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(54) BLOWER AND OUTDOOR UNIT OF AIR CONDITIONER HAVING THE SAME

GEBLÄSE UND AUSSENEINHEIT EINER KLIMAANLAGE DAMIT

SOUFFLANTE ET UNITÉ D'EXTÉRIEUR DE CLIMATISEUR DOTÉE DE LADITE SOUFFLANTE

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Description

Technical Field

[0001] The present invention relates to an outdoor unit of an air conditioner having a blower for blowing air.

Background Art

[0002] An outdoor unit of air conditioner includes a fan blowing air by being rotated, a heat exchanger exchanging heat with air blown by the fan, a motor driving the fan, and a motor support member supporting the motor.

[0003] As for the various types outdoor unit of air conditioner, the outdoor unit of air conditioner having a motor support member and a rectifying member is known. The motor support member is formed of a rigid material so that the motor support member can support the motor. The rectifying member is installed upstream of the airflow direction of the motor support member and guides air flowing toward the motor support member.

[0004] Since the motor support member is disposed on the flow path for guiding air flowing by the fan, the flow resistance and noise can be increased or decreased depending on the shape of the motor support member.

[0005] JPH1123009A discloses an air-blower fixing tool for attaching an air-blower to a heat-exchange chamber of an outdoor unit of an air conditioner.

Disclosure of Invention

Technical Problem

[0006] Therefore, it is an aspect of the present invention to provide a blower capable of reducing a flow resistance and noise generated by a motor support member supporting a motor in an outdoor unit of an air conditioner.

Solution to Problem

[0007] In accordance with the invention, there is provided an outdoor unit of air conditioner according to claim 1. Optional features are set out in the dependent claims. Other aspects that do not fall within the scope of the claims relate to exemplary embodiments of the present disclosure not part of the present invention.

[0008] The upstream portion has a cross-sectional shape having a width curvedly increased, the downstream portion has a cross-sectional shape having a width curvedly reduced, and the upstream portion and the downstream portion have a cross-section curvedly connected therebetween.

[0009] A ratio of an upstream portion length to the maximum width may be equal to or greater than 1.00 and equal to or less than 1.50.

[0010] A ratio of a downstream portion length to the upstream portion length may be equal to or greater than 0.58 and equal to or less than 1.00.

[0011] The cross-sectional shape of the motor support member may be formed on some portions of the motor support member in a longitudinal direction of the motor support member.

[0012] The cross-sectional shape of the motor support member may be formed on some portions adjacent to a blade of the fan.

[0013] The cross-sectional shape of the motor support member may be formed on some portions adjacent to the motor.

[0014] The motor support member may include a motor supporter formed of a metal material to form the downstream side of the motor support member and a rectifying member formed of a resin material to form the upstream side of the motor support member.

[0015] The motor supporter may include an opening opened upstream, and the rectifying member is provided in such a manner that a downstream end portion thereof is inserted into the opening.

[0016] The motor support member may further include a sealing member configured to seal between the motor supporter and the rectifying member.

[0017] The outdoor unit of air conditioner may further include an additional rectifying member installed on a cross section of the downstream side of the motor supporter.

[0018] The additional rectifying member may be formed in a shape corresponding to a shape obtained by rotating a half of the cross-sectional shape of the motor support member by 90 degrees clockwise or counterclockwise.

[0019] The outdoor unit of air conditioner may further include a step formed in such a manner a width of the additional rectifying member is smaller than the downstream end width of the motor supporter.

[0020] The motor supporter may include an opening opened upstream, and the rectifying member surrounds an upstream side, opposite side surfaces and a downstream side of the motor supporter.

[0021] The downstream side end portion of the rectifying member is formed in a shape corresponding to a shape obtained by rotating a half of the cross-sectional shape of the motor support member by 90 degrees clockwise or counterclockwise.

[0022] In accordance with an embodiment of the invention, an outdoor unit according to claim 1 is provided. In particular, a blower includes a fan, a motor driving the fan, and a motor support member disposed on a flow path, through which air generated by a rotation of the fan flows, to support the motor. The motor support member includes a cross-sectional shape including a maximum width portion having a maximum width in a direction perpendicular to the airflow direction, an upstream portion having a width being increased from the upstream side to the downstream side, and a downstream portion having a width being reduced from the upstream side to the downstream side. A downstream end located down-

stream of the downstream portion has a width in a direction perpendicular to the airflow direction.

[0023] Before undertaking the DETAILED DESCRIPTION below, it may be advantageous to set forth definitions of certain words and phrases used throughout this patent document: the terms "include" and "comprise" as well as derivatives thereof, mean inclusion without limitation; the phrases "associated with" and "associated therewith," as well as derivatives thereof may mean to include, be included within, interconnect with, contain, be contained within, connect to or with, couple to or with, be communicable with, cooperate with, juxtapose, be proximate to, be bound to or with, have.

[0024] Definitions for certain words and phrases are provided throughout this patent document, those of ordinary skill in the art should understand that in many, if not most instances, such definitions apply to prior, as well as future uses of such defined words and phrases.

Advantageous Effects of Invention

[0025] Since the cross sectional shape of the motor support member includes the upstream portion having the width that is increased from the upstream side to the downstream side, and the downstream portion having the width that is reduced from the upstream side to the downstream side, it is possible to reduce the width of the vortex generated in the rear side of the motor support member and thus it is possible to reduce the flow resistance and the noise.

Brief Description of Drawings

[0026]

FIG. 1 is a schematic view illustrating an outdoor unit of air conditioner according to a first embodiment of the invention;

FIG. 2 is a cross-sectional view illustrating a motor support member according to the first embodiment;

FIG. 3 is a view illustrating airflow generated by the motor support member;

FIG. 4 is a view illustrating a dimension name of the cross-sectional view of the motor support member;

FIG. 5 is a graph for examining a ratio value between an upstream portion length and a maximum width in the motor support member;

FIG. 6 is a graph for examining a ratio value between a downstream portion length and the upstream portion length in the motor support member;

FIG. 7 is a graph for examining a ratio value between a downstream end width and the maximum width in the motor support member;

FIG. 8 is a view illustrating a configuration of the motor support member according to the first embodiment;

FIG. 9 is a cross-sectional view illustrating a motor supporter of the motor support member;

FIG. 10 is a perspective view illustrating a mounting structure of a sealing member in the motor support member;

FIG. 11 is a graph illustrating a noise reduction value of blowing air acquired by a test that is actually performed with the motor support member according to the first embodiment;

FIG. 12 is a view illustrating a configuration of a motor support member according to a second embodiment of the invention ;

FIG. 13 is a view illustrating a configuration of a motor support member according to a third embodiment of the invention ;

FIGS. 14A and 14B are views illustrating a case in which a motor supporter is surrounded by a rectifying member when the rectifying member is formed of resin in the motor supporting member according to a fourth embodiment of the invention;

FIG. 15 is a view illustrating a case in which a motor supporter is surrounded by a rectifying member when the rectifying member is formed of a foaming agent in the motor supporting member;

FIG. 16 is a view illustrating a relation between the motor support member and a front edge of a blade of a fan;

FIG. 17 is a side cross-sectional view illustrating a motor, a leg portion, and the motor support member;

FIGS. 18A and 18B are views illustrating a state of a mounting portion before and after the motor support member is mounted to the mounting portion;

FIG. 19 is a schematic view illustrating an outdoor unit of air conditioner according to a fifth embodiment of the invention ;

FIG. 20 is a schematic view illustrating an outdoor unit of air conditioner according to a sixth embodiment not part of the invention; and

FIG. 21 is a schematic view illustrating an outdoor unit of air conditioner according to a seventh embodiment of the invention

Mode for the Invention

[0027] There is growing need of an air conditioner that is smaller in size and higher in efficiency with the commerciality and an air conditioner has been developed with focus on the increase of the airflow rate.

[0028] As the airflow rate is increased, the blowing noise is increased in the air conditioner.

[0029] Therefore, in order to increase the airflow rate while reducing the noise, it is required to improve the shape of structure installed on a flow path through which air flows, and the shape of the fan.

[0030] Embodiments relate to a structure for reducing a flow resistance and a noise generated by a motor support member, which is a structure disposed in the flow path through which air flows.

[0031] For this, embodiments relate to reducing the pressure variation by making a width of a vortex, which

is generated on the downstream side in the air flow direction by the motor support member, small, by improving a cross-sectional shape of the motor support member, and a structure and an arrangement of the motor support member.

[0032] Hereinafter an outdoor unit of an air conditioner according to embodiments will be described in detail with reference to the accompanying drawings, FIGS. 1 through 21.

[0033] FIG. 1 is a schematic view illustrating an outdoor unit 1 of an air conditioner according to a first embodiment of the invention.

[0034] The outdoor unit 1 includes a blower blowing air and a heat exchanger 60 arranged upstream of the blower to perform heat exchange with air blown by the blower.

[0035] The blower includes a fan 10 suctioning and discharging air by being rotated, a motor 20 driving the fan 10, a leg portion 30, a motor support member 40, and a bell mouth 50.

[0036] The fan 10 receives a torque and rotates to allow air to flow in a direction of a white arrow. As the air flows in the direction of the white arrow by the fan 10, the air flows in a direction of a black arrow and passes through the heat exchanger 60.

[0037] The motor 20 receives a power to generate a torque and transmits the torque to the fan 10 through a rotating shaft. The leg portion 30 is in contact with the motor 20 to directly support the motor 20. The motor support member 40 is fixed to the leg portion 30 and supports the motor 20 through the leg portion 30.

[0038] The bell mouth 50 forms a flow path for guiding the air that flows in accordance with the rotation of the fan 10, and the motor support member 40 is disposed in the flow path.

[0039] The heat exchanger 60 allows a refrigerant to exchange heat with the air passing through the heat exchanger 60 in the direction of the black arrow.

[0040] In addition, the outdoor unit 1 includes a compressor (not shown) compressing the refrigerant, an expansion valve (not shown) expanding and decompressing the refrigerant, and a refrigerant pipe (not shown) transmitting the refrigerant.

[0041] The outdoor unit 1 is an upper discharge type outdoor unit, and thus the motor support member 40 is disposed upstream of the airflow direction than the fan 10.

[0042] The motor support member 40 of the outdoor unit 1 is installed higher than an upper end of the heat exchanger 60. That is, the motor support member 40 is installed more downstream of the airflow direction than an end portion of the heat exchanger 60 in the downstream side of the airflow direction.

[0043] The motor support member 40 is extended in the front-rear direction so that the front end and the rear end thereof are fixed to the inside of the outdoor unit 1.

[0044] The motor support member 40 is extended in the front-rear direction, but is not limited thereto. The motor support member 40 may be extended in the left-right direction or the diagonal direction. Hereinafter a direction in which the motor support member 40 is extended is referred to as a longitudinal direction of the motor support member 40 and the longitudinal direction of the motor support member 40 is referred as a direction perpendicular to the cross section of the motor support member 40.

[0045] FIG. 2 is a cross-sectional view of the motor support member 40, and the motor support member 40 is formed in a substantially streamlined wing. The motor support member 40 includes a cross-sectional shape including a maximum width portion that is a portion having a maximum width in a direction perpendicular to the airflow direction at a cross section perpendicular to the longitudinal direction, an upstream portion that is located upstream of the airflow direction with respect to the maximum width portion, and a downstream portion located downstream of the airflow direction with respect to the maximum width portion.

[0046] The upstream portion of the motor support member 40 has a cross-sectional shape having a width thereof increased from the upstream side to the downstream side in the airflow direction, as illustrated by a solid line arrow. Particularly, the upstream portion of the motor support member 40 has a cross-sectional shape having a width thereof that is curvedly increased from the upstream side to the downstream side.

[0047] The downstream portion of the motor support member 40 has a cross-sectional shape having a width thereof reduced from the upstream side to the downstream side, as illustrated by a solid line arrow. Particularly, the downstream portion of the motor support member 40 has a cross-sectional shape having a width thereof that is curvedly reduced from the upstream side to the downstream side.

[0048] In the cross-sectional shape of the motor support member 40, a portion, which forms the maximum width portion between the upstream portion and the downstream portion, has a cross-sectional shape smoothly connected as a curved line, as illustrated by a broken line arrow.

[0049] In addition, a downstream end located downstream of the downstream portion in the airflow direction of the motor support member 40 has a width formed in such a manner that the middle of a wing-shaped reduction portion is cut out in a plane substantially perpendicular to the rotating shaft of the fan 10. That is, the downstream end of the motor support member 40 has a width in a direction perpendicular to the airflow direction. According to embodiments, the downstream end of the motor support member 40 is formed in a linear shape substantially perpendicular to the airflow direction.

[0050] FIG. 3 is a view illustrating the flow of air passing through the motor support member 40. As air flows along the motor support member 40 having the cross sectional shape shown in FIG. 2, air flows in a virtual wing cross-sectional shape, as illustrated by an arrow.

[0051] FIG. 4 is a view illustrating a dimension name of the cross-sectional view of the motor support member

40. As illustrated, the maximum width of the cross section of the motor support member 40 is referred to as "W" That is, when a point of the left side and a point of the right side in the maximum width in which a width of the cross section of the motor support member 40 becomes the maximum is referred to as "X"and "Y" a distance between the point X and the point Y becomes the maximum width W.

[0052] With respect to the cross-section of the motor support member 40, a width of an end portion of the motor support member 40 (hereinafter referred to as "downstream end width) downstream of the airflow direction is referred to as "W1" Particularly, left and right points of the intersection between an extension line to the downstream side of the motor support member 40 and an extension line of the downstream end of the motor support member 40 are respectively referred to as "X1" and "Y1" and a distance between the point X1 and the point Y1 is referred to as the downstream end width (W1).

[0053] With respect to the cross-section of the motor support member 40, a length from an upstream end to the downstream end is referred to as a total length (L). A length of the portion, which is from the upstream end of the motor support member 40 to the portion having the maximum width of the motor support member 40 (hereinafter referred to as the "upstream portion"), is referred to as an upstream portion length (L1), and a length of a portion, which is from the portion having the maximum width of the support member 40 to the downstream end of the motor support member 40 (hereinafter referred to as the "downstream portion"), is referred to as a downstream portion length (L2).

[0054] FIG. 5 is a graph for examining a ratio value (L1/W) between the upstream portion length (L1) and the maximum width (W). Based on the graph, it is identified that a noise reduction value is sufficiently great when the ratio (L1/W) between the upstream portion length (L1) and the maximum width (W) is equal to or greater than 1. 00 and equal to or less than 1.50. As illustrated by a double white arrow, it is appropriate that the ratio (L1/W) between the upstream portion length (L1) and the maximum width (W) is equal to or greater than 1. 00 and equal to or less than 1.50.

[0055] FIG. 6 is a graph for examining a ratio value (L2/L1) between the downstream portion length (L2) and the upstream portion length (L1). Based on the graph, it is identified that a noise reduction value is sufficiently great when the ratio (L2/L1) between the downstream portion length (L2) and the upstream portion length (L1) is equal to or greater than 0. 58 and equal to or less than 1.00. As illustrated by a double white arrow, it is appropriate that the ratio (L2/L1) between the downstream portion length (L2) and the upstream portion length (L1) is equal to or greater than 0. 58 and equal to or less than 1.00.

[0056] FIG. 7 is a graph for examining a ratio value (W1/W) between the downstream end width (W1) and the maximum width (W). Based on the graph, it is identified that the ratio (W1/W) between the downstream end width (W1) and the maximum width (W) is acquired by the ratio (L2/L1) between the downstream portion length (L2) and the upstream portion length (L1). When the ratio (W1/W) between the downstream end width (W1) and the maximum width (W) is greater than 0.94, it is difficult to reduce the width of the airflow formed in a virtual wing cross-sectional shape in the downstream of the motor support member 40 of FIG. 3.

[0057] Conversely, when the ratio (W1/W) between the downstream end width (W1) and the maximum width (W) is less than 0.86, it is difficult to secure the rigidity of the motor support member 40 and thus it is difficult to secure a space for installing the motor 20 and a space for forming a coupling portion. Therefore, as illustrated by a double white arrow of FIG. 6, it is identified that the ratio (W1/W) between the downstream end width (W1) and the maximum width (W) is equal to or greater than 0. 86 and equal to or less than 0.94.

[0058] In addition, the above mentioned conditions of dimensions are acquired by a result of a test in which the blower is used in the outdoor unit 1, but is not limited thereto. Therefore, it is possible to use conditions of dimensions acquired by considering aerodynamics when the blower is used alone. Particularly, it is possible to use a condition in which the upstream portion length (L1) is greater than the maximum width (W) or a condition in which the upstream portion length (L2) is less than the maximum width (W).

[0059] Next, a configuration of the cross-sectional shape of the motor support member 40 will be described in details.

[First embodiment of the invention]

[0060] FIG. 8 is a view illustrating a configuration of the motor support member 40 according to the first embodiment.

[0061] As mentioned above, the motor support member 40 has a cross-sectional shape in which the upstream portion and the downstream portion are gently connected to each other so as to allow the air to flow from the upstream to the downstream of the airflow direction in the virtual wing shape.

[0062] The motor support member 40 includes a motor supporter 41 formed of a metal material to form the downstream of the motor support member 40 and a rectifying member 42 formed of a resin material to form the upstream of the motor support member 40.

[0063] The motor supporter 41 of the motor support member 40 is formed of a member having certain strength such as a metal so as to support the motor 20.

[0064] As illustrated in FIG. 9, the motor supporter 41 includes an opening 414 opened upstream and configured to have a cross-sectional shape surrounding the downstream of the motor support member 40 by using three thin and elongated portions 411, 412 and 413. The

motor supporter 41 includes a downstream surface portion 411 forming a downstream surface thereof and opposite side surface portions 412 and 413 extending upstream from opposite sides of the downstream surface portion 411. The opposite side surface portions 412 and 413 form the maximum width portion forming the maximum width. A downstream end portion of the rectifying member 42 is inserted into the opening 414 of the motor supporter 41 and then in contact with an inner surface of the portions 412 and 413 extended from the upstream to the downstream of the motor supporter 41. The motor supporter 41 is fixed to the rectifying member 42 through a screw 46.

[0065] A sealing member 47 is provided between the motor supporter 41 and the rectifying member 42. Therefore, the sealing member 47 prevents water from flowing through a gap between the motor supporter 41 and the rectifying member 42.

[0066] FIG. 10 is a perspective view illustrating a state in which the sealing member 47 is installed between the motor supporter 41 and the rectifying member 42.

[0067] It is appropriate that the sealing member 47 is installed at an end portion in a direction perpendicular to FIG. 1. Further, in order to stably install the sealing member 47 or reliably seal a portion to be sealed, it is appropriate that a sheet 421 is installed on the rectifying member 42. In addition, the sealing member 47 is installed to fill the gap between the motor supporter 41 and the rectifying member 42, but is not limited thereto. A cap formed of a resin may be installed instead of the sealing member 47.

[0068] Although not shown, when the upstream side of the motor supporter 41 is covered with the rectifying member 42, it is appropriate to form a discharge port in a lower side of the rectifying member 42.

[0069] When installing the discharge port, a slop inclined toward the discharge port may be provided at the lower side of the rectifying member 42 to effectively discharge water through the discharge port.

[0070] FIG. 11 is a graph illustrating a test result of a noise reduction effect. A broken line in the graph indicates the noise when the motor support member 40 having the conventional cross-sectional shape is applied, and a solid line indicates the noise when the motor support member 40 having the cross-sectional shape (cross-sectional shape shown in FIG. 2) is applied. As illustrated in the graph, when the motor support member 40 having the cross-sectional shape according to the embodiment is applied, it is identified that the noise is reduced by approximately 3.0 dB in comparison with the case where the motor support member 40 having the conventional cross-sectional shape is applied.

[Second embodiment of the invention]

[0071] FIG. 12 is a view of a motor support member 40 according to a second embodiment.

[0072] As illustrated in FIG. 12, according to the second embodiment, the motor support member 40 includes a motor supporter 41 forming a downstream side of the motor support member 40 and a rectifying member 43 forming an upstream side of the motor support member 40, and further include an additional rectifying member 44 installed on a cross-section of the downstream side of the motor supporter 41.

[0073] The rectifying member 43 and the additional rectifying member 44 formed of a resin material are inserted to the upstream side and the downstream side of the motor supporter 41, respectively and are fixed to the motor support member 41 through screws.

[0074] The first rectifying member 43 is a rectifying member provided upstream of the motor supporter 41 and corresponds to the rectifying member 42 disclosed in the first embodiment.

[0075] The second rectifying member 44 is a rectifying member provided downstream of the motor supporter 41, and is installed on cross-section of the downstream side of the motor supporter 41.

[0076] According to the second embodiment, the cross-sectional shape of the additional rectifying member 44 is formed in a shape corresponding to the cross- sectional shape of the motor support member 40 as illustrated in FIG. 12. That is, the additional rectifying member 44 is formed in a shape corresponding to a shape obtained by rotating the right half of the cross-sectional shape of the motor support member 40 by 90 degrees counterclockwise.

[0077] The above mentioned shape of the additional rectifying member 44 has been described with a condition that the motor 20 is located on the right side of the motor support member 40, but is not limited thereto. Therefore, when the motor 20 is located on the left side of the motor support member 40, the additional rectifying member 44 may be formed in a shape corresponding to a shape obtained by rotating the left half of the cross-sectional shape of the motor support member 40 by 90 degrees clockwise.

[0078] According to second embodiment, the second rectifying member 44 may be changed in the longitudinal direction of the motor support member 40 while having the cross-sectional shape according to embodiments. That is, it is possible to form the maximum width portion, the upstream portion, the downstream portion, and the downstream end on some portions in the longitudinal direction of the motor support member 40.

[0079] As illustrated in the second embodiment, when the additional rectifying member 44 is added, a step 48 is formed between the additional rectifying member 44 and the motor supporter 41. The step 48 is formed in such a manner a width of the additional rectifying member 44 is smaller than the downstream end width (W1) of the motor supporter 41.

[Third embodiment of the invention]

[0080] FIG. 13 is a view illustrating a configuration of

a motor support member 40 according to a third embodiment.

[0081] According to the third embodiment, the motor support member 40 is installed such that a rectifying member 45 surrounds a motor supporter 41. That is, the motor support member 40 includes the motor supporter 41 having a substantially inverted U-shaped cross section as shown in the drawing, and the rectifying member 45 covering an upstream side, opposite sides and a downstream side of the motor supporter 41.

[0082] The rectifying member 45 includes a member formed to have a gradually increasing diameter to form an upstream portion of the motor support member 40 and a member covering the opposite sides and the downstream side of the motor support member 41 to form the maximum width portion and the downstream portion of the motor support member 40.

[0083] The downstream side of the rectifying member 45 is formed in the same shape as the additional rectifying member 44 according to the second embodiment. That is, the downstream end of the rectifying member 45 is formed in a shape corresponding to the shape obtained by rotating a right half of the cross-sectional shape of the motor support member 40 by 90 degrees counterclockwise.

[Fourth embodiment of the invention]

[0084] When a rectifying member 45 is formed of a resin material, the rectifying member 45 may be installed to cover opposite side surfaces and a downstream side of a motor supporter 41, as illustrated in a fourth embodiment of FIGS. 14A and 14B.

[0085] FIG. 14A is a view of a shape of the rectifying member 45 covering the motor supporter 41, and FIG. 14B is a view of a shape of the rectifying member 45 in the middle of the process of covering the motor supporter 41. However, in this case, a portion corresponding to the additional rectifying member 44 according to the second embodiment is omitted.

[0086] Alternatively, the rectifying member 45 may be formed of a foam material. In such a case, it is appropriate that the motor supporter 41 is surrounded by the rectifying member 45, as illustrated in FIG. 15. FIG. 15 is a view of a shape of the rectifying member 45 in the middle of the process of covering the motor supporter 41. However, in this case, a portion corresponding to the additional rectifying member 44 according to the second embodiment is omitted.

[0087] FIG. 16 is a view illustrating a relation between the motor support member 40, in which the rectifying member having the cross-sectional shape of the motor support member 40 is installed on a rear end portion, and a front edge 11 of a blade of a fan 10. By installing the rectifying member having the cross-sectional shape of the motor support member 40 on the rear end portion, the flow, which is separated by the motor support member 40 with respect to the rotational flow direction of the air indicated by the white arrow, may flow smoothly.

[0088] Next, a description related to a configuration in a longitudinal direction perpendicular to the cross section of the motor support member 40 will be described.

[0089] FIG. 17 is a view illustrating the configuration composed of the motor 20, the leg portion 30 and the motor support member 40 when viewing from the side surface of the outdoor unit 1. The left side of the drawing is the front side of the outdoor unit 1 and the right side of the drawing is the rear side of the outdoor unit 1. The motor support member 40 according to the embodiment employs the motor support member 40 according to the first embodiment. That is, the motor support member 40 includes the motor supporter 41 and the rectifying member 42.

[0090] As illustrated in FIG. 17, from the front side of the outdoor unit 1 to the rear side of the outdoor unit 1, a cross-sectional shape in the longitudinal direction of the motor support member 40 has a cross-sectional shape 40a, at first. Subsequently, a cross-sectional shape of the motor support member 40 is changed through a sectional shape-changing region 40c and then becomes a cross-sectional shape 40b. The cross-sectional shape of the motor support member 40 is changed through a sectional shape-changing region 40d and then returns to the cross-sectional shape 40b. In addition, the cross-sectional shape of the motor support member 40 is changed through a sectional shape changing region 40c and then returns to the cross-sectional shape 40a.

[0091] As mentioned above, it is appropriate to change a cross-sectional shape of the motor support member 40 in the longitudinal direction while maintaining a cross-sectional shape of the motor support member 40 as the cross-sectional shape (the cross-sectional shape of FIG. 2). That is, a cross section, which is generated by being cut out in another plane according to the airflow, may have another shape satisfying the condition of the cross-sectional shape according to the embodiments.

[0092] The cross-sectional shape of the motor support member 40 (the cross-sectional shape of FIG. 2) may be formed on some portions of the motor support member 40.

[0093] That is, it is appropriate to apply the above-described cross-sectional shape to the position adjacent to the blade of the fan 10 in the motor support member 40 or the position adjacent to the motor 20.

[0094] FIG. 17 illustrates that the rectifying member 42, which is integrated in the longitudinal direction of the motor support member 40, is used as the rectifying member 42, but is not limited thereto. It is also possible to use the rectifying member 42, which is divided into a plurality of portions in the longitudinal direction of the motor support member 40. That is, the rectifying member 42 may be divided into a plurality of portions in the longitudinal direction of the motor support member 40.

[0095] In FIG. 17, a mounting portion 70 for mounting the motor support member 40 to a housing of the outdoor unit 1 is indicated by thick black lines on the right and left

sides of the motor support member 40. Although not shown in FIG. 1, the mounting portion 70 is installed on the left side and the right side of the inner front surface and the rear surface of the housing of the outdoor unit 1.

[0096] Hereinafter a method of mounting the motor support member 40 will be described in detail.

[0097] FIG. 18A is a view illustrating a state of the mounting portion 70 before the motor support member 40 is mounted to the mounting portion 70. As illustrated in FIG. 18A, a bent portion 72 is provided on the mounting portion 70 to secure an installation sheet surface 71 of the motor support member 40, and a pair of slits 73 is provided in the bent portion 72. The pair of slits 73 is inserted into opposite side surface portions 412 and 413 of the motor supporter 41.

[0098] FIG. 18B is a view illustrating a state of the mounting portion 70 after the motor support member 40 is mounted to the mounting portion 70. In a state in which the motor support member 40 is inserted into the slit 73, the screw 74 is fastened and thus the motor support member 40 is fixed to the installation sheet surface 71. The screw 74 may be fastened from above with respect to the drawing.

[Fifth embodiment of the invention]

[0099] FIG. 19 is a schematic view illustrating an outdoor unit 2 of air conditioner according to a fifth embodiment. As illustrated in FIG. 19, the outdoor unit 2 includes a fan 10, a motor 20, a leg portion 30, a motor support member 40, a bell mouth 50, and a heat exchanger 60. The functions of the fan 10, the motor 20, the leg portion 30, the motor support member 40, the bell mouth 50 and the heat exchanger 60 are the same as those of the outdoor unit 1 of the first embodiment and thus a description thereof will be omitted.

[0100] The outdoor unit 2 according to the fifth embodiment is an upper surface blower type in the same manner as the outdoor unit 1 according to the first embodiment. In addition, the outdoor unit 2 is a type in which the motor support member 40 is disposed upstream of the airflow direction of the fan 10. However, the motor support member 40 is disposed lower than an upper portion of the heat exchanger 60, such as the motor support member 40 is installed on a position overlapped with the heat exchanger 60 in the height direction, which is different from the outdoor unit 1 according to the first embodiment. In other words, the motor support member 40 is installed on a position overlapped with the heat exchanger 60 in the airflow direction.

[Sixth embodiment not part of the invention]

[0101] FIG. 20 is a schematic view illustrating an outdoor unit 3 of air conditioner according to a sixth embodiment not part of the invention. As illustrated in FIG. 20, the outdoor unit 3 includes a fan 10, a motor 20, a leg portion 30, a motor support member 40, a bell mouth 50, and a heat exchanger 60. The functions of the fan 10, the motor 20, the leg portion 30, the motor support member 40, the bell mouth 50 and the heat exchanger 60 are the same as those of the outdoor unit 1 of the first embodiment and thus a description thereof will be omitted.

[0102] The outdoor unit 3 according to the sixth embodiment is an upper surface blower type in the same manner as the outdoor unit 1 according to the first embodiment. However, the outdoor unit 3 is a type in which the motor support member 40 is disposed downstream of the airflow direction of the 10, which is different from the outdoor unit 1 according to the first embodiment.

[Seventh embodiment of the invention]

[0103] FIG. 21 is a schematic view illustrating an outdoor unit 4 of air conditioner according to a seventh embodiment.

[0104] As illustrated in FIG. 21, the outdoor unit 4 includes a fan 10, a motor 20 driving the fan 10, a leg portion 30, a motor support member 40, a bell mouth 50, and a heat exchanger 60. The functions of the fan 10, the motor 20, the leg portion 30, the motor support member 40, the bell mouth 50 and the heat exchanger 60 are the same as those of the outdoor unit 1 of the first embodiment and thus a description thereof will be omitted.

[0105] The outdoor unit 4 according to the seventh embodiment is a side surface blower type, which is different from the outdoor unit 1 according to the first embodiment. That is, the embodiments may be applicable to the side surface blower type outdoor unit.

[Effect of these embodiments of the invention]

[0106] As is apparent from the above description, according to the proposed blower and outdoor unit, the airflow may be generated along the reduction portion of the motor support member 40 by improving the cross-sectional shape of the motor support member 40. Therefore, it is possible to form the airflow having a virtual wing shaped cross-sectional shape, and thus it is possible to prevent the width of the vortex from being more increased than the width of the motor support member 40.

[0107] In addition, the cross-sectional shape of the motor support member 40 has a shape in which a rear end portion is cut out. Therefore, by forming the airflow having a virtual wing shaped cross- sectional shape, which is along the incident angle to some extent against the airflow having the incident angle, it is possible to prevent the width of the vortex from being increased.

[0108] The cross-sectional shape of the motor support member 40 has a shape in which a rear end portion of the reduction portion is cut out. Therefore, it is possible to reduce the flow resistance since a frontal projected area of the motor support member 40 is reduced with respect to the air flow having the incident angle.

[0109] Further, since the shape of the rear portion of the motor support member 40 is improved, it is possible

to prevent interference between the rear end of the streamlined shape and the airflow in the blade rotation direction, which is a weak point of the streamlined shape.

[0110] By reducing the pressure loss in the air flow path and by reducing the change in the vortex and the speed in the upstream of the blade, it is possible to reduce the temporal change of the pressure on the blade surface so as to reduce the noise of the blowing air. In addition, it is possible to sufficiently reduce the noise in the motor support member 40.

[0111] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the scope of the invention which is defined in the appended claims.

Claims

1. An outdoor unit of an air conditioner, wherein the outdoor unit is an upper discharge type outdoor unit comprising:

   a blower configured to flow air;
   a heat exchanger (60) disposed upstream of the blower in the direction of airflow; and
   a housing configured to accommodate the blower and the heat exchanger (60),
   wherein the blower comprises a fan (10), a motor (20) driving the fan (10), a leg portion (30) in contact with the motor (20), and a motor support member (40) disposed upstream of the fan (10) on a flow path, through which air generated by a rotation of the fan (10), flows,
   wherein the motor support member (40) is fixed to the leg portion (30) and configured to support the motor (20) through the leg portion (30),
   wherein the motor support member (40) comprises a cross-sectional shape comprising a maximum width portion having a maximum width (W) in a direction perpendicular to the airflow direction, an upstream portion having a width that increases from the upstream side to the downstream side, and a downstream portion having a width that reduces from the upstream side to the downstream side,
   wherein a width (W1) of a downstream end of the downstream portion has a linear shape in a direction perpendicular to the airflow direction, and the width (W1) is formed in such a manner that the middle of a wing-shaped reduction portion is cut out in a plane substantially perpendicular to a rotating shaft of the fan (10),
   wherein a ratio of the downstream end width (W_1) of the downstream portion to the maximum width (W) is linked with the ratio between a downstream portion length and an upstream portion length, and
   wherein the ratio of the downstream end width (W1) to the maximum width (W) is equal to or greater than 0.86 and equal to or less than 0.94.

2. The outdoor unit of the air conditioner of claim 1, wherein the upstream portion has a cross-sectional shape having a width that curvedly increases,

   the downstream portion has a cross-sectional shape having a width that curvedly reduces, and the upstream portion and the downstream portion have a cross-section curvedly connected therebetween.

3. The outdoor unit of the air conditioner of claim 1, wherein a ratio of the upstream portion length (L1) to the maximum width (W) is equal to or greater than 1.00 and equal to or less than 1.50.

4. The outdoor unit of the air conditioner of claim 3, wherein a ratio of a downstream portion length (L2) to the upstream portion length (L1) is equal to or greater than 0.58 and equal to or less than 1.00.

5. The outdoor unit of the air conditioner of claim 1, wherein the cross-sectional shape of the motor support member (40) is formed in a longitudinal direction of the motor support member (40).

6. The outdoor unit of the air conditioner of claim 1, wherein the motor support member (40) comprises:

   a motor supporter (41) formed of a metal material to form the downstream side of the motor support member (40), and
   a rectifying member (42) formed of a resin material to form the upstream side of the motor support member (40).

7. The outdoor unit of the air conditioner of claim 6, wherein the motor supporter (41) comprises an opening (414) that is opened on the upstream side of the motor supporter (41), and
   the rectifying member (42) is provided in such a manner that a downstream end portion thereof is inserted into the opening (414).

8. The outdoor unit of the air conditioner of claim 6, wherein the motor support member (40) further comprises a sealing member (47) configured to seal between the motor supporter (41) and the rectifying member (42).

9. The outdoor unit of the air conditioner of claim 1, further comprising an additional rectifying member (44) installed on a cross section of the downstream side of the motor supporter (41).

10. The outdoor unit of the air conditioner of claim 9, wherein the additional rectifying member (44) is formed in a shape corresponding to a shape obtained by rotating a half of the cross-sectional shape of the motor support member (40) by 90 degrees clockwise or counterclockwise.

11. The outdoor unit of the air conditioner of claim 9, further comprising a step (48) formed in such a manner a width of the additional rectifying member (44) is smaller than the downstream end width of the motor supporter (41).

12. The outdoor unit of the air conditioner of claim 6, wherein the motor supporter (41) comprises an opening that is opened on the upstream side of the motor supporter (41), and
the rectifying member (42) surrounds an upstream side, opposite side surfaces (412, 413) and a downstream side (411) of the motor supporter (41).

13. The outdoor unit of the air conditioner of claim 12, wherein the downstream side end portion of the rectifying member (42) is formed in a shape corresponding to a shape obtained by rotating a half of one side end portion of the motor support member (40) by 90 degrees clockwise or counterclockwise.

Patentansprüche

1. Außeneinheit einer Klimaanlage, wobei die Außeneinheit eine Außeneinheit mit oberem Auslass ist, umfassend:

ein Gebläse, das dazu konfiguriert ist, Luft strömen zu lassen;
einen Wärmetauscher (60), der in der Richtung des Luftstroms stromaufwärts dem Gebläse angeordnet ist; und
ein Gehäuse, das dazu konfiguriert, das Gebläse und den Wärmetauscher (60) aufzunehmen,
wobei das Gebläse einen Ventilator (10), einen Motor (20), der den Ventilator (10) antreibt, einen Schenkelabschnitt (30) in Kontakt mit dem Motor (20) und ein Motorstützelement (40) umfasst, das stromaufwärts des Ventilators (10) in einem Strömungsweg angeordnet ist, durch den durch eine Drehung des Ventilators (10) erzeugte Luft strömt,
wobei das Motorstützelement (40) an dem Schenkelabschnitt (30) befestigt und dazu konfiguriert ist, den Motor (20) durch den Schenkelabschnitt (30) zu stützen,
wobei das Motorstützelement (40) eine Querschnittsform umfasst, die Folgendes umfasst, einen Abschnitt maximaler Breite mit einer maximalen Breite (W) in einer Richtung senkrecht zu der Luftströmungsrichtung, einen stromaufwärtigen Abschnitt mit einer Breite, die von der stromaufwärtigen Seite zu der stromabwärtigen Seite zunimmt, und einen stromabwärtigen Abschnitt mit einer Breite, die von der stromaufwärtigen Seite zu der stromabwärtigen Seite abnimmt,
wobei eine Breite (W1) eines stromabwärtigen Endes des stromabwärtigen Abschnitts in einer Richtung senkrecht zu der Luftströmungsrichtung eine lineare Form aufweist und die Breite (W1) auf eine derartige Weise gebildet ist, dass die Mitte eines flügelförmigen Reduktionsabschnitts in einer Ebene im Wesentlichen senkrecht zu einer rotierenden Welle des Ventilators (10) ausgeschnitten ist,
wobei ein Verhältnis der Breite (W1) des stromabwärtigen Endes des stromabwärtigen Abschnitts zu der maximalen Breite (W) mit dem Verhältnis zwischen einer Länge des stromabwärtigen Abschnitts und einer Länge des stromaufwärtigen Abschnitts verbunden ist und
wobei das Verhältnis der Breite (W1) des stromabwärtigen Endes zu der maximalen Breite (W) gleich oder größer als 0,86 und gleich oder kleiner als 0,94 ist.

2. Außeneinheit der Klimaanlage nach Anspruch 1, wobei der stromaufwärtige Abschnitt eine Querschnittsform mit einer Breite aufweist, die bogenförmig zunimmt,

der stromabwärtige Abschnitt eine Querschnittsform mit einer Breite aufweist, die bogenförmig abnimmt, und
der stromaufwärtige Abschnitt und der stromabwärtige Abschnitt einen Querschnitt aufweisen, der bogenförmig dazwischen verbunden ist.

3. Außeneinheit der Klimaanlage nach Anspruch 1, wobei ein Verhältnis der Länge (L1) des stromaufwärtigen Abschnitts zu der maximalen Breite (W) gleich oder größer als 1,00 und gleich oder kleiner als 1,50 ist.

4. Außeneinheit der Klimaanlage nach Anspruch 3, wobei ein Verhältnis der Länge (L2) des stromabwärtigen Abschnitts zu der Länge (L1) des stromaufwärtigen Abschnitts gleich oder größer als 0,58 und gleich oder kleiner als 1,00 ist.

5. Außeneinheit der Klimaanlage nach Anspruch 1, wobei die Querschnittsform des Motorstützelements (40) in einer Längsrichtung des Motorstützelements (40) gebildet ist.

6. Außeneinheit der Klimaanlage nach Anspruch 1, wobei das Motorstützelement (40) Folgendes umfasst:

eine Motorhalterung (41), die aus einem Metallmaterial gebildet ist, um die stromabwärtige Seite des Motorstützelements (40) zu bilden, und ein Gleichrichterelement (42), das aus einem Harzmaterial gebildet ist, um die stromaufwärtige Seite des Motorstützelements (40) zu bilden.

7. Außeneinheit der Klimaanlage nach Anspruch 6, wobei der Motorträger (41) eine Öffnung (414) umfasst, die auf der stromaufwärtigen Seite des Motorträgers (41) geöffnet ist, und
das Gleichrichterelement (42) auf eine derartige Weise bereitgestellt ist, dass ein stromabwärtiger Endabschnitt davon in die Öffnung (414) eingeführt ist.

8. Außeneinheit der Klimaanlage nach Anspruch 6, wobei das Motorstützelement (40) ferner ein Dichtungselement (47) umfasst, das dazu konfiguriert ist, zwischen dem Motorträger (41) und dem Gleichrichterelement (42) abzudichten.

9. Außeneinheit der Klimaanlage nach Anspruch 1, ferner umfassend ein zusätzliches Gleichrichterelement (44), das an einem Querschnitt der stromabwärtigen Seite des Motorträgers (41) eingebaut ist.

10. Außeneinheit der Klimaanlage nach Anspruch 9, wobei das zusätzliche Gleichrichterelement (44) in einer Form gebildet ist, die einer Form entspricht, die durch Drehen einer Hälfte der Querschnittsform des Motorstützelements (40) um 90 Grad im Uhrzeigersinn oder gegen den Uhrzeigersinn erhalten wird.

11. Außeneinheit der Klimaanlage nach Anspruch 9, ferner umfassend eine Stufe (48), die auf einer derartige Weise gebildet ist, dass eine Breite des zusätzlichen Gleichrichterelements (44) kleiner ist als die Breite des stromabwärtigen Endes des Motorträgers (41).

12. Außeneinheit der Klimaanlage nach Anspruch 6, wobei der Motorträger (41) eine Öffnung umfasst, die auf der stromaufwärtigen Seite des Motorträgers (41) geöffnet ist, und
das Gleichrichterelement (42) eine stromaufwärtige Seite, gegenüberliegende Seitenflächen (412, 413) und eine stromabwärtige Seite (411) des Motorträgers (41) umgibt.

13. Außeneinheit der Klimaanlage nach Anspruch 12, wobei der stromabwärtige seitliche Endabschnitt des Gleichrichterelements (42) in einer Form gebildet ist, die einer Form entspricht, die durch Drehen einer Hälfte eines seitlichen Endabschnitts des Motorstützelements (40) um 90 Grad im Uhrzeigersinn oder gegen den Uhrzeigersinn erhalten wird.

Revendications

1. Unité extérieure d'un climatiseur, dans laquelle l'unité extérieure est une unité extérieure du type à évacuation supérieure comprenant :

un souffleur configuré pour faire circuler l'air ;
un échangeur de chaleur (60) disposé en amont du souffleur dans la direction du flux d'air ; et
un boîtier configuré pour loger le souffleur et l'échangeur de chaleur (60),
dans lequel le souffleur comprend un ventilateur (10), un moteur (20) entraînant le ventilateur (10), une partie de pied (30) en contact avec le moteur (20), et un élément de support de moteur (40) disposé en amont du ventilateur (10) sur un trajet d'écoulement, à travers lequel l'air généré par une rotation du ventilateur (10), circule,
dans lequel l'élément de support de moteur (40) est fixé à la partie de pied (30) et configuré pour supporter le moteur (20) par le biais de la partie de pied (30),
dans lequel l'élément de support de moteur (40) comprend une forme en coupe transversale comprenant une partie de largeur maximale comportant une largeur maximale (W) dans une direction perpendiculaire à la direction du flux d'air, une partie amont comportant une largeur qui augmente du côté amont vers le côté aval, et une partie aval comportant une largeur qui diminue du côté amont vers le côté aval,
dans lequel une largeur (W1) d'une extrémité aval de la partie aval comporte une forme linéaire dans une direction perpendiculaire à la direction du flux d'air, et la largeur (W1) est formée de manière à ce que le milieu d'une partie de réduction en forme d'aile soit découpé dans un plan sensiblement perpendiculaire à un arbre rotatif du ventilateur (10),
dans lequel un rapport de la largeur d'extrémité aval (W1) de la partie aval à la largeur maximale (W) est lié au rapport entre une longueur de partie aval et une longueur de partie amont, et
dans lequel le rapport de la largeur d'extrémité aval (W1) à la largeur maximale (W) est égal ou supérieur à 0,86 et égal ou inférieur à 0,94.

2. Unité extérieure du climatiseur selon la revendication 1, dans laquelle la partie amont comporte une forme en coupe transversale comportant une largeur qui augmente en courbe,

la partie aval comporte une forme en coupe transversale comportant une largeur qui diminue en courbe, et
la partie amont et la partie aval comportent une section transversale raccordée en courbe entre elles.

3. Unité extérieure du climatiseur selon la revendication 1, dans laquelle un rapport de la longueur de partie amont (L1) à la largeur maximale (W) est égal ou supérieur à 1,00 et égal ou inférieur à 1,50.

4. Unité extérieure du climatiseur selon la revendication 3, dans laquelle un rapport d'une longueur de partie aval (L2) à la longueur de partie amont (L1) est égal ou supérieur à 0,58 et égal ou inférieur à 1,00.

5. Unité extérieure du climatiseur selon la revendication 1, dans laquelle la forme en coupe transversale de l'élément de support de moteur (40) est formée dans une direction longitudinale de l'élément de support de moteur (40).

6. Unité extérieure du climatiseur selon la revendication 1, dans laquelle l'élément de support de moteur (40) comprend :

un support de moteur (41) formé d'un matériau métallique pour former le côté aval de l'élément de support de moteur (40), et
un élément de redressement (42) formé d'un matériau en résine pour former le côté amont de l'élément de support de moteur (40).

7. Unité extérieure du climatiseur selon la revendication 6, dans laquelle le support de moteur (41) comprend une ouverture (414) qui est ouverte sur le côté amont du support de moteur (41), et
l'élément de redressement (42) est prévu de manière à ce qu'une partie d'extrémité aval de celui-ci soit insérée dans l'ouverture (414).

8. Unité extérieure du climatiseur selon la revendication 6, dans laquelle l'élément de support de moteur (40) comprend en outre un élément d'étanchéité (47) configuré pour assurer l'étanchéité entre le support de moteur (41) et l'élément de redressement (42).

9. Unité extérieure du climatiseur selon la revendication 1, comprenant en outre un élément de redressement supplémentaire (44) installé sur une section transversale du côté aval du support de moteur (41).

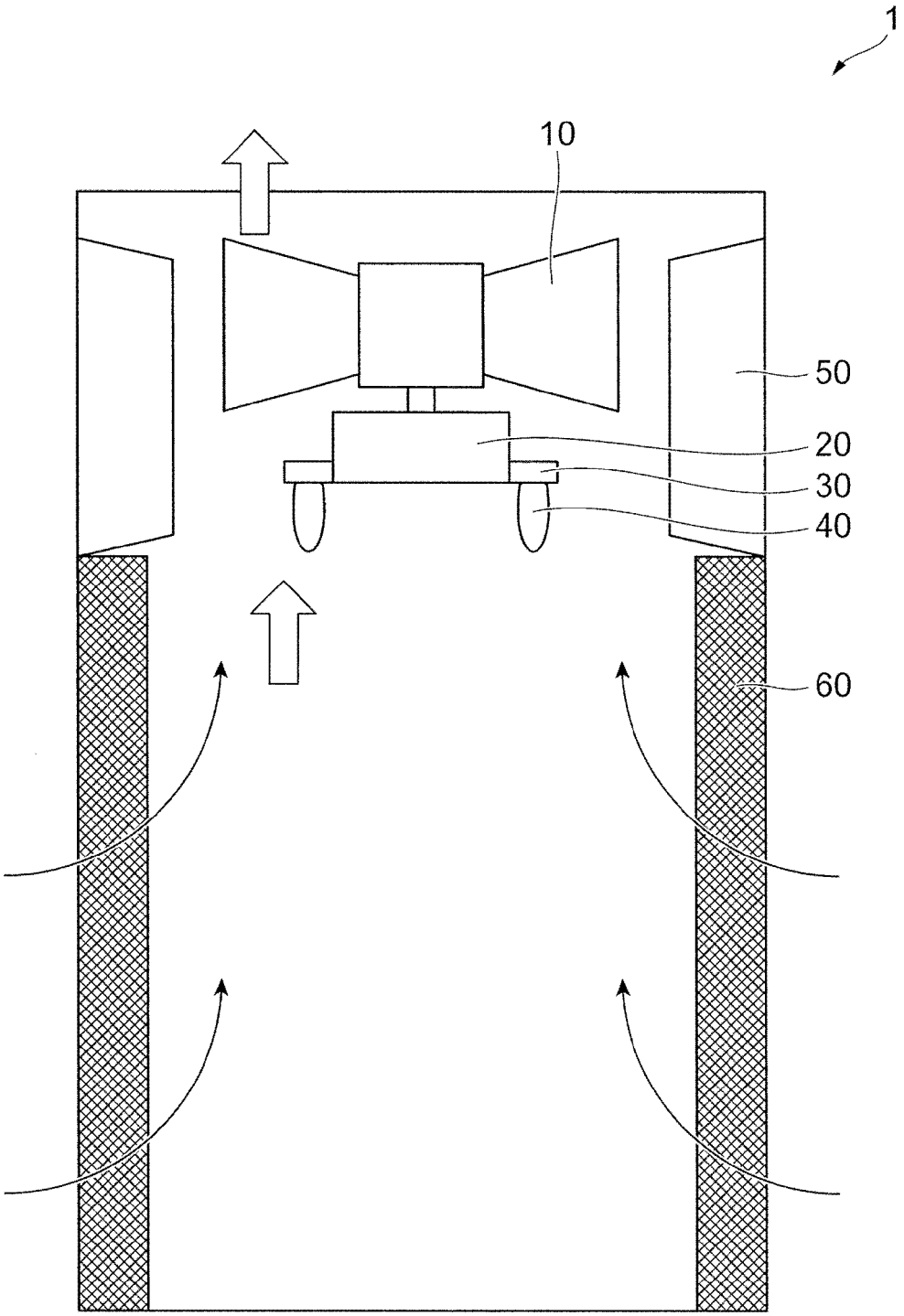
10. Unité extérieure du climatiseur selon la revendication 9, dans laquelle l'élément de redressement supplémentaire (44) est formé dans une forme correspondant à une forme obtenue en faisant tourner une moitié de la forme en coupe transversale de l'élément de support de moteur (40) de 90 degrés dans le sens des aiguilles d'une montre ou dans le sens inverse des aiguilles d'une montre.

11. Unité extérieure du climatiseur selon la revendication 9, comprenant en outre un palier (48) formé de telle manière qu'une largeur de l'élément de redressement supplémentaire (44) soit inférieure à la largeur d'extrémité aval du support de moteur (41).

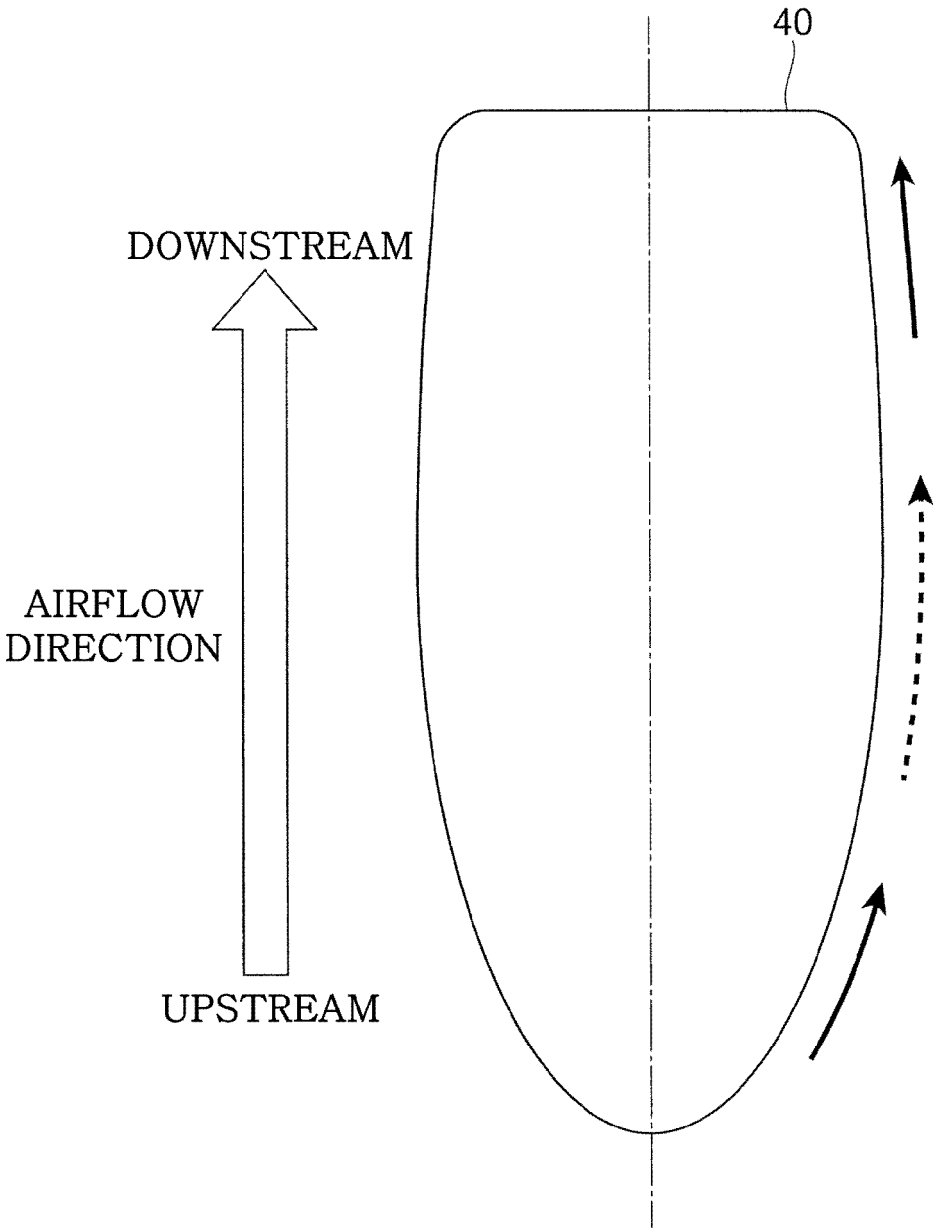
12. Unité extérieure du climatiseur selon la revendication 6, dans laquelle le support de moteur (41) comprend une ouverture qui est ouverte sur le côté amont du support de moteur (41), et
l'élément de redressement (42) entoure un côté amont, les surfaces latérales opposées (412, 413) et un côté aval (411) du support de moteur (41).

13. Unité extérieure du climatiseur selon la revendication 12, dans laquelle la partie d'extrémité côté aval de l'élément de redressement (42) est formée dans une forme correspondant à une forme obtenue en faisant tourner une moitié d'une partie d'extrémité latérale de l'élément de support de moteur (40) de 90 degrés dans le sens des aiguilles d'une montre ou dans le sens inverse des aiguilles d'une montre.

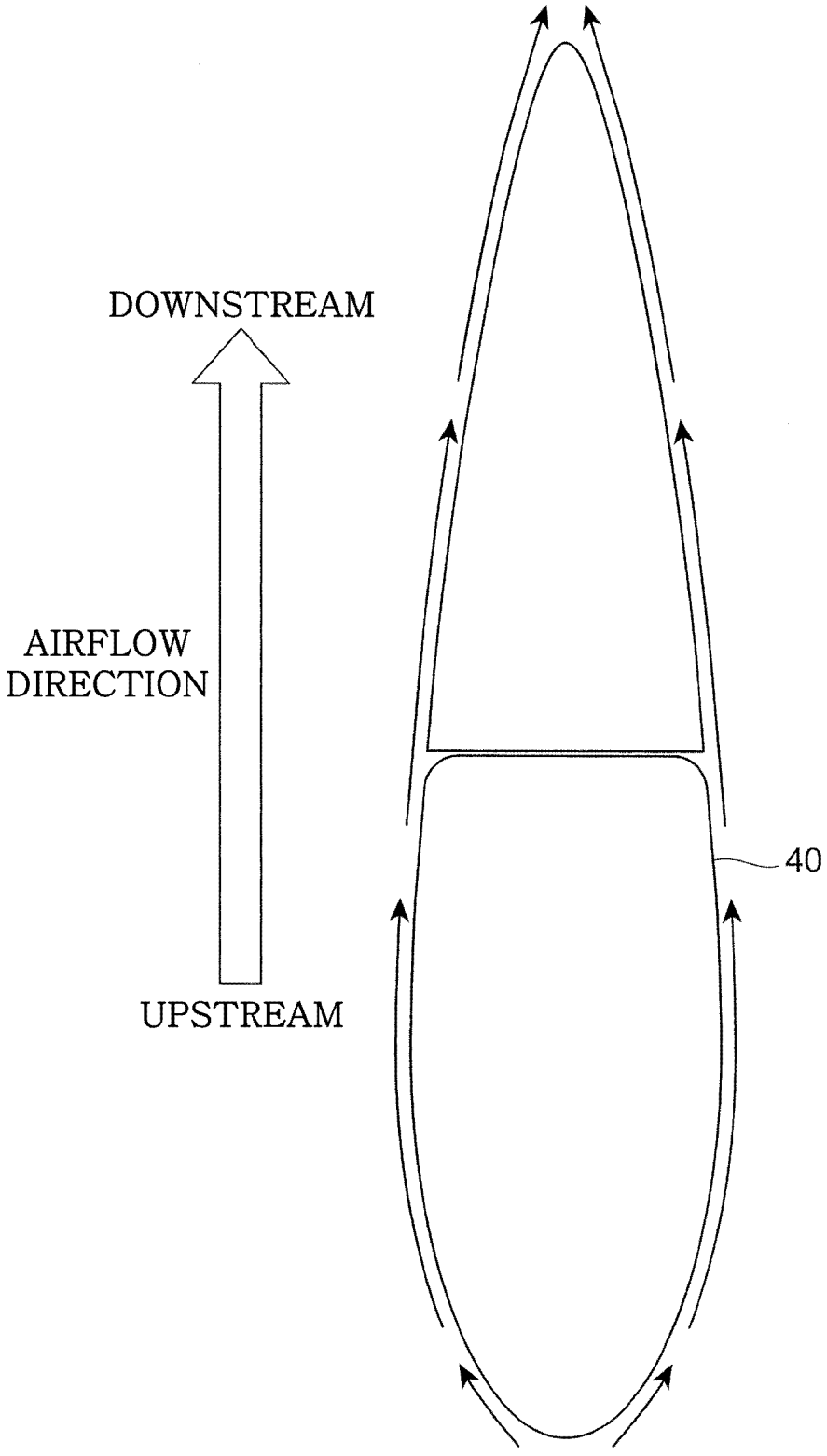
[Fig. 1]



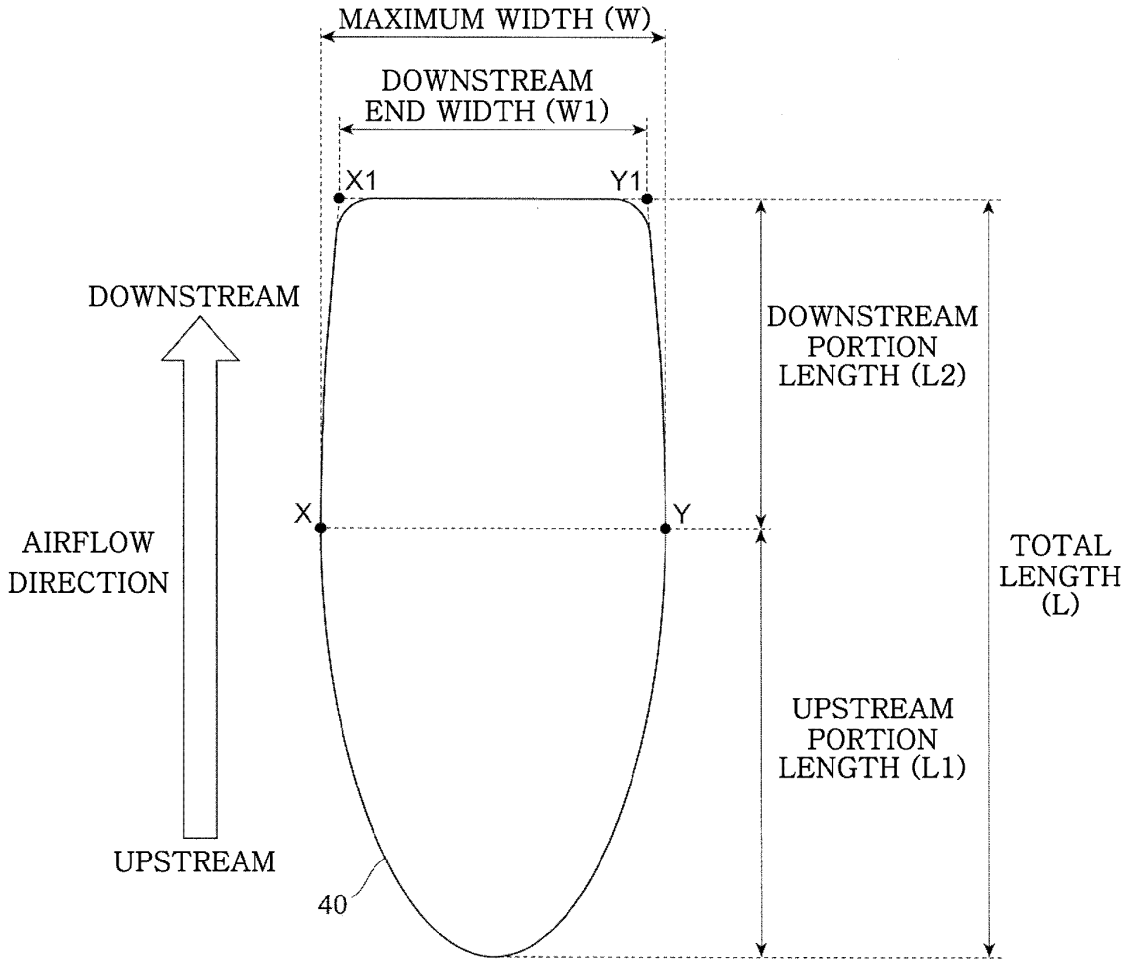
[Fig. 2]



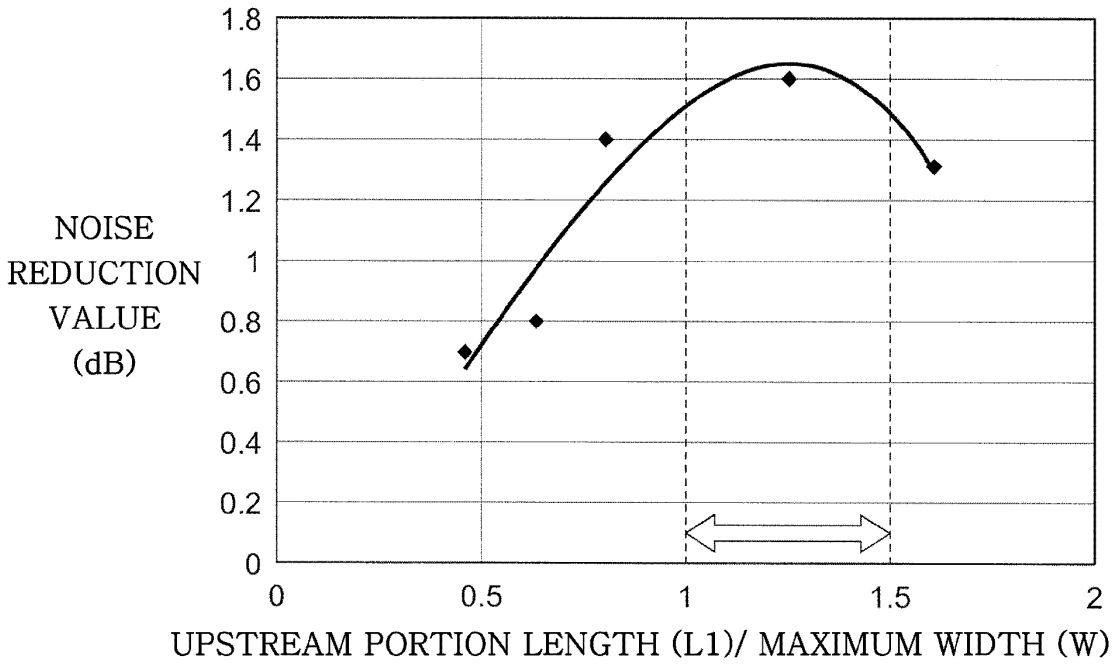
[Fig. 3]



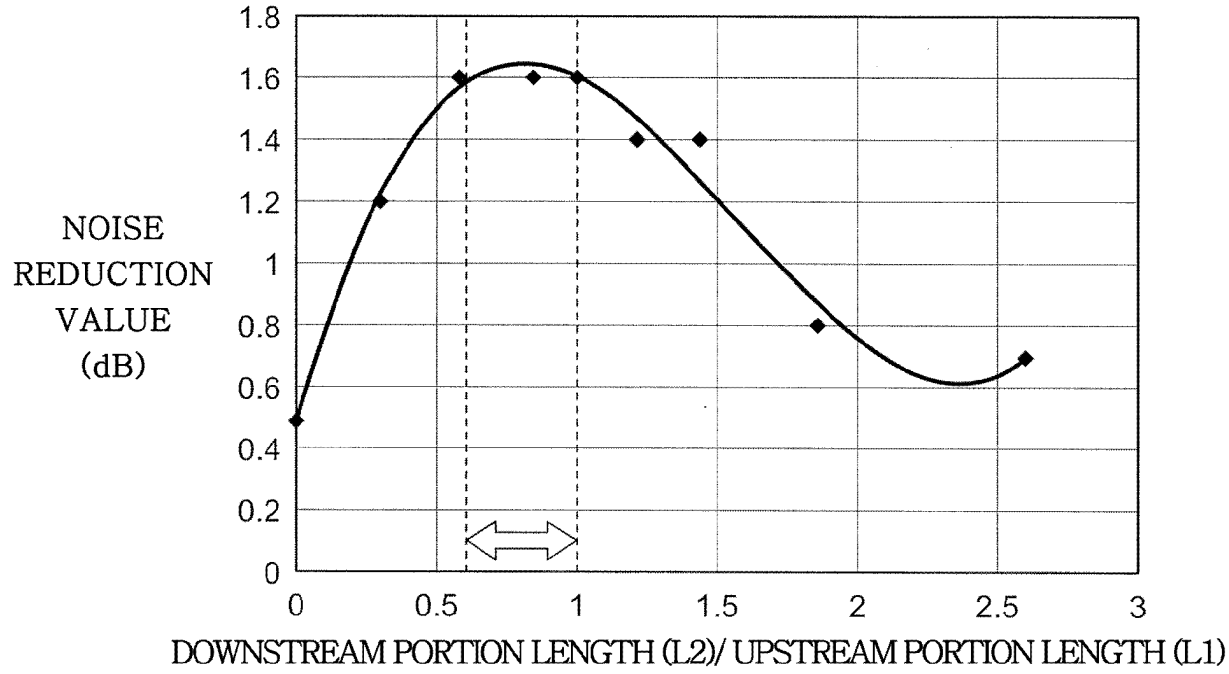
[Fig. 4]


MAXIMUM WIDTH (W)
DOWNSTREAM END WIDTH (W1)
X1
Y1
DOWNSTREAM
DOWNSTREAM PORTION LENGTH (L2)
X
Y
AIRFLOW DIRECTION
TOTAL LENGTH (L)
UPSTREAM PORTION LENGTH (L1)
UPSTREAM
40

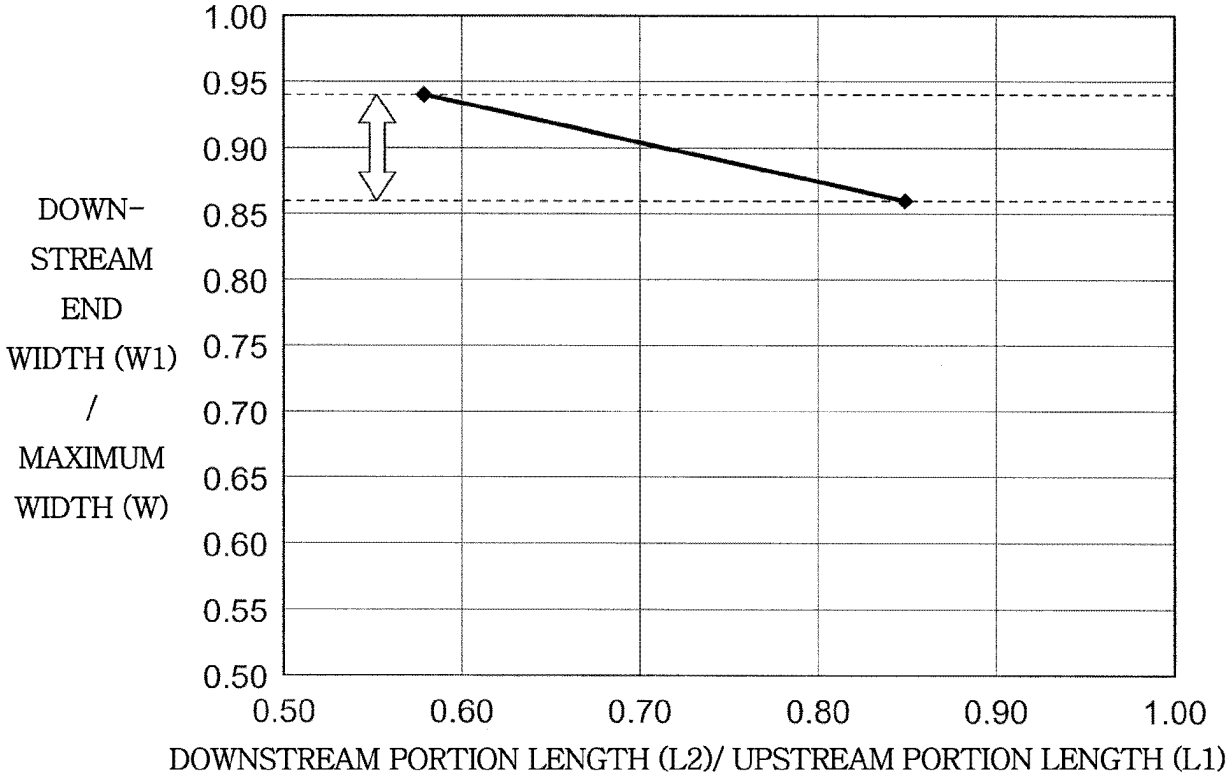
[Fig. 5]


NOISE REDUCTION VALUE (dB)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
UPSTREAM PORTION LENGTH (L1)/ MAXIMUM WIDTH (W)

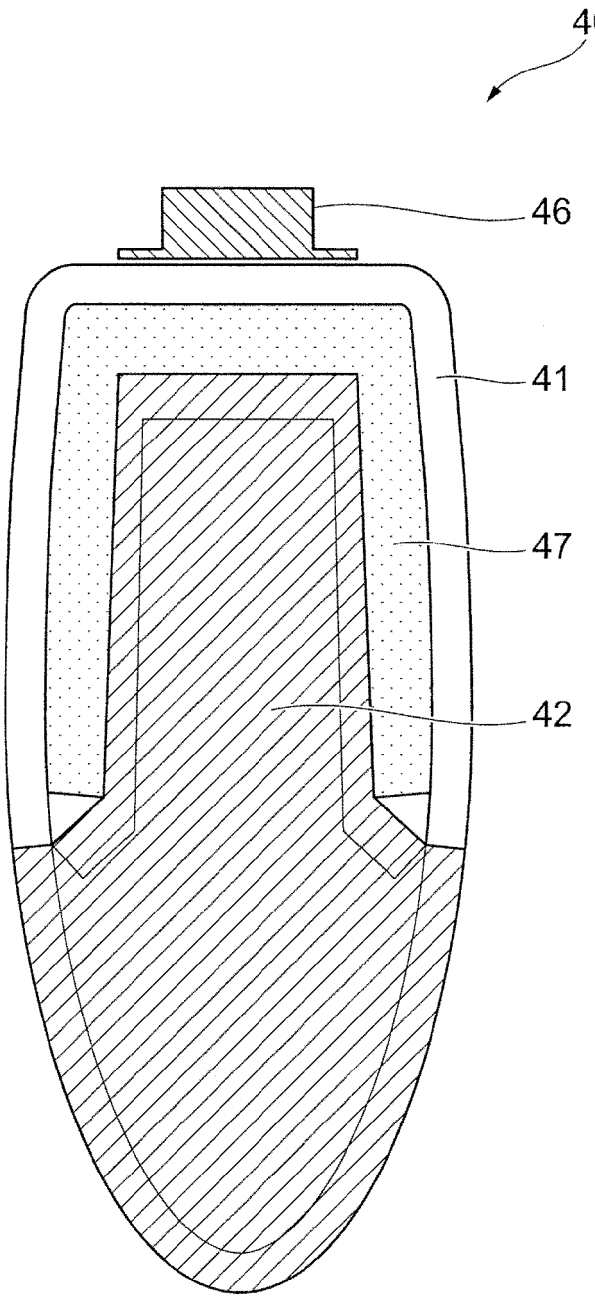
[Fig. 6]


NOISE REDUCTION VALUE (dB)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5
3
DOWNSTREAM PORTION LENGTH (L2)/ UPSTREAM PORTION LENGTH (L1)

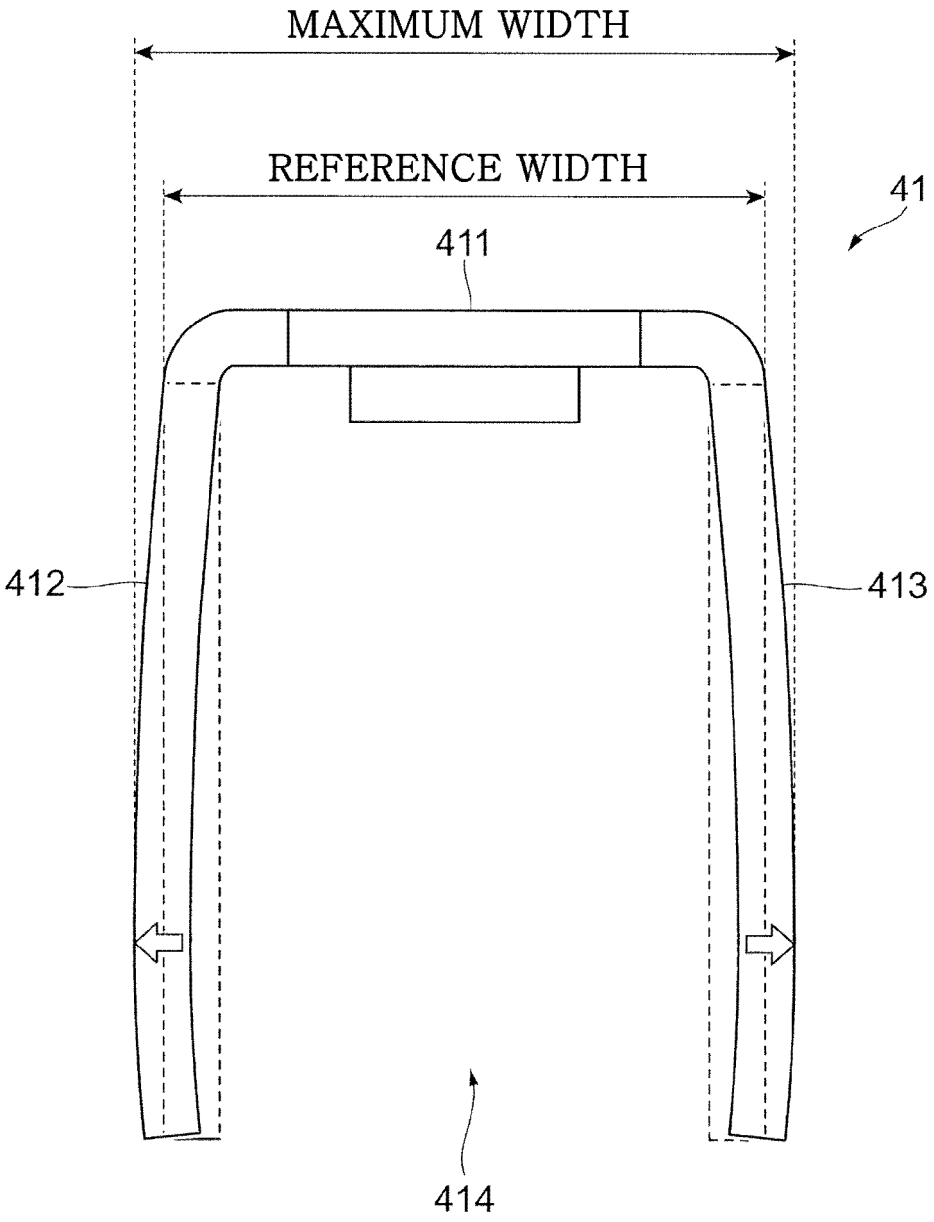
[Fig. 7]


DOWN-STREAM END WIDTH (W1) / MAXIMUM WIDTH (W)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.50
0.60
0.70
0.80
0.90
1.00
DOWNSTREAM PORTION LENGTH (L2)/ UPSTREAM PORTION LENGTH (L1)

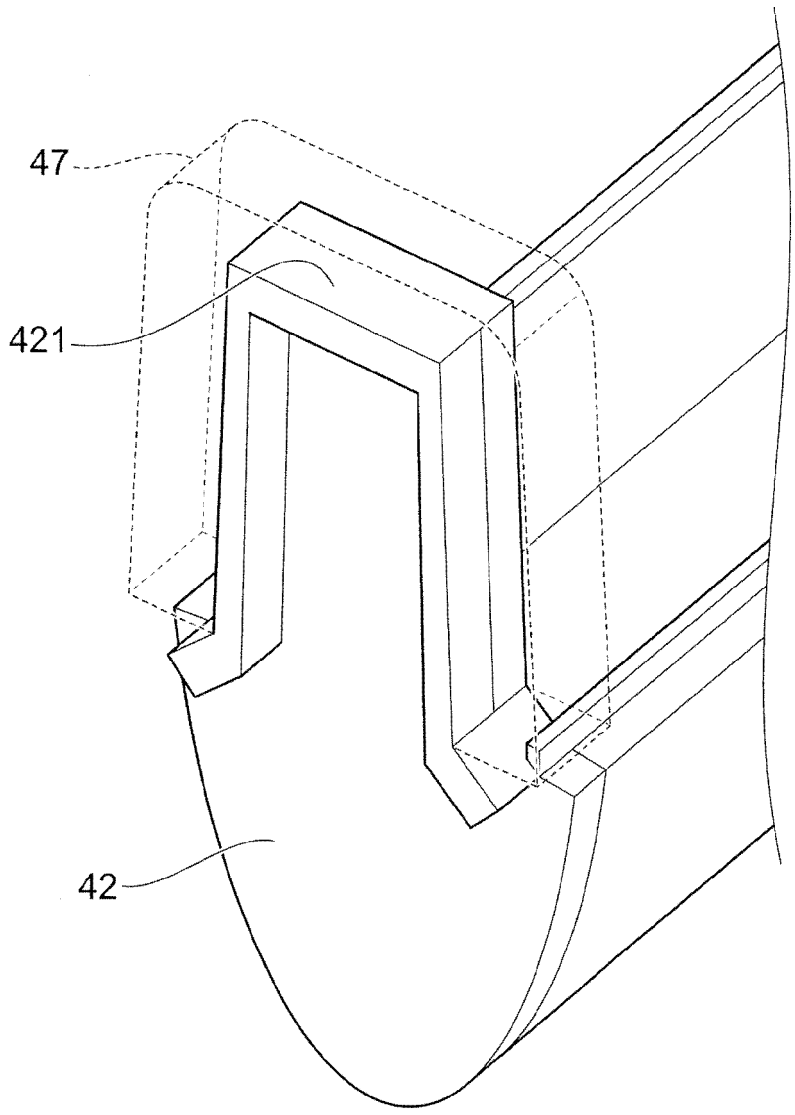
[Fig. 8]



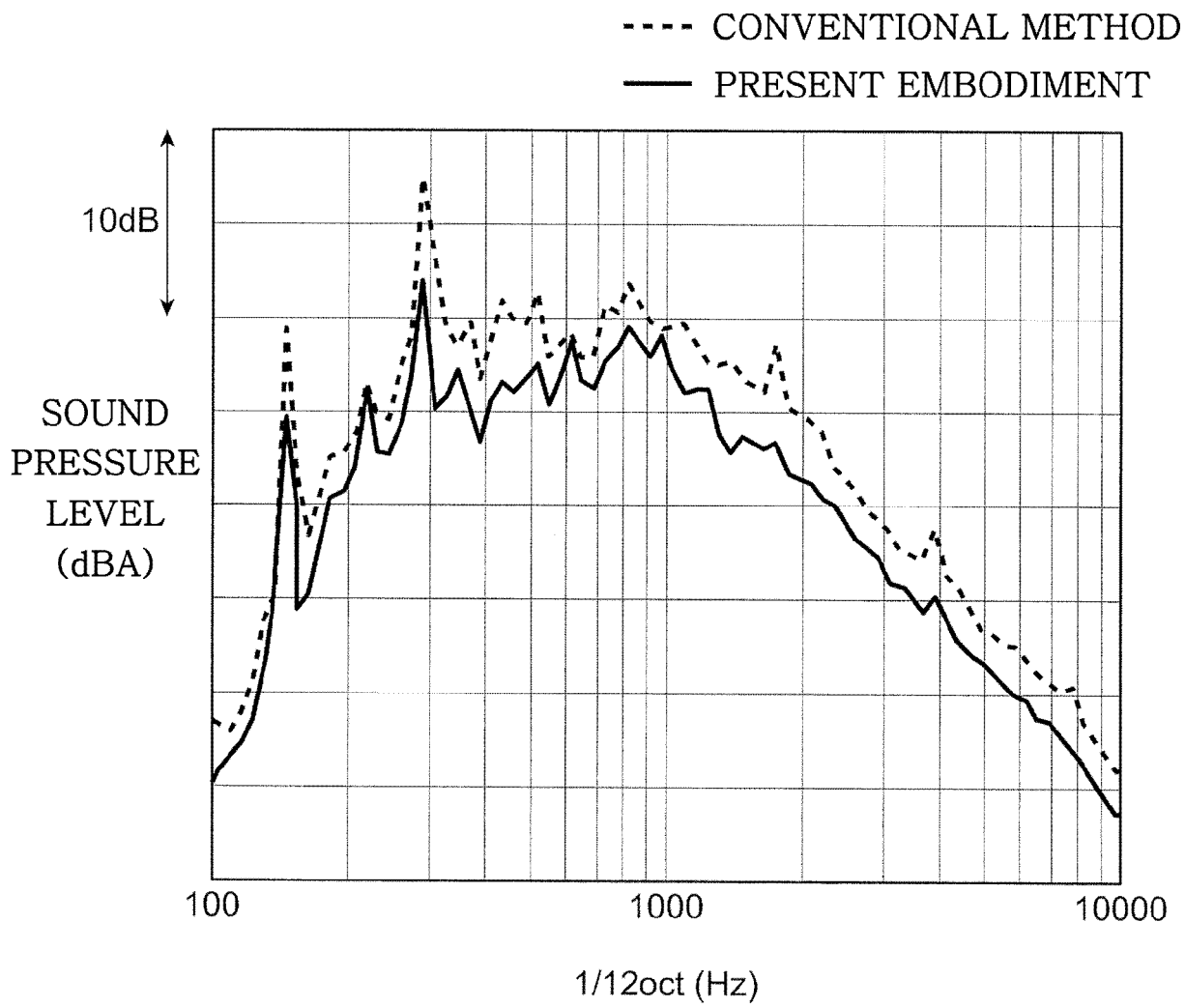
[Fig. 9]



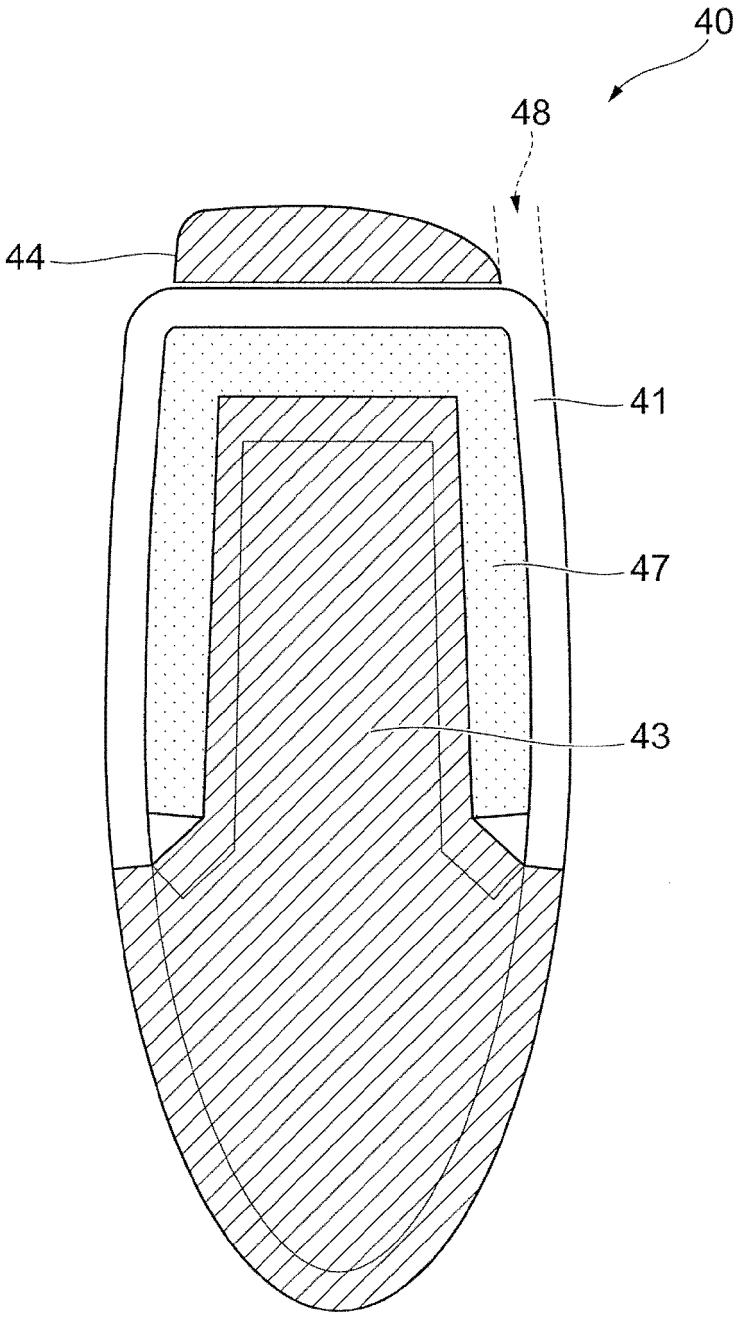
[Fig. 10]



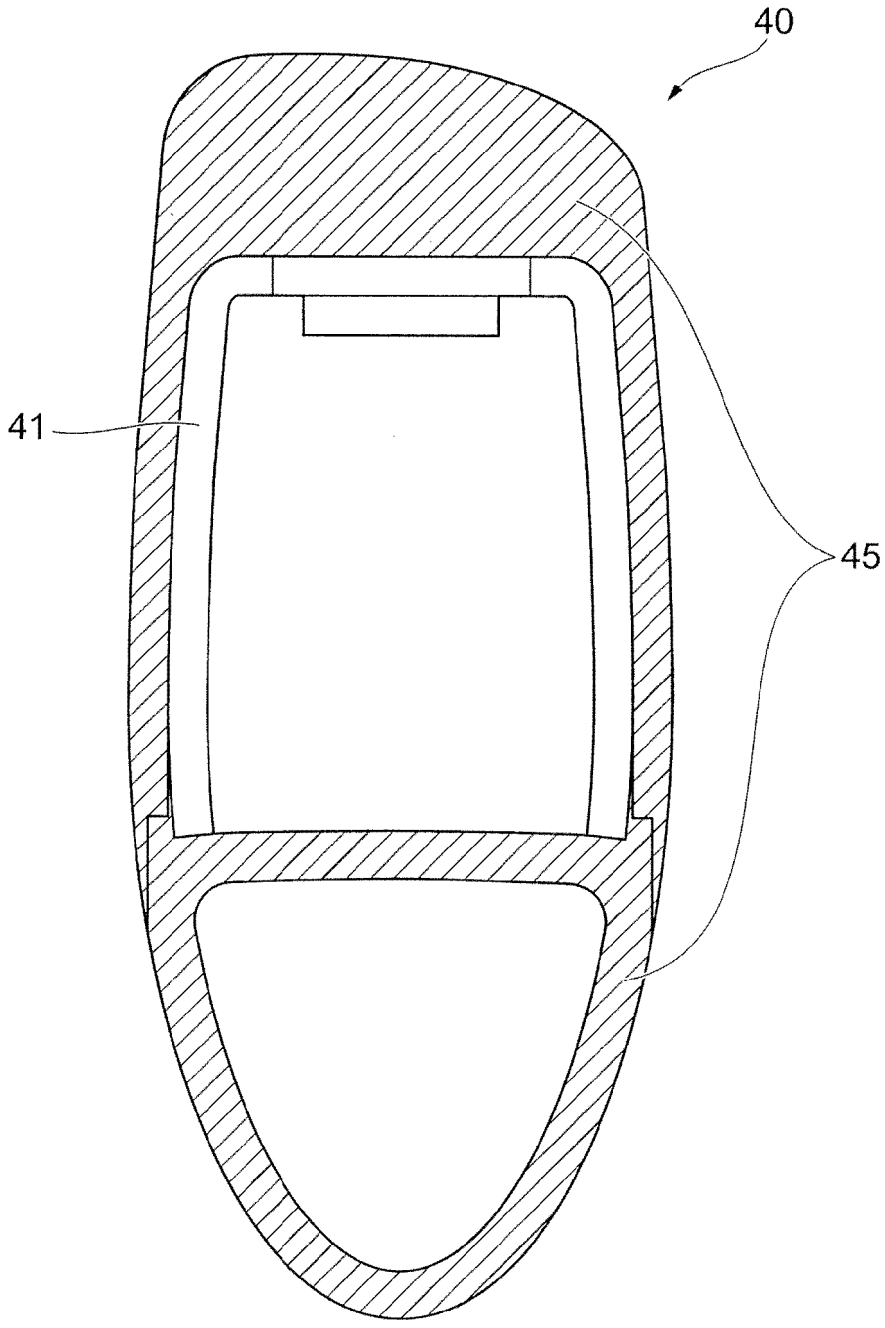
[Fig. 11]


CONVENTIONAL METHOD
PRESENT EMBODIMENT
10dB
SOUND PRESSURE LEVEL (dBA)
100
1000
10000
1/12oct (Hz)

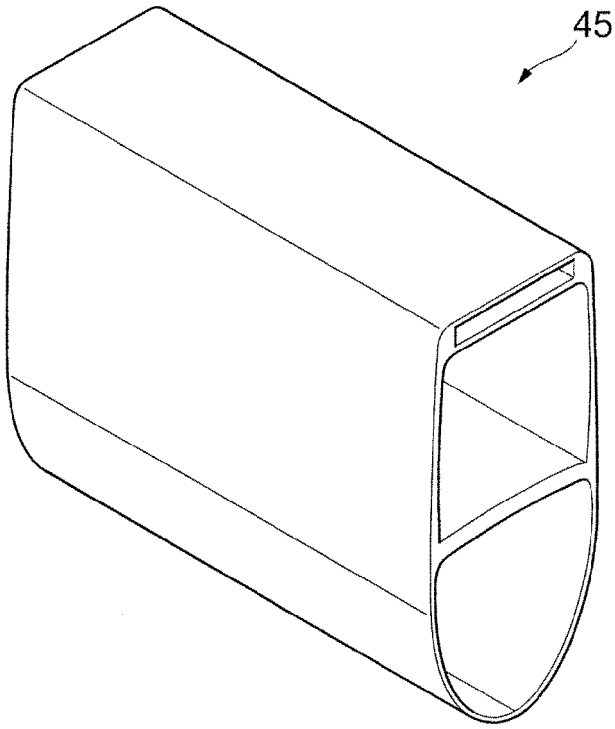
[Fig. 12]



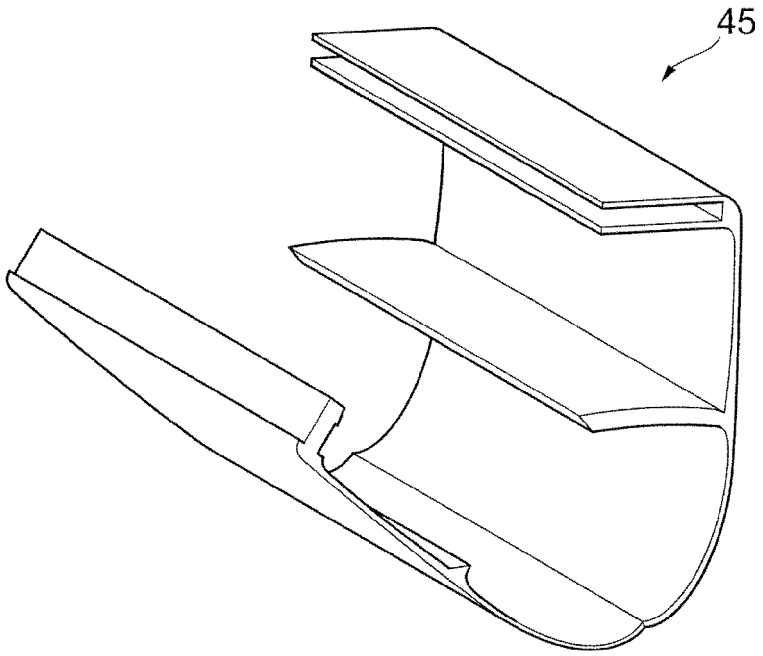
[Fig. 13]



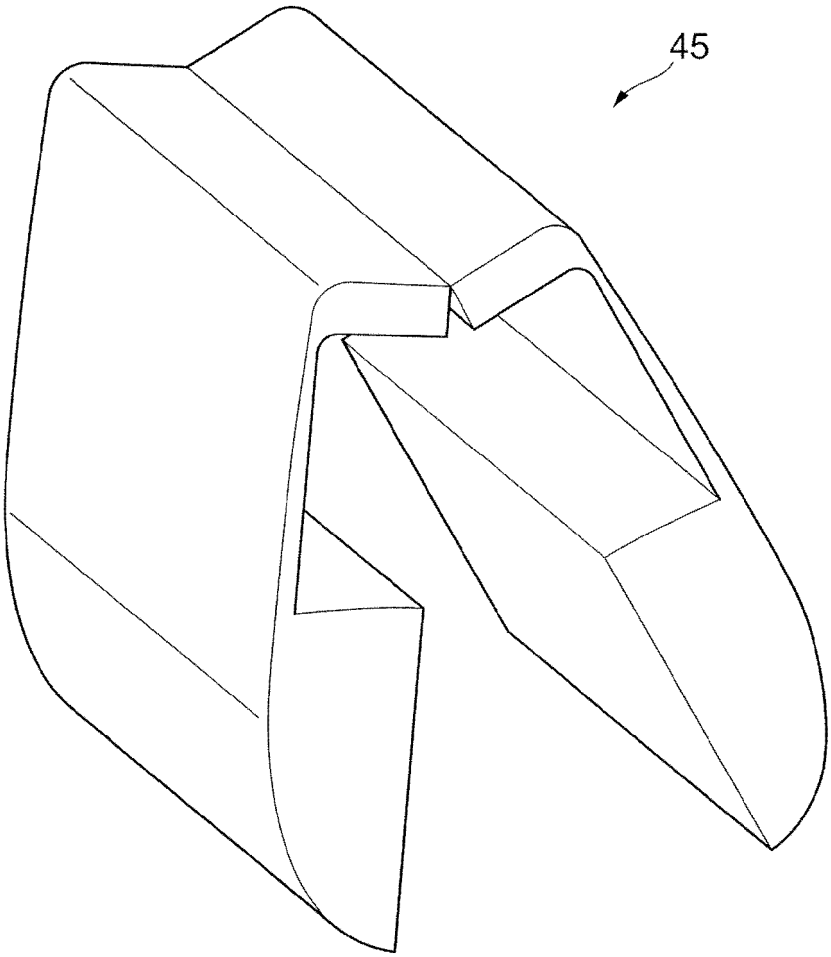
[Fig. 14A]



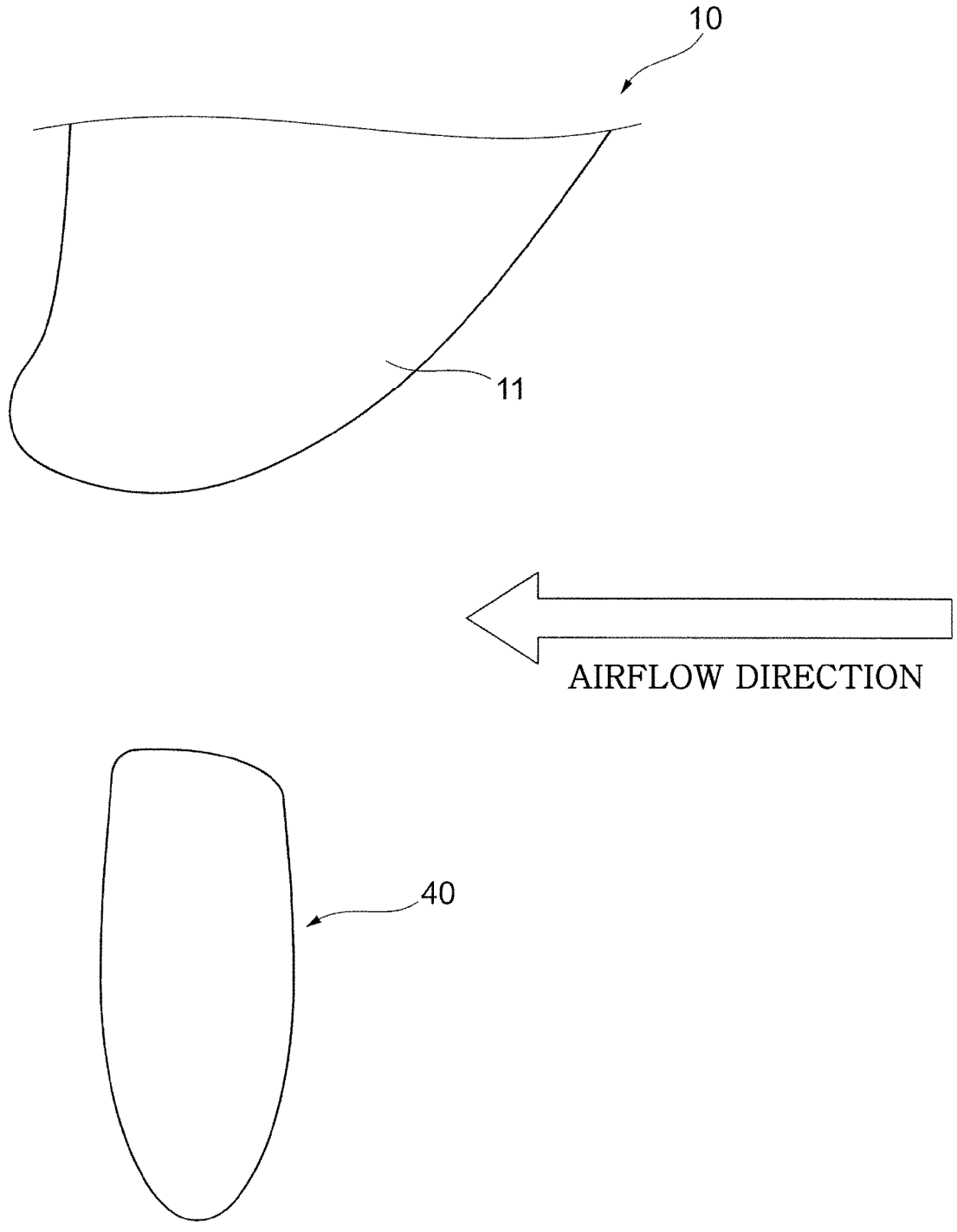
[Fig. 14B]



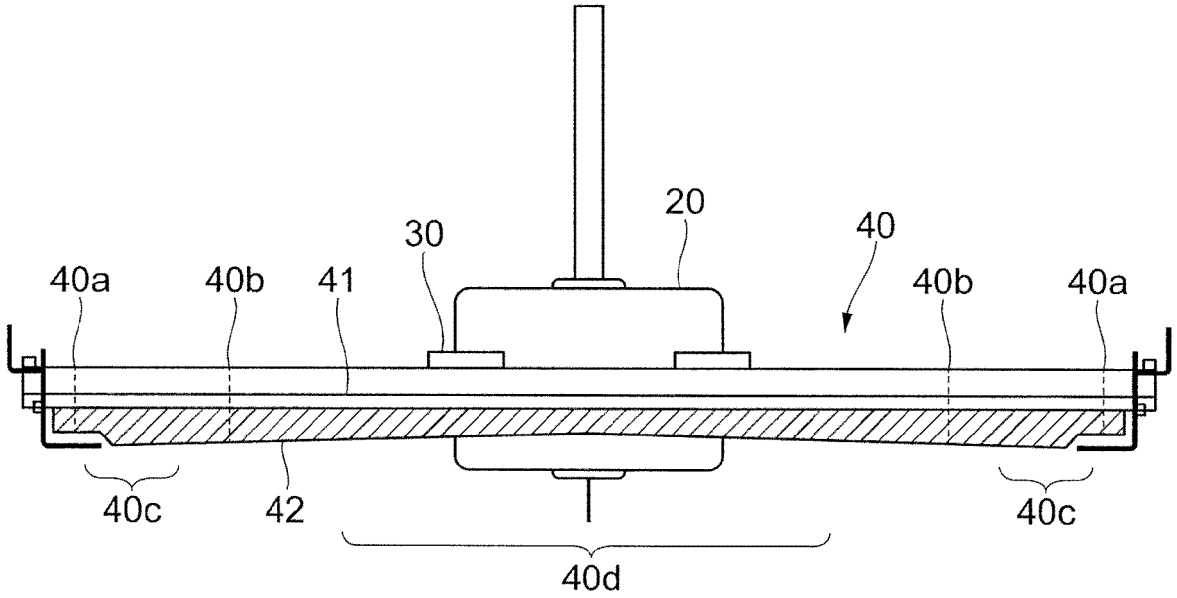
[Fig. 15]



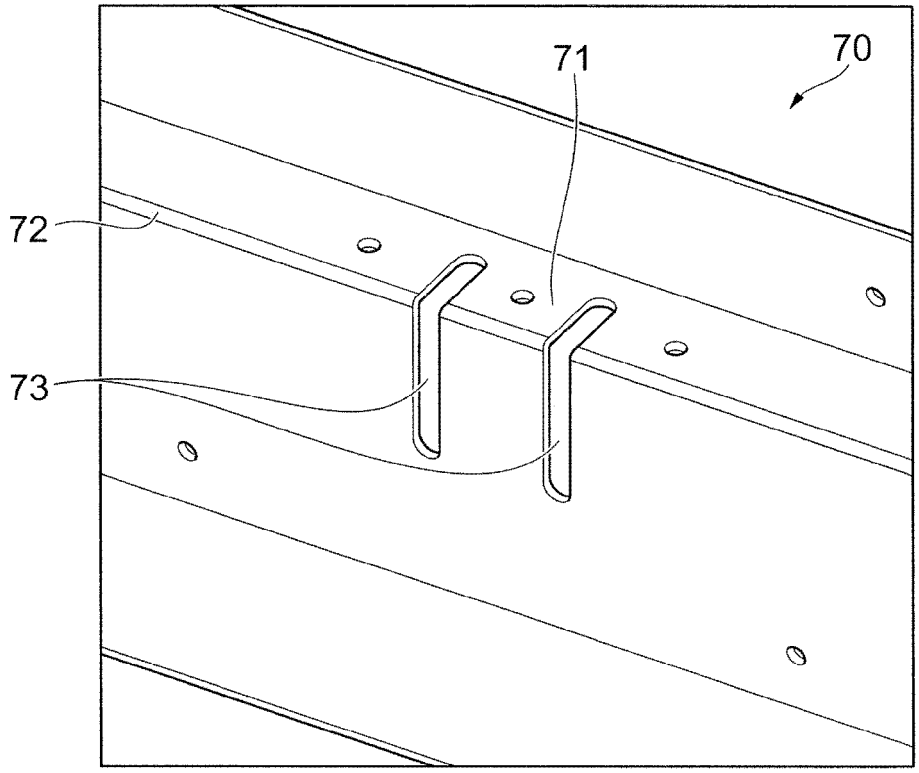
[Fig. 16]



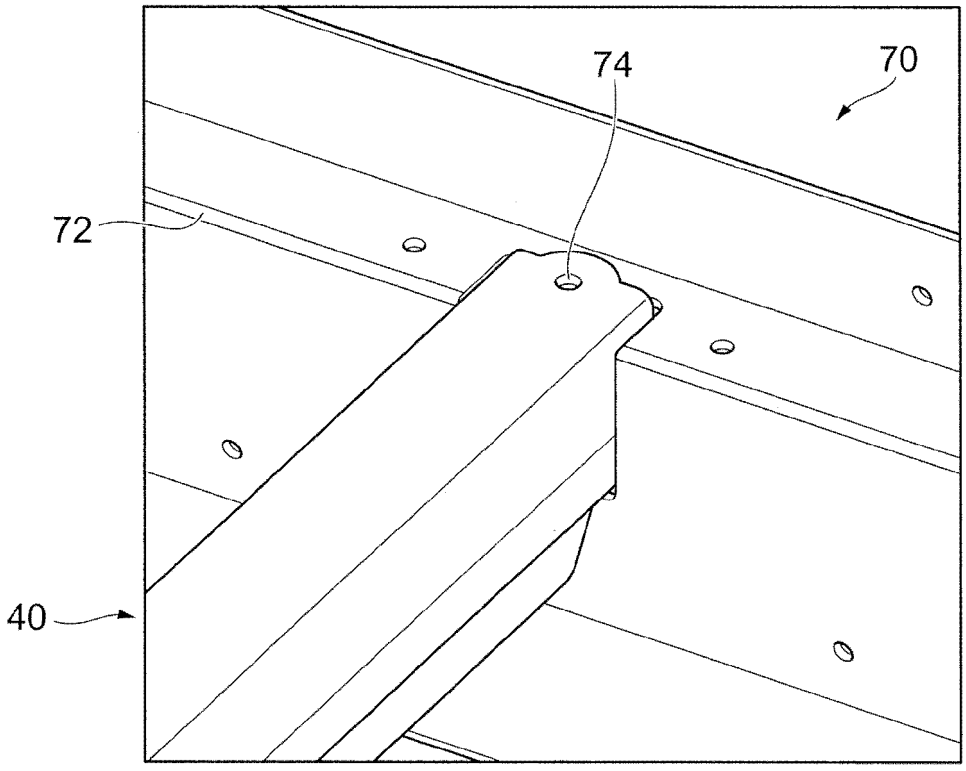
[Fig. 17]



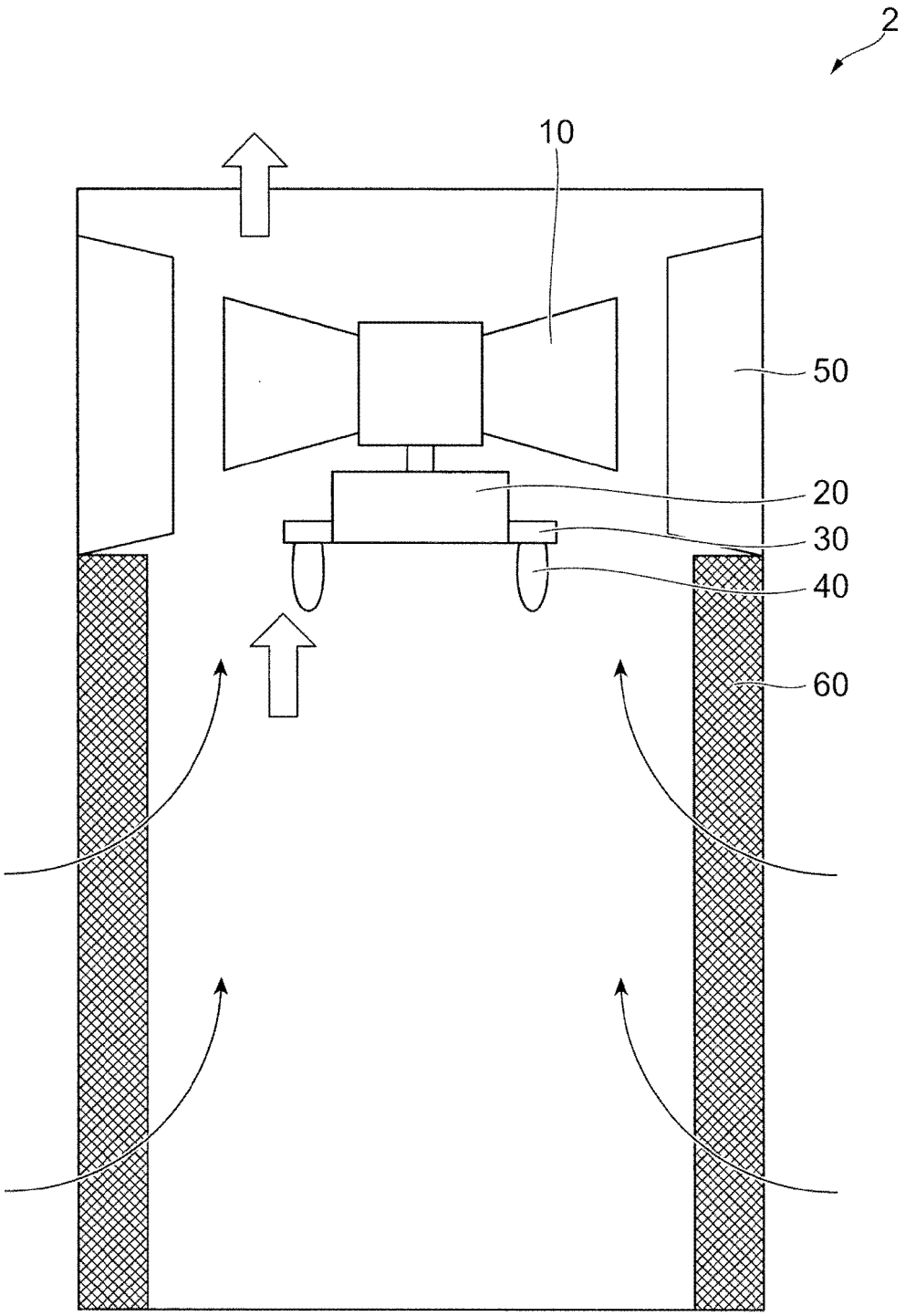
[Fig. 18A]



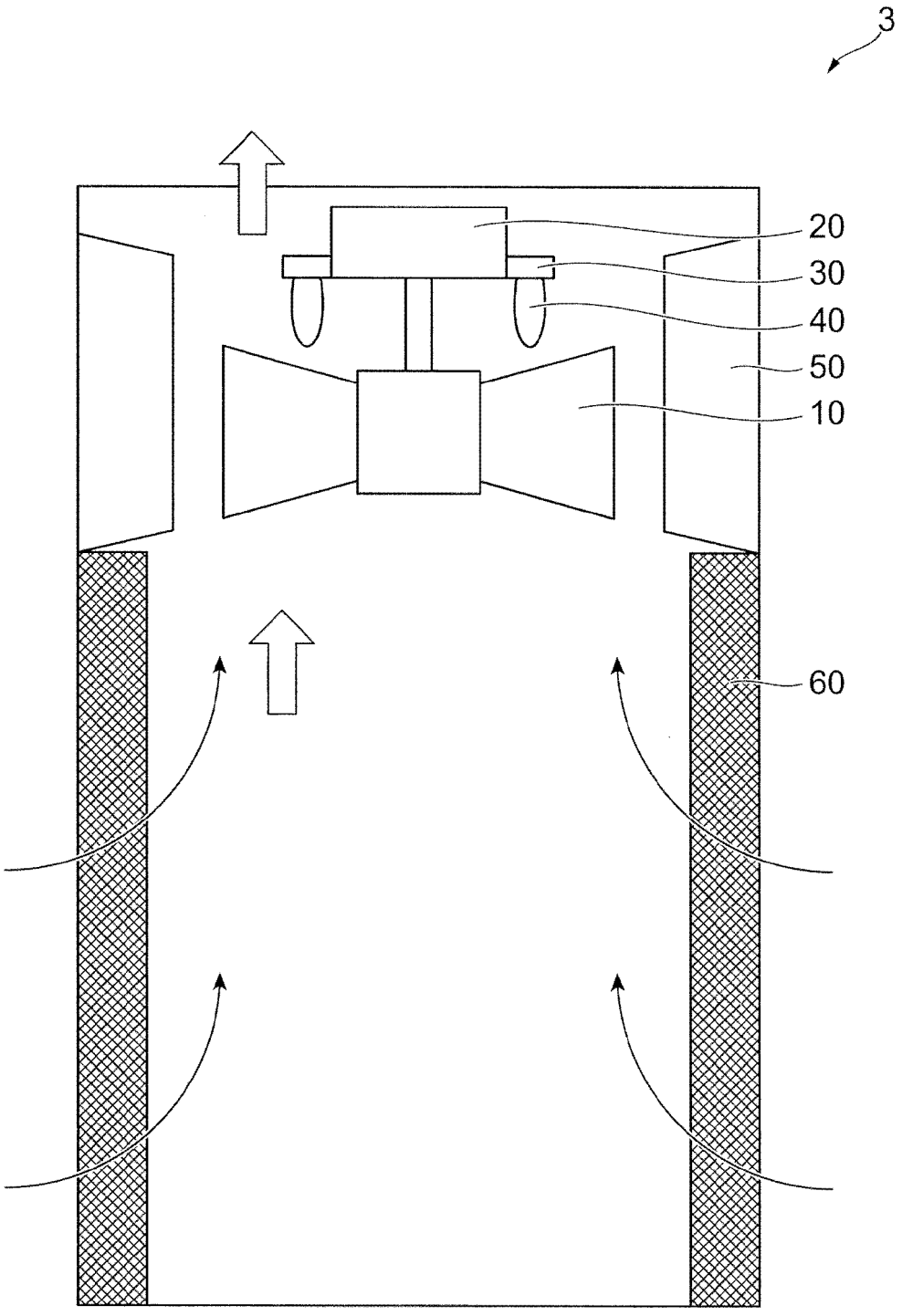
[Fig. 18B]



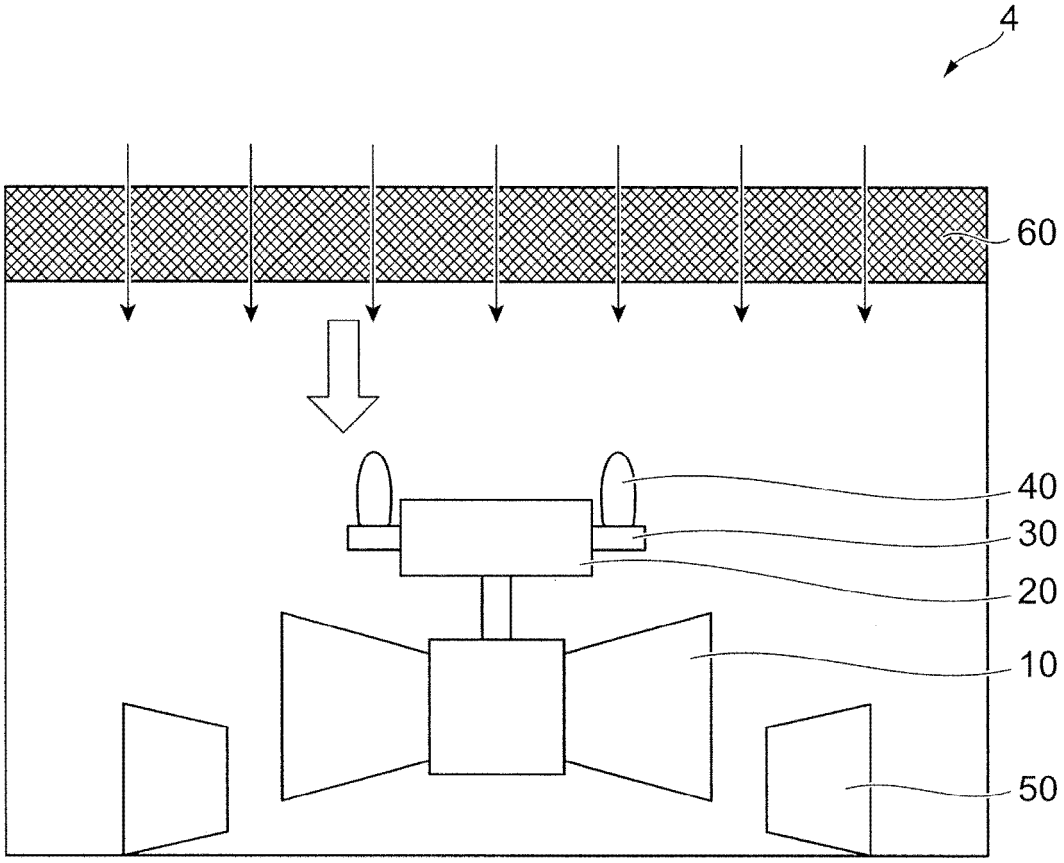
[Fig. 19]



[Fig. 20]



[Fig. 21]



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Patent documents cited in the description

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