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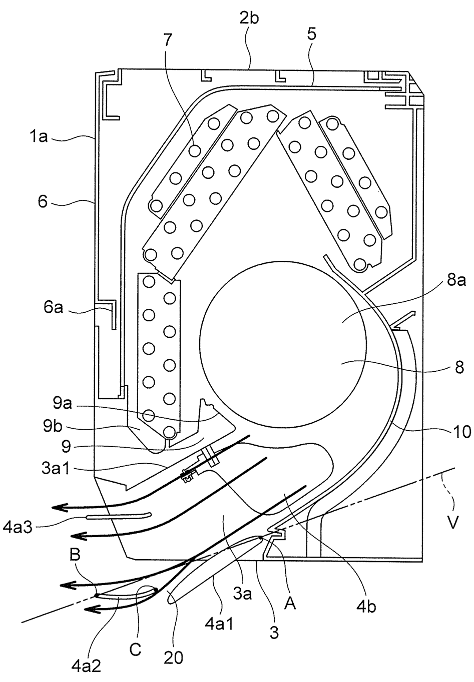
(54) **AIR CONDITIONER**

(57) Provided is an air conditioner (100), including: a main body (1) having an air inlet and an air outlet (3) formed therein; an air sending unit arranged in the main body; a heat exchange unit arranged in the main body; and a first vane (4a1) and a second vane (4a2) supported in a movable manner, in which the first vane opens the air outlet during operation, and closes the air outlet during shutdown, and in which the second vane is accommodated in the main body during the shutdown, and is moved to an outside of the air outlet during the operation.

FIG. 3



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Description

Technical Field

[0001] The present invention relates to an air conditioner.

Background Art

[0002] In Patent Literature 1, there is disclosed an air conditioner including two pivotable air direction changing vanes, namely, an upper vane and a lower vane. The two air direction changing vanes are connected to each other through intermediation of link arms, and the two air direction changing vanes are arranged in a pivotable manner. The two air direction changing vanes are aligned in series during cooling, and are aligned in parallel during heating.

Citation List

Patent Literature

[0003] [PTL 1] JP 5128697 B2

Summary of Invention

Technical Problem

[0004] However, in the air conditioner disclosed in Patent Literature 1, in a shutdown state, the two air direction changing vanes are aligned in series to form an outer surface of an apparatus body. Accordingly, each of the two air direction changing vanes is restricted by design conditions required for the outer surface of the body. Thus, there may be caused a problem in that no air direction changing vane having a shape suitable for controlling airflow directions is obtained.

[0005] The present invention has been made in view of the above-mentioned problem, and has an object to provide an air conditioner capable of easily obtaining at least one vane having a shape suitable for controlling airflow directions.

Solution to Problem

[0006] In order to achieve the above-mentioned object, according to one embodiment of the present invention, there is provided an air conditioner, including: a main body having an air inlet and an air outlet formed therein; an air sending unit arranged in the main body; a heat exchange unit arranged in the main body; and a first vane and a second vane supported in a movable manner, in which the first vane opens the air outlet during operation, and closes the air outlet during shutdown, and in which the second vane is accommodated in the main body during the shutdown, and is moved to an outside of the air outlet during the operation.

Advantageous Effects of Invention

[0007] According to the present invention, it is possible to easily obtain at least one vane having a shape suitable for controlling airflow directions.

Brief Description of Drawings

[0008]

FIG. 1 is a view for illustrating an installing state of an air conditioner according to a first embodiment of the present invention when viewed from the interior of a room.
FIG. 2 is a side view of the internal structure of the air conditioner of FIG. 1.
FIG. 3 is a side view of the internal structure of the air conditioner of FIG. 1.
FIG. 4 is a side view of the internal structure of the air conditioner of FIG. 1.
FIG. 5 is a view for illustrating a second embodiment of the present invention in the same manner as in FIG. 1.
FIG. 6 is a view for illustrating the second embodiment of the present invention in the same manner as in FIG. 2.
FIG. 7 is a view for illustrating the second embodiment of the present invention in the same manner as in FIG. 3.
FIG. 8 is a view for illustrating the second embodiment of the present invention in the same manner as in FIG. 4.
FIG. 9 is a view for illustrating a third embodiment of the present invention in the same manner as in FIG. 1.
FIG. 10 is a view for illustrating the third embodiment of the present invention in the same manner as in FIG. 1.
FIG. 11 is a view for illustrating the third embodiment of the present invention in the same manner as in FIG. 2.
FIG. 12 is a view for illustrating the third embodiment of the present invention in the same manner as in FIG. 3.
FIG. 13 is a view for illustrating the third embodiment of the present invention in the same manner as in FIG. 4.
FIG. 14 is a view for illustrating an installing state of an air conditioner according to a fourth embodiment of the present invention when viewed from the interior of a room.
FIG. 15 is a side view of the internal structure of the air conditioner of FIG. 14.
FIG. 16 is a side view of the internal structure of the air conditioner of FIG. 14.
FIG. 17 is a side view of the internal structure of the air conditioner of FIG. 14.
FIG. 18 is a side view of the internal structure of the

air conditioner of FIG. 14.

Description of Embodiments

[0009] Now, an air conditioner (indoor unit) according to embodiments of the present invention is described with reference to the accompanying drawings. Note that, in the drawings, the same reference symbols represent the same or corresponding parts. Further, existing outdoor units may be used as an outdoor unit of the present invention.

First Embodiment

[0010] FIG. 1 is an installation schematic view of an air conditioner according to a first embodiment of the present invention when viewed from a room. FIG. 2 to FIG. 4 are side views of the internal structure of the air conditioner of FIG. 1. FIG. 2 is an illustration of a state of the air conditioner during shutdown. FIG. 3 is an illustration of a state of the air conditioner during horizontal blowing (frontward blowing) operation. FIG. 4 is an illustration of a state of the air conditioner during downward blowing (vertical blowing) operation.

[0011] As illustrated in FIG. 1, an air conditioner (indoor unit) 100 includes a main body 1 that forms a contour of the air conditioner 100. The air conditioner 100 is of a wall-mounting type, and is installed on a wall 11a of a room 11 that is a space to be air-conditioned. Further, the air conditioner 100 is not limited to be installed in a room of a home, but may be installed in a room of a building for an institution or in a storehouse, for example.

[0012] The main body 1 has a box-like shape, and includes a rear surface 1c opposed to the wall 11a of the room 11, a front surface 1a opposite to the rear surface 1c, an upper surface 1b, a lower surface 1d, and a pair of right and left side surfaces 1e.

[0013] In the upper surface 1b forming an upper portion of the main body 1, there is formed an air inlet 2b in a grille form, which is configured to suck air inside the room into the air conditioner 100. Further, a front grille 6 is mounted on the front surface 1a, and an air inlet 2a is formed in a center portion of the front grille 6 in a height direction of the main body. The air inlet 2a extends in a width direction of the front grille 6. An air guide wall 6a is arranged on a downstream side of the air inlet 2a. A front surface side of an air duct on the downstream side of the air inlet 2a is formed by a back surface of the front grille 6, whereas a rear surface side of the air duct on the downstream side of the air inlet 2a is formed by the air guide wall 6a. The air guide wall 6a extends to the rear surface side from a portion of the front grille 6 above the air inlet 2a, and then extends downward.

[0014] An air outlet 3 configured to supply the conditioned air into the room is formed in the lower surface 1d forming a lower portion of the main body 1. Strictly speaking, the air outlet 3 is formed in a region extending from a front portion of the lower surface 1d to a lower portion of the front surface 1a. The lower portion of the front surface 1a faces frontward substantially similarly to a center portion and an upper portion of the front surface 1a, which are most part of the front surface 1a. However, the lower portion of the front surface 1a is inclined slightly downward as compared to the center portion and the upper portion of the front surface 1a.

[0015] Inside the main body 1, a cross-flow fan (air sending unit) 8 including an impeller 8a, and a guide wall 10 are arranged. The cross-flow fan 8 is arranged between an inlet-side air duct E1 and an outlet-side air duct E2. The cross-flow fan 8 is configured to suck air through the air inlets 2a and 2b, and to blow out air through the air outlet 3. The guide wall 10 extends from a rear side of the cross-flow fan 8 to a lower side thereof, and is configured to guide, to the air outlet 3, air discharged from the cross-flow fan 8.

[0016] Further, in the main body 1, there are arranged a filter (ventilation resistor) 5 configured to remove dust and the like in the air sucked through the air inlets 2a and 2b, a heat exchanger (heat exchange unit, ventilation resistor) 7 configured to generate conditioned air by transferring hot or cold energy of refrigerant to air, and a stabilizer 9 configured to partition the inlet-side air duct E1 and the outlet-side air duct E2.

[0017] The guide wall 10 forms the outlet-side air duct E2 in cooperation with a lower surface side of the stabilizer 9. The guide wall 10 forms a helical surface from the cross-flow fan 8 toward the air outlet 3.

[0018] The filter 5 is formed into, for example, a mesh shape, and is configured to remove dust and the like in the air sucked through the air inlets 2a and 2b. The filter 5 is mounted on the downstream side of the air inlets 2a and 2b and on the upstream side of the heat exchanger 7 in the air duct from the air inlets 2a and 2b to the air outlet 3. The filter 5 extends from an upper side of the heat exchanger 7 to a front side thereof.

[0019] The heat exchanger 7 (indoor heat exchanger) functions as an evaporator to cool the air during cooling operation, and functions as a condenser (radiator) to heat the air during heating operation. The heat exchanger 7 is mounted on the downstream side of the filter 5 and on the upstream side of the cross-flow fan 8 in the air duct from the air inlets 2a and 2b to the air outlet 3 (center portion inside the main body 1). In FIG. 2, the heat exchanger 7 is shaped so as to surround the front portion and the upper portion of the cross-flow fan 8. However, this shape is merely an example, and the present invention is not limited thereto.

[0020] The heat exchanger 7 is connected to an outdoor unit of a known mode including a compressor, an outdoor heat exchanger, an expansion device, and the like, to thereby construct a refrigeration cycle. Further, as the heat exchanger 7, for example, a cross-fin type fin-and-tube heat exchanger including a heat transfer tube and a large number of fins is used.

[0021] The stabilizer 9 is configured to partition the inlet-side air duct E1 and the outlet-side air duct E2, and as illustrated in FIG. 2, the stabilizer 9 is mounted on the lower side of the heat exchanger 7. The inlet-side air duct E1 is positioned on the upper side of the stabilizer 9, and the outlet-side air duct E2 is positioned on the lower side of the stabilizer 9.

[0022] The stabilizer 9 includes a tongue portion 9a configured to separate the inlet-side air duct E1 and the outlet-side air duct E2 from each other, a drain pan 9b configured to temporarily accumulate water droplets dripping from the heat exchanger 7, and a diffuser 3a1 being an upper wall surface (front-surface-side wall surface) of an outlet air duct 3a of the air outlet 3.

[0023] A vertical airflow-direction vane 4a and a lateral airflow-direction vane 4b are arranged in the outlet air duct 3a. The lateral airflow-direction vane 4b is arranged between the vertical airflow-direction vane 4a and the cross-flow fan 8 in a pivotable manner. The vertical airflow-direction vane 4a is configured to vertically adjust a direction of air blown out from the cross-flow fan 8, and the lateral airflow-direction vane 4b is configured to laterally adjust the direction of the air blown out from the cross-flow fan 8.

[0024] The vertical airflow-direction vane 4a includes a first vane 4a1, a second vane 4a2, and a third vane 4a3. The first vane 4a1, the second vane 4a2, and the third vane 4a3 have separate driving sources, respectively, and are pivoted individually.

[0025] During shutdown, the first vane 4a1 closes a part of the air outlet 3 in the front portion of the lower surface 1d, and forms an outer surface of an apparatus body. That is, the first vane 4a1 serves as both an airflow-direction control portion and a designed portion for the contour of the main body. An upper surface (surface on the air duct side) of the first vane 4a1 during shutdown has a convex shape. Further, the first vane 4a1 is arranged in a pivotable manner, and a pivot axis of the first vane 4a1 is positioned close to the guide wall in a lower portion of the outlet air duct 3a.

[0026] During shutdown, the third vane 4a3 closes a part of the air outlet 3 in the lower portion of the front surface 1a, and forms the outer surface of the apparatus body. That is, the third vane 4a3 also serves as both the airflow-direction control portion and the designed portion for the contour of the main body.

[0027] During shutdown, the second vane 4a2 is accommodated in the outlet air duct 3a, and is arranged between the first vane 4a1 and the cross-flow fan 8 and between the third vane 4a3 and the cross-flow fan 8. More specifically, during shutdown, the entire second vane 4a2 is accommodated in the main body 1. Meanwhile, during operation, the second vane 4a2 is moved to an outside of the air outlet 3, that is, a part of the second vane 4a2 or the entire second vane 4a2 projects outward from the air outlet 3. That is, the second vane 4a2 functions as the airflow-direction control portion, but does not function as the designed portion for the contour of the main body.

[0028] Further, although details are described below, inbrief, the second vane 4a2 is directly aligned with the first vane 4a1 during horizontal blowing (frontward blowing) as illustrated in FIG. 3, whereas the second vane 4a2 is aligned in parallel to the first vane 4a1 during downward blowing (vertical blowing) as illustrated in FIG. 4. Further, the third vane 4a3 is aligned substantially in parallel to the second vane 4a2 during both horizontal blowing and downward blowing.

[0029] Further, a pivot axis of the second vane 4a2 is positioned in an upper portion of the air outlet 3 and close to the stabilizer. During horizontal blowing, the second vane 4a2 is moved to a front side of the first vane 4a1 in a forward direction of the blown-out air, and then is aligned with the first vane 4a1 in series. It is necessary to arrange the first vane 4a1 and the second vane 4a2 in series under a state in which, in side view of FIG. 3, an upstream end C of the second vane 4a2 is positioned below an imaginary line V connecting an upstream end A of the first vane 4a1 and a downstream end B of the second vane 4a2 to each other (state in which the upstream end C is positioned on a side away from the main body 1 with respect to the imaginary line V). With this arrangement, during horizontal blowing, the first vane 4a1 and the second vane 4a2 form a single imaginary vane having an imaginary chord larger than a chord of each of the first vane 4a1 and the second vane 4a2. During downward blowing, the first vane 4a1 and the second vane 4a2 function as two separate vanes each having an individual chord. That is, it can be said that it is possible to obtain a mode in which vane chords are varied in accordance with airflow directions without exchanging the vanes themselves.

[0030] Further, during horizontal blowing, a clearance 20 is secured between the first vane 4a1 and the second vane 4a2 arranged in series. In particular, in the first embodiment, the first vane 4a1 and the second vane 4a2 are moved in a pivoting manner so that, when the first vane 4a1 and the second vane 4a2 are aligned in series, the upper surface (surface on the main body side) of the first vane 4a1 has an upward convex shape (shape convex toward the main body) and a lower surface (surface on a side opposite to the main body) of the second vane 4a2 has a downward convex shape (shape convex toward the side opposite to the main body).

[0031] Further, as illustrated in FIG. 4, during downward blowing, a part of the second vane 4a2 is out of the air outlet 3. As illustrated in FIG. 3, during horizontal blowing, the second vane 4a2 is completely out of the air outlet 3 (the entire second vane 4a2 is out of the air outlet 3).

[0032] Meanwhile, during downward blowing, the second vane 4a2 is moved to a position between the first vane 4a1 and the third vane 4a3, and is shifted to a posture substantially parallel to the first vane 4a1 and the third vane 4a3. That is, during downward blowing, the second vane 4a2 is aligned in parallel to the first vane 4a1. Further, at this time, the first vane 4a1 and the second vane 4a2 are moved in a pivoting manner so that a surface of the second vane 4a2 opposed to the first vane

4a1 has a convex shape swelling toward the first vane 4a1 and a surface of the first vane 4a1 opposed to the second vane 4a2 has a convex shape swelling toward the second vane 4a2.

[0033] The air conditioner having the above-mentioned configuration can obtain the following effects. The second vane 4a2 is accommodated in the outlet air duct 3a during shutdown, whereas the second vane 4a2 projects outward from the air outlet 3 during operation. Accordingly, the second vane 4a2 can have a shape suitable for controlling airflow directions without being restricted by design conditions required for the outer surface of the body, and at least one airflow-direction control vane having a shape suitable for controlling airflow directions is reliably secured. Further, in view of evaluating a design of the outer surface of the main body, it is preferred that, under external appearance observation, the outer surface of the main body include a smaller portion that can be recognized as an openable/closable portion during shutdown. In the first embodiment, in spite of using three vanes, it is possible to provide a design enabling only two vanes to be recognized as the openable/closable portions during shutdown. Further, there are quite a few fears in that dust and the like intrude into the main body from an outer edge of the openable/closable portion during shutdown. However, in the first embodiment, in spite of using three vanes, the number of vanes recognized as the openable/closable portions during shutdown is reduced to two, thereby being capable of expecting prevention of undesirable intrusion of dust and the like into the main body.

[0034] Further, the second vane 4a2 is aligned with the first vane 4a1 in series. Accordingly, during horizontal blowing, the first vane 4a1 and the second vane 4a2 form the single imaginary vane having the imaginary chord larger than the chord of each of the first vane 4a1 and the second vane 4a2. During downward blowing, the first vane 4a1 and the second vane 4a2 function as the two separate vanes each having the individual chord. That is, it can be said that it is possible to obtain the mode in which the vane chords are varied in accordance with airflow directions without exchanging the vanes themselves. As described above, it is possible to obtain the imaginary vane having the imaginary chord larger than the chord of the individual vane. Thus, during horizontal blowing, a flow of the air blown out from the cross-flow fan downward can be turned significantly frontward using the large imaginary chord, with the result that airflow-direction controllability can be significantly enhanced.

[0035] Further, during horizontal blowing, the clearance 20 is secured between the first vane 4a1 and the second vane 4a2 arranged in series. As described above, the first vane 4a1 and the second vane 4a2 are arranged in series under a state in which the clearance 20 is secured. Thus, after passing over the first vane 4a1, the air during cooling flows over both upper and lower surfaces of the second vane 4a2 beyond the clearance 20 between the first vane 4a1 and the second vane 4a2, thereby reducing a temperature difference between both the upper and lower surfaces of the second vane 4a2. Accordingly, dew condensation can be prevented, and quality can be enhanced. In particular, in the first embodiment, the first vane 4a1 and the second vane 4a2 are moved in a pivoting manner so that, when the first vane 4a1 and the second vane 4a2 are aligned in series, the upper surface (surface on the main body side) of the first vane 4a1 has the upward convex shape (shape convex toward the main body) and the lower surface (surface on the side opposite to the main body) of the second vane 4a2 has the downward convex shape (shape convex toward the side opposite to the main body) . Owing to effects of directions of curves of the surfaces of the first vane 4a1 and the second vane 4a2, an airflow further easily flows between the first vane 4a1 and the second vane 4a2. Thus, an effect of preventing dew condensation is further increased.

[0036] Further, as illustrated in FIG. 4, during downward blowing, a part of the second vane 4a2 is out of the air outlet 3. As illustrated in FIG. 3, during horizontal blowing, the second vane 4a2 is completely out of the air outlet 3 (the entire second vane 4a2 is out of the air outlet 3). Accordingly, the part of the second vane 4a2 out of the air outlet 3 is released from restraining action of the airflow from sides of the side surfaces 1e of the main body 1. Thus, it is possible to obtain such an advantage that airflow-direction control is easily performed.

[0037] Further, during downward blowing, the second vane 4a2 is aligned in parallel to the first vane 4a1. In addition, the first vane 4a1 and the second vane 4a2 are moved in a pivoting manner so that the surface of the second vane 4a2 opposed to the first vane 4a1 has the convex shape swelling toward the first vane 4a1, and that the surface of the first vane 4a1 opposed to the second vane 4a2 has the convex shape swelling toward the second vane 4a2. Accordingly, during heating, the airflow flowing between the first vane 4a1 and the second vane 4a2 flows through a region surrounded by the convex shape of the first vane 4a1 and the convex shape of the second vane 4a2. Thus, the airflow is gradually narrowed so that a separation vortex is prevented. Then, the airflow is gradually enlarged, with the result that disturbance of the airflow is prevented. Therefore, generally speaking, straight flowability of the airflow is increased, and a floor reachable distance of the airflow is extended, thereby increasing an effect of being capable of heating a region around feet of a user.

Second Embodiment

[0038] Next, a second embodiment of the present invention is described with reference to FIG. 5 to FIG. 8. FIG. 5 is a view for illustrating the second embodiment of the present invention in the same manner as in FIG. 1. FIG. 6 is a view for illustrating the second embodiment in the same manner as in FIG. 2. FIG. 7 is a view for illustrating the second embodiment in the same manner as in FIG. 3. FIG. 8 is a view for illustrating the second embodiment in the same manner as in FIG. 4. Note that, the configuration in the second embodiment is the same as the above-mentioned configuration in the first embodiment except for portions to be described below.

[0039] In an air conditioner 200 according to the second embodiment, an air outlet 203 is formed only in the lower surface 1d of the main body 1. That is, the air outlet 203 is not formed in the front surface 1a of the main body 1.

[0040] The air conditioner 200 includes a vertical airflow-direction vane 204a. The vertical airflow-direction vane 204a includes the first vane 4a1 and the second vane 4a2 according to the first embodiment, but does not include a member corresponding to the third vane 4a3 according to the first embodiment.

[0041] The second embodiment described above can also obtain the same advantage as that of the above-mentioned first embodiment. In addition, in the second embodiment, the air outlet is formed only in the lower surface of the main body, but is not formed in the front surface thereof. Accordingly, noises generated by functional components arranged inside the main body (such as a noise generated when driving a motor of the cross-flow fan, a wind noise of the cross-flow fan, and a noise generated when refrigerant in the heat exchanger flows) are prevented from directly leaking frontward. As a result, there are achieved both noise prevention, and increase in airflow-direction controllability exerted by a vane that is not restricted by the design conditions. Further, as described above, the second vane projects outward from the main body, and is aligned with the first vane in series. Accordingly, even in the mode in which the air outlet is not formed in the front surface of the main body, suitable horizontal blowing can be performed, and both noise prevention and comfort can be achieved.

Third Embodiment

[0042] Next, a third embodiment of the present invention is described with reference to FIG. 9 to FIG. 13. FIG. 9 and FIG. 10 are views for illustrating the third embodiment of the present invention in the same manner as in FIG. 1. In particular, FIG. 9 is an illustration of a state of the air conditioner during downward blowing (vertical blowing) operation, and FIG. 10 is an illustration of a state of the air conditioner during horizontal blowing (frontward blowing) operation. FIG. 11 is a view for illustrating the third embodiment in the same manner as in FIG. 2. FIG. 12 is a view for illustrating the third embodiment in the same manner as in FIG. 3. FIG. 13 is a view for illustrating the third embodiment in the same manner as in FIG. 4. Note that, the configuration in the third embodiment is the same as the above-mentioned configuration in the first embodiment except for portions to be described below.

[0043] In an air conditioner 300 according to the third embodiment, an air outlet 303 is formed in a region extending from the front portion of the lower surface 1d to the lower portion of the front surface 1a. A vertical airflow-direction vane 304a includes the first vane 4a1, the second vane 4a2, and a shutter 4a4. The first vane 4a1, the second vane 4a2, and the shutter 4a4 have separate driving sources, respectively. The first vane 4a1 and the second vane 4a2 are the same as those in the first embodiment.

[0044] Meanwhile, the shutter 4a4 opens and closes a part of the air outlet 303 in the lower portion of the front surface 1a. The shutter 4a4 extends along an extending direction of the front surface 1a of the main body 1. During shutdown, the shutter 4a4 forms an outer surface in the lower portion of the front surface of the apparatus body, and functions as the designed portion for the contour of the main body.

[0045] Further, the shutter 4a4 is moved along the extending direction of the front surface 1a of the main body 1, in other words, the shutter 4a4 is slid vertically. During horizontal blowing operation, the shutter 4a4 is slid upward to open the part of the air outlet 303 in the lower portion of the surface 1a, thereby allowing the air blown out from the cross-flow fan 8 to flow frontward. Meanwhile, during downward blowing operation, the shutter 4a4 is slid downward to close the part of the air outlet 303 in the lower portion of the surface 1a, thereby guiding downward the air blown out from the cross-flow fan 8.

[0046] The third embodiment described above can also obtain the same advantage as that of the above-mentioned first embodiment. In addition, also in the third embodiment, the air outlet is formed only in the lower surface of the main body, but is not formed in the front surface thereof. Accordingly, noises generated by functional components arranged inside the main body are prevented from directly leaking frontward. As a result, there are achieved both noise prevention, and increase in airflow-direction controllability exerted by a vane that is not restricted by the design conditions. Further, as described above, the second vane projects outward from the main body, and is aligned with the first vane in series. Accordingly, even in the mode in which the air outlet is not formed in the front surface of the main body, suitable horizontal blowing can be performed, and both noise prevention and comfort can be achieved.

Fourth Embodiment

[0047] Next, a fourth embodiment of the present invention is described with reference to FIG. 14 to FIG. 18. FIG. 14 is an installation schematic view of an air conditioner according to the fourth embodiment of the present invention when viewed from the room. FIG. 15 to FIG. 18 are side views of the internal structure of the air conditioner of FIG. 14. FIG. 15 is an illustration of a state of the air conditioner during shutdown. FIG. 16 is an illustration of a state of the air conditioner during upward blowing (vertical blowing) operation. FIG. 17 is an illustration of a state of the air conditioner during horizontal blowing (frontward blowing) operation. FIG. 18 is an illustration of a state of the air conditioner during downward blowing (vertical blowing) operation. Note that, the configuration in the fourth embodiment is the same as the above-mentioned configuration in the first embodiment except for portions to be described below.

[0048] An air conditioner 400 is of a floor-installation type, and is installed on a floor 11b of the room 11 that is the space to be air-conditioned. In the air conditioner 400, except for an air inlet 402c, a drain pan 409b, and a third vane 4a5 to be described below, the filter 5, the heat exchanger 7, the cross-flow fan 8, the stabilizer 9, the guide wall 10, the first vane 4a1, and the second vane 4a2 are arranged in an inverted manner from the above-mentioned configuration of the air conditioner according to the first embodiment.

[0049] As illustrated in FIG. 14, the air conditioner (indoor unit) 400 includes the main body 1 that forms a contour of the air conditioner 400. The main body 1 has a box-like shape, and includes the rear surface 1c opposed to the wall 11a of the room 11, the front surface 1a opposite to the rear surface 1c, the upper surface 1b, the lower surface 1d, and the pair of right and left side surfaces 1e.

[0050] In a lower portion of the front surface 1a, there is formed an air inlet 402c in a grille form, which is configured to suck air inside the room into the air conditioner 400. Further, the front grille 6 is mounted on the front surface 1a, and the air inlet 2a is formed in an upper portion of the front grille 6 in the height direction of the main body. The air inlet 2a extends in the width direction of the front grille 6. The air guide wall 6a is arranged on the downstream side of the air inlet 2a. The front surface side of the air duct on the downstream side of the air inlet 2a is formed by the back surface of the front grille 6, whereas the rear surface side of the air duct on the downstream side of the air inlet 2a is formed by the air guide wall 6a. The air guide wall 6a extends to the rear surface side from a portion of the front grille 6 above the air inlet 2a, and then extends upward.

[0051] The air outlet 3 configured to supply the conditioned air into the room is formed in the upper surface 1b of the main body 1. Strictly speaking, the air outlet 3 is formed in a region extending from a front portion of the upper surface 1b to the upper portion of the front surface 1a.

[0052] Inside the main body 1, the cross-flow fan (air sending unit) 8 including the impeller 8a, and the guide wall 10 are arranged. The cross-flow fan 8 is arranged between the inlet-side air duct E1 and the outlet-side air duct E2. The cross-flow fan 8 is configured to suck air through the air inlets 402c and 2a, and to blow out air through the air outlet 3. The guide wall 10 extends from the rear side of the cross-flow fan 8 to an upper side thereof, and is configured to guide, to the air outlet 3, air discharged from the cross-flow fan 8.

[0053] Further, the main body 1 includes the filter (ventilation resistor) 5 configured to remove dust and the like in the air sucked through the air inlets 402c and 2a, the heat exchanger (heat exchanging portion, ventilation resistor) 7 configured to generate conditioned air by transferring hot or cold energy of refrigerant to air, and the stabilizer 9 configured to partition the inlet-side air duct E1 and the outlet-side air duct E2.

[0054] The guide wall 10 forms the outlet-side air duct E2 in cooperation with an upper surface side of the stabilizer 9. The guide wall 10 forms a helical surface from the cross-flow fan 8 toward the air outlet 3.

[0055] The filter 5 is formed into, for example, a mesh shape, and is configured to remove dust and the like in the air sucked through the air inlets 402c and 2a. The filter 5 is mounted on the downstream side of the air inlets 402c and 2a and on the upstream side of the heat exchanger 7 in the air duct from the air inlets 402c and 2a to the air outlet 3. The filter 5 extends from a lower side of the heat exchanger 7 to the front side thereof.

[0056] The heat exchanger 7 (indoor heat exchanger) functions as the evaporator to cool the air during cooling operation, and functions as the condenser (radiator) to heat the air during heating operation. The heat exchanger 7 is mounted on the downstream side of the filter 5 and on the upstream side of the cross-flow fan 8 in the air duct from the air inlets 402c and 2a to the air outlet 3 (center portion inside the main body 1). In FIG. 15, the heat exchanger 7 is shaped so as to surround the front portion and the lower portion of the cross-flow fan 8. However, this shape is merely an example, and the present invention is not limited thereto.

[0057] The heat exchanger 7 is connected to the outdoor unit of a known mode including the compressor, the outdoor heat exchanger, the expansion device, and the like, to thereby construct the refrigeration cycle. Further, as the heat exchanger 7, for example, the cross-fin type fin-and-tube heat exchanger including the heat transfer tube and the large number of fins is used.

[0058] The stabilizer 9 is configured to partition the inlet-side air duct E1 and the outlet-side air duct E2, and as illustrated in FIG. 15, the stabilizer 9 is mounted on the upper side of the heat exchanger 7. The inlet-side air duct E1 is positioned on the lower side of the stabilizer 9, and the outlet-side air duct E2 is positioned on the upper side of the stabilizer 9.

[0059] The stabilizer 9 includes the tongue portion 9a configured to separate the inlet-side air duct E1 and the outlet-side air duct E2 from each other, and the diffuser 3a1 being a lower wall surface (front-surface-side wall surface) of the outlet air duct 3a of the air outlet 3. Further, the drain pan 409b configured to temporarily accumulate water droplets dripping from the heat exchanger 7 is arranged on the lower side of the heat exchanger 7.

[0060] The vertical airflow-direction vane 4a is arranged in the outlet air duct 3a. The vertical airflow-direction vane 4a includes the first vane 4a1, the second vane 4a2, and the third vane 4a5. The first vane 4a1, the second vane 4a2, and the third vane 4a5 have the separate driving sources, respectively, and are pivoted individually.

[0061] During shutdown, the first vane 4a1 closes a part of the air outlet 3 in the front portion of the upper surface 1b, and forms the outer surface of the apparatus body. That is, the first vane 4a1 serves as both the airflow-direction control portion and the designedportion for the contour of the main body. A lower surface (surface on the air duct side) of the first vane 4a1 during shutdown has a convex shape. Further, the first vane 4a1 is arranged in a pivotable manner, and the pivot axis of the first vane 4a1 is positioned close to the guide wall in an upper portion of the outlet air duct 3a.

[0062] During shutdown, the third vane 4a5 closes a part of the air outlet 3 in the upper portion of the front surface 1a, and forms the outer surface of the apparatus body. That is, the third vane 4a3 also serves as both the airflow-direction control portion and the designed portion for the contour of the main body.

[0063] During shutdown, the second vane 4a2 is accommodated in the outlet air duct 3a, and is arranged between the first vane 4a1 and the cross-flow fan 8 and between the third vane 4a5 and the cross-flow fan 8. More specifically, during shutdown, the entire second vane 4a2 is accommodated in the main body 1. Meanwhile, during operation, the second vane 4a2 projects outward from the air outlet 3. That is, the second vane 4a2 functions as the airflow-direction control portion, but does not function as the designed portion for the contour of the main body.

[0064] Further, although details are described below, inbrief, the second vane 4a2 is directly aligned with the first vane 4a1 during horizontal blowing (frontward blowing) as illustrated in FIG. 17, whereas the second vane 4a2 is aligned in parallel to the first vane 4a1 during upward blowing (vertical blowing) as illustrated in FIG. 16. Further, as illustrated in FIG. 18, the first vane 4a1 and the second vane 4a2 are aligned in a fore-and-aft direction during downward blowing (vertical blowing).

[0065] During upward blowing, the third vane 4a5 is at the same position and in the same posture as those during shutdown. During horizontal blowing, the third vane 4a5 is in the same posture as that during upward blowing, and rises from the position during upward blowing, thereby guiding air toward the lower surface of the second vane 4a2 in cooperation with the stabilizer 9. During downward blowing, the third vane 4a5 opens a part of the air outlet 3 above the front surface 1a. At this time, the third vane 4a5 is inclined so that a front portion of the third vane 4a5 is positioned below a rear portion of the third vane 4a5. With this configuration, the third vane 4a5 guides downward the air passing through the part of the outlet 3 above the front surface 1a.

[0066] Further, the pivot axis of the second vane 4a2 is positioned in a lower portion of the air outlet 3 and close to the stabilizer. During horizontal blowing, the second vane 4a2 is moved to the front side of the first vane 4a1 in the forward direction of the blown-out air, and then is aligned with the first vane 4a1 in series. It is necessary to arrange the first vane 4a1 and the second vane 4a2 in series under a state in which, in side view of FIG. 17, the upstream end C of the second vane 4a2 is positioned above the imaginary line V connecting the upstream end A of the first vane 4a1 and the downstream end B of the second vane 4a2 to each other (state in which the upstream end C is positioned on the side away from the main body 1 with respect to the imaginary line V). With this arrangement, during horizontal blowing, the first vane 4a1 and the second vane 4a2 form the single imaginary vane having the imaginary chord larger than the chord of each of the first vane 4a1 and the second vane 4a2. During downward blowing, the first vane 4a1 and the second vane 4a2 function as the two separate vanes each having the individual chord. That is, it can be said that it is possible to obtain the mode in which the vane chords are varied in accordance with the airflow directions without exchanging the vanes themselves.

[0067] Further, during horizontal blowing, the clearance 20 is secured between the first vane 4a1 and the second vane 4a2 arranged in series. In particular, in the first embodiment, the first vane 4a1 and the second vane 4a2 are moved in a pivoting manner so that, when the first vane 4a1 and the second vane 4a2 are aligned in series, the lower surface (surface on the main body side) of the first vane 4a1 has a downward convex shape (shape convex toward the main body) and an upper surface (surface on the side opposite to the main body) of the second vane 4a2 has an upward convex shape (shape convex toward the side opposite to the main body).

[0068] Further, as illustrated in FIG. 16, duringupward-blowing, apart of the second vane 4a2 is out of the air outlet 3. As illustrated in FIG. 17, during horizontal blowing, the second vane 4a2 is completely out of the air outlet 3 (the entire second vane 4a2 is out of the air outlet 3).

[0069] Meanwhile, during upward blowing, the second vane 4a2 is moved to a position between the first vane 4a1 and the third vane 4a5, and is shifted to a posture substantially parallel to the first vane 4a1 and the third vane 4a5. That is, during upward blowing, the second vane 4a2 is aligned in parallel to the first vane 4a1. Further, at this time, the first vane 4a1 and the second vane 4a2 are moved in a pivoting manner so that the surface of the second vane 4a2 opposed to the first vane 4a1 has the convex shape swelling toward the first vane 4a1 and the surface of the first vane 4a1 opposed to the second vane 4a2 has the convex shape swelling toward the second vane 4a2.

[0070] The air conditioner having the above-mentioned configuration can obtain the following effects similarly to the first embodiment. The second vane 4a2 is accommodated in the outlet air duct 3a during shutdown, whereas the second vane 4a2 projects outward from the air outlet 3 during operation. Accordingly, the second vane 4a2 can have a shape suitable for controlling airflow directions without being restricted by design conditions required for the outer surface of the body, and at least one airflow-direction control vane having a shape suitable for controlling airflow directions is reliably secured. Further, in view of evaluating a design of the outer surface of the main body, it is preferred that, under external appearance observation, the outer surface of the main body include a smaller portion that can be recognized the openable/closable portion during shut down. In the first embodiment, in spite of using three vanes, it is possible to provide the design enabling only two vanes to be recognized as the openable/closable portions during shutdown. Further, there are quite a few fears in that dust and the like intrude into the main body from the outer edge of the openable/closable portion during shutdown. However, in the first embodiment, in spite of using three vanes, the number of vanes recognized as the openable/closable portions during shutdown is reduced to two, thereby being capable of expecting prevention of undesirable intrusion of dust and the like into the main body.

[0071] Further, the second vane 4a2 is aligned with the first vane 4a1 in series. Accordingly, during horizontal blowing, the first vane 4a1 and the second vane 4a2 form the single imaginary vane having the imaginary chord larger than the chord of each of the first vane 4a1 and the second vane 4a2. During upward blowing, the first vane 4a1 and the second vane 4a2 function as the two separate vanes each having the individual chord. That is, it can be said that it is possible to obtain the mode in which the vane chords are varied in accordance with the airflow directions without exchanging the vanes themselves. As described above, it is possible to obtain the imaginary vane having the imaginary chord larger than the chord of the individual vane. Thus, during horizontal blowing, a flow of the air blown out from the cross-flow fan upward can be turned significantly frontward using the large imaginary chord, with the result that airflow-direction controllability can be significantly enhanced.

[0072] Further, during horizontal blowing, the clearance 20 is secured between the first vane 4a1 and the second vane 4a2 arranged in series. As described above, the first vane 4a1 and the second vane 4a2 are arranged in series under the state in which the clearance 20 is secured. Thus, after passing over the first vane 4a1, the air during cooling flows over both upper and lower surfaces of the second vane 4a2 beyond the clearance 20 between the first vane 4a1 and the second vane 4a2, thereby reducing the temperature difference between both the upper and lower surfaces of the second vane 4a2. Accordingly, dew condensation can be prevented, and quality can be enhanced. In particular, in the first embodiment, the first vane 4a1 and the second vane 4a2 are moved in a pivoting manner so that, when the first vane 4a1 and the second vane 4a2 are aligned in series, the lower surface (surface on the main body side) of the first vane 4a1 has the downward convex shape (shape convex toward the main body) and the upper surface (surface on the side opposite to the main body) of the second vane 4a2 has the upward convex shape (shape convex toward the side opposite to the main body). Owing to the effects of the directions of the curves of the surfaces of the first vane 4a1 and the second vane 4a2, the airflow further easily flows between the first vane 4a1 and the second vane 4a2. Thus, the effect of preventing dew condensation is further increased.

[0073] Further, as illustrated in FIG. 16, duringupward-blowing, apart of the second vane 4a2 is out of the air outlet 3. As illustrated in FIG. 17, during horizontal blowing, the second vane 4a2 is completely out of the air outlet 3 (the entire second vane 4a2 is out of the air outlet 3). Accordingly, the part of the second vane 4a2 out of the air outlet 3 is released from the restraining action of the airflow from the sides of the side surfaces 1e of the main body 1. Thus, it is possible to obtain such an advantage that the airflow-direction control is easily performed.

[0074] Further, during upward blowing, the second vane 4a2 is aligned in parallel to the first vane 4a1. In addition, the first vane 4a1 and the second vane 4a2 are moved in a pivoting manner so that the surface of the second vane 4a2 opposed to the first vane 4a1 has the convex shape swelling toward the first vane 4a1, and that the surface of the first vane 4a1 opposed to the second vane 4a2 has the convex shape swelling toward the second vane 4a2. Accordingly, the airflow flowing between the first vane 4a1 and the second vane 4a2 flows through the region surrounded by the convex shape of the first vane 4a1 and the convex shape of the second vane 4a2. Thus, the airflow is gradually narrowed so that the separation vortex is prevented. Then, the airflow is gradually enlarged, with the result that the disturbance of the airflow is prevented. Therefore, generally speaking, the straight flowability of the airflow is increased, and the reachable distance of the airflow is extended, thereby obtaining an advantage in that an effect of air conditioning is easily spread in the entire room.

[0075] In addition, in the fourth embodiment, during upward blowing and horizontal blowing, the air outlet is open only toward the upper surface of the main body, but is not open toward the front surface thereof. Accordingly, noises generated by functional components arranged inside the main body (such as a noise generated when driving the motor of the cross-flow fan, the wind noise of the cross-flow fan, and the noise generated when refrigerant in the heat exchanger flows) are prevented from directly leaking frontward. As a result, there are achieved both noise prevention, and increase in airflow-direction controllability exerted by a vane that is not restricted by the design conditions. Further, as described above, the second vane projects outward from the main body, and is aligned with the first vane in series. Accordingly, even under a state in which the air outlet is open only toward the upper surface of the main body, suitable horizontal blowing can be performed, and both noise prevention and comfort can be achieved. Further, according to the floor-installation type of the fourth embodiment, upward blowing, horizontal blowing, and downward blowing can be performed, and an air-conditioning function covering a wide blowing range can be provided.

[0076] The details of the present invention have been described above specifically with reference to the preferred embodiments, but it is apparent that a person skilled in the art may employ various modifications based on the basic technical thoughts and teachings of the present invention.

Reference Signs List

[0077] 1 main body, 2a, 2b, 402c air inlet, 3, 203 air outlet, 4a1 first vane, 4a2 second vane, 7 heat exchanger (heat exchange unit), 8 cross-flow fan (air sending unit), 20 clearance, 100, 200, 300, 400 air conditioner

Claims

1. An air conditioner, comprising:

a main body having an air inlet and an air outlet formed therein;
an air sending unit arranged in the main body;
a heat exchange unit arranged in the main body; and
a first vane and a second vane supported in a movable manner,
wherein the first vane opens the air outlet during operation, and closes the air outlet during shutdown, and
wherein the second vane is accommodated in the main body during the shutdown, and is moved to an outside of the air outlet during the operation.

2. An air conditioner according to claim 1, wherein the entire second vane is out of the air outlet during frontward blowing.

3. An air conditioner according to claim 1 or 2,
wherein the first vane and the second vane are aligned in series during the frontward blowing, and
wherein during the frontward blowing, in side view, an upstream end of the second vane is positioned on a side away from the main body with respect to an imaginary line connecting an upstream end of the first vane and a downstream end of the second vane to each other.

4. An air conditioner according to claim 3, wherein during the frontward blowing, a clearance is secured between the first vane and the second vane.

5. An air conditioner according to claim 3 or 4,
wherein a surface of the first vane on the main body side has a shape convex toward the main body, and
wherein a surface of the second vane on a side opposite to the main body has a shape convex toward the side opposite to the main body.

6. An air conditioner according to any one of claims 1 to 5,
wherein during vertical blowing, the first vane and the second vane are aligned in parallel, and
wherein during the vertical blowing, a surface of the second vane opposed to the first vane has a convex shape swelling toward the first vane, and a surface of the first vane opposed to the second vane has a convex shape swelling toward the second vane.

FIG. 1

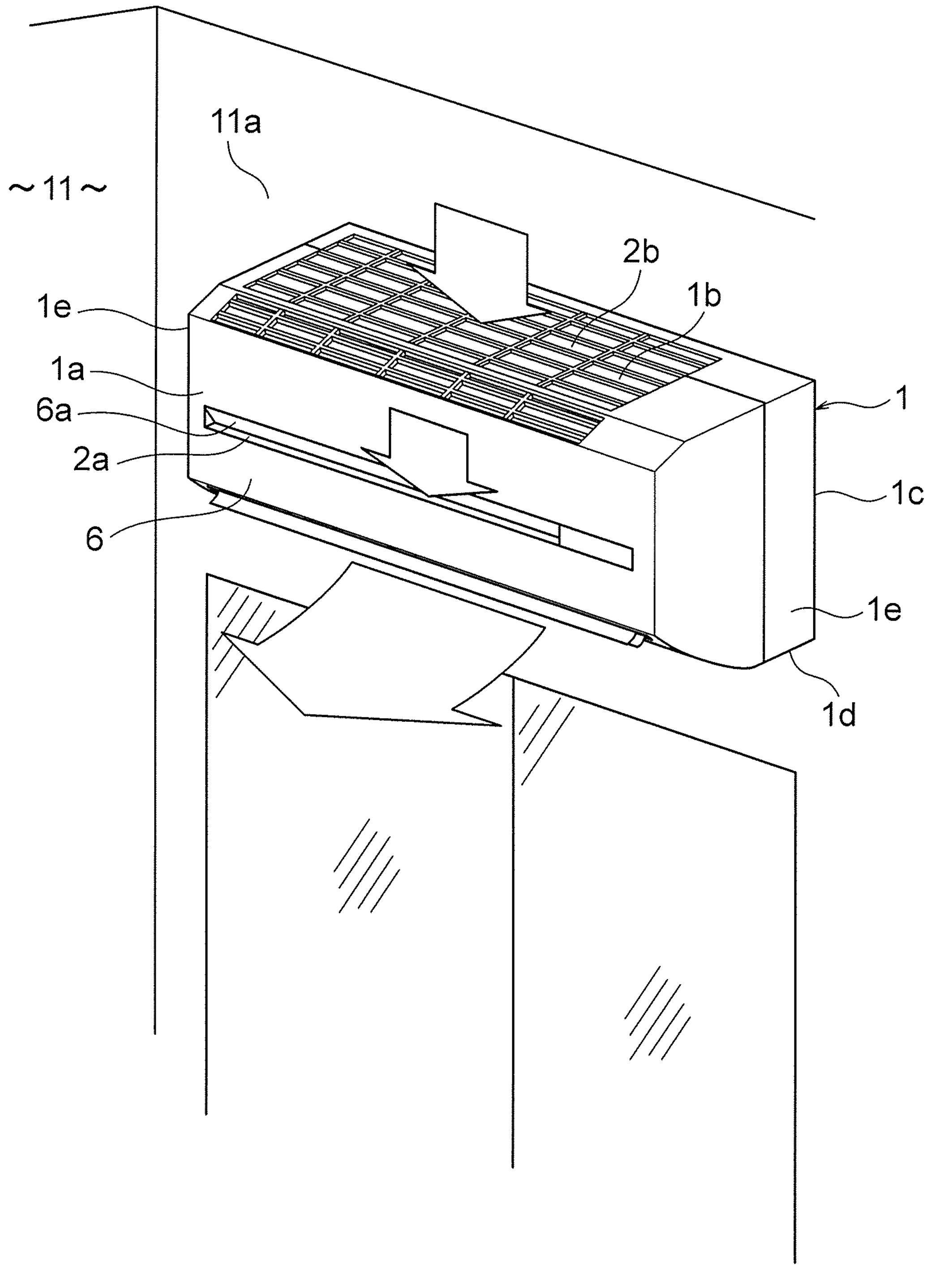

FIG. 2

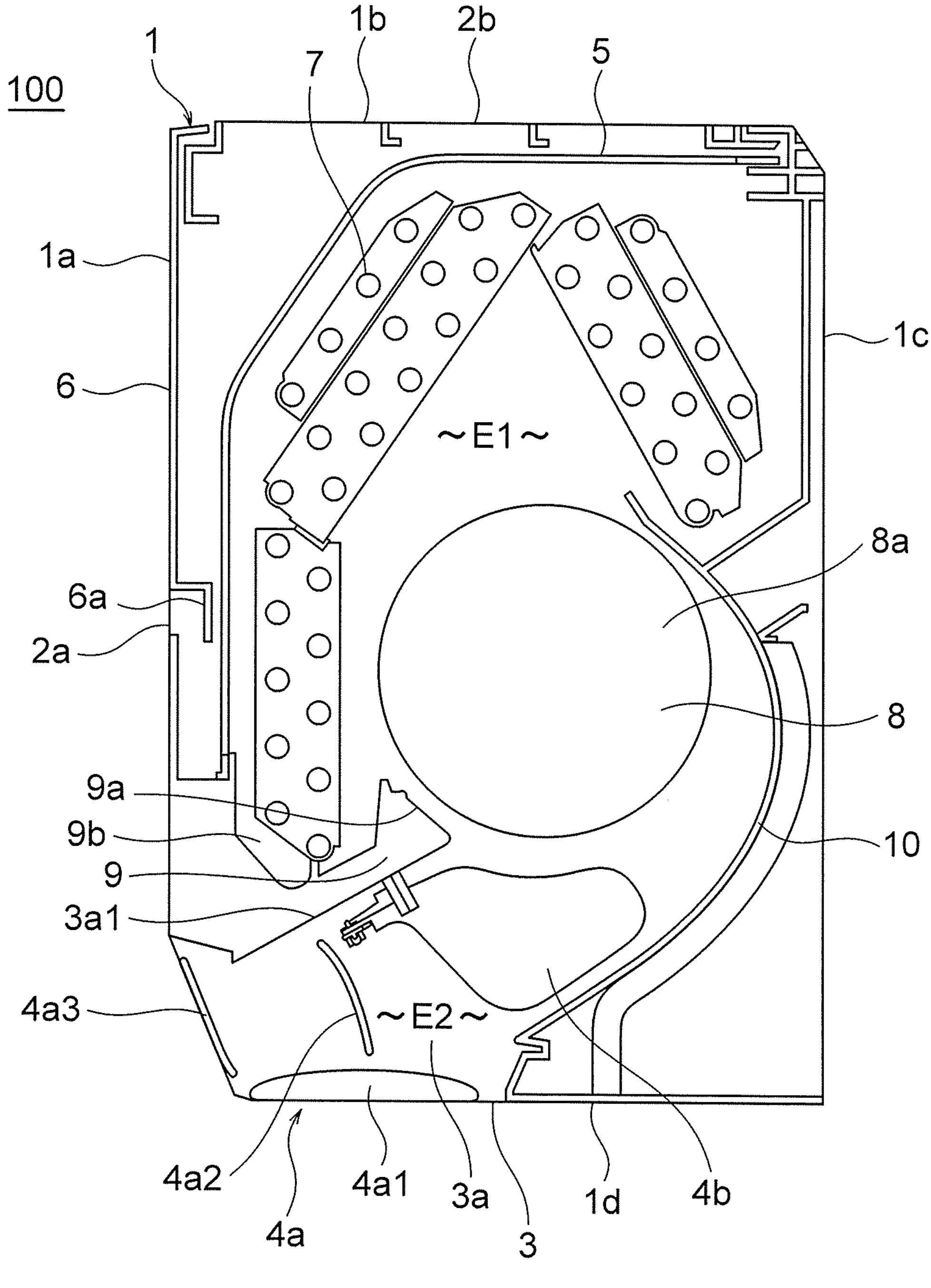
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FIG. 3

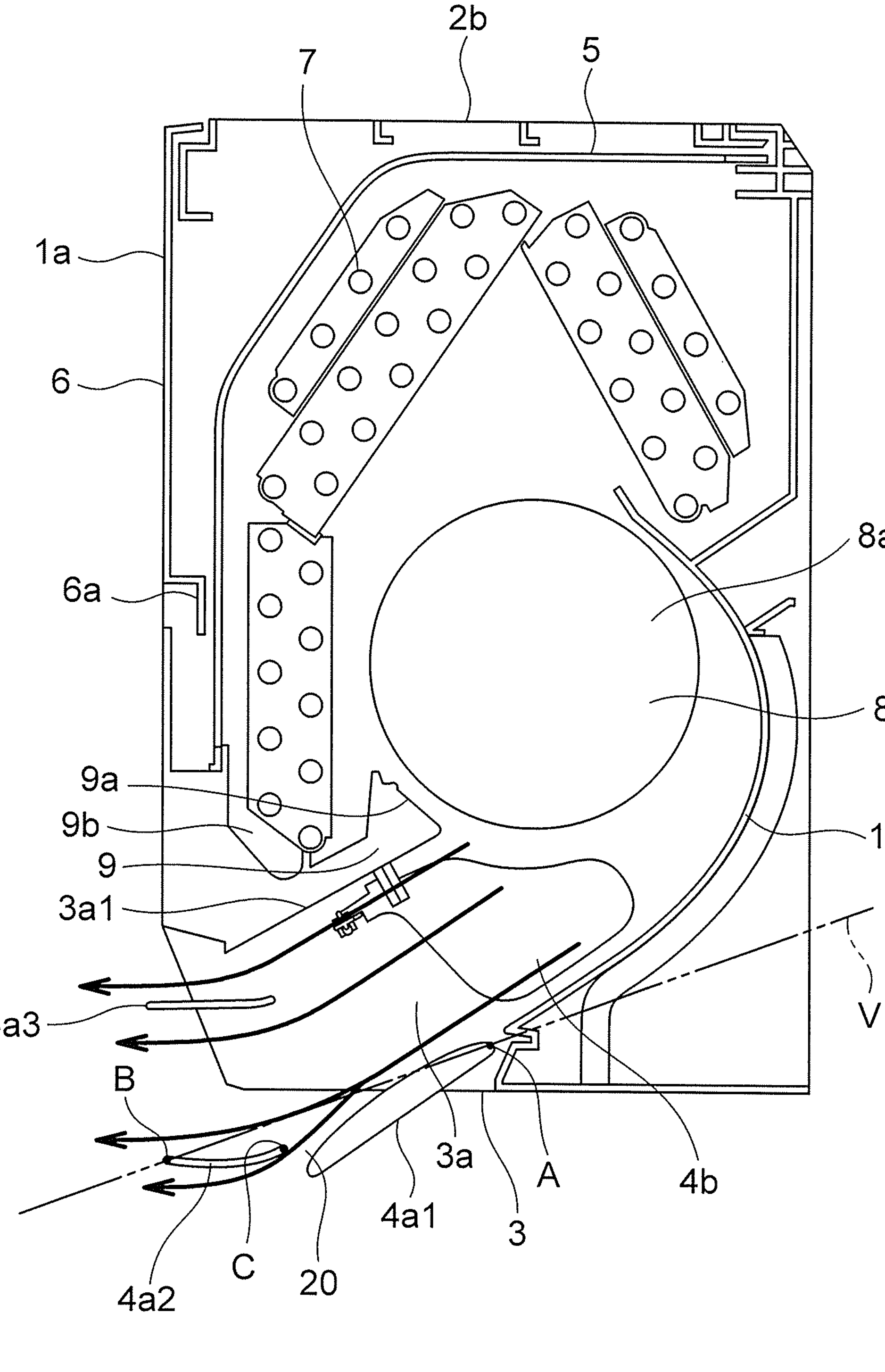


FIG. 4

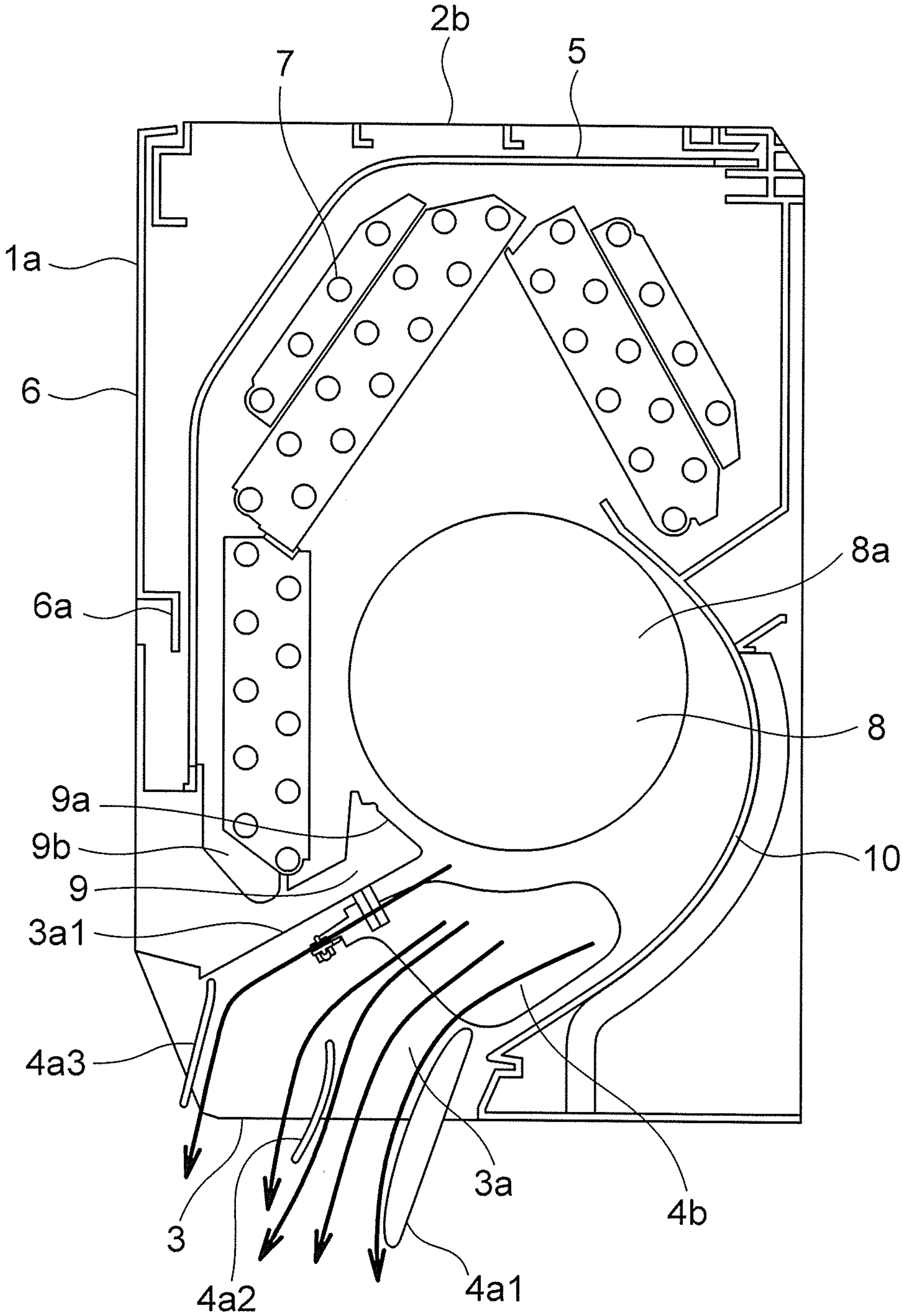


FIG. 5

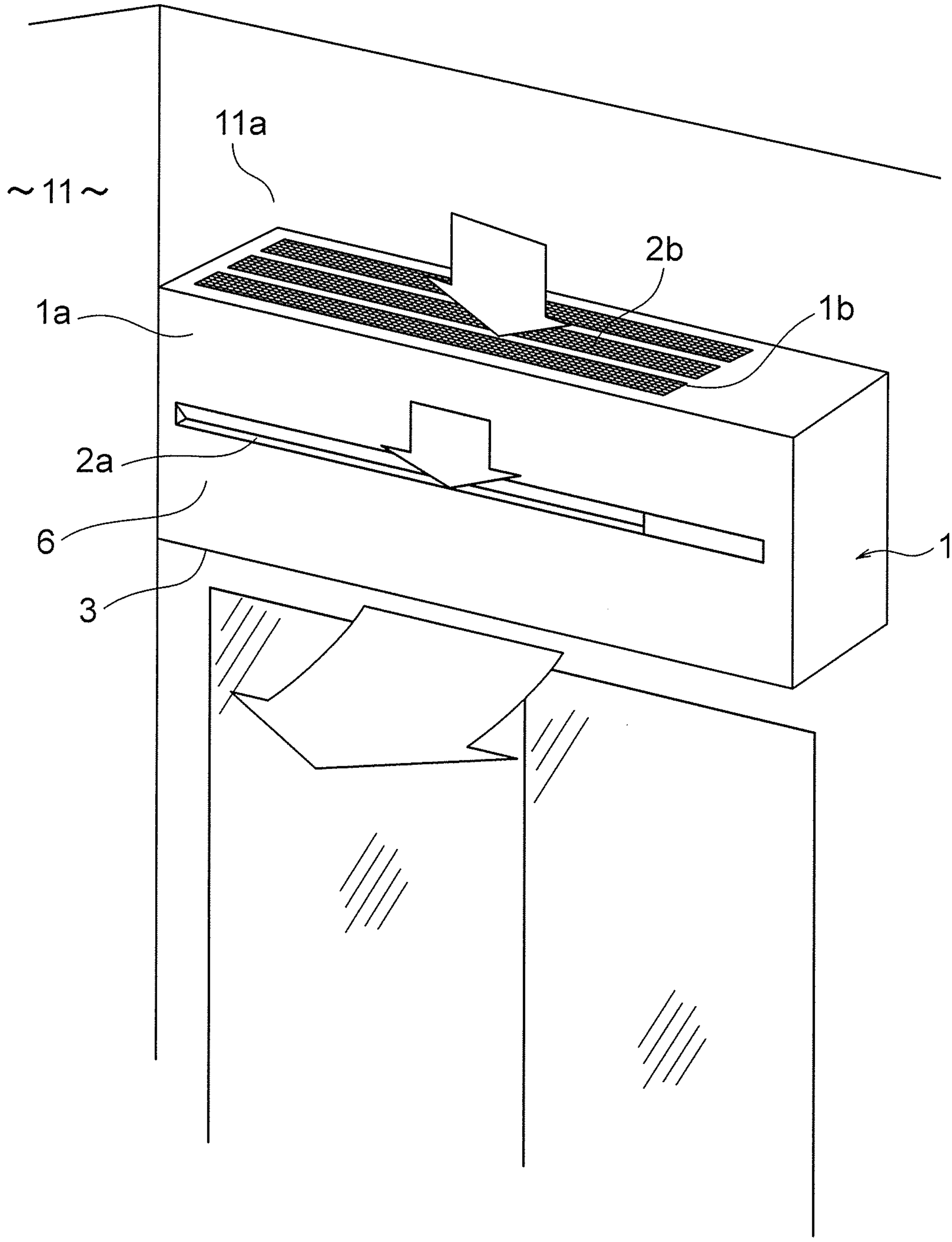


FIG. 6

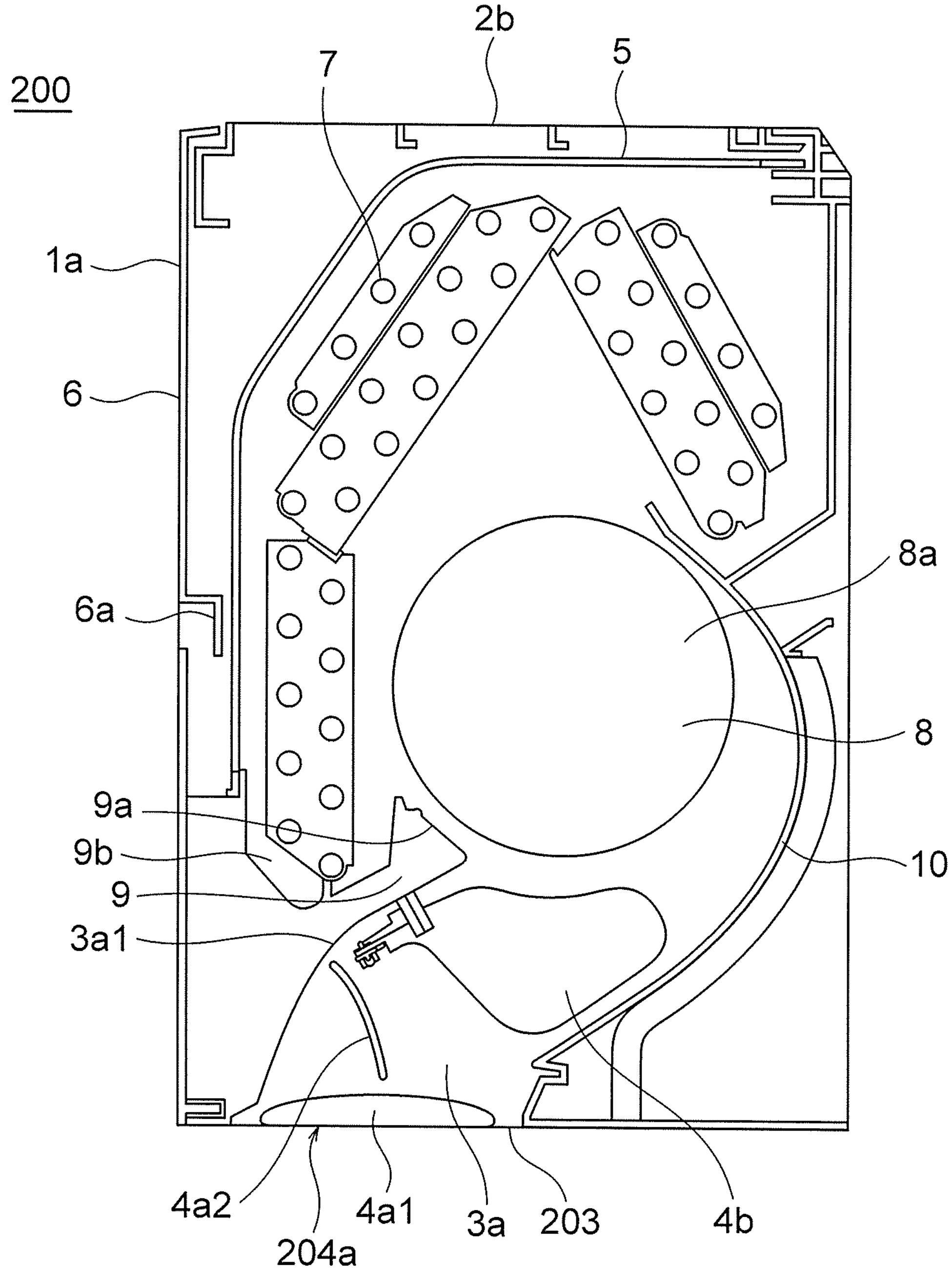


FIG. 7

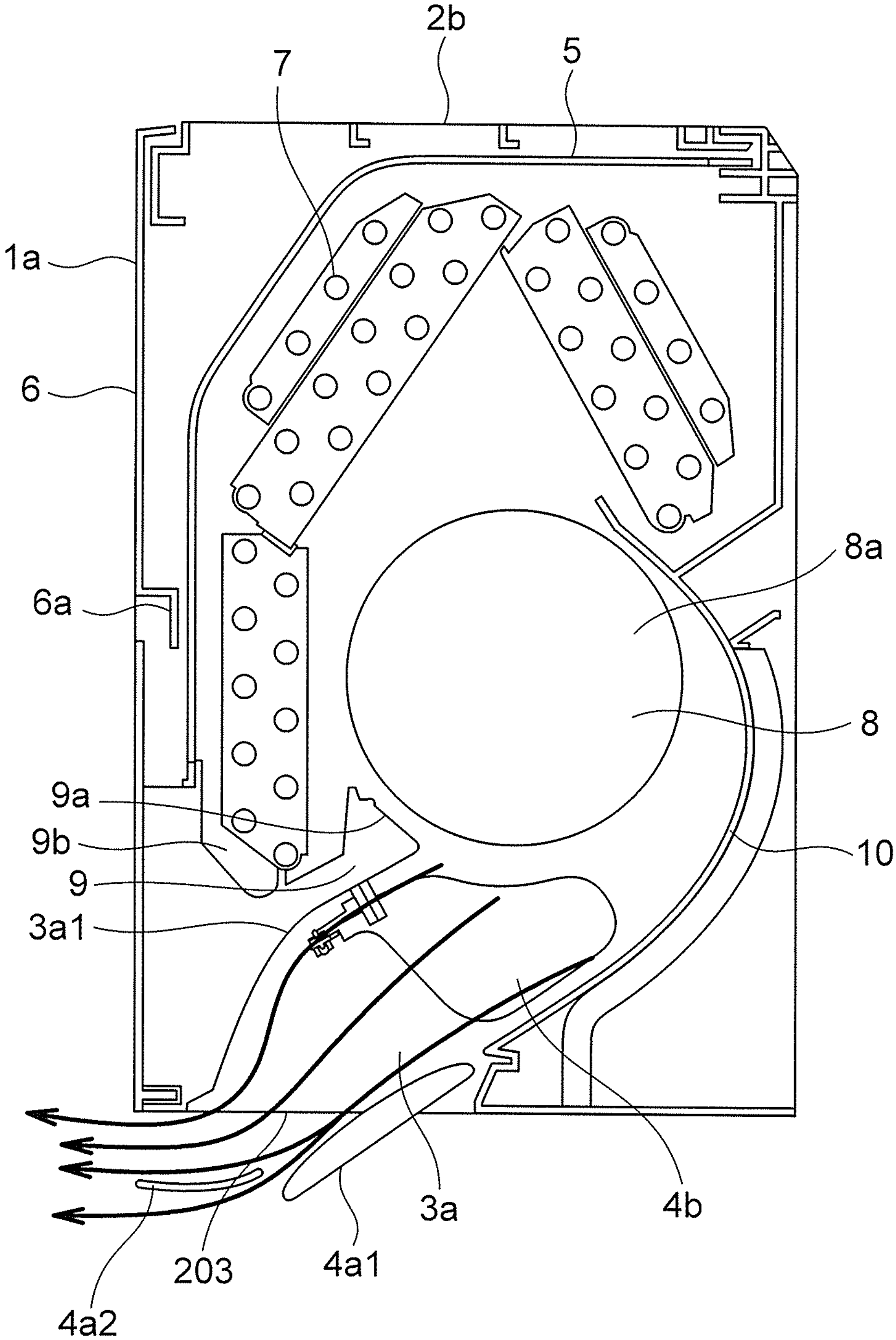


FIG. 8

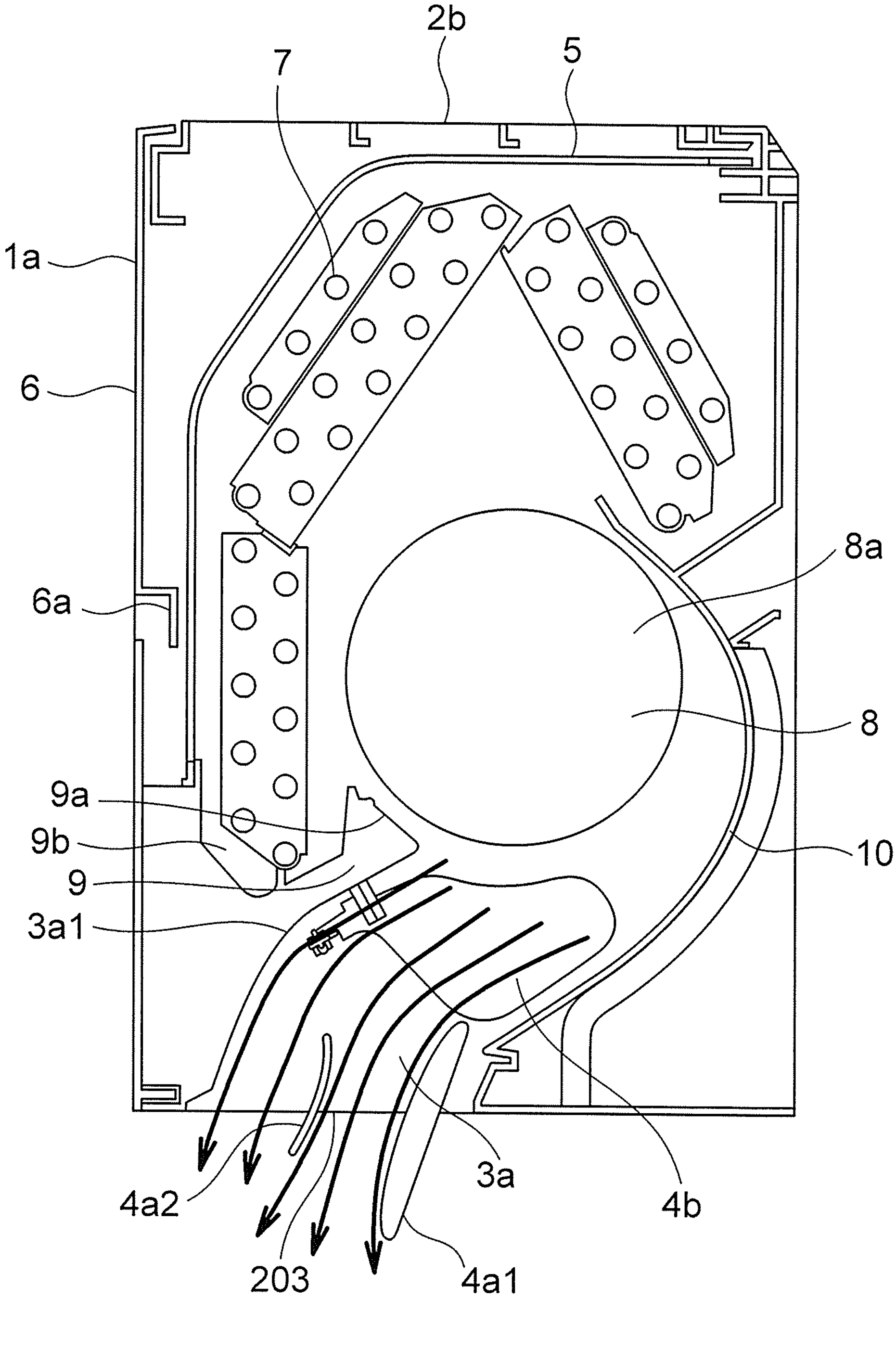


FIG. 9

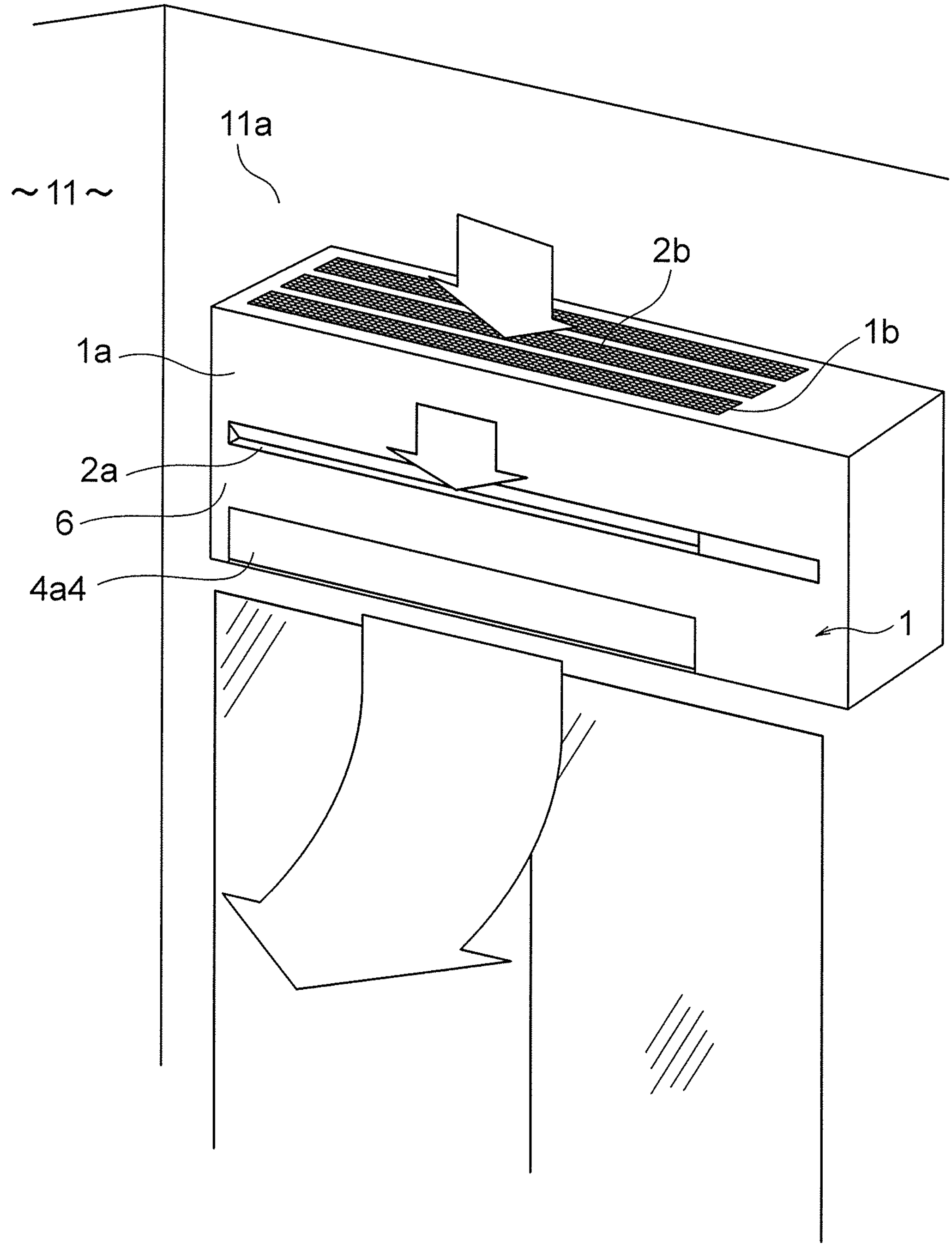


FIG. 10

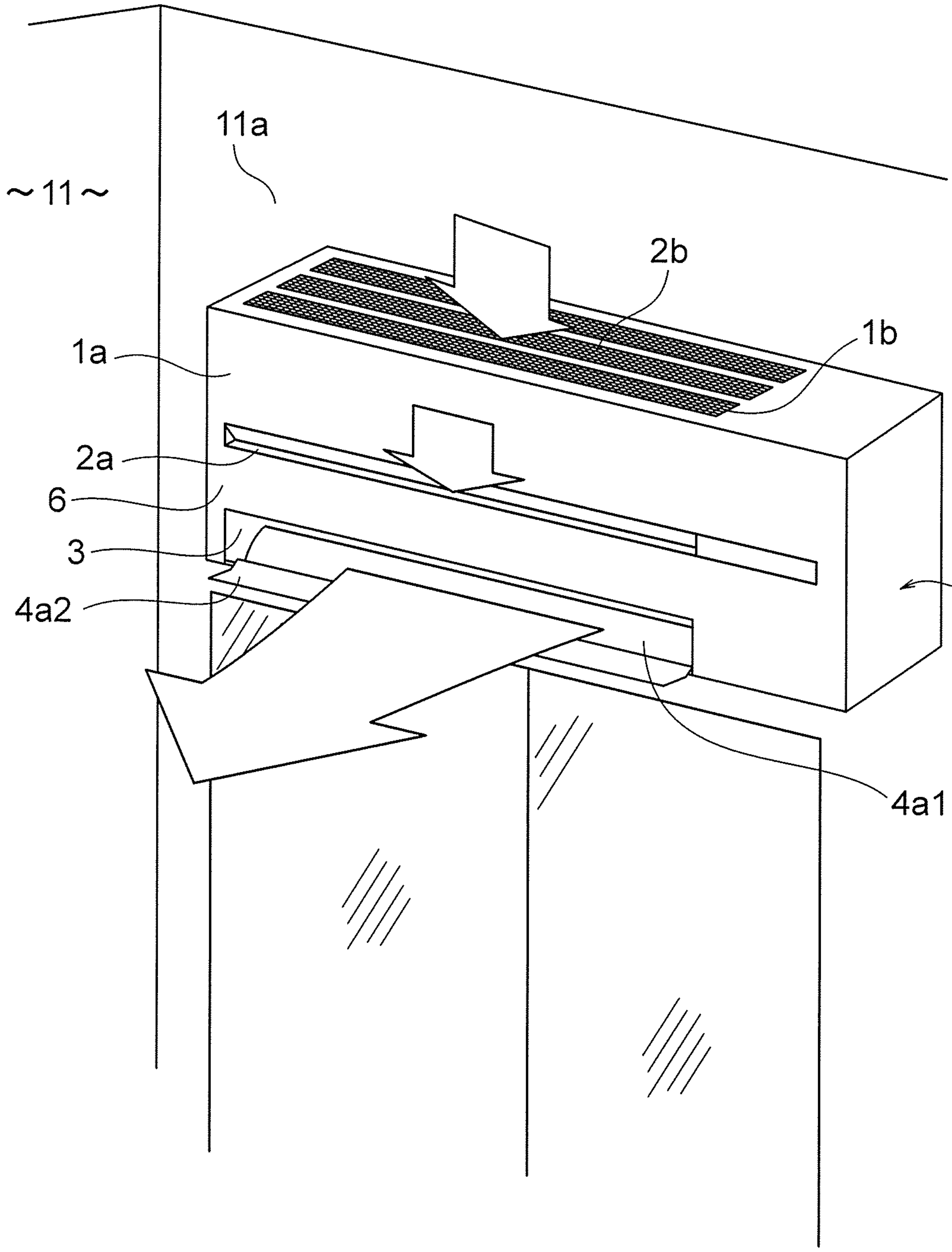


FIG. 11

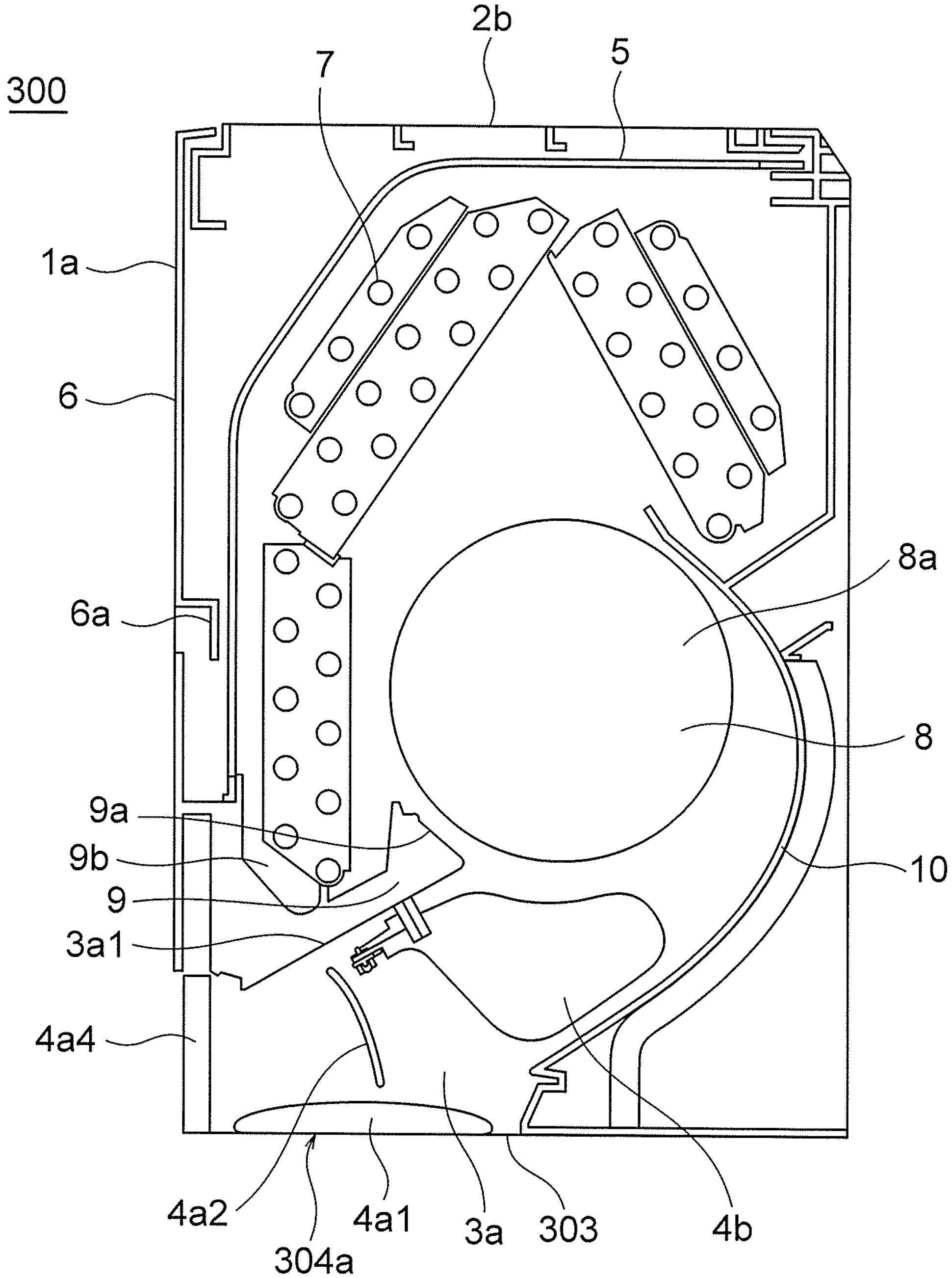


FIG. 12

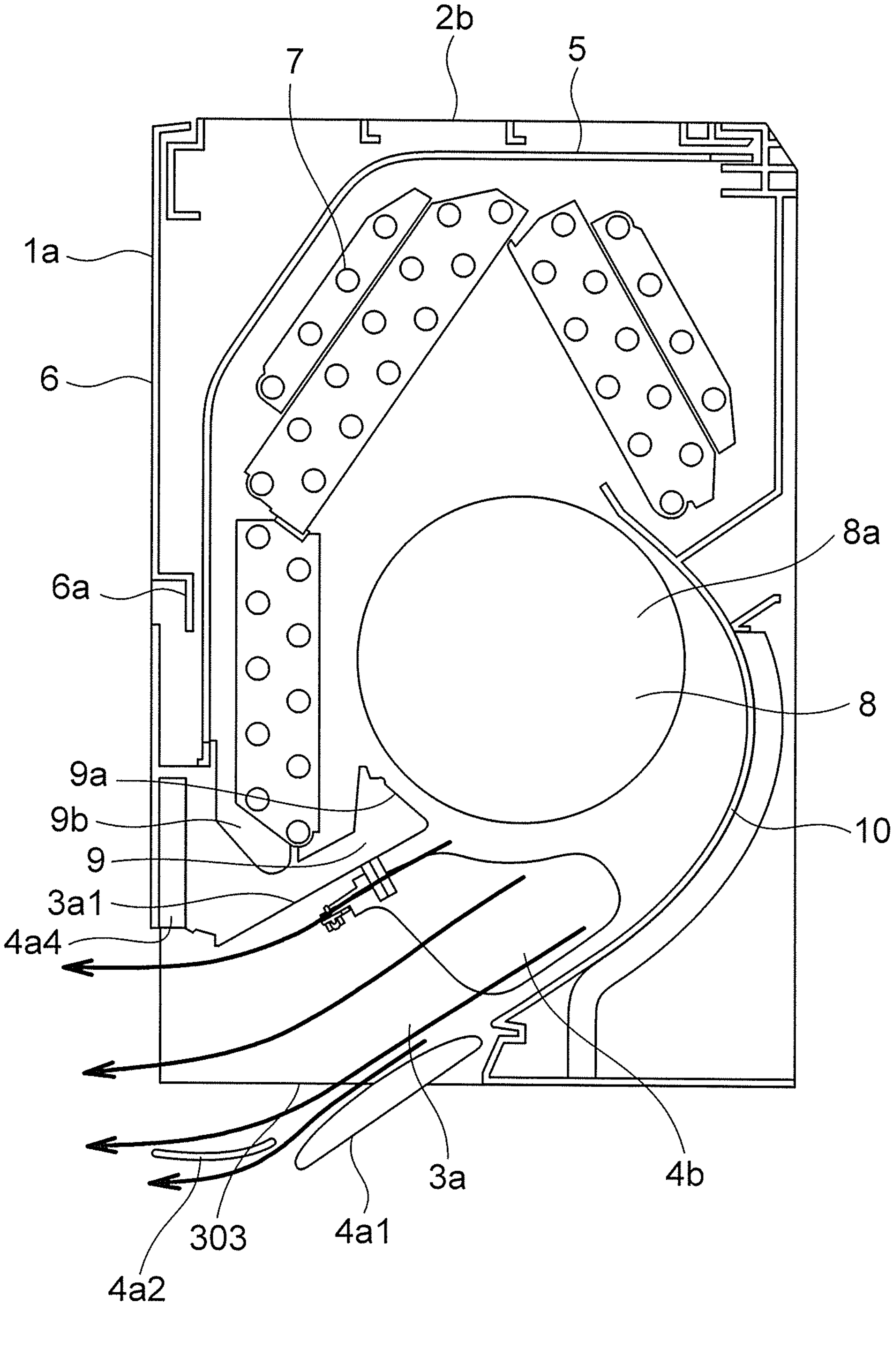


FIG. 13

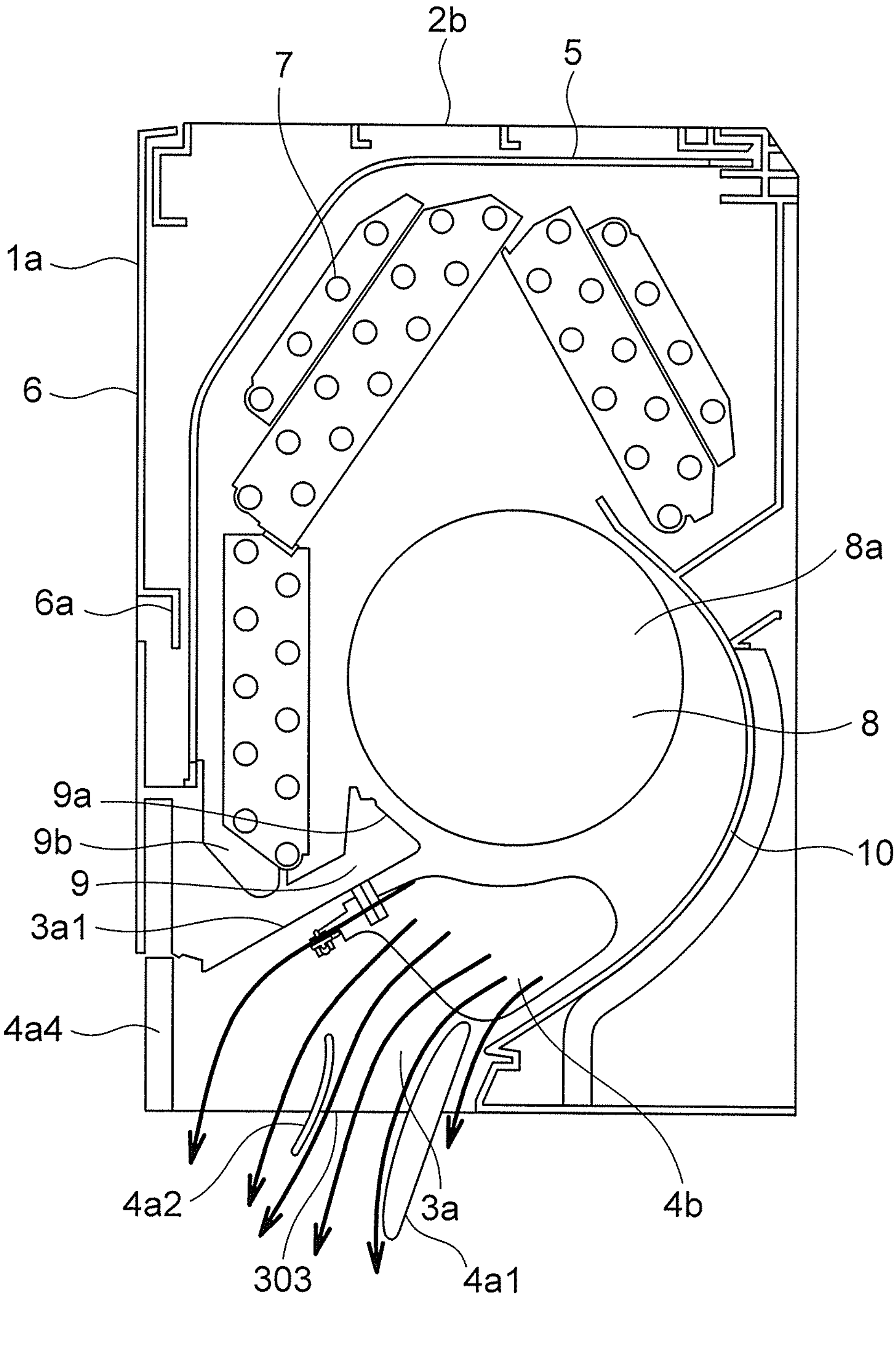


FIG. 14

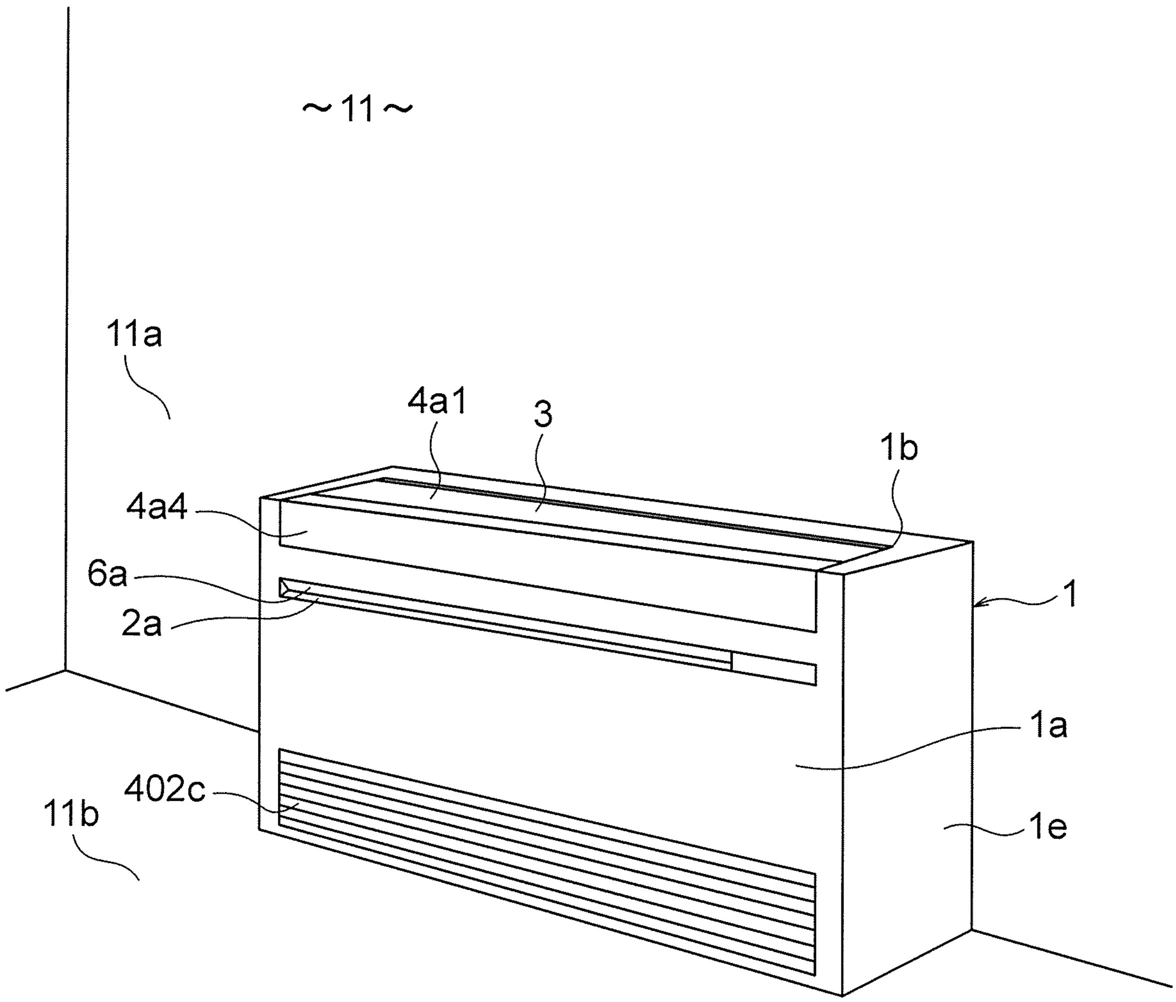
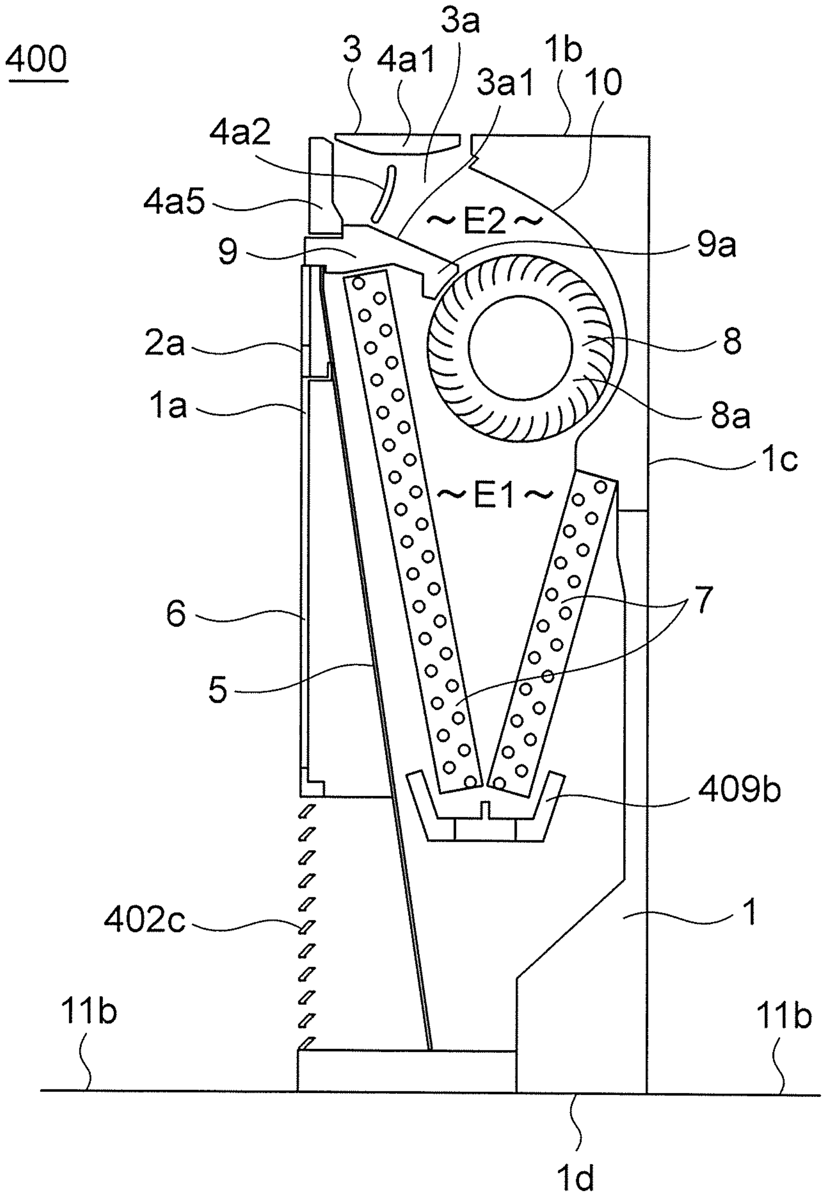


FIG. 15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1c
~E1~
7
6
5
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402c
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11b
11b
1d

FIG. 16

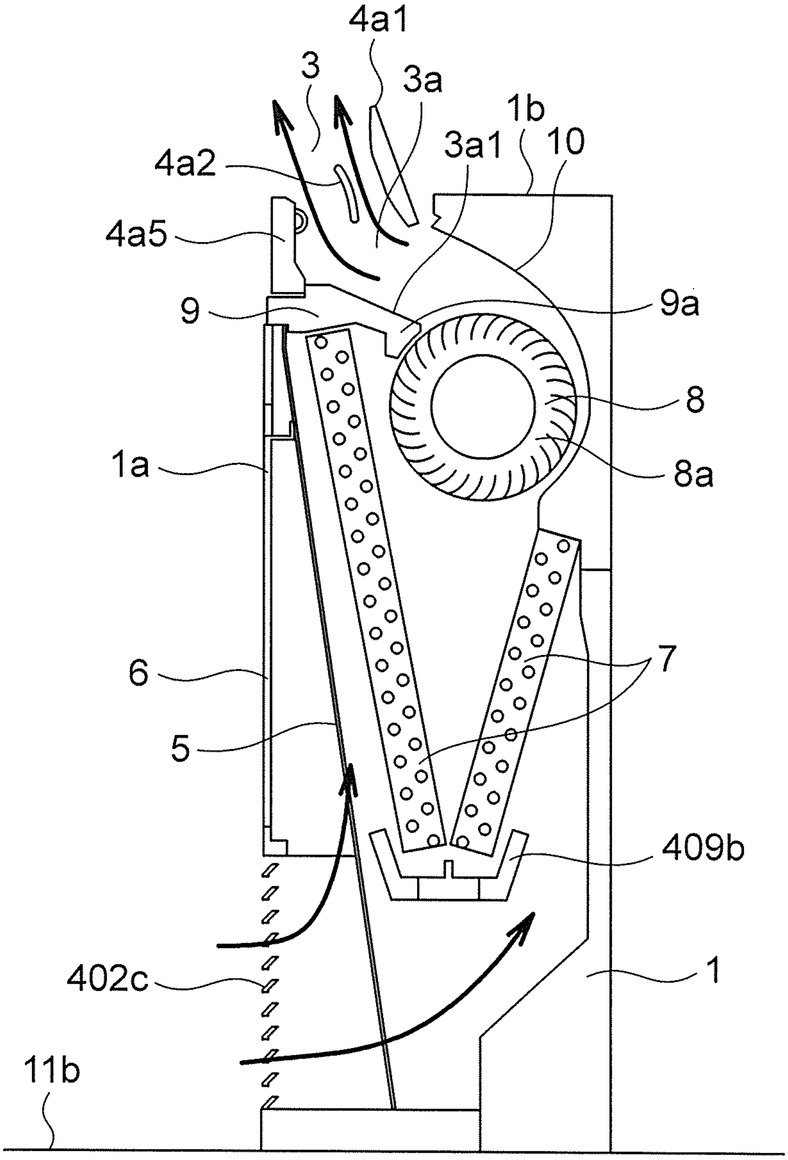


FIG. 17

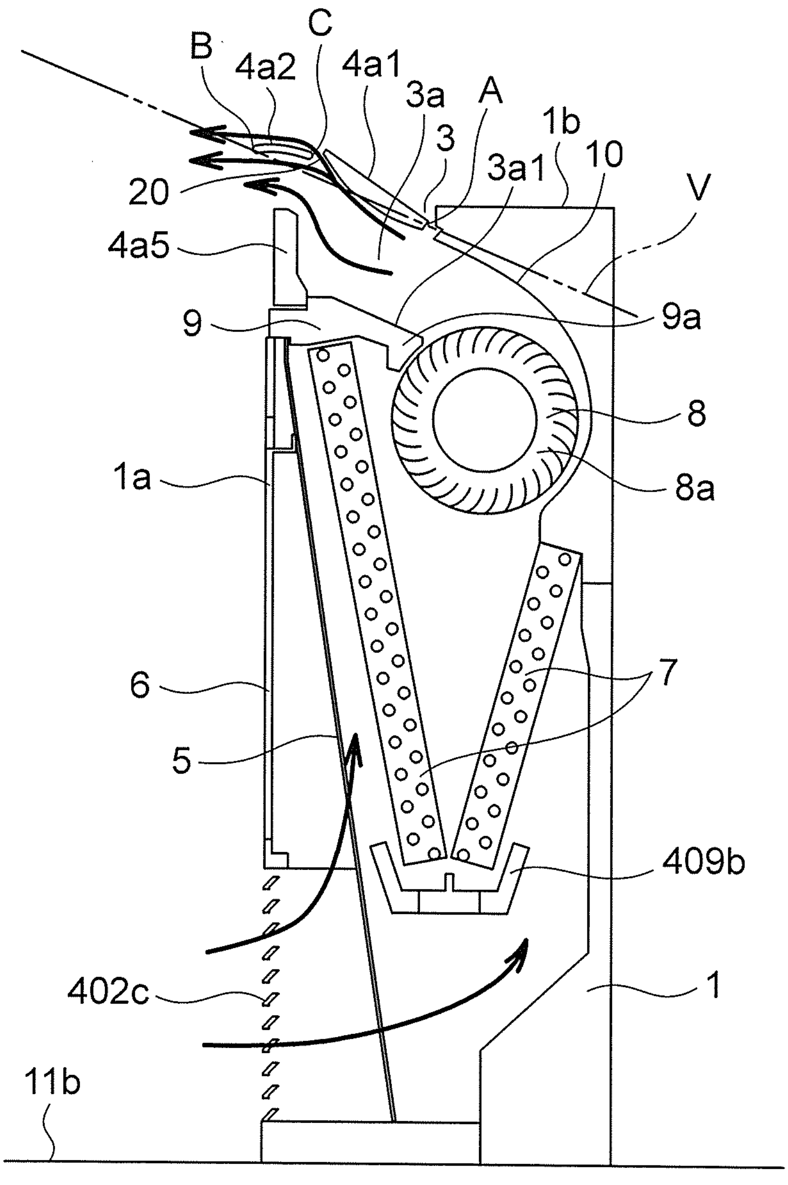
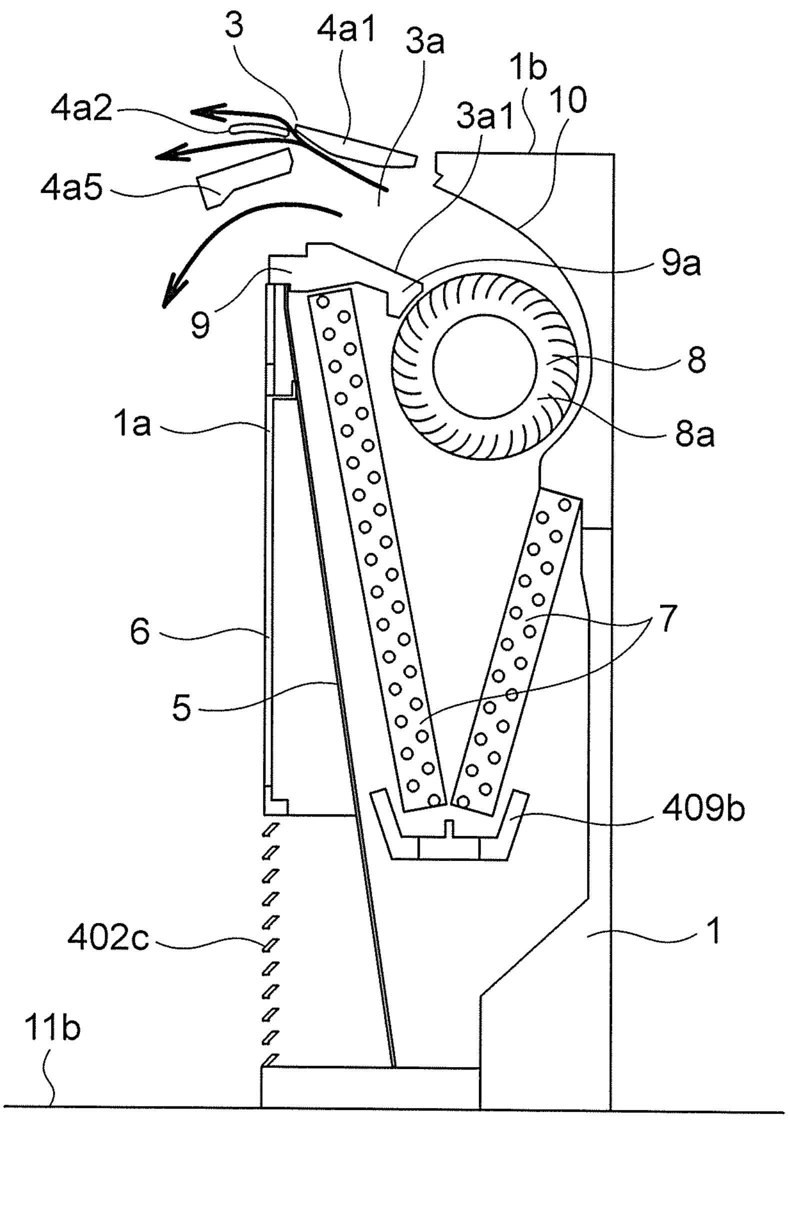


FIG. 18



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/059152

A. CLASSIFICATION OF SUBJECT MATTER
F24F13/20(2006.01)i, *F24F13/06*(2006.01)i, *F24F13/10*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F13/20, F24F13/06, F24F13/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2014
Kokai Jitsuyo Shinan Koho	1971-2014	Toroku Jitsuyo Shinan Koho	1994-2014

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 Y	JP 2009-222302 A (Panasonic Corp.), 01 October 2009 (01.10.2009), paragraphs [0017] to [0064]; fig. 1 to 7 (Family: none)	1-2 3-6
Y	JP 2007-205711 A (Sharp Corp.), 16 August 2007 (16.08.2007), paragraphs [0052] to [0053]; fig. 4 (Family: none)	3-6
Y	JP 2004-361011 A (Hitachi Home & Life Solution, Inc.), 24 December 2004 (24.12.2004), paragraphs [0019] to [0038]; fig. 1 to 4 (Family: none)	6

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

* Special categories of cited documents:
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 16 June, 2014 (16.06.14)	Date of mailing of the international search report 24 June, 2014 (24.06.14)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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