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(11) **EP 1 471 310 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
27.10.2004 Bulletin 2004/44

(51) Int Cl.7: **F24F 1/00**

(21) Application number: **02738810.7**

(86) International application number:
PCT/JP2002/006456

(22) Date of filing: **26.06.2002**

(87) International publication number:
WO 2003/027576 (03.04.2003 Gazette 2003/14)

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**

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(30) Priority: **21.09.2001 JP 2001287998**

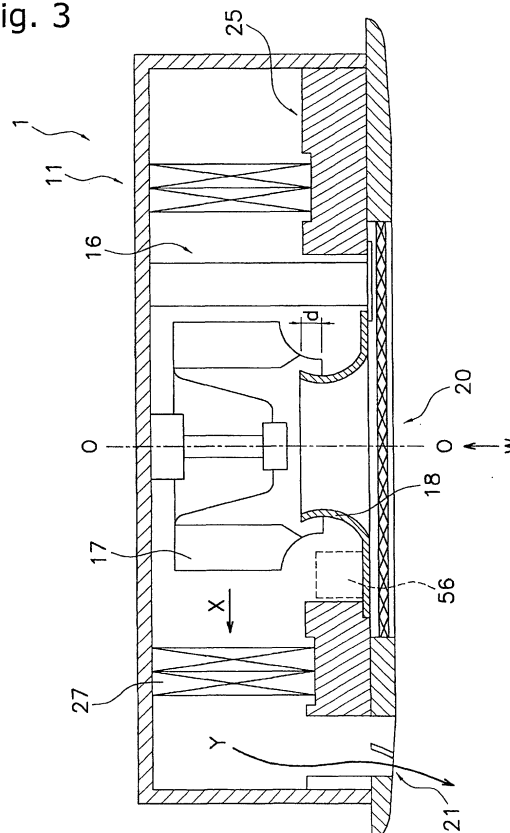
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(54) **AIR CONDITIONER**

(57) The present invention is an air conditioner that is built into or hung from a ceiling, and in which the relative position between a centrifugal fan and a bell mouth therein is maintained at a predetermined amount. An indoor unit (1) includes a casing (11) that is approximately rectangular in shape, a centrifugal fan (17), a heat exchanger (27) having a plurality of concave portions (27a, 27c) and a plurality of convex portions (27b, 27d), a drain pan (25), a bell mouth (18), and an electrical component box (16). The electrical component box (16) is a device for storing electrical components used for such things as the operational control of the air conditioner, and has a shape which extends from a top surface of the casing (11) to the bell mouth (18). The electrical component box (18) is disposed between the outer circumference of the centrifugal fan (17) and one of the convex portions (27b) of the heat exchanger (27), and supports the bell mouth (18).

Fig. 3



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Description

Technical Field

[0001] The present invention relates to an air conditioner, and more particularly to an air conditioner either built into or hanging from a ceiling.

Background Art

[0002] An air conditioner is mainly constructed of an outdoor unit that has a compressor and a heat exchanger, and an indoor unit that has a centrifugal fan and a heat exchanger. The indoor unit can be any one of a variety of types, such as one mounted on a wall, built into a ceiling, hanging from the ceiling or the like.

[0003] Indoor units that are built into or hanging from a ceiling are primarily composed of a casing that has an air suction port and a plurality of air discharge ports on the lower surface thereof, a bell mouth disposed on the upper side of the air suction port, a centrifugal fan disposed inside the casing, and a heat exchanger disposed such that it surrounds the centrifugal fan. In addition, an electrical component box is disposed inside the indoor unit, and stores electrical components that are used for such things as the operational control of the air conditioner.

[0004] As shown in Japanese Published Patent Application No. H04-236024, a conventional electrical component box in an indoor unit is disposed on the outer circumference of a bell mouth (see the electrical component box 56 illustrated with dotted lines in Figs. 2 and 3).

[0005] However, there is a risk that the weight of the aforementioned electrical component box will act upon the outer circumferential portion of the bell mouth and change the vertical position of the bell mouth. On the other hand, the vertical position of the centrifugal fan is maintained in a fixed position because it is mounted to the top surface of the casing. Because of this, there is a risk that the relative distance between the centrifugal fan and the bell mouth will change from a predetermined amount, and that the ability of the centrifugal fan to blow air will be diminished.

[0006] The task of the present invention is to maintain the relative distance between the centrifugal fan and the bell mouth of an air conditioner built into or hung from a ceiling at a predetermined amount.

Disclosure Of The Invention

[0007] An object of the present invention is to maintain the relative distance between the centrifugal fan and the bell mouth of an air conditioner built into or hung from a ceiling at a predetermined amount.

[0008] The air conditioner disclosed in claim 1 is an air conditioner built into or hung from a ceiling, which includes a casing, a centrifugal fan, a heat exchanger,

a bell mouth, and an electrical component box that stores electrical components. The casing has an air suction port for taking in air into the interior thereof, and a plurality of air discharge ports for discharging air to the exterior thereof. The centrifugal fan is disposed in the interior of the casing and above the air suction port. The heat exchanger is disposed such that it surrounds the centrifugal fan. The plurality of air discharge ports are disposed around the outer circumference of the heat exchanger. The bell mouth is disposed between the air suction port and the centrifugal fan. The electrical component box is mounted on the top surface of the casing.

[0009] In this air conditioner, it is difficult for the weight of the electrical component box to act upon the bell mouth because the electrical component box is mounted on the top surface of the casing. Thus, the relative distance between the centrifugal fan and the bell mouth will be maintained at a predetermined amount, and the ability of the centrifugal fan to blow air will not be diminished.

[0010] The air conditioner disclosed in claim 2 is the air conditioner of claim 1, in which the electrical component box extends from the top surface of the casing to the bell mouth, and the bell mouth is supported by the electrical component box.

[0011] In this air conditioner, the bell mouth is supported by the electrical component box mounted on the top surface of the casing. In other words, the bell mouth is supported by the top surface of the casing via the electrical component box. Thus, the vertical position of the bell mouth will be made more stable.

[0012] The air conditioner disclosed in claim 3 is the air conditioner of claim 2, in which the electrical component box includes an electrical component box main body that stores electrical components, a main body mounting member that allows the electrical component box main body to be freely attached and detached therefrom, and a lid member for opening and closing the electrical component box main body. The main body mounting member is mounted on the top surface of the casing. The lid member is disposed such that it is interposed between the bell mouth and the lower edge of the electrical component box main body.

[0013] In this air conditioner, the electrical component box main body can be easily removed when the electrical components are to be inspected because it can be freely attached to and detached from the main body mounting member mounted to the top surface of the casing. In addition, the number of parts can be reduced because the lid member of the electrical component box closes the lower edge of the electrical component box and supports the bell mouth.

[0014] The air conditioner disclosed in claim 4 is the air conditioner of any of claims 1 to 3, in which the electrical component box is disposed in a position between the plurality of air discharge ports.

[0015] In this air conditioner, it is difficult to impede the flow of air blown out from the outer circumferential

sides of the centrifugal fan because the electrical component box is disposed in a position between the air discharge ports.

[0016] The air conditioner disclosed in claim 5 is the air conditioner of claim 4, in which the casing has an approximately rectangular shape, and the plurality of air discharge ports are disposed in positions opposite each side of the casing. The electrical component box is disposed in a position opposite a corner of the rectangular casing.

[0017] In this air conditioner, the space inside the casing can be effectively used because the electrical component box is disposed in a position opposite a corner in which an air discharge port in the casing is not disposed.

[0018] The air conditioner disclosed in claim 6 is the air conditioner of claim 5, in which the heat exchanger includes a plurality of convex portions that are formed such that they extend away from the outer circumference of the centrifugal fan, and a plurality of concave portions that are formed such that they draw near to the outer circumference of the centrifugal fan. The convex portions are at least disposed in positions opposite the corners. The electrical component box is disposed in a position that is interposed between the outer circumference of the centrifugal fan and a convex portion.

[0019] In this air conditioner, the heat exchanger includes a plurality of concave portions and a plurality of convex portions, and the convex portions are disposed in positions opposite the corners of the approximately rectangular casing. Thus, the area that is interposed between the outer circumference of the centrifugal fan and the convex portions of the heat exchanger is bigger than other areas. Thus, because the electrical component box is disposed in these areas, the effective length of the heat exchanger can be increased by forming a plurality of concave portions and a plurality of convex portions, and the space inside the casing can be effectively used.

Brief Description Of The Drawings

[0020]

Fig. 1 is an outer perspective view of an indoor unit of an air conditioner according to one embodiment of the present invention.

Fig. 2 is a bottom view showing the interior of the indoor unit of the air conditioner according to one embodiment of the present invention.

Fig. 3 is a cross-sectional view taken along the line A-O-A shown in Fig. 2.

Fig. 4 is an exploded perspective view showing the assembly of the bell mouth and electrical component box of the casing.

Fig. 5 is an enlarged cross-sectional view of the area around the electrical component box of Fig. 2.

Best Mode For Carrying Out The Invention

[0021] An embodiment of the present invention will be described below with reference to the figures.

(1) Structure of the air conditioner

[0022] An outer perspective view (ceiling omitted) of an indoor unit 1 of an air conditioner according to one embodiment of the present invention is shown in Fig. 1. The indoor unit 1 is built into a ceiling, and includes a casing 11 that is built into the ceiling and a decoration panel 12 disposed on the bottom surface of the casing 11.

[0023] The casing 11 is a member for supporting the components of the indoor unit 1 therein. In the present embodiment, the casing 11 has a substantially rectangular shaped exterior.

[0024] The decoration panel 12 includes an air suction port 20 provided in the middle of the bottom surface, and four rectangular air discharge ports 21 that are provided around the outer circumference of the air suction port 20.

[0025] Next, the interior of the casing 11 will be described with reference to Figs. 2 and 3. Fig. 2 is a bottom view of the interior of the indoor unit 1, and Fig. 3 is a cross-sectional view taken along the line A-O-A of Fig. 2. The casing 11 primarily includes a centrifugal fan 17, a heat exchanger 27, a drain pan 25, a bell mouth 18, and an electrical component box 16. In addition, a line connector 26 is formed in one corner 11a of the casing 11, and is composed of an empty space in which a connecting line between the heat exchanger 27 and an outdoor unit (not shown in the figures) is disposed. Here, the electrical component box 16 depicted with a dashed line in Figs. 2 and 3 illustrates the position of a conventional electrical component box.

[0026] The centrifugal fan 17 is a device for taking air in from the air suction port 20 and discharging air on the sides thereof, and is disposed on the upper side of the air suction port 20 and mounted on the top surface of the casing 11. Here, the rotational axis of the centrifugal fan 17 is represented by the line O-O, and the direction of rotation of the centrifugal fan 17 is represented by R.

[0027] The heat exchanger 27 is a device for exchanging heat with the air discharged from the centrifugal fan 17, and is disposed such that it surrounds the centrifugal fan 17. In the present embodiment, the heat exchanger 27 is a member in which a cross fin type heat exchange panel has been bent, and includes two concave portions 27a, 27c and two convex portions 27b, 27d. Specifically, the concave portion 27a is a member that is formed such that it draws near the outer circumference of the centrifugal fan 17, and in the present embodiment, is formed opposite one of the air discharge ports 21 that is adjacent to the line connector 26. In addition, the convex portion 27b is a member that is formed such that it extends away from the outer circumference

of the centrifugal fan 17, and in the present embodiment, is formed opposite one of the corners 11a nearest the line connector 26. Moreover, the concave portion 27c is disposed opposite one of the air discharge ports 21 that is between the convex portions 27b and 27d, and the convex portion 27d is formed opposite the corner 11a that is adjacent to the concave portion 27c.

[0028] The drain pan 25 is a plate like member made of a resin and serves to receive condensed water produced when air in the heat exchanger 27 is cooled. It is disposed on the lower surface of the heat exchanger 27, and is mounted on the lower part of the casing 11. As shown in Fig. 4, the drain pan 25 includes a cylindrical hole 25a that corresponds to the air suction port 20, square holes 25b that correspond to the four air discharge ports 21, and a first slot 25c that is notched in a rectangular shape in the peripheral surface of the cylindrical hole 25a. The first slot 25c is disposed in a position corresponding to one of the corners 11a of the casing 11.

[0029] As shown in Figs. 3 and 4, the bell mouth 18 is a plate member that has a bell shaped opening in the center thereof, is disposed in between the air suction port 20 and the drain pan 25, and is mounted to the drain pan 25 with attachment screws 30. A second slot 18a that is notched in a position corresponding to the first slot 25c of the drain pan 25 is formed in the peripheral surface of the bell mouth 18. Thus, by vertically stacking the first slot 25c with the second slot 18a, an opening 44 is formed, and the lower end of the electric component box 16 is disposed thereon.

[0030] The electric component box 16 is a device for storing electric components used for such things as operational control of the air conditioner, and has a shape that extends from the top surface of the casing 11 to the bell mouth 18. As shown in Fig. 2, in the present embodiment the electric component box 16 is disposed between the outer circumference of the centrifugal fan 17 and the convex portion 27b of the heat exchanger 27. As shown in Figs. 4 and 5, the electrical component box 16 includes an electrical component box main body 41 that stores electrical components used for such things as operational control of the air conditioner, a main body mounting member 42 that allows the electrical component box main body 41 to be freely attached and detached therefrom, and a lid member 43 for opening and closing the electrical component box main body 41.

[0031] The electrical component box main body 41 is a rectangular box shaped member that stores electrical components used for such things as operational control of the air conditioner, and a catch member 41a is formed on an upper lateral surface thereof.

[0032] The main body mounting member 42 includes an attachment surface 42a that is attached to the top surface of the casing 11 by means of attachment screws 31, a first lateral surface 42b that extends downward from the edge of the attachment surface 42a adjacent to the centrifugal fan 17, a second lateral surface 42c that extends downward from the edge of the attachment

surface 42a adjacent to the heat exchanger 27, and a support surface 42d that extends from a lower edge of the second lateral surface 42c toward the centrifugal fan 17. A slit 42e is formed in the first lateral surface 42b, and engages with the catch member 41a on the electrical component box main body 41. A projection 42f that projects toward the electrical component box main body 41 is formed on the second lateral surface 42c, and supports one lateral surface of the electrical component box main body 41. The support surface 42d supports the lower end of the electrical component box main body 41. **[0033]** The lid member 43 is a plate shaped member that is disposed such that it is interposed between the periphery of the second slot 18a of the bell mouth 18 and the lower edge of the electrical component box main body 41. The lid member 43 is mounted to the electrical component box main body 41 by means of attachment screws 32.

[0034] The construction of the aforementioned electrical component box 16 allows the electrical component box main body 41 to be freely attached to and detached from the main body mounting member 42. In addition, the periphery of the second slot 18a of the bell mouth 18 is supported such that it is pushed upward by the lid member 43.

(2) Operation of the air conditioner

[0035] The operation of the indoor unit 1 will be described with reference to Fig. 3.

[0036] As shown by the arrow W in Fig. 3, when the centrifugal fan 17 is rotated, indoor air is drawn into the interior of the indoor unit 1 from the air suction port 20. The air drawn therein, as shown by the arrow X in Fig. 3, is discharged to the outer circumferential portion of the centrifugal fan 17. The air discharged to the outer circumferential portion of the centrifugal fan 17, as shown by the arrow Y, exchanges heat with the heat exchanger 27 disposed on the outer circumferential side of the centrifugal fan 17, and is discharged to the interior of the room from the air discharge ports 21 provided in the bottom portion of the casing 11.

(3) Attachment and removal of the electrical component box

[0037] The attachment and removal of the electrical component box main body 41 that occurs during inspection of the electronic component box 16 will be described with reference to Fig. 5.

[0038] The process of removing the electrical component box main body 41 from the main body mounting member 42 will be described.

[0039] First, the attachment screws 32 are removed, and the lid member 43 is removed. Next, the lower edge of the electrical component box main body 41 is pulled toward the centrifugal fan 17. When this occurs, the electrical component box main body 41 uses the projec-

tion 42f on the main body mounting member 42 as a fulcrum and tilts, and the catch member 41 a on the electrical component box main body 41 is detached from the slit 42e in the main body mounting member 42. After this, the electrical component box main body 41 is pulled downward diagonally from the opening 44.

[0040] When mounting the electrical component box main body on the main body mounting member, the aforementioned removal process is reversed.

(4) Special characteristics of the air conditioner

[0041] As described above, the special characteristics of the air conditioner of the present embodiment are as follows:

- ① Maintenance of the gap between the bell mouth 18 and the centrifugal fan 17

[0042] As shown in Figs. 2 and 3, because the conventional electrical component box 56 is disposed on the outer circumference of the bell mouth 18, the weight of the electrical component box 56 acts upon the outer circumference of the bell mouth 18, and there is a risk that the vertical position of the bell mouth 18 will change.

[0043] However, because the electrical component box 16 of the present embodiment is mounted to the top surface of the casing 11, it is difficult for the weight of the electrical component box 16 to act upon the bell mouth. Thus, the overlap distance (relative distance) d between the centrifugal fan 17 and the bell mouth 18 can be maintained at a predetermined amount, and the ability of the centrifugal fan 17 to blow air will not be hindered.

- ② Stability of the vertical position of the bell mouth 18

[0044] In the present embodiment, the bell mouth 18 is supported by the electrical component box 16 mounted on the top surface of the casing 11. In other words, the bell mouth 18 is supported by the top surface of the casing 11 via the electrical component box 16. Thus, the vertical position of the bell mouth 18 can be set and stabilized.

- ③ Ease of attaching and removing the electrical component box 16

[0045] In the present embodiment, the electrical component box main body 41 can be easily removed during inspection of the electrical components because the electrical component box main body 41 is mounted to the main body mounting member 42 mounted to the top surface of the casing 11 such that it can be freely attached thereto and removed therefrom. In addition, the number of parts can be reduced because the lid member 43 of the electrical component box 16 closes the lower end of the electrical component box 16 and supports the

bell mouth 18.

- ④ Placement of the electrical component box 16 so that it provides little resistance to the flow of air

[0046] In the present invention, the electrical component box 16 provides little resistance to the air blown out from the centrifugal fan 17 to the outer circumference thereof because it is disposed in a position between the air discharge ports 21 provided in each side of the casing 11.

- ⑤ Increase in the effective length of the heat exchanger 27

[0047] In the present embodiment, the effective length of the heat exchanger 27 is longer than that of a conventional heat exchanger because it has two concave portions 27a, 27c and two convex portions 27b, 27d. Thus, the surface area of the openings of the air discharge ports 21 will not be reduced because the concave portions 27a, 27c are disposed in positions opposite the air discharge ports 21.

- ⑥ Increase in the amount of space in the casing 11

[0048] In the present embodiment, the convex portion 27b in the heat exchanger 27 is disposed in a position opposite the corner 11a of the casing 11. Thus, the size of the area between the outer circumference of the centrifugal fan 17 and the convex portion 27b is larger than the other areas. Thus, the space in the casing 11 can be effectively used because the electrical component box 16 is disposed in this area.

(5) Other Embodiments

[0049] An embodiment of the present invention was described above based upon the figures. However, the specific construction of the present invention is not limited to this embodiment, and can be modified within a range that does not depart from the essence of the invention.

[0050] For example, in the aforementioned embodiment, the present invention is applied to an air conditioner that is built into a ceiling. However, the present invention can also be applied to an air conditioner that is hung from the ceiling.

Industrial Applicability

[0051] The relative position between the centrifugal fan and the bell house can be maintained at a predetermined value and the ability of the centrifugal fan to blow air will not be hindered because the present invention is constructed such that is difficult for the weight of the electrical component box to act upon the bell mouth.

Claims

1. An air conditioner (1) built into or hung from a ceiling, comprising:
 - a casing (11);
 - an air suction port (20) provided in the lower surface of the casing (11) for taking in air into the interior thereof;
 - a centrifugal fan (17) disposed inside the casing (11) and above the air suction port (20);
 - a heat exchanger (27) disposed such that it surrounds the centrifugal fan (17);
 - a plurality of air discharge ports (21) provided in the casing (11) and disposed in an outer circumference of the heat exchanger (27) discharge air to an exterior of the casing (11);
 - a bell mouth (18) disposed between the air suction port (20) and the centrifugal fan (17); and
 - an electrical component box (16) that is mounted on a top surface of the casing (11) and which stores electrical components.
2. The air conditioner (1) according to claim 1, wherein the electrical component box (16) extends from the top surface of the casing (11) to the bell mouth; and the bell mouth (18) is supported by the electrical component box (16).
3. The air conditioner (1) according to claim 2, wherein the electrical component box (16) comprises
 - an electrical component box main body (41) that stores electrical components;
 - a main body mounting member (42) that is mounted to the top surface of the casing (11) and serves to mount the electrical component box main body (41) such that it may be freely attached thereto and removed therefrom; and
 - a lid member (43) disposed between the bell mouth (11) and a lower end of the electrical component box main body (41) that serves to open and close the electrical component box main body (41).
4. The air conditioner (1) according to any of claims 1 to 3, wherein the electrical component box (16) is disposed in a position between the plurality of air discharge ports (21).
5. The air conditioner (1) according to claim 4, wherein the casing (11) is approximately rectangular in shape; the plurality of air discharge ports (21) are disposed in positions opposite each side of the casing (11); and the electrical component box (16) is disposed in a position opposite one corner (11a) of the casing (11).
6. The air conditioner (1) according to claim 5, wherein the heat exchanger (27) includes a plurality of convex portions (27b, 27d) that are formed such that they extend away from an outer circumference of the centrifugal fan (17), and a plurality of concave portions (27a, 27c) that are formed such that they draw near to the outer circumference of the centrifugal fan (17); the convex portions (27b, 27d) are at least disposed in positions opposite the corners (11a); and the electrical component box (16) is disposed in a position between the outer circumference of the centrifugal fan (17) and the convex portions (27b, 27d).

Fig. 1

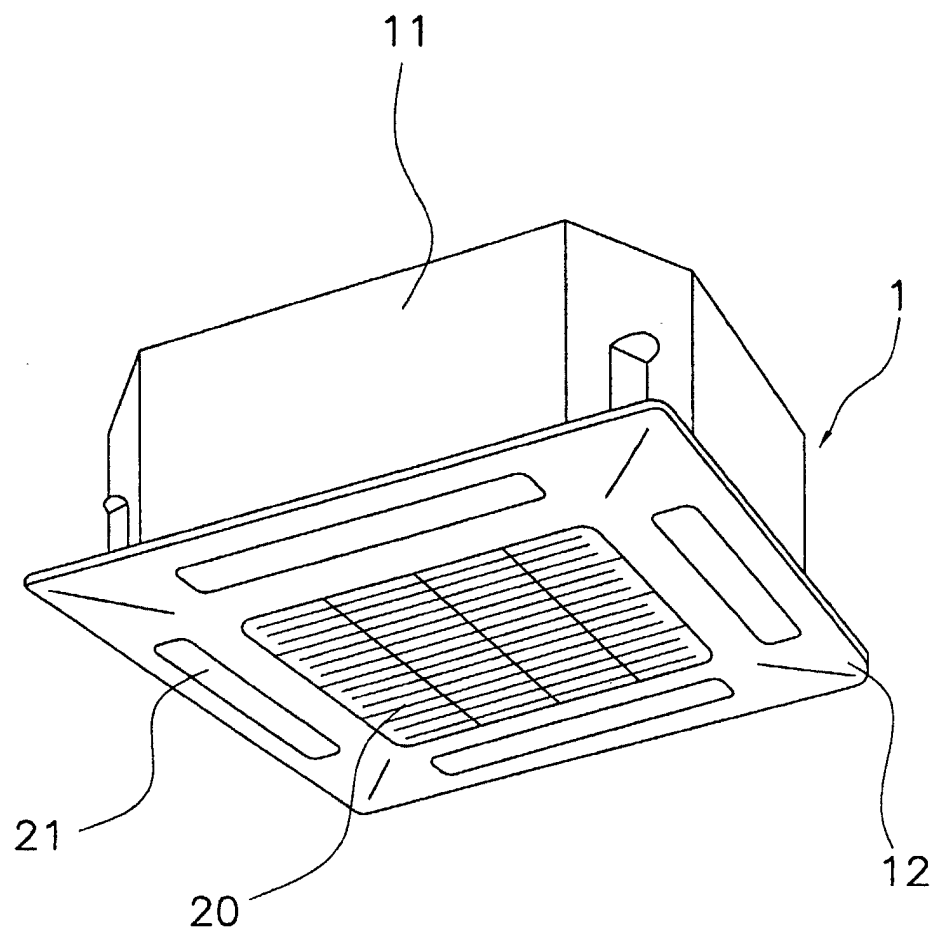


Fig. 2

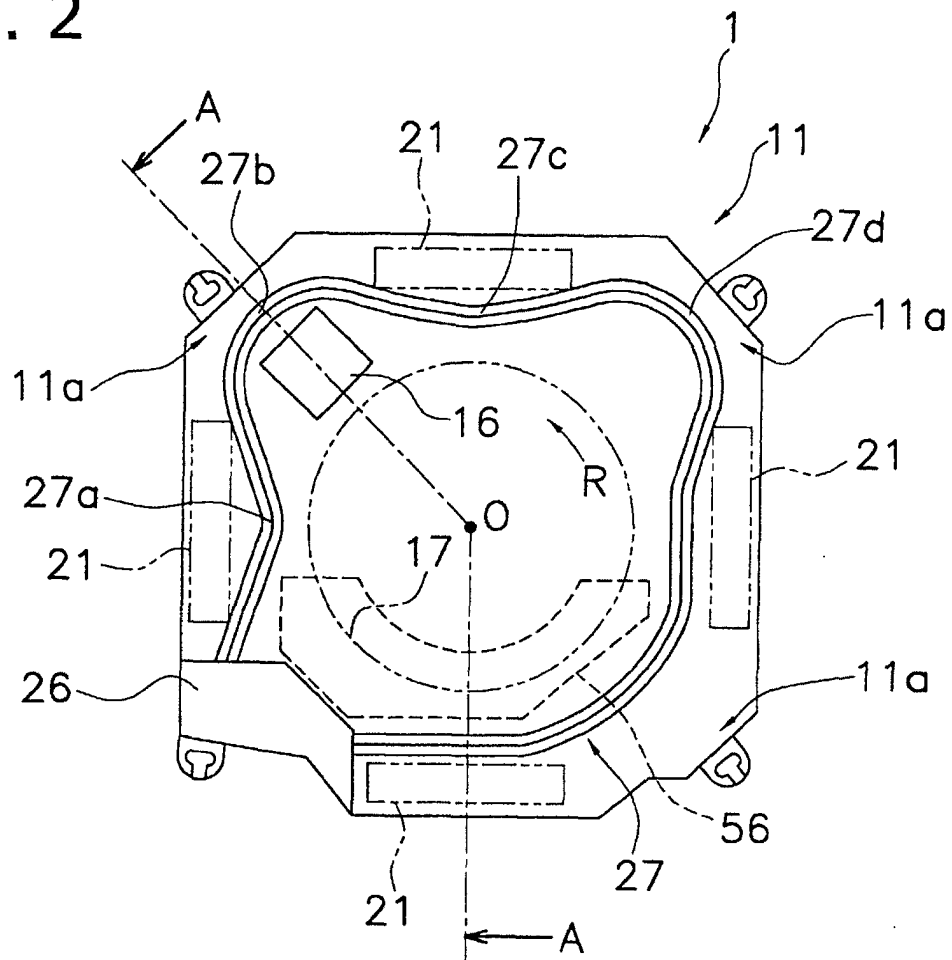


Fig. 3

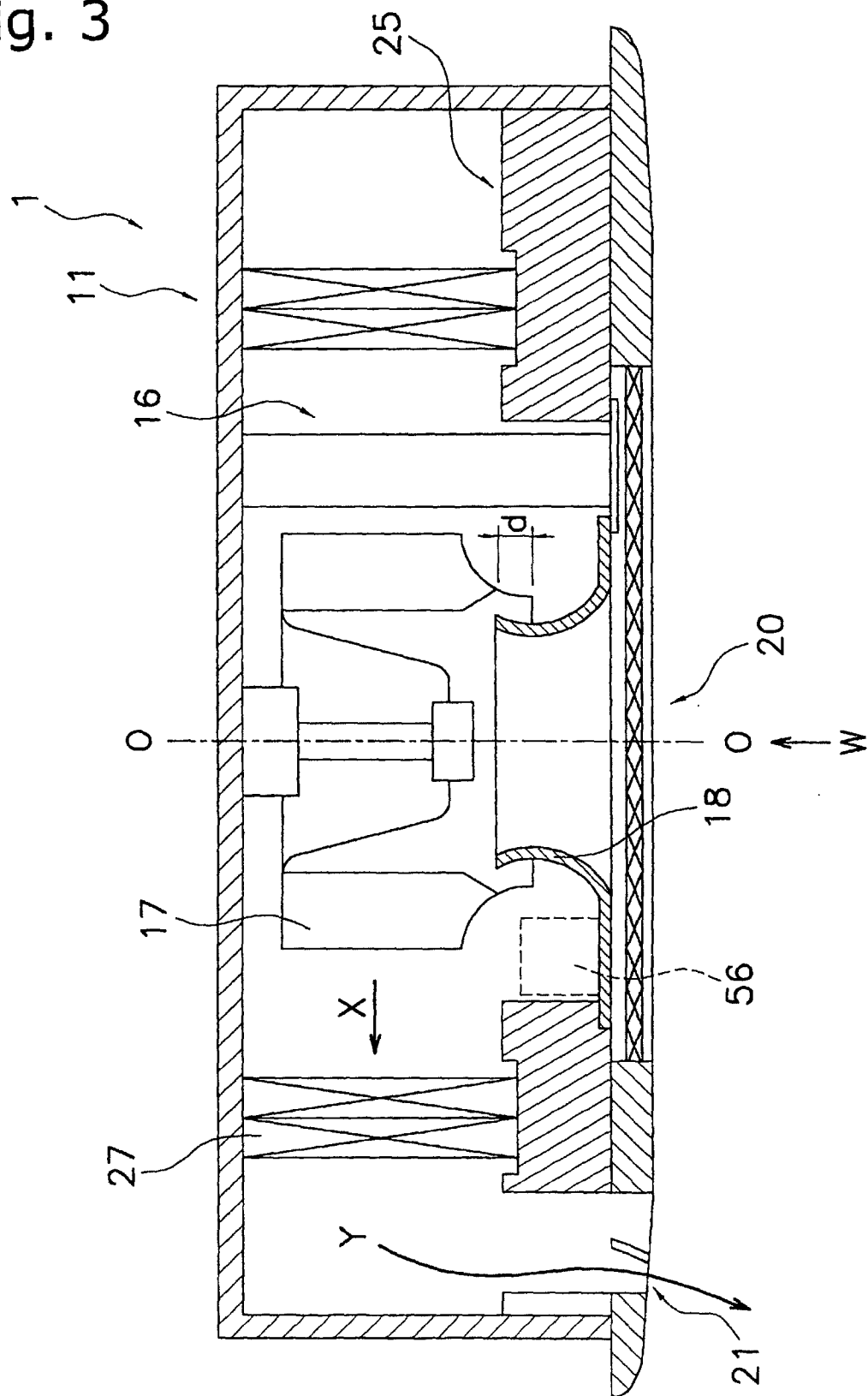


Fig. 4

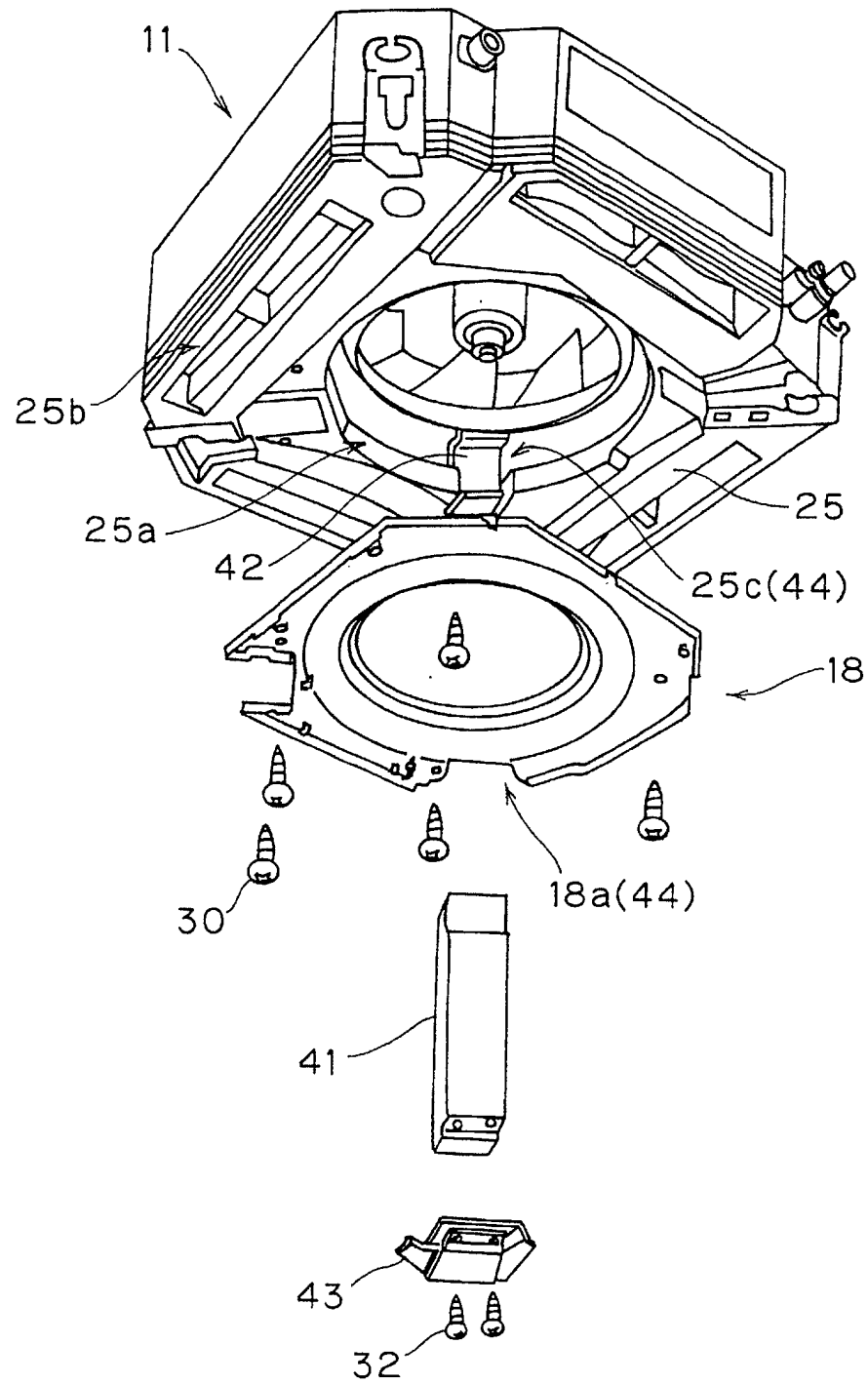
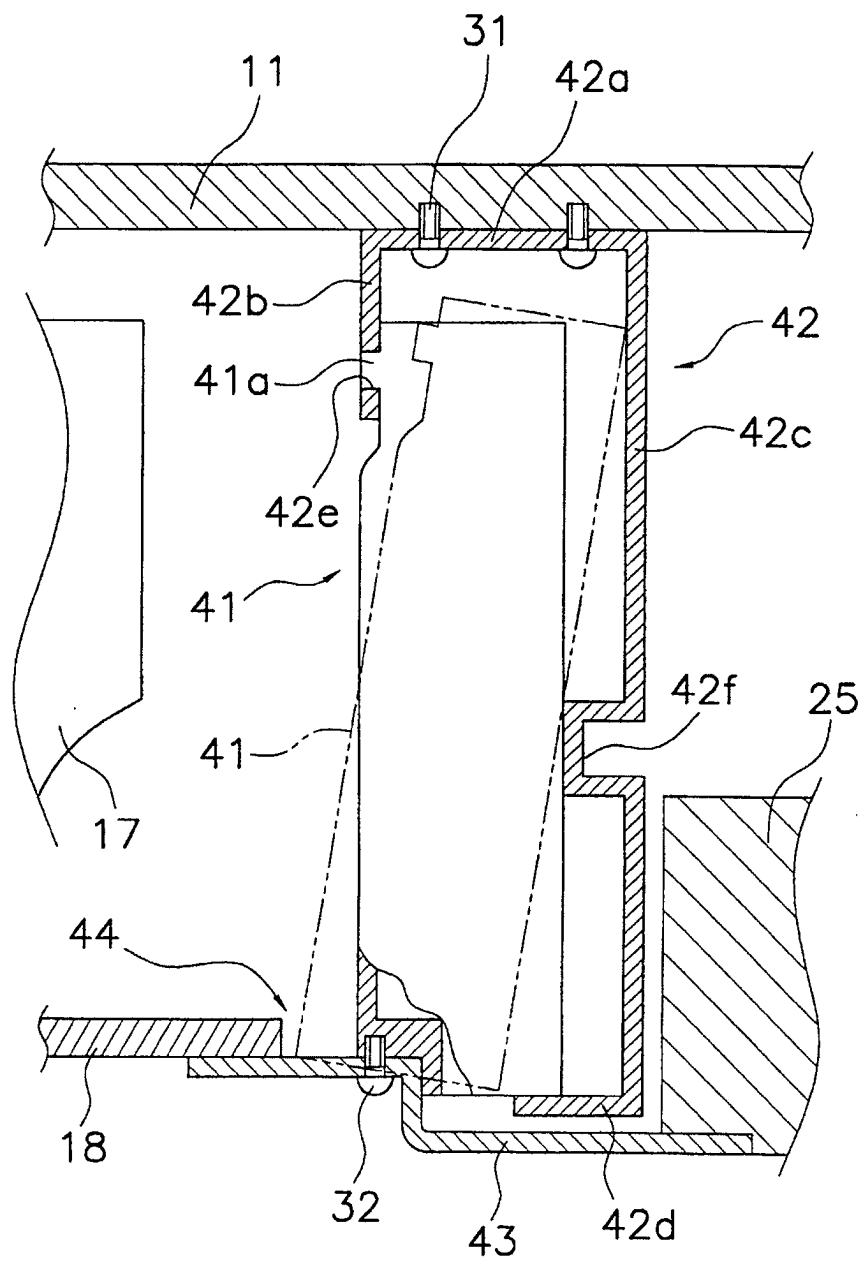


Fig. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/06456

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl.⁷ 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.⁷ F24F1/00Documentation 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 1996-2002
Kokai Jitsuyo Shinan Koho 1971-2002 Toroku Jitsuyo Shinan Koho 1994-2002

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.
X	JP 9-243109 A (Daikin Industries, Ltd.),	1
Y	09 September, 1997 (09.09.97), Par. Nos. [0017] to [0022]; Fig. 1 (Family: none)	2-6
Y	JP 2000-65385 A (Fujitsu General Ltd.), 03 March, 2000 (03.03.00), Par. Nos. [0015] to [0025]; Figs. 1 to 8 (Family: none)	1-6
X	JP 4-236024 A (Mitsubishi Electric Corp.).	1
Y	25 August, 1992 (25.08.92), Full text; all drawings (Family: none)	2-6

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

* Special categories of cited documents:

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Date of the actual completion of the international search
18 July, 2002 (18.07.02)Date of mailing of the international search report
30 July, 2002 (30.07.02)Name and mailing address of the ISA/
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/06456

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-201497 A (Daikin Industries, Ltd.), 30 July, 1999 (30.07.99), Full text; all drawings (Family: none)	1-6
Y	WO 01/55649 A1 (Toshiba Carrier Corp.), 02 August, 2001 (02.08.01), Full text; all drawings & JP 2001-221455 A & JP 2001-208370 A & EP 1166018 A & AU 2706401	1-6

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