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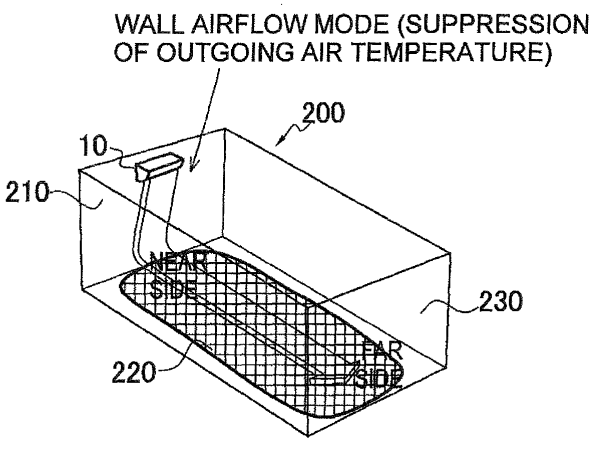
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(54) **AIR CONDITIONER**

(57) It is a problem of this invention to provide an air conditioning indoor unit with which an airflow that flows along a floor surface is suppressed from rising even in a case where by some chance the floor surface is not sufficiently warmed. In an air conditioning indoor unit (10), by lowering the temperature of outgoing air, the temperature of an airflow that flows along a floor surface from a wall surface in a wall airflow mode also becomes lower, so even in a case where by some chance the floor surface is not sufficiently warmed, rising of the airflow that flows along the floor surface can be suppressed more than has conventionally been the case. The wall airflow is an airflow that crawls along the floor surface from the side wall, and it does not strike occupants, so even when the temperature becomes lower, it is less likely to impart a feeling of discomfort to the occupants.

FIG. 12D



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Description

TECHNICAL FIELD

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

BACKGROUND ART

[0002] In recent years, efforts to improve, through various types of air direction control of outgoing air, the comfort of air conditioning target spaces have been undertaken in the field of air conditioning. For example, the air conditioner disclosed in patent document 1 (JP-A No. H6-109312) is configured in such a way that, when the temperature of a floor surface is low, it directs warm air toward the center of the floor surface to quickly and efficiently warm a living space, and in a steady state in which the temperature of the floor surface is saturated, it blows out warm air that flows downward along the wall surface to ensure that, without lowering the temperature of the living space, it does not apply the warm air to occupants.

SUMMARY OF INVENTION

<Technical Problem>

[0003] However, in the above air conditioner, in a case where the warming of the floor surface is insufficient, it is also conceivable for the warm air that has flowed from the wall surface to the floor surface to rise and strike the occupants.

[0004] It is a problem of the present invention to provide an air conditioning indoor unit in which an airflow that flows along a floor surface is suppressed from rising even in a case where by some chance the floor surface is not sufficiently warmed.

<Solution to Problem>

[0005] An air conditioning indoor unit pertaining to a first aspect of the invention is a wall-mounted air conditioning indoor unit that is installed on a side wall of an air conditioning target space and has the function of changing the air direction of outgoing air blown out from an air outlet, the air conditioning indoor unit comprising air direction switching means and a control component. The air direction switching means changes the air direction of the outgoing air. The control component executes, via the air direction switching means, a plurality of airflow modes. The plurality of airflow modes includes modes that change the outgoing air to airflows corresponding to a plurality of air directions set beforehand, and these include a wall airflow mode. The wall airflow mode is a mode that changes the outgoing air to an airflow that flows along the side wall and a floor of the air conditioning target space at the time of a heating operation. The control component performs outgoing air temperature suppression control. The outgoing air temperature suppression control is control that lowers the temperature of the outgoing air at the time of the execution of the wall airflow mode below what it is at the time of the execution of the other airflow modes in the heating operation.

[0006] In this air conditioning indoor unit, by lowering the outgoing air temperature, the temperature of the airflow that flows along the floor surface from the wall surface in the wall airflow mode also becomes lower, so even in a case where by some chance the floor surface is not sufficiently warmed, rising of the airflow that flows along the floor surface can be suppressed more than has conventionally been the case. The wall airflow is an airflow that crawls along the floor surface from the wall surface, and it does not strike the occupants, so even when the temperature becomes lower, it is unlikely to impart a feeling of discomfort to the occupants.

[0007] An air conditioning indoor unit pertaining to a second aspect of the invention is the air conditioning indoor unit pertaining to the first aspect, further comprising an indoor heat exchanger that functions as a condenser at the time of the heating operation. The control component lowers a temperature target value of the indoor heat exchanger in the outgoing air temperature suppression control.

[0008] In this air conditioning indoor unit, in the outgoing air temperature suppression control, by controlling the target temperature of the indoor heat exchanger through which the outgoing air travels, the ability of the outgoing air temperature to follow the intended temperature becomes better.

[0009] An air conditioning indoor unit pertaining to a third aspect of the invention is the air conditioning indoor unit pertaining to the first aspect or the second aspect, wherein the plurality of airflow modes includes a first airflow mode and a second airflow mode. The first airflow mode is a mode that changes the outgoing air to a forward and downward airflow. The second airflow mode is a mode that changes the outgoing air to an airflow that is more downward than in the first airflow mode and heads toward the floor surface of the air conditioning target space. The control component executes the wall airflow mode after it has sequentially executed the first airflow mode and the second airflow mode.

[0010] In this air conditioning indoor unit, first, the entire air conditioning target space is warmed by the first airflow mode to a room temperature with which the user is satisfied. Next, the section of the floor from the center to the far side is warmed by the second airflow mode to suppress airflow rise caused by conditions that the floor temperature is low when the airflow mode has moved to the wall airflow mode. As a result, even when the airflow mode is moved to the wall airflow mode, rising of the airflow is suppressed.

[0011] An air conditioning indoor unit pertaining to a fourth aspect of the invention is the air conditioning indoor unit pertaining to the third aspect, wherein the plurality of airflow modes further includes a third airflow mode.

The third airflow mode is a mode that changes the outgoing air to an airflow heading toward a lower portion of the side wall. The control component executes the wall airflow mode after it has sequentially executed the first airflow mode, the second airflow mode, and the third airflow mode.

[0012] In this air conditioning indoor unit, first, the entire air conditioning target space is warmed by the first airflow mode to a room temperature with which the user is satisfied. Next, the section of the floor from the center to the far side is warmed by the second airflow mode to suppress airflow rise caused by conditions that the floor temperature is low when the airflow mode has moved to the wall airflow mode. Moreover, the near side of the floor is warmed by the third airflow mode to prevent thermo-off caused by airflow rise directly under the air conditioning indoor unit caused by the temperature of the near side of the floor being low. As a result, even when the airflow mode is moved to the wall airflow mode, rising of the airflow is further suppressed and unnecessary thermo-off is prevented.

[0013] An air conditioning indoor unit pertaining to a fifth aspect of the invention is the air conditioning indoor unit pertaining to the fourth aspect, wherein the control component finds a temperature difference between a room temperature, which is the temperature of the air conditioning target space, and a set temperature, which is a target value of the room temperature. Moreover, the control component moves the airflow mode from the first airflow mode to the second airflow mode when the absolute value of the temperature difference has become equal to or less than a first threshold value during execution of the first airflow mode, and the control component moves the airflow mode from the second airflow mode to the third airflow mode when the absolute value of the temperature difference has become equal to or less than a second threshold value during execution of the second airflow mode.

[0014] In this air conditioning indoor unit, the control component sequentially moves from the first airflow mode to the third airflow mode on the basis of the temperature difference between the set temperature and the room temperature, so it can wait for the room temperature to reach a comfortable temperature before moving to the wall airflow mode.

[0015] An air conditioning indoor unit pertaining to a sixth aspect of the invention is the air conditioning indoor unit pertaining to the fourth aspect, wherein the control component moves the airflow mode from the third airflow mode to the wall airflow mode after the elapse of a first predetermined amount of time since moving to the third airflow mode.

[0016] In this air conditioning indoor unit, the control component sequentially moves from the first airflow mode to the third airflow mode on the basis of the temperature difference between the set temperature and the room temperature, so the room temperature becomes a comfortable temperature, and the control component moves the third airflow mode to the wall airflow mode after the floor surface directly under the air conditioning indoor unit also becomes warm, so airflow rise is further suppressed.

[0017] An air conditioning indoor unit pertaining to a seventh aspect of the invention is the air conditioning indoor unit pertaining to the fifth aspect, wherein when, after the move to the wall airflow mode, the absolute value of the temperature difference between the room temperature and the set temperature has exceeded a third threshold value before the duration of the wall airflow mode reaches a second predetermined amount of time, the control component delays the next move to the wall airflow mode.

[0018] In this air conditioning indoor unit, depending on the load, there is the potential for the supply capacity to be insufficient after the move to the wall airflow mode so that the wall airflow mode must be immediately stopped, so when such a situation has arisen, the control component tightens conditions for the next move to the wall airflow mode, delays the move, and avoids the occurrence of such a situation.

<Advantageous Effects of Invention>

[0019] In the air conditioning indoor unit pertaining to the first aspect of the invention, by lowering the outgoing air temperature, the temperature of the airflow that flows along the floor surface from the wall surface in the wall airflow mode also becomes lower, so even in a case where by some chance the floor surface is not sufficiently warmed, rising of the airflow that flows along the floor surface can be suppressed more than has conventionally been the case.

[0020] In the air conditioning indoor unit pertaining to the second aspect of the invention, in the outgoing air temperature suppression control, by controlling the target temperature of the indoor heat exchanger 13 through which the outgoing air travels, the ability of the outgoing air temperature to follow the intended temperature becomes better.

[0021] In the air conditioning indoor unit pertaining to the third aspect of the invention, first, the entire air conditioning target space is warmed by the first airflow mode to a room temperature with which the user is satisfied. Next, the section of the floor from the center to the far side is warmed by the second airflow mode to suppress airflow rise caused by conditions that the floor temperature is low when the airflow mode has moved to the wall airflow mode. As a result, even when the airflow mode is moved to the wall airflow mode, rising of the airflow is suppressed.

[0022] In the air conditioning indoor unit pertaining to the fourth aspect of the invention, first, the entire air conditioning target space is warmed by the first airflow mode to a room temperature with which the user is satisfied. Next, the section of the floor from the center to the far side is warmed by the second airflow mode to suppress

airflow rise caused by conditions that the floor temperature is low when the airflow mode has moved to the wall airflow mode. Moreover, the near side of the floor is warmed by the third airflow mode to prevent thermo-off caused by airflow rise directly under the air conditioning indoor unit caused by the temperature of the near side of the floor being low. As a result, even when the airflow mode is moved to the wall airflow mode, rising of the airflow is further suppressed and unnecessary thermo-off is prevented.

[0023] In the air conditioning indoor unit pertaining to the fifth aspect of the invention, the control component sequentially moves from the first airflow mode to the third airflow mode on the basis of the temperature difference between the set temperature and the room temperature, so it can wait for the room temperature to reach a comfortable temperature before moving to the wall airflow mode.

[0024] In the air conditioning indoor unit pertaining to the sixth aspect of the invention, the control component sequentially moves from the first airflow mode to the third airflow mode on the basis of the temperature difference between the set temperature and the room temperature, so the room temperature becomes a comfortable temperature, and the control component moves the third airflow mode to the wall airflow mode after the floor surface directly under the air conditioning indoor unit also becomes warm, so airflow rise is further suppressed.

[0025] In the air conditioning indoor unit pertaining to the seventh aspect of the invention, depending on the load, there is the potential for the supply capacity to be insufficient after the move to the wall airflow mode so that the wall airflow mode must be immediately stopped, so when such a situation has arisen, the control component tightens conditions for the next move to the wall airflow mode, delays the move, and avoids the occurrence of such a situation.

BRIEF DESCRIPTION OF DRAWINGS

[0026]

FIG. 1 is a configuration diagram of an air conditioner pertaining to an embodiment of the invention.
FIG. 2 is a perspective view of an air conditioning indoor unit of the air conditioner.
FIG. 3 is a sectional view of the air conditioning indoor unit in FIG. 2.
FIG. 4 is a control block diagram of the air conditioner.
FIG. 5 is an enlarged sectional view of a front flap and a rear flap in FIG. 3.
FIG. 6 is a sectional view of the air conditioning indoor unit when operation is stopped.
FIG. 7 is a sectional view of the air conditioning indoor unit at the time of a forward and downward airflow mode utilizing an auxiliary front flap.
FIG. 8 is an enlarged sectional view of the front flap, the auxiliary front flap, and the rear flap in FIG. 7.
FIG. 9 is a sectional view of the air conditioning indoor unit at the time of the forward and downward airflow mode not utilizing the auxiliary front flap.
FIG. 10 is a partial sectional view of the air conditioning indoor unit at the time of a circulation airflow mode.
FIG. 11 is a partial sectional view of the air conditioning indoor unit at the time of a middle airflow mode.
FIG. 12A is an explanatory drawing showing a first airflow mode executed in a preliminary operation.
FIG. 12B is an explanatory drawing showing a second airflow mode executed in the preliminary operation.
FIG. 12C is an explanatory drawing showing a third airflow mode executed in the preliminary operation.
FIG. 12D is an explanatory drawing showing a wall airflow mode executed in an unfelt airflow operation.
FIG. 13A is a control flowchart from the preliminary operation to the start of the unfelt airflow operation.
FIG. 13B is a control flowchart from the start to the end of the unfelt airflow operation.
FIG. 14 is a control flowchart from the preliminary operation to the start of the unfelt airflow operation in an example modification.
FIG. 15 is a block diagram showing conditions for moving from the first airflow mode to the wall airflow mode.
FIG. 16 is a graph showing moves from the first airflow mode to the wall airflow mode and changes in a room temperature and an effective floor mean temperature.

DESCRIPTION OF EMBODIMENT

[0027] An embodiment of the invention will be described below with reference to the drawings. It will be noted that the following embodiment is a specific example of the invention and is not intended to limit the technical scope of the invention.

(1) Configuration of Air Conditioner 1

[0028] FIG. 1 is a configuration diagram of an air conditioner 1 pertaining to the embodiment of the invention. In FIG. 1, the air conditioner 1 is an air conditioner capable of performing a cooling operation and a heating operation and is equipped with an air conditioning indoor unit 10, an air conditioning outdoor unit 70, and a liquid refrigerant communication pipe 7 and a gas refrigerant communication pipe 9 for interconnecting the air conditioning outdoor unit 70 and the air conditioning indoor unit 10.

(1-1) Air Conditioning Outdoor Unit 70

[0029] In FIG. 1, the air conditioning outdoor unit 70 mainly has a compressor 73, a four-port switching valve

75, an outdoor heat exchanger 77, an expansion valve 79, and an accumulator 71. Moreover, the air conditioning outdoor unit 70 also has an outdoor fan 78.

(1-1-1) Compressor 73, Four-Port Switching Valve 75, and Accumulator 71

[0030] The compressor 73 variably adjusts its operating capacity with an inverter and sucks in and compresses gas refrigerant. The accumulator 71 is disposed in front of the suction port of the compressor 73 and ensures that liquid refrigerant is not directly sucked into the compressor 73.

[0031] The four-port switching valve 75 switches the direction of the flow of the refrigerant when switching between the cooling operation and the heating operation. In the cooling operation, the four-port switching valve 75 interconnects the discharge side of the compressor 73 and the gas side of the outdoor heat exchanger 77 and also interconnects the suction side of the compressor 73 and the gas side of an indoor heat exchanger 13. Namely, this is the state indicated by the solid lines in the four-port switching valve 75 in FIG. 1.

[0032] Furthermore, in the heating operation, the four-port switching valve 75 interconnects the discharge side of the compressor 73 and the gas side of the indoor heat exchanger 13 and also interconnects the suction side of the compressor 73 and the gas side of the outdoor heat exchanger 77. Namely, this is the state indicated by the dashed lines in the four-port switching valve 75 in FIG. 1.

(1-1-2) Outdoor Heat Exchanger 77 and Outdoor Fan 78

[0033] The outdoor heat exchanger 77 can condense or evaporate the refrigerant flowing inside by causing the refrigerant to exchange heat with outdoor air. It will be noted that the outdoor fan 78 is disposed so as to face the outdoor heat exchanger 77, and the outdoor fan 78 takes in outdoor air by rotating, delivers the outdoor air to the outdoor heat exchanger 77, and promotes heat exchange between the refrigerant and the outdoor air.

(1-1-3) Expansion Valve 79

[0034] The expansion valve 79 is connected to a pipe between the outdoor heat exchanger 77 and the indoor heat exchanger 13 to adjust the refrigerant pressure and the refrigerant flow rate and has the function of expanding the refrigerant in both the cooling operation and the heating operation.

(1-2) Air Conditioning Indoor Unit 10

[0035] FIG. 2 is a perspective view of the air conditioning indoor unit 10 of the air conditioner 1, and FIG. 3 is a sectional view of the air conditioning indoor unit 10 in FIG. 2. In FIG. 1, FIG. 2, and FIG. 3, the air conditioning indoor unit 10 is equipped with a body casing 11, an indoor heat exchanger 13, an indoor fan 14, and a frame 17.

(1-2-1) Body Casing 11

[0036] The body casing 11 houses the indoor heat exchanger 13, the indoor fan 14, the frame 17, and a control component 50 inside.

[0037] An air outlet 15 is provided in the lower portion of the body casing 11. A rear flap 40 serving as air direction switching means that changes the direction of outgoing air blown out from the air outlet 15 is attached to the air outlet 15 in such a way that the rear flap 40 may freely rotate. The rear flap 40 is driven by a motor (not shown in the drawings) and not only changes the direction of the outgoing air but can also open and close the air outlet 15. The rear flap 40 can adopt plural postures whose angles of inclination are different.

[0038] Furthermore, a front flap 31 serving as air direction switching means is provided in the neighborhood of the air outlet 15. The front flap 31 can adopt a posture in which it is inclined in the front and rear direction by a motor (not shown in the drawings), and, when operation is stopped, the front flap 31 is stowed in a stowage portion 130 provided in a sloping lower surface portion 11d between the lower end of a front surface panel 11b and the air outlet 15. The front flap 31 can adopt plural postures whose angles of inclination are different. An auxiliary front flap 32 serving as air direction switching means is rotatably disposed upstream, relative to the flow of the outgoing air, of the front flap 31.

(1-2-2) Indoor Heat Exchanger 13 and Indoor Fan 14

[0039] The indoor heat exchanger 13 is a cross-fin heat exchanger and can evaporate or condense the refrigerant flowing inside by causing the refrigerant to exchange heat with room air to thereby cool or heat the room air. Furthermore, the indoor heat exchanger 13 is shaped like an inverted V in which both ends bend downward as seen in a side view, and the indoor fan 14 is positioned under the indoor heat exchanger 13. The indoor fan 14 is a cross-flow fan, causes air taken in from the room to be applied to and pass through the indoor heat exchanger 13, and blows out the air into the room. The indoor heat exchanger 13 and the indoor fan 14 are attached to the frame 17.

(1-3) Control Component 50

[0040] FIG. 4 is a control block diagram of the air conditioner 1. In FIG. 1 and FIG. 4, a control component 50 has an indoor-side control component 50a built inside the air conditioning indoor unit 10 and an outdoor-side control component 50b built inside the air conditioning outdoor unit 70. Sending and receiving of infrared signals is carried out between the indoor-side control component 50a and a remote controller 52. Sending and receiving of signals is carried out via a wire between the indoor-

side control component 50a and the outdoor-side control component 50b.

[0041] The indoor-side control component 50a drives a front flap drive motor 315, an auxiliary front flap drive motor 325, a rear flap drive motor 405, and the indoor fan 14 on the basis of command signals from the remote controller 52.

[0042] Furthermore, the outdoor-side control component 50b controls the operating frequency of the compressor 73, the switching actions of the four-port switching valve 75, the opening degree of the expansion valve 79, and the rotation of the outdoor fan 78 on the basis of command signals from the indoor-side control component 50a which has received commands from the remote controller 52.

(1-4) Remote Controller 52

[0043] A remote-control unit (hereinafter called the remote controller 52), in response to being operated by a user, controls the air conditioner by exchanging communications with the control components built into the air conditioning indoor unit 10 and the air conditioning outdoor unit 70.

[0044] The remote controller 52 is provided with an operation switch 522, an operation switching switch 524, a temperature setting switch 526, an on-timer switch 528, an unfelt airflow operation on/off switch 530, and an air direction adjustment switch 532.

[0045] It will be noted that the air direction adjustment switch 532, the front flap 31, the auxiliary front flap 32, the rear flap 40, the front flap drive motor 315, the auxiliary front flap drive motor 325, and the rear flap drive motor 405 will collectively be called air direction switching means.

[0046] The operation switch 522, each time it is operated, alternately switches between operating and stopping the air conditioner 1. The operation switching switch 524, each time it is operated, switches operation in the order of automatic → cooling → dehumidification and cooling → dehumidification → heating → humidification and heating. The temperature setting switch 526 is configured in such a way that, each time it is operated by being pushed up, the set temperature increases, and each time it is operated by being pushed down, the set temperature decreases. The on-timer switch 528 is configured in such a way that, each time it is operated, the on-time is changed sequentially in the manner of "in 1 hour", "in 2 hours", and so on to "in 6 hours".

[0047] The unfelt airflow operation on/off switch 530 is operated when switching on an unfelt airflow operation, which is one condition for starting the unfelt airflow operation.

[0048] The air direction adjustment switch 532, each time it is operated, alternately switches between swinging the front flap 31 and the rear flap 40 up and down and fixing them in arbitrary positions.

(2) Details of Air Direction Switching Means

(2-1) Vertical Air Direction Adjustment Plate 20

[0049] A vertical air direction adjustment plate 20 has plural blade pieces 201 disposed along the longitudinal direction of the air outlet 15 (the direction perpendicular to the surface of the page of FIG. 3). The vertical air direction adjustment plate 20 is disposed in an air outflow passage 18 in a position closer to the indoor fan 14 than the rear flap 40. The plural blade pieces 201 swing right and left, so as to across a plane perpendicular to the longitudinal direction of the air outlet 15, by horizontally moving back and forth along the longitudinal direction of the air outlet 15.

(2-2) Front Flap 31

[0050] FIG. 5 is an enlarged sectional view of the front flap 31 and the rear flap 40 in FIG. 3. Furthermore, FIG. 6 is a sectional view of the air conditioning indoor unit when operation is stopped. In FIG. 6, the front flap 31 is stowed in the stowage portion 130 while air conditioning operations are stopped.

[0051] The front flap 31 moves away from the stowage portion 130 by rotating. A rotating shaft of the front flap 31 is set under a front rib 15a of an upper partition wall 161 of an air outlet forming wall 16, and the rear end of the front flap 31 and the rotating shaft are coupled to each other with a predetermined distance being maintained between them. Therefore, the front flap 31 rotates in such a way that, as it rotates and moves away from the stowage portion 130, the height position of the rear end of the front flap 31 becomes lower.

[0052] By rotating in the counter-clockwise direction in-from the perspective of one looking directly at-FIG. 6, the front flap 31 moves away from the stowage portion 130 while both the front end and the rear end of the front flap 31 describe circular arcs. Furthermore, by rotating in the clockwise direction in-from the perspective of one looking directly at-FIG. 3, the front flap 31 moves toward the stowage portion 130 and eventually becomes stowed in the stowage portion 130.

[0053] The postures of the front flap 31 in an operating state include a posture in which the front flap 31 is stowed in the stowage portion 130 (see FIG. 6), a posture in which the front flap 31 rotates to become inclined forward and upward, a posture in which the front flap 31 rotates further to become substantially horizontal, a posture in which the front flap 31 rotates further to become inclined forward and downward, and a posture in which the front flap 31 rotates further to become inclined rearward and downward (see FIG. 3 and FIG. 5).

[0054] The front flap 31 has a first surface 31a that forms an outer surface of the front flap 31 and a second surface 31b that forms an inner surface of the front flap 31 when the front flap 31 is in the posture in which it is stowed in the stowage portion 130. The first surface 31a

and the second surface 31b form a rear surface and a front surface, respectively, of the front flap 31 when the front flap 31 adopts the posture shown in FIG. 3 and FIG. 5 in which it is inclined rearward and downward.

[0055] A recessed portion 311, at which the dimension of the front flap 31 becomes smaller in the thickness direction thereof as shown in FIG. 5, is provided in the first surface 31a. The recessed portion 311 is positioned near the rotating shaft as seen from the center of the front flap 31.

(2-3) Auxiliary Front Flap 32

[0056] The auxiliary front flap 32 is a plate-like member positioned upstream, relative to the flow of the outgoing air, of the front flap 31. The auxiliary front flap 32 is smaller than the front flap 31, but the auxiliary front flap 32 is set to a size sufficient to guide the air that has traveled through the air outflow passage 18 to the first surface 31a of the front flap 31.

[0057] When it is not used, the auxiliary front flap 32 is stowed in a stowage portion 16a provided in the upper partition wall 161 of the air outlet forming wall 16. The auxiliary front flap 32 has a first surface 32a that forms a lower surface of the auxiliary front flap 32 and a second surface 32b that forms an upper surface of the auxiliary front flap 32 when the auxiliary front flap 32 is in the posture in which it is stowed in the stowage portion 16a. The first surface 32a and the second surface 32b form a rear surface and a front surface, respectively, of the auxiliary front flap 32 when the auxiliary front flap 32 adopts the posture shown in FIG. 3 and FIG. 5.

[0058] The stowage portion 16a is formed by recessing the upper partition wall 161 of the air outlet forming wall 16 in its thickness direction. The depth of the stowage portion 16a is set in such a way that when the auxiliary front flap 32 is stowed in the stowage portion 16a, the first surface 32a of the auxiliary front flap 32 does not project beyond the surface of the upper partition wall 161 into the flow path.

[0059] Furthermore, when it is used, the auxiliary front flap 32 moves from the stowage portion 16a by rotating and projects beyond the surface of the upper partition wall 161 into the flow path. A rotating shaft of the auxiliary front flap 32 is set under the upstream-side end portion of the stowage portion 16a.

[0060] When, for example, the front flap 31 adopts a posture in which it is inclined rearward and downward as shown in FIG. 5, the auxiliary front flap 32 rotates in such a way that its distal end enters the recessed portion 311 of the front flap 31. If at this time the entire auxiliary front flap 32 is away from the stowage portion 16a, the outgoing air bypasses the air outlet 15 through a gap between the upper partition wall 161 and the auxiliary front flap 32, so to prevent this, the rear end of the auxiliary front flap 32 remains in the stowage portion 16a to keep the gap between the upper partition wall 161 and the auxiliary front flap 32 from becoming larger.

[0061] After this, the first surface 32a of the auxiliary front flap 32 and the first surface 31a of the front flap 31 form an airflow guide surface 30a and, together with the rear flap 40, generate an airflow heading toward the lower portion of the side wall.

(2-4) Rear Flap 40

[0062] The rear flap 40 has an area sufficient enough to be able to close off the air outlet 15 as shown in FIG. 6. The rear flap 40 has a first surface 40a that forms an outer surface of the rear flap 40 and a second surface 40b that forms an inner surface of the rear flap 40 when the rear flap 40 adopts the posture in which it closes the air outlet 15. The first surface 40a and the second surface 40b form a rear surface and a front surface, respectively, of the rear flap 40 when the rear flap 40 adopts the posture shown in FIG. 3 and FIG. 5 in which it is inclined rearward and downward.

[0063] The first surface 40a is, emphasizing design attractiveness, finished to a gentle circularly arcuate curved surface that projects outward. In contrast, the second surface 40b includes a flat surface 40ba and a curved surface 40bb, and, as shown in FIG. 5, the flat surface 40ba and the curved surface 40bb are disposed in this order in the second surface 40b heading from the upper end toward the lower end of the rear flap 40. Furthermore, in FIG. 5, the curved surface 40bb is a curved surface that bulges forward and has a radius equal to or greater than 200 mm.

[0064] A rotating shaft of the rear flap 40 is set in a position adjacent to a rear rib 15b of a lower partition wall 162 of the air outlet forming wall 16. By rotating in the counter-clockwise direction in-from the perspective of one looking directly at-FIG. 6 about the rotating shaft, the rear flap 40 acts so as to move away from the front end of the air outlet 15 and opens the air outlet 15. Conversely, by rotating in the clockwise direction in-from the perspective of one looking directly at-FIG. 3 about the rotating shaft, the rear flap 40 acts so as to move toward the front end of the air outlet 15 and closes the air outlet 15.

[0065] In a state in which the rear flap 40 has opened the air outlet 15, the outgoing air that has been blown out from the air outlet 15 flows generally along the second surface 40b of the rear flap 40.

(3) Controlling Direction of Outgoing Air

[0066] The air conditioning indoor unit of the present embodiment adjusts the direction of the outgoing air by changing the postures of the front flap 31, the auxiliary front flap 32, and the rear flap 40 according to each air direction mode as a means to control the direction of the outgoing air. The air direction modes will be described below with reference to the drawings. It will be noted that the air direction modes can be controlled in such a way that they are changed automatically and can be selected via a remote controller or the like by the user.

(3-1) Rearward and Downward Airflow Mode

[0067] The rearward and downward airflow mode is a mode that directs the outgoing air toward the lower portion of the side wall on which the air conditioning indoor unit 10 is installed. In the rearward and downward airflow mode, the outgoing air travels from the lower portion of the side wall to the floor surface and then flows along the floor surface toward the opposing side wall.

[0068] In the rearward and downward airflow mode, the front flap 31, the auxiliary front flap 32, and the rear flap 40 adopt the postures shown in FIG. 2, FIG. 3, and FIG. 5. In terms of FIG. 5, the auxiliary front flap 32 has its lower end positioned more forward than its upper end so that the auxiliary front flap 32 is inclined an angle α (0 to 10°) relative to a vertical plane.

[0069] Furthermore, the front flap 31 has its lower end positioned more toward the side wall than its upper end so that the front flap 31 is inclined an angle β (0 to 20°) relative to a vertical plane. Because of this, the first surface 32a of the auxiliary front flap 32 and the first surface 31a of the front flap 31 form the airflow guide surface 30a with a projecting shape that bulges forward.

[0070] The lower end of the front flap 31 at this time is positioned lower than the height position of the distal end of the rear rib 15b that projects vertically downward from the rear end position of the air outlet 15. The distal end of the rear rib 15b is the lowermost end of the air outlet 15.

[0071] Meanwhile, the rear flap 40 has its lower end positioned more toward the side wall than its upper end so that the second surface 40b of the rear flap 40 is inclined relative to a vertical plane. Specifically, as shown in FIG. 3, the rear flap 40 becomes inclined until the first surface 40a of the rear flap 40 contacts or is in close proximity to the distal end of the rear rib 15b.

[0072] In the present embodiment, the gap between the rear flap 40 and the rear rib 15b is equal to or less than a certain value (5 mm), so air resistance when the air flows through the gap increases, and the outgoing air flows, in avoidance of the gap, in an air passage space sandwiched between the airflow guide surface 30a and the second surface 40b which is a wider passage.

[0073] Consequently, the outgoing air travels through the air passage space sandwiched between the airflow guide surface 30a and the second surface 40b. At that time, the outgoing air that has been guided by the auxiliary front flap 32 flows along the front flap 31 that is larger than the auxiliary front flap 32. Because the front flap 31 has its lower end positioned more toward the side wall than its upper end so that the front flap 31 is inclined relative to a vertical plane, the outgoing air can be guided to the lower portion of the side wall that is equal to or more than 90° downward from the horizontal.

[0074] Furthermore, the outgoing air traveling through the air passage space sandwiched between the airflow guide surface 30a and the second surface 40b proceeds along the air passage space in a state in which forward spreading of the outgoing air is blocked by the front flap 31 until the outgoing air reaches lower than the height position of the distal end of the rear rib 15b (the lowermost end of the air outlet 15). The outgoing air becomes an airflow along the second surface 40b of the rear flap 40 when the outgoing air leaves the air passage space, so an airflow heading toward the lower portion of the side wall is sufficiently generated.

[0075] Moreover, the outgoing air flows along, and in the order of, the flat surface 40ba and the curved surface 40bb of the second surface 40b of the rear flap 40. The curved surface 40bb is set to a radius equal to or greater than 200 mm so as to easily exhibit the Coanda effect, so the outgoing air becomes a downward airflow along the flat surface 40ba and thereafter is drawn to the curved surface 40bb because of the Coanda effect and becomes an airflow heading toward the lower portion of the side wall.

[0076] A front flap group 30, comprising the front flap 31 and the auxiliary front flap 32, and the rear flap 40 interact as described above so that a rearward and downward airflow heading toward the lower portion of the side wall is easily generated.

(3-2) Forward and Downward Airflow Mode

[0077] In the forward and downward airflow mode, a mode utilizing the auxiliary front flap 32 or a mode not utilizing the auxiliary front flap 32 is selected automatically or by the user.

(3-2-1) Mode Utilizing Auxiliary Front Flap 32

[0078] FIG. 7 is a sectional view of the air conditioning indoor unit 10 at the time of the forward and downward airflow mode utilizing the auxiliary front flap 32. Furthermore, FIG. 8 is an enlarged sectional view of the front flap 31, the auxiliary front flap 32, and the rear flap 40 in FIG. 7.

[0079] In FIG. 7 and FIG. 8, first, the front flap 31 rotates to adopt a posture in which the first surface 31a of the front flap 31 becomes inclined downward a predetermined angle x1 from the horizontal. It will be noted that in a case where it is difficult to establish a baseline for the angle because the first surface 31a is a circularly arcuate surface, a line joining both ends of the first surface 31a may also be used as a baseline for the angle as shown in FIG. 8.

[0080] Furthermore, the auxiliary front flap 32 also rotates to adopt a posture in which the first surface 32a of the auxiliary front flap 32 becomes inclined downward a predetermined angle y1 from the horizontal. If at this time the entire auxiliary front flap 32 is away from the stowage portion 16a, the outgoing air bypasses the air outlet 15 through the gap between the upper partition wall 161 and the auxiliary front flap 32, so to prevent this the rear end of the auxiliary front flap 32 remains in the stowage portion 16a to keep the gap between the upper partition wall 161 and the auxiliary front flap 32 from becoming larger.

[0081] Moreover, the rear flap 40 also rotates to adopt a posture in which the flat surface 40ba of the second surface 40b of the rear flap 40 becomes inclined downward a predetermined angle z1 from the horizontal.

[0082] As shown in FIG. 8, when the front flap 31 and the auxiliary front flap 32 are viewed from the front in the horizontal direction, the front end portion of the auxiliary front flap 32 overlaps the rear end portion of the front flap 31 by a dimension L upstream, relative to the flow of the outgoing air, of the front flap 31 and vertically lower than the rear end surface of the front flap 31.

[0083] The positional relationship between the front flap 31, the auxiliary front flap 32, and the gap between them becomes a relationship where the auxiliary front flap 32, the gap, and the front flap 31 are lined up in this order as seen from upstream relative to the flow of the outgoing air, and the gap is hidden by the auxiliary front flap 32 that is upstream of the gap, so the air that has traveled through the air outflow passage 18 and has been guided by the first surface 32a of the auxiliary front flap 32 naturally flows forcefully to the first surface 31a of the front flap 31 without flowing to the gap. As a result, even with the gap, the conditioned air is prevented from bypassing the air outlet 15 through that gap.

[0084] As described above, in the forward and downward airflow mode utilizing the auxiliary front flap 32, the auxiliary front flap 32 adopts a posture in which it blocks an airflow traveling through the gap between the upper partition wall 161 and the front flap 31, and prevents the outgoing air from flowing from the upper end of the front flap 31 along both surfaces of the front flap 31, so the upper end of the front flap 31 does not create air resistance. As a result, an increase in the energy consumed by the indoor fan 14 and a decrease in energy saving performance are prevented.

[0085] Furthermore, the forward and downward airflow mode utilizing the auxiliary front flap 32 is effective when generating forward and downward outgoing air particularly in the cooling operation. The reason is that there is the effect of preventing dew condensation because air that has been cooled does not flow toward the second surface 31b of the front flap 31.

[0086] In the present embodiment, the auxiliary front flap 32 is used except when generating an upward airflow in the cooling operation.

(3-2-2) Mode Not Utilizing Auxiliary Front Flap 32

[0087] FIG. 9 is a sectional view of the air conditioning indoor unit 10 at the time of the forward and downward airflow mode not utilizing the auxiliary front flap 32. In FIG. 9, the auxiliary front flap 32 is stowed in the stowage portion 16a, and the first surface 32a of the auxiliary front flap 32 lies along an extension surface of the adjacent upper partition wall 161 and does not obstruct the flow of air along the upper partition wall 161.

[0088] In the forward and downward airflow mode not utilizing the auxiliary front flap 32, the auxiliary front flap 32 itself does not create air resistance. However, the auxiliary front flap 32 cannot block an airflow traveling through the gap between the upper partition wall 161 and the front flap 31, so it is undeniable that the upper end of the front flap 31 creates air resistance.

(3-3) Forward Airflow Mode

[0089] In the forward airflow mode, a circulation airflow mode that forcefully delivers the outgoing air forward and a middle airflow mode that thickly delivers the outgoing air forward are selected automatically or by the user.

(3-3-1) Circulation Airflow Mode

[0090] FIG. 10 is a partial sectional view of the air conditioning indoor unit 10 at the time of the circulation airflow mode. In FIG. 10, the front flap 31 adopts a horizontal posture or a posture in which the front end of the front flap 31 is pointed horizontally forward. The auxiliary front flap 32 is stowed in the stowage portion 16a. The rear flap 40 adopts an inclined posture in which the flat surface 40ba of the second surface 40b lies along an extension of a tangent to the terminal end of the lower partition wall 162 of the air outlet forming wall 16. The lower partition wall 162 is also inclined so as to lie along an extension of a tangent to the terminal end of a lower scroll 172, so the lower scroll 172, the lower partition wall 162, and the flat surface 40ba become lined up as if to form one scroll wall, and the flow of air is guided on the second surface 40b of the rear flap 40 without being obstructed.

[0091] In the circulation airflow mode, the distance between the first surface 31a of the front flap 31 and the second surface 40b of the rear flap 40 is narrow, so the outgoing air becomes restricted and increases in flow speed, is forcefully delivered forward, and stirs up the air in the air conditioning target space. As a result, stagnation of the air in the air conditioning target space can be eliminated.

(3-3-2) Middle Airflow Mode

[0092] FIG. 11 is a partial sectional view of the air conditioning indoor unit 10 at the time of the middle airflow mode. In FIG. 11, the front flap 31 adopts a posture in which the front end of the front flap 31 is pointed upward from the horizontal. The auxiliary front flap 32 is stowed in the stowage portion 16a. The rear flap 40 adopts a posture in which the flat surface 40ba of the second surface 40b is inclined forward and downward.

[0093] At first glance it might seem that the outgoing air would flow forward and downward along the flat surface 40ba of the rear flap 40, but because of the Coanda effect the outgoing air that has exited the air outlet 15 is drawn to the first surface 31a of the front flap 31, becomes an airflow that is horizontal and a little more upward than horizontal, and is delivered.

[0094] Here, the Coanda effect is a phenomenon

where, when there is a wall next to a flow of gas or liquid, the gas or liquid tends to flow in a direction along the wall surface even if the direction of the flow and the direction of the wall are different (*Hōsoku no jiten,* Asakura Publishing Co., Ltd.).

[0095] In FIG. 11, the angle formed by the front flap 31 and the rear flap 40 needs to be equal to or less than a predetermined opening angle for the first surface 31a of the front flap 31 to produce the Coanda effect. The positional relationship between them is disclosed in a patent document (JP-A No. 2013-76530) filed on September 30, 2011, by the applicant, so description will be omitted here.

(4) Unfelt Airflow Operation

[0096] In the air conditioner 1, in the heating operation at the time of a low load, an unfelt airflow operation is performed wherein the air conditioner 1 maintains the room temperature with an airflow in which the outgoing air crawls along the floor surface from the wall on which the air conditioning indoor unit 10 is installed.

[0097] Contrasting just the direction of the airflow, it is the same as in the rearward and downward airflow mode described in (3-1), but in order for the unfelt airflow operation to be performed, a preliminary operation is performed before that.

(4-1) Actions in Preliminary Operation

[0098] The preliminary operation is an operation for raising the room temperature to store heat in the floor at the time of a high load before entering the unfelt airflow operation. Because of this preliminary operation, the time of the subsequent unfelt airflow operation can be maintained a long time.

[0099] FIG. 12A is an explanatory drawing showing a first airflow mode executed in the preliminary operation, FIG. 12B is an explanatory drawing showing a second airflow mode executed in the preliminary operation, and FIG. 12C is an explanatory drawing showing a third airflow mode executed in the preliminary operation.

[0100] First, in FIG. 12A, temperature-regulated air is blown out from the air conditioning indoor unit 10 toward the center of the space of a room 200. The airflow direction at this time is the same as in the forward airflow mode described in (3-3), and hereinafter the forward airflow mode in the preliminary operation will be called a first airflow mode. The entire room 200 is warmed by the first airflow mode.

[0101] Next, in FIG. 12B, temperature-regulated air is blown out from the air conditioning indoor unit 10 toward the center of a floor 220. The airflow that has reached the center of the floor surface flows along the floor surface to the far side. Here, "far side" refers to the lower section of a wall 230 opposing a side wall 210 on which the air conditioning indoor unit 10 is installed.

[0102] The airflow direction at this time is the same as in the forward and downward airflow mode described in (3-2), and hereinafter the forward and downward airflow mode in the preliminary operation will be called a second airflow mode. The section of the floor surface from the center to the far side is warmed (the elliptical section in FIG. 12B) by the second airflow mode, so a situation where the warm air flows on the floor surface and rises when the temperature of the floor 220 is still low, thus imparting a feeling of discomfort to the occupants, is avoided.

[0103] Then, in FIG. 12C, temperature-regulated air is blown out from the air conditioning indoor unit 10 toward the lower portion of the side wall 210. The airflow warms the near side of the floor 220 when the airflow flows along the floor surface from the side wall. Here, "near side" refers to the region directly under the air conditioning indoor unit 10.

[0104] The airflow direction at this time is the same as in the rearward and downward airflow mode described in (3-1), and hereinafter the rearward and downward airflow mode in the preliminary operation will be called a third airflow mode. The near side of the floor 220 is warmed (the elliptical section in FIG. 12C) by the third airflow mode, so a situation where the warm air blown out directly downward from the air conditioning indoor unit 10 rises when the near side is not warm, leading to thermo-off in the air conditioning indoor unit 10, is avoided.

[0105] The control component 50 starts the unfelt airflow operation after it has sequentially executed the first airflow mode, the second airflow mode, and the third airflow mode in the preliminary operation.

(4-2) Actions in Unfelt Airflow Operation

[0106] FIG. 12D is an explanatory drawing showing a wall airflow mode executed in the unfelt airflow operation. In FIG. 12D, in the wall airflow mode of the unfelt airflow operation, the airflow direction is to the eye an airflow that is the same as in the third airflow mode (the rearward and downward airflow mode) or directed more toward the side wall 210.

[0107] The crucial difference between the wall airflow mode and the third airflow mode is that the control component 50 lowers, by outgoing air temperature suppression control, the temperature of the outgoing air at the time of the execution of the wall airflow mode below what it is at the time of the execution of any of the first airflow mode, the second airflow mode, and the third airflow mode in the preliminary operation.

[0108] That is, the control component 50 warms the entire air conditioning target space with the first airflow mode to a room temperature with which the user is satisfied, and warms the section of the floor from the center to the far side with the second airflow mode to suppress airflow rise when it moves to the wall airflow mode. Moreover, the control component 50 warms the near side of the floor with the third airflow mode and suppresses rising

of the airflow when it moves to the wall airflow mode, and prevents unnecessary thermo-off.

[0109] Because the control component 50 executes the first airflow mode, the second airflow mode, and the third airflow mode, the room 200 is sufficiently warmed and heat is stored by the floor 220, which results in a low-load state for the air conditioner 1. Hence, the room temperature is maintained a long time even when the temperature of the airflow that flows along the floor surface from the wall surface in the wall airflow mode is lowered by the outgoing air temperature suppression control. Furthermore, the wall airflow is an airflow that crawls along the floor surface from the wall surface, and it does not strike the occupants, so it has the advantage of being unlikely to impart a feeling of discomfort to the occupants even when the temperature becomes lower, and hence it is also called an unfelt airflow.

(4-2-1) Flow from Preliminary Operation to Start of Unfelt Airflow Operation

[0110] Actions from the preliminary operation to the start of the unfelt airflow operation will be described below with reference to a flowchart.

[0111] FIG. 13A is a control flowchart from the preliminary operation to the start of the unfelt airflow operation, and FIG. 13B is a control flowchart from the start to the end of the unfelt airflow operation.

(Step S1)

[0112] First, in FIG. 13A, the control component 50 determines in step S1 whether or not conditions for starting the unfelt airflow operation are met; when the conditions are met, the control component 50 proceeds to step S2, and when the conditions are not met, the control component 50 continues the determination. The conditions for starting the unfelt airflow operation are as follows.

[0113] A first condition is that the unfelt airflow operation needs to be switched on. "Switching on the unfelt airflow operation" means switching on the unfelt airflow operation on/off switch 530 on the remote controller 52.

[0114] A second condition is that an outside air temperature Tout needs to be equal to or greater than a predetermined permissible temperature Tper. The reason is because the air conditioner 1 becomes unable to maintain the unfelt airflow operation if the outside air temperature is too low.

[0115] A third condition is that the actual operating mode needs to be the heating operation. Moreover, a fourth condition is that the air direction setting needs to be set to automatic.

[0116] When all of the first condition to the fourth condition are met, the control component 50 determines that the conditions for starting the unfelt airflow operation are met and proceeds to step S2, and when even one of the first condition to the fourth condition is not met, the control component 50 continues the determination until the conditions for starting the unfelt airflow operation are met.

(Step S2)

[0117] Next, the control component 50 starts executing the first airflow mode of the preliminary operation in step S2 and then proceeds to step S3.

(Step S3)

[0118] Next, the control component 50 determines in step S3 whether or not the absolute value $|Tr - Ts|$ of the temperature difference between a room temperature Tr and a set temperature Ts is equal to or less than a first threshold value $\Delta T1$; when it is the case that $|Tr - Ts| \leq \Delta T1$, the control component 50 proceeds to step S4, and when it is not the case that $|Tr - Ts| \leq \Delta T1$, the control component 50 returns to step S2.

(Step S4)

[0119] Next, the control component 50 starts executing the second airflow mode of the preliminary operation in step S4 and then proceeds to step S5.

(Step S5)

[0120] Next, the control component 50 determines in step S5 whether or not the absolute value $|Tr - Ts|$ of the temperature difference between the room temperature Tr and the set temperature Ts is equal to or less than a second threshold value $\Delta T2$; when it is the case that $|Tr - Ts| \leq \Delta T2$, the control component 50 proceeds to step S6A, and when it is not the case that $|Tr - Ts| \leq \Delta T2$, the control component 50 proceeds to step S6B.

(Step S6A)

[0121] When the control component 50 has proceeded to step S6A, it activates a timer to start counting the amount of elapsed time and then proceeds to step S7.

(Step S6B)

[0122] When the control component 50 has proceeded to step S6B, it determines whether or not the absolute value $|Tr - Ts|$ of the temperature difference between the room temperature Tr and the set temperature Ts exceeds a back threshold value $\Delta Tback$. The back threshold value $\Delta Tback$ is a threshold value for judging whether or not to go back and redo the preliminary operation from the first airflow mode because the temperature difference between the room temperature Tr and the set temperature Ts has increased.

[0123] When the control component 50 has determined that it is the case that $|Tr - Ts| > \Delta Tback$, it returns to step S2, and when the control component 50 has determined that it is not the case that $|Tr - Ts| > \Delta Tback$,

the control component 50 proceeds to step S4.

(Step S7)

[0124] Next, the control component 50 starts executing the third airflow mode of the preliminary operation in step S7 and then proceeds to step S8.

(Step S8)

[0125] Next, the control component 50 determines in step S8 whether or not an amount of elapsed time t since activating the timer has reached or gone beyond a predetermined amount of time tw; when it is the case that $t \geq tw$, the control component 50 proceeds to step S9, and when it is not the case that $t \geq tw$, the control component 50 returns to step S7.

(4-2-2) Actions from Start to End of Unfelt Airflow Operation

(Step S9)

[0126] In FIG. 13B, the control component 50 executes the wall airflow mode in step S9. The temperature control in the wall airflow mode switches to control based on the temperature of the indoor heat exchanger 13 rather than control based on |Tr - Ts| as in the first airflow mode, the second airflow mode, and the third airflow mode.

[0127] In the wall airflow mode, the outgoing air temperature is suppressed below what it is in the first airflow mode, the second airflow mode, and the third airflow mode, so by controlling a target temperature of the indoor heat exchanger 13 through which the suction air travels, the ability of the outgoing air temperature to follow the intended temperature becomes better.

(Description of Outgoing Air Temperature Suppression Control)

[0128] An upper limit temperature Tct of the indoor heat exchanger 13 is calculated from the equation "$Tct = \alpha(Ts - Tr) + Ts + \beta$" using the set temperature Ts and the room temperature Tr as parameters.

[0129] The control component 50 performs droop control of the compressor 73 when the deviation between the temperature Tc of the indoor heat exchanger 13 and the upper limit temperature Tct is within $\gamma 1$. Furthermore, the control component 50 raises the operating frequency of the compressor 73 when the deviation between the temperature Tc of the indoor heat exchanger 13 and the upper limit temperature Tct exceeds $\gamma 2$ ($\gamma 1 < \gamma 2$).

[0130] For example, when Tc rises, the control component 50 lets it run its course in the range of $Tct - \gamma 2 \leq Tc \leq Tct - \gamma 1$ and performs droop control of the compressor 73 in the range of $Tct - \gamma 1 \leq Tc \leq Tct$.

[0131] Furthermore, when Tc falls, the control component 50 performs droop control of the compressor 73 in the range of $Tct - \gamma 1 \leq Tc \leq Tct$, lets it run its course in the range of $Tct - \gamma 2 \leq Tc \leq Tct - \gamma 1$, and raises the operating frequency of the compressor 73 in the range of $Tc < Tct - \gamma 2$.

[0132] Control that maintains the outgoing air temperature lower than what it is in the first airflow mode, the second airflow mode, and the third airflow mode while controlling the upper limit temperature of the indoor heat exchanger temperature Tc in this way is called outgoing air temperature suppression control.

(Step S10)

[0133] Next, the control component 50 determines in step S10 whether or not conditions for going back to any of the first airflow mode, the second airflow mode, and the third airflow mode of the preliminary operation are met; when the conditions are met, the control component 50 goes back to the modes, and when the conditions are not met, the control component 50 proceeds to step S11. The back conditions are as follows.

[0134] Condition A is that the absolute value |Tr - Ts| of the temperature difference between the room temperature Tr and the set temperature Ts exceeds a first back threshold value $\Delta Tback1$.

[0135] Condition B is that an effective floor mean temperature Tyuka is less than [set temperature Ts - constant c].

[0136] Condition C is that neither condition A nor condition B applies after having returned from thermo-off.

[0137] The control component 50 goes back to step S2 when it has determined that condition A is met, goes back to step S4 when it has determined that condition B is met, and goes back to step S6 when it has determined that condition C is met.

(Step S11)

[0138] Next, the control component 50 determines in step S11 whether or not conditions for ending the unfelt airflow operation are met; when the conditions are met, the control component 50 ends the unfelt airflow operation, and when the conditions are not met, the control component 50 goes back to step S9. The conditions for ending the unfelt airflow operation are as follows.

[0139] A first ending condition is that the unfelt airflow operation needs to be switched off. "Switching off the unfelt airflow operation" means switching off the unfelt airflow operation on/off switch 530 on the remote controller 52.

[0140] A second ending condition is that the outside air temperature Tout needs to be less than the predetermined permissible temperature Tper. The reason is because the air conditioner 1 becomes unable to maintain the unfelt airflow operation if the outside air temperature is too low.

[0141] A third ending condition is that the actual operating mode needs to no longer be the heating operation.

Moreover, a fourth ending condition is that the air direction setting needs to no longer be automatic.

[0142] When all of the first ending condition to the fourth ending condition are met, the control component 50 determines that the conditions for ending the unfelt airflow operation are met and ends the unfelt airflow operation.

[0143] It will be noted that, depending on the load, there is the potential for the supply capacity to be insufficient after the move to the wall airflow mode so that the wall airflow mode must be immediately stopped. When such a situation has arisen, the occurrence of this situation can be avoided by tightening conditions for the next move to the wall airflow mode and delaying the move (e.g., step S3 and/or step S5).

[0144] The above is the unfelt airflow operation, whereby at the time of a low load an energy-saving operation can be performed while maintaining the room temperature a long time without applying the outgoing air to the occupants.

(5) Characteristics

(5-1)

[0145] In the air conditioning indoor unit 10, by lowering the outgoing air temperature, the temperature of the airflow that flows along the floor surface from the wall surface in the wall airflow mode also becomes lower, so even in a case where by some chance the floor surface is not sufficiently warmed, rising of the airflow that flows along the floor surface can be suppressed more than has conventionally been the case. The wall airflow is an airflow that crawls along the floor surface from the wall surface, and it does not strike the occupants, so even when the temperature becomes lower, it is unlikely to impart a feeling of discomfort to the occupants.

(5-2)

[0146] In the outgoing air temperature suppression control, by controlling the target temperature (the upper limit temperature Tct) of the indoor heat exchanger 13 through which the outgoing air travels, the ability of the outgoing air temperature to follow the intended temperature becomes better.

(5-3)

[0147] In the preliminary operation, first, the entire air conditioning target space is warmed by the first airflow mode to a room temperature with which the user is satisfied. Next, the section of the floor from the center to the far side is warmed by the second airflow mode to suppress airflow rise caused by conditions that the floor temperature is low when the airflow mode has moved to the wall airflow mode. Moreover, the near side of the floor is warmed by the third airflow mode to prevent thermo-off caused by airflow rise directly under the air conditioning indoor unit caused by the temperature of the near side of the floor being low. As a result, even when the airflow mode is moved to the wall airflow mode, rising of the airflow is further suppressed and unnecessary thermo-off is prevented.

(5-4)

[0148] In the air conditioning indoor unit 10, the control component 50 sequentially moves from the first airflow mode to the third airflow mode on the basis of the temperature difference between the set temperature Ts and the room temperature Tr, so the room temperature becomes a comfortable temperature, and the control component 50 moves the third airflow mode to the wall airflow mode after the floor surface directly under the air conditioning indoor unit 10 also becomes warm, so airflow rise is further suppressed.

(6) Example Modifications

[0149] In the above embodiment, the determination for moving from the first airflow mode to the second airflow mode and the determination for moving from the second airflow mode to the third airflow mode are performed on the basis of the absolute value of the temperature difference between the room temperature Tr and the set temperature Ts, but the determinations are not limited to this.

[0150] FIG. 14 is a control flowchart from the preliminary operation to the start of the unfelt airflow operation in a first example modification. In FIG. 14, step S3' and step S5' are modifications of step S3 and step S5 of FIG. 13A, but steps other than these are the same as was described in FIG. 13A and FIG. 13B, so here step S3' and step S5' will be described.

(Step S3')

[0151] In step S3', the control component 50 determines whether or not the absolute value |Tr - Ts| of the temperature difference between the room temperature Tr and the set temperature Ts is equal to or less than the first threshold value $\Delta T1$ and also determines whether or not the effective floor mean temperature is equal to or greater than [set temperature Ts - Tyuka1]. When it is the case that "$|Tr - Ts| \leq \Delta T1$ and effective floor mean temperature $\geq$ [set temperature Ts - Tyuka1]", the control component 50 proceeds to step S4, and when it is not the case that "$|Tr - Ts| \leq \Delta T1$ and effective floor mean temperature $\geq$ [set temperature Ts - Tyuka1]", the control component 50 returns to step S2.

(Step S5')

[0152] In step S5', the control component 50 determines whether or not the absolute value |Tr - Ts| of the temperature difference between the room temperature

Tr and the set temperature Ts is equal to or less than the second threshold value ΔT2 and also determines whether or not the effective floor mean temperature is equal to or greater than [set temperature Ts - Tyuka2]. When it is the case that "|Tr - Ts| ≤ ΔT2 and effective floor mean temperature ≥ [set temperature Ts - Tyuka2]", the control component 50 proceeds to step S6A, and when it is not the case that "|Tr - Ts| ≤ ΔT2 and effective floor mean temperature ≥ [set temperature Ts - Tyuka2]", the control component 50 proceeds to step S6B.

[0153] By changing step S3 and step S5 of FIG. 13A to step S3' and step S5' as described above, the moving conditions become tightened, so the result is that the time in which the wall airflow mode is maintained can be lengthened.

(7) Supplement

[0154] Here, the moves from the first airflow mode to the wall airflow mode will be supplementarily described with reference to a block diagram and a graph.

[0155] FIG. 15 is a block diagram showing the conditions for moving from the first airflow mode to the wall airflow mode. As shown in FIG. 15, the airflow mode alternately moves back and forth between the first airflow mode and the second airflow mode depending on increases/decreases in room temperature/floor temperature. There is a move from the second airflow mode to the third airflow mode, but the reverse does not happen.

[0156] In the wall airflow mode, when the room temperature becomes lower, the airflow mode moves to the first airflow mode, and when the floor temperature becomes lower, the airflow mode moves to the second airflow mode.

[0157] In the case of continuing the wall airflow mode when there has been a return from thermo-off, the airflow mode moves to the third airflow mode.

[0158] FIG. 16 is a graph showing the moves from the first airflow mode to the wall airflow mode and changes in the room temperature and the effective floor mean temperature. In FIG. 16, it will be understood that from the first airflow mode to the third airflow mode the room temperature and the effective floor mean temperature rise at substantially constant pitches, and after the move to the wall airflow mode the room temperature and the effective floor mean temperature are maintained at constants.

[0159] Namely, the unfelt airflow operation exhibits an energy-saving effect by warming the room and the floor with airflow modes in three stages and then performing, with the wall airflow mode, control of the airflow that crawls along the floor surface from the wall.

REFERENCE SIGNS LIST

[0160]

10 Air Conditioning Indoor Unit
13 Indoor Heat Exchanger
15 Air Outlet
30 Air Direction Switching Means
40 Air Direction Switching Means
50 Control Component

CITATION LIST

<Patent Literature>

[0161] Patent Document 1: JP-ANo. H6-109312

Claims

1. A wall-mounted air conditioning indoor unit (10) that is installed on a side wall of an air conditioning target space and has the function of changing the air direction of outgoing air blown out from an air outlet (15), the air conditioning indoor unit comprising:

air direction switching means (30, 40) that changes the air direction of the outgoing air; and
a control component (50) that executes, via the air direction switching means (30, 40), a plurality of airflow modes that change the outgoing air to airflows corresponding to a plurality of air directions set beforehand,
wherein
the plurality of airflow modes includes a wall airflow mode that changes the outgoing air to an airflow that flows along the side wall and a floor of the air conditioning target space at the time of a heating operation, and
the control component (50) performs an outgoing air temperature suppression control that lowers the temperature of the outgoing air at the time of the execution of the wall airflow mode below what it is at the time of the execution of the other airflow modes in the heating operation.

2. The air conditioning indoor unit (10) according to claim 1, further comprising an indoor heat exchanger (13) that functions as a condenser at the time of the heating operation, wherein the control component (50) lowers a temperature target value of the indoor heat exchanger (13) in the outgoing air temperature suppression control.

3. The air conditioning indoor unit (10) according to claim 1 or claim 2, wherein
the plurality of airflow modes includes a first airflow mode that changes the outgoing air to a forward and downward airflow and a second airflow mode that changes the outgoing air to an airflow that is more downward than in the first airflow mode and heads toward the floor surface of the air conditioning target space, and

the control component (50) executes the wall airflow mode after it has sequentially executed the first airflow mode and the second airflow mode.

4. The air conditioning indoor unit (10) according to claim 3, wherein
the plurality of airflow modes further includes a third airflow mode that changes the outgoing air to an airflow heading toward a lower portion of the side wall, and
the control component (50) executes the wall airflow mode after it has sequentially executed the first airflow mode, the second airflow mode, and the third airflow mode.

5. The air conditioning indoor unit (10) according to claim 4, wherein
the control component (50) finds a temperature difference between a room temperature, which is the temperature of the air conditioning target space, and a set temperature, which is a target value of the room temperature,
the control component (50) moves the airflow mode from the first airflow mode to the second airflow mode when the absolute value of the temperature difference has become equal to or less than a first threshold value during execution of the first airflow mode, and
the control component (50) moves the airflow mode from the second airflow mode to the third airflow mode when the absolute value of the temperature difference has become equal to or less than a second threshold value during execution of the second airflow mode.

6. The air conditioning indoor unit (10) according to claim 4, wherein the control component (50) moves the airflow mode from the third airflow mode to the wall airflow mode after the elapse of a first predetermined amount of time since moving to the third airflow mode.

7. The air conditioning indoor unit (10) according to claim 5, wherein when, after the move to the wall airflow mode, the absolute value of the temperature difference has exceeded a third threshold value before the duration of the wall airflow mode reaches a second predetermined amount of time, the control component (50) delays the next move to the wall airflow mode.

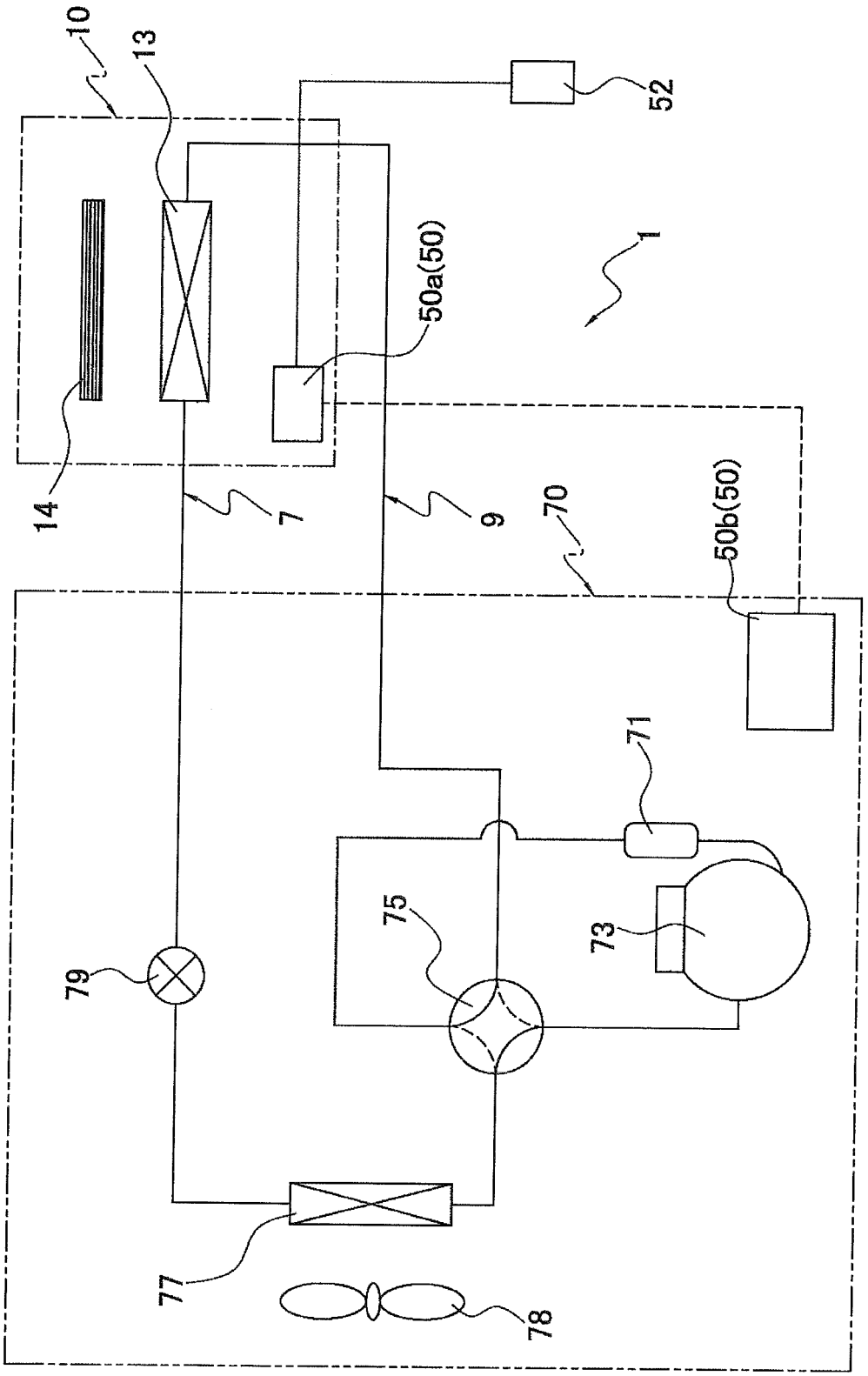


FIG. 1

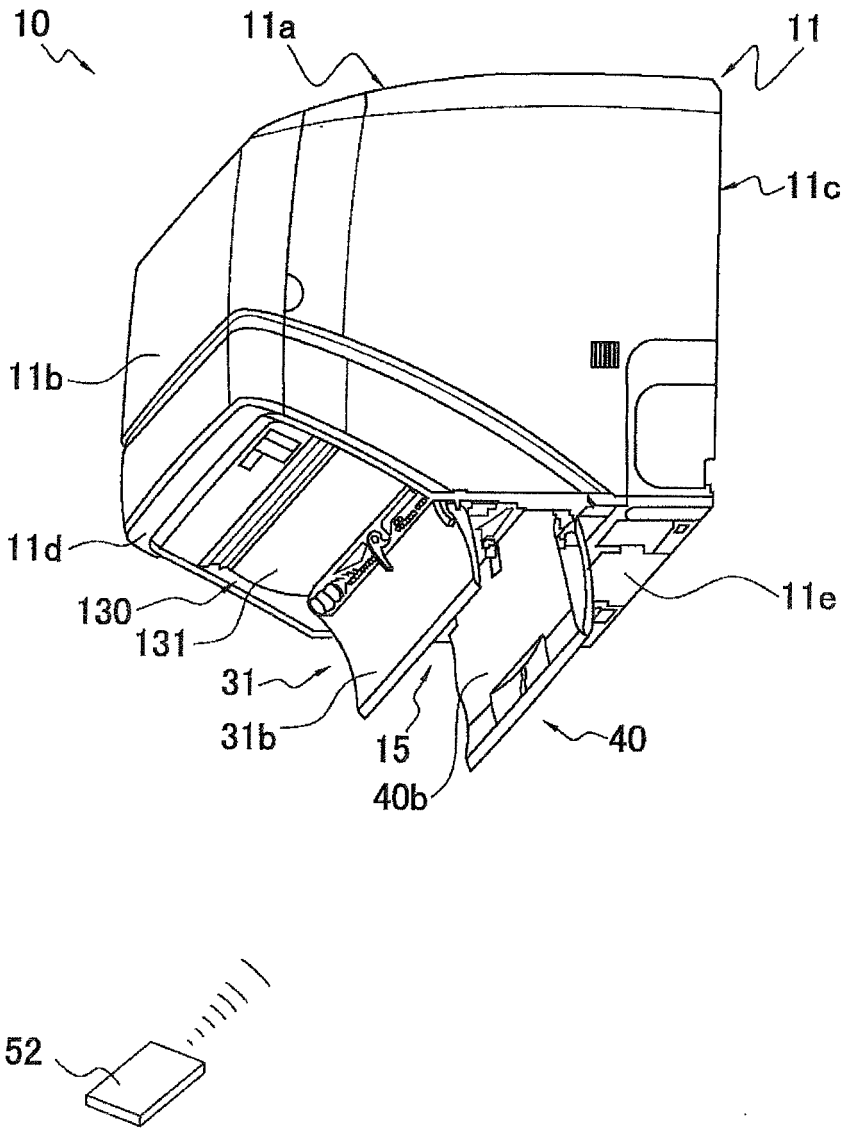


FIG. 2

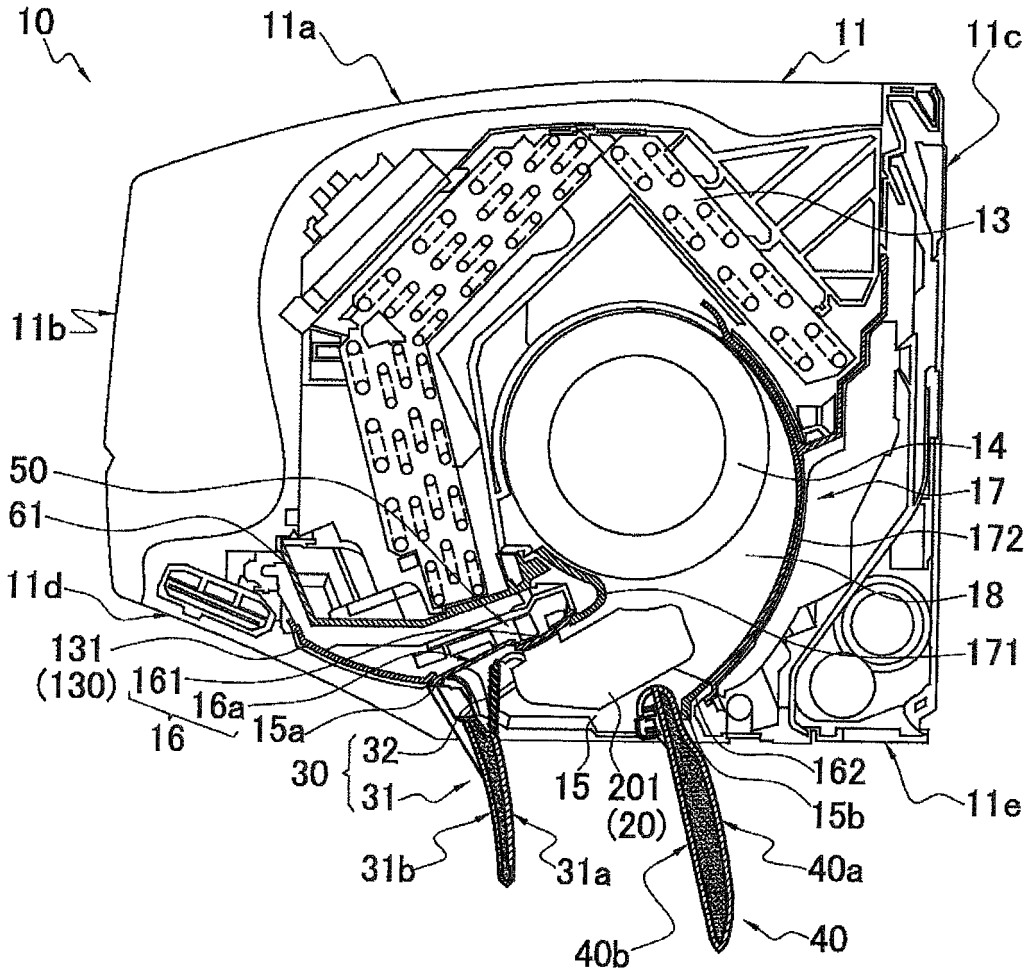

10
11a
11
11c
13
11b
50
61
11d
131
(130)
161
16a
15a
16
30
32
31
31b
31a
15
201
(20)
40b
40
40a
15b
162
11e
171
18
172
17
14

FIG. 3

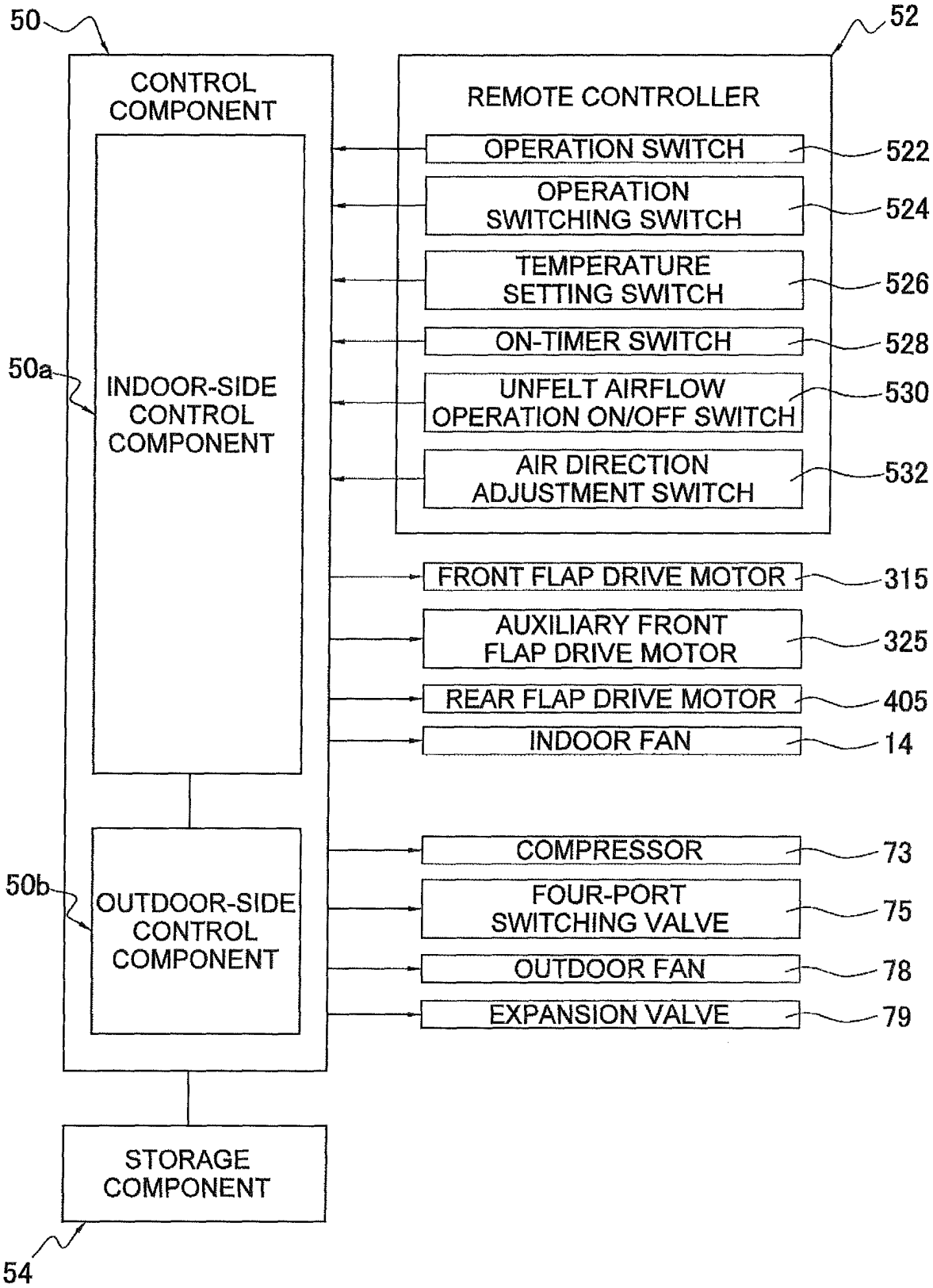

50
CONTROL COMPONENT
50a
INDOOR-SIDE CONTROL COMPONENT
50b
OUTDOOR-SIDE CONTROL COMPONENT
STORAGE COMPONENT
54
52
REMOTE CONTROLLER
OPERATION SWITCH
522
OPERATION SWITCHING SWITCH
524
TEMPERATURE SETTING SWITCH
526
ON-TIMER SWITCH
528
UNFELT AIRFLOW OPERATION ON/OFF SWITCH
530
AIR DIRECTION ADJUSTMENT SWITCH
532
FRONT FLAP DRIVE MOTOR
315
AUXILIARY FRONT FLAP DRIVE MOTOR
325
REAR FLAP DRIVE MOTOR
405
INDOOR FAN
14
COMPRESSOR
73
FOUR-PORT SWITCHING VALVE
75
OUTDOOR FAN
78
EXPANSION VALVE
79

FIG. 4

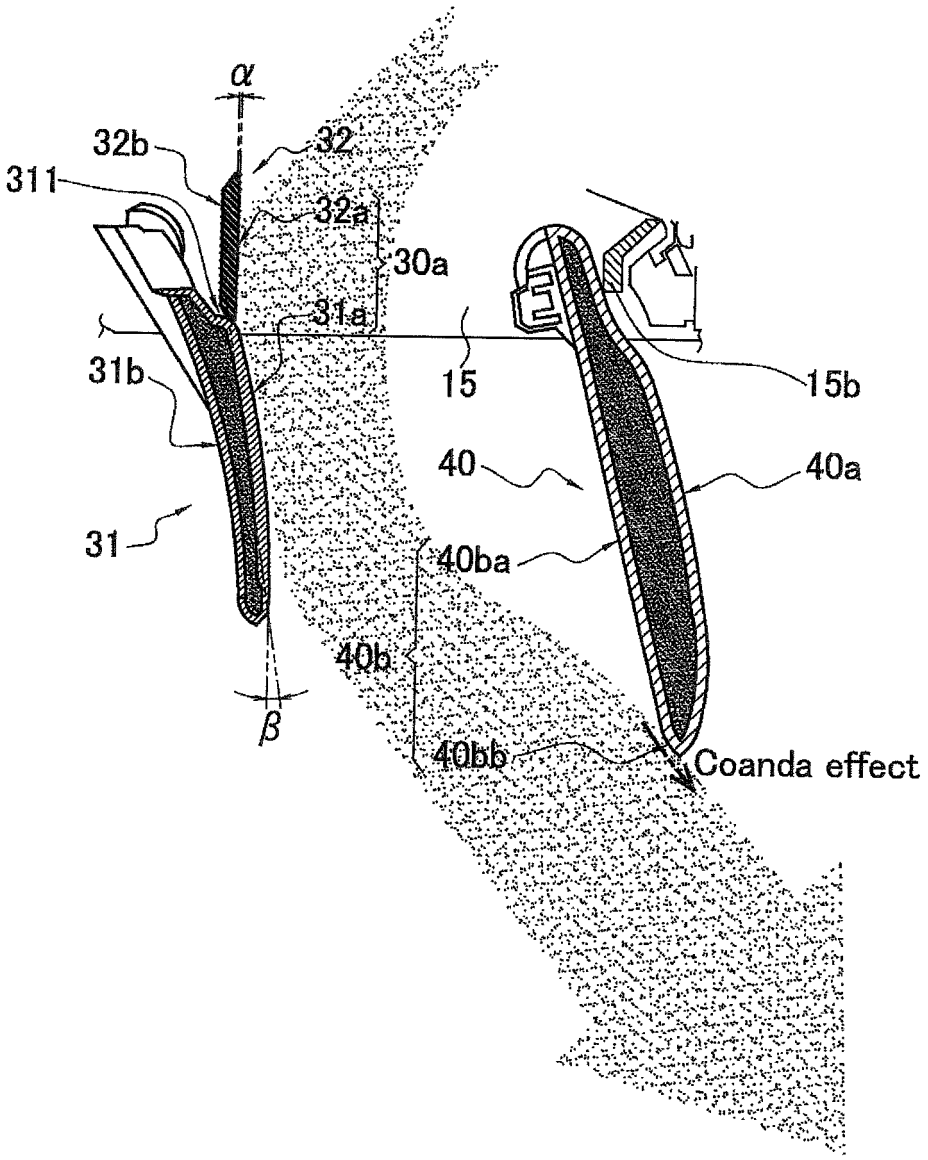

α
32b
32
311
32a
30a
31a
15
15b
31b
40
40a
31
40ba
40b
β
40bb
Coanda effect

FIG. 5

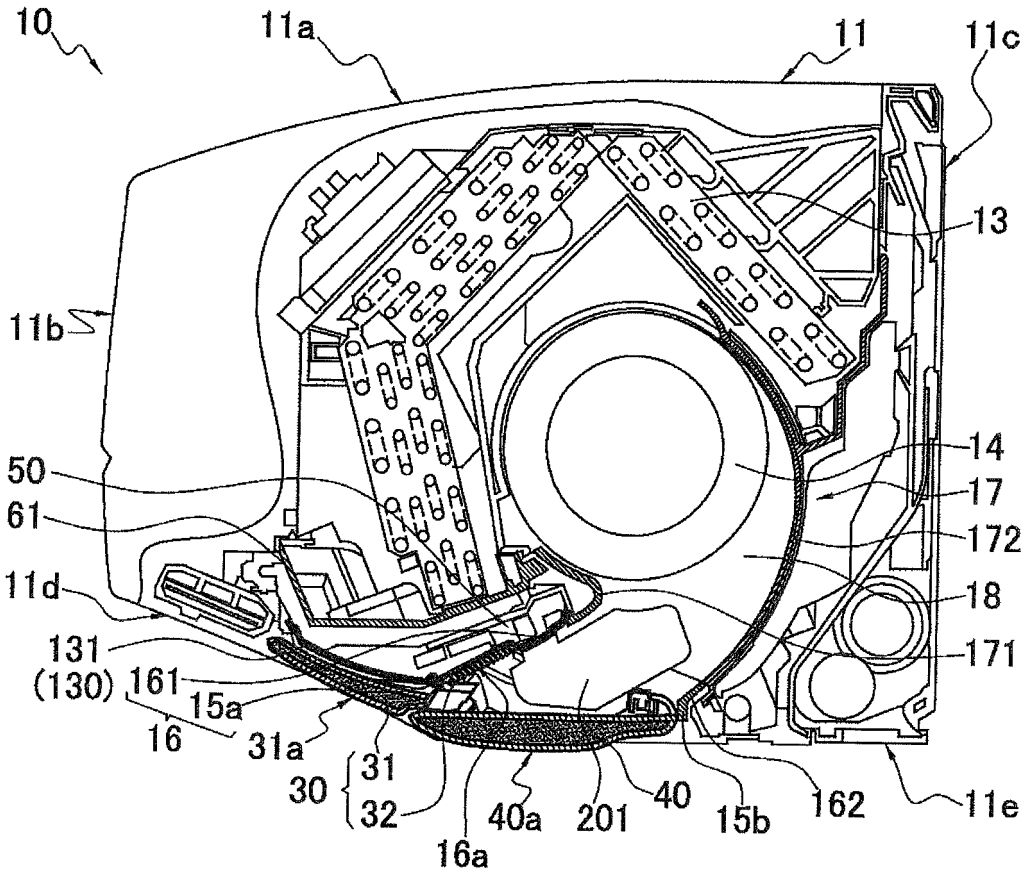

10
11a
11
11c
13
11b
50
61
14
17
172
11d
18
131
171
(130)
161
15a
16
31a
30
31
32
16a
40a
201
40
15b
162
11e

FIG. 6

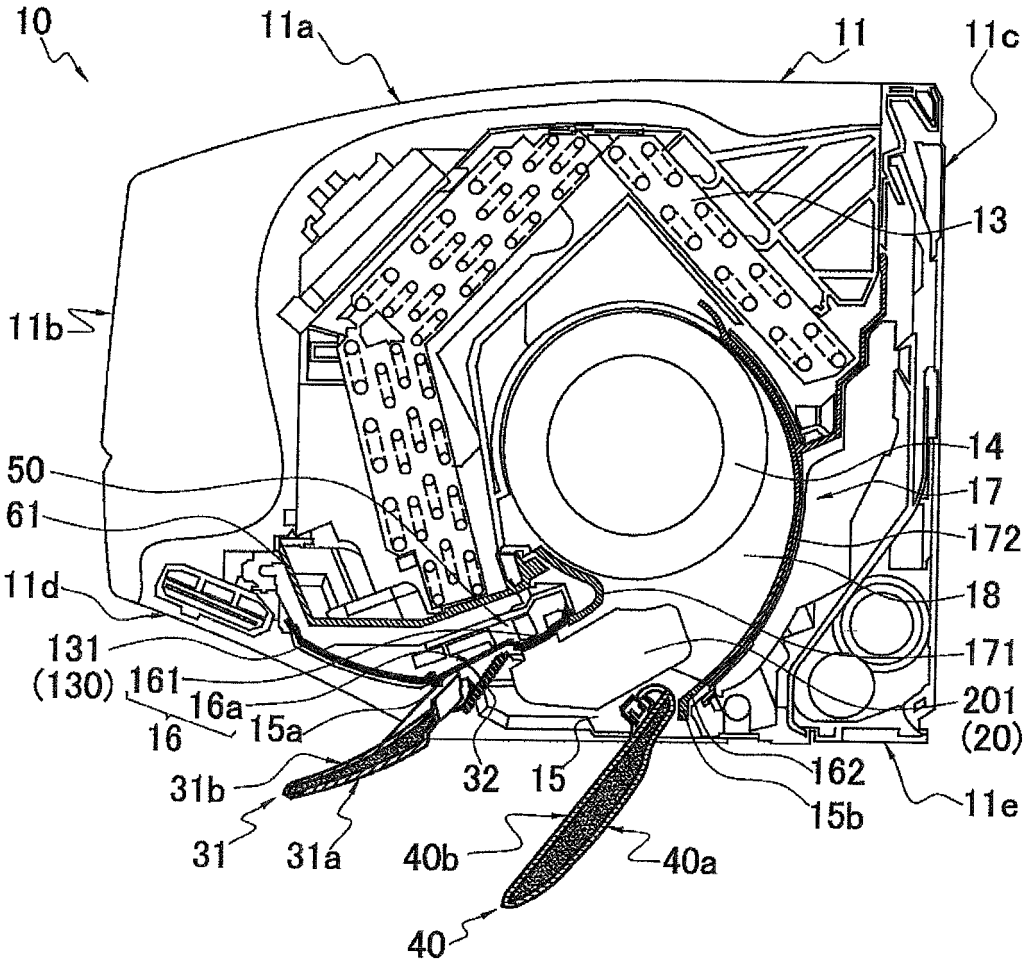

10
11a
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11c
13
11b
50
61
14
17
172
11d
18
131
(130)
161
16a
15a
16
171
201
(20)
31b
32
15
162
15b
11e
31
31a
40b
40a
40

FIG. 7

FIG. 8

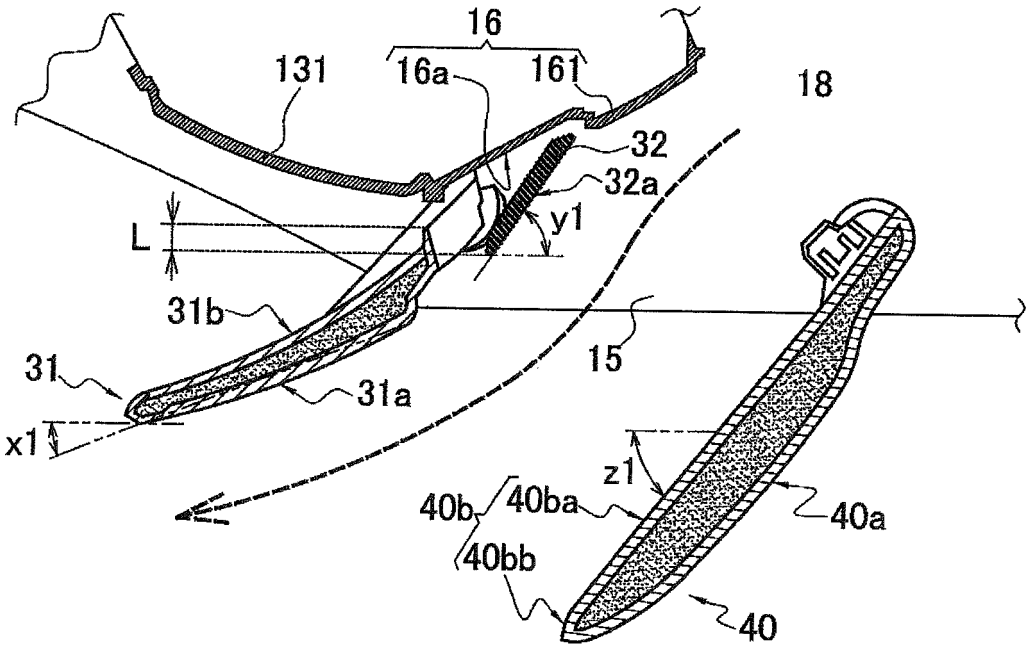

16
131
16a
161
18
32
32a
y1
L
31b
31
31a
15
x1
z1
40b
40ba
40a
40bb
40

FIG. 9

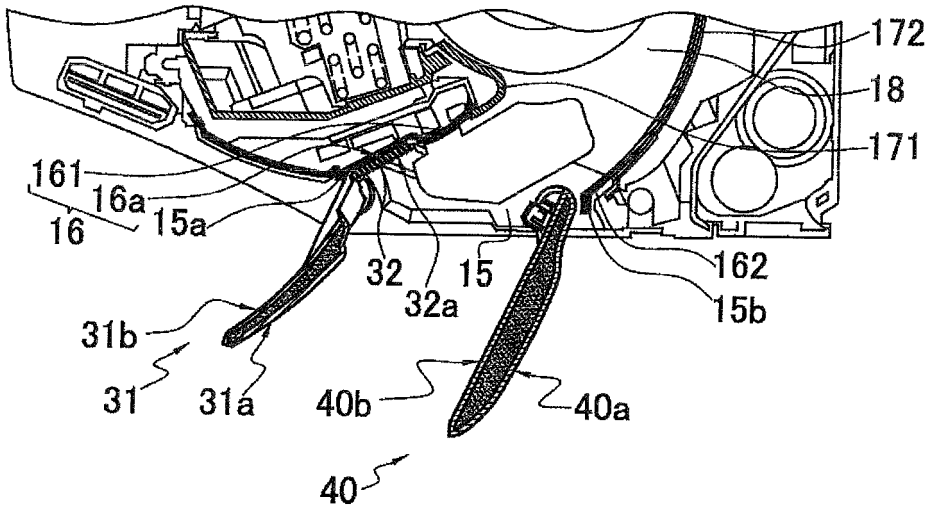

172
18
171
161
16a
16
15a
32
15
32a
162
15b
31b
31
31a
40b
40a
40

FIG. 10

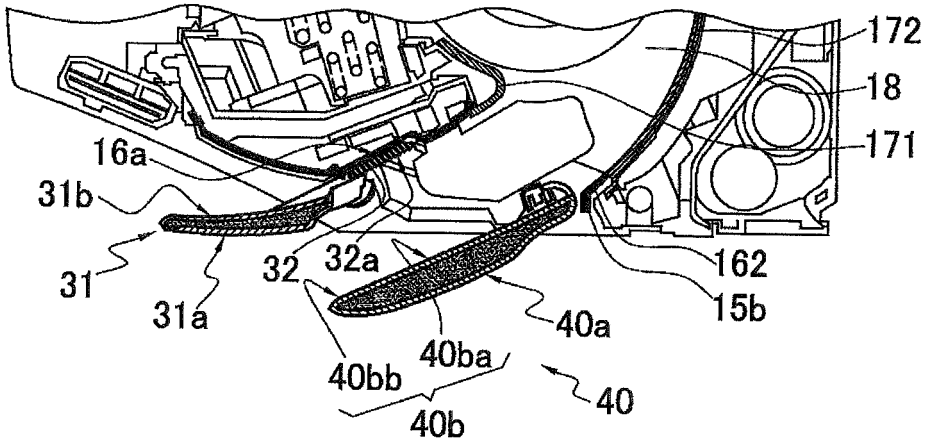

172
18
171
16a
31b
31
31a
32
32a
162
15b
40a
40ba
40bb
40
40b

FIG. 11

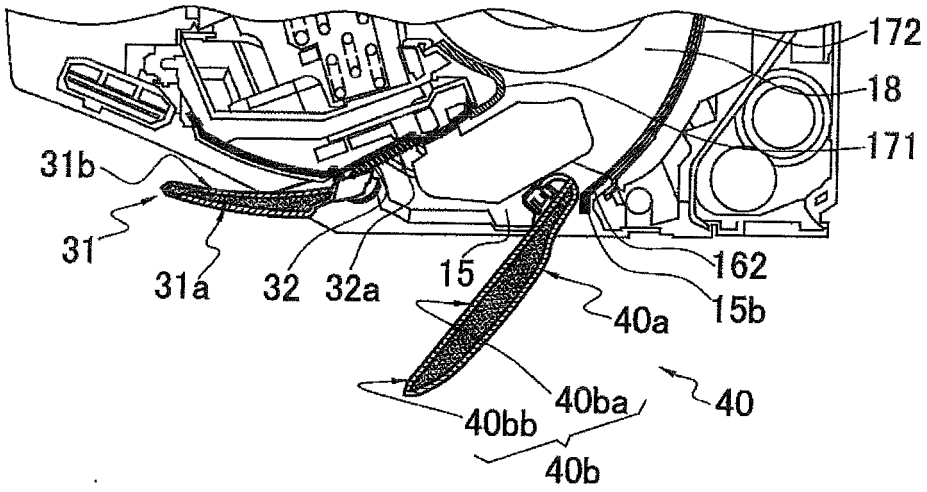

172
18
171
31b
31
31a
32
32a
15
162
15b
40a
40ba
40bb
40
40b

FIG. 12A

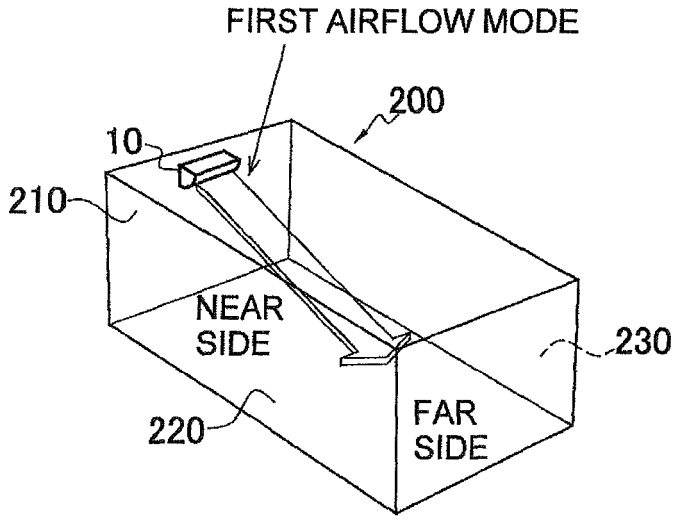


FIG. 12B

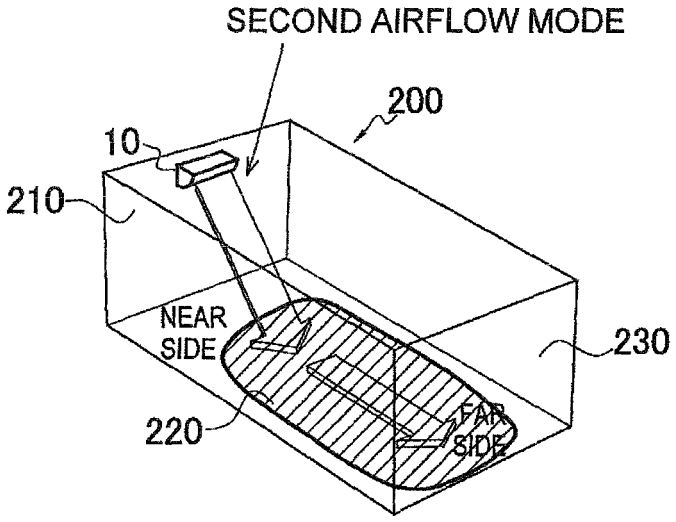


FIG. 12C

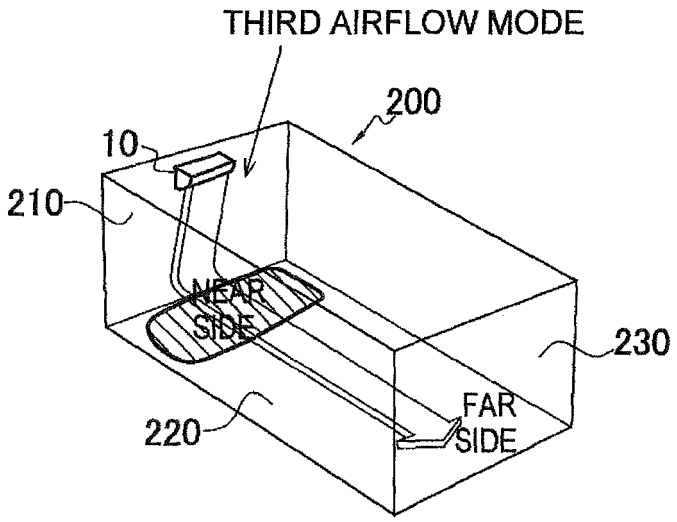
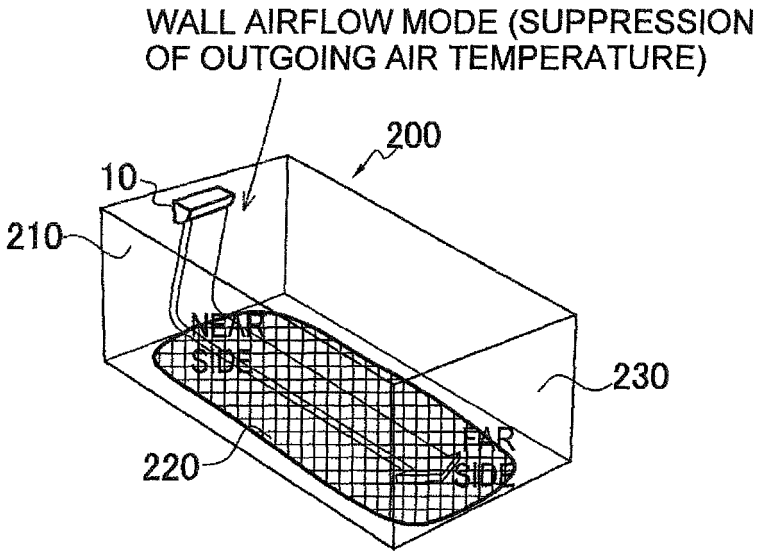


FIG. 12D



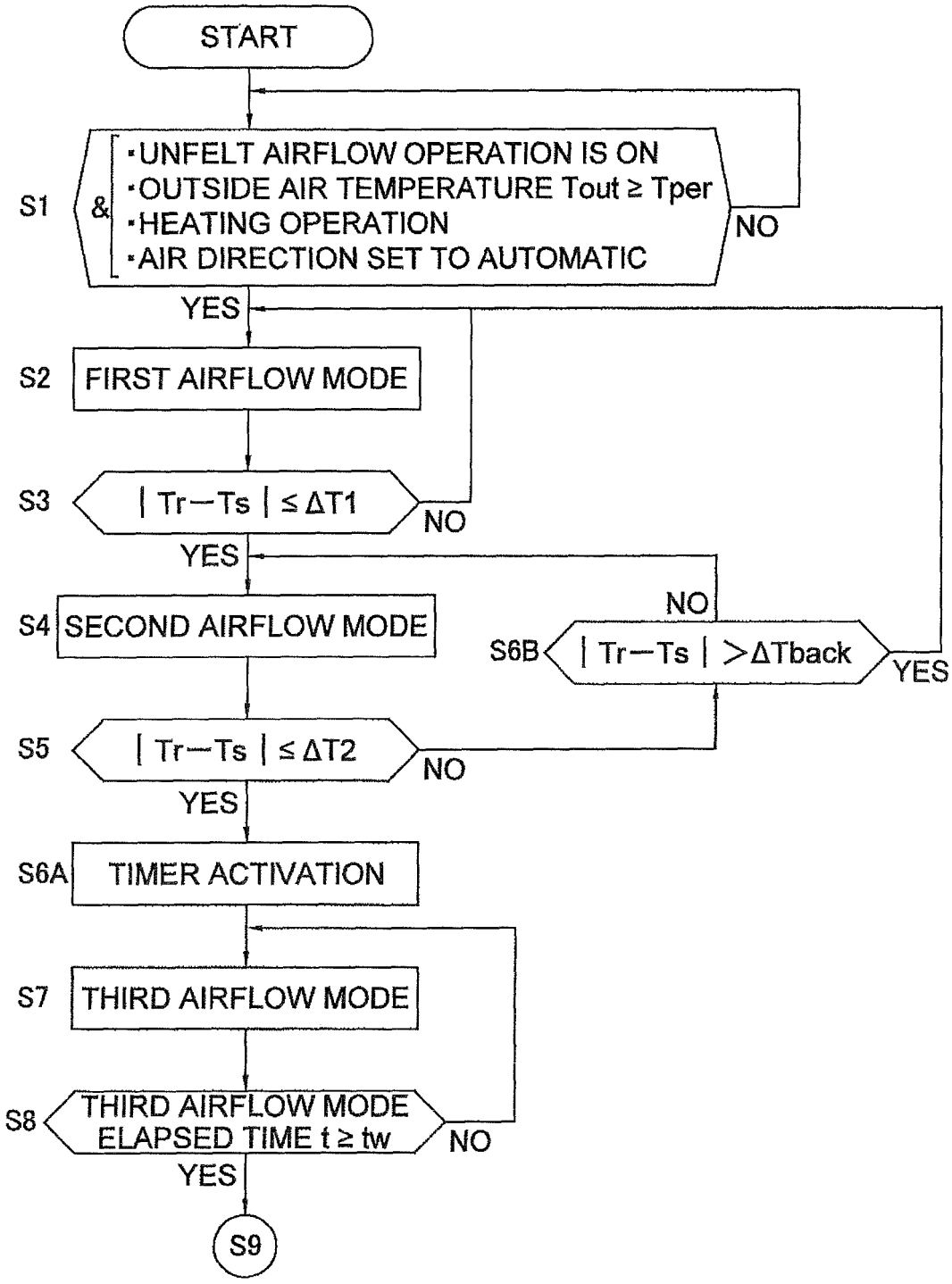

START
S1
&
・UNFELT AIRFLOW OPERATION IS ON
・OUTSIDE AIR TEMPERATURE Tout ≥ Tper
・HEATING OPERATION
・AIR DIRECTION SET TO AUTOMATIC
NO
YES
S2
FIRST AIRFLOW MODE
S3
| Tr−Ts | ≤ ΔT1
NO
YES
S4
SECOND AIRFLOW MODE
NO
S6B
| Tr−Ts | >ΔTback
YES
S5
| Tr−Ts | ≤ ΔT2
NO
YES
S6A
TIMER ACTIVATION
S7
THIRD AIRFLOW MODE
S8
THIRD AIRFLOW MODE
ELAPSED TIME t ≥ tw
NO
YES
S9

FIG. 13A

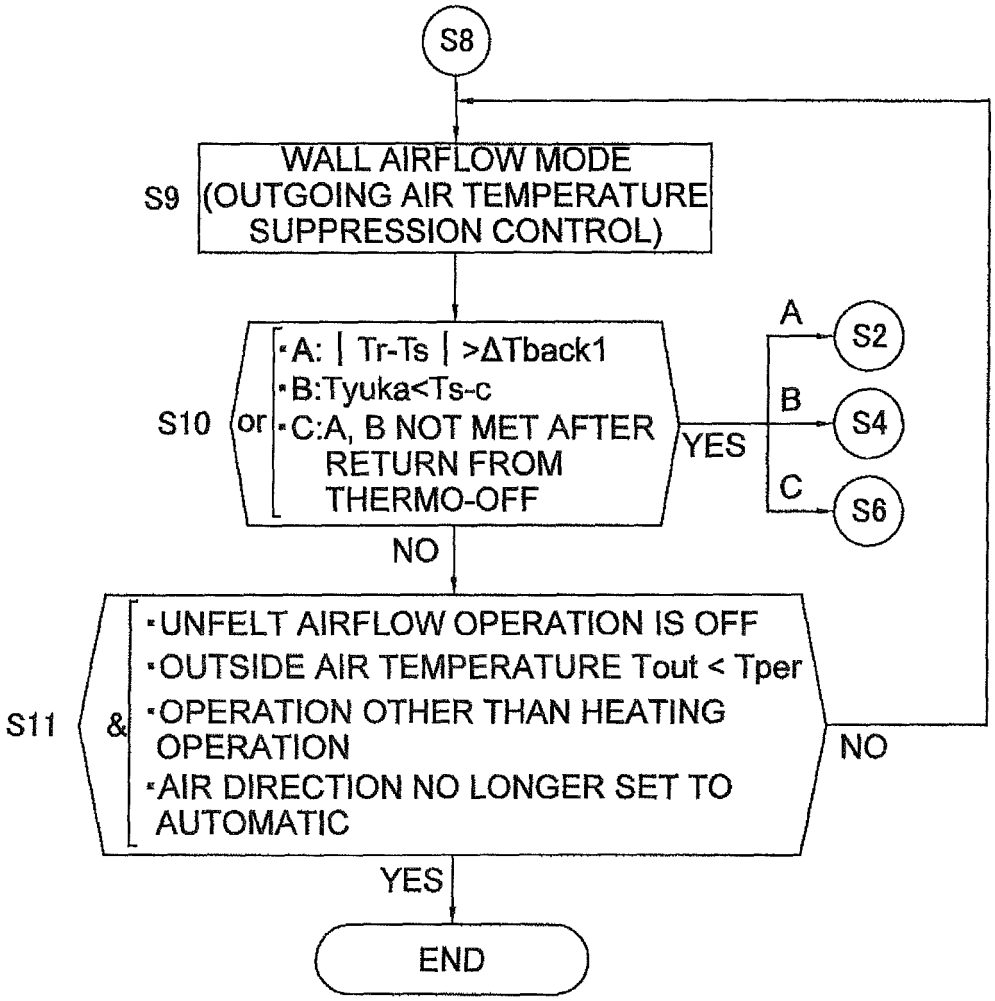

S8
S9
WALL AIRFLOW MODE
(OUTGOING AIR TEMPERATURE SUPPRESSION CONTROL)
S10
or
A: | Tr-Ts | >ΔTback1
B:Tyuka<Ts-c
C:A, B NOT MET AFTER RETURN FROM THERMO-OFF
YES
A
S2
B
S4
C
S6
NO
S11
&
UNFELT AIRFLOW OPERATION IS OFF
OUTSIDE AIR TEMPERATURE Tout < Tper
OPERATION OTHER THAN HEATING OPERATION
AIR DIRECTION NO LONGER SET TO AUTOMATIC
NO
YES
END

FIG. 13B

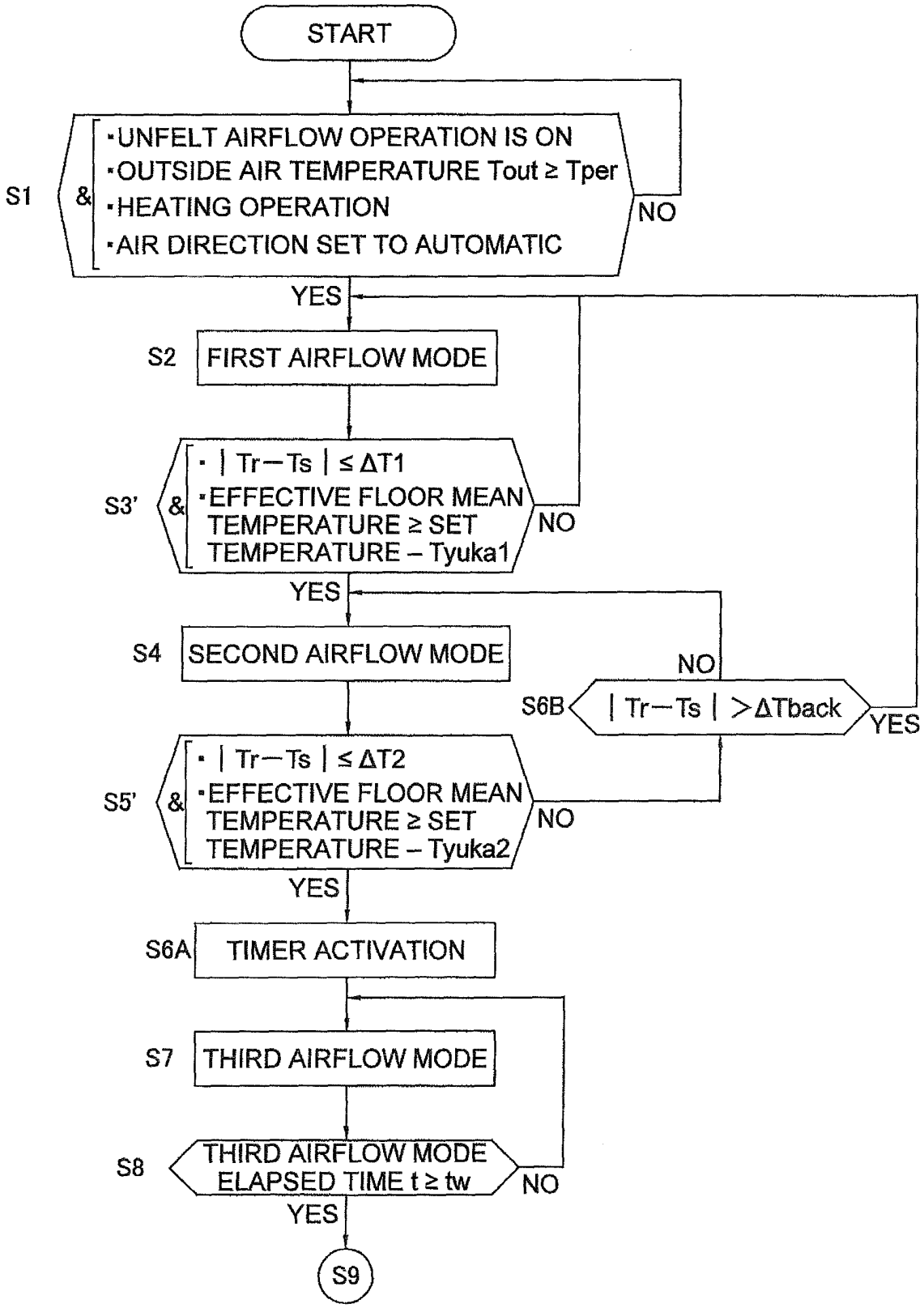

START
S1
&
・UNFELT AIRFLOW OPERATION IS ON
・OUTSIDE AIR TEMPERATURE Tout ≥ Tper
・HEATING OPERATION
・AIR DIRECTION SET TO AUTOMATIC
NO
YES
S2
FIRST AIRFLOW MODE
S3'
&
・| Tr−Ts | ≤ ΔT1
・EFFECTIVE FLOOR MEAN TEMPERATURE ≥ SET TEMPERATURE − Tyuka1
NO
YES
S4
SECOND AIRFLOW MODE
S6B
| Tr−Ts | >ΔTback
NO
YES
S5'
&
・| Tr−Ts | ≤ ΔT2
・EFFECTIVE FLOOR MEAN TEMPERATURE ≥ SET TEMPERATURE − Tyuka2
NO
YES
S6A
TIMER ACTIVATION
S7
THIRD AIRFLOW MODE
S8
THIRD AIRFLOW MODE ELAPSED TIME t ≥ tw
NO
YES
S9

FIG. 14

FIG. 15

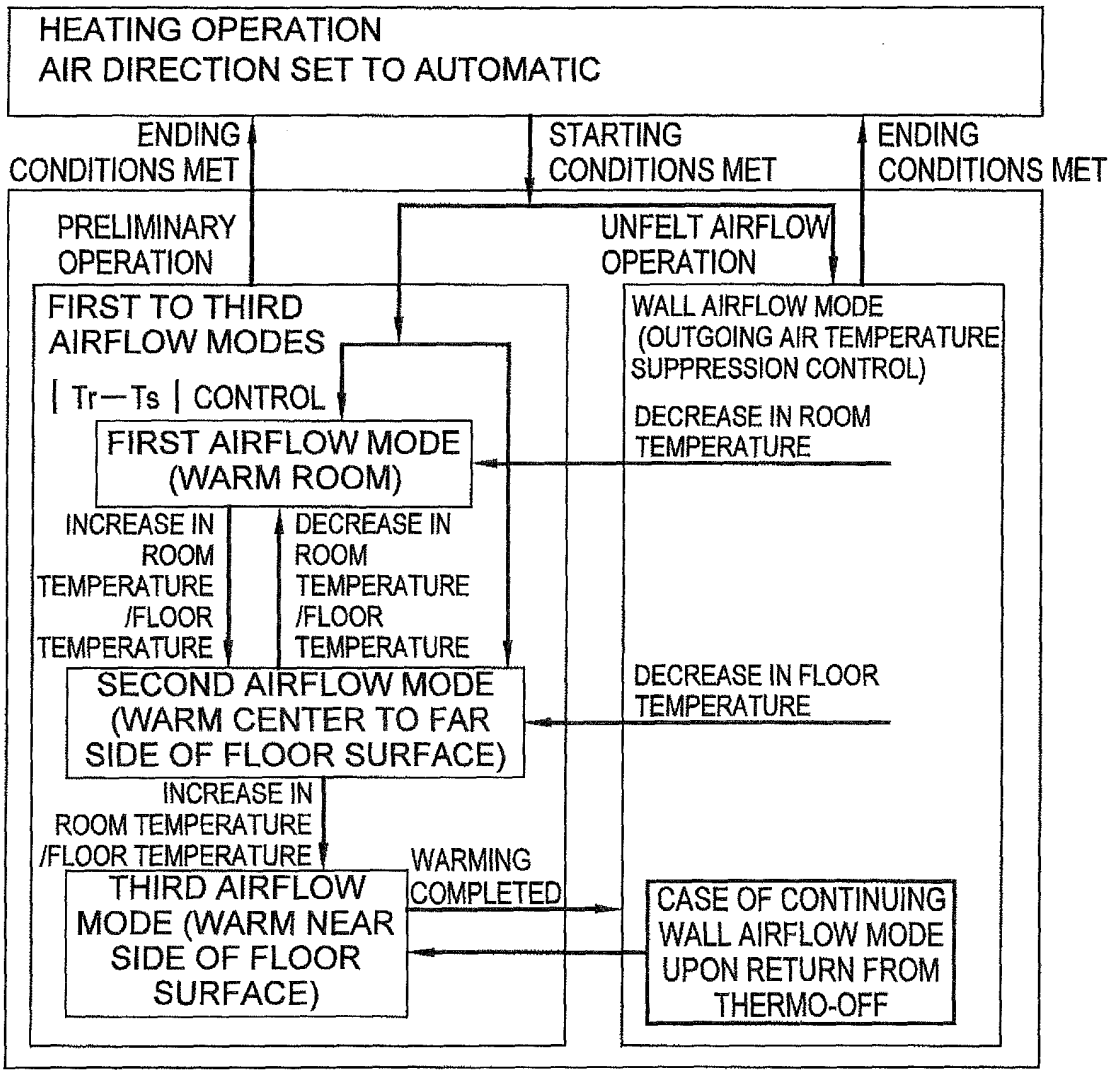
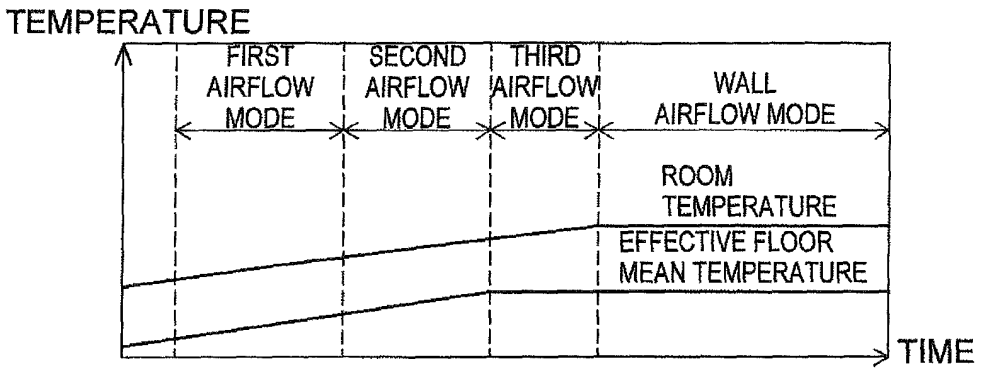

HEATING OPERATION
AIR DIRECTION SET TO AUTOMATIC
ENDING CONDITIONS MET
STARTING CONDITIONS MET
ENDING CONDITIONS MET
PRELIMINARY OPERATION
UNFELT AIRFLOW OPERATION
FIRST TO THIRD AIRFLOW MODES
| Tr—Ts | CONTROL
FIRST AIRFLOW MODE (WARM ROOM)
INCREASE IN ROOM TEMPERATURE /FLOOR TEMPERATURE
DECREASE IN ROOM TEMPERATURE /FLOOR TEMPERATURE
SECOND AIRFLOW MODE (WARM CENTER TO FAR SIDE OF FLOOR SURFACE)
INCREASE IN ROOM TEMPERATURE /FLOOR TEMPERATURE
WARMING COMPLETED
THIRD AIRFLOW MODE (WARM NEAR SIDE OF FLOOR SURFACE)
WALL AIRFLOW MODE (OUTGOING AIR TEMPERATURE SUPPRESSION CONTROL)
DECREASE IN ROOM TEMPERATURE
DECREASE IN FLOOR TEMPERATURE
CASE OF CONTINUING WALL AIRFLOW MODE UPON RETURN FROM THERMO-OFF

FIG. 16


TEMPERATURE
FIRST AIRFLOW MODE
SECOND AIRFLOW MODE
THIRD AIRFLOW MODE
WALL AIRFLOW MODE
ROOM TEMPERATURE
EFFECTIVE FLOOR MEAN TEMPERATURE
TIME

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/078320

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

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

B. FIELDS SEARCHED

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

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-308930 A (Sharp Corp.), 04 November 2004 (04.11.2004), paragraphs [0022] to [0043]; fig. 1 to 5 (Family: none)	1-7
A	JP 5-157320 A (Toshiba Corp.), 22 June 1993 (22.06.1993), paragraphs [0012] to [0023]; fig. 1 to 5 (Family: none)	1-7

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
25 November 2016 (25.11.16)	06 December 2016 (06.12.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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Patent documents cited in the description

- JP H6109312 A **[0002] [0161]**
- JP 2013076530 A **[0095]**