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(54) INDOOR UNIT OF FLOOR-TYPE AIR CONDITIONER

RAUMEINHEIT FÜR BODENMONTIERTE KLIMAANLAGE

UNITÉ INTÉRIEURE POUR UN CLIMATISEUR D'AIR MONTÉ AU SOL

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an indoor unit of a floor-type air conditioner having a centrifugal fan generating an air flow in centrifugal direction.

[0002] KR 2003 0089142 discloses an indoor unit of an air conditioner which aims to improve efficiency and noise reduction of a turbo fan by preventing back flow phenomenon generated between a bell mouth and a shroud. A back flow preventing rib is placed on a blow guiding plate of an indoor unit of an air conditioner to prevent back flow phenomenon by cutting off air flowing back between a bell mouth and a shroud. The back flow preventing rib is formed annularly, and extended from a rear side of the blow guiding plate on an outside of the bell mouth to an outside of a turbo fan. An end of the back flow preventing rib is formed within 15-30% of width of a blade of the turbo fan to cover some of the outlet of the turbo fan. Air passed through the turbo fan by the back flow preventing rib is stopped from flowing back between the bell mouth and the shroud to be smoothly discharged into a room through a discharge port. Air volume discharged from the indoor unit is increased by prevention of back flow phenomenon to improve efficiency of the turbo fan and reduce noise of the indoor unit.

[0003] A known indoor unit of an air conditioner is arranged such that, by using a centrifugal fan housed in a casing, air sucked through an inlet port on the front of the casing is arranged to be an air flow in centrifugal direction, and the air flow is blown out from an inlet port provided around the outlet port (see e.g. Patent Document 1). In this indoor unit of Patent Document 1, the air flow blown out from the centrifugal fan in centrifugal direction collides a guide wall (fan casing) which is radially outside the centrifugal fan, so that the air flow is guided to the outlet port.

[Patent Document]

[0004] [Patent Document 1] Japanese Unexamined Patent Publication No. 2007-183013

[0005] The indoor unit of Patent Document 1, however, is disadvantageous in that noise is generated because the air flow blown out from the centrifugal fan in centrifugal direction collides the guide wall (fan casing).

SUMMARY OF THE INVENTION

[0006] The present invention was done to solve this problem and hence an object of the present invention is to provide an indoor unit of a floor-type air conditioner which is capable of restraining noise caused by the collision of air blown out from a centrifugal fan onto a casing or the like.

[0007] An indoor unit of a floor-type air conditioner according to the first aspect of the invention includes: a centrifugal fan which generates an air flow in centrifugal direction; a fan motor which has a motor shaft attached to the centrifugal fan and is configured to rotate the centrifugal fan; and a casing which stores the centrifugal fan and has an inlet port sucking air from outside to supply the air to the centrifugal fan and an outlet port which blows out an air flow generated by the centrifugal fan to the outside, wherein, the centrifugal fan includes an impeller disk (main blade), an impeller shroud (sub blade) on the inlet port side of the impeller disk (main blade), and a plurality of blades provided between the impeller disk (main blade) and the impeller shroud (sub blade), the impeller disk (main blade) has a first extension portion which extends from an outer periphery of the impeller disk (main blade) toward the outside of outer peripheries of the blades and is linearly inclined toward the inlet port with respect to a plane orthogonal to the motor shaft, and the impeller shroud (sub blade) includes a second extension portion which extends from an outer periphery of the impeller shroud (sub blade) toward the outside of outer peripheries of the blades and is linearly inclined toward the inlet port with respect to a plane orthogonal to the motor shaft, and an angle of inclination of the first extension portion with respect to a plane orthogonal to the motor shaft is smaller than an angle of inclination of the second extension portion.

[0008] This indoor unit of the floor-type air conditioner arranges, by means of the first extension portion and the second extension portion, an air flow blown out in centrifugal direction from the space between the impeller disk (main blade) and the impeller shroud (sub blade) to be an air flow toward the outlet ports. In other words, the indoor unit is able to form a smooth air flow which moves from the centrifugal fan to the outlet ports in the casing without colliding the casing or the like. As a result, it is possible to restrain the noise caused by the collision of an air flow blown out from the centrifugal fan onto the casing or the like.

[0009] Furthermore, since the angle of inclination of the first extension portion on the impeller disk (main blade) side where the air flow blown out from the centrifugal fan is fast is arranged to be smaller than that of the second extension portion, the fast air flow on the impeller disk (main blade) side is directed toward the outlet ports without being sharply diverted.

[0010] According to the second aspect of the invention, the indoor unit of the floor-type air conditioner includes: a centrifugal fan which generates an air flow in centrifugal direction; and a casing which stores the centrifugal fan and has an inlet port which sucks air from outside to supply the air to the centrifugal fan and outlet port which blows out an air flow generated by the centrifugal fan to the outside, wherein the centrifugal fan includes an impeller disk (main blade), an impeller shroud (sub blade) on the inlet port side of the impeller disk (main blade), and a plurality of blades provided between the impeller disk (main blade) and the impeller shroud (sub blade), the impeller disk (main blade) has a first extension portion which extends from an outer periphery of the impeller disk (main blade) toward the outside of outer peripheries of the blades and curves toward the inlet port, the impeller shroud (sub blade) includes a second extension portion which extends from an outer periphery of the impeller shroud (sub blade) toward the outside of outer peripheries of the blades and curves toward the inlet port, and the second extension portion is more curved than the first extension portion.

[0011] The indoor unit of the floor-type air conditioner is arranged so that the second extension portion on the impeller shroud (sub blade) side, where the air flow is slow, is curved. This facilitates airflow to the outlet ports.

[0012] According to the third aspect of the invention, the indoor unit of the floor-type air conditioner according to any one of the first to second aspects of the invention is arranged so that the external diameter of the first extension portion is identical with the external diameter of the second extension portion.

[0013] According to this indoor unit of the floor-type air conditioner, the first extension portion and the second extension portion are efficiently extended in the casing which defines the maximum size of the external diameter of the centrifugal fan.

[0014] According to the fourth aspect of the invention, the indoor unit of the floor-type air conditioner according to any one of the first to third aspects of the invention is arranged so that the first extension portion is formed along the entire outer periphery of the impeller disk (main blade), and the second extension portion is formed along the entire outer periphery of the impeller shroud (sub blade).

[0015] This indoor unit of the floor-type air conditioner allows the air flow blown out in centrifugal direction to be equally directed to the outlet ports from the entire outer peripheries of the impeller disk (main blade) and the impeller shroud (sub blade).

[0016] As described above, the following effects are obtained from the present invention.

[0017] According to the first aspect of the invention, by means of the first extension portion and the second extension portion, an air flow blown out in centrifugal direction from the space between the impeller disk (main blade) and the impeller shroud (sub blade) are arranged to be an air flow toward the outlet ports. Therefore, the indoor unit is able to form a smooth air flow which moves from the centrifugal fan to the outlet ports in the casing without colliding the casing or the like. As a result, it is possible to restrain the noise caused by the collision of an air flow blown out from the centrifugal fan onto the casing or the like.

[0018] Furthermore, since the angle of inclination of the first extension portion on the impeller disk (main blade) side where the air flow blown out from the centrifugal fan is fast is arranged to be smaller than that of the second extension portion, the fast air flow on the impeller disk (main blade) side is directed toward the outlet ports without being sharply diverted.

[0019] According to the second aspect of the invention, the second extension portion on the impeller shroud (sub blade) side, where the air flow is slow, is curved. This facilitates airflow to the outlet ports.

[0020] According to the third aspect of the invention, the first extension portion and the second extension portion are efficiently extended in the casing which defines the maximum size of the external diameter of the centrifugal fan.

[0021] According to the fourth aspect of the invention, the first extension portion is formed along the entire outer periphery of the impeller disk (main blade), and the second extension portion is formed along the entire outer periphery of the impeller shroud (sub blade).

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Fig. 1 is a circuit diagram of a refrigerant circuit of an air conditioner in accordance with the present invention.

Fig. 2 is an oblique perspective showing the appearance of the floor-type indoor unit.

Fig. 3 is a cross section of the floor-type indoor unit shown in Fig. 2 according to a Reference Example.

Fig. 4 is an elevation view showing the internal structure of the floor-type indoor unit shown in Fig. 2.

Fig. 5 is a schematic cross section of a fan unit and the bottom frame according to a Reference Example.

Fig. 6 is an oblique perspective of the turbofan shown in Fig.5.

Fig. 7 is an elevation of the turbofan shown in Fig.5.

Fig. 8 is a cross section taken along the A-A line in Fig. 7.

Fig. 9 is an oblique perspective when the shutter unit is viewed from the back side.

Fig. 10 is an oblique perspective when the shutter unit is viewed from the back side.

Fig. 11 is a cross section of the shutter unit when the shutter is open.

Fig. 12 is a cross section of the shutter unit when the shutter is closed.

Fig. 13 is a graph showing the relationship between an angle of inclination of the extension portion of the impeller disk (main blade) of Reference Example and noise.

Fig. 14 is a graph showing the relationship between an angle of inclination of the extension portion of the impeller disk (main blade) of Reference Example and an input to the fan motor.

Fig. 15 is a schematic cross section of a turbofan according to First Embodiment of the present invention.

Fig. 16 is a schematic cross section of a turbofan according to Second Embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] The following will describe an embodiment of an air conditioner having a floor-type indoor unit according to the present invention, with reference to figures.

[0024] Fig. 1 is a circuit diagram of a refrigerant circuit of an air conditioner according to the present invention. Fig. 2 is an oblique perspective showing the appearance of the floor-type indoor unit. Fig. 3 is a cross section of the floor-type indoor unit shown in Fig. 2 according to a Reference Example. Fig. 4 is an elevation view showing the internal structure of the floor-type indoor unit shown in Fig. 2. Now, an air conditioner according to the present invention will be described with reference to Fig. 1 to Fig. 4.

<Air Conditioner>

[0025] An air conditioner 100 according to an embodiment of the present invention is an apparatus for supplying conditioned air into a room, and includes, as shown in Fig. 1, a floor-type indoor unit (hereinafter, indoor unit) 1 disposed in the room, an outdoor unit 2 disposed outside the room, and a connection pipe 3 connecting the indoor unit 1 with the outdoor unit 2. The components and valves housed in the indoor unit 1 and the outdoor unit 2 and the connection pipe 3 are connected with one another and constitute a refrigerant circuit. The refrigerant circuit is chiefly made up of an indoor heat exchanger 10, an outdoor heat exchanger 20, an accumulator 21, a compressor 22, a four-pass switching valve 23, and an electric expansion valve 24.

[0026] In the air conditioner 100 arranged as above, the four-pass switching valve 23 is switched to the position indicated by the solid line, when heating. As a result, a hot high-pressure refrigerant discharged from the compressor 22 flows into the indoor heat exchanger 10 via the four-pass switching valve 23. The refrigerant condensed in the indoor heat exchanger (condenser) 10 is depressurized by the electric expansion valve 24 and then flows into the outdoor heat exchanger 20. Thereafter, the refrigerant evaporated in the outdoor heat exchanger (evaporator) 20 returns to the sucking side of the compressor 22 via the four-pass switching valve 23 and the accumulator 21. As such, the air around the indoor heat exchanger 10 is heated and hot air is supplied into the room.

[0027] On the other hand, when cooling, the four-pass switching valve 23 is switched to the position indicated by a dotted line. Upon switching, the hot high-pressure refrigerant discharged from the compressor 22 flows into the outdoor heat exchanger 20 via the four-pass switching valve 23. The refrigerant condensed in the outdoor heat exchanger (condenser) 20 is depressurized by the electric expansion valve 24, and then flows into the indoor heat exchanger 10. Thereafter, the refrigerant evaporated in the indoor heat exchanger (evaporator) 10 returns to the sucking side of the compressor 22 via the four-pass switching valve 23 and the accumulator 21. As such, the air around the indoor heat exchanger 10 is cooled and cool air is supplied to the room.

<Outdoor Unit>

[0028] The outdoor unit 2 includes the compressor 22, the four-pass switching valve 23 connected to the discharging side of the compressor 22, the accumulator 21 connected to the sucking side of the compressor 22, the outdoor heat exchanger 20 connected to the four-pass switching valve 23, the electric expansion valve 24 connected to the outdoor heat exchanger 20, and an outdoor fan 25 attached to the outdoor heat exchanger 20. The electric expansion valve 24 is connected to a liquid refrigerant pipe 31, and is further connected to one end of the indoor heat exchanger 10 via the liquid refrigerant pipe 31. The four-pass switching valve 23 is connected to a gas refrigerant pipe 32, and is further connected to the other end of the indoor heat exchanger 10 via the gas refrigerant pipe 32. The refrigerant pipes 31 and 32 are equivalent to the above-described connection pipe 3.

<Indoor Unit>

[0029] The indoor unit 1 is, as shown in Fig. 2 and Fig. 3, a floor-type indoor unit and chiefly includes a casing unit 50, an indoor heat exchanger 10 housed in the casing unit 50, a fan unit 60, and a shutter unit 70.

<Casing Unit>

[0030] The casing unit 50 constituting the contour of the indoor unit 1 includes a front panel 51, a front grill 52, a bottom frame 53, and a back heat-insulating material 54. These components are disposed in the order of, from the front side of the indoor unit 1, the front panel 51, the front grill 52, the bottom frame 53, and the back heat-insulating material 54. The space formed inside the casing unit 50 is, as shown in Fig. 4, divided into a fan chamber 50A in which the indoor heat exchanger 10, the fan unit 60 and the like are provided, and a pipe chamber 50B in which electric units or the like are provided.

[0031] The front panel 51 is, as shown in Fig. 2 and Fig. 3, attached to cover a filter 55 which is attached to the front grill 52. At the top of this front panel 51 is provided an upper inlet port 51a, whereas at the bottom of the front panel 51 is provided a lower inlet port 51b. Furthermore, on the both sides of the front panel 51 are formed side inlet ports 51c. The upper inlet port 51a and the lower inlet port 51b are long in the width directions (X directions) whereas the side inlet ports 51c are long in the vertical directions (Z directions). These ports allow the unit to suck indoor air in four directions, i.e. from above, from below, from left, and from right, and the air sucked through the inlet ports 51a, 51b, and 51c are evenly passes through the indoor heat exchanger 10.

[0032] The front grill 52is, as shown in Fig. 2 and Fig.

3, provided between the front panel 51 and the indoor heat exchanger 10. At the top of the front grill 52 is provided an upper outlet port 52a, whereas at the bottom of the front grill 52 is provided a lower outlet port 52b. These upper outlet port 52a and the lower outlet port 52b are both long in the width directions (X directions). At the center of the front grill 52 is formed a substantially rectangular parallelepiped opening 52c. This opening 52c is provided with a filter 55 to catch the dust in the air sucked through the inlet ports 51a, 51b, and 51c of the front panel 51.

[0033] The bottom frame 53 is, as shown in Fig. 3, disposed between the later-described fan unit 60 and the back heat-insulating material 54. This bottom frame 53 includes a bottom portion 53a forming the bottom of the indoor unit 1 and a standing portion 53b standing on the bottom portion 53a. The bottom portion 53a is provided with a pipe introducing hole 53c to introduce the connection pipe 3 into the pipe chamber 50B (see Fig. 4). Substantially at the center of the standing portion 53b is provided a fan attaching portion 53d for attaching the fan unit 60 thereto.

[0034] The back heat-insulating material 54 is provided on the back side of the bottom frame 53 for heat insulation.

[0035] In the casing unit 50 structured as above, as shown in Fig. 3, an upper air duct 50a is formed to connect a later-described turbofan 62 with the upper outlet port 52a. This upper air duct 50a is formed along the inner wall surface of the bottom frame 53. This duct 50a curves and extends forward and upward from the turbofan 62 to the upper outlet port 52a. Above the upper air duct 50a are provided a vertical flap 40 by which the direction of air flow blown out from the upper outlet port 52a is controlled in regard to the horizontal direction and a horizontal flap 41 by which the direction of air flow is controlled in regard to the vertical direction. In the casing unit 50, furthermore, a lower air duct 50b is formed to connect the turbofan 62 with the lower outlet port 52b. The lower air duct 50b curves and extends forward and downward from the turbofan 62 to the lower outlet port 52b. Above this lower air duct 50b is provided a vertical flap 42 by which the direction of air flow blown out from the lower outlet port 52b is controlled in regard to the horizontal direction. On the windward side of the vertical flap 42 is provided a later-described shutter 72.

<Indoor Heat Exchanger>

[0036] The indoor heat exchanger 10 is provided for conducting heat exchange with the indoor air. This indoor heat exchanger 10 is, as shown in Fig. 3, provided between the fan unit 60 and the front grill 52 and conducts heat exchange on the windward side of the fan unit 60.

<Bell-Mouth>

[0037] In addition to the above, between the indoor heat exchanger 10 and the fan unit 60 is provided a bell-mouth 11. This bell-mouth 11 guides the air having passed through the indoor heat exchanger 10 to the later-described turbofan 62 (opening 64a).

<Fan Unit>

[0038] Fig. 5 is a Reference Example of a schematic cross section of an unclaimed fan unit and bottom frame. Fig. 6 turbofan shown in is an oblique perspective of the turbofan shown in Fig.5, Fig. 7 is an elevation of the turbofan shown in Fig. 5, and Fig. 8 is a cross section taken along the A-A line in Fig. 7. Now, the fan unit 60 will be detailed with reference to drawings such as Fig. 5 to Fig. 8, and is provided for background information.

[0039] The fan unit 60 includes a fan motor 61 which is a drive source and provided on the leeward side of the indoor heat exchanger 10 and the turbofan 62 which is a type of centrifugal fan generating an air flow in centrifugal direction. The air flow generated by this fan unit 60 is blown out from the upper outlet port 52a via the above-described upper air duct 50a and from the lower outlet port 52b via the lower air duct 50b.

[0040] The fan motor 61 is attached to the fan attaching portion 53d (see Fig. 3) of the standing portion 53b of the bottom frame 53. The motor shaft 61a of this fan motor 61 extends in the front-back directions (Y directions), and rotates about a rotational axis extending in the front-back directions.

[0041] As shown in Fig. 3, the turbofan 62 is attached to the motor shaft 61a of the fan motor 61 and rotates in accordance with the rotation of the motor shaft 61a. This turbofan 62 includes, as shown in Fig. 5 to Fig. 8, a impeller disk (main blade) 63, a impeller shroud (sub blade) 64 opposing the impeller disk (main blade) 63, and seven blades 65 provided between the impeller disk (main blade) 63 and the impeller shroud (sub blade) 64.

[0042] The impeller disk (main blade) 63 is substantially disc-shaped in elevation, and a protrusion 63a protruding toward the impeller shroud (sub blade) 64 is formed at its center. This protrusion 63a is formed to correspond to the fan motor 61, and is attached to the above-described motor shaft 61a. Around the protrusion 63a formed substantially at the center of the impeller disk (main blade) 63, a flat portion 63b is formed to extend along the plane orthogonal to the above-described motor shaft 61a. In the Reference Example, as shown in Fig. 5 and Fig. 8, the impeller disk (main blade) 63 further has an extension portion 63c which linearly extends from the outer periphery of the impeller disk (main blade) 63 toward the outside of the outer peripheries of the seven blades 65. This extension portion 63c is inclined for an angle of theta (see Fig. 5) toward the impeller shroud (sub blade) 64, with respect to the flat portion 63b. The extension portion 63c is arranged to be close to the impeller shroud (sub blade) 64 toward its leading end.

[0043] The impeller shroud (sub blade) 64 is spaced apart from the impeller disk (main blade) 63 and is on the port 52a side and on the port 52b side of the impeller disk (main blade) 63. This impeller shroud (sub blade) 64 is substantially ring-shaped in elevation and an opening 64a formed at its center functions as an air inlet. In the Reference Example, furthermore, the impeller shroud (sub blade) 64 has an extension portion 64b which curves and extends from the outer periphery of the impeller shroud (sub blade) 64 toward the outside of the outer peripheries of the seven blades 65. This extension portion 64b is inclined away from the impeller disk (main blade) 63. More specifically, the extension portion 64b is arranged to be close to the outlet ports 52a and 53b toward its leading end. The impeller shroud (sub blade) 64 is further provided with an extension portion 64c which curves and extends inward from its inner periphery. This extension portion 64c is inclined away from the impeller disk (main blade) 63 in the same manner as the extension portion 64b described above. More specifically, the extension portion 64c is arranged to be close to the outlet ports 52a and 52b toward its leading end.

[0044] In the Reference Example, as shown in Fig. 6, the extension portion 63c of the above-described impeller disk (main blade) 63 is formed along the entirety of the outer periphery, and the extension portion 64b of the impeller shroud (sub blade) 64 is formed along the entirety of the outer periphery. Furthermore, as shown in Fig. 5, the external diameter R1 of the extension portion 63c is identical with the external diameter R2 of the extension portion 64b.

[0045] The seven blades 65 are, as shown in Fig. 7, provided at predetermined intervals and angles along the direction of the rotation of the turbofan 62.

[0046] As shown in Fig. 3 and Fig. 5, as the fan motor 61 is activated, the turbofan 62 rotates, the air having passed through the indoor heat exchanger 10 is sucked into the turbofan 62 via the opening 64a, with the result that an air flow in centrifugal direction is generated. This air flow in centrifugal direction is directed toward the outlet ports 52a and 52b of the indoor unit 1 by the extension portion 63c of the impeller disk (main blade) 63 and the extension portion 64b of the impeller shroud (sub blade) 64. In other words, the air flow blown out from the upper part of the turbofan 62 progresses along the upper air duct 50a and is then blown out from the casing unit 50 through the upper outlet port 52a. The air flow blown out from the lower part of the turbofan 62 progresses along the lower air duct 50b and is then blown out from the casing unit 50 through the lower outlet port 52b.

<Shutter Unit>

[0047] Each of Fig. 9 and Fig. 10 is an oblique perspective when the shutter unit is viewed from the back side. Fig. 11 is a cross section of the shutter unit when the shutter is open. Fig. 12 is a cross section of the shutter unit when the shutter is closed. Now, the shutter unit 70 will be detailed with reference to drawings such as Fig. 9 to Fig. 12.

[0048] The shutter unit 70 is provided around the lower outlet port 52b and determines whether the air flow from the turbofan 62 to the lower outlet port 52b is allowed to be blown to the outside, by opening or closing a port 50c on the lower air duct 50b which connects the turbofan 62 with the lower outlet port 52b. This shutter unit 70 is provided with a shutter driving motor 71 which is a drive source, the shutter 72, and a shutter casing 73 which rotatably supports the shutter 72.

[0049] The shutter casing 73 includes, as shown in Fig. 4, Fig. 9, and Fig. 10, a shutter supporter 73a to which the shutter driving motor 71 and the shutter 72 are attached and a drain pan 73b provided above the shutter supporter 73a. The shutter supporter 73a is a tubular member functioning as a part of the above-described lower air duct 50b as shown in Fig. 9 and Fig. 10, and its longitudinal end is attached to a mounting portion 73c to which the shutter driving motor 71 is mounted. This mounting portion 73c has a through hole 73d (see Fig. 10) through which the motor shaft 71a of the shutter driving motor 71 penetrates. The other longitudinal end of the shutter supporter 73a is attached to a bearing portion 73e which rotatably supports a later-described shaft 72b of the shutter 72. The drain pan 73b is, as shown in Fig. 4, disposed along the lower edge of the indoor heat exchanger 10 and receives water drained from the indoor heat exchanger 10. This drain pan 73b is arranged to be inclined downward toward the pipe chamber 50B. At the bottom of the drain pan 73b on the pipe chamber 50B side, a drain pipe 73f is provided to drain the water in the drain pan to the outside.

[0050] The shutter driving motor 71 is a stepper motor and is provided outside the shutter casing 73 so as not to obstruct the air flow in the lower air duct 50b. The motor shaft 71a of this shutter driving motor 71 is, as shown in Fig. 10, attached to the shutter 72 via the through hole 73d penetrating the shutter casing 73. The shutter driving motor 71 rotates the shutter 72 in the direction of the arrow G about a rotational axis extending along the longitudinal directions of the shutter 72. The shutter 72 therefore moves from the open position shown in Fig. 11 to the close position show in Fig. 12 or moves from the close position shown in Fig. 12 to the open position shown in Fig. 11.

[0051] The shutter 72 is provided around the lower outlet port 52b. This shutter 72 is able to take a position to close the port 50c on the lower air duct 50b and a position to open the port 50c. The shutter 72 is, as shown in Fig. 9 and Fig. 10, arranged to be long in the width directions (X directions) of the indoor unit 1. At one longitudinal end of the shutter 72 is provided a fitting hole 72a to which the motor shaft 71a of the shutter driving motor 71 is fit, whereas at the other longitudinal end is provided the shaft 72b which is rotatably supported by the bearing portion 73e.

Features of Floor-Type Indoor Unit of Reference Example

[0052] The floor-type indoor unit 1 of the Reference Example has the features described below.

[0053] As stated above, the indoor unit 1 of the present embodiment is arranged so that the impeller disk (main blade) 63 and the impeller shroud (sub blade) 64 of the turbofan 62 have the extension portions 63c and 64b, respectively. With this structure, the air flow in centrifugal direction, which is blown out through the space between the impeller disk (main blade) 63 and the impeller shroud (sub blade) 64, is directed to the upper outlet port 52a and the lower outlet port 52b by the extension portion 63c and the extension portion 64b. In other words, the indoor unit 1 is able to form a smooth air flow which heads for the upper outlet port 52a and the lower outlet port 52b from the turbofan 62 in the casing unit 50, before colliding the bottom frame 53. This makes it possible to restrain the generation of noise on account of the collision of an air flow blown out from the turbofan 62 onto the bottom frame 53.

[0054] In addition to the above, the indoor unit 1 of the Reference Example is arranged so that the extension portion 64b on the impeller shroud (sub blade) 64 side, where the air flow is slow, is curved. This facilitates airflow to the upper outlet port 52a and the lower outlet port 52b.

[0055] In addition to the above, the indoor unit 1 of the Reference Example is arranged so that the external diameter R1 of the extension portion 63c is identical with the external diameter R2 of the extension portion 64b. This allows the extension portion 63c and the extension portion 64b to be efficiently extended in the casing unit 50 which defines the maximum size of the external diameter of the turbofan 62.

[0056] In addition to the above, the indoor unit 1 of the Reference Example is arranged so that the extension portion 63c is formed along the entirety of the outer periphery of the impeller disk (main blade) 63 and the extension portion 64b is formed along the entirety of the outer periphery of the impeller shroud (sub blade) 64. This structure allows the air flow blown out in centrifugal direction to be equally directed to the upper outlet port 52a and the lower outlet port 52b from the entire outer peripheries of the impeller disk (main blade) 63 and the impeller shroud (sub blade) 64.

[Examples]

[0057] Fig. 13 is a graph showing the relationship between an angle of inclination of the extension portion of the impeller disk (main blade) of Reference Example and noise. Fig. 14 is a graph showing the relationship between an angle of inclination of the extension portion of the impeller disk (main blade) of Reference Example and an input to the fan motor.

(Example 1)

[0058] In Example 1, the angle theta of inclination (see Fig. 5) of the extension portion of the impeller disk (main blade) was about 9 degrees. In this case, as shown in Fig. 13, the generation of noise caused by the collision of wind blown out from the turbofan onto the casing or the like was restrained in Example 1, as compared to a comparative example of the conventional structure in which the impeller disk (main blade) does not have the extension portion. Furthermore, in Example 1, the input to the fan motor was slightly restrained as shown in Fig. 14.

(Example 2)

[0059] In Example 2, the angle theta of inclination (see Fig. 5) of the extension portion of the impeller disk (main blade) was arranged to be about 18 degrees. In this case, as shown in Fig. 13, the generation of noise caused by the collision of wind blown out from the turbofan onto the casing or the like was restrained in Example 2, as compared to the comparative example of the conventional structure in which the impeller disk (main blade) does not have the extension portion. Furthermore, in Example 2, the input to the fan motor was slightly restrained as shown in Fig. 14. In Example 2, however, both the noise reduction and the reduction in the input of the fan motor were less effective than Example 1. This is presumably because the increase in the angle of inclination of the extension portion narrowed the blowing path of the turbofan and hence the channel loss was increased.

First Embodiment of the Invention

[0060] Fig. 15 is a schematic cross section of a turbofan according to the First Embodiment of the present invention. The following will describe the turbofan according to the First Embodiment of the present invention with reference to Fig. 15. The turbofan 162 of First Embodiment is different from the turbofan 62 of the Reference Example in the shape of an extension portion 164b of a impeller shroud (sub blade) 164. It is noted that the components other than the turbofan 162 in First Embodiment are identical with those recited in Reference Example, and hence the same reference numerals are assigned to them and the descriptions thereof are not repeated.

[0061] The turbofan 162 of the present embodiment includes, as shown in Fig. 15, a impeller disk (main blade) 163, a impeller shroud (sub blade) 164 opposing the impeller disk (main blade) 164, and a plurality of blades 165 provided between the impeller disk (main blade) 163 and the impeller shroud (sub blade) 164. The impeller disk (main blade) 163 and the blade 165 will not be described in the present embodiment because they are identical with the impeller disk (main blade) 63 and the blade 65 of Reference Example, respectively.

[0062] In First Embodiment, the impeller shroud (sub blade) 164 is provided with an extension portion 164b which linearly extends from the outer periphery of the impeller shroud (sub blade) 164 toward the outside of the outer peripheries of the blades 165. In other words, First Embodiment is arranged so that both of the extension portion 163c of the impeller disk (main blade) 163 and the extension portion 164b of the impeller shroud (sub blade) 164 linearly extend. The extension portion 164b is inclined away from the impeller disk (main blade) 163. More specifically, the extension portion 164b is arranged to be close to the outlet ports 52a and 52b (see Fig. 3) toward its leading end. The angle theta of inclination 101 of this extension portion 164b of the impeller shroud (sub blade) 164 is larger than the angle theta of inclination 102 of the extension portion 163c of the impeller disk (main blade) 163.

(Second Embodiment)

[0063] Fig. 16 is a schematic cross section of a turbofan according to Second Embodiment of the present invention. The following will describe the turbofan according to Second Embodiment of the present invention with reference to Fig. 16. The turbofan 262 of Second Embodiment is arranged so that both of an extension portion 263c of a impeller disk (main blade) 263 and an extension portion 264b of a impeller shroud (sub blade) 264 are curved. It is noted that the components other than the turbofan 262 in Second Embodiment are identical with those recited in Reference Example, and hence the same reference numerals are assigned to them and the descriptions thereof are not repeated.

[0064] The turbofan 262 of the present embodiment includes, as shown in Fig. 16, a impeller disk (main blade) 263, a impeller shroud (sub blade) 264 opposing the impeller disk (main blade) 263, and a plurality of blades 265 provided between the impeller disk (main blade) 263 and the impeller shroud (sub blade) 264. The blades 265 will not be described because they are identical with the blades 65 of Reference Example.

[0065] According to Second Embodiment, as shown in Fig. 16, the impeller disk (main blade) 263 is provided with an extension portion 263c which curves and extends from the outer periphery of the impeller disk (main blade) 263 toward the outside of the outer peripheries of the blades 265. This extension portion 263c is arranged to be close to the impeller shroud (sub blade) 264 toward its leading end.

[0066] The impeller shroud (sub blade) 264 is provided with an extension portion 264b which curves and extends from the outer periphery of the impeller shroud (sub blade) 264 toward the outside of the outer peripheries of the blades 265. In other words, in Second Embodiment both of the extension portion 263c of the impeller disk (main blade) 263 and the extension portion 264b of the impeller shroud (sub blade) 264 are curved. The extension portion 264b is inclined away from the impeller disk (main blade) 263. More specifically, the extension portion 264b is arranged to be close to the outlet ports 52a and 52b (see Fig. 3) toward its leading end. The curvature of this extension portion 264b of the impeller shroud (sub blade) 264 is greater that that of the extension portion 263c of the impeller disk (main blade) 263.

[0067] While the present invention has been described in conjunction with the specific embodiments outlined above, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the preferred embodiments of the invention as set forth above are intended to be illustrative, not limiting.

[0068] For example, while the embodiments above describe the separated air conditioner including the outdoor unit and the indoor unit, the present invention is applicable for integrated air conditioners.

[0069] Also, the Reference Example is arranged so that the extension portion of the impeller disk (main blade) is linear whereas the extension portion of the impeller shroud (sub blade) is curved, First Embodiment is arranged so that the extension portions of the impeller disk (main blade) and the impeller shroud (sub blade) are both linear, and Second Embodiment is arranged so that the extension portions of the impeller disk (main blade) and the impeller shroud (sub blade) are both curved. In addition to this, the present invention may be arranged such that the extension portion of the impeller disk (main blade) is curved whereas the extension portion of the impeller shroud (sub blade) is linear.

[INDUSTRIAL APPLICABILITY]

[0070] The present invention makes it possible to realize an indoor unit of a floor-type air conditioner, which is capable of restraining noise caused by the collision of air blown out from a centrifugal fan (turbofan) onto a casing or the like.

[0071]

1 INDOOR UNIT
50 CASING UNIT (CASING)
51a UPPER INLET PORT (INLET PORT)
51b LOWER INLET PORT (INLET PORT)
52a UPPER OUTLET PORT (OUTLET PORT)
52b LOWER OUTLET PORT (OUTLET PORT)
62, 162, 262 TURBOFAN (CENTRIFUGAL FAN)
63, 163, 263 MAIN BLADE
63c, 163c, 263c EXTENSION PORTION (FIRST EXTENSION PORTION)
64, 164, 264 SUB BLADE
64b, 164b, 264b EXTENSION PORTION (SECOND EXTENSION PORTION)
65, 165, 265 BLADE

Claims

1. An indoor unit (1) of a floor-type air conditioner, com-

prising:

a centrifugal fan (162) which generates an air flow in centrifugal direction;
a fan motor (61) which has a motor shaft (61a) attached to the centrifugal fan (162) and is configured to rotate the centrifugal fan (162); and
a casing (53) which stores the centrifugal fan (162) and has an inlet port (51a, b, c) which sucks air from outside to supply the air to the centrifugal fan and an outlet port (52a, b) which blows out an air flow generated by the centrifugal fan to the outside, wherein,
the centrifugal fan (162) includes an impeller disk (163), an impeller shroud (164) on the inlet port side of the impeller disk, and a plurality of blades (165) provided between the impeller disk and the impeller shroud, and **characterised in that**
the impeller disk (163) has a first extension portion (163c) which extends from an outer periphery of the impeller disk toward the outside of outer peripheries of the blades (165) and is linearly inclined toward the inlet port (51a, b, c) with respect to a plane orthogonal to the motor shaft,
the impeller shroud (164) includes a second extension portion (164b) which extends from an outer periphery of the impeller shroud toward the outside of outer peripheries of the blades (165) and is linearly inclined toward the inlet port (51a, b, c) with respect to a plane orthogonal to the motor shaft, and
an angle of inclination (θ 102) of the first extension portion (163c) with respect to a plane orthogonal to the motor shaft is smaller than an angle of inclination (θ 101) of the second extension portion (164b).

2. An indoor unit (1) of a floor-type air conditioner, comprising:

a centrifugal fan (262) which generates an air flow in centrifugal direction; and
a casing (53) which stores the centrifugal fan (262) and has an inlet port (51a, b, c) which sucks air from outside to supply the air to the centrifugal fan (262) and an outlet port (52a, b) which blows out an air flow generated by the centrifugal fan (262) to the outside, wherein,
the centrifugal fan (262) includes an impeller disk (263), an impeller shroud (264) on the inlet port side of the impeller disk, and a plurality of blades (265) provided between the impeller disk and the impeller shroud, and **characterised in that**
the impeller disk (263) has first extension portion (263c) which extends from an outer periphery of the impeller disk toward the outside of outer peripheries of the blade (265) and curves toward the inlet port (51a, b, c),
the impeller shroud (264) includes a second extension portion (264b) which extends from an outer periphery of the impeller shroud toward the outside of outer peripheries of the blades (65, 265) and curves towards the inlet port (51a, b, c), and
the second extension portion (264b) is more curved than the first extension portion (263c).

3. The indoor unit (1) of the floor-type air conditioner according to any one of claims 1 to 2, wherein, the external diameter of the first extension portion (163c, 263c) is identical with the external diameter of the second extension portion (164b, 264b).

4. The indoor unit (1) of the floor-type air conditioner according to any one of claims 1 to 3, wherein, the first extension portion (163c, 263c) is formed along the entire outer periphery of the impeller disk (163, 263), and the second extension portion (164b, 264b) is formed along the entire outer periphery of the impeller shroud (164, 264).

Patentansprüche

1. Innenraumeinheit (1) einer Boden-Klimaanlage, umfassend:

ein Zentrifugalgebläse (162), das einen Luftstrom in Zentrifugalrichtung erzeugt;
einen Gebläsemotor (61) mit einer Motorwelle (61a), die an dem Zentrifugalgebläse (162) angebracht ist und dazu konfiguriert ist, das Zentrifugalgebläse (162) zu rotieren; und
ein Gehäuse (53), das das Zentrifugalgebläse (162) lagert und eine Einlassöffnung (51a, b, c) aufweist, welche von außen Luft saugt, um die Luft dem Zentrifugalgebläse zuzuführen, und eine Auslassöffnung (52a, b) aufweist, die einen von dem Zentrifugalgebläse erzeugten Luftstrom nach außen bläst, wobei
das Zentrifugalgebläse (162) eine Gebläseradscheibe (163), einen Gebläseradkragen (164) auf Seiten der Einlassöffnung der Gebläseradscheibe und eine Vielzahl von Flügeln (165) beinhaltet, die zwischen der Gebläseradscheibe und dem Gebläseradkragen angeordnet sind,
und **dadurch gekennzeichnet, dass**
die Gebläseradscheibe (163) einen ersten Erweiterungsbereich (163c) aufweist, der sich von einer äußeren Peripherie der Gebläseradscheibe in Richtung der Außenseite von äußeren Peripherien der Flügel (165) erstreckt und in Richtung der Einlassöffnung (51a, b, c) in Bezug auf

eine zu der Motorwelle orthogonale Ebene linear geneigt ist,
der Gebläseradkragen (164) einen zweiten Erweiterungsbereich (164b) beinhaltet, der sich von einer äußeren Peripherie des Gebläseradkragens in Richtung der Außenseite von äußeren Peripherien der Flügel (165) erstreckt und in Richtung der Einlassöffnung (51a, b, c) in Bezug auf eine zu der Motorwelle orthogonale Ebene linear geneigt ist, und
ein Neigungswinkel (θ 102) des ersten Erweiterungsbereichs (163c) in Bezug auf eine zu der Motorwelle orthogonale Ebene kleiner ist als ein Neigungswinkel (θ 101) des zweiten Erweiterungsbereichs (164b).

2. Innenraumeinheit (1) einer Boden-Klimaanlage, umfassend:

ein Zentrifugalgebläse (262), das einen Luftstrom in Zentrifugalrichtung erzeugt; und
ein Gehäuse (53), das das Zentrifugalgebläse (262) lagert und eine Einlassöffnung (51a, b, c) aufweist, welche von außen Luft saugt, um die Luft dem Zentrifugalgebläse (262) zuzuführen, und eine Auslassöffnung (52a, b) aufweist, die einen von dem Zentrifugalgebläse (262) erzeugten Luftstrom nach außen bläst, wobei
das Zentrifugalgebläse (262) eine Gebläseradscheibe (263), einen Gebläseradkragen (264) auf Seiten der Einlassöffnung der Gebläseradscheibe und eine Vielzahl von Flügeln (265) beinhaltet, die zwischen der Gebläseradscheibe und dem Gebläseradkragen angeordnet sind, und
dadurch gekennzeichnet, dass
die Gebläseradscheibe (263) einen ersten Erweiterungsbereich (263c) aufweist, der sich von einer äußeren Peripherie der Gebläseradscheibe in Richtung der Außenseite von äußeren Peripherien der Flügel (265) erstreckt und in Richtung der Einlassöffnung (51a, b, c) gekrümmt ist,
der Gebläseradkragen (264) einen zweiten Erweiterungsbereich (264b) beinhaltet, der sich von einer äußeren Peripherie des Gebläseradkragens in Richtung der Außenseite von äußeren Peripherien der Flügel (65, 265) erstreckt und in Richtung der Einlassöffnung (51a, b, c) gekrümmt ist, und
der zweite Erweiterungsbereich (264b) mehr gekrümmt ist als der erste Erweiterungsbereich (263c).

3. Innenraumeinheit (1) der Boden-Klimaanlage nach einem der Ansprüche 1 bis 2, wobei

der Außendurchmesser des ersten Erweiterungsbereichs (163c, 263c) identisch mit dem Außendurchmesser des zweiten Erweiterungsbereichs (164b, 264b) ist.

4. Innenraumeinheit (1) der Boden-Klimaanlage nach einem der Ansprüche 1 bis 3, wobei

der erste Erweiterungsbereich (163c, 263c) entlang der gesamten äußeren Peripherie der Gebläseradscheibe (163, 263) gebildet ist und der zweite Erweiterungsbereich (164b, 264b) entlang der gesamten äußeren Peripherie des Gebläseradkragens (164, 264) gebildet ist.

Revendications

1. Unité intérieure (1) d'un climatiseur du type au sol, comprenant :

un ventilateur centrifuge (162) qui génère un flux d'air dans une direction centrifuge ;
un moteur de ventilateur (61) qui a un arbre de moteur (61a) attaché au ventilateur centrifuge (162) et qui est configuré pour mettre le ventilateur centrifuge (162) en rotation ; et
un boîtier (53) qui loge le ventilateur centrifuge (162) et a un orifice d'entrée (51a, b, c), qui aspire de l'air depuis l'extérieur pour fournir l'air au ventilateur centrifuge et un orifice de sortie (52a, b) qui souffle un flux d'air généré par le ventilateur centrifuge vers l'extérieur, dans lequel,
le ventilateur centrifuge (162) comprend un disque de rotor (163), une enveloppe de rotor (164) du côté de l'orifice d'entrée du disque de rotor, et une pluralité de pales (165) disposées entre le disque de rotor et l'enveloppe de rotor,
et **caractérisée en ce que**
le disque de rotor (163) a une première partie d'extension (163c) qui se prolonge depuis une périphérie extérieure du disque de rotor vers l'extérieur de périphéries extérieures des pales (165) et qui est linéairement inclinée vers l'orifice d'entrée (51a, b, c) par rapport à un plan orthogonal à l'arbre de moteur,
l'enveloppe de rotor (164) comprend une deuxième partie d'extension (164b) qui se prolonge depuis une périphérie extérieure de l'enveloppe de rotor vers l'extérieur de périphéries extérieures des pales (165) et qui est linéairement inclinée vers l'orifice d'entrée (51a, b, c) par rapport à un plan orthogonal à l'arbre du moteur, et
un angle d'inclinaison (θ 102) de la première partie d'extension (163c) par rapport à un plan orthogonal à l'arbre de moteur est plus petit qu'un angle d'inclinaison (θ 101) de la première deuxième partie d'extension (164b).

2. Unité intérieure (1) d'un climatiseur du type au sol, comprenant :

un ventilateur centrifuge (262) qui génère un flux d'air dans une direction centrifuge ; et
un boîtier (53) qui loge le ventilateur centrifuge (262) et a un orifice d'entrée (51a, b, c), qui aspire de l'air depuis l'extérieur pour fournir l'air au ventilateur centrifuge (262) et un orifice de sortie (52a, b) qui souffle un flux d'air généré par le ventilateur centrifuge (262) vers l'extérieur, dans lequel,
le ventilateur centrifuge (262) comprend un disque de rotor (263), une enveloppe de rotor (264) du côté de l'orifice d'entrée du disque de rotor, et une pluralité de pales (265) disposées entre le disque de rotor et l'enveloppe de rotor, et
caractérisée en ce que
le disque de rotor (263) a une première partie d'extension (263c) qui se prolonge depuis une périphérie extérieure du disque de rotor vers l'extérieur de périphéries extérieures des pales (265) et qui se courbe vers l'orifice d'entrée (51a, b, c),
l'enveloppe de rotor (264) comprend une deuxième partie d'extension (264b) qui se prolonge depuis une périphérie extérieure de l'enveloppe de rotor vers l'extérieur de périphéries extérieures des pales (65, 265) et qui se courbe vers l'orifice d'entrée (51a, b, c), et
la deuxième partie d'extension (264b) est davantage courbée que la première partie d'extension (263c).

3. Unité intérieure (1) d'un climatiseur du type au sol selon l'une quelconque des revendications 1 et 2, dans laquelle,

le diamètre extérieur de la première partie d'extension (163c, 263c) est identique au diamètre extérieur de la deuxième partie d'extension (164b, 264b).

4. Unité intérieure (1) d'un climatiseur du type au sol selon l'une quelconque des revendications 1 à 3, dans laquelle,
la première partie d'extension (163c, 263c) est formée le long de toute la périphérie extérieure du disque de rotor (163, 263), et la deuxième partie d'extension (164b, 264b) est formée le long de toute la périphérie extérieure de l'enveloppe de rotor (164, 264).

FIG. 1

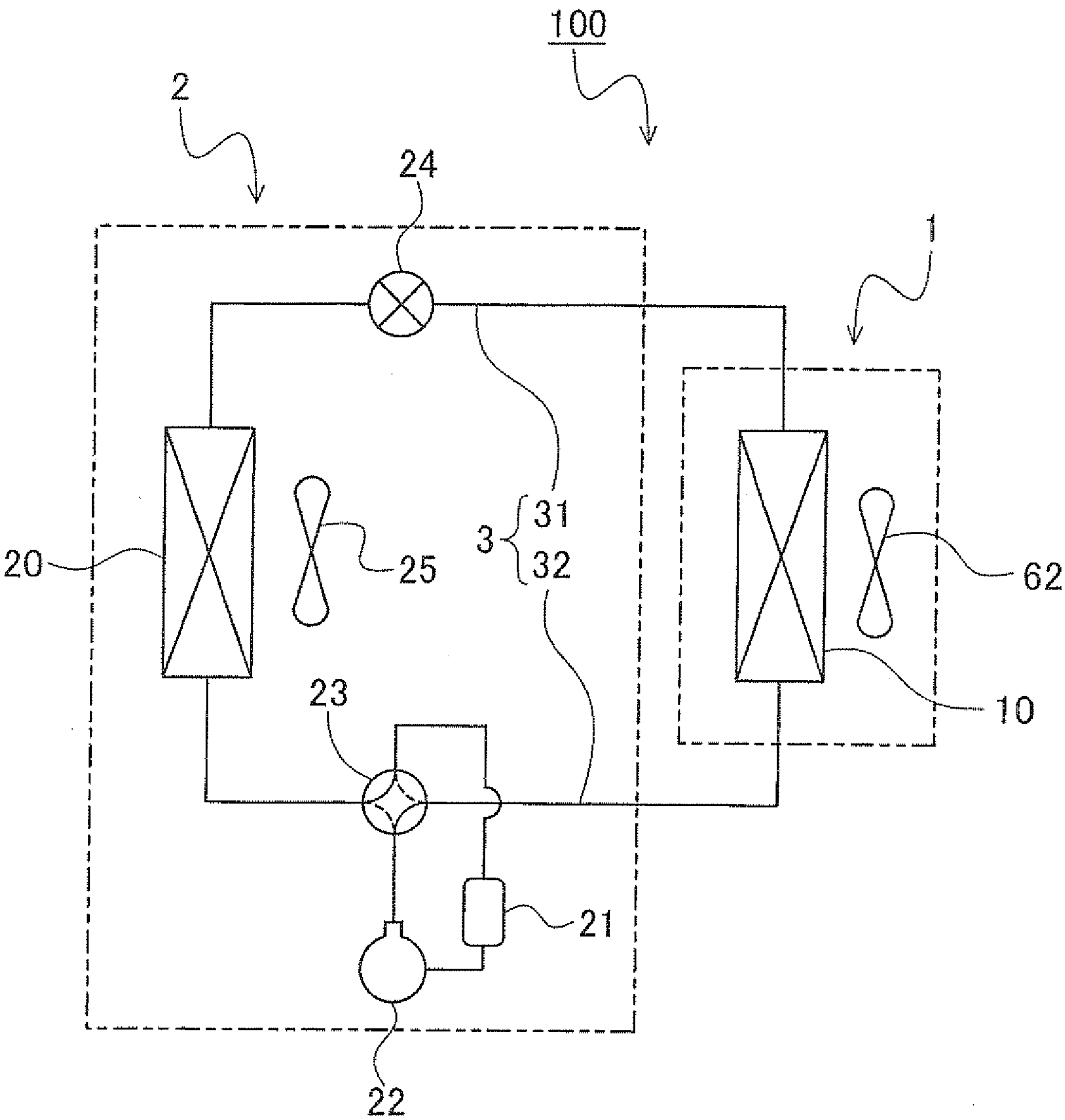


FIG. 2

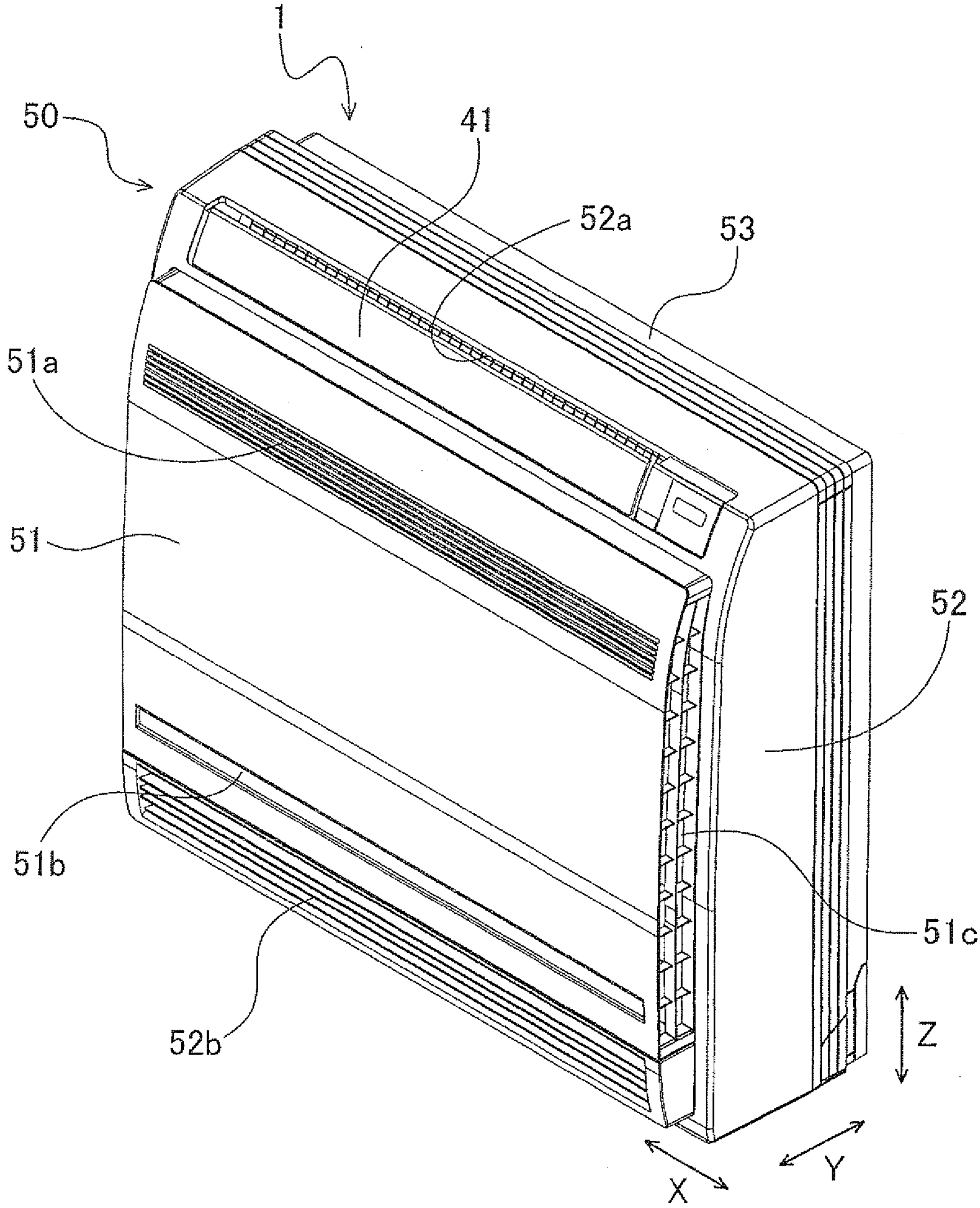


FIG. 3

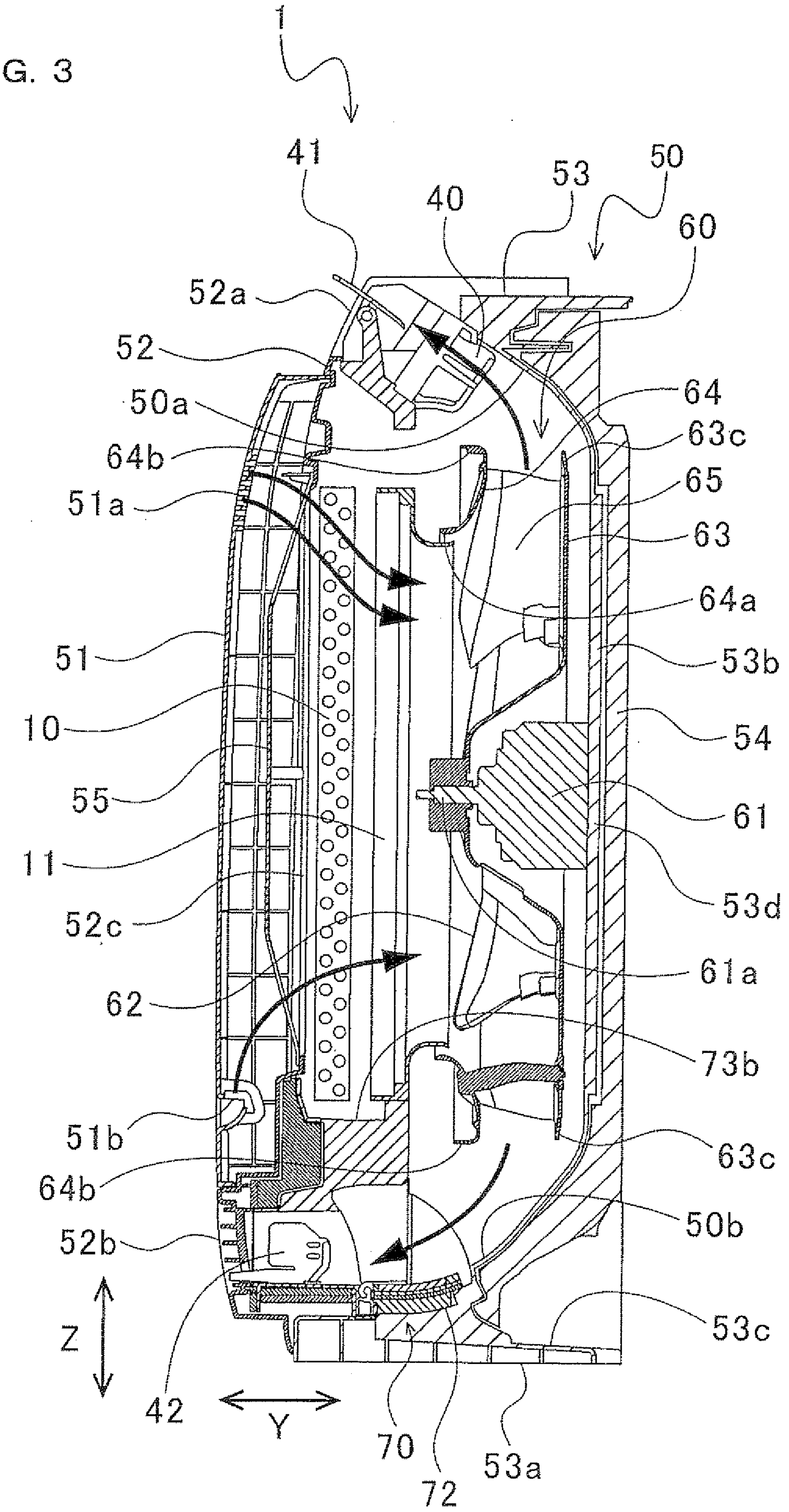

1
41
40
53
50
60
52a
52
64
50a
63c
64b
65
51a
63
64a
51
53b
10
54
55
61
11
53d
52c
61a
62
73b
51b
63c
64b
50b
52b
53c
Z
42
Y
70
53a
72

FIG. 4

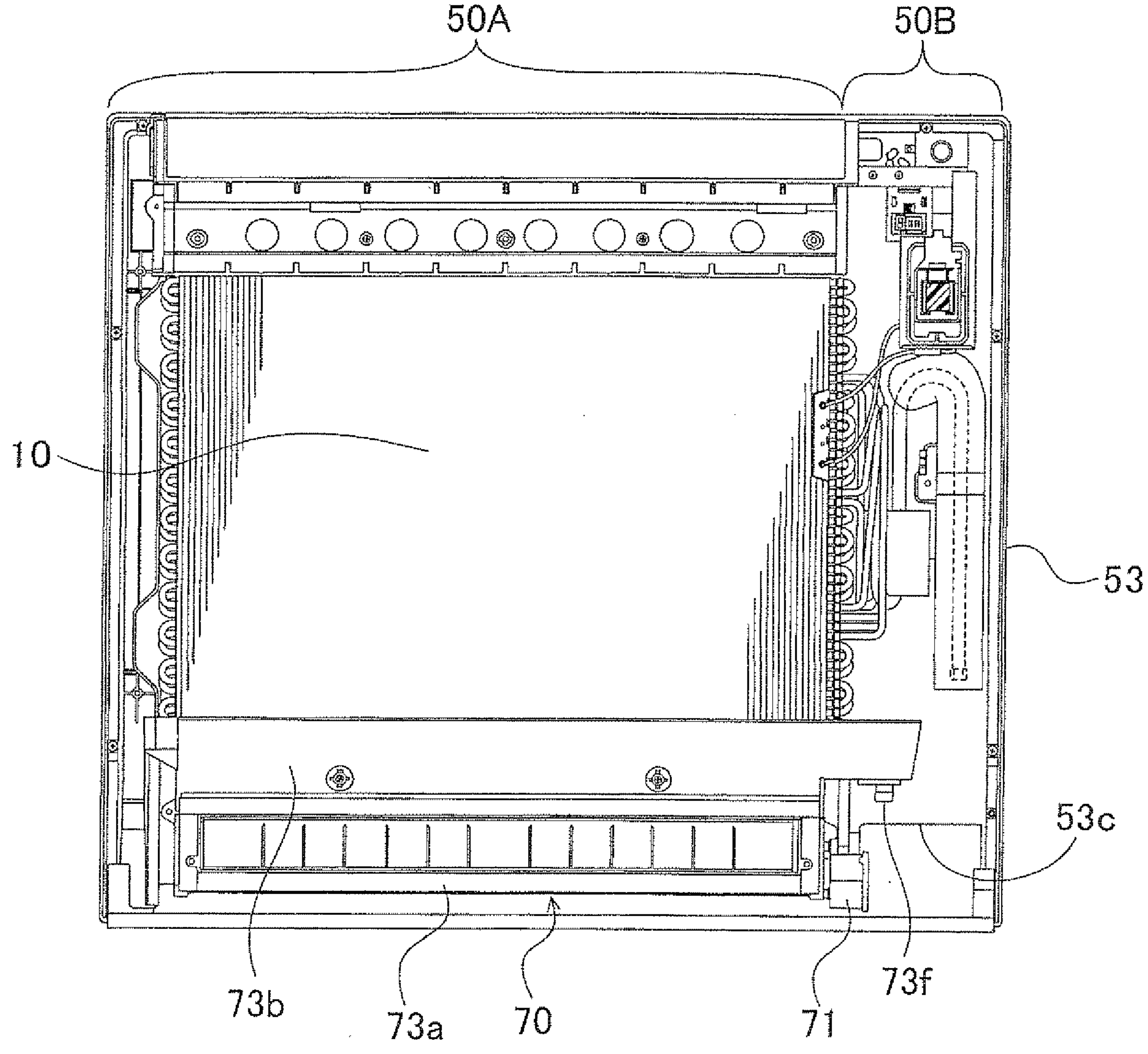


FIG. 5

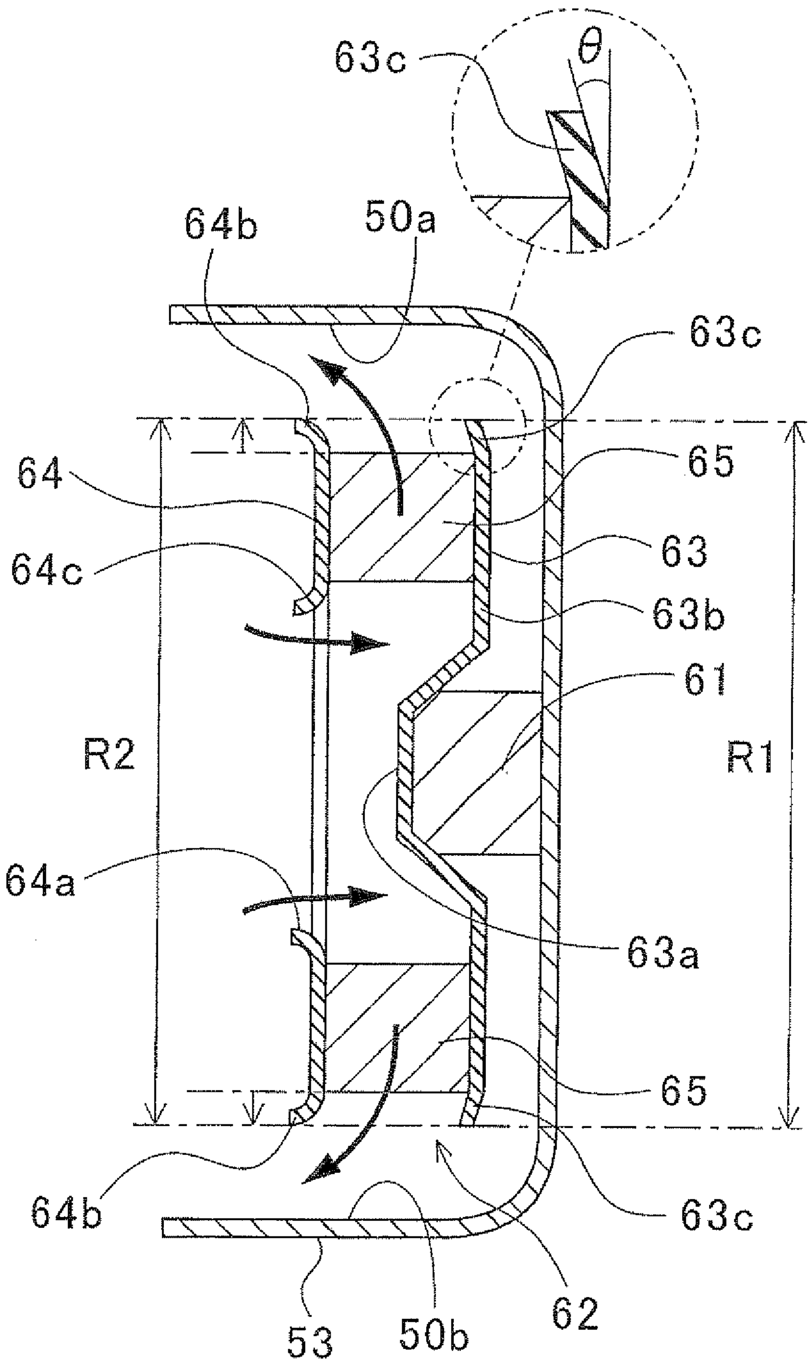

63c
θ
64b
50a
63c
64
65
63
64c
63b
61
R2
R1
64a
63a
65
64b
63c
53
50b
62

FIG. 6

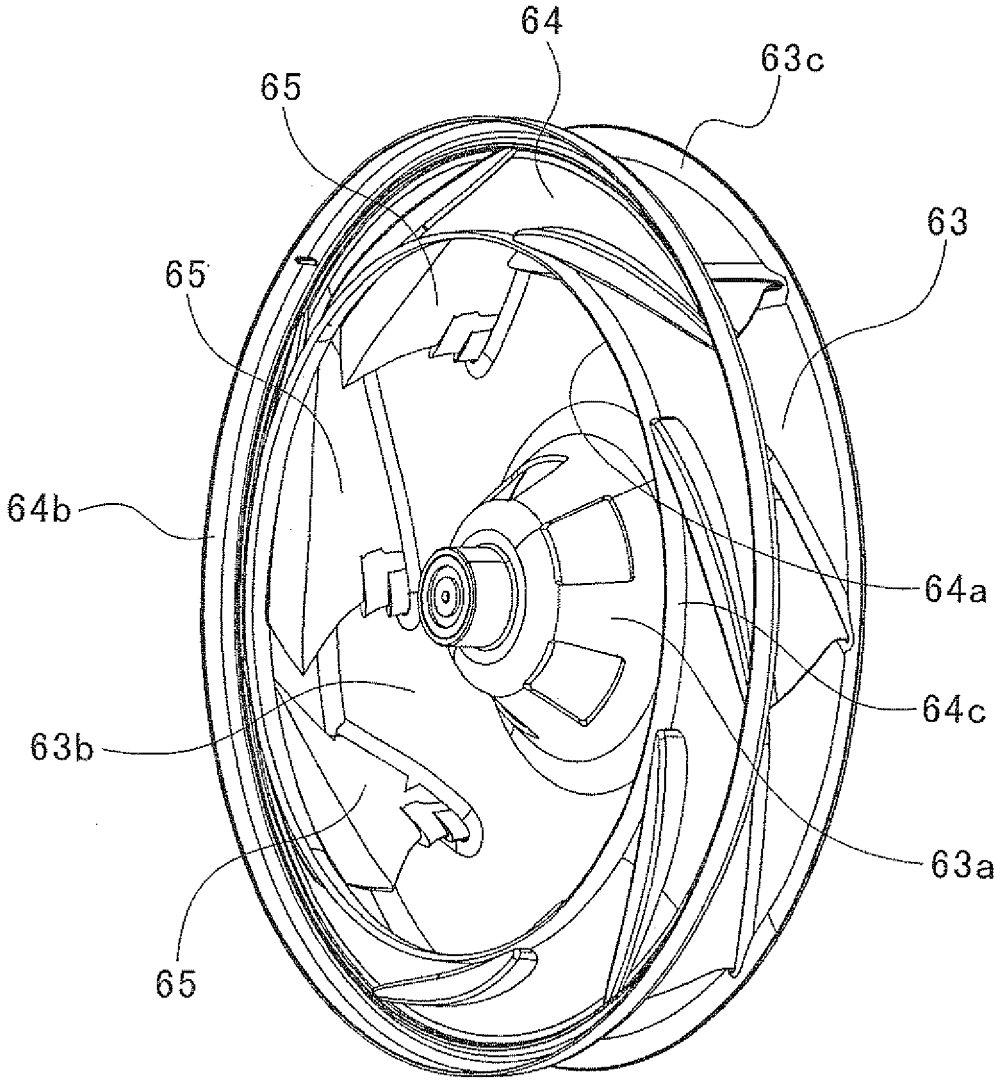


FIG. 7

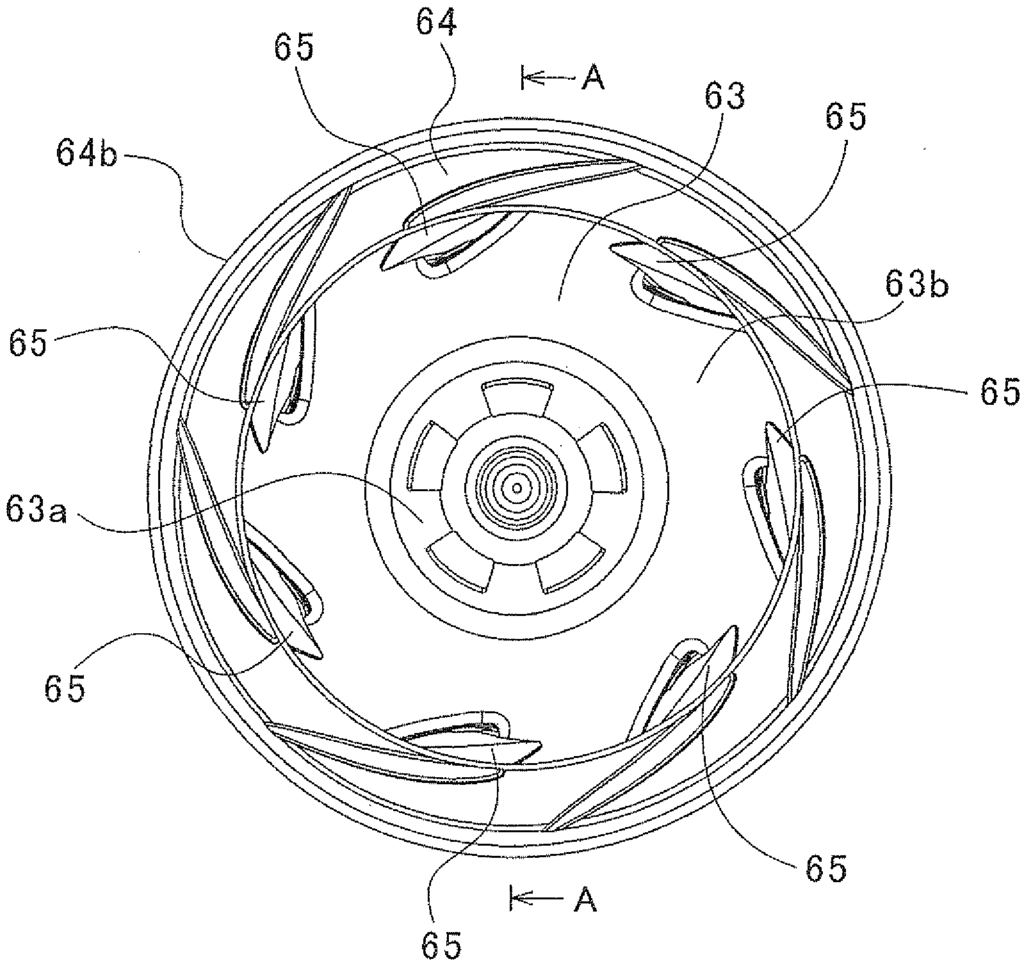


FIG. 8

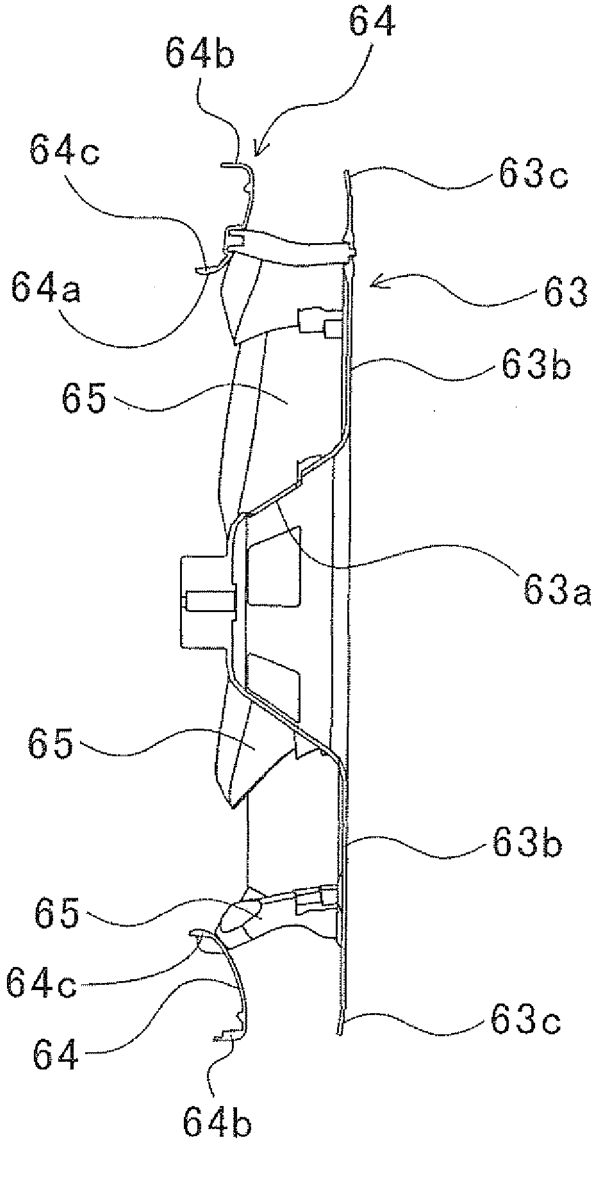


FIG. 9

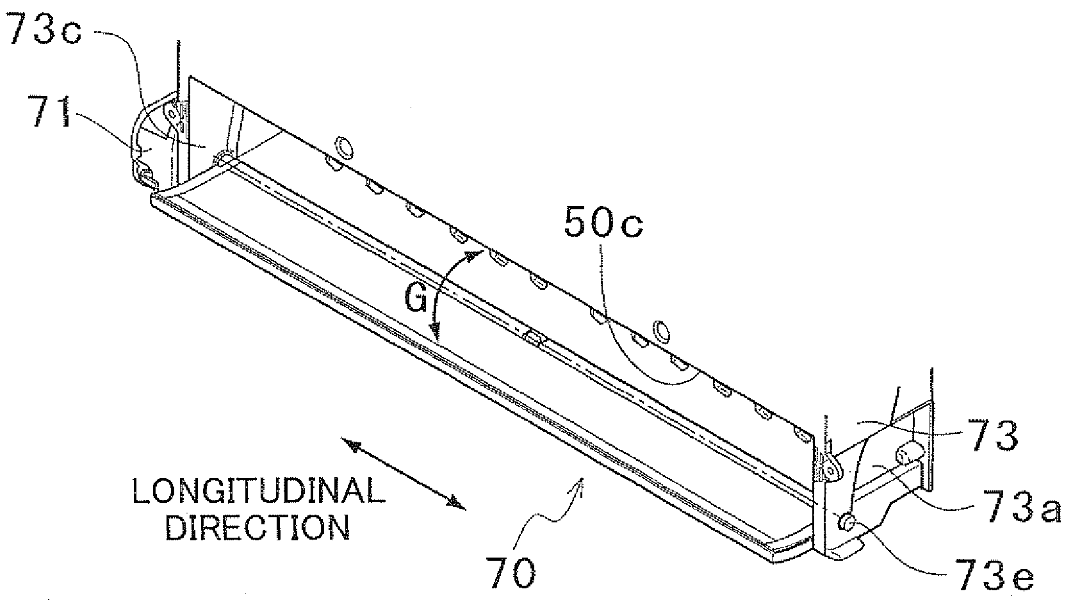

73c
71
50c
G
73
73a
LONGITUDINAL
DIRECTION
70
73e

FIG. 10

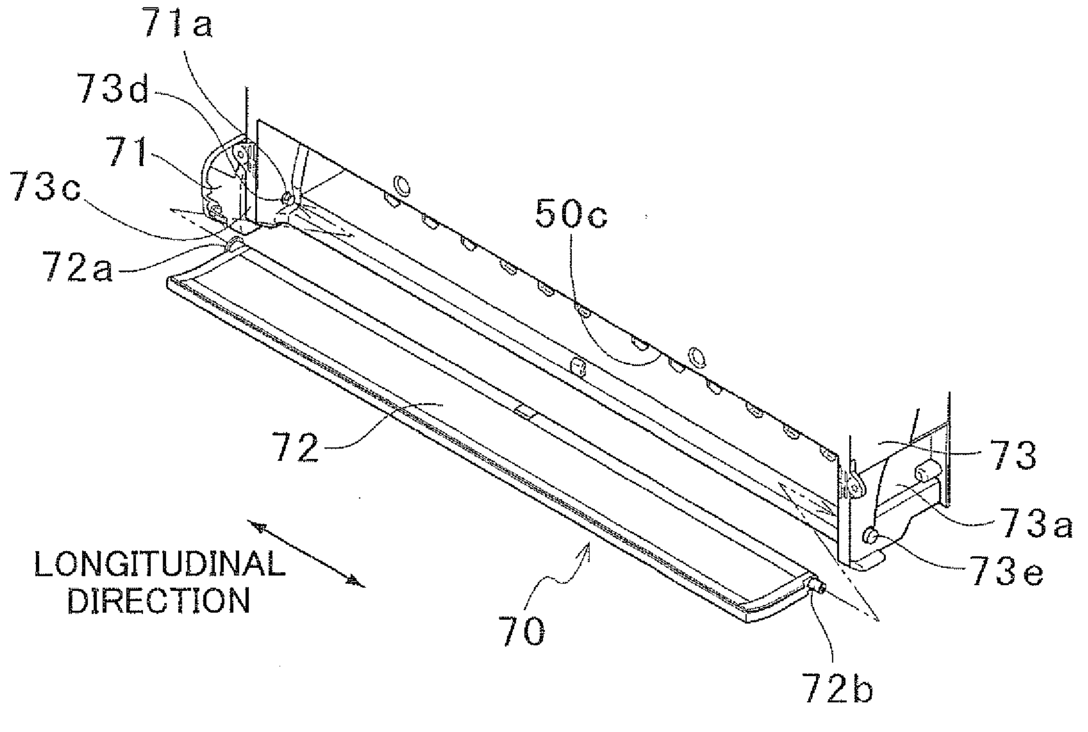

71a
73d
71
73c
50c
72a
72
73
73a
LONGITUDINAL
DIRECTION
73e
70
72b

FIG. 11

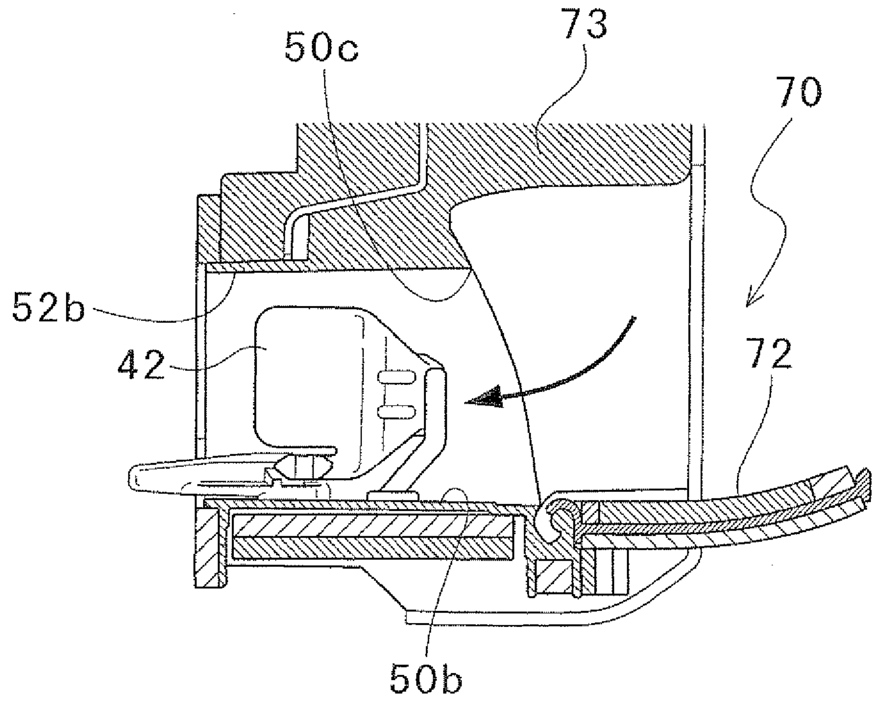


FIG. 12

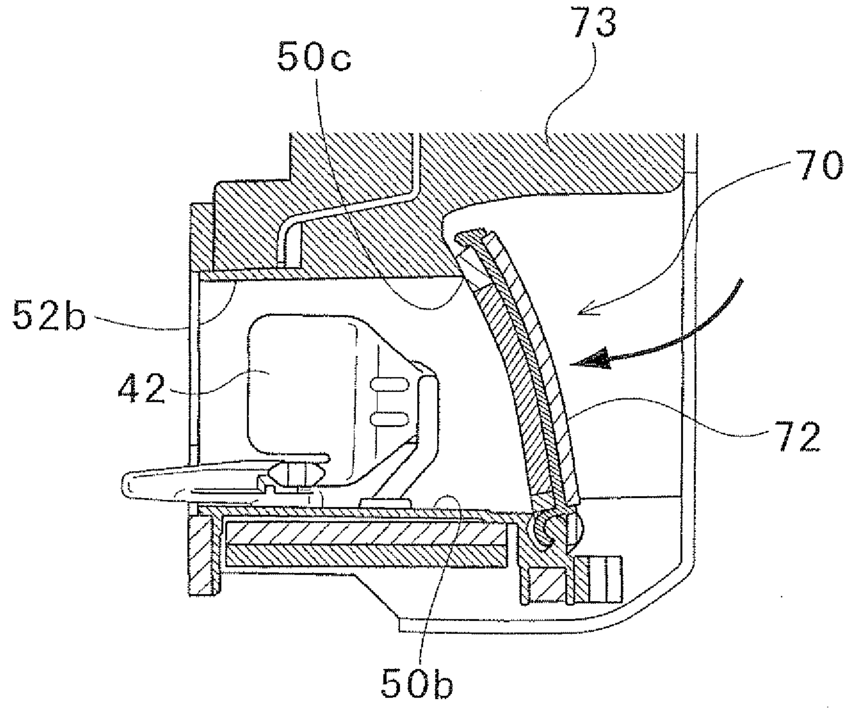


FIG. 13

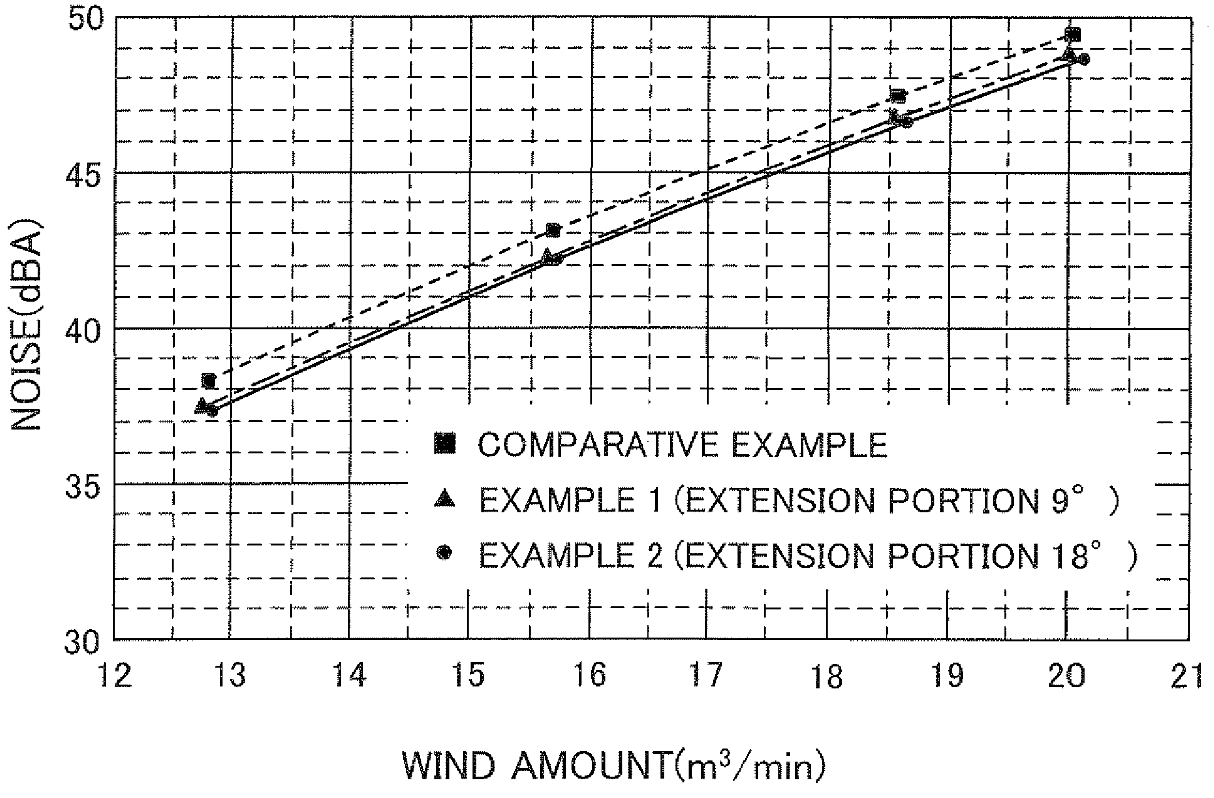
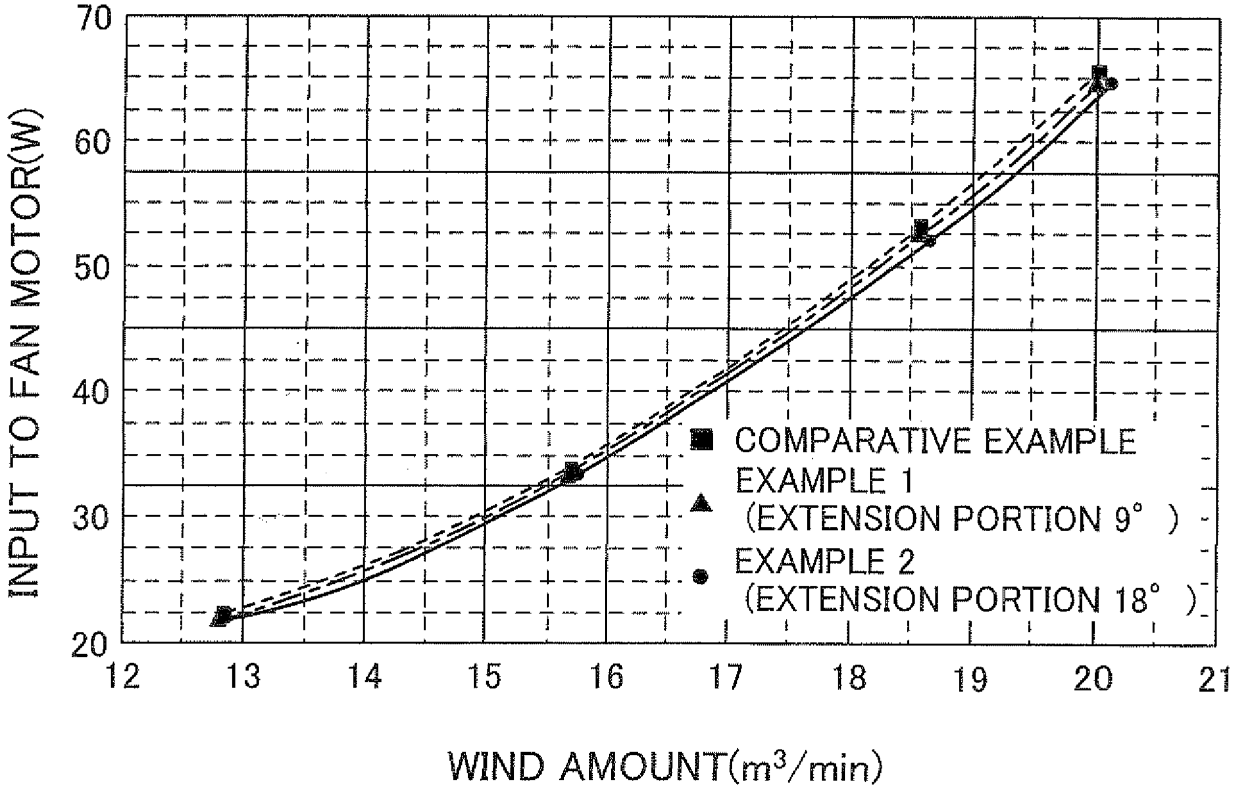

50
45
40
35
30
NOISE(dBA)
12
13
14
15
16
17
18
19
20
21
WIND AMOUNT(m³/min)
COMPARATIVE EXAMPLE
EXAMPLE 1 (EXTENSION PORTION 9°)
EXAMPLE 2 (EXTENSION PORTION 18°)

FIG. 14



70
60
50
40
30
20
12
13
14
15
16
17
18
19
20
21
INPUT TO FAN MOTOR(W)
WIND AMOUNT(m3/min)
COMPARATIVE EXAMPLE
EXAMPLE 1
(EXTENSION PORTION 9°)
EXAMPLE 2
(EXTENSION PORTION 18°)

FIG. 15

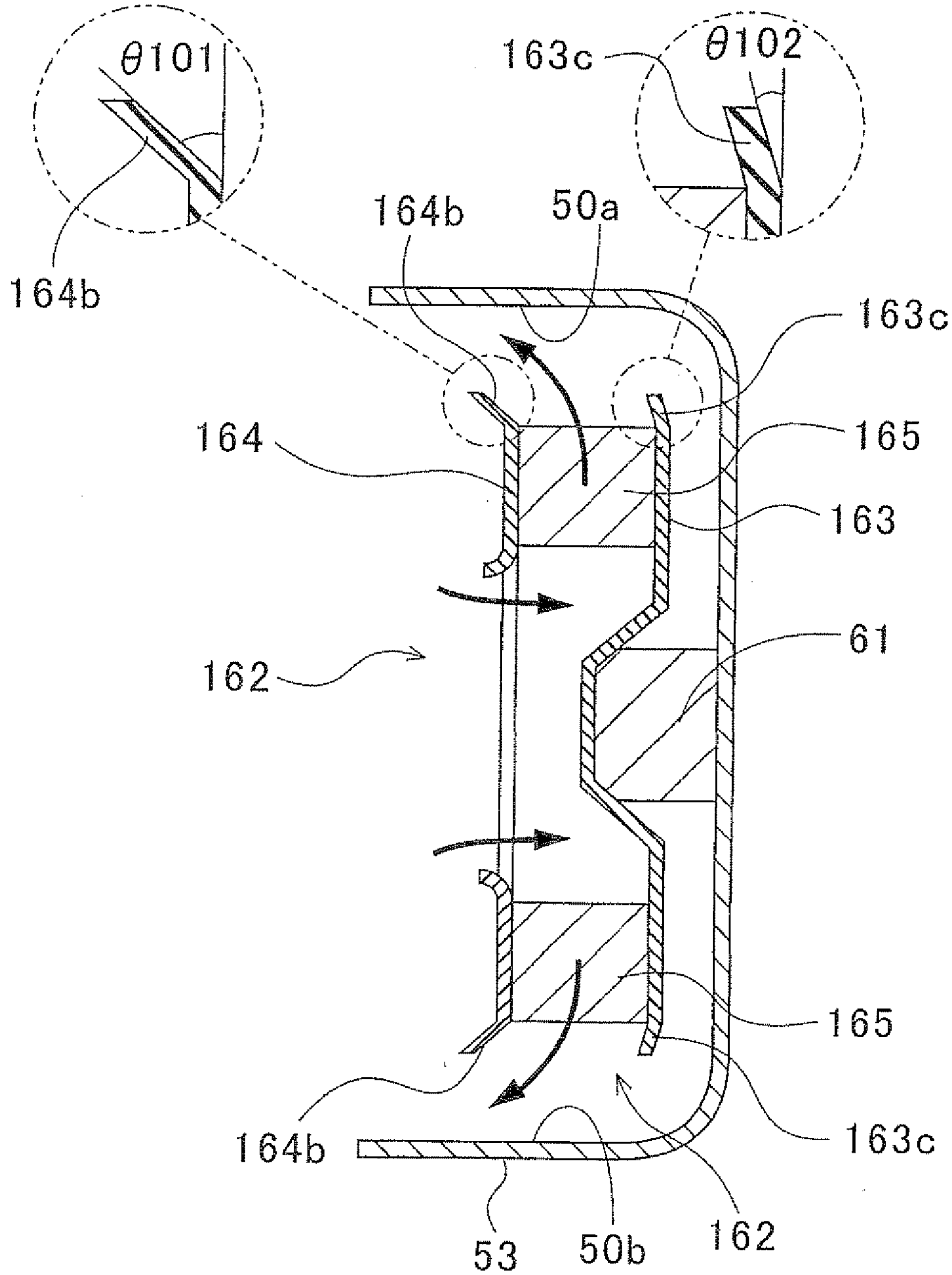
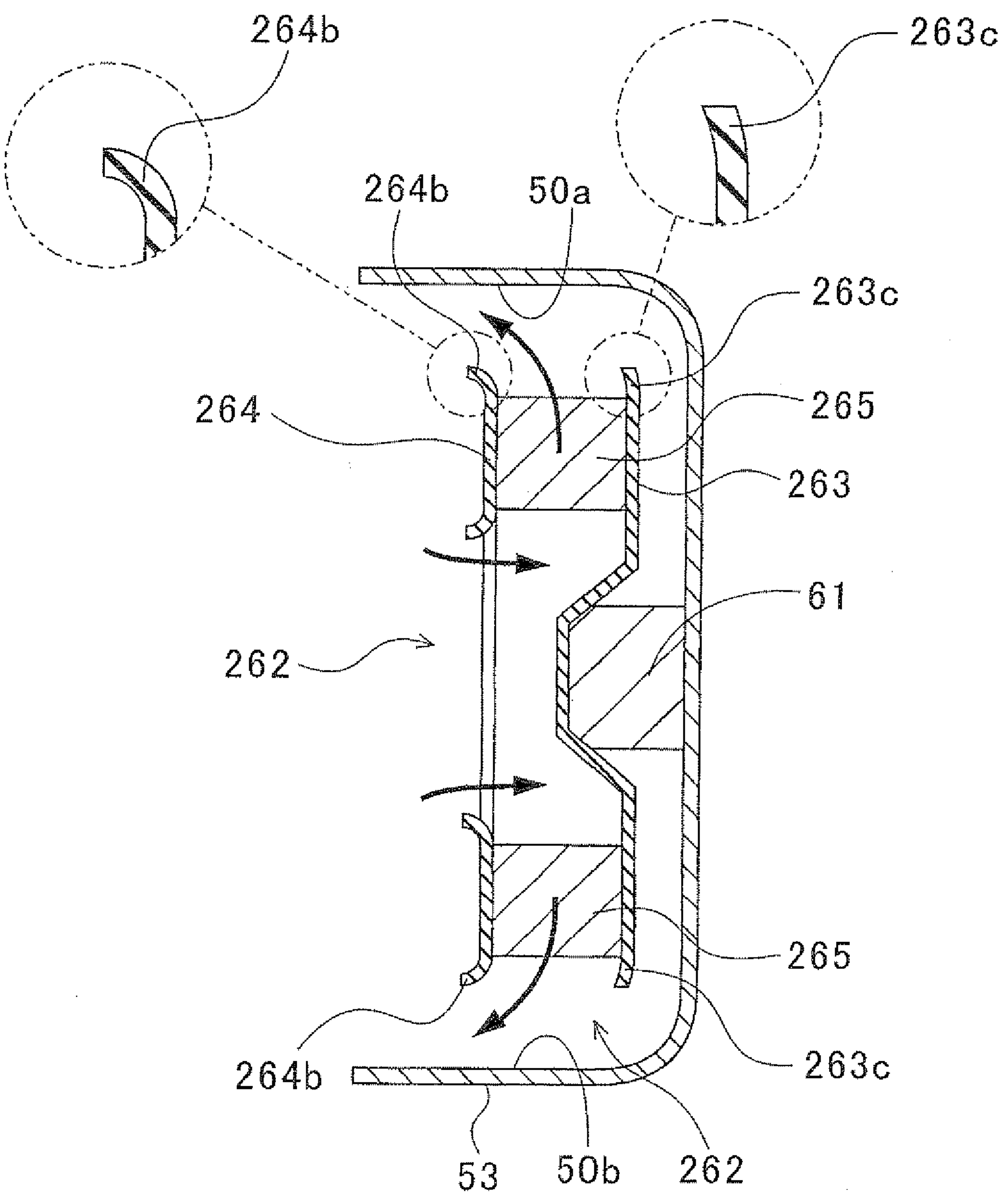

θ101
θ102
163c
164b
50a
164b
163c
164
165
163
61
162
165
164b
163c
53
50b
162

FIG. 16


264b
263c
264b
50a
263c
264
265
263
61
262
265
263c
264b
53
50b
262

REFERENCES CITED IN THE DESCRIPTION

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- JP 2007183013 A **[0004]**