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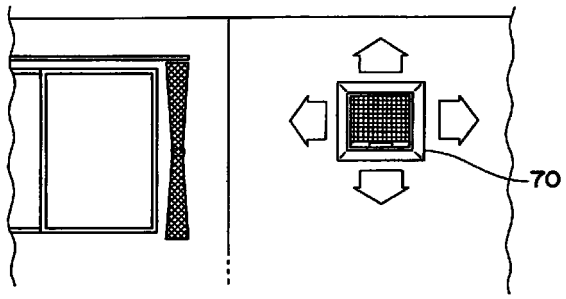
(54) METHOD AND APPARATUS FOR CONTROLLING AIR FLOW IN INDOOR MACHINE OF AIR CONDITIONER

(57) There is provided an airflow control method and airflow controller for an air conditioner indoor unit capable of executing air conditioning so that indoor temperature distribution becomes uniform without any sense of airflow during heating operation. There are provided a turbofan 3 that has an axis extending in an anteroposterior direction and blows air taken in from a front surface side radially outwardly with respect to an axis inside a casing and a heat exchanger 5 disposed on the front surface side of the turbofan 3 inside the casing. The casing is provided with outlet ports for blowing air from the turbofan 3 in the vertical direction and the horizontal direction. During the heating operation, a control signal is outputted by a flap control section 10a to an upper flap stepping motor 41 and a left-hand flap stepping motor 44 so as to narrow the openings of the upper, right-hand and left-hand flaps and make the opening of the lower flap wider than the openings of the upper, right-hand and left-hand flaps.

Fig. 7



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Description

TECHNICAL FIELD

[0001] The present invention relates to an airflow control method and airflow controller for an air conditioner indoor unit to execute indoor air conditioning.

BACKGROUND ART

[0002] There has conventionally been an air conditioner indoor unit that includes a cross-fin heat exchanger and a cross-flow fan provided inside a roughly rectangle-shaped casing mounted on a wall surface and blows conditioning air from an outlet port provided in the lower portion of the casing.

[0003] However, in the above air conditioner indoor unit, as shown in Fig. 8A, the blowoff wind direction of the conditioning air of an indoor unit 80 mounted on the wall surface is almost limited to one direction. Therefore, the human being tends to feel a sense of airflow in a living space S1 during heating operation or particularly at the time of starting the heating operation. Furthermore, a uniform temperature distribution cannot be obtained unless a flap for controlling the blowoff wind direction is operated to swing, and this leads to a problem of comfort.

DISCLOSURE OF THE INVENTION

[0004] Accordingly, the object of the present invention is to provide an airflow control method and airflow controller for an air conditioner indoor unit capable of executing air conditioning so that the indoor temperature distribution becomes uniform with no flap swing function without causing a sense of airflow during heating operation.

[0005] In order to achieve the above object, the present invention provides an airflow control method for an air conditioner indoor unit including a casing, a turbofan that has an axis extending in an anteroposterior direction and blows air taken in from a front surface side radially outwardly with respect to an axis inside the casing, a heat exchanger disposed on the front surface side of the turbofan inside the casing, outlet ports that are provided for the casing and blow air from the turbofan in a vertical direction and a horizontal direction and flaps for controlling wind directions of the blowoff air from the respective outlet ports, wherein, openings of upper, right-hand and left-hand flaps are narrowed and opening of a lower flap is made wider than the openings of the upper, right-hand and left-hand flaps during heating operation.

[0006] According to the airflow control method for the air conditioner indoor unit of the present invention, the blowoff air flows and circulates so as to cover the indoor living space along the wall surface, ceiling surface and floor surface by virtue of the four-direction blowoff. Then, by narrowing the openings of the upper flap, right-hand flap and left-hand flap and making the opening of lower flap wider than the openings of the above flaps during heating operation, the blowoff air volume from the outlet ports located on the upper side, right-hand side and left-hand side is reduced to consequently increase the air volume from the outlet port located on the lower side. This allows the indoor air to circulate and further allows warm air to reach the level of feet. Therefore, air conditioning can be achieved so that the indoor temperature distribution becomes uniform with no flap swing function without causing a sense of airflow during the heating operation. The total volume of blowoff air from the upper, lower, right-hand and left-hand outlet ports at the time of starting the heating operation at a low temperature in the living space scarcely changes, and therefore, the indoor heating can be immediately achieved without reducing the heating capacity.

[0007] The present invention also provides an airflow controller for an air conditioner indoor unit including a casing, a turbofan that has an axis extending in an anteroposterior direction and blows air taken in from a front surface side radially outwardly with respect to an axis inside the casing, a heat exchanger disposed on the front surface side of the turbofan inside the casing, outlet ports that are provided for the casing and blow air from the turbofan in a vertical direction and a horizontal direction and flaps for controlling wind directions of the blowoff air from the respective outlet ports, the controller comprising:

> drive sections for driving the flaps, respectively; and
> a flap control section for outputting control signals to the drive sections in a manner that openings of upper, right-hand and left-hand flaps are narrowed and opening of a lower flap is made wider than the openings of the upper, right-hand and left-hand flaps during heating operation.

[0008] According to the airflow controller for the air conditioner indoor unit of the present invention, the blowoff air flows and circulates so as to cover the indoor living space along the wall surface, ceiling surface and floor surface by virtue of the four-direction blowoff. Then, by narrowing the openings of the upper flap, right-hand flap and left-hand flap and making the opening of lower flap wider than the openings of the above flaps with the control signal outputted to the drive section by the flap control section during heating operation, the blowoff air volume from the outlet ports located on the upper side, right-hand side and left-hand side is reduced to consequently increase the air volume from the outlet port located on the lower side. This allows the indoor air to circulate and further allows warm air to reach the level of feet. Therefore, air conditioning can be achieved so that the indoor temperature distribution becomes uniform with no flap swing function without

causing a sense of airflow during the heating operation. The total volume of blowoff air from the upper, lower, right-hand and left-hand outlet ports at the time of starting the heating operation at a low temperature in the living space scarcely changes, and therefore, the indoor heating can be immediately achieved without reducing the heating capacity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is an exploded perspective view of the essential part of an indoor unit using an airflow control method for an air conditioner indoor unit according to one embodiment of the present invention;
Fig. 2 is a front view of the above indoor unit;
Fig. 3 is a sectional view taken along the line III-III of Fig. 2;
Fig. 4 is a schematic view of the above indoor unit;
Fig. 5 is a sectional view showing the essential part of the outlet port structure on the upper side of the indoor unit;
Fig. 6 is a sectional view showing the essential part of the outlet port structures on the lower side, right-hand side and left-hand side of the indoor unit;
Fig. 7 is a view showing a state in which the above indoor unit is mounted on an indoor wall surface;
Fig. 8A is a view showing the wind blowing state of the indoor unit of a prior art air conditioner; and
Fig. 8B is a view showing the wind blowing state of the indoor unit of the air conditioner of the embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0010] The airflow control method and airflow controller for the air conditioner indoor unit of the present invention will be described in detail below on the basis of the embodiments shown in the drawings.

[0011] Fig. 1 is an exploded perspective view of the essential part of an indoor unit that uses the airflow control method for the air conditioner indoor unit according to one embodiment of the present invention and includes a roughly square-shaped bottom frame 1 fastened to an indoor wall surface on its rear surface side, a motor 2 fastened via a motor clamping plate 12 to a mounting section 11 provided roughly at the center of the bottom frame 1, a turbofan 3 whose axis is arranged in the anteroposterior direction with respect to the bottom frame 1 and driven by the motor 2 to blow air taken in from the front surface side radially outwardly with respect to the axis, a bellmouth 4 fastened to the bottom frame 1 on the front surface side of the turbofan 3, a heat exchanger 5 fastened on the front surface side of the bellmouth 4, a front panel 6 that is fastened to the bottom frame 1 on the front surface side of the heat exchanger 5 and has a roughly square-shaped inlet port 6a and an inlet grill 7 that is fastened to the inlet port 6a of the front panel 6 and is provided with an air filter 8 attached to its rear surface side. A circular hole 14 is provided roughly at the center of the bellmouth 4, and a drain pan 13 is provided in the lower portion of the bellmouth 4. It is to be noted that the bottom frame 1 and the front panel 6 constitute a casing.

[0012] Fig. 2 shows a front view of the air conditioner indoor unit with the inlet grill 7 and the front panel 6 shown in Fig. 1 removed. As shown in Fig. 2, an outlet port 21, an outlet port 22, an outlet port 23 and an outlet port 24 are provided on the upper side, lower side, right-hand side and left-hand side, respectively, of the bottom frame 1. The outlet ports 21 through 24 are provided with an upper flap 31, a lower flap 32, a right-hand flap 33 and a left-hand flap 34, respectively. The upper flap 31, lower flap 32, right-hand flap 33 and left-hand flap 34 are driven by an upper flap stepping motor 41, a lower flap stepping motor 42, a right-hand flap stepping motor 43 and a left-hand flap stepping motor 44, respectively, to control the blowoff wind direction from the outlet ports 21 through 24.

[0013] Fig. 3 is a sectional view taken along the line III-III of Fig. 2, where the turbofan 3 and the heat exchanger 5 are reduced in thickness and the motor 2 fastened to the bottom frame 1 is housed in a recess portion defined by the curved surface 3a of the turbofan 3. Air taken in from the front surface by the turbofan 3 is blown from the upper, lower, right-hand and left-hand outlet ports 21 and 22 (only two are shown in Fig. 3) as indicated by the arrows R1 and R2 via the inlet grill 7, the air filter 8 and the heat exchanger 5. The outlet port 21 located on the upper side blows air from the turbofan 3 forwardly diagonally upward when the upper flap 31 has a specified opening, so that the wind direction makes an angle of approximately 60 degrees with respect to a plane perpendicular to the axis of the turbofan 3. On the other hand, the outlet port 22 on the lower side blows air from the turbofan 3 forwardly diagonally downward when the lower flap 32 has a specified opening, so that the wind direction makes an angle of approximately 30 degrees with respect to the plane perpendicular to the axis of the turbofan 3. The outlet port 23 on the left-hand side and the outlet port 24 on the right-hand side (shown in Fig. 2) have the same constructions as that of the outlet port 22 on the lower side and blows air from the turbofan 3 forwardly diagonally sideward when the right-hand flap 33 and the left-hand flap 34 (shown in Fig. 2) have a specified opening, so that the wind direction makes an angle of approximately 30 degrees with respect to the vertical plane including the axis of the turbofan 3.

[0014] Fig. 4 schematically shows the construction of the above indoor unit. The above indoor unit is provided with a drive section constructed of the upper flap stepping motor 41, lower flap stepping motor 42, right-hand flap stepping motor 43 and left-hand flap stepping motor 44 and the controller 10 for controlling the step-

ping motors 41 through 44, the turbofan 3 and so on. The controller 10 is constructed of a microcomputer, an input/output circuit and so on and includes a flap control section 10a for controlling the openings of the upper flap 31, lower flap 32, right-hand flap 33 and left-hand flap 34 by outputting a control signal to the stepping motors 41 through 44 according to the state of operation. The stepping motors 41 through 44 and the flap control section 10a of the controller 10 constitute an airflow controller.

[0015] Figs. 5 and 6 are sectional views of the essential part of the outlet port located on the upper side of the air conditioner indoor unit and the essential part of the outlet ports located on the lower side, right-hand side and left-hand side of the air conditioner indoor unit. It is to be noted that Figs. 5 and 6 are provided for explaining the detail of the air conditioner outlet port structure and are different from the outlet port structure of the indoor unit shown in Fig. 3.

[0016] As shown in Fig. 5, a guide section 51 having a curved surface 51a that is gradually curved forwardly diagonally from the turbofan 3 side is arranged on the rear surface side of an outlet port 53 located on the upper side of a casing 50. A guide section 52 having a curved surface 52a that is gradually curved forwardly diagonally from the turbofan 3 side is arranged on the front surface side of the outlet port 53. These guide sections 51 and 52 form a blowoff path for blowing the conditioning air forwardly diagonally upward. An upper flap 54 that is rotatably supported at a pivot pin 55 is attached to the outlet port 53. The upper flap 54 has its front edge side curved toward the turbofan 3 side so that air smoothly flows along the blowoff path in a state in which the flap is opened with a specified opening. A plurality of vertical plates 56 (only one is shown in Fig. 5) extending roughly perpendicularly at regular intervals are provided on the front surface side of the wing surface of the upper flap 54. Airflow control of air blown from the turbofan 3 is executed so that the wind direction comes to have an angle of approximately 60 degrees with respect to the plane perpendicular to the axis of the turbofan 3 forwardly diagonally upward by the guide sections 51 and 52 and the upper flap 54 when the upper flap 54 is opened with a specified opening. In order to narrow the opening of the upper flap 54, the upper flap 54 is pivoted in the direction of the arrow R3.

[0017] As shown in Fig. 6, a guide section 61 having a curved surface 61a that is gradually curved forwardly diagonally from the turbofan 3 side is arranged on the rear surface side of the outlet ports 63 located on the lower side, right-hand side and left-hand side of the casing 50. A guide section 62 having a curved surface 62a that is gradually curved forwardly diagonally from the turbofan 3 side is arranged on the front surface side of the outlet ports 63. There is formed in the lower outlet port 63 a blowoff path for blowing the conditioning air forwardly diagonally downward from the outlet port 63 by the guide sections 61 and 62. There are formed in the right-hand and left-hand outlet ports 63 a blowoff path for blowing the conditioning air forwardly diagonally sideward from the outlet ports 63 by the guide sections 61 and 62. Lower, right-hand and left-hand flaps 64 that are pivotally supported at pivot axes 65 are attached to the outlet ports 63. On the front surface side of the wing surface of the upper flap 64 is provided a plurality of vertical plates 66 (only one is shown in Fig. 6) that extend roughly perpendicularly at regular intervals. In the outlet port 63 located on the lower side, airflow control of air blown from the turbofan 3 is executed so that the direction of air comes to have an angle of approximately 30 degrees with respect to the plane perpendicular to the axis of the turbofan 3 forwardly diagonally downward by the guide sections 61 and 62 and the flap 64 when the lower flap 64 is set to a specified angle. In the outlet ports 63 located on the right-hand side and left-hand side, the flow control of air blown from the turbofan 3 is executed so that the direction of air comes to have an angle of approximately 30 degrees with respect to the plane perpendicular to the axis of the turbofan 3 forwardly diagonally sideward by the guide sections 61 and 62 and the flap 64 when the right-hand flap 64 and the left-hand flap 64 are set to a specified angle. In order to narrow the opening of the flap 64, the flap 64 is pivoted in the direction of the arrow R4.

[0018] As shown in Fig. 3, the air conditioner indoor unit having the above construction operates upon driving the motor 2 to rotate the turbofan 3, by which air is taken in axially from the front side of the turbofan 3 via the heat exchanger 5 and the air flows along the curved surface of the curved section 3a of the turbofan 3 to blow the conditioning air that has undergone heat exchange through the heat exchanger 5 radially outwardly from the upper, lower, left-hand and right-hand outlet ports 21 through 24 (shown in Fig. 2). In this stage, by controlling the stepping motors 41 through 44 respectively by the flap control section 10a of the controller 10 shown in Fig. 4, the openings of the upper flap 31, lower flap 32, right-hand flap 33 and left-hand flap 34 shown in Fig. 2 are controlled, so that the blowoff wind directions from the outlet ports 21 through 24 are each controlled. For example, if an indoor unit 70 of the present invention is mounted on an indoor wall surface and made to blow air in the four directions of the upper, lower, left-hand and right-hand directions as shown in Fig. 7, then the air blown in the four directions flows and circulates so as to cover the indoor living space S2 along the wall surface, ceiling surface and floor surface as shown in Fig. 8B, thereby preventing the person in the living space S2 from feeling a sense of airflow and improving the comfort during the cooling and heating operations.

[0019] Then, at the time of starting the heating operation, a control signal is outputted to the upper flap stepping motor 41, lower flap stepping motor 42, right-hand flap stepping motor 43 and left-hand flap stepping motor 44 by the flap control section 10a of the controller

10 so as to narrow the openings of the upper flap 31, right-hand flap 33 and left-hand flap 34 and making the opening of the lower flap 32 wider than the upper flap 31, right-hand flap 33 and left-hand flap 34. By the above operation, the air volumes from the outlet ports 21, 23 and 24 located on the upper side, right-hand side and left-hand side reduce and the air volume from the outlet port 22 located on the lower side conversely increases to allow the warm air to easily reach the level of feet.

[0020] Therefore, air conditioning can be executed so that the indoor temperature distribution becomes uniform without causing any sense of airflow during the heating operation. Furthermore, the total volume of air blown from one turbofan 3 via the four outlet ports 21 through 24 at the time of starting the heating operation at a low temperature in the living space scarcely changes, and therefore, the indoor heating can be immediately achieved without reducing the heating capacity.

INDUSTRIAL APPLICABILITY

[0021] The air conditioner indoor unit airflow control method and airflow controller of the present invention are used for an air conditioner indoor unit that blows conditioning air in the vertical direction and the horizontal direction.

Claims

1. An airflow control method for an air conditioner indoor unit including a casing (1, 6), a turbofan (3) that has an axis extending in an anteroposterior direction and blows air taken in from a front surface side radially outwardly with respect to an axis inside the casing (1, 6), a heat exchanger (5) disposed on the front surface side of the turbofan (3) inside the casing (1, 6), outlet ports (21-24) that are provided for the casing (1, 6) and blow air from the turbofan (3) in a vertical direction and a horizontal direction and flaps (31-34) for controlling wind directions of the blowoff air from the respective outlet ports (21-24), wherein, openings of upper, right-hand and left-hand flaps (31, 33, 34) are narrowed and opening of a lower flap (32) is made wider than the openings of the upper, right-hand and left-hand flaps (31, 33, 34) during heating operation.

2. An airflow controller for an air conditioner indoor unit including a casing (1, 6), a turbofan (3) that has an axis extending in an anteroposterior direction and blows air taken in from a front surface side radially outwardly with respect to an axis inside the casing (1, 6), a heat exchanger (5) disposed on the front surface side of the turbofan (3) inside the casing (1, 6), outlet ports (21-24) that are provided for the casing (1, 6) and blow air from the turbofan (3) in a vertical direction and a horizontal direction and flaps (31-34) for controlling wind directions of the blowoff air from the respective outlet ports (21-24), the controller comprising:

drive sections (41-44) for driving the flaps (31-34), respectively; and

a flap control section (10a) for outputting control signals to the drive sections (41-44) in a manner that openings of upper, right-hand and left-hand flaps (31, 33, 34) are narrowed and opening of a lower flap (32) is made wider than the openings of the upper, right-hand and left-hand flaps (31, 33, 34) during heating operation.

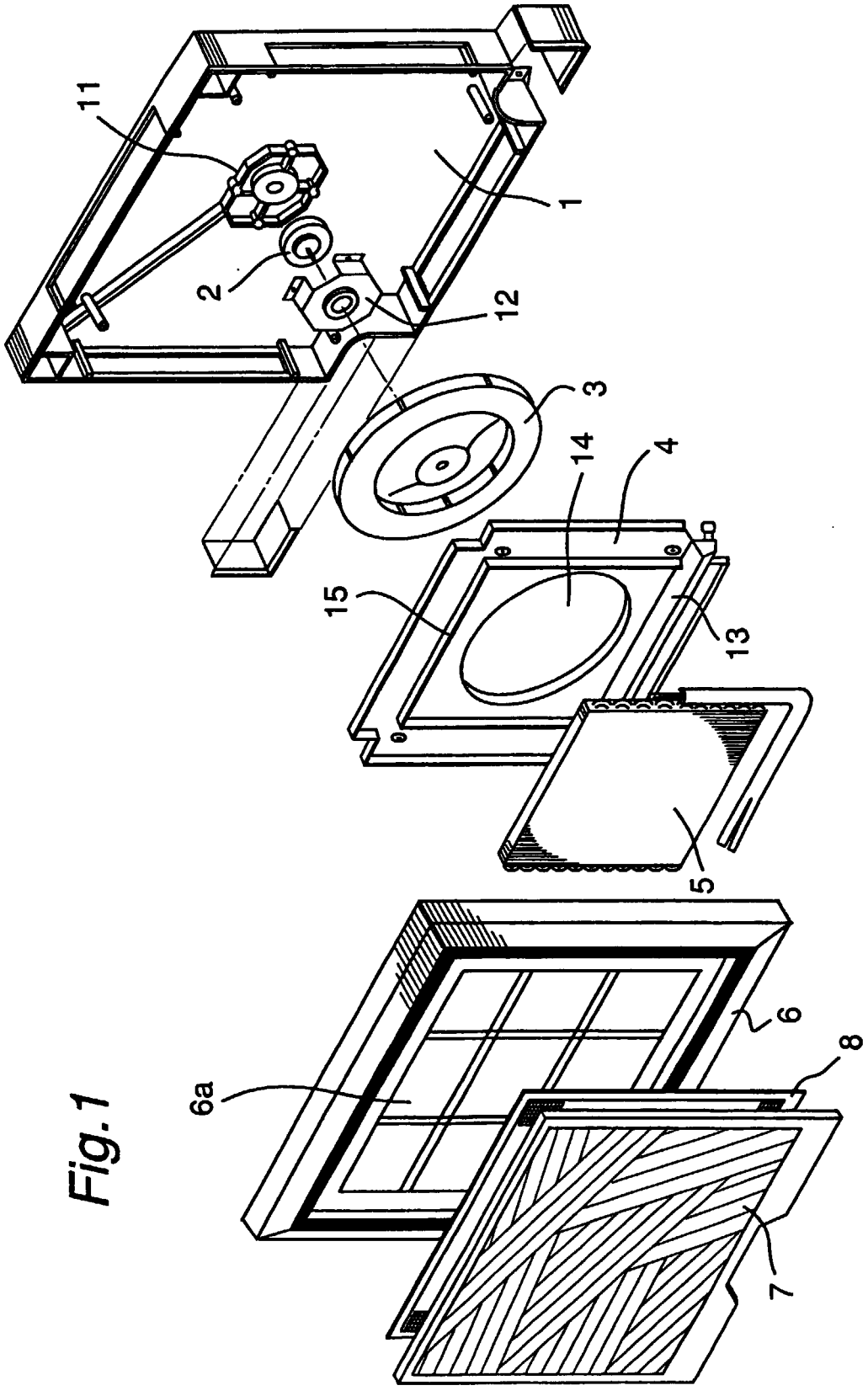


Fig.1

Fig.2

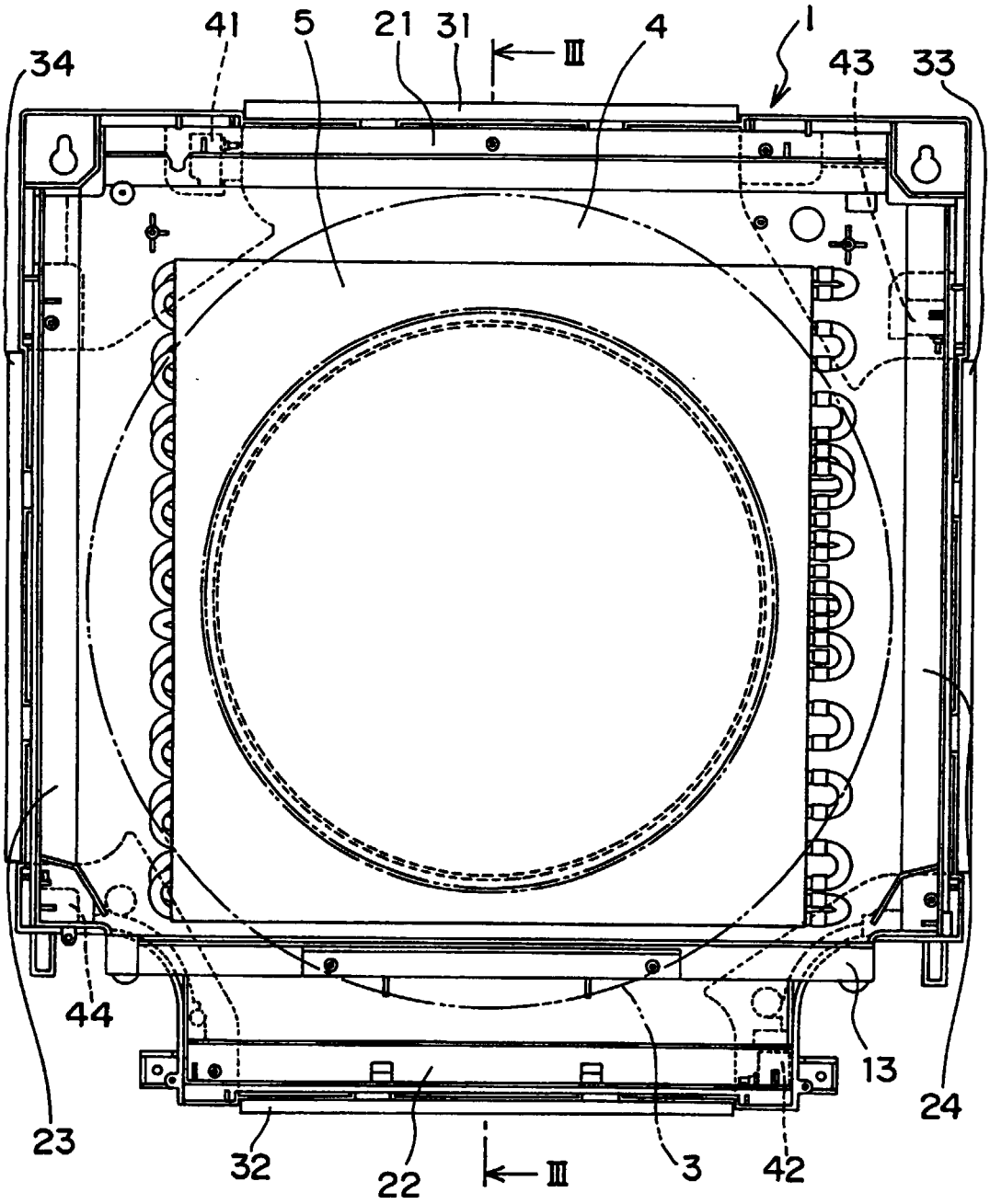


Fig.3

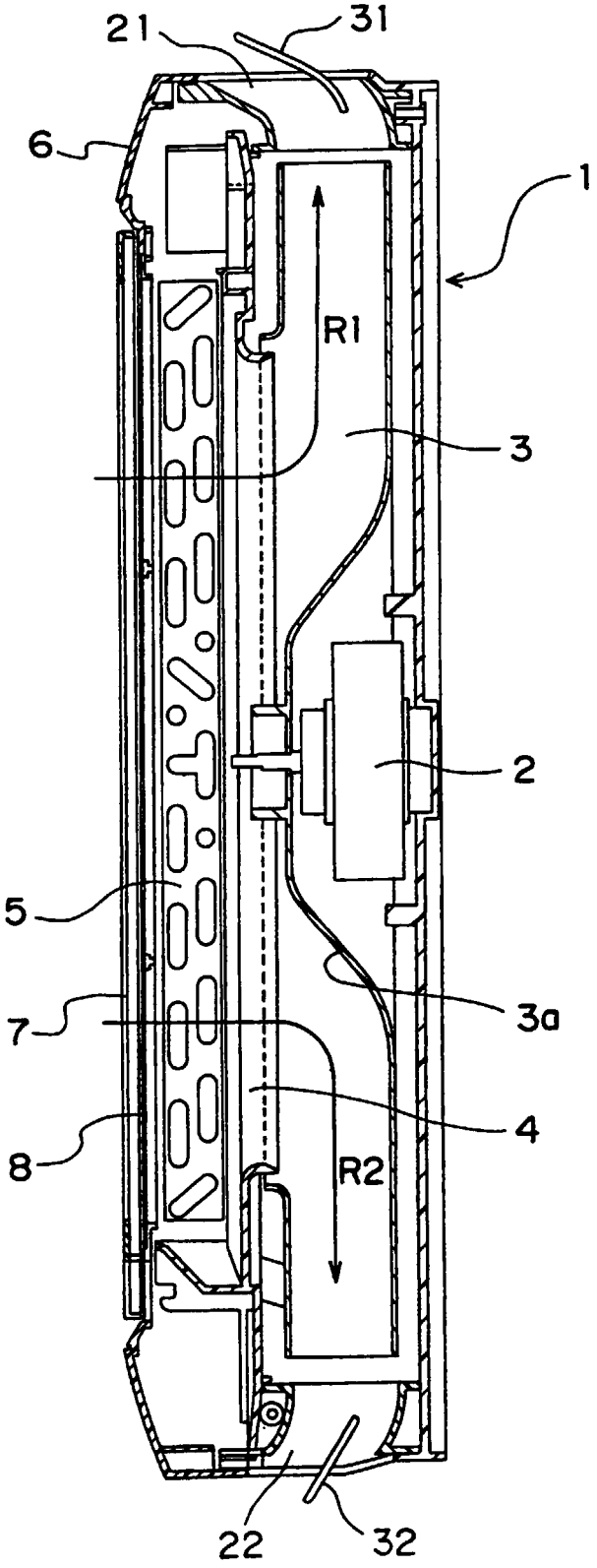


Fig.4

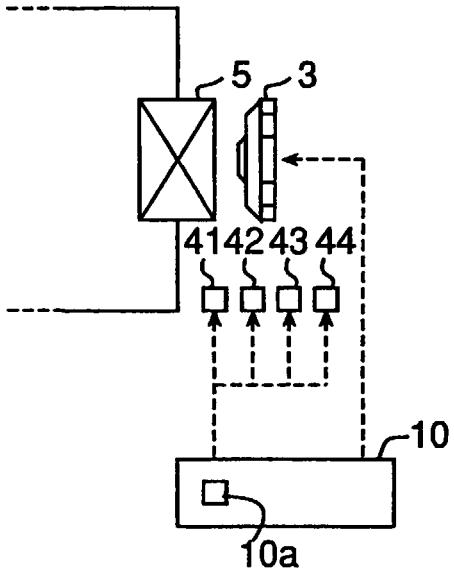


Fig. 5

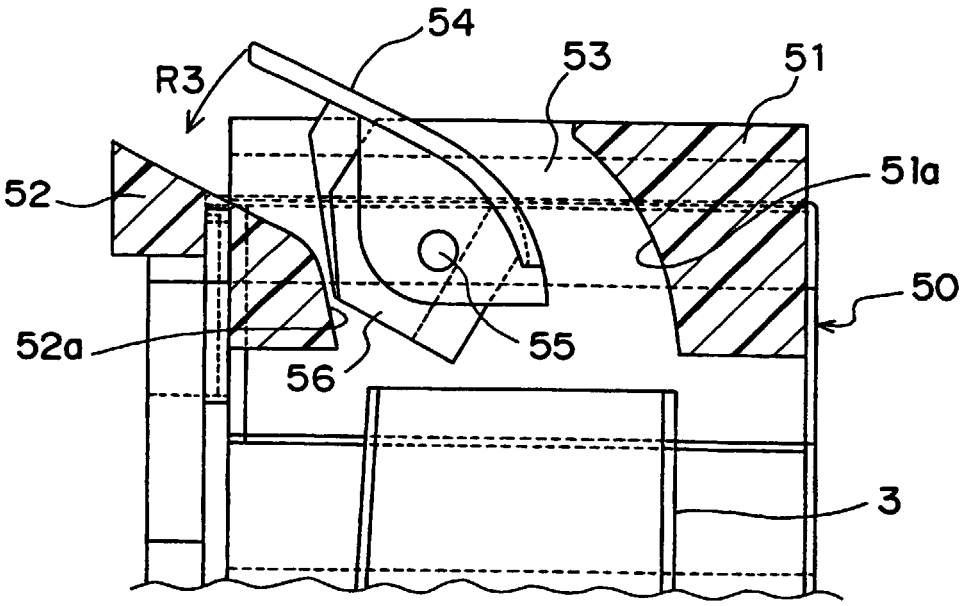


Fig. 6

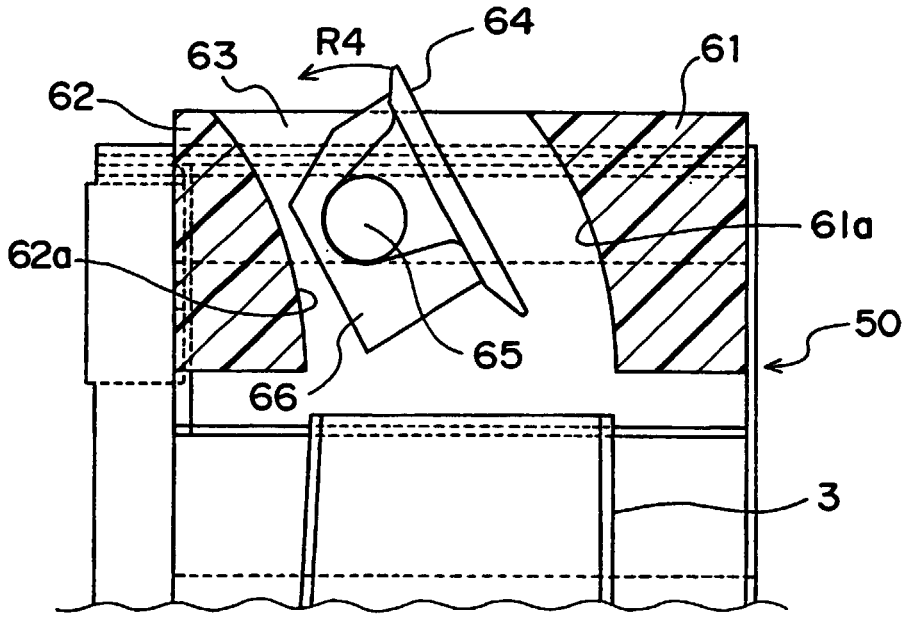


Fig. 7

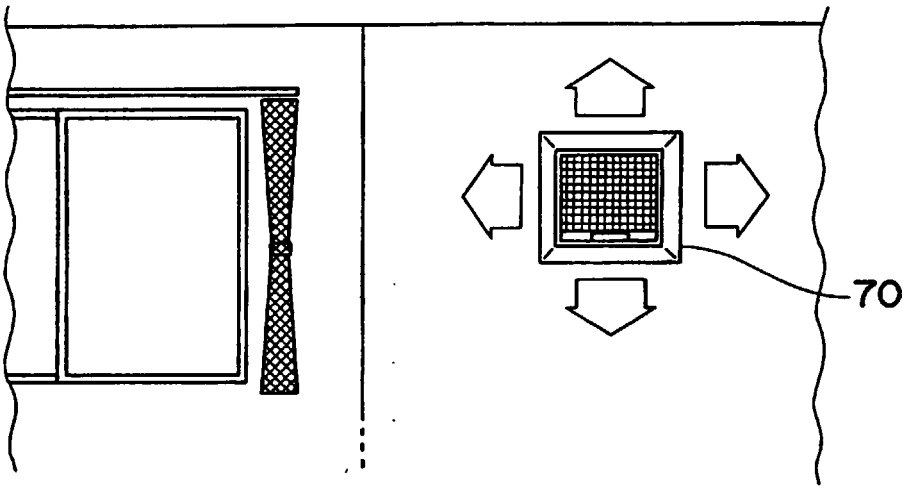


Fig. 8A

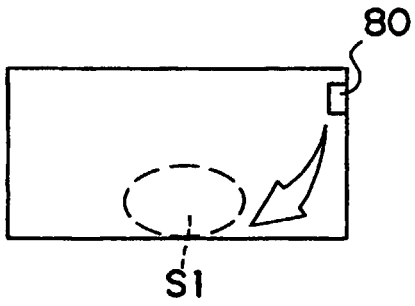
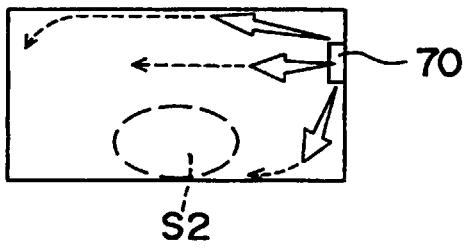


Fig. 8B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP98/03102

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl^6 F24F11/02, F24F1/00

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)
Int.Cl^6 F24F11/02, F24F1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1998 Toroku Jitsuyo Shinan Koho 1994-1998
Kokai Jitsuyo Shinan Koho 1971-1998

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 2-136628, A (Mitsubishi Electric Corp.), 25 May, 1990 (25. 05. 90) (Family: none)	1, 2
Y	JP, 4-344037, A (Hitachi, Ltd.), 30 November, 1992 (30. 11. 92) (Family: none)	1, 2
Y	JP, 3-63444, A (Matsushita Refrigeration Co.), 19 March, 1991 (19. 03. 91) (Family: none)	1, 2
Y	JP, 2-57850, A (Fujitsu General Ltd.), 27 October, 1992 (27. 10. 92) (Family: none)	1, 2
A	JP, 61-128057, A (Mitsubishi Electric Corp.), 16 June, 1986 (16. 06. 86) (Family: none)	1, 2
P	JP, 10-122589, A (Daikin Industries, Ltd.), 15 May, 1998 (15. 05. 98) (Family: none)	1, 2
P	JP, 10-213329, A (Daikin Industries, Ltd.), 11 August, 1998 (11. 08. 98) (Family: none)	1, 2

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

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Date of the actual completion of the international search	Date of mailing of the international search report
6 October, 1998 (06. 10. 98)	20 October, 1998 (20. 10. 98)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
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