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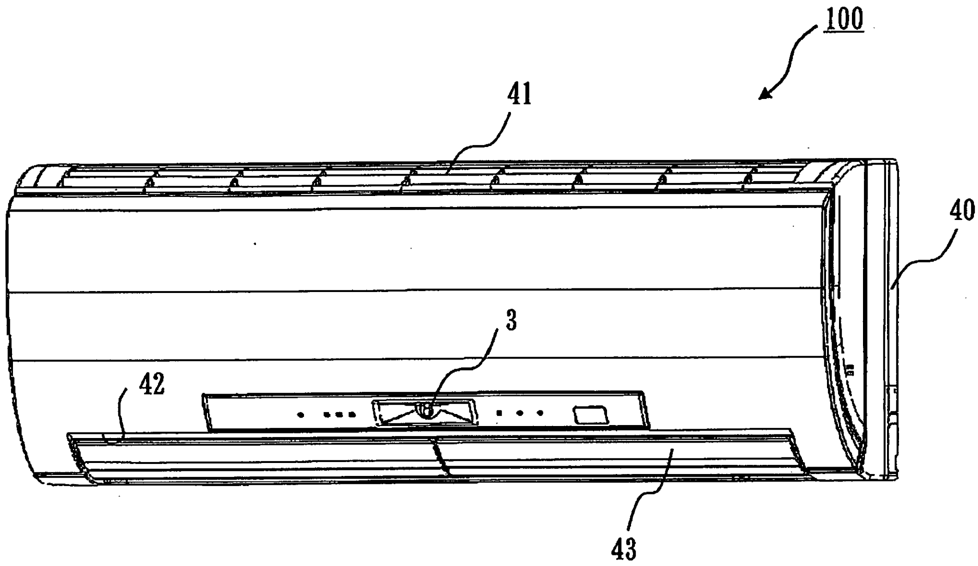
(54) **Air conditioner**

(57) To provide an air conditioner that displays the whole content of energy saving advice at once on the interface part of a remote controller and incorporates an acceleration sensor in the remote controller, so that pre-operation information from a main body can be received instantly only by raising the remote controller. An air conditioner includes an almost box-shaped main body, a controller, a remote controller, and a communication part. The almost box-shaped main body has a suction port to take in room air and a blowing port to blow out conditioned air. The controller controls operation of the air conditioner. The remote controller includes a remote controller main body, an acceleration sensor provided in the remote controller main body, and an interface display part constituted by a full-dot liquid crystal display, and allows a user to control operation of the air conditioner. The communication part performs bidirectional communication between the controller and the remote controller. When the user raises the remote controller, pre-operation information is displayed on the interface display part.

Fig. 1



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Description

Technical Field

[0001] The present invention relates to an air conditioner and, more particularly, to an air conditioner that displays the whole content of energy conservation advice on the interface part of a remote controller, and incorporates an acceleration sensor in the remote controller, so that the pre-operation information (pre-operation indoor environment information, running cost (future electricity rate) information) and the like from the main body can be received instantly only by raising the remote controller.

Background Art

[0002] As the functions of the air conditioner advance more and more and the number of value-added devices incorporated in the air conditioner increases, the number of buttons of a remote controller which transmits signals to execute/stop the advanced functions increases.
[0003] In order to cope with the increase in number of buttons located within the limited space of the remote controller, for example, an interface manipulation part between the remote controller and the user is formed by:

(1) reducing the size of each button;
(2) reducing the space among button arrays; and
(3) employing an interface that allows selection of a large number of functions with a single button.

[0004] Accordingly, the words that explain the functions of the buttons depend on the button size and the space among the buttons. This makes it difficult for the user to select the functions of the air conditioner which are necessary to realize comfortable air conditioning. Simultaneously, the function explanatory words printed on or near the button may not be sufficient for the user to understand what function is to be realized when he or she presses a specific button. Consequently, the user may give up selecting a specific function at all.
[0005] In view of this situation, a remote controller for an air conditioner that can reduce the operation load for the user has been proposed (see, e.g., Patent Literature 1).

Prior Art Literature

[Patent Literature]

[0006] Patent Literature 1: JP 2009-127960A

Summary of Invention

Technical Problem

[0007] The remote controller of the air conditioner described in Patent Literature 1 is not provided with an interface display constituted by a full-dot liquid crystal display. Even if it is provided with one, its screen size is small as compared to the segment-display main display that can only display a limited content within a limited region. Therefore, the whole content of the energy saving advice of the air conditioner cannot be displayed in detail.
[0008] No literature has been found that discloses the technical idea of incorporating an acceleration sensor in the remote controller of an air conditioner, so that the pre-operation information (pre-operation indoor environment information, running cost (future electricity rate) information) from the main body can be received instantly only by raising the remote controller.
[0009] The present invention has been made to solve the above problem, and has as its object to provide an air conditioner that displays the whole content of the energy saving advice at once on the interface part of the remote controller, and incorporates an acceleration sensor in the remote controller, so that the pre-operation information (pre-operation indoor environment information, running cost (future electricity rate) information) from the main body can be received instantly only by raising the remote controller.

Solution to Problem

[0010] An air conditioner according to the present invention includes
an almost box-shaped main body having a suction port to take in room air and a blowing port to blow out conditioned air,

a controller that controls operation of the air conditioner,
a remote controller that includes a remote controller main body, an acceleration sensor provided in the remote controller main body, and an interface display part constituted by a full-dot liquid crystal display, and allows a user to control operation of the air conditioner, and
a communication part that performs bidirectional communication between the controller and the remote controller, wherein when the user raises the remote controller, pre-operation information is displayed on the interface display part.

Advantageous Effects of Invention

[0011] An air conditioner according to the present invention incorporates an acceleration sensor in its remote controller, so that pre-operation information (pre-operation indoor environment information, running cost (future electricity rate) information) from the main body can be received instantly only by raising the remote controller.

Brief Description of Drawings

[0012]

Fig. 1 refers to the first embodiment, and is a perspective view of an air conditioner 100:
Fig. 2 refers to the first embodiment, and is a perspective view of the air conditioner 100:
Fig. 3 refers to the first embodiment, and is a longitudinally sectional view of the air conditioner 100:
Fig. 4 refers to the first embodiment, and shows an infrared sensor 3 and the light-distribution view angles of light-receiving elements;
Fig. 5 refers to the first embodiment, and is a perspective view of a casing 5 that stores the infrared sensor 3;
Fig. 6 refers to the first embodiment, and includes perspective views of the vicinity of the infrared sensor 3, in which (a) shows a state in which the infrared sensor 3 has moved to the right end, (b) shows a state in which the infrared sensor 3 has moved to the center, and (c) shows a state in which the infrared sensor 3 has moved to the left end;
Fig. 7 refers to the first embodiment, and shows vertical light-distribution view angles on the longitudinal section of the infrared sensor 3;
Fig. 8 refers to the first embodiment, and shows thermogram data of a room where a housewife 12 carries an infant 13;
Fig. 9 refers to the first embodiment, and is a table showing the numbers of *tatami* mats and corresponding room sizes (areas) during cooling operation specified by the capacity bands of the air conditioner 100;
Fig. 10 refers to the first embodiment, and is a table which specifies the sizes (areas) of the floor surface for the capacity bands with reference to the maximum areas of the sizes (areas) of the respective capacity bands shown in Fig. 9:
Fig. 11 refers to the first embodiment, and shows the length and width limit values of the room shape when the capacity is 2.2 kw;
Fig. 12 refers to the first embodiment, and is a table showing length and width conditions obtained from the capacity bands of the air conditioner 100;
Fig. 13 refers to the first embodiment, and shows conditions when the air conditioner is installed at the center, with the capacity being 2.2 kw;
Fig. 14 refers to the first embodiment, and shows a case wherein the air conditioner has a capacity of 2.2 kw and is installed at the left corner (when seen from the user);
Fig. 15 refers to the first embodiment, and shows the positional relationship between the floor surface and wall surfaces on the thermogram data, with the installation position button of the remote controller being set at the center, when the air conditioner 100 has a capacity of 2.2 kw;
Fig. 16 refers to the first embodiment, and shows the flow of calculating the room shape based on the temperature non-uniformity;
Fig. 17 refers to the first embodiment, and shows the line between upper and lower pixels that forms the boundary between the wall surfaces and floor surface on the thermogram data of Fig. 15;
Fig. 18 refers to the first embodiment, and shows detection of a temperature between one pixel and two pixels (a total of three pixels) below and above the position of a boundary line 60 set in Fig. 17;
Fig. 19 refers to the first embodiment, and shows a pixel detection region in which pixels detected by a temperature non-uniformity boundary detection unit 53, which detects the temperature non-uniformity boundary, as exceeding the threshold value, or exceeding the maximum value of the gradient, are marked with black;
Fig. 20 refers to the first embodiment, and shows the detection result of the boundary line based on the temperature non-uniformity;
Fig. 21 refers to the first embodiment, and shows the projection image onto the floor surface 18 of coordinate points (X, Y) of elements plotted below the boundary line on the thermogram data, as they are transformed into floor surface

coordinate points by the floor surface coordinate transformation unit 55;

Fig. 22 refers to the first embodiment, and shows a region 66 of target pixels for detection of the temperature difference in the vicinity of the position of a front wall surface 19 under the initial preset condition that the installation position button of the remote controller is set to the center, with the capacity being 2.2 kw;

Fig. 23 refers to the first embodiment, and shows the wall surface positions of the front wall surface 19 and floor surface 18 which are obtained by calculating, in Fig. 21 that shows the projection images onto the floor surface 18 of the boundary line element coordinates of the respective thermogram data, the mean values of the dispersion element coordinate points of elements in Fig. 22 that detect the vicinity of the position of the front wall surface 19;

Fig. 24 refers to the first embodiment, and shows the flow of calculating the room shape based on the human body detection position log;

Fig. 25 refers to the first embodiment, and shows the determination result of human body detection based on the difference between thermogram data indicating the presence of a human body and the immediately preceding background image with respect to the threshold values A and B;

Fig. 26 refers to the first embodiment, and shows results obtained by coordinate-transforming human body detection points obtained from differences of the thermogram data by the floor surface coordinate transformation unit 55 into human position coordinate points (X, Y), and accumulating the human position coordinate points (X, Y) for each of X-axis and Y-axis;

Fig. 27 refers to the first embodiment, and shows the determination result of the room shape based on the human body position log;

Fig. 28 refers to the first embodiment, and shows the result of human body detection position log for an L-shaped living room;

Fig. 29 refers to the first embodiment, and shows the counts which are accumulated in the floor surface region (X coordinate) for the lateral-direction X coordinate;

Fig. 30 refers to the first embodiment, in which the floor surface region (X coordinate) obtained in Fig. 29 is divided into three equal regions A, B, and C so as to examine in which region the maximum cumulative value is present, and to obtain the maximum value and minimum value of each region simultaneously;

Fig. 31 refers to the first embodiment, and shows a case wherein when a count equal to or larger than 90% of the maximum cumulative value is present at y count locations or more (the number in sub-regions decomposed by every 0.3 m) in the region C, it is determined that the maximum cumulative value of the cumulative data is present in the region C,;

Fig. 32 refers to the first embodiment, and shows a case wherein when a count equal to or larger than 90% of the maximum cumulative value are present at γ count locations or more (the number in sub-regions decomposed by every 0.3 m) in the region A, it is determined that the maximum cumulative value of the cumulative data is present in the region A;

Fig. 33 refers to the first embodiment, in which when the room is determined to have an L shape, portions where the count is equal to or larger than 50% of the maximum cumulative value are searched;

Fig. 34 refers to the first embodiment, and shows the boundary points between the floor surface and wall surfaces of the L-shaped room obtained in Fig. 33, and the shape of the floor surface region of the L-shaped room obtained from the floor surface regions of the X coordinate and Y coordinate where the count is equal to or larger than the threshold value A;

Fig. 35 refers to the first embodiment, and shows a flow that integrates three types of information;

Fig. 36 refers to the first embodiment, and shows the room shape obtained as the result of temperature non-uniformity detection when the capacity is 2.8 kw and when the installation position button of the remote controller is set to the center;

Fig. 37 refers to the first embodiment, and shows a case wherein, when the distance to the left wall surface 16 exceeds the maximum distance to the left wall, it is reduced to the maximum position of the left wall;

Fig. 38 refers to the first embodiment, and shows a case wherein, when the room shape area of Fig. 37 after correction exceeds a maximum area value of 19 m^2, it is adjusted by reducing the distance to the front wall surface 19 until the resultant area becomes equal to the maximum area value of 19 m^2;

Fig. 39 refers to the first embodiment, and shows a case wherein, when the distance to the left wall surface does not reach the minimum distance to the left wall, it is adjusted by enlarging it until the region defined by the left wall that is at the minimum distance;

Fig. 40 refers to the first embodiment, and shows a case wherein whether or not a room shape area after correction falls within an appropriate area range is determined by calculating the room shape;

Fig. 41 refers to the first embodiment, and shows the obtained results of the Y coordinate Y_front which is the distance to the front wall surface 19, the X coordinate X_right of the right wall surface 17, and the X coordinate X_left of the left wall surface 16, which represent the distances to the respective wall surfaces;

Fig. 42 refers to the first embodiment, and shows a state wherein the respective coordinate points on the floor surface boundary line, which are obtained from the distances to the front wall surface 19 and between the right and left walls (right wall surface 17, left wall surface 16) calculated under the integral conditions, are projected in a reverse manner onto the thermogram data;

Fig. 43 refers to the first embodiment, and shows the respective wall regions that are surrounded by thick lines;

Fig. 44 refers to the first embodiment, and shows the front-side region of the floor surface 18 which is divided into five segments (A1, A2, A3, A4, and A5) in the right-to-left direction;

Fig. 45 refers to the first embodiment, and shows the deep-side region of the floor surface 18 which is divided into three segments (B1, B2, and B3) in the back-and-forth direction;

Fig. 46 refers to the first embodiment, and shows examples of radiation temperature obtained by calculation;

Fig. 47 refers to the first embodiment, and shows a flowchart of the operation of detecting a curtain open/closed state;

Fig. 48 refers to the first embodiment, and shows thermogram data obtained when the window curtain on the right wall surface is open during heating;

Fig. 49 refers to the first embodiment, and is a flowchart formed by adding an information presentation unit to the flowchart of Fig. 47;

Fig. 50 refers to the first embodiment, and is an outer appearance view of the air conditioner 100 having a display 100a;

Fig. 51 refers to the first embodiment, and is a plan view showing the remote controller 200;

Fig. 52 refers to the first embodiment, and is a flowchart showing the contents displayed on the guidance display 220 of the remote controller 200;

Fig. 53 refers to the first embodiment, and shows a state wherein OPERATION START IN PREPARATION is displayed on the guidance display 220 of the remote controller 200;

Fig. 54 refers to the first embodiment, and shows a state wherein APPROACHING PRESET TEMPERATURE is displayed on the guidance display 220 of the remote controller 200;

Fig. 55 refers to the first embodiment, and shows a state wherein RESTORE TO INITIAL SETTING? is displayed on the guidance display 220 of the remote controller 200;

Fig. 56 refers to the first embodiment, and shows the display contents displayed on the guidance display 220 of the remote controller 200 when the air, conditioner 100 determines that the influence of cold radiation from the window is large during heating;

Fig. 57 refers to the first embodiment, and shows the display contents displayed on the guidance display 220 of the remote controller 200 when the outdoor temperature has dropped below the indoor preset temperature during cooling while the user is not aware of it;

Fig. 58 refers to the first embodiment, and shows the detailed contents of energy saving advice obtained from the infrared sensor 3 during cooling/dry operation;

Fig. 59 refers to the first embodiment, and shows the detailed contents of energy saving advice obtained from the infrared sensor 3 during heating;

Fig. 60 refers to the first embodiment, and is an outer appearance front view of a remote controller 300 according to a modification;

Fig. 61 refers to the first embodiment, and shows a state wherein an interface display 301 of the remote controller 300 displays the scene select window and the cursor is at RAPID COOLING;

Fig. 62 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays the scene select window and the cursor has moved to CLEAN AIR;

Fig. 63 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays the scene select window and the cursor has moved to GUEST;

Fig. 64 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays the normal window;

Fig. 65 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays the scene select window (menu window) to indicate the transition of states until the user selects a scene, in which the cursor is at RAPID COOLING in (a), AVOID WIND in (b), and GUEST in (c);

Fig. 66 refers to the first embodiment, and shows states wherein the interface display 301 of the remote controller 300 displays the scene content in (d), and the detailed scene setting in (e) to (g);

Fig. 67 refers to the first embodiment, and shows an animation of a scene select item CLEAN AIR;

Fig. 68 refers to the first embodiment, and shows an animation of a scene select item SKIN CARE;

Fig. 69 refers to the first embodiment, and is an enlarged view of the scene select window when a plurality of scene select contents are selected;

Fig. 70 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays a combinational scene select item such as RAPID COOLING & CLEAN AIR;

Fig. 71 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of INFORM OF MODERATE ENERGY SAVING EFFECT;

Fig. 72 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of DETECTS HUMAN MOTION. WHEN PEOPLE DO NOT MOVE AROUND FOR LONGER THAN PREDETERMINED PERIOD OF TIME, SUGGESTS PEOPLE'S STAYING TOGETHER LEADS TO ENERGY SAVING OPERATION;
Fig. 73 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of CHECKS OPEN/CLOSING STATE OF DOOR/ CURTAIN BY INFRARED SENSOR BASED ON SUMMERTIME SUNLIGHT AND WINTERTIME LOW RADIATION. SUGGESTS CLOSING DOOR/CURTAIN;
Fig. 74 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of QUICK ADVICE FOR USER COLD AT FOOT;
Fig. 75 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of ADVICE WHEN ACTIVE HUMAN MOTION IS DETECTED;
Fig. 76 is a comparative side view of a general remote controller 400 with a cover closed;
Fig. 77 is a comparative side view of the general remote controller 400 with the cover open;
Fig. 78 is a comparative front view of the general remote controller 400 with the cover closed;
Fig. 79 is a comparative front view of the general remote controller 400 with the cover open;
Fig. 80 refers to the first embodiment, and is an outer appearance front view of a remote controller 500 according to a modification;
Fig. 81 refers to the first embodiment, and is an outer appearance side view of the remote controller 500 according to the modification;
Fig. 82 refers to the first embodiment, and is a conceptual front view showing the internal structure of the remote controller 500 according to the modification;
Fig. 83 refers to the first embodiment, and shows the basic structure of an acceleration sensor 520;
Fig. 84 refers to the first embodiment, and shows the indoor environment information (information 1) displayed on an interface display 501 of the remote controller 500;
Fig. 85 refers to the first embodiment, and shows the electricity rate information (information 2) at the start of recommended operation displayed on the interface display 501 of the remote controller 500;
Fig. 86 refers to the first embodiment, and is an outer appearance view of the air conditioner 100 having the display 100a which indicates that when the user raises the remote controller 500, the color of an ECO lamp 20 of the main body is changed to indicate that the remote controller 500 and the air conditioner main body perform bidirectional information communication;
Fig. 87 refers to the first embodiment, and is an outer appearance view of the air conditioner 100 which indicates that the remote controller 500 and the air conditioner main body perform bidirectional information communication, by turning on three LEDs 550a, 550b, and 550c in turn;
Fig. 88 is an enlarged view of a portion X of Fig. 87;
Fig. 89 refers to the first embodiment, and is an outer appearance view of the air conditioner 100 which indicates that the remote controller 500 and the air conditioner main body perform bidirectional information communication, by turning on a plurality of (three) LEDs 560 in turn;
Fig. 90 is an enlarged view of a portion Y of Fig. 89;
Fig. 91 refers to the first embodiment, and shows how the power consumptions are summed and stored at different memory locations in accordance with the time zones of midnight, morning, day, and night;
Fig. 92 refers to the first embodiment, and is a table showing the rate of change of energy saving depending on the body-sensible temperature difference; and
Fig. 93 refers to the first embodiment, and is a table showing the rate of change of energy saving depending on the humidity difference.

Description of Embodiments

[0013] Embodiment 1 First, the outline of an air conditioner (indoor unit) according to this embodiment will be described. The air conditioner (indoor unit) is provided with an infrared sensor which detects temperature while scanning a temperature detection target range, and detects the presence of a human being or heat-generating equipment by detecting a heat source using the infrared sensor, thus performing control operation well.

[0014] Normally, the indoor unit is installed at a high location on the wall of a room. The lateral installation location of the indoor unit on the wall varies. The indoor unit may be installed at almost the center of the wall in the right-to-left direction, or to be close to the left or right wall seen from the indoor unit. In this specification, the right-to-left direction of the room is defined as "the right-to-left direction seen from the indoor unit (an infrared sensor 3)" hereinafter.

[0015] The overall structure of an air conditioner 100 (indoor unit) will be described with reference to Figs. 1 to 3. Both

Figs. 1 and 2 are outer-appearance perspective views of the air conditioner 100 observed in different directions, and differ from each other in the following respects. In Fig. 1, vertical flaps 43 (two vertical wind direction control plates provided on the right and left sides, respectively) are closed. In Fig. 2, the vertical flaps 43 are open to expose internal horizontal flaps 44 (a large number of right-to-left wind direction control plates).

[0016] Figs. 1 to 3 show the first embodiment, in which Figs. 1 and 2 are perspective views of the air conditioner 100, and Fig. 3 is a longitudinally sectional view of the air conditioner 100.

[0017] As shown in Figs. 1 to 3, a suction port 41 through which room air is taken in is formed in the upper surface of an almost box-shaped indoor unit housing 40 (defined as the main body) of the air conditioner 100 (indoor unit).

[0018] An outlet port 42 through which conditioned air (air that is cooled, heated, or dehumidified) is blown out is formed in the lower portion of the front surface of the air conditioner 100. The outlet port 42 is provided with the vertical flaps 43 and horizontal flaps 44 which control the wind direction of the blowing air. The vertical flaps 43 control the vertical wind direction of the blowing air, and the horizontal flaps 44 control the horizontal wind direction of the blowing air.

[0019] At the lower front surface of the indoor unit housing 40, the infrared sensor 3 is arranged above the outlet port 42. The infrared sensor 3 is attached to face downward at a descending vertical angle of about 24.5°.

[0020] The descending vertical angle is an angle formed by the central axis of the infrared sensor 3 and the horizontal line. In other words, the infrared sensor 3 is attached to face downward at an angle of about 24.5° with respect to the horizontal line.

[0021] As shown in Fig. 3, the air conditioner 100 (indoor unit) incorporates a blower 45 (e.g., a cross-flow fan). An almost inverted V-shaped heat exchanger 46 surrounds the blower 45.

[0022] The almost inverted V-shaped heat exchanger 46 is constituted by an upper-front heat exchanger part 46a, a lower-front heat exchanger part 46b, and a rear heat exchanger part 46c.

[0023] The heat exchanger 46 is connected to a compressor and the like loaded in an outdoor unit (not shown) to form a refrigerating cycle. The heat exchanger 46 serves as an evaporator in cooling operation, and as a condenser in heating operation.

[0024] The room air is taken in by the blower 45 through the suction port 41, and heat-exchanges with the refrigerant of the refrigerating cycle, to generate conditioned air (air that is cooled, heated, or dehumidified). The conditioned air passes through the blower 45 and is blown out to the indoor space through the outlet port 42.

[0025] At the outlet port 42, the vertical flaps 43 and horizontal flaps 44 control the vertical and horizontal wind directions. In Fig. 3, the vertical flaps 43 are closed.

[0026] Fig. 4 refers to the first embodiment, and shows the infrared sensor 3 and the light-distribution view angles of light-receiving elements. As shown in Fig. 4, in the infrared sensor 3, eight light-receiving elements (not shown) are vertically arranged in an array inside a metal casing 1. A lens window (not shown) to pass infrared rays therethrough is formed in the upper surface of the metal casing 1. A light-distribution view angle 2 of each light-receiving element is 7° in the vertical direction and 8° in the horizontal direction. Although the light-distribution view angle 2 of each light-receiving element is 7° in the vertical direction and 8° in the horizontal direction in Fig. 4, the light-distribution view angle 2 is not limited to these specific values. The number of light-receiving elements change in accordance with the light-distribution view angles 2 of the light-receiving elements. It suffices as far as the product of the vertical light-distribution view angle of each light-receiving element and the number of light-receiving elements is constant.

[0027] In Fig. 4, as the vertical light-distribution view angle of each light-receiving element is 7° and the number of light-receiving elements arranged in an array in the vertical direction is eight, their product is 56. Accordingly, for example, the vertical light-distribution view angle of each light-receiving element may be 4°, and the number of light-receiving elements arranged in an array in the vertical direction may be 14.

[0028] Fig. 5 refers to the first embodiment, and is a perspective view of a casing 5 that stores the infrared sensor 3. Fig. 5 shows the vicinity of the infrared sensor 3 seen from the rear side (from inside the air conditioner 100). As shown in Fig. 5, the infrared sensor 3 is stored in the casing 5. A stepping motor 6 which drives the infrared sensor 3 is arranged above the casing 5. An attachment 7 integral with the casing 5 is fixed to the lower front surface of the air conditioner 100, so that the infrared sensor 3 is mounted on the air conditioner 100. With the infrared sensor 3 being mounted on the air conditioner 100, the stepping motor 6 and casing 5 stand vertically. Inside the casing 5, the infrared sensor 3 is attached to face downward at a descending vertical angle of about 24.5°.

[0029] A stepping motor is a synchronous electric motor that operates in synchronism with pulse power, and is called a pulse motor as well accordingly. As the stepping motor can realize accurate positioning control with a simple circuit configuration, it is employed often for, e.g., positioning a device.

[0030] Fig. 6 refers to the first embodiment, and includes perspective views of the vicinity of the infrared sensor 3, in which (a) shows a state in which the infrared sensor 3 has moved to the right end, (b) shows a state in which the infrared sensor 3 has moved to the center, and (c) shows a state in which the infrared sensor 3 has moved to the left end. The infrared sensor 3 is driven by the stepping motor 6 to pivot within a predetermined angular range in the right-to-left direction (such rotational driving will be described as "move" in this specification). As shown in Fig. 6, the infrared sensor 3 moves from the right end (a) to the left end (c) via almost the center (b). As the infrared sensor 3 reaches the left end (c), it reverses in the opposite direction and continue moving. The infrared sensor 3 repeats this movement. The infrared sensor 3 detects the temperature of a temperature detection target while scanning the temperature detection target range of the room in the right-to-left direction.

[0031] How to acquire the thermogram data of the walls and floor of the room by using the infrared sensor 3 will be described. The infrared sensor 3 and the like are controlled by a microcomputer programmed with a predetermined operation. The microcomputer programmed with the predetermined operation will be defined as a "controller". In the following description, a description that the controller (the microcomputer programmed with the predetermined operation) performs each control operation will be omitted.

[0032] When acquiring the thermogram data of the walls and floor of the room, the infrared sensor 3 is moved in the right-to-left direction by the stepping motor 6. Every time the stepping motor 6 has driven for a movable angle (the rotational driving angle of the infrared sensor 3) of 1.6°, it stops the infrared sensor 3 for a predetermined period of time (0.1 to 0.2 sec).

[0033] After the infrared sensor 3 is stopped, at a lapse of a predetermined period of time (a time shorter than 0.1 to 0.2 sec), the detection results (thermogram data) of the eight light-receiving elements of the infrared sensor 3 are fetched.

[0034] When fetching of the detection results of the infrared sensor 3 is ended, the stepping motor 6 is driven (for the movable angle of 1.6°) again, and stopped. Then, the detection results (thermogram data) of the eight light-receiving elements of the infrared sensor 3 are fetched by the same operation.

[0035] The above operation is performed repeatedly. The thermogram data corresponding to the detection range is computed based on the detection results obtained by the infrared sensor 3 at 94 locations in the right-to-left direction.

[0036] The thermogram data is fetched by stopping the infrared sensor 3 each time the stepping motor 6 has moved through the movable angle of 1.6°, i.e., at a total of 94 locations. Hence, the movable range in the right-to-left direction (the angular range of rotational driving in the right-to-left direction) of the infrared sensor 3 is about 150.4°.

[0037] Fig. 7 refers to the first embodiment, and shows the vertical light-distribution view angles on the longitudinal section of the infrared sensor 3. Fig. 7 shows, with the air conditioner 100 being installed at the height of 1,800 mm above the room floor surface, the vertical light-distribution view angles on the longitudinal section of the infrared sensor 3 including the eight light-receiving elements vertically arranged in an array.

[0038] The angle of 7° shown in Fig. 7 is the vertical light-distribution view angle of one light-receiving element.

[0039] The angle of 37.5° in Fig. 7 is the angle, measured from the wall on which the air conditioner 100 is mounted, of the region that does not fall within the vertical view region of the infrared sensor 3. If the descending vertical angle of the infrared sensor 3 is 0°, the angle of 37.5° will be 90° - 4 (the number of light-receiving elements below the horizontal level) x 7° (the vertical light-distribution view angle of each light-receiving element) = 62°. With the infrared sensor 3 of this embodiment, as the descending vertical angle is 24.5°, the above angle becomes 62° - 24.5° = 37.5°.

[0040] Fig. 8 refers to the first embodiment, and shows thermogram data of a room where a housewife 12 carries an infant 13. Fig. 8 shows the thermogram data as the computation result of a scene of a life where the housewife 12 carries the infant 13 in a room of an eight-*tatami*-mat size, based on a detection result obtained by moving the infrared sensor 3 in the right-to-left direction.

[0041] The thermogram data shown in Fig. 8 is acquired on a cloudy winter day. Accordingly, the temperature of a window 14 is as low as 10 to 15°C. The temperatures of the housewife 12 and infant 13 are highest. Particularly, the temperature of the upper half body of each of the housewife 12 and infant 13 is 26 to 30°C. In this manner, by moving the infrared sensor 3 in the right-to-left direction, for example, the temperature information on the respective portions of the room can be acquired.

[0042] A room shape detection means (space recognition/detection) will be described which determines the room shape based on the overall judgment of the capacity bands of the air conditioner, information on the temperature difference (temperature non-uniformity) between the floor surface and wall surfaces which occurs during air-conditioning, and the human body detection log.

[0043] The floor surface size within the air-conditioning area which is under air conditioning is obtained from the thermogram data acquired by the infrared sensor 3, and the wall surface positions within the air-conditioning area on the thermogram are obtained.

[0044] The regions of the floor surface and wall surfaces (the wall surfaces refer to the front wall surface and the right and left wall surfaces seen from the air conditioner 100) can be seen on the thermogram. Accordingly, the average wall-surface temperature of each wall surface can be obtained, and a highly accurate body-sensitive temperature, which reflects the wall surface temperature detected on the thermogram with respect to the human body, can be obtained.

[0045] The means that obtains the floor surface size on the thermogram data enables accurate floor surface size detection and room shape detection if the following three types of information are integrated:

(1) the room shape based on the initial preset value and the shape limit value which is obtained from the capacity band of the air conditioner 100 and the setting of the installation position button of the remote controller;
(2) the room shape based on the temperature non-uniformity of the floor and walls occurring during the operation

of the air conditioner 100; and
(3) the room shape calculated from the human body detection position log.

[0046] Fig. 9 refers to the first embodiment, and is a table showing the appropriate numbers of *tatami* mats and corresponding room sizes (areas) during cooling operation specified by the capacity bands of the air conditioner 100. The capacity bands of the air conditioner 100 correspond to the different reference sizes of the rooms to be air-conditioned. As shown in Fig. 9, when the air conditioner 100 has a capacity of 2.2 kw, the appropriate number of *tatami* mats during cooling operation is six to nine. The room size (area) of six to nine *tatami* mats is equivalent to 10 to 15 m^2.

[0047] Fig. 10 refers to the first embodiment, and is a table that specifies the sizes (areas) of the floor surface for the capacity bands with reference to the maximum areas of the sizes (areas) of the respective capacity bands shown in Fig. 9. When the capacity is 2.2 kw, the maximum size (area) of Fig. 9 is 15 m^2. If the ratio of the length to width is 1 : 1, from calculation of the square root of 15 m^2, the length and the width are each 3.9 m (3.873 m). The maximum and minimum lengths and the maximum and minimum widths are determined from the lengths and widths obtained by changing the ratio of the length to width within the range of 1 : 2 to 2 : 1 while the maximum area is fixed to 15 m^2.

[0048] Fig. 11 refers to the first embodiment, and shows the length and width limit values of the room shape when the capacity is 2.2 kw. From the square root of the maximum area of 15 m^2 of the corresponding capacity band, if the ratio of the length to width is 1 : 1, the length and width are each 3.9 m. The maximum length and width are set from the lengths and widths obtained by changing the ratio of the length to width within the range of 1 : 2 to 2 : 1 while the maximum area is fixed to 15 m^2. If the ratio of the length to width is 1 : 2, the length is 2. 7 m and the width is 5.5 m Similarly, if the ratio of the length to width is 2:1, the length is 5. 5 m and the width is 2.7 m.

[0049] Fig. 12 refers to the first embodiment, and is a table showing length/width conditions obtained from the capacity bands of the air conditioner 100. Each initial value of Fig. 12 is obtained from the square root of the median area of the corresponding capacity band. For example, when the capacity is 2.2 kw, the appropriate area is 10 to 15 m^2, and the median area is 12 m^2. The initial value of 3.5 m is obtained from the square root of 12 m^2. The initial length and width of each capacity band are calculated based on the same idea. Also, the minimum value (m) and maximum value (m) are the same as those calculated in Fig. 10.

[0050] Hence, regarding the initial values of the room shape obtained for each capacity band of the air conditioner 100, the initial values (m) in Fig. 12 are treated as the length and width of the room shape. Note that the origin as the installation position of the air conditioner 100 can change depending on the installation position condition received from the remote controller.

[0051] Fig. 13 refers to the first embodiment, and shows conditions when the air conditioner is installed at the center, with the capacity being 2.2 kw. As shown in Fig. 13, note that the intermediate point of the initial width value is determined as the origin of the air conditioner 100. The origin of the air conditioner 100 is located at the center (1.8 m from the side wall) of a room having a size of 3.5 m x 3.5 m.

[0052] Fig. 14 refers to the first embodiment, and shows a case wherein the air conditioner has a capacity of 2.2 kw and is installed at the left corner (when seen from the user). When the air conditioner 100 is installed at a corner, the distance to the right or left closer wall is determined to be 0.6 m from the origin (central point of the room width) of the air conditioner 100.

[0053] Accordingly, regarding (1) the room shape based on the initial preset value and the shape limit value which is obtained from the capacity band of the air conditioner 100 and the setting of the installation position button of the remote controller, the boundary line between the floor surface and wall surfaces can be drawn on the thermogram data acquired from the infrared sensor 3, by determining the installation position of the air conditioner 100 with respect to a floor surface size set from the capacity band of the air conditioner 100 under the condition described above, in accordance with the installation position condition set by the remote controller.

[0054] Fig. 15 refers to the first embodiment, and shows the positional relationship between the floor surface and wall surfaces on the thermogram data, with the installation position button of the remote controller being set at the center, when the air conditioner 100 has a capacity of 2.2 kw. A left wall surface 16, front wall surface 19, right wall surface 17, and floor surface 18 seen from the infrared sensor 3, are indicated on the thermogram The dimensions of the floor surface shape for the capacity of 2.2 kw under the initial setting condition are as shown in Fig. 13. The left wall surface 16, front wall surface 19, and right wall surface 17 will be altogether referred to as wall surfaces hereinafter.

[0055] A means for calculating (2) the room shape based on the temperature non-uniformity of the floor and walls occurring during the operation of the air conditioner 100, will now be described. Fig. 16 refers to the first embodiment, and shows the flow of calculating the room shape based on the temperature non-uniformity. The range of temperature non-uniformity detection on the thermogram data is restricted, by a reference wall position calculation unit 54, on an 8 (vertical size) x 94 (horizontal size) thermogram generated as thermogram data by an infrared image acquisition unit 52 from an output of an infrared sensor driving unit 51 which drives the infrared sensor 3 described above.

[0056] The function of the reference wall position calculation unit 54 will be described referring to a case wherein the air conditioner 100 has a capacity of 2.2 kw and the installation condition set by the remote controller is center, as shown in Fig. 15.

[0057] Fig. 17 refers to the first embodiment, and shows the line between upper and lower pixels that forms the boundary between the wall surfaces and floor surface on the thermogram data of Fig. 15. More specifically, Fig. 17 shows a boundary line 60 between the upper and lower pixels, which forms the boundary between the wall surfaces (the left wall surface 16, front wall surface 19, right wall surface 17) and the floor surface 18 on the thermogram data of Fig. 15. The pixels above the boundary line 60 are light-distributing pixels that detect the wall surface temperature, and the pixels below the boundary line 60 are light-distributing pixels that detect the floor surface temperature.

[0058] Fig. 18 refers to the first embodiment, and shows detection of a temperature between one pixel and two pixels (a total of three pixels) below and above the position of the boundary line 60 set in Fig. 17. Referring to Fig. 18, the temperature between one pixel and two pixels (a total of three pixels) below and above the position of the boundary line 60 set in Fig. 17 is detected.

[0059] The temperature difference is searched not among all the pixels on the entire thermogram. Rather, the temperature difference is sensed roughly on the boundary line 60 between the wall surfaces (the left wall surface 16, front wall surface 19, right wall surface 17) and the floor surface 18, so that the temperature on the boundary line 60 between the wall surfaces and the floor surface 18 is detected.

[0060] Consequently, this detection is provided with the both advantages of reduction of unnecessary software computation (reduction of the computation time and load) caused by full-pixel detection, and erroneous detection processing.

[0061] A temperature non-uniformity boundary detection unit 53 which detects the boundary formed by the temperature non-uniformity with respect to the inter-pixel region described above can detect the boundary line 60 by any one of the following means:

(a) a determination means based on an absolute value obtained from the thermogram data on the floor surface temperature and wall surface temperature;
(b) a determination means based on the maximum value of the gradient (primary differentiation) of the temperature difference between the upper and lower pixels within the detection region in the depth direction; and
(c) a determination means based on the maximum value of the gradient of gradient (secondary differentiation) of the temperature difference between the upper and lower pixels within the detection region in the depth direction.

[0062] Fig. 19 refers to the first embodiment, and shows the pixel detection region in Fig. 18 in which pixels detected by the temperature non-uniformity boundary detection unit 53, which detects the temperature non-uniformity boundary, as exceeding the threshold value, or exceeding the maximum value of the gradient, are marked with black. In Fig. 19, within the pixel detection region described above, pixels detected by the temperature non-uniformity boundary detection unit 53, which detects the temperature non-uniformity boundary, as exceeding the threshold value, or exceeding the maximum value of the gradient, are marked with solid hatching lines. Pixels that do not exceed the threshold value or the maximum value of detection of the temperature non-uniformity boundary are not marked.

[0063] Fig. 20 refers to the first embodiment, and shows the detection result of the boundary line based on the temperature non-uniformity. The boundary line between the pixels is drawn below marked pixels where the temperature difference is detected by the temperature non-uniformity boundary detection unit 53 as exceeding the threshold value or the maximum value. In the column of upper and lower pixels in the detection range where the temperature difference is detected by the temperature non-uniformity boundary detection unit 53 as not exceeding the threshold value or the maximum value, the boundary line is drawn at a reference position between pixels that have been subjected to initial setting in Fig. 17 by the reference wall position calculation unit 54.

[0064] Fig. 21 refers to the first embodiment, and shows the projection image onto the floor surface 18 of coordinate points (X, Y) of elements plotted below the boundary line on the thermogram data, as they are transformed into floor surface coordinate points by the floor surface coordinate transformation unit 55. In Fig. 18, the coordinate points (X, Y) of the elements, which are plotted below the boundary line on the thermogram data and then transformed into the floor surface coordinate points by the floor surface coordinate transformation unit 55, are projected onto the floor surface 18. It will be readily understood that the element coordinates plotted below the boundary line 60, across 94 columns, are projected.

[0065] Fig. 22 refers to the first embodiment, and shows a region 66 of target pixels for detection of the temperature difference in the vicinity of the position of the front wall surface 19 under the initial preset condition that the installation position button of the remote controller is set to the center, with the capacity being 2.2 kw.

[0066] Fig. 23 refers to the first embodiment, and shows the wall surface positions of the front wall surface 19 and floor surface 18 which are obtained by calculating, in Fig. 21 that shows the projection images onto the floor surface 18 of the boundary line element coordinates of the respective thermogram data, the mean values of the dispersion element coordinate points of elements in Fig. 22 that detect the vicinity of the position of the front wall surface 19. The wall surface positions of the front wall surface 19 and floor surface 18, which are obtained by calculating, in Fig. 21 that shows the projection images, onto the floor surface 18, of the boundary line element coordinates of the respective thermogram data, the mean values of the dispersion element coordinate points of elements in Fig. 22 that detect the vicinity of the position of the front wall surface 19, form a front wall surface boundary line 122 shown in Fig. 23.

[0067] Note that the boundary lines will be drawn based on the mean values of the dispersion element coordinate points of the respective elements, corresponding to the right wall surface 17 and left wall surface 16, in accordance with the same idea as that of the front wall surface boundary line drawing means. A left wall surface boundary line 120 and right wall surface boundary line 121 in Fig. 23 are the boundary lines that are drawn based on the mean values of the dispersion element coordinate points of the respective elements. A region defined by the left wall surface boundary line 120, the right wall surface boundary line 121, and the front wall surface boundary line 122 is the floor surface region.

[0068] To draw an accurate floor/wall boundary line by temperature non-uniformity detection, another means is available that obtains the mean value and a standard deviation α of the element coordinates Y within the region in Fig. 22, for which the front surface boundary line is to be obtained, thereby re-calculating the mean value using only target elements for which the value α is equal to or smaller than the threshold value.

[0069] Similarly, the mean value and the standard deviation α of the respective element coordinates Y can be employed in calculation of the boundary lines of the right and left wall surfaces as well.

[0070] According to still other means that calculates the boundary lines of the right and left wall surfaces, the boundary lines are obtained by using the mean value of the X coordinates of the respective elements that are distributed in 1/3 to 2/3 of the intermediate region of the distance between Y coordinates with respect to the Y coordinate obtained by calculation of the front wall surface boundary line, that is, the distance from the wall surface where the air conditioner 100 is installed. Either means can be employed.

[0071] Note that a distance Y to the front wall surface 19, a distance X_left to the left wall surface 16, and a distance X_right to the right wall surface 17, each measured from the installation position of the air conditioner 100 as the origin and obtained by a front/right/left wall position calculation unit 56 that employs either one of the above means, are accumulated by a detection log accumulation unit 57 as the sums of the respective distances. The number of times of the accumulation operation is accumulated as a distance detection count, and each average distance is calculated by dividing the sum of the detection distances by the corresponding count. Also, note that the same applies to the right and left walls.

[0072] The determination result of the room shape based on the temperature non-uniformity is determined to be valid only when the number of times of detection counted by the detection log accumulation unit 57 exceeds the threshold number of times.

[0073] Calculation of (3) the room shape based on the human body detection position log will be described. Fig. 24 refers to the first embodiment, and shows the flow of calculating the room shape based on the human body detection position log. A human body detection unit 61 determines the human body position by calculating the difference between 8 (vertical size) x 94 (horizontal size) thermogram generated as the thermogram data by the infrared image acquisition unit 52 from an output of the infrared sensor driving unit 51 that drives the infrared sensor 3, and an immediately preceding thermogram data.

[0074] The human body detection unit 61 which detects the presence/absence of the human body and the position of the human body has a threshold value A that enables differential detection of the vicinity of a human head where the surface temperature is comparatively high, and a threshold value B that enables differential detection of a human foot portion where the surface temperature is rather low, independently of each other for the purpose of obtaining the difference of the thermogram data.

[0075] Fig. 25 refers to the first embodiment, and shows the determination result of human body detection based on the difference between the thermogram data indicating the presence of a human body and the immediately preceding background image with respect to the threshold values A and B. A thermogram difference region of thermogram data having elements exceeding the threshold value A is determined to correspond to the vicinity of the human head, and a thermogram difference region of thermogram data adjacent to the region obtained by using the threshold value A and having elements exceeding the threshold value B is obtained. This is based on the premise that the thermogram difference region obtained by using the threshold value B is adjacent to the thermogram difference region obtained by using the threshold value A. In other words, a thermogram difference region where elements exceed only the threshold value B is not determined to correspond to a human body. The relationship between the difference thresholds of the two pieces of thermogram data satisfies threshold value A > threshold value B.

[0076] The human body region obtained by this means enables detection of a region ranging from the human head to the human foot. The thermogram coordinates X and Y (the coordinates of the hatched Δ in Fig. 25) at the central portion of the lowermost end of the thermogram difference region, which indicates the human foot portion, are treated as the human body position coordinates (X, Y).

[0077] A floor surface coordinate transformation unit 55 transforms the human foot position coordinates (X, Y), obtained from the difference of the thermogram data, into floor surface coordinate points, as in Fig. 21 described previously concerning the temperature non-uniformity detection. A human body position log accumulation unit 62 accumulates the human body position log via the floor surface coordinate transformation unit 55.

[0078] Fig. 26 refers to the first embodiment, and shows results obtained by coordinate-transforming human body detection points obtained from differences of the thermogram data by the floor surface coordinate transformation unit 55 into human position coordinate points (X, Y), and accumulating the human position coordinate points (X, Y) for each of the X-axis and Y-axis. In the human body position log accumulation unit 62, as shown in Fig. 26, assume that the minimal decomposition of the X coordinate in the lateral direction and of the Y coordinate in the depth direction is ensured to 0.3 m, and that position coordinates (X, Y) generated every time a human body is detected are assigned in the 0.3-m pitch regions reserved for each axis, and counted.

[0079] Based on the human body detection position log information from the human body position log accumulation unit 62, a wall position determination unit 58 obtains the floor surface 18 which indicates the room shape, and wall surfaces (the left wall surface 16, right wall surface 17, and front wall surface 19).

[0080] Fig. 27 refers to the first embodiment, and shows the determination result of the room shape based on the human body position log. A region where the cumulative counts are equal to or larger than 10% of the maximum cumulative value of the X coordinate in the lateral direction and the Y coordinate in the depth direction, respectively, is determined as the floor surface region.

[0081] A case will be described wherein the room shape is calculated accurately by estimating whether the room is rectangular (square) or L-shaped based on the cumulative data of the human body detection position log, and by detecting the temperature non-uniformity in the vicinity of the floor surface 18 and the wall surfaces (the left wall surface 16, right wall surface 17, and front wall surface 19) of the L-shaped room.

[0082] Fig. 28 refers to the first embodiment, and shows the result of human body detection position log for an L-shaped living room. The minimal decomposition of the X coordinate in the lateral direction and of the Y coordinate in the depth direction is ensured to 0.3 m, and position coordinates (X, Y) generated every time a human body is detected are assigned in the 0.3-m pitch regions reserved for each axis, and counted.

[0083] Naturally, the human body moves in the L-shaped room. The count accumulated in the floor surface region in the right-to-left direction (X coordinate) and the count accumulated in the floor surface region in the depth direction (Y coordinate) are proportional to the depth regions (areas) of each of the X and Y coordinates, respectively.

[0084] A means that determines whether the room is rectangular (square) or L-shaped based on the cumulative data of the human body detection position log will be described.

[0085] Fig. 29 refers to the first embodiment, and shows the counts which are accumulated in the floor surface region (X coordinate) for the X coordinate in the lateral direction. A distance where the cumulative counts are equal to or larger than 10%, being the threshold value A, of the maximum cumulative value is determined as the distance (width) of the floor surface in the x direction.

[0086] Fig. 30 refers to the first embodiment, in which the floor surface region (X coordinate) obtained in Fig. 29 is divided into three equal regions A, B, and C so as to examine in which region the maximum cumulative value is present, and to obtain the maximum value and minimum value of each region simultaneously. As shown in Fig. 30. the floor surface region (X coordinate) obtained in Fig. 29 is divided into the three equal regions A, B, and C. In which region the maximum cumulative value is present is examined. Simultaneously, the maximum value and minimum value of each region are obtained.

[0087] When the maximum cumulative value is present in the region C (or region A) and the difference between the maximum value and minimum value in the region C is equal to or smaller than $\Delta\alpha$, and when the difference between the maximum cumulative value in the region C and the maximum cumulative value in the region A is equal to or larger than $\Delta\beta$, it is determined that the room is L-shaped.

[0088] To obtain the difference $\Delta\alpha$ between the maximum value and minimum value of each region is one of erroneous detection processes aimed at estimating the room shape from the cumulative data of the human body detection position log. Fig. 31 refers to the first embodiment, and shows a case wherein when a count equal to or larger than 90% of the maximum cumulative value is present at γ count locations or more (the number in sub-regions decomposed by every 0.3 m) in the region C, it is determined that the maximum cumulative value of the cumulative data is present in the region C. Another means is also available with which, as shown in Fig. 31, when a count equal to or larger than 90% of the maximum cumulative value is present at γ count locations or more (the number in sub-regions decomposed by every 0.3 m) in the region C, it is determined that the maximum cumulative value of the cumulative data is present in the region C.

[0089] Fig. 32 refers to the first embodiment, and shows a case wherein when a count equal to or larger than 90% of the maximum cumulative value is present at γ count locations or more (the number in sub-regions decomposed by every 0.3 m) in the region A, it is determined that the maximum cumulative value of the cumulative data is present in the region A. The above computation is performed for the region C, as shown in Fig. 32, and the same computation as in Fig. 31 is performed for the region A as well, to determine whether the room is L-shaped.

[0090] Fig. 33 refers to the first embodiment, in which when the room is determined to have an L shape, portions where the count is equal to or larger than 50% of the maximum cumulative value are searched. When the room is determined to have an L shape in the above manner, portions where the count is equal to or larger than 50% of the maximum cumulative value are searched, as shown in Fig. 33. The explanation is made concerning the X coordinate in the lateral direction. The same explanation applies to the cumulative data of the Y coordinate in the depth direction.

[0091] A coordinate point where the cumulative count is equal to or larger than 50%, being the threshold value B, of the maximum cumulative value on the floor surface region of the X coordinate in the lateral direction and of the Y coordinate in the depth direction, is determined as the boundary point between the floor and wall surfaces of the L-shaped room.

[0092] Fig. 34 refers to the first embodiment, and shows the boundary points between the floor surface and wall surfaces of the L-shaped room obtained in Fig. 33, and the shape of the floor surface region of the L-shaped room obtained from the floor surface regions of the X coordinate and Y coordinate where the count is equal to or larger than the threshold value A.

[0093] The result of the L-shaped floor surface obtained above is fed back to the reference wall position calculation unit 54 in the temperature non-uniformity room shape algorithm, and the range to perform temperature non-uniformity detection in the thermogram data is calculated again.

[0094] How to integrate three types of information for obtaining the room shape will be described. Note that a description on the process of feeding back the result of the L-shaped floor surface to the reference wall position calculation unit 54 in the temperature non-uniformity room shape algorithm, and calculating again the range to perform temperature non-uniformity detection in the thermogram data, will be omitted.

[0095] Fig. 35 refers to the first embodiment, and shows a flow that integrates three types of information. With the flow shown in Fig. 35, the following three types of information are integrated:

(1) the room shape of the initial preset value and the shape limit value obtained from the capacity band of the air conditioner 100 and setting of the installation position button of the remote controller;
(2) the room shape obtained based on the temperature non-uniformity of the floor surface 18 and wall surfaces occurring during operation of the air conditioner 100; and
(3) the room shape calculated from the human body detection position log

[0096] Regarding (2) the room shape obtained based on the temperature non-uniformity of the floor surface 18 and wall surfaces occurring during operation of the air conditioner 100, a temperature non-uniformity validity determination unit 64 validates the determination result of the room shape based on the temperature non-uniformity only when the number of times of detection counted by the detection log accumulation unit 57 as the count of detection by the temperature non-uniformity boundary detection unit 53 is larger than the threshold number of times.

[0097] Similarly, regarding the room shape obtained by the human body position log accumulation unit 62 in accordance with (3) the room shape calculated from the human body detection position log, the room shape is determined in accordance with the following conditions by the wall position determination unit 58 under the premise that the determination result of the room shape based on the human body detection position log is validated by a human body position validity determination unit 63 only when the number of times of human body position log, with which the human body position log accumulation unit 62 accumulates the human body position log, exceeds the threshold number of times.

[0098] A. When both (2) and (3) are invalid, the room shape of the initial preset value obtained from the capacity band of the air conditioner 100 and setting of the installation position button of the remote controller in accordance with (1) is employed.

[0099] B. When (2) is valid and (3) is invalid, the output result according to (2) is employed as the room shape. If the room shape according to (2) falls outside the length of the side or the area determined by (1) in Fig. 12, the room size is reduced to fall within the specified range. When reducing the room area, it is done by changing the distance to the front wall surface 19.

[0100] A practical correction method will be described. Fig. 36 refers to the first embodiment, and shows the room shape obtained as the result of temperature non-uniformity detection when the capacity is 2.8 kw and when the installation position button of the remote controller is set to the center. From Fig. 12, when the capacity of the air conditioner 100 is 2.8 kw, the minimum value of the longitudinal and lateral sides is 3.1 m, and the maximum value of the longitudinal and lateral sides is 6.2 m. Hence, from the central installation condition set by the remote controller, the limit length of the distance X_right to the right wall surface and the limit length of the distance X_left to the left wall surface are respectively halves of those indicated in Fig. 12. Consequently, the minimum distance to the right and left walls shown in the drawings is 1.5 m, and the maximum distance to the right and left walls shown in the drawings is 3.1 m.

[0101] Fig. 37 refers to the first embodiment, and shows a case wherein, when the distance to the left wall surface 16 exceeds the maximum distance to the left wall, it is reduced to the maximum position of the left wall. When the distance to the left wall surface 16 exceeds the maximum distance to the left wall, as in the room shape shown in Fig. 36 that resulted from the temperature non-uniformity, it is to be reduced to the maximum position of the left wall, as shown in Fig. 37.

[0102] Similarly, when the distance to the right wall is between the minimum position of the right wall and the maximum position of the right wall, as shown in Fig. 36, this positional relationship is to be maintained. The distance is reduced to the maximum position of the left wall, as shown in Fig. 37, and the area of the room shape is calculated. It is then checked whether or not the resultant area falls within the appropriate range, i.e., the area range of 13 to 19 m^2, for the capacity of 2.8 kw shown in Fig. 12.

[0103] Fig. 38 refers to the first embodiment, and shows a case wherein, when the room shape area of Fig. 37 after correction exceeds the maximum area value of 19 m^2, it is adjusted by reducing the distance to the front wall surface 19 until the resultant area becomes equal to the maximum area value of 19 m^2. When the area of the room shape of Fig. 37 after correction exceeds the maximum area value of 19 m^2, it is adjusted by reducing the distance to the front wall surface 19 until the maximum area reaches 19 m^2.

[0104] Figs. 39 and 40 refer to the first embodiment. Fig. 39 shows a case wherein, when the distance to the left wall surface does not reach the minimum distance to the left wall, it is adjusted by enlarging it until the region defined by the left wall that is at the minimum distance. Fig. 40 shows a case wherein whether or not the room shape area after correction falls within an appropriate area range is determined by calculating the room shape area. In the case shown in Fig. 39, in the same manner as that described above, when the actual distance to the left wall surface 16 does not reach the minimum distance to the left wall, it is enlarged until the region defined by the left wall that is at the minimum distance. After that, the area of the room shape after correction is calculated, as shown in Fig. 40, to determine whether or not the resultant room shape area falls within the appropriate area range.

[0105] C. When (2) is invalid and (3) is valid, the output result based on (3) is determined as the room shape. In this case, in the same manner as in the case B wherein (2) is valid and (3) is invalid, correction is performed to comply with the side length limitation and area limitation determined by (1).

[0106] D. When both (2) and (3) are valid, the room shape based on the temperature non-uniformity of (2) is treated as the reference. If a room shape obtained according to the human body detection position log of (3) has a shorter distance to the wall than the reference of (2), the output as the room shape based on the temperature non-uniformity is reduced with a maximum width pitch of 0.5 m

[0107] On the contrary, if the room shape according to (3) is larger, no correction is to be performed. When the room shape is to be corrected, it is done to comply with the side length limitation and area limitation determined by (1).

[0108] Fig. 41 refers to the first embodiment, and shows the obtained results of the Y coordinate Y_front which is the distance to the front wall surface 19, the X coordinate X_right of the right wall surface 17, and the X coordinate X_left of the left wall surface 16, which represent the distances to the respective wall surfaces. From the integral condition described above, the Y coordinate Y_front which is the distance to the front wall surface 19, the X coordinate X_right of the right wall surface 17, and the X coordinate X_left of the left wall surface 16, which represent the distances to the respective wall surfaces can be obtained as shown in Fig. 41.

[0109] Calculation of the floor/wall radiation temperature will be described. Fig. 42 refers to the first embodiment, and shows a state wherein the respective coordinate points on the floor surface boundary line, which are obtained from the distances to the front wall surface 19 and between the right and left walls (right wall surface 17, left wall surface 16) calculated under the integral conditions, are projected in a reverse manner onto the thermogram data.

[0110] How the region of the floor surface 18 and the regions of the front wall surface 19, left wall surface 16, and right wall surface 17 are divided can be understood from the thermogram of Fig. 42.

[0111] First, in calculation of the wall surface temperature, the average of the temperature data obtained from the thermogram data on the respective wall regions, which are obtained on the thermogram data, is determined as the wall temperature.

[0112] Fig. 43 refers to the first embodiment, and shows the respective wall regions that are surrounded by thick lines. As shown in Fig. 43, the regions surrounded by the thick lines are the respective wall regions.

[0113] The temperature region of the floor surface 18 will be described. Assume that the floor surface region on the thermogram data is divided into, e.g., 5 (the right-to-left direction) x 3 (the depth direction) = 15 segments. Note that the number of segments into which the region is to be divided is not limited to this, but can be arbitrary.

[0114] Fig. 44 refers to the first embodiment, and shows the front-side region of the floor surface 18 which is divided into five segments (A1, A2, A3, A4, and A5) in the right-to-left direction. As shown in Fig. 44, the front-side region of the floor surface 18 is divided into the five segments (A1, A2, A3, A4, and A5) in the right-to-left direction.

[0115] Fig. 45 refers to the first embodiment, and shows the deep-side region of the floor surface 18 which is divided into three segments (B1, B2, and B3) in the back-and-forth direction. The deep-side region of the floor surface 18 is similarly divided into the three segments (B1, B2, and B3) in the back-and-forth direction, as shown in Fig. 45. In the front-side region and deep-side region of the floor surface 18, the floor surface regions overlap in the right-to-left direction and in the back-and-forth direction, respectively. Accordingly, the temperatures of the front wall surface 19, left wall surface 16, and right wall surface 17, and the temperature data of the floor surface divided into 15 segments appear on the thermogram data. The temperatures of the respective divisional floor surface segments should be the respective average temperatures. Based on the temperature information for the respective regions defined on the thermogram data, the radiation temperature of each human body sensed within the living area is obtained from the thermogram data.

[0116] The radiation temperatures from the floor surface and wall surface for each human body are calculated in accordance with the following expression.

[0117]

$$T\_calc = Tf.ave + \frac{1}{\alpha}\left[\frac{T\_left - Tf.ave}{1+(Xf - X\_left)^2}\right] + \frac{1}{\beta}\left[\frac{T\_front - Tf.ave}{1+(Yf - Y\_front)^2}\right] + \frac{1}{\gamma}\left[\frac{T\_right - Tf.ave}{1+(Xf - X\_right)^2}\right]$$

where
T_calc: radiation temperature
Tf.ave: floor surface temperature of the location where the human body is detected
T_left: left wall surface temperature
T_front: front wall surface temperature
T_right: right wall surface temperature
Xf: X coordinate of human body detection position
Yf: Y coordinate of human body detection position
X_left: distance to left side wall surface
Y_front: distance to front wall surface
X_right: distance to right side wall surface
α , β, γ: correction coefficient
The floor surface temperature at a location where the human body is detected, the wall surface temperatures of the respective wall surfaces, and the radiation temperature which reflects the effects of the distances to the wall surfaces can be calculated.

[0118] Fig. 46 refers to the first embodiment, and shows examples of radiation temperature obtained by calculation. Fig. 46 shows examples of radiation temperature calculated using the calculation equation. On the thermogram data, the radiation temperatures are calculated provisionally based on the conditions with which a subject A and a subject B have been detected on thermogram data within a living space sensed on the thermogram data. Calculation is performed under conditions that the wall surface temperatures satisfy T_front = 23°C, T_left = 15°C, and T_right = 23°C, the floor surface temperature of the subject A satisfies Tf.ave = 20°C, the floor surface temperature of the subject B satisfies Tf.ave = 23°C, and the correction coefficients of the radiation temperature calculation equation are all 1. As the result of the calculation, the radiation temperature of the subject A can be obtained as T_calc =18°C, and the radiation temperature of the subject B can be obtained as T_calc = 23°C.

[0119] Conventionally, the radiation temperature is calculated based on only the temperature of the floor surface 18. However, it has become possible to consider the temperature of radiation of a wall surface which is calculated by recognizing the room shape, enabling calculation of the radiation temperature perceived by an entire human body.

[0120] A description will be made on an example of detecting the curtain open/closed state by utilizing the wall surface temperature which can be obtained by recognizing the room shape described above. In an air-conditioned room, in many cases, the air conditioning efficiency is better with the curtain closed than open. This example is aimed at prompting the user of the air conditioner 100 to close the curtain when the curtain is detected to be open.

[0121] Fig. 47 refers to the first embodiment, and shows a flowchart of the operation of detecting a curtain open/closed state. The flow of detecting the curtain open/closed state will be described with reference to the flowchart of Fig. 47.

[0122] The following control is performed by a microcomputer programmed with a predetermined operation. Similarly as in the case described above, a microcomputer programmed with a predetermined operation is defined as a "controller". In the following description, a description that the controller (the microcomputer programmed with the predetermined operation) performs each control operation will be omitted.

[0123] A thermogram acquisition unit 101 scans the infrared sensor 3 within the temperature detection target range to the right and left, and detects the temperature of the temperature detection target, thereby acquiring thermogram.

[0124] As described previously, when acquiring the thermogram data of the walls and floor of the room, the infrared sensor 3 is moved in the right-to-left direction by the stepping motor 6. Every time the stepping motor 6 has driven for a movable angle (the rotational driving angle of the infrared sensor 3) of 1.6°, it stops the infrared sensor 3 for a predetermined period of time (0.1 to 0.2 sec). After the infrared sensor 3 is stopped, at a lapse of a predetermined period of time (a time shorter than 0.1 to 0.2 sec), the detection results (thermogram data) of the eight light-receiving elements of the infrared sensor 3 are fetched. When fetching of the detection results of the infrared sensor 3 is ended, the stepping motor 6 is driven (for the movable angle of 1.6°) again, and stopped. Then, the detection results (thermogram data) of the eight light-receiving elements of the infrared sensor 3 are fetched by the same operation. The above operation is performed repeatedly. The thermogram data corresponding to the detection range is computed based on the detection results obtained by the infrared sensor 3 at 94 locations in the right-to-left direction.

[0125] The controller described above scans the infrared sensor 3 to acquire the thermogram data of the room, and the following three types of information are integrated. Thus, a floor/wall detection unit 102 obtains the floor surface size within the air-conditioning area, and the wall region (wall surface position) within the air-conditioning area on the thermogram data is acquired:

(1) the room shape of the initial preset value and the shape limit value obtained from the capacity band of the air conditioner 100 and setting of the installation position button of the remote controller;
(2) the room shape obtained based on the temperature non-uniformity of the floor surface 18 and wall surfaces occurring during operation of the air conditioner 100; and
(3) the room shape calculated from the human body detection position log

[0126] Based on the thermogram acquired by the thermogram acquisition unit 101, the process of the temperature condition determination unit (a room temperature determination unit 103 and an outdoor temperature determination unit 104) (to be described later) is applied to the background thermogram (Fig. 43) generated by the process described above, so that whether or not the current temperature condition requires detection of the window state is determined.

[0127] A state that requires detection of the window state means that, during heating, the outdoor temperature is lower than the room temperature by a predetermined temperature (for example, 5°C) or more, and that the window is cold, so the heating efficiency is low if the curtain is open.

[0128] On the contrary, during cooling, the state that requires detection of the window state means that the outdoor temperature is higher than the room temperature by a predetermined temperature (for example, 5°C) or more, and that the window is warmed up, so the cooling efficiency is low if the curtain is open.

[0129] The room temperature determination unit 103 of the temperature condition determination unit is a means that detects the room temperature. The room temperature can be estimated based on:

(1) the average temperature of the entire image of the background thermogram;
(2) the average temperature of the floor region of the background thermogram; and
(3) the value of a room temperature thermister thermometer (not illustrated) mounted on the suction port 41 of the indoor unit housing 40 (main body) of the air conditioner 100.

[0130] The outdoor temperature determination unit 104 is a means that detects an outdoor temperature. The outdoor temperature can be estimated based on:

(1) the value of an outdoor temperature thermister thermometer (not illustrated) loaded on the outdoor unit (not shown) of the air conditioner 100.
(2) The following temperatures may substitute the value of the thermister thermometer without causing a trouble in determining whether the detection of the window state is required or not:

a. (during heating) lowest temperature in the wall region of the background thermogram; or
b. (during cooling) highest temperature in the wall region of the background thermogram

[0131] If the difference between the room temperature detected by the room temperature determination unit 103 and the outdoor temperature detected by the outdoor temperature determination unit 104 is equal to or exceeds a predetermined value (e.g., 5°C), then the flow advances to the process of the window state detection unit as follows.

[0132] Fig. 48 refers to the first embodiment, and shows thermogram data obtained when the window curtain on the right wall surface is open during heating. With the window state detection unit, a region in the background thermogram where the temperature is remarkably different (by a predetermined temperature of, e.g., 5°C) is detected as a window region 31 (Fig. 48). A change over time of the window region 31 is monitored. Also, detection of a curtain closing operation is made possible.

[0133] For example, when the indoor temperature distribution during heating is sensed with the infrared sensor 3, the thermogram as shown in Fig 48 is obtained. A low-temperature portion of the right wall surface 17 in the thermogram is detected as the window region 31. In Fig. 48, highs and lows of the temperature are expressed by hatching. A hatched portion has a lower temperature than a non-hatched portion.

[0134] An intra-wall-region temperature difference determination unit 105 determines whether or not the temperature difference within a wall region is equal to a predetermined value (e.g., 5°C) or more in the background thermogram data. The temperature difference within the wall region changes depending on whether the room is under heating or cooling, the room size, the time lapse since the start of air conditioning, and the like. During air conditioning, the wall temperature differs often from the reference temperature such as the floor temperature or room temperature. It is thus difficult to determine the presence/absence of the window region 31 by only simply processing the difference from the reference temperature with respect to the threshold value.

[0135] In view of this, the intra-wall-region temperature difference determination unit 105 determines the presence/absence of the temperature difference within the wall region based on the idea that a remarkable difference in temperature in the same wall indicates the presence of the window region 31.

[0136] If no remarkable temperature difference is present within the wall region, the intra-wall-region temperature difference determination unit 105 determines that the window region 31 is not present, and subsequent processes are not to be performed.

[0137] An intra-wall-region outdoor-temperature zone extraction unit 106 extracts in the background thermogram a zone within the wall region the temperature of which is close to the outer temperature. In other words, the intra-wall-region outdoor-temperature zone extraction unit 106 extracts a high-temperature zone in the wall region during cooling, and low-temperature zone in the wall region during heating.

[0138] To extract in the background thermogram a zone within the wall region the temperature of which is close to the outer temperature, a method is available that extracts a zone the temperature of which is higher (lower) than the average temperature of the wall region by a predetermined temperature (e.g., 5°C) or more.

[0139] Note that the intra-wall-region outdoor-temperature zone extraction unit 106 deletes a small zone as being detected erroneously. For example, assume that the minimum window size is 80 cm (width) x 80 cm (height). When a window is present at a certain position on the thermogram, the size of the window on the thermogram can be calculated from the positions of the floor and walls detected by the floor/wall detection unit 102 and the angle at which the infrared sensor 3 is set. If a window on the thermogram obtained by calculation indicates a zone with a size equal to or smaller than the minimum window size, this window is deleted as being a small zone.

[0140] A window region extraction unit 107 extracts, out of the region extracted by the intra-wall-region outdoor-temperature zone extraction unit 106, a zone that is very likely to be a window region 31.

[0141] The window region extraction unit 107 detects, as the window region 31, a region that has been extracted as the window region 31 by the intra-wall-region outdoor-temperature zone extraction unit 106 continuously for a predetermined period of time (e.g., 10 min) or more.

[0142] An intra-window-region temperature difference determination unit 108 monitors a temperature change in the zone detected by the window region extraction unit 107 as being the window region 31, and determines whether the temperature of the zone detected as being a window has changed to near the average wall temperature. If the temperature does change, the intra-window-region temperature difference determination unit 108 determines that the window region 31 disappears.

[0143] If the intra-window-region temperature difference determination unit 108 determines that the entire portion of the window region 31 detected by the window region extraction unit 107 is not a window region 31, then a curtain closing operation determination unit 109 determines that the curtain has been closed.

[0144] In a state wherein the window region extraction unit 107 detects the window region 31, if the intra-wall-region temperature difference determination unit 105 determines the absence of the window region 31, the curtain closing operation determination unit 109 determines that the curtain has been closed.

[0145] As described above, the thermogram acquisition unit 101 scans the infrared sensor 3 to the right and left within the temperature detection target range, and acquires thermogram by detection of the temperature of a temperature detection target. The floor/wall detection unit 102 acquires the wall region in the air-conditioned area on the thermogram data. The temperature condition determination unit determines whether the current temperature condition requires window state detection. If so, the window state detection unit detects a region having a remarkable temperature difference in the background thermogram as the window region 31. The window state detection unit monitors a change over time of the window region 31, and simultaneously enables detection of a curtain closing operation.

[0146] With this structure, it becomes possible to detect that a window is exposed and thus under the influence of the outdoor temperature, which state requiring extra power consumption for air conditioning, and to prompt the user of the air conditioner 100 to close the curtain or the like.

[0147] The user of the air conditioner 100 may close the curtain or the like, thereby reducing the power consumption of the air conditioner 100.

[0148] A practical method of detecting, e.g., exposure of a window under the influence of the outdoor temperature and prompting the user of the air conditioner 100 to close the curtain or the like will be described.

[0149] Fig. 49 refers to the first embodiment, and is a flowchart formed by adding an information presentation unit to the flowchart of Fig. 47 of detecting the open/closed state of the curtain. The information presentation unit is, for example, a user interface unit 110.

[0150] The information presentation unit (user interface unit 110) serves to prompt the user to take an energy saving action by conveying him energy saving information which the user does not notice easily or does not know.

[0151] Even if the user does not now about energy saving well, by following the guidance content displayed on a remote controller 200 (refer to the display content displayed on a guidance display 220 in Fig. 51), energy saving operation is enabled.

[0152] The basic information obtained from the thermogram acquired by the infrared sensor 3 described in this embodiment are:

(1) information on the human body position (the detection result as to where the human body is in the room) within a living space;
(2) information on the action amount (shift amount) of the human body obtained from the detection result of the human body on the time base. If the human body is detected constantly at different locations, it is determined that the action amount (shift amount) is large. Inversely, if the human body stays at the same location (as in a case of relaxing on a sofa), it is determined that the action amount (shift amount) is small; and
(3) temperature information on the window region 31 within the wall surface which is obtained by space recognition.

[0153] The energy saving advice which prompts the user to take an energy saving action is given based on the above three types of information.
[0154] The information presentation unit serves to prompt the user to take an energy saving action by conveying him energy saving information which he does not notice easily or does not know, by means of the user interface unit 110 of the information presentation unit. Even without energy saving knowledge, if the user follows the guidance content displayed on the remote controller 200 (see Fig. 51), energy saving operation is enabled.
[0155] The user interface unit 110 will now be described in detail.
[0156] Fig. 50 refers to the first embodiment, and is an outer appearance view of the air conditioner 100 having a display 100a. As shown in Fig. 50, the air conditioner 100 is provided with the display 100a on the front surface of an indoor unit housing 40. The display 100a has an ECO lamp 20 (capable of guidance display) and the like.
[0157] Upon obtaining energy saving information that the user does not know (or notice) based on information from the infrared sensor 3, the air conditioner 100 turns on the ECO lamp 20 (capable of guidance display) of the display 100a of the indoor unit housing 40, to notify the user that energy saving information is available.
[0158] Fig. 51 refers to the first embodiment, and is a plan view showing the remote controller 200. The user is supposed to have the remote controller 200 shown in Fig. 51 at hand so that he can control the operation of the air conditioner 100. The remote controller 200 shown in Fig. 51 is provided with an ECO advice button 210 (information request button) and the guidance display 220 in addition to an ordinary operation ON/OFF button, temperature setting button, and the like.
[0159] If the user notices that the ECO lamp 20 on the display 100a of the air conditioner 100 (indoor unit) is ON, he may press the ECO advice button 210 (information request button) provided on the operation part of the remote controller 200, so that he can obtain detailed energy saving information.
[0160] The energy saving information may be transferred between the air conditioner 100 (indoor unit) and the remote controller 200 by bidirectional infrared communication or wireless communication.
[0161] The air conditioner 100 (indoor unit) is provided with a communication unit (not shown) which performs bidirectional communication between the controller of the air conditioner 100 (indoor unit) and the remote controller 200 by bidirectional infrared communication or wireless communication.
[0162] The detailed energy saving information is displayed on the guidance display 220 located at the upper portion of the remote controller 200.
[0163] As shown in Fig. 51, the remote controller 200 is provided with the dot-matrix guidance display 220 at its uppermost portion, which is capable of displaying energy saving operation information (information on the recommended operation or on energy saving advice) as well as operation modes such as cooling, dry, heating, and air blowing.
[0164] The guidance display 220 employs a dot-matrix-type liquid crystal panel formed by arranging pixels evenly like a grating, so that it can display a variety of images.
[0165] When a large number of dot-matrix pixels are to be wired to electrodes, all terminals for the electrodes cannot be derived from the peripheral portion of the substrate. For this reason, either active matrix driving or simple matrix driving is performed. According to the active matrix driving, active elements are arranged for the respective pixels, and the respective pixels are driven. According to the simple matrix driving, orthogonal stripe electrodes are formed on both substrates above and below the liquid crystal panel, and liquid crystals at the intersections of the orthogonal stripe electrodes are driven.
[0166] A preset data display 230 which displays time, preset temperature, and preset humidity is provided under the guidance display 220.
[0167] An ON/OFF button 240 which starts and stops operation of the air conditioner 100 (indoor unit) is provided under the preset data display 230.
[0168] Under the ON/OFF button 240, a temperature control button 250 which controls the temperature and a humidity control button 260 which controls the humidity are arranged side by side.
[0169] Under the temperature control button 250 which controls the temperature and the humidity control button 260 which controls the humidity, an operation mode change button 270 which changes the operation mode is provided. The

operation mode change button 270 consists of a cooling button for cooling, a dry button for dry operation, and a heating button for heating (enumerated from the left) that are arranged side by side.

[0170] Under the operation mode change button 270, the ECO advice button 210 (energy saving operation information request button) is provided which requests the air conditioner 100 (indoor unit) to transmit information on the energy saving operation. The ECO advice button 210 features a leaf

[0171] A timer button 280 and a mist button 290 which instructs generation of mist are provided under the ECO advice button 210.

[0172] Detailed energy saving information is displayed on the guidance display 220 at the upper portion of the remote controller 200. Alternatively, the remote controller 200 may be provided with a voice function, and the detailed energy saving information may be communicated to the user by voice. Then, even when the user does not notice the display content on the guidance display 220 of the remote controller 200, the energy saving information can be conveyed to the user reliably.

[0173] The ECO lamp 20 of the air conditioner 100 (indoor unit) and the ECO advice button 210 of the remote controller 200 employ the same illustration (leaf), and the color of the ECO advice button 210 of the remote controller 200 is green. In line with this, the ECO lamp 20 of the air conditioner 100 (indoor unit) employs a green LED (Light-Emitting Diode) or a green filter. This allows the user to understand that the ECO lamp 20 and the ECO advice button 210 serve the same function. Note that in Figs. 50 and 51, the illustration on the ECO button 20 of the air conditioner 100 (indoor unit) and that on the ECO advice button 210 of the remote controller 200 are not completely the same.

[0174] Conditions under which the ECO lamp 20 of the air conditioner 100 is turned on will be described.

[0175] The ECO lamp 20 is turned on when energy saving information, which is obtained by analyzing the thermogram obtained from the infrared sensor 3 and which the user is not aware, is generated during the operation of the air conditioner 100 (when a condition for generating ECO advice is established). The ECO lamp 20 is not turned on if the operation of the air conditioner 100 is not stable as in immediately after the start of the operation. In other words, the condition for turning on the ECO lamp 20 is that the air conditioner 100 operates stably.

[0176] Conditions under which the ECO lamp 20 is turned off will now be described. The turn-off conditions are as follows.

(1) When the user presses the ECO advice button 210 of the remote controller 200 and receives energy saving information from the main body of the air conditioner 100. In other words, when an ECO navi signal is received (when bidirectional infrared communication with the ECO navigator is established).

(2) While the air conditioner 100 presents energy saving information to the user by means of the ECO lamp 20 (while the ECO lamp 20 is ON), when the user, being unaware of the ON state of the ECO lamp 20 (with the ECO advice button 210 of the remote controller 200 being not pressed), cancels the state indicated by the energy saving information presented by the main body of the air conditioner 100. In other words, when the content of the ECO advice is practiced (checked), even if the ECO navi signal has not been received yet. The energy saving information presented by the main body is, for example, during heating, COLD SPOT ON THE WALL SURFACE. CLOSING CURTAIN/DOOR LEADS TO ENERGY SAVING. At this time, if the user voluntarily closes the curtain or door, the air conditioner 100 detects this, and turns off the ECO lamp 20.

(3) When a predetermined period of time (e.g., about 30 min) has elapsed since the ECO lamp 20 is turned on.

[0177] The ECO lamp 20 is turned off when one of (1) to (3) is satisfied.

[0178] The content of the guidance display 220 which is displayed when the user presses the ECO advice button 210 of the remote controller 200 will be described.

[0179] The guidance display 220 can display information on the energy saving advice as well as the operation mode or operation status of the air conditioner 100.

[0180] In a situation where the ECO lamp 20 of the air conditioner 100 is ON, when the user presses the ECO advice button 210 of the remote controller 200, information on the energy saving advice is displayed on the guidance display 220.

[0181] Also, a phrase is displayed on the guidance display 220 that prompts the user to change the setting to an optimum operation mode in accordance with the energy saving advice.

[0182] With the ECO lamp 20 of the air conditioner 100 being OFF, when the user presses the ECO advice button 210 of the remote controller 200, the content of the operation state of the air conditioner 100 is displayed on the guidance display 220.

[0183] Figs. 52 to 57 refer to the first embodiment. Fig. 52 is a flowchart showing the contents displayed on the guidance display 220 of the remote controller 200. In Fig. 53, OPERATION START IN PREPARATION is displayed on the guidance display 220 of the remote controller 200. In Fig. 54, APPROACHING PRESET TEMPERATURE is displayed on the guidance display 220 of the remote controller 200. In Fig. 55, RESTORE TO INITIAL SETTING? is displayed on the guidance display 220 of the remote controller 200. Fig. 56 shows the display contents displayed on the guidance display 220 of the remote controller 200 when the air conditioner 100 determines that the influence of cold radiation from the window is large during heating. Fig. 57 shows the display contents displayed on the guidance display 220 of the remote controller 200 when the outdoor temperature has dropped below the indoor preset temperature during cooling while the user is not aware of it.

[0184] A detailed description will now be made referring to the flowchart of Fig. 52. Immediately after the start of operation of the air conditioner 100 and before the lapse of a predetermined period of time (time α) (the actual operation status of the air conditioner 100 is a time point before the compressor is started, or a cold window prevention time before the start of heating), when the user presses the ECO advice button 210 of the remote controller 200, the operation information of the air conditioner 100 is displayed on the guidance display 220. For example, OPERATION START IN PREPARATION is displayed (refer to Fig. 53 as well).

[0185] Then, after the start and before the stabilization of the operation of the air conditioner 100 (fluctuation period), when the user presses the ECO advice button 210 of the remote controller 200, the operation information of the air conditioner 100 is displayed on the guidance display 220. For example, APPROACHING PRESET TEMPERATURE is displayed (refer to Fig. 54 as well).

[0186] Then, after the operation status of the air conditioner 100 has shifted to the stable state, when the content of the energy saving advice is determined based on the information from the infrared sensor 3, the ECO lamp 20 of the display 100a of the air conditioner 100 is turned on.

[0187] While the ECO lamp 20 is ON, when the user presses the ECO advice button 210 of the remote controller 200, the content of the energy saving advice is displayed on the guidance display 220 of the remote controller 200.

[0188] After the content of the energy saving advice is displayed, a guide content that encourages the user to switch to an optimum operation mode is displayed. When the user operates the remote controller 200 in accordance with the displayed guide content, the air conditioner 100 operates in accordance with the instructed operation content.

[0189] After the operation mode is changed and before the lapse of a predetermined period of time (time β), when the user presses the ECO advice button 210 again, a guide content as to whether or not to cancel the operation mode recommended in the preceding guidance is displayed. For example, RESTORE TO INITIAL SETTING? is displayed (see Fig. 55 as well).

[0190] When, e.g., the user puts comfort before the previous energy saving operation mode, the operation mode is restored to the initial setting in accordance with an advice cancel instruction.

[0191] A detailed expression method of the energy saving advice will be described. In the window detection algorithm employing the infrared sensor 3, during heating, when the air conditioner 100 determines that the influence of the cold radiation from the window is large, the following contents are displayed on the guidance display 220 of the remote controller 200 (Fig. 56).

[0192] First, COLD SPOT ON WALL SURFACE is displayed for 5 sec. Then, the display content changes to CLOSING CURTAIN/DOOR. This is displayed for 5 sec. The display content changes again to LEADS TO ENERGY SAVING. This is displayed for 5 sec.

[0193] By displaying these energy saving advice contents, the user is prompted to take an energy saving action.

[0194] Furthermore, when, e.g., the outdoor temperature drops below the indoor preset temperature during cooling while the user is not aware of it, the following display contents are displayed on the guidance display 220 of the remote controller 200 (Fig. 57).

[0195] First, OUTDOOR TEMPERATURE APPROACHING PRESET TEMPERATURE is displayed for 5 sec. Then, the display content changes to AIR BLOWING WOULD BE JUST AS NICE. This is displayed for 5 sec. The display content changes again to display guidance SHIFT TO AIR BLOWING? YES: PRESS "ECO"; NO: DO NOTHING. This prompts the user to switch from cooling to air blowing. This is displayed for 5 sec.

[0196] In response to this guidance, if the user presses the ECO advice button 210, the operation mode will change from cooling to air blowing.

[0197] Fig. 58 refers to the first embodiment, and shows the detailed contents of energy saving advice obtained from the infrared sensor 3 during cooling/dry operation. The contents of the energy saving advice obtained from the infrared sensor 3 during cooling/dry operation will be described in detail with reference to Fig. 58. The examples of the contents of the energy saving advice at this time are as follows, which will be described in the order of priority (high to low).

(1) The purpose of the advice is to INFORM OF MODERATE ENERGY SAVING EFFECT, which effect the user did NOt know. The guidance display 220 of the remote controller 200 displays, as display 1, UNDER CONTROL BY AIR TEMPERATURE ONLY for 5 sec. Then, the display content changes to display 2 of OPERATION AT BODY-SENSIBLE TEMPERATURE. This is displayed for 5 sec. The display contents changes again to display 3 of SET BODY-SENSIBLE TEMPERATURE OPERATION? YES: PRESS "ECO"; NO: DO NOTHING. This is displayed for 5 sec.

(2) The purpose of the advice is DETECTS HUMAN MOTION. WHEN PEOPLE DO NOT MOVE AROUND FOR LONGER THAN PREDETERMINED PERIOD OF TIME, SUGGESTS PEOPLE'S STAYING TOGETHER LEADS TO ENERGY SAVING OPERATION, which effect the user did NOt know. The guidance display 220 of the remote

controller 200 displays, as display 1, ENTIRE ROOM UNDER AIR CONDITIONING for 5 sec. The display content then changes to display 2 of DIVERTING WIND LEADS TO ENERGY SAVING. This is displayed for 5 sec. The display content changes again to display 3 of DIVERT WIND? YES: PRESS "ECO"; NO: DO NOTHING. This is displayed for 5 sec.

(3) The purpose of the advice is CHECKS OPEN/CLOSING STATE OF DOOR/CURTAIN BY INFRARED SENSOR BASED ON SUMMERTIME SUNLIGHT AND WINTERTIME LOW RADIATION. SUGGESTS CLOSING DOOR/ CURTAIN, which action the user had FORGOTTEN to take. The guidance display 220 of the remote controller 200 displays, as display 1, HOT SPOT ON WALL SURFACE for 5 sec. Then, the display content changes to display 2 of CLOSING CURTAIN/DOOR. This is displayed for 5 sec. The display content changes again to display 3 of LEADS TO ENERGY SAVING. This is displayed for 5 sec.

(4) The purpose of the advice is QUICK ADVICE FOR USER COLD AT FOOT, which situation the user had FORGOTTEN. Description on the display content of the guidance display 220 of the remote controller 200 will be omitted.

(5) The purpose of the advice is ADVICE WHEN ACTIVE HUMAN MOTION IS DETECTED, which situation the user had FORGOTTEN. The guidance display 220 of the remote controller 200 displays, as display 1, BE AWARE OF INDOOR AIR POLLUTION for 5 sec. Then, the display content changes to display 2 of MIST WILL SUPPRESS AIRBORNE MICROBE. This is displayed for 5 sec. The display content changes again to display 3 of SET MIST? YES: PRESS "ECO"; NO: DO NOTHING. This is displayed for 5 sec. Note that FORGOTTEN includes, e.g., the user was not aware, was not conscious, and had forgotten.

[0198] Fig. 59 refers to the first embodiment, and shows the detailed contents of energy saving advice obtained from the infrared sensor 3 during heating. The contents of the energy saving advice obtained from the infrared sensor 3 during heating will be described in detail with reference to Fig. 59. The examples of the contents of the energy saving advice at this time are as follows, which will be described in the order of priority (high to low).

(1) The purpose of the advice is to INFORM OF MODERATE ENERGY SAVING EFFECT, which effect the user did NOt know. The guidance display 220 of the remote controller 200 displays, as display 1, UNDER CONTROL BY AIR TEMPERATURE ONLY for 5 sec. Then, the display content changes to display 2 of OPERATION AT BODY-SENSIBLE TEMPERATURE. This is displayed for 5 sec. The display contents changes again to display 3 of SET BODY-SENSIBLE TEMPERATURE OPERATION? YES: PRESS "ECO"; NO: DO NOTHING. This is displayed for 5 sec.

(2) The purpose of the advice is DETECTS HUMAN MOTION. WHEN PEOPLE DO NOT MOVE AROUND FOR LONGER THAN PREDETERMINED PERIOD OF TIME, SUGGESTS PEOPLE'S STAYING TOGETHER LEADS TO ENERGY SAVING OPERATION, which effect the user did NOt know. The guidance display 220 of the remote controller 200 displays, as display 1, ENTIRE ROOM UNDER AIR CONDITIONING for 5 sec. The display content then changes to display 2 of DIVERTING WIND LEADS TO ENERGY SAVING. This is displayed for 5 sec. The display content changes again to display 3 of DIVERT WIND? YES: PRESS "ECO"; NO: DO NOTHING. This is displayed for 5 sec.

(3) The purpose of the advice is CHECKS OPEN/CLOSING STATE OF DOOR/CURTAIN BY INFRARED SENSOR BASED ON SUMMERTIME SUNLIGHT AND WINTERTIME LOW RADIATION. SUGGESTS CLOSING DOOR/ CURTAIN, which action the user had FORGOTTEN to take. The guidance display 220 of the remote controller 200 displays, as display 1, COLD SPOT ON WALL SURFACE for 5 sec. Then, the display content changes to display 2 of CLOSING CURTAIN/DOOR. This is displayed for 5 sec. The display content changes again to display 3 of LEADS TO ENERGY SAVING. This is displayed for 5 sec.

(4) The purpose of the advice is QUICK ADVICE FOR USER COLD AT FOOT, which situation the user had FORGOTTEN. The guidance display 220 of the remote controller 200 displays, as display 1, UPWARD WIND. NOT COLD AT FOOT? for 5 sec. The display content changes to display 2 of AUTOMATIC WIND SPEED LEADS TO ENERGY SAVING. This is displayed for 5 sec. The display content changes again to display 3 of SET AUTOMATIC WIND DIRECTION? YES: PRESS "ECO"; NO: DO NOTHING. This is displayed for 5 sec.

(5) The purpose of the advice is ADVICE WHEN ACTIVE HUMAN MOTION IS DETECTED, which situation the user had FORGOTTEN. The guidance display 220 of the remote controller 200 displays, as display 1, BE AWARE OF INDOOR AIR POLLUTION for 5 sec. Then, the display content changes to display 2 of MIST WILL SUPPRESS AIRBORNE MICROBE. This is displayed for 5 sec. The display content changes again to display 3 of SET MIST? YES: PRESS "ECO"; NO: DO NOTHING. This is displayed for 5 sec.

[0199] As described above, by conveying the energy saving information, which the user does not notice easily or does not know, to the user by means of the user interface unit 110 of the information presentation unit, it is possible to prompt the user to take an energy saving action. Even if the user does not know about energy saving well, by following the guidance content displayed on the remote controller, energy saving operation is enabled.

[0200] The guidance display 220 provided to the remote controller 200 shown in Fig. 51 employs a dot-matrix-type liquid crystal panel formed by arranging pixels evenly like a grating, so that it can display a variety of images. As the liquid crystal panel of the guidance display 220 is small, as shown in Fig. 51, the energy saving advice contents must be displayed dividedly in a small amount a plurality of number of times (e.g., three times) at an interval of a predetermined period of time (e.g., 5 sec), as shown in Figs. 56 to 59.

[0201] In view of this, a case will be described in which a remote controller 300 according to a modification having an interface display 301 (see Fig. 60) employing a full-dot (255 x 160) LCD (Liquid Crystal Display), and in which the whole content of the energy saving advice is displayed at once on the interface display 301 that uses the full-dot (255 x 160) LCD (Liquid Crystal Display).

[0202] Figs. 60 to 68 refer to the first embodiment. Fig. 60 is an outer appearance front view of the remote controller 300 according to the modification. In Fig. 61, the interface display 301 of the remote controller 300 displays the scene select window, and the cursor is at RAPID COOLING. In Fig. 62, the interface display 301 of the remote controller 300 displays the scene select window, and the cursor has moved to CLEAN AIR. In Fig. 63, the interface display 301 of the remote controller 300 displays the scene select window, and the cursor has moved to GUEST. In Fig. 64, the interface display 301 of the remote controller 300 displays the normal window. In Fig. 65, the interface display 301 of the remote controller 300 displays the scene select window (menu window) to indicate the transition of states until the user selects a scene, in which the cursor is at RAPID COOLING in (a), AVOID WIND in (b), and GUEST in (c). In Fig. 66, the interface display 301 of the remote controller 300 displays the scene content in (d), and the detailed scene setting in (e) to (g). Fig. 67 shows an animation of a scene select item CLEAN AIR Fig. 68 shows an animation of a scene select item SKIN CARE.

[0203] The remote controller 300 according to the modification, which has the interface display 301 (see Fig. 60) using the full-dot (255 x 160) LCD (Liquid Crystal Display), will be described with reference to Figs. 60 to 68.

[0204] The characteristic feature of the remote controller 300 of the modification shown in Fig. 60 resides in that the number of user manipulation buttons is greatly smaller than in an ordinary remote controller. The remote controller 300 does not have a cover. This will be described later in detail. The user needs to manipulate only buttons shown in Fig 60.

[0205] The air conditioner (not shown) is not operating. Hence, in the remote controller 300 of the modification shown in Fig. 60, the interface display 301 of a remote controller main body 310 displays only time.

[0206] The interface display 301 employs, e.g., a full-dot (255 x 160) LCD (Liquid Crystal Display).

[0207] The display restriction (the function limitation that only a limited content can be displayed within a limited region) of the segment display employed in the interface display of a conventional remote controller is eliminated. Restriction-free expressions and animations can be developed within the interface window.

[0208] The preset data display 230 of the remote controller 200 shown in Fig. 51 is of the segment display type, and can only display a limited content within a limited region.

[0209] Referring to Fig. 60, under the interface display 301, an operation ON/OFF button 302 and an operation mode switching button 303 are arranged at almost the center of the remote controller 300.

[0210] The operation mode switching button 303 is constituted by a cooling button, a dry button, and a heating button.

[0211] Under the operation mode switching button 303, a scene button 304, a humidity control button 305, and a temperature control button 306 are arranged in one circle.

[0212] The scene button 304 is constituted by a scene select button 304a, an UP/DOWN button 304b, and an ENTER button 304c.

[0213] The UP/DOWN button 304b is arranged at the center of a big circle and has a round shape. The UP/DOWN button 304b is a one-part button. As the user presses the "Δ" portion of the UP/DOWN button 304b, the cursor (see Fig. 61) of the interface display 301 moves upward.

[0214] When the user presses the "Δ" portion of the UP/DOWN button 304b once, the cursor of the interface display 301 moves up by one line.

[0215] As the user presses the "∇" portion of the UP/DOWN button 304b, the cursor (Fig. 61) of the interface display 301 moves downward.

[0216] When the user presses the "∇" portion of the UP/DOWN button 304b once, the cursor (Fig. 61) of the interface display 301 moves down by one line.

[0217] The scene select button 304a, humidity control button 305, ENTER button 304c, and temperature control button 306 are arranged to form a ring.

[0218] A RETURN button 307 and a message NAVI button 308 are arranged below the scene button 304. The RETURN button 307 has functions such as setting end, which will be described later.

[0219] The above layout is an example. The actual layout is not limited to that shown in Fig. 60. The remote controller 300 can have an arbitrary layout.

[0220] How to use the remote controller 300 will be explained. Assume that the air conditioner 100 is not operating. When the operation of the air conditioner 100 is to be started, the user presses the operation ON/OFF button 302, or any one of the cooling button, dry button, and heating button of the operation mode switching button 303. Then, the air conditioner 100 starts operation.

[0221] If the user wishes cooling, he is supposed to press the operation ON/OFF button 302, or the cooling button of the operation mode switching button 303. When the operation ON/OFF button 302 is pressed, the last operation mode is selected. For example, if the last operation mode is cooling, cooling is automatically selected this time. If the user wishes to set an operation mode different from the last one, he is supposed to press the button corresponding to the operation he desires. For example, assume that the last operation mode is dry operation and the user wishes cooling operation this time. When the user presses the operation ON/OFF button 302, dry operation is started. Then, by pressing the cooling button of the operation mode switching button 303, cooling operation is started.

[0222] In a state wherein the air conditioner 100 is not operating, when the user presses the operation ON/OFF button 302, or any one of the cooling button, dry button, and heating button of the operation mode switching button 303, the air conditioner 100 starts operation. At this time, the interface display 301 of the remote controller 300 displays the scene select window (see Fig. 61).

[0223] After the user selects a scene select item, when a predetermined period of time elapses, the interface display 301 of the remote controller 300 switches to the normal window (a setting window for the temperature, humidity, and the like. See Fig. 64). This will be described later in detail.

[0224] Assume that the interface display 301 of the remote controller 300 displays the normal window and that no scene has been set yet. To display the scene select window, the user is supposed to press the scene select button 304a of the scene button 304. Then, the interface display 301 displays the scene select window.

[0225] Examples of the contents of scene select will be described. The interface display 301 displays select items that best describe the user's needs for a variety of living scenes (the contents to be set then). For example, the input contents of the scene select items are:

(1) rapid cooling (rapid heating);
(2) avoid wind (expose to wind);
(3) clean air;
(4) dry room;
(5) skin care;
(6) guest hospitality; and
(7) comfortable sleep

[0226] At the start of the operation of the air conditioner 100, or during the operation of the air conditioner 100, if the user presses the scene select button 304a of the scene button 304 to set a scene, the interface display 301 of the remote controller 300 displays the scene select window (menu window) as shown in, e.g., Fig. 61. The cursor is at RAPID COOLING at the top.

[0227] In order to move the cursor to an input content that the user wises to select, he is supposed to manipulate the UP/DOWN button 304b of the scene button 304. For example, if wishing to select CLEAN AIR, in the state shown in Fig. 61, the user presses the "∇" portion of the UP/DOWN button 304b twice. Then, the cursor moves to CLEAN AIR, as shown in Fig. 62.

[0228] When selecting GUEST, in the state shown in Fig. 61, the user presses the "∇ " portion of the UP/DOWN button 304b five times. Then, the cursor moves to GUEST, as shown in Fig. 63.

[0229] Selection of the input content on the scene select window (menu window), the content of the selected scene, and the flow of detailed scene setting will be described with reference to Figs. 65 and 66.

[0230] First, at the start of the operation of the air conditioner 100 or during the operation of the air conditioner 100, when the user presses the scene select button 304a of the scene button 304 to set a scene, the interface display 301 of the remote controller 300 displays the scene select window (menu window) as shown in, e.g., (a) of Fig. 65. The cursor is at RAPID COOL at the top.

[0231] Subsequently, when the user presses the "∇" portion of the UP/DOWN button 304b of the scene button 304 once, the cursor moves to AVOID WIND, as shown in (b) of Fig. 65.

[0232] Assume that the content that the user wishes to set is not AVOID WIND but GUEST. The user presses the "∇" portion of the UP/DOWN button 304b of the scene button 304 four times to move the cursor to GUEST, as shown in (c) of Fig. 65.

[0233] While the cursor is at GUEST, when the user presses the ENTER button 304c of the scene button 304, the interface display 301 of the remote controller 300 displays the corresponding scene content, as shown in (d) of Fig. 66.

[0234] For example, HIGH POWER 30 MIN, WIND UPWARD, and PLATINUM NANOCOLLOID are displayed from the top in this order as the content of GUEST.

[0235] If the user approves of this scene content, he presses the RETURN button 307 to end the scene. After the scene is ended, when a predetermined period of time elapses, the display content of the interface display 301 of the remote controller 300 changes to the normal window (a setting window for the temperature, humidity, and the like) (see

Fig. 64).

[0236] If the user wishes to change, e.g., WIND UPWARD of the scene content to an off state, he presses the ENTER button 304c of the scene button 304. Then, the display content of the interface display 301 of the remote controller 300 changes to the detailed scene setting window as shown in (e) of Fig. 66.

[0237] The detailed scene setting window displays, for example, GUEST OFF ON HIGH POWER 30 MIN OFF ON CHANGE TIME, WIND UPWARD OFF ON ADJUST, and PLATINUM NANOCOLLOID OFF ON from the top downward.

[0238] In (e) of Fig. 66, the triangular cursor at the left end on the detailed scene setting window indicates HIGH POWER 30 MIN OFF ON CHANGE TIME.

[0239] Suppose that the user wishes to change WIND UPWARD to an off state.

[0240] The user presses the "∇" portion of the UP/DOWN button 304b of the scene button 304 once to move the triangular cursor to WIND UPWARD OFF ON ADJUST.

[0241] The user then presses the ENTER button 304c twice to change the setting to WIND UPWARD OFF ON ADJUST ((f) of Fig. 66).

[0242] Furthermore, the user presses the RETURN button 307 to end setting. Then, the interface display 301 of the remote controller 300 displays HIGH POWER 30 MIN and PLATINUM NANOCOLLOID from the top in this order as the content of GUEST, as shown in (g) of Fig. 66.

[0243] After that, when a predetermined period of time elapses, the display content of the interface display 301 of the remote controller 300 switches to the normal window (the setting window for the temperature, humidity, and the like) (see Fig. 64).

[0244] A supplementary explanation will be made on the scene select window (menu window) of (a) to (c) of Fig. 65. For example, in (a) to (c) of Fig. 65, most of the interface display 301 of the remote controller 300 is occupied by the scene select widow (menu window), but along with the input content of a scene select item, the lower portion of the interface display 301 displays an animation corresponding to the selected scene (where the cursor is), as shown in each illustration.

[0245] When the cursor is at RAPID COOLING at the top as in (a) of Fig. 65, an animation of a person sweating in the sunlight is presented at the lower portion of the interface display 301, as illustrated in (a) of Fig. 65.

[0246] When the cursor is at AVOID WIND as in (b) of Fig. 65, an animation of conditioned air blowing from the air conditioner 100, which is split to avoid a person, is presented at the lower portion of the interface display 301, as illustrated in (b) of Fig. 65.

[0247] When the cursor is at GUEST as in (c) of Fig. 65, an animation of people (guests) approaching a house is presented at the lower portion of the interface display 301, as illustrated in (c) of Fig. 65.

[0248] The animation of each of (a) to (c) of Fig. 65 does not remain the same but changes gradually. Each of (a) to (c) of Fig. 65 shows one frame of the animation.

[0249] In the scene select windows (menu windows) of (a) to (c) of Fig. 65, the animation is presented in two methods. According to one method, an animation is presented under the scene select window (menu window) as in (a) to (c) of Fig. 65.

[0250] According to the other method, only the scene select window is displayed at first. When a predetermined period of time elapses (e.g., at the lapse of several sec), an animation is presented on the entire screen of the interface display 301 of the remote controller 300. This helps the user understand the content of the corresponding scene well. After that, when the user presses the ENTER button 304c at an appropriate timing during presentation of the animation, the scene content shifts to that of (d) of Fig. 66.

[0251] Examples of an animation that change gradually will be indicated. Fig. 67 shows examples of an animation when the scene select item is CLEAN AIR. EMITTING PLATINUM NANOCOLLOID is presented at the uppermost portion of the interface display 301 of the remote controller 300. The animation changes in the order of arrows. In the animation, small circles and rhombuses represent platinum nanocolloid. It can be understood from the animation that viruses in the air disappear or become small.

[0252] When the cursor is at CLEAN AIR on the scene select window, the animation for the scene select item CLEAN AIR shown in Fig. 67 is presented under the scene select window or on the entire screen of the interface display 301.

[0253] In this manner, to explain that a device having the function of removing viruses in the air will be operated as a method of cleaning the air, a verbal explanation of EMITTING PLATINUM NANOCOLLOID and an animation that features the content of the function are presented.

[0254] By indicating, with the animation, that the viruses in the air will be removed by using platinum nanocolloid, the content of the function can be conveyed to the user simply. This allows the user to utilize the function of the air conditioner fully, so that the user can practice an operation that is more energy saving.

[0255] Fig. 68 refers to the first embodiment, and shows an animation for a scene select item SKIN CARE. Fig. 68 shows examples of the animation when the scene select item is SKIN CARE. EMITTING PLATINUM NANOCOLLOID is presented at the uppermost portion of the interface display 301 of the remote controller 300. The animation changes in the order of arrows. In the animation, small circles represent platinum nanocolloid. It can be understood from the animation that platinum nanocolloid acts on the human face to moisturize the skin.

[0256] Fig. 69 refers to the first embodiment, and is an enlarged view of the scene select window when a plurality of scene select items are selected. In this manner, two (a plurality of) scene select items can be selected. In this manner, the air conditioner can operate to cope with a variety of conditions and the user's needs, e.g., a case wherein the user's needs cannot be satisfied by selecting only one scene select item.

[0257] In the example of Fig. 69, two scene select items, i.e., RAPID COOLING and CLEAN AIR, are selected. Selection of two or more, a plurality of scene select items is also possible.

[0258] Regarding the display priority order of the scene select items, the display content order of the selection window changes based on the preceding use/selection frequency of the user. A scene select item that is selected frequently is displayed at the higher portion on the interface display 301.

[0259] The air conditioner learns how frequently a multiple item selection is made and the combination of the scene select items, and changes the input contents of the scene select items accordingly.

[0260] Fig. 70 refers to the first embodiment, and shows a state wherein the interface display 301 of the remote controller 300 displays a scene select item combination such as RAPID COOLING & CLEAN AIR As shown in Fig. 70, if a plurality of scene select items are selected frequently such as RAPID COOLING and CLEAN AIR, a new scene select item combination such as RAPID COOLING & CLEAN AIR is presented.

[0261] In this manner, scene select items that are easy to use for the user and match the life are presented.

[0262] The product functions are indicated and explained on the interface display 301 of the remote controller 300. This can partly reduce the functions of the user manual that accompanies an air conditioner product.

[0263] In order to clarify the characteristic features of this embodiment, a general remote controller 400 for an air conditioner will be described briefly.

[0264] Figs. 76 to 79 are views for comparison. Fig. 76 is a side view of the general remote controller 400 with a cover closed. Fig. 77 is a side view of the general remote controller 400 with the cover open. Fig. 78 is a front view of the general remote controller 400 with the cover closed. Fig. 79 is a comparative front view of the general remote controller 400 with the cover open. The general remote controller 400 for the air conditioner will be described with reference to Figs. 76 to 79.

[0265] The general remote controller 400 of the air conditioner shown in Figs. 76 to 79 is of a longitudinally long stick type.

[0266] The remote controller 400 is provided with a display 402 which displays the operation state of the air conditioner, e.g., the operation mode including cooling, dry operation, and heating, the preset temperature, the preset humidity, the wind velocity, and the wind direction.

[0267] An ON/OFF button 403 which starts and stops operation of the air conditioner is provided under the display 402.

[0268] Under the ON/OFF button 403, a temperature control button 407 which controls the temperature and a humidity control button 404 which controls the humidity are arranged side by side.

[0269] The remote controller 400 is provided with a remote controller cover 415 under the temperature control button 407 which controls the temperature and the humidity control button 404 which controls the humidity. The remote controller cover 415 opens downward (see Fig. 77).

[0270] On the upper surface of the remote controller cover 415, buttons that can be manipulated with the remote controller cover 415 being closed are provided. As shown in Fig. 78, a cooling button 412, dry button 411, and heating button 410 are arranged side by side on the upper portion of the upper surface of the remote controller cover 415.

[0271] A message NAVI button 413 which requests information from the air conditioner is provided at almost the center of the upper surface of the remote controller cover 415.

[0272] Under the message NAVI button 413, a blow button 414, timer ON button 416, and timer OFF button 417 are arranged side by side on the lower portion of the upper surface of the remote controller cover 415.

[0273] A detailed setting button group 405 which is exposed when the remote controller cover 415 is open is provided under the temperature control button 407 and humidity control button 404 (see Fig. 79). The detailed setting button group 405 is used when setting, e.g., the timer and the velocity and direction of the wind blown from the indoor unit, in detail.

[0274] A cover opening/closing detection switch 406 which detects the opening/closing state of the remote controller cover 415 is provided at the center of the lowermost portion of the detailed setting button group 405.

[0275] The rear side of the remote controller cover 415 has a projection (not shown) which presses the cover opening/closing detection switch 406 when the remote controller cover 415 is closed, to turn on the cover opening/closing detection switch 406 that has been OFF.

[0276] In this manner, the remote controller 400 of the general air conditioner has many buttons on the surface of the remote controller 400 and on the remote controller cover 415. Hence, the user may feel uneasy as he does not know how to set the remote controller 400 appropriately in a specific life scene which is different from his daily life scenes. Also, the user does not know how to use a specific function if he does not use it normally. Even when a situation should occur where the user needs to use such a specific function, he does not how to use it, so he may give up using them eventually. In this manner, the remote controller 400 gives an impression of being complicated and thus being difficult to use. Even if the button is printed with the new value-added name, the user cannot imagine what effect and function he can obtain by pressing the button.

[0277] In the remote controller 300 according to the modification, the number of manipulation buttons is greatly smaller than in the general remote controller 400, as has been described previously. Also, unlike in the general remote controller 400, the remote controller 300 according to the modification has no remote controller cover 415.

[0278] The user can control the air conditioner 100 in various manners by selecting and deciding on a scene select item (menu) displayed on the interface display 301 of the remote controller 300 through manipulation of only the scene button 304 in place of a plurality of buttons,.

[0279] In addition, the scene select items (menu) on the interface display 341 of the remote controller 300 verbally express the user's daily life scenes and display them by animations. Thus, the user can fully utilize the additional functions of the air conditioner 100 without being puzzled by the value-added functions and without giving up using them.

[0280] If the number of scene select items (menu) to be displayed on the interface display 301 of the remote controller 300 is large and the whole scene select items cannot be displayed on the interface display 301 at once, the user can select and decide on any one of all the scene select items by scrolling.

[0281] The relationship between the scene select items (menu) displayed on the interface display 301 of the remote controller 300 and the various types of buttons of the general remote controller 400 will be explained lightly.

[0282] For example, a scene select item RAPID COOLING corresponds to HIGH POWER BUTTON (not specified in the drawings) of the detailed setting button group 405 of the general remote controller 400.

[0283] A scene select item AVOID WIND corresponds to EXPOSE TO WIND/AVOID WIND (not specified in the drawings) of the detailed setting button group 405 of the general remote controller 400.

[0284] A scene select item CLEAN AIR corresponds to MIST BUTTON (not specified in the drawings) of the general remote controller 400.

[0285] A scene select item SKIN CARE corresponds to MIST BUTTON (not specified in the drawings) of the general remote controller 400.

[0286] A scene select item DRY ROOM corresponds to LAUNDRY BUTTON (not specified in the drawings) of the general remote controller 400.

[0287] A scene select item SLEEP corresponds to SLEEP BUTTON (not specified in the drawings) of the general remote controller 400.

[0288] In this manner, the respective types of buttons of the general remote controller 400 can be replaced with the input content of the scene select items displayed on the interface display 301 of the remote controller 300. In the above description, the relationship between some buttons of the general remote controller 400 and the input content of the scene select items displayed on the interface display 301 of the remote controller 300 has been explained. All buttons of the general remote controller 400 can be replaced with the scene select items displayed on the interface display 301 of the remote controller 300, although the description thereof will be omitted.

[0289] In this manner, in the remote controller 300 according to the modification, the buttons of the general remote controller 400 which are many and thus difficult to understand are eliminated and replaced with the scene select items displayed on the interface display 301. The scene select items are provided to express the user's daily life scenes verbally, and the corresponding scenes are displayed by animations. The user's daily life scenes can be selected not by using a large number of input buttons, but by selecting items that express the scenes verbally. The user can fully utilize the additional functions of the air conditioner 100 without being puzzled by the value-added functions and without giving up using them. This makes it possible to realize energy saving of the air conditioner 100 easily.

[0290] Also, the effect of an additional function of the air conditioner 100 that realizes the user's need selected by deciding on a daily life scene is expressed by words verbally and by animations. This simply conveys the benefit of the selected function to the user. Consequently, the troublesome job and necessity of referring to the user's manual that accompanies the product are eliminated.

[0291] Figs. 71 to 75 refer to the first embodiment. In Fig. 71, the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of INFORM OF MODERATE ENERGY SAVING EFFECT. Fig. 72 shows a state wherein the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of DETECTS HUMAN MOTION. WHEN PEOPLE DO NOT MOVE AROUND FOR LONGER THAN PREDETERMINED PERIOD OF TIME, SUGGESTS PEOPLE'S STAYING TOGETHER LEADS TO ENERGY SAVING OPERATION. In Fig. 73, the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of CHECKS OPEN/CLOSING STATE OF DOOR/CURTAIN BY INFRARED SENSOR BASED ON SUMMERTIME SUNLIGHT AND WINTERTIME LOW RADIATION. SUGGESTS CLOSING DOOR/CURTAIN. In Fig. 74, the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of QUICK ADVICE FOR USER COLD AT FOOT. In Fig. 75, the interface display 301 of the remote controller 300 displays the whole content of energy saving advice in heating of ADVICE WHEN ACTIVE HUMAN MOTION IS DETECTED.

[0292] With reference to Figs. 71 to 75, a display example will be described in which the whole contents of the energy saving advice displayed in Figs. 58 and 59 are displayed on the interface display 301 (see Fig. 60) of the remote controller 300 according to the modification which uses a full-dot (255 x 160) LCD (Liquid Crystal Display).

[0293] Referring to Figs. 58 and 59, the detailed energy saving operation information (information on recommended operation and on energy saving advice) which is to be displayed on the guidance display 220 (which uses a full-dot-matrix-type liquid crystal panel obtained by arranging pixels evenly in a grating in order to display a variety of images) of the remote controller 200 cannot be displayed whole because of the small area of the guidance display 220. Instead, display 1, display 2, and display 3 of the advice contents are displayed sequentially in this order each for a predetermined period of time (e.g., for 5 sec).

[0294] The interface display 301 (see Fig. 60) of the remote controller 300 which uses the full-dot (255 x 160) LCD (Liquid Crystal Display) according to the modification can display the whole content of display 1, display 2, and display 3 (see Figs. 58 and 59) of the advice contents.

[0295] Figs. 71 to 75 show a practical example of displaying the whole detailed content of the energy saving advice for heating of Fig. 59, which is obtained from the infrared sensor 3, on the interface display 301 of the remote controller 300 according to the modification.

[0296] In Fig. 71, the whole advice content which is generated when the purpose of the advice of Fig. 59 is INFORM OF MODERATE ENERGY SAVING EFFECT is displayed on the interface display 301 of the remote controller 300.

[0297] More specifically, the interface display 301 displays the time at the uppermost portion, and the operation mode (heating in this case), the preset temperature (20.5°C), and the preset humidity (50%) under the time. Under this display content, UNDER CONTROL BY AIR TEMPERATURE ONLY, OPERATION AT BODY-SENSIBLE TEMPERATURE, and SET BODY-SENSIBLE TEMPERATURE OPERATION? YES: PRESS "ECO"; NO: DO NOTHING are displayed as MESSAGE NAVI. This allows the user to grasp the entire advice content at a glance.

[0298] In Fig. 72, the whole advice content which is generated when the purpose of the advice of Fig. 59 is DETECTS HUMAN MOTION. WHEN PEOPLE DO NOT MOVE AROUND FOR LONGER THAN PREDETERMINED PERIOD OF TIME, SUGGESTS PEOPLE'S STAYING TOGETHER LEADS TO ENERGY SAVING OPERATION is displayed on the interface display 301 of the remote controller 300.

[0299] More specifically, the interface display 301 displays the time at the uppermost portion, and the operation mode (heating in this case), the preset temperature (20.5°C), and the preset humidity (50%) under the time. Under this display content, ENTIRE ROOM UNDER AIR CONDITIONING, DIVERTING WIND LEADS TO ENERGY SAVING, and DIVERT WIND? YES: PRESS "ECO"; NO: DO NOTHING are displayed as MESSAGE NAVI. This allows the user to grasp the entire advice content at a glance.

[0300] In Fig. 73, the whole advice content which is generated when the purpose of the advice of Fig. 59 is CHECKS OPEN/CLOSING STATE OF DOOR/CURTAIN BY INFRARED SENSOR BASED ON SUMMERTIME SUNLIGHT AND WINTERTIME LOW RADIATION. SUGGESTS CLOSING DOOR/CURTAIN is displayed on the interface display 301 of the remote controller 300.

[0301] More specifically, the interface display 301 displays the time at the uppermost portion, and the operation mode (heating in this case), the preset temperature (20.5°C), and preset humidity (50%) under the time. Under this display content, COLD SPOT ON WALL SURFACE, CLOSING CURTAIN/DOOR, and LEADS TO ENERGY SAVING are displayed as MESSAGE NAVI. This allows the user to grasp the entire advice content at a glance.

[0302] In Fig. 74, the whole advice content which is generated when the purpose of the advice of Fig. 59 is QUICK ADVICE FOR USER COLD AT FOOT is displayed on the interface display 301 of the remote controller 300.

[0303] More specifically, the interface display 301 displays the time at the uppermost portion, and the operation mode (heating in this case), the preset temperature (20.5°C), and preset humidity (50%) under the time. Under this display content, UPWARD WIND. NOT COLD AT FOOT? AUTOMATIC WIND SPEED LEADS TO ENERGY SAVING, SET AUTOMATIC WIND DIRECTION? YES: PRESS "ECO"; NO: DO NOTHING is displayed as MESSAGE NAVI. This allows the user to grasp the entire advice content at a glance.

[0304] In Fig. 75, the whole advice content which is generated when the purpose of the advice of Fig. 59 is ADVICE WHEN ACTIVE HUMAN MOTION IS DETECTED is displayed on the interface display 301 of the remote controller 300.

[0305] More specifically, the interface display 301 displays the time at the uppermost portion, and the operation mode (heating in this case), the preset temperature (20.5°C), and preset humidity (50%) under the time. Under this display content, BE AWARE OF INDOOR AIR POLLUTION, MIST WILL SUPPRESS AIRBORNE MICROBE, and SET MIST? YES: PRESS "ECO"; NO: DO NOTHING are displayed as MESSAGE NAVI. This allows the user to grasp the entire advice content at a glance.

[0306] Figs. 80 to 83 refer to the first embodiment. Fig. 80 is an outer appearance front view of a remote controller 500 according to a modification. Fig. 81 is an outer appearance side view of the remote controller 500 according to the modification. Fig. 82 is a conceptual front view showing the internal structure of the remote controller 500 according to the modification. Fig. 83 shows the basic structure of an acceleration sensor 520.

[0307] The remote controller 500 according to the modification shown in Figs. 80 to 82 has an interface display 501 which uses a full-dot (255 x 160) LCD (Liquid Crystal Display), in the same manner as the remote controller 300 shown in Fig. 60.

[0308] The most distinctive characteristic feature of the remote controller 500 according to the modification resides in that the remote controller 500 incorporates the acceleration sensor 520, as shown in Figs. 80 and 82. In Figs. 80 and 82, the acceleration sensor 520 is arranged above the interface display 501 (the uppermost portion when seen from the front surface of the remote controller 500).

[0309] The remote controller 500 according to the modification shown in Fig. 80 has, in the same manner as the remote controller 300, a greatly smaller number of user manipulation buttons than an ordinary remote controller does. The remote controller 500 has no cover. The user needs to manipulate only buttons shown in Fig 80.

[0310] The air conditioner (not shown) is not operating. Hence, in the remote controller 500 of the modification shown in Fig. 80, the interface display 501 at the upper front surface of the remote controller main body 510 displays only the time.

[0311] The interface display 501 employs, e.g., a full-dot (255 x 160) LCD (Liquid Crystal Display).

[0312] The display restriction (the function limitation that only a limited content can be displayed within a limited region) of the segment display employed in the interface display of a conventional remote controller is abolished. Restriction-free expressions and animations can be developed within the interface window.

[0313] Under the interface display 501, an operation ON/OFF button 502 and an operation mode switching button 503 are arranged at almost the center of the remote controller 500.

[0314] The operation mode switching button 503 is constituted by a cooling button, a dry button, and a heating button.

[0315] Under the operation mode switching button 503, a scene button 504, a humidity control button 505, and a temperature control button 506 are arranged in one circle.

[0316] The scene button 504 is constituted by a scene select button 504a, an UP/DOWN button 504b, and an ENTER button 504c.

[0317] The UP/DOWN button 504b is arranged at the center of a big circle and has a round shape. The UP/DOWN button 504b is a one-part button. As the user presses the "Δ" portion of the UP/DOWN button 504b, the cursor of the interface display 501 moves upward.

[0318] When the user presses the "Δ" portion of the UP/DOWN button 504b once, the cursor of the interface display 501 moves up by one line.

[0319] As the user presses the "∇" portion of the UP/DOWN button 504b, the cursor of the interface display 501 moves downward.

[0320] When the user presses the "∇" portion of the UP/DOWN button 504b once, the cursor of the interface display 501 moves down by one line.

[0321] The scene select button 504a, humidity control button 505, ENTER button 504c, and temperature control button 506 are arranged to form a ring.

[0322] A RETURN button 507 and a message NAVI button 508 are arranged below the scene button 504. The RETURN button 507 has functions such as setting end.

[0323] The above layout is an example. The actual layout is not limited to that shown in Fig. 80. The remote controller 500 can have an arbitrary layout.

[0324] The acceleration sensor 520 will be described. The acceleration sensor 520 is a compact sensor that can detect a physical quantity such as acceleration (or force or magnetism) of each component of the three dimensions. In the acceleration sensor 520, a gage resistor is formed on a semiconductor substrate such as a silicon substrate. The acceleration sensor 520 converts a mechanical strain generated in the substrate based on an external force into an electrical signal by utilizing the piezo resistance effect. The basic principle of the acceleration sensor is disclosed in, e.g., Publication of International Application (WO 93/02342).

[0325] The acceleration sensor 520 shown in Fig. 83 is a three-axis force/moment sensor that detects a three-axis force/moment. In the acceleration sensor 520, a Si substrate 522 (strain generator) is fixed to a base 521, and a weight 523 is bonded to the Si substrate 522 (strain generator).

[0326] The force applied to the Si substrate 522 causes strain in the piezo resistor (not shown) formed on the Si substrate 522. Based on the piezo resistance effect, the electrical resistance of the piezo resistor changes in proportion to the strain. The applied force is detected by utilizing the change in resistance.

[0327] A diaphragm is formed on the Si substrate 522. The Si substrate 522 is used as the strain generator. Thus, the resultant structure serves as a three-axis acceleration sensor.

[0328] Three sets of gage resistors to detect the three-axis acceleration components are formed on the surface of the Si substrate 522. The annular diaphragm is formed on the lower surface of the Si substrate 522. The weight 523 is bonded to the center of the lower surface of the Si substrate 522, and the base 521 is bonded to the peripheral portion of the lower surface of the Si substrate 522.

[0329] When acceleration in an X-, Y-, or X-axis direction acts on the weight 523, the annular diaphragm displaces in the corresponding direction. By connecting the gage resistors formed on the Si substrate 522 to a bridge circuit, the acceleration of each axis can be detected independently.

[0330] As shown in Figs. 80 and 81, the three-axis directions of the acceleration sensor 520 are determined such that the vertical direction and the horizontal direction (right-to-front direction) on the front surface of the remote controller 500 correspond to Y-axis and the X-axis, respectively, and that the right-to-left direction (the back-and-forth direction of the remote controller 500) on the side surface of the remote controller 500 corresponds to the Z-axis.

[0331] Although the acceleration sensor 520 that detects the three-axis acceleration components is indicated, in implementing the following function, the acceleration sensor 520 may be one that detects a one-axis acceleration component. It must be noted that the acceleration sensor 520 must be able to detect at least a one-axis acceleration component.

[0332] As shown in Fig. 82, inside the remote controller 500, for example, the acceleration sensor 520 (or acceleration sensor substrate), the interface display 501, a control board 530, and a radio module 540 (e.g., a 2.4-GHz radio module) are arranged in this order from above. This layout is merely an example, and the actual layout is not limited to this.

[0333] The user may take, with his hand, the remote controller 500 (stick type remote controller) in which the acceleration sensor 520 (or acceleration sensor substrate) is mounted on the control substrate (not shown), and may press various types of buttons. The acceleration sensor 520 is mounted at a position which is separate from the position where the user grips the remote controller 500 with his hand. In other words, as shown in Fig. 82, the acceleration sensor 520 is arranged above the interface display 501 (the uppermost portion when seen from the front surface of the remote controller 500). Usually, the user grips the remote controller 500 with his hand at, e.g., a position near the control board 530 in Fig. 82.

[0334] Assume that the user holds and raises the remote controller 500 (stick type remote controller). The larger a distance L from the holding position where the user grips the remote controller 500 to the acceleration sensor 520 (or acceleration sensor substrate), the more accurate the detection output that can be obtained from the acceleration sensor 520 as the user shakes the remote controller 500 in the right-to-front and back-and-forth directions.

[0335] More specifically, for example, the acceleration sensor 520 is mounted at the position where an infrared communication part was conventionally mounted on a remote controller to enable communication between the remote controller and the air conditioner main body, that is, at the uppermost portion of the remote controller when seen from the front surface.

[0336] When the radio module 540 (radio module communication part) is employed in place of the infrared communication part (having directivity) that was necessary for communication with the air conditioner main body, and is mounted at the lowermost portion of the remote controller 500 when seen from the front surface, then the space to mount the acceleration sensor 520 can be ensured.

[0337] When the conventional remote controller employing infrared communication is to transmit a signal to the air conditioner main body, the signal is transmitted based on, as the trigger, depression of a button mounted on the surface of the remote controller.

[0338] In the layout as shown in Fig. 82, since the acceleration sensor 520 is mounted on the remote controller 500, the remote controller 500 can transmit a request signal when the user raises the remote controller 500 or shakes the remote controller 500 in the back-and-forth direction, the right-to-left direction, or in the vertical direction (or when the user moves the remote controller 500 otherwise), without the need for the user to press a button of the remote controller 500. Conventionally, the user needs to direct the transmitter part of the remote controller to the receiver part of the air conditioner main body. In this respect, as the radio module 540 is employed, communication with the air conditioner main body free from the influence of the directivity is enabled.

[0339] An application concerning the remote controller 500 having the above structure and the air conditioner main body will be described. It seems that, e.g., a housewife who is in a living room alone sometimes refrains from using the air conditioner because she feels it is uneconomical to do so. The up-to-date air conditioner can provide information on the electricity rate or environmental temperature during operation. However, the housewife, even though she wishes to check the electricity rate that she can refer to when determining whether or not to turn on the air conditioner, or the environmental condition at that time before the operation, might not know how to check. This problem can be solved by using the remote controller 500 having the above structure.

[0340] While the air conditioner is not operating, when the user raises the remote controller 500, the air conditioner provides pre-operation information such as environmental condition information (indoor temperature, humidity, and the like) at that time, and the electricity rate.

[0341] The pre-operation information is provided to the user who conventionally refrains from using the air conditioner. Thus, further improvement in energy saving consciousness can be achieved, and a quantitative index can be provided for the individual feeling concerning the environmental condition.

[0342] The pre-operation information will be described. While the air conditioner is not operating, when the user raises the remote controller 500, the controller of the air conditioner main body provides the information to be displayed on the interface display 501 of the remote controller 500. In a situation where the air conditioner is not operating and the remote controller 500 is placed on a table or the like, the interface display 501 of the remote controller 500 displays nothing but the time (see Fig. 80).

[0343] The following control is performed by a microcomputer programmed with a predetermined operation. Note that a microcomputer programmed with a predetermined operation is defined as a "controller". In the following description, a description that the controller (the microcomputer programmed with the predetermined operation) performs each control operation will be omitted.

[0344] When the user raises the remote controller 500, radio communication is performed based on, as the trigger, an output from the three-axis acceleration sensor 520 mounted in the remote controller 500, and bidirectional communication is performed between the air conditioner main body (controller) and the remote controller 500. At this time, communication of the latest data on the environmental condition information and pre-operation electricity rate information which the air conditioner had detected while not operating is completed, and the communicated data is displayed on the interface display 501 of the remote controller 500.

[0345] Even if the remote controller 500 has a conventional infrared communication part (with directivity) and does not have a radio module 540 (radio module communication part), it can display the pre-operation information (indoor environmental condition information and pre-operation electricity rate). The pre-operation information (environmental condition information and pre-operation electricity rate) computed during the operation of the air conditioner is obtained from the main body of the air conditioner after an operation stop signal is transmitted from the infrared communication part of the remote controller 500 to the main body of the air conditioner. The remote controller 500 retains the information from the air conditioner main body, so that it can display the pre-operation information (environmental condition information and pre-operation electricity rate) while the air conditioner does not operate.

[0346] Figs. 84 and 85 refer to the first embodiment, in which Fig. 84 shows the indoor environment information (information 1) displayed on an interface display 501 of the remote controller 500, and Fig. 85 shows the electricity rate information (information 2) at the start of recommended operation displayed on the interface display 501 of the remote controller 500.

[0347] The pre-operation information (the indoor environmental condition information which was detected while the air conditioner was not operating, and pre-operation electricity rate information) is displayed on the interface display 501 of the remote controller 500 by two-frame presentation. First, the first frame displays the indoor environmental condition as indicated as information 1 in Fig. 84. The indoor environmental condition includes:

(1) the indoor temperature; and
(2) the indoor humidity.

In addition, radiation temperature such as floor temperature may be displayed.
[0348] After the indoor environmental information as information 1 of Fig. 84 is provided, the electricity rate information at the start of the recommended operation, which is indicated as information 2 in Fig. 85, is provided. Regarding how to cause a shift from information 1 to information 2 on the interface display 501 of the remote controller 500, several seconds after information 1 is displayed, when a time necessary for the user to understand the indoor environmental condition information elapses, the shift to the frame of information 2 takes place. It is also possible to allow the user to cause the shift to the frame of information 2 arbitrarily. If the user wishes to cause the shift to the frame of information 2 arbitrarily, for example, frame transition is performed based on the output signal of the acceleration sensor 520 incorporated in the remote controller 500.
[0349] With the frame of information 1 (Fig. 84) being displayed, for example, when the user shakes the remote controller 500 in the left-to-right direction (X-axis direction), a shift to information 2 (Fig. 85) takes place.
[0350] State transition can be made based on an X-axis output from the acceleration sensor 520 mounted in the remote controller 500. State transition can also be made based on an action of the user of moving his arm, with the remote controller 500 in his hand, in the back-and forth direction (Z-axis direction) or vertical direction (Y-axis direction), or to draw a big circle. Basically, the frame transition takes place based on the output signal from the acceleration sensor 520 mounted in the remote controller 500.
[0351] Information 2 will now be described. Information 2 includes:

(1) the electricity rate for one person (1-person mode) per hour;
(2) the electricity rate charged when the entire room is air-conditioned (entire room mode); and
(3) the electricity rate charged when rapid operation start is performed (high power mode, rapid heating mode)

which are displayed on the interface display 501 of the remote controller 500 together with the indoor environmental information (temperature and humidity).
[0352] Since the electricity rate per hour depending on the user's life scene is displayed, detailed information can be provided to the user.
[0353] In a state wherein the interface display 501 of the remote controller 500 displays the electricity rate of the recommended operation, the user selects the electricity rate information for a desired user's life scene displayed on the frame of information 2 on the interface display 501, by the UP/DOWN button 504b of the remote controller 500. When the user presses the ENTER button 504c, the operation can be started.
[0354] When starting the operation of the air conditioner, conventionally, the user presses a direct button mounted on the surface of the remote controller. Usually, the direct button refers to the operation ON/OFF button 502 and operation mode switching button 503 (cooling button, dry button, and heating button).
[0355] Several seconds after information 1 is displayed on the interface display 501 of the remote controller 500, when the time necessary for the user to understand the indoor environmental information elapses, the shift to the frame of information 2 takes place. After that, operation of the air conditioner can be started by an input means of using an output from the acceleration sensor 520 as well, without the need for user to press a button (e.g., the UP/DOWN button 504b) of the remote controller 500. Namely, on the frame of information 2 displayed on the interface display 501, the user can select and decide on the electricity rate information for the desired user's life scene by moving the remote controller 500 in any one of the following manners (1) to (4):

(1) holding the remote controller 500 with his hand and shaking it in the right-to-left direction (X-axis direction);
(2) holding the remote controller 500 with his hand and shaking it in the back-and-forth direction (X-axis direction);
(3) taking the remote controller 500 with his hand and shaking it in the vertical direction (Y-axis direction); and
(4) taking the remote controller 500 with his hand and moving his arm to draw a big circle

[0356] For example, with the frame of information 2 being displayed on the interface display 501, the user shakes the remote controller 500 in the right-to-to left direction (X-axis direction), in the back-and-forth direction (Z-axis direction), or in the vertical direction (Y-axis direction), to select the electricity rate information for the desired user's life scene displayed (without pressing a button, e.g., the UP/DOWN button 504b, of the remote controller 500). Then, the user can decide on the selected scene by, e.g., moving his arm to draw a big circle with the remote controller 500 in his hand (without pressing the ENTER button 504c of the remote controller 500).

[0357] Other than the above method, with the frame of information 2 being displayed on the interface display 501, if he shakes the remote controller 500 in the right-to-to left direction (X-axis direction), in the back-and-forth direction (Z-axis direction), or in the vertical direction (Y-axis direction), or moves his arm to draw a big circle with the remote controller 500 in his hand, he can select the electricity rate information for the desired user's life scene displayed (without pressing a button, e.g., the UP/DOWN button 504b, of the remote controller 500). Then, the user can decide on the selected scene by taking any one of the actions described above with the remote controller 500 in his hand (without pressing the ENTER button 504c of the remote controller 500), excluding the action employed to select the electricity rate information for the desired user's life scene displayed.

[0358] As a means for switching the operation mode (among cooling, dry operation, and heating), the user selects any one of the operation modes (cooling, dry operation, or heating) by shaking the remote controller 500 in the back-and-forth direction (controlling the cursor movement based on the Z-axis output of the acceleration sensor 520) or in the right-to-left direction (controlling the cursor movement based on the X-axis output of the acceleration sensor 520).

[0359] To start the air conditioner in the selected operation mode (any one of cooling, dry operation, and heating), it is also possible to decide on the selected operation mode by shaking the remote controller 500 in the vertical direction (to start the air conditioner based on the Y-axis output of the acceleration sensor 520). The user can start operation easily without pressing a button of the remote controller 500.

[0360] Fig. 86 refers to the first embodiment, and is an outer appearance view of the air conditioner 100 having the display 100a. When the user raises the remote controller 500, the color of an ECO lamp 20 of the main body is changed to indicate that the remote controller 500 and the air conditioner main body perform bidirectional information communication.

[0361] When the user raises the remote controller 500, the air conditioner informs the user that the remote controller 500 and the air conditioner main body perform bidirectional information communication, by linking the remote controller 500 to the display function of the main body. As shown in Fig. 86, this function is realized by changing the ON color of the message NAVI (the ECO lamp 20).

[0362] The message NAVI function of informing the user of the energy saving information which the user does not notice easily during the operation, is realized by changing the ON color of the display button (ECO lamp 20).

[0363] Usually, the message NAVI lamp (ECO lamp 20) is lit in green when a message is generated during the operation. To inform that the bidirectional information communication is being performed, the ECO lamp 20 is lit in red or blue. The ON color of the NAVI lamp (ECO lamp 20) can be switched by mounting LEDs (Light-Emitting Diodes) of three colors. Note that the NAVI lamp (ECO lamp 20) can employ ON colors different from those described above to indicate the normal operation and the above bidirectional information communication function. It suffices as far as the ON colors are different between the normal operation and this function.

[0364] Figs. 87 to 90 refer to the first embodiment. Fig. 87 is an outer appearance view of the air conditioner 100 which indicates that the remote controller 500 and the air conditioner main body perform bidirectional information communication, by turning on three LEDs 550a, 550b, and 550c in turn. Fig. 88 is an enlarged view of a portion X of Fig. 87. Fig. 89 is an outer appearance view of the air conditioner 100 which indicates that the remote controller 500 and the air conditioner main body perform bidirectional information communication, by turning on a plurality of (three) LEDs 560 in turn. Fig. 90 is an enlarged view of a portion Y of Fig. 89.

[0365] An example has been described in which the message NAVI function of informing the user of the energy saving information which the user does not notice easily during the operation from the air conditioner, is realized by changing the ON color of the display button (ECO lamp 20). Alternatively, the energy saving information may be informed to the user by mounting a plurality of LEDs and turning them on in turn, as shown in Figs. 87 to 90.

[0366] For example, as shown in Figs. 87 and 88, this function may be realized by turning on, in turn, the three LEDs 550a, 550b, and 550c provided on the front surface of the air conditioner.

[0367] As shown in Figs. 89 and 90, this function may be realized by repeatedly turning on, among a pair of LEDs 560 formed at almost the center of the front surface of an air conditioner and each constituted by three LEDs 560a, 560b, and 560c, first the two LEDs 560a, then the two LED 560b, and furthermore the two LED 560c.

[0368] This function is implemented by a display means using LEDs. This function can also be implemented by a display means using voice.

[0369] How to produce information 1 and information 2 as the pre-operation information will now be described. First, information 1 represents the following items:

(1) indoor temperature:
(2) indoor humidity (or floor temperature): and
(3) comfort index

[0370] Regarding the indoor temperature and indoor humidity (or floor temperature), while the air conditioner is not operating, the power supply of the indoor unit of the air conditioner is turned on once for every 30 min, and data at that time on the indoor temperature, humidity sensor, and the floor temperature are accumulated. Data accumulation is done in accordance with the moving average process. Sampling of data detection is changed in accordance with the temperature change in a day of the indoor temperature. If a difference between the moving average value of the indoor temperature or humidity information accumulated every 30 min and an actual detection temperature that can be detected at the time of sampling becomes equal to or larger than a threshold value Δ, the sampling time is changed to every 20 min or 10 min to follow the change in indoor temperature.

[0371] Usually, the gradients of the indoor space temperature and humidity in a day are not very large, but a large gradient occurs when, e.g., the user opens the window on a rainy day. The sampling time is set to follow this large gradient. As the gradients of the air temperature/humidity and the gradient of the floor temperature differ largely, the respective moving average processes based on sampling are performed independently of each of each other.

[0372] Regarding floor temperature detection, if the floor temperature is to be sensed by moving the 8-element infrared sensor 3 (see Fig. 4) in the right-to-left direction while the air conditioner is not operating (the operation of the infrared sensor 3 is the same as that during normal operation), the floor temperature detection cannot be realized due to the standby power restriction during an operation halt. Regarding this, the life area information (e.g., Fig. 26) of the user which is detected from the infrared sensor 3 is used. During the operation halt, the infrared sensor 3 stops at a location where it can detect the position of the life area, and performs sensing.

[0373] Generation of the comfort index will be described. The body-sensible temperature is calculated based on the information on the indoor temperature, indoor humidity, and floor temperature which are detected in the above manner. The difference between the body-sensible temperature which is calculated during the operation halt and the preset body-sensible temperature which is usually preset by the user during the cooling/heating operation is expressed by an indicator.

[0374] For example, assume that the user operates the air conditioner in cooling by setting the body-sensible cooling temperature to 28°C, and that the body-sensible temperature calculated during an operation halt when the user refrains from using the air conditioner is 31°C. In this case, the temperature difference of 3°C between 31°C and 28°C indicates the current state of discomfort as the difference from the comfortable state. Similarly, the term "comfort index" may be employed as the energy saving index, and the difference between the officially recommended temperature (20°C for heating and 28°C for cooling) and the body-sensible temperature calculated during an operation halt may be expressed using the energy saving index.

[0375] Information 2 as the pre-operation information will be described. Information 2 as the pre-operation information describes calculation of the following energy consumption data:

(1) energy consumption data for operation in the 1-person mode; and
(2) energy consumption data when the life area region obtained from the detection result of the infrared sensor 3 is air-conditioned

[0376] The energy consumption discussed here is defined as the electricity rate charged per unit time, and is calculated based on the actual measurement data of the integral electrical power consumed per basic unit time. A means that calculates the energy consumption will be described hereinafter.

[0377] The integral electrical power consumed per unit time is obtained, as will be described below, by dividing the total integral power consumption (kWh) consumed during operation by the total cumulative operation time (h). More specifically, power consumption per unit time [kWh/h]
= total integral power consumption [kWh]/total cumulative operation time [h]
The above calculation yields the power consumption per unit time which reflects all the operation/use conditions of the user. This value is an actual value based on the past usage (past record). A prediction value is calculated by referring to this actual data. The energy consumption data is computed for each of the three modes of heating operation, cooling operation, and dry operation which are the operation modes of the air conditioner.

[0378] Simultaneously with the measurement of the total cumulative operation time described above, the area detection frequency of the infrared sensor 3 is measured as the cumulative data, and the occurrence frequency of the area air-conditioning state is calculated. The infrared sensor 3 detects the detection area of the user every 30 sec.

[0379] The life scene of the user is estimated based on the area detection occurrence frequency from the infrared sensor 3 with respect to the total cumulative operation time. For example, assume that the occurrence frequency for one detection area is high. It is estimated from the operation status for the life scene that the user uses the air conditioner in the 1-person mode. The power consumption of the actual measurement data is the prediction electricity rate for the 1-person mode. The reference value for the actual measurement data is determined as the area detection frequency of the infrared sensor 3. Then,

(1) the prediction electricity rate for the 1-person mode,

(2) the prediction electricity rate for the life area that includes four different areas, and the like can also be corrected based on the same concept by multiplying them by the energy saving correction coefficient of the corresponding area.

[0380] Fig. 91 refers to the first embodiment, and shows how the power consumptions are summed and stored at different memory locations in accordance with the time zones of midnight, morning, day, and night. The electricity rate per hour which is to be displayed on the interface display 501 of the remote controller 500 is obtained by multiplying the power consumption calculated above by the electricity rate unit price of major electric power companies. As shown in Fig. 91, assume that the major electric power companies have different electricity rate unit price charging systems for different time zones of 24 hours, i.e., midnight rate, morning rate, day rate, and night rate. Strictly speaking, various charging systems are present depending on the contract of the user and the electric power company. The basic electricity rate unit price is computed in three modes in which the morning rate and the night rate are the same.

[0381] When the user takes with his hand the remote controller 500 which is a basic application of this embodiment, an electricity rate unit price based on the clock time of the remote controller 500 is selected and displayed. The electricity rate unit price can be set for each user in accordance with the preset condition of the remote controller 500. Regarding a user who does not have a midnight power contract, if the electricity rates of the 3 modes described above are set to have the same unit price, a highly precise electricity rate that matches the contract of the user can be displayed on the remote controller 500.

[0382] Fig. 92 refers to the first embodiment, and is a table showing the rate of change of energy saving depending on the body-sensible temperature difference. The electricity rate is corrected, using the correction table, by considering the temperature difference between the environmental temperature condition (body-sensible temperature setting) which is usually set by the user to realize a comfortable environment, and the pre-operation environmental temperature condition (body-sensible temperature state). The resultant electricity rate is as follows:

[0383] prediction value of power consumption per unit time [kWb/h]
= {power consumption per unit time [kWh/h]}
x {100 - (correction rate of actual value [%])}/100
Accordingly, the electricity rate is calculated as:

electricity rate energy consumption [yen/h]
= (prediction value of power consumption per unit time [kWh/h])
x electricity rate unit price (unit price per hour)

Fig. 93 refers to the first embodiment, and is a table showing the rate of change of energy saving depending on the humidity difference. When the air conditioner is to operate in the dry operation mode, the table of the rate of change of energy saving shown in Fig. 93 which is based on the humidity difference is employed.

[Reference Signs List]

[0384] 1... metal casing; 2... light-distribution view angle; 3... infrared sensor; 5... casing; 6... stepping motor; 7... attachment; 12... housewife; 13... infant; 14... window; 16... left wall surface; 17... right wall surface; 18... floor surface; 19... front wall surface; 20... ECO lamp; 31... window region; 40... indoor unit housing; 41... suction port; 42...outlet port; 43... vertical flap; 44... horizontal flap; 45... blower; 46... heat exchanger; 51... infrared sensor driving unit; 52... infrared image acquisition unit; 53... temperature non-uniformity boundary detection unit; 54... reference wall position calculation unit; 55... floor surface coordinate transformation unit; 56... front/right/left wall position calculation unit; 57... detection log accumulation unit; 58... wall position determination unit; 60... boundary line; 61... human body detection unit; 62... human body position log accumulation unit; 63... human body position validity determination unit; 64... temperature non-uniformity validity determination unit; 66... region; 100... air conditioner; 100a... display; 101... thermogram acquisition unit; 102... floor/wall detection unit; 103... room temperature determination unit; 104... outdoor temperature determination unit; 105... intra-wall-region temperature difference determination unit; 106... intra-wall-region outdoor-temperature zone extraction unit; 107... window region extraction unit; 108... intra-window-region temperature difference determination unit; 109... curtain closing operation determination unit; 110... user interface unit; 120... left wall surface boundary line; 121... right wall surface boundary line; 122... front wall surface boundary line; 200... remote controller; 210... ECO advice button; 220... guidance display; 230... preset data display; 240... ON/OFF button; 250... temperature control button; 260... humidity control button; 270... operation mode change button; 280... timer button; 290... mist button; 300... remote controller; 301... interface display; 302... operation ON/OFF button; 303... operation mode switching button; 304... scene button; 304a... scene select button; 304b... UP/DOWN button; 304c... ENTER button; 305... humidity control button; 306... temperature control button; 307... RETURN button; 308... message NAVI button; 310... remote controller main body; 400... remote controller; 402... display; 403... ON/OFF button; 404... humidity control button; 405... detailed setting button group; 406... cover opening/closing detection switch; 407... temperature control button; 410... heating button;

412... cooling button; 411... dry button; 413... message NAVI button; 414... blow button; 415... remote controller cover; 416... timer ON button; 417... timer OFF button; 500... remote controller; 501... interface display; 502... operation ON/OFF button; 503... operation mode switching button; 504... scene button; 504a... scene select button; 504b... UP/DOWN button; 504c... ENTER button; 505... humidity control button; 506... temperature control button; 507... RETURN button; 508... message NAVI button; 510...remote controller main body; 520... acceleration sensor; 521... base; 522... Si substrate; 523... weight; 530... control board; 540... radio module; 550a... LED; 550b... LED; 550c... LED; 560... LED; 560a... LED; 560b... LED; 560c... LED

Claims

1. An air conditioner (100) comprising:

an almost box-shaped main body (40) having a suction port (41) to take in room air and a blowing port (42) to blow out conditioned air;
a controller that controls operation of the air conditioner;
a remote controller (500) that includes a remote controller main body (510), an acceleration sensor (520) provided in the remote controller main body, and an interface display part (501) constituted by a full-dot liquid crystal display, and allows a user to control operation of the air conditioner; and
a communication part that performs bidirectional communication between the controller and the remote controller,
wherein when the user raises the remote controller, pre-operation information is displayed on the interface display part.

2. The air conditioner according to claim 1, wherein the remote controller is of a stick type, and the acceleration sensor is mounted at a position which is separate from a position where a user grips the remote controller with his hand.

3. The air conditioner according to claim 1 or 2, wherein the communication part of the remote controller is constituted by a radio module (540).

4. The air conditioner according to any one of claims 1 to 3, wherein the pre-operation information includes indoor environmental condition information which the controller had detected while the air conditioner was not operating, and pre-operation electricity rate information which is to be displayed subsequent to the indoor environmental condition information.

5. The air conditioner according to any one of claims 1 to 4, wherein the indoor environmental condition information shifts to the pre-operation electricity rate information by either one of:

(1) an automatic shift that takes place when a time required for the user to understand the indoor environmental information elapses; and
(2) a shift based on an output signal from the acceleration sensor mounted in the remote controller.

6. The air conditioner according to claim 4 or 5, wherein the indoor environmental condition information includes an indoor temperature, an indoor humidity, and a radiation temperature such as a floor temperature.

7. The air conditioner according to any one of claim 4 to 6, wherein the pre-operation electricity rate information includes:

(1) an electricity rate for 1-person mode per hour;
(2) an electricity rate charged when an entire room is air-conditioned; and
(3) an electricity rate charged when rapid operation start is performed.

Fig. 1

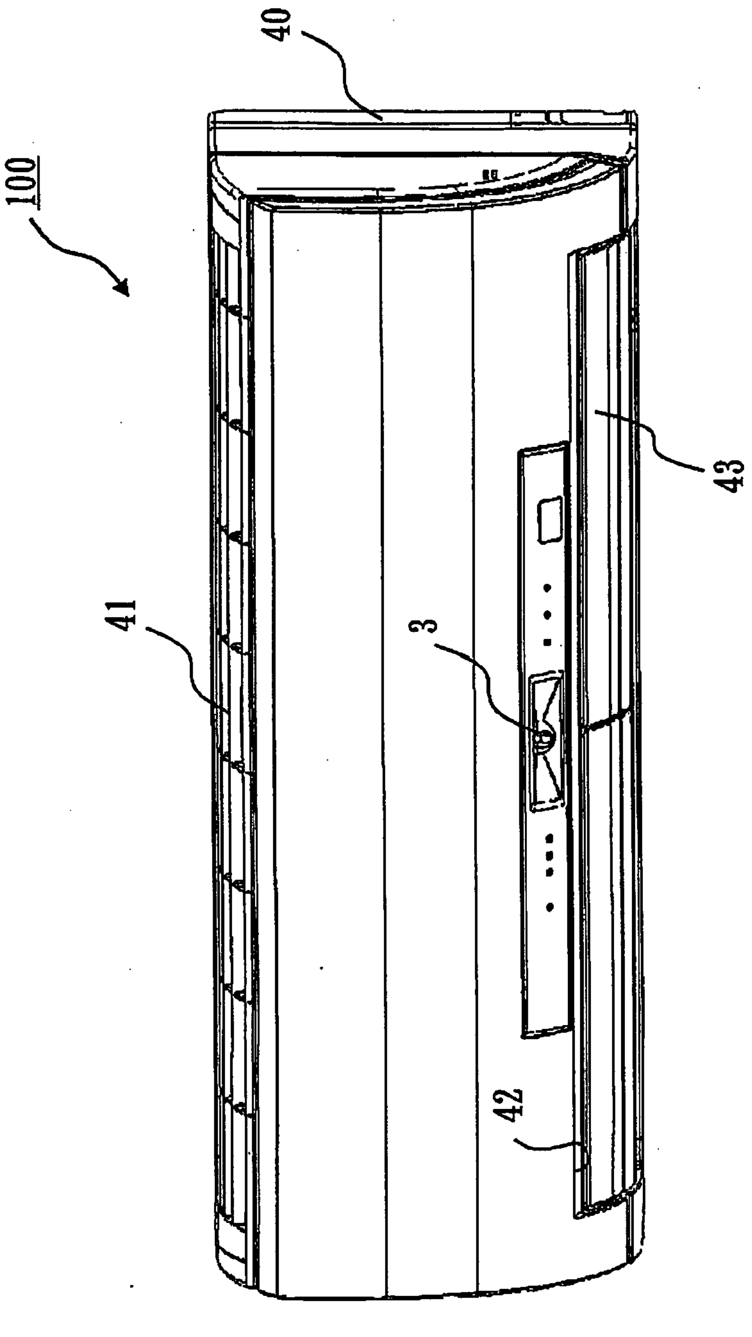


Fig. 2

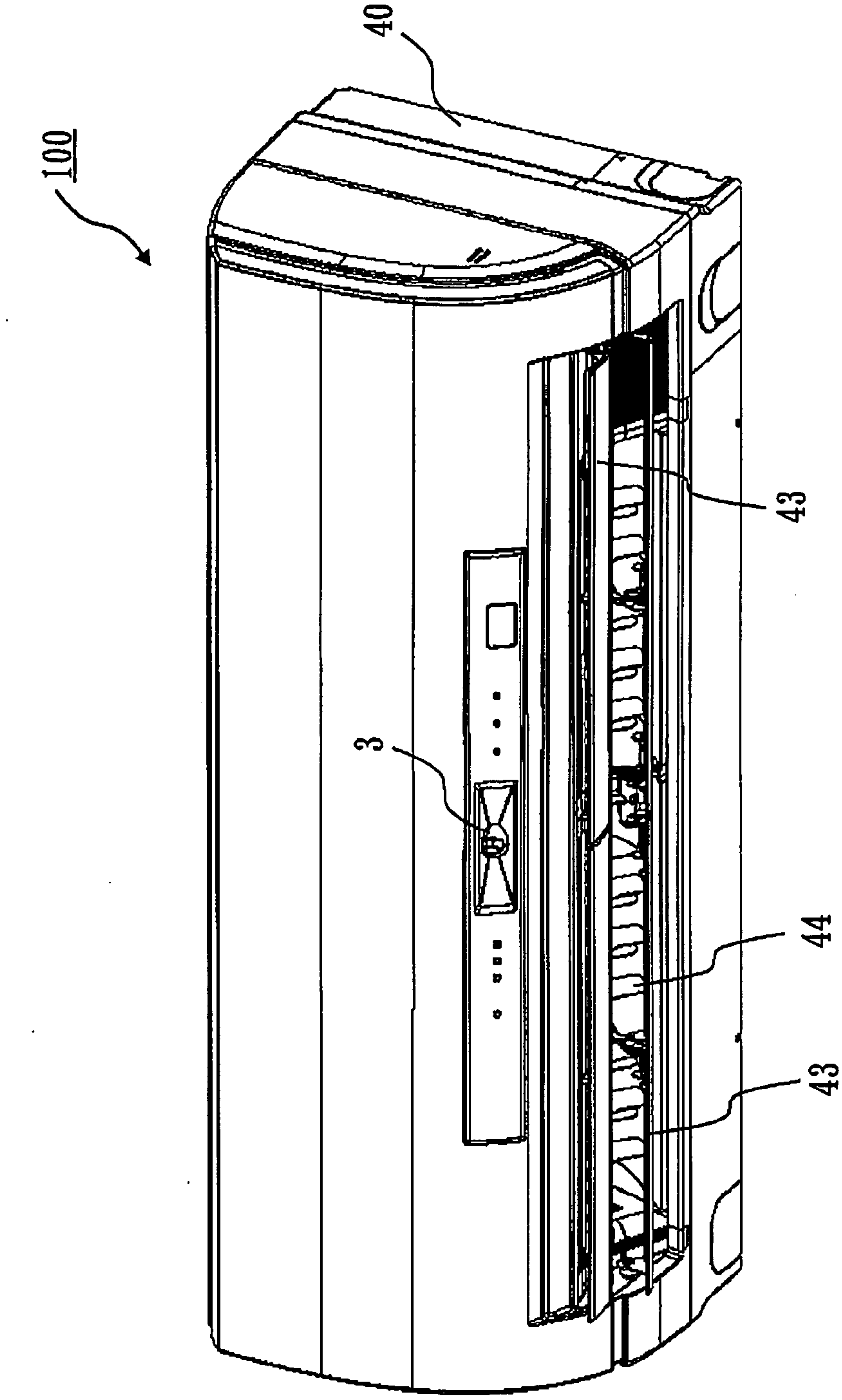


Fig. 3

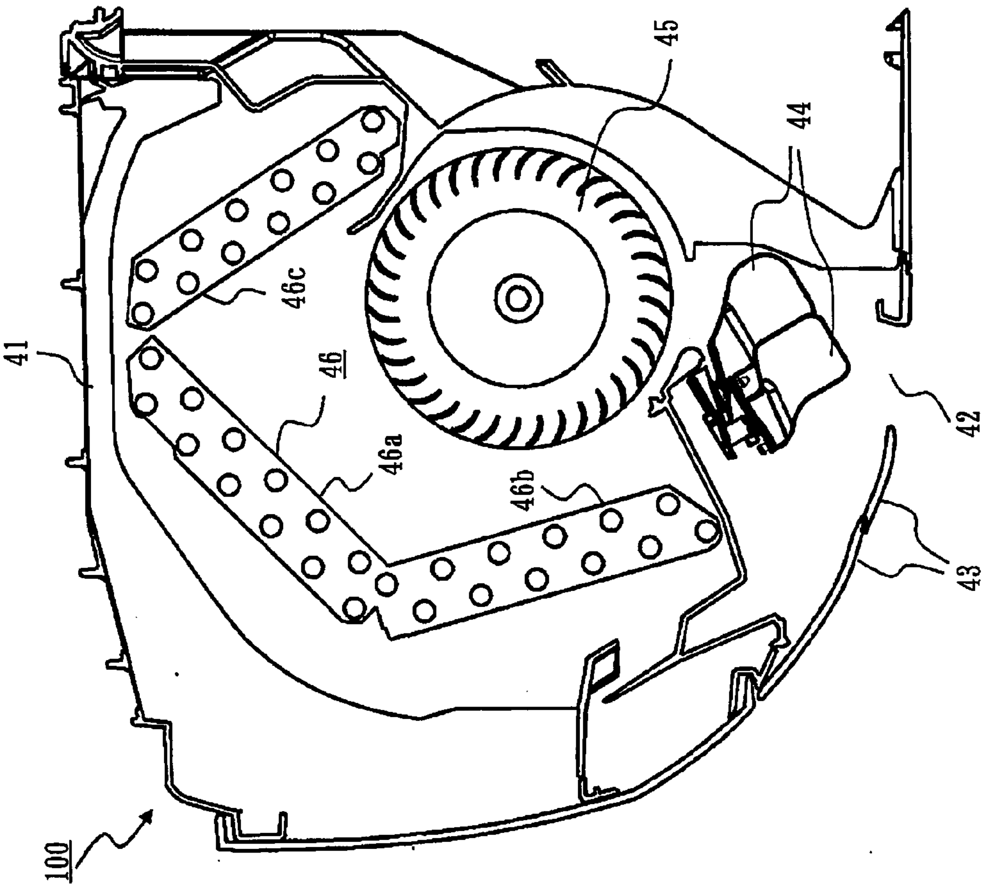


Fig. 4

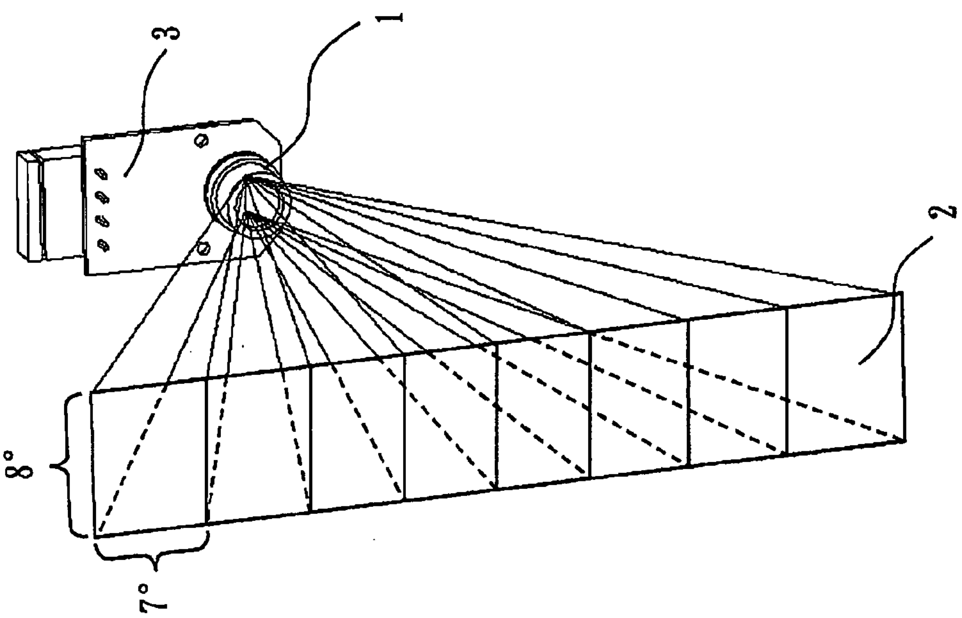


Fig. 5

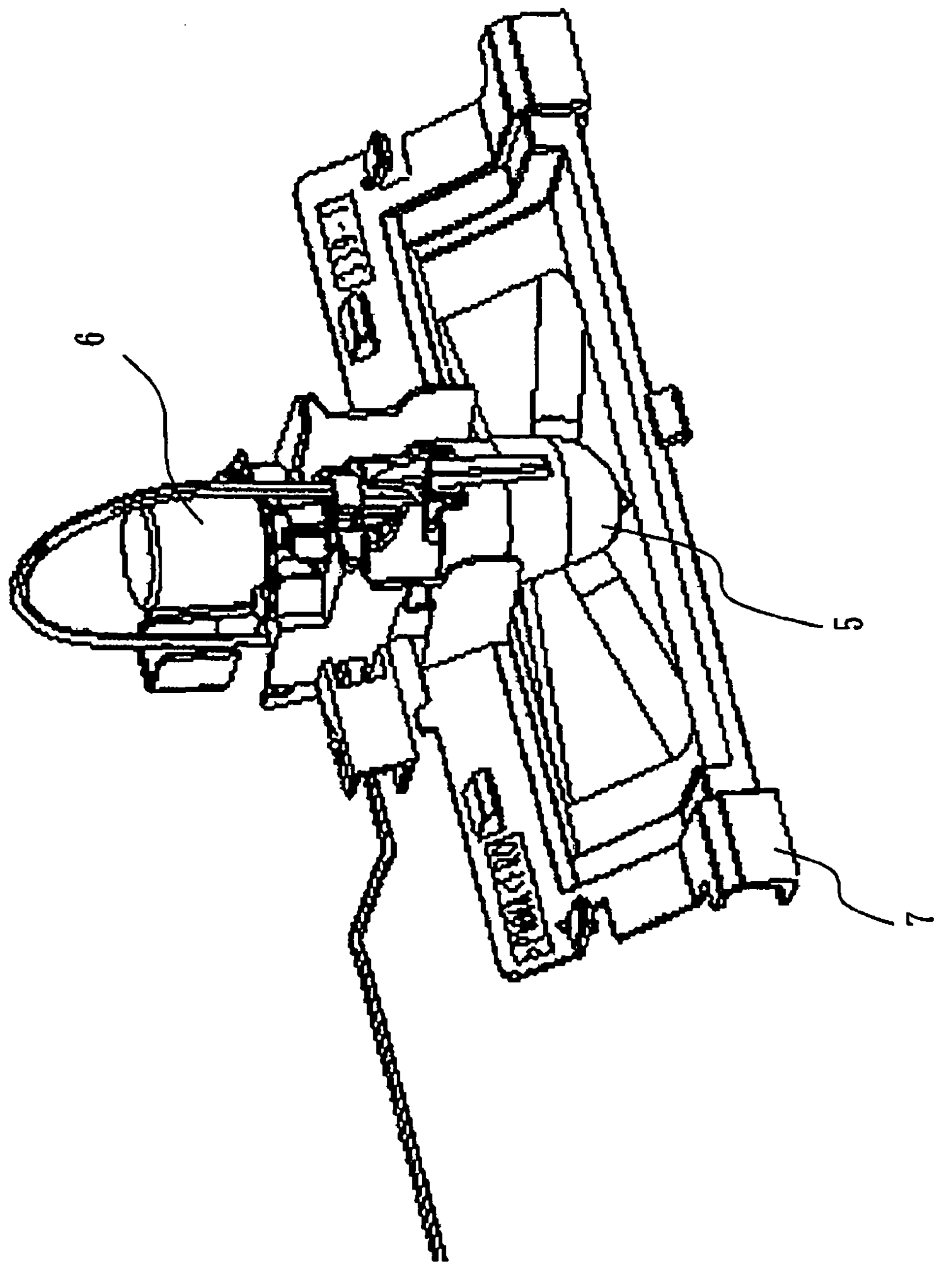
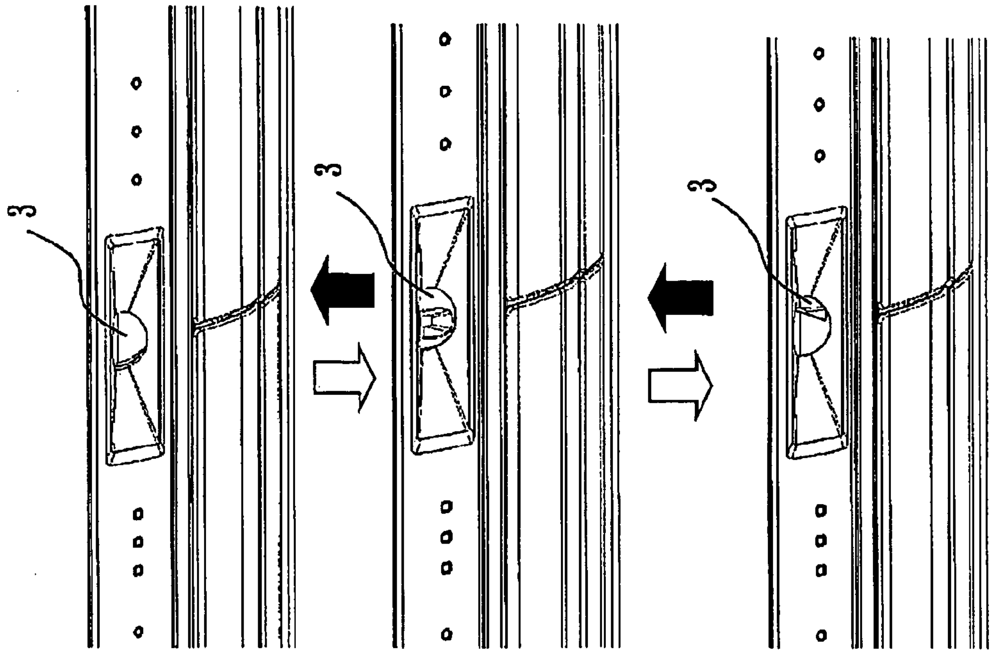


Fig. 6



(a) (b) (c)

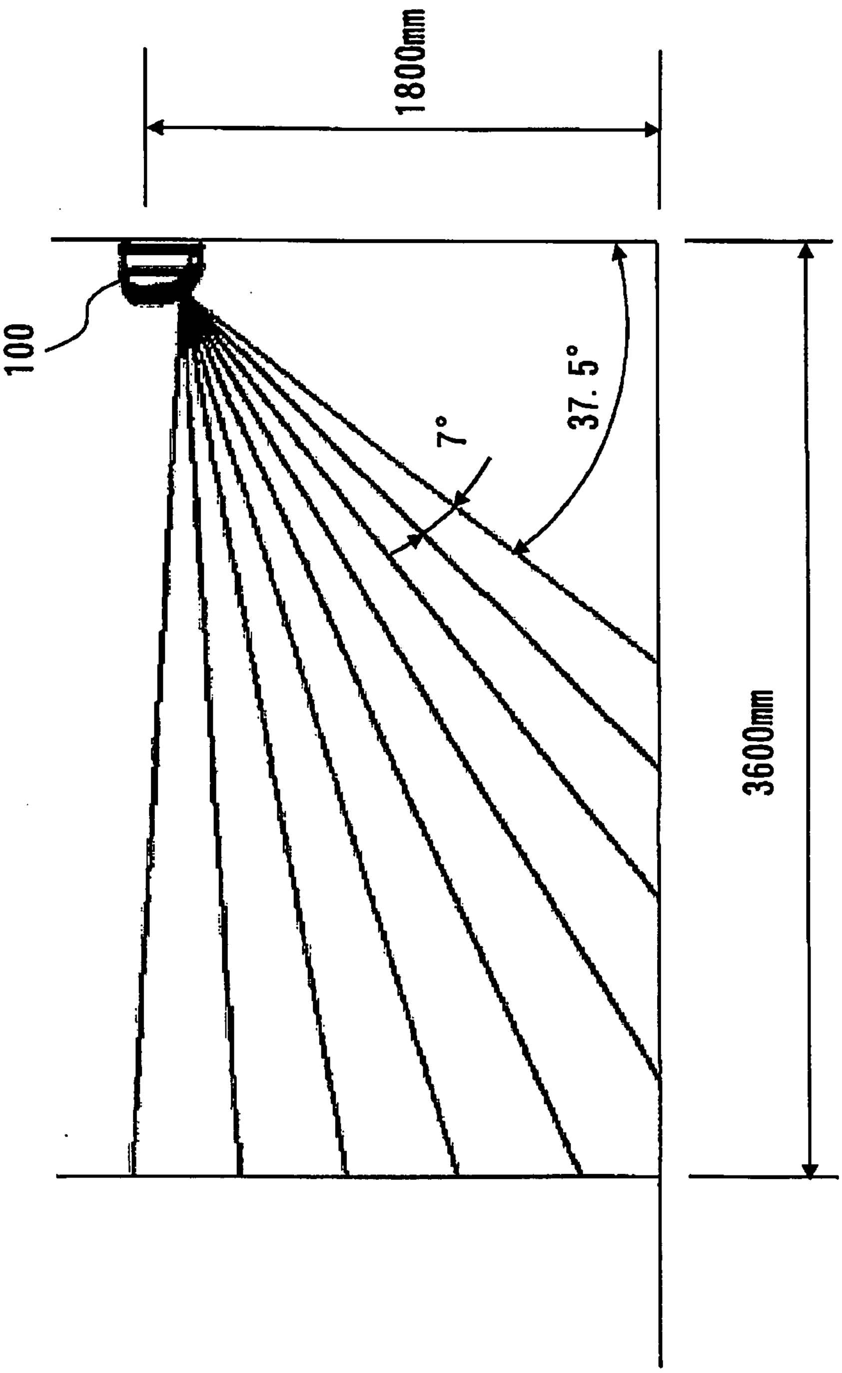


Fig. 7

Fig. 8

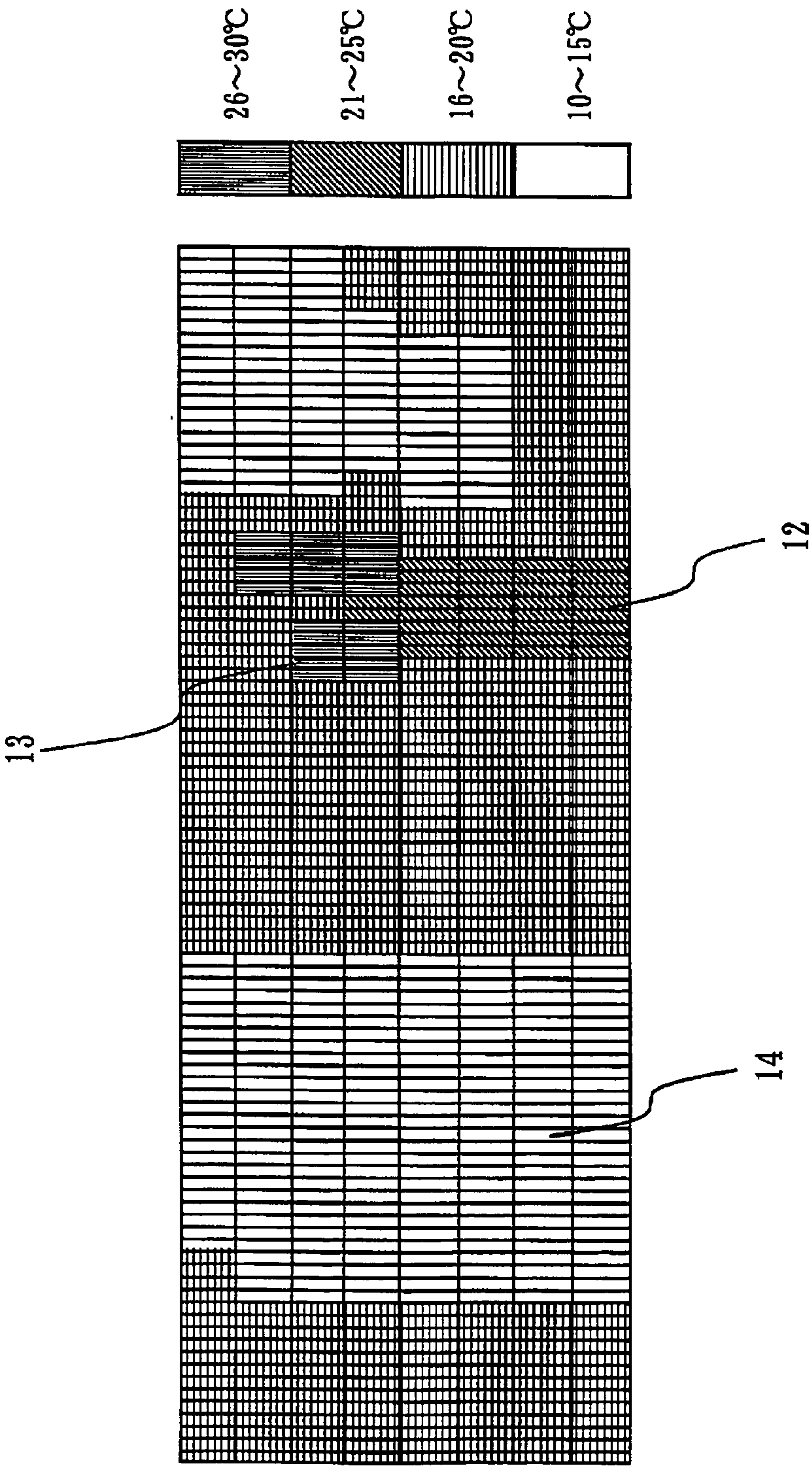


Fig. 9

CAPACITY [kw]	ROOM SIZE (NUMBER OF TATAMI MATS) IN COOLING [MAT]	ROOM SIZE (AREA) [m^2]
2. 2	6～9	10～15
2. 5	7～10	11～17
2. 8	8～12	13～19
3. 6	10～15	16～25
4	11～17	18～28
5	14～21	23～34
6. 3	17～26	29～43
7. 1	20～30	32～49

Fig.10

CAPACITY [kw]	LENGTH × WIDTH (m) 2 : 1	LENGTH × WIDTH (m) 1 : 1	LENGTH × WIDTH (m) 1 : 2
2. 2	5. 5×2. 7	3. 9×3. 9	2. 7×5. 5
2. 5	5. 8×2. 9	4. 1×4. 1	2. 9×5. 8
2. 8	6. 2×3. 1	4. 4×4. 4	3. 1×6. 2
3. 6	7. 1×3. 5	5. 0×5. 0	3. 5×7. 1
4	7. 5×3. 7	5. 3×5. 3	3. 7×7. 5
5	8. 2×4. 1	5. 8×5. 8	4. 1×8. 2
6. 3	9. 3×4. 6	6. 6×6. 6	4. 6×9. 3
7. 1	9. 9×4. 9	7. 0×7. 0	4. 9×9. 9

Fig.11

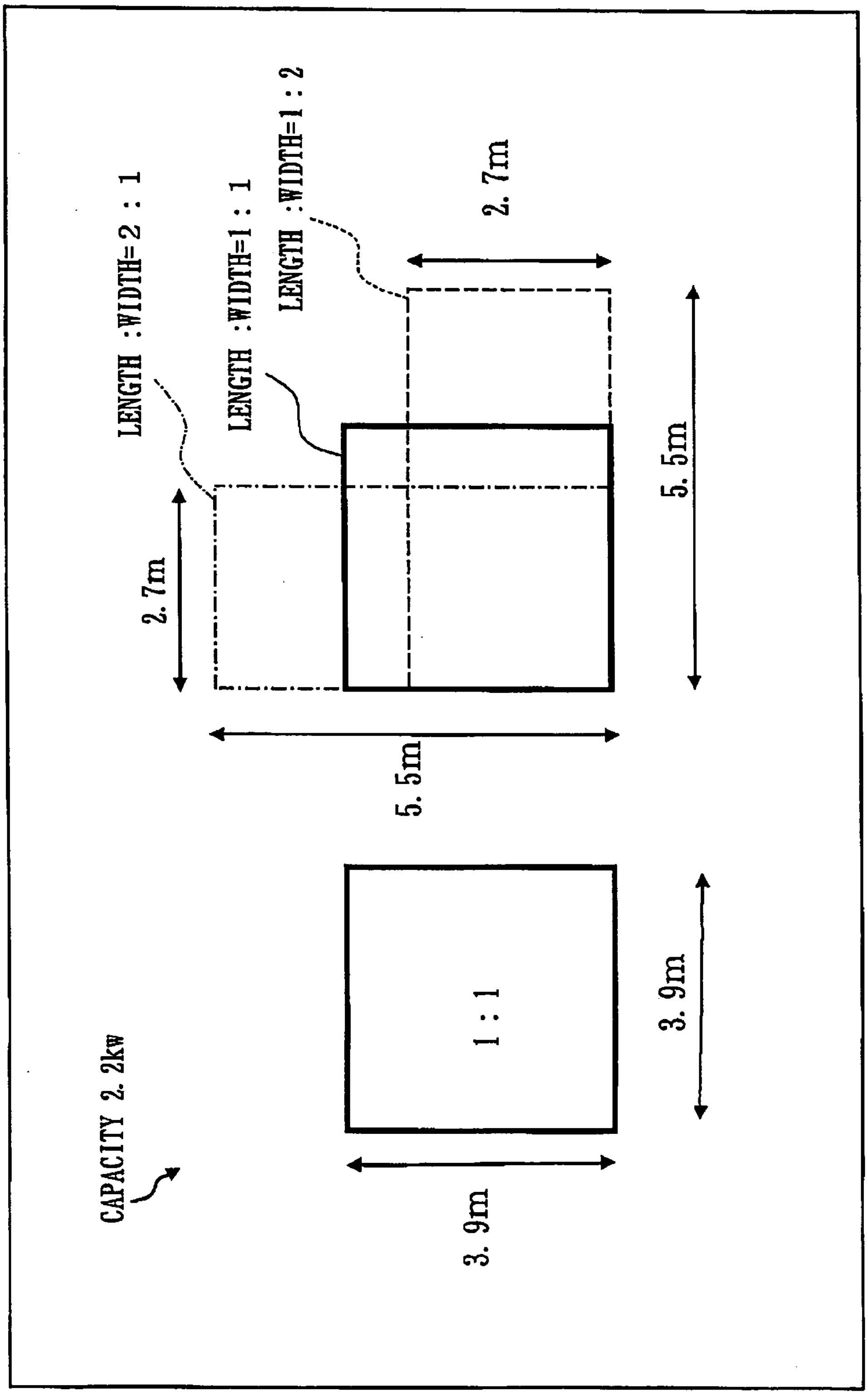

CAPACITY 2.2kw
LENGTH :WIDTH=2 : 1
LENGTH :WIDTH=1 : 1
LENGTH :WIDTH=1 : 2
2.7m
2.7m
5.5m
5.5m
1 : 1
3.9m
3.9m

Fig.12

CAPACITY [kw]	AREA [m²]	MINIMUM VALUE [m]	MAXIMUM VALUE [m]	INITIAL VALUE [m]
2.2	10~15	2.7	5.4	3.5
2.5	11~17	2.9	5.8	3.7
2.8	13~19	3.1	6.2	4.0
3.6	16~25	3.5	7.1	4.5
4	18~28	3.7	7.5	4.8
5	23~34	4.1	8.2	5.3
6.3	29~43	4.6	9.3	6.0
7.1	32~49	4.9	9.9	6.4

Fig.13

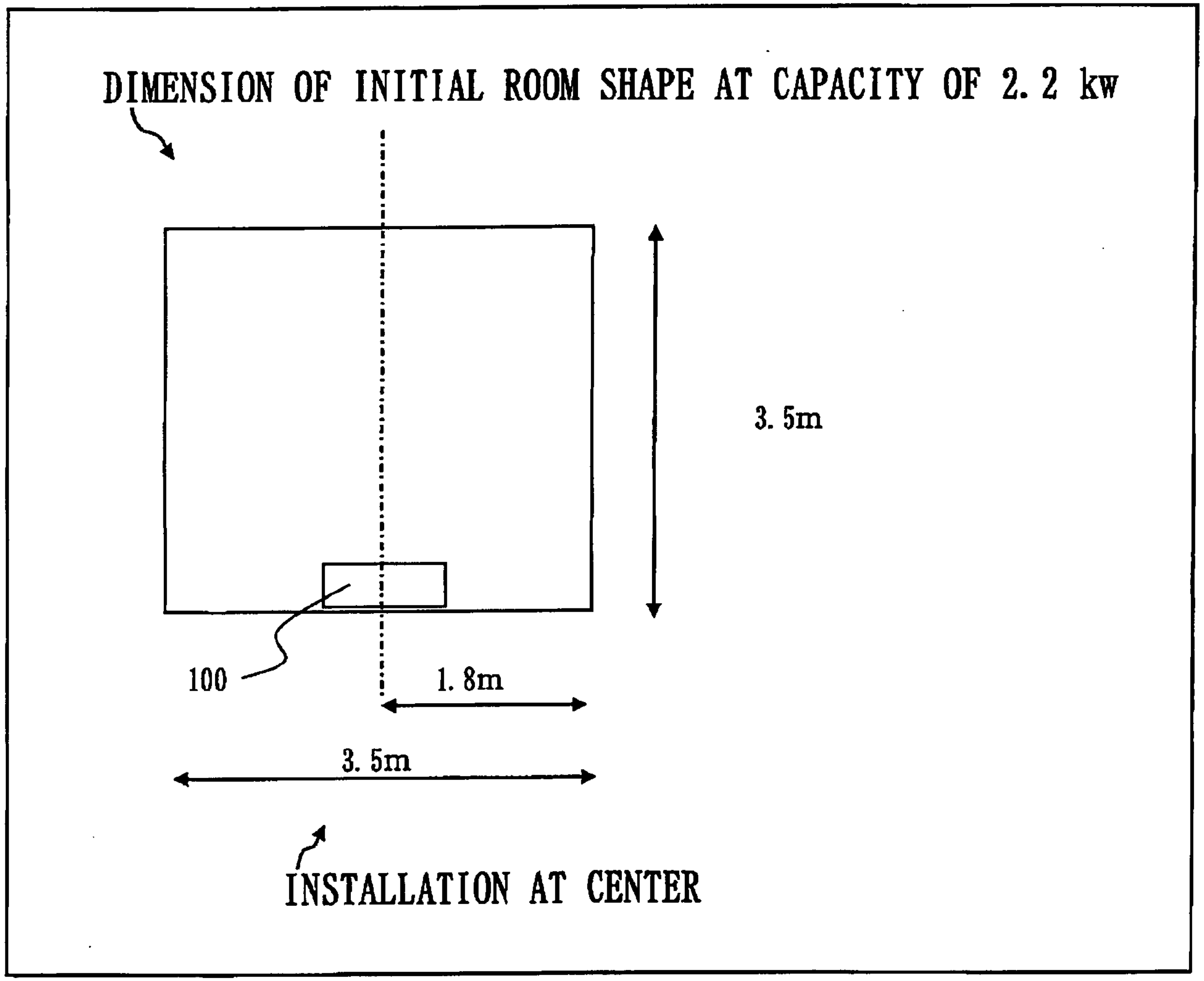

DIMENSION OF INITIAL ROOM SHAPE AT CAPACITY OF 2. 2 kw
3. 5m
100
1. 8m
3. 5m
INSTALLATION AT CENTER

Fig.14

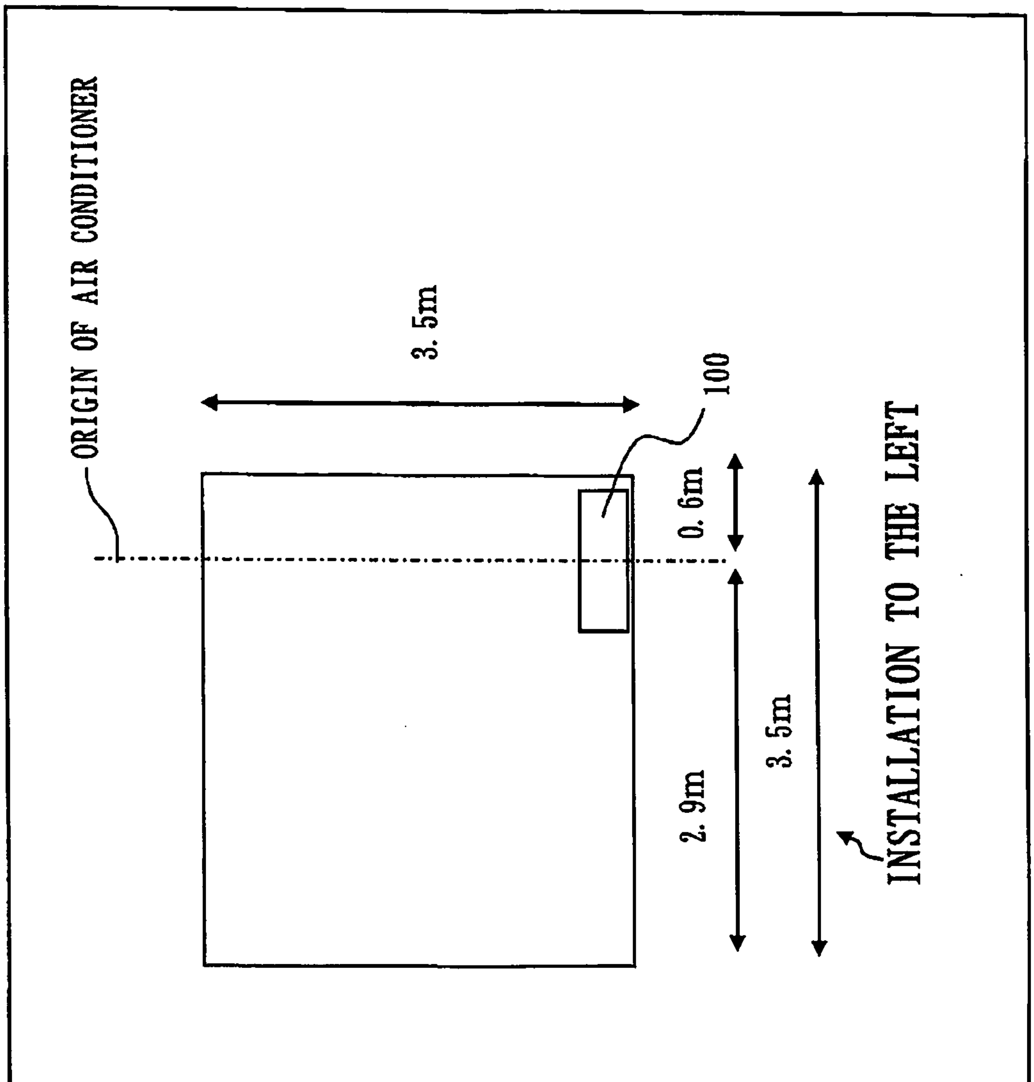

ORIGIN OF AIR CONDITIONER
3. 5m
100
0. 6m
2. 9m
3. 5m
INSTALLATION TO THE LEFT

Fig.15

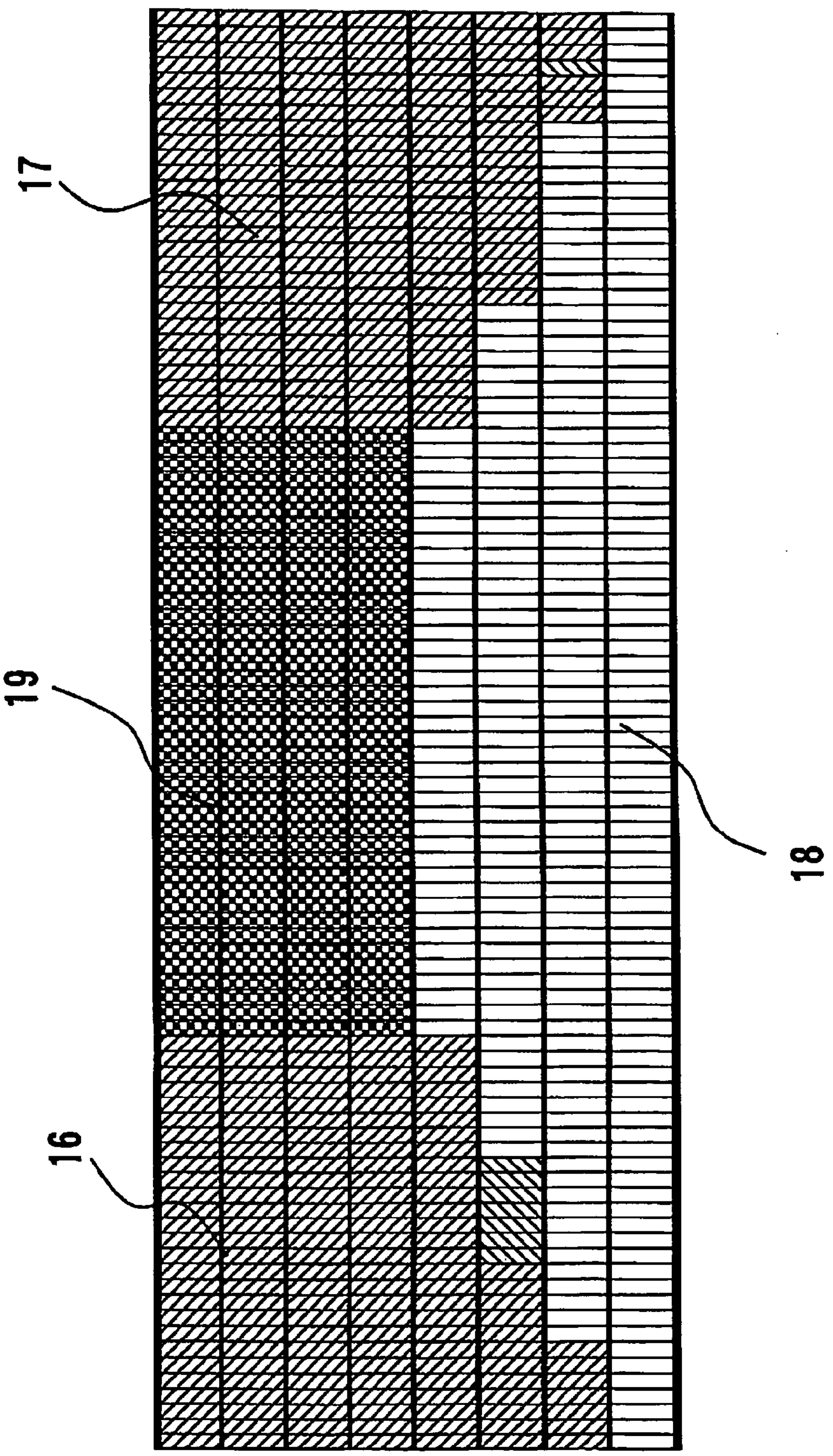


Fig.16

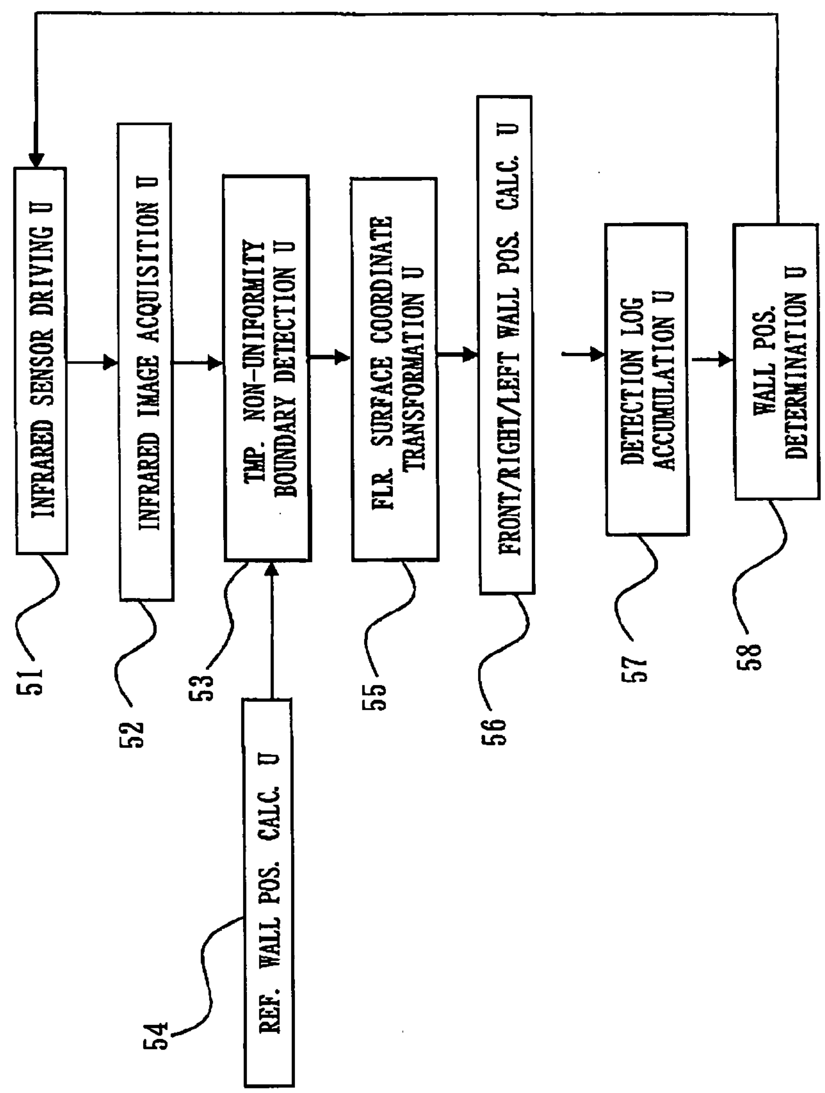

INFRARED SENSOR DRIVING U
INFRARED IMAGE ACQUISITION U
TMP. NON-UNIFORMITY BOUNDARY DETECTION U
REF. WALL POS. CALC. U
FLR. SURFACE COORDINATE TRANSFORMATION U
FRONT/RIGHT/LEFT WALL POS. CALC. U
DETECTION LOG ACCUMULATION U
WALL POS. DETERMINATION U
51
52
53
54
55
56
57
58

Fig.17

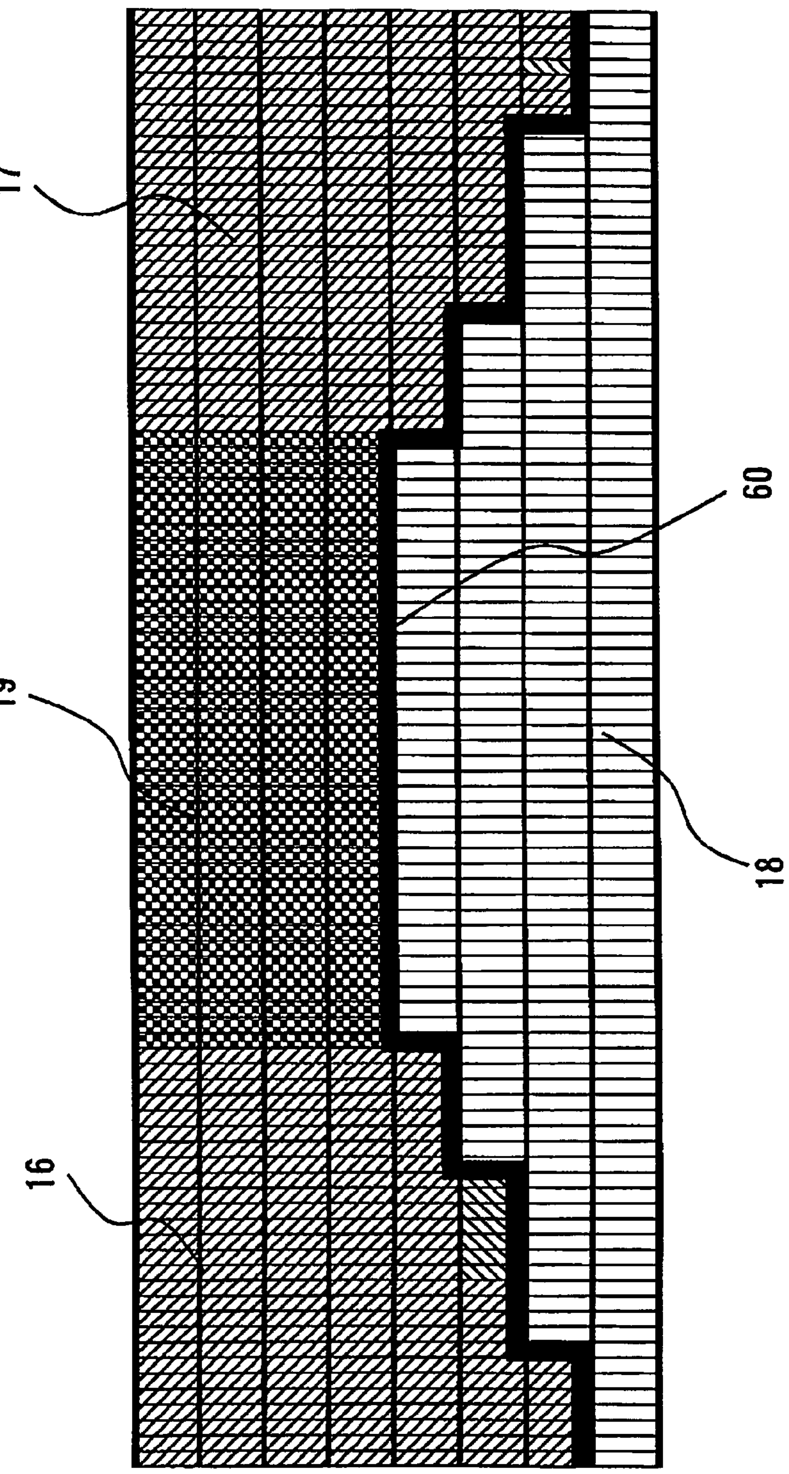


Fig.18

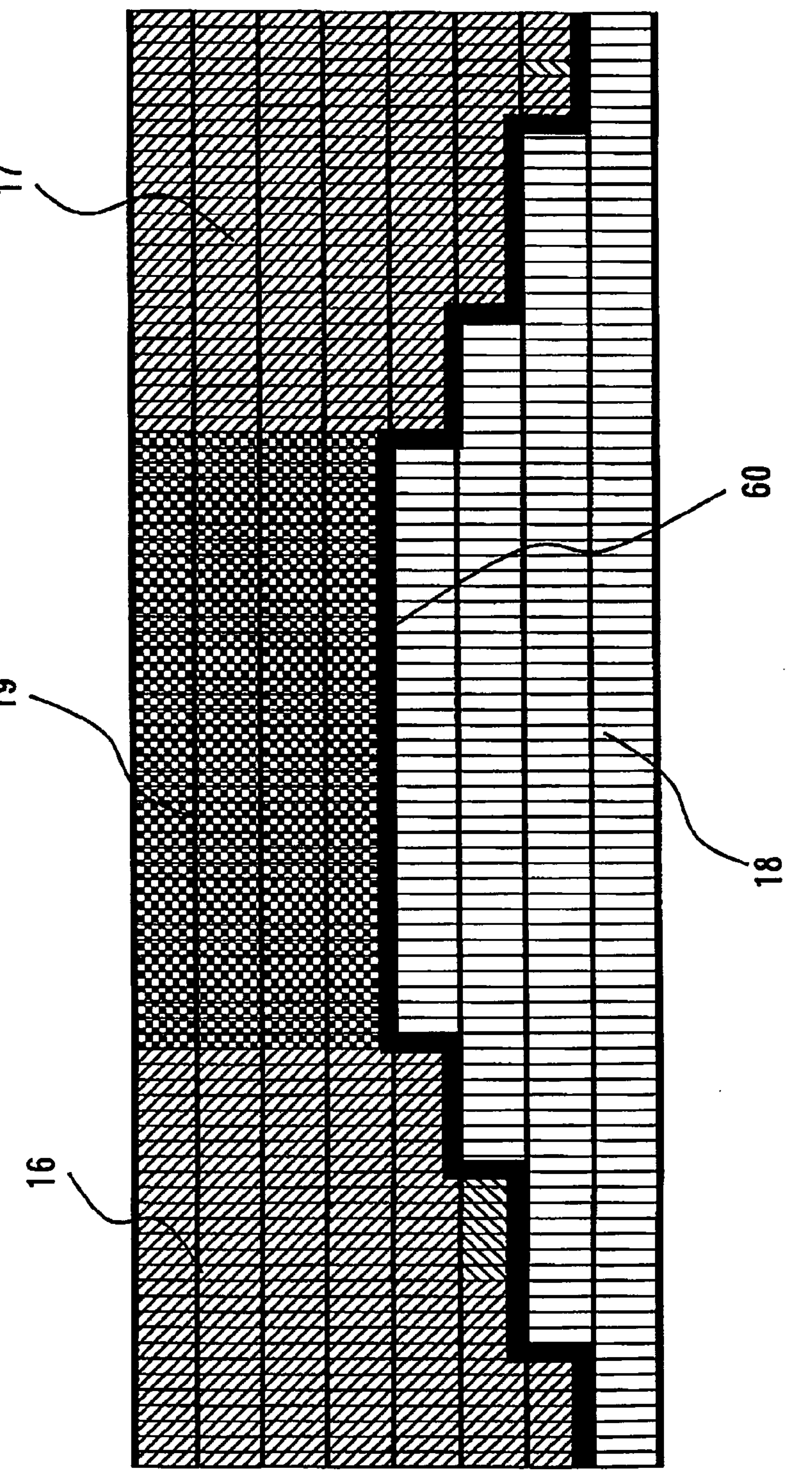


Fig.19

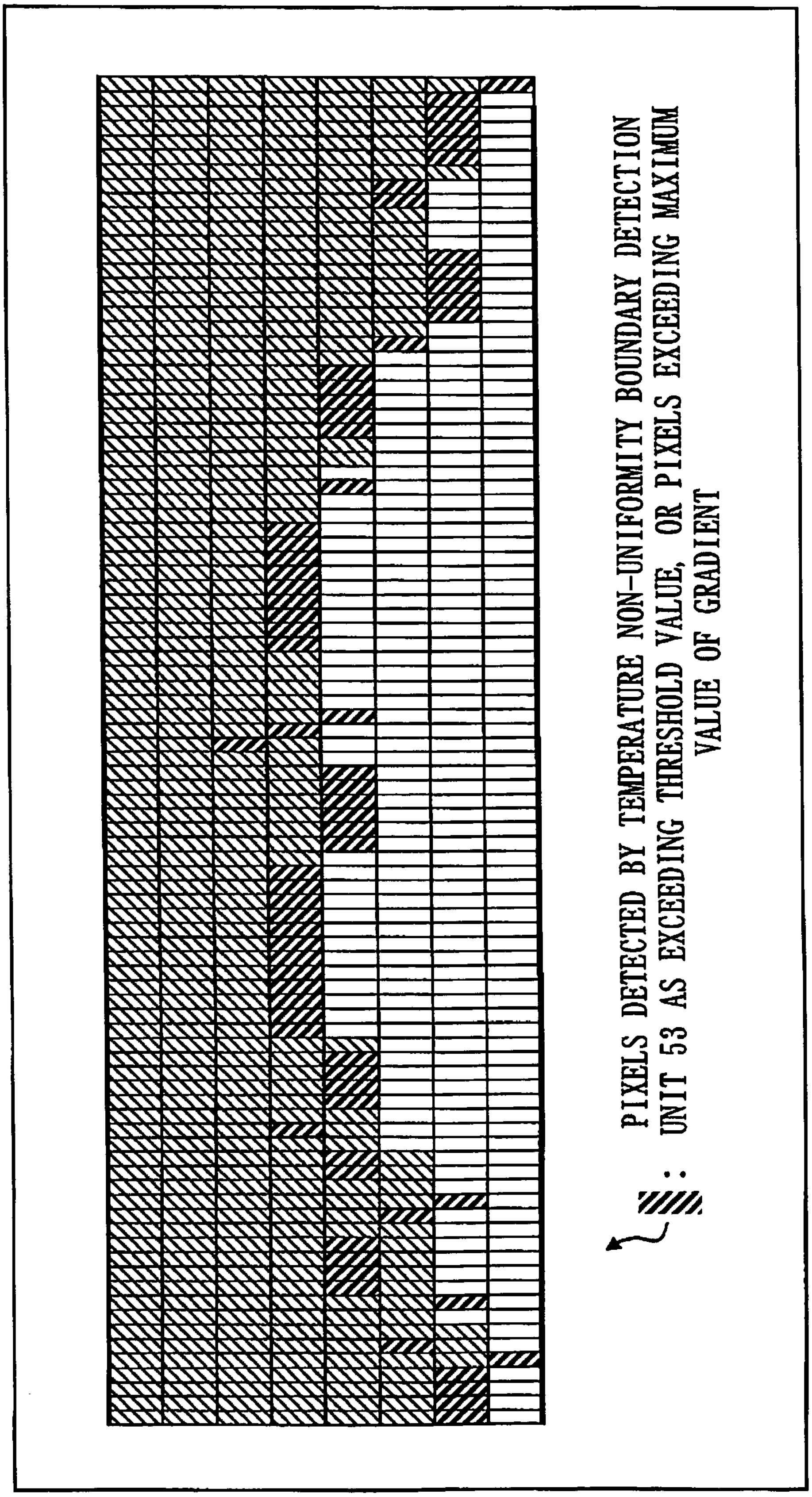

PIXELS DETECTED BY TEMPERATURE NON-UNIFORMITY BOUNDARY DETECTION UNIT 53 AS EXCEEDING THRESHOLD VALUE, OR PIXELS EXCEEDING MAXIMUM VALUE OF GRADIENT

Fig.20

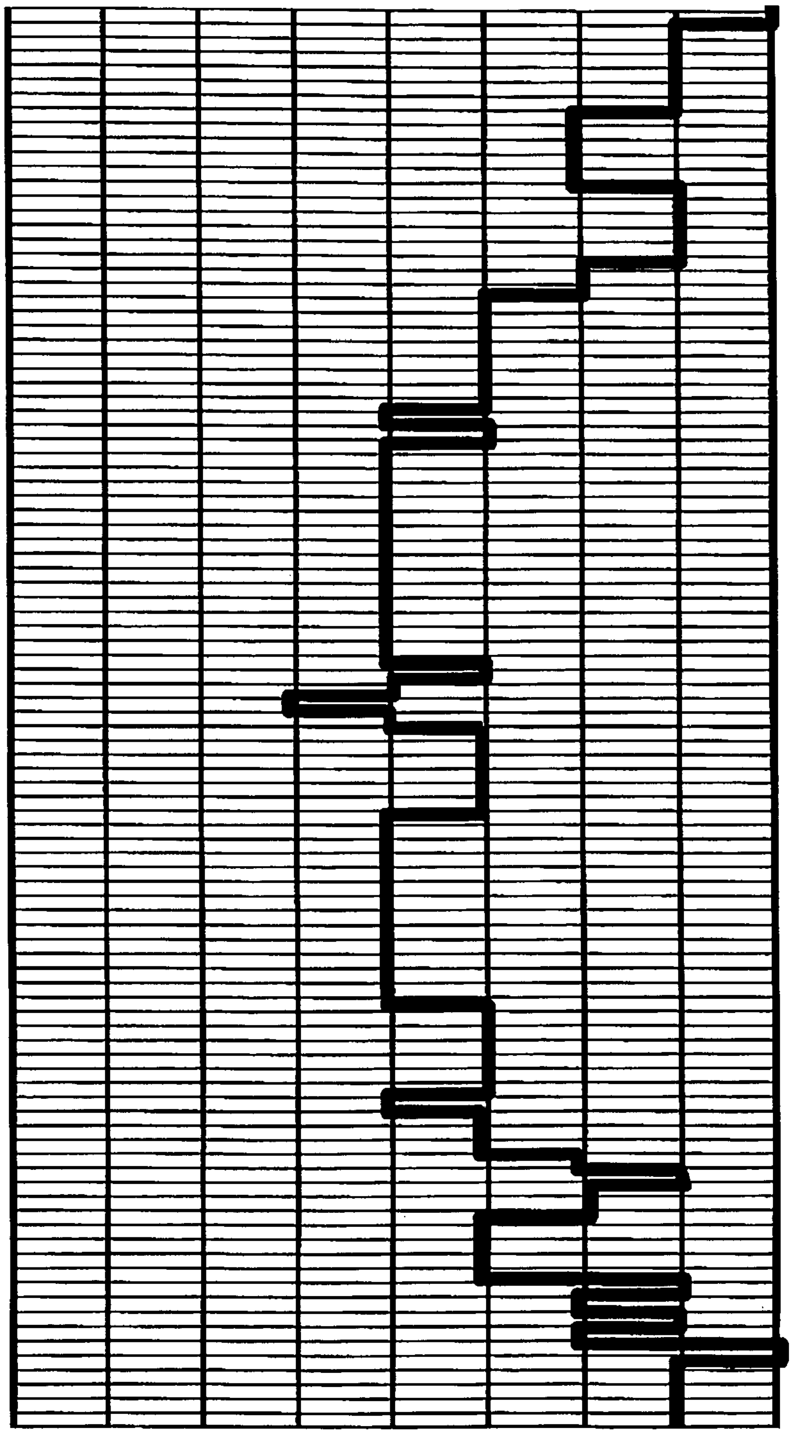


Fig.21

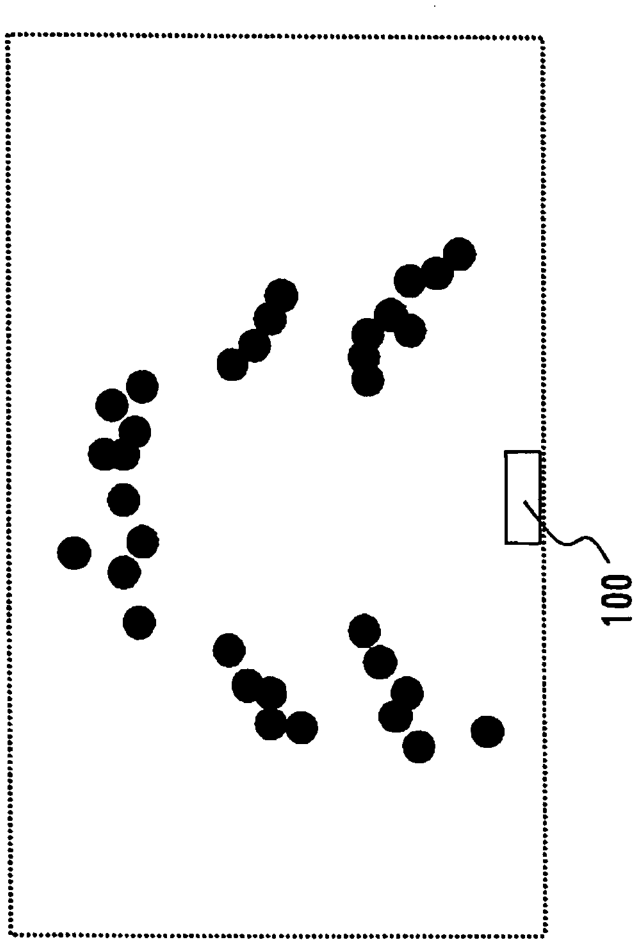


Fig. 22

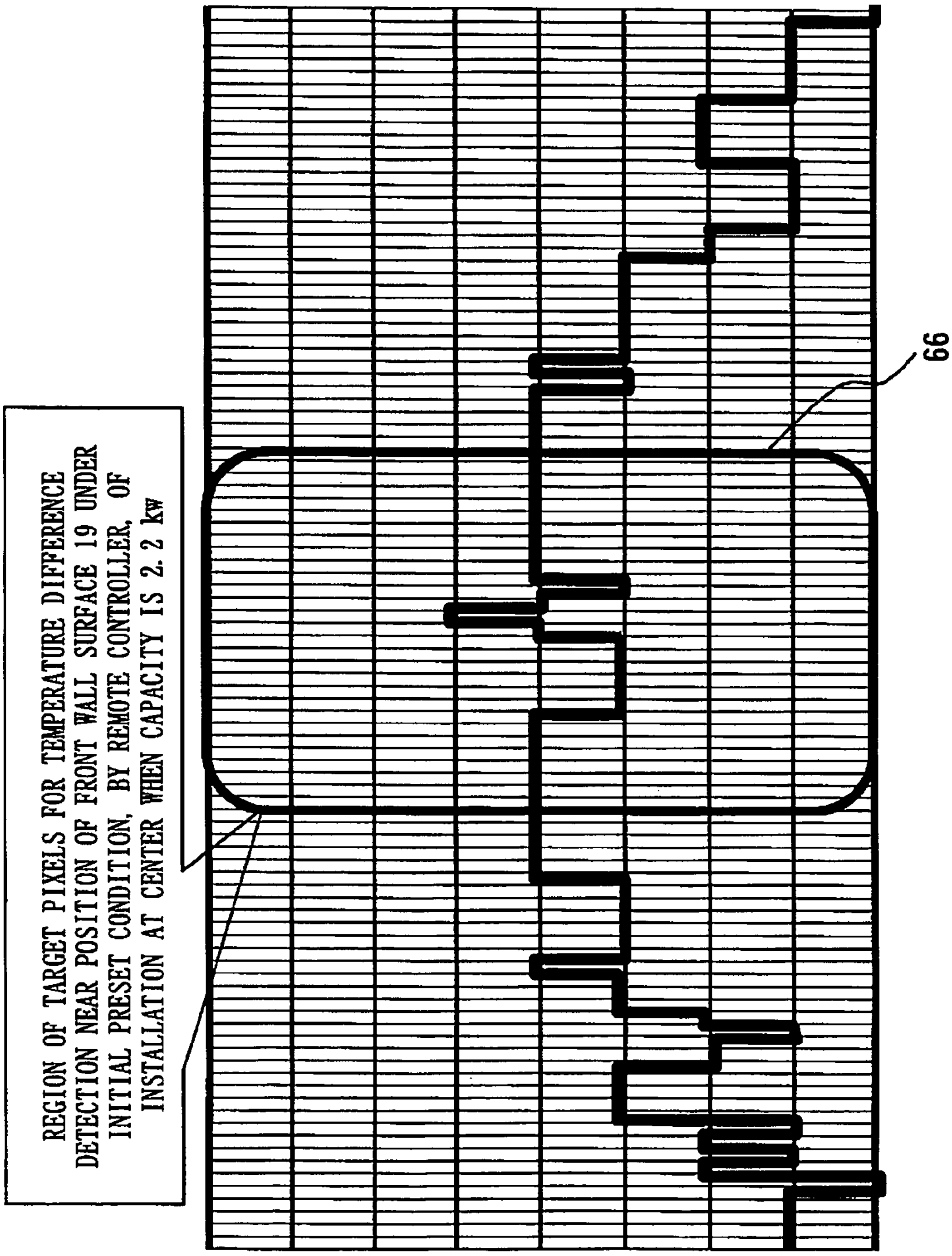

REGION OF TARGET PIXELS FOR TEMPERATURE DIFFERENCE DETECTION NEAR POSITION OF FRONT WALL SURFACE 19 UNDER INITIAL PRESET CONDITION, BY REMOTE CONTROLLER, OF INSTALLATION AT CENTER WHEN CAPACITY IS 2. 2 kw
66

Fig.23

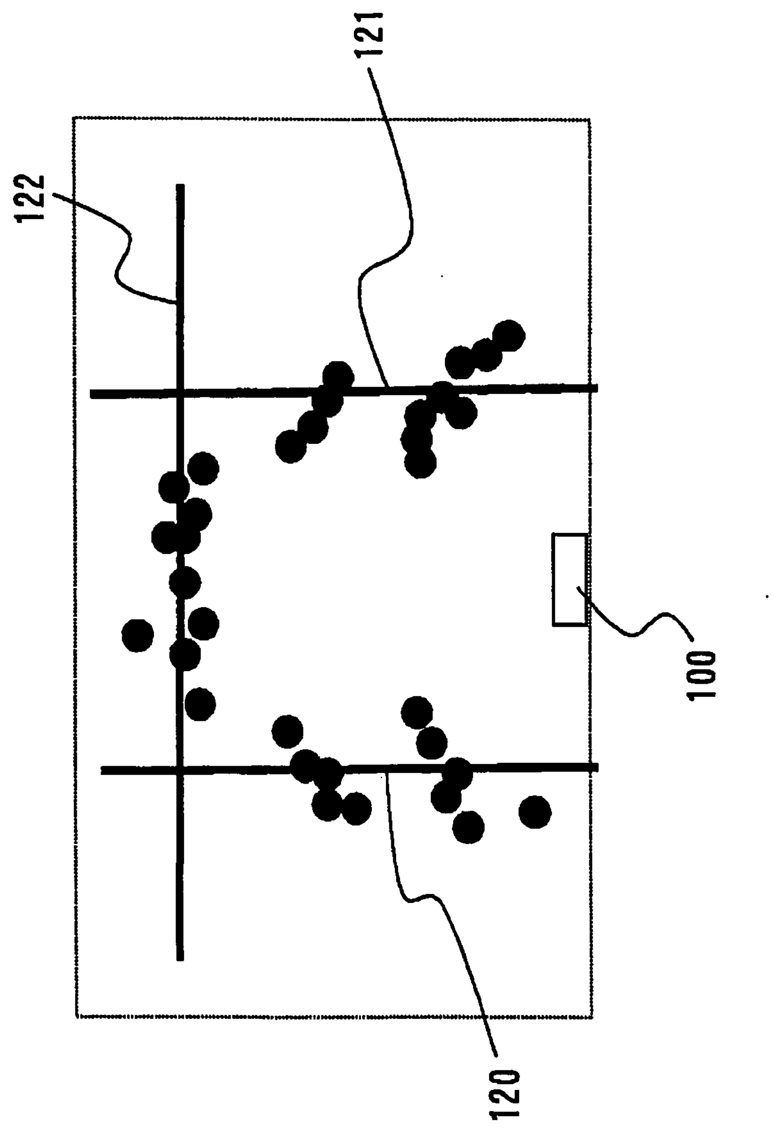


Fig.24

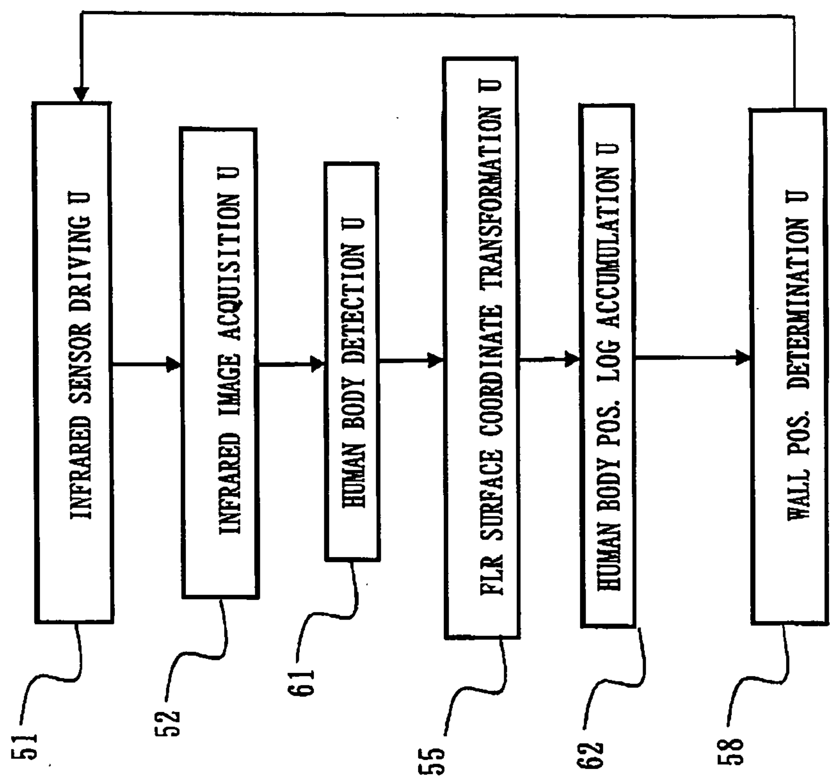

INFRARED SENSOR DRIVING U
INFRARED IMAGE ACQUISITION U
HUMAN BODY DETECTION U
FLR SURFACE COORDINATE TRANSFORMATION U
HUMAN BODY POS. LOG ACCUMULATION U
WALL POS. DETERMINATION U
51
52
61
55
62
58

Fig.25

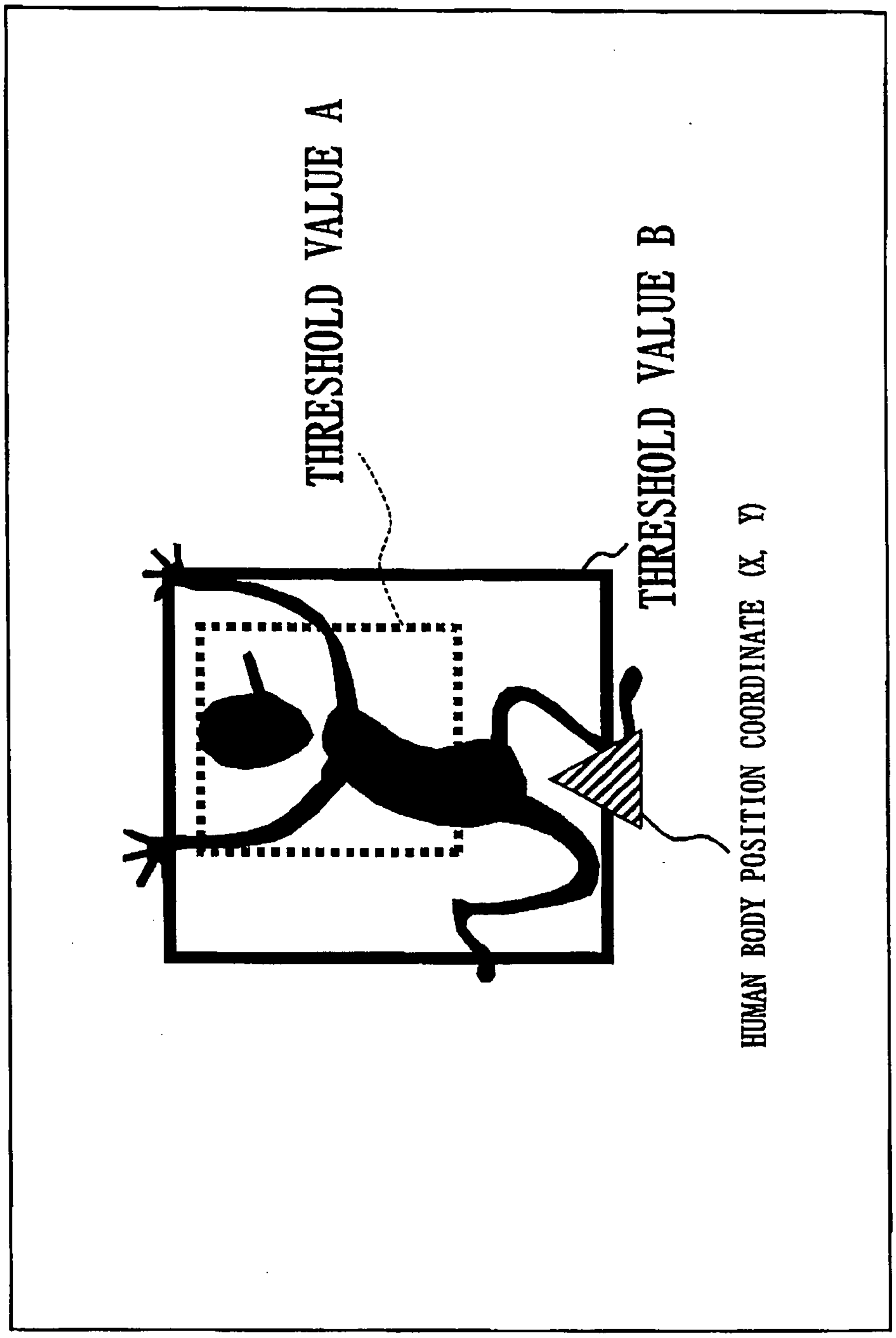

THRESHOLD VALUE A
THRESHOLD VALUE B
HUMAN BODY POSITION COORDINATE (X, Y)

Fig.26

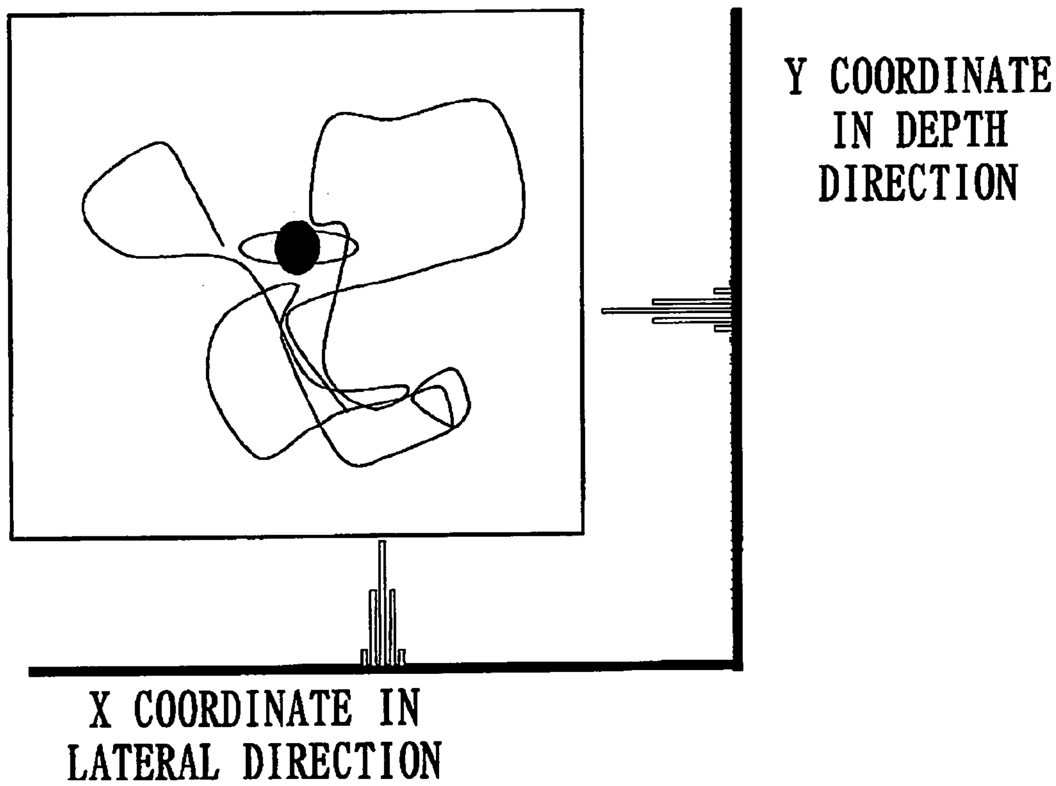

Y COORDINATE IN DEPTH DIRECTION
X COORDINATE IN LATERAL DIRECTION

Fig.27

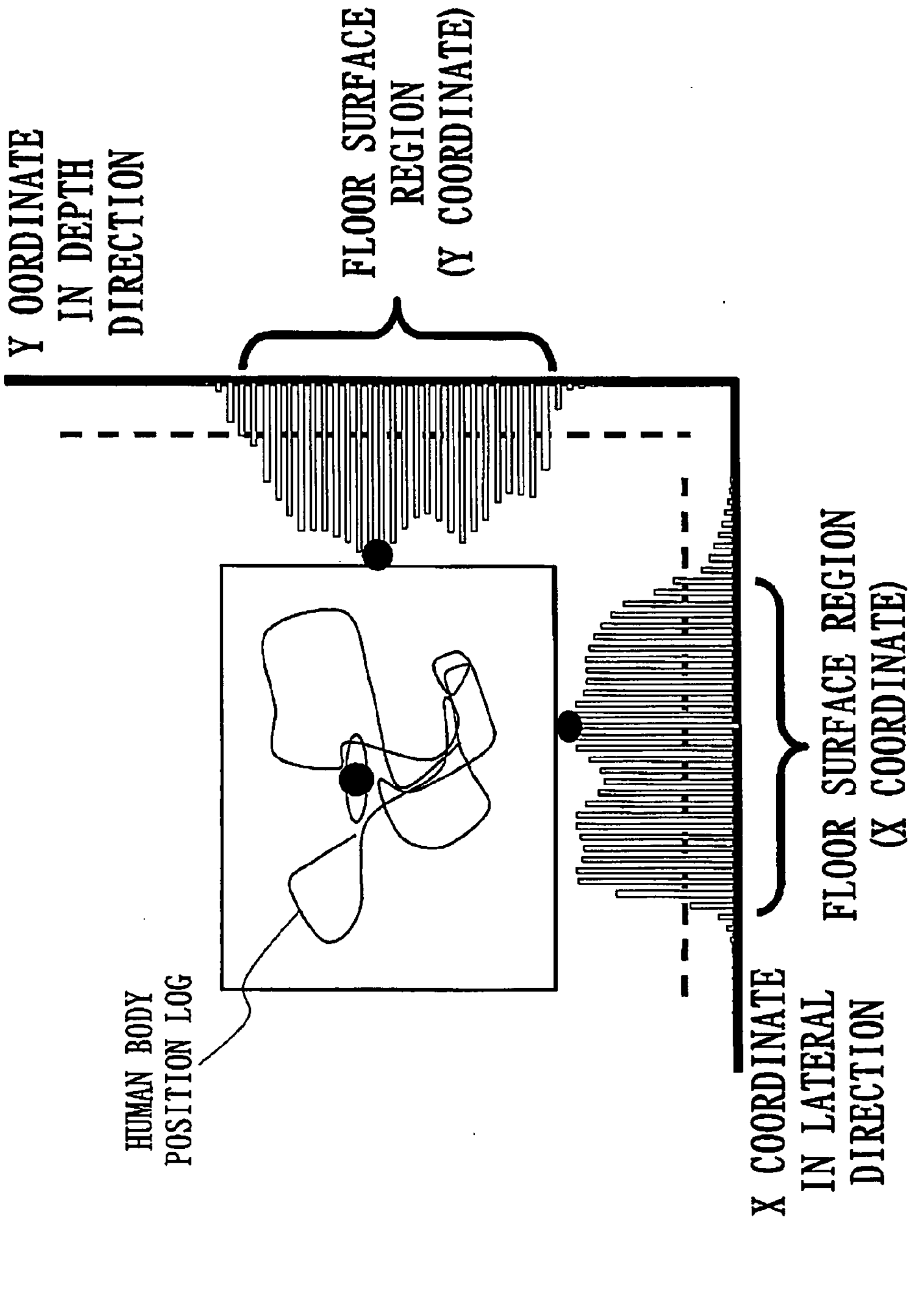

Y OORDINATE
IN DEPTH
DIRECTION
FLOOR SURFACE
REGION
(Y COORDINATE)
HUMAN BODY
POSITION LOG
FLOOR SURFACE REGION
(X COORDINATE)
X COORDINATE
IN LATERAL
DIRECTION

Fig.28

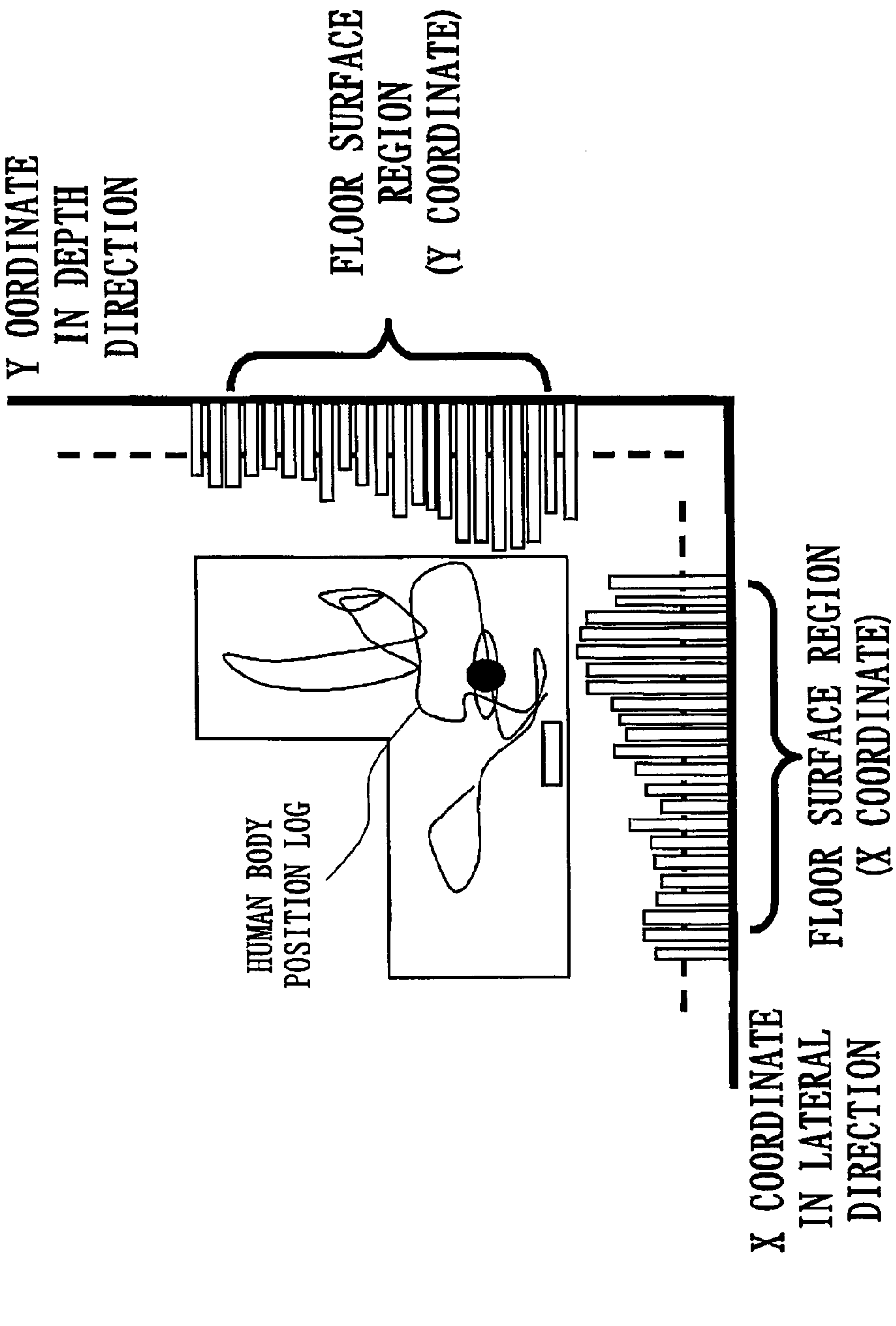

Y OORDINATE
IN DEPTH
DIRECTION
FLOOR SURFACE
REGION
(Y COORDINATE)
HUMAN BODY
POSITION LOG
FLOOR SURFACE REGION
(X COORDINATE)
X COORDINATE
IN LATERAL
DIRECTION

Fig.29

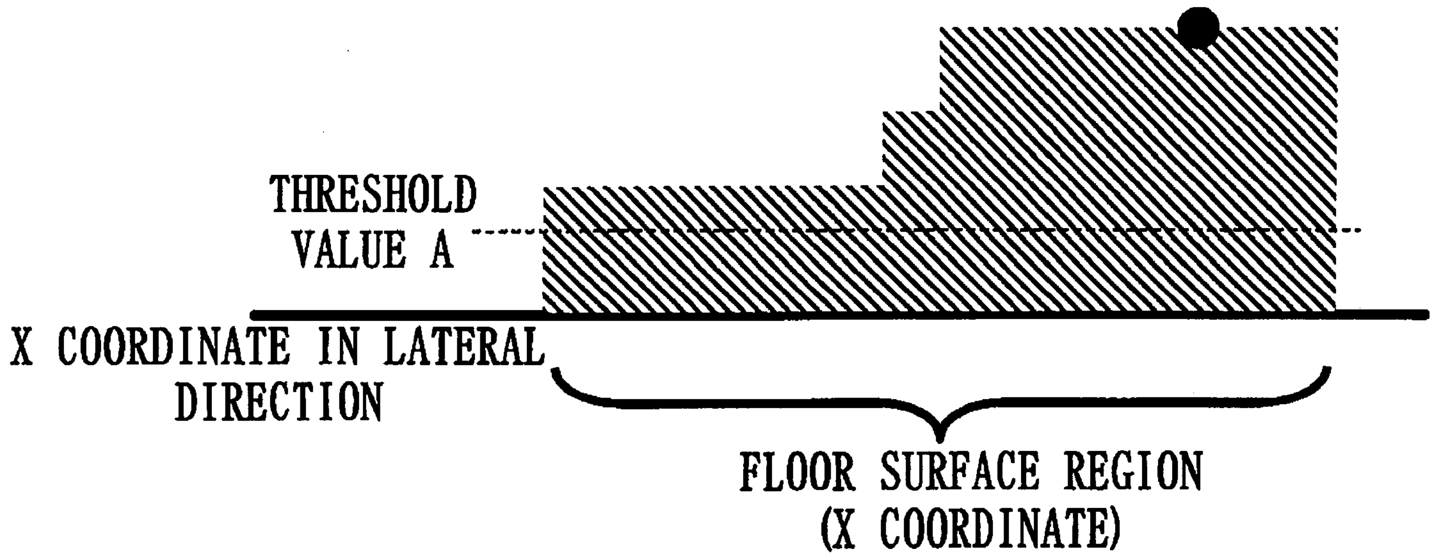

THRESHOLD
VALUE A
X COORDINATE IN LATERAL
DIRECTION
FLOOR SURFACE REGION
(X COORDINATE)

Fig.30

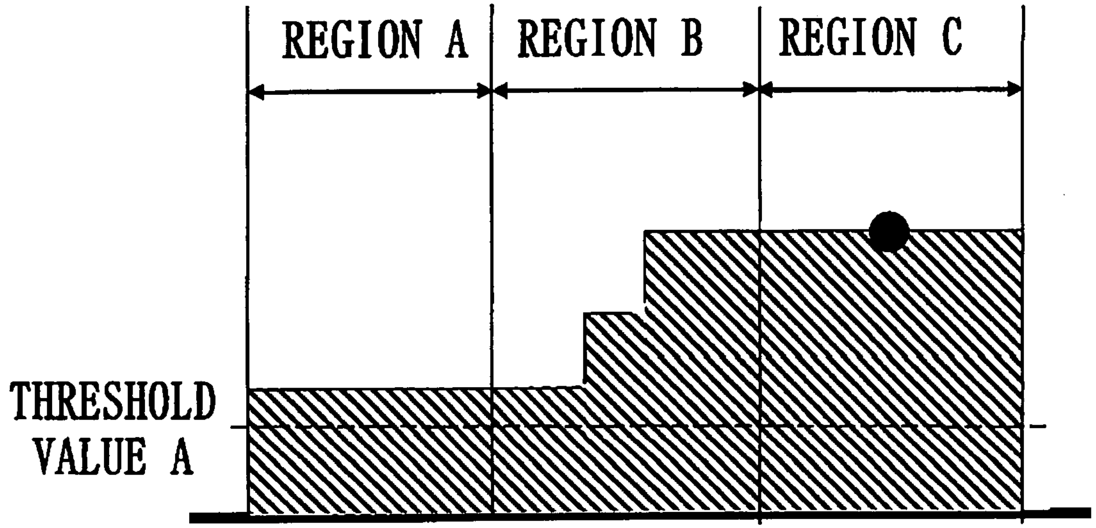


Fig.31

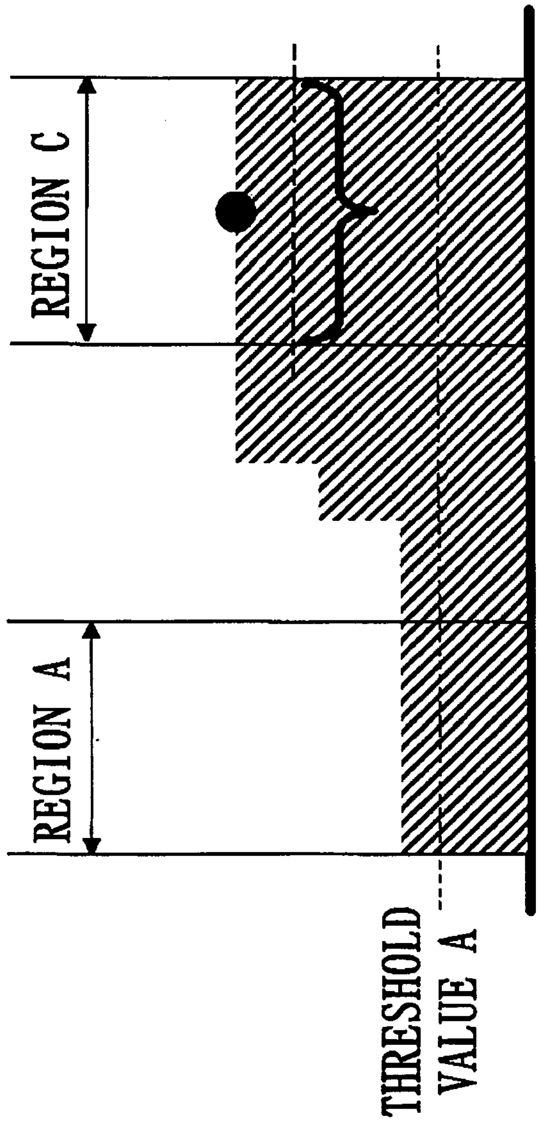


Fig.32

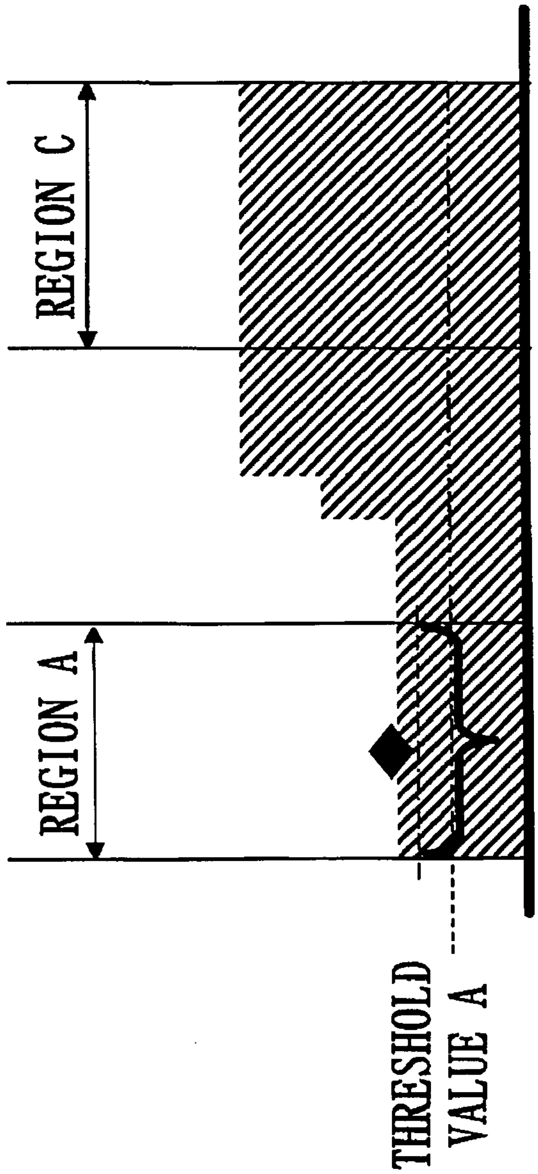


Fig.33

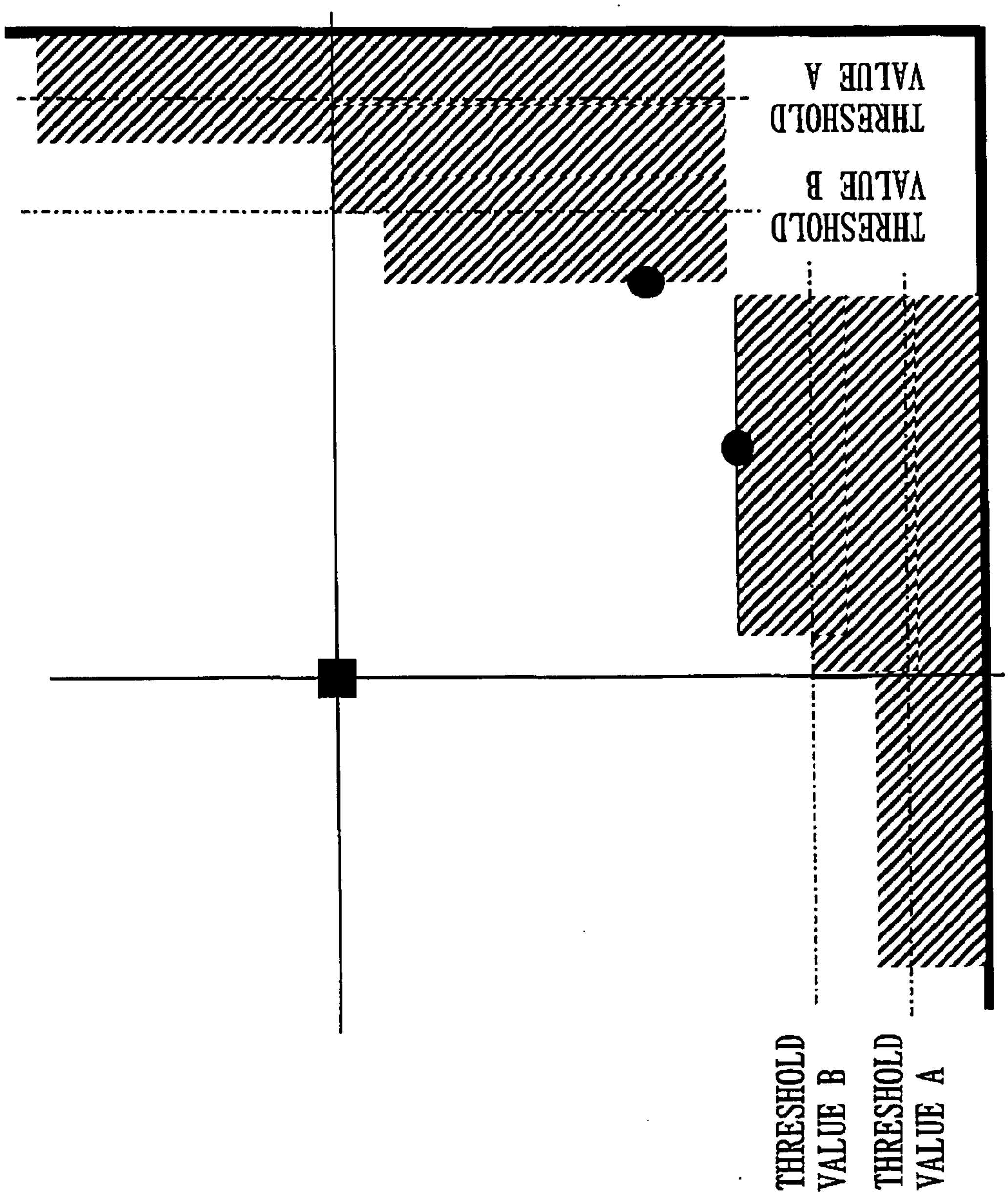

THRESHOLD VALUE A
THRESHOLD VALUE B
THRESHOLD VALUE B
THRESHOLD VALUE A

Fig.34

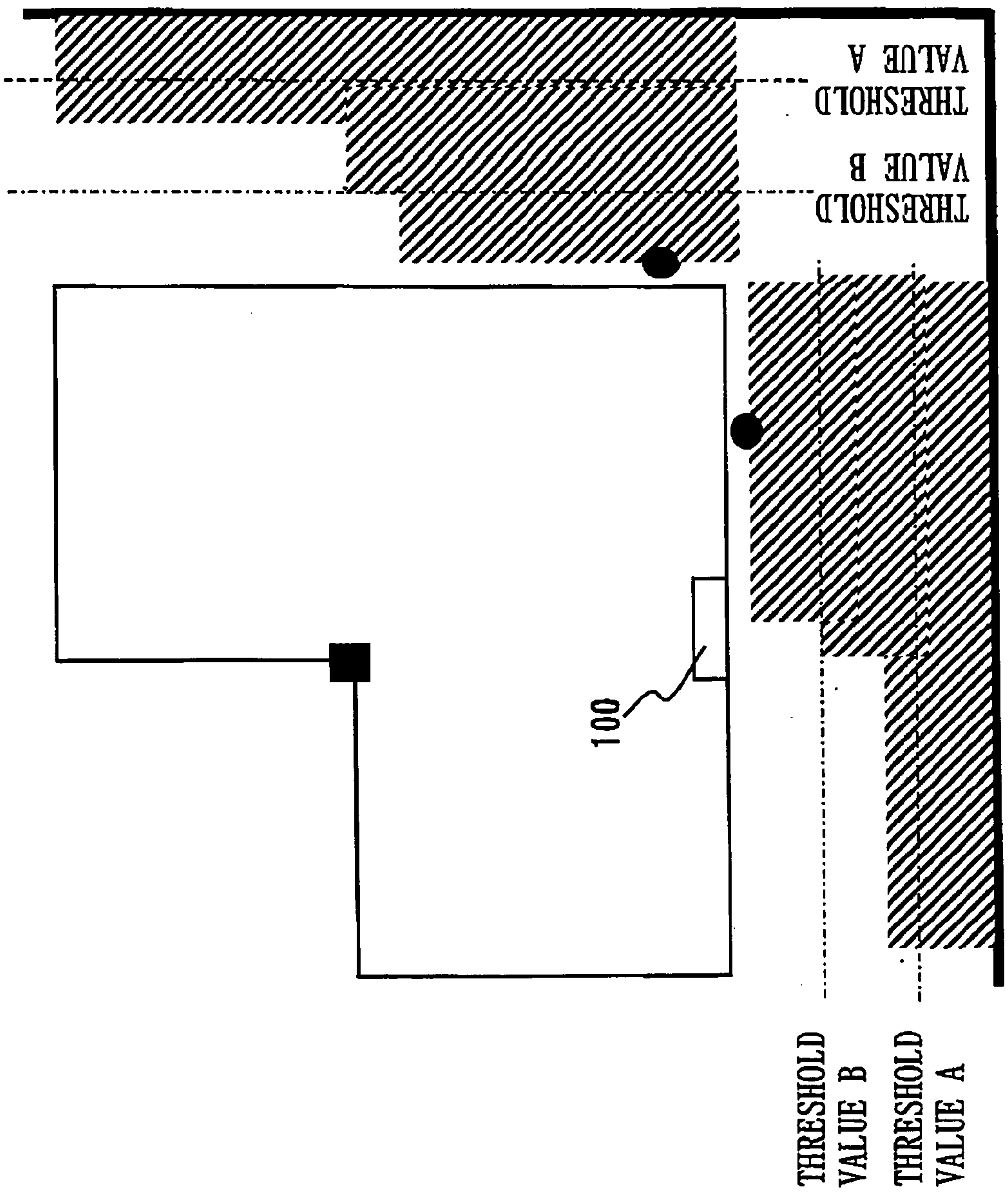
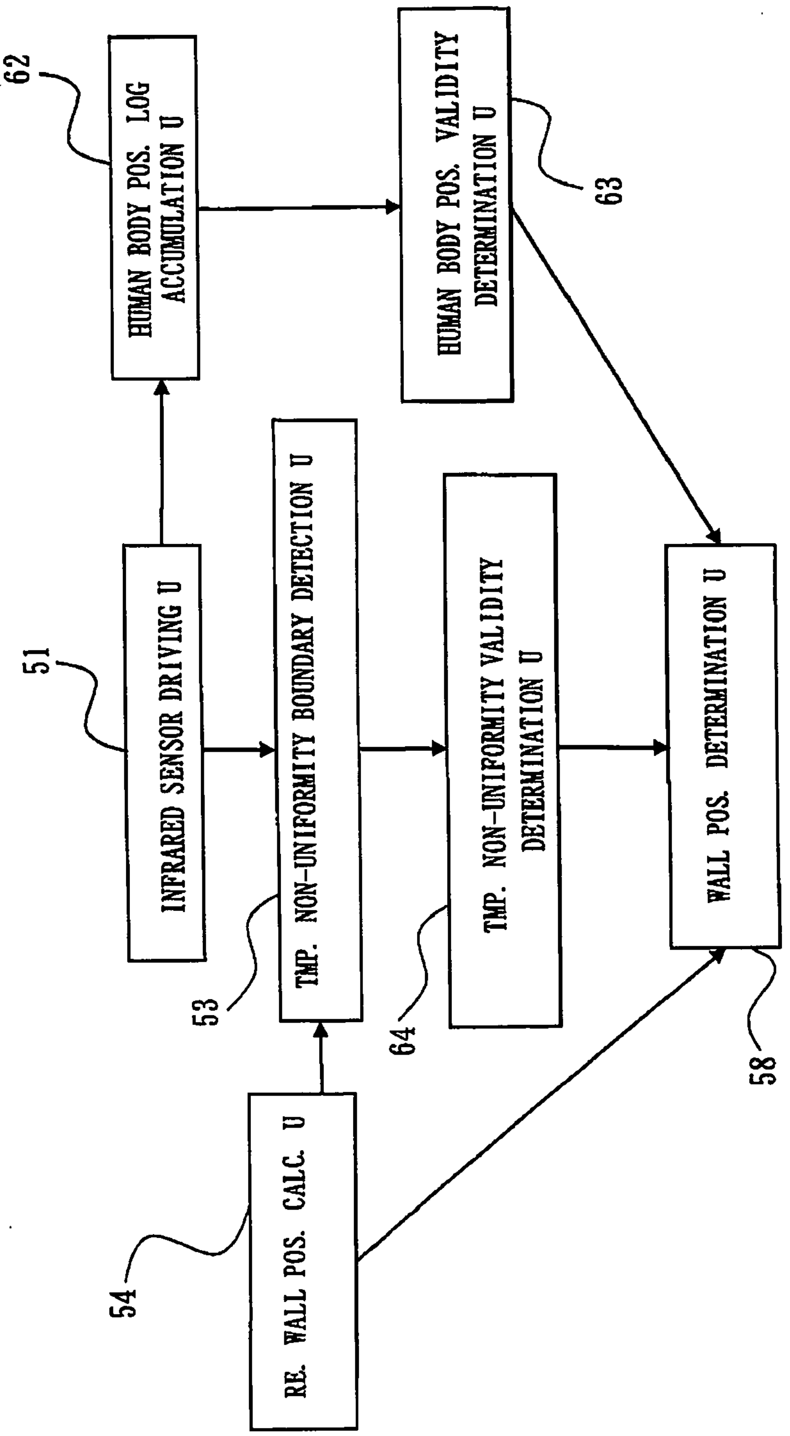

THRESHOLD VALUE A
THRESHOLD VALUE B
100
THRESHOLD VALUE B
THRESHOLD VALUE A

Fig.35



INFRARED SENSOR DRIVING U
51
HUMAN BODY POS. LOG ACCUMULATION U
62
HUMAN BODY POS. VALIDITY DETERMINATION U
63
TMP. NON-UNIFORMITY BOUNDARY DETECTION U
53
TMP. NON-UNIFORMITY VALIDITY DETERMINATION U
64
WALL POS. DETERMINATION U
58
RE. WALL POS. CALC. U
54

Fig.36

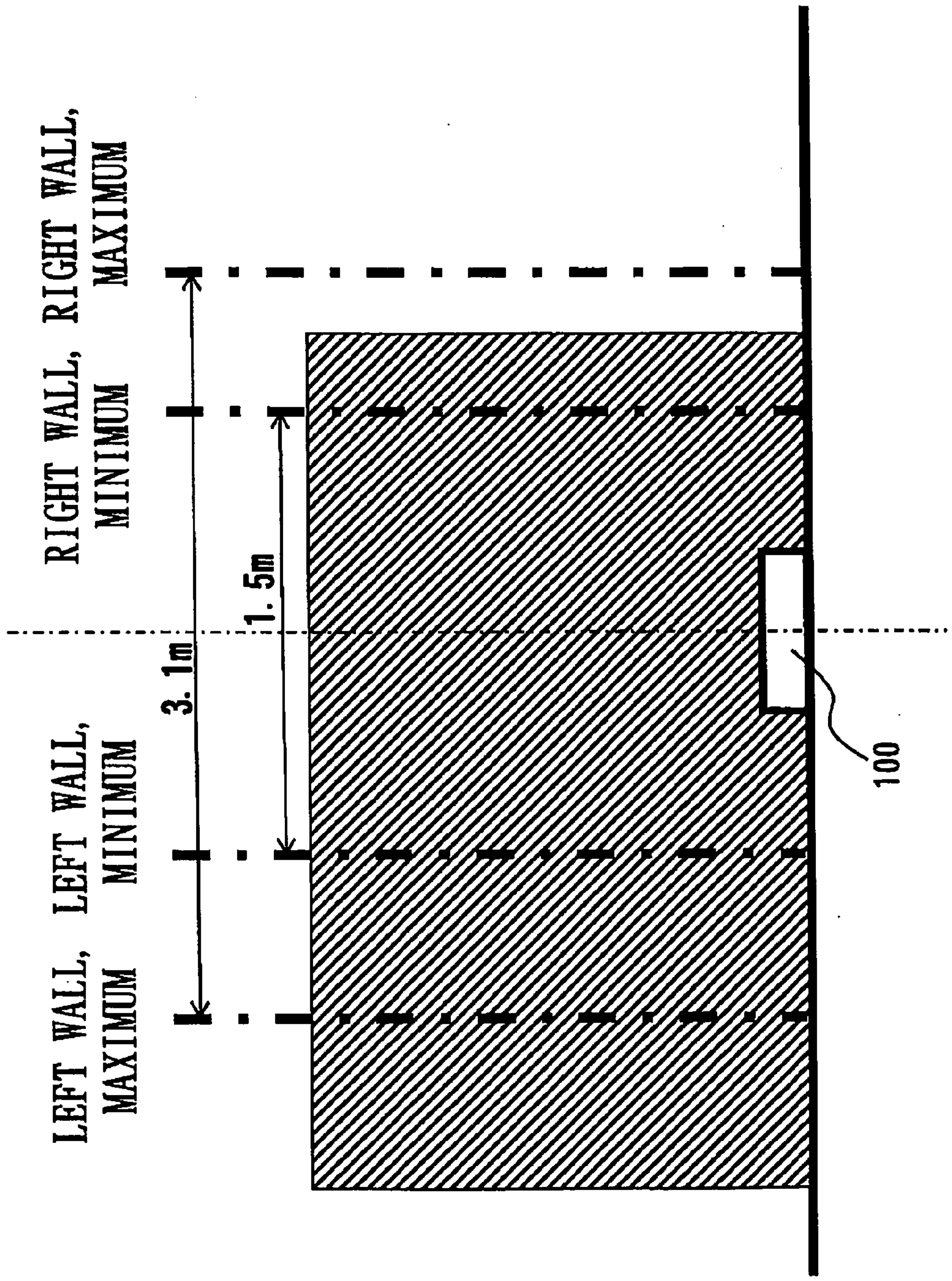

LEFT WALL,
MAXIMUM
LEFT WALL,
MINIMUM
RIGHT WALL,
MINIMUM
RIGHT WALL,
MAXIMUM
3. 1m
1. 5m
100

Fig.37

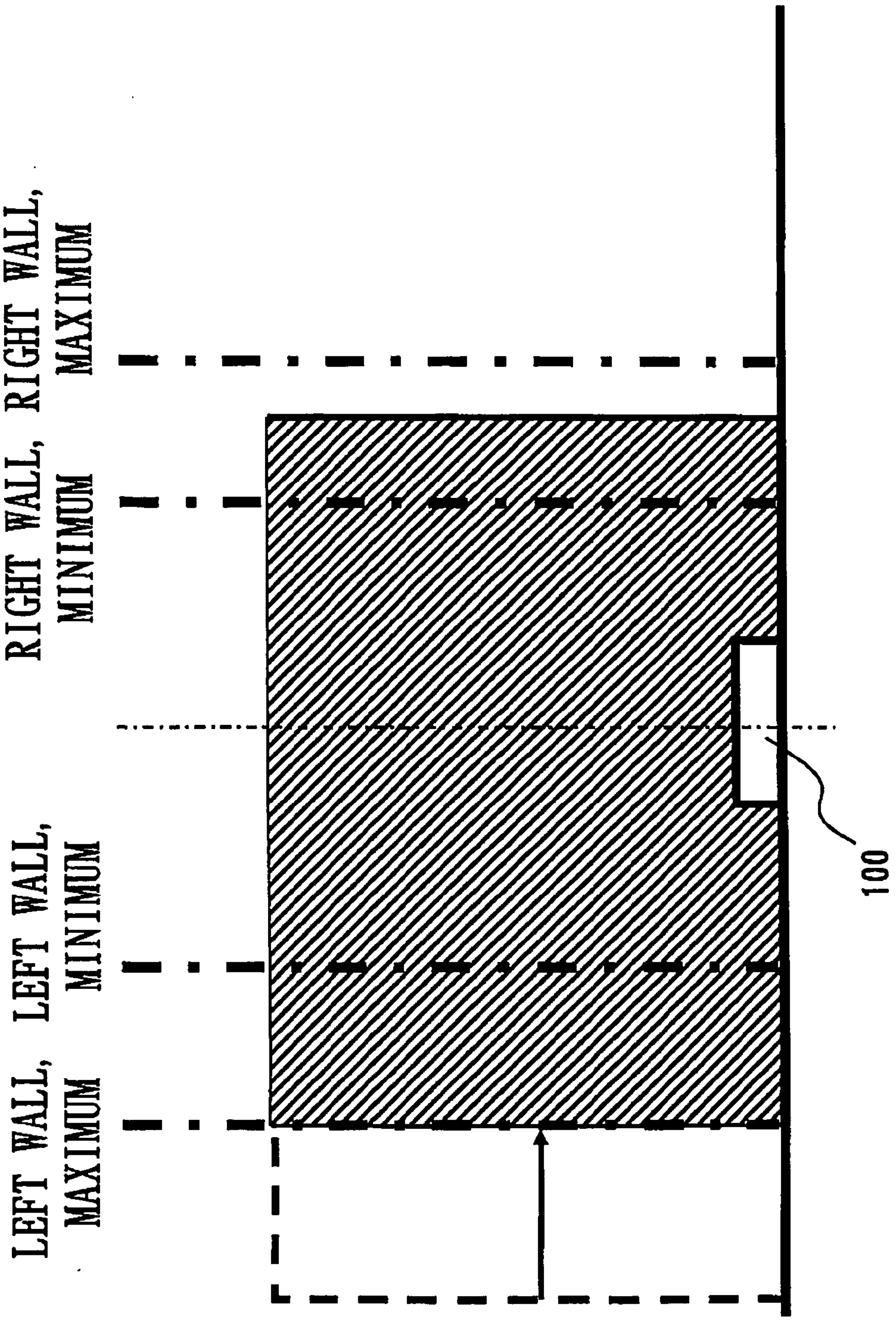

LEFT WALL, MAXIMUM
LEFT WALL, MINIMUM
RIGHT WALL, MINIMUM
RIGHT WALL, MAXIMUM
100

Fig.38

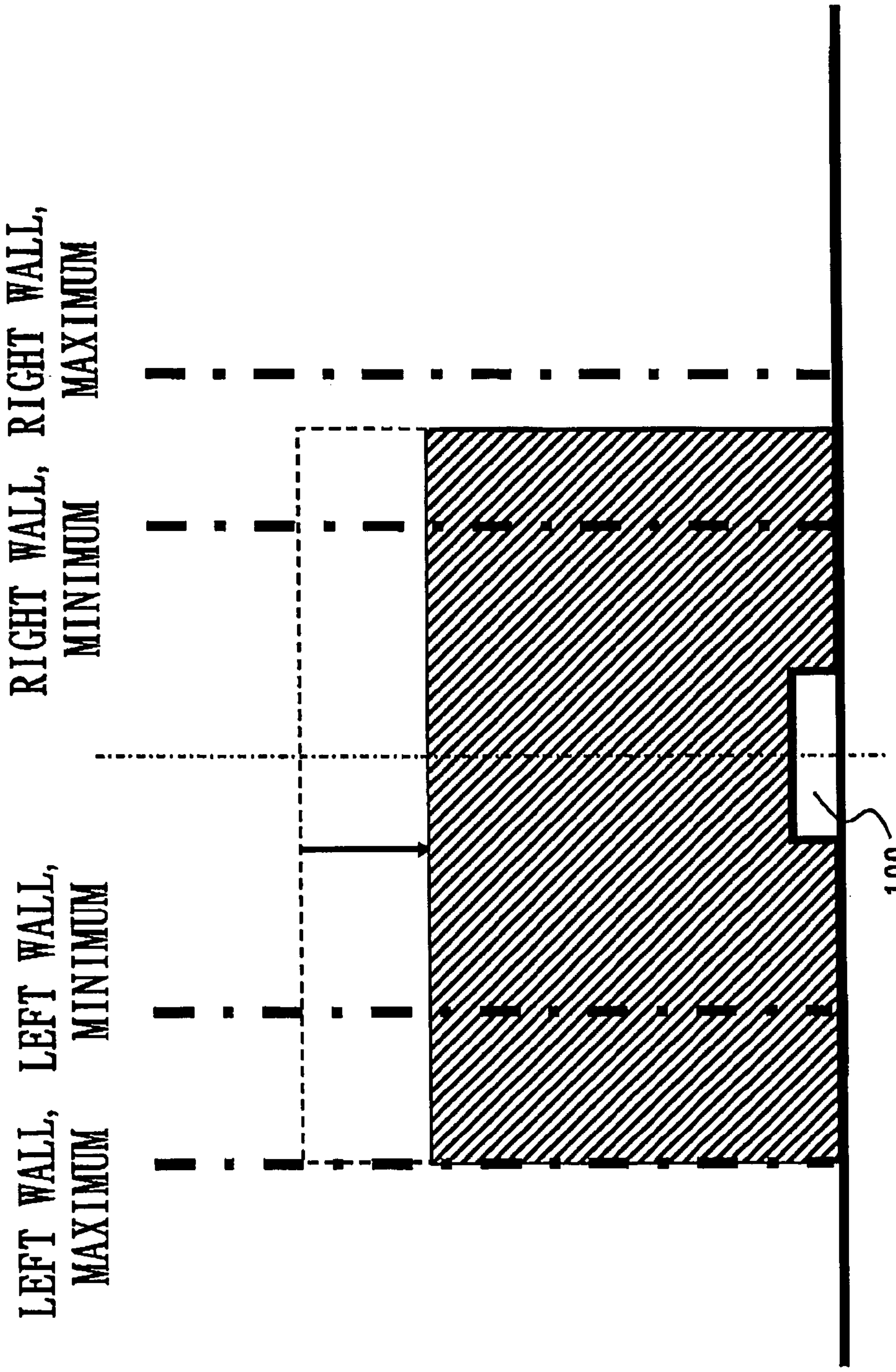

RIGHT WALL, MAXIMUM
RIGHT WALL, MINIMUM
LEFT WALL, MINIMUM
LEFT WALL, MAXIMUM
100

Fig.39

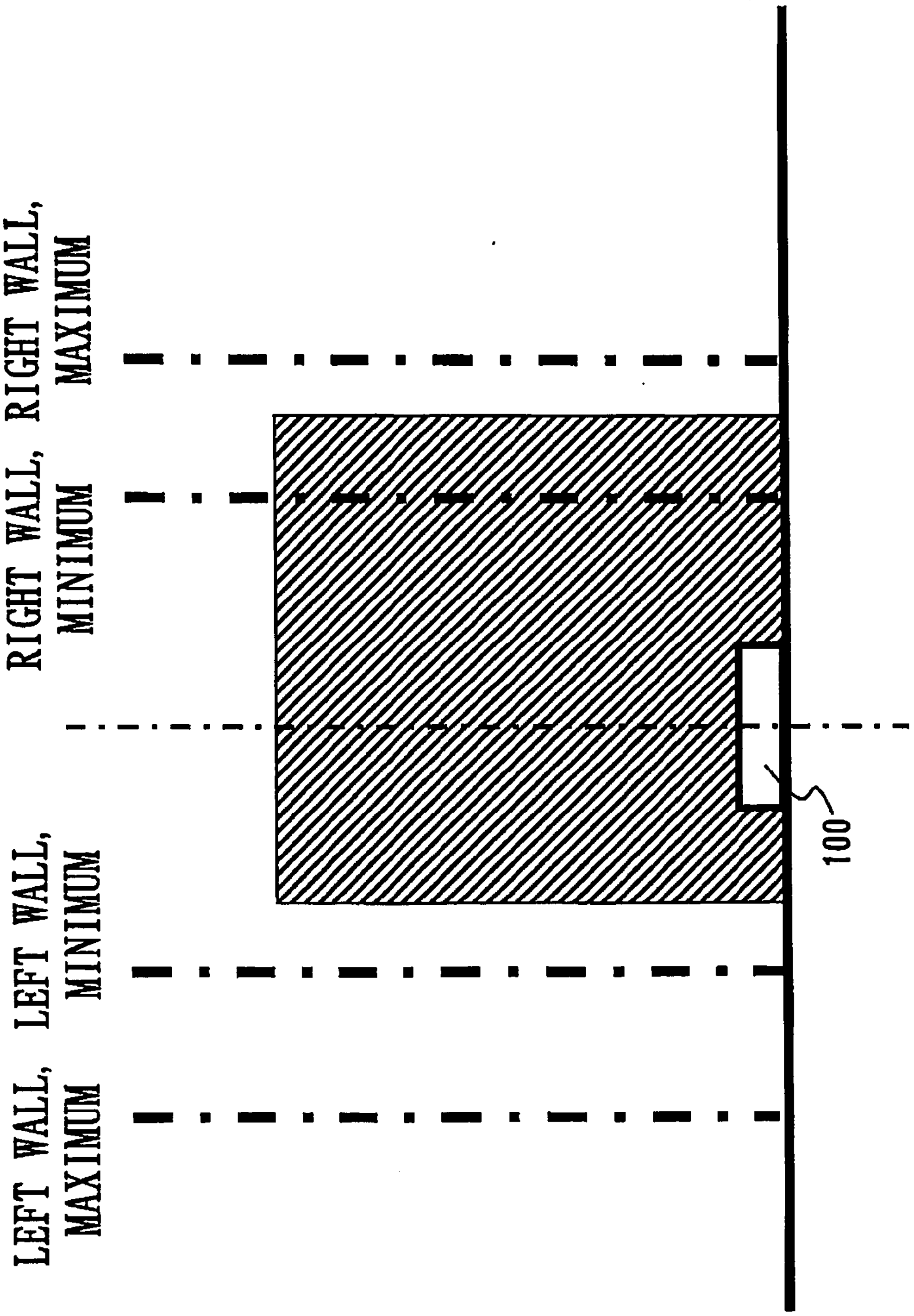

LEFT WALL,
MAXIMUM
LEFT WALL,
MINIMUM
RIGHT WALL,
MINIMUM
RIGHT WALL,
MAXIMUM
100

Fig.40

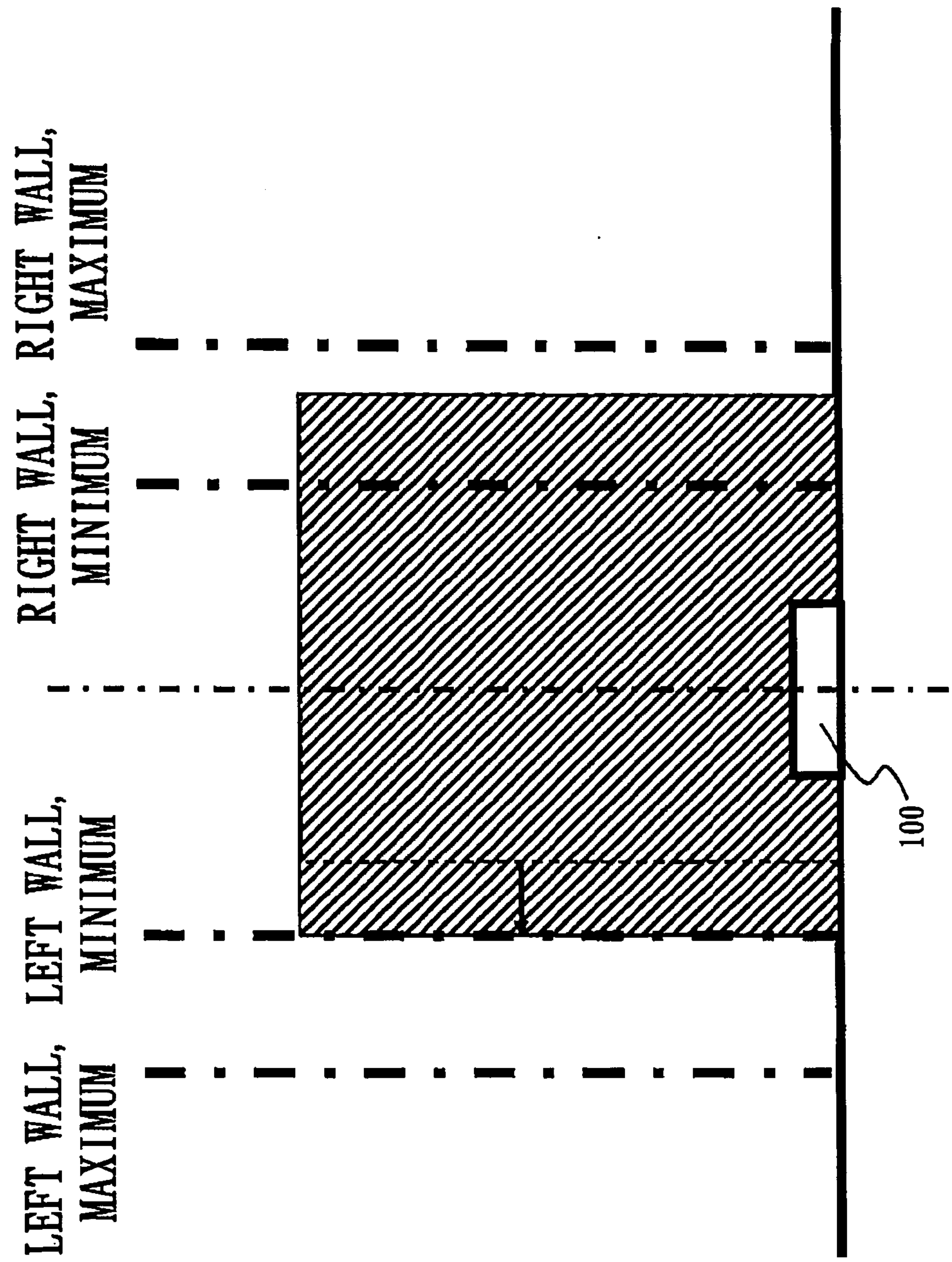

LEFT WALL, MAXIMUM
LEFT WALL, MINIMUM
RIGHT WALL, MINIMUM
RIGHT WALL, MAXIMUM
100

Fig.41

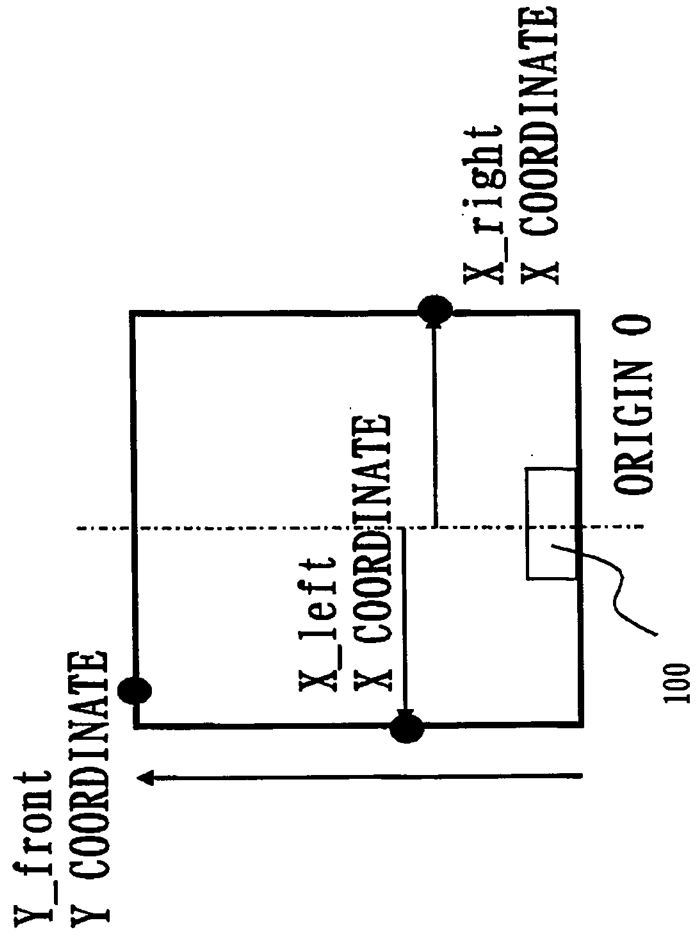

X_right
X COORDINATE
ORIGIN O
X_left
X COORDINATE
Y_front
Y COORDINATE
100

Fig.42

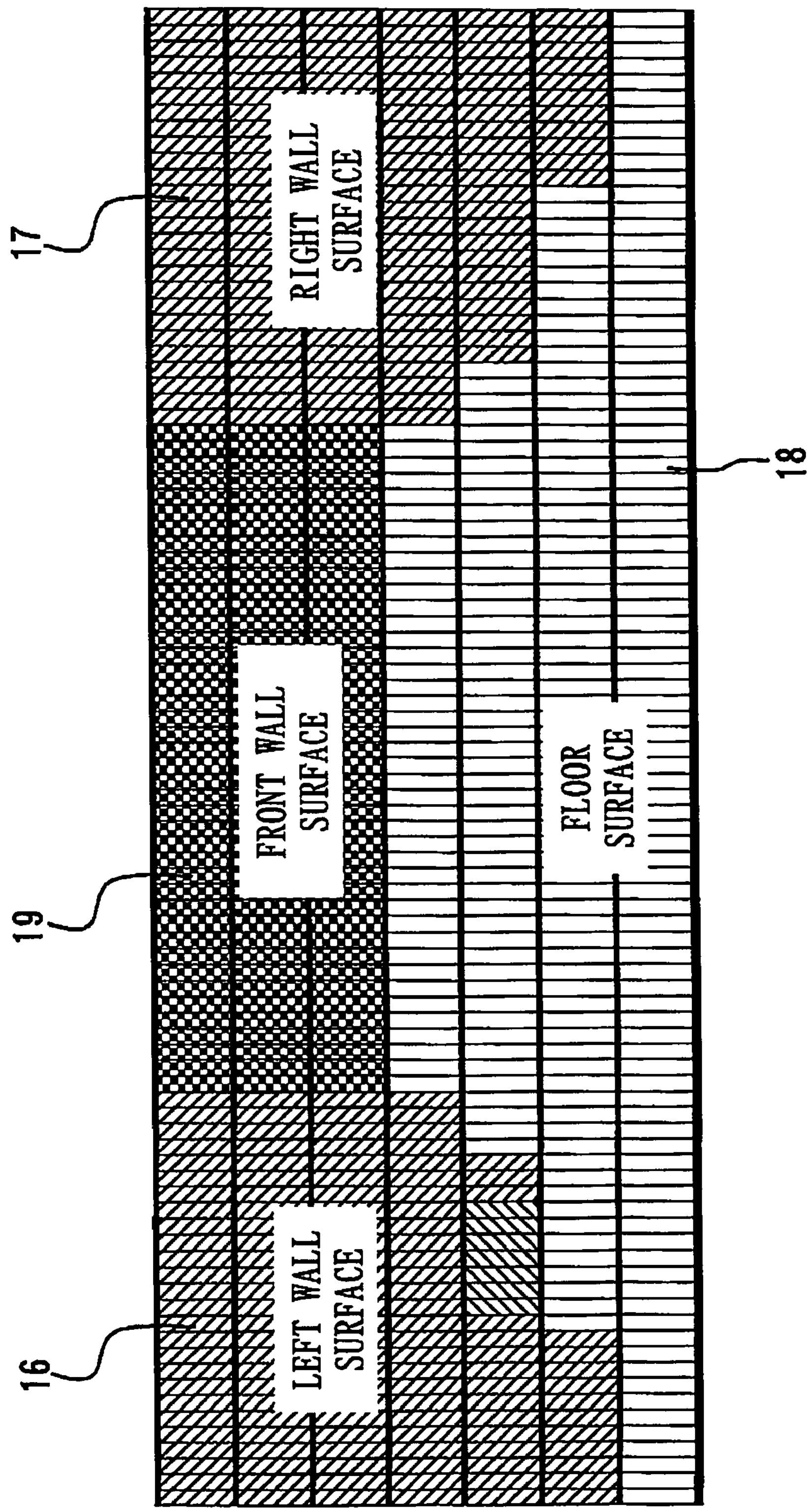

RIGHT WALL SURFACE
FRONT WALL SURFACE
LEFT WALL SURFACE
FLOOR SURFACE
17
19
16
18

Fig.43

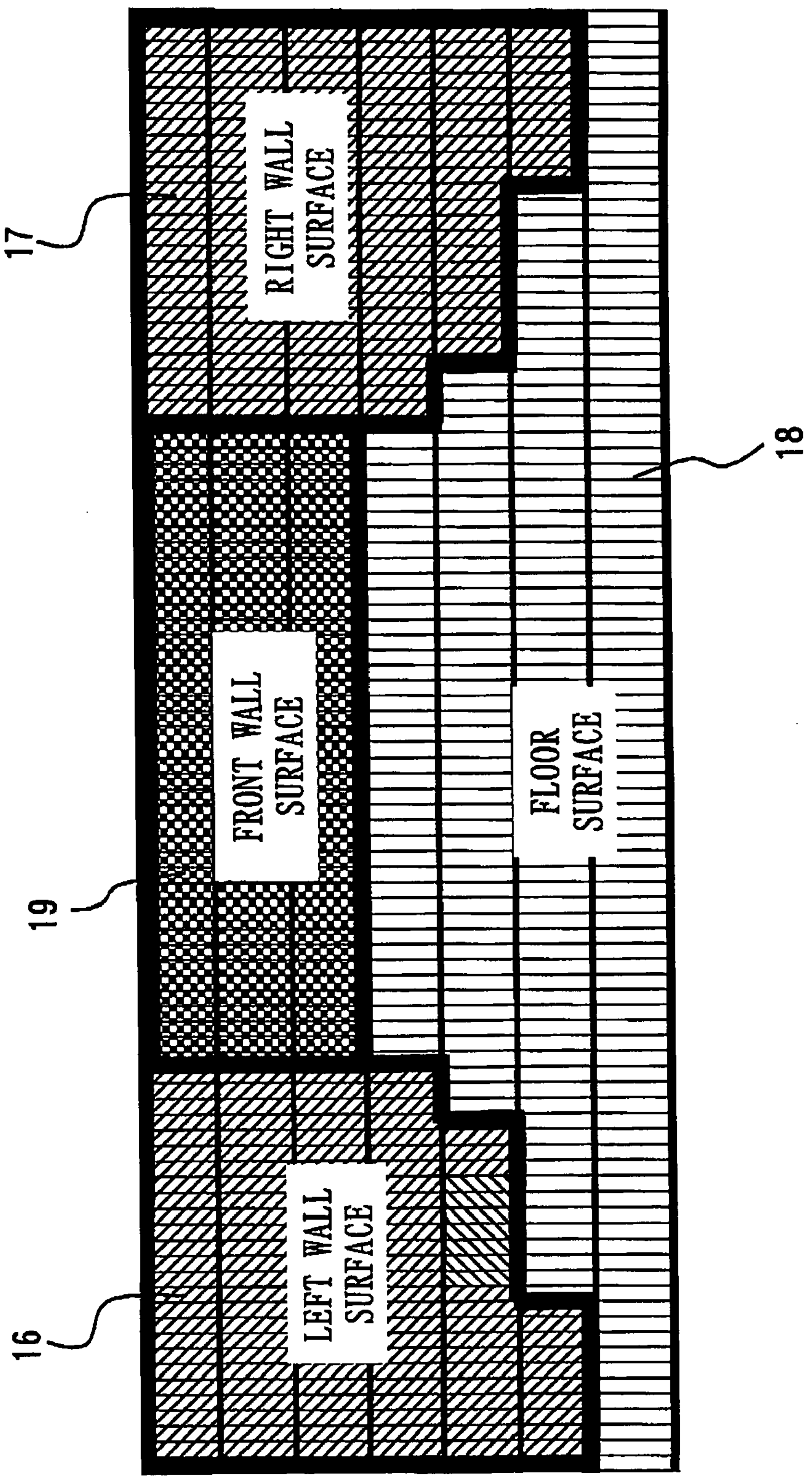

17
RIGHT WALL SURFACE
18
19
FRONT WALL SURFACE
FLOOR SURFACE
16
LEFT WALL SURFACE

Fig.44

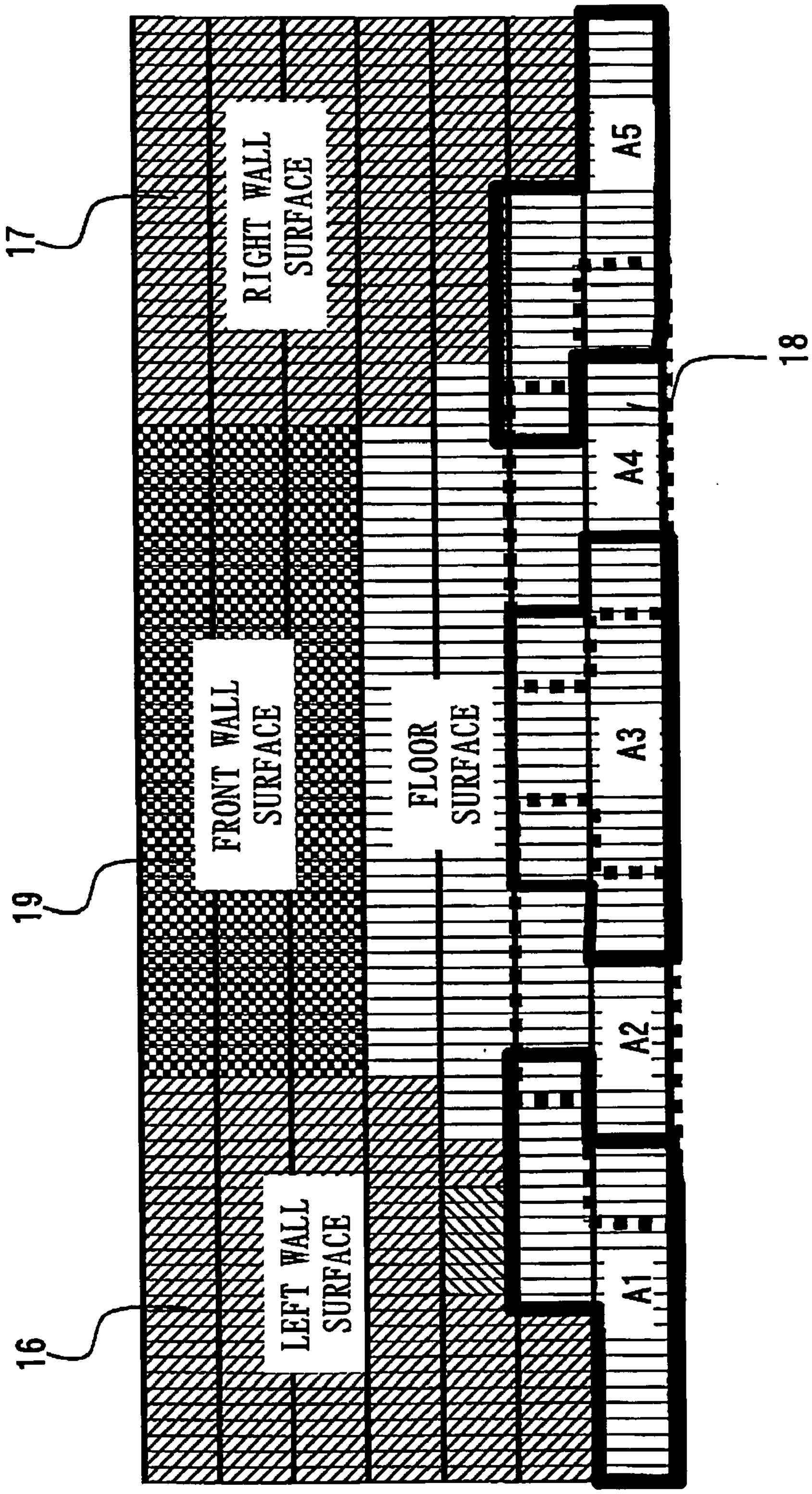

17
RIGHT WALL SURFACE
A5
18
A4
19
FRONT WALL SURFACE
FLOOR SURFACE
A3
A2
16
LEFT WALL SURFACE
A1

Fig.45

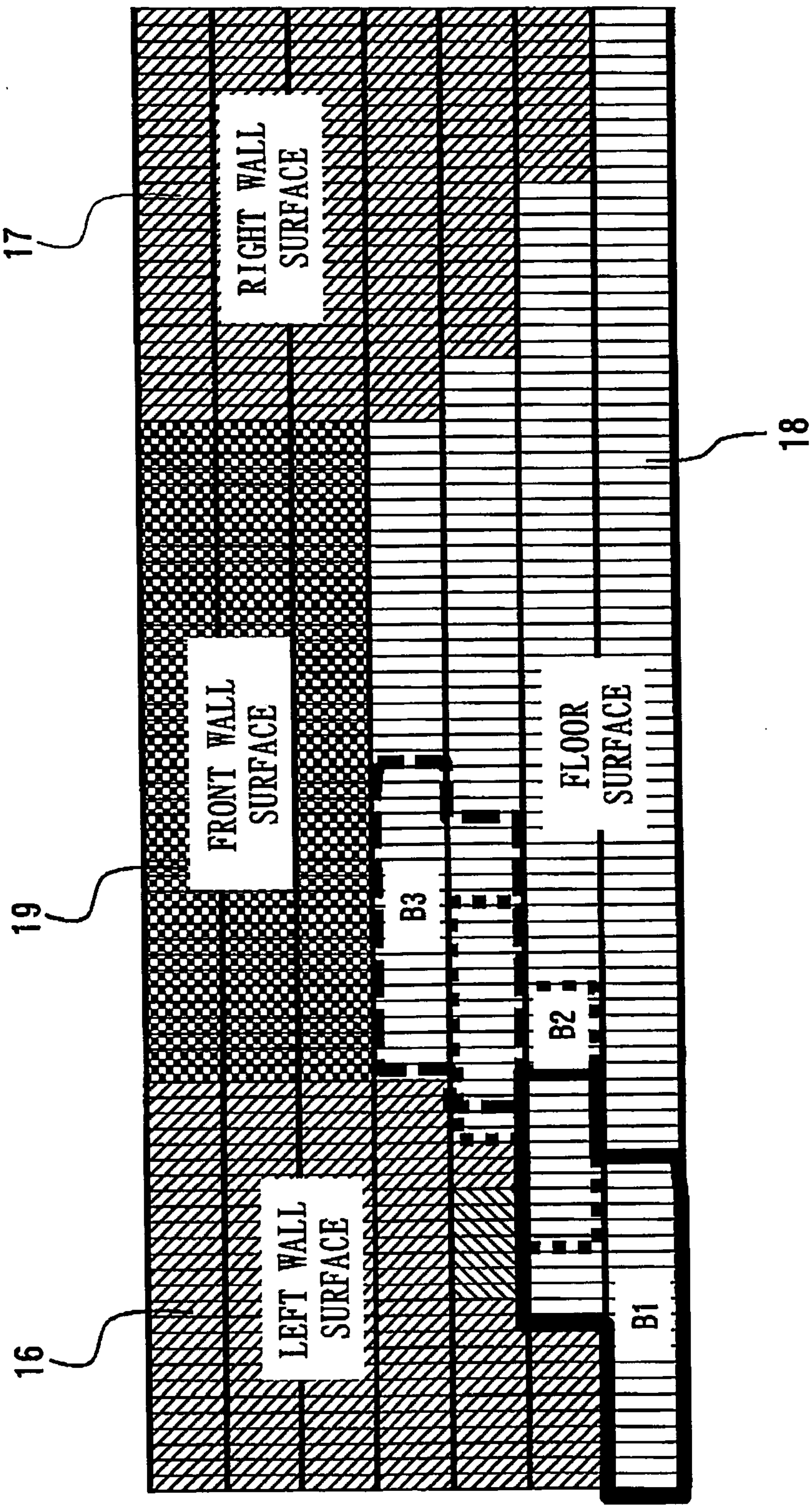

17
RIGHT WALL SURFACE
18
19
FRONT WALL SURFACE
FLOOR SURFACE
B3
B2
B1
16
LEFT WALL SURFACE

Fig.46

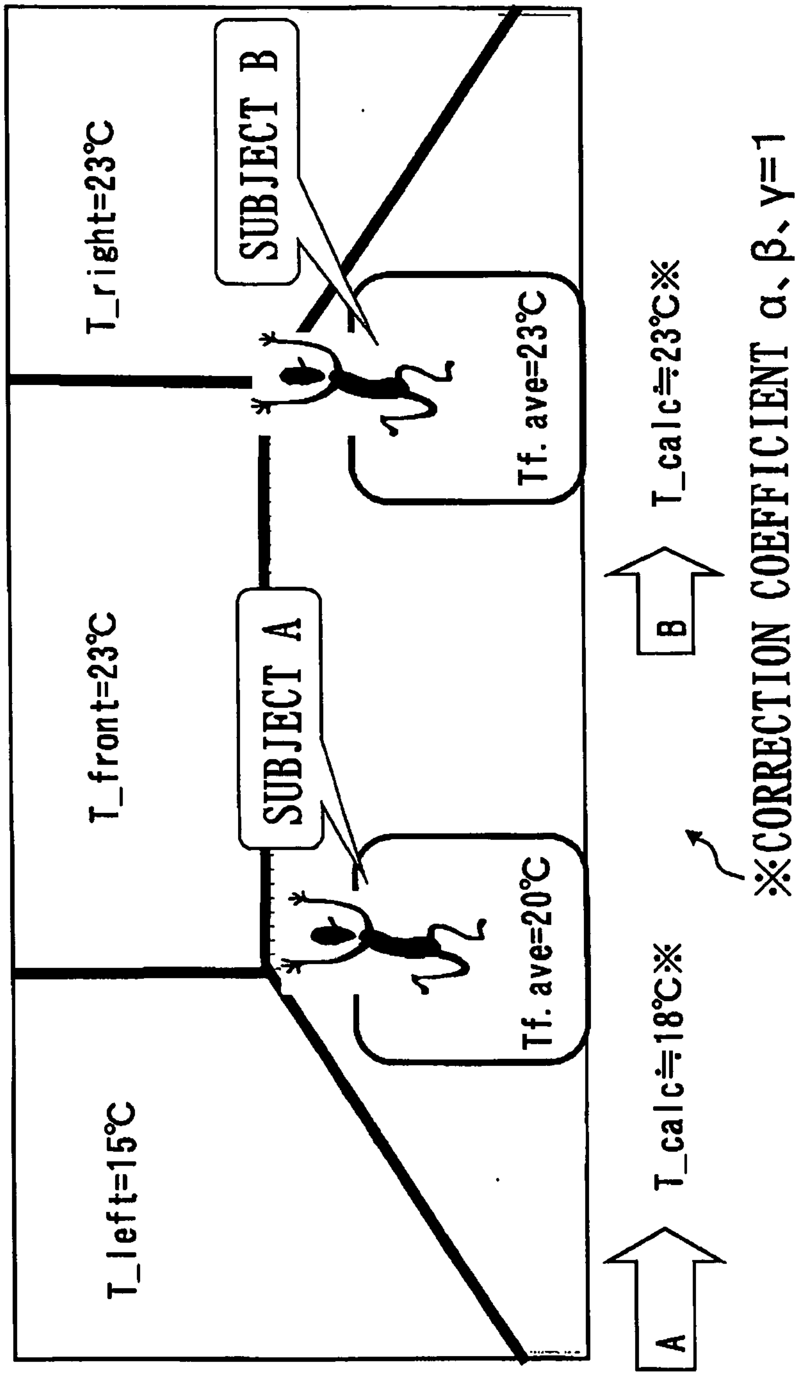

T_left=15°C
T_front=23°C
T_right=23°C
SUBJECT A
SUBJECT B
Tf. ave=20°C
Tf. ave=23°C
A
T_calc≒18°C※
B
T_calc≒23°C※
※CORRECTION COEFFICIENT α、β、γ=1

Fig.47

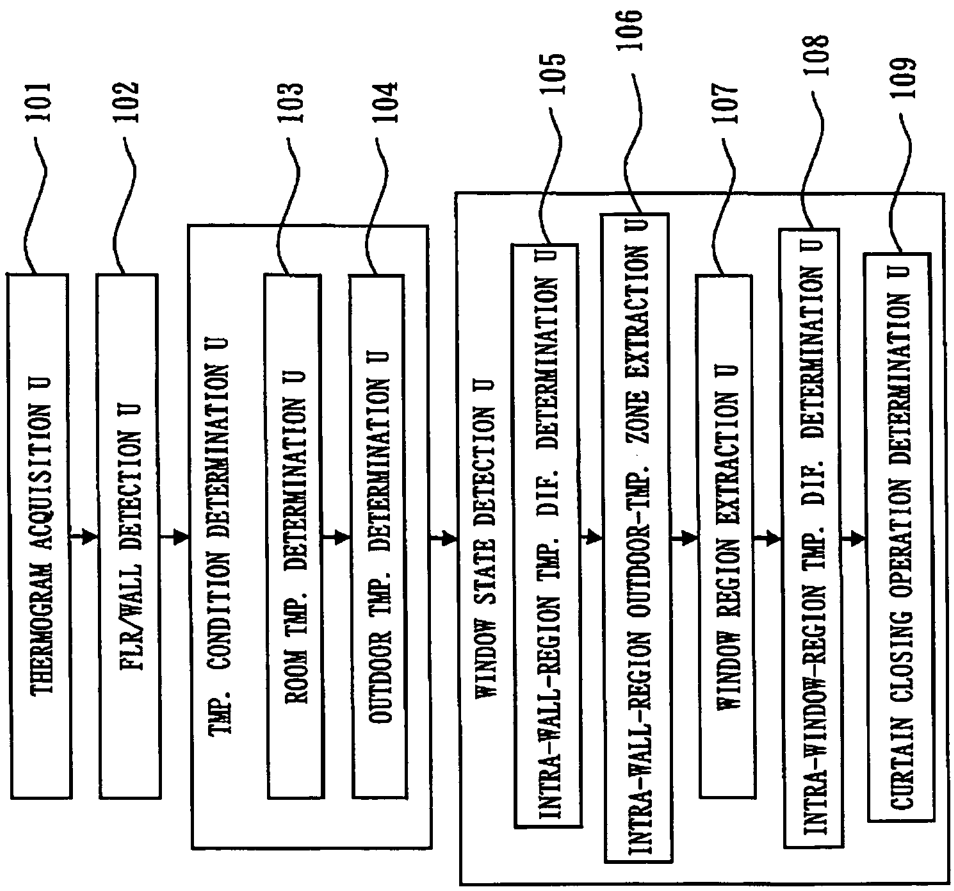

THERMOGRAM ACQUISITION U
101
FLR/WALL DETECTION U
102
TMP. CONDITION DETERMINATION U
ROOM TMP. DETERMINATION U
103
OUTDOOR TMP. DETERMINATION U
104
WINDOW STATE DETECTION U
INTRA-WALL-REGION TMP. DIF. DETERMINATION U
105
INTRA-WALL-REGION OUTDOOR-TMP. ZONE EXTRACTION U
106
WINDOW REGION EXTRACTION U
107
INTRA-WINDOW-REGION TMP. DIF. DETERMINATION U
108
CURTAIN CLOSING OPERATION DETERMINATION U
109

Fig.48

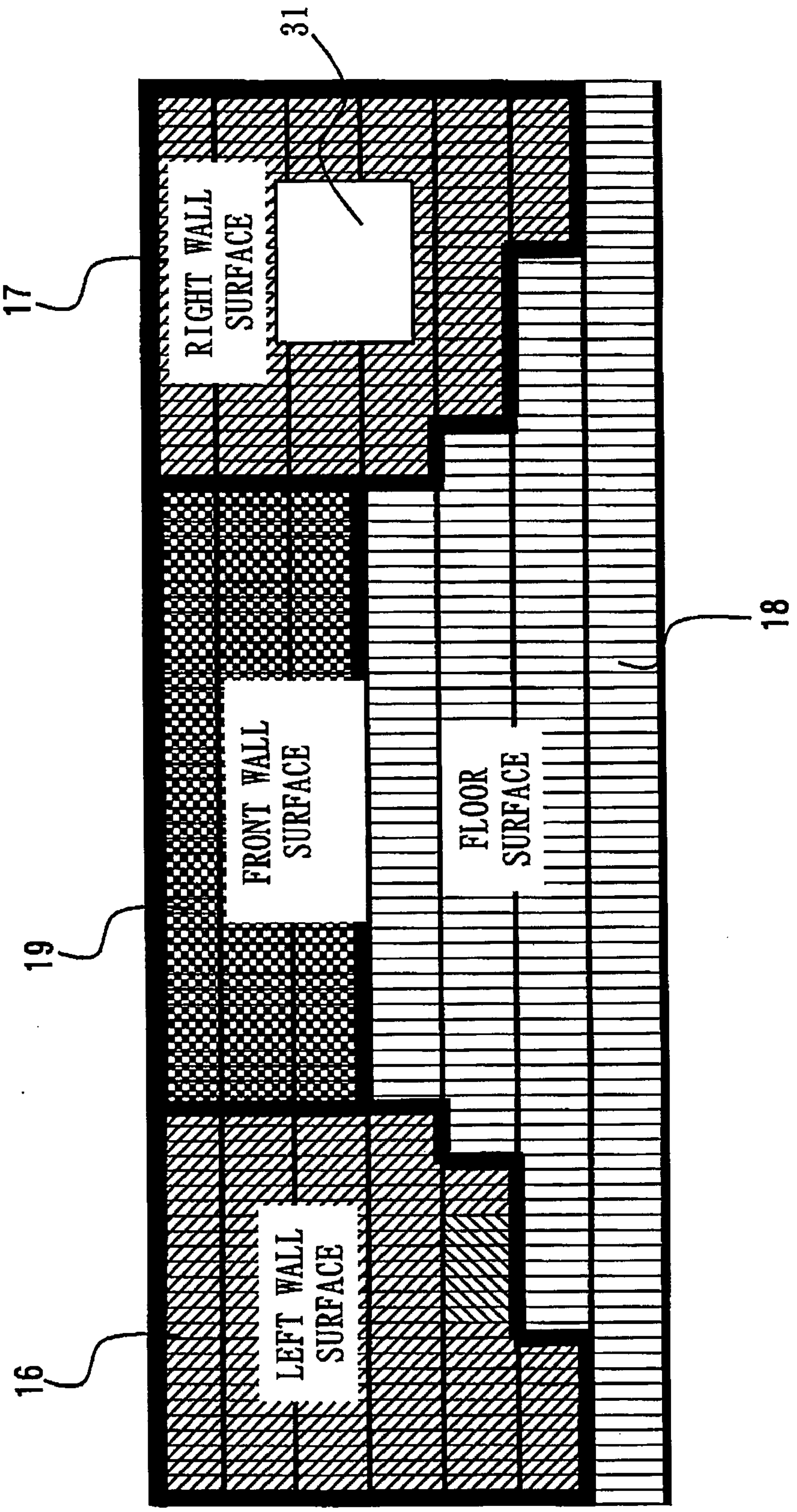

31
17
RIGHT WALL SURFACE
FRONT WALL SURFACE
19
18
FLOOR SURFACE
LEFT WALL SURFACE
16

Fig.49

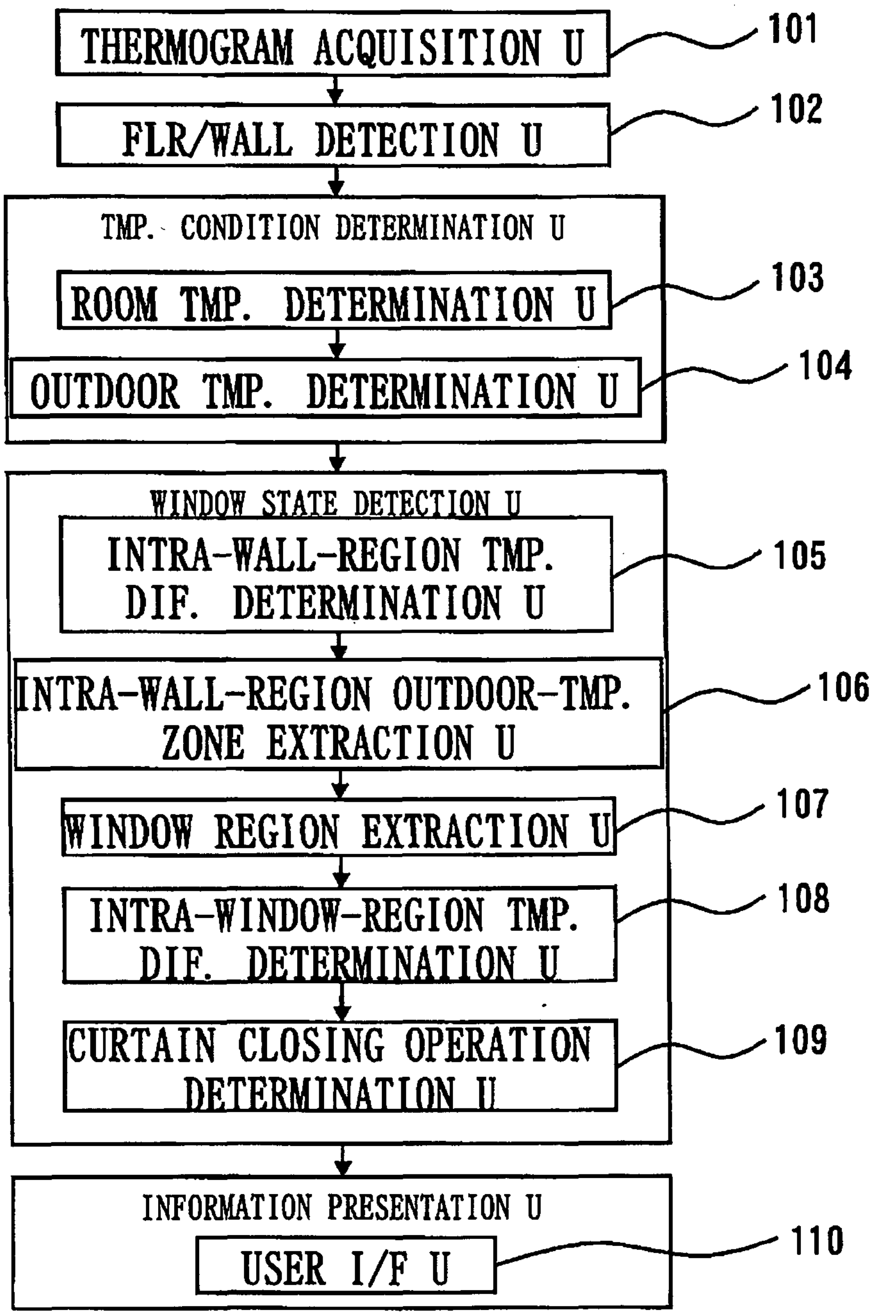

THERMOGRAM ACQUISITION U
101
FLR/WALL DETECTION U
102
TMP. CONDITION DETERMINATION U
ROOM TMP. DETERMINATION U
103
OUTDOOR TMP. DETERMINATION U
104
WINDOW STATE DETECTION U
INTRA-WALL-REGION TMP. DIF. DETERMINATION U
105
INTRA-WALL-REGION OUTDOOR-TMP. ZONE EXTRACTION U
106
WINDOW REGION EXTRACTION U
107
INTRA-WINDOW-REGION TMP. DIF. DETERMINATION U
108
CURTAIN CLOSING OPERATION DETERMINATION U
109
INFORMATION PRESENTATION U
USER I/F U
110

Fig.50

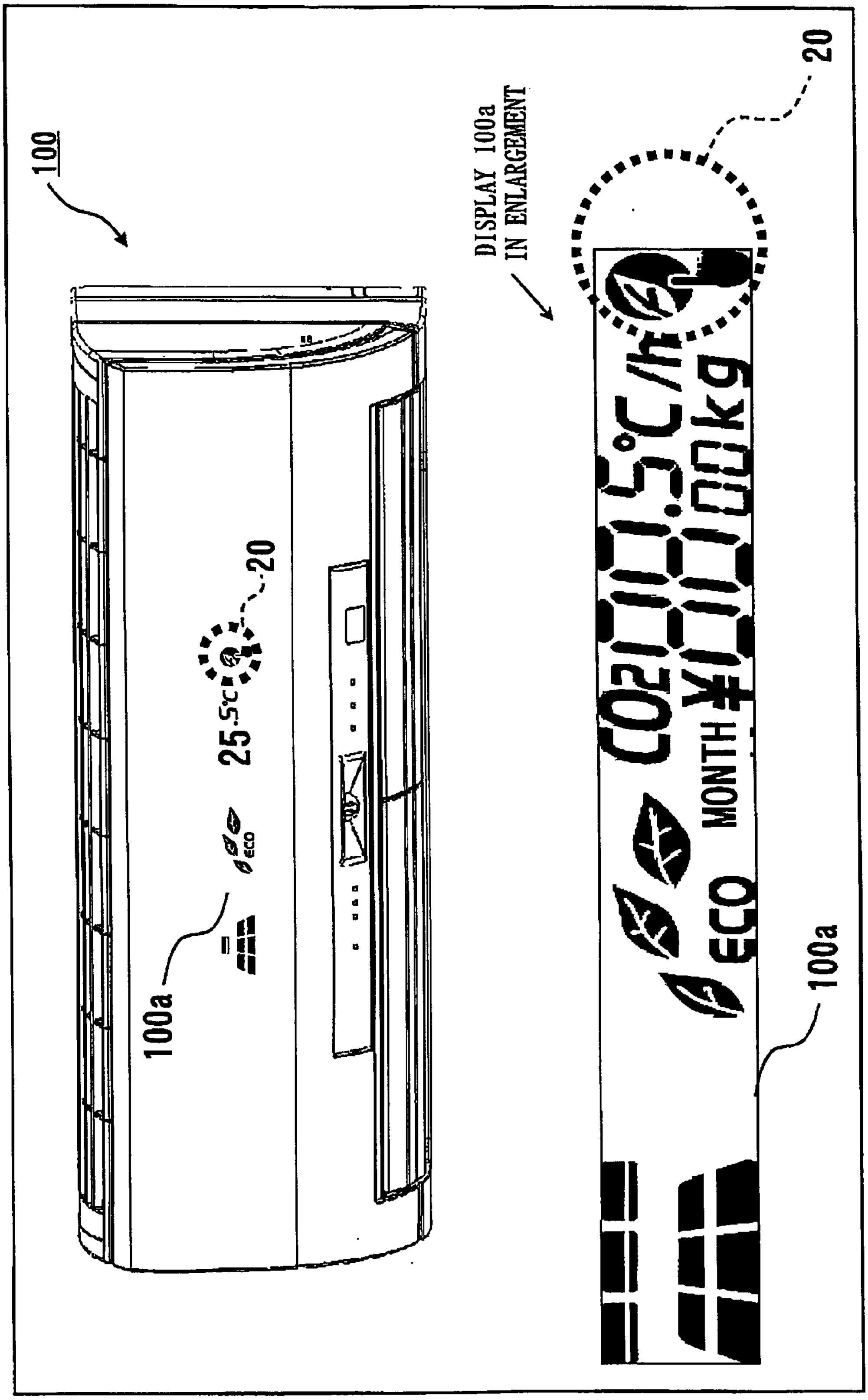

100
100a
20
25.5°C
ECO
DISPLAY 100a
IN ENLARGEMENT
20
CO2
MONTH
ECO
kg
100a

Fig.51

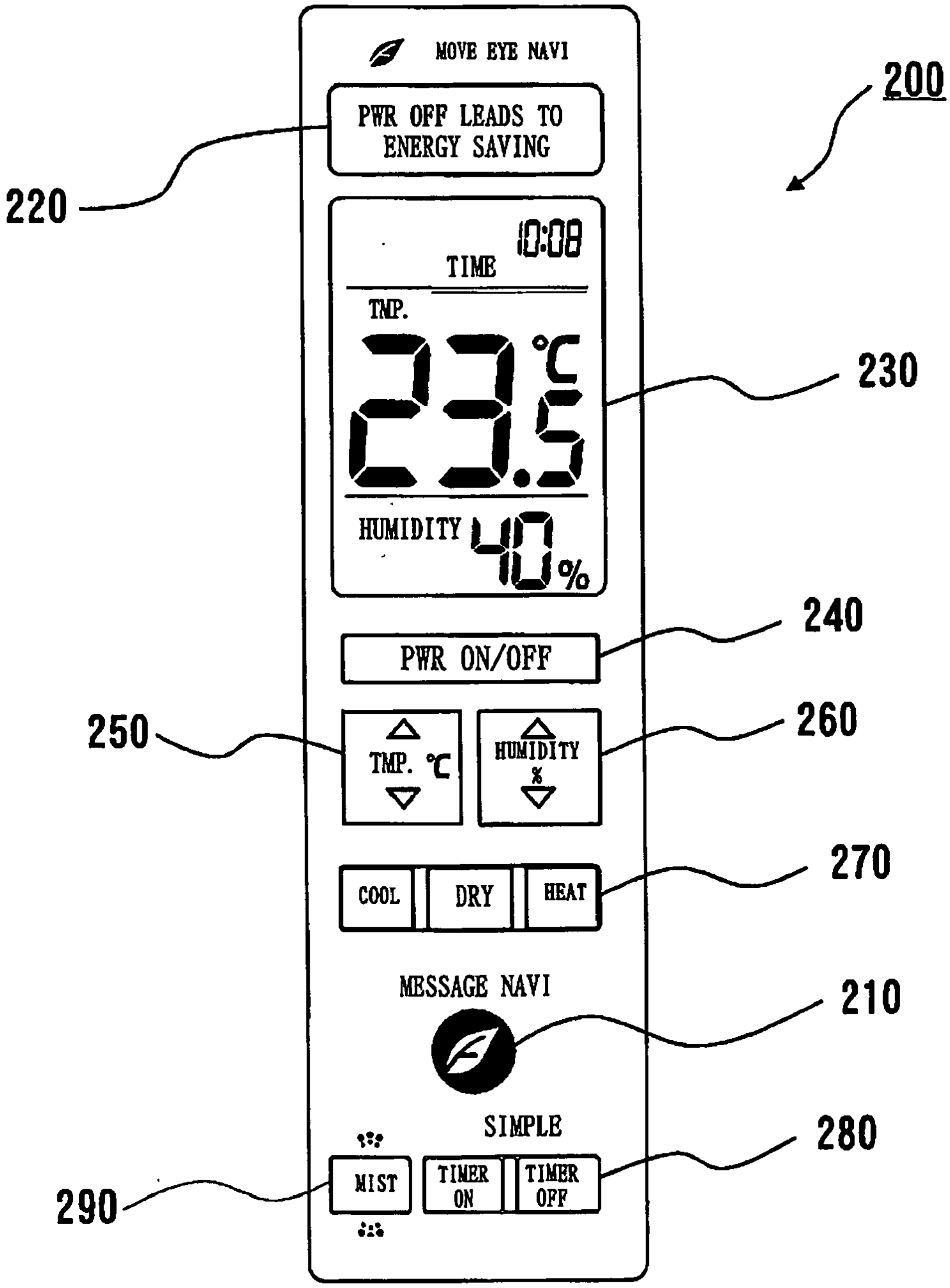

200
MOVE EYE NAVI
PWR OFF LEADS TO ENERGY SAVING
220
TIME 10:08
TMP.
23.5 ℃
230
HUMIDITY 40 %
PWR ON/OFF
240
250
TMP. ℃
HUMIDITY %
260
COOL
DRY
HEAT
270
MESSAGE NAVI
210
SIMPLE
280
MIST
TIMER ON
TIMER OFF
290

Fig.52

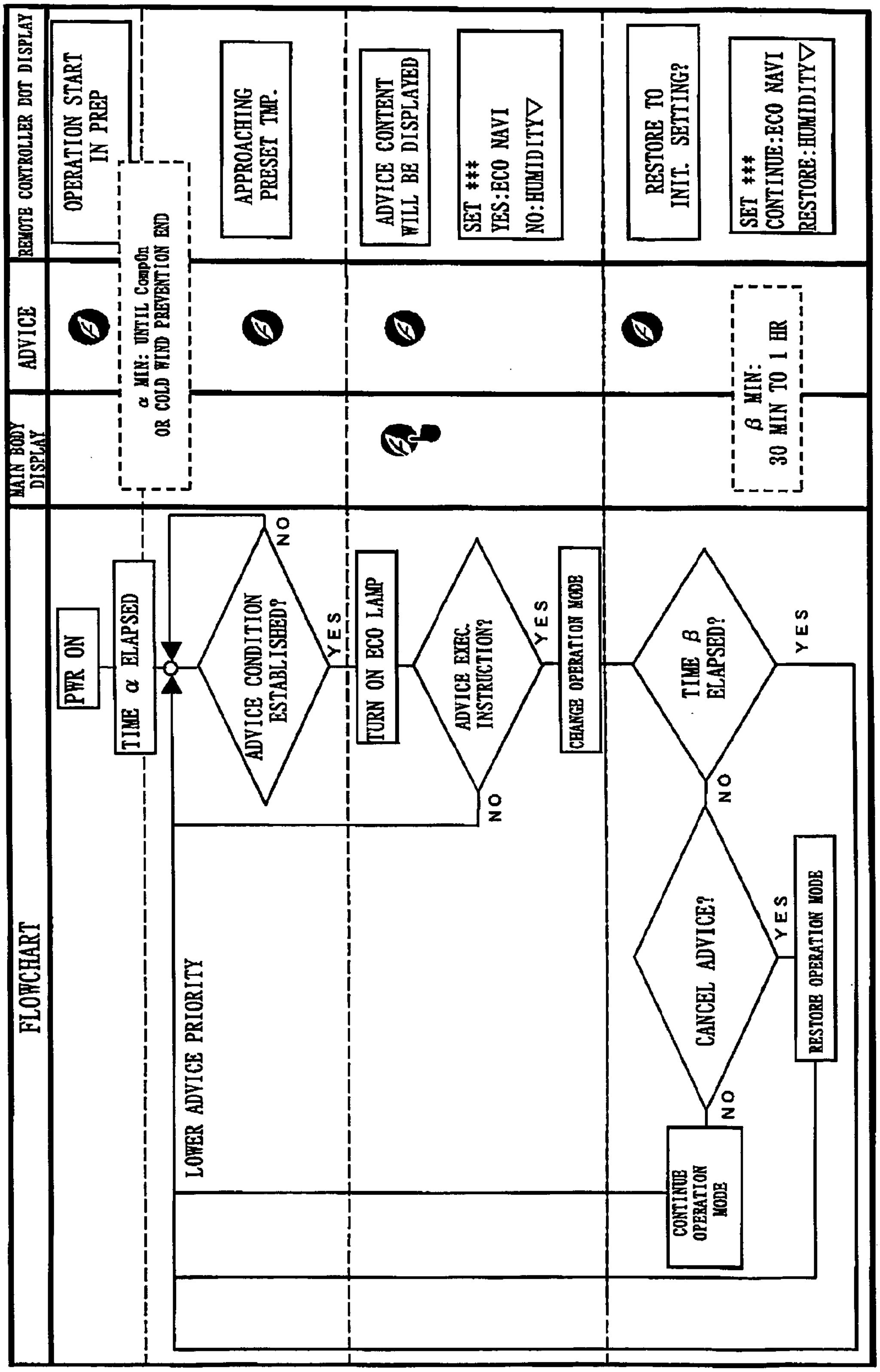

FLOWCHART
MAIN BODY DISPLAY
ADVICE
REMOTE CONTROLLER DOT DISPLAY
PWR ON
TIME α ELAPSED
α MIN: UNTIL CompOn
OR COLD WIND PREVENTION END
OPERATION START
IN PREP
ADVICE CONDITION ESTABLISHED?
YES
NO
APPROACHING
PRESET TMP.
TURN ON ECO LAMP
ADVICE EXEC. INSTRUCTION?
YES
NO
ADVICE CONTENT
WILL BE DISPLAYED
SET ***
YES:ECO NAVI
NO:HUMIDITY▽
CHANGE OPERATION MODE
TIME β ELAPSED?
YES
NO
β MIN:
30 MIN TO 1 HR
RESTORE TO
INIT. SETTING?
SET ***
CONTINUE:ECO NAVI
RESTORE:HUMIDITY▽
CANCEL ADVICE?
YES
NO
RESTORE OPERATION MODE
CONTINUE OPERATION MODE
LOWER ADVICE PRIORITY

Fig.53

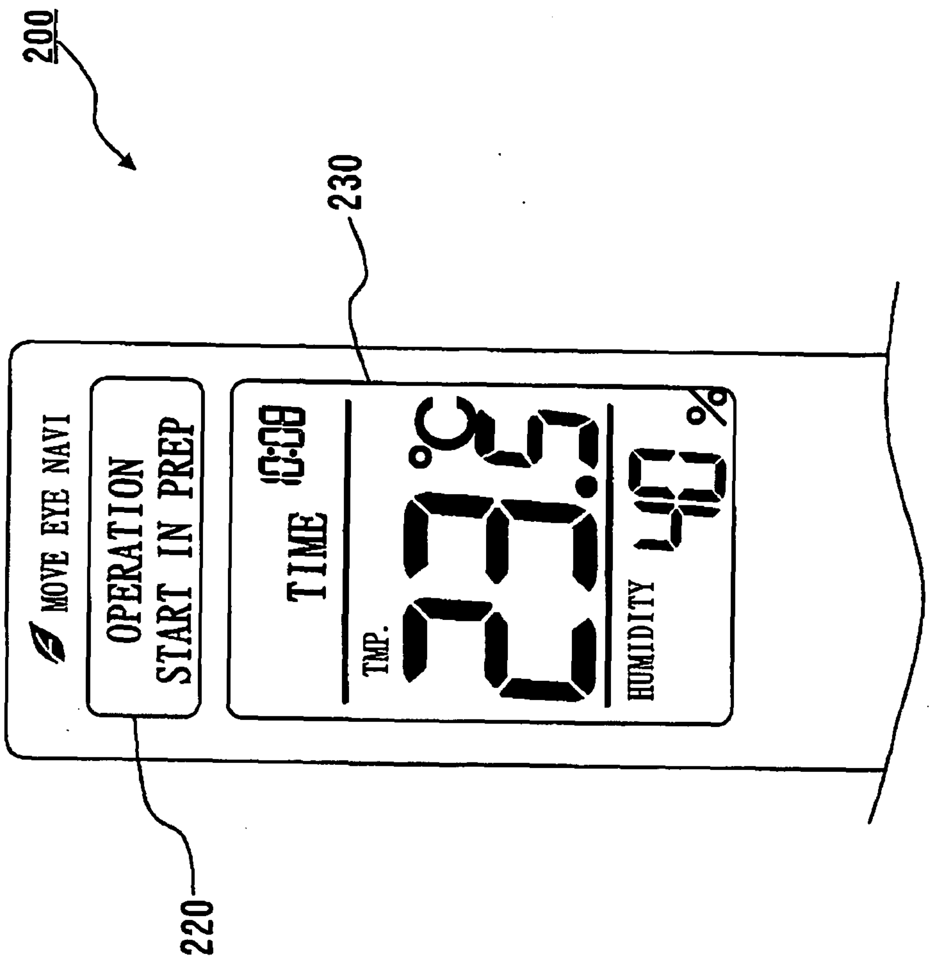

200
230
220
MOVE EYE NAVI
OPERATION
START IN PREP
TIME
TMP.
°C
HUMIDITY
%

Fig.54

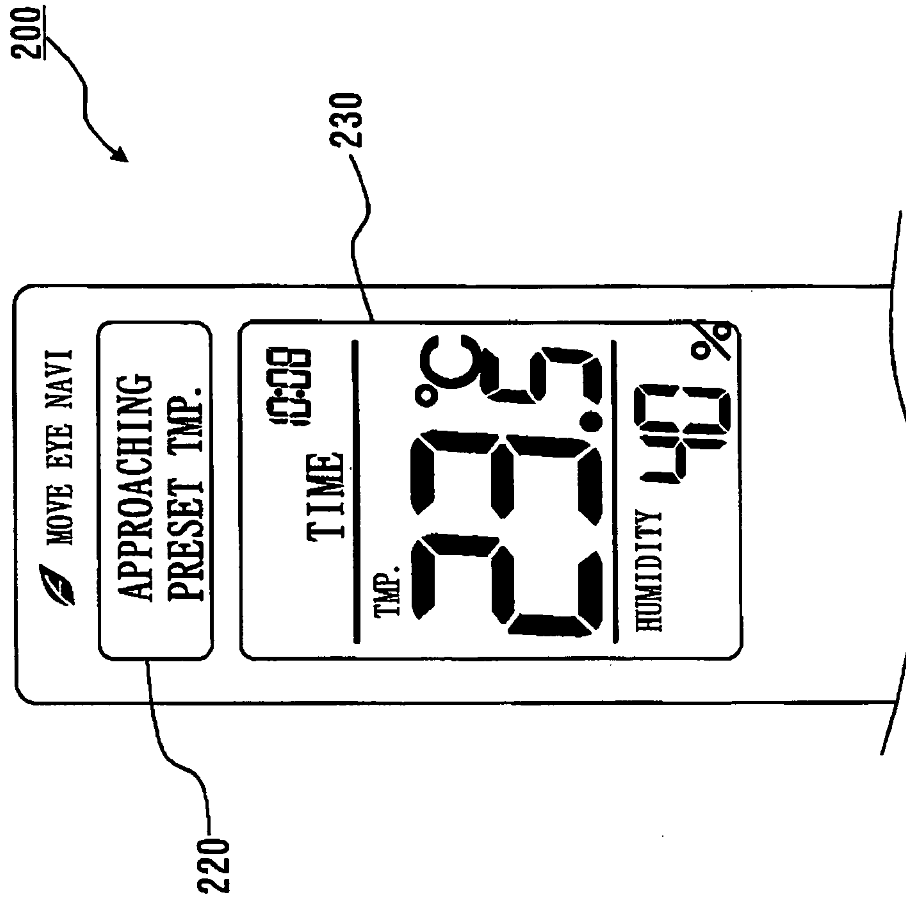

200
230
MOVE EYE NAVI
APPROACHING
PRESET TMP.
TIME
10:09
TMP.
25.5°C
HUMIDITY
40%
220

Fig.55

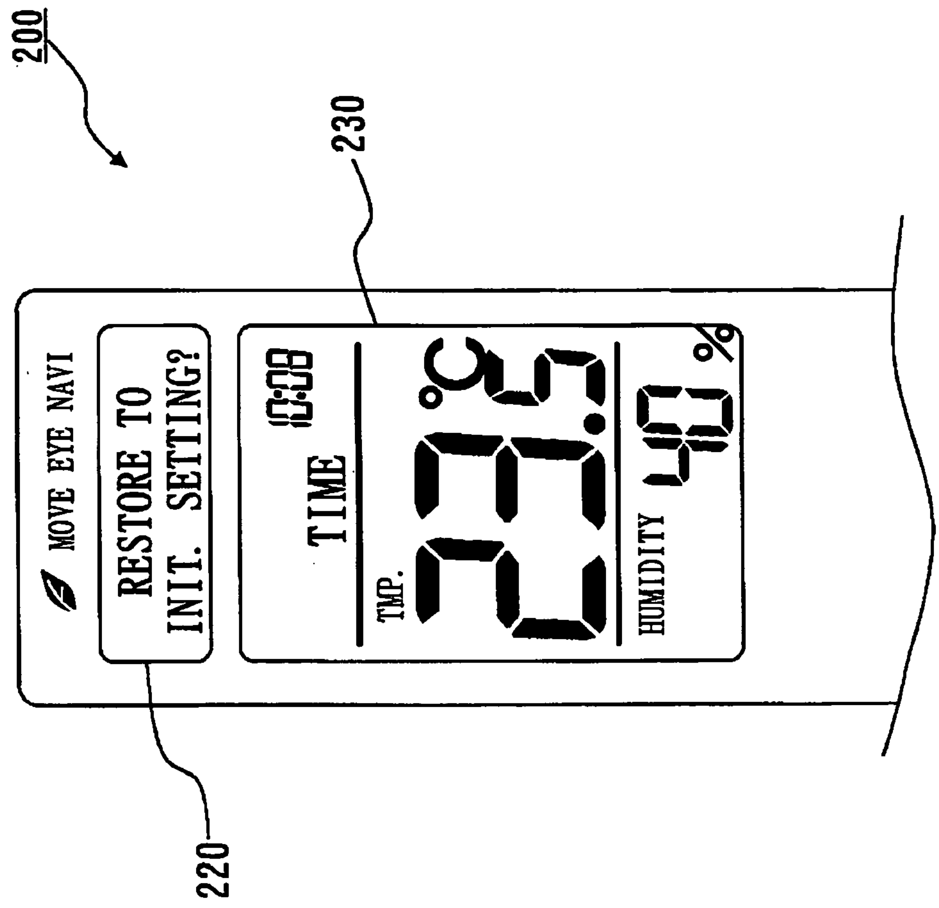

200
230
220
MOVE EYE NAVI
RESTORE TO
INIT. SETTING?
TIME
TMP.
HUMIDITY
°C
%

Fig.56

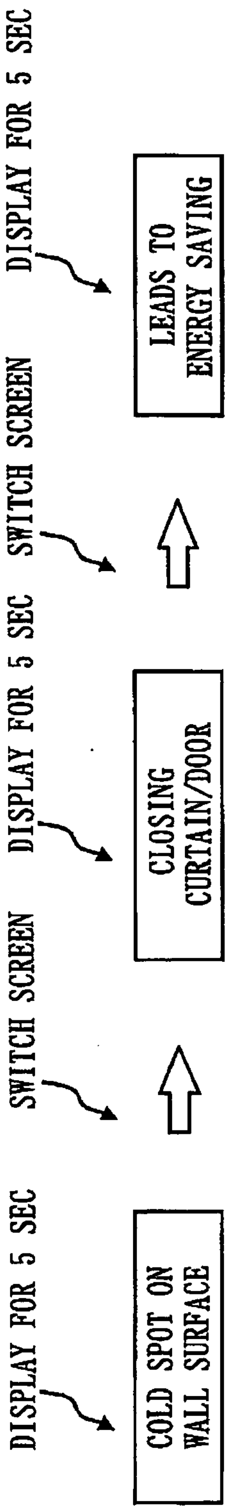

COLD SPOT ON WALL SURFACE
DISPLAY FOR 5 SEC
SWITCH SCREEN
CLOSING CURTAIN/DOOR
DISPLAY FOR 5 SEC
SWITCH SCREEN
LEADS TO ENERGY SAVING
DISPLAY FOR 5 SEC

Fig.57

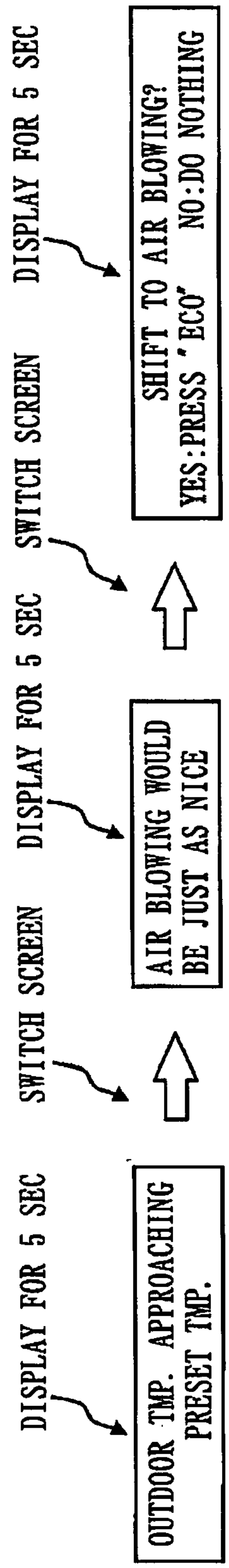

DISPLAY FOR 5 SEC
OUTDOOR TMP. APPROACHING PRESET TMP.
SWITCH SCREEN
DISPLAY FOR 5 SEC
AIR BLOWING WOULD BE JUST AS NICE
SWITCH SCREEN
DISPLAY FOR 5 SEC
SHIFT TO AIR BLOWING?
YES:PRESS 'ECO' NO:DO NOTHING

Fig.58

KEYWORD	PURPOSE	USER AWARE OF ENERGY SAVING EFFECT?	ADVICE CONTENT (DISPLAY) IN COOLING/DRY DISPLAY 1 (5 SEC) →	DISPLAY 2 (5 SEC) →	DISPLAY 3 (5 SEC)
INFRARED SENSOR	INFORM OF MODERATE ENERGY SAVING EFFECT	NO	UNDER CONTROL BY AIR TMP. ONLY	OPERATION AT BODY-SENSIBLE TMP.	SET BODY-SENSIBLE TMP. OPERATION? YES:PRESS 'ECO' NO:DO NOTHING
PRIORITY H	DETECTS HUMAN MOTION. WHEN PEOPLE DO NOT MOVE AROUND FOR LONGER THAN PREDETERMINED PERIOD OF TIME, SUGGESTS PEOPLE'S STAYING TOGETHER LEADS TO ENERGY SAVING OPERATION	NO	ENTIRE ROOM UNDER AIR CONDITIONING	DIVERTING WIND LEADS TO ENERGY SAVING	DIVERT WIND? YES:PRESS 'ECO' NO:DO NOTHING
↑	CHECKS OPEN/CLOSING STATE OF DOOR/CURTAIN BY INFRARED SENSOR BASED ON SUMMERTIME SUNLIGHT AND WINTERTIME LOW RADIATION. SUGGESTS CLOSING DOOR/CURTAIN	FORGOTTEN	HOT SPOT ON WALL SURFACE	CLOSING CURTAIN/DOOR	LEADS TO ENERGY SAVING
↓	QUICK ADVICE FOR USER COLD AT FOOT	FORGOTTEN	–	–	–
PRIORITY L	ADVICE WHEN ACTIVE HUMAN MOTION IS DETECTED	FORGOTTEN	BE AWARE OF INDOOR AIR POLLUTION	MIST WILL SUPPRESS AIRBORNE MICROBE	SET MIST? YES:PRESS 'ECO' NO:DO NOTHING

Fig.59

KEYWORD	PURPOSE	USER AWARE OF ENERGY SAVING EFFECT?	ADVICE CONTENT (DISPLAY) IN HEATING DISPLAY 1 (5 SEC) →	DISPLAY 2 (5 SEC) →	DISPLAY 3 (5 SEC)
INFRARED SENSOR	INFORM OF MODERATE ENERGY SAVING EFFECT	NO	UNDER CONTROL BY AIR TMP. ONLY	OPERATION AT BODY-SENSIBLE TMP.	SET BODY-SENSIBLE TMP. OPERATION? YES:PRESS 'ECO' NO:DO NOTHING
PRIORITY H ↑	DETECTS HUMAN MOTION. WHEN PEOPLE DO NOT MOVE AROUND FOR LONGER THAN PREDETERMINED PERIOD OF TIME, SUGGESTS PEOPLE'S STAYING TOGETHER LEADS TO ENERGY SAVING OPERATION	NO	ENTIRE ROOM UNDER AIR CONDITIONING	DIVERTING WIND LEADS TO ENERGY SAVING	DIVERT WIND? YES:PRESS 'ECO' NO:DO NOTHING
	CHECKS OPEN/CLOSING STATE OF DOOR/CURTAIN BY INFRARED SENSOR BASED ON SUMMERTIME SUNLIGHT AND WINTERTIME LOW RADIATION. SUGGESTS CLOSING DOOR/CURTAIN	FORGOTTEN	COLD SPOT ON WALL SURFACE	CLOSING CURTAIN/DOOR	LEADS TO ENERGY SAVING
	QUICK ADVICE FOR USER COLD AT FOOT	FORGOTTEN	UPWARD WIND. NOT COLD AT FOOT?	AUTOMATIC WIND SPEED LEADS TO ENERGY SAVING	SET AUTOMATIC WIND DIRECTION? YES:PRESS 'ECO' NO:DO NOTHING
↓ PRIORITY L	ADVICE WHEN ACTIVE HUMAN MOTION IS DETECTED	FORGOTTEN	BE AWARE OF INDOOR AIR POLLUTION	MIST WILL SUPPRESS AIRBORNE MICROBE	SET MIST? YES:PRESS 'ECO' NO:DO NOTHING

Fig.60

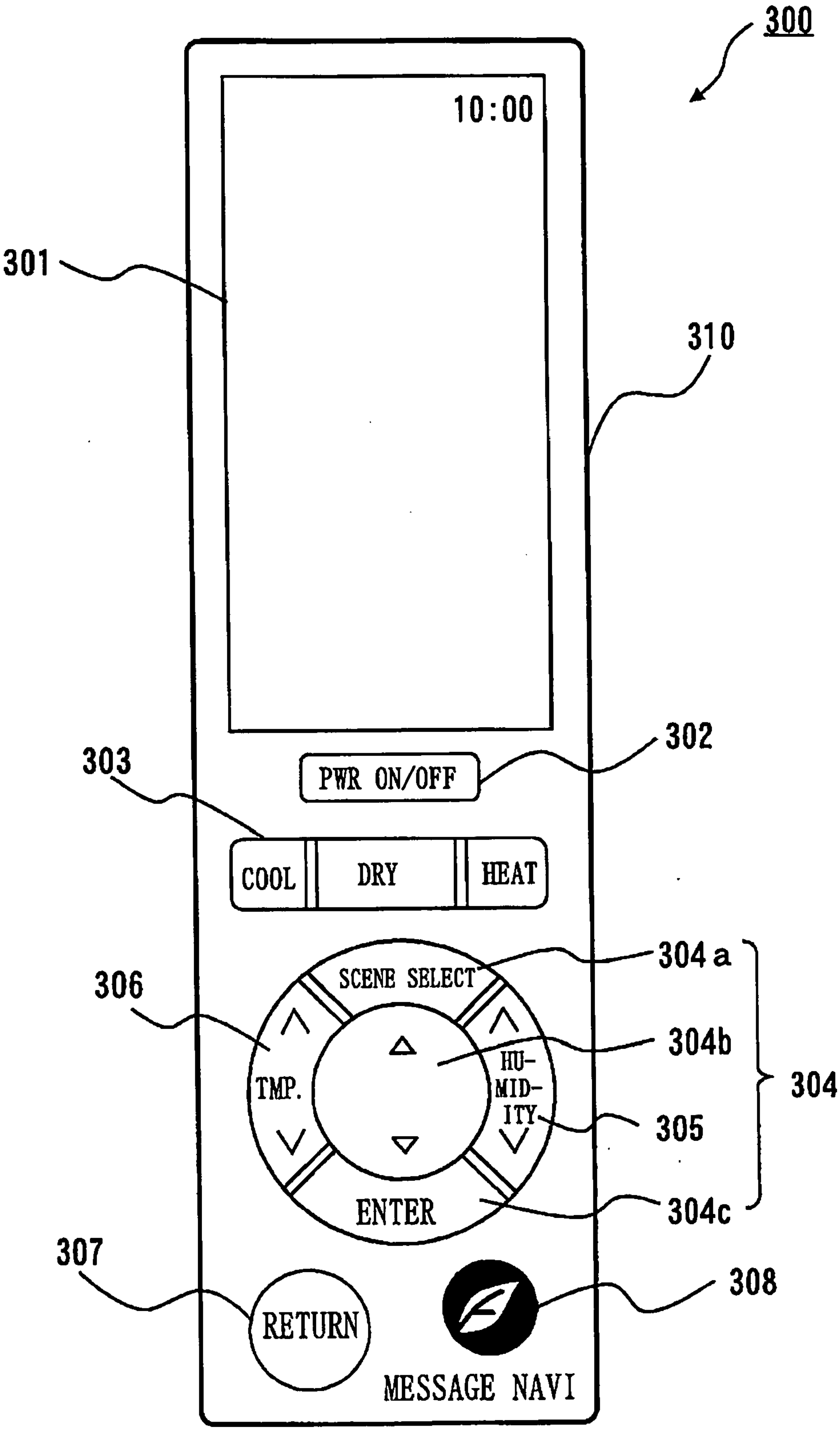

300
10:00
301
310
302
PWR ON/OFF
303
COOL
DRY
HEAT
304 a
SCENE SELECT
306
304b
TMP.
HU-
MID-
ITY
304
305
304c
ENTER
307
RETURN
308
MESSAGE NAVI

Fig.61

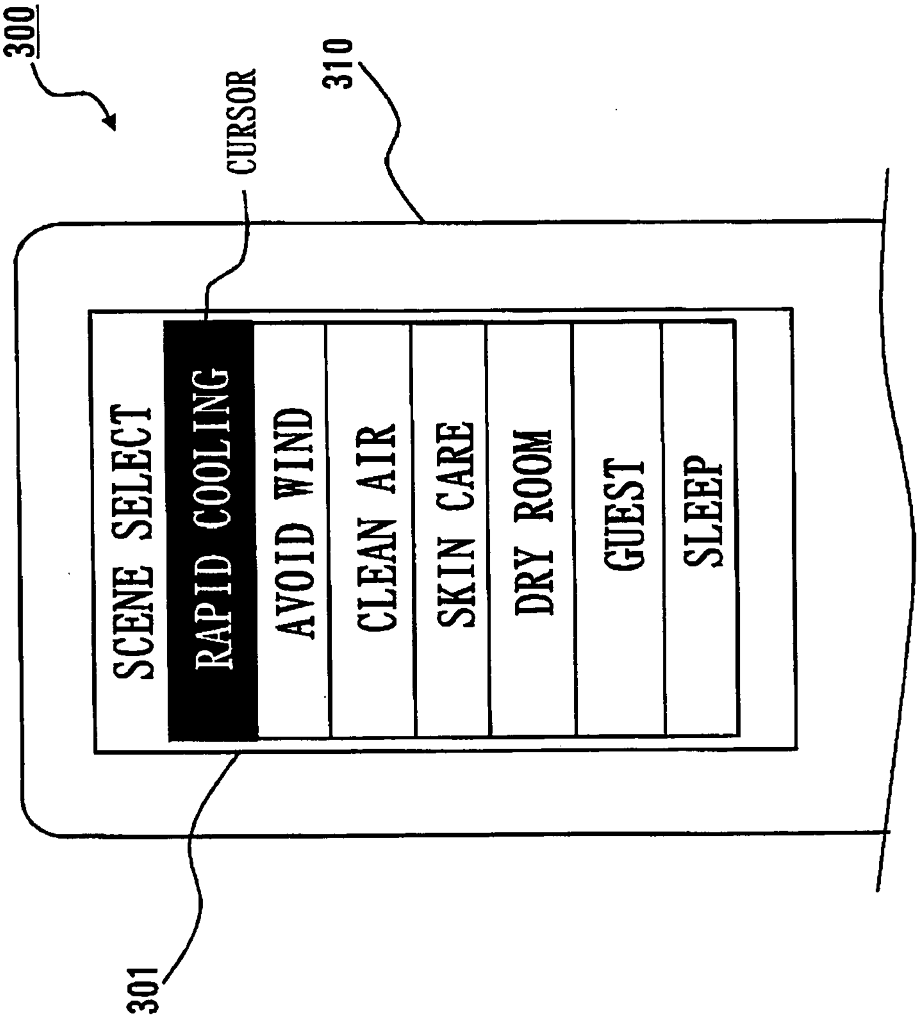

300
310
CURSOR
SCENE SELECT
RAPID COOLING
AVOID WIND
CLEAN AIR
SKIN CARE
DRY ROOM
GUEST
SLEEP
301

Fig.62

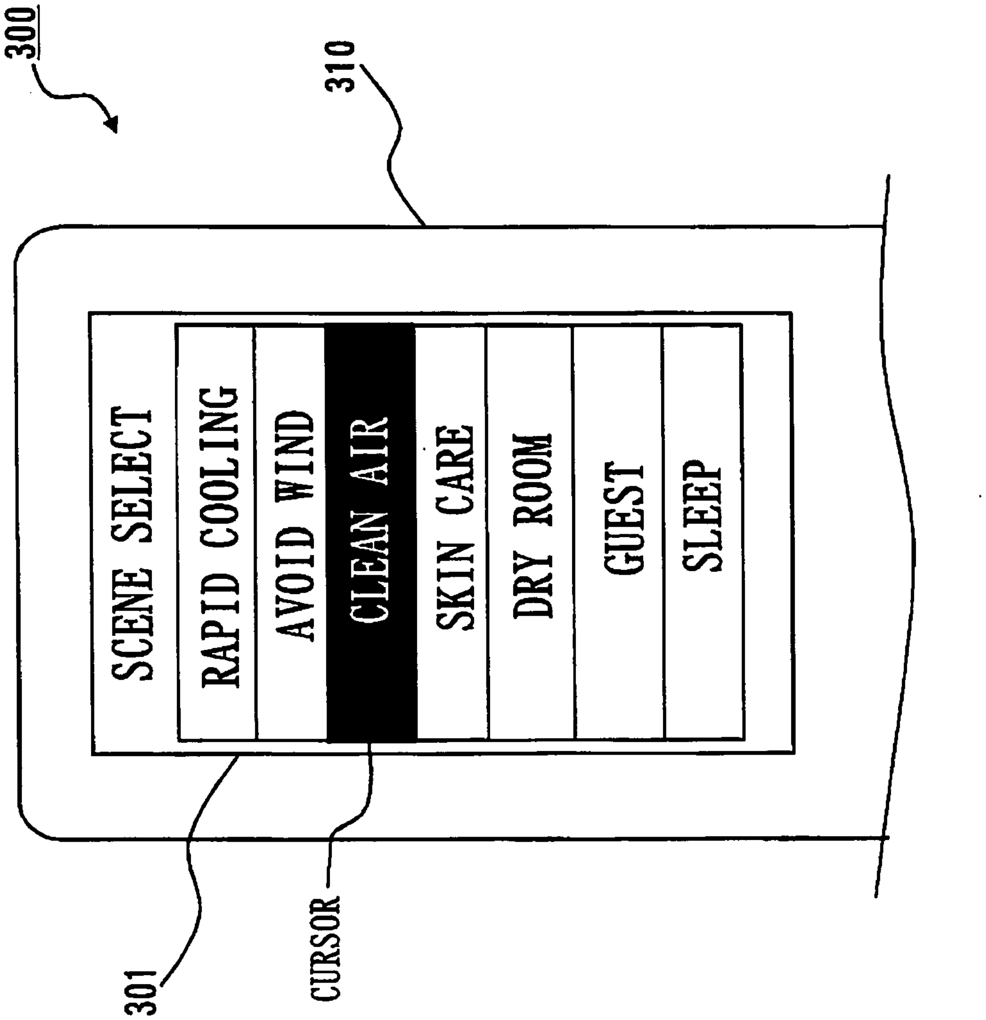

300
310
SCENE SELECT
RAPID COOLING
AVOID WIND
CLEAN AIR
SKIN CARE
DRY ROOM
GUEST
SLEEP
301
CURSOR

Fig.63

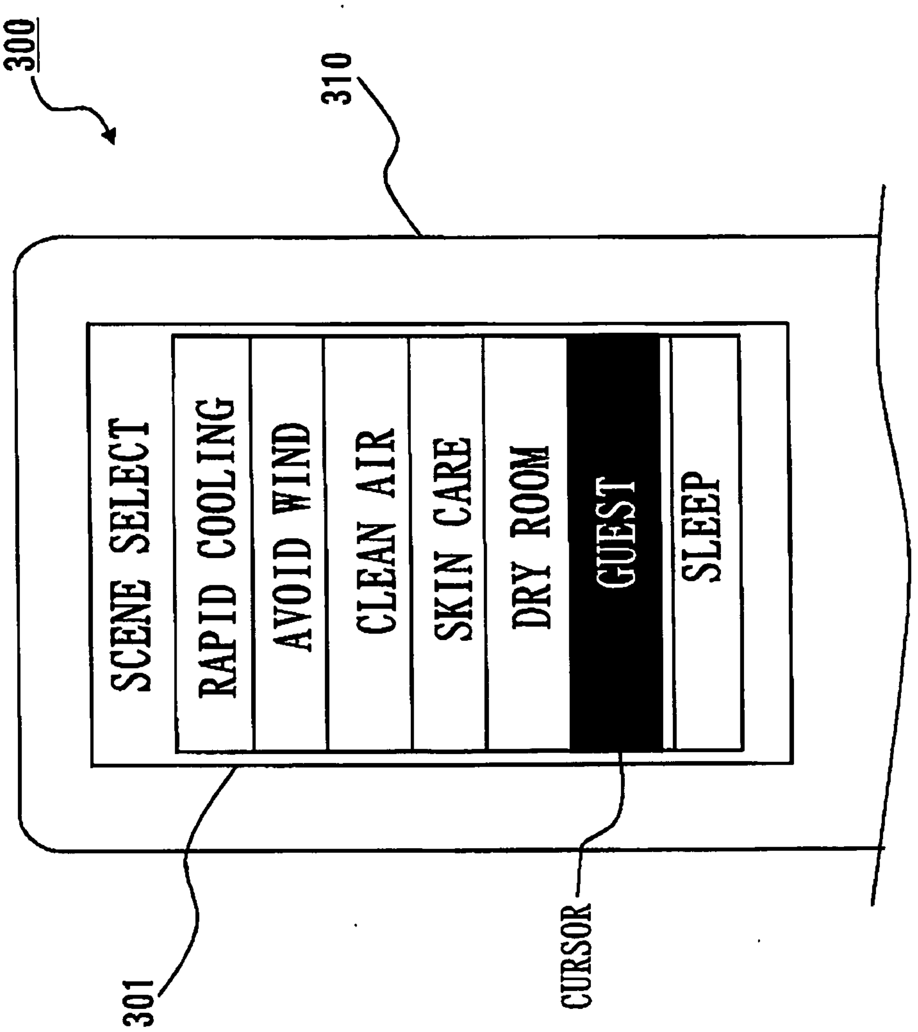

300
310
SCENE SELECT
RAPID COOLING
AVOID WIND
CLEAN AIR
SKIN CARE
DRY ROOM
GUEST
SLEEP
301
CURSOR

Fig. 64

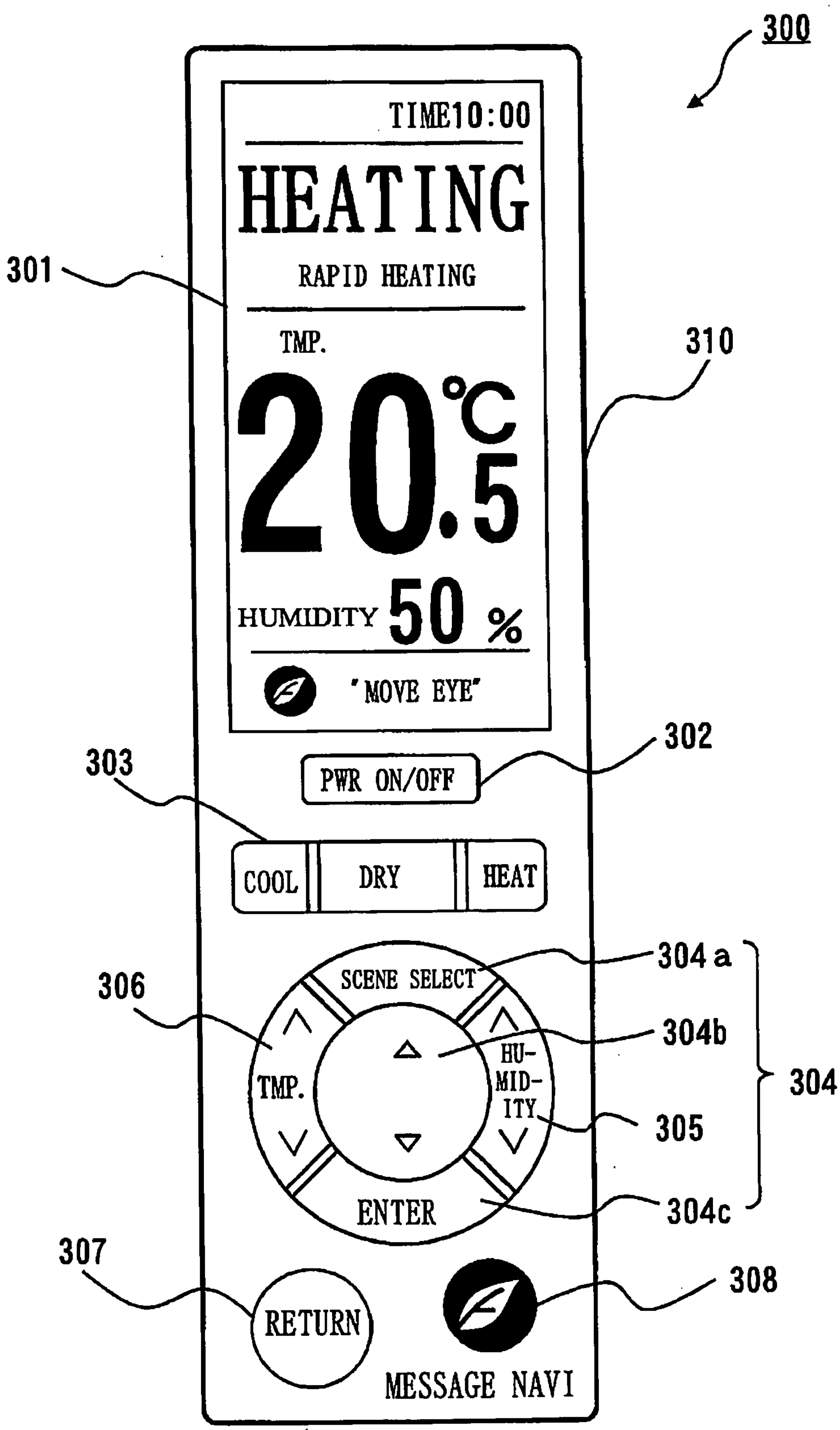

300
TIME10:00
HEATING
RAPID HEATING
301
310
TMP.
20.5℃
HUMIDITY 50 %
'MOVE EYE'
302
303
PWR ON/OFF
COOL
DRY
HEAT
304 a
306
SCENE SELECT
304b
HU-
MID-
ITY
TMP.
304
305
ENTER
304c
307
308
RETURN
MESSAGE NAVI

Fig.65

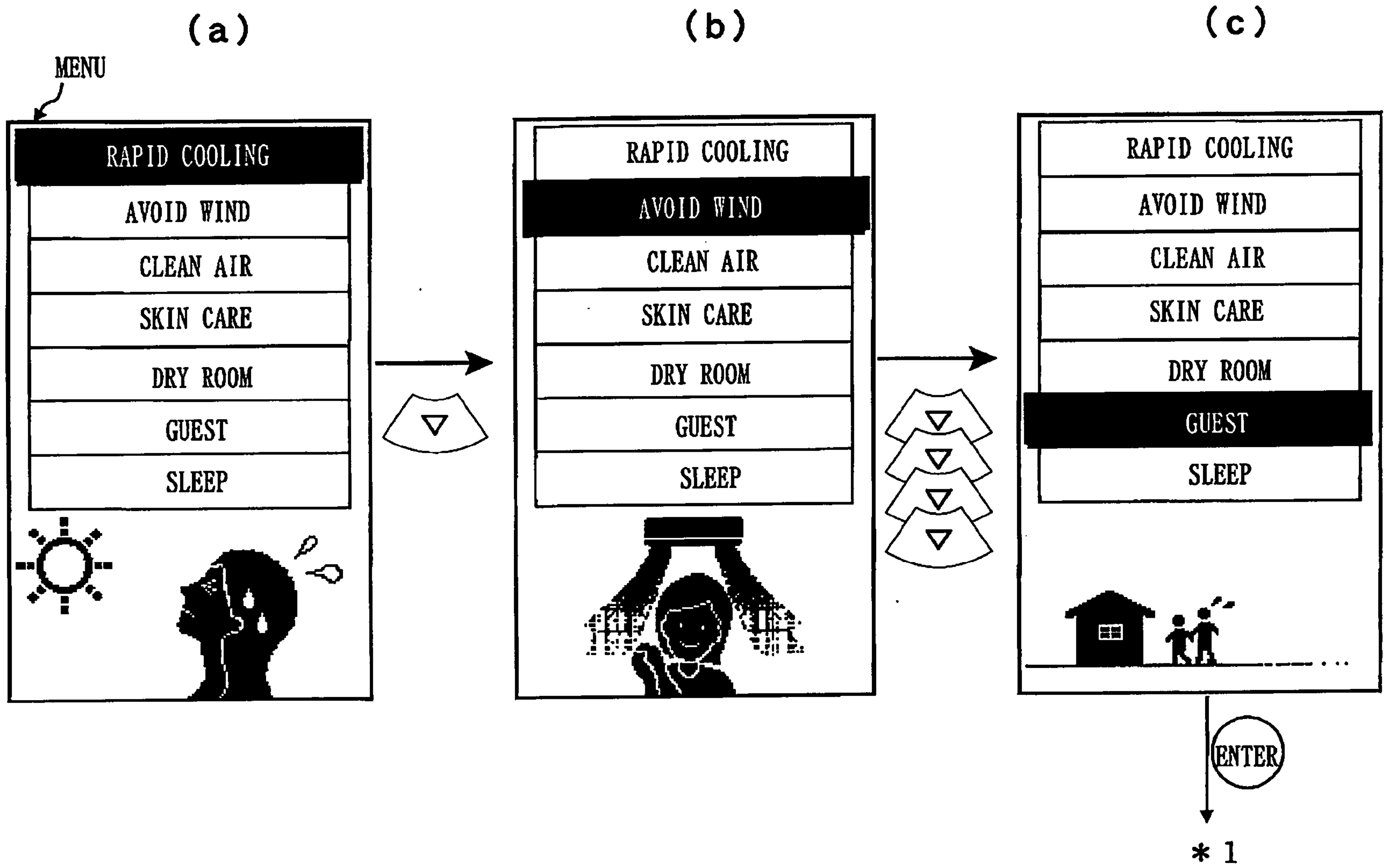

(a)
MENU
RAPID COOLING
AVOID WIND
CLEAN AIR
SKIN CARE
DRY ROOM
GUEST
SLEEP
(b)
RAPID COOLING
AVOID WIND
CLEAN AIR
SKIN CARE
DRY ROOM
GUEST
SLEEP
(c)
RAPID COOLING
AVOID WIND
CLEAN AIR
SKIN CARE
DRY ROOM
GUEST
SLEEP
ENTER
*1

Fig.66

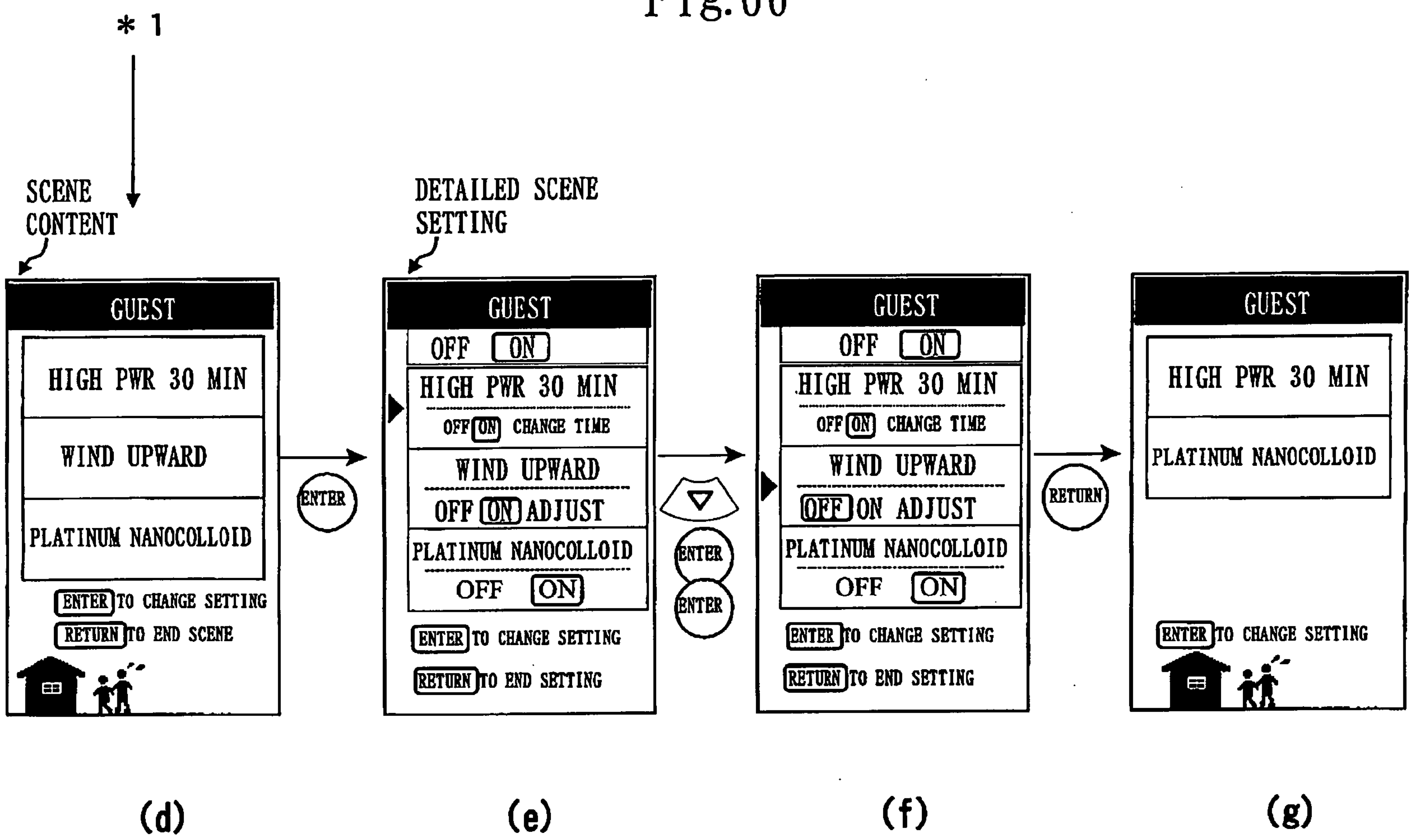

*1
SCENE CONTENT
DETAILED SCENE SETTING
GUEST
HIGH PWR 30 MIN
WIND UPWARD
PLATINUM NANOCOLLOID
ENTER TO CHANGE SETTING
RETURN TO END SCENE
ENTER
GUEST
OFF ON
HIGH PWR 30 MIN
OFF ON CHANGE TIME
WIND UPWARD
OFF ON ADJUST
PLATINUM NANOCOLLOID
OFF ON
ENTER TO CHANGE SETTING
RETURN TO END SETTING
ENTER
ENTER
GUEST
OFF ON
HIGH PWR 30 MIN
OFF ON CHANGE TIME
WIND UPWARD
OFF ON ADJUST
PLATINUM NANOCOLLOID
OFF ON
ENTER TO CHANGE SETTING
RETURN TO END SETTING
RETURN
GUEST
HIGH PWR 30 MIN
PLATINUM NANOCOLLOID
ENTER TO CHANGE SETTING
(d)
(e)
(f)
(g)

Fig.67

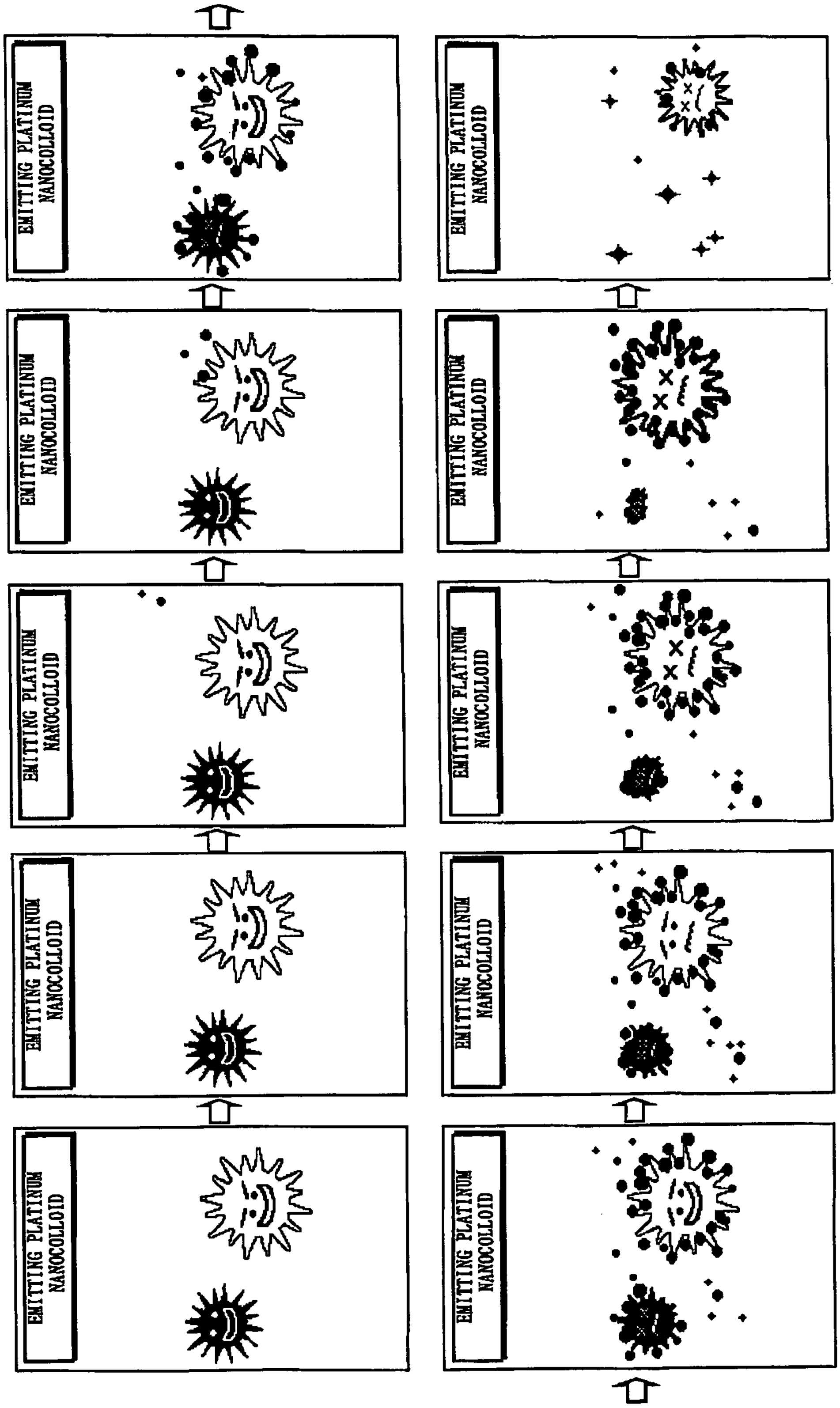

EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID

Fig.68

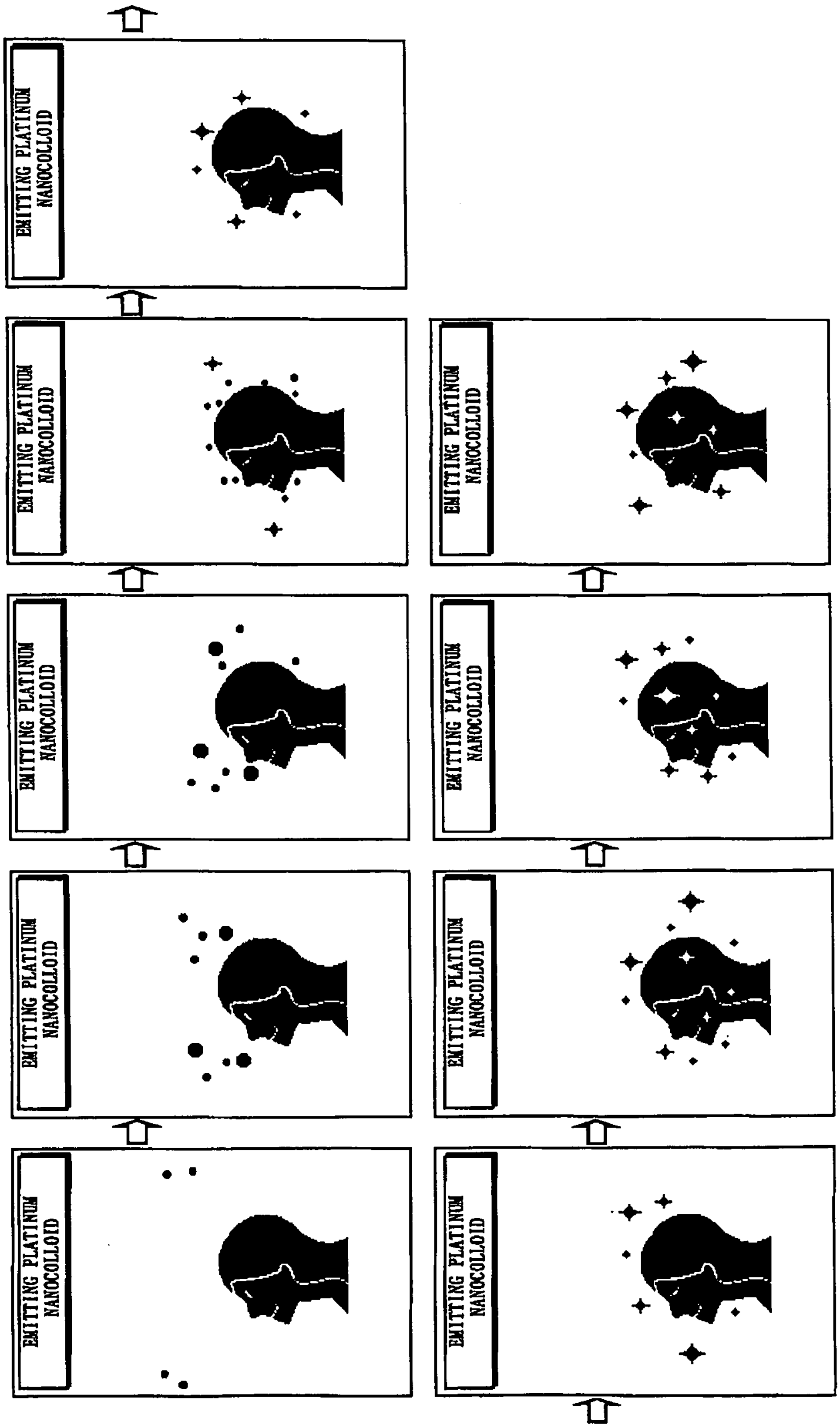

EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID
EMITTING PLATINUM NANOCOLLOID

Fig.69

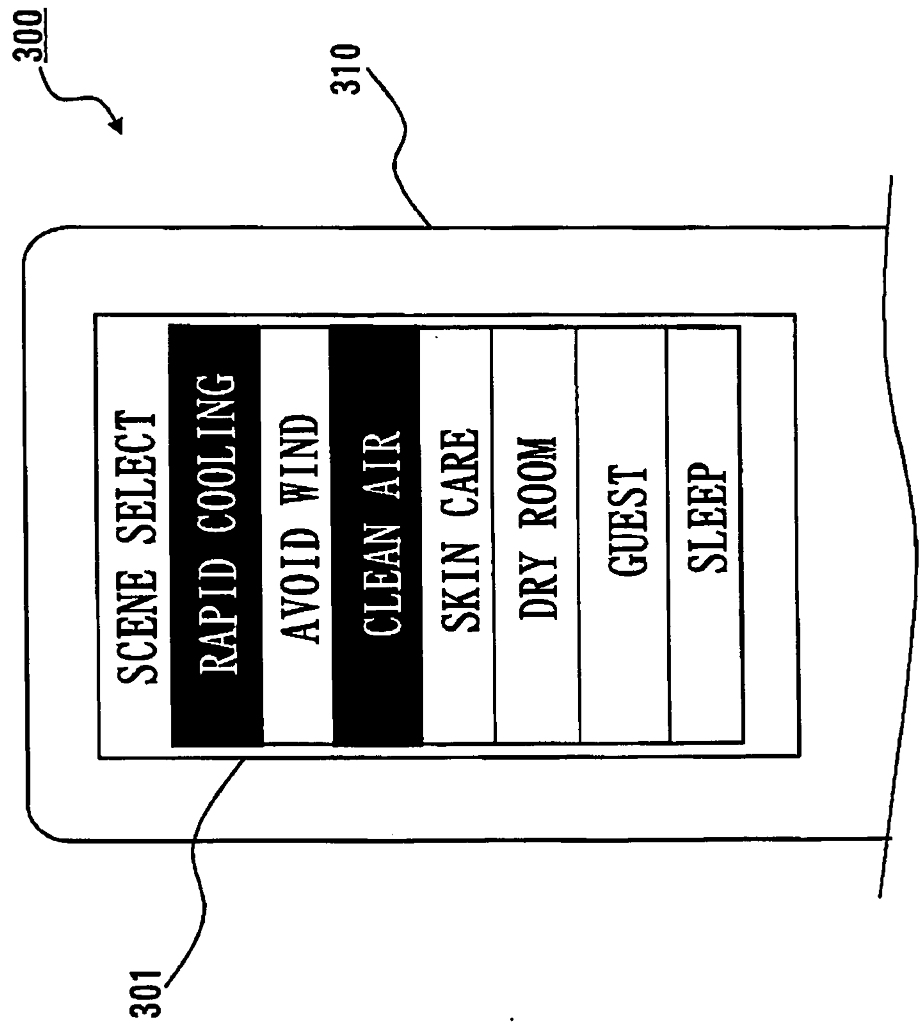

300
310
SCENE SELECT
RAPID COOLING
AVOID WIND
CLEAN AIR
SKIN CARE
DRY ROOM
GUEST
SLEEP
301

Fig.70

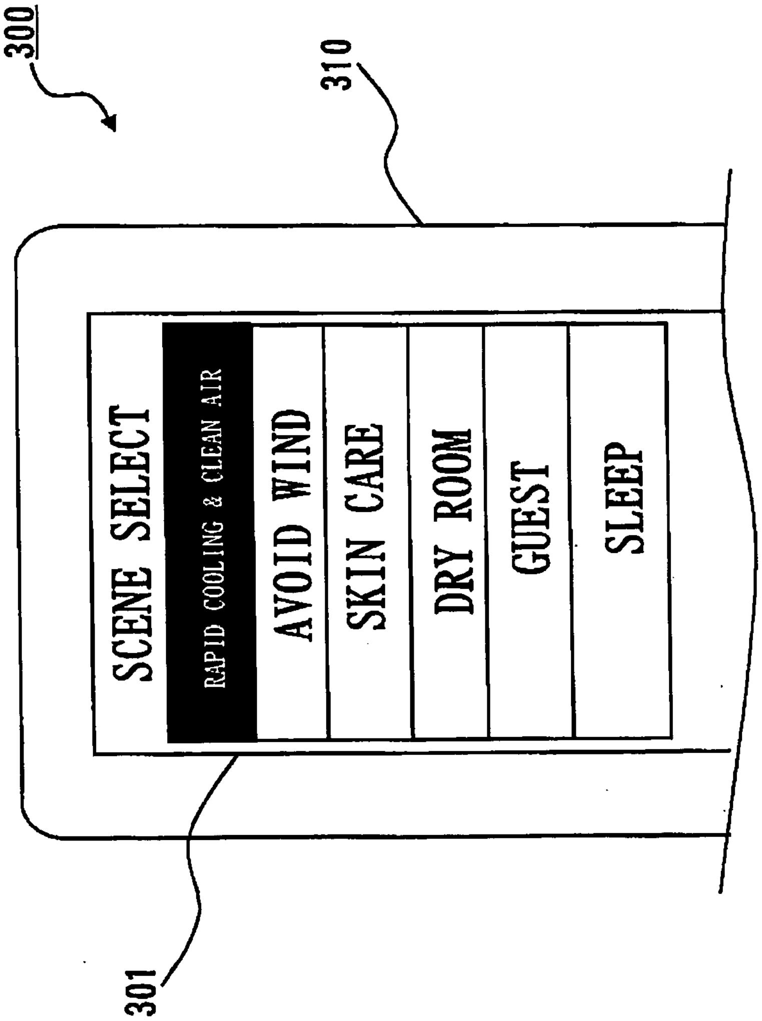

300
310
SCENE SELECT
RAPID COOLING & CLEAN AIR
AVOID WIND
SKIN CARE
DRY ROOM
GUEST
SLEEP
301

Fig. 71

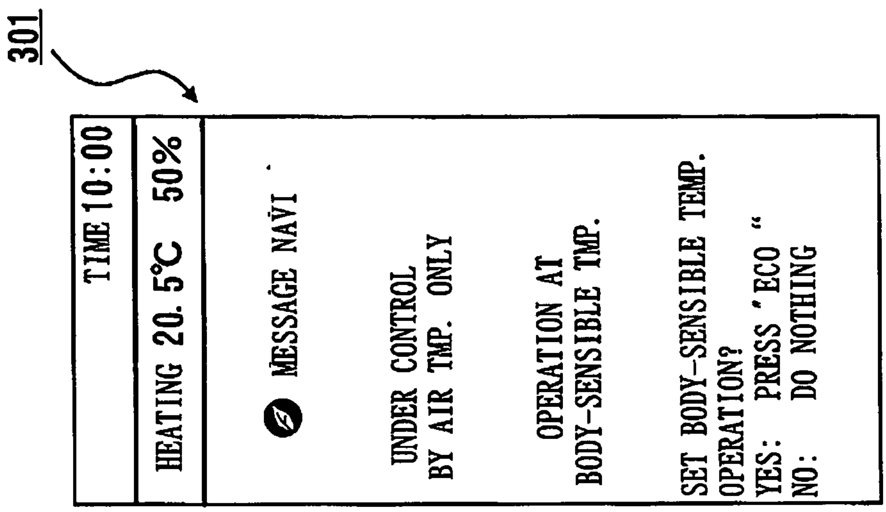

301
TIME 10:00
HEATING 20. 5°C 50%
MESSAGE NAVI
UNDER CONTROL
BY AIR TMP. ONLY
OPERATION AT
BODY-SENSIBLE TMP.
SET BODY-SENSIBLE TEMP.
OPERATION?
YES: PRESS "ECO"
NO: DO NOTHING

Fig.72

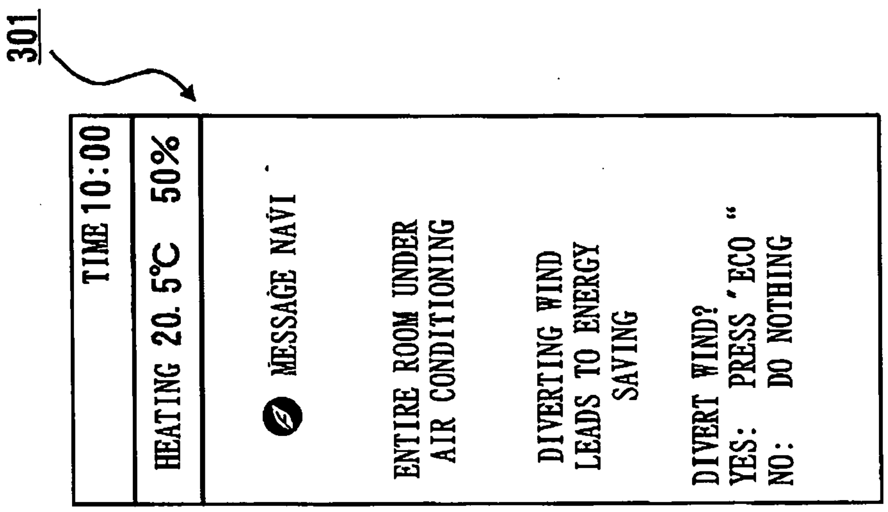

301
TIME 10:00
HEATING 20.5°C 50%
MESSAGE NAVI
ENTIRE ROOM UNDER AIR CONDITIONING
DIVERTING WIND LEADS TO ENERGY SAVING
DIVERT WIND?
YES: PRESS "ECO"
NO: DO NOTHING

Fig. 73

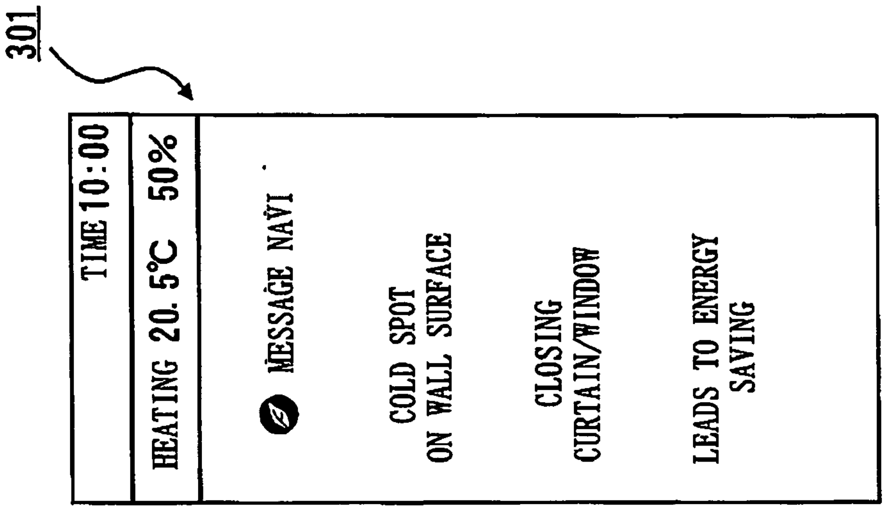

301
TIME 10:00
HEATING 20. 5°C 50%
MESSAGE NAVI
COLD SPOT
ON WALL SURFACE
CLOSING
CURTAIN/WINDOW
LEADS TO ENERGY
SAVING

Fig.74

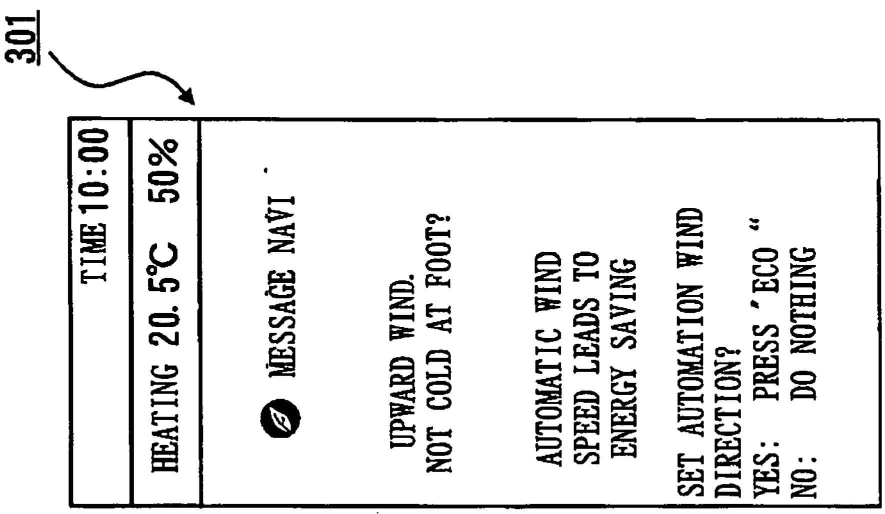

301
TIME 10:00
HEATING 20.5°C 50%
MESSAGE NAVI
UPWARD WIND.
NOT COLD AT FOOT?
AUTOMATIC WIND
SPEED LEADS TO
ENERGY SAVING
SET AUTOMATION WIND
DIRECTION?
YES: PRESS 'ECO"
NO: DO NOTHING

Fig.75

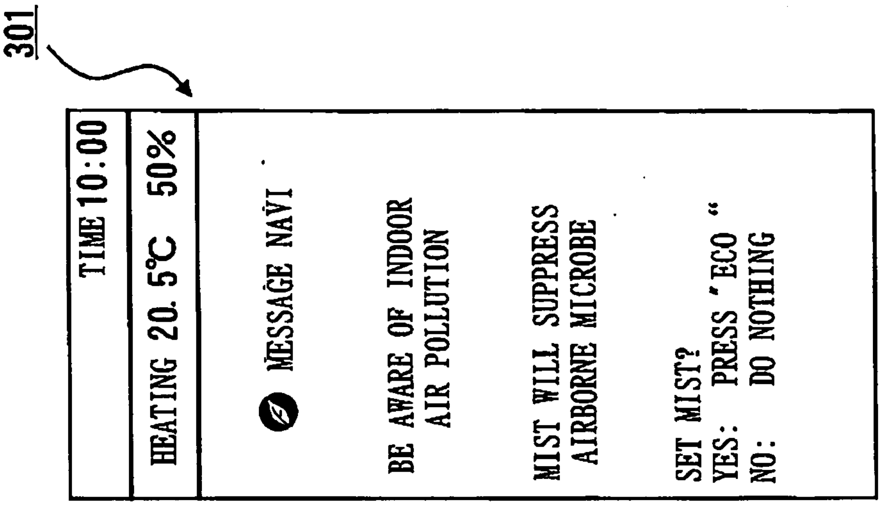
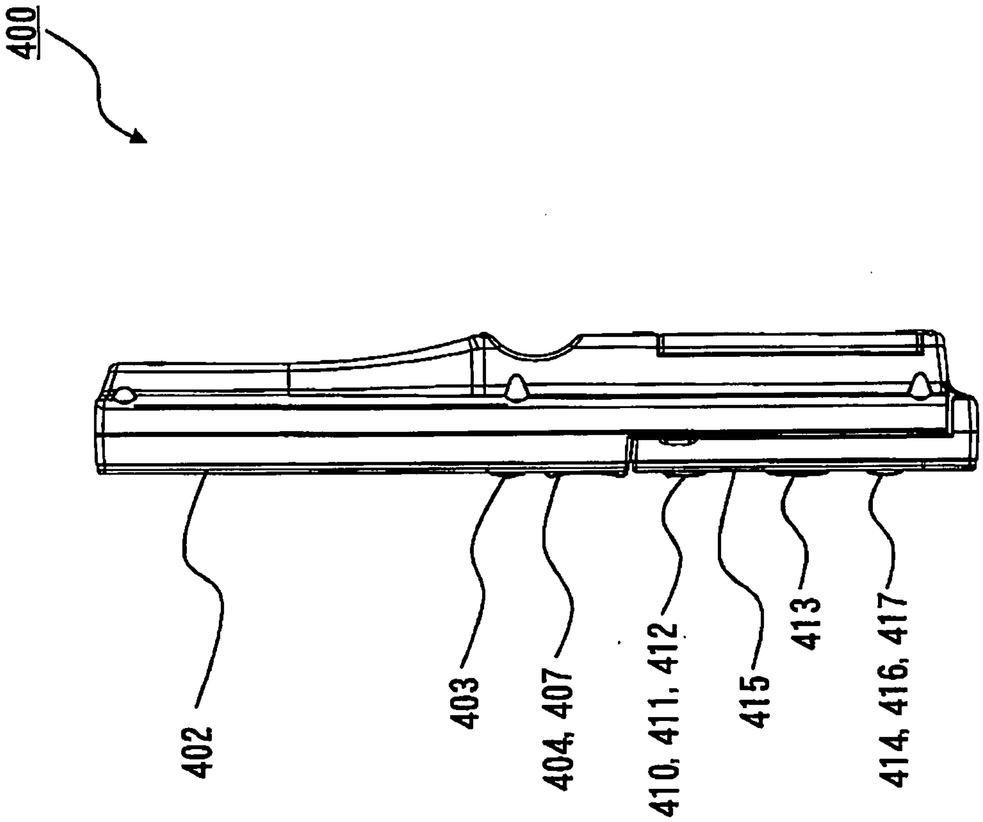

301
TIME 10:00
HEATING 20.5°C 50%
MESSAGE NAVI
BE AWARE OF INDOOR
AIR POLLUTION
MIST WILL SUPPRESS
AIRBORNE MICROBE
SET MIST?
YES: PRESS "ECO"
NO: DO NOTHING

Fig. 76



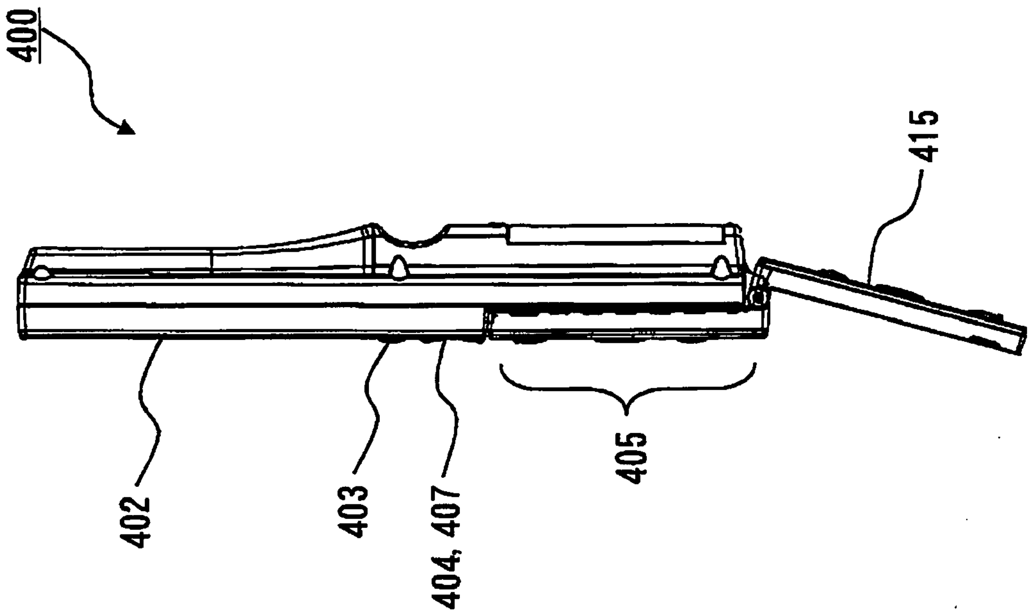


Fig. 77

Fig.78

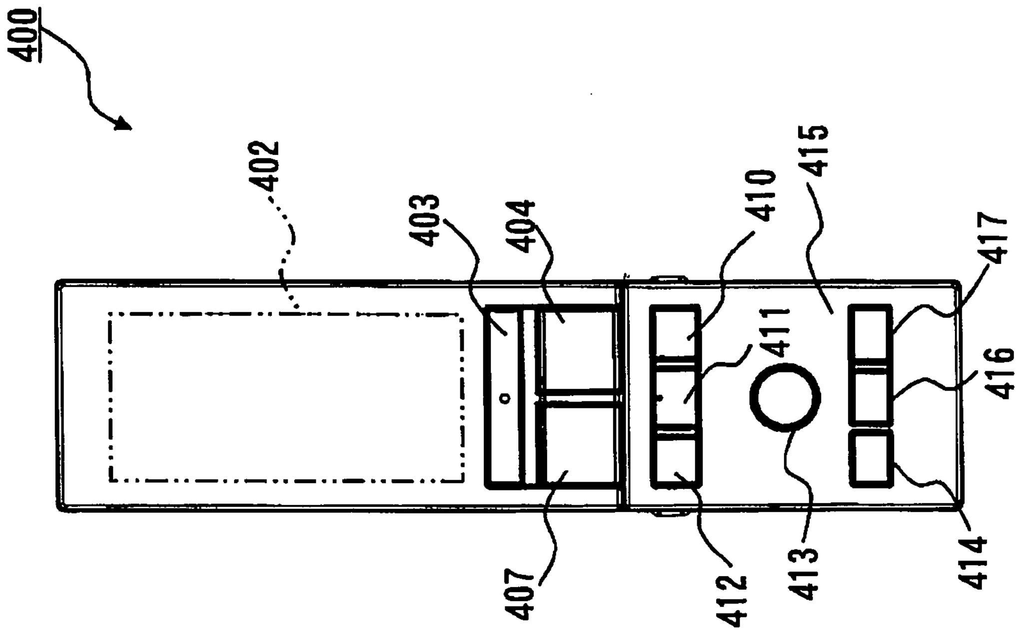


Fig.79

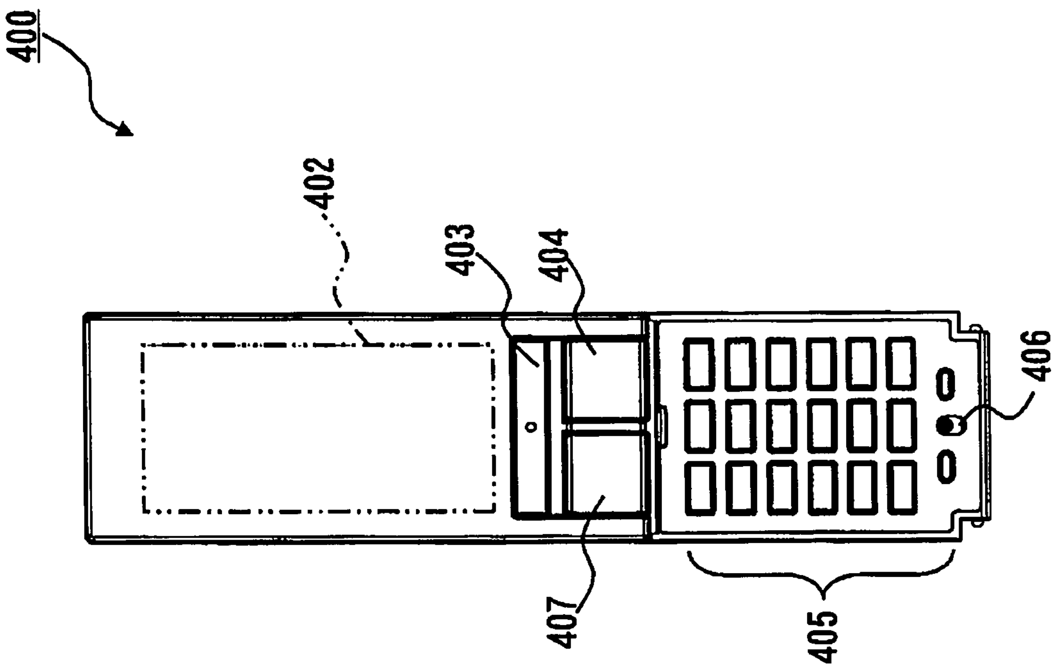
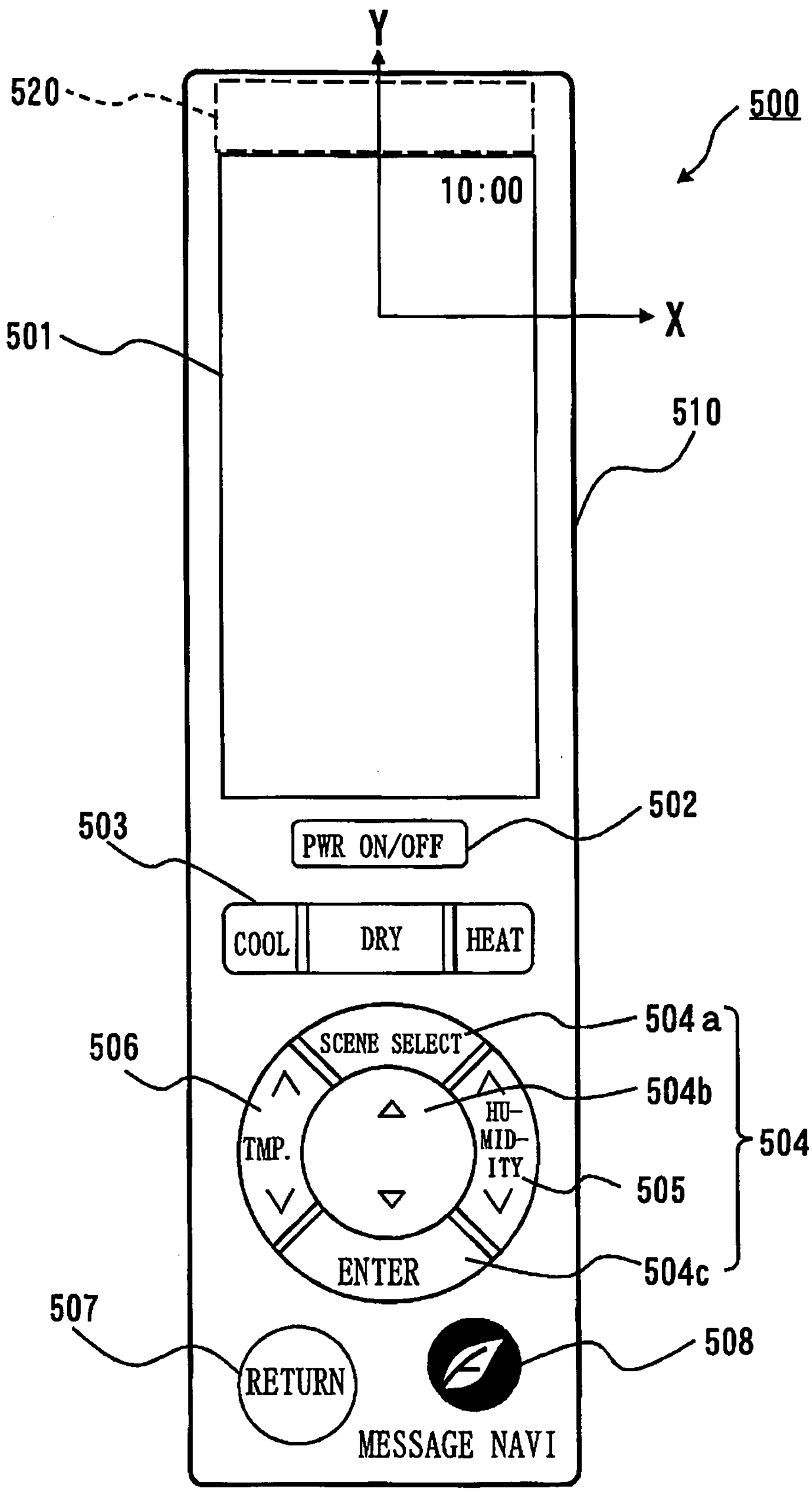


Fig.80



Y
X
520
500
10:00
501
510
502
PWR ON/OFF
503
COOL
DRY
HEAT
504 a
SCENE SELECT
506
504b
HU-
MID-
ITY
TMP.
504
505
ENTER
504c
507
RETURN
508
MESSAGE NAVI

Fig.81

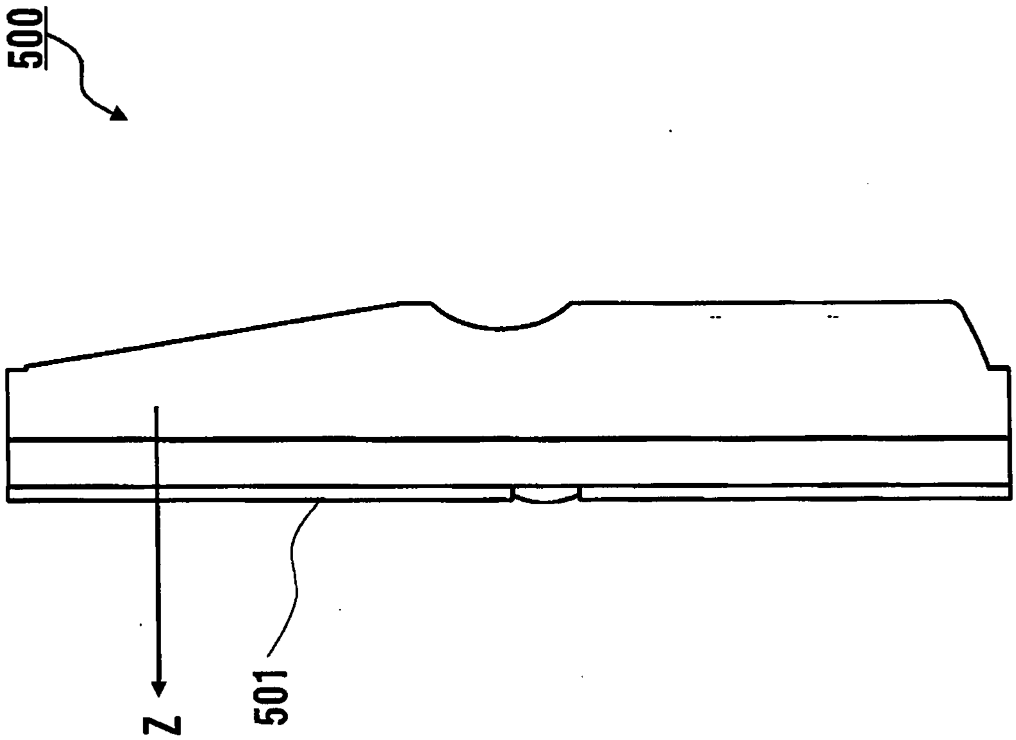


Fig.82

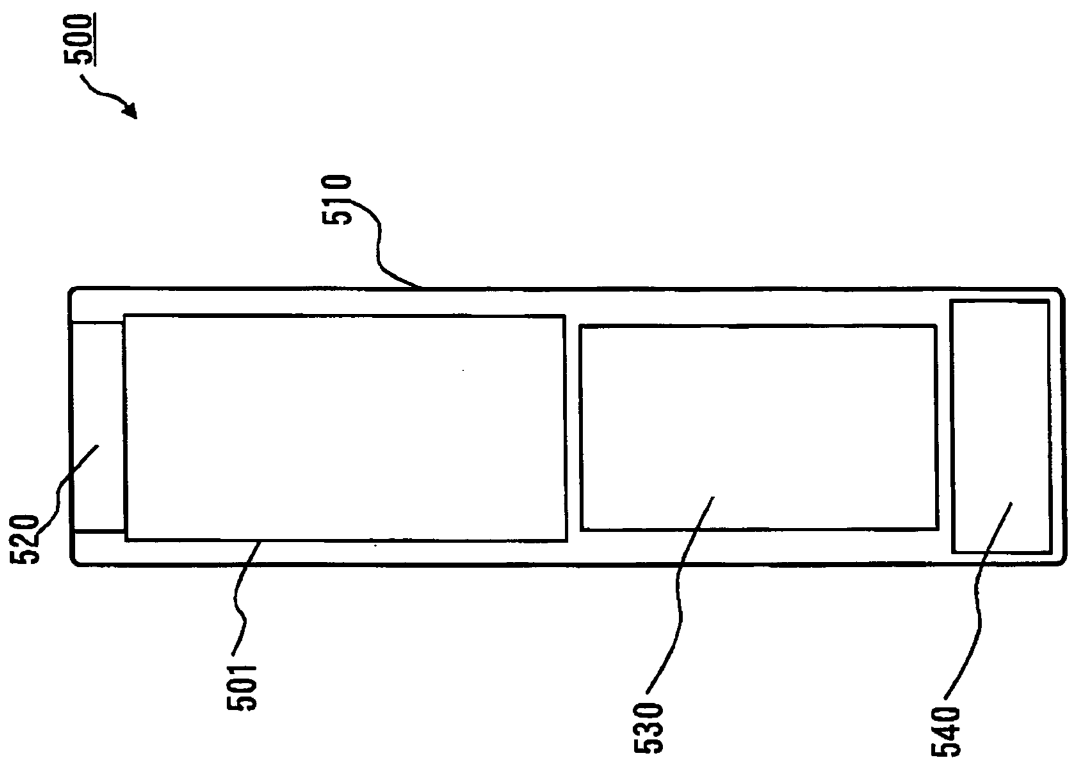
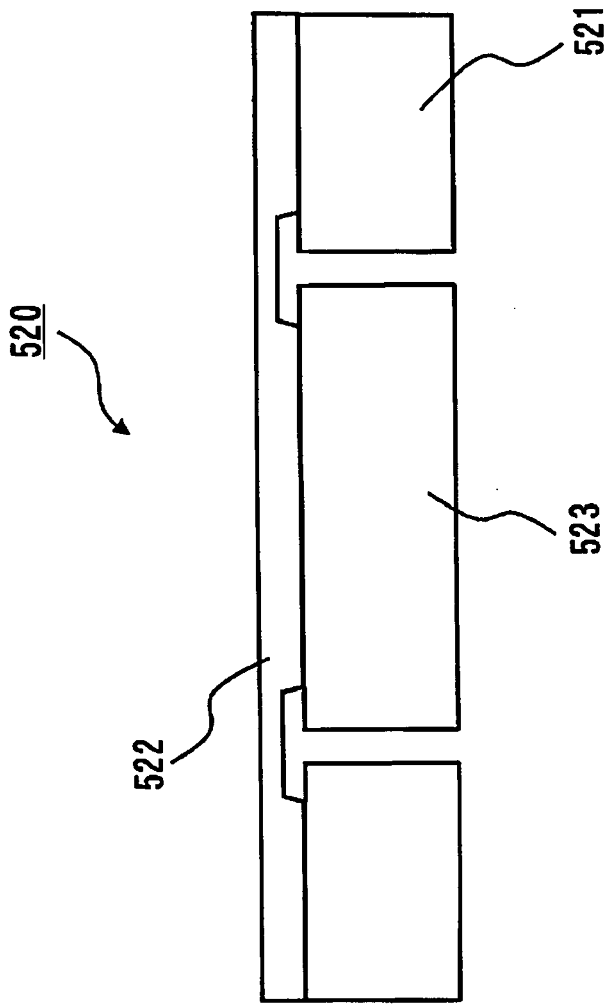


Fig.83



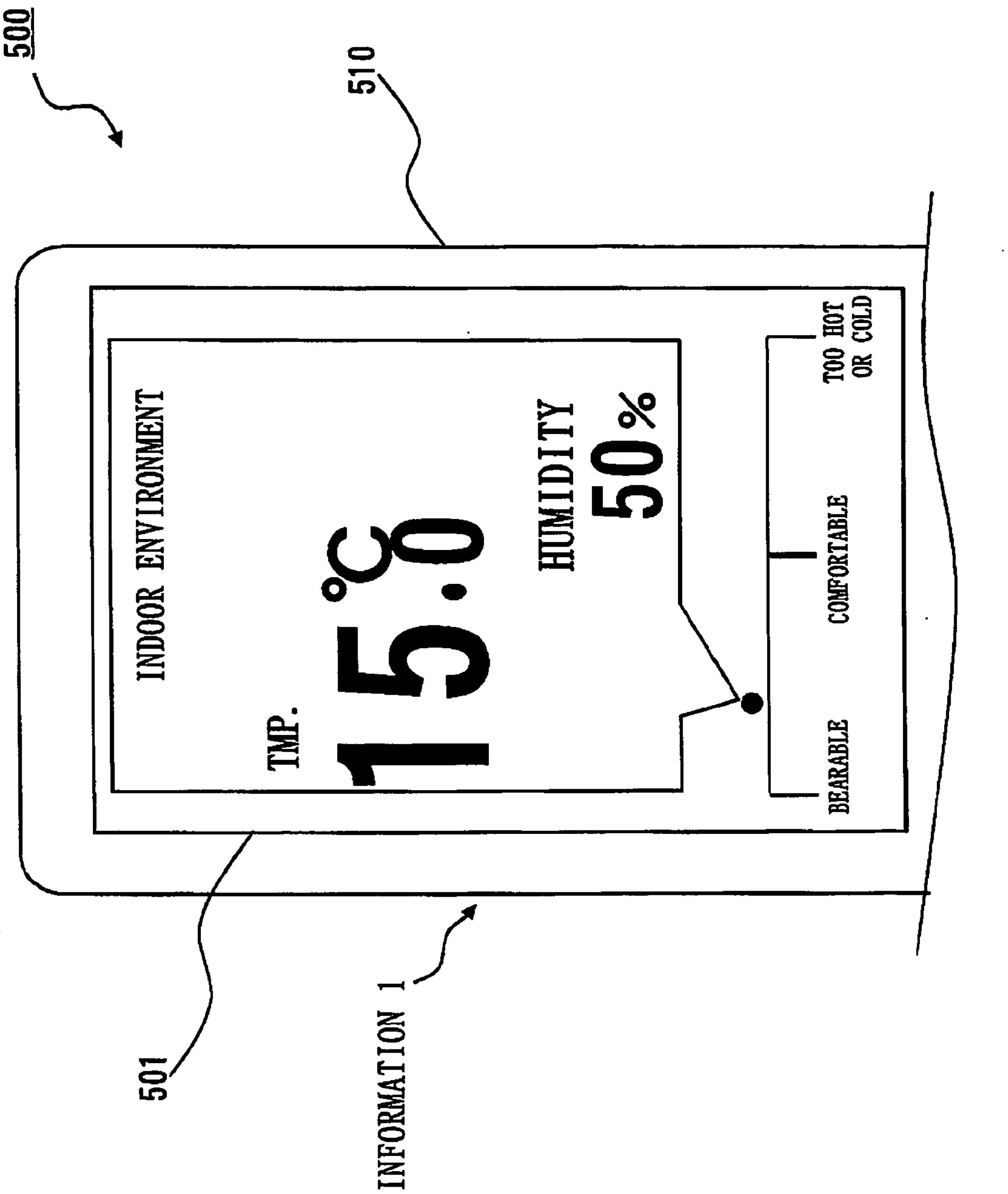

500
510
INDOOR ENVIRONMENT
TMP.
15.0℃
HUMIDITY
50%
BEARABLE
COMFORTABLE
TOO HOT OR COLD
501
INFORMATION 1

Fig.84

Fig.85

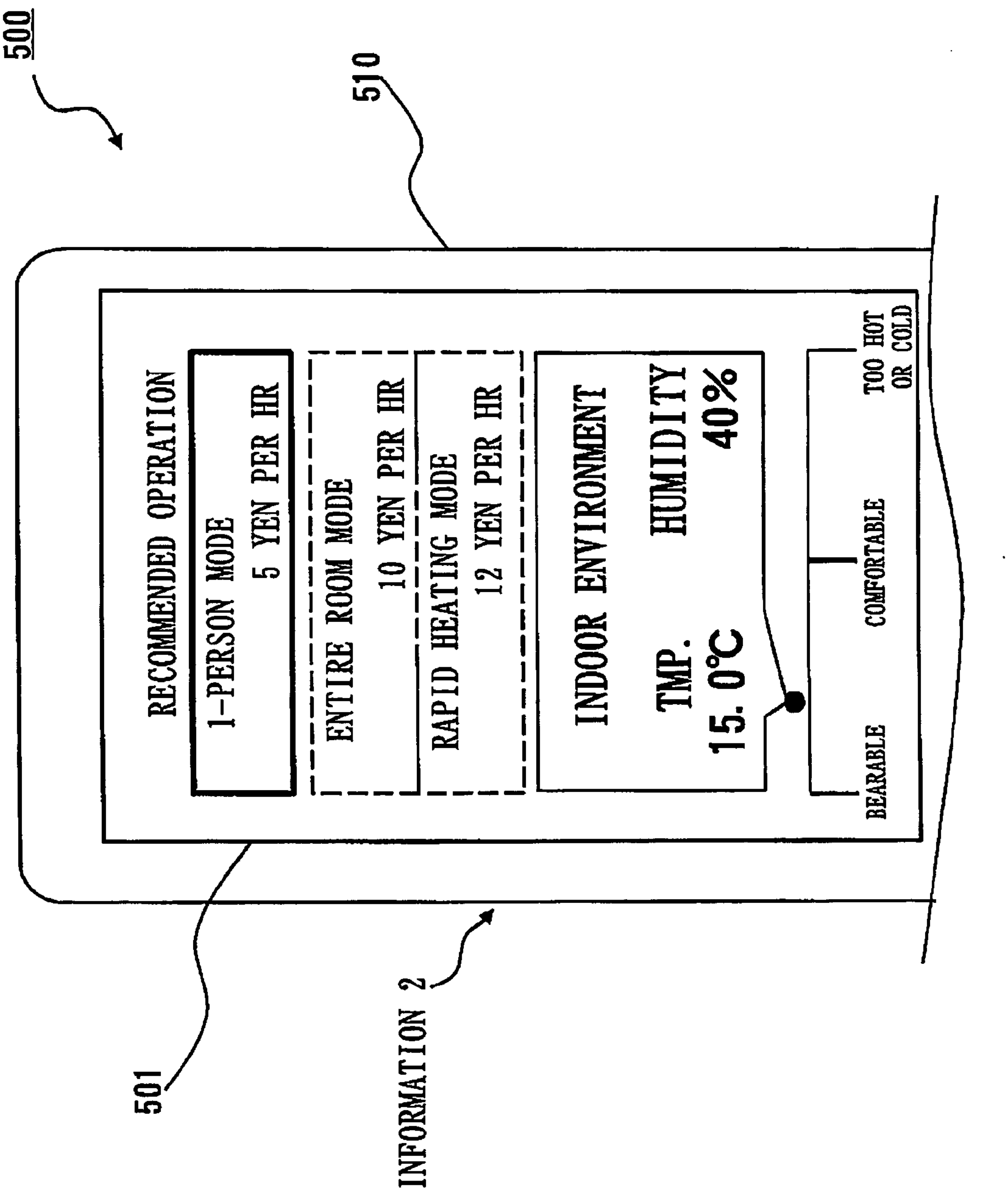

500
510
RECOMMENDED OPERATION
1-PERSON MODE
5 YEN PER HR
ENTIRE ROOM MODE
10 YEN PER HR
RAPID HEATING MODE
12 YEN PER HR
INDOOR ENVIRONMENT
TMP.
15.0°C
HUMIDITY
40%
BEARABLE
COMFORTABLE
TOO HOT OR COLD
501
INFORMATION 2

Fig.86

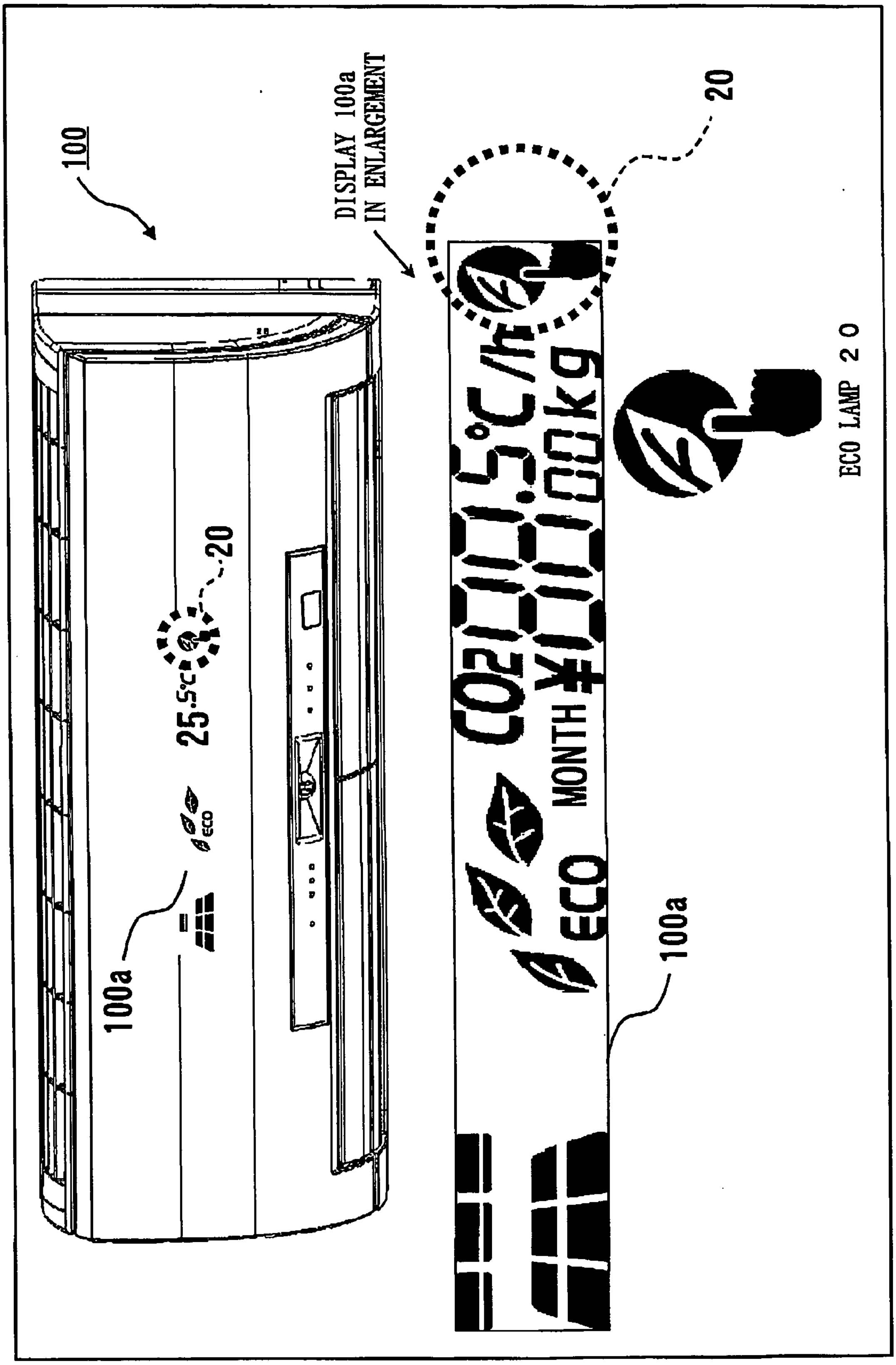

100
DISPLAY 100a
IN ENLARGEMENT
20
100a
25.5°C
ECO
MONTH
ECO LAMP 20

Fig.87

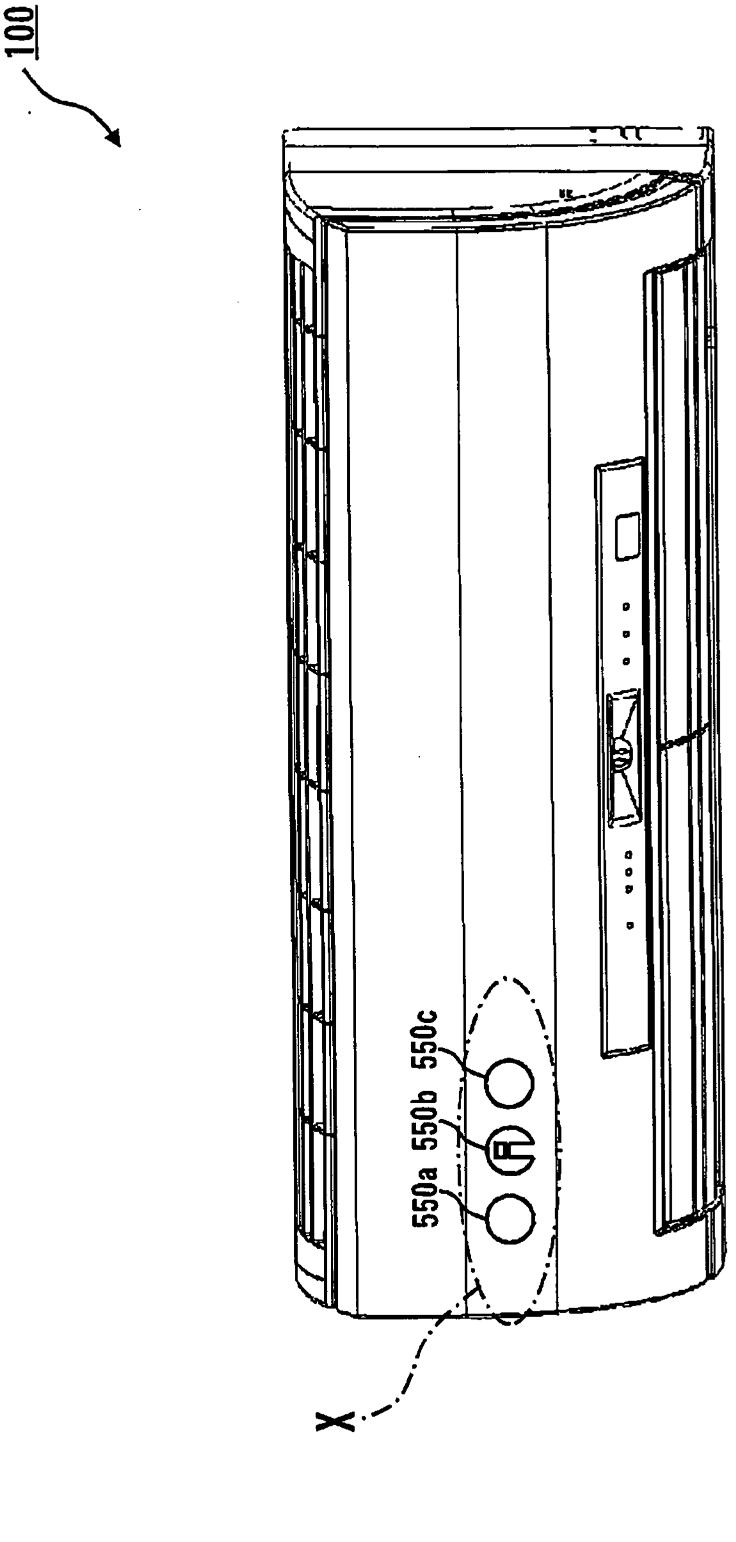


Fig.88

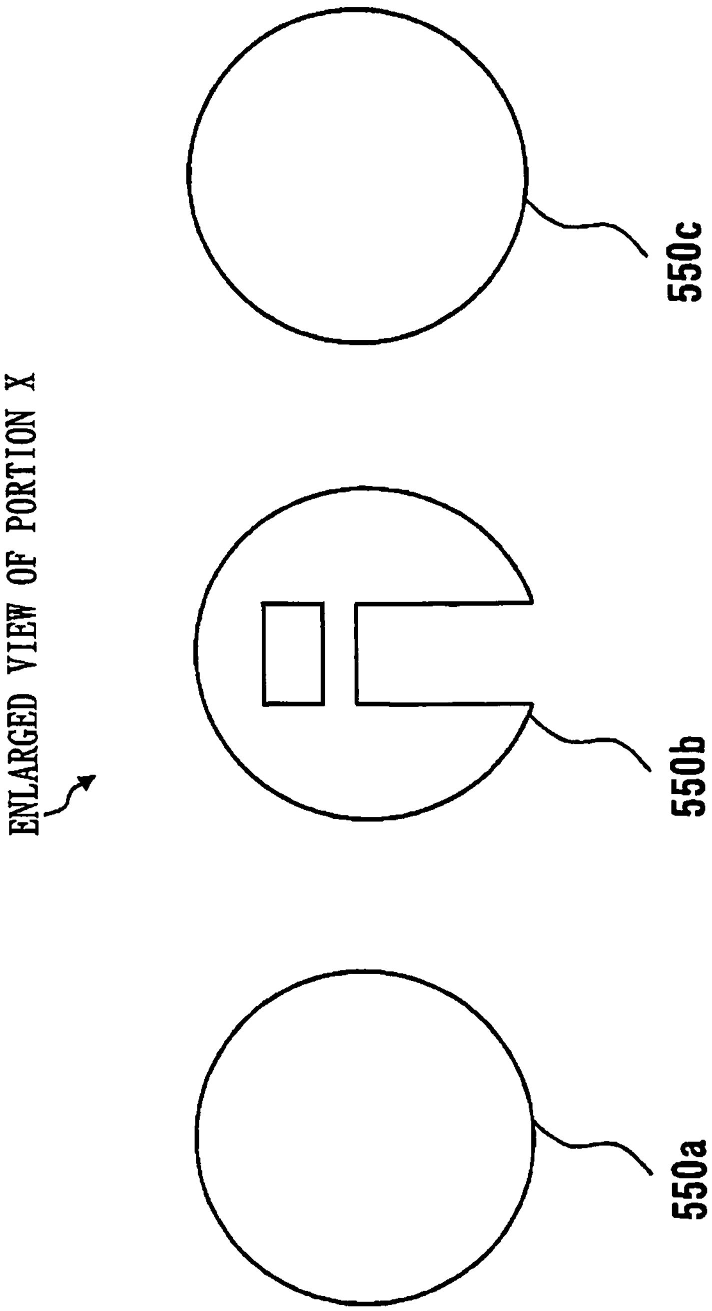


Fig.89

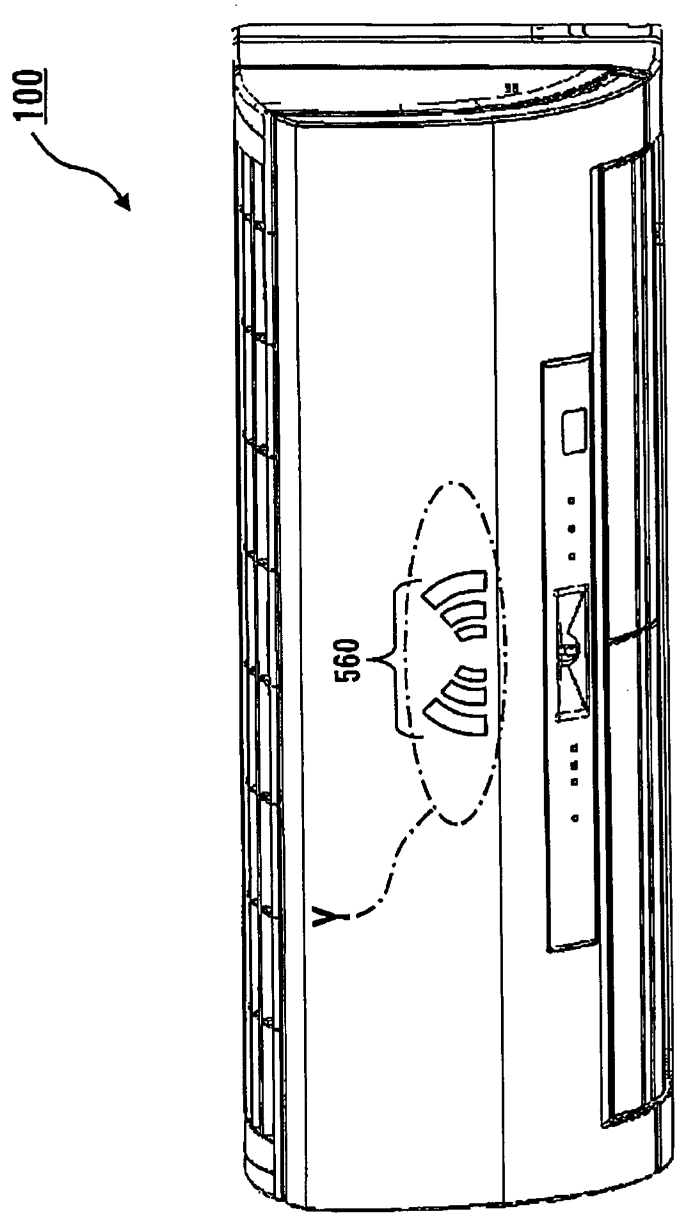


Fig.90

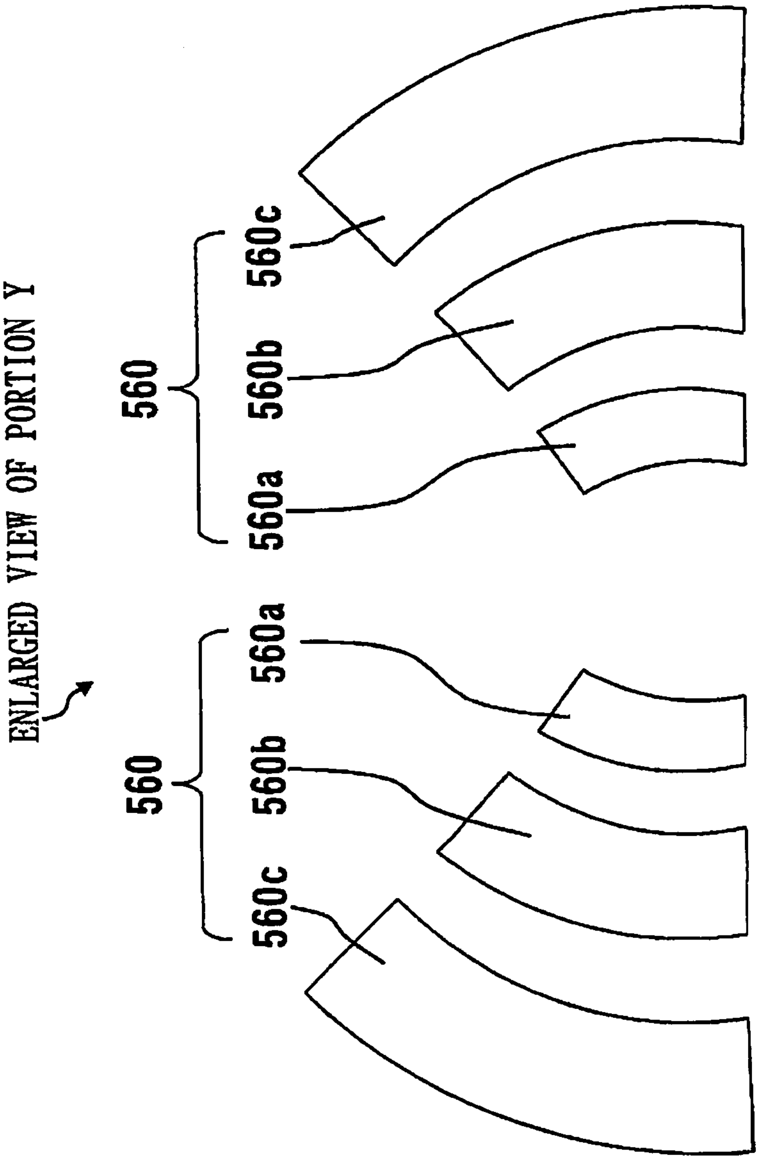

ENLARGED VIEW OF PORTION Y
560
560a
560b
560c
560
560a
560b
560c

Fig.91

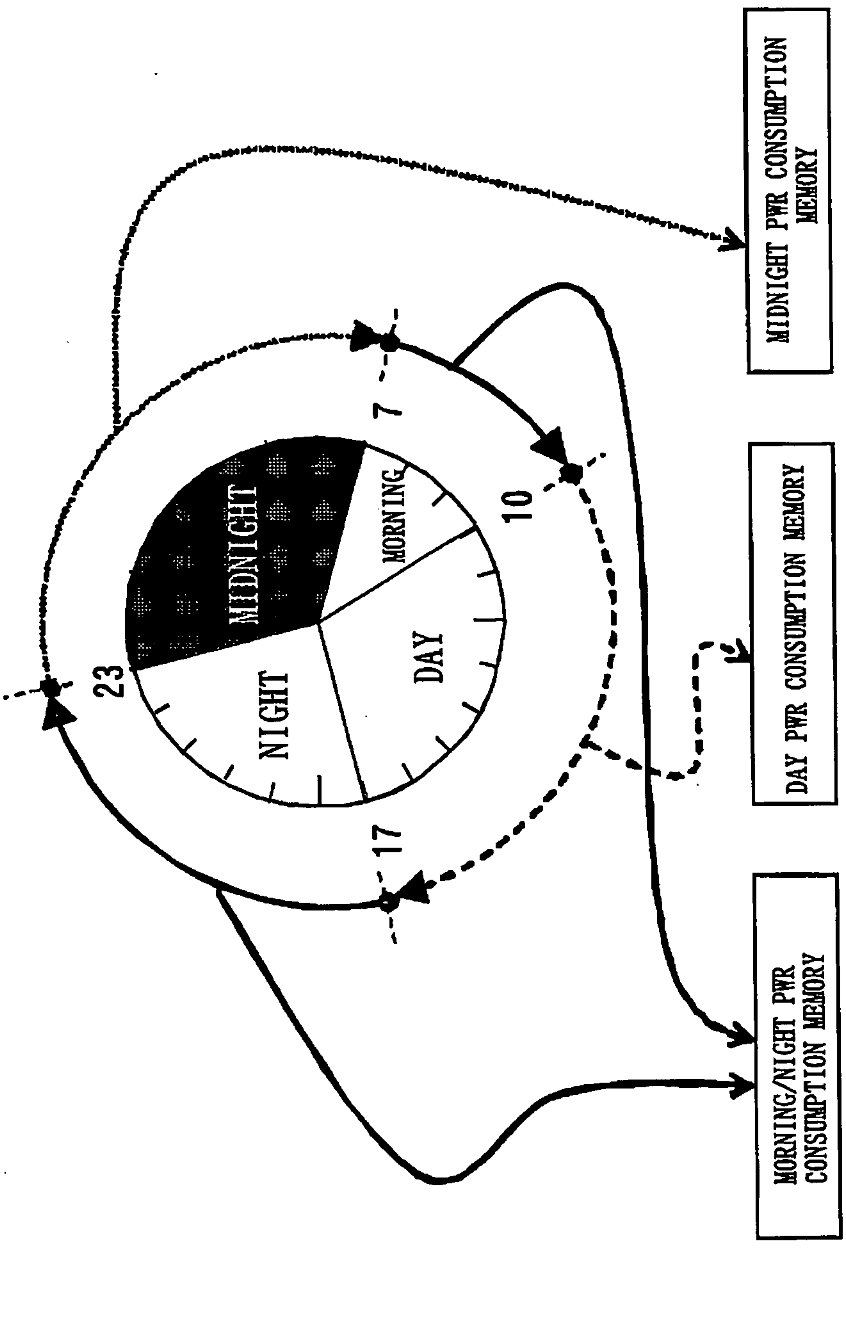

MIDNIGHT
MORNING
DAY
NIGHT
7
10
17
23
MIDNIGHT PWR CONSUMPTION MEMORY
DAY PWR CONSUMPTION MEMORY
MORNING/NIGHT PWR CONSUMPTION MEMORY

Fig.92

TMP. DIFFERENCE [℃]	RATE OF CHANGE [%]
0	0
1	10
2	20
3	30
4	35
5	40
6	42
7	44
8	46
9	48
10	50
11	52
12	54
13	56
14	58
15	60

Fig.93

HUMIDITY DIFFERENCE [%]	RATE OF CHANGE [%]
0	0
10	10
20	20
30	30

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 2009127960 A **[0006]**
- WO 9302342 A **[0324]**