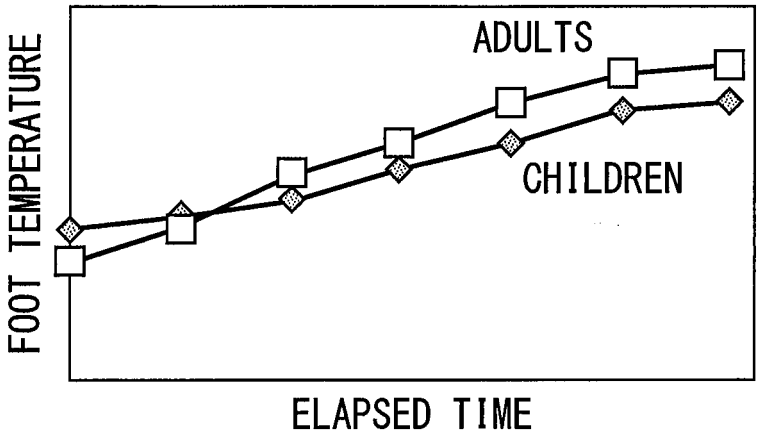

ADULTS
CHILDREN
FOOT TEMPERATURE
ELAPSED TIME

FIG. 9

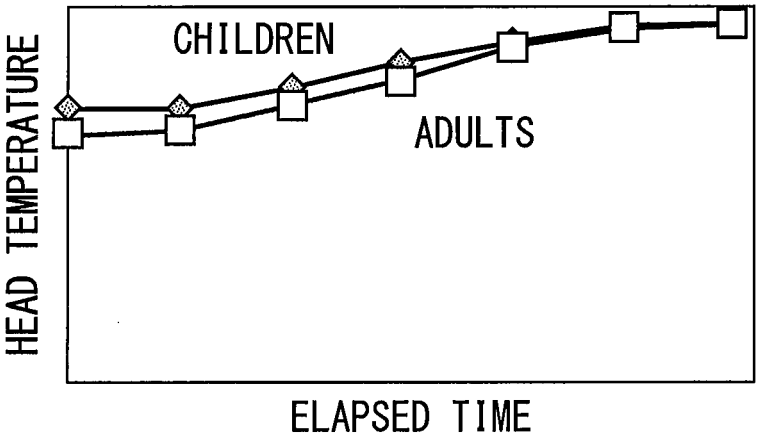

CHILDREN
ADULTS
HEAD TEMPERATURE
ELAPSED TIME

FIG. 10

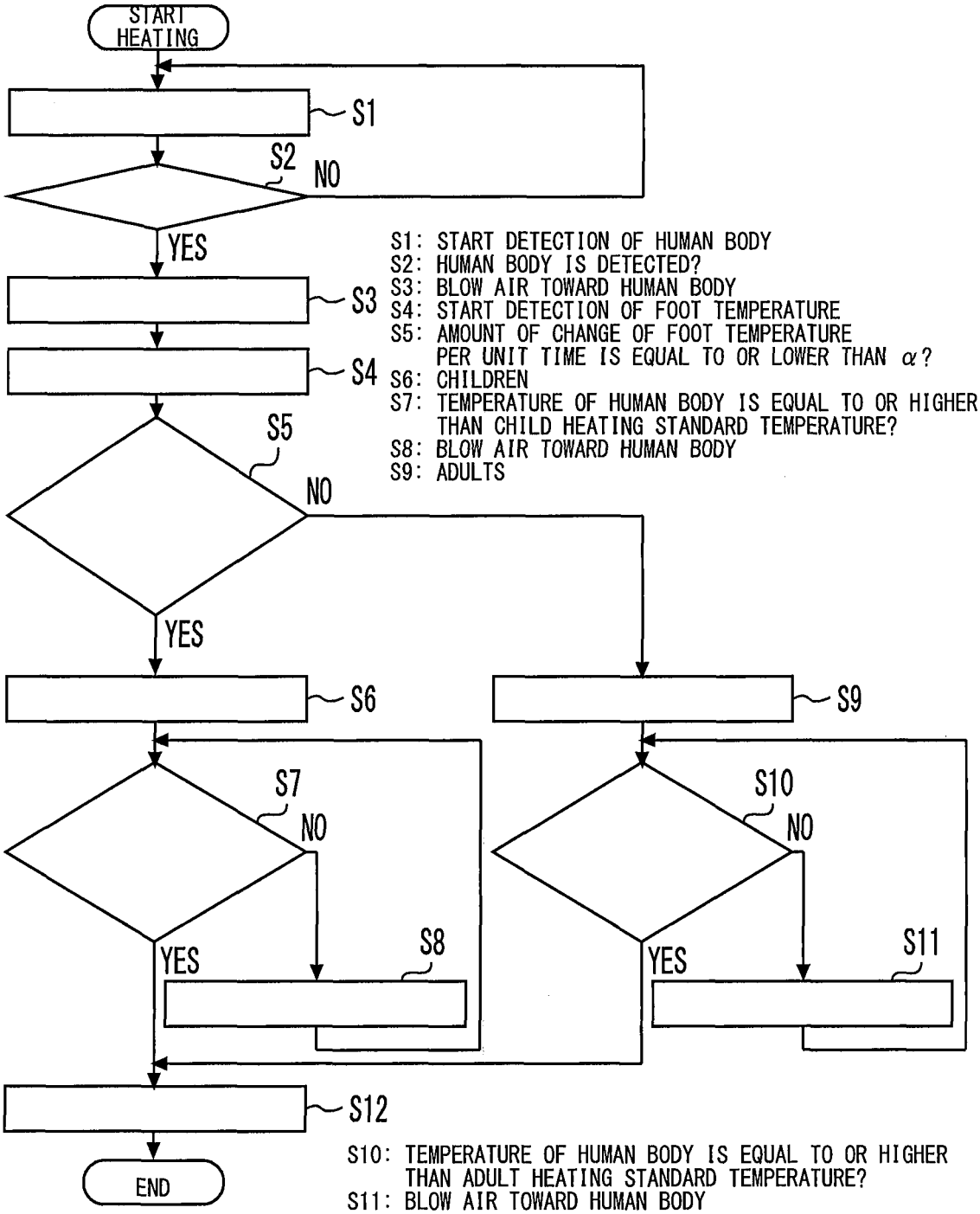

START HEATING
S1
S2
NO
YES
S3
S4
S5
NO
YES
S6
S9
S7
NO
S10
NO
YES
S8
YES
S11
S12
END
S1: START DETECTION OF HUMAN BODY
S2: HUMAN BODY IS DETECTED?
S3: BLOW AIR TOWARD HUMAN BODY
S4: START DETECTION OF FOOT TEMPERATURE
S5: AMOUNT OF CHANGE OF FOOT TEMPERATURE PER UNIT TIME IS EQUAL TO OR LOWER THAN α?
S6: CHILDREN
S7: TEMPERATURE OF HUMAN BODY IS EQUAL TO OR HIGHER THAN CHILD HEATING STANDARD TEMPERATURE?
S8: BLOW AIR TOWARD HUMAN BODY
S9: ADULTS
S10: TEMPERATURE OF HUMAN BODY IS EQUAL TO OR HIGHER THAN ADULT HEATING STANDARD TEMPERATURE?
S11: BLOW AIR TOWARD HUMAN BODY
S12: PERSON AVOIDANCE AIR BLOWING

FIG. 11

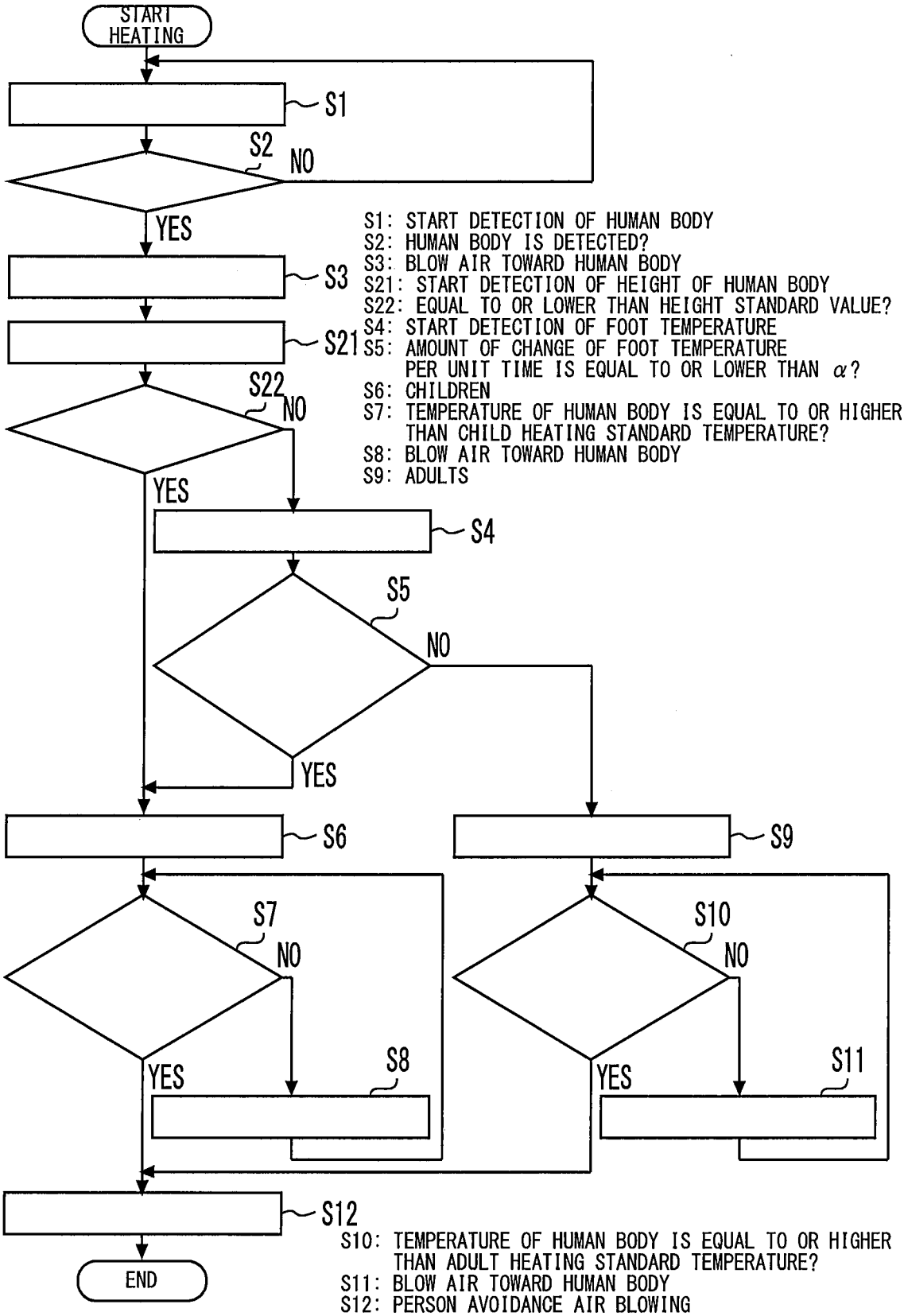

START HEATING
S1
S2
NO
YES
S3
S21
S22
NO
YES
S4
S5
NO
YES
S6
S9
S7
NO
S10
NO
YES
S8
YES
S11
S12
END
S1: START DETECTION OF HUMAN BODY
S2: HUMAN BODY IS DETECTED?
S3: BLOW AIR TOWARD HUMAN BODY
S21: START DETECTION OF HEIGHT OF HUMAN BODY
S22: EQUAL TO OR LOWER THAN HEIGHT STANDARD VALUE?
S4: START DETECTION OF FOOT TEMPERATURE
S5: AMOUNT OF CHANGE OF FOOT TEMPERATURE PER UNIT TIME IS EQUAL TO OR LOWER THAN α?
S6: CHILDREN
S7: TEMPERATURE OF HUMAN BODY IS EQUAL TO OR HIGHER THAN CHILD HEATING STANDARD TEMPERATURE?
S8: BLOW AIR TOWARD HUMAN BODY
S9: ADULTS
S10: TEMPERATURE OF HUMAN BODY IS EQUAL TO OR HIGHER THAN ADULT HEATING STANDARD TEMPERATURE?
S11: BLOW AIR TOWARD HUMAN BODY
S12: PERSON AVOIDANCE AIR BLOWING

FIG. 12

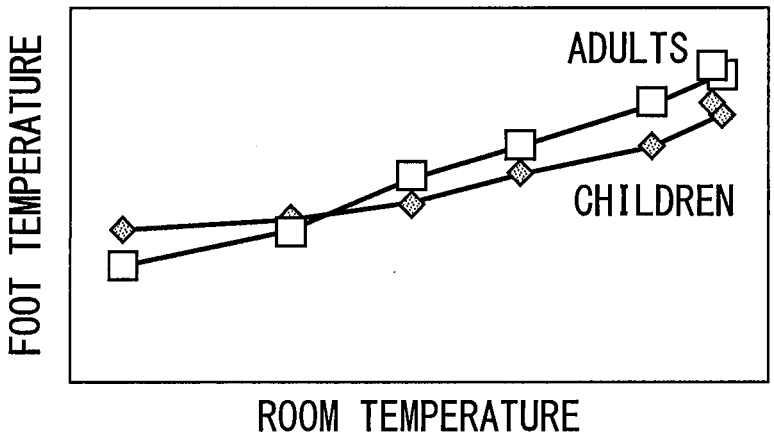
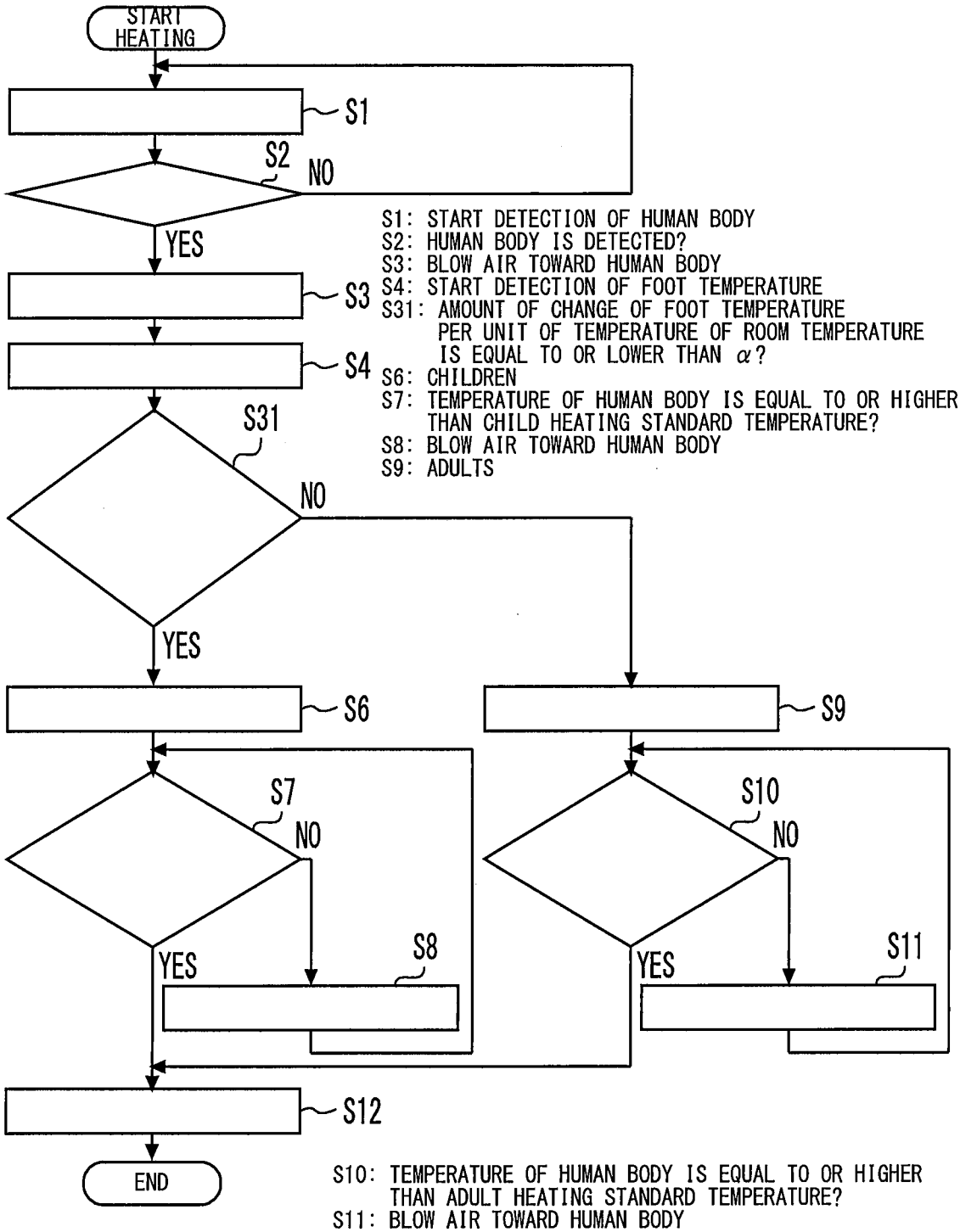


FIG. 13


START HEATING
S1
S2
NO
YES
S3
S4
S31
NO
YES
S6
S9
S7
NO
S10
NO
YES
S8
YES
S11
S12
END
S1: START DETECTION OF HUMAN BODY
S2: HUMAN BODY IS DETECTED?
S3: BLOW AIR TOWARD HUMAN BODY
S4: START DETECTION OF FOOT TEMPERATURE
S31: AMOUNT OF CHANGE OF FOOT TEMPERATURE PER UNIT OF TEMPERATURE OF ROOM TEMPERATURE IS EQUAL TO OR LOWER THAN α?
S6: CHILDREN
S7: TEMPERATURE OF HUMAN BODY IS EQUAL TO OR HIGHER THAN CHILD HEATING STANDARD TEMPERATURE?
S8: BLOW AIR TOWARD HUMAN BODY
S9: ADULTS
S10: TEMPERATURE OF HUMAN BODY IS EQUAL TO OR HIGHER THAN ADULT HEATING STANDARD TEMPERATURE?
S11: BLOW AIR TOWARD HUMAN BODY
S12: PERSON AVOIDANCE AIR BLOWING

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/080112

A. CLASSIFICATION OF SUBJECT MATTER
F24F11/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F11/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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.
A	JP 2006-112680 A (Tokyo Institute of Technology), 27 April 2006 (27.04.2006), paragraphs [0001] to [0042]; fig. 1 to 10 (Family: none)	1-8
A	JP 2009-139010 A (Sharp Corp.), 25 June 2009 (25.06.2009), paragraphs [0065] to [0072] (Family: none)	1-8

☒ 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
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"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
02 December 2016 (02.12.16)	13 December 2016 (13.12.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/080112

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 2015-164844 A (Panasonic Intellectual Property Corporation of America), 17 September 2015 (17.09.2015), paragraphs [0012] to [0487]; fig. 1 to 58 & US 2015/0204556 A1 paragraphs [0117] to [0564]; fig. 1 to 58 & WO 2014/185033 A1 & CN 104471362 A	1-8
A	JP 5-240488 A (Daikin Industries, Ltd.), 17 September 1993 (17.09.1993), paragraphs [0023] to [0027] (Family: none)	1-8
A	JP 2010-60250 A (Panasonic Corp.), 18 March 2010 (18.03.2010), paragraphs [0001] to [0041] (Family: none)	1-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013024534 A **[0003]**